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LETTERS TO THE EDITOR

Engineering-Contracting for 1911.

With this issue, ENGINEERING-CONTRACTING is exactly five years old. By successive purchases and consolidations with itself of three other civil engineering and contracting periodicals, but more particularly by its own exceptionally rapid growth, the paper possesses on its fifth birthday a paid circulation that is believed to be unequalled in the special field that it covers—the field of civil engineering construction. No such growth as this could possibly have occurred to this journal without the active aid of its readers. It has therefore, become our custom in the first issue of each new year to acknowledge this indebtedness and to outline such increased services to these readers as we had in mind.

During the coming months of 1911 and as rapidly as conditions will permit the reading pages of [illegible] increased [illegible] pages of [illegible] contract [illegible] over the average number published weekly during 1910. [illegible] the matter [illegible] not the superficial area of the pages but the number of words contained on each page, and, further, [illegible] printed [illegible] articles on civil engineering and contracting subjects. We use the term civil engineering here in [illegible] neering [illegible] mechanical [illegible] neering. Articles on mechanical and electrical engineering [illegible] properly belonging in and actually largely composing the [illegible] journal [illegible] ENGINEERING-CONTRACTING only when they enter its special field of civil engineering economics.

More diligent effort than ever will be made during 1911 to cover this special field of ENGINEERING-CONTRACTING. [illegible] its methods and costs articles which were in the beginning its only articles will not only be continued but will be increased in number and quality, and it also means that attention will be given to economics of design, to public service properties appraisals and valuations, to questions of [illegible] and to the variety of other matters that lead to [illegible]

As it has been the policy of ENGINEERING-CONTRACTING [illegible] with those readers by giving them more pages of articles and news items, it has never hesitated frankly to ask their aid to increase its number of subscribers. Thousands of names [illegible] by sending us the names of engineers and contractors [illegible] ENGINEERING-CONTRACTING in writing to [illegible]

A Noteworthy Article On a Common Problem in Engineering Economics, and Announcement of a Series of Articles Involving the Solution for Minimum Ordinates of Unit Cost Curves.

[illegible] words, how many have realized that the problems of engineering are problems of minima, [illegible] most direct and speedy method of solution?

[illegible] ing have usually had but a vague conception of [illegible] stresses are taught to design structures that shall contain the minimum amount of material required to support a given load, but how often are the same students taught that the economic length of a bridge span is a function of the cost of the bridge piers wherever there are several spans in sequence? Even in solving the problem of the most economic distribution of steel in a span of given length, how often is an attempt made to deduce a general formula for the weight of the bridge, and then solve for a minimum weight? Instead of such a procedure, the common method is to design a span, and then another and another, until, by a series of approximations, a span of minimum weight is secured. This same crude [illegible] out the entire engineering world. Yet, as we shall show during the year of 1911, nearly every common problem in engineering design lends itself to a direct solution by the simple and elegant method of differential calculus which involves finding the first differential coefficient and placing it equal to zero.

We are aware that many engineers seem proud of the fact that they have forgotten their higher mathematics, and that it is the consensus of opinion that any one who can use it at all must necessarily be too "theoretical" to be able to handle "practical" problems of engineering well. To every such engineer we earnestly commend the article on the deduction of a rational formula for the most economic length of bridge span, given elsewhere in this issue. We urge the reading of the article, whether or not the reader ever expects to design a bridge; for it possesses the merit of illustrating the rational method of attacking all problems in engineering economics, and it proves that only the most elementary principles of differential calculus are involved in the solution.

To those who will read the various articles that we shall publish this year on similar problems in engineering economics, it will become evident that the true difficulty of correct solution is not to be found in the application of the calculus, but in first deriving a correct equation for the curve of unit cost. Once the unit cost curve has been derived, the rest is comparatively easy, for any college trained engineer can refresh himself on his differential calculus in an hour's time sufficiently well to solve for the minimum unit cost ordinate of the curve.

In the article on bridge economics to which we have just referred, it will be seen that twenty years ago a celebrated bridge engineer applied the correct method of solving for a minimum unit cost, but that he failed to derive a correct curve of unit cost, because he failed to capitalize the cost of maintenance. Consequently his rule for securing minimum cost is incorrect.

For five years the editors of ENGINEERING-CONTRACTING have been assiduously gathering and publishing cost data. Before a philosophy of engineering economics could be produced, it was necessary to secure reliable unit costs. This has been accomplished sufficiently well to enable us now to take the next great step—the deduction of the laws of engineering economics. In the article elsewhere given we deduce one law, expressed as a formula, for determining the most economic span of a bridge where there are spans in sequence. In a forthcoming issue we shall present the deduction of the maximum gradient economically permissible on a railway or on a wagon road. This will be followed by similar deductions, some of greater complexity, but all involving the application of the fundamental principle of engineering economics, namely, *to solve for* [illegible]

How Transportation Conditions Influenced the Design of a Dam.

The problem of transportation is an important one in most works of engineering construction. It may be the task of clearing away waste as in tunnel work, or it may be the task of bringing construction materials to the work as in constructing a building, but in all except rare instances it is a problem to be met. Cases are infrequent, however, where so many matters of design and methods of construction hinged upon the question of transportation as there did in the construction of the Aziscohos Dam, which is described elsewhere in this issue. For a description of the transportation conditions and of the means of meeting and improving them the reader may consult the article itself; the feature that we wish to note here is that the design of dam adopted was adopted primarily because, keeping in mind safe conditions of stability, it best met the transportation conditions. In a word a cellular concrete structure was designed because it required a minimum weight of materials to be transported. The design [illegible]

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[illegible] As a model [illegible] different from [illegible] books we [illegible] We commend the article to contractors and construc[illegible] example of engineering planning and forethought

The Top Heading and Bottom Heading Methods of Attack in Tunnel Construction.

[illegible] as the "top heading and bench" method is in [illegible] United States. The reason assigned for this, or rather the general understanding in regard to it, is that this method is both cheaper and safer than any other method of attack. It may therefore in[illegible] methods employed in tunnel construction in Europe, and especially in the Alps, where conditions that are practically unknown in this country are encountered. We publish elsewhere in this issue a full description of the tunnel construction in the Austrian Alps, on what is called the "second railway to Triest." The magnitude of this work is indicated by the fact that on this line it was necessary to construct 149 single-track tunnels having a total length of 31.38 miles, and 3 double-track tunnels having a total length of 14.21 miles. Many of these tunnels were short, and presented no unusual problems. But one of the single-track tunnels (the Bosruck), and the three double-track tunnels (the Wochein, Karawanken and Tauern) are of such magnitude, and presented such unusual difficulties, that they are worthy of study by engineers interested in tunnel construction.

[illegible] bottom heading" [illegible] its forms is employed almost universally. European engineers are convinced of the superiority of this method over the "top heading and bench" method employed in America. It may be said, however, that the most convincing arguments in support of the superiority of the European practice are based on the necessity for dealing with the tremendous rock pressures encountered in parts of Europe, and particularly in the Alps, a condition that does not prevail in this country.

These rock pressures are an interesting phenomenon. They make necessary the employment of careful methods of excavation, of timbering, and of lining. In tunnel construction in this country timbering is often necessary to prevent rock falls, which are apparently due to the weight of rock masses that are insecurely attached to the adjacent mountain masses. In the Alps, on the contrary, the phenomenon is one of actual pressure from all sides, a pressure tending to crush in the roofs and sides of a tunnel and to raise the floors. These pressures are not due to a disintegration of the rock masses with consequent tendency to displacement, but are apparently caused by forces imprisoned, we might say, in the formation of the mountains. Experience has shown that these forces are ultimately exhausted in so far as they effect any individual tunnel. This is indicated in the case of the Karawanken tunnel, where the rock pressures, which were of unusual intensity during the early stages of construction, have greatly diminished and now show signs of ceasing entirely. It is evident that a method rendered necessary by such conditions might be highly uneconomical where, as in America, these conditions do not exist.

With reference to economical considerations it is claimed as an advantage of the "bottom heading" method that all the different working operations in connection with the construction of the tunnel, such as driving the bottom heading and the top heading, excavating the full section and lining the tunnel, are confined to one track which is extended as fast as the bottom heading is driven and remains in one position until construction is completed. At the same time the bottom heading drains the whole tunnel section, and inflowing water is led away in the bottom of the tunnel. Comparison is here made with the straight "top heading" method, in which the top heading is driven complete, and the full section is afterwards excavated. It may be said that this method is only used in tunnels of large size where the adjustment of spoils removal to rate of advance introduces an economic question of more importance than the maintenance of a track in one position. The argument has little force against the "top heading and bench" method, especially where the excavation of the full section follows closely behind the heading, since conditions as to track and drainage are practically the same in the two cases. It therefore appears that the superiority of the bottom heading method is confined to cases where rock pressures exist.

The method employed in the construction of the tunnels under consideration was, with one exception, what is known as the "Austrian" method. Briefly, this method is as follows: A bottom heading is driven as an advance heading. Shafts are then excavated from this heading to the top of the tunnel arch. The top heading is then driven, all spoils being dumped through the shafts already excavated, and removed through the bottom heading. The full section is then excavated and lined in detached lengths of from 25 to 35 ft. Finally the intermediate sections are excavated and lined. It will be seen that this process has in view at every stage the resistance to rock pressure, great care being taken not to have too much unlined excavation open at any one time.

A variation of the above method is what is known as the "Belgian" method. In this method the top and bottom headings are driven and shafts excavated in the order as given above. Instead, however, of excavating and lining the whole tunnel section, excavation is first made in short lengths for the arch ring alone, and the arch is built, resting on the rock at the level of the springing line. After this is completed the full section is excavated and side walls built under the arches. It will be observed that in this process the greatest precaution is taken against damage from rock pressure, since the arch is put in at the earliest possible stage.

In the Karawanken tunnel a top heading was driven independently of the bottom heading. This was done because of the presence of fire damp in large quantities, which interfered greatly with the construction of this tunnel. It was not considered safe to excavate shafts from the bottom heading to the arch as was done in the other tunnels, as it was feared that they would serve as pockets for collecting this light gas. The most intense pressures were here encountered, extending over a length of more than a mile. The high cost per foot of this tunnel ($284 per lin. ft.) is doubtless due to the trouble caused by rock pressures, the frequent collapse of timbering and completed lining, and the many interruptions due to inbursts of water. So great were the pressures in this tunnel that the layer of rock, 13 ft. in thickness, lying between the top and bottom headings, was seriously distorted in many places, and heavy bracing was installed to prevent the total collapse of the tunnel.

In a bulletin of the International Railway Congress Association, Mr. F. Hennings, professor of engineering at the Zurick Polytechnic School, advocates the top-cut or high-heading method in the construction of Alpine tunnels. This was the method used successfully by Rziha in constructing the Czernitz tunnel, where great pressure was also encountered. In this method a bottom heading is first driven, and is then extended upward in two layers to the tunnel arch. The semicircle of the arch is then excavated in segments, bracing by means of crown bars following the excavation closely. This process is then continued downward, the walls of the bottom heading being the last material excavated.

In the methods outlined above the controlling factor is resistance to rock pressure, safety at each stage of the process being carefully provided for. Where rock pressures do not exist, it would seem far more ecomonical to use the "top heading and bench" method as employed in this country.

Are Corrugated Metal Culverts for Roads and Railroads Economic? Can Enameled Metal Culverts Be Made Commercially Successful?

There are many engineers who labor under the misapprehension that what is most durable is necessarily most economic in the long run. This fallacious idea exists largely because many engineers have not been thoroughly taught the essential principles of engineering economics. A wooden trestle is frequently the most economic form of railway or wagon road bridge, in spite of the fact that its life may not exceed 10 or 12 years. Money at 6 per cent compound interest doubles itself in 12 years. Hence if an everlasting bridge of some material other than wood cannot be built for less than double the cost of the wooden bridge, it is not usually true economy to build the everlasting bridge. This holds true in any community where money is worth 6 per cent to the average taxpayer, for if the excess cost of the everlasting bridge were loaned at 6 per cent interest, it would yield enough interest to rebuild the perishable bridge in 12 years' time and still preserve the principle intact.

The same reasoning holds good of culverts. Throughout the far West timber culverts have been extensively used in years past, simply because engineers perceived that true economy was often obtained by using a cheap though perishable material. Within more recent years, corrugated iron culverts have sprung into popularity, because their low first cost and rapidity of construction made them the most economic form of culvert under certain conditions—not merely most economic in first cost, but most economic after making due allowance for depreciation and interest on investment.

In culvert construction there is also a factor that every experienced road and railway engineer appreciates, namely the difficulty of estimating the proper size of culvert opening. How often does it happen that not enough water ever passes through a culvert to fill one-quarter its area of cross-section. And, on the other hand, how often is a culvert flooded by the first heavy rain, and embankments badly eroded because of inadequate culvert capacity. So often do such things occur that an experienced engineer realizes it to be frequently economic to build as cheap a culvert as possible, if only to use it to ascertain what size of culvert opening is needed. After all has been said that can be said of formulas for predicting the run off from a given area, there remains the fact that they are only engineering guesses. Hence the need of experimental data in every locality to determine the run off after heavy rains or thaws. Incidentally, by the way, no run off formula provides for run off due to a rapid thaw of snow and ice, which is one of the most frequent causes of washed-out culverts.

For these reasons, even if a corrugated iron culvert were as short lived as wood, it would merit extensive use. But there is reason to believe that such culverts when made of pure iron, and well galvanized, have a life that is by no means short. Extensive experiments made by Mr. Allerton L. Cushman, now of the Institute of Industrial Research, Washington, D. C., and formerly in the service of the government Office of Public Roads, resulted in proving that the rusting of steel and iron is due primarily to galvanic action between the iron and other elements contained in it. Having proved this fact, the obvious method for preventing rusting was to use as pure an iron as possible, and to coat it heavily with a non-oxidizing material. Certain manufacturers were quick to grasp the commercial value of this fact, and, accordingly, we have the non-corrosive, galvanized, corrugated metal culvert.

It is not unlikely that still further improvements in the art of metal preservation will add still more to the durability of this type of culvert. For example, why is it not commercially feasible to enamel the metal instead of galvanizing it? The cost would be increased, but would not the added life justify the added cost? A well-known bridge engineer recently expressed the opinion that within a few years practically all bridge steel would be enameled. Already a part of the floor system of a steel bridge has been built of enameled steel sections, and at a cost that is by no means prohibitive.

It is our belief that an enameled metal culvert can be made that will be even more widely used than the galvanized metal culvert, and that both types will have their particular fields of usefulness.

Boston's New Public Works Department Administrated by Engineers.

That the directing head of a city public works department and that even the division heads of such a department should be good executives will be admitted by everyone. For some reason hard to understand the average business man assumes that to be an engineer is not to possess executive ability. The office of President of a large railway system will be acknowledged to call for a high measure of executive [illegible] engineers have held it and are now holding it. There are scores of other examples which might be cited were it worth while. All engineers are not good executives and no more are all business men. Certainly the chance of finding a good executive head of a city public works department among engineers should be as fair as it is among ward politicians to whom the office generally goes. Assuming that the man who constructs, maintains and operates a city's sewer system is a good executive, the public certainly loses nothing by his being also an engineer and it may gain much.

We have been led to make these remarks by the reports coming from Boston that the recent ordinance calling for the reorganization of the public works department of that city and providing that the heads of the several bureaus shall be ingineers has led to unfavorable criticism. The men who head such bureaus, it is asserted by the critics, should be executives and not engineers. If there is any reasoning behind this criticism it must be that a man cannot be an executive because he is an engineer. Nothing could be more silly except, perhaps, to reason that because a man is an engineer he is also a good executive.

The new public works department organization of Boston is to our mind distinctly praiseworthy because it provides that all division bureaus and the department itself shall be headed by engineers. It is furthermore praiseworthy because it provides salaries somewhat commensurate with the responsibilities of the work which the department and bureau heads are called upon to administrate. It places no restrictions in the form of party affiliations or residence as to the engineer selected to head the department or bureau, so that if engineers having adequate executive abilities are not selected it is an error of the appointing power.

The new public works department of Boston is a noteworthy step toward eliminating the old time political system of administrating public works. Engineers in municipal service everywhere have the right to congratulate themselves for this. There is another lesson that engineers can take to heart in the reorganization work which has been accomplished at Boston. It has come about in no small measure by the work of engineers. It was the thoroughly detailed study made and the specific cost data worked out by the engineers of the Boston Finance Commission that demonstrated beyond the possibility of dispute the extravagances and inefficiency of the old department organization. Without this work of engineers the change which has come would have been long delayed if ever it was made. Engineers have it within their power to do a similar work in every city and by doing it to benefit themselves while working toword a more honest and efficient conduct of public works.

[illegible]

CONCRETE AND REINFORCED CONCRETE SECTION

Methods of Constructing the Black Rock Harbor Lock; New York State Barge Canal.

The building of the government lock at Black Rock Harbor, the westerly entrance to the New York Barge Canal, involved as its principal features the construction of an elaborate cofferdam and a plant of large capacity for mixing and handling concrete. Fig. 1 is a general view of the work, which was completed Sept. 1, 1910. After the cofferdam, shown in the illustration, has been removed, guide walls will be extended from the near end of the lock walls to the land on either side. Navigation will then be carried through the lock. The contract for the lock work was let to MacArthur Bros. & Co. of New York, who built the cofferdam and sublet to Cullen-Friestedt of Chicago the balance of the work.

The site of the lock was at the beginning of the work under from 3 to 15 ft. of water. Bed rock was located 35 to 46 ft. below the normal water surface, the surface of the rock being slightly raised in the center of the lock site.

Cofferdam.—To excavate to bed rock and unwater the site for the construction of the lock, a cofferdam was built of steel sheet piling. The contract plans called for a rectangular cofferdam 260 ft. wide and 947 ft. long. It was built to these dimensions of two rows of sheet piling spaced 30 ft. apart and tied together at 30-ft. intervals by transverse rows, thus making pockets or compartments 30 ft. square. In taking out the excavation for the lock a 20-ft. berm of material was left on the inside of the piling, thus providing an interior pressure against the cofferdam to counterbalance the pressure from the outside. The pockets were filled to water level with the material excavated from the site. As was expected, the only resulting pressures on the cofferdam were from the weight of the material in the pockets. The main stresses were in the tension of the transverse rows of piling.

The contractor selected the piling for the work with considerable care, as it was necessary to choose a section of piling which would stand considerable tension. The Lackawanna section was selected as a result of field tests both for driving and for tensile strength.

Two pile drivers were used on the work, which covered about ten months.

The piles were 45 and 50 ft. long and were handled in driver leads 60 ft. high. The drivers were equipped with Vulcan steam hammers, one driver with a No. 1 and the other with a No. 2 hammer. From 25 to 30 piles were driven a day by each driver.

During the construction of the cofferdam a dredge worked inside and excavated the site of the lock to as low a depth as was possible before the dredge had to be floated out for closing the cofferdam. The dredge excavated to about 35 ft. below water. The 7,000 tons of sheet piling were driven and the cofferdam closed in February, 1909, and the cofferdam was pumped out by July. A much larger leakage of water than was expected came through the bed rock under the lock site and considerable time and money were spent in trying to close the larger fissures but the volume of water coming through under a head of nearly 50 ft. prevented anything being accomplished further than increasing the pumping capacity and continuing the pumping. To this end the following plant was installed, a part of which is illustrated by Fig. 2:

[illegible] in. Morse Centrifugal..	[illegible]
1 15 in. Buffalo Centrifugal..	7,000 gals. per min
[illegible] in. Buffalo Centrifugal..	[illegible]
1 20 in. Worthington Turbine	11,000 gals. per min
Total [illegible] per min.	29,000 gals.

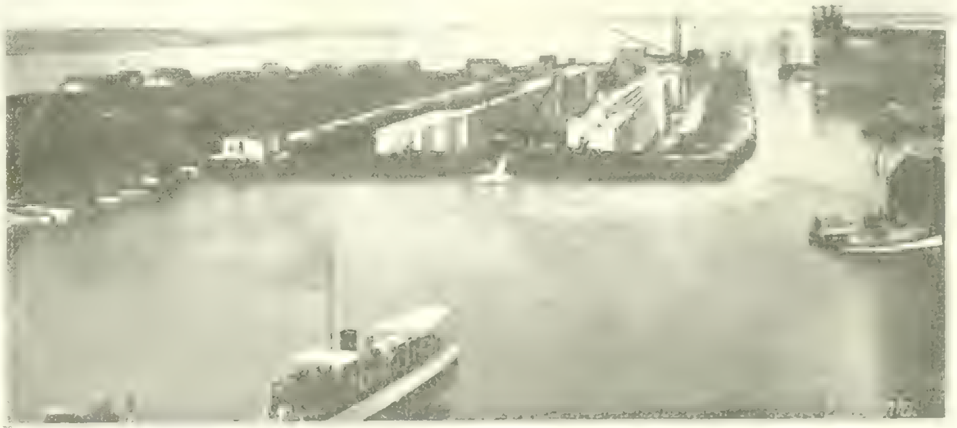

Fig. 1—A general View, Looking West, of the Completed Lock and Cofferdam at the Westerly Entrance of the New York Barge Canal.

This pumping plant was installed on the berm, left inside the cofferdam, after the water had been lowered enough to permit the installation. The pumps operated against a head of about 50 ft. and handled an average amount of 15,000,000 to 16,000,000 gals daily.

Such large streams came in at various places that it would have been impossible to place any concrete over them. The method of handling this problem was to lead the water to one side behind the lock walls. Pipes were laid for this purpose, a pile of loose rock was made over the crevice and the whole was boxed over and concreted in.

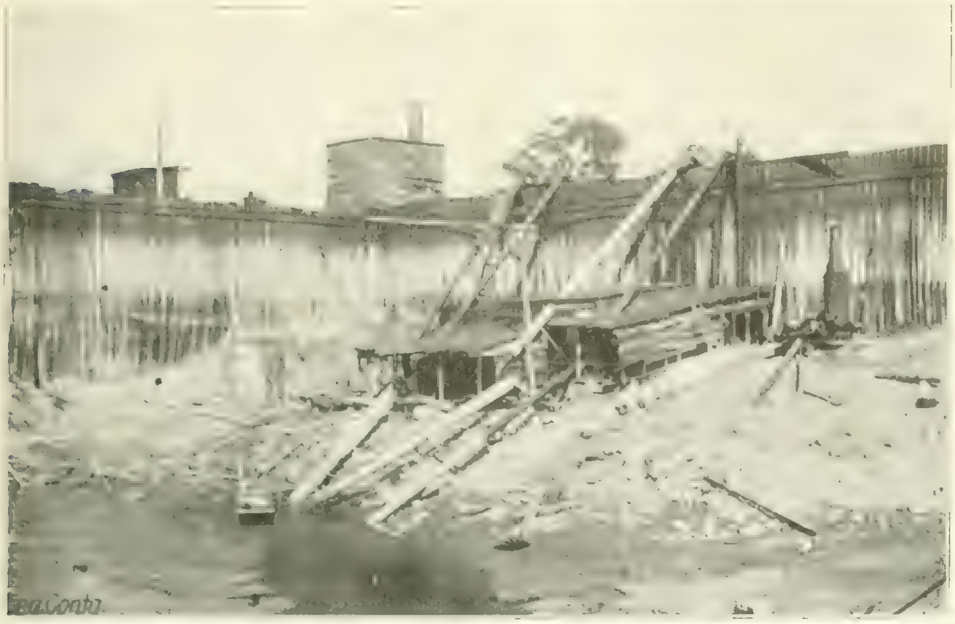

Fig. 2—View Showing the Pumping Plant Necessary to Care for the Leaks Through the Bed Rock.

The cofferdam itself was water tight and the interlocking piling did not pull apart at any point, although the walls were [illegible] the pressure of the earth contained in the pockets.

[illegible] The small portion of the excavation remaining after the site was unwatered was carried on by hand, and was done by sections. After each section was cleared, concrete was immediately placed and the construction of the lock was carried on up.

The lock is 70 ft. inside and 817 ft. long, with walls 50 to 55 ft. high, founded on bed rock. The walls are 8 ft. wide on top and are stepped at the back to 22 ft. in width at 17 ft. above bed rock. The lock has five pairs of gates, a pair of guard gates at each end, operating gates 55 ft. from the guard gates, and the fifth pair of gates dividing the lock into two chambers. One chamber is 250 ft. long and the other 400 ft. to permit small vessels to pass through without using the entire space between the two end pairs of gates. The side walls contain culverts through which the water is admitted and discharged from the lock. The gates for these will be operated by motors.

In making ready for the construction of the lock it was decided to put the concrete mixing plant at one end and to carry the concrete from the mixers in large batches on dinky trains through the center of the lock. From the trains to be handled by derricks to the wall forms. The sand and gravel was furnished by a local company, mixed in the proper proportions. It was obtained by dredging in the river. Alsen cement was used almost entirely.

The storage and mixing plants were built just outside and partly over one end of the cofferdam. The storage bin for sand and gravel had a capacity of 1,000 cu. yds. and was built on a pile foundation. The cement shed had a capacity for storing 7,000 bbls. of cement. The sand and gravel arrived in barges and was transferred to the bins with a derrick operating a 2½ yd. Hayward clamshell bucket.

The cement, which arrived from Alsen, N. Y., in canal boats, was handled on belt conveyors. A conveyor was arranged for lowering into a canal boat and when the mixer was running the cement was carried directly to the mixer by the conveyors, but at other times the bags were tripped off the belts en route to the mixer and were stored in the shed.

The mixing plant was located inside the cofferdam and consisted of two Ransome 2 cu. yd. mixers placed [illegible] over them. The material was delivered to them from the bins by gravity. Fig. 3.

[illegible] gage tracks were laid from the mixers along the center line of the lock at the level of the floor. A switch was provided as shown in Fig. 3, so that it was possible to [illegible] mixer from either track. The concrete was dumped from the mixers into 2½ cu. yd. Steubener dump buckets located on small flat cars. The three concrete trains used were of two cars each and were hauled by a 10-ton Porter locomotive. The locomotive pushed two cars to position for receiving concrete from the mixers and while these trains were being loaded the locomotive shifted the loaded cars from the other mixer to within reach of the derricks.

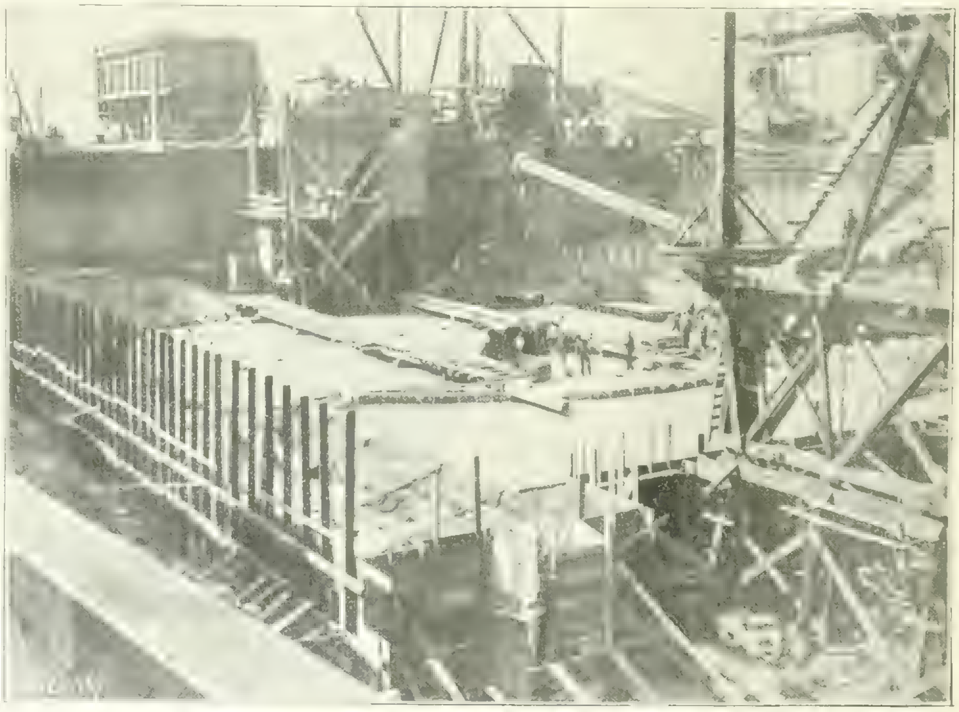

Fig. 3—View of Storage Bins and Mixing Plant and the First Section of Completed Floor.

Four men were used to place cement on the belts which delivered to the mixer, six men were used for charging the hoppers, and two men were used for dumping the mixers. One engineer tended the mixer engines and one [illegible] the [illegible] and com[illegible].

On the dinky trains two brakemen and one engineer were employed. Only one locomotive was required. For dumping the buckets and spreading concrete seven to eight men were employed.

It was usual to run only one mixer, however, as it was found that this was sufficient for supplying concrete for one wall at a time. With one mixer and one derrick the number of 2 yd. batches handled every 8 hours averaged between 140 and 187.

The lock walls were built in sections of unusual length for this class of work, the sections running from 122 to 165 ft. For handling all the material for the forms and for handling the concrete from the trains to the forms a special traveler was built. The traveler carried three derricks, two of which were located on the forward corners of the traveler, each serving the work on one of the lock walls.

A third derrick located in the center and at the rear of the traveler was intended to be used for cleaning up the excavation work ahead of the concrete and form work. The traveler consisted of a timber platform about 45 ft. square, which was carried 18 ft. above the upper floor of the lock, and upon which the three derricks were mounted as shown by Fig. 4. The supports carrying the platform, shown in cross section by Fig. 5, consisted of heavy timber posts and sway bracing and a truss 40 ft. long. As indicated in the drawing the traveler was carried on tracks which straddled the narrow gage tracks and was so designed that the largest piece of material for the lock construction could be carried on a flat car under the traveler. Supports for the narrow gage and traveler tracks were necessary because they were located at the level of the lock floor of the upper chamber. Where no concrete was to be put in, pile bents were used, but where concrete was to be placed the tracks were supported on piers built of concrete, which were afterward surrounded with and incorporated into the concrete floor. The three derricks on the traveler were each supplied with separate engines and boilers. There were two Lidgerwood engines 8¼x10 ins. and 7x10 ins. respectively, and one Mundy engine, 7x12 ins. Connections were made between each engine and boiler so that any one of the engines could be operated with steam from any of the boilers. The derricks were each provided with swinging engines, two of the Dake type and one American Hoist Co. engine. The operation of the traveler required three engineers and one fireman and one signal man.

With this plant the concrete work could

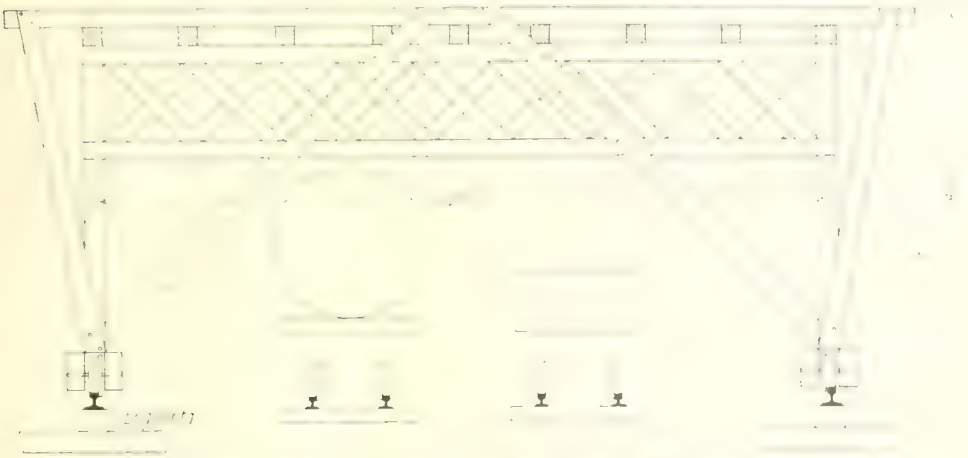

Fig. 4—Section of the Traveler Which Carried Three Stiff Leg Derricks and was Designed to Allow Passage of all Construction Materials Beneath It.

have been carried on continuously on both walls, but this was not desired by the government engineers, and work was therefore carried on alternately on the two walls. For the long sections of wall built the concrete was deposited in the forms in layers, and the traveler was moved back and forth as required for spreading the concrete. The movement of the traveler did not permit the use of the rear derrick for excavation, as this derrick could only reach its work when the traveler was located at the extreme end of the section of wall being erected. For this reason an extra derrick was installed for handling this work. If the walls had been built in 30 to 50 ft. sections the rear derrick might have served the above purpose without the aid of an extra derrick, but the greater number of bulkheads required in the wall forms would have offset this advantage.

The forms used were very simple. They consisted of panels 16 ft. long and 4 ft. wide. The panels were made up of 2x12-in. plank dressed on one side and both edges, nailed to 2x4-in. vertical studs placed 3 ft. on centers. The wallings consisted of two 3x6-in. pieces spaced apart so that ⅝-in. bolts could be inserted between them. These bolts passed through the form plank and were fastened by sleeve nuts to the anchor bolts, which had been previously bedded into the concrete.

The concrete work was commenced in July, 1909, and was about half completed when the work was closed for the winter on Dec. 15. The work was resumed again in March and was completed on August 31, 1910.

The lock was built by the U. S. Government under the general charge of Col. W. L. Fisk, corps of engineers, U. S. A., Buffalo, N. Y. Mr. L. L. Davis was assitant engineer in direct charge. The contractors were Mac Arthur Bros. & Co. of New York, which company engaged the Cullen-Friestedt Co. of Chicago to handle the excavation and construction other than that of the cofferdam. The design of the plant and the construction of the lock were in charge of Mr. Frank Cullen of the above company.

Specifications for Scrubbed Concrete Surface.*

For all surfaces of concrete that are to be exposed to view face forms shall be straight, smooth, evenly matched, and watertight, and so framed and fastened together at corners and angles with screws or clamps as to be detachable and removable without the necessity of jarring or of prying against the concrete. Any offsets that may appear at joints shall be dressed off flush, and any openings at joints or corners, or any known holes or other voids, shall be plugged flush with some stiff plastic substance such as clay mixed with Plaster of Paris or sand. Before placing the concrete the whole surface of the face form shall be coated with petroleum or other water repellant to prevent adhesion of the concrete.

The concrete shall be thoroughly mixed, be wet enough [illegible] face form [illegible] flushed against the form, i. e. until the cement soup or grout follows and envelops the spade. Then the spade is to be used to ram the concrete near [illegible] gate of the concrete forward to the face, care being taken [illegible] texture at the face.

The work of placing concrete shall be continuous [illegible] joints between different days' work shall be at some feature line, or be made truly straight and level

On the day after placing concrete, or later, as will be determined according to the temperature and the weather and the setting quantity of the cement used, while the concrete is friable and pulverable, the forms shall be carefully removed and the concrete surface immediately scrubbed until the surface film is removed and the aggregate is exposed to a uniform degree [illegible]

[illegible] void space appear [illegible] the defects shall be patched with similar mix immediately after [illegible] hand or a wooden float—not a steel trowel—for applying and [illegible] After they are [illegible] for several days

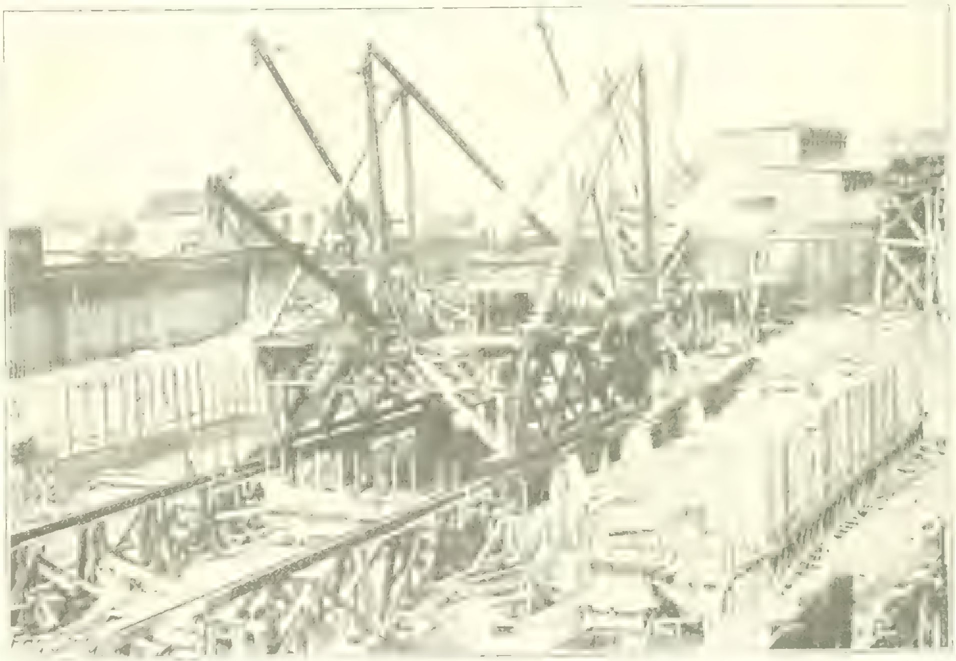

Fig. 5—View of the Traveler During the Early Stages of the Lock Construction.

If a granolithic surface is specified it shall be made by placing against the face forms in advance of the body concrete a fine granolithic or facing concrete composed of 1 part Portland cement, 1½ parts sand, and 2½ parts pebbles or crushed granite or other approved stone as may be selected, screened to pass ½-in. and be retained on ¼-in. screen, thoroughly mixed and soft enough for full flushing. This granolithic must be maintained between the body concrete and the face form in a thickness of about 1 in., care being taken that the body concrete is rammed into and perfectly united with it. If iron or wooden moldboards are used to retain the granolithic against the face while placing the body concrete, care must be taken that the board is not permitted to remain until initial set takes place, but be frequently jarred and raised slightly at short intervals to prevent the formation of shuts and seams and air spaces between granolithic and concrete.

For scrubbing the surface ordinary fibre brushes with a light stream of water from hose or can will be sufficient if the set is not too hard. If set is harder, wire brushes followed by fibre brushes and rinsing may be used.

If for any reason a portion of the face form can not be or fails to be removed before the concrete has become too hard for removing the surface film by scrubbing, the hard face shall be treated by sand-blasting or tool-dressing to a texture matching the scrubbed portion. If it be tool-dressed it shall be cleaned after tooling by washing it with a 1 by 10 solution of muriate acid and water, then thoroughly rinsing with water to remove all traces of the acid.

In scrubbing, or sand-blasting, or tool-dressing, care must always be taken to avoid roughening or blunting corners of the work, and to maintain all edges sharp.

On construction of the concrete penstock for the Ontario Light and Power Company, an unusual method was employed for raising the concrete materials so as to chute by gravity into the mixer. A standard gage track was laid on top of the excavated material along the trench. This made the proper height for unloading directly from standard railroad cars to the mixer. This method was employed at various points along the work.

The first contract plans for the Cayuga and Seneca Canal are now completed. This canal is a branch of the New York Barge Canal. The route selected follows substantially that of the present canal, which is also largely the channel of the Seneca River, which is the natural outlet from Seneca to Cayuga Lake

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*Presented to the National Association of Cement Users, Dec. 13-17, 1910.

Methods of Depositing Concrete by Gravity Chutes and Pipes.

Only two or three years ago the general idea of running concrete to place in pipes or chutes by gravity was ridiculed by the engineering profession on the ground that a homogeneous mixture was impossible because the larger particles of the aggregate would become separate from the cement. Today the system is being used on a large number of works, producing excellent results both from the standpoint of the engineer, because of the good quality of the mixture and the reduction of displacement of forms and steel as is always to be expected when traffic of wheel barrows is continually carried on over forms; and from the standpoint of the contractors, because of the greatly reduced costs of carrying on the work.

Many arrangements of plants have been developed on the various jobs where chuting has been used and various improvements in details have been developed as the system came into more general use.

Most of these systems have been gotten up from material at hand or easily obtained. The most completely worked out system, however, is that of the Los Angeles Concrete Appliances Co., which company has recently secured all patents "pertaining to and embodying the principle of transporting concrete through a pipe or trough by gravity." The system is known as the "Gravity System" and the company proposes to dispose of the right to use the system to contractors by license. The William B. Hough Company, Chicago, are agents for the territory east of the Mississippi.

The system is illustrated in the accompanying drawing, Fig. 1. The tower carries at its top, a concrete hopper, to which the concrete is hoisted in a bucket from the mixer at the bottom of the tower. The top hopper discharges the concrete into the feed hopper which is directly connected with the pipe. The concrete is then carried through the pipe by gravity into the forms. The mast shown is sometimes located on the tower in such a way that the boom can swing nearly a full circle. The end section of pipe beyond the swivel joint has a horizontal swing of a full circle at any position of the boom, and independent of the boom movement. The revolving mast is also used as an auxiliary distributor and a number of these may be located at convenient points and served by a main tower. The inclination of the booms, as shown in the figure, is a recent development of the system and has not been illustrated heretofore. Its advantage lies in the reduction of the horizontal thrust upon the tower.

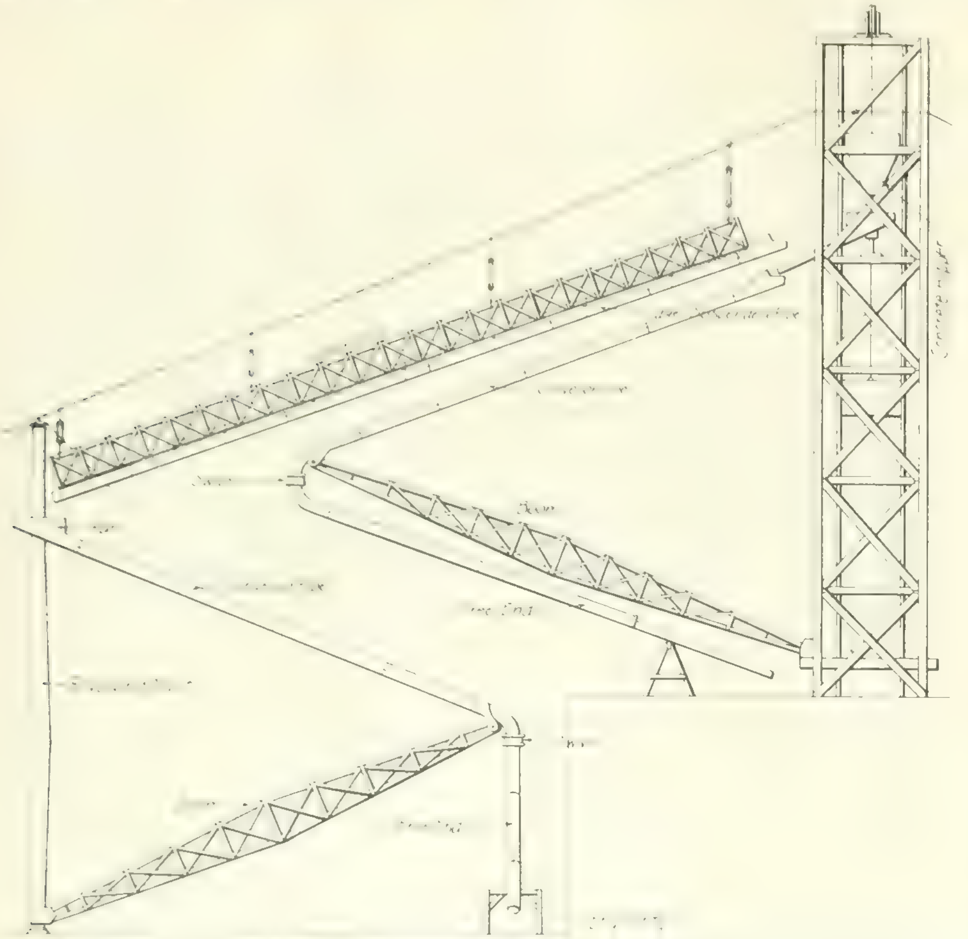

Fig. 1—General Type of the Plant of the Concrete Appliances Co., for Depositing Concrete by Gravity.

Among the many cases where systems of distribution of concrete by gravity have been used, are the following:

The Church of Christ Scientist at Pasadena, Cal., a building 120 ft. square and 120 ft. high with a central dome 60 ft. in diameter. A triangular tower of the above described system, was erected in the center of the building and all the concrete was poured with a single pipe line. One man handled the discharge. The cost of mixing, hoisting, and placing was 12 cts. per cu. yd. The contractors were the F. O. Engstrum Co., of Los Angeles. This company also built the Majestic Theater and office building in Los Angeles. Here the tower was placed at one side of the building and concrete deposited through a 7-in. pipe.

The track elevation work at Grand Crossing, Chicago, (Engineering-Contracting, Oct. 5, 1910), was served by a system of open chutes on a grade of 23° to the horizontal. The system here carried the concrete over half a dozen busy tracks of the Illinois Central Ry., to the retaining walls for the street subways. The wheel barrow method would have cost about $1.50 per yd. here but by the chuting system the cost was about 40 cts. per cu. yd.

The construction of a seven story building, (Engineering-Contracting, Oct. 12, 1910) in Chicago, by the Falkman Construction Co., was carried on with the use of a main tower at the side of the building, and an auxiliary tower at its center. The building was 126x115 ft. in plan. A record run of 50 yds. an hour for 5 hours was made and a floor was completed each week.

The cost of mixing, hoisting and placing was about 20 cts. per cu. yd. The labor was paid at the rate of 37½ cts. per hour.

One of the first works on which the chuting system was used, was the Grand River Bridge of the L. S. & M. S. Ry., near Paineville, Ohio. The chutes used were 2x2 ft. square, made of wood, and were built on a grade of 3 in. to the foot. There were two 80-ft. towers, one at each end of the bridge, which was 400 ft. long, and the chutes led to the center of the bridge. At intervals branch chutes were placed for receiving concrete from the main chute and carrying it to the various points in the forms. The cost of this work, including material, forms, plant, labor and work train service, was less than $10.50 per cu. yd.

In building the cooling house for refrigerator cars of the Santa Fe Ry. at San Bernardino the Gravity system of the Concrete Appliances Co. was used. (Engineering-Contracting, Mar. 30, 1910). The building has a total length of 1,212 ft., a width of 132 ft. and a height of 42 ft., and contains 6,500 cu. yds. of concrete. A main hoist tower 172 ft. high, was used, with two auxiliary towers 302 ft. from the main tower.

The gravity pipe was suspended between the towers by cables and the auxiliary towers carried 70-ft. booms for distributing the concrete to the forms. The concrete was delivered by gravity for a distance of 502 ft. The cost of feeding the mixer, hoisting the concrete and distributing it in place was 21 cts. per cu. yd.

The general claims made for this system, which have been borne out in the various examples are substantially as follows:

First: Obtaining the initial set of the concrete by rapid handling and depositing in the forms.

Second: An uniform, homogeneous mixture due to the large quantity which can be poured at one time.

Third: The unlimited design of buildings or structures to which it can be applied.

Fourth: The use at all times of a standard equipment for the entire process of mixing and handling.

Fifth: The reduction of the labor force and the doing away with running over the forms, reinforcement, and newly deposited concrete.

Sixth: The saving in cost of building and shifting runways.

The quality of the concrete seems to be generally acknowledged as equal at least to that poured by any method yet used. The cost of mixing and placing, as given in the examples above, excels all other methods by comparison. The wheel barrow method of distributing concrete costs from 60 cts. to $1.50; by the use of the gravity system it costs from 12 cts. to 40 cts. The use of tampers is not necessary.

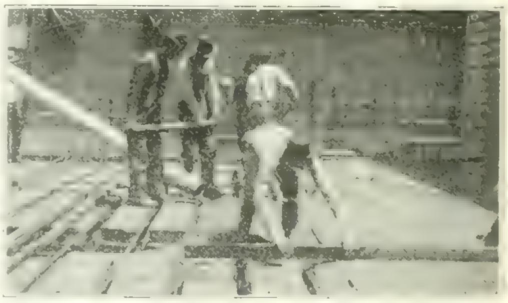

Fig. 2—Showing the Method of Depositing Concrete in the Floor of the Union League Building, Los Angeles.

Ada, Okla., has voted the issuance of bonds to the amount of $100,000 for extensions to its water works. It is proposed to construct a reservoir in the mountains, a distance of 15 miles from the city, and pipe the water from the reservoir to the city.

Some Thermal Properties of Concrete.*

During the last three years a series of experiments have been carried on in the Laboratory of Heat Measurements of the Massachusetts Institute of Technology, having for their object the study of those physical properties of Portland cement concrete which affect its value as a fire resistant material. While these researches are by no means complete, it is perhaps of interest at this time to discuss some of the results obtained.

It was proposed at the outset to make a study of the various physical properties of concrete over as wide range of temperatures as possible, and among those selected were the following: (1) Coefficient of linear expansion: (2) diminution of mechanical strength after heating; (3) specific heat; (4) the coefficient of thermal conductivity.

The measurements of the coefficient of linear expansion are practically complete, but the uncertainty attaching to some of the high temperature values, though slight, makes it seem wise not to report in detail until one or two check measurements can be made. This uncertainty arises from the great difficulty which attends the measurement of the temperature of the interior of a large block of cement concrete so as to be sure of its absolute uniformity at high temperatures. Thermal junctions embedded in the block at distances of 3 ins. from one another are not sufficiently close to give the desired precision.

The method adopted for the measurements of the elongation caused by heating was the common so-called "telescope" method. The specimens in the shape of 6-in. or 10-in. cubes were slowly heated in a double gas muffle or an electric resistance furnace. The temperature of the furnace and of a number of points in the concrete was taken by means of platinum-rhodium couples.

Near the furnace were mounted two telescopes which might be sighted through holes in the furnace wall upon reference points on the surface of the block. At low temperatures an arc light and a system of mirrors were used to furnish adequate illumination. One of the telescopes was provided with a micrometer eye piece by means of which a movement of the reference mark of 0.0001 in. could be measured.

The values obtained at low temperatures agree very well with the commonly accepted value of .0000055 for the elongation per unit of length per degree Fahrenheit. Apparently this value increases slightly up to 575° F. Above this point the coefficient becomes smaller; at 1,500° F. the coefficient becomes zero, and above this point slightly negative. On cooling the blocks which had been heated to 1,500° they did not return to their original dimension, their permanent elongation being about 75 per cent of their maximum elongation. On a second heating the specimens all returned to the same dimensions, there being no sensible permanent elongation resulting from the second heating.

All of the specimens tested for expansion were of stone concrete, of the proportions 1:2:5. The stone was clean, the sand sharp, the cement of good quality, and every precaution was taken to secure a concrete of the first order. The specimens weighed on the average 150 lbs. per cu. ft.

In order to study the effect of high temperatures upon the compression strength of concrete several scores of 6-in. cubes were made and allowed to set for 90 days or slightly longer. These blocks were then heated for different lengths of time at different temperatures in a gas furnace similar to that used for the expansion experiments.

The cubes which were not heated showed an average compression strength of 2,700 lbs. per sq. in. Those which were heated to 932° for two hours lost only 15 per cent of their original strength, and when this temperature was prolonged for four hours the loss was 43 per cent. If the blocks were heated to 1,500° for two hours the loss of compressive strength was 38 per cent and at the end of four hours the loss was 66 per cent. The most important information secured from these tests was to the effect that even after exposure to a fire in which the concrete block, small in size, was subjected to flames at a temperature of 1,500° for four hours it was still able to carry twice its normal safe load in compression. The larger beams with their great masses are not often exposed for so long a time to so great a hazard.

It should be noted, however, that there was a considerably greater deformation under load of the heated blocks than of those not heated.

A large number of small beams were next made, some with and some without reinforcement; most of these were either 6x6x48 ins. of 8x8x48 ins. The specimens which were reinforced contained four ½-in. round steel rods situated near the corners, equidistant from the two faces of the beam. In some the distance from the steel to the face of the beam was 1 in. In others 1½ ins., and a few beams had a 2-in. protection to the steel. Not many of these specimens have been tested as yet, but, from a few, we are able to get a general idea of what happens to beams of this type in case of exposure to fire.

A set of three beams for instance, each 6x6x48 ins., in which the reinforcing rods were 1 in. from the face of the beams, were broken by center load, the first beam not having been heated at all, the second heated for one hour in a fire that fused the surface of the concrete, and the third being similarly heated for two hours. The beam which was not heated broke under a load of 5,700 lbs.; the second, heated for one hour, broke at 2,750 lbs., while the third, heated for two hours, broke at 1,950 lbs. I consider this a most remarkable showing under severe conditions. It should be borne in mind that these small beams were so slow in cooling down that they were in effect heated much longer than the time mentioned. The flames, moreover, surrounded the beams on all sides.

Several similar tests were made with concrete beams of the same dimensions, 6x6x48 ins., with no reinforcement. These were heated for two and four hours at 1,700° F. After this exposure all of the beams were very frail, not one of them showed any cracking or spalling, however. It was not considered necessary to break any of these beams, as it was apparent that the concrete on the tension side of the beam was much weakened. Some of the more recent experiments made on beams 8x8x48 ins. show that these larger beams are much less weakened, proportionally, as would be expected to be the case.

A series of similar beams were next made up of cinder concrete, the proportions of the mixture being 1:2:5. A portion of these were mixed with clean cinders, which showed upon analysis but little carbon; a second part was mixed with cinders to which 10 per cent of fine bituminous coal had been added and the other beams were mixed with cinder to which had been added 25 per cent of fine coal. The 25 per cent mixture can be disposed of in a word. When once thoroughly heated it burned until it fell to pieces. With the 10 per cent mixture, however, no such action occurred; there was no indication that the concrete would support its own combustion even for a short time. It was apparent that the 10 per cent mixture was not so good a fire-resisting material as that which contained no added carbon. From the few specimens containing less than 10 per cent which have been examined up to the present, it seems probable that the safe limit is close to 5 per cent. More data are now being secured on this point.

[illegible] was made by the ordinary calorimeter method, the "method of mixtures" of Regnault. Specimens of the concrete, usually fragments of the larger test pieces, were heated slowly in an electric resistance furnace to the desired temperature and then plunged into the calorimeter. The weight of the water and its rise in temperature give the amount of heat given off by the body in cooling.

Extraordinary precautions were taken in getting the exact average temperature of the specimen in the furnace, and to insure its rapid transfer to the calorimeter. In most of the experiments a double calorimeter was used so that the specimen did not come in contact with the water of the calorimeter, so that any evolution of heat by hydration of the cement was avoided. Table I gives the specific heat of concrete.

TABLE I. SPECIFIC HEAT OF DIFFERENT MIXTURES AND COMPOSITIONS OF CONCRETE.

Temperature.	Stone Concrete. 1-2-5	Stone Concrete. 1-2-4	Cinder Concrete. 1-2-4
72° to 212°	.156	.154	....
[illegible]	[illegible]	[illegible]	.180
72° to 1172°	.201	.210	.206
72° to 1472°	.219	.214	.218
72° to 2172°			[illegible]

The measurements of thermal conductivity were made by a number of methods and have taken far more time and energy than all the others put together. The thermal conductivity is that property which determines how rapidly heat will travel through a substance and how rapidly therefore objects beyond will be heated by transmission. The conductivity becomes of prime importance in all questions of protection of the steel in reinforced concrete buildings. There is very little data to be found as to this important property of any of the common materials of engineering and such data as is to be found is not at all concordant. As to the conductivity of concrete or its variation with temperature and with composition, practically nothing has been known.

The methods adopted for the measurement will be described in full in papers now being submitted to one of the scientific societies for publication and it probably will not be of interest here to more than outline them.

The formula showing the relation of the temperature upon the two sides of a plate to the amount of heat which would flow through it is as follows:

[illegible]

[illegible]

K — The coefficient of thermal conductivity dependent upon the nature of the material and its temperature.

Q = the qnantity of heat flowing through the plate in the area measured.

A = the area.

t_1 = the temperature of the hotter side of the plate.

t_2 = the temperature of the cooler side of the plate.

d = the thickness of the plate.

s = the time during which Q units flow through the area A.

The formula will be seen to be merely an expression of the following relations, that the flow of heat is proportional to the area, to the temperature, and the time, and that it is inversely proportional to the thickness.

After spending many months in developing other methods the electrical method used by the writer for the past 15 years in studying the flow of heat through steam pipe coverings was [illegible]

[illegible] CONDUCTIVITY OF CONCRETE.

[illegible] of plate. C	F	[illegible]	Coefficient Calories per [illegible]	Coefficient B.T.U. [illegible] per [illegible]
35°	95°	[illegible]	[illegible]	
[illegible]		Stone 1:2:4		
		[illegible]	[illegible]	[illegible] to 114.
50°	95°	Cinder 1:2:4	[illegible]	56.
[illegible]	392°	Stone 1:2:4	0021	146.
400°	752°	Stone 1:2:4	.0022	
500°	[illegible]	Stone 1:2:4	.0023	[illegible]
1000°	1832	Stone 1:2:4	[illegible]	[illegible]
1100°	[illegible]	Stone 1:2:4	.0029	202.

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*A paper by Prof. Charles L. Norton, Massachusetts Institute of Technology, Boston, Mass., read before the National Association of Cement Users, Dec. 13, 1910.

[illegible] of the heating of a conductor carrying a current of electricity. By measuring the electrical energy supplied the quantity of heat developed may be known with great precision. Further, if this heat is passed through the plate under test and into a colorimeter on the far side, a check upon the value *Q* may be had. For determination of the temperature difference thermal couples, resistance thermometers, and mercury thermometers were used, but thermal junctions made of thin strips of copper and nickel or of platinum and platinum-rhodium were generally found most serviceable.

The apparatus used for the lower temperatures consisted of a thin, electrically heated plate, to the two sides and edges of which concrete could be applied. Outside of the concrete there was then placed heavy copper or brass plates which could be kept at a constant temperature by an internal circulation of water. Thermal junctions were placed at several points on each surface of each concrete plate. The electrical input was measured by calibrated Weston instruments, the calibrated thermal junctions gave the value of the temperature difference to the nearest one-one hundredth of a degree. For the thickness, numerous measurements were made by a pair of flat-nosed calipers and averaged.

It was necessary to keep this apparatus running for several days before it could be balanced, that is, before the rate of flow of heat outward through the plates became constant and equal to the electrical input. The number of measurements has now reached many hundreds, and it seems apparent that the precision of the method depends on the accuracy with which the thickness of the specimens can be maintained constant. Otherwise the accuracy is better than 1 per cent. This apparatus has been named by my assistants the "flat plate tester" and perhaps it is well to so designate it here.

Later, in order to make tests on plates as thick as some of the walls in common use, another method was adopted. Cubical boxes 36 ins. in outside dimension were built with walls of several thicknesses. Inside the boxes were placed electric heaters which served to raise the inside surface to a temperature above that of the surroundings. A small fan served to keep the air in the box stirred to insure uniformity of temperature throughout. The boxes were tightly sealed. The power supplied to both heater and fan was measured as before. Mercury thermometers and thermal junctions, as well as a Cammender recording resistance thermometer, were used to measure the difference in the temperatures inside and outside of the box. Data have been secured on scores of specimens and they are practically identical with the results obtained by the flat plate tester.

For the high temperatures a modification of the entire process was found necessary. The concrete to be tested was cast in the form of a cylinder on the outer surface of and concentric with a steel bar which could be heated to a high temperature by the passage of a heavy current. Outside of the cylinder of concrete was applied a closely fitting "continuous" calorimeter. The temperature of the bar and of the calorimeter were measured by thermal junctions, and the amount of water and its rise in temperature gave the value of *Q*.

In order to guard against the uncertainty of the temperature at the ends of the bar, the calorimeter was made so as to enclose only about one-half the length of the bar, the rest being covered by guard rings similar to the calorimeter but without any provision for the measurement of the quantity of water.

The heating of the bars required a considerable amount of special apparatus, since it was necessary to provide a current of upwards of 2,000 amperes for the high temperatures, and to be able to vary its amount to any desired value below that point. For this purpose there were installed three 15 k. w. transformers connected [illegible] primary side with a three phase 2,300 volt circuit. By means of divided secondaries and a rather elaborate arrangement of switches, the secondary voltage could be varied from 190 volts down to 55 volts. This secondary voltage was applied to the primary of a second step-down transformer, whose secondary was divided into 20 coils. By means of a switchboard the entire output of the transformer could be had at almost any desired low voltage. This enables us to heat bars insulated by materials of different composition and of different thicknesses to any desired temperature up to 2,800° F. With this arrangement both the steel and the concrete can easily be melted.

The results obtained are tabulated below. It is to be regretted that there is no uniformity of practice as to the units to be adopted in reporting the measure of effectiveness of insulators. While the physicist renders his report in calories per square centimeter, per centimeter thickness, per 1° Centigrade per second, the steam engineer confines his observations to B. T. U. per hour, per square foot, per inch of thickness, per 1° F. and the refrigerating engineer reports on the basis of a 24-hour time unit. I have even seen a report in terms of hogsheads of water raised to the boiling point, time not stated.

A brief comparison of these values with those for other materials may be interesting.

The specific heat of concrete is slightly less than that of either red brick or fire brick, hence the same amount of heat needed to raise the temperature of a pound of brick is about 10 per cent more than for a pound of concrete. But the density of concrete is enough greater than that of brick to raise the heat capacity of a cubic foot of concrete above that of brick. The difference is not large, however.

While the expansion data are not complete, it seems clear that for a time after the beginning of exposure to fire the concrete and its reinforcement will expand at much the same rate, but that the further expansion of the surface will not proceed at so rapid a rate. This will tend to reduce the stresses which the expansion of the heated surface would otherwise set up in the cooler interior. It is perhaps because of the failure of the concrete to return to its original dimensions that the small amount of surface cracking found after a fire is due.

The experiments made with coal and cinder mixtures indicate the necessity of added care in the selection of cinders for this purpose.

The tables of thermal conductivities give us data as to the rate at which heat will travel through concrete. It is interesting to note the great difference between the tamped and the untamped concretes made from stone. The one was as porous as possible, and the other as dense. One transmits nearly twice as much heat as the other. The cinder concrete, as is commonly believed, is much better as a heat insulator than the stone concrete, being nearly three times as effective as the denser stone concrete in retarding the flow of heat. It may be interesting to call attention to the heat insulation afforded by other materials. The best of the commercial articles used for this purpose is compressed cork, which is nearly 25 times as effective as stone concrete. Steel on the other hand transmits heat from 75 to 100 times as fast as the densest of the stone concrete.

EARTH AND ROCK SECTION

Construction of Tunnels in the Austrian Alps.*

The new Austrian Alpine line, known as the "second railway to Triest," was begun in 1901 and completed in the fall of 1910. The construction of this line involved tunneling through four important mountain systems, namely, the Julian Alps (Wochein tunnel), the Karawanken (Karawanken tunnel), the Bosruck mountain in the Northern Calcareous Alps (Bosruck tunnel), and the Hohen Tauern (Tauern tunnel). In addition, a large number of medium sized tunnels had to be built for these mountain lines. A total of 50,494.6 m. (31.376 miles) of single track tunnels, and 22,865.6 (14.208 miles) of double track tunnels were constructed.

[illegible]

The methods employed in constructing these tunnels was in general as follows: A bottom heading was driven as an advance heading; then shafts were made from the bottom heading to the top of the arch, and following this the top heading was driven; then from the top heading, for a certain distance back, the full section was excavated in rings of a length of 8 to 10 m. (26.25 to 33 ft.), the latter then served as working places for beginning the [illegible] after there rings had been completed, the full section was excavated between the rings, and the masonry work of the intermediate rings completed; then the inverts were put in, where required, ring by ring, and finally, following behind the work of tunnel lining, the bottom channel was constructed, and the bottom or sole of the tunnel was covered with concrete in the section which had already been lined.

This method of excavating the full section was only departed from at some of the parts of the single-track Bosruck tunnel, in which, after the top and bottom headings had been made, the so-called "Belgian method" was adopted. As the top heading advanced, the space for the tunnel arch was excavated and the arch itself was built. After successive sections of the arch had been completed, and at same distance behind it, the space for the side walls was excavated and the side was built in successive sections, the arch being in the mentime temporarily supported.

Crown-bar timbering was used in the full section; side sleepers and intermediate sleepers were put in at the height of the imposts [illegible] which the crown bars are supported, with bearers under the cross-sleepers, where the pressure allows this to be done, [illegible] sleepers and bearers by props [illegible]

[illegible] supporting timbering satis- [illegible] of safety and strength, it can be used with nearly every kind of rock, makes it possible to adopt a uniform and regular method of constructing the lining in different thicknesses and under different conditions of pressure, can easily and quickly be put up by experienced miners, and requires no unnecessary excavation. Moreover, a minimum amount of timber is cut to waste, and if there is not much pressure the same timber can be used several times over, and the timber can be quickly changed in a safe and simple way while the masonry work is carried on.

This method of timbering and lining, together with the use of a bottom heading and the excavation of full sections, may be described as the modern "Austrian method of tunnel driving."

WOCHEIN TUNNEL.

The double track Wochein tunnel is nearly due north and south through the Kolba, one of the eastern spurs of the Julian Alps. The length of the tunnel is 6,334 m. (20,781 ft.) or 3.93 miles, not including portals. The formation penetrated is limestone with intercalated layers of slate and containing schist, all frequently much folded and distorted. Figure 1 is a diagram profile of the tunnel giving daily and monthly progress and other data as explained.

Drilling Character of Rock.—The character of the rock as regards ease of drilling varied and is reported as follows for the 15 divisions indicated by Arabic numerals on the diagram, Fig. 1:

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*Abstract of paper [illegible] lished in Bulletin of [illegible] tional [illegible] Congress [illegible]

(1) Drilled very well; good action of blasts; no pressure; compact rock but owing to loosening by blasts and ease of weathering particularly when wet always bottom heading, top heading in most cases with timbering; owing to want of air the advance was at first very often stopped for hours at a time.

(2) Drilled very well, very good action of blasts; timbering up to kilometer 1.59; no pressure; dry.

(3) Drilled with more difficulty; very good action of blasts; no timbering; dry.

(4) As compared with Section 1, more difficult to drill; at some places very poor action of blasts; timbering only between kilometers 1.8 to 1.9 owing to inflow of water, advance much interrupted.

(5) Drilled well; no pressure, no timbering; water 14.13 cu. ft. per second; springs at kilometers 2.582 and 2.62.

(6) Drilled well; at kilometer 2.85 drilling stopped by rock cracking off; strong timbering; dry.

(7) Very difficult to drill; poor action of blasts.

(8) Drilling much impeded by inflow of water; timbering in places.

(9) Drilled well; good action of blasts; dry; a little timbering.

(10) Difficult to drill owing to schist; good action of blasts.

(11) Difficult to drill as compared with Section 10; good action of blasts; spring at kilometer 2.168; a little timbering.

(12) Drilled and blasted very well; timbering; no pressure; quite dry; unimportant inflow of gases at kilometer 1.632.

(13) Drilled well; action of blasts according to strike and dip of slate; timbering; no pressure; dry; in December, 1902, advance difficult by presence of limestone clunch.

(14) Drilled less well than No. 13; action of blasts the same; no pressure; little water; advance often stopped.

(15) Drilled well; action of blasts raised according to arrangement of slate; timbering; no pressure; inflow of water considerable; advance very frequently interrupted by want of ventilation and wages troubles.

Working Methods and Progress.—Referring to the diagram, Fig. 1, there will be found the daily advance averaged for each month; the total advance for each month; the general size of heading, and the kilograms of explosive used per meter of advance. The average advance per day from start to meeting of headings was as follows:

North side, hand drilling	7.28 ft.
North side, machine drilling	16.04 ft.
North side, hand and machine	9.38 ft.
South, side, hand drilling	7.01 ft.

BOSRUCK TUNNEL.

This is a single-track tunnel 4,766 m. (15,632 ft) in length, passing through the Northern Cretaceous Alps near the summit of the Bosruck, its direction being 21° west of north. The center line of the tunnel is a straight line except a section 236 ft. long at the entrance on the north side, which forms a curve having a radius of 250 m. (820 ft.). A section of this tunnel 1,387 meters long consisted of limestone containing many clefts and fissures filled with water. This condition led to many interruptions in the work in the driving of the bottom heading owing to the inflow of water.

At metre [illegible] difficulty with water was encountered. This was accompanied by a serious cave-in. The water came in at the rate of 28.25 cu. ft. per second. The work of getting rid of this water by driving the top heading and constructing water headings, of supporting and filling up the hollow formed by the cave-in, which extended to a height of 72 ft above sleeper level; and finally of constructing the bottom channel for draining water that continued to enter, took seven months. Details of this work are shown by Fig. 2

In the piagram, Fig. 3, is shown progress in constructing the bottom heading, all interruptions, as well as progress by hand and machine drilling, being indicated.

Driving Methods and [illegible] drilling was resorted to as far as kilometer 1,470 in the north heading, and to kilometer 821 in the south heading. A water-power plant having been completed machine drilling was then begun in both headings. In the north heading four compressed air drills, on the Gatti system, mounted on a drill truck, were used. The average daily advance was 12.93 ft. in the Dolomite limestone and 14.58 ft. in the fissured Guttenstein limestone.

In the south heading four compressed air drills of the Hoffman-Waehrwolf system, were used, mounted on two vertical pillars. The average daily advance varied from 13.53 ft. in the Werfen schist to 20.28 ft. in the Hasel formation.

On the north side the Triassic limestone (containing many clefts filled with water) was reached at metre 1,170, where the machine drilling began. At metre 1,200 the inflow of water had increased to such a degree that it was feared that further advance might interfere with the proper progress of the excavating and the masonry construction. Accordingly the driving of the heading was stopped from October 20 to December 21, 1903, and during this time the bottom channel was completed to metre 1,180.

Power for operating and ventilation had been secured up to this time by a water-power installation using the "Schreiende Bach," a small mountain stream which had its source in the Boruck mountain. This stream gradually failed, and it was apparent that this failure was connected with the flow of water into the tunnel.

The work of driving the heading on the north side had to be entirely stopped at metre 1,540. It was necessary to install a steam power plant of 100 h. p. This work required from July to October, 1904. During this time work in the tunnel was continued to a limited extent in spite of the lack of ventilation. It was necessary to allow intervals of many hours to elapse in order to secure natural ventilation, and the shifts were reduced in length, down to two hours. At the beginning of October the ventilation could again be set going, and by November 2, 1904, the tunneling on the north side was again in full operation

The advance of the north heading was further interrupted by some smaller inrushes of water. The most important of these was at metre 2,102, which interrupted the driving for sixteen days.

It was necessary to enlarge the bottom channel, in order to provide for the inflowing water, which had increased to 550 litres (19.42 cu. ft.) per second. This was effected, in that part of the tunnel which had already been completed, by raising the side walls of the channel 50 centimetres (1 ft. 7 11/16 ins.) by means of concrete. This it is true resulted in raising the level of the track and in reducing the clear cross-section. In the subsequent limestone section the bottom channel was given a larger cross-section and placed towards one side.

The great inrush of water at the working face of the south heading which occurred on May 17, 1905, and the simultaneous appearance of fire damp made it necessary to stop the advance at metre 2,170 on the north side, in order to provide against the risk of a dangerous inburst of water there. Only after the tunnel lining and the channel had been completed nearly up to the heading was driving again resumed.

The south side, which at first also depended on the water power of the "Schreiende Bach," which was transmitted as electricity, was made independent of the north side in February, 1904, by the erection of a separate steam plant giving 150 h. p. When the Triassic limestone was reached, the natural water reservoir inside the mountain, which had already been tapped from the north side, was also tapped from the south side. As the bottom heading advanced, the inflow of water continually increased, until at metre 2,170 an inrush of 1,100 litres (38.83 cu. ft.) per second occurred. After twenty-four hours the inflow became reduced to 600 litres (21.19 cu. ft.) per second, and it continued to enter at that rate for a long time. This inrush of water stopped the ventilation, as the whole length of the air conduit became immersed in water. While this was being set in order, a violent explosion of fire-damp took place on the morning of May 22. A shift of 16 men and a foreman, who were to remove the trucks and the remaining dynamite left in the heading, were entering the upper working place, the Belgian method of driving being in use. At that moment the naked lights set off the fire-damp, the presence of which was totally unexpected. Seventeen men were killed by this explosion.

These occurrences made it necessary to introduce radical changes in the method of construction adopted on the south side. In the first place the appearance of fire-damp made a very thorough ventilation of all the working places necessary, and for this purpose a second steam plant, of 300 h. p. was erected, and the ventilation installation was increased to three sets of two blowers each. As the bottom heading was kept flooded by the continuous inflow of 600 litres (21.19 cu. ft.) of

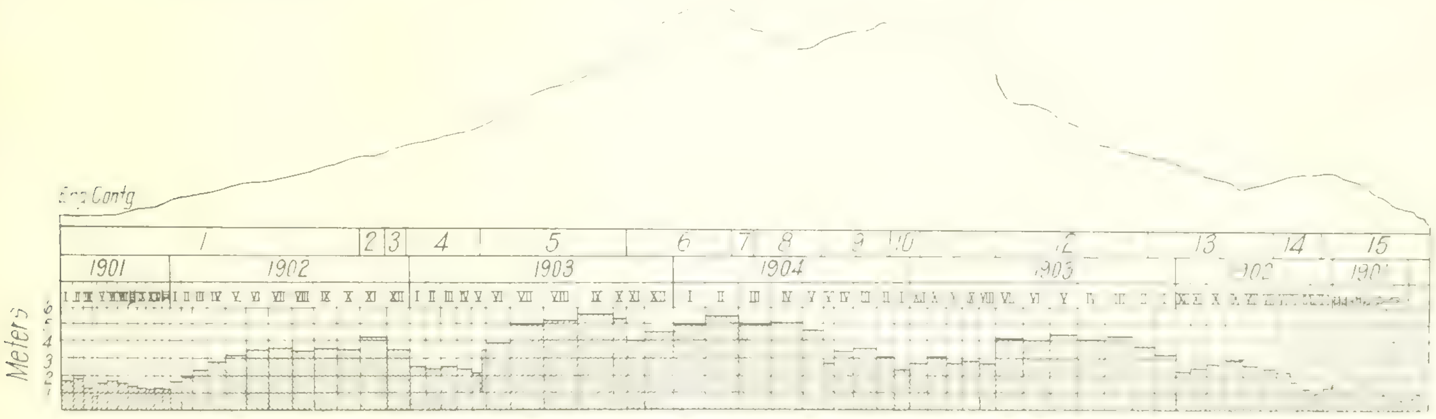

Fig. 1—Profile of Wochein Tunnel, Showing Advance of Headings.

water per second and made it wholly useless for the conveying, the operations were transferred to the top heading and from metre 1,864 the Belgian method of tunnel driving was adopted. At the end of the completed section of the tunnel a ramp and a transhipping stage were erected, and the conveying operations were transferred there from the tunnel bottom to the arch and to the top heading. The latter was driven as a cut with the bottom at the level of the imposts to above the end of the bottom heading and then stopped at metre 2,469. The space for the arch was then excavated and the arch put in up to metre 2,416.

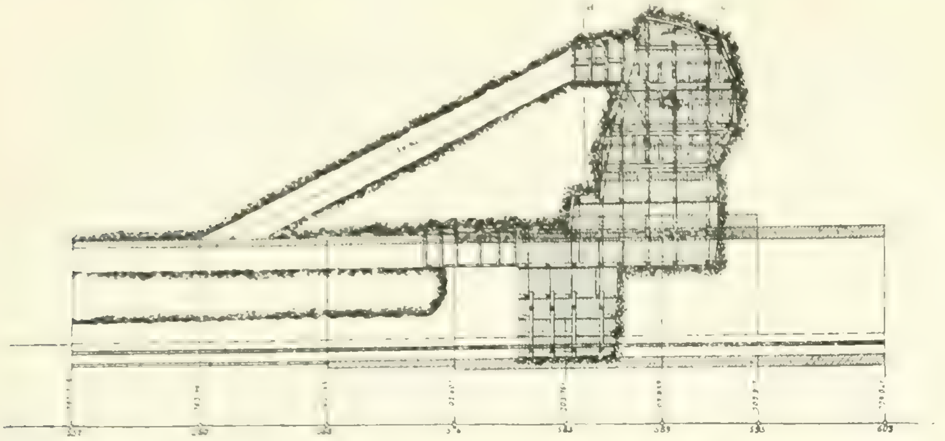

Fig. 2—Cavity Formed by Cave-In in Bosruck Tunnel, and Method of Support by Timbering.

In the meantime the tunnel lining and the bottom channel were completed to within 10 m. (33 ft.) of the end of the heading, and the 123 m. (403.5 ft.) left were attacked on Oct. 25, 1905, from the north side. The junction was effected on Nov. 22, 1905, at metre 2,291.6 from the north side, corresponding to metre 2,470.7 from the south side.

The whole inflowing water could then be diverted to the north side by means of dams, and there it could freely flow away through the bottom channel which was completed up to metre 2,160. Only then did it begin to be possible to construct the side walls and inverts on the south side from metre 1,864 to metre 2,416; the arches had already been put in according to the Belgian method.

Finally the inflowing water was again diverted to the south side and the last part of the tunnel was then completed. The lining was finished by the end of June, and the ballasting and the laying of the track by the end of July; the tunnel was opened to traffic Aug. 22, 1906.

Both the Belgian and the Austrian methods were used during the lining of the tunnel. On the north side the Belgian method was used almost exclusively. On the south side the Belgian method was used up to metre 584 (where the great inrush of water took place), with every ninth ring as full-section ring; from there onwards the full-section excavation system was used for the next 1,300 m. (4,264 ft.). In the Werfen schists and anhydrites of the south side pressures as a rule were low and the lining was given a thickness of 0.50 m. (1 ft. 7 11/16 ins.); a few rings in soft or much-fissured sections had arches 0.60 to 0.80 m. (1 ft. 11⅝ in. to 2 ft. 7½ ins.) thick and side walls 0.90 to 1.15 m. (2 ft. 11 7/16 ins. to 3 ft. 9 5/16 ins.) thick. in the firm dolomitic limestone the linings for smaller pressures were made 0.50 m. (1 ft. 7 11/16 ins.) thick; in the Guttenstein fissured water-bearing limestone the arches were given a thickness of 0.60 m. (1 ft. 11⅝ ins.). In the Hasel formations on the north and south sides the tunnel lining, where there was considerable pressure, was given a thickness of 0.60 to 0.80 m. (1 ft. 11⅝ ins. to 2 ft. 7½ ins.) in the arch and of 0.90 to 1.15 m. (2 ft. 11 7/16 ins. to 3 ft. 9 5/16 ins.) in the side walls and inverts. On the north side rather a large number of the rings, which were made of rubble work, were strengthened by the insertion of six courses of ashlar, from [illegible] from 10 ins. to 1 ft. in height, in order to obtain a more uniform distribution of the pressure and a better connection of the masonry work.

In the parts through magnesian limestone where there was greater pressure the arches were given a thickness of 0.70 to 0.80 m. (2 ft. 3 9/16 ins. to 2 ft. 7½ ins.), and the side walls one of 1.05 to 1.15 m. (3 ft. 5⅜ ins. to 3 ft. 9 5/16 ins.). At the cave-in there is a specially strong cross-section with concrete foundations and ashlar arches.

On the north side the building stone was obtained from a rock fall,[*] consisting of dolomitic limestone, near the tunnel entrance. On the south side compact laminated quartzite schist was chiefly used, from the neighboring Ardning quarry; also Gosau conglomerate erratic blocks and graywacke from more distant quarries.

In the Hasel formation on the north side pressure phenomena became apparent in the case of some of the rings, of strong cross-section, nearly two years after they had been finished. Some of the masonry was split off, particularly at the imposts, and cracks and fissures were formed in the side walls and the arches.

This gradually increasing pressure, which finally destroyed the lining, is to be attributed to the presence of rock-salt and of gysum in this section. These minerals became softened by the action of the air, and with them the rock. After the lining had been removed, the rock was found to be perfectly plastic to a depth of 1 m. (3 ft. 3⅜ ins.); in some places it was even in a semi-liquid condition. Fourteen rings were entirely rebulit and sixteen partly. The ashlar for the arches of nine of the rebuilt rings was obtained from the distant granite quarries near Mauthausen on the Danube.

KARAWANKEN TUNNEL

This double-track tunnel, on account of the intense rock pressures encountered, was one of the most difficult mountain tunnels ever built. Its length is 7,976 m. (26,161 ft.), and pressure phenomena extended over a section nearly 2 km. (1.25 miles) in length. The pressure made itself felt in the bituminous-shale sections as soon as the heading was made; in the carboniferous limestone and in the quartz conglomerates it developed some time after. Pressure phenomena are not attributable to superficial swelling, but are due to stresses existing in the rock, partly caused by the weight of the overlaying strata, but partly also representing some of the forces involved in the formation of the mountains.

In the bituminous-shale section fire-damp appeared after nearly every blast, and greatly retarded the progress of the work; it was accordingly decided in advance that compressed air drills were to be used.

Timbering had to be done as soon as any advance was made. At first strong sleepers and a grillage were tried, but this did not prove satisfactory because the sleepers were broken by the rising of the ground, and because of the difficulty of replacing broken beams. The pressures were too great for an iron frame, and it was decided to use a simple close timbering consisting of heavy vertical struts along the side of the tunnel supporting beams under the tunnel top. This proved satisfactory, although the timbering frequently had to be renewed (in one case as many as eight times). An instance of collapsed timbering due to pressure during construction is shown by Figs. 4 and 5. Collapse of tunnel due to pressure after completion is showns by Figs. 6 and 7.

On account of the frequent collapse of the ordinary passing places, a plan providing for "heading passing places" was adopted. The height of the tunnel was increased 0.4 m. (1 ft. 3¾ ins.) at intervals, and means were provided for hauling up empty trucks and holding them suspended while loaded trucks passed under them. These "heading passing places" were made about 15 m. (49 ft.) long.

Methods and Progress.—At first four drilling machines were mounted on one truck, but as the heading frequently became contracted in cross-section and the ground swelled up, the movement of the truck was often interfered with. It was therefore found necessary to use two vertical drilling pillars. A close lining was only put in at the top of the heading, while the struts at the sides were relieved of pressure as long as possible by removing the advancing schist by means of picks.

After tedious work extending over one and three-quarters years, the section where pressure occurred, 1,920 m. (6,300 ft.) in length, was passed and the heading then entered the Triassic rock on Oct. 8, 1904. As inflows of water were to be expected from the Triassic rock, which might have been dangerous to the unlined sections in the bituminous schist, the south heading was bricked up at kilometer 3.03 and the remaining 900 m. (2,952 ft.) had to be pierced from the north side. The junction was effected on May 17, 1905.

After the bottom heading had been made, the top heading was then made according to the ordinary method. On account of the fire-damp, which collects at the highest points, it was considered dangerous to make shafts from the lower heading to the top of the tunnel. Consequently the top heading had to be constructed independently, similarly to the bottom heading, and with the same difficulty. Compressed air drills were used in this case also.

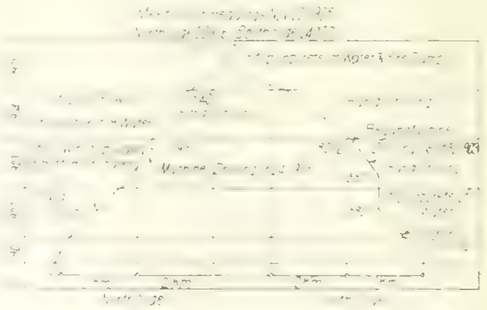

Fig. 3—Diagram Showing Advance of Headings, Bosruck Tunnel.

Before the cross-section was finished the two headings were above each other on long sections for a considerable time. It was found that the layer, 4 m. (13 ft. 1½ in.) thick, between the two headings did not furnish sufficient support. It gave way in such a manner that the floor rose in the upper heading, while in the bottom heading the roof came down.

The whole cross-section was cleared out and lined in the following way: At intervals of 36 m. (118.2 ft.) rings 9 m. (29 ft. 6⅜ ins.) long were cleared, from which the work progressed always by rings of the same length, care being taken not to begin to clear out a ring until the lining of the previous ring had been completed.

Great difficulties were encountered, especially in constructing the first ring of such a 36-m. section. Some rings could only be finished off with much trouble, and some rings showed signs of failure in a short time, although the thickness of ring was 1.3 m. (4 ft. 3 3/16 in.)

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[*] From paper by F. Hennings published in Bulletin of February, 1910, International Railway Congress Association.

When building the masonry of the arch it was generally necessary to reconstruct the top heading, which had in most cases crushed in. This was done to a height extending 1 m. beyond the normal cross-section. The work was completed by putting in the invert; but this was not done, as a rule, until the arch of the next ring had been completed, and sometimes even later. Until this was done, the side walls were kept apart at every 2 m. (6 ft. 6¾ ins.) by powerful struts.

On the average, the work of clearing out or of putting in masonry proceeded simultaneously on thirty rings. The top heading followed the bottom heading at an interval of two months. From that time, till the whole cross-secction was cleared out, took about four months in the case of the first ring of a section, and fifteen and a half months in the case of the last ring. The masonry work took about two months on the average, not including the invert. From the time of putting in the top heading till completion of the invert, took from ten to twenty-one months.

Although in the sections where pressure occurred the stone arches were made from 1 to 1.5 m. (3 ft. 3⅜ ins. to 4 ft. 11 ins.) thick, and at the worst places the work was built wholly of ashlar, yet it became necessary over a length of 481 m. (one-fourth of the whole section where pressure occurred) to renew the masonry extensively. Over a length of 350 m. (1,149 ft.) of this nearly the whole circumference had to be renewed. An attempt was made to line the tunnel with brick, but this had to be given up as they could not resist the pressure. In all about 73,000 cubic meters (95,500 cu. yds.) of ashlar was used, part of it being brought from a distance.

As a rule, the masonry began to move while it was being put up. This movement was not only sideways; the sidewalls were lifted, the maximum movement of this kind being 25 c.m. (9 13/16 ins.). The raising of the foundations of the sidewalls ceased, as a rule, with the completion of the arch; but at two places the floor began to rise when the adjoining ring was taken out.

TABLE I—MONTHLY AND DAILY ADVANCE OF HEADINGS IN WOCHEIN TUNNEL.

Months.	North Heading Monthly advance	North Heading Average Daily advance	South Heading Monthly advance	South Heading Average Daily advance
	Ft.	Ft.	Ft.	Ft.
Nov., 1900	...	...	98.4	3.28
Dec.	...	...	76.4	2.46
Jan., 1901	168.3	[illegible]	102.3	3.28
Feb.	159.1	5.68	67.9	2.43
Mar.	124.6	4.02	82.0	2.10
Apr.	77.4	2.58	21.3	0.82
May	157.1	5.08	71.2	2.30
June	161.4	5.38	87.9	2.92
July	161.7	5.02	134.5	4.33
Aug.	141.7	4.56	174.5	5.64
Sept.	133.2	4.43	83.0	2.76
Oct.	130.2	4.20	129.6	4.17
Nov.	125.6	4.03	103.0	3.44
Dec., 1901	115.8	3.74	117.1	3.77
Jan., 1902	[illegible]	[illegible]	133.5	4.30
Feb.	169.2	6.04	105.3	[illegible]
Mar.	226.7	7.32	100.7	[illegible]
Apr.	266.0	8.86	122.3	4.07
May	321.8	10.36	169.2	5.45
June	337.9	11.25	216.5	7.22
July	356.3	11.48	239.8	7.74
Aug.	344.5	11.12	258.5	8.33
Sept.	337.9	11.25	281.5	9.38
Oct.	351.4	11.31	268.0	8.66
Nov.	404.8	13.48	235.9	7.87
Dec., 1902	349.8	11.31	221.1	7.12
Jan., 1903	250.6	8.07	319.2	10.30
Feb.	211.9	7.58	335.6	11.97
Mar.	246.0	7.94	424.8	13.64
Apr.	223.4	[illegible]	397.0	13.22
May	210.9	6.82	436.7	14.07
June	375.0	12.50	393.7	13.12
July	499.7	16.10	414.1	13.25
Aug.	521.6	16.92	264.7	8.53
Sept.	534.8	17.81	268.0	9.58
Oct.	223.1	17.15	265.1	[illegible]
Nov.	286.7	13.02	291.6	9.71
Dec., 1903	448.5	14.46	262.8	8.46
Jan., 1904	492.1	15.88	221.4	[illegible]
Feb.	508.5	17.52	280.1	9.65
Mar.	494.1	15.88	347.8	11.22
Apr.	480.0	16.01	325.4	10.86
May	297.9	21.45		8.33

[illegible] CONSTRUCTION OF SOME LARGE ALPINE TUNNELS

Name		Length of tunnel miles	Total construction proper.	Power installation.	Total cost	Cost per lineal ft.
Wochein		[illegible]	$3,638,157	$343,699	$3,981,856	$191.44
Karawanken		[illegible]	6,681,156	750,813	7,431,969	[illegible]
Tauern		[illegible]	5,551,149	986,316	6,537,465	233.02
Bosruck		[illegible]	1,660,209	[illegible]	1,905,705	121.88
Bukovo		[illegible]	[illegible]		722,394	237.24
Obern		[illegible]	[illegible]		[illegible]	[illegible]
Great Hartberg	1	1.54	[illegible]	40,435	[illegible]	121.40

The maximum [illegible] sidewalls was 2 mm. (3/32 in.) per 24 hours. This movement become reduced when the arch was completed, but did not become confined to small limits until a considerable length of the part in question had been completed.

Accordingly the foundations were begun 10 c.m. (3 15/16 ins.) deeper, and the sidewalls were placed 20 c.m. (7⅞ ins.) farther apart than in the original plans.

The pressure usually manifested itself first at the crown of the arch; the cement separated and thin flakes cracked off along the bed-joints where pressure was greatest; then individual stones became crushed and wide cracks formed parallel to the abutting joints. It was found that the stones cracked most frequently in the inner third of the lining, and only rarely in the outer third.

Figs. 4 and 5—Collapse Due to Rock Pressure During Construction of Karawanken Tunnel.

When the masonry was renewed it was found, on the whole, that the pressure had become materially reduced. As the mountain load remains unaltered, this is no doubt due to the fact that internal stresses which existed independently of the load had become equalized.

An inspection made in May, 1909, failed to disclose any disquieting sypmtoms, although very slight movements in the sidewalls were observed.

COST OF CONSTRUCTION

As the difficulties which had to be overcome in building the great Alpine tunnels, and particularly the Karawanken tunnel, were very great, the cost of construction per metre of tunnel is very high. Table II also includes the Great Hartberg tunnel, the Bukovo tunnel, where there was great pressure, and the Obern tunnel, on account of the very abnormal difficulties of construction (exceptionally large pressures, many large inrushes of water); the two last named tunnels are [illegible]

[illegible]

We will now consider the machine and power installations. The construction of four large Alpine tunnels forms a good basis for the discussion of the chief questions concerned.

Power Required [illegible] operating the plant used during the construction of a large tunnel can hardly be determined by definite rules; the particular local conditions will in every case form the predominant factor. In Table III, which follows, we give the power required for the four great Alpine tunnels and its distribution to the different machines. The figures given represent in all cases the maximum power, that is at about the beginning of the last third of the construction.

The figures for the totals show that a rather considerable quantity of power was required for all the four large Alpine tunnels. This is due to the great difficulties encountered during their construction: inrushes of water, fire-damp, abnormal pressure phenomena, as well as the high pressure at which it was consequently necessary to do the work, in order to avoid any material increase in the time required for construction. In order to reduce expenditure water power was used as much as possible and every attempt was of course made to limit the additional power not to be obtained in this way, but which had to be supplied by the steam plants, to a minimum. There was sufficient water power at the Wochein and Karawanken tunnels as well as at the south side of the Tauern tunnel; at the north side of the Tauern tunnel a steam plant with a normal output of 700 h.p. supplemented the available water power of 230 h.p. (in summer, up to 320 h.p.). Mr. Canat, in his report, has already dealt with the unfortunate fate of the water power installation (300 horse-power) at the Bosruck tunnel, which, as already stated above, had to be replaced by a 400 h.p. plant when the stream in the Boruck mountain system, supplying the power, dried up. In connection with this case it may be mentioned that the collecting reservoir for the "Schreiende Bach" was not far from its source, and was at a distance of over 2,000 metres (1 mile 427 yards) from the center line of the Bosruck tunnel. As the geological examination did not show that there could be any communication between the dolomitic central sections of the Bosruck, through which the tunnel was to pass, and the sources of the "Schreiende Bach," and as moreover this was the only water power available for the tunnel construction, it will be intelligible why in drawing up the original scheme no provision was made for the erection of a steam plant.

The figures given in Table II for the cost of the power installations not only includes the cost of the different machines used, but also the considerable expenditure on all buildings, hospitals, quarters for workmen, workshops, sheds, drinking and other water, as well as the lighting installations, sidings at the tunnel entrances, stores for materials, dump heaps for the excavated rock, roads of access, roads from quarries, etc. What also contributed towards the very high cost of the plant in the case of the Tauern tunnel, particularly on the north side, was the fact that the working places near the north entrance were in the immediate neighborhood of Bad Gastein, the world-renowned health resort, and that in consequence of the large number of patients there, it was necessary to provide many expensive hygienic arrangements for the workingmen with regard to their board and lodging, and also in order

TABLE III—POWER REQUIRED [illegible] CONSTRUCTION OF THE FOUR GREAT ALPINE TUNNELS

NAME OF TUNNEL	Ventilation. [illegible]	Ventilation. [illegible]	[illegible]	[illegible]	[illegible]	Horse power for traction. [illegible]	Horse power for traction. [illegible]	Horse power for traction. [illegible]	[illegible]	Saws [illegible] power	Electric lighting	Water supply and small machines	Total horse-power required in horse-power. Supplied by Water power	Steam	Gas engine	Total
Wochein tunnel [illegible]																
(a) North side	[illegible]	[illegible]		[illegible]		[illegible]			[illegible]	20	[illegible]	[illegible]	370	215	[illegible]	[illegible]
(b) South side	[illegible]	120				50			10		1	[illegible]	17	[illegible]		225
Karawanken tunnel [illegible]																
(a) North side	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	60	20	20	50	[illegible]	740	80	60	[illegible]
(b) South side	[illegible] (12,360)	[illegible]	[illegible]			[illegible]	160	60	[illegible]	20	60	30	730	160	[illegible]	950
Tauern tunnel (two tracks).																
(a) North side	[illegible] (12,360)	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20	[illegible]	45	250	[illegible] [illegible]	[illegible]	1220
(b) South side	[illegible]	360			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25	[illegible]	[illegible]	550	110	[illegible]	1020
Bosruck tunnel [illegible]																
(a) North side	[illegible]	[illegible]	[illegible]			[illegible]			20	20	[illegible]	[illegible]	(300)	110 90		500
(b) South side	[illegible] (12,360)	280	100			[illegible]			[illegible]	20	[illegible]	[illegible]		[illegible] 90		540

[illegible]

As Table III shows, 350 cu. m. (12,360 cu. ft.) of air per minute was the standard amount of air sent into the tunnel in the case of the four large Alpine tunnels; this rule was only departed from at two working faces owing to the presence of favorable conditions. The air was compressed by high-speed blowers, running in the different cases at 1,450 or 2,000 r. p. m. They were driven by rotary-current motors and each gave a pressure of about 60 cm. (24 ins.) of water. In order to drive the same quanity of air, as the tunnel progressed, through the longer conduits, where the loss of pressure was greater, greater pressure was necessary. In most cases two blowers were at first used, the number being increased to four as the work progressed, and even to six during the last stage of the operations in some cases, where ventilation was most requisite, the blowers being arranged in series. Placing them in parallel would have been useless for the purpose and must be described from this point of view as technically wrong practice.

As it is known that the loss of pressure in air conduits, and consequently also the power the blowers require, vary inversely as the fifth power of the diameter of the conduit, it was considered as the most important principle, that the conduits should have as large a diameter as possible. Unfortunately the ventilation expert, with this demand, comes into conflict with the tunnel builder, particularly as regards the bottom heading, as the space available there has so many demands made on it that the diameter of the air conduits must be strictly limited. In the case of the large Alpine tunnels the air conduits had an internal diameter of 800, 750 and 700 mm. (2 ft. 7½ ins., 2 ft. 5½ ins. and 2 ft. 3 9/16 ins.) in the case of the Bosruck tunnel, 500 mm. (1 ft. 7 11/16 ins.) in the completed tunnel; in the working sections it was 500 mm. (1 ft. 7 11/16 ins.) in all cases, and in the bottom headings it was 300 mm. (11 13/16 ins.) in the Karawanken tunnel, also 500 mm. (1 ft. 7 11/16 ins.). In the case of tunnels exceeding 8,000 m. (4 miles 1,700 yards) in length it is however advisable, taking into consideration the large amount of

TABLE IV—PERFORMANCE OF DRILLS AND POWER REQUIRED FOR DRILLS OF DIFFERENT SYSTEMS

System of drill.	Place where used.	Class of rock.	Mean diameter of hole drilled, in millimeters (in ins.)	Average time required for drilling a hole 1 meter (3 ft. 3⅜ in.) deep, in minutes. Each	All	Material removed by drill per minute, in cubic centimeters (in cubic ins.)	Power per drill at main shaft, in horse-power.
	Simplon tunnel, north side.	Dolomitic limestone, mica schist, gneiss.		26.5			
	Simplon tunnel, south side.	Ditto.		42.6			
Brandt hydraulic drill.	Albula tunnel.	Albula granite, limestone and argillaceous schist.		35.35	37.4		
	[illegible] west side.	Gneiss.	80 (3 5-32)	42.2		119 (7.26)	
	Tauern tunnel, [illegible] side.	Granitic gneiss.	80 (3 5-32)	43.3		116 (7.08)	45
	Tauern tunnel, south side.	Granitic gneiss and mica schist.	80 (3 5-32)	42.0			
Compressed air drill.	Arlberg tunnel, east side.	Mica schist containing granite.		31.8			
(a) Feroux system; (b) Gatti system; (c) Waehrwolf system; (d) Ingersoll system.	Bosruck tunnel.	Dolomitic limestone.	45 (1 25-32)	22.7		70 (4.27)	25
	[illegible]	Dolomitic limestone, Werfen schist	45 (1 25-32)	24.9	24.5	64 (3.91)	14
	[illegible]	Ditto.	50	26.1		[illegible] (4.58)	15
Siemens-Schuckert electric crank percussion drill, two horse-power type.	[illegible]	[illegible] Dachstein and Jurassic limestone with calcite.	45 (1 25-32)	25.2	23.0	63 (3.85)	5
	[illegible]	Gray limestone and Werfen schist.	45 (1 25-32)	20.7		77 (4.70)	[illegible]

power required for the ventilation, to go a step further and increase the diameters [illegible] still practicable amount: working section, an internal diameter of 600 mm. (1 ft. 11⅝ ins.); bottom heading one of 500 mm. (1 ft. 7 11/16 ins.) or at least not less than 400 mm. (1 ft. 3¾ ins.).

The investigations made by the railway construction department of the Austrian State Railway gave very interesting information as to the efficiency of such long air conduits:

Let η_1 be the volumetric efficiency of the conduit, *i. e.* the ratio of the quantity of air delivered to the quantity blown into the conduit, and η_2 manometric efficiency, *i. e.* the ratio of the initial pressures in the conduit corresponding to the aforesaid quantities; then $\eta_1 : \eta_2 = \eta_m$, the mechanical efficiency of the conduit. According to the measurements made by Dr. Brabbée $\eta_m = 82$ per cent in the case of a conduit 2,500 m. (1 mile 974 yards) long with well made joints. It was also found that the loss by leakage in the conduit in the completed part of the tunnel amounted to 0.5 per cent of the volume passing through, per 100 m. (109 yards) of length of conduit. As the length of conduit increases, η_m decreases very quickly and according to the example given it is only 50 per cent when the length is 5,000 m. (3 miles 188 yards). Now as experience shows that such conduits are as a rule rather leaky, η_m will probably generally be between 30 and 45 per cent in case of most long tunnel conduits. This leads to another important conclusion: in order to obtain a supply of air rationally and suitably, the air conduits (particularly in the part of the tunnel which is completed) should be made to leak as little as possible. Leaky conduits reduce the mechanical efficiency very considerably; much more power is used for the ventilation, without supplying the intended quantity of air to the working section.

POWER DRILLS.

All the three systems, namely, hydraulic, pneumatic and electric operation, were applied, in the case of the Alpine tunnels, in accordance with local conditions and with special requirements, as follows: Wochein tunnel, bottom and top headings on north side, electric; Karawanken tunnel, south side pneumatic, north side electric; Bosruck tunnel, bottom and top headings on north and south sides, pneumatic; Tauern tunnel, bottom heading on north and south side hydraulic, top heading on north side, electric.

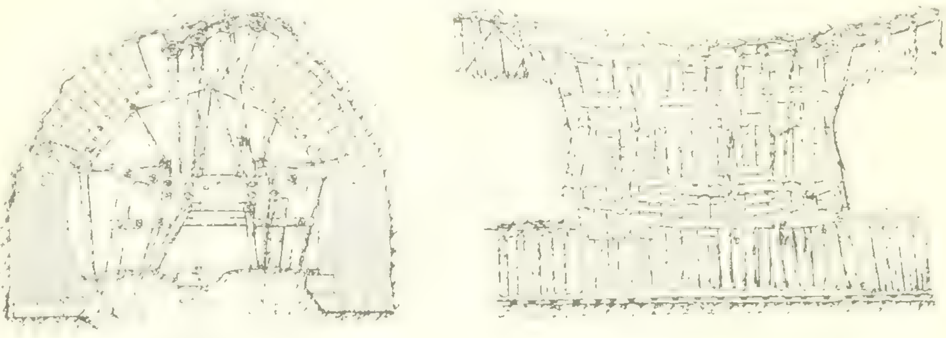
This machine drilling was not limited to the bottom heading, but was also used rather extensively in driving the top heading. In the hard dolomitic limestone of the Bosruck tunnel and in the granite gneiss of the Tauern tunnel machine drilling was also used over long sections for making the cut for the bottom channel. The Hoffmann-Waehrwolf compressed air drill, which is easy to manipulate, was used for this purpose in the Bosruck tunnel, and the crank percussion drill, made by the Austrian Siemens-Schuckert works (type 1 h.p.), in the Tauern tunnel.

In considering this question the chief interest lies in the value of the different drilling systems. Each system has its own individual peculiarities; but the chief point is the drilling power:

1. As a measure of this we will take in the first place the time in minutes (mean time of drilling), which under normal conditions in the tunnel is required on the average for drilling a hole 1 m. (3 ft. 3⅜ ins.) deep, including the time required for setting up and adjusting the drill and exchanging the drills. If we calculate the volume drilled out in drilling a hole of the given diameter 1 m. (3 ft. 3⅜ ins.) deep, then dividing this by mean time of drilling we obtain the mean volume drilled out per minute. This figure can be considered a measure of the performance of the drill.

2. Power required for the drill at the main shaft of the power station. As the efficiency of the power transmission also affects this number, it is of greater importance for comparison than the horse-power consumed on the spot by the drilling machine. The performance of the drills and the power required for the different systems of drilling are shown in Table IV; several other great tunnels, besides the four Alpine tunnels, are also included in the comparison.

The [illegible] in the first place that the Brandt hydraulic drills are the most efficient. This becomes still more apparent if we remember that the high figures for the quantity of material removed were obtained in the case of the Brandt (116 to 119 cu. c.m. [7.08 to 7.26 cu. ins.]) drill in hard primary rock, while the much lower figures for [illegible] [3.91 to 4.58 cu. ins.]) and electric (63 to 77 cu. c.m. [3.85 to 4.70 cu. ins.]) percussion drills were obtained in limestone which was less hard. It can also be noted that the performances of the most modern compressed air drills and of the electric crank percussion drills (Siemens-Schuckert, 2-h.p. type) are very much the same. The figures on this point are especially suitable for comparison, because the mean hardness of the rock was about the same in the Wochein and in the



Figs. 6 and 7.—Failure of Completed Lining Due to Rock Pressure, Karawanken Tunnel.

Karawanken tunnel, [illegible] in the Bosruck tunnel.

The experience obtained in the Alpine tunnels leads to the following conclusions as regards the different [illegible]:

Brandt [illegible] [illegible] fully justified its high reputation, in the case of the Tauern tunnel. The advantages of this drill are: good efficiency and hence specially suitable for very hard rock; easy manipulation, no injurious knocking while running, hence less need for repair, smooth running, hence also little noise, no production of dust, simple regulation of power required, convenient utilization of the water spray for condensing the dynamite fumes. Disadvantages: very high cost of the whole drilling installation, owing to the costly compressor pumps and pipe lines, very large amount of power required, consequently the working expenses are also high. The general recognition of these properties has limited the field of application of the Brandt drill, but at the same time clearly defined its suitability for driving the bottom headings of very long tunnels. In such cases so much power is usually required for the whole work, that an additional consumption of 100 horse-power for drilling is not of very great importance, particularly if cheap water power is available, as is frequently the case in mountainous countries.

This real competition between drills, when building tunnels, only exists between compressed air and electric percussion drills. In the case of the Alpine tunnels, both systems gave good results in the limestone formations.

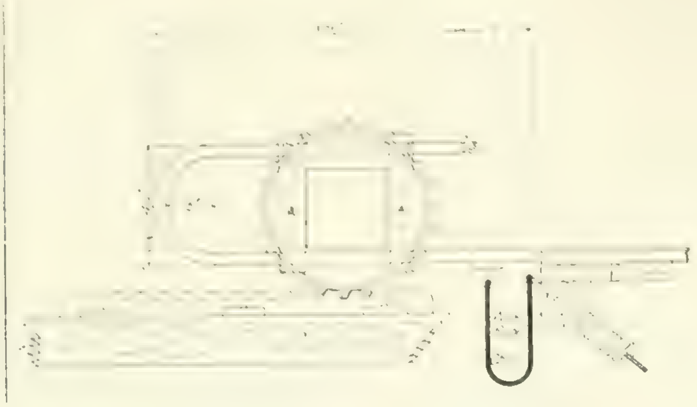
[illegible]pressed [illegible] unnecessary to give, in this report, descriptions of the different systems used (Gatti, Waehrwolf, Ingersoll, Schwarz and R. Mayer). The differences between these systems are not very important and they are of approximately the same efficiency. The advantages of compressed air drills are: strong percussive action, simple manipulation, low cost of repair, ventilation and cooling of the working face by the expanding air, easy removal of chips, possibility of using the [illegible] other operations (for instance pneumatic hammers; or as in the case of the Bosruck tunnel, for pumping the water out of the trenches cut for the foundations of the side walls). The disadvantages are: low efficiency, great consumption of power, rather high initial cost of the whole drilling installation.

[illegible] Siemens-Schuckert crank percussion drill (2-h.p. type) gave good results in the cases of the Wochein, Karawanken and Great Hartberg tunnels. The 1-h.p. type, which was used for the top heading of the Tauern tunnel, could make no satisfactory advance in the hard primary rock; the absence of a trained staff no doubt had a good deal to do with this. The electric percussion drills are accordingly most suitable for medium-hard rock. The advantages of the electric crank percussion drill are: good efficiency of the power transmission, very much smaller amount of power required, low cost of the drilling installation in a short time, very simple method of supplying power. The disadvantages are: owing to the required absorption, while running, of the very considerable momentum of the back stroke, the cost of repair is very high, as the parts subject to wear and tear have to be renewed very frequently; consequently the working expenses are high in spite of the small amount of power required; the drills require the careful attention of a trained staff.

This comparison of the different properties of the electric percussion drills and the compressed air drills shows that at present the balance between merits and demerits is still nearly the same in both cases. Consequently local conditions and special circumstances will decide, in every individual case, which system is to be preferred. The continual growth in the use of pneumatic hammers, which enable hard work to be eliminated, in a most practical way, even in the excavation of the full section, makes it certain that compressed air will be used extensively in future. Moreover the use of these hammers, which use up large quantities of air, are a proof that but little importance is attached to an economic consumption of air when drilling in mines and tunnels.

The most recent improvements in percussion drills tend to the development of a new system of drilling, in which the good qualities of compressed air and of electric drills are combined as far as possible. As compressed air is the most suitable form of power for operating percussion drills, while on the other hand electricity alone furnishes an easy and economic method of transmitting power, this in the first place led to portable electro-compressors connected with the central power station by cable. These consist of small compressors coupled up with electric motors; they are brought to the place where the drills are used and are there connected with the air drills, a small compressed air holder being interposed. As a rule there is one electro-compressor to four drills.

A further development in this direction consists in combining the portable compressor and the air drill to form one whole, and this is effected in the electro-pneumatic percussion drill of the Ingersoll Rand Company. This machine consists of three chief parts: 1, the compressed air percussion drill, which is mounted on a drilling pillar in the usual way; 2, the air compressor, known as the pulsator, which is operated by an electromotor directly connected with it; 3, two tubes connecting the drill and the pulsator. The compressor has two cylinders, which are connected by two tubes with the front and back part of the drilling machine respectively. Thus the compressed air goes forwards and backwards between the drilling machine and the pulsator, without issuing into the outer air. In consequence of this arrangement the very complicated valve gear, otherwise necessary, together with the throttle valve chest, buffer, etc., are eliminated; thus the drill becomes very much simpler in its construction. The compressed air thus working in a closed circuit, the expansion is fully utilized and compression losses are avoided; consequently the whole arrangement shows a high degree of efficiency.



Cradle Dumping Device for Cars.

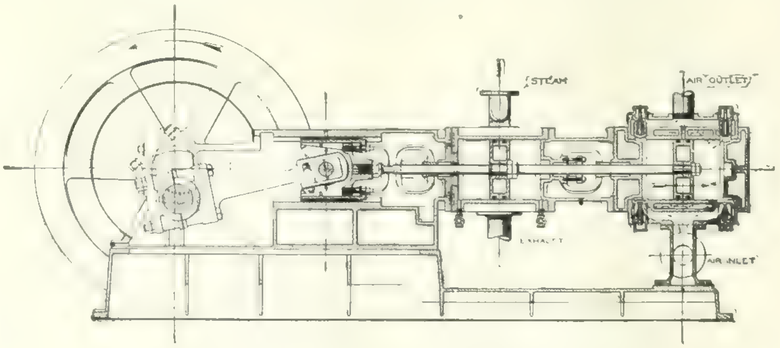
The pulsator is best driven by a strong rotary-current motor. The pulsator and motor are mounted on a small under-frame fitted with wheels. Two types of this machine are built for use in tunnel building; the lighter one (4-D) requires 3 to 5 h.p., delivered to it on the spot, the heavier one (5-C), 5 to 8 h.p.

HAULAGE.

Haulage by horses was used only at two working places in the cases of the four great Alpine tunnels, namely, at the south side of the Wochein tunnel and at the south side of the Bosruck tunnel. Man power was only exclusively used for hauling in the working section on the north side of the Wochein tunnel. Steam locomotives were used in the completed part of the tunnel on the north side of the Wochein tunnel and the north and south sides of the Bosruck tunnel; in the case of the latter tunnel they were also used on the working section on the north side. Electric locomotives were used in the completed part of the tunnel, in the case of the Karawanken and Tauern tunnels; in the working sections of these tunnels, including the bottom headings, benzine motors were used.

Steam locomotives should in future no longer be used for haulage in the working sections during tunnel-building operations. It is unreasonable on the one hand to pump air into the tunnel at great expense, and on the other then to allow this air to be vitiated by using this primitive method of conveyance. Even when used in the completed part of the tunnel, steam locomotives have an injurious effect on the working sections, and it is hence best to eliminate them altogether from the tunnel. Electric traction is the most suitable system in the completed part of the tunnel and has given very good results in the case of the Alpine tunnels.

In the working section and in the bottom headings noteworthy results were obtained with benzene motors. Fourteen horsepower benzene locomotives, on the Oberursel system, were used in the Karawanken tunnel; such 14 h.p. locomotives were also used in the Tauern tunnel, together with more powerful ones, of 18 and 22 h.p. As a rule two and three locomotives were used for each material train. When these locomotives were used, several accidents occurred in the working sections, both in the Karawanken and in the Tauern tunnel, workmen being made insensible by the exhaust gases of the locomotives and suffering from carbonic-oxyde poisoning; but this was caused by a defect in the design of the motors, easy to remedy. These motors, which have hitherto been used underground only in mines, can only be started from the side. In narrow bottom headings it is not possible to do so from the side; the machines must accordingly go on running light when standing still in the heading, and while doing so produce large quantities of exhaust gases, which, when other conditions were also unfavorable, produced the accidents mentioned. It is therefore advisable that motors which are to be used for tunnel work should be designed in such a way, that they can be started either from the back or from the front, as in the case of motor cars. In consequence of this experience, in the case of the Tauern tunnel, locomotives were only allowed to stand still at the passing place in the heading, or in fully-excavated sections, which were being lined, where accordingly enough room was available. As regards the use of benzene locomotives for traction in tunnels, it is finally necessary to note that the motors do not stand overloading. Even a slight overload will produce misfires; the combustion is incomplete and the gases formed are of a very objectionable nature. The load admissible for every type of locomotive was accordingly accurately specified later on; and under these altered working regulations the benzene-locomotive traction worked very successfully till the completion of the tunnel.



Section of Small Air Compressor.

LIGHTING.

The ordinary miner's lamps used everywhere in the working places had to be replaced for a considerable time on the south side of the Karawanken and the Bosruck tunnel by safety lamps. Electric lighting of the completed section, which is doubtlessly very effective, was only applied to a very limited extent on the south side of the Karawanken and of the Tauren tunnel. Acetylene lamps were used at some of the working places in the Tauern tunnel. Gasolene (petroleum spirit) was also tried to a small extent, namely in the Bosruck tunnel at some rings which were being lined, and in the Bosruck and the Tauern tunnels when laying the track. Acetylene and gasolene lamps have undoubtedly certain advantages for tunnel-building purposes. The more recent types of gasolene lamps for mining use have a strong illuminating power and also work well in a tunnel. Their use at the working sections would materially reduce the number of smoky miner's lamps and hence improve the state of the air at the workings.

Cradle Dumping Device for Small Cars.

The accompanying cut illustrates automatic dumping device for cars of narrow gage, as used at various mines in Missouri and described by S. S. Clarke in the *Mining and Scientific Press.* The figure shows the elevation and gives dimensions of a crade which is calculated for a 1-ton capacity car of 24-in gage and wheels 12 ins. in diameter. The cradle operates by over-balancing when the trucks of a car run into the looped rail shown. The function of the spring is to right the car after it has been delivered of its load. The curve of the looped rail is governed by the radius of the car wheel. The looped rails consist of two pieces of 3 x 1¼-in. iron, 7 ft 9¾ ins. long.

These are riveted inside of the rail frame. the distance being the same as the gage of the track. The gear-wheel and rack-rail are made of cast iron, the gear usually being chilled. while gray cast iron answers for the rack-rail.

New Types of Air Compressors.

Air compressors, involving some new and useful points in their construction have recently been put upon the market by the Sullivan Machinery Co., of Chicago. These compressors are of small to moderate capacity and are built for various pressures running from 10 to 100 lbs. per square inch. Also, on account of the less careful attention given to small machinery, they have been made as simple and durable as possible, without lowering the efficiency of the machine.

The new compressors are of two types, one is for steam power only, and the other is belt driven.

In the steam driven machines (see Fig. 1) the plain steam slide valve is controlled by an eccentric on the shaft, with which it is connected by a simple but satisfactory arrangement of valve rods. The air cylinder is placed on the outside of the steam cylinder, and is connected to it by a heavy distance pipe. The air cylinder is supported on a sub-base which runs the entire length of the compressor, and maintains proper alignment of all the parts.

In the belt driven machines the air cylinder is attached directly to the rear end of the frame, and all working parts, such as the crank shaft, cross head, connecting rods and main bearings are of dimensions and contain an amount and quality of material which provide a factor of safety very much higher than is considered necessary in standard compressors of larger size.

The air cylinder; it is cored to form water jackets, and the cylinder heads are also jacketed over their whole surface.

The air valve mechanism consists of radial automatic poppet valves for both inlet and discharge. These valves are placed close to the end of the cylinder, the inlet valves being at the bottom and the discharge valves at the top of the cylinder. These valves act in a true radial direction to the axis of the cylinder, and reduce to the lowest terms the losses in efficiency made necessary by clearance.

The ports or pockets leading to the valves are very short and direct so that practically no air is trapped after compression instead of being expelled from the cylinder. The valves and their parts are so made that in case of breakage it is impossible for the broken pieces to enter the bore of the cylinder. The valves are held in place in cages, which seat, by means of taper fits, in the cylinder walls. To remove these valves it is only necessary to unscrew the plug on the outside of the cylinder, when the entire valve and cage may be withdrawn for inspection or regrinding. The main bearings have adjustable caps and are heavily lined with babbitt metal. They are bored out at right angles to the center line of the piston rod by a fixture which assures accurate alignment. A box pattern cross head is used, being the same type as that employed in cross compound machines. It is fitted with adjustable shoes and is regarded as unexcelled in wearing qualities and ease of adjustment.

The steam machines are governed by a split ball throttling regulator with an extra cylinder which places the throttle valve under the influence of the air receiver pressure. Ordinarily, the governor varies the speed of the compressor to supply the demand for air, the halves of the ball by their centrifugal action preventing the compressor from exceeding a safe speed.

These machines may be fitted by a loading device which is set to shut off the incoming air to the compressor when the receiver pressure exceeds a pre-determined point. This enables the compressor to run at regular speed, compressing no air until the receiver pressure again falls below the point set. This secures important reduction in the amount of power used when the compressor is furnishing air intermittently.

Some Notes on the Cape Cod Canal.*

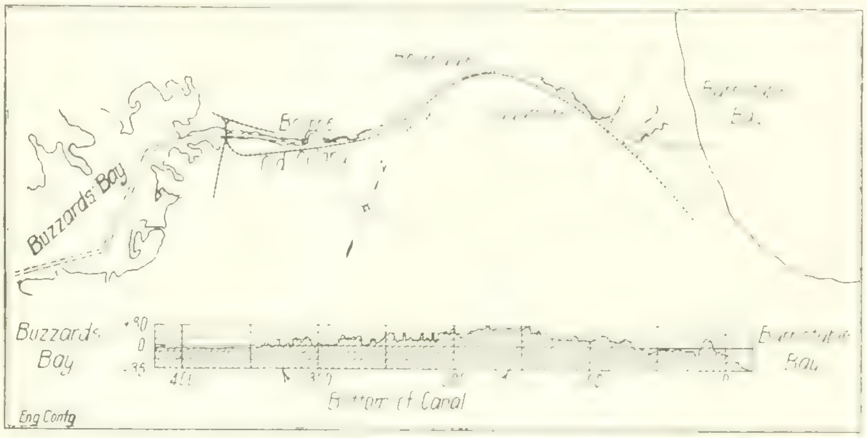
From an engineering point of view, the problem is not great. The total length over the isthmus is 8 miles. The total length to 30-ft. depth in both bays is 13 miles. The soil to be cut is sand, and amounts to 17,000,000 cu. yds. The deepest cut is 29 ft. above tidewater. The channel at both ends of the route, the natural marshes and streams already furnish a waterway for boats of light draft. The difference in tide between the two bays necessitates no locks. The depth of the canal is to be 25 ft. The minimum width of bottom will be 100 ft. through the central portion of the canal, and this will give a surface width at the narrowest point of 250 ft. The approaches will have a minimum bottom width of 250 ft. The right of way has been obtained, and in addition other tracts of land essential to the undertaking.

Agreements for the change of the railroad line have been made with the N. Y., N. H. & H. R. R. Co.; the railroad bridge necessitated thereby is completed; four dredges are deepening the five-mile western approach from Buzzard's Bay; two large suction dredges are removing about 20,000 cu. yds. per day for the channel through the marshes at the eastern end of the canal.

A breakwater, 3,000 ft. in length, is being built northward of the channel, where it enters Barnstable Bay. Several other dredges are at work on the central portion of the line. Administration and other buildings have been brought and the necessary preparation made for a campaign of activity on the ground during the coming winter.

The bridges are being constructed on the basis of an ultimate depth of canal of 34 ft. They will each have an opening of 160-ft. span of the type known as the Bascule lift bridge. The local travel across the canal will be accommodated by such bridges or ferries as experience may dictate.

The final estimates for the canal include the thorough electric lighting and other aids to navigation of the whole channel and approaches requisite for a region where fog prevails.



Plan and Profile of Cape Cod Canal.

The tonnage through Vineyard Haven Sound today, which will be all tributary to the canal, amounts to 25,000,000, of which there is:

	Tons.
Coal	[illegible]
Stone	[illegible]
Nova Scotia plaster	[illegible]
Oil	[illegible]
High-class merchandise	2,000,000

the remainder being crude material of various descriptions.

The number of passengers between New York southern and eastern points by water is today over 500,000. This number will be greatly increased through the opening of the canal, as the neighboring regions will be much more accessible, and steamers of the Sound type car leave New York late in the evening, land their passengers at desirable resorts, and arrive at Boston early the next morning.

The N. Y., N. H. & H. R. R. Co. runs along the southern bank of the canal. A large manufacturing center will be developed at the eastern end, where mills will have the advantage of both land and sea transportation. Water abounds in the hills back of the center of the line, and on these hills an increasing summer population will undoubtedly be settled.

Skepticism as to the success of the canal has been natural, being based on the conditions of the past, when the great majority of the coastwise tonnage was carried in sailing vessels. Today:

(*a*) This tonnage is under the control of a small number of corporations, which tow the merchandise in barges containing from 1,000 to 3,500 tons.

(*b*) The towing companies now require a plant for a three-weeks' round trip on account of the dangers and delays via the Vineyard Haven route.

(*c*) The cost of this plant will be reduced at least one-third, for the reason that not only is the distance shortened 66 miles, but the duration of the trip is greatly diminished.

(*d*) Insurance from perils of the sea will be lessened.

(*e*) The congested railroad systems of the Atlantic coast are now heartily in favor of water transportation for crude material, thus relieving their lines for the transportation of high-class merchandise and passengers.

(*f*) This new waterway is not in the strictest sense a canal, but a short passage connecting two portions of a much-traveled route through which a known traffic exists. Its conditions are analogous to those at Suez, where the profits have far exceeded the estimates.

(*g*) Humanity demands the elimination of the dangerous, stormy and fog-bound route around the Cape. The loss of life and property in that locality has been appalling. The record, more or less incomplete, from 1843 to 1903, gives a minimum of 2,131 vessels wrecked in the Nantucket Shoals region, 908 of which were total losses. Ten complete crews disappeared with their ships, and in addition, about 700 men lost their lives.

The completion of the canal will render unnecessary the proposed dredging of Pollock Rip channel at an estimated cost of some $3,000,000, a sum which could be much more advantageously used by the Government in the neighborhood of the canal rather than being wasted in the tortuous and ever-shifting channels off Chatham.

Such is the description of the work being done by the Boston, Cape Cod & New York Canal Co., a corporation which is expending $12,000,000 under a charter granted by the State of Massachusetts on June 1, 1899. Its promoters are assured that it will be a financial success.

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[*] From a paper by J. W. Miller, Vice-Pres., Boston, Cape Cod & New York Canal Co., read at the annual convention of the Society of Naval Architects and Marine Engineers, New York city, Nov. 17, 1910.

Cost of Two-Story Brick Building.

The following costs are for the construction of a two-story brick store building, which was built in Chicago in 1903:

[illegible] Stone	
Material	[illegible]
Labor	[illegible]
	[illegible]
[illegible]	
[illegible]	[illegible]
[illegible]	[illegible]
Labor	[illegible]
	[illegible]
[illegible]	
Brick, 23.1 M..................................	$115.56
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
	[illegible]
[illegible]	
Material	[illegible]
Labor	[illegible]
	[illegible]
[illegible]	
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
	[illegible]

The Delaware, Lackawanna & Western R. R. has submitted plans to the City Council of Buffalo, N. Y., for a new station to be erected on the water front. The railroad owns property on the water front on both sides and it is said if the plans go through, the present structures will be razed and new ones built in their stead.

Experimental Asphalt Macadam Pavement at Washington, D. C.

During the fiscal year ended June 30, 1910, portions of two streets in Washington, D. C., were paved with asphalt macadam. This type of pavement was laid for experimental purposes, and according to the last annual report of the engineering department of the District of Columbia, the conditions of the streets indicated that the pavement will prove satisfactory. The total area of the asphalt macadam was [illegible] sq. yds., of which [illegible] sq. yds. was laid in 13th St. N. W. The roadway of this street is 40 ft. wide, including vitrified block gutters 1½ ft. wide on each side, making the width of the asphalt macadam 37 ft.

The asphalt macadam was laid 2 ins. deep on the surface of the original macadam, where this was high enough, after scarifying and rolling. Where the surface of the old road was not macadamized the gravel was removed to a depth of about 7 ins. below grade and a base consisting of 3 ins. of stone broken to 2-in. size and 2 ins. of stone broken to 1-in. size was put in and compacted by rolling to 2 ins. below grade. The work of preparing subgrade was done by day labor, the cost, including stone, being $2,948, or about 26 cts. per sq. yd.

Upon that macadam foundation the hot asphalt (Bermudez) macadam mixture was spread. This mixture consisted of two parts trap rock crushed to a size from 1 in. to screenings, and one part sand, to which was added about 1 per cent limestone dust. The crushed stone and sand were heated to a temperature of about 250° F., the limestone dust being added in a cool state to the hot mixture, conveyed to an asphalt mixer and thoroughly mixed.

Hot asphalt cement was then added and the whole thoroughly mixed for about five minutes. It was then hauled to the site of the work, spread over the roadbed to a thickness of 3 ins., and rolled with 5 and 10 ton steam rollers until thoroughly compact. Over this surface was then spread a thin coating of hot asphaltic cement for the purpose of filling voids. A thin coating of trap rock screenings ⅜ in. to dust was then spread on the surface as a top and final coating and rolled with a 10-ton steam roller.

About 1,866 sq. yds. of this type of pavement was also laid on the east side of 14th St. N. W., between Florida Ave. and Clifton St. This square has a steep grade rising in the direction of travel, and a better foothold than that afforded by sheet asphalt is required. The asphalt macadam on this square was laid on an existing concrete base, and was 2 ins. thick. Excepting as to the base, it was laid under the same specifications as that for 13th St. The asphalt macadam on both of the above streets was laid by contract at a price of 93 cts. per sq. yd. The following is an extract from the specifications for the asphalt macadam on the above contract:

Paving Materials—The paving mixture shall be composed of crushed trap rock screenings, concrete sand and mineral dust in the following proportions: Trap rock screenings, 2 parts; concrete sand, 1 part, and mineral dust, at least 5 per cent of the above aggregate; mixed with asphaltic cement. The trap rock shall be of a quality to be approved by the Engineer, and shall be equal to that used by the District of Columbia for macadam roadways. The crushed stone will vary in size from 1 in. to screenings and shall be devoid of dust.

The materials complying with the above specifications shall be mixed in proportions by volume depending upon their character and the traffic on the street, and upon the character of the asphalt, but the percentage of bitumen in any mixture soluble in carbon bisulphide shall not exceed [illegible] per cent.

The stone and paving cement shall be heated separately to a temperature [illegible] mixed while hot by machinery. The proportion of paving cement shall be sufficient to thoroughly coat each particle of the aggregate, and the entire mixture shall be [illegible] to the approval of the Engineer. The mixture will be hauled while hot to the site of the work and shall be covered until deposited on the street. The temperature at the time of dumping shall not be less than 220°. The hot mixture shall be evenly spread with hot tools upon the base to such a thickness as will make a layer 2 ins. in thickness after rolling. It shall then be rolled with a steam roller weighing not less than one ton per foot of tread of roller, until no further compression occurs. The finished surface shall be free from lumps or depressions and shall be true to the required cross-section.

The average results of laboratory tests of asphaltic cement and the mineral aggregate used in the preparation of the asphalt macadam were as follows:

Asphalt cement (Bermudez) soluble in carbon bisulphide . . . . per cent	98
Penetration:	
At 32° F., 200 grams, 5 seconds	[illegible]
At 77° F., 100 grams, 5 seconds	[illegible]
At 115° F., 50 grams, 5 seconds..........	210
Ductility at 77° F. (length of stretch in centimeters at the rate of 5 centimeters per minute)	30
Brittleness at 32° F. (in centimeters, drop of 25 grams weight)	17
Loss of volatilization at 300° F., 48 hours, per cent	2.6
Per cent hardening after heating 18 hours at 300° F., per cent........................	50.3
Action of water on cement, 7-day immersion	None

Macadam Mixture.

	Per cent
Bitumen soluble in carbon bisulphide (not including flush coat)........................	7.1

Mineral aggregate, mesh composition.

Retained on—	Per cent
1-in. mesh sieve...........................	1.0
¾-in. mesh sieve...........................	13.0
½-in. mesh sieve...........................	30.2
¼-in. mesh sieve...........................	19.2
8-mesh sieve	2.6
10-mesh sieve	.3
20-mesh sieve	1.3
40-mesh sieve	10.7
60-mesh sieve	10.7
80-mesh sieve	6.2
100-mesh sieve	1.6
Passing 100-mesh sieve........................	3.2
Specific gravity of stone........................	2.851
Specific gravity of sand........................	2.690
Voids in aggregate................per cent	26.4

Average Cost Per Mile of "State Reward" Gravel and Macadam Roads in Michigan.

During the fiscal year, July 1, 1904, to June 30, 1910, the mileage of state reward roads constructed in Michigan was as follows:

	Miles
Clay gravel, 2-course, each 5 ins. deep..	2.744
Gravel, 2-course, 8 ins. in all............	127.820
Macadam base, gravel top, 7 ins. in all....	1.
Gravel base, macadam top, 7 ins. in all..	3.355
Macadam, 2-course, 6 ins. in all..........	69.479

The conditions under which state rewards are granted for the above classes of roads require that the roads must be graded to a width of at least 18 ft. between side ditches, must be properly drained and given the proper crown, and the surfacing must be at least 9 ft. wide. No grades of over 6 per cent are permitted.

The accompanying tabulations, which have been compiled from figures given in the third biennial report of the Michigan State Highway Commissioner, show the average cost per mile in the various counties of the state reward gravel and macadam roads constructed during the year July 1, 1909, and June 30, 1910.

The specifications for the state reward gravel roads provide that the first course of gravel shall be spread on the prepared bed so as to have a uniform compacted thickness of 5 ins. The gravel is required to be good clean bank gravel, not less than 60 per cent by weight of which shall be pebbles that will be retained on a screen of ⅛-in. mesh and pass through a screen of 2½-in. mesh. The second course is spread to such a uniform thickness as to be [illegible] deep after compacting. The gravel is also required to be good clean bank gravel, of which not less than 60 per cent by weight shall be pebbles that will be retained on a screen of ⅛-in. mesh and will pass a screen of 1½-in. mesh.

In the case of the macadam roads the standard specifications require that the bottom course shall consist of 3½ ins. (compacted) of crushed limestone, cobbles or trap rock passing over the ¾-in. section and through the 3-in. section of the crusher screen. This bottom course after being rolled over two or three times, is covered with ½ to ¾ in. of stone screenings and rerolled. The top course consists of 2½ ins. (compacted measure) of stone passing over the ¾-in. section and through the 2-in. section of the crusher screen. The top course after being rolled two or three times over is then covered with ¾ in. of stone screenings.

The average cost per mile of the gravel and macadam roads was as follows:

COST OF GRAVEL ROADS IN 1909-10.

County.	Miles built.	Av. cost per mile.
Antrim	4.342	$3,412
Barry	6.008	1,482
Benzie	6.408	2,518
Branch	1.004	1,627
Calhoun	4.004	987
Cass	1	1,100
Eaton	3.002	1,233
Emmet	.998	2,840
Genesee	1.494	2,632
Grand Traverse	3.546	2,542
Gratiot	11	1,125
Hillsdale	2	2,184
Huron	1.916	2,046
Ingham	1.16	1,792
Iron	1.320	4,741
Isabella	3.998	1,239
Jackson	1.008	2,674
Kalkaska	2	2,853
Kent	6.150	2,573
Lake	1.050	1,382
Lapeer	1.514	1,794
Manistee	4.128	2,916
Mason	1	1,390
Mecosta	5.108	1,556
Menominee	3.626	1,271
Midland	1.500	1,298
Montcalm	2.650	1,190
Muskegon	1.500	3,365
Newaygo	.976	1,538
Oakland	3.146	2,201
Oceana	1.556	1,310
Osceola	1.974	1,127
Ottawa	2	1,618
Roscommon	[illegible]	1,936
Shiawassee	[illegible]	1,474
St. Clair	1.038	1,791
Tuscola	4.118	1,746
Wayne	2	2,548
Wexford	6.472	2,732

COST OF MACADAM ROADS IN 1909-10.

County.	Miles.	Av. cost per mile.
Alger	4	$9,991
Bay	5.587	3,426
Calhoun	1	4,350
Delta	8.571	3,456
Dickinson	2.426	6,724
Huron	1.908	3,534
Kent	1.998	2,847
Marquette	1.806	8,826
Menominee	1	2,930
Monroe	2	3,638
Muskegon	4.374	4,003
Newaygo	1	5,302
Oceana	4.792	4,174
Saginaw	16.845	4,809
St. Clair	2.98[illegible]	6,788
Tuscola	1	5,233
Wayne	3.984	7,242

Experiences of the Massachusetts Highway Commission in Road Surface Preservation Work.*

To overcome the disintegration of road surfaces caused by motor traffic, road builders all over the world have used every effort of science, skill and experiment. Tar distilled to varied degrees of refinement, residuum and asphaltic oils and asphalt have been used in every way that ingenuity could suggest.

The method of applying these different bituminous products is perhaps as important a feature as the material itself. It has been found necessary to determine by experiment what, if any, penetration there was of any of these materials into the surface of the road to be treated. It has also been necessary to determine the depth to which these ingredients should extend in order to preserve the road surface.

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*From a paper prepared by Harold Parker, Chairman Massachusetts Highway Commission, for presentation before the American Road Makers Association at the Indianapolis convention, Dec. 6-9, 1910.

Several years ago I heard of the Aitkin spraying machine, which was used in England for spraying refined tar under considerable air pressure. It had previously seemed to me that to make a surface application sufficient, the way to apply it was by forcing the material onto the road, in different layers, under high pressure. I therefore looked up and examined with great interest this machine when I went to England two years ago. I found that it was serving the purpose of protecting suburban and country roads with tarvia in a highly satisfactory way, and that many hundreds of miles of road about London and in the so called provinces had been treated in this manner. Two of these machines were imported and put into use on our roads in Massachusetts and have well borne out my views in regard to them.

We find after trying the different methods known as mixing, grouting, penetration and different kinds of surface treatment that where a road has once been well built with macadam or a good quality of gravel and asphaltic oil of suitable quality and consistency applied under a pressure of from 70 to 100 lbs. to the square inch, in layers of ¼ gal. to the square yard, and this immediately covered with stone chips, clean sand or gravel, and rolled with a 10-ton roller, a result is produced which, for any but exceedingly heavily used roads, will preserve and maintain the surface for two years or more, according to the number of applications that are made. The specifications for asphaltic oil used by the Massachusetts Highway Commission for the present year are as follows:

ASPHALTIC OIL.

[illegible] submitted shall be of uniform color, [illegible], general character and viscosity and must fulfill the following requirements:

(a) It shall not froth when heated to 100° C.

(b) It shall have a specific gravity of at least [illegible]

(c) It shall not contain more than 0.5 per cent of dirt or adventitious mineral matter.

(d) It shall contain not more than 1 per cent of matter insoluble in carbon bisulphide.

(e) It shall be of such viscosity that 60 c. c. measured at room temperature (78° F. or 26° C.) shall when at 100° C. be not less than 250 seconds nor more than 500 seconds in passing the Lawrence viscosimeter, or 200 c. c. measured and tested at the same temperatures shall be not less than 900 seconds nor more than 1,800 seconds in passing the Engler viscosimeter.

(f) When 20 grams are heated in a flat bottom dish 3 ins. in diameter for 21 hours in a well ventilated oven kept at a temperature of 250° C., the loss in weight shall not be greater than 15 per cent.

(g) When subjected to a number of heatings at 250° C. in a well ventilated oven with intermediate separations of asphaltene and of matter insoluble in carbon bisulphide until the final petroleum ether extract is not more than 10 per cent by weight of the original sample, it shall show the following results, assuming also that this final 10 per cent has the same composition as the 90 per cent of the material examined: The total loss shall be not more than 35 per cent by weight; the amount of asphaltene in the original sample shall not be greater than 6 per cent by weight, and the amount of asphaltene formed by this treatment plus that in the original samples shall be at least 58 per cent by weight of the original sample. The amount of matter insoluble in carbon bisulphide as a result of this treatment, shall be not greater than 5 per cent.

Our experience shows that not less than two applications of ¼ gal. each should be used in the beginning, and then single applications applied as often as may be necessary. Before any application is applied, however, the road should be made perfectly clean and its inequalities or any holes in the surface patched, so as to secure a uniform surface.

The [illegible] material on the [illegible] varies, as all costs do, according to the availability of material and labor; but the material can ordinarily be applied in two layers at a cost varying from 1½ to 8½ cts. per sq. yd.

Where the traffic is extremely heavy, however, a surface treatment as before described is hardly sufficient, and it is wise to have a depth of bituminous surface material from 1½ to 2 ins. in thickness. This thickness of surface may be formed by the mixing or by the grouting method.

Our experience in Massachusetts has led us to believe that the most durable and therefore economical material to be used as a bituminous binder in the construction of a course 2 ins. in thickness, is an oil asphalt or asphaltic oil, having a composition of about 85 per cent asphalt. This material combined with 1½-in. stone in the proportion of 18 gals. of bitumen to the cubic yard of stone, and placed upon the old surface, or a properly prepared new surface, to the depth mentioned, and thoroughly rolled and sealed with a coat of bituminous material, and immediately covered with sharp sand or stone chips, furnishes a wearing surface that is hard, smooth and satisfactory where the conditions do not warrant the construction of a stone, brick or other solid pavement.

Bids Asked for Lock Valve Machinery, Panama Canal.

The Washington office of the Isthmian Canal Commission has been directed to advertise for bids for the machinery to operate the Stoney gate valves and cylindrical valves in the locks at Gatun, Pedro Miguel and Miraflores. Bids on this machinery will be requested, both in Europe and in the United States. There will be required 116 machines, motors, and limit switches for operating the Stoney gate valves, and 120 machines, motors, and limit switches for operating the cylindrical valves. Tests of the type of valves to be used are being made at Gatun and Pedro Miguel.

The Stoney gate valves will be used for letting the water into and out of the lock culverts or tunnels. The machinery for which bids are to be asked will operate a rising valve stem fastened to the gate valve at the lower end and to a guided crosshead at the upper end. The crosshead will move vertically through a distance of 18 ft. by means of two vertical revolving screws which transmit the pull through two nonrevolving nuts in the crosshead. Each screw will be driven from the motor shaft by a gear and pinion reduction and two bevel gears.

The 78-in. cylindrical valves will let the water from the main culvert of the center wall of the locks into the lateral culverts, or *vice versa*. The machinery for operating them will consist of a guided rising stem fastened at its lower end to the cylindrical valve and having a nonrevolving nut fastened to its upper end. This nut, and hence, the valve and valve stem, is moved vertically through a distance of 3 ft. by means of a revolving screw, the end thrust being taken up by a roller-bearing at the upper end of the screw. The screw is actuated by a bevel gear which is driven by a pinion on the motor shaft.

The motors for operating the machinery will be induction, totally inclosed, moisture-proof, squirrel cage form, mill type, high torque, designed for 25-cycle, 220-volt system. It is the desire of the commission to purchase motors which have been developed and successfully used in the operation of steel rolling mills for a period of at least one year, such service being comparable with that which will be required on the lock valves. The service for which they will be used will be intermittent, and the excessive moisture of the Canal Zone, with its deteriorating effect, must be guarded against. Tests will be made on the Isthmus to ascertain whether the motors furnished are fit to stand the effects of the moisture, and to this end the commission may buy a sample of any, or all, of the motors offered.

All [illegible] operating will be [illegible] by the commission, and the time of delivery extends over a period of about two years, in order that the material may be on hand when the completion of successive parts of the concrete will permit its erection.

The Effect of Moisture on Road Tarring and Oiling.

In our issue of Dec. 14, this subject was discussed and some English experiments were described. From those experiments it was inferred that surface treatment of a macadam road with tar is far less effective when the road is damp than when it is dry. Not only does moisture prevent the tar from penetrating the macadam to any considerable depth, but even the slight degree of penetration secured is not satisfactory, due to the fact that the small voids are unevenly filled with tar.

We call attention to this fact again, primarily for the purpose of pointing out that tar seems to differ from crude asphaltic oil in its action in the presence of moisture. Some years ago the Petrolithic Pavement Co., of Los Angeles, developed a process of mixing asphaltic oil with natural soil, the success of which depended largely upon the liberal use of water prior to sprinkling the oil upon the pulverized soil. In some manner not wholly clear, the water in the soil seems to cause the oil to diffuse itself and penetrate the voids with much greater uniformity and effectiveness than is attainable when the soil is dry. While it may be true that "oil and water do not mix," it is evident that water in the voids of soil does cause a better mixture of the oil and soil than is secured when the soil is dry.

Incidentally, we may remark, another effective method of obtaining a uniform mixture of oil and soil was developed by the Petrolithic Co. After the pulverized soil has been sprinkled with water and with asphaltic oil, an ordinary "road machine" is driven over the road, with its blade set at such an angle that the soil is thrown to one side of the road in a sort of "winrow" of mixed oil and soil. On the return trip the blade of the road machine throws the mixture back into its original place.

This process is repeated a few times; and, aided by the use of a farm cultivator, or harrow, the road machine effects an astonishingly uniform mixture of oil and soil. The final process is the consolidation of the mass by the "iron sheep's feet" of a rolling tamper.

Essentially the same process of mixing and tamping has been used in California in making sand-clay and gravel-clay roads, omitting the oil entirely. For the cheaper grades of country roads this process merits serious consideration, since it yields not only a uniform mixture but an amazingly dense product.

Rolling Stock and Equipment Repair Costs, Panama.—The cost of repairs to locomotives, cars and other railway equipment employed on the Panama Canal work was for the six months ending June 30, 1910, as follows:

Item.	Days service.	Per day.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Unloaders	1,655	20.55
Spreaders	1,127	17.30
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Pile drivers	442	9.42
[illegible]	[illegible]	[illegible]

The cost per day of repairs to cars of all kinds was $1.03. For the same period the cost of repairs to plant and equipment per unit of work done was as follows:

Item.	Cu. yds.	Per cu. yd.
[illegible]	[illegible]	[illegible]
Wet excavation	5,274,633	0.0713
Concrete	565,459	0.1741
[illegible]	[illegible]	[illegible]
Stone	581,812	0.2410
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Locomotive Repair Costs, Panama.—The cost of repairs to locomotives, 286 in service, at Panama for the year ending June 30, 1910, was as follows per locomotive:

Item.	Cost.
[illegible]	[illegible]
[illegible]	
[illegible]	

Some Structural Features of the Vancouver Water-Works With General Construction Costs.

The new water supply of Vancouver comprises an intake on Seymour Creek, a combination wood stave, steel and cast iron pipe line, and a reservoir in the city. One of the special features of the work was the submerged pipe line under the harbor entrance and the methods of constructing and the cost of this line were given in our issue of April 28, 1910. This article deals with other items of the work and is made up from a paper by H. M. Burwell presented to the Canadian Society of Civil Engineers.

The water-works intake is located seven miles above the mouth of Seymour Creek at an elevation of 465 ft. above sea level. Owing to the large amount of boulders, gravel, and finer sediment which the creek carries down during freshets, it was necessary to design the intake so that it would not become completely choked up under such conditions, and means had also to be provided to prevent the finer sediment entering the pipe.

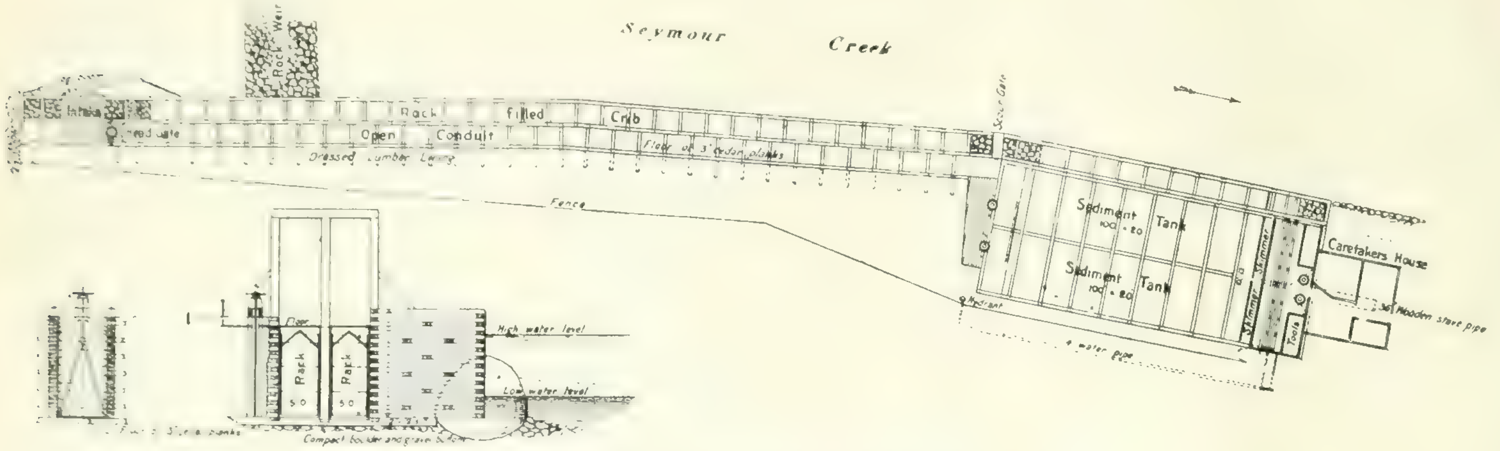

Fig. 1—Plan of Intake. Vancouver Water Works.

The intake, Fig. 1, is formed by a hewn cedar crib with rock filling, 13 ft. high. It has two openings, each 5 ft. in width, and on the face of each opening is placed an oak rack, set in an iron frame. The water enters the intake at right angles to the direction of the stream, the faces of the racks being parallel with the axis of the stream. This allows boulders and most of the heavy sediment to be swept away, as the current of the stream is stronger than the current of water entering the intake.

About 50 ft. below the intake a low weir, composed of large, broken rocks, extends across the creek. This weir is only of such height as to keep a sufficient depth of water on the intake during extreme low water periods.

The water, after passing through the racks, enters an 11x14-ft. forebay. From this there is an open conduit 6 ft. in width, of hewn cedar cribwork. This conduit extends down stream along the bank of the creek for a distance of 300 ft. Its upper end is furnished with a 6x10-ft. head-gate. At the lower end of the open conduit is placed a scour-gate, discharging into the creek, to flush out the sediment which may enter the intake and deposit itself along the flume.

Just below are located two sediment tanks, Fig. 2, designed to separate the finer sediment and floating matter from the water and prevent it entering the pipe. These tanks are built of 6x12-in. sawn cedar timbers, the sticks all being placed flat and drift-bolted together, with frequent tie-sticks extending into the bank. Each tank is 20x100x6 ft. deep, and is lined with 3 ins. of concrete, fastened on the sides with expanded metal, spiked to the timber walls.

The floors of the tanks were made by first covering the ground (which consisted of a compact mass of boulders and gravel) with expanded metal, held in place by numerous ¾-in. anchor bolts driven between the boulders. On this as a bed 3 ins. of concrete was floated. The object of the anchor bolts was to withstand the upward pressure which occurred at extreme high water.

Each tank is supplied with a 4x5-ft. inlet gate, and there is also one of the same dimensions at the lower end, which admits the water to the supply main leading to the city. A few feet in front of the lower gates are placed two rows of screens, extending across the entire width of both tanks. There are 16 screens in all, each 5 ft. square, having iron frames, backed with heavy steel wire netting, and fitted in front with light wooden frames on which the fine screens are fastened. The screens are operated by a hydraulic hoist, which lifts a row of 8 at a time, the whole row being cleaned by means of a strong jet of water. The refuse falls into a cement trough in the floor and is carried out into the creek. The water for this work is supplied from a small mountain stream through a 4-in. pipe, under a 125 ft. head.

Across the bottom of both tanks is placed a weir or baffle, 18 ins. in height, situated about 6 ft. in front of the screens. Its duty is to prevent the sunken matter and heavier sediment from coming in contact with the screens.

Just above the weir is built a skimmer, which crosses both tanks. This contrivance makes provision for the overflow and carries off all floating matter.

Each tank is provided with a scour-gate, 24 ins. square, placed on the floor. A tank can thus be flushed out without interfering with the supply to the city.

The Supply Main.—Before constructing the supply main, a good wagon road was built along the pipe line. It has a maximum grade of 4½ per cent and a total length of 7 miles. For the first 3¾ miles below the intake it is located on the westerly side of Seymour Creek. It then crosses the creek on a steel bridge, and extends along the easterly side to the Second Narrows of Burrard Inlet. About half a mile below the bridge the creek passes through the Seymour Canyon, a deep cleft in the rock, having almost perpendicular walls. Here the road is excavated through rock along the edge of the canyon for some distance and is very picturesque.

Wood-stave Pipe.—The pipe line is along the side of the road farthest away from the creek. For the first 1,000 ft. it consists of a continuous wood-stave pipe, 36 ins. inside diameter. From this point, where there is a slight summit in profile, the wood-stave pipe is 39 ins. diameter. The total length of the wood pipe is 4⅛ miles. The staves, of which the pipe is built, have a thickness of 2 ins., and were chiefly fir timber, although some cedar was used. These staves were manufactured near the site of the work. The lumber used in the sediment tanks and intake buildings was also cut on the works, a portable sawmill and logging donkey engine having been procured for this purpose.

The price of the class of lumber required would have been $40 per M. ft. B. M. if purchased at the mills in Vancouver. The necessary haulage and handling would have increased the cost to at least $50 per 1,000 ft. The actual cost of the lumber used in the pipe, including equipment, was $28.50 per 1,000 ft.

The wood pipe is supplied with two 30-in. gate valves, one placed about 1½ miles and the other about 3 miles below the intake. These positions were selected partly for use in case of emergency and partly to facilitate the construction of the pipe. The pipe in one place will be subjected to a pressure due to a static head of 210 ft., and on this portion (which is near the bridge) the steel bands are spaced 1¾ ins. c. to c. The bands are of ½-in. steel, fitted with forged steel shoes, and have an average spacing of 3¾ ins. c. to c.

Bridge Crossing.—The crossing of the bridge is made with a 32-in. continuous steel riveted pipe, with bends and special connections for wooden pipe at both ends. It rests upon the floor-beams of the bridge, and is provided with a 6-in. blow-off valve at the center. The watertight connections between this steel pipe and the wooden pipes are made with ordinary lead joints. Where the pipe line crosses ravines or small hillside creeks, it is supported on substantial cedar trestles, and is enclosed in cedar cribwork filled in with sand and gravel.

In places where it is thought there might be danger from fires, the pipe line is supplied with 2-in. globe valves, with a length of hose and a nozzle in each place, enclosed in a small house.

Welded Steel Pipe.—From the canyon down to the Second Narrows the pipe line is constructed with 24-in. lap-welded steel pipe. The shell of the pipe has a thickness of 5/16 in. (being the standard thickness of plate with which this kind of pipe of the above diameter is made). It is in about 19-ft. lengths, and is known as "Stewart's patent inserted joint lap-welded steel pipe," costing $3.80 per ft. delivered at Vancouver.

At the upper end the pipe is supplied with a gate-valve and a 6-in. blow-off. At the Narrows it connects with the two 18-in. submerged mains by means of a Y special, and is supplied with a 6-in. blow-off placed within a concrete well, which also encloses the Y and two 18-in. gate-valves. This portion is covered with tidal water at times.

Submerged Mains.—The total distance across the Second Narrows is 2,600 ft., but only 1,000 ft. of the channel is deep water, the rest being tidal flats uncovered at low water. In the central portion of the channel, which has a depth of 85 ft. at low water, two 18-in. flexible cast-iron pipes are used, in lengths of 9 ft., with a 1½-in. shell. Each pipe length weighs 3,300 lbs., and each joint is capable of a deflection of 19°. The pipe is of the ball and socket type. The ball is formed by running lead into the joint after the pipe has been placed. The shore connections, amounting to 1,600 ft., are made partly of steel and partly of ordinary cast-iron pipes.

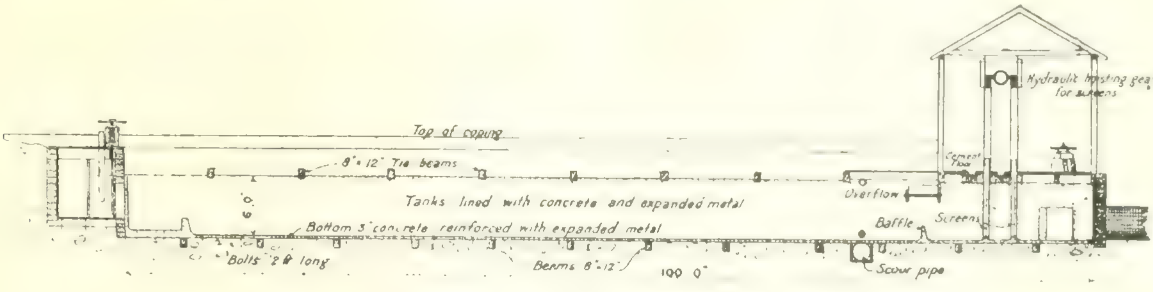
Top of coping
8"x12" Tie beams
6' 0"
Tanks lined with concrete and expanded metal
Bottom 3" concrete reinforced with expanded metal
Bolts 2 ft long
Berms 8"x12"
100' 0"
Overflow
Baffle
Screens
Scour pipe
Cement floor
Hydraulic hoisting gear for screens

Fig. 2—Section of Sedimentation Basin, Vancouver Water Works.

Steel Pipe.—The conduit from the Second Narrows to the city, a distance of about 3 miles, is a 24-in. lap-welded steel pipe, with the exception noted below. Its connection with the submerged pipe is made by means of a Y, the same as on the north shore, but, in addition, the two 18-in. gate-valves have two 18-in. check-valves bolted to them. The pipe passes under the railway tracks in a concrete-lined tunnel, in which is placed a special steel-riveted pipe, with the necessary T and bends all riveted together and resting in concrete saddles and concrete backings at the bends.

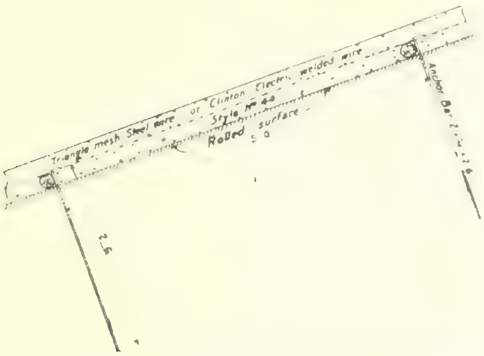

Fig. 3—Detail of Concrete Lining for Reservoir, Vancouver Water Works.

The pipe line, after passing through the tunnel, follows the railway right-of-way for a distance of about half a mile, and, in accordance with an agreement with the railway company, this portion is made of ⅜-in. steel plates.

The total length of the main from the intake to the city is about 10½ miles, and the capacity of the system 9,000,000 gals. per day, or about equal to that of the present Capilano system.

Cost Data.—The wagon road along Seymour Creek was built by contract at a cost of $44,500. The work contained some very heavy side-hill cuttings and a considerable quantity of rock work.

The pipe trench for most of its length was excavated through a compact mass of large boulders and gravel, deposited by glacial action. That portion along the edge of the canyon was excavated through granite rock. The trench for the wooden pipe, 4 ft. in depth by 5 ft. in width, was excavated by contract, the price being 49 cts. per lin. ft. The rock work was paid for per cubic yard, making the average cost of the trench 73 cts. per lin. ft.

Cost of Wood-stave Pipe:	Per lin. ft.
Excavation of trench (contract)	$0.73
Building pipe	.39
Steel bands, including haulage	1.38
Lumber, including haulage	.65
Tongues, including haulage	.02
Paint for bands, including haulage	.02
Inspection	.01
Back-filling over pipe (day labor)	.25
Total	$3.4[illegible]

Cost of the Steel Pipe:	
Excavating trench (day labor)	[illegible]
Steel pipe	[illegible]
Laying and making joints, including lead	.23
Back-filling	[illegible]
Haulage of steel pipes (day labor)	.07
Total	[illegible]

Summary of the Cost of the Whole Work Performed:	
North Side of Burrard Inlet:	
Wagon road (contract)	$ 44,500
Wharf and approach at Narrows (contract)	[illegible]
Steel bridge	[illegible]
Warehouse and camp buildings	1,500
Intake and sediment tanks, including lumber, screens, gates, complete (day labor)	[illegible]
Wooden-stave pipe line	78,500
Steel pipe line (day labor)	76,500
Gate-valves, special steel pipe, bends, air valves, etc	3,500
Trestles and culverts (day labor)	3,500
Repair work to road, cutting out slides and corduroy work (day labor)	3,500
Protection work to pipe line, riprap and crib work (day labor)	5,500
Telephone line	1,000
Portable sawmill	[illegible]
Logging donkey engine	3,000
Rough lumber in stock	9,000
Teaming	1,000
Total	[illegible]
Submerged Main:	
Flexible c.i. pipe, 1,000 ft	$ 8,500
Hauling flexible pipe (day labor)	4,000
1,600 ft. steel and c.i. pipe (shore connection)	7,500
Laying pipe and making shore connections, including delivery from city of all pipes	1,000
Gate valves and specials	2,500
Lumber and tools	500
Protection work, riprap and concreting	1,000
Lead	2,000
Total	$ 27,000
South Side of Burrard Inlet:	
Tunnel under railway track, concrete lined, with 40-ft. shaft	$ 2,000
Special steel riveted pipe, with concrete saddles and anchoring	2,000
Steel main to city connecting with Capilano system complete	[illegible]
Total	$ 41,000
This brings the cost of the Seymour Creek system at the present date up to	[illegible]
For engineering and superintendence	11,000
Total	$399,000

This amount does not include the cost of the land purchased for reservoir sites, foreshore land, pipe line right-of-way, and legal expenses. The cost of the ordinary labor varied from $2.80 to $3 per day of 10 hours.

Reservoir.—[illegible] there is now being constructed a 24,000,000-gallon distribution reservoir to be used for a high-level system. This reservoir is situated about 1 mile south of the city boundary on the top of a rocky hill, known as Little Mountain, and has an elevation of 395 ft. above sea level at high water mark.

The formation at the site of the reservoir consists of a top layer of very compact sand, gravel, and boulders, from 3 to 4 ft. in thickness, overlying hardpan, which rests on trap rock. The [illegible] excavated was used to form the banks of the reservoir, the finer being placed on the inside slopes and the coarser material and rock on the outside. The total excavation was about 80,000 cu. yds., of which 18,000 cu. yds. were from solid rock. This rock was placed around the outside of the earth-bank, forming a riprap extending from the bottom to the top of the bank for its entire length, and adding to its stability as well as greatly improving its appearance. The excavation was performed under contract by Mr. M. P. Cotton, of Vancouver, who received 54 cts. per cu. yd. for earthwork and $1 per cu. yd. for rock-in-place.

With the exception of the top layer of about 3 ft., the entire mass had to be drilled and blasted after which it was excavated with a steam shovel and hauled to place by dump cars. For this purpose a track was carried around on top of the bank and shifted as the work advanced. The wages paid on the work ranged from 25 cts. to 35 cts. per hour.

The bottom lining will consist of concrete slabs not greater than 12 ft. square by 4½ ins. thick, with V-shaped joints, which will be filled with the best quality of clay or asphaltum.

The side slopes, which are 1 on 2, will be lined with reinforced concrete, with expansion or parting joints every 50 ft. This lining will have an average thickness of 4½ ins. and will be reinforced with Clinton electrically-welded wire. The reinforcement for the bottom half will weigh about 42 lbs. per 100 sq. ft., and the top half 24 lbs. per 100 sq. ft. This reinforcement will be held in place during the construction of the lining by flat anchor rods, driven into the bank, and the concrete will be poured into the forms in a wet condition.

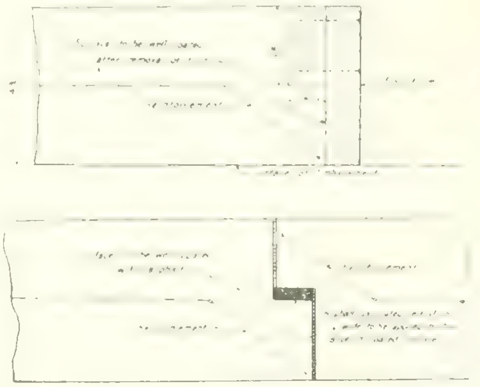

Fig. 4—Details of Expansion Joints in Reservoir Lining, Vancouver Water Works.

All concrete used in the work will consist of the following ingredients: 1 part of Portland cement, 2 parts coarse, sharp sand, 2 parts broken rock, free from dust or dirt, which will pass through a ring half an inch in diameter, 2 parts broken rock, free from dust or dirt, which will pass through a ring 1 in. in diameter.

Bids are to be opened this spring for the construction of the Panama-David R. R. The Panama Assembly has approved the bill authorizing President Arosemena of Panama to receive bids for the work. The cost of this work is not to exceed $10,000,000.

Methods and Costs of Operating the Washington, D. C. Slow Sand Filter Plant With Particular Reference to Handling Sand.*

The W[illegible] pleted [illegible] It [illegible] the water from the McMillan Park Reservoir [illegible] sand [illegible] each; the filtered-water reservoir, having a capa[illegible] necessary piping and valves for carrying water, controlling rates of filtration, etc.

The filters and filtered-water reservoir are built entirely of concrete masonry. The floors are of inverted groined arches upon which rest the piers for supporting the groined arch vaulting. The filters contain, on an average, 40 ins. of filter sand and 12 ins. of filter gravel. The gravel is graded from coarse to fine; the lower and coarser part acts as part of the underdrain system, and the upper and finest layer supports the filter sand. The raw water from the pumps is carried to the filters through riveted steel rising mains which have 20-in. cast-iron branches for supplying the individual filters. The filtered water is collected in the [illegible] filter beds, and is carried through 20-in., cast-iron pipes to the regulator-houses. These regulator-houses contain the necessary valves, registering apparatus, etc., for regulating the rate of filtration, showing the loss of head, shutting down a filter, filling a filter with filtered water from the underdrains, and for turning the water back into the raw-water reservoir, or wasting it into the sewer. From the regulator-houses, the filtered water flows directly to the filtered-water reservoir. Generally, five filters are controlled from one house, but there are two cases where the regulator-houses are smaller, and only two filters are controlled from each.

The dirty sand removed from the filters is carried by a portable ejector through one or more lengths of 3-in. hose and a fixed line of 4-in. pipe, to the sand washers. From the sand washers, the washed sand is carried to the reinforced concrete storage bins, each of which has a capacity of 250 cu. yds., and is at such an elevation that carts may be driven under it and loaded through a gate.

Until April, 1909, the sand was replaced in the filters by carts which were filled through the gates in the sand bins. It was then hauled to the top of the filter beds and dumped through the manholes on the chutes, which could be revolved in any direction. These chutes were used to prevent the sand from being unduly compacted in the vicinity of the manholes, and to facilitate spreading it in the filters. Since April, 1909, all the sand has been replaced by the hydraulic method. An ejector is placed under the gate in the sand bin, and the sand is carried in a reverse direction from the bin through the 4-in. piping and one or more lengths of hose to the filter bed. This process has lowered the cost of re-sanding considerably, and present indications are that it will prove entirely satisfactory in every way.

W[illegible].—The water supply of Washington is taken from the Potomac River, at Great Falls, about 16 miles above the city. At that place, a dam has been built across the river, which holds the water at an elevation of 150.5 ft. above mean tide at Washington. From Great Falls the water flows by gravity for a distance of 16 miles through a 9-ft. conduit, three reservoirs, and a tunnel. From McMillan Park Reservoir, the last of the three, the water is lifted by centrifugal pumps about 21 ft. to the filters. After passing through the filters, it flows to the filtered-water reservoir, and later to the city mains. In its passage from Great Falls to the filters, the water flows through three settling reservoirs, which have already been referred to. These reservoirs are known as the Dalecarlia, the Georgetown, and the McMillan Park Reservoirs, and have available capacities of 141,000,000, 140,000,000, and 180,000,000 gals. respectively.

[illegible] OF OPERATING WASH[illegible] FILTERS FOR CAL[illegible] YEAR 1909

[illegible]	Per mil. gals.
[illegible]	$0.81
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]*
[illegible]	0.36
[illegible]	0.14
[illegible]	$2.[illegible]6
M[illegible]	
[illegible]	$0.13
[illegible]	0.69
[illegible]	0.02
[illegible]	0.21
[illegible]	0.17
[illegible]	0.02
[illegible]	$1.24
[illegible]	$3.80

*[illegible] new [illegible] system.
[illegible] new sand handling system.

Turbidity.—The Potomac River water is rather turbid, the turbidity being cause by very fine particles of clay. The river is subject to sudden fluctuations, it being no uncommon thing to have a turbidity of 100 one day, and 1,000 the next. The high turbidity usually disappears about as rapidly as it comes, and is seldom higher than 500 for more than 5 days at a time. It is frequently the case, however, that a succession of waves of high turbidity will appear so close together that the effect of one has not disappeared before that of another is felt.

The clarification of the water supply begins at the dam at Great Falls. Here, it is a clarification by exclusion, for when an excessive quantity of mud appears in the river water, the gates are closed, and the muddy water is allowed to flow over the dam and form mudbars in the Lower Potomac, while the city is supplied from the water stored in the three settling reservoirs. Until a comparatively recvent date, the excessively muddy water was never excluded, having been taken, like other decrees of Providence, as it came.

When the reservoirs are well filled, and the consumption of water is less than 70,000,000 gals. per day, it is safe to close the gates at Great Falls for a period of about 4 days.

While a considerable reduction in turbidity is effected in each of the reservoirs, the bulk of the mud is deposited at the upper end of Dalecarlia Reservoir. This reservoir had become so completely filled, that, in 1905, it was necessary to dredge a channel through the deposit, in order to allow the water to pass it. During the summers of 1907 and 1908, a 10-in. hydraulic dredge removed more than 100,000 cu. yds. of mud which had been deposited in this reservoir. The mud deposited in Georgetown and McMillan Park Reservoirs is so fine that the accumulation of many years is not very noticeable in its effect on the depth of water.

Raking.—At the time the filters were first put in service, the sand bins had not been completed, and, consequently, the work of cleaning the filters was carried on in the old fashioned way of scraping by hand and wheeling out the sand in barrows. This method of cleaning was used from October, 1905, to April, 1906; then the regular sand handling system was commenced.

At times, during the first two summers the filters were in operation, considerable difficulty was experienced in keeping them cleaned as fast as was necessary to provide an ample supply of filtered water. For a short period in each summer it was found necessary to organize night shifts, and keep the work of cleaning in progress for from 16 to 24 hours per day.

In order to relieve the situation at such times, the expedient of raking was tried. This was first attempted with the filters filled with water; the effluent was first shut off in order to prevent a downward flow of water, and the filter was then raked or harrowed from boats. This method was not satisfactory, however, as the work was neither as uniform nor as thorough as necessary. Later, the filters were drained to the necessary depth, and the surface of the sand was thoroughly stirred with iron garden rakes. The filters were then

TABLE II. LIST OF EMPLOYEES, RATES OF PAY, AND APPROXIMATE COST FOR SUPPLIES.

1	Superintendent	$ 3,000
1	Chief chemist and assistant supt.	2,100
1	First assistant chemist	1,500
1	Second assistant chemist	1,000
1	Stenographer and clerk	1,[illegible]00
1	Surveyor	1,200
1	Laboratory helper	720
1	Janitor	600
1	Chief steam engineer	1,800
1	First assistant steam engineer	1,440
1	Second assistant steam engineer	1,080
3	Oilers, at $900 each	2,700
3	Firemen, at $900 each	2,700
3	Laborers, at $540 each	1,620
1	Filter foreman	1,200
2	Foremen, at $900 each	1,800
1	Timekeeper	900
3	Watchmen and gauge tenders, at $900 each	2,700
1	Machinist	1,140
1	Blacksmith	900
1	Storekeeper	900
1	Painter	900
1	Mechanic	900
1	Electrician	900
4	Skilled laborers, at $600 each	2,400
1	Watchman and special officer	900
1	Recorder	720
27	Laborers, at $1.50 per day for 300 days	12,150
3	Teams, at $2.00 per day for 200 days	1,200
	Laboratory and office supplies	2,700
	Filter supplies, tools, hose, repair of roads, parks, shrubs, etc	8,820
	Pumping station supplies, oil, waste, packing, repairs, etc	3,570
	3,600 tons of coal, at $3.15 per ton	11,340
	Charges in U. S. Engineer office, labor	2,900
	Charges in U. S. Engineer office, materials	400
	Total	$82,[illegible]

TABLE III. AVERAGE COST FOR LABOR FOR SAND HANDLING, 1909.

Per Million Gallons Pumped to Filter.

Month	Scraping.	Ejecting.	Washing.	Smoothing.	Raking.	Re-sanding.	Total.
1909.							
July	$0.1[illegible]	$0.21	$0.03	$0.02	..	$0.21	[illegible]
August	[illegible]	0.16	0.03	0.01	.	0.04	0.31
September	0.0[illegible]	0.13	0.02	0.01	$0.01	0.27	0.49
October	0.0[illegible]	0.15	0.03	0.01	0.02	0.12	0.39
November	0.02	0.06			0.02	...	0.1[illegible]
December	0.02	0.04	0.01		0.01	0.01	0.09
1910.							
January	0.04	0.07		0.01	0.02	...	0.14
February	0.04	0.10		0.01	.	0.02	0.17
March	0.04	0.06		0.01	0.01	0.05	0.17
April	0.1[illegible]	0.15	0.04	0.01	0.02	0.06	0.38
May	0.02	0.03	0.01		0.01	0.11	0.18
June	0.02	0.04			0.02	0.01	0.09
Average	[illegible]	$0.10	$0.01	$0.01	$0.01	$0.08	$0.26

Per Cubic Yard of Sand.

Month	Scraping.	Ejecting.	Washing.	Smoothing.	Raking.	Re-sanding.	Total.
1909.							
July	$0.08	$0.1[illegible]	$0.03	$0.01		$0.10	$0.37
August	0.0[illegible]	0.15	0.03	0.01		0.11	0.3[illegible]
September	0.07	0.17	0.03	0.01		0.17	0.4[illegible]
October	0.06	[illegible]	0.03	0.01		0.0[illegible]	0.34
November	0.10	0.23	0.02	0.02			0.37
December	0.1[illegible]	[illegible]	0.04	0.02		0.08	0.[illegible]1
1910.							
January	0.1[illegible]	0.19		0.02			0.31
February	0.07	0.[illegible]1		0.01		0.09	0.32
March	0.06	0.11		0.02		0.08	0.27
April	0.0[illegible]	0.09	0.03	0.01		0.0[illegible]	0.25
[illegible]	0.0[illegible]	0.09	0.03	0.01		0.06	0.25
[illegible]	0.0[illegible]	0.12		0.01		0.10	0.29
[illegible]	[illegible]	[illegible]	$0.02	$0.01		$0.1[illegible]	$[illegible]

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*Re[illegible]rranged and [illegible] Purification Plant at Washington, D. C.; [illegible] sults of Operation," by E. [illegible] Soc. C. E., Vol. XXXVI, p. 156[illegible].

filled with filtered water through the underdrains and put in service.

This latter method proved so satisfactory that it has been resorted to at all times when the work was at all pressing. When the runs were of short duration, and the depth to which the mud had penetrated the filter sand was slight, a raking seemed to be nearly as effective in restoring the filter capacity as a scraping; it could be done in 8 hours by 3 laborers, and there seemed to be no ill effects from lowered efficiency.

Sand Handling.—For the first three years of operation, the sand was carried from the sand bins in carts and dumped through the numerous manholes of the filters on chutes which could be revolved in various directions, in order to facilitate the spreading of the sand evenly over the surface of the filter.

About a year ago, however, this method was changed, by substituting sand ejectors for the carts. By this method, an ejector is either attached to, or placed directly under, the outlet gate of the sand bin, the gate is opened, and the ejector is started. From this ejector, the sand is carried back through the line of 4-in. fixed pipe, and one or more lengths of 3-in. hose, to the point of discharge in the filter bed which is being resanded.

In re-sanding a filter, it is first filled with water to the proposed depth of the sand layer. The outlet end of the house is connected to a 3-in. pipe which is supported on a boat, and the sand is discharged through this pipe at the point required. Work is first begun at the far end of the filter, and it is gradually filled by swinging the boat from side to side and backing it by degrees to the front end.

At first it was feared that a small quantity of mud would be deposited on the surface of the old sand, and that this mud would ultimately cause subsurface clogging. For this reason, when this method was first adopted, a man was required to rake the sand very thoroughly in front of the discharge. Later, it was found that by giving the end of the discharge pipe a slope of about 45° downward from the horizontal, the force of the current of sand and water could be depended on to cut the old surface of sand to any required depth, and move it ahead together with the new sand, thus completely breaking up the possible mud layer between the old and new sand layers. After having used this method almost exclusively for 15 months, in which time eleven filters have been re-sanded, and 24,531 cu. yds. of sand have been replaced, there seems to be no indication of an increased initial loss of head. The sand is very compact, and has no apparent tendency to separate into different sizes. The general appearance is similar to that of very fine sand on the seashore. The filters re-sanded in this way have been considerably more efficient than those in which the sand was replaced with carts, and as yet, no harmful results have been noted. The cost of labor for sand handling, as given in detail in Table I, shows that quite a perceptible saving has been effected by the hydraulic method. The figures showing the cost for sand handling do not include any charge for the quantity of water used, that item having been carried on the pumping-station account.

The cost for pumping water for sand handling, including all labor, materials, and repairs, amounts to $0.06 per cu. yd. of sand ejected and washed, and $0.03 per cu. yd. for replacing.

In addition to water used for carrying the sand which is being replaced, it is customary to keep a slight upward flow in the filter, thus using about 500,000 gals. of [illegible] day for this purpose. Assuming the value of this water to be the total cost for pumping, filtering, etc., or $3.80 per 1,000,000 gals., the cost per cubic yard of sand replaced would be about $0.02 when one ejector is used, and $0.01 when two are in operation.

It is not considered absolutely necessary to have an upward flow of water in the filter which is being re-sanded, and it is not always done. It was used, however, as an additional safeguard against the formation of a stratum of mud between the old and new layers of sand while the hydraulic method was in an experimental stage.

Cost of Operation.—It is frequently difficult to compare the relative cost of corresponding items for different plants, because of the different methods of dividing the cost and the varying opinions of the officials as to what should properly be charged to each item.

In order that the data may be in sufficient detail to permit it to be rearranged to compare with other plants, a list of employes and charges for supplies is given in Table II. This list accounts for the entire appropriation for the care and maintenance of the filtration plant, including pumping the water to the filters, parking and caring for the grounds, buildings, roads, sidewalks, etc. The cost for the various items per million gallons pumped to the filters is shown in Table I, and the cost per cubic yard of sand handled in Table III.

STEAM AND ELECTRIC RAILWAY SECTION

Deduction of a New Rational Formula for the Most Economic Length of Each of a Series of Bridge Spans.

Up 'till 20 years ago, the common rule for determining the approximate length of bridge span, where a crossing consisted of a series of spans supported by piers, was to design the spans so that the cost of the substructure would equal the cost of the superstructure. In 1890 Mr. J. A. L. Waddell, M. Am. Soc. C. E., deduced the following rule:

For any crossing, the greatest economy will be attained when the cost per lineal foot of the substructure is equal to the cost per lineal foot of the trusses and lateral system.

The mathematical demonstration of Mr. Waddell's rule is reprinted in the 1910 edition of Gillette's "Handbook of Cost Data," page 1489. It will be noted that the rule omits the cost of the floor system, the cost of which, as Mr. Waddell correctly pointed out, is practically independent of the length of the span, and therefore not a factor in determining the most economic span.

So far as we know, the correctness of Mr. Waddell's rule has never been disputed. Nevertheless it is quite as incorrect as its predecessor, which Mr. Waddell severely condemned. In fact it usually gives results farther from the truth than the old rule that the cost of superstructure should equal the cost of the substructure for a series of spans. The reason why this is so lies in the fact that Mr. Waddell's rule fails to take into account the cost of maintenance and renewals of the superstructure, which is an item of very considerable importance in every steel railway bridge and by no means negligible in any steel bridge whatsoever. Mr. Waddell's rule, like its predecessor, involves the assumption that both the substructure and superstructure are equally permanent which is rarely the case.

In ENGINEERING-CONTRACTING, Oct. 7, 1908 (reprinted in Gillette's "Handbook of Cost Data," page 1490, [illegible] that the average life of steel railway bridges has been less than 20 years on the main lines of American railways. Mr. J. E. Greiner has also stated that the life of iron or steel railway bridges "has been scarcely 25 years" in America. The cause of this short life has been the repid increase in the weight of locomotives and cars. Perhaps we have reached the limit of weight or rolling stock, but, if we are to judge the future by the past, we certainly have not reached the limit; and, if we have not, the life of steel bridges built today will probably be little if any greater than was the life of steel bridges built 20 years ago—at the time that Mr. Waddell deduced the rule above quoted.

Our object is to present a rational formula for determining the most economic span of each of a series of bridges, taking into consideration not only first cost but maintenance and depreciation. We shall show that, when these important factors are considered, a correct rule (= equation 17 deduced below) to be applied is as follows:

For [illegible] of spans rest on piers, the length of span must be such that the first cost plus the capitalized cost of annual maintenance and depreciation of the longitudinal trusses (or girders) and the lateral system must equal the first cost plus the capitalized cost of annual [illegible] substructure.

We shall also deduce a general formula (eq. 16) that will give the most economic length of span, for any class of bridge, upon substitution of proper values for the constants.

Proceeding [illegible] the following symbols will be used:

L=length, in feet, of span.

K=cost, in dollars, of each pier.

S=cost of substructure, in dollars, per lineal foot of bridge.

I=cost of trusses, in dollars, per lineal foot of bridge.

y=cost of entire bridge (piers and superstructure) per lineal foot.

p=price, in dollars, per pound of steel trusses in place.

w=weight of steel, in pounds, per lineal foot of entire superstructure.

C=a constant in the straight line formula for bridge weight ($w=CL+F$), the value of C depending on the type of bridge and the loading.

F=weight of steel floor system, in pounds, per lineal foot of bridge.

M=capitalized cost of annual repairs and renewals of steel trusses, expressed as a percentage of the first cost of the trusses.

N=capitalized cost of annual repairs and renewals of the pier, expressed as a percentage of the first cost of the pier.

B=width, in feet, of floor of a highway bridge.

The weight per lineal foot of a steel bridge, whether plate girder of truss bridge, may be expressed by the following general formula:

[illegible]

Hence the cost of the steel per lineal foot of bridge is

[illegible]

When the cost of a pier is not affected by increasing or decreasing the length of bridge span, as is usually the case, then

[illegible]

[illegible]

[illegible]

To determine the [illegible] value of y (=cost per lineal foot of entire bridge), differentiate eq. (5), remembering that L and y are the only variables.

[illegible]

Placing the first differential coefficient $\frac{dy}{dL} = 0$, we have

$p\,C = \frac{[illegible]}{[illegible]}$ .... (7)

Substituting [illegible] its value [illegible], we have

$$pC = \frac{S}{L} \qquad (8)$$

$$pCL = S \qquad (9)$$

But pCL is the cost of the trusses per lineal foot of bridge, hence

$T =$ [illegible] (10)

$T = S$ (11)

[illegible] of the trusses per lineal foot of bridge must equal the cost of the pier per lineal foot of bridge, provided there is no annual expense for maintenance and depreciation.

[illegible] we have

$$L = \sqrt{\frac{K}{pC}} \qquad (12)$$

[illegible] we have

$K =$ [illegible] (13)

Equation (12) is to be used only where there is no annual expense for repairs or renewals of either substructure or superstructure, which is rarely the case.

If a steel bridge has a life of 20 years, and if money is worth 5 per cent per annum to the investor, a sinking fund table shows that $3 must be put in the fund annually to amount to $100 at the end of 20 years. This $3 is the annual cost of renewals. Capitalizing it at 5 per cent, we have $3 ÷ 0.05 = $60, which is the capitalized cost of renewals on every $100 of first cost of bridge steel in place. Hence the value of M in this case is 60 per cent, or 0.60. In other words the total cost of the steel per pound is $p + Mp$, or $(1 + M)p$, or $1.6p$ in this case, if we include not only the first cost but the capitalized cost of renewal.

In addition there is the annual cost of painting the steel. If it costs $2 a ton to scrape and paint the steel, and if this is done every 5 years, we have $0.40 as the annual cost of painting, which capitalized at 5 per cent is $8 per ton. If steel costs $80 per ton in place, the capitalized cost of painting the steel is 10 per cent, or 0.10, of its first cost. This 0.10 also is a part of M, hence the total value of M in this case is $0.6 + 0.1 = 0.7$. Hence in this case the entire cost of the steel per pound is its first cost plus its capitalized cost of renewal and painting, or $1.7p$. Therefore, if the steel in a bridge has a limited life, we must substitute for p, in eqs. (9) and (12) its entire cost, namely $1.7p$ in the particular case just discussed, or $(1 + M)p$ in any case. This gives us, instead of eqs. (9) and (12),

$(1 + M)$ [illegible] $(1 + M)T = S$ (14)

$$L = \sqrt{\frac{K}{(1 + M)pC}} \qquad (15)$$

Assuming money to be worth 5 per cent per year, we can readily derive the capitalized cost of steel renewals for any given life of steel bridge, by the method above indicated, and adding 0.10, or 10 per cent, as the capitalized cost of painting, we have the total value of M as in Table I.

TABLE I.

Life in years.	Value of M.
[illegible]	[illegible]
25	0.52
30	0.40
[illegible]	0.32
[illegible]	0.27
50	0.20

Values of C may be derived from formulas giving the weight of steel per lineal foot of bridge. Using the formulas given on pages 1471, 1474 and 1478 of Gillette's "Handbook of Cost Data," 2nd edition, we have Table II.

TABLE II.

$C =$ [illegible] bridges. Cooper's E-50 loading.

$C = 12$, for plate girder bridges, ditto.

$C =$ [illegible] bridges, [illegible] lbs. per lin. ft.

$C = 5$, for plate girder bridges, ditto.

$C = \frac{B}{11.3} =$ [illegible] B for [illegible] bridges with sidewalks, wooden floor, [illegible] loaded [illegible] lbs. per [illegible]

[illegible] width in feet of floor (including width of sidewalk)

$C = \frac{B}{9.5} = 0.11$ B, for ditto without sidewalks.

$C = \frac{B}{4}$ = [illegible] B, for through plate girders, ditto.

$C = \frac{B}{5}$ = [illegible] B, for deck plate girders, ditto.

$C = \frac{B}{4}$ = [illegible] for truss highway bridge with solid floors (assumed dead weight being [illegible] lbs. per sq. ft. of floor)

$C = \frac{B}{3}$ = [illegible] B, for through plate girders, ditto.

$C = \frac{B}{5}$ = [illegible] B, for deck plate girders, ditto.

There are some rivers and river beds of a character that necessitate considerable expenditures for riprap and other pier protection at frequent intervals. In such cases, the annual cost of pier protection should be capitalized and added to the first cost. Thus, if $50 is the average annual expenditure for pier protection and maintenance, we have $50 ÷ 5 per cent = $1,000, which is the capitalized cost of pier maintenance. If the first cost of the pier is $2,500, this $1,000 is 40 per cent, or 0.40, of the first cost. Hence $N = 0.4$, and in eq. (15) we must substitute $(1 + N)K$ for the value of K there given, if we are to take into consideration the capitalized maintenance cost of the pier as well as its first cost. Then we have

$$L = \sqrt{\frac{(1+N)K}{(1+M)pC}} \qquad (16)$$

In like manner, eq. (14) becomes

$$(1 + M)T = (1 + N)S \qquad (17)$$

Eq. (17) is the rule printed above in italics.

EXAMPLES.

Example I.—Assume a first cost for a bridge pier of $2,500, a first cost of $0.04 per lb. for steel in place, a life of 30 years for the steel, of a single track railway truss bridge, Cooper E—50 loading. What is the most economic span when there are a series of spans?

In eq. (15) substitute the above values, and we have

$$L = \sqrt{\frac{K}{(1+M)pC}} = \sqrt{\frac{2{,}500}{(1+M)\times 0.04C}} \qquad (6)$$

Table I gives $M = 0.4$ for a life of 30 years.

Table II gives $C = 7$ for a truss railway bridge.

Therefore,

$$L = \sqrt{\frac{2{,}500}{1.4\times 0.04\times 7}} = 80 \text{ ft.} \qquad (17)$$

Hence the most economic span is 80 ft.

Example II.—Assume a solid floor highway truss bridge with floor width (B) of 24 ft., a cost of each pier of $3,600, a first cost of $0.04 per lb. for steel in place, a life of 40 years for the steel. What is the most economic span?

$$L = \sqrt{\frac{K}{(1+M)pC}} = \sqrt{\frac{3{,}600}{(1+0.27)\times 0.04\times 6}} = 109 \qquad (16)$$

Hence the most economic span is 109 ft.

Example III.—A series of railway truss bridge spans consists of 150 ft. spans; the loading is Cooper E-50; steel costs 4 cts. per lb. in place. What should be the cost of each pier to justify such a span, even assuming that the steel requires no repairs and renewals?

Eq. (13) gives the desired value for K, hence

$K = pCL^2 = 0.04 \cdot 7 \cdot 150 \cdot 150 = \$5{,}300$ (17)

A concrete pier containing 200 cu. yds. and costing $12.50 per cu. yd. including cost of coffer dam, excavation and foundation piles, costs $2,500. Such a $2,500 pier is fairly typical, and railway spans of 150 ft. may be frequently seen on piers of no greater size and cost, showing that a much shorter span than [illegible] should have been used. In fact, as was shown in Example I, a span of 80 ft. is the most economic where piers cost $2,500 each, and where the life of the steel bridge is 30 years, money being worth 5 per cent.

DISCUSSION.

It will be noted that Mr. Waddell's rule (eq. 11), or its equivalent as given in eq (12), results in a considerably longer span than is obtained by the use of the correct rule (eq. 17), or its equivalent as given in eq (16).

A study of eq. (16) or (17) shows that an engineer should make the surveys for and designs of the piers of a bridge crossing, and should carefully estimate the cost of piers, before attacking the problem of designing the span. The size and cost of a pier are usually not materially affected by the cost of the span, whereas the length and cost of the span are functions of the cost of the pier. Many bridge engineers have attacked such problems wrong end to, selecting span lengths in advance of determining the probable cost of piers. Witness to this may be had by studying published costs of bridge crossings, as well as by even cursory examination of many crossings.

Rules For Designing Bridge Spans, the Cost of Whose Supports Varies With the Span Length.—In the deduction of the preceding formulas it has been assumed that the cost of each pier, K, was not affected by the length of the span. This usually holds true of piers in rivers, for their cross-section is designed to resist the thrust and impact of ice, logs, boats, etc., and is, therefore, far in excess of a cross-section required merely to support the bridge spans and their loads. But when a bridge is built over the land, or in still water where boats do not ply, or wherever the piers (or their equivalent) are given a cross-section sufficient merely to support the load, the preceding formulas can not be used without modification.

When a pier becomes merely a supporting column, its crosssection varies directly with the load. Hence doubling the span doubles the load on the column, and therefore doubles its area of cross-section and approximately doubles its cost. In brief, the total cost of columns is practically a constant for any given length of crossing, regardless of the lengths of individual spans. Such columns are like the floor system in that their cost per lineal foot of bridge is unaffected by changes in the span lengths. Hence, the formulas above given can be applied to a series of spans supported by columns, only upon condition that the cost of the columns be entirely ignored. In the case of an elevated railway, for example, K (in the above formulas), becomes merely the cost of the foundations, or, more correctly, the cost of that part of the foundation not appreciably affected by the load upon the column. The same holds true of viaducts.

A study of the detailed cost of a number of steel viaducts, given in Gillette's "Cost Data," page 1620 et seq., shows that several viaducts approximate closely to eq. (17), but that many of them fall wide of the economic mark, so wide, in fact, that it is quite clear that the designers made little or no advance study of the cost of the foundation and pedestals.

Cost of elevated railways, in the same book, page 1376 et seq., show similar errors of economic design, if no account is taken of the fact that close spacing of columns on city streets is often prohibitory, because of damage, or alleged damage, to property. This last factor, however, is one that frequently operates to produce longer spans of elevated railway girders than would otherwise be economically permissible.

It is evident that in applying eq. (17), the designer must bear in mind that no part of the cost of the substructure which is a function of the load of the span and its live load should be regarded as being a part of K. When this provision is held clearly in mind, eq. (17) furnishes a correct solution not only for bridge spans on masonry piers, but for viaducts and elevated railways.

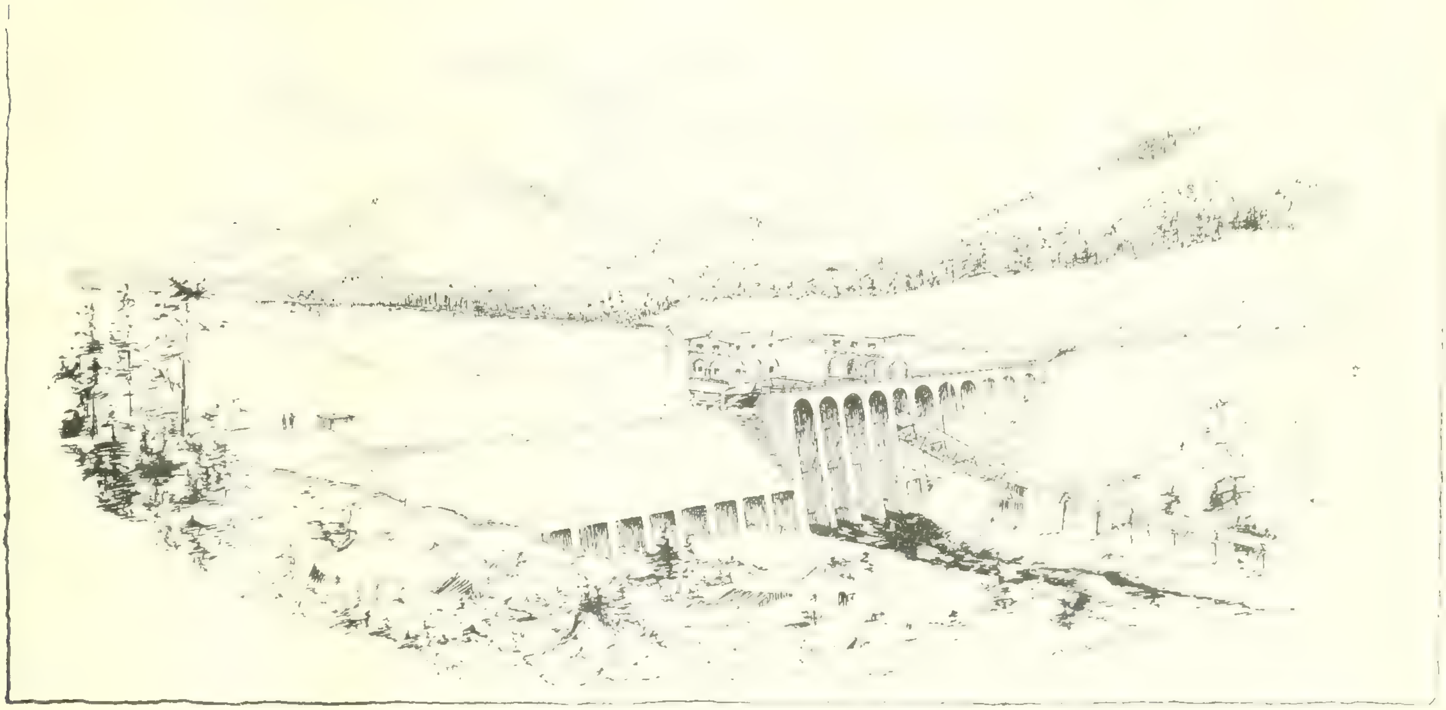
GENERAL ARTICLES AND CLASSIFIED ITEMS

Methods of Constructing a Storage Reservoir Dam at Aziscohos Falls of the Androscoggin River.*

The new reservoir, which will be created by the construction of the Aziscohos Dam, will be a unit in the comprehensive system of water storage which has been developed at the head waters of the Androscoggin River in Maine. The present reservoir system has storage capacity for about 17,000,000,000 cu. ft. of water and the new basin a capacity of about 8,000,000,000 cu. ft., or an additional supply equal to practically 50 per cent of that now available. The value of the increased storage is best defined by stating that the Aziscohos Lake will furnish a volume of water sufficient to operate all the mills in the city of Lewiston for a period of 72 days, without supply from any other source.

ORGANIZATION.

Before proceeding with a description of the work proper, brief mention should be made of the construction organization, as the methods adopted for its perfection produced an exceptionally efficient and frictionless machine which proved to be well adapted to the requirements, anticipating the needs of the component parts of the work in a manner far exceeding the most sanguine expectations.



Sketch Showing Aziscohos Dam, Androscoggin River, Maine.

Owing to the prolonged delay in the selection of the type of dam, it was considered impossible to prepare sufficient detailed plans and specifications, from which satisfactory contractors' bids might be obtained, in season to proceed with the work during the year 1910. On account of this condition, the company instructed the engineering firm of Sawyer & Moulton to proceed with the work on the "force account" basis, with orders to commence at once to accumulate the necessary apparatus and supplies for its execution.

This decision was reached on Feb. 15, 1910, allowing, under the most favorable weather conditions, a period of only 8 weeks in which to collect and deliver to the dam site an exceptionally large contractors' equipment; comprising, as it did, a 1,200-ft. span, 5-ton cable way, hoisting engines, derrick fittings, sluicing pumps, concrete mixers, stone crushers and such other heterogeneous materials as are ordinarily required for work of this description.

The tank seemed almost impossible, involving, as it did, the purchasing and transporting of 250 tons of material within so short a time limit. Fortunately, success attended the attempt to obtain and deliver the necessary outfit; although at one time the situation seemed dubious, owing to the fact that an early thaw set in before the cable way was delivered at the railroad terminal, at which time the snow had practically disappeared from a portion of the highway and beyond this section a streak of slush and mud indicated where the road should have been. The cable was started on wheels but met with disaster when transported but a few miles; and from thereon brute force alone accomplished the dragging of the cable on an improvised timber sled through the mud to the dam. The cable was a piece of apparatus absolutely essential to the efficient conduct of the work, accordingly no expense was spared in the endeavor to deliver the same, and after 3 weeks of gruelling effort, with the aid of 20 horses, it was successfully landed at its destination.

The engineers were confronted with the problem of economically constructing a work of first magnitude in a wild and undeveloped country, with the contingent difficulty of maintaining a large community remote from its base of supplies. To accomplish the above careful detailed analysis was made of each separate item of the work, the results of which are assembled and graphically depicted in the "Organization Diagram," Fig. 1.

This diagram is of particular interest on account of the variety and complexity of the work which it covers and also from the fact that its deductions made possible proper provision for temporary buildings and construction equipment; while its existence, in connection with written field instructions, which were issued to the several officials, practically eliminated any question regarding the respective authorities of the various employes.

Throughout operations the construction work has proceeded smoothly, without delay, other than that occasioned by natural conditions; in consequence, since the commencement of the concreting on July 13, 1910, an average of 100 cu. yds. per day has been placed; a very satisfactory accomplishment considering the character of the design.

Simple and efficient methods were adopted to keep the engineers in constant touch with the work, consisting of a progress diagram (Fig. 2) copies of which were filled out daily by the field engineer and forwarded to the offices of the agent and engineers, in connection with a complete system of daily reports that tabulate in detail the day's work and the distribution of the labor. From these daily reports, the cost keeper, in the engineers' office, compiled the unit cost of the several parts of construction, transcribing same to cost charts which showed, by plotted curves, the daily unit cost and the average unit cost of each specific class of work up to the date in question. A typical example of these cost curves is shown by Fig. 3, and their use enabled the engineers to keep constantly informed of the condition and cost of the work [illegible] examining numerical cost sheets.

TRANSPORTATION.

The remote location of the dam made it apparent that the most difficult problem to be solved would be that of transportation. The work is situated about 38 miles from the nearest available railway station at Colebrook, N. H., the intervening highway being of the ordinary country type; which, owing to adverse climatic conditions, is practically impassable during from 6 to 8 weeks in the ordinary spring season, or from about April 1 to the middle or last of May, and it is useless to attempt to haul a load of any magnitude during this period. Even during the most advantageous summer weather sections of the roads are in poor condition for heavy teaming due to the nature of the road material and the effect on it of the frequent showers combined with almost continuous cloudy weather.

During the first two months of the ordinary winter season "toting" can be carried on more advantageously than at any other time; but after the first 6 to 8 weeks of sledding, the fall of snow [illegible]

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*From a paper by Seth A. Moulton of Sawyer & Moulton, Engineers, Portland, Me., before the National Association of Cement Users.

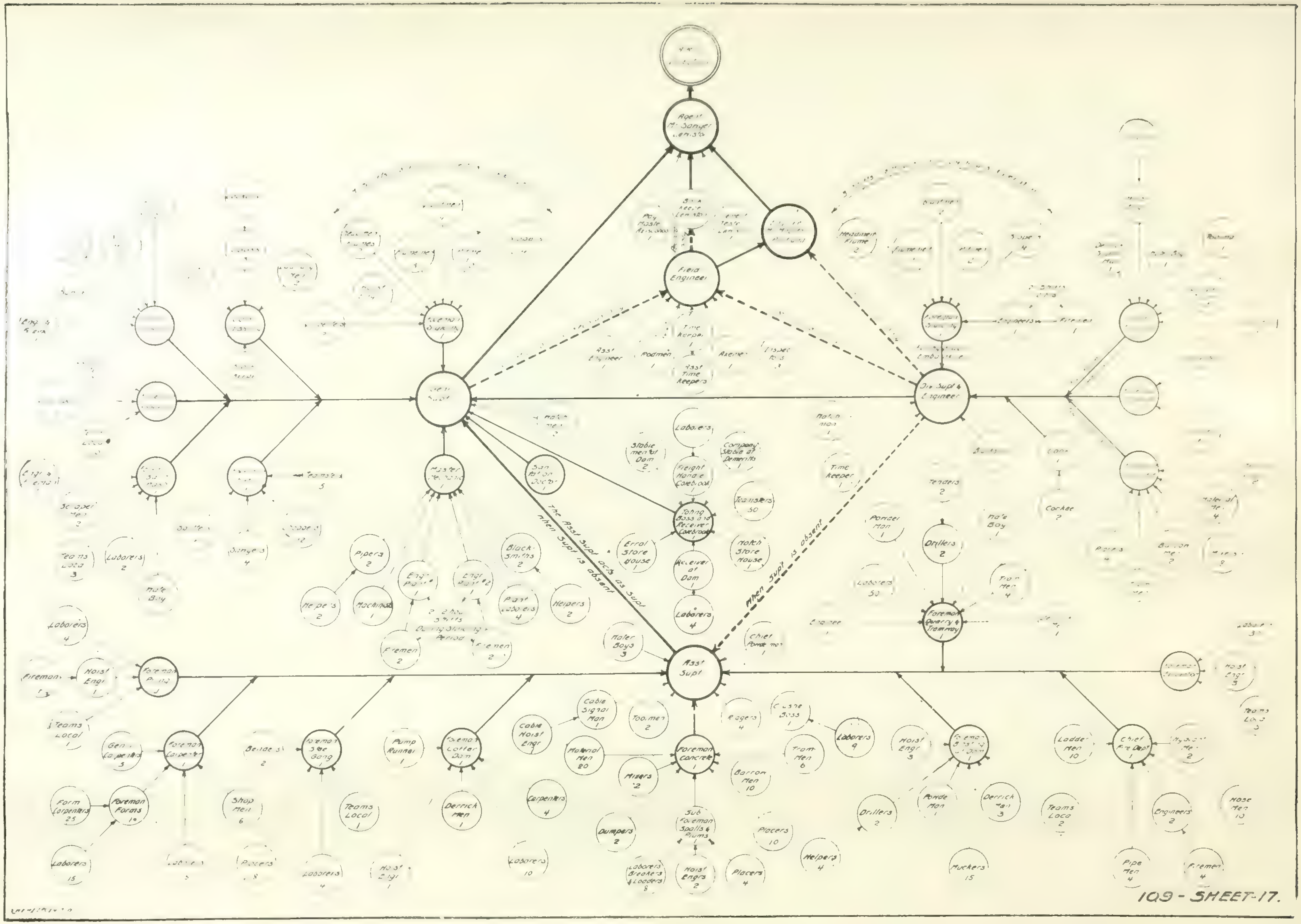


Fig. 1—Organization Diagram for the Construction of the Aziscohos Dam.

difficult to keep the teams on the built-up trodden section of the roadway unless special precaution is taken to provide proper turnouts and to keep the surface of the hard road well below the level of the surrounding snow.

It was obvious that whatever type of dam was adopted it would be necessary to haul material at least during one winter and one summer season, and possibly during two winter seasons. The "toting" situation necessitated that the volume of material to be hauled should be carefully predetermined in order that it might be delivered in anticipation of the needs of the work.

Serious consideration was given the advisability of employing traction engines with trailer sleds for winter toting and motor trucks for summer toting, but after an exhaustive study of the conditions it was decided to haul the materials with "tote" teams, the method of transportation common to this section of the country.

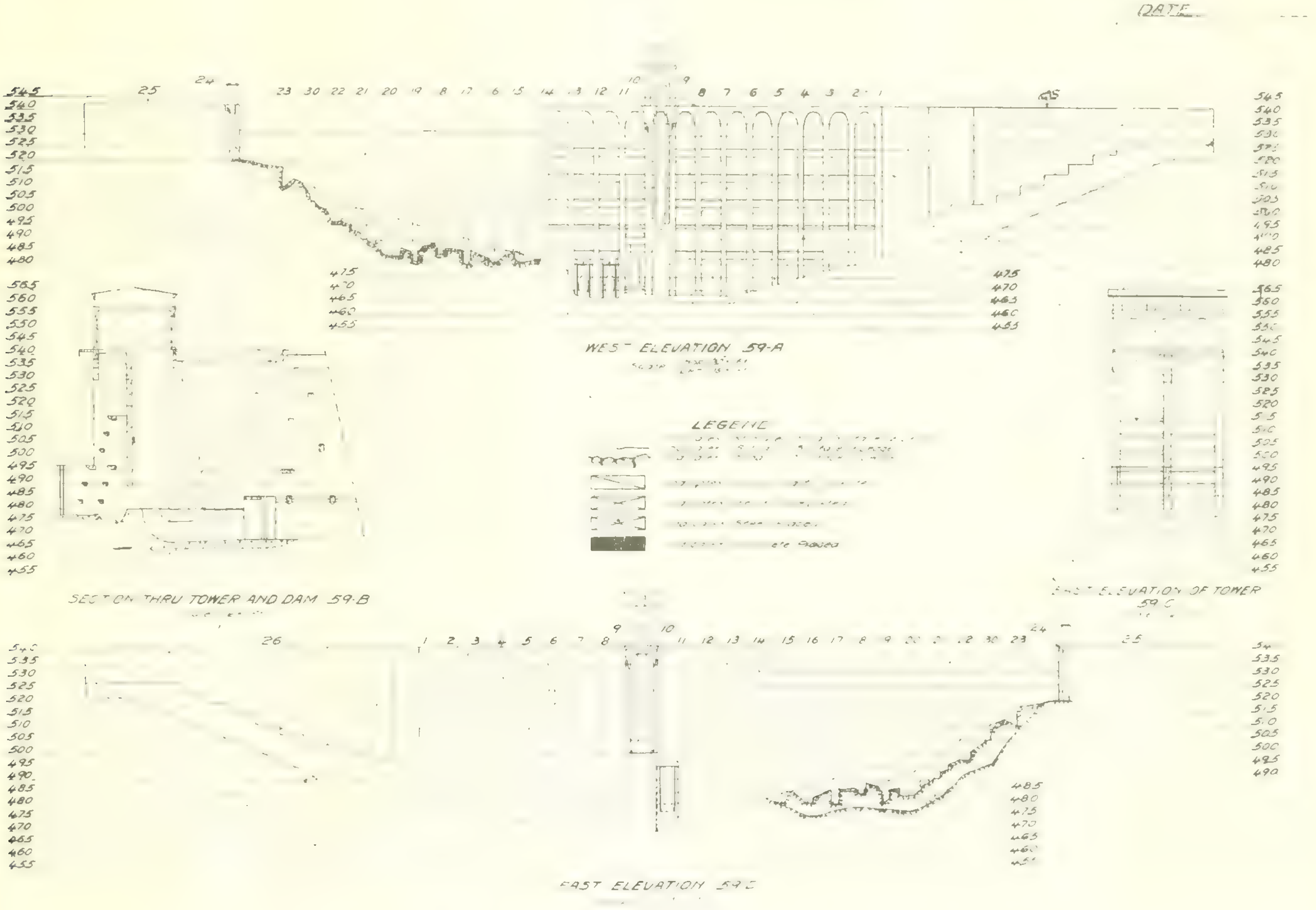


Fig. 2—Diagram for Recording Progress of Work on Aziscohos Dam.

The country passed through being very sparsely settled, it was with difficulty that provision was made for sufficient accommodations at the intermediate stopping points, and carefully prepared time tables were established, to which, barring accidents, the teamsters were compelled to adhere, neglect to obey the toting superintendent's orders regarding stopping points being considered sufficient reason for the discharge of the offending teamster, unless ample proof could be furnished for the necessity of disobedience.

All material was hauled by the hundredweight and each operator was held responsible for the material in his custody from the time it was delivered to him at the railway station until deposited in the company's store houses at the dam site. A comprehensive system of triplicate way billing and checking was devised whereby exact but simple records were kept of the material hauled at both the Colebrook and the dam store houses, one way bill being retained by the teamster as a voucher.

The round trip of 76 miles from Colebrook to the dam and return is made in four days, each team making two complete round trips without rest and laying off the ninth day. Four, five, and six horse teams were employed, averaging 4½ horses to a team, and by a proper arrangement of the time schedule a maximum total of 180 horses could be accommodated on the road, making a total of 40 teams, which, on the basis of 4 days to a trip, gave an average of 10 teams arriving at the dam during each day of the toting season.

During the best period of toting, or for the 6 weeks from Dec. 1 to Jan. 15, the average loads were as follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The average load per horse was 1,680 lbs.

During the best period of summer toting the average loads were as follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The average load per horse was 1,430 lbs.

During the most adverse condition of toting the average loads were as follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The average load per horse was 1,220 lbs., or 20 per cent less than could be hauled during the best sledding.

The total average load hauled per horse was 1,460 lbs., for which the toting contractors received 65 cts. per 100 lbs. as a flat rate for all seasons, making $2.11 the average earnings per horse per day. The average cost to the company for materials delivered to the dam is 85 cts. per 100 lbs., the additional 20 cts. per 100 lbs. being due to overhead charges, including the cost of superintendence, book keeping and store house expenses.

[illegible] problem indicated that the maximum volume [illegible] a winter sledding season would not exceed 5,000 lbs. of cement or a gross weight of 2,000,000 lbs., if the usual methods of procedure in vogue prior to this time were em-[illegible]ficient, even for the preliminary stages of the work, that special effort was made to overcome each interfering detail in order that a maximum tonnage might be moved during the first season.

Consultations were held with teamsters and toting contractors, who had devoted their entire lives to hauling supplies into the woods for the lumbermen, and no encouragement was obtained from these sources as to the probability or possibility of exceeding the previously stipulated quantity of 5,000 bbls. of cement, or its equivalent of 2,000,000 lbs. In spite [illegible] carefully analyzed and a [illegible] adopted which has had no material change since its inception.

The prime factor limiting the quantity of the material which can be transported is the topographical condition of the country over which the road is constructed. The highway passes over a divide in the Dixville Mountains at a distance of about 12 miles from Colebrook and this portion of the road has a constant up-hill grade, necessitating much lighter loading of the teams than would be otherwise essential, as the road between Dixville Notch and the dam is comparatively level. To obviate this condition an intermediate store house was erected beyond the height of land in the Dixville Notch, to which relay teams hauled materials from Colebrook. This arrangement permits the through teams to start with [illegible] loads, increasing same at the Dixville store house to the full capacity of the equipment if the roads beyond are favorable.

A second intermediate store house was provided at Errol, New Hampshire, about 20 miles from Colebrook, to which relay teams delivered materials. This provision permits the hauling of maximum loads from Errol to the dam even in the event of bad roads between the Dixville store house and the above mentioned village, a likely condition, owing to the exposed situation of this region.

That the system was successful is shown by the .results of the first season's toting, for from Dec. 1, 1909, to Feb. 10, 1910, a period of 72 days, 11,000 bbls. of cement, together with other miscellaneous supplies amounting in total to 4,500,000 lbs., were delivered to the dam site, more than 100 per cent in excess of the prophesied quantities. From the commencement of the toting on Dec. 1, 1909, until Nov. 1, 1910, a period of 335 days, the total amount conveyed, as shown by the teamsters' records, was 7,250,000 lbs.

The consideration of the above mentioned facts reveals the obvious need of a design requiring a minimum weight of toted materials.

DESIGN.

The reconnoissance surveys and preliminary borings made during the summer of 1908 indicated that the best location for the dam would be at a point in the river valley about 250 ft. below the old crib structure, as shown by Fig. 4, which is a plan indicating the relative positions of the old and new dams, the contiguous laborers' settlement, and the general arrangement of the complete construction plant.

The conditions controlling the selection of a proper design for the dam places this work in a class peculiar to itself, for in addition to the limitations imposed by the transportation problem, the logging situation presents structural difficulties rarely, if ever, before encountered in constructing a storage dam.

No claim is made that the elemental scheme of the adopted type is original, as the idea has been closely paralleled by several projected prototypes, although to our knowledge none of these has been carried to completion. The structure contemplated for the "Pioneer Power Plant," described in Vol. XXXVIII, Transactions Am. Soc. C. E., has a very similar cross section.

The accompanying sketch shows the dam as it will appear when completed. The selection of the cellular construction was made after careful consideration of all the conditions involved, its final acceptance being based on the fact that it contained a minimum of material with maximum stability, an essential property for this particular dam; but the writer wishes to record at this time the general statement that in his opinion with less adverse conditions of transportation and of auxiliary complications, no economical reason can be offered for its adoption. Certainly the engineering duties are much more arduous and taxing than they would be for a design of more simple composition. The general dimensions of the dam are as follows:

Total length from end to end of core walls	881 ft.
Maximum height from crest of main dam to ledge foundation	78 ft.
Length of main dam	[illegible] ft.
Length of spillway	226 ft.
Height from surface of water in river to level of water surface at full lake	60 ft.
Crest of main dam above full lake level	7 ft.
Top of embankment above full lake level	12 ft.
Maximum high water above full lake level	6 ft.
Depth of draft from reservoir	47 ft.

Figure 5 shows a typical cross section of the main dam, taken centrally between buttresses. This portion of the structure consists of 14 4-ft. thick buttresses spaced 20 ft. on centers. The tops of the buttresses being approximately 13 ft. 6 ins. wide, with slopes on the up-stream and down-stream faces respectively of 7 9/16 ins. and 2½ ins. per foot of height, these proportions were found ample to insure the stability of the structure, with conservative unit pressures in the buttresses. Arched slabs spanning between the piers form the deck and crest, the intrados of the arches having a radius of 8 ft. The cross section of the deck slabs near the top of the dam is shown at 29-D, Fig. 5. It will be noticed that the first 3 ft. of the intrados of the arch ring are cast on a bevel instead of circular, and integral with the buttresses. This was done to simplify the form construction, details of which will be later explained. It will also be seen by reference to 29-D that the haunches of the arches are cast with solid spandrels, making the water face of the dam a smooth slope with a batter from the vertical of 8 ins. per foot. The crown thickness of the arch slabs at the crest of the dam is 2 ft. and at the lowest point approximately 4 ft. Referring to sections 29-C and 29-D, Fig. 5, particular attention is called to the shrinkage joints provided over the center of each buttress, and the locks in these joints, between the abutting spandrels, which are incorporated to prevent seepage, these locks being staggered at the various vertical stopping points in the manner indicated on section 29-E. Rectangular reinforced concrete struts, or beams, are provided between the buttresses to insure lateral stability.

A typical cross section of the spillway is shown by Fig. 6. The spacing of buttresses, the up-stream profile of buttresses, and the deck slab for this work are identical with the main dam construction. A mass of cyclopean masonry is provided for the spillway crest to resist ice pressure, and an overflow apron is constructed on the down-stream face to deflect the water from the buttress bases. Owing to the existence of the crest and apron the stiffener beams employed between the main dam buttresses are omitted between the spillway piers. All of the arched slabs are reinforced with corrugated steel bars, sufficient metal being used to prevent cracks at the crown of the arches and to concentrate the effect of temperature and shrinkage stresses at the spandrel joints.

The deck slabs for the spillway were completed in August and have consequently been finished about 4 months, a period sufficient to develop the greater part of the shrinkage deformation, during which time there has occurred a temperature change of 90° F. Apparently the shrinkage reinforcement has successfully accomplished the desired results, for all of the completed joints have opened equally about 1/16 in. throughout their entire height on the up-stream face of the dam, these cracks diminishing from the face until they become invisible at the arch springing lines on the buttresses.

The heavy spillway crest is reinforced with channel beams, provided more especially to support the forms and heavy weight of the concrete during construction. The overflow apron is reinforced by sufficient steel to withstand the impact due to a maximum freshet overflow.

The different grades or mixtures of concrete used in the several portions of the structure are designated as classes *A*, *B*, *C*, *D*, *E*, *F*, *G*, and *H*, with proportionate parts as follows:

Class.	Cement.	Sand.	Stone.
A	1	2	4
B	1	2½	
C	1	3	6
D	1	4	7
E	1	2½	5 with spalls
F	1	3	6 with spalls
G	1	2½	5 cyclopean
H	1	3	6 cyclopean

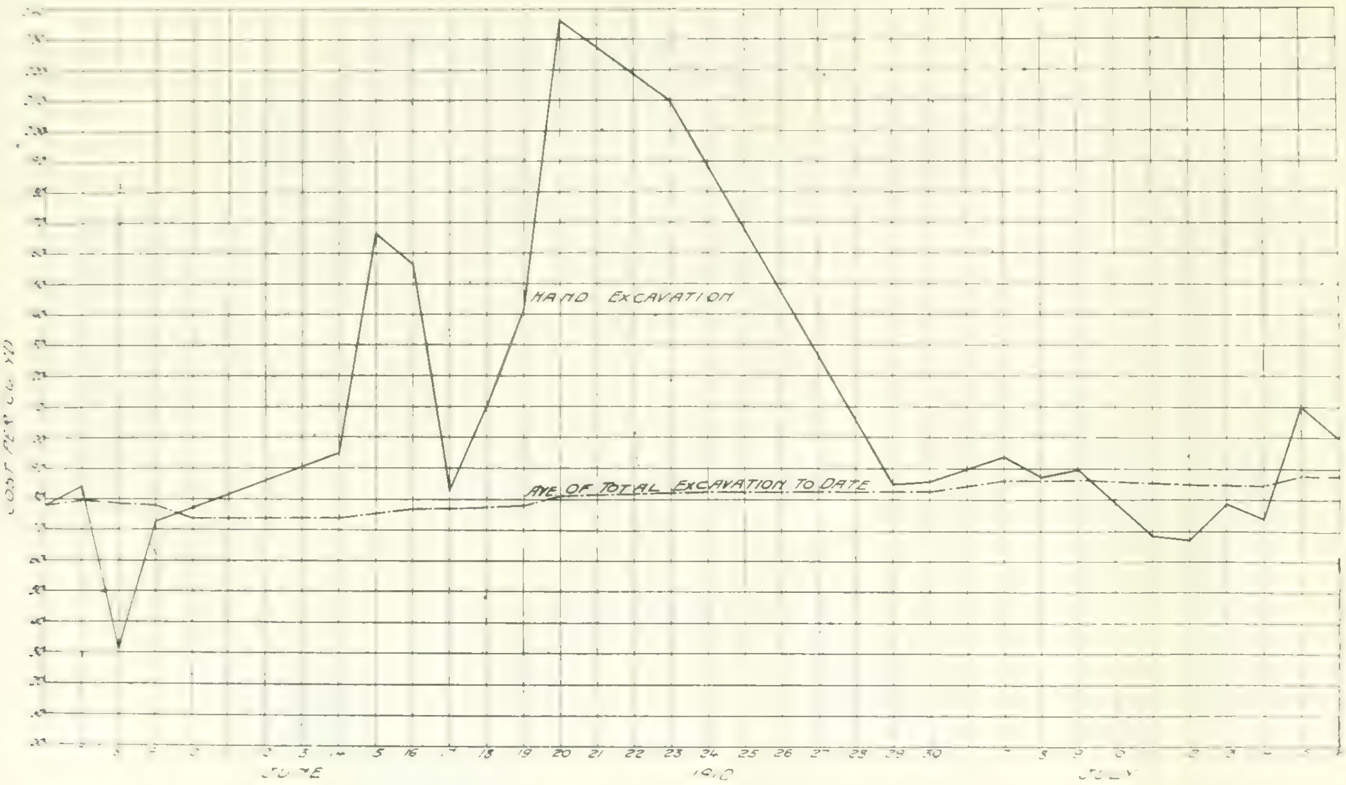


Fig. 3—Typical Cost Record Diagram Aziscohos Dam.

The varying aggregate dimensions for the above were defined by exponent figures in connection with the class letters; for example: "A-¾" indicates a 1:2:4 composition having a graduated crushed stone aggregate, with sizes varying from the fine material rejected by a ¼-in. dust screen up to and including the fragments that pass the perforations of a ¾-in. diameter screen. The use of stone dust was permitted by considering same as sand, and reducing the amount of sand proportionately.

The class *A* concrete is employed in the construction of the gate and logway buildings and for those portions of the structure that require slender cross sections of maximum strength. The arch deck slabs and all concrete placed below water level are composed of class *B*, *E* or *G* concrete, the two latter grades being used in situations where the cross sections will admit the interspersion of hand or derrick placed, thoroughly clean stone.

Above water level the buttresses are constructed of class *C*, *F* or *H* concrete, the permissible grade depending on the area and shape of the cross sections. Class *D* concrete is only used for heavy mass work of minor importance, where bulk alone is needed.

The southerly end of the main dam is embedded in an earth embankment with a reinforced concrete diaphragm, or core wall, extending from the last buttress into the solid material of the natural bank a sufficient distance to insure a practically impervious cut-off. This construction was adopted on account of the extreme depth of the ledge at this point, as is shown on the cross sections, Figs. 7 and 8.

It was originally intended to place the embankments by the hydraulic sluicing process, and apparatus was obtained for the purpose; but the exceedingly hard formation of the borrow pit material made it uneconomical to employ this method, on account of the expense contingent on pumping a large quantity of water under high pressure with very low efficiency of earth displacement.

Test pits indicated that after the hard surface soil had been penetrated, water bearing subsoil would be encountered; accordingly provision was made for driving steel sheet piling under the south core wall for a considerable distance from the main dam buttress, but this was found to be unnecessary.

Mention has been previously made of the logging contingency, but for a full appreciation of its effect on the work a brief description of the problem is essential, in order that the adopted methods for solving this difficulty may be understood.

The entire water shed appurtenant to the Aziscohos Lake is heavily wooded and will undoubtedly be for all time a timber growing country, owing to its location and mountainous character.

Investigation of the lumbering situation revealed the fact that without question an average of 20,000,000 ft. B. M. of logs will be sluiced annually from the lake during the next 20 years. The river below the proposed dam has a fall of 200 ft. in a distance of two miles, a condition necessitating the flow [illegible] volume of water to float the logs over the falls and rapids; and for supplying this "sluicing head" the existing dam was built.

Records of the water discharged from the old dam during the "sluicing season" show that under the most favorable existing conditions 137,000,000 cu. ft. of water are required for each million of logs passed through the dam, with an average annual total of 2,740,000,000 cu. ft., or more than 25 per cent of the entire storage capacity of the lake. By improving the river channel with wing dams, that will restrict the width of the water ways at abrupt pitches, it will be possible to reduce the average total quantity of water required for sluicing to 1,000,000,000 cu. ft. per annum.

Ultimately still greater economy of water for log driving will be obtained by constructing a V-shaped flume, or log chute, from the dam to the foot of the rapids, when the average total water required will be reduced to 250,000 cu. ft. per annum.

The total annual average run-off from the water shed is about 10,596,000,000 cu. ft., or roughly 30 per cent more than the 8,000,000 cu. ft. essential for filling the lake; but study of the run off records indicates that the lake will not be filled every year, also that the lake will be at its lowest level during the latter part of March, and will, in ordinary seasons, obtain most of its supply from melting snow in the spring. The log driving season commences as soon as the ice leaves the lake, an event several weeks in advance of the thaws that melt the snow and [illegible]

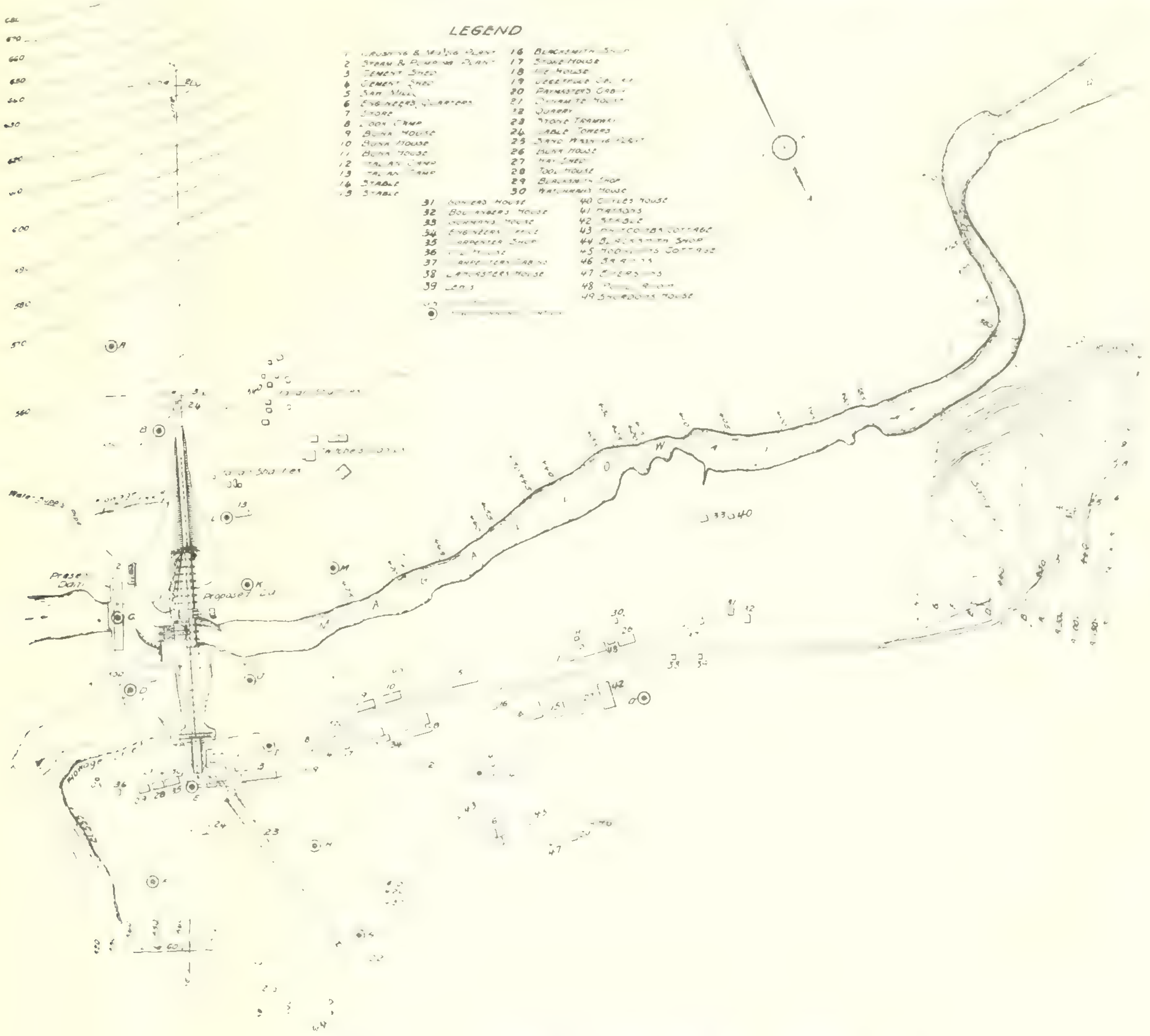


Fig. 4—Plan of Structure and Lay-Out of Construction Plant, Aziscohos Dam.

Consideration of the above facts makes it apparent that provision must be made for sluicing the logs through the dam at various stages of lake level.

Thorough study was made of the range in relation to the sluicing requirements, resulting in the conclusion that it would be necessary to design a log-way which could be utilized at any lake level between elevation 510 and the crest of the flash boards at elevation 535, or for a range of 25 ft.

General views of the perfected arrangement for the log sluice and its accessories, together with the adjacent low head waste gate, which will be used to drain the lake and possibly as an emergency log sluice-way, are shown by Fig. 11.

The essential features of the log-way are a vertical slot cutting out the arched face slab between two of the buttresses for a depth of 38 ft. below the crest of the main dam, the adjacent buttresses being of sufficient increased thickness to make the clear opening of this slot 7 ft. wide; a movable steel truss, having a clear span of 93 ft. 9 ins. between centers, supporting a V-shaped flume; and an inclined fixed section of V-shaped spout, or flume, continuing from the end of the truss to a downstream point convenient for discharging the logs into the river.

The raising and lowering of the truss is accomplished with the aid of a 15-ton hand power traveling crane which is furnished with a double speed hoist for quickly handling the stop-logs and the small section of spout that is set in the stop-log grooves, and overlaps the entrance mouthpiece to prevent leakage.

The swinging truss is suspended at the upstream end between a gallows frame, riding on bronze sliding strips, which bear against the planed surfaces of cast iron guides set in the sides of the concrete buttresses. The truss bearings rotate on a trunnion shaft which is attached to the gallows. A rectangular steel mouthpiece is rigidly fastened to the gallows frame, providing an entrance to the log sluice always at right angles to the stop-logs, with a minimum clearance from same.

On top of the gallows frame headers a working platform is secured, from which the attending lumberman guides the approaching logs or manipulates the locking mechanism when changing the position of the sluice. A special system of automatic locks, seating in notches provided in the gallows guide castings, has been devised whereby the truss always rests on rigid supports, unless the lifting hook is securely fixed in its proper position, thus precluding the possibility of releasing the load from the crane until the truss is safely anchored in the desired position. Chains from the gallows frame are passed over idlers into the adjacent bays of the dam, supporting concrete counter weights which neutralize to a large extent the dead load of the truss, relieving the crane proportionately.

The down-stream end of the truss is supported on trucks that travel on T-rail tracks having curved profiles of proper shape to maintain a minimum clearance between the overhanging section of steel flume, which protrudes from the truss, and the section of fixed flume that rests on a concrete abutment, designed to resist the shock due to the impact of the rapidly descending logs. The base receiving the end of the truss and the end of the fixed spout consists of a substantial concrete pier founded on bed rock. A heavy cast iron wearing plate is imbedded at the entrance of the fixed spout in the concrete abutment to prevent excessive wear anticipated at this point, owing to an abrupt change in the grade of the flume.

The log-way opening is closed with 12x16-in. yellow pine stop-logs bearing in cast iron grooves, situated at the end of the taper approach formed by the converging faces of the concrete abutments. The stop-log castings are imbedded flush with the buttress masonry, and are designed to act as guides for a gravity drop gate which travels in front of the upstream face of the stop-logs. This gate is composed of a structural steel frame incased in concrete, and is suspended on counterweighted chains, controlled by means of a hand-operated hoist located on the floor of the log-way house. When the log sluice is operating at the highest levels the drop gate will be submerged a small distance below the top of the stop-logs ready for the instantaneous closure of the log-way in the event of an accident in the flume. At the lower stages of sluicing the gate will be suspended a proper distance above the water level, and will be in a position permitting expeditious control. The

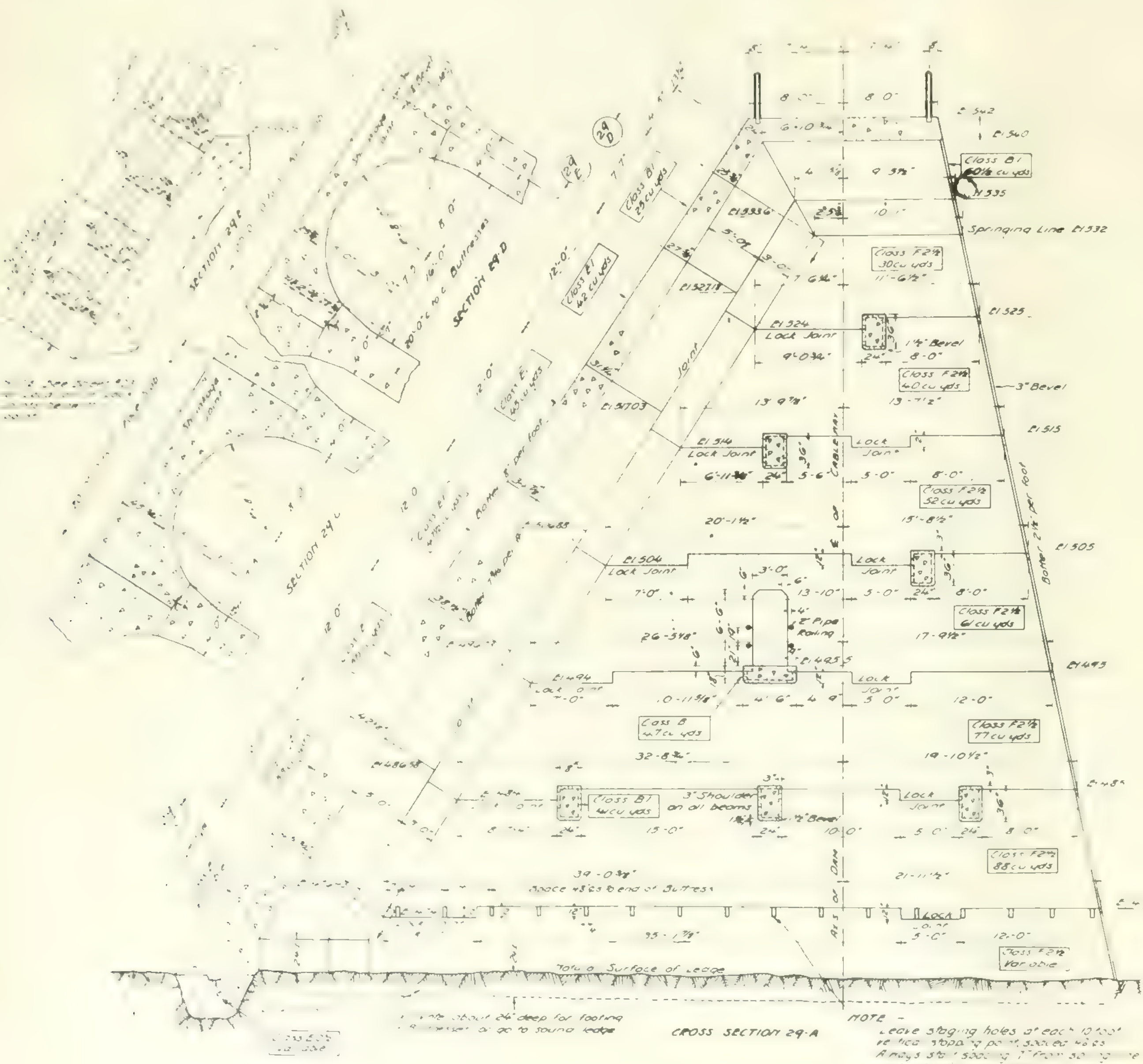


Fig. 5—Typical Section of Main Dam Showing Stops.

gate is made of sufficient height to close the log-way with bottom submerged 2 ft. below the top of the stop-logs when they are removed for the full depth of the flume en-

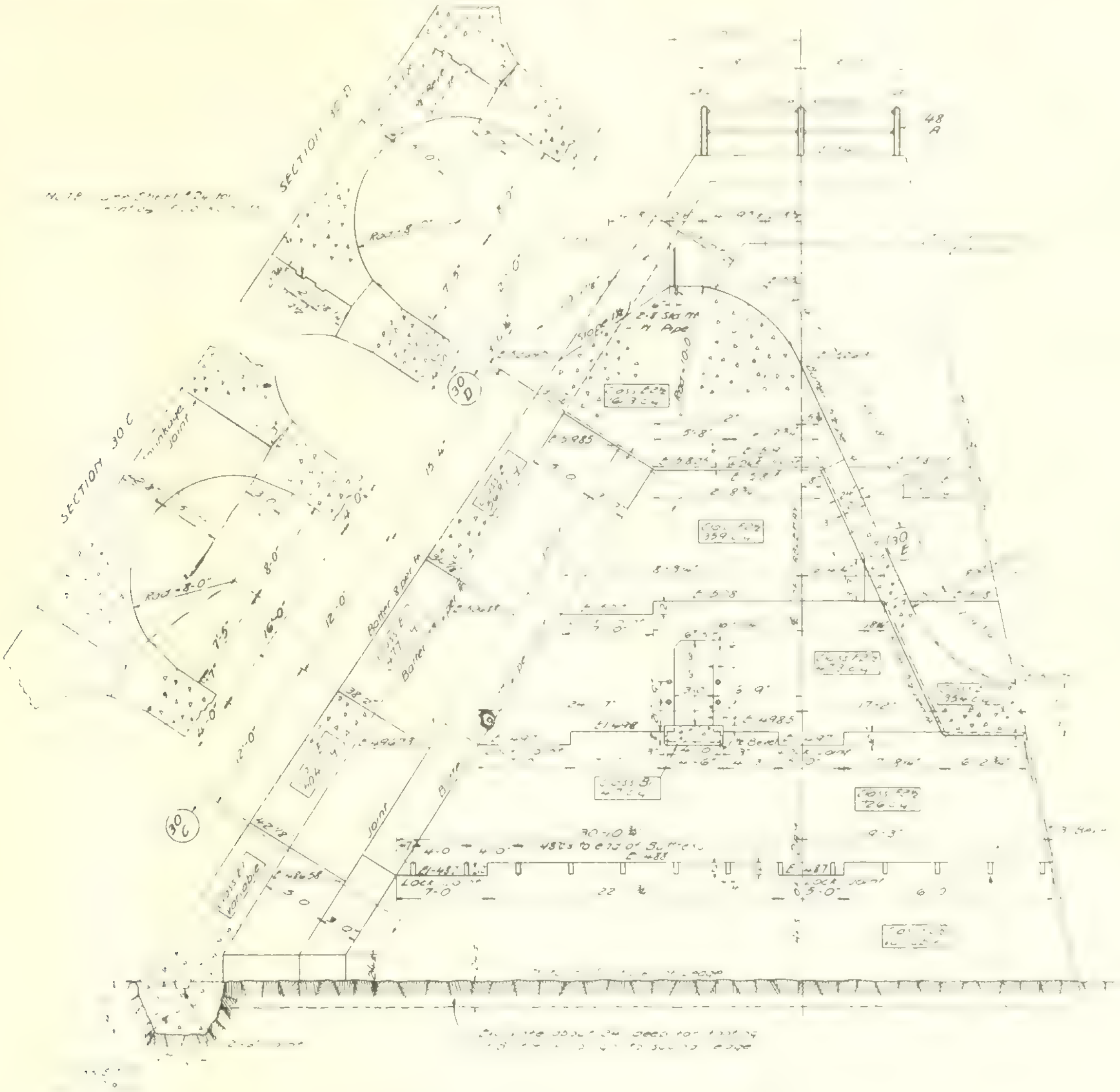


Fig. 6—Section Through Spillway of Aziscohos Dam.

trance, providing a screen to protect the operator when removing or placing the stop-logs.

A space of 6 ins. is left between the upstream face of the stop-logs and the down-

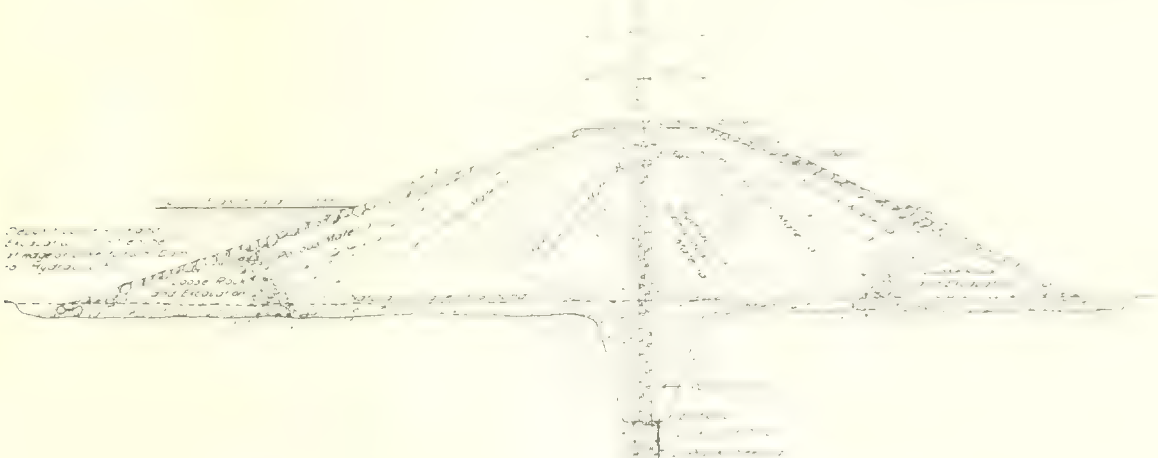


Fig. 7—Transverse Section of South Dike, Aziscohos Dam.

stream face of the drop gate. A timber bolted to the bottom of the drop gate closes this space sufficiently to create a pool of quiet water between the stop-logs and the gate, which eliminates the spurting streams that would otherwise occur, seriously handicapping the manipulation of the stop-logs, if this water cushion was not provided.

Before deciding upon the design for the log-way a series of experiments were conducted with large scale working models, and experienced river drivers, called upon to criticise the various schemes, strongly advocated the adopted apparatus, claiming that its capacity would be limited only by the quantity of logs which could be delivered to the entrance, a feature always the controlling factor regulating the [illegible] log-way [illegible] mates show that at the higher sluicing levels, under favorable conditions, 3,000,000 ft. b. m. of logs may be easily sluiced in 10 hours, and that the minimum capacity of the outfit will be not less than 1,000,000 ft. b. [illegible] hours.

The maximum velocity of [illegible] junction of the movable and fixed flume will be approximately 3,000 per minute, and the minimum velocity 1,000 ft. per minute. The swinging spout, which is the elemental feature of this design, is simply an amplification of crude timber structures that have been erected to accomplish the same purpose, under smaller variations of head, by the ingenious Yankee lumbermen of northern Maine and is only noteworthy on account of its exceptional proportions.

CONSTRUCTION.

The preparatory work of clearing the site, building roads, cutting timber for fuel and saw logs, and the erection of temporary buildings, preliminary to the actual construction, was commenced on Sept. 1, 1909. The selected form of dam was not determined upon until February, 1910, consequently the tasks accomplished during the winter of 1909 and 1910 were necessarily confined to the execution of such general work as would be required for the erection of any type of structure, and comprised the construction of cement sheds, temporary log sluice, bunk houses and saw mill; also the hauling of cement, lumbering operations and the digging of test pits to determine the location and character of the foundation rock.

Estimates were prepared in the engineers' office showing the probable time limits essential to complete the various sections of the work, compiled from the evidence of test pit data and based upon diagram sketches of the several stages of operation. The test pits indicated that the overlaying ledge cover was a very refractory material composed almost entirely of compacted, impalpable rock flour deposited by glaciers. The test pits, in conjunction with a meagre number of borings, indicated that the ledge was a very coarse granite formation of medium hardness, providing a foundation entirely suitable for sustaining the contemplated loads.

To successfully complete the work in the season of 1910 the progress estimates showed that the concrete plant equipment must be ready for operation, and the spillway excavation be completed, ready for placing concrete, about the first of June. These desired results were attained.

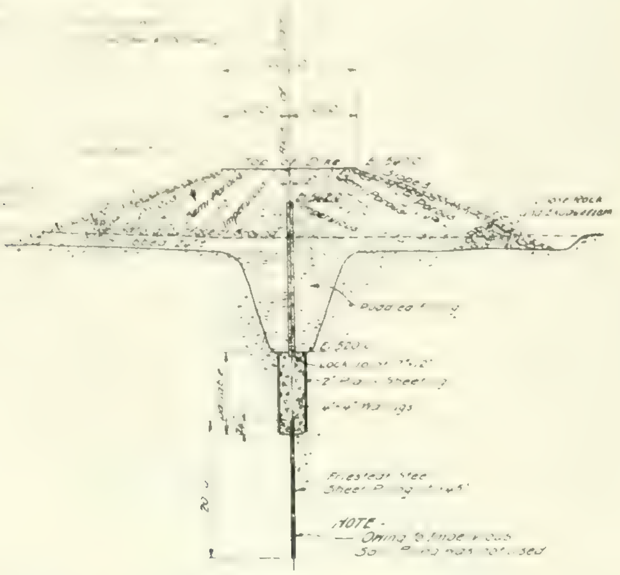


Fig. 8—Transverse Section of South Dike, Aziscohos Dam.

While excavating the ledge trenches for the buttress footings and the cut-off wall at the base of the up-stream face of deck slabs, suspicious and disconcerting seams were encountered after the first 2 or 3 ft. of the hard granite surface rock had been removed. These seams appeared to consistently exist at all points excavated and it was realized that the situation was serious. Accordingly immediate steps were taken to determine the extent of the stratification with the ultimate result that it became essential to excavate from 8 to 16 ft. of the surface rock before the laminated formation was sufficiently removed to insure an unyielding foundation. The ledge seams were from ½ in. to 12 ins. deep and were filled with rock flour, intermingled with an occasional layer of disintegrated granite.

The faulty condition of the ledge necessarily upset all time calculations, and precluded the possibility of commencing the concrete work on the first of June as anticipated. This unfortunate predicament seriously handicapped the whole work and delayed the placing of any concrete until July 13. A peculiar circumstance in connection with this incident is the fact that the preliminary shot drill borings, although admittedly insufficient, gave no indication that there existed any very soft material, except in one instance where a large clay pocket was encountered; but this was on the south side of the stream under the deep natural bank and was attributed to a local fault. The only explanation which can be offered for the above inaccurate representation is that the shot drill was too small, making it impossible to remove a whole core of any great length, thus deceiving the operators and making them accept the short cores as a result of the apparatus limitations.

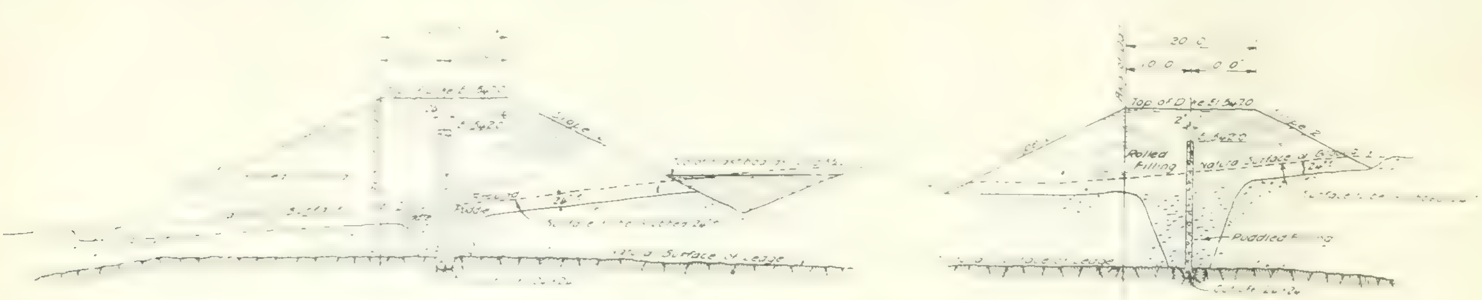
Forms are always an element of first importance in concrete construction, for they have material effect on both cost and progress, and should accordingly be subjected to as careful consideration as any other detail of the design. Realizing the truth of the above assertion and also appreciating the fact that the proposed dam consisted of a series of duplicate parts, it was apparent that a system of interchangeable forms, in standard unit sections, would be not only feasible but would economically expedite the work, if they were properly constructed. Accordingly complete plans were prepared for the principal form work of the buttresses, arched slabs and core walls; also for forms having special conditions of loading or that were structurally complex.

The methods of constructing and assembling the buttress forms are clearly illustrated in the accompanying Fig. 12, and a detailed description of this work is therefore unnecessary; but special attention should be called to certain novel features, which practically eliminated all shoring and bracing, at the same time providing rigid adjustable attachments, to which the arch forms were secured. These are the tie bolts and separators, shown at 72-D, located at the junction of the straight buttress sections with the beveled nosing, forming arch haunches; the bolt sockets set central with the up-stream face of the buttress nosings and the coreboxes, illustrated by 72-F, which were set in the nosing forms, as shown on 72-D, for receiving the studding of the shrinkage joint forms later described. An especially valuable but not original device is the extensible double ledger boards, which act as separating struts and spacers for the buttress side panels and also as stringer support for the working platforms. These ledger boards consist of two 3x10-in. timbers, 14 to 15 ft. long, yoked together with two welded iron loops, which are held rigidly in position by means of plates and wedges, as shown on 72-H. This arrangement provides a stiff beam of variable length that can be easily removed without mutilation by simply releasing the loop wedges, the ends of the sticks being beveled to facilitate their extraction from the concrete.

The arch forms shown by Fig. 13 appear to be very complex, a difficulty hard to overcome in preparing plans for form work. Careful examination will, however, reveal that this work is much simpler than at first apparent. The essential and radical features of this construction are the methods employed for supporting the intrados arch forms, and for tying the up-stream face panels to the buttress concrete, and the intrados forms, dispensing with the need for bracing of any description except the small amount necessary for the temporary support of the forms while they are being placed in position.

The intrados arch panels consist of two circular sections 4 ft. deep, jointed and held in position at the arch crown by specially designed, adjustable tie rod spacers, which pass through the crown of the arches, tying the intrados forms rigidly to the stringer beams of the up-stream face panels. The buttress ends of the arch sections are held in position entirely by the friction grip of abutment blocks, that are securely clamped to the sides of the piers with bolts which pass through the pipe separators cast into the concrete buttresses, and to which attention has already been called. Spreader struts, securely wedged against the abutment blocks, hold the ends of the arch segments tightly against the edge of the buttress bevels. The ends of the segments are supported by 4x6-in. sill strips that are seated in shoulders on the abutment blocks and are rigidly keyed in correct position with wedges.

The end panels for the shrinkage joints,



Figs. 9 and 10—Transverse Sections of North Dike, Aziscohos Dam.

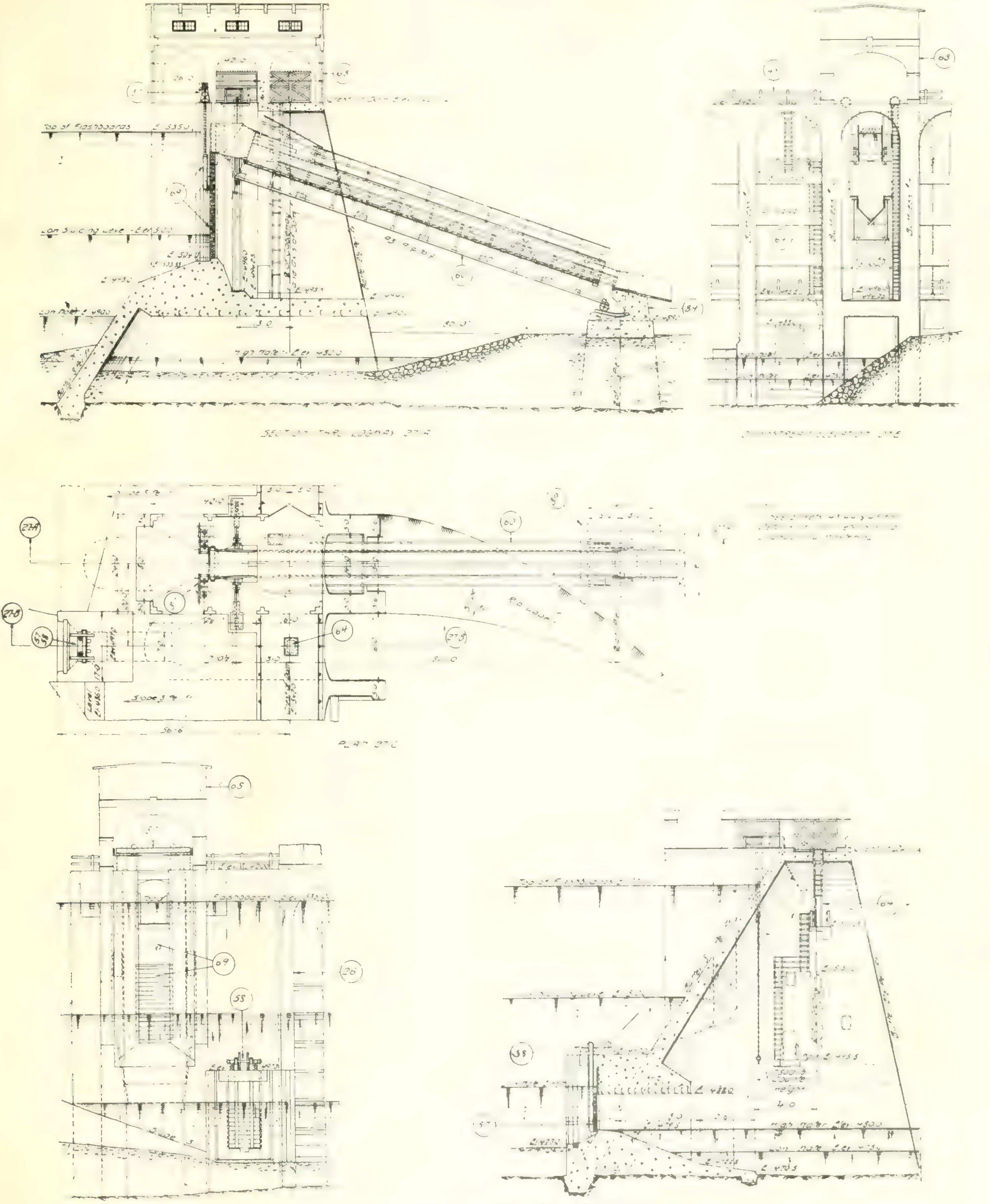


Fig. 11—Details of Log Way, Aziscohos Dam

entral with buttresses, are held by means of the notched recesses provided in the nose of the piers, the top reaction of the studding being received against 3x8-in. plates which abut against the shouldered blocking securely spiked to the end of the face slab stringers. The end reaction of the face slab forms is held by anchor rods which are inserted in the pipe sockets incorporated in the buttress concrete. View 73 C clearly shows the above described construction.

To reduce as much as possible the opening of the shrinkage joints between the face slabs, the bays are [illegible] sections. To obtain maximum benefit from the initial shrinkage of the concrete a time interval, as long as possible, is allowed to elapse before pouring the concrete on the intermediate bays. Pipe sockets are set in the faces of the [illegible] face slabs for receiving the anchor bolts that resist the end reaction from the intermediate face form stringers. (See Fig. 13.)

The writer does not intend [illegible] idea that sectional forms are materially, if any, cheaper per unit of contract surface than the ordinary kind built in place, but their use is strongly advocated on account of the rapidity

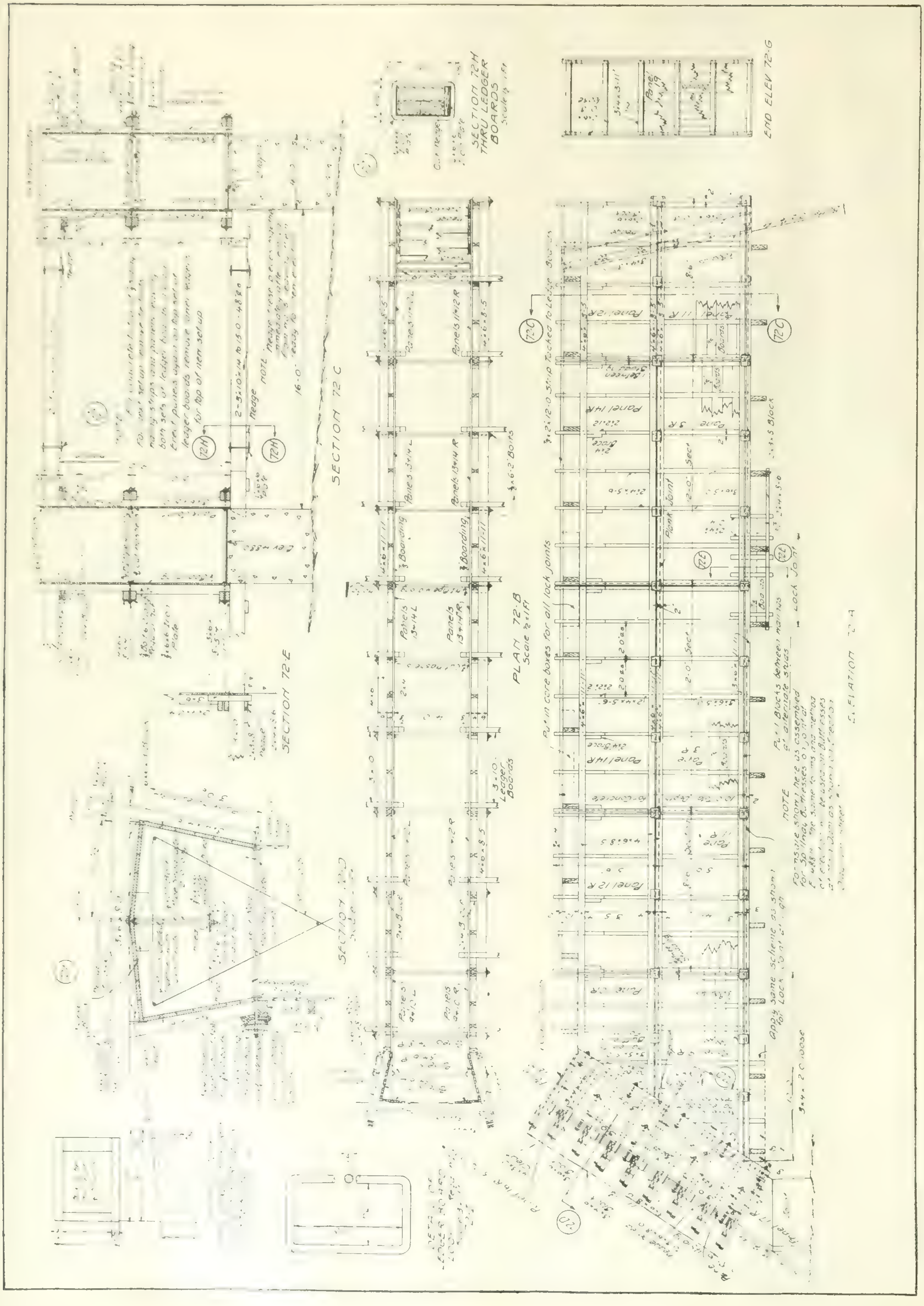


Fig. 12—Details of Buttress Forms. Aziscohos Dam.

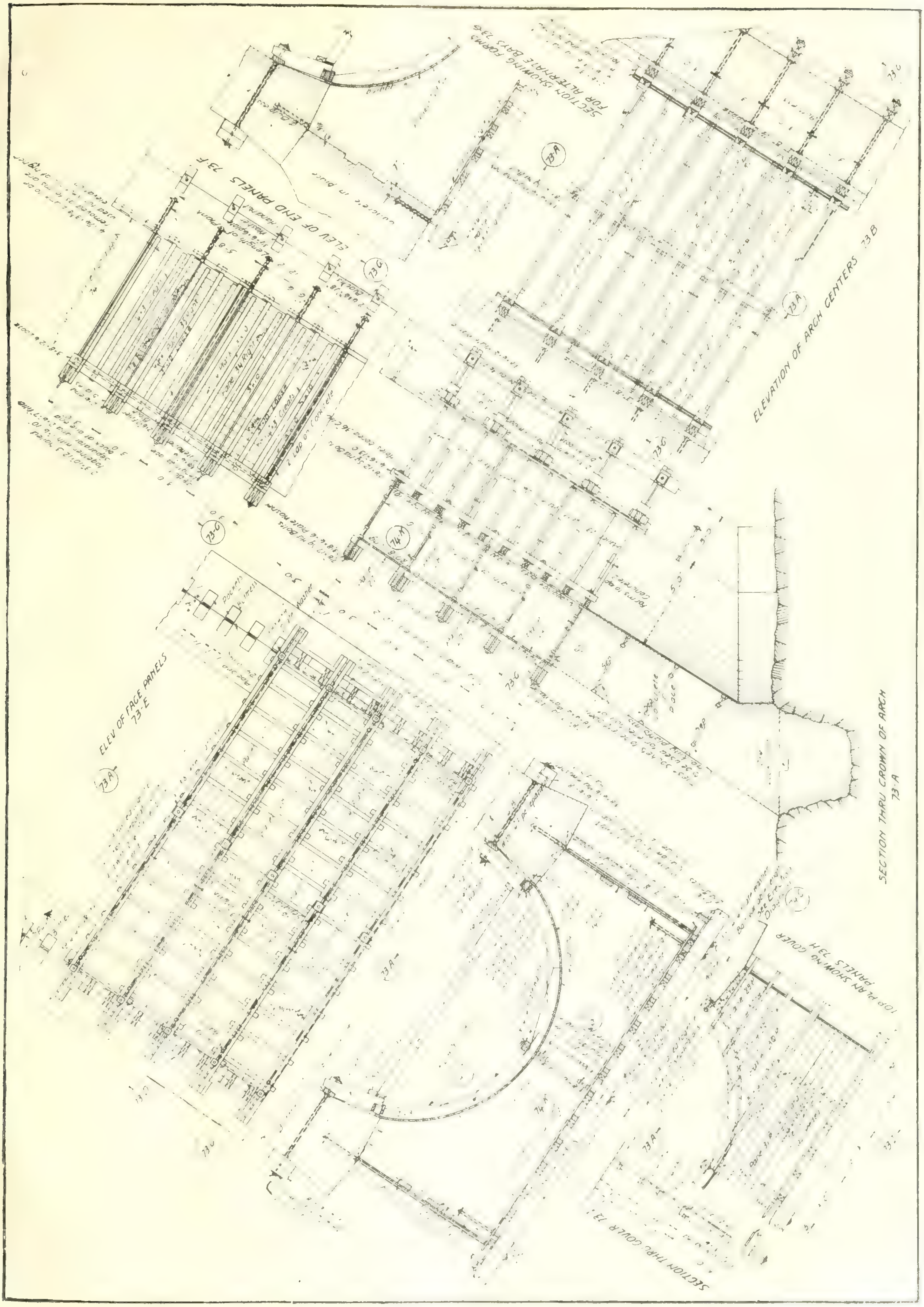

SECTION SHOWING FORMS FOR ALTERNATE BAYS 73G
ELEV OF END PANELS 73F
ELEVATION OF ARCH CENTERS 73B
ELEV OF FACE PANELS 73E
SECTION THRU CROWN OF ARCH 73-A
TOP PLAN SHOWING COVER PANELS
SECTION THRU COVER 73
73A
73G
74A

Fig. 13—Details of Arch and Slab Forms, Aziscohos Dam.

with which they can be assembled ready for the placing of concrete, without employing an army of carpenters to keep the form work ahead of the concreters. It is undoubtedly true that the unfortunate foundation difficulties encountered in this instance had material effect on the unit cost of the forms on account of the concentration and consequent congestion which it occasioned. Had it been possible to spread out the work over a sufficient number of piers, a much more creditable showing could have been made; as matters stand, the forms have accomplished a saving of from 150,000 to 200,000 ft., board measure, of lumber and have been instrumental in effectively increasing the quantity of concrete placed, the average since commencement being 100 cu. yds. daily.

LETTERS TO THE EDITOR.

Cement Curb and Sidewalk Construction Without Mortar Surface Coat.

Sirs: As an engineer in building bridge work all of our good concrete jobs were put in wet without any attempt at mortar facing outside of spading the concrete along the inside of forms.

I want to ask why this same method of construction would not be better in the building of curbs than the usual method of a lean mixture for the interior of the curb and a rich mixture for the outer coat, as there is a difference of expansion caused by the amount of cement used. I am of the opinion that a better curb can be built by merely spading that portion that is exposed and finishing the top by bringing the mortar to the surface. This does away with any liability of the mortar coat not uniting with the core of the curb.

Also I want to ask why a sidewalk cannot be built with a tolerably rich mixture throughout and finished on top by bringing the cement to the surface. Of course the sidewalk would have to be built with a wet concrete, and not too fine a sand, so that an excess of sand would not work to the top. We have had numerous failures in our concrete sidewalks, and I do not see why this would not be satisfactory. I see no reason why a smooth, white surface is so much sought in a sidewalk. This method of which I speak would give a comparatively rough surface and would be an advantage in many ways.

Will you please let me have your opinion on this matter, and greatly oblige.

Yours truly,
H. M. HOCKMAN,
City Engineer.

Frankfort, Ind., Dec. 23, 1910.

Drainage Areas and Areas of Waterways.

Sirs: I have read with interest the article on "Drainage Areas and Areas of Waterways" in your issue of Dec. 14. Perhaps some data which I have may be of interest to engineers who are located in the mountain regions of the west.

The stream which flows through the center of the city of Pomeroy, Wash., has a slope of 0.01 and drains an area of 70 square miles above the city. In March, 1910, occurred the heaviest flood that has been known during the past 20 years, and the cross section of the stream as it passed under the several bridges in the city averaged 230 square feet. This is only about one-eighth the area given in the tables. One point should be mentioned affecting this flood. The lower tributaries of the stream delivered their quota before the crest of the flood from the upper tributaries arrived, thus distributing the crest of the flood over some 20 hours of time. The stream flows through the city in an earth channel, but the course is very direct and unobstructed.

Another case. In the latter part of the year 1906 I constructed a concrete culvert across another stream in this county, having a drainage area above the culvert of 22 square miles, and a slope in the immediate vicinity of the culvert of 0.015. The structure was founded on bed rock, above which was 2 feet of gravel which was left in place under the culvert. It was built as a semi-circular arch with the springing line at the surface of the gravel bed, and a radius of 9 ft.

In February, 1907, 12 ins. of snow fell on frozen ground, followed within two or three days by a heavy rainfall which carried it all off, and created a flood that did much damage along the lower course of the stream. For about three hours the culvert was taxed to its utmost capacity, and about one-half of the gravel bed under the culvert was washed away. The area of the waterway did not then exceed 155 sq. ft.

This is one-seventh the tabular area for that water shed.

We have another water shed adjacent to the city that has been giving us considerable trouble. The area is 1.12 square miles. Some years ago a wood flume was constructed having an area of 7 sq. ft. to care for the discharge. This it was able to do so long as it could be kept clear, but owing to poor alignment and irregular gradient the sand and gravel carried by the stream would collect in the bottom along the more nearly level places and cause the flume to overflow. A new flume has just been constructed under my supervision, with a cross-section of 8.5 ft. and a slope of 0.04, uniform throughout. The flume is of concrete, in the shape of an inverted parabole, with base of 3.5 ft. and depth of 3.5 ft. This will be left open until after the spring floods pass when, if it proves sufficient, it will be covered with concrete slabs.

It would be interesting to learn the slope for which the tables given by Mr. Gearhart were computed. The road culverts of small size are put in here with a slope of 0.04, and serve more than ten times the area given in the tables. I doubt if such tables can be made much use of outside of the immediate region for which they are computed.

The maximum annual rainfall for this region is 18 ins., or about one-half that given for the tables, but this, too, is liable to be very misleading. The only rainfall data that are of much use is the maximum for 24 hours. Even then unusual torrential storms should be eliminated unless they can reasonably be expected to occur within fairly regular intervals. Not only each separate region, but also each separate watershed constitutes a separate problem and should be solved to meet each individual case. A culvert or bridge that would be ample for all of the requirements of one water shed might be entirely too small for another adjacent water shed of equal area, and to construct all of the culverts and bridges in the county or state on the basis of the maximum requirements of the stream having the greatest ratio of flow to area would be an unwarranted waste of money.

J. E. TUPPER,
County Engineer.

Pomeroy, Wash., Dec. 17, 1910.

Mr. Godfrey's Design for Reinforced Concrete Retaining Wall.

Sirs: Beginning on page 546 of your issue of December 21, 1910, Mr. Edward Godfrey discusses the design of retaining walls. He enters a somewhat general condemnation of theories which have governed the design of retaining walls and masonry dams in the past. The possible upward pressure of water on the base of a masonry dam is not a contingency that has always been ignored in designing such structures. At the time the Austin dam failed, one of the causes of the failure was recognized to be the floating power of the water in the porous limestone foundation discovered at the time.

Mr. Godfrey states that the most neglected factor in the design of retaining walls is the effect of frost. This is probably true, and there is nothing in his design, nor in his discussion thereof, that indicates that he has made any provision for this factor.

Mr. Godfrey's conversion of earth pressure into fluid pressure would be all right providing it could be demonstrated that for a particular case the converted pressure was equivalent to the actual pressure. In this respect he does not appear to have made any real improvement upon other theories of earth pressure. It should also be noted that you cannot safely assume a fluid pressure of 1/6 or 1/5 of the weight of the earth filling for a general rule. The amount of moisture in the earth and its fluidity for any particular case would have to be known to determine the proper factor, and this introduces quite [illegible] as in old theories.

Referring to his design, Mr. Godfrey says: "The office of the rib is here recognized as being merely to protect these rods from corrosion." Assuming that the curved diagonal rods shown in the counterfort of his design were not enclosed in concrete, what would there be to prevent the vertical face of the wall bulging outward and failing under the earth thrust? What bridge designer would dare introduce a curved eye-bar intended to resist tension? The counterfort has a much more important function to perform than the preservation of the steel against corrosion.

Mr. Godfrey's method of fastening the ends of the tension rods by nuts is good, except that it is wasteful of metal on account of the strength of the entire rod being limited to the net area of metal under the threading, or in lieu of that, the expense of upsetting the rods.

The method of failure indicated in Figure 6 is not at all due to the arrangement of the rods, but solely to lack of proper anchorage at the end. Lacking such anchorage, Mr. Godfrey's design would be equally liable to such failure. Much of the other criticism of Mr. Godfrey is equally applicable to his own design.

The general design proposed by Mr. Godfrey is perhaps the most economical form for a reinforced concrete retaining wall. Another and expensive design is shown on page 559 of your issue above specified, which shows a 100,000-gallon reservoir on the Panama Canal work. Referring to the design of this reservoir, a more economical structure would have been a circular reservoir 43 ft. 9 ins. in diameter and 10 ft. deep, with a shell 6 ins. thick. The saving of the circular design as compared to the rectangular plan would be as follows:

Concrete, 53.3 cu. yds. at $10.25	$546.33
Steel, 4,500 lbs. at 3 cts.	135.00
23 lin. ft. forms at 3.64 cts.	83.72
Total	$765.05

From this it appears that the rectangular design has cost 36 per cent more than the circular plan would have cost on the basis of the actual unit costs in the construction of the rectangular plan. These costs refer to the retaining walls of the tanks only. The cost of the concrete bottom is not necessarily affected by the design of the walls.

Yours truly,
J. L. CAMPBELL.

El Paso, Tex., Dec. 24, 1910.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Drag Bucket Excavators.—Paper, 12⅜x9¼ ins.; 32 pp. Monighan Machine Co., 2016 Canal ave., Chicago.

This catalog contains a table of condensed dimensions of the different types of drag line excavators, complete descriptions of the machines, their parts and materials of which they are built. The book is exceptionally well illustrated.

Fire Brick—Leather, 8⅛x3¾ ins.; 48 pp. Geo S. Good Fire Brick Co., Patton, Pa. A useful catalog, showing by perspective illustrations, the shapes and sizes of all stock fire brick. Tables of sizes and analyses are given.

Sewer Pipe.—Leather, 8⅛x3¾ ins.; 56 pp. Patton Clay Mfg. Co., Patton, Pa.

A catalog of shapes of all classes of vitrified clay products including pipe, conduit, roof tile, and ornamental work. Complete information as to sizes, prices, and discounts.

Acme Corrugated Metal Culverts.—Paper, 3½x6 ins.; 16 pp. The Canton Culvert Co., Canton, O.

A folder which illustrates and describes the corrugated metal "knock down" culvert pipe.

Ammonia Dynamites.—Paper, 3½x6 ins.; [illegible] pp. E. I. DuPont de Nemours Powder Co., Wilmington, Del.

A description of the properties and methods of exploding ammonia dynamites.

Charging Bore Holes.—Paper, 5x7 ins.; 12 pp. E. I. DuPont de Nemours Powder Co., Wilmington, Del.

Reprints and extracts from government reports as to the uses and abuses of explosives and a few pointers on charging and tamping bore holes.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week.

Announcement has been made that the Copper River & Northwestern Ry. will about March 1 have work started on an extension toward Fairbanks in the Tanana gold district in Alaska. It is estimated that the extension will cost about $30,000,000.

Bids are to be opened this spring for the construction of the Panama-David R. R. The Panama Assembly has approved the bill authorizing President Arosemena of Panama to receive bids for the work. The cost of this work is not to exceed $10,000,000, for which the government may issue 5 per cent bonds.

The contract for the construction of the new prison at Kingdale, Dutchess County, New York, has been awarded to the P. J. Carlin Construction Co., New York City, at $2,196,000.

The Coastwise Dredging Co., Norfolk, Va., has just been awarded the contract for a large government dredging job in Providence River, R. I. The contract calls for dredging 1,698,240 cu. yds. of material, the contract price being 7.84 cts. per cu. yd.

Several new railroad companies have announced that their plans were so well along that they hoped to let construction contracts this spring. Among these companies are the following: The Oklahoma, Kansas & Missouri Ry., which projects a 40 mile line, and the Columbus Connecting R. R. Co., which projects a 32 mile double track steam belt line around the city of Columbus, O.

Among the railroad construction contracts let recently are the following: Mason & Hanger Co., Richmond, Ky., for constructing a second track from Oakdale to Lansing, Tenn., for the Queen & Crescent Route, the contract covering about 12 miles of work and amounting to about $250,000; W. F. King, for the concrete work for bridges and culverts for the line of the Interstate Transfer Ry., from Pokegama Junction, the present terminus of the road; H. E. Owen, a sub contract for grading on the Colorado & Southern Ry.'s new line from Cheyenne to Wellington, Colo.; Thrasher & Gunter, Chattanooga, Tenn., for widening the Covington tunnel for the Louisville & Nashville R. R.

The first contracts for work on the Cayuga and Seneca Canal in New York have been awarded as follows: Scott Brothers, Rome, N. Y., at $393,135 for contract A, providing for the construction of locks and controlling works in the Seneca River; Crowell Sherman Stalter Co., 3111 Carnegie Ave., Cleveland, O., $1,448,500 for contract B, providing for 17 miles of dredging work.

The U. S. Reclamation Service is now calling for bids for the earth work on about 22 miles of the North Canal of the Belle Fourche project. The work involves the excavation of about 770,000 cu. yds. of material.

Conklin, Rooney, Johnson & Hofman, Chandler, Okla., have been awarded a large contract by the Deep Fork Drainage District No. 1, the work calling for the construction of a drainage ditch in Lincoln County, Okla.

The city of Salem, Ore., is now calling for bids for a large paving contract. The work calls for the construction of 175,000 sq. yds. more or less of hard surface pavement.

The mayor of Oklahoma City, Okla., is to call a special election to vote on the issuance of bonds in the sum of $1,250,000 for securing an additional water supply for the city. The plans propose a new 3,300-acre reservoir and the bringing of the water to the city in a 42-in. pipe line, eight miles long.

The Outlook for 1911.

[illegible] that 1911 will be a fat year for construction work. Not the least of these signs is the optimistic feeling [illegible] in all sections of the country. But the most convincing sign of all is the $ sign, as represented by the immense bond issues already voted for public work, and by the large number of private enterprises that have been financed in whole or in part. While there has been undoubtedly much manufactured-for-a-purpose pessimism among the older railroads as regards the construction of new branch lines and the continuation of extension work, yet railroad officials have not hesitated to express their belief that a correct solution of the pending questions, which have seemed to defer these works, will be reached early this year. Whether or not this correct solution is reached, there are good grounds to believe that much of the extension work of these older railroads will be continued during the present year, and that many new branch lines will be put under construction. In any case these railroads have a vast amount of betterment work which must be done in the near future. The elimination of grade crossings will be an important feature in railroad work this year. In Ohio, particularly in the cities of Cleveland, Youngstown and Cincinnati, plans have been made for the expenditure of many millions of dollars for work of this kind. The past year has seen the incorporation of many new railroads—steam and electric—and many of these companies have already succeeded in securing their construction capital. Many other railroad companies, organized two or three years ago, have also completed their financial arrangements and are planning to begin construction work in the spring. In other lines of construction work the prospects are fully as good. The prospects are particularly bright for irrigation work. The present condition of the money market is such as to make the financing of private irrigation enterprises much more easier than it has been the past two years. In Colorado, Wyoming and Arizona, many irrigation districts have been organized during the past few months, and many bond issues have been voted for construction work. The recent allotment by the special board of army engineers of the new $20,000,000 fund provided by Congress for the completion of projects of the U. S. Reclamation Service makes sure much work for the next few months. This $20,000,000 is to be spent within the next five years. In the Southern States, particularly, drainage work promises to offer much construction work this year, and many thousand acres of land will be reclaimed. In Oklahoma many projects of this kind will be put under contract this year. In Missouri, in Indiana and in Arkansas there is also much of this work in prospect. In Texas extensive levee work for the reclamation of land is proposed, and much similar work will be undertaken in other States. The construction of municipal wharves will also furnish much work. Portland, Ore., has voted a large bond issue for a system of municipal docks and piers, and Baltimore, Md., has likewise voted several million dollars for similar work. Seattle, Wash., and Philadelphia, Pa., also have extensive wharf work under consideration. In the line of municipal work the prospects are excellent. Many cities and towns in Ohio and Pennsylvania will have to erect sewage disposal plants. The long projected $15,000,000 Passaic Valley sewer will probably be put under construction this year, and the Board of Water Supply of New York City will place under contract the $20,000,000 system of rock tunnels under the city. Many cities have voted large bond issues for the construction of trunk sewers and improvements to the existing facilities. The city of Pittsburg, Pa., alone has voted a several million bond issue for municipal improvements and has already made plans to dispose of a large part of this issue. The general awakening throughout the country to the importance of good roads will lead to the construction this year of many miles of improved highway. In California alone an $18,000,000 bond issue has been voted for the construction of good roads, and much work will undoubtedly be done under this bond issue this year. Several counties in California have also arranged to make large bond issues for the construction of systems of county roads. In Wayne County, Michigan, a $2,000,000 bond issue has been voted for the continuation of work on the road system of that county. In many other States, notably Virginia, Tennessee, Florida and Texas, many counties have voted bond issues for the construction of county systems of roads. In addition, practically all of the States which have some form of State supervision for highway construction are asking larger appropriations this year for their work. It is safe to say that all signs indicate that there will be no rust on the scrapers in 1911, nor will contractors be obliged to pay storage charges on their outfits.

The Hobo's Swan Song.

Owing to its [illegible] bathos, pathos and anti-climax we consider the following [illegible] worthy of a place in our authology of hobo pomes. The verses in question were found among the possessions of a traveling gentleman, who is sojourning during the winter months at the well-known resort as Sioux Falls, S. Dak., vulgarly called the penitentiary.

[illegible] cold November day,
[illegible]
[illegible]
[illegible]

[illegible] is bright;
[illegible]
[illegible]
[illegible]

[illegible]
[illegible] going through.
[illegible]
[illegible]

[illegible] on the fly!
[illegible]
[illegible]
[illegible] around the [illegible]

Government Irrigation Work. The report of the special board of army engineers appointed to arrange the apportionment of the new $20,000,000 fund provided by Congress for U. S. reclamation projects has been approved by President Taft, thus assuring much activity for the coming season in many sections of the West. The $20,000,000 was split up among 14 projects, the Rio Grande project, preliminary work on which is now well under way, receiving the largest allotment. The $20,000,000 is to be spent in the next five years, and the interest on the loan is to be charged against the project. In addition to the report on the apportionment of the new fund the special board of engineers also made a report on the reclamation work in general. In this report the special board state that the engineering structures of the various projects are, as a whole, well designed and well built. Particular reference is made to the Pathfinder Dam, the Shoshone Dam, the Roosevelt Dam and the Gunnison Tunnel as reflecting great credit on both designer and builder. As to the minor structures the report points out that modern irrigation being a relatively new art in this country, much freedom was allowed local engineers in the design of minor structures. While this, the report states, was a wise policy in the early stages of the work, it has resulted in some complicated and unnecessarily expensive structures. With the present knowledge of the comparative merits of the different types, the special board of engineers gives as its belief that standard designs of the simplest satisfactory type should be adopted for all minor structures. Regarding the cost of the various projects the special board has the following to say:

> The actual cost of completed work has almost invariably exceeded the original estimates, and in the case of some structures has been two or three times as large. This increase in cost has been the cause of much of the discontent among the settlers. It was partly due to a general increase in the cost of labor and materials, partly to underestimates and an insufficient allowance for contingencies and partly to the necessity of doing more work than was originally contemplated.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

Business men of Huntsville, Ala., are trying to induce the Nashville, Chattanooga and St. Louis R. R. to build its Fayetteville and Lax branch on down to Huntsville. The present terminal is only twelve miles from Huntsville.

Surveys for the line of Gadsden & Birmingham R. R. are now under way, and it is stated that contractors will be put on the work by March 1. This road is to be an extension of the Chattanooga Southern R. R., of which C. H. Fisk, Chattanooga, Tenn., is Chief Engineer.

The Washington & Choctaw R. R. Co., incorporated on Dec. 27 with a paid in capital stock of $200,000, proposes a railroad to run from Yellow Pine, Washington County, in a general northeasterly direction through the counties of Washington and Choctaw to a point 18 miles south of Butler, Choctaw County.

Alaska.

The Copper River & Northwestern Ry., E. C. Hawkins, Chief Engineer, Seattle, Wash., will complete its line to Kennecott about March 1, and shortly thereafter will have work started on an extension toward Fairbanks in the Tanana gold district. The northern extension will begin at Chitina and will be pushed toward Fairbanks as rapidly as possible. The distance from Chitina to Fairbanks is about 300 miles. It is estimated that the extension will involve the expenditure of $30,000,000. Chitina is 150 miles from Cordova, the ocean terminus of the railroad.

Arkansas.

The Commercial League of Fayetteville, Ark., has made an agreement with the Arkansas, Oklahoma & Western R. R., to furnish a cash bonus, a right of way for 17 miles and terminal facilities. This road is to be built from Siloam Springs within a year. It will ultimately be built east to Memphis.

The Blytheville, Leachville & Arkansas Southern R. R. has about completed surveys for its proposed line into Marked Tree, Ark. A. C. Lange, Blytheville, Ark., is General Manager, and W. P. Orr, 140 W. Chicago Ave., Chicago, Ill., is Chief Engineer.

Officials of the Missouri & North Arkansas R. R., according to advices from Helena, Ark., have announced that they will construct new terminals at that place providing the city gives them a bonus of $125,000 for the purchase of right-of-way and other terminal site. John R. Scullin is President of the company, and W. S. Roberts, Eureka Springs, Ark., is Secretary.

The Chicago, Rock Island & Pacific R. R. has secured land between 3rd and 4th Sts., at the Rock Island tracks at Rector Ave., at Little Rock, Ark., on which to erect a new station. Considerable filling work will be required, it being estimated that one block will have to be filled in about 10 ft. to bring it to the required level. This part of the work will probably be started early this year.

California.

⊙The Ocean Park Scenic Ry. Co. of Los Angeles, Cal., which was recently organized to construct a railway on the Marine St. pier, has let the contract for its construction to P. D. Howse, for $100,000. The work is to be completed by May 1, 1911.

The Pasadena Rapid Transit Co., Chamber of Commerce Bldg., Pasadena, is reported to have preliminary work well along, and is said to be planning to have construction work started soon on its proposed street car line from Pasadena to the business center of Los Angeles. The proposed line is seven miles long with underground terminals at both ends and the promoters state that their cars will cover the distance between the two cities in twelve minutes. This proposition was started about a year and a half ago. A $3,000,000 bond issue was voted several months ago.

The United Properties Co. of California has been chartered under the laws of Delaware. The capital stock is $200,000,000 and the company has organized for the purpose of effecting a merger of all the public utilities companies of Oakland and Berkeley, Cal., including the ferry line that connects those places with San Francisco. The charter was obtained by the Delaware Trust Co. of Wilmington, by direction of Christian B. Zabriskie of 100 William St., New York, manager in New York of the Pacific Coast Borax Co., of which F. M. Smith is president. The directors are from New York, San Francisco and Oakland. They are F. M. Smith, W. S. Tevis, R. G. Haferd, Gavin McNab, C. B. Zabriskie, W. R. Alberger and Denis Searles. The purposes, as set forth in the charter, cover the equipment, construction and operation of railroads, steamship lines, electric light, power and traction lines, supplying water for domestic purposes and irrigation, building and operating wharves, docks and warehouses. The operating offices will be in San Francisco and Oakland.

The directors of the Oakland Traction Co., Oakland, voted Dec. 31 on issuing $250,000 of bonds for the purchase of additional cars.

The status of plans on Dec. 17 for furnishing materials for the municipal Geary St. electric railway at San Francisco was as follows: Contract No. 2—For furnishing and delivering joints, plates and rail fastenings. Plans and specifications prepared. Contract No. 3—For furnishing and delivering rail bonds. Plans and specifications 98 per cent completed. Contract No. 4—For furnishing trolley wire. Specifications 95 per cent completed. Contract No. 5—For furnishing and delivering special track work. Plans and specifications 90 per cent completed. Contract No. 6—For furnishing and delivering trolley poles. Plans and specifications 80 per cent completed. Contract No. 7—For furnishing and delivering cast iron trimmings for trolley poles. Plans and specifications 15 per cent completed. Contract No. 8—For furnishing and delivering redwood railroad ties. Specifications 35 per cent completed. Contract No. 9—For furnishing and delivering tie plates and railroad spikes. Specifications 50 per cent completed. Contract No. 10—For furnishing and delivering tie bars and nuts. Specifications 25 per cent completed. Contract No. 11—For furnishing and delivering street cars. Contract No. 12—For furnishing and delivering line material. Specifications 10 per cent completed. Contract No. 1, furnishing and delivering steel rails, was awarded to the Pennsylvania Steel Co. by the Board of Public Works on Nov. 30, 1910, at the following prices, f. o. b. factory: Steel grooved girder rails, $34.25 per gross ton; steel guard rails, $44.25 per gross ton. M. Manson is City Engineer of San Francisco.

The San Joaquin Valley Electric R. R., ("Brackett road"), has applied to the City Council of Modesto for a franchise over some of the principal streets of the city.

Advices from Auburn, Cal., state that plans are under way for the construction of a new railroad from that place on the Southern Pacific to Cool, on the south side of the American River in Eldorado County, a distance of 6 or 8 miles, ascending and descending the canyon walls. The primary purpose of the road is to develop an immense limestone quarry.

Surveyors who are working in Deer Creek Pass and along the canyon leading into the Sacramento Valley, and who, it has been thought were under the employ of the Hill interests, are, according to reliable information, working for the lumber interests of Thomas B. Walker. A line is being run tapping the vast forests in Siskiyou, Shasta, Modoc, Lassen, Tehama and Plumas Counties, Cal., and it is planned to have 100 miles in operation to a point near Red Bluff within three years.

A report from San Luis Obispo, Cal. states that the local chamber of commerce has taken up a project to establish railroad connection directly over the Coast Range mountains with this city. The plan involves the purchase of the Stone canyon railroad. Those at the head of the movement say that they have consulted with the owners of that road and the latter have agreed to the sale, placing a figure at about $200,000. The promoters will endeavor to persuade the Southern Pacific to build a line connecting the Coalinga branch with the Stone canyon road, and in the event of failure, will attempt to organize a local company to build a line to connect the two roads.

A committee of citizens from all parts of the county is to meet with the officers of the Western Pacific at the Mills Bldg., San Francisco, to try and secure the construction of a branch line from Niles to San Jose, Cal., and Los Gatos, through Milpitas, Warm Springs, Irvington and Alviso.

Advices from Anderson, Cal., state that a large quantity of supplies is being shipped to a corps of surveyors in the vicinity of Ingot.

It is surmised that the crew is under the employ of the Southern Pacific and that the company intends to construct a line south from Klamath Falls to Pit River and down that stream into Shasta County to make a connection with the main line at Anderson.

Advices from Lakeport, Cal., under date of Dec. 19, state that four miles of the grading has been completed on the Santa Rosa & Clear Lake R. R., and the work is proceeding rapidly. The survey is completed from Lakeport through Middletown to the top of the mountains on the divide, and nine miles of the trail has been cut and is ready for the graders. Of the $5,000 which it is proposed to raise from the citizens of Middletown and vicinity, the sum of $3,000 has been subscribed.

Colorado

⊙Actual construction work has been started on the Colorado & Southern line from Cheyenne to Wellington, Colo., by H. E. Owen, who has been awarded a sub-contract for grading a stretch near Warren Valley ranch, by Kilpatrick Bros., General Contractors, Beatrice, Nebr.

The Montrose & Interurban Electric Ry. Co., of Montrose, is reported to have awarded a contract to M. L. Paret, Kansas City, Mo., for the engineering work for its proposed line from Montrose through the Uncompahgre Valley to several fruit and farming districts of Delta County.

The Union Pacific R. R. R. L. Huntley, Chief Engineer, Omaha, Neb., is believed to be planning to have construction work started in the spring on its new line from Denver to Fort Morgan. This line will cost about $3,500,000. It has been surveyed, the route determined, terminal facilities purchased, and new steel procured. New territory will be opened up and the present line of the Union Pacific will be made 25 miles shorter by the use of this line. It is believed that the Fort Collins line ultimately will be extended into Wyoming to connect with the through line of the Union Pacific.

The Denver & Rio Grande R. R. is now seeking a better route into the southwestern part of Colorado. One route has been surveyed from Creede over the range at the head of the Pine River to Durango. Another survey is down the Rio Grande to the Chama River in New Mexico. Still another lies from Antonito over Cumbres pass.

The Denver & Rio Grande R. R., J. G. Gwyn, Chief Engineer, Denver, Colo., is planning to have work started early in the spring on widening of its narrow-gage line between Montrose and Salida.

The Pueblo Union Stock Yards & Traffic Co., has been organized with a capital stock of $500,000 and purposes the establishment of union stock yards at Pueblo. The officers of the company are: President, Fred L. Roof; vice president, J. H. Thatcher, Jr.; secretary-treasurer, Miles G. Saunders; directors, G. H. Nuckolls, Elijah Bosserman, Albert Porter, Mahlon Everhart, Fred O'Rourke, Miles G. Saunders and J. H. Thatcher, Jr.

The Pueblo & Southeastern R. R. Co., of Pueblo, incorporated last month with a capital stock of $500,000, proposes the construction of a line between Pueblo and the new town of Wilson, 15 miles southeast. It is planned to have this portion of the line in operation by next fall, and later to extend it in a southeasterly direction. The railroad is being backed by the Pueblo-Rocky Ford Irrigation Co. Wm. J. Lester, President, and the Pueblo-Rocky Ford Land Co.

Business interests on the Western slope have revived the plan for the Colorado & Southern R. R. to extend its lines from Gunnison County into Montrose and Delta Counties. The present terminus of the line is at the coal camp of Baldwin. The extension of the road would open up a large tonnage of fruit and farm products to the Colorado & Southern and shorten the haul from this section to Denver by over 100 miles.

Representatives of New York bond houses have been in conference with George J. Spear, Denver, in reference to purchasing the bonds of the Denver, Greeley & Northwestern Ry.

Delaware.

The Wilmington & New Castle Electric Ry. Co., which owns a trolley line between the places named, has been sold to E. Clarence Jones & Co., bankers of New York, owners of $131,500 of the $150,000 first mortgage bonds. A foreclosure of this mortgage caused the sale. The New Castle & Delaware City Electric Ry. Co., which operates an extension between those places, will be sold under foreclosure of a first mortgage bond issue of $125,000 this month. The two companies have been merged into the Wilmington, New Castle & Southern Ry. Co., and the property will be reorganized.

Georgia.

Construction work on the Brinson Ry. extension, which is being constructed from Savannah to Athens, is progressing rapidly, a large force of hands being engaged in grading and laying ties at Waynesboro, in Burke county, 100 miles this side of Savannah. The road will come by Thomson, Washington and Lexington. It is believed that a connection may be made with the Gainesville Midland, owned by Savannah capitalists, and running from Athens north to Gainesville, and that ultimately the road may be pushed through the mountains to connect with the Louisville & Nashville, and give Georgia another through line from the west to the seaboard. S. T. Grimshaw, Springfield, Ga., is chief engineer.

Idaho.

The Spokane International and Milwaukee Railroads are rushing work on their Coeur d'Alene lines between Atlas and Coeur d'Alene. The Milwaukee has finished its excavations from the Lake Coeur d'Alene water front almost to Gibbs, and has begun to construct its concrete single tracked tube in the heart of the city of Coeur d'Alene. The grading of the Milwaukee main line on the old Mullan road has progressed to a point about 1,500 yards east of Gibbs, where the work was halted pending the final adjustment of right of way through the property of the Stack Gibbs Lumber Company. While negotiations for the right of way have been completed, the necessary papers have not yet been drawn up or signed. Meanwhile the Milwaukee crews are centering their efforts on the grading of the line, both east and west of Gibbs. The Spokane International tracks are laid into Gibbs from the west and the Milwaukee tracks to McGuires.

Illinois.

The Wabash R. R., Ed. Shelah, Engineer Maintenance of Way, Decatur, Ill., is to enlarge its yards just south of Quincy.

J. J. McCaughey and McCaughey Bros., have shipped their grading outfits from Wisconsin, where they have been working during the past season, to Tampico, Ill., where they will winter. F. J. McCaughey, who has been doing subway and track elevation work in Chicago near Clyde, has also shipped his outfit to Tampico. Land has been rented about 10 miles south of Tampico, and the three outfits will have a winter camp there.

Surveys have been made between Batavia and Geneva for the projected Belt Line R. R of Elgin. Right-of-way is to be secured at once with the idea of starting construction work in the spring. The plan contemplates a belt line steam railroad connecting the factories, mills and shipping districts of St. Charles, Geneva, Batavia, Aurora and Elgin. The project is backed largely by the Commercial Club of Elgin, which has incorporated the Belt Line R. R. of Elgin with a capital of $25,000.

The Chicago & Western Indiana R. R., E. H. Lee, Chief Engineer, Chicago, Ill., has purchased ten acres of land between Division and Augusta Streets and North 47th and North 48th Aves., Chicago, and will enlarge its freight [illegible]

Indiana.

Citizens of Clay County held a meeting at the Court House at Brazil to take steps to promote [illegible] Jasonville, passing through Clay City. A number of farmers owning land along the proposed route have signified a willingness to donate the right of way to any company which constructs the line. An organization was effected with A. W. Adams as permanent secretary.

The final step in the reorganization of the Chicago, Terre Haute & Southeastern railway, known as a John R. Walsh railroad, was taken on Dec. 31 with the filing in the recorder's office of deeds transferring the property to the new company. The mortgages covering the bond issues were also filed. The first mortgage is an authorized issue limited to the principal amount of $20,000,000 to secure a 50-year gold bond issue, and is a first lien on the former property of the Chicago & Southern railway. A mortgage also was recorded from the Chicago, Terre Haute & Southeastern Ry. Co., the Indiana corporation, which secures an issue of 50-year gold bonds, limited to the principal amount of $6,500,000.

The Board of Public Works of Indianapolis, has directed the Indianapolis Traction & Terminal Co. to extend its Brightwood ave. street car line from 25th St to 30th St. The company is given until May 1 to complete the work, but will probably finish it much before that time.

The Southern R. R. is said to be contemplating theconverting of its Jasper, Evansville, Rockport and Cannelton lines into traction lines, and the use of locomotive engines only for the purpose of hauling freight. It is also understood the Southern R. R. will take over the branch line running from Huntingburg, Ind., to Ferdinand, Ind., and that it, too, will be converted into a traction line and eventually be built on to St. Meinrad, Ind.

Iowa.

A plan is under consideration for building an electric railway connecting Forest City and Mason City. C. N. Christoferson, Forest City, is interested in this proposition.

The last spike in the Atlantic Northern & Southern Ry. connecting Atlantic with Villisea, 38 miles south, was driven on Dec. 27. The road was started July 15, but not much work was done before Sept. 15. The road, including the 17 miles north of Atlantic cost $1,000,000, and has been entirely paid for by farmers and business men in towns and country along the route. H. S. Rattenberg of Atlantic is president. The road is now 55 miles in length. Next March interurban service will be established between Atlantic and Villisca. Promoters plan now to get busy on the extension from Villisca, south through Clarenda, 16 miles, College Springs, Blanchard and Tarkio, Mo., to Savannah, Mo., where arrangements have been made for terminal facilities into St. Joseph over the Great Western road. It will also be extended north to Manning and eventually to Sioux City.

The Iowa City, Ottumwa Southwestern Electric R. R. Co., which projects a 70-mile line, has completed surveys and will let some of the construction contracts next spring. Some of the contracts for this road have already been let, Campbell & Steffen, Davenport, Ia., and Aug & Steffin, Davenport, being the contractors W. J. Kettelwell, Iowa City, Ia., is Chief Engineer and Frank Tanner, Iowa City, is Vice-President and General Manager.

Kansas.

The Hutchinson Interurban R. R. Co., W. A. Scothorn, General Manager, Hutchinson, is to extend its line at that city from the Country Club to the switch near the stock yards.

The Santa Fe System is said to be planning to double track its line on from Mission, near Newton, to Hutchinson, the coming spring and summer.

The Oklahoma, Kansas & Missouri Ry., which projects a 40-mile line, has completed surveys and has partly secured the capital for construction work. Construction contracts will be let in March or April. The route is from Hattonville to Galena or Columbus, of Robert E. Strahorn, with headquarters in Spokane.

Panama.

The Panama Assembly has approved the bill authorizing President Arosemena of Panama, to receive bids for the construction of the Panama-David R. R. The cost of this work is not to exceed $10,000,000, for which the government may issue 5 per cent bonds. The bids will be opened at the end of four months.

Pennsylvania.

Developments of the past week indicate that the Lewisburg, Milton & Watsontown Passenger Ry Co., Milton, Pa., may have work started early in the spring on an extension to Allenwood, Montgomery and Muncy.

The Lebanon Valley Street Ry. Co., 170 North 8th St., Lebanon, Pa., is planning to build a new line from 8th and Walnut Sts. eastward on Walnut through The Heights to Water St., Hebron, thence northward on Water St. to Cumberland and there connecting with the East Cumberland St. branch of the Lebanon Valley line.

The Erie R. R. is said to be contemplating building a cutoff line several miles southward of Sharon connecting with the New Castle branch. The idea is to run freight trains through to Ferrona, where they will again strike the track now used. Another plan of the Erie is said to be the swinging of its tracks along the east bank of the Shenango River near the plant of the Carnegie Steel Co. at Sharon. This would give the Carnegie Steel Co. additional room for extensions that might be needed.

David Addlesberger, of Waynesboro, foreman of a dynamite gang employed on the construction of the trolley line from Pen Mar to Blue Ridge Summit, had a narrow escape last week while thawing dynamite. Addlesberger was about 10 ft. away from the bonfire near which the dynamite was being thawed. Twenty-five sticks of dynamite and 50 caps exploded with the result that Addlesberger's coat, trousers, cap, gloves and shoes were scattered around in different directions and the coat and trousers were torn to shreds; however, he was only slightly bruised by being hurled to the ground.

The Chester & Philadelphia Ry. Co., of Philadelphia, has filed notice of an increase of capital from $400,000 to $470,000.

The Pennsylvania R. R. has taken definite steps toward the enlargement of its Broad St. station at Philadelphia, mentioned in our last issue. A board of engineers consisting of E. B. Temple, assistant chief engineer; A. M. Parker, superintendent of the Hudson division; B. V. Somerville, principal assistant engineer of the lines west of Pittsburg, and E. R. Hill, assistant chief electrical engineer of the New York terminal, has been appointed by the railroad to give its whole time to assembling and studying the many plans and suggestions which have been made to relieve the congestion at Broad St. Station and to obtain every possible bit of information which might have some bearing on the subject. It will be noted that the Board Engineer contains two electrical engineers and this is taken as an indication that the Pennsylvania R. R. road is seriously considering a plan of electrifying its system in Philadelphia and its environs. The cost of enlarging the station will be about $6,000,000, and it is declared that every effort will be made to have the work started by the middle of 1912.

South Carolina.

The Charleston Consolidated Ry., Gas & Electric Co., 141 Meeting St., Charleston, S. C., is to extend its King St. line through South South Battery extension to Chisholm's Mill, at Charleston, a distance of 3,500 ft.

South Dakota.

It is reported in Sioux Falls that the Chicago, Milwaukee & St. Paul Ry. is to build a new line from Flandreau, north of Sioux Falls, to Ortonville, Minn. The preliminary survey of the line is said to have been completed and everything is stated to be in readiness for the work of construction to commence as early in the spring as the weather will permit. The new line will run parallel with the South Dakota-Minnesota boundary line almost the entire distance, but will be on the South Dakota side of the line until a point opposite Ortonville is reached, when it will turn eastward into Minnesota, with the terminus at Ortonville. Such a line would traverse a section which now is without direct railroad connection north and south.

It is reported in Lead, S. Dak., that a party of engineers, believed to be under the employ of either the Northwestern or the Milwaukee roads, is running lines in the vicinity of the head of Bull Creek. It is surmised that the surveys will terminate at Faith and Rapid City.

Tennessee.

⊙Mason & Hanger Co., Richmond, Ky. (temporary address Oakdale, Tenn.), has been awarded the contract for constructing a second main track from Oakdale to Lansing, Tenn., for the Queen & Crescent Route. The distance is 12 miles, and the contract amounts to about $250,000.

The city of Nashville has raised a $25,000 subscription for the proposed Nashville-Gallatin interurban line. Gallatin and Sumner have also raised subscriptions and it is said that the line is now assured. Surveys are to be started next year and it is probable that active construction work will be started by May. The cost of the line is estimated at about $750,000. This is the project promoted by H. H. Mayberry.

The Louisville & Nashville R. R., J. E. Willoughby, Engineer of Construction, Louisville, Ky., has completed surveys and estimates, and will, it is believed, shortly be in a position to call for bids for rebuilding its line from Edgefield Junction, Tenn., ten miles north of Nashville, to Decatur, Ala. This will be a large piece of work, costing something like $3,000,000.

Texas.

The Cleburne Street Ry. Co. of Cleburne has been chartered with a capital stock of $65,000. The incorporators are all from Johnson County, Texas. They are as follows: Daniel Hewitt, Corpus Christi, Texas, President of the Corpus Christi Street & Interurban Ry.; J. M. Moore, J. C. Blakeney, L. W. Chase, A. M. Morgan, W. M. Odell, Brown Douglass, J. H. Douglass, E. A. Rice, S. T. Shaw, O. L. Bishop, J. A. Feagin, Perry E. Coon, C. M. Bentley, Lawrence Hewitt.

The Rio Grande R. R., J. Ayala, Chief Engineer, Brownsville, Tex., is to be rebuilt and placed in first-class condition. The road was bought by William Guy of St. Louis, who is said to represent the Frisco Railway. The road runs between Brownsville and Point Isabel, the gulf shipping point for the lower Rio Grande Valley region. The Rio Grande R. R. was constructed by a syndicate of Spaniards in 1868. Its original equipment came from Spain, and its books were kept in Spanish until the line passed into the hands of Americans a few years ago.

Surveyors for the Quanah, Seymour, Dublin & Rockport R. R. reached Belton from the north Dec. 21. The survey of the line from Sparta in the northern part of the county, to Belton, is a preliminary one.

It is reported in Dallas, Tex., that the Missouri, Kansas & Texas Ry. has made a preliminary survey from Cleburne, to Glen Rose and expects to build a line between the two cities during the early part of this year. This move, with the construction of the Egan-Dallas line and the completion of the Walnut Springs and Glen Rose line will give the Katy a through line to the southwest out of Dallas.

At a meeting of the citizens of Columbia, Rosenberg, Guy and Needville at Dawson, Texas, it was found that in that vicinity $50,000 has been pledged for the construction of the proposed railroad from Sealy via Rosenberg, Damon and West Columbia to Velasco on the west side of the Brazos river and via Bravoria to the State farm. The next meeting will be held at West Columbia, Jan. 11.

Citizens of Slidell have raised a bonus of $5,000 to secure a railroad connection between that place and Dallas via Denton. Greenwood is expected to co-operate in the matter and with Slidell, Greenwood, Denton and Dallas working together, those interested are hopeful of the line being built.

Farmers and capitalists of San Antonio, Tex., and vicinity, are preparing to organize a company with $500,000 capital, to construct a railroad between San Antonio and some point in the lower Rio Grande Valley, a distance of 260 miles. The proposed line will cut into a ranching territory 200 miles wide and provide transportation facilities for the entire Rio Grande Valley.

Recent reports from Bridgeport, Tex., state that good progress is being made in grading the Chicago, Weatherford & Brazos Valley R. R. between Weatherford, Texas and Gainesville. The new line will connect with the Texas & Pacific, the Rock Island and the Fort Worth & Denver City, giving an outlet in both directions for extensive coal fields through which it will pass.

Utah.

The Ogden Rapid Transit Co., Ogden, Utah, which recently completed a line to Brigham City, has filed important amendments to its articles of incorporation by which it will have right to operate its lines beyond the limits of Weber county, and will also be incorporated to operate its own telephone and telegraph lines. Furthermore, it is proposed to increase the number of directors from seven to nine. It is understood that this step is preparatory to beginning an interurban system reaching through northern Utah. The company now has a line running through Ogden canyon, which is to be extended on to Huntsville, and thence north to Cache valley and Logan. It is rumored that the newly finished Brigham City line will also be extended to connect with the Cache valley line, completing a circuit, taking in the entire northern part of the state.

According to advices received from Salt Lake City, Utah, construction work will be commenced on the Utah & Grand Canyon R. R. as soon as contracts for the work can be closed and forces obtained. Frank A. Dudley is President of the company.

Virginia.

The Rinehart & Dennis Co., Railway Contractors, Evans Bldg., Washington, D. C., has increased its capital stock from $250,000 to $1,000,000. The company has under active construction at the present time the following contracts: Catskill Aqueduct Contract No. 55, for the Board of Water Supply of the City of New York, amounting to $4,500,000. Elkhorn Extension of the Carolina, Clinchfield & Ohio Railway, 40 miles in length, amounting to approximately $2,500,000. Two contracts on the Norfolk & Western Railway amounting to approximately $600,000. The company has just completed a large steam shovel contract on the Winston-Salem Southbound Ry. in North Carolina, amounting to $500,000. Also contract on the Chesapeake & Ohio Ry. amounting to about $150,000.

The North Carolina-Virginia Ry. Co. has been chartered with a capital stock of not more than $5,000, and proposes a line to run from Henry County, a distance of six miles, into some point in Carolina. The track passes through the town of Ridgeway, in Henry County, Va. The officers of the company are as follows: E. C. Wing, President, New York; E. G. Demarest, Secretary and Treasurer, Brooklyn; P. Minturn Smith, Brooklyn; J. W. Davis, Brooklyn; Bronson H. Smith, Brooklyn; S. Strayer, Passaic, N. J., and Malcolm K. Harris, Danville, Va.

Surveyors, said to be under the employ of the Louisville & Nashville R. R., are cross-sectioning in the vicinity of Elkhorn City, Va., near the C. & O. R. R., and the Northern projective terminus of the Carolina, Clinchfield & Ohio Ry. It is believed that the work is being done in connection with the proposed extension of the L. & E. into the coal fields in that vicinity from Jackson, Ky. B. M. Starks, Louisville, Ky., is General Manager of the Louisville & Nashville.

The Southern Ry. will in the next year or two replace the 24 miles of single track between Danville and Whittles with a new line over an entirely new route, to be laid around Danville in almost exactly the same manner in which the line has been constructed around Lynchburg.

Washington.

A water right at the mouth of Tumtum Canyon of the north fork of the Lewis River has been filed on, and it is proposed to construct there a large hydro-electric development. The plan also includes the construction of trolley lines from Amboy or Yacolt to Vancouver and Camas. Eastern capitalists are reported to be interested in this project, which is being promoted by W. H. Arnold of Vancouver, Wash.

The Mount Adams Ry. Co., incorporated recently and projecting an electric railroad from White Salmon to Camas Prairie and back via Trout Lake and Husum—a circuit of 80 miles—at a recent meeting at White Salmon, Wash., elected officers as follows: W. W. Swan, President; T. Wyers, Sr., Vice-President; T. F. Shepler, Secretary; R. Field, Treasurer; C. L. Colburn, Auditor; R. Lauterbach, T. F. Shepler, R. Field, C. L. Colburn, W. W. Swan, T. Wyers, and A. H. Jewett, Directors.

The city council of South Bend has taken up the matter of granting a franchise for an electric railway which is to connect the city with Raymond. T. D. Crary, the Grays Harbor railway builder and P. E. Hall, Jr., South Bend, have applied for the franchise.

The Chicago, Milwaukee & Puget Sound Ry., is said to be running location surveys for its line north from Everett. Late reports state that the engineers were working between Everett and Anacortes. The route as laid out now indicates that the road will tap the rich LaConner flats country, in Skagit county, skirting the coast to Anacortes and then north by the waterfront route to Bellingham.

The city council of North Yakima has granted the franchise by which the North Coast R. R. can build into the city.

West Virginia.

The city council of Morgantown has granted a franchise to the Morgantown and Southern Ry., which proposes to build a line through the city and ultimately connect with other cities.

Wisconsin.

⊙W. F. King, according to reports, from Superior, has been awarded the contract for the construction of the concrete piers for bridges along Interstate Transfer Ry. between Pokegama Junction, the present terminus of the road, and Wisconsin Point. In addition to the piers there will be a number of large concrete culverts built at the various ravines along the line. Mr. King had the contract for the concrete work on the St. Louis River bridge and that section of the road west of Pokegama Junction.

The Chicago & Northwestern Ry. is considering extending its branch line, now in operation from Wausau to Rothschild, from the latter place to Mosinee, where the Wausau Sulphate Fibre Co. is erecting a $1,500,000 plant. Nothing will probably be done regarding the extension before next summer.

A large crew of surveyors, according to advices from Frederic, Wis., is at work surveying for an extension of the Polk County branch of the Minneapolis, St. Paul & Saulte Ste Marie (Soo) Ry. line north to Duluth and Superior. The proposed extension will be from Frederic and probably strike the Wisconsin Central at some point near Gordon. Thomas Green, Minneapolis, Minn., is Chief Engineer of the Soo System.

The Lake Southern & Southeastern R. R., according to information recently received from Viroqua, Wis., has placed in the field a crew of ten surveyors under direction of Engineer A. E. Rau, Sparta, Wis., to run lines for a proposed extension of the line to Retreat, Wis., and ultimately to Prairie du Chien. At present the company operates a line from Viroqua to La Crosse.

The Pacific Coast Condensery Co., Richland Center, Wis., is taking steps to secure the construction of an electric railway for Richland Center to Yuba.

Wyoming.

Reports from Cheyenne state that during the last year only about 35 miles of new railroad was built in Wyoming, while 150 miles of grading was done, on which steel will be laid at once. It may be added that there is in progress grading for 30 additional miles to be completed during the coming year.

The Galveston, Houston & Henderson Ry., H. R. Cooper, Chief Engineer, Galveston, the Southern Pacific and the Houston-Galveston interurban are reported to be making arrangements by which they may join in a contract for a joint fill of the land between Texas City Junction and Virginia Point. The roads parallel each other from Texas City Junction to the bay and the grade of the Galveston causeway is considerably above that maintained on the existing rail lines. By the service of the same suction dredge used to make the fill on the mainland end of the causeway proper a considerable expense may be saved in conforming to the requirements of the physical situation. On the island side the fill has practically been made.

Canada.

The Grand Trunk Pacific ceased further construction on its Calgary-Edmonton branch on Dec. 22, when the steel was laid in to Lignite, pending the construction of a high level bridge across the Red Deer river. Lignite will be the head of the steel for the next year. A siding a mile long was put in to secure sand for road ballast.

The Canadian Pacific Ry. is considering constructing a parallel line of track on the main line west out of West Toronto to Cooksville. A new survey to find a better grade, if possible, between that point and London, may also be made. The line west is now double-tracked to about one mile west of Islington Junction. From there on to Cooksville the country is fairly level. From Cooksville westward there are many serious difficulties for the construction men to overcome, and it is said that before continuing the double tracking farther it will be ascertained first whether the existing line is the best obtainable for the future. After London is passed the grades become more easy again. On to Windsor the railway has a grade that does not exceed, in either direction, three-tenths of one per cent. This section will also, of course, in the future plan come in for double-tracking, but at present the grades are so easy that the work would be unnecessary.

C. L. Armstrong, C. E., and J. M. Shanley, representing the Montreal Central Terminus Co., has submitted a proposition to the Board of Control of Montreal, Que., providing for the tunneling of the River St. Lawrence and the establishment of a central terminus for all the railways lines entering Montreal. The terminus company is capitalized at $30,000,000, and it is endeavoring to secure the good will of the city in order to build a large central station, where all lines can meet. The proposition involves tunneling the river just above Isle Ronde to give access to the south shore routes, including the New York Central and Delaware & Hudson. From the north would come the Canadian Northern Railway, and from the west the Grand Trunk. The plan also involves the abolition of all level crossings on the Island of Montreal, approach to the station being by elevated or subway routes.

Officials of the Canadian Pacific Ry. will early this year take up a scheme for the shortening of the main line from Montreal to Winnipeg by cutting across the loop around the Peninsula that projects into Lake Superior at Fort William and Port Arthur. By building 75 miles of new road, 50 miles can be cut out of the journey between the east and west.

It is reported that the Grand Trunk Pacific Ry. will in the spring have work started on two branches to Rivers, Man. It is said that one branch will connect with the Great Northern at Brandon and form an A line from the Wheat City through Rivers, northwest to Kamsack, Sask., where it will join the Regina-Melville Hudson Bay line. The other branch will be from Rivers to Regina crossing the C. P. R. main line at Elkhorn or Kirkella, and making the shortest possible route between the Manitoba and Saskatchewan capitals, fully 25 miles shorter than the proposed line through Brandon.

The Kettle River Valley Co. will apply to parliament for power to build a railway from the Similkameen valley to the Granite Creek coal areas.

The first section of the Canada & Gulf Terminal Ry., which is to connect Gaspe Basin with the National Transcontinental Ry., was opened on Dec. 29. This is the 40-mile section from St. Flavie to Matane. The line is being built by M. J. O'Brien, who is President of the company.

The Canadian Northern Pacific Ry. (Canadian Northern Ry., M. H. McLeod, General Manager, Winnipeg, Man.) is said to have taken tenders for the clearing of right-of-way and subsequent construction of the first section of the transcontinental line of Vancouver Island, consisting of the 20 miles for which plans and profiles have been filed with the government, carrying the new road from the outskirts of Victoria city to Cooper Cove, Spoke Harbor.

A company to be known as the Alberta Electric Ry. Co., will apply at the present session of the Dominion parliament for an act incorporating the company with power to equip and operate lines of electric railway and telegraph and telephone lines throughout the province. The members of the proposed company are said to be a strong English firm of electric railway builders, and it is their intention to proceed with the work as soon as a charter is granted. One of the branches of the road is proposed to run from Calgary to Macleod, through Southern Alberta.

The Canadian Pacific Ry. is to have work started shortly on a branch line from Sandon to Whitewater tapping the mining district in the Slocan County, near Bear Lake, B. C.

More railroad construction work was done in Canada last year than in any previous season in the history of the country. Statements prepared in the late fall by the engineering departments of the Grand Trunk Pacific, the Canadian Northern and the Canadian Pacific show that 1,265 miles of new grade was built by these three railroads last season. This mileage was divided up as follows: Grand Trunk Pacific, 350 miles; Canadian Northern, on 14 lines, 380 miles; Canadian Pacific, 535 miles. The last report of the engineers showed that there had been steel laid to the amount of 784 miles. Since the report was prepared the work of steel laying has been steadily going on in spite of the advent of cold weather and at the close of the year the showing indicates that during the summer there were a little over 1,000 miles of steel laid in the course of the twelve months. On the Grand Trunk Pacific steel has been laid from Edmonton to Edson and the grading has been done west of Edson to the Athabasca river, a distance of 100 miles. Steel has been laid west of Edson for a distance of 47 miles. This steel laying is still in progress and will be continued for some time. South from Edson the right of way has been cleared for the branch to the [illegible] of the Pacific Pass Coal Company, a distance of 50 miles. This road will be built in 1911. On the line from Tofield to Calgary there were competed during the summer 88 miles and before the work ceases for the winter the steel will be laid to the Red Deer river. Grading has been done in patches to the south of the river and by the end of 1911 the steel will be laid into Calgary. Of the [illegible] from Olds to [illegible]

✣ indicates work now op[illegible] • indicates a contract let recently.

per cent of the grading was completed during the summer, and track laying will be begun early in the spring. On the line from Young to Prince Albert 80 per cent of the grading is done and the track is laid for 35 miles. The road will be ready for operation during the summer of 1911. The road from Melville to Yorkton was completed and the line from Yorkton to Canora was also completed [illegible] Regina track was laid for 35 miles. The grade is practically completed into Regina and track was laid for 35 miles. It will be resumed early in the spring. The steel will reach Regina in July or August. Construction will also be carried on next year on the line from Regina to Moose Jaw and this road will be built before the close of the building season of 1911. South from Regina the grade is well advanced on the way to the international boundary. About 100 miles of dump has been thrown up and all [illegible] be tracked by October, 1911. East of the city the Grand Trunk Pacific commenced operating the National Transcontinental for grain in October, and grain is still being carried east over the line. The Canadian Northern had some interesting projects under process of completion. One of these was the building of a line in the direction of Lethbridge, southern Saskatchewan. This is an extension of the Maryfield branch, which was built in 1909 to the coal mines at Bienfait. This year 86 miles of steel were laid west from Lampman. The grade of the road now ends near the Willow bunch country, and in addition considerable grading was done on the line which will run north from this branch to Moose Jaw. There are two lines running toward Calgary on which a large amount of work was done. These two are the lines from Vegreville and Saskatoon. In all there have now been laid on the Vegreville-Calgary line 175 miles of steel and on the line from Saskatoon to Calgary 51 miles of steel have been laid west of Kindersley. This road has been finished in Saskatchewan and [illegible] 1911 on the line will be in Alberta. In the northern portion of Saskatchewan the Canadian Northern has had under construction lines out of Prince Albert to the northwest and out of North Battleford to the northwest. The line out of Prince Albert runs to Crooked Lake and the line out of Battleford will eventually be built through to Athabasca Landing. It runs now out past Jackfish Lake. The C. N. R. also have a line under construction from Prince Albert, and on this steel is being laid this winter. About 25 miles more steel will be laid on the line this winter. Progress was made during the summer in the connecting of the Rossburn branch with the main line, some steel being laid. In Manitoba the chief increase in the line of the C. N. R. was that made on the Oak Point branch which was built through to Gypsumville. This point was reached with the steel late in the present month. On the Canadian Pacific construction work has been in progress on several important lines. On the line west from Weyburn 25 miles was completed. This road will be built through eventually to Lethbridge. Construction work was carried on on the line from Macklin to Kerr Robert. This road will eventually be a main line from Edmonton to Minneapolis and St. Paul. A bridge is being built at Outlook, and in the summer of 1911 there will be established a through service. In Alberta the grade of the line from Carmangay to Aldersyde was built, but no steel was laid. This work will be done early in 1911. From Irricana east a road 30 miles long was built, and the steel is being laid at the present time. In Saskatchewan the longest stretch of line on which work was done was the line from Craven to Colonsay—110 miles. Steel was laid for 50 miles, and the work has now been suspended for the winter. The line from Regina to Craven was completed, and much work was done on the line from Craven to Bulyea.

Application is to be made to parliament for an act to incorporate the Pacific & Hudson Bay Ry., a new company, which proposes a line from Kimsquit at the head of Dean channel, thence northeasterly following the Dean river, Sigutla lake, Kwalchola lake, the Entiace river and the Upper Nechace river to Fort Fraser, thence northeasterly to Fort Macleod, thence crossing the Parsnip river, through Pine river pass and following Pine river to Coalbrook and thence northeasterly to Dunvegan, continuing along the Peace river to Peace River Landing, thence easterly, passing the headwaters of the Bear river to the Athabasca river and Fort McMurray, thence crossing the Athabasca river and following the Clearwater river and Churchill river to a point on the Hudson Bay Ry. south of Washaiowaka lake and thence to Churchill or [illegible] Hudson Bay.

Mexico.

Construction work on the Madera-Te[illegible] extension of the Mexico Northwestern [illegible] R. is being continued, and on Dec. 15 th[illegible] had been laid to kilometer 70 miles from [illegible]razas. The graders were keeping ahe[illegible] the trackmen and bridgemen, and will probably continue to keep in advance until the b[illegible] tunnel at kilometer 94 is reached. This tunnel will be 1,200 meters long, and is on the continental divide. Very little track has been laid beyond kilometer 17 out of Madera during the past month, as the force was taken off and put on the Cusihuiriachic to Cusi section which is about 16 miles long. Grading from Madera to the divide was practically finished. W. A. Bird, Chihuahua, Mex., has the contract for the masonry work on this extension.

The Mexican government has granted a concession for the construction of a railway from Port Lobos, on the Gulf of California to Sassade on the United States boundary, with a provision that 20 miles of track must be completed by April 26, 1911. This line when completed will penetrate the rich Altar Gold district of Sonora.

ROADS, STREETS AND PAVEMENTS

California.

✣Bids will be received by the State Highway Commission, Sacramento, Cal., until January 16, for the construction of the Huntington Drive road from Los Angeles to Pasadena and from Bairdstown to Alhambra.

✣It is reported that bids will be received until Jan. 14, by Board of County Supervisors, Fresno, Cal., for the construction of a mountain road from the plains to the old Millwood road and Happy Gap. According to the specifications the road will be 21.46 miles long, roadway clearing 12 ft. from center, roadbed 14 ft. wide, 8 ft. being in solid earth and the bed to be 6 in. higher on the outer edge. Over 40 turnouts are provided, these being 18 ft. wide and 50 ft. long. Eight bridges will be included in the work also.

⦿The Board of Supervisors, Los Angeles, Cal., has awarded George A. Rogers the contract for construction of the Valley Road from Downey to American Ave., near Long Beach, a distance of eight miles, for $42,822. The county will furnish the oil and stone and pay freight, making the cost of the road $9,003 per mile.

⦿The City Council of San Jose, Cal., has awarded a contract to Henshaw, Bulkley & Co., to furnish a sanitary street flushing machine for $910.

The County Commissioners at San Jose, Cal., have granted a petition for the opening of a new road in Road District No. 2, commencing at the end of Mount Pleasant road and ending at Norwood Ave.

The Orange County Highway Commission, Santa Ana, Cal., has filed its report and recommendations [illegible] with the Board of Supervisors. The Commission has outlined a road system which will call for the expenditure of $1,400,000, and asks the Supervisors to call a bond election for that amount. The system includes 127.85 miles of roads.

Citizens of Reedley have urged the County Supervisors at Fresno, Cal., to call for bids for the proposed 14 ft. wide Sand Creek road into the mountanis above Millwood and Happy Gap. The road, it is estimated, will cost $25,000.

The Board of Public Works of Los Angeles, Cal., has asked the City Council to authorize advertising for 9,000 barrels of oil for street work.

Colorado.

El Paso County Commissioners, Colorado Springs, Colo., have urged the Highway Commission at Denver for an appropriation of $20,000 for road improvements in that county. The County Commissioners have also made arrangements for straightening one mile of the Colorado Springs-Denver highway near Pring, a station on the Santa Fe railroad. The repairs will cost $4,000.

Illinois.

⦿The following contracts for paving were awarded by the Board of Local Improvements, City of Chicago; bids published in ENGINEERING-CONTRACTING Dec. 28th: alley, 47th St. to 48th St., Michigan Ave. and Indiana Ave., to F. K. Shobe Co., 524 W. 63rd St.; alley, 37th St., 38th St., State St. and Dearborn St., Alley, E. 45th St. south Evans Ave. and Cottage Grove Ave., alleys between 26th St. and 28th St., Michigan Ave. and Wabash Ave., Alley between 42nd St., 43rd St., Evans Ave. and Cottage Grove Ave., alley between 42nd St. and 43rd St., Langley Ave. and Evans Ave., alleys between 41st St., 42nd Pl., Drexel Blvd. and Ellis Ave., alley between 42nd Pl., 43rd St., Ellis Ave. and Berkeley Ave., and alley between Bowen Ave., 42nd St., Vincennes Ave. and St. Lawrence Ave., to Jno. A. McGarry & Co., 1001 Security Bldg.; alley between 35th St., 37th St., Grand Blvd. and Vernon Ave., to Parker Washington Co., 920 Chamber of Commerce Bldg.; alley between 21st St., 22nd St., Prairie Ave. and Indiana Ave., alley between Woodlawn Ave., Lake Ave. and E. 46th St., to Jno. A. McGarry & Co., 1001 Security Bldg.; S. Center Ave., W. 21st St. to W. 22nd St., Cullom Ave., N. Clark St. to N. Ashland Ave., Evans Ave., 43rd St. to 47th St., to R. F. Conway Co., 720 Chamber of Commerce; N. 41st Ct., Hirsch St. to W. North Ave., to Standard Paving Co., W. 50th St.; Ashland Ave. and Robey St., Ready & Callahan Co., 47th St. and Halsted St.; W. 52nd St., Loomis St. to Ashland Ave., to R. F. Conway Co., 720 Chamber of Commerce; N. Hamlin Ave., Dickens Ave. to Fullerton Ave., Standard Paving Co.; Ellen St. system to Jas. A. Sackley Co., 307 Chamber of Commerce; alley between Hyde Park Blvd., Woodlawn Ave. and E. 52nd St., to Jno. A. McGarry Co., 1001 Security Bldg.; N. Campbell Ave., Austin Ave. to Grand Ave., R. F. Conway Co., 720 Chamber of Commerce; W. 53rd St., S. Ashland Ave. to S. Robey St., R. F. Conway Co., 720 Chamber of Commerce.

The Village Board of Silvis, Ill., will pave First Ave., from the limits of Rock Island to the eastern limits of Silvis.

Indiana.

⦿The County Commissioners at Logansport, Ind., have awarded Frank Justice the contract

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

for constructing the Harvey road between Cass and White counties for $8,900.

Iowa.

The City Council of Des Moines, Ia., has passed resolutions providing for the paving of West Locust St., from 10th to 12th and Vine St., from Third to Fifth Sts., both with creosote blocks. James Burrows is Assistant Civil Engineer.

The City Council of Red Oak, Ia., is considering the matter of additional paving next spring.

The City Council of Corning, Ia., contemplates paving Davis Ave., from the railroad right of way to the north line of Ninth St., and Eighth St., from the alley between Davis Ave. and Adams St. to Grove Ave. The work will include 2,550 ft. of combined curb and gutter, 2,419 ft. of gutter to be laid to old curb, 14,133 sq. yds. of brick paving, 292 yds. of concrete alley approach paving. Theo. S. DeLay, Creston, Ia., engineer in charge.

Kansas.

✣Bids will be received until noon, Jan. 9, by the County Clerk, Oskaloosa, Kan., for the construction of 2.27 miles of rock road between Sections 4 and 5, 8 and 9, 16 and 17, in Oskaloosa Township, Jefferson County. Plans are on file at the office of the County Surveyor and W. S. Gearhart, Highway Engineer, Manhattan, Kan.

Tholen Bros., of Leavenworth, Kan., were the lowest bidders for the construction of roads, walks, etc., and sewers and water connections to buildings Nos. 328, 329 and 31 at Fort Leavenworth, for which bids were opened Dec. 2 by Capt. J. E. Normoyle, Constructing Quartermaster at Fort Leavenworth. The contract has not yet been awarded.

Kentucky.

✣Bids will be received until 2 p. m., Jan. 10, by Board of Public Works, Louisville, Ky., for grading, curbing and paving with the vitrified block gutters and asphalt pavement, the following streets: Ransdell Ave., from the southerly curb line of Transit Ave. to the center line of Glen Mary Ave.; Ransdell Ave., from the center line of Glen Mary Ave. to the extension across Ransdell Ave. of the line common to lots 1 and 2 in block 1 of Henry S. Barker's subdivision. Samples of vitrified block must be furnished with bid. Roger G. McGrath is Secretary.

Maryland.

✣Until 11 a. m., Jan. 11, Board of Awards, Baltimore, Md., will receive the following proposals: "Proposals for Lumber," "Proposals for Sand," "Proposals for Cobble or Rubble Paving Stone and Broken Stone," "Proposals for Vitrified Paving Blocks," "Proposals for Vitrified Sewer Pipe," "Proposals for Asphalt Blocks," "Proposals for American Portland Cement," "Proposals for Curbstone, Gutterstone and Flagstone," "Proposals for Sidewalk and Sewer Brick," "Proposals for Sheet Asphalt Repairs for Whole City," "Proposals for Tools and Hardware," "Proposals for Paints, Oils," etc , "Proposals for Coal," "Proposals for Sewer Traps," "Proposals for Inlet Covers and Dripstones of North River Bluestone," "Proposals for Square and Oval Cast-Iron Manhole Frames and Covers," "Proposals for Cast-Iron Inlet Covers," "Proposals for Road Gravel, Washed Concrete Gravel and Washed Filler Gravel" for general purposes in the City Engineer's Department during the year of 1911.

The City Council of Cumberland, Md., has been petitioned for the paving with vitrified brick of Springvale St., between First St. and the B. & O. R. R.

Michigan.

✣Bids will be received until 10 a. m., Jan. 5, by Department of Public Works, Detroit, Mich., for furnishing and delivering in the city of Detroit, in accordance with instructions to bidders, for paving brick to be had on application at the office of said department, one million paving brick, to be delivered in such quantities and such places and times as directed within the year ending Jan. 31, 1912.

L'Anse Township of Baraga County, L'Anse, Mich., contemplates bonding itself for $25,000 for the building of a highway connecting Houghton and Marquette counties.

Minnesota.

✣Bids [illegible] Jan. 13, by Henry N. Knott, City Clerk, Minneapolis, Minn., for furnishing the city for use in the construction of paving during the 1911 season, the following materials: Creosoted wood blocks, sandstone paving blocks, vitrified paving blocks, crushed granite, granite curb, sandstone curb, Portland cement.

⦿It is reported that the City Council of Crookston, Minn., has awarded the contract to P. McDonnell of Duluth for asphalt pavement on Ash St., from the Central High School to Houston Ave., and on East Third St., from Broadway to Elm St., two blocks in front of the high school, for $2.20 per yd., with concrete "A" and $1.90 using concrete "B," including 3-in. tile drains, and other changes in manholes, etc.

City Engineer S. S. Chute of St. Cloud, Minn., has prepared plans and specifications for the paving of St. Germain St. bridge and estimated the cost at $8,400. The specifications call for four lines of 40-lb. steel eyebeams, a 3-in. thickness of creosoted lumber to be covered with a 4-in. creosoted paving block.

Missouri.

⦿The Board of Public Improvements of St Louis, Mo., has awarded William H. Redemeyer the contract for sprinkling the streets of 19th district, comprising 285 miles, and Stephen Radican the contract for sprinkling the streets of seven districts, comprising 115 miles. Both contracts are for the year 1911.

Nebraska.

⦿The City Council of Lincoln, Neb., has awarded the contract for repaving district No. 41 to Abel & Roberts.

The County Board of Commissioners, Lincoln, Neb., has decided to ask for bids for the construction of a permanent road starting at the west end of the O St. viaduct, running north to P, thence west for a distance of a mile and a quarter. The improvements will be continued, it is planned, until the road extends to Milford. The estimated cost is between $12,000 and $13,000. The estimates of County Surveyor W. S. Scott call for a 6-in. base of cinders, and a 3-in. layer of limestone chips, then a layer of asphalt filler, with another layer of chips and filler and the top coating of stone dust. The work will not begin until next spring.

New Jersey.

✣Bids will be received until 8 p. m., Jan. 21, by Alpine Borough Council, Mahler Bldg., Alpine, N. J., for the construction of a stone road in the Borough of Alpine, N. J., known as Sylvan Ave. Southern Section Blvd., extending from the North Line, Borough of Tenafly, N. J., to the Southern Line of lands of McNell Alpine, N. J., a distance of 2,570 ft. A certified check for $1,000, payable to the Collector of the Borough, Chester Du Bois, must be filed with each bid.

✣Bids will be received until 11 a. m., Jan. 19, by Board of Chosen Freeholders, Burlington County, N. J., at the city of Mt. Holly, for graveling the road from Gardner's corner through Akron to the Atlantic County line in that county. Plans and specifications may be seen at the office of the State Commissioner of Public Roads, Trenton, N. J., or at the office of Earl Thomson, County Engineer, 301 Market St , Camden, N. J. All bids must be accompanied by a certified check for $1,000 payable to the order of Harry E. Dubell, Director of the Board.

✣It is reported that bids will be received until Jan. 11 by Board of Chosen Freeholders, Salem County, Salem, N. J., for the construction of a portion of the new State road from Salem to Woodstown.

New Mexico.

The City Council of Albuquerque, N. Mex., has created a new paving district which will include all property abutting First St., between Coal and Tijeras Aves.; on Second St., between Silver and Copper; on Fourth St., between Silver and Tijeras; on Fifth St., between Silver and Copper; on Gold Ave., between First and Fifth; on Central Ave., between Broadway and Sixth, and on Copper Ave., between First St. and Fifth Ave. F. H. Lester is Mayor and H. J. Collins is City Attorney.

New York.

✣Bids will be received until 2 p. m., Jan. 5, by George McAneny, President of the Borough of Manhattan, New York, for repairing and maintaining sheet asphalt pavements in the Borough of Manhattan. The engineer's estimate includes 270,000 sq. yds. of asphalt pavement, including binder course; 500 cu. yds. of Portland cement concrete; 1,000 sq. yds. of old stone pavement to relay. The amount of security required will be $65,000.

Citizens of the Fifth ward, Rochester, N. Y., favor the paving of St. Paul St., between Lowell St. and Driving Park Ave., with Medina block and asphalt, and the laying of sidewalks on the same street. The work, it is estimated, will cost approximately $95,000.

The Board of Trustees of Scotia (P. O. Schenectady, N. Y.), has adopted an ordinance for the pavement of the Scotia dyke and a portion of Mohawk Ave., and presented the same to the State Highway Commission at Albany. The Commission will immediately call for bids for the work

Citizens of West Utica, Utica, N. Y., petitioned the City Council to extend Hickory St. from York St., westerly through the State Hospital lands and other property to the Champlin road.

North Carolina.

The Anson County Good Roads association was recently organized in Wadesboro, N. C., with U. B. Blalock, president; H. L. Horne, vice-president, and T. V. Howell, secretary-treasurer. A meeting will be held this month to complete plans for aggressive work. It is proposed to issue $250,000 in bonds to build roads in the county. W. L. Spoon, Raleigh, N. C., is State Road Engineer.

Ohio.

✣Bids will be received until noon, Jan. 6, by H. S. Holton, Director of Public Service, Columbus, O., for furnishing the labor and materials for the construction of retaining walls, cement steps, cement walks, sodding and doing other miscellaneous work on West Rich St., between Lucas St. and first alley east of Lucas St

✣Bids will be received until noon, Jan. 6, by H. S. Holton, Director of Public Service, Columbus, O., for furnishing the labor and materials for the paving of the Mound St. viaduct and approaches, Contract No. 12, separation of street and railway grades. The work will include the following approximate quantities: 2,500 cu. yds. excavation; 3,900 lin. ft. straight curb; 300 lin. ft. circle curb; 550 lin. ft. edging; 3,000 sq. yds. stone relaid, including foundation; 5,000 sq. yds. brick, including foundation, 900 sq. yds. brick, excluding foundation; 600 cu. yds. gravel roadway; 1,250 sq. yds. cement sidewalk; two granite wall guards; 74 iron wheel guards; 1,100 lin. ft. 4-in. subdrain.

✣Bids will be received until noon, Jan. 6, by Board of County Commissioners, Cincinnati, O., for the improvement, under Specifications No. 32, of the Dick Road from Howard's Creek to the Oxford Road in Crosby Township. Fred Dreihs is Clerk. A bond for $500 must accompany each bid

✣Bids will be received until noon, Jan. 20, by Board of County Commissioners, Cincinnati, O., for the improvement, under Specifications No. 127, of the Dayton Pike, from Sharon to Butler County line in Sycamore Township. Each bid must be accompanied by a bond for $1,000. Fred Dreihs is Clerk.

⦿Alex. Tubman & Wm. Burkhardt, 2153 Fairmount St., Cleveland, O., have been awarded the contract for grading and loaming the parkway between Harvard road and [illegible]

Public Works, Cleveland, for $1,500. Bids were opened Dec. 1.

⊙The contract for the improvement of Wilstach St. with granite, from Denman St., to McLean Ave., in Cincinnati, O., has been awarded to Kirchner & Co., for $16,256. The contract for the improvement with brick of Wise alley from Cutter to Linn Sts. has been awarded to J. E. Mahoney for $1,752.

The County Commissioners at Ashtabula, O., have been petitioned for a macadam road from Bunker Hill to Austinburg, a distance of seven miles.

A petition has been presented to the Board of County Commissioners at Cleveland, O., providing for the establishment of a new road in North Olmsted village from the Lorain Road to Mastick Road.

The County Commissioners at Akron, O., received bids Dec. 27 for the paving of the Hudson Road. The road is divided, the first section being from Akron to the gorge, where the Cuyahoga Falls pavement is encountered. The second section is from Grant St., Cuyahoga Falls, to the Stow Township line, where the third section starts, which extends from the Stow Township line to the Hudson Township line and includes the curve at Stow Corners. The fourth section extends from the Hudson line through the village of Hudson to the Twinsburg line and the last part is through the Twinsburg Township to the line between Summit and Cuyahoga counties. The total cost of the road will be about $300,000.

People along the Manchester road from Kenmore to Lockwood's Corners are circulating a petition which will be presented to the County Commissioners, Akron, O., asking that the State aid be given them in the construction of a brick road along their road.

The Chamber of Commerce of Ashtabula, O., has circulated a petition for the improvement of the road between Ashtabula and Austinburg by laying macadam.

A petition has been presented to the County Commissioners at New Philadelphia, O., asking for a paved road with State aid in Dover Township. The road proposed for improvement is the Wooster Ave. road from the city limits to London.

City Council of Akron, O., has passed a resolution declaring it necessary to improve Atlas St. and Bailey Ave. by paving.

City Council of Cincinnati, O., has decided to pave Summers St. with granite.

The City Engineer of Defiance, O., is preparing plans for the proposed Fifth, Perry and Second St. extension pavement improvement.

Muskingum County Commissioners, Zanesville, O., have been petitioned for the improvement of four roads, as follows: One-half mile on the road from New Concord, the one-half mile of road between Dresden and Trinway, the one-half mile of road on the Maysville pike between Zanesville and South Zanesville, a mile on the South River road from the present paving to the Brush Creek bridge, and for a mile of paving on the East and West pike and on the Frazeysburg road from the present paving.

Oklahoma.

✣Bids will be received until 5 p. m., Jan. 9, by Bob Parman, City Clerk, Oklahoma City, Okla., for grading 15th, 11th, 12th, 13th, 14th Sts., Louisa Ave., Indiana Ave. and Kentucky Ave.

Oregon.

✣Bids will be received until 8 p. m., Jan. 16, by Common Council, Salem, Ore., for paving 175,000, more or less, square yards of street surface with hard pavement. Proposals must be accompanied by specifications and must state price per square yard of pavement. Proposals for any kind of hard surface pavement will be received and upon opening said proposals the City Council will proceed to adopt such specifications as it may deem for the best interest of the city. W. A. Moores is City Recorder.

⊙The Street Committee of the City Executive Board, Portland, Ore., has awarded the following contracts for street improvements: East Harrison St. from East Forty-fourth to East Fiftieth, grading and concrete curbs and walks, Giebisch & Joplin, $3,776; Cora Ave. from Milwaukee to East Ninth, grading and concrete curbs and walks, T. A. Sweeney, $1,024; East Grant St. from Glenn to East Thirtieth, grading and concrete curbs and walks, Giebisch & Joplin, $3,195; East Harrison St. from Glenn to East Thirtieth to Sunnyside, grading and concrete curbs and walks, Stevens Bros., $1,869; East Lincoln St. from East Thirty-fourth to Chestnut Hill, grading and concrete curbs and walks, Joplin & Meeks, $1,381; East Thirty-eighth St. from Stephens to East Grant, grading and concrete curbs and walks, Giebisch & Joplin, $1,774; Sheridan St. from First to Front, elevated roadway, Pacific Bridge Co., $2,025.

Advices from Hermiston, Ore., state that H. G. Newport is completing arrangements for the opening of a new addition to the city, to be known as Highland Road addition. E. T. Erickson has been engaged to survey the tract and lay out the streets, etc.

The Salem, Ore., Board of Trade is urging the building of a hard surface drive to encircle the city, beginning at the Mute school on the north of the city, near the Willamette River, easterly to the new Open Air Sanitarium for Tubercular Patients on the south of the city.

Pennsylvania.

⊙The Penn Reduction Co. has been awarded the contract by the city of Philadelphia, Pa., for the removal of garbage this year for $510,000.

⊙Edwin H. Vare has been awarded the contract by the city of Philadelphia, Pa., for cleaning the streets and removing ashes this year for $1,372,000. The contract will embrace the use of flushing carts twice a week on all asphalt streets and daily in the central streets of the city.

⊙The County Commissioners at Washington, Pa., have awarded the contracts for paving two and forty-five hundredths miles of the Meadowlands and Houston road as follows: The Donley Brick Co., of Washington, red brick at $12.50 per thousand, one-half mile; Pittsburg-Buffalo Co., vitrified buff block at $15 per thousand, one-half mile, and the remaining part of the road to James M. Poter Co., half the distance with Forter Toronto block and the rest with American Sewer Pipe Porter block, for $15 per thousand.

Plans have been prepared by City Engineer Franz Engstrom of Altoona, Pa., for the paving of 52 streets, which will be done under the $100,000 loan recently provided for by the legislature.

South Dakota.

Hughes County Commissioners, Pierre, S. Dak., have decided upon a large amount of highway improvement for the coming year, much of which will be in the shape of steel bridges.

Tennessee.

Plans for a new system of public highways in Tennessee will be presented to the legislature, which convenes Jan. 2. The principal feature of the system will be a central highway through the State from Memphis to Bristol. Intersecting roads at all important towns and cities are included in the general plan of improvement prepared by the State Highway Commissioners. The Commissioners, E. C. Lewis of Nashville, chairman; Harry W. Brennan of Memphis and W. J. Oliver of Knoxville, have completed their report and submitted it to the Governor. It is recommended by the Commissioners that the State issue bonds to aid in the construction of good roads, bearing a portion of the cost in each county. A system similar to used in building the dirt roads in Shelby county is proposed. Much sentiment in favor of the good roads proposition prevails throughout the State, according to Mr. Brennan, who has been one of the leading factors in the movement since its inception four years ago. It is thought that the proposed legislation will meet with the hearty approval of Governor-elect Hooper.

Texas.

✣Bids will be received until Jan. 11 by City Council, Wichita Falls, Texas, for paving the business district of that city with various pavements.

⊙Business men and farmers of Martindale, Tex., have contracted with Van B. Flowers of Lockhart, Tex., to build about three and one-half miles of gravel road south of town for $1,500 per mile.

⊙The City Commissioners of Galveston, Tex., have awarded the contract for the relaying of the pavement on Tremont St., between Avenue P½ and the north line of the county boulevard to Kelso & Vautrin for $1,551.

Preparations are being made in Sherman, Tex., for additional vitrified brick pavement in Houston and Travis Sts.

County Surveyor Clifton Rice, Richmond, Tex., is engaged in surveying the public road between Richmond and Thompson's station on the Brazos at the instance of the jury of view appointed for the purpose of widening and straightening the road between the two points.

The Board of Trade of Fort Worth, Tex., contemplates inaugurating another campaign for a $1,000,000 good roads bond issue for Tarrant county early this year.

The City Council of Dallas, Tex., has been petitioned for the opening, paving and sidewalking of Pearl St., from McKinney Ave. to Cedar Springs.

City Engineer A. T. Dickey of Galveston, Tex., has estimated the city's share of surfacing with mudshell Avenue Q from the east line of 22nd St. to the east line of 25th St., at $1,155.

Citizens of Martindale precinct, Tex., have voted the issuance of bonds to the amount of $25,000 for the construction of good roads.

Virginia.

The City Council of Norfolk, Va., has approved a petition for the paving of 10th, 11th, 13th, 14th and 15th Sts. and Omohundro, Llewellyn and Moran Aves.; a petition for the improvement of The Hague next to Olney Road; extension of Front St., to make a connection with Colley Ave., extending to Fort Norfolk.

The Board of Supervisors of Bedford County, Bedford City, Va., at its January meeting will hear citizens from four magisterial districts who desire elections to be called to provide bond issues in each district, which will aggregate $200,000 for road improvement.

A movement has been started in Tazewell County, Tazewell, Va., looking to a bond issue for the construction of good roads. P. St. Julien Wilson, Richmond, is State Highway Commissioner.

Hanover County Supervisors, Hanover, Va., contemplate completing a first-class road from Richmond to the Carolina line. This has been made possible by the Town Council of Ashland at a recent meeting having appropriated $400 for the completing of a stretch of road along the telegraph line, within the corporate limits.

Washington.

The City Council of South Bend, Wash., contemplates paving the main business street of the city next spring.

Property owners along McLaren Ave., North Yakima, Wash., have asked City Engineer Doolittle to investigate the merits of tar macadam, suggesting its use on that street.

The Board of Public Works of Spokane, Wash., is advertising for bids for the paving of Wall St., from Garland Ave. to the north city limits, with asphalt. The estimated cost is $52,000.

West Virginia.

The County Court of Fayette County, Fayetteville, W. Va., has approved the report of County Road Engineer Gentry, and has ordered the construction of the proposed new road from Fayetteville to the C. & O. depot at South Fayette station. S. L. Walker is Superintendent of Roads.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BRIDGES—STEEL AND CONCRETE

Alabama.

A definite agreement has finally been reached by the railroads and city of Birmingham, Ala., in regard to eliminating the grade crossing on 1st Ave. and 28th St. A viaduct will be constructed 60 ft. in width and extending from 25th to 34th St. The city will provide the right of way and pay all damages and also the cost of constructing the approaches. The following railroad companies will construct the viaduct proper: South & North Alabama R. R. Co.; Southern Ry. Co.; Alabama Great Southern R. R. Co.; Birmingham Belt R. R. Co.; Birmingham Ry., Light & Power Co.; Sloss-Sheffield Steel & Iron Co.; Seaboard Air Line Ry.

Arkansas.

⊙The Van Buren-Fort Smith Free Bridge Commission disposed of $600,000 bonds to pay for the cost of the bridge which is now under construction, connecting Fort Smith and Van Buren, Ark. The Mercantile Trust Co., St. Louis, Mo., was the successful bidder. The bonds will be dated Jan. 1, 1911, bearing 5 per cent interest.

California.

⊙The City Council of Berkeley, Cal., has awarded the contract to the Easterly Construction Co., for the erection of a culvert over Codornices Creek at $6,560. The only other bid submitted was that of the Contra Costa Construction Co., $9,990.

Colorado.

City Council of Colorado Springs, Colo., has decided upon the expenditure of about $14,000 for the construction of bridges over the El Paso Canal, which is owned by the city. The street committee and the mayor also took up the matter of constructing a culvert at 6th St. and beyond the Midland tracks with the Superintendent of the Midland R. R.

Iowa.

✣Bids will be received until Jan. 6, by Board of County Commissioners, Grundy Center, Ia., for construction and repair work on all wooden and steel bridges; concrete floors and abutments for steel bridges and for the construction of concrete bridges and culverts complete. E. G. Ensminger is Auditor of Grundy County.

⊙Advices from Denison, Ia., state that Lana & Co., Harlan, Ia., have been awarded the contract for the construction of bridges in Crawford County.

A meeting was recently held by Council Bluff, Ia., members of the committee on the new Missouri River bridge project. The following officers were elected: A. C. Keller is president, George W. Adams, vice-president; C. C. Clifton, secretary; E. F. Test, corresponding secretary and T. J. Brooks, treasurer. Various plans were discussed as to the kind of bridge desired, its location and the means of securing its construction.

Fire recently destroyed the Great Western Ry. bridge over the Iowa River four and one half miles out of Marshalltown. The structure was 70 ft. in length. Immediate steps will be taken to replace the bridge. H. Carland, Des Moines, Ia., is Supervisor of Bridges and Buildings of the road.

Connecticut.

Efforts are being made by a number of prominent citizens of Middlesex County, Conn., according to advices from Middletown, to introduce a bill at the coming session of the legislature providing for a bridge across the Connecticut River at East Haddam.

Georgia.

Board of County Commissioners, Cordele, Ga., have under consideration the construction of a new steel bridge over Flint River.

Illinois.

Plans for the construction of the proposed Morgan St. bridge have been filed with the City Engineer of Rockford, Ill. As proposed the structure will have one arch over the Burlington tracks, from the end of the street to the first abutment and then two spans of 150 ft. each to the remaining piers, with two 75-ft. arches west of them and then 5 flat arches above dry ground to the street level. It is planned to have a 30-ft. driveway with 2 10-ft. walks, in place of the 19-ft. drive at present, and 7-ft. walks.

Adams township is to get aid of LaSalle County Commissioners, Ottawa, Ill., to the extent of $1,250 for the construction of a bridge over Little Indian Creek.

The Township Highway Commission, Macomb, Ill., in connection with the committee representing the Board of Supervisors are arranging to replace what is known as Crabb bridge across Crooked Creek. The estimated cost of the improvement is $2,000, of which amount the county will pay one-half.

Engineers of the State Highway Commission of Springfield, Ill., have prepared plans and specifications for the construction of the new Wilson St. bridge at Batavia, Ill.

Plans have been prepared by Carl E. Plum, City Engineer, Elgin, Ill., for the construction of a concrete bridge to replace the structure recently destroyed by fire at Willard Ave. These, together with an estimate of the cost, will be submitted to the finance committee in order to secure an appropriation for the work.

Kansas.

Advices from Great Bend, Kan., state that an election was recently held in Liberty Township in that county for the purpose of voting bonds for the construction of a bridge across the Arkansas River at Dundee, a small town in that township. The proposition carried and the matter of building the structure will be taken up at once.

Maryland.

Plans are being prepared by engineers of the Hagerstown & Clearspring Ry. Co., Hagerstown, Md., for the construction of a bridge over Conococheague Creek. The structure as proposed will be nearly 2,000 ft. long.

Michigan.

City Council has instructed Street Commissioner S. Crane, Owosso, Mich., to investigate the matter of constructing a walk at the overhead bridge of the Lansing & North Eastern R. R. crossing at Gute St.

Minnesota.

Plans have been prepared by S. Chute, City Engineer, St. Cloud, Minn., for the paving of the St. Germain St. bridge which was authorized by the City Council and for which a levy of $7,500 was made. The plans call for four lines of 40-lb. I beams and the old wooden stringers at present under the bridge, will be used for strengthening the beams.

Missouri.

City Council of Joplin, Mo., has under consideration an ordinance authorizing an election for voting on bonds amounting to $40,000 to be used for the construction of the Broadway viaduct over the bottoms. J. C. Hodgson is City Engineer.

Plans have been prepared by Ira G. Hedrick, Consulting Engineer, for the construction of the proposed W. 12th St. viaduct, Kansas City, Mo. As proposed the traffic way will have three decks from 12th St. and Bellehill Ave. and a tunnel through the hill at 13th St. and Bell hill Ave. to Broadway. The lower deck of the structure will lead into the tunnel at a grade of 2.9 per cent. The second deck, grade 5.75 per cent, would land at 12th and Lincoln Sts. from where the north and south roadways would be built around the mill. The third deck would be for street cars, grade 5.5 per cent and by it cars could land at 12th and Washington Sts.

Boone County, Mo., is to have 22 new steel bridges erected at once. Plans are already being prepared for the structures, which it is estimated will cost $10,000.

Nebraska.

✣Bids will be received until noon, Jan. 10, by H. F. Chapin, County Clerk, York, Neb., for the construction of steel and wooden bridges that may be built in the County of York, Neb., during the year of 1911. Each bid must be accompanied by a certified check for $500 payable to the county clerk.

✣Bids will be received by the Board of County Commissioners, St. Paul, Neb., until Jan. 5, for furnishing materials, erecting and repairing all county bridges, required during the year beginning Jan. 1, 1911. J. J. Sazama is County Clerk.

✣Bids will be received until noon, Jan. 10, by Uriah F. Standard, County Clerk, Geneva, Neb., for the construction of bridge fills and doing grading in Fillmore County for the year of 1911.

⊙ The Board of County Supervisors, David City, Neb., at the last regular session awarded the following contracts for the year 1911-1912: All wood and steel bridges to be constructed in Butler county to the Nebraska Construction company of Lincoln; all cement culverts to the Wilson Reinforced Concrete company of Nebraska City; all metal culverts to the Nebraska Culvert Manufacturing company of Wahoo.

Business men of Ashland, Neb., are advocating the construction of a new bridge over the Platte River at that place.

New York.

✣Bids will be received until 2 p. m., Jan. 10, by Kingsley L. Martin, Commissioner of Bridges, Park Row Bldg., New York, N. Y., for constructing the elevators, stairs, drainage, ornamental and electrical work for the anchor piers of the Queensborough bridge over the East River between the Boroughs of Manhattan and Queens.

The New York Central Ry. Co. has purchased land for the construction of an overhead bridge at Knowlesville to replace the present structures. The new bridge will be midway between the old structures and it is planned by the company to connect the telegraph road and south road approaches just south of the tracks at that point. E. B. Menuez, New York, N. Y., is Engineer of Grade Crossings.

The North Side Improvement Association of Syracuse, N. Y., is to hold a meeting to agitate the construction of a new bridge over the Oswego Canal at Division St. It is proposed to build a structure of modern design.

A special election was held December 30 at Chemung, N. Y., for the tax payers to vote on an appropriation not to exceed $20,000 for the construction of a bridge to replace the present suspension bridge that now spans the Chemung River near the village.

The New York Central R. R. has submitted to the Board of Albion, N. Y., a proposition to construct free of any cost to that city a bridge at Clarendon St. crossing. The structure will give a clearance of 21 ft. and will be 18 ft. wide with 4-ft. sidewalk on the right side.

North Dakota.

✣Bids will be received until 2 p. m., Jan. 10, by Board of County Commissioners, LaMoure, N. Dak., for the furnishing of all corrugated galvanized metal culverts as may be needed during the year of 1911. C. J. Alister is County Auditor.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Ohio.

✣Bids will be received until noon Jan. [illegible] by Board of County Commissioners, Cincinnati, O., for the construction, under Specifications No. [illegible] of [illegible] bridge on [illegible] Ave. in Lockland, Springfield township. A bond for $[illegible] must accompany each bid. Fred Dreihs is Clerk.

Engineers of the Louisville & Nashville and Chesapeake railroads have approved plans prepared by City Engineer, Newport, Ky., for the construction of the viaduct over the tracks at the head of Monmouth St. in that city. It is announced that active work will be started soon.

In complaince with the resolution recently adopted by the City Council the engineering department of Akron, O., is preparing plans for the construction of an overhead crossing of the C. T. & V. R. R. tracks on Kelley Ave. It is proposed to erect a reinforced concrete bridge on Kelley Ave. between 4th and 5th Aves., near the Buckeye Rubber Co. Plant. The structure will be of regular street width, 60 ft., and 90 ft. in length, and is estimated to cost between $10,000 and $15,000.

Oklahoma.

The Chicago, Rock Island & Pacific System has closed a deal, whereby construction work will be commenced at once on a $90,000 viaduct over its tracks in Chickasha, Okla. H. M. Hallock, El Reno, Okla., is Division Superintendent.

Advices from Tulsa, Okla., state that construction work has been started on the new suspension bridge over the Arkansas River at Bixby. The structure will be a half mile long and will cost $70,000.

Oregon.

⊙The County Court at Astoria, Ore., has awarded a contract for the construction of a bridge over the Necanicum River between Seaside and Elk Creek to the Coast Bridge Co., Portland, Ore., at $2,600. The structure, which will be of steel, will have span of 100 ft. and piers of steel tubing filled with concrete.

Pennsylvania.

⊙The contract for the construction of the new bridge over George's Creek at Westernport, Md., has been awarded Nelson Meridith Co., Chambersburg, Pa., at $4,365. The structure will be of concrete having a double driveway and one sidewalk.

Officials of the Lehigh Valley Transit Co. have submitted to the Finance Committee of the [illegible] Council, a proposition to build a new bridge across the Little Lehigh Creek at the foot of Lehigh St. leading from the 2nd to the 12th wards, to be higher than the present structure.

A hearing by the Secretary of War was held at Washington of all the interests affected by the proposed raising of the bridges over the Allegheny River at Pittsburg, on Jan. 3. The contemplated action of the government is designed to improve navigation at that point.

Borough Surveyor of Kutztown, Pa., will prepare plans for the construction of a new bridge over the Suacony Creek at the lower end of Main St. in that place. The structure will carry trolley tracks and will have 12-ft. sidewalks on each side of the roadway.

South Carolina.

According to reports from Charleston, S. C., the officials of the Atlantic Coast Line Ry. have under consideration the construction of a viaduct to eliminate the Magnolia Grade crossing. The cost of the work will probably be about $300,000.

Tennessee.

Advices from Ducktown, Tenn., state that the County Court Bridge Committee has awarded the contract for the construction of two steel bridges to the Joliet Bridge Co., Memphis, Tenn. The structures will be over Burra Burra and Isabella Creeks. Grading for the piers and approaches will be done by local firms.

Texas.

⊙The Aransas Ry. has contracted to replace the present bridge over the Guadalupe River at Cuero, Texas, with a steel structure to cost $236,000.

Efforts are being made in Fort Worth, Texas, to induce the county to pay the entire cost of constructing a new bridge over the Trinity River on North Main St.

Washington.

Engineering department of the Northern Pacific Ry. has prepared plans and specifications for the construction of the new bridge across the city waterway in Tacoma, Wash., to replace the present structure. The new bridge will be of steel throughout and will carry two tracks. The cost of the work is estimated at $150,000. A. R. Cook, Tacoma, Wash., is Engineer Maintenance of Way.

The project for the construction of a viaduct at Washington St. has been revived and will probably be taken up by the city council of Spokane, Wash., for consideration. The cost of such an improvement, it is estimated, would be about $[illegible].

An ordinance appropriating $415,000 for the new concrete bridge over Latah Creek, introduced by President E. V. Lambert of the Spokane City Council has been passed. It is understood, however, that the county will pay $50,000 toward the cost and that the Washington Power Co. will also assist.

West Virginia.

It is reported that the Norfolk & Western Ry. is planning to construct a new bridge across the Ohio River at Kenova, W. Va., to supplement the present structure. According to the plans the new bridge will be 200 ft. below the present one, thus eliminating a heavy curve and steep grade. Two footways will be included. Work, it is said, will be started in the spring. J. E. Crawford, Roanoke, Va., is Bridge Engineer.

Two steel bridges of the Pennsylvania R. R. at Wheeling, W. Va., over Wheeling Creek, will, it is said, be replaced with two deck plate girder spans, each 80 ft. in length resting on masonry abutments. Final plans for the structure have not yet been approved.

It is rumored in New Martinsville, W. Va., that the Baltimore & Ohio R. R. has under consideration the construction of a new bridge to replace the present structure over Fish Creek in Brooklyn, W. Va.

Wisconsin.

City Council of Chippewa Falls, Wis., has adopted a resolution instructing the city engineer to make plans and estimates of the cost of building a bridge of heavier type than the $35,000 structure planned by former city engineer.

City Council of Euclaire, Wis., has adopted a resolution instructing the city engineer to make plans and estimates of the cost of building a heavier bridge at that place to cost approximately $35,000. Steel and concrete structures are under consideration.

Canada.

City Council of Edmonton, Alta., recently passed debenture by-laws totalling $456,000 which will be voted upon the rate payers on Jan. 22. Included in the expenditures mentioned were the following: $167,000 for another bridge over the Saskatchewan; $12,000 for the Jasper subway.

Citizens of Toronto, Can., are advocating the construction of a viaduct at Bloor St., estimated to cost over a million dollars, and a meeting was recently held to discuss the matter.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arizona.

The $20,000,000 fund provided by Congress for work of the U. S. Reclamation Service has been apportioned among the following irrigation projects: Salt River project, Ariz., office of project engineer, Roosevelt, Ariz., $495,000; Yuma project, Ariz. and Cal., office of project engineer, Yuma, Ariz., $1,200,000; Grand Valley project, Colo., office of project engineer, Grand Junction, Colo., $1,000,000; Uncompahgre project, Colo., office of project engineer, Montrose, Colo., $1,500,000; Payette-Boise project, office of project engineer, Boise, Idaho, $2,000,000; Milk River, Montana, office of project engineer, Malta, Mont., $1,000,000; North Platte project, Wyo. and Nebr., office of project engineer, Mitchell, Nebr., $2,000,000; Truckee-Carson project, Nevada, office of project engineer, Fallon, Nev., $1,193,000; Rio Grande, New Mex., Tex., and Mexico, H. J. Gault, engineer, El Paso, Tex., $4,500,000; Umatilla project, Ore., office of project engineer, Hermiston, Ore., $325,000; Klamath project, Ore. and Cal., office of project engineer at Klamath Falls, Ore., $600,000; Strawberry Valley project, Utah, office of project engineer, Provo, Utah, $2,272,000; Sunnyside project, Wash., office of project engineer, Sunnyside, Wash., $1,250,000; Tieton project, Wash., office of project engineer, North Yakima, Wash., $665,000. The above sums are to be spent within the next five years.

Arkansas.

The Miller & Bowie Red River Improvement Association is to raise about $1,000 to pay the expenses of making surveys for leveeing a large portion of Red River, which will reclaim about 170,000 acres of the best Red River bottom lands. The government will be asked to pay at least half the expenses of the proposed improvement and the owners of the lands will pay the balance. At a recent meeting of the Association at the County Court House at Texarkana, Ark., the following officers were elected: President, R. H. T. Mann; vice-presidents, W. A. Arthur and M. D. Tilson; secretary, G. A. Hays; treasurer, B. H. Kuhl.

Colorado.

J. J. Lumsden, Grand Junction, Colo., has completed the Orchard Mesa dam across Grand River in Mesa County. Work has been under way for about a year and an average daily gang of 65 men has been employed on it. The dam is 370 ft. long, 40 ft. wide and varies from 7 to 14 ft. in depth. It is almost wholly of concrete.

The electors of the Bent-Prowers Irrigation district, according to advices from Lamar, voted Dec. 31 upon the construction contract which provides for the completion within three years of a $4,000,000 irrigation project. The entire territory to be watered lies within the Lamar district on the south and extends from a point southwest of Candad and the area included therein is about 80,000 acres—the water, therefore, being derived principally from the Purgatoire and stored in a reservoir with a capacity of about 225,000 acre feet. The main canals will aggregate about 110 miles, while it is estimated that the laterals will be nearly 200 miles in length. The contract provides for modern construction methods, with tunnels, bridges, flumes and syphons necessary. The Southwest Construction Co. has this contract.

The Hardscrabble Irrigation district, southwest of Pueblo, will shortly issue bonds for $900,000 for the purpose of building an irrigation system in that quarter. An irrigation

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

district election was held Dec. 21, and the authorizing of a bond issue of $900,000 was carried by a vote of 2 to 1. Estimates and surveys of the plans of a series of storage reservoirs and laterals on Hardscrabble creek are in the hands of the directors of the district. The new board of irrigation directors assumed their duties Jan. 1, and the work of selling the bonds will be taken up by them immediately. About 12,000 acres will be brought under cultivation.

An election will be held Jan. 16 to vote on the formation of a new irrigation district to be known as the Poudre Valley and Weld County Irrigation district. The district will take in 80,000 acres of land, of which 50,000 is deeded, and the remainder homesteads or desert claims. The project is said to involve an expenditure of more than $2,000,000. The land to be reclaimed is in the vicinity of Nunn, Dover, Carr and Bulger, in the extreme northern part of the county. New York City and Stamford, Conn., capitalists are back of the project and are furnishing the larger part of the money.

The Blanch Canal Co., of Alamosa, has been incorporated with a capital stock of $10,000, the incorporators being Charles Williams. William P. Hapney and Oscar Wilkins.

Atchison & Dailey, Fort Morgan, Colo., have completed the Pan Arroya irrigation dam and have shipped their outfit to Kimball, Nebr., where they have large contract. On the Pan Arroya dam they have had 75 men and 200 horses constantly at work and have hauled 600,000 cu. yds. of earth in less than nine months. The dam is 3,670 ft. long, 270 ft. wide at the bottom and 55 ft high at the creek bed. It will store 16,000 acre feet of water, which will be used on some of the best land in Morgan county.

Surveys under way to determine the feasibility of securing a water supply from Plateau creek for the irrigation of the 10,000 acres of the Hnter Mesa tract near Rifle, are said to have shown that the plan is practicable. The surveys have been made by Engineer Waring of Grand Junction, Colo. The Magenheimer Bros., Chicago, Ill., are interested in this project.

Indiana.

⊙R. A. Brown, Washington, Ind. has been awarded the contract for construction of a ditch in Daviess County, his bid for the work being $2,848.

Iowa.

✣Bids will be received until 2 p. m., Jan. 17 by the North Nishnabotna Drainage District, G. M. Moore, President, Bank of Hamburg, Hamburg, Ia., for the construction of a flume at a point about 3½ miles southeast of Hamburg, Ia., to be constructed of steel and concrete. Official advertisement will be found elsewhere in this issue.

Louisiana.

Surveys are under way for the reclamation of 80,000 acres of meadow and submerged prairie south of Gueydan, La. The company interested in this project will reclaim the land for farming purposes. Chas. D. Babbit, Gueydan Bank bldg., Gueydan, La., is the engineer.

Plans are under way for the Kenner Reclamation project, which is located about six miles from New Orleans. The matter will not be in shape for letting contracts for several months. John A. Kruse, 706 Goff bldg., Chicago, Ill., is the consulting engineer.

Michigan.

A company is being formed by Kalamazoo and Paw Paw parties to put an irrigation project in operation at Paw Paw, in the heart of the "original fruit belt." The promoters have purchased the Taliaferro farm on the west bank of the Paw Paw river, one and one-half miles north of Paw Paw, on the Bloomingdale road, as the site of the reservoir, where sufficient water will be stored to irrigate all the district lying north of Paw Paw, east of Bloomingdale road and west of Maple Lake.

Mississippi.

The Swamp Dredging Corporation, of Tupelo, Miss., has been formed with a capital stock of $10,000. D. W. Robins, B. H. Stubbs and J. Q. Robins are interested.

New Jersey.

According to a statement of Henry W. Schneider, State Inland Waterway Commissioner, Trenton, N. J., $100,000 additional will be required to complete the interresort canal from Bay Head to Cape May. Of the $300,000 originally fixed by the legislature as the total cost of the waterway, about $200,000 has been expended.

New York.

⊙Contracts for the first work on the Cayuga and Seneca canal have been awarded as follows by the State Superintendent of Public Works: Scott Brothers, Rome, N. Y., at $393,135 for contract A, providing for the construction of locks and controlling works in the Seneca River; Crowell-Sherman-Stalter Co., 3111 Carnegie Ave., Cleveland, O., $1,448,500 for contract B, providing for 17 miles of dredging work.

Ohio.

⊙The County Surveyor at Springfield, has awarded the contracts for the improvement of Jackson creek in Pike township, as follows: Labor on sections 1 and 2, to Charles Bird for $3,739; sections 3 and 4 to J. H. Berner for $1,175; the contract for the tile for the improvement was awarded to the Madison Tile Co., of London, O.

Oklahoma.

⊙Conklin, Rooney, Johnson & Hofman, Chandler, Okla., have been awarded the contract for constructing a drainage ditch in Lincoln County for the Deep Fork Drainage district No. 1.

South Dakota.

✣Bids will be received until 1 p. m., Jan. 28, by M. Volz, County Auditor, Alexandria, S. Dak., for the construction of tile drains in Drainage District No. 6 of Hanson County. The work includes approximately 7½ miles of drains from 5 in. to 24 in. in diameter Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 3 p. m., Feb. 24, by R. A. Ballinger, Secretary, Department of Interior, U. S. Reclamation Service, Washington, D. C., for the earth work on about 22 miles of the North Canal, involving the excavation of approximately 770,000 cu. yds. of material. For particulars address the U. S. Reclamation Service, Washington, D. C.; Denver, Colo. or Belle Fourche, S. D

Washington.

The formation of a drainage district to include about 3,500 acres lying south and east of Cheney, is proposed. Several pond and tule lakes are to be drained, including upper and lower Turnbull lakes.

Wyoming.

Advices from Cheyenne state that the Wyoming Central Irrigation Co., will submit proposals to the state officials embodying plans for the construction of an irrigation system to cover 120,000 acres of ceded lands of the Wind River Indian Reservation.

WATER-WORKS

Arizona.

✣Bids will be received until 1 p. m., Jan. 19, by the Water Works Commission, Douglas, Ariz., for the following work for water works improvement: Pumping plant, two 110 h. p. crude oil engines; two 750 gal. power pumps; two 200 cu. ft. 50 lb. belted air compressors; one simplex type venturi meter; station piping, valves, fittings, etc. Building, 34x65 ft. brick and steel pumping house, one 5 ton hand crane; one 20x12 ft. concrete sump; one 19,000 gal. concrete oil reservoir; one 4-room frame dwelling house; reservoir; one 3,000,000 50 ft. steel water tower, 125 cu. yds. foundation, one 8 in. and one 10 in. altitude valve, alternate, bid on 25 ft. x 100 ft. steel standpipe. Water mains: 10,000 ft. of 10 in. 70 lb. cast iron pipe; 5,000 ft. of 10 in. 64 lb. cast iron pipe; 6,730 ft. of 8 in. 47 lb. cast iron pipe; cast iron specials for the above water mains. Valves and Hydrants: 15 5 in. hydrants with two nozzles and steamer connections; five 4 in. hydrants with two nozzles and steamer connections; two 10 in. gate valves and boxes; two 8 in. gate valves and boxes. Proposals must be accompanied by certified check or bidder's bond, in a sum equal to 5 per cent of the bid. Specifications for the above material may be secured at the office of the Water Works Commission, Douglas, Ariz., or at the office of the engineers, E. T. Archer & Co., 426 Beals Bldg., Kansas City, Missouri.

Arkansas.

Plans are being perfected by the city of Fort Smith, Ark., to raise $500,000 to purchase the water works plant, owned by a private corporation.

California.

City Engineer Randle of Sacramento, Cal., has submitted alternative plans for the additional pumping unit which is to be installed at the water works. The estimated cost is $158,000.

Advices from Hemet, Cal., state that the Lake Hemet Land & Water Co. will construct a new steel pipe line in the San Jacinto Canyon and do a considerable amount of new concrete work W. F Whittier is president.

The citizens of Sierra Madre, Cal., have voted the issuance of bonds to the amount of $40,000 to increase water supply and establish [illegible]

The Pine Mountain Water Co. has been organized in California with a capital stock of $3,000,000 to take over and operate a number of power and water plants. Duncan McDuffie, W. G. Vincent, Jr., C. L. Cory of Berkeley, and C. G. Dall of San Francisco are directors.

Florida.

⊙The city of Pensacola, Fla., has awarded contracts for water works improvements as follows: American Cast Iron Pipe Co., Birmingham, Ala., for pipe for the extension of 18,000 ft. of 6-in. cast iron water mains: Ahrens & Ott of New Orleans, La., for hydrants and lead; Fairbanks Co. of New Orleans, for water gate valves.

⊙The City Council of Chipley, Fla., has awarded the contract for the re-building of its water works to Moore & Gammon of that city for $20,000.

Illinois.

✣Bids will be received until Jan 9, 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, for furnishing and delivering before April 15, 1911, the following special castings: Job No. 1, 104th St., Harvard Ave. to Vincennes Rd., 1 36x36 tee, 2 48x36 tees, 1 48x16 tee, 1 48x24 tee, 1 48x8 tee, 2 48x12 M. H. B. O., 2 36-in. sleeves, 2 48-in. sleeves 2 24-in. ⅛ bends, 4 48x36 reducers, bell on large

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end, 2 48-in. caps; Job No. 2, 104th St., Harvard Ave. to State St., State St., 104th St. to 103rd St., 1 48x36 tee, 1 48x8 tee, 1 36-in. sleeve, 2 48-in. sleeves, 1 48-in. cap; Job No. 9, Calumet Ave. and 31st St., 1 36x30 tee; Job No. 10, Southport Ave., Devon Ave. to Pratt St., Pratt St., Southport Ave. to Perry Ave., Perry Ave., Pratt St. to Kenilworth, 1 20x12 tee, 4 20-in. ⅛ circle bends, 1 24x20 reducer, 1 20-in. cap; Job No. 11, Robey St., Devon Ave. to Pratt St., 1 20x12 tee, 1 20x12 tee, 1 20-in. cap; Job No. 17, La Salle St. tunnel, La Salle St. and Chicago River, 8 36-in. 1/16 bends, 2 36-in. ¼ flange bends (special), 2 36-in. ¼ flange chair castings (special), 22 36-in. flanged pipe 7½ ft. long (special), 4 36-in. flange and spigot castings (special), 2 36-in. flange filler castings (special), 1,000 1⅛-in. bolts, hexagonal heads and nuts, 5¼ in. long; Job No. 18, Roseland pumping station, 104th St. and Harvard Ave., 7 48x48 tees, 8 48x12 manholes, blowoffs, 20 48 to 36 reducers, bells on large end, 5 48-in. caps, 1 48x36 tee, 1 48x24 tee, 4 48-in. sleeves, 1 48-in. split sleeve. Deliver at pipe yards the following casting: 2 20x12 tees, 1 20x20 tee, 2 24x6 B. O., 4 20-in. ⅛ bends, 3 36-in. sleeves, 6 24-in. ⅛ bends, 4 30-in. ⅛ bends, 4 36-in. ⅛ bends, 1 24x20 reducer, 1 48-in. split sleeve, 10 24-in. 1/16 bends, 2 30-in. bends, 4 36-in. 1/16 bends. Total weight of castings to be delivered under this contract is approximately 242 tons. Full specifications as to size, weight, materials, etc., may be had upon application to the Commissioner of Public Works. (This contract was advertised to be opened Jan. 3, 1911.)

✣Bids will be received until 3 p. m., Jan. 9, by Joseph Burkhart, Jr., City Clerk, La Salle, Ill., for the construction of a water supply well. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 11 a. m., Jan. 12, by B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 705, City Hall, for furnishing 30,000 lbs. of lead pipe to the water works shop, 22nd St. and Ashland Ave., for the period ending May 31, 1911.

✣Bids will be received until Jan. 9, 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, City Hall, for furnishing and delivering cast iron water pipe as follows: Job No. 1, 104th St., Harvard Ave. to Vincennes Road, to be delivered March 1, 1911, approximately 567 pieces 48-in. pipe, 2,551 tons, 63 pieces 36-in. pipe, approximately 171 tons; Job No. 2, 104th St., Harvard Ave. to State St., State St., 104th St. to 103rd St., to be delivered March 1, 1911, approximately 200 pieces 48-in. pipe, 900 tons, approximately 59 pieces 36-in. pipe, 161 tons; Job No. 3, 103rd St., State St. to Cottage Grove Ave., to be delivered March 1, 1911, 361 pieces 24-in. pipe, 505 tons; Job No. 4, Canal St., 95th St. to 101st St., to be delivered April 15, 1911, 334 pieces 24-in. pipe, 467 tons; Job No. 5, 91st St. to 95th St., 95th St., Halsted St. to Canal St., approximately 872 pieces 24-in. pipe, 1,221 tons, Vincennes Road, 91st St. to 88th St., approximately 159 pieces 12-in. pipe, 79 tons, to be delivered April 15, 1911; Job. No. 6, Vincennes Road, 81st St. to 79th St., 79th St., Harvard Ave. to State St., to be delivered April 15, 1911, 210 pieces 12-in. pipe, 103 tons; Job No. 7, 45th St., Wabash Ave. to Wentworth Ave., approximately 144 pieces 24-in. pipe, 202 tons, to be delivered April 15, 1911; Job No. 8, 39th St., Prairie Ave. to Wabash Ave., 39th St. to 43rd St., approximately 345 pieces 24-in. pipe, 483 tons; Job No. 9, 31st St., Calumet Ave. to Vernon Ave., 31st St. to 35th St., 35th St., Vernon Ave. to Ellis Ave., Ellis Ave., 35th St. to 43rd St., 665 pieces 30-in. pipe, to be delivered March 1, 1911, 1,333 tons, approximately 250 pieces 24-in. pipe, 350 tons, to be delivered April 15, 1911; Job No. 10, Southport Ave., Devon Ave. to Pratt St., Pratt St., Southport Ave. to Perry St., Perry St., Pratt Ave. to Kenilworth Ave., approximately 488 pieces 20-in. pipe, 512 tons, to be delivered March 1, 1911; Job No. 11, Robey St., Devon Ave. to Pratt St., approximately 225 pieces 20-in. pipe, 236 tons, to be delivered March 1, 1911; Job No. 17, La Salle St. and Chicago River, approximately 68 pieces 36-in. pipe, 184 tons; Job No. 18, 104th St. and Harvard Ave., 14 pieces 48-in. pipe, 63 tons, to be delivered March 1, 1911. The approximate weights of pipe in this contract are 3,514 tons of 48-in. pipe, 516 tons 36-in. pipe, 1,333 tons 30-in. pipe, 3,228 tons 24-in. pipe, 748 tons 20-in. pipe, 181 tons 12-in. pipe. All pipes shall be made of cast iron of good quality and must be soft enough to admit of drilling and cutting. All pipe must be up to the specifications, as on file in the office of the Commissioner of Public Works. In bidding each job will be considered independent of all others. The price per ton will be multiplied by the tonnage specified for each size of pipe and the lowest aggregate bid on each job will be considered the lowest bidder for that particular job. Bidders must submit prices on all of the tonnage of any job. Bidders may bid on any one or more jobs. This letting was originally advertised for Jan. 3, 1911.

⊙It is reported that Keys & McNamara of La Salle, Ill., have been awarded the contract by that city for the construction of the new water supply well in the bottoms for $6,500.

⊙The Brady Foundry Co., 35th St. and Ashland Ave., Chicago, has been awarded the contract for furnishing suctions and glands for the new Roseland pumping station, 104th St. and Stewart Ave. Itemized bids published in ENGINEERING-CONTRACTING Dec. 21, 1910.

Jno. Mohr & Sons, 349 W. Illinois St., Chicago, have submitted a bid of $4,558 to B. J. Mullaney, Commissioner of Public Works, City of Chicago, for furnishing and installing the smoke flues for the new Roseland pumping station, 104th St. and C. & W. I. R. R.

Indiana.

The city water works department of Fort Wayne, Ind., is preparing to establish a new pumping station in the eastern part of the city. This will be the fourth station in the system, and the pumps will be driven by electric power.

Iowa.

⊙J. W. Turner Improvement Co., 309 Youngerman Bldg., Des Moines, Ia., has been awarded the contract by Capt. C. E. Babcock, Fort Crook, Neb., for the construction of a reservoir and well at Fort Crook for $18,500. The work includes material, labor, tools, etc., under plans 3-867A and specifications 4-990 prepared in the Quartermaster General's office, Washington, D. C. Bids were opened Dec. 16.

The citizens of Boone, Ia., voted bonds Dec. 12, to the amount of $180,000 for additions and extensions to the water works.

The citizens of Whittmore, Ia., voted Dec. 19 the issuance of bonds to the amount of $7,000 for the construction of a water works. T. G. White is Mayor.

Kansas.

Mound City, Kan., contemplates holding an election shortly to vote on the proposition of issuing bonds for the construction of a water works.

The citizens of Cherryvale, Kan., at a special election held Dec. 20, voted in favor of the proposition to install a water works system at a cost of $105,000. A 12-in. pipe line will be built to the Verdigris river, six miles west of town.

Kentucky.

Advices from Lexington, Ky., state that the Lexington Water Co. and the Prison Commission have arranged for the construction of a pipe line to the Reform School, a distance of 22,000 ft. The legislature has made an appropriation for this purpose.

Massachusetts.

The Old Colony Trust Co. of Boston, Mass., has been authorized by Judge Carl Hasch of Helena, Mont., to sell the Helena Water Works to the city for a consideration of $590,000.

Michigan.

The Board of Public Works of Holland, Mich., has purchased 50 ft. east of Maple St., between 20th and 21st Sts., where a new pumping station will be located. The board has instructed Acting Superintendent Champion to draw up plans and specifications for the erection of the station. The estimated cost of the work is $15,000.

Minnesota.

✣Bids will be received until noon, Jan. 9, by Board of Water Commissioners of the City of St. Paul, Minn., for furnishing hydrants during the year of 1911. John Caulfield is Secretary of the Board.

✣Bids will be received until noon, Jan. 9, by Board of Water Commissioners, St. Paul, Minn., for the furnishing and delivering f. o. b. cars, St. Paul or at the storage yards of the Board of Water Commissioners, 25 East Fifth St., freight prepaid, certain valve and service stop boxes (Buffalo box, St. Paul pattern), required during the year 1911, in accordance with the plans and specifications on file in the office of the Board: 1,500 stop boxes, with the privilege of 500 additional; also for all valve boxes from 4 in. to 24 in. that may be required, of which we guarantee to take 50 4-in., 50 6-in., 10 12-in. and 10 16-in., all to include covers.

✣Bids will be received until noon, Jan. 9, by Board of Water Commissioners, St. Paul, Minn., for furnishing water gates from 4 in. to 36 in. diameter. All 16-in., 20-in., 24-in., 30-in. and 36-in. gates must be geared, and the 24-in., 30-in. and 36-in. must have 6-in. bypasses. All valves shall be double-faced and made with two independent gates, which shall have their only point of contact with the stem at the centers, i. e., be center bearing. John Caulfield is Secretary of the Board.

The City Council of Albert Lea, Minn., is considering the construction of a new dam at the east end of Fountain lake. W. Barneck is City Engineer.

Citizens of Easton, Minn., voted in favor of the proposition of issuing bonds for the erection of a steel tower and tank. Election was held Dec. 15.

Nebraska.

✣Bids will be received until 8 p. m., Jan. 6, by City Clerk J. C. Robbins, Superior, Neb., for the construction of extensions and improvements to the water works system in that place.

The City Trustees of Battle Creek, Neb., have passed an ordinance providing for the holding of a special election Jan. 15 to vote on the proposition of bonding the town for $10,000 for the construction of a water works.

The City Council of South Omaha, Neb., has passed an ordinance granting a franchise to the Union Stock Yards Co. and packers of South Omaha to build a water plant of their own in South Omaha.

New Jersey.

✣Bids will be received until 3 p. m., Jan. 6, by Committee of Building, Board of Chosen Freeholders, Essex County, Newark, N. J., for furnishing and laying water pipe with the necessary connections for the Tuberculosis Hospital at Soho, N. J. Louis E. Voorhees is Chairman of the Committee.

North Carolina.

The city of Durham, N. C., contemplates the issuance of bonds to the amount of $500,000 for the purchase and improvement of the water works.

The Water Commissioners of Charlotte, N. C., have recommended to the City Council the construction of a pipe to Catawba River to furnish additional water supply. The cost is estimated at $275,000. Joseph Firth is City Engineer.

Ohio.

The village of Sylvania, O., contemplates installing a complete municipal water works system. Riggs & Sherman, The Nasby, Toledo, O., Engineers.

The citizens of Grand View, O., have voted to bond the town to install a system of water works at an estimated cost of between $50,000 and $60,000.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Oklahoma.

⊙The Southwestern Engineering Co. of Oklahoma City, Okla., has been awarded the contract by the city of Stillwell, Okla., for the construction of a water works for $40,000.

Ada, Okla., has voted the issuance of bonds to the amount of $100,000 for extensions to its water works. It is proposed to construct a reservoir in the mountains, a distance of 15 miles from the city, and pipe the water from the reservoir to the city.

Advices from Tulsa, Okla., state that work has begun upon the new Gulf Pipe Line from Glen Pool, south to Tulsa, to Bartlesville, a distance of some 60 miles. The line will be 8 in. in diameter and susceptible of branching out into all sections of the adjacent country. The Gulf Pipe Line Co. of Beaumont, Tex., expects to have this line completed within a few months.

Plans to furnish Oklahoma City, Okla., with an additional water supply by means of a 3,300-acre reservoir have been accepted by the City Council and the Mayor has been authorized to call a special election to vote on the issuance of bonds in the sum of $1,250,000 to construct the same. The plans were prepared by Alexander Potter, 114 Liberty St., New York City. The reservoir is to be formed by the construction of a concrete dam 1,000 ft. long and 32 ft. high across the North Canadian river. The water will be conducted from the reservoir to the city by means of a 42-in. conduit eight miles long. The cost of the improvements are outlined as follows: Land for reservoir, $400,000; dam and reservoir construction, $325,000; pipe line to city pumping station, water softening plant, $175,000.

Oregon.

⊙Hoge & Swift have been awarded the contract by the City Water Board, Portland, Ore., for 175 Ludlow fire hydrants at $40.20 each, and the John D. Wood Co. was awarded the contract for 25 hydrants for $39.75 each. The hydrants are to be delivered early in the spring, to be installed at the same time as new water mains are laid by the water board.

Advices from Hood River, Ore., state that A. Welch of Portland, Ore., has secured the property of the Hood River Light, Power & Water Co., of which H. F. Davidson is the principal owner. The purchasers secure the city water system and the electric plant at Powerdale and other property.

The City Council of Forest Grove, Ore., has contracted with O. P. Gates of Hillsboro, by which he takes the surplus water of the Forest Grove water system for a term of 10 years at $0.04 per 1,000 gals. A pipe line will be laid from the Forest Grove reservoir to Hillsboro and Cornelius to furnish water to those two cities.

Pennsylvania.

✣Bids will be received until noon, Jan. 17, by Charles T. Straughn, County Controller, Pottsville, Pa., for general contract, including increased water supply, sewage disposal plant, power plant, elevator, heating, ventilating, plumbing and electric wiring complete for the construction of a building for the insane at Schuylkill Haven, Pa.

Steps have been taken by the Borough Council of Glen Rock, Pa., to improve local water conditions and prevent a recurrence of the water famine. Borough Attorney S. D. Wareheim has been instructed to draw up the necessary papers for the enlarging of the plant.

The city of Warren, Pa., contemplates establishing municipal ownership of the water plant.

South Carolina.

The city of Kingstree, S. C., has retained Engineer J. Newton Johnston of Florence, S. C., to survey the city for the installation of a water works system. An election will be held soon to vote on the proposition.

South Dakota.

The voters of Willow Creek, Butte Township, Stanley County, S. Dak., voted bonds Dec. 26 for sinking four township artesian wells in that township, the wells to be located near the heads of several different "draws," to allow the flow of water to spread generally to all parts of the township. Work is to begin before the middle of February.

Tennessee.

The city of Manchester, Tenn., will probably issue bonds in the near future in the amount of $25,000 for the construction of a water works system. E. P. Vaughn is Mayor.

Texas.

⊙It is reported that the Stamford Water Co. of Stamford, Tex., has awarded the contract for the construction of a 300,500,000-gal. reservoir to William C. Cox of that city. Gurley & Hill of Stamford are the Engineers.

Water Commissioner Powell of Fort Worth, Tex., has asked for funds for the establishment of the south side artesian plant.

J. R. Findley and associates of Pittsburg, Pa., have sold the Taylor, Tex., water works to Andrew J. Zilker and associates of Austin, Tex., for a consideration of $90,000, of which $7,000 is in cash and $83,000 in bonded indebtedness. The sale took place Dec. 19 and the new owners took charge Jan. 1.

Information obtained from Brady, Tex., is to the effect that the Gulf, Colorado & Santa Fe Ry. will construct a storage reservoir and dam at an estimated cost of $20,000. The reservoir will have a capacity of 60,000,000 gals. F. Merritt, Galveston, Tex., is Chief Engineer.

The city of Elkhart, Tex., will hold an election some time during this month to vote on the issuance of bonds for the construction of a water works.

A committee appointed by the City Council of Port Lavaca, Tex., to find a suitable water supply for the city has recommended the construction of a reservoir having a capacity of 36,000,000 gals.

Utah.

The city of Trenton, Utah, contemplates the installation of a water works system.

Virginia.

⊙A. W. Maynard & Co. have been awarded the contract by the Water Committee of the City Council of Richmond, Va., for cleaning out the basins of the new reservoir for $6,294. A subcommittee has been appointed to get plans and bids for the proposed new pumps at the Lee district pipe.

⊙Wm. C. Robinson, Son & Co. have been awarded the contract by the Board of Control of Norfolk, Va., for furnishing oils for the City Water Department for $1,260.

Wisconsin.

The City Council of Manitowoc, Wis., has voted to appeal to the State Rate Commission for immediate condemnation of the water works plant of that city for city purchase.

Wyoming.

⊙The Town Council of Greybull, Wyo., has awarded the contract for the construction of a new water works system to the Garrard Construction Co. of Sheridan, Wyo., for $31,960.

Canada.

✣Bids will be received until Jan. 16 (extension of date), by E. A. Dunlop, Chairman of Water Committee, Pembroke, Ont., for either riveted or lapwelded steel piping. Prices to include for 18 in. diameter steel piping ¼ in. thick. Approximate length 6,000 ft. Cast steel flanges. Wood or other approved gaskets. Approximate number fifteen flexible joints cast iron double flanged ball and socket joints. Prices to include delivery f. o. b. cars, Pembroke. Tenders to specify price per foot for piping, including flanges, bolts and gaskets complete. For flexible joints, price per joint to be specified. Tenders to specify price for delivery with limit period for completion up to end of February, 1911, and price for delivery with limit period for completion up to May 31, 1911. T. Aird Murray, Toronto, Ont., is Consulting Engineer.

✣Bids will be received until Jan. 16 (extension of time) by E. A. Dunlop, Chairman of Water Committee, Pembroke, Ont., for delivering cast iron water main. Prices to include for 16-in. diameter cast iron hub and spigot joints. Approximate length 5,900 ft. At least in 12-ft. lengths, exclusive of socket. Pipes to be in accordance with the Canadian Society of Civil Engineers' Standard Specifications for cast iron pipe and special castings. Class D tenders to specify price per foot and include delivery f. o. b. cars, Pembroke. T. Aird Murray, Toronto, Ont., is Consulting Engineer.

SEWERAGE AND GARBAGE DISPOSAL

Arizona.

Phoenix, Ariz., recently held an election to vote on the proposition of issuing bonds to the amount of $60,000 for the installation of a sewer system.

California.

⊙E. R. Werdin & Co., of Los Angeles, Cal., have been awarded the contract for constructing the outfall sewer of the city of Orange, Cal.

⊙The Mervy-Elwell Co., of Oakland, Cal., has been awarded the contract as the lowest bidder on two important pieces of work in the development of the Key Route basin as a municipal harbor, the bids aggregating approximately $50,000. The work includes the extension of the main lake sewer and the 36th St. sewer beyond the Key Route rock wall, which is to follow the line of the present Key Route pier. The company bid $37,369 on the main lake sewer and $7,947 on the 36th St. sewer.

⊙John Ganilla has been awarded the contract by the Board of Public Works of Los Angeles, Cal., for the construction of the sewer on Western Ave., from Slauson Ave. to 50th St., for $9,250.

Plans have been completed and the Board of Trustees of Monrovia, Cal., are ready for bids for constructing an extensive public sewer system in that city. The sum of $120,000 is available. There will be a total of over 30 miles of sewer, ranging in size from 6-in. to 24-in. in diameter. Bids will be received for furnishing the labor and material necessary to complete the entire work and also on the labor and material separately. Vitrified pipe will be used for all sewers except the 24-in., on which bids will be received for both vitrified and reinforced concrete pipe.

The City Council of Berkeley, Cal., has passed a resolution ordering the laying of a sewer on Fulton St., from Ward St., northerly.

The city of Orland, Cal., contemplates holding a special election soon to vote on the proposition of installing a sewer system.

City Engineer Turner of Oakland, Cal., will undertake at once the reconstruction of the sewers between Wood St., and the bay shore. Plans are being prepared for diverting the sewage from the Wood St. district outlets into the Wood St. sewer. The work includes the erection of a pumping plant.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Colorado.

The Westcott Doan Investment Co. of Denver, Colo., submitted the lowest bid Dec. 22 at Colorado Springs, Colo., for the construction of a sanitary sewer in that city.

Illinois.

[illegible] Board of Local Improvements, City of Chicago, Chas. A. V. Standish, Secretary, room 302, City Hall, for furnishing and laying 2,000 ft. of house drains in Sacramento Ave. from Irving Park Blvd. to Montrose Ave., average depth 7.0 ft., work to be completed May 1, 1910: Jno. Deraney, 24 cts. per lin. ft.

City Engineer Daniels of Freeport, Ill., has completed the estimates of cost of the East Freeport and West Freeport sewers, [illegible] The east system which includes a pumping station will cost about $15,164, and the west system about $32,691. The east system will be about two miles in length and will drain the territory from Henderson St. east to the city limits, and from the north city limits to the river. The west system will drain all the territory from American St., on the south to Stephenson St., on the north, and from Globe Ave. on the west to the old city limits on the east. The sewer pipe necessary for the two systems will be 22,359 ft. of 8-in., and 2,303 ft. of 12-in.

The Board of Local Improvements of Hoopeston, Ill., has secured plans and estimates for a system of sewerage which it is proposed to construct in that city. It is planned to put in over 10 miles of sewers with all necessary modern appurtenances such as septic tanks, etc., at a cost of approximately $70,000.

Indiana.

⊙The Julius Keller Construction Co. of Indianapolis, Ind., has been awarded the contract for the construction of a sanitary sewer system in Shelbyville, Ind., for $45,105.

The Board of Public Works of Gary, Ind., has passed resolutions for the construction of district sewer No. 4, which will drain a large part of the east side property south of 13th Ave. Bids will be received for this work some time this month.

The city of Gary, Ind., will erect a septic tank system of sewage disposal in the southern part of the city as soon as possible. This is to be done to turn the flow of sewage away from the lake. The city also contemplates the construction of a sewerage system in the 1st St. district to drain the whole Tolleston district.

Iowa.

The City Council of Mt. Vernon, Ia., has voted to establish a sewerage system with the entire town as one sewerage district.

Kentucky.

✣Bids will be received until noon, Jan. 20, by Commissioners of Sewerage of Louisville, Ky., 605 Equitable Bldg., Louisville, Ky., for the construction of a sewer known as the 2nd St. sewer, Contract No. 77, for the comprehensive system of sewerage for the city. The work will include the construction of about 2,430 ft. of 42-in. and 48-in. concrete sewer, including about 850 cu. yds. of concrete. Excavation from 10 to 22 ft. deep. J. F. Breed is Chief Engineer of the Commission.

Contracts for the construction of sewers were awarded by the Board of Public Works of Louisville, Ky., Dec. 23, as follows: Park Ave., between 6th and 7th Sts., and Brook St. between Avery and Lee Sts., R. D. Smith & Co., $3,600; Jefferson St., between Clay and Shelby Sts., and Baxter Ave., between Rogers St. and Broadway, L. W. Hancock & Co., $3,200; Green St., between Clay and Hancock Sts., and Herp Ave., between Beardstown road and Tyler Park, L. R. Figg & Co., $3,800.

The Board of Public Works of Louisville, Ky., has decided to build lateral sewers in the territory south of the Louisville & Nashville R. R. tracks, between 3rd and 4th Aves. to the city limits. Plans and specifications are being prepared by First Assistant Engineer Roy Burke. City Engineer David Lyman, it is reported, has stated that ordinances and plans and specifications have been prepared for a large amount of street work, the contracts for which will be let about April 1.

Maryland.

✣Bids will be received until 11:30 a. m., Jan. 17, by Commissioners of Anne Arundel County, Annapolis, Md., for the construction of a sewer on Carroll St. and Fifth St., Brooklyn. Plans and specifications may be seen on file in the office of the Commissioners or in the office of John H. Geis & Co., Brooklyn, Md. S. O. Tilghman is Clerk.

Bids as follows were received Dec. 28 by the Sewerage Commission, C. W. Hendrick, Chief Engineer, of Baltimore, Md., for the construction of sanitary contract No. 61—lateral sewers in District No. 40-C: B. F. Sweeten & Son, 820 Sharp St., Baltimore, Md., $92,090.30; Wm. McCarthy & Co., 1007 American Bldg., Baltimore, Md., $94,737; Irwin Bros., Greenville, O., $102,088; David Peoples, 60 Knickerbocker Bldg., Baltimore, $103,658; W. H. & C. F. Thompson, Baltimore, Md., $127,283; Ryan & Reilly, American Bldg., Baltimore, Md., $129,635; The Whiting-Middleton Constr. Co., Sexton Bldg., Baltimore, Md., $138,293. For storm water sewer contract No. 11 the following bids were received: Wm. McCarthy & Co., 1007 Amer. Bldg., Baltimore, Md., $14,584; B. F. Sweeten & Son, 820 Sharp St., Baltimore, Md., $15,297; W. H. & C. F. Thompson, Baltimore, Md., $15,845; Shreve & Caple, 848 Equitable Bldg., Baltimore, Md., $16,113; The Whiting-Middleton Constr. Co., Sexton Bldg., Baltimore, Md., $166.49; David Peoples, 60 Knickerbocker Bldg., Baltimore, Md., $18,371; Ryan & O'Reilly, American Bldg., Baltimore, Md., $19,457; McCay Engineering Co., 9 E. Lexington St., Baltimore, Md., $22,378.

Michigan.

⊙Julius Porath has been awarded the contract by the Board of Public Works of Detroit, Mich., for the construction of a public sewer in Harbaugh Ave., from Dearborn Ave., to Cedar St., for $9,162. Bids were opened Dec. 21.

The City Council of Traverse City, Mich., is having a survey made and data compiled relative to an entire new sewerage system and sewage disposal plant, and has asked the Northern Michigan asylum to join with the city in the new system.

Advices from Grand Rapids, Mich., states that a proposition will probably be submitted to the voters of East Grand Rapids at the spring election providing for the installation of a water and sewer system at an estimated cost of $35,000. Plans are now being prepared by the engineers of the street railway, which will embrace a pumping plant, sewer and water supply. Benjamin S. Hanchett is President of the village.

Minnesota.

✣Bids will be received until 7:30 p. m., Jan. 13, by H. N. Knott, City Clerk, Minneapolis, Minn., for furnishing the city for use in sewer construction during the year of 1911, Portland cement. Specifications are on file at the office of the city engineer.

✣Bids will be received until 7:30 p. m., Jan. 13, by H. N. Knott, City Clerk, Minneapolis, Minn., for furnishing the city for use in the construction of the filter plant during the season of 1911, Portland cement. Specifications are on file at the office of the City Engineer.

Professor Frederick Bass of the state university, Minneapolis, Minn., has prepared plans and specifications for the installation of a sewer system in the city of Hibbing, Minn. By the new sewage system the outlet of the main sewer into Penobscot Creek and from thence into the St. Louis River will be changed, and near this point a devitalizing plant will be erected, at a cost of approximately $30,000. The system will also include percolater, settling tank and sludge bed.

Missouri.

✣Bids will be received until noon, Jan. 6, by Board of Public Improvements, 300 City Hall, St. Louis, Mo., for the construction of a sewer in Rocky Branch Sewer District No. 16 embracing 450 ft. of 18-in. pipe sewer and 690 ft. of 12-in. pipe sewer. W. B. Dryden is Secretary of the Board.

The Board of Public Works of St. Joseph, Mo., has ordered estimates and plans for the 5th Ave. main sewer, which is to extend from the Blacksnake sewer east to 15th St. It will be a 4-ft. drain and will cost about $7,000.

Bills have been introduced in the city council by the Board of Public Improvements of St. Louis, Mo., to authorize the construction of the proposed foul water sewer in Forest Park. The sewer is to be in three sections and will extend from the mouth of the Blackstone sewer to the River des Peres at Rosedale Ave., several thousand ft. through the world's fair section of the park. The cost, including a pumping station and building, is about $71,000.

City Engineer J. B. Hodgdon of Joplin, Mo., has submitted an estimate to the city council from Lewis & Kitchen of Kansas City, Mo., of the cost of a South Joplin septic tank. The estimated cost is $49,000.

New Mexico.

The Board of Trade of Santa Fe, N. Mex., has appointed a committee to confer with the city council for the purpose of inaugurating the formation of an improvement district for sewerage purposes. Frank A. Owen is chairman of the committee.

New York.

✣Bids will be received until 10 a. m., Jan. 26, (instead of Jan. 28, as noted in our last issue), by the Syracuse, N. Y., Intersepting Sewer Board, City Hall, for the improvement of Harbor Brook and the construction of the Harbor Brook Intercepting sewer system under contract No. 10. The work includes approximately 2 miles of brook improvement and 2½ miles of intercepting sewer ranging in diameter from 25 to 50 ins., which will be divided into two divisions. Harry J. Hamlin is Secretary of the Board.

⊙Thos. A. Reilly, 107 E. 75th St., New York City, has been awarded the contract by the president of the Borough of Manhattan, New York City, for the extension and repairs to sewer and appurtenances at 142d St., North River, for $1,981. Bids were opened Dec. 5.

Plans have been completed by Chief Engineer John H. Weinberger of the Bureau of Design, Borough of Queens, New York City, for the construction of a disposal plant for Richmond Hill sewers in the section of Queens. The plans provide for the extension which is to go from the cut-off point, at Lefferts Ave., and the Rockaway road, along Lefferts Ave., to Panama St., thence to Stanley Ave., and thence to the disposal plant. It is planned to let the contracts before spring.

The City Council of Binghampton, N. Y., has instructed City Engineer John A. Giles to survey the 11th, 12th and 13th wards with the view to planning a trunk sewer and the necessary laterals. The city engineer has just completed the survey of the route for a trunk sewer in the 5th ward and the work of mapping out the sewer route will begin at once.

North Carolina.

⊙The Clarendon Construction Co., of Wilmington, N. C., has been awarded the contract by the Public Works Commission of Fayetteville, N. C., for the construction of filtration plant, having two filter units of 500,000-gal. capacity per day. The work includes piping and machinery. The contract price is $12,858. Bids were opened Dec. 15.

The city of Durham, N. C., contemplates holding an election to vote on the proposition of issuing bonds in the sum of $300,000 for extending the sewer system.

Ohio.

The City Council of Ashtabula, O., has been petitioned for the construction of a sewer from Austinburg road to the city, along a road which is now under consideration for the establishment of a macadam pavement.

The village of Bryan, O., contemplates constructing a complete sanitary sewer system, including a sewage disposal plant. Riggs & Sherman, 613 The Nasby, Toledo, O., Engineers.

Plans are being prepared for the construction of an intercepting sewer and sewage disposal plant for Bucyrus, O., by Riggs & Sherman, 613 The Nasby, Toledo, O.

Plans are being prepared by Riggs & Sherman, 613 The Nasby, Toledo, O., for sewage purification for Delaware, O.

The City Council of Lorain, O., contemplates the installation of a sewer system at an estimated cost of between $50,000 and $70,000. F. J. King is mayor.

Plans have been prepared for the construction of sewers in Mathers St., from existing sewer north of Altoona St., to Altoona St.; Altoona St., from Mathers St., to Walter St., and Walter St., between Gilbert Ave. and Altoona St., Cincinnati, O. Edwin Henderson is City Clerk.

Oklahoma.

⦿The City Commissioners of Tulsa, Okla., have awarded the contract for the construction of a sanitary sewer in District 27 to the New State Paving Co., for $1,812. E. C. Fike & Co. secured the contract to build a submain in the Burgess Hill addition for $289.

Pennsylvania.

The city of Pittsburg, Pa., has sold bonds to the amount of $4,878,000 for city improvements. Among the improvements is the prevention of floods, a sewer system, a new city hall, a subway, and the freeing from toll of half a dozen bridges across the Allegheny river to the old city of Allegheny, now the north side of Pittsburg.

The Common Council of Lebanon, Pa., has passed an ordinance providing for the preliminary details of floating the special $110,000 loan for sewerage purposes.

Plans are under consideration in Carlisle, Pa., for the installation of a sewer system, which [illegible] Februar [illegible]

William McClurg Donley has prepared plans for the construction of a one and one-half mile trunk sewer to connect the new sewerage systems of the boroughs of Carrick, St. Clair and Mt. Oliver, and has presented the same to the state department of health in Harrisburg for approval. A disposal plant [illegible] of Beck's Run, opposite Glenwood to take care of the sewage.

South Carolina.

Engineer J. Newton Johnston of Florence, S. C., is surveying the city of Kingstree, S. C., preparatory to the installation of a sewerage system.

South Dakota.

The Aberdeen, S. Dak, City Council has completed arrangements for the special election to be held Jan. 10, for the purpose of voting on a proposition of issuing bonds in the sum of $100,000 for sewer extensions.

Tennessee.

The Shelby County delegation to the Legislature has approved the plan of the citizens of Binghampton, Tenn., to float bonds for public improvements. It is planned to issue bonds in the sum of $60,000, of which $40,000 will be for a new school building and $20,000 for extensions to sewers.

Texas.

⦿The City Commission of Dallas, Tex., has awarded the contract for the construction of a sewer in South Dallas from the Fair Grounds to the Trinity River to J. C. Underwood for approximately $32,000. The pipe to be used is to be 24-in. in diameter.

⦿A contract has been awarded to Hicks & Leland of El Campo, Tex., by that city for the construction of a sewer system for $3,600. The work includes 2,500 ft. of 12-in. pipe, 2,100 ft. of 8-in. pipe, 3,000 ft. of 6-in. pipe and a septic tank.

⦿The City Council of Beeville, Tex., has awarded the contract for the construction of the sewer system to Trueheart & Jackson of San Antonio, Tex., for $21,000. The city will within a short time construct sewers to the residence sections not included in this system at an estimated cost of $9,000.

The City Council of Corpus Christi, Tex., has decided to enter upon the construction of a sewer system in the main business and residence portion of the city. The system will cost approximately $75,000. F. H. Lancashire of Dallas, Tex., has been engaged to prepare plans. Bids will be received in about 10 days for the work.

Virginia.

The City Council of Richmond, Va., recently passed ordinances providing for the construction of sewers as follows: Hampton St., and William Byrd park, from Colorado Ave. to Ashland and Sycamore Sts., estimated cost, $26,170; Colorado Ave., from Hampton to Sumpter Sts., estimated cost, $26,368; Dance St., estimated cost, $12,847; Davis Ave., estimated cost, $5,553, and Leigh St., estimated cost, $6,089.

Washington.

The City Council of Spokane, Wash., contemplates the construction of a number of sewer extensions at an estimated cost of $500,000. The work will be done in District No. 10, which serves the 5th and part of the 4th wards, and district No. 9, which comprises the territory bounded by Washington and Howard Sts., and Sharp and Maxwell Aves. Morton Macartney is City Engineer.

Wisconsin.

The City Council of Sheboygan, Wis., has been petitioned for the construction of a sewer system on both sides of N. 15th St., north of Geele Ave., at an estimated cost of $50,000. C. U. Boley is City Engineer.

The City Council of Kenosha, Wis., has provided for the construction of a trunk line sewer. The city attorney has been instructed to draw up an ordinance providing for the issuance of bonds in the sum of $50,000 for this purpose, and instructed the street assessment committee to advertise for bids for 8¼-ft. or a 10-ft. brick and concrete sewer. The sewer will follow the bed of Jerome creek.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

✣Bids will be received from 10 a. m. until 11 a. m., Jan. 11, by Board of Public Works, Oakland, Cal., for furnishing necessary labor and material for the dredging and filling in of the Key Route Basin, Oakland, Cal. James W. Nelson is Secretary of the Board. To secure faithful performance of contract a bond in the sum of $50,000, with sureties approved by the Board of Public Works, will be required, or successful bidder will deposit with the Secretary of the Board of Public Works a certified check upon some solvent bank for said amount for the faithful performance of said contract, and a bond of 50 per cent of the contract price with sureties approved by the Board of Public Works for the protection of persons furnishing labor and material will also be required.

Delaware.

✣Bids will be received until noon, Jan. 24, by Inspector, Fourth Light House District, Philadelphia, Pa., for rebuilding wharves and retaining walls at Edgmore Light House, Del.

District of Columbia.

✣Bids will be received until Jan. 6 by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing 6 jackboxes and 6 base plates of cast steel for repairs to 95-ton Bucyrus shovels.

✣Bids will be received until 2 p. m., Jan. 10, by Commissioners of the District of Columbia, Washington, D. C., for the construction of a central heating plant and boiler house at M St. High, Simmons and Douglass Schools, Washington, D. C.

✣Bids will be received until Jan. 13 by William Crozier, Chief of Ordnance, Washington, D. C., for furnishing five hand operating shell trolley hoists for turret chambers and 10 hand operating shell hoists for magazines.

✣Bids will be received until 10:30 a. m., Feb. 25, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing machinery to operate the Stoney gate valves for controlling the main culverts, and the machinery to operate the cylindrical valves for controlling the lateral culverts of the locks at Gatun, Pedro Miguel and Miraflores.

Georgia.

✣Bids will be received until 8 p. m., Jan. 10, by B. S. Huie, Mayor, College Park, Ga., for $50,000 of City of College Park Water and Sewer Bonds and $15,000 Electric Light Bonds, both issues bearing 5 per cent semi-annual interest and maturing serially. Each bid must be accompanied by a certified check for $250.

✣Bids will be received until noon (Eastern time), Jan. 26, by Col. Daniel C. Kingman, U. S. Engineer, Savannah, Ga., for bank protection of Savannah River at Augusta, Ga.

Illinois.

⦿B. J. Mullaney, Commissioner of Public Works, City of Chicago, has awarded the contract for winter tug service to the Dunham Towing & Wrecking Co. at $1,800 per month and extra service at $7 per hour.

Indiana.

✣Bids will be received until 10 a. m., Jan. 9, by Depot Quartermaster, Jeffersonville, Ind., for oil as follows: 1,000 gals. cylinder, dark oil; 400 gals. oil for use on Meitz & Weiss kerosene engine; 150 gals. Ammo Cylinder oil; 300 gals. high speed engine oil; 150 gals. gas engine oil; 300 gals. machine oil; 300 gals. N. F. O. oil for use on G. E. 25 k. w. gasoline sets. Maj. J. T. Davidson is Quartermaster.

Louisiana.

The Consolidated Oil & Pipe Line Co. has been organized at Rayville, La., with a capital stock of $5,000,000. W. Kline, of Mangham, is President; John M. Ferguson, of Rayville, vice-president, and E. B. Toombs, of Rayville, secretary-treasurer.

Maryland.

✣Bids will be received until 11 a. m., Jan. 1, by Board of Awards, Baltimore, Md., for delivering timber for the Harbor Board for the year ending Dec. 31, 1911.

✣Bids will be received until 11 a. m., Jan. 17, by Board of County Commissioners, Annapolis, Md., for lighting certain of the streets or roads or portions thereof of Brooklyn, Curtis Bay and vicinity and the vicinity of Linthicum Heights by arc or incandescent electric lamps, term of one, two, five or ten years. Specifications may be obtained of John H. Geis & Co., south end of Long Bridge, Brooklyn, Md.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Michigan.

✣Bids will be received until [illegible] p. m., Feb. 6, by James Knox Taylor, Supervising Architect Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Mount Clemens, Mich.

Minnesota.

✣Bids will be received until noon, Jan. 21, by Board of Park Commissioners, Minneapolis, Minn., for dredging in Lake Calhoun and for filling low lands and boulevard adjacent. The work includes about 500,000 cu. yds. of material. Each bid must be accompanied by a certified check for $1,000. J. A. Ridgway is Secretary of the Board.

⊙Carpenter & Anderson, Grand Rapids, Mich., have been awarded the contract for completing the dam across the St. Joe River at Sturgis, Mich.

New Mexico.

✣Bids will be received until 3 p. m., Feb. 2, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office and Court House at Roswell, N. Mex.

New York.

✣Bids will be received until 1:30 p. m., Jan. 20, by Gen. M. Gray Zalinski, Deputy Quartermaster, New York, N. Y., Army Bldg., for electric freight and passenger cars.

✣Bids will be received until 2 p. m., Jan. 11, by Mayor, Chairman of Armory Board, Hall of Records, Chambers and Centre Sts., New York, N. Y., for six supply contracts, the largest being Item No. 1, for furnishing labor and material to install carpenter work, hardware dumbwaiter, iron work, tablet picture molding, etc., in the armory of the Second Battery, Franklin Ave. and E. 166th St., Borough of the Bronx. Security required is $[illegible]

✣Bids will be received until noon, Jan. 24, by Secretary of the Trustees of Public Buildings in the Executive Chamber, Capitol, Albany, N. Y., for 1, the electric lighting fixtures; 2, the metal book stacks and metal cases; 3, the wood book cases; 4, the electric wiring for book stacks and book cases and extension to existing plant; 5, the elevators and book lifts; 6, the glazed grilles and miscellaneous ornamental iron and bronze items, and 7, the interior decoration, for the New York State Education Building, situated on the north side of Washington Ave., extending from Hawk St. to Swan St., in the city of Albany, N. Y., and opened publicly by the Trustees of Public Buildings in the Executive Chamber. A separate and distinct proposal is required for each of the seven items of work for which proposals will be received.

⊙The P. J. Carlin Construction Co., New York city, has been awarded the contract by the State Commission on New Prisons, for the construction of the new prison at Wingdale, Dutchess County. The contract price is $2,196,000.

⊙Wells, Boughton & Co., 838 Second Ave., Troy, N. Y., has been awarded Barge canal contract No. 91, calling for the construction of a power house and equipment, at Crescent Dam. The contract price was $42,940. Bids were opened at Albany, on Dec. 21.

Snare & Triest Co., New York city, at $122,980, was low bidder Dec. 22 for the construction of caissons for the U. S. dry dock now being built at New York City.

Ohio.

✣Bids will be received until 9 a. m., Jan. 13, by Board of Managers of the Ohio State Penitentiary, Columbus, O., for a plenum system of heating and ventilation and changes in East Hall. Plans and specifications will be on file at the office of Marriott & Allen, Architects, 20 E. Broad St., Columbus, Ohio, and the Osborn Engineering Company, Osborn Building, Cleveland, Ohio; and will be open for public inspection between the hours of 8 o'clock a. m. and 5 o'clock p. m., on every working day.

Oregon.

✣The Port of Toledo Commission, Toledo, Ore., is reported to be calling for bids until July 11, for building an 8-in. suction dredge. Bids will also be received on a clam shell type of dredge.

⊙The Spokane, Portland & Seattle R. R., a Hill line, has awarded a contract to Joseph Supple, Portland, Ore., for the construction of a new dredge to be used in making fills on the North Bank where trestles and bridges are now used. It is expected that the dredge, which will be equipped with an 18-in. suction pipe, will have a monthly capacity of about 150,000 yds. Its cost will approximate $100,000. The dredge itself will be 120 ft. long over all, 34 ft. beam and will have a depth of hold of 7 ft. In addition two oil barges 50 ft. long, 16 ft. beam, and having 4 ft. depth of hold will be built at the Supple ship yard as fuel tenders for the dredge. The pontoons for the pipe line will be 20 in number and will be 20 ft. long by 10 ft. wide. The pipe line will have a length of about 2,000 ft. and an electric light plant will be installed to facilitate night work.

Pennsylvania.

✣Bids will be received until noon, Jan. 20, by Joseph F. Hasskarl, Acting Director of the Department of Wharves, Docks and Ferries, 555 Bourse Bldg., Philadelphia, Pa., for the construction of the superstructure of Vine St. pier (Pier No. 19, North, Delaware River). Plans, specifications and blank forms upon which bids must be made can be obtained at this office, upon the deposit of $25 to cover the cost of making blue prints, etc., which will be refunded to the bidder upon the return of the drawings and specifications in good condition. The successful bidder will be furnished all necessary blue prints free of charge. The amount of money at present available for this work is $200,000, and as the estimated cost of the superstructure complete is between $350,000 and $400,000, the contractor will be obliged to enter into a Supplemental Contract or contracts for the completion of the work, upon the request of the Director of the Department of Wharves, Docks and Ferries, when further appropriations are made or become available.

✣Bids will be received until noon, Jan. 17, by Charles T. Straughn, County Controller, Pottsville, Pa., for general contract, including masonry, carpentry, iron and steel, ornamental iron roofing, painting, fireproofing plastering, etc., labor and materials complete.

Rhode Island.

✣Bids will be received until 2 p. m., Jan. 13, by Lieut. Col. J. C. Sanford, U. S. Engineers, Newport, R. I., for dredging Newport Harbor, R. I.

⊙The Coastwise Dredging Co., Norfolk, Va. has been awarded the contract at 7.84 cts. per cu. yd., for dredging 1,698,240 cu. yds. of material from the Providence river, R. I., for the U. S. Government. Bids for this work were opened Dec. 17 at the office of the U. S. Engineer, Newport, R. I.

Texas.

✣Bids will be received until Jan. 6 by Fred H. Gallup, Capt. and Quartermaster, Fort San Houston, Texas, for furnishing 24 cast iron soil bends, 16 tee branches, 20 Y-branches, 200 pounds Portland cement, 8 vitrified curves, 16 brass ferrules, 8 vitrified increasers, 16 plugs, 600 ft. water pipe, 100 ft. sewer pipe, 6 compression stops, 1 barrel sand and 7 laundry tubs.

Utah.

✣Bids will be received until 3 p. m., Feb. 3, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus and electric conduits and wiring system, of the United States Post Office and Court House at Salt Lake City, Utah.

Washington.

The Municipal Commissioners of Tacoma have accepted the designs for a new municipal dock. The plans call for a structure of concrete to cost about $120,000. W. C. Raleigh is City Engineer of Tacoma.

The following bids were received by the U. S. Engineers for dredging in the Willapa river: Standard American Dredging Co., 26 cts. per cu. yd.; Puget Sound Bridge & Dredging Co., 19.9 cts.; International Dredging Co., 26.3 cts.; Tacoma Dredging Co., 23½ cts.

Residents of McMillan have petitioned the County Commissioners at Tacoma, to erect a dam to restore the Puyallup river to its original bed near McMillan.

It is expected that the Chamber of Commerce of Aberdeen will take some action shortly looking to the securing of a municipal dock for the city.

The Morton Co., Seattle, Wash., was the low bidder Dec. 22 for the construction of caissons for the U. S. dry docks now being built at Pearl Harbor, Hawaii station and the Puget Sound navy yard. The bid for the Pearl Harbor caissons was $110,000; for the Puget Sound caissons the bid was $125,000.

Wisconsin.

⊙Whitney Bros., Superior, Wis., and W. F. Hill, Superior, have been awarded the contract for tearing down dock No. 1, of the Duluth & Iron Range Rys. ore handling system at Two Harbors and for construction of the foundation for the new steel dock to replace the one torn down. The contract amounts to about $200,000. The present dock, which is to be torn down, is 1,380 ft. long and 60 ft. wide, and contains 6,300,000 ft. of timber. The construction of the new dock will involve the building of a cofferdam around the site, the driving of 200,000 ft. of piling. This will be covered with gravel and a double concrete floor laid on top of it. In addition to the 200,000 ft. of round piling there will be 70,000 ft. of sheet piling to be driven, 20,000 cub. yds. of gravel filling and 13,000 yds. of concrete work.

The Great Northern Ry. has detailed plans underway at its St. Paul offices of the superstructure for its ore dock at Allouez. Orders have been placed for 9,000 tons of steel for the dock and construction work will be started early this year.

Canada.

✣Bids will be received by the Chairman, Board of Control, addressed to M. Peterson, Secy., Winnipeg, Man., until 11 a. m., Jan. 12, for the manufacture, delivery and erection at Point du Bois, Man., of one stop log winch. Specifications and form of tenders may be obtained from Power Engineers, Carnegie Library.

The Canadian government will pay a subsidy of $2,000,000 to the Grand Trunk for its proposed drydock at Prince Rupert. The dock will be one of the second-class, and will get a subsidy of three and a half per cent for 25 years. The estimate has been made by the Chief Engineer of the Department of Public Works from plans filed by the company. There is another second-class drydock planned for Vancouver. The Messrs. Bullen, shipbuilders, of Vancouver, are completing plans which they will file in a few days, and will at the same time apply for the second-class subsidy.

⊙The Saskatoon Investment & Trust Co., Saskatoon, Sask., on Dec. 30 let the contract for the building of the King George hotel to the Carter-Halls-Aldinger Co., Ltd., of Winnipeg, the price being $246,000. The total cost of the hotel with furnishings and site will be in the neighborhood of $400,000.

Private corporations, believed to be backed by Mackenzie & Mann of Toronto, are reported to be securing available hydro-electrical sites on the Winnipeg River below Lac du Bonnett and Point du Bois.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

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The Rapid Solution of Quadratic and Cubic Equations by the Method of Substitution.

When an engineer wishes to solve a problem in applied mathematics, such as the flow of water through a pipe, he commonly refers to a general formula in which proper substitutions can be made, or to a table that gives the result even more quickly. But when the same engineer [illegible] equation, such, for example, as a quadratic equation, [illegible] method of solution and work out the root of the equation [illegible] formula [illegible] the equation.

[illegible]

form:

[illegible]

of the general form:

[illegible]

There is greater expedition and less chance of error when quadratic equations are thus solved by substitution.

[illegible] by substitution is preferable.

The general form of a cubic equation is

[illegible]

Its root is:

(10) [illegible]

Cubic equations do not occur [illegible] in engineering practice, but when they do occur they are apt to dismay the engineer who has grown rusty in his algebra. Whereas there should be no cause for dismay, and there would be none if he had at hand the general equations (9) and (10).

A more difficult form of the cubic equation is one containing the second power of the unknown quantity, thus:

$$(11)\quad x^3 + mx^2 + nx = r$$

This, however, can be readily reduced to the form of Eq. (9), by substituting

[illegible]

Then we have

(12) [illegible]

In Eq. (12) the [illegible] Eqs. (9) and (10) [illegible] right hand side [illegible] (9) and (10). From which, by substitution in Eq. (10), the [illegible]

and, since [illegible]

in Eq. (11) [illegible] applicable.

[illegible] quently perceive that the numerical value of mx^2 is so small compared with the other terms as to be negligible. In that case the equation [illegible] that a substitution of numerical values of the [illegible] ties in any complex equation, frequently results in greatly simplifying it, by indicating what terms are so small as to be infinitesimal compared with the others, and therefore to be dropped entirely if connected to the others by a plus or minus sign. Obviously if the in[illegible] multiplication or division sign to finite quan[illegible] dropped.

Due to the usual school and college training that an engineer receives, neither methods of substitution in solving equations nor the elision of infinitesimal terms are apt to receive the attention of the young engineer. So fixed does habit become that not even all older engineers are free from wading through [illegible]

The Suspended Bracing for the Open Cut Work of the La Salle Street Tunnel.

Elsewhere in this issue we give a description of the construction work which has been in progress for the past year at the La Salle St. [illegible] large work carried on in the center of a large city, this work involves many interesting features. Attention is called to the design of the bracing of the open cut work which occupies the width of the street for nearly one block. The plans given on another page show the design of the bracing in detail. The main consideration in the design of the bracing was the prevention of settlement of the buildings along the street, bordering the work on either side and all of them on "floating" foundations. Secondarily, although about as important, were the problems of designing the bracing to serve as many purposes as possible and not be in the way of any part of the work. The design provides a platform on top of the bracing from which a large share of the work is done and provides storage room for material going into the construction. By suspending the entire framework of the bracing from above, the excavation work has not been cramped or hampered underneath; the bracing was added as the work was carried down—each member of the bracing being suspended to the piece above as soon as the excavation allowed room for it. When the excavation was completed the concrete work was carried up from the bottom and the bracing was dismantled from the bottom upward. In this way the work was at all times free underneath.

The bracing was supported at the sides of the [illegible] ft., heavy timbers were required. As the bracing bore its own weight, that of the working platform and the weight of considerable material the heavy timbers had to be trussed between the upper two tiers. The pressure against the sides of the cut was taken care of by forcing wedge blocks between the timbers and the steel sheet piling.

The success of the method has been apparent in every way.

The Economic Value of Waterway Transportation With Reference to the Proposed Deep Waterway from Chicago to the Gulf.

All of the engineering problems connected with the proposed deep waterway from Chicago to the Gulf are capable of definite solution by direct methods. In fact, an investigation has already been made by a Board of Army Engineers, and, from an engineering point of view, the undertaking has been found to be feasible. The economic expediency of such a thing is, however, open to question, and prevents some difficult problems.

An impartial view of this question, based on reliable data, is particularly valuable at the present time. For this reason we wish to call the attention of our readers to a paper published elsewhere in this issue, entitled "Waterways: Their Limitations and Possibilities," by Mr. F. A. Delano.

In this paper the whole question of the economic value of waterways is discussed. What is of timely interest is the portion relating to inland waterways. Trans-oceanic routes are in [illegible]

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ent. Here the water transportation comes into competiton with the railways, and it is necessary to make a comparison of the efficiency of the two modes of transportation from an economic point of view.

In what follows it is not our intention to take the part of an advocate, but rather to review some of the facts and arguments offered in Mr. Delano's paper. It is only fair to say, however, that the conclusions reached, based as they are on adequate and reliable data, would be hard to refute.

One of the most difficult questions in waterway transportation is that of terminals. The wharves of a water route are of necessity usually so located as to be inconvenient of access for a large part of the traffic served. However important a factory, for instance, may be, its inbound freight must be hauled from the wharf, and its outbound freight must be delivered to the wharf for shipment. In contrast with this a railway car, by means of a siding, delivers goods at the door of the factory. As stated in the paper, a railway can go wherever there is traffic. A further disadvantage of the waterway is that trans-shipment is necessary where freight is delivered to connecting lines.

The greatest economic value of the coastwise steamship lines and the steamship lines of the Great Lakes seems to lie in their use as private carriers for large industrial companies, and as links in through rail-and-water routes. For this reason most of the important steamship lines of this class are owned by industrial or railway companies. Economic necessity, and not the stifling of competition, seems to have been the controlling factor in bringing about this condition. It is thus seen that there is little competition between the railways and the trans-oceanic, coastwise or Great Lakes steamship lines.

But a radically different situation exists with reference to transportation by canals and rivers. Here competition with the railways is direct, and in order to justify such an expenditure as would be required in constructing and maintaining a deep waterway from Chicago to the Gulf it is necessary to show that such transportation is superior in an economic way to railway transportation. In determining the cost of transportation by water it is not sufficient to consider alone the rates paid to the transportation companies. Additions must be made to these rates to cover maintenance of waterways, interest on investment, and other legitimate charges. These charges are made in an indirect way through the medium of taxation, but they must be taken into account in any broad consideration of the question. This principle is so self-evident as to need no proof.

From this point of view how do water rates compare with railway rates? The extensive use of inland waterways in Europe, particularly in France and Germany, is often used as an argument in favor of the development of the inland waterways of this country. Accepting as correct the data given in Mr. Delano's paper, the conclusion is inevitable that the extensive use of inland waterways in Europe, and the relatively insignificant use of such waterways in the United States is due not to the superiority of the European waterway, but to the superior efficiency and lower rates of the American railways.

Contrary to popular opinion, the canals and rivers of France and Germany do not appear to be in any way superior to those of the United States. The maximum depth of the rivers and canals of France is 8.5 ft., much of the traffic being carried in depths under 5 ft., and some of it in depths as low as 1.5 ft. The Rhine and the Elbe, on which 67 per cent of the water-borne traffic of Germany is carried, have a depth of 4.5 ft., which is the minimum depth of the present water route from Chicago to New Orleans. In the United States there are 2,600 miles of river channel having a depth of 10 ft. or more, and 3,200 miles having a depth of 6 to 10 ft. With such barges as are used in Europe it would be feasible to handle a large traffic on a great proportion of the rivers of the United States. The [illegible]

transportation, then, is not due to any inferiority of our inland waterways.

The average rate per ton mile on the railways of France is 14 mills, and on those of Germany 13 mills. The average rate per ton mile on the inland waterways of Europe cannot be accurately stated; but it is about 6 mills in France, and 5 mills in Germany. With interest on investment and maintenance added to these rates, the economic cost of waterway transportation in France is about 10 mills per ton mile, and in Germany it is about 6 mills per ton mile.

Since a water route is usually longer between terminals than a rail route the relative cost of shipment by water is somewhat greater than indicated by these figures. But after allowing for this there is still ample margin to account for the popularity of inland waterways in Europe.

The average rate per ton mile on the railways of the United States for the year 1909 is given as 7.63 mills. This is an average figure for the entire country, including mountain railways, with which waterway transportation can never compete. In general the rate is much lower than this. On the Pennsylvania R. R. it is 6.3 mills and on the Chesapeake & Ohio R. R., 4.33 mills. There is no apparent reason for believing that rates for waterway transportation can be made any lower in this country than in Europe. These figures indicate that the economic cost of waterway transportation might be greater in this country than that of railway transportation. In any event it is difficult to see how such an economic gain could be brought about as would justify the expenditure required for constructing a deep waterway from Chicago to the Gulf. In considering this point every legitimate charge against the waterway must be taken into account, and the rates placed on the same basis as railway rates. It is evident that the low rates of American railways offer a serious obstacle to the economic success of our inland waterways.

The proposed 14-ft. channel is in the nature of a compromise. With this depth only a small percentage either of ocean or Great Lakes shipping could use the waterway. It is stated that over 95 per cent of the vessel tonnage on the Great Lakes draws more than 14 ft., and that this percentage is still greater for sea-going vessels. Even if a 14-ft. channel were adequate it would be necessary to transship freight at every one of the branches or "feeders" of this waterway, as it would be impracticable to create and maintain a 14-ft. channel in each branch. The Board of Army Engineers that investigated this waterway found the 14-ft. channel to be impracticable from an economic point of view, but recommended a 9-ft. channel for barge traffic.

A great deal has been said and written in favor of this waterway. In view of the clear arguments presented by Mr. Delano, it seems time for its advocates to come forward with definite proof of the economic value of the undertaking.

The Efficiency of the Plan of Administration of the New York Barge Canal Work.

The act governing the construction of the New York State Barge Canal was formulated in the shadow of the nine million dollar Erie Canal improvement scandal. Responsibility for the Erie Canal improvements had been vested substantially in a single official. When the disclosure of mismanagement and waste came there was a natural revolt first from further expenditure and afterward from placing such expenditure unchecked in the hands of a single person. The Barge Canal act was formulated with the necessity in mind of allaying this revolt; otherwise it was probable that the project would not be authorized by the taxpayers. The reversal of policy was complete. Instead of concentrating responsibility in the hands of a single official, as had the Erie Canal improvement act, the Barge Canal act divided responsibility between no less than four State officials and official bodies, as is described elsewhere in this issue. Criticism and complaint of this division of authority and responsibility have developed and accumulated.

Early in December, 1910, as the result of the conditions last named, Governor White requested the State Engineer, the Superintendent of Public Works and the Board of Advisory Consulting Engineers to report to him upon "the situation presented by the constitutional and statutory provisions and the character of the work up to the present time." He also expressed fear that the total cost of the work might exceed the estimate, implying that he should welcome assurances on that matter as well as on the quality of the work done. Two of these reports, those of the Superintendent of Public Works and of the Board of Advisory Consulting Engineers, are published somewhat condensed in another column of this issue. They are interesting.

To summarize briefly, there seems slight reason to fear that the actual cost of the work will greatly exceed the estimated cost of $101,000,000. There appears also no reason to doubt the generally good quality of the work done. Both reports make it clear that the method of administration has been cumbersome and has for one cause and another led to delays and made the work slow. Necessarily this must have increased costs. Both reports agree that the method of administration has resulted in a careful safeguarding of the Barge Canal work from the vicious conditions manifested in the Erie Canal improvement work as alluded to above. With these facts before us one may naturally conclude with the Board of Advisory Consulting Engineers that it is probably not advisable at this stage of the Barge Canal work to make any attempt at a sweeping change in the present form of administrating this work. The pro-waterway interests have read into these facts a proof of efficiency, however, and this matter deserves consideration.

The plan adopted for the administration of the New York Barge Canal work has never been and is not now a businesslike plan. It is slow and it is expensive. Practically every point in criticism made by the Superintendent of Public Works in his report is a point well taken. The fact that the construction has probably proceeded too far to justify a change; the fact that the people's money has been safeguarded; the fact that the canal will be constructed within the original cost estimates, and the fact that the construction work has been of satisfactory quality do not affect the pertinence of this criticism. Neither does the plea that the main disturbing feature has been the frequent changes of State engineers, due to political upheavals. Such changes were to be anticipated; no assurance of escaping them could be had except by devising a plan of administration that would have eliminated the effect of election returns. Had no other way been possible to safeguard the public from possible repetition of the Erie Canal improvement scandal, then probably the price was worth paying. But there were other ways. A commission organization would have been one way. It is claimed that this was not legally possible. Granting this, we venture to say that had there been as much concern evidenced by the lawmakers in formulating a well thought out and efficient plan for administrating the expenditures of a hundred millions of the people's money as there was evidenced in granting the desire of the pro-canal interests for immediate construction, a way would have been devised to make a commission legally possible.

The report of the Board of Advisory Consulting Engineers admits that the plan of administrating the Barge Canal work is not an ideal one. It not only is not ideal, but it is cumbersome and inefficient, and we say inefficient advisedly. The fact that none of the people's money has been stolen or wasted, or that the work is not costing more than the people expressed themselves willing to pay, does not spell efficiency. On the other hand, rushing to get work under construction before complete plans were formulated, withdrawing and revising plans with each change in the office of State Engineer, these changes of the technical head of the work in themselves, and a half dozen other items noted in the report of the Superintendent of Public Works, do all spell inefficient administration. As an organization for the business of constructing a hundred million dollar public work the four-headed Barge Canal administration is decidedly faulty.

In making the above criticisms it will be understood that we are referring wholly to the plan of administration as established by statute and not to the men who have filled the various offices of this organization. These men generally deserve praise for the manner in which they have acted together to make the best of an unwieldy organization plan. And right here we wish to note with approval the comments of the Superintendent of Public Works on the salary paid the State Engineer, who is the technical head of the work. Think of it, the munificent sum of $5,000 a year for the man who is to conceive, develop and execute the plans for all the work of a hundred [illegible]

CONCRETE AND REINFORCED CONCRETE SECTION

Method of Finishing Concrete by Rubbing, Floating and Brushing, with Some Costs.

BY S. M. [illegible]*

In order to give any concrete structure a pleasing, durable and inexpensive surface finish, the most important consideration is to have a good foreman on the work; a foreman who understands how to lay out his work to advantage, who knows how to build forms, who can handle concrete intelligently, and who can train his men. Intelligent inspection and supervision is another important requirement.

Beginning with the form work, I have seen good carpenters construct careless and poor forms, when a little attention by the foreman or inspector could have remedied many defects. It is just as cheap and often cheaper to build the forms well and substantial from the start as to patch, chink and shim later on.

In constructing forms tongue and grooved lumber is not necessary. Hard pine boards, planed on one side or both, 1½x8 ins., will best do for face lumber. Boards of this width do not warp so much as wider boards, and do not corduroy the face to the same extent as narrower boards will. Studs can be made 2x4-in. 2x6-in., 4x6-in. and walls 6x6-in., 6x8-in., sometime of 8x10-in. according to the nature of the work and amount of concrete deposited each day.

It is essential to start all face boards horizontally and keep them horizontal by drawing the boards down with a wedge, which also closes all openings and leaves the forms tight, and nail each board securely to every stud. By shimming some boards and nailing others tight, the unsightly fins on the face can be largely avoided.

The same care need not be taken with back forms and bulkheads; 1-in. boards can be used if securely studded and waled. However, the back forms and bulkheads should be tight to avoid honeycombing.

After the forms are built they should never stand long in the sun and be exposed to the weather. If such is the case they will need relining, shimming and chinking. The boards will shrink and warp and the whole formwork will be twisted out of shape unless kept wet. All forms should be studded carefully to avoid bending of boards between studs. They should be nailed every 5 ft. and if possible rodded and not wired. From cost data which I kept I learned that rodding was much cheaper than wiring. Further, it was safer on large structures and, what is very essential, rodding left more working room for dumping buckets and the men to work in the forms. Rules for designing concrete forms are difficult to deduce as every structure has its own peculiarities: the amount of concrete deposited in the form, if wet or dry, if deposited by hand mixing or machine mixing from a board or from dump buckets, all influence the design. I have built forms which were perfectly safe with a dry mixture shoveled off a board, but which began to give and needed rebracing when the concrete was wet and was dumped from buckets.

Great care should be exercised with the mixing and depositing of concrete. Ignorant supervision and inspection are often the cause of careless work. With careful and intelligent supervision and inspection all men co-operate with the foreman and inspector and good work is the result. Concrete should be thoroughly mixed and should never look raw when deposited in the forms. Where possible machine mixing is preferable to hand mixing. If hand mixing is used concrete should not be shoveled into the forms until the mixture has a uniform fatty appearance and when struck with the back of a shovel on the mixing board the concrete should be left smooth and the shovel clean. Concrete should never be mixed too wet and the cement drowned out.

On the triple 60-ft. arches built by the Pennsylvania R. R. west of Richmond, Ind., a four pan Haines mixer was used which mixed 1 cu. yd. of concrete per batch. When work was started in the morning the foreman used 25 gals. of water per batch until a 6-in. layer of concrete was deposited on the bottom of the forms, then the water was reduced, but to never less than 15 gals. per cubic yard, so that the concrete quaked in the forms but water seldom accumulated on the surface. The foreman used great care in depositing all concrete in 6 or 8-in. layers, following the horizontal marks between two boards and forking the concrete with a potato fork after spading first with a shovel. The forking was carefully done by pushing the fork down into the concrete 8 ins., drawing the fork back from the face slowly to allow the grout to reach the face, then withdraw the fork and repeat the process. The man forking had to tramp around the face tamping the concrete with his feet. Spading was thus done all around, giving a homogeneous, impervious concrete everywhere.

Generally 150 cu. yds. of concrete constituted a day's work. Expansion joints were arranged in such a way as to facilitate concreting and to finish one or two sections each day. However, if a section was too large or through a breakdown could not be filled and a horizontal joint was required the foreman left the concrete at the end of the day or whenever a stop was made perfectly level following the joint between two boards. If any excess water was in the forms the foreman drew it off by boring holes with an auger in the back and plugged the holes the next day. A man washed the face boards with a whitewash brush and water to have them clean next day, then he forked all around the forms and with a shovel or float smoothed the concrete for 6 ins. along the face. The concrete was sound and solid around the face next day and not soggy, dirty and full of mud. At the back the concrete was left about 2 ins. lower than in front and 2x12-in. or 3x8-in. plank was laid along the back and forced into the concrete. Through the center 6x6-in. timbers were forced in to form keys for the upper layer and were taken out next day.

By drawing the water off the top before closing a day's work and taking care that no water should accumulate the foreman avoided laitance altogether and never had any trouble after he learned how to avoid the same. Laitance is caused by the very fine impurities, finer than pass a 200 mesh, floating on top of the water and accumulating as the impurities increase. If the water is allowed to stand and to evaporate the impurities are deposited on the surface. These impurities seldom if ever set up hard and if not cleaned off will leave a yellow band along the face, a mark showing ignorance and carelessness by the foreman and by the engineer or his inspector.

Every time a day's work is finished and a horizontal joint is thereby required, forethought should be used to either stop 6 ins. below a wale, wiring or rodding, or 6 ins. above. If stopped 6 ins. below the wires and rods can be tightened and the face boards made to hug the previous day's work, thus avoiding an unsightly lip and a saggy contact which will always show and deform an otherwise good surface. If stopped 6 ins. above the rods or wires the weight of the concrete will tighten the wire and draw the wale close to the studs and thus bring the boards tight to face. Should the foreman neglect the above precaution he must shim the boards away from the studs with shims and not just drive them out with the hammer. Unless the boards are shimmed the wet concrete will force them back against the studs and the result will always be an ugly fin.

In finishing the forms the foreman was careful to have them the exact height on the top. He made it a rule to chamfer all sharp corners and copings with a ¾-in. beveled strip of wood. He also inserted a ¾-in. strip vertically at every expansion joint, leaving a notch 1½ ins. wide and ¾-in. deep at every expansion joint, thus doing away with irregular and saggy contact, especially where the forms were built in sections and moved, the whole face and back to construct another section and save carpenter work. In such a case the forms were oiled and cleaned before they could be used over again, and the face was repaired where needed.

The concrete was always filled an inch higher than the finished forms and was allowed to settle. Copings and exposed surfaces were well spaded on the top to bring mortar to the surface and after allowing an hour for settlement were leveled off with a straight edge, then smoothed off with a wooden trowel and stroked with a moist whitewash brush. This gave a homogeneous surface which did not scale. Topping off copings with mortar was not allowed, and better results can be obtained by spading the concrete and then straight edging than by topping off with a layer of mortar which sooner or later will crack off. As soon as the concrete was set the top of all copings was covered with an inch layer of sand and kept wet for 10 days to prevent crazing.

Forty-eight hours after the last batch was placed in the forms they were removed whenever possible. If the surface was green and soft, fins were scraped off with the edge of a trowel where noticeable, then the surface was wetted with a whitewash brush with clean water and easily rubbed with a 2½x2½x6-in., 2 to 1 mortar brick not more than 8 days old. The men rubbed the wall with a circular motion which left spots in places. Next day the wall was moistened and floated all over the surface with a wooden float and after that stroked in one direction up and down with a moist, clean whitewash brush. Two men rubbed and finished a section 10 ft. high, 30 ft. long and 3 days old in four hours at 17½ cts. per man per hour.

Where the concrete was a week old and older after forms were removed all fins were removed with a bush hand chisel having five blades. The surface was then wetted with plenty of cold water and rubbed with a 2½x2½x6-in. 1 to 1 mortar brick not more than 6 days old. One section was rubbed down well, all rod holes were plugged and next day the section was floated down and stroked with a moist, clean whitewash brush. No cement [illegible]

corners had to be carefully repaired by thoroughly cleaning the surface, wetting the patch down well, then if possible driving 20d nails [illegible]

---

*[illegible] Commission.

[illegible] brushed bleached out uniformly everywhere, showed neither spots nor blemishes and gave the whole face a beautiful smooth dull finish. [illegible] at 17½ cts per hour averaged 25 sq. yds. per man nearly every day rubbing and finishing was done, and they became very efficient at it [illegible]

Some Methods Employed in Constructing Two Reinforced Concrete Reservoirs.*

[illegible] of the new water-works of [illegible] Mexico, and may be designated as the Guadalupe and the Obispado reservoirs.

GUADALUPE RESERVOIR

The reservoir is a covered one, of rein[illegible] the circular form the [illegible] desirable. On the [illegible] 2 m. (6.56 ft.) below the [illegible] ground line, [illegible] 1621.

while the excavation at the upper part of the slope was about 12 m. (39.4 ft.) deep. The excavated material consisted chiefly of sillar and limestone conglomerate, which when [illegible] clay of an excellent character for the formation of embankments, when proper care is taken. The dimensions fixed for the internal diameter of the finished concrete work of the reservoir were: 81 m. (265.68 ft.) at the top, and a depth of water of 9 m. (29.5 ft.), with sides sloping 55 in 100.

On the lower side the original ground line was cut down in steps, and all loose earth, roots, etc., were carefully removed. The floor of the reservoir was chiefly sillar conglomerate, a hard material that required a considerable amount of blasting for its removal. [illegible] embankments were formed in 10 cm (3.9 [illegible]) layers of clay and conglomerate broken into small fragments and then rolled with 3-ton sectional rollers drawn by teams of 4 and 6 mules, which assisted in disintegrating the mass thoroughly, and produced by constant wetting a homogeneous and compact clay. The excavation and embankment were left so that 15 cm (5.9 ins.) of trimming could be done at a later date, immediately prior to the lining of the reservoir. The excavated material amounted to about 34,000 cu. m., and, of this quantity, 31,500 cu. m were used to form the embankment; the remainder was taken to a spoil bank immediately adjoining, the black earth stripping being separated and reserved [illegible] The [illegible] prices for the excavated material placed in the embankment were:

	Pesos per cu. m.
[illegible] removed [illegible]	0.60
[illegible] chiefly of "sillar"..	1.09
[illegible] conglomerate (requir[illegible])	1.6[illegible]

The prices (for the same classification) for material taken to the spoil bank, were 0.40, 0.80, and 1.40 pesos, respectively. Of the material taken out 15 per cent came under No. 1 classification, 80 per cent under No. 2, and 5 per cent under No. 3.

The excavation was begun at the end of May, 1907, and completed in January, 1908, by Scott and Lee, the contractors. The embankments were then allowed to stand until the beginning of July, 1908, to permit the whole to become thoroughly settled and consolidated prior to beginning the lining. In July the work of trimming the embankments and excavating for the foundations of the reservoir columns was commenced, under the company's own administration, which completed the entire work.

Concrete Lining and Roof.—The general arrangement and details of the side-walls, columns, and roof are shown by Fig. 1. The principal feature consists in dividing the reservoir into radial sections and supporting the roof on 135 primary and 670 secondary beams, from 135 columns spaced as follows:

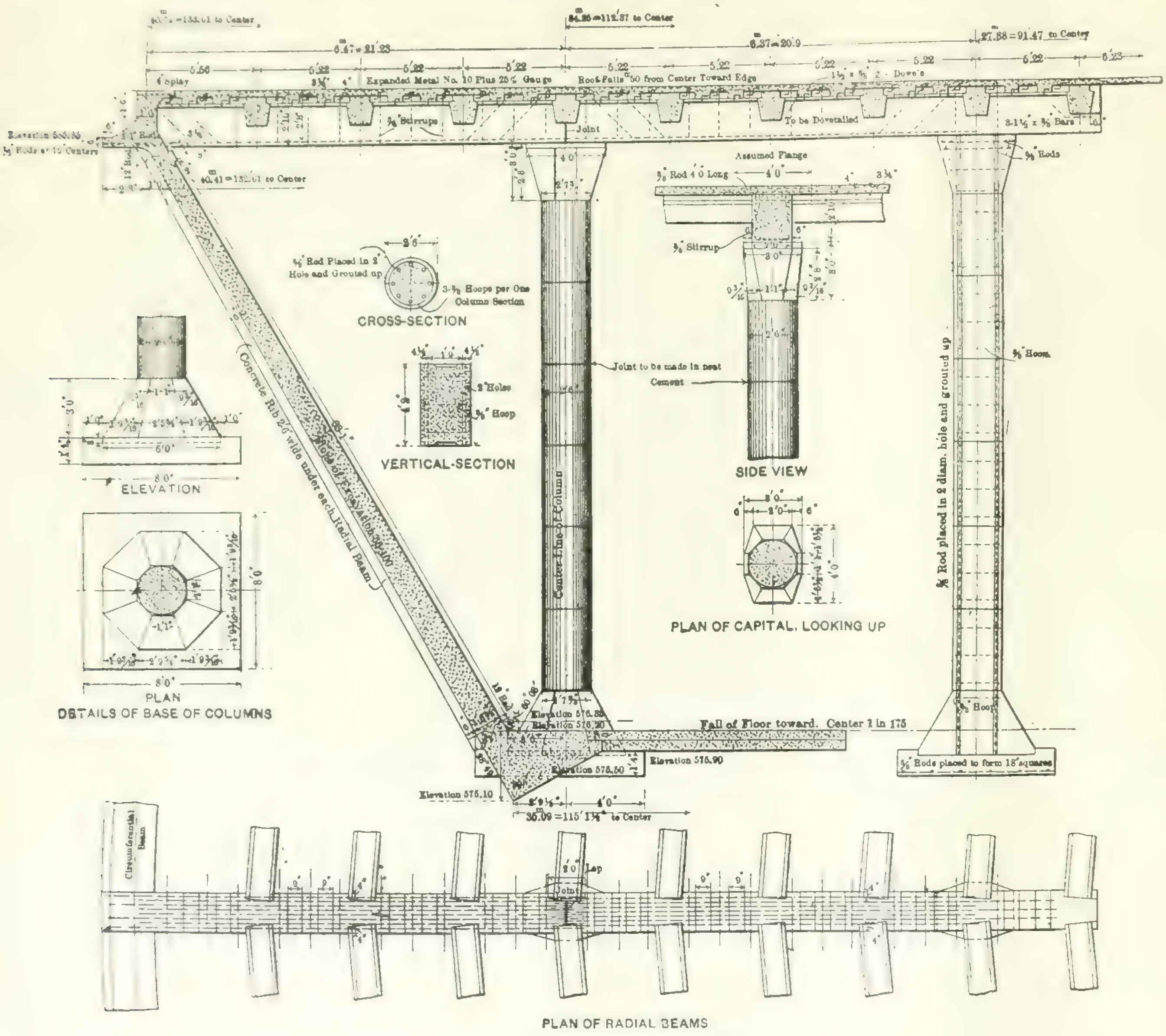
40.41 = 133.01 to Center
34.36 = 112.87 to Center
6.47 = 21.23
6.37 = 20.9
27.88 = 91.47 to Center
Expanded Metal No. 10 Plus 25% Gauge
Roof Falls 1/60 from Center Toward Edge
To be Dovetailed
Joint
Stirrups
Elevation 585.85
Assumed Flange
Stirrup
SIDE VIEW
Joint to be made in neat Cement
Rod Placed in 2" Hole and Grouted up
3-⅜ Hoops per One Column Section
CROSS-SECTION
2" Holes
Hoop
VERTICAL-SECTION
ELEVATION
PLAN
DETAILS OF BASE OF COLUMNS
Concrete Rib 2'0" wide under each Radial Beam
Center Line of Column
PLAN OF CAPITAL, LOOKING UP
⅝ Rod placed in 2 diam. hole and grouted up
Fall of Floor toward Center 1 in 175
Elevation 576.85
Elevation 576.30
Elevation 575.90
Elevation 575.50
Elevation 575.10
35.09 = 115' 1¼" to Center
Rods placed to form 18" squares
Circumferential Beam
Lap
PLAN OF RADIAL BEAMS

Fig. 1—General Details of Concrete Work for Guadalupe Reservoir.

	Columns
Outer ring, at [illegible] m. from center	[illegible]
2d ring, at 27.88 m. from center	[illegible]
3d ring, at 21.51 m. from center	[illegible]
4th ring, at 14.41 m. from center	[illegible]
5th ring, at [illegible] m. from center	[illegible]
6th ring, at [illegible] m. from center	[illegible]
Total	[illegible]

The inner bottom diameter of the reservoir is 70.3[illegible] m. (230.[illegible] ft.); the upper inside diameter is 81 m. (265.[illegible] ft.); the water depth at the overflow level is 9 m. (29½ ft.).

The roof was designed to carry a dead load (the earth cover) of 150 lbs. per sq. ft., and a live load of 100 lbs. The maximum compressive fiber stress in the concrete was assumed at 550 lbs. per sq. in. for the beams, and at 350 lbs. for the columns, a low figure, because of their eccentric loading. The tensile strength of the steel was taken at 14,500 and 16,000 lbs. per sq. in. The twisted steel used for the column reinforcement was made at the local steel plant, but for the beams, etc., a twisted lug bar, of higher quality and a greater permissible tensile stress, was used. The total quantity of steel used was 178 tons. It was calculated that the load on the column foundations would not exceed 1¼ tons per sq. ft.

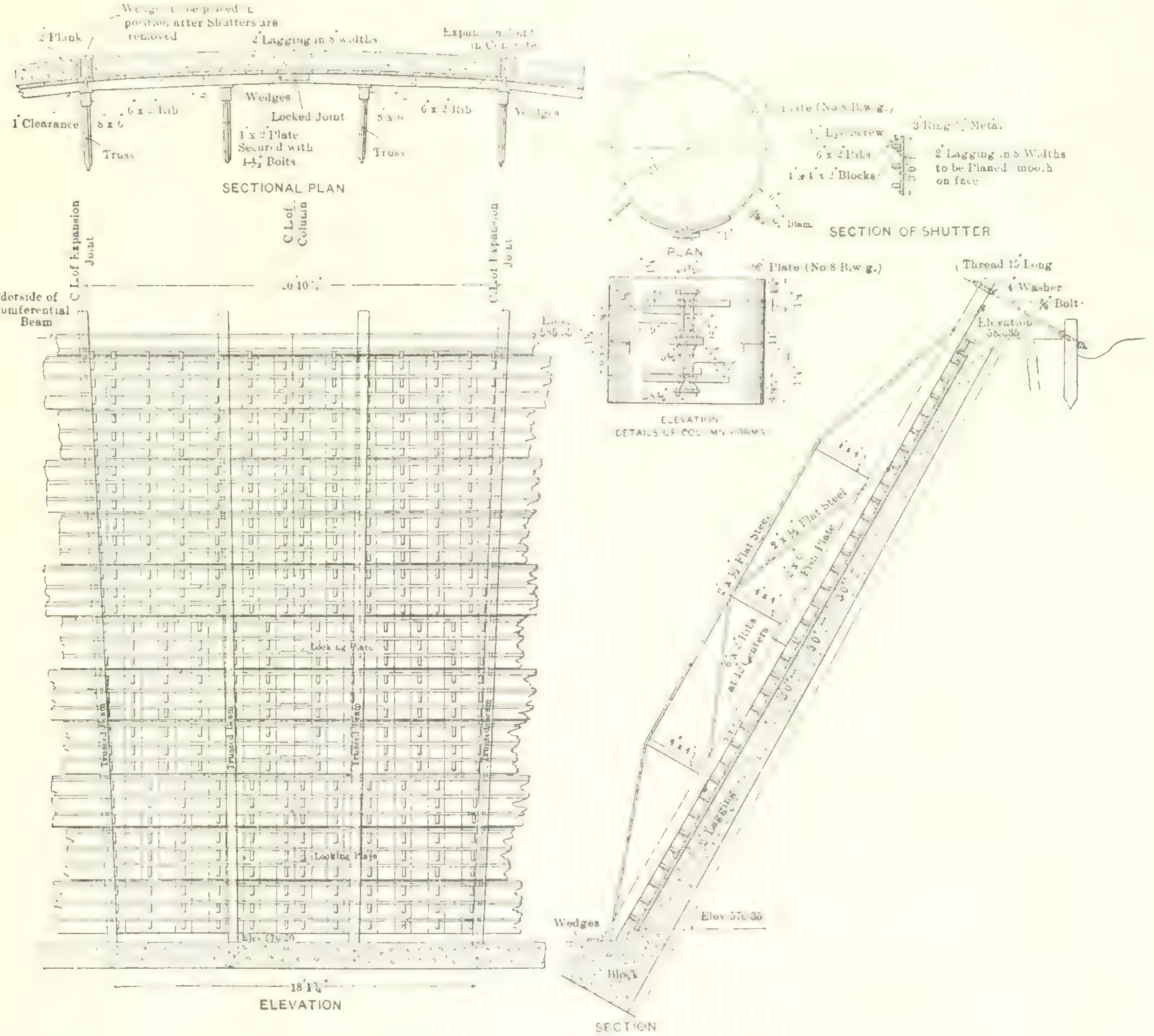

Fig. 2—Slope Wall Forms for Guadalupe Reservoir.

[illegible].—The question of ordinary forms, requiring very heavy timber work, was a serious one, as suitable lumber is very expensive in Mexico; and the necessity of finishing this reservoir before the end of the first term allowed under the concession, which expired on Dec. 31, 1908, led to the adoption of what the writer believes is an original scheme for so large a structure. This scheme was to cast the [illegible] and secondary beams as separate members, and then place them in position with derricks. At the same time, in the case of the beams, it was important not to sacrifice either the benefit of that part of the slab which is ordinarily [illegible] part of the beam, or the additional strength due to continuity; and, in case of the columns, the strength due to the reinforcement extending from the foundation to the beams.

The T-beam section was secured by notching the tops of the moulded members, with notches 10 cm. (3.9 ins.) deep, throughout the lengths of the beams. A computation of the maximum flange increment shows that these notches [illegible] stresses to the stem, but, for additional security, flat steel bars were bent to a Z-shape, and embedded in the top of the beam about 60 cm (23.6 ins.) apart. Continuity in the beams was secured by carrying the steel to the tops of the beams over all supports, and, after erection, concreting them into the roof slab. The secondary beams, after casting, were droped into recesses left in the radial beams for the purpose.

Concreting, Mixing, etc.—The radial beams [illegible] possible under their ultimate positions; the [illegible] mediately adjoining the reservoir.

The rock and sand was brought from the Company's crushing plant, in 3-cu. yd., side-dump cars, running on a 30-in. track by gravity a distance of 1 km (0.62 mile), the last [illegible] the crusher by gravity. These cars dumped the material into bins on the high ground above the reservoir; from there it was hoppered into cars which carried to the mixer all the material for one batch of concrete. Two No. 1 Smith mixers were used, and from 25 to 30 batches per hour could be handled in each machine.

The concrete was transported from the mixers to place in ½-cu. yd., 18-in. gage, swivel, steel dump-cars pushed by two men. All the concrete used in the bottom of the reservoir, for the main beams, columns, and floor, amounting to about 2,460 cu. m., was dumped through a chute into smaller cars. The chute [illegible] resembled a gravity mixer, but, although it was 12 m. (39.4 ft.) long, it effectively prevented the separation of the materials.

[illegible].—The square foundations for the columns were deposited *in situ*, a recess being left for the reception of the pedestals, which were molded in place afterward. The capitals and pedestals were cast in one piece, and the columns in 1.21-m. (18-in.) sections, eight 5-cm. holes being left in them by using wrought iron pipes, held in place by templates and removed when the castings were about 3 hours old. The columns were erected by threading them on the 15.8-mm. (⅝-in.) reinforcing rods, which extended from the pedestals up through the capitals. The rods were in two lengths, arranged to lap alternately at one-fourth, the center, and three-fourths of the height of the

was used in conjunction with the derrick, and, as the columns were placed, the reinforcing steel was grouted solid with 1:2 cement mortar.

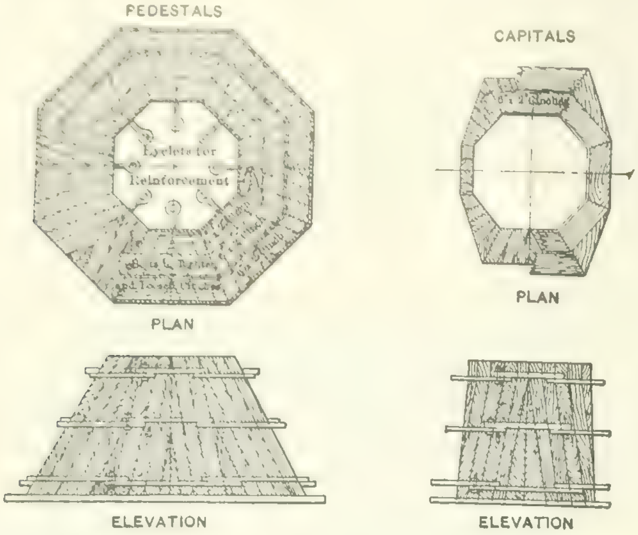

Fig. 3.—Column Pedestal and Capital Forms, Guadalupe Reservoir.

All the erection was done with a combined stiff-leg or guy derrick, having an 80-ft. boom an[illegible] Lambert hoisting engine. The derrick was erected seven times at the circumference, and its final position was on top of the center columns. The moving of the derrick a distance of about 45 m. (147.6 ft.) and its subsequent erection occupied usually about 48 hours. The erection work was carried on continuously, day and night, the placing of the whole of the radial and secondary beams and columns occupying 2½ months.

Forms.—As the erection scheme was designed to reduce the cost of forms, economical construction was of considerable importance. The wall was formed in 40 panels, about 6 m. (19.7 ft.) wide and 11.27 m. (37 ft.) high. The chief object in arranging them in this manner was to permit an expansion joint, 30 cm. (11.8 ins.) wide, at each panel; this joint was not filled until after the completion of the roof, when the temperature inside the reservoir was uniform and not subjected to such great fluctuations as if exposed alternately to the hot sun and comparatively cool nights. The range of temperature during the construction period sometimes amounted to 80° F. in 24 hours.

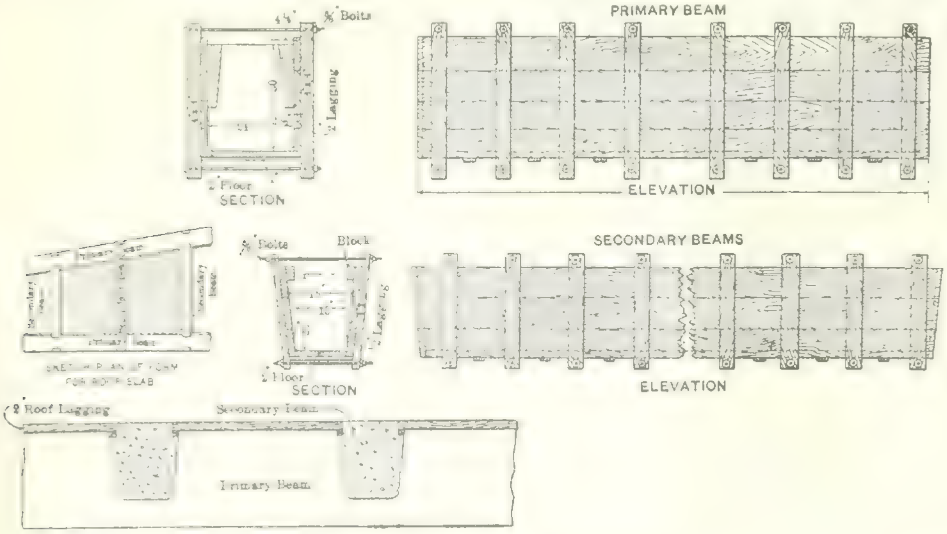

Fig. 4—Roof Forms, Guadalupe Reservoir.

The expansion joints were left to the last, when a uniform temperature of about 70° inside permitted the filling of the joints, thus avoiding all trouble from expansion cracks.

The forms are shown in detail by Figs. 2 to 4. They consisted of shutters stiffened with four trapezoidal trusses. The bottom posts of the trusses were fixed in holes formed in the foundation block; they were propped back from the embankment at the top, and secured to anchorages by iron rods.

Six sets of these forms were used to construct the whole wall. The concrete was placed in position through stove-pipe chutes, 20 cm. (7.87 ins.) in diameter, in continuous layers, the workmen treading and spading it well as it was deposited. The forms were allowed to remain 4 or 5 days, and were then struck and removed to another section. The pedestals and capital forms were of lumber, and five of each were used to cast the total number required. In the column sections the outer steel forms used in the manufacture of the Estanzuela pipes were adapted for this purpose. The radial beam forms, shown by Fig. 4, were arranged with internal wedge-shaped blocks to mold accurately the recess for the secondary beams. The bottom forms were left attached to the beams for 28 days, but the sides and ends were removed after 24 hours. Eight forms were sufficient for the whole 135 beams.

For the secondary beams, 29 forms were used for the 670 beams, the bottom lumber also being left until they were mature for handling.

By referring to the cross-section of the secondary beam, it will be noticed that it is jug-shaped, shelves being left on either side for the support of the roof forms, which were placed after the secondary beams had been properly grouted to the radial ones. The lagging was laid diagonally, so that the short diameter was slightly greater than the distance between the beams. This greatly facilitated the removal of the lagging, as it was merely necessary to strike the wedge-shaped fillets beneath, and turn them clockwise, after tearing out the end lagging.

The writer believes that the adoption of forms of this type, rather than the ordinary kind, led to a saving of lumber of about 400,000 ft. B. M. During the erection and placing of the concrete, all the joining surfaces were carefully picked and cleaned, particular care being taken at the junction of the secondary with the radial beams, and the upper surfaces of all beams before laying the roof slab.

After the greater part of the roof was completed, the floor was laid in those sections where it was protected from the sun's rays. The concrete was placed in two 15-cm. (5.9 ins.) thicknesses, and the work was carried on night and day, without any joints. The laying of the floor occupied 8 days, or an average of nearly 100 cu. m. daily.

Proportions of Concrete.—All the concrete work was brought to a smooth face by careful spading, no plastering being used throughout the reservoir, except in the superstructures. The work was kept well watered in every case for about 15 days. The whole of the concrete work in connection with the reservoir was completed in 5½ months. The concrete for the columns and foundations was a 1:3:5 mixture, the aggregate consisting of equal parts of 19-mm. (¾-in.) and 38-mm. (1½-in.) crushed stone. The remainder of the concrete, except that for the roof, was a 1:2:4 mixture, the aggregate also consisting of equal parts of 19 and 38-mm. stone. With the exception of a short length of the side-walls, the sand used was that manufactured by the company. When the crushing plant was unable to produce all the sand required, the Hornos sand was used in the side-walls in equal proportions with the crusher sand.

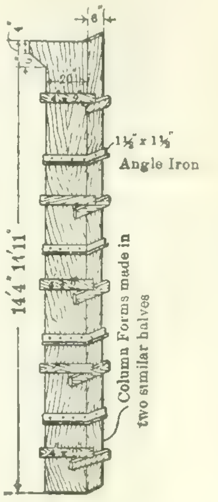

Fig. 5—Column Form, Obispado Reservoir.

OBISPADO RESERVOIR.

This reservoir is rectangular 126x81 m. (413.28x265.68 ft.) and has a water depth of 4 m. (13.1 ft.). It was built in excavation with floor and slope walls of concrete. The roof is slab and girder construction carried by 360 columns spaced 5 m. (16.4 ft.) apart in both directions.

The concrete mixing plant, which consisted of two No. 1 Smith mixers, was arranged in connection with bins and hoppers for the rock and sand on high ground and from there the material was conveyed in a framed timber gangway carried right across the center of the reservoir. From this central platform the concrete for the columns was filled from stages placed on the top of traveling towers, 5 m. (164.4 ft.) high, which were run between two rows of columns on standard-gage rails laid on the floor of the reservoir. By this arrangement 24 columns could be filled from each length of track. A main narrow track was also laid right around the reservoir, with the necessary turn-outs.

The forms for the columns, primary and secondary beams, are shown by Figs. 5, 6 and 7. The side forms for the primary beams were struck in 24 hours, so as to economize lumber; but the bottom lumber was left in position for 28 days. To avoid much unnecessary timber, the secondary beam forms were supported at the ends on reinforced concrete corbels cast on the primary beams.

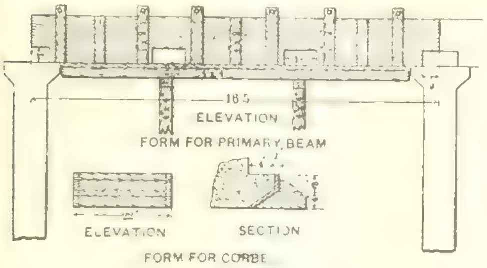

Fig. 6—Primary Beam Form, Obispado Reservoir.

For placing the side-walls, a special traveling form was used, the details of which are shown clearly by Fig. 8. At the end of each form an expansion joint of 25 cm. (9.84 ins.) was left to be filled after the roof was placed in position. The concrete was delivered to the wall through stove-pipe chutes, and carefully spaded by workmen in the limited space between the forms and the embankment. The wall form was removed after 36 hours, by loosening the jacks and pulling forward the hooked tie-rods.

The concreting of the roof slab was carried on continuously, and, when partly completed, the floor was laid in the shade. The bottom layer of the floor, 13 cm. (5.12 ins.) thick, was laid in continuous panels between the columns, and brought to a fairly smooth surface. On this surface, after keeping it wet for 10 days and then allowing it to dry thoroughly, a layer of asphaltum, supplied by the American Asphaltum & Rubber Co., of Chicago, was placed. The work was done by ordinary Mexican laborers after they had received a few days' instruction from one of the Asphaltum company's superintendents. The surface of the lower layer was kept perfectly clean, and then received one coat of "Pioneer" paint. The asphaltum, heated in a boiler inside the reservoir to a temperature of approximately 425° F., was then poured over the floor from buckets, in a layer approximately 4 mm. thick. Where the floor joined the column pedestals, and at each new panel section, a double thickness was used. The labor cost of water-proofing, including superintendence, etc., amounted to 3.3 cts. (Mexican) per sq. m. for painting with "Pioneer" paint, and 5.4 cts. for the asphaltum coating, or a total labor cost of 8.7 cts. per sq. m for the complete water-proofing. This cost is based on a rate of 8.00 pesos per day for a foreman, and 1.00 peso for each laborer. It required 50 U. S. gals. of the paint to cover 265.2 sq. m., and an average of about 6 lbs. of asphaltum for 1 sq. m.

The upper concrete layer of the floor, 10 cm. (3.94 ins.) thick, was placed so as to break joint with the lower, and was brought to a smooth surface with wooden floats sheathed with steel and reaching across the panels. In this way a perfectly smooth surface was obtained without any plastering. The concrete for the beams, columns, side-walls, and floor was a 1:2½:4 mixture, crushed sand and stone being used throughout. In the roof slab the mixture was 1:2:3. The whole of the concrete work of the reservoir was completed in 6 months, by the company's own administration.

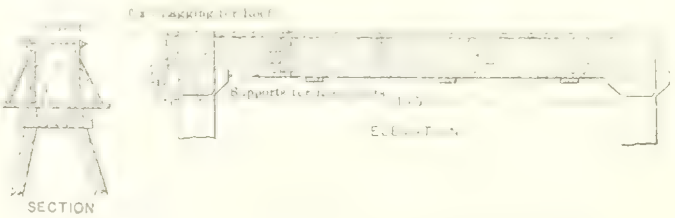

Fig. 7—Secondary Beam Form, Obispado Reservoir.

[illegible] Reservoirs.—The two reservoirs are practically of the same capacity, the only difference being the level of the overflows in their relationship to the roof, which gives the Obispado Reservoir a slightly greater capacity. Some comparative figures may be of interest, owing to the differences in type and construction. Table I gives the comparative quantities of material in each reservoir proper, that is to say, exclusive of the valve-houses, lay-out of grounds, etc.

The total cost of these reservoirs, including valve-houses, by-passes, and the length of supply pipe where the by-pass joins, and including all engineering expenses, etc., but exclusive of the cost of lands, planting, fencing, and special work in connection with the formation of parks, was as follows:

South Reservoir: 394,000 pesos, or 10,368 pesos per million liters ($2,400 per million gallons).

Obispado Reservoir: 375,000 pesos, or 9,375 pesos per million liters ($2,150 per million gallons).

These rates may be regarded as reasonable when taking into consideration the special difficulties of construction in Mexico, and the high cost of all imported material, on which heavy duties are levied. The value of the materials alone in these reservoirs amounted to more than 70 per cent of their total cost.

Surveys for a project involving the draining of 70,000 acres of bottom land in Obion county, Tennessee, have been completed by the Tennessee Geological Survey. The work will cost less than $1,000,000

TABLE [illegible] COMPARISON [illegible] MATERIALS IN [illegible]

	[illegible]		Obispado Reservoir.	
	No.	Quantities [illegible]	[illegible]	Quantities in cubic meters
Earthwork:				
[illegible]				56,179
Pl[illegible]		31,500		7,255
[illegible]				
Concrete:				
Column[illegible]				
Primary [illegible]				
Second[illegible]		515		
Side-walls				710
	meters		meters.	
Roof [illegible]				1,020
Floor				2,120
[illegible]				
Total concrete				
				Pounds
Reinforcing [illegible]				
		meters		meters.
Expanded metal in roofs, slabs, etc.		5,691		10,490

A Discussion of the Carrying Capacity of Bulb-Pointed Concrete Piles.

BY [illegible]*

In soft soils pile foundations can carry comparatively large loads because the pressure, instead of being imposed on the unreliable surface soil (as it would be by masonry footings), is transferred to the firmer subsoil. The failure of footings resting directly on the surface is due to the inability of the surface soil to transmit the load to the subsoil without compression and displacement. By using piles, however, the load is carried without such failure. It follows, therefore, that when piles are placed in the earth, the load is transmitted to the subsoil by an instrument or medium of increased strength and rigidity, i. e., the pile itself.

The purpose of this article is to study the factors which determine the load which can be transmitted by pile foundations to the subsoil, and then to determine the most economical method of increasing this carrying capacity.

If we consider a pile of the ordinary type, as in Fig. 1, we find that at some level *A-A*, the total load on the pile is being transferred to the soil below the line *A-A* in two ways: (1) by the soil above the line *A-A*, and (2) the area at the point of the pile. As this area is very small, practically all the load on the pile is therefore transferred to the subsoil by the overlying earth.

Now the pressure thus transmitted down to the subsoil by the earth above it can be transmitted from the pile itself, by but one method, frictional adhesion, between the pile surface and the particles of earth in contact with it. Thus, regardless of the strength of the subsoil, the load carried by the pile is limited by the frictional adhesion along the pile surface. This resistance is in turn dependent on the nature and amount of pile surface, texture, moisture and general character of the soil. Each element of pile surface provides a carrying capacity dependent on the normal pressure and texture of the soil in contact with it. At any level the total pressure is the summation of the elements of frictional pressure above that level. Hence, the greater the depth the greater is the total pressure being transferred to the soil beneath that level. On the other hand, the nearer the top of the pile, the less is the frictional resistance, the less the pressure transferred by the surrounding soil, and hence the less the sectional area of the earth-solid transferring the load. At the surface of the ground the area under pressure is zero. Thus it is evident that the earth body surrounding the pile, which transmits the pressure, must increase in sectional area as the depth increases.

Mr. E. P. Goodrich, who suggested the existence of a conoid of this form, states:

> [illegible] the frictional resistance holding the pile has been transferred through the earth in the shape [illegible] a total bearing value equal to the load and a unit bearing value which the earth at that [illegible] of compactness will give a different angle for the slope of the conoidal surface.

Now, to increase the carrying capacity of a pile we must increase the strength of the

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*11 Pine St., New York City.

[illegible] load on the pile in Fig. 1 is a conoidal body [illegible]

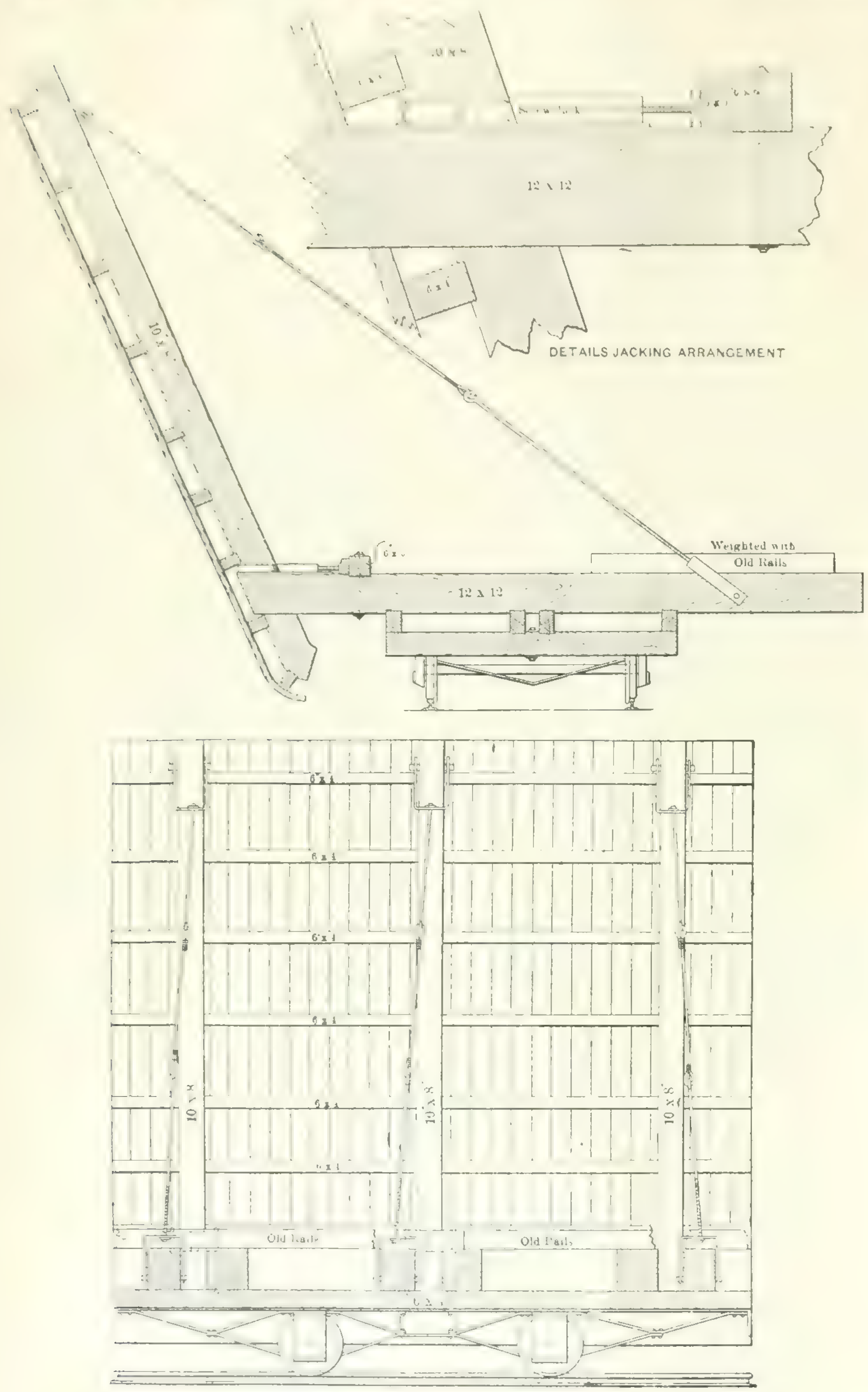


Fig. 8—Traveling Slope Wall Form, Obispado Reservoir.

umn can transfer, depends upon the area of the base of the pile which covers the subsoil. It is also limited by the crushing strength of the [illegible]. The load which the conoid of earth can transfer to the subsoil is dependent upon the magnitude of frictional adhesion between the pile surface and the soil in contact with it.

The frictional resistance between a given soil and the surface of a pile is a fairly definite quantity. Patton, in "A Practical Treatise on Foundations," states that frictional resistance [illegible] pending on the nature of the soil. Mr. Elmer C. Corthell in "Allowable Pressures on Deep Foundations," gives the following data: "In [illegible] for the Papaghni bridge the following frictional resistances were obtained

[illegible]
In black clay .350-560 lbs. per sq. ft.
In silt below clay .272-428 lbs. per sq. ft.
In the lower sand [illegible] lbs. per sq. ft.

In sinking cylinders for the Chittrivatri bridge, the frictional resistance was 232 to 377 lbs. per sq. ft., through 33 ft. of sand, 10 ft. of clay, and 7 ft. of clay and sand clay and boulders. Through 33 ft. of sand, 10 ft. of clay and 3 ft. of sand and clay, the frictional resistance was 293-362 lbs. per sq. ft.

At La Rochelle and Rochefort, as reported in the minutes of the meeting of the Institute of Civil Engineers, Vol. L, page 112, the frictional resistance was found to be 161 lbs. per sq. ft.

In silt at Laurient, 123 lbs. per sq. ft. (Colson, "Notes on Dock Construction.")

In firm [illegible] good quality, Dutch engineers [illegible] on piles at 611 lbs. per sq. ft.

In another portion of the same report a summary [illegible] collected shows that in two cases of cylinder piers the average frictional resistance [illegible] 40 lbs. per sq. ft. Gravel gave the greatest resistance and mud the least.

Twenty-three examples of masonry piers showed an average frictional resistance in sand and gravel of 522 lbs. per sq. ft.

Five examples of walls, quays and other structures showed an average frictional resistance of 270 lbs. per sq. ft.

We may, therefore, assume as a basis for calculations four different surface soils: (1) Firm sand or gravel, in which the frictional resistance equals 575 lbs. per sq. ft.; (2) Firm clay, in which the frictional resistance equals 450 lbs. per sq. ft.; (3) Medium clay or sand, in which the frictional resistance equals 250 lbs. per sq. ft.; and (4) Soft clay, alluvium and silt, in which the frictional resistance equals 100 lbs. per sq. ft. The load a pile can carry in frictional adhesion will depend on its surface area and the soil it penetrates. Assume as average piles, (1) a large tapered pile 30 ft. long, diameters 18 ins. at top and 6 ins. at bottom, and (2) a large cylindrical pile, diameter 16 ins. The surface areas of these piles will be 94.3 sq. ft. and 125.7 sq. ft., respectively. Thus, in a medium clay the large tapered pile will support

$$\frac{94.3 \times 250}{2{,}000 \text{ lbs.}} = 11.8 \text{ tons,}$$

and the cylindrical pile will support

$$\frac{125.7 \times 250}{2{,}000 \text{ lbs.}}$$

15.7 tons loading, by frictional resistance. A wooden pile would have somewhat less surface than the tapered concrete pile and would, therefore, carry somewhat less load by frictional resistance.

Now the load carried by any of these piles in frictional resistance will be increased by increasing the diameter of the pile, that is, the square feet of frictional surface, and by increasing the pressure of the earth against the pile. Larger diameter necessitates more concrete per pile, a large shell (if one is used), and thus a more expensive pile. Increase of pressure of earth against the pile surface necessitates driving piles on closer centers, hence, more piles and therefore greater foundation cost. We may conclude then that an increase in foundation strength resulting from an increase in frictional resistance will entail a large increase in foundation cost.

In addition to the load carried by frictional adhesion, these piles are also carrying load by the direct pressure of their bases on the subsoil. It remains to investigate the magnitude of this carrying capacity and by what means and with what cost it can be increased.

The four surface soils considered above, providing 575, 450, 250 and 100 lbs., frictional resistance, can carry even at the surface of the ground direct bearing loads ranging from 1 to 7 tons, a shown by the Tables I and II:

TABLE I—SAFE BEARING POWER OF SOILS

(As given in "Allowable Pressures on Deep Foundations," by E. C. Corthell.)

The pressures of stable structures on fine sand range from 2.25 to 5.80 tons; average, 4.5.

On coarse sand and gravel, 2.4 to 7.75 tons; average, 5.1 tons.

Sand and clay, 2.5 to 8.5; average, 4.9 tons.

Alluvium and silt, 1.5 to 6.2; average, 2.9 tons.

Hard clay, 2.0 to 8.0; average, 5.08.

Hardpan, 3.0 to 12; average, 8.7 tons.

Clay 4.50 to 5.60; average, 5.2 tons.

TABLE III—ESTIMATED CARRYING CAPACITY OF 30-FT. BULB POINTED PILES, 17-IN. STEM AND 3-FT. BULB.

Nature of subsoil.		Rock 15 Tons.	Hardpan Tons.	Clay and gravel Tons.	[illegible] Tons.	[illegible]
[illegible]	[illegible]	144.7	109.4	88.1	74.2	52.6
[illegible]	[illegible]	136.3	101.0	79.7	65.5	44.2
Sand	250	123.0	87.7	[illegible]	[illegible]	30.9
[illegible]	[illegible]	113.0	77.7	56.4	42.2	20.9

TABLE II.—SAFE BEARING POWER OF VARIOUS SOILS.

(From a [illegible] Treatise on Masonry Construction by I. O. Baker.)

Kind of Material.	Safe bearing power. Tons per sq. ft. Min.	Max.	Av.
Rock [illegible]	[illegible]		
Rock [illegible] masonry	[illegible]	[illegible]	[illegible]
Rock [illegible] masonry	[illegible]	[illegible]	[illegible]
Rock, equal to poor brick masonry		[illegible]	[illegible]
Clay, in [illegible]	[illegible]	[illegible]	
Clay, in thick beds, moderately [illegible]		[illegible]	
Clay, soft		[illegible]	[illegible]
Gravel and coarse sand, well cemented	[illegible]	10	[illegible]
Sand, [illegible] cemented	[illegible]	6	
Sand, [illegible]	[illegible]		[illegible]
Quicksand [illegible]		[illegible]	[illegible]

[illegible] would carry a somewhat greater load, by rea- [illegible]

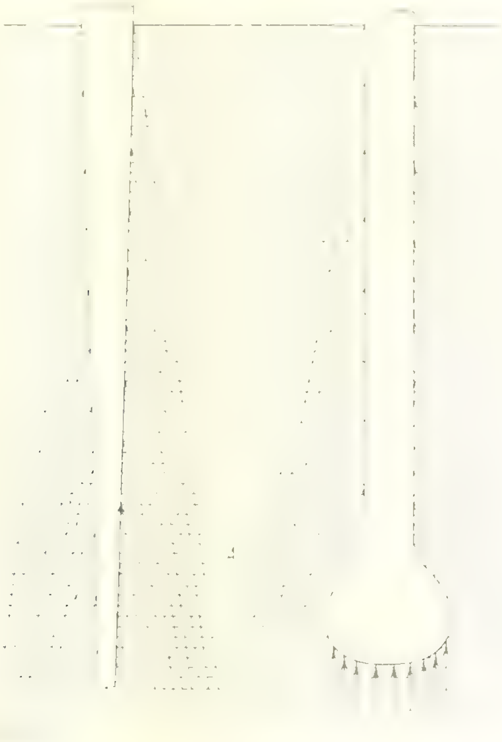
Straight Pile:

	Tons.
Frictional resistance	15.70
[illegible]	[illegible]
	22.66

Assume now that the diameter of the base of a pile were increased to 3 ft. as shown in Fig. 2. Disregarding for the present the cost of obtaining this enlarged footing, let us investigate what increase in carrying capacity would be obtained. A 3 ft. diameter base has [illegible] case considered this base would provide an additional direct column loading of 7.10 × 5 = 35.5 tons. Assuming that the columns of the pile provided the same frictional resistance as the straight pile, we have:

[illegible]	Tons.
[illegible]	[illegible]
[illegible]	35.5
	51.2

Thus, the total carrying capacity of a pile is doubled by increasing the base area of the pile to 7.1 sq. ft. The cost of obtaining this



Sketch Comparing Tapered and Bulb-Pointed Piles.

causes compression. Furthermore, as we go deeper into the earth's surface, the soil becomes firmer in natural texture, until at some depth we strike hardpan and firm rock. In general, therefore, the direct bearing power of the earth increases as the depth increases. The magnitude of this direct bearing power will vary with the site. In one case we might find a loose earth capable of providing 200 lbs. frictional resistance overlying a subsoil whose direct bearing power is 10 tons per square foot; in another case we might find the same surface soil overlying a subsoil whose direct bearing power is only 3 tons per square foot.

Before considering these possibilities, let us assume that, with a surface soil of medium clay capable of providing 250 lbs. frictional resistance, the subsoil at a depth of 30 ft. can support a direct bearing load of 5 tons per square foot. This bearing power would be readily obtained with a firm sand or clay, as may be seen from the table. The base area of the tapered pile is 0.205 sq. ft., of the cylindrical pile 1.395 sq. ft. The safe bearings are 0.205 × 5 = 1.03 tons for the tapered pile, and 1.395 × 5 = 6.96 tons for the cylindrical pile.

Repeating the figures for frictional resistance and direct column loading we have:

Tapered Pile:

	Tons.
Frictional resistance	11.[illegible]
Direct column loading	1.03
	[illegible]

[illegible] the enlarged base is obtained [illegible] were jetted into place, or made by excavating with an expanding drill, or by using air or hydraulic pressure, the cost would not warrant the increase in strength obtained. The simplest method of obtaining the enlarged footing is to bulge it out down in the ground. This method has not only proven to be inexpensive, [illegible] bulging or mushrooming out the foot, compresses the surrounding soil and, therefore, increases its bearing power.

The process of forming the pile is as follows: The casing and core fitting into it are first driven together to the required depth. The lower end of the core projects a few feet below the end of the casing. After driving is completed the inner core is withdrawn, leaving the casing in the ground. It is to be noted that the casing does not reach to the very bottom of the cylindrical hole. Now a small batch of concrete is dumped into the casing, falling down to the very bottom. The core, which has a cast steel point, and is now used [illegible] driven down, thereby displacing the concrete at the bottom of the hole, and forcing it out into the surrounding soil. The operation is repeated; more concrete is dropped to the bottom of the hole and rammed out again. Wi[illegible] (about 16 cu. ft.) to make the base 3 ft. in diameter, the casing is filled to the top with concrete and withdrawn from the ground. This leaves the completed concrete pile down in the earth.

The economy of increasing the carrying capacity of a pile by this method is self-evident. The only costs that need be considered are additional concrete and labor. The additional cost for the few cubic feet of concrete used in the foot, evidently adds but slightly to the total cost, and the simple method of making the base necessitates no additional labor and requires but little additional time. In fact, 37 40-ft. piles have been driven in one day by two pile drivers, and practical experience has shown that a concrete pile with an enlarged base may be formed in the ground at a cost no greater than that necessary to drive the ordinary type with which a far smaller carrying capacity is obtained.

The accompanying table gives the carrying capacities of pedestal piles under different soil conditions. The surface soils are the four previously assumed. At the same time a subsoil bearing power is assumed and in each case a different subsoil is considered as existing beneath the various surface soils. The surface area with the pedestal pile is based on a 17 in. diameter stem (which is the column actually used with piles of this type) and the assumption that the surface of the foot provides the same frictional resistance as would a corresponding length of 17 in. diameter pile column. This assumption errs on the safe side.

Cost of Keeping Work Horses in Canada.

The average cost of keeping a work horse, valued at $180, in Canada, is shown in the following itemized account which we abstract from the *Canadian Engineer.* The figures are based on the practice of keeping stable from November till June and turning the horses out to pasture during the remaining five months of the year:

Interest on money invested	$ 9.00
Decrease in value per year	12.00
Risk on horse per year	5.00
[illegible]	[illegible]
Extra setting	5.00
Wear and interest on harness	3.00
Clipping in the spring	1.25
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Usually, in the cartage and transport service, the teams turn out to work at 6:45 a. m. Feeding is done in the morning from 4:30 to 5 o'clock, by the regular barn men, whose duties are to attend to the feeding and the stables of from 25 to 30 horses, and in some cases as many as 48 animals. The teamsters reach the barn from 5:30 to 6 o'clock. They have nothing to do with the feeding of their horses, but each man has to care for his own team and harness, and everything is done by the companies to stimulate a pride on the part of the driver in the fitness and attractiveness of his hitch. Each man is supplied with brushes, combs, dressings, cloths and whatever he can use in caring for his team and harness, and no questions are asked, no matter how often the brushes are worn out or the bottles emptied. The teams come in as near 12 o'clock as their work permits, and at night as near six as possible; in such haulage work, however, teams may be from two to three [illegible]

At the Dominion Transport Company's barns, Montreal, the feeding is 18 lbs. of mixed grain per day in three equal amounts; 20 lbs. of hay per day, most of it being given at night. The grain feed is made up of oats, bran and molasses mixed in the following proportions: 70 lbs. oats, 15 lbs. bran, 15 lbs. molasses, the molasses in this mixture being two-thirds water. This is found to be a most satisfactory ration.

EARTH AND ROCK SECTION

Shape of Air Hammer Drill Bits.

In spite of all that has been written about the proper shape of steel bits for different machines and different conditions, writes Mr. G. H. W[illegible] in the *Mining and Scientific Press,* there is still considerable ignorance or misunderstanding of the proper requisites.

Of first importance, in considering the matter, is the distinction between two types of [illegible] effect they have upon the behavior of the drill bit and upon the cutting capacity of the drill. There is, first, that class of machines in which the air goes through the stoping bar before going to the piston. By this arrangement a slight vibration up and down is produced and the bit partakes of this motion. This style of stoping-bar is exemplified in most of the older machines, such as the Murphy, Hardsocg, Shaw and Eclipse. Second, there is that class in which the machine is held up by a constant air pressure, as in the Weaugh and Cleveland. In these machines the bit is held firmly against the rock with little vibration. The difference in effect of these arrangements is reflected in the cutting capacity of the machine and the difficulty of turning the bit in the hole. The first style gives a machine that will turn easily, but has a lower drilling capacity, while the second gives a machine that will turn with difficulty but has a higher cutting capacity for the same air consumption. It is evident, therefore, that the second arrangement is the more economical if the drill bit can be so shaped as to overcome the difficulty incident to turning it in the hole. A machine has often been condemned where a proper understanding of this point would have overcome the difficulty. Figure 1 shows the construction of a bit which has been made to overcome the objection of difficult turning and which has been widely adopted for air-hammer machines. The dimensions given are such as would ordinarily [illegible] steel is used. The object of the high center is briefly this. When starting a hole with a square bit it is always found that there is a tendency, more or less pronounced, according [illegible] the steel rather than about the center. The result is either a broken center or difficulty in getting the hole started, or both. With the high center, the latter strikes the rock first and rotation about the center is easily effected. The result is that no difficulty or loss of time is [illegible] vantage is that the drill stays sharp longer than with a square bit. The tendency in any bit is for the outer corners, which have the most cutting to do, to wear away or become blunt first. With the high center the cutting is more equally distributed. In the illustration the angle between the faces of cutting edge has been shown as 90°. The exact angle is not material, but it is of the utmost importance that it should not be acute. It is natural to imagine that a sharp bit means fast cutting, but the reverse of this is frequently the case, especially with the second type of stoping-bars mentioned. In Fig. 2 is illustrated the reason for this. In *a* has been represented by the wedge *A* the conditions which exist on a bit with a 90° angle, and in *b,* conditions with a bit having an acute angle. Suppose these wedges to be drawn along the smooth surface *ss* and to meet the obstruction *o*. The difficulty in passing over the obstruction will be proportional to the angle *x*. The result is that with a sharp bit either the obstruction must be broken off by the force exerted in turning the drill, or the point of the bit will be broken. In this case the operator, rather than the machine, does the work of breaking the rock. With a slight interruption in the turning, the difficulty at once increases as the hammer is continually striking and the relative height of the obstruction constantly increases until it is impossible to turn the bit. Another reason for the blunt edge is that a hard temper may be given it without danger of breakage, and in drilling hard ground this is a prime requisite. Often the importance of having proper steel with proper bits is not fully realized and too little attention is given to this point. The result is that in many cases hundreds of dollars are lost every month in wages paid to men who are doing nothing but waiting for steel or trying to perform work with such tools as render it impossible to accomplish good results.

Fig. 1.

Methods and Costs of Driving Tunnel Drifts in a Nevada Mine.

The average costs in making the records of tunnel driving are not much less than the costs of average tunnel driving, the principal advantage being the speed at which the work is accomplished. This has been the case in the records made at the different mines of the Consolidated Mines Company, of which Mr. Claude T. Rice writes in the *Engineering and Mining Journal* and from which we abstract the following information on the methods and costs of work on three separate drifts. All the work is done by means of small, one-man piston drills. The drills used by the company were A50 Ingersoll-Sergeant machines. An air pressure of about 80 lbs. per sq. in. at the machine was used. It is thought that the driving of 260 ft. in a 5x7.5-ft. drift with only one working face, in 30 days is a record for two-shift work with only two men working on each shift, a machine man and a shoveler.

The rock in which the driving was done is dacite, in which the feldspars have been changed to alunite, while there has been an addition of some silica in much of the rock in which these drifts were driven. The rock is in general good drilling and good breaking ground, requiring but little timber as the costs for timbering indicate. But wherever there has not been much silicification of the dacite when it was altered, the rock is dead and will not throw "its mud" on water holes, requiring frequent use of the scraper.

Wet spots were struck in places in all these drifts, but in few instances was there enough water to require the men to wear slickers. While the water hampered, the mucker during tramming, owing to the chafing of his body by the wet clothes, this was to a large extent offset by the fact that the moisture "killed" the powder smoke quickly.

In all the drifts the machine man drilled from a cross bar and had to make two setups to get in the round. He made it a point to finish the holes drilled from above the bar by noon. In the case of the record drift the machine man mucked while the shoveler ate his lunch.

The ground in the different drifts broke with from 8 to 10 holes per round. The round as drilled by the men who made the record is fairly typical of the other drifts. They used in most of the ground 2 roof holes, 2 breast holes, 3 cut holes, 1 easer (drilled in front of the center cut hole) and 2 lifters. The easer was drilled about 4 ft. deep; the cut holes about 8 ft. deep and the other holes from 6 to 6½ ft. This required about 65 ft. of holes to be drilled with two setups of the machine to be made each shift, besides tearing down and blasting. The main obstacle in making the record was the mucking, although the ground did not break ahead of the holes. The machine man generally gets the honor of records, but the problem in small drifts, where the rock is of usual hardness, is really to get the broken rock out, rather than the round in.

The following table gives the progress and costs per lin. ft. of all the work. In the case of the Laguna drift the advance per shift averaged, during the month, 4 ft. 4 ins., but during the last four shifts the men drove the drift ahead 21 ft. or an average of 5 ft. 3 ins. per shift. The average amount of waste broken per shift was 13 tons and the shoveler had to tram this waste in cars holding 21 cu. ft., a distance of 800 ft. The men did not do any timbering.

In the Combination mine, shown in the second column of the table the men advanced the drift 228 ft. in the 27.5 days, or an average advance of 4 ft. 2 ins. per shift. The men also placed five sets of timbers, which was the equivalent of driving another 15 ft. so that their real advance per shift, had they done no timbering would have been about 4 ft. 5 ins. or slightly greater than that of the men who made the record of 260 ft. in 30 days. The length of tram in this drift was 1,200 ft.; so considering that the main problem in these small drifts is the mucking, this drift, in many respects, represents the best work.

In the Jumbo drift the work progressed 203 ft. in 29 days. This is at the rate of 3 ft. 6 ins. per shift. There was a tram of 1,200 ft. and the temperature was over 80° F. In all these drifts the men had to lay the track.

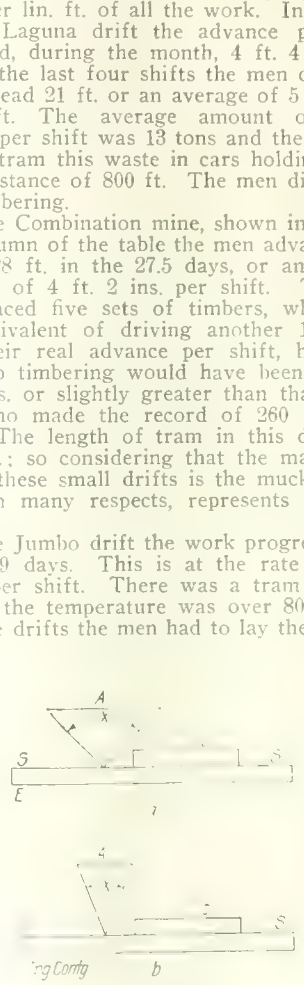


Fig. 2.

In this fast driving, the men worked on a day-pay bonus system. Up to an average of 1 ft. of advance per day per man working in the drift (four per day as there were two on each shift in all these instances), the men were paid by the day. For all distance driven above that footage the men were paid a bonus of $1 per foot per man in the Laguna and Jumbo drifts, while in the Combination drift as the conditions were more favorable, the men were paid a bonus of 50 cts per man per foot.

In regard to the cost per foot of the drift, it must be borne in mind that at Goldfield framed timbers cost at the rate of 4 cts. per ft. B. M.; 40 per cent dynamite costs 14.5 cts.

per lb. at the mine and that the wages are $4 for machine men and $3.75 for shovelers per 8-hr. shift. The reason that the cost of hoisting is so low in the record drift is that a good deal of the waste was used for filling in stopes below that level. In the other cases all the waste was hoisted to surface.

COST PER FOOT OF DRIVING DRIFTS GOLDFIELD, NEV.

	[illegible] drift	Combination drift	Jumbo drift
Distance driven, ft	60	28	[illegible]
Number of days of two shifts each worked	30	[illegible]	29
Advance averaged per 8-hour shift	[illegible]	[illegible]	[illegible]
Number of men working on each shift	2	2	
Distance trimmed, ft	[illegible]	[illegible]	[illegible]
Machine drill charge[1]	$0.41	$0.37	$0.51
Timber	[illegible]	0.26	0.21
Explosives	1.00	0.93	1.02
Labor	[illegible]	2.91	1.15
Hoisting[2]	0.28	0.63	1.02
Total cost per foot	[illegible]	[illegible]	[illegible]

[1] In calculating the machine drill cost, which covers the cost of machine drill repairs, new parts, lubricant and compressed air, the average figure of last year for this item is used, which was $1.83 per machine shift.

[2] Part of waste from drift used as filling in the stopes.

Methods of Constructing the Land Sections of the La Salle Street Tunnel, Chicago.

During the past year work has been in progress for the reconstruction of both the land sections and river section of the LaSalle St. tunnel, Chicago. This work involves the removal of the old brick tunnel, which was lost by flooding four years ago, the sinking of the new concrete lined steel tubes for the river section; the construction of the north and south connections of the river tunnel with the future Chicago subways, and the construction of a temporary approach for surface cars, which will be used until the subways are put in operation. This article will describe the work of the construction of the approaches only. A description of the work on the river section will be given in a future issue.

The entire length of the tunnel and approaches is 2,000 ft. The grades of the subways approaching the river section will be 3 per cent and that of the temporary track leading to the surface will be 9 per cent. Figure 1 shows a general plan and profile of the tunnel which will serve the reader as a key in locating the various sections as represented by the other drawings. As far as possible the new tunnel has been designed to meet the requirements of the permanent subway construction. To this end the sidewalls of the permanent design are continued for the entire length as may be seen by reference to the cross-sections. At the beginning of the rise of the temporary grade, the permanent arch is omitted and a single bore temporary arch is substituted. This arch runs longitudinally on a grade practically the same as that of the temporary track, and ends at its intersection with the street grade. The side walls are built up as high as 40 ft. acting as abutments for this arch. Instead of increasing the thickness of the walls where the height is increased, a series of reinforced concrete struts 1½x2½ ft. are built between the side walls. These struts are placed 8 ft. on centers and parallel with the temporary track grade. There are two tiers of struts, the lower tier is so located as to carry the temporary track. The upper tier of st[illegible] 11½ [illegible] above the [illegible]. [illegible] struts support the temporary grade and are also designed to act as columns in taking the effect of the earth pressures at the back of the high walls of the tunnel. When the temporary trestle is removed, the struts also will be removed, and the permanent arch will be placed. The arches were designed to withstand a heavy loose fill as it was regarded as possible that the entire work would be done in open cut.

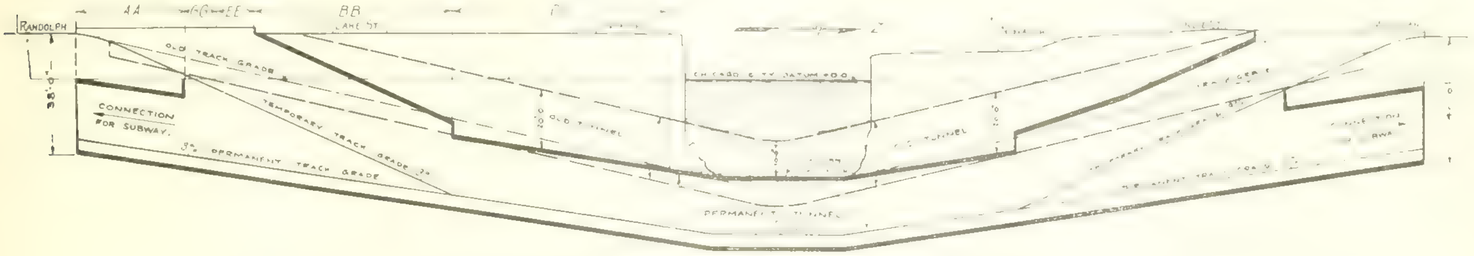


Fig. 1—General Profile of Old and New Tunnels for Street Railway Traffic Under the River at LaSalle St., Chicago.

[illegible] walls of the open approach as shown by Fig. 6 is peculiar. These tunnel walls were required to support the guard railings on the street level and the opening was narrowed to [illegible] The walls were therefore projected, toward the center and the overhang was designed to be made by using the tunnel centering of the [illegible]

The tunnel was designed originally to be [illegible] laid in asphalt, and an 8-in course of concrete was to be placed outside of the brick. Upon request of the contractors the Board of Supervising Engineers made a series of [illegible] waterproofing compounds, to be mixed with the cement, which resulted in allowing the use of McCormick waterproofing compound. The Board of Supervising Engineers allowed the substitution of an integral compound for the purpose of hastening the tunnel work, but desires it be understood that the waterproofing of brick and asphalt, which was called for in the specifications and used for a portion of the work, is giving entire satisfaction.

The construction work was started on the [illegible] 1909, [illegible] to be done in open cut has thus far been prosecuted. The balance of the land work will be done in tunnel. The open cut section at the south end of the tunnel lies between Randolph and Lake streets, as indicated by Fig. 1, and that on the north end of the work lies between Michigan and Kinzie streets. The sides and extreme ends of each of these cuts were enclosed with a row of United States Steel sheet piling 45 ft. long. The work proceeded slowly during the winter principally on account of the removal of public utilities

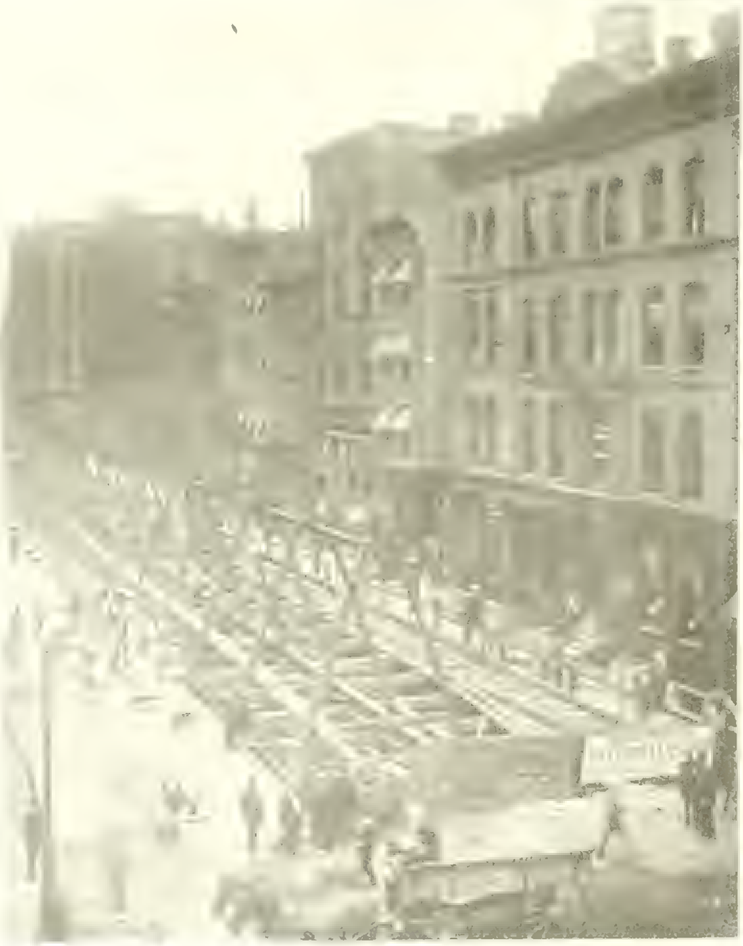


Fig. 2—View Showing the Open Cut Work at the South Approach to the LaSalle St. Tunnel, Chicago, Working Platform Supported on the Bracing.

This was done by the corporations occupying the street.

[illegible] the south end excavation was started in April and on the north end somewhat later. Narrow gage tracks were laid in the approach to the old tunnel. The walls and invert were broken out, and the material was trammed in 1 cu. yd. cars toward the Lake St. end of the cut to a hoist. The cars were here hoisted and mechanically tipped into wagons driven under the chute. This method of excavation proceeded until the excavating forces were concentrated at the south end of the cut to clean up a section for beginning the invert. This made a considerable grade in the industrial tracks and in July a new method of handling the excavated material by means of a Carson machine was put into use. The buckets were dumped, as before, into wagons at the end of the cut.

It may be mentioned here that the only difference between the methods of handling the work at the north end and those used at the south end was the use of a cableway instead of a Carson machine. The cost of handling the material by either method was about the same, but the cableway interferred less with the other work as it did not have to be supported on the bracing and was not in the way of other operations.

The material excavated, after the old tunnel walls and invert were disposed of, consisted of heavy blue clay of about the consistency of putty. This is most difficult to excavate. The general method of attacking it was first to excavate in the center, making a berm about 4 ft. high, and then to attack the berm with Bonnell knives working the vertical face of the berm back toward the sides. The excavation in the center is done with short round pointed shovels, two men facing each other and forcing their spades into the clay about 8 ins. apart, then prying out the piece between the shovels. A pail of water is kept handy so that the shovels may be wetted to prevent the sticking of the clay to them. The clay knives, which have been previously described in these pages, are handled by two, three, or four men. They carve out of the bank a long rounded strip of clay which is picked up by another man and thrown in the car or bucket. It is often necessary to sprinkle each piece with sand and to put sand into the cars and buckets to prevent the adhesion of the clay. A gang of 8 men averages from 100 to 115 buckets of 1 cu. yd. capacity in 8 hours. The work is handicapped by rain because the clay when too wet must be dug entirely with shovels.

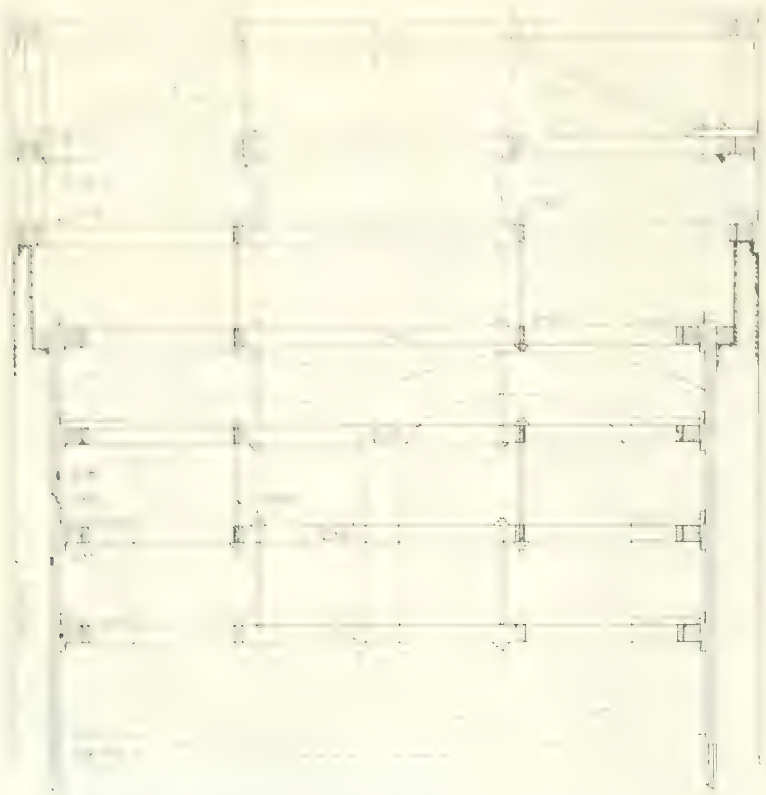


Fig. 3—Plan of Bracing Showing Truss and Method of Suspending Bracing from the Sheet Piling.

Bracing.—Owing to the weight of the rows of buildings several stories high on each side of the cut, it was necessary to provide an elaborate bracing between the rows of steel sheet piling which were 40 ft. apart. The system used by the contractors was unique. It provided for carrying the weight of a platform laid upon it for one-half its width and upon which material for concrete was dumped from wagons and all concrete work was carried on. It further provided for its construction from the top down as the excavation was carried down and also for the removal of bracing as fast as the concrete was carried up. These advantages were possible because the entire system was suspended, its entire weight being carried on the sheet piling at the sides. Cables were run through holes at the tops of the sheet piling and heavy waling timbers were tied and suspended in the cables. Upon these walling timbers the top tier of transverse bracing timbers were rested and the rest of the tiers of timbers were suspended by bolts to the top tier. A drawing showing a section of the timber bracing is given by Fig 3. It will be noted from the figure that a truss is constructed between the upper two tiers of bracing to stiffen the structure vertically and wedge blocks are forced between the steel sheet piling and the bracing to take the lateral pressure of the earth against the steel sheeting. Fig. 4, which shows the first method of tramming the excavated material, also shows the system of bracing.

Forms.—The first work done on forms was the driving of the Wakefield sheathing to form the outside face of the tunnel wall. This wood sheathing was driven only far enough inside the steel sheathing to allow clearance for the steam hammer. The Wakefield was left in place. This method of making the outside form was required in order to prevent the excavation of any material outside the tunnel walls and thereby avoid the possibility of a settlement of the ground which might occur with back filling and the weight of the adjacent buildings. Near the north end of the cut, however, this sheeting was left out as the line of sheeting was far enough away from the steel sheet piling so that the clay stood up without support, making several feet of berm inside the steel piling. The Wakefield piling was made with three planks laid flat together and with the edges of the two outside planks projecting 2 ins. beyond the edge of the center one. These nailed together made a tongued and grooved pile. The center plank was 3x12 ins., the inside plank 2x12 ins. so as to make the continuous surface required for the concrete wall, while for the outside plank 2x8 ins. was wide enough to serve the purpose. The piling was 26 ft. long. For driving it a 4,700-lb. Arnott steam hammer suspended from a stiff leg derrick was used. The crew consisted of 1 engineer, 1 firemen and 1 nigger head man on the machine. Because of the interference

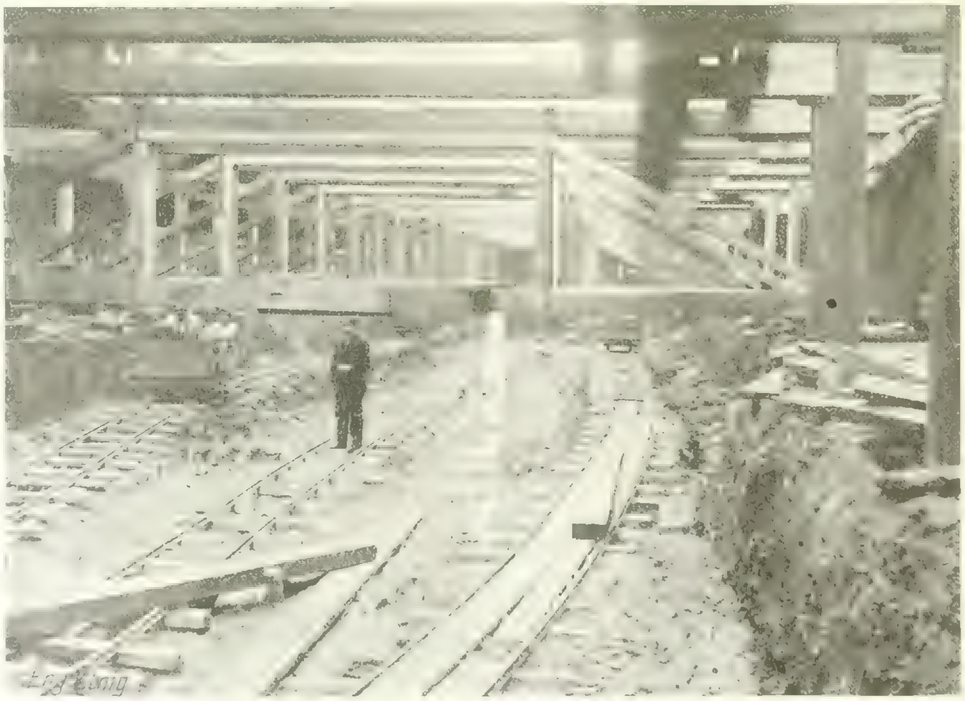


Fig. 4—View Showing Upper Two Tiers of Bracing in Place and First Method of Tramming Excavated Material.

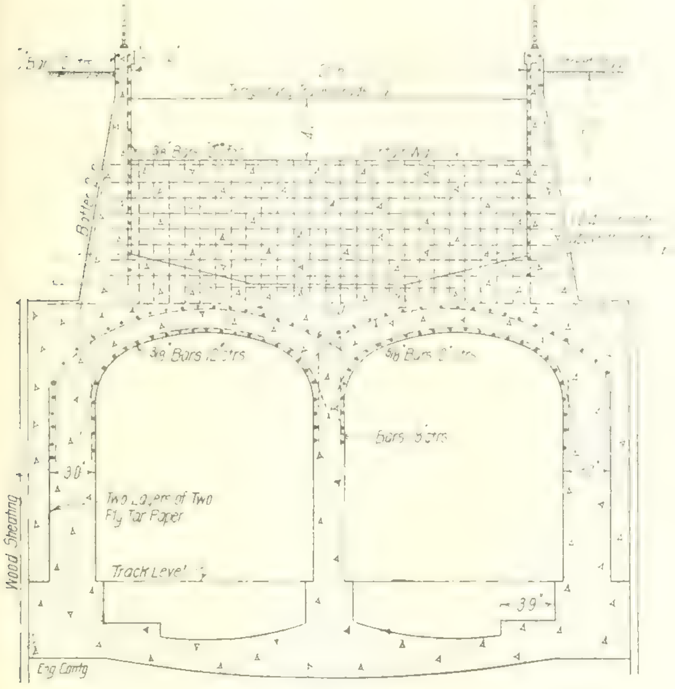


Fig. 5—Section A A of Tunnel.

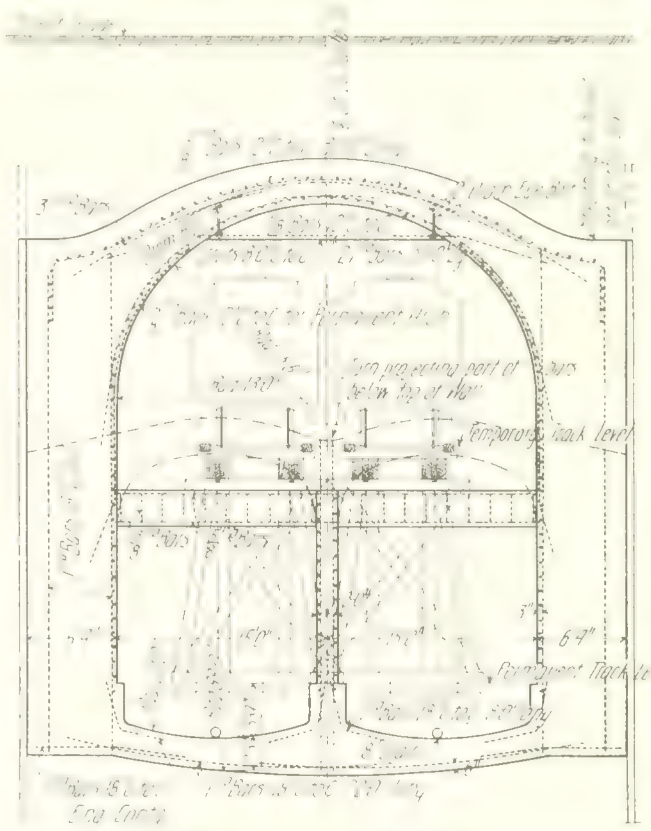
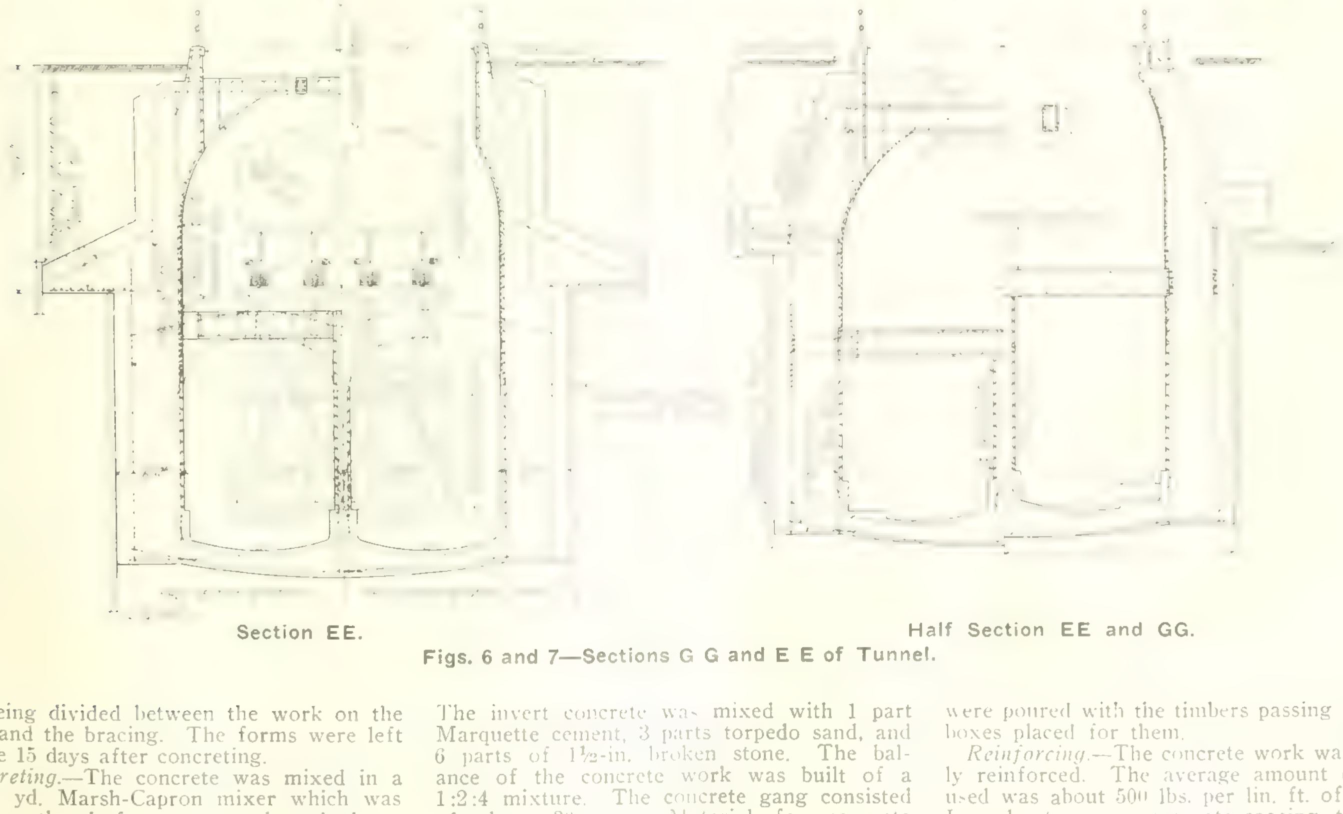


Fig. 8—Section B B of Tunnel.



Section EE.

Half Section EE and GG.

Figs. 6 and 7—Sections G G and E E of Tunnel.

of the bracing and the difficult location five men were required to guide the hammer and place the piles, although in ordinary work only three men would be necessary. From 28 to 35 piles a day were driven.

The other form work consisted of the interior wall faces of the tunnel and the arches. Fig. 8 is reproduced from the contractor's plan of these forms. It shows an elevation and plan. The shiplap was placed outside of the vertical studs and on the steel ribs which were bent in a shop to the radius of the arch. This method of placing the lagging loosely on the rigid skeleton frame makes the removal of the forms very easy and results in the least harm to the form material. About 20 carpenters and helpers were continuously employed on the work, their time being divided between the work on the forms and the bracing. The forms were left in place 15 days after concreting.

Concreting.—The concrete was mixed in a 1/3 cu. yd. Marsh-Capron mixer which was located on the platform supported on the bracing. A flexible chute from the discharge of the mixer carried the concrete directly to place in the forms. The mixer was built upon skids which traveled along the platform on rollers. The accompanying photograph, Fig. 2, illustrates the [illegible] concrete and Fig. 11 shows the mouth of the chute ready for depositing the concrete in the center wall and arches. In laying the invert concrete, sections 30 ft. long were taken at a time. This work followed directly upon the cleaning up of the excavation the concreting usually [illegible]

The invert concrete was mixed with 1 part Marquette cement, 3 parts torpedo sand, and 6 parts of 1½-in. broken stone. The balance of the concrete work was built of a 1:2:4 mixture. The concrete gang consisted of about 30 men. Material for concrete was hauled in and dumped in piles upon the working platform. It was transported from the piles to the mixer in wheelbarrows. The mixer was supplied with an elevating charging hopper so that wheelbarrows were dumped into it directly from the [illegible] sections vertically, so that each section poured required the removal of one tier of bracing. [illegible] ft. Above the arches of the permanent work the bracing was left in as it was needed to [illegible] were poured with the timbers passing through boxes placed for them.

Reinforcing.—The concrete work was heavily reinforced. The average amount of steel used was about 500 lbs. per lin. ft. of tunnel. In order to secure accurate spacing, the rods were wired together over the arch. The ver tical reinforcing bars were hooked at the end and suspended as shown in Fig. 11. The blocks used for holding the reinforcing away from the forms were of concrete.

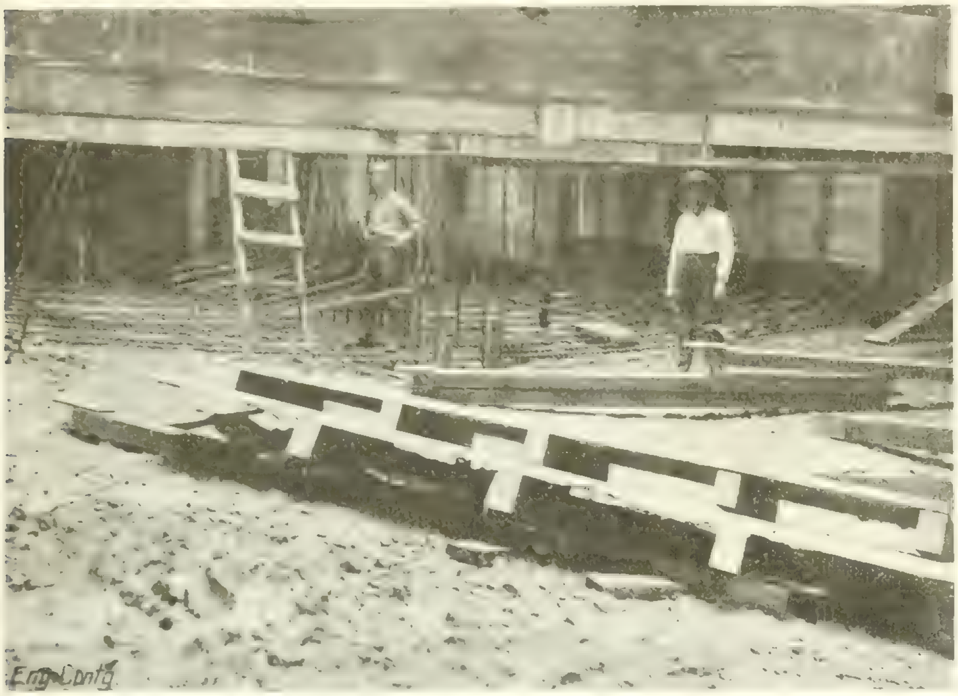


Fig. 9—View Showing a Section of Invert with Reinforcing Bars Ready to Receive Concrete. Wall Forms Built Up to Bottom Tier of Bracing.

Tunnel Work.—The contract for the work of the construction of the land sections of the tunnel will be done by the tunneling method. This decision was reached by the Board of Supervising Engineers for the purpose of maintaining the street without interruption to traffic. The contractor had proposed carrying on the work with the aid of a steel shield but, on account of the many obstructions underground, and the trouble of working a shield through the old tunnel another method was devised by the engineers. This, in brief consists of sinking of two shafts, one on each side of the river, and prosecuting a main drift at the elevation of the invert of the new tunnel. The work from the north shaft will proceed north and from the south shaft as far south as it is possible to use the tunnel method. The main drift at the level of the invert will be solidly timbered and afford a means of taking care of the excavation as the tunneling is prosecuted.

At different points, for example 30 ft. apart, there will be side drifts leading off from the main drift, which will be excavated to the full height and about 10 ft. in width. The side drift will then present space for constructing 10 lin. ft. of tunnel as called for on the plans. As it will take several days to complete each of these sections of tunnel, it will afford ample time for the concrete to set and be able to carry the load of the existing tunnel above it. After this the next 10 lin. ft. of tunnel adjoining the first series of side drifts will be attacked in the same manner. By this method a third series of side drifts will complete the tunnel.

The work is being done for the Chicago Railways Co.—Mr. John M. Roach, President —by the M. H. McGovern Co., who have associated with them Messrs. J. A. Charles, and R. H. Green of Chicago. The designs were made and the work is being carried out under the direction and supervision of the Board of Supervising Engineers, Chicago Traction, which has charge of all street railway reconstruction in Chicago. Mr. Bion J. Arnold is Chief Engineer, Mr. Geo. Weston represents the city, and Mr. Jno. Z. Murphy represents the Chicago Railways Co. Mr. William Artingstall is Division Engineer of the Board, Mr. J. H. Harris is Division Engineer of the Chicago Railways Co.

Surveying Methods Employed for Underground Excavation.

The methods employed in surveying mines differ somewhat from those employed for other underground excavations. The survey of a mine often follows the actual excavation, whereas the surveys for construction work precede the excavation work.

Mr. Paul A. Gow, in the *Engineering and Mining Journal* describes his methods of surveying at Butte, Mont., from which we abstract portions useful to engineers in construction work.

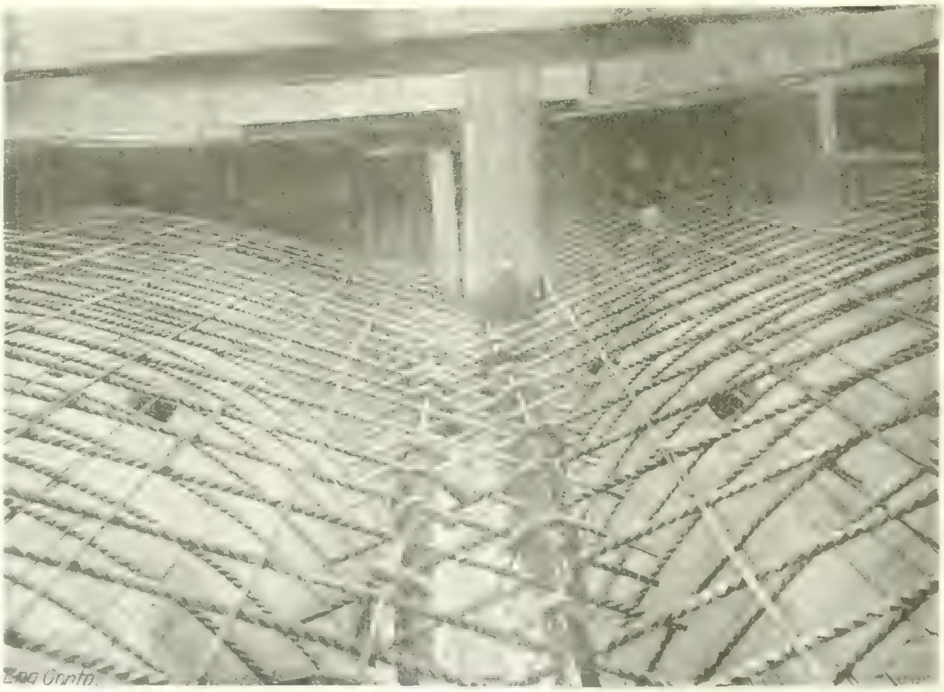


Fig. 11—View Showing a Section of Arches with Reinforcing Bars Wired Together in Place. The Concrete Chute from the Mixer Is Shown.

All surveys, both surface and underground, are run from an established base line about 500 ft. long, situated upon firm ground. This base line is marked by two iron pipes 6 ft. long, which are set in concrete. An iron plug, with a hole drilled in the center for the survey point, is screwed into each pipe. The elevation of these points is ascertained and all levels are run from them as permanent benchmarks.

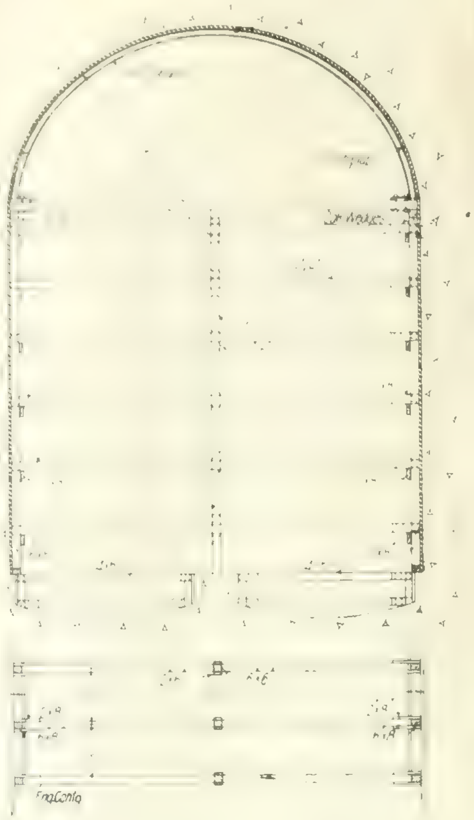


Fig. 10—Plan of Inside Wall and Arch Forms.

The surface surveys consist of the location of corners, shafts, buildings, roads, fences, pipe lines, tanks, and also show the 5-ft. contours. Platting is done by co-ordinates, to a scale of 40 ft. to the inch. The co-ordinate lines are 200 ft. apart, making 5-in. squares on the maps, which are 38 x 44 ins.

From the base line, surveys are run to points near the various shafts, one point being located directly in front of one of the compartments of each shaft.

In establishing a line at the bottom of a shaft two plumbing wires are used for establishing points on the line. A plumbing board is made, for suspending the plumbing wires, which is about 6 ft. long and supports two reels which can be adjusted by sliding along the board. Under each reel is a lug with a vertical slot at the end, in which the wire rests when let out. These lugs carrying the wires may be moved in or out to bring the wires in line with the transit. A plank is nailed on each side of the shaft to support the plumbing board. The wires are brought approximately into line with the transit by shifting the plumbing board on the supports. The reels are then set so that the wires will clear the wall plates when lowered. Both wires should not be lowered at the same time as they are apt to swing and tangle. Fifteen-pound plumb bobs, made in the form of a cross, are attached to the wires and hung in buckets of water with about an inch of oil on top of the water.

After the bobs have been attached, the wires are set by screwing the lugs in or out till the wires come in line with the transit.

Underground the transit may be lined in, after the [illegible] by setting [illegible] until the [illegible] of the wires.

In order to avoid having the helper stand in the shaft to illuminate the wires, five or six candles [illegible] tracing cloth tacked over the front, and this is hung on a nail behind the wires.

In making plumbings it is generally most satisfactory to plumb not over 600 ft. If it is required to make a plumbing from the surface to the 1,000-ft level, instead of dropping the wires from the surface to that level it is best to plumb to the 500 ft. level and then make another plumbing from there to the 1,000-ft. level. If the wires are dropped 1,000 ft. at one plumbing it takes some time for them to come to rest if the shaft is wet or windy.

In the double-wire method with a base of from 3 to 3.5 ft. a very slight movement or swing of the wires will throw the courses out appreciably. In wet and windy shafts the swing of the wires is irregular and it is difficult to split the distance of the swing.

Double-wire plumbings are always made twice and for ordinary work should check within 2′.

Survey points underground are marked by brass screw eyes driven into plugs which are marked by numbered brass tags. The transit is always set up under the point. When a drift is timbered and it is impossible to put plugs in the back the point is put on a cap. Points on timber often hold for a considerable time, but when the timbers carry much weight they are quite apt to move.

While the engineer is setting up the transit the helper hangs up the back-sight lamp and then goes ahead to put in the point for the foresight. From this point the helper hangs a plumb bob and gives the sight by holding a candle shaded by a piece of tracing cloth behind the plumb line. After the angle has been taken and doubled, the distance is measured with a 100-ft. tape graduated to tenths and hundredths for the entire length. In case the distance is over 100 ft., one point or as many as required are lined in. Horizontal distances are measured, no vertical angles being taken except in surveying raises. The instrument man holds the zero end of the tape on the instrument and the helper reads the tape, moving it up and down on the plumb line and reading the shortest measurement.

ROADS AND STREETS SECTION

Highway Legislation.*

Adequate transportation facilities are a vital factor in the prosperity and civilization of any country. They are essential to the development of its agriculture and manufactures, to the working of its forests and mines, and to the spread of education and enlightenment among its citizens. This necessity has been recognized by the foremost nations of every age and steps taken to meet it by improving the methods of transportation then current.

In the United States a movement for internal improvements was projected almost contemporaneously with the establishment of the Federal Government. This first took the form of highway improvement through the construction of toll roads by private corporations and the building of national highways by appropriations from the National Government. These appropriations for national highways were continued by Congress for a period of nearly half a century, and a total of about $14,000,000 was thus appropriated.

In 1832, however, the steam locomotive was invented and an era of railroad development followed. It was believed by many that the development of railroads would obviate the necessity for highway improvement, and, consequently, all efforts at improving the public highways of the country were soon abandoned. During this period of activity in railroad construction many thousands of miles of railroads were built.

The success and energy attending this movement for developing the facilities for railroad transportation throughout the country is evidenced by the fact that today we have practically 235,000 miles of railroad, costing about $15,500,000,000, including equipment and carrying annually about 900,000,000 passengers and more than 1,500,000,000 tons of freight. During this period railroad freight rates have fallen from 7⅓ cts. per ton mile, in about 1837, to 7½ mills per ton mile, or about one-tenth the original rate, and yet, even at this low rate, the annual receipts of the railroads amount to about $1,800,000,000.

The cost of ocean transportation has been reduced ever more phenomenally than railroad transportation, and has reached such astonishingly low figures that it now costs only 2.2 cts. per bushel to carry wheat from New York to Liverpool, a distance of 3,000 miles. These rates have remained practically unchanged for a number of years, which would indicate that the minimum reduction has been produced [illegible] rates.

[illegible] we [illegible] in railroad and ocean rates. This does not mean, however, that all of our transportation problems have been solved, nor that there can be no further saving in our cost of hauling, because the public roads throughout the country, which constitute the primary means of transportation for all agricultural products, for many millions of tons of forest, mine and manufactured products, and which for a large percentage of farmers are the only avenues of transportation leading from the point of production to the point of consumption, are practically in as unimproved condition today as they were one hundred years ago.

By reason of this fact the prevailing cost of hauling over these roads is 23 cts. per ton mile [illegible] over these roads each year, and the average haul is 9.4 miles, from which it can readily be seen that our annual bill for hauling over our earth roads is more than $500,000,000. In France and other European countries which have improved their roads to a high state of excellence the cost of hauling is less than half what it is in this country. From this fact it is perfectly apparent that if our roads were put in an equal state of excellence the annual saving in the cost of hauling would be not more than $250,000,000, which demonstrates that any further material reduction in the cost of transportation in the United States must be effected through the improvement of our public roads.

There exists today throughout the United States a stronger sentiment in favor of highway improvement than ever before. Spasmodic efforts have been made heretofore, but no concerted or systematic movement has ever been inaugurated looking to this end. In the early history of our country the movement took the form of the construction of toll roads by private corporations and the building of National highways by the National Government. Both of these methods were abandoned and the whole responsibility for improving and maintaining the highways left to the local authorities of the counties throughout the various states.

The system under which these local authorities undertook to maintain the roads was that of extreme localization, borrowed from England when the colonists first came over to America. Under this system the State contributed nothing to the cause in the way of money aid or supervision and the county or town relied on local revenues, consisting mainly of statute labor, for prosecuting the work. For a long time this system seemed to be adequate to the needs of existing conditions, but it has long since become obsolete and should be abandoned in every State, for the reason that it fails to insure skilled supervision, provides an inadequate revenue, depends upon a purely unskilled and unreliable class of labor, and practically precludes any construction of a permanent character.

Under this system a great host of petty road officials was appointed, each of whom undertook the improvement of the roads under his supervision according to his own ideas and without any central or competent authority directing him in the matter. Approximately 100,000 of such road officials exist throughout the United States. In the State of Indiana there is a multitude of road officials, many of whom are absolutely unnecessary. Under your present system the revenues for the construction and maintenance of roads are paid partly in cash and partly in labor, and there is a provision of law which authorizes the payment of even cash taxes in labor at a given rate per day. The county commissioners of each county are also authorized to appoint superintendents of roads for not less than 10 or more than 15 miles of free gravel roads in a district; while, in addition to this official, each district has a supervisor elected by the people to hold office for two years. In addition to these officials there is a township advisory board, which is authorized to levy certain taxes for road purposes, and the township trustees, who are also authorized to levy road taxes. In each county it would appear that there are the county commissioners, the superintendents of free gravel roads, the township supervisors, the township advisory board and the township trustees, each probably pursuing a different policy in the administration of road affairs.

It is apparent, therefore, that the present system of road administration is heavily encumbered with officials, none of whom have complete authority to formulate or direct a definite road policy for any one of the counties, and each receiving such a small salary that he cannot afford to devote his time and attention to the subject. This system should be abolished, and the administration of the road affairs of each county in the state placed in the hands of one competent man having full authority to formulate plans and prosecute the work of improving the highways throughout the county, and with sufficient compensation to justify him in devoting his entire time and attention to the work.

Along with this reform should come a change in the system of road revenues. The policy of having road taxes paid in labor has proved a signal failure. Those who discharge their taxes in this manner have no further interest in the work than to meet their tax obligations, and in many instances the roads would be better off if they were not touched. A law should therefore be passed requiring all road taxes to be paid in cash.

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*Paper by L. W. Page, Director U. S. Office of Public Roads presented at the meeting of the American Road Builders' Association at Indianapolis Dec. 6-9, 1910.

The present trend of road legislation is to abandon these old methods, which have proved so ineffective, and adopt more progressive methods for the administration of road affairs. The principle of State aid and State supervision seems to be the solution of this problem. The first State to adopt State aid was New Jersey, a law having been passed by the legislature of that State in 1891. Since that time, however, two-thirds of the states of the Union have adopted some form of State aid or State supervision, and the tendency in every instance of an amendment of a State-aid law has been to increase the scope and authority of the State Highway Department and also the State appropriation. In 1905 a road census, taken by the United States Office of Public Roads, disclosed the fact that about $79,000,000 was being expended on our roads annually, and of this amount it was estimated that about 50 per cent was wasted through the inefficient methods of administration. At present it is safe to approximate the annual expenditures at $100,000,000, and of this increase a large percentage consists of appropriations by states for State aid.

During the year 1910 some of the States have appropriated for State-aid roads the following amounts: Maryland, $350,000; Massachusetts, $750,000; New Hampshire, $300,000; New Jersey, $300,000; New York, $2,500,000; Pennsylvania, $1,000,000; Rhode Island, $300,000; Vermont, $175,000; Virginia, $250,000; Washington, $375,000, and West Virginia, $120,000; and other States are extending aid in varying amounts. In the South, while the States are not giving much money aid, yet they are helping along the movement by the use of State and county convicts. The State of Georgia, for instance, has about 4,500 convicts working its roads every day during the year, and the States of Virginia and West Virginia furnish convict labor aid in addition to the money aid appropriated. Practically every southern state works its county convicts, or both its county and State convicts, on its roads.

Indiana is one of the States which has not joined in the State-aid movement. According to a road census taken in 1905 by the United States Office of Public Roads, 34.94 per cent of the roads of the State were reported as improved, only two other States, Massachusetts and Rhode Island, having a larger percentage of improved mileage. From this it might be said that the progress of the state in the matter of improving its roads will justify the claim that the present system is a good one, and that there is no necessity for reform. However, when the situation is analyzed, there appear to me the following points of fundamental weakness: First, extreme localization, involving the employment of a multitude of road officials and a consequent distribution of road authority; second, the omission of any requirement or provision to insure skilled supervision; third, the payment of road taxes in labor, and fourth, no provision for continuous inspection and maintenance of roads after improvement.

I have prepared a bill embodying what I consider the principles which should govern in a state highway law. In the first place, such a law should be so framed as to remove its administration as far as possible from politics. This is sought in the bill referred to by providing for a non-paid State Highway Commission, to consist of the state geologist, a professor of civil engineering from Purdue University, and one civilian member to be appointed by the Governor of the state. A commission thus constituted would have a majority of its members chosen because of their training and ability and without reference to political affiliations, which would insure a non-partisan and technically competent commission; while the civilian member to be appointed by the Governor should bring to the commission a certain amount of experience and business ability necessary to a proper organization and economic prosecution of its work. The actual work of the State Highway Department should, however, be under the direction of one man, possessing technical qualifications and executive ability, and hence the State Highway Commission should be authorized to appoint some one, a civil engineer, skilled and experienced in road construction and maintenance, to be state highway engineer and to have full authority in all executive work of the department. Through this arrangement it is sought to preserve the proper balance of power and give to each branch of the department the duties for which it is best fitted, and, at the same time, to place each of these branches as far removed as possible from political influences.

The initiative in obtaining state aid should rest with the county or local authorities. This is best because, in the first place, the country or local authorities are in better position to know what roads could be most advantageously improved, and, in the second place, they are best able to determine the ability of the county to share in the expense of such road improvement. Another important consideration in this connection is that if the initiative were to rest with the state there would most likely be a conflict of authority between the states and the counties, resulting in either the ultimate failure of the state aid plan or the breaking down of county authority.

The only cases in which roads can be built by the state without the full and hearty cooperation of the county is when the state pays the entire cost of building state or trunk line roads. For this reason this bill vests the initiative in securing state aid with the county authorities, but, at the same time, it provides that no state aid shall be granted until the application of the county authorities has been approved by the state highway engineer, which enables the state highway engineer to exercise a sort of supervisory power over the selection of roads to be improved, to the end that any roads which may be improved under the act shall conform to a general system of highways, which he shall devise. It is also provided that all surveys, plans, specifications and estimates shall be made by the state highway engineer's office, and that improvements to cost over $2,000 shall be let to contract.

It is thought more conducive to the development and general welfare of the state, as well as to a more uniform and systematic prosecution of the work of road improvement, to have a larger proportion of the cost of state aid roads borne by the state in the poorer counties than in the wealthier ones. It is provided, therefore, that the counties are to reimburse the state a certain portion of the cost of state-aid roads, the cost in the first instance being paid by the state when the taxable valuation is above a certain amount, and a smaller portion when the taxable valuation is less than such certain amount. This provision is thought wise because it will enable the state to move forward uniformly in its efforts at road improvement and will distrubte the benefits of any appropriation made by the state legislature from the state treasury equitably throughout the state.

This proposed bill also provides that the engineer shall prepare a general highway plan of the state and shall within one year prepare a map of such of the main highways of the state as, in his judgment, are of sufficient importance to be designated as a system of trunk or state roads, to be improved and maintained at the cost of the state, and report the same to the State Highway Commission for submission to the legislature for adoption as a proposed system as trunk or state roads. I regard this provision as a very important one, for the reason that all money expended by the state on road construction should be in pursuance of a plan looking to the ultimate establishment of a connected system of state roads. This cannot be as successfully attained by any other methods as by the adoption of a trunk line system.

The states which are now making greatest progress in the improvement of their roads are adopting the trunk line plan and are making liberal expenditures each year to the improvement of these trunk line roads. Among these are Maryland, to spend $1,000,000 for trunk line roads in 1910; New Hampshire, to spend $430,000; New York, to spend $2,500,000, and Washington, to spend $620,000, while at the recent election a law was ratified in California providing for the issuance of $18,000,000 in bonds for the construction of a system of trunk roads throughout that state.

One phase of road work which seems to command the neglect of every state and county in the Union is that of maintenance. The impression seems to prevail that "once a good road always a good road." Up to within just a few years ago even those states which have adopted state aid gave no attention and made no provision for maintaining the roads after they were constructed. It is useless to spend money in the construction of improved roads without making adequate provision for their maintenance. Road maintenance should be systematic and continuous. Every mile of road improved should be kept under constant surveillance, and the first appearance of the slightest deterioration repaired.

France, which has the most superb system of roads of any country in the world, has adopted the patrol system for maintaining its roads, a patrolman or cantonnier being kept on every mile of road every day during the year. It is this excellent system of maintenance which gives France its magnificent roads, and not that their methods of construction are at all superior. We build as fine roads in this country as are built anywhere, but we have failed to maintain them after we have built them. The folloy of this neglect is beginning to be realized now, and attention is being given to road maintenance as well as road construction in those states most active in the work of improvement.

In the bill prepared for Indiana it is provided that all roads constructed with the aid of the state shall be kept in proper repair by the state highway engineer, the total cost of such maintenance to be paid from the state treasury, the counties to reimburse the state their proportionate share of such cost; and if a system of trunk or state roads should be adopted, to be constructed entirely at the expense of the state, they should be maintained wholly at state expense and a system of patrol adopted so as to keep each mile of road under constant observation and in a state of perfect repair. Indiana is in excellent condition financially for adopting a system of state aid. In point of wealth it is surpassed by only eight states, and only eleven states have a smaller tax rate. The assessed valuation of the state for 1909 was $1,776,132,096, on a 60 per cent basis of assessment, while the bonded indebtedness of the state is only $1,510,163. A levy of one-fourth of a mill is suggested for the purpose of creating a state highway fund. This levy is so light that it will not materially increase the taxes of any individual, but, at the same time, it will yield an annual revenue of about $450,000, to be expended for road purposes throughout the state.

This sum, while it is quite sufficient to begin with, is rather small for a prosperous and progressive state like Indiana. Massachusetts has appropriated for road improvement during 1910 the sum of $700,000 from the state treasury, and this is to be supplemented by the proceeds from automobile licenses, which will amount to about $250,000 more; and yet the taxable valuation in Massachusetts is only $4,574,136,145, with a bonded indebtedness of $78,097,595. During 1910 Maryland will spend $1,350,000 on its road, and its taxable valuation is less than half that of Indiana, being only $765,109,228, with a bonded indebtedness of $5,978,926, and New Hampshire, with a taxable valuation of only $249,219,335, and a bonded indebtedness of $831,700, will expend on its roads during this year the sum of $739,000. So Indiana, as compared with other states which are spending the most money on their roads, is well able to adopt a state-aid system and make liberal appropriations from the state treasury for the purpose of promoting the improvement of its highways. In fact, being an agricultural state, it can better afford to improve its roads than to not improve them. During the year 1909 this state produced 19,000,000 lb. of tobacco, 3,080,000 tons of hay, 55,510,000 bushels of oats, 33,124,000 bushels of wheat and 196,520,000 bushels of corn. In addition to these products various other miscellaneous agricultural products, aggregating probably an equal amount, were produced.

Practically all of these products had to be hauled over the roads of the state. If these roads were in first-class condition at all seasons of the year the farmers could haul these products to the markets at such times as prices were best, but when the roads are not in good condition and are practically impassable during certain seasons of the year, the farmers are forced to market their products when the roads are good, regardless of prices. The roads, except in the case of improved ones, are always best during the summer months, when they are dry and hard. Take the one crop of wheat. During the year 1909 the price ranged in Chicago from 99¼ cents to $1.60 per bushel, the lowest price being reached in August, the very month in which the roads were probably the best and the farmers would be putting their wheat on the market, unless conditions were such that they could haul it to market at any season of the year when the prices suited them. A difference of 1 cent per bushel in price of the 1909 wheat crop of the state of Indiana would mean a difference of $331,240, and a difference of 1 cent per bushel in the corn crop would mean $1,965,200. These facts are incontrovertible, and stand forth as a strong argument for the state of Indiana to immediately take up the matter of establishing a State Highway Department and make liberal appropriation for carrying on the work of improving its highways.

Nature has favored Indiana to an exceptional degree in the distribution of road materials. Along the Wabash River and the larger streams in the northern portion of the state there is an abundant supply of excellent gravel and many exposures of limestone, only three counties in this section, according to the report of the state geologist, being entirely devoid of both gravel and stone, and the same is largely true of the southern half of the state. Only three counties in the northwestern and six in the southwestern portions of the state are devoid of road materials. Being thus favored with an abundant supply of materials Indiana could, with a proper system of administration, soon move from third to first place among the states of the Union in the percentage of improved roads.

During the ensuing year the legislatures of 42 states will be in session and the indications are that it will be a banner year in the matter of road legislation. Already members of the legislatures of various states and various good roads organizations and state boards are formulating highway bills with the hope of having them enacted into laws The sentiment in every state is strongly in favor of effective highway legislation, and in most of the states not having already adopted it, new legislation, either enacted or pressed for enactment, wi[illegible] the [illegible] state supervision. [illegible] states of the [illegible] department. Indiana, long one of the most progressive states of the Union, must neces[illegible] in enacting an efficient state highway law, in order that it may keep abreast of them in the [illegible]

Principles Governing the Selection of Paving Materials.

[illegible] fronts the city engineer is the selection of the paving material best suited for any particular street. Streets are built to serve the general public as a whole, and in particular the different people doing business upon them. These interests often conflict and perhaps as often interests of each class conflict. To harmonize these interests is always difficult and sometimes impossible. Certain principles, however, governing the selection of paving material can be established which will materially aid the city official [illegible] the Borough of Manhattan, New York City, the standard paving materials are stone, asphalt (block and sheet) and wood. The principles governing the selection of one of these materials for paving a given street were given as follows by Mr. George W. Tillson, Chief Engineer of Highways of Manhattan Borough, in a paper read last fall before the Society of Municipal Engineers of the City of New York.

The general properties that are commonly required of a pavement are that it shall be durable, smooth but not slippery, free from noise under traffic, and sanitary. These properties may seem simple, but it is safe to say that, while they are all contained in the materials mentioned above, no one pavement has ever been constructed that contained them all. It is the harmonizing and modifying of these different traits to suit the needs of the different streets that will test the knowledge and skill of the engineer.

For heavy traffic streets where the pavement is in constant use under all weather conditions and where the question of noise is not important, a well-laid granite pavement will be most satisfactory; but suppose, for instance, that such a street passes a hospital and it is necessary to reduce the noise to a minimum, then a change must be made. Under such conditions, where the grade is less than 2 per cent, the author would always recommend wood block. On steeper grades asphalt, sheet or block, to about 5 per cent, when a return must be made to granite. The problem then is to use this material in such a way that it will produce the least possible [illegible] that American stone pavements are inferior to European more on account of the character and shape of the blocks themselves than the material. If, then, the blocks are so dressed that when laid the surface of the pavement shall be smooth and the joints between the blocks so small that it is practicable to fill them with a bituminous compound, the noise element will be eliminated to as great an extent as possible. If, on the contrary, the traffic on a street be heavy, the question of noise on its entire length all-important and the grades below 2 per cent, the material to be used is undoubtedly wood block.

On light traffic, business or residential streets, either asphalt or wood can be used according to local wishes within grade limitations. It must be remembered, however, that on streets not in continuous use grade restrictions need not be so strictly adhered to, as on the comparatively few days when smooth pavements are unduly slippery they can be avoided to a great extent. To sum up briefly, then, the principles governing the selection of materials for different streets, one would say, first, for heavy traffic wholesale streets, granite block; second, for heavy traffic streets where noise must be eliminated where possible, wood block, asphalt-block, or improved granite, according to grades; third, for light traffic or residential streets, asphalt or wood, according to local desires.

The above conclusions have been reached by taking into account the effect of using materials that do not contain all the requisites previously stated so as to produce the best results. For instance, granite is durable, fairly smooth when well laid, but so noisy as to prohibit its use on certain streets. Wood block is smooth, durable and almost noiseless, but slippery under certain conditions. Asphalt is smooth, less slippery than wood block and also less durable than either wood block or granite. With well-laid granite there is not much difference in the sanitariness of either of the above kinds. It has been considered that a smooth pavement should always be laid whenever conditions are such as to permit it.

It will be noticed that up to the present time no mention has been made of the cost of the different kinds of pavement. The reason for this is that the author believes that in the Borough of Manhattan the pavement best adapted to any one street should be used irrespective of its cost.

In deciding specifically upon the material for any particular street the question of cost sometimes comes up and may be an important factor in reaching a decision; then the first cost and frequently that of repairs must be taken into consideration. Interruptions to traffic are very objectionable and should be reduced to a minimum. Streets are in use at all times and under all weather conditions. If a pavement be put in good condition and then weather conditions arise so that it is not possible to make repairs for three months, for instance, and in the meantime it becomes bad and in a general state of disrepair, it can safely be admitted that it has not been constructed of proper material. This last principle is important in making the decision. From all reports it is probable that the pavements of the cities of London and Liverpool are kept in better condition than those of any other large city. It would be of the greatest importance to know whether this is due to a more intelligent selection of material, better construction, or a more uniform and systematic method of making repairs. It is very likely due to all three, and a study of this would undoubtedly be of great value to American cities.

WATER-WORKS AND SEWERS SECTION

Methods of Laying Sewers in Wet Trenches.*

The following data were secured in response to a request for information concerning the advisability of laying sewer pipe upon plank and holding it to line and grade by wooden wedges placed back of each bell.

The city engineer of Beverly, Mass., has employed iron pipe for wet trenches, the particular trench in question being in very wet, running sand. The pipes were blocked up at the bell ends until an inch or so above grade. The joints were then calked by oakum, followed by lead wool, after which two men using a piece of 6 in. x 6 in. timber as a rammer drove the pipe to grade. No other method was reported from New England, aside from the common practice there of first laying an underdrain surrounded by crushed stone or gravel, thereby draining off the water from the trench and permitting the laying of sewers directly above it on comparatively dry ground.

In the Central States a number of engineers reported having used the plank and wedge method. From New York one engineer reports that "In wet quicksand this is about the only plan I have found at all practical, but a trough or cradle was often necessary instead of simply a plank. Without such a foundation the pipes will not be apt to stay in place at all." Mr. E. B. Codwise, of Kingston, N. Y., states, "I have had 18-in. to 24-in. pipe sewers laid on a timber and plank foundation held in place by wooden wedges. Some such sewers were built 15 to 18 years ago and I have never [illegible]. From Elizabeth, N. J., Mr. W. H. Luster reports laying [illegible] sewer pipe in this way without having [illegible].

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*From information collected for the American Society of Municipal Improvements as published in the "Municipal Journal and Engineer."

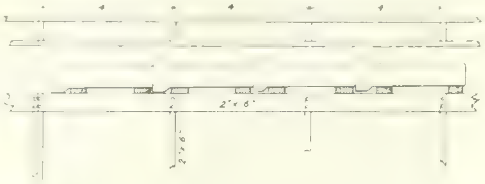
Among the Pennsylvania reports Mr. B. E. Briggs, of Erie, states that in bad trenches of running sand he prefers to lay the pipe on plank, but block it up with dry earth; two pieces of 2x6-ft. or 2x8-ft. laid lengthwise of the trench being used. Mr. B. K. Finch, of Wilkes-Barre, has used the plank, but in place of wedges employs collars or blocks of wood having an arc of a circle sawed in the top to fit the pipe, which collars are placed under the pipe resting upon the plank. Mr. Harry T. Barker, of New Brighton, Pa., reports this method having been used very satisfactorily and states, "The plank ought to outlive the usefulness of the sewer which rests upon it." Still another states that his experience warrants him in recommending this plan, without giving details. In Wilmington, Del., practically this plan has been followed, and is reported by Mr. A. J. Taylor, Chief Engineer of the Sewer Department, to have given very satisfactory results so far as known. Mr. Hatton of that city writes somewhat at length concerning this method as follows:

> I [illegible] cradle blocks if it be in 3-ft. lengths. These cradle blocks are usually made of 3-in. or 4-in. timber cut out to fit the external radius of the [illegible] to the plank on the bottom. In laying pipes under these conditions [illegible] the bottom plank to precise line and grade, and then, the blocks [illegible] and the pipes of uniform thickness, it is an easy problem to lay them all to a true line and grade. I would not recommend the use of wedges under the pipes because the stability of these wedges would depend entirely upon the manner in which they were placed by the pipe-layer, who is usually working under the most adverse conditions, it being possible for the position of the wedges to [illegible] the knowledge of the inspector; but if the cradle blocks are all made [illegible] possibly make any mistake, as the inspector can readily see whether these blocks are placed under each pipe and toe-nailed to the foundation plank."

[illegible] Mr. Hatton states that he has [illegible] work in wet trenches using for pointing material a mixture of cement with soft pine tar in the proportion of 2 cement to 1 tar, the mixture being worked up to the consistency of putty and inserted in the joint in this condition.

City Engineer Allen of Syracuse reports that his plan is to "Excavate from 6 to 12 ins. below grade and fill with hard sand and gravel; also fill around and over the pipe to 6 ins. above the top with the same material. Joints are made with [illegible] gasket and Portland cement." He has considered the plank and wedge method, but fears that it would not be successful in maintaining the [illegible] would be crushed with the load. Mr. Theo. S. Oxholm, of Richmond Borough, N. Y., has used a foundation plank where the bottom per[illegible], the plank being fastened to the sheeting to hold it in place. Wedges were not used, however. In Bronx Borough, N. Y., the plank foundation method has been used, but preference is given to a concrete bed "as the support is more uniform and there is less liability to breaking from unequal bearing." Professor H. N. Ogden, of Ithaca, N. Y., has laid pipe in V-shaped wooden troughs with concrete placed around and under the pipe. He believes the plank and trough method would be useful in many cases. Mr Walter Greenalch, [illegible] N. Y., reports that in that city it has been the general practice, in the case of wet trenches, to lay sewer pipe on a concrete bed. His objection to the use of plank is that a much greater length of trench [illegible] while the plank and sewer [illegible] laid, whereas with concrete it is necessary to open the trench for only a few lengths at a time. Mr. R. A. McClanathan, city engineer of Niagara Falls, states that he has laid an 18-in. tile sewer in a 12-ft. cut with 3 ft. of quicksand at the bottom; in which case he "used planks of various lengths, usually not over 4 to 6 ft., being unable to bottom more than that length ahead of the work; wedging up the pipe temporarily just enough to hold and immediately bedding it and covering it to a thickness of 2 ins. with gravel concrete. Six months after this sewer was finished I examined it and the greatest settlement found at any one point was about 1¼ ins. out of grade. The quicksand in this trench was very soft, so much so that I excavated a good part of it by attaching a hose to the hydrant, stirring up the sand ahead of the work and working it back through the pipe, afterwards scraping it out from the sewer outlet." The same engineer also built a 48-in. brick sewer in quicksand by using a plank cradle formed of three planks 10 ins. wide and 10 ft. long, laid to break joints. There was no appreciable settlement in this sewer.

Mr. Edward S. Rankin, engineer of sewers of Newark, N. J., reports having used the plank and cradle method, a cradle being placed under each end of each pipe. He believes, however, that there is danger of the pipe cracking with this style of construction unless very great care is taken in back filling around the pipe; also that they obtained as good results without this blocking up. The city of Plainfield, N. J., has formerly had considerable trouble with sewers in wet trenches, and City Surveyor Andrew J. Gavett states that most of their sewers in wet trenches are now laid of cast iron. Mr. Edw. D. Rich reports that while city engineer of Summit, N. J., he used cradles consisting of two 2x10-in. plank laid flat and connected by cross ties of 2x4's spaced so as to have one come under each end of the pipe. Wedges cut to fit approximately the outside of the pipe were placed on top of the 2x4's to hold the pipe in line. In quicksand such cradles had to be braced to the sheeting to prevent their being raised above the grade by the upward pressure. "This method holds the pipe from 4 to 6 ins. above the bottom of the trench, and if pumping is continuous the joints can be kept dry until set. Back filling should be carefully made around the pipe, and if the trench is deep the pipe should be concreted. The only objection I can see to the cradle method is that the pipe rests largely on the two points; and the back filling should be compact enough, whether of earth or of concrete, to prevent this."



Method of Laying Sewer Pipe in Wet Trench at Oak Park, Ill.

In Carbondale, Pa., Mr. Benj. Anthony always puts a flat stone under the bell, using wedges for holding the pipe in position on this. Mr. N. S. Sprague, Superintendent of Construction of Pittsburg, states that their method, where a plank foundation is used, is to bed the pipes on concrete about 3 ins. thick so as to insure a uniform bearing along the full length of the pipe. The use of wedges he considers bad practice. Mr. S. Cameron Corson, Borough Engineer of Norristown, Pa., advises sub-drains of tile or otherwise for draining the ditch, on top of which he would place concrete carried up to the haunch of the pipe, if necessary covering the pipe entirely after the joints have been properly connected. "In some instances most excellent results have been obtained by a plank reinforced with concrete, using bell-less pipe entirely, especially made or by breaking off the bells. If the special bell-less pipe is used on top of the [illegible] mortar collar may be placed entirely around the joint. The water passes down the trench under the plank."

Mr. H. L. Shaner, city engineer of Lynchburg, Va., reports:

> We have had considerable experience in laying sewer pipe in wet trenches. Our practice is, if possible, to first lay a porous tile drain about 18 or 20 ins. below the grade of the sewer pipe and fill in over the sub-drain with broken stone, the object being to carry off the ground water into the sub-drain and present a firm, dry surface on which to lay the sewer pipe. It has also been our practice in wet trenches where sub-drainage was not practicable or too expensive to lay a plank floor embedded solidly on the bottom of the trench for holding the sewer pipe; the pipes of course being placed on wood blocking resting upon the plank floor in the bottom of the trench. Of the two methods I greatly prefer the first one, although we have had good results in using the second, and I believe good work can be secured by laying a plank floor in the bottom of wet trenches and blocking up and holding the pipe to line and grade by wooden wedges back of each bell.

Mr. J. N. Ambler, of Winston, N. C., reports having had considerable experience in laying timber foundations for pipe sewers. He uses short 4x4 in. piles driven by mauls, on the top of which battens are spiked. The horizontal planks are spiked to the battens and the sewers laid on these, the adjustment to grade being made by a pair of wedges driven from opposite sides under each pipe. City Engineer Dingle, of Charleston, S. C., reports the plank and wedge method as being in use in that city and that it has so far proved satisfactory. Mr. W. D. Neves, of Greenville, S. C., also has used the method, but believes that, to be satisfactory, concrete should be placed about the pipes and the wedges removed before back filling. The plank and wedge method is used at Tuscaloosa, Ala., with success, but it is stated that care should be taken to backfill and tamp a good bed of dry dirt under the pipe. Mr. Maury Nicholson, city engineer of Birmingham, Ala., reports having had success in laying sewers across swampy ground by laying 2x12-in plank on 2-ft. lengths of 2x6 laid across the trench at 6-ft. intervals, and blocking the pipes up on saddles cut to fit the pipe and placed just behind the bells. Wedges he considers cheaper and practically as good if nailed to the plank. This method he recommends from his experience.

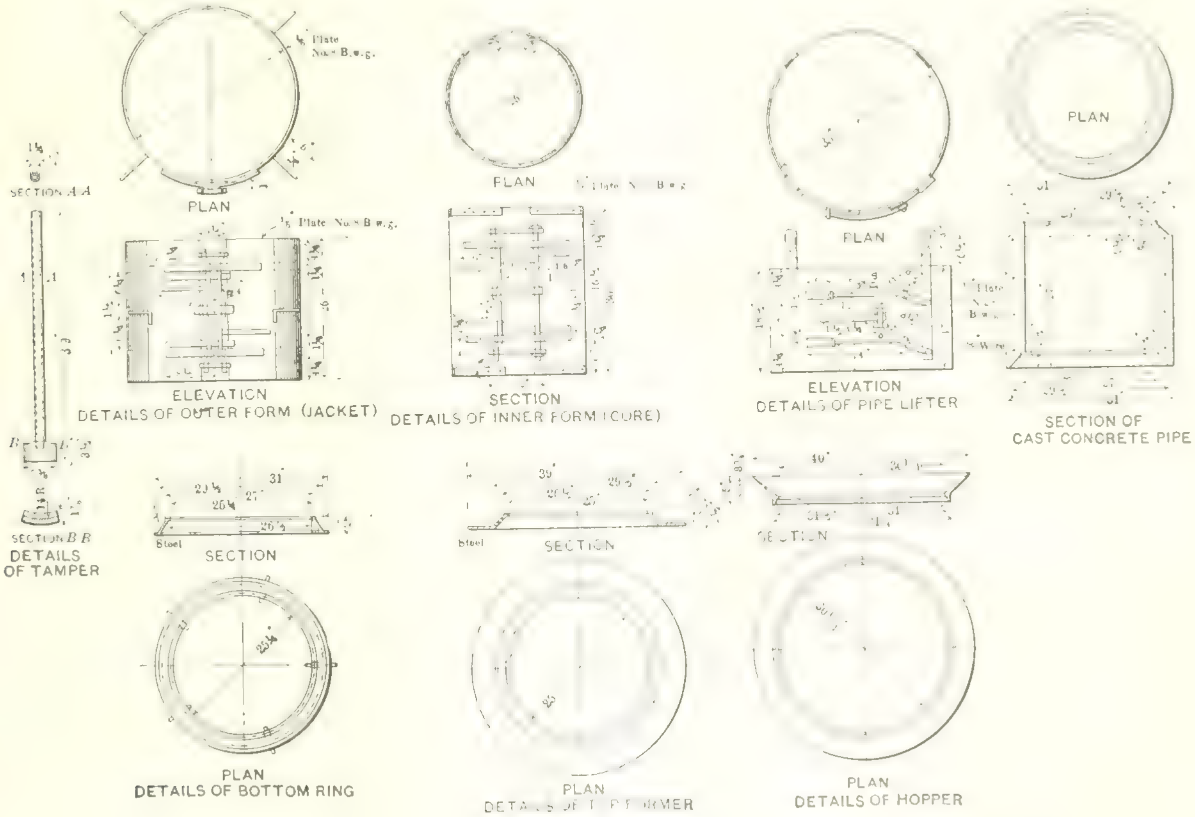
Possibly no city of the south has had more extensive experience with wet trenches than New Orleans. Mr. Geo. G. Earl, general superintendent of the sewer and water works construction there, describes their method as follows:

> "Our practice in laying sewer pipe in bad bottoms is to lay either a horizontal plank under the pipe or, if the bottom is very bad, floor over the whole trench bottom. The top of this plank or flooring is laid deep enough to give a good strong clearance for the bell of the pipe. Over this shells or gravel (porous material through which water will run freely) is spread and the pipe laid to grade there and filled around and up at least to the center of the pipe with similar material. We prefer to have the pipe nowhere in contact with the foundation plank, sheeting, or bracing of the trench."

In Knoxville, Tenn., City Engineer Thompson has used the plank and block method and finds it satisfactory in some cases. Another method he has used "is to take out the soft material below grade and refill to a depth of 6 to 12 ins. with steam coal cinders. Where cost is not to be considered, but it is desired to obtain the best results, or where foundation is very unstable, I would recommend a concrete base of 4 to 6 ins. Sometimes a cushion of sand, fine stone screenings, pulverized slag or cinders can be used to advantage on this base, in which to bed the pipe and render it less liable to breakage."

Mr. E. E. Colby, city engineer of Chickasha, Okla., has laid a large amount of sewer in wet trenches and finds the plank and wedge method the best he knows of for holding the pipe in shifting ground.

Mr. W. F. Sargent, of Oak Park, Ill., reports having had considerable experience in laying sewers in saturated sand where the "well point" system was used with wonderful success (as at Gary, Ind., in 1908). In other cases he has supported both ends of each length of pipe on cross plank fastened to the sheeting. In a particularly difficult case a sewer was supported on a wooden foundation constructed as follows, Fig. 1: 2x6-in planks were driven as piles in the bottom of the trench every 4 ft. the 6-in. being crosswise of the trench, and 2x6 stretchers, with the 6 ins. vertical, were nailed one to each edge of the plank piles, and with their top edges slightly below sewer grade. The pipes were supported on this by short pieces of plank laid across the trench and resting upon the tops of these stretchers. This plan he reports to have been perfectly successful in a 12-ft. trench in sand which was completely saturated with water.



Details of Reinforced Concrete Pipe and Pipe Forms, Monterery, Mexico, Water-Works.

Method and Cost of Molding and Laying Reinforced Concrete Pipe for an Aqueduct, Monterey, Mexico, Waterworks.*

The aqueduct considered is 18,700 in. (61,336 ft.) long, made up as follows:

18-in. cast iron pipe	361 ft.
22-in. reinforced concrete pipe	14,674 ft.
25-in. reinforced concrete pipe	39,488 ft.
18-in. cast iron siphon	3,169 ft.
20-in. cast iron siphon	3,644 ft.
Total	61,336 ft.

The following data relate only to the improved concrete pipe line. The concrete pipes were manufactured and laid under contract with Mr. Arthur S. Bent, of Los Angeles, Cal., the company providing all materials, labor, etc. The contractor was paid 10 cts. per lin. ft. of pipe manufactured and 10 cts. per lin. ft. laid. He was also responsible for the satisfactory completion of the work. Figure I shows the details of the joint recommended by Mr. J. D. Schuyler and adopted for these pipes. The 63.5-cm. (25-in.) pipes were 61 cm. long and 76 mm. (3 ins.) thick. The 55.9 [illegible] length [illegible] the purpose of strengthening [illegible] pipes while hauling [illegible] reinforc[illegible] ized-iron wire.

Manu[illegible] manufactured under the supervision of Mr. H Stanley [illegible] the [illegible] rock and sand were delivered by gravity in bogies [illegible] of the pi[illegible] [illegible] of 76-mm. (3-in.) galvanized iron piping with hose couplings for sprinkling purposes. After trials with aggregates of various sizes, the concrete for the pipes was proportioned by volume as follows:

	Cu. ft.
Crushed [illegible]	[illegible]
19 mm [illegible]	[illegible]
Manufactured [illegible]	[illegible]
Portland cement	[illegible]
Total	[illegible]

The above quantity manufactured two 63.5-cm. (25-in.) pipes; a 55.9-cm (22-in.) pipe required 0.1415 cu. m. (5 cu ft.) of the material, in the same proportions. Figure I shows the forms for these pipes. The forms consist of cast-iron bottom rings, to the proper section of the joint, and inner and outer steel forms of 3-mm. (0.12-in.) plate, provided with inner and outer locking arrangements. The concrete was poured through a cast-iron hopper which fitted to the top of the outer form.

The concrete, which was mixed very dry, in a ½ [illegible] Smith" mixer, was thoroughly tamped with a 22-lb. tamper, and worked until it was of a stiff jelly-like consistency, the wire rings being added as the concrete was placed. The best results were obtained with the minimum quantity of water. The upper joint was molded with a heavy cast-iron ring. The jack[illegible] forms were loosened immediately and placed over other rings [illegible] rings being used for a day's work. For the pipes required for curves, special forms were used to give the necessary bevel to the joint. After 24 hours [illegible] were lifted from the bottom ring with a special lifter, and ranged in position for coating internally with a Portland cement grout to which a little freshly slaked lime was added. The pipes were all numbered, and were kept moist for 10 days by constant sprinkling. They were not hauled to the work until 28 days after they were molded, although this rule was sometimes broken, to the detriment of the [illegible] factured, but some were used for purposes other than the aqueduct.

[illegible] with him experienced concrete pipe makers from California, and these were afterward assisted by Mexican labor. In a day two tampers could manufacture from 45 to 50 pipes of the larger (25-in.), and from 55 to 60 of the smaller (22 in.) size. The cost* varied from 2.75 to 3.25 pesos ($1.33 to $1.58) per [illegible] pesos ($1.70 to $1.91) for the larger size.

The [illegible] as follows: Taking, as a fair example, one week's work during March, 1908, the wages paid to the 71 men comprising the total payroll (though part of this labor was intermittent) amounted to 981 pesos. This includes [illegible] per day, four American tampers at 7.50 pesos, and Mexican labor varying from 4 to 1 peso, and all labor necessary to handle and finish the pipes, including coating the interiors. During this week there were made 1,126 of the 63.5 cm. (25-in.) and 1,095 of the 55.9-cm. (22-in.) size. The pay-roll includes 520 pesos for the larger pipes (46 cts. each) and 461 pesos for the smaller pipe (42 cts. each). Table I shows the quantities and cost of the materials used in the manufacture of these pipes.

From Table I it is seen that the cost of the 63.5-cm. pipe was 3.37 pesos for material plus 0.46 peso for labor = 3.83 pesos per pipe, or 6.26 pesos per lin. m. (1.91 pesos per lin. ft.).

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*Reprinted from "The Water Works and Sewerage of Monterey, N. L., Mexico," by G. R G. Conway, Proc. Am. Soc. C. E., Vol. XXXVI, p. 1621.

*The value of the Mexican peso is [illegible] In the cost data that follow [illegible] conversions from pesos to dollars [illegible] figures. For [illegible] approximate [illegible] while reading, the peso [illegible] cts., which gives amounts [illegible] the text figures by two.

TABLE I. COST OF CONCRETE PIPE.

Materials.	For 1,12[illegible] pipes 63.5 cm. (25 ins.) in diameter. Quantities.	Cost.	For 1,0[illegible] pipes 55.9 cm. (22 ins.) in diameter. Quantities.	Cost.
Portland cement, at 8.00 pesos per bbl., delivered at pipe-making yard	401 bbl.	3,208.00 pesos	303 bbl.	2,424.00 pesos
[illegible]	[illegible]	225.25 pesos	68 cu. m.	180.20 pesos
Crushed rock 19-mm. (¾-in.), at [illegible]	[illegible]	164.30 pesos	50 cu. m.	132.15 pesos
No. [illegible]	3,[illegible]	[illegible] pesos	1,780	18[illegible] pesos
[illegible]		3,800.55 pesos	......	2,919.45 pesos
[illegible]		3.37 pesos	......	2.66 pesos
		[illegible]		($1.33)

[illegible] amounted to 2.66 pesos for material plus 0.42 [illegible] pesos per lin. m. or 1.54 pesos per lin. ft. (75 cts. per lin. ft.)

The cost of cement included hauling from the bodega to the yard, a distance of about 5 km. (3.1 miles.) At a later date, after the company had commenced using the "Hidalgo" cement, some additional 55.-9 cm. pipes were manufactured, so as to have them on hand as a reserve in case of emergency. In this work only Mexican labor was used, as the previous gang had been dispersed, but the tampers had had previous experience. Taking the cost of 418 pipes made during one period of 9 days, the detailed cost was as given in Table II.

TABLE II. [illegible] CONCRETE PIPES.

Labor for 9 days—	Pesos.
[illegible]	[illegible]
[illegible]	[illegible]
Water boy	4.50
[illegible] one-third of 6 pesos, 2 pesos	18.00
Making 1,672 wire hoops, at 5 pesos per [illegible]	[illegible]
Man coating pipe, at 1 peso per day	5.00
Cost of labor making 418 pipes	161.86
Cost of labor per pipe	0.38
Material—	**Pesos.**
Cement, 118½ bbl., at 6.40 pesos per bbl. [illegible]	[illegible]
Sand, 24.6 cu. m., at 2.50 pesos per cu. m.	61.50
Rock, 21.6 cu. m., at 2.00 pesos per cu. m.	43.20
No. 6 wire, 3,362 lin. m.	55.56
[illegible]	[illegible]
Cost of material for 418 pipes	920.16
Cost of material per pipe	2.20
Add cost of labor	0.38
Total cost per pipe for labor and material	[illegible]
Equivalent to 4.23 pesos per lin. m., or 1.29 pesos per lin. ft.	

Excavation for Pipe Line and Siphons.—The [illegible] works, etc., was let by contract to Messrs. Scott and Lee, of Monterey, under three classifications:

(1) All material which in the judgment of the Engineer can be economically loosened with [illegible] and handled with shovel.

(2) Indurated earth or gravel, shale or rock which can be loosened without blasting, and "sillar," locally so-called, whether pure or mixed with other substances, and whether it [illegible] blasting or not.

[illegible] not included in the above which requires drilling or blasting.

Locally, this classification is well understood, particularly No. 2, as it covers the sillar soils which are common in the neighborhood of Monterey. The contract prices were: No. 1, 50 cts.; No. 2, 1.50 pesos, and No. 3, 2.50 pesos per cu. m. These prices were over and above the clearing and grubbing of the line, which was paid for at the rate of 100 pesos per hectare.

The route of the pipe line being along broken country, at some points difficult of access, service roadways, about 3 m. (9.84 ft.) wide, for hauling material were constructed, and, for about 7 km. (43½ miles), a roadway was made along the line of the trench. The prices for the roadway, under the above classification, were: For No. 1, 35 cts.; No. 2, 1.50 pesos, and No. 3, 2.50 pesos per cu. m.

The trenches were excavated 5 cm. (2 ins.) below the required finishing depth, to allow for grading the pipes in selected material, and were taken out to an average width of 40 cm. (15¾ ins.) greater than the outside diameter of the pipe, to allow for their proper jointing, and also to give sufficient room to roll the pipes in the trenches.

The route of the pipe line was laid out so as to obtain an average fill of not more than 1 m. (3.28 ft.) over the tops of the pipes, but in some cases the cuts, for short lengths, were 3 m. (9.84 ft.) deep. The excavation for this work began in June, 1907.

Hauling Pipes.—The pipes were hauled to the site of the work with ox-carts and mule teams. The cost of hauling varied from 25 cts. per pipe at the lower end, to 1 peso per pipe at the upper and, comparatively speaking, inaccessible portion of the line. The weight of the 55.9-cm. (22-in.) pipe was about 182 kg. (400 lbs.); that of the 63.5-cm. pipes was about 216 kg. (475 lbs.)

The breakages in all the pipes cast at the pipe yard amounted to about 1 per cent, due chiefly to unloading them carelessly near the pipe line.

Pipe Laying.—The pipe-laying gang was composed of 7 Mexicans under the direction of an American foreman, who was in charge of several gangs. One gang could lay daily from 60 to 73 m. (from 100 to 120 pipes). The following was the ordinary pay-roll for [illegible]

	Pesos.
[illegible] at 3 pesos [illegible]	[illegible]
1 pipe layer at 3 pesos	3.00
1 pipe layer's assistant at 2 pesos	2.00
1 cement mixer at 2 pesos	2.00
2 outside plasterers at 2.50 pesos	5.00
2 inside plasterers at 2.25 pesos	4.50
1 water boy at 0.50 pesos	0.50
Total	20.00

This brings the average cost of laying the pipes to 32.8 cts. per lin. m.

The pipes were jointed with 1 : 2 cement mortar, the outer joint being rounded over both pipes for a width of 12½ cm. (5 ins.) and a height of about 19 mm. (¾ in.). In making these joints the pipe layers wore rubber gloves. The joints were kept moist, and the trench was back-filled with fine, screened material to a depth of 10 cm. above the top of the pipe. Inside, the joints were carefully caulked with cement and rendered smooth, the plasterers working continuously along with the pipe layers, doing from 20 to 35 m. at a time. Water had to be conveyed to the trenches by barrels on burros, and during the dry season it was sometimes carried 5 or 6 km.

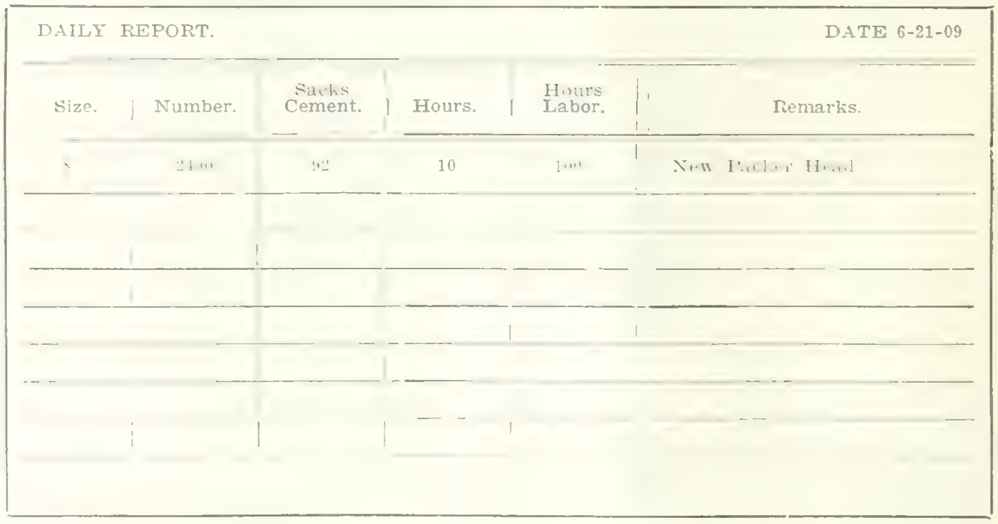
Testing.—When the line was completed it was tested for water-tightness, and the loss was found to be about 5 per cent, part of which was probably due to absorption. At a later date it was found that the waters of the Estanzuela River, which contain 150 parts of calcium carbonate ($CaCO_3$) per million, deposited a very fine film of lime on the interior of the pipes, completely filling any pores there might have been. At the present time there is no measurable leakage, thus proving that the character of the work is very satisfactory.

DRAINAGE AND IRRIGATION SECTION

Cost of Cement Tile and Cost Keeping Methods for a Tile Factory.*

The manufacture of concrete drain tile necessarily resolves itself into three main divisions: those which are made by machine using a rotating trowel; those which are tamped, either by hand or machine, and those which are poured.

There are two different methods of manufacture for tile made by a rotating packer-head, the distinguishing feature being in the packer-head itself. In one case the packer-head is split into two sections, the upper portion being called the packer and the lower the trowel. The trowel rotates at one-half of the packer speed, the idea being to give a dense mixture and a smooth inner surface with as little wear on the head as possible. The other method of troweling tile into shape consists of using a one-piece packer-head obtaining much the same effect as with the one split into two sections. It should be the object of any machine to so compress the concrete that when the jacket is removed the tile will stand on either end. With some heads it is necessary to stand the tile on the upper end as it comes from the machine, since that one is packed better than the lower.



DAILY REPORT. DATE 6-21-09

Size.	Number.	Sacks Cement.	Hours.	Hours Labor.	Remarks.
8	2400	92	10	100	New Packer Head

Fig. 1.

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*Condensed from a paper by J. H. Libberton, Assistant Inspecting Engineer, Universal Portland Cement Co., read before the National Association of Cement Users.

8" TILE

Day	No. Tile.	Sacks Cement	Tile Per Sk.	Mix	Am't Sand	[illegible]	Fuel,&c	Total	STOCK. Sales.	[illegible]
6/21/09	2,400	92	26.1	1:4	[illegible]		$1[illegible].30		[illegible]	6,400

Fig. 2.

Under the division of tamped tile are found those made by hand and those made by machine. The hand method is not recommended since it does not tend to produce tile which are uniform. The fact that the material is tamped in layers is apt to produce planes of weakness which materially affect the quality of the finished product. The personal equation also enters, and in all probability the tile which were made in the morning are of a better quality than those which the workman rams up in the evening after a hard day's work. Mechanically tamped tile are proving very satisfactory and are made by a machine which revolves the inner and outer jackets, feeding the concrete in meanwhile. A tamper working up and down at about 300 strokes per minute, gives a blow of 60 or 80 lbs. It is evident that with this method the operation of manufacturing tile can easily be duplicated time and time again, thus insuring their uniform quality.

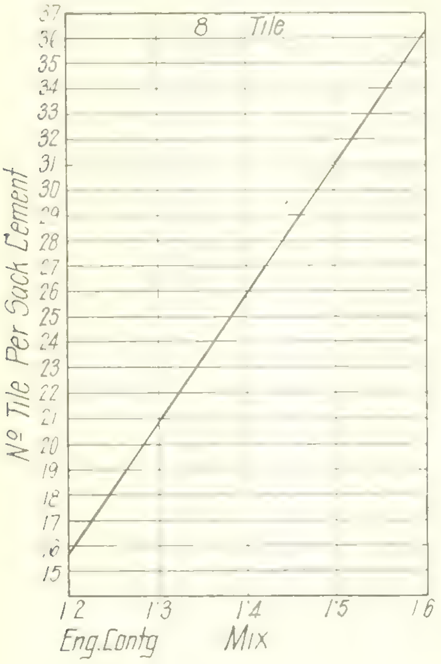

Fig. 3.

A more or less satisfactory substitute for machine tamping is found in the pneumatic rammer which, although it will always strike the same blow, has the objection that the concrete must necessarily be rammed into position in layers.

The third division embraces tile which are made by the poured process, or with a concrete of such consistency that no tamping is required, but the concrete is rather jarred or churned into place. This method is proving quite satisfactory where a particularly dense concrete is required for draining alkaline soils or for the manufacture of sewer pipe.

[illegible] endeavor to calculate the maximum or minimum costs per thousand tile, but rather to indicate a method of procedure which will place the manufacturer in a position to know definitely what his tile cost him, as well as the distribution of cost over the different headings. It is to be regretted that the manufacturers of concrete tile machines are inclined to paint a more brilliant horizon for the prospective tile manufacturers than is warranted by actual practice, and often omit important items of cost such as interest on the investment, depreciation on the plant, renewals of machinery parts and the repairs on the building and machinery. The manufacturer also is inclined to neglect these details and consequently is oftentimes at a loss to determine why his plant does not pay better.

Since the methods of keeping costs can be equally as well illustrated with one method of manufacture as another, the cost data will be confined to tile of small diameter, 4 to 12 ins., as made with a rotating packer.

After studying the different methods generally employed for keeping cost data it was found that the card system was in all probability the most practical. By this method, space is saved and the bookkeeping reduced to a minimum. It will be necessary to use two styles of cards, Figs. 1 and 2, one for the daily record about 3 x 5 ins. in size and the other for cost and stock, preferably about 5 x 8 ins.

The Daily Report Card is to be made out by the foreman and each size of tile should be filled in showing the time required as well as the cement used for each size. The cards are perforated so that they can be hung on a nail in the factory. Unfortunately, such a record is not generally kept by the tile manufacturer, consequently, when several sizes of tile are made on the same day it is impossible to make any proportional division of cost. This record is turned in at the close of each day and the different items transferred to the large cards under the various sizes, after which they are filed in a separate drawer, marked "Day" or "Daily Record." The tile per sack is then determined for each size by dividing the number of tile made by the sacks of cement used. From the curve, Fig. 3, the mixture is then obtained and multiplying the sacks of cement used by the proportion gives the cubic feet of sand.

The curve showing the tile per sack and the mixture has been figured on the assumption that the amount of cement in a tile can be determined [illegible] the mixture known. For instance, a tile weighing 20 lbs. made with a 1:4 mixture would contain an amount of cement equal to 1/5 of its weight, or 4 lbs. To find the tile per sack it is only necessary to divide the weight of a sack of cement, approximately 94 lbs., by 4, which gives 23½ tile per sack. In calculating the tables and plotting the resulting curves the average weight as determined in twelve tile factories was taken.

To prove the truth of this assumption the drain tile plant of Griffin and Todd at Shabbona, Ill., was operated for about three weeks on all sizes of tile from 4 to 12 ins., inclusive, and with mixtures of cement and torpedo sand varying from 1:2 to 1:6. The materials were accurately measured in one sack batches and after adding the water and mixing thoroughly were run through the machine and the number of tile made noted. The machine was then cleaned and a new batch put up in a similar manner. The actual test and theoretical calculation checked very closely and furnish a set of curves which should be of great value to the manufacturer of concrete drain tile.

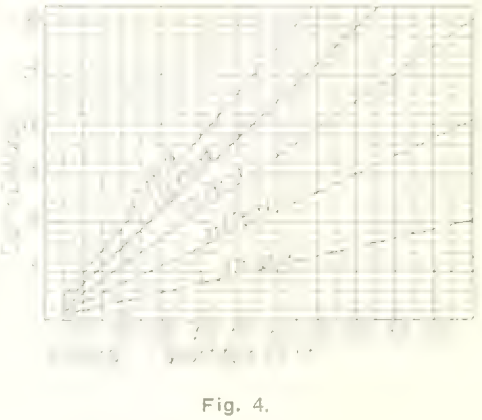

Fig. 4.

After the amount of material has been determined the cost should be added on the large cards. From a curve, Fig. 4, it will be possible to determine immediately the cost of sand. The cost of cement, being a variable, must be figured for each entry. The labor is calculated by multiplying the hours by the rate per hour.

The next column will include the interest, power, depreciation, etc., and must be proportioned to the size of tile. For instance, if the daily cost for these items was $9 and the average number of tile made per day of a certain size was 3,000, the charge per 1,000 would be $3. If, however, the plant was working on tile of which the plant produced only 1,500 per day the added cost would be double the other, or $6 per 1,000.

The several items of sand, cement, etc., when added together give the total cost for the total [illegible]

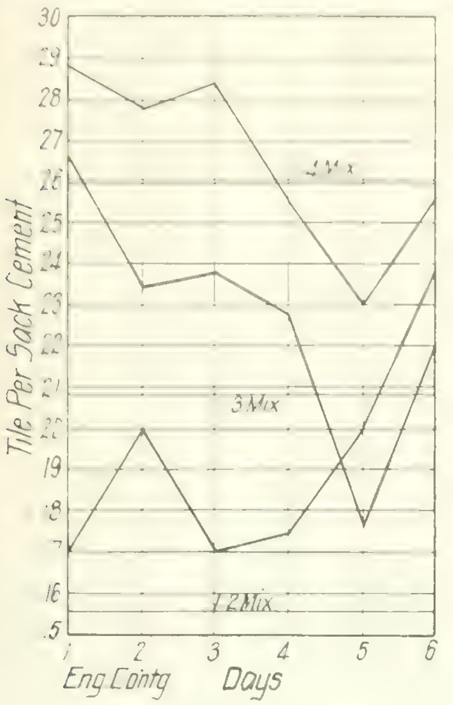

Fig. 5.

a certain day. The cost per 1,000 can be obtained by dividing the total cost by the number of thousand tile made.

The next division on the large card is intended to be a perpetual inventory of stock on hand. At the top under "Forward" should be placed the total from the last card filed. To that number is added the day's production. After subtracting the sales for the day the last column should indicate the stock on hand.

To illustrate the manner of keeping the record a case has been taken of a day's run of 2,400 8-in. tile using 92 sacks of cement. Dividing 2,400 by 92 gives 26 tile per sack. By referring to the curve, Fig. 3, the mixture is found to be 1 : 4. Multiplying 92 by 4 gives 368 cu. ft. of sand used. If this costs $1 per cu: yd. the sand curve, Fig. 4, shows the total to be $13.60. Ninety-two sacks of cement at $1.50 per barrel will equal $34.50. The labor is obtained by multiplying the rate per hour by the number of hours. One hundred hours labor at 20 cts. per hour equals $20.

The next item is by far the most interesting and is the one hardest to estimate. In the particular case cited it is based on a plant and equipment costing $5,000, and operating 160 days in the year. The power is assumed to cost $1.50 per day and the foreman paid at the rate of $25 per week for the entire year. In a plant of this kind the depreciation must be included and is estimated at [illegible] per cent, while interest on the investment is taken at 6 per cent.

Plant repairs, insurance and taxes are taken from the sheet of an actual plant at $600; foreman at $25 per week or $1,300 per year. Operation 160 days, therefore, daily foreman expense is $8.00

Interest on [illegible]	$[illegible]
Depreciation at [illegible]	[illegible]
Repairs [illegible]	[illegible]
Total	[illegible]

The expense per day is $8.70. Adding the foreman cost increases the expense to $16.70, and the power to $18.30. Added to the cost of the cement, sand and labor, makes the total cost for the manufacture of 2,400 8-in cement tile $86.42. Dividing this by the number of thousand made, viz., 2.4 gives $34.35 as the cost per 1,000.

This same reasoning has been continued throughout the various sizes with a 1 : 4 mixture assuming that 10 men work continually and that the plant sustains a breakage loss of 3 per cent on tile of all sizes. The same assumptions are made as before regarding investment, interest, power, etc. Assuming the following average daily production: 4 ins., 2,900; 5 ins., 3,000; 6 ins., 3,000; 7 ins., 2,500; 8 ins., 2,400; 10 ins., 1,800; 12 ins., 1,450, we have Tables I to IV:

TABLE I.—MATERIAL COST PER 1,000 TILE.

[illegible]	[illegible]	[illegible] Sand	Cement	Sand	Total
			Cost		
[illegible]	[illegible]	1.44	$4.87	$1.44	$ 6.31
[illegible]	[illegible]	2.01	6.82	2.01	8.83
[illegible]	[illegible]	2.64	8.90	2.64	11.54
[illegible]	7.59	3.37	11.40	3.37	14.77
[illegible]	9.60	4.27	14.40	4.27	18.67
[illegible]	[illegible]	5.96	20.10	5.96	26.06
[illegible]	[illegible]	8.63	29.10	8.63	37.73

TABLE II.—FIXED COST PER 1,000 TILE.

Size, inches	Production	Foreman	Interest, etc.	Power	Total.
4	2,900	$2.76	$3.02	$0.52	$ 6.30
5	3,000	2.66	2.92	.50	6.08
6	3,000	2.66	2.92	.50	6.08
7	2,500	3.20	3.50	.60	7.30
8	2,400	3.34	3.65	.63	7.62
10	1,800	4.45	4.86	.84	10.15
12	1,450	5.50	6.04	1.04	12.58

TABLE III.—LABOR COST PER 1,000 TILE; TEN MEN AT WORK CONTINUALLY.

Size. Inches.	Cost.
4	$ 6.90
5	6.70
6	6.70
7	8.00
8	8.35
10	11.10
12	13.80

TABLE IV.—SUMMARY.

Size Inches	Labor	Material	Fixed Charges	—Total Cost.— Net	Adding for 3% Culls
4	$6.90	$6.31	$6.30	$19.51	$20.10
5	6.70	8.83	6.08	21.61	22.25
6	6.70	11.54	6.08	24.32	25.00
7	8.00	14.77	7.30	30.07	30.90
8	8.35	18.67	7.62	34.64	35.70
10	11.10	26.06	10.15	47.31	48.70
12	13.80	37.73	12.58	64.11	66.00

It is probable that these results do not agree with those found in actual practice because of the variation in some of the items such as number of men, daily production, and plant investment. It nevertheless shows a method of getting at the cost of tile to the manufacturer.

In an independent investigation of the drain tile question it was disclosed that it is oftentimes the custom to employ mechanical methods for the proportioning of the materials. The manufacturers thought that such a method was satisfactory and that after once setting the proportioner it would continue to grind out the proper relative quantities of cement and sand. Figures 5 and 6 show very plainly the result. Fig. 5 shows actual runs from day to day on 8-in. tile, the manufacturer supposing he was obtaining a 1 : 4 mix. Figure 6 shows the results of an endeavor to obtain a 1 : 3 mixture on tile of the same size. If the plants are operated as they should, and as they would if properly proportioning the materials, the zigzag lines would straighten themselves out and coincide approximately with those marked 1 : 3 and 1 : 4. Since the quality of the output of a plant is judged by the quality of the poorest product, it is necessary that tile manufacturers should investigate methods for uniformly proportioning their materials.

To increase the effect of the blow when driving small sheathing with a pneumatic hammer, the operator should place his weight on the piece of sheathing being driven. The value of the stroke, in foot pounds, will then be increased by the weight of the operator, multiplied by the distance ordinarily driven per blow.

The Silting Up of Reservoirs and Canals and Some Methods for Preventing Same.

BY W. D'ROHAN.*

With the phenomenal growth of the west necessitating the building of dams for the storage of water for irrigation, power and domestic uses, the obliteration of reservoir sites by silt is about to become a question of serious moment. That this is a matter of grave importance, is shown by a comparison of two surveys made, one in 1895, and the other in 1905, by the U. S. Geological Department, of LaGrange Reservoir on the Tuolomne River, California. The first survey, which was made Oct. 1, 1895, by Mr. J. B. Lippincott, showed the storage capacity of 2,332 acre feet. A second survey made by Mr. E. Johnson on Nov. 1, 1905, showed the capacity decreased to 1,068 acre feet. In other words, 54.2 per cent of the reservoir storage was destroyed by silt in ten years and one month.

Another instance is the Austin Reservoir on the Colorado River. The Colorado River at Austin, Tex., drains an area of 40,000 square miles, from which the discharge has a range of from 200,000 to 250,000 sec. ft. The dam was completed in May, 1893, giving a total storage capacity of 53,490 acre feet. In May, 1897, Professor Taylor, of Texas University, Austin, made accurate sounding of the lake to determine the volume of silt accumulated in 4 years, and found that the deposit amounted to 968,000,000 cu. ft., or 41.54 per cent of the original capacity. The dam has since been destroyed.

Writing about the Colorado River of Texas, Mr. Schuyler, of Hydraulic Fill fame, says, "that a stream the size and character of this river, to be utilized for irrigation, would require a reservoir of one to two million acre feet capacity, to be in proper proportion to the volume of run off and amount of silt carried, and maintain a sufficiently long period of usefulness to be profitable."

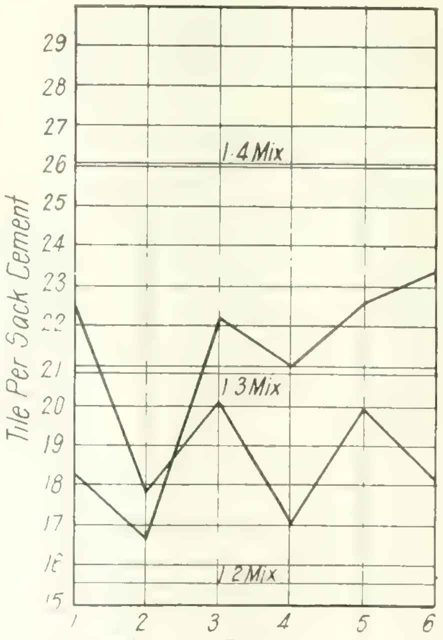

Fig. 6.

As we have no data available as to the ratio of discharge of American Rivers to the amount of silt carried in suspension, and must base our calculations on the percentages obtained from Indian and European engineers on similar rivers in these countries, the following resume of the methods employed to delay this destruction, will be of interest.

These methods, the writer proposes to treat under two heads, viz: (1) Appliances to cleanse the reservoir from silt after it is deposited and, (2) Devices to prevent [illegible] from entering the reservoirs at all.

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Perhaps the oldest and most effectual device is the scouring gallery, which is known as the Spanish Gate and is an appendage of all Spanish and Algerian Dams. As they are all typical, Sir William Willcock's description of such a sluice will be given. Figures 1 and 2 are referred to in the following description:

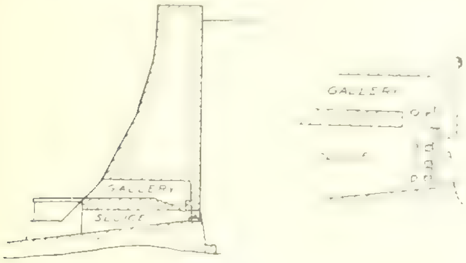

Fig. 1.

The under-sluice of Khamis (in Algeria) is on the Spanish principle. It is situated at the bottom in the line of the bed of the original stream. A Spanish under-sluice consists of an opening of from 1 to [illegible] and from 1 [illegible] meters in width at the up-stream end; it increases gradually as it advances down-stream, and it is sometimes as much as 4 meters wide and 6 meters high. This opening is closed at the up-stream end by a wooden door, called a Spanish door, supported against horizontal timbers let into apertures in the two sides at the point A in the figures. Just above the under-sluice is a gallery. This gallery is about a meter wide and 2 meters high, and is closed on the up-stream side, and open on the down-stream face to allow the workmen to enter. It communicates with the under-sluice by an opening some 60 centimeters in diameter just down-stream of the gate A.

The door is put in position in the under-sluice from the down-stream side when the reservoir is empty, and the three horizontal timbers, B, C, D, are let into slots in the jambs, and the whole door is well caulked. The water now rises in the reservoir and as the deposits accumulate they bury the door and gradually gain great consistency. It takes four years for the deposit to become solid, though it is generally left ten years. When the reservoir has got filled up with deposits to the extent which is considered a maximum, the workmen enter the under-sluice, bore with an auger through the door to be sure that the mud is solid, saw the timbers, B, C and D, and then escape into the gallery. The door is now free to drop, but it is generally held by the solidified mud. The workmen now go to the top of the dam and work a hole through the deposit with a long iron pole until after the water touches the door. When this happens the door falls, and the mud follows it in a tremendous avalanche. The reservoir is soon emptied, and more or less of the deposit removed. What sediment is not swept by the velocity of the current is shoveled into the stream by the workmen. A new gate is then put in, new horizontals, B, C, D, are placed behind it, and the reservoir begins to fill again.

The total cost of cleaning the Alicante Reservoir with length of 5,900 ft., capacity of 2,982 acre ft., is $50.

The main outlet of the Mercedes Dam, Mexico, consists of a cut-stone culvert, 6 ft. wide, 7.87 ft. high, having vertical sides and a semi-circular arched roof. This connects with a rectangular shaft or tower built against the dam on the up-stream side, extending from the base to and above the top, the interior dimensions being 5.1 ft. thick. At the base of the tower on the outside is a 6-ft. circular sluice gate of cast iron, operated by a steel gate stem, 1.75 ins. diameter, a ball-bearing geared hoisting device, resting on a platform projecting from the tower, at the level of the crest of the dam.

On the inside of the tower, against the face of the dam proper, is a similar sluice gate, 5 ft. in diameter, also operated from the top. The method of operating these [illegible] the smaller [illegible] both gates are [illegible] which can be kept well oiled, as it will be easily accessible, can presumably be easily raised under full pressure as much as desired. [illegible]

These huge gates, which were to be used to wash out silt accumulations in the reservoir, [illegible] silt be made by the building of some small dams above the main reservoir, as any attempt to sluice it out of the reservoir could only result [illegible] of the silt, which had precipitated over the [illegible]

Recognition of the liability to obliteration by deposit of silt, to which most reservoirs formed by solid dams, are subject, led to [illegible]

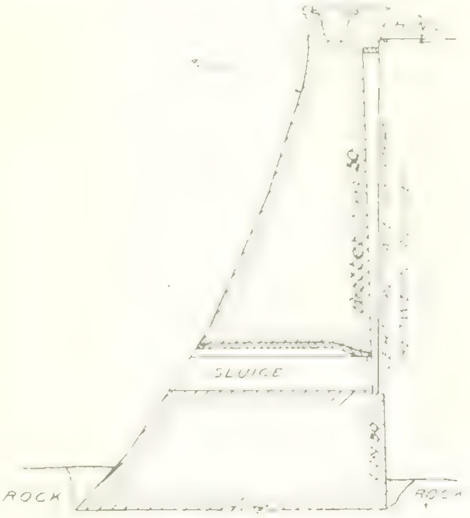

Fig. 2.

[illegible] Dam in India, constructed about 1892. This dam has a maximum height of 127 ft. There are two overflow waste weirs, one at each end of the dam. But there are also 15 under-sluices, Fig. 3, each 8x4 ft., piercing the dam near its center, with their sills 12 ft. only above the bed of the river, which is 103 ft. below the crest of the dam. The object of these sluices is to prevent the deposit of silt in the reservoir by providing a passage for the early floods at a low level. If the flood water, heavily laden with silt, were to be discharged over the high level waste weirs, it would drop the greater proportion of its silt on the bed of the reservoir in its passage through the deep pond above the dam. In ordinary floods the discharge through the under-sluices is effected under a head averaging 15 ft., and the ponding up extends [illegible] Consequently a certain proportion of silt will be deposited in the reservoir, even when the under-sluices are open to pass the early floods. But as they are closed on July 31, or earlier, to ensure the filling of the reservoir, there will be a further deposit due to the later floods which enter the reservoir basin after the low level exit is closed. Still it is a great point gained that, at the time when the floods are carrying the greatest amount of silt, the discharge is allowed to flow forward through the reservoir with a comparatively small heading-up. The surface of the back-water, when the under-sluices are open and working under a head of 15 ft., is less than one-thirtieth of the area of the reservoir when full; and, therefore, twenty-nine thirtieths of the reservoir bed are out of the reach of the silt [illegible] water, there is also less tendency to deposit than there would be if the discharge from the reservoir had to find its way over high level waste weirs. Undoubtedly, the action of the under-sluices will be effectual in prolonging the life of the reservoir; the experience of the last eighteen years has demonstrated this.

The principle of allowing the silt-laden waters of floods to pass through the reservoir basin without serious diminution of velocity, has been applied in a more thorough-going way to the design of the Assuan Dam on the Nile. This dam is remarkable as being the first insubmergible dam built without any provision of overflow waste weirs to discharge excess water. The whole river discharge at all times of the year is passed through sluices pierced in the body of the dam. The dam is also remarkable on other accounts. It is about 1¼ miles long, and contains over 1,000,000 tons of masonry. (Fig. 4.)

The American type of insubmergible dam is known as the Indian Weir. That designed by the U. S. Reclamation Service on the Colorado River is so well known and has been described so often as to render further detail superfluous.

The writer is not aware of any special method of cleaning reservoirs formed by solid dams, beyond draining them and then moving the accumulated silt with scrapers or machines. Dredging is far too expensive, and the best way of all is to prevent the silt from entering at all. In this connection, the following extract taken from the Proceedings of the Institute of Civil Engineers, Vol. LVIII, and written by Mr. R. B. Buckley, C. E., admirably covers the subject:

[illegible]

(1) By works in the river, which will clear [illegible] the head of, and in the canal itself, to be cleared [illegible] practically the same thing, by making two sup-[illegible] used while the other is being cleansed.

[illegible] the water is drawn off from the lower row car-[illegible] signed that the deposit in the tank can be [illegible]

These systems are, of course, applicable under different circumstances. The first can be rarely used, and only when the local conditions are suitable. As, for example, when the bed of an inundation canal is perhaps 8 ft. or 10 ft. above the level of the bed of the river, and which canal is therefore only sup-[illegible]

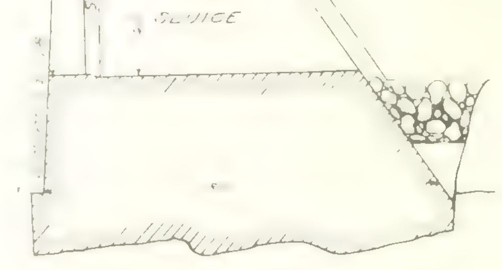

Fig. 3.

case, if a position for the head of the canal can be selected behind an island covered with brushwood, the top of which is perhaps a little below, or even slightly above the high flood level, it may be well worth the cost to make an artificial connection between the head of the island and the main land, so that all the water entering the canal will first flow through the bay, found between the island and the main land, entering that bay from below. The velocity of water in the bay will thus be diminished; the water will deposit silt in the bay instead of carrying it into the canal; and if the bay be a large one the canal may work for many years without its bed silting up.

The same principles can be employed on large irrigation schemes, by altering the methods now generally adopted on these works. The almost invariable arrangement is that the weir which stretches across the river, at a height of from 8 ft. to 15 ft. above the bed, is cut by two sets of under-sluices which are purposely set as close as possible to the head-sluices of the canal immediately above the weir; the floors of the head-sluices and of the under-sluices being at the same level.

The under-sluices are placed in this position so that silt may not accumulate in front of the entrances to the canal, and thus impede the free entrance of boats to the lock, and of water to the canal. This object is attained by opening the under-sluices during floods, thus drawing down a rapid stream immediately in front of the opening to the canals, which scours the channel and removes any deposit that may have accumulated. At the same time that the action of the under-sluices clears the approaches to the canal, it causes the canal to be more deeply silted, for the higher velocity produced by the scour of the under-sluices removes an extra quantity of silt from the bed of the river, and it is from this rapid and silt-bearing stream, impinging directly on the head-sluices, that the canal is supplied. But if the weir were constructed with a double set of under-sluices at each end, one set being in the line of the weir, and about 200 ft. from the river bank, and the other set some distance lower down the river, but connected to the upper set by a flank wall parallel to the river bank, and if the off-take of the canal were placed immediately above the lower set, the stream flowing to the upper set would not pass in front of the off-take to the canal. The silt-bearing water would pass through the upper set of under-sluices with full velocity, while that portion of the river destined for the canal would have its velocity checked, immediately opposite the flank wall, and would deposit its silt to a great extent before it reached the head-sluices of the canal. To sweep away the silt, which would be deposited between the weir and the head-sluices, it would be necessary to close the upper under-sluices and to work the lower ones. This plan would be rendered most effective by closing the head of the canal for a few hours every week, while the lower under-sluices were opened, so that the channel might be kept clean without allowing any silt-bearing water to have access to the canal.

In almost all cases the head sluice of a canal is formed by rows of single shutters, sliding in vertical grooves, so that the water is always first admitted to the canal from below the shutters, that is, at a level of the sluice floor. If the sluices were constructed so that the water was drawn from the top instead of from the bottom of the river, much less silt would be carried into the canal. In rivers which rise moderately it is best to have a single opening in each vent, covered by three or four shutters sliding in a vertical groove, and each of these shutters should have an independent opening gear. In rivers liable to floods rising 30 feet it is necessary to have in each vent of the sluices, several openings at different levels, each opening being fitted with an independent shutter, so that water can be drawn off at different levels as the flood rises or falls. This way of dealing with the silt can at most be but partially effective, but there are some rivers, carrying a small amount of silt, to which this system may be applied with sufficient effect to render the clearance of silt from the canal unnecessary.

The third method is frequently adopted on Indian canals. The first half mile of the canal is excavated with a base sufficently large to cause a great diminution of velocity; the silt is deposited during floods, and excavated when the canal is closed during the summer, or perhaps it is dredged out at a cost even more excessive than that of excavating it by hand.

The fourth method is peculiarly suitable for rivers with a rapid fall. It is also most desirable when a canal runs alongside of the river for some distance before branching off into the country. If this method be adopted, the channel of the first mile or so must be of such capacity that the velocity of the water in it, when carrying the full volume required for the canal, shall not exceed that which will allow of the deposit of the matter in suspension; so that the water, when it reaches the end of its length, shall contain only that proportion of silt which the channels below are arranged to convey to the fields. At the end of this broad channel a sluice will have to be built to carry the full discharge required in the canal with little or no head upon it. The head sluice on the river bank must be designed so that, with only a moderate flood in the river, a sufficient quantity of water can be introduced into the canal to generate a velocity of three to four feet per second in the broad reach, the flushing sluices leading back from this reach to the river being arranged to discharge a corresponding quantity, or even a larger quantity of water. These sluices might be fitted with falling shutters. The largest flushing sluice should be about 150 ft. to 300 ft. from the head sluice, for it is about this point that the heavy sand is deposited and where the greatest scour will be required. This system is the most effective and the least expensive for large schemes. If the head sluice on the river bank be constructed on the principle of taking water from the surface of the river, instead of from below, the minimum amount of silt will enter the broad reach, and that can under conditions, be cleared away by closing the sluices at the extremity of the broad channel for a short time, and opening all the shutters of the head sluice on the river bank and the various flushing sluices."

On the Marseilles Canal, in the south of France, with a maximum capacity of 424 cu. ft. per second, the water of which is used, not only for irrigation, but also for domestic use, settling basins were provided to rid the water of the sediment mechanically suspended, in order to render the water fit for domestic purposes.

After several settling basins were silted up and rendered useless, one of them having a capacity of about 159,000,000 cu. ft., another large basin was constructed with the necessary works for flushing it out periodically. This basin has an area of fifty-seven acres, and its capacity is about 81,000,000 cu. ft. It is formed by constructing a masonry dam across a valley 654 ft. in length, 72 ft. in height, and 55¾ ft. in width at the base. At the end of each year, when a deposit of about 5 ft. of sediment has accumulated at the bottom, it will be flushed out into the river Durance at a low level.

Part of the Berthoud Canal (Colorado) consists of a stave-pipe siphon 3,500 ft. long. The lowest point in this siphon is 80 ft. below the hydraulic grade line and is fitted with a large valve. The stream becoming sluggish going through this pipe naturally deposits its silt, which can be easily removed by opening the valve.

Mr. A. D. Foote, M. Am. Soc. C. E., fixed a trap and small gate for the purpose of intercepting and scouring out debris in a canal from the Boise River, Idaho. This trap is a trench cut in the bottom of the canal, and running diagonally upward across it from the gate. In this trench all small stones and sediment that may be loosened from the high banks by spring thaws, will be caught, and on opening the gate they will be carried out of the canal by the rapid current through the opening.

The C. F. & I. Canal, Colorado, 45 miles long, has two sedimentation basins with scouring sluices located half a mile from the entrance to the reservoir.

The headworks of the Community Canal across South Boulder Creek, Colorado, are of concrete on a solid rock foundation. Water enters the canal through three steel sluice gates, each 5.5 ft. square, the sill on which they rest being 5 ft. above the bed of the stream. A wooden rack in front of these gates prevents the passage of trees and other debris which come down the creek in large quantities during high water. Above the gates is a large settling pool, which reduces the velocity sufficiently to deposit its silt. Three sand gates 2 ft. by 5.5 ft. placed underneath the gate section, when open, convey all the silt deposited in front of the gates through an opening under the canal to the creek bed, while the pool is cleansed by flushing through a gate by the side of an overflow gravity section concrete dam, 60 ft. long, and used to raise the water level with the top of the canal gates. These headworks were designed by the Arnold Engineering Company of Chicago, and were very satisfactory.

A suggestion of the writer's to a local client, which will soon be put in operation, is as follows:

To build a wall from 3 to 6 ft. high across the head or intake of the reservoir. Through this wall, which may be of concrete, earth or rock, lay one, two or more lines of small pipe, continuing it through the reservoir and out through the dam. These pipes can be regulated by gates at either end. In this way, all the water which would enter the reservoir would have to come over the wall, and before doing so would have to deposit the greater part of its silt, which would be conveyed through the pipes and out of the reservoir. As it is necessary in nearly all cases to allow part of the stream to pass, this part, with less friction in the pipe than in its natural channel, would move with greater velocity, and therefore be able to carry all the silt.

Briefly to summarize, it will be seen that there is no cheap or efficient way to clean a reservoir from silt. Sand gates and scouring sluices cost money to build and waste a lot of valuable water for a very small clearance. The only feasible method is to prevent the silt from entering the system by silt traps, sand boxes or sedimentation basins which can be cleansed. With the very muddy streams and cloudbursts in this western country, the period of usefulness of a reservoir varies from 10 to 40 years, and rarely exceeds 50 years.

If this life can be made 25 years longer by a little care and extra work, there is no reason why such work should not be undertaken.

A magnetized iron rod is useful in removing, from the drill hole, pieces of steel broken from the drill bits.

Classified Cost of a Cinder Concrete Roof.

BY [illegible]

The following cost data were gathered in the construction of a cinder concrete roof in a large city located in the central portion of New York state. The area of the roof was 40x75 ft. = 3,000 sq. ft.

	Total.	Per square
Material:		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
30.0 squares expanded metal lath.	183.00	6.10
Total cost of materials.....	$487.60	$16.25
Labor:		
[illegible] lathers and plasterers [illegible] ...	$[illegible]	$1.6[illegible]
4 days, engineers at $2.80.........	11.20	0.37
2 days, carpenters at $3.25.......	6.50	0.22
9 days, hod carriers at $2.25......	20.25	0.68
21.5 days, laborers at $2.00........	43.00	1.43
Total cost of labor..........	$130.45	$4.35
Labor and material..........	618.05	20.60

In segregating these costs the time of the lathers and plasterers was lumped. The data would have been more valuable had these two items been separated.

STEAM AND ELECTRIC RAILWAY SECTION

Waterways—Their Limitations and Possibilities.*

INTRODUCTORY.

There is no more important subject today than that of waterways. It involves great questions of public policy, and every true and loyal citizen of the United States is interested in seeing those questions settled right;—settled without reference to personal bias or party prejudice, and in a way justified by the conditions. All the facts upon which opinions must be based are facts for the engineer and the economist to determine after careful investigation. It is important that those facts should be accurately determined and correctly recorded. Therefore, in my discussion of this subject, I shall endeavor to keep in mind these principles.

I do not believe that the development of waterways solely in the interest of the general public would hurt the railways. Even if I thought otherwise, I hope that I should have enough public spirit to advocate that which I believed to be for the public good. Whatever is for the public good ought to be done, even if in consequence some special interest suffers. For the same reason that I do not think railway men should discuss such a large question of public policy from the railway standpoint, I do not think shippers should discuss it merely from the shipper's standpoint. The question that ought to be considered by all is whether development of waterways is the best way to secure cheaper and more adequate facilities for transportation; and when I say "cheaper," I have in mind the entire economic cost of transportation, including not only the rates that the shipper pays to the owners of the boats, but also what the public pays in taxes† for the improvement and construction of the waterways.

When we consider the cost of railway transportation, we do not consider merely the cost of moving the engines and the cars. We consider also the cost of providing and maintaining the roadway, the stations and other structures. Obviously, all costs incidental to the soliciting of freight, insuring it in transit, interest on capital invested, and overhead charges for replacements and betterments are applicable to waterways as well as to railways; and we must not deceive ourselves by reason of the fact that some of these expenses are borne by the general Government, instead of by the traffic moved.

The subject of waterways in the United States naturally divides itself into: (I) Trans-Oceanic Waterways; (II) Coastwise Routes; (III) The Great Lakes; (IV) Canals Connecting Great Waterways; (V) Navigable Rivers; and (VI) Canals and Canalized Rivers. I shall try to say something of each.

[illegible]

The question of developing trans-oceanic waterways is mainly one of deepening harbors. Sea-going steamships have attained such draft that no harbor with a depth less than 20 to 40 ft. can accommodate the largest of them. Any place that is to remain or become a great port must have a harbor dredged to these depths for the large steamships* make for economy in transportation, and only to such ports can the large steamships come.

The development of harbors seems a proper, and even necessary function of the general government. Every commercial interest in the country (including railways) benefits by it; and for this very reason, private capital would have no incentive to engage in it, even if it were given the opportunity.

While it is a proper function of the general government to develop harbors, it certainly is not a proper function for it to undertake to develop them at all the cities that aspire to become great ports. Great ports are created by a combination of natural and commercial conditions, by the existence of good natural harbors and the focusing at them of rivers or railways, or both, capable of carrying large traffic to and from them, and of a spirit of trading enterprise that attracts to them over the rivers and railways from "Hinterland" or inland territory and over the ocean from other directions, a large commerce. The government cannot merely, by dredging a harbor, make a city located on it a great port; and, therefore, expenditures should be almost entirely confined to places where the combination of conditions mentioned is found. Repeated attempts have been made to create ports by governmental fiat and cash, merely because members of congress have had enough "pull" to secure by "logrolling" methods the necessary aprpopriations; and a great deal of money has been wasted, which if it had been spent where natural and commercial conditions warranted it, would have done much good.

The increasing capacity and draft of sea-going vessels which necessitates the dredging of harbors to great depths, has a most important bearing on the question of development of inland waterways. It is sometimes contended that we should dredge our rivers and dig our canals so wide and deep that vessels can carry goods directly and without transshipment between cities situated on them and all the ports of the world. Some of the people of Chicago have visions of ocean vessels loading in their harbor, steaming down through the drainage canal, the Illinois river and the Mississippi river, and thence to Europe; also through the Panama canal to the Orient; or by the Great Lakes and St. Lawrence canals, to Europe. Such thoughts are idle dreams, and the trend of economic conditions in ocean transportation make any such suggestions increasingly impossible. It might, for example, have been considered with the class of vessels which were used on the ocean twenty-five or more years ago. It cannot be considered with the class of vessels which are economical and necessary today, for, regardless of the relative depths of waterways, vessels which must withstand the buffetings of the waves and storms of the ocean must be built much more strongly and, therefore, at much greater cost than vessels for inland carriage. The average cost of an ocean steamship per ton of capacity is $71; of a steamship on the Great Lakes, $41.50; and of river tow boats and barges capable of carrying 10,000 tons of freight on an 8½ ft. draft, only $12.†

A lake or ocean vessel is poorly constructed for navigating a canal or tortuous river, even with a moderate current; its ratio of length to beam is too great and it cannot be maneuvered at slow speed. Furthermore, a vessel costing $71 per ton of capacity cannot be operated economically where it must, perforce, be navigated slowly.

COASTWISE ROUTES.

Trans-oceanic waterways are mainly connections, and not competitors of railways. The relations between the coastwise routes and the railways are widely different. In some cases, coast-wise water lines compete with railways; in others, rail-and-water lines compete with railways; in others, again rail-and-water lines compete with rail-and-water lines.

It is often said that our merchant marine is declining. This statement is not strictly correct. The part of our merchant marine engaged in foreign trade is declining, the reduction in its tonnage between 1889 and 1909 being from 999,619 to 878,523 tons. But the tonnage engaged in our coastwise traffic increased between the same years from 3,211,416 to 6,451,042, or over 100 per cent. This increase is mainly attributable to three things:

(1) To the monopoly of the coastwise traffic which the government gives to American vessels, but for which it is improbable that our ships would have been able to meet the competition of foreign vessels any better in our own waters than they have been able to on the high seas;

(2) To the fact that many large industrial concerns have acquired and operate lines of boats to handle their own traffic; and

(3) To the fact that many railway lines have acquired coastwise steamship lines, or at least controlling interests in them, make favorable through rates and issue bills of lading in connection with them, and use their own soliciting staffs or other well developed soliciting organizations to get traffic for them.

There is much criticism of the railways for getting control of steamship lines engaged in coastwise and lake traffic. But experience indicates that the control of such steamship lines by either large industrial corporations or railways is requisite to the development of a large water traffic. A railway can go anywhere that traffic is available. A steamship line can skirt only the fringe of the country, and can touch that fringe at only a few places, the number of harbors capable of receiving a good-sized boat being much smaller than the number of stations on a railway. The amount of freight originating at the relatively few places at which a steamship can be docked is comparatively small. Before it can get a large and regular traffic, some agency must cause commodities to be laid down at places where it can pick them up. A large industrial corporation, such as the Standard Oil Company, the United Fruit Company, or the United States Steel Corporation, can cause a great amount of freight to be concentrated at points where its own boats stop. A railway with a soliciting staff represented at every point on 2,000 or 5,000 or even 10,000 miles of line, may similarly cause enough freight to be concentrated at certain places to make profitable the regular operation of large steamship lines from those places. But—except under conditions peculiarly favorable to water transportation—a steamship line which has not the co-operation of a large industrial concern or a large railway cannot get traffic with such regularity and volume as to enable it to compete effectively, permanently and on a large scale against well-organized railways having strong soliciting staffs and giving regular and dependable service.

In an admirable book by Professor Smith, of the University of Pennsylvania, called "The Ocean Carrier," the great vicissitudes surrounding ocean transportation are pointed out. The business is essentially very hazardous and must either be done on a very large scale in order to distribute the risk, or be backed by very powerful influence. Marine disasters or "lean" traffic years are overwhelming to any small vessel owner, even though the profits

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*Paper by Frederick A. [illegible] read before the National Rivers and Harbors Congress, Washington, D. C., [illegible]

†The Public [illegible] we have very little data in this country which are reliable. In Europe it is different. There the Governments endeavor to keep accurate information on such matters; and on the much used canals of Germany and France, that portion of the expense per ton of freight carried, by reason of interest on the first cost of the waterways runs from approximately 1 mill to 4 mills per ton mile.

*[illegible] of moderate draft, which may be classed as sec- [illegible] feet; (c) carriers of the third class less important steamers and more common "tramp" [illegible] with due regard to [illegible]

†A modern freight car costs approximately [illegible]

[illegible] large. Coastwise water transportation, like ocean transportation, is cheaper than rail transportation, and when its lower cost is supplemented by efficient steamship management it is [illegible] is common for the railroads to make practically as low rates per ton mile for short distances as for long distances. While this does [illegible] transportation, it serves to make the railways valuable as feeders for the waterways, because the railway with relatively high long distance rates can not compete with the waterway, whereas the comparatively low *short* distance rate enables them to act as essembling agents for the waterway.

One thing that has hindered the development of the coastwise traffic has been the failure of the municipalities at most ports to provide good and adequate docks and other necessary facilities. It does not seem a proper function of the general government to provide these things. It should be left to the cities themselves or to private enterprise under regulation and control by the cities. If the cities do not provide them and do not encourage and regulate their development and use by private corporations, the public cannot consistently criticise private corporations for so developing and using them as to make them primarily profitable to those who furnish the capital.

THE GREAT LAKES.

The most rapid growth in our water-borne commerce during the past 20 years has been on the Great Lakes. Between 1889 and 1906 the gross tonnage of vessels used on the Mississippi and its tributaries increased 31 per cent; on the Atlantic coast and Gulf of Mexico, 82.5 per cent; on the Pacific coast, including Alaska, 133.3 per cent; on the Great Lakes and the St. Lawrence river, 160 per cent; and meantime the gross tonnage of the vessels used on our other inland waterways declined 74 per cent. During the same period the net tons hauled on the Great Lakes and the St. Lawrence river increased 200 per cent; on the Atlantic coast and the Gulf of Mexico, 166 per cent; on the Pacific coast, including Alaska, 56 per cent; and the net tons hauled on the Mississippi river decreased 6 per cent, and on all other inland waters, 65 per cent. The average gross tonnage per vessel on all our coastwise and inland waterways increased from 274 to 345 per vessel, while on the Great Lakes it has increased from 336 to 800 tons per vessel. The average tonnage per vessel on the Great Lakes is larger than on any other of our waterways, it being but 385 tons per vessel on the Pacific coast, and but 242 tons per vessel coastwise on the Atlantic coast and Gulf of Mexico. Only on the Great Lakes does the average tonnage of steam vessels exceed 1,000 tons. The rapid growth of commerce on the Great Lakes has been largely due to the wise policy of the Government in developing harbors and in deepening the Sault Ste. Marie canal. It has also been largely owing to the course of large industrial corporations and of the railways in acquiring control of or putting on the Great Lakes large steamship lines. These things have contributed to its increase for precisely the same reasons that they have helped to stimulate our coastwise traffic.

You may be disposed to reply that the important thing that has built up the coastwise and lake traffic has been the very low rates which the water lines have made. It is true that their rates have been much lower than those by rail. But the fact is that a water line that seeks to attract business from a competing railway merely by low rates is very apt to get worsted. This is illustrated by the existing conditions on the Great Lakes. The report of the Bureau of the Census on Transportation by Water [illegible] which many of the statistics that I have cited are derived, shows that the total shipments on the Lakes in 1906, excluding bunker coal, were about 73,000,000 tons, and that of this amount about 43,000,000 tons were iron ore or its products, practically all of which, of course, was carried in vessels owned by large industrial corporations—the steel manufacturers. Of the rest of the traffic, very much the greater part was carried in vessels owned by coal operators, lumbermen and railways, leaving only a comparatively small part for other boat lines. Practically all of the shipments of package freight were carried by railway boat lines. While the traffic on the lakes has been increasing so rapidly, that of the railways running between the same points that are reached by the boats has increased even more rapidly. Why have not independent boat lines taken the business away from the railways and the water lines they control? There are independent water lines and they make low rates. The answer is that the railway (and substantially the same thing is true of water lines controlled by railways) has a soliciting force and offices everywhere that are accessible to the shipper and when he delivers it goods it issues him a bill of lading which is a merchantable and bankable paper and almost absolutely protects him against loss of and damage to his goods, while when he wants to make a shipment by an independent boat line he has to go and hunt up a captain who may have two or three boats available, and who will give him a mere receipt for his goods which affords him little or no protection against loss and damage. To be on the safe side, he must incur the trouble and expense of insuring the goods while in transit. Even if he can save a small amount, this will not compensate him for the trouble and time of hunting for someone to carry his goods and for the risk incidental to water transportation. Indeed, it is safe to say that not to exceed 20 per cent of the tonnage carried on the Great Lakes is carried by common carriers. The railway steamship lines and half a dozen or more independent lines, are common carriers; but the great bulk of the tonnage is carried by vessels owned by the shippers or by "tramp" steamers that are chartered to the shippers.

As already stated, the railway has the great advantage that it can send for goods anywhere, pick them up anywhere, and carry them without trans-shipment to any point to which the shipper may want them to go. No independent boat line can attract business away from a steamship line owned by the same industry whose commodities it transports; and it is also difficult, although not so hard, to attract traffic away from a boat line owned by a railway, because the railway can to a very large extent influence the routing of traffic which may be carried by its boat line. Even if an independent boat line builds up a good business, there is nothing to prevent some rival boat line coming in, cutting rates, and taking a large part of it away; for it is easy for a group of men to get together a fleet of vessels by charter and form a line to compete for any traffic; but the vulnerability of independent boat lines tends to prevent them from being established. In other words, the very freedom of waterway competition militates against waterway competition.

It is chiefly due to these conditions that the boat lines on the Great Lakes have in the main passed into the control of the large industrial corporations and the railways. One of the results of their control by these large interests is that the public has to rely for water transportation mainly on the lines controlled by railways; for the steamships owned by the large industrial corporations are private carriers and handle only commodities shipped by their owners. Therefore, if the public gets any of the benefit of the low rates they make, it is only in the form of low prices for the commodities they sell. Whether the benefit is passed along to the "ultimate consumer" in this form, I must leave to your own observation.

[illegible] CONNECTING GREAT WATERWAYS

No wiser and more effective expenditure of public money for waterways could be made than for the purpose of deepening and widening rivers and digging canals to connect large bodies of water when the distance between the waterways is not too great. The best example in the world of such connecting canals is the Sault Ste. Marie canal. The American canal at Sault Ste. Marie was first opened to navigation in 1855. During the forty years to 1895 101,244,162 tons of freight passed through it. During the next 11 years, ending in 1906, after the canal was improved, 343,288,393 tons passed through it. The development of this canal, which is 2.7 miles long and 25 ft. deep, has cost $13,000,000 or $4,800,000 per mile. Its great value consists not merely in its ability to handle a large traffic, but in the fact that it makes more available and useful the great waterways it connects. Its cost was large, considering its length, but all the great ship canals have cost very large sums. The Suez canal, which also was built to connect great waterways, is 9 miles long, 31 ft. deep, and cost over $1,100,000 per mile. The Kaiser Wilhelm canal, 61 miles long and 29½ ft. deep, cost $656,000 a mile. The Manchester Ship canal, 35.5 miles long and 26 ft. deep, cost $2,100,000 per mile. These very large figures show that the longer it is necessary to make a ship canal to render it useful, the more dubious becomes the desirability of building it. When it must be made more than a comparatively few miles long, its cost is apt to become so very great as to make it an entirely uneconomical means of transportation if to the rate paid by the shipper is added an allowance for interest, maintenance and depreciation of the original undertaking.

This subject should not be passed without mentioning our splendid undertaking at Panama. True, this undertaking may cost from eight to ten millions per mile of canal, but as an undertaking for the benefit of the world at large, it is one of the greatest ever conceived. No one can forsee the economic effects which may flow from the Panama canal. We can see its military value to us. We can see that it will bring the Pacific coast nearer to our Atlantic seaboard; but, by the same token, it will also give our European competitors easier access to our Pacific markets. We can readily see that it will be an advantage as a new route for the manufacturing centers of our east coast to the west coast of South America, and between our own west coast and the east coast of South America. Incidentally, an interesting effect of the Panama canal will be to sound the death knell of the last great sailing vessel world route—that from San Francisco to Europe. The tramp steamer plying through the canal will certainly put the last of these "wind-jammers" out of business.

NAVIGABLE RIVERS

A widespread public demand for the general improvement of the navigable rivers of the United States has been voiced within recent years. This demand is generally promised on the assumption that the greater commercial use made of the rivers of Europe is due to their having been developed by the governments to a greater extent than our rivers have been, and that similar action by our government is necessary to make our rivers equally useful transportation facilities. But the fact is that our navigable rivers in their present conditions are better able to carry a large traffic than are those of Europe. The maximum depth attained on the rivers and canals of France is 8.5 ft., while most of the traffic is carried on water varying in depths from 1.5 to 5 ft. The depths of the rivers in Germany vary from 3 to 6 ft., except on the lower reaches of some of the larger streams, where there are depths of from 8 to 10 ft.; and the canals and canalized rivers vary from 2.6 ft. to 10 ft., 4 to 6 ft. being most common. The Rhine and the Elbe, on which 67 per cent of Germany's water commerce is carried, have together only 617 miles of channel, with a depth of as much as 4½ ft., which is the minimum depth of the Mississippi, the Illinois river and the Illinois state canal between Chicago and New Orleans, a distance of 1,657 miles. There are in the United States forty streams, with a length of 2,600 miles, which have a depth of 10 ft.; and seventy more, with a length of 3,200 miles, which have a depth of 6 to 10 ft. Practically all the traffic on the waterways of Belgium, France and Germany is carried in shallow barges varying in capacity from 100 to 1,000 tons. One thousand ton barges are practically confined to the Rhine in Germany and the Seine in France. The great bulk of the traffic is carried in barges having drafts of 2 to 6 ft., and capacities of 150 to 600 tons, and which are commonly towed in trains at from 2½ to 4 miles an hour. It would be perfectly feasible to handle a big traffic with such barges as these on a very large proportion of the rivers of the United States. If some of our rivers such, for example, as the Hudson, which has ample depth and width for navigation by large vessels and which runs in the direction of large currents of traffic, were located in Europe, they would be bearing a heavy commerce.

The main reason why the commerce on our navigable rivers is so much smaller than on those of Europe is not that our rivers are potentially less efficient facilities of transportation, but that our railways are more efficient than their railways and make lower rates. The average rate per ton per mile on the railways of France is 14 mills, and on those of Germany, 13 mills. It is not possible to state the average rates per ton per mile on European waterways, but the figures given in the report of the British Royal Commission on Canals and Waterways, which was published early in the present year, indicate that the average rate per ton per mile on the waterways of Germany is about 5 mills and on the waterways of France about 6 mills. This takes no account of the fact that in Europe the haul by water between any two points is usually considerably greater than the haul by rail. If the water rates were estimated on the basis of the shorter distances by rail, they would be higher, but they would still be much lower than the rail rates. The Governments of continental Europe so regulate the rates of the railways, as to make them rather inflexible, while the boats are allowed to give all the flexibility to their rates necessary to secure business. In view of these differences in the water and rail rates of Europe, it is not surprising that the boats on the rivers, despite their relative shallowness, have been able successfully to compete against the railways.

Railway rates in the United States are very much lower than they are in Europe. The average railway rate per ton per mile in this country in 1909 was but 7.63 mills,* and the rates on roads having great densities of traffic, or handling mainly cheap and bulky commodities, are much lower.

The average rate per ton per mile on all traffic on the Pennsylvania Railroad, for example, is 6.3 mills; of the Illinois Central, 5.8 mills; of the Lake Shore & Michigan Southern, 5.27 mills; and of the Chesapeake & Ohio, 4.33. Furthermore, our railways have been allowed in the past freely to adjust their rates so as to meet water competition, and even destroy it.

The policy of both the railways and the government of the United States in reference to railway rates recently has been changing to a marked degree. Until lately, the tendency of railway managers was voluntarily, or under the stress of fierce competition, to reduce rates to a lower and lower basis. This unrestrained competition caused unfair discrimination between localities. The efforts of the government and of the railways to stop unfair discrimination necessarily have reduced competition, and thereby checked the downward tendency of rates. The increasing costs of railway operation have had a similar effect. If railway managers are allowed to carry out their present plans, rates will be advanced somewhat. Furthermore, the Mann-Elkins act has amended the Interstate Commerce act in ways that will tend to prevent the roads from meeting water competition as they have in the past. They often have made lower rates for longer than for shorter hauls in order effectively to meet at points on navigable rivers competition which they did not meet at intermediate points. If they had been required to reduce all their rates to the same basis as those they made to meet such competition, they would not have tried to meet it. Under the revised Interstate Commerce act the Commission [illegible] when [illegible] longer [illegible] exercises its discretion will depend how and to what extent the roads may in future meet water competition. Another provision of the Mann-Elkins act absolutely prohibits a railway from raising a rate that has been reduced to meet water competition, unless since the rate was fixed some change in conditions has occurred other than the elimination of water competition. This restriction on advances in rates is sure to operate as a hindrance to their reduction. With railway rates tending upward, rather than downward, and also tending to become less flexible, it is quite possible that the opportunity for the development of traffic on our navigable rivers is improving.

CAN[illegible]

A great many of intelligent persons concede that the traffic on the inland waterways of the United States, except the Great Lakes, has declined, while that on the waterways of Europe has increased, because of the cheap and superior service of our railways, and contend that we can make our waterways successful competitors of our railways only by making our waterways greatly superior to the waterways of Europe. They, therefore, advocate digging canals and canalizing our rivers to depths exceeding those attained on such waterways in any other country. One of the plans is for a 14 ft. waterway from Chicago to New Orleans. It is questionable if the results would be worth the cost. The aim of public policy should be to cause the provision of such facilities of transportation as will be able to handle our commerce at the least economic cost; and in economic cost I include the taxes the public would have to pay in order to provide and maintain deep waterways. The report of the British Royal Commission shows that the expenditures of France on its rivers up to 1905 averaged $30,000 a mile, and on its canals, $102,675 per mile. The average density of traffic on French waterways in 1905 (that is, the number of tons handled one mile per mile of waterway per year) was 420,000 tons. Germany had spent on its waterways an average of $30,300 per mile, and on its canals, an average of $42,250, and the average density of traffic on them was 1,500,000 ton miles. The canalization of the main cost $95,000 per mile. The construction of the Teltow canal cost $390,000 per mile. The interest and maintenance charges paid by the Government of France on its waterways amounted to 4.2 mills per ton mile of traffic handled, which, added to the average rates which the shippers paid to the boats, makes the economic cost of water transportation 10 mills. The interest and maintenance charges paid by the Government of Germany amount to about 84 mills per ton mile, which, added to the average rate of 5 mills, makes the total economic cost of water transportation almost 6 mills. The greatest density of traffic on any river in Europe is on the Rhine, where it amounts to 11,400,000 ton miles. The density on the Elbe is 5,800,000 ton miles. To get the depths advocated in this country would require very much greater public expenditures than those that have been made in Europe. Indeed, it might in many cases involve expenditures approximating those for the Kaiser Wilhelm and the Manchester ship canals, the former of which cost $656,000 per mile, and the latter, $2,100,000.

The capitalization of the railways of the United States is $59,259 per mile of line, and this, of course, includes equipment and terminals, as well as roadway. The number of tons carried one mile per mile of line by our railways in 1909 was 953,986. The density of traffic of some of our large railways rival those of the greatest waterways of Europe. The number of tons hauled one mile per mile of line by the Delaware, Lackawanna & Western in 1908 was 3,886,811; by the Philadelphia & Reading, 4,164,131; by the Pennsylvania Railroad, 4,723,831; and by the Bessemer & Lake Erie, 5,561,712, or over 13 times as much as the average density of traffic per mile on the [illegible] and almost four times as much as on the waterways of Germany.*

These figures indicate to my mind that if, in order to provide inland water transportation which will be able to compete effectively against the railways, it is necessary to dig canals and to canalize rivers to depths of 14 to 20 ft. or more, we had better forego having effective water transportation facilities and use our money to provide facilities for transportation by rail.

To dig a waterway 14 ft. deep would be to provide one that would not be any more useful than the Missisippi river already is for the most of its length and than numerous other streams are. For over 95 per cent of the vessel tonnage on the Great Lakes draws over 14 ft. of water, and over 80 per cent of this draws over 18 ft. It is evident, therefore, that lake vessels could not be used on a 14-ft. waterway, and, of course, ocean steamships could not be used where lake steamships could not. Even if the Lakes-to-the-Gulf waterway were made sufficiently deep for lake vessels, and it were economical for them to use it, all water transportation on tributary streams would have to be carried in shallower draft vessels, requiring transfer. Would it not be better to serve the entire Missisippi river basin with tow boats and barges which, like the much abused freight car, could go anywhere within the sphere of navigability, say 5,000 to 8,000 miles? Isn't the real problem to find an economical vehicle of transportation adaptable in a large river system like the Mississippi river and its tributaries; a vehicle which shall do for that river system what the freight car does on our system of railways?

The stern reality is that even if a 14 or a 21 ft. waterway were dug, it would never be used by deep draft boats. As I have already said, a large vessel cannot be profitably navigated on a narrow channel, because the interest on its high cost makes it uneconomical. Colonel Symons estimated that it would cost 38 per cent more to carry grain with a lake freighter on a ship canal than it would with a tow boat and barges, and it was in consequence of his investigations and conclusions that the State of New York decided to deepen the Erie canal only to 9 ft., instead of making a ship canal of it. Colonel Symons' estimate did not allow for the greater cost of building and maintaining ship canals, but referred only to the expense that would be incurred by the owners of the boats. The operation of a deep draft vessel in a river channel having any considerable currents might be even more expensive than on a ship canal.

Furthermore, I assume that no one would advocate making not only the Mississippi, but all of its navigable tributaries, 14 to 20 ft. deep; yet if the Mississippi were made a deep waterway while streams emptying into it were not, even if it proved practicable to navigate deep draft vessels on the Mississippi, they could not be navigated on the tributary streams, and then one of two things would happen—either the vessels in which goods were loaded on the smaller streams would be sent through to destination with the goods—in which case the deep draft vessels would not get to haul them—or the goods would have to be transferred to the deep draft vessels, and transferring goods from boat to boat is as expensive as, and often even more expensive than transferring them from car to car. It seems to me that to develop a waterway system in this way would be like building the main line of a railway with a broad gage and the branches with a narrow gage. So far as I can learn, it is the opinion of practically all of the United States army engineers who have investigated the subject, that a tow boat with 6 to 9 ft. draft, towing barges with a combined capacity of 8,000 to 10,000 tons, would be able to handle traffic cheaper on the Mississippi river, even if it were deepened 14 ft. or 21 ft., than could a lake vessel with a deep draft; and the tow boat and barges would be able to navigate many of the shallow tributaries as well as the Mississippi, which would avoid the cost of transferring freight originating on the branch rivers. Needless to say, the cost of dredging the Mississippi river and its tributaries to a minimum depth of 6 ft. or even 9 ft., and maintaining that depth, would be very much less than the cost of digging it to a uniform depth of 14 ft. Boats having a draft from 25 to 30 ft., can now be taken from the Gulf of Mexico 270 miles to New Orleans; boats of a draft of 9 ft., 840 miles further, to Cairo, Illinois; and boats of 8 ft., another 182 miles from Cairo to St. Louis; and it is stated by the board of army engineers that the Mississippi and Illinois rivers and the Illinois state canal from St. Louis to Chicago are now able to accommodate vessels having a draft of 4½ ft. It would seem, therefore, that all that reasonably could be asked, or that ought to be asked of the general government, so far as our navigable rivers are concerned, is that it shall dredge them to depths sufficient to accommodate tow-boats and barges such as can now be operated on the greater part of the Mississippi river drainage system. To do more than this would involve an expenditure which would not be justifiable—which, in other words, would not make the total cost of water transportation less than it is by rail, whether it made it cheaper for the shipper or not.

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*This oft-quoted figure of the average ton mile rate in this country is made up by taking the average of all the tonnage of the country. It includes the movement of less than carload package freight; the movement of business over mountain ranges where the rates are necessarily high; it includes the movement of live stock, perishable freight, citrous fruits, and many high class commodities on which speed is a requisite.

*A density of 3,000,000 tons of freight per mile of road on single track lines is not at all uncommon in the United States and this movement is in addition to a very considerable passenger traffic.

If the government provided such channels as I have indicated; if the municipalities or private corporations provided modern and adequate water terminals; and if the water lines made rates, gave service, and formed soliciting staffs adapted to competing effectively with the railways, the water lines on our rivers would be as well situated to compete with railways as are those of any waterways in the world, except, of course, the oceans and the Great Lakes; and unless good water terminals were provided and the steamboat companies formed soliciting staffs, issued bankable and negotiable bills of lading and in other ways gave service which was as good in proportion to the rates charged as that of the railways, they would be as unsuccessful in competing for business, even if the government dug the rivers 20 ft. deep, as are the independent boat lines on the Great Lakes now in competition with the railways or with the steamship lines owned by the railways and large industrial corporations.*

I do not say that if all these things were done, river steamships would be able to compete successfully against the railways, and I feel very sure that if the water lines were subjected to the same kind of regulation as the railways are, they would continue for an indefinite time to be unable to compete with the rail lines.

I merely say that under any circumstances these are conditions that must be met if our inland waterways other than the Great Lakes are ever to compete successfully against the railways. Whether, when the results that would be obtained are so entirely problematical, it is worth while to go on and spend millions in dredging the rivers and equipping water terminals, is for the public to decide.†

Up to 1907 the Government had spent over $208,000,000 on the improvement of the Mississippi Valley waterway system alone. Between 1880 and 1906, canals and canalized rivers having a length of 2,841 miles, which had cost $73,168,000 were abandoned. Up to that time our total expenditures on canals and canalized rivers had been $283,208,863. The total Congressional appropriations for the survey, improvement and maintenance of harbors and waterways had been $552,943,525, and many millions of dollars have also been spent by the various states. We all know that a large part of these expenditures has been very unwise, that certainly before expenditures are entered on which would be very much greater than any made in the past, the projects on which it is proposed to make them should be studied to very much better purpose than like projects have been in the past.

IN CONCLUSION.

I do not claim to have traversed this great subject. I have only attempted to show some of the real possibilities of waterway development, and at the same time point out that there are equally real limitations. As I said at the outset, the facts surrounding this question must be studied by thorough and unbiased men, and when the facts are before us we can safely decide what should be done. Let me, therefore, suggest that it should be one of the purposes of this organization to try to prevent mere "pork barrel" expenditures and to see that those which are made have for their object the good of the whole country. If its efforts are directed to carry out this purpose, it will do a work for which it will deserve the thanks of every citizen.

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*Although I have never seen the statement made, I regard it as a fact and one worth determining by actual test that it takes less power to move five thousand tons, or ten thousand tons of freight loaded on cars, on a railroad the grade of which does not exceed three-tenths of 1 per cent, than to move the same tonnage on a canal or canalized river. Train resistance on a smooth and level track is less than the resistance of moving a boat through water.

The reason that the public have been misled as to the comparative cost of rail transportation and water transportation is that in the case of rail transportation the shipper pays the entire cost, including terminal service, and on top of this cost, a profit to the transportation company, whereas in the case of water transportation, the shipper pays only the bare cost of carriage, and no interest on the money invested in the waterways, in the harbors and terminal improvements, nor in the maintenance and upkeep of the waterways.

Furthermore, the interruption of water transportation in our northern waters is more than a serious inconvenience. It puts the burden of heavy interest charges for the entire year upon the traffic which can be handled only in the summer months.

†A fact often overlooked in considering the cost of transportation as a whole, between producer and consumer, is the cost of assembling freight at the initial point or distributing it at terminal points. In this respect, while the railways have a great advantage, yet even with the railways, the cost of assembling farm products in many of our states (as pointed out in a recent report of the Department of Commerce and Labor) is greater than the freight paid by the farmer from his initial station to the point at which he markets his produce. In other words, a farmer who has to haul his produce eight miles to a railroad station, at a cost of, say 20 cents per ton per mile, is spending as much as he would pay the railroad for two hundred and ten miles of transportation at the average rates prevailing over the whole country.

Thus, it is fair to expect that good roads and automobile trucks will contribute much in the future towards cheapening the cost of assembling and distributing freight; and that there is much to be gained by intelligent public expenditures in the direction of improving the public highways and so reducing the cost of haulage to and from shipping points, whether these shipping points be stations of railways or of waterways.

GENERAL ARTICLES AND CLASSIFIED ITEMS

The Situation Presented by the Constitutional and Statutory Provisions Governing the New York State Barge Canal Work and Character of Work Up to Date

The Governor of New York recently directed the State Engineer, the Superintendent of Public Works and the Board of Advisory Engineers having charge of the State Barge Canal work to report to him on the matters designated in the title to this article. These reports have been made, and two of them contain matters of such general economic interest that we print them somewhat condensed.

R[illegible] SUPERINTENDENT OF [illegible]

The original statute was specific as to some things and carries with it a suggestion of a close study of the general problem of canal improvements by those who had the legislation in charge, and also it contains certain provisions clearly intended to safeguard the work and the State's interest in all particulars. While the desirability of all these was most commendable and exhibited care and foresight, nevertheless some of these provisions neither tend to the most rapid progress of the work nor to its accomplishment by the most economical methods. There was not in the original act such a division of authority as to make it difficult in the event of criticism either as to the adequacy of plans, the progress of the work or its character, to definitely locate full responsibility. Section 3 of the act, among other things, states:

> Within three months after issuing the said bonds or some part thereof the Superintendent of Public Works and the State Engineer are hereby directed to proceed to improve the Erie canal, the Oswego canal and the Champlain canal in the manner hereinbelow provided.

After which follows in detail the general route to be chosen, and in general, the character and dimensions of structures.

Section 6 of the act, after providing that all of the work shall be done by contract, further provides:

> Before any such contract shall be made the State Engineer shall divide the whole work into such sections or portions as may be deemed for the best interests of the state in contracting for the same, and shall make maps, plans and specifications for the work to be done and materials furnished for each of the sections into which said work is divided and shall ascertain with all practicable accuracy the quantity of embankment, excavation and masonry, the quantity and quality of all materials to be used and all other items of work to be placed under contract and make a detailed estimate of the cost of the same, and a statement thereof with the said maps, plans and specifications, when adopted by the Canal Board, shall be filed in his office and a copy thereof shall be filed in the office of the Superintendent of Public Works and publicly exhibited to every person proposing or desiring to make a proposal for such work.

As bearing on my construction of the meaning of this provision, I quote from my annual report for the year 1907:

> From the study that I have given this act since I have assumed the duties of my office, I have become clearly convinced that the intent of the framers of this act, as it was also the intent of the Legislature in passing the act, was to require that no work should be undertaken until detailed plans and specifications for the whole improvement should be matured, following such solution of engineering problems as might be met with; and that it was clearly the intent that bids should be invited covering the whole of the work, which work, however, was to be divided "into such sections or portions as may be deemed for the best interests of the state in contracting for the same." Certainly, this view of the meaning of the words of the act, quoted, is in keeping with the provisions of the Finance Law, which provides in section 35, as amended by chapter 580, Laws of 1899:
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> A state officer, employee, board, department or commission shall not contract indebtedness on behalf of the state, in an amount in excess of money appropriated or otherwise lawfully available.
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> And section 38 of the same law, as amended by chapter 479 of the laws of 1899, provides:
>
> A contract or contracts made in pursuance of an appropriation by the state for a specific object shall be for the completion of the work contemplated by the appropriation, and in the aggregate shall not exceed the amount of such appropriation. A contract for a part of such work shall not be binding upon the state until contracts are also made covering the entire work contemplated by such appropriation * * *

These views both as to the intent of the law and as to the wisdom of applying it, I still hold, though I am aware that very brilliant lawyers who were consulted at the time this question was raised by me, rendered the opinion that the point was not well taken; and though fully aware also that the pro-canal interests who were exceedingly anxious that the work should be started as promptly as possible after the Act became effective, fully approved the methods pursued. While this may have been the proper manner of emphasizing their enthusiasm, I then believed and still believe the method was short-sighted as a business policy, since, aside from the cost of plant by multiplicity of contracts, aside from the uncertainty as to final cost and aside from the many difficulties which may beset it, the cost to the State in the matter of engineering and other supervision must be greatly increased as the result of any increase in the length of the construction period.

In other words, had what I term the "make haste slowly" policy been adopted at the inception of the work, had the whole work been divided "into such sections or portions as may be deemed for the best interests of the State in contracting for the same," and had "maps, plans and specifications for the work to be done and materials furnished for each of the sections into which said work is divided" been prepared after all the engineering problems to be considered had been solved, the actual construction work would not have been begun so soon but the completion of the improvement in my mind would be nearer at hand.

At the present time the total work under contract in dollars is $67,209,652, exclusive of alterations, some of which increase the cost of the work, while others effect a decrease of saving. In addition, there are now pending contracts on which bids will be received, aggregating $5,525,910, these contracts included in such total being outside of the work of improving the Cayuga and Seneca canal which was authorized by chapter 391 of the Laws of 1909. Bids will also be received on two contracts for the Cayuga and Seneca canal improvement, such contracts having a total of $2,225,083.

Of the contracts awarded up to the present time, there were in force on Jan. 1, 1910, contracts with a total of $53,856,940, the balance having been placed under contract at different times since then.

On these more recent contracts with the exception of a few of the smaller pieces of work, contractors are still engaged in assembling plant and machinery so that progress thereunder in actual construction work is not yet under way.

The total payments to contractors on account of the progress of work up to Nov. 1, 1910, were $21,787,687.82.

Before submitting my annual report for the year 1907, I studied carefully into the question of lack of progress which even then seemed only too clearly apparent, and suggested what to my mind seemed at least contributory causes.

First, a lack of sufficient capital by the contractors; second (and this in some cases may be closely allied to the first cause), the employment of machinery totally inadequate to the doing of the work in hand; and third, the knowledge on the part of contractors that since only a certain percentage of the whole work was under contract no good reason exists for confining them to their contract periods, since even if completed the portions of the canal embraced within their contracts could not be utilized until the completion of the whole.

There is another cause for the long drawn out period of construction, but for this the statute, and not those who have been charged with the duty of administering the statute, is responsible.

I referred in what was almost my opening sentence to what appeared in my judgment to have been a lack of conception as to the importance and far-reaching effect of this work. Without casting even the faintest criticism on any official who has had to do with this work from its inception, I confess to amazement that so important an undertaking, while apparently clothed with so many safe- [illegible] chinery, which [illegible] under our form of [illegible] ceiving the plans, to interpret them and see them carried out to completion.

Under the statute the inception of the plan is left to the State Engineer and Surveyor, and wh[illegible] 1903, provides for the maintenance of a board of advisory engineers and places certain responsibility upon the Canal Board as respects the approval of plans, the interpretation of the plans and the supervision of work during the construction period are duties devolving upon the State Engineer and Surveyor. That official holds office for a term of two years, and rarely in the history of our State government has a re-election been accorded him—never since the work was undertaken. Up to within the past two years, in addition to the gigantic task of conceiving the plans and carrying out the work embodied in the plans, the State Engineer and Surveyor was charged also with the duty of planning and supervising the construction of a system of good roads, besides being given many other duties and responsibilities.

It thus appears that the official charged with the greatest responsibility in connection with this work, and given the greatest authority, is such a one as under existing conditions can give only a portion of his time to the duties in connection with the improvement, and all this under provisions of law he is required to do at the paltry compensation of $5,000 a year. Very wisely, as I believe, the last Legislature made provision, which the Governor sanctioned, whereby the compensation of this official is to be somewhat increased. Nevertheless, in comparison with what is paid by railways, contractors and others having to do with work requiring the services of skilled engineers, the compensation paid to the State Engineer is so small as to be almost ridiculous. It so happened that since the act authorizing this improvement became a law, four different engineers have been charged with the chief responsibility for the undertaking, and a fifth is soon to be inducted into office.

It is but human nature, emphasized in the case of a person of professional standing, to be so jealous of that professional standing as to wish to know of and for himself as to all the details of work for which he may become responsible under his oath of office, and this human trait has been exhibited in connection with this work.

[illegible] quire a period of six months or perhaps a year to familiarize himself with the work, and during this period plans for work which might be well under way would either be at a standstill or else, because of a different viewpoint on the part of the new incumbent, plans would be so changed as to render all previous, or nearly all previous work futile.

During the last six months, or perhaps year, of his incumbency, plans might be rushed toward completion, but failing of actual completion so as to render their approval possible, millions of dollars worth of work would be left on his table or desk for his successor, who in turn, exhibiting the same caution, the same human and very proper instinct, would require a year in a study, a revamping or an entire reconstruction of the plans, and that by this method delay has resulted, can neither be a surprise nor can it be a subject of criticism of officials who under other circumstances could and would be held responsible.

To be specific on this point, just prior to the year 1906, the then State Engineer and Surveyor presented for approval plans for contracts aggregating an estimated cost of about $11,000,000. These contracts were submitted at the meeting of the Canal Board in December, [illegible] 12, 13, 14 and 20. On January 29, 1907, these plans were withdrawn by the new State Engineer. Of these contracts, what was known as 3B is still pending; No. 12 was resubmitted [illegible] 13 [illegible]

In turn just prior to the close of the administration of 1908, contracts aggregating several millions of dollars were submitted, and failing of prompt approval as seemed proper, they were withdrawn by the incoming Engineer, and of these contracts, No. 36 so withdrawn was resubmitted for the approval of the Canal Board Sept. 22, 1909, and Contract No. 42 was resubmitted March 18, 1909.

There are many other examples similar to these cited. I, however, do not cite these as carrying with it a suggestion of criticism of the officials responsible for the act or acts. In a sense it shows extreme care, caution and desire to subserve the best interests of the State, but that it is a criticism of the methods of carrying on so important a work hardly needs to be pointed out.

There is another phase of the work both as relates to the preparation of the plans and to their interpretation as well as to the oversight of the actual progress of work, which has been to my mind a serious handicap to the work and an embarrassment to those having to do with it, but for which they are in no sense responsible. I refer to the legal requirements whereby the State Engineer and Surveyor has little voice in the selection of his force of subordinates, his subordinates being in actuality selected for him by those who have no responsibility for the work and whose selection is based upon a written test—a civil service examination which may develop a knowledge of books and which may not display an existing ignorance of men, machinery and multitudinous other requirements, the knowledge of which is so essential to effectiveness both in the drafting room and in the field.

Under the existing law, and I am not a disbeliever in a general application of civil service based on merit and fitness, the official charged with the supreme duty and supreme responsibility is bereft of his power for effectiveness in that he is not even permitted to make promotions for merit shown by actual work, being limited in such promotions to selections made by those who have as in the first instance neither authority nor responsibility nor conception of what is actually needed, and whose test is merely academic.

Though I have no intimate knowledge in detail, yet from a general knowledge I know that often it has been necessary to place in charge of work men who come from technical schools who by reason of recent technical studies and reviews secured a high standing but who have had no actual experience in field work. These persons are able to interpret plans and specifications from a text book standpoint but their strict text book interpretation may, and I believe often does, result in detriment to the work and a handicap to the contractor.

In other words, the civil service as applied to an improvement of this kind results in making the State work a gigantic training school for engineers.

I have referred briefly to what I believe to have been an inadequate study of plans as a whole, and I am confirmed in my belief by the frequent changes which it has been necessary to make in the plans and specifications of innumerable contracts. I am not raising any question as to the wisdom of these changes, some of which have entailed an increase and others have resulted in a decrease in the cost of the particular work. Some, possibly many, of the changes which have been found to be necessary could not have been foreseen even had a longer and closer study been made before placing the work under contract, but that many of these changes, involved in these alterations, could have been foreseen has seemed to me probable. Many of these changes at least are due to the different viewpoint of one State Engineer and Surveyor as to the effectiveness of plans and methods from that held by his predecessor or former Engineer whose thought and study conceived the plans. Some changes have been the result of direct legislation, but all changes, from whatever cause, of necessity have tended to delay the progress of the work.

A contractor will [illegible] which he [illegible] for a certain character of construction or structures, plans and [illegible] plant for the carrying out of the work. Sometimes after [illegible] have been delivered and installed changes are made which render the plant and machinery so provided almost, if not quite useless, and renders other machinery of a different type necessary.

[illegible] the cost to the contractor in such change, there is delay necessitated. In some cases, the necessity for a change of plans is discovered, but what change or how the problem newly discovered is to be solved is not clear to the engineering force, and to determine this point has in some cases involved a study of many months. To be sure, the contractor might be and has been able to progress other portions of his work, but this change in contemplation could not otherwise than result in disarrangement of progress plans, stop the continuity of work and increase the length of the contract period.

Another feature tending to the prolonging of the contract periods is the operation of the existing canals during the construction.

It goes without saying that construction work which is in the nature of an enlargement of the present canals, cannot be conducted with as rapid a progress where there is an interruption during the six months of the year best suited to the carrying on of construction work.

I referred at the beginning of this communication to the fact that one cause for delay was inadequate machinery and insufficient capital on the part of some of the contractors. This is an opinion based upon personal observations covering a period of four years. The Barge canal statute, in section 7, contains a provision which undoubtedly is intended to meet just such contingencies. This provision is:

> If in the judgment of the State Engineer the work upon any contract is not being performed according to the contract or for the best interests of the state, he shall so certify to the Canal Board, and the Canal Board shall thereupon have power to suspend or stop the work under such contract while it is in progress and direct the Superintendent of Public Works and it shall thereupon become his duty to complete the same in such manner as will accord with the contract specifications and be for the best interests of the state or the contract may be cancelled and readvertised and relet in the manner above prescribed, and any excess in the cost of completing the contract beyond the price for which the same was originally awarded shall be charged to and paid by the contractor failing to perform the work.

Since the beginning of the work this provision for correcting existing conditions has been resorted to in very few cases only. In the case of one contract, known as No. 17, the contractors went into the hands of Receivers in Bankruptcy, and under the clause referred to, the contract was cancelled and the work readvertised and relet. One other contract, No. 2, has gone through a similar process, and the work is now again under contract and the contractors are maintaining a satisfactory progress, in my opinion.

In the year succeeding that in which action was taken by the State officials in the case of Contract No. 17, the work on Contract No. 10, located at Fulton, was being conducted in an indifferent manner, and after careful consideration, upon [illegible] the State Engineer and Surveyor that the work was not being conducted to the best interests of the State, the contract work was suspended. In view of the assurances given after such suspension by the contractors as to the furnishing of additional equipment, material and forces, the contractor was put in possession of the work and for a time it proceeded with a fair degree of satisfaction. The increased progress was maintained for only a short time, however, when the contractors [illegible] either embarrassed or discouraged, disposed of their contract by assignment. The assignment of the contract was formally approved, and the new interests went forward with the work for a time, when through financial embarrassments caused by the relations of these contractors to other contracts outside the State, they were compelled to go into the hands of Receivers in Equity. This resulted in a practical shutting down of the work for many months. The receivers are now carrying forward this contract under the direction of the Court, and an increased and fairly satisfactory progress is being maintained by them.

In the case of a number of other contracts which had been in force for a considerable period and where lack of progress had been shown from the start, this department, though not charged with the duty of deciding as to this point, has taken occasion to call attention of the Engineering department to existing conditions, and has proffered its aid and co-operation in any efforts which might be made to better conditions.

In several cases, I have expressed the opinion that the lack of progress was so unsatisfactory as to warrant the State Engineer in certifying the contracts to the Canal Board for suspension or cancellation. In several such cases, I have been of the opinion that the State Engineer and Surveyor erred in his judgment when he has concluded not to so certify, but in reaching such decision I believe he had been guided by reasons which to him seemed sound and convincing. It has been argued that in such cases, the delay which would ensue as a result of the cancellation of a contract, such process rendering a revision of the plans and a readvertising of the work necessary, would be so great as to offset the better progress which might be expected from new contracting interests.

There has been the other feature also present when such matter is considered, namely, the litigation which might ensue and the increased cost to the State of the work on this account. In the case of some recalcitrant contractors the State Engineer and Surveyor has believed with me that the work was not progressing as it should be progressed and suggestions have been made that the proper course to pursue would be to suspend the contract and have the work completed by department forces. For several reasons I have been reluctant to advise this course.

In the first place, the same litigation feared as developing in the other case would be present, and what is more serious, while the statute and the contracts specifically provided that the work may be suspended and completed by department forces, nowhere do the statutes make provision for furnishing the Superintendent of Public Works with adequate forces for the progressing of such improvement work. Where work under contract is taken from the contractor and progressed by the State, it should be done only when there was full assurance that a better progress could be made by the State, and while the State would not be handicapped in the matter of funds, the cost of any such work being chargeable against the contractor and his bond, in the matter of forces the department would be required under the statute to select foremen, superintendents and other important men making up the force from Civil Service eligible lists. Under such conditions, the responsible authority ought to be able to go into the open market and get the very best and most experienced men just as a contractor would be able to do, paying such compensation as might be necessary to command the services of proper assistants.

After all, these matters of delay to progress are only of judgment. I suppose Hope springs eternal in the breast of the Engineer the same as it does in any other human breast, and for this reason the State Engineer has been hoping that a better progress would be made, and that, all in all, though conditions are not satisfactory, the State might lose rather than gain by the taking of extreme measures.

As to the character of the work, in my judgment there are few, if any cases where work of a deficient nature has been done which either has not been replaced or repaired, or which cannot be and which in the nature of things will be insisted upon being done before the work is passed upon for final acceptance.

One of the most serious features is the early completion of certain structures long before such structures in the nature of things can and will be placed in commission, and the proper preservation of such structures presents an important, if not a serious problem to be dealt with.

Finally, you ask me, by inference at least, to submit suggestions as to changes which might be made to advantage in the conduct of this work.

I am aware that commissions are not popular, and, generally speaking, are not considered an economical means of conducting public business, and, generally speaking, I would not contest this point, but in the case of so great an undertaking as the Barge canal work, it is my judgment that some method should have been devised which would have guaranteed a continuity of the work under a head of recognized ability, and a separate commission for this purpose is the only method I can conceive that would guarantee such results.

I am aware that the framers of this act had the necessity of some such system in mind and that they believed they were furnishing this when provision was made for an Advisory Board of Consulting Engineers, and when later, provision was made for continuing such engineers in charge during the continuance of the work. The weakness of this plan, however, lies in the fact that the advisers are made continuous, whereas the responsible, conceiving and directing force is left changeable, with the results already pointed out, of already having given the work four such separate directing heads.

I have spoken of the inadequacy, as it seems to me, of the compensation provided for one charged with the duties and responsibility of conceiving and directing so large an undertaking.

If a commission composed of three members, the chief of whom should be required to be an engineer, one of whom should be a broad-gaged, experienced man of affairs, and the third an experienced and well qualified attorney, could have been provided and salaries made adequate to command the services of the very best men obtainable, provision being also made for such commission to remain in continuous charge until the completion of the work unless removed for cause, I believe far better results would be attained.

I am aware that it has been pointed out there is constitutional prohibition to such course on account of the powers with which the Constitution clothes the Superintendent of Public Works and the State Engineer and Surveyor. If, however, the constitutional provisions cited should be so narrowly construed, it seems to me they already have been violated in the matter of the authority granted to the Advisory Board of Consulting Engineers.

If, however, such constitutional prohibition does exist, it would seem to me that this objection could have been met by the creation of a commission of five members, of which the State Engineer and Surveyor and Superintendent of Public Works should be *ex-officio* members, retaining to the Superintendent of Public Works certain prerogatives as regards contracting for work, and retaining to the State Engineer and Surveyor certain prerogatives as to the preparation of plans, but rendering the commission as a whole the controlling power. By this means, though the personnel of the Superintendent of Public Works and the State Engineer and Surveyor might change biennially, the majority of the commission would be continuous and there would not be the revising and the new viewpoints shown to be present in the system that has been followed.

Where there is full authority, full responsibility is easily placed, but where there is a division of authority, it is difficult to place responsibility.

If it be urged that such system would tend to increase the cost to the State for doing the work on account of engineering, I would cite the fact that up to Nov. 1, 1910, there has been paid for advisory engineers' salaries and expenses, since the beginning of the work, the sum of $257,482. There was paid up to Nov. 1, 1910, for other engineering, including the making of surveys, the preparation of plans and the supervision of work, the sum of $4,150,406.

Delay in final completion of this improvement is not the only objection to be urged against improper progress. It is fundamental that the longer the period of construction in the case of anv undertaking the greater the percentage of cost for engineering and supervision.

You will, I believe, understand that none of the seeming criticisms which this communication contains are directed against any individual or collection of individuals or officials who have had to do with this work from its inception. I believe very largely the men having to do with this work have been imbued with a high sense of duty and have taken a just pride in being officially connected with the work. Such criticisms as are contained, or seemingly implied, in this communication, when it comes to last analysis, apply, as I believe you will see, to the manner and methods embodied in the authorizing statute.

In your letter to me you express the fear that the total cost of this work "may exceed the original estimate of $101,000,000 as a result of litigation and damages." The question of final cost is one which at this juncture should be capable of fairly accurate and reliable estimation and determination, but since this is almost wholly an engineering and legal question, I shall not attempt to go into the subject further than to give the data at hand:

[illegible] amount to	[illegible]
[illegible] will amount to	[illegible]
The work for which [illegible] cluding all work of whatever nature, is estimated to cost	[illegible],000,000
Total	[illegible]
[illegible] payments to contractors and payments [illegible]	[illegible]
The total awards [illegible] through the Canal Board on settlements made [illegible] and Appraisal [illegible]	[illegible]
The total amount of recoveries on account of damages [illegible] Court of Claims is....................	989,175
Taking the awards thus far made, namely, $989,175.61, on the total of the claims ($6,574,553.93), gives a percentage of awards of about 15 per cent; and assuming that this percentage is a fair basis for consideration and that the claims thus far adjudicated as a whole are representative of the claims still pending, and applying this percentage to the amount still claimed, gives, as the probable future award or recovery of undetermined claims	[illegible]
Total	[illegible]

The amount of recoveries made through the Court of Claims represents claims whose amounts as originally filed aggregated $6,574,553.

The seemingly large total of settlements through the Canal Board arises from the fact that the larger claims, growing out of the appropriations of railway lines or sections of lines, which have resulted in the building of detour lines, such as that at Niskayuna, Rome and other places, have been settled through this board.

The larger claims in the Court of Claims which have been and still are being contested are those for damages on account of interference with water power. One important case which has been regarded as a test case is now on appeal and of course much depends upon the final outcome of this case, but all those having to do with this improvement, including the Attorney-General and his assistants, who have given these cases exceedingly close study and the greatest care, are extremely hopeful that the State's position will in the end be upheld by the Court of Appeals, in which event the final cost to the State on ac[illegible] dollars below what otherwise would be the result.

[illegible] work for which plans are in progress and not [illegible] which ultimately may be eliminated from consideration. Besides including terminal and harbor at Syracuse, which was provided for [illegible] 1903, and a harbor and basin at Rochester, it includes basin improvements at Albany which were provided for in the original estimate in connection with the improvement of the so-called Albany level of the Erie canal, but which latter improvement, it is under[illegible] projected terminals which would render such improvement unnecessary and useless.

This estimate does not include the reconstruction of highway and railway bridges which originally were estimated for in the construction account, since it has appeared to me these should be embraced not in the construction account but in the damage account. In round numbers this amounts to upwards of $4,000,000. The attitude of the State officials having to do with this contract work, however, has been, briefly, that the streams to be canalized were State highways, in the sense of the State's owning fee to the bed of the streams, and that therefore the cost for recon[illegible] the railway companies. In pursuance of such decision the Superintendent of Public Works has from time to time, as the completion of plans and progress of work required, officially ordered railway companies operating their lines over such rivers and streams to alter and reconstruct their bridges in such manner as to conform to Barge Canal dimensions and afford navigable conditions without expense to the State.

The question as to whether the State's position in this regard is correct is now before the Court for determination. It is a very important question and one upon which, from Court decisions already had, the Barge Canal act seems to have been deficient, but if so, it is not too late to have these deficiencies corrected. In my annual report I shall speak specifically of this matter and shall recom[illegible] if any exist.

[illegible]

The canal duties and responsibilities of the various State officials are herewith briefly stated.

State Engineer and Surveyor: Has general executive charge, and makes the surveys, maps, plans and specifications for the work to be done, ascertains quantity and quality of materials to be used with detailed estimates and cost of the same; makes all measurements, inspections and estimates as to amount, character and quality of the work done and material furnished; also has many other minor duties, and is a member of the Canal Board and Barge Canal Terminal Commision

[illegible] tises for, opens bids received and awards contracts. Has power to suspend the canal contracts under certain conditions, and right to complete or relet the work. Pays estimates to contractors and has to approve of contract work done before making final payment. He [illegible] Barge Canal Terminal Commission.

Advisory Board of Consulting Engineers: [illegible] timates and all proposed alterations and changes in contracts, examines and reports [illegible] items of cost for all railroad and trolley changes necessary by canal construction. Makes frequent and generally monthly field inspection of all contract work, reporting to the State Engineer all defects noted in either workmanship or material used, and changes deemed desirable. Chairman is a member of the Barge Canal Terminal Commission.

Canal Board: Consists of all the elective State officers, with the exception of the Governor, and in addition thereto, the Superintendent of Public Works. It takes final action on all plans and estimates and its approval must be had before any item of work is placed under contract, and its assent must be obtained for any changes involving additional cost to the State or before any contract can be suspended. Each official has also particular canal duties which relate directly to his department.

The division of authority and responsibility among the State officials having charge of Barge canal matters by statutory enactment by the Barge Canal Act, was purposely made after thorough study and consideration with a view of securing honest administration. While this division of executive authority and responsibility is at times somewhat awkward and a cause of delay, yet on the other hand it has certain marked advantages in giving two executive heads besides the Canal Board and the Advisory Board to consider important questions, a better supervision and oversight and a triple guard in finally fixing upon plans, purchasing lands, letting contracts, inspecting and accepting work, and paying for it from month to month and when finally completed. It is especially valuable on account of the frequent changes of executive officials in charge brought about by political upheavals. During a preceding administration this "divided authority and responsibility" in one instance alone resulted in saving to the State a sum of fully $500,000. This saving was initiated through the instrumentality of the Advisory Board.

We do not look upon the existing system of administering the canal work as the ideal system, but it is doubtful if it can be improved upon under the present constitutional requirements. It would be of great value to the State if it had a permanent engineering organization carefully selected and free from politics and political changes with which to intrust all its work of public improvement and maintenance. To create such an organization and intrust the public works of the State to it would require material changes in the Constitution, but it is believed to be well worthy of consideration when the time comes for remodeling the Constitution. But the State has no such non-political organization and it seems to be necessary under the terms of the State Constitution to put the canal work in the hands of both the Superintendent of Public Works and the State Engineer. These two officers have brief tenure of office and it is believed it would be a very serious mistake to give the unrestricted charge of the construction work of the Barge canal improvement to any one man selected for so brief a period as two years. This was shown very clearly in the administration of the $9,000,000 canal work in 1895 and 1898, which was practically in sole charge of a single official and was so strongly criticised by examining boards and the public as to be the prime cause of the administration of the Barge canal work being placed where it is at present by the terms of the Barge [illegible] belief that whatever differences in authority and administration have arisen in the conduct of the work the final result has been on the whole to the advantage of the State.

The really serious defect of the present administrative system of the Barge canal work arises from the frequent changes of officials in control of it. Since starting the work there have been four State Engineers and three Superintendents of Public Works and four Canal Boards, differing in personnel and of varying political faiths. On January 1 next there will be a change in the State Engineer, Superintendent of Public Works and in the personnel of the Canal Board. Such changes militate against the best administrative results, and they would be almost fatal were it not for the fact that the original Barge Canal Law provided for a permanent element in the administration of the work—the Advisory Board of Consulting Engineers. This Board has been in continual existence since the work started and while its functions are entirely advisory, has been of the highest value to the work, studying and passing upon canal location and all plans and features thereof, and the alterations and extra work connected therewith, the lands taken, the monthly estimates for payment, the many and complicated questions connected with water power rights, bridges, equipment of locks and other structures, etc., and by going over the work and keeping in touch therewith. It may not be out of place to state that a member of the Advisory Board, while engaged in preparing the Barge Canal Act to be considered by the Legislature, had several interviews with the then Governor of the State, who strongly desired to place the work in the hands of a permanent commission or headship with power to carry it out, but after full and careful consideration he came to the conclusion that it had to be placed in the hands of the Superintendent of Public Works and the State Engineer under the requirements of the Constitution, and to get the benefit of a permanent commission he accepted the plan of an Advisory Board of Engineers which on his recommendation was made permanent by legislative action during the continuation of the work.

Giving full consideration to the lessons of the past and the chances and prospects of the future under existing constitutional requirements, we believe that it is not desirable at this stage of the work that there be any change in the administrative system under which the canal work is being carried on. The Board believes that the present system, while cumbersome in some respects does and will in its final result succeed in guarding the work and having it carried to completion in a good and economical manner and within the appropriation.

The character of the work, in some details, is not all that could be desired. This generally is chargeable to inexperience and not to deliberate wrong doing. As the force gained experience the work is of a better grade, and as a whole compares favorably with other large constructions. While some of the work presents a bad appearance, it is believed that little or none of it is of such a character as to impair its safety or lasting quality.

The status of the Barge canal work may be briefly stated as follows: As of Dec. 1, 1910, there are in force 73 contracts. The estimated cost of these contracts made up in 1903 aggregated $69,500,000. The actual contract costs, including alterations or changes now in force, amounts to substantially $67,600,000, or about $1,900,000 less than the amount estimated for said work in 1903. In addition to the foregoing, 6 contracts are now advertised. These contracts aggregate $5,500,000. So that at present there are contracts let and advertised amounting to about $73,100,000. There are yet to be let 11 contracts representing an aggregate of $3,000,000. There is also required for railroad and highway changes, railroad and other bridges, the construction of the basin at Albany, operating machinery, etc., work to the estimated value of about $7,300,000, thus bringing the total construction costs up to about $83,400,000. It will be seen, therefore, that 80½ per cent of the construction work inferred by the Barge Canal Act is now under contract, and that an additional 6½ per cent has been advertised, leaving but 13 per cent yet to be constructed, which, if let at as reasonable figures as the above 87 per cent shows, the total expense of constructing the original Barge canal will be about $98,800,000 or about $2,200,000 less than called for in the original Barge Canal Act, notwithstanding the fact that [illegible] ft. at an added cost of $3,306,000; that the 18-mile level from Lockport to Tonawanda has been lowered 6.5 ft. (which change was of great benefit to the State) at an added cost of $462,000; that by special act of the Legislature the harbor at Syracuse is to be improved at quite considerable added cost, and that in the Mohawk valley eight dams, originally estimated as timber fixed dams, have been supplanted by a better type of movable dam constructed of steel which will better regulate the floods in said valley. A harbor at Lockport has been provided and numerous turning basins on the Rochester and Lockport level. All of the above changes have cost upwards of $4,000,000 but this added amount is included in the 80 per cent of work already let, hence it is conservative to believe that all of the work can be constructed within the estimate of 1903.

Physical status of work: There are 14 more or less important contracts out of 73 that are sensibly behind their theoretical percentage of completion at this date. These are behind from various causes, chiefly lack of capital, improper equipment or incompetent management. In three instances these contracts have been relet and are being carried on either by bondsmen or by new contractors. It should be remembered, however, that all of these contracts will be finished before those let later, and therefore the fact that they are behind does not delay the completion of the entire canal work. Again referring to physical conditions it is proper to record the fact that, as a whole, the work has been well done. Under date of June 15, 1910, the Superintendent of Public Works addressed to former Governor Hughes a report on the physical status of certain contracts, in which he criticised the matter of some embankment construction, the surface finish of certain concrete, etc. None of these matters were serious and a reply to the Superintendent's criticisms was made by the State Engineer under date of June 25, 1910. In this connection it should be noted that the Board does not believe that any State official has contemplated that work not done according to specifications should ever be finally accepted or paid for, and that where minor defects exist they will ultimately be remedied at the contractors' expense and before the account is finally settled. The contracts provide for the retention of 10 per cent of estimates of work done to meet such contingencies.

In considering the present status of the Barge canal construction weight must not only be given to the frequent changes in administration and executive heads referred to, but to adverse climatic conditions which most seriously affect the orderly progress of the work, so that as far as contractors are concerned they can advantageously pursue most of the work only from eight to nine months in the year. This obviously involves more or less lost time, loss in the interest account, deterioration of plants, also serious delay in the progress of contract work, not only because of the actual loss of working time, but because of the necessary breaking up of efficient labor and operating organizations in the late fall and the recruiting of the men in the following spring. For instance, an examination of the progress of contract work the past year will show a continually increasing percentage of work done from June to November, and then the approach of the winter season made it necessary to virtually disrupt contractors' organizations. Under milder climatic conditions the work would have continued with increasing efficiency at least up to January 1st; and in locations such as New York city proper, or points south of Washington could have been continuous.

The following table shows the amounts earned by the contractors for each year during the progress of the work from January 1, 1906:

All work done previous to Jan. 1, 1906	[illegible]
During the year 1906	[illegible]
During the year 1907	[illegible]
During the year 1908	[illegible]
During the year 1909	[illegible]
During the year 1910	9,808,685
Total	[illegible]

From the above it will be seen that the work in 1906 was double that done in all previous years; that in 1907 more than three times the work of 1906 was accomplished, and that in 1910 more than four times the work of 1907 was accomplished, and it is our belief that with substantially the entire work now under contract the amounts earned by the contractors for the next two years will be at a maximum of about $20,000,000 each year.

On the whole, the work can be considered as progressing satisfactorily at the present time. There has been much delay in preparing plans and getting work under contract. This has been brought about by the great magnitude and exceedingly complicated character of the work but principally by the many changes in the office of the State Engineer. This official has been changed every two years and a considerable portion of each term had had to be expended by the new State Engineer and his new principal assistants appointed by him, studying into and becoming acquainted with the work. Now, however, that practically the whole work is under contract, there is no good reason why it should not go forward rapidly to completion, and it is difficult to see how any administrative change could operate to expedite the work.

PERSONALS.

Mr. Freeman Bloodgood, who was for many years a prominent building contractor of New York city, died at his home in Westfield, N. J., on Dec. 27, at the age of 91.

The Pennsylvania Railroad Company has announced the consolidation of its engineer of branch lines department with the chief engineer's department. Mr. Joseph U. Crawford, engineer of branch lines, is appointed consulting engineer of the company, and his chief assistant, Mr. Horace C. Booz, is appointed assistant chief engineer.

Prof. J. D. Newton of the University of Kansas has been appointed dean of the new department of engineering at Loyola University. He is a graduate of the Holy Cross College and of the mechanical engineering department of Cornell University. He served in the engineer corps of the U. S. Army during the Spanish-American war.

Dr. N. Clifford Ricker of the Department of Architecture of the University of Illinois has been appointed a member of a commission of awards to judge and to report upon the relative merits of the designs and plans submitted in competition for three department buildings to be erected in Washington, D. C. The commission began its sittings on January 4.

Mr. Clarence T. Johnston, state irrigation engineer of Wyoming, has been appointed professor of surveying in the University of Michigan. Mr. Johnston was graduated from that institution in 1895 and received the degree of civil engineer in 1899. A short time ago he spent two years in Egypt making investigations of irrigation problems for the U. S. Department of Agriculture.

Mr. J. E. Schwitzer, at present Assistant Chief Engineer in charge of the western lines of the Canadian Pacific Ry., has been appointed Chief Engineer of that system, with headquarters in Montreal. In addition to his duties as Chief Engineer, Mr. Schwitzer will act as consulting engineer for the subsiding lines. Although no announcement has been made, it is surmised that Mr. J. G. Sullivan will be appointed to fill the vacancy on the western lines.

Mr. R. Forrester, consulting engineer of the Denver & Rio Grande Ry., died in a hospital in Seattle, Wash., on Dec. 30, of cancer of the stomach. He had been connected, directly or indirectly, with that company for over 20 years, being for a portion of the time an official of the Pleasant Valley Coal Co., a subsidiary of the Denver & Rio Grande. He was well known among Colorado railway men, and possessed a wide reputation as a geologist, mineralogist and mining engineer.

At the annual election of the Western Society of Engineers the following officers were chosen for the year 1911: President, O. P. Chamberlain, chief engineer, C. & I. W. R. R., Chicago; first vice-president, W. C. Armstrong, terminal engineer, C. & N. W. Ry., Chicago; second vice-president, C. R. Dart, resident engineer, Sanitary District of Chicago; third vice-president, Ira O. Baker, professor of civil engineering, University of Illinois; treasurer, Albert Reichmann (re-elected), resident engineer, American Bridge Co., Chicago; trustee, Ernest McCullough, consulting engineer, Chicago.

Mr. F. H. Clark, who has been for the past five years general superintendent of motive power of the Chicago, Burlington & Quincy R. R., has resigned to accept a similar position with the Baltimore & Ohio R. R., succeeding Mr. J. D. Harris. Mr. Clark is a graduate of the University of Illinois. He began as chief draftsman with the Burlington in 1894, and advanced through successive stages until made general superintendent of motive power in 1905. He is succeeded by Mr. F. A. Torrey, general superintendent of motive power for Lines East. Mr. Torrey is succeeded by Mr. J. W. Cyr, master mechanic at Hannibal, Mo. Mr. W. C. Walz is appointed to the position at Hannibal.

Mr. Gustavus C. Henning, for many years a prominent consulting engineer and an authority on iron and steel, died at his home in New York City on Dec. 30. He was born in Brooklyn, N. Y., in 1855. He received his education at the Brooklyn Polytechnic Institute and the Stevens Institute of Technology, graduating from the latter institution in 1876. He began his professional career as an inspector under the late William Hildebrand on the construction of the Brooklyn bridge. He traveled extensively abroad introducing American testing machines, some of which were of his own invention. He was a member of the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Society for the Advancement of Science, and of a number of international scientific and technical societies.

CONTRACT NEWS SECTION

ENGINEERING-CONTRACTING

A Couple of Knights.

Up in Canada when a man does great things, such as making a [illegible] or building a great system of railroads, the king rewards him by making him a knight. It doesn't cost the king anything and it shows that he keeps an appreciative eye on the efforts of his subjects. All of the great railroad systems of Canada now have a knight on their staff, the latest addition being the Canadian Northern, with Sir William Mackenzie and Sir Donald Mann, Knights Bachelor. Both Mackenzie and Mann are practical railroad builders. They began by building railroads for other people, and now they are building railroads for themselves. Mackenzie started out as a school teacher; he didn't like this work and so went into the lumber business. He ran a saw mill for a while and then took up railroad contracting. His first contract was on the Grand Trunk, in the building of the Toronto & Nipissing and the Victoria Divisions. Later he had a contract in connection with the construction of the Canadian Pacific Ry. through the mountains of British Columbia. After this he became connected with the company which constructed the Calgary & Edmonton, the Regina & Long Lake, the Canadian Pacific short line through Maine and the Hudson Bay Rys. It was his work on these undertakings which inspired the conception of the Canadian Northern Ry., a system that is now within sight of completing a line from end to end of Canada. Mann began his contracting work in 1880 on the Canadian Pacific, and he worked continuously on contracts between Whitemouth and the Selkirk Mountains until 1885. The next year he entered into a partnership with Mr. MacKenzie and since that time the firm has built several important railroads. In 1895 Mr. Mann took the initiative in purchasing the charter of the Lake Manitoba Railway & Canal Co., from which has grown the Canadian Northern Ry. We can give no better summing up of the personality of these newly made knights than to quote the simple statement of an old-time contractor who has worked with them on their contracts in Canada. Said this contractor: "When they were bossing a bunch of mule skinners they were just plain Bill Mackenzie and Don Mann, and I know blamed well that if any of us old-timers floated up to Toronto to-morrow, they'd lay aside their blooming swords and hang up their sirs, and it would be plain Bill and Don, just as it was in the days when they were piling up the estimates on the C. P."

Putting Down Piles and Raising Bore Casings.

The following method of putting down piles by the aid of a water jet was used with much success by a Southern contractor. The piles were being sunk in soft ground, but some little difficulty was encountered in getting them down. Finally the foreman decided that he would put some weight on the pile in order to make it sink faster. One of the gang engaged on the work was a man weighing some 300 lbs. On account of his weight and the fact that he was not a very hearty worker, this man was unanimously elected to serve as pile driver. A board was nailed to the pile and the man boosted to the improvised seat. He then embraced the pile lovingly with his arms and legs, the men see-sawed on the ropes to churn the pile, the water jet was applied and the pile sunk easily. The process was repeated with much success and practically all of the piles were put down in this way.

[illegible] interesting as the above method of putting [illegible] gravels in the bed of the Aruwina River in [illegible] were being carried out from pontoons. It was necessary, for economy's sake, to recover the casings on the completion of each bore hole. The ordinary method of hammering up the pipes could not be employed, as through a series of transport disasters certain necessary mountings were missing, and to screw them up with jacks was too slow. Accordingly the following method was employed: A wide flanged collar was bolted round the casing and screw jacks placed under the collar. Next 70 to 80 natives were crowded onto the pontoon, which sunk bodily about a foot, the jacks meanwhile being kept screwed up tight. Before the decks were awash the weight was removed by the simple process of all hands jumping overboard, when up came the casing sometimes with very little grinding, but generally quite easily. This process was repeated until the pipes were loose enough to be pulled direct. This method, it may be remarked, is only applicable to rivers in which there are no alligators.

How the Dollar Is Spent

Most citizens think of the annual city budget as simply a bunch of figures [illegible] running the city government the next year will be greater than it was the last year. In New York City, thanks to the Bureau of Municipal Research, the citizens have a clearer idea of the question than they formerly had. The budget of New York City for 1911 calls for the expenditure of $171,079,335, this sum representing the fixed expenses of all the city departments, the courts and the county government. It does not include subways or special improvement work that may be started during the year. In order to show how this immense sum is to be expended the Bureau of Municipal Rerearch has prepared a chart showing how each dollar of taxes is appropriated to the various departments in defraying the budget expenses. As it may be of interest to show the part the maintenance of public work departments in New York City play in eating up the city budget, we will give the figures shown on the chart. To illustrate we may take a pie costing $1, and divide it into sections representing the part that goes to each department. Then in New York City [illegible] vice, that is, to paying interest on city bonds and corporate stock and redemption of bonds. This piece of the pie costs 29 cts. The next largest piece goes to the Board of Education and represents 17 cts. in each dollar of taxes. The Police Department gets the next largest piece, costing 9 cts. Next comes the Fire Department with a 5 ct. piece, and then comes the Borough Presidents' departments with a piece costing 4.5 cts. The Borough Presidents' departments, it may be noted, have charge of the repairing and maintenance of streets and sewers. Next comes the Street Cleaning Department, which gets a 4 ct. piece, as does the Department of Water Supply, Gas and Electricity. Charitable institutions, which includes hospitals, asylums and other institutions that receive money from the city, get a section costing 2½ cts., and the Department of Public Charities, which includes the various institutions maintained by the city, gets a 2 ct. piece. The Department of Parks also gets a 2 ct. section. For the Department of Docks and Ferries a 1½ ct. piece is allotted, and the Department of Health gets a similar section. The remainder of the pie, or a piece valued at 18 cts., is divided up among the remaining city departments.

The Doings of the Week.

The Canadian Northern Pacific Ry. (a Mackenzie & Mann project) opened bids Dec. 30 at Vancouver, B. C., for clearing, grubbing, fencing, grading, bridging, etc., for that section of its line from Victoria, B. C., 20 miles westerly.

Several good sized railroad construction contracts have been let recently, among them being the following: Will Ireland, Maysville, Ky., for constructing bridges and grade for the double track between Lawrence Creek and Foster, Ky., for the Chesapeake & Ohio Ry., the contract being reported to amount to over $1,000,000; Callahan Construction Co., for 16 miles of work on the Lexington & Eastern Ry. near Whitesburg, Ky., the contract including some mountain rock work, team work, stone box culverts and concrete masonry; the Utah Construction Co., Ogden, Utah, for completing the line and yards of the Porterville Northeastern R. R. in California, the contract including several miles of heavy rock work.

A considerable amount of new station and building work is being planned for the coming spring by various railroads. Among the largest of these projects is a new union station to be erected at Detroit, Mich. Plans for the station, which will cost about $3,000,000, are now being prepared by Reed & Stem, architects, St. Paul, Minn.

A Southern project which seems likely to offer much construction work in the near future is well advanced. This work is to be done near Birmingham, Ala., by the Dauphine Island & Tidewater Syndicate. The plans include the building of a railway and the construction of deep water terminals at Dauphine Island. The total expenditure of the syndicate will be about $8,000,000.

Bids were opened Dec. 30 at Portland, Ore., for a large bridge substructure contract. Five bids were received on the work and unofficial reports state that the contract will probably be awarded to the Union Bridge & Construction Co., Kansas City, Mo., at a bid of something like $600,000. Bids have also been received at Peoria, Ill., for the construction of the new bridge over the Illinois River at Bridge St. This work was readvertised, the new bids to be opened at 8 p. m., Jan. 21.

Two large drainage districts in Cameron County, Texas, are getting ready to have construction work started this year. One of these districts, Drainage District No. 1, is planning to sell $204,500 of bonds this month, so as to be ready to call for bids for construction work. The other district is less far along, as surveys for it have just been started.

A distance record for aeroplane flight has been established by Maurice Taubteau, in contesting for the 1910 Michelin trophy. In a continuous flight of 7 hrs. 45 min., he covered 362.7 miles. In 1909 the trophy was won by Henry Farman by a flight of 150 miles.

On Dec. 20, 17 shovels working in the Culebra construction district of the Central Division of the Panama Canal, excavated 27,199 cu. yds. of rock and earth during the working day of eight hours, an average per shovel of 1,600 cu. yds. The shovels were under steam 136 hours and were actually at work 90 hours and 5 minutes.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

The Dauphine Island and Tidewater Syndicate is planning to have work started shortly on the construction of the Tidewater R. R. and the building of deep water terminals at Dauphine Island. The latter work will be done by the Dauphine Island Ry. & Harbor Co., of which Capt. T. W. Nicol, Mobile, Ala., is Chief Engineer. The total expenditures of the syndicate will be about $8,000,000. J. M. Dewberry, Birmingham, Ala., is interested.

The Union Springs & Northern Ry., W. M. Blount, President, Union Springs, Ala., is understood to have its plans well along for building its proposed extension into the Birmingham District.

The place of business of the Washington & Choctaw R. R. Co., the incorporation of which was mentioned in our last issue, is to be at Yellow Pine, Ala. The incorporators are J. W. Gilchrift, George T. Baker, J. T. Burlingame and S. H. [illegible].

It is believed here in Bessemer that the Birmingham Southern R. R., J. B. McIntyre, Chief Engineer, Ensley, Ala., will, early this year, begin work on large yards near Bessemer on 19 acres of land purchased from the Bessemer Coal, Iron & Land Co. some time ago. The yards have been staked off and as the new line will soon be operating between Bessemer and Ensley, it is thought that the company will at once begin work on its terminals to handle the number of cars that will be hauled over the line.

Location work has been completed for the railroad from Selma to Bessemer, a distance of 75 to 80 miles. Field work was started in October and the work was really a relocation of the old Selma & Cahaha Valley R. R., which was projected along in 1887. George H. Clark, Birmingham, Ala., is the engineer.

Arizona.

An engineering crew under supervision of L. H. Long, Chief Engineer of the Arizona Eastern lines, Tucson, Ariz., is working between Hayden and Winkelman, about 50 miles north of Tucson providing for a material cutoff by relocating the line. The west end of the cutoff will start in the vicinity of Burns station, and the new line will be located some distance back from the Gila river, and well up into the hills. Just where it will intersect the main line of the Phoenix & Eastern has not been determined. It is presumed, however, that it will verge back and connect at Winkelman. The cutoff is being designed to furnish means for handling the tailings from the Ray Consolidated reduction works at Hayden which, it is expected, will be in operation by February 15.

Reports sent in from Yuma, Ariz., state that surveyors of the San Diego & Arizona railroad have been at work recently on the west side of the valley changing the location line from the mountains to the west side canal to avoid some broken ground. The new line runs south from Coyote Wells and strikes the canal about a mile south of the bridge instead of a mile north and thence runs northeasterly to the crossing of New river. This is probably the final location. The surveyors began work on a tentative line from the mountains to Calexico but abandoned the survey after a day and a half of work because of the im-[illegible]

California.

⊙The Utah Construction Co., Ogden, Utah, has been awarded the contract for the completion of line and freight yards of the Porterville Northeastern R. R. Most of the grading work will be light, but between [illegible] and the Springville terminus, there are several miles of heavy rock work.

Announcement has been made that the Northern Electric Ry. Co., of Chico, is planning to go ahead with the extension of its line from Chico to Red Bluff and Redding. Surveys and rights of way have been obtained from Chico to Red Bluff and six miles of road have been graded through the Los Molinos section. The citizens of Red Bluff are making inducements to the Northern Electric to build to that city at once.

A. M. Erickson, a cousin of the late Charles Erickson, of the railroad contracting firm of Erickson & Petterson, San Francisco, has been appointed as Superintendent of the construction work the firm has under way on the Southern Pacific cut-off between Rocklin and Clipper Gap. Gust Petterson will have the general supervision of the contracts under way by the firm in various places. He has been in Oregon for some time, supervising the big contract on the Klamath Falls-Natron line of the Southern Pacific. His partner, Charles Erickson, was the General Superintendent up to the time of his death. The firm will continue to be conducted under the name of Erickson & Petterson, the estate of the deceased senior member of the firm still holding his interest in it.

Proposition has been made to the Park Commission of San Francisco by Willis Polk, an architect with offices in the Merchants Exchange Bldg., San Francisco, to construct a beach railroad along the ocean beach from the Cliff House to Sloat Boulevard. The plan proposes the construction of a 3 ft. gage road three miles long, double tracked, the cars to be operated either by storage battery or with gasoline.

The Northwestern Pacific R. R., W. C. Edes, Chief Engineer, San Francisco, is said to be planning to award a contract shortly for closing the gap in its line between Eureka and San Francisco. The Utah Construction Co., Ogden, Utah, which was awarded a contract for work on this road some time ago, will probably employ 3,000 men this sumer, and has already let the contract for tons of supplies in addition to several carloads of meat.

Colorado.

Advices from Pueblo state that the Pueblo & Southeastern R. R. Co., mentioned in our last issue, has made preliminary surveys for a line from Pueblo southeasterly to the new town of Wilson, in Pueblo County. Location surveys are to be started shortly and active construction work w'll be taken up at an early date. The directors of the railroad company are B. H. Tallmadge, F. C. Tallmadge, C. L. Tallmadge, E. W. Waite and F. L. Hunt, Jr.

The Costilla Estates Development Co., F. E. Shafer, General Manager, Denver, is planning to extend its railroad to several portions of its 500,000 acre tract in Southern Colorado. At present the company has a line of railroad, 30 miles long, extending from San Acacia to a point near the New Mexico line to Costilla county.

The Rangeley Construction Co., of Denver, has grading work well along on the Grand Valley, Meeker & Salt Lake R. R. between Chapman, the point where the new road connects with the joint track of the Denver & Rio Grande and the Colorado Midland. It is estimated that 20 miles of grading will have been done before spring, and that the road will be graded into Meeker, 50 miles distant, by fall. William D. Lippett, Ernest & Cranmer Bldg., Denver, is president of the road.

Track laying has been started on the Pueblo to Walsenburg joint double track line of the Denver & Rio Grande and Colorado & Southern, and it is expected that by Jan. 25 20 miles will have been laid. This portion of the line will be put into immediate use. There remain 21 miles of the double track to be built, but as construction work on the remainder of the track is of the heaviest type, it is expected that grading and track laying will not be completed before September of this year. Work to the end of last year cost $1,250,000; the track yet to be built will cost in the neighborhood of $3,000,000.

Connecticut.

The Council Committee on Railroads of Hartford, Conn., has recommended the passage of a resolution requesting the Connecticut Co., Hartford, to consider the construction of a trolley line through Maple Ave., from Franklin Ave. to Fairfield Ave., in that city.

The Connecticut Co., New Haven, will, early in the spring, begin construction work on its trolley line through Lawrence, Foster and Canner, etc., in the 8th Ward at New Haven.

Georgia.

The Atlanta, Birmingham & Atlantic Ry., has acquired the Fitzgerald, Ocilla & Broxton R. R., a 41-mile line.

The Southern Ry. is said to be planning to lay new 70-lb rails on its line between Columbus and McDonough early this year.

The Chattanooga & Southern Ry Co., chartered on Jan. 3, with a capital stock of $20,000, is a subsidiary company of the Chattanooga Southern and will enable that company to secure a line from Chattanooga to Atlanta by way of Rome.

Idaho.

Preparations are being made to have work started this year on the projected electric railway from Malad, Idaho, to American Falls, a distance of 65 miles. A company of which W. M. Thomas, Earl M. Dives and Lewis Dan Jones, all of Malad, are the principal stockholders, has been formed and negotiations made with eastern capitalists. The proposed route as surveyed goes through the mountainous district north of Malad, thence through the head of Curlew valley, through Rockland and then to American Falls. The mountainous nature of the route will make the road somewhat expensive.

The Southern Pacific Co., Wm. Ashton, Chief Engineer, Salt Lake City, Utah, is planning to have work started in the spring on the building of 69 miles of railroad from Wood River to Camas Prairie. Residents of Camas Prairie have been assured that the line will be completed to that place by next fall unless something unforseen, such as a shortage of material, interferes.

Illinois.

Sheppard & Morgan, Engineers, Edwardsville, have started preliminary surveys for the proposed interurban through Madison, Bond and Clinton Counties. Franchises through most of the cities and towns through which the line will pass have already been secured by A. W. Crawford, Hillsboro, promoter of the enterprise.

The Bloomington & Normal Railway & Light Co., Bloomington, has filed notice of an increase of capital stock from $600,000 to $900,000.

The Southern Traction Co. has formally accepted the extension of time granted it by the City Council of East St. Louis. The company plans to have cars in operation in East St. Louis within six months. The terminals will be at Fourth street and Broadway in East St. Louis and at Third and St. Charles streets in St. Louis. Wm. E. Troutmann, East St. Louis, Ill., is President.

Norman Paulson and Charles Sauber, both of Lockport, Ill., are to engage in a contracting business. Mr. Sauber has been engaged in the line for some time, while Mr. Paulson has been connected with the Santa Fe road in connection with its track elevation work.

The Illinois Traction System (McKinley lines) is reported to be negotiating for the purchase of the Wabash, Chester & Western R. R., which extends from Mount Vernon to Chester, a distance of 50 miles. The McKinley interests completed a survey last summer which parallels the Illinois Central R. R. almost the entire distance between Cairo and

✣ **indicates work now open for bids.** ⊙ **indicates a contract let recently.**

East St. Louis. The line is now in operation between Cairo and Mounds, and it is said to be the intention of the promoters to resume the construction of the road as soon as weather conditions will permit.

The Chicago & Western Ry. (Chicago City Ry. Co.) Chicago, Ill., is to construct a new line on 56th Ave., Chicago, from West 63rd St. to 63rd Place, and on West 63d Place, from 56th Ave. to Stickney.

The Bedford Belt Ry., a former property of John R. Walsh, has been sold to the newly organized Chicago, Terre Haute & Southwestern Ry. The $250,000 capital stock of the former line had passed into the hands of Chicago banks in 1909 in the settlement of the Walsh affairs. Permanent officers of the new company have been named as follows: President, M. J. Carpenter, Chicago; vice-president, E. K. Boisot; treasurer, E. S. Young. The new securities in the reorganization of the property are now being delivered.

Indiana.

A bill providing cities with means for bringing about elevation of railroad tracks and the elimination of the city grade crossing will be introduced in the coming session of the state legislature.

A meeting is to be held in Brazil on Jan. 26 to take further steps for the organization of a company to build a traction line from that city to Jasonville. It is planned to have the line reach Coalmont, Howesville, Middlebury, Clay City, Saline City, Ashboro, Center Point, Asherville and Hoosierville. It is the plan to have the townships vote a 2 per cent subsidy, which will amount to about $125,000.

Iowa.

The plan of the Chicago, Burlington & Quincy R. R., W. L. Breckinridge, Engineer Maintenance of Way, Chicago, Ill., for the reconstruction of its tracks into the Keokuk Yards call for the building of a retaining wall about 1,000 ft. in length.

Advices from Clarinda, Ia., state that work on the Clarinda-Blanchard R. R., has been abandoned until the spring, as the work is nearly complete and the company has until June to place the road in operation.

The Rock Island System surveyors, it is said, have completed a preliminary line for the proposed extension from Des Moines to a connection with the Kansas City line at Allerton, Wayne county. It is said that right of way agents are in the field negotiating for the necessary land. As now understood the new line southward will diverge from the Winterset line at Carlisle, pass on to Dallas, in Marion county, where the company owns 6,000 acres of coal land, cross the Burlington road at Chariton and connect with the Kansas City line at Allerton. The proposed line is only sixty miles in length, counting the ten miles from Des Moints to Carlisle. As now located, it will traverse a territory much in need of transportation facilities, and give the Rock Island the shortest route from Minneapolis, St. Paul and Des Moines [illegible] Kansas City.

Kansas.

John S. Dawson, [illegible] Railroad Board, has filed a motion with the board asking that engineers of the Union Pacific be compelled to submit figures showing the cost of putting the Lincoln branch into shape for a through line to Denver.

Preliminary surveys are to be started shortly for an interurban electric railway to run south from Hutchinson to South Hutchinson, thence along the south bank of the Arkansas River on an air line to a point a mile east and half a mile north of Yoder, between sections 22 and 23, at school house in district 20. Here a half section line will be struck which will be followed due east, crossing the Arkansas river near the Haven bridge, passing a short distance south of Bland, and running due east to Patterson. From here the line will run on east to Sedgwich. T. J. Colbert, Indianapolis, Ind., is interested in this project.

The City Commissioners of Kansas City, Kan., have passed a new ordinance to provide [illegible] The line will be extended from 25th St., [illegible] Parallel Ave. to the city limits.

J. A. Hopkins, Wichita, Kan., right of way agent of the Midland Valley R. R., mentioned [illegible] Geuda Springs, which is owned by S. L. Ward, Wellington, Kan.

The Rock Island System is to furnish materials for the construction of a switch track and storage yards for the Soda Ash Company at Hutchinson, Kan. The work will be done by the latter company.

[illegible] construction of a new roadbed of smelter cinders on the Kiowa branch and it is planned to equip same with 75 lb. steel rails between Wichita and Kiowa, Kan., a distance of 86 miles. A. N. Beckett is Division Roadmaster.

It has been announced in Hutchinson, Kan., by F. T. Henninway, a promoter of the proposed Garden City-Liberal Ry., that on account of the unexpected delay in getting the bonus in one or two of the counties, work could not be started when planned but that the construction of the line will be taken up in the spring. It is expected to have the Garden City-Santa Fe section completed by June.

Kentucky.

⦿Will Ireland, Maysville, Ky., has been awarded the contract for constructing the bridges and grade for the double track between Lawrence Creek and Foster for the Chesapeake & Ohio R. R. The contract is said to amount to over $1,000,000.

⦿The Callahan Construction Co., Empire Bldg., Knoxville, Tenn., has just been awarded 16 miles of work on the Lexington & Eastern Ry., extending out from Jackson, Ky., in the southeastern portion of the state. The work is located near Whitesburg, Ky., and is comprised of quite a good deal of very fine mountain rock work, some team work, stone box culverts and concrete work. This is said to be a very fine piece of work and contractors who might be interested could communicate with the Callahan Construction Co., at its home office in Knoxville and in that way could get in touch with the General Superintendent, Mr. E. R. Keller, who will be in charge of and located on the work.

Surveys have been started for the projected electric railway from Murray, Ky., to the Tennessee River. The line will be about 16 miles long. N. Ryan, Murray, Ky., is interested.

The Louisville & Eastern R. R. (electric) [illegible] ville, Ky., President of the Louisville Ry. Co., and the Louisville & Interurban Ry. Co. The Louisville & Interurban R. R. and the Louisville & Eastern R. R. probably will be operated as one company in the near future, with an increased capitalization. The cost of the Louisville & Eastern to the Louisville & Interurban is $3,050,000 in round figures. Two million dollars of this sum was invested in [illegible] 000 in common stock. The purchase price at the commissioner's sale was $1,000,000. For this sum, all of the property of the Louisville & Eastern R. R. Co. is transferred to [illegible] about 49 miles of railway from Louisville to Lagrange and Shelbyville, all lands, buildings, [illegible] provements, fixtures, 15 passenger cars, six express cars, one motor car, one flat car and all other property. Twenty-two miles of track has been laid since Henry E. Glover was appointed receiver on Oct. 23, 1908. This track [illegible]

A meeting will probably be held in Paducah next month to take steps for the organization of a company to build an interurban [illegible] Ben Weille, Paducah, is interested.

Louisiana.

The Powell Lumber Co. is to extend the line of the Lake Charles Ry. & Navigation Co. from Edna into Kinder, six miles. D. A. Kelly, Lake Charles, La., is General Manager of the railway.

The Lafourche Valley & Gulf R. R. Co., of Donaldsonville, which projects a 90 mile line from Donaldsonville to Leesville, is reported to have been financed.

The Lake Arthur, Jennings & Northern R. R., which is now grading for a line from Lake Arthur to Elton, is said to be planning to continue the line to Alexandria, via Oakdale. The report states that the road will be completed to Elton by May 1 next, and that work will then be started on an extension to Oakdale so as to reach the latter place by Jan. 1, 1912. E. P. Fox, Lake Arthur, La., is General Manager.

Maryland.

Engineers of the Pennsylvania R. R. have been making surveys at Centreville, Md., with a view to finding the best route for a connecting link at that place for the Queen Anne's and Kent division of the road and the Maryland, Delaware & Virginia R. R.

The Hagerstown and Clearspring Electric Ry. Co. is to be granted a franchise to enter Hagerstown over West Franklin St. This company plans to build a line to Mercersburg by way of Clearspring. Maj. L. N. Downs, New York City, is one of the promoters. The incorporation of the company was noted in our Dec. 28 issue.

The Wicomico Electric & Power Co., which projects a 30-mile line from Salisbury, Md., to deep water, has completed its survey and has partly secured its construction capital. Construction contracts will be let very soon. M. V. Brewington, Salisbury, Md., is President.

Michigan.

The Detroit & Mackinac Ry., H. S. Waterman, Chief Engineer, East Tawas, Mich., is said to be planning to extend its Hillman branch as far as Atlanta next summer. The railway now has a large crew of men completing the construction work of the Rogers City branch and when this is done it is believed they will be transferred to the Hillman branch for work.

It is expected that plans will be completed this winter for the new $3,000,000 Union Station at Detroit, Mich., so that bids can be asked by March. Reed & Stem, Endicott Bldg., St. Paul, Minn., are the Architects. The construction work will be in charge of G. H. Webb, Detroit, Mich., Chief Engineer of the [illegible]

The Grand Trunk, according to reports, has been surveying the right of way with the view of building a double track from Detroit, Mich., to Durand, and an effort is being made [illegible]

Minnesota.

Construction work on the extension of the Canadian Northern Ry. from Virginia, Minn., to Duluth, on Dec. 31 was about 75 per cent completed. The contractors, Foley Bros., St. Paul, Minn., are required to have the work finished by Sept. 1, 1911, but will probably be in position to turn the road over before that date. Good progress is being made on the tunnel at Shortline Park, which is one of the heavy pieces of the construction. About 24 miles of track has been laid at the northern end of the extension.

It is believed that the Minneapolis, St. Paul & Sault Ste. Marie Ry. will be in a position, early this spring, to let contracts for its proposed extension from Frederic, Wis.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is said to be negotiating for the purchase of the logging road of the Itasca Lumber Co., to be used in connection with a new branch from the Duluth-Thief River Falls line north from near Portake Lake into the Cut Foot Sioux country and to Round Lake. [illegible]

Deer River into about the same district as the proposed new branch.

The Minneapolis & St. Paul Suburban Ry. Co., an auxiliary of the Twin City Rapid Transit Co., Minneapolis, which has control of the Stillwater, Minnetonka and other suburban lines, has filed with the secretary of state an amendment to its articles of incorporation, increasing its capital stock from $1,000,000 to $3,000,000.

Missouri.

The Southwest Missouri Electric R. R. Co., Webb City, Mo., has asked a franchise at Joplin to extend its lines from the junction of Main and 20th Sts., south to the city limits. The extension will be about one mile long and is to be completed in 12 months.

The construction of an electric interurban from Canton, Mo., to Memphis, Mo., is proposed. It is planned to use the old road bed of the Mississippi & Missouri River Ry., which was built in 1870 from Canton to Memphis, and which fell into disuse after one train had run over it. H. P. Taussig and J. M. Gore, St. Louis, Mo., are promoting the project.

The Iowa Southwestern Ry., A. H. Ross, General Manager, Manning, Ia., contemplates the construction of a connecting link between its 60 miles of road, extending from Manning, Ia., to Blanchard, from the latter place to Savannah, Mo.

St. Louis Items.

BY A. F. KOENIG.

The labor market in St. Louis is easier right now than it has been in years. Railroad companies are putting on a few extra gangs, but at reduced wages. With the exception of a few cold days at the beginning of the year the weather has been all that any one could desire for outside work.

Reorganization of the interurban lines of the Illinois Traction System will be accomplished in the near future. The several subsidiary companies will be merged into two corporate divisions. The new arrangement will simplify and perfect the financial as well as the operating features in behalf of investors and the company's officers. The lines running from St. Louis to Springfield, Mackinaw and Peoria, from Mackinaw to Bloomington, and the Hillsboro branch will be known as the St. Louis, Springfield & Peoria. The lines running from Springfield and Bloomington to Decatur, Champaign, Urbana, Danville and Ridge Farm will be known as the Bloomington, Decatur and Champaign. It is not improbable that the St. Louis Electric Bridge Company, the Tri-City lines and the St. Louis street railway will be merged into the St. Louis Electric Terminal Railway. The line in Northern Central Illinois, running from Princeton to Ottawa, and known as the Chicago, Peoria & Ottawa, does not belong to the Illinois Traction Company. It is controlled by the Western Railways and Light Company, another of W. B. McKinley's holding corporations. The Western Railways and Light owns railway and lighting plants in Illinois, Iowa and Kansas. Arrangements have been perfected for the organization of the Bloomington, Decatur & Champaign. The new company has been incorporated. At the start it will absorb the Chicago, Bloomington & Decatur and the St. Louis, Decatur and Champaign, 89 miles long, and including the lines extending from Bloomington via Decatur to Champaign and Urbana. The Springfield-Decatur section and the line from Champaign and Urbana to Danville and Ridge Farm will be absorbed as soon as legal and other requirements can be met. Arrangements have not yet been outlined thoroughly for the organization of the St Louis-Springfield-Peoria-Bloomington line and the Hillsboro branch as the St. Louis, Springfield & Peoria. The Bloomington, Decatur & Champaign will have a gross capitalization of $3,979,000, consisting of $1,525,000 of stock and $2,454,000 of bonds. There will be $1,000,000 of common and $525,000 of preferred stock, and $1,506,000 of first mortgage bonds and $954,000 of second mortgage bonds.

"The two Pats," Hannon & Hickey, spent the holidays here. Hannon left for Mt. Carmel, Ill., and Hickey for New York after the reunion. Everything lovely.

Once more the Cape Girardeau & Thebus Terminal Railway has bridged a difficulty, and at the same point where it had to build a long trestle in order to get its tracks over the Government levee, which was built across the road, it has had to rebuild a portion of its trestle because the highway engineer of Scott County destroyed one span of the structure, claiming it obstructed the county highway. The county official on Jan. 4 sawed off the pilings supporting a span of the trestle, which tied up traffic. But the railroad began at once the construction of a temporary span and trains are once more running.

The City Council of Cape Girardeau, Mo., passed an ordinance granting a franchise to the Frisco for right of way through the city. By the terms of the ordinance the Frisco will build a $35,000 passenger station, a sea wall along the river, pave and improve the levee, maintain a division here for the Hoxie and Gulf branches and give certain rates and train service.

Cary Bros., Memphis, Tenn., are in the market for some team work.

⦿The Board of Local Improvements of East St. Louis last week let to Meyer & Thomas the contracts for improving 40th St. from Waverly Ave. to Forest Blvd and from Forest Blvd. from 40th St. to the eastern city limits, for $20,956.45. The same firm also was awarded the contract for improving Linden Ave. from 38th to 40th Sts., at a cost of $3,584.50. The board authorized the payment of $6,190.78 to various contractors on account of work already done on improvements.

Charley Nagel has put on additional force of men on his rock work on the new electric line north of Jerseyville, Ill.

The first car load of steel for the spans of the Municipal Free Bridge reached the storage yards of the American Bridge Co., the contractor for the steel work last week. The erection of the steel will not begin until after high water in the spring. Scouts are now at work in Southern forests selecting long-leaf yellow pine for piling for the false work. These piles must be 100 ft. long, and are therefore not easy to find. With these piles sawed timber for posts and braces will be used. These are not so difficult to find, they will be made ready in the yards in the interim, so they may be easily installed at the proper stage of the river. No false work will be erected during the winter or early spring because of the danger that an ice gorge may carry it away. Only sufficient timber for the false work for two spans will be provided. After the steel of one span is erected the false work that supported it during construction will be taken down and re-erected for the third span. Even the piling will be pulled out to be driven to carry the false work for the third span. The American Bridge Co. already has a considerable force of workmen employed. A large commissary building has been erected on the site to house these workmen.

Montana.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is said to be considering the construction of a new line from Ambrose, N. Dak., to Plentywood, Mont., and work will probably be started next spring. The line will be about 50 miles long and will extend over comparatively level country opening up a territory not now accessible by railroad. Thomas Green, Minneapolis, Minn., is Chief Engineer of the M., S. P. & S. M. Ry.

Although there is little railroad construction work being done in this vicinity at present, it is reported here in Lewiston that construction work will be under way shortly on a number of important pieces of work. A force of men will arrive shortly to commence work on the long tunnel which the Great Northern will bore through the McDonald Creek divide about twelve miles east of this city. This tunnel will be several thousand feet in length and it is necessary in order to give the Great Northern the desired main line grade over the hill. It will keep a big force of men at work for from one to two years, during which time it is the intention to complete the rest of the grade. It is also stated that the Milwaukee and Great Northern have practically agreed to use the same track from Weede, on the Musselshell River, to Lewistown. The Great Northern will do the construction work, using the 22 miles of grade now already completed between Lewistown and Grass Range by the Milwaukee. From Weede eastward, the Milwaukee will construct a line to Saugus, which is a station on their present main line in Dawson County and directly east of Weede. From the Musselshell, the Great Northern will build its line northeasterly to Buford, on the Missouri River. The Milwaukee engineers are still endeavoring to locate a feasible route from Lewistown to Great Falls across the big Arrow Creek country, while the Great Northern line from this city to a point between Benchland and Moccasin, on the Billings-Northern, has already been surveyed and a portion of the right-of-way purchased. It is further reported that the Northern Pacific will also construct a line across Dawson County from near the Milwaukee station of Saugus, the present lines of the Northern Pacific and Milwaukee being within a few hundred yards of each other at that place. This line will also end at Weede, and there is talk of the Northern Pacific trains being run on into Lewistown over the Milwaukee-Great Northern track. From this city, the Northern Pacific will build into White Sulphur Springs, and ultimately through White's Pass to Helena.

New Jersey.

The Pennsylvania R. R. will probably take steps soon to close Poplar St., running from Main to Irving St., at Rahway, N. J., in accordance with that company's plans for elevating the tracks through the city.

The Board of Aldermen of Morristown, N. J., have voted $10,000 to aid in track elevation at the Morris St. grade crossing of the Delaware, Lackawanna & Western R. R. in that city. The money for the present is to rest in the bank ready to be handed over to the railroad when the company decides to elevate and its plans are approved by the town authorities.

New York.

The Delaware & Hudson R. R., Geo. H. Burrgess, Chief Engineer, Albany, N. Y., is preparing plans for the construction of new shops just west of the southern end of Watervliet, which will involve the expenditure of nearly $2,000,000. The plans are so well along that it is expected that construction work will be started this spring. The yards will extend south from the western half of the southern wall of the Watervliet arsenal and along the western boundary line of the southern end of the city. There will be about 130 acres in all. A. B. Apples, Green Island, N. Y., is Mechanical Engineer of the Delaware & Hudson.

The New York Central Lines has included in the current year's budget an appropriation for the construction of a new station at Poughkeepsie, N. Y. The new station if erected on the east side of the tracks will extend 600 feet from Main St. This will mean an

The State Public Service Commission has granted the Coney Island R. R. Co., Brooklyn, N. Y., permission to sell $500,000 of 6 per cent notes. The proceeds are to be applied to betterment and equipment, the most important item being $355,000 for an improvement in Coney Island Ave., under an arrangement with the city of New York. This improvement involves the shifting of the tracks from the west side to the middle of the avenue, and the placing of a parkway between the tracks.

extension of Davies place and a street through the Pelton park, coming out at Mill St. This will cost $240,000. If the station should be erected on the site of the present station it will require the moving of the roundhouse and other buildings and will cost $600,000.

The State Public Service Commission has issued an order for the elimination of grade crossings on the north side division of the Long Island R. R. in Flushing. The work will involve an expenditure of more than $1,000,000 and the reconstruction of the road for about 2½ miles. J. R. Savage, Jamaica, N. Y., is Chief Engineer.

Grade crossing work to cost about $1,000,000 is planned for Buffalo, by the Erie R. R., by an agreement signed by the railroad and the Grade Crossing Commission of Buffalo. The plans call for the elimination of grade crossings on the Niagara Falls and International Bridge Division of the Erie R. R., in the northern part of the city, at Walden Ave., Doab St., Genesee St., East Ferry St., East Delavan Ave., Kensington Ave., Main St. and Military Road.

North Carolina.

The North Carolina Traction Co., mentioned in our last issue, has elected the following officers: President, A. M. Clark, of Southern Pines; Vice-President, J. W. Sikes, of Raleigh; General Manager, E. L. Kraft, of Indianapolis; Purchasing Agent, Robert Lee Walker, of Indianapolis; Master Mechanic, T. E. Walker, of Cincinnati; Secretary, J. W. Kraft, of Indianapolis; Treasurer, H. M. McAllister, cashier of the First National Bank of Lumberton, N. C. A $2,000,000 bond issue has been authorized, and it is reported that the company has placed, or is about to place, construction contracts with the object of having work started Feb. 1. This company plans to build an interurban electric line from Raleigh, N. C., to Floyd, Va., a distance of 92 miles.

Contractors have commenced grading work from Micaville on the first section of the Black Mountain R. R. The first section is to extend from the above mentioned place to Aylers Creek. The line will then follow this creek to Galax where a connection will be made with the C. C. & O. From Galax the road is to be built to Burnsville.

Wadesboro, N. C., has two railroad rumors. One of them is that the Southern Ry. will build from Norwood immediately and come to Wadesboro and on to Florence, S. C. From Wadesboro to Norwood is only 20 miles and the road to Florence, 50 miles, would give the Southern a short cut from the west to Charleston. The other report is that the Atlantic Coast Line will build from Wadesboro to Charlotte, leaving the main line just south of town and running through the southern part of the town. It is understood that engineers will make the survey in the early part of the year.

A press dispatch from Waterville, N. C., under date of Jan. 4, states that two opposing construction crews, representing the Transcontinental R. R. Co. and the Tennessee & Western North Carolina R. R. ,have been fighting for possession of right-of-way through a difficult mountain pass near Newport, Tenn., and Waterville. The report states that W. J. Oliver, who is at the head of the undertaking to build a railroad from Sevierville, Tenn., through the moutains to Greenville, S. C., is thought to be interested in the project.

Ohio.

The Wabash R. R. is reported to be planning to resume work on its proposed Zanesville, Marietta and Parkersburg division. If the road is built it will connect with the Wheeling & Lake Erie R. R. at Zanesville, thus giving the Wabash a direct route from the Atlantic seaboard through the West Virginia coal fields to the great lakes.

Oklahoma.

The Oklahoma Quarries & Construction Co., of Oklahoma City, has been incorporated with a capital stock of $100,000, the incorporators being John M. Wheeler, Daniel B. Redpath and E. J. Heaver.

The citizens and Commercial Club, according to advices from Wagoner, Okla., are organizing to make certain the construction to that city of the Kansas City & Memphis Ry., which was recently chartered with a capital stock of $6,000,000, to build from Rogers, Ark., with its terminal at Memphis. Branches from the main line will extend to Faulkner and Little Rock and from Rogers to Siloam Springs and Eureka Springs, with Wagoner as the western terminal.

M. C. Harper, Muskogee, Okla., promoter of the railroad to be constructed in the states of Missouri, Kansas and Oklahoma, has recently completed negotiations in Joplin, Mo., for the purchase of the Oklahoma Kansas Ry. Co. and the Smith road from Miami, Okla., and Hattonville, Kan. Chicago capital has [illegible] has been underwritten. The general office of the company will be at Miami, Okla.

The Winnipeg, Salem & Gulf Ry. is reported to have made arrangements with an English syndicate which will take the entire issue of bonds of $29,997,000 Preliminary work on the road is being rushed. Two engineering corps are now in the field, one between Salina, Kan., and Alva, Okla., under the supervision of Chief Engineer C. A. Slayton. The second corps of engineers is in the field between Alva., Okla., and Des Moines, N. M. They have been for 60 days under the direction of W. K. Palmer Engineering Co. of Kansas City, Mo., working west to Alva through Woods County, Okla

Oregon.

The Rogue River Valley R. R., according to advices from Medford, Ore., has grading work under way on a portion of its new extension from Jacksonville to Rush, five miles. From the latter place surveys will be made by the Hill interests to the coast.

According to the latest report received here in Portland, Ore., concerning the construction of the Central Oregon line, tracklaying on the Oregon Trunk is progressing more rapidly than was expected, about two miles per day being the average maintained since work was commenced. The crews have reached the 57-mile post and will continue to push on as long as the weather permits. It was hoped to get down about a mile and a half of track each working day so that even the most sanguine expectations of the engineers in charge have been excelled. Very little interference has been caused by bad weather, little snow having fallen and none having remained long on the ground. The weather, in fact, has been just the kind wanted for rapid work, so the foremen report, for it has been cool enough to put the tracklayers in fine trim for work. At the rate work is now progressing track will have been laid to Crooked River bridge early in the spring

Work, it is reported, has begun on the grade of the Oregon & Washington branch of the Union Pacific between a point on the north side of the river, where the new bridge is being built, and Hoquiam, Wash. This indicates the construction of the roadbed along the north side of the tracks on the Northern Pacific. Work will be done on the grade ready for steel within 90 days, according to the terms of the contract.

The surveying corps, working on a railroad line from Junction City to Coos Bay, has, according to advices from Gardner, Ore., arrived at that place.

The Kings Height Co., J. R. Wetherbee, President, Portland, has perfected plans for building a street car line from the head of Washington St. at Portland, to the top of the hill, where it will join the new line of the United Railways, now building to Mount Calvary Cemetery.

Pennsylvania.

The Pennsylvania R. R is planning extensive improvements for its waterfront holdings at Philadelphia. These improvements will include a new grain elevator and possibly new piers.

The Pittsburg & Shawmut R. R. has placed an order for 61,700 tons of 85-lb. rails to be used for the completion of the 62 miles of that road from Knoxdale to Freeport, Pa. The first 34 miles will be started in the spring and are expected to be laid by midsummer. The remaining distance, from Mahoning down the west side of the Allegheny river, will be completed before the end of the year. At present the 42 miles of line which is constructed from Hyde to Knoxdale is being operated by the Pittsburgh, Shawmut & Northern R. R., under lease. The two roads are to be merged when the new road is completed and the receivership lifted from the latter. H. S. Wilgus, Angelica, N. Y., is Engineer Maintenance of Way for the Pittsburg, Shawmut & Northern R. R.

The Erie R. R. is reported to be planning to build a line from Punxsutawney to Blairsville.

Advices from Reading, Pa., where extensive improvements are being made by the Philadelphia & Reading Ry., state that a small portion of the new track has been laid and that contracts for the proposed new roundhouse, car shop, office and other buildings have not yet been let. It is thought, therefore, that it will be some time next summer before the work, which will cost approximately $1,500,000, will be completed.

Rhode Island.

The Newport & Providence Ry. Co. (electric), Newport, R. I., is to petition the State Assembly for permission to build a line about 6½ miles long across the towns of Warren and Bristol to a point near the Bristol lighthouse where it is proposed to locate a ferry terminus.

Tennessee.

The Southern Ry. is reported to be considering building a line from Bull's Gap to Newport, for the accommodation of coal trains from the Holston Valley railway.

As a further development in the plans of the Chattanooga Southern R. R., E. F. Blomeyer, General Manager, Chattanooga, Tenn., for securing a line from Chattanooga to Atlanta, Ga., a new company to be known as the Tenessee, Alabama & Georgia Ry. is being organized. This company will merge the several roads recently chartered for the Chattanooga Southern interests into one company. Ultimately it is planned to have a direct route from the Great Lakes to the Gulf of Mexico.

Utah.

It is believed that the San Pedro, Los Angeles & Salt Lake R. R. will undertake extensive revision work this spring on its lines in the Provo District. This work was planned for last year but heavy floods a year ago caused postponement. This work will involve 132 miles of track.

Texas.

Grading work on the Gulf Coast & Provident City R. R. has been completed to a point about seven miles from Provident City. The lower terminus of the line is at Provident City, in the corner of Jackson, Wharton and Lavaca counties. The road will also have termini at Glenflora on the Santa Fe, and Pierce, on the Southern Pacific. The first shipment of steel is due to arrive in about six months and within eight months from date the company expects to be running trains on a regular schedule. The new road is to cost in the neighborhood of $500,000 at the outset, which includes every expense necessary to get it ready for business. Albert Schlafli, of the engineering firm of Schlafli & Porter, Houston, Tex., is Assistant General Manager in charge of construction. The general offices of the railroad are at Provident City.

According to the annual report of the State Railroad Commission the railway mileage in Texas is as follows: Main line mileage and branches 13,813 miles, increase 709 miles; yard track and sidings 3,409, increase 17; an aggregate increase of 887 miles. New lines placed in operation, 308 miles; old lines, 810 miles, and other increases, 7 miles. There are but 22½ miles of narrow gage and 14 miles of iron rails of the main line mileage.

On Dec. 29 last a large blast was set off on the extension of the Fort Worth & Rio Grande Ry. to Menard, Tex., on Wm. McCarty's contract. The blast contained nearly 14½ tons of black powder. Mr. J. C. Gallagher was foreman in charge.

Construction work on the new Santa Fe cutoff from Coleman to Texico is progressing rapidly and early this year track was laid and finished as far as Lanius, a point about 12

✣ indicates work now open for bids. ◉ indicates a contract let recently.

miles northwest from Sweetwater, on the westerly extension of the cutoff. There is a gap of about 68 miles yet to be filled in between Coleman and Lubbock. The road from Lubbock, in an eastwardly direction, is being rapidly extended.

The City Council of Beaumont has at last granted a new franchise to the Beaumont Traction Co. as a substitute for the existing franchises of the company.

The town of Anahuac, Tex., has offered right-of-way and a good bonus to any company that will construct a line from either Port Arthur or Beaumont, via that place, to Houston, Tex.

It is reported that the Missouri, Kansas & Texas Ry. is planning the construction of extensive improvements at Waco, Tex., during this year, but nothing definite has been allowed for publication.

It is rumored in Sherman, Tex., that the Atchison, Topeka & Santa Fe Ry. System has acquired the franchises and completed grade of the Gainesville, Whitesboro and Sherman Interurban and will extend it to Sherman from Gainesville.

Advices from Faith, S. Dak., state that the Chicago, Milwaukee & St. Paul R. R. has constructed a branch within three miles east of that place and that the line will be extended into the town by spring.

Virginia.

The Southern Ry. will, early this year, begin the operation of passenger and freight service over its new low grade double track line at Lynchburg. The construction of this required an entire change of line for seven miles from Winesap, north of Lynchburg, to Durmid on the south, the most important construction features being the following: A tunnel 1,300 ft. long under Rivermont, a suburb of Lynchburg; a tunnel 120 ft. long under Park Ave.; a steel bridge 1,860 ft. long and 150 ft. high over the James river; steel viaducts 600 ft. long and 115 ft. high over Harris creek, 1,000 ft. long and 135 ft. high over Blackwater creek, and 500 ft. long and 80 ft. high over Fishing creek; a concrete viaduct 700 ft. long carrying Fifth St. over the railroad yards in West Lynchburg; a concrete viaduct 150 ft. long, carrying the Lynchburg water supply; a steel viaduct 150 ft. long, carrying spur track of the Norfolk and Western railroad; and a concrete bridge 80 ft. long carrying 12th St. Work has been under way 4½ years, the contract having been let on April 2, 1906, and the first work done in May of that year.

Steps will probably be taken this year looking to the establishment of union passenger terminals for the Seaboard Air Line, Atlantic Coast Line and Southern Railways on the property known as the Swimming Point flats at Portsmouth. It is proposed in connection with these passenger terminals to operate a ferry, which can be done to make three-minute trips between Portsmouth and Norfolk. Tentative plans have been prepared by Neff & Thompson, architects, of Norfolk.

The Kentucky-Virginia R. R., which has a line from Norton to Wise, is reported to be planning to build an extension into Dickenson county, a distance of about 15 miles. A ten-mile line is also projected from Norton up Guests' River to its headwaters to develop the Virginia Coal & Iron Co.'s properties.

Washington.

An ordinance has been introduced in the Municipal Commission of Tacoma by Com- [illegible] to the Island Railway & Navigation Co. for a single track electric railway on 6th Ave. from Proctor St. to the Narrows, a distance of about three miles. The project is backed by property owners on the west side and rails and ties have already been ordered. Power will probably be obtained from the Tacoma Ry. & Power Co.

A proposition has been placed before the Chamber of Commerce of Spokane for a new railway, to extend from that city to Yuma, Ariz. Only two short stretches of [illegible] from Lewiston, Idaho, to Huntington, Ore.; the other from Elko to Carson City, Nev.

The Chicago, Milwaukee & Puget Sound Ry. Co. has filed plats and maps of the entire route with profiles and specifications at the land office, Kalispell, Wash., and it is believed that the construction of its Kalispell line will be commenced in the spring. The route is through the canyon of the North Fork country, running north to the headwaters of the Swan River, thence northeast from Bonner up the Blackfoot to the town of Clearwater, down that stream and up into the Flathead Valley to Creston, where it turns westward for six miles to Kalispell, crossing the Great Northern main line and heading for South Fork, crossing the Great Northern again between Whitefish and Columbia Falls.

As a result of the Northern Pacific Ry. Co. suddenly ordering the Chehalis, Wash., engineering corps recruited to the full standard, it is believed that the company has under consideration some new construction work in that vicinity.

Contractors working on the double track line of the Northern Pacific Ry. between Tacoma and Kalama, a portion of the Seattle-Portland double track line, have suspended operations for the winter, over half of the entire line being completed. Between Portland and Kalama the work is practically complete and from Seattle to Tacoma the double track line has been in operation for some time. The new work south of the latter city is completed in small sections. Most of the right-of-way has been graded for two tracks and wherever possible the double line has been laid and is in use. From Tenino to Chehalis there is perhaps the longest stretch of completed track. South of Chehalis, however, the work is piece-meal, and nothing more will be done upon it until next summer. The work is being dropped on account of the rainy season.

Wisconsin.

Representative engineers of the Chicago, Milwaukee & St. Paul Ry. and the Chicago & Northwestern R. R. are conferring with the city officials of Beloit, Wis., in regard to constructing switch tracks on Pleasant St.

Wyoming.

Kilpatrick Bros., Beatrice, Neb., who, as stated in recent issue of ENGINEERING-CONTRACTING, have the contract for the construction of the Colorado & Southern line from Cheyenne to Wellington., have established headquarters at Cheyenne, Wyo., and are planning to rush work through to completion by the end of July.

Advices recently received from Cheyenne, Wyo., state that steel laying on the Canon line from Thermopolis to Powder River is to be started soon, but it is not anticipated that trains will be in operation before April.

According to a statement reported to have been made by General Superintendent Madden of MacArthur Bros., at Shoshoni, Wyo., grading work has been about completed and tracklaying and bridge decking will be commenced at once. It is believed the road will be in operation about April.

Canada.

At the end of 1911 fully 90 per cent of the total work on the 257 miles of line of the National Transcontinental R. R. across New Brunswick and 70 per cent of the 203 miles in the province of Quebec east of the St. Lawrence at Levis had been completed. The first section west of Moncton, a distance of 50 miles, ending at a point near Chipman, which was awarded to the Grand Trunk Pacific Construction Co., and sub-let to Corbett, Floech & Co., has been fully completed, including tracklaying and ballasting, and so has the following section of eight miles, which has been built by J. W. McManus & Co., Ltd. The third section to the westward, 40 miles in length, was first taken by the Grand Trunk Pacific Construction Co., but sub-let later to the Toronto Construction Co., and fully completed to McGivney Junction, where the road crosses the old Canada Eastern, now a part of the Intercolonial. The Toronto Construction Co. also built the fourth section in New Brunswick, a distance of 66 miles, and it will be to this point, 166 miles from Moncton, that the Transcontinental Ry. will be opened during next year. The fifth section was awarded to Wellard, Kitchen & Co., and the grading has been almost completed by that firm from Tobique River to the Grand Falls on the St. John River, some 31.8 miles. There are some very long stretches of steel trestle over the Salmon River. This is 4,000 ft. in length and is the longest of any of the kind on the eastern section of the Grand Trunk Pacific Ry. The trestle is 200 ft. high and three spans remain to be completed. The No. 6 or last section in New Brunswick, extending from Grand Falls to the Quebec province boundary some 61 miles. Lyons & White are the contractors, and their track is all laid, although a good deal of ballasting has yet to be done. The work, however, is progressing rapidly at this point. The next two sections to the west, numbering 7 and 8, were given to M. P. and J. T. Davis, who are also building the substructure of the Quebec bridge. The first section of a little over 53 miles from the New Brunswick boundary has been sub-let to an Italian firm, Messrs. Casechi & Pegano, and they have completed three-quarters of the grading and have also laid about 30 miles of track. The Davis Brothers are building the final section of the Transcontinental east of the St. Lawrence to Point Levis, the distance being a little over 149 miles. The substructures of all the bridges on these contracts are completed, and the superstructure furnished by the Dominion Bridge Co., the Hamilton Bridge Co., and the McNeill Bridge Co., of New Glasgow, is well advanced.

Canadian press reports state that W. Stewart, a contractor on the Grand Trunk Pacific, has gone to Scotland to bring out 5,000 laborers to work on the construction of the road.

The Grand Trunk Pacific Ry. now has over 2,500 men at work on its grade east of Prince Rupert, B. C. This would indicate that the labor scarcity of last summer has been very much relieved. Sixty per cent of the grade has been finished from Kitsalas to Hazelton.

The Grand Trunk Pacific Ry. System is awaiting the arrival of a shipment of 200,000 cross ties from southern United States ports to Galt wharf in Portland, Ore. A large amount of steel rails have also been contracted for in Sydney, C. B., and that shipment will also be received at the same wharf

A Grand Trunk Pacific survey party which has spent the season looking over the ground north of Harrison lake as a route for a railway line into Vancouver, has reached Vancouver. It is understood that the party found the country without insuperable difficulties for railway building, and the route is looked upon as a good one. The party was in charge of W. O. Bassett who was with one of the parties in the field this year doing preliminary work for the proposed line from Fort George to Vancouver. He went in by way of Harrison Hot Springs, and planned to look over 115 miles of country between there and Lillooet, north of which town another survey party was working.

Ritchie, Ludwig & Ballantyne, Toronto, Ont., are to apply to Parliament for permission to build a line of railroad from Toronto to Barrie. The line will probably be operated by electricity.

Steel has been laid on 227 miles of the 400 miles of the National Transcontinental Ry. in Quebec now under construction. East of Quebec city 50 miles are completed; 50 miles are complete on the Weymontashene section, which is 197 miles long; 47 miles on the section immediately west of the city of Quebec, and 30 miles of MacDonald and O'Brien's 107-mile contract. M. P. and J. T. Davis have 50 miles ready on their Quebec contract also

Good progress is being made with the work of clearing the right of way for the branch line of the Teniskaming & Northern Ontario Ry. from Kelso to the Porcupine District and it now looks as though the branch would be completed by July 1. The clearing work is being done by station men.

Mexico.

It is now believed that the branch line of the National Railways of Mexico, which is being constructed from Durango to Llano Grande, 75 miles, will be extended southwest another 50 miles as soon as the work on the pre[illegible] con[illegible] ping [illegible] Sierra Ma[illegible] than 2,000 [illegible] timber [illegible] with the State of Durango in guaranteeing 6 per cent interest on the money expended in constructing the line. The new road will ultimately be extended to the port of Mazatlan, on the Pacific Coast, if a feasible route across the high Sierra Madre range can be found, it is said.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣Bids will be received until Jan. 23, by H. J. Lancaster, Judge of Probate, Wetumpka, Ala., for road improvements, according to plans and specifications prepared by Solomon Norcross Co., Engineers, Atlanta, Ga. The cost of the work is estimated at $170,000.

California.

The county supervisors at Eureka, Cal., have ordered the construction of a road from Mattole Valley to Dyerville in the Eel River Valley. County Surveyor G. W. Conners is making a survey in Southern Humboldt for the road.

Bills are being prepared by N. Ellery, State Engineer, Sacramento, to be presented to the legislature when it meets, which will make appropriations for completing and maintaining certain state roads and highways. One of the bills will be for $200,000, which is to be used in maintenance of the state highway when constructed. Other bills will call for the following amounts: For the Trinity, Tehama, Shasta and Humboldt road, $50,000 to complete this highway, which is to connect the Sacramento Valley with the counties named. For the Kings River road, which taps the most beautiful scenic route in the state, $10,000 to continue the work. For the Lake Tahoe road, $15,000, and this amount will include $3,500 to be asked annually for maintenance of this road. For the Sonora and Mono road $16,000, and for the Emigrant Gap and Donner Lake road $6,000 for maintenance.

The County Supervisors, Los Angeles, have voted to recommend to the County Highway Commission the grading, paving and placement of concrete culverts on the valley road from Whittier to Foothill boulevard in Lamanda Park.

The Highway Commission of Orange County, Santa Ana, Cal., as noted in our last issue, have recommended the construction of 127.8 miles of improved roads. The roads projected are: One from Santa Ana through Orange and Olive and up the Santa Ana canyon to the Riverside County line, 15.51 miles; one from Santa Ana through Tustin, Irvine and San Juan Capistrano to the San Diego County line, 32.55 miles; one from Santa Ana through Anaheim and Fullerton to Whittier Ave. of Los Angeles County, 10.29 miles; one from Anaheim to Buena Park and Northam, 7.57 miles; one from this road to Cyress and the Los Angeles County Downey road, 4 miles; Anaheim to Olive, 3.37 miles; from this road to Olinda, 7.12 miles; Santa Ana to Garden Grove and then to the Buena Park road, 7.81 miles; from Garden Grove through West minster and Bay City to Los Angeles County Naples road, 11.12 miles; from this road through Los Alamitos to the Los Angeles County line, 4.19 miles; from near Westminster to Huntington Beach, 5.32 miles; from Santa Ana through Old Newport to Newport Beach, 9.25 miles; from this road through Talbert to Huntington Beach road, 4.86 miles; from Orange to Tustin, through McPherson, 4.02 miles, and from Fullerton to the Olinda road, .87 mile. The Board of Supervisors set January 4 for final consideration of the highway recommendations.

Advices from Los Angeles, Cal., state that bids have been received and referred to the Highway Commission for the improvement of the El Monte Covina road in that county. F. F. Prendergast, bid $25,150; A. C. St. John bid $17,100.

Colorado.

✣Bids will [illegible] Jan. 17, by Board of Public Works, Denver, Colo., for the furnishing of the necessary labor and materials for grading and constructing a concrete curb and gutter, etc., in the North Side Improvement District No. [illegible] Denver. A [illegible] check [illegible] be filed with [illegible] Henry Read, President of the Board.

✣Bids will be received until [illegible] Jan. 16, by Board of Public Works, Denver, Colo., for furnishing [illegible] supplies [illegible] and to sustain all the [illegible] construction of [illegible] Hill Improvement District No. [illegible] A certified check for $[illegible] must [illegible] each bid. Henry Read is President of the Board of Public Works.

At the Colorado Good Roads Conference to be held at Denver, Jan. 1[illegible] and 1[illegible], a petition will be prepared [illegible] to the legislature [illegible] appropriate at least $500,000 to be spent on state highways under the direction of the State Highway Commission. This, together with $1,000,000 which the counties desiring to avail themselves of this fund must put up, would give a fund amounting to $1,500,000 to be expended under the direction of the State Highway Commission.

Plans were discussed at the annual banquet of the Commercial Association, Boulder, Colo., for the improvement of the old mail road from Denver to Boulder, which runs via Marshall and Broomfield and an effort will be made to interest the State Highway Commission and County Commissioners.

Florida.

✣Bids will be received until 7:30 p. m., Feb. 7, by City Council of Palatka, Fla., for the construction of 10,000 sq. yds. of concrete sidewalks. Plans and specifications are on file at the office of S. C. Stillings, Engineer of the city. A certified check for $500 must accompany each bid filed.

Illinois.

✣Bids will be received until [illegible] a. m., Jan. 14, 1911, for furnishing sectional wooden pavement at the various bridges and viaducts in the city of Chicago, by B. J. Mullaney, commissioner of public works, room 70[illegible], City Hall. The pavement shall be made up in slabs, the length and width to be determined by the commissioner of public works, and shall be 2¾ ins. and 3½ ins in thickness; the weight shall not exceed 4¼ pounds per sq. ft. for each inch of thickness. The slab shall be made of strips of hard wood not to exceed 1¼ ins. and shall be of uniform thickness and length. The strips constituting the slabs shall be treated with asphalt or some other water proof substance and shall then be fastened securely together and prove water tight. Two twousand square yards (approximate) of pavement 2¾ ins. in thickness and 2,000 sq. yds. (approximate) of pavement 3½ ins. are required. Detailed specifications may be had upon application to the commissioner of public works.

⊙Sam Cox of Arcola, Ill., has been awarded the contract by the Clinton highway commissioners, Carlysle, Ill., for grading the roads of the [illegible] repair for the ensuing year.

⊙Bids were opened Dec. 29 by the Village Board of [illegible], Engineers, for the [illegible] pavement on Harbor St., South St., etc., the con[illegible] McGarry & Co., 1001 Security Bldg., Chicago, Ill., at the following bid:

21,140 sq. yds. macadam, av. depth 9½ in.	$ 1.02½
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible] complete	.26
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

[illegible] on six systems of special assessment sidewalks. About 8,373 lin. ft. were awarded to [illegible], Chicago, Ill., at [illegible] cts., and about 1,325 lin. ft. to C. T. Bartlett, Evanston, Ill., at 84 cts. and 88 cts.

⊙Following are the low bids submitted Dec. 28th to the Board of Local Improvements, City of Chicago, Chas. A. V. Standish, Secy., Room 302 City Hall, for paving streets and alleys, the contracts being awarded as indicated. The work includes the following general items: [illegible] concrete sidewalks, granite concrete combined curb and gutter on a foundation of sand or cinders, furnishing and setting sandstone curbing on limestone blocks, furnishing and setting wood curbing spiked to cedar posts, grading and paving with repressed vitrified paving brick on a 6-in. Portland cement concrete foundation with a 2-in. sand cushion, the joints to be filled with coal tar or asphaltic filler, the surface to be dressed with ½-in. of sand, grading and paving with asphalt on a 6-in. Portland cement concrete base, the surface to be swept with natural hydraulic cement; constructing a macadam pavement consisting of 8 in. of blast furnace slag, 3 in. of limestone and 3 in. of granite bonded with gravel, and ½-in. of granite screenings; constructing a pavement of No. 2 granite blocks on 6-in. Portland cement concrete foundation with a 2-in. sand cushion, the joints to be filled with coal tar and gravel, the surface to be dressed with ¾-in gravel; repairing curb walls adjusting manholes, catch basins, etc.:

⊙Jas. A. Sackley Co., 307 Chamber of Commerce.

Alley Menominee St., Wisconsin St., Sedgwick St., Hudson St.

1,190 lin. ft. concrete curb	$ 0.20
1,070 sq. yds. brick pavement	2.51
Total	2,923.70

Alley Grant Pl., Ashland Ave., Belden Ave., Hamilton Ct.

1,650 lin. ft. sandstone curb (4"x24")	$ 0.20
340 cu. yds. earth cutting	0.80
1,400 sq. yds. brick pavement	2.59
Total	4,228.00

Alley 42nd St., 43rd St., Indiana Ave., Prairie Ave.

1,190 lin. ft. concrete curb	$ 0.10
1,182 sq. yds. brick pavement	2.61
Total	3,198.80

⊙Parker Washington Co., 920 Chamber of Commerce:

Alley 29th St., 30th St., Vernon Ave., Cottage Grove Ave.

1,620 lin. ft. concrete curb	$ 0.17
1,540 sq. yds. brick pavement	[illegible]
Total	4,204.10

⊙Jas. A. Sackley Co., 307 Chamber of Commerce:

Alley [illegible] St., [illegible] St., Jefferson St., Clinton St.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible]	0.10
[illegible]	
[illegible]	
Total	[illegible]

Alley, [illegible] Ave., 40th Ave.

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Alley, Colorado Ave., Van Buren St., Homan Ave., Trumbull Ave.

1,100 lin. ft. concrete curb...	[illegible]
[illegible]	
[illegible]	
Total	2,318.00

⊙Central Paving Co., 172 Washington St., [illegible]

1,100 lin. ft. concrete curb................$	0.15
400 cu. yds. earth filling..................	0.85
[illegible]	
[illegible]	

⊙Jas. A. Sackley Co.:

[illegible]

Claremont Ave.:

1,100 lin. ft. concrete curb..............$	0.10
[illegible]	
[illegible]	

Alley, Forquer St., Taylor St., Des Plaines St., Halsted St.

1,600 lin. ft. concrete curb...............$	0.20
300 cu. yds. earth cutting..............	0.80
1[illegible]	[illegible]
Total	[illegible]

⊙American Asphalt Paving Co., 138 Washington St., Chicago:

Ainslie St., Clark St., to W. Ravenswood, [illegible]

[illegible]	.61½
1,900 cu. yds. earth cutting..........	.35
[illegible]	.20
[illegible]	1.75
[illegible]	45.00
4 old catch basins to be adjusted....	[illegible]
[illegible]	5.00
[illegible]	10.00
20 lin. ft. 9-in. tile pipe..............	[illegible]
[illegible]	10.00
Total	11,[illegible]

Artesian Ave., Fullerton Ave. to Logan Blvd.

2,415 lin. ft. combination surb and gutter ....$	.61
[illegible] sidewalk	.20
3,715 sq. yds. asphalt on 6-in. concrete base	1.73
[illegible]	45.00
[illegible] to be adjusted	20.00
[illegible] adjusted	5.00
[illegible]	10.00
50 lin. ft. 9-in. tile pipe................	.75
[illegible]	10.00
Total	[illegible].60

Belmont Ave., Sheffield Ave. to Ashland Ave.

7,600 lin. ft. sandstone curb (5"x30") $	.70
260 lin. ft. curb wall repair...........	.30
300 sq. ft. concrete sidewalk.........	.20
10,500 sq. yds. creosoted wood blocks	3.00
31 new catch basins..................	45.00
36 old catch basins to be adjusted..	20.00
[illegible] to be adjusted	5.00
[illegible] with [illegible]	10.00
900 lin. ft. 9-in. tile pipe...........	.75
[illegible] gratings	10.00
Total	40,313.00

Belmont Ave., Lincoln Ave. to Robey St

4,800 lin. ft. sandstone curb (5"x30")..$	.70
1,080 cu. ft. concrete curb wall........	.70
[illegible] sidewalk	.20
7,700 sq. yds. creosoted wood block..	3.00
14 new catch basins....................	45.00
21 old catch basins....................	20.00
1 old manhole to be adjusted..........	5.00
21 new covers with iron lids..........	10.00
240 lin. ft. 9-in. tile pipe..............	.75
12 [illegible] gratings	10.00
Total	28,389.00

Berteau Ave., Clark St. to Ashland Ave.

2,600 lin. ft. combination curb and gutter $	.615
1,000 sq. ft. concrete sidewalk..........	.20
4,200 sq. ft. asphalt on 6-in. concrete [illegible]	[illegible]
[illegible]	[illegible]
6 old catch basins to be adjusted....	20.00
6 old manholes to be adjusted..........	5.00
6 new covers with iron lids..........	10.00
40 lin. ft. 9-in. tile pipe................	.75
Total	9,619.00

⊙Parker Washington Co.:

California Ave., 35th St. to 39th St.

4,[illegible]	.55
800 sq. ft. concrete sidewalk..........	.18
[illegible]	2.09
[illegible]	45.00
19 old catch basins to be adjusted......	20.00
12 old manholes to be adjusted........	5.00
[illegible]	10.00
300 lin. ft. 9-in. tile pipe..............	
19 iron gratings	10.00
[illegible]	

⊙American Asphalt Paving Co.:

Huron St., 51st Ave. to 52nd Ave.

1,170 lin. ft. combination curb and gutter	.595
270 cu. yds. earth cutting............	.25
1,660 sq. yds asphalt..................	1.73
Total	3,635.45

Lubeck St., Robey St. to Western Ave.

5,050 lin. ft. combination curb and gutter	.615
60 lin. ft. concrete gutter............	.38
250 sq. ft. concrete sidewalk..........	.20
8,030 sq. yds. asphalt................	1.71
6 new catch basins..................	45.00
10 old catch basins to be adjusted....	20.00
19 old manholes to be adjusted........	5.00
4 new covers with iron lids............	10.00
20 lin. ft. 9-in. tile pipe............	.75
16 iron gratings	10.00
[illegible]	17,909.87

Park Ave., Belt Ry. to 48th Ave.

2,620 lin. ft. combination curb and gutter [illegible]	.58
900 cu. yds. earth cutting.............	.25
[illegible] concrete sidewalk	.20
4,120 sq. yds. asphalt.................	1.73
[illegible]	45.00
8 old catch basins to be adjusted........	20.00
[illegible] to be adjusted	5.00
3 new covers with iron lids...........	10.00
12 lin. ft. 9-in. tile pipe................	.75
[illegible]	10.00
Total	9,581.20

Rhodes Ave., 60th St. to 61st St.

1,260 lin. ft. combination curb and gutter	.565
50 sq. ft. concrete sidewalk...........	.20
1,900 sq. yds. asphalt.................	1.81
4 old catch basins to be adjusted......	20.00
[illegible] to be adjusted	5.00
8 new covers with iron lids............	10.00
[illegible] tile pipe	[illegible]
[illegible] gratings	10.00
Total	[illegible]

Sawyer Ave., Fullerton Ave. to Wrightwood Ave.

2,500 lin. ft. combination curb and gutter	.61
[illegible] sq. ft. [illegible] sidewalk	.20
[illegible] asphalt	1.72
8 new catch basins.....................	45.00
4 old catch basins to be adjusted.....	20.00
[illegible] to be adjusted	5.00
4 new covers with iron lids.........	10.00
60 lin. ft. 9-in. tile pipe..............	.75
4 iron gratings........................	10.00
Total	[illegible]

Sawyer Ave., Wrightwood Ave. to Milwaukee Ave.

1,320 lin. ft. combination curb & gutter $	[illegible]
1,100 cu. yds. earth cutting...........	.30
[illegible] sq. ft. concrete sidewalk	.20
[illegible] sq. yds. asphalt..........	1.72
4 new catch basins.....................	45.00
2 old catch basins to be adjusted.......	20.00
4 old manholes to be adjusted..........	5.00
1 new cover with iron lid..............	10.00
20 lin. ft. 9-in. tile pipe.............	.75
2 iron gratings	10.00
Total	[illegible]

23rd St., Rockhill St. to Washtenaw Ave.

1,200 lin. ft. combination curb and gutter $	.615
100 sq. ft. concrete sidewalk..........	.20
1,900 sq. yds. asphalt	1.72
2 new catch basins....................	45.00
4 old catch basins to be adjusted	20.00
4 old manholes to be adjusted	5.00
4 new covers with iron lids	10.00
10 lin. ft. 9-in. tile pipe...............	.75
4 iron gratings....	10.00
Total	4,303.50

29th St. Throop St. to Halsted St.

1,380 lin. ft. combination curb and gutter $	.62
[illegible] lin. ft. concrete gutter	.36
100 sq. ft. concrete sidewalk.	.20
1,000 sq. yds. asphalt	1.75
2 new catch basins.	45.00
7 old catch basins to be adjusted.....	20.00
10 old manholes to be adjusted.......	5.00
7 new covers with iron lids	10.00
140 lin. ft. 9-in. tile pipe............	.75
4 iron gratings	10.00
Total	[illegible]

⊙J. A. Sackley Co.

Troy St. Elston Ave. to Waveland Ave.

2,490 lin. ft. sandstone curb (5"x30")..$	.70
1,200 cu. yds. earth cutting............	[illegible]
500 sq. ft. concrete sidewalk............	.15
[illegible] sq. yds. macadam (8-3-3½)	1.26
4 new catch basins.....................	45.00
13 old catch basins to be adjusted......	20.00
10 old manholes to be adjusted..........	[illegible]
1 new iron cover with iron lid........	10.00
60 lin. ft. 9-in. tile pipe................	[illegible]
11 iron gratings........................	10.00
Total	[illegible],200.00

⊙American Asphalt Paving Co.:

Whipp St., Fillmore St. to 12th St.

1,200 lin. ft. combination curb and gutter $	.61
100 sq. ft. sidewalk.....................	.20
1,800 sq. yds. asphalt....................	1.70
2 new catch basins......................	45.00
4 old catch basins to be adjusted.......	20.00
4 old manholes to be adjusted...........	5.00
4 new covers with iron lids	10.00
10 lin. ft. 9-in. tile pipe.................	.75
[illegible]	10.00
Total	[illegible]

Wilton Ave., Cornelia Ave. to Sheridan Rd.

5,050 lin. ft. combination curb and gutter $	.565
150 lin. ft. concrete gutter............	.36
1,000 sq. ft. concrete sidewalk........	.20
[illegible] asphalt	1.81
[illegible] basins	45.00
16 old catch basins to be adjusted....	20.00
22 old manholes to be adjusted........	5.00
2 new covers with iron lids..........	10.00
[illegible] tile pipe.	.75
[illegible]	10.00
[illegible]	18,2[illegible]

Avondale Ave. System.

5,160 lin. ft. combination curb and gutter	.61
4,000 cu. yds. earth cutting....	.40
150 sq. ft. concrete sidewalk..	.20
6,670 sq. yds. asphalt...........	1.74
5 new catch basins...........	45.00
1 old catch basin to be adjusted	20.00
2 old manholes to be adjusted..	5.00
1 new cover with iron lid......	10.00
30 lin. ft. 9-in. tile pipe........	.75
1 [illegible]	10.00
Total	16,680.90

Waveland Ave. System.

12,110 lin. ft. combination curb and gutter .....$	.52
9,000 cu. yds. earth cutting............	.30
1,000 sq. ft. sidewalk..................	.20
1[illegible] asphalt	1.74
24 new catch basins.......................	[illegible]
35 old catch basins to be adjusted......	20.00
37 old manholes to be adjusted........	5.00
5 new covers with iron lids...........	10.00
360 lin. ft. 9-in. tile pipe...............	.75
34 iron gratings...	10.00
Total	[illegible]

Marshfield Ave. System, 66th St., 67th St., etc.

5,670 lin. ft. combination curb and gutter ....$	.615
1,000 cu. yds. earth cutting............	.30
[illegible] concrete sidewalk	.20
8,840 sq. yds. asphalt..................	1.74
[illegible] catch basins.	45.00
20 old catch basins to be adjusted....	20.00
[illegible] manholes	5.00
10 new covers with iron lids..........	10.00
1,000 lin. ft. 9-in. tile pipe............	.75
4 iron gratings........................	10.00
Total	20,993.65

Indiana.

✣Bids will be received until 1 p. m., Jan. 21, by Board of County Commissioners at Frankfort, Ind., for the construction of two gravel roads. Charles F. Cromwell is Auditor of Clinton County.

⊙The county commissioners at Muncie, Ind., have awarded the contract for the construction of two miles of brick roadway in Delaware county, connecting the present brick road extending from the center of Muncie along the Middletown road for two miles, to William Birch for $42,000.

⊙W. A. Woodward, Ossian, Ind., has been awarded the contract by the county commissioners at Bluffton, Ind., for the construction of three gravel roads in Wells County for $10,039. Bids were opened Dec. 29.

⊙The county commissioners at Bluffton, Ind., have awarded the contract for the construction of two gravel roads in Wells County to Charles North of Bluffton for $4,960. Bids were opened Dec. 29.

⊙The board of public works of Gary, Ind., has awarded the contract for paving Massachusetts St. from 22nd to 25th, and 22nd Ave. from Massachusetts to Jefferson St., to S. A. Smith.

⊙The board of public works of Gary, Ind., has awarded the contract for the construction of 17th Ave., from Georgia to Madison St., to P. T. O'Brien, and the contract for the construction of Hart St., in Tolleston, to M. D. Heiny.

⊙Hutzell & Wolfeale, Markle, Ind., have been awarded the contract for constructing 6 miles of stone road. Bids were opened Jan. 4 by John W. Weaver, Auditor of Huntington County.

⊙The County Commissioners at Wabash, Ind., have awarded the contracts for two macadam roads, bids for which were received Jan. 3, as follows: One road to Geo. M. Sewell, Laketon, Ind., at $9,200; one road to Wm. Reffert, Monroe, Ind., at $10,434.

⊙The County Commissioners, Indianapolis, Ind., have awarded the contract for furnishing 309 carloads of stone to be used in improving highways to the A. F. Zearing Contractor's Supply Co., at $11,858. The other bidders were A. B. Meyer Co., $12,776; Frank M. Dell, $12,488.

⊙Advices from Mt. Vernon, Ind., state that the petition of the citizens of Smith township, in the northern part of the county, for a 13-mile graveled road, has been granted. The road bed is to be graveled 9 ft. wide and 12 ins. deep in the center.

⊙The contract for the construction of the Parsons et al. and McPherson et al. roads in Barr township, Daviess County, Ind., has been awarded to M. H. Wilson, Montgomery, Ind., at $10,201. The work includes 3 miles of road grading and graveling. Thomas Nuget is County Auditor. Bids were opened Jan. 3.

⊙The contract for the construction of the gravel road on the line between Pike and Steuben townships in Warren County, for which bids were received until 1 p. m., Jan. 2, by the Board of County Commissioners, was not let. According to recent advices from Williamsport, Ind., a change will be made in the specifications before the work is readvertised.

⊙The contract for the construction of the William Bunger et al. gravel road, for which bids were received until Jan. 2, has been awarded to John S. Rogers, Bloomington, Ind., at $4,744. The work includes grading and placing metal on gravel road, 2 miles in length. Horace Glakely is County Auditor.

It is reported that business men of LaPorte, Ind., are contemplating a campaign for the construction of a macadam road from LaPorte to the Starke county line, a distance of 20 miles, through Center, Scipio, Noble and Hanna townships, connecting with the stone road to Knox.

Bids were opened Jan. 3 by Ellis S. Rees, County Auditor, Winimac, Ind., for the improvement of two public highways. No contracts were awarded.

No bids were received Jan. 3 by the Board of County Commissioners, Martinsville, Ind., for the construction of the highway improvements in Adams township.

Iowa.

⊙The city council of Sioux City, Ia., has awarded the contract for the paving of the streets from Sixth to 14th, inclusive, between Pearl and Jackson Sts., to Flinn & Hanlon for $1.18 per sq. yd. for concrete, and $1.23 for corrugated concrete. The total cost involved is about $36,000. About 31,000 yds. of pavement will be placed.

Mayor Maloney of Council Bluffs, Ia., is advocating the passage of a resolution ordering East Pierce St. and McPherson Ave. paved to the cemetery within next month.

The city council of Mason City, Ia., has instructed the city solicitor to draw up resolutions for the paving with cement of Washington St., from Marna to Ada; Washington, State to Fifth; Fifth, Washington to Adams; State, Washington to Adams, with brick; Michigan, Fourth to Fifth; Michigan, State to Eighth, and Seventh, Washington to Michigan. Most of the work will be of concrete paving.

City Council of Des Moines has approved specifications for seven stretches of paving to be laid next year. They are as follows: Sheet asphalt from Walnut to Mulberry Sts. on 11th St.; sheet asphalt from 16th to 18th Sts. on Center St.; creosote blocks from Vine to Elm on 4th St.; creosote blocks from Locust St. to Grand Ave. on 10th St.; sheet asphalt from Maple to Lyon Sts. on 6th Ave.; concrete in east and west and north and south alleys between 10th and 11th Sts. from Locust to Walnut Sts.

A mass meeting of the citizens of Jefferson and Port Louisa townships, according to advices from Wapello, Ia., was recently held in the city hall to discuss the matter of building a new road east from the bridge crossing the Iowa River.

Kansas.

Farmers north of Hutchinson, Kan., are agitating the improvement of the Plum St. road and the Monroe St. road through the sand hills.

Kentucky.

Advices from Jeffersonville, Ky., state that an election was recently held near Otto on the question of building a free gravel road through a part of Owen township.

Michigan.

A resolution has been introduced in the city council of Battle Creek, Mich., providing for the submission to the voters the question of raising the bonding limit from $125,000 to $250,000 for street paving.

The county road commission, Houghton, Mich., is working on plans for the improvement of the h[illegible] Hancock and [illegible] in a month or two [illegible] the first road [illegible] county road system.

[illegible]

Mississippi.

[illegible] Brookhaven, Miss., to vote on issuing bonds in the sum of $100,000 to be used in the con[illegible] haven is located in the district where the election is to be held, and the plan proposed is to construct a modern system of public highways radiating in all directions from this municipality.

The Board of Supervisors of Harrison County, Gulfport, Miss., have sold $50,000 road bonds issued for District 2.

The County Supervisors at Brookhaven have authorized the issuance of $25,000 worth of bonds for the purpose of building and maintaining good roads in the third supervisor district of the county.

Missouri.

⊙The Board of Public Improvements of St. Louis, Mo., has awarded street sprinkling contracts as follows: 1, Heman Construction Co., $3,600; 2, Stephen J. Ratican, $5,113; 3, same, $6,013; 4, Peter Fabick, $4,490; 5, William H. Redemeyer, $7,300; 6, Timothy E. Cavanagh, $9,189; 7, William H. Redemeyer, $7,390; 8, Heman Construction Co., $9,500; 9, William H. Redemeyer, $9,000; 10, same, $9,800; 11, Stephen J. Ratican, $5,213; 12, William H. Redemeyer, $9,700; 13, same, $4,800; 14, same, $6,800; 15, same, $8,978; 16, Timothy E. Cavanagh, $7,800; 17, William H. Redemeyer, $7,090; 18, same, $5,700; 19, Heman Construction Co., $5,400; 20, William Cogan, $6,475; 21, William H. Redemeyer, $5,890; 22, James Davis Contracting Co., $4,777; 23, John McMahon, $3,517; 24, Charles A. Kalbfell, $4,950; 25, Stephen J. Ratican, $7,513; 26, same, $5,713; 27, James Davis Contracting Co., $5,500; 28, William H. Redemeyer, $4,000; 29, same, $4,900; 30, William Cogan, $6,200; 31, William H. Redemeyer, $9,500; 32, Frank A. Stiers, $5,199; 33, William H. Redemeyer, $4,700; 34, same, $5,800; 35, Frank Stiers, $8,730; 36, William H. Redemeyer, $8,100; 37, same, $6,400; 38, same, $6,370; 39, Stephen J. Ratican, $4,213; 40, same, $8,813. Total, $260,436.

The Board of Public Works of Kansas City, Mo., has adopted plans and specifications for the grading of 24th St. from Main St. to Grand Ave.

Nebraska.

The city council of Omaha, Neb., has passed an ordinance providing for the paving of 16th St., from Farnam to Leavenworth Sts., with creosoted blocks.

The city of Hastings, Neb., sold bonds Jan. 9 to the amount of $12,000 for the construction of pavement in Districts Nos. 9 and 10. District No. 9 includes the territory between Second St., Burling and Briggs Aves., and District No. 10 includes that between Bellevue Ave., First and Second Sts.

New York.

• [illegible] awarded the contract for improving the highways known as Columbus Ave. and Commerce Ave. to Molloy & Murray, for $45,000. Columbus Ave. is located at Valhalla, and is 1.66 miles in length. The road to be improved on Commerce Ave. starts from where it crosses the New York Central & Hudson River Railroad tracks at Kensico Cemetery, and runs northerly to Broadway at Hawthorne, a distance of 1.78 miles.

The Board of Supervisors at Lockport have passed a resolution to improve Carmon road [illegible] 2 miles. The county and town benefited will bear the expense, the state having no share. The county superintendent of highways will prepare the plans.

North Carolina.

Citizens of Wake County, Raleigh, N. C., have decided to ask the approaching legislature for a special Wake county act providing for a $300,000 bond issue for road building to extend into every section.

Ohio.

✣Bids will be received, it is said, until Jan. 14, by James C. Wonders, State Highway Commissioner, Columbus, O., for building one mile of macadamized road in Goshen township. The road will extend from Mechanicsburg and is estimated to cost about $7,984

✣Bids will be received until noon, Jan. 20, by Board of County Commissioners, Cincinnati, O., for the extension and improvement of Hillside Ave., from Anderson Ferry eastwardly in Delhi township. Fred Dreihs is [illegible]

⊙J. T. Lynch, Flint, Mich., has been awarded the contract by the city of Circleville for paving Court St. The work includes 41,883 sq. yds. of vitrified brick with asphalt filler and two small sewers. The contract price was $73,052. Bids were opened Jan. 3.

⊙The contract for building a stone road in Johnson township beginning at the township line inside the corporation line of St. Paris and extending north ½ mile, has been awarded to F. A. Gearhart, of St. Paris, at $1,126.

⊙The County Commissioners, Columbus, O., have awarded to J. W. Jewett, Worthington, O., at $13,000, the contract for resurfacing the North High St. road extension from the corporation line to Worthington with tar finish.

⊙The contract for laying sewer pipe in Independence Road No. 1 has been awarded by the County Commissioners, Cleveland, O., to the Asphalt Block Paving Co., Toledo, O., Frank R. Lander is County Engineer. Bids were opened December 31. J. F. Goldenbogen is Clerk.

The council committee of the city council of Canton, O., recommends the paving of East Third St. Phil H. Weber is city engineer.

Attorney F. J. Hanlon has asked the Kenton county commissioners to adopt a resolution providing for the purchase of the Banklick turnpike for $17,500. The question of buying the pikes of the county and abolishing toll gates has been agitated for some time in Kenton county.

The county commissioners at Lisbon, O., have filed with the state highway commission two petitions presented to them by property owners in Elkton township who desire state aid in improving the roads in front of their properties.

Early this year the city of Cleveland, O., will ask for bids for the paving of 33 streets at an estimated cost of $600,000. The city plans to expend $1,100,000 for street paving during the year. Robert Hoffman is city engineer.

The lowest bidders for three sections of the Akron-Hudson Road were as follows: Section 1, McShaffrey & Son, of Akron, at $38,682. Section 3, Vildes & Davidson, Akron, at $63,264. Section 5, Paul & Henry of Barberton, at $106,652. The road is to be 14 ft. wide.

Steps will probably be taken shortly by H. F. Duesing, Director of Public Service, Youngstown, O., for securing two additional street flushers.

Village of Montpelier, O., will hold a special election on Jan. 31 to vote on the proposition to issue bonds for the purpose of paving Empire St. and Main St. from the east side of Monroe St. to the east corporation line. According to the estimates furnished by Riggs & Sherman, Engineers, Toledo, the paving will cost from $50,000 to $70,000, according to the paving constructed. Estimates were furnished for brick, asphalt and treated macadam pavement. According to present plans the village will pay the cost of street intersections and 15 per cent of the frontage.

Oklahoma.

The Chamber of Commerce of Chickasha, Okla., has launched a movement to improve the county roads in Grady county. F. F. Colby is city engineer of Chickasha

Oregon.

The following bids have been received by the City Executive Board at Portland, Ore., for street improvement work: East 46th St., grading and concrete curbs and walks, Giebisch & Joplin $1,731; East [illegible] St., grading and concrete curbs and walks, Giebisch & Joplin, $780; East [illegible] St., grading and concrete curbs and walks, J. M. Manning $[illegible]; Princeton St., grading and concrete curbs and walks, Bechill Bros. $5,000, R. J. Debuhr $4,000; [illegible] St. from [illegible] to East [illegible], grading and concrete curbs and walks, Giebisch & Joplin $[illegible], Jacobs & Marks $[illegible]; East 53d St., grading and concrete curbs and walks, O. Paulsen $4,388, Bechill Bros., $4,973; East 15th St., grading and concrete curbs and walks, Bechill Bros., $1,572; East 54th St., grading and concrete curbs and walks, J. M. Manning, $4,359.

Pennsylvania.

It is reported that the Pennsylvania Railroad will pave the subway under its tracks at Marysville, Pa., with Belgian blocks early in the spring.

The city administration of Philadelphia, Pa., has decided to postpone opening proposals for next year's paving pending judicial decision in the current street repair injunction suits. The street repair proposals for 1911 represented a total estimated expenditure of about $1,000,000, including $500,000 for repair of streets occupied by street railway tracks.

The citizens of Swissvale, Pa., at a recent election defeated a bond issue to the amount of $100,000 for street improvements and sewerage.

The city of Philadelphia has purchased a tract of almost 20 acres at 67th and Race Sts. for a consideration of $115,000. The ground was acquired by the city for the Cobb's Creek Parkway.

Tennessee.

Lafayette Turnpike Co. of Macon County, has been incorporated with a capital stock of $5,000, the incorporators being M. S. Woodmore, W. J. Gray, Prentice Harlan, John [illegible], John L. Holland and James T. Sullivan.

The State has granted an amendment to the charter of the Hartsville & Lafayette Turnpike Co., authorizing it to extend its line of road.

Willard Turnpike Co. of Trousdale County, has been chartered with a capital stock of $1,000.

Texas.

✣Bids will be received until 3 p. m., Jan. 24, by City Council, Millsboro, Tex., for brick, bitulithic and concrete amounting to about 31,500 sq. yds. Plans are on file at the city hall or at the office of F. L. Dalton, Engineer, Dallas, Tex.

⦿Advices from Denison, Tex., state that the contract has been let and the work started Jan. 2 for the good roads work by the Southwestern Surety Insurance Co., to Roberts & McSpaddin of Vinita, Okla. The work is to be completed within the two years allowed by the original contract, which was awarded Dennis McNerney.

⦿The Municipal Commissioners of Dallas have awarded the contract for the paving of South Harwood St. to the Texas Bitulithic Co. The paving is to extend from Jackson St. to Forest Ave., and upon request of the property owners is to be of bitulithic. It will be on a 5-in. concrete base. The contract embraces 27,951 sq. yds., or more than 1½ miles of 30-ft. roadway. The total cost with five-year maintenance will be $64,192.95, with a possible additional $5,000, according to the sort of stone selected for the surfacing. The bids received were: Texas Bitulithic Co., for brick on 5-in. gravel concrete foundation, $78,294.70 without maintenance, $81,089.80 for five-year maintenance; for bitulithic without maintenance $62,239.91, with five-year maintenance $64,192.95, with additional $3,417.82 for Arkansas tap rock and $4,638.47 for Llano granite. Stevens Construction Co., brick without maintenance $74,086.75, with five-year maintenance $75,484.30; for rock asphalt without maintenance $58,289.80, with five-year maintenance $60,731.10; for asphaltic concrete $59,510.45 without maintenance, $60,731.10 with five-year guaranty.

A $150,000 bond issue of Fort Bend County, Richmond, Tex., has been registered. These bonds have been issued by Road District No. 1, lying between Richmond and the Harris county line. The bonds have been sold and among the projected improvements is to gravel and shell the public road from Richmond to the Harris county line below Missouri City. The road has been graded and is now ready for the gravel and shell. George C. Baker, Richmond, is County Judge.

Virginia.

The Town Council of Harrisburg, Va., has instituted condemnation proceedings against the old Woodson & Albert stable property. The town will purchase the property for the purpose of building an approach to the new $30,000 Baltimore & Ohio passenger depot, which will be ready for use in a few weeks.

Washington.

✣Bids will be received until 2 p. m., Jan. 18, by State Highway Board, Olympia, Wash., for clearing, grubbing, grading, draining and macadamizing State Aid Road No. 99, known as the McDonald Road, in Walla Walla County.

• The State Highway Board at Olympia has awarded the contract for a State road four miles in length east of Tonasket, in Okanogan County to Wood & Rubert at $5,000.

Canada.

It is reported the Ontario government will take steps to build a highway in the Dominion, within a short time, to extend between Windsor and Niagara Falls, with branches to Hamilton and Toronto.

The Province of British Columbia contemplates the expenditure of $4,500,000 in road building this coming spring and summer. Among the roads to be built is the road leading to the recently established Battles Lake National Park reserve on Vancouver Island. Richard McBride is premier of the province and Thomas Taylor is minister of public works.

According to information received from Victoria, B. C., the Vancouver Island Development League is taking up the proposal for the construction of a through trunk road from Victoria to Barkley Sound.

BRIDGES—STEEL AND CONCRETE

California.

Information received from Stockton, Cal., states that bids for the construction of three bridges on Coggswell Road north of Peters were received by the Board of County Supervisors as follows: F. E. McIntire, $3,948; F. H. Martin, $4,120; M. B. White, $3,855; H. Wait, $3,749; W. J. O'Brien, $3,942.

Plans have been prepared by S. H. Finley, C. E., Santa Ana, Cal., for the construction of a highway bridge to be built at Newport Bay for the purpose of connecting Balboa Island with the main land. The structure will be owned jointly by the county of Orange and the town of Newport Beach and private parties. It will be 180 ft. long and will be built of reinforced concrete or with concrete abutments and steel trusses. Permission for the improvement has been applied for to the War Department. Material for the construction will be furnished by Collins Commercial Co., Los Angeles, Cal.

Colorado.

An agreement [illegible] the Board of Public Works, Denver, Colo., and officers of Jefferson [illegible] bridge will be constructed [illegible] at 12th Ave. [illegible] stream [illegible].

According to advices from Greeley, Colo., work was started Dec. 26, 1910, on the construction of the proposed new bridge across the Platte River between Evans and that city. The cost of the work will range about $35,000.

City Engineer, Denver, Colo., has reported favorably on the proposition to construct a bridge over Cherry Creek to the Platte River.

Florida.

The Florida East Coast Ry. Co., E. Ben Carter, Superintendent of M. of W., St. Augustine, Fla., will soon call for bids for a Strauss bascule bridge. The accompanying cut shows the profile of the site of the structure which is to be erected over the St. John's River near Cook's Ferry in Volusia County, Fla., just north or on the down-river side of Lake Harney. It will be part of the Kissimmee Valley Division extension of the Florida East Coast Ry., which will be constructed from Maytown, in the above county, southwardly through Osceolo and Palm Beach counties to the north side of Lake Okeechobee, probably having a terminus at Tantie. No unusual engineering conditions will be encountered, the line being through what is known in Florida as "Pine Woods" with occasional saw grass ponds interspersed. It is thought that the main line will be 130 miles, with a branch 36 miles from [illegible] to Bassinger.

Georgia.

✣Bids will be received until noon, Feb. 6, by Commissioners of Roads and Revenues, [illegible], Ga., for the construction of a steel bridge over Alapaha River on Irwinville and Tifton public roads. The structure will consist of four 100-ft. spans on concrete abutments and steel cylinder piers. G. T. Young is Clerk. H. T. Fletcher, Ocilla, Ga., is Chairman of the Commission.

Idaho.

Efforts are being made to secure the construction of a new bridge over the Snake River north of Burley, Idaho, at the end of Overland Ave., and petitions will be submitted to the Boards of County Commissioners of Lincoln and Cassia Counties. Business men of Burley and farmers of Lincoln and Cassia Counties, whom the bridge would benefit, are willing to donate liberally toward its construction. The legislature will also be petitioned to make an appropriation for the improvement.

Illinois.

✣Bids will be received until 11 a. m., Jan. 14, 1911, by B. J. Mullaney, commissioner of public works, city of Chicago, room 705 City Hall, for making the following repairs to the pile constructions at the various bridges in the city of Chicago. The work consists of the following general items: Furnishing 20 piles 30 ft. long, 40 piles 35 ft. long, 300 piles 40 ft. long, 200 piles 45 ft. long, 50 piles 50 ft. long, 1,500 hours' use of pile driver, crew and scow, 4,500 lin. ft. of pile chain and 3,000 pounds of boat spikes (these quantities approximate only). The piles shall be white or burr oak, sound, straight, with a uniform taper from the butt to the small end, the former to be not less than 14 inches, the latter not less than 9 inches; the pile chain is to be ¾ in. (6 pound chain) for all pile clumps and the pile clumps shall be bound securely by 5 laps of chain securely spiked in position with wrought iron boat spikes of the best quality. The spikes shall be 6x⅜ in. and shall be of standard quality. The contractor shall furnish for the price bid tug service necessary to handle scow, equipment, etc., to the satisfaction of the commissioner. Full specification may be had upon application to the commissioner of public works.

✣Bids are asked until 8 p. m., Jan. 24 (change of date), by the Commissioner of Public Works, Peoria, Ill., for the construction of the new bridge over the Illinois River at Bridge St., including the removal of the debris of the old structure which collapsed some time ago. The following parts of the former reinforced concrete bridge are standing and will be used as a part of the new bridge: A Scherzer bascule span resting on piers which are about 135 ft. apart in the clear. The piers are to be remodeled. What is known as Abutment A on the westerly side of the river. This abutment is to be remodeled. The approach on the westerly side of the river. This approach is to be paved. The principal part of the new work required will be as follows: One 27 ft. 6 in. deck plate girder span over Abutment A; one steel arch span, 110 ft., center to center of end pins; three riveted through truss spans, 182 ft., 8 15-16 ins., center to center of end pins; two new concrete piers and a new abutment to be carried down to bed rock.

The Kelly Construction Co., of Chicago, Ill., has started work on the construction of the new bridge across the Flatrock River at St. Paul, Ind., for the Cleveland, Cincinnati, Chicago & St. Louis R. R. It is necessary first to tear the old iron work out to make room for the new structure.

Plans and estimates are being prepared by Engineer G. C. Broyhill for the construction of a concrete bridge over Sugar Creek on Virginia Ave. between Franklin Ave. and Main St., Normal, Ill. As proposed, the structure will be 43 ft. long and 28 ft. wide with two openings to accommodate high water.

Indiana.

✣Bids will be received until 10 a. m., Jan. 18, by Board of County Commissioners at Indianapolis, Ind., for the construction of a bridge over Canal at College Ave. Albert Sahm is Auditor of Marion County.

⊙The contract for the construction of the Edwardsport bridge was let to the Vincennes Bridge Co., Vincennes, Ind., at $15,548. The bids were opened on January 5.

It is reported that Fairfax Harrison, President of the Chicago, Indianapolis & Louisville Ry. Co. (Monon Route), and the Kentucky & Indiana Terminal R. R., formerly the Kentucky & Indiana Bridge & Railroad Co., announced recently that the Kentucky & Indiana Terminal R. Co. has sold to Messrs. J. P. Morgan & Co., New York, $5,000,000 of its new first mortgage bonds, to be marketed in London, and with the proceeds of such sale will retire all of the existing mortgages upon the property and proceed actively with the construction of the new bridge across the Ohio River between Louisville and New Albany and the double-tracking and other improvements of the terminal railroad and facilities in and about Louisville. The new bridge is to be a double-track bridge, capable of loading with the heaviest modern engines and cars, and this increased facility, removing as it will the restrictions now placed upon traffic crossing the Ohio River at Louisville, and the improved terminals at Louisville, are expected to materially expedite the movement of the Lousville traffic handled by the Southern railway, Baltimore & Ohio and the Monon, which railways are the joint owners of the Kentucky & Indiana Terminal R. R.

Board [illegible] Park B[illegible] [illegible] of the p[illegible] of a bridge [illegible] [illegible]

Iowa.

City C[illegible] [illegible] being made in the matter

Kansas.

✣Bids [illegible] 28, by W. R. Green, County Clerk, Lawrence, Kan., for the removing and erecting and furnishing a certain amount of new material for a bridge. A certified check for $100 [illegible]

A proposition will probably be voted upon at the spring election at Topeka, Kan., to authorize the Board of City Commissioners [illegible] $40,000 in bonds for [illegible] construction of bridges in that city. [illegible] wooden bridges will b[illegible]

Maryland.

•[illegible] port, Md., in the county of Cumberland have awarded the contract for the erection of a two span bridge across George's Creek, which runs through the center of the town to the Nelson-Meredith Co., Chambersburg, Pa., at $4,365

Michigan.

Arrangements have been made by officials of the Detroit & Mackinac Ry. for the construction of a bridge over Swan River on the Rogers City branch. H. S. Waterman, E. Tawas, Mich., is Chief Engineer.

Minnesota.

•Bids were opened [illegible] of the proposed bridge over the LeSueur River at Red Jacket by the County Commissioners, Mankato, Minn., and the contract awarded Marsh Engineering Co., at $12,650. The bids were as follows for a steel bridge: Pennsylvania Bridge Co., Beaver Falls, Pa., superstructure, $6,350; Beach Manufacturing Co., Sioux Falls, S. D., superstructure, $8,995. Minneapolis Bridge & Iron Co., superstructure, $6,896; Twin City Bridge Co., Minneapolis, superstructure, $6,006, concrete $12 per yd., piles 48 cts. per lin. ft.; Hennepin Bridge Co., Minneapolis, superstructure, $4,977, bridge complete, $8,277; A. Y. Bayne & Co., Minneapolis, superstructure, $6,700; Des Moines (Iowa) Bridge & Iron Works, complete, $11,966; Joliet (Ill.) Bridge & Iron Co., superstructure, $6,100, complete $9 500; Johnson, Carey & Helmers Co., St. Paul, complete, $10,987; J. B. Nelsen & Co., Mankato, complete $13,439. The following bids were received on a reinforced concrete bridge: Marsh Engineering Co., Des Moines, Iowa, according to one plan submitted $9,750, according to another plan, $12,650; Johnson, Carey & Helmers Co., St. Paul, three-arch plan, $12,887; North Star Concrete Co., Mankato, four span flat deck plan, $12,256.30, concrete arch, gravel filled roadway and approaches $14,476.50; A. Bashaw, according to plan submitted, $13,779; J. B. Nelson & Co., according to plan, $8,993.

City Council of Stillwater, Minn., received [illegible] new wooden bridge over the St. Croix River at that place. The following bidders submitted propositions which were referred to the City Engineer, L. W. Clarke: A. Y. Bayne & Co., Minneapolis, Minn.; Hewett Bridge Co., Minneapolis, Minn.; George [illegible]

Mississippi.

Municipal authorities of Meridian, Miss., have adopted resolutions demanding that the various railroads entering Meridian construct a viaduct over their tracks which separate South Side from the northern part of the city. Five railroads are involved.

At a meeting of the Board of Supervisors, Port Gibson, Miss., it was decided to ask bids in the near future for the construction of a new bridge at Port Gibson to replace the large iron suspension structure over Little Bayou Pierre. All bids will be acted upon at the February meeting.

Montana.

•[illegible] Neb., state that the Board of Supervisors of Butler County has awarded the following contracts for the year 1911-1912: All wood and steel bridges to be constructed in Butler County to the Nebraska Construction Co. of Lincoln, all cement culverts to the Wilson Reinforced Concrete Co. of Nebraska City, all metal culverts to the Nebraska Culvert Manufacturing Co. of Wahoo.

Commissioner of Indian Affairs has been authorized to apply $10,000 from the proper fund to assist officials of Rosebud and Yellowstone Counties, Mont., in the construction of a bridge across Big Horn River southeast of Hardin. The counties will pay $18,500 of the cost

Nebraska.

✣Bids will be received until Jan. 12, by Board of County Supervisors, Kearney, Neb., for new bridge work, repairs and material [illegible]

New Hampshire.

Advices from Concord, N. H., state that the Boston & Maine R. R. Co., has authorized among other improvements and repairs the construction of a new double track steel bridge across the Merrimack River at Bow Junction on the line of the Portsmouth road.

New York.

A special town meeting was held at Warsaw, N. Y., Jan. 4 for the purpose of appropriating money to construct a new bridge across the Oatka Creek just north of the village.

According to advices from Albion, N. Y., the Board of Trustees had a hearing Dec. 30 on the Clarendon bridge proposition submitted by the New York Central Ry. A contract was drawn up for a new bridge 21 ft. above the track with approaches to be kept in order by the company.

North Dakota.

Work is to be started at once by the Northern Pacific Ry. System on the construction of two steel bridges to span the Heart and Cannon Ball Rivers on the Missouri River line, North Dakota. Each span will be 200 ft. long resting on concrete abutments that supported the old structures.

Ohio.

✣Bids will be received until 1 p. m., Jan. 16, by Board of County Commissioners, Jefferson, Ohio, for the necessary labor and material for the construction of the superstructure of a riveted steel Pratt truss bridge over the Grand River on the East and West Center Road in Orwell township. J. S. Matson is County Surveyor.

All bids received for the substructure of the new Fifth St. bridge at Zanesville, O., were rejected by the County Commissioners. The bids ranged from $3,500 to $6,000 and the bidders were R. H. Evans & Co., J. W. Hyser, J. L. Mercer, Adams Bros. Contracting Co.

Flood waters destroyed the bridge of the Western Ohio R. R. on the Lima Stone Co. spur and immediate steps will be taken by the company to replace the old wooden structure with a new steel bridge. F. B. Mason, St. Marys, O., is Chief Engineer.

City Council of Toledo, O., took for consideration at a recent meeting the petition presented by the residents of the 10th Ward asking for the construction of a bridge over Swan Creek on the extension of Champion St. Action was delayed for a short time, however, to give the engineer an opportunity to present some estimates. Such a structure would give a direct outlet to Air [illegible]

Oklahoma.

✣Bids will be received until Jan. 21 by Board of County Commissioners, Bartlesville, Okla., for the construction of a bridge 283 ft. north of southeast corner of Section 11, township 23, range 13 in Washington County. The structure will be 50 ft. long and will have a 16 ft. roadway.

An agreement has been reached between the officials of the Santa Fe. System and the Guthrie Street Railway Co. to accept the plans of the Topeka Bridge & Iron Works for the construction of the concrete viaduct at Cleveland Ave., Guthrie, Okla. The height will be sufficient to give the standard overhead clearance, except over the Denver, Enid & Gulf tracks west of the Cottonwood and the Santa Fe Co. is granted permission to raise the viaduct at its own expense, should it ever desire to use the D. E. & G. tracks or right of way for any active railroad purposes. The viaduct is to be 40 ft. in width so as to carry one track of the Guthrie street railway and an additional one in the future if it should be necessary. It is to be constructed of reinforced concrete except the open span across the right of way of the railway company over the main track, which is to be either of steel or concrete construction, and to be any length desired by the company.

Material has arrived at Manford, Okla., to be used in the construction of the proposed bridge to be built across the Cimarron river at that place. It is planned to have the work completed by the spring.

Oregon.

Advices from Newberg, Ore., state that farmers of Clackamas, Marion and Yamhill Counties have organized the Tri-county Push Club, for the purpose of securing funds for the construction of a high bridge across the Williamette River at Butteville.

It is reported that the contract for the construction of the substructure of the Broadway Bridge at Portland, Ore., for which bids were received December 30 has been awarded to the Union Bridge & Construction Co., New Nelson Bldg., Kansas City, Mo. Ralph Modjeski, Chicago, Ill., is Consulting Engineer.

Pennsylvania.

Preliminaries are well under way in Johnston, Pa., for the elimination of the Morrellville grade crossings and it is expected that the Councils committee having charge of the negotiations will be able to come to terms with the railroad company. It was reported that the Pennsylvania R. R. representatives had instituted negotiations with the Southern Cambria Railway officials with the view of abandoning the wooden overhead crossing in Woodvale and using the trolley road's viaduct for traffic to Woodvale Avenue and Woodvale Heights.

Following a conference at the City Hall, Scranton, Pa., between the Director of Public Works and Engineer William Schunk and M. W. Easby, representative of the American Ry. Co., it was announced that plans for the proposed Mulberry St. viaduct will be ready the middle of this month and that bids will be received the early part of February.

Consulting Engineer of Allegheny County, Pittsburg, Pa., has submitted a report on the projected South Hills bridge and tunnel, recommending the Bell House tunnel and bridge project as the one which the county ought to construct. It is estimated that the cost will be about $2,000,000.

Texas.

City of Houston, Texas, at the present time has under consideration the construction of a number of bridges. A recent report from that place states that providing the bond issue voted upon January 10 carried, the following bridges would be built: Main St. viaduct, complete, estimated to cost $500,000; San Jacinto St. bridge, 70 ft. wide and 300 ft. long; concrete bridge at Preston Ave. over Buffalo bayou; Houston Ave. bridge over White Oak bayou, 230 ft. long and 50 ft. wide; bridge over the ravine at the intersection of Houston and Beauchamp Sts., 77 ft. long and 50 ft. wide; bridge over same ravine further out where Beauchamp St. again crosses.

Wisconsin.

City Council of Marinette, Wis., has taken up the matter of construction of a new paper mill bridge and securing permission for building that structure and the middle bridge from the legislatures of the states of Wisconsin and Michigan.

City Council of Superior, Wis., is still undecided as to the type of structure to be built at W. Fourth St., the body being divided between a fill, a wooden bridge at the present grade and a wooden bridge at a depressed grade with a draw similar to the Northern Pacific R. R. bridge in St. Louis Bay. City Engineer will prepare estimates of the relative costs and it is believed that the matter will be decided according to expense.

Canada.

The Railway Commission, according to advices from Belleville, Ont., has ordered five piers to be used in the construction of the Canadian Northern Ry. bridge across the River Moira in that city. The Public Works Engineer has also recommended the dredging of the rocky shoal at the point where the bridge is to be constructed.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

✣Bids will be received from 2 to 4 p. m., Jan. 16, by Engineer J. H. Burke, Drainage District No. 6 of Craighead County, Jonesboro, Ark., for the construction of a canal and improvements in drainage district. The canal is to be about 36,000 ft. in length, 18 ft. wide at the bottom and 24 ft. wide at top, with an average depth of 7 ft. It is estimated that the work will include about 183,000 cu. yds. of material. R. L. Collins is Clerk.

An extensive drainage project for Chicot, Desha and Lincoln County is under consideration, according to advices from Lake Village. The plan proposes that separate drainage districts be formed in each county with the object of using Cypress Creek as a main drain. It is believed that nearly 300,000 acres can be reclaimed at a cost of about $500,000. County Judge C. H. Halley, of Arkansas City, Ark., is interested.

A contract has been made for the survey of Rio River in Miller county for the purpose of establishing a levee district. An engineer of the United States Department of Agriculture will assist in the survey, which has for object the reclamation of 170,000 acres.

California.

Citizens of San Jose, headed by Capt. E. G. Cooper, are agitating a proposition to build a lock canal connecting San Jose and the South San Francisco Bay. The distance is ten miles, and the lay of the land is such that only two locks would be required to give the city a waterway connecting it directly with practically all the maritime business of San Fran- [illegible] estimated cost is less than $500,000.

Farmers of Arcata and vicinity will petition the State Legislature for an appropriation for the protection of the banks of Mad River.

Colorado.

Reports from Greeley, Colo., state that W. E. Day of Riverside will spend $6,000 in building a drain ditch three miles long, to provide drainage and irrigation for land along the Platte river.

During the month of December the tunnel of the Laramie-Poudre Reservoir Irrigation Co. was advanced 482 ft. from the east portal alone. This makes the total distance driven to date 7.287 ft., leaving 4,500 ft. to be driven. The contract calls for the completion of the tunnel by Dec. 1, 1911, but it is expected that this time will be beaten by a good margin. A meeting of stockholders was held in Denver Jan. 6 to discuss a proposition to renew work from the west portal. This tunnel is being driven northwest of Fort Collins to divert the waters of the Laramie River in Wyoming to the Poudre in Colorado. James McIlwee is the general contractor for the tunnel work.

Business men of Boulder have secured a large tract near Wellington, will settle a family on each 40 acres and provide reservoirs and ditches for irrigation next summer. The reservoir will hold 147,643,490 cu. ft. of water. Its dam will be about 35 ft. high and a mile in length. The work is to cost $25,075 and the reservoir will be about seven miles north of Wellington.

Indiana.

⊙Daniels & Yost, Anderson, Ind., have been awarded the contract for constructing a dredge ditch in Scott County near Scottsburg. The contract price was about $18,000. Work is to be started in March.

Louisiana.

⊙John G. Sessions has been awarded a contract at 12.4 cts. per cu. ft. for the construc- [illegible] cu. yds. of levee work in the Atherton levee on the right bank of the Mississippi River in East Carrol Parish. Bids were opened Dec. 20 by the Board of State Engineers at New Orleans.

Thomas L. Means and Leslie W. Symmes of San Francisco have purchased from the North American Land & Timber Co. 305,000 acres of overflow prairie located between the Calcasieu and Mermentau Rivers, the north line being 16 miles south of Lake Charles. The work of draining the land will be begun soon.

Massachusetts.

Work has been suspended for the winter months on the long granite breakwater which is to protect the Cape Cod Bay end of the Cape Cod Canal. Much has been accomplished in the construction of the big sea wall, which reaches out from the shore for 3,500 ft. and is of about one-third of its completed length. It is on the northerly side of the entrance to the canal. The Degnon Contracting Co., New York City, has the contract for constructing the breakwater. The dredging work on the canal, which is being done by the Maryland Dredging Co., will be continued during the winter.

Missouri.

⊙Swift, Rust & Co., Chemical Bldg., St. Louis, Mo., have been awarded the contract at $107,770 for the construction of 13,000 lin. ft. of standard revetment. Bids were opened Jan. 5 by Maj. Edward H. Schulz, U. S. Engineer, Kansas City, Mo. The revetment is to be constructed on the left bank of the Missouri River, in Randolph Bend, about six miles below Kansas City, Mo. The mattress is to be 12 ins. thick and 86 ft. wide; the shore edge to be not more that 3 ft. above standard low water, to be made of bar growth willow, cut not longer than one week in ad-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

vance of delivery and use, ½ to 2 ins. diameter at the butt end and 10 to 25 ft. long. The slope is to be paved with one-man stone, either sandstone or limestone of good quality, or other hard stone that will not disintegrate under action of air or water. The stone is to be in pieces approximately rectangular in cross section, and weighing on an average 100 lbs., no piece to be less than 25 nor more than 200 lbs. The paving is to commence at the top of the slope and work down, each stone to be placed by hand, slanting up hill, and to a depth normal to the face of the slope of at least 8 ins. at the top and 12 ins. at the bottom, and to extend from the top of the slope to the water and into the water 18 ins. For the next 10 ft. a compact layer of stone 12 ins. thick is to be placed on the mattress by casting into the water.

North Carolina.

⦿The Brett Engineering & Contracting Co., Wilson, N. C., has been awarded the contract by the Lyon Swamp Drainage District for drainage work in Pender and Bladen Counties, North Carolina. The work includes excavating 13 miles of canal, from 16 to 24 ft. bottom width, requiring approximately 345,000 cu. yds. of excavation, and the construction of a dam on Cape Fear River, requiring 36,000 cu. yds. fill. Bids were opened Dec. 29.

Oklahoma.

⦿The Sprankle Contracting Co., Fort Wayne, Ind., has been awarded the contract for improving Deep Fork River in Oklahoma County for Drainage Ditch No 1. The channel will be dredged for a distance of about 15 miles. The contract is said to amount to about $100,000.

Texas.

A company is being organized at Lyford, Tex., for the purpose of securing the irrigation of some 60,000 acres of land about Lyford, Raymondville and Sebastian. The plan proposes to take the water from a point on [illegible] resaca through which the water will flow for about 30 miles, [illegible] entire distance necessary to bring the water. At a point between the river and McAllen and San Juan, there is a 6,000 acre natural reservoir which, [illegible] put a foot of water on 60,000 acres. Further on there is another natural reservoir which, while unsurveyed, it is believed will hold nearly as much water as the first. There are also known to be other natural reservoirs or depressions that can be used as storage reservoirs. A. L. Stanford, Lyford, and C. H. Pease of Raymondville, are interested.

The State Levee and Drainage Board, Austin, may order a survey preliminary to reclaiming river bottom land along the Trinity between Dallas and Arlington.

Two drainage systems are proposed in Cameron County. For Drainage District No. 1 it is expected that the State Attorney General will give his approval to the project by the end of this month, so that the sale of $204,500 of bonds can be advertised and the work let to contract. A. W. Amthor, Brownsville, Tex., is Engineer of the district. District No. 2 has just been formed and W. W. Vann, Brownsville, has been appointed as the Engineer. Surveys will be made and estimates of cost secured and in about two months an election may be held to vote on issuing bonds for the work.

Utah.

✣Bids will be received until 2 p. m., Jan. 16, by the Board of Directors of the Green River Irrigation District at Green River, Utah, for the construction of the following portions of work to be done for the District: First, for the completion of the dam across the Green River, a part of which dam has already been constructed by the Green River Mutual Irrigation Co., and the widening and deepening of the raceway from the head gates to the intake; second, for the construction and installation of a pumping plant to lift water from the said raceway to the 90-ft. canal; third, for the completion of the 90-ft. canal [illegible] the work can be seen at the office of the Board of Directors of the Green River Irrigation District at Green River, Utah. J. F. Ingels is Secretary of the District.

Washington.

✣Bids will be received until noon, Jan. 19, by C. W. Kutz, U. S. Engineers, Seattle, Wash., for dredging and excavating in Lake Washington Canal right of way.

⦿The U. S. Secretary of the Interior has approved the award of a contract to Nelson Rich, Prosser, Wash., for the construction of about 73 miles of laterals in connection with the Tieton unit of the Yakima irrigation project, Washington. The contract amounts to $50,160.

Wyoming.

⦿Samuel Thomas, Byron, Wyo., has been awarded the contract for the construction of distributory ditches under the Frannie Canal and lateral A, of the Shoshone irrigation project, Wyoming. The work involves excavation of about 21,000 cu. yds. of material. The contract price is $4,940. The work covered by schedules 3 to 6 inclusive, involving construction of structures under the Frannie Canal and lateral A, wil be done by force account.

Canada

The Western Canal Co. has applied to the Canadian Parliament for an act of incorporation. The company asks power to construct a canal from the Rainy River below Fort Frances to a point on the river five miles below the Long Sault Rapids, and to develop electrical power thereby.

The Nepigon Albany Canal & Transportation Co. is applying to Parliament for power to construct a continuous waterway from Nepigon Bay on Lake Superior to James Bay, via the Nepigon River, Lake Nepigon and the Albany River, with incidental power and transportation rights.

WATER-WORKS

Alabama.

The Montgomery Light & Water Power Co., of Montgomery, Ala., is preparing for an expenditure of $350,000 for the purpose of increasing the capacity of its plant. Engineers are at present at work on plans for enlarging the plant at Tallassee.

California.

⦿C. W. Corbaley of Los Angeles, Cal., has been awarded the contract to build the salt water circulating system in that city, which is to be installed by the San Diego Street Car Co., in connection with its new power plant being built on lower E St.

The Mutual Water Co., of Escondido, Cal., is considering increasing the impounding capacity of the reservoir by adding to the heighth of the dam.

Colorado.

W. P. Robinson, general manager of the Denver Union Water Co., Denver, Colo., says the improvements planned for this year will cost approximately $500,000. These will include the laying of a 48-in. conduit from Platte canon to Marston lake, the extension of a 40-in. line from its present terminus to the Ashland Ave. reservoir, and extensions that are made necessary by the growth of the city.

Georgia.

Mayor John T. Moore of Macon, Ga., has presented formal resolution for passage in the city council for a special election to be held March 18 to decide upon an issue of $900,000 in bonds with which to purchase the Macon water system and place it in operation by the city government.

In the annual report of General Manager W. Z. Smith, of the Water Works to the Board of Water Commissioners, Atlanta, Ga., it was recommended to purchase two new vertical triple expansion pumping engines for the Hemphill station and one new 20,000,000 gal. pump for the river station. Other recommendations to be made by the General Manager are as follows: The purchase and installation of two 300-horsepower water tube boilers at the river station, the estimated cost to be $10,000; an enlargement of the coal chute at the same station; the building of a rip-rap dam between the island and west bank of the river so that the water supply over the intake pipes can be increased; purchase of additional land at the Hemphill station for future coagulating basins; the appropriation of $10,000 for the beautifying of the waterworks [illegible] on constant duty at the filter plant; tearing away of the old frame stables at the [illegible] and the erection in their stead of a brick or concrete building. The water depart[illegible]

Illinois.

✣[illegible] Jan. 19, by Board of Public Works, Chicago, Ill., for furnishing and installing in [illegible] switchboard and other appurtenances at the [illegible] accompanied by a certified check for $1,000. [illegible]

✣[illegible] 18, 1911, by B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 705 City Hall, for furnishing and delivering 9 36-in. hydraulic gate valves to the Roseland Pumping Station, 104th St. and C. & W. S. R. R.; the valves shall be of standard design with hub ends, of the kind known as "double gate valves" with iron body and bronze mountings and shall work equally well with the pressure on either side. Each valve shall be provided with a 6-in. by pass, hydraulic cylinders, steam, etc. Full specifications may be had upon application to the Commissioner of Public Works.

✣Bids will be received until 11 a. m., Jan. 14, 1911, by B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 705, City Hall, for furnishing and delivering gate valves as follows: one 36-in., 104th St. and Stewart Ave., March 15, 1911; one 36-in., 104th St. and Halsted St., March 15, 1911; two 36-in., 104th St. and Center Ave., April 15, 1911; one 36-in., 104th St. and State St., April 15, 1911; one 36-in. Pipe Yard "B" 2352 S. Ashland Ave., May 15, 1911; one 30-in., Calumet Ave. and 31st St., April 1, 1911; one 30-in., Vernon Ave. and 35th St., April 1, 1911; one 30-in., Ellis Ave. and 35th St., April 1, 1911; one 30-in., Pipe Yard "B," 2352 S. Ashland Ave.; May 15, 1911; one 24-in., 104th St. and Halsted St., April 15, 1911; one 24-in., 103rd St. and State St., April 15, 1911; one 24-in., 103rd St. and South Park Ave., May 1, 1911; two 24-in., 95th St. and Canal St., May 1, 1911; one 24-in., 99th St. and Canal St., May 1, 1911; one 24-in., 95th St. and Halsted St., May 1, 1911; one 24-in., 91st St. and Halsted St., May 15, 1911; one 24-in., 91st St. and Center St., May 15, 1911; one 24-in., 45th St. and Wabash Ave., May 1, 1911; one 24-in., 43rd St. and Wabash Ave., May 1, 1911; one 24-in., 39th St. and Prairie Ave., May 1, 1911; one 24-in., 39th St. and Ellis Ave., May 1, 1911; one 24-in., 43rd St. and Ellis Ave., May 1, 1911; two 24-in., Pipe Yard "B," 2352 S. Ashland Ave., May 15, 1911; one 20-in., Devon Ave. and Southport Ave., March 15, 1911; one 20-in., Pratt Ave. and Southport Ave., March 15, 1911; one 20-in., Robey St. and Devon Ave., March 15, 1911; two 20-in., Pipe Yard "B," 2352 S. Ashland Ave., May 15, 1911; two 16-in., 104th St. and Vincennes Rd., April 15, 1911; one 16-in., 103rd St. and Michigan Ave., April 15, 1911; one 16-in., 91st St. and Ashland Ave., May 15, 1911; one 16-in., 43rd St. and Ellis Ave., May 1, 1911; five 16-in., Pipe Yard "B," 2352 S. Ashland Ave., May 15, 1911. The valves shall be of the kind known as "Double Gate Valves" with iron body and bronze mountings; of standard design with hub ends. They shall be of single stem inside screw valves with nut for opening, etc. All valves 24 in. in diameter and larger shall be provided with indicators showing the position of the gate through travel, shall be bevel gear valves and shall be provided with a by pass and valve, 4-in. by pass for 24-in. valve and 6-in. by pass for 30-in. valve. Bidders submitting bids on this work shall be prepared to submit a price for each of the different sized valves. Full specifications as to material, delivery, method of bidding, etc., may be had upon application to the Commissioner of Public Works.

⊙Bids were opened Dec. 20 by the Village Board of Glencoe, for constructing 6-in. water main in Green Bay Road and Lincoln Ave., the contract being let to C. T. Bartlett, 827 Greenleaf St., Evanston, Ill., at $2,797.

⊙C. T. Bartlett, 327 Greenleaf St., Evanston, Ill., has been awarded the contract at $1,747, for constructing a 6-in. water main in Laurel Ave., Fig and Lake Sts., for the village of Winnetka, Ill. Bids were opened Dec. 20.

The city of Park Ridge, Ill., is considering extending its sewer outlet as far east as Main St. William Kobow is city clerk.

The special election held recently at Stamford, Ill., resulted in favor of installing a system of water works to cost $13,500, with new central plant and mains reaching every part of the town.

Iowa.

The city of Boone, Ia., will sell bonds Jan. 18 in the sum of $150,000 for the construction of a water system.

The city council of Mason City, Ia., has purchased more land in the vicinity of the pumping station where additional wells will be dug to keep up the supply of water for the city.

Kansas.

The city of Hugo, Kan., is considering the proposition of installing a city water works. It is planned to pipe the water from springs nine miles north of town.

The J. S. Worley Co., 206-7 Reliance Bldg., Kansas City, Mo., has been awarded the contract to prepare plans and specifications for the proposed sewage disposal plant to be constructed at Wellington, Kan. It is said that this plant will be the largest planned so far in the state.

The city of Englewood, Kan., has sold bonds for the construction of a water works. Plans are being prepared by The J. S. Worley Co., 206-7 Reliance Bldg., Kansas City, Mo.

The J. S. Worley Co., 206-7 Reliance Bldg., Kansas City, Mo., has been engaged to prepare plans for the installation of a water works system at Mound City, Kan.

Kentucky.

✣Bids will be received until 2 p. m., Jan 24, by Board of Public Works, Louisville, Ky. for the erection of 64 fire hydrants.

Plans have been formulated by Mayor Quinby of Dayton, Ky., whereby the mayor and members of the city council are considering a proposition for the establishment of a municipal water plant for that city.

Missouri.

✣Bids will be received until 2 p. m., Jan 26, by E. B. Harrington, Secy., Fire and Water Commissioners, Kansas City, Mo., for construction, delivering and erection of horizontal shaft centrifugal pump direct connected to vertical cross compound engine of capacity to deliver 30,000,000 gals. of water 50 ft. high at speed not exceeding 150 revolutions per minute. A certified check for $2,000 must accompany each bid. W. Kiersted is Chief Engineer of the Water Department.

⊙The Des Moines Bridge & Iron Works of Des Moines, Ia., has been awarded the contract by the city of Warrenton, Mo., for the construction of a municipal water works system for $6,220. The work includes furnishing and laying complete 108 ft. of 6-in. and 3,200 ft. of 4-in. cast iron pipe, taking up and relaying 2,200 ft. of 2-in. 2½-in. galvanized iron pipe, furnishing and setting 10 new fire hydrants, and taking up and resetting 7 old hydrants, furnishing and setting 11 valves and boxes, and furnishing and erecting complete one 40,000-gal. steel tank on 82 ft. steel tower. Bids were opened Dec. 28. All sewer bids were rejected.

The Webb City & Carterville Waterworks Co., of Missouri, has increased its capital stock from $150,000 to $180,000 for improvements.

The assembly committee on streets, St. Louis, Mo., has acted favorably on the request of the water board for authority to issue $100,000 in bonds for improvements outside the city limits this year.

The Ozark Power & Water Co. has filed articles of incorporation in Missouri with a capital stock of $5,000. The incorporators are: R. W. Morrison, Chester E. Burg, and Frank Nottbusch. The company will generate electricity at Arcadia.

Montana.

Advices from Washington, D. C., state that Senator Dixon has introduced a bill granting to Miles City, Mont., a part of the old Fort Keogh military reservation for a pumping plant for an adequate supply of water for the city, at $1.25 per acre. The bill also seeks to grant right-of-way for a water pipe and pole line across the Fort Keogh reservation, 50 ft. wide, about an acre in extent.

Nebraska.

A petition is to be presented to the village board of Louisville, Neb., asking that an election be called for the purpose of voting bonds to the sum of $16,000 for the installation of a system of water works in that place.

The citizens of York, Neb., at a recent election voted against the proposition to issue bonds in the sum of $52,500 for the purchase of the water works.

The city of Chadron, Neb., will extend its water mains at an estimated cost of $38,000 under the supervision of H. D. Mead of that city. Bonds have been voted for the purpose.

The city of Gordon, Neb., will re-construct its water works during the year at an estimated cost of $12,500. The work will be done under the supervision of Civil Engineer H. D. Mead of Chadron, Neb. A bond election will be held to vote the issuance of bonds for the purpose.

New Jersey.

Plans are being prepared by Clyde Potts, Consulting Engineer, 30 Church St., New York city, for a 5,000,000 gal. water pumping and filter works for the city of Bridgeton, N. J. The works will include two cross compound pumping engines and 10 500,000 filter units of the mechanical type.

New York.

The citizens of Watervliet, N. Y., have [illegible] resolution declaring in favor of a municipal water works, and a bill providing for such a system will be introduced at the next session of the legislature.

Commissioner of Public Works A. J. Quackenbush of Schenectady, N. Y., has recommended in the annual report to Mayor Charles C. Duryee, the installation of a water storage reservoir.

Ohio.

Plans for a serilization plant at the California filtration station, Cincinnati, O., have been completed and work on the construction will soon be begun. The estimated cost is $6,5[illegible]

The Rensselaer Valve Co. was the lowest bidder at Cincinnati, O., for the furnishing of a 48-in. check valve to the water works department, which will be installed on Walnut Hills as a precaution against a shortage of water due to a possible break in the supply mains. The bid was $1,075.

The approximate estimate of cost for laying water mains on 16 streets in the village of Silverton, O., amounts to $21,342. Plans and specifications have been completed and the work will be let the latter part of February. All mains are 6-in. in diameter. Ferd Grillo is village engineer.

The city of Cleveland, O., plans the following improvements to the water works system this year: West Side water tunnel, estimated cost $800,000; new water mains, estimated cost $150,000; new pumps, estimated cost $250,000, and high pressure pumping station, estimated cost, $225,000. Robert Hoffman is city engineer.

Oklahoma.

The city council of Guthrie, Okla., has passed a resolution providing for the appropriation of $20,000 for the construction of water mains.

According to Mayor Dan V. Lackey of Oklahoma City, Okla., the city will call a bond election within a few days to vote on the proposition of issuing bonds in the sum of $1,500,000 for water site and reservoir. Of that amount $1,250,000 is to finance the water proposition, while $250,000 is to extend the water mains of the city. The extensions will probably be made in the northern and northeastern portions of the city. W. C. Burke is city engineer.

Pennsylvania.

The common council of Philadelphia, Pa., has referred to the finance committee a bill authorizing the mayor to negotiate a permanent loan of $4,000,000 for various municipal purposes. Among the improvements are the completion of the Queen Lane filtration plant, $525,000; the completion of the Northeast high pressure fire main service, $500,000; continuing work on the Northeast Blvd., as well as the Southern Blvd., and League Island Park, and for the repairs to streets, country roads, sewers and bridges.

Tennessee.

Walter G. Kirkpatrick of Jackson, Miss., has made surveys and preliminary plans for water works for Jellico, Tenn. Plans call for gravity supply from mountain springs, comprising about 17 miles 10-in. to 3-in. cast iron pipe, 70 hydrants and reinforced concrete reservoir; also for system of house sewers, comprising about 5½ miles of 15-in. to 8-in. clay pipe sewers, discharging into Clear Fork. Bonds for $90,000 will be offered. A. B. Mahan, Pres. First National Bank, is Secretary Waterworks and Sewer Commission, Jellico, Tenn.

Texas.

The engineers employed by the city of Fort Worth, Tex., to find a suitable site for a surface reservoir on the river above the city, announced that an adequate supply of surface water can be secured on either fork of the Trinity with a site at a cost of about $1,000,000. The sites suggested as as follows: Live Oak Ridge on the Clear Fork, containing 2,000 acres, at a cost of $908,000. Eagle Cliff, ten miles above the city on the West Fork, comprising 3,000 acres, at a cost of $995,000;

Mound Dam site on West Fork, eight miles from the city, 600 acres, at a cost of $1,235,000. The Eagle Cliff reservoir would hold 20,000,000,000 gallons of water. The Mound Dam 30,000,000,000 gallons. The Live Oak Ridge reservoir, it is estimated, would contain 6,000,000,000 gallons. The estimates on each include the cost of the overflowed land, earthwork, concrete spillway, slope paving, pipeline, filter beds and engineering design, supervision and contingencies.

The city of Georgetown took over the [illegible]

Washington.

[illegible] ter system, which will be completed this year

Wisconsin.

The [illegible] purchasing the plant of the Green Bay Water Co., capitalized at $300,000. Winford Abrams [illegible]

City Engineer Charles J. Poetsch of Milwaukee, Wis., is planning for extending the Wright St. high service main two miles from 29th St., and Highland Blvd. to National Ave. and Arnauld St. at a cost of $100,000, and to extend the south side feeder main from Greenbush and Lapham Sts. to Lincoln Ave. and Layton Blvd. at a cost of $66,000. Both [illegible]

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

✣Bids will be received until 11 a. m., Jan. 18 (postponement of date from Dec. 21, 1910), by Maury Nicholson, City Engineer, Birmingham, Ala., for the construction of certain storm sewer mains and branches thereto at an estimated cost of $300,000 [illegible]

California.

✣Bids will be received until Jan. 12, by W. H. Wheelan, City Clerk, Brawley, Cal., for the construction of sewer mains and outfall sewer and septic tank. The work includes septic tank 24x200 ft., 8 ft. deep, capacity 85,000 gals.; 300 ft. of 8-in.; 1,542 ft. of 10-in.; 8,250 ft. of 12-in.; 1,700 ft. of 14-in. vitrified pipe; 31 manholes; 3 catch basins; wooden outfall conduit. The work is estimated to cost about $18,000.

The board of public works of San Francisco, Cal., has recommended that the sum of $28,000 be set aside for the construction of an outlet sewer, running in Diamond St., from Sussex southerly to Islais creek, Glenn Park district.

The board of supervisors, San Francisco, Cal., has ordered the construction of sewers in section A of Ingleside outlet sewer at a cost not to exceed $34,000.

Colorado.

✣Bids will be received until 11 a. m., Jan. 18, by Board of Public Works, Denver, Colo., for furnishing the necessary labor and material for the construction in place of sanitary sewers, manholes, appurtenances, etc., in a portion of Sub-district No. 6 of the East Side sanitary sewers District No. 1. A certified check for $3,000 must be filed with each bid. Henry Read is President of the Board.

⊙The city council of Colorado Springs, Colo., has awarded the contract for the construction of the Park Lawn sanitary sewer to the Westcott-Doan Construction Co., of Denver, Colo., for $6,132.

Illinois.

The city council of Murphysboro, Ill., has authorized the construction of a sewer system to drain the north half of the city.

The board of improvements of the village of Upper Alton, Ill., has planned a sewer improvement for that village, to take in many streets. The system will empty into septic tank.

Indiana.

✣Bids will be received until Jan. 26, by the Board of Public Works, Richmond, Ind., for the construction of a sewer system including approximately 4,200 ft. of 12 to 42-in. sewer. Fred R. Charles is City Engineer.

✣Bids will be received until 7:30 p. m., Jan. 23, by Common Council of Lebanon, Ind., for the construction of a gravel roadway, cement curbs and gutters and sewers in Baronne St. Edmund Connor is City Clerk.

The Interstate Construction Co., of Hammond, Ind., at $19,728, will probably be awarded the contract in Gary, Ind., for building the following sewers: 3,120 ft. of 60-in. brick sewer; 3,160 lin. ft. of 54-in. sewer; 2,055 lin. ft. of 36-in. brick sewer; 3,320 lin. ft. of 20-in. pipe sewer; 6,540 lin. ft. of 24-in. brick sewer; 3,900 lin. ft. of 8-in. pipe sewer; 12 manholes, five catch basins and four gutter inlets. Bids were [illegible] G. Moose is city clerk.

The council committee [illegible] resolutions of Kokomo, Ind., has reported favorably on a bond issue of $50,000 for the construction of the [illegible] Wildcat.

Iowa.

The J. S. Worley Co., 206-7 Reliance Bldg., Kansas City, Mo., has been engaged to prepare plans for the construction of a sewer system at Jefferson, Ia.

The citizens of Dewitt, Ia., voted Jan. 3 on the proposition of letting a contract for a sanitary sewer system and a disposal plant for the town, to cost not to exceed $25,000.

A petition has been presented to the city council at Cedar Rapids, Ia., asking for a sanitary sewer on Ninth Ave., between Fourth and Sixth Sts.

Kansas.

City Engineer G. L. McLane of Hutchinson, Kan., is working out estimates for the proposed sewer system to be installed in the spring. The state board of health has ordered the city to either install pumping stations and pump the sewage on to the Arkansas river, instead of emptying into Cow Creek, or else to install septic sewage basins to dispose of it by chemical processes.

Maryland.

✣Bids will be received until 11:30 a. m., Jan. 17, by Board of County Commissioners, Annapolis, Md., for the construction of a sewer on Carroll St. and Fifth St., Brooklyn. Plans and specifications may be seen on file in the office of the Commissioners, or in the office of John H. Geis & Co., Brooklyn, Md. A certified check for $100 on a National or State bank, payable to the order of the County Commissioners of Anne Arundel County must accompany each bid. S. O. Tilghman is clerk.

Michigan.

⊙Chester C. Davis has been awarded the contract in Houghton, Mich., for the construction of a sewer system in the park addition by F. W. Nichols, agent for the property. A tunnel is to be constructed for a distance of 570 ft. under the central portion of the addition from Florence St., north to Portage lake.

The city council of Wyandotte, Mich., has sold bonds to the amount of $68,000 for sewer extension in West Wyandotte.

The village council of Grosse Pointe Park, Mich., is considering and is about to accept a set of plans for the construction of a sewer system. It is planned to connect the system with the proposed Jefferson Ave. trunk sewer to be constructed in Detroit. The question of issuing bonds for the improvement will probably [illegible] election.

Missouri.

⊙The board of public w[illegible] of St. Joseph, Mo., has awarded the [illegible] for the construction of sewers in districts Nos. 53, 114, and 117 to F. F. Migner [illegible] $0.59½ per lin. ft., for district No. 53, [illegible] per lin. ft., for district No. 114, and [illegible] lin. ft., for district No. 117.

Rep[illegible] nors of Kansas an[illegible] meeting held in Kansas City, Mo., adopted resolutions declaring that the disposal of sewage and manufacturing wastes in the Missouri river between Sioux City and Kansas City was such that it is desirable that the condition of the river, especially with reference to the water supply of the towns in this district, be investigated by a specitl commission. W. C. Hoad is sanitary commissioner of the Kansas state board of health.

The board of public improvements of St. Louis, Mo., received bids Jan. 10 for the construction of the Dale Ave., sewer system, to serve the district south of Forest Park, just east of the city limits. The cost of the work is estimated at $24,000. It includes 1,176 ft. of brick sewer ranging in diameter from 38 to 32 ins., and 13,144 ft. of pipe sewer ranging in diameter from 24 to 12 ins. The system will empty into River des Peres south of Forest Park.

The board of public improvements of St. Louis, Mo., has rejected all bids except the lowest on the two districts of the North Harlem Creek sewer, which will serve the district bounded by Bircher, Florissant and Thekia Aves., and the city limits. The lowest bids were made by the Herman Construction Co., one of $162,200 for the First district, and one of $163,275 for the Second district.

Engineer Lawlor has been instructed by the board of public works of St. Joseph, Mo., to prepare ordinances for the construction of sewers in districts Nos. 37, 64 and 112.

Nebraska.

The city of Gordon, Neb., will construct a sewer system this year at an estimated cost of $8,500. The work will be done under the supervision of Civil Engineer H. D. Mead of Chadron, Neb. A bond election will be held Jan. 17 to vote the issuance of bonds for the purpose.

New Jersey.

✣Bids will be received until 8:30 p. m., Jan. 16 by City Council of Elizabeth, N. J., for the following work to be done and material furnished: For 570 lin. ft. 10-in. pipe sewer, caulked joints; 26 6-in. connections; for 26 6-in. ⅛ turns; 416 lin. ft. 6-in. pipe to curb line, caulked joints; for 505 lin. ft. 8-in. pipe sewer, caulked joints; 32 4x8-in. connections; for 32 4-in. ⅛ turns, 512 lin. ft. 4-in. sewer to curb, caulked joints; for 8 manholes; also, inspector's pay at $2 per day. Plans and specifications may be examined at the office of J. K. Thompson, Street Commissioner.

At the request of the improvement commission of Hackensack, N. J., Town Engineer Lemuel Lozier has called in consultation Sanitary Engineer James H. Fuertes, 140 Nassau St., New York City, relative to the disposal of the city sewage, pursuant to the order of the state board of health, to have a system in operation by 1914. It is planned to construct two disposal plants, one at the lower end of town at the River Ditch, near the Essex St. station of the New Jersey & New York Railroad, and the other at the northern end of the town. The estimated cost is $155,000.

New York.

The village board of trustees of Frankfort, N. Y., contemplate the installation of a sewer system. Engineers have prepared pla[illegible]

✣ indicates work now open for bids. indicates a contract let recently.

estimates of the cost of the system. The esti- [illegible] president of the village.

Plans are being proposed for sewerage and sewage disposal works for the village of Sea Cliff, N. Y. (L. I.). Clyde Potts, 30 Church St., New York City, is the Engineer.

[illegible] submitted plans to the village trustees of East Aurora, N. Y., for the installation of a pro- [illegible] which includes a disposal plant.

Ohio.

⊙Matthew McCourt has been awarded the contract by the city of Akron, O., for building the proposed sewer in Sumner, Allyn and Brown Sts., and the Glenwood Ave. storm sewer for $2,561 and $2,030, respectively. Bids were opened Dec. 24.

⊙The city of Akron, O., has awarded M. H. O'Toole the contract for the construction of the Water St. sewer for $3,197. Bids were opened Dec. 24.

⊙Riddle & Fegley have been awarded the contract by Public Director James McDonald of Delaware, O., for furnishing the labor and material for constructing a sanitary sewer in North Sandusky St., from near Pennsylvania Ave. to the Children's Home, covering a distance of 300 ft.

The city of Cleveland, O., plans the expenditure of $1,000,000 during this year for intercepting sewer extensions and $230,000 for the construction of new sewers. Robert Hoffman is city engineer.

The citizens of Grand View, O., have voted in favor of the proposition to install a sewer system. According to the present plans, the village expects to lay pipes to the Columbus sewage disposal plant and the Columbus water purification plant and secure contracts with the city for the use of its improvements. The improvements are expected to cost in the neighborhood of $50,000 or $60,000.

Oklahoma.

City Engineer W. C. Burke of Oklahoma City, Okla., at the request of O. A. Mitcher, president of the Retailers' Association, has made plans for the extension of sewers in the business limits of the city.

The Oklahoma Credit Men's Association has requested the city council of Oklahoma City, Okla., that the city spend $15,000 to improve the downtown storm sewer facilities. They also recommend that intakes on Broadway from First St., north be taken out and replaced by modern catch basins. W. C. Burke is city engineer.

All bids received Jan. 3 by Bob Parman, City Clerk, Oklahoma City, Okla., for the construction of a lateral sewer in Block 8 were rejected and the work will be readvertised.

Oregon.

Citizens of North Albina, Portland, Ore., have asked City Engineer J. W. Morris to hasten the completion of the plans for the sewer district between Killingsworth Ave. and Columbia Blvd., Union Ave. and Ockley Green. This district will be two miles square and includes many streets on which hard-surfaced pavement are to be laid as soon as the sewers are under ground.

Pennsylvania.

✣Bids will be received until noon, Jan. 16, by W. W. Caldwell, Commissioner of Highways, Harrisburg, Pa., for the construction of sewers in and for the grading of the following highways: Sewer in Chestnut St. from 18th to 100 ft. west of 19th St., and in Peffer St. from 7th to 60 ft. east of Sixth St.; grading of Front St. from Maclay to Division, and of Paxton St. from 13th to 180 ft. east of 18th St. Plans and specifications may be obtained at the office of the Highway Department.

The citizens of Swissvale, Pa., at a recent election voted against the proposition to issue bonds to the amount of $100,000, of which $70,000 was for street improvements, and $30,000 for sewerage.

Borough Engineer Neumeyer of South Bethlehem, Pa., is preparing plans to designate a site for the proposed sewage filtration plant for the borough.

Costello & Co., of Philadelphia, Pa., have obtained a permit for the first buildings to be built by the city on the tract of ground on State road north of Holmesburg Ave., on which an experimental sewage disposal plant is to be established. The buildings consist of a two story operating department, 22 ft. by 13 ft., with another building, 41 ft. by 31 ft., with a wing 27 ft. 6-in. by 23 ft. 6-in. The cost to the city will be $18,725.

The department of sewers of Easton, Pa., has asked the city council for an appropriation of $13,550 for this year. The committee will recommend that $6,000 be spent for a sewer running through Sullivan St., from Monroe St., to the Bushkill creek, and $3,000 for the lowering of the Bank St. sewer between Northampton and Bushkill Sts.

Texas.

⊙I. H. Roberts of Wichita Falls, Tex., has been awarded the contract by that city for the construction of the storm sewers on the streets that are shortly to be placed in the city. The bid was as follows: 24-in. per lin. ft., $1; 30-in. per lin. ft., $1.35; 36-in. per lin. ft., $1.70; 48-in. per lin. ft., $2.40, and 60-in. per lin. ft., $3.40; manholes, $15 each, extra; intakes, $6 each, extra. Total amount of bid is $14,000.

The city council of Pecos, Tex., has called a special election for Jan. 30 to vote on the question of issuing $25,000 sewerage bonds for the installation of a sewer system. Plans have been drawn by the O'Neill Engineering Co., of Dallas, Tex.

According to information received from Houston, Tex., work will be started on the South Side sewerage farm this year. The city has secured 197 acres of land on the north side of Sims bayou and on the west side of the Santa Fe track in the Prentiss survey. To sewer the south side it will be necessary to construct five miles of cast iron pipe, settling tank, combination septic tank and double contract filters. The city also plans to enlarge the pumping station on Willow St., in order to take care of the sewage on the north side after extensions have been made.

Washington.

City Engineer Morton Macartney of Spokane, Wash., has asked the board of public works to recommend to the city council the repeal of a resolution providing for the sewering of all that territory between Addison and Perry Sts., and Sinto and Olive Aves. The engineer desires a resolution providing for plans for the sewering only between Boone Ave., and Broadway.

Wisconsin.

The city of Antigo, Wis., contemplates installing a sewer system at an estimated cost of $55,000. Plans and specifications have been prepared by John W. Alvord, Hartford Bldg., Chicago, Ill.

Sewers are to be laid on the following streets in Racine, Wis., at a total cost of $17,082: La Salle St., State to Prospect, $2,693; 10th St., Blue River to Hilker Place, $618; Flett Ave., Oak Wood Grove addititition to Chicago, Milwaukee & St. Paul Railroad tracks, $1,946; Park Ave., Seventh to 10th Sts., $2,536; Anderson St., Root River to West Sixth, $1,207; 17th St., Grand St. to Center St., $181; 15th St., Park to Villa St., $126; English St., North Chatham to North Wisconsin Sts., $602; 18th St., Grand to Villa St., $166; DeKoven Ave., Grand to Center St., $166; Kearney Ave., 16th to 17th St., $920; Barker, Buchanan to Lincoln Sts., $157; West Blvd., Wright to Washington Aves., $1,596; West Blvd., 16th to 17th Sts., $1,022; Parke Ave., 13th to 16th Sts., $2,923; Hubbard St., $224.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

✣Bids will be received between 10 and 11 a. m., Feb. 1, by Board of Public Works, Oakland, Cal., for furnishing the necessary labor and apparatus for making excavation for new city hall and grading with the material an athletic field at Washington School, grading the grounds around the fire alarm and police telegraph building and grading park lands in the vicinity of the 12th St. dam for the Board.

The city of Oakland has begun suit to condemn water front lands extending from Grove to Castro Sts., at present occupied by the Pacific Coast Lumber & Mill Co. under a lease. This is a portion of the property upon which the city intends to construct wharves and docks in connection with the plan for municipal improvement of the [illegible]

The Truckee River General Electric Co., S. L. Naphtaly, General Manager, San Francisco, will shortly start work on another power house at Verdi. The plant will be erected east of Verdi and the large flume will pass through the Verdi lumber yard from west to east.

An act will be introduced in the State Legislature to enable the Supervisors of Alameda County, Oakland, to appropriate a fixed sum to make borings, other tests and procure necessary data upon which to base an estimate of the cost of a tunnel beneath the estuary between Oakland and Alameda; the act will also provide that the county may vote bonds for this improvement.

Colorado.

The city administration of Denver, Colo., is contemplating a plan for having all overhead electric light and powers in the business section of the city placed in underground conduits.

Connecticut.

The stockholders of the Connecticut River Co., which owns the dam and canal at Windsor locks, have voted to accept the amendment to the company's charter obtained from the Legislature. The amendment gives the company the right to make improvements at Windsor Locks by building a new dam and an electric power plant.

District of Columbia.

✣Bids will be received until 2 p. m., Jan. 12, by Capt. F. C. Boggs, General Purchasing [illegible] Canal Commission, Washington, D. C., for furnishing 6 leathers, 24-in. piston packing for 24-in. air cylinders, necessary for repair parts of Mann McCann Spreader No. 45.

✣Bids will be received until 2 p. m., Jan. 18, by Commissioners of District of Columbia, Washington, D. C., for the construction of a garage and lodge at Fort Reno, D. C. Plans and specifications may be obtained of the Chief Clerk of the Engineering Department, 427 District Bldg.

✣Bids will be received until 2 p. m., Jan. 16, by Commissioners of District of Columbia, at Washington, for the construction of an engine house at Pennsylvania Ave. and 28th place southeast, Washington, D. C.

✣Bids will be received until 11 a. m., Feb. 4, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Washington, D. C., for new roof and crane runway for building No. 23.

Following bids were received Dec. 30 by the District Commission, Washington, for constructing a rubble retaining wall at the Western High School, Washington: Louis Perna, Washington, D. C., $3,580; George W. Philips, Washington, $4,269; Boyle-Robertson Construction Co., Washington, D. C., $4,734.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Florida.

Bids [illegible] were received Dec. [illegible] by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for constructing a quay wall at the Naval station, Key West, Fla.: Grant Wilkins, 23 Whitehall St., Atlanta, Ga., $88,300; McArthur Concrete Pile & Foundation Co., 11 Pine St., New York, $125,000; Penn. Bridge Co., Washington, D. C., $154,700.

Georgia.

✣Bids will be received until 3 p. m., Feb. 8, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Milledgeville, Ga.

✣Bids will be received until 11 a. m., Jan. 30, by Constructing Quartermaster, Fort Screven, Ga., for construction and installation of electric light system. Plans and specifications may be obtained of the Constructing Quartermaster upon a deposit of $15.

Bids will be received until noon Feb. 1 by Mayor C. S. Winn, Atlanta, Ga., for the purchase from the city of the following generating plant: Three gas engines direct connected to 2-25 and 1-15 K. W. generator. The above engines and generators are manufactured by the Westinghouse Electric & Mfg. Co. and are in first-class condition. The 25 K. W. sets run at 300 R. P. M. and the 15 K. W. sets at 325 R. P. M. The generators are all 125 volts. The switchboard consists of three generator panels and one feeder panel. Each of the generator panels has a Weston ammeter 200 amperes, one Ite circuit breaker 200 amperes, one main generator switch 200 amperes, one Thompson recording watt meter. There is also two Weston volt meters 150 volts. Feeder panel consists of 1-200 ampere switch and 6-100 ampere switch. Switchboard is mounted on suitable frame and is 1½ in. pink Tennessee marble. The switches, however, are of the link fuse type, which are not approved by the Underwriters at this time. They could, however, be easily changed to National Code fuses. There are also two single cylinder air compressors with belted type. The above gas engines are of two cylinder type. The serial numbers on the machines are as follows: No. 55417, No. 65418, and No. 65589. Further information that any dealer desires can be obtained from the Westinghouse Electric & Mfg. Co., Pittsburg, by giving them the above numbers.

Illinois.

✣Bids will be received until 11 a. m., Jan. 14, 1911, by B. J. Mullaney, commisioner of public works, city of Chicago, room 705, City Hall, for furnisihng the lumber to be delivered for use at the various bridges and viaducts in the city for the period ending June 30, 1911. The lumber shall consist of white pine, Norway pine, yellow pine and white oak, and shall be of good quality, live, sound and sawed to standard size, full length and square cornered, and shall be free from such defects as will materially impair its strength. Grading, dressing, etc., shall be governed by rules adopted by the various lumber associations. Full specifications may be had upon application at Room 705, City Hall. Following are the quantities, sizes, etc., as shown on specifications: White pine, No. 1 common: 2,000 ft. B. M. 1 in. by 6 in., 12 ft. to 16 ft. long,s1s; 1,000 ft. B. M. 1 in. by 6 in., 12 ft. to 16 ft. long, s2s; 3,000 ft. B. M., 1 in. by 6 in., 12 ft. to 16 ft. long, s4s; 25,000 ft. B. M. 1 in. by 6 in., 12 ft. to 16 ft. long, dressed and matched; 5,000 ft. B. M. 1 in. by 12 in., 12 ft. to 16 ft. long, s1s; 1,000 ft. B. M. 1 in. by 12 in., 12 ft. to 16 ft. long, s2s; 1,000 ft. B. M. 1 in. by 12 in., 12 ft. to 16 ft. long, s4s; 4,000 ft. B. M. 2 in. by 4 in., 10 ft. to 16 ft. long. sized; 1,000 ft. B. M. 2 in. by 4 in., 10 ft. to 16 ft. long, s2s; 4,000 ft. B. M. 2 in. by 4 in., 10 ft. to 16 ft. long, s4s; 5,000 ft. B. M. 2 in. by 6 in., 12 ft. to 16 ft. long, s1s; 1,000 ft. B. M. 2 in. by 6 in., 12 ft. to 16 ft. long, s2s; 3,000 ft. B. M. 2 in. by 6 in., 12 ft. to 16 ft. long, s4s; 1,000 ft. B. M. 2 in. by 6 in., 10 ft. to 16 ft [illegible] s2s; 3,000 ft. B. M. 2 in. by 8 in., 10 ft. to 16 [illegible] ft. B. M. 2 in. by 10 in., 10 ft. to 16 ft. long, rough; 25,000 ft. B. M. 2 in. by 10 in., 10 ft. to 16 ft. long, s1s; 2,000 ft. B. M. 2 in. by 10 in., 10 ft. to 16 ft. long, s4s; 1,000 ft. B. M. 2 in. by 10 in., 18 ft. to 20 ft. long, rough; 20,000 ft. B. [illegible] 3,000 ft. B. M. 2 in. by 12 in., 10 ft. to 16 ft. long, s2s; 4,000 ft. B. M. 2 in. by 12 in., 18 ft. to 20 ft. long, s1s; 6,000 ft. B. M. 3 in. by 6 in., 12 ft. to 16 ft. long, s4s; 1,000 ft. B. M. 3 in. by 8 in., 12 ft. to 16 ft. long, s4s; 2,000 ft. B. M. 3 in. by 10 in., 12 ft. to 16 ft. long, rough; 1,000 ft. B. M. 3 in. by 10 in., 12 ft. to 16 ft. long, s1s; 3,000 ft. B. M. 3 in. by 10 in., 12 ft. to 16 ft. long, s4s; 6,000 ft. B. M. 3 in. by 10 in., 22 ft. to 24 ft. long, rough; 15,000 ft. B. M. 3 in. by 12 in., 10 ft. to 16 ft. long, rough; 1,000 ft. B. M. 3 in. by 12 in., 10 ft. to 16 ft. long. s1s; 12,000 ft. B. M. 3 in. by 12 in., 18 ft. to 20 ft. long, rough; 7,000 ft. B. M. 3 in. by 12 in., 22 ft. to 24 ft. long, rough; 1,000 ft. B. M. 4 in. by 4 in., 12 ft. to 16 ft. long, rough; 10,000 ft. B. M. 4 in. by 4 in., 12 ft. to 16 ft. long, s4s; 1,000 ft. B. M. 4 in. by 6 in., 12 ft. to 16 ft. long, rough; 3,000 ft. B. M. 4 in. by 6 in., 12 ft. to 16 ft. long, s1s; 8,000 ft. B. M. 4 in. by 6 in., 12 ft to 16 ft. long s4s; 5,000 ft. B. M. 4 in. by 8 in., 12 ft. to 16 ft. long, s4s; 1,000 ft. B. M. 4 in. by 12 in., 18 ft. to 20 ft. long, s4s; 1,000 ft. B. M. 4 in. by 14 in., 32 ft. to 34 ft. long, rough; 1,000 ft. B. M. 6 in. by 8 in., 12 ft. to 16 ft. long, rough; 1,000 ft. B. M. 6 in. by 8 in., 18 ft. to 20 ft. long, rough; 1,000 ft. B. M. 6 in. by 8 in., 22 ft to 24 ft. long, rough; 1,000 ft. B. M. 6 in. by 12 in., 18 ft. to 20 ft. long, rough; 1,000 ft. B. M. 8 in. by 10 in. 18 ft. to 20 ft. long, rough; 2,000 ft. B. M. 10 in. by 10 in., 18 ft. to 20 ft. long, rough; 1,000 ft. B. M. 10 in. by 10 in., 22 ft. to 24 ft. long, rough; 1,000 ft. B. M. 10 in. by 10 in., 26 ft. to 28 ft. long, rough; 4,000 ft. B. M. 12 in. by 12 12 in., 10 ft. to 16 ft. long, rough; 1,000 ft. B. M., 12 in. by 12 in., 18 ft. to 20 ft. long, rough; 1,000 ft B. M. 12 in. by 12 in., 22 ft. to 24 ft. long, rough; 4,000 ft. B. M. 12 in. by 12 in., 26 ft. to 28 ft. long, rough; 15,000 ft. B. M. 12 in. by 12 in., 30 ft. to 32 ft. long, rough; 2,000 ft. B. M. 12 in. by 12 in., 34 to 36 ft. long, rough. Yellow pine, No. 1 common: 2,000 ft. B. M. 4 in. by 6 in., 18 ft. to 20 ft. long, s4s; 4,000 ft. B. M. 4 in. by 6 in., 22 ft. to 24 ft. long, s4s; 10,000 ft. B. M. 4 in. by 12 in., 12 ft. to 16 ft. long, rough; 10,000 ft. B. M. 4 in. by 12 in., 18 ft. to 20 ft. long, rough; 10,000 ft. 4 in. by 12 in., 18 ft. to 20 ft. long, rough; 15,000 ft. B. M. 4 in. by 12 in., 18 ft. to 20 ft. long, s4s; 10,000 ft. B. M. 4 in. by 12 in., 22 ft. to 24 ft. long, s4s; 1,000 ft. B. M. 6 in. by 10 in., 12 ft. to 16 ft. long, s1s; 1,000 ft. B. M. 6 in. by 12 in., 12 ft. to 16 ft. long, s1s; 3,000 ft. B. M. 6 in. by 12 in., 18 ft. to 20 ft. long, s1s; 5,000 ft. B. M. 6 in. by 12 in., 22 ft. to 24 ft long, s4s; 1,000 ft. B. M. 6 in. by 16 in., 18 ft to 20 ft. long, s1s; 1,000 ft. B. M. 6 in., by 16 [illegible] in. by 8 in., 18 ft. to 20 ft. long, rough; 1,000 [illegible] rough; 5,000 ft. B. M. 8 in. by 10 in., 18 ft. to 20 ft. long, rough; 2,000 ft. B. M. 8 in. by 12 in., 22 ft. to 24 ft. long, rough, 1,000 ft. B. M. [illegible] 3,000 ft. B. M. 10 in. by 10 in., 22 ft. to 24 ft. long, rough; 10,000 ft. B. M. 10 in. by 12 in., 22 ft. to 24 ft. long, rough; [illegible],000 ft. B. M. 12 [illegible] by 12 in., 22 ft. to 24 ft. long, rough; 3,000 ft. B. M. 12 in. by 16 in., 22 ft. to 24 ft. long, rough; 10,000 ft. B. M. [illegible] blocks, 4 in. by 6 in., 4 in. by 8 in. [illegible] in., 4 in. by 12 [illegible] 1 common: 1,000 ft. B. M. 2 in., by 8 in., 12 ft. to 16 ft., s4s, 8,000 ft. B. M. 3 in. by 10 in., 12 [illegible] in., 12 ft. to [illegible] in. by 12 in. 18 ft. [illegible] rough; 1,000 ft. B. M. 3 in. by 1[illegible] B. M. 3 in. [illegible] 18 [illegible] to 20 ft., rough; 1,000 ft. B. M. 8 in. by 12 in., 18 ft. to 20 ft., rough; 1,000 ft. B. M. 12 in. by 12 in., 12 ft. to 16 ft., rough; 1,000 ft. B. M. 12 in. by 12 in., 18 ft. to 20 ft., rough; 1,000 ft. B. M. 12 in. by 12 in., 22 ft. to 24 ft., rough.

The Special Board of Commissioners will probably reach a decision this week regarding the site for the proposed new state penitentiary building to be erected in Joliet. John Lambert, 863 Rookery Bldg., Chicago, Ill., is Commissioner.

P. Olson, 78 LaSalle St., Chicago, submitted a bid of $1,686 to B. J. Mullaney, Commissioner of Public Works, City of Chicago, room 705, City Hall, for furnishing and installing a new steam heating plant at the 95th St. engine house. The contract has not [illegible]

The following bids were received by B. J. Mullaney, Commissioner of Public Works, City of Chicago, for furnishing 2,000 bbls. of natural cement and 100 bbls. of Portland cement to the city of Chicago: Garden City Land Co., 68 cts. and $1.70; Wm. E. Dee Co., 70 cts. and $1.70; Thos. Connelly Co., 68 cts. and $1.70; Knickerbocker Land Co., 74 cts and $1.60; Meacham & Wright, 69 cts. and $1.80

The following bid was received by Wm. Carroll, City Electrician, City of Chicago, for furnishing 15,000 ft. more or less, of No. 6 B. & L. G., single conductor paper insulated, lead covered electric light cable. Jno. A. Roebling & Sons, 171 Lake St., Chicago, 75 cts. per lin. ft.

Louisiana.

✣Bids will be received until 11 a. m., Jan. 26 by Maj. H. Burgess. U. S. Engineer, 3338 St. Charles Ave., New Orleans, La., for constructing and delivering two steel barges.

Massachusetts.

⊙W. H. Ellis, 18 Tremont St., Boston, Mass., has been awarded a contract at $6,176 by the city of Boston for dredging and building a wharf for Fire Boat Engine 31. Bids were opened Dec. 12.

Maryland.

✣Bids will be received until 11 a. m., Jan. 18, by Board of Awards, Baltimore, Md., for the furnishing of two automobile hose wagons. J. Barry Mahool is President of the Board of Awards.

✣Bids will be received until noon, Feb. 1, by Frank W. Keating, M. D., for the erection of the following buildings on the grounds of the Maryland Asylum and Training School for Feeble Minded, Owings Mills, Baltimore, Md. Dining room and dormitory building; single dormitory and day room building; one double dormitory and day room building; one manual training and assembly building. A certified check for $500 on a clearing-house bank, made payable to the order of the Maryland Asylum and Training School for Feeble Minded, will be required to be deposited by each bidder when proposals are submitted; and successful bidders will be required to give satisfactory bond in the usual form for the faithful per-[illegible]fications may be secured at the office of the Architects, Ellicott & Emmart, 1101 Union Trust Building, Baltimore city, Maryland, for which there will be a charge of $10; one-half to be refunded if drawings and specifications are returned in good condition on or before [illegible]

✣Bids will be recieved until 11 a. m., Jan. 17, by Board of County Commissioners, Annapolis, Md., for lighting certain of the streets or roads or portions thereof of Brooklyn, Curtis Bay and vicinity and the vicinity of Linthicum Heights, by arc or incandescent electric lamps, for the terms of one, two, five or ten years. S. O. Tilghman is Clerk.

Atlanta Fertilizer Co., Baltimore, has made plans for constructing a double-decked pier, about 250 ft. long.

Michigan.

✣Bids will be received until 3 p. m., Feb. 3, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Hillsdale, Mich.

⊙Dupins Co., Detroit, Mich., has been awarded the contract at [illegible] for constructing a sea wall and filling at Owen Park for the city of Detroit. Bids were opened Dec. 17.

Julius B. Lund & Sons Co., Cheboygan, Mich., is considering increasing the facilities at the shipyard in Cheboygan by the construction of a marine railway dry dock to cost about $25,000.

The Lake Shore & Ishpeming Ry., R. C. Young, Chief Engineer, Marquette, Mich., is planning to construct a new ore dock in Presque Isle harbor, Marquette, about 200 ft. southwesterly from the present ore dock and running parallel with it.

The Board of Public Works of Grand Rapids, Mich., has been requested to furnish to the Common Council an approximate estimate of the cost of constructing a dock line wall along the east dock line of Grand River from Fulton St. to about 100 ft. south of the Power Dam, together with the reinforcing and supporting where necessary of building walls already in place along the dock line, including the installation of gates for the purpose of closing up during flood stages in Grand River all flumes, tail-races, or openings from the East Side Water Power Co.'s canal into the river. Estimates are also asked for the construction of flood walls around the power dam, and approach to the East Side canal on the line of existing walls as now maintained east of the dock line, including flood gates at the gate house and waste where necessary to exclude the flow of water from the river into the canal during floods; also including the raising, if necessary, of the Grand Trunk bridge across the opening into the canal at the dam with such other incidental work as may be necessary to secure flood protection between the points named.

Minnesota.

The City Council of Tower, Minn., has decided to submit to the voters of the city the proposition of voting enough bonds to build a power plant at Pike River Falls for the municipal lighting plant. The amount necessary to be raised is estimated at from $10,000 to $15,000.

Missouri.

But one bid was received Dec. 7 at the office of the U. S. Engineer, Kansas City, Mo., for removal of a wreck of the excursion boat "Uncle Sam," from the Missouri river. This bid was considered too high and was rejected.

Nebraska.

✣Bids will be received until 3 p. m., Feb. 2, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus and electric conduits and wiring, of the United States Post Office at Holdredge, Nebr.

New York.

✣Bids will be received until 10 a. m., Jan. 16, by Commanding Officer, Torpedo Depot, Fort Totten, N. Y., for delivering f. o. b. point of manufacture 450 large cast iron junction boxes.

✣Bids [illegible] until Jan. 16, by Board of [illegible] & Supply, Albany, N. Y., for the street [illegible] contract.

✣Bids [illegible] until 2 p. m., Jan. 30, by Quarter[illegible] Point, N. Y., for furnishing and [illegible] complete Central Energy Telephone [illegible] and specifications are on file [illegible] of the Quartermaster.

⊙The R. T. Ford Const[illegible] Rochester, N. Y., has [illegible] for the erection [illegible] Hawk St., Albany, for the State Trust[illegible] of Public Buildings. The contract price [illegible] $346,287.

⊙Advices from Washington, D. C., state that the Albeiger Pump Co. of New York City has been awarded the contracts aggregating $325,000 for electric pumping plants for New York, Pearl Harbor and Puget Sound navy yards.

Ohio.

Bids were opened Jan. 4 by Maj. H. Jervey, U. S. Engineer, Cincinnati, O., for the construction of three steel flatboats and three steel barges (Ohio River Improvement), the bids received being as follows (1) standing for bid for each steel flat boat and (2) for the bid for each steel barge: Milwaukee Bridge Co., Milwaukee, Wis. (1), $7,066 each, (2) $6,200 each; Howard Shipyards Co., Jeffersonville, Ind., (1) $8,600 each, (2) $7,100 each; American Bridge Co., of New York, Cincinnati, O., (1) $6,300 each or $6,450 each, (2) $5,200 each or $5,350 each ($200 to be deducted for each boat if accepted at Ambridge, Pa.); Des Moines Bridge & Iron Works, Pittsburg, Pa., (1) $7,124 each, (2) $6,039 each.

Appropriations of $40,000 for river dredging and $36,000 for river widening are included in the appropriation ordinance of the City Council of Cleveland, O. Robert Hofman is City Engineer.

Oregon.

The Port of Portland Commission, Portland, Ore., has included in the summary of funds required for 1911 an item of $125,000 for starting work on a steel hull dredge, a duplicate of the digger Columbia. The Commission has plans nearing completion for a steel sternwheel towboat to cost in excess of $100,000. There will also be ordered 30 pipe pontoons. J. B. C. Lockwood, Portland, is Consulting Engineer to the Commission.

The Port Commission, of Marshfield, Ore., has levied a tax of three mills for harbor work for the coming year. This applies to all property within the port district. In addition to the tax money the port by the vote of the people at the recent election is allowed to issue bonds in the sum of $300,000 for harbor improvements.

The Warrenton Development League, G. Clifford Barlow, Secretary, Warrenton, Ore., has a project under way for the dredging of Skipanon Creek and the construction of a dike. The cost of the work will be about $100,000. Surveys have not been made as yet. The commissioners of the Port of Astoria, C. A. Lester, Secretary, Astoria, Ore., will be asked to take up the matter.

The Port Commission of Toledo, Ore., has sold $50,000 worth of bonds to S. Kean & Co., of Chicago. The money received from the sale of these bonds will be used in the deepening of the local harbor. A 16 foot channel will be dug from Toledo to the sea. A suction dredge will be built to be used in the removal of the three or four small bars which lie between Toledo and Oysterville. Several wing dams will also be built.

Pennsylvania.

✣Bids will be received until noon, Jan. 17, by Charles T. Straughn County Controller, Pottsville, Pa., for general contract, including increased water supply, sewage disposal plant, power plant, elevator, heating, ventilating, plumbing and electric wiring, complete of a building for the insane at Schuylkill Haven, Pa.

Texas.

✣Bids will be received untily 2 p. m., Jan. 20, by Capt. P. Whitworth, Quartermaster, Fort Crockett, Galveston, Texas, for the construction of a reinforced wagon shed at that post.

✣Bids will be received until 6 p. m., Jan. 24, by M. O. Woodward, City Secretary, Temple, Texas, for the erection of a high school building at Temple, also bids for plumbing, wiring, heating, etc., thereof. Plans and specifications may be seen at the offices of Sanguinet & Staats, Fort Worth, Dallas, Houston or Temple. A certified check for 1,000 must be filed with each bid.

⊙The Westlake Construction Co., Houston, has been awarded the contract at about $400,000 for the construction of the Union National Bank building in Houston.

The U. S. War Department will shortly advertise for the construction of a new dredge to supersede the dredge Port Arthur, used in the canal and slips. The sum of $75,000 is available for the dredge, which will be of the latest design of hydraulic auger boring type.

The International & Great Northern R. R., O. H. Crittenden, Chief Engineer, Palestine, Tex., is preparing to go ahead with the work of improving the docks at Constitution Bend in anticipation of a large rice movement from the lower country.

A syndicate represented by H. P. Hilliard, President of the Central National Bank, of St. Louis, Mo., has purchased the Las Mestanas ranch in Hidalgo County, comprising 62,000 acres. It is said to be the intention of the purchasing syndicate to obtain railroad communication, subdivide the tract and open to settlement. The east line of the property is eleven miles from the main line of the St. Louis, Brownsville & Mexico R. R.

Washington.

The Municipal Commission of Tacoma will open bids early next month for the remainder of the work on the construction of the Nisqually power plant. The work will include a steel bridge over the Nisqually, an earth tunnel, reservoir, penstock, power house and transmission line. The cost will be about $1,000,000. Nicholas Lawson is Commissioner of Light and Water of Tacoma.

West Virginia.

✣Bids will be received until 11 a. m., Jan. 28, by Capt. F. W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for building 10 lockmen's houses with water closets at Locks Nos. 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11, Kanawha River.

Wisconsin.

✣Bids will be recieved until 3 p. m., Feb. 7, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Watertown, Wis.

⊙The O'Keefe-Orbison Engineering & Construction Co., Appleton, Wis., has been awarded a contract by the Combined Locks Paper Co. for the construction of a $90,000 dam to replace the present structure on the Fox River at Combined Locks. The new dam will be of steel and concrete construction and will be located a few feet down stream from the present dam. It will be 645 ft. long and 28 ft. wide at the base. It will carry a head of 19 ft. of water and will increase the dam capacity of the Fox River about 750,000 cu. ft. of water per minute. The new dam will be provided with seven steel gates of the Tainter

Canada.

✣Bids will be received until 4 p. m., Jan. 30, by R. C. Des Rochers, Secy. Department of Public Works, Ottawa, Ont., for the construction of a breakwater at Port Burwell, Elgin County, Ont. Plans and specifications may be seen and forms of tender obtained at this department at the office of J. G. Sing, District Engineer, Confederation Life Bldg., Toronto, Ont.; H. J. Lamb, District Engineer, London, Ont., and upon application to the Post Master at Port Lurwell, Ont.

✣Bids will be received until 4 p. m., Jan. 18, by R. C. Des Rochers, Secy., Department of Public Works, Ottawa, Ont., for the Post Office Fittings, Fergus, Ont. Plans and specifications may be seen on application to William Mahoney, Architect, Guelph, Ont., and the Department of Public Works, Ottawa.

✣Bids will be received until 4 p. m., Jan. 18, by R. C. Des Rochers, Secy., Department of Public Works, Ottawa, Can., for Post Office fittings, Elora, Ont. Plans and specifications may be seen on application to William Mahoney, Architect, Guelph, Ont. and at the Department of Public Works, Ottawa.

✣Bids will be received until noon, Jan. 14, by S. P. Porter, Deputy Minister, Railways and Telephones, Regina, Sask, for 45,000 telephone poles.

⊙The Board of Control of Winnipeg has awarded a contract to the Seamens Dynamo

Works, Toronto, for the 500-kilowatt generator sets for the power station. The bid amounted to $16,410.

The International Contracting Co., of Winnipeg, Man., has been incorporated with a capital stock of $50,000,000. The nominal incorporators include Robert Lush Miller and Eugene W. Peters, financial brokers of Winnipeg. The company is authorized to erect all kinds of buildings, to treat any kind of wood, timber, etc., with oils, chemicals, etc., for the purpose of waterprofing or preserving, and to manufacture, refine and deal in all kinds of oils, etc.

The Consulting Board of Power Engineers employed by the city of Winnipeg, Man., has recommended to the Board of Control that $55,000 be spent during the coming season on conduit construction for the distribution of power along Main St. and Portage Ave.

TRADE NOTES.

The T. L. Smith Co., Old Colony Bldg., Chicago, Ill., has secured the contract for all the mixers to be used upon the Keokuk & Hamilton Water Power Co.'s dam at Keokuk, Ia. The first plant will be installed on the Hamilton side, where work is now in progress. The work involves 550,000 cu. yds. of concrete, and when completed the dam will develop 200,000 to 250,000 h. p. The mixers are of 1½-yd. mixed material and equipped with the Smith Co.'s latest power tilting device and steam engine.

A year ago the J. I. Case Threshing Machine Co., of Racine, Wis., offered a free trip to the factory to two salesmen in each territory. The trip was a reward for the salesman selling the most goods for the year, and the salesman showing the largest increase over the year 1909 in the territory he worked for that year. No one salesman was allowed to have both records. As a result about seventy salesmen are now in Racine, looking over the plant and getting a line on the output for the coming year. They are also receiving instructions that will help them in their sales work. While they are in Racine they are the guests of the J. I. Case Threshing Machine Co. and will be entertained by them. The time they spend at the factory will be three days.

The Cement Age Co., of New York City, pubpublisher of the "Cement Age," has purchased "Concrete Engineering," heretofore published at Cleveland, O. Beginning with the January, 1911, issue, the two magazines will be consolidated under the title: "Cement Age, with which is combined Concrete Engineering." Mr. Allen Brett, editor of "Concrete Engineering" for the past two years, will take the position as associate editor of the new publication, and Mr. Arthur E. Warner, formerly business manager of "Concrete Engineering," will become western manager. There will be no change in the present staff of "Cement Age," Mr. Robert W. Lesley continuing as editor, Mr. Frederic F. Lincoln as president of the Cement Age Co., in charge of the New York office at 30 Church St. and of the eastern advertising field, and Mr. Edward A. Trego as associate editor.

STREET PAVING.

Sealed proposals for paving with brick block, wood block, concrete, asphaltic concrete, or sheet asphalt pavement, will be received by the City Clerk of the City of Manhattan, Kans., up to 6 o'clock p. m. of Tuesday, the 7th day of February, 1911.

Approximate quantities are 12,200 square yards of paving and 4,000 cubic yards of excavation, on Poyntz avenue, and 16,200 square yards of paving and 5,450 cubic yards of excavation on Houston and Fourth streets, in accordance with plans and specifications now on file in the office of the City Clerk.

Parties desiring plans may obtain same by application to City Engineer on payment of $1.00 to cover cost.

The city reserves the right to reject any and all bids. Each bid must be accompanied by a certified check of $1,-000.00, payable to the City Treasurer.

C. L. BURT, City Engineer.
C. T. GIST, City Clerk.

POSTPONEMENT OF OPENING BIDS [illegible] PORTO RICO IRRIGATION SERVICE.

The ope[illegible] construction of (1) Carite Dam, (2) Guayabal Dam, and (3) Patillas Canal and Appurtenant Structures, is hereby postponed from January 3, 1911, to February 7, 1911.

J. W. BEARDSLEY,
Chief Engineer, Irrigation Service, Guayama, Porto Rico.
By order of
JOHN A. WILSON,
Commissioner of the Interior, San Juan, Porto Rico.

ADVERTISEMENT.

DEPARTMENT OF THE INTERIOR
OFFICE OF PORTO RICO IRRIGATION SERVICE.

Guayama, P. R., Oct. 10, 1910.

Sealed proposals will be received at the office of the Commissioner of the Interior of Porto Rico until 2 o'clock p. m., February 7, 1911, for the construction of—

(1) Carite Dam and appurtenant structures, containing about 150,000 cubic meters of earth and loose rock, the estimated cost of which is about $190,000.

(2) Guayabal Dam and appurtenant structures, containing about 73,500 cubic meters of concrete masonry and 82,000 cubic meters of excavation, the estimated cost of which is about $550,000.

(3) Patillas Canal and appurtenant structures, including about 32,000 cubic meters of open-cut excavation, 2,060 lineal feet of tunnels, 2,500 lineal feet of flumes, 600 lineal feet of siphons, and 100 bridges, the estimated cost of which is about $70,000.

Plans and specifications may be obtained from this office, or from the Commissioner of the Interior, San Juan, Porto Rico, or from the Bureau of Insular Affairs, Washington, D. C.

A deposit of $2 is required for each set of plans, which will be refunded upon the return of the plans upon or prior to the date set for opening the bids. The right is reserved to reject any and all bids.

J. W. BEARDSLEY,
Chief Engineer Irrigation Service,
Guayama, P. R.
By order of:
JOHN A. WILSON,
Commissioner of the Interior of Porto Rico, San Juan, P. R.

PROPOSALS FOR DREDGE. — U. S. ENGINEER OFFICE, Vicksburg, Miss., Dec. 15, 1910. Sealed proposals for steel hull, self-propelling hydraulic dredge, steel pontons and pipe line, and also for the component groups thereof, including steel dredge hull, steel pontons and pipe line, upper works, steam plant, propelling machinery, electric plant, pumping engine, condenser plant, and evaporator, sand pump, suction pump and ladder, cutter head, gear and engine, winches and refrigerating plant, will be received at this office until 12 m., January 18, 1911, and then publicly opened. Information on application. CLARKE S. SMITH, Capt., Engrs.

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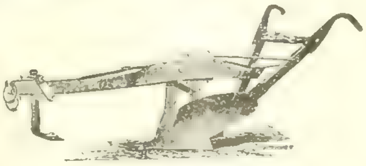

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TORONTO MAIN DRAINAGE.

Sealed tenders addressed to the Chairman of the Board of Control, City Hall Toronto, Canada, endorsed "Tender for Section No. 1, Low Level Interceptor," or "Tender for Laying Reinforced Concrete Overflow Pipe from Sewage Tanks," etc., as the case may be, for the construction of the several sections of Low Level Interceptor and other works, as mentioned below, will be received by registered post only, until noon of Tuesday, February 7, 1911.

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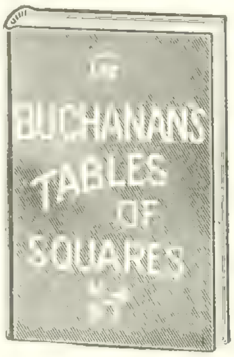

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When the Engineer Acted as Arbitrator.

Contracts for construction work formerly stated that the engineer was to be the arbitrator between the contractor and the owner. Of late years these words have been dropped and with them, very frequently, the spirit which they expressed. In another column of this issue we record an instance where the spirit was kept to the letter, without the words. The engineer acted truly as arbitrator. The instance is not unique, neither is it too common to deserve mention, and we shall recite its history.

The contractor for the Springfield, Mass., water purification works described in this issue signed a contract under which he assumed all risks. It was about the usual form of contract—not quite so exacting perhaps as some in holding the contractor responsible for all acts of man and God, but yet rigid enough to keep the engineers and the owner safe from ordinary mischances. The contractor made his bid, as a contractor must nearly always do, on conditions as stated by the engineer. In two respects in particular in this work these conditions were far different than had been assumed. Test pits sunk to determine the nature of the material to be excavated disclosed [illegible] actually, the greater portion of the material proved far different than the test pits indicated and enormously more expensive to excavate and handle. Likewise test pits showed readily available sources from which to secure filter sand, which actually were deposits not suitable [illegible] rendered? The engineers assumed that it lay in the [illegible] his share in the error and could be best rendered by making reasonable concessions to recompense the contractor for the added cost to him because of the error. How it was done is described in the article which we publish elsewhere.

So much for the bare history of the case. Its human interest, and, in great measure, its professional interest, lie in the reasoning of the engineers justifying their action. We have this reasoning in the words of both Mr. Lochridge, the [illegible] engineer, and Mr. Allen Hazen, the consulting engineer for the work. Briefly it was as follows:

The engineers as well as the contractors had been misled by test pits and conditions were found to be widely different from those which were supposed by the contracting parties to exist when the contract was made. It seemed under the circumstances that it was fair to hold that the city had in effect guaranteed certain conditions and that it was equitable for the city to make good to the contractor for the additional expense reasonably involved in any differences found. In contracts of this type the engineer acts as arbitrator between the contractor and the owner. He is bound to do even handed justice to both parties. It is just as wrong for him to underestimate the contractor's work, to refuse to allow reasonable extras, or make decisions that hamper the contractor or obstruct his work unnecessarily, as it is for him to overestimate the contractor's work or favor the contractor in any way at the expense of the owner. In other words the contractor's interest must be protected by the engineer just as carefully as the owner's interest. In this case the disposition shown by the contractor to do his work, regardless of consequences to himself in accordance with the intention and spirit of the specifications was a further strong appeal for a just appreciation of his difficulties and for fair dealing.

The point above all others which should not be overlooked in this statement is that the fair dealing of the contractor begot fair dealing by the engineer. Another point scarcely less important is the frank admission by the engineers of error in their findings and their honest courage in shouldering the blame. We do not believe that these qualities are rare among engineers, but we do believe that the ordinary form of contract placing all risks on the contractor offers a shelter behind which it is a constant temptation to seek safety from negligence and error [illegible] the contractor assume responsibility for unexpected conditions. One party to a construction contract must have full power or else the way is open to constant dispute and delay. It is logical too that the engineer should be the one to possess full power. Assumption of absolute power, however, brings with it the obligation to dispense absolute justice, and this is a truth that the engineer cannot allow himself to overlook.

The professional value to an engineer of a reputation for fairness and justice toward contractors is not merely the "consciousness of rectitude," which one engineer recently told us had been his only reward for "trying to be decent to contractors;" it is a saving in dollars and cents to the engineer's clients. The contractor for the work being considered it will be noticed gives pertinent testimony on this point in his paper published in another column, but in offset to the engineer's statement quoted above we will also present the statement recently made by a prominent and reputable contractor:

> [illegible] cution, to have this spirit exist? It permeates [illegible] gains.

There are in the work which is described in the article mentioned above a number of technical matters that are deserving of comment and we shall consider them in a succeeding issue. We have felt here that a short sermon on the human element of contracting as exemplified at Springfield was not out of place.

Is Convict Labor On Roads In Northern States Economic?

The apparent success of convict labor on roads in the south has led a few northern states to experiment with such labor. Among these states is Washington, and the results of the experiment there will be watched with great interest. Thus far the use of convicts in Washington has not been uniformly successful. On one important piece of road work on Puget Sound, for example, the cost has been as great as it would have been if the work had been done by contract. In a succeeding issue we shall print the report of an investigating board of engineers appointed by the Governor of Washington to advise him as to the general efficiency of the administration of the state highway department. The board was unable to come to a final decision as to the economy of using convicts on state road work in general, but, in view of the successful use of convicts in certain roads, the board is of the opinion that convict labor on roads should be continued. The board offers the novel suggestion that the bonus system of payment be applied to convict labor, and the prediction is made that the result in increased efficiency of the convicts will prove to be very marked.

Few states have convicts enough to do more than a small percentage of all the necessary road work, so that free laborers and contractors need fear no ultimate ill effect from the employment of convicts on road construction. Convicts in the northern states are a much more independent and dangerous class of men than those in southern states. Hence, when working in the open, they must be so closely guarded that the expense of guarding alone becomes a very considerable sum. It seems not unlikely that convicts can be used with much better results in quarrying and crushing stone than in general road work. Several large quarrying and crushing plants have been built in the state of Washington to [illegible] quent issue we shall publish a [illegible] these plants and their operation.

[illegible] mention above is the recommendation that the Highway Department shall make a monthly financial and progress report to the Governor, following the practice of the department heads of railways and other corporations.

Still another feature is the recommendation [illegible] of the Highway [illegible] be materially increased.

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Oscar P. Chamberlain, President Western Society of Engineers.

Oscar P. Chamberlain, elected president of the Western Society of Engineers at the recent annual election, was born at Pittstown, N. Y., on Nov. 26, 1870. He is the son of Alonzo Bradner Chamberlain and Laura Arceville (Munson) Chamberlain, the Chamberlains of New York being a branch of the prominent New England family of that name. He received his early education in the public schools of Auburn, N. Y., and Philadelphia graduating from the high school of the latter city in 1885. He immediately entered the civil engineering section of the University of Pennsylvania, and in 1889 was graduated from that institution with the degree of civil engineer.

Beginning with the Pennsylvania R. R. as rodman in 1889 Mr. Chamberlain advanced rapidly to the position of assistant engineer and [illegible] was placed in responsible charge of important extensions and bridge reconstruction on the Philadelphia, Baltimore & Washington R. R., a subsidiary line then recently acquired by the Pennsylvania and now a part of the main line between Philadelphia and Washington.

An important part of his work on this line was the construction of the three span stone arch bridge over Darby Creek, costing $80,000, in 1892 At that time this bridge was considered a large and difficult piece of construction, and its successful completion attracted general attention among engineers.

Following this work he had charge of other important bridge construction on the Pennsylvania R. R.—the Burmont culvert, in 1893; the Wallingford viaduct, in 1895; the Media viaduct in 1896 and 1897, and the Elk View viaduct, in 1899 and 1900. During the last two years of his service with this company, he made an exhaustive study of the relation of wheel flange to flange ways in frogs, crossings and guard rails. These studies had especial reference to wear on flanges and guard rails, and the proper mounting of wheels to reduce this wear to a minimum. His recommendations were submitted to the Pennsylvania Association of Operating Officers, and served an important purpose later in determining the standards ultimately adopted by the Master Car Builders' Association.

In August, 1902, Mr. Chamberlain left the Pennsylvania and entered the service of the Chicago Great Western R. R. at Minneapolis. This road was then planning extensive realignments and grade reduction on its eastern division, and Mr. Chamberlain was placed in entire charge of the work. A great part of this work, in accordance with the plans made by Mr. Chamberlain, has been done in recent years, and practically all the remainder is now under construction. On the completion of this work he was appointed division engineer of the southwest division, with headquarters at Des Moines, Iowa. The departmental type of organization was then in force on this road. All engineering, maintenance and construction was carried on under the supervision of the division engineer, the forces in all these departments reporting directly to him. The division engineer, in fact, was, within the limits of his territory, virtually chief engineer and superintendent of maintenance and construction.

In May, 1903, the Kansas City flood occurred. This was one of the heaviest floods known on the Missouri River. At the same time the Kaw River, which has its junction with the Missouri River at Kansas City, was in the midst of a phenomenal flood and the result was the loss of hundreds of terminal tracks and the destruction of all but one of the bridges over the Kaw River.

Like the other roads entering Kansas City, the Chicago Great Western suffered heavy losses through the destruction of its terminals. In addition to this about 40 miles of road in southern Iowa and northern Missouri was washed out. As division engineer Mr. Chamberlain was responsible for the rapid reconstruction of both main line and terminals. It was work requiring the highest grade of engineering and executive ability. How well the work was handled is indicated by the fact that in less than four days after the subsidence of the flood this road was in full operation between Des Moines and Kansas City, and within six weeks the destroyed terminals had been rebuilt. He also had charge of the design and reconstruction of the Kansas City Northwestern bridge over the Kaw River, which was operated jointly by that road and the Chicago Great Western.

O. P. Chamberlain

This bridge, originally a pile trestle, was the furthest downstream of the bridges over the Kaw River, being a few hundred feet from the junction of that stream with the Missouri.

This was the only bridge not washed out, and accordingly, it acted as an obstruction for catching the debris from the other bridges. A dangerous jam resulted, which threatened to destroy the structure. With all other bridges gone, this one was of the greatest importance to the roads entering Kansas City from the west. Mr. Chamberlain volunteered to take charge of the work of breaking up the jam. Much personal risk was involved, but the work was successfully accomplished in four days with a small volunteer force working day and night. Immediately after the subsidence of the flood the pile trestle was replaced by a steel structure, under Mr. Chamberlain's supervision.

Prior to 1905 the Northern Pacific R. R. had experienced great difficulty in maintaining its tracks along the Yellowstone River in Montana. At many places this road lies adjacent to the river on bottom lands formed of silt. The river is subject to high floods and swift currents, and washouts along the railroad were frequent. Mats such as are used on the Missouri River, and carefully placed riprap, were found to be ineffective, the riprap failing largely because of the undermining effect of the current. In 1905 Mr. Chamberlain was asked to make a study of the problem and to devise some means for protecting the railroad from further damage by floods. As a result of investigations made by him and his assistants, a unique means for providing a foundation for riprap was adopted. It was believed that stone of large size would in a short time settle through the silt of the river, much of which was quicksand, and find permanent lodgment on the rock stratum lying a few feet below the bed of the river. Owing to lack of facilities, however, it was impracticable to handle stone of such a size as to serve this purpose. It was therefore decided to use cylinders 4 ft. in diameter and about 20 ft. in length, and consisting of a core of stones wrapped and bound thoroughly with willow brush. These cylinders were rolled into the river and allowed to sink. In this way a permanent foundation was provided for the riprap for protecting the road bed. The process was an inexpensive one, as all stone was secured from cliffs near the track The Yellowstone River is heavily silt bearing and a careful study of the currents led to the placing of this protection in such a way as to cause other portions of the river bank, that were not protected, to build up through the silting action of the river. This work seems to have been a permanent solution of the problem, as little or no trouble has occurred during the four years that have elapsed since the work was completed.

In 1906 Mr. Chamberlain became chief engineer for Dolese & Shepard, manufacturers of crushed stone and lime, with extensive plants in the vicinity of Chicago. At the same time he became chief engineer of the Chicago & Illinois Western R. R., an industrial line controlled by the Dolese & Shepard Co. This road has practically all been built under his supervision. He is also general manager of the Union Paving Co., of Chicago.

For the past two years he has acted in a consulting capacity for the Midland Continental R. R., and has recently been appointed its chief engineer. This is a projected line extending from Edgeley, N. D., the northern terminus of the Chicago, Milwaukee & St. Paul Ry., to Winnipeg, and is designed ultimately to extend southward to the Gulf of Mexico.

During recent years Mr. Chamberlain has taken an active part in the work of the engineering societies, and has been a frequent contributor to technical literature. He became a member of the Western Society of Engineers in May, 1906. He served on the publication committee during the years 1907 and 1908, and became chairman of this committee on his election as second vice-president of the society in 1909. In January, 1910, he was elected first vice-president. For the past six years he has been a member of the American Railway Engineering and Maintenance of Way Association, and has been chairman of the committee on buildings for the past three years. He is also a member of the Engineers' Club of Chicago, and of the Illinois Society of Engineers and Surveyors.

Mr. Chamberlain is unmarried, and resides at La Grange, Ill.

CONCRETE AND REINFORCED CONCRETE SECTION

Influence of Design on the Cost and Speed of Erecting Concrete Buildings.

(Contributor)

Obviously the standardization of parts can be made a great factor in reducing the cost and increasing the speed of assembling or erecting either machinery or buildings, regardless of their general type of construction. The two large reinforced concrete factory buildings, a machine shop and a store house, designed by the Stone and Webster Engineering Corporation of Boston and recently added to the plant of the General Electric Co., at Schenectady, are striking examples of the extent to which standardization of parts can be carried in this type of construction. The designing engineers being thoroughly familiar with actual operations in the field were enabled to combine the requirements of the owners as regards size and purpose of the buildings with a maximum economy of material and labor in erection. These buildings are known respectively as Nos. 40 and 46. The former is 83x403 ft. with two adjacent towers 32 ft. 8 ins. wide having a combined length of 134 ft. and with a two story leanto 192 ft. long between the towers.

A distinguishing feature in the design of these buildings is the fact that story heights and spans are greater than in the average factory building. Both buildings are five stories high the first story height being 24 ft. and the ones above 17 ft. 8 ins. Provision is made for an additional story in the future on both buildings, the roof being flat and the slope for the drainage obtained by a cinder fill. In the machine shop the floor loads throughout are 200 lbs. per sq. ft., but in the store house the second floor is designed for a live load of 400 lbs. per sq. ft., the third and fourth floors for 300 lbs., and the fifth floor and roof for 200 lbs.

In the erection of building No. 46 a really remarkable speed record was made. The piling, which is of the Raymond modified type of concrete pile, was completed during July. In the latter part of this month the actual erection of the superstructure was commenced. A railroad siding extended along one side of the building and the construction plant so arranged that stone and sand could be readily unloaded and hoisted into bins by means of belt conveyors. The mixer was located between and below these bins so that the aggregate was delivered into the mixer through chutes. After mixing the concrete was discharged from the mixer directly into [illegible] tower. It was then hoisted to the proper floor and dumped into concrete carts and wheeled to the point of placement

In designing the beams all the stems below the slab were made the same size, 12 ins. wide by 23 ins. deep Variations in the loading and [illegible] the area of steel. This arrangement greatly facilitated the form work and effected a big economy in same. The general procedure was to erect the forms and follow along closely with the fabrication of the steel and the concreting. By the time the forms were erected for one floor the concrete at the other end of the building had set sufficiently to permit the stripping of the forms which were then erected on the floor above. Hence it was only necessary to purchase sufficient lumber for forms for one floor.

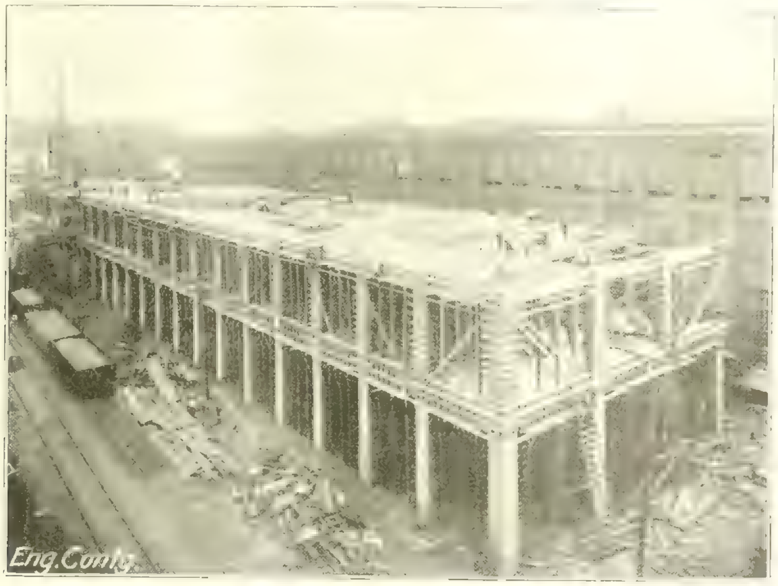

Fig. 1—View of Machine Shop and Storehouse Building, Showing Forms.

Perhaps the greatest economy effected, however, was in the designing of the steel reinforcement. In regard to this the engineers developed a system which provided for the fewest sizes of bars and bent shapes and devised a method which insured the proper placing of steel and prevented displacement during the pouring and ramming of the concrete.

In the beams [illegible] reinforcing bars [illegible] the bottom were [illegible] being bent. The negative bending over the supports was provided for by bent bars the lower ends of which were hooked around short cross rods placed between the two layers of main reinforcing bars. These bent bars were [illegible] sible and [illegible] in the length of the beams or girders merely required a change in the length of the straight unbent bars in the bottom. An independent adjustment of the steel to take care of sheer and negative bending moment was possible by having the loose negative bars. The bending of the heavy girder bars was accomplished on a bending table made up of two ⅜-in. plates with holes punched in them into which steel pegs were placed at any desired distance apart and at any angle.

The stirrups which were all of the double loop type of ⅜-in. square twisted stock were bent on a machine consisting of a slide which was operated by a lever attached to one end. At the other end of the slide a slot was cut the exact width of the desired bend and the rods were bent by placing them across the slotted end of the slide and being forced into the slot by a peg when the slide was moved forward.

For the slab rods a uniform set was designed a typical bar of which was straight at one end, cambered at the center over a beam, and also at the other end. These were bent by means of a special double bending machine designed by Lewis F. Brayton. This machine will offset a bar parallel to itself and put in two bends at one pull of the lever. Figure 2 shows one of these machines in operation. It was found that with labor at 18 cts. per hour bending the ⅜-in. square bars used in the slab ran about 7 cts. per hundred bends, approximately one-third the cost by other methods.

The actual time consumed in erecting Building No. 46 from footings to roof was 39 working days. In that time 1,180,000 lbs. and 6,100 cu. yds. of concrete were placed. The steel contained in the neighborhood of one-third of a million bends and the bending was done at the average rate of fifteen to the minute. In the two buildings something over 1,400 tons of steel reinforcing was handled at a cost slightly less than $6.25 per ton. This included the entire cost of bending, handling and placing, including the making of the rectangular and spiral column cages.

The exterior columns are of the Hennibeque type but in order to save floor space the interior columns were designed of the spirally hooped type which have considerably greater strength for an equal area of cross section. In placing the steel for the latter four 1¾x¼-in. spacer bars were used which were so punched that the pitch of the spiral winding could be perfectly maintained.

The general design for the two buildings was very similar, the longitudinal bays being 16 ft. while across each building there were three bays 23 ft. wide in No. 46 and 27 ft. wide in No. 40. Each longitudinal line of [illegible] which are framed the transverse floor beams which are spaced 8 ft. on centers.

Fig. [illegible]-View of Device for Bending Reinforcing Rods.

The arrangement of the steel for the girders and the manner of transferring the web stress out into the flange of the Tee section were interesting. The accompanying cut, Fig. [illegible] of the reinforcement in one of the girders, the main features of which [illegible] straight loop bar which extends the entire length of the girder [illegible] arated.

The loop bar is supported on blocks resting [illegible] The bottom reinforcing bars are hung from [illegible] in the form of a W. These stirrups in combination with the negative bars are designed [illegible] 35 lbs per sq. in. Alternate slab bars pass underneath the loop bar which serves to transfer the web stresses into the flange. The cut, [illegible] three different types of beams which were designed for this building. There is a great deal of variation in the allowable width of flange according to different opinions but the width of 42 ins. allowed in this case seems to be conservative practice.

The construction work proceeded as follows:—the column forms were erected, plumbed and squared, and securely braced. The girder forms made up in units were then put in place and finally the sheathing for the floor slab. The construction tower for hoisting the concrete was located about one-quarter the length of the building from one end so that when the sheathing reached this point it was possible to commence wheeling the concrete over the forms and placing same at one end of the building. Fabrication of the steel followed very closely after the erection of the forms. The following summary indicates [illegible] was erected. On July 29th the column forms on the first floor were all in place, the girder forms for half the second floor were erected and the sheathing for the second floor slab had been laid as far as the construction tower. The actual concreting for the superstructure commenced about August 1. Three weeks later the concreting for the first floor and about half the second floor had been completed. The forms for the entire second floor were erected and the column forms for four bays on the third floor were in place. By September 7 the concreting of the first three floors had been entirely completed and the [illegible] floor were practically all in place. On September 26 the concreting had been practically finished and the forms were stripped from the entire building with the exception of the fifth floor columns and the roof. As indicated before the erection of the entire frame work of the superstructure occupied a period of but 39 working days. The system of reinforcement worked out admirably for construction and the various details fulfil perfectly the purpose for which they were intended.

Great assistance was rendered the contractors by the transportation department of the General Electric Co. whose co-operation made possible the handling of 407 car loads of material [illegible] Aug. 21 and Sept. [illegible] without incurring a dollar's worth of demurrage.

[illegible] rapidity with which this building was erected is surely a striking example of the large extent to which the proper design of a building may influence the cost and the speed of erection.

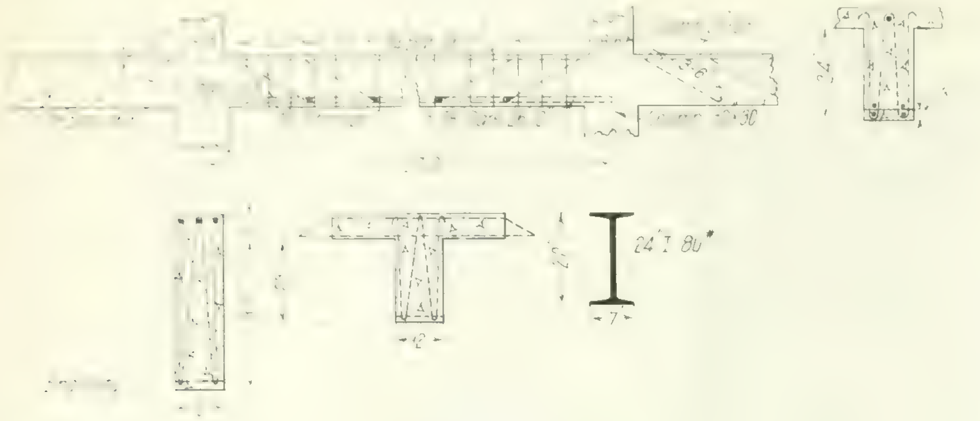

Fig. 3—Sketch Showing Girder Reinforcement and Comparison of Three Types of Beams.

Some Tests to Determine the Effect of Varying Percentages of Mixing Water on the Impermeability of Concrete.*

It is of the first and greatest importance in the making of a waterproof concrete that the mixture shall be so proportioned as to sizes of the particles that the mass shall be of maximum density and therefore of minimum voids. Yet, after the utmost diligence has been employed in the selection of the mixture and in the proportioning of it, there are other factors still to be considered, one of which, very often not considered, is the amount of water to be used.

It has long been recognized that the quantity of water used in mixing concrete had a large influence upon the impermeability of the resulting mass. This fact has been well established and most works on the subject of concrete, however brief, call attention to it. That impermeability may be regulated to some extent by the amount of water used is of great importance to the concrete trade. It is perhaps of as great importance to the block makers as to any other branch of the industry. We frequently read the claims of the block machine makers to the effect that this or that machine produces an impervious block because it is made "wet" or "semi-wet" or "dry." But we doubt whether it is generally realized what a large difference in permeability a small difference in the percentage of water used will make.

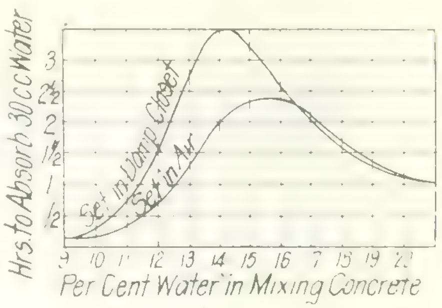

Fig. 1.

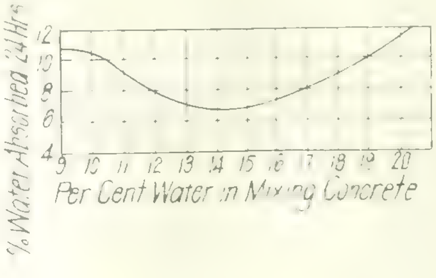

Fig. 2.

The theory is generally held, we believe, that other conditions being the same, a wet mix makes a more water-proof concrete and that a dry mix produces a more porous mass unless very tightly compacted by much hard tamping or enormous pressure.

It was in an endeavor to make a very spongy porous concrete for a special purpose that Westinghouse Church Kerr & Co. made up a series of blocks with varying percentages of water, and noted the great difference in porosity made by slight changes in the percentage of water used. The blocks used in this series of experiments were about 3½x3½x2 ins. high, with a circular depression or cup in the cop about 2½ ins. in diameter and 1 in. deep.

Some of these blocks were made of 1:2 and 1:3 mixtures of Portland cement and a good grade of building sand, while others were made of the same mixtures of cement and crushed granite screened through a five-mesh sieve.

The molds were of wood and the mixtures were tamped in by hand with a light tamper. A metal bell was used to form the depression or cup. In some cases the blocks were allowed to set in a damp closet for 24 hours before being exposed to the air, while in other cases the blocks were left in the air to set as soon as made. The day after being made the inside surface of the depression was brushed with a wire brush to remove any cement film or laitence from the surface, which might affect the results. When the blocks were one week old 30 cu. cm. of water was placed in the depression of each block and the time noted which was required for the block to absorb all the water.

After the first test the blocks were allowed to dry out and were again tested at two weeks old. After the second test they were exposed to the weather on the roof and tested again at the end of a month. Many blocks were made of each mixture of materials and of each percentage of water, and the average time taken in absorbing the water was used in comparing results. In all about 230 blocks were made and tested.

The curves in Fig 1 show graphically the results obtained at the first test when the blocks were one week old. The upper curve represents the results obtained on the blocks which were placed for 24 hours in a damp closet before being exposed to the air, and the lower curve shows results on blocks dried in air immediately after making and not sprinkled. The ordinates represent the time in hours required for the block to absorb 30 cu. cm. of water placed in the depression, while the abscissae represent the amount of water used in percentage of the total weight of cement and aggregates. It will be noted that the results obtained with blocks which set in the damp closet were considerably better than those obtained with the blocks which set in dry air. There was so little difference between the results at the end of a week and those at the end of two weeks and one month that only the results at the age of one week are shown. The other curves would practically coincide with these. While the best percentage of water probably varies with different cements and aggregates and should be determined for any particular combination that is to be used, yet it is evident that for the cement and sand used in these experiments the amount of water should lie between 13 per cent and 16 per cent of the total mixture by weight, if the blocks are to be cured in a damp place. When exposed to the air immediately after making, somewhat more water should be used, say, between 14 per cent and 17 per cent. The point we wish to emphasize is the importance of using the right amount of water. We cannot state that under other conditions the percentages given here will be correct.

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*A paper by Cloyd M. Chapman before the National Association of Cement Users. [illegible]

The above experiments indicate, not the amount of absorption of the blocks, but the rapidity or rate of absorption. After the blocks had had their third test at the age of 30 days they were dried out for a week in a warm room, carefully weighed and then immersed for 42 hours in water. The surplus water was then wiped from their surface and they were weighed again. Figure 2 shows graphically the results of this series of absorption tests. In this curve the ordinates represent the percentage of water, by weight, absorbed by the dry blocks during 24 hours immersion, while the abscissae represent the percentage of water by weight used in mixing the concrete. The relation to the former curves is at once apparent. The least absorption occurs with about 14 per cent of water and it is fairly uniform between 13 per cent and 15 per cent. By either method of determination, that is, by rate of absorption or by amount of absorption, we arrive at the same conclusion. A concrete may be too wet or too dry to produce the most impermeable product, and one extreme is as surely an evil as the other, if it is impermeability we seek.

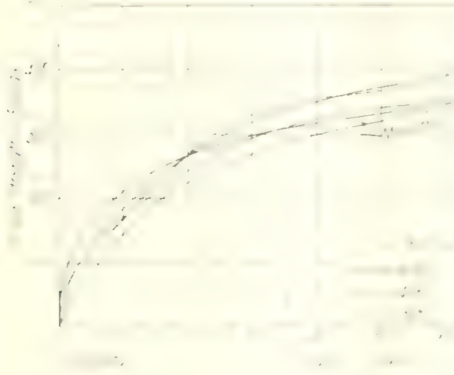

Fig. 1.

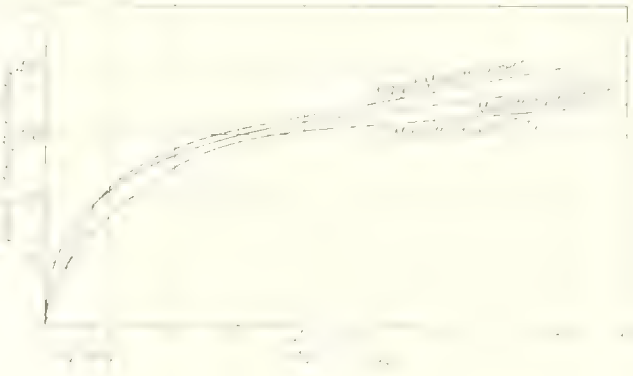

Fig. 2.

Experience With Portland Cement Blended by Grinding With Tufa for Making Concrete for the Los Angeles Aqueduct.*

The Los Angeles Aqueduct is designed to be 215 miles in length, extending from Owens River on the eastern face of the Sierra Nevade, to the city of Los Angeles. All but the first 21 miles, and the 12 miles of steel siphons, will be lined with concrete, calling for a total consumption of 1,200,000 bbls. of cement.

The Aqueduct is located in a sparsely populater region where transportation charges are unusually heavy. A local railroad has been built from Mojave to the intake, and freight charges on this line average 4½ cts. a ton mile, or approximately 1 ct. a barrel per mile. There is a stretch of 60 miles southwesterly from Mojave that diverges from all railroad transportation, at one point the conduit being 35 miles from the nearest railway. The transportation charges on the cement are a more important factor than its first cost.

The city of Los Angeles has constructed a municipal cement mill at Monolith, 15 miles north of Mojave, which is the approximate center of the aqueduct. This mill has now been operating for two years and has a capacity of 1,000 barrels a day. It is of standard construction, making a Portland cement which complies with the specifications of the American Society for Testing Materials. The brand name of the cement is "Monolith." While this cement mill has been successful in producing a product at a reasonable cost near the center of the work, it does not obviate either the high local freight charges north of Mojave, which amount to as much as $1.25 a barrel, or the expensive wagon haul charge to points southwest of Mojave, which, in addition to the local railroad freight, amounts to as much as $1.50 a barrel.

Deposits of volcanic tufa were discovered along the line of the Los Angeles Aqueduct in the Owens Valley, 85 miles north of Mojave, in the Mojave desert about 20 miles west of the railroad, and at the site of the cement mill at Monolith. Tuff or tufa is a volcanic fragmental rock which is made up of minute particles bearing the indications of having been laid down in water and partly consolidated. Sometimes tufa is a calcareous deposit, but that used for the manufacture of the cement described here is of volcanic origin. It is of a grayish or creamy color and of a low specific gravity when in the rock form. When pulverized, the powder has a specific gravity of 2.2. It closely resembles and is probably the same as the German trass and the Italian pozzuolana, except that these last two are defined as of volcanic origin only, while tufa is described as being either volcanic or calcareous. The tufa found along the line of the Los Angeles Aqueduct occurs in large deposits and shows lines of stratification, indicating the probability of the ash having fallen on water and been laid down by sedimentation. In texture, tufa closely resembles the pumice of commerce. Its chemical analysis is:

Silica	[illegible]
Alumina	[illegible]
Iron	[illegible]
Lime	[illegible]
Magnesia	[illegible]
Sulphur	[illegible]
Loss on ignition	[illegible]
Total	[illegible]

[illegible] past the writer has been connected with the construction of hydraulic works in western desert regions where transportation charges often result in high cost of cement. This has led to experiments being made at different points on the possibility of making silica cements by blending ground quartzite rock with standard cement, and later, by grinding and blending volcanic products with standard cement. When investigations looking to the construction of the Los Angeles Aqueduct were undertaken, Mr. E. Duryee, who formerly was a cement chemist with the U. S. Reclamation Service, was engaged by the city for the purpose of conducting tests of material along the line of the aqueduct suitable for the manufacture of cement. The blending and grinding of tufa with cement was suggested by the writer. The development of the process described below was under the immediate direction of Mr. Duryee, assisted by Mr. G. M. Andrus, who at present is the chemist for the city in charge of the tests at all plants. Mr. Roderick MacKay is manager of the cement mill and tufa plant at Monolith, Mr J. A. Roesch being in charge of Tufa Plant No. 1 at Fairmont, and Mr. O. J. Riggs in charge of Tufa Plant No. 2 at Haiwee.

The experiment was early made of grinding in the laboratory at the cement mill, the tufa of the Mojave desert and blending it with hydrated lime. This resulted in a strong, hydraulic mortar, subject to considerable checking when made in standard pats, but a mortar which became hard when set in water. This indicated that there was a chemical union between the ground tufa and the lime. The experiment was also made in the laboratory of grinding and blending tufa with standard Portland cement. The laboratory tests showed that briquettes made of the tufa and cement without sand were not as strong as briquettes made of straight Portland cement, but when the tufa cement was mixed with standard sand in proportions of 3 to 1, it developed as much strength in 28 days as the standard sand briquettes made with standard cement in the same ratio. Experiments were made with tufa from the three deposits in which the aqueduct engineers were interested, to-wit, the Haiwee deposit in Owens Valley, the deposit at Monolith, and the deposit at Fairmont. Practically the same results were obtained from each one. A mill run was then made of the tufa cement and this was put into the conduit work in the desert under conditions of extreme summer heat. The work stood up well.

After completing these experiments, the first tufa cement plant was erected at Fairmont at a cost, for all charges, of $22,000. This mill consists of an ordinary rock crusher with elevators, a ball mill and a tube or pebble mill. This plant is operated by electric motors. The tufa is quarried, then run through the rock crusher and through the ball mill, where it is passed through a 25 mesh screen. At this point the raw tufa is blended with the straight Portland cement, and the blended product is then run through the tube mill, where it is ground so that 90 per cent will pass through a 200 mesh screen. The output of this mill, under ordinary working conditions, will average about 100 bbls. of the blended product per 8-hour shift. A great deal depends upon the dryness of the tufa when it is fed into the mill. If the tufa is but slightly moist, it runs through the fine screen much more slowly than if it is dry. In midsummer when the tufa is thoroughly dry, the output of the mill may be increased 30 or 40 per cent with the same operating crew. The tufa is not artificially dried, heated or burned in any way in the process of manufacture.

As the tufa is very light and easily crushed, the machinery for the first crushing and grinding of the tufa probably could have been made less elaborate and expensive than that which was installed. The limiting factor in the product is the fine grinding in the tube mill. It is possible to run the product through the ball mill in about 60 per cent of the time that it can be put through the tube mill. The mill that has been erected at Haiwee is practically a duplicate of the Fairmont mill, and has the same capacity. The tufa will be handled in the same manner at the cement mill at Monolith as at the regular tufa mills.

The following is a cost statement for the month of July 1910, per barrel of blended product, for operating the Fairmont tufa plant on a one shift basis:

[illegible]	[illegible]
[illegible]	105
[illegible]	025
[illegible]	[illegible]
[illegible]	[illegible]

The characteristics of tufa cement, as compared with regular Portland cement in field work are that the tufa cement requires more water in the mix, hardens more slowly but continues the hardening process for a greater length of time. Tests made in the laboratory of the City Engineer of Los Angeles showed that the Monolith tufa cement, with one part tufa cement to three parts of sand, gave a tensile strength in 28 days of 430 lbs., in 90 days, 487 lbs. and in 180 days, 573 lbs. In this instance, the blend consisted of 62½ per cent of tufa by volume and 37½ per cent of "Monolith" Portland cement.

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*Extracts from a paper by J. B. Lippincott, Assistant Chief Engineer, Los Angeles Aqueduct, before the National Association of Cement Users.

The characteristic of absorbing more moisture and apparently holding it for a longer period of time than is the case with straight cement, makes it a better cement to use in hot, dry weather and not so good a cement to use in cold weather under freezing conditions. The diagram, Fig. 1, shows the results of some tests with tufa cement. The samples used in these tests were actual mill runs of 30 per cent by volume of tufa, 40 per cent, 62½ per cent and 75 per cent respectively. There is also shown on this diagram, tests made with straight Monolith Portland cement. The blend showing the best results is 62½ per cent by volume of tufa and 37½ per cent of straight cement. The results, however, are little different from those obtained with 30 per cent of tufa and 70 per cent of straight cement. The tufa has been ground with "Riverside" Portland cement manufactured at Riverside, Cal., and similar results obtained.

The blend that is being made at the Fairmont mill is 50 per cent by volume of tufa and at the Haiwee mill the blend is 60 per cent by volume of tufa, the Haiwee tufa being somewhat lighter than the Fairmont. The tests given in diagram, Fig. 2, are the results of averaging a large number of samples. The extreme fineness of grinding and the natural plasticity of the tufa produces a dense concrete and one that finishes with remarkable smoothness. Tufa cement makes a smoother plaster than straight cement. A disadvantage, in some classes of work, consists in the fact that it attains its strength slowly, so that forms have to be left on the work somewhat longer. The roof forms on the Los Angeles aqueduct, where the clear span is 12 ft., are stripped in six days when straight cement is used, and two or three more days are allowed when tufa cement is used.

In conclusion it may be stated that, both from laboratory tests and field experience, the tufa cement has proved as strong and as satisfactory generally as straight cement when used in making concrete. Its advantage on the Los Angeles aqueduct is in the way of economy. The quarry and mill charge for taking one barrel of straight cement and blending it so as to make two barrels of tufa cement is about 74 cts.; the price of straight cement at the points where the tufa plants are located is about $2.50.

It must be remembered that these grinding plants are relatively small, operating on a one shift basis, with an output of about 100 barrels per shift, and that if operations were carried on on a larger scale, the cost of grinding and blending this tufa would be much less, and I see no reason why there should not be marked economy in producing such a blended cement, where tufa is available.

EARTH AND ROCK SECTION

New Type of Excavator Used on the North Shore Drainage Canal, Chicago.

Among the many types of drag bucket excavators used for the excavation of canals, the one invented and built by J. T. Fanning of Chicago, is noted for the excellent work which it has accomplished. Its record on the North Shore Drainage Channel shows that it has made the neatest canal section on the entire route, and that less than 1½ yd. of excavation per lineal foot of canal was excavated outside of required lines. This is less extra excavation than was made elsewhere on the canal.

The material excavated is clay. The section of the canal measures 26 ft. wide at the base with slopes of 1 on 2. The average depth of the canal on the sections which this machine was used, is about 27½ ft. The country through which the canal runs is a practically level plain.

In this article we propose to give only the description and illustrations of the principles upon which the machine works, together with some notes as to the progress made by it. The costs of the work thus far done by the machine do not give a fair idea as to its economy. This is because the machine has been, during this work, in its experimental stage and many delays were incurred in making repairs and changes in various details.

Fig. 1 is a diagram illustrating the principles upon which the machine operates. There are two towers and two buckets. In each tower is located a double drum engine which operates one of the buckets. The booms, which extend on an incline to the rear of the tower and over the spoil bank, are also offset horizontally from the center lines of the towers. This can better be understood by reference to the plan. The boom on one tower is offset to one side of the center line which runs between the two towers, and the boom on the other tower is offset to the opposite side of this center line. In this way a straight line from the apex of one tower to the end of the boom of the opposite tower, shows a clear working line for the bucket. A similar condition is presented for another bucket to work in the opposite direction.

Each bucket is operated by two lines. The drag or digging line is run from the small drum of the double drum engine to the bucket which digs downwardly on the opposite bank of the canal. The bucket is dragged down the slope, with its other line slack, and takes its load. The other line of load line runs from the large drum on the engine up over a pulley near the apex of the tower, then out over another stationary pulley which is suspended from a cable placed between the two towers, down through a shieve attached to the bale of the bucket, and out to the end of the boom on the opposite tower. By winding in on this line and holding the drag line the bucket is raised until, by slacking the drag line, it can be run down by gravity to the dump pile at the end of the boom. The location of the bucket in digging was controlled partly by the location of the fixed pulleys suspended above the canal section. The positions of these were changed from time to time to suit the requirements of the work.

The bucket is of ¾ yd. capacity, and is arranged so that a tripping device, near the end of the boom causes the bottom of the bucket to swing loose and drop the load on the spoil bank.

In operation the skill with which the bucket is handled depends upon the experience of the engineer. Skillful handling as evidenced by the results shown in Fig. 2. The work is always in plain view of the operator, and by proper manipulation of the lines the slopes may be carved down at any angle desired. The constant rubbing of the buckets down the slope carries all loose material down the bank, and produces a compact and plane surface.

The bucket travels very easily and rapidly out to the end of the boom, the spud being controlled by the angle of the line on which it runs and by the dragline. Some speed is necessary to enable the bucket to throw out its load. The speed is desirable because the clay sticks to the bucket.

The principal disadvantage comes in the wear of the dragline which bears a considerable strain when used to stop the bucket. This disadvantage, it is understood, is to be taken care of by a new arrangement, according to the developed plans of the machine, which patents are now being applied for.

The machine was used on two sections of the North Shore Drainage canal, covering a period of two years. It was operated 10 hrs. per day with an engineer and fireman in each tower, and a track gang consisting of about 5 men. An average of 12 men, including the superintendent, watchmen and all labor, was employed. The maximum yardage excavated, during one month, was in June, 1910, when 19,000 yds. were excavated. The minimum yardage for a complete month was excavated in December, 1908, when 4,750 yds. were taken out. The average amount of excavation per working day was between 500 and 600 cu. yds. It was possible for each bucket to make two trips per minute, but the output per day shows that each bucket averaged less than one trip per minute.

The new machines, for which plans are being made, will be built stronger throughout, and a larger bucket will be used.

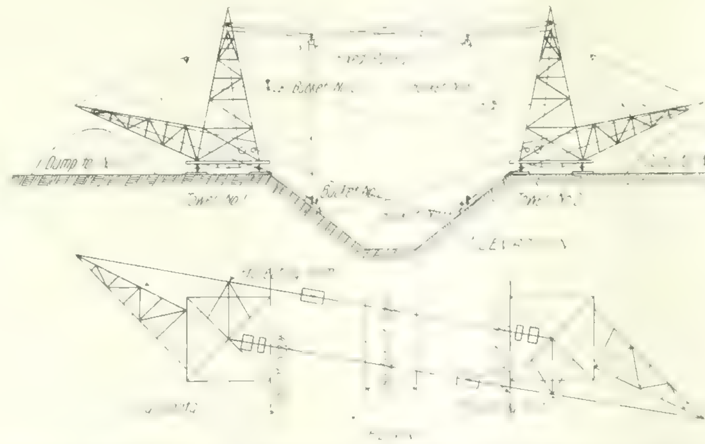

Fig. 1—Diagram Showing the Method of Operation of Double Bucket Excavator, North Shore Drainage Channel, Chicago.

Cost of Setting a Boiler.

A boiler for supplying steam heat in a church building at Oak Park, Ill., was set with the following costs in 1901:

Common [illegible] M at $[illegible]	$[illegible]
Fire brick, 1 [illegible] at $[illegible] per M	6.88
Fire clay, [illegible] bbls. at $[illegible]	4.00
Lime, 6½ [illegible]	2.9[illegible]
Sand, 4 [illegible]	3.90
Skilled labor, 39 hrs. at 50 cts.	13.20
Common labor [illegible] hrs. [illegible]	11.70
Foreman	7.28
Timekeeper	[illegible]
Watchman	1.7[illegible]
Total cost	$[illegible] 64

Methods of Making Computations for a Compressor Plant.*

The problem presented was to select machinery, layout and design a plant for a mine operated through 1,000 ft. vertical shaft, and at an altitude of 10,500 ft. above sea level. The cost of fuel at the mine being considered as excessive, an electrical installation was favored, current to be purchased from an independent company.

It is proposed to use compressed air for drilling during a period of 16 hours, two 8-hour shifts, loading and shooting to be done during the remaining shift. Assuming that a 2¼-in. piston drill will break 10 tons of rock in an 8-hour shift, it is found that the approximate number of drills required will be as follows: Rock to be broken per 16 hours = 225 tons; capacity of one 2¼-in. drill for 16 hours = 20 tons; number of 2¼-in. drills necessary, 11.25. These drills are to break all the rock to be hoisted in the mine; the waste broken by drills doing development to be used to fill open stopes. The 2¼-in. drills are equivalent to 68 per cent of 3-in. drills, and hammer drills to 36 per cent of 3-in. drills. These two constants are based on the relative air consumption of the drills. The drills cannot be operated continuously, due to loss of time in setting up and changing steel. Hammer drills require scarcely any time to set up and change steel, and therefore this consideration is not necessary. With the equivalent of a total of 8.3 3-in. drills in operation at one time, each requiring 125 cu. ft. of free air per minute at a pressure of 90 lbs., a total of 1,038 cu. ft. of free air (62° F. and 14.75 lbs. pressure per sq. in.) is required at the drills; the operating pressure at the drills to be 90 lbs. gage.

The barometer at the mine reads approximately 20.39 in. equivalent to 10 lbs. per sq. in. absolute pressure. This may be corrected for altitude as follows:

$$\frac{14.7 \times 1.038}{10} = 1{,}525 \text{ cu. ft.}$$

To estimate the air required, allow 10 per cent loss in transmission through the pipes. Then there will be required 1,525 ÷ 90 = 1,694 cu. ft. under atmospheric conditions at the discharge valves of the compressor. Allowing a loss of 5 per cent for imperfect valve action and heating of incoming air, 1,694 ÷ .95 = 1,783 cu. ft. of air will be required to be taken into the compressor per minute under atmospheric conditions.

To allow for loss of pressure in transmission it is considered that the final discharge pressure at the compressor is 95 lbs. gage. It is better, therefore, to select a two-stage machine. The absolute discharge pressure of the low pressure cylinder should be: $\sqrt{10 \times 105} = 324$ absolute. It is assumed in this computation that there is complete cooling between the stages and equal distribution of the work. Assuming 2 per cent clearance, the factor of clearance becomes,

[illegible]

100 10

The factor of clearance is equivalent to the ratio of the displacement of the piston to the total value of the cylinder. Then the displacement of the low-pressure cylinder is:

1,785 ÷ 0.974 = 1,832 cu. ft. per minute.

Assume a 24-in. stroke with the compressor running at 150 r.p.m. Then the displacement per stroke of low-pressure cylinder is:

1,832 ÷ (2 × 150) = 6.106 cu. ft., and

6.106 ÷ 2 = 3,053 sq. ft = area of low pressure cylinder.

The diameter of the low pressure cylinder is approximately 24 sq. ins., and of the high pressure cylinder 13.4 ins. The indicated horse power of the cylinder is 218. Allowing 77 per cent efficiency of the motor and compressor, the horse power required for the motor is 218 ÷ 77 = 283 h. p.

From the above data a belt-driven two-stage compressor has been selected. The compressor is to be driven by a 440-volt, 60-cycle, three-phase, 285-hp. induction motor running at 600 r.p.m. with a driving pulley 30-ins. in diam. The belt is to be extra heavy double-ply leather, 21 ins. wide. This compressor is rated at 1,885 cu. ft free air per minute at 95-lb. gage pressure, which corresponds closely with calculations.

Air should be supplied to the low-pressure cylinder at as low a temperature as possible to secure greatest efficiency. There is an increase in volumetric efficiency of 1 per cent for every 5° F. reduction in temperature of entering air, below that of the engine room. To accomplish this, a wood conduit 2x2 ft. is led from the inlet valves of the compressor to a point under the eaves on the north side of the building. Receivers are not so much for the purpose of storing the air, thus acting as a reservoir of energy, as to partly cool the air and free it from moisture before entering the main pipe-line, and to reduce the pulsating effect produced by the operation of the compressor. With these objects in view a 36-in. x 8-ft. upright receiver is to be erected. A second 30-in. x 5-ft. receiver is to be placed at the seventh level station to supply the seventh and eighth levels by means of suitable and separate 2-in. pipe lines. A third 30-in x 5-ft receiver is to be placed near the pump station on the tenth level, supplying the ninth and tenth levels through 2-in. pipe lines. The pipe, from compressor to receiver, is placed in a conduit, one foot square, in the cement floor; the floor at top of the conduit is recessed for receiving a cast-iron cover. From receiver to shaft the pipe is buried 18 ins. underground. In the shaft the pipe is supported every 10 ft. From compressor to seventh level the pipe is 5-in. inside diameter; at this point a 4-in. branch line runs to the receiver and the main line, reduced to 4-in., extends to receiver on tenth level. All piping is to be standard weight, lap-welded mild steel, with flanges screwed on and supplied with suitable rubber gaskets.

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*Abstracted from thesis of Messrs. J. W. Whitehurst and W. P. Cory, Class of 1910, Colorado School of Mines. The thesis secured the prize offered by the "Mining and Scientific Press."

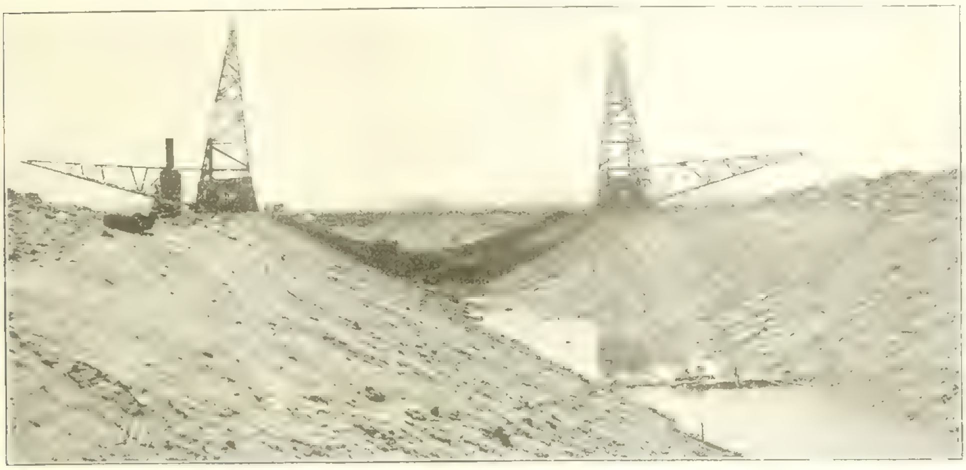

Fig. 2—View of Double Bucket Excavator, Showing the Character of the Work Done.

Methods and Instruments Used In Aligning the Rondout Pressure Tunnel From Shafts.*

Surveying underground is, next to boring investigations, attended by the greatest feelings of uncertainty on the part of the engineer. Particularly is this true where underground surveys are connected to surface surveys by means of shafts. Transferring a surface alinement to a tunnel calls for exceptionally careful work within the shaft, the limits of which determine the length of the shaft base line, and any error in the bearing of the base line is greatly multiplied as the underground work advances.

A great deal of this kind of surveying is necessary in the work for the New York Board of Water Supply in its project for furnishing Catskill Mountain water to New York city. The valleys of tributary streams to the Hudson River cross the line of the aqueduct. The economic construction for crossing most of these valleys is by a tunnel through solid rock. Because these valleys are so far below the hydraulic grade of the aqueduct, the pressure tunnels or siphons have been located so as to have a minimum of about 200 ft. of solid rock over them to withstand the hydrostatic pressure from within.

The most northerly of these tunnels is the Rondout pressure tunnel. Its profile, Fig. 1, shows two preglacial gorges, each worn about 200 ft. into the underlying rock, and it was in order to pass the required minimum of 200 ft. below them that the tunnel grade was fixed as shown. Likewise the left hand half of the tunnel beyond Station 600 was influenced by the desire to fall below the porous High Falls shale and to keep as far as possible in the Hudson River shale, an easier tunnelling rock than the Shawangunk grit, which is practically pure quartz. Thus the northerly or right hand half of the tunnel is from 100 to 104 ft. below sea level, and the southerly half from 220 to 250 ft. below sea level. The tunnel, nearly 4½ miles long, with an excavation diameter of about 17 ft. 6 ins. and a clear diameter of 14 ft 6 ins. inside the concrete lining, is being constructed from eight shafts varying from 380 to 710 ft. in depth. The end shafts are waterway

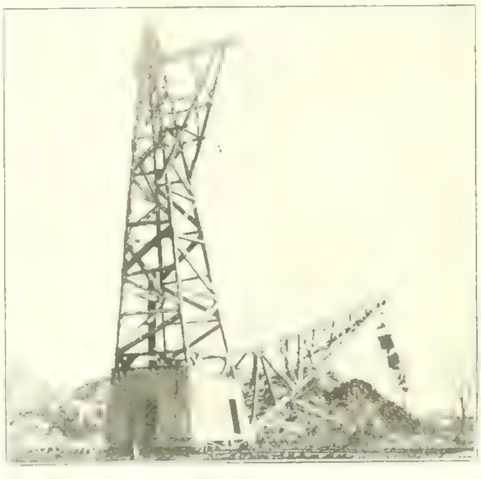

Fig. 3—Near View of One Tower, Showing Offset Boom and Upper Guide Arm on Tower.

[illegible]

No. 1 being the downtake and Shaft No. 8 the uptake, the former having a top elevation 16 ft. above that of the latter. Shaft No. 5, the drainage shaft, is located 75 ft. to one side of the center line, and is connected with the tunnel by a drift, in which will be installed the valves and door necessary for the relief of pressure before unwatering the tunnel.

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*[illegible] New York [illegible] Water Sup- [illegible]

The alinement of the tunnel is straight from Shaft No. 1 to Shaft No. 7, with a [illegible] to Shaft No. 8. For the final monumenting of the line, the right of way was cleared and primary monuments established at the ends near Shaft No. 1 and Shaft No. 8. A primary monument [illegible] was set by [illegible] instrument into the line of the two end targets. Similarly a monument was set at each quarter point on the line by using the end and middle line monuments. From these smaller divisions two control monuments were set by use of shorter sights. All line work within the shafts was in general dependent upon the control movements. The straight alinement of the whole eliminated the troublesome work always found in railroad tunnels on curves.

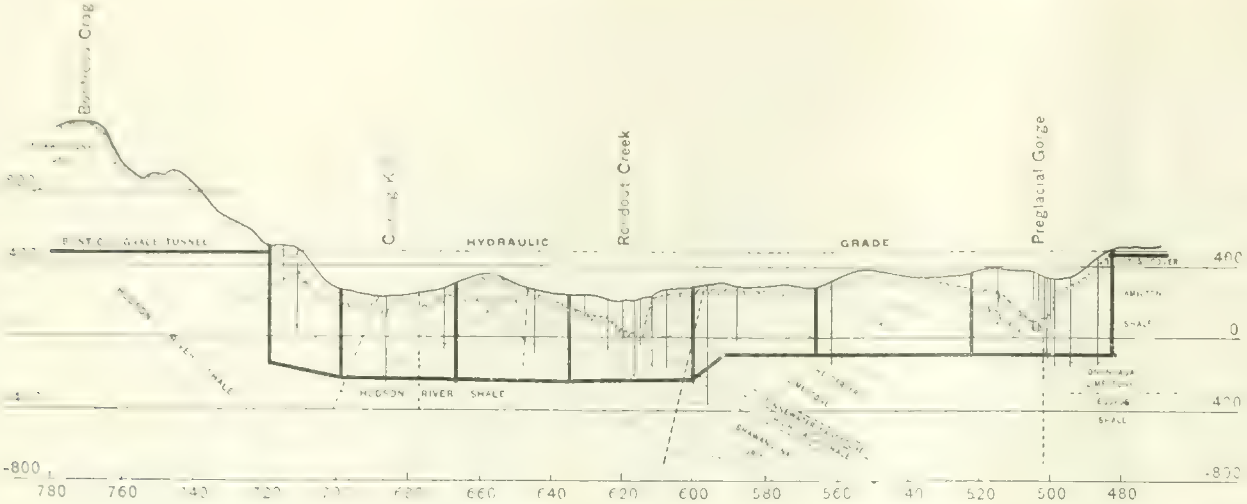

Fig. 1—Profile of Rondout Pressure Tunnel.

All shafts except Nos. 1, 5, and 8 are construction shafts and will be finally sealed with concrete sufficiently far above the tunnel as to form an effective plug. The construction shafts, a cross section of which is given by Fig. 2, have the smaller width along the tunnel center line. This shaft width of 8 ft. in the clear makes a base line of only a little over 7 ft. between the centers of the alinement boxes, which are 8 ins. square inside and extend down to the tunnel. This short base line compared to the distances between shafts, the distances varying from 2,000 to 4,400 ft., together with the shaft depths, is the one feature which determined the use of two general methods of dropping line—namely: those by (1) weighted piano wires, (2) shaft transit and sighting board.

Weighted Piano Wires. This method followed the ordinary tunnel practice of setting two piano wires on the center line at the top of the shaft and getting the direction of the same line at the bottom by a transit set in that line produced.

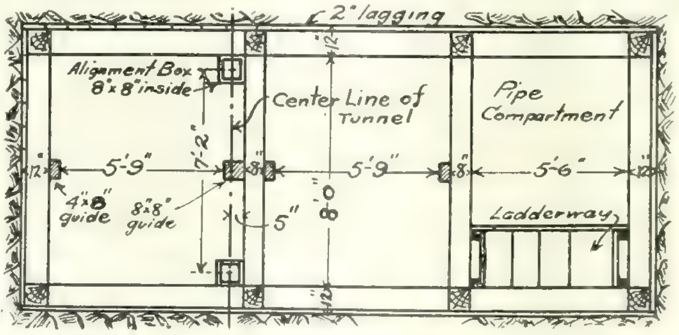

Fig. 2—Construction Shaft, Rondout Pressure Tunnel.

For the purpose of adjusting the hanging wires, special reels were made, consisting of a reel for winding in the wire and a small sheave wheel which worked at right angles to the direction of the center line of the tunnel by means of a slow motion screw fitted with a set nut. With a small weight on the end, the wire was unreeled, passing over the small sheave wheel and down the shaft in the center of the alinement box. When weighted at the bottom of the shaft with a 20-lb. weight and submerged in a large can of water, the wires were set with the slow motion screw by a transit 15 ft. from the shaft and on the center line of the tunnel. It was customary below ground to have two transits, each about 20 ft. in the tunnel from the near wire. When each transit had been adjusted to sight in line with the two wires, readings were obtained in both tunnels on a brass scale set firmly by hangers into the roof. Two settings of the transit were made, then the wires were thrown off line by means of the slow motion screw on the reels, brought back into line again, locked by the set nuts, and the foregoing operations repeated.

Every means was employed to eliminate instrumental error, both above and below ground; the wires were inspected throughout their length and the instrument men changed about. Little difficulty was encountered due to the swinging of the wires, yet the observations took time, for the swing of the pendulums of such length as used was very slow. When the two transit vertical hairs coincided with the apparent centers of swing of the two wires, the scale readings were taken.

[illegible] While the wires were hung from the reels, the line obtained in the tunnel was further checked by the direct application of the pendulum principle. In this instance the weights on the end of the drop wires were taken out of water and the pendulum allowed to oscillate freely in the air. A scale for reading the amplitude of the pendulum swing was secured, as close as possible behind each wire, to posts or other timber.

The extreme readings of the swings were taken, likewise the time for each set of five swings. When the pendulum swung around sufficiently to cause the wire to strike the scale, it was stoppped swinging, pulled again to one side and set in motion for another set of readings. Averaging the scale readings for both scales gave two points from which roof scale readings were obtained in both tunnels.

As a check on the freedom of the wire from contact throughout its length in the shaft, the time of oscillation was compared with the theoretical time for a pendulum of the same length. The comparison was extremely close, and, as shown after the headings from adjacent shafts met, the line thus obtained would have been sufficiently good to carry the tunnel alinement throughout.

The disturbing elements in the use of the foregoing methods are the spattering of water on the wires, air currents in the shaft, and material in contact with the wires at some part of their length. Falling water spattering from the shaft timbers causes vibrations of the wire, which are usually more pronounced in one wire than in the other. Air currents, probably of a spiral tendency due to changing from the tunnel to the shaft, have more of the effect of making the pendulum oscillation of the two wires relatively unbalanced. The wires in deep shaft work must be very carefully inspected to avoid contact with stray nails or splinters of wood which are nearly always present. For this reason, to insure absolutely perfect inspection, the alinement boxes were finally made of three sides, with the fourth open the entire length. This inspection must [illegible] also after the weights in the water have come approximately to rest. The writer has sometimes found that when the wire comes in contact with the wet side of the alinement box for part of its length, the adhesion to the wet surface has been sufficient to hold the weighted wire to one side of the true position of the point of suspension at the reel.

Shaft Transit Method.—A special vertical sighting shaft transit was manufactured for this work by C. L. Berger, it being a modified form of the general type of mine transits, after suggestions of Mr. James F. Sanborn, division engineer, Board of Water Supply.

The transit consists of a heavy standard having a double set of telescope bearings, one directly over the center of the instrument and the other about 5 ins. forward of the center. The telescope is detachable, to be used in either set of bearings. When in the center set of bearings it is an ordinary transit; when in the forward set the line of sight passes by the base of the instrument, thus sighting vertically down the shaft. To counterbalance the weight of the telescope in the forward bearings, an iron weight is fitted to the opposite of the transit base plate. Fitted with an extra striding level and the four-screw leveling system the instrument can be operated very easily.

With a good shaft transit at hand, the method of its application presented some study. It was found that in England an illuminated stretched wire in the tunnel, passing across the bottom of the shaft, had been adjusted into the line of sight of the instrument at the top of the shaft. Still another [illegible]

TABLE I—READINGS OF BOARD AS SET BY SIGNALS FROM SHAFT TRANSIT.

No.	Scale "B"	Scale "A"	Difference "B"-"A"	Groups No.	Groups Differences.	Groups Average-difference.
1	.269	.248	.021	1	.021	
2	.260	.241	.019	2	.019	
3	.257	.238	.019	3	.019	.020
*4	.277*	.235*	.042*	12	.019	
5	.218	.217	.001	20	.020	
6	.238	.242	—.004			
7	.224	.226	—.002	10	.006	
8	.225	.234	—.009	11	.008	
9	.257	.256	.001	16	.009	
10	.229	.223	.006	19	.010	.010
				14	.011	
11	.268	.260	.008	15	.013	
12	.241	.222	.019	18	.013	
13	.251	.256	—.005			
14	.259	.248	.011	5	.001	
15	.280	.267	.013	9	.001	.001
16	.259	.250	.009	17	.001	
17	.244	.243	.001	7	—.002	
18	.280	.217	.013	6	—.004	—.005
19	.263	.253	.010	13	—.005	
20	.225	.205	.020	8	—.009	

*Disregarded.

black X on the illuminated faces on some arbitrary line at the bottom of the shaft. The shaft transit was then set into line of the two all but touched the board, proved very troublesome. By a process of elimination of one defect after another, the independent method was finally worked out and used. This is shown in Fig. 3.

The sighting board with the crosses is fitted with a beveled vernier at each end, one reaching left to right, the other from right to left. On the reverse beveled faces are similar verniers having the same zero points. The line connecting the zeros of the verniers passes through the center of the crosses. This movable sighting board operates on two scales, rearing in the direction of the verniers, the scales being secured to the ends of the frame supporting the whole.

Setting up the apparatus consists in fastening the frame by nails to rigid timbers in such a manner that the center line of the frame approximates the tunnel center line. With a transit set approximately in the tunnel line and about 20 ft. from one end of the frame, a foresight is taken on any fixed reading on the roof scale in the far tunnel. A reading is then taken direct on the two fixed frame scales with the same transit, the telescope then plunged and a reading on the back tunnel roof scale ten, are obtained, then repeated with the telescope reversed, thus eliminating instrumental error which at the depth of the shafts would amount to considerable if the transit were not in good adjustment. A further precaution against error is to throw the transit off center, and reset, after every twenty readings. A sample of the notes appears in Table I:

As before stated, the fixed scales at the ends of the frame read in the same direction, hence in the "Difference" column the comparison of differences indicates the swing of the board settings. The difference between differences indicates the amount which one setting lacks of being parallel to another in the board length. The "Groups" show how the "differences" cluster about certain averages, each difference varying but little from that average. In other words, the board in its settings swings in a fan-shaped manner, yet the separate groups of nearby parallel settings are quite equally weighted. The writer believes that with more powerful lights this particular set of notes would have been more generally consistent throughout. The line obtained, however, was a very good one. Reading No. 4 compares in position with no other setting or group of settings, and therefore was considered eccentric and disregarded. From the average readings of scales *B* and *A* the true line in the tunnel scales can be determined from the relation of the four fixed scales embodied in the arbitrary line. This calculation is one of simple proportion after the distances between scales are known.

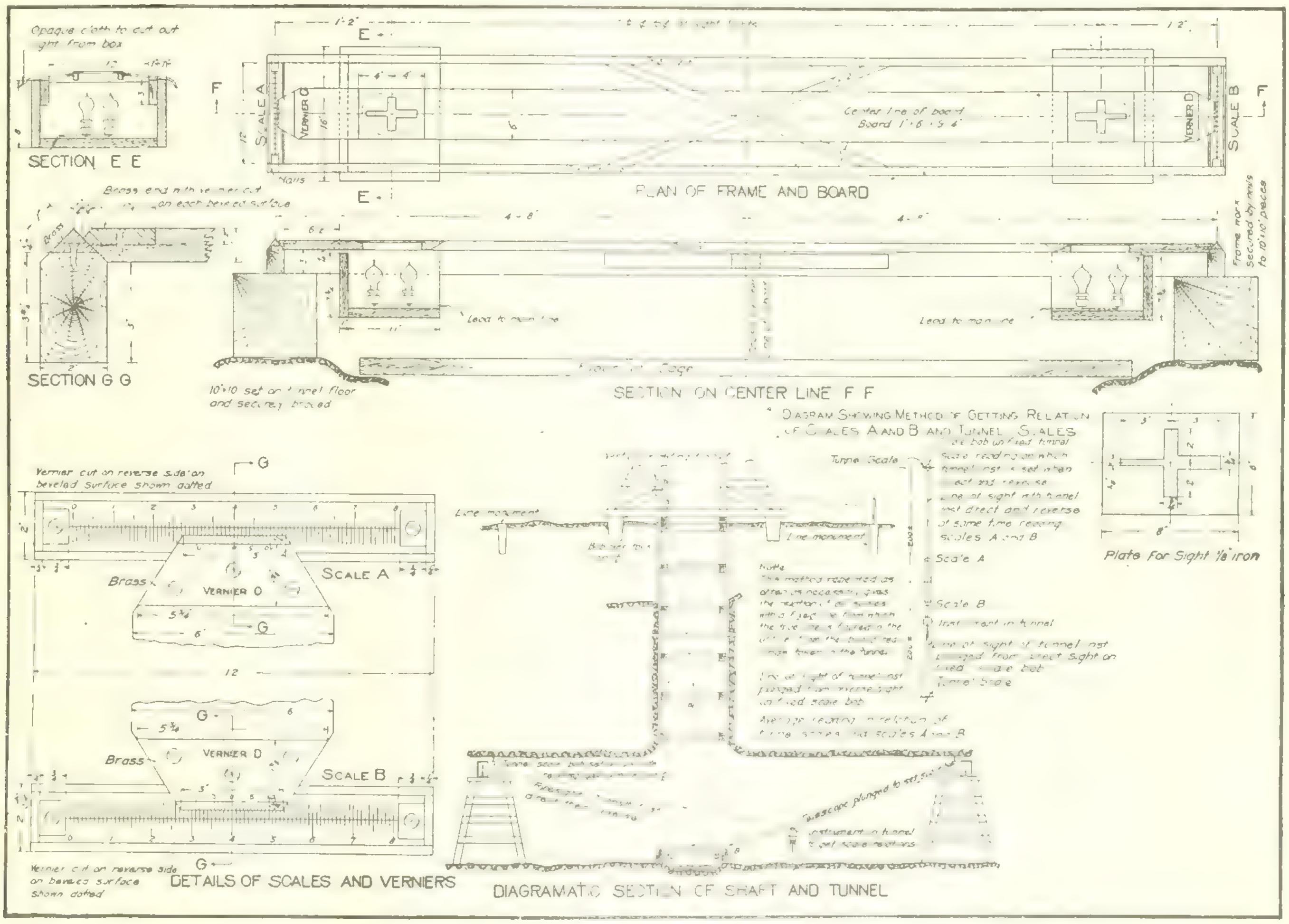
Opaque cloth to cut out light from box
SECTION E E
E
F
SCALE A
VERNIER C
Center line of board
Board 1'-6" x 6"
VERNIER D
SCALE B
F
Nails
E
PLAN OF FRAME AND BOARD
Brass end with vernier cut on each beveled surface
Lead to main line
Lead to main line
SECTION G G
10"x10" set on tunnel floor and securely braced
Frame work secured by nails to 10"x10" pieces
SECTION ON CENTER LINE F F
Vernier cut on reverse side on beveled surface shown dotted
G
SCALE A
Brass
VERNIER C
G
12
G
Brass
VERNIER D
SCALE B
G
Vernier cut on reverse side on beveled surface shown dotted
DETAILS OF SCALES AND VERNIERS
DIAGRAM SHOWING METHOD OF GETTING RELATION OF SCALES A AND B AND TUNNEL SCALES
Line monument
Line monument
Tunnel Scale
Line of sight with tunnel inst direct and reverse at same time reading scales A and B
Scale A
Scale B
Instrument in tunnel
Tunnel Scale
Note
Telescope plunged to set
Instrument in tunnel
Plate For Sight ⅛" iron
DIAGRAMATIC SECTION OF SHAFT AND TUNNEL

Fig. 3—Sketches of Methods and Apparatus Used in Aligning Rondout Pressure Tunnel.

crosses, and this line relation with the true surface line determined. The correction thus found was afterward applied to the arbitrary line in the tunnel.

In the Rondout shafts a stretched wire in the tunnel was first tried. The shafts are so deep that there was found to be no satisfactory means of illuminating the wire for direct setting. The wire, about 300 ft. long, supported so as to pass just below the roof scales in each tunnel heading, was set over the centers of two illuminated cross-cut holes in a sighting board similar to that shown in Fig. 3. In this particular case the board had no end scales. The board was set on line from signals from the instrument man on top. This method presented the difficulty of adjusting the wire over the center line of the illuminated crosses. Having also to alter the catenary or sag of the wire by tension at the ends, so that the wire obtained by setting an illuminated plumb bob string or plummet lamp. This set of readings is repeated with the telescope reversed. The average of all readings on the four scales determines the arbitrary line from which the true line from the top of the shaft is subsequently figured. The relation of the scale readings is checked from time to time in the manner described.

The shaft transit at the surface, set on the true line, is sighted at one of the control monuments and thus directly throws the line down the shaft. The men at the board below insert electric light clusters into the boxes of the frame under the crosses, then set the sighting board into position, by signal from above, so that the center of the crosses coincides with the sight of the shaft transit, whereupon the scale readings for both ends of the board are taken by verniers. A number of readings, say

[illegible] is [illegible] more intricate than the piano w [illegible] Its great advantage is in being [illegible] operation. Including th [illegible] paratus set up for work, [illegible] made in three hours and [illegible] Two [illegible] one check droppi [illegible] re, [illegible] of minimum number o [illegible] so on. of four times at th [illegible] remembered [illegible] belief [illegible] to the contract shafts has a tendency to be overdone. Sufficiently good alinement depends more on having used two independent methods than in the [illegible] often result in one bad day's work varying so decidedly from previously good work as to cast discredit on the whole.

In the Rondout shaft droppings more attention has been paid to getting tunnel lines such that the headings would meet within the limits of driving a rock tunnel. Therefore, if in three or four droppings the extreme lines produced, say for 2,200 to 2,500 ft. to the probable point of meeting between shafts, showed a difference of anything under 1 ft., the average of the droppings was taken as the line from that shaft. All tunnel headings, at the time of writing, except those between Shafts Nos. 3 and 4, have met. The variations in the meet[illegible] in. to 8 ins., with the lines differing from 0 to 6 ins. from the true center line between shafts.

The center line in the first tunnel scales in the roof was prolonged on similar scales about 350 or 400 ft. apart, put in as the tunnels progressed. The prolongation was accomplished by centering the transit under one scale and sighting to the back scale, then throwing the telescope over. Several check runs were made in this way. It was found to be immaterial whether in prolonging the line the transit was set under the scale or "bunked" into line between two scales. Some tunnel parties preferred the ordinary tunnel plummet lamps with oil wick flame for line work, while others used a plumb bob with the string set in contrast against white cloth over the face of an illuminated box. Granting that pressure tunnels meet within the allowable error for good work, the getting of grade in the tunnel is the more important of the two on account of the slight grade for drainage purposes. Grade was carried down the shaft by the use of a weighted steel tape. All necessary corrections for weight, temperature, etc., were made in determining the bench mark below. The difference in grades after heading meeting was not over ½ in. in any case.

The shaft transit method as an independent check has since been used with equally gratifying results in the Wallkill pressure tunnel, having nearly the same depth of shafts as the Rondout.

The Rondout pressure tunnel of the Esopus division in the northern aqueduct department is being constructed under the supervision of Mr. J. Waldo Smith, chief engineer of the Board of Water Supply; Mr. Robert Ridgway, department engineer; and Mr. L. White, division engineer.

ROADS AND STREETS SECTION

Notes on Steam Rolling in Road Construction.*

No hard and fast rules can be laid down for this sort of work, but at the same time it is absolutely necessary that the driver should understand how to make a road, or, rather, he should know how not to unmake it—for the spreader of the material is the man on whose eye and judgment falls the brunt of the task of shaping the roadway. The chief point for the driver to observe, and in which his roller is specially concerned, is that he should so drive his roller that he first of all completes the work of the spreader in doing his share towards the actual shaping of the roadway, while he should also endeavor so to use his roller that any inequalities of surface left by the spreader are eliminated; and, generally speaking, these two men must understand each other thoroughly and "work to each other" if good work is to be effected. The roller should first be driven carefully along the outsides, working out a little at the ends before starting to go back, as if the driver goes along the outside of the roadway without getting away from the side before starting back he will find that the engine will drop a few inches nearer the side when reversed, so that on all occasions it is best to get out a few inches, working the width of the hind rollers up towards the center of the road. Then do the other side the same way, always trying to keep the margins in towards the middle of the road; or, put another way, first form the abutment of your arched roadway, only putting on the crown as you would the keystone of an arch—namely, last of all.

A roller should not be run along too fast, 2 miles an hour, generally speaking, being quite fast enough; and in some cases this could be brought down to 1½ miles an hour with advantage. The driver should not go twice along the same track unless on the outsides. Of course, if the outsides are well consolidated there will not be much chance of the metal squeezing out and the crown getting flat, a point which is of vital importance on roads subjected to heavy and fast motor car traffic. Besides it is no use the spreader shaping the road if the roller is used in such a way as to partially undo his work. In fact, the great aim of the driver should be to complement the work of the spreader by what might be termed a "leveling up and down" process, care being taken to add any additional material required to fill any depressions as soon as they show themselves under the roller, instead of leaving these until the roller has made them worse, while also making the filling up more difficult by consolidating the material around the depressions.

I might here, perhaps, give one or two of the chief causes of these depressions, or incipient potholes, which are often the rule in coating work badly done, but which occasionally appear in even the best of work.

All depressions or potholes, or at least all large ones, in the old surface, should be filled up and rolled before the regular coating is applied. As the result of my experience on heavily motor trafficked roads, I might add that I have this done even before the foundation coat is applied, as I consider such preparatory work absolutely necessary if a finished surface is to be obtained.

No stone should be tipped, either from carts or barrows, within such distance from the edge of the metal as will preclude the possibility of that stone being applied without being completely "turned over." This is, of course, more necessary when the spreader is fed from carts than from barrows, as not only do the small stone, chips and dirt fall principally over a comparatively small area under the center of the heap, but the larger stones, of course, roll down the outside, and thus practically form a ring of the larger sized and, generally speaking, sound metal around the comparatively small and probably softer material. At least this is what generally happens when coating with material which has been broken by hand on the roadside.

The spreader should be a spreader in reality, not one who merely levels down the heaps of materials in the defective manner I have endeavored to describe, while also for the most part thus managing to get the smallest of the stone at the bottom and the largest at the top—the exact reverse of which procedure should be his chief aim. Further, when spreading particular care should be taken to work round the outside of each heap and get the largest sized material on that portion of the road where it is most required—e. g., when dealing with one of the narrow or "single track" roads I take particular care to see that the largest sized metal is carefully put in the wheel tracks, the smaller sized material being left for the crown, which will generally be found on such roads to be unduly high, in some cases in fact being squeezed up by the weight of the heavier vehicles passing over it.

To revert, however, more particularly to the duties of the driver, he should, of course, avoid, all hollow places and depressions (especially with the hind wheels of his roller) until they are filled up, while trying his best to keep down all places that appear high. These places are easily seen from the roller by an observant driver, and if the results of his observation are pointed out in a good spirit, and the men all work together, first class work is the result.

All stone should be well rolled before any binding is applied, and here again it is experience that counts, the object to be aimed at being to consolidate the stone as thoroughly as possible without crushing, before any attempt is made to bind the coating. When this stage has been reached the driver should immediately stop rolling until the binding is applied, even if it means keeping the roller standing, as the "grinding down" of stone is the most costly method of producing binding that can be imagined, while at the same time resulting in that most deceptive finish so often seen where these "dust manufacturing" methods have been resorted to.

In any case the aim should be quality, not quantity; but if the latter term must be the objective, why, then, use fine soil in its virginity? If the road is very narrow and "round" or high in the middle the driver will find he has only to lap over a few inches instead of the whole width of the wheel, as in such cases only the insides will be touching the road, and so will leave ridges along the coating unless covered a little at a time.

The sweepers should try to get the stones "covered up" as soon as possible, as this gives the driver a much better chance of getting them down properly. Slag can be got down pretty tight before any binding is put on, but stone requires much more thorough "working in" of the binding material; where stones are applied in excessive thickness they will keep "on the work" unless the binding is judiciously worked in. I believe in getting the material down as tightly as possible before being watered, and in having any stones carefully put back into place that get moved from any cause whatever. Instead of excessively rolling any soft spots, try to avoid these as much as possible, and apply a little extra binding to keep the material down after you have got it in shape. If this soft place extends over only part of the road, it is much better to come over it backwards as much as possible, as the front wheels take out the track of the back ones, so by running forward on the side that is hard and coming back over the soft place it will be got into shape.

The outside edges of the metal should not be pushed in by the brooms when trying to get the water and binding over, but instead this should always be left until the driver has got the edges thoroughly down, so that the stones are not so liable to be displaced by the brooms.

To obtain a good finish to the coating I invariably have a slight sprinkling of chippings applied after the work has somewhat "dried out," but when this is done care should be taken to afterwards pass the roller over the whole surface of the roadway, as such chippings under these conditions are exceedingly dangerous to cyclists and deleterious to all rubber tired vehicles.

In making a new road over treacherous, heavy or clayey subsoils I invariably have the excavations made extra deep and a good coat of clinker ashes put down, and then over this it is best to put the largest of the pitching, on which another coat of ashes will do no harm. I have, for instance, used such methods with advantage in taking out "knuckles" on severe gradients where the underlying strata was practically pure clay, which was got out to an average depth of about 3 ft.

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*[illegible] presented [illegible] Municipal Engineers of Great Britain.

The Present Status of Laboratory Tests and the Use of Materials in Road Construction.*

The art of roadmaking has been recognized for centuries. The science underlying the art has barely begun to be appreciated, especially in this country. The recent great growth of complexity in road conditions has awakened the artisans to the desirability in construction of a better knowledge of the underlying facts, and attention has been directed to the possibilities for obtaining some of them at least, from proper research and laboratory work. It is then found that certain tests have been carried on with satisfactory results for a considerable period and that others have seemed to give practical satisfaction for a shorter time. Concerning the materials of earlier use, such as sand, cement, steel or iron, and wood, when in what might be called "ordinary" use, certain co-ordinated knowledge has been recorded in mathematical language, so that laboratory experiments, if necessary, may be made or easily ascertainable facts secured and, by comparison with the established facts, a reasonable guide furnished for the further use of such materials under similar ordinary conditions of use.

When, however, as now frequently happens, these conditions become extraordinary or unusual, it is only too frequently found to be the case that little or no reliable information has been collected that can be used or that such theories as have been put forth have emanated from sources that unfortunately do not inspire the confidence they may even deserve. The same condition of affairs may be found, of course, surrounding a new material.

In expanding the foregoing, for the sake of clearness, let us first consider material for road-metalling. Certain laboratory tests of stone have been worked out, which, up to the present time, have given fair satisfaction. The French, by the "Deval" or rather test of small pieces of broken stone, reached a very fair basis for comparing the value of different rocks for use in ordinary macadam, subjected to traffic of horses and metal-tired vehicles. A supplement to this test is the one for the cementing ability of rock powders, proposed by Massachusetts Highway Commission early in its work, and more fully developed perhaps in later years by the United States Government.

Both of these tests have been of the greatest value to road builders under former conditions, though perhaps now found to be crude and unsatisfactory under the new conditions of traffic and the demands for more accurate knowledge. For instance, under the feet of horses and metal tires, the ability of a road metal to resist abrasion was more desirable generally than its strength under purely compressive stresses. Again an ability to cement into a mass, fairly resistant to disintegration under such traffic during prolonged droughts, might offset in a road material under certain conditions what otherwise might seem to be an inherent defect as regards undue lack of toughness or hardness.

During the experience of the writer (1896-1901) with the Massachusetts Highway Commission, the stone proposed to be used for the macadam was tested by the rattler and cementation tests and the relation was influenced by the results obtained. Traffic censuses were not conducted but the probable severity of traffic was considered. It was known from experience or assumed, that a stone having a "co-efficient of wear" of less than, say, 15, or with a cementation indicated as "poor" would be in many cases undesirable, and in such cases the effort was made to secure what was felt would be a more suitable stone; of course it must be clearly understood that there were other factors in the problem of the selection of the material for the macadam and no lack of consideration was accorded these. The work of the Massachusetts Highway Commission speaks itself for the intelligence and reason of those directing it. The writer believes the consideration of the tests has been justified by the facts found in the maintenance of the roads so built. Later, in the experience of the writer for the past ten years directing similar work, fairly satisfactory use has been made of the same two tests as aids in selecting material for macadam. Over 500 tests have been made for the "co-efficient of wear" of stone for macadam, and a similar test has been used by the writer in the selection of brick and stone block for paving. In almost all cases, the writer has felt that a true comparison of the value of stone for the purpose has been furnished by the tests and his experience with the after-maintenance of the work has confirmed this judgment. There have been a few instances where exceptions have been noted and the writer has heard of the same exceptions in the experience of others.

To cite a specific instance in 1904, a readily available quartzite gave a low "co-efficient of wear" of about 7. Its cementing value was "fair" only and yet, in actual use on certain park roads, the material has given good results under traffic. This average traffic per hour as counted by the writer in 1904, was as follows:

Saddle horses	3
One-horse vehicles	28
Two-horse vehicles	[illegible]
Cycles	[illegible]
Motor vehicles	1

Oyster shells give a co-efficient of wear of about one, and a cementing value of 100. Their value under some conditions, however, is well known. It seems probable that the apparent exceptions of experience to the indications from these tests are due more to unknown (at present) factors than to defects in the tests.

In the majority of instances where the records of tests of the materials exist, no facts are known concerning the amount of traffic or its characteristics. Several years ago, the writer publicly suggested the advisability of collecting traffic records, and since then some have been made. The record is not yet complete enough to show clearly why some roads "horse-path" as they do, nor why others rut, and still others ravel or wear out quickly, but the writer believes that with proper records of traffic and of the above tests of the material (with probably the addition of a test for compressive strength) the existing deficiencies referred to may be relieved. With water-bound macadam, it is the writer's experience that the cementation test is equally as important as the wearing test, but low results from the former can be partly offset by variations in methods of use in many cases.

The earlier standards have recently been felt to be insufficient for modern demands because they were purely comparative and seem now to be neither flexible nor comprehensive enough. Those, whose experience with actual road construction and maintenance, has long been enough locally to enable them to more or less intuitively attach a relation between the comparative results of such tests and the nature and amount of traffic over the various roads under their supervision are perhaps able in many cases to work out fairly satisfactorily the solutions of the problems presented to them. The new comer, however, suffers from a lack of important facts bearing directly on the solution, and it may be doubted whether any solution otherwise arrived at would be as good as that which might be more accurately reached by additional co-ordinated knowledge recorded from careful previous observation. It would seem to the writer that there is now a demand for a connection between the comparisons between the results of such tests and a traffic census, to a far greater extent than now appears from the records to be available.

During the past few years, a mighty change in the work on and use of our highways has taken place, and the end is not yet. Many roads are, and for some time yet will still be, built for old conditions. But in a large number of these cases questions concerning the use of new materials arise which are unsolvable by any accepted tests or standards and which rely for their answers on the good judgment of the individual in charge—frequently a thing difficult to obtain and, when had, as hard to support by facts of ready comprehension. Further, comparative results elsewhere are not always acceptable in certain localities where it may be felt that conditions may differ. In the absence of fact, what is deemed expedient may decide—to the later regret.

Oyster shells, marl, and gravel cannot be tested in a rattler or with the impact machine, and then a comparison made with the results on stone for a determination of the comparative value of the different materials mentioned, unless the traffic census of the road proposed to be built can be accurately secured. The need is evident for more definite records, comparisons and standards for these problems.

Where traffic has materially changed, and the new tires, new modes of locomotion, giving different stresses to the road surface and materials composing it, and new demands from the public, such as the suppression of dust, are to be considered, we are at the present time in rather unfortunate shape. It is true that intelligent investigation, such as is certainly necessary in the matter, has begun in many quarters, but it may be regarded as unfortunate, though probably not more than that in view of the impossibility as yet for even engineers to pierce "the veil beyond which we might not see," that such work was not sooner begun. The demands are already insistent and our masters are impatient. And yet the facts can most of them only be had by careful work, and with the aid of Time.

The destruction of macadam by abrasion under the new traffic is practically past. Its failure by excessive compression stresses on the pieces composing it may still be sufficiently dangerous to demand a test for, and consideration of, the compressive strength of the stone, and possibly one such should be used hereafter even more than heretofore.

Even the most cementitious of rock powders has failed to withstand successfully the shearing stresses of motor traffic. Hence, in many cases, a stronger cement seems necessary and standards for it must be had. They cannot be had until facts are known from experience. These facts are now being collected, but in this work, it seems that the effort should be now made to avoid the mistakes of earlier work. The facts should be collected with, and not without, those concerning the traffic, cost, etc., so that the results of the work will not merely be as before referred to in the case of the Deval test—purely comparative. What is needed today, and what will be demanded in the future, are actual careful records of experience, so that conclusions may be reached from them, and not from assumed theories alone. The writer believes that it may eventually, if not soon, be possible to reduce a large number of the problems of highway engineering to a mathematical solution, particularly if the Science underlying the Art is properly developed. There is need to go surely in this work, and as slowly as may be necessary for sureness. Acceleration in the work may certainly be had by co-operation.

In probably a number of instances, courses in Highway Engineering are being offered by colleges. The writer does not intend to present here arguments for or against such, nor even to criticise these courses in any way, but does wish to offer, as a suggestion to those connected with such work, the thought that, as it seems to him, there is a splendid opportunity for research in the foundations of Highway Engineering and f[illegible] development of the Science of it[illegible] knowledge is collected, anal[illegible] and arranged so as to be [illegible] and advantageously applied [illegible] probably be no question a[illegible] value of the course referre[illegible]

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*A paper presented before Section D of the American Association for the Advancement of Science by Maj. W. W. Crosby, Chief Engineer Maryland Geological and Economic Survey.

An election was h[illegible] [illegible] of Jan. 13, to vote on is[illegible] [illegible] so on $2,000,000, of whic[illegible] [illegible] remembered the improvement of [illegible] to the contract

Certain Considerations Affecting the Selection of Bitumens and Mineral Matter for Road Construction and Road Surface Treatment.*

Everywhere highway engineers are giving much thought to the use of bitumen in the construction of macadam roads; and while the standardization of specifications for bitumens in the forms of oils, asphalts, tars and pitches is probably near at hand, I believe that sufficient thought is not being given generally to the mineral matter used in conjunction with the bitumen. Whether the bitumen be used in the body of the roadway, or to form a waterproof and resilient mat on the surface to protect the macadam from wear by abrasion, the results from this form of road construction will largely depend upon the mineral matter and its suitability for the bitumen used. The same difficulty was experienced in the first sheet asphalt pavements that were laid.

In the constructionof bituminous roads and pavements, I am of the opinion that a great many bituminous materials, when properly used, may prove entirely satisfactory, but that the use of these same cementing products may result in complete failure, if the mineral matter has not been suitable. Not only may the cementing properties of most bitumens be lost by the use of too much mineral dust, but whether oil, asphalt, tar or pitch is used, it is also fully as essential to study the character of the available mineral matter, as it is to determine the nature and character of the bitumen to be used.

Experience has shown that the life of an asphalt or bitulithic pavement depends as much upon the character of the aggregate as it does upon the cementing bitumen, and this theory holds good in the formation of a bituminous concrete or a bituminous wearing surface for a macadam road.

Different bitumens vary in their ability to penetrate the mineral matter. Coal tar products possess a penetration property not usually found in oil-asphalt cements, and further in using these last in the construction of a bituminous macadam road, it is necessary that the stone be free from dust to secure proper adhesion. With the coal tar products this precaution is not so essential, but in a broad sense, mineral dust is about as objectionable as moisture in the construction of bituminous roads.

The life of a bituminous road or pavement depends as much upon the wearing qualities and the grading of the mineral matter that forms the roadway surface, as it does upon the adhesive and cohesive properties of the bitumen.

A soft limestone wearing surface of a bituminous macadam road, provided the road be constructed according to the generally accepted practice of placing the larger stone on the bottom, will not prove a success if subjected to heavy traffic. If the process of construction be reversed, however, good results may be obtained, since crushing strength varies as the square of the lineal dimensions. This method affords stability in road construction that cannot be obtained in the usual way. The life of the road may be increased by a cushion coat of fine material matter to absorb the impact of the calks of the horses' shoes and to lessen the abrasion caused by steel wagon tires.

My experience in the construction and maintenance of roads and pavements leads me to believe that the nearer the approach to a resilient wearing surface, the longer will be the life of the road or pavement. For example, a treated wood block pavement is to a certain degree resilient which adds to its life and increases its desirability; extremely hard-burned vitrified brick will not wear as uniformly nor as well as softer brick and where a cushion coat of clay or sand only a fraction of an inch in depth is maintained over the surface of the brick, the life of the pavement is greatly increased; an asphalt pavement in which the cement is very hard will wear much more rapidly than one in which a softer cement has been used, and likewise, the squeegee coat of a bithulithic pavement adds much to the life of the latter. Not brittle at low temperature, nor extremely soft at high temperature are two desirable requirements characteristic of resilient road construction bitumens.

The statement that certain heavy road oils on the market "carry" a certain per cent of asphalt, does not mean much to a road engineer familiar with their use. It is admitted that the greater per cent of asphalt, the better the oil for the work; but an oil carrying sufficient asphalt to have adequate adhesive and cohesive properties for making a bituminous concrete or bituminous wearing surface, is other than what is ordinarily sold for the purpose. Such an oil-asphalt product could not be handled in the tank cars now in the service of the oil companies, since they do not possess the necessary steam coil capacity to raise the temperature sufficiently high for successful handling.

St. Louis has specifications for four grades of oil for surface treatment, and from careful study of results during the past three years, I am fully satisfied that there is place for each grade.

The grades of oil used are as follows:

No. 1.—Residuum oil, having a gravity of 30° Be., it is applied cold and is used on cinder roads and for the purpose of giving life to the surface of a road that has previously been treated with a heavier product and is becoming dusty. Being merely a dust layer, it should not be considered as having any binding properties.

No. 2—Residuum oil, having a gravity of 20° Be., it is applied hot and is recommended for park roads and roads that are not main arteries of travel.

No. 3—Residuum oil, having a gravity of 16° Be., it is applied hot and is used on the main thoroughfares having a mixed traffic and acts as a temporary binder for the mineral matter.

No. 4—An oil-asphalt compound having a gravity of 12° Be., it is applied hot and is recommended for any type of road, since it simply forms a binder for the mineral matter which actually bears the traffic.

In the use of all the grades of oil referred to, with the exception of No. 1, there should be a covering of mineral matter, uniformly distributed over the surface of the oil to a depth of from ⅛ to ½, depending upon the amount and gravity of the oil applied.

The work of treating a road surface after applying the oil and mineral matter is not completed for several weeks. As soon as the road is open to traffic, it is necessary to give it attention for some time to take care of any wet spots that may appear.

It must not be presumed that surface treatments will provide a dustless roadway from April to November, without any additional work. What would be the appearance of any improved street, under heavy traffic, if not properly cleaned for a period of six months? It is therefore necessary to properly patrol treated road surfaces to keep them in a cleanly condition. It is also essential that all road intersections be treated, as the dust and dirt carried onto a road will materially shorten the life of the treatment.

When traffic and road conditions have been ideal, we have had surface treatments last through two summers with every indication of at least a year or more of wear without attention other than the maintenance. This condition, however, will not exist on the average highway and it is not reasonable to presume that a road receiving such a wearing surface should have a long life. The cost of treatment being inexpensive, considering the results, the work may be done each year.

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*Paper by Jas. C. Travilla, Street Commissioner, St. Louis, Mo., presented at the recent Minneapolis Meeting of the American Association for the Advancement of Science.

Some Performances of Motor Trucks.

A 5-ton motor coal truck in the service of the Syracuse University hauls an average of 45 tons of coal a day from the D. L. & W. R. R. coal pockets in Syracuse, N. Y., to the University. The distance is 3 4-10 miles and three-quarters of the distance is up grade, the average being 7 per cent and the maximum 12 per cent. One man operates the truck, which is loaded by gravity from the coal pockets and delivers its loads by gravity through a chute in the side of the steel body into underground coal bins through manholes. On one day recently the truck hauled 46 6-10 tons of coal to the university in 9 loads and in addition hauled two 5-ton loads from the coal pockets to the downtown building of the institution.

A 3-ton motor truck with self-dumping steel body has been used for some time in upper New York City in fulfilling a contract taken by McDonald & Barry to fill in a tract of low ground at Broadway and 204th St. The truck hauls loads of wet ashes from a power house about a mile away. Each load contains 7 cu. yds. or just double the load hauled in a horse-drawn wagon. The motor truck makes ten to twelve trips a day as compared with an average of five or six trips made in a working day with horses. Thus the power vehicle is doing the work of four horse-drawn wagons, and is hauling from 70 to 84 cu. yds. of material a day. In this case the saving in time is of especial importance because the filled ground is to be used for the construction of buildings that are badly needed by the owners.

Averages compiled from actual records of 20 light motor express and delivery wagons operating in as many different lines of trade in Syracuse, N. Y., for periods of time ranging from 6 to 22 months show annual operation and maintenance costs as follows: Fuel and oil, $168; depreciation estimated at 20 per cent, $180; repairs and replacements, exclusive of tires and ignition batteries but including repairs due to accidents and drivers' carelessness, $150; drivers' wages, at $12 a week, $624; tires, $50; interest on investment at 5 per cent, $45. This gives a total cost per wagon of $1,217 a year. The machines average 50 miles a day. Assuming that two single-horse wagons could do the work of one of the motor wagons, and that the cost of stabling, shoeing, drivers' wages and other items averaged $22 a week, the horse service would cost $2,112 a year, or $895 more than the motor wagon. Syracuse is subject to very severe winter conditions and in general has very poor pavements, while many streets are not paved at all. Hence the actual figure of $13.25 per month per car for repairs arrived at by the records of a score of wagons in a variety of services is considered an excellent average upon which to base estimates for maintenance repairs for this particular type of power vehicle.

Fourteen longshoremen with hand trucks have been displaced at the Hoboken, N. J., docks of the Hamburg-American Steamship Co., by a three-wheeled platform truck of one-ton capacity which has a low platform 5x12 ft. without sides and can travel 24 miles a day on one charge at a rate of 4½ miles an hour. Two similar 1-ton trucks and two three-wheeled trucks with a carrying capacity of 4 tons are used for transferring castings and finished parts from one part of a factory in a large industrial plant to another and between factory buildings. They can be taken on freight elevators to any floor in the factory buildings. The four motor industrial trucks, which operate independently of rails and have rubber tired wheels, are today doing the work of many horses formerly used and a large gang of men.

Six 1-ton motor delivery wagons used by the Chicago Public Library for distributing and collecting books among the branch circulating libraries in the city average 33 miles a day apiece. One has been in regular service since 1904 and several of the others have passed by several years the period for which depreciation was figured. Depreciation is generally estimated now at 20 to 25 per cent, giving the machine an assumed useful life of four or five years. The total annual cost for operation and maintenance is $10,846.62, or an average of $6 per working day per truck. At least ten horses and wagons and four extra drivers would be needed to do the same work, figuring 20 miles a day as the horse's maximum day-in and day-out capacity.

WATER-WORKS AND SEWERS SECTION

Methods and Cost of Constructing Water Purification Works at Springfield, Mass.[*]

The city of Springfield, Mass., has within the past year completed and put into operation an entire new water supply system, embracing among other features a purification plant located near the source of supply in Westfield. It is the purpose of this paper to describe in detail the methods and costs of constructing the several works comprising the purification plant. This work was carried on under the supervision of the Water Commission of the city of Springfield, for which Mr. E. E. Lochridge was chief engineer, Mr. Allen Hazen consulting engineer and Mr. H. M. King resident engineer. The writer served in the capacity of contractor for the purification plant.

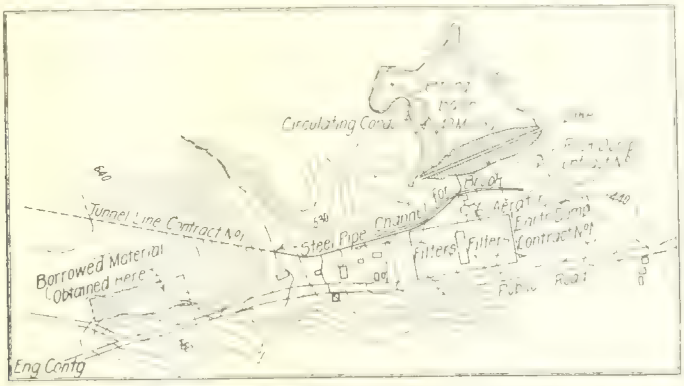

Fig. 1—Plan of Water Purification Works, Springfield, Mass.

No claim is made in this paper for novelty of methods used nor for any special economy in costs, the writer's intention being merely to present a statement of the actual problems, the conditions governing them and the results obtained. With the feeling that more knowledge is to be gained from the study of failures than of successes, it is his intention to point out the mistakes made as freely as the commendable features, and to suggest possible improvements which might in a future similar case increase efficiency or reduce costs.

An idea of the features embraced in this contract can be obtained from a study of Fig. 1, which shows in general plan the relative locations of the several parts of the works.

Raw water from the river, after arriving through a tunnel built under a previous contract, is carried by the 54-in. steel pipe shown at the left, which later reduces to 42 ins. to the settling basin, passing under the earth dam which impounds the water of the basin, entering a reinforced concrete conduit 4x5 ft., by means of which it is finally discharged into the upper end of the basin.

The settling or sedimentation basin is of approximately 10 acres in area at spillway level and contains, when full, 40,000,000 gals. Its location is in a natural recess in the surrounding hills, which required only the clearing and grubbing of the surface and the construction of an earthen dike, as shown, to be transformed into a suitable reservoir. The main purpose of this basin is the natural removal by sedimentation of such suspended matter as may be contained in the river water, thus relieving the filters of these solids to a large extent.

The water, after settling, passes by means of a second 42-in. steel pipe outlet through the earth dam to the office and laboratory building, where are located certain regulating devices and hydraulic apparatus, and from there to the aerator, an open circular concrete tank 50 ft. in diameter, where aeration may be effected if desired by fountain action. The water level of the aerator is adjusted to regulate that in the filters, and water is distributed from this point to the filters by means of a 30-in. cast iron header pipe connected by independent 16-in. connections to each filter.

The filters are of the slow sand type and six in number, each unit covering 0.52 acres and yielding one-half acre net sand area. Figure 2 illustrates the details of concrete construction. The pure water is collected in 24-in. drains laid under each filter and conducted in independent pipes to the regulator house, from which it enters the 42-in. steel main to the city.

The contract for this work as let covered 28 different items of work upon which unit prices were obtained. Seventeen bidders submitted proposals, the totals of the various bids ranging from a minimum of $201,525 to a maximum of $293,752, with an average bid of $250,108. The contract was awarded and signed March 31, 1908, and provided that the work should be completed on or before Oct. 1, 1909, or in two working seasons. Work was begun on April 6, 1908, and the contract finally completed Nov. 17, 1909, 48 days overtime.

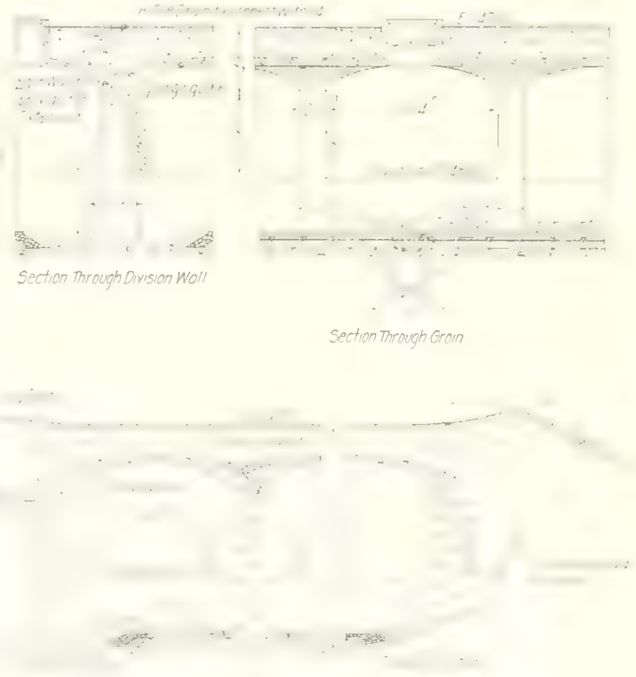

Fig. 2—Details of Filters, Springfield, Mass.

To avoid confusion, the various features of interest will be considered and treated as independent subjects in the descriptions which follow. All cost figures shown include every expense chargeable to the item either directly or indirectly except interest on invested capital and the proportion of main office expenses.

Cost Keeping System.—A new system of cost keeping was originated and introduced on this work by the writer and gave such satisfactory results as to warrant, in his opinion, a brief description here.

The various items of work embraced by the contract were numbered from 1 to 28, corresponding to the several classifications upon which unit prices were bid. Thus, Grubbing No. 1, General Excavation No. 2, Trench Excavation No. 3, etc. In addition to the 28 main headings, a number 0 was added to cover the General Expense item, to which was charged such expenses as could not from their general nature be charged directly to any individual classification of work. Owing to the fact that items 13, 14 and 15 referred to three different classes of concrete masonry, it became necessary to introduce item 29, to which was charged all general concrete expenses such as plant erection, preparation of stock, etc., which could not be divided daily between the three classes. The third extra item, No. 30, was introduced to cover the stable account by means of which the unit cost of teams was ultimately determined. These three extra items were, of course, finally divided, in proper proportion, among such of the 28 main items as were affected by them.

Having thus designated each main item from 0 to 30, the various subdivisions required were referred to alphabetically, 1-*a*, 1-*b*, 1-*c*, etc. Thus, when it was desired to subdivide General Excavation, 2-*a* referred to hand excavation, 2-*b* to steam shovel excavation, 2-*c* to teaming excavated material, etc. In case it was desired to subdivide a subdivision, recourse was had to a numerical suffix such as a^1, b^1, a^2, b^2. Thus, for example, while item 2 referred to General Excavation and 2-*c* to teaming General Excavation, 2-c^1 referred to teaming from steam shovel and 2-c^2 referred to teaming from hand excavation. By introducing c^3, an additional division of teaming could be kept if desired, and so on. The main numerals were easily remembered since they referred in each case to the contract item of that number. The alphabetical designations and their suffixes soon became familiar to the user, inasmuch as they were added to the list gradually as the work progressed, and only a comparatively few headings were in use at any one time.

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[*] A paper, by Charles R. Gow, read before the Boston Society of Civil Engineers and published in the Journal of the Association of Engineering Societies for December, 1910.

The following schedule shows the division [illegible] of the method employed:

Item 2. [illegible]
a. [illegible]
a^1. Labor.
a^2. Materials.
b. [illegible] excavation.
b^1. Labor operating.
b^2. Fuel and oil.
b^3. Labor repairing.
b^4. Materials repairing.
b^5. Labor moving to work.
b^6. Materials installing.
c. Teaming.
c^1. From shovel.
c^2. From hand excavation.
d. Foremen.

It will be readily seen that there is no limit to the possible elasticity of this system of subdividing. It should be borne in mind, however, that attempts at too fine a subdivision not only entail much additional clerical work but also invite inaccuracies. The divisions adopted were deemed sufficiently fine for the purpose of showing the relative costs of each important item of expense. It was desired to ascertain the cost of some small feature of an item, the expenses chargeable to the feature were temporarily detached from their natural parent subdivision and given an alphabetical or numerical designation of their own. When the desired information had been obtained, the temporary division was again merged with its parent division and its cost consolidated with it.

The time keeper, on making his first morning trip, entered on a convenient pocket pad the various numerical and alphabetical designations of the different kinds of work he found in progress, and under each such heading the names or numbers of the men he found employed thereon. On his subsequent trips he checked this list, and if changes had occurred ascertained from the foreman the time of such changes. In this manner, at the close of each day his pad showed under the separate headings what men had worked under each division of labor during the day and for how many hours each had so worked.

A large office time book, made especially for the purpose, was employed, and the time was transferred to it daily from the field pad. This book was so ruled that the width of the vertical space allotted to each day of the week was sufficient to permit of its being ruled into several narrow vertical columns. These columns were headed by inserting the various designations of the different classes of work carried on during that day. The men's names or numbers were grouped on the pages of this book according to their rates of pay, and a sufficient number of lines was left between groups to permit the insertion of different names or numbers of new men who might commence work in the middle of the week. In posting from the field pad to this time book, the time keeper considered one heading at a time and gave each man who had been employed under it during the day credit for the number of hours he was so employed. In this manner, if a man had been employed under several different divisions of work during the day, his name or number appeared under each on the field pad and due credit was given in the proper columns opposite his name for the number of hours he had worked under such division. It will be noticed that this book served the double purpose of a time book and a division of labor record.

When the time book had been posted for the day, a daily labor force account was drawn off by adding in the time book the number of hours which had been entered under each heading for the day. As the names were grouped together in the time book according to the rates—i. e., all names of men receiving similar rates of pay being carried on the same page or pages, the total number of hours at each rate chargeable to any given division could be readily obtained by adding the proper column in the time book, and the sums so obtained, when multiplied by the proper hourly rate, gave the money value of labor expended on that particular item for the day. A typical daily labor force account showed the method of transferring from the time book and of final consolidation, the grand total of the sheet representing the total expense for labor and teams on the whole work for this particular day. It further showed for example that there had been expended for the day $9.50 on 0-*a* (General Expense, miscellaneous labor), $46.20 on 5-$c^2$ (teaming from borrow), etc. These figures were then transferred to a card system kept for the purpose, there being a separate card for each division or subdivision. A daily entry was made on each card of the amount shown by the labor sheet to be chargeable to it, and the total of such entries was carried forward so that at a glance the total cost of labor and teaming to date could be ascertained for any division. A similar card system was kept for materials, each invoice being marked by the receiving clerk to indicate which division or subdivision it was chargeable to, and a corresponding entry was made on the proper card. Every expense incurred on the work, therefore, whether for labor or materials, was posted somewhere in these two card systems and frequent checks were applied to prove their accuracy by comparison with the total of the office ledger. Approximate daily estimates were made of the quanitity of work done under the several classifications, and unit labor cost prices were noted. An accurate estimate of quantities was obtained monthly and a report made of the unit cost for the month. With this system but one man was necessary to attend to the timekeeping and clerical work involved.

General Expense.—In the description and costs which follow, frequent reference is made to the item of General Expense, and a brief explanation of its meaning and application may not be out of place at this time. In all attempts to apportion daily expense among the several items of work, it is found that many of the charges cannot be debited directly to any individual item or items. Thus, for example, the various preliminary expenses before actually beginning operations, all time of the superintendent, timekeeper, watchman, water boy, etc., are impossible of accurate division among the items as the work progresses. On this work, all expenses which were of such nature that they applied to the entire work and could not, therefore, be charged directly to some one or more items, were charged to a General Expense account. The following table shows the detail of expenses making up this account on this contract

COST OF GENERAL EXPENSE ITEMS.

		Per cent of contract
a. Supt. and miscl. general labor	$ 7,190.6[illegible]	
Teams on general work	975.51	
Miscel. small supplies	2,054.28	
Total general charges	$10,220.49	[illegible]
b. Insurance, employes only	$ 1,704.19	0.9
c. General plant:		
Shipping, labor, loading	$ 229.45	
Shipping, teams loading..	136.15	
	$ 365.60	
Freight to Westfield	$ 787.07	
d. Labor unloading plant	$ 363.87	
Teams hauling to work	419.14	
Storage and rent of siding.	91.09	
	$ 874.10	
Total cost to plant job	$ [illegible]	1.0
e. Removing general plant, labor	$ 481.92	
Transportation of same....	631.29	
Total to remove plant....	$ 1,113.21	0.6
f. General plant repairs, labor	$ 617.12	
Materials for same.........	365.23	
Total general plant reprs.	$ 982.35	0.52
g. General plant depreciation.	$ 1,958.56	1.0
h. Building office, labor	$ 417.11	
Materials for same.........	415.04	
Furnishings for office......	225.04	
Total for office..........	$ 1,057.22	0.56
i. Maintaining office building:		
Labor	$ 329.42	
Food and table supplies..	2,171.65	
Kitchen and table utensils	136.18	
Total for maintaining..	$ 2,637.25	1.4
j. Amount paid for small tools and supplies	$ 1,536.71	
Care of tools	59.40	
Total for small tools and supplies	$ 1,596.11	0.84
k. Blacksmithing:		
General labor	$ 961.01	
Supplies	87.16	
Total for general blacksmithing	$ 1,048.17	0.5[illegible]
Grand total for general expense	$24,344.32	12.9

Comment on the above figures: The percentages given indicate the per cent. to be added to all other costs to cover the cost of this particular item. It will be noticed that in the aggregate the charge of 12.9 per cent must be added to the direct cost of each contract item to cover its proportion of General Expense.

In explanation of the several items entering into the General Expense account, the following comments may be made: Item *a* refers to the general labor and teams involved of a miscellaneous character. It also covers the cost of incidental small supplies furnished from time to time for the general maintenance of the work. Items *c* and *d* relate to the original shipping and delivery of tools, plant and apparatus necessary to commencing work, while item *e* refers to the final removal of same. Item *f* covers the expense of repairs on such plant as was used for general purposes. Item *g*, the depreciation on this plant. Item *h* refers to the building and furnishing of an office building which contained in addition living quarters for the superintendent, foremen, timekeeper, etc. This building was of rough construction, 30x30 ft. in plan, with an upper story 30x20 ft. The lower story contained a public and private office, a large dining room, a kitchen, and a cook's living quarters. The second story contained eight sleeping rooms, each 8x6 ft. The outer walls were protected by tar paper and the roof by "Rubberoid' roofing. It is possible that a smaller building would have answered the purpose equally well with a material saving in first cost. Item *i* refers to the expense of maintaining the office building, including the cost of board for the superintendent, foremen, timekeeper, etc., who were fed and quartered by the company in addition to receiving their usual salary. It may be of interest to add that the average cost per meal served, including all expense for kitchen and table ware, together with the services of the cook, amounted to 25 cts. Item *j* covers the cost of purchasing and caring for all small tools. Item *k* takes care of the balance of the expense of the blacksmith shop, which could not be otherwise divided and charged direct.

Transportation.—The location selected for these works lies in that part of Westfield known as Mundale, at a distance from the railroad siding of approximately 5½ miles and at an altitude approximately 300 ft. higer than that of the town proper. It was reached for the most part by means of a rough country road containing many sharp grades, some of them as great as 15 per cent. The road was exceedingly dusty in dry weather and exceptionally muddy in wet weather, making the transportation problem difficult and expensive. A team of horses would make two trips daily from the railroad siding, hauling 3,000 lbs. to the load, and in bad weather two teams traveled together, doubling up on the steep grades.

A steam traction engine was tried as an experiment, but this method of hauling was abandoned after one trip, the failure being due partly to the poor condition of the machine itself and largely to the poor condition of the road and the steep grades which caused the water level to vary in the boiler, flooding the steam dome when going up hills and uncovering the crown sheet when going down. An experiment was then made with a gasoline-driven traction engine, and this, too, resulted in failure owing to the existence of several sandy sections of the road which destroyed the tractive force of the wheels and made it difficult for the engine to propel itself even without its load. Later, on an automobile truck was introduced, and proved to be a marked success. The truck was of two tons' capacity, made by the Reliance Co., of Detroit; and by using a longer but better road succeeded in making six trips per day, carrying two tons per trip. It is highly probable that had two of these trucks been purchased in the beginning of the work, a great saving would have been effected in the cost of hauling materials. Although successful as a means of transportation during the summer months, the automobile truck was obliged to give up the work when the late fall arrived, because of the frost in the ground, which thawed out sufficiently at midday to make the roads muddy on top with ice underneath. This condition rendered the operation of the truck on the steep grades very dangerous, and it was deemed best to withdraw it from service. The great bulk of the transportation was, therefore, handled with horses, and was let out by the ton to various teaming contractors, the prices varying from $1.50 to $2 per ton, according to the nature of the materials to be hauled. The total tonnage of all kinds hauled from the railroad to the work was approximately 5,000 tons and cost $1.65 per ton, or an average of 30 cts. per ton mile. The following table shows the character and relative amounts of the materials hauled:

	Lbs.
Plant, etc.	1,098,846
Cement	6,114,200
Akron pipe	522,239
Cast iron pipe	633,200
Coal	1,298,10[illegible]
Lead	8,800
Steel reinforcement	51,870
42-in. steel pipe	100,000
Castings, etc.	30,820
Hay	24,875
Grain	112,900
Miscellaneous	74,496
Total	10,371,146

Clearing and Grubbing.—The work required to be done under this classification included the removal of stumps, roots, brush and rubbish from about 10.44 acres, comprising the area covered by the sedimentation basin and the earth dam. This site had originally contained a rather thick growth of timber, the average size of which may have been 12 ins. in diameter, but nearly all of this timber had been cleared prior to the letting of the contract, so that the removal of stumps and roots only was necessary.

The removal of stumps, consisting largely of red oaks, chestnuts and maple, was exceedingly difficult. The land was very rocky, with frequent outcroppings of ledge, and a large percentage of the stump roots either grew out of fissures in the ledge or extended underneath large bowlders. A stump-pulling machine of the Hawk-Eye type was used consisting [illegible] vertical windlass operated by a lever and a horse traveling in a circle. A considerable number of stumps were removed by blasting, and many of them too large for the puller to handle were split with dynamite and pulled piecemeal. A record of the number of stumps removed was kept and showed an average of 475 per acre. Owing to the fact that the basin was designed for use as a sedimentation basin, and that its bottom would consequently be covered by an increasing depth of silt and vegetable deposit, complete grubbing was not required. The bottom was entirely cleared of stumps, large roots and all loose material and was then burned over. The detail cost per acre for this grubbing is shown in the following table:

COST P[illegible] ING, 1911

[illegible] 1910

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Cost of special tools and supplies	1.97
Total	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The cost as shown above is undoubtedly high for this class of work and may be accounted for partly by the fact that no special study was made of the possibilities of economic handling. This work was in general used as a spare job whenever there were extra men available. On the other hand, there is little question that the cost of grubbing work is too often underestimated and underbid and that the actual costs are in many cases much higher than popular impression would indicate. The general character of this work was probably more difficult than the average case, the rocky soil and the nature of the growth rendering it very difficult. Had it been necessary, however, to completely remove all fine roots, the above figures would have been largely increased.

	Per acre
The contract price for this item was	$1[illegible]
The maximum price bid was	300
The minimum price bid was	100
The average price bid was	194

General Excavation.—The item of General Excavation included all excavation for the filters, for the aërator and various building foundations, for stripping at the site of the dike, and in general all cases of earth excavation required under the contract in which the depth of the excavation was less than its breadth. The total amount of yardage included under this item was 56,147 cu. yds., of which 45,081 cu. yds. were handled by steam shovel and 11,066 by hand loading.

The excavation for the filters was handled for the most part by a steam shovel, while all other General Excavation, including a small amount in the filters, was excavated and loaded by hand labor. The cost records were so kept as to only designate between these two methods. Some further division might have been made with advantage, as there was, of course, a material difference in the conditions surrounding the different classes of hand excavation. Unfortunately, however, this was not done, and the cost results shown for hand excavation represent an average cost for the several cases.

Steam Shovel Excavation.—The site on which the filters were constructed was originally part of an open clearing adjacent to the highway and had been under cultivation more or less. A brook of substantial size passed longitudinally through the lot but was diverted under the contract to a new and permanent location so that it offered no serious problem. The contour of the ground was such that a fill of a few feet was required for a small area at the easterly end in preparing the subgrade of the filter floor at that point, while at the westerly end a 17-ft. cut was necessary for the same purpose, the original surface grade being approximately uniform between these points. This condition necessarily involved a considerable amount of light cutting in the easterly half of the filter lot.

Previous to the letting of the contract, test pits had been sunk to grade by the city authorities at three points on a line running longitudinally of the site, for the purpose of determining the character of the proposed excavation and for the assistance of intending bidders. All of these pits showed a very fair quality of gravel somewhat cemented by nature, but with no indication of the existence of boulders or ledge. It was assumed, therefore, that the material shown by these pits was fairly indicative of the nature of the material to be encountered throughout. This assumption was erroneous, as will be subsequently shown.

On account of the large amount of light cutting on the first half of this excavation and the consequent frequent moving which would be required, it was decided to install a No. 1 Thew steam shovel of the traction type, equipped with a 1¼-yd. dipper. This make of shovel possesses a great advantage over the ordinary type of steam shovel in light cutting work, owing to the extent of horizontal motion imparted to the dipper during the loading process. With this machine it was possible to crowd the dipper 7 ft. horizontally along the ground at each scoop. It can be readily understood that in cuts of from 1 to 2 ft. a reasonably full dipper load can be picked up in this manner. The Thew shovel of this size is made to revolve on the truck in a manner similar to that of a locomotive crane, so that it may dig or dump at any point within the circle of its swing. It weighed when in use about 30 tons, was mounted on wide flanged traction wheels and was self-propelling. The machine used on this work was delivered by freight at Westfield, was unloaded and assembled there and brought to the work over 6½ miles of highway on its own wheels and by its own power. It required six days to accomplish the task, being equivalent, therefore, to an average of a little better than one mile per day of travel. Owing to its weight and the poor quality of the roads passed over, it was necessary to lay a plank track for nearly the entire distance to prevent the wheels from sinking through the road bed. The cost of unloading from the car, assembling and transporting this shovel to the work was $255.15. It required for operation 1 engineer, 1 fireman and 2 laborers who trimmed up the bottom of the pit and assisted in moving.

Satisfactory progress was made in excavating for the first two filters. The nature of the material encountered up to this point was, if anything, somewhat better than that shown by the test pits. An output of from 300 to 500 cu. yds. per day was maintained during this period.

Except when moving, which, of course, occurred often in this shallow cutting, no difficulty was found in loading a team per minute, and as the dumping point was then at the base of the dike, the haul was over practically level ground.

When excavation for the third filter was reached, many large boulders were encountered, and from that point onward their occurrence became general. The work of excavation now became most tedious and expensive. The shovel, although not designed for such work, was able to dislodge many of the small boulders of 1 cu. yd. or less, but a large percentage were of such size as to require blasting before the shovel could proceed. The delays incident to meeting these obstructions frequently reduced the daily average to less than 100 cu. yds. In some places boulders were so thickly grouped in the ground that it was necessary to resort to hand excavation to clear around and remove them. The gravel surrounding the boulders was cemented to such an extent as almost to resemble concrete. Attempts were made to blast the bank ahead of the shovel, but it was impossible to drill into the material with any degree of success. The ground contained so large a percentage of stone, both large and small, that neither a churn drill nor a steam drill could be put down without its course being deflected. There remained nothing to do but to scratch away the gravel from around the boulders and pry them out with the dip-[illegible] the frequent delays from boulders, breakdowns of the shovel due to the excessive strain upon it occurred almost daily. This, of course, was to be naturally expected when using a 30-ton [illegible] 7-ton machine.

Although the excavation for the filters was nearly completed during the first season, the delay caused by the unexpected nature of the material prevented the completion of both the filter excavation and masonry in that season.

As practically all of the excavated material was to be utilized in fills, either in the earth dam or in grading over and around the completed filters, no satisfactory system of car transportation for the excavated material was deemed available. Two-horse teams hauling bottom-dump wagons were used throughout the work, and the excavated material was deposited without further rehandling in its final position. The elevation of filter subgrade was 455, while that of the finished dam was 495, necessitating a final maximum uphill haul of 40 ft., although the haul was practically level to the base of the dam. Various schemes for using incline railways and cable machines in transporting the excavated material were considered but finally abandoned as impracticable, and dependence placed entirely upon horses. When the fill on the dam had progressed to about elevation 475, or 15 ft. above the normal surface level at its base, it became necessary to devise some means of assisting the teams up the steep grade to the surface of the fill. This was accomplished in the following manner.

A short, steep road was selected up the side hill at the westerly end of the dam and an 18-in. gage railway track laid in a straight line from the bottom to the top of this road. A hoisting engine was installed at the top of this track and a weighter car, consisting of a small steel tank filled with concrete and mounted on four wheels, was operated up and down the track by this engine with a cable. The top of this car was just high enough to catch the rear axle of the wagons. In operation the teams drove on to and over the track near its lower end and headed uphill with the wheels astride the track, the car at this time being at the lower extremity of the railway. The car was then started up the track, catching against the rear axle of the wagon, and practically boosted the load uphill, the horses being only required to keep the pole headed in the proper direction. At the top of the track the team swung off downhill toward the fill, and the car ran back by gravity to await the next load. The grade of this road was about 18 per cent and its length about 150 ft. The teams could be handled on it at the rate of one per minute.

The detailed cost of steam shovel excavation, including that of teaming it to its disposal point was as follows:

COST OF STEAM SHOVEL EXCAVATION IN FILTERS; 45,081 CU. YDS.

	Per cu. yd.
Cost of delivering and installing shovel ready for work	$0.011
Cost for foreman supervising excavation	0.037
Cost of shovel operation, labor	0.047
Cost of coal, oil, etc.	0.033
Total	$0.128
Cost of repairs, labor	0.007
Cost of repairs, materials	0.014
Total	$0.149
Cost of depreciation on shovel	0.039
Cost of teaming excavated material	0.215
General expense, 12.9 per cent	0.052
Grand total cost, including all expenses	$0.455

The cost of installing shovel includes the expense of four sections of oak platform, each section being 12 ft. long by 5 ft. wide and 4 ins. thick. Each section was fitted with lifting rings so that it could be easily handled by the dipper of the shovel and transferred from the rear to front as the shovel moved forward. A second set was required after a few months' use. This second set of platforms was made from rock maple and remained in use through the balance of the work. The cost of the subsequent removal of the shovel is not included in the above figures but is charged to another item of work on which the shovel was later used.

The charge for foreman is an average charge per cubic yard for all foremen and subforemen employed on General Excavation during the work.

The cost of shovel operation includes, in addition to the engineer and fireman, all laborers required in the pit.

The cost of repairs is exceptionally high on account of the very difficult nature of the work performed. Two new booms were supplied by the makers to take the place of broken ones, the second being of a special design. Several new dipper arms were required, and the dipper teeth, chains and ropes were replaced every few weeks. The thought may suggest itself that it would have been economy to have installed a larger shovel when the difficult excavation was encountered. It was, however, expected from day to day that the character of the excavation must change for the better, since the original test pits showed no rough material and the earlier material encountered had been easily handled. The depreciation charged may possibly appear large, but is in reality the actual shinkage in value between its new and its selling price. The entire depreciation is charged to this item although the shovel was used on two subsequent items. This is due to the rougher usage suffered by it comparatively on this part of the work and is undoubtedly somewhat unfair to this item.

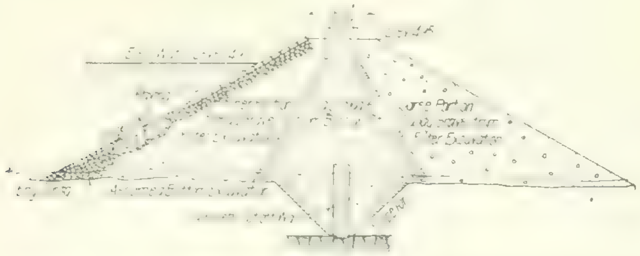
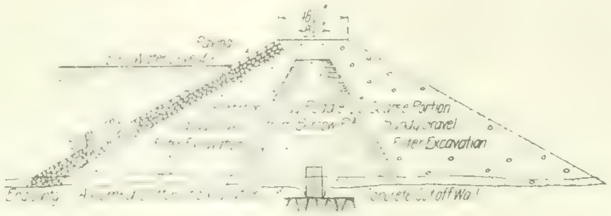



Fig. 3—Sections of Settling Basin Dam.

The teaming was done as before stated, with bottom-dump wagons hauling ordinarily one dipperful from the 1¼-yd. dipper. During the early stages of the work, when the hauling was over approximately level roads, two small dipperfuls were carried. The greater part of the excavated material was deposited in the earth dam at an average haul of about 800 ft. each way and, as previously explained, over an uphill road. A small amount was used in filling over and around the filters at an average haul of approximately 500 ft. each way, but the bulk of this fill was obtained from another source. No dumping expense is charged to this item as all labor of that nature is chargeable to the items of Earth Embankment or to General Fill.

The number of actual working days required to complete the filter excavation was 191, representing, therefore, an average of only 236 cu. yds. per day.

Hand Excavation.—As previously stated, 11,066 cu. yds. of General Excavation was loaded by hand methods. A small amount of loam stripping over the filter site was done with wheel scrapers. Much of the area to be stripped, however, was of a marshy nature, due to the presence of springs at the upper end of the lot. This rendered the soil so soft as to prohibit the working of horses over it. Other parts of the lot were so stony under the surface as to continually stall the scrapers, and the scraper method of excavation was finally abandoned and wagons and shovels substituted therefor. Reference has already been made to the use of hand-loading in certain parts of the filter excavation, i. e., in spots where the boulders were so numerous as to actually block the shovel. This class of excavation was, of course, naturally very expensive, requiring the picking of cemented gravel from under and around the boulders.

The permanent diversion of the brook required about 1,200 cu. yds. of excavation, which was executed entirely by hand methods. Part of this channel was quite deep and required some staging and rehandling for the bottom part.

Excavation for the office and laboratory building, for the regular house and for the aërator were carried to depths of 7, 9 and 7 ft. respectively. The material in this excavation was cemented sand and gravel, requiring loosening with picks but without the presence of boulders.

The removal of all soil covering the area of the dam site and the first 4 ft. in depth of the cut-off wall trench were also handled by hand. Excavation for central drains in each filter was also done by hand labor and was exceedingly difficult, being composed mostly of small boulders. The following figures give the average cost of all work above enumerated:

COST OF GENERAL EXCAVATION REMOVED BY HAND LABOR; 11,066 CU. YDS.

	Per cu. yd.
Foreman	$0.037
Picking and shoveling	0.527
Miscellaneous supplies	0.005
Teaming	0.215
Total	$0.784
General expense 12.9 per cent	0.101
Grand total cost of this item	$0.885

The charge of $0.527 per cu. yd. for picking and shoveling is probably high in spite of the difficulties experienced in some portions of the work. There is a tendency to use such jobs as these for spare work on which to employ a few men from time to time when they are temporarily prevented for some reason from following their usual duties, and for this reason efficiency is not always looked for or attained. On the other hand, excavation in and around boulders may easily cost one dollar or more per cubic yard. and partly accounts for this high average. The average cost of all general excavation, including both steam shovel and hand loading, was 54 cts.

The contract price for this item was	$0.57
The maximum price bid was	0.60
The minimum price bid was	0.35
The average price bid was	0.46

It should be borne in mind that these prices were bid upon the expectation of encountering an entirely different class of material from that actually met with, viz., the moderately cemented sand and gravel free from boulders as indicated by the test pits.

Trench Excavation.—Various pipes and and drains in connection with the several parts of the work required 4,759 cu. yds. of trench excavation. Of this account, 653 cu. yds. were in the cut-off trench for the earth dam. In general, all excavations whose depth exceeded their width were classed as trench excavation. The excavation in the cut-off trench of the dam involved special treatment and was subsequently handled and paid for as a separate proposition.

The average cut of the many pipe trenches was about 7 ft. and their average width at the bottom was approximately 4½ ft. The specifications provided that the measurement for payment should include slopes of 2 vertical to 1 horizontal, regardless of whether more or less was actually removed. The general nature of the material, however, was such as to allow vertical banks in all cases, mostly without boulders. The cost of this being a compact cemented sand and gravel work was as follows:

COST PER CUBIC YARD OF TRENCH EXCAVATION; 4,106 CU. YDS.

	Per cu. yd.
Picking and shoveling, inc. backfilling	$0.2[illegible]
General expense, 12.9 per cent	0.032
Grand total for this item	$0.275

Comment on above figures: This figure is small because of the excess measurement allowed under the contract for the slopes which were not excavated. The actual excavation was only about 60 per cent of the measurment allowed in accordance with the specifications. The unit cost for the amount actually removed would be approximately 46 cts. This excavation required no removing of surplus as in all cases it was possible to distribute it over the surrounding ground.

The contract price for this item was	$0.75
The maximum price bid was	1.50
The minimum price bid was	0.45
The average price bid was	0.922

Borrowed Excavation.—This item of the work embraced the securing and delivery of such material as was required for the fills in excess of that supplied from General Excavation. It was originally expected that Borrowed Excavation would only be necessary in supplying about 16,500 cu. yds. of clayey material for the core or middle portion of the earth dam. It subsequently became necessary to increase the amount of borrow to 30,000 cu. yds. on account of the deficiency of material caused by the elmination of boulders and large stones from the material brought from General Excavation.

Material conforming to the requirements of the specifications for use in the core of the dam was obtained on land belonging to the city, at a distance of approximately 2,500 ft. from the dam in an uphill direction. The haul from this point to the dam was, therefore, downhill to the filter site, from which it was necessary to haul up grade as the dam fill increased.

The material was a compact, clayey sand, containing at times a moderate amount of gravel. Its location in a side hill afforded an excellent opportunity for loading and eventually a face of 50 ft. in height was obtained.

An attempt was made to loosen the material by blasting, using black powder in holes drilled some distance back from the face. It was found, however, that water seeping through the material wet the holes, and even when not troubled from water the shots were unsatisfactory, due mainly to the elastic nature of the material.

An attempt was then made to loosen a large section of the bank by means of a tunnel driven into the hill and exploding a mine therein. Again the result was unsatisfactory, the effect of the shot manifesting itself in the shape of a small crater while only a comparatively small amount of material was loosened in proportion to the amount of labor and explosives required. A successful method of loosening was finally obtained by the use of undercutting shots. A row of short holes was churned in diagonally downward along the base of the vertical face of the pit. These holes were fired simultaneously, using dynamite for the purpose. The resulting shot kicked out a triangular strip of the material from under the face, while the shock of the explosion caused the overhanging mass above to crack and topple over, thereby breaking it into a loose pile which was easily shoveled. At times, after the face had reached a considerable height, four or five holes loaded with 10 or 15 sticks of dynamite would loosen and break up from 100 to 150 cu. yds.

For loading the material into wagons a large guyed derrick was installed and equipped with a 1-yd. orange-peel bucket which delivered into a hopper under which the teams drove and received their loads. This arrangement was very satisfactory while working, but the frequent delays caused by minor breakdowns and repairs rendered it uneconomical. Material from this pit was required sometimes at the rate of a load every 3 minutes, and it can be readily understood that a delay of a half hour while repairing a broken chain or worn-out sheave might result in the tying up for that time of 10 teams and in the disorganization of the work on the dam where this filling was needed in an amount proportionate to that of the other material being placed. It was finally deemed more satisfactory and dependable to load this material by hand, and after the second month of the work hand-loading was used entirely. It was estimated at the time that, considering the expense, direct and indirect, due to delays, it would be more economical to use old-fashioned methods.

As stated above, the average length of haul from the pit was about 2,500 ft., or a round trip of 5,000 ft. The greatest number of trips per team, made or required, was 20 in 10 hours. The average for the entire work was about 18. The wagons holding 1½ cu. yd. level measure were ordinarily well rounded up when leaving the pit, but the average load, bank measure, was only about 1 cu. yd.

The nature of the material rendered it difficult to team over during or immediately after wet weather, and the same was true of the highway over which the teams were obliged to pass. On the other hand, in dry weather, the highway was deep with dust, adding another unpleasant feature. The cost of this item of the work was as follows:

COST OF EXCAVATION AND TEAMING TO DAM OF CLAY BORROW FOR CORE WALL; 13,952 CU. YDS.

	Per cu. yd.
Blasting	
Cost of labor drilling holes	$0.017
Cost of explosives	0.018
Total cost of blasting	[illegible]
Loading	
Cost of foreman, labor, etc.	[illegible]
Cost of coal, oil, plant, etc.	0.0226
Cost of special tools used	0.0014
Total cost of loading	$0.226
Cost of teaming to dam	0.36
General expense, 12.9 per cent	0.08
Grand total cost for this item	$0.701

The average cost of blasting would have been lessened had it not been for the expensive experimenting resorted to in the beginning. The labor item of $0.2022 for loading contains a charge of $0.045 for foreman, which may appear high, as a $5-a-day foreman was employed to supervise the work of 10 to 12 men. An attempt to substitute a cheaper foreman, however, resulted in increased cost and decreased output, and the more expensive man was returned. The cost of labor exclusive of foreman was $0.157, and represented an average of only a little over 11 cu. yds. per man. Much of the labor, however, was employed in maintaining roads, stripping loam, breaking and removing boulders, etc., and it is probable that of the men actually employed in loading, an average of 15 cu. yds. loaded per man was secured. This, of course, was not a large output for material which had already been loosened, but as an average of good and bad days extending over a long period is possibly all that could be expected.

The coal and oil were used on the mechanical handling apparatus during the short period of its use and the plant charges cover the cost of erecting and removal of same.

Since double teams cost $6 per day, the teaming charge of $0.36 gives an average of 17 cu. yds. per team. It may be added that but few teams could stand this work continuously, and frequent changes of teams were required to rest the horses.

The [illegible]	[illegible]
The [illegible]	[illegible]
The [illegible]	[illegible]
The average price bid was	0.715

Second Borrow Pit.—When the filter excavation was completed it was found that additional material to the extent of several thousand yards would be required to complete the fills. This deficiency was due to two causes, first, from shrinkage in volume due to the removal of stones, and, second, the excessive shrinkage due to compacting in fills especially under the roller.

A borrow pit was accordingly designated by the engineer located near the tunnel portal at the westerly end of the work, an average distance of 1,400 ft. from the dam and 1,000 ft. from the general fill over and around the filters. The general level of the floor of this pit was somewhat higher than that of the finished dam, and at a slight expense a sidehill road was constructed, which permitted a practically level haul to this point. The steam shovel from the filter excavation was installed in this pit and worked under much more favorable conditions than it had met in the filter excavation. The material first encountered was of a compact, rough gravel, but this soon changed to a sandy clay which was used throughout the upper portion of the dam, both for core and outer fill. The cost of excavation in this pit and teaming to the fills was as follows:

COST OF GRAVEL AND CLAY BORROW FROM SECOND BORROW PIT; 16,296 CU. YDS.

	Per cu. yd.
Foreman	[illegible]
Loading teams	0.081
Coal and oil	0.016
Total cost of loading	$0.10
Cost of moving shovel from filters	$0.004
Repairs on shovel	0.082
Total	[illegible]
Cost of teaming to fills	0.21
Constructing roads and bridges	0.012
General expense, 12.9 per cent	0.055
Grand total cost for this item	$0.485

The cost of loading is somewhat misleading, since it includes the loading by hand of all soil stripping, a total of 2,330 loads out of 13,843 loads taken from the pit.

It cost $55.50 to take the shovel out of the filter pit and install it ready for work in this borrow pit.

The cost of repairs is high, due to the replacing of several expensive parts which were worn out in the filter excavation. The charge against the present item is, however, perhaps fair, since no depreciation is included, it all being charged against General Excavation. The price of $0.21 for teaming corresponded to a daily average per team of about 30 cu. yds. It will be noticed that the loads from this pit average 1.18 cu. yds. bank measurement, the larger loads being due to the comparatively level haul obtainel. The contract price of $0.70 per cu. yd. also applied to this work.

Rolled Embankment.—With the exception of a few hundred yards or fill in and around the northeasterly corner of the filters, this item related solely to the construction of the earth dam. It was 740 ft. long at the crest and its maximum height above the natural ground was 35 ft. Its maximum width at ground level was 165 ft. The slopes were carried 1 on 2 and a roadway 16 ft. wide surmounted its top. A cut-off trench was carried to rock for the entire length, in which was built a concrete cut-off wall 3 ft. thick, extending upward from the ledge to a little above the natural surface. Surrounding this cut-off wall and extending upward through the middle portion of the cross-section is a clay core built with the material secured from the borrow pit previously described.

After the area to be covered by the dam had been grubbed and stripped of soil, and after the cut-off wall was constructed, material from the borrow pit was dumped, spread by hand and tamped on both sides of the wall until its level reached that of the surrounding ground. From the ground level the fill was carried upward as indicated on the cross-section Fig. 4, material from the filter excavation being dumped and spread on the two outside thirds and that of the clay borrow pit on the middle third. The several layers were so deposited that the clay and gravel lapped each other alternately at their joints, giving a dovetailed bond between the core and the main fill. The specifications required that the layers should be carried 4 ins. thickness. This provision, however, was not rigidly insisted upon, the usual thickness being at least 6 ins., and at times even heavier layers were permitted at the judgment of the engineer if the material was of a nature to admit of proper consolidation by rolling. This feature is a most important factor in reducing cost, and must, therefore, be considered in connection with the cost figures herein given.

For a while the spreading was accomplished by means of a No. 2 Climax road machine drawn by two horses. The teams dumped the material in rows and the machine following leveled the rows to the required thickness. When the rough material was encountered in the filter excavation, it became impracticable to use the grader, as the large stones were so numerous that the machine was unable to spread the piles even when drawn by four horses. This necessitated recourse to hand-leveling and the use of a stone drag and teams to remove stones larger than 6 ins. in diameter which the specifications directed should be excluded from the fill. Small stones from 6 to 12 ins. in size were thrown down the slopes, those on the upstream side remaining there and constituting part of the 3-ft. rock fill called for on that slope, while stones thrown out on the downstream slope were collected and teamed to the crusher to be broken for use in concrete. All large stones were loaded on a drag and rolled into the rock fill.

The specifications provided for the rolling of the embankment with a grooved roller weighing not less than 1½ tons per linear foot of roll. This provision, of course, necessitated the use of a power roller. For a short time a traction engine weighing about 10 tons was used for the purpose and gave excellent results so far as the quality of rolling was concerned. It was out of commission so often, however, due to breakdowns and defects, that a new Buffalo-Pitts tandem type of roller was purchased and its two rolls equipped with heavy steel bands to give them the grooved effect. This roller was rated by the makers at 8 tons, but with its boiler and tank filled and the added weight of the steel bands it actually weighed 12 tons. This total weight of the roller produced the necessary load specified by the specifications on each of its two rolls, consequently every layer received two rollings every time the roller passed, each conforming to the specified requirements.

While awaiting the arrival of this roller, a horse roller weighing 2½ tons, or ½ ton to the linear foot of roll, was used and was drawn by four horses. This roller did not, of course, meet the contract requirements, but a temporary concession was made in the matter by the engineer during this interval. This same horse roller was later used near the top of the dam during a short interval while the steam roller was undergoing repairs. It is estimated that from 8,000 to 10,000 cu. yds. of this embankment were rolled with this horse roller.

Considerable difficulty was encountered in rolling the clay core after a rainstorm, with the heavy roller. This material when once wet retained the moisture for a long period and when saturated assumed a jelly-like consistency. On such occasions, layers of gravelly material were spread over it and rolled until the clay squeezed up through it. Sometimes several layers of gravel were required to stiffen the clayey material sufficiently.

As a general thing, the teams passed over the dam longitudinally with their loads, and it is highly probable that the grooving action of the wheels, together with the tamping action of the horses' hoofs, was of great assistance in consolidating the fill. Very little watering was required, as the material from the filter excavation was usually moist if not wet, and it was found difficult to wet the clay without softening it too much.

It is unfortunate that there is no way of determining accurately the amount of shrinkage suffered by the material due to rolling and otherwise compacting it. It is known that there were 86,400 cu. yds. of material excavated in general and in borrowed excavations, while only 75,700 cu. yds. were finally measured in fills. This shrinkage of 11,000 cu. yds. includes approximately 1,000 cu. yds. wasted, and in addition the volume of stones and boulders rejected from the fills. It seems probable to the writer that 5,000 cu. yds. would conservatively cover these two sources of loss, leaving 6,000 cu. yds. due to shrinkage by compacting. This 6,000 cu. yd. shrinkage undoubtedly occurred entirely in the rolled embankment, as the general fill was not compacted except by the teams driving over it. If this assumption is correct, it would indicate a shrinkage of 11 per cent in volume due to rolling and compacting, and would be, therefore, an important factor not to be overlooked when estimating the amount of material required for similar fills.

In spite of the occasional deviation from specified requirements, both as to thickness of layers and of intensity of rolling this dam when finally completed, and subjected to its full hydrostatic head of water, did not show a single indication of leakage, and after a year's test under service conditions still remains absolutely water tight.

The cost of building this embankment was as follows:

COST OF ROLLED EMBANKMENT, 53,233 CU. YDS.

	Per cu. yd.
Cost of labor and teams used in spreading material and picking stones	$0.0435
Cost of labor making roads and bridges	0.001
Miscellaneous supplies	0.0005
Total for spreading in layers	$0.045
Cost of operating steam roller	0.0098
Cost of coal, oil, etc	0.0055
Depreciation and repairs on roller	0.017
Cost of teams on horse roller	0.0075
Total cost of rolling	$0.0399
Cost of teams watering	0.0008
Cost of foreman	0.0151
General expense, 12.9 per cent	0.013
Grand total cost for this item	$0.1138

Owing to the use of bottom-dump wagons, the labor was much less than it would have been with end-dump carts or cars. The presence of so many large stones in the loads necessitated at least 50 per cent more labor than would otherwise be required. The labor on roads and bridges was used in maintaining satisfactory approaches to and returns from the dam.

The gross cost of both steam and horse rolling has been divided into the entire yardage of the dam. The steam roller was used in rolling probably 85 per cent, while the horse roller was used on about 15 per cent of the whole volume rolled. As a matter of fact, the daily cost of operating the steam roller was not much if any less, if depreciation and repairs are included, than that of the horse roller using four horses.

Depreciation was large in this instance, since the roller was purchased new and disposed of at second-hand price at the completion of the work.

The item of watering is almost negligible, but might easily become important in the case of a different material requiring more wetting.

The charge for foreman constituted a substantial fraction of the grand total, yet a competent and consequently high-priced man was necessary to intelligently supervise the placing and to direct the teams.

	Per cu. yd.
The contract price for this item was	$0.16
The maximum price bid was	0.48
The minimum price bid was	0.16
The average price bid was	0.242

General Fill.—The work embraced under this item included the fills around and over the filters, the grading and loaming of the same and all other fills around the grounds which might be made under the direction of the engineer. It was originally expected that the first four filters built would be backfilled with earth teamed directly from the steam shovel, but that the material required to fill over the last two filters would be temporarily stored in spoil banks and be subsequently rehandled to the fill, since the last of the filter excavation would naturally be removed before the roof of the second last filter was completed ready to receive the fill. Owing, however, to the shortage of material available for fills, and the subsequent opening as previously described of a special borrow pit, this part of the fill was also deposited directly from its excavation point and without rehandling. This condition, therefore, effected a substantial saving in the cost of this work.

The loam originally stripped from the filter site was the only earth rehandled under this item, representing perhaps 1,000 cu. yds. The balance of loam necessary to cover the various fills was paid for both as borrow and as general fill. With the exception of the 1,000 cu. yds. of loam mentioned, the expense charged to this item was limited to that of dumping, spreading and grading material hauled from the excavations. The cost of general fill was as follows:

COST OF GENERAL FILL, 22,521 CU. YDS.

	Per cu. yd.
Labor dumping, spreading and grading	$0.0618
Teams and labor rehandling 1,000 cu. yds. of loam	0.0147
General expense, 12.9 per cent	0.01
Grand total cost of this item	$0.087

Comment on above figures: The total expense of rehandling 1,000 cu. yds. of loam is here divided into the entire yardage of the item. It actually cost about $0.33 per cu. yd. of loam rehandled, the average haul being about 500 ft. each way.

The contract price for this item was	$0.22
The maximum price bid was	0.45
The minimum price bid was	0.17
The average price bid was	0.327

(To be continued.)

Concrete Flume in Obispo Diversion, Panama Canal.—As soon as the dry season is far enough advanced, the wooden flume in the Obispo Diversion at La Pita, a point immediately north of Empire, on the east side of Culebra Cut, will be replaced by a reinforced concrete flume. This is the point at which the diversion broke through its banks early in the rainy season of 1910, and at which a further break occurred during the heavy rains of December. It is planned to excavate from the toe of the slope all the loose material in the slide that caused the break, and to build the new flume on such foundation as may remain, moving the line eastward a short distance, if necessary, in order to avoid the slide. The highest measured flow in the diversion since the American occupation is 2,325 cu. ft. per second, and under the French regime, 2,700 cu. ft. per second. The capacity of the flume will be over 3,000 cu. ft. per second.

Data on 2-in. Solid Metal Lathe Partitions.—The following data are furnished by A. Dixon:

	12-in. stud centers.	16-in. stud centers.
Steel channels, weight lb. per sq. yd.	4.25	3.00
Erecting channels, sq. yds. per hour	6.0	9.0
Metal lathe, applying, sq. yds. per hour	6.5	8.25
Plastering, three coats, sq. yds. covered per hour	1.25	1.25

In the above the figures on plastering are the amount of completed three coat work which one man can do in one hour and are based on the average of a gang of men and the total time required to apply three coats on a given area.

Costs of Core Boring in Virginia.

The following costs of drilling operations in drilling prospect holes in Virginia is given by Mr. Moffet in *Mines and Minerals.* Ferry core drills, 3¾ in. size were used, which removed a 2⅞ in. core. The men operated the drill 9 hours a day, drilling from 13 to 36 ft. per day, but averaging 18 ft. Drilling was in slate.

Drill runner and helper, per day	$ 7.00
Hauling fuel and water, per day	4.00
Miscellaneous	2.00
Total cost	$13.00
Average number feet per day	18
Average cost per foot drilled	$0.722

STEAM AND ELECTRIC RAILWAY SECTION

Lock Joint Cast Iron Culvert Pipe.

In the discussion relating to iron pipe culverts at the annual meeting of the American Railway Bridge and Building Association several of the members told of using the National lock joint pipe manufactured by the American Castings Co. of Birmingham, Ala. The consensus of opinion seemed to be that this pipe, if properly placed, would not pull apart.

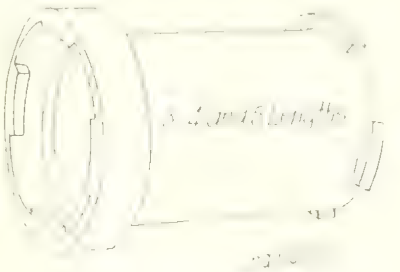
The means for locking are shown in the accompanying illustration. The pipes are placed together so that the lugs on the bell and spigot end slide past each other. The loose pipe is then given a turn—a full quarter turn if the culvert is on straight line, or as much of a turn as is necessary to tighten it if laid on a curve. The fact that the lugs are beveled makes this adjustment to line possible. The pipe is made in lengths of 3, 4 and 5 ft., and it is stated that two men are sufficient to place and lock it. The cost of handling should be materially less than that of handling pipe in 12-ft. lengths.

Owing to the fact that culvert pipe is not a pressure pipe, it is unnecessary to use the same thickness of metal as is required in pressure pipe designed to withstand from 300 to 500 lbs. pressure per square inch. The National pipe is made in thicknesses varying from 7/16 in. for a 12-in. pipe to 15/16 in. for a 48-in. pipe. Although economy in metal per foot is thus secured, it is estimated that the close spacing of the bells introduces an element of strength that more than offsets the loss due to diminished thickness.

The pipe is cast in green sand molds. Shrinkage strain is prevented by stripping out the inside core member while the pipe is white hot. Nothing but the best grades of No. 2 and No. 3 foundry pig iron enter into its composition.

There are several advantages in using pipe of short lengths, where this is made practicable by the use of a locking device. It is never necessary to use materially more pipe than is actually needed to clear the slopes of the embankment. This alone is a great advantage over the 12-ft. lengths, in placing which it is often necessary to leave from 1 to 5 ft. of the pipe protruding beyond each slope. If a section is broken, the loss of only a short unit results. Where a crown effect is desired, each joint takes its share of the curve. Any curvature desired can be secured according to the extent the pipe is turned in locking.

Sixes, approximate weight and estimated drainage areas are shown in the accompanying table:



Lock Joint Cast Iron Culvert Pipe.

TABLE OF SIZES AND APPROXIMATE WEIGHTS OF NATIONAL LOCK JOINT PIPE AND ESTIMATED AREA PIPE WILL DRAIN OF STORM WATER UNDER [illegible] GRADE.

Diam. of pipe	Thickness of metal	Weight per foot		[illegible] 100 feet, in [illegible]							
Ins.	Ins.	Lbs.		1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24	36
12	7/16	[illegible]	Acres	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	10
14	7/16	[illegible]	Acres	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	13	16
16	[illegible]	[illegible]	Acres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16	[illegible]
18	[illegible]	[illegible]	Acres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13	20	30
20	[illegible]	120	Acres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20	30	45
[illegible]	9/16	[illegible]	Acres	10	[illegible]	15	[illegible]	[illegible]	30	[illegible]	60
[illegible]	[illegible]	220	Acres	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	160
[illegible]	11/16	[illegible]	Acres	40	50	60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13/16	390	Acres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	300	[illegible]
48	15/16	[illegible]	Acres	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	560

Reduction in Cost of Handling Freight And Increase in Capacity of Freight Terminals by the Use of Mechanical Devices for Hoisting and Conveying.

The usual discussion of this subject has dealt almost entirely with the merits of mechanical versus manual handling of freight as viewed from the point of saving in costs, principally in relation to the present type of terminal and freight shed.

Further consideration of the problem shows that it has a far reaching effect on the whole transportation question and a full discussion of the subject cannot fail to bring out its direct or indirect bearing on every phase of the freight transportation problem. Its application has a direct and important bearing on the costs of transportation and even a more direct effect on the efficiency of the transportation system as a whole.

[illegible]

I wish at the beginning to emphasize this feature of the subject and to make it plain that the object aimed at is not wholly the reduction in the cost of handling goods at freight stations, although that is a result well worth accomplishing, but to show as well the possibilities in increasing the general efficiency of transportation.

It must be admitted that there is a widespread demand, on the part of the public at least, for a decrease in freight charges and improvement in the efficiency of the service, the need for which is also recognized by the transportation companies themselves.

In a paper by James J. Hill, presented last June before the National Association of Millers, the inefficiency of the country's transportation service is strongly emphasized and is emphatically stated to be due to inadequate terminal facilities. He also states that the pressure upon existing terminals is a present menace and a future handicap; that the problem of terminals is the greatest problem of the country and that if neglected for the next five years as it has been during the last ten the results will be disastrous.

That a reduction in the cost of terminal freight handling will make possible a material reduction in rates, a material increase in the net income to the transportation companies or perhaps a combination of both can be easily shown. It is almost wholly a terminal problem. This is, in fact, so far considered to be true that the following have become recognized as axioms: (*a*) the efficiency of a transportation system is limited, not by its carrying capacity, but by its terminal facilities; (*b*) the essential factor in transportation costs is not the cost of hauling the goods, but the expense of handling at terminal stations.

It is obvious that there can be no improvement either in the efficiency of the service or in its carrying capacity by the mere addition of more trains when the present inefficiency is due to congestion in yards and terminals. I do not understand that it is contended by anyone that the actual capacity to haul goods has been anywhere near reached. In the last few years immense sums of money have been expended in straightening out curves, cutting down grades and in other ways adapting the permanent way for the use of larger cars and more powerful locomotives, until a point has been reached where any further reduction in the cost of transporting freight is of no material importance. In water transportation there has been the same increase in carrying capacities and motive powers and any further reduction in transportation costs must be brought about by a decrease in the terminal expenses.

It is well recognized that statistics of transportation costs are to a certain degree unsatisfactory and more or less unreliable when it comes to comparisons. This is due largely to the lack of uniformity in methods employed in arriving at results as well as to a variance in practice as to what items are included in calculating a given cost.

The actual cost of transporting freight by rail can safely be stated as 3 mills per ton-mile, which includes the operating expense and interest on rolling stock and permanent way investment. This figure is for the average freight traffic; bulk freight, such as ore or coal, can be hauled for less.

A careful study of the published costs of handling L. C. L. freight at terminals seems to warrant, as a conservative estimated cost, 40 cts. per ton for outbound and 35 cts. per ton for inbound freight, a total terminal charge of 75 cts. on each ton. That the cost of transportation may equal the terminal cost, this ton of freight must be hauled 250 miles; but the average ton-haul is only 135 miles.

The cost of hauling this distance is 40 cts.; added to the terminal expenses of 75 cts., the total cost of transporting one ton the average haul is $1.15, 65 per cent of which is therefore terminal expense. It is estimated that in terminals provided with machinery for freight handling the terminal cost can be reduced at least to about one-quarter of its present expense, or to 10 cts. per ton.

The total transportation cost would then amount to 59 cts. per ton, a decrease in total cost of practically 50 per cent.

The problem before us is one of terminals only. It is an engineering problem along the broadest lines.

It is not a problem of designing a machine or a system of machines adapted to the transference of goods between freight sheds and cars or vessels, but rather the adaptation of well-known devices to this work; not the simple adaptation of machinery to the transportation of merchandise, but a study of the effects of such adaptation on methods to be employed at terminals in the future; not the introduction of machinery in the present type of terminal, but rather the designing of an entirely new style of terminal adapted to the use of machinery.

Not long ago the cost of loading ore at the ports on the Great Lakes was 35 cts. per ton; it now costs less than 2 cts. per ton. This has been accomplished by the use of machinery in loading and by the design of a different type of terminal, adapted to the use of this specially designed machinery.

In considering the transportation terminal problem we have to deal with two distinct types of terminals, one for rail-borne freight, one for water-borne freight. The inefficiency of each method of transportation is the same, that of inadequate terminal facilities.

[illegible]

The solution of the terminal problem resolves itself into two factors, the increase in capacity and the reduction of terminal costs. On first thought the natural solution of the first factor is the purchase of more land, thus increasing by as much as is necessary the area required to handle the increasing traffic.

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*Abstract of paper entitled "The Mechanical Handling of Freight," by S. B. Fowler, Proceedings, American Society of Mechanical Engineers, Vol. 33, p. 23.

Unfortunately the land adjacent to the average terminal has so increased in value that its cost, for terminal uses, is prohibitive; the interest on the required investment would be a greater fixed charge than the traffic would warrant. In addition the necessary increase in area would involve an increase in operating expenses, particularly in the trucking costs, which is the largest item in the handling expense.

That the present terminals are worked to their capacity is evident; no additional truckers can be put to work as they are already in each others way, every truck is carrying its capacity in bulk or weight and is moved at its maximum speed, and still the freight is coming in faster than it can be handled. Congestion is the result and congestion means rehandling, which spells additional expense.

With these limitations imposed it is evident that to increase the capacity of the terminal we must increase the unit movement; that is, in moving goods to and from the cars, more freight must be taken in each load and this increased load must be moved at greater speed. Manual labor must be eliminated as much as possible, for in no other way can larger loads be handled and at greater speeds.

The most feasible method of bringing about these necessary improvements seems to be the substitution of machinery for hand trucks and manual labor, wherever possible. This substitution would in general have the following marked effects on the capacity of a terminal:

a. If this machinery were of the overhead type, that portion of the shed floor now necessarily kept free for truck runways would at once be available for the receiving, weighing and sorting of merchandise.

b. As the mechanical transporter could carry much greater loads and at much faster speeds, goods would be removed from the receiving floor more rapidly and the capacity for receiving new loads correspondingly increased. For the same reason cars would be unloaded much faster and, as it is practically as cheap to tier goods as to set them on the floor, the capacity of the inbound shed would be increased accordingly. The cost of tiering by hand is now prohibitive, it being equivalent to a rehandling.

c. In mechanical transportation the increase of a few feet in the distance traveled has an immaterial effect on the time or the cost of transportation. The delivering and receiving platform capacity could be practically doubled if both sides of the sheds could be used to receive from or deliver to teams.

d. As the time consumed and the cost of hoisting or lowering a few additional feet is unimportant, upper floors could be utilized and a large increase in floor area thus obtained.

e. Freight-handling machinery could be utilized to assist in the loading and unloading of teams and the time consumed in this operation could be materially reduced.

The entire cost of handling L. C. L. freight is practically in the labor involved and the wages of truckers is the largest item. A single transporting machine operated by one man should be able to replace at least 16 truckers. The "spotting" of cars, an expensive tedious operation, could be entirely done away with.

With a properly designed terminal the shifting of cars from the inbound unloading tracks to the outbound loading tracks could be largely eliminated; it might be possible to approximate closely that ideal condition where the movement of an empty car about the yards becomes unnecessary. Even the partial elimination of these operations would reduce the number of switching engines and crews, and the saving represented by the cost of operation of only one engine and crew is the interest on a considerable investment.

Much of the damage to freight for which the transportation companies must eventually pay comes from yard switching and the recoupling of "spotted" cars. Added to this expense is the damage done to the rolling stock itself. Numerous economies could also be brought about in the operations of sorting, weighing and distributing.

COMMENTS ON MODERN INSTALLATIONS.

The application of machinery to freight handling in railway terminals is of very recent date as is also the interest in such applications. At the Sixth Session of the International Railway Congress held at Paris in September, 1900, a committee previously appointed made its report covering practically all the railway systems of the world. The gist of this report was that the use of machinery at freight stations was extremely limited, although in one or two instances the installation of such equipment had been proposed. The only use was that of elevators where stations were of more than one floor, and a limited application of cranes, some hand-operated, some hydraulically and a few electrically.

It will be noted that the applications are limited to vertical movement alone, except as to the radius of the crane jib. No recognition is apparent of the need of horizontal movement for the purpose of distribution.

Since that time, however, England in particular, has made more or less progress and I believe a brief description of one of the more modern and complete installations will be of interest.

This equipment is installed in the North-Eastern Railway Company's warehouse, New Bridge Street, Newcastle. The station contains two floors and a basement; the basement and the first floor being utilized for the regular in- and out-traffic, and the top floor for storage and warehouse purposes. The first floor is provided on the inside with two platforms approximately 300 ft. long and 25 ft. wide, between which is a double line of car tracks. Each platform is served by two overhead traveling cranes of the conventional type of overhead shop cranes, and each can travel the length of the building parallel with the freight car track, except as limited by the position of another crane. Mounted on this traveling crane is a traveling revolving jib crane having a lifting capacity of one ton. Each of these units is, therefore, provided with four motors, the traveling cross-traversing, revolving and hoisting motor, with a speed at capacity load respectively as follows: 350 ft., 150 ft., 250 ft., and 150 ft. per minute. On the outside wall are two revolving jib cranes each equipped with two motors, one for hoisting, the other for revolving, the respective speeds being 60 ft. and 150 ft. per minute.

The basement has the same arrangement of platforms and tracks, each platform having one crane identical with those of the first floor. There are in addition one car traverser for moving cars the length of the basement and two car elevators having a lift capacity of 20 tons and a lowering capacity of 30 tons. Revolving pillar cranes are also installed. A transporter capable of hoisting to the floor level and transporting the length of the building is provided on each side of the building for operation on the top floor.

Inside the top floor are six electric hoists operating through hatches from the floor below. There are also the usual number of capstans without which an equipment would be considered incomplete. The maximum lifting capacity of all apparatus except the car elevators is one ton, and the speed of operation of each varies considerably.

In an earlier installation where stationary revolving cranes of the hydraulic type were used the horse power per 1,000 sq. ft. of platform was 30.3 and the lifting capacity 1.4 tons for the same area. In the later installation just described but 6.13 h. p. for each 1,000 sq. ft. of area was needed and a lifting capacity of but 0.27 tons.

It will be noted that this installation is defective in two very important respects:

a. The horizontal or distributing movement is limited to straight lines and does not cover areas. Those units which have a horizontal movement are limited in action to the platform which they serve and also as to the amount of this platform over which they can travel by the position of the other pieces of apparatus. It is impossible for them to reach any portion of their own platform beyond the other unit.

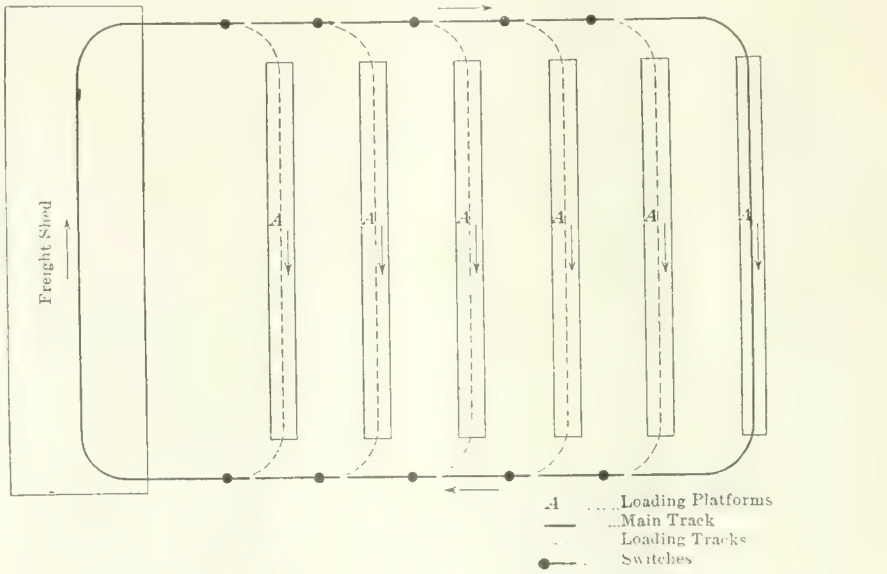

Fig. 1—Arrangement of Overhead Tracks at Outbound Freight Terminal.

b. All the freight to be handled must be brought to the freight house and all cars to be loaded or unloaded either to the platform inside or outside the freight house, and the range of operation of the freight-handling apparatus confined to the freight station itself.

Such an arrangement of machinery and station buildings has plainly very little effect in increasing the capacity of the terminal, but is principally advantageous in decreasing the costs of loading and unloading at the station platforms. It lacks the flexibility requisite to eliminate the hand truck and is evidently not in the least adapted to handle so-called transfer freight.

We are unable to suggest any installation so comprehensive in this country; in fact, we can point to no installation whatever. The United States is, I believe, recognized as the leader in the application of labor-saving machinery, but in this particular instance there is an entire absence of it, if we except a few isolated installations designed for some particular class of merchandise or type of package. This condition applies to all classes of freight, except such bulk freights as coal, grain or ore.

In general, the merchandise passing through a railway freight terminal is of three classes: inbound, outbound and transfer freight, the inbound and outbound being further divided into L. C. L. and team freight; the L. C. L.

freight passing through the freight sheds, the team freight, as its name implies, being handled in the yards from cars to teams or the reverse.

HANDLING INBOUND AND OUTBOUND FREIGHT.

The operations in handling outbound freight are about as follows (*a*) receiving goods from teams; (*b*) checking and receipting for same; (*c*) weighing and classifying; (*d*) sorting for the proper car; (*e*) trucking to the car; and (*f*) stowing in the car. The operation of handling inbound freight, except in the reversal of sequence, is essentially the same with the omission of the weighing, which is not ordinarily done, the weight of the shipping station being accepted.

In connection with these enumerated operations certain clerical and record work will be required and hand labor will continue to be a factor to some extent. But the introduction of freight-handling machinery will undoubtedly have an influence on these necessary manual operations, both as to cost and speed of handling.

As already indicated, one way, at least, of increasing the capacity of a railroad terminal is to move freight to and from the cars in greater unit loads and at greater speeds; at the same time changes will become possible in the terminal arrangement which will permit a still greater increase in capacity as well as further important economies.

A mechanical system for this work must be extremely flexible; it must have both vertical and horizontal movement in the required degree; receive and deliver its loads at any portion of any floor of the freight stations, and at any place in the yards to be served; occupy little, if any, space of value for other purposes; and should be simple in operation, not requiring skilled or high-priced labor for its control. The design of the equipment must be such that there must be no interference between machines, and it should be possible to add to the equipment from time to time as required without interfering with the working plant.

Consideration of the above requirements points to the suspended or overhead system operated by electric motors. The use of such transporting systems is now very common in industrial plants and a large number of manufacturing companies offer a variety of such appliances. These installations have been highly successful and the mechanical and electrical features of the transporting machines are satisfactorily worked out.

The requirements for service in a railway terminal are radically different, however, in many respects. The transporting units in operation will necessarily be far greater in number. Each unit must easily be able to reach and operate over every foot of trackage required to serve all parts of the terminal used for loading and unloading and must be able to do this without interference and without possibility of congestion. The very first effort to apply mechanical transportation of goods between cars and freight sheds or vice versa will prove that the present type of terminal is not suited for the purpose if the maximum results that can be attained are desired.

A conventional outbound station having a capacity of 100 cars is operated much as follows: The length of the shed will be such that a string of 20 cars can be accommodated at its side on one of the loading tracks of which there are five. One hundred cars will be placed on these tracks, five rows of 20 each, these cars having been "spotted" so that the doors of the cars abreast of each other will be opposite one another in order to provide a continuous runway for trucks through the five cars. The opposite side of the house provides the teaming platforms for the reception of loads. The merchandise as received is placed on hand trucks, wheeled to the proper runway and through to the designated car where it is unloaded and stowed away. While the application of transporting machinery is in this case perfectly feasible and larger loads can be carried with greater speed to the designated runway, it is still necessary to push these loads through the cars to the one for which the merchandise is intended. It would evidently be a distinct gain if the transporter could set its load down directly at the proper car door. To accomplish this the loading tracks must be relocated and at least arranged in pairs with island platforms between the pairs. It would be of advantage to move the first loading track far enough from the station platform to allow for teaming space, thus doubling the receiving platform facilities at the shed.

The same arrangement is equally applicable to the inbound freight traffic and we thus find ourselves confronted with a rearrangement in which no car is placed at the station platforms for direct loading and unloading. It at once suggests the doing away with the distinction between loading and unloading tracks; the tracks served from the outbound and inbound stations being filled with loaded cars in the morning which will be unloaded into the inbound house and loaded from the outbound house in the same day without the need of switching the empty cars from one house to the other; at the same time the "spotting" and the recoupling being eliminated. The possibility of accomplishing this hinges on the trackage arrangement that can be worked out. The types of transporting machines now in use employ two different kinds of tracks; one type of machine is supported and propelled by single flange wheels so arranged in pairs that the wheels of each pair track on the opposite sides of the web of an I-beam, straddling the beam, as it were, the other type is supported and propelled by wheels having a double flange and running on the top of an ordinary T-rail properly suspended. Each has its advantages as compared with the other, although the true test for selection in any particular case is the cost of installation and future operation.

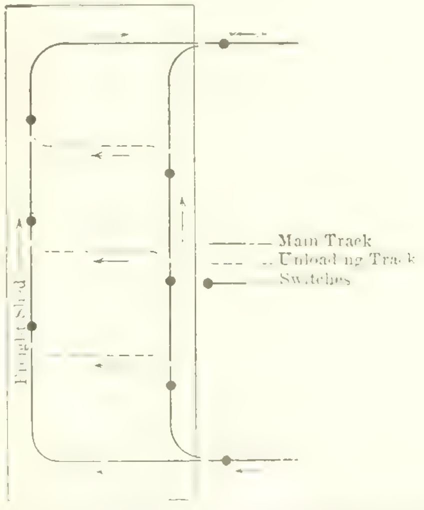

Fig. 2—Arrangement of Overhead Tracks in Inbound Freight Shed.

A number of lines of tracks with means of passing from one to the other will be required so that any individual transporter can reach every part of the area indicated. The I-beam type of track will therefore require an installation of permanent trackage erected over the entire space to be served and must include at the junction points of these various tracks some type of switch included in the track itself. These switches must be controlled by the operator of the transporting machine and should be provided with suitable indicating signals showing the position of the switch as the machine approaches.

The T-rail type of track with transporting machine hung from wheels running on top of the rail does not require the use of tongue switches included in the tracks. Each transporter carries with it the switching apparatus which consists, in the main, of an extra set of traveling and propelling wheels that are adapted to engage, when desired, a system of trackage at a different level than that of the main track. These different levels of tracks, which we will designate as loading and unloading tracks, can be moved to any desired location within certain limits as they can be entered from any point of the main track opposite which they happen to be located. The existing conditions at the particular terminal under consideration would of course determine which system of trackage would be the best suited to the individual cases.

ARRANGEMENT OF TRACKS AND TERMINAL

The following diagrams are submitted to illustrate only the general idea involved. They show in a general way the application to an inbound freight station provided with six unloading or island platforms, arranged to serve ten lines of cars. Figue 1 shows the arrangement of overhead tracks where the I-beam type of track is used, one track only being indicated through the freight house. The main track is indicated by the solid line and extends through the shed along one end of the platforms, over the platform farthest from the shed, along the other end of the platforms into the shed where it connects with the track through it and forms a closed loop. This main or loop track is normally continuous, the switches permitting a machine to enter or leave the tracks over the loading platforms being controlled by the operator of the machine.

In unloading the cars the merchandise is broken out and placed on trucks, flat-boards or any design of carrier that is best adapted to the purpose and placed on the platforms ready for moving to the house by any of the machines; the operators of these can see on what platforms loads are waiting as they move along the main track at the entering end of the platforms, and by operation of the switches pass them on to the platform track where loads are ready. They are then conveyed to the sheds, deposited at the proper place and the transporter is ready to return to the platforms for another load.

If the T-rail type of track is used no switches are required on the main or loop track; the platforms or unloading tracks are at a different level from the main track and are entered by placing the second set of wheels of the transporter in a position to engage the platform track and continue around it, at the same time lifting the main track wheel from engagement with the rail on which they are running. It is, therefore, obvious that unless it is required to unload cars at each platform at the same time, a plainly unnecessary requirement, permanent tracks over each platform are not necessary. It becomes possible in this system to suspend these platform tracks on a traveling crane parallel with the platform, operated either by hand or electric power, and to move it over the platform when it is desired to unload cars. Under some conditions of operation one such movable platform track would be all that would be required; under other conditions two would be ample to serve the six platforms; or it might be necessary to have tracks becoming permanent at each platform. The same method of switching the transporters to the platform tracks would still be used, thus eliminating track switches.

At an outbound station of the same car capacity the same arrangement as already illustrated would be in general adopted, differing, however, in this respect: in loading cars it is necessary to have free access to any of the cars set all of the time, and, therefore, loading tracks must be placed over all platforms. In other words, the essential distinction between the two equipments, is that the required distribution facilities are at a different terminal of the transporting line; in both instances it is at the receiving end of the line, but in the case of outbound freight it is the car end, and in the case of inbound freight it is the freight shed end.

In loading goods the distribution is arbitrarily determined by the setting and the designation of the cars to be loaded. The overhead trackage in the freight shed, therefore, can be such as shown in Fig. 1, as the transporter has only to pass through the shed, picking up whatever loads, properly assembled, are ready for movement to the designated car. The reverse operation would require a somewhat different arrangement of trackage in the inbound freight shed as the loads coming in require sorting and distribution to prepare them for delivery. Two main line tracks with cross tracks between them, as [illegible]; and location being determined by the local requirements and the methods worked out for handling the freight on the house floor.

The average distance traversed by the transporter, under the conditions shown in Fig. 1, is the maximum. The addition of another main track parallel to and between those indicated in Fig. 1, will reduce the average haul materially. Additions of loop tracks at certain points will accomplish the same result. The various possible combinations of tracks are too great to attempt even to outline. They vary as much as the present arrangements of terminals themselves. It must be borne in mind, however, that in mechanical transportation up to a certain point, increase in distance traveled has an immaterial effect on the cost or time consumed, and that the added expense required to reduce to the minimum the average haul would often be unwarranted.

Although we have referred to the inbound and outbound stations and the overhead trackage associated with them as separate units it is evident that while the freight sheds themselves can be and, under many conditions, should be separate, the trackage over the loading and unloading platforms can be used in common from either shed, and the loading and unloading platform be one and the same. Freight can first be moved from the cars to the inbound shed and then from the outbound house to the cars for loading; or the two operations can be carried on at the same time. This arrangement makes possible a material reduction in the original investment in overhead trackage and further in the actual number of transporting machines required, as these machines can be utilized for the service of either shed.

Freight comes to the outbound house but slowly in the early part of the day; the rush of delivery occurring in the latter portion of the afternoon. This leaves the larger part of the equipment available in the morning for inbound freight and with a sufficient number of transporting machines the entire work of unloading can be accomplished long before the rush period of loading begins.

Without taking up in detail the handling of transfer freight at the regular stations, the moving of goods from one car to another, it is plain that the adoption of such a system will effect the same economies in this class of service and in addition reduce the time of car detention at the transfer points.

TYPE AND OPERATION OF CARRIERS

In considering the transporting equipment it is evident that the control of each machine must lie in the hands of one man who travels with the machine. Automatic systems are not applicable to this work. The operator, in a cab or on a platform, suspended from the traveling motor, controls the starting and stopping of the train, operates the switching devices and depending on the detail adopted may or may not control the hoisting and lowering operations.

Because of the time involved in sorting and loading packages for transference, too large a load cannot be put on any one carrier and, therefore, a transporting machine should convey more than one load. For convenience we will consider that on each trip four loads will be carried, although it is entirely possible to draw a larger number. We will assume the transporting device consists of five units, the traversing machine from which is suspended the cab for the operator and four trailers, each equipped with an electric hoist. There are two methods of operation in such a device; the trailers may be considered a permanent part of the device and the control of the hoisting apparatus centered in the cab, or the trailers may be detachable at the will of the operator, magnetic couplers being provided, and the control of each hoist local to the trailer itself.

In the case of permanent trailers, the operator not only moves the loads to their proper destination but lowers and raises them as well; where detachable trailers are used the function of the operator is simply to move empty or loaded trailers. This requires a main or traveling track always clear for continuous movement, and shunt tracks for the trailers must be provided where the operator can leave them or from which he can pick them up. The raising or lowering of the loads is then controlled by the men who handle the freight at the car or on the shed floor. The balance of the equipment required consists of the carriers attached to the trailer hoists.

The kind of merchandise handled at any given terminal would determine the type of carrier best adapted. It may be a simple flatboard or a wheel truck and each can be provided with detachable or hinged sides if necessary. In the case of special packages, as bales of wool or cotton for an illustration, neither flatboard nor truck would be required.

In thus transporting merchandise the solution evidently does not lie in excessive loads or abnormal speeds, but rather in a moderate limit as to both. Os the load must be hoisted and the distances traveled are comparatively small, the time required to reach maximum speed must be short. Small loads on each hoist and a total load on the transporting motor small enough to admit of rapid acceleration and quick stopping are necessary. Let us assume that the average load on each hoist will be 500 lbs., and the average load on each machine one ton; the capacity of each motor being double that of this normal load to allow for variation in load. The average load of a hand truck will be less than 250 lbs., and the speed of movement will average about 125 ft. per minute. With an average load of 500 lbs. per carrier the total load carried will be 2,000 lbs.; at least eight times as much as the hand truck will move each trip. The hoisting speed can be practically anywhere from 60 to 120 ft. per minute, and the conveying speed anywhere up to 1,000 ft. per minute. That we may not overestimate in our calculation, allowing for curves, delays at switches, etc., we will limit the estimated speed to 250 ft. per minute, a speed of less than 3 miles per hour. This is, as will be admitted by everyone, an extremely conservative estimate, yet it makes it possible for one man with the transporter to accomplish the work of 16 men in the same period of time. It will be seen that the preceeding is a ridiculously conservative estimate; that loads can be increased and speed of conveying easily doubled. Considering only these conservative figures it is apparent that the costs of conveying can be reduced in a tremendous degree if one man can replace 16, and the freight-handling capacity of a given floor space can be doubled if the goods can be moved twice as fast from it or to it

OPERATIONS INVOLVED IN HANDLING MERCHANDISE.

The various operations involved in the receiving of merchandise either at the inbound or the outbound house and preparing it for delivery to the consignee or to the car we can consider only in the most superficial way. Freight delivered to the outbound house arrives in packages of varying weights and sizes, any anything from a full load of one kind of goods consigned to a single destination to a load in which there are as many classifications and destinations as there are packages.

In many cases it is possible to have the packages piled on flatboards, to be instantly removed from the teams by the transporting machines. This would mean a great reduction in the time a team would have to stand at the platform, a direct saving in trucking expense to the shipper, a relief to the team congestion at platforms and an increase of the platform receiving capacity.

Where deliveries for one destination are sufficient in amount to constitute an average trailer load all manual handling can be entirely eliminated as the transporting machine can remove the goods direct from the team, run the load over a scale included in the overhead track and then move it to the proper car for loading. Where a delivery is a load of various packages for different destinations, the packages must of course be sorted and handled separately. Machinery can unload these from the team as well, but must then leave them for weighing, sorting, etc.

It seems probable that it would be advantageous to have a freight house so arranged that a certain portion of it is assigned for the handling of each of these classes of freight deliveries. While there is a multitude of variations in types of loads between the two extreme types mentioned, it would not be difficult to determine into what division of the freight shed the load should go, the distinction between loads being the amount of classification and sorting required. A practical freight house arrangement would be to have two floors, the ground floor for the loads requiring the least, the upper floor for the loads requiring the most handling. In this way the drivers of teams can go to the platforms at any vacant space, the railroad employes classifying the load and the goods taken to the proper floor. It is probable that the floor for handling the miscellaneous freight could be provided with special machinery for sorting according to destination. Some of the appliances could probably be of an automatic type and hand trucking practically eliminated.

A similar method of handling inbound freight could be adopted and its operation facilitated, since in unloading cars a more intelligent arrangement of loads for the different station floors could be made than could be expected in the case of team delivery.

Thus far we have been considering only L. C. L. freight. It is by far the most expensive to handle and comprises about 40 per cent of the total freight handled. It is, however, the freight for which additional terminal capacity is badly needed.

The balance of the freight with which we are concerned is the team-track freight, goods which are handled in car-load lots and delivered to or removed from the car floors direct by teams. The cost to the railroad in loading or unloading this class of freight is comparatively small, about five cents per ton. In spite of this low cost the application of machinery to handle this merchandise would prove of value. Some of this freight is of great bulk and weight and much time and labor is required to load and unload it. Special overhead tracks, capable of carrying heavy loads, can be used for this service and transporting machines and hoists of large capacity provided. Any device that will hasten the work at the team tracks will not only reduce the cost but the car detention as well. This car detention is an important matter as shown by the daily earning capacity ($3 per day) a car is quoted as having.

REDUCTIONS IN HANDLING COSTS.

A fair estimate of the average load of a car is 45,000 lbs., 22½ tons. The cost of handling this freight on the team tracks is now five cents per ton, $1.12½ per car. If inbound L. C. L. freight can be unloaded for ten cents per ton, and we believe it can, it would cost the railroad only $1.12½ more per car to handle much of the present team freight through the freight sheds as in the case of L. C. L. freight. This car could then be unloaded and reloaded in a day, a saving at least of one day, as two days are usually allowed for unloading before demurrage is charged, a direct saving to the railroad company of $1.87½ on each car so handled, and a storage charge can be substituted for the demurrage charge. A saving might even be effected on outbound team freight by treating it as house freight for in so handling what possible of the in and outbound team freight much switching, coupling, and uncoupling might be avoided.

The general lines of development toward accomplishing the above results have been pointed out and some of the leading reasons for working along these lines have been indicated. Further than this it is impossible to go in this paper. Each terminal presents a different problem for solution, as any proposed application of machinery must take into consideration in a greater or less degree practically every operation now carried on at the terminal under study.

GENERAL ARTICLES AND CLASSIFIED ITEMS

An Efficient Method of Erecting Structural Steel for the Heisen Building, Chicago.

A particularly economical and rapid method of erecting the steel work for a large building is being employed in constructing the Heisen Building now under construction at Harrison and Dearborn streets in Chicago. The steel work for the building is being set at the rate of two floors a week. The tonnage is of course greater in the lower floors than in the upper floors but the number of pieces is the same. The building is rectangular, 300 ft. long and 60 ft. wide. Its panels measure 15 ft. in both directions. The regularity of the dimensions, and the fact that each floor is a duplicate of the others, makes for rapid work. Although the building is in the business district, the work is facilitated by its location between two streets which parallel the sides of the building, and a third street upon which the end of the building abuts.

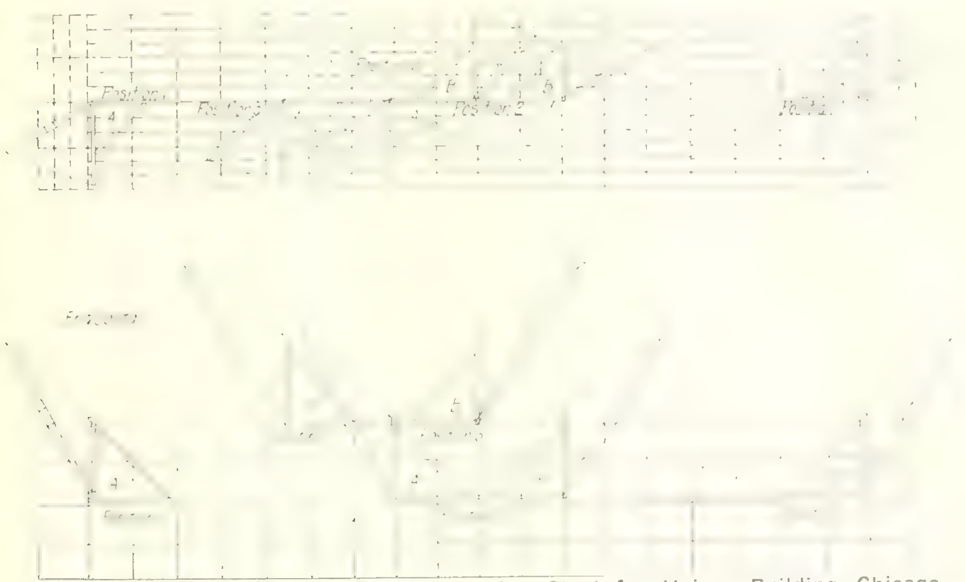

Fig. 1—Diagram Showing Method of Erecting Steel for Heisen Building, Chicago.

(Position 1 Show Derrick Beginning Work of Erecting Two Floors, [illegible] Ready to Lift Each Other [illegible])

The method of erecting the steel consists in the use of two traveling steel derricks equipped with 60 ft. booms, and 50 h. p. motors.

These, located on one level, erect two stories of the steel work above them. The work is begun with the derricks at the ends of the building and is carried toward the center. When seven panels are completed from each end toward the center the derricks have then traveled backward until they abut one another. One derrick is then dismantled, in three pieces, and lifted by the other derrick to a new position two stories higher. It is then assembled and in turn lifts the other derrick to its new position two stories up. The derricks are dismantled in three pieces, the 60 ft. boom, the motor and drums, and the steel frame. The motor and drums make the heaviest lift, which is about 5 tons. Each derrick, however, is rated at 6 tons capacity when using a "flat" boom and 12 tons when using the boom at an angle of about 65° from the horizontal.

Referring to the accompanying sketch; position 1 shows the derricks ready to begin work of erecting two floors, position 2 shows the derricks ready for being lifted to the next level, and position 3 shows their location after each has been raised. After raising, each derrick has to erect steel in that area which was occupied by it when dismantled for being raised. This work requires one extra man to transfer the signals. When all the steel is erected up to the new level occupied, the derricks proceed to the ends of the building and repeat the above described process. The two derrick gangs accomplish the work of dismantling, raising and assembling both derricks in six hours. The derricks travel on I-beams which are placed temporarily as a track for the steel rollers. One double I-beam is placed on the tops of the center row of columns which is about 3 ft. above the floor. The other end of the derrick is bolstered up on its rollers so as to level the derrick frame. Each derrick hoists its own steel from the wagons in the street. Six wagons are employed to bring the steel from the yards of the B. & O. R. R., where it is loaded from the cars onto the wagons with a traveling electric girder crane.

The gang at each derrick consists of 6 men. There are 5 gangs of riveters with 4 men in each gang. About 400 rivets are driven per gang per day. The riveters were started after the steel had been set for the first 6 stories and are expected to complete the 22 stories within a very short time after the last steel has been set. The total number of men employed is 51.

The lower two floors contain about 1,100 tons of steel and the upper floors run about 450 tons each. The entire work contains 6,000 tons. Riveting is done with Chicago Pneumatic Tool Company's hammers, and a Franklin air compressor rated at 105 cu. ft. free air per minute, furnishes air for the 5 gangs at 100 lbs pressure. It is estimated that the cost will run under $6.00 per ton. The work is being done by the Modern Structural Steel Co., of Waukesha, Wis. Mr. D. M. Carr is superintendent on the work.

Puddle Walls for Earthen Dams With a Short Discussion of Other Cores.

In 190[illegible], [illegible] three very prominent members of the American Society of Civil Engineers, Messrs. Croes, Smith & Sweet, were called in to report on the safety [illegible] New Croton Dam. The extension was to be of earth [illegible] 180 ft. in height. Under their direction, borings were made in several earthen dams with concrete and masonry core walls at right angles to the axis, and at such intervals as to show that in almost every case there was a continuous water plane extending from the water surface of the reservoir to the core wall, and on the down stream side to the lower toe having a maximum inclination of 20 per cent, thus showing that the cores were not water tight and not effective in preventing water from passing through the dam, as the dams were saturated below this plane. While this seepage may be low and have no power to remove any particles of the dam, nevertheless, it is a source of danger and the recommendation of the Board to substitute a masonry dam was immediately adopted.

Commenting on this finding, Mr. Sherman Gould, M. Am. S. C. E., in the *Engineering News*, Feb. 9, 1902, says:

> It is to be feared that in many cases the masonry center walls of earth dams are built too light. They should be more than mere diaphragms; they should be walls in fact as well as in name. My own rule is to give the center wall a bottom thickness equal to one-quarter of the greatest depth of water in the reservoir, and to draw in by offsets 2 ft. in every 10 ft. in height. I would never voluntarily reduce this thickness, although I might increase it, except [illegible]

Mr. R. E. Middleton, M. Inst. C. E., London, in the same Journal says, March 29, 1902:

> Where masonry alone is used, should there be any movement in the bank, the wall will be fractured, serious leakage may take place and the dam be so much weakened thereby that its unforeseen destruction may result, and it is exceedingly difficult to make a thin, or even thick, masonry wall perfectly water-tight.

An earth dam built at Lynn, Mass., in 1903, with a concrete core-wall, has been found to leak from about 239,000 to about 448,000 gals. per day, depending on the water-level of the basin. As described in *Engineering Record* of March 7, 1908, the dam is 2,200 ft. long, 45 ft. high, 52 ft. wide at the crest, and has a core-wall of concrete 4 ft. 8 ins. thick at the top, 9 ft. 6 ins. thick at the bottom. The core-wall contains 22,000 cu. yds. of concrete. It extends to a depth of 25 ft. below the base of the dam. The front face of the wall was plastered with 1:1 mortar. The core-wall was built between two rows of 6-in. sheet piling, driven by steam hammer in the bottom of the trench to a depth of 26 ft., or about 18 ft. below the bottom of the concrete wall, where the piles brought up against hard material. The earth in the dam "was deposited in layers and puddled or rolled where necessary." The slopes of the dam are 1¾ on 1 each side. The fact that a dam with a core-wall of the thickness described, and plastered as it was, should leak is significant of the untrustworthiness of concrete or masonry core-walls in general.

The other strictly American types of diaphragm walls are: Wood, which soon rots; steel plates, of which there are but two examples, Chollas Height and Lower Otay Dams, both in California. The latter dam is of loose rock, and as the reservoir has never been filled since its completion, there are but very few data to go by.

Up to the present time British engineers have adhered strongly to the clay puddle core-walls and are not to be convinced that the supporting of a rigid masonry wall with a plastic material like earth, is a good engineering practice. In this, they are supported by many American engineers. The way in which masonry or concrete core-walls are regarded by English engineers is partly expressed by the language used by the late James Mansergh, F. R. S., when President Institution of Civil

Engineers, in an address to the Society, in which he said:

> I am not sure that such a core may not be made from end to end of an earth dam, if very special precautions are taken by well rolling the bank to insure that unequal settlement or surging does not take place. I have never yet ventured to try it, but if I do not get nervous as I grow older, I may some day.

Indian engineers, however, do not use puddle walls, owing to the scarcity of good puddling clay and the presence of soluble salts. They prefer to make the dam a homogeneous whole with a masonry or concrete core to prevent burrowing by animals. As all dirt is deposited by hand, and Indian labor is cheap, they can do this at small cost. With them the masonry wall is growing in favor, but only as a protection against vermin.

In England it is the universal practice to have the puddle wall along the center line of the dam and vertically over the puddle trench, so as to form with it a water-tight septum, (extending throughout the dam from below bed-rock level to above the high-flood level), which is designed completely to intercept any infiltration which may have penetrated so far. The following are the sections which have been adopted for the puddle wall for certain works: (1) Dale Dyke dam, top width, 4 ft.; batters, 1 in 16, giving a base width of 16 ft. where the dam is 96 ft. high; this section is very light; (2) Vehar dam, Bombay waterworks (in this particular not a typical Indian dam), top width, 10 ft.; batters 1 in 8; (3) The Bann and Harelaw dams, top width, 8 ft.

Rankine states that the thickness of the base of a puddle wall should be about ⅓ of its height, and that the thickness of the top should be ⅔, or ½ that of the base.

The objects of placing the puddle wall in the center of the dam are: (1) To make it in vertical continuation of the puddle trench; (2) To diminish its amount to the minimum; (3) To protect it from the action of the reservoir and the weather and from damage by vermin.

The disadvantages of this position are: (1) It may be distorted or broken by unequal settlement of the embankment on each side of it, and during its own settlement, which will be considerable in amount; (2) It is buried out of sight, and cannot be repaired for any considerable depth; (3) The embankment upstream of it may be saturated to an undesirable extent.

If this latter condition occurred, and fortunately it hasn't yet, we would have the puddle core as a facing supported by two-thirds of the dam, a supposition sufficiently alarming, and which led to the advocacy of slope puddle walls, in which the puddle wall has been placed on the up-stream slope of the dam, so as to form a water-proof covering to it. The advantages claimed for the puddle wall in this position are that: (1) It will settle regularly with the up-stream slope; (2) Being on the surface, it can be repaired at any time when necessary; (3) It renders the whole mass of the dam as dry, and thus as stable, as possible:

The objections raised to it are that: (a) It has no direct connection with the puddle trench, and thus seeped water is not intercepted at it and may enter and soak the dam; (b) It involves the construction of a greatly increased amount of puddle work compared with that in a central wall; (c) It is liable to be washed by waves in the reservoir, to become cracked when exposed to the sun, and to be penetrated by vermin; (d) It may not be able to stand at the ordinary slope of the dam.

In some works the puddle wall has been placed between the up-stream slope and the center line of the dam. In such a position its advantages and disadvantages are between those of the ones described above. The general opinion of English engineers is much in favor of the central position for the puddle wall, but Indian and American engineers, when they adopt a puddle wall, seem to prefer placing it on the extended slope, in order to secure greater water-tightness of the dam as a whole.

Clay is usually preferable in a core as the outlying masses help to squeeze out its surplus water. In this condition clay, no matter what its original character, whether it be a "fat" clay, subject to excessive shrinkage, or a clay which readily slacks when exposed to the weather, will mature and ripen to a condition where it will neither absorb water nor permit of percolation through it. Surface clays and soils which are thoroughly weathered are preferable to deep-seated clays in beds of such depth as to have undergone few of the changes produced by the action of the elements. Mr. Schuyler, however, says that fine sand, glacial flour, rock dust, or any finely pulverized non-plastic material is really preferable to clay as core material for a hydraulic fill dam, for the reason that when settled in water it is not subject to shrinkage or further settlement, and is practically impervious to water if the particles are fine enough to pass a 100-mesh sieve. A combination or admixture of clay and fine sand is still better and less subject to shrinkage than pure clay.

It is not necessary, however, to have one of the above soils for a core, as in recent experiments with the black alkali (carbonate of soda) soils of California, Professor E. W. Hilgard found that the addition of 1/10 per cent of carbonate of soda will make clay impervious and convert sandy and light loamy soils into a tough hardpan, impenetrable by water, so that by a little care, with this addition to the water in which the puddle is mixed, almost any material is available for puddling.

Table I shows the dimensions of some of the principal earthen dams with puddle cores entirely through the dam. As the height given for the puddle walls includes the depth of the puddle trench, the latter can be easily found by deducting the height of the dam. The puddle walls are designed on the formula of Rankine, quoted above:

TABLE I—DIMENSIONS OF NOTABLE DAMS WITH PUDDLE CORES.

Name of Dam.	Height of dam. ft.	Height of puddle wall. ft.	Side Slopes Water.	Side Slopes Lower.	Top width. ft.
Dodder, Ireland	115	115	1 on 3	1 on 3½	22
Stubden, Ireland	63	75	1 on 3	1 on 2	12
Lough Island	..	..	1 on 2½		..
Peavy, Ireland	40	40	1 on 3	1 on 2	12
Yarrow, England	87	173	1 on 3	1 on 2	30
Rotten Park, England	50	55	1 on 3	1 on 2	20
Ulley Brook, England	42	54	1 on 3	1 on 2	25
			....	1 on 2	..
Vale House, England	47	98	1 on 3	1 on 3	18
Llanefydd, Wales	32	154	1 on 3	1 on 2	10
Vehar, India	84	84	1 on 3	1 on 2½	24
			1 on 2	....	..
Pilarcities, Cal	95	135	1 on 3	1 on 2	24
San Andres, Cal	93	139	1 on 3½	1 on 3	24
Temescal, Cal	95	95	1 on 4½	....	12
San Leandro, Cal	125	175	1 on 3	1 on 2½	28
Cuyamaca, Cal	40	75	1 on 2	1 on 1½	15
Mormon Canyon, Cal	45	75	1 on 1½	1 on 1½	6

The puddle core built in the north and south dikes of the Wachusett dam, consisted of 6-in. layers of fine loam soil, well sprinkled and rolled. Recent experiments to determine the permeability of this type of earth or loam core in an earth dam have been made by means of a series of pipes driven into the embankments of the Wachusett dikes. The results as reported indicate that while the plane of saturation on the reservoir side of the loam core was level with the water in the reservoir, it dropped immediately below this core to a level slightly above the base of the dam. Weekly measurements proved that the amount of water draining out of the dike was not in excess of what might be expected, as the natural drainage from precipitation on the area of the dike itself. No masonry or concrete core-wall ever built in an earth dam can show better results than these, and few can compare with them in the absence of percolation from the reservoir. The dike type of dam is undoubtedly a reliable type, when properly made with suitable materials especially where the core can be sluiced out of the available material and deposited under water.

The Mormon Canon dam, California, is an earth embankment, 75 ft. high from its bedrock foundation 30 ft. below the natural surface, to the top. Its length is 270 ft. on top. Thickness at base, 136 ft., at top, 6 ft. The slopes are 1½ to 1 on each side. A trench was cut 22 ft. wide, from the surface to bedrock, all the way across the canon, and filled with good puddling clay, which had to be hauled 3 miles, at a cost of $1 per cu. yd. delivered on the dam. This was well rammed into place, and a puddle wall of it carried up from the surface of the ground to the top of the dam, its thickness gradually diminishing to 2 ft. on top. The puddle wall contains 3,000 cu. yds., and the backing of earth on either side contains 12,500 cu. yds. The cost of the dam was $10,000. The puddle wall and excavation cost $4,000.

The following description of the Ashti dam, taken from Mr. H. M. Wilson's Irrigation in India, is typical of most tank dams in that country:

> The site of the dam was cleared of vegetation and top soil, so that the entire structure rests upon a firm and sound foundation. There is no puddle-wall proper, but a puddle-trench, 10 ft. wide, was excavated down to a compact, impervious bed, the entire length of the dam, and was filled to one foot above the natural ground surface. This filling was composed of two parts sand and three parts black soil. The central third of the dam is built up of selected material of black soil, extending in a triangular section, 60 ft. wide at the base, to the crest of the dam. Outside of this central section are two triangular sections of brown soil, faced with 1 to 15 ft. of puddle of sand and black soil. On the inside a stone paving 6 ins. thick is laid over the slope to resist wave-action. Across the river-bed a trench 5 ft. wide was excavated along the entire length of the dam and extending 100 ft. into the banks. On each side, this trench was filled with concrete and connected with the puddle trench. The puddle trench was curved around the concrete wall and continued across the river at a distance of 20 ft. from the concrete wall on the up-stream side. This work having been finished in dry weather, the sand of the river-bed was sluiced out of the way by confining the stream and directing it into narrow channels by loose rock spur-walls and piers.

The site of the Cuyamaca dam, California, was one which had all the surface indications of solid rock. The whole surface was covered with loose granite boulders, and before sinking test pits, preparations and plans had been made for making a masonry dam. The excavation for foundation developed a bed of clay instead of bed-rock as anticipated, and an abundance of good clay being found in the immediate neighborhood, the plans were changed and an earthwork dam was built.

A puddle trench was cut under the center of the embankment, and the clay filling built up in layers. The embankment has a base of 115 ft., inside slope of 2 to 1, outside slope of 1½ to 1, top width 15 ft. The high-water mark is fixed at 5 ft. below the top, at which point a waste-way 50 ft. wide is placed at one side. The water-face of the dam is covered with stone riprap laid, dry, 8 ins. in thickness.

The Monument Creek dam is situated 15 miles north of Colorado Springs, at an elevation of 7,000 ft. above sea level. It is 855 ft. long, 40 ft. high and 20 ft. wide on top, and is sloped on the water side 1 on 3, on the outer slope 1 on 2. The water line is 7 ft. below the crest of the dam. The inner face of the dam is covered with a clay puddle-wall laid on the slope, with a horizontal thickness of 50 ft. at the base and 10 ft. at top.

This puddle is carried down to bed-rock in a trench 14 ft. deep, at the inner toe of the dam, the minimum width of the trench being 5 ft. Over the puddle-wall is laid a riprap wall of stone, placed with care by hand. The outer half of the dam is composed of coarse gravel, rock and earth. These general principles must be regarded as unexceptionable in earth-dam construction.

From the foregoing it will be easily seen that the puddle-wall is by far the cheapest and most effective core, and with the use of carbonate of soda, good puddling dirt is available almost everywhere. Where the puddle is placed on the slope, if it is well sprinkled with saltpetre before rolling it will not crack or wash off with the waves or heavy rains. This is an old custom among the French peasantry. A rough raft of heavy timbers, 6, 8 or 10 ft. wide, loosely moored along the face of the dam, has been found a most effective protection against wave action.

Mr. Clemens Herschel, M. Am. S. C. E., says that "pure gravel, just as it comes from the gravel pit will make a watertight stop when used between planks, or in any other position for which puddle is used, as far as my experience goes, better than clay or a clay mixture ever did." He describes gravel as "a natural mixture of earth and pebbles, of various attributes and consistencies, some of which are good for building dams and some not. The best for that purpose is gravel that will puddle, or 'binding gravel.' To tell whether any given gravel would puddle and to judge of its fitness for use in a dam, it should be mixed with water in a pail to the consistency of moist earth, about to be used in a dam or before rolling. If on turning the pail upside down the gravel remained in the pail it was fit for use, but if it dropped out it should be discarded."

The usual Indian test for puddle dams is to dig a hole 2 ft. square, through the week's work, then fill the hole with water and note the time it takes to disappear. Good puddle clay four days after depositing should cut like a cheese and show no air spaces. For protection from burrowing animals, a 6-in. layer of broken stones on the lower slope has been found sufficient in English and Indian dams.

The following are the usual specifications of British engineers governing the construction of the puddle trench and core in an earthen dam:

POSITION AND EXTENT.—The puddle trench shall be excavated continuously along the centre line of the dam and shall extend from the high-flood margin on one bank to that on the other bank.

DEPTH.—The trench shall be excavated until sound rock, or impervious soil, is met with, and shall be carried into it for a minimum depth of 1 foot. It shall not be filled until it has been passed by the Engineer himself, who shall carefully consider, by taking into account the nature of the subsoils passed through and the full supply pressure head of the reservoir, whether the depth is sufficient to ensure the staunchness of the work. (As a general guide it may be stated that, where sound rock is not met with but compact subsoils exist, the depth of the trench shall not be less than half the full-supply pressure head of the reservoir at the point considered, and, where the subsoils are less compact, the depth shall not be less than that pressure head. In both these cases the bottom of the puddle trench shall be carried for at least one-tenth of that pressure head into sound, retentive clayey material.)

The puddle trench shall not be continued below the foundation of the outlet culvert, but where that is crossed at a lower level, shall be replaced by a concrete trench well keyed into the puddle at its flanks.

The puddle trench shall be replaced by a concrete trench when the pressure head is great and the sub-strata are of fissured, hard material, as the Engineer by written order may direct. The concrete shall be laid and consolidated as specified.

SIDE-SLOPES.—The ratio of the side-slopes shall be determined by the Engineer from a consideration of the nature of the soils through which the trench passes, but in no case shall it be less than 1 in 8 in rock, nor less than 1 in 4 in soils, nor greater than is necessary to ensure stability of the sides of the trench until it is filled in. The side-slopes shall be steepest at the base and flattest at the ground level, and nowhere shall they be taken out vertically. Shoring shall not be reverted to if it can be possibly avoided, but, where it is necessary, it shall be made in short lengths with slopes battering not less than 1 in 8, and the trench shall be rapidly filled in.

BOTTOM-WIDTH.—The bottom-width of the trench shall not be less than one-eighth of the full-supply pressure head plus 3 feet, nor less than 6 feet. It shall be taken out level in cross section, except where a key trench shall be ordered and shall not have any vertical steps in longitudinal section, all changes of level being effected by gentle slopes.

KEY TRENCH.—If there is fissured rock at the bed of the puddle trench, a key trench, not less than 3 feet wide, shall be excavated along the entire line of the dam, and shall extend, both vertically and horizontally, into sound rock. It shall be filled with fine, rich concrete in well-rammed 4-in. layers constructed at once, one on top of the other, until the whole key is completed, and on this filling a concrete wall shall be carried up at least 2 feet above the bed of the main trench, and shall be finished off with battering sides and a smooth, rounded top.

RIVER CROSSING CONCRETE WALL.—At the river crossing the puddle trench shall be replaced by a concrete wall whose foundations shall be carried at least 2 feet into perfectly sound unfissured rock, and whose superstructure shall be raised to a height not less than one-eighth of the full-supply pressure head. The side-slopes of the superstructure shall be faced with masonry, and shall batter not less than one-eighth; its top-width shall not be less than 6 feet, and shall be finished off with a longitudinal key recess to secure proper union with the embankment. The concrete wall shall be continued well into the natural banks of the river, and shall be well keyed into the puddle trench, which shall be thickened out to overlap it on both sides for a distance not less than one-quarter of the full-supply pressure head. The concrete wall shall be constructed with smooth sides, plastered with mortar or luted with clay, and small vertical pilasters and recesses shall be formed on its sides so as to make it key thoroughly with the earthwork of the dam. On the down-stream side of this wall shall be constructed a drain leading to the rear drain.

MINOR DRAINAGE CROSSINGS.—At these the puddle trench shall be deepened and widened, or shall have a key trench constructed at its base, or shall be replaced by a concrete wall, as the Engineer shall direct in writing after taking into consideration the depth of the full-supply pressure head and the nature of the subsoils.

SPRINGS IN THE TRENCH.—All large springs in the trench shall be led into pipes to its down-stream side, and shall be carried up with the trench filling. When the trench filling has reached a sufficient height, the pipes shall be carefully plugged with fine cement concrete. Small quantities of water shall be carefully drained off so as not to affect the filling of the trench in any way.

MATERIAL FOR FILLING.—The material to be employed for filling shall be the most retentive clay procurable within one-half a mile of the site; it shall be quite free from vegetable or slushy matter and earth impregnated with salt, and shall not be liable to deterioration by the infiltration of water. It shall not be mixed with gritty soils or with sand

METHOD OF FILLING.—Just before filling is commenced the sides and bottom of the trench shall be slightly roughened, so that the new material may unite perfectly with the natural soil. Where the bed of the trench is not rock or other hard material, it shall be swept and washed free from dust, etc. The bed having been thus prepared, shall be wetted and the first layer of the filling material, which shall have been made into stiff plastic balls, shall be thrown on to the bed and trodden so as to secure a perfect junction with it. The rest of the filling shall be constructed in layers not exceeding 3 ins. in thickness and these shall be smoothened and then thoroughly consolidated by ramming or by rolling with heavy rollers, and, after their completion, they shall be wetted slightly to receive and unite with the next layer. The material of the filling shall be only slightly damp, and all clods in it shall be broken up. The surface of the layers shall rise downstream at an inclination of about 1 in 6. At vertical and horizontal intervals and breaking joint with each other shall be excavated wedge-shaped trenches, 3 feet wide at top and 1 foot deep, and these shall be refilled with the clayey material and thoroughly rammed before the upper layers are constructed.

Where sand pockets occur at the up-stream side of the trench, they shall be excavated out just before the filling reaches them, and the filling shall be thoroughly worked into the cavities thus formed. If much sand is met with, the trench shall be widened on the up-stream side to such an extent as the Engineer may direct.

The filling shall be continued until the trench is completely filled, and for 2 feet above the ground surface, this upper part being constructed together with the embankment on each side, and thereafter the embankment shall be carried uniformly over it.

If the construction of the embankment is not at once to be undertaken, the puddle shall be covered with 2 feet of soil to prevent it from cracking—for the same reason the layers of the puddle trench filling shall be constructed, one on top of the other, as rapidly as possible.

PUDDLE TRENCH DRAIN.—When such a drain has been designed, it shall be carefully constructed of the specified dimensions in a trench excavated in the main bed of the puddle trench and founded throughout on an unyielding foundation, and shall have a continuous longitudinal slope to its outfall, which shall be continued across all depressions in the puddle trench. The walls and covering slabs shall be constructed of as long stones as possible, laid in mortar, with half inch dry joints at intervals of 5 feet intermediate with each other at the bed and sides. The whole shall be surrounded with dry material (in accordance with a detailed drawing) and this shall be carefully covered with the material of the trench filling for a depth not exceeding 3 feet. After the whole drain has been completed, it shall be tested with water to see that it is perfectly free from obstructions, and, when this has been proved to be the case, the filling of the main trench shall be resumed and completed. Should the flow be obstructed, the defective part shall be cut out and properly remade.

Wherever the nature of the ground permits, the drain shall be led out of the dam and allowed to discharge into the natural drainage channels, and shall in this case be constructed in sections independent of each other, and each starting at least 5 feet down-stream of the end of the upper section.

Record for Ladder Dredges.—The Marmot of the Pacific Division, Panama Canal, dredging fleet broke all records for the daily, weekly and monthly output of ladder dredges in the Canal service during December. The output for the month was 219,795 cu. yds.; for the best week of 6 working days, 47,693 cu. yds., and for the best day—Dec. 14—8,569 cu. yds. The output for the best 10-day period during the month was 77,838 cu. yds., or an average of 7,783.8 cu. yds. a day; for a 25-day period, 183,163 cu. yds. The average per working day over the whole month was 7,326 cu. yds. The above figures are based upon place measurement. The dredge was working the entire month in the approach channel to the site of the new docks at the Pacific entrance to the Canal, excavating earth to a depth of 31 ft. below low tide. The crew set deliberately to work on Dec. 1 to exceed all previous records, and by request of the men themselves, the dredge was kept at work every day in the month, excepting Christmas day. All the dredges work night and day. The best previous record for old French ladder dredges was made by the Atlantic Division dredge, No. 5, in July, 1909, which excavated 176,082 cu. yds.

Important Projects of River and Harbor Improvement Provided for in the Federal Law of 1910.*

It is believed that the present interests in matters relating to the improvement of the waterways of the country is such that some interest may be taken in the following notes, prepared mainly from official reports of officers of the Corps of Engineers.

The River and Harbor Act which was signed by President Taft on June 25, 1910 contained appropriations aggregating $41,329,113.50 and authorized an additional sum of $10,618,600 to be placed under contracts. Of the funds appropriated or authorized, $25,593,155 will be used in prosecuting projects which had been previously commenced, $2,454,110 will be expended for maintenance of 138 works already completed, while the balance of $23,900,448.50 will be expended in work upon 175 new projects. In addition to the 453 new and old projects for which provision is made in this act, there are many other works now under way for which the funds previously provided are sufficient to cover the work which can be done during the next year.

One feature which distinguishes this act from others which have preceded it, is the adoption of a policy which indicates the intention of Congress to provide funds at rates sufficient to insure the completion of the most important projects within a definite and reasonable number of years. For example, the act adopts a new project for the Ohio River "with a view to the completion of such improvement within twelve years;" for the Upper Mississippi River "with a view of completing said improvement within a period of twelve years;" for the Mississippi River, below the mouth of the Missouri, and above the mouth of the Ohio, "with a view to completion within twelve years;" for the Mississippi River below the Ohio River "with a view to completion within twenty years;" for a deeper channel to Mobile "with a view to completion within four years," etc. Such a provision is of service to the engineers charged with the execution of the work, since it authorizes such a disposition of the funds appropriated as will lead to the maximum economy, assuming that Congress has practically pledged itself to provide funds at the rates necessary to insure completion of the projects within the periods stated. In the past, the funds have not generally been provided at rates necessary for economical prosecution of the works.

The interest of the Federal Government in the improvement of waterways arises from "the commerce clause" of the Constitution, and until recently no ground was advanced for improvement by the Federal Government except the necessities of commerce. All plans of improvement have been thus limited. The act of March 3, 1909, however, prescribed:

> That every report submitted to Congress in pursuance of this section in addition to full information regarding the present and prospective commercial importance of the project covered by the report, and the benefit to commerce likely to result from any proposed plan of improvement, shall contain also such data as it may be practicable to secure regarding (first) the establishment of terminal and transfer facilities, (second) the development and utilization of water power for industrial and commercial purposes, and (third) such other subjects as may be properly connected with such project: Provided further, That in the investigation and study of these questions consideration shall be given only to their bearing upon the improvement of navigation and to the possibility and desirability of their being co-ordinated in a logical and proper manner with improvements for navigation to lessen the cost of such improvements and to compensate the Government for expenditures made in the interest of navigation.

In compliance with this law, the related subjects mentioned in the act are now given very careful consideration in connection with all proposed improvements. For example, in the case of canalization schemes consideration is given to the possibility of an ultimate saving by the construction of high dams and the development and sale of water power, etc.

An instance of this is found in the revised project adopted by the 1910 act, for the Mississippi River between Minneapolis and St. Paul. That portion of the river has been under improvement under a project, adopted many years ago, involving two locks and dams with lifts of 13 ft. each, to provide a 6-foot navigable depth. Under the authority granted by the act of 1909, a careful study was made of the possibility of reducing the ultimate cost to the United States, and at the same time conserving the water power. This resulted in a recommendation to Congress that the lift of the lower dam be increased to 30 ft., thus making possible a water-power development of about 15 000 hp. The original project was ample in all respects for present or reasonably prospective navigation, and to complete the canalization by means of the high dam will cost $230,000 more than by completing the lower dam with a lift of 13 ft.

However, the newly adopted project will provide a depth of at least 9 ft., instead of 6 ft., from the site of the lower dam (near Minnehaha Falls) to Minneapolis, thus affording increased facilities for navigation. The additional cost of the project will be recovered in a short time from the sale of the power which will be created by the high dam. The water power will be conserved and there will be a perpetual surplus revenue for the Government. In this connection, it might be remarked that the interest of the Federal Government in the waterways of the country extends only to their control in the interest of navigation. The Federal Government has no possessory interest in the water power created by dams constructed by interests other than the Federal Government itself. Under our present form of Government the control of the water power pertains to the individual States; however, when the power is created as a result of expenditures made by the United States the case is different; the Government owns the power thus created and can use it or dispose of it the same way as any individual owner.

New York Harbor.—One of the costly projects adopted by the present act is that which initiates the work of construction of a deep-water harbor in Jamaica Bay, Long Island, the entrance being through Rockaway Inlet. The work is to be undertaken by the United States in co-operation with the city of New York. It has been stated that in ten years the available sites for wharfage around Manhattan and upper New York Bay will be exhausted. The new harbor will provide for a very great extension of wharfage. The project adopted provides for the excavation of an entrance channel 18 ft. deep and 500 ft. wide through Rockaway Inlet, its enlargement when needed to 30 ft. deep and 1,500 ft. wide, and the excavation of a main channel in the bay 30 ft. deep by 1,000 ft. wide and over 8 miles long, aggregating 70,000,000 cu. yds. of excavation. This amount is not far from the amount of excavation necessary in the famous Culebra Cut of the Panama Canal from the date upon which work was commenced by the United States. The project also includes an east and a west jetty, 7,000 ft. and 10,000 ft. in length, respectively, to be constructed if experience indicates their necessity. In addition to the above work, which will be done by the United States at a total cost of $7,430,000, the city of New York is to build piers and bulkheads along the main channel, the estimate of cost of the work to be done eventually by the city aggregating about $69,000,000, including the cost of land reclamation, concrete bulkheads, 112 piers of the Chelsea type, etc.

The Hudson River.—The portion of the Hudson River which has been under improvement by the United States Government is that portion about 28 miles long between Coxsackie and the State dam above Troy. Before improvement there was a channel 6½ ft. deep up to Albany, 6 ft. deep to Troy, and about 5 ft. to the State dam. This dam is provided with a small lock, 28 by 130 ft., with a depth of 4½ ft. on the lower miter sill. As a result of the work of improvement there is now a channel 12 ft. deep at mean low water with a least width of 190 ft. from Coxsackie to Troy, and a depth of 11 ft. with a least width of 75 ft. to within a short distance of the State dam. This improvement upon original conditions has been effected by dredging, rock removal, the construction of training dikes, etc. The State dam is too low to provide a sufficient depth over the lower miter sill of the lowest lock of the State Barge Canal, the terminus of which is at Waterford, about 2½ miles above the dam. Immediately below the dam is a rock ledge with only about 4½ ft. of water over it. The full value of the work now under way by the State of New York cannot be realized unless this portion of the Hudson River is still further improved. The act of 1910 adopts a new project which includes the construction by the Federal Government of a new lock and dam to cost about $540,000; the removal of the old State lock and dam; about 7,000,000 cu. yds. of dredging; about 400,000 cu. yds. of rock removal, and the construction of dikes and training walls. The improvements above outlined are designed to afford a channel at least 12 ft. deep at all stages of the river up to Waterford, the channel to be 400 ft. wide below Troy (with harbor basins at Albany and Troy) and 200 ft. wide from above the new dam to Waterford. The entire work is estimated to cost $5,186,064.

Norfolk Harbor.—Norfolk Harbor has been under improvement since about 1876, when the available depth was about 20 ft. and when the value of the exports was about $6,000,000 per annum. The latest work done has been under a project adopted by Congress in 1907, which provided for a channel 30 ft. deep, which will be completed in 1911. The value of exports has greatly increased in thirty years, being now about $600,000,000, showing the advantage commerce has taken of the increased facilities. The total cost of all work ever done by the Government at Norfolk (including the amount required to complete the 30-ft. project) is about $3,000,000, which is about 0.5 per cent of the value of the commerce for a single year. The act of 1910 adopts a project for a channel 35 ft. deep and 400 ft. wide from the ocean to the Navy Yard at Norfolk, and 25 ft. deep and 300 ft. wide for some distance in the southern branch of the Elizabeth River above the Navy Yard. This new 35-ft. project will involve the excavation of about 10,000,000 cu. yds. and will cost about $1,712,500. It will give Norfolk an entrance channel of the same depth as has recently been provided for Baltimore and as will soon be completed for Boston. The 40-ft. Ambrose Channel to New York is already completed to a depth of 40 ft. for a width of more than 1,000 ft.; its width when entirely completed will be 2,000 ft.

The Delaware River.—For the Delaware River the act of 1910 adopts two new projects. The work already done between Trenton and Philadelphia has been confined to the removal of shoals to provide a channel with a depth of 7 ft. over a width of 200 ft. Under the new project a depth of 12 ft. will be obtained at a cost of about $360,000. The work will include about 1,100,000 cu. yds. of dredging and the construction of dikes to concentrate the currents.

Up to June 30, 1909, the Government had dredged about 58,000,000 cu. yds. from the portion of the Delaware River at and below Philadelphia, thus obtaining a channel 30 ft. deep by 600 ft. wide. Philadelphia has a valuable and rapidly increasing commerce which cannot be successfully handled in the present depth of 30 ft., many vessels being compelled to load to less than their full capacity. The foreign commerce of Philadelphia for 1909 was valued at $158,000,000. The new project is for a channel 35 ft. deep and 800 ft. wide with increased width at the bends from Philadelphia to the sea. This will involve the excavation of about 73,000,000 cu. yds. of soft material and 53,000 cu yds of rock, an amount of excavation approximately equal to that of the Culebra Cut of the Panama Canal. Dikes will be built to control the tidal flow and thus assist in maintaining the channel. Of the 63 miles between Philadelphia and the 35-ft. depth in Delaware Bay, dredging will have to be done throughout all but 5 miles. The new project is estimated to cost about $11,000,000 and will probably require about six years to complete, if funds are appropriated in sufficient amounts at the proper time.

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*From a paper by Capt. E. N. Johnston, Corps of Engineers, U. S. A., in "Professional Memoirs," January-March, 1911.

Charleston Harbor.—Previous to the improvement by the Government of the entrance to the harbor of Charleston, S. C., the greatest depth over the bar was 12 ft. By the construction of a north jetty and a south jetty, 3 miles and 4 miles long, respectively, and by auxiliary dredging a channel with a depth of 26 ft. and width of 600 ft. has been obtained. This channel, after it leaves the outer ends of the jetties, is not in exact prolongation of the jetty channel, because of the formation of a shoal formed by material scoured from between the jetties. The new project provides for the formation by dredging of an entrance channel 28 ft. deep, 500 ft. wide between the jetties and 1,000 ft. wide beyond them, thus straightening out the outer portion of the channel over the bar. The work involves about 2,400,000 cu yds. of dredging estimated to cost about $371,000. Besides the advantages to commerce, this increased depth will be of advantage in connection with the Charleston Navy Yard.

St. Johns River.—In 1879, there was a depth on the bar at the mouth of the St. Johns River, Florida, of only 6 ft. at mean low water. In 1880, work was begun on a project which included the construction of two long jetties converging from the opposite shores at the mouth of the river until near the bar and then extending parallel to each other and 1,600 ft. apart across the bar. The jetties have been built to lengths of 13,000 and 11,000 ft., various training walls and cut-off dams have been built in the river proper below Jacksonville, and certain dredging in the river has been done. As a result, there is a stable channel at least 24 ft. deep from Jacksonville 27 miles to the ocean. This depth was obtained across the bar by scour unaided by dredging, the increase of depth across the bar being about 18 ft. The commerce of Jacksonville has increased from 196,000 tons in 1897 to 2,500,000 tons in 1907. The act of 1910 adopts a project for obtaining—by about 10,750,000 cu. yds. of dredging, 300,000 cu. yds. of rock removal, and the construction of training walls—a channel to Jacksonville 30 ft. deep by 300 ft. wide, estimated to cost $2,852,000.

Mobile Harbor.—Before improvement, the channel to Mobile had an available depth of only 8 ft. By 1880, a depth of 13 ft. had been obtained. In 1909, a draft of between 23 and 24 ft. could be carried over the shoalest part of the dredged channel in Mobile Bay, while over the bar at the entrance to the bay the depth ranged from 30 to 35 ft. where before improvement there was only 23 ft. The dredged channel up to Mobile is 33 miles long. Since 1899, more than 15,000,000 cu. yds. of dredging has been done and many snags and logs have been removed. The new project adopted by the 1910 River and Harbor Act provides for a channel 27 ft. deep, 200 ft. wide in Mobile Bay and 300 ft. wide in the river, with a turning basin at the upper end. This will require dredging amounting to about 23,000,000 cu. yds. It is estimated that, including the cost of construction of two new hydraulic pipe-line dredges, the cost will be about $1,800,000. It is expected that export business will increase with an improved channel and heavy shipments of coal will probably result from the completion of the canalization of the Black Warrior, Warrior, and Tombigbee rivers, which work, involving the construction of 19 locks and dams, will probably be completed within a few years. These will carry a least depth of 6 ft. from the coal fields in northern Alabama to Mobile Bay.

(To be continued.)

LETTERS TO THE EDITOR.

The Design of Retaining Walls.

Sirs: Kindly permit me space to reply to Mr. J. L. Campbell, M. Am. Soc. C. E., in his letter (your issue [illegible] of my article on retaining walls, published in your issue of Dec. 21, last.

Mr. Campbell states that at the time the Austin dam failed, one of the causes of the failure was recognized to be the floating power of the water in the porous limestone foundation discovered at the time. I am aware that this was given as the cause of the failure in a report published [illegible] after the failure but I am unable to find it mentioned at the time of the failure. I further do not see how this proves that this contingency has not been ignored [illegible] evidently ignored in designing that one.

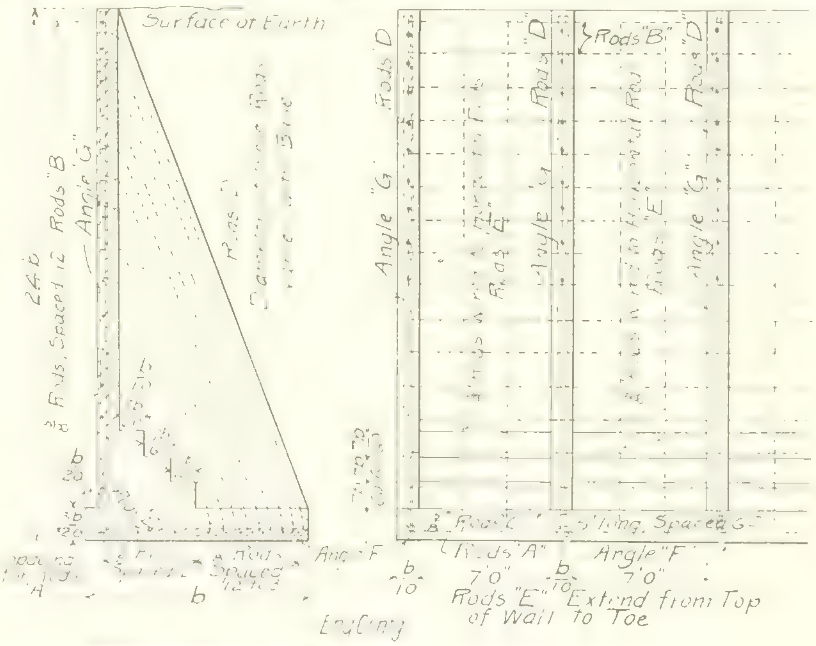
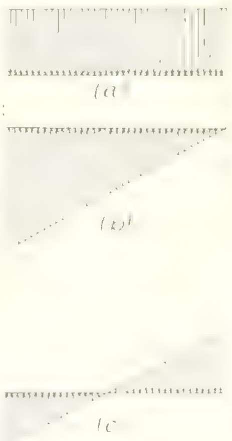


Fig. 7—Godfrey's Retaining Wall.



Mr. Campbell says that there is nothing in my design, nor in my discussion thereof, that indicates that I have made any provision for the effect of frost. He seems to have overlooked the fact that on page 548, at the bottom of the middle column, the article states: "Near the top of the wall this extra reinforcement is especially useful in resisting local effects of frost in the ground, which are more intense near the surface."

Mr. Campbell does not seem to grasp my point in discarding the old theories. There are two objections to the old theories. One is that they make assumptions about earth pressures, which facts prove to be untrue, because earth will stand up alone, that these theories find to be exerting enormous horizontal pressure against "constructive" retaining walls. The other objection is that the theories are excessively complex. Practically the same results can be found by the simple method of assuming a fluid pressure, and [illegible] used in the calculations, why resort to complex methods, based on imaginary action of soils, when simple methods will accomplish the same results?

If a soil is so saturated with water as not to be capable of being drained, the conditions are unusual, and unusual provision must be made. The principles of design laid down in the paper are just as applicable in such case, though of course the horizontal pressure is greater.

Mr. Campbell's point about the curving of the rods in the counterfort does not in any sense affect my criticism of the "standard" treatment of the counterfort as a beam. There is nothing to hinder the rods being made straight in my design. Beveled washers could be used at the ends. In fact straight rods are expressly mentioned on page 548. The rods are curved merely for the purpose of entering them normally in the anchoring angle; this does not by any stretch of imagination make a beam of the counterfort. It is true that it puts some local stress in the concrete, close to the slabs, but the major portion of the counterfort merely protects the straight part of the rods.

The other point regarding reduction of area of rods at threads has not much weight in rods embedded in concrete. Rods with rolled threads sometimes break in the body and not in the thread in tests. Rolled threads are now quite common. In any event the tensile strength of the concrete of the counterfort, though small, would be ample to make up for the reduction at the root of threads in the rods. In a case tried this tension, at a maximum, is found to be less than 50 lbs. per sq. in. This could be made up, if desirable, by a very small allowance in the diameter of rods. Upsetting is quite unnecessary.

Mr. Campbell's statement—"Lacking such anchorage, Mr. Godfrey's design would be equally liable to such failure," is unwarranted. This anchorage is an essential feature in my design and is covered by my patent. This is more clearly shown by a clearer drawing of Fig. 7, which I am asking Engineering-Contracting to print, as the other omitted some of these special features.

Yours very truly,

Edward Godfrey.

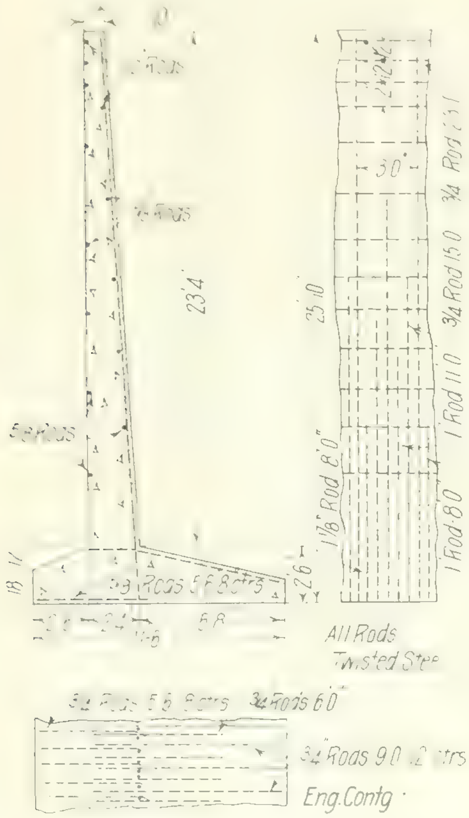
Pittsburg, Pa., Jan. 6, 1911.

The Design of Retaining Walls.

Sirs: I read Mr. Godfrey's article on "The design of retaining walls" in Engineering-Contracting of Dec. 21, 1910, with much interest and think he arrives at the earth pressure a reinforced concrete wall should be designed to resist in a most reasonable and reliable way.

The counterfort retaining wall which he has designed and patented no doubt overcomes one serious objection to the counterfort wall, as it [illegible] way of [illegible] the face and base slabs that is not secured by the ordinary methods of design. But when he refers to walls not using counterforts and says "Cantilever walls are not economical and they are difficult to reinforce," my experience leads me to differ with him. He shows a section of a cantilever wall of an inverted T-shape (Fig. 4 of his article). This is reinforced with four series of rods placed at different angles. One series having two curves and another a reverse curve which taken altogether does look rather complex. On page 559 Fig. 3 of the same issue of your paper, is shown a section of a similar shaped cantilever wall, designed by the Panama Canal engineers which uses three series of rods (all straight) to resist the overturning stresses, and it certainly looks quite simple and easy to construct.

Mr. Godfrey says "two cantilever slabs would be specially troublesome to reinforce." This is done by the Panama engineers by simply extending ends of the reinforcing rods of one slab across the ends of the rods in the other slab, and this extension for the heel and face slab does not have to be 50 times the diameter of the rod to obtain the proper anchorage of the rods, as these ends extend into the region of the beams where the maximum compression of the concrete occurs. Tests have shown that in such cases the adhesion or grip of the concrete on twisted rods is from 1,016 lbs. to 1,300 lbs. per sq. in. (See Eng. News, August 15, 1907, also May 21, 1908). The greater the load on the cantilevers the greater the grip on the ends of the rods under the conditions mentioned.



As to the economy of the cantilever type of retaining wall the writer has made a design of a cantilever wall shown by Fig. 1, having the same height and width of base as that shown in Fig. 6 of Mr. Godfrey's article using 150 lbs. for weight of concrete, 100 lbs. for weight of fill and for the outward horizontal pressure 16⅔ lbs. per cu. ft. considered as a liquid. Internal stresses of wall are on a factor of safety of 4.

Comprising the quantities of the two walls each 25 ft. 10 ins. high, it is found that the counterfort wall contains 8 per cent more concrete and 45 per cent more steel than the cantilever wall. And even if the quantities were the same the cantilever wall would be much more economical, as the form work is plainer and does not cut the lumber up so much, and uses at least 30 per cent less lumber. As to the steel it, being all ordinary twisted rods with no screws, nuts nor holes to be made, can be obtained at a low price and can be placed in the wall at a fraction of a cent per pound.

It is peculiar to the cantilever wall, that each series of rods, that is the vertical rods, the transverse rods in the heel and in the toe, and the longitudinal or shrinkage rods, each have but one kind of stress which it is subjected to, with no negative or compound loads to enter into the calculations for stresses. All loads are applied directly to the member which must resist them and do not have to be transmitted from one member to another to be concentrated at intervals in the wall and thus requiring heavy members at such points.

For the above reasons it is evident that a cantilever wall is much simpler to design and that the results can better be relied on from the very fact of the direct application of the loads to the resisting member. The economy in material results because the loads have to be transmitted through but one member to obtain ultimate resistance. The economy of construction results from the comparative simplicity of forms, etc.

EVAN P. BONE,
Junior U. S. Engineer.

Cincinnati, O., Dec. 30, 1910.

A Question as to Suitable Mixtures for Concrete Sidewalks.

Sirs: A point has come up on which I would like to have your opinion. In southern Georgia there is an abundance of a very pure silica sand that has, by measurement, about 33 per cent voids. In some places this sand is course like torpedo sand, in other places it is much finer, but the percentage of voids is the same—33 per cent.

Gravel and crushed rocks for concrete is very scarce and costs \$3 or more per cubic yard, except in the immediate locality where found. For my own immediate use it will cost me \$3.40 on the work. For reinforced concrete I can see nothing to do but pay that, but for sidewalk work it seems to me a substitution can be made and it is on this point I am seeking good advice. Sand costs 60 cents per cubic yard delivered. Natural cement can be had at \$1 per bbl. Portland at \$1.80 per bbl. I propose to lay the base of the sidewalks a 1:3 natural cement and sand, and the top, of course, 1 : 2 Portland. The soil is 60 per cent sand and there is no frost. The soil fall is 42 ins. If the top is put on, not later than 20 minutes after the base is layed, would you consider the work first-class, in every respect, equal to 1 : 3 : 5 base and 1 : 2 top ordinarily used?

Another substitution can be made as follows: i. e. so far as economy in materials is concerned.—Use a 1 : 5 mixture of Portland cement with sand for the base, and add enough clay (which abounds combined with sand ½ to ½) to fill the voids. In my own case that would be 1 cement to ⅔ clay to 5 sand.

Taylor and Thompson, on page 154 of their book, state that for a 1 : 3 mortar, as high as 20 per cent of the sand may be clay without injuring the strength. I am not prepared to say that the 1 : ⅔ : 5 as above stated, is as strong as the 1 : 3 Portland cement mortar, but it seems to me ifeht sm atten daionSndwcem;i addition of clay in finely divided condition to the mortar is beneficial up to 20 per cent, the 1 : ⅔ : 5 mixture should make a very good base for sidewalks. Would the 1 : 2 top adhere to it?

Sincerely yours,
E. O. KEATOR.

Cincinnati, O., Dec. 30, 1910.

(Our correspondent opens the way for an extended discussion on concrete materials and concrete sidewalk construction methods. We shall, however, confine ourselves to a mere categorical expression of opinion on the several questions raised, and invite our readers who have experience to present to make use of these columns to state it. (1) It is our opinion that a natural cement base and a Portland cement surface is not a satisfactory combination, the adhesion between the two layers is seldom good. (2) A 1:3 mixture of cement and of the sand described by our correspondent does not provide enough cement to fill the voids. (3) A sidewalk having a 1 : 3 natural cement base and a 1:2 surface coat using the sand named will not in our opinion be "equal to the 1:3:5 base and 1:2 surface ordinarily used." (4). While experiments do show that the addition of clay in a certain state and under certain conditions is at least not harmful we do not believe that it is a safe practice under ordinary conditions.—Editors.)

Constructing Concrete Walks in Freezing Weather.

Sirs: Can you tell me if there is any method for putting in concrete sidewalk or basement with thin walls in freezing weather, and what success to expect?

A. J. COBURN.

Basin, Wyo., Dec. 28, 1910.

(Concrete walks should not be constructed in freezing weather if it can be avoided. They can however, be constucted safely in such weather if proper precautions are taken. Use heated aggregates and mixing water and as soon as finished cover with sand (2 ins. or more) and then with manure and over all place a covering of canvas or tar paper to shed rain or snow. Hasten the concrete work as much as possible, first so as to get the cover on and conserve as much of the heat as possible and second because with heated materials the concrete will set more rapidly than at normal temperatures.—Editors.)

The Significance of Cracks Developed in a Test of a Reinforced Concrete Building Floor.

Sirs: The writer has been informed that the fact that cracks were developed in the test of a reinforced concrete building for actual stresses (described in your issue of Dec. 29, 1910), has been used by certain parties to mislead prospective builders as to the results of the test. I wish to repeat the statement made in the article referred to above, that all the cracks observed in this building were of a very faint, hair-like character, such as must necessarily appear in any reinforced concrete structure when the stress in the steel reaches 5,000 to 10,000 lbs. per sq. in. Similar cracks may be observed in every properly designed reinforced concrete structure when loaded, and their presence is in no wise an indication of improper design. As was stated in the account of the test, cracks are exceedingly easy (not) to find, and the fact that they are not ordinarily reported in building tests is probably due to two chief causes: First, they are not ordinarily sought after with very great eagerness or with proper aids to the sight; and second, the position of the load is frequently such as to conceal the more noticeable crack formations.

It is a matter of regret to the writer that a test of this character should be wilfully misinterpreted, especially in view of the fact that we must look to engineers and contractors for cooperation in making more such tests. The progressive designers and erectors of the building tested at Minneapolis bore the greater part of the expense of the test, and showed the confidence in their construction to submit it to test by a public institution like the University of Illinois Engineering Experiment Station. In justice to them it should be stated that the test showed a well balanced design for the floor slab tested.

ARTHUR R. LORD.

Urbana, Ill., Jan. 3, 1911.

The Swedish state railways have closed a contract with the steel combine of Germany for the delivery of 22,800 tons of rails during 1910 at certain seaport towns at \$29.48 per ton. They have also closed another contract for the delivery of the same quantity for the year 1911 at \$32.16 per ton, delivery to be made at certain seaports in the kingdom.

Rapid drilling by hand is not accomplished by use of heavy hammers and forceful blows, but by hammers of proper size handled by men who know how to strike the blow that will cause the drill to cut and keep the bottom of the hole clear so that the drill is working on solid rock and not on a lot of loose fragments. This is an art and is only learned by experience.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

Railroad construction work, especially in the south and the east, has begun to open up in fine shape, and a number of large construction contracts have been let since the first of the year. One of the largest contracts let recently is the one secured last week by MacArthur Bros. Co., New York and Chicago. This contract calls for 32 miles of railroad work for the Lehigh & New England R. R. This work is between Danielsville and Tamaqua, Pa. Another good sized contract was the one secured by the Rhinehart & Dennis Co., Washington, D. C. This contract calls for 17 miles of steam shovel work on the Chesapeake & Ohio Ry., near Augusta, Ky., and will take about a year for completion. Another large contract let within the last three weeks is the one secured by Mason & Hanger Co., Richmond, Ky., for work on the second track of the Queen & Crescent Route from Oakdale to Lansing, Tenn. This work includes 642,500 cu. yds. of rock excavation. The Gibson-Carr Co., Middlesboro, Ky., has recently secured a large subcontract on this work.

Recent reports from the Pacific Coast indicate that the Harriman lines are planning to have construction started shortly on a considerable amount of work in Washington. One of these jobs calls for the construction of 35 miles of new double-track main line between Tacoma and Tenino for the Northern Pacific. It is reported in some quarters that this contract has already been let, the successful contractor being Winston & Co., who have the contract for the new grading and double-tracking between Tenino and Kalama. Another piece of work which it is believed the Harriman lines will shortly place under contract is the construction of 80 miles of new road for the North Coast division of the Oregon-Washington Railway & Navigation Co., from Spokane to a junction with the present main line of the Oregon-Washington between Spokane and Portland at Perry on the Snake River.

In the south the Chattanooga Southern R. R. is rushing plans for a large piece of construction work. This work will call for the construction of about 40 miles of new line to be used in connection with a proposed extension from Harrisburg to Atlanta, Ga. The new work is now being located and bids will be asked about March 1. The work will be heavy, averaging about 40,000 yds. per mile, 20 per cent of which will be rock work. There will also be one tunnel about 2,000 ft. long.

The New York State Department of Highways at the request of the Governor has deferred indefinitely the lettings for highway work which were to have been held Jan. 9, 11 and 13, at Albany, N. Y. The contracts which were to have been let amounted to about $3,750,000. Governor Dix is reported to have announced that the work would not be long delayed.

An interesting press report floats up from Texas. This report quotes B. F. Yoakum, Chairman Board of Directors of the St. Louis & San Francisco R. R., as stating that the Frisco intends extending its lines in the future from Quanah, Tex., to the Pacific Coast. Beyond a statement that the preliminary plans are completed, Mr. Yoakum would not commit himself, save that he repeated that the line will be built in the near future. The distance from Quanah, Tex., to Los Angeles, is something like 1,000 miles.

The directors of the Pennsylvania R. R. Co. have decided to present to the stockholders at their annual meeting in May a resolution authorizing an increase of $100,000,000 in the capital stock. At present the authorized capital stock of the company is $500,000,000, of which $412,610,000 has been issued. All of the differences between the amount issued and the amount authorized is at present reserved for the possible conversion of the companys' outstanding convertible bonds, except $22,000,000. The company's needs of this year, to provide for maturing obligations and necessary improvements, require the raising of between $30,000,000 and $40,000,000, according to a statement issued by the company.

Something Doing in Vermont.

War has been declared between the Grand Trunk R. R. and the New York, New Haven & Hartford R. R. and it looks as though the coming battle would result in both combatants sustaining severe punctures in their war chests. Some months ago the Grand Trunk R. R. decided to secure an additional outlet on the Atlantic seaboard and accordingly applied to the legislature of Rhode Island for permission to build a line through that state to tidewater at Providence. This charter was granted despite the bitter opposition of the New York, New Haven & Hartford R. R. A charter was also secured in Massachusetts for that portion of the line from the Rhode Island state line to Palmer, Mass., where a connection was to be made with the Central Vermont R. R., a subsidiary company of the Grand Trunk. Everything was fine so far and the Grand Trunk went merrily ahead with its plans little reckoning of the large bunch of trouble that the villainous New York, New Haven & Hartford R. R. had in store. To reach Palmer, Mass., the Grand Trunk runs from Montreal to Windsor, Vt., over the tracks of the Central Vermont R. R., and from the latter place to Brattleboro, Vt., a distance of 50 miles, it runs over the tracks of the Boston & Maine R. R. From Brattleboro it again runs over the Central Vermont to South Vernon, Vt., at which place the Central Vermont line branches off and runs to New London, Conn., by way of Palmer, Mass., A short time ago the New York, New Haven & Hartford R. R. acquired control of the Boston & Maine R. R., and at once proceeded to inform the Grand Trunk, or rather its subsidiary company, the Central Vermont, that it could no longer have running rights over the B. & M. tracks from Windsor to Brattleboro, Vt. The Grand Trunk retaliated by refusing to give the Boston & Maine running rights over the Central Vermont tracks from White River Junction, Vt., to Windsor, Vt., a distance of some 12 miles, and from Brattleboro, Vt., to South Vernon, Vt., a distance of 12 miles. As these two stretches of track are important links in the main line of the Boston & Maine to New York, this road has made surveys to close the gap with lines of its own. The Grand Trunk has also taken steps to secure its own line from Windsor, Vt., to Brattleboro, and has applied to the state legislature for permission to build a line 50 miles long in that state paralleling the Boston & Maine. The total cost of building this piece of road and other sections which must be built, the securing of terminals, etc., is said to be in the neighborhood of $15,000,000. It will thus be quite evident that unless a truce is declared the war chests of the two railroads will be punctured so badly that there presently will be more railroad construction in Vermont than there has been before in the past 60 years.

Thoughts of a Pessimist.

It is an easy matter to predict that some time airships will be in general use; but it takes a brave man to set the time when our roads will be so good that they cannot be made better. A writer in Puck asserts that we will have good roads when airships come into use; he expresses his opinion in the following pessimistic verses:

I walked to town one day
In the long ago,
And said
"These roads seem to be a little bad!"
And soon the roads got better.

I walked once again,
And rode back on a bicycle
A hundred punctures,
And the wheel was out of date.
I cried:
"These roads are simply awful!"
And the roads continued to get better.

Once more I walked to town,
And rode back in an automobile.
Hundred breakdowns.
And the auto, too, was out of date.
I wept: "These roads are a disgrace!"
And immediately the roads became perfect

And then again I walked to town
And sailed back in an airship.
I declared: "Just as I expected.
Now that we have good roads
We don't need them!"

Some Advertising.

Many and various have been the schemes by which cities have endeavored to make public their advantages. Many thousands of dollars have been spent for advertising in national magazines, and many systematic booster campaigns have been conducted. But all of these campaigns, judged from the amount of publicity secured and its cost, pale to insignificance when compared with the campaign just inaugurated by the city of Memphis, Tenn. With a confidence, which is to be commended, Memphis, has challeneged 20 progressive cities in the north, east and west to a public comparison of advantages, industrially, commercially, socially and educationally. The Mayor of Memphis challenges the Mayors of the 20 others cities to show if their cities were "better to dwell in and to do well in"; the Park Commissioners of Memphis challeneged the Park Commissioners of the 20 cities to show as fine a park system; the Water Commissioner challenged the Water Departments of the 20 cities to show a more complete water works system or water as healthrful as Memphis; the Superintendent of Schools challenged the school superintendents to a comparison of the courses of study, the [illegible] school buildings, [illegible] of the [illegible] body [illegible], the Memphis Clearing House Association challenged as to prosperous banks; the traffic bureaus and commercial clubs as to industrial advantages and opportunities; the real estate exchanges as to profitable investments; the lumber exchanges as to supremacy in assembling and distributing hard wood lumber products; the automobile clubs as to number of cars owned—in short, challenges were issued by every industrial club and every city department of Memphis. The challenges were sent by telegram and to show that Memphis is thrifty as well as ingenious, the telegrams were sent by night rates. P. S.—Des Moines, Ia., was the first city to accept the challenges.

Modesto: Port of Airships.

In the good old days when flying machines were such a novelty that everybody had stiff necks from watching them it was the custom for hotel proprietors eager for free advertising to assemble a bunch of reporters on the roof of their hotels and gravely point out where airship landings were to be at once constructed. This was always good for a considerable amount of space in the newspapers. These far-seeing hotel proprietors have nothing on Modesto, Cal., for that city is going to have airship landings of its own. "Visions of the days when men shall fly as they now ride in street cars," states a press dispatch from that city, "are called up by a provision in the new charter adopted by the citizens of Modesto. Power is given to the city to construct and operate aviation landings as a municipal enterprise and it is said that the clause is wide enough to enable the city fathers to conduct aerial contests and to build aviation parks."

RAILWAYS, STEAM AND ELECTRIC

Arizona.

The Arizona Eastern R. R., L. H. Long, Chief Engineer, Tucson, Ariz., has settled right of way matters and is now said to be making preparations to begin at once on the construction of the line out of Globe with Durargo, Colo., as the ultimate destination. Work is also to be shortly started on constructing that portion of the Arizona Eastern to be known as the Hayden cut-off, surveys for which have just been completed. This calls for the rebuilding of the main line of the Arizona Eastern from a point near Burns station through Hayden and verging back to the main line about three miles east of the present site of the town of Winkelman. The construction of this line will considerably shorten the present line and will in addition place Hayden on the main line.

Arkansas.

The Chicago, Rock Island & Pacific R. R. is reported to have engineers in the field running a line from the Rock Island south of Pine Bluff to the city. It is said that the Rock Island will soon build a line to connect Pine Bluff with this line, which extends from Little Rock south. It is understood that the route which is being surveyed is practically the one selected for the Rutherford road, for which a bonus was raised in Pine Bluff two years ago.

Reports from Pine Bluff, Ark., state that J. F. Rutherford, of Pine Bluff, has sold 14 miles of the Anderson & Salina River R. R. which runs from Clio, in Cleveland County, to Erin, in Grant County. The purchasers were Northern capitalists. It is stated that the investors propose to give Pine Bluff a Rock Island extension from the southwest over its newly acquired railroad. The Rock Island will connect with the old Rutherford road at Leola, Ark. A deal is also said to be on for the sale of the remaining 21 miles of the road to the same parties.

California.

The Board of Public Works of San Francisco has asked the Board of Supervisors to appropriate funds for the immediate purchase of the general materials for the construction of the Geary St. municipal railroad. On specifications submitted by M. Marsden, City Engineer, a request was made for authorization to purchase 30,000 redwood cross ties, $17,000; 530 tubular steel trolley poles, $17,000; 48,500 pounds of copper wire, $8,000; rail bonds, $5,000; rail fasteners, $18,000; steel tie nuts and rods, $3,000. The rails have already been purchased.

The Oakland & Bay Shore R. R. Co., recently incorporated with a capital stock of $500,000, proposes to build seven miles of railroad on Shafter Ave. and Webster St., Oakland. The incorporators are R. H. Miller, Attorney John R. Selby and Albert J. Krutmeyer, all of San Francisco. The company intends to develop a large suburban area not reached at present by either the Key Route or the Southern Pacific.

Officials of the Santa Fe system have allowed an appropriation for an extension from the terminus at Lakeview through Moreno and back to the main line two miles north of Alessandro. Construction may be started this spring.

The Oakland & Antioch Ry. Co. is now seeking right of way for its terminus at Oakland.

Capitalists are investigating the feasibility of the rehabilitation of the Watsonville Electric Transportation Co., of Watsonville, which formerly operated a line between that city and Port Watsonville, with the view of extending the line farther back into the valley.

The Western Pacific Ry., T. J. Wyche, Chief Engineer, San Francisco, will, it is believed, acquire the rights of way of the California Midland road between Marysville and Auburn, Grass Valley and Nevada City. From this it looks as though the Western Pacific of the Gould lines would enter Placer and Nevada counties via the California Midland route from Marysville to Grass Valley and Nevada City, with a loop at Auburn. From Auburn a loop would probably be built paralleling the Southern Pacific to Sacramento.

The City Council of Oklahoma has passed the ordinance granting the Southern Pacific Co. a 50-year franchise on 7th St. The ordinance granting the privilege provides for a division of the net profits of the line on the basis of 25 per cent to the city and 75 per cent to the railroad.

The Nevada-California-Oregon Ry., Geo. S. Oliver, Chief Engineer, Reno, Nev., has ordered 3,000 tons of steel rails for the extension of line from Alturas, Cal., to Oregon.

Permanent location surveys for the Arizona, Mexico & Gulf of California R. R. have been completed and it is expected that construction work will be started this month from the Port Lobos end. The Lantry Construction Co., as noted in these columns some time ago, has the grading contract.

Steps have been taken for the organization of a company to build proposed Fresno-Coalinga tidewater railroad. This project is being promoted by E. R. Shaw and A. Albrecht, Fresno.

Isaac B. Parsons has applied to the Town Trustees of Hayward for a 50-year franchise for an electric street railway through town, beginning near the Western Pacific depot and extending to the northeasterly limits. The road, it is said, is thence to extend into and through Castro Valley.

The Santa Fe system, R. J. Arey, Engineer, Los Angeles, has appropriated $46,500 to cover the cost of filling at the opening at Ashland Ave., in Richmond, Cal.

The Santa Fe system has planned to spend $11,000 in building a pipe line from McLellan, Ariz., to the siding between Supai and Fair View, Ariz.

Colorado.

The Argentine tunnel on the Montezuma & Western R. R. is now in over 6,000 ft., leaving about 2,000 ft. yet to be driven. An English company drove the tunnel for a distance of about one mile, and on Sept. 1, 1910, the Montezuma & Western took up the work of completing it. The Montezuma & Western was incorporated last fall for the purpose of connecting the Argentine Central at a point near Waldorf, where the eastern portal of the transcontinental tunnel is, with the mining camps on the western slope, in Summit County, by way of the tunnel. Col. Robert H. Dwyer, Denver, Colo., is General Manager.

Interests allied with the Laramie, Hahns Peak & Pacific R. R., R. D. Stewert, Chief Engineer, Laramie, Wyo., have secured control of lands estimated to contain 250,000,000 tons of coal in the vicinity of Coalmont, a small town in the North Park district. The line is completed for 55 miles west and south of Laramie to Fox Park. From the latter point it is being extended to Coalmont, where the coal properties are located.

The Atchison, Topeka & Santa Fe System, D. E. Helvern, Division Engineer, Pueblo, has estimated that it will cost about $60,000 to construct a switch track to the coal property of B. F. Rockafellow, located 2½ miles south of Rockdale.

The Uncompalegre & Gunnison Valley R. R. Co. has engineers in the field securing data for estimates as to the costs of constructing its proposed electric railroad from Montrose to Delta City and on to Cedaredge.

Representatives of C. G. Mantz and Watson Zeigler, incorporators of the Fairview Railroad Co., are said to be preparing to ask for a franchise in the city of Delta.

Reports from Denver indicate that the Denver & Rio Grande R. R., J. G. Gwyn, Chief Engineer, Denver, Colo., may take over the San Luis Southern Ry. a 32-mile line, and build to Santa Fe, N. Mex. If this is done it will give the Denver & Rio Grande a broad gage road from Blanca south to Santa Fe and southwest to Durango.

Citizens of Hotchkiss have subscribed $10,000 as a bonus for a proposed railroad from that town to the gypsum beds in Montrose County.

Connecticut.

The Shore Line Electric Ry. Co., 82 Church St., New Haven, Conn., is preparing to have work started this spring on its line in the towns of Essex, Old Saybrook, Westbrook, Clinton, Branford, North Branford, East Haven and other towns. The company has made layouts and prepared plans showing highways and private lands through and across which it proposes to lay its tracks, the location of the same as to grade, and such changes as are proposed to be made in such highways to allow the tracks to pass through certain parts of the towns of North Branford and East Haven. Selectmen of both towns have approved the plans.

Delaware.

The Wilmington, New Castle & Southern Ry. Co. (electric), New Castle, Del., is contemplating making a number of improvements to its line, and has engineers in the field making surveys for the work.

Florida.

Wright & Wadley Co., Macon, Ga., have a considerable amount of work at Oviedo, Fla., on the Kissimee Valley R. R., which they

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

will let to station men. The work will last for a year or more.

A company to be known as the Gulf, Florida & Alabama Ry. Co. will apply for a charter early next month for the purpose of building a line from Pensacola north to the Alabama boundary and thence for about 250 miles to some point in that state. Roy C. Megargel, 5 Nassau St., New York City, is interested.

Georgia.

The Macon Railway & Light Co. is considering a proposition to extend its Bellevue line out to Rivoli, a distance of eight miles, within the next few months.

It is believed that the Ocilla Southern Ry. Co., J. A. J. Henderson, President, Ocilla, Ga., will shortly announce its plans for its proposed extension road through the middle of Georgia. Plans looking to this extension have been under consideration for some time, and it may be stated that but for certain minor details would have been announced before now. The extension will reach Waycross by a connection with roads now in operation, and proposes also to touch the Southern, Seaboard Air Line, Atlantic Coast Line, Atlanta, Birmingham and Atlantic, and Georgia and Florida. The Southern extension will be to Nashville, the Northern toward Abbeville.

The Georgia Ry. & Electric Co., Atlanta, Ga., is planning to have work started early this year in double tracking its line on Forrest Ave., from Peachtree St. to Jackson St., at Atlanta.

The Chattanooga Southern R. R. Co., through the recently incorporated subsidiary company, the Chattanooga & Atlanta R. R., propose to build an extension of its line from Harrisburg to Atlanta. This line from Harrisburg contemplates certain trackage agreements with new construction of about 40 miles. The new work is now being located and bids will be asked about March 1. The new work is very heavy, average about 40,000 yds. per mile, of which about 20 per cent is rock work. The extension will require three 120-ft. spans and one tunnel about 2,000 ft. long. C. H. Fisk, Chattanooga, Tenn., is Chief Engineer of the Chattanooga Southern R. R.

Illinois.

The activity of engineers of the Chicago, Burlington & Quincy R. R. in Franklin County, has led to the report that that railroad was to build another line through the county. It is reported that the line is contemplated from St. Louis, and will pass through Franklin County in a southeasterly direction, tapping rich coal fields. It is said that the new line would pass through Sesser, Benton, Hanaford, and probably terminate at Harrisburg for the present.

E. E. Headley & Son, R. R. No. 5, Springfield, Ill., have completed the grading of the park at Riverton, Ill., and have moved their outfit four miles northwest of Springfield where they are hauling 12,000 bu. of corn to elevator at Springfield. When this work is completed they will be ready for grade work.

The Northwestern Elevated R. R., 1117 Merchants' Loan & Trust Bldg., Chicago, is planning to construct a stub terminal at the north end of State St., at Chicago. The Northwestern Elevated stub terminal running over North Water St., now stops at Clark St.

The Chicago, Burlington & Quincy R. R., W. L. Breckenridge, Engineer Maintenance of Way, Chicago, Ill., is considering a proposition for building terminal facilities in Quincy that will involve an outlay of $500,000. Several of the chief officers of the road were recently in the city and looked over matters recommended in the survey of the Chief Engineer.

The Joliet & Southern Traction Co., L. D. Fisher, Chief Engineer, Joliet, has about completed its extension from Pontiac to Chenoa. The grading work has been practically all completed, and some tracks laid. The remainder of the track will be completed as soon as weather conditions permit. Right of way for a further extension from Chenoa to Lexington is practically assured, and it is likely that steps will be taken shortly to secure right of way for a further continuation of the line to Bloomington.

The St. Louis, Terre Haute & Quincy Traction Co. proposes to commence work at once on that portion of its road between Quincy and Pittsfield, provided the citizens of Quincy will subscribe for $20,000 of stock. The company is also planning to increase its capital stock from $50,000 to $1,500,000. The plan is to bond the road at $20,000 per mile, the first $1,000,000 of bonds to be gold bearing on first mortgage bearing 5½ to 6 per cent interest. George O. Rogers and Henry Scheib, St. Louis, Mo., are interested.

The Santa Fe System has planned to extend its passing tracks at Edlestein, Monica, Williamsfield, Appleton and Knox, Ill.

The Santa Fe System will install an interlocking plant at Monica, Ill., to cost $3,300.

Indiana.

Engineers and right of way men are at work preparing the way for a large amount of double track work to be done between Indianapolis and Kokomo, Ind., by the Lake Erie & Western Ry., and the Pennsylvania R. R. The work will probably cost about $2,000,000.

The Bluffton, Geneva & Alina Traction Co. is planning to extend its line eastward during the present year. W. A. Kunkel, Bluffton, Ind., is Treasurer.

It is reported that the St. Joseph Valley Traction Co., H. E. Bucklen, President, 275 Michigan Ave., Chicago, Ill., will by July 1 next have its line in operation from Eikhart, Ind., to Pioneer, O.

The commissioners of Newton county have ordered an election to vote upon a subsidy for the Indiana & Northwestern Traction Co., in Jackson township. The election is to be held on Feb. 9th. It is probable that a petition will be circulated for an election in Newton township, Jasper county, through which the road would have to pass if the route through Mt. Ayr is selected.

Iowa.

The Chicago, Rock Island & Pacific R. R. is said to have right of way agents in the field securing the right of way for the new line from Des Moines to a connection with the Kansas City line at Allerton. As now understood the new line southward will diverge from the Winterset line at Carlisle, pass on to Dallas, in Marion County, where the company owns 5,000 acres of coal land, cross the Burlington road at Chariton and connect with the Kansas City line at Allerton. The proposed line is 60 miles in length, counting the 10 miles from Des Moines to Carlisle.

The city of Mason City is to build a spur track from the Iowa Central main line near the city limits to the municipal pumping station. The Iowa Central will handle all the cars.

Surveys have been completed for the South Dakota Interurban Ry. Co., which projects a steam railway line from Chamberlain, S. Dak., to Sioux City, Ia. The W. K. Palmer Co., Dwight Bldg., Kansas City, Mo., is the Engineer.

The Des Moines City Ry. Co., Des Moines, is considering extending its Walker St. car line out over Hubbell Ave. to Grand View Park in Des Moines.

The Cedar Rapids & Iowa City Railway & Light Co., Cedar Rapids, is to expend $80,000 the coming year for improvements. These will include a new sub-station in Iowa City.

Kansas.

The Missouri & Kansas Interurban Ry. Co., W. B. Strang, President, Kansas City, Mo., has engineers in the field planning for an extension of the line to Fort Scott, Kan. As proposed the line will give direct electric connection for Ottawa, Paola, Lawrence, Joplin, Carthage, C[illegible]

The Chicago, Burlington & Quincy R. R. is reported to be considering a proposition to extend its l[illegible] the extreme northwestern corner of Kansas, to Falcon, near Colorado Springs, and then into Pueblo over the tracks of the Colorado & Southern, which are now in place.

Special elections are to be held on Feb. 14 in the townships of Valverde, Oxford, Palestine and Belle Plaine to vote on issuing township bonds at the rate of $2,000 per mile in exchange for stock in the Wichita, McPherson & Gulf R. R., a company which proposes to build the extension of the Midland Valley R. R. from its present terminus at Arkansas City to Wichita and from there on to a connection with the Union Pacific at McPherson. The amount of bonds asked is from Valverde Township $12,000, Oxford $15,000, Palestine $10,000, and Belle Plaine $18,000. C. Kaighn, Muskogee, Okla., is Chief Engineer.

The Southwestern Kansas & Colorado R. R. Co. will shortly take up the matter of securing right of way for its proposed railroad from Anthony to Raton, N. Mex. The road will be 350 miles long, and will traverse the first two tiers of counties in the southwestern portion of Kansas. Thence it will run through southern California and north into New Mexico. The counties which the road will serve are Harper, Barber, Comanche, Clark, Meade, Seward, Stevens, Martin, Kiowa, Ford, Gray, Grant and Stanton. The officers of the company are: R. W. Scott, President; A. A. White, Vice President and General Manager; J. C. Lewis, Second Vice President; H. Knecht, Treasurer; W. S. Richardson, Secretary; E. H. Hurd, General Attorney. The general offices are at Coldwater.

The Santa Fe Systems plan on increasing its water facilities at Augusta, Kan., at a cost of $2,500.

The Santa Fe System has appropriated $4,300 to cover the cost of cranes and increasing its water facilities at Cambridge, Kan.

The Santa Fe System has appropriated $3,200 to cover the cost of installing fuel cranes at Newton, Kan.

The Santa Fe System has planned to construct a combined sewer at Wellington, Kan., at a cost of $8,400.

Fred Coe and Jack Trayer have completed their grading contract at Valley Center for the Santa Fe.

The Wichita R. R. & Light Co., Wichita, has been petitioned to extend its lines into West Wichita, the route suggested being as follows: Branching off from the West Side line at Osage and running south on Osage and Campbell Aves. to Dayton, thence west on Dayton to Martinson and south on Martinson to McCormick.

Kentucky.

⊛Rinehart & Dennis Co., Evans Bldg., Washington, D. C., has just been awarded 17 miles of steam shovel work on the Chesapeake & Ohio Ry., near Augusta, Ky. This work will cover a period of about one year.

Announcement has been made that the Chicago, Burlington & Quincy R. R. will not commence survey work for its Kentucky Division before spring. The engineers are now surveying a route from Centralia, Ill., to St. Louis and when it is completed they will pick up the route south of the Ohio River. About the same time work is expected to begin on the $3,000,000 bridge at Metropolis, Ill., 12 miles below Paducah. By the time the Burlington's southern connections are established the bridge will be ready for traffic and two or three other roads will be completed to Metropolis. With the completion of the connections the Burlington will practically have an airline from the Pacific slope to the Gulf. It will probably take two or three years to complete all these connections and the big bridge.

The City Council of Louisville is considering the ordinances granting to the Louisville & Nashville R. R. the right to rearrange tracks and lay additional lines in the vicinity of its terminal at 1st and Water Sts.

The light plant, street railway and power house and water works of the Somerset Water, Light & Traction Co., of Somerset, Ky., which have been operated by a receiver for the past two years, was offered for sale by

✣ indicates work now open f[illegible] ⊛ indicates a contract let recently.

th[illegible]

The Kentucky Midland R. R. Co. has made surveys in part for its projected 14 mile extension. G. B. Hengen, Chicago, Ill., is President and M. M. Wheeler, Central City, Ky., is Chief Engineer.

Louisiana.

The Louisiana & Arkansas Ry., Wm. Buchanan, President, Texarkana, Ark., has engineers in the field for an extension from Jena to Vidalia, opposite Natchez, Miss., a distance of [illegible]

The Southern Ry. & Navigation Co., J. C. Ulrich, Chief Engineer, Pullman Bldg., Chicago, Ill., is considering extending its railway line to Alexandria, La., a distance of 65 miles. The company is controlled by D. K. and M. J. Jeffris, lumber men.

Massachusetts.

The Old Colony R. R. Co. (Boston & Maine R. R., has petitioned the State Railroad Commissioner for approval of an issue of 8,000 additional shares of stocks, the proceeds to be expended on improvements and additions to the property.

The Boston & Maine R. R., H. Bartlett, General Superintendent Mechanical Department, Boston, Mass., has secured options on nearly 600 acres of land in the town of Tewksbury along the line of the tracks of the Lowell and Lawrence division for the purpose, it is believed, of building a centralized repair shop and car constructing shops to care for the entire railroad systems of northern New England.

Michigan.

Announcement has been made that the Lansing & Northeastern Ry., which has nearly completed an interurban line from Lansing to Owosso, will take over the Owosso & Corunna electric line and operate it in connection with its new road.

The construction of an electric railway from Pentwater to Crystal Valley is being advocated by the business men of the former place. I. C. Harwood, Crystal Valley, is said to be interested.

The Michigan Central R. R. is building a four-mile spur from its Mackinac Division to reach 25,000,000 ft. of timber belonging to Kneeland, Buell & Bigelow Co.

Minnesota.

The Chicago, Milwaukee & St. Paul Ry. has under consideration two projects for lowering its tracks at West 7th St., St. Paul. One involves a gradual grade from Cedar St. to a point in the neighborhood of Selby Ave. By the alternative plan the road would go under ground near the City Hospital, and run in a tunnel from that point to some point beyond the line of bluffs. If the tunnel were driven it would pass through sand rock, and the material taken from the tunnel could be utilized along the river front and protecting the embankment of the railway. It would also fill up ground which is to be utilized by the gas company and other concerns.

The Northern Pacific and Minneapolis, St. Paul & Sault Ste. Marie have purchased 600 acres in Minneapolis, which will be used in the construction of new switches.

Duluth and the Ranges.

BY PETER E. MEAGHER

Mr. Arthur Mitchell, contractor, returned from a trip to Lower Canada and then left for Chicago. He is not doing anything at the present time.

Mr. C. J. A. Morris, of Morris & Shepard, St. Paul, was a caller. The only work they are engaged on at the present time is the completion of a concrete bridge for the Great Northern Ry. at St. Paul. Mr. Morris stated that the outlook for work the coming season was very bright.

Mr. Lewis Leimer, grading contractor who has been working on the Great Northern Ry. in North Dakota for A. Guthrie & Co. the past season, was a visitor. He is not doing anything at the present time, and has placed his horses in the woods for the winter.

Mr. Thomas Higgins, of Higgins & McDonald, left here to spend Christmas with his family in Nebraska. He has not shown up yet, and if anyone runs across him, tell him that his railroad work on the Canadian Northern near Duluth is progressing nicely. The writer understood that the cold weather did not agree with Tom. I presume that is what accounts for his absence.

Mr. C. A. Lewellen, General Agent for the State of Minnesota for the J. I. Case Threshing Machine Co., was a caller here recently. He stated that business was pretty fair with them, especially in their automobile line.

The Duluth & Iron Range Ry. Co. a few days ago let a contract to Whitney Bros. & Hill, of Superior, for the tearing down of their No. 1 ore dock at Two Harbors, Minn., and the rebuilding of the same of concrete and steel. Whitney Bros. & Hill will tear down the old dock and put in a concrete foundation. The steel work and erecting thereof will be done by another concern. The dock will cost, when completed, $1,500,000. To give an idea of the enormous size of this dock would say over 15,000,000 lbs. of steel will be used in this construction.

Mr. G. H. Thompson, General Manager of the Drake & Stratton Co., stripping contractors, was in our city at the writing of this letter. He was accompanied by his wife and son, and they will leave here to spend the winter in Florida.

Mr. J. P. Daugherty, railroad contractor, was a visitor in Duluth a few days ago. He has completed the contracts that he had for grading on the Northern Pacific, Great Western and Soo railways.

Mr. Timothy Foley, head of Foley, Welch & Stewart, spent a couple of days in our city recently, and when talking to the writer, said that his firm had a great deal of work under construction at the present time, and quite a bit more to keep busy on. They expect that 1911 will be a very busy year for railroad contractors.

Mr. Wick O'Connell, of Wick O'Connell & Co., general contractors, came in to see us the other day. His firm has a contract for the completion of the tunnel on the Canadian Northern Ry. near Duluth.

Mr. John Butler, of Butler Bros., stripping contractors on the Iron Range near Duluth, was in our city the other day. They are working on one or two contracts that they have, but have closed down some of their work.

Mr. C. J. Franzen, of Franzen & Berglund, grading contractors, was a caller. They are not doing anything at the present time and have placed their horses in the woods, but are in the market for some grading work.

Mr. J. P. Bains, General Superintendent for the Drake & Stratton Co. in this vicinity, was a caller. He was on his way East to spend a month's vacation. He stated that his firm is not doing any work at the present time, having closed down all of their contracts on account of the severe weather, and they do not expect to start operations until early in the spring. This means that about 1,800 men were laid off, as Drake & Stratton are large employers of labor.

Mr. Fred Halliday, of the Winston-Dear Co., and in charge of one of their large stripping contracts on the Range, was a caller in the city a few days ago. He left for the South to spend a few weeks' vacation with relatives.

Andrew Perrin, of Carl Hall & Co., dropped in to see us and stated that they had about 350 men working on the railroad near Grand Rapids, Minn.

Mr. R. F. Jones, of Jones Bros., railroad contractors, spent a couple of days in our city recently. They are very busily engaged on several contracts in the vicinity of Chicago and Columbus, O.

Dale & Bumgardner, steam shovel contractors, have closed down their work for the winter, at the present time are busily engaged in overhauling their outfit.

MacArthur Bros. Co., who had two large stripping contracts at Aurora, Minn., and on which they were working both standard and narrow gage equipment, have closed down their work for the winter, and will not reopen the same until early in the spring.

Mr. Harry Roberts, of the Roberts-Kingston Contracting Co., stripping contractors, returned from spending the holidays with relatives at Marquette, Mich.

Mr. John J. Meagher, western representative for Peter E. Meagher, was home for the holidays. He reported that as far as he could see, business was rather quiet in the West at the present time, but prospects for 1911 were very bright.

In the next issue of this paper I believe I will be in a position to announce the letting of a large stripping contract in this vicinity. One of the large companies has asked for bids on this work, which amounts to at least 4,000,000 cu. yds. The work is to be started as soon as possible, and is to be finished in about three years. There are seven bidders on this work, and I understand that it will be announced this week as to who are the lucky bidders.

Another prospect which is attracting the attention of some contractors in this vicinity is the prospective building of an electric line to connect the Range towns in the vicinity of Duluth. This railway will be about 80 miles long, and I understand that the right of way has been secured, and also the finances, and that the completion of the same is an assured fact.

The Almar Iron Mining Co., of Duluth, has advertised for bids for sinking a shaft on their property. I do not know how much of a contract this amounts to, but anyone interested, by addressing the company at Duluth, will undoubtedly receive the information that they desire.

Contractors and others interested in this line of business, when in the vicinity of Duluth, are cordially invited to make the offices of Peter E. Meagher, No. 409 West Michigan St., their headquarters while here.

Missouri.

The City Council of Cape Girardeau, Mo., has passed an ordinance granting a franchise to the St. Louis & San Francisco R. R. F. G. Jonah, Chief Engineer Construction, St. Louis, Mo. By the ordinance the city gets a $35,000 passenger station, terminals for the Gulf and Hoxie divisions, repair shops for those divisions, and a wall along the river.

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

All local contractors are awaiting with great interest the decision of the Supreme Court of this state relative to the proposed extension of our city boundaries. The boundaries of Kansas City were materially extended last summer by an act of the City Council, but on account of objections having been filed, court proceedings became necessary to confirm the action of the council. The case is now in the Supreme Court and a favorable decision is expected daily. The final confirmation of the boundaries will open a large field for grading operations. There are miles of proposed streets to be graded in the new addition and, like all Kansas City property, this will entail the removal of immense hills. Hundreds of thousands of yards of material will be available for contractors upon the opening of the new addition.

G. E. Dutcher of Kansas City has recently purchased a new grader to add to his already nice outfit. Mr. Dutcher has a sub-contract on the Kaw River levee and from now on expects to show them all how dirt can be moved.

Work on the new depot site at Kansas City is progressing nicely. The weather this winter has been ideal for outside work and the two large shovels now on the ground have been making wonderful progress. The Kansas City Terminal Co. is doing the grading entirely with its own forces. The material is being hauled on flat cars several miles in the country. It is estimated the grading of the new depot site will take several months longer and it is probable the great hill which is soon to be replaced by one of the finest depot structures in the world, will not be entirely removed until September, 1911.

John S. Spitcaufsky and G. A. Wagner have formed a corporation to be known as the Spitcaufsky & Wagner Construction Co. They have taken a contract to open up Main St. from Grand Ave. to 22d St. There will be about 150,000 yds. to be moved and the cut in places is 74 ft. Most of the material is solid rock. When one considers that this work runs only four city blocks, an idea can be gained as to the immense amount of labor necessary to be done in order to make new roadways in Kansas City. A steam shovel was installed last week and a good start has already been made on the contract. Standard gage equipment is being used.

The contracting firm of Baker & Campbell, with principal offices in Kansas City, has recently been organized. They have secured a sub-contract at Horatio, Ark., under Burke & Joseph of Cape Girardeau, Mo. There will be about 30,000 yds. in this work and it is reported to be the best of material. The work is on the Kansas City Southern Ry.

G. G. Clarkson & Sons undertook a contract late last fall to grade a roadway in the east end of this city. There were about 75,000 yds. in the work and Clarkson did not hope to make much more than a good start before cold weather would overtake him. Instead of that he has the contract practically completed and declares he has never worked under more favorable conditions.

It is reported here that dirt will soon fly along the right of way of the proposed Tulsa-Sapulpa, Okla., Electric Ry. There is no very heavy grading to be done on this line, which will run a distance of about 14 miles. The contract has not as yet been awarded, it is said. A pleasure park, situated about midway between the two cities, will be constructed. There will be considerable concrete work necessary both in the construction of the road and of the park mentioned.

It is persistently reported that the Kansas City-St. Louis Electric Ry., principal offices in the Commerce Bldg., Kansas City, Mo., will soon let contracts for the first 145 miles of its proposed road. The bonds of the road found a ready market it is said. The section reported to be ready is that portion between Kansas City and Columbia, Mo. Only the highest grade of construction is to be done. The road is to be double tracked the entire distance and only rock ballast will be used. Within 90 days the section between Columbia and St. Louis will be ready for construction and it is intended there will be no delay in putting the road through. A 1½ per cent grade is the heaviest along the entire distance. The grading will be of the very heaviest nature and there will be a great deal of rock work. The proposed road is the shortest distance by 40 miles between Kansas City and St. Louis and the scheduled running time will be much less than that on which steam roads are now running. As this proposition develops, we will report the progress to our readers.

St. Louis Items.

BY A. B. [illegible]

The Manufacturers Railway Co. last week placed on record five deeds for property in South St. Louis which is to be used for terminal yards. The aggregate consideration was $39,000. The property was transferred in all cases to Hollis March, whose name does not appear in the city directory, but claimed by agents on Realty Row to be the "Straw Man" for the Busch railway people.

The Burlington is conducting surveys for a new line from Sesser, Ill., about midway between Centralia and Herrin to St. Louis, to form a direct route from Metropolis, on the Ohio river to St. Louis. The Burlington hauls about 5,000,000 tons of coal annually from the Carterville district mines to points in the north and northwest. All the tonnage has moved from the mines north through Monmouth, Savannah and Dubuque, to St. Paul, where it has been turned over to the Hill lines traversing the northwest. The extension from Sesser, in Franklin county to St. Louis will enable the rapid and expeditious movement of coal over the Burlington rails via St. Louis to Kansas City, St. Joseph, Omaha and points in the northwest as far as Billings, Mont.

The Board of Local Improvements of East St. Louis last week authorized City Comptroller Frank B. Hanna to draw a voucher for $45,557.36 in favor of the O. T. Dunlap Construction Co. on account of work already done on the big outlet sewer. This payment makes a total of $232,135.36 that has been paid out on account of the work on the sewer. The contract was let Feb. 17, 1909, at a price of $710,266.65. The payment was the fifteenth that has been made the contractors thus far, and leaves a balance due them of $478,131.29 which will be paid from time to time as the work is completed. The work on the sewer is now running full force and all the necessary machinery has been installed and is in operation. The sewer is believed by the citizens of East St. Louis to be the biggest improvement that can be made in the city and that it will improve the health and the value of property more than any other one thing.

A new advertisement for bids for the wrecking of the 84 buildings which now cover the west approach to the municipal free bridge was published last Tuesday. At the letting a week previous not one bid was received. Wrecking companies have assured members of the Board of Public Improvements that under the new specifications they will make bids. The time limit for the execution of the contract is extended from May 15 to July 15, and the contractor is authorized to store the materials obtained from the wrecked buildings on certain unused portions of the approach for one year after the letting. This storage area is to be carefully fixed so as not to interfere with the construction, the places assigned being between the footings of the approach. A bond of $5,000 is to be given by the contractor in addition to a certified check for $5,000. Two considerations actuated the Board of Public Improvements in readvertising the contract. One was that if the city itself did the wrecking, as had been planned, the cost of the work would have to be paid out of the funds available for the construction of the free bridge, whereas the money received for the material would have to be paid into the general municipal revenue. The other was that wreckers explained that if storage facilities were given for a limited period they would undertake the work. The city officials considered that as the city had no sales organization through which the material could be satisfactorily sold, and would have to organize one if it did the wrecking, the wrecking companies offer supplied the better alternative.

At a meeting of the commissioners of the East Side Levee and Sanitary District last Friday the contract was let for building the four highway bridges to span the great diversion channel [illegible] East St. Louis and the East Side from high water in future years.

The contract went to the Joliet bridge & Iron Works Co. of Joliet, Ill., whose bid was $53,475. Under the terms of the contract the work must be started immediately and completed by May 15. These bridges are to be at the Alton, Poag, Grollnes and Wanda roads. Three will be 16 ft. wide and one 20 ft. One will have a footpath. Each will be 300 ft. long. Within two weeks the Levee Commissioners will advertise for bids for the construction of five railroad bridges necessary to take the railroads across the channel. This work will cost, approximately, $300,000. It is expected the work of the highway and railroad bridges, and on the channel will be completed and water be pouring into the big ditch by August 1 next. The channel is to be 4½ miles long and 500 ft. wide. The dirt to be taken out will be thrown up on both sides and will form a system of levees.

In mapping out the 1911 appropriation ordinance for East St. Louis, Mayor Silas Cook has provided for the purchase of much additional equipment for the fire department, including more hose and another steamer, for improvements at the No. 1 house and for starting the work of building two new houses. The ordinance, which will go to the city council this month, when the Committee on Finance, Ways and Means gets through with it, provides for $100,000 for the fire department alone, against $95,000 for 1910. About $10,000 left over from last year with the $5,000 additional for this year, will provide a fund with which the new work may be started. Mayor Cook said a lot soon will be bought in Landsdowne on which to build a combination fire and police substation, and another lot will be bought at 74th and State streets, in Edgemont for like purpose. It is also probable that during the year the size of the water mains will be increased from six to twelve inches.

Mayor Kreismann and President Maxine Reber of the Board of Public Improvements conferred with members of the city council Saturday and urged them to vote for the passage of a bill now pending in the council providing for the construction of a viaduct over the Missouri Pacific railroad tracks at Chouteau avenue. The bill provided that the expense of building the viaduct shall be paid by the railroad, and that the consequential damages shall be paid by the city. The damage to adjoining property resulting from the viaduct has been variously estimated at from $20,000 to $250,000 and more. The Board of Public Improvements prepared two bills providing for a viaduct at this crossing. In one it is provided that the damages must be paid by the railroads. In the other the expense must be paid by the city. Both bills were presented to the House of Delegates. That body recently passed the bill providing for the payment of damages by the city and sent it to the council. The other bill is yet held in the House.

Montana.

The Missoula & Hamilton Ry. Co. has been incorporated with a capital stock of $500,000 and proposes the construction of a steam or electric railway from Missoula to Hamilton. The company is reported to be backed by parties interested in the Bitter Root Valley Irrigation Co. The incorporators of the Missoula & Hamilton Ry. are H. M. Sloan and R. A. O'Hara, of Hamilton, Mont., and Frank I. Bennett, Ira M. Cobe and L. A. Busby, of Chicago. Of the capital stock of $500,000, $100,000 has already been subscribed.

The Polson-Whitefish Electric R. R. has secured a right of way from Whitefish to Kalispell, a distance of about 55 miles, and 30 miles of the right of way has been surveyed. The company has a capital stock of $200,000, of which over half is said to have been subscribed. It is stated that as soon as the remainder of the stock is placed construction and material contracts will be let. The officers of this company are as follows: J. A. Edge, President; O. P. J. Mosby, Vice President; J. H. Stevens, Secretary; A. W. Swaney, Treasurer, and G. H. Adams and J. E. White, directors.

White Bros., Missoula, Mont., have completed the construction of the Y grades for the Puget Sound Ry. at Haugan, and immediately moved their outfit to De Borgia to grade for a 3,500 ft. siding.

The Billings Traction Co. is reported to be planning to start work in the spring on the construction of its electric street railway system in Billings, Mont. John A. Connolly, Muskogee, Okla., is interested in this project.

Nebraska.

The W. K. Palmer Co., Engineers, Dwight Bldg., Kansas City, Mo., has completed surveys for the Nebraska-Dakota Ry., which projects a line from Valentine, Neb., to Sioux City, Ia.

New Mexico.

[illegible]

[illegible] crease its water facilities at Albuquerque, N. M[illegible] addition to its boiler house at a cost of $3,600.

The Santa Fe System proposes to build an addition to its engine house at Belen, N. Mex., [illegible]

The Santa Fe System has appropriated $18,000 to cover the cost of changes to the round house facilities at Clovis, N. Mex.

The Santa Fe System will soon install an autogenous welding plant at Albuquerque, N. Mex. [illegible]

New York.

According to a statement made before the Interstate Commerce Commission improvements costing $42,000,000 have been laid out by the New York Central lines, consisting principally of freight terminals on the west side of New York City.

The Brooklyn Rapid Transit Co., Brooklyn, has submitted a proposition to the Public Service Commission of New York, for the improvement of transit facilities in the Borough of Brooklyn. The proposition comprehends a system by which the 4th Ave. subway, in Brooklyn, will be operated by the Brooklyn Rapid Transit Co and connected at Flatbush Ave. with the Brighton Beach "L" line, which is to be four-tracked, and with the West End, Culver and Sea Beach "L" lines at 43d St., the extreme end of the sixth section of the subway now under construction. It also is proposed to extend the 3d Ave. "L" from 65th St., Bay Ridge, to Fort Hamilton. The proposition also makes the condition that the city build a double track crosstown subway line in Manhattan from the Manhattan Bridge terminus, the route to be agreed upon, to the North River, and that provision be made for connections with the Subway system in Manhattan now existing and extensions or routes to be constructed. The Rapid Transit Co. proposes to spend $30,000,000, which will include all expenses of elevating and equipping the former steam roads now operated by the company and the connections with the 4th Ave. subway at the two points named, less such portion, to be agreed upon between the company and the city, as will represent a fair share to the city of abolishing grade crossings.

The New York Central & Hudson River R. R., J. W. Eber, Superintendent, Utica, has acquired all the land necessary for its new station at Utica and it is expected that construction contracts will be awarded early in the spring. The new station will be two stories high, built of brick with stone trimmings and it will be about 400 ft. in length. The approach to the trains will be by subways as at Albany.

The Dunkirk, Allegheny Valley & Pittsburg R. R. (New York Central Lines), has filed a $5,000,000 mortgage. The purpose of the mortgage is to liquidate bonds and provide for an extension costing $2,100,000. The mortgage was filed in Venango County, and it looks as though this meant that the New York Central will extend this line from Titusville to Oil City or Franklin, to make connection with the Lake Shore & Michigan Southern. Such a road would give the Central a direct route for coal from the Pennsylvania fields to the lakes and would provide a much more direct line between Pittsburg and Buffalo. Samuel Rockwell, Cleveland, O., is Chief Engineer of the Lake Shore & Michigan Southern Ry., which operates the Dunkirk, Allegheny Valley & Pittsburg.

Ohio.

City Council of Hamilton has taken the first steps for the construction of the proposed underground South Hamilton crossing by the passing of a resolution declaring it necessary to lower the grade of Central Ave. at the South Hamilton crossing, so that the thoroughfare would pass under the Cincinnati, [illegible] & Dayton R. R. tracks. Estimates place the cost of the work at from $48,000 to $57,000. F. E. Weaver is City Engineer of Hamilton.

The Hocking Valley R. R., F. B. Sheldon, Chief Engineer, Columbus, O., has plans under way for the construction of new arriving and departing yards and engine roundhouse south of the end of Parsons Ave. at Columbus. The work involves the expenditure of about $1,000,000.

Ordinance is to come before the City Council of Columbus to grant a franchise for the proposed new East Side crosstown car line, to run from the Panhandle shop district south in Champion Ave. and adjoining streets, to the steel plants. Plans and surveys for the proposed line have been completed by Stanley D. Pugh, C. E., New Hayden Bldg., Columbus. It is said that work on the new line, which is to cost in the neighborhood of $400,000 and which will be seven miles in length, will be commenced as soon as a franchise can be secured.

Mayor George T. Lehrer, of Sandusky, has recommended to the City Council that steps be taken for the elimination of four grade crossings in the city.

The Cleveland, Alliance & Mahoning Valley R. R. has completed surveys for its projected 19 mile electric railway from Alliance to Ravennor. The project is now being financed and construction contracts will be let this spring. C. R. Morley, Cleveland, O., is interested.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. has brought condemnation suits at Dayton to secure property in Miamisburg to be used to complete a change in route near the latter place and thus shorten the line between Dayton and Cincinnati.

A petition has been presented to the City Council of Toledo asking for an extension of the street railway system south of Fassett St., East Toledo, and including the territory tapped by Owens, Oakdale, Prentice and the Stillman Brown addition to Toledo.

It is reported that the capitalization of the Columbus, Mount Vernon & Mansfield Traction Co., which was recently incorporated with a nominal stock of $2,500,000, is to be increased and the property of the Columbus, New Albany & Johnstown Traction Co. transferred to the new corporation. The new company was incorporated to take over the Johnstown line and extend it. Reports from the east are that the plans for financing the new company are progressing satisfactorily and it is expected that with the opening of spring the construction work on the extension will begin.

Oklahoma.

The W. K. Palmer Co., Engineers, Dwight Bldg., Kansas City, Mo., has surveying parties now in the field on the branch of the proposed Winnipeg, Salina & Gulf Ry., from Alva, Okla., west to Des Moines, N. Mex.

Surveys have been completed and construction work will probably be started soon on an electric railway proposition from Joplin, Mo., and Columbus, Kan., through Baxter Springs, Kan., to Miami, Okla. The W. K. Palmer Co., Dwight Bldg., Kansas City, Mo., is the Engineer.

The St. Louis & San Francisco Ry., has been making surveys at Chickasha for the construction of tracks and buildings for stock yards in that city.

Oregon.

The Lane County Asset Co., Eugene, is reported to have financed its proposed electric railway from Eugene to the coast. Kansas City parties are said to have agreed to furnish the necessary capital, and it is further said that contracts for the first 20 miles of grading have been let.

According to the annual report of the State Railroad Commission there were on Dec. 15, 1910, a total of 2,491.09 miles of railroad in operation in the state, an increase of 90.13 miles over the mileage in operation on the same date a year ago. This new mileage came out of the Oregon Short Line, Pacific Railway & Navigation Co., and the Sumpter Valley road, and does not include any mileage on the Deschutes River R. R., Oregon Trunk or Natron branch of the Southern Pacific Co. in Oregon, which have not yet been placed in operation.

The Crown Paper & Pulp Co., according to advices from Astoria, Ore., is securing right of way for a proposed logging road to be constructed this spring to tap a timber track in the vicinity of Svensen.

Good progress is being made in driving the tunnel at Cornelius on the United Rys. line and it is expected that the heading will be entirely through by the later part of February. The bore is 16x24 ft. and an average progress of 460 ft. is being made. During December the progress was 503 ft. The tunnel when completed will be 4,103 ft. long and will cost over $400,000. Porter Bros., Spokane, Wash., are the contractors.

The Peninsula Tunnel of the Oregon Railroad & Navigation Co. was completed, ready for the operation of trains on Jan. 15. This tunnel is 5,430 ft. long and was driven at a cost of about $1,000,000. By use of the tunnel six miles will be saved. Track-laying on the Troutdale cut-off from Troutdale to the tunnel will be started as soon as the weather will permit. It is expected that the cut-off will be completed by the early part of June. The distance between the mouth of the tunnel and Troutdale is 11 miles.

Pennsylvania.

⊙MacArthur Bros. Co., 11 Pine St., New York, and 227 Dearborn St., Chicago, Ill., has been awarded the contract for the extension of the Lehigh & New England R. R. from Danielsville to Tamaqua. Under the agreement entered into, construction is to begin at once and be pushed rapidly forward so that trains will be running by April 1, 1912. The extension will be 32 miles long. From Danielsville it will cross the Blue Ridge over easy grades to Lehigh Gap, where a river bridge will be constructed across, 110 ft. above the water. Thence the line will be extended through the Lizard Creek and Mahoning Valleys to the collieries of the Lehigh Coal & Navigation Co., in the Tamaqua region. The most important single feature will be the river bridge at Lehigh Gap, which will have concrete piers and a steel superstructure. This bridge alone will cost upwards of $500,000. The total cost of the extension will be close to $3,000,000. MacArthur Bros. Co.'s office on the work will be located at Lehighton, Pa. The contractors expect to sub-let a portion, at least, of the work. J. H. Gilchrist, Hazelton, Pa., is Chief Engineer in charge of construction for the railroad.

An ordinance is now before the City Council of Johnstown, Pa., calling for a new Pennsylvania R. R. depot, and subways or viaducts replacing the Fairfield, Delaware and Laurel Ave. crossings in Morrellville, and a similar provision for pedestrian traffic at the Haws brick works east of Brownstown.

The Pennsylvania R. R. is said to be contemplating extending its Tyrone and Clearfield branch across the mountain to Du Bois. The extension would be about 14 miles and would give a shorter route from the Clearfield region to the West.

Capitalists of Pittsburg have applied to the Borough Council of South Sharon for a franchise to be used in connection with a proposed electric railway from Sharon to the South Shore. It is estimated that the road will cost about $300,000.

The Western Maryland Ry., H. R. Pratt, Chief Engineer, Baltimore, Md., is planning to extend its track from York across the Codorus creek in the vicinity of Queen St. and thence to the northern end of the Borough of North York. Land owners have practically promised to donate the right of way and it is believed that the spur will be started shortly.

Philadelphia parties are reported to have offered to purchase all of the stock of the Lancaster & York Furnace trolley line, operating between Millersville and York Furnace.

The same parties are said to have already obtained control of the Lancaster and Southern Trolley line, an independent branch. It is said that the Susquehanna will be bridged and a projected line will be built along the York County shore to York, giving complete trolley service through to Baltimore.

The directors of the Pennsylvania R. R. Co. have decided to present to the stockholders at their annual meeting in May a resolution authorizing an increase of $100,000,000 in the capital stock. At present the authorized capital stock of the company is $500,000,000, of which $412,610,000 has been issued. All of the differences between the amount issued and the amount authorized is at present reserved for the possible conversion of the company's outstanding convertible bonds, except $22,000,000. The company's needs of this year, to provide for maturing obligations and necessary improvements, require the raising of between $30,000,000 and $40,000,000, according to a statement issued by the company.

It is now said that the Central R. R., of New Jersey. J. O. Osgood, Chief Engineer, New York, has changed its plans regarding its proposed improvements at Glen Onoko. It was intended to blast away the mountain at this place but now the engineers have announced another plan under which, by the expenditure of less than $200,000, greater results can be obtained in facilitating traffic. The tunnel will be left as it is, but the nose of the mountain will be excavated to make room for tracks outside the tunnel, which will be carried over the river by a new steel bridge. Excavation work for the foundations of this bridge has already been started by Hugh Boyle, Contractor, Scranton, Pa.

As soon as weather permits the Lehigh Valley R. R. Co. will resume work on its four-track system. The work starts at Cementon and about five miles of mountain will have to be chopped off. The cost of the work between Cementon and Laurys will be in the neighborhood of $500,000 and will require about a year. The work has been delayed considerably by the action of State officials in declining permission to the railroad to build up from the Lehigh River bed.

The City Council of Waynesboro, Pa., has plans under consideration for building a subway to carry 3rd St. under the tracks of the Western Maryland R. R. and the Cumberland Valley R. R.

The Philadelphia & Reading Ry., Wm. Hunter, Chief Engineer, Philadelphia, is securing land for the erection of a large bituminous coal storage plant about 1½ miles east of South Bethlehem. It is said the plant is to be erected in connection with the big coking plant to be erected by the Bethlehem Steel Co.

Tennessee.

⊙Gibson-Carr Co., Middlesboro, Ky., have secured a sub-contract from Mason & Hanger Co., Richmond, Ky., for work on the second track for the Queen & Crescent Route (C. N. O. & T. P. Ry.), from Oakdale to Lansing, Tenn. This work follows Emery River for a distance of 15 miles. The work includes 642,500 cu. yds. of rock excavation, the general contract being secured by Mason & Hanger Co. late in December.

The Nashville Interurban Ry. Co., of Nashville, Tenn., now operating 20 miles of electric railway from Franklin to Nashville, are about to extend the line from Nashville to Gallatin. The W. K. Palmer Co., Engineers, 717-720 Dwight Bldg., Kansas City, Mo., have been retained as Engineers, to make all surveys, prepare maps, estimates and profiles, and have charge of the construction work.

Surveys for the Nashville-Gallatin Interurban Electric Ry. Co.'s line are to be started about Jan. 20, according to a statement of H. H. Mayberry, Franklin, Tenn., the promoter of the line. It is believed actual construction work will be started in May.

The Louisville & Nashville R. R. has placed an order for 72,000 tons of steel rails with the Tennessee Iron Co., to be rolled at Ensley. The rails will be used in the double-tracking of the line between Decatur and Nashville

Texas.

Proposition has been made to the city of El Paso looking to the securing of a franchise to enter the city for Altus, Roswell & El Paso Ry.

Representatives of the Rock Island, Texico-Farwell & Southern Ry., which has recently completed about 25 miles of grade and has steel on the ground for same in the vicinity of Texico, N. Mex., has made a proposition to the Commercial Club of Pecos to bring the road into this city in consideration of a cash bonus of $75,000. The contract calls for the completion and operation of the road within two years from the signing of the contract. It is understood that the road is a part of the new proposed Pecos Valley extension of the Rock Island, two branches of which are to be constructed, one from Texico via Midland to San Antonio, and one from Texico via Knowles, N. Mex., to Pecos, Tex. By the terms of the tentative contract Pecos becomes the Southern or rather Southwestern terminus of the Pecos Valley extension, while Midland will become the present prospective Southern terminus of the San Antonio extension. Midland has accepted a similar proposition and has raised already her required bonus of $100,000, which has been turned over to the railroad company, the railroad company having given a bond in the sum of $100,000, guaranteeing construction of line into Midland within two years. Pecos has practically accepted the proposition made and will probably close negotiations within the present month.

Stockholders of the Missouri, Oklahoma & Gulf Ry., J. J. Harrison, Chief Engineer, Durant, Okla., have authorized a bond issue not to exceed $1,000,000. The money will be used to extend the line to the Gulf of Mexico, and improve the terminals at Denison, Tex.

Press reports quote B. F. Yoakum, Chairman Board of Directors of the St. Louis & San Francisco R. R., as stating that the Frisco intends extending its lines in the future from Quanah, Tex., to the Pacific Coast. One or two surveys made a number of years ago will be followed, and the distance from Quanah to Los Angeles will be less than 1,000 miles. Beyond a statement that the preliminary plans are completed, Mr. Yoakum would not commit himself, save that he repeated that the line will be built in the near future. One of the surveyed routes is by way of Albuquerque and the other by way of Phoenix. By way of Albuquerque would mean construction almost due west, practically paralleling the Santa Fe. By way of Phoenix would be more direct and would traverse for some distance country comparatively undeveloped by railroads.

The St. Louis & San Francisco R. R. has appropriated $50,000 for pre-cooling plant to be erected at San Benito.

Business men of Austin have decided to accept proposition of R. A. Love to build a 30-mile railroad from Austin to Lockhart.

The Pecos Valley & Northeastern R. R. will shortly begin work on an extension south from Pecos City through Marathon to Boquillas on the Rio Grande.

The Santa Fe System has appropriated $8,700 to cover the cost of new freight yard tracks at Brownwood, Tex. The company has also appropriated $18,000 to cover cost of improvements at Temple, Tex., and has had plans drawn up for its proposed improvements at Somerville, Tex.

Utah.

Residents of the Capitol Hill section of Salt Lake City are asking the Utah Light & Ry. Co. to extend its line to that section. It is the desire of the residents of Capitol Hill to get a line extended north on Main St. to Second St., east of Second north and the east side of Capitol Hill, and thence north on the hill.

The Oregon Short Line R. R. is reported to be planning to ask a franchise at Brigham City for a line from its depot up Forest St., to Main St. The object of such a line would be to compete with the Ogden Rapid Transit Co., which is now operating between Ogden and Brigham City. It is said that if the proposition goes through the Oregon Short Line will likely operate hourly service with motor cars between the city and Ogden.

It is reported that the Utah Midland R. R. will have construction work started this month at Milford. The route of this road is projected to go by way of Beaver, Parowan and Cedar, and on to the Grand Canyon of the Colorado, with a branch to St. George.

Vermont.

The State Legislature has granted a charter to the Taconic Valley R. R. Co., which proposes the construction of a steam railroad from Bennington, Vt., to Dorset, Vt., passing through the towns of Glastenbury, Shaftsbury, Arlington and Manchester. A charter was granted a short time ago to the Mettowee R. R. Co. to build a line from Dorset to Lake St. Catherine, and it is probable that this latter road will be built as an extension to the Taconic Valley R. R. It is reported on good authority that the construction work may be started this spring on the Taconis Valley R. R. The incorporators of the road include Collins M. Graves, Guy B. Johnson, E. J. Hall, John Nash and Henry T. Cushman, all of Bennington, Vt. It is believed that the projects are backed by the New York, New Haven & Hartford, R. R.

Washington.

Officials of the Northern Pacific have approved the expenditure of upwards of $2,000,000 for the construction of 35 miles of new main line, all double-tracked, between Tacoma and Tenino. The first surveys for this work were made a year ago, but the contract was held back until now because of financial conditions in New York. It is believed that Winston Bros. Co., Minneapolis, Minn., who have the contract for the new grading and double-tracking of the Seattle-Portland main line between Tenino and Kalama, will probably get the $2,000,000 contract for the new construction between Tacoma and Tenino. The work will be finished this summer.

It is expected that Robert S. Lovett, President of the Harriman system of railroads, will within a few days authorize the letting of a contract for 80 miles of new road for the North Coast division of the Oregon-Washington Railway & Navigation Co., from Spokane to a junction with the present main line of the Oregon-Washington between Spokane and Portland at Perry on the Snake River. G. W. Boschke, Portland, Ore., is Chief Engineer.

The W. K. Palmer Co., Dwight Bldg., Kansas City, Mo., has secured the contract for the engineering work for the Puget Sound, Chelan & Spokane Ry. Co., which projects an electric railway in the State of Washington.

Work has progressed so far on the new double track of the Northern Pacific Ry., between Portland and Puget Sound, that it is believed that the last spike will be driven next August. The work when completed will have cost about $5,000,000, and has involved much heavy construction. The grading of the new double track roadbed between Tenino and Kalama, Wash., has involved the moving of approximately 4,500,000 cu. yds. of earth. The work was commenced in September, 1909, but on account of excessive rainfall little could be accomplished until last April. Seventeen steam shovels, five Channon excavators, 200 teams, ten work trains and about 2,500 men were engaged in the work until Nov. 1, when the grading was practically completed. The new track is now in operation between Tenino and Chehalis, Newaukum and Winlock and between Kalama and Vancouver. All of the new track is laid with 90-pound steel rails. By the end of February the double track will be extended from Tenino to Sopenah and also from Carrolls to Kalama and Tillicum to Kelso. While the betterments were under way a heavy traffic has been handled over the operating track with little delay. There have been ten passenger trains a day each way, and as many freight trains. Some of the grading between Vancouver and Kalama was done in 1906 and 1907, but only a single track was laid.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

This grade covered a distance of 26 miles. For a distance of 66 miles the old line was relocated and both grades and curvature reduced. [illegible] mile in distance was saved in the 66 miles. The curvature of the old line, however, has been reduced by about 45 per cent, or nearly one-half.

W. H. Coughlin and George W. H. White, real estate dealers, Seattle, Wash., have applied to the City Council of Seattle for a franchise to operate a street car system from Michigan St., along West Michigan St. to the intersection of Detroit Ave. and West the intersection of Frist Ave. South and West Michigan St., thence over private property to Ninth Ave., Southwest and West Kenyon St., thence south on Ninth Ave. to West Henderson St., on West Henderson to Sixteenth Ave. Southwest, and on Sixteenth to the city limits. The application for this franchise was made in order to develop the territory between the city and Lake Burien. To reach the lake will require a franchise from the county to cover the additional 3½ miles between the city limits and the lake.

The Chicago, Milwaukee & Puget Sound Ry. has ordered 9,000 tons of 85-lb. steel rails to be used in building new branch lines along the Puget Sound extension.

Wisconsin.

The Minneapolis, St. Paul & Sault Ste. Marie Ry., Thos. Green, Chief Engineer, Minneapolis, Minn., is to have work started shortly on the construction of extensive yards at Superior for the handling of the Cuyunna range business. The yards will be two miles in length and 600 ft. in width, and there will be between 35 and 50 tracks.

Canada.

The Toronto Suburban Ry. Co., Toronto Junction, Ont., is to apply to Parliament for permission to extend its present line from West Toronto to Milton, and also to build a line from Guelph to Berlin, Preston, Hespeler and Galt, and to Hamilton, passing through the townships of Guelph, Waterloo, Dumfries, Puslinch, Beverly, Flamboro West and Ancaster.

Application is to be made to the Canadian Parliament by George Lynch-Staunton, of Toronto, for an act to incorporate the Hamilton, Caledonia & Dover Ry., to build a line from Hamilton to Port Dover, by way of Caledonia, Hagersville and Jarvis.

The Hamilton, Waterloo & Guelph Ry. Co. has applied to the Canadian Parliament for permission to issue a large block of preference stock, and this is taken to indicate that the road will build. This company was incorporated in 1906 with a capital stock of $2,000,000. It is believed that the government will grant the application and that the promoters will be in a position to organize the company. No steps have yet been taken in that connection, the provisional directors still remaining in office. John Paterson, Hamilton, Ont., is the promoter.

The Cowan Construction Co., Ltd., of Winnipeg, Man., has applied to the lieutenant-governor-in-council for authority to change its name to the Union Construction Co., Ltd. Two of the original members of the company have sold out their interests to T. J. Merry and Joseph M. Mackenzie. Mr. Mackenzie is a son of Sir William Mackenzie, president of the Canadian Northern Ry. F. W. Tisdale and Frederick Fox are also named on the directorate of the reorganized company. It is understood that the company will undertake an important contract on the Canadian Northern main line, between the Pembina river and the Rocky mountains, in addition to other contracts in the prairie country. Under the name of the Canadian Northern Branch Lines Co., the Canadian Northern is aplying for incorporation with power to build eighteen branch lines in Manitoba, Saskatchewan and Alberta.

The Dominion Minister of Railways on Jan. 11 considered a large number of applications for approval of route maps for railways in different parts of Canada. In general the results of the hearings were as follows: The first maps approved were those of the Canadian Northern and Grand Trunk Pacific from South Battleford westerly. Both lines were approved into South Battleford and westerly for 50 miles, thence westerly for over 100 miles. From the fifteen mile post westerly they are to follow separate routes. The Canadian Northern line southwesterly from Moose Jaw was approved, details of the entrance to be fixed by the railway board. Objections were heard at length to the Canadian Northern Moose Jaw, Kindersley branch, Kindersley southwesterly branch, Canadian Pacific Moose Jaw northwesterly revision and the Canadian Pacific Swift Current southeasterly branches, all of which were allowed to stand. Revision of the Canadian Pacific main line route between Austin and Melbourne, Man., also stood over. The Alberta Central line from Rock Mountain House to Yellow Head Pass and the Canadian Northern revision of the Humbolt-Calgary line were approved without opposition. The Canadian Northern and Grand Trunk Pacific Railway plans for entrance to Calgary stand until the railway board approves the details of the entrance. The Grand Trunk Pacific revised plans for its Calgary branch was approved. Approval was also given to the G. T. P. line from Biggar westerly to township 37, fourth meridian. The Grand Trunk Pacific line from Moose Jaw to a point near Elbow stands. The G. T. P. revision of the plan of the Regina boundary branch was approved with the condition that its line must pass through Frobisher. The revised plan of the C. N. R. Sudbury-Port Arthur line was approved. The Stonewall branch of the C. P. R., revised plan, was approved. The C. P. R. plan for Swift Current to Brooks line was approved from mile 46 to mile 100. The Southern Waldo branch in British Columbia was approved from Elco to near Waldo. The Hudson Bay and Pacific line from Prince Albert northeasterly was approved for 70 miles easterly north of the Saskatchewan River. The C. N. R. line on the way to the Athabasca River stands. The C. P. R. withdrew its plan for a line from East Selkirk to Traverse Bay on Lake Winnipeg. With a slight change the C. P. R. line from Weyburn to Lethbridge was approved.

While no definite announcement has been made by officials of the Canadian Pacific regarding the construction plans for new lines in Western Canada this year it is believed that work will undoubtedly be started on the road running southwest from Moose Jaw. The line will run between Lake Chaplin and Lake Johnston, and will probably terminate at Gravelbourg. This territory is already well settled, much of it having been farmed for a number of years. The road will connect with the line which the company is engaged in building from Weyburn to Lethbridge. On this latter road work will without doubt be carried on this year, and in the list of appropriations for which the company will be asked possibly $1,000,000 will be for this important line. It is also believed that building operations will be carried on from the west as well as from the east on the line. During 1911 work will also be done on the line west from Outlook and a through line will be completed from Moose Jaw to Edmonton by way of Lacombe. At the present time the company is engaged in building a costly bridge over the Saskatchewan River at Outlook, and this will be completed in the spring of this year.

The Canadian Pacific Ry. will expend a considerable sum this year for the enlargement of its stock yards at Winnipeg, Man.

It is expected that by the end of the coming season location surveys of the Canadian Northern Pacific Ry. (a Mackenzie & Mann project) will be complete from Port Mann to the Yellow Head Pass and, subject to possible slight revisions here and there, will be ready for contractors anywhere in British Columbia. At present the final lines have only to be run over little over 250 miles before the eastern and western surveys are linked up. The trial lines have been finished for some time, and the end of this year, it is said, will easily see its completion of the location surveys, which mean route staking from the coast to Yellow Head Pass.

ROADS, STREETS AND PAVEMENTS

Alabama.

County Engineer, J. W. Gwin, Birmingham, Ala., has inspected the road between Bessie Mines and Gon Rown and it is thought that the Board of Revenue will make considerable improvements.

A petition will be presented to the County Commissioners at their next session at Bay Minette, Ala., for the opening of a new road which will lead from Carney, a town about 6 miles north of Bay Minette, Ala., to the present road known as the Pensacola road, the latter leading to Pensacola. Another petition will be submitted asking for the construction of a road in the lower end of Baldwin county running almost directly south from Foley to Oak postoffice.

California.

On Jan. 4 the Board of Supervisors of Yolo County, Woodland, Cal., appointed a committee of five to meet similar committees of counties of the Sacramento Valley on the west side of the Sacramento river in relation to the state highway to be constructed under the authority of the law authorizing the expenditure of $18,000,000.

According to report of S. J. Norris, Engineer to the Chamber of Commerce, Oroville, Cal., in regard to the construction of the Oroville-Downieville road, the improvement will necessitate an expenditure of $33,000.

A movement is now on foot among the substantial property owners of the county, according to advices from Yreka, California, to bond Siskiyou County for $400,000 or $500,000 for the construction of a number of good permanent roads through the mountains. Siskiyou will get a share of the bond issue of $18,000,000 voted in November for a state road connecting the county seats of California and it is expected that the road will be continued to the Oregon line. This will give the county a good road from south to north. A road may also be built from Yreka, the county seat of Siskiyou, to Alturas and Weaverville. These roads, with the improvements that can be made with the money from the proposed bond issue, will give the county a system of excellent roads.

A resolution was submitted to the city council of Los Angeles by the City Planning Committee and referred to the Streets Committee. In the resolution the Council, Board of Public Works, County Supervisors and Highway Commissioners are urged to act as speedily as possible toward construction of the road connecting Los Angeles, Cal., with its harbor.

Colorado.

Board of Commissioners of Pueblo County, Pueblo, Colo., has authorized the construction of the greater part of a road that will connect the Marion Mines near the western county line with an improved highway that enters the city. All but 6 miles of the highway is reported to be in good condition and the commissioners propose to put the remaining portion in first-class shape. It is understood that the owners of the mine are willing to assist the county in the work. The road was surveyed by a representative of the commissioners, and upon receipt of the report of the surveyors the board ordered work started on the improvement.

El Paso County, Colo., hopes to receive $20,000 from the State Highway Commission the coming year to be used in the improvement of the roads.

Advices from Boulder, Colo., state that on Jan. 11, the opening meeting of the Commercial Association was held to devise ways and means by which all roads of the county may be permanently improved. Passage of a law by which counties may issue bonds for financing road improvements was discussed and Attorney F. S. Luethi, an authority on road law, presented the legal side of the question. Senator Harry Casaday spoke on the need of improvements on highways. If found lawful a legal committee was to be appointed to draft a bill providing for issuance of county road bonds.

Delaware.

In the court of general sessions, Jan. 2, at Wilmington, Del., a petition was filed asking for the opening of a new road in Brandywine Hundred. The road is about ¾ of a mile in length and runs from Binstead to the Delaware river.

Florida.

⊙The contract for the grading and paving with vitrified brick laid flat and curbing with granite of 2d St. from 1st Ave. north to 7th Ave. has been awarded by W. F. Divine, City Clerk, St. Petersburg, Fla., to Georgia Engineering Co, Augusta, Ga., at $1.40 per sq. yd. The work includes 40,000 sq. yds. of brick. Bids were opened Jan. 5.

Georgia.

Mayor of Columbus, Ga., in his annual message recommends the construction of pavement on 2d Ave.

Illinois.

✣Bids will be opened at 11 a. m., Jan. 24, by B. J. Mullaney, commissioner of public works, Chicago, room 705, City Hall, for furnishing and delivering sewer pipe as follows: 15,000 pieces of 4-in. sewer pipe, 300 pieces of 6-in. sewer pipe, 300 pieces of 9-in. sewer pipe, all to be delivered to the various pipe yards. The sewer pipe shall be salt glazed, clay sewer pipe of the hub and spigot variety. All pipe shall be in 2-ft. lengths and of standard dimensions.

The Highway Commissioner of the Township of Sheldon, Sheldon, Ill., is planning the construction of more hard roads in Sheldon township. According to a statement reported to have been made by W. H. Callahan, one of the commissioners, the next road to be built is one running west from the city limits of Sheldon to the township line on the main road toward Watseka. This would mean a road four miles long and, if the north route were taken, would come within a little more than three miles of the end of the Cemetery road. If Middleport township would build this three miles there would be a continuous hard road between Sheldon and Watseka. If the south route were taken Belmont township would have to build nearly five miles to connect the two towns.

Good-roads advocates at Sycamore, Ill., will present a petition to the town clerk asking that a levy be made this year for the continuation of construction of hard roads and that the matter be submitted to the voters at the April election. The improvement of the Genoa and Brickville roads are already under consideration.

Member of the Board of Local Improvements, Joliet, Ill., has presented a resolution providing for the construction of vitrified block pavement on Hickory St. from the north line of Spring St. to the north line of Marble St., at an estimated cost of $16,893. Harry Stephens is City Engineer.

Indiana.

✣Bids will be received until 10 a. m., Feb. 6, by Board of County Commissioners, Tipton, Ind., for the construction of six gravel roads in Tipton County. J. H. Tranbarger is Auditor.

✣Bids will be received until 10 a. m., Feb. 7, by Board of County Commissioners, Logansport, Ind., for the construction of a gravel road in Tipton township, Cass County. J. E. Wallace is Auditor.

✣Bids will be received until 2 p. m., Feb. 7, by Board of County Commissioners, Crawfordsville, Ind., for the construction of a road in Union Township, Montgomery County. B. B. Engle is Auditor.

✣Bids will be received until noon, Feb. 7, by Board of County Commissioners, Winamac, Ind., for the construction of three gravel roads in Pulaski County. W. E. Munchenburg is Auditor.

✣Bids will be received until [illegible] p. m., Feb. 7, by Board of County Commissioners, Rushville, Ind., for the construction of a macadam road in Ripley Township, Rush County. J. M. Stone is Auditor.

✣Bids will be received until 2 p. m., Feb. 8, by Board of County Commissioners, Mt. Vernon, Ind., for the construction of a gravel road in Robb township, Posey County. Paul Maier is Auditor of the County.

✣Bids will be received until 2 p. m., Feb. 7, by Board of County Commissioners, Marion, Ind., for the construction of a macadam road in Fairmont township known as the Alvin B. Scott et al road. A. Y. Stout is Auditor of Grant county.

✣Bids will be received until 9 a. m., Jan. 23, by Board of Public Works, Gary, Ind., for the improvement of Connecticut St. from 23d Ave. to 27th Ave. The work includes the following approximate quantities: 6,941.3 sq. yds. brick pavement (stone foundation), 2,123.4 sq. yds. sidewalk, 4,312.9 lin. ft. curb, 176 lin. ft. header, 11,350.3 cu. yds. grading, 2,360 cu. yds. muck to be replaced. Certified check required, $690. Engineer's estimate, $23,415.16.

✣Bids will be received until 9 a. m., Jan. 23, by Board of Public Works, Gary, Ind., for improving 16th Ave. from Madison St. to Broadway. The work includes the following approximate quantities: 3,696.2 sq. yds. brick pavement (stone foundation), 1,900.7 sq. yds. sidewalk, 2,070.9 lin. ft. curb, 160 lin. ft. header, 4 catch basins, 5 gutter inlets, 7 covers reset, 976.2 cu. yds. grading, 1,000 cu. yds. muck to be replaced, 260 lin. ft. 10-in. pipe. Certified check required, $355; engineer's estimate, $12,144.62.

⊙The Boards of County Commissioners of Wells and Huntington Counties in joint session at Huntington, Ind., awarded the contract for the construction of the county line road to Lewis Huttsell and I. J. Wolfcale, Markle, at $17,997. The road will begin at Markle and extend north for six miles and will be built of stone.

⊙Commissioners of Benton County, Benton, Ind., have awarded the following contracts for the construction of roads: Cooley Road, Crouch & Sammons, at $3,638; Shonkwiler Road to A. E. Gray, at $1,518; Kirkpatrick Road to William Penick for $3,551.

⊙The Board of County Commissioners, Vincennes, Ind., has awarded the contract for the construction of the J. O. Loten et al road, to James O'Donnel at $3,600.

⊙A contract has been awarded H. F. Jones at $3,795 by the Board of County Commissioners, Vincennes, Ind., for the construction of the F. P. Emison et al road.

⊙Board of County Commissioners, Bluffton, Ind., recently awarded the following contracts for the construction of roads: C. W. North, at $4,960, for the Spade road; Wilson Woodward, Kunkel Road, at $4,203; Wilson Woodward, Kizer Road, at $3,043; Wilson Woodward, Newman Road, at $2,793.

⊙The Board of County Commissioners, Michigan City, Ind., has awarded the contract for the construction of the Van Wilkinson macadam road to Jacob Ackerman, Laporte, Ind., at $21,350.

Board of County Commissioners, Rushville, Ind., received no bids Jan. 11 for the construction of the proposed macadam road in Anderson township that were within the appropriation and consequently no contract was awarded. J. M. Stone is County Auditor.

Proof was made before the Board of Commissioners, Brazil, Ind., on six new gravel roads for which petitions were filed at the November term of court. Viewers will be appointed and bids advertised in the near future. All roads will be constructed under the three-mile law.

The County Commissioners, Mt. Vernon, Ind., have acted upon the petition of Perry Pritchard asking for an election on the question for gravel road construction near Cynthiana in Smith township. Viewers and engineers were appointed to inspect the proposed roads. The road is twelve miles long and will cost about $30,000.

Iowa.

A hearing will be held by the City Council of Red Oak, Ia., 8 p. m. Feb. 14, upon the proposed resolution of necessity for the construction of 7,390 ft. curb and gutter, 2,373 ft. curb and 23,725 sq. yds. of pavement. Richard Roberts is City Clerk.

Paving Committee of Muscatine, Ia., City Council, will hold a meeting in the near future at which time the proposed paving extensions for the coming year will be discussed.

City Council of Sioux City, Ia., has taken into consideration the construction of new pavement on North Pierce St. up to 29th St.; Jennings St. from Fifth to 14th Sts.; Third St. where the old paving is worn out. The service company which would pay the greater part of the paving cost because of its double street car track on Pierce St., asks for asphalt pavement in place of concrete. Brick probably will be laid on Third St. and it is probable that concrete will be favored for Jennings St.

Kansas.

Advices from Wichita, Kan., state that the County Engineering Department has about completed preliminary work for the construction of improvements on Central Ave. and Maple St., and that contracts for the work will probably be let in the near future.

Louisiana.

Early steps are to be taken by Governor Saunders of Louisiana and F. M. Kerr, New Orleans, Chief Engineer of the State Board of Engineers, towards organizing the Good Roads Bureau. The provision for the preliminary work of this bureau was made by the State Board of Liquidation when it authorized the governor to borrow $25,000 to organize this bureau and start the work. There is a great amount of preliminary work that must be done before the actual construction of the roadways can begin. Surveys must be made, grades established, bids advertised for and contracts let. All this will take some months before any actual good road work under the new law can be gotten under way. Ouachita, East Baton Rouge, St. Mary, Winn, Grant and Natchitoches Parishes have made arrangements to raise money to begin construction under the 1910 law, which provides that the state pay half and the parish half of the cost of construction. This fund will be available about November of this year, when the 1911 taxes begin to come in, and it is the governor's idea to pay for the construction up to that time out of the parish funds.

The Police Jury in monthly session, Jan. 5, at New Iberia, La., passed upon considerable routine business and appropriated $3,500 annually for 10 years towards model roads in that parish.

The police jury of Caddo Parish, Shreveport, La., has started a movement looking to the securing of $50,000 from the state, provided an equal amount be appropriated by Caddo Parish, for the purpose of constructing permanent highways. W. T. Crawford is president of the police jury.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Maryland.

The [illegible] Roads Commission, according to advices from Baltimore, Md., is taking steps toward purchasing the Belair Turnpike and the Clarksville Turnpike and abolishing the toll gates. It is estimated that the first will cost about $3,000 and the latter which is 10 miles long running from Ellicott City to Clarksville will probably cost the state $8,000.

Michigan.

✣Bids will be received until Feb. 14 at 2 p. m., by County Road Commissioners, Menominee, Mich., at the office of the engineer, for the construction of a gravel road on the Bay Shore Road between Beatty's and Arthur Bay. Carl A. Anderson is Clerk.

Advices from Detroit, Mich., state that the contract for furnishing cement to the county road commissioners this year was awarded to the Aetna Portland Cement Co. The contract, as signed, calls for a payment of $57,583, a saving over the first price offered of $2,965.

Minnesota.

Advices from Duluth, Minn., state that the 18th St. road one of the most important pieces of road recommended by C. J. Morrisset, Highway Commissioner, will be started in the Spring. The highway will be improved for eleven miles beginning at Parkland asylum and running south. The road will be widened to twenty-four feet and will be macadamized and when completed will be one of the finest thoroughfares in the state. A good portion of the $58,000 appropriated will be spent in fixing up the Eighteenth St. road.

Mississippi.

District 1, Copiah County, Miss., will sell, Feb. 6, 1911, road bonds amounting to $75,000 of $500 each, Nos. 1 to 14 maturing in 11 to 24 years and 15 to 150 maturing in 25 years, bearing 5 per cent interest payable annually at Treasurer's office. The population in 1900 was 34,395. At the election 247 voted for the bonds and 108 against. The valuation of property in District 1 is $2,000,000. The total indebtedness of the county is $130,000. J. H. Long, Hazlehurst, Miss., is Clerk of Chancery Court.

The Hinds County Board of Supervisors, Jackson, Miss., opened bids Jan. 5 for the working of the county roads; all bids were rejected. The work will be advertised again and bids opened at the February meeting.

New York.

President of the Common Council of Schenectady, N. Y., is considering urging an appropriation in the budget of 1911 for the purchase and operation of a municipal asphalt plant.

In accordance with the request of Governor Dix, Albany, N. Y., the State Highway Commission of New York has postponed indefinitely the opening of proposals for the highway improvement work estimated to cost about three and a quarter million dollars. Bids for this work had been advertised to be received on January 9, 11 and 13.

Ohio.

✣Bids will be received until Jan. 20 by Director of Public Service, Cleveland, O., for the construction of pavement on 40 streets.

✣Bids will be received until 11 a. m., Feb. 11, by Board of County Commissioners, Cleveland, O., for the grading of Broadview Road No. 3 from Wallings Corners School House to Boston Road in Brecksville and Strongsville townships. A certified check for $1,000 must be filed with each bid. Frank R. Lander is county surveyor. J. F. Goldenbogen is clerk of the board.

✣Bids will be received until 11 a. m., Feb. 8, by Board of County Commissioners, Cleveland, O., for the grading, draining and improving of Fairmount Road from East Blvd. to Coventry Road, in Cleveland Heights township. A certified check for $1,000 must be filed with each bid. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein at the office of the county engineer at the new court house on W. 3d St., Cleveland, Ohio. John F. Goldenbogen is clerk of the board.

✣Bids will be received until noon, Jan. 20, by the Director of Public Service, Youngstown, O., for furnishing the necessary labor and materials for the paving of Williamson Ave., between South Ave. and Franklin Ave. Plans and specifications may be obtained at the office of the City Engineer. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Directors.

✣Bids will be received until noon, Jan. 20, by Director of Public Service, Youngstown, O., for furnishing the necessary labor and materials for the grading of Gladstone St. between Lincoln Park and City Limits. Plans and specifications can be obtained of City Engineer. A certified check for $100 must be filed with each bid. W. H. McMillin is Clerk of the Director.

✣Bids will be received until noon, Jan. 20, by Director of Public Service, Youngstown, O., for the construction and material for paving South Ave., between Kyle St. and Marion Ave. Plans and specifications may be obtained at the office of the City Engineer. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Director.

✣Bids will be received until noon, Jan. 20, by Director of Public Service, Youngstown, O., for furnishing the labor and material for the construction of pavement on Superior St., between Federal St. and Delaware Ave. Plans and specifications are on file at the office of the City Engineer. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Director.

✣Bids will be received until noon, Jan. 20, by the Director of Public Service, Youngstown, O., for the necessary labor and material for the construction of pavement on Hillman St., between Warren Ave. and Grace St. Plans and specifications may be seen at the office of the City Engineer. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Director.

✣Bids will be received until noon, Jan. 20, by the Director of Public Service, Youngstown, O., for the construction and necessary material for the pavement of Jefferson St., between Federal St. and Kyle St. Plans and specifications may be obtained of the City Engineer. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Director.

✣Bids will be received until noon, Jan. 20, by the Director of Public Service, Youngstown, O., for furnishing the necessary labor and material for the paving of Oak St. between Watt St. and Truesdale Ave. Plans and specifications may be obtained at the office of the City Engineer. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Director.

✣Bids will be received until noon, Jan. 20, by Director of Public Service, Youngstown, O., for the necessary labor and material for the construction of pavement on Logan Ave., between Broadway and the city limits. Plans and specifications may be had at the office of the City Engineer. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Director.

✣Bids will be received until noon, Jan. 20, by the Director of Public Service, Youngstown, O., for furnishing the labor and material for the paving of Millicent Ave., between Woodbine Ave. and Out Lot No. 249. Plans and specifications are on file at the office of the City Engineer. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Director.

⦿The contract for the improvement of the Dick Road from Howard's Creek to the Oxford Road in Crosby township has been awarded by the Board of County Commissioners to W. S. Nugent, Harrison, O., at $3,816. Bids for the work were opened at Cincinnati, O., on January 6.

⦿According to information received from Marietta, O., Peters & Palmer, Contractors of that city, have been awarded a 5-mile stretch of the Akron-Hudson Road from Akron, O., to a point near Cleveland in Summit County. The contract price was $75,000.

⦿Board of Control, Hamilton, O., has awarded the contract for paving East Ave., South B St., and North Sixth St. to the Andrews Asphalt Paving Co., Hamilton, O., at $1.90 per sq. yd.

Negotiations are about to be taken up by City Council of Cleveland, O., which will result in the construction of 10 miles or more of new boulevard driveways and parkways.

At a recent meeting of the Board of County Commissioners, at New Lexington, O., initial steps were taken in the matter of permanently improving highways and as a result three miles in Perry County will be paved under direction of the State Highway Commission. James C. Wonder, Columbus, O., is Highway Commissioner of the State.

Oregon.

Advices from Hood River, Ore., state that efforts are being made to construct a wagon road up Hood River Gorge, leading out of Hood River, thus avoiding steep grades on both sides of the stream. The proposed road will tap the valley in the neighborhood of the Vanderbilt orchard and will probably be about 1 per cent grade.

North Hillsboro Road District, according to information submitted from Hillsboro, Ore., recently voted in favor of a 5-mill special road tax for building rock roads leading out of the city toward the North and East Tualatin Plains. About $1,700 is already on hand for the proposed work and it is thought at least $6,000 will be available soon.

South Dakota.

At the coming session of the Legislature of South Dakota, a bill will be presented by the Legislative Committee appointed by the Good Roads Conference of South Dakota which, it is thought, will meet the approval of the good roads advocates and will enable the counties and townships to build and repair country roads by contract and under competent supervision. The new law proposes to abolish the road overseer and make the township supervisors directly responsible for the roads in each township. A more important feature is the provision for the payment of the fall taxes in cash instead of in labor. The law also provides for the building and repair of roads by contract in each township and also contains the provision that where the expenditure proposed is more than $200,000 the amount shall be paid out of the county road fund and under county supervision. The County Commissioners are authorized to levy a road tax not to exceed 5 mills, and this may be increased to 10 mills if authorized by vote of the county. In addition to this each automobile owner in the county is taxed at $5.00 per year to be paid into the county fund, this assessment to be in lieu of all other road and bridge taxes. It is believed that this measure will allow the county and township authorities to co-operate in the maintenance of good roads and compel the automobile owners to pay their fair share of the expense.

Tennessee.

Commissioners of Putnam County, Cookeville, Tenn., who are strongly in favor of the construction of the proposed Memphis-Bristol Highway, have adopted resolutions favoring the big undertaking and suggesting that it follow the old Walton Road through that county. Chas. C. Gilbert, secretary of the Davidson county highway commission, has collected much data from the various counties now taking the lead in the work of organization. The Davidson county association sent out a request to forty-five counties asking them to perfect an organization for the purpose of promoting the great highway project. These various organizations will appoint delegates to the mass-meeting to be held in Nashville on Thursday, January 19. It is expected that a large number of delegates will be present at that meeting.

City Council of Knoxville, Tenn., has taken up the matter of selling the remainder of street-widening bonds for the opening of

Jackson Ave., between Broadway and the Louisville & Nashville freight depot.

According to the quarterly report of the Hamblen County Pike Commission, Morristown, Tenn., for the last three months in 1910, of the total mileage outlined in the original bill, there are only 7 miles yet to grade and but 33 miles still lack macadam. The Commission has on hand $96,352 for the completion of the work.

Texas.

✣Bids will be received until 3 p. m., Jan. 24, by Ed. Woodall, mayor, Hillsboro, Tex., for 31,500 sq. yds. of paving and 12,711 lin. ft. of combination curb and gutter. Specifications cover brick, bitulithic, and concrete pavements. Specifications on file at City Hall, Hillsboro, Texas, or E. L. Dalton, consulting engineer, Dallas, Texas. Bidders wanting specifications sent out of city for personal use will be charged the actual cost. A certified check for $1,000 made payable to the mayor of Hillsboro must accompany each bid.

⊙The City Commissioners of Dallas, Texas, have awarded the contract to the Texas Bithulithic Co., at $64,192, for the paving of South Harwood St., from Jackson St. to Forest Ave., with bitulithic on 5-in. concrete base. The work includes 27,951 sq. yds.

An election was held in Fort Worth, Texas, Jan. 13, to vote on the question of issuing bonds to the amount of $2,000,000, of which $165,000 will be spent for the improvement of streets.

Senator H. G. Terrell, McLennan, Texas, is reported to have announced at Austin, Texas, that he will introduce two bills in the next session of the legislature; one of these will provide for the creation of a State Highway Commission and the other will provide for the [illegible] Canada to the Gulf, to be built by convict labor.

Committee of Aldermen has been appointed by the Mayor of Temple, Texas, to confer with the property owners on North Main St. and French Ave. regarding the kind of paving material to be used in improving those thor[illegible]

Virginia.

⊙The Norfolk County Permanent Road Commission on Jan. 2 awarded a contract to E. Parke Lindsay, Norfolk, Va., at $16,103, for macadamizing the new road which the county has opened from the Tanner's Creek Cross Roads to Ocean View. The two next lowest bids were those of F. J. McGuire, of Norfolk, $16,270, and Dalby, Nottingham & Co., of Norfolk, $16,297.20.

Washington.

Bids were opened by Board of Works, Spokane, Wash., Jan. 3, for grading, curbing and paving with granite concrete, Bernard St., from Pacific Ave. to Eighth Ave., and Boone Ave., from Pearl St. to Division St. For the former there were two bids, R. S. Blome & Co., $41,200, and James H. Fife, $37,500. The engineer's estimate was $36,900. For the latter R. S. Blome & Co. bid $12,600 and James H. Fife $11,744. The engineer's estinate was $11,600. Bids were offered for both contracts by Boynton, Church & McCoy, $40,500, and $13,000, respectively, but they were rejected as the contractors stipulated that the city should protect them from any litigation on account of the use of alleged patented processes, inventions or trade marks. Other bids opened were for paving with Brick Eighth Ave., from Cannon to Chestnut Sts., James H. Fife, $4,352, engineer's estimate $3,550; grading, curbing and paving Lacey St., from Twenty-ninth to Thirty-third Aves., Inland Engineering Company, $6,550, and Naylor & Norlin, $6,589, engineer's estimate $6,300, and sewer, Main Ave., from Cedar to Ash Sts., G. Burgie, $3,050. The engineer's estimate was $2,690.

Advices from La Center, Wash., state that a survey for a route for the proposed state road has been made through that country following along or near the road between that place and Vancouver and Woodland.

West Virginia.

✣Bids will be received until 1 p. m., Feb. 6, by Board of Commissioners, Huntington, W. Va., for grading and paving with vitrified brick, bitulithic, sheet asphalt, asphalt block or concretic asphalt various streets, including 8th Ave. from 8th to 16th St., Adams Ave. from 6th to 11th St. and from 14th to 18th St., 5th St. from Washington to Adams Ave., 6th St. from Washington to Adams Ave., Johnson's La. from 3d to 6th Ave., 2d St. from 3d to 4th Ave. and from 5th to 6th Ave., etc. The work amounts to about 125,000 sq. yds. of paving and 69,000 lin. ft. of curb. A. B. Maupin is city engineer.

Canada.

✣Bids will be received until 2 p. m., Feb. 7, by William McQueen, City Clerk, Vancouver, B. C., for furnishing a new road roller weighing not less than 15 tons for the city.

At the recent election held at Thorold, Ont., a by-law was carried for the purpose of improving the municipal roads.

Plans are being prepared by W. A. McLean, Provincial Good Roads and Highways Engineer, Toronto, Ont., for a system of experimental roads between Bridgeburg and Niagara-on-the-lake. The expense of the work will be defrayed by the Niagara Falls Park Commission.

BRIDGES—STEEL AND CONCRETE

Arkansas.

At a conference held at Texarkana, Ark., Jan. 11, between the Mayor, City Attorney and engineers representing the Texas & Pacific, Cotton Belt and Kansas City Southern Railroads, relative to the construction of a viaduct across the tracks of the roads named from Broad Street to Carmichael Hill at Elm Street, an agreement was reached on the principal details and an ordinance embodying the same will be submitted to the City Council.

California.

Plans have been filed with the Board of Public Works, Los Angeles, Cal., by the City Engineer for the construction of the proposed concrete ornamental work for the Buena Vista Street bridge, and it has been recommended that bids be asked for the work soon. The improvement will necessitate an expenditure of $15,000, but will not include the four bears, ordered by the Council for the approaches, the construction of which will be handled under special contract.

Property owners of Rancho del Paso land have begun an active campaign for the construction of a boulevard from Sacramento, Calif., to the grant and for the construction of a new steel bridge over the American River wide enough to accommodate street cars, in addition to vehicle traffic. A petition has been filed with the Board of County Supervisors, [illegible]

District of Columbia.

✣Bids will be received until 2 a. m., Jan. 23, by District Commissioners, Washington, D. C., for the strengthening and stiffening of the iron bridge across Rock Creek in the line of Calvert St. Plans and specifications may be obtained of the Chief Clerk, Engineering Department, 427 District Bldg., Washington.

Florida.

The accompanying cut shows the profile of the site of the proposed bridge to be erected over the St. Johns River near Cook's Ferry in Volusia County, Florida, for the Florida East Coast Ry. E. Ben Carter, Superintendent of Maintenance of Way, St. Augustine, Fla. This work was mentioned in our last issue.

Georgia.

[illegible] Mayor of Atlanta are the following bridges: [illegible] near the point that Bellwood Ave. crosses before its intersection with Mariett St.; the ex[illegible] viaduct over the railroad tracks and intersect[illegible]

Idaho.

⊙Contracts were awarded December 29 by W. L. Cuddy, County Auditor, Boise, Idaho, as follows: For the construction of steel highway bridge at 9th St., Missouri Valley Bridge Co., Leavenworth, Kan., at $28,000; for the construction of a steel highway bridge over the Boise River near Barberton, Idaho, to J. H. Forbes & Co., Caldwell, Idaho, $8,395; for removing and resetting 9th St. bridge to Linder, Security Bridge Co., Minneapolis, Minn., at $4,600.

Illinois.

Advices from Hickory, Ill., state that the bridge over the river at that place has been condemned and must either be repaired or reconstructed.

Bids were opened Jan. 9, by the Trustees of the East Side Levee & Sanitary District, East St. Louis, Ill., for the construction of four steel highway bridges over the Cahokia Creek Diversion Channel, the contract being awarded to the Joliet Bridge & Iron Co., Joliet, Ill. The bids received on the work were as follows: (1) stating price four highway bridges completed; (2) for additional plain masonry, per cu. yd.; (3) allowance for reduction in masonry, per cu. yd.; (4) additional piling, per lin. ft.: Milwaukee Bridge Co. (1) $58,549, (2) $10, (3) $10, (4) 80 cts.; Toledo Bridge & Crane Co., (1) $57,557, (2) $10.51, (3) $8, (4) 40 cts.; Winamac Bridge Works, (1) $52,993, (2) $10, (3) $5, (4) 70 cts.; Midland [illegible] 60 cts.; Missouri Bridge & Iron Co., (1) $53,685, (2) $10, (3) $7.50 (4) 60 cts.; Central States Bridge Co., (1) $56,000, (2) $10, (3) $8, (4) 60 cts.; S. R. H. Robinson & Son Contracting Co., (1) $60,990, (2) $10.50, (3) $7, (4) 45 cts.; Stupp Bros. Bridge & Iron Co., (1) $63,900, (2) $8.50, (3) $7, (4) 65 cts.; McClintic-Marshall Cons. Co., (1) $59,900, (2) $9, (3) $7, (4) 40 cts.; Murphy Cons. Co., (1) $58,206, (2) $8.72, (3) $6.81, (4) 59 cts.; National Contracting Co., (1) $65,817, (2) $6,

(3) $6, (4) 40 cts.; Joliet Bridge & Iron Co., (1) $53,475, (2) $8.50, (3) $6.50, (4) 65 cts.; Massilon Bridge & Structural Co., (1) $62,000, (2) $9.75, (3) $4.60, (4) 50 cts.

Indiana.

Board of Public Works of Elkhart, Ind., has [illegible] the matter of securing $[illegible]000 of the County Commissioners for the construction of three bridges, one over the river at the east end of Berdsley Ave., opening a thoroughfare to the Conn Horn factory.

The Pittsburg & Shawmut Ry. bridge across the Mahoning Creek, which was being erected by the American Bridge Co., was recently washed out by an ice gorge, according to advices from Indianapolis, Ind. The structure was within three days of completion.

Iowa.

⦿The Board of County Commissioners, Creston, Ia., has let the Union County bridge contract to the Standard Bridge Co., Omaha, Neb.

⦿Contracts for the construction and necessary material of four reinforced concrete bridges have been awarded by the Board of Supervisors, Marshalltown, Ia., to N. M. Stark Co., Des Moines, Ia., at $11,500, and Wheeler Lumber Co., Des Moines, Ia., at $6.268. The bridges include one 140-ft. span; two 50-ft. spans; one 70-ft. span.

Kansas.

Commissioners of Wyandotte County at Kansas City, Kan., have approved the plans of J. M. Lindsey, County Surveyor, for the extension of the north approach to the Fifth St. bridge over the Kaw River. The structure will be rebuilt temporarily, a span added where the present approach is located, and the latter carried over the dike. The cost of the proposed work is estimated at $8,000. Bids for the work will be advertised at once.

Michigan.

City Engineer H. A. Johnston, Kalamazoo, Mich., is preparing instructions relative to the construction of the new Gull St. bridge. According to the plans, the structure will consist of three reinforced concrete spans, each 59 ft. in the clear, with a rise of 6 ft. 6 in., 38 ft. wide between the parapet walls with an 8-ft. cement sidewalk on the north side. The estimated cost of the work is $25,000, bonds for the amount having been voted at the November election.

Minnesota.

✣Bids will be received until 10 a. m., Feb. 4, by County Auditor Warren, Marshall County, Minn., for the following corrugated culverts, about 2.200 ft., including 25 culverts of 3 ft. diameter; 25 culverts 4 ft. diameter; 35 culverts of 5 ft. diameter; 15 culverts of 6 ft. diameter. Specifications will be furnished by W. R. Hoag, C. E., 1320 S. E. 7th St., Minneapolis, Minn.

⦿Commissioners of Hennepin County, Minn., have awarded the contract for the construction of a bridge over the "Narrows," Lake Minnetonka, to the Minneapolis Steel & Machinery Co., Minneapolis, Minn., at $38.500.

City Council of Duluth, Minn., passed a resolution declaring that in building bridges across Grand Ave. and 59th Ave. the Canadian Northern Ry. should leave a clear span on both thoroughfares.

Mississippi.

Advices from Port Gibson, Miss., state that the County Suspension bridge over Little Bayou Pierre, just north of that city, was swept away by a flood, and immediate steps will be taken toward the construction of a new bridge.

⦿Board of Supervisors, Gulfport, Miss., awarded a contract Jan. 2 to the Vincennes Bridge Co. at $3.102 for building a bridge connecting the counties of Harrison and Hancock.

Missouri.

✣Bids will be received until Jan. 30, by Board of Public Works, Kansas City, Mo., for the construction of the following bridges: A reinforced concrete arch bridge over the Blue River at 15th St., in which there will be approximately 3,600 cu. yds. of concrete, 300,000 pounds of steel and 1,260 sq. yds. of creosoted block pavement. Second. A reinforced concrete arch bridge over Brush Creek at Cleveland Ave., containing 900 cu. yds. of concrete, 80,000 lbs. of metal and 360 sq. yds. of creosoted block pavement. Tenders may be made upon each bridge separately or they may both be included in one tender. Plans and specifications are on file in the office of the Board of Public Works, or bidders may obtain copies by application to Waddell & Harrington, Leslie-Orear Building, Kansas City, upon the payment of $25, the same to be refunded if the papers are returned to the engineers.

A bill was recently passed by the City Council of Springfield, Mo., appropriating $5,000 out of the current expense fund to pay the city's share of the cost of constructing a concrete arch bridge on Boonville St. over Wilson Creek. The Springfield Traction Co. has submitted a check for $1,500, its portion of the cost.

Plans for the construction of the proposed 12th St. viaduct in Kansas City, Mo., according to advices from that city under date of Jan. 11, are still unsettled, but will probably be decided upon in the near future.

According to advices from Joplin, Mo., the matter of arranging for the necessary funds has now reached a tangible form, and it is likely that by the middle of summer something definite will be decided in regard to the construction of the proposed Broadway viaduct over the bottoms at that city. J. C. Hodgson is City Engineer.

Nebraska.

⦿The Western Bridge & Construction Co., Omaha, Nebr., has been awarded the contract for constructing all steel and wooden bridges for York County during 1911. Bids were opened Jan. 10, by H. F. Chapin, County Clerk, York, Nebr.

⦿Standard Bridge Co., Omaha, Nebr., has been awarded the contract for constructing all steel and wooden bridges for Fillmore County for the year 1911. Bids were opened Jan. 10 at Geneva, Nebr.

New Mexico.

The Santa Fe Ry System has appropriated $11,000 to cover the cost of the construction of two concrete arches between mile posts 416 and 417 on the Albuquerque division. of which B. H. Newlee, Las Vegas, New Mexico, is Engineer.

New York.

At a special town election at Northampton Beach, L. I., Jan. 3, it was voted to build a new bridge over the canal at Quogue. It is proposed to erect at a cost of approximately $8 000 a level-balanced swing bridge, plans of which have been prepared by the State Highway Department. The plans make the swing a part of the bridge, which is 84 feet long, 25 feet wide and gives a span of thirty feet in the clear. This is to be built entirely of iron and concrete, and will be a first-class structure in every respect.

At the special town meeting held Jan. 4 at Warsaw, N. Y., as mentioned in our last issue, it was voted to appropriate the sum of $3.000 for the construction of a bridge over Oatka Creek, near the north town line on the proposed state highway.

According to an announcement reported to have been made by Frederick P. Flanagan, Secy., Joint Commission on the Interstate Bridge at New York, engineering investigation of the river bottom preliminary to the definite approval of a site for the proposed bridge across the Hudson River, connecting New York and New Jersey, has been discontinued until funds are available for the New Jersey section of the Interstate Bridge Commission.

Fire Chief of Schenectady, N. Y., has recommended in his report to the Commissioner of Public Safety that a viaduct be built to the Ninth Ward. The Board of Estimate will be instructed to consider the matter by the Commissioner.

North Carolina.

⦿The Commissioners of Forsyth County at Winston-Salem, N. C., have awarded the contract for the construction of a new concrete bridge spanning the Eno river at Christiam's Mill to the Carter Construction Co., at $10,500. Other bidders on the work were the Cates Machine Co., Carolina Construction Co. and C. C., Jacobs, Winston-Salem, N. C.

Ohio.

⦿City of Columbus has awarded the contract for the construction of pavement on the Mound St. viaduct to A. G. Pugh, the lowest of seven bidders, at $18,000. Work will be started as soon as weather conditions permit.

At a meeting of the Board of County Commissioners, Cleveland, O., it was decided that the new high level bridge to connect Superior and Detroit Aves. would be a straight-line bridge. Resolutions were adopted authorizing County Engineer Lander to prepare sketches and estimates of cost for a bridge 120 feet wide. Car tracks will be separated from vehicle and other traffic.

Steps are being taken by Committee of the Whole, Cincinnati, O., to secure the construction of a viaduct over the tracks of the Louisville & Nashville at Willow St. or State St.

Oklahoma.

⦿Advices from Muskogee, Okla., state that the contract for the construction of twenty-nine bridges has been awarded the Vincennes Bridge Co., Vincennes, Ind., at $54,000.

Oregon.

A petition signed by several hundred property owners in the vicinity of Roseburg, Ore., has been presented to the County Commissioners asking for the construction of a bridge across the Umpqua River to connect the Garden Valley District with the city. Another petition filed asked the construction of a bridge near the Dimmick Ferry at Kellogg, Ore.

The Harriman railroad interests have awarded the contract for furnishing the steel work for the superstructure of their new bridge at Portland, Ore., to the American Bridge Co., New York. The Union Bridge & Construction Co., Kansas City, Mo., which, as mentioned in our last issue, was low bidder for the municipal bridge substructure in Portland, Ore., has the contract for the substructure of the railroad bridge, and expect to have their part of the work completed by March 1. The work of filling concrete between piling driven in the frame of the pier located on the West Side harbor line has been commenced and is progressing rapidly, so that after it is permitted to set for three or four days the piling will be cut off that project above the bed. After the water is pumped out the shaft is to be started. Pier No. 4, which is located in deep water toward the East Side, is being sunk rapidly, and within another week is expected to be resting on the bottom. where the depth of water is over 100 feet. When details are arranged concerning the placing of abutments in the street, between Front and First on Glisan, the contractors will proceed at once to finish that portion of the undertaking, which will afford an approach to the foot of Third St. from the upper deck, where all but steam railroad traffic is to cross. The completion of the bridge will be hurried when the steel arrives, and it is not doubted but that it will be ready for the public when Christmas rolls around.

Plans have been completed by City Engineer of Portland, Ore., for the construction of the proposed South Portland Bridge at Woodward Avenue, and same will be submitted to the City Council as soon as estimates of the cost can be made. As proposed, the structure will be 4,000 ft. long, connecting Woodward Ave. and Meade St., with a lift type draw span.

Pennsylvania.

Street Committee recommended to the Borough Council of Jeannette, Pa., that the Second St. bridge, when a new one be constructed, be raised so as to clear the tracks at a height of 22½ ft. It was also decided to widen the span in accordance wtih the request of the railroad company.

Court of Berks County, Pa., has approved the recommendation for the construction of

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

a new bridge across the Schuylkill River between Reading and West Reading.

The court has approved the contracts awarded recently by the County Commissioners, York, Pa., to Hartley, Zeigler Co., for the reconstruction of the College Ave. Bridge, and work will be rushed through to completion.

South Dakota.

✣Bids will be received until 7:30 p. m., Feb. 27, by John W. Summers, City Auditor, Yankton, S. Dak., for furnishing all materials and labor connected with constructing and completing ready for travel a steel reinforced concrete bridge across the Rhine Creek on Walnut St., Yankton, S. Dak. Bridge to have a clear span of 50 ft., rise of 8 ft. 6 in. Concrete railing, clear roadway of 26 ft. Height from bed of creek to arch 10 ft. 10 in., from bed of creek to street grade 12 ft. 7 in. Bidders to furnish their own plans and specifications for a bridge designed to carry a 20-ton road roller or 200 lbs. to the square foot. For further information apply to the City Engineer.

Texas.

⦿City Council of Austin, Texas, on Jan. 6 awarded the contract for the construction of a reinforced concrete bridge or culvert over Shoal Creek at Fifth and Nueces Sts. to Raymond McDonald, Austin, Texas, at $2,300.

⦿Dallas County Commissioners Court, Dallas, Tex., has awarded the contract for the construction of the Wilmer, Hutchins and Malloy bridges across the Trinity River to the Missouri Valley Bridge & Iron Co., at $41,780. The contract does not provide for the construction of the approaches to the bridges, but covers the cost of the structures only. The approaches will be built under the supervision of the Commissioners' Court, members of which estimate that of the bond issue of $73,000 they will have left after the bridges are completed approximately $13,000.

Virginia.

Citizens of Matoaca, Va., recently held a mass meeting to take up for discussion the matter of constructing a steel bridge across the river at that point. County Commissioners, Chesterfield, Va., will probably be asked for assistance.

The Board of Commissioners, Northampton County, Va., at Eastville, Va., recently held a conference with the railway officials in regard to constructing a bridge where the public road crosses the railroad tracks leading into Cape Charles. It is planned to erect a concrete structure with graded approaches, to cost about $10,000.

A meeting was recently held at Spottsylvania, Va., by the Road Commission and the Board of Supervisors, to discuss the matter of constructing bridges over Hazel Run and Massaponax Run. It was decided to bridge both streams with either concrete or steel structures. Plans and specifications will be made at once and bids asked shortly.

Washington.

Advices from Tacoma, Wash., state that the bridge which the city will construct over the city waterway on 11th St. will be a 200-ft. vertical lift structure.

City Council of Tacoma, Wash., has passed an ordinance authorizing the Mayor to sign a contract with the engineering firm Waddell & Harrington, New Nelson Bldg., Kansas City, Mo., for plans and superintendence of construction of the proposed 11th St. and Puyallup Ave. bridges.

At a recent meeting of the City Council of Tacoma, Wash., an ordinance authorizing the Commissioner of Public Works to let a contract for the construction of a bridge across Buckley Gulch to North 29th St. was given its first reading.

West Virginia.

At a recent meeting of the City Council of Benwood, W. Va., City Engineer Clem Smith was instructed to prepare estimates of the probable cost of the construction of a bridge from Kentucky Heights across the B. & O. tracks at Sixth St. The city and the Wheeling Traction Co. will each bear one-third of the expense.

Wisconsin.

City Council of Hudson, Wis., adopted the report of the Special Joint Committee providing for the construction of a bridge across the St. Croix River, to replace the present wooden structure, at an estimated cost of $20,000.

Canada.

The Board of Control. Winnipeg, Man., has instructed City Engineer to prepare specifications for the archways which are to be constructed on Armstrong's Point, and tenders for the work will be called as soon as the details have been worked out.

Henry Holgate, Engineer, Montreal, Can., in a communication to the Civic Guild, recommends instead of the proposed Bloor St. viaduct the construction of a bridge over the Don to Danforth Ave., which he estimates would effect a saving of $438,000.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Colorado.

✣Bids will be received until 10 a. m., Jan. 26, by Board of Directors of the Omer Irrigation District, Fowler, Otero County, Colo., for the construction of a dam for Omer Reservoir No. 1, a diversion dam head works and sluice gates for the Omer Canal, and for the removal of about 100,000 cu. yds. of earth work in the extension and enlargement of said canal and for furnishing of cement, valves, steel and other material necessary for the construction. Plans, specifications and other particulars may be obtained at the office of the District at Fowler, Colo., or at the office of The Field, Fellows & Hinderlider Engineering Company, 435 Century Building, Denver, Colo. E. H. Hall is Secretary of the District.

As noted in the issue of Jan. 4, the U. S. Government has allotted $1,500,000 for work on the Uncompahgre Irrigation project. This money will be expended in the construction of lateral systems and a dam for the Taylor Park Reservoir. No contracts will be let on this work before spring. C. T. Pease, Montrose, Colo., is Engineer.

Idaho.

The sum of $6,585,435 has been allotted by the U. S. Government for the Payette-Boise project in Idaho. A large part of this allotment will be used in building a dam at Arrow Rock for storage purposes. This dam is located on the Boise River about 25 miles above the city of Boise and will supplement the water supply for about 175,000 acres of land. The dam will be approximately 340 ft. high. F. E. Weymonth, Boise, Idaho, is Supervising Engineer.

Illinois.

✣Bids will be received until 10 a. m., Jan. 21, at the office of Paul MacGuffin, Attorney, Libertyville, Ill., for the construction of drainage ditch of Seavey Slough Drainage District in Libertyville and Vernon Townships, Lake County, Ill. The nearest railroad stations are Libertyville, Ill., on the C. M. & St. Paul Ry., Rockefeller and Prairie View, Ill., on the Minn., St. Paul & Sault Ste. Marie Ry. (Wisconsin Central), the Elgin, Joliet & Eastern crosses the district on the north. The work on which bids are to be received consists of the excavation of approximately 8,872 lin. ft. of ditch 6 ft. deep and 15 ft. bottom width, 5,776 lin. ft. of ditch, 14 ft. bottom width and 6 ft. 2 in. deep and 3,104.3 lin. ft. of ditch 6 ft. 8 in. deep and 4 ft. bottom width, all with side slopes of 1 to 1, making a total excavation of approximately 75,963 cu. yds., from which 8,484 cu. yds. must be deducted as a credit to property owners for work already done. Windes & Marsh, Winnetka, Ill., are the Engineers.

✣Bids will be received until 2 p. m., Feb. 3, by Commissioners, East Peoria Drainage & Levee District, Tazewell County, Illinois, for the following work: Section 9—Levee and Muck Ditch, 105,500 cu. yds.; Sec. 10—Drainage ditches, 64,300 cu. yds.; Sec. 11 and 12—Furnishing and erecting a complete drainage pumping plant, including excavations, foundations, building and machinery. The pumping plant shall have a capacity of 33 cu. ft. per second against a maximum static head of 22 ft. The plant shall contain two centrifugal pumps, two induction motors, of the proper size to pump at specified capacity, two speed reducing transmission gears, and all auxiliary appurtenances, including priming apparatus, switchboard, station wiring, etc. For further information address Harman Engineering Co., 120 Fredonia Ave., Peoria, Ill. Official advertisement will be found elsewhere in this issue.

Indiana.

Bids are to be asked soon by H. A. Blunk, Commissioner of Construction, Martinsville, Ind., for completing the L. C. Cook ditch. The work includes about four miles of ditch work, requiring about 68,000 cu. yds. of excavation.

Hearings have been held by the Commissioners of Dekalb County, Auburn, Ind., on the petitions for the establishment of the Spangler ditch.

Iowa.

Supervisors of Woodbury County, Sioux City, Ia., have voted to establish the Little Sioux ditch.

Kentucky.

The Caldwell Concrete Co., 1516 Jefferson St., Paducah, Ky., has about 25,000 cu. yds. of excavation, suited for a drag line outfit or a dredge, which it will sub-let.

Louisiana.

The taxpayers of the drainage district in the interior of St. Bernard Parish, St. Bernard, La., have voted a special tax for drainage purposes. The special tax will be followed by a bond issue of $500,000, which is also authorized, so that the Board of Commissioners for the Bayou Terre-aux-Boeufs Drainage District can undertake the work at once.

Minnesota.

In a report to the Commissioners of Ramsey County, J. H. Armstrong, County Surveyor, St. Paul, states that the county lakes should be improved by deepening and clearing out stumps and weeds.

Mississippi.

The Board of Mississippi Levee Commissioners, Greenville, Miss., will award a 600,000 cu. yd. levee contract next month.

Missouri.

⦿Matt & Bemis, Seward, Neb., have been awarded the contract for furnishing 40,000 cu. yds. of rock for the standard revetment to be constructed at Randolph opposite Kansas City for the U. S. Government. The contract for constructing the revetment was awarded to Rust, Swift & Co., Chemical Bldg., St. Louis. Mo., as noted in our last issue at $8.29 per lin. ft. for revetment, 35 cts. per lin. ft. for yellow pine piling driven and 30 cts. per lin. ft. for cotton wood piling driven. The other bids received on the work were as follows: Jones & Sons, Leavenworth, Kans.: Standard revetments $8.60 per ft., yellow pine piling driven, 50 cts. per ft.; cottonwod pil-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

ing, driven, 40 cts. per ft. Matt & Bemis, Seward, Neb., standard revetments, $8.60 per ft.; yellow pine piling driven, 40 cts. per ft. Dewitt & Shobe, Glasgow, Mo., standard revetments, $8.44 per ft.; yellow pine piling driven, 35 cts. per ft.; cottonwood piling driven, 25 cts. [illegible]

Minnesota.

✣Bids will be received until 10 a. m., Feb. 4, by J. L. George, Auditor of Beltrami County, Bemidji, Minn., for the construction of Judicial Ditch No. 3, Beltrami County, according to the plans and specifications of the engineer now on file. Said ditch as surveyed by the engineer is about 15 miles long, and the estimated number of yards of dirt to be excavated is about 81,000 yds.; the amount of road and bridge work to be done is estimated at about $4,000. Total estimated cost of the construction of said ditch being about $19,000. Bids will be received for the work as one job or for one or more sections of said work. Each bid must be accompanied by a certified check on a bank of Bemidji, Minn., for not less than 10 per cent of the bid. The successful bidder will be required to furnish a good and sufficient bond in amount of the contract conditioned upon the faithful performance of said contract.

✣Bids will be received until 10 a. m., Feb. 4, by J. L. George, Auditor of Beltrami County, Bemidji, Minn., for the construction of Judicial Ditch No. 4, Beltrami County, according to the plans and specifications of the engineer now on file in said office. Said ditch, as surveyed by the engineer is about 12 miles long, and the estimated number of yards of dirt to be excavated is about 63,000 yds.; the amount of road and bridge work to be done is estimated at about $3,200. Total estimated cost of the construction of said ditch being about $15,600. Bids will be received for the work as one job or for one or more sections of said work. Each bid must be accompanied by a certified check on a bank of Bemidji, Minn., for not less than 10 per cent of the bid. The successful bidder will be required to furnish a good and sufficient bond in the amount of the contract conditioned upon the faithful performance of said contract.

✣Bids will be received until 2 p. m., Jan. 27, by G. C. Smith, Auditor, Isanti County, Cambridge, Minn., for digging and constructing Ditch No. 8 in Isanti County. The approximate amount of work included in the ditch is as follows: Number of cubic yards to be excavated in the construction of said ditch, 112,659.7 yds.; 12 acres clearing; building 2 new bridges and rebuilding 3 old bridges. The estimated total cost of the work is $11,935.97. All bids must be accompanied by a certified check payable to the auditor of said county, for not less than 10 per cent of the amount of each bid.

✣Bids will be received until 2 p. m., Jan. 20, by Samuel G. Iverson, State Auditor, St. Paul, Minn., for the construction of State Ditch No. 89, St. Louis County. Plans and specifications are on file at the office of George A. Ralph, State Drainage Engineer, St. Paul, Minn.

Montana.

The allotments from the combined special loan and general reclamation funds recommended by the Engineer Officers, and approved by the President, provide for Milk River Project in Northern Montana, $3,950,000; for Sun River Project, in western central Montana, $3,278,000; for completing the Lower Yellowstone Project in eastern Montana, $578,000; for completing the North Dakota Pumping Projects $270,000; for completing the Huntley Project in southern central Montana $110,000; for the Shoshone Project in northern Wyoming $2,000,000. The Milk River Project involves also the construction of the St. Mary feature; the majority of the work can probably best be handled with steam shovels, as can also the majority of the Milk River Valley work. The combined features will aggregate upwards of 5,000,000 cu. yds. of excavation, most of which is earth. The Sun River Project will, in addition to several million cubic yards of steam shovel excavating work, invovle tunnel construction, and the building of several storage reservoirs, both earth and rock embankment and masonry. The Shoshone Project work will also involve considerable steam shovel work, and several reaches of rock tunnel. Excellent opportunities for the very economical development of power exists at the Shoshone dam. The power may be used in the tunnel work, and can be conveniently transmitted to and along the canal excavation work for actuating power shovels. There will, in addition to the larger features on each project, be the lateral and distribution system canal works, which are in themselves necessarily very extensive. H. N. Savage, Helena, Mont., is Supervising Engineer, U. S. Reclamation Service.

Nebraska.

✣Bids will be received until 11 a. m., Jan 20, by R. E. Evans, Dakota City, Neb., for the construction of the Elk Creek cut off ditch and Pigeon Creek ditch. Plans and specifications are on file at the office of the Towl Engineering Co., Omaha, Nebr.

New Mexico.

⊙W. R. Winburn, Maxwell, N. Mex., has been awarded the contract for constructing the Eagle Tail ditch in Colfax County, N. Mex. This ditch is 17 miles long and 31 ft. wide in the bottom. Work was started last month with 40 teams and this force will be increased as the work progresses. The entire ditch is to be completed within the year.

North Carolina.

⊙The Stetzer Engineering & Construction Co., Philadelphia, Pa., has been awarded the contract, at $7.40 per lin. ft., for constructing 2,000 lin. ft. of concrete retaining wall for Moorhead City, N. C. Bids were opened Jan. 2.

Ohio.

⊙The contract for constructing the Benninghofen levee in Fairfield Township has been let to M. J. Lewis, of Fairplay, and Elmer Nugent, Cleves. The work includes 30,155 cu. yds. of excavation. The contract price is $4,703.

County Engineer Swisher, Urbana, O., has made revised estimates of the cost of dredging Mad River north of the Pennsylvania R. R. The county commissioners considered the revised estimates on Jan. 10.

The West Side Board of Trade, Randall Baker, Secretary, of Columbus, O., has formulated plans to change the channel of the Scioto River through the city of Columbus and divert it west of the Columbus State Hospital. The scheme entails the diverting of the Olentangy near the O. S. U. grounds southwest to a point opposite the State Hospital pumping station. The Scioto would be changed from a point directly north of the hospital, so that the two streams would conjoin near the hospital grounds.

The assessment ordinance for the proposed levee improvement at Hamilton, O., will be presented to the City Council of that city shortly. John W. Hill, Cincinnati, O., is Consulting Engineer for this levee.

Oregon.

⊙The U. S. Department of the Interior has approved the award of the contract to George C. Clark, Everett, Wash., for the construction of the Lost River diversion dam for the U. S. Reclamation Service. The dam will cost $83,512 and extra work $15,044. Work is to be commenced this month and is to be completed within one year.

Texas.

The Commissioners' Court of Washington County at Brenham, Tex., has authorized issuance of $57,000 worth of bonds, money to be used for construction of improvements on the Brazos River to prevent overflows between Old Washington and Chappell Hill.

Utah.

Concreting work on the Davis-Weber County irrigation canal has been suspended for the winter season and will not be resumed until spring, when 400 men will be placed on the job. About 162,000 cu. ft. of concrete had been completed on the canal before cold weather put a stop to operations. Seven miles of completed canal has been finished, including a half mile of rock work. The canal is 34 ft. wide on top and 22 ft. at the bottom, and has a depth of 6 ft., giving a capacity of 750 cu. ft. of water per second. The concrete work in the canal will cost $450,000, and a project is now on foot to increase the size of the big reservoir in Weber canyon at a cost of $350,000. William Bostaph, Ogden, Utah, is Chief Engineer.

Virginia.

Norfolk County Court, Portsmouth, Va., has authorized the formation of a drainage district to drain about five miles of land in the Butts Road District. The district will be known as Brides Drainage District No. 1.

Washington.

The U. S. Reclamation Service is planning a considerable amount of force account for the completion of the Tieton unit of the Yakima project. The Board of Army Engineers recently allotted $665,000 for the Tieton unit. The contract for excavation of main laterals on Wide Hollow branch of this unit was recently awarded to Nelson Rich, Prosser, Wash., as noted in our last issue, his bid being $116,070. Contract for sub-laterals on this branch has also been awarded to him, his bid being $50,160. The balance of the allotment will be used on force account work for the completion of the unit. Chas. H. Swigart, North Yakima, Wash., is Supervising Engineer, U. S. Reclamation Service.

WATER-WORKS

California.

City Trustees of Anaheim, Cal., have decided to call an election Jan. 30 to vote $8,500 for waterworks improvement.

Florida.

At a recent meeting of the City Council of Ocala, Fla., the Mayor recommended the installation of a new waterworks system to supply the residents instead of that now under control of the Ocala Water Co., whose franchise will expire next year.

Hawaii.

✣Bids will be received until 10 a. m., Jan. 21, by Constructing Quartermaster Capt. M. N. Falls, Honolulu, H. T., for sinking a 12-in. tubular deep well at Papahulu, near Fort Ruger, H. T.

Illinois.

✣Bids will be received until Jan. 21, by B. J. Mullaney, Commissioner of Public Works, City of Chicago, for furnishing and delivering packing to the various pumping stations. Contractors proposing to bid on this work are expected to submit a sample of each kind of packing. The approximate quantities, sizes, etc., are as follows; 1,600 lbs. for high pressure steam (175 lbs.), in ring or spiral form; 2,000 lbs. for medium pressure steam (100 lbs.), in ring or spiral form; 1,400 lbs. for hot water, 200° F. and 175 lbs. pressure; 500 lbs. cold water packing, 100 lbs. pressure; 3,000 lbs. long fibre Italian Flax Packing or some brand equally as good for 75 lbs. pressure; 1,400 lbs. of Daniels' P. P. P. special hydraulic packing

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

or some brand equally as good; 900 lbs. Ebonite or some brand equally as good; 600 lbs. sheet packing, Rainbow or some other brand equally as good; 500 lbs. Square Duck Rubber Back Packing for piston; 600 lbs. asbestos metallic gaskets, handhole manhole; 150 lbs. Goodsell One Dollar Rubber Back packing or some brand equally as good, and 100 lbs. asbestos wicking.

✣Bids will be received until January 21, 1910 (11 a. m.), by B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 705 City Hall, for furnishing and delivering to the various city pipe yards, tapping connections as follows: Five, 4x3; two, 4x4; twenty, 6x3; fifty, 6x4; five, 6x6; five, 8x3; thirty, 8x4; twenty, 8x6; five, 8x8; two, 10x3; two, 10x4; two, 10x6; two, 10x8; one, 10x10; two, 12x13; ten, 12x4; twenty, 12x6; twenty, 12x8; five, 12x12; one, 14x4; one, 14x6; one, 14x8; one, 14x12; five, 16x4; twenty, 16x6; ten, 16x8; five, 16x12; one, 18x4; one, 18x6; one 18x8; one 18x12; two 20x4; two, 20x6; two, 20x8; two 20x12; two, 20x16; five, 24x4; five, 24x6; fifteen, 24x8; five, 24x12; two, 24x16; two, 24x20; two, 30x4; two, 30x6; five 30x8; two, 30x12; two 30x16; two, 30x20; two, 36x4; five 36x6; five, 36x8; two, 36x12; one, 36x16; one, 36x20; one, 36x24; one, 42x4; one, 42x6; one, 42x8; one, 42x12; one, 48x4; one, 48x6; one, 48x8; one, 48x12. Each bidder must submit with his bid complete and detailed information concerning the tapping connection he proposes to furnish. The tapping connections shall be designed to provide a lateral connection at right angles to a main waterpipe under pressure, using a Smith tapping machine.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 705 City Hall, until Jan. 27, 1911, for furnishing and delivering 2 motor driven centrifugal pumping units; each unit shall comprise a horizontal shaft single staged pump directly connected to an alternating current motor by a flexible coupling both mounted on the same substantial sub-base, all designed for permanence and convenience of operation. Each pumping unit shall be capable of operating continuously at the rate of discharge of 20,000,000 gallons or more per 24 hrs., with a total suction and discharge head of 130 ft. and shall be of sufficient capacity to deliver 25,000,000 gallons or more per 24 hours under a total suction and discharge head of 115 ft. Each pump shall be of the single stage, horizontal shaft centrifugal type, with single main suction and discharge pipe connections not less than 24 in. in diameter, the impeller to be properly balanced against the end thrust. The motors shall be of the synchronous type, designed to operate on three phase, 60 cycles, at 440 volts, and designed to start without the use of auxiliary motive power. Besides furnishing pumps and motors the contractor shall furnish, deliver and erect in connection with same, the following: bedplates, starting apparatus, switchboard and equipment thereof, exciters, transformers to step down the current from 12,000 volts to 440 volts required at motor terminals, make the necessary connections between the service lines, transformers and switchboard and between the switchboard and the motors, all necessary suction and discharge pipes, etc., as shown on specifications on file at the office of the Commissioner of Public Works.

⊙Jno. A. Devoney has been awarded the contract for furnishing and laying house drains in N. Sacramento Ave., between Irving Park Blvd. and Montrose Ave., by the Board of Local Improvements, City of Chicago. Chas. A. V. Standish, Secy., Room 302 City Hall.

The following bids have been submitted to B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 705 City Hall, for furnishing special castings as follows: flange specials, United States Cast Iron Pipe & Foundry Co., $54.25 per ton; hub and spigot specials, $44.65 per ton; Brady Foundry Co., 35th St. and Ashland Ave., flange specials, $70.00 per ton; hub and spigot specials $60.00 per ton.

Following the low bids for furnishing lead pipe to the water department of the Department of Public Works, Chicago: E. W. Blatchford, 230 N. Clinton St., $5.05 per cwt.; Raymond Lead Co., 34 N. Clinton St., $5.05 per cwt.

Following is the bid submitted to B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 705 City Hall, for furnishing and delivering cast iron water pipe: United States Cast Iron Pipe and Fdy. Co., 638 The Rookery, Chicago, $23.75 per ton for all sizes of pipe.

Indiana.

Mayor of Logansport, Ind., has recommended the appropriation of $19,000 for the installation of new pumps and condensers at the water works plant and to place the same in good condition by spring.

Iowa.

A mass meeting was recently called by J. P. Starr, Mayor, Fairfield, Ia., of the citizens, to discuss the matter of improving the water works and lighting systems.

Bids were opened Jan. 3 by N. P. Reid, city clerk, Stafford, Kan., for furnishing material and constructing a water works and electric light plant. The probable successful bidder is Joseph A. Burtenlanger, Omaha, Neb.

Kansas.

⊙W. W. Cook & Son, Junction City, Kan., has been awarded the contract at $3,575 for furnishing material and constructing water works for the city of Onaga, Kan. Work includes everything except furnishing hydrants and valves, oil tower and tank. Bids were opened Jan. 10.

Advices received from Kansas City, Kan., state that the remaining $375,000 of the $900,000 voted for the extension and betterment of the water works system, will be spent this year extending the mains and establishing hydrant service in parts of the city heretofore without service.

Minnesota.

⊙The Water Board of St. Paul, Minn., let the following contracts Jan. 9: Crane & Ordway, St. Paul, for brass taps and stops for underground work, which will amount to close to $3,000. The South Park Foundry & Machine Co., for hydrants, the small size at $39.75, and the large size at $48.50, a saving of $1.25 and $1.75 per hydrant, respectively, as compared with 1910. For meters to the National Meter Co., which has supplied the department for several years. No bids for water pipe have so far been advertised for, as the board cannot make its proposed extensions unless given authority to issue the $100,000 in bonds asked for. The bond resolution has been passed by the aldermen, and members of the board will appear before the assembly at its next regular meeting to urge concurrence.

It is reported that the city of Argyle, Minn., has under consideration the matter of issuing bonds for the installation of a water works system.

At a special meeting of the Common Council of the city of Faribault, Minn., the report of the committee on new wells was taken up for discussion. Specifications for a new well to be drilled at some point designated by the committee on water works were read and adopted by the Council.

Mississippi.

Among the improvements recommended by Mayor of Laurel, Miss., in his message to the Board of Aldermen, is the improvement and enlargement of the city water works plant.

Missouri.

✣Bids will [illegible] Webb City, Mo., for the construction of a reinforced concrete reservoir for the Webb City & Carterville Water Co. The reservoir is to have a capacity of 1,500,000 gals. Plans may be obtained at the company's office.

The Fire and Water Board of Kansas City, Mo., is planning the construction of an oblong basin of 360,000 gals. capacity so constructed of reinforced concrete that four fire steamers can connect with it at the same time. It will be built under the pavements in the V-shaped space at the Junction of Ninth, Main and Delaware Sts. There is a small basin at this point now, and it will be torn out to make room for the new one. The basin will be attached to the water main and will be kept filled continuously to be available during a fire and in the event that an accident should occur to the water supply. The cost of the improvement is esimated at about $11,000.

The W. K. Palmer Company, engineer, 717-720 Dwight building, Kansas City, Mo., is preparing plans for a new pumping and electric light plant for the city of Atlantic, Iowa; bond issue, $50,000.

A delegation of citizens of Waldo, recently taken into the city limits of Kansas City, Mo., appeared before the Fire and Water Board and demanded a supply of Missouri River water. The Board announced that the demands upon its available funds were so great and that the Waldo proposition presented such physical conditions that would first have to be looked into that no definite answer could be given as yet.

A resolution was received and placed on file by the City Council of Hannibal, Mo., in relation to the water question, recommending the Mayor to notify the Chairman of the Committee of Six to investigate the needs of the city with reference to the water service and to report as to expediency of buying the plant of the Hannibal Water Co. or extending the franchise.

Montana.

It is reported that city of Helena, Mont., has authorized a bond issue of $650,000 to provide funds for the installation of a municipal water works plant.

Nebraska.

⊙The contract for the construction of a water and lighting system in the city of Beatrice, Nebr., has been awarded to the Mathews Construction Co., Kansas City, Mo., and work will be started about February 9. W. K. Palmer Co., 717-720 Dwight Bldg., Kansas City, Mo., Engineers.

Preliminary plans and specifications have been prepared by W. K. Palmer Co., Engineers, Kansas City, Mo., for water and lighting improvements in Norfolk, Nebr.

Plans and specifications have been prepared by the W. K. Palmer Co., Engineers, 717-720 Dwight Bldg., Kansas City, Mo., for the improvement of the Water and Lighting System and the construction of a new power plant in Grand Island, Neb. Bonds for the work have not yet been voted.

The water works plant at Atlanta, Neb., has been purchased by W. D. Van Meter, Cambridge, Nebr., from C. E. Corell.

The West End Improvement Club, Omaha, Neb., favors South Omaha, following the example of Omaha, in taking steps for the acquisition of a municipal water plant and with that in view intends to submit to the Charter Revision committee a proposal that the Mayor and City Council be empowered to issue bonds to the extent of $500,000 for such a purpose.

New Jersey.

Borough Council of Glen Ridge, N. J., voted Jan. 9, to expend $250 for maps of a proposed new water system in the borough. President Frederick M. Sheppard, of the Orange Water Company, suggested that the borough engage a disinterested party, competent to make an examination of the plant in Glen Ridge, and to submit figures as a basis for negotiations for the purchase of the system in the borough. The subject was referred to the Water Committee, of which Councilman Skillen is chairman, and he will submit a report at a future meeting after consulting with the other members of the council.

A meeting was recently held at Union, N. J., by the Executive Committee of the Connecticut Farms Improvement Association; the matter of improving water supply, street lighting and highways was discussed.

New York.

At a recent meeting of the Village Board of Trustees, Granville, N. Y., among other matters discussed were those of enlarging and improving the water reservoir and the installation of a better fire fighting equipment.

Common Council of Rochester, N. Y., is to take up at its next meeting a resolution approving plans of the State Water Supply Commission for the construction of a storage dam in the Genesee River.

North Dakota.

City Commissioners of Mandan, N. Dak., have voted to accept the plans submitted by Burns & McDonald, Scarritt Bldg., Kansas City, Mo., for the establishment of a water works plant in that city. It is believed that actual construction work will be started in the spring.

City Engineer of Fargo, N. Dak., has completed surveys of the site proposed for the new filtration plant and drawings of the preliminary plans for the improvement is now being made.

Ohio.

The first recognition of the report of the Board of Health is to be taken when a resolution will be introduced into the City Council of Cleveland, O., authorizing the appointing of a committee to investigate the cost, location and systems in various large cities of the world, with the view of installing a permanent filtration plant.

The Water Works Commissioners as a result of a recent inspection will petition the City Council of Cincinnati, O., to install a set of new pumping engines to replace the old ones at the water works plant.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. is taking steps to secure the condemnation of the water works property at Miamisburg, O., to make possible a change in route near that city. The city values the property at $15,000, and such a move would necessitate the construction of a new plant.

Oklahoma.

Town of Duncan, Okla., recently voted on the question of issuing $12,000 of bonds for the purpose of extending and developing the present water works system.

Advices from Haskell, Okla., under date of January 5, state that the bond issue election authorizing $35,000 for the construction of a water works system in that town carried.

Citizens of Sapulpa, Okla., have advanced the city a sufficient sum of money to drill and equip five deep wells in hopes of relieving the present water situation. The wells will be drilled in the limestone country 4 miles west of the city.

As a preliminary to the work of rehabilitating the present municipal water works system the City Council of Muskogee, Okla., authorized the engineering department to enter into a contract for the sinking of not over three wells in the Arkansas at a cost of $50 each, for the purpose of ascertaining the depth of solid rock in the stream. This is necessary before a new intake from the pumping station to a point in the Grand river is laid.

McAlester, Okla., is preparing to vote a bond issue for the purpose of building a dam to supplement its water supply and prevent a recurrence of the recent water famine.

Pennsylvania.

The Ohio Valley Water Co. has employed Chester & Fleming, Consulting Engineers, Union Bank Bldg., Pittsburg, Pa., to design and construct a reinforced concrete roof for the clear water storage reservoir at Bellevue, Pa.

Town Council of Schuylkill Haven, Pa., has decided to hold a special election Feb. 14 to allow the voters of the town to decide upon the question of borrowing $50,000 to build new water works system.

Board of Health has recommended in the annual report, that the Council of Coatsville, Pa., make an effort toward securing a better water supply.

The Edgeworth Water Co., Edgeworth, Pa., has employed Chester & Fleming, Consulting Engineers, Union Bank Bldg., Pittsburg, Pa., to prepare plans for the installation of a stand pipe for the high district and extensions to the mains in that district.

Texas.

✣Bids will be received until Jan. 23 by R. E. Ward, mayor, Georgetown, Texas, for furnishing approximately 300 tons of class "B" cast iron water pipe. Specifications are on file with F. H. Lancashire, Dallas, Texas.

⊙City Commission of Dallas, Texas, has awarded a contract to Kinnison Bros. for the construction of an 8-in. pipe line up Pacific Ave., from the Trinity River to Harwood St., at $7,280. The contracting firm will install at the river a pump and engine of not less than 75-horsepower and will suitably house this equipment. Six-inch gate valves are to be installed at all street intersections, with nipples for fire hose connections, such valves to be inclosed in wooden boxes. The work is to be completed in twenty-five days, and a penalty of $50 per day is fixed for each day longer than the time specified in the contract. A bonus of $10 per day is offered for completion of the work in less than contract time.

Citizens of Karnes City, Texas, are, according to advices from that city, advocating the installation of a new water works system.

An election was held in Fort Worth, Texas, Jan. 13, to vote on the question of issuing bonds to the amount of $2,000,000, of which sum $1,500,000 will be spent for the improvement of the water works system.

City of Baird, Texas, will make extensions to the water works system to cost about $3,500. Some new apparatus will also be added to the fire department. J. H. Walker is City Clerk.

Information received from Taylor, Texas, states that Andrew J. Zilker, Austin, Texas, has purchased the water works of that city and is planning to make extensive improvements at once.

City Commission of Polytechnic, Texas, has instructed City Secretary to procure plans for the construction of the proposed municipal water works system.

Virginia.

A resolution is to be presented to the City Council providing that the body view the city lakes and water works of Norfolk Va., in order to understand the conditions which must be met in safeguarding the city against a water famine.

Washington.

✣Bids will be received until 11 a. m., Jan. 23, by Lieut. A. L. Sneed, constructing quartermaster, Fort George Wright, Wash., for sinking one 10-in. tubular deep well at that post. All necessary machinery, work and material to be furnished by contractor, who should state in his proposal where his plant may be seen and inspected. Proposals must be accompanied by certified check or guaranty in the sum of $500. Specifications, instructions to bidders and full information in regard to the work required will be furnished upon application at this office.

It has been announced, according to advices from Walla Walla, Wash., by W. B. Forshay, Manager of that branch of the Pacific Power & Light Co., that a power line for pumping will be constructed through the entire country between Freewater, Touchet and Gardena.

Bids were opened Jan. 3, by the Board of Works, Spokane, Wash., for the construction and completion in full of the addition to Lincoln Heights concrete reservoir. The bids were as follows: Elrick & Hartnett, $162,500; Boynton, Church & McCoy, $163,000. The Engineer's estimate was $140,000.

Wisconsin.

A special election was recently held at New Lisbon, Wis., to decide the question of bonding the city for $20,000 for the installation of a water and electric light system.

Canada.

✣Bids will be received until 11 a. m., Feb. 6, by M. Peterson, secretary, board of control, Winnipeg, Man., for the manufacture, delivery, and erection complete of two pumping plants, each of a capacity of 1,000,000 gals. per 24 hours. Specifications and forms of tender, together with conditions governing tenders as prescribed by by-law, may be obtained at the office of the city engineer, 223 James avenue, Winnipeg.

SEWERAGE AND GARBAGE DISPOSAL

Arizona.

⊙The following contracts were awarded recently by City Council of Tucson, Ariz., for the installation of the proposed sewer system in the southwest section of the city at a cost of approximately $20,000: Pacific Sewer Pipe Co., at $8,000, for furnishing pipe; Tucson Concrete Construction Co., at $4,956, for laying the street sewers; Arizona Home Building & Construction Co., at $996, for installing outfall sewer; Tucson Iron Works, at $13 each, for manholes and at $5.50 for lampholes.

California.

⊙The Board of Works, San Francisco, Cal., has awarded a contract to the Coast Improvement Co., for the construction of sewer improvements in Section A of the Sunnyside district, at $12,050.

⊙The contract for the construction of the proposed sanitary sewer system in the city of Oroville, Cal., has been awarded by the Board of Trustees to the Contra Costa Construction Co., 2323 Shattuck Ave., Berkeley, Cal., at $90,372. Bids were opened Jan. 3. E. J. Mitchell is City Clerk.

An election will be held in the city of Anaheim, as a result of a decision of the City Trustees, on Jan. 30, to vote on the question of issuing bonds amounting to $90,000 for the sewer system.

City of Calexico, Cal., which recently voted bonds in the sum of $35,000 for the installation of a new sewer system, has commissioned I. B. Funk, Engineer, Imperial, Cal., to prepare plans for the work.

Colorado.

City Council of Colorado Springs, Colo., has passed a resolution authorizing City Attorney to draw up an ordinance authorizing the construction of storm sewers in the main business section of that city. The cost of the work is not to exceed $48,000.

Georgia.

✣Bids will be received until 3 p. m., Feb. 6, by Mayor and General Council, at the office of the City Clerk, Atlanta, Ga., for the following work to be done during the year of 1911: The construction of all sewers that may be passed upon by the Mayor and General Council during the year 1911. Furnishing vitrified pipe, furnishing cement, and furnishing castings that will be needed in the above work. Furnishing and setting concrete and granite curbing. Furnishing and laying brick, tile and sheet cement sidewalks. Furnishing chert or gravel for macadam streets. Furnishing brick for repairs of sewers and sidewalks. Furnishing and laying tile and sheet cement for repairs of sidewalks. Furnishing tile for the city to make the repairs. Furnishing rubble stone and crushed stone for macadam and concrete. Furnishing sand for the repairs in street and sewer departments. Furnishing cement for repairs for ordinary street work. Specifications for the above work will be furnished upon application to the chief of construction. A certified check must accompany each bid in amount required in the specifications. R. M. Clayton is Chief of Construction.

Illinois.

✣Bids will be received until 11 a. m., Jan. 19, by Board of Local Improvements, Aledo, Ill., for furnishing the necessary labor and material for the construction of certain local improvements consisting of approximately 3,200 ft. of 10-in., 4,120 ft. of 8-in., 8,460 ft. of 6-in. tile pipe sewers; 51 manholes and 8 flush tanks. Plans and specifications may be examined and blank proposals secured at the office of the City Clerk, Aledo, Ill., or at the office of The W. S. Shields Co., Engineers, 1201 Hartford Bldg., Chicago.

Advices from Galesburg, Ill., state that preliminary work on the North Side sewer, which will be the largest of its kind in that city, is progressing nicely and by all indications will be completed during 1911. The work, it is estimated will require an expenditure of approximately $50,000.

◉City Council of Rockford, Ill, at a recent meeting, awarded the contract for collecting garbage for next year to C. Magnusson. The bidders for the work were as follows: A. T. Anderson, $4,944; A. O. Ferguson, $4,800; Charles Johnson, $4,775; C. Magnusson, $4,674

An ordinance was recently read before the City Council of Rockford, Ill., authorizing the construction of a combination storm and sanitary sewer in the territory north of Harrison Ave., estimated by City Engineer to cost $142,000. The sewer will be laid in portions of Harrison Ave., Albert, Fourteenth, Nineteenth, Twentieth and Twenty-fourth Aves., and Ninth, Tenth and Eleventh Sts.

Residents of the First Ward, Rockford, Ill., have entered a protest against the expenditure of $107,000 for the construction of the proposed Highland storm and sanitary sewer.

At a public meeting recently held in Rio, Ill., the majority of the citizens present were in favor of the construction of the proposed north side sewer.

Property owners of East Freeport, according to information just received from Freeport, Ill., held their first meeting recently to discuss the proposed new sewer system and pumping station to be installed in the near future in accordance with resolution recently adopted.

An assessment was recently made against the property owners of West Dundee, Ill., for the construction of a sewer system. Surveys for the work were made last year and it is believed that the work will be taken up shortly

City Council of Princeton, Ill., at a recent meeting passed an ordinance providing for the construction of five and one-half miles of sewers in that place, at an estimated cost of $24,400. The engineer's estimate of the work is as follows: 3,950 ft. of 15 in. sewer, complete with house junctions; 2,710 ft. of 12 in. sewer, complete with house junctions; 2,250 ft. of 10 in. sewer, complete with house junctions; 20,070 ft. of 6 in. sewer, complete with house junctions; 730 ft. of 6 in. house drains, including elbows in deep trenches; 110 manholes, complete with covers; 19 flush tanks, complete with siphons and pipe connections.

Plans prepared by W. B. Ewing, Village Engineer, La Grange, Ill., for the construction of an outlet sewer in that place have been approved. Estimates on the cost of the work prepared by the engineer have also been announced ample to cover the proposed improvement.

Indiana.

An election has been called for February 2 to vote on the question of installing general sanitary sewer in the town of Danville, Ind.

The town board of Bloomfield, Ind., has ordered the construction of an extensive addition to the sanitary sewer system. The addition will cover two sides of the public square as well as several blocks on Main, Washington and Spring Sts. Work, it is said, will be started at an early date

The trustees of the Indiana Epileptic Village, according to advices from New Castle, Ind., have awarded the contract for the construction of a sewer at that village to James Garvey, New Castle, Ind.

Iowa.

Advices from Clinton, Ia., state that there are to be several new sewers to be constructed in that place soon and several new water ways. It is hoped that other matters will be cleared up in order that active work may be started on the new sewers in early spring.

City of Mt. Vernon, Ia., has under consideration the construction of a new sanitary sewer system in that place and efforts are being made to obtain all information possible on the question before active work is begun.

Preliminary surveys have been made and estimates have been prepared for the construction of a sewer system in Winterset, Ia. Construction work has not yet been started. W. K. Palmer Co., 717-720 Dwight Bldg., Kansas City, Mo., Engineers.

It was decided by the citizens of DeWitt, Ia., at the election held Jan. 3, mentioned in our last issue, not to take any further steps at present toward the construction of the proposed sewer system.

Among the many improvements contemplated for Webster City, Ia., during the year of 1911 is the construction of an extensive sewer system which will, if constructed, require an expenditure of about $50,000.

Kansas.

The matter of constructing a storm water sewer in the vicinity of Wichita and Gilbert Sts., for which a petition was filed some time ago and for which bids were recently asked, will be again taken up by the Commissioners and the City Clerk, Wichita, Kans., authorized to readvertise the work.

At a recent meeting of the City Council of Leavenworth, Kan., ordinances providing for the construction of lateral sewers Nos. 5, 7, 8, 12, 14 and 18, were read and laid over until the next regular meeting.

A petition has been presented to the City Council of Wichita, Kan., asking for the construction of another sanitary sewer in that place. The new district will take in all that portion of the city north of the No. 1 Sewer District, most of that part being between the railroads and the drainage canal, and south part of the city below Harry St. It is believed that the cost of the work will be about $350,000.

Complete plans are now underway for the construction of a sanitary sewer in Garden City, Kan. The question as to whether the citizens want the improvement will be submitted at an election in the near future. The plan is to build about eight miles of main trunk line and laterals, thoroughly covering the business and main residence parts. The town will probably vote bonds to the extent of about $12,000 to cover the main line. The total cost, it is estimated, will be about $65,000.

Kentucky.

Zachery & Raymond, Paducah, Ky., have secured Civil Engineer E. F. Layman, Cincinnati, O., to prepare plans and specifications for the construction of a system of sewage purification for Colonial Heights, an addition to Paducah

Michigan.

The Common Council of Wyandotte, Mich., has approved the plans and specifications and blank estimates of Mason L. Brown, for the extension of sewers to south and west Wyandotte, mentioned in our last issue. The plans and specifications for the extension of the Orchard St. sewer were also approved and also the action of the Board of Works engaging M. L. Brown as Construction Engineer.

The Mayor of Muskegon, Mich., advocates in his New Year's Message, the complete rehabilitation of the city' water system, the improvement of Wood Ave. in the Ryerson Creek valley with crushed stone, the construction of a sewer to benefit residents in the Lake St. and Davis St. district east of the Ryerson Creek. D. C. Tabor is City Engineer.

The City Council of Grand Rapids, Mich., recently adopted the report of the Committee on Sewers recommending the construction of a sewer in South College Ave., between Logan St. and Wealthy Ave. immediately. An estimate of the approximate cost of building a sewer in College Ave. and in the alley which extends between Paris Ave. and College Ave. was also asked.

A petition is being circulated, according to information from Grand Rapids, Mich., by E. B. Gansser, for the installation of a sewer and water works system in East Grand Rapids. The matter will probably be placed before the voters for decision.

Minnesota.

◉H. L. Bartlett Co., Virginia, Minn., has two contracts for installing both storm and sanitary sewers in the towns of Marble and Keewatin. The work amounts to a sum of about $80,000 and active work will be pursued throughout the winter.

It has been recommended to the Health Commissioner by George Kreager, Plumbing Inspector, Duluth, Minn., to discontinue the practice of allowing sanitary sewer connections to be made with storm sewers.

Upon the request of the citizens in the vicinity of the Washington School, St. Cloud, Minn., City Engineer S. S. Chute is preparing plans for the construction of a proposed sewer system for that district.

Missouri.

According to advices from Kansas City, Mo., the geological and topographical survey work for the reconstruction and betterment of the city's sewer system will require this year the expenditure of about $50,000 or one-half the amount of bonds voted for that purpose. This is a necessary preliminary to plans that will require several years to work out and the expenditure of several million dollars, which will be charged chiefly against watershed drainage districts in special assessments.

At a recent meeting of the Horn Heights Improvement Club, St. Joseph, Mo., plans for beginning an active campaign to bring about the establishment of sewer districts and to securing other improvements were discussed.

A bill was passed by the City Council of Springfield, Mo., at a recent meeting adopting the specific plans made by the City Engineer for the construction of a district sewer in Sewer District No. 18, of section No. 4, and to fix and define the route and to order its construction.

In accordance with the request of the residents of Clifton Heights, the Board of Public Improvements, St. Louis, Mo., will prepare an ordinance for establishment of a sewer district in that section of the city.

Nebraska.

City of Broken Bow, Nebr., has under consideration the construction of a sewer system and has taken up the matter with the W. K. Palmer Co., 717-730 Dwight Bldg., Kansas City, Mo., Engineers.

A resolution has been introduced into the City Council of Omaha, Nebr., instructing the City Engineer to prepare plans and specifications for the construction of a storm sewer from Hanscom Park District to Jones St. The cost of the work must not exceed $57,000.

Preliminary plans have been prepared and estimates of cost made for the construction of a sewer system in Wymore, Nebr. Construction work has not yet been started. W. K. Palmer Co., 717-720 Dwight Bldg., Kansas City, Mo., Engineers.

Preliminary plans have been made and estimates prepared of the cost of constructing a sewer system in Madison, Nebr.; construction work has not yet begun. W. K. Palmer Co., 717-720 Dwight Bldg., Kansas City, Mo., is Engineer.

New Jersey.

At a recent meeting of the City Council of Camden, N. J., an ordinance was passed authorizing the construction of sewers or drains

✣ indicates work now open for bids. ◉ indicates a contract let recently.

n, and along Morton St. from Mount Ephraim Ave. to Louis St. and in Louis St. from Thurman St. to Morton St. William D. Brown is Clerk.

At a meeting of the City Council of Passaic, N. J., held recently, a resolution was adopted authorizing the Mayor to sign the contract with the Passaic Valley Sewerage Commission to aid in the construction of the trunk sewer.

New York.

The Board of Trustees, Lestershire, N. Y., are contemplating taking up in the near future the matter of installing a sewage disposal plant. According to present plans it will be located near the banks of the Susquehanna river on the Cook tract and away from any inhabited district. The trunk line sewer ends at this point and it is believed that sufficient property can be purchased at a nominal figure as a site for a septic tank and accessories.

Advices from Rochester, N. Y., state that Chairman Cromwell's Streets and Sewers Committee of the Common Council met recently to take up the petition of Chase Bros. Co., for the extension of the sewer in Gould St., 1,000 ft. south from its present terminus. The petition was referred to the City Engineer for an ordinance.

In accordance with the recent order of the Board of Health, Water and Sewer Board of the Utica, N. Y., City Council discussed the matter of installing a new sewage disposal plant. The cost of such an improvement is roughly estimated at about $150,000 or $250,000. The duty of obtaining advice from some expert was assigned to the Mayor.

Ohio.

✣Bids will be received until 11 a. m., Feb. 8, by Board of County Commissioners, Cleveland, O., for grading, draining and improving Union Road from the limits of the city of Cleveland to the intersection of the road with Kinsman road in Newburg township. A certified check for $1,000 must be filed with each bid. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the County Engineer at the New Court House on W. 3rd St., Cleveland, Ohio. John F. Goldenbogen is Clerk of the Board.

✣Bids will be received until noon, Jan. 19, by Director of Public Service, Cleveland, O., for the construction of sewers in the following avenues: Chesterfield Ave., N. E., between Lake View road, N. E. and E. 125th St.; Philips Ave., N. E., between Lake View road N. E. and E. 125th St. Ira O. Hoffman is Secretary of the Directors.

✣Bids will be received until noon, Jan. 27, by Director of Public Service, Lorain, Ohio, for furnishing the necessary labor and materials for the construction of a storm water sewer in the Dallas Ave. Storm Water Sewer District according to plans and specifications on file in the office of said Director. Said sewer to begin at a point about 600 ft. northerly from E. 21st St. and 500 ft. easterly from the B. & O. R. R. and running southerly in a straight line under the B. & O. R. R. tracks to the northerly terminus of Railroad St.; thence southerly in said street and across the lands of the Industrial R. R. Co. to about 330 ft. south of E. 29th St. Also two lateral sewers in E. 28th St. The work includes 3,930 lin. ft. of brick sewer 42 to 76 in. in diameter, 2,510 lin. ft. of 12 to 24-in. pipe sewer, 15 intakes, 11 manholes. L. B. Johnston is Clerk of the Directors.

City Engineer has been instructed to investigate the feasibility of constructing a sewer on Lingluff Ave. and in that part of the city north and if the sewer for the proposed district can be drained into the mains now laid it is possible that the City Council of Canal Dover, O., will grant the improvement.

Plans and specifications have been filed with the City Council of Dayton, O., for the construction of sanitary sewers in part of District No. 4 on Second St., from Miami to Erie Canal. F. J. Cellarius is City Engineer.

In communications to the City Council George T. Lehrer, Mayor, Sandusky, O., among other improvements, recommends the reconstruction of the city's sewage system and a general overahuling of the water filtration system.

City Council of Cincinnati, O., has passed an ordinance authorizing the construction of sewer improvements in Potomac Ave. (formerly Fairview Ave.), from Duckcreek road to Ivy Ave.; Grigg Ave., from Belmont Ave. to Potomac Ave.; Ivy Ave., from Vista Ave. to Holly Ave.; Holly Ave., from Ivy Ave. to Vista Ave.; Vista Ave., from Ivy Ave. 430 ft. south, and from Holly Ave. to a point 680 ft. south of Holly Ave., and Patton Ave., from Vista Ave. to a point about 430 ft. east. The estimated cost of the work is $13,324.

Oklahoma.

At a recent election held in Duncan, Okla., the question of issuing $38,000 of bonds for the construction of a system of sewers was voted on. W. L. Bonham, Oklahoma City, made the necessary surveys for the system.

The City Council, Oklahoma City, Okla., at an adjourned session held recently voted to expend a sum not to exceed $15,000 for enlarging the sewer system in the downtown districts. The streets affected will include: Broadway, Reno, Main, California, Harvey and Robinson Sts.

Oregon.

✣Bids will be received by the City Council of St. Johns, Ore., until Feb. 23, for the construction of hard surface pavement on 13 blocks of Jersey St. A. M. Esson is City Recorder.

The North Albina Improvement Club, Portland, Ore., has appointed a Committee to hurry the laying of sewers north of Killingsworth. No work has yet been done although the improvement was ordered five years ago and the matter will be taken up with the City Engineer.

New York.

Plans are being prepared by Charles E. Collins, Consulting Engineer, Drexel Bldg., Philadelphia, Pa., for the extension of the sewerage system in Dolgeville, N. Y. Bids for the work will be advertised about March 1.

Pennsylvania.

⊙Contracts for the construction of sewers were let by the City Council of Chester, Pa., Jan. 6, as follows: Henry Pritchard—Central Ave, Third St. to Seventh St., $1,785.50; Flower St., Second St. to Seventh St., $2,030; Ward St., Second to Third, $448.10; Ninth St., Kerlin to Butler, $344.20; Edwards St., Second to Third, $481.50; Pennell St., railroad to Seventh, $669; Lloyd, railroad to Seventh, $1,335; John Hanna & Sons—Academy St., Fifteenth to Seventeenth, $350.90; Edgemont Ave., Eleventh to Twelfth, $505.40; Twenty-second St., Upland to Potter, $400.34; Twentieth St., Madison to Hyatt, $1,768.30; Fifth St., Pennell to Lloyd, $381.80; Broomall St., Front to Second, $370.50; Madison St., Third to Fourth, $275.80; Front St., Franklin to Fulton, $375.66; Potter St., Eighteenth to Twenty-second, $1,475.75; Chestnut St., Tenth to Thirteenth, $1,631.50.

The Town Council of Norristown, Pa., has been notified by the Attorney General, that the State Health Department insists that immediate action be taken toward the construction of a sewage disposal plant. At present the town's sewage is emptied into the Schuylkill River.

Chester & Fleming, consulting engineers, Pittsburg, Pa., have been employed by the officials of Valley Camp to prepare plans for the remodeling of the existing sewer system and installing a sewage disposal plant.

The city of Pleasantville, Pa., has under consideration the construction of a new sewage disposal plant and a number of sewer extensions.

The City Council of Jeannette, Pa., has instructed the sewer committee to confer with the engineer and devise some means for obtaining plans for a sewage disposal plant for that place.

City Council of Pottstown, Pa., voted to have surveys made of the town for the installation of a sewer system, but nothing definite was decided in regard to employing an engineer for the purpose.

City Controller of Lancaster, Pa., has recommended the City Council to transfer $3,204 from the reserve fund to the construction of various sewers ordered by the Street Committee. Resolution carrying into effect the transfer was adopted.

South Carolina.

Board of Health, Columbia, S. C., has decided that all houses east of Assembly St. must have sewerage connections.

South Dakota.

⊙Fraser & Danforth, Rochester, Minn., have been awarded the contract at $10,680 for constructing a sewer for the city of Aberdeen, S. Dak., the work including 2,900 ft. of 12-in., 700 ft. of 15-in. and 2,000 ft. of 20-in. pipe and 14 manholes. Bids were opened Jan. 9.

Texas.

✣Bids will be received until Jan. 27 by the city of Corpus Christi, Texas, E. Cubage, controller, for furnishing the following material for the construction of a sewer system: Four motor driven centrifugal pumps, three sets of Cameron 6x8x4 alternating gear, 5,000 cu. yds. of gravel or crushed stone and sand, 1,100 sq. ft. of steel sheet piling, 85 c.-i. manhole covers, 10 flush tank syphons, 4,000 lin. ft. of c.-i. pipe, 2 car loads of lumber, 2,900 ft. of 15-in., 7,000 ft. of 12-in., 3,300 ft. of 10-in., 9,660 ft. of 8-in. vit. sewer pipe; 57 "Ys" 6 on 15, 78 "Ys" 6 on 10, 288 "Ys" 6 on 12, 258 "Ys" 6 on 8. Specifications are on file in the mayor's office and in the office of the engineer at 842 Wilson Bldg., Dallas, Texas. F. H. Lancashire is engineer in charge of construction.

⊙City Commission, Galveston, Texas, has awarded the contract to A. C. Falligant to construct 15-in. vitrified drain pipe along Avenue P. from 21st St. to 23d St. to cost $1,369.

⊙City Council of Corpus Christi, Texas, has awarded Engineer F. H. Lancashire, Houston, Tex., the contract for the construction of a city sewerage system. Mr. Lancashire is to dispose of $75,000 worth of the $140,000 sewer bond issue, supervise the installation, provide the tools and receive as compensation 10½ per cent of the $75,000 expended. Materials will be bought as early as possible and work will be pushed. The remainder of the bond issue will be expended later.

⊙The contract for the extension of the sewer system in Corsicana, Texas, was let by the Council to Freehart & Jackson, San Antonio, Texas, at $17,364. The extension will increase the present system 2½ miles in length.

An election was held in Fort Worth, Texas, Jan. 13, to vote on the question of issuing bonds to the amount of $2,000,000 of which $120,000 will be spent for the construction of storm water sewers throughout the city.

Utah.

⊙The following contracts were recently awarded by the Board of Public Works, Salt Lake City, Utah: Extension 245, 775½ ft. of sewer in Snow's Court from Eighth South between Main and West Temple to A. A. Clark at $.94; Extension 280, 896 ft. of sewer, Lambert's and Corliss Court, north from Seventh South between Main and West Temple, to A. A. Clark at $.93; Extension 285, 445 ft. Gregory Court west from State St., between Sixth and Seventh South, to J. F. Johnson at $1; Extension 286, 519½ ft. of sewer Strong's Court north from Fourth South between Eighth and Ninth Sts., east, to A. A. Clark at $.92.

⊙A. A. Clark, Judge Bldg., Salt Lake City, Utah, has been awarded the contract at 92 cts. per lin. ft. for constructing sewer extension No. 286, Salt Lake City. Bids were opened Dec. 30.

Washington.

⊙The contract for furnishing all labor and material, including vitrified glazed pipe, manholes, flush tanks, lampholes, etc., for the construction of a main sewer in Chehalis, Wash., was awarded W. J. Murphy at $51,258. Bids for the work were opened Jan. 2. C. E. Prixnitt is City Clerk.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

West Virginia.

Plans have been completed for the construction of a complete santitary sewerage system and surface drainage system for Moundsville, W. Va., and the bond issue for $170,000 has also been voted by the citizens. Charles E. Collins, Drexel Bldg., Philadelphia, Pa., prepared the plans and is also Engineer on the construction. It is thought that bids for the work will be asked about March 1.

Wisconsin.

At a recent meeting of the Common Council of Stoughton, Wis., Thomas Hurd, Civil Engineer, submitted plans complete for the construction of sewers.

Canada.

✣Bi[illegible], Feb. 7, by Board of Control, Toronto, Can., G. R. Geary, chairman, for Section No. 1, Low Level Interceptor or "Tender for Laying Reinforced Concrete Overflow Pipe from Sewage Tanks," etc., as the case may be, for the construction of the several sections of Low Level Interceptor and other works, as mentioned below. The following is an approximate description of the various works: 1. Low Level Interceptor, Section No. 1, egg shape, 2 ft. 10 ins. by 4 ft. 3 ins., 4,566 lin. ft. 2. Low Level Interceptor, Section No. 2, egg shape, 3 ft. 2 ins. by 4 ft. 9 ins., 2,475 lin. ft. 3. Low Level Interceptor, Section No. 3, egg shape, 3 ft. 6 ins. by 5 ft. 3 ins., 2,295 lin. ft.; circular, 4 ft. 6 ins. diameter, 1,023 lin. ft. (Total length Section No. 3, 3,318 lin. ft.) 4. Laying reinforced concrete overflow pipe from sewage tanks, 292 lin. ft. of 60-in. circular pipe, in lengths of about 24 ft. 5. Cast Iron Penstocks for Low Level Interceptor.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

Citizens of Watsonville, Cal., will endeavor to secure an appropriation from the Legislature for building a detached breakwater at Port Watsonville, costing $60,000.

Assemblyman Herbert W. Slater, of Santa Rosa, Cal., is to present a bill to the State Legislature calling for an appropriation of a sum of money in the neighborhood of $30,000 for the cleaning, deepening and surveying of Russian River west of Rio Nido, or, as it is more commonly known, Eagle Nest, and for the construction of dams or lock dams. The work, if allowed, will back up the river from the mouth to Eagle Nest, a distance of six miles, and will greatly improve the river as a summer playground and recreation district.

District of Columbia.

✣Bids will be received until 2 p. m., Feb. 15, by Commissioners of District of Columbia, Washington, D. C., for furnishing one gasoline motor driven fire engine and hose wagon combined.

✣Bids will be received until 10:30 a. m., Jan. 31, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 517, lumber, manganese, steel pins, chain, nails, screws, buoys, anchors, valves, cocks, oil cups, hose strainers, slip scrapers, counter scales, manila rope, packing leathers, leather fillet, coke, cupola lining blocks, fire brick, chairs, rules, shellac enamel, etc.

✣Bids will be received until 10:30 a. m., March 30, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 616, and erecting emergency dams at the canal locks and for furnishing and delivering certain tools, equipment and spare and repair parts.

The juries in charge of the competitions for designs for three new Government buildings to be erected at Washington, D. C., have announced their awards as follows: York & Sawyer, 156 Fifth Ave., New York, for the Commerce and Labor Department building; Donn Barber, 25 E. 26th St., New York, for the Department of Justice building; Arnold W. Brunner, 320 Fifth Ave., New York, for the State Department building. Congress already has provided land south of Pennsylvania Ave., near the Treasury building on which the structures will stand. The three successful designs now will be worked over so that the three buildings, which will stand in a row, may form a harmonious group. It will be a year at least before ground is broken for them.

Florida.

⊙The Hillsboro Dredging Co., Tampa, Fla., has been awarded the contract at 12½ cts. per cu. yd. for dredging 177,550 cu. yds. of material from Sarasota Bay, Fla. Bids for the work were opened Jan. 5 at the office of the U. S. Engineer at Jacksonville, Fla.

Georgia.

✣Bids will be received until 11:45 a. m., Feb. 6, by Constructing Quartermaster, Fort Screven, Ga., for the construction, including plumbing, electric wiring and fixtures for a fire station.

✣Board of County Commissioners will receive bids at once for the construction of a new county court house at Griffin, Ga., for Spalding County. A. Ten Eyck Brown, Atlanta, is Architect. The cost of the work is estimated at $80,000. W. E. H. Searcy, Griffin, Ga., is Clerk of the Board.

Illinois.

✣Bids will be received until Jan. 23 by B. J. Mullaney, Commissioner of Public Works, city of Chicago, for furnishing and delivering 37,000 fire brick as follows: (A) 32,000 Osceola, Tiger Crown, Beech Creek, Lumber City, Mount Savage, Woodlawn, Olive Hill or equally as good; (B) 5,000 wire cut fire brick.

✣Bids will be received until 3 p. m., Feb. 23, by James Knox Taylor, Supervising Architect, Treasury Dept., Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at, Murphysboro, Ill.

The County Board of Supervisors, Edwardsville, Ill., will next month take up the matter of improving the County Court House. The plans have been approved and the work will cost about $225,000. The plans proposed provide for a building 122 ft. wide, 116 ft. deep and 100 ft. long, and fireproof throughout.

Indiana.

⊙Louman Banks has been awarded the contract at $1,895 for steam heating plant for the county infirmary at Greenfield, Ind. Bids were opened Jan. 14 by the County Auditor.

Iowa.

S. E. Irish is having plans prepared for the construction of a 15 ft. concrete dam across the Des Moines River at Bonaparte, Ia. Geo. H. Craig, Keosauqua, Ia., is Engineer.

Maryland.

✣Bids will be received until noon, Feb. 1, by Frank W. Keating, M. D., Superintendent of Maryland Asylum and Training School for Feeble Minded, Owings Mills, Md., for the plumbing, electric equipment, heating and power equipment in connection with new buildings to be erected at that institution. A certified check for $250 must be filed with each bid.

⊙The contract for the foundations, including Raymond concrete piles, for the box factory to be built for Becker Brothers, Baltimore, has been awarded to the Raymond Concrete Pile Co., of New York and Chicago. Theodore Wells Pietsch is the Architect.

⊙The Piedmont Construction Co., of Atlanta, Ga., has been awarded the contract to erect the 9-story warehouse for the Coca Cola Company at Pratt and Concord Sts., Baltimore, Md. William Tuft, of Atlanta, is the Architect. For construction alone the proposed structure will cost $200,000.

The Mayor and City Council of Cumberland, Md., have rejected all bids submitted for the construction of the new city hall because of their exceeding the estimate made by the architects. It was decided to do nothing further in the matter until such time as plans and specifications are submitted by the architects, Helmbee & Lafferty, Clarksburg, W. Va., for a building that will not exceed in cost $75,000.

Massachusetts.

⊙The Fairbanks Co., Boston, Mass., has been awarded the contract at $1,509 for supplying tools and supplies for the machine shop of the Mechanic Arts High School of the city of Boston, Mass. Bids were opened Jan. 5.

Minnesota.

✣Bids will be received until 10 a. m., Jan. 23, by Maj. D. W. Arnold, Quartermaster, St. Paul, Minn., for stationery desk and office supplies, tinware, tools, electric light supplies, plumbing supplies, lumber, saddlers' and miscellaneous supplies.

The Miller bill to authorize the Great Northern Development Co. to construct a dam across the Mississippi River from a point in Hennepin County to a point in Anoka county has been passed by Congress and is now before the President. This bill is generally known as Coon Rapids project and it is said much Duluth capital is interested in the proposed dam.

Mississippi.

Surveys are underway for a pipe line from Fayette gas fields to Columbus, Miss. The line will be about 40 miles long and surveys will be completed within a few weeks. Citizens of Columbus are reported to have financed the project. Blair Hughes, Birmingham, Ala., is the Engineer.

Missouri.

⊙Wall Bros., St. Louis, Mo., has been awarded the contract at $197,712 by the Board of Education of St. Louis for the construction work on the New Harney Heights School.

Legislation is being sought from Congress to permit eastern and Missouri capitalists to construct a dam across White River between Branson and Forsythe in Taney County for the development of water power. It is estimated that about 2,500 H. P. could be developed. The cost of the proposed plant, including the cables for the transmission of the power to Springfield, Mo., will be about $400,000. R. W. Morrison, of the St. Louis Car Co., St. Louis, Mo., is interested.

Nebraska.

✣Bids will be received until Jan. 31, by Capt. F. C. Bolles, Depot Quartermaster, Omaha, Neb., for furnishing miscellaneous supplies, including acid, drill bits, tackle blocks, etc.

Nevada.

The U. S. Reclamation Service has been authorized by Secretary of the Interior Ballinger to begin the preliminary work for the construction of the Carson River dam, in connection with the Truckee-Carson Irrigation project, Nevada. The sum of $1,250,000 has been allotted to this project. D. W. Cole, Fallon, Nev., is Project Engineer.

New Hampshire.

✣Bids will be received until 11 a. m., Feb. 11, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for six oil tanks with pumps, meters, gauges, piping, etc., for the U. S. Navy Yard, Portsmouth, N. H.

New Jersey.

J. S. Stiger, Bernardsville, N. J., wants to get in touch with contractors who are familiar with excavating in quicksand. The work is to be done at Summit, N. J.

New York.

✣Bids will be received until noon, Feb. 14, by Col. W. M. Black, U. S. Engineer, Army Bldg., 39 Whitehall St., New York city, for dredging and rock removal in the Harlem river, N. Y.

✣Bids will be received until noon, Jan. 18, by W. M. Black, U. S. Engineer, Army Bldg., Whitehall Bldg., New York city, for dredging and rock removal in the Hudson river, N. Y.

The City Council of Dunkirk has directed the Finance Committee to get an option on the most desirable site for a public dock. The council plans to buy a site and build a public dock at the earliest possible time.

Following bids were received Jan. 5 by Col. S. W. Roessler, U. S. Engineer, New York, for dredging in Bay Ridge Channel, New York Harbor; Coastwise Dredging Co., Norfolk, Va., 15.89 cts. per cu. yd.; Maryland Dredging & Contracting Co., Baltimore, Md., 17½ cts. per cu. yd.; Daly & Hannan Dredging Co., Ogdensburg, N. Y., 19 cts. per cu. yd.; Morris & Cummings Dredging Co., 17 State St., New York City, 18 4-11 cts., per cu. yd.; P. Sanford Ross, Inc., 277 Washington St., Jersey City, N. J., 28.65 cts. per cu. yd.; American Paving & Construction Co., 211 S. 9th St., Philadelphia, Pa., 20.9 cts. per cu. yd.

A bill will be introduced at the current session of the Legislature providing for the construction of storage dams along the Hudson River, watershed, in accordance with the recommendations made by the State Water Storage Commission. The improvement calls for the construction of several dams and reservoirs in the Hudson watershed—on the Hudson, Schroon and Sacandaga Rivers. It is said that in addition to conserving the flow of water and preventing floods and increasing the supply in the summer, that it will likewise provide power which may be used for the generation of electricity with a view of increasing the power and light facilities in the Albany section at a decrease in cost.

Ohio.

✣Bids will be received until noon, Jan. 26, by Director of Public Service, Cleveland, O., for the furnishing and installing of a rectangular steam pressure disinfector and sterilizer at the tuberculosis sanitarium, infirmary division, Colony Farm, Warrensville, O. C. A. Marvin is Secy. of the Directors.

⊙The Cleveland Electric Illuminating Co., Cleveland, O., has been awarded the contract for furnishing arc lamps and electricity for street lighting for the city of Cleveland. The contract price was $53.88 per lamp per year, making a total of $107,760. Bids were opened Dec. 31.

The Northern Ohio Power Co., of Akron, has been incorporated with a capital stock of $10,000, for the purpose of constructing dams to generate power for electricity. The incorporators are Will Christy, Chas. H. Lohr, Chas. Currie, C. F. Moore and N. O. Mather.

Oregon.

The Portland Railway, Light & Power Co., Portland, Ore., has preliminary work well along for its $2,500,000 power development on the Upper Clackamas River, and when spring opens up actual construction work will be started. The work includes the construction of a gravity type concrete dam at a point three miles above the Cazedero station. The dam will be 160 ft. in height and 750 ft. in length across the top. The head created will be about 135 ft. It will create in the gorge of the Clackamas River a reservoir or lake five miles long by one-half to three-quarters of a mile in width. The power house will be located immediately below the dam, water being conducted to turbines by means of steel penstocks.

Pennsylvania.

✣Bids will be received until 1 p. m., Jan. 26, by H. G. Ashmead, Secy. Pennsylvania Commission to erect a State Hospital for the criminal insane, 608 Real Estate Trust bldg., Philadelphia, Pa., for completing buildings C. and D. pertaining to the State Hospital for the Criminal Insane for the Commonwealth of Pennsylvania at Farview, Pa.

✣Bids will be received until 1 p. m., Jan. 26, by H. G. Ashmead, Secy. Commission to erect a State Hospital for the Criminal Insane, 608 Real Estate Trust Bldg., Philadelphia, Pa., for completing building G., pertaining to the State Hospital for the Criminal Insane for the Commonwealth of Pennsylvania at Farview, Pa.

✣Bids will be received until 1 p. m., Jan. 26, by H. G. Ashmead, Secy. Pennsylvania Commission to erect a State Hospital for the Criminal Insane, 608 Real Estate Trust Bldg., Philadelphia, Pa., for excavating, grading, hauling, depositing and leveling the excavated material on the site of the State Hospital for Insane at Farview, Pa. There will be required to be excavated 1,320 cu. yds. approximately, which will be filled in front of building G as may be directed. A price is required per cubic yard. Specifications and form of proposal may be had on application at the office of J. C. M. Shirk, Architect, No. 518 Philadelphia Bank Bldg., Philadelphia, Pa.

✣Bids will be received until 1 p. m., Jan. 26, by H. G. Ashmead, Secy. Pennsylvania Commission to erect a State Hospital for the Criminal Insane, 608 Real Estate Trust Bldg., Philadelphia, Pa., for the completing of the main sewage and storm water pipe lines for the State Hospital for the Criminal Insane at Farview, Pa. Drawings and specifications and form of proposal may be had on application at the office of J. C. M. Shirk, Architect, No. 518 Philadelphia Bank Building, Philadelphia, Pa.

✣Bids will be opened Jan. 24 by the School Board, Harrisburg, Pa., for the construction of the Woodward school building and the annex to the Melrose school building.

The Board of Education of Philadelphia, Pa., has voted to expend $1,400,000 for the erection, improvement and enlargement of high schools as follows: Two West Philadelphia buildings, $950,000; new Central Manual Building on Parkway, $200,000; additions and improvements to girls' Normal School, $50,000; additions and improvements to Northeast Manual, $140,000; lot for girls' High School in South Philadelphia, $50,000.

South Dakota.

✣Bids will be received until 10 a. m., Feb. 9, by Constructing Quartermaster, Fort Meade, S. Dak., for furnishing all labor and material for the construction of steel fences for troop corrals at the fort.

Texas.

✣Bids will be received until 3 p. m., Jan. 24, by W. W. Graham, Secy., School Board, Burkburnett, Texas, for erection of concrete, brick and stone school building to cost about $13,000. Plans and specifications may be obtained of Hull & Spear, Architects, 912½ Main St., Fort Worth, Texas. A certified check for $250 must be filed with each bid.

✣Bids will be received until 6 p. m., Jan. 24, by M. O. Woodward, City Secretary, Temple, Texas, for erection of high school building, also for plumbing, wiring and heating according to plans and specifications which are on file at the offices of Sanguinet & Staats, Architects, Fort Worth, Dallas and Houston. A certified check for $1,000 must be filed with each bid.

✣Bids will be receiverd until Jan. 21, by George L. Fearn, County Auditor, Dallas, Texas, for 12,760 ft. of Best No. 1 heart rough lumber f. o. b. Dallas, following sizes: 5,760 ft. 2x12x16, 2,000 ft. 3x10x12, 4,000 ft. 3x12x16, 1,000 ft. 2x10x16.

✣Bids are asked until Feb. 11 by Maj. G. P. Howell, U. S. Engineer, Galveston, Tex., for dredging an inland canal between the Brazos River and Matagorda Bay. The estimated cost is $400,000, and Congress has appropriated $200,000 to begin the project. It will form a connecting link between the finished canals in the sections between Galveston and the Brazos River and Matagorda Bay and Corpus Christi. From the Brazos River end the route commences just above Quintana and extends westward through a series of small lakes and low, marshy land, mouth, and connects First, Second, Third, Cedar and Choctaw lakes, thence into Caney Creek, and through its new mouth into Matagorda Bay at the extreme east end, and extends into the bay itself several miles. The total length of the route is 27 miles. The canal will be 40 ft. wide and 5 ft. deep, in conformity with the canals on either end.

⊙W. C. Whitney, Beaumont Tex., has been awarded the contract at $72,050, for the construction of the new Bee County court house at Beeville, Tex.

The citizens of Port Arthur have raised $150,000 for a proposed pleasure pier at that place. This project has been under consideration for about a year. G. N. Bliss is President of the Board of Trade of Port Arthur.

Virginia.

✣Bids will be received until 11 a. m., Feb. 4, by R. C. Hollyday, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for the furnishing of a 60-ton electric traveling crane in building No. 23, at the navy yard, Norfolk, Va.

Washington.

✣Bids will be received until 3 p. m., Feb. 18, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, except elevator, but including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at North Yakima, Wash.

⊙The Moran Co., Seattle, Wash., has been awarded the contract at $125,000 for the construction of the caisson for the dry dock at the U. S. Naval Station, Puget Sound, Wash.

⊙C. F. Graff, Seattle, Wash, has been awarded the contract at $77,400 for constructing a concrete pier at the U. S. Navy Yard, Puget Sound, Bremerton, Wash. Mr. Graf is at present building a $255,000 general storehouse at the navy yard, Puget Sound. The new pier will include reinforced concrete piles sunk to hardpan, with a reinforced concrete floor system. The dock complete is to measure 60 ft. wide and 40 ft. in length.

Canada.

✣Bids will be received until noon, Jan. 28, by Chairman of the Building Committee, at the office of Darling & Pearson, 2 Leader Lane, Toronto, Ont., Architects, for erection and completion of a Power House in connection with the General Hospital.

✣Bids will be received until 4 p. m., Jan. 30, by R. C. Desrochers, Secy. Department of Public Works, Ottawa, Can., for the construction of a public building, Mount Forest, Ont. Plans, specification and form of contract can be seen and forms of tender obtained on application to the Postmaster at Mount Forest, Ont., at the office of Mr. Thos. Hastings, Clerk of Works, Postal Station F., Yonge St., Toronto, and at this Department.

✣Bids will be received until noon, Feb. 15, by G. J. Desbarats, Deputy Minister, Naval Service, Ottawa, Ont., for boiler of ordinary cylindrical, return tube, marine type 129-in. external diameter, 11 ft. long. Working pressure 100 lbs., to be delivered at Halifax for installation in the Fisheries Protection Cruiser "Curlew."

⊙Morrow & Beatey, Peterborough, Ont., have been awarded the contract at $51,220 for the construction of a concrete dam and power plant for an extension to the municipal electric light plant of the city of Sherbrooke, Que. Bids were opened Dec. 29.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

TORONTO MAIN DRAINAGE.

Sealed tenders addressed to the Chairman of the Board of Control, City Hall Toronto, Canada, endorsed "Tender for Section No. 1. Low Level Interceptor," or "Tender for Laying Reinforced Concrete Overflow Pipe from Sewage Tanks," etc., as the case may be, for the construction of the several sections of Low Level Interceptor and other works, as mentioned below, will be received by registered post only, until noon of Tuesday, February 7, 1911.

The following is an approximate description of the various works:

1. Low Level Interceptor, Section No. 1, egg shape, 2' 10" x 4' 3", 4566 linear feet.
2. Low Level Interceptor, Section No. 2, egg shape, 3' 2" x 4' 9", 2475 linear feet.
3. Low Level Interceptor, Section No. 3, egg shape, 3' 6" x [illegible], 2295 linear feet circular, 4' 6" diameter, 1023 linear feet.

Total length Section No. 3, 3318 linear feet.

4. Laying reinforced concrete overflow pipe from sewage tanks, 292 linear feet of 60-inch circular pipe in lengths of about 24 feet.
5. Cast iron penstocks for low level interceptor.

Tenderers shall submit with their tender the names of two personal sureties approved by the City Treasurer, or in lieu of said personal sureties the bond of a guarantee company, approved as aforesaid.

Specifications may be obtained from and original drawings will be on file and can be seen at the Main Drainage Department, City Engineer's Office, on and after January 9, 1911.

For the convenience of contractors sets of blue prints have been prepared and will be issued to contractors upon application to the City Engineer and upon receipt of deposits as follows: For items 1, 2 and 3, combined, $5.00; for item 4, $2.00, and for item 5, $2.00. Deposits should be made by check, payable to the City Treasurer. The deposits will be refunded upon return of blue prints in good condition within thirty days of receiving tenders.

The usual conditions relating to tenders as prescribed by city by-law must be strictly complied with or the tender will not be entertained.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman, Board of Control.
City Hall, Toronto, January 3, 1911.

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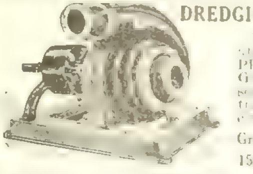

DREDGING—IRRIGATION
Write for information about BUSH IMPROVED CENTRIFUGAL PUMPS used by [illegible] contractors and dredging [illegible]
Greaves Specialty Mfg. Co.
154 Nassau St., N. Y City

STREET PAVING.

Sealed proposals for paving with brick block, wood block, concrete, asphaltic concrete, or sheet asphalt pavement, will be received by the City Clerk of the City of Manhattan, Kans., up to 6 o'clock p. m. of Tuesday, the 7th day of February, 1911.

Approximate quantities are 12,200 square yards of paving and 4,000 cubic yards of excavation, on Poyntz avenue, and 16,200 square yards of paving and 5,450 cubic yards of excavation on Houston and Fourth streets, in accordance with plans and specifications now on file in the office of the City Clerk.

Parties desiring plans may obtain same by application to City Engineer on payment of $1.00 to cover cost.

The city reserves the right to reject any and all bids. Each bid must be accompanied by a certified check of $1,000.00, payable to the City Treasurer.

C. L. BURT, City Engineer.
C. T. GIST, City Clerk.

EAST PEORIA DRAINAGE AND LEVEE DISTRICT, TAZEWELL COUNTY, ILLINOIS.

NOTICE TO CONTRACTORS.

Sealed bids will be received at Peoria, Illinois, until 2:00 o'clock P. M., February [illegible] the following work:

Section [illegible] Levee and Main Ditch [illegible] cubic yards.

Section X [illegible] cubic yards.

Sections XI and XII [illegible] pumping plant, including excavations, foundations, building and machinery.

The [illegible] capacity of 33 cubic feet per second against a maximum static head of 22 feet. The plant shall contain two centrifugal pumps, two induction motors, of the proper size to [illegible] capacity, two speed reducing transmission gears, and all auxiliary appurtenances, including priming apparatus, switch-board, station wiring, etc.

For further information address Harman Engineering Co., 120 Fredonia Ave., Peoria, Ill.

COMMISSIONERS.
Horace Clark
Eugene Brown,
Jas. Millard,

Harman Engineering Co.,
Civil & Mechanical Engineers,
[illegible]

POSTPONEMENT OF OPENING BIDS FOR THE PORTO RICO IRRIGATION SERVICE.

The opening of sealed proposals for the construction of (1) Carite Dam, (2) Guayabal Dam, and (3) Patillas Canal and Appurtenant Structures, is hereby postponed from January 3, 1911, to February 7, 1911.

J. W. BEARDSLEY,
Chief Engineer, Irrigation Service, Guayama, Porto Rico.

By order of
JOHN A. WILSON,
Commissioner of the Interior, San Juan, Porto Rico.

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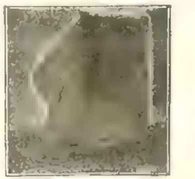

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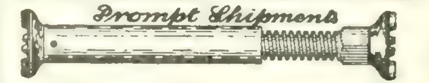

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DEPARTMENT OF THE INTERIOR. OFFICE OF PORTO RICO IRRIGATION SERVICE.

Guayama, P. R., Oct. 10, 1910.

Sealed proposals will be received at the office of the Commissioner of the Interior of Porto Rico until 2 o'clock p. m., February 7, 1911, for the construction of—

(1) Carite Dam and appurtenant structures, containing about 150,000 cubic meters of earth and loose rock, the estimated cost of which is about $190,000.

(2) Guayabal Dam and appurtenant structures, containing about 73,500 cubic meters of concrete masonry and 82,000 cubic meters of excavation, the estimated cost of which is about $550,000.

(3) Patillas Canal and appurtenant structures, including about 32,000 cubic meters of open-cut excavation, 2,060 lineal feet of tunnels, 2,500 lineal feet of flumes, 600 lineal feet of siphons, and 100 bridges, the estimated cost of which is about $70,000.

Plans and specifications may be obtained from this office, or from the Commissioner of the Interior, San Juan, Porto Rico, or from the Bureau of Insular Affairs, Washington, D. C.

A deposit of $2 is required for each set of plans, which will be refunded upon the return of the plans upon or prior to the date set for opening the bids. The right is reserved to reject any and all bids.

J. W. BEARDSLEY,
Chief Engineer Irrigation Service,
Guayama, P. R.

By order of:
JOHN A. WILSON,
Commissioner of the Interior of Porto Rico, San Juan, P. R.

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We have the following Rebuilt Machinery in our yards at Milwaukee, Wis., and can be inspected at any time for Immediate Delivery:

1—Marion Model, 50-60 Ton Steam Shovel, No 1723.
1—No. 0 Thew Shovel, Full Circle, 5-8-Yard Dipper with Both Traction and Track Wheels.
1—50-Ton Vulcan, Class D Fire Box Boiler, 1½-Yard Dipper Steam Shovel

TRENCH MACHINES

1—10 Foot Buckeye Trench Machine, Cuts a Trench 28 Inches Wide by 10 Feet Deep.

2—7½-Foot Buckeye Trench Machines, 28 Inches Wide.

1—7½-Foot Buckeye Trench Machine, 20 Inches Wide.

1—10-Foot Buckeye Trench Machine that Cuts a Trench 20 Inches to 32 Inches Wide, Equipped with Apron Wheels.

CONCRETE MIXERS

1—No. 1 Chicago Concrete Mixer with Steam Engine and Boiler Mounted on Trucks with Turbine Loader.

1—No. 1 Smith Concrete Mixer, Mounted on Trucks with Steam Engine and Boiler

1—No. 1 Chicago Concrete Mixer, Mounted on Trucks with Steam Engine, Boiler, Standard Equipment.

1—No 1. Koehring Mixer, Mounted on Trucks with Steam Engine and Boiler and Side Loader

Write us your wants. We manufacture the Cream City Concrete Mixer, new in all sizes.

CREAM CITY EQUIPMENT CO., 811 Majestic Building, MILWAUKEE, WIS.

PLANT FOR SALE

1 65-ton Bucyrus Steam Shovel No. 375.
New solid A frame, thoroughly overhauled this last summer, boiler and water tank repaired, new house on shovel, 3-yard dipper. All in A1 condition. Just laid up after finishing work at Beech Grove, Ind., December 15, 1910.
Price F. O. B. Cincinnati, O., Indianapolis Ind., Cleveland, O., $3,600.

1 65-ton Bucyrus Steam Shovel No. 566.
All in A1 condition, just finished work on the Wheeling & Lake Erie Ry., December 1, 1910.
Price F. O. B. Berea, O., $4,500.

1 10x16 Porter Locomotive No. 2065.
1 10x16 Porter Locomotive No. 2162.
All in A1 condition. Equipped with hand-power brakes. Working now at Beech Grove, Ind., but can be released immediately.
Price F. O. B. Cincinnati, O., Indianapolis, Ind., Cleveland, O., $1,500 each.

1 10x14 Vulcan Locomotive No. 347.
1 10x14 Vulcan Locomotive No. 348.
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A Remarkably Simple Result Derived in Solving a Complex Problem in Engineering Economics.

Elsewhere in this issue we give a general solution of a very common problem in engineering economics. To the reader who merely glances at the page of algebraic formulas it might seem that so much complexity in deriving a general formula could scarcely result in a simple formula applicable in the daily solution of such problems. And even if the reader were to concede that the final formula might be simple, he would be quite likely to deride its very simplicity on the ground that no such simplicity can coexist with any great degree of accuracy where a large number of cost and other factors enter the problem. Yet if the reader were to jump to such a conclusion, he would find upon investigation that he had jumped into a serious error of logic.

Mill has pointed out in his celebrated treatise on Logic that simple causes or forces may lead to very complex results, and that it is wholly illogical to infer, *a priori*, that the processes of nature are necessarily simple in their results. Mill did not mention the converse of this statement, but it is equally true—namely: that a complex combination of a large number of elements or forces may yield an exceedingly simple result. A remarkable example of this fact is to be found in the solution of the problem of determining the most economic diameter of a pipe designed to carry pumped water, as set forth in the Water Works section of this issue of ENGINEERING-CONTRACTING.

Considering that more than two dozen symbols are used in solving the problem and that the final equation contains only two symbols, and that these two symbols are sufficient to give a sufficiently correct value for the most economic diameter of pipe under a wide range of conditions, we can not fail to be impressed with the truth of the generalization that complexity of process does not necessarily involve complexity of result. The "complexity" of the algebraic processes is, in this case, not one that need alarm even the reader who has become accustomed to "fight shy" of symbols.

In our issue of Jan. 4 we asked our readers not to look askance upon the solution of a certain problem in bridge economics on account of the use there made of differential calculus in deriving a minimum cost. We repeat the suggestion that every engineer should brush up on the differential calculus, for it is an aeroplane compared with an ox cart in its swiftness. And, carrying the simile a step farther, the aeroplane is perhaps a dangerous mode of travel if one is not somewhat skilled in its use. On the other hand, the reader is in the position of a spectator rather than of a performer, in this particular case, and risks no harm to himself in the flight, whereas he gains a message of great value that could scarcely be delivered to him at all by ox cart transportation.

In fine, by the wings of calculus we can fly to a general formula and secure it with certainty, whereas if limited to the speed of oxen we should not essay to go at all.

In the preface to his great work on Railway Location, Wellington says:

> The mathematical form of discussion has been intentionally avoided, first, because the book has been written for practical men as well as for students, and mathematical methods are apt to repel them; and secondly, and chiefly, because mathematical methods of solution are not only inexpedient, but positively dangerous for the class of problems considered. When the difficulty of a problem lies only in finding out what follows from certain fixed premises, mathematical methods furnish invaluable wings for flying over intermediate obstructions; but whenever the chief difficulty of a problem lies in the multiplicity and dubiousness of the premises themselves, and in reconciling them with each other, there is no safe course but to remain continually [illegible] concrete fact.

Doubtless this statement meets the first-thought approbation of most civil engineers, certainly of all those educated in the old school to which Wellington belonged. Nevertheless not only do we not agree with the statement, but to us it seems little less than defense of ignorance of mathematics. What logic is there [illegible] of mathematics because the *premises* demand careful investigation? Mathematics is a system of logic applied to numbers or the symbols that designate numbers. In some form or other, every engineer must use mathematics. Hence his results are certain to be wrong if his premises are wrong, no matter what form of mathematics he applies, crude or elaborate. Wellington solves for minimum unit costs by an ox cart process in mathematics—namely: by a method of successive substitutions and approximations in the effort to derive a minimum cost. In brief, every individual economic problem of railway location is solved with much greater labor than is really required. Instead of deriving general formulas in which substitutions can be made, Wellington usually leaves his readers in a jungle of data, belaboring their brains in the effort to work a way out.

Let us assume, by way of comparison, that Newton had not deduced his law $v = \sqrt{2gh}$, for velocity, of a falling body, but had provided us merely with some data and an ox cart method of applying them to any particular problem where gravity is involved. We should then find ourselves deep in the intricacies of formula derivations, the substitution of constants, and the use of integral calculus every time we might attempt a solution of a hydraulic problem of any difficulty, in precisely the same condition that we now find ourselves in attempting to solve any rather difficult problem in engineering economics, such as those that Wellington discusses.

The time surely has come when civil engineering writers should cease railing at mathematics in the fashion that has been so popular in America for the last fifty years. Trautwine was among the first author to start the fashion, for his first preface carries this absurdity:

> Comparatively few engineers are good mathematicians; and in the writer's opinion, it is fortunate that such is the case; for nature rarely combines high mathematical talent with that of practical tact, and observation of outward things so essential to a successful engineer.

High mathematical talent is not absolutely essential to an engineer, but its possessor is unquestionably the better engineer for having it. Else it were equivalent to saying that a mastery of mathematical logic makes a man a poor engineer. Conceding that many mathematicians have no inclination to apply their mathematics to engineering problems, but take greater pleasure in problems of another nature, we still fail to find reason for regarding the possessor of mathematical skill as being likely to fail as an engineer.

Moderate mathematical talent is probably the asset of nearly every engineer of any ability. If the talent has not been cultivated or has been allowed to become more or less atrophied through disuse, it is a pity and not a reason for belittling mathematical talent in engineers.

We show in this issue how a problem in engineering economics, which is every whit as complex as the ordinary economic problem in railway location, can be solved by mathematics and solved in such a way as to make it unnecessary for an engineer to plod through the entire process every time a similar problem arises.

In subsequent issues we shall apply the same general method of attack to problems in railway economics, and we shall show how immeasurably superior the deduction of general formulas and laws is to the methods of Wellington wherein a mountain must be climbed every time one wishes to see the sun come up.

The Danger of Over Plant-Equipment of Construction Work.

A common charge made by engineers against contractors is that they under-equip their work with construction plant. Contractors, on the other hand, accuse engineers of a leaning toward extravagance in plant equipment. Neither complaint is generally true although both are doubtless true in chosen cases. Because, perhaps, engineers are more likely to publish their opinions than are contractors, the more familiar charge is that of under-equipment of work with construction plant. Manifestly lack of adequate plant may be the cause of loss of money in construction work, but quite as certainly also money may be lost [illegible] ment. The last truth is as great as the first.

In the second instalment of the article on the construction of the Springfield, Mass., water purification works, which is published elsewhere in this issue, the contractor mentions two instances where too elaborate plant lost money for him. In the first instance a large combination crushing and mixing plant was installed. Considered merely as a plant of its kind, this plant, as will be seen from the plans on another page, was of decidedly neat and effective design. To the ordinary observer it would have given distinct "side" to the job. Even the majority of engineers, we shall venture to assert, would have regarded it approvingly as evidencing the "enterprise" of the contractor handling the work. Now as a matter of fact, as the contractor points out in the article mentioned, a gravel screen at the pit, a small isolated crusher and one or two half-yard mixers on the work would have been a far more efficient plant. The exact figures are presented in detail in the article and we suggest that the reader study them.

In the second instance an over-supply of forms was provided. The contractor estimates that half the supply would have been ample for the work. He also shows that the over-supply cost him 87 cts. a cu. yd. of con[illegible] its.

These two examples of over plant equipment are not unique though it is seldom that we get so clearly the cost of such mistakes. In our issue of Nov. 23, 1910, we described the work of an elaborate bridge conveyor excavator on the New York Barge Canal. This machine had something like a possible million cubic yards of excavation that it could handle and its cost was about $175,000 complete. Briefly the first cost of the machine put a charge of 17½ cts. per cu. yd. on the excavation before a single cubic yard was excavated. Again in our issue of Dec. 7, 1910, we described a portable concrete mixing and handling plant for the Catskill Aqueduct. This plant had a possible 30,000 cu. yds. of concrete to mix and place and its first cost and cost of remodeling it were some $40,000 or a charge of $1.34 per cubic yard of concrete. As devices for these particular purposes both of these machines were reasonably efficient just as was the crushing and mixing plant described in another column, but they were just as clearly over elaborate and uneconomical.

There is in construction work quite as present a danger of over equipping a job with plant as there is of under equipping it. There is in nearly any construction work always a limiting factor, independent of the plant, which controls the plant's output. The ability to place only 150 cu. yds. of concrete per day in the filter structure was the limiting factor for the crushing and mixing plant being considered. This plant could readily turn out 600 cu. yds. of concrete per day; conditions entirely independent of the plant limited its output to one-fourth its capacity; the excess three-quarters of capacity was an expense to no purpose. Incidentally it may be noticed that the first cost, $9,500, of the crushing and mixing plant laid a charge of 73 cts. per cu. yd. on the 13,000 cu. yds. of concrete in the work.

There is another point, which is worth bearing in mind, which is mentioned by the contractor in connection with this crushing and mixing plant. The several operations—screening, crushing, conveying and mixing—of this plant were interdependent. A break down in any part of the plant stopped all operations.

In summing up his experience with the crushing and mixing plant for the Springfield filters, the contractor lays down a rule to [illegible] when economy is desired is to select the very simplest mechanical arrangement of plant that will produce the required daily output and in general to avoid elaborate installations unless the re[illegible]

Removing Snow from Roads and Streets by Spreading Coal or Earth upon the Snow.

It has long been the practice in the mining regions of the Rocky Mountains to spread charcoal on the snow-covered roads in the spring of the year. The particles of charcoal "bite into" the snow at an astonishing rate, and cause the snow on a road to disappear long before the snow elsewhere is gone. The phenomenon is easily explained and it is well worth understanding, because this use of a black solid to remove snow is one that has not had the extensive application that it deserves.

The sun delivers 600 B. T. U. (British thermal units) per hour to each square foot of surface, when shining with full force upon a surface that is perpendicular to the sun's rays. It requires 142 B. T. U. to melt a pound of snow, or ice, at 30°. Therefore, if all the heat of an overhead sun were absorbed by the snow, we should find that 4.2 lbs. of snow had been melted each hour on each square foot of the earth's surface, for $600 \div 142 = 4.2$. As a matter of fact, considerably less than this is melted even during the noon hour of a spring day, for the white surface of the snow reflects a large percentage of the heat radiated from the sun. We know of no experiments that show exactly what percentage of heat is thus reflected, although it would be a very simple matter to conduct such experiments.

If any black substance, like charcoal or coal, is spread upon the snow, practically all the radiant heat that strikes the black substance is absorbed by it, and much of it is then transmitted by conduction to the snow. If the entire surface of the snow were covered with a thin layer of black substance having a fairly good conducting power, nearly all the sun's heat would be transmitted to the snow beneath. Péclet's experiments indicate that about ¾ B. T. U. per sq. ft. per hour are radiated from dull (not polished) solids, per degree of difference in temperature between the solid and the adjacent air. Since the adjacent air would have a temperature but slightly exceeding the temperature of a thin solid supported by melting snow, it is clear that very little heat would be radiated from the solid to the air. The heat lost by the solid to the air by convection or other air currents would be correspondingly small, and in still air it would be even less than the heat lost by radiation. However, to reduce these two sources of heat loss, the black solid should be as thin as practicable and should be as good a heat conductor as can be secured at low cost. Small particles of charcoal or coal seem to fill these conditions very well.

If the entire heat of the sun, 600 B. T. U. per sq. ft. per hour, were transmitted to the snow, we have seen that 4.2 lbs. of snow would be melted per square foot per hour. This is equivalent to a layer of water 0.8 in. thick. Since fairly compact snow weighs about one-fourth as much per cubic foot as water, it would follow that nearly $4 \times 0.8 = 3.2$ ins. of compact snow would be melted per hour if the snow were completely covered with a thin layer of a black conducting substance. In practice, however, no such high degree of efficiency is attained by the use of charcoal or coal, largely because there are usually quite wide spaces between the particles of charcoal or coal spread upon the snow.

We suggest that some of our readers will find it a fruitful line of experiment to determine actually how rapidly snow can be melted in this manner. By filling a small box of snow of known weight, and sprinkling the surface with coal dust, or dark colored earth, exposure to the sun for a few hours will determine the melting effect. It is desirable that the layer of snow be thin, and that the snow water be drained away as rapidly as formed. Other conditions for successful experimenting will occur to any one who gives the matter thought.

It occurs to us that in removing snow from country roads in the late Winter and Spring of the year, it would be wise first to spread coal or charcoal dust over the ditches, the object being to remove the snow first from the channels that are to conduct away the snow water from the road surface. Subsequently a treatment of the rest of the road with coal, charcoal dust, or earth, would result in clearing the roadway without causing a mass of slush to accumulate upon it.

Suggestion has been made that salt be used to thaw snow on roads, but it takes but a little calculation to ascertain that the cost of any such method is prohibitive.

Assuming that solid coal weighs 80 lbs per cu. ft., a layer of solid coal a mile long, 30 ft. wide and a thirty-second of an inch thick would weigh nearly 15 tons. However, no such amount is needed for it is neither essential that the particles be in contact or that they average a thickness of 1-32 in. Probably 3 to 5 tons of coal dust per mile of road would serve the desired purpose. In many localities coal dust can be secured for the mere cost of hauling it away. In other localities it might be practicable to store earth or sand to be used for the same purpose. In that event it would probably be necessary either to store the earth under cover or to pile it over stovepipes that could be used as flues in thawing and drying the earth preparatory to spreading it over the snow.

Snow can be cheaply pushed to the side of a road by snow plows, or by leveling scrapers, or by road machines, provided the snow is freshly fallen and has not become consolidated under traffic. The trouble usually is that the snow becomes packed solid before mechanical means of removing it can be applied. Furthermore, merely pushing the snow into the ditches of a road does not remove the trouble, for the ditches thus become clogged, and the melted snow is forced to collect in the roadway. Possibly a combination of the use of coal dust or earth to melt the snow over the ditches, with the use of snow plows or scrapers to push the snow from the roadway into "winrows" along side the open ditches, might prove to be the most economic and expeditious method of clearing snow from a road.

The problem of economic and expeditious snow removal from roads is one worthy of the serious study of every highway engineer in the northern part of America, and with the increased use of motor vehicles the problem will become even more important than it now is.

Among the commercial motor vehicles that will be exhibited at Chicago Feb. 6 to 11 under the auspices of the National Association of Automobile Manufacturers is a combination farm tractor and truck of three tons load capacity. This machine is used for all sorts of work on the farm. It hauls gang plows; pulls two ordinary 14-ft. harrows; hauls threshing machines into the field and then drives the belt to operate them. It furnishes power to run a circular saw to cut fire wood, drags a road scraper, hauls loads of three and a half tons of grain, hay or other farm products to the railroad and carries back loads of machinery, household goods or supplies from the stores. The tractor-truck is driven by a 36-h. p. gasoline engine. It is provided with a pulley at the front from which a belt can be run to operate all kinds of heavy farm machinery, thus making the truck a portable power plant. Instead of the usual rubber tires, the tractor has steel tires that are perforated and filled with 2-in. cylindrical hardwood blocks. For use in the field where great pulling ability is required, there is a special attachment for the rear wheels which has broad steel blades so designed that they dig deep into the earth as the wheels revolve but automatically fold up when the tractor is driven on hard roads. There are also different body attachments permitting quick changes to be made from an open platform to hay rack, stock rack, grain tank and dray stake types of body for hauling different kinds of loads.

CONCRETE AND REINFORCED CONCRETE SECTION

A Comparison of the Initial Cost of Concrete and Wood Piling.

By [illegible]

When, in the construction of any large building structure, an investigation of the foundation site has shown that piling will have to be used, the engineer or architect is immediately confronted with the advisability of selecting either of two types, wood or concrete.

In this selection of the kind of piling many things will undoubtedly be considered by the engineer, such as the permanency of the concrete piling, the ability of securing a perfect bond between the pile and the foundation piers of footing, and the additional loading which a concrete pile will safely carry compared to a wood pile. Also, since concrete piling is comparatively new, the engineer will probably consult with the agents of a concrete pile, who, feeling that the burden of the proof is in them, will bring forth many additional arguments as to why concrete piling should be used and why wood piling should not be considered. They will show that wood piling is only safe from decay when below the ground water line, necessitating considerable excavation and extra concrete in the piers to bring the work up to the grade of the top of concrete piles, which of course can be left protruding if desired. Then it will be proven that by the constant lowering of sewer grades in many of the cities, this ground water line is being lowered with the result that pile foundations which were all right a year ago may be unsafe and dangerous today, and an expensive rebuilding of them becomes necessary. Many other arguments favoring the use of the concrete pile will be brought out, but Mr. Architect interrupts to ask what the piling will cost his client. The answer in all probability is that the concrete piles will cost about $1 per foot in place, while timber piles can be secured at a price varying from 22 to 30 cts. per foot driven. At once the favorable impression created by the concrete pile agents begins to vaporize, the owner is consulted and nine chances to ten he wants to economize in every way possible, so that when assured by his engineer that the wood piles are safe, he decides that the concrete piles are an expensive luxury and the former are driven. In vain the concrete pile engineer shows that while the initial cost may be more, the investment is permanent and no depreciation takes place, and that less feet of concrete piling will be required to support the same load than will of timber. The difference in initial cost is a disparagement too great to overcome.

It is to show the fallacy of the conclusion arrived at by the architect and owner in the above paragraph that this article is written and to prove that even on the prices quoted the first cost of the concrete piling will be less expensive in many cases. The cost data hereinafter given were carefully collected. The conditions under which the work was prosecuted were most favorable and the unit prices are quite reasonable.

In the erection of a large industrial shop in the Chicago district during the summer of 1910, a pile foundation was necessary and the question as to the kind of piling arose. The building site was on filled ground, near a river, with the ground water line approximately 14 ft. below grade, and the piling depended largely on skin friction for bearing power.

A proposal was made to furnish concrete piles at $1 per ft. but wood piles were selected because they could be secured at 23½ cts. per ft. in place. The piles were designed to carry 20 tons each and the number of piles varied from 4 to 9 under each pier. The contractor was allowed 12 cts. per ft. for each foot followed.

[illegible]

Total piles driven, approximately.... 1,250
[illegible]

[illegible] August.

[illegible] with a cross cut saw about 4 ft. long worked by two men who received 35 cts. per hour each. The heads were hoisted out by a three-leg derrick and single block, six men being required to hoist up and dispose of them. These laborers received 25 cts. per hour. Water existed in many of the holes which varied from 12 to 15 ft. in depth. The average cost to cut off each head, get it out of the hole and dispose of it was 38 cts. The unit cost varied from 17½ cts. to $1.35.

Excavation.—The cost per cubic yard for excavation was $2, which price included backfilling. The pier holes were in many instances full of water, entailing pumping, sheeting was necessary to prevent caving, double and triple casting of dirt was frequently required and much of the material handled was slush, so that the price per yard was not excessive. The amount of excavation required for various size piers and the cost per pile was as follows:

[illegible] $9.65 per pile.
[illegible]
[illegible] $7.51 per pile.
[illegible] or $6.71 per pile.

The majority of the piers rested on the smaller number of piles so that the average cost of excavation per pile was $8.61.

Concrete Caps and Piers.—The cost of the concrete work in the piers was $5.10 per cu. yd., the contractor furnishing all materials and forms. From the detail drawings the cubical contents of the piers are found to be as follows: 4 pile, 6.3 cu. yds.; 5 pile, 6.8 cu. yds.; 7 pile, 8.0 cu. yds.; and 9 pile, 8.7 cu. yds. At $5.10 per yd. the cost of the concrete work in place was as follows:

[illegible] pile.
[illegible] pile 6.8 cu. [illegible] pile.
7 pile 8.0 cu. yds. at $5.40 = [illegible] pile.
9 pile 8.7 cu. yds. at $5.40 [illegible] pile.

The average price per pile for the concrete cap and the pier from cap to footing grade, was $7.15.

Recapitulation.—From the foregoing figures the following table summarizing the cost of a pile in the various size piers is obtained:

Item.	4 pile.	[illegible]	[illegible] pile.	9 pile.
Driving and following ..	[illegible]	$10.21	[illegible]	[illegible]
Sawing [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Excavation backfill	[illegible]	[illegible]	[illegible]	[illegible]
Concrete	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
Cost of completed pier	$111.98	$136.05	$169.89	$202.68

Concrete Piles. — Numerous tests have shown that where the loading is supported by skin friction, a short tapering concrete pile will sustain as great or greater a load than a long wood pile and for that reason it was proposed to use 24 ft. piles on this work had concrete piles been selected. In tests made in just such soil conditions as existed in this case, it was demonstrated that the concrete piles could stand from two to three times the loading, without settlement, that the wood piles could carry, but in order to be conservative 50 per cent greater loading is assumed for a comparative basis of cost. The cost of a 4 pile cluster (assuming same loading as on wood piles) of concrete piles would be:

Piling, 4 at $24	$ 96.00
Excavation for cap at 2 cu. yds. at $1.00	2.00
[illegible]	10.80
	$108.80

Assuming 50 per cent greater bearing power, piles to be driven on 2 ft. centers, the cost of a 4 pile cluster would have been:

Piles, 3 at $24.00........................	$72.00
Excavation, 2 cu. yds. at $1.00..............	2.00
Concret cap, 2 at $5.40.......................	10.80
	$84.80

This is a saving of approximately 26.5 per cent of the initial cost of the wood piles. Upon the same premises, the cost of the different size piers would have been as follows:

COST OF CONCRETE PILE PIERS.

[illegible]	4	[illegible]	7	[illegible]
Cost of concrete piles.	$72.00	$ 96.00	$120.00	$144.00
Cost of excavation....	2.00	2.00	3.00	3.00
[illegible]	[illegible]	[illegible]	16.20	[illegible]
Total cost	$84.80	$108.80	$139.20	$163.20

A comparison of the cost of the complete wood pile piers necessary to take care of the same loading, with the concrete piles and the per cent saving in initial cost in favor of the latter is shown in the following table:

SIZE OF WOOD PILE PIERS.

	4-pile.	5-pile.	7-pile.	9-pile.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Per cent saving in initial cost.	26.4	19.45	18.1	19.5

It is evident from the above figures that a saving of over 20 per cent of the initial cost of the foundation work would have been effected by the use of concrete piles, under the conditions which existed on this job. This saving is brought about by avoidance of expensive excavation and deep concrete piers necessitated by the wood piling and would be approximately the same percentage in the nine-pile cluster, as it is in the four-pile.

On further analysis, it would appear that where the ground-water line is 8 ft. or more below grade, the initial cost of the foundation work below grade would be less if concrete piles were selected in preference to wood, although the cost of concrete piles would be $1 per foot and wood piles 25 cts. per foot driven.

Chicago, Ill

Tests to Determine the Values of Clay and Reground Cement for Securing Impermeable Concrete.*

The work was to investigate the value of reground cement and clay as waterproofing materials in cement mortars and concrete.

Cement.—Northwestern States Portland cement was used. Tested in the laboratory it was found to conform to the specifications of the American Society for Testing Materials.

Reground Cement.—The reground cement was made from the ordinary factory product by grinding it for 14 hours in a ball mill, in the cement laboratory. About 10 lbs. were put in each cylinder at a grinding. The average fineness of the three grindings made was 98.5 per cent passing a No. 200 sieve.

Sand.—The sand used was obtained from a pit near the college, all being used which passed a No. 8 sieve. The sand analysis was as follows:

Retained on No. 8 sieve 27.75 per cent.
Retained on No. 20 sieve 22.66 per cent.
Retained on No. 30 sieve 12.35 per cent.
Retained on No. 50 sieve 27.75 per cent.
Retained on No. 100 sieve 7.20 per cent.
Retained on No. 200 sieve 0.72 per cent.
Passed No 200 sieve 1.44 per cent.
Total.........................99.87 per cent.

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*Condensed from Bulletin No. V, Iowa State [illegible] Station, Ames, [illegible]

The voids were [illegible] per cent. The amount of clay was 15 per cent.

Clay.—The clay used was of good quality, free from sand. It was dried at a low heat for 24 hours and was then ground until 98 per cent passed a No. 200 sieve.

Stone.—The stone used was a good quality Iowa limestone, broken to pass a 1.5 inch ring. All dust passing a No. 8 sieve was removed.

Mixtures.—The mixtures used were as follows: 1 common cement to 2 sand; 1 reground cement to 2 sand; 0.9 common cement to .1 clay to 1 sand; 0.85 common cement to .15 clay to 2 sand; 1 common cement to 3 sand; 1 reground cement to 3 sand; 0.9 common cement to .1 clay to 3 sand; 0.5 common cement to .15 clay to 3 sand; 1 common cement to 2 sand and 4 broken stone; 1 reground cement to 2 sand and 4 broken stone; 0.9 common cement and .1 clay to 2 sand and 4 broken stone; 0.85 common cement and .15 clay to 2 sand and 4 broken stone; 1 common cement to 3 sand and 5 broken stone, and 1 reground cement to 3 sand and 5 broken stone. In the mixtures of clay and common cement, the clay replaced part of the cement.

Mixing.—Proportioning was by weight. The mixing was done by hand; as nearly as possible imitating actual operations as practiced in the field. In the case of the clay it was first mixed with the cement and then with the sand and broken stone. In filling the forms the material was well tamped to make as dense a mixture as possible. The test specimens were made by filling forms of corrugated galvanized iron, each in shape the frustrum of a cone; 4 ins. in diameter at the larger end and 3⅓ ins. at the other. These were filled to within 1 in. of the larger end. Two sizes of test pieces were used—6 and 3 inches thick—and three specimens of each size for each mixture were made, making 84 specimens all told.

The tests were divided into three series with regard to age; viz.: 30, 40 and 60 day specimens. One 6-in. and one 3-in. specimen were used for each test. The specimens were all tested under pressure by being clamped on to a cast iron head, as shown by Fig. 1, through which the water was conducted by a ½-in. pipe, connected to an inlet pipe from the college pressure mains. The connection between the test piece and the cast-iron head was made water-tight by means of a rubber gasket placed in a groove in the head. The pressure was read by a pressure-gage attached to the inlet pipe; the maximum pressure from the mains being about 60 lbs. per sq. in. The water was started at 30 lbs. per sq. in. and at the end of 6 hours was increased to 40 lbs. After 16 hours at 40 it was increased to 60 lbs. and this pressure was maintained from 7 to 22 hours in the initial tests. Nearly all of the specimens were broken open at the end of tests and the penetration of water, or moisture line, observed.

For the tension test briquettes of standard size were made and tested in a Fairbanks Standard Testing machine. The briquettes were made along with the specimens for the pressure test, and from the same material. They were all stored in moist air for 24 hours and then put under water. The object of this test was to compare the strength of the different mixtures.

In the absorption tests the specimens were cubes 3x3x5 ins. made from the same mixtures as the pressure specimens. They were allowed to set in dry air for one week, then weighed and stored under water for 90 days. They were then removed, wiped dry, and reweighed and the percentage of absorption determined.

In the pressure test no measurement of the water passing the material in the 30 day test was made, but in the 40 and 60 day specimens and all special tests, the water was caught in pans and measured. In the initial tests the rate of drip per hour was noted while in the special tests the total amount was measured. The tops of all specimens in the pressure test were kept filled with water to prevent any tendency of the material to shrink away from the forms. In fastening the specimens on the testing apparatus the water was allowed to force out the air in the top of the form before the final clamping to the rubber gasket, as it was noticed that otherwise the air confined between the pressure face of the specimen and the cast-iron head would be forced out through the concrete.

Mortars.—In the 1:2 mixtures of common cement the age of the specimen did not seem to have any effect on the permeability. The 30 day and 60 day specimens were reserved for special tests but the 40 day specimens were broken and found quite fully saturated. The special tests showed up well but when broken were also found badly saturated. The clay specimens improved slightly with age, but all except No. 35, in the initial and special tests were largely saturated. No. 35 was dry on the outer face during the entire test and passed no water, but was wet half way through when broken. As a whole the clay specimens were less impermeable than the specimens with common cement alone. The 1:2 mixtures of reground cement were much better than the clay or common cement mixtures. Age had no effect on the reground pieces as the 30 day specimens, Nos. 15 and 17, gave better results than any others. Neither of these leaked at all during the tests.

The 1:3 common cement mortars were all badly saturated in every case, when broken. The 10 per cent clay mixtures were badly wet and in most cases completely saturated when broken. Age seemed to have no effect on these mixtures. On an average these specimens were slightly better than the 1:3 common cement specimens. The 15 per cent clay mixtures as a whole were a failure. No. 45 was the only one that passed no water in the special tests but when broken it was found to be wet to within 2 inches of outer face. The reground 1:3 mixtures were all good examples of impermeability. Every specimen, when broken showed wetting in but slightly.

Concrete.—The 1:2:4 concrete mixtures with common cement either leaked badly or were found to be completely saturated when broken. The 1:2:4, 15 per cent clay specimens became wet on the outer than those made of common cement. All specimens leaked badly and in almost every case were completely saturated when broken. The 1:2:4, 15 per cent specimens became wet on the outer face almost as soon as the pressure was applied and remained so during the entire test. All specimens were completely saturated when broken. The 1:2:4 reground cement specimens showed in every case but little penetration of water. No. 53 leaked quite badly at the beginning of the test but when broken it was found to be dry in the interior and showed that the leak was around the edge next to the form; evidently due to imperfect bond.

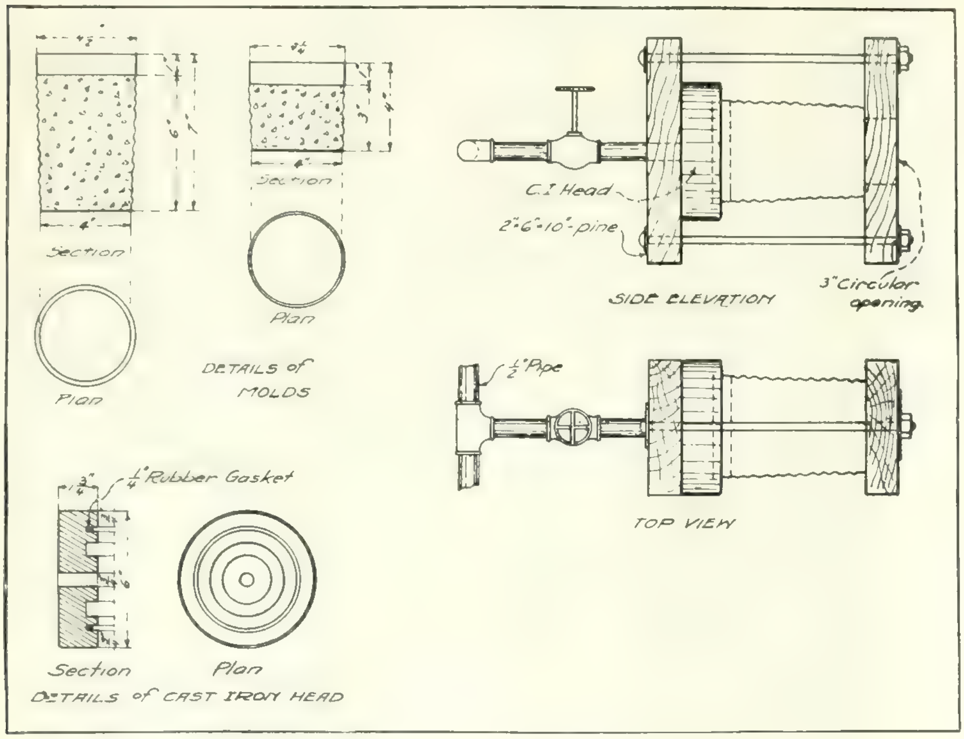
The 1:3:5 common cement specimens of this mixture all leaked badly and when broken were found completely saturated. The reground cement specimens of this mixture were all good and compared favorably with the 1:2:4 specimens with reground cement.

Remarks.—From the data secured, it will be noticed that leaking took place in a great many cases, while in some instances the amount of leak was nil. This was readily explained when the specimens were broken. The leak in some cases was next to the form, due to imperfect bond between the cement and iron, while in other cases the leak was through the edge of the material, apparently due to a less density here than in the center; in still other instances the water penetrated through the center as readily as through the edge. Taking into consideration the outward appearances during the test and the appearance of the interior when broken, there was little difficulty in drawing conclusions as to the permeability of the different mixtures.

It has been advocated in the use of clay as a water-proofing material, that it unites chemically with the other materials of the mortar or concrete, but in these tests the clay was washed out when the specimens were placed under pressure, showing that only a mechanical combination had been produced. All clay specimens when broken showed very poor bond; in some cases there was a noticeably honey-combed condition. In all these specimens, it was also noticed that leaking increased with time under pressure; in some cases becoming so great as to necessitate removal of the specimen. These conditions are readily explained if we consider the clay only mechanically combined. The clay in this case being an inert material, prevents perfect contact of the cement with the sand or stone.

Conclusions.—In conclusion, we would say that the mixtures, using common cement alone, were all failures from the standpoint of impermeability, except the 1:2 specimens, Nos. 7, 8, 10 and 12. These last while not leaking, were deeply penetrated by the water, rendering it unsafe to recommend them where impermeability is required.

The clay instead of making the specimen more impervious increased the permeability,



Details of Test Pieces and Molds for Determining Impermeability of Concrete.

as was shown by both the pressure and absorption tests. It is our belief, therefore, that sand should be free from clay to obtain the most impermeable mixture.

The specimens, in which reground cement was used, showed up well in all three tests. The different mixtures gave fairly uniform results and it was not difficult to see their superiority over those with common cement and clay.

From the results obtained, we would not hesitate in recommending any of the mixtures with reground cement in preference to those with clay or common cement. Not alone does reground cement make a better waterproofing material, but it also increases the strength, as was shown in the tensile tests. The fact that reground cement sets more quickly, will not, we believe, be a serious hindrance to its use. When used in mortar or concrete 20 to 30 minutes were required for it to set which would be ample time for good workmen to mix and place material.

The Effect of Electrolysis on Metal Embedded in Concrete.*

Portland cement mortar and concrete form an excellent protecting cover for iron and steel under ordinary conditions, but when concrete has steel embedded in it under such conditions that there are electric currents passing through the steel and from the steel to the concrete, there is set up a corrosive action due to electrolysis that may rapidly deteriorate both the metal and the concrete.

The conditions which bring about this destructive action are neither uncommon nor complicated. If electric currents pass into dense concrete through steel which is tightly embedded in it, an action takes place which will in time disrupt the surrounding concrete. If the concrete is not dense, but contains an appreciable percentage of voids and is therefore somewhat compressible, as in the case of a cinder concrete, then the result of the swelling action may be that of closing up some of the voids and so no actual rupture of the mass may occur. If the steel but rests upon the surface of the concrete and is not embedded in it, the action may take place on the plane of contact without disrupting the concrete. The current passing may be extremely small, with the result that the action is very slow, but the effect is the same in the end.

It is not uncommon practice to embed the bases of steel building columns in concrete, or the bases of elevated electric railway structures and bridge and trestle columns. In any of these cases there may be small stray electric currents passing from the metal to the surrounding concrete if electric currents are much used in the building or if electric railways pass over the bridges or trestles.

If the conditions are fulfilled—that is, if a portion of the steel is solidly embedded in dense concrete and if even small electric currents pass through the steel and leave it and enter the concrete where it is thus firmly embedded—it is only a matter of time until the concrete will crack and break away from the steel.

These facts have been well established. They have been previously studied, experiments demonstrating them carried out, and results reported in several technical publications during the past four years. Some of these investigators reported their work in the following publications: Mr. Maxmillian Tock, *Journal of the American Electro-Chemical Society* for June, 1906; Mr. A. A. Knudson, in *Journal of American Institute of Electrical Engineers* for 1907; Mr. [illegible], in *Engineering News*, for Dec. 24, 1908, and Dec. 1, 1910; Mr. A. S. Langsdorf, in *Journal of the Association of Engineering Societies* for February, 1909 and Mr. G. B. Shaffer, in *Engineering Record*, for July 30, 1910.

Some further data bearing upon this destructive action is shown by a series of experiments conducted by Westinghouse, Church, Kerr & Co. and which are described as follows:

A series of steel plates about 1-16 in. thick, 2 ins. wide and 6 ins. long were embedded in concrete blocks. These plates had been previously painted with two full flowing coats of paints of various kinds. In each concrete block were placed 11 plates, 10 of which were painted and one uncoated. The purpose of painting the plates was to seek a proper protecting medium for steel exposed to these conditions, but "that is another story," and the results so far as they have to do with protective coatings will be reported at another time.

The concrete blocks were about 6x6x14 ins. They were made of dense concretes, using a mixture of samples of good brands of American Portland cement, and for the coarse aggregates crushed limestone, crushed granite, gravel and cinder. Two sets of blocks were made up. They were made of the same mixtures and in them were embedded plates coated with the same paints. The one difference in the treatment of the two sets of blocks was that a small electric current was passed through the plates in the one case and not in the other. In both cases the blocks were kept standing in a shallow metal pan of water to keep the concrete damp.

All the plates were connected in parallel to the source of the current and the direction of flow of the current was from the plates through the concrete to the metal pan. The voltage was maintained at about 10 by means of a lamp bank. The total current flowing was less than two-tenths of an ampere.

The first effect apparent on the blocks subjected to electrolysis was the appearance around the plates where they entered the concrete of small brown globules or bubbles, apparently of iron oxide. These may have been caused by the escape of small quantities of gas liberated by electrolytic action on the surface of the plate down in the concrete, which has traveled up along the plate, and, carrying iron oxide with it, has left a deposit of rust where the gas escaped on the surface.

This excrescence made its appearance after one to three weeks and gradually increased. Its amount seems to be proportionate to the amount of corrosion taking place on the plate about which it forms. Those plates which corroded very little showed no such excrescence as those which were badly affected.

The next noticeable effect was a very fine hair crack on the top of the concrete block, extending from one or both edges of the plate outward. Gradually this hair crack grew until it reached the sides of the block and finally the block split through completely. This bursting of the block has occurred only in cases where the corrosion has been very bad and has taken place at periods ranging from a week to three months or more after current was turned on. The tests were continued until the blocks began to crack and split. They were then broken open and the plates removed. These results took place only in the set of tests which were subjected to the electric current. The other set showed no change in appearance whatever on the outside of the concrete block. In these the plates were all free from rust or corrosion except at the point where they entered the concrete and where the metal was subjected both to the moisture of the concrete and to the air. Here and there appeared some slight rusting. The concrete was all sound and hard.

In the case of the blocks subjected to the electric current the corrosion of the metal was very marked and the plates were deeply pitted. The denser blocks were broken in many places, while the [illegible] concrete had was still sound and whole, although the corrosion of the [illegible] the other cases.

[illegible] experiments and results agree with those described in the articles mentioned above. But here the close resemblance ceases.

When the cracked blocks were broken apart the concrete [illegible] except immediately adjacent to the metal plates, where the concrete seemed slightly softer to a depth of perhaps 1/16 in. There was no appreciable spreading of iron rust along the fracture, which showed clean, fresh concrete, except for some discoloration extending very slight distances from the metal, ⅛ in. or less.

As to the cause of this rupture of the concrete five different theories have been offered as follows: (1) Expansion of the metal due to change in its chemical nature; (2) hydrostatic pressure; (3) pressure of liberated gases; (4) internal heating and consequent expansion; (5) expansion of metal due to corrosion. It will be noted that only one of these theories, the last one, depends upon the presence of a metal. Each of the others would hold equally well if some non-metallic conductor were embedded in the concrete and a current passed.

In order to get further evidence as to which of these five explanations is the nearer correct, the following experiment was carried out:

Two 6-in. cubes of dense concrete were made up, in one of which was embedded a ½-in. round iron rod and in the other a ½-in. round carbon rod. Carbon was chosen because under the temperature and conditions it would not oxidize or swell appreciably, yet it would transmit current to the heart of the concrete block just as the iron rod would and offer little resistance. Electrolysis would take place on the surface of the carbon as it would on the surface of the iron, gas would be formed in the one case as in the other; in fact, the only important difference in the action between the carbon and the iron rods, for the purpose of this investigation, is the fact that the iron oxidizes or rusts under these conditions, while the carbon remains passive and unaffected. These two blocks were then connected up in parallel and a current passed through them. There was no rise in temperature which the hand could detect. A difference of potential of about 10 volts direct current was maintained on the two blocks. In just one week the block containing the iron rod burst and after a period of over two months the block containing the carbon rod was apparently as sound as ever. The voltage was then raised to 30 and two days after to 50 with no apparent effect.

In the light of these results the theories enumerated above may be examined to ascertain which of them seems most fully to explain the phenomena described. The first mentioned theory—namely: that the cracking is caused by the expansion of the concrete due to change in its chemical nature—is commented on by its advocate as follows:

> Experiments * * * seemed to show that * * * the strong oxidizing agents, chlorine and oxygen, permeating the pores of the concrete and in the presence of water, changed some of the cement compounds to higher states of oxidation. Such a change should make more space necessary and so act as a bursting force.

This may be answered with the statement that with the carbon electrode the same gases would be liberated and the action of these gases upon the concrete would be the same, therefore the concrete should have burst as surely with the carbon rod as with the iron rod. The fact that this was not the result throws doubt upon this theory.

The second theory is that a hydrostatic pressure is produced at the anode which ruptures the block. An advocate of this theory says:

> [illegible] currents. * * * This transference caused a [illegible]

If this were true when iron is used, there [illegible] should not be equally true when a carbon electrode is used, and a theory which does not explain this discrepancy is defective.

Of the third theory, which accounts for the cracking by the presence of a gas pressure at the anode, an exponent says:

> The cracks in the concrete are best accounted for by the following theory of gaseous pressure:

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*A paper by Lloyd M. Chapman before the National Association of Cement Users.

The [illegible] its [illegible] gases were [illegible] the surrounding concrete they would accumulate and gradually increase in pressure. As the pressure in a particular void increased the surrounding cement crystals would be subjected to a tensile stress * * * and [illegible] crack.

To this the same answer applies, namely, that the gases are liberated by the carbon as well as by the iron rod.

The next or fourth theory mentioned is to the effect that the current heats up the concrete internally and the consequent expansion bursts the block. Its sponsor says:

> This leads to the belief that the indirect thermal effect of the current is a more important factor than the formation of gases under sufficient pressure to rupture the concrete. * * * The temperature may be supposed to have risen considerably along the path, giving rise to local expansion, cracking and general disintegration.

As to the former theories, the reply again is that this heating by current is in no way peculiar to an iron electrode and therefore the block containing the carbon rod should burst as quickly as the one having the iron rod. Even the increase in voltage from 10 to 50, with the consequent increase in current passing, and in the heat generated, apparently had no effect on the block, though the iron burst its block in one week at 10 volts.

The fifth or last theory, which is the one most commonly advanced, seems to explain more completely the phenomena noted. We all know that iron rust occupies more volume than the original metal from which it was formed, and as the rust which formed on iron subjected to the conditions here described must find space for itself, a great internal pressure is set up as the amount of rust increases until the inclosing and confining concrete gives way. This great internal pressure also explains the partial breaking down, or crushing or softening of the layer of concrete immediately adjacent to the metal.

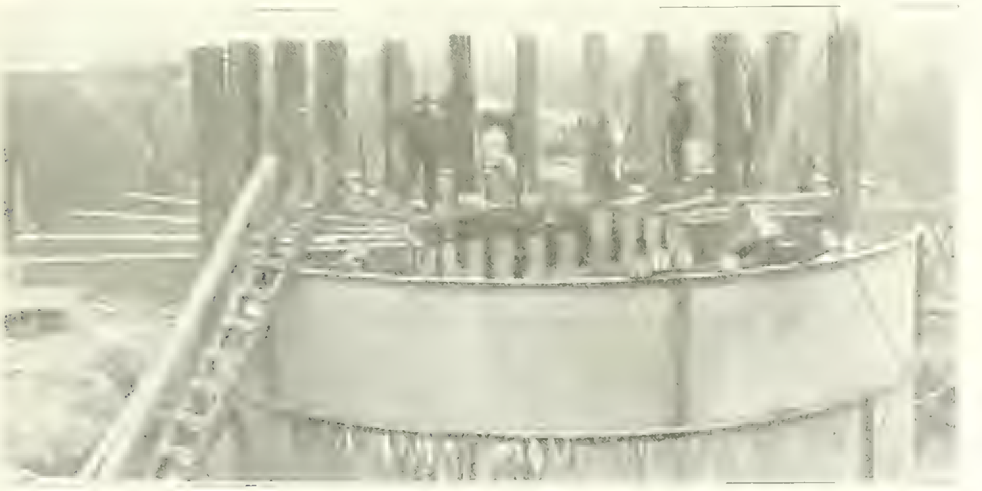
It is not only when a current is passing that steel corrodes when embedded in concrete. Reinforcing bars are somtimes placed so close to a surface that is exposed to the weather that air penetrates the concrete to the steel in dry weather and water reaches it in wet weather. Under these conditions the concrete does not possess sufficient protective power to overcome the corroding tendencies of steel which is alternately wet and dry. This becomes especially true after repeated rains have washed out a portion or all of the free lime in the outside layer of the concrete which so effectively protects iron and steel from corrosion. In outside walls the reinforcing steel should be kept far enough from the surface to be well protected. As an illustration of the failure that may follow the placing of steel too near the surface there may be mentioned an exterior wall in which the steel in a few places was less than ½ in. under the surface. The result was the corroding of the metal first at the points where the rods were nearest the surface and then the gradual extending of the corrosion along the rods, with the consequent bursting out of the concrete in which it was embedded. This building was erected about nine years ago and the rusting of the bars and cracking out of the concrete became apparent after some two or three years.

Similar effects have followed the use of ungalvanized metal lath over which insufficient coating of mortar had been placed. In some cases large areas have scaled from outside stucco walls because the rusting of the iron lath and the consequent swelling action separated the stucco on the outside of the lath from that on the inside. Having thus lost its bond the outside stucco falls off very easily. The painting of steel lath to protect it against such action we believe to be of little avail. The remedy lies in the use of a substantial, well galvanized lath and placing on it a good and sufficiently heavy coating of dense plaster.

EARTH AND ROCK SECTION

Methods of Sinking a Deep Concrete Shaft at Hibbing, Minn.

In sinking a deep shaft at Hibbing, Minn., many interesting methods were employed, among which was the method used for plumbing the shaft, as it was sunk, by means of eccentric loading. This is illustrated in the accompanying photograph. The photograph shows a system of trussed supports as built for loading the shaft on one side. The method has the effect of a cantilever and reduces the load necessary to accomplish the desired effect.



View Showing Method of Loading Eccentrically a Steel Cylinder.

The friction of the outside surface of the concrete shaft with the ground through which it is sunk varies from 250 lbs. to 1,200 lbs. per sq. ft. of surface, depending upon the character of the soil. The friction is greatest in sand and quicksand and least in clay.

For reducing the friction, water jets are run down between the shaft and the soil at short distances apart around the circumference of the shaft.

The work at Hibbing is being done by the Foundation Co. of Chicago. It is of special note because the shaft has been sunk 164 ft. below water level, or in all, 185 ft. below the surface of the ground.

The shaft is 29 ft. in diameter with a rectangular cageway 10′-10″x14′-10″.

The shaft is made circular because of the saving in surface friction over that which would obtain with a rectangular shaft of the same size.

The outside forms were of steel plate placed in 5 ft. sections. Three sections were used for ordinary sinking, the bottom section being removed and placed at the top as fast as the concreted sections were sunk.

The inside forms were of wood, made in 5 ft. sections using a set of 6x6 in. dressed timbers braced across the corners with 3x6 in. pieces. The 6x6 in. timbers were tied at the corners with 4x½ in. iron straps. The timber sets were placed at 30 in. centers and 2 in. sheeting was used. The rectangular opening was made 4 in. wider and longer than was required by the plans in order to care for any small inaccuracy due to the shaft being out of plumb when bed rock was reached.

In sinking the shaft the excavation was at first carried on through the cageway by using the clam shell bucket attached to the derrick. When the excavation had proceeded to a depth at which it was impracticable to dig with the clam shell a Moran lock was installed and the work was carried on under the pneumatic process. Air pressure was not put on until the shaft had reached a depth of about 166 ft. An air pressure of 47 lbs. per sq. in. was used, and 40 min. shifts were worked.

Estimating Panama Excavation by Car Accounting.

The amount of material excavated from the Culebra cut, Panama, is kept account of both by cross section measurements and by the number of cars of material taken out. By a long series of tests this average content of any given car has been established and the monthly estimate of the number of cars of material taken out agrees very closely with the cross section measurements.

Three classes of cars are used in hauling spoil from the cut. The wooden flat cars with one high side, so constructed that they may be unloaded by an unloading plow, have a rated capacity of 19 cu. yds. Twenty of these cars are ordinarily hauled in a train, and the spoil on a train would, therefore, be about 380 cu. yds. The next largest cars are the Western & Oliver air dump cars, which have a rated capacity of 17 cu. yds., and are used almost exclusively in hauling rock to Gatun dam. Twenty-seven of these cars compose a train, and the amount of spoil on each train is therefore, about 459 cu. yds. The small Western & Oliver dump cars, known as the "12-yd. dumps," are rated at 10 cu. yds. capacity each, and 35 of these cars ordinarily compose a train, the amount of spoil in each train being, therefore, 350 cu. yds.

The time taken for loading each car varies according to the material in which a shovel is excavating, and to innumerable small delays incident to the excavation and transporting of the spoil. An illustration is the work done by 20 steam shovels in the Culebra construction district on Nov. 11, when 30,077 cu. yds. of rock and earth, an average of 1,503 cu. yds. per shovel for the 8-hour working day, were excavated. The shovels were under steam 160 hours, were actually digging 109 hours, were waiting for cars 38 hours and 40 min., and were delayed the remainder of the time by mining, cleaning track, repairs to shovel, track repairing and moving the shovels forward. With all conditions favorable a shovel can complete a digging operation in one minute and thus load a 19-yd. car in about 8 minutes.

Four Designs for Automatic Dumps.

Various methods of dumping skips containing excavated material are illustrated in the accompanying drawings. The first two figures show two methods employed for dumping cars which are hauled upon an incline, while the last two figures show dumping arrangements used on vertical hoists. The devices illustrated are now being employed in New York mines and are described by Mr. G. C. Stoltz in the *Engineering and Mining Journal.*

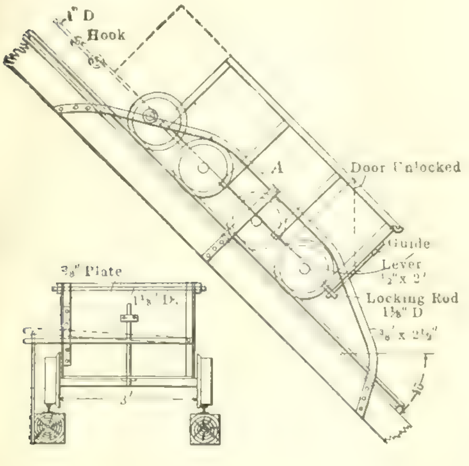


Fig. 1.

Figure 1 is a 2-ton capacity car, equipped with an end-locking door, hoisted up a 23° slope, to a point near the surface, where the inclination is increased to 45°. At the storage bin the lever which actuates the locking device on the door is mechanically raised on encountering a flat iron truss *A* bolted to the rail stringer, the ore being discharged from the rear of the car. The car is then lowered to the hoisting level, the door locked, the cable disengaged and the car is trammed to the stope to be filled. The cable provided with a locking hook is then attached to a loaded car which is in waiting at the foot of the incline.

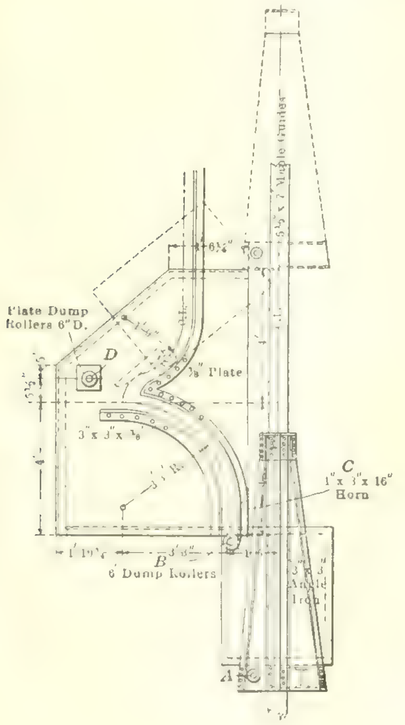


Fig. 4.

Figure 2 shows another 2-ton capacity car which dumps forward, instead of from the rear. In dumping, the front wheels, which are of 4-in. tread, leave the main stringers and [illegible] auxiliary stringers, while the rear wheels of 7-in. tread run over the dumping point on the inclination of the main stringers. No guides are used on the hoist and the front wheels of the skip are prevented from lifting off the rails in hoisting by having the bail press against lugs riveted on each side of the skip. The whels are stationary on the axle, the latter turning in brass lined journals. This method of stationary wheels is to be recommended since the wheels cannot become loose or wabbly by wearing of wheel hubs or axles and consequently reduces to minimum the chances of skips jumping the tracks. In case of an overwind through the dump the skip is hoisted in its dumping position of 45°, since lugs on the skip at the back bear against the bail as the skip assumes the angle of discharge.

A skip dumping arrangement for cars which are hoisted vertically, is illustrated by Fig. 3. This is well designed and differs considerably from the usual type. The fore and rear wheels have the same dimensions and are so guided at the dump that the tilting of the skip is positive, [illegible] track guides will enable the skip to right itself quickly.

[illegible] ways.

In Fig 4 the 4-ton Kimberly skips are shown. They are turned on the axle *A* by means of the rollers *B* taking a course away from the vertical guides as described by the angle-iron guides until the horns *C* intercept the rollers *D*, whereupon the skip rollers *B* are elevated to the upper angle-iron guides. The skip overwinds at approximately the angle of discharge.

The hoisting cables for all the above buckets are plow steel, 1 in. to 1⅛ ins. in diameter, and are generaly attached by passing through a clevis on the bail of the skip, being lapped 3 ft. and held by 3 to 6 grips. Iron head sheaves are 5 to 8 ft. in diameter. Eight to 14 ft. are allowed for overwinding. The usual gage of skipways is 4 ft.

Improvements in Transportation Equipment, Panama Canal.

Much attention has been devoted, at Panama, to the improvement of the facilities for transporting the spoil from the large cuts. The transportation factor is the most important feature to be looked after, because the output of the steam shovels is limited more by the rate at which the material can be carried away than by any other factor.

Flat cars with one high side and the other side open are used for hauling most of the spoil from Culebra Cut. The high side, permitting of a heavier load on that side of the car than on the other, was found to be the cause of an unequal distribution of weight, and to overcome this the floor has been extended 11 in. on the low side, making it possible to distribute the weight of the load nearer the center line of the trucks, and also enabling the unloading plows to throw the spoil farther away from the tracks when the material is ploughed off. It was found early in the use of these cars that the unloading plow was causing a lot of damage to the high sides by running into them, in passing from one car to another. This cause of trouble and expense has been eliminated by binding the high side of the car with an iron ferrule, known as the "bull nose," which presents a beveled edge to the plow and thus steers it into position as it passes from car to car.

Trouble was also experienced in the first days of the heavy trains by the coupling breaking and the trains separating. A bridle has been devised which overcomes this difficulty by holding the cars together in case the automatic [illegible] worn knuckle, worn or broken lock, broken knuckle tongue, broken jaw, or even in case a drawbar carrier is down. By using the bridle the cars are held in their original position, [illegible] and the parting of the compressed air line is thus obviated. They are especially serviceable in the coupling between a Lidgerwood unloader reel car and its locomotive, where the pipe which carries the steam from the locomotive to the reel engine formerly broke every time a coupling gave way, subjecting anyone near the break to a scalding.

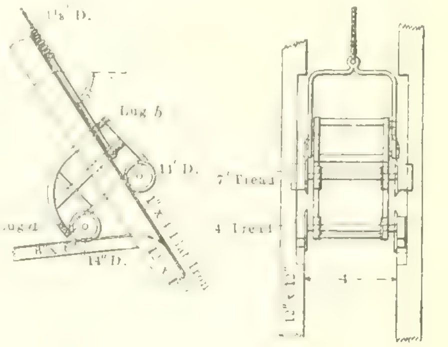


Fig. 2.

The unloading of flat cars is done by pulling a steel plow from one end of the train to the other by means of a cable attached to a drum. When first used on the canal work the plow was a skeleton with a plate wing. It was weighted down with from 7 to 12 tons of ballast, in order to keep it on the bottom of the cars and so prevent it from riding over the spoil. Small rock was continually working under the bottom and over the top of the plow, and, as there was no way for it to escape except by being ground out, it did constant damage to the floor and was continually catching in the aprons. The plow has been covered with sheet steel on the top and bottom and thus the small rock has been excluded, while, by an adjustment of ballast along the share, 3½ tons of weight have been found sufficient to hold the plow on the floor, entirely overcoming its tendency to rise.

It was necessary formerly to spend several minutes in digging the end of the cable attached to the plow out of the spoil along the face. This waste of time has been eliminated by forming grommets out of worn-out cable and attaching them to the plows where they are always in plain sight, so that the unloading cable can be coupled to the grommet without any of the work of digging rock and earth away from the face.

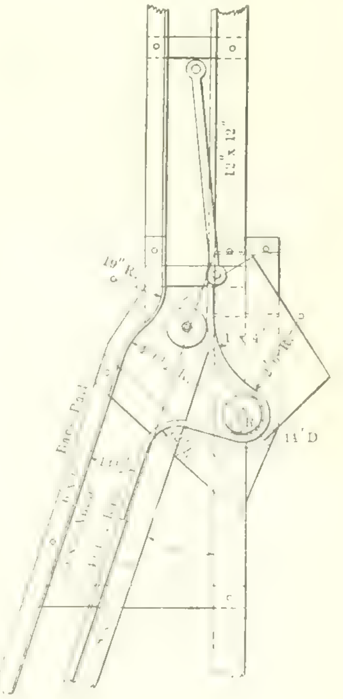


Fig. 3.

Another waste of time was that formerly experienced in attaching the cable to the stretching frame and loosening it after it had been stretched over the train. A slip link has been placed in the chain, which holds the cable to the stretching frame, and a blow from an iron rod opens this link, allowing the cable to fall upon the car without the train even stopping. In this chain there has been placed a soft link with a breaking strain of 1½ tons, and if anything interferes with the plow which may place an unduly heavy strain on the cable, this link will give way.

Frequently, it is desirable to unload a train on a curve, and under such conditions it is almost impossible to keep the cable on the train, because under the great strain of the unloading it naturally seeks the shortest line. A block to hold the cable in place has been devised. This block is fixed to a 3¾-in. chain 8 ft. long, on the other end of which is a hook that can be attached to the arch bar of the car truck. The cable runs through this block and is thus held in place.

On one day, about 8 months ago, one unloader at Tabernilla unloaded 18 trains of 19 cars to a train, in all 3½ miles of cars. In August, an average of 40 cars a day was unloaded at Balboa, or 13⅓ trains to an unloader; 19 cars of 20 cubic yards to each train.

In handling soft dirt in slides, and other material, where it is necessary to uncouple cars from a train and back them alongside the shovels, the steel aprons that join the cars are thrown back, in order that the couplings may be broken. In the loading, these aprons are frequently covered with a ton or so of spoil, and when it becomes necessary to throw them back into position, so that the plow can pass over them, considerable labor is required to take the spoil off the top of the apron. All this work has been obviated by an apron thrower, which consists of a short chain with a hook on one end and a cable grip on the other. The hook is placed under the apron and the grip fixed to the moving unloading cable, and thus the apron is returned to its correct position in advance of the plow.

The spreader is the most complicated machine, requiring long continued practice on the part of the operator before he becomes thoroughly efficient.

Fifty-one improvements have been made on the machine, and each one has added something to the efficiency. This spreader consists of a car on which is erected a machine with steel wings, which reach out 11½ ft. from the rails on either side and level off the material dumped from the spoil trains. The spreader does the work of more than 2,000 men, and probably does it better than could be done with shovels. It is operated by compressed air. The main reservoir in which the air is stored has been moved from its original position, parallel with the length of the car, and placed in a position where it is less in the way, while all the piping has been rearranged for pressure from this reservoir, instead of from the train air line. An operator's table, under cover, has been erected at the rear of the car, and the operator occupies an elevated position from which he can witness all the movements of the machine.

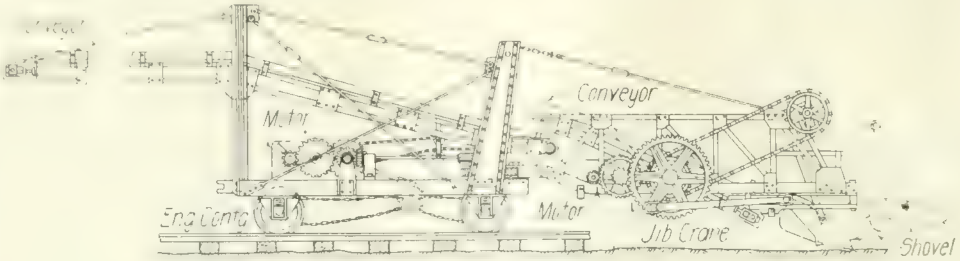
When they arrived on the Isthmus, these machines were so constructed that they could not clear one another on the main line of the railroad, even when the spreading wings were folded, and they have been altered so that they now clear. A wheel on the front wing, which ran along the track and frequently caught in and split expansion rails and switches, has been replaced by a shoe which rests on the rail and takes the weight off the wing without in any way interfering with the rails. Shoes have been added along the edge of the wings to take the wear, thus saving the main ploughshare. Other improvements are in minor parts, but each one has added to the efficiency of the spreader.

The track shifters have been improved so that they can now throw track 9 ft. from its original position instead of 5 ft. as formerly. Another change now being made to the shifters, by which the machines now running the hoists, will take steam from the locomotives, saving a fireman's wages and also coal.

An example of the work of one of these shifters was that done at Tabernilla dump about eight months ago, when 1¼ miles of track were shifted 12 ft. from the original position in 1 hr. and 50 min.

A New Shoveling Machine for Tunnel and Mine Work.

A machine for use in shoveling rock from a tunnel heading has recently been patented by Mr. William Whaley of the firm of Meyers & Whaley of Knoxville, Tenn. The first machines were built for use in coal mines and were built very low so as to work in 5 ft. of head room. Up to the present time the coal handling machines are the only ones in actual use, but we are able to present, by courtesy of Mr. Whaley, a diagram of the machine as designed for tunnel work or for loading railroad cars, and some data showing the performance of the original coal handling machine. The coal handling machine embodies all the principles of the new machine, but was designed to come within certain height limits. The present machine is limited in the same manner, but not to the same extent. It is limited merely to proper height for working in higher mine workings and ordinary tunnels.



Shoveling Machine for Tunnel Work.

The machine consists of a four wheeled car, intended to rest on a track; a jib crane, pivotally mounted upon one end of the car and projecting forward; two belt conveyors, one supported over the car and the other over the jib crane; a scoop shovel supported at the free end of the jib crane and so controlled as to move forward upon the ground and take a load, lift the load and revolve it rearward, discharging upon the conveyor.

The machine is operated by two motors, one for driving the shovel and forward conveyor and the other for swinging the jib, for raising and lowering the jib, for propelling the car and the rear conveyor.

The first machine built was operated in the Wind Rock mine, in Tennessee, and was tested at different times covering a period of three years. It did excellent work and was able to load a 1 yd. car in from 2 to 3 minutes. The conditions at the mine, however, made it impossible to supply the machine with enough cars to operate continuously, thus reducing the output. The machine was, therefore, taken to the United States Coal & Oil Co.'s mine in West Virginia, where better conditions were obtainable for a test of longer duration. During six days of its operation a record was kept of its performance, which showed the number of cars loaded, time required to load and shift cars, time required to change the machine, and time lost for whatever cause.

The machine averaged, in spite of delays and lost time, about 141 cu. yds. per day. The minimum day's work was about 100 cu. yds. (due to lack of coal), and the maximum 165 cu. yds. Much of the work was done on curves. The average time of loading and shifting a car was 8.4 minutes, or about 23½ cu. yds. per hour. The crew of the machine consisted of 4 men—1 runner, 1 man in front pulling down coal and 2 men handling cars.

The following table shows the results as given on the report of the best day's work of the 6 day test: Total time worked, 9 hrs. 32 mins.; time lost repairing, 45 mins.; time shifting machine to other drifts, 1 hr. 3 mins.; total time lost, 1 hr. 50 mins.; total time shoveling, 6 hrs. 39 mins.; number of men, 4; number of cu. yds. loaded, 165.

Methods of Driving the Cripple Creek Drainage Tunnel.

The drainage tunnel for the Cripple Creek mining district about two months ago tapped the deep water levels of the district and thus commenced to serve its purpose in reclaiming $317,500,000 worth of mineral territory. A history of the work and a description of the methods used in driving the tunnel are given in the *Mining World* by Mr. A. W. Warwick, from which article we abstract the following notes:

The work was commenced in May, 1907. It was originally estimated that the tunnel (10 ft. high by 7 ft. wide) could be driven 300 ft. a month. The tunnel company required the contractors to make a monthly average of not less than 260 ft. The early contractors barely exceeded 200 ft., and some of these men were regarded as being the most expert miners in the district. Early in 1908 Mr. J. H. McIlwee was given charge of the work and under his direction the progress has exceeded the original estimate. The first month's work saw the breast of the tunnel advanced 211 ft., and omitting this month the first year's work gave an average of 344½ ft. driven each month, which rate has been sustained ever since. From Jan. 1 to Sept. 1, 1910, the average monthly rate has been 346 ft. per month.

The granite through which this tunnel is being driven has the reputation of being about the hardest and toughest in the Rocky Mountains. The rock is not as hard as can be occasionally found, but it is questionable if a continuous stretch of 15,000 ft. of similar rock can be found outside of the Pike's Peak district.

The rock is known as "Pike's Peak granite." It is a pinkish rock composed of coarse crystals of red feldspar, very little quartz and is marked by a general deficiency of ferro-magnesian minerals. In the whole stretch of tunnel the main characteristic to be noted is that the rock appears to be absolutely seamless. Thus soft bars are entirely absent, and the resistance of the rock to the explosive power of dynamite is at a maximum. In comparing records made in this tunnel with those made in others these facts must be kept in mind. The only rock that could compare with the Pike's Peak granite in hardness and toughness is the notorious tin-capel of Cornwall, but, of course, no such masses of tin-capel are found in Cornwall that can compare with the masses of the Pike's Peak district.

The problem of attacking the work has been solved by a study of the men, appliances and explosives. The location of the drill holes has followed ordinary practice.

The first step taken in reorganizing the work was to change the shape of the tunnel. As originally planned, a great deal of time was lost in the setting up. By changing the shape of the tunnel to 7 ft. high by 10 ft. wide, as against 10 ft. high and by 7 ft. wide, and using a horizontal drill support, two set-ups of the drilling bar allowed the entire number of holes to be drilled.

Two rounds of drill holes each about 8 ft. deep were drilled every 24 hours. In general, 22 holes with a total depth of 188 ft.

were drilled on each shift. However, when very tough ground is being passed through, it is customary to put in six extra holes, making an additional depth drilled of 52 ft. The time consumed in drilling varies from 6 to 8 hours per round.

A No. 7 water Leyner drill is used. These machines are given credit for a large percentage of the speed which has been maintained. The shank of the drill has two projecting lugs which fit into the slots in the drill chuck. To change the drill, a quarter twist is given to it, which loosens it so that it may be removed. Helpers change the bits in from ½ to 1 minute.

A great deal of attention has been paid to figuring out the number of steels needed to drill a hole. This is an important detail. The drill runners demand that the bits must be kept sharp until they have done their share of the draft. Each steel is 2 ft. longer than the preceding drill used and thus the long cut holes will require six lengths of steel, and all the others are given five. The diameter of the bits used at first is 2¾ ins. and the diameter of the last bit is 1½ ins.

The drills are sharpened by a Leyner drill sharpener. This sharpener will turn out 150 drill bits a shift. Two blacksmiths are employed on the day shift; one for sharpening and one for welding. The welder by means of a small steel hammer can weld enough steel for the entire 24 hours, so that the night blacksmith crew only needs one sharpener.

The system of drilling the holes follows the ordinary rules. There is the usual cutting holes in the center, a line of back and side holes and the usual line of bottom or lifting holes. The accompanying diagram shows the manner in which these holes are drilled. However, when extraordinarily hard ground is encountered, an additional six holes are drilled, two extra cutting holes and four holes drilled directly into the rock, and placed in a quadrangle so as to relieve the upper, bottom and side holes. The two right-hand lifters are drilled so as to look downward at a fair angle. This is for the purpose, of course, of assisting in excavating for the drainage ditch.

In starting the work the horizontal drill bar is set between 2 and 2½ ft. from the roof, and from this setting the upper half of the round can be drilled without moving the bar. This arrangement allows the drill runners to commence work without waiting for the muckers to complete cleaning up, and by the time all the holes have been drilled from this position of the bar, the muckers have cleared away the dirt sufficiently to allow it to be moved to its lower position, and thus time is economized.

The explosive used is blasting gelatine 60 and 50 per cent dynamite. The shots are fired with fuse. Electric firing has been tested, but was not believed to be as satisfactory as fuse. The explosives used are made by the Dupont Co., and the fuse is the Silvanite brand made in Denver.

The blasting gelatine is used in an identical manner with that of ordinary dynamite, but it being less sensitive, a very powerful cap must be used. It is customary to use a No. 20 blasting cap. In loading the cutting holes, from five to seven sticks of blasting gelatine, 1/14 by 8 ins. are used. On top of this seven or eight sticks of 60 per cent powder are rammed, each stick being 1½ by 8 ins. In loading the relief cuts no gelatine is used, the primers being two sticks of 60 per cent powder, the charge being completed with six sticks of 50 per cent powder. The other holes usually are loaded with 12 sticks of 50 per cent powder.

The order of shooting is, of course, fixed by the length of the fuse and the order by which they are "spitted." The cutting holes, one and two, have fuses about 10 ft. 6 ins. long. Holes three, four, five and six have their fuses 2 ins. longer. The last holes to be shot, of course, are the lifters—19, 20, 21 and 22. On these, the fuses are about 12 ft. long. The result is that the lifters throw the broken rock back from the face, so that the drill runners can get to work as soon as possible, without waiting for the muckers to do much cleaning away.

Immediately after shooting the suction fan is started, and by means of a 16-in. pipe, which is carried usually within 150 ft. of the breast, the smoke is rapidly drawn out. Less than one-half hour after shooting the men can return to their work.

The use of these explosives, and the system of placing the holes, has been an important factor in making the records in this tunnel. From 25 to 40 tons of material are broken in each round, according to the hardness of the rock.

In cleaning out the broken material from the face, the last few tons of material are used for weighting the sheet iron plates, which are laid on the floor before shooting. This materially facilitates mucking and allows the drillers to expedite the setting up of the drill bar.

The force of the explosion is so tremendous that unless there is from 6 ins. to 1 ft. of material on the iron plates, they would be lifted and thrown back and badly crumpled. Of course, the material on the plates also acts as a cushion to prevent them from being unduly dented. The broken material is hauled out by mule over a single track. When a train of empty cars is brought up to the breast, the cars are unshackled, and the car man, by a dexterous jerk, throws the cars over on their sides, so that they rest on the sills over the water ditch. In this way the wheels of the empty cars clear the side of the rails by several inches. As a car is required it is jerked back on the track, run to the face and filled. It is then pushed back beyond the train of empties, and thus the cars are readily handled at the breast without confusion.

The drainage ditch usually follows within 150 ft. of the breast and this is drilled by machines set on tripods. This drainage ditch has kept back the progress of the tunnel by, possibly, 20 ft. a month, but it was undoubtedly a good policy to have the ditch carried along with the breast.

ROADS AND STREETS SECTION

Cement Grout Cushion in Street Railway Pavement Construction.

One of the most difficult problems confronting the paving engineer is that of construction around "special" work, such as street car tracks, manholes and sewer inlets. This special work necessitates a break in the pavement foundation as well as in the paving surface and unless it is properly treated it is quite apt to develop a disastrous weakness. Of the various forms of special work, the greatest amount of trouble comes from street car track construction. While the manholes and sewer inlets are scattered here and there over the paved roadway of the street where the pavement gets only an average amount of traffic, the street car tracks are laid longitudinally down the center of the street, just at the brow of the crown, where the traffic is most confined and the stress so great that, unless it is sufficiently strong, the pavement must go to pieces.

The contributing causes of trouble in construction along street car tracks appear to be: Vibration caused by the movement of cars over the tracks. Leakage of water into the cushion between the rails and adjoining pavement. The heavy stress to which the pavement is subjected, owing to the concentrated traffic upon it. A study of these conditions as they affect the pavement along street railway tracks has been made by Mr. Harry G. Davis, C. E. of Chicago, on behalf of the Chicago Street Improvement Association, and from his recently issued report we have taken the matter in this article.

The policy of street car company officials of increasing the weight of their cars and moving them at a greater speed means that present construction on a carline street must be much stronger than in the past. Every tendency of one part of the pavement to separate from the adjoining part is augmented, and every possible effort must be made to prevent this. For instance, in a creosoted block, brick or granite pavement, which is laid on a sand cushion, special treatment is needed to prevent this sand from being jarred out of place, causing a corresponding sinking of the pavement over the spot where the sand has "shifted."

Another evil effect of vibration upon the pavement, is that it has a tendency to cause disintegration. The disintegrating effects of vibration on a creosote block, brick, or granite street is probably confined to the concrete foundation and to the cushion which is laid between the foundation and the pavement surface. Experience has proved that a well-made Portland cement concrete, properly mixed and tamped, is not effected by vibration to any serious degree.

Still another disastrous effect of vibration is to open a joint between the car rail and the abutting pavement, permitting water and mud to seep down into the cushion between the foundation and the pavement surface, permeating and diluting it to such a degree as to cause it to "shift" easily. This shifting process leaves a void beneath the paving surface and as soon as that part of the surface is subjected to the stress of traffic it sinks. This sinking [illegible] fraction of an inch, is disastrous to any pavement and especially to a creosoted block, which, probably more than any other form of pavement, demand the maintenance of a smooth, even surface. As soon as the block goes down the least bit, it begins to get the pounding effects of the heavily loaded vehicles and a "rut" is produced.

With the sand cushion, usually laid underneath a creosoted block, brick or granite pavement surface, filled with water to saturation, the sand in reality becomes a quicksand, and extremely mobile. And it would appear that the "ruts" frequently seen along the car tracks on a comparatively recently paved street are the results of leakage of water from the surface of the pavement through the interstice between the pavement and the rail, opened, no doubt, by vibration, into the sand cushion and converting it into a quicksand which, through its mobility, shifts beneath another part of the pavement, or out through the interstice upon the surface of the pavement. The vibration also has a "pumping" effect upon the saturated sand and augments the leakage to the surface of the pavement or the shifting to another position beneath the surface.

The leakage of water into the sand cushion may have another deteriorating effect upon the pavement aside from that of converting the sand into a quicksand. If the sand is thoroughly saturated and then frozen, it is likely to heave to such an extent as to subject the pavement adjoining the rails to undue stress. This might result in serious damage to the pavement.

It is doubtful if there can be any disastrous results from the stress of traffic upon the pavement adjoining the street car rails if the evils caused by vibration and leakage are overcome and the pavement set at the proper grade in reference to the grade of the car tracks. Unless there is a "drop" of the wheels of vehicles from the car rails to the pavement, or a "climb" from the rails to the pavement, there should be no trouble whatever. It might be well, at this point, to emphasize the importance of as nearly perfect joint as possible between the rails and the pavement.

It appears then that the chief difficulty comes from the leakage of water into the sand cushion, augmented by vibration and the stress of [illegible] pavement, causing a shifting of the sand in the cushion. This would indicate that the remedy lies solely in a treatment of the cushion which would render it impervious to water and thus remove the liability of "shifting" or leakage to the surface of the pavement, causing a shifting of the sand in the cushion. This would indicate that the remedy lies solely in a treatment of the cushion which would render it impervious to water and thus remove the liability of "shifting" or leakage to the surface of the pavement.

Several years ago, the South Park Commission in the city of Chicago adopted the policy of paving all intersections of parkways and carline streets with creosoted blocks. Not being bound by the specifications of the city of Chicago, the Park Commission laid its blocks on a cement grout cushion. Some of these intersections have been paved for nearly five years and altogether there are about 25 or 30 of them. In every case they have proved a success. Although some of the intersections have been subjected to extremely heavy traffic (for instance, at Jackson Blvd. and Wabash Ave., or at Jackson Blvd. and Fifth Ave.), the pavement adjoining the street car tracks is in as good condition as it was the day it was laid. There can be little doubt that the success of these intersections is due to the fact that the grout cushion, being impervious to water, does not "shift" or leak out upon the surface of the pavement, and therefore remains in place and supports the blocks. No other explanation has been suggested.

The remedy, then, for the troubles surrounding street car track construction—and this applies with equal force to creosoted block, brick or granite pavements—is to provide for a cement grout cushion both between the street car tracks and for a distance of at least 1 ft. outside of the outside rails. This will make the cushion impervious to water and will prevent its shifting either from vibration or under the stress of traffic.

One of the features of this form of construction is that it adds but little to the cost of the pavement, and is easily made. The grout should be what is known as a "dry-mix" and should be prepared in this way: Mix three parts of sand with one part of Portland cement, all dry, and work well together before placing in position. After being thoroughly mixed, spread the cushion in the same manner that a sand cushion is spread. Lay the blocks on this cushion and tamp them to place. Then flush the blocks thoroughly, so that the water may enter through such interstices as exist and into the cushion. If possible, keep traffic off the blocks for 24 or 48 hours to give the grout time to set, although this is not absolutely necessary, as the cement will "cake" sufficiently to make it a great improvement over a sand cushion, even though traffic goes on the blocks almost immediately.

Another difficulty that has been experienced with creosoted blocks on car line streets is the development of transverse "ruts" between the tracks. These "ruts" apparently result from the tie rods which are set at regular intervals, tying the rails together. Where this form of track construction is adopted, the blocks should be chamfered so as to provide for the tie rod. This would add but little to the cost of the pavement, probably not more than a cent or two per yard, as only two courses of blocks in every 6 lin. ft. would need to be thus specially prepared

Road Construction Methods in Semi-Arid Regions.

By CHAS. F. THOMAS*

A number of unusual conditions which require special treatment are encountered in road construction in very dry country. Semi-arid sections are usually subject to intense heat, strong winds, sudden and extreme changes of temperature and infrequent but heavy rains. The methods used in meeting these conditions are, so far as given here, based on the writer's experience and observation in Kansas, New Mexico and more especially west Texas.

On open prairie land where travel is light [illegible] laid out by plowing two shallow furrows with a broad winged plow about 5 ft. apart. This furnishes a smooth track for wheels to run in that will remain in good shape for from 3 to 12 months, at a cost of from $2 to $3 per mile. When these tracks become badly worn a new set is thrown out near them.

On heavier traveled roads where the roadway is fenced it is economical to round the road with a road grader and put in culverts. These roads are graded for a width of not less than 30 ft. with a fall of from 18 ins. to 24 ins. from the center of the road to the bottom of the ditch. There is a marked tendency for the wheel tracks to dust out into ruts, but the lateral slope of the road serves to drain the ruts and protect them from excessive washing during heavy rains. Dry land soil usually goes all to pieces when it is wet and right after a rain a graded earth road is very little superior to an ungraded one as far as mud is concerned. The advantage comes in the graded road having a quicker drying surface and protection against wash.

On long grades in prairie land where the rounding of the road converts the road ditches into drains for a large surrounding country, the drainage problem becomes serious. The lower end of the grade is converted into a wet weather creek and the whole road usually washed out. Probably the most successful way to handle this is to dig tanks on the adjoining farm land at intervals of about half a mile and divert the water from the road ditches into them.

In hilly country the soil wash in the ditches is always excessive and it is imperative that either the grades shall be light, or the road placed on a divide.

During periods of drouth the soil shrinks and cracks open badly. In ordinary black, sandy loam soils these cracks vary from 1 to 4 ins. in width; in what is generally known as "hog wallow" land, a rich, black soil, they sometimes get to be 12 ins. wide. The "hog wallows," or depressions, which occur over large areas of prairie land, are probably due to the sloughing off and filling in with soil of the excessive cracks in time of rain. Ordinarily, the land swells and the cracks close in wet weather, but not until the soil below is saturated to such an extent that a loblolly is produced if the surface is traveled over.

Large areas of the dry lands are covered with sand varying from a few inches to several feet in depth, underlaid with a firm soil or tough clay. The dry weather and steady winds keep the sand loose and shifting to such an extent as to make it very heavy pulling for loaded teams. The sand has been successfully surfaced with this lower soil in a number of localities.

In building clayed or sand-clay roads, the roadway is first graded not less than 2 ft. above the level of the surrounding country. Roads running at right angle to the direction of the prevailing wind are graded higher than those running in the same direction with it. This elevation of the surface is necessary in order that the wind may get a clean sweep over the top and keep the road surface clear of drifting sand. It is wise, also, to make the windward ditch rather deep to provide a sand catch.

The top of the grade is covered with clay or sand-clay for a width of from 12 to 16 ft. This surfacing is never placed less than 12 ins. thick for a tough clay and 18 ins. thick for a sand-clay. This unusual depth is necessary to allow for the excessive wear that comes upon the surface. Practically all material loosened by the feet of horses and the wheels of vehicles is blown away and lost. For this reason the less sand the surfacing contains the better it will wear.

In sandy sections culverts are sometimes completely buried under blown sand during dry weather. For this reason small culverts must be of a type that can be readily taken up, cleaned out and relaid.

Vitrified pipe is well adapted for small culverts where sufficient cover can be obtained to protect it. Corrugated metal pipe should be of pure iron and heavily galvanized for protection against alkali.

Steel bridges last well in a dry climate and are very satisfactory for long spans. The absence of drift and current in the streams and the uncertain character of the soil make the use of leg piers permissible when not used as abutments and when supported on concrete pedestals to the surface of the ground. The majority of the streams fill rapidly, but run only for a few days after a rain. For those that are broad and shallow I-beam spans with steel trestle bents are economical.

Concrete is used only for large openings where there is no doubt as to the permanency of the crossing. When alkali is present in the soil a rich, dense mixture is necessary, using water free of alkali in mixing. In designing concrete culverts and other structures of that material it is very necessary that the foundations be thoroughly reinforced and tied together with steel to provide for the shrinking and swelling of the soil in dry and wet weather, the action of which is much the same as that of the frost soil in the north.

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*[illegible], Mc[illegible], Tex.

Report by a Board of Engineers on the Management of the Highway Department of the State of Washington.

Governor M. E. Hay, of the state of Washington, appointed an engineering board, last October, to report to him on the administration of the State Highway Department, under the two successive Highway Commissioners, Mr. J. M. Snow and Mr. H. L. Bowlby. The board of engineers consisted of Mr. H. P. Gillette, chairman, Mr. J. J. Donovan and Mr. E. E. Beard.

Criticism had been made that the cost of engineering on state-aid roads in Washington had been excessive. It had also been said that convict labor on certain roads had cost an excessive amount.

The report of the board of engineers to the Governor follows in full:

In compliance with your letter asking us to act on a board of engineers to examine into the department of the state highway commissioner, we submit the following findings of fact, together with certain recommendations relative to the management of this state department. We also submit some comments on possible improvements in the state highway law, which we believe will result in the more economic management and construction of state and state aid roads.

Beginning with specific charges made from time to time in the public press and by word of mouth, we shall consider first the charge that the cost of engineering on state and state aid roads has been excessive.

Cost of Engineering.—Engineering costs on highway work should be divided into two elements: first, the cost of surveys, maps, plans and estimates; second, the cost of engineering during actual construction. Calling the first of these elements the "Cost of Location," and calling the second of these elements the "Cost of Engineering Supervision," it is evident that the best unit in which to express the cost of location is the mile of highway located, while the best way to express the cost of engineering supervision is as a percentage of the total cost of road construction. If, for example, 20 miles of road had been located at a cost of engineering amounting to $3,000, and if subsequently only three miles of this line have been built at a cost of $30,000 for construction, of which $2,100 was engineering supervision, we would then express the cost of engineering thus:

Cost of location, 20 miles at $150..........$3,000
Cost of supervision of three miles, 7 per cent of $30,000, or........................ 2,100

Clearly it would not be rational to add the $2,100 to the $3,000 and charge this total of $5,100 to the cost of constructing the three miles, when the other 18 miles are to be built at a later date. What we should do is to add a location cost of three miles at $150, or $450, to the $2,100, giving us a total of $2,550 for cost of location and supervision on the three miles, which is about 8.4 per cent of the total cost of construction and engineering. Were we to charge the entire $5,100 to three miles, the percentage would be

$5,400 divided by $33,000, or nearly 16 per cent. This latter method, as we have said, is irrational, yet it is the method that has been applied by some critics, particularly in the case of State Road No. 14 (Hood's Canal), where it has been said that the engineering has cost 30 per cent. We shall discuss this particular road later, but pass now to a statement of our findings as to what has been expended by the state highway department from its inception up to October 10, 1910.

During the past 14 months Mr. H. L. Bowlby has been highway commissioner; his predecessor was Mr. J. M. Snow. Statements of moneys expended under these two administrations were submitted to us, and we have analyzed them as follows:

EXPENSES UNDER J. M. SNOW'S ADMINISTRATION.

35.5 miles state aid roads construction...	$165,106
10.7 miles state roads construction......	60,367
Total construction	$225,473
Engineering supervision, state aid roads	16,900
Engineering supervision, state roads....	4,181
Total construction and supervision....	$246,554
51.6 miles location of state aid roads....	11,119
132.5 miles location of state roads........	35,546
Total, 184.1 miles location.............	$ 46,665
Camp expenses, state roads	2,736
Camp expenses, state aid roads..........	17
Miscellaneous expenses, state aid roads	3,292
Miscellaneous expenses, state roads	609
Total camp and miscellaneous expenses	$ 6,654
Grand total	$299,873

Since the engineering supervision cost is $21,081, we see that it amounted to 8.5 per cent of the total, $246,554. The 184.1 miles located cost $46,665 for location, or $253 per mile. The $6,654 of camp and miscellaneous engineering expense should be distributed between the cost of engineering supervision and location. This increases the cost of engineering supervision to about 9.3 per cent of the total; and it increases the cost of location to about $280 per mile.

The average cost of the 46.2 miles of road built was about $5,580 per mile, including the engineering supervision camp and miscellaneous expense, and the $880 location expense.

EXPENDITURE UNDER H. L. BOWLBY'S ADMINISTRATION.

55.3 miles of state aid road, construction	$302,523
80.6 miles of state roads, construction...	236,491
Total, 135.9 miles, construction........	$539,014
Engineering supervision, state aid roads.	19,736
Engineering supervision, state roads....	21,141
Total construction and engineering supervision	$579,891
206.9 miles location of state aid roads...	22,072
143.9 miles location of state roads	25,259
	$ 47,331
Camp expense, state aid roads..........	300
Camp expense, state roads..............	715
Miscellaneous expense, state aid roads	4,828
Miscellaneous expense, state roads	6,411
Total camp and miscellaneous expense	$ 12,254
Grand total	$639,476

The $40,877 spent for engineering supervision is 7 per cent of the total, $579,891.

The 350.8 miles of location cost $47,331, or $134 per mile located.

If we distribute the $12,254 of camp and miscellaneous engineering expense between the cost of engineering supervision and location, we increase the cost of engineering supervision to about 8.0 per cent of the total, and we increase the cost of location to about $153 a mile, each of which is a reasonable expenditure, the average cost of the 135.9 miles of road built was about $4,450 per mile, including the engineering supervision, camp and miscellaneous expense, and the $153 location expense.

To the foregoing costs of construction and engineering there should be added the cost of administration, which includes the salaries of the regular office staff at Olympia. For this purpose the last legislature appropriated $35,000, which is equivalent to $17,500 per annum. Since Mr. Bowlby has been in office, 14 months, his pro rata would be about $21,000 for administration and office expenses for the 14 months. This should be prorated to the $88,208 spent for location and engineering supervision, and, since those two items are about equal in amount, we may say, roughly, that about $10,000 should be charged to the 135.9 miles of road completed. Administration has, therefore, cost approximately $75 per mile of completed road.

We are now provided with sufficient data upon which to base judgment as to the economy with which the engineering has been performed.

Engineering on railway construction ordinarily ranges from 3 to 8 per cent of the total cost, the higher percentage being common on the branch lines, and often amounting to more than 8 per cent, depending upon the difficulties of construction.

Engineering (location and supervision) on wagon roads ordinarily ranges between 5 and 10 per cent. For many years the engineering on Massachusetts state aid roads was 10 per cent. Lately it has grown less, and this reduction is naturally to be expected in any similar case, for several reasons. When state aid construction of first-class highways is first begun there are few contractors equipped with adequate plants, nor can they be expected to make heavy plant investments until they feel sure that the state has committed itself irrevocably to an extensive plan of road building. Then, too, we almost invariably witness a scattering of the road appropriations over many small sections of highway construction. It always takes considerable time to assemble a plant, gather a gang of men and get the work under way. During this time an engineering force must be kept on hand, yet very little actual construction is accomplished.

The history of this early state aid road work in Washington has merely repeated the history in other states, and we can already begin to see the reduction in the cost of engineering supervision in this state, since it was 9.3 per cent under Mr. Snow, and has been 8.0 per cent under Mr. Bowlby's 14 months of administration. That it will be further reduced is beyond doubt, but even as it stands there is no sound cause for criticism.

Hood's Canal Road (No. 14).—This state road has been the subject of severe criticism. We find that 22.6 miles were surveyed under Mr. Snow at a cost of $5,435, which is about $240 per mile, a not unreasonable expenditure where careful engineering work is done. However, we do not attempt to pass upon the character of the surveying and location, for this would require no slight amount of study in the field as well as in the office. We find that 3.2 miles have been built at a cost of $17,073 for construction, plus $1,478 for engineering supervision, and $431 for miscellaneous, or a total of $18,978 for construction, engineering supervision and miscellaneous expense. The engineering supervision has, therefore, cost about 7.7 per cent of this total. This is hardly an unreasonable expense for engineering supervision. If we add thereto the $240 per mile for the cost of the surveys made under Mr. Snow, we find that the total cost of engineering supervision and location is practically 11 per cent of the grand total. Nor is this an unreasonable percentage. It will be seen that the critics of this road, having added the $5,435 spent in locating the 22.6 miles and the $1,478 spent in engineering supervision, and the $450 for miscellaneous expense, making a total of $7,363, adding this to the $17,073 spent on construction, they have a grand total of $26,436, and then they have said that engineering has cost nearly 30 per cent of the grand total. We believe it is unnecessary to point out at greater length the fallacy of this sort of reasoning. The 19.4 miles of uncompleted but surveyed road should not be charged against the 3.2 miles of completed road.

Chuckanut Mountain Road (No. 6).—This state road is to be 5½ miles long, and has been the subject of severe criticism because less than one mile of it has been completed with the $25,000 appropriated for it. The three members of the board of engineers are thoroughly familiar with the site of this road and the local conditions, and one member of the board has examined the work already done by the convicts who have been building it. The Great Northern Ry. bought from Skagit county part of the right of way on which the original road along the west side of Chuckanut mountain was built, leaving no good right of way for a road of any character. Indeed, it has been testified before the supreme court that it was wholly impracticable to build a wagon road along this mountain at any cost, while other testimony was to the effect that $100,000 to $150,000 would not suffice to build the road. However, starting at the worst end of this road, a mile has been built at a cost of $25,000, going almost entirely through a heavy sidehill cut of solid rock. Heavy masonry retaining walls have been built, and the work, so far as it has gone, is excellent. Up to October 8 the following quantities had been moved:

334 acres heavy clearing.
6,198 cu. yds. solid rock
9,853 cu. yds. shell rock.
1,80[illegible] cu. yds. of dry wall masonry.

If ordinary contract prices are applied to the foregoing quantities, and if the reasonable costs of locating the 5½ miles and of engineering supervision are added thereto, it will be seen that this road work does not show up in an unfavorable light. It is conceded and the records show that not as much work was accomplished per convict day on this road as on others built elsewhere in the state. Perhaps the rugged character of the country makes this road one that is not well adapted for building under the convict labor system, due to the large number of guards required. In any event, we recommend the completion of this road by contract.

The public criticism of this road strikingly illustrates the necessity of either making appropriations for particular state roads only after a complete survey and estimate of costs has been made, or of abandoning entirely the previous practice of legislative action in appropriating funds for specified state roads. We believe that the latter policy should be adopted, and we shall discuss the matter later in this report.

It is evident that the people who expect to be benefited by this Chuckanut road had come to expect a completed 5½ mile road for $25,000 appropriated by the last legislature, when, in fact, no engineering estimate of its cost appears to have been made prior to the time the $25,000 was appropriated.

Incidentally, we may add, the public should learn neither to condemn any road for its high cost per mile nor to praise any road for its low cost per mile, until it has before it the itemized quantities of work involved and a full statement of the character of the work done.

Appropriations for Specified State Roads Should Not Be Made by Legislature.—In the past it has been the practice of the state legislature to specify the particular roads that are to be built by the state highway commissioner, and specific sums have been appropriated for each of these roads. This practice, as we have just seen, has led to trouble. Moreover, it has caused much money to be spent on small sections of road that begin nowhere and end nowhere—state roads without termini. Several roads have been built in the mountains, where neither present nor prospective traffic warrants their construction. It seems to us unwise to introduce anything that savors in the least of old-fashioned "pork barrel" methods in the distribution of highway funds. The success of state highway commissions in other states is largely attributable to their freedom from legislative restrictions in the matter of deciding where state roads shall be built.

Moneys Appropriated for State Aid Roads Should Not Revert to General Fund.—As a corollary of the principle that a state highway commission should not be too closely circumscribed as to places where funds shall be expended, it follows that the highway commissioner should not be required to spend each county's share of the state aid fund during the two-year period under the penalty of causing that part of the highway fund to revert to the general fund. Under the present law it frequently happens that a county is entitled to so small an amount from the state aid appropriation that only a fraction of a mile of road can be built. It is clearly not good business to build these very small pieces of road, and the law should be so changed that the funds to which any county is entitled should become cumulative over a period of several years, if need be, until enough is available to justify the building of a road of some length.

It should be remembered that short lengths of road cost more per mile than long lengths, not only for engineering, but for construction.

Separate Appropriation For Administration Not Advisable.—At the last session of the legislature $35,000 was appropriated for the entire office expenses of the highway commissioner's department. In future it would seem better to merge this appropriation with the general appropriations for state and state aid roads. It is almost impossible for a legislature to determine in advance exactly how much money will be needed properly to run an office of this character. While it may be well to specify the maximum salaries that shall be paid to the highway commissioner and to certain of his assistants, it does not seem well to limit the entire appropriation for office expenses to a predetermined sum.

Salary of Highway Commissioner Too Low.—The salary of the highway commissioner is $2,500 a year. This is not a sum commensurate with the responsibilities of the position. It is often possible to secure a competent engineer, having executive capacity, without paying a larger sum than $2,500 annually for his services, but it usually happens that such an engineer soon receives more attractive offers, in which evént it is more a matter of good luck than of good judgment as to salaries on the part of his employers if the engineer does not resign. It is particularly desirable not to make frequent changes in the staff of the state highway department. Otherwise all the experience that has been acquired by such a staff is lost to the state. One of the reasons why private work is usually better managed than public work is found in the fact that better salaries are paid to, or higher profits are made by, the men in charge of private work. The magnetic pull of the dollars is responsible for the passing of the most competent engineers out of public service into private occupations. While exceptions exist everywhere, the general rule is as stated. Hence the wisdom of paying liberally for brains engaged in designing and managing public works.

The highway commissioner should receive not less than $4,000 a year, and this salary should be increased from time to time in future years.

State Crushing Plants.—A separate appropriation of $124,000 was made by the last legislature for quarries and crushing plants. This appropriation has been exhausted, and we are informed by Mr. Bowlby that about $10,000 more is needed to complete the construction of the five plants. Here, again, is an example of the trouble that often arises when several separate, special appropriations are made. There is at present money available in other funds under the control of the highway commissioner, but none of it can be legally used to complete these important plants. Had one general highway fund been provided, every crushing plant could have been completed. We have not attempted to visit these plants, nor have we studied the plans sufficiently closely to determine whether the $124,000 was judiciously expended. About $30,000 of the appropriation was spent by the state board of control on the plant at Fidelgo Island. Subsequently $42,000 was spent on the same plant by the highway commissioner and we understand that the plant is now in operation, convict labor being used to run it.

We believe that all the state crushing plants should be operated by convicts, under the direction of the state highway commissioner, so that there may be no division of responsibility. It is exceedingly important that crushed stone be delivered promptly when and where it is required for road work, if the work is to be economically conducted. With the operation of the quarries and crushers in the hands of one state department, and the building of roads in the hands of another department, each department will be likely to blame the other for any high costs that may occur. The state board of control may attribute high costs of crushing to the large amount of time lost by the convict forces while waiting for orders from the highway commissioner as to the amount of stone required and the points of delivery. Delays on the highway work will run up crushing costs. Delays on the crushing will run up road costs. Some delays are inevitable, but the number is sure to be more where two distinct departments are involved than where entire control is vested in one.

Economy of Convict Labor.—This is an important matter, but one that we have not had time to investigate thoroughly. Moreover, not enough time has yet elapsed to make it worth while to attempt to pass final judgment.

On the Chuckanut Road No. 6) it is an open question whether convict labor has been as economical as the contract system would have been. On the other hand, there are examples of work like that on the Lysle road, which indicate excellent economic results from the use of convict labor. In this connection it is well to note that it has cost about $1 per day per convict for all expenses, including transportation, food, clothes, salaries of guards, etc. We are informed that when convicts are kept in prison it costs 37 cts. a day per man for food, clothes and guarding. The true cost of road work done by convicts is, therefore, not $1 a day, but $1 minus 37 cts., or 63 cts. per day. Hence all the office records of labor costs of road work done by convicts should really be reduced about 37 per cent to arrive at the true costs under this system. In all probability the cost of convict labor on the quarry and crushing plants will be not much in excess of 50 cts. a day per man.

The convict system can be made far more economic by adopting a bonus method of paying the convicts. Thus, in operating a quarry it may be found that, without any incentive, such as a bonus offers, each convict may average daily 2 cu. yds. of solid rock, quarried and delivered to the crusher. If, then, a bonus of 25 cts. per cu. yd. is offered to the men for each yard in excess of 2 cu. yds. per man, the output may increase 50 to 100 per cent, or even more. Whether this bonus money is given to the family of a convict, or is retained for him until the expiration of his sentence, is a detail relatively unimportant. The important thing is to stimulate the ambition of the men, and no way compares in the remotest degree with the bonus system of payment in attaining such an end.

Where the conditions are such that the work of individual men or of gangs of men cannot be measured up and expressed in standard units, then the wage system should be applied to convict labor. A wage of, say, 50 cts. a day might be decided upon as being sufficient to induce the convicts to work with some industry and ambition. But wherever the bonus system can be applied we strongly recommend its use.

If the bonus system is used, a careful cost-keeping system must be installed on all work done by convicts under the highway commissioner; and, in any event, such a cost-keeping system is essential to the most economic conduct of work done by convict labor.

Monthly Financial Reports.—The manager of an industrial corporation is usually required to make at least a monthly financial report to the president of the corporation. Such a report, if well devised, shows not only itemized operating expenses, but unit costs of various classes of product. We believe that the time has come when every department of every government should report monthly to the executive head of the government in a manner entirely analogous to that existing in the operation of private corporations.

Particularly is this desirable in the case of a government department whose function is to spend public money for constructing or operating public enterprises. Therefore, we recommend that a system of monthly financial and progress reports be devised for the use of the highway commissioner. This reporting should entail only a slightly greater amount of clerical work, and it will automatically insure that all records are kept up to date and complete. The highway commissioner is now keeping very full cost records of the work done under his direction, but, in the absence of a monthly report to the governor, garbled and unfair figures are frequently published by his critics. Every public officer who is performing his duty, as we believe the present highway commissioner is doing, welcomes the opportunity of spreading before the public the record of his achievement. Moreover, it is the right of the public to have such a record presented to it; not annually, as is the present practice throughout the country, but once a month, as is the practice among industrial organizations. Such monthly reports need not be printed, but typed copies should be given to representatives of the daily press, as well as to the governor of the state.

Among the things that such monthly reports would show would be the mileage of roads surveyed and located during the month, and during all the months of the current year, and the unit cost of engineering per mile. Likewise the mileage of roads constructed, the cost per mile, and the cost of engineering expressed as a percentage of the total, should be shown. Of course, partly completed roads should be estimated in equivalent completed mileage; thus, four miles 60 per cent finished are equivalent to 2.4 miles completed. Many other facts occur to us as essential in such a report, but it is not our province to do more than indicate in a general way what is desirable.

Annual Report by Board of Engineers.—It would probably be well were it the regular practice for every department of government to receive an investigation by a disinterested committee at least once a year; not with the view of making destructive criticism, or of gaining political capital by exposing minor errors of administration. In private life the owner visits his employes frequently, talks over conditions, inquires as to policies and procedure, with a view to increasing efficiency by kindly yet keen criticism. In public affairs the owner—who is the butcher, the baker, the candlestick maker, and is too numerous to make visits to his public service employes if he wished—should adopt the policy of hiring men whose special function it is to act in the capacity of a private employer. We conceive that special commissions or boards should exist for this very purpose. Preferably members of such boards should be men drawn entirely outside of the realm of politics. They might be selected by the boards of trade of cities, by the grange, and by other non-political organizations. In any event, they should be chosen without regard to political affiliations, and should make it their aim to improve the service rendered by public employes. The present method of subjecting an engineering department, for example, to public criticism by those who know nothing of engineering, cannot be too strongly condemned. It tends still further to drive all but thick-skinned and thick-skulled engineers out of public service positions of responsibility. It is particularly desirable, therefore, that the department of the state highway commissioner be periodically examined by a board of engineers, if only for the purpose of protecting an honest and able incumbent of that office from ill-judged or biased criticism.

As bearing upon this matter, we may cite the fact that we were told that many of the engineers employed by the highway commissioners were either engineering students or young engineering graduates without adequate experience—"kid engineers."

After a careful examination of the surveys, maps, reports, etc., made by some of these young engineers, and after a similar examination of the work done by some of the older men whom they have succeeded, we cannot agree with those who have criticised this department on the score of having employed some young engineers. The fact is that young engineers acting under the direction of experienced superiors are generally more efficient than men who have grown gray without growing competent enough to rise to higher positions. In this particular case, also, a corps of men must be trained to do work that is comparatively new in this state, namely, the location and building of modern highways. Since it is not easy to teach an old dog new tricks, the part of wisdom is to select young engineers for most of the subordinate positions.

The board of investigating and advising engineers, which we recommend, should be asked to pass upon all standard plans and specifications for state roads and bridges. That "two heads are better than one" is particularly true when it comes to passing upon methods of solving engineering problems in design. The experience of no one engineer can possibly cover the whole range of desirable experience. Hence the almost invariable gain in economic results through the conferences of several independent engineers, none of whom is a subordinate of the other.

The State Aid Law and Its Merits.—We are told that there is a strong likelihood that an attempt will be made to repeal the present state aid road law. Some short-sighted county surveyors who think that their field of activity has been limited by the creation of a state highway department, some farmers who dread increased taxes, and others are named as enemies of the present law. Perhaps it is well for us to recite the fact that this same sort of opposition has risen in other states that have adopted state aid road laws, but it is noteworthy that not a single state has yet taken a step backward by repealing the law establishing a state highway department. In New York state, 12 years ago, a state aid law, similar to that in this state, was adopted, and, after much opposition, $50,000 was appropriated for the first year's work. The opposition to further appropriation became even more violent the following year when it was learned that the modern hard roads were costing $10,000 a mile. Fortunately, however, the state aid work was allowed to go on. As a result, the demand for larger appropriations began to grow, until a few years ago the citizens of New York voted a bond issue of $50,000,000 for the state's share of the cost of state aid roads. This money is to be expended during a period of ten years.

Similarly, the grange in New Jersey fought the proposed state aid law, fearing increased taxes. A few years after the law had been in operation the farmers were found fighting for increased road appropriations.

It is a noteworthy fact that only those states that have adopted state aid laws have secured any considerable mileage of good roads, and it is noteworthy, also, that the road tax which the farmers have dreaded has proved to be a lamb in wolf's clothing.

Cost of Roads.—We have been unable to study the costs of road construction done under Mr. Bowlby. Eastern states are spending $6,000 to $10,000 a mile for macadam roads. Perhaps $8,000 is a general average in the east. Average costs of construction are higher in Washington, due to higher rates of wages. It is idle to talk of securing first-class highways, paved 16 ft. wide, for less than about $8,000 a mile. On the other hand, it is not always necessary to make the paved portion more than 8 ft. wide, if turnouts are provided at short intervals where two loaded wagons can pass. Thus can good single track roads be secured at reasonable cost—roads that will be serviceable in all sorts of weather.

We believe that many of the cheaper forms of gravel roads, and of tamped earth roads, etc., will more economically serve certain communities than will the expensive types of macadam. Each case is an economic problem in itself, the solution of which depends mainly upon the amount of traffic naturally tributary to the road in question.

We are informed by Mr. Bowlby that California asphaltic oil has been costing about 6 cts. per gallon delivered in tank cars, but that the same oil delivered in tank steamer can be secured for 3 cts. per gallon. In view of the remarkably cheap and excellent roads that have been built in California with the use of asphaltic oil, it is practically certain that the ability to secure such oil at 3 cts. a gallon at Puget Sound ports will effect a great reduction in the cost of good roads. Gravel, and even ordinary earth, can be "bound" or cemented together with the California asphaltic oil, yielding a hard, waterproof surface. Members of this board have seen many excellent roads of this character in California, and in the state of Washington there are several sample roads that conclusively prove the adaptability of the California asphaltic oil to this climate.

While we have not attempted to visit the various roads built under Mr. Bowlby, we have examined plans, specifications, etc., and have, as above outlined, analyzed the costs in a general way. As a result of this study we are of the opinion that Mr. Bowlby has managed his department with efficiency, and that he has organized a competent corps of engineering assistants.

We believe that the state would make a serious mistake were it to abandon its policy of building state aid highways under the direction of a state highway commissioner.

WATER-WORKS AND SEWERS SECTION

Methods and Cost of Constructing Water Purification Works at Springfield, Mass.*

(Continued from page 84.)

CONCRETE MASONRY

The proposal contained three separate items of concrete masonry, viz., "concrete masonry with reinforcement," "concrete masonry in piers and vaulting" and "all other concrete." The first class of concrete was mostly vaulting of slightly heavier design than the standard filter roof, reinforced to carry the additional load to be imposed by future sand storage. There was in addition a small amount of reinforced concrete conduit work, and the fall of the aerator contained some reinforcement.

"Pier and vaulting" concrete included concrete in all filter piers and roof exclusive of the small amount included in reinforced concrete. The contract price received was identical for "reinforced concrete" and "piers and vaulting concrete," and no special distinction was made between them in the cost records so far as the filter roof was concerned. "All other concrete" included the walls and floors of the filters, foundation and mass concrete and miscellaneous concrete masonry in various parts of the work.

Of the 13,282 cu. yds. total, of the several kinds of concrete placed, 81 per cent went into the filters proper, 9 per cent into the cut-off wall of the earth dam and the remaining 10 per cent into miscellaneous structures, such as conduits, buildings, aerator, etc. The concrete plant was consequently designed with the idea of convenient handling to the filters, leaving the other 19 per cent to be transported by teams or otherwise, as might be convenient.

In the attempt to design an efficient and economical handling plant for the purpose of the concrete work, a mistake was made which is not uncommon in many such cases, viz., the adoption of an elaborate arrangement, capable of a much larger output than could possibly be handled under the conditions existing and much more expensive than was justified by the quantity of concrete to be handled.

There was no ledge in the neighborhood, of a satisfactory quality, from which stone for crushing could be obtained. There were, however, many stone walls in the vicinity available for the purpose, and also, it proved, enough boulders from the excavation to supply a sufficient quantity of stone for crushing. In addition, the sand pit located on city land about a mile above the work contained a considerable percentage of gravel and small cobblestones. It was deemed advisable to load this material as it ran in the bank and separate it at the crusher and screening plant, thus utilizing the stones and gravel which it contained and lessening to a considerable extent the quantity of stone to be secured and hauled to the crusher.

The plant as above adopted is shown in Fig. 4. A 10-in x 20-in. jaw crusher received the stone, which was hauled to the crusher platform in teams, where it was dumped and fed by hand. The teams from the sand pit were also dumped on another part of this platform and their contents shoveled on to an inclined bar grating just above the opening of the crusher. This grating allowed the sand and gravel to fall through to the buckets of the 14-in. elevator which fed a 42-in. revolving screen. All large gravel and cobbles were rejected by the bar grating and fell into the crusher. The 42-in. revolving screen was located above and transversely across an A-frame partition, as shown on the plan, the sand and dust falling on the crusher side of the partition and the stones on the opposite side. The material thus separated piled against the opposite sides of the A-frame and by means of chutes and gates in its bottom walls were drawn into a measuring hopper which dumped into a skip car traveling on a track laid in a trench under the A-frame and below the level of the ground. The skip car was hoisted up a long incline, passing in its travel close by the cement shed and under a steel hopper into which the requisite amount of cement had been dumped. A suspended lever from this cement hopper engaged with the skip car as it passed, causing the cement to fall into the car with the other materials. The car continued on its way up the incline until it reached the proper elevation at the mixing tower, where it automatically dumped into the receiving hopper of a 1-yd. Ransome mixer. After emptying itself, the skip car returned by gravity to the loading trench, where the operation was repeated. The mixer was located in a high tower, as shown on the plan, and discharged the concrete into a delivery hopper, which in turn fed into 1-yd. hoisting buckets traveling upon flat cars. These cars were conveyed by means of a service track and cable running longitudinally over the center line of the finished filter roof to within reach of the derricks used for placing.

The mixing tower was located on the extension of the longitudinal center line of the filter side at the easterly end of the work. As the excavation work commenced at this end, so also did the concrete work. As soon as a filter was completed, the service track from the mixing tower was extended over its completed roof.

The cost of the mechanical equipment embraced in this plant was about $5,000 at the factory. It cost in addition $600 to freight and transport to the work and $3,900 to install and maintain in working condition, making the total cost of the plant $9,500. It was easily capable of turning out a batch per min-

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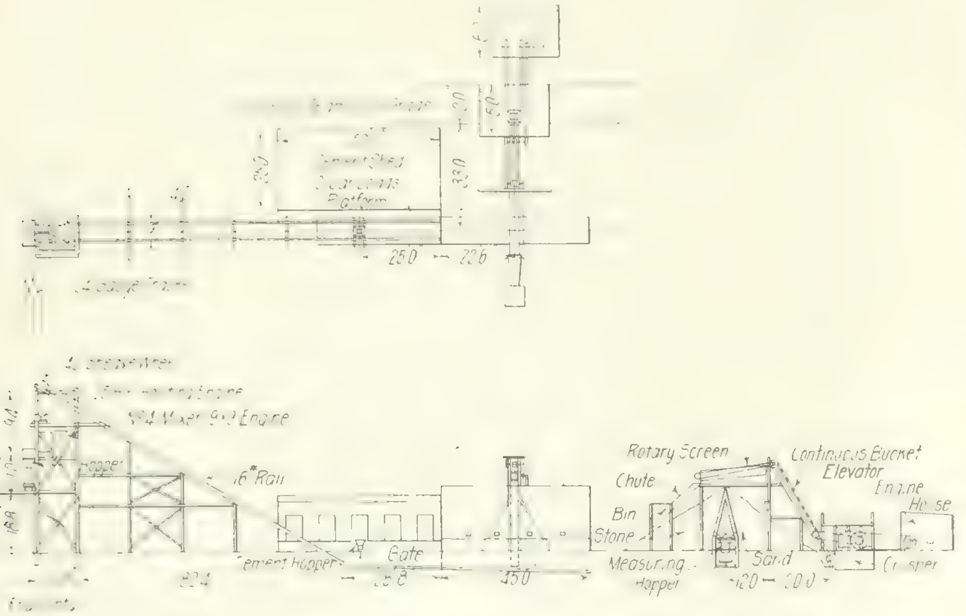
*A paper by Charles R. Gow, read before the Boston Society of Civil Engineers and published in the Journal of the Association of Engineering Societies for December, 1910.

[illegible] have utilized this output would have necessitated the completion of the entire filter concrete [illegible]. As a matter of fact [illegible] 12½ [illegible] days work and represented the contents of a considerable area of filter in addition to the use of an extensive amount of forms. The installation of a simple screening plant at the gravel pit to separate the sand and gravel which could then be hauled as needed to one or two ½-yd. portable mixers located within reach of the derricks would have been a far more economical, sensible and equally serviceable arrangement.

A serious objection to the type of plant used is the possibility of frequent delays resulting from breakdowns in any part of the mechanical system, inasmuch as the operation of one part of the plant depends upon the successful operation of each other part. The breaking of a rope, wheel or bolt in almost any part of the plant resulted in the suspension of concrete work until the repairs were made. In the writer's opinion, a safe rule to follow in such matters when economy is desired is to select the very simplest mechanical arrangement of plant that will produce the required daily output and in general to avoid elaborate installations unless the requirements of progress demand outputs beyond the capacity of the simple methods.



Fif. 4—Plan of Screening, Crushing and Mixing Plant, Springfield Filters.

The area covered by the filters was 546 ft. long and 260 ft. wide. It was deemed advisable to employ two derricks for placing the concrete in preference to a traveling cableway which is quite commonly used for the purpose on similar types of construction. The considerations which led to the adoption of the derrick method were as follows:

The cost of a traveling cable machine equipment is much greater than that of the double derrick installation.

The cable arrangement admits of placing concrete in only one narrow transverse zone at a time, while the derricks may be used to deposit concrete at any point within the circle of their swings.

The derricks could be used in setting and removing forms, easily transferring them from one filter to the next, while it would not be practicable to utilize the cableway for this purpose.

The derricks were more likely to be of future service or could be more readily disposed of on the completion of the work than the cable plant.

The double derrick installation insured the work against delay from breakdowns, whereas a single cable outfit might easily suspend concrete work frequently while undergoing repairs.

The two derricks could handle the concrete as fast as a single cable could and, in any event, could place it as rapidly as it was required to be placed and as fast as the concrete plant could deliver it.

Nothing which occurred has altered the original opinions as outlined above, and the derrick method of handling was considered a fortunate selection.

Two ordinary contractors' guy derricks with 70 ft. masts and with booms spliced to 80 ft. were erected on small timber towers tall enough to clear the finished roof level of the first filter built. They were located on the longitudinal center line of the filter and were equidistant from the two end walls of the same. Each filter was 260 ft. long by 91 ft. wide and, with this arrangement, the two derrick booms not only covered the entire area of the filter, but each boom could reach 34 ft. into the second filter and also beyond the end walls, where they were of frequent service in handling heavy piping or loading and unloading teams. The swings of the two booms crossed each other in the center of the filter and each was capable of reaching the service track from the concrete tower, which approached very closely the line of the easterly filter wall.

Concrete was delivered by the service cars to each derrick, the empty bucket being landed on one end of the car and the full bucket removed from the other end. Excelsior bottom-dump buckets were used.

When the derrick had completed the placing of concrete required to construct its half of the first filter it was moved forward to a similar position to the second filter and received its concrete by means of an extension of the service track laid over the finished roof of the first filter. This process was repeated with each derrick for the six filters. During the construction of the first filter the hoisting engines operating these derricks were located on the ground outside of the filters, but from this point on they followed the derricks, resting on top of the completed roof. After the third filter had been completed a change of method was adopted. The use of supporting towers was abandoned and the derricks thereafter were moved ahead on the roof as soon as the same was completed to the limit of their reach.

These derricks were also utilized at times for loading teams with concrete to be hauled to the various outside structures, and in a few cases they were able to dump concrete within easy shoveling or wheeling distance of its destination.

The detailed cost of this concrete plant was as follows:

COST PER CUBIC YARD FOR CRUSHER AND CONCRETE PLANT; 13,282 CU. YDS.

	Per cu. yd.
Transporting to Work.	
Freight of plant to Westfield	$0.0139
Cost of unloading plant from cars	0.0148
Cost of teaming plant to work	0.0161
Total cost of landing on job	$0.0448
Final Removal of Plant.	
Cost of labor dismantling and loading	$0.0302
Cost of teaming to railroad	0.01
Cost of freight returning	0.0043
Total cost of removing plant.	$0.0445
Erecting and Maintaining Crusher and Concrete Plant.	
Cost of labor	$0.1725
Cost of materials and supplies	0.1139
Cost of miscellaneous teaming	0.0054
Total cost of erection and maintenance of plant	$0.2918
Cement Store House, 50 ft. by 25 ft.	
Cost of materials used	$0.0205
Cost of labor building	0.012
Total cost of cement house	$0.0325
Erecting, Moving and Removing Derricks and Hoisters.	
Cost of labor	$0.1008
Cost of miscellaneous supplies	0.0033
Cost of miscellaneous teaming	0.0011
Total cost on derricks	$0.1052
Depreciation on Plant.	
Cost of depreciation on concrete plant	$0.1003
Cost of depreciation on crusher plant	0.1370
Total depreciation	$0.2373
Coal and Oil used in Mixing and in Operating Derricks.	
Cost of coal	$0.1222
Cost of oil	0.011
Total cost	$0.1332
Grand total cost of crusher and concrete plant	0.8893

The above total of $0.89 per cu. yd. of concrete mixed, chargeable alone to the item of planting the concrete end of the work, illustrates forcibly the point previously made concerning the relative economy of different types of plant. It will be noticed that it would require at least 100,000 cu. yds. of concrete to have rendered this plant anything like an economical selection.

The cost of removing the plant on the completion of the work is practically the same as that of originally delivering it. The larger labor item for removing is due to the additional expense of demolishing timber and other structures in connection with the removal, whereas the original labor of delivery included only that of unloading from cars and from teams. The cost of freight for removing is much less than for delivering because a large part of the plant was sold on completion of the work and delivered f. o. b. cars at Westfield.

The cost of labor for erecting and maintaining was larger perhaps than it should have been, amounting in the aggregate to about $2,300. Of this amount $1,560 was contracted in the original installation of this plant and the balance in removing, extending and repairing during the period of its use. The crew employed on this part of the work was not particularly efficient, as the work was naturally done during the early period of organization.

The total expense chargeable to the erection, moving and final removing of the derricks was about $1,400. As the two derricks were each erected once, moved five times and removed once, there were fourteen independent handling costing an average of $100 for each handling of each derrick. This is, of course, a high cost for such work, but is partly explained by the fact that for the first three filters built it was necessary to construct and erect the timber supporting towers previously referred to, and was also due in part to the cost of a rigger at $5 per day who was employed permanently on the work and when not actually moving derricks was charged with examining guys, fastenings, etc., and supervising their use, his entire time being charged against this item. Although it may at first sight appear needlessly extravagant to employ so high priced a man with so comparatively little to do, the fact that not one serious accident occurred on the entire work is of itself a justification of the expense.

Preparation of Concrete Stock.—A peculiar situation arose on this work with respect to the cement. It was the original intention to use the Atlas brand, and shipments of several cars were received preparatory to starting concrete work. The several car loads were subjected to the required tests, both neat and with standard Ottawa sand, and in every case far exceeded the requirements of the specifications in all respects. The first attempt to use this cement in the work, however, resulted in an almost entire lack of setting quality on the part of the concrete. Additional tests were made in the laboratory which checked the original ones and it was then discovered that the local sand in use, although to all appearances excellent in quality, contained some agent antagonistic to the cement. Washing the sand gave only slightly increased strength results. The addition of an acid solution intended to neutralize any possible alkaline agent which the sand might contain also resulted in only a very slight improvement. When, however, an alkaline solution (caustic soda) was added, very material improvement was manifested, indicating the apparent presence of an acid of some kind. An experiment was then tried to determine the effect of introducing into the standard sand a small amount of sap squeezed from the pine and chestnut roots which were prevalent in the local sand pit. The briquettes made from the sand so treated developed the same characteristics that had marked those made with the local sand, thus apparently establishing a connection between these roots and the cement troubles. It was found that these roots penetrated the sand bank more or less to a depth of from 16 ft. to 18 ft., and that below that depth the sand gave fairly good results, although hardly up to requirements. The locality was searched for a more satisfactory sand but without success. Acting on the suggestion of Mr. Hazen, consulting engineer of the work, experiments were made to determine the relative effects of this sand upon different brands of cement. Some eight or ten standard brands were selected for the purpose and the briquettes made therefrom gave widely varying results. Out of this number of different brands a few developed more than the required strength, while the majority were absolutely unsatisfactory. The Vulcanite brand was selected as the most satisfactory for use with the sand and was subsequently used throughout the work.

The sand and gravel pit was located in a side hill on land belonging to the city, at a distance of about a mile uphill from the work. It was conveniently located with respect to the road so that small cars could be loaded at the face of the pit, run out on a short trestle and dumped into a hopper at the side of the road from which teams were filled. The pit contained a large proportion of gravel, much of which ran very large, even to fair-sized boulders. The sand constituted about two-thirds of the total volume of the bank and was rather coarse. In fact, the bank was a much better gravel than a sand bank. However, there was no better pit available within reasonable hauling distance from the work, and while the coarseness of the sand had a marked effect at times upon the consistency of the concrete, it gave in general satisfactory results. It was helped considerably by the fact that it was screened simultaneously and in the same screen with the product of the stone crusher so that the stone dust was mixed with it. The material as excavated from the sand and gravel pit was teamed to the crusher and screening plant and there shoveled as previously described to the bucket elevator, the large gravel and stones being diverted into the crusher to add to the crushed stone product, while the gravel and sand were elevated with the cracked stone and dust, separated by the revolving screen and delivered to their respective storage piles.

Since gravel constituted only about one-third of the volume hauled from the sand and gravel pit, it was necessary to augment the gravel supply by the addition of enough broken stone to supply the deficiency. Stone for this purpose was secured from a variety of sources, some from stone walls in the immediate vicinity, some from small stones rejected from the [illegible] and some from the many boulders which required blasting in their removal from the General Excavation. All of this stone was loaded by hand into the teams and hauled to the crusher, an average distance of possibly 800 ft. Some of it required sledging, perhaps 20 per cent. The teams dumped on a platform which was level with the top of the crusher and stone was fed by hand to it. The situation did not admit of the automatic return of the tailings, but they were caught in a hopper from which they were subsequently reloaded and teamed to the crusher. The daily output of the crusher was not obtainable, as it was complicated more or less by the introduction of the gravel feature.

The elevator was equipped with 14-in. buckets, and was 34 ft. long from center to center of sprockets. It was driven from the crusher by means of a 6-in. belt on a 24-in. pulley, and an E No. 88 sprocket chain system operated both the elevator drive and the 42-in. revolving screen. The screen was of the punch-plate variety and consisted of an 8-ft. section perforated with ⅜-in. holes for removing the sand and dust and another 8-ft. section perforated with 2½-in. holes for passing the gravel and broken stone. The ⅜-in. section of the screen was built square in cross section, instead of cylindrical as is customary, the supposition being that it would screen more effectively. As a matter of fact, however, it was far less efficient than a cylindrical section would have been, as it tended to raise and dump the material in a mass instead of scattering it over the area of the perimeter. This action resulted in the frequent plugging of the holes, especially if the sand was at all damp. It also introduced an irregular jerky motion to the screen and thus caused a severe backlash on the driving chains. This back-lash, together with the strains due to the length and size of the elevator, caused considerable chain troubles, and in another similar installation a heavier pattern of driving chain would be preferable.

The crusher, elevator and screen were driven by a 40-hp. Brown gasoline engine. The difficulty of obtaining a boiler within a reasonable time, which would conform to the required Massachusetts standard, made it necessary to adopt some other power than steam. This engine was unnecessarily large for the work it had to do and undoubtedly a 25-hp. engine would have been sufficient, but it was at first intended to run additional apparatus from this engine, the idea being later abandoned. Outside of the additional first cost involved, this surplus power, of course, cost practically nothing. In fuel consumption and operating costs this engine was very economical and after its many peculiarities and corresponding remedies had been discovered, gave general satisfaction. The following figures show the cost of securing and preparing the cement, sand, gravel and stone entering into the concrete work

COST OF CEMENT, SAND, [illegible] PER [illegible]

[illegible]	[illegible]
Cement	
Cost of [illegible]	[illegible]
Cost of [illegible]	[illegible]
[illegible]	[illegible]
Total [illegible]	[illegible]
Sand [illegible]	
[illegible]	[illegible]
Cost [illegible]	[illegible]
Total [illegible]	[illegible]
[illegible]	
Cost of [illegible] ing crusher	$0.2256
Cost of [illegible]	[illegible]
Cost [illegible]	[illegible]
Cost [illegible]	[illegible]
Total	[illegible]
Grand total [illegible] cu. yd.	[illegible]

Comment on above figures: The mixture required for this work, aside from that of a small quantity used in reinforced concrete, was as follows: 1 bbl. cement, 11 cu. ft. sand, 19 cu. ft. stone. This mixture gave, with the materials used, a batch of 23.5 cu. ft., or 1.15 batches per cubic yard of concrete.

On the basis of the sand and gravel, consisting of two-thirds sand and one-third gravel, there were about 9,300 cu. yds. of the combined materials loaded, hauled and screened; and the above figures would, therefore, indicate a cost of $0.72 for each cubic yard of sand or gravel so loaded, hauled and screened. Owing to the necessity of deep stripping (about 3 ft.) at the pit to remove the more objectionable of the roots, the cost of loading this material was high. Then trips was the usual performance of a double team hauling about 1.5 cu. yds. to each load, so that the cost per cubic yard of hauling was about $0.40, leaving $0.32 to cover the cost of stripping, loading and shoveling on to the elevator.

Based on the above assumption of the quantity of gravel used, there would remain 7,600 cu. yds. or 10,260 tons of crushed stone which must have been supplied by the crusher to complete the required amount of aggregates. At the above cost figures, the cost per ton of crushed stone would be as follows:

COST PER TON OF STONE ACTUALLY CRUSHED; 10,260 TONS.

	Per ton.
Cost of labor loading teams and feeding crusher	$0.[illegible]
Cost of teaming to crusher	0.18
Cost of fuel and supplies	0.07
Total cost of crushing	$0.[illegible]

From the two foregoing articles it will be apparent that before a cubic yard of concrete entered the mixer it had contracted a cost of $0.89 for its proportional expense of the plant charges, and of $2.87 for the cost of cement, sand, gravel, and stone which it contained. The total of $3.76 for these two charges is a constant, therefore, to be added to the cost of mixing, placing and form work for each cubic yard of concrete in the work, regardless of its position. This constant will be referred to in the following items as "plant and stock constant."

Filter Floors.—The filter floor was of the common, inverted groined arch type, 6 ins. thick at the valleys and 12 ins. at the pier points, which points were 13 ft. on centers each way. The floor blocks were, therefore, square in plan and measured 13 ft. on their diagonals. The subgrade was level throughout and the increasing thickness from valley to pier points was obtained by the use of four curved templates, as shown in Fig. 5. These four templates were assembled to form the side forms of the square floor blocks and were in touch at their corner points with the corresponding corners of alternate floor block forms. Concrete was deposited in these alternate blocks and the top surface was formed by screeding over the curved templates which formed the sides. When the concrete in the alternate blocks had attained sufficient set, the surrounding templates were removed and the remaining blocks were completed, using the finished edges of the first blocks as templates upon which to screed. Special templates were necessary where the floors met the surrounding walls, but the same principle of depositing concrete was retained. The details of floor construction are shown in Fig. 2. The concrete used in floor construction was, in general, dumped directly into place by means of the derricks and 1-yd. bottom-dump buckets, although at times when it became desirable to lay floor in advance of the reach of the derrick, the concrete was dumped on the finished floor at the nearest point to which the boom could reach and was then wheeled to place in barrows. It was often considered advisable to incur this additional expense of wheeling on account of the increased progress attained thereby.

[illegible] CONCRETE IN FILTER FLOORS
3,933 CU. YDS.

	Per [illegible]
[illegible]	$0.[illegible]
[illegible]	0.[illegible]
[illegible]	[illegible]
[illegible]	0.1[illegible]
Total [illegible]	$0.[illegible]

Concrete.

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Cost of proportion of expense of final cleaning up of filters	0.019
Total cost of concrete and labor thereon	$4.512
General expense, 12.9 per cent	0.614
[illegible]	[illegible]

Comment on above figures: A sufficient number of forms was provided to permit concreting an entire floor of one filter. This proved to be an excessive number and one-third of the amount would have been ample to have assured the necessary progress, with a saving of $0.05⅓ per cu. yd. of concrete. These forms cost $0.95 each, or $3.80 per set, and were cut from 2x12-in. spruce stock.

The cost of mixing covers all labor used in measuring aggregates, feeding cement and operating skip car and mixer. The cost of placing covers all labor employed beyond the mixer, such as the operating of cars on the service track, derrick crews, shovelers, spaders, etc. The cost of placing appears to be high for such simple work, but this is explained by the fact that the time of two men was required constantly screeding the surfaces of the blocks. The occasional extra wheeling in barrows as explained also added considerably to the cost. The above figures represent an average cost of $0.149 per sq. ft. of floor area and covers in addition the cost of 50 cu. yds. of concrete extra in each filter, which was used for surrounding the 24-in. central drains.

The contract price for this concrete was	$5.50
The maximum price bid was	[illegible]
The minimum price bid was	5.50
The average price bid was	7.75

Filter Walls.—The walls as shown in detail by Fig. 2 were about 10 ft. high, 20 ins. thick on the top and 29 ins. thick at the bottom for the outside walls, while the division walls between the filters were 39 ins. thick at the bottom. The specifications required that all walls should be built in sections 13 ft. in length, so as to distribute possible shrinkage among the several joints and thus minimize its effect.

The forms for these walls were made in panels 10 ft. high and 20 ft. long as shown in Fig. 5. They were of ⅞-in. matched spruce with 2x6-in. uprights and a main frame of 4x6 ins. Each panel weighed when in use about 1,500 lbs. and was provided with eye-bolts in the top of the frame to allow convenient handling by the derricks. In erecting wall forms a double row of these panels was placed in position by the derricks, carefully lined by hand and wired together with frequent strands of No. 11 galvanized wire. A few outside struts maintained the top line in correct position and wooden spreaders placed between panels assured the correct thickness of wall. These spreaders were, of course, removed as the concrete progressed. Bulkheads of the exact cross section of the wall were accurately placed between forms every 13 ft., each bulkhead containing a vertical roughing piece triangular in shape intended to form a bonding groove in the joint. Alternate sections of wall were then concreted and when set sufficiently the bulkheads were removed and intermediate sections completed, thus making the wall continuous.

In filling the wall sections dumping platforms were employed. These platforms were 13 ft. square, made of 2-in. plank, one edge being supported by the top of the wall form panel and the opposite edge by wooden legs resting on the filter floor. A pitch of about 1 ft. was given the platform toward the wall. This platform was easily moved and placed by means of the derricks, each platform having wire ropes permanently attached to it for the purpose of convenient handling. The contents of the buckets were dumped on these platforms close to the edge nearest the wall, and the mixture being quite wet flowed down the slope of the platform and into the forms. This method allowed an entire batch to be dumped at one time without straining the forms. A man was required to clean the end of each batch off the platform by shoveling it into the wall.

When the concrete had obtained a sufficient set the wires were cut and the panels removed by the derricks to be again placed in position for a new length of wall. The use of these large panels and their convenient handling by the derricks simplified the form work materially.

COST OF CONCRETE IN FILTER WALLS. 2,481 CU. YDS.

Forms.	Per cu. yd.
Cost of panels, lumber, wire, etc., at Westfield	$0.69
Cost of teaming same to work	0.051
Cost of labor erecting and removing	0.55
Total cost of form work	$1.30

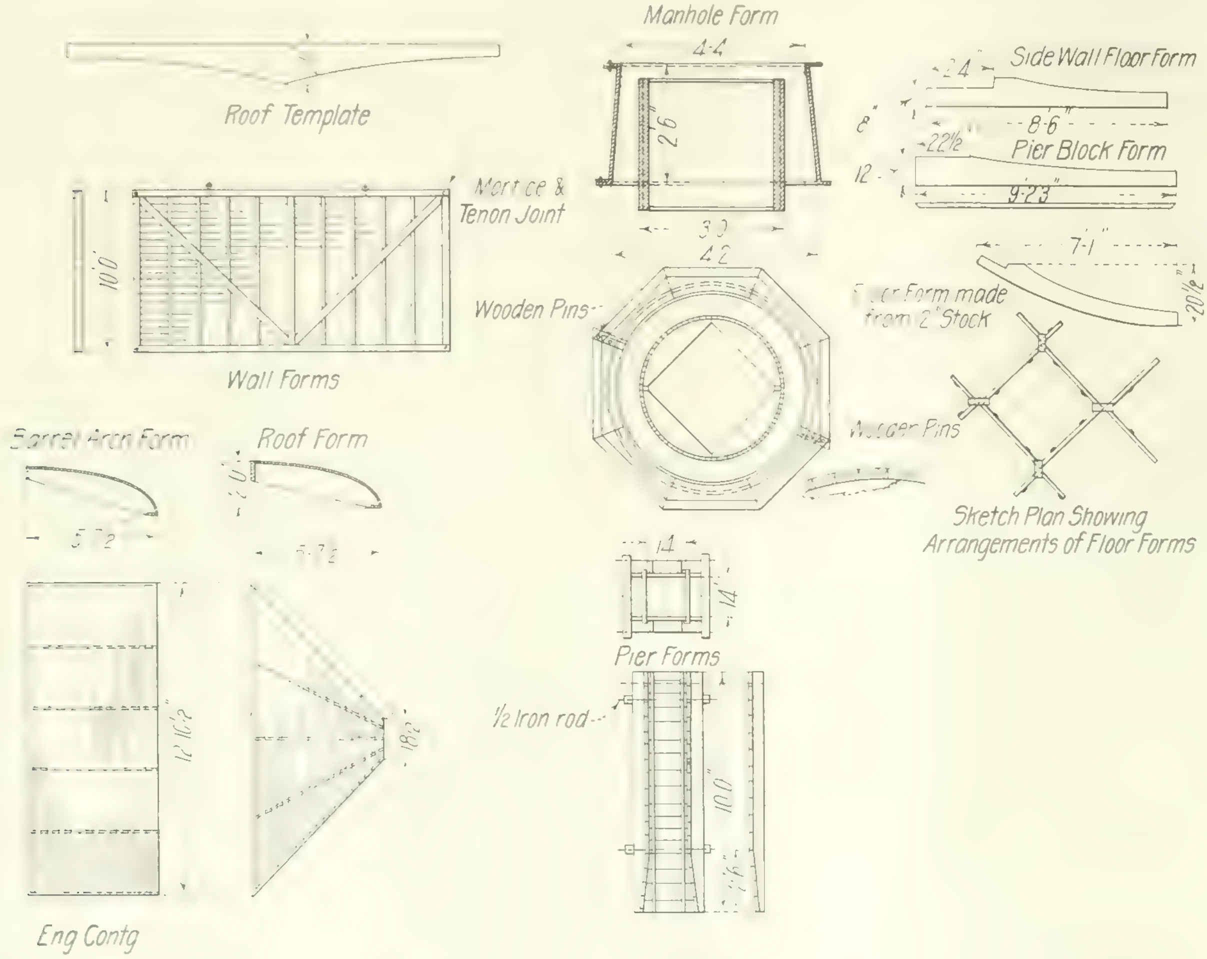


Fig. 5—Details of Forms for Springfield, Mass., Filters.

Concrete.	
Plant and stock constant	$3.76
Cost of labor mixing	0.173
Cost of labor placing	0.44
Cost of miscellaneous supplies	0.017
Cost of proportion of expense of final cleaning of filters	0.019
Total cost of concrete materials and labor thereon	$4.409
General expense, 12.9 per cent	0.741
Grand total cost for this item	$6.45

Wall forms were provided in sufficient number to have concreted the entire four walls of one filter simultaneously. This subsequently proved to have been a serious blunder and half the amount of panels would have been adequate. This mistake in judgment represented, therefore, a waste of $0.34 per cu. yd., or a total amounting to $843. These panels cost $15.54, delivered in Westfield.

The cost of wall form work per square foot of surface covered, exclusive of bulkhead surfaces, was as follows:

	Per sq. ft.
Cost of materials	$0.031
Cost of labor erecting and removing	0.024
Total cost	[illegible]

This would have been reduced at least $0.015 per sq. ft had only the necessary amount of panels been provided.

	Per cu. yd.
The contract price for this work was	$5.50
The maximum price bid was	9.00
The minimum price bid was	5.50
The average price bid was	7.75

Filter Piers.—The piers shown in Fig. 2 were 20 ins. square, with the exception of the lower 2 ft. which tapered to 26 ins. They were arranged 13 ft. on centers in either direction and were 9.5 ft. high. A simple and very convenient type of form was used for casting these piers and is shown in detail in Fig. 5. It consisted of four sides to each made from 2-in. spruce planks and nailed horizontally to two 2x6-in. uprights. These 2x6-in. uprights were cut for their lower 2 ft. with a 3-in. bevel which formed the flare called for at this point. The 2-in. lagging of two of the sides was prolonged 2 ins. beyond the edges of the other two sides and vertical strips 2 ins. wide were nailed to these projections, thus forming cleats against which the other sides rested when under pressure from the inside. Two sets of 4x4-in. clamps secured by ½-in. bolts held the two wide sides firmly against the edges of the two narrow sides.

In setting these forms, cross lines were chalked on the filter floor, representing the center lines of piers in both directions. These lines were prolonged well outside the area to be covered by the form. A template was made to fit the top of the pier form with projecting arms whose edges also represented the center lines in both directions, and four plumb bobs were suspended from these projecting arms until they just cleared the filter floor. Center marks on the bottom of the forms were set to match the chalk marks and the top of the form was moved one way or another until the four plumb bobs coincided with the projected cross lines. This arrangement assured both the top and bottom of the forms being on exact centers. Once in their proper position, the forms were secured by light bracing from one to another, checkerboard fashion.

In filling these forms the same dumping platforms were used as for the walls. They were supported at their corners by four pier forms and these four piers were filled simultaneously by shoveling concrete which was dumped on the platform into them. When the four piers were filled the platform was raised by the derrick, together with any surplus concrete which remained on it and was transferred to another group of four piers. The cost of concrete piers was as follows:

COST OF CONCRETE IN FILTER PIERS: 684 PIERS, 708 CU. YDS.

	Per cu. yd.
Forms.	
Cost of forms delivered on work	[illegible]
Cost of labor erecting and removing	1.123
Total cost of form work	$3.773
Concrete.	
Plant and stock constant	$3.76
Cost of labor mixing	0.173
Cost of labor placing	0.506
Cost of proportion of expense of final cleaning of filters	0.019
Total cost of concrete materials and labor in place	$4.458
General expense, 12.9 per cent	1.060
Grand total cost for this item	$9.291

One hundred and fourteen pier forms were provided, or enough for one complete filter. This was at least double the number actually required. Each complete form delivered in Westfield cost $14.25. The waste represented by this surplus supply amounted to $1.33 per cu. yd., or a total of $938. The pier forms were subsequently sold for use on another similar contract and were the only portion of the forms on which any salvage was realized. At the above figures the form work cost per square foot of surface covered, as follows:

	Per sq. ft.
Cost of materials	$0.042
Cost of labor	0.018
Total	$0.06

Had only the necessary number of forms been supplied, this cost would be reduced to $0.021.

The contract price for this item was	$ 8.00
The maximum price bid was	12.00
The minimum price bid was	7.00
The average price bid was	9.69

Vaulting.—The vaulting or roof of the filters consisted of groined arches supported on the walls and the piers as shown in Fig. 2. The vaulting in general has no reinforcement, is 6 ins. thick at the crown and 12 ins. at the skew backs, with a rise of 2 ft. between piers. The upper or outer surface of the finished roof forms a series of flat arches in two directions terminating in depression over each pier.

The details of forms used for the vaulting are shown by Fig. 5. They consisted of sections whose shape was triangular in plan view except that the points of the triangle were cut off to fit the sides of the piers. They were 20 ins. wide at the narrow or pier edge and spread out to 13 ft. at the wide or outer edge. Looked at in side view they possess the requisite elliptical curvature conforming to that of the proposed arch intrados between the springing line and the crown. Thus four of these sections, when assembled around the four sides of a pier, formed a section of roof 13 ft. square and extending on all sides half way to each next adjacent pier. Subsequent squares when erected about adjacent piers conected with them and formed a continuous area of roof forms.

The outer edges of these triangular-shaped sections were supported by posts from the filter floor, using for the purpose small saplings cut in the near-by woods. The pier ends of these forms were at first supported upon wooden clamps bolted around the tops of the finished concrete piers and set exactly to springing line grade. In the last two filters constructed, however, these inner edges rested directly on top of the pier forms and both piers and roof were concreted simultaneously. In erecting these forms, four men lifted a section in the air on pike poles, resting its narrow end on the pier support. Two men then held the wide ends with their poles while the other erected the posting which was to carry it. The posts all being cut to one length, no further adjustment was usually required. In subsequently striking these forms they were held with pike poles while the posting was knocked out from under them and were then lowered to the floor.

Adjacent to the walls, barrel arch forms were required springing from the wall skew back and meeting the 13-ft. ends of the groined arches.

The openings and cracks which occurred at the joints of the forms were covered with heavy brown paper tacked on to the forms in narrow strips. This paper could be subsequently removed by wetting, or if left alone would peel off in a few days of its own accord.

The dumping platforms previously described were also used in placing the roof concrete, as it was deemed unsafe to dump the buckets directly on top of the arch forms. The platforms were supported by the crown points of the forms and the load was carried directly by the posting under these points. Concrete was shoveled from the platforms into place, a 13 ft. square around the pier being filled in one operation. The upper surface was formed by means of a template or gage shown in Fig. 5.

A rule was made, and strictly adhered to, providing that at least two lines of roof squares should always remain supported by forms adjacent to every open end, the object being to take up any possible arch thrust which might be transmitted from the finished roof in the rear. It was also deemed prudent to carry a line of incline struts against the outer row of arch forms to prevent pushing out of that section while being filled.

An opening was left at the center of each division wall through which the forms could be carried forward into the next filter after their removal. The cost of the vaulting was as follows:

COST OF CONCRETE IN FILTER ROOF; 3,673 CU. YDS.

	Per cu. yd.
Forms.	
Cost of forms and teaming same	$1.055
Cost of labor erecting and removing	0.704
Total cost of form work	$1.759
Concrete.	
Plant and stock constant	$3.76
Cost of labor mixing	0.15
Cost of labor placing	0.40
Cost of proportion of expense of final cleaning of filters	0.019
Total cost of concrete materials and labor	4.329
General expense, 12.9 per cent	0.782
Grand total cost of this item	$6.87

The specifications required that roof forms for one complete filter should be provided and this requirement was complied with. It is probable that one half this amount of forms would have sufficed, although the forms used were in rather bad shape at the completion of the work. Had they been originally made stronger it is probable that they could have been used a much greater number of times without serious deterioration. Each triangular section cost $7.39, and each barrel section $8.21. Had it been possible to complete the work with one half the number of forms, a saving of $1,940, or $0.53 per cu. yd. would have resulted. The form cost figures would indicate the cost per square foot of surface covered to have been as follows:

	Per sq. ft.
Cost of materials	$0.027
Cost of labor erecting and removing	0.018
Total	$0.045

The total cost per square foot of finished roof was $0.175.

The contract price for this work was	$ 8.00
The maximum price bid was	12.50
The minimum price bid was	7.00
The average price bid was	9.69

Aërator.—The aërator is a circular concrete ank 50 ft. internal diameter, with a level floor 12 ins. thick and walls 9.75 ft. high and 24 ins. thick. A 16-in. and a 24-in. cast-iron pipe enter through the bottom of the wall from the office and laboratory building and deliver the raw water after sedimentation. These pipes turn upward at right angles in the center of the aërator and terminate with perforated flanges. In addition to these pipes a 4-ft. by 5-ft. reinforced conduit enters through the wall from the wet well of the office and laboratory building and is intended for the ordinary means of supply when aëration is not desired. A 42-in. steel pipe leaves the aërator through the wall on the opposite side from the supply and distributes water to the filters. A waste way consisting of a 4-ft. by 5-ft. reinforced conduit connects the aërator with a near-by brook and terminates inside the aërator in a small chamber shut off from it by a set of stop planks. By adjusting the height of these stop planks the desired water level is assured in case of the failure of other regulating devices upon which dependence is ordinarily placed.

When the excavation for this structure was completed the floor was laid and finished in one operation. Concrete was obtained at the mixer by a chute delivering into bottom-dump wagons. These wagons were hauled from the mixer to the aërator site and the concrete dumped directly into place, the teams driving down into the excavated pit. This concrete, therefore, required only leveling and the smoothing of its surface.

When the floor concrete was set sufficiently circular ribs made from segments cut at the mill were assembled and accurately centered. The inside ribs were cut convex, while the outer ribs were concave in shape. These rings were lagged with a 2-in. lagging set vertically. The corresponding inside and outside ribs were wired together to resist the spreading strains of the concrete during the operation of placing. The bottom half of the outer face was concreted directly against the earth bank so that forms were required on this side for only the upper half of the wall. The wall was reinforced with three hoops of ¾-in. twisted rods spaced equidisant from top to bottom. The cost of the concrete work in this structure was as follows:

COST OF CONCRETE IN [illegible]
[illegible] CU. YDS.

	Per cu. yd.
Cost of [illegible]	[illegible]
Cost of labor mixing	[illegible]
Cost of labor placing	[illegible]
Cost of [illegible]	[illegible]
Total cost of concrete	[illegible]
General expense, 12.9 per cent	0.564
Grand total cost for this item	$4.90
The contract price for this work was	5.50
The maximum price bid was	[illegible]
The minimum price bid was	[illegible]
The average price bid was	[illegible]

COST OF CONCRETE IN AERATOR WALL
131 CU. YDS.

	Per cu. yd.
Forms.	
Cost of lumber, nails, etc.	$0.99
Cost of labor erecting and removing	0.583
Total cost of forms	$1.[illegible]
Concrete.	
Plant and stock constant	$3.76
Cost of labor mixing	0.12
Cost of labor placing	0.6[illegible]
Cost of teaming from mixer	0.181
Cost of finishing surface	0.122
Total cost of concrete	$4.87
General expense, 12.9 per cent	0.831
Grand total cost for this item	$7.274
The contract price for this item was	$ 8.00
The maximum price bid was	13.00
The minimum price bid was	8.00
The average price bid was	11.46

The cost of lumber is large on account of the necessary use of a sufficient amount of lumber to form the entire wall at one time. The cost figures for forms indicate a cost per square foot of surface covered as follows:

	Per sq. ft.
Cost of materials	$0.045
Cost of labor erecting and removing	0.028
Total	$0.073

No allowance is here made for second-hand value of the lumber. The cost of placing included the entire charge of a five-dollar-a-day foreman, or a trifle less than 4 cts. per cu. yd. The concrete after being hauled from the mixer was dumped on platforms adjacent to the walls to be filled and partly shoveled into place and partly wheeled in barrows on elevated runways. The finish referred to consisted in rubbing the surface with a carborundum brick and water as soon as the forms were stripped. The cost figures given for this feature are equivalent to a cost of $0.006 per sq. ft. of surface finished.

Building Foundations.—The foundations of the office and laboratory building, together with that of the regulator house, required the placing of a total of 450 cu. yds. of concrete. The walls were mostly 2 ft. in thickness. The substructure of the regulator house is divided into several pockets or wells into which the water pipes from the filters discharge. The construction of these wells necessitated much cutting of forms, especially so because of the numerous pipes passing through the several walls, all of which required special fitting.

The specifications required the entire foundation walls of the regulator house to be placed in one operation, the purpose being to avoid all danger of leakage through joints. This provision necessitated the use of enough lumber to form the entire surface of the walls at one time. The office and laboratory building foundation was built in two parts, permitting the use of the forms a second time. Concrete for the regulator house foundation was dumped by one of the derricks on a platform adjacent to one side of the foundation and was deposited in the forms by shoveling or was wheeled in barrows. Concrete for the office and laboratory building foundation was teamed from the nearest derrick, dumped on a platform and placed as described for the regulator house foundation. The cost of these building foundations was as follows:

COST OF CONCRETE IN REGULATOR HOUSE FOUNDATION; [illegible] CU. YDS.

	Per cu. yd.
Forms.	
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Concrete.	
Plant and stock constant	$3.76
Cost of labor mixing	0.11
Cost of labor placing	[illegible]
Total cost of concrete	$4.402
General expense, 12.9 per cent	0.718
Grand total cost of this item	$6.285

COST OF CONCRETE IN OFFICE AND LABORATORY BUILDING FOUNDATION

	Per cu. yd.
Forms.	
Cost of lumber, nails, etc.	$0.2[illegible]
Cost of labor erecting and removing	0.98
Total cost of forms	$1.211
Concrete.	
Plant and stock constant	$3.76
Cost of labor mixing	0.15
Cost of labor placing	0.796
Cost of teaming from nearest derrick	0.101
Total cost of concrete	$4.807
General expense, 12.9 per cent	0.777
Grand total cost of this item	$6.798

The lumber used for forms in this work was about one-half new, while the balance had been used before on other parts of the work. The new lumber only is charged in the above figures. The form costs indicate a cost per squart foot of surface covered as follows:

For Regulator House Foundation.	sq. ft.
Cost of materials	$0.0113
Cost of labor	0.045
Total	$0.0563

Office and Laboratory Building.	Per sq. ft.
Cost for materials	$0.013
Cost for labor	0.057
Total	$0.07

The high labor cost per square foot for the office and laboratory building foundation can be explained only by the assumption that the labor was much less efficient in this case than that of the regulator house foundation, the latter being really the more difficult to build of the two.

The contract price for this work was	$5.50
The maximum price bid was	9.00
The minimum price bid was	5.50
The average price bid was	7.75

Concrete Cut-Off Wall.—This work consists of the building of a 3-ft. wall running longitudinally under the center of the earth dam. It was carried to ledge in all cases and varied in depth from 1 to 25 ft. Its finished top extended only about 2 ft. above the natural surface of the ground. There was also included, in connection with this work, 200 cu. yds. of concrete deposited around the 42-in. steel pipe lines at the point where they passed through the ledge immediately under the dam. As the concrete was all buried beneath the fill, no attempt was made to secure smooth form work, and in general rough boards or planks were used to confine the masonry to its proper width. Small stones and boulders were imbedded in this concrete as freely as its dimentions and consistency would allow, the stones being plentiful in the surrounding locality. A small amount of this concrete was mixed by hand during the early stages of the work and prior to the completion of the concrete plant. The bulk of it, however, was teamed from the mixer, an average distance of about 1,200 ft., and was dumped upon platforms from which it was shoveled into place. Its cost was as follows:

COST OF CONCRETE CUT-OFF WALL IN DAM AND AROUND PIPES; 1,155 CU. YDS.

	Per cu. yd.
Forms.	
Cost of lumber, nails, etc.	$0.138
Cost of labor erecting and removing forms	0.1[illegible]
Total cost of forms	$0.308
Concrete.	
Plant and stock constant	$3.7[illegible]
Cost of labor mixing	0.12[illegible]
Cost of teaming from mixer	.21[illegible]
Cost of placing	.54[illegible]
Cost of miscellaneous charges	0.0[illegible]
Total cost of materials and labor therein	$4.69[illegible]
General expense, 12.9 per cent	0.646
Grand total cost of this item	$5.652
The contract price for this item was	$[illegible]
The maximum price bid was	[illegible]
The minimum price bid was	[illegible]
The average price bid was	[illegible]

Reinforced Concrete Conduits.—Mention has previously been made of certain reinforced concrete conduits 4 x 5 ft. in cross-section. The greater portion of this conduit work was necessitated in the construction of the circulating conduit, extending from the inlet pipe through the dam to the upper end of the sedimentation basin. This piece of conduit was approximately 600 ft. in length and was built in the side hill forming the westerly wall of the basin. In addition there were 125 ft. of conduit of the same design used for connecting the aërator with the wet well of the office and laboratory building and with the brook.

The design was of the horseshoe type, 4 ft. wide and 5 ft. high. It was built with plumb side walls and an elliptical arch. The invert and arch were each 6 ins. thick and the walls averaged 10 ins. The volume of concrete per lineal foot was approximately 0.5 cu. yd. One-half inch square twisted rods, spaced 15 ins. on centers, were placed circumferentially; and in parts of its length ½-in. longitudinal reinforcement was used in the bottom and the walls.

About one-half of this work was built with concrete teamed from the mixer, and shoveled into the forms, the average distance of teaming being about 1,000 ft. The last half of the circulating conduit was mixed by hand, using materials teamed from the stock piles at the crusher.

Blaw collapsible steel centers were used in part, together with an equal amount of wooden centers. The steel centers produced a much smoother finished surface, but in the cost of handling showed no special advantage over the wooden forms, as in this instance both types were comparatively light and easy to handle.

The cost of this conduit work was as follows:

COST OF 4 FT. BY 5 FT. REINFORCED CONCRETE CONDUITS; 725 FT., 326 CU. YDS.

	Per cu. yd.
Forms.	
Cost of lumber, Blaw centers, etc.	$0.302
Cost of labor erecting and removing forms	0.972
Total cost of forms	$1.274
Concrete.	
Plant and stock constant	$3.76
Cost of labor mixing and placing	1.516
Cost of teaming concrete and stock	0.56
Total cost of concrete materials and labor	$5.836
General expense, 12.9 per cent	0.917
Grand total cost of this item	$8.027

Comment on above figures: Based on the cost of form work as shown above, the cost per sq. ft. of surface covered was as follows:

	Per sq. ft.
Cost of lumber, lease of centers, etc.	$0.007
Cost of labor erecting and removing	0.023
Total cost of forms	$0.03

The low cost per square foot as compared with the other cases given is due mainly to the frequency of re-using and to the fact that common labor could be used more generally, thus dispensing with expensive carpenter labor. The cost of mixing and placing was high as conditions were poor for economical handling. The high cost of teaming is partly accounted for by the fact that the greater part of the hand-mixed concrete was also teamed to place in the work, there being but one point available for mixing the concrete. The cost of the completed conduit exclusive of reinforcement was about $4 per lin. ft.

	Per cu. yd.
The contract price for this work was	$ 8.00
The maximum price bid was	13.00
The minimum price bid was	8.00
The average price bid was	11.465

Reinforcing Steel.—There were required in the 1,032 cu. yds. of reinforced concrete 48,014 lbs. of twisted steel bars. Of this amount 38,000 lbs. were of ¾-in. size in comparatively long lengths and required little or no bending. The ½-in. and ⅜-in. sizes were used in the conduit work and were, of course, easily bent.

The cost of the steel reinforcement was as follows:

	Per lb.
Cost of steel f. o. b. Westfield	$0.0168
Cost of teaming to work	0.0012
Cost of handling, bending and placing	0.0015
Total cost of steel in place	$0.0195
General expense, 12.9 per cent	0.0025
Grand total cost of steel reinforcement	$0.022

	Per lb.
The contract price for this item was	$0.03
The maximum price bid was	0.08
The minimum price bid was	0.03
The average price bid was	0.0443

Deduction of a General Formula for Determining the Most Economic Size of Pipe to Carry Pumped Water.

We propose showing that the most economic diameter for a cast iron pipe to carry pumped water is secured when the diameter in inches is equal to 15.7 times the square root of the number of millions of gallons of water pumped per day at eight hours. This astonishing simple rule, or formula, will be shown to be closely applicable even under wide variations of pipe, fuel and pump costs, etc. That such can be the case may seem incredible.

However, we shall show that in the general formula for most economic size of pipe (eq. 23), all the elements of cost occur under a radical sign and that their sixth root must be taken. When the sixth root of a factor is extracted, it is clear that the factor may have a wide range of variation without altering its sixth root very materially.

We think it will be difficult to find a better illustration of simplicity of a final formula in a problem of engineering economics where many factors enter than is seen in the one above announced, to the deduction of which we now pass.

While the numerical examples that we shall give will relate to cast iron pipe, the general formula (eq. 23) applies to any sort of pipe—wood, steel, etc.

It will be seen that, in solving for the most economic diameter of pipe, we use the method of the differential calculus. In other words, we solve for a minimum unit cost by first deriving a formula for the cost curve and then placing the differential coefficient equal to zero, which is tantamount to finding the point of the lowest point of the cost curve—the point where the tangent to the curve is horizontal. Engineers who do not understand the calculus can arrive at precisely the same results by substituting the values of the various factors in equation (18), and then substituting various values for the diameter of the pipe, x, until, by successive approximations, a minimum value for the total cost, T, is derived. However, that is a crude—though very common—method of solving problems in engineering economics. The differential calculus used in solving for minimum values is exceedingly simple, and it has the immense advantage of enabling us to derive general formulas, or rules, for quickly ascertaining the most economic combination in any given case. In brief, it enables us to deduce the general laws of engineering economics, such as the one above expressed, and more particularly such as that given by equation (23).

The symbols that will be used in this discussion are as follows, arranged alphabetically:

A = area of waterway of pipe in square feet.
B = number of British thermal units (B. T. U) per pound of fuel.
C = tons (2,240 lbs.) of fuel used per year pumping.
E = thermal efficiency of pump, engine and boiler (being the product of their several efficiencies).
G = millions of gallons pumped in day of 8 hours.
g = acceleration of gravity, 32.2 ft. per sec.
h = actual head in feet.
H = friction head in feet.
I = capitalized cost of labor for operating pumping plant.
K = total capitalized cost of pipe line in dollars.
L = total length of pipe line in feet.
M = capitalized cost of fuel.
N = number of seconds of pumping per year.
n = number of hours of pumping.
p = price of fuel in dollars per ton.
P = capitalized cost of pumping plant.
Q = cubic feet of water pumped per second.
r = per cent of interest on capital.
R = work of overcoming the resistance of friction of water in pipe, expressed in foot-pounds for each second.
s = capitalized cost per lineal foot of pipe line in place.
T = total capitalized cost of pipe line plus capitalized cost of pumping plant plus capitalized cost of fuel and labor.
t = the fraction of a dollar by which the diameter of the pipe (in inches) must be multiplied to give the capitalized cost per lineal foot of pipe line.
U = capitalized cost per [illegible] power of pump.
W = weight in pounds of water pumped per second.
[illegible] = inside diameter of pipe in feet.
x = inside diameter of pipe in inches.

The total capitalized cost of any plant is the sum of its first cost and its capitalized annual expenses of operation, maintenance and depreciation. To capitalize any annual expense, divide the annual expense by the rate per cent paid for the use of capital. Where the total output of the plant is a fixed number of units of work or product per year, we may, therefore, regard the total capitalized cost of the plant as being the "unit cost."

To illustrate what we mean by capitalized cost of a structure or machine, let us assume that the first cost of a pumping plant is $70, and that the annual cost of maintenance (including depreciation) is $7. If the rate of interest on capital is 5 per cent, then the capitalized value of the $7 is $7 ÷ 0.05 = $140. Adding this capitalized cost of maintenance, $140, to the first cost, $70, we have a total capitalized cost of $210.

For a given annual output of product, that plant is most economic whose total capitalized cost is a minimum.

In the case under consideration—a pumping plant and pipe line—we may ignore the labor item of annual cost of operating the pumping plant, for it is practically a constant (within the limits of choice of sizes of pipe and of pumps needed to effect the greatest economy). A constant added to a variable disappears upon differentiating for a minimum value. To make this clear, however, we shall include the capitalized cost of labor of operating the pumping plant.

The grand total capitalized cost is

$$T = K + [illegible] \quad (1)$$

$$K = [illegible] \quad (2)$$

$$s = tx \quad (3)$$

$$K = Ltx \quad (4)$$

We [illegible] below.

[illegible]

$$H [illegible]$$

$$[illegible] = 62.4 [illegible]$$

$$62.4\,Q\,[illegible]$$

[illegible]

$$M = \frac{p\,C}{[illegible]}$$

Substituting [illegible] (4), [illegible] (8) in eq. (1)

$$T = Ltx + [illegible]$$

Any [illegible] on the subject of hydraulics is discussed, will give the same general formula for the friction head of water as is given in Weisbach, page 864, as follows:

$$H = [illegible]\left(\frac{1}{\pi}\right)[illegible]$$

[illegible]

Since [illegible] (10) becomes

$$H = \frac{6259\,f\,L\,Q^2}{[illegible]}$$

The work done in moving the water against the friction head, H, is

$$R = [illegible] H \quad (13)$$

Substituting [illegible] we have

$$R = 62.4\,Q\,[illegible] = \frac{390,562\,[illegible]}{[illegible]} \quad (14)$$

The energy of the fuel used [illegible] this frictional resistance may be expressed in terms of the number of heat units (B. T. U.) in a pound of fuel, multiplied by 778 (the mechanical equivalent, in foot pounds, of 1 B. T. U.), multiplied by the number of pounds of coal used per second. This product must be multiplied by the thermal efficiency of the pumping plant. Hence:

$$R = \frac{2240\,C}{[illegible]} \times 778\,B\,E = \frac{1,742,720\,[illegible]}{[illegible]} \quad (15)$$

Hence:

$$C = \frac{N\,R}{1,742,720\,B\,E} \quad (16)$$

Substituting in eq. (16) [illegible] given in eq. (14) we have

$$C = \frac{390,562\,f\,N\,L\,Q\,[illegible]}{1,742,720\,B\,E\,x\,[illegible]} \quad (17)$$

Substituting eqs. (12) and (17) in eq. (9) we have:

$$T = [illegible] + \frac{[illegible] + I \quad (18)$$

Equation (18) gives the grand total capitalized cost in terms of known constants and the pipe diameter, x. To solve for a minimum value of T, differentiate eq. (18), remembering that T and x are the only variables, and place the first differential coefficient equal to zero. This will give us the lowest point on the curve of capitalized cost. Note that the second and fifth terms on the right side of the equation are constants and disappear when we differentiate.

$$[illegible] \quad (19)$$

[illegible]

$$[illegible] \quad (20)$$

Solving for x we have

$$[illegible] \quad (21)$$

But

$$[illegible] \quad (22)$$

Hence:

$$[illegible] \quad (23)$$

Equation (23) gives, in the most general form, the most economic diameter of pipe (x), for it is this value of x that satisfies the condition of minimum capitalized cost in eq. (18).

Let us now consider the numerical values that should be assigned to the various constants in eq. (23), under any given conditions. [illegible] of friction, f, is strictly speaking a variable; but it varies only in a slight degree within quite wide limits of pipe diameter (if we use Darcy's formula, [illegible] velocity of water (if we use Weisbach's formula). On page 867 of Weisbach's Mechanics we find

$$f = 0.0144 + \frac{0.017}{\sqrt{v}} \qquad (21)$$

On the following page, Weisbach gives Darcy's formula for cast iron pipe, which is:

$$f = 0.02 + \frac{0.02}{x} \qquad (22)$$

x being the diameter of the pipe in inches.

In either case we can select a value for f that is practically constant within the limits of size of pipe or of velocity of water, under consideration. Nor shall we err materially in the value of x in eq. (23) if we call $f = 0.2$ for all sizes of pipe and velocities of water.

The price of coal per ton, p, may range from $2 to $5 without producing a great effect on the value of x in eq. (23), for the sixth root of $2 is 1.12, and the sixth root of $5 is 1.30. Assuming coal to cost $3 a ton, the sixth root of p is 1.20.

The number of hours actually pumped yearly may have a wide range, but generally a pump is worked only 8 or 10 hours daily for about 300 days in the year, so that $n = 2{,}400$ to 3,000 hrs. Even if it is worked 24 hrs. daily for 300 days or three times as long as the 8 hrs. that we shall assume, it will increase the value of x only 20 per cent, for the sixth root of 3 is 1.20.

The rate of interest on capital, r, is usually 4 to 6 per cent, and we shall assume $r = 0.05$.

The first cost per horse power of pumping plant will usually not vary far from $70. But to this must be added the capitalized cost of annual maintenance. If annual maintenance cost is 8 per cent of the first cost, we have $5.60 per year per h. p. for maintenance, which capitalized at 5 per cent gives $112. Hence the total capitalized cost per horse power is $70 + $112 = $182, which is the value of V in eq. (23).

The thermal efficiency of the pumping plant, E, is the product of the following efficiencies: (1) Thermal efficiency of the boiler, (2) thermal efficiency of the engine, (3) mechanical efficiency of the engine, and (4) mechanical efficiency of the pump. This product is usually about 0.05, or 5 per cent, for fairly large pumping plants, and rarely exceeds 7 per cent. We shall assume $E = 0.05$. Its value may be derived from known coal consumption per horse power of work done by the pumping plant in lifting water against the combined head and friction head. If, for example, the work thus done requires 4 lbs. of coal per hour per h. p., and if the coal will yield 12,000 B. T. U. (British thermal units per pound), we have 48,000 B. T. U. required to do 1 h. p. of work; but 1 B. T. U. = 778 ft. lbs., hence 48,000 × 778 ÷ 60 mins. = 622,400 ft. lbs. of coal energy to perform 33,000 ft. lbs. of pump work per minute. Dividing the 33,000 by the 622,400, we get about 0.05, or 5 per cent thermal efficiency of the pumping plant.

The first cost of cast iron pipe, including trenching, laying, etc., is given quite closely by the following rule, applicable to all diameters from 4 ins. up to and including 30 ins., for heads of water up to 100 ft.: *To ascertain the cost in cents per lineal foot of cast iron pipe in place, multiply the diameter in inches by* 14.

This rule is derived from actual detailed costs given in the Water Works section of the second edition of Gillette's "Handbook of Cost Data." It applies very closely when cast iron pipe costs $30 a ton delivered on cars, and for ordinary rates of wages.

If there were no maintenance cost of the cast iron pipe, then the t in eq. (23) would be 0.14, according to the above rule. As a matter of fact, it is usually necessary to scrape cast iron pipe at intervals to remove rust, etc., from its interior, and it is certainly economy to do so wherever water is pumped through a pipe that has become even slightly tuberculated. We have no very reliable data as to the desired frequency of such scrapings, but we have accurate costs of each scraping (see Gillette's "Cost Data," second edition, page 698 et seq.). Pipes that had accumulated scale [illegible] were scraped clean for [illegible] to 5 cts. per lin. ft. If we assume that a cast iron pipe is scraped once at 2 per cent of its first cost, and if the scraping is done once in 4 years, we have 0.5 per cent per year for cleaning. Capitalizing this at 5 per cent, we have 0.5 per cent ÷ 5 per cent = 10 per cent. Hence the capitalized annual cost of scraping is 10 per cent of the first cost.

If cast iron pipe has a life of 40 years and if interest is 5 per cent, a sinking fund table shows that 0.8 per cent of the first cost deposited annually in the sinking fund will amount to the full first cost at the end of the 40 years. Hence the capitalized cost of this depreciation is 0.8 per cent ÷ 5 per cent = 16 per cent. Therefore we have to add 10 per cent for scraping and 16 per cent for depreciation, or a total of 26 per cent, to the first cost of the pipe, to get its total capitalized cost. Hence if $t = 0.14$ for first cost, $t = 0.14 + (26 \text{ per cent} \times 0.14) = 0.176$ (nearly) for the total capitalized cost. In other words the total capitalized cost of the cast iron pipe in dollars per lineal foot is 0.176 times the diameter in inches.

The number of British thermal units per pound of coal, B, does not vary greatly from 12,000; hence we shall assume $B = 12{,}000$.

Summarizing our various values for the constants in eq. (23) we have:

$f = 0.02$ (coef. of friction).

$p = 3$ (price of coal in dollars per ton).

$n = 2{,}400$ (hours pumped per year).

$r = 0.05$ (rate of interest).

$V = 112$ (capitalized cost of pumping plant, dollars per h. p.).

$B = 12{,}000$ (B. T. U. per lb. of coal).

$E = 0.05$ (thermal efficiency of pumping plant).

$t = 0.176$ (constant by which to multiply diameter of cast iron pipe in inches to get its capitalized cost in dollars per lin. ft.).

Substituting these values in eq. (23) we have:

$$x = 3.9 \sqrt[6]{\frac{0.02\,Q^3\,(1.13 \times 3 \times 2{,}400 + 0.05 \times 112 \times 12{,}000 \times 0.05)}{0.05 \times 12{,}000 \times 0.05 \times 0.176}} \qquad (24)$$

This reduces to

$$x = 7.3\sqrt{Q} \qquad (25)$$

Thus, if 4 cu. ft. are pumped per second, $x = 7.3\sqrt{4} = 14.6$ ins.

If 4 cu. ft. are pumped per second for 8 hours, we have a delivery of 862,000 gals.

In order to convert eq. (25) into millions of gallons (G) pumped per day of 8 hours, we have:

$$x = 15.7\sqrt{G} \qquad (26)$$

Hence if one million gallons are to be pumped in 8 hours, $G = 1$, and eq. (26) becomes $x = 15.7$ ins.

Expressing equation (26) in words we have this rule:

The most economic diameter (in inches) of cast iron pipe for carrying pumped water is found by multiplying 15.7 *by the square root of the number of million gallons pumped per day of eight hours.*

In using this rule, it should be remembered that we have assumed that the pump is working only 8 hours out of the 24, or that $n = 2{,}400$ in eq. (23). If n is three times as great, or $n = 7{,}200$, or pumping is done for 24 hrs. daily for 300 days in the year, then we must multiply the constant (15.7) in the above rule by 1.2, for the sixth root of 3 is 1.2. For a 24 hour day of pumping, the rule then becomes:

Multiply 18.8 by the square root of the number of millions of gallons pumped per day of 24 hours, and the product is the most economic diameter of cast iron pipe in inches.

Comparing Relative Economy of Pipes Made of Different Materials.—Equation (23) gives us a ready means of comparing the economic merits of different kinds of pipe through which water is to be pumped. Thus, if wood stave pipe is contemplated, plat the first cost per lineal foot of wood stave pipe of different diameters. On the curve of unit cost thus platted select a straight line that most closely fits the curve between the limits of size of pipe likely to be used. From this straight line derive the first cost value of t, as above indicated in the cast iron pipe example. Then estimate the life of the pipe, and derive the annual cost of depreciation, which must be capitalized and added to the first cost, as above explained. This will give the total capitalized cost value of t for the wood pipe. Insert the proper coefficient of friction for wood pipe, bearing in mind that in eq. (10) the friction coefficient, f, is exactly four times the friction coefficient given by Kutter for use in the Chézy formula ($v = c\sqrt{RS}$). In other words, if Kutter's friction coefficients are available, multiply them by 4 to get the proper value of f to be used in eq. (23). Having selected the proper values of f and t for wood pipe, either substitute in eq. (23) and solve for x, or, more quickly, determine the ratio of $\frac{f}{t}$ for wood pipe to $\frac{f}{t}$ for cast iron pipe, and extract the sixth root of that ratio. This sixth root multiplied into the value of x in eqs. (25) or (26) will give the proper value of x for wood pipe. Thus the value of $\frac{f}{t}$ for cast iron is

$$\frac{0.02}{0.176} = 0.11 \text{ nearly.}$$

If the corresponding value of $\frac{f}{t}$ for wood pipe should prove to be 0.22, then the ratio would be $0.22 \div 0.11 = 2$. The sixth root of 2 is 1.12, hence eq. (25), for cast iron pipe, would become $x = 1.12 \times 7.3\sqrt{Q}$ for wood pipe. We assume this value of $\frac{f}{t} = 0.22$ for wood pipe merely for illustration.

Having determined the most economic diameter for both wood and cast iron pipe, the pipe to select is the one giving the lowest total capitalized cost (T) when the respective values of x are substituted in eq. (18), remembering that the second and fifth terms of the right hand member need not be considered, as they are constant, and that the length, L, need not be considered, as it is common to all terms containing the variable x.

However, if a numerical problem is worked out in this manner and the respective economic values of x for any two kinds of pipe be substituted in eq. (18), it will be seen that all terms except the first term in the right hand member of eq. (18) can be ignored in making the comparisons. In other words the element of added capitalized cost of pump or fuel is so slightly affected by differences in the pipe diameters of the two kinds of pipe under consideration that it may be ignored, the question then resolving itself merely into which kind of pipe shows the least capitalized cost per lineal foot.

Illinois Society of Engineers and Surveyors Annual Meeting at East St. Louis.—The Illinois Society of Engineers and Surveyors will hold its Twenty-sixth Annual meeting at East St. Louis, Ill., Jan. 25, 26 and 27. This will be in the nature of a "Jubilee" celebrating the completion of 25 years of active work of the Society, which is composed of civil engineers engaged in municipal, drainage, water supply, land drainage and other lines of work; it has also a number of county and other surveyors, contractors, professors of engineering colleges, etc. The meetings will be held at the City Hall, and will be opened by the Mayor, Hon. Silas Cook. The President of the Society is Mr. A. N. Johnson, State Highway Engineer; the Vice-President is Mr. J. W. Dappert, Drainage Engineer of Taylorville; the Secretary is E. E. R. Tratman, C. E., of Chicago. Mr. W. J. Crocken, City Engineer of East St. Louis, and Mr. W. A. Thompson, Assistant City Engineer, are on the local committee.

STEAM AND ELECTRIC RAILWAY SECTION

Notes on the Design and Construction of Railroad Crossings.

As a rule every railroad now has what is called a "standard crossing plan," which shows types of construction required for different conditions, and details of construction so far as it is possible to designate on a general plan. But in spite of all the standardizing that can be done, there are always some special points to be considered, some of them being of vital importance, and each separate crossing is, to a great extent, a special problem. The man who settles these points, whatever may be his title, is the real designer.

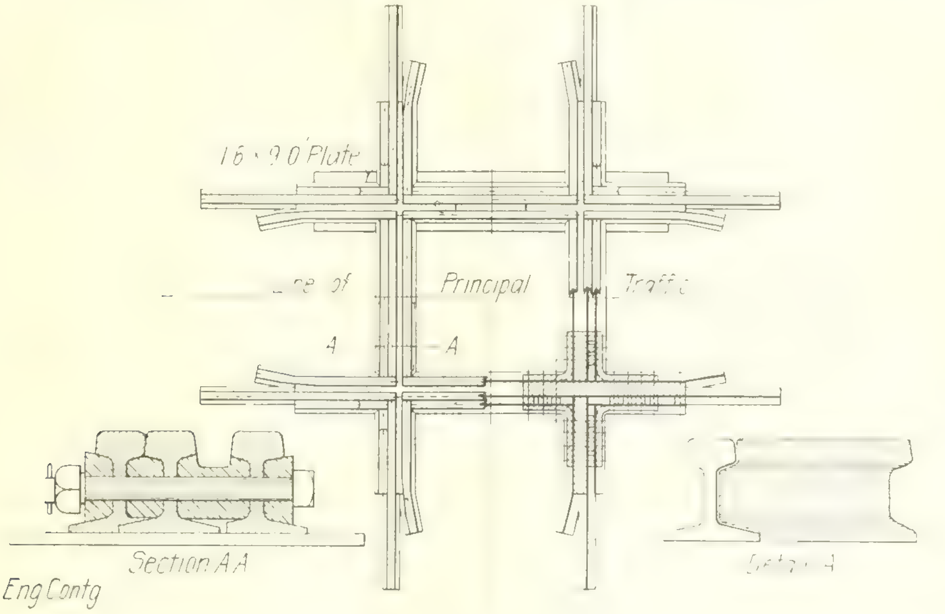


Fig. 1—90 Degree Crossing, Showing General Plan and Details of Two-Through-Rail Construction.

Before the computation for a crossing can be begun it is necessary that the designer shall secure for himself, or be furnished, certain information.

In an ordinary case the following is all that is needed: Intersection angles of center lines of tracks, radii of curves (if any), location of beginning of curve if it falls within crossing, and importance of tracks from traffic point of view; the gage of track being a matter of standard.

In addition to this, if the new crossing is to join another crossing or the stock rail of a switch, it is essential to have exact measurements to these, and to know the kind of joint required; this is in order that the wing rail of the new crossing may be properly planned.

With the necessary information at hand, the first step is to make the computation for the crossing. This work requires, on the part of the computor, a thorough working knowledge of trigonometry, and a general knowledge of crossing construction. The computor's work is finished when he has made a rough sketch showing lengths of sides, diagonals (the distances between opposite points of frogs), spreads of frogs for specified distances, middle ordinates and offsets of curves.

The crossing is then laid out to scale (usually ½ in. to 1 ft. or 1 in. to 1 ft.), and the plan started in this way is finally developed into the finished plan to be sent to the manufacturer. In the manufacturer's drafting room other details are figured out, such as angles for cutting or planing rail, location of bolts and rivets, the notching of fillers, etc. By the time the work reaches the shop, each small detail has been planned, and the workmen can go ahead with the assurance that the many pieces, scattered as they are through the different departments of the shop, will fit together accurately when assembled.

Crossings are classified, as a general thing, according to angle. There are three groups: the so-called 90° crossings (with angles from 50° to 90°), the 40° crossings (with angles from 33° to 50°), and the 20° crossings (with angles from 15° to 33°). These groups differ greatly in type of construction. The 40° and 90° crossings are of the type known as "crossing construction"; that is, the rails run through on the line of principal traffic, while the rails of the secondary track are cut to fit against the through rails, and are secured to them by means of angle straps. The 20° crossing, on the other hand, is of the type known as "frog construction," the different frogs of the crossing being made in a general way like ordinary turn-out frogs. The angle 33° is a natural point of division between the two types of construction, since this is the practical limit to which rail can be bent when cold or after the slight heating known as "taking the chill off."

When a crossing for two important main lines is being planned, the problem for the designer is an easy one. It is then simply a matter of making the best crossing that can be made, using the company's standards. When the tracks are of secondary importance, however, there are many details that become matters of judgment. The extent to which guard rails and reinforcing rails shall be used, is, in such a case, especially important. A mistake in this particular can easily result in a crossing entirely too light for the service required of it, or one on which 50 per cent more money is spent than is justifiable.

TYPES OF CROSSINGS.

Practice as to details varies with different roads, and there are certain types of construction differing materially from the ones shown; but the general practice on American railroads is shown in Figs. 1, 2 and 3.

There are two types of the "crossing construction." The difference between these two types seems small at first glance, yet this difference is a thing that is considered of great importance among designers and is a constant source of argument. Briefly, the difference is this: in one type the three rails of the line of principal traffic (in case a reinforcing rail is used) run through the crossing, the rails of the line of secondary traffic being fitted to the outside of the reinforcing rail. In the other type, shown in Figs. 1 and 2, the reinforcing rail of the principal track is cut, and the main rail and guard rail of the secondary track are fitted against the main rail of the principal track. The term "through rail" is in common use in descriptions of this type of construction. The term is slightly misleading, as these rails are often sawed at the intersections of flangeways to prevent irregular breaking, as explained below.

The three-through-rail type of construction is undoubtedly cheaper in the matter of labor. It possesses the further advantage of permitting the placing of an extra filler across the flangeway of the secondary track, thus strengthening the crossing where it most needs strengthening. On the other hand, the two-through-rail type of construction provides a stiffer and better connection between the two tracks. There is much to be said in favor of either construction, but the tendency among the railroads is to adopt the latter type, since it is thought to give a slightly longer service in the track.

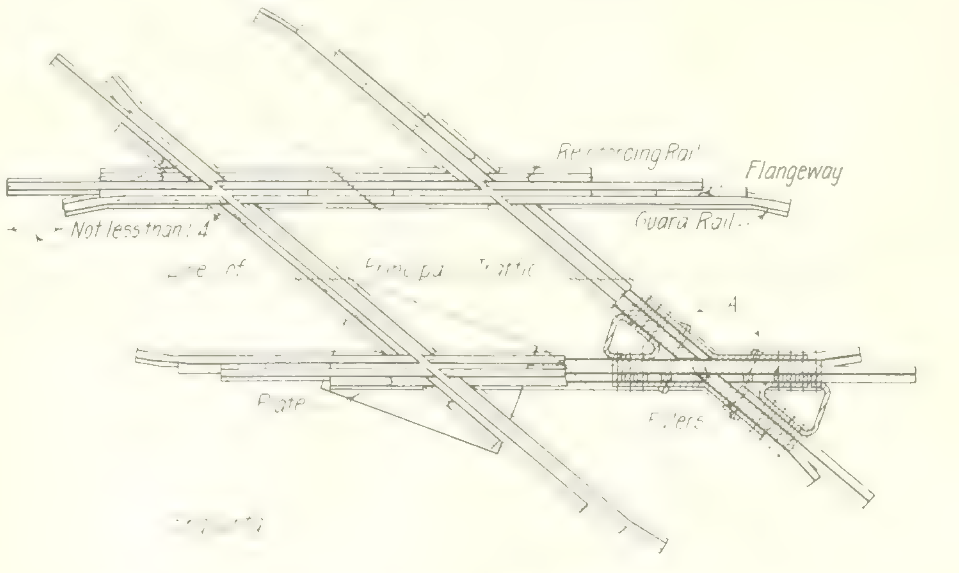


Fig. 2—40 Degree Crossing, Showing General Plan and Details of Two-Through-Rail Construction.

As shown in the illustrations, a filler, usually a rolled section, but preferably of wrought steel, is placed between the main and guard rails of the principal track and extends across the flangeway of the secondary track. This filler must be made to fit accurately to the [illegible] rails, since it serves not only as a separator, but, with the help of the plate and the structural connections, it must supply all the stiffness that the crossing has at the intersection of the flangeways. The form of the fillers, as well as the planing of the rail bases, is shown in Section *AA* of Fig. 1. In the three-through-rail construction, the filler between the main and reinforcing rails, which in the other construction acts only as a separator, extends across the flangeway of the secondary track and adds to the stiffness of the crossing.

In Fig. 3 is shown the type of construction known as "frog construction." The characteristic feature of this construction is that all outside main and reinforcing rails, as well as the inside guard rails at the middle frogs, are bent to the proper angle instead of being cut. As explained above, the angle to which rail can be bent when slightly heated is about 33°, and this determines the dividing line between the two types of construction. There is little to be said about this type, as the general features are well shown in the illustration. In contrast with the "crossing construction," there is little difference of opinion among designers as to the general plan of a crossing of this type.

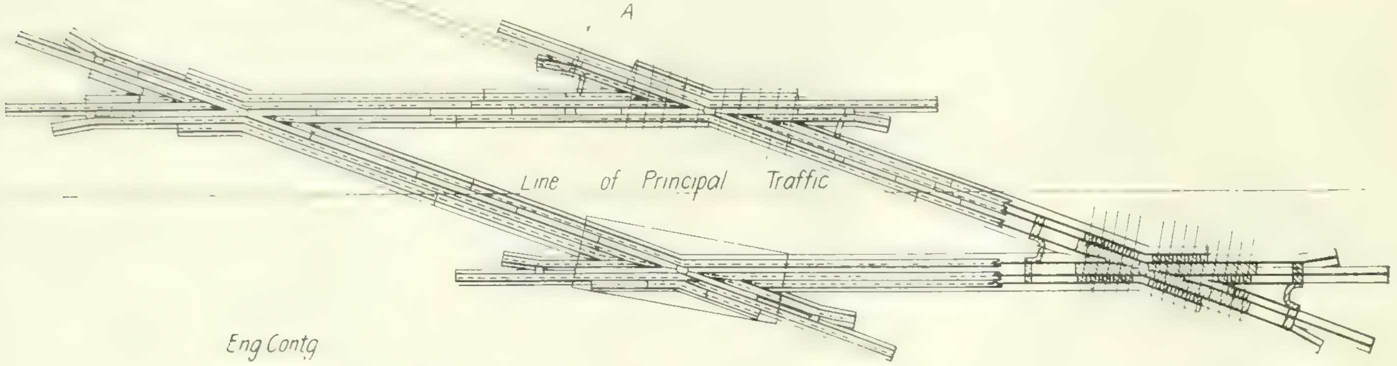


Fig. 3—General Plan and Details of a Typical Frog Crossing.

A matter to which careful thought should be given in the design of any crossing is the extent to which guard rails and reinforcing rails are to be used. This is purely a matter of judgment and depends on the volume of traffic carried by the tracks and the speed at which trains pass over the crossing. It is a point that is often overlooked. In crossings of the "crossing construction" there is no question in regard to guard rails. They should run continuously through the crossing, as shown in Figs. 1 and 2. The same is true of the reinforcing rails, if used at all.

Reinforcing rails are used for two purposes: to stiffen the crossing, and to provide a riding surface for the "double flange" of badly worn wheels. The latter is the more important, as worn wheels will pound badly at the cross rails and flangeways of a crossing, unless carried by a reinforcing rail, and will thus shorten the life of the crossing. But it is not necessary to use them on all crossings. Where both tracks are unimportant sidings or back tracks it is not economy to use reinforcing rails. Where main tracks are concerned they should invariably be used. Often, in planning a frog crossing, it is best in the interest of economy to use short reinforcing rails to protect the frogs, and short guard rails.

[illegible]

It will be observed that in general plan the two types of "crossing construction" are exceedingly simple. It took designers and manufacturers a good many years, however, to arrive at these simple types. Every old trackman will probably remember crossings, if he has not now one in some back track or industry track, in which there were no through rails—all the rails being cut diagonally [illegible] time this construction was in vogue there was also used the "star filler," which consisted of four fillers welded together at the intersection of flangeways. The star filler was highly prized in its day, but is not now used in up-to-date construction. Aside from the difficulty of making such a filler accurately, it was found that it did not possess the strength and durability of a through filler made of wrought iron or steel.

While there are, of course, differences in practice in matters of detail, these differences are not so great as might be supposed; and it is thought that the construction outlined below represents, both in "crossing construction" and in "frog construction," what might be called standard practice.

In Fig. 1 is shown a 90° crossing of the "crossing construction" type, the tops of the rails being cut away in the lower right hand corner so as to give a view of bolts, fillers, spacing blocks, angle braces and webs of rails.

In order to provide a flangeway for the secondary track it is necessary to cut the rails of the principal track to a depth of at least 1⅞ ins. This is the full depth of the rail head, and the rail accordingly is greatly weakened at this point. In spite of all that can be done in the way of providing a solid foundation, there is sure to be a slight vertical movement in the crossing as loads pass over it. Rails cut in this way often break. The break is usually irregular, and often destroys the support of the rail head. In many cases it passes through the nearest bolt hole. In order to avoid this irregular break it is common practice to saw the rail where it is cut for flangeway, and to secure strength and stiffness by means of fillers, base plates and the joining of the rails. This is done whether the construction is of the two-through-rail or the three-through-rail type.

Where the end of one rail fits against the side of another careful shaping of the abutting rail is necessary. This shaping is shown in Detail A of Fig. 1. Care in this particular is required by all railroads, as accurate shaping and a close fit add greatly to the stiffness of a crossing. It is because of this that the interlocking of rails in the two-through-rail type is thought to result in the best and most durable crossing.

In this type of construction the filler between the main and reinforcing rails acts only as a separator. As a matter of economy cast-iron spacing blocks (one for each bolt) should be used, as they serve the purpose fully as well as a filler. In Section *AA* of Fig. 1 a section of the best form of angle brace is shown. This should be of the D-bar shape, as shown, in order to secure angle-bar action in stiffening the crossing. D-bars are rolled for all standard rail sections and it is only necessary to cut them and bend them to the proper angle in the shop.

In the matter of bolting, practice varies. Some roads require 16 bolts at each corner, and some require only 12. In the crossing shown 14 bolts are used, 4 on each of the outside arms and 3 on each of the inside arms. It should be noted that the fifth or outer bolt on the outside arm is not a part of the crossing bolting proper, but is provided for the purpose of holding the end of the guard rail. The use of 1-in. bolts is probably the most common practice. There is a growing tendency, however, to use 1⅛ bolts, especially with rail of heavy section. Crossing bolts are spaced from 4 to 6 ins. apart, center to center. The latter should be considered a maximum in first-class construction; while 4 ins. is necessarily the minimum, as closer spacing than this does not allow sufficient room for the track wrench in tightening nuts.

It is well to use a nut lock on all crossing bolts. A nut lock, however, will not keep a bolt tight. It will only prevent the nut from working off of the bolt. On account of the continual pounding on a crossing, the bolts stretch, and frequent tightening is the only way to keep the bolts of a crossing tight This is also the case with the bolts in frogs and rail joints.

The best practice now requires a drive fit for all bolts in a crossing. This holds the rails and fillers in their proper position and prevents a slight shifting of the parts that is injurious to the crossing, and especially so to the bolts. The usual method of drilling the holes is to drill each rail and filler separately, to a diameter slightly less than that of the bolt, and then, after clamping the parts together, to ream the hole to the proper diameter. In some of the largest and best equipped shops apparatus is provided for drilling the hole through all the parts at one operation.

The base plate of a crossing is ordinarily ¾ in. in thickness. The plate is punched for spiking and is attached to the filler lying between the main and guard rails of the principal track by means of heavy rivets. Rivets should always be counter-sunk at the upper or filler end, and preferably at the lower or plate end as well. It will be noted that the outside arms or "wings" on the secondary track are not attached directly to the base plate, but are attached to the body of the crossing by means of bolts and angle braces. They can therefore be detached for shipment and replaced when crossing is installed.

In forming the end of the guard rail, a sharp bend is first made in the rail at a distance of 12 ins. from the end of the rail. This bend is such as to increase the opening between the main rail and guard rail to 4½ ins., at the end of the guard rail, the standard opening or flangeway for straight track being 1¾ ins. The side of the rail head is then planed on a straight line between points 6 ins. each side of the bend in the guard rail. In this way a safe and gradual approach is provided for the wheel flange in entering the flangeway. It may be said that practice varies considerably on this point. The method outlined above represents average practice.

This type of construction is used in crossings having angles between 50° and 90°.

In Fig. 2 is shown the type of construction for crossings of angles between 33° and 50°. This type is also of the "crossing construction" type with some additional features made necessary by the decrease in angle. Diagonal bolts *A* are used. These should be located as shown and not, as is sometimes done, replaced by a single bolt passing through the intersection of flangeways. A bolt hole in the latter position will weaken the crossing at its weakest point. To the angle brace as used in the 90° crossing an outside brace is added, the two forming a triangle. In crossings of this angle the matter of guarding the frog points must be watched, as the constructional requirements of the crossing do not always provide for this. The guard rail should be extended beyond the end of the wing rail, if necessary, to protect the opposite frog point. The straight part of the guard rail should extend as much as 3 ins. beyond a point opposite the frog to be guarded. Plates should be made as small as possible on account of their interference with the work of surfacing. But they must be large enough to support the joining of the rails, and must in turn have their ends supported on ties.

The details of construction of the end frog of a frog crossing are shown in Fig. 3. Here much more of planing and careful fitting are required than in the other type of crossing. A vital matter in shaping the point rails and such other rails as must be planed to a point, or nearly so, is the providing of web support for the head of the rail. Accordingly, the rail is first bent to such a shape that when planed to fit, the remaining portion of the rail head will be supported by the web.

No through fillers are used in a frog crossing, a space of 3 or 4 ins. being left between ends of fillers at the intersection of flangeways. This is done for the reason that the straight side of the filler would not have a bearing on the web of the side rail where it is curved, and the material would, therefore, be wasted. The notching of fillers required in order to make room for the webs of bent rails is shown in the illustration. Adjacent fillers are planed at the point end (where they project beyond the point rail) in such a way as to allow a clearance of about ¼ in. There is no reason why they should bear against each other, and this clearance prevents their acting against the tightening of bolts. Fillers welded together at this point were once in vogue but the fact that they interfered with tightening the crossing after wear had taken place, led to their abandonment. Plates are used in a frog crossing in exactly the same way as in the type of crossing shown in Fig. 2—the object being the support of the built-up portion of the crossing, and the support of the plate by the ties.

Frog crossings are made in four pieces. In crossings of extreme length the frogs are often made as short as possible and short lengths of rail inserted between the frogs. Owing to the "double flange" frequently found on worn wheels it is necessary to plane the tops of reinforcing rails at the ends, thus providing a riser, by which the double flange mounts gradually to the top of the rail. Each road has its standard, the riser varying from an incline of ½ in. in 9 ins. to ¾ in. in 20 ins.

Detachable guard rails are often used for protecting the end frogs, as shown by dotted lines in Fig. 3, and are attached to the wing rail of the side frog by bolt and spacing block, as shown at *A*. It is always best, however, where there is sufficient room to protect the end frogs with standard guard rails.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Important Projects of River and Harbor Improvement Provided for in the Federal Law of 1910.*

(Continued from page 93.)

Oakland Harbor.—Oakland Harbor, California, is a tidal slough or channel opening into San Francisco Bay and lying between the cities of Oakland and Alameda. Before improvement it had a depth at the entrance of only 2 ft. at mean lower low water. It has been improved by dredging, by the construction of jetties to connect the channel with deep water in San Francisco Bay, and by digging a tidal flushing canal from the head of the slough to connect with San Leandro Bay. The total water frontage of the channel is about 7 miles, and the commerce in 1908 was about 3,600,000 tons. For a distance of about 5 miles from San Francisco Bay a channel 25 ft. deep by 300 ft. wide has been dredged up to a tidal basin, certain portions of the length having been widened. Considerable dredging has also been done in the tidal basin, the total length of the navigable portion of the channel being about 7 miles. While the facilities already provided have been of great value, the depth is not yet sufficient for large ocean vessels. Situated on the eastern shore of San Francisco Bay, in a convenient position for ocean and railroad terminals, the commerce of the port will undoubtedly develop rapidly if the navigable depths are suitably increased. The new project provides for a channel 30 ft. deep and 500 ft. wide up to the tidal basin, 25 ft. deep and 300 ft. wide around the basin, and for an increase in depth in the tidal canal from 8 ft. to 18 ft., retaining its present width of 400 ft. This work is estimated to cost about $1,100,000.

Los Angeles Harbor.—The city of Los Angeles, Cal., has increased in population by 200 per cent in the last ten years, having now a population of about 300,000. It is situated about 20 miles from the towns of San Pedro and Wilmington, which are located near the seashore. Harbor improvement work has been carried on by the Government at the two latter localities. A stone breakwater nearly 2 miles long has been built to afford a harbor of refuge for deep draft vessels and to shelter the harbor of San Pedro. This work required the placing of about 2,500,000 tons of stone and cost about $2,900,000. Opening out into San Pedro Bay is Wilmington Lagoon. Before any work of improvement was done by the Government there was only 2 ft. available depth in the entrance to the lagoon at low tide. The entrance channel has been dredged to a depth of 21 ft. and jetties have been built to protect the entrance. The channel, up to the wharves at San Pedro (a distance of about a mile from the entrance), has been dredged to a depth of 24 ft. and a width of 400 ft. A channel 25 ft. deep has been excavated for a mile beyond the wharves toward Wilmington to a turning basin 1,600 ft. in diameter, the excavation of which is practically completed to a depth of 24 ft. There is great interest in harbor development in this region, and recently Los Angeles, San Pedro, and Wilmington have been consolidated under the name of Los Angeles; it is understood to be the intention of the city authorities to do all in their power to make the harbor one of the finest in the world. Although the lagoon in which the main inner channel and turning basin have been excavated and in which other improvements are proposed is a tidal slough with a depth of water at low tide in the unimproved portions averaging probably about 1 ft., harbor lines have been established by the Government to mark out the limiting lines for all wharf extensions and channel improvements in the future. The completion of the entire amount of excavation contemplated will probably take many years, but eventually this will be one of the greatest harbors in the country. Already the commerce for one year is valued at about $25,000,000, and the harbor has been used by vessels drawing 24 ft.

The act of 1910 provides for deepening to 30 ft. those portions of the inner harbor of Los Angeles which have already been improved, and for the excavation of additional channel [illegible] one extending into the adopted location for the future "East Basin" and one into the future "West Basin." The San Pedro breakwater, which commences at the 24-ft. contour [illegible] to the shore, thus affording increased protection to the outer harbor.

[illegible] Lakes many important improvements have been completed and others are already under way under authority granted in previous river and harbor acts, notably that of 1907. Included in this category is the new canal and fourth lock in the rapids of the St. Marys River at Sault Ste. Marie, Mich. This new lock will be 80 ft. wide by 1,350 ft. long, with a depth [illegible] be connected at the upper end with the river above the [illegible] excavated mainly in rock to a width of 300 ft. The cost of this new lock and canal will be about $6,200,000. The act of 1907 either appropriated or authorized the total amount required for this work.

The Detroit River.—In 1907, the Detroit River carried a commerce of 71,226,895 tons. This large commerce has been rendered possible by the improvements made in the lower portion of the river and elsewhere throughout the Great Lakes. Before improvement, there existed in the river at a depth of only 12½ ft. over a rocky ridge at Limekiln Crossing. A great deal of rock has been removed from this portion of the river and a depth of 20 ft. can now be counted upon. The recent project provides for two channels—an upbound channel and a down-bound one—in the portion of the river near Bois Blanc Island; the upbound channel, which skirts the Canadian shore, is to be 21 ft. deep by 600 ft. wide, while the down-bound channel on the opposite side of the Island was to be 22 ft. deep by 300 ft. wide in the rocky portion and 800 ft. wide where the river joins Lake Erie.

The act of 1910 provides for widening the down-bound channel where it passes through rock from 300 ft. to 450 ft. and for the construction of a dike extending northward from Bois Blanc Island, designed to separate the channels and prevent cross currents. This additional work will cost about $630,000.

Ashtabula Harbor.—The commerce of Ashtabula, Ohio, for 1909 amounted to 13,178,172 tons, consisting principally of iron ore from the Lake Superior region and coal and steel products from the Pittsburg region. In its natural condition there was never more than 9 ft. of water over the bar at the mouth of the Ashtabula River, the only "harbor" being inside the mouth of the river. Parallel jetties have been built out into the lake, one on each side of the mouth of the river. Converging breakwaters have been built outside to protect the entrance to the channel between the jetties, and considerable dredging and rock removal has been done. The channel at the mouth of the river is now at least 20 ft. deep. These improvements have caused the tonnage to double within the last ten years. The breakwaters are detached from the shore and some trouble has been had because the currents alongshore tend to cause filling in the harbor and also make it difficult for large vessels to enter the channel between the jetties. The act of 1910 adopts a project which includes the extension of the west breakwater to shore and 1,700 ft. farther lakeward. A new easterly breakwater, 5,400 ft. long, will be built with an entrance channel 500 ft. wide separating the adjacent ends of the two breakwaters. The breakwaters will be of the rubble-mound type. The new work will cost about $1,385,529. It will create a splendid outer harbor for Ashtabula.

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*From a paper by Capt. E. N. Johnston, Corps of Engineers, U. S. A., in Professional Memoirs, January-March, 1911.

Conneaut Harbor.—Conneaut, Ohio, is another lake harbor which has been well provided for by the recent River and Harbor Act. This harbor is about 70 miles east of Cleveland, and the harbor proper is formed by the lower part of the Conneaut River. Before the Government commenced the work of improvement, the depth over the bar at the mouth of the creek was only 2 ft. This has been deepened to 20 ft., parallel jetties have been built to protect the entrance channel, and two detached converging breakwaters have been built to protect the entrance to the jetty channel. As is the case at Ashtabula, difficulty has been had at Conneaut from sand carried along the shore tending to fill the channel inside of the detached breakwaters. Moreover, additional room is required in the outer harbor in order that large vessels may turn before leaving the protection of the breakwaters. The project adopted by the act of 1910 provides for extending the east breakwater to shore and lakeward for a distance of 800 ft. From a point 600 ft. west of the new outer end of the east breakwater, a west breakwater is to be built extending in a westerly direction 1,000 ft. and then in a southwesterly direction 3,700 ft. toward the shore. The present small western breakwater will be removed and, when necessary, portions of the outer harbor will be dredged. The commerce of Conneaut amounted to about 8,350,000 tons in 1907 (principally iron ore and coal), and there seems little doubt that the increased facilities will be taken advantage of by a growing commerce. The estimated cost of the new work is $1,338,681.

Lorain Harbor.—Where Black River flows into Lake Erie, 25 miles west of Cleveland is situated the city of Lorain. This is an important shipping point for coal and receiving point for ore from the Lake Superior region. The bar at the mouth of the river had a depth of water before improvement of only 3 ft. Parallel jetties have been built to concentrate the currents from the river on the bar and to protect the channel from filling due to alongshore currents, and dredging has been done to aid the river currents in securing increased depth on the bar. There is now a depth of 21 ft. where the bar formerly existed and a depth of 20 ft. can be carried for 3 miles up the river to a turning basin. Two converging rubble-mound breakwaters have been built to protect the entrance. Between the outer ends of the breakwaters is an opening 500 ft. wide in prolongation of the channel between the jetties. The river is narrow, and in order to turn and leave the harbor bow-on vessels have to go all the way up to the turning basin or else have to leave the river stern-first and then turn after leaving the channel between the jetties. This is difficult at times because of the currents which flow past the ends of the jetties, the breakwaters not having been carried to the shore. Moreover, the currents interfere with vessels entering the narrow channel between the jetties after they have safely entered between the outer ends of the breakwaters. The new project for Lorain provides for extending the west breakwater 1,500 ft. to shore, for prolonging the east breakwater toward shore a distance of 800 ft., and for dredging in the protected area behind the breakwaters. The breakwaters will be of the rubble-mound type. This work is estimated to cost $248,000.

The Ohio River.—Up to the present the work of improvement of the Ohio River has been carried on by two methods: *first*, open-channel work, and *second*, canalization. The open-channel work on the Ohio River has included improvement by means of dredging, construction of wing dams to concentrate the flow over shoals, dams to close side-channels, snagging, removal of wrecks, rocks, etc. This work has been done throughout the length of the river between Pittsburg and Cairo, a distance of 967 miles.

The work done on the general improvement of the river has been of great value, but navigation is entirely suspended during certain seasons of the year because of low water. In addition to the open-channel improvement, certain locks and dams have been built. They are numbered from the head of the river, and up to date Dams Nos. 1 to 6 have been completed, except in minor particulars, furnishing slack water navigation with a least depth of 9 ft. over the first 30 miles of the river below Pittsburg, that portion in its natural condition having been the worst section of the river. At present there are under construction seven other dams, namely: No. 8, near East Liverpool, Ohio; No. 11, at Wellsburg, W. Va.; No. 13, just below Wheeling; No. 19, below the mouth of the Little Kanawha; No. 26, below the mouth of the Great Kanawha; and No. 37, just below Cincinnati. It is expected that Nos. 8, 11, and 13 will be completed during the present year. No. 18, just below Marietta, has recently been put in operation.

The act of 1910 adopts a project for the Ohio River which involves the canalization of the entire length of the river by means of 54 locks and movable dams, so located as to provide a least depth of 9 ft. in the pools.

In order to complete the improvement of the river as contemplated by the project above mentioned, there will be required 41 locks and dams in addition to those at present completed or under construction. The amount necessary to complete the 41 locks and dams just mentioned is estimated at $57,566,800. In order to complete the locks and dams now under construction there will be required $3,213,800 in addition to the amounts already authorized, making a total of $60,780,600 to complete the 9-ft. project for the Ohio River.

The work to be done at Louisville is of great importance, irrespective even of the improvement of the river as a whole. The work proposed at this place includes the widening of the present canal and the construction of a new lock, 85 ft. wide by 600 ft. long.

The upper portion of the river is by far the worst for navigation. While in the vicinity of Wheeling the river is at a natural stage above 9 ft. on only about 120 days of the year, it is at a stage of at least 9 ft. on about 240 days in each year between Cincinnati and Louisville. For this reason the act provides for the beginning of construction of locks and dams Nos. 7, 9, 10, and 12, which, in conjunction with the dams already completed or under construction, will complete the canalization of that portion of the river between Pittsburg and Wheeling.

In past appropriation acts provision has been made for the construction of various individual locks and dams, located below the mouths of important tributaries or below important cities to form harbors of considerable local importance. In accordance with this policy the 1910 act provides for the commencement of construction of locks and dams Nos. 29 and 48, the former being located below the mouth of the Big Sandy River, which has already been partially canalized by the government, and the latter being located below the mouth of Green River, which has also been canalized by the government. These two dams will therefore afford a navigable connection between the Ohio and the tributaries named. No. 29 will also provide a harbor for Catlettsburg, Ky., and Kenova, W. Va., while No. 48 will provide a harbor for Evansville, Ind., and Henderson, Ky.

The Ohio River locks are each 110 ft. wide by 600 ft. long, and will pass 12 coal boats at one lockage. The dams are about 1,100 ft. long just below Pittsburg, and this length will not be much increased in the portion of the river above Cincinnati. The principal portions of the dams will be composed of chanoine wickets supported in the raised position by props. The dams will each be provided with one or more regulating weirs of the common two leaf bear trap variety.

The present act adopts the Ohio River canalization project "with a view to the completion of such improvement within a period of twelve years." In order that the work may be completed in the time specified, it will be necessary for the funds to be furnished as needed, and this is understood to be the intention of Congress.

The Missouri River.—On the Missouri River the first work included snagging and bank protection work at various localities. In 1884 the work was undertaken in a serious manner and was placed under the immediate charge of the Missouri River Commission, reporting to the chief of engineers. The commission selected the worst stretch of the river and by dike construction and revetment secured a continuous channel at least 6 ft. deep at low water where before improvement the depth had been only 2½ ft. The length of the river thus improved was 45 miles in the vicinity of Jefferson City, Mo. The works have remained in fairly good condition with small expenditures for maintenance, and this stretch of the Missouri River is practically the only part in which a good continuous navigable channel can be found at low water. Moreover the dikes and revetments have reclaimed land equal in value to the cost of the improvements. In 1902, the Missouri River improvement was practically abandoned by Congress, and since then the appropriations had been too limited to permit of any systematic work. The funds have had to be applied to work at widely separated localities in order to improve conditions at the worst bars and revet the worst of the caving banks as far as was possible with the small amounts available. The act of 1910 appropriates $1,000,000 for work between Kansas City and the mouth of the river, to be applied to securing a 6-ft. channel. The act also provides for a report by a board of officers upon the subject of co-operation by local interests in the work of improvement. It is thought that this is designed to ascertain whether or not some method can be devised whereby the property owners whose lands are protected by the government dikes and revetments can be caused to pay an equitable portion of the cost of improvement. The work done on the Missouri River has been eminently successful wherever funds were available in sufficient amounts, and the results demonstrate that it is possible to adequately improve the lower portion of the river for purposes of navigation at a reasonable cost.

The Upper Mississippi.—On what is generally called the upper Mississippi River—that is, the portion of the river between St Paul and the mouth of the Missouri River—the first regular improvement work undertaken was the removal of wrecks, snags, etc This work has been prosecuted since 1867. with the result that danger from them is practically a thing of the past. In 1877 a lateral canal around the Des Moines rapids was completed. The canal is 5 ft. deep and 200 ft. wide, with three locks. Originally the larger boats were unable to go farther upstream at time of low water than La Crosse or Winona. Since 1878 the systematic improvement of the river has been carried on The project adopted in 1878 contemplated the securing of a channel at least 4½ ft. deep as far up as St. Paul by contracting the channel with wing dams, closing of side channels, revetting banks, etc. The work has been quite successful, although not yet completed, large boats being now able to proceed to St. Paul at very low stages of the river. The reservoirs constructed at the head waters of the river increase the low water depths at St. Paul on the average about 14 ins. during the low water season of 90 days. The effect of the reservoirs disappears at Lake Pepin, 51 miles below St. Paul.

In 1907 a project was adopted which looks to the obtaining of a least depth of 6 ft. throughout this section of the Mississippi. This is to be done by methods similar to those already followed with success, the general idea being that a further narrowing of channels will increase the depth still more. The project includes also a lateral canal around the Rock Island rapids, and a certain amount of auxiliary dredging. The estimate of cost of this project is $20,000,000. The act of 1910 provides that the work shall be so conducted as to complete it within 12 years.

The Middle Mississippi.—The Mississippi River between the mouths of the Missouri and Ohio rivers originally had a channel depth of only 3½ to 4 ft. at low water. The portion between St. Louis and Cairo, a distance by river of 182 miles, is characteristic of a river with shifting bed and caving banks, and in this respect differs greatly from that portion of the Mississippi River above the mouth of the Missouri. In fact the conditions as to stability of bed are like those of the Missouri.

In 1881 a systematic improvement of this portion of the river was commenced with a view to obtaining a least depth of 8 ft. under a project which contemplated the confining of the channel to a width of 2,500 ft. at bank full stage by closing side channels and causing the building out of new banks by permeable dikes so constructed as to cause a deposit of material by slackening the water currents, and the revetting of old and new banks wherever necessary. Since the date of the adoption of this project, it has been extended to include dredging, and in recent years the annual appropriation has been little more than enough to provide for the dredging necessary to keep open a channel during times of low water. This dredging has been done so effectively that for several years a channel with an 8-ft. depth has been maintained between St. Louis and Cairo throughout the navigation season with only occasional interruptions of a day or two. However, the channels are constantly shifting in position and until the complete regularization contemplated by the present project is completed, the improvement can not be considered as satisfactory. Although much remains to be done to complete the project, much has already been accomplished. Seventy-one miles of banks have ben protected by hurdles and 60 miles have been protected by revetment. This work has materially decreased the amount of bar making material which comes from caving banks. While between 1879-1889 an average amount of 64,000,000 cubic yards of earth fell into the river from caving banks annually between St. Louis and Cairo, the average amount for the years 1899-1907 was 49,500,000, the decrease being due to the revetment work done between 1881 and 1905. The act of 1910 appropriates $500,000 for continuing the improvement of this portion of the Mississippi along the lines of the present project, and adopts the policy of completing the improvement within a period of twelve years.

The Lower Mississippi.—The Mississippi River Commission has been in immediate charge of the improvement of the Mississippi between the mouth of the Ohio and the head of the passes, and the surveying and gaging of the river throughout its length. The commission was organized in 1879, pursuant to congressional action. It is composed of three officers of the corps of engineers and four civilians, with an additional engineer officer as secretary to the commission. The act creating the commission directed it to mature plans for preventing destructive floods as well as for facilitating navigation. The original project of the commission, which was adopted by Congress in 1881, provided for narrowing the low water channel to about 3,000 ft. by dikes, the revetment of caving banks, and the construction of levees to confine the flood waters within the river bed. Later acts of Congress authorized the use of hydraulic dredges to obtain a channel 9 ft. deep and 250 ft. wide, and authorized the building of levees above the mouth of the Ohio as far up as Cape Girardeau.

The Mississippi below the mouth of the Ohio flows through a thick alluvial bed and is similar in characteristics to the portion above Cairo. However, all features are on a grander scale. The difficulties of navigation are due to the changing and shallow channels caused by the shifting of the bed of the river and the caving of the banks. The amount of caving is very great. At one place it has amounted to a cutting of the bank back for 500 ft. in three months and at another to a cutting of 1½ miles within ten years. The depths of erosion sometimes is as much as from 30 to 140 ft. below low water level in the portion of the river now under consideration. Measurements made in 1892 indicated that about 100,000 cu. yds. per mile annually fell into the river from caving banks between Cairo and Donaldsonville, La., while measurements made in 1908 showed that between Cairo and Red River there were 749 miles of caving banks along a channel 790 miles long. Until the caving of banks is stopped there can be no permanent improvement of the navigable condition of the river, and until the banks are securely held in position proper terminal facilities can not be established.

Much revetment work has been done in the past, but at present the work of this nature is mainly for the revetment of places where important levees or harbors are threatened. The revetment generally used consists of continuous submerged mattresses, with riprap bank protection above low water.

The levees along the river have been built by private property owners by the states and by the federal government. In the floods of 1882-1884, before work was done by the Mississippi River Commission, the overflowed area was about 29,740 square miles, while in 1903 it was only 6,820 square miles, the difference being due to the levees built in the meantime. The system now includes 1,486 miles of levees. These levees held the floods of 1907 and 1908 so that the territory overflowed was of insignificant area.

The ten hydraulic dredges used in the river below Cairo are now depended upon to keep open the 9-ft. channel and they have done so during recent years, except for very short periods.

For the Mississippi River below Cairo the act of 1910 appropriates $2,000,000 and provides for a continuance of the work already begun with a view to securing a permanent channel 9 ft. deep within a period of twenty years. In addition to the amount mentioned the sundry civil act of 1910 carries an appropriation of $2,000,000 previously authorized, making a total of $4,000,000 available for the Mississippi River Commission work.

The Cumberland River.—The Cumberland River is navigable for light draft steamboats about half of each year as far up as Burnside, Ky., 518 miles above the mouth of the river, and 326 miles above Nashville. The river has been improved by the removal of snags, gravel bars and rock ledges, by the confining of the low water channel to proper limits by means of wing dams, training walls, etc., and by the construction of locks and dams. Two locks and dams have been built below Nashville, Lock A located 41 miles and Lock No. 1 two miles below that city. The former drowned out a very obstructive shoal and lengthened the period of useful navigation below Nashville by about two or three months per year. Above Nashville there have been completed locks and dams Nos. 2, 3, 4, and 5. Nos. 6 and 7 will be completed in the near future and will carry a 6-ft. depth to Carthage, 116 miles above Nashville, the eight dams providing a least navigable depth of 6 ft. over about 157 miles of the river. However, this continuously navigable portion is separated from the Ohio River by a portion about 150 miles long in which for about four months of each year it is impracticable to carry on a profitable navigation. A project for the canalization of the greater part of the distance between Lock A and the mouth of the river was adopted by the recent river and harbor act. Five locks and dams, known as Locks B, C, D, E, and F., are to be built below Lock A at a cost estimated at $3,066,122. These dams are to be of the fixed type and will be of timber cribs with concrete tops. The locks will be 52 ft. wide by 280 ft. in available length with 6-ft. depth on the sills, thus providing for four standard coal barges at one lockage. The average lift of the dams will be 12 ft. The portion of the river, about 50 miles in length, below the lowest projected lock will be improved by dredging a 6-ft. channel 150 ft. wide through the obstructive bars at a cost estimated at $98,760. The funds appropriated and authorized by the 1910 act amount to $663,000, which will be applied to purchase of land required for Locks B, C, D, E, and F, toward the construction of Locks B and C.

Puget Sound-Lake Washington Waterway.—The 1910 act makes provision for substantial progress in the construction of the Puget Sound-Lake Washington Waterway. This improvement has been under consideration for many years and several surveys have been made of the route of the waterway. However, because of lack of funds, not much progress has been made. Lake Union lies about 4 miles east of Puget Sound and within the limits of the city of Seattle, while Lake Washington lies east of Lake Union and separated from it by a strip of land about 2,000 ft. wide. A channel at least 10 ft. deep has been excavated by the government from Puget Sound for a distance of about 2 miles to the Ballard bridges at the head of Salmon Bay, within 2 miles of Lake Union. However, neither Lake Union nor Lake Washington is at present connected with Puget Sound by any navigable waterway.

Lake Union has a depth of at least 40 ft. over an area of about 500 acres, while Lake Washington is about 19 miles long by 2 miles wide. The new project contemplates the excavation of a channel across the neck of land separating the lakes and the lowering of Lake Washington to the level of Lake Union; the excavation of a canal 25 ft. deep by 75 ft. bottom width from Lake Union to the western end of Salmon Bay, where will be located a double lock to form the connection between the lake and sound levels; and enlargement of the channel leading from the lock site to Puget Sound. The lock chamber will be 80 ft. wide by 825 ft. long with a depth on the sills of 25 ft. at extreme low tide. Alongside the large lock a smaller one, 30 ft. by 150 ft., with 16 ft. on the sills, will be built. The plans contemplate also the construction alongside of the locks of a power plant and works to regulate the level of the lakes. The power plant will furnish about 1,000 h. p. in addition to the amount needed by the government, and it is the intention that the plant will be leased by the government, thus being a source of continuous revenue. The work will result in the formation of a single fresh water harbor with a shore line about 100 miles in length. At present Elliott Bay, an arm of Puget Sound, is used as the harbor of Seattle. The new harbor will possess certain advantages over the present one, among them being the absence of salt water and marine life, the greater ease of wharf construction due to less depth of water, the absence of tidal oscillation, and the greater wharfage space available. The projected work is estimated to cost $3,554,932. A local assessment district has been formed to cooperate with the United States in this work, and the work to be done by the United States will include only the construction of the lock and accessory structures and the enlargement of the channel between it and Puget Sound, the limit of cost of the government work being $2,275,000.

Formulas for Determining Approximate Cost for Large Riveted Steel and Cast Iron Pipes.*

At present market prices of labor and materials, contractors bid about 4 cts. per pound for soft steel riveted pipe, including bituminous coating, moderate transportation, and jointing in the trench. Under the same conditions cast iron pipe would cost about 1.3 cts. per pound, plus the cost of placing and jointing. Owing to its greater roughness of surface, it is found that the riveted pipe should have a diameter about 8 per cent larger than that of the cast iron pipe to give the same discharge on the given hydraulic grade. The internal water pressure determines largely the thickness of the metal, as it brings the tensile strength thereof into action. The physical tests of soft steel and good cast iron show that these materials have ultimate tensile strengths of about 60,000 lbs. and 16,500 lbs. per sq. in., respectively, thus giving a ratio of 3.6 to 1.0, but general experience has established the practice of allowing the stress in the

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*Extract from a paper by Emil Kuichling before the New England Water Works Association.

[illegible]

It has also been learned that the normal pressure [illegible] for short periods of time when the motion of the water is rapidly stopped by the closing of a main valve in the line. The magnitude of this increase is difficult to determine, as it depends greatly on the time taken to close the valve. From such observations on large conduits as have come to the writer's notice, this increase is about one-half of the static pressure at the point under consideration; hence in computing the thickness of the pipe, at least 1.5 times the static pressure should be used in the formula. Furthermore, to compensate for unavoidable differences in thickness [illegible] as well as to allow for a gradual reduction of thickness by corrosion, a certain arbitrary addition is usually made, which is about ¼ in. for cast iron pipes and 1/16 in. for steel pipes.

The formulas for the weights and costs of such pipes per linear foot are rather complicated, so that a comparison of results is not easily made. It must also be remembered that the costs will vary from time to time with the market prices of materials, labor, and transportation. Under the conditions stated above, however, and the further assumption that the static water pressure is 100 lbs. per sq. in., the writer has deduced two simple formulas for the approximate costs of large riveted steel and cast iron pipes, as follows:

(1) For steel pipe, $y_1 =$ [illegible] $1125d$

(2) For cast iron pipe, $y_2 = 19 + d($[illegible]d

[illegible] in which y is the cost of the pipe in cents per linear foot exclusive of trenching, and d is the nominal diameter of the pipe in inches. The value of d to be used in these expressions is that of the cast iron pipe, although the actual diameter of the steel pipe is 8 per cent larger. It should also be noted that the expressions apply to diameters ranging from 2 to 6 ft. and the aforesaid pressure.

These formulas indicate that the cost of steel pipe is less than that of cast iron pipe for all diameters, and that the difference in cost in cents per linear foot can be expressed by: $y_2 - y_1 = 19 + d(0.072d - 0.851)$. Applying this to the case of the Rochester conduit, where d was 36 ins., we have: $y_2 - y_1 =$ [illegible] 81.7 cts. per foot, whereas the actual difference was in the vicinity of 50 cts., with rather light cast iron pipe. With more conservative thicknesses for the latter and due allowance for overweight and loss by breakage it is probable that the difference would have been at least 60 cts. per foot. The circumstances in this case, however, were of unusual character, as the lowest bidder declined to enter into contract, and the work was subsequently awarded to and performed [illegible] considerable [illegible]

[illegible]

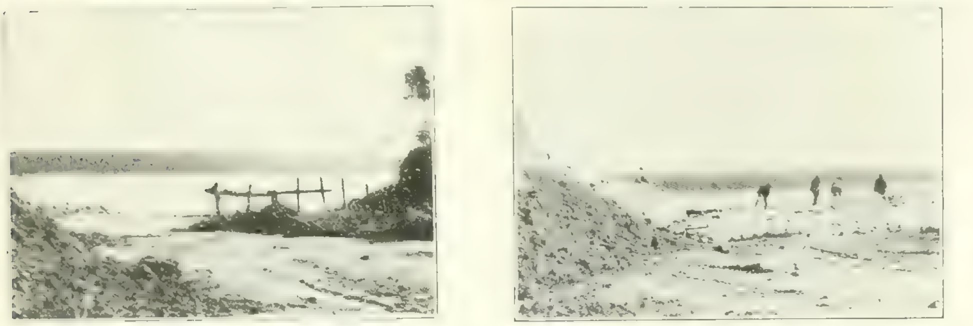
[illegible] also evident that the life of a steel pipe is still invested with much uncertainty; hence it [illegible] general conclusion with respect to the economic advantage [illegible] steel and cast iron pipes at 25 and 50 years respectively, it will at once follow that a steel pipe will be equivalent economically to a cast iron pipe, if the investment of the initial difference in cost at compound interest yields a sum at the end of 25 years sufficient to renew the steel pipe. When the cost of renewal is the same as the original cost, and the rate of compound interest is 4 per cent, financial equivalency will occur if the initial difference in cost is three-eighths of the original cost of the steel pipe; and if the interest be 6 per cent, about one-fourth of the original cost will suffice.

Methods and Costs of Closing a Break in a River Bank.

BY E. N. PARKER.*

Under the plan of improving the Mississippi River between the Ohio and Missouri rivers, repairs were made, in August and September, 1910, to the bank protection at Sawyer Bend, Mo. Opposite the upstream end of the work and less than one-fourth of a mile from the riven bank a small stream, Maline Creek, runs parallel to the river for about 1¼ miles. Between the creek and the protective work the Chicago, Burlington & Quincy Ry. passes on an embankment that has a single opening through it—a roadway opposite the upstream end of the bank protection.

The first week in September an overbank flood from the creek poured down the roadway and over the river bank, forming a large serrated pocket, normal to the bank and 600 ft. long; the opening, through the river bank, was 15 ft. deep and 100 ft. wide. The mouth of the pocket exposed 50 ft. of the upstream end of piling, used in the fall of 1905 to close a similar pocket at this locality (Eng.-Contg., Nov. 6, 1907). Fig. 1. As this old piling was sound and as neither piles nor pile driver were readily available, material on hand was used to make repairs.



Figs. 1 and 2—Views Showing Break in River Bank and Method of Making Repairs.

A barge each of stone and brush was moored opposite the mouth of the pocket, and stage planks were placed, for runways, from each barge to the scene of operations. Brush ($2\frac{1}{2}$ to $3\frac{1}{2}$ ins. at the butt and 25 to 30 ft. in length) was carried by hand to the work, an average distance of 150 ft. Stone, one man size, was wheeled in barrows about the same distance that the brush was carried. With the brush a jumbo mattress, between 6 and 7 ft. in height and between 40 and 50 ft. in width, was constructed on a line with the old work of 1905.

As far as the old piling extended, the mattress was securely fastened to it by wire cables and lightly weighted with stone, beyond the piling the mattress was heavily weighted with stone. At each end of the work, to prevent scour, a wing mattress was built against the bank and loaded with stone. The cost of the work was as follows:

Materials:	
Nails	$ [illegible]
Wire	[illegible]
Brush 20 yds. at $2.05	41.00
Stone 237 cu. yds. at $0.70	165.90
Total	$21[illegible]
Supplies:	
Subsistence	$ 40.00
Labor:	
1 foreman 2 days at $75.00 per month	$ 5.00
1 foreman 2 days at $60.00 per month	4.00
4 boatmen 2 days at $35.00 per month	4.67
40 laborers 2 days at $1.28 per day	102.40
Total	$116.07
Grand total	372.97

Working days were of 8 hours each, and no time was lost on account of accidents or rain. One day was used for building and one day for weighting the mattress with stone.

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*Engineer Office, U. S. A., St. Louis, Mo.

LETTERS TO THE EDITOR.

Reasons for Using a Dry Mixture in Concrete Curb and Walk Construction.

Sirs: Answering H. M. Hockman's questions as to why a wet mix thoroughly spaded would not be better for curbs and sidewalks than the usual method of mixing dry with a surface coat of mortar, I would say that the principal reason is on account of the much less cost of forms for a dry mix. The forms for a dry mix do not have to be watertight and may be removed in much less time than the forms for a wet mix.

The coating of mortar on the surface also presents a more uniform wearing surface than would be the case if the larger pieces were near the surface. It is also desirable to use limestone screenings or some coarse and hard aggregate for the surface mortar. This may be roughened to present a foothold on steep grades.

Incidentally the dry mixed concrete is stronger than the wet mixed, especially at first.

Yours truly,

N. F. Hopkins.

Pittsburg, Pa., Jan. 9, 1911.

The Silting of Reservoirs.

Sirs: Referring to Mr. D'Rohan's article on silting of reservoirs, page 56, of your issue of Jan. 11, 1911: It is impossible to remove sediment by sluicing except within a limited area adjacent to the sluice gates. In large reservoirs, the greater part of the silt is dropped entirely beyond any possible effect of sluices. If a reservoir of prevailing sectional areas and several miles in length were full and the dam should be instantly lifted bodily out of place, very little of the sediment would be removed. This was demonstrated by the Austin dam which failed while a great flood was flowing over it. A section of this dam 250 ft. long was swept from the foundation and the reservoir was emptied much more quickly than possible by any sluice gates that could be made and operated by man. Very little of the sediment, filling 40 per cent of the original reservoir capacity, was removed.

The explanation is simple and fundamental. The scouring action of water increases as the square and its carrying capacity as the 6th power of the velocity. The bulk of the sediment (especially the heavier parts) is carried into the reservoir by the flood stages of the stream when the velocity of inflow is a maximum. It is never possible to maintain that velocity of flow through the enlarged area of the reservoir and the silt is inexorably dropped. For the same reason it can never be picked up again.

The great storage reservoirs of the arid West supplied, as they are, by torrential streams carrying exceptionally large quantities of sediment will inevitably fill with mud and, in all probability, will remain so filled. A solution for the silt problem is yet to be found.

Yours truly,

J. L. Campbell.

El Paso, Tex., Jan. 1[illegible], 1911.

English Methods of Tunneling.

Sirs: I was much interested in the articles on Tunneling in Engineering-Contracting for Jan. 4, and a few further notes on English methods and reasons for their existence may [illegible] interesting.

I gather from various articles that I have read on this side, that the impression exists that English engineers construct their tunnels the way they do because they believe their method superior to the American, whereas it is really force of circumstances alone that is the cause.

In the first place the most important factor in deciding the methods in use in England is that in [illegible] per cent of cases there is an absolute necessity for heavy timbering to carry the ground, hence slow progress from any one working face. In my experience of tunnel work since 1893 in England, in only one instance have I known of railway tunnel work being done there, where timbering could be done without, and that was through a red sandstone of a very tough nature. The rest of the tunnels I have worked in or heard of being built during that period, were through shale or softer material.

There can be no question of economy as compared with the American method where the natural conditions allow of choice, as all who have any great experience know that where very little or no timbering at all is necessary the American top heading and bench method is an easy first both in economy and speed.

Owing to the necessity of this heavy timbering the brick work lining being generally so thick, a progress in England of one length a week of 15 ft. excavated and bricked up, from any one face, is extremely good progress, thus the necessity arises of evolving a scheme to attack the work at more points than would be given at either end, and this is done by adopting one of two methods.

(A) By driving a bottom heading and rushing this ahead as rapidly as possible, and, when the distance driven ahead warrants this, widening out to full section, thus having two other working faces, and so continuing thus until the bottom heading is completely through. The whole length of tunnel is thus split up into a number of working faces, the aim being to so space these working faces or "breakups" as they are called, that all sections are completed as nearly as possible at an equal date.

This bottom heading is also driven large enough, generally 12 ft. x 10 ft., to take a type of locomotive and wagons generally used on this class of work, the wagons having a capacity of from 3 to 5 cu. yds.

(B) Method B is to sink shafts equidistant from each other, from the surface to tunnel level, when circumstances permit, and from these shafts work one face each way, and here it is that English practice coincides with the American, no bottom heading being driven, only a top heading, and the tunnel widened out to full section and bricked up (section by section). This, of course, is where the practice differs, but this is only from necessity, not by any means from choice.

Here I must differ from the "general understanding" that the American method is both cheaper and safer; cheaper it undoubtedly is, safer it is not. I would rather say "safe enough under the conditions to be met with here." I can say from experience that in only one of the tunnels in which I have been employed would the American method of timbering whole sections of tunnel and going ahead again with the excavation, have been either safe or practicable.

The system of timbering followed in England closely resembles the English-American shown in Stauffer's "Tunneling," the "Crown Bar Method," and I have seen crown bars used as large as 3 ft. in diameter to carry a 15-ft. length, but in most cases 2 ft. or a little over meets all requirements, bars ranging from this size in the crown down to 10 ins. about midway down the side walls being put in at 2 ft. 6 ins. centers. In very few cases are lengths of more than 15 ft. practicable owing to the size of timber necessary to carry the ground, but I have known of the length being cut down to 10 ft.

The cost in lumber is not so high by comparison as one might be led to think, a set of bars, props, stretchers, etc., cut for a face, will in a great measure see that face through, with the exception of poling boards, which may be bricked in and replaced, and an occasional bar that is broken by weight of the ground, and the whole timbering is carried out so systematically that all props, etc., come into their own place in each succeeding length.

Perhaps these few remarks will show the "why and wherefore" of English procedure, a difference to the American practice due not to any mistaken idea as to superiority or economy, but to the natural obstacles to be overcome, and is up to now the only practical method yet evolved to meet the conditions.

These remarks do not apply, of course, to tube tunneling as practiced in London, the English practice in this class of work being similar to that in New York.

As regards the interesting article on tunnel work in the Alps, it seems to me that had the engineers followed more closely the English method constructing those portions where the rock pressure was great, less trouble would have been caused

It is common knowledge amongst tunnel men that where the strata have been allowed to move through inefficient timbering in any particular length, the succeeding lengths or sections are heavier both on the timbering and lining than they otherwise would be, and had the lining of "Karawanken" been completed invert and all clear to the excavation, it would have been better. I note the writer states that the ground was open on an average two months, excluding the invert, which was open from 10 to 20 months, and further, that the upward movement of the walls generally stopped when the arch was completed. Judging by this, it seems reasonable to me to suppose that had the invert been placed at the same time as walls and arch, there would have been little trouble from the floor rising whilst excavating succeeding rings.

Yours truly,

JOHN [illegible] MARSH,

A. Q. S. W. R. G.

[illegible], Canada, Jan. 1, 1911.

The Calculation of Plates Supported by Four Columns.

Sirs: In your issue of [illegible] the first formula in the second column should read:

[illegible]

On page [illegible] the last formula [illegible] article should read:

[illegible]

The result of this latter equation should be $\frac{pd^3}{16}$ and the moment [illegible] $\frac{pd^3}{23}$

Yours truly,

C. E. MITCHELL [illegible]

[illegible] Jan. [illegible] 1911.

The Failure of the Center for the Spokane Concrete Arch.

Sirs: It has been some time since the failure of the arch centering for the main arch of the Spokane bridge, [illegible] will be of 281 ft. span. In the meantime I have been hoping to [illegible] on the [illegible] but [illegible] attention [illegible] engineering department and the construction was also being undertaken, I believe, by the city on the day labor system. This fact may or may not have been responsible for the failure of the arch [illegible] that the trouble would have been avoided if the work had been let by contract to responsible parties with experience. The design of engineering structures is one problem, but the construction of them is distinctly another problem [illegible] experienced in the different lines of work. From a photograph which I have seen of the arch centering and the plans which have previously been published, I note that the arch spans 281 ft. and rises 115 ft. It is 6.75 ft. deep [illegible] 20 ft. wide at the springing line. The arch center dimensions have not been published, but the photograph shows it to have been an arched timber framework of outside dimensions slightly [illegible] general lines of the timber center were very similar to the concrete arch it was intended to support [illegible] shaped sections and each was lowered to position from the existing steel bridge and suspended in place [illegible] work [illegible] and the [illegible] was left standing independent of any support. It was [illegible] only support at the shore ends was confined to the butt ends of the seven timbers forming the [illegible] upper chord timbers not being carried back to the ground beyond. Any tendency of the timber arch to twist, due to wind pressure, would have placed the arch timbers in stress, and this was apparently not taken care of in the slightest degree. This is obvious because those who saw it say that when the wind struck the bridge the arch center commenced to turn about the upstream points of support, and when [illegible] collapsed like a pile of blocks.

The manner in which the center collapsed indicates that the timber center could never have been successfully loaded with concrete to form the arch. In the first place it would have had to be loaded uniformly [illegible] over the entire arch at one time in order to prevent its collapse due to eccentric loading. A system of small concrete vossoirs might have been poured, but so many of these would have been necessary that it would have been impractical.

I make this statement, of course, only as an observer and in the absence of the necessary plans and material to work out the figures. To the casual observer it would seem that this type of center for an arch would be very economical if it were practical. I write, therefore, more with the object of calling forth opinions of those who are in touch with this class of work than with any desire to condemn a thing upon which I [illegible] definite opinion.

Yours truly,

SUBSCRIBER.

Chicago, Ill., Jan. 19, 1911.

PERSONALS.

Mr. Bion J. Arnold, well-known traction expert and chairman and chief engineer of the Board of Supervising Engineers of Chicago, has been given the honorary degree of Doctor of Engineering by the University of Nebraska.

The W. K. Palmer Company Engineers, 717-721 Dwight Building, Kansas City, Mo., announce the engagement of Mr. D. F. Collins as business manager. Mr. Collins assumed charge of the office on Jan. 1. He was formerly with the Bell Telephone Co.

The Bates & Rogers Construction Co., civil engineers and contractors, announce the removal of their offices from the Ellsworth building to the Old Colony building, 84 Van Buren street, Chicago. Their western office will be located as formerly at 213 Lindelle block, Spokane, Wash.

The engineering firm of Dodge, Day & Zimmerman, of Philadelphia, have added to their organization Mr. Walter Loring Webb and Mr. James M. Kennedy. Both are well known in the engineering world, Mr. Webb being the author of a number of important engineering text books.

Mr. W. A. Parker, Chief Engineer of the St. Joseph & Grand Island Ry., at St. Joseph, Mo., has been appointed acting general manager of that line, succeeding Mr. James Berlingett, resigned. It is stated on good authority that Mr. Parker will continue permanently as General Manager.

The Michel-Kurze Co., with offices in the Hudson Terminal building, New York City, has been organized to do photo retouching and illustrating of machinery subjects. The business will be managed by Mr. A. Eugene Michel, and the art work will be done under the supervision of Mr. Wm. F. Kurze.

Watson, Flagg & Standifer Company announces that it has acquired by purchase the plant and unfinished contracts of the Pacific Coast Construction Company of Portland, Oregon, and will conduct a railroad and general contracting business with headquarters at 310 Wells Fargo Building, Portland, Oregon.

Mr. Francis Lee Stuart has been appointed chief engineer of the Baltimore & Ohio R. R., succeeding Mr. A. W. Thompson, recently appointed general manager of that company. Mr. Stuart has been for the past five years chief engineer of the Erie R. R.

Mr. Charles D. Miller has been appointed territorial engineer of New Mexico by Governor Mills, and assumed the duties of the office on Jan. 1. Mr. Miller is a graduate of the New Mexico College of Agriculture and Mechanic Arts, and has had extended experience in irrigation engineering.

Mr. S. M. Savage has resigned as resident engineer in charge of the barge canal work at Utica, N. Y., to engage in the contracting business. Mr. Savage had been connected with the barge canal work since 1905, at Fort Plain, Little Falls and Utica, and during two years of that period served as secretary to the advisory board of consulting engineers.

Mr. A. O. Anderson, mining and civil engineer of Lake City, Ia., has been placed in charge of the Iowa Engineering Experiment Station at Ames, Ia. A 20,000-lb. testing machine for testing tile, brick, sewer pipe, concrete beams, etc., has recently been installed at this institution. Mr. Anderson will devote a limited amount of time to private practice as expert in drainage, municipal and mining litigation.

Mr. [illegible] F. Kastl, advisory engineer of the New York City Water Supply Commission, has been appointed Deputy State Engineer of the state of New York [illegible] salary of $6,000 per year. He will have charge of all work on the New York state barge canal. Mr. Kastl was graduated from the University of Michigan in 1882 and has had engineering experience in Chicago, Denver, Boston and New York.

Sir John Aird, head of the contracting firm of John Aird & Sons, and builder of the Assuan dam across the Nile in Egypt, died at his [illegible]. He was born on [illegible]. He took an active part in public [illegible] and was a member of Parliament from 1887 to 1905, representing North Paddington. In recognition of his work, particularly in connection with the Assuan dam, he was created a baronet in 1901.

The Stephens-Adamson Mfg. Co., of Aurora, Ill., manufacturers of conveying, elevating, screening and power transmission machinery, have secured the services of Mr. G. H. Stephens as manager of their eastern business, with offices at 50 Church street, New York City. Mr. Earl D. Stearns, formerly in charge of the eastern business, will take charge of the company's Chicago office, located in the First National Bank building in that city.

Mr. W. D. Hodge, chief engineer of the Denver, Laramie & Northwestern R. R., was made general superintendent of that road on Jan. 1 succeeding Mr. D. L. Hutchins, resigned. Mr. Hodge will continue to perform the duties of chief engineer. Before coming to the Denver, Laramie & Northwestern, about a year ago, he had an extensive experience as roadmaster and superintendent on various roads, and was for three years prominently connected with the reconstruction work of the Chicago & Northwestern Ry.

Mr. Charles Hill Morgan, a prominent mechanical engineer and official of the United States Steel Corporation, died at his home in Worcester, Mass., Jan. 10. He was born in Rochester, N. Y., in 1831, and has been in the steel business since he was 12 years of age. He was a past-president of the American Society of Mechanical Engineers, a member of the American Institute of Mining Engineers and of the Iron and Steel Institute of Great Britain, and an honorary member of the Societé des Ingénieurs Civils de France.

The British government has retained Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, president of the American Institute of Electrical Engineers, and senior member of the firm of D. C. & Wm. B. Jackson, of Boston and Chicago, as an expert adviser in the matter of the valuation of the plant of the National Telephone Company, which the British government is to purchase at the end of this calendar year. Prof. Jackson sailed for England by the Lusitania this week for a preliminary conference with the postoffice officials.

Mr. Louis C. Kelsey, civil and hydraulic engineer, Salt Lake City, Utah, has opened an office in Portland, Ore. He will engage in practice as a consulting engineer, and will give special attention to the design and construction of waterworks systems, hydro-electric plants, irrigation, sewers and sewage disposal systems, and pavements. He has been engaged to design and supervise the construction of a water works distributing system for Gresham, Ore., and a sanitary sewerage system for Sparks, Nev. He will also maintain his office at Salt Lake City.

Mr. H. Eicholtz, one of the leading citizens of Denver, died at his home in that city on Jan. 30. He was born in Lancaster, Pa., in 1827, and received his education as a civil engineer at the Moravian Academy at Lititz. He entered the service of the Pennsylvania R. R. as a rodman in 1852. During the civil war he served as assistant engineer of military railways of the department of the Mississippi under Gen. Sherman. At the close of the war he took up the practice of engineering in the west, and continued in this work until about 1870, when he established a real estate and brokerage business in Denver.

Mr. William J. Harahan, assistant to the president of the Erie R. R., has been elected a vice-president of that company. Mr. F. L. Stuart having resigned as chief engineer, to become chief engineer of the Baltimore & Ohio R. R., Mr. Harahan will have charge of the engineering department. He has had an unusually broad experience in both engineering and operation. Beginning as a messenger with the Louisville & Nashville R. R. in 1881, he has served in various capacities with a number of roads. He became chief engineer of the Illinois Central R. R. in 1901, general manager in 1904, and in 1905 was elected fourth vice-president. He left the Illinois Central in June, 1907, to become assistant to the president of the Erie R. R.

Mr. John Wright Seaver, mechanical consulting and contracting engineer, died at his home in Cleveland, O., Jan. 14, from an attack of apoplexy. He had been in poor health for several months. He was born in Madison, Wis., in 1855. He obtained his education by attending night school and by private study. At the age of 13 he began work in the shops of the Shepard Iron Works, at Buffalo. In later years he was connected with the Schultz Bridge Works, of Pittsburg, the Ritter-Conley Mfg. Co., and the Wilson-Seaver-Morgan Co. He was prominent as a bridge designer and was an authority on steel manufacturing and coke oven machinery. Mr. Seaver was a member of the American Society of Mechanical Engineers, the American Society of Civil Engineers and the Cleveland Engineering Society.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Blue Print Machinery and Drafting Supplies. Paper, 6x9 ins., 91 pp. The C. F. Pease Company, 167 Adams St., Chicago.

This catalog describes and illustrates blue print apparatus and drafting room supplies of all kinds. Prices of drafting materials are given. The book is very useful as a catalog and is of special interest because of the new direct white print papers which were patented by this company.

Gurley's Manual.—Cloth, 4½x6¾ ins., 516 pp. W. & L. E. Gurley, Troy, N. Y.

This is the forty-fifth edition of the general catalog of the Gurley Company. It is somewhat of a departure from the ordinary catalog make-up and is designed to be useful as a book of instructions in the adjustment and use of field instruments. Illustrations in colors are shown and a complete price list is given.

United Steel Sash.—Paper, 10¾x8¾ ins., 30 pp. Trussed Concrete Steel Co., Detroit, Mich.

A catalog of steel window frames and sash. It is well illustrated and descriptive of the details of construction and application.

Sergeant Rock Drills.—Paper, 6x9 ins., 24 pp. The Ingersoll-Rand Company, 11 Broadway, New York.

Form No. 4202, recently published, describes and illustrates in detail the "Sergeant" drills of latest types. A table of sizes and prices is given.

Baldwin Locomotives.—Paper, 9x16 ins., 36 pp. Baldwin Locomotive Works, Philadelphia, Pa.

This is Record No. 68 of the above company, which deals with the mechanical features of the Mallet articulated locomotive. Drawings, photographs and descriptions are given, together with tables of dimensions.

Ironite.—Paper, 6¼x9¼ ins., 32 pp. Ironite Company, 84 LaSalle St., Chicago.

This book contains a description of the properties of this waterproofing material. Instructions for its use are given.

Ditching With Dynamite.—Paper, 6x9 ins.; 16 pp. E. I. DuPont de Nemours Powder Co., Wilmington, Del.

An illustrated article, describing the methods and procedure of excavating trenches with dynamite. Methods of handling the dynamite and preparation of holes are illustrated and described with great detail.

Concrete Surface Finishes.—Paper, 6x9 ins.; 12 pp. Vulcanite Portland Cement Co., Fifth Avenue Building, New York.

A paper by Albert Moyer, with colored illustrations and descriptions of various decorative concrete work.

Concrete in the Country.—Paper, 6x9 ins.; 112 pp. Vulcanite Portland Cement Co., Fifth Avenue Building, New York.

A carefully illustrated book with descriptions and advice to beginners in carrying on concrete work in the country and on the farm.

The Isolated Plant.—Paper, 6¾x10 ins., 40 pp. Isolated Plant Pub. Co., 43 W. 34th St., New York.

A monthly magazine published in the interest of the private plants for furnishing electric current in large buildings.

"Heart Beat" Oiler.—Paper, 3¼x4 ins., 4 pp. Ingersoll-Rand Company, 11 Broadway, New York.

A pamphlet, illustrating and describing the above named oiler for rock drills.

Builders' Hoists.—Paper, 8½x11 ins., 4 pp. C. H. & E. Manufacturing Co., Inc., 321 Mineral St., Milwaukee, Wis.

An illustrated folder with description and prices, of a 1,000-lb. capacity hoist.

Gravity Chute.—Paper, 5¼x6¼ ins., 4 pp. C. H. & E. Manufacturing Co., Inc., 321 Mineral St., Milwaukee, Wis.

An illustrated description, with prices, of a gravity chute for concrete.

Explosives.—Paper, 6x9 ins., 116 pp. E. I. Dupont De Nemours Powder Co., Wilmington, Del.

The Farmers' Handbook published by this company is exceptionally interesting and useful for all users of dynamite. Methods of clearing land, ditching, and of handling dynamite are clearly set forth.

Lehigh Cement.—Paper 6x9 ins. 16 pp. Lehigh Portland Cement Co., Indianapolis, Ind.

This is the January Bulletin of the company containing an article describing the construction of a dam and power station at King's Creek, Carolina.

Cranes.—Paper 6x9 ins. 40 pp. Whiting Foundry Equipment Co., Harvey, Ill.

This catalog shows the major features of construction in Standard Whiting Cranes and illustrates a few typical installations. It is intended that the catalog will convey mainly, the understanding that there is a type of Whiting crane for every service.

Belt Conveyors.—Paper 6x9 ins. 24 pp. Stephens-Adamson Mfg. Co., Aurora, Ill.

This catalog illustrates and describes various installations of conveying and transmission machinery. Conveyors for construction work and for permanent work are shown. Details of transmission machinery are illustrated.

Edison Waterproofing Paint.—Paper 6x9 ins. 12 pp. North Jersey Paint Co., 1133 Broadway, New York city.

Illustrating work which has been waterproofed with this material and describing its qualities and methods of application.

Concrete Mixer.—Paper 6x9 ins. 4 pp. Elite Mfg. Co., Ashland, Ohio.

This illustrates and describes continuous mixer with low down hoppers within reach of a man shoveling from the ground and with an automatic forced feed.

The Mushroom System.—Paper 8x9 ins. 6 pp. C. A. P. Turner M. Am. Soc. C. E., 816 Phoenix Bldg., Minneapolis, Minn.

A description, with illustration, of the mushroom system. Salient points regarding its advantages are set forth.

Contractors' Equipment.—Paper 6x9 ins. 48 pp. The Ohio Ceramic Engineering Co., Cleveland, Ohio.

A catalog of buckets, cars, and portable track. A dozen or more standard types are illustrated both by photograph and drawings. Tables of sizes, weights, capacities and prices are given.

Power Transmission Machinery.—Cloth 6x9 ins. 194 pp. The Hill Clutch Co., Cleveland, Ohio.

Catalog Number Nine just published is a carefully arranged book on Power Transmission Machinery. It shows the latest improvements in that class of machinery. Illustrations are given of the different machinery and also drawings to illustrate the dimensions shown by the tables. Prices are given in tabulated form.

Concrete and Reinforced Concrete.—Paper 4¾x7¼ ins. 40 pp. Robert W. Hunt & Co., Engineers. The Rookery, Chicago.

This is the Progress Report of the joint committee of the Am. Soc. for Testing Materials. It embodies the present judgment of the committee concerning the proper use of concrete and reinforced concrete.

Cement Concrete.—Paper 3⅜x6¼ ins. 20 pp. Robert W. Hunt & Co., Engineers. The Rookery, Chicago.

Describes the service offered by the company's Bureau of Inspection Tests and Consultation.

Sidewalk Science.—Paper 9x6 ins. 16 pp. Hotchkiss Lock Metal Form Co., Binghamton, N. Y.

An illustrated catalog of steel forms for sidewalks, crossings, curbs and gutters, and their concrete work. Prices are given.

Curb and Gutter Construction.—Paper 9x6. 10 pp. Hotchkiss Lock Metal Form Co., Binghamton, N. Y.

An illustrated catalog showing the built up metal forms for curb and gutter construction with directions for the work. Prices are given.

Rubber Boots.—Paper 3⅛x6¼ ins. 6 pp. Morse & Rogers, 134-140 Duane St., New York.

A folder which illustrates and describes various styles of boots for workers.

Alkali Proof Portland Cement.—Paper 4x6¾ ins. 34 pp. Colorado Portland Cement Co., Denver, Colo.

This little book covers quite completely the effects of alkali and sea water upon concrete, and shows results of tests, in alkali, of alkali proof cement. The book is carefully arranged and has some unique features as a catalog.

Duplex Power Driven Air Compressors.—Paper 6x9 ins. 24 pp. Ingersoll-Rand Co., 11 Broadway, New York.

Bulletin No. 3007 illustrates and describes class "P B" compressors. Half tone cuts of machines and parts are given. Tables of dimensions, displacement, horsepower required, etc., are given.

Corner Posts of a Great City.—Paper 5x6¾ ins. 36 pp. Chas. F. Roland, Commissioner, Winnipeg, Canada.

A booklet compiled by the Winnipeg Development and Industrial Bureau and setting forth the opportunities and resources of Winnipeg. Illustrated.

Blaw System.—Paper 6x9 ins. 96 pp. Blaw Collapsible Steel Centering Co., Westinghouse Bldg., Pittsburg, Pa.

Catalog No. 12 of steel forms for general concrete construction. This catalog gives descriptions of the Blaw forms and is perfectly illustrated with photographs of various work intending to show that Blaw forms can be used on practically any class of concrete work.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

The past week has brought out a number of reported awards of large railroad construction contracts. Among these reports are the following: Degnon Constructing Co., 60 Wall St., New York City, for constructing the first section of the Tidewater R. R., extending from East Lake to Bessemer, Ala.; MacArthur Bros. Co., New York and Chicago, for constructing the new Greeley, Colo.-Hudson branch for the Chicago, Burlington & Quincy R. R.; the Pinkerton Construction Co., Land Title Bldg., Philadelphia, Pa., for constructing the Fresno-Hanford interurban line in California, and Eyre & Shoemaker, Arcade Bldg., Philadelphia, Pa., for a considerable amount of improvement work in the vicinity of Harrisburg, Pa., for the Pennsylvania R. R. At this writing it is impossible to confirm any of the above reports.

McKenzie & Snider, Wrightsville, Ga., have just been awarded a nice contract for grading between Wrightsville, Ga., and Adrian, Ga., a distance of 17 miles, for the Wrightsville, Adrian & Lyons R. R.

Late reports from the Western Maryland extension to Connellsville, Pa., state that it is believed that the grading will be entirely completed and ready for tracklaying by April 1 next. From this it is thought that trains will be running about Sept. 1. The work is now about 4½ months ahead of schedule time.

The Water Board of Portland, Ore., has just awarded a contract for 5,792 tons of 6 in. to 30 in. cast iron pipe. The contract went to the U. S. Cast Iron Pipe & Foundry Co., and amounted to $178,987.

One of the largest dredging contracts let recently has been awarded to the Standard American Dredging Co., San Francisco. This contract calls for dredging the Key Route Basin at Oakland, the work including the removal of 3,000,000 cu. yds. of material. The contract price was 9.9 cts. per cu. yd.

The contract for constructing the first part of the sewer system for the city of North Vancouver, B. C., has been awarded to McDonnell, Gzouski & Co., Vancouver, B. C., at $200,000.

A high official of the Canadian Pacific Ry. announced last week that that railroad during the present season would double track 100 miles of its western system and would lay over 300 miles of new track in different parts of the prairie provinces.

Two large pieces of drainage work in Arkansas are about ready for construction work. One of these pieces of work calls for the construction of 24 miles of main ditch and 30 miles of laterals for Drainage District No. 8, of Clay County, the work involving 1,850,000 cu. yds. of excavation. Bids are to be opened March 16. The other work calls for the construction of 16 miles of main ditch and 34 miles of laterals for Drainage District No. 1 in Greene and Lawrence counties, the work involving some 2,510,000 cu. yds. of excavation. It is expected that contracts for this work will be ready for letting some time in March. J. D. Mitchell, Rector, Ark., is Chief Engineer for both of the above districts.

Excavation for the Panama Canal during the month of December amounted to 2,946,404 cu. yds., a daily average of 115,323 cu. yds. for each of the 26 working days. During the month 150,170 cu. yds. of concrete was laid and 520,601 cu. yds. of fill placed.

City Council Finance Committee of Chicago, Ill., on Jan. 21, decided to submit to the voters at the coming spring election the question of issuing about $1,000,000 of bonds for new bridges. It is expected that work on all of the bridges provided for in the budget will be started this year.

Developments of the past week indicate that the Canadian Government has at length decided to go ahead with the Georgian Bay Canal. A supplementary estimate for $3,000,000 may be included by the Canadian Government in its budget for this year. This sum would be used for deepening the Back River at Montreal Riviere des Prairies, and the French River. The works mentioned would all be of utility in any event, but they are also on the proposed route of the canal, and in that the significant part of it lies.

The Sinking Fund Commission of New York City has asked the Board of Estimates to appropriate $950,000 for the beginning of the initial work for the improvement of Jamaica Bay.

Notes on Pavement Construction.

Citizens everywhere are gradually learning the advantages of good pavements. Some citizens have even gone so far as to burst into poetry in praise of the surfacing on the streets in front of their residences. The following, "Walt Masonized," from the Washington Star, is an example of the length to which a citizen will sometimes go: They took a little gravel and they took a little tar with various ingredients imported from afar; they hammered it and rolled it, and when they went away they said they had a pavement that would last for many a day. But they came back with picks and smote it to lay a water main, and then they called the workmen to put it back again. To run a railway cable they took it up once more, and they put it back again just where it was before. They took it up for conduit to run the telephone; and then they put it back again as hard as any stone. They took it up for wires to feed the 'lectric light, and then they put it back again, which was no more than right. Oh, the pavement's full of furrows, there are patches everywhere; you'd like to ride upon it, but it's seldom that you dare. It's a very handsome pavement, a credit to the town; they're always diggin' of it up or puttin' of it down.

Oklahoma's State Owned Railroad.

For some months there has been considerable agitation in Oklahoma for the construction of a state owned railroad. This agitation has been fostered by labor organizations and farmers' unions, and has now reached the stage where it is seriously being considered. According to press dispatches the public service corporation committees of the State Legislature met recently in joint session with representatives of the Oklahoma Federation of Labor, the Farmers' Union and the Oklahoma City Chamber of Commerce to discuss the basis of a bill which will give the State power to construct a railroad 425 miles long. The road as proposed is to run from the northwest to the southeast sections of the State, opening up new agricultural, coal and timber lands. The bill which is to be introduced in the Legislature will ask for a $10,000,000 bond issue to be decided by a special election. According to figures of the U. S. Office of Public Roads New Mexico and Oklahoma in 1904 were contestants for the cellar hole position in the matter of mileage of improved roads. Just how small was the mileage of improved roads in these two States at that time is shown by the fact that Nebraska, which was just above them in the averages, had 23 miles of improved roads. Of course since 1904 there has been much improved road construction in Oklahoma, but nevertheless it would seem that this field offers a better vent for the surplus energies of the State than does the building of a commonwealth railroad. Anyway it would seem to be good policy for Oklahoma to secure the opinions of Texas and Georgia regarding their State owned railroads before embarking on the construction of a railroad itself.

Origin of Chicago Track Elevation.

Great things often hinge on trifles. If Cleopatra's nose had been half an inch longer the whole history of the Roman nation might have been different; if Napoleon the night before the battle of Waterloo had taken a little pill for his dyspepsia (authority for this is a patent medicine ad.), the whole map of Europe might have been changed; if a certain railroad official had not refused to provide means for a political junket, track elevation work in Chicago might now be in its preliminary stages instead of its final stages. This last event, according to ancient political history, was brought about in this way: According to the story upon a certain occasion, quite a few years ago, a certain Mayor of Chicago desired to reward some of his faithful party workers by a little junket to New York City. This was in the good old days when most anyone with the proper drag could get free transportation over the railroads. So the Mayor did the customary thing and sent one of his henchmen around to the local passenger office of an Eastern road and demanded a private car and its free transportation to New York and back. Something went wrong right here; perhaps the "boys" had used up their quota of private cars for the week or perhaps this particular request was proffered in such an assured take-it-for-granted way that it went against the railroad man's grain. Anyway, the request was refused. The next day, so runs the ancient history, this railroad man was notified that unless he changed his attitude something would happen that would make the railroads mighty sorry. Other railroads were notified regarding this man's obstinacy and its danger to their interests. But in desperation they rallied around their beleaguered compatriot and threw up bulwarks. The siege was continued for several days, and then the ultimatum was delivered. Unless the desired transportation was handed to the Mayor that night, at the opening of the Council meeting, the blow would fall. The transportation didn't come, but the blow did. The first ordinance requiring the raising of tracks within the city limits of Chicago was introduced in the Council and started towards its passage. In this way, if there is any truth in the story, did the vast scheme of track elevation in Chicago have its beginning.

The Union Pacific R. R., according to advices from Greeley, is reported to be contemplating building a line from the southeast to compete with the Burlington in northeastern Colorado and for traffic from the east and south going to the west coast. The new line, it is said, is to cross the Kansas Pacific at Deer Trail and run direct to La Salle, so that passengers from the south bound for the Pacific coast need not go through Denver.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

⊙It is now believed that construction will be started by March 1 on the proposed line of the [illegible] R. R. The first section to be built will extend from East Lake to Bessemer and it is reported in Birmingham that the contract for this has already been let to the Degnon Contracting Co., 60 Wall St., New York city. J. M. Dewberry, Birmingham, Ala., is President.

The Manistee & Repton R. R. Co., of Monroe County, has been chartered with a capital stock of $10,000, the incorporators being J. H. Lyons, Marshall Turner, R. F. Mitchell and the United Lumber Co., Inc.

The Louisville & Nashville and the Birmingham Southern railroads have reached an agreement in their injunction fight and work on the latter road has now been resumed between Ensley and Bessemer. Recently the Louisville & Nashville secured a temporary injunction against the Birmingham Southern from building on certain property near Ensley and this held up the work. The differences are said to have been amicably adjusted.

Tht City R. R. Co. of Birmingham has filed its articles of incorporation, the capital stock being placed at $5,000. The officers are Paul Mitchell, president; DeWitt B. Lightber, vice-president and treasurer, and A. F. Kummer, secretary. The objects of the concern are to build and operate a railroad in the Birmingham district.

Advices from Bay Minette, Ala., state that work on the Pensacola & Southwestern R. R., which company was incorporated about a year ago, is progressing rapidly and that a number of new contracts have been let for the further progress of building the road and that several mills have been given contracts for sawing out timber to be used in the construction of bridges along the right-of-way. The officers at the head of the company are pushing the project with great energy and hope to have the track completed in a short time.

Arizona.

The Railroad Committee of the Chamber of Commerce of Tucson, Ariz., has secured renewals of options for the right of way through Tucson for the western extension of the El Paso & Southwestern System, covering a period up to March 1, by which time it is believed the company will make its final decision whether it will use the road through this city or that suggested via Mammoth and down the San Pedro Valley.

Arkansas.

The Helena Interurban Co., E. C. Hornor, president, Helena, Ark., has applied to the city council of Helena for permission to extend its lines for a distance of about two miles. Ultimately the company proposes to extend the line as far south as Westover, which is opposite Friars Point, Miss., about nine miles south of Helena.

California.

⊙The Fresno-Hanford Interurban line is to have grading work started shortly on its line running south from Fresno by way of Fowler, to Hanford, to tap the Kings River bottom country. The Pinkerton Construction Co., Land Title Bldg., Philadelphia, Pa., is reported to have the contracts. F. S. Granger, Fresno, is the promoter.

The Public Utilities Board of Los Angeles has been petitioned to advertise the sale of a franchise for a street car line on Jefferson St.

The Los Angeles Street Ry. Co., George Kuhrts, Chief Engineer, Los Angeles, will probably reach some definite decision shortly as to the route for its projected crosstown line at Los Angeles.

The Pacific Electric Ry. Co., Los Angeles, has completed final surveys for its extension from Glendale to Burbank, the route running through the lowlands at Glendale, thus avoiding the heavy grade along the foothills. The work is to be started as soon as right of way into Burbank is secured.

The Atchison, Topeka & Santa Fe System (coast lines) has completed a survey for a proposed 6-mile spur track running into the citrus country just back of Corona as far as the foothills. M. C. Bryan, San Bernardino, Cal., is division engineer.

The Santa Fe System, according to advices from Bakersfield, Cal., will spend about $885,000 for the improvement of its lines in Bakersfield and San Joaquin Valley during the present year. The entire line from Point Richmond to Bakersfield is being relaid, the roadbed being widened to twenty feet and raised from two to three feet on the average, and thirty-three foot, ninety-pound steel laid. The greatest attention is being given to the roadbed, and when completed and treated it will be practically dustless, even in the middle of summer. The crushed rock which is used in the roadbed comes from a quarry on a branch line leading out about eighteen miles beyond Reedley. All wooden bridges and culverts are being replaced with steel and concrete structures.

At a meeting held January 10 by the Southern Pacific Ry. officials the principal topic for discussion was the partial consolidation of the Pacific Electric and the Los Angeles Pacific. The Los Angeles Pacific offices, now on Hill street, near Fifth street, Los Angeles, are to be moved to the Pacific Electric building and conducted in connection with those of the Pacific Electric railway. It is persistently rumored along railroad row that there will be some changes in the officials of the two roads, but no intimation has been given as to whose official heads are to go. It is also said that the local executive offices of the Southern Pacific, now in the Grosse building, are to be moved to the Pacific Electric building.

Business men of San Obispo, Cal., have drawn up articles of incorporation for the proposed company which will build a railway from that city to Hanford. It is proposed to interest capital in the San Joaquin Valley in the project.

Promoters of the proposed Fresno-Monterey Ry. have received so much encouragement from the citizens of the two cities named that steps will be taken at once toward organizing a company and securing rights-of-way for the construction of the line. Preliminary surveys will be started at once.

The Fresno, Coalinga & Tidewater Co., of Fresno, has been incorporated with a capital stock of $300,000 to undertake a general investment business and act as the promotion company to build the electric railroad from Fresno to Coalinga and from there to tidewater at Monterey. The organizing directors are the following: Charles J. Shaw, of Hollister, A. G. Metz of Monterey, W. J. Kilby, and Frank Cheney of Coalinga, J. W. Briscoe of Bakersfield, G. W. Cartwright, G. P. Cummings, Roy Hall, T. C. White Dr. W. T. Burks, Montgomery Thomas, H. H. Alexander and C. S. Pierce of Fresno. This is the railroad which has been promoted by A. Albrecht and Charles J. Shaw.

The field work for the resurvey of the proposed line of the San Diego & Arizona Ry. from Hayden Summit to Seely on the banks of New River, a distance of about 60 miles, has been completed and at last reports the engineers in charge of C. R. Rankin, had opened offices in the Hotel Oregon Bldg., El Centro, Cal., to prepare the final papers, maps and figures for submission to San Diego headquarters. The grade stakes for the uncompleted portion of the road have been definitely set as far east as Hayden Summit. From there to Seely a survey has been made, but Engineer Rankin was instructed to run the course over again in an effort to secure, if possible, easier grades and better curves. At Seely there is a choice of two routes, one running northwest over or paralleling the Holt road into El Centro, or dipping to the southeast into Calexico, near the Mexican border. Both these points are touched by the Southern Pacific. Should it be decided to drop down into Calexico, the Arizona road will again have to cross and recross the Mexican line en route east to Yuma. From El Centro there are two routes that could be followed into Yuma.

Colorado.

⊙The Denver, Laramie & Northwestern R. R. has awarded a contract to the Cook Railway Signal Co., 1065 Gas and Electric building, Denver, Colo., for the installation of an automatic signal system, including a block signal and a crossing gate signal, which in time will extend the entire length of the road. Within a short time men will begin work at Utah Junction and make their way toward Greeley as fast as possible, placing the new device in shape for operation.

The Uncompahgre & Gunnison Valley R. R. is now making surveys and has tentatively secured the construction capital for its projected 50-mile line. The route is from Montrose north through the fruit belt to Olathe, Delta and Andaredge. Construction contract will probably be let in May. M. P. Paret, Kansas City, Mo., is Engineer; T. B. Townsend, Denver, Colo., is President, and Sol. A. Sprague, Montrose, Colo., is Secretary.

The Chicago, Burlington & Quincy R. R. now has sufficient rails stored at its yard at 31st street to construct 35 to 40 miles of new main line track. It is believed that these rails have been purchased for use on the new Greeley-Hudson branch. It is expected that work on this branch will be started shortly, as bids for its construction were received some time ago. MacArthur Bros. Co., New York and Chicago, are said to be the probable contractors.

The Commercial Association of Montrose has taken up with the officers of the Denver & Rio Grande R. R. the matter of extending the third rail on the line to Olathe, on the north, and to Jujane on the east. At present shippers at these points put their products on the narrow gage cars and are compelled to transfer them to broad gage cars at Montrose.

Connecticut.

Citizens of Stafford, Conn., are taking steps to secure an extension of the trolley system from Stafford Springs to Staffordville, a distance of five miles. At a recent meeting at the rooms of the Business Men's Club at Stafford, a committee of which William Park is chairman, was appointed to investigate the matter and find out, if possible, whether the present holders of the charter rights intend to construct the road. If not an effort will be made to get a new charter.

The New York, New Haven & Hartford R. R., H. L. Ripley, Engineer of Construction, New Haven, Conn., is to have work started shortly on the second track of the branch between East Providence and East Junction, R. I. When finished this stretch of track, which is seven miles long, will complete the double-track system from East Providence to Boston. Considerable filling and grading work will have to be done on the stretch between East Providence and Rumford and beyond that point the work will include considerable cutting to broaden the roadway.

Florida.

Work is progressing on the Key West extension. Beginning from central supply camp the following camps are working with full forces: Central supply, under P. L. Wilson, near Indian Key; Trestle No. 5 under M. E.

Malone above Long Key; Long Key sand pit on Long Key; quarter boat No. 2 at Grassy Key, loading dock at Marathon on Key Vaca; Boot Key Harbor, under E. Rue; machine shops on Hog Key; steel yard on Knights Key; Bridge construction on Pigeon Key and Moser channel under Ed. Sheerhan and C. S. Coe; grading work on Bahia Honda Kek, under A. W. Hunt; quarter boat No. 1, at Bahia Honda Steel Camp, and a large camp at Pine channel under H. L. Cook. The work at Boca Chica under G. W. Smiley, is reported to be progressing exceptionally well, while the work at Key West under Resident Engineer Ernest Cotton, looks well for the terminal. It is reported that a big camp will be opened up at the lower end of Grassy Key; the object being a sand pit. A spur nearly a mile and a half long is now being laid at that place. It is also expected that the old camp at West Summerland will be opened in the near future.

The Atlantic, Okechobee & Gulf Ry. Co. has been chartered and proposes to build a railroad across the lower peninsula of Florida from Tampa to Miami, tapping the everglades. H. C. Leriott of New Orleans, La., and former U. S. Senator W. H. Milton of Florida are interested in the enterprise.

The Gulf, Florida & Northern R. R. Co., which is being promoted by Megargel & Co., 5 Nassau street, New York city, as noted in our last issue, has applied to the city council of Pensacola, Fla., for a franchise. The company plans a line to extend from Pensacola to Jasper, Ala., a distance of 250 miles. It is stated that if the franchise is granted work will begin within 60 days and the road be completed within two years. The road has an option upon the road of the Southern States Lumber Co., a line about 50 miles in length.

Georgia.

⊙McKenzie & Snider, Wrightsville, Ga., have been awarded the contract for grading the Wrightsville, Adrian & Lyons R. R. between Wrightsville and Adrian, a distance of 17 miles. McKenzie & Snider will sublet a part of the work to a wheeler outfit.

The St. Mary's & Kingsland R. R., L. Johnson, president, St. Mary's, Ga., has plans under consideration for constructing an extension this year to Waycross and west probably as far as Nashville, in Berrien county. A connection would be made at the latter place with the proposed extension of the Ocilla Southern mentioned in our last issue.

The Atlanta & Carolina Ry. Co., J. W. English, president, Atlanta, Ga., has taken action in regard to extending the interurban line now in course of construction to Augusta, Ga. The company has already secured a franchise which will entitle them to build the railway system to that point. Work is now being done on the division of the road connecting Atlanta with Conyers.

The town of Pavo is negotiating with H. H. Tift, Tifton, Ga., to have him extend his road, at present running from his lumber mills near Adel to Berlin. A 6-mile extension to Pavo is desired: A further extension to Thomasville is also considered.

Idaho.

The Gilmore & Pittsburg Ry., T. H. Bacon, Chief Engineer, Machesney Bldg., Pittsburg, Pa., completed a few months ago to Salmon City, is said to have accepted the surveys for the continuation of its line from Salmon to Challis. It is believed that grading work between these points will be started early next spring

Illinois.

The Rock River Traction Co. is said to be planning to have construction work started this year on that portion of its proposed line from Moline to Geneseo. It is possible that the line may be continued to Princeton. The company proposes a line having a total length of 60 miles. Two tentative rights of way have been secured by the company, and estimates by the engineers place the cost of the road at $20,000 per mile. At the annual meeting held recently at Geneseo the following officers were elected: President and General Manager, Hugh W. Cole, Geneseo; First Vice-President, J. H. O'Bryan, Geneseo; Second Vice-President, Bernard Lacher, Geneseo; Secretary, William Harbaugh, Geneseo; Treasurer, C. F. Luther, Geneseo; Executive Committee, Hugh W. Cole, Bernard Lacher and C. F. Luther.

The Chicago Burlington & Quincy R. R., W. L. Breckenridge, Engineer Maintenance of Way, Chicago, Ill., will, as soon as weather permits, begin work extending its double track from Bushnell to Beardstown and from that place to Concord, making about 100 miles of track to be laid.

Steps are being taken for the formation of a state association of interurban roads, similar to the Central Electric Railway Association, to which the electric lines of Michigan, Kentucky, Ohio and Indiana now belong. The objects of the proposed association are set forth as follows: To connect all interurban lines in Illinois. To fix uniform tariffs. To prepare uniform mileage books. To make a concerted campaign for freight traffic now handled by the steam roads. To bid for the government mail contracts. To improve the interurban service throughout the Middle West. A meeting to advance this state association was held in Chicago last week and was attended by a number of interurban officials.

The presence of a corps of surveyors in the vicinity of Sesser, Ill., along the line of the Burlington in Franklin county, has given rise to the report that the Chicago, Burlington & Quincy Co. is figuring on running a line from Herrin-Centralia off in an easterly direction toward Harrisburg, thus traversing some of the virgin coal fields of that region.

Indiana.

The Commercial Club, of Westfield, Ind., has been negotiating with Cleveland, O., capitalists in an effort to secure the construction of a traction line. The capitalists are said to have promised their support, provided $10,000 in stock is subscribed. This, it is believed, will be done. As proposed the line would pass through Carmel, Westfield, Sheridan and Frankfort, reaching a large territory that is now traversed only by the Monon.

The Indianapolis, Nashville & Southern Traction Co. (Abe Martin route), Indianapolis, has been incorporated with a capital stock of $150,000 and proposes to promote, construct and operate a railway from Indiaapolis to Nashville, Bloomington, Bedford, Mitchell, Paoli, French Lick and Evansville. The directors are John A. Johnson, Thomas F. Wakeland, John A. Shafer, Robert J. Espy and George W. Long.

The Commercial Club, of Clinton, Ind., has appointed a committee to investigate the proposition of building a street railway from Clinton to Fairview Park, a town of 800 inhabitants. As proposed the new road would be financed and managed by local people.

The Calumet United Rys. Co. has been chartered at Indianapolis. This company is being promoted by C. H. Geist, and proposes the construction of a new line of electric railways across the Calumet region.

As the result of increasing business in Anderson, Ind., the Big Four System finds it necesary to increase the trackage in the yards at that city.

Mayor H. M. Ferguson, of Clinton, is advocating the formation of a local company to operate street cars between Clinton and Fairview Park, one mile north of Clinton

Iowa.

⊙The contract for the construction of a 5-foot conduit to supply the shops of the Chicago & Northwestern Ry. at Clinton with water from the Mississippi River has been let to Henry Keerl, Clear Lake, Ia. The work will require three months' time for completion.

Arrangements are reported to have been practically completed in London, England, for the financing of the Iowa City-Ottumwa interurban project, and it is believed that the prospects are good for the commencement of construction work shortly. The present right of [illegible] a distance of 80 miles. Frank Tanner, Davenport, Ia., is President.

Location surveys have been started of the route of the Davenport-Muscatine interurban. This line is to be built for the Tri-City Ry. Co., Jos. F. Porter, President, Davenport, Ia. It is believed that construction work will be started early in the spring and that the line will be completed and in operation by 1912.

The Fort Dodge, Des Moines & Southern R. R. (elective), Boone, Ia., is said to be planning to extend the line that now passes through Rockwell City to Sioux City and to Spirit Lake. The line would pass through Lake View, Odebolt and Ida Grove, while the Spirit Lake branch would take in Pomeroy, Pocahontas, Emmetsburg and Estherville.

The Minneapolis & St. Louis R. R., W. D. Taylor, chief engineer, Chicago, Ill., is said on good authority to be planning to begin work in the spring on new track to connect Ruthven and Terrill, in northern Iowa. This work would mean about 14 miles of new track. It also is stated that when this work is done, new steel will be laid from Terrill, clear through to Otho, south of Fort Dodge.

Kansas.

The Manhattan City & Interurban Ry. Co., Manhattan, Kan., has completed surveys for its electric interurban line from Manhattan to Fort Riley and has secured a considerable amount of right of way. Ogden Township recently voted a $10,000 bond issue to aid in the construction of the road.

The Atchison, Topeka & Santa Fe Ry. is to have work started in the spring on lowering the grade on the Wichita & Western Division tracks in West Wichita. The grade will be changed at the intersection of a number of streets, the deepest cut being about 4 ft. The cost will be about $8,000.

E. A. Hadley, St. Louis, Mo., Engineer of Design for the Missouri Pacific Ry., was recently in Wichita for the purpose of taking up with the city commissioners the matter of lowering the Missouri Pacific grade at the crossings on North Lawrence Ave, North Market and North Main St. It is said that the Missouri Pacific Ry. may decide to lower its grade gradually from 12th to 21st Sts. at all the crossings. Bert C. Wells is City Engineer of Wichita.

The Illinois Traction System (McKinley line) is to ask the city council of Atchison for trackage rights over certain streets. This is the first step of the McKinley syndicate toward building a new bridge over the Missouri River at Atchison.

The county commissioners, Wichita, Kan., have decided to hold a special election Feb. 14 to vote on the proposition of issuing bonds for the construction of the proposed Wichita, McPherson & Gulf Ry.

Kentucky.

A project is under consideration for the construction of an electric railway to extend from Madisonville to Ashbyburg, a distance of 15 miles. The plan proposes that the farmers give the right of way and do the grading and then secure a company to operate the line. Dock Fowler, a farmer near Madisonville, Ky., is the principal promoter.

Louisiana.

With the announcement that F. M. Welch, former immigrant agent for the Gould lines, is to be president of a new railway to be built from Donaldsonville, La., to Leesville, La., a distance of 150 miles, comes the report that the new line will be built by either the Frisco System or the Kansas City Southern. As proposed the new railroad will tap one of the richest farming and grazing sections in Louisiana and will give the Middle West another deep water outlet.

Maine.

The R. & T. Cement R. R. Co. has filed its article of incorporation. The company has a capital stock of $25,000 and is formed for the purpose of building a railroad from the cement properties in Thomaston, Me., to the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] Surveys were completed the past summer. The company has the following officers: A. S. Black, President and Treasurer; S. T. Kimball, Clerk; Alfred A. Cook, New York, Frederick G. Braun, New York, A. S. Black, E. B. MacAllister and S. T. Kimball, Directors.

Maryland.

Right of way is being purchased for the proposed new line to connect the Cumberland & Westernport Electric Ry., Cumberland, Md., and the Pennsylvania & Maryland system, operating in Somerset County, Pennsylvania. Steps are being taken to merge these two companies and if this is accomplished it will ultimately mean a line between Cumberland and Johnstown through the Meyersdale and Somerset coal fields.

The State Public Utilities Commission will hold a hearing today, Jan. 25, on the application of the Washington, Westminster & Gettysburg R. R. Co. for permission to construct the road through Prince George, Montgomery, Howard, Frederick and Carroll counties, to the Pennsylvania state line, and then to Gettysburg. In order to pay for the rights-of-way and for the construction the company asks the approval of the commission to issue $100,000 of stock, and in addition $35,000 of bonds and $6,000 of preferred stock at 6 per cent for each mile constructed.

Massachusetts.

Citizens of Ludlow are endeavoring to have the Holyoke Street Ry. Co., Holyoke, make a short extension of its line from the latter city so as to enter Ludlow, coming across the plains from Fairview, through the section known as "Little Canada," down north to Hubbard St., with a terminal on East St. This line was surveyed several years ago and the grades are all easy, except in one or two places.

The Boston & Maine R. R. is said to have a plan under consideration for improvements to its Marblehead-Lynn branch. According to these plans a freight yard would be constructed near the present Phillips Beach railroad station and the line would then be double tracked to the Swampscott station. In order to construct the double track, it would be necessary to blast out the ledge midway between the Phillips Beach and Swampscott stations and to build an addition to the present embankment which crosses the state road at Swampscott. The idea of the double track is for the purpose of creating a waiting place for the Saugus branch trains which are now put up for the night at Lynn.

Minnesota.

Funds are being raised to make surveys for an electric interurban line to extend from Mankato, Minn., to St. Peter by way of Kasota. H. E. Hance, Mankato, Minn., manager of the Mankato Traction Co., is interested.

Work is still being pushed ahead rapidly on the Canadian Northern's extension from Virginia to Duluth. At present in the neighborhood of 1,000 men are employed in the several gangs. Three steam shovels were working on Jan. 15 as against five in the fall, the other two knocking off on account of the extreme cold. Half the grading has been completed between Smithville and Short Line Park, and the contractors are confident that all the operations in that department will have been rounded up over the whole right-of-way well within the contract time. A number of muskegs have been encountered twenty miles out from Virginia, and it is proposed to begin on Feb. 1 to haul the material in to fill them. To accomplish that, 200 additional men will be taken on at that time.

Mississippi.

On Jan. 17 the Illinois Central Ry. Co. took over the Brookhaven & Pearl River Ry. in Mississippi. The new line is 23 miles long, extending from Brookhaven, Miss., to Monticello, Miss.

Missouri.

A bill is now before the state legislature to create a state public service commission for the regulation of railroads and all other public utilities. This measure was recommended by Gov. Hadley, and is patterned after the New York law. The bill would abolish the railroad and warehouse commission. It provides for a commission of five, to be appointed by the governor for a term of four years, at an annual salary of $3,500. The governor is not permitted to appoint more than three men from any one party.

Most of the grading for the line of the St. Louis & Missouri Southern Ry. has been completed to within 120 miles of St. Louis, and a large force is continuing the work. It is expected that track laying will be started shortly. This road is planned to extend from St. Louis to Memphis. E. S. McCarthy, St. Louis, Mo., is president. The headquarters of the road are at New Madrid, Mo.

St. Louis Items.

BY A. B. KOENIG.

A message recommending a special election April 7 or 8, a few days after the regular municipal election, April 4, to authorize a bond issue of $2,250,000 for the completion of the municipal free bridge, was sent by Mayor Kreismann of St. Louis to both branches of the Municipal Assembly at their first meeting following the holiday recess. Mayor Kreismann, in his message, makes no reference whatever to the proposition of the Manufacturers' R. R. to construct the approaches to the bridge. The message gives a detailed statement of the expenditures on the bridge up to the present and a close estimate, based upon data supplied by the experts engaged on the work, of the funds required for the completion of the structure. He states the balance now remaining from the original bond issue of $3,500,000 to be $941,746.54, and estimates the sum needed to complete the bridge at $2,884,000. This indicates that $1,942,253.45 more is required. The estimate of the funds required for the completion of the bridge is as follows:

Remaining right of way	$ 350,000
Paving and track on channel spans	73,000
St. Louis Railway approach; structural work—	
Steel	250,000
Masonry	47,000
Track	28,000
Railroad station	26,000
St. Louis highway approach; structural work	
Steel	246,000
Masonry and fill	33,000
Paving	66,000
East St. Louis Railway approach; from Pier IV to Station 23-63; structural work—	
Steel	250,000
Masonry	165,000
Track	25,000
From Station 23-63 to 18th St. and Boismenue Ave., 4,637 ft. steel viaduct to 16th St. and 1,000 ft. embankment to 18th St.	
Steel	462,000
Masonry	120,000
Track	58,000
East St. Louis highway approach, 2,363 ft. long to Station 23-63; structural work	
Steel	251,000
Masonry	29,000
Paving	63,000
2,947 ft. from Station 23-63 to Piggott Ave.—	
Steel	248,000
Masonry and fill	76,000
Paving	78,000
Grand total	$2,884,000

The Roberts & Schaefer Co. are getting a good start on their job at Christopher, Ill. F. Jobin is superintendent of this job.

More than 260,000 cu. yds. of earth have been removed from the site of the new Union Station in Kansas City, representing more than a third of the excavation work. The final plans for the station building are being completed. Officials of the Kansas City Terminal Railway Co. expect to be able to let the contract for the structure within six weeks, and it is planned to start work when two-thirds of the site has been excavated.

The syndicate organized by John Nickerson, Jr., of St. Louis, and W. Graham Browne of Montreal, about a week ago, to sell $500,000 of the preferred stock of the Illinois Traction Co. to St. Louis investors, has already disposed of more than $100,000. Mr. Browne having virtually finished his work at St. Louis, returned home last week. Mr. Nickerson previously had sold approximately $500,000 of the bonds of auxiliary companies of the Illinois Traction System in St. Louis. It is estimated that St. Louis investors now own more $900,000 of the stock and bonds of the McKinley companies. The preferred stock sold by the Nickerson-Browne Syndicate was purchased in Montreal. It was acquired on the strict condition that it should be scattered among investors, and limitations were imposed as to the amount which any individual might receive. The object of the sale was to interest St. Louis capital in the McKinley properties and thereby get the advantages of their influence. The disposal of $900,000 of stock and bonds in St. Louis is the first step toward the listing of McKinley securities with the St. Louis Stock Exchange.

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

Mr. George Townsend, of this city, who is promoting the St. Joseph-Kansas City Electric Ry., says the road is a sure go and that it will be started in the early spring. Mr. Townsend is a well known successful railroad builder, having operated at one time or other in almost every section of the country. At one time he was a partner of Wm. Reed, the firm name at that time being Townsend & Reed. Mr. Townsend's present address is Midland Bldg., Kansas City, Mo.

Mr. C. H. Sharp, the well known railroad contractor, has been suffering from a severe attack of the grippe for the past ten days. He is at this writing reported to be improving, but is still confined to his home.

The Sharp Contracting Co., which has secured Santa Fe work in Texas, reports that the contract has all been sub-let. Under anything like favorable conditions there will be quick work done, as some splendid outfits are on the line.

The Burke & Joseph Contracting Co. is progressing nicely on its Kansas City Southern contracts. Their work is now all covered. Mr. Jno. Rickards, Superintendent for that company, is in Kansas City quite frequently but for the most part of the time is on the work at Gans, Okla.

The Kansas-Oklahoma Electric line, proposed to run between Galena, Kan., and Miami, Okla., has not as yet been let to contract. However, the grading will soon be ready for bids. W. D. Palmer, Dwight Bldg., Kansas City, Mo., is the Chief Engineer.

Work on the Kaw River levee in Kansas City, Kan., was delayed a few days on account of a heavy sleet storm. However, the big drag lines of the Callahan Co. are now doing business once more. The Callahan Construction Co., who are the general contractors, have taken offices in the Daniels Bldg., Kansas City, Kan.

There is going to be an earnest effort made here to get early action by the Missouri Legislature on the bill to make possible the prevention of floods in what is known as the Turkey Creek Valley. Jno. G. Park, City Counselor and representative of the Commercial Club, will go to Jefferson City for this purpose. The bill is planned to make legal assessments against the railroads and other property on the Missouri side to share the cost of improvements on the Kansas side that would secure necessary protection to Missouri property. The plan is to construct a tunnel in the hills south of the Kaw in Rosedale, and abandon the old channel in Kansas City.

The Kansas Good Roads Convention devoted a morning's session to discussing a north and south highway across Kansas and Oklahoma. Jno. C. Nicholson, of Newton, presented the idea, and it met with favor. The route, material to be used and cost of the road will be decided on later.

Montana.

Advices from Missoula state that it is believed there that work will be started this year on the proposed electric railway between Missoula and the Flathead reservation and possibly through the reservation to Kalispell. The route proposed is from Missoula through a portion of the Frenchtown valley, then north to the reservation, thus eliminating a long stretch of barren mountainous country.

The Butte Electric Ry. Co., Butte, Mont., may extend its street car line at that city from Regan's road house to the Five Mile house.

Nebraska.

The Commercial Club, of Beatrice, Neb., is considering a proposition for the construction of a 44-mile electric railway from Adams to Diller via Beatrice. As it is now proposed, the electric line from Beatrice to Adams would probably follow a survey made for the Omaha-Lincoln-Beatrice project. Leaving Beatrice, the right of way would loop past the Institute, and following Bear Creek northward would cut diagonally across Hanover, Hooker and Adams Townships. No definite action has been taken.

Citizens of Logan county are taking steps for building a railroad from Gandy, Logan county, through the Loupe valley, connecting with the Union Pacific trunk line at Kearney or some other town along the line. At a recent meeting at Gandy a committee, of which G. C. Peckham is president, was appointed to push the matter.

The Omaha & Council Bluffs Street Ry. Co., Omaha, will this year rebuild about 8 miles of track in Omaha and South Omaha.

New Jersey.

The Township Committee of Lakewood, N. J., is considering the proposition for the granting of a franchise to the Trenton-Coast Trolley Co. for laying its tracks on Ocean Ave., Lakewood. The company has been almost ten years attempting to get the right of way through private grounds, but the attempt has finally been abandoned and it has applied for a franchise to come into Lakewood over the public highways.

The City Council of Millville, N. J., is to appoint a committee to confer with the Philadelphia & Reading Ry. in an effort to have that road build a branch into Millville. The proposed road would branch from the main line about eight miles south of Camden and pass through Glassboro, Williamstown, Clayton, Vineland and intermediate stations to Millville, a distance of less than 40 miles.

Mayor Haussling of Newark, N. J., in a reply to a letter of Thomas N. McCarter, president of the Public Service Corporation, offering to build subways in Newark, gives it as his opinion that the municipality should build and own the proposed subways and lease them at a rental which would pay interest on the cost and establish a sinking fund more than sufficient to retire the bonds at maturity. The mayor further states in his letter that the companies operating cars on streets where subways may be built should be compelled to run their cars in the subways, and that additional subways when necessary should be built by the city under the same conditions.

The bore of the Delaware, Lackawanna & Western Rys. air line tunnel at Netcong, N. J., was completed on Jan. 15. The tunnel is 600 feet long and all that remains to be done is to lay the tracks, wires and signal system. The engineers of the road finally decided to abandon the plan to blow away the top of the mountain on the Lackawanna cutoff. The whole countryside had become terror stricken at the prospect of the giant explosion and every family within a mile of the mountain by daybreak on Jan. 15 had abandoned its home, because of the announcement that the blast was then a matter of hours. Another thing that caused the engineers to modify the plan was the danger of such an explosion to an expensive railroad trestle near by. The plan now is to blow up the mountain in a quiet and orderly manner, a little at a time, by means of small charges. A complete ring around the mountain thus was set off on Jan. 15 by a succession of comparatively small discharges.

New Mexico.

Carden Bros., Griswold, Ia., who have a contract for grading the first 50 miles of railroad north from Knowles, N. Mexico, have their outfit on the ground and have begun work. This road is being built out of Texico, and will run south from that city to Knowles and Pecos. Some 30 miles of the line out of Texico have already been graded. This is the road being promoted by M. J. Healy.

New York.

The New York Central lines are planning several improvements in Canadaigua. These include the enlargement of its yards and the double tracking of its line through the village. To accomplish this later very little extra tracking will be laid, as it will be possible to connect the Auburn and Batavia branches near the MeKechnie Brewery.

The Hudson & Manhattan R. R. Co., New York city, has applied to the public service commission for an extension of time in which to build the company's branch line from 6th ave. under 9th st. to 4th ave., in New York. The franchise stipulated that the branch should be completed June 15, 1911, but the company wants until June, 1913. The commission will probably grant the extension.

The New York, New Haven & Hartford, H. L. Ripley, engineer construction, New Haven, Conn., has had work started at a number of places on the line between the New Haven terminal in New York and across Hell Gate to connect with the Pennsylvania System on Long Island and the Pennsylvania terminal station in Manhattan. Contracts for some of the minor work have been let, the right-of-way is almost entirely purchased and the New Haven company has paid in its part of the first expenses. Plans for the bridge over Hell Gate call for a structure carrying four tracks. The bridge and its approaches will be about three miles long.

The Brooklyn City R. R. Co., Brooklyn, N. Y., proposes to extend its line along 16th ave., Brooklyn, between 49th and 64th sts.

The Corning, Keuka Lake & Ontario Ry. Co. has been reorganized at Bath and proposes to construct a railroad from Savona to Penn Yan, Lyons and Lake Ontario, following the route of the Sodus Bay R. R., which was abandoned in 1870. Solomon Wixson, Frank Plaisted, Robert Curtis and John Zimmerman of Bath are directors.

The Buffalo, Lockport & Rochester R. R. (electric), which was recently acquired by the Beebe interests of Syracuse, is to be double tracked in the near future. A complete signal system is to be installed at once. The road is 55 miles long and has a total trackage of 65 miles. J. M. Campbell, Rochester, N. Y., is general manager.

Included in the improvements planned by the New York Central R. R. in Canandaigua, N. Y., is the double tracking of the line through the village. The yards are also being enlarged.

North Carolina.

Citizens of Hickory, N. C., have taken steps for securing the construction of an electric railway from Hickory to Cherryville. The plan contemplates the building of a branch line from Hickory to connect at Cherryville with the Isothermal traction line that is to be built from Asheville to Isothermal. Hickory's share of the capital stock has been subscribed, and it is thought that the survey will begin at once.

The Atlantic Coast Line R. R., E. B. Pleasants, chief engineer, Wilmington, N. C., is said to have plans under way for building a double track from Mount Holly, N. C., northward to Bonneau, 20 miles.

North Dakota.

The Midland Continental R. R., O. P. Chamberlain, chief engineer, 184 LaSalle st., Chicago, Ill., is said to be preparing contracts at its Chicago offices for materials to complete the construction of the first section of the first division, covering 212 miles from Edgley to Pembina, N. Dakota. The road is planned to run from Winnipeg to the Gulf of Mexico, and the first section from Edgley, embracing 50 miles of roadbed, has been graded and bridges built. It is proposed next to push the work of construction rapidly in the north from Jamestown to Pembina, a distance of 192 miles, including sidings, and thence working south from Edgley through South Dakota, Nebraska, Kansas, Oklahoma and Texas.

Ohio.

Representatives of the Lake Shore & Michigan Southern Ry. have been consulting with the City Council of Port Clinton, in regard to securing a franchise through the city for the new track which will do away with the dangerous curve through a part of the central section of the city.

Officials of the Lake Shore & Michigan Southern Ry. and City of Cleveland have agreed on plans for reconstructing the subway under the Lake Shore tracks at Lake Ave., Cleveland. Robert Hoffman is City Engineer of Cleveland.

The Columbus, Marion & Bucyrus Ry. Co. (electric), Delaware, O., has filed notice of the increase of its capital stock from $500,000 to $600,000.

Tracklaying on the line of the Fostoria & Fremont Ry. Co. from Fostoria to Fremont is well along. Work on a sub-station at Burgoon has also been started. All material for this road has been purchased, and the work is being done by force account. At the recent annual meeting at Fostoria of the stockholders the following were elected directors: F. D. Carpenter, of Lima; J. H. Greeke, of Wapakoneta; F. W. Cohen, of Sandusky; G. H. McDonel, J. D. McDonel and J. W. McDonel. The directors re-elected the following officers: President, F. D. Carpenter; Vice-President, J. H. Goeke; Secretary and Treasurer, J. D. McDonel.

The city council of Youngstown has granted the Lake Erie & Youngstown R. R. Co. an extension of franchise. The line, as previously mentioned in these columns, is to be built from Conneaut to Youngstown. The franchise permits the company to operate cars over part of the right of way of the Mahoning Valley line in Youngstown. John H. Ruhlman, Youngstown, is the promoter.

The Lake Erie & Pittsburg Ry. is reported to have agents in the vicinity of Lorain, O., seeking to secure options on farms east of the city near the company's present holdings south of the Nickel Plate Ry. and on the east bank of the Black River. The railway already holds a large acreage at Lorain and owns a right-of-way as far as Columbus. Considerable of the roadbed has been improved, but tracks never have been laid.

The Ohio Valley R. R. Co. of Pomeroy has been chartered with a capital stock of $20,000 by Thomas J. Kelly and others.

The Lake Shore & Michigan Southern Ry. is said to have obtained options on 25 parcels of land in Elyria, which will be used in connection with extensive improvements contemplated in that city. These are said to include the construction of a four-track roadbed through the city. The railroad has made a proposition to the city relative to constructing a high level roadbed at a height of 14 feet through the city.

Articles of incorporation have been filed with the secretary of state, Columbus, O., by the Ohio Valley Railroad Co., Pomeroy, O., with a capital stock of $20,000. It is proposed to run a line from Bowman's Run, in Meigs county, to Orange township, Athens county. The incorporators are H. W. Wemann, Thomas J. Kelley, William Acher, John H. Menkhaus and Edward M. Cramer.

The Stevens Contracting Co., Cleveland, O., has been incorporated with a capital stock of $15,000 and will engage in general contracting business. The incorporators are R. M. Calfee, Mrs. B. Woods, James G. Blackburn, Charles M. Stelling and E. R. Poulson.

Oklahoma.

[illegible] construction will again be started on the American Central Ry., south from Vernon, Tex., by April 1, by the Central Construction Co., which has the contract. The line northwest runs from Vernon to Miami, Tex., via Olustee and Mangum, Okla. Considerable work on the construction was done in the neighborhood of Mangum several months ago.

At the annual meeting of the directors of the Anadarko & Western R. R. Co., at Anadarko, on Jan. 14, E. H. Luitwieler was elected president for the ensuing year, L. M. Spivey, vice president; W. S. Tilton, secretary, and G. A. Reinmiller, assistant secretary. The Board of Directors was elected as follows: C. H. De Ford, Levi Ogle, L. M. Spivey, H. C. Bradford, J. C. Stelzner, E. B. Teis, J. F. Mitchell, Fred Pfaff and William Plum. The road was chartered last April, with $50,000 capital stock to build 50 miles from Alden, across Caddo, through the City of Anadarko, to Chickasha.

Charles Page, a wealthy oil man of Tulsa, Okla., has applied to the City Council of Tulsa for a franchise for an interurban railway which will connect Tulsa with a large amusement park to be built and maintained by Mr. Page. The interurban and park will cost $250,000 and will be completed by spring. The franchise will undoubtedly be granted.

Oregon.

The Kings Heights Transit Co., mentioned in our last issue, has completed surveys and has secured the capital for the construction of a 2-mile line at Portland, connecting the line of the Portland, Reading, Light & Power Co., and the line of the United Rys. Co. Construction will be done by force account and work will be started soon. Hegardt & Clark, Board of Trade Bldg., Portland, Ore., are the engineers; J. R. Witterbee, Board of Trade Bldg., Portland, is president.

The Pacific Great Western Ry. Co., has filed its articles of incorporation and proposes to construct a railroad from Eugene westerly to the Siuslaw River, thence following the banks of the stream through the town of Mapleton to Florence, on Siuslaw bay on the coast of Lane County. The capital stock is $50,000 and incorporators are R. B. Hunt, Jesse C. Ayers and Frederick M. Deneffe.

The Prineville & Eastern R. R. Co., Prineville, Ore., has been incorporated with a capital stock of $100,000 of which $50,000 has been subscribed, and it is proposed to commence grading at once. The survey is almost completed for the distance of 18 miles, which will be the length of the new road. The terminal of the new road will be almost directly west of Prineville, at a point where the Hill and Harriman interests are using the same track. There is a move on foot also for a railroad through the wheat belt east of the Oregon Trunk from Metolias to Prineville. This will be a somewhat longer one than the Prineville & Eastern, but can be built through a rich territory. At no point will the grade be greater than 1 per cent. It is said that the Hill interests are behind the move. Men prominent in the organization are T. M. Baldwin, W. A. Booth, G. M. Cornett, A. J. Noble, T. H. LaFollette, G. W. Noble and D. F. Stewart.

Pennsylvania.

The Pennsylvania R. R. has made plans for a considerable amount of improvement work in the vicinity of Harrisburg. This will include the completion of the three-track plans for the Philadelphia and Erie System between Harrisburg and Renovo, the completion of the low grade line from the north to cross the river at Juniata bridge, and connecting at Marysville and Enola and other important work and in connection with the other improvements, it is proposed to construct a connecting link between the Fort Wayne road and the low grade division of the Allegheny Valley R. R., by which through freight will be carried around Pittsburg. It is understood that the work of construction will be done by Eyre & Shoemaker, Arcade Bldg., Philadelphia, Pa., now in charge of the work of extension in the Northumberland yards of the Pennsylvania Co. and it is said that operations will be begun as soon as the present contract is completed.

It is believed here in Pittsburg that the Harriman interests are figuring on getting into this city by the Wabash-Pittsburg Terminal tracks. Those interests, it is said, hope to profit by the split of the Wabash from the Wheeling & Lake Erie, the Wabash-Pittsburg Terminal and the West Side Belt Line. For years one of the Harriman lines, the Erie, has been coming into Pittsburg on the Pittsburg & Lake Erie road, which is a branch of the New York Central. The arrangement is to end in a year and then, it is understood, the Erie may be barred from Pittsburg. To prevent that, it is accepted generally that the Erie will try to connect with the Wheeling & Lake Erie in Bedford, O., and come into Pittsburg via that line and the Wabash-Pittsburg Terminal.

The Southern Cambria Ry. Co., Johnstown, Pa., will probably have work started early this spring on its new trolley line from Johnstown to Ebensburg. Several construction companies are said to have put in bids for doing the work.

The Northern Electric Street Ry. Co., F. C. Dougherty, Chief Engineer, 406 Linden St., Scranton, Pa., is to have work started this spring on a 7-mile extension from the present terminus at Factoryville to Nicholson. Also it is planned to build a branch to Montrose, passing through Hildale, Lindeyville, Brooklyn, Bridgewater and Montrose. The company has obtained practically all its right of way and franchises through these towns.

About $80,000 will be spent at Christiana this year by the Pennsylvania R. R. A subway and new station will be built, additional trackage will be added and a dangerous crossing abolished.

The City Council of Lebanon is to be petitioned to amend the franchise ordinance so as to permit the new Lebanon-Campbelltown Street Railway to enter the city via Eighth st. instead of 9th st.

The Pennsylvania R. R. is said to be planning to resume some time this year the work of completing its six-track system from Pittsburg to New York. This means the construction of two two-track low grade freight lines to fill the minor gaps that still exist. One of these is between Trenton and New York, and another lies west of Harrisburg.

Engineers of the Pennsylvania R. R. began surveys last week of a new route for the proposed cut-off to eliminate heavy freight traffic from the Pittsburg district. The new survey starts at a point on the Connemaugh Division near Great Belt, and extends southwest to the Beaver Valley. It is said the main line of the Pennsylvania will be reached at Homewood, where the large classification yards are located. The distance on this route is 30 miles.

The purchasing of the property in the vicinity of its freight terminal at Pittsburg, Pa., by the Baltimore & Ohio Ry., gives rise to the report that steps are about to be taken toward the construction of the proposed $3,000,000 depot in that city.

South Dakota.

The Chicago & Northwestern Ry. Co. has filed with the secretary of state at Pierre, S. Dakota, a plat showing an extension of the Belle Fourche line out as far as Red Owl, in Eastern Meade County. W. H. Finley, Chicago, Ill., is Assistant Chief Engineer of the railway company.

Tennessee.

The Hoover Co., Davidson County, has filed its charter in the Secretary of State's office, Nashville, Tenn. The company has a capital stock of $10,000 and proposes to construct for other persons or corporations, railroads, bridges, locks, dams, etc. The incorporators are J. T. Hoover, J. S. Clayton, Elmore Hill, J. H. Zarecor and LeRoy McGregor.

Texas.

Good progress is being made with the promotion work for the construction of the Velasco, Rosenberg & Northern R. R. Right of way has already been mapped out and funds provided for the securing of charters and purchase of right of way and incidentals. Several meetings of committees have been held recently at which it was decided to carry out the plans previously laid at once. The line is backed largely by farmers of Brazoria. It will pass considerably to the westward of West Columbia, opening up a new region to railroad communication and encouraging the laying out of many new townsites. C. S. Edwards, West Columbia, is reported to be interested in this enterprise.

The Chamber of Commerce of Denton, Tex., is formulating plans for the organization of a $50,000 company to build and operate the proposed Denton-Slidell R. R. It is estimated that the railroad which will be about 20 miles long, can be built and equipped for about $250,000. Alvin C. Owsley is president of the Chamber of Commerce.

The proposed Jacksboro-Southern R. R. Co. is reported to have been financed. Negotiations are now under way for bonuses and rights of way, and it is believed that construction will be started in the spring. The line will be 20 miles long, extending from Jacksboro to Oran on the Weatherford, Mineral Wells & Northwestern R. R. E. N. McIlheran, Dallas, Tex., is the engineer.

J. J. Harrison, chief engineer of the Missouri, Oklahoma & Gulf Ry. Co., of Texas, has taken up with the railroad commission at Austin, Tex., the matter relative to the proposed bond issue on that part of the company's road in Texas about 9 miles from Red River to Denison, Texas, where the headquarters of the company are situated. The road is principally an Oklahoma corporation, being built from Denison to Wagoner, Okla., a distance of 211 miles.

Citizens of Madisonville, Texas, recently held a meeting for the purpose of discussing the matter of offering inducements to the Trinity & Brazos Valley R. R. and the Missouri, Kansas & Texas R. R. to build a line into that place. The latter company has already begun construction work on a line from Trinity west and has the route surveyed to the Trinity River, the east boundary line of Madison County. A committee of which O. A. Parten is a member, was appointed to communicate with the proper authorities of the railroads.

According to an announcement reported to have been made by C. M. Case, engineer in charge of the construction of the Frisco line between Brady and Menard, track laying was then within five miles of the terminus, Menard. That town, the officials of the road say, will be the terminus for some time. When the Menard extension was decided on that was the announced temporary terminus and nothing has ensued since then to warrant the management of the road in making a change from the plans then outlined.

Arrangements are under way by the Frisco System for securing finances for the construction of its Texas line, the Quanah, Acme & Pacific R. R., which, according to plans will be built from the present terminus at Paducah, Tex., to El Paso, a distance of about 350 miles. The survey for the line was finished several months ago. The route follows an almost direct course from Paducah and El Paso. It runs through the southeast corner of New Mexico for about 100 miles. It traverses a big scope of territory in Texas and New Mexico that is at present entirely without railroad transportation facilities. The new road connects at Quanah with the branch line of the Frisco that runs here from Sapulpa, Okla. The extension of the road to El Paso will afford a new and direct route between St. Louis, Kansas City and intermediate points and El Paso and far Western points.

All bonus contracts are being closed up according to advices from Beeville, Texas, by officials of the Nueces River Valley R. R. Co., headquarters of which are at that place, preparatory to construction of the proposed lines west to Eagle Pass and south to Aransas Pass from Beeville. The proposed route is over a country comparatively free from grades of any consequence and the cost of construction will be cheap, while, on the other hand, the bonuses are enormous, which facts have made it easy to get financial firms to back it. Fifty-three miles of the road to the west have been permanently located and will take the road through Clareville, up the Nueces River to Oakville and then toward Cotulia. According to reports, W. A. Frisby, Beeville, president, stated that actual construction work would be started March 1, and that steel in 10-mile sections has been ordered delivered at Beeville.

Advices from Alpine, Tex., state that prospects for the construction of railroads through that city are brighter now than at any previous time. The Kansas City, Mexico and Orient has located the route of its main line through Alpine and has acquired ground for its depot and division terminals. It is stated that as soon as the gap between San Angelo and Fort Stockton, now under construction, is finished, grading will be started on the extension of the line from Fort Stockton and Alpine and between that place and the proposed crossing of the Rio Grande, just below Presidio. The Pecos Valley Southern is preparing to extend its line from Balmorhea to Alpine, a distance of about fifty miles. The latter road will give this place direct connection with the Pecos Valley System of the Santa Fe and the Texas and Pacific at Pecos, Tex. The third road which is arranging to build into Alpine is the Pecos Valley Northeastern. It is now obtaining right of way for its proposed extension that will run from Pecos, via Alpine, to Bouquillas, the latter place being situated on the Rio Grande.

Advices from Galveston, Tex., state that the budget for the Gulf lines of the Santa Fe System is about completed and will shortly be forwarded to the general offices at Chicago. The budget calls for $750,000 for improvements this year on the lines in Texas, Oklahoma and Louisiana. It is estimated that about $150,000 will be expended on the Galveston Division. Some of the items determined upon for Galveston are as follows: Track changes in the Galveston yards at 42nd st., $15,000. Construction of a new 16-stall brick and concrete engine house, $40,000. Construction of a new standard sandhouse, $1,750. Construction of a new 60x100 brick machine and blacksmith shop with boiler rooms, $8,000. Construction of a new standard 85-foot turntable and motor $7,500. Construction of a new oil and storehouse with office and platform 70x100, $17,000. Construction of new wooden sidewalks in coach cleaning yards, $300. These separate items represent approximately $90,000 of the sum to be expended in the city of Galveston, and to this is to be added also another item of approximately $10,000 for new machinery and tools, which is not included in the figures given above. The tracks in the Galveston yards, under the new plan, are to be rearranged on a new basis and the present facilities are to be torn down or dismantled with a few minor exceptions. The construction work of the buildings planned in the budget is to be of brick or reinforced concrete and the improvements will in every way be permanent.

Citizens of Madisonville have appointed a committee to offer inducements to the Trinity & Brazos Valley R. R., and the Missouri, Kansas & Texas R. R. to build a line through that place. The latter road has already begun the construction of a line from Trinity west, and is having the line surveyed to the Trinity River, the east boundary line of Madison County. It is also rumored that the Trinity & Brazos Valley contemplates building a feeder through the territory.

Utah.

According to an announcement received from Salt Lake City, Utah, the Oregan Short Line Ry. Co. is planning the expenditure of $7,000,000 for improvements during the present year. Th[illegible] and terminals, platform extensions, etc., $7,000 [illegible] laid on grade, Caldwell to Homedale, 11.2 miles, estimate $111,045 [illegible] High Prairie summit 67.2 miles, estimate $1,596,500 [illegible] summit traversing the Raft River project, 60.5 miles, estimate $2,045,000. Lay track on line Ashton to Driggs, 37.5 miles, estimate $994,957. Extension Buhl to Salmon River crossing, 8.6 miles, estimate $256,865. Extension from Nyssa east toward Homedale, 26 miles, estimate $778,950. All of the above have been authorized and work will begin early in the spring.

Vermont.

The State Legislative Committee has given the final hearing on the bill giving the Boston & Maine R. R. (N. Y., N. H. & H. R. R.) permission to construct a line of railroad from South Vernon to Brattleboro, paralleling the present line of the Central Vermont R. R., which is now used by the Boston & Maine. J. P. Snow, Boston, Mass., is Chief Engineer of the Boston & Maine.

Virginia.

The Southern Ry. Co. will have work started soon on 10 miles of double-tracking between Franklin Junction and Whittles, in Virginia.

The Old Dominion Development Co., operating the Carbon Hill coal mines, 15 miles northwest of Richmond, will begin work in the early spring on a line of railroad from its mines to Laurel Station, on the Richmond, Fredericksburg and Potomac R. R.

Washington.

The City Council of South Bend, Wash., has granted an electric car line franchise to J. D. Crary, of Aberdeen. The company to operate the line will be known as the Twin City Electric Ry. Co. It already has a franchise for the City of Raymond and has asked the County Commissioners for a franchise between the two cities. The company is under a $250 bond to begin construction by May 1, and the franchise calls for the completion and operation of the line within two years through and between the two cities. This means the expenditure in the two cities of at least $200,000.

The Chehalis & Cowlitz R. R. Co. has been incorporated with a capital stock of $300,000 and proposes to construct a steam or electric railroad from Chehalis to a point on the Cowlitz River at or near the Plamondon donation land claim on Cowlitz prairie, 20 miles southeast of Chehalis. A considerable amount of right of way for this road has been secured by H. C. Coffman and George A. Robinson, of Chehalis, the incorporators of the company.

The Nooksack Valley Traction Co. is planning to have actual construction work started this spring on its projected line. The necessary construction capital is reported to have been assured. The first line to be built will be to Blaine and with the completion of the line from Bellingham, the British Columbia Electric Co., of Vancouver, B. C., will build into Blaine from White Rock. That company already has an electric line constructed and the connecting link is but a short line which can be completed in a brief period. The Nooksack line will also build from Blaine to Lynden and Sumas. J. E. Morrison is president of the Nooksack Valley Traction Co., Dr. William Welch and A. J. Welch, of Bellingham, are also interested, and it is said that the last named will be in charge of the construction work.

Wisconsin.

Engin[illegible] Sault Ste. Marie Ry. have located a [illegible] route out of Frederick across the Wood River Valley. A number of lines have been run, the [illegible] this. The line adopted leaves the present line of the Soo three-fourths of a mile south of Freder[illegible] town about 80 rods. The new depot is to be located on the new line just east of the main part of town. From the site of the proposed new depot the new surveys runs in a northeasterly direction to section 32-3816 in Bennett County. If the line continues in the same direction from that point the new line will pass Clam Lake in Burnett County to the westward. It will also run just west of Webb Lake in the same county. The surveying party early in January was working eight miles northeast of Frederic and four miles east of the line the Soo located three years ago. The old line ran west of Siron postoffice in Burnett County while the new line runs east of that place.

State Railroad Commission has been asked for a certificate of public convenience and necessity for the West Grant & Northern R. R. Co. This company plans to build a line to start from a connection with the Burlington in the neighborhood of Potosi and run northward through Bloomington, Mt. Hope, Woodman, thence to Boscobel to Hillsboro, where it will conect with the Hillsboro & Northwestern, which operates a short line connecting with the North-Western at Union Center. W. E. Howe, Boscobel, Wis., is applying for the certificate

A project is under consideration for the construction of an electric railway from Green Bay to Sturgeon Bay, a distance of 50 miles. It is estimated that such a line could be built for $15,000 per mile. Mitchell Joannes, Green Bay, Wis., is interested.

The contract for closing the gap in the Omaha line between the Omaha depot at Kaiser and Park Falls, Wis., is reported to have been let to A. Larson, who had a subcontract on the last piece of road built during the past year.

It begins to look as though the Flagg River R. R. Co., of Superior, might start work this year on its proposed line to connect Superior and Ashland. The Pokegama Land Co. which is controlled by the parties backing the railroad has been securing properties at Wisconsin Point and it is believed that this will be used as terminal ground for the new railroad.

The Council Finance Committee of Milwaukee, Wis., has recommended that provision be made in the budget for $500,000 of mortgage certificates for a terminal station.

It is reported in Eau Claire, Wis., that the management of the Chicago, St. Paul, Minneapolis & Omaha R. R. has under consideration the expenditure of about $300,000 for the construction of a new railway line between Eau Claire and Truax and also a new bridge at the first city. C. W. Johnson, St. Paul, Minn., is Chief Engineer.

Wyoming.

The Laramie, Hahns Peak & Pacific R. R., R. D. Stewart, chief engineer, Laramie, Wyo., is reported to have let all contracts for the construction of its line into North Park. It is said that contractors have assembled outfits at Laramie preparatory to the establishment of numerous grading camps. The company has contracted for the sale of $8,600,000 worth of bonds for the purpose of extending the road

Canada.

The Minister of Railways has referred to the Railroad Commission the application of the Canadian Northern Ry. for approval of the location plans of its Ottawa to Toronto line from Macpherson Ave., Toronto, to Rosedale Heights. As the new line will run through a thickly settled district the Commission is asked to consider the details of location before final approval is given.

The Railway Committee of the House of Commons has adopted the bills extending the time in which the Walkerton & Lucknow Ry. may complete construction from Walkerton to Lucknow, and in which the Guelph & Goderich Ry. may be completed from Woolwick, Peel or Wellesley Townships, to St. Mary's and Clinton via Stratford. A bill was also adopted to extend the time in which the South Ontario Pacific Ry. Co. may build from Guelph Junction to Hamilton. The company is owned by the Canadian Pacific Ry.

The Quebec & Great Northwestern Ry. Co. is to apply for a charter authorizing the construction of lines from Port Arthur to New Liskeard, and thence to Quebec city, from a point on the main line 75 miles west of Maniwaki, northerly to the National Trans-continental to Ottawa; from New Liskeard to a point on the National Transcontinental east of Lake Abitibi, and from New Liskeard to Temiskaming Station.

The People's Ry. Co. has applied to Parliament for a Federal charter. The company already has a charter from Province to Ontario. The Dominion charter is being asked to extend the present authorized lines as follows: From the village of Arthur to Flesherton, with branches to Meaford, Owen Sound and Collingwood, and a line from Owen Sound to Midland along the shore of Georgian Bay; also a line from Woodstock to Sarnia, via London, Strathroy, Alvinston and Petrolea; also from Woodstock to Simcoe, from Waterford to Hamilton, from Otterville to Tillsonburg, from Stratford to Seaforth, Clinton and Goderich, from St. Thomas to London, Lucan, Woodhouse, Kirkton, Mitchell, Listowel, Harrisburg and Mount Forest, and from Guelph to Hespeler and Puslinch Lake.

The Canadian Parliament has been asked to grant a charter for a railway from the mouth of Columbia across the Rockies to Peace River Landing, and thence to Fort Churchill or Fort Nelson on Hudson Bay.

The Peace River & Pacific Ry. Co. is applying for a charter to construct a line from Port Nelson across the hinterland to Fort Vermilion and on across the rockies to Port Simpson.

Green & Burdick Bros., Victoria, B. C., are securing the right of way for the first 20 miles of the Victoria & Barkley Sound Ry. Already a number of contracts have been entered into with the owners of land, and it is anticipated that the necessary right of way between Victoria and Sooke will have been purchased within a short time. Construction work will commence at the Victoria end of the section, probably some four miles from Victoria.

Six laborers were killed and another fatally injured on Jan. 13 by the premature explosion of a blast on the Grand Trunk Pacific right of way, near Prince Rupert, B. C.

Among the other railroad matters which will shortly come before Parliament are the following: The Hudson Bay, Peace River & Pacific Ry. Co. will apply for incorporation. This company proposes to build from Port Nelson to Fort Churchill, then westerly to Fort Vermilion on the Peace River, thence southwesterly to Fort St. John, thence westerly to Laurier Pass and on to Port Simpson, also from St. John to Edmonton. The Aisek & Yukon Ry. will apply for an extension of time for construction for legislation to expend 15 per cent of the amount of its capital, for four years, and for completion in seven years. The Dominion Development Co. will seek incorporation. It proposes a line to run from the Nass River on the Portland Canal to Fort Churchill and Port Nelson.

The Canadian Pacific Ry. on Jan. 15, took over the St. Maurice Valley Ry. and the New Brunswick Ry., and added them to its system. These roads have been operated by the C. P. for some time. The St. Maurice Valley runs from Three Rivers, on the Quebec main line of the Canadian Pacific, through Shawinigan Falls to Grand Mere, 27 miles. It will after the date named be known as part of District No. 3 of the Eastern Division. The New Brunswick Southern runs from West St. John to St. Stephen, N. B., and will be operated as part of District No. 1 of the Atlantic Division.

The Toronto & York Radial Ry. Co. is reported to be purchasing a private right-of-way for its metropolitan line south from Woodlawn ave. to a point on the Canadian Northern Ontario right-of-way two or three hundred feet west of Yonge st., Toronto. From Woodlawn Ave. the road would run north on the highway, as at present.

There has been a considerable amount of railroad construction during the past year in the vicinity of Moose Jaw Sask. During the past year the Grand Trunk Pacific has had its line approved from from Regina to Moose Jaw, paralleling the main line of the C. P. R. on the north side. Construction work on this line has already started and will be carried on to completion during 1911. An extension of this line is planned running northwesterly from Moose Jaw between the main line of the C. P. R. and the Moose Jaw-Lacombe branch to the Saskatchewan River. The route of this line has not yet been approved by the railway committee at Ottawa. The Canada Northern Ry. has also had approved during the past year a line running from Regina to Moose Jaw on the north side of the proposed G. T. P. line to a point in township 17, range 24, w. 2nd, where it intersects the G. T. P. line coming into the city toward the north. This road will be started at an early date. Construction work has been active on the Maryfield extension of the C. N. R., which enters from the south, and this road is graded to New Warren, a point about thirty miles southeast of Moose Jaw. The route of this line has been somewhat diverted since the original survey and instead of coming in close to the C. P. R. at Pasqua, it runs in a more westerly direction, approaching Moose Jaw from the south. The line has now been surveyed to the city limits, but it has not yet been made public where it will enter the city. The C. N. R. has another proposed line running from Moose Jaw to the south side of Lake Johnston, thence in a northwesterly direction to Swift Current. This route has not yet been approved at Ottawa, but will be under consideration during the present month. The Alberta Central has also obtained approval for a branch from Red Deer, Alta, to Moose Jaw. This line will approach Moose Jaw from the northwest, crossing the Saskatchewan River at a point somewhere between the Moose Jaw-Lacombe branch and the main line of the C. P. R.

The Grand Trunk Ry. has offered to negotiate with the Government respecting the operation of the Hudson Bay Railway. It is supposed that the Grand Trunk Pacific would desire a lease similar to the one under which it will operate the eastern section of the National Trans-Continental. A substantially similar offer, it is said, has already been received from the Canadian Northern. The present proposition contemplates the construction of a line from the Grand Trunk Pacific from Saskatoon to the Pas Mission.

In an interview at Montreal, William Whyte, vice president of the Canadian Pacific, stated that that company will build 500 miles of track in the west during the coming summer, including the completion of the double-tracking of the line between Winnipeg and Brandon. In addition to this there will be a good deal of double-tracking around Moose Jaw, which is becoming an important shipping center. In order to make the road through the Mountain section more secure, Mr. Whyte stated that it would be given a rock ballast, the ballast being obtained from the mountains with two large crushers. In addition to this the western program includes the strengthening of a number of bridges to keep up with the increasing weight of equipment, and a number of new steel bridges. The rest of the construction program includes a number of short lines, from 20 to 40 miles long, to connect newly-settled districts with the main lines.

Mexico.

Arrangements are being made by an American Syndicate of which A. D. Meloye, New York City, is at the head, for the construction of a railroad from Tepehuanes, Mex., to the mining camp and district of Guanacevi, State of Durango. The survey for the proposed road has been made and is now in the hands of the government for formal approval. The construction of this proposed line will afford a shipping outlet for one of the richest mineral regions in Mexico, and it is said that it will lead to the immediate establishment of a large smelter either at Guanacevi or Tepehuanes. The line will connect with the National Railways of Mexico at Tepehuanes. J. T. Odell, vice president of the Kansas City, Mexico & Orient, is also a member of the syndicate.

ROADS, STREETS AND PAVEMENTS

Alabama.

The City Council of Tuscaloosa, Ala., has authorized the city engineer to open bids for paving of the principal streets.

Arkansas.

A petition has been introduced in the city council of Texarkana, Ark., by Alderman Charles Conway creating improvement district No. 12 for the purpose of draining and paving with vitrified brick the alley between Broad and Third Sts., from State Line Ave. to Walnut St.

California.

⦿The town trustees of Chico, Cal., have awarded the contract to the Chico Construction Co. of that city for street improvement under the Local Improvement Act of 1901. The contract calls for the grading and gravel- [illegible] specified by the board. The accepted bid amounts to $32,000.

The Nevada County supervisors, Nevada City, Cal., have decided not to purchase the toll road and bridge between Grass Valley and Allegheny at the present time. The road and bridge are owned by Theodore Wayman.

Northern California counties held a convention in Sacramento on Jan. 14, to consider what action should be taken to obtain their share of the $18,000,000 voted at the last election for the building of the state highways.

The board of supervisors at Nevada, Cal., has appointed viewers for a proposed road between Nevada and Washington. P. H. Brophy is supervisor.

The board of supervisors, Marysville, Cal., divided $6,588.45, which was unapportioned in the Road Fund, as follows: Road District No. 1, $3,142.18; Road District No. 2, $2,635.34; Road District No. 3, $810.93.

Colorado.

✣Bids will be received until 11 a. m., Jan. 30, by Board of Public Works, Denver, Colo., for furnishing labor and material for grading, curbing and surfacing streets in Capitol Hill Improvement District No. 7. A certified check for $2,000 must be filed with each bid. Henry Read is president of the board.

The Fremont County Goods Roads Association has been organized in Canon City, Colo., with Charles R. McLain of that city, president; W. B. Rowland, first vice-president and chairman of the executive committee, and H. F. Maddox, secretary and treasurer. The association has been formed to urge the construction of good roads, and the continuance of the new Santa Fe trail from Pueblo up the Arkansas to Salida and to the western limits of the state. It is proposed to build two branches from Salida, one over the Continental divide to Gunnison and on to the Uncompahgre valley, and the other north through Buena Vista, Leadville and Glenwood Springs and down the Eagle and Grand rivers to Grand Junction.

According to information received from Colorado Springs, Colo., El Paso county delegates to the good roads conference in Denver have decided to join with the delegates from the Arkansas valley and western slope in an effort to secure from the State Highway Commission $25,000 for construction of 12 miles of road west of Canon City. This is the connecting link necessary to complete a road from Denver through Colorado Springs, Canon City, Salida and other important towns to Grand Junction.

Advices from Greeley, Colo., state that it is proposed to bond Weld county for $1,000,000 for the purpose of giving the county a modern road system, with 600 miles of macadam. The county already has 3,000 miles of district roads.

At a recent meeting of the Commercial Association of Boulder, Colo., plans were discussed for building a new county road from Boulder, to connect with the Denver road at Bloomfield. The association will raise funds for building the new road and hopes to have it finished before June.

Delaware.

Advices from Wilmington, Del., state that a commission appointed to investigate the matter of building a road from the Boulevard extended to the Foulk Road, Brandywine Hundred has reported in favor of building the road. Jackson Pierce is a committeeman.

Florida.

✣Bids will be received until 2 p. m., Feb. 7, by the city of Tampa, Fla., for paving 1½ miles of road southward from Six-Mile Creek. The roadway is to be of shell 10 ft. in width. G. Sullivan is City Engineer.

The St. Johns County Board of Commissioners, St. Augustine, Fla., has made the road between Hastings and Palatka the official county road, declaring it a highway to the Putnam county line and ordering it advertised as such.

The Brooksville Automobile Club, Brooksville, Fla., has notified the Tampa Automobile Club, Tampa, Fla., that funds have been raised for laying out the air line hard road between the two cities. Capt. C. S. Washington is president of the Tampa club.

Georgia.

✣Bids will be received until 3 p. m., Feb. 6, by J. P. Foster, City Clerk, Atlanta, Ga., for furnishing and setting concrete and granite curb; furnishing and laying brick, tile and sheet cement sidewalks; also tile and sheet cement for repairs for ordinary street. R. M. Clayton is City Engineer.

A 24-ft. macadamized roadway is being built from Asheville, N. C., to Altapass, Ga., under the supervision of Dr. Joseph Hyde Pratt, state geologist. This road will run 100 miles along the crest of the Blue Ridge by gentle grades at an altitude of from 2,500 ft. to 3,000 ft.

A resolution has been presented to the board of county commissioners at Atlanta, Ga., by Shelby Smith of that city, providing for a smooth paved driveway from Whitehall St. to Grant Park. The driveway would connect with Ormwood Ave., South Boulevard, Confederate Ave., Moreland Ave., and indirectly with Inman Park, Druid Hills and Ponce de Leon Ave., and would be one and one-half miles long.

The Upson County Commissioners, Thomaston, Ga., have determined to take up the work of giving the county better roads, and to this end have called for an election for $100,000 of road bonds. The election will be held Feb. 13. If defeated the roads will be constructed by local taxation. H. H. Sandbridge is chairman of the commissioners.

Illinois.

◉The contract for the paving of 38th St., was awarded by the board of local improvements of Rock Island, Ill., to the Northwestern Construction Co., of Davenport, Ia., for $47,080. The paving is to extend from Seventh Ave., to the city limits at 18th Ave. The street is to be 30 ft. wide and work will begin within 30 days. The company bid as follows on the work: Excavating, $0.30 per yd.; brick paving, $1.65 per yd.; concrete curbing, $0.60 per yd.; stone curbing, $0.50 per yd.; relaying of sewer, $0.52 per yd.

A petition is being circulated in Mendota, Ill., for the construction of a new hard road from the southwest corner of Section 16, at the H. A. Gardner farm and run east to the township line, a distance of four miles. The petition is for the purpose of having the proposition of levying a special hard road tax submitted to the voters at the coming spring election.

Bids for sectional wood pavement were opened Jan. 14 by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill. Geo. P. Cullen, 78 LaSalle St., submitted the lowest bid, as follows: Pavement, 2¾-in. thick, 2,000 sq. yds., $2.35 per sq. yd.; pavement, 3½-in. thick, 2,000 sq. yds., $2.70 per sq. yd. Detailed specifications were published in ENGINEERING-CONTRACTING of Jan. 11.

A petition is to be circulated in Sycamore, Ill., asking for a vote on the proposition of providing more hard roads to the north of the town. The election will probably be held in April

Indiana.

✣Bids will be received until 2 p. m., Feb. 7, by Board of County Commissioners, Marion, Ind., for grading, graveling or macadamizing road in Fairmont township known as the Calvin B. Scott et al. road.

✣Bids will be received until noon, Feb. 1, by Board of County Commissioners of Benton and Warren Counties at Fowler, Ind., for the construction of a gravel road on the county line. Lemuel Shipman is auditor.

✣Bids will be received until 10 a. m., Feb 3, by Board of Public Works, Indianapolis, Ind., for the improvement of Sanborn St. from the south curb line of New York St. to the north property line of Owosso Ave. by grading and paving the roadway.

✣Bids will be received until 1 p. m., Feb. 6, by Board of County Commissioners, Greensburg, Ind., for the construction of a free macadam road in Greensburg, 8,343 ft. long. F. E. Ryan is auditor of Decatur County.

✣Bids will be received until 1 p. m., Feb. 6, by Board of County Commissioners, Fowler, Ind., for the construction of a free stone road consisting of seven different highways in the town of Ambia, Benton County. Lemuel Shipman is auditor of Benton county.

✣Bids will be received until 2 p. m., Feb. 7, Board of County Commissioners, Martinsville, Ind., for the construction of highway improvement in Adams township. Frank E. Ryan is auditor of Morgan County.

✣Bids will be received until 11:30 a. m., Feb. 7 by Board of County Commissioners at Brazil, Ind., for the construction of a gravel road in Van Buren township, Clay County. E. A. Staggs is county auditor.

✣Bids will be received until noon, Feb. 7, by Board of County Commissioners, Winamac, Ind., for the improvement of two public highways. W. E. Munchenburg, auditor of Pulaski county.

✣Bids will be received until 10 a. m., Feb. 8, by Board of County Commissioners, Lafayette, Ind., for the construction of a gravel road in Tippecanoe County of which George W. Baxter is auditor.

The board of public works of Evansville, Ind., has been asked to improve by paving W. Illinois St., between Ninth and St. Joseph Aves. The estimated cost is $5,000.

Judge Fox of Richmond, Ind., has ordered the construction of the Cummins three-mile road on the Jay and Randolph line. The county commissioners at Richmond will shortly ask for bids for the construction of this road.

Plans for the improvement of many streets in Evansville, Ind. during this year are being made by the board of public works. Petitions are before the board of the improvement of Farvin St., from Green river road to Sweetser Ave.; Grand Ave., from Powell to Monroe Ave.; East Michigan St., from Sixth to Garvin Sts.; Linwood Ave., from Monroe Ave., to Green river road; Heidelbach Ave., from Franklin to Columbia St., and Iowa St., from Edgar to Garvin St.

Iowa.

The City Council of Mason City, Ia., has made a levy of a half mill to run for 10 years for the purpose of taking care of the paving of intersections throughout the city which amount now has reached $8,267.

The City Council of Sioux City, Ia., favors the proposed paving of Pierce St., up to 29th St.; Jennings St., from Fifth to 14th Sts., and Third St., where the old paving is worn out

Kentucky.

◉The city of Paducah, Ky., has awarded the contracts for the construction of concrete sidewalks, granite curbing, etc., as follows, bids being opened Jan. 16: Geo. W. Ketterjohn, city, on Broadway St., from 11th to 15th Sts., $6,755; Tenth St., from Trimble to Burnett, $1,218; Knoxville Roofing & Paving Co., Knoxville, Tenn., Jefferson St., from 11th to 14th St., $4,787.

The board of public works of Louisville, Ky., has under consideration the improvement of the Bardstown road from the old city boundary line at Duker Ave., to the present boundary line, 250 ft. southeast of Douglas Blvd. D. R. Lyman is chief engineer for the work.

Louisiana.

The City Council of Mandeville, La., has adopted a banquette ordinance which requires the banquette on Lake St., and in the business portion of the town to be paved with bricks, shells or cement work. Work will be commenced on Marigny Ave., at an early date.

Maryland.

Advices from Belair, Md., are to the effect that the state roads commission is to take over the road owned by the Belair Turnpike Co., for a consideration of $3,000.

The state roads commission, Baltimore, Md., has notified the commissioners for opening streets, that the Frederick road had been acquired by the state and that the city would be expected to pave the section between the city line at Irvington and Payson Sts. Belgian blocks will be used.

Massachusetts.

✣Bids will be received until 1 p. m., Feb. 20, by Capt. A. M. Miller, Constructing Quartermaster, 263 Summer St., Boston, Mass., for the construction of roads, walks, drains, etc., at Fort Andrews, Boston Harbor, Mass. Plans and specifications may also be seen at the office of the chief quartermaster, department of the East Governor's Island, N. Y. H., a deposit of $5 being required as guarantee for safe return of the plans and specifications.

Michigan.

✣Bids will be received until Feb. 1, by Board of County Road Commissioners, Hancock, Mich., for the construction of about 4 miles of 15-ft. macadam road on the Hancock-Calumet highway between Mesnard and Osceola. Plans and specifications may be seen at the office of the commissioner, Room 6, Epstein Bldg., Hancock, Mich. R. Martin is engineer.

The Kent County Board of Supervisors, Grand Rapids, Mich., has adopted a resolution which provides for voting on the proposition of adopting the county good roads system at the April election.

The township of Brant, Brant, Mich., has been given permission to bond for $10,000, the money to be used for the construction of good roads, bridges and improvements which will be of benefit to the township.

Minnesota.

◉The City Council of Minneapolis, Minn., has awarded the contract for furnishing 2,000 sq. yds. of creosoted wood blocks per day during the year 1911 to the Republic Creosoting

✣ indicates work now open for bids. ◉ indicates a contract let recently.

[illegible] $1.75 for 4-in. Norway and Tamarack blocks, $1.40 for 3½-in. yellow pine block, and $1.59 for 4-in. yellow pine block. The total amount will [illegible].

Mississippi.

⊙[illegible] Block Paving Co. [illegible] awarded the contract by the city council of Wichita Falls, Tex., for paving the business district of the city with various pavements for $2.55 per sq. yd. T. B. [illegible] Bids were opened Jan. 11.

Missouri.

The city council of Joplin, Mo., has instructed the city engineer to furnish estimates on the paving of Main St., from Broadway to A St., vitrified brick block to be used; A St., from Main to Joplin St.; Joplin St., from Second St. to A. St.; First St., from Main St. to Byers Ave.; and curbing and guttering on [illegible] Ave., from A to 10th St.

The City Council of Springfield, Mo., has passed a resolution declaring it necessary to improve the roadway of Commercial St., from Euclid Ave., to Broad St., by grading and paving with brick.

The board of public improvements of St. Louis, Mo., opened bids recently for the installation of a municipal asphalt plant. Two bids were received, one being from Hetherington & Berner of Indianapolis, Ind., $21,750, and the other from Warren Bros. Co., of Boston, who bid $29,687. The plant is to enable the city of St. Louis to resurface the asphalt streets on which the guarantee or contract for maintenance has expired. It will be located at Eager road and King's Highway. The contract has not as yet been awarded

Nebraska.

An ordinance has been introduced in the City Council of Omaha, Neb., providing for the paving of 35th St., from Woolworth Ave., to Lincoln St.

New Jersey.

⊙The Road Committee of the Board of Chosen Freeholders of the County of Salem, Salem, N. J., has awarded the contract for grading and placing gravel and oyster shell surface on the Mannington, Pilesgrove and Woodstown road 5 miles in township of Mannington and Pilesgrove and Borough. of Woodstown to Tuft and Kelty of Salem for $26,441. Bids were opened Jan. 11.

⊙Benjamin L. Tuft and Frank H. Kelty of Salem, N. J., were the successful bidders at $26,442 for the construction of the new state road to be built from Mannington Hill to Woodstown, over five miles in length. Work must be commenced in March and completed not later than October 1.

New York.

Bids were received Jan. 5 by George McAneny, President of the Borough of Manhattan, New York City, for repairing and maintaining sheet asphalt pavements in the Borough of Manhattan were rejected. The engineer's estimate includes 270,000 sq. yds. of asphalt pavement, including binder course, 500 cu. yds. of Portland cement concrete; 1,000 sq. yds. of old stone pavement to relay. The lowest bid received was $247,500.

The lowest bid received by Central Park Commissioner Stover, New York City, for repaving the 79th St. transverse road through Central Park with asphalt block, exceeded by $7,000 the amount appropriated for that purpose. Bids will be readvertised for a brick pavement on this thoroughfare. The appropriation is $25,000.

Ohio.

✣Bids will be received until 11 a. m., Feb. 8 by Board of County Commissioners, Cleveland, O., for the grading, draining and improvement of Union Road from the limits of the city of Cleveland to the intersection of the road with Kinsman Road in Newburg township. Frank R. Lander is county surveyor and John F. Goldenbogen is clerk of the county commissioners. A certified check for $1,000 must be filed with each bid. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the county engineer at the New Court House on W. 3rd Street, Cleveland, Ohio.

✣Bids will be received until 11 a. m., Feb. 15, by Board of County Commissioners, Cleveland, O., for the grading of Broadview Road No. 3, from Wallings Corners School House to Boston Road in Brecksville and Strongsville townships. A certified check for $1,000 must be filed with each bid. Frank Lander is county surveyor. Plans, descriptions, bills and specifications for the above work can be seen and are open to public inspection of persons interested therein, at the office of the county engineer at the New Court House on 3rd Street, Cleveland, Ohio. J. F. Goldenbogen is clerk of the Board of County Commissioners.

⊙W. S. Pace, 11027 Clifton Blvd., Cleveland, O., has been awarded the contract by the village of Lakewood, O., for furnishing the labor and material for the paving with brick of Gladys, Rosewood Ave., Thoreau Road, Sloane Ave. The Wm. H. Evers Engr. Co., 332 The Arcade, Cleveland, is engineer. B. M. Cook is village clerk. Bids were opened Jan. 16.

⊙Harvey B. Stephens of Mechanicsburg, O., has been awarded the contract for the construction of one mile of macadamized road in Goshen township for $7,363. The work will include 7,618 cu. yds. of excavation; 7,040 sq. yds. of macadam water bonded, and 30 cu. yds. of loose stone approaches. Bids were opened Jan. 14 by James C. Wonders, state highway commissioner, Columbus, O.

⊙Wm. S. Nugent of Harrison, O., has been awarded the contract by the board of county commissioners, Cincinnati, O., for the improvement, under Specifications No. 32, of the Dick Road from Howard's Creek to the Oxford Road in Crosby Township for $3,817. Bids were opened Jan. 6.

The county commissioners at New Lexington, O., have been petitioned for the improvement of the road leading toward Corning with brick under the state aid law.

People along Mayfield Ave., Akron, O., from the city limits to Twin Oaks road have petitioned the county commissioners to have the road paved for a distance of 800 ft., to a width of 14 ft.

Plans are being made in Canfield, O., for the paving of Broad St., with brick next spring.

Residents of Center township, south of Lisbon, O., have given notice to the county commissioners at Lisbon that they will present to them a petition for a county road to be opened to connect the Lisbon and Salineville road with the Lisbon and New Philadelphia road. The road will require about three-quarters of a mile of construction work.

The board of health of Steubenville, O., has recommended that fire brick paving be constructed on Slack St., from Third to High St., and that the W. & L. E. R. R. Co., be instructed to lower their tracks to conform with the grade of said street.

Oklahoma.

⊙J. R. Alley & John Alplin have been awarded the contract by the city of Oklahoma City, Okla., for grading 15th, 11th, 12th, 13th, 14th St., Louisa Ave., Indiana Ave., and Kentucky Ave. The work includes about 30,000 yds. of grading. Bob Parman is City Clerk. Bids were opened Jan. 17.

Oregon.

Members of the Seaside, Ore., town council recently appeared before the county court at Astoria, Ore., and requested the court to direct the opening of the main street in that town, which is also a county road, to its full width of 60 ft.

The County Court of Marion County, Salem, Ore., has issued an order for the construction of the macadam road on the line known as the Silverton-Marquam road. The road is about five miles in length and taps some of the best territory in Marion county. The plans call for a 4½ per cent grade, which will necessitate the cutting down of a number of steep hills. Bids for the work are to be asked at once.

Advices from Hillsboro, Ore., state that 12 road districts have voted a special tax for construction of rock roads during the coming season, and thousands of dollars will be expended in permanent road work next summer. It is estimated that nearly 30 miles of macadam road will be constructed during 1911.

The City Council of Forest Grove, Ore., has asked W. H. Hollis of that city, a member of the state legislature, to introduce a bill making a distinct road district out of the territory within the corporate limits. This will provide more money for the improvements of the highways running through Forest Grove.

Pennsylvania.

⊙W. W. Caldwell, City Highway Commissioner of Harrisburg, Pa., received the following bids Jan. 19 for the grading of the following streets, the lowest bidder in each instance receiving the contract: Paxton St.—United Ice & Coal Co., $7,758; Stucker Bros. Construction Co., $7,230; Jos. L. Shearer, Jr., $8,950. Front St.—United Ice & Coal Co., $14,800; Jos. L. Shearer, Jr., $14,131.

The Allegheny county commissioners, Pittsburg, Pa., and Road Engineer Samuel D. Foster, have selected 56.51 miles of improved highway for resurfacing this year. Upwards to $400,000 will be spent on the work, which will be started just as early in the spring as the weather will permit. Roads nearest to the city will receive attention first. The following roads will be resurfaced: Noblestown, No. 2, 1.40 miles; Steubenville pike, 2.00 miles; Imperial and Clinton 3.80 miles; Narrows Run extension, 1.65 miles; Washington pike, 2.70 miles; Coraopolis and Carnot, 2.50 miles; Unity and Trestle, 1.80 miles; Greensburg, pike, 4 miles; Millerstown and Cuimerville, 2.80 miles; Logan's Ferry, 1.65 miles; Hulton, 2.50 miles; Verona extension, 1.80 miles; Leechburg, 3.30 miles; Crooked Run, 1.50 miles; Library, .70 mile; Fairhaven and Provost, .40 mile; Dravosburg, 1.35 miles; Mt. Lebanon extension, 1.80 miles; Banksville, 1.50 miles; Lock No. 3, 2.76 miles; Washington, .76 mile, Butler pike, 3.00 miles; Lofrie's Run and Rochester, 6.00 miles; Glenfield extension, 1.40 miles, and Dairy Farm, 1.00 mile. An asphalt top will be used on about 26 miles of the roads, and five miles will be bricked. Over 200 miles of improved highways will be oiled during the year.

The county court at Wilkes-Barre, Pa., has approved the petition of the county commissioners asking for the construction of three roads in the county, according to plans adopted for a system of good roads in Luzerne county. The roads approved are from Fairview to Freeland, by way of White Haven; Pittston through Duryea to the Lackawanna county line, and Fairview to Hazleton, by way of Alberts. Work is expected to commence in the spring.

Representative Lafean of Pennsylvania has introduced a bill in the House providing for the construction of a Lincoln memorial highway 200 ft. wide, beginning in the neighborhood of the White House in Washington and extending to the battlefield of Gettysburg. The bill carries an appropriation of $3,000,000.

South Dakota.

Residents of Potter County, Gettysburg, S. Dak., are seeking the construction of an automobile road from Gettysburg to Forest City, to accommodate traffic to Cheyenne Agency across the river from Forest City.

Tennessee.

Property owners and residents in the newly created paving districts in Chattanooga, Tenn., have selected the kind of material to be used in the paving of the streets of the districts The following streets are to be paved, curbed and sidewalked: Ninth ward, Willow, from Chamberlain Ave. to Main St.; Willow, from Carolina to Main; Beech, from Vine to Chamberlain; Orchard, Knob Ave., from Kirby to Main; Oak, from Kelley to Orchard Knob

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Ave.; Vine, from Orchard Knob Ave. to Kelley, and in the old city: [illegible]th, from Carter to Boyce; East Terrace, from Sixth to Ninth, Fourth, from Chestnut to Market; and from Pine to Poplar, and 10th, from Georgia Ave. to King.

Texas.

◉The Metropolitan Paving Co., which has extensive paving contracts in Fort Worth, Tex., has sublet its work to Roche & Mannigan of Memphis, Tenn. The contracts comprise the paving of 14 streets. Work will be commenced at once.

It is reported that the Northern Texas Traction Co., G. H. Clifford, Mgr., Fort Worth, Tex., will spend $500,000, to defray its part of the paving which the commissioners of Fort Wayne have ordered for 1911. The company also plans the expenditure of a considerable amount for improvements in Oak Cliff, improving the main thoroughfare traversed by the interurban and Oak Cliff cars.

The city of Wichita Falls, Tex., has sold bonds in the sum of $45,000 for street paving. Contracts for this work will be let immediately.

The citizens and property owners of Greenville, Tex., are making arrangements to have the streets paved, the city having voted bonds to the amount of $100,000, with which to pave one-third the width of the streets. The City Council has decided upon streets to be paved as follows: North Stonewall, from Jordan to Anderson; West Lee, from Katy tracks to city limits; East Lee, from public square to Texas Midland track; South Wesley, from Lee to city limits; North Wesley, from Lee to Anderson; West Washington, from public square to Sayle; East Washington, from public square to Bois d'Arc; Park, from Stonewall to Fourth; South Johnson, from public square to Katy tracks; Pickett, from Johnson to Wesley; North Johnson, from public square to Church; North King, from Washington to Bourland; East Jones, from Stonewall to Travis. This is 34,550 feet of paving, or about seven miles, besides about three miles by the street car line, and will cost $75,000.

Mayor S. J. Hay of Dallas, Tex., has recommended to the city commission that all petitions filed by property owners for street paving be taken up and acted on at once. About $200,000 is available for paving purposes at present.

Utah.

Advices from Salt Lake City, Utah, state that the present legislature will probably undertake either a revision or a repeal of the state road law, authorizing the districting of counties into road districts to systematize the building of good roads. County Commissioner O. W. Carlson, Salt Lake City, is interested.

Vermont.

The State Legislature has appropriated $150,000 for the construction of highways throughout the state during 1911. It is estimated that approximately $1,000,000 will be expended on state highways during the year.

Virginia.

✣Bids will be received until 1 p. m., Feb. 6, by John Coon, commissioner of streets, Huntington, W. Va., for approximately 124,500 sq. yds. of street paving and 69,100 lin. ft. of curbing. A. B. Maupin is city clerk.

Contracts have been let, with the approval of the state highway department of Virginia, for the building of 11 miles of soil road in Mecklenburg county. The estimated cost of the work is between $800 and $1,400 per mile.

Canada.

✣Bids will be received until 11 a. m., March 1, by Board of Control, M. Peterson, Secy., Winnipeg, Man., for the supply of from 1,000 to 1,500 tons of asphalt for street paving for the city of Winnipeg. Specification and form of tender, together with conditions governing tender, as prescribed by by-law, may be obtained at the office of the City Engineer, 223 [illegible] Ave.

BRIDGES—STEEL AND CONCRETE

Arkansas.

In regard to the progress in construction of the new free bridge over the Arkansas river at Van Buren, Ark., mentioned in recent issues of Engineering-Contracting, the following statement was recently made by J. W. McMurray of the firm of Kahman & McMurray, who have the contract for the substructure. The recent zero weather, while it did not stop work, retarded it greatly, as it was impossible for the men in certain departments to work. However, a full force of men have been at work every hour in the day and night, including Sunday, since the weather moderated. The building of the tramway from the Van Buren side of the river is now well advanced, and a distance of only three piers is yet to be constructed before the Sebastian County side of the stream is reached. Piers 5 and 8 have been sunk to rock bed and are now ready for the 12 ft. of form work required to bring them up to the required height. Air was turned into Pier No. 6 a week ago, and the pouring of concrete has been commenced. The caisson for pier No. 7 is being built and will be ready for sinking before the end of the week. The remainder of the false work, or tramway, that is to span the stream is now being built over the water, and as soon as completed, the sinking of piers Nos. 1, 2 and 3 will be commenced from the Sebastian county side, where a concrete mixer, air compressors and other machinery have been installed. As the present low stage of water can reasonably be expected to continue for sixty days longer, the contractors hope to complete the eight piers before the spring floods reach here, leaving them only the two large abutments to build during the season when high water is expected.

Directors Board of Trade, Pine Bluff, Ark., are agitating the construction of a bridge over the Arkansas River by the county of Jefferson. J. L. Caldwell is secretary of the Board of Trade.

California.

◉The contract for the construction of the reinforced concrete girder bridge over the Arroyo Seco at the north end of Prospect Square for the Arroyo Park corporation has been awarded to Andrew Holloway, Pasadena, Cal., at $15,000. The bridge will run straight for 200 ft. and 155 ft. on a curve with a radius of 204 ft. It will be 50 ft. in length and 50 ft. wide, with a [illegible] roadway in the center and 5-ft. sidewalks on each side. The roadway will have asphalt surface with 15-in. concrete curb, concrete pilasters, galvanized iron pipe rail and four electroliers.

Advices from Sacramento, Cal., state that a bill has been introduced in the lower house asking for an appropriation of $5,000 for the building of a bridge on the Lake Tahoe wagon road at Bridal Veil Falls.

Residents on E. St. are taking steps to induce the City Council of San Diego, Cal., to construct a bridge across the street at the intersection of Seventh St.

J. C. Albertson, Supervisor of Sutter County, according to information received from Yuba City, Cal., has been in communication with officials of the Northern Electric in reference to the preliminary work on the proposed joint bridge across the Sacramento River at Meridian to be built by Sutter and Colusa Counties and the Northern Electric Co. Sutter County has agreed to pay for one-third of the expense of the borings at the site of the bridge for the purpose of ascertaining the conditions for the abutments and the piers of the proposed bridge.

It has been resolved that the California Development Board recommend the Governor and Legislature to instruct the state engineer to make a survey for a suspension pier bridge of such height as will not impede the free navigation of the bay, at or about the straits of Carquinez, and that a sufficient fund be appropriated by the Legislature to carry out this recommendation; and further, that the State Engineer be directed to make a careful estimate as to the cost of said bridge, including the necessary railway tracks thereon, and submit to the Governor his plans and estimates covering said work with a view to further [illegible]

Delaware.

On[illegible] eration of the Levy Court, according to ad[illegible] Del., is the issuance of bonds for the erection of a new bridge to replace the present structure [illegible]

Idaho.

[illegible] that city.

Bill has been introduced into the State Senate of Idaho providing for the construction of a bridge over the Salmon River at a point 2 or 4 miles below Barrs Bridge in Custer County.

The Lewiston-Clarkston Improvement Co., Lewiston, Idaho, is to start work immediately on the construction of a foot bridge across the Snake River as an addition to the present wagon bridge. The new structure, which will be 6 ft. wide, will require an expenditure of about $7,000.

Illinois.

The Board of Trustees of the East St. Louis Levee and Sanitary District have arranged with the five steam railroads whose tracks cross the diversion channel to erect bridges after specifications laid down. These will cost in the neighborhood of $300,000 and contracts for the work will be let about May 15. It is understood that all the bridges will be completed by the end of the year.

The Wabash R. R. Co. has decided to expend about $30,000 this year for the filling in of the old bridges spanning the Little Wabash River and rebuilding a portion of the bridge which spans the river proper between Shumway and Effingham, Ill. A. O. Cunningham, St. Louis, Mo., is chief engineer of the company.

Indiana.

✣Bids will be received until 10 a. m., Feb. 6, by Board of County Commissioners, Columbus, Ind., for the construction of a bridge in Rockcreek township. P. J. Sater is Auditor of Bartholomew County.

Advices from Rockville, Ind., state that a petition is being circulated in Wabash township for the construction of a modern bridge across Raccoon Creek at Armiesburg, to replace the old structure.

The Winimac Bridge Co., which has the contract for the construction of the superstructure of the bridge over Tippecanoe River at Nice's ford, between Buffalo and Pulaski, Ind., has begun active construction work. The bridge will be 289 ft. long, consisting of a single span and will cost $9,000.

Information from Indianapolis, Ind., states that Paul Julian, County Surveyor, has asked the board of county commissioners for appropriations amounting to about $140,000 for the construction of bridges and culverts which he thinks are needed. Among the larger items asked are $10,000 for a bridge over the canal in Washington township, $10,000 for a bridge over Williams Creek in Washington township, [illegible] for a bridge over Little Eagle Creek in West Washington street, Wayne Township, $7,500 for a bridge over Indian Creek in Lawrence Township, and [illegible] for bridges and culverts on township and free gravel roads.

Iowa.

⊙Advices from Corydon, Ia., state that the contract for the construction of all iron bridges in Wayne County for the year of 1911 has been awarded by the Board of Supervisors to the Corydon Lumber Co., which was also awarded the contract for furnishing oak lumber and cedar piling.

⊙On Jan. 5, the Board of County Commissions, Grundy Center, Ia., awarded contract to L. F. Volberding, Hudson, Ia., for the construction work and repairs and cement work on steel bridges.

⊙City Council of Des Moines, Ia., has according to reports awarded the contract for the construction of the Melan bridge to the Clinton Bridge Co., Clinton, Ia., at $25,000.

Representative Robert Odendahl, Carrol County, Ia., is to introduce at the next meeting the Iowa State Legislature, a bill providing for the creation of a state bridge and culvert commission, the duty of which shall be to make uniform designs for bridge and culverts in the state.

City Council of Cedar Rapids, Ia., at a recent meeting passed a resolution declaring it advisable and necessary to build a concrete bridge across the Cedar River at Third Ave. Plans and specifications are being prepared for the work and it is expected that it will be advertised for bids the latter part of February.

Kansas.

✣Bids will be received until noon, Feb. 6, by Board of County Commissioners, Erie, Kan., for the construction of a bridge across the Neosha River in the vicinity of Chanute.

⊙Board of County Commissioners has awarded the contract for the construction of a pile bridge north of Section 3 in Lincoln township to the Wichita Construction Co., Wichita, Kan., at $320.

The request of the McKinley Syndicate, filed with the City Council of Atchison, Kan., for track rights over certain streets is considered the first step of the syndicate toward the construction of the proposed new bridge over the Missouri River at that city. The structure as proposed will be available for both steam and electric roads and will cost, it is estimated, about $300,000. The foot of Commercial St. is looked upon as a favorable site.

At a meeting of the Board of County Commissioners of Riley County, Manhattan, Kan., a petition was filed by resident taxpayers asking for the construction of a county bridge on the line between Sections 5 and 6-6-6, Swede Creek. The matter will be considered at the April meeting. George H. Hungerford is county clerk.

Kentucky.

The approach of the Louisville & Nashville bridge across the Coosa River at Gadsden, Ala., is to be rebuilt. The work will require several car loads of material and will be started during the early spring. E. E. Kuersteiner, Louisville, Ky., is bridge engineer.

At a recent meeting of the Newport, Ky., Council two plans were submitted for the construction of the proposed viaduct over the tracks on the C. & O. and L. & N. R. R. at the head of Monmouth St. City Engineer and Dr. Shaler Berry were the designers. Plans drawn by the city engineer provide that the viaduct shall begin at Eleventh and Monmouth St., run west to John St., thence north over the railroad tracks to Fifteenth St., turning east and ending at Monmouth St. Dr. Berry's plans are for a straight [illegible] reached. The plans were thoroughly discussed but no definite action was taken.

Louisiana.

At a meeting of the City Council of New Orleans, La., it was reported by the commissioner that $4,800 would be required for the repair of the bridge over the old basin at Hagan Ave., which recently collapsed.

Maryland.

State Road Engineers, Baltimore, Md., have just completed a survey for the proposed new state bridge over the Nanticoke river at Sharptown, between Wicomico and Dorchester counties. The bridge will be about 1,200 ft. long. The plans are now being made, but will not be finally approved till they pass inspection by the United States Government, the stream being navigable water.

Massachusetts.

The Park Commissioners of Fall River, Mass., have journeyed to Boston for the purpose of inspecting different types of bridges in that place in view of selecting the most economic style of structure for South Park.

Michigan.

✣Bids will be received until noon, Jan. 30, by City Council, Kalamazoo, Mich., for the construction of the Gull St. bridge, which will consist of three reinforced concrete arches aggregating 190 ft. The structure is to be 38 ft. between parapet walls, containing an 8-ft. cement sidewalk along the north side and 30 ft. roadway. Each arch will be 59 ft. in the clear with a rise of 6 ft. 6 in. A certified check of $1,500 must be filed with each bid.

A committee has been appointed by the City Council of Saginaw, Mich., to confer with the Saginaw Valley Traction Co. as to the restoration of the street car service on the Bristol St. bridge. It was announced by F. T. Hepburn, general manager of the company, that negotiations were under way at the present time for plans and estimates of the cost of altering the bridge to comply with the requirements of the War Department.

Mississippi.

✣Bids will be received until noon, Feb. 6, by J. D. Laughlin, Chancery Clerk, Warren County, Vicksburg, Miss., for the construction of a steel bridge over the Bayou near John Wright residence.

Nebraska.

⊙The Board of County Supervisors, Kearney, Neb., has awarded the contract for the bridge work during 1911 to W. T. Gibson, Loup City, Neb. Four other bids were filed for the work.

⊙The Board of County Supervisors has let a contract to the Western Bridge & Construction Co., Omaha, Neb., for the construction of all bridges in York County, Neb., during the year of 1911.

⊙Board of County Commissioners, York Neb., awarded the contract for the construction of all steel and wooden bridges for the year of 1911 to the Western Bridge & Construction Co., Omaha, Neb.

⊙The Board of County Commissioners, St. Paul, Neb., on Jan. 5, awarded the contract for the construction of all new county bridges and repairing all old structures during the year of 1911 to the Nebraska Construction Co., Lincoln, Neb. John J. Sazama is county auditor.

New Jersey.

✣Bids will be received until 10:30 a. m., Feb. 8, by Board of Chosen Freeholders, Salem, N. J., for the construction of a bridge in the Borough of Woodstown at the end of the State road. As proposed the structure will have a concrete floor. Plans and specifications are on file with L. Prickett, Woodstown, N. J.

A committee appointed recently by the Board of Freeholders, Salem, N. J., have reported it necessary to build a new reinforced concrete bridge to replace the Woodstown bridge over the Salem creek. The structure as proposed will have a 20 ft. roadway with sidewalk of 5 ft. and span of 50 ft.

The Morris County Traction Co., according to advices from Dover, N. J., is planning to replace the Wiggins and Dickerson bridges over the Morris Canal on the road from Rockaway to Dover with heavy steel bridges.

It is now reported that instead of blasting away the great mountain cliff at Glen Onoko, the Jersey Central will abandon the tunnel built through the mountain and bridge the Lehigh River below the one now in use, and which will be reached by removing the bump between the Jersey Central and Lehigh Valley tracks. The Lehigh is also to erect a two-track bridge over the river at Glen Onoko, the double track to extend five miles along the foot of the mountain to Penn Haven Junction. The road will then have four tracks from Easton to the coal regions.

New York.

⊙Charles Meads & Co., 299 Broadway, New York City, have been awarded the contract by Commissioner of Bridges, Kingsley L. Martin, Park Row Bldg., New York City, for constructing the elevators, stairs, drainage, ornamental and electrical work for the anchor piers of the Queensborough bridge over the East River between the Boroughs of Manhattan and Queens for $57,300. Bids were opened Jan. 10.

City Council of Rochester, N. Y., has reached an agreement whereby the railroads will construct a subway at Saxton St. Under an act of the Legislature a subway at Brown St. has also been ordered.

Among the improvements decided upon by William E. Harries, Superintendent, Niagara State Reservation, Niagara Falls, N. Y., for the year of 1911 is an item of $8,000 for the construction of a new bridge connecting Goat Island with Luna Island.

North Dakota.

⊙The Beach Mfg. Co., of Charlotte, Mich., has been awarded the contract by the board of county commissioners, La Moure, N. Dak., for the furnishing of all corrugated galvanized metal culverts as may be needed during the year of 1911, sizes ranging from 12-in. to 72-in. in diameter. C. J. Alister is County Auditor. Bids were opened Jan. 10.

Ohio.

✣Bids will be received until 11 a. m., Jan. 30, by the Board of County Commissioners, Akron, O., for the construction of the superstructure of the Haulk bridge, one mile north of Clinton, O., Franklin township. Plans and specifications may be seen at the office of the commissioners or of the county engineer. A certified check for $300 must be filed with each bid. Charles L. Wirth is clerk.

✣Bids will be received until noon, Feb. 6, by Board of County Commissioners, Zanesville, O., for furnishing the necessary labor and materials for the construction and repair of the substructure of the Fifth St. bridge in the city of Zanesville. Plans and specifications are on file at the office of the county auditor. H. A. Buerhaus is county auditor.

✣Bids will be received until noon, Feb. 3, by Board of County Commissioners, Cincinnati, O., for the construction, under specifications No. 137, of culverts on the Kirby road, through lands of Ungruhe and Kirby, in Millcreek township. Fred Dreihs is clerk of the board. All bids must be accompanied by a bond in the sum of $2,000.

⊙The Modern Construction Co., Fremont, O., has been awarded the contract for reflooring the south side of the East Perry St. bridge in Tiffin, O., at $750.

⊙The Director of Public Service, Cincinnati, O., awarded the contract for the construction of the Cooper Ave. bridge under Specifications 125, to Gerald W. Knight, 3037 Woodburn Ave., Cincinnati, O., at $13,971. Fred Dreihs is clerk.

⊙Board of County Commissioners, Jefferson, O., on Jan. 16 awarded the contract for the construction of the superstructure of Riveted Pratt truss bridge to the Riverside

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Bridge Co., Martins Ferry, O., at $1,280. The work includes fabrication and erection complete. The following are the quantities: 118,795 lbs. structural steel; 7,258 lbs, reinforcing steel; 54.5 cu. yds. 1-2-4 concrete, and 580 lin. ft. of 2½-in. wrought iron guard railing. J. S. Matson is county engineer.

Plans are under way by the engineering department, Cincinnati, O., for the construction of a new bridge at the Hopple St. crossing of the Cincinnati, Hamilton & Dayton tracks. F. E. Morris, assistant city engineer, is in charge of the work.

An effort is to be made in the City Council of Dayton, O., to build a bridge over Wolf Creek, connecting the West Side and Dayton View at the Orth Plat, and a bond issue of $15,000 for the work is under contemplation.

The Cleveland (Ohio) Chamber of Industry at a recent meeting passed a resolution favoring definite plans for a high level bridge from Superior Ave., N. W., to W. 25th St. It was proposed that the new high level structure be of sufficient width to carry four car tracks and two roadways and two sidewalks.

City Council of Warren, O., has submitted to the attorney representing the Mahoning Valley R. R., plans for the construction of the bridge at Summit St.

Board of County Commissioners, Defiance, O., received the following bids for constructing the permanent grade leading to the north abutment of the new Frances St. bridge: Levy & Brown, 29c per cu yd.; G. W. Farrison, 26½c per cu. yd.; John Karnes, 25 90-100c per cu. yd.; Clemmer & Johnson, 25c per cu. yd.; Thos. Dohoney, 24¾c per cu. yd.; C. F. Leaders, 24½c per cu. yd.; Joseph Weber, 23c per cu. yd.

Oklahoma.

A bill has [illegible] Oklahoma legislature [illegible] for the construction of a bridge across the Grand River in Canadian County.

Material for the construction of the Bixby bridge over the Arkansas River, according to advices from Tulsa, Okla., will be delivered at the site about Feb. 1 and construction work on the structure, which will be one of the longest wagon bridges in the middle west, will be started shortly thereafter by the contractors. The cost of the work is estimated at $65,000.

Advices from Mannsford, Okla., state that a bridge will be built over the Cimmaron River a mile north of the town.

Oregon.

An ordinance has been introduced into the City Council of Portland, Ore., providing that the Portland Railway, Light & Power Co. and the Oregon and Washington Railway and Navigation Co. build an overhead viaduct at East 37th St. on Sandy Road. The ordinance was referred to the street committee.

Active steps are being taken by W. A. Teutch, mayor of Nyssa, Ore., to secure an appropriation of the state of Oregon toward the construction of the proposed bridge across the Snake River. Idaho Legislature has agreed to appropriate $10,000, the county will pay $5,000 and the same amount has been raised by subscription in Nyssa. The estimated cost of the proposed structure is $30,000.

The work includes fabrication and erection

The County Court has taken up the matter of selecting the best site for the construction of a bridge across the Coquille River at Coquille, Ore. The structure will necessarily be a draw type, as the river is navigable at that point.

Citizens of Harrisburg, Ore., are considering taking up the matter of securing the construction of a bridge over the Williamette River at that city to replace the old ferry.

Pennsylvania.

Steps are being taken by the Board of Allegheny County Commissioners to free the county bridge over the Youghioughney River. A petition to that effect was filed as soon as the proceedings were started for the freeing of the bridges in the city of Pittsburg, Pa.

The Grand Jury, according to advices from Reading Pa., has taken in hand the matter of constructing a new bridge at the foot of Penn St. in that city.

Virginia.

✣Bids will be received until noon, Jan. 30, by P. St. J. Wilson, State Highway Commissioner, Richmond, Va., for the construction of a bridge over the Meherrin River in Brunswick County, Va., near Hilton.

Washington.

A bill has been introduced into the City Council of Seattle, Wash., providing for the construction of a viaduct extending from Fourth Ave. south on Railroad Ave., across the East and West Waterways, to Railroad Ave., in West Seattle, with an incline to the business sections of that suburb, at the cost of the property benefited. It is estimated that the improvement will cost between $800,000 and $1,000,000, including a drawbridge over both the East and West Waterways.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arizona.

✣Bids will be received until 2 p. m., Feb. 15, by F. H. Newell, Director, Department of Interior, U. S. Reclamation Service, Washington, D. C., for furnishing centrifugal pumps for Salt River project, Ariz.

Arkansas.

✣The Commissioners of Drainage, District No. 8, Clay County, Arkansas, will, on March 16, let the contract for the construction of an extensive drainage system. The work will include 24 miles of main ditch and 30 miles of laterals. The total excavation required amount to $1,850,000 cu. yds. J. D. Mitchell, Rector, Ark., is chief engineer.

⦿Louis Engle, of Engle Bros., Monterey, Ind., has been awarded the contract for constructing Drainage Ditch No. 6, of Craighead County, known as the Viney Slough Ditch. The ditch is to be seven miles long and the contract price was 11¾ cts. per cu. yd.

The County Courts of Greene and Lawrence Counties, Ark., will, on Jan. 30, pass on the assessments of lands in Drainage District No. 1, Greene and Lawrence Counties. It is expected that they will be able to let the contract for the work some time in March. The work consists of 16 miles of main ditch and 34 miles of laterals, the whole requiring 2,510,000 cu. yds. of excavation. J. D. Mitchell, Rector, Ark., is chief engineer.

J. H. Burke, commissioner, of Craighead County, Jonesboro, Ark., has sold the bonds for Drainage District No. 4, known as the Gum Slough Ditch of Craighead County, valued at $24,000, payable at 6 per cent in 1925, to Clyde A. Walb, of La Grange, Ind.

California.

City Engineer Randle, Sacramento, has prepared plans and specifications for closing the 6th st. canal in the Third Ward at Sacramento. The work will cost about $2,100.

Colorado.

The stockholders of the Water Supply & Storage Co., at Fort Collins, have levied an assessment of $135 per share and authorized completion of the Chambers-Lake reservoir, now about half completed.

Advices from Greeley state that owing to the unusually fine weather and open winter, contractors building ditches and reservoirs have concluded to begin work a month earlier than usual this year, if the good weather continues.

Land holders, according to advices from Greeley, have voted to form the Poudre Valley-Weld County Irrigation District, embracing 50,000 acres [illegible] waters.

Election [illegible] formation of the Northern Colorado Irrigation District just north of the Greeley-Poudre District. This project, as previously noted in these columns, involves the expenditure of $2,000,000 and the land to be reclaimed is in the vicinity of Nunn, Dover, Carr and Bulger. New York and Stamford, Conn., men are furnishing the bulk of the money and associated with them [illegible] Salisbury [illegible] Denver.

Illinois.

✣Bids [illegible] by the [illegible] Special Drainage District of Champaign and Ford counties, Champaign, Ill., for furnishing, hauling and laying tile in subdistrict No. 1.

The petition filed in the County Court at Edwardsville, Ill., for the establishment of the Wanda levee and drainage district has been withdrawn. There are said to be slight differences among the property owners as to the boundaries of the proposed district and another petition agreeable to all will be filed. The district will embrace several hundred acres in the vicinity of Wanda and provide for the maintenance of levees to check the flood waters.

The Wood River Drainage Commissioners, according to advices from Alton, Ill., are now securing right-of-way for a proposed drainage canal.

Indiana.

•Robert Huddleston, East Connersville, has been awarded the contract at about $2,200 for constructing a ditch in Rush County.

William Schoonover, County Surveyor, Plymouth, Ind., has surveys under way for the Morgan Ward Ditch in Tippecanoe Township.

Bill is before the State Legislature to pave the way for an agreement between the states of Indiana and Illinois for the removal of a quantity of rock in the bed of the Kankakee River opposite Momence, Ill., so as to complete the work of dredging the Kankakee and its tributaries and drain and reclaim the Kankakee swamp lands in this state. More than $1,000,000 has been spent in the reclama- of the Kankakee region, but this work will come to naught unless the obstruction in Illinois is removed and an outlet provided.

William Harley, County Surveyor, Hartford City, Ind., has recommended that the proposed Hiram Thomas Ditch in Harrison Township be constructed. This will be a tile drain, about two miles long, and will cost about $1,100.

Surveys have been made for a ditch in Daviess County, to be about four miles long and to drain several ponds in the vicinity of Sandy Hook. Washington is the county seat of Daviess County.

Iowa.

✣[illegible] W. L. Fitkin, Garner, Ia., County Auditor for the construction of drains in Districts Nos. 1 and 2, Hancock County, Ia. The work is divided in sections as follows: Sec. 1, open ditch including approximately 215,500 cu. yds. material; Sec. 2, open ditch including 98,900 cu. yds. material; Sec. 3, 1,600 ft. of 18-in., 2,200 ft. 15-in. tile, 1,100 ft. 12-in. tile, 1,700 ft. 10-in. tile; Sec. 4, open ditch including 75,000 cu. yds. material; Sec. 5, open ditch

✣ indicates work now open for bids. • indicates a contract let recently.

[illegible] Sec. [illegible] including 299,700 cu. yds.; Sec. 7, open ditch, [illegible] includes [illegible] to 22-in. tile; Sec. 10, includes 31,100 ft. of 12 to 20-in. tile; Sec. 11, includes 18,200 ft. of 8 to 20-in. tile; Sec. 12, includes 13,800 ft. of 10 to 18-in. tile; Sec. 13, includes 35,000 cu. yds. of open ditch work; Sec. 14, includes 16,900 ft. of 12 to 18-in. tile; Sec. 15, includes 6,500 cu. yds. open ditch work; Sec. 16, includes 1,052,500 cu. yds. open ditch work.

County Supervisors, of Hancock County, Garner, Ia., have ordered the construction of a 60-mile ditch which will cost about $260,000. The ditch will start at the boundary line of Hancock and Franklin Counties, where it will be 60 ft. in width and 12 ft. in depth. Near Britt it will divide, one branch extending to the wet land near Hayfield and the other running 12 miles north of this place.

The Western Drainage Contractors' Association will hold its annual meeting at 10 a. m., Feb. 21, 1911, at the Commercial clubrooms, Fort Dodge, Ia. S. F. Moeller, Knierim, Ia., is secretary of the association.

Plans are under consideration for having work started this spring on the dredging of Clear Lake. The channel between the island and main land and in some other parts of the lake will be cleared out. H. H. Shepard, of Clear Lake, Ia., has the matter in charge.

Louisiana.

⊙Advices from Jennings, La., state that Dr. A. C. Wilkins, of the Wilkins Co., has been awarded the contract to construct a 13-mile ditch west of Lake Arthur, in the Thornwell Drainage District, which recently voted a tax for the work. More than 1,000 acres will be drained. The ditch will be 20 ft. wide at the bottom, having an average depth of 5 ft.

Minnesota.

⊙A. C. Davisson, Rochester, Minn., has been awarded the contract at 8.95 cts. per cu. yd. for constructing State Ditch No. 89, St. Louis County. The other bids received were as follows: Forrestal & Feyen, St. Paul, Minn., 13 cts. per cu. yd.; Standard Drainage Co., Windom, Minn., 13 cts. per cu. yd. Bids were opened Jan. 20 by S. G. Iverson, State Auditor, St. Paul, Minn.

Mississippi.

✣Bids are asked until 2:30 p. m., Feb. 16, by the Board of Drainage Commissioners of Bolivar County, Missisippi, at the office of Sillers, Owen & Sillers, attorneys, Cleveland, Miss., for the excavation of the following drainage canals: Holmes Lake—Length, 7.2 miles; average cut, 10.2; bottom widths, 10, 14 and 16 feet; excavation, 388,000 cu. yds. Snake Creek—The channel of Snake Creek is sufficiently large to discharge all the water falling in its water-shed, but for the fact that it is congested by standing timber, logs and debris of all sizes. Bids will be asked for clearing 21 miles of Snake Creek between Holmes Lake cut-off and the Bogue Phalia. Mound Bayou —Length, 8.7 miles; average cut, 8.3; bottom widths, 10, 15 and 20 ft. excavation, 320,000 cu. yds. Jones' Bayou Cut-Off—Length, 0.8 miles; average cut, 11.6; bottom widths, 4 ft.; excavation, 34,000 cu. yds. Goose Lake Cut-Off—Length, 1.7 miles; average cut, 9.3; bottom widths, 10 ft.; excavation, 71,000 cu. yds. Cypress, oak and gum timber will be encoun[illegible] the character of the soil to be encoun[illegible] loam and sand loam. The plans, [illegible] profiles and blank forms on which bids must be made are on file for inspection at the offices of W. W. Boone, Chief Engineer, Cleveland, Miss. Payment for the above work will be made from the monthly estimate of the Engineer. The bonds have been sold.

The Swamp Dredging Construction Co., of Tupelo, Miss., has been incorporated with a capital stock of $10,000, the incorporators including D. W. Robins, B. H. Shubbs and J. Q. Robins.

Missouri.

Bash & Gray of Joplin, Mo., have been awarded the contract by J. L. Hanrahan, County Auditor, Fort Dodge, Ia., for the construction of Drain No. 49 for Webster County for $24,990. Section 1, the main line, will require 37,300 cu. yds. of excavation, the bottom width being 6 ft. and the berm 8 ft. Section 2 will require 7,350 ft. of 15-in. to 28-in. tile, the average cut running from 6.6 ft. to 9.7 ft. Section 3 will require 7,100 ft. of 18-in. to 30-in. tile, the average cut being 6.8 ft. to 7.9 ft. Sections 4, 5 and 6 will require 200 ft. of 30-in. tile and 2,015 ft. 28-in. tile. The work is located four miles northwest of Dayton, Ia., on the C. & N. W. and the M. & St. L. Rys., and four miles northeast of Harcourt, Ia., on the C. & N. W. Ry. The average tile haul is 4½ miles and the average coal haul is 4 miles. There will be no clearing. Work is to be commenced on or before April 1, 1911, and to be completed on or before July 1, 1911. Tile work to be commenced when outlet is finished and to be completed on or before Jan. 1, 1912. G. P. Smith, Fort Dodge, Ia., is Engineer. Bids were opened Jan. 13.

Nebraska.

⊙Bids were opened Jan. 20 by R. E. Evans, Dakota City, Neb., for constructing two ditches, the contracts being let as follows: Elk Creek Ditch to Pollard Campbell Dredging Co., Omaha, Neb., at 10¼ cts. per cu. yd.; Pigeon Creek Ditch to Horton & Mosely Co., Lafayette, Ind., at 9½ cts. per cu. yd.

New Mexico.

Hugo Seaberg, an attorney of Raton, N. Mex., has purchased 100,000 acres of the land holdings of the Santa Fe Co. in Curry County. The land is in one tract northeast of Melrose, and the new owner will colonize it, bore for artesian water, install pumping plants and irrigation systems, lay out town sites and establish a beet sugar factory.

Ohio.

County Commissioners, Urbana, will hold a hearing at Urbana today (Jan. 25), to take definite action on the dredging of Mad River water of the Pennsylvania Lines bridge. According to the estimate of County Engineer Swisher, this work will cost about $39,000.

Temporary organization has been formed at Massillon with Mayor Remley as chairman, to complete arrangements for the incorporation of a stock company to take up the work of improving the Tuscarawas River.

Utah.

✣The Directors of the Green River Irrigation District, J. F. Ingels, secretary, Green River, Utah, have rejected all bids received Jan. 16 for the following work: Completion of a dam across the Green River and widening and deepening of the raceway from the headgates to the intake; the construction and installation of a pumping plant to lift water from the raceway to the 90-ft. canal; and the completion of the 90-ft. canal. New bids will be received until March 1.

G. F. McGonagle, City Engineer, Salt Lake City, Utah, has been preparing plans for the extension of the East Jordan canal from its present terminus to connect with the Big Cottonwood canal at Salt Lake City. The extension will be built large enough to accommodate the waters of the Sale Lake, Jordan and East Jordan canals.

Washington.

A bill is now before the State Legislature to empower counties to engage in the construction of harbors, canals and waterways. If passed this bill will validate the $3,000,000 bond issue of King county for the construction of Lake Washington canal.

Wyoming.

Advices from Thermopolis, Wyo., state that engineers of the Owl Creek Irrigation & Development Co., have reported that 37,000 acres along Owl Creek can be irrigated and sufficient flood water for it stored by the erection of five dams. The system will cost about $250,000.

Canada.

The Great Lakes & Atlantic Canal & Power Co., the latest canal project, is to apply to Parliament for a charter. The company asks power to construct a canal from some point on the eastern shore of Lake Huron in the County of Huron to the northern shore of Lake Erie in the County of Elgin, and another canal from some point on the northeastern shore of Lake Erie in the County of Haldimand to the western shore of Lake Ontario, near the County of Lincoln, to improve and deepen, if necessary, a channel in Lake Ontario, and also in the River St. Lawrence to a point in the County of Grenville, also to construct a canal from Grenville to the City of Ottawa; to deepen a ship channel in the Ottawa River from the canal to its junction with the Riviere des Prairies; to deepen the channel in the said Riviere des Prairies to join the St. Lawrence ship channel below the Island of Montreal or by an alternate route from St. Ann's in the County of Jacques Cartier through Lake St. Louis to Montreal. This would make and complete throughout the entire district from Lake Huron to the St. Lawrence ship channel or the port of Montreal a navigable canal and ship channel of a depth of not less than 28 ft. and not over 33 ft. and of such width as may be found necessary to enable ocean-going vessels to meet and pass in safety at any point in the canal, lake or river channels.

The Canadian Government is considering including in its supplementary estimates an item of $3,000,000 for deepening the Back River at Montreal Riviere des Prairies, and the French River. This is taken to indicate that the Government has at length decided to go ahead with the Georgian Bay Canal. The works mentioned would all be of utility in any event, but they are also on the proposed route of the canal, and in that the significant part of it lies. Wm. Pugsley, Ottawa, Ont., is Minister of Public Works.

WATER-WORKS

California.

⊙R. A. Meier has been awarded the contract by the city of Porterville, Cal., to drill a 14 in. well at $4.50 for the first 100 ft., with an addition of $0.50 for each 100 ft. or fraction thereafter.

District of Columbia.

The Secretary of the Interior at Washington, D. C., has granted the city of Lawton, Okla., a deed to the 14 tracts of Indian land desired by that city for a reservoir site, on Medicine Creek. The reservoir site includes 2,300 acres. Judge C. C. Black is special attorney for the city.

Illinois.

✣Bids will be received until 8 p. m., Jan. 30, by City Council of Highland Park, Ill., for furnishing and installing three million gallon Corliss cross compound high duty crank and fly wheel pumping engine. Fritz Bahr is chairman of the fire and water committee.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 705, City Hall, until 11 a. m., Feb. 1, 1911, for furnishing and delivering 845 pieces, 36 in. cast iron water pipe (2,303 tons), and 500 pieces 30 in. cast iron water pipe (1,000 tons), as follows: 36 in. pipe, Larrabee

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

St., Chicago Ave. to Crosby St.; Division St. Crosby St. to Hawthorne Ave.; Hawthorne Ave., Division St. to North Ave.; North Ave. to Clybourn Pl., Clybourn Ave., Hawthorne Ave. to Southport Ave. Southport Ave., Clybourne Ave. to Clybourne Pl.; 30 in. pipe, Clybourne Ave, Southport Ave. to Fullerton Ave.; Diversey Blvd., Clybourne Ave. to Western Ave.

⊙Charley Bros., of La Salle, Ill., have been awarded the contract by that city for the construction of a water supply well for $5,200. Bids were opened Jan. 9 by City Clerk Joseph Burkhart, Jr.

The village board of Losant, Ill., at a special election held there Jan. 16, was authorized to make a loan of $3,200 for the erection of a water works system.

Iowa.

The town of Villisca, Ia., is sinking a well in the hope of solving the problem of water shortage in the town. The well will be 10 ft. in diameter and will be sunk to a depth of 26 ft.

The water company stockholders of Centerville, Ia., recently held a meeting with a committee from the Commercial Club to discuss plans for future betterments to the water system. It is thought that the present deep well water supply system will be abandoned and the building of a surface reservoir with 100,000 gals. capacity is expected. The company has under way the reservoir project; blue prints and engineer's estimates have been made.

Kansas.

The Council Clubs of Kansas City, Kan., recently held a meeting to make plans for getting out the registration preparatory for the bond election to be held in that city Feb. 14. The issue will include $50,000 for an incineration plant; $350,000 for a municipal light plant; $50,000 for a central fire station; $50,000 for a levee near the foot of Minnesota Ave., preparatory for a steam boat landing and the building of factories, and $100,000 for an auditorium to be built in connection with the new city hall.

Kentucky.

The State Board of Health has condemned the water supply of Frankfort, Ky., and will direct the water company of that city to construct a filter.

The city of Lexington will vote Jan. 31 on the issuance of $75,000 in bonds to increase the water supply. It is proposed to secure water from Moore's creek and convey by gravity to the present reservoir. The minimum supply obtainable is estimated at 252,000, and the water shed will cover about 22,814 acres. Samuel B. Walker, Jr., is Mayor.

Michigan.

The Caro water works system, owned by the Caro Water Works Co., Caro, Mich., has been purchased by Tip Atwood for a consideration of about $40,000.

The Water Commissioners of Detroit, Mich., have been conferring with Wayne delegation and other legislators regarding a bill to empower the board to issue $2,000,000 additional bonds for extending the water works system.

Missouri.

Plans have been prepared by Rollins & Westover, Beals Bldg., Kansas City, Mo., for extensions and improvements to the water works system of Moberly, Mo., estimated to cost $50,000. The work will include new pumping station, new pumps, new boilers and miscellaneous equipment. The supply will be secured from the lake and deep wells.

Montana.

The city of Helena, Mont., has voted to issue bonds to install a water works plant.

The plan to provide the money needed for the rebuilding of the water works system of Lewiston, Mont., by creating an improvement district embracing the entire city, under what is known as the Havre law, has been acted upon finally by the City Council. It is planned [illegible] 000.

Nebraska.

⊙Advices from Palisades, Neb., state that P. A. Strayer has secured the contract for laying the pipe for the Trenton water works system and the Bladen, Neb., water works system.

The city of Lodgepole, Neb., have voted to erect a municipal water plant by the issuance of bonds in the sum of $10,000.

The City Council of Utica, Neb., has called an election for Feb. 7 to vote on a water works and electric light proposition.

New Jersey.

✣Bids will be received until 8 p. m., Feb. 13, by Charles Anderson, Borough Clerk, South River, N. J., for the enduring construction of a suction well to be built of brick and concrete 25 ft. in diameter and 33 ft. deep. W. W. Young is Consulting Engineer.

⊙William H. Jacobson, Stephen St., Belleville, N. J., has been awarded the contract by the Committee of Building, Board of Chosen Freeholders, Essex County, Newark, N. J., for furnishing and laying water supply pipe with the necessary connections for the Tuberculosis Hospital at Soho, N. J., for $1,451. Bids were opened Jan. 6.

The Borough Council of Glen Ridge, N. J., has voted to expend $250 for maps of a proposed new water system in the borough.

The city of Plainfield, N. J., contemplates purchasing the present water works system at an estimated cost of $1,000,000.

New Mexico.

It is said that the city of Tucumcari, N. Mex., has been negotiating for the purchase of the light and water plant at that place. The company now in control is capitalized at $100,000.

New York.

⊙The Board of Public Works of Geneva, N. Y., has awarded the contract for furnishing the city with cast iron pipe, to be used in connection with the construction of the new force main from the pumping station to the city mains, and also to connect the new reservoir with the main leading from the present ponds, to the Charles Miller & Son Co., of Utica, N. Y., for approximately $30,000. According to the estimates, 1,300 tons of straight pipe will be required at least and about 90 tons of specials, including elbows of various angles. The straight pipe, it is figured, will cost $26,585, and the specials will cost $4,050.

Ohio.

✣Bids will be received until 10 a. m., Feb. 4, by A. E. Sinks, Auditor of the county, Troy, O., for furnishing the necessary labor and material for the installation of water mains from the intersection of Water and Adams Sts. to the Miami County Infirmary.

Supt. George Cotter of the water works department of Springfield, O., has recommended the completion of the water works system; that the city consider the installation of a new [illegible] pump; that the new 20-in. main be constructed from the new to the old pumping station.

Oklahoma.

⊙The Delaware, Okla., City Council has let the contract for the construction of its water works system [illegible] for about $21,000.

The village of Dundee, Okla., plans the construction of a water works, a new city hall, and a fire department of modern apparatus.

The citizens of Duncan, Okla., on Jan. 10 voted the issuance of bonds to the amount of $12,000 for the extension of water works.

The city of Tulsa, Okla., has sold bonds to the amount of $185,000. The amount will be spent as follows: Water works improvements, $100,000; sewer extensions, $35,000; incinerating plant, $25,000; viaduct, $25,000.

The city commissioners of Sapulpa, Okla., have taken steps to have plans and specifications prepared for the installation of a water works system. John S. Ely, assistant engineer of the bureau of water, Philadelphia, it is reported, has been engaged to draw the plans.

The City Council of Cherokee, Okla., has called an election for Jan. 31 to vote on the proposition of issuing bonds in the sum of $25,000 for water works extensions and a sewage disposal. It is planned to run the city sewage into the Great Salt Plains, a distance of four miles.

Oregon.

⊙The Phoenix Iron Works of Portland has been awarded the contract by the city water board of that city for furnishing 400,000 lbs. of special castings for water pipe for $9,600. This material will be used in extending the Bull Run water service to districts which do not now have city water, and to reinforce the mains in those districts which now have an inadequate water supply. The board will lay the reinforcing system to supply Sellwood and contiguous districts first. This will consist of a 16-in. main on East 26th St., from the main in Division St. to Holgate, a 10-in. main will be laid in Milwaukee Ave., to tie into the present 10-in. main running to Sellwood. In addition, the 16-in. main will be extended south on 26th St. from Holgate to connect with the system of Westmoreland, and ultimately it will be laid as far out as Eastmoreland so as to supply the Reed Institute and contiguous territory. These extensions will cost in the neighborhood of $45,000.

⊙The United States Cast Iron Pipe & Foundryl Co., of Chicago, Ill., has been awarded the contract by the water board of Portland, Ore., to furnish the city with 5,792 tons of cast iron pipe ranging from 6 to 30-in. in diameter for $178,972.

Members of the City Council of Redmond, Ore., have estimated that it will cost $10,000 to install a gravity water system in that city. The plan is to build two concrete reservoirs each 100 ft. square. They would be located on the hill about three miles south of town and near the main canal, from which it is proposed to take water.

The Hermiston Commercial Club of Hermiston, Ore., urges the reapportionment of the reclamation fund, giving sufficient amount to start work on the extension of the Umatilla irrigation project, to save the water rights of Umatilla river to the government. G. H. Upthegrove is secretary of the club.

Pennsylvania.

The borough of Tarentum, Pa., is preparing to build a water works. Bids are to be asked for the purchase of $100,000 in bonds.

Texas.

The Taylor Water Co., of Taylor, Tex., has purchased 10½ acres of land which will be used for the construction of a reservoir to enlarge the water service. Andrew J. Zilker is president of the company.

Work is progressing on the plans of the board of experts, Fort Worth, Tex., for the $1,500,000 surface reservoir. The board consists of Engineer John B. Hawley of Fort Worth, Dr. T. U. Taylor of Austin and Engineer Trammell of Fort Worth.

The attorney general's department, Austin, Tex., has approved an issue of $11,000 water works bonds for the city of Belton.

Washington.

The City Council of Centralia, Wash., is aiming to acquire a city water system to cost approximately $200,000. The present supply is obtained by pumping from the Skookemchuck river and is unsatisfactory. The suggested system would be gravity supply.

Wisconsin.

The city of Manitowoc, Wis., held an election Jan. 17 to vote on the proposition of purchasing the water works plant for approximately $225,000.

The city of Marysville, Wis., contemplates the installation of a municipal water works system. The Commercial Club is interested.

The city of Mankato, Wis., has employed Prof. W. G. Kirchoffer of Madison to locate a new water supply for the city. He suggests that the city build a conservation reservoir near the pumping station to catch the waste water which now runs into the river when the pumps are not in use. The estimated amount of water lost in this way amounts to 186,000 gals. per day of 18 hours.

Wyoming.

✣Bids will be received until 3 p. m., March 6, by city of Sheridan, Wyo., for constructing water supply main connecting the city reservoirs to the city line, including furnishing approximately 7,934 ft. of 14-in. and 760 ft. of 10-in. cast iron pipe valves and special castings. Arnold Tschirgi is city engineer.

Canada.

The board of control of Toronto, Ont., has instructed City Engineer Rust to go ahead with the extension of the intake pipe.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

⊙It is reported that the J. W. Gurley Co., of Mobile, Ala., has been awarded the contract by the City Council of Birmingham, Ala., for the construction of the Northside sewers, which includes six sections, for $255,400.

The city of New Decatur, Ala., is to build two additional storm sewers, one in West and one in South New Decatur, to relieve those sections of the city during heavy rains.

Arizona.

Mayor Coplen of Globe, Ariz., has suggested a stock company plan to raise the $500,000 needed for the establishment of a sewerage system.

Arkansas.

The City Council of Texarkana, Ark., has adopted an ordinance creating improvement district No. 10 for the purpose of installing a system of sewerage in the East Side, lying north of Seventh St.

California.

⊙The California Ornamental Brick Co., of Los Angeles, Cal., has been awarded the contract by the city of Brawley, Cal., for the construction of a sewer system for $13,201. The work includes septic tank, 24x200 ft., 28 ft. deep, capacity, 85,000 gals.; 300 ft. of 8-in.; 1,542 ft. of 10-in.; 8,250 ft. of 12-in.; 1,700 ft. of 14-in. vitrified pipe; 31 manholes; 3 catch basins, and wooden outfall conduit. W. H. Wheelan, City Clerk. Bids were opened Jan. 9.

⊙R. C. Lowell of Los Angeles, Cal., has been awarded the contract by the city of Monrovia, Cal., for the construction of a new sewer system, which includes about 30 miles of sewers for $85,744. Bids were opened Jan. 3.

⊙The board of trustees of Oroville, Cal., has awarded the contract for building the sanitary sewer system to the Contra Costa Construction Co., for $90,019.

Advices from San Francisco, Cal., state that the Spring Valley Water Co. has donated a permanent right of way to the city for the Ingleside main discharge sewer to a connection with the main sewer of the Parkside tract at 34th and Vincente Sts. It is estimated that this action will save to the city about $100,000 of the bond issue money.

City Engineer Jensen of Fresno, Cal., has the planning and superintendency of the enlargement of the sewer system of Hanford, Cal. The town council has adopted his plans and specifications and it is proposed to issue bonds in the sum of $85,000 for the improvement. The plans call for the extension of the sewer main line by three miles, the erection of a settling tank with two chambers and the extension of the water mains for fire purposes by one mile of piping.

The Richvale Townsite Co., according to advices from Biggs, Cal., plans many improvements for the new town of Richvale, just above Biggs. Among the improvements are a first-class concrete sewer, estimated to cost $75,000, and an irrigation well with a 12-in. pipe, 150 ft. deep. The townsite comprises an acreage of about seven blocks square.

The board of public works of Los Angeles, Cal., has approved the recommendation of City Engineer Hamlin providing for the construction of the Alameda St. storm drain system at an estimated cost of $157,000, and a recommendation providing for the construction of the proposed Arroyo De La Brea storm drain system.

Florida.

Plans have been prepared by S. C. Stallings, City Engineer of Palatka, Fla., for the construction of new sewers, estimated to cost $2,800. The contract for furnishing 4,000 ft. of vitrified salt glazed pipe for this purpose has been let to the Southern Sewer Pipe Co., of Birmingham, Ala. The pipe ranges in size from 18 ins. to 24 ins. in diameter. The city will construct the sewers.

Georgia.

⊙The city of College Park, Ga., on Jan. 10 sold bonds in the sum of $65,000 for water, sewers and electric lights to the J. H. Hilsman Co. for $65,750. The J. B. McCrary Co., of Atlanta, Ga., have the contract for the improvements. B. S. Huie is mayor.

⊙John C. West, 110 Irwin St., Atlanta, Ga., has been awarded the contract by the board of health of that city for disposing of the city's garbage and other yard trash. He proposes to collect and dispose of this material for a term of not less than five years for the sum of $153,852 per year, with a bonus of $10,000 per year after each year.

Plans are now under way for the construction of sewers in the new territory in South Macon and Western Heights, in the city of Macon, Ga. Half of the money of the bond issue for sanitary sewers in Vineville and North Macon will be used for this purpose.

Illinois.

⊙Lany & Clifford, 235 North Genessee St., Waukegan, Ill., have been awarded the contract by the city of Aledo, Ill., for the construction of a sewer for $9,806. Bids were opened Jan. 19.

The citizens of Plainfield, Ill., contemplate the installation of a sewer system. Engineer H. D. Hallott of Aurora, Ill., has made a preliminary survey of the village and has submitted the blue prints to the board of local improvements. Coll McNaughton of Joliet, Ill., is city attorney.

Village Engineer B. B. Stakemiller of Upper Alton, Ill., has completed the plans for the proposed sanitary sewer system for that village.

Plans for the new sewer districts in Ottawa, Ill., in connection with the new sewer trunk line are practically completed. The trunk sewer will be completed in about a month.

The City Council of Princeton, Ill., passed an ordinance providing for the construction of five and one-half miles of sewer during this year. The sewer will cover the south, southwest and southeastern parts of the city and will cost approximately $24,400.

Indiana.

An ordinance has been presented to the common council of South Bend, Ind., by the engineering department of the board of public works asking permission to construct the new Bowman creek sewer which is to drain the south end of the city. Wm. S. Moore is city engineer.

Iowa.

⊙The City Council of Anamosa, Ia., has awarded the contract for the sewer that is to be constructed on North Garnaville St., to E. W. Harrison for $0.33½ per running ft., with an agreed price of $27.75 each for the manholes.

Engineer J. C. McCabe, A. H. Van Scoy, and L. P. Duvail, members of the committee appointed by the Logan Business Men's Association to investigate sewerage systems of towns of like population of Logan, are now soliciting correspondence with city engineers, mayors and other city officials, where sewerage systems have been installed, in whole or in part, with a view to not only collect data, but also to find an ideal sewerage system which might be applied to Logan.

Kansas.

⊙C. R. Nichols of Caney, Kan., has been awarded the contract by the city of Checotah, Okla., for constructing approximately 11 miles of 8-in., 10-in. and 12-in. sewer, together with manholes, disposal works, etc., for $29,602. Bids were opened Jan. 16 by W. W. Southard, City Engineer.

Complete plans are now being made for a sanitary sewer in Garden City, Kan. The plan is to build about eight miles of main trunk line and laterals, thoroughly covering the business and main residence parts. The town will probably hold an election shortly to vote bonds in the sum of $12,000 to cover the main line. The total cost, it is estimated, will be about $65,000.

Kentucky.

It is reported that the City Council of Louisville, Ky., has passed an ordinance providing for the rebuilding of the Preston St. sewer. It is estimated that it will cost $30,000 to rebuild the sewer.

It is reported that the city of Henderson, Ky., has been notified by the state board of health to stop polluting Canoe Creek. This will necessitate an entire change of the sewer system of the city, and will cost in the neighborhood of $150,000.

Maryland.

⊙Band & Bates, Pratt and President Sts., Baltimore, Md., have been awarded the contract by the county commissioners, Annapolis, Md., for the construction of sewers in the town of Brooklyn, Md., for $1,132. Bids were opened Jan. 17.

Massachusetts.

The City Council of Springfield, Mass., will soon consider the question of changing the location of the main trunk sewer on Depot St.

Advices from Lynn, Mass., state that the harbor commissioners have decided to employ consulting engineers in connection with the sewage nuisance on the tidal flats of Lynn harbor. The commissioners are: William E. Dorman, Lewis H. Bartlett and Thomas W. Gardiner.

Michigan.

✣Bids will be received until 10 a. m., Jan. 26, by Board of Public Works, Detroit, Mich., for furnishing all labor and material except cement and iron manhole rings and covers, and building and finishing complete, together with the back filling, the following brick public sewer: Fairview sewer pumping station, inlet and outlet, 195 ft. by 9 ft. cylinder, 3-ring brick outlet, 169 feet. The sewer is to brick in tunnel or in open trench, at option of contractor. A certified check payable to the order of Department of Public Works for $3,000 must be filed with each bid. J. J. Haarer is commissioner.

The citizens of Cassopolis, Mich., on Jan 12 voted against the proposition of bonding the village for $30,000 to install a sewer system. The citizens have asked to have Stone lake dredged and the shores beautified instead.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Minnesota.

⊙The City Council of Albert Lea, Minn., has awarded the contract for the construction of lateral sewer No. 4 to Pastoret, Lawrence Co., of Duluth, Minn., for $7,647. Other bids received were: Greene Bros., $16,600; Frazier & Danforth, Rochester, $11,601, and Illstrup & Olson, Minneapolis, $11,641. Wm. Barneck is city engineer.

It is reported that the City Council of Minneapolis, Minn., has adopted the recommendation of the sewers committee, which provides that the contract for materials needed in sewer construction work be awarded in the near future. Carl Illstrup is city sewer engineer.

The city of Melrose, Minn., plans to install a sewer system during the coming summer. Engineer S. S. Chute of St. Cloud, Minn., has been called upon to draw plans for the improvement. The estimated cost is from $8,000 to $10,000.

Steps are being taken by the board of public works of St. Paul, Minn., to let the contract and begin the construction of the sewerage system planned for North St., Anthony Park. This project involves an estimated expenditure of $130,000.

City Engineer S. S. Chute of St. Cloud, Minn., has prepared sketches of a proposed sewer system for the Washington school building. The sketches have been submitted to the board of education for approval.

At a recent meeting of the county board of poor commissioners, Duluth, Minn., it was decided to wait until spring before beginning work on the new sewerage system to be installed. The sewage at the present time flows into Chester Creek. The board consists of J. H. Heading, Dr. C. W. Moore and Andrew Hawkinson.

Missouri.

⊙The board of public works of St. Louis, Mo., has awarded the contract for the building of the Dale Ave. sewer, in District No. 1, to Jno. B. Turner, for $21,401. Bids were received Jan. 10 and the contract awarded Jan. 17.

Residents of Ridge and Wells Ave., in Wellston, Mo., recently met at the city hall to raise a fund for building a sewer. It is planned to construct a 36-in. sewer.

An ordinance has been introduced in the City Council of Joplin, Mo., calling for a bond election to authorize the issuance of $50,000 worth of bonds for a sewer system and septic tank in South Joplin. It is estimated that the tank will cost about $15,000. The election will probably be held some time during June.

Nebraska.

The city of Lincoln, Neb., will sell bonds Feb. 2, in the sum of $50,000 for the construction of sewers. Roscoe C. Ozman is city clerk.

The council committee on roads, bridges and sewers, Fremont, Neb., voted to recommend to the City Council that a petition be presented to the legislature for authority to issue bonds for the construction of new sewers that will be required.

Plans have been drawn by Acting City Engineer J. E. Bruce, Omaha, Neb., for the construction of a modern sewer system for that city. It is estimated that the work will cost approximately $1,051,000, and that it will take five years to complete the system.

New Jersey.

The board of finance of Paterson, N. J., has adopted a resolution authorizing Mayor Andrew F. McBride to sign the contract entering Paterson in the Passaic Valley trunk sewer project, providing the total cost does not exceed $12,250,000. The three largest cities have now voted to co-operate in the work, namely, Newark, Passaic and Paterson.

New York.

✣Bids will be received until 2 p. m. Jan. 26, by George McAneny, President of the Borough of Manhattan, New York City, for six sewer contracts, the largest being No. 1, for furnishing all the labor and material required for the construction of sewer in Buena Vista Ave. between 177th St. and Summit south of 172d St. The engineer's estimate of amount of work to be done is: 421 lin. ft. of brick sewer of 3 ft. 6 in. by 2 ft. 4 in. interior diameter, including embankment, class I; 474 lin. ft. of brick sewer of 3 ft. 6 in. by 2 ft. 4 in. interior diameter, class II; 210 lin. ft. of salt-glazed, vitrified stoneware pipe sewer of 15-in. interior diameter, including embankment, class III; 217 lin. ft. of salt-glazed vitrified stoneware pipe sewer of 15-in. interior diameter, class IV; 125 lin. ft. of salt-glazed vitrified stoneware pipe culvert of 12-in. interior diameter; 7 receiving basins of the circular pattern and [illegible] and bluestone heads; 2,000 cu. yds. of rock to be excavated and removed; 1,300 ft. oBard Measure of timber and planking for foundations; 250 cu. yds. of dry rubble masonry wall. The time allowed for completing the work will be 200 working days. The amount of security required will be [illegible]

Plans have been prepared by Frederick K. Wing, 920 White Bldg., Buffalo, N. Y., for the construction of a sewer system and sewage disposal plant for East Aurora, N. Y. The taxpayers will vote on the proposition to bond the village in March, and will undoubtedly build the system this year.

Plans have been completed for the construction of a sewer along Park Creek in Binghamton, N. Y., to care for the surface water. The sewer as planned is square shaped with a rounding base. John A. Gilas is city engineer.

The board of public works of Watertown, N. Y., contemplates the construction of a sewer in Vale and Grove Sts. Morris Griffin is president of the board.

A petition has been presented to the common council of Syracuse, N. Y., asking for an 18-in. sewer in Winton St., from Burnet Ave., to Hawley Ave., and a 15-in. sewer in Winton from Hawley to Craton.

Plans and specifications are being prepared by engineers for the installation of a sewage disposal plant for Oneida, N. Y.

The citizens of Glen Cove, L. I., have organized a sewer committee to take up the matter of providing Glen Cove with a sewer system. It has been decided to sewer the entire town and later divide it into districts. The improvement, it is estimated, will cost from $150,000 to $200,000. James H. Cocks is chairman of the committee.

North Carolina.

Plans for a complete sewerage system for Wilmington, N. C., have been submitted to the state board of health by the sewerage commission of that city. The plans call for the installation of a sewerage system at a cost of about $180,000.

Ohio.

Plans have been prepared by [illegible] 514 Main St., Cincinnati, O., for the construction of a disposal plant for Colonial Heights, Paducah, Ky., estimated to cost $1,000. The work will include settling tank and filter beds built of reinforced concrete. The work will be done by the owners.

The board [illegible] has authorized the calling for new bids for the completion of the northeast district trunk sewer, which [illegible]

James J. Smith, member of the board of health of the city of Cleveland, O., has recommended the establishment of a sewage disposal plant at the mouth of the intercepting sewer in old Collinwood and the use of individual water filters in the homes of consumers, in place of the general filtration scheme recommended by the special committee on water purification. It is estimated that the construction of the separate sanitary sewer system would mean an expense of $10,000,000.

Engineer E. G. Bradbury of Columbus, O., in his report to Service Director Gauthier of Akron, O., names three systems for sewage disposal for that city. They include filtering by sand beds; by the sprinkling system, and by the [illegible] system. The [illegible] system is eliminated because it would require about 200 acres to build the plant. The second system would require the expenditure of about $350,000, and the third system would require about $520,000. The engineer recommends the contact system, as it would be easier and less expensive to operate than the sprinkler system.

Oklahoma.

According to J. H. Wheatley, commissioner of water and sewer, Tulsa, Okla., his department is contemplating expending about $15,000 of the proceeds of the recent bond sale for sewering the East end. It is planned to begin the construction of an 18-in. sewer near the intersection of Cheyenne with the Arkansas, and continue it indefinitely to the northeast. The main will have several branches of about 10-in. in diameter.

The citizens of Duncan, Okla., voted the issuance of bonds, Jan. 10 to the amount of $38,000 for the establishment of a sewer system and the erection and maintenance of a sewage disposal plant. Estimates were made by Engineer W. L. Benham, 714-16 Campbell Bldg., Oklahoma City, Okla.

Oregon.

Plans for the commercial sewer district have been prepared by City Engineer J. W. Morris of Portland, Ore., and have been submitted to the City Council together with estimates of its cost. It will embrace the territory between Killingsworth Ave., and the city limits north, Union Ave., on the east and 100 ft. west of Patton Ave. According to the plans the main conduit will empty into Oregon Slough. The system will cost about $250,000.

Pennsylvania.

The borough council of Bridgewater, Pa., contemplates the installation of a sewer system. Engineers are now at work on the survey of the sewer.

South Dakota.

The Missouri Valley Engineering Co., 408-412 Western National Bank Bldg., Mitchell, S. Dak., has practically completed the surveys and plans and specifications are being prepared for the construction of a sewer system for Madison, S. Dak. Bids for this work will be advertised for about Feb. 15.

The citizens of Aberdeen, S. Dak., on Jan 10, voted in favor of the issuance of $100,000 bonds for sewer extensions.

Danforth & Frasher of Eau Claire, Wis., were the low bidders at $10,680 for the construction of sewers in the city of Aberdeen, S. Dak.

Texas.

⊙Trueheart & Jackson of San Antonio, Tex., have been awarded the contract by the city of Corsicana, Tex., for the construction of 13,200 ft. of additional sewer mains, average depth 10 ft., for $17,360. Walter Burgess is City Secretary. Bids were opened Jan. 3.

The Texas City Transportation Co., of Texas City, Tex., Capt. A. B. Wolvin, Duluth, Minn., president, is planning to expend $1,000,000 during this year in the enlargement of the terminal facilities. The company has been granted permission by the county commissioners court to construct and maintain waterworks, lighting and sewerage systems.

Virginia.

City Engineer Charles E. Bolling of Richmond, Va., has submitted his list of needs for the year to the City Council. His budget calls for a total of $2,400,000 to be expended on streets and sewer work.

Wisconsin.

✣Bids will be received until Feb. 1, by City Clerk Clarence Schoenike, city clerk of Oconomowoc, Wis., for approximately 12,000 lin. ft. of sanitary sewers and 5,466 sq. yds. of [illegible]

Commissioner J. W. Alvord, in his report to City Engineer C. J. Poetsch of Milwaukee, Wis., states that the Menomonee sewage commission has reached a decision on the method for flushing the Nemomonee river and slips, and also on other details. The commission

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] J. W. Alvord, Hartford Bldg., Chicago, Ill.; Harris P. Eddy, 14 Beacon St., Boston, Mass., and George C. Whipple, [illegible] Park Ave., New York City.

Wyoming.

• A contract for a comprehensive and complete municipal sewer system for Buffalo, Wyo., has been awarded to Peter O'Brien of Denver, Colo., for $37,369. Sixteen bids were submitted, ranging from $33,000 to $59,000.

Canada.

• McDonnell, Gzowski & Co., of Vancouver, B. C., have been awarded the contract by the city of North Vancouver, for supplying materials and constructing complete the first part of the sewer system, including sewers on seven streets, for $206,000. George S. Hanes is City Engineer. Bids were opened Jan. 5

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

⊙Standard American Dredging Co., San Francisco, has been awarded the contract for the dredging in the Key Route basin, at Oakland. The contract calls for the removal of 3,000,000 cu. yds. of earth at 9.9 cts. per yd. Other bidders were: San Francisco Bridge Co., 14.7 cts.; N. R. Harris, 16 cts.; Associated Construction Co., 16.6 cts.

The Guaranty Pipe Line Co., of Los Angeles, recently incorporated, proposes the construction of an oil pipe line from the Midway field to the sea. The proposed line, the cost of which, with pumping stations, is estimated at $2,000,000, is to extend from sections 31, 32-34, and 32, 32-24, about 1½ miles from Maricopa, along a short route to tidewater. The terminal has not been definitely selected, two points being under consideration. This line will be 60 miles long, and will probably be a 6-in. pipe. Eventually it is to be tapped with a line to be built to Los Angeles, a distance of not less than 150 miles. The incorporators are Cromwell Simon, Thomas Ball, M. A. Fleming and Drew Pruitt. The concern is to be affiliated with the Guaranty Oil Co., which has considerable holdings at Midway and Coalinga.

A bill is now before the State Legislature to appropriate $150,000 for the rectification and improvement of the channels of the Sacramento, San Joaquin and Feather rivers, so as to make them more navigable. The bill provides that the work, which is to be in charge of the Department of Engineering, is not to be begun until the plans are approved by the United States engineers who look after river improvements in California.

John A. Anderson, San Pedro, has applied to the City Council of Los Angeles for a franchise for a wharf. The proposed wharf is to cost about $5,000 and is to be constructed in connection with a fish cannery, soon to be erected in the vicinity of Mesa and 22nd Sts.

L. A. Thompson is to apply to the City Council of Ocean Park, Cal., for a franchise for an amusement pier to be erected at the foot of Kinney St. He plans to erect a pier 550 ft. wide and 100 ft. long.

Connecticut.

Bids as follows were received Jan. 21 by Lt. Col. Harry Taylor, U. S. Engineer, New London, Conn., for dredging 60,000 cu. yds. from Stamford Harbor, Conn: John H. Gerrish, 25.2 cts. per cu. yd.; Maritime Dredging Co., 25 cts.; John P. Randerson, 34 cts.

District of Columbia.

✣Bids will be received until 10:30 a. m., Jan. 27, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal circular 618, trolley crane and runway, couplers for rock drill air hose, wire rope, copper ladder rungs, pig tin and emery wheels.

✣Bids will be received until 10:30 a. m., March 24, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under canal circular 619, rack railway material for Panama Canal Locks, including rack steel crossties, bolts and nuts, tie clips, washers, steel channels, rail bonds, copper conductor rails, steel conductor rails, insulators, bumpers, frogs, svitches.

Georgia.

✣Bids will be received until [illegible] Feb. 14, by R. V. Ladow, superintendent of Prisons, Washington, D. C., for furnishing and delivering at the United States Penitentiary, Atlanta, Ga., electric light and power installation in the hospital building.

✣Bids will be received until 11:45 a. m., Feb. 15, by Constructing Quartermaster, Fort Screven, Ga., for construction, including plumbing, heating, electric wiring and fixtures of one additional hospital ward.

Illinois.

✣Bids will be received by the City Electrician, City of Chicago, Room 403, 76 5th Ave., until Feb. 1, 1911, for furnishing and delivering the following supplies for street lighting during the year 1911: 120,000 incandescent gas mantles, 150 gross Mica chimneys, 5,000 mantle burners complete, 1,500 boxes glass "sides" (44 lights to a box, 600 boxes of glass tops (64 lights to a box), 50 boxes glass "doors" (50 lights to a box). The supplies must fulfill the following general requirements: The first supply of mantles shall be delivered on or about Feb. 15, 1911, and shall consist of 10,000 mantles, subsequent deliveries of 5,000 to be delivered the first and third week of each month following, to the gas lamp repair shop, Chicago Ave. and Sedgwick St.

⊙The following contracts for furnishing drawing materials to the Board of Assessors of Cook County, Jas. M. Slattery, Supt. of Public Service, 519 County Bldg., Chicago, have been awarded: Keuffel & Esser Co., 111 Madison St., Chicago, 10,000 yds. K. & E. Columbia blue print paper, $602, 1 zinc bath tray, $6.56; United States Blue Print Co., 5,000 yds. negative paper, $400, 10 rolls tracing cloth, $68.90, 2 16 oz. bottles Higgins' black waterproof tracing ink, $5.88, 1 each 16 oz. bottle Higgins' red and blue waterproof tracing ink, $5.88; Eugene Dietzgen Co., 181 Monroe St., 5 doz. boxwood scales.

The bill to give Chicago an outer harbor was introduced in the State Senate on Jan. 17. The bill provides for an extensive outer harbor on the lake front at a cost of $50,000,000.

Following is the low bid submitted by Fitz Simons & Connell Co., 131 La Salle St., Chicago, for furnishing the Department of Public Works, City of Chicago, B. J. Mullaney, Commissioner of Public Works, Room 705 City Hall, with the necessary material, labor, equipment, etc., required for making pile construction repairs during the coming year: 2,550 lin. ft. pile at 22 cts. per ft., $5,610; 4,500 lin. ft. pile chain at 24 cts., $1,080; 3,000 lbs. of boat spikes at 40 cts. per lb., $120; 1,500 hrs. use of pile driver, crew and scow at $6.50 per hr., $9,750. Total, $16,560

Indiana.

✣Bids will be received until 10 a. m., Feb. 7, by Board of Public Works, Michigan City, Ind., for the construction of docks along the harbor.

Kansas.

✣Bids will be received until 10 a. m., Feb. 16, by R. V. Ladow, superintendent of prisons, Washington, D. C., for furnishing and delivering at the United States Penitentiary, Leavenworth, Kan., electric light and power installation in the hospital building.

Kentucky.

✣Bids will be received until 2 p. m., Feb. 20, by Maj. H. Jervey, U. S. Engineer, Cincinnati, O., for constructing lock and dam No. 29, Ohio River near Ashland, Ky.

Louisiana.

✣Bids will be received until 1:30 p. m., Feb. 21, by the Board of Commissioners of port of New Orleans, La., 200 New Court Bldg., for the fabrication and erection of the structural steel and cast iron for the William A. Kernagham Shed. Plans and specifications prepared by J. F. Coleman & Co., are on file at the office of A. C. Bell, Engineer, 200 New Court Bldg., New Orleans, La.

Minnesota.

⊙The George J. Grant Construction Co., St. Paul, Minn., has been awarded the contract for the construction of the Finch, Van Slyck & McConville Building at 5th and Wacouta Sts., in St. Paul. The structure will be 9 stories high and is estimated to cost about $600,000. J. F. Denson is architect.

Mississippi.

Blair Hughes, C. E., Birmingham, Ala., has completed the survey for the gas pipe line between Fayette, Ala., and Columbus, Miss. The line will be 37 miles long and is calculated to cost $4,000 per mile to construct. The project is backed by the Peoples Gas Co., and it is announced that steps will be taken at once to start work on the line.

New Jersey.

✣Bids will be received between 3 and 3:15 p. m., January 31, by Board of Education of Newark, N. J., for the construction complete of the Peshine Ave. and the West Side School, to be completed December 30, 1911. Bids may be for the whole or one or more items, viz: Masonry, carpentry, steel and iron, roofing, and sheet metal, painting, plumbing, electric, heating and ventilating, lighting fixtures and vacuum cleaning system. Terms of proposal and surety required are fixed by the specifications. Blank proposals are obtainable at the board's construction department, fourth floor, city hall, where contract and bond forms, drawings and specifications may be examined. R. D. Argue, secretary.

✣Bids will be received until 2 p. m., Feb. 3, by James Wilson, Secretary, Department of Agriculture, Washington, D. C., for furnishing and installing a storage battery at the United States animal quarantine station, Athenia, N. J.

⊙Dennis Mullins, Inc., Jersey City, N. J., has been awarded the contract at $75,490 by the Board of Education of Jersey City, for the erection of the new No. 34 School at Boulevard and Warren Ave. The Mullins concern also got the contract for new School No. 35, at Sip and Hawthorne Aves

⊙Fire Board of Jersey City, N. J., has awarded the contract for a new combination engine and hose motor wagon to the Pope Motor Co. of Hartford, Conn. The contract price is $5,200, and the wagon is to be delivered within 90 days. A contract for 750 ft. of 2½-in. 4-ply cotton jacketed rubber lined hose was awarded the Eureka Fire Hose Co., at $1.20 per foot. The Voorhees Rubber Manufacturing Co. was awarded a contract for 1,150 ft. of 2½-in. hose at 95 cts. a foot.

New Mexico.

✣Bids will be received until 3 p. m., Feb. 23 (extension of time from Feb. 2), by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office and Court House at Roswell, N. M.

✣Bids [illegible] until 10 a. m. [illegible] by Board of County Commissioners, Roswell, N. Mex. [illegible] [illegible] and [illegible] [illegible] [illegible] M. [illegible] chairman.

New York.

✣Bids will be received until Feb. 1, by Maj. [illegible] U. S. Army [illegible] Purchasing [illegible] Panama Railroad Co., 24 State St., New York, N. Y., for furnishing [illegible]

• [illegible] Dredging Co., Norfolk, Va., has been awarded the contract at [illegible] [illegible] dredging [illegible] Bay Ridge Channel, New York Harbor, for the U. S. Government. Bids were opened Jan. 5 by the U. S. Engineer at New York City. The sum of $150,000 is available for the work.

The wage schedule for 1911 of the members of the New York Building Trades Council [illegible]

	Per Day.	Overtime Per Hour.
[illegible]	$[illegible]	$1.40
Plumbers	5.50	1.40
Carpenters	5.00	1.25
Masons	[illegible]	1.2[illegible]
Ironworkers	5.00	1.25
Metal workers	[illegible]	1.20
Decorators	[illegible]	1.15
Boilermakers	4.25	1.10
Painters	4.00	1.05

Helpers in the various trades receive from $3 to $3.50 per day, with overtime at 75 cents an hour. The schedule is based on eight hours' work per day with Saturday half holidays and all legal holidays observed. Work Sundays or holidays, or after the noon hour Saturdays, must be paid for at overtime rates.

Ohio.

✣Bids will be received until noon, Jan. 30, by Director of Public Service, Cleveland, O., for wire fence for deer and elk corrals. Plans and specifications are on file at the office of the engineer of parks, Room 216 City Hall. Ira O. Hoffman is secretary of the director.

✣Bids will be received until 2 p. m., March 8, by Cuyahoga County Building Commissioners, 425 Garfield Bldg., Cleveland, O., for all the electric light fixtures for the new county court house at Cleveland. A certified check for $5,000 must be filed with each bid. J. J. Boyle is secretary of the commission.

✣Bids will be received until noon, Jan. 2[illegible], by Director of Public Safety, Cleveland, O., for furnishing and installing a rectangular steam pressure disinfector and sterilizer at the tuberculosis sanitarium, infirmary division, Colony Farm, Warrensville, O. Specifications may be seen and blank proposals can be obtained at the office of the Director of Public Safety, after January 17, 1911. Each proposal must be accompanied by a certified check for $200, payable to the Director of Public Safety.

The D. & C. Navigation Co., Cleveland, O., has completed plans for the erection of docks, depots and warehouses at the front of E. 9th St., Cleveland. About $200,000 [illegible] expended, work being started March 1.

The Park Department of the city of Cleveland, O., has plans under consideration for making Herron Pond, opposite Woodland Hills Park, the largest artificial lake in the city park system. It will be 1,400 feet long and about 400 feet wide, if present plans are carried out. To follow the new plan it will be necessary to purchase another tract of land opposite the park.

Pennsylvania.

⦿The Raymond Concrete Pile Co., of New York and Chicago, has been awarded the contract for placing Raymond concrete piles in the foundations of a brewery building to be built for Ernest F. Rush at 21st and Sidney sts., South Side, Pittsburg. Ellsworth Dean is the architect.

Representatives of the General Electric Co. have been at Lansford, Pa., looking for a site on which to erect a large power house for the Lehigh Coal & Navigation Co., Mauch Chunk, Pa. The structure will be equipped [illegible]

Texas.

✣[illegible] Immigration Service, Galveston, Texas, for [illegible]

✣[illegible] range boilers, one hot water tabasco heater, 12 light clusters, 4 gross rubber bumpers, 12 pairs pipe basin supply, 200 ft. cast iron soil pipe and 1,764 washers.

The Texas City Transportation Co., Capt. A. B. [illegible], president, is planning to [illegible] 1911 in the enlargement of the [illegible] facilities. Another pier will be constructed, and at the coming meeting of the stockholders definite plans will probably be adopted and contracts let for the work.

The Board of Commissioners of the Beaumont Navigation District [illegible] National Bank, Beaumont, have authorized the disposal of the navigation district bonds, amounting to $498,000, at private sale to the best advantage. The commission thought best to have the bonds sold without further delay, so that in the event an appropriation is made by Congress the commissioners will be in readiness to turn the bond money over to the Government, while if an appropriation is not secured the work of beginning the project will be undertaken by the canal commissioners under the permit to do the work already obtained from the war department.

Utah.

Advices from Salt Lake City, state that Free & Taylor, the contractors driving the Snake Creek drain and operating tunnel into the Park City hills during the month of December made an advance of 355 ft. On Dec. 2 last the tunnel was exactly 2,068 ft. in length, and on Jan. 2, 1911, it was 2,423 ft. long. Thirteen shifts were lost during this period on account of the holidays and power trouble, which, at the rate driven, prevented the distance from being [illegible] for the month. It is stated that the ditch is completed for 2,350 ft., the permanent ties are laid for 2,310 ft., while the sucker pipe is laid for 2,305 ft. from the portal. The formation is a series of hard lime beds interspersed [illegible]. The ground breaks cleanly and stands well, the only timbers so far necessary being three half sets at one point where the roof gives indications of sagging. The face is blue lime and the tunnel [illegible]. The Snake Creek tunnel is 7 ft. by 9 ft. in the clear, with a water ditch 3½ by 4 ft.

Virginia.

✣Bids will be received until 10 a. m., Jan. 31, by Curtis G. Roebeck, Capt. U. S. Arm, Quartermaster, Fort Monroe, Va., for furnishing 6 columbia batteries No. 6, 1 wall bracket, 48 heavy brooms, 100 ft. flexible copper cable, 1 pipe cutter, 8 ft. hose with brass couplings, 24 40-watt lamps, 1 hose nozzle, 200 ft. galvanized iron pipe, 12 cakes soap, etc.

The Old Dominion Steamship Co. is preparing to begin the construction in July of the piers upon [illegible] Old Dominion Terminal Co. at South Ghent, Norfolk, Va., which was acquired for this purpose at a cost of about $350,000.

Washington.

The Port of Newport Commission, Newport, Wash., has been granted a lease on 430 ft. along the waterfront for docking purposes. Work must begin on the building of a dock within five years.

The [illegible] Holman, Assistant General Manager, Seattle, has plans in preparation for the construction of wharves at Railroad Ave. S and Weller St., Seattle, to cost about $400,000.

The W. K. Palmer Co., Dwight Bldg., Kansas City, Mo., has contracts for the engineering work for several hydro-electric projects in the state of Washington.

Wisconsin.

Advices from Hudson, Wis., state that B. W. Ultman has purchased the power site formerly used for a grist mill and secured three miles of flowage rights on the Kinnickinic River. By building a 40-ft. dam and running a flume across a bend of the river it is said that a 90-ft. head will be secured.

West Virginia.

✣Bids will be received until 2 p. m., Feb. 15, by Department of Interior, United States Reclamation Service, Washington, D. C., for furnishing motors, transformers and switchboards for centrifugal pumps for Salt River project, Ariz.

Canada.

✣Bids will be received until 4 p. m., Feb. 13, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of a wharf at the mouth of the Michipicoten River, District of West Algoma, Lake Superior, Ont. A certified check for $2,000, payable to the Minister of Public Works, must be filed with each bid. Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.; E. B. Temple, Esq.; District Engineer, Port Arthur, Ont., and on application to the postmaster at Michipicoten River, Ont.

✣Bids will be received until 11 a. m., Feb. 1, by M. Peterson, Secretary, Board of Control, Winnipeg, Man., for the supply of labor and material for the masonry and iron work required in the erection of 3 gatevalves on Cornish Ave., Armstrong Point. Specifications and forms of tender, together with conditions governing tenders, as prescribed by by-laws, may be obtained at the office of the city engineer, 223 James Ave.

The Winnipeg Electric Ry. Co., Winnipeg, Man., has decided to erect a $500,000 subsidiary steam power house at the foot of Mill St., Winnipeg.

TRADE NOTES.

The Penton Publishing Co., of Cleveland, O., has moved its Cincinnati office [illegible] building to [illegible] Bank building. Louis P. Zimmerman is now in charge of the Cincinnati office as representative for the Iron Trade Review, The Foundry, The Marine Review and Power Boating.

[illegible] the Galveston [illegible] New Orleans [illegible] Roofing & Metal Works, and [illegible] managers of the factory, which is located at [illegible] the capacity increased.

[illegible]

The Cyclone Drill Co., Orrville, O., reports [illegible] that the number of inquiries for the Special [illegible] large. Among the machines sold recently by the Cyclone Drill Co. are the following: Two No. 14 Special Blast Hole Drills to the Rio Tinto Mining Company for drilling blast holes in their [illegible] clone machines which will be installed on this property for blasting out the material ahead of [illegible] & W[illegible] [illegible] quarry, S. B. Martin & Co., Fiborn Quarries, [illegible] Bros., of Chicago, a No. 14 gasoline traction [illegible] Toledo, O., a No. 14 plain gasoline drill.

✣ indicates work now open for bids. • indicates a contract let recently.

Is there a Contract?

If Jones, a contractor, after getting quotations on scrapers, telegraphs an order for three, which the operator by an error makes four and fifty,—

Is there a Contract?

If a building contractor agrees to put an extra coat of paint on the inside of a house and the promise is made without additional consideration,—

Is there a Contract?

If Smith offers Brown to sell tin at a certain price, and Brown replies: "Will accept your offer if full weight plates,"—

Is there a Contract?

If A agrees to buy and B agrees to sell a cargo of lumber today at noon in B's New York office, and the lumber is lost at sea at nine A. M.,—

It there is Contract?

If a watchman agrees to work for one dollar and a half a day, and nights the same; if the employer understands the rate to be one dollar and a half a day of twenty-four hours, while the watchman means a day of twelve hours.—

Is there is Contract?

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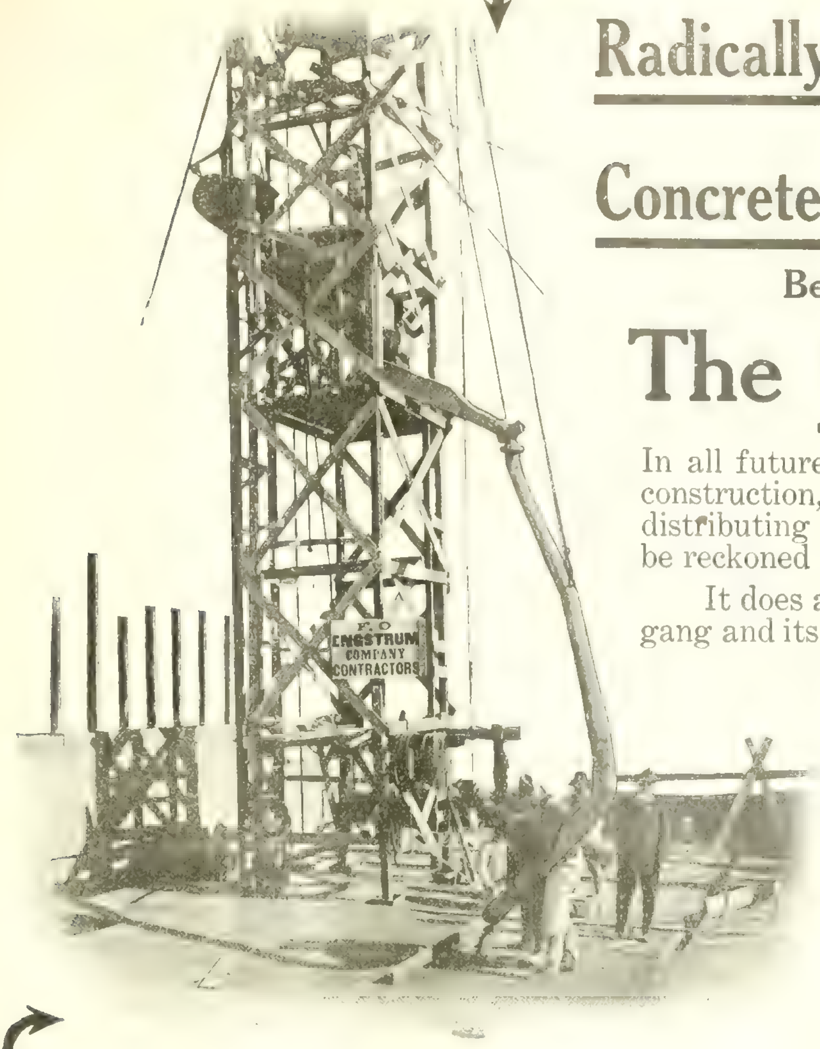

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Guayama, P. R., Oct. 10, 1910.

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(1) Carite Dam and appurtenant structures, containing about 150,000 cubic meters of earth and loose rock, the estimated cost of which is about $190,000.

(2) Guayabal Dam and appurtenant structures, containing about 73,500 cubic meters of concrete masonry and 82,000 cubic meters of excavation, the estimated cost of which is about $550,000.

(3) Patillas Canal and appurtenant structures, including about 32,000 cubic meters of open-cut excavation, 2,060 lineal feet of tunnels, 2,500 lineal feet of flumes, 600 lineal feet of siphons, and 100 bridges, the estimated cost of which is about $70,000.

Plans and specifications may be obtained from this office, or from the Commissioner of the Interior, San Juan, Porto Rico, or from the Bureau of Insular Affairs, Washington, D. C.

A deposit of $2 is required for each set of plans, which will be refunded upon the return of the plans upon or prior to the date set for opening the bids. The right is reserved to reject any and all bids.

J. W. BEARDSLEY,
Chief Engineer Irrigation Service,
Guayama, P. R.

By order of:
JOHN A. WILSON,
Commissioner of the Interior of Porto Rico, San Juan, P. R.

POSTPONEMENT OF OPENING BIDS FOR THE PORTO RICO IRRIGATION SERVICE.

The opening of sealed proposals for the construction of (1) Carite Dam, (2) Guayabal Dam, and (3) Patillas Canal and Appurtenant Structures, is hereby postponed from January 3, 1911, to February 7, 1911.

J. W. BEARDSLEY,
Chief Engineer, Irrigation Service, Guayama, Porto Rico.
By order of
JOHN A. WILSON,
Commissioner of the Interior, San Juan, Porto Rico

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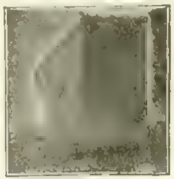

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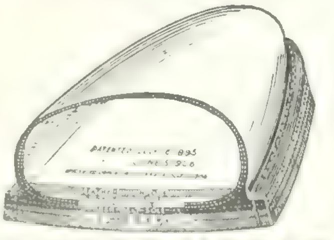

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The Amazing Economic Efficiency of the Express Companies Contrasted with the U. S. Post Office, as Deduced from the First Annual Report on Express Co. Statistics.

In ENGINEERING-CONTRACTING, Dec. 28, 1910, was presented an analysis of the cost of handling the mails per ton and per ton mile. In [illegible] ing a remarkable contrast in favor of the express companies. We were altogether too conservative in our estimate of express company efficiency, as can now be seen by the statistics just published by the Interstate Commerce Commission in their First Annual Report on the Express Companies of the United States. This is really a remarkable document, and we predict that it will have a profound influence on the operations of the post office.

W[illegible] it is costing the Government not less than two and probably more than four times as much per ton of mail as it is costing the express companies. This was an estimate [illegible] involving an assumption as to the weight of the average express package. We now have before us the exact average weight of express packages and the exact cost of handling, transportation, etc. The truly amazing fact is disclosed that it costs the express companies [illegible] compared with the $325 per ton that it costs the Government to handle and transport the mails! In short, the Government performs a service roughly comparable with the service performed by express companies, and it costs the Government more than eleven times per ton what it costs the express companies!

And again:

[illegible]

First we purpose repeating our analysis of the cost of handling the mails, as given in our Dec. 28 issue. We showed in that issue that in 1908 the Post Office Department handled 645,000 short tons of mail at the following cost per ton:

	Per Ton.
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Bear clearly in mind that this includes no interest on the enormous sums of money invested in post office buildings and real estate.

The Interstate Commerce Commision report on railways for the year 1908 shows that the railways received $48,517,563 for carrying the mails, or about $75 per ton.

The average length of rail haul for second-class mail was:

	Miles.
[illegible]	[illegible]
[illegible]	[illegible]
Miscellaneous periodicals	1,130

Since second class mail amounted to 396,000 tons, it is clear that the average haul for all mail was less than 1,000 miles. Hence it cost the Government fully 32½ cts. per ton of mail per mile of haul.

Let us now contrast these unit costs with those of all the express companies of the United States.

[illegible] Commission Report on Express Companies, for the fiscal year ending June 30, 1909, we find that during April, August and December—three typical months—2,329,312,192 lbs. of express matter were handled by all the ex[illegible] this rate for 3 months, the entire 12 months express would total 4,658,800 tons. However, we find that the receipts for carrying this express for 3 months (25 per cent of the year) were 27 per cent of the total receipts for the year. Hence it is somewhat more accurate to assume that the 1,161,700 tons were 27 per cent of the year's business than to assume that they were 25 per cent. Ac[illegible] express were carried during the entire fiscal year. Therefore we have divided each of the express companies' operating expense items given on page 31 of the report by 1,310,000, and thus deduce the following cost per ton:

TABLE I.—COST OF OPERATING EXPRESS COMPANIES.

[illegible]	Per ton.
1. Superintendence	$ 0.01
[illegible]	[illegible]
3. Oth[illegible]	[illegible]
4. Car repairs and renewals	0.01
[illegible]	[illegible]
6. Vehicle repairs and renewals	0.19
7. Stable equipment	0.05
8. Transportation equipment	0.04
[illegible]	[illegible]
Traffic Expense.	
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total traffic expense	$ 0.15
[illegible]	
12. Superintendence	$ 0.54
[illegible]	[illegible]
14. Commissions	1.54
[illegible]	[illegible]
16. Office supplies and expenses	0.33
17. Rent of local offices	0.51
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
21. Train supplies and expenses	0.03
22. Transfer employes and expense	0.52
23. Stationary and printing	0.27
[illegible]	[illegible]
[illegible]	[illegible]
26. Operating joint facilities	0.04
[illegible]	[illegible]
General Expense:	
27. Salaries and expenses of general officers	$ 0.20
28. Salaries and expenses of clerks and attendants	0.56
29. General office supplies and expenses	0.04
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
33. Stationary and printing	0.02
[illegible]	[illegible]
[illegible]	[illegible]
35. Total items to 35	$13.05
36. Railway transportation payments	14.85
[illegible]	[illegible]
Grand total, Items 1 to 37	$28.11

In total expenses we have:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
General expense (Items 28 to 35)	4,142,697
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Grand total expense	$121,211,702
[illegible]	[illegible]
[illegible]	[illegible]

During the three months when the weights of express packages were reported it was found that the average package weighed 32.8 lbs.—not quite 33 lbs. The average revenue was 50½ cts. per package, or 1.54 cts. per lb., or $30.80 per ton. The report unfortunately does not give the average distance that the packages were transported, but we can deduce this roughly as follows:

The "base rate" from New York to Chicago is $2.50 per 100 lbs. Packages weighing 33 lbs. are carried at $1.25 per 100 lbs., when the "base rate" is $2.50. This is equivalent to 3.8 cts. per lb. Hence if all express matter weighing 33 lbs. per package were carried at this same rate of 3.8 cts. per 1,000 miles (the distance between New York and Chicago), the average charge of 1.54 cts. per lb. would indicate a haul of $(1.54 \div 3.8) \times 1000 = 405$ miles. However, express rates west of the Missouri river average twice as great as rates east of that river, so it is certain that the average haul must be less than 400 miles. On the other hand, the amount of express matter handled west of the Missouri river must be a relatively small part of the total.

No precise estimate of the average length of haul will be possible until the Interstate Commerce Commission secures as accurate data relating to the haul in miles as it has already secured relating to the weight. For our present purpose it is a matter of no great moment whether the average haul of express packages is 400 miles or considerably less. It is well known that once a small package of any kind is put upon a train, the distance that it is transported does not greatly affect the cost of transportation. Hence the cost per ton for transporting light packages by rail is a much truer criterion than the cost per ton-mile.

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Let us now tabulate the foregoing data so as to show the cost per ton of mail and of express:

TABLE II.

[illegible] transportation [illegible]

[illegible] Express	Per Ton	
[illegible]	Mail	Exp.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
Train employees and supplies.....		1.11
Total rail transportation......	$121.00	$15.96
Collecting, Delivering, Etc.:		
Rural delivery	$ [illegible]	...
Clerks, carriers, etc...............	134.00	......
Office employees		$ 3.15
Wagon employees		1.75
Stable employees and supplies....		1.33
Maintenance and traffic		0.66
Commissions		1.54
General expense		0.96
Taxes		0.21
Other expense	17.00	3.55
Total collecting, delivering, etc..	$204.00	$13.15
Grand total	325.00	28.11

Thus we see that the expenses of "rail transportation" for mail are 8 times as great as for express, and the expenses of "collecting, delivering, etc.," are 15 times as great for mail as for express. The total expense for mail is nearly 11¼ times as great per ton as for express.

Obviously there will be four important reasons given by the Postal Department for this astounding difference in cost per ton between the mails and express: First, it will be urged that the public demands a much more prompt service by mail than by express; second, that rural delivery entails a great expense that is justified only on broad general grounds of public policy in building up the country; third, that the haul for mails is greater than for express; and, fourth, that the mail items average smaller than the express items, consequently requiring more expense per ton in handling.

It is not our present purpose to discuss these explanations, for, on the very face of these unit costs, all of them put together fall far short of any sufficient explanation of the greatly superior efficiency of the express companies.

It is true that rural delivery alone costs nearly twice as much per ton of mail as the entire cost per ton of express. But this merely serves to raise the question as to the real worth of rural delivery to the general public. It does not explain away the extravagant administration of the post office, but rather confirms it.

It is true that the service of postal "clerks, carriers, etc.," amounts to $134 per ton of mail, which is alone more than 20 times the combined expense of "office employes, wagon employes, stable employes and supplies" per ton of express, or nearly 5 times the entire cost of express per ton including the sum paid to railways by the express companies! No possible explanation on the ground of prompt service can begin to justify this element of postal expense.

It is true that the mails have an average haul by rail greater than for express matter. Perhaps the haul is three times as great. Yet this does not explain away the fact that "rail transportation" charges aggregate nearly 8 times as much per ton for the mails as for express.

It is true that mail items average smaller than express items. However, it must be remembered that two-thirds of the mail tonnage consists of second-class matter—periodicals and newspapers, which probably average nearly half a pound each, *and are delivered to the post offices by the publishers.* Any careful investigation of the added cost of handling each mail item, due merely to its lighter weight, will disclose no increase in cost sufficient to account for more than a small fraction of the higher cost per ton for handling the mails. This is clearly indicated by the fact that express companies themselves handle newspapers and magazines in competition with the Government, the mail rate on such matter being $20 per ton. Evidently, then, the express companies find it profitable to undertake long hauls of matter that is the equivalent of second-class mail at a $20 per ton price. Why they can do so appears clearly from the data in Table I; for, with a total average cost of only $28 per ton, the express companies can obviously afford to handle certain goods at even $20 per ton, once they have secured sufficient income to meet the fixed charges. Yet the Postmaster General has claimed that the postal department is losing 8 cts. per lb., or $160 per ton, on all the second-class mail!

There has been much talk of establishing parcels posts, and it has even been suggested that the Government shall take steps to prohibit express companies from competing with it in carrying periodicals and other small packages. The farce of Government operation of any public service plant is much clearer now that we have exact express company data by which to gage the economic operation of that great plant, the post office.

Incidentally, the statistics of operation of the express companiese serve to dispel another popular illusion, namely, the belief that huge profits are wrung from the people by the express companies. Referring back to Table I we see that the net operating income of all the express companies was $11,837,489, or less than 9 per cent of the gross operating receipts. But from this $11,837,489 should be deducted $1,115,680, for this is 5 per cent of $22,313,575 which is the investment in real estate, buildings, fixtures and equipment used in operating the express companies, and the express companies are at least entitled to charge 5 per cent interest on this plant as a plant expense. Otherwise they would sell the plant and pay rent for its use, even as they now pay for the use of part of the railway plant. Making this deduction, the true net profit of the express companies is only 8 per cent of the gross income, which any business man must concede is not high. We have previously pointed out in these columns that it is fallacious to estimate profits as a percentage of the cost of the plant in any business. We now have an excellent illustration on a large scale of the absurdity of looking upon profits as a return on capital. Profits are, fundamentally, the payment that brains receive for managerial ability in handling a business, and should always be rated as a percentage of the gross income from the business.

Finally we repeat the suggestion made in our issue of Dec. 28:

> *Take the post office out of politics by delivering its management to a board of direction consisting of men selected by the express companies and of men selected by the Government. Let the postal and express business be operated jointly, and for profit, half the profit going to the Government and half to the express companies.*

This is, in essence, the plan that is working so admirably in Chicago for joint operation of the street car system by the city and the traction corporations. The same plan will assuredly affect enormous reductions in the cost of operating both the post office and the express companies. It will insure the benefits of private incentive to reduce costs, and at the same time preserve public control.

It is a curious fact that ever since the Interstate Commerce Commission was created, 24 years ago, its attempts to secure detailed reports from express companies have been vigorously resisted by those companies. Now that they have been forced to report their operating costs and income, it develops that the statistics are such as to justify the existence of the express companies as exceedingly economic instruments in the service of the public. We believe that precisely the same sort of justification of the railway companies will come when the Interstate Commerce Commission is provided with an appropriation that will enable it to appraise the physical property of all the railways. From such data already secured by various states, it is reasonably certain that after allowing 5 per cent on the cost of reproducing the physical property of the railways, the remaining net profit will not exceed 10 per cent of the gross annual income, and it may even be lower than the modest 8 per cent profit earned by the express companies.

Motor Trucks for Contractors' Hauling.

The possibilities of motor trucks for contractors' hauling have been noted at various times in this journal and in our issue of Jan. 18, 1911, we gave a brief account by Mr. Charles R. Gow of his successful use of a two-ton motor truck for hauling construction materials some seven miles for the Springfield, Mass., filter plant. In discussing this experiment elsewhere Mr. Gow says:

> In long hauls I should say that undoubtedly the automobile truck would pay, not only in hauling sand and gravel but in the hauling of any material. In the shorter hauls, I have some doubt as to its relative efficiency. The value of the automobile truck lies in the fact that it can cover long distances in a short time, and we found that particularly advantageous in this case. The paper mentions the fact that late in the season we commenced to experience difficulty with the automobile truck. The grades were very steep, and the roadbed was of the type usually found in country districts where no attempt has been made at surfacing. At this season of the year the ground froze at night to a depth of 2 or 3 ins. or more, and remained so until the middle of the forenoon, when it started to thaw. As soon as the thawing action commenced, a film of mud formed on top of the frost, so that on the grades the truck was practically uncontrollable, and it became so dangerous, and there were so many narrow escapes from capsizing the truck, that it was considered advisable to withdraw it. That was so even with chains. We had difficulty on some of the steeper grades in keeping the truck from sliding bodily. Outside of that feature, there is no question in my mind that automobile trucks would be serviceable, as a general thing, for all long hauls.

So far but little use has been made by contractors of motor trucks for hauling and this evidence from a practical contractor is of decided interest. Comparatively speaking motor trucks have of course been little used in hauling of any kind, but we believe that both engineers and contractors will be surprised to learn the extent to which they are used. From figures made public by automobile manufacturers it appears that there are now in use some 20,000 motor trucks and delivery wagons, and of this number about 50 per cent are motor trucks of from 2 to 7 tons capacity. The report giving these figures says further:

> There are, by careful count, 130 active builders of motor trucks, delivery wagons and other forms of industrial motor vehicles in America, and of this number 36 are manufacturing gasoline trucks of from 3 tons capacity up, 10 build electric trucks of 1 ton capacity or more and the rest make trucks of from 1 to 2½ tons.

While most contractors have become familiar through general observation with the idea that the automobile delivery wagon for light loads is assuming an important place in city transportation, it will, we think, be news to them that so large a use is being made of motor trucks for heavy hauling. As further information along this line we will quote again from the report mentioned above:

> Practically all builders of these machines, whether gasoline or electrically driven, build the running gear, power plant and driving mechanism as an independent operative unit called a chasis. Any desired style of body for any special line of work can be built to fit this chassis to adapt it to the peculiar needs of the buyer. By this method a single model of chassis can be applied to a most varied line of work, thereby eliminating the cost of special construction except in body work. Many forms of bodies have been designed to facilitate the rapid loading and unloading, with the object of keeping the machine actually running as many hours in the day as possible, on the same principle that every factory manager keeps his machinery constantly in operation to increase the earning capacity of the investment. The market affords power trucks of every capacity, from 1 ton to 10 tons, with speed limits of from 5 miles to 15 miles an hour, loaded. There is every possible choice for the purchaser in the

matter of power, type of engine or battery, form of transmission and final drive, in tire and other equipment and in price.

As to cost of operation, which is the important feature from the contractor's viewpoint the report says:

Very carefully compiled figures show that ten 3-ton gasoline trucks, all covering 40 miles a day and operating 300 days a year, can be maintained and operated at an average daily cost per machine of $9.75. The items contributing to this average are as follows:

Fixed Charges per Year on One Truck

Interest at 6 per cent on $3,000, cost price..	$ 180
Depreciation, at 20 per cent	600
Insurance, at ½ per cent	15
Storage, 200 sq. ft. at 50 cts	100
	$ 895
Add 20 per cent for two spare machines	179
	$1,074

Dividing by 300, the number of working days in the year, this gives $3.58 per day.

Running Expenses Per Day for 10 Trucks:

Wages of 10 drivers at $2.50 for 10 hours..	$25.00
Wages of repair man, helper and washer..	7.00
Gasoline, 80 gals. at 12 cts	9.60
Lubricants [illegible] per truck	4.00
Maintenance, at 10 per cent a year	10.00
Superintendence	3.20
Incidentals, light, heat, tools, waste, etc.	2.87
	$61.67
Average running expense per truck	6.17
Fixed charges per truck per day	3.58
Total maintenance and operating cost..	$ 9.75

Calculated in the same way, it is shown that a service of ten 5-ton trucks can be operated at [illegible] figures can only be taken as a fair guide to the probable cost of an installation. They are, if anything, rather high, in the light of results obtained by some users, but conditions of work, usage and care vary so much with different installations that no figures can be made to apply to all. A most carefully compiled estimate, based on known costs, for an installation of 44 electric trucks in the meat packing trade, made by the leading manufacturers of such vehicles, gave the following as the average daily total cost per vehicle: Five-ton truck, $10.35; 3½-ton truck, $8.76; 2-ton, $7.73; 2,500-lb., $7.07. This estimate, however, was based on the assumption that the entire transportation equipment would be converted from horses to motor trucks, with the resulting greater proportionate economy of maintenance and operation. On the complete installation it was shown that an annual saving of $23,569 could be effected, representing a 17½ per cent cut in transportation expense. The required additional investment of $88,779, [illegible] wagons could be extended [illegible] period the annual saving would amount to 26 per cent.

Naturally we may expect these figures to be liberal toward motor truck economy. For example, it will be seldom that the contractor can base his fixed charges on nearly as many as 300 working days a year. Take the case of a contractor for road work, whose plant will seldom average 100 days actually worked per year, and we get [illegible] given a fixed charge of [illegible] $10 per [illegible] worked. In another respect, as indicated by the statement of Mr. Gow quoted above, we find a decided difference between ordinary contract work and city trucking in the character of the roads to be hauled over. It is not our purpose to enter into details in these matters, but they require mention in considering the cost figures commonly presented for motor truck haulage. As an example of the kind of cost data needed we may mention those given by an engineer in another column on the operation of an ordinary passenger automobile employed for pleasure and inspection trips.

In conclusion, while it is absolutely certain that the economy of motor truck haulage for contractors must be considered on a largely different basis than is haulage for commercial houses such as the packing house mentioned above, there is a wide field, we believe, for the development of the motor truck for contractors' uses. We may mention also that an excellent opportunity to make a study of practically all the types, styles and sizes of motor trucks and delivery wagons that are in the market today will be presented to contractors and engineers by the automobile show to be held in Chicago from Jan. 28 to Feb. 11, under the auspices of the National Association of automobile manufacturers. More than 50 of the leading buildings of these machines will make displays of their products during the second week of the show, when from 150 to 200 of these vehicles will be on exhibition.

CONCRETE AND REINFORCED CONCRETE SECTION

Results of Tensile Tests of 6x6x18-in. Concrete Prisms.*

The series of tests covered three grades of concrete designated as follows:

Class (a) First Class Limestone Concrete.—The mixture used in this class was one part Nazareth cement, two parts bank sand, and four parts limestone from Rock-cut, south of Syracuse, N. Y., crushed to pass a 1½-in. ring.

Class (b) First Class Sandstone Concrete.—The mixture was in this case one part Nazareth cement, two parts bank sand, and four parts sandstone, the latter being field cobbles of several varieties, mostly sandstone, crushed on the work so as to pass a 2½-in. ring.

Class (c) Second Class Sandstone Concrete.—The mixture was in this case one part Nazareth cement, two and one-half parts bank sand, and five parts sandstone similar to that used for concrete . . Class (b).

Tension Tests.—The tension tests herein reported are believed to be to a certain extent unique. The method of testing as well as the results obtained should be of interest since we have been able to find very little published information upon the tensile strength of concrete in general and none as to methods of testing or the tensile strength shown by large concrete specimens. We do not contend that the apparatus herein illustrated and described cannot be materially improved upon, especially if the concrete specimens be made with a reduced section between the ends to be gripped, but for the tests of the particular specimens dealt with its working was entirely satisfactory.

Attempted tests of large size specimen of concrete in direct tension have shown its tendency to crush or shear off in the jaws which grip it before actual failure in tension occurs; less difficulty would be encountered as noted above were the specimen cast with a reduced section, between the gripping ends. Consideration of the danger of failure occurring under complex stresses instead of direct tensile stress led to the final adoption of the device described.

Each grip consists of a solid cast steel envelope having the form of a hollow truncated pyramid of square section. The sides of this envelope were machined inside and out to a slope of 1 in 10, the smallest interior diameter being 7 ins., the largest 8 ins., and the length of the envelope 5 ins. Wedges were made of hard maple and, in order to permit them to slide with little friction upon the envelope, they were shod on the outside and ends with steel, machined smooth. The use of four wedges permitted the specimen to be gripped alike on all four sides; ⅝-in. steel bolts placed at the corners connect the envelope to a cross-shaped bearing-plate of cast steel which transmitted the stress to a 1½-in. steel bar which was in turn gripped by the jaws of the testing machine. The connection of this steel bar to the bearing-plate was a spherical bearing so that there was no possibility of the stress being applied in any manner except along the central axis of the apparatus and specimen. Care was taken in every case to drive wedges in to an equal degree of pressure before applying the load

The results attained by this device were very satisfactory in every way, it will be seen that the majority of the specimen broke well away from the grips at some point within the 3 to 4-in. space between the grips. In no case, even when failure occurred close to the grips, was there the least indication of any crushing between the wedge grips. The break was always perfectly clean, there being absolutely no loose particles, and the fracture was usually in a plane practically at right angles to the direction of application of the load

In many instances, in the tests of the sandstone concrete, stones were split in two in the plane of the fracture instead of breaking the bond with the mortar, this was particularly true in the case of the red sandstones previously mentioned.

The results of the tests bring out some very interesting points concerning the tensile properties of concrete, and the close degree of uniformity in the strength shown by the different specimens of one lot give a good indication of the reliability of the method of testing used. (See Table I for test data.)

The first-class limestone concrete in six tests shows an average tensile strength of 278

[illegible] TENSILE STRENGTH OF [illegible] PRISMS

Mark	[illegible]	[illegible]	Ult. load (lbs.)	Unit. stress lbs sq. in.	Remarks
16 (a)	[illegible]		10,000	[illegible]	[illegible]
16 (b)	[illegible]	[illegible]	11,100	308	[illegible]
[illegible]		[illegible]	9,100	253	[illegible]
16 (d)		207	11,000		[illegible]
16 (e)		[illegible]	9,500	264	[illegible]
16 (f)		207	9,250	257	[illegible]
Ave.			9,990		
20 (a)	2nd class sandstone		4,350	121	[illegible]
20 (b)	[illegible]		[illegible]	114	[illegible]
20 (c)		[illegible]	3,800	106	Broke 1" below upper grip
Ave.			[illegible]		
[illegible]		185	5,350	149	[illegible]
[illegible]			[illegible]	142	[illegible]
[illegible]			4,800	[illegible]	Broke 1" below upper grip.
Ave.			5,083	141	
10 (g)	2nd class sandstone		5,700	[illegible]	[illegible]
10 (h)			4,100	114	Broke even with upper grip.
10 (i)			3,500	97	[illegible]
10 (m)			[illegible]		[illegible]
10 (n)			4,650		[illegible]
10 (o)			5,000	139	[illegible]
Ave.			4,900	136	
23 (a)	[illegible]	202	6,400	178	[illegible]
[illegible]			5,700		[illegible]
[illegible]			4,600	128	[illegible]
23 (d)			[illegible]		[illegible]
[illegible]		202	5,400	[illegible]	[illegible]
23 (f)			[illegible]	161	Broke 1" below upper grip
Ave. ..			5,567	[illegible]	

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*Extract from a paper by Prof. A. P. Mills in the "Cornell Civil Engineer," January, 1911.

lbs. per sq. in., the highest being 308 lbs. per sq. in., and the lowest 253 lbs. per sq. in.

The first class sandstone concrete in nine tests shows an average tensile strength of 150 lbs. per sq. in., the highest being 178 lbs. per sq. in., and the lowest 128 lbs. per sq. in.

The second class sandstone concrete in nine tests shows an average tensile strength of 129 lbs. per sq. in., the highest being 179 lbs. per sq. in., and the lowest being 97 lbs. per sq. in.

By a comparison of the tensile tests with compressive tests* it appears that the tensile strength is in the neighborhood of 10 per cent of the compressive strength, being 11.1 per cent for the first class (1:2:4) limestone concrete, 9.3 per cent for first class (1:2:4) sandstone concrete, and 8.8 per cent for second class (1:2½:5) sandstone concrete.

Comparing the sandstone concrete with the limestone concrete it is seen that while the first class sandstone concrete has 64.6 per cent of the strength of the limestone concrete of the same mix in compression, it has only 51 [illegible] of the limestone concrete in tension. The second class sandstone concrete has 58.8 per cent of the strength of the first class limestone concrete in compression, but only 46.4 per cent of the strength of the limestone concrete in tension.

Design and Equipment of a Floating Concrete Plant With Costs.†

The type of concrete plant described in this sketch is substantially the same as one which was recently operated very successfully in connection with the hired-labor work at new Lock and Dam No. 5, Monongahela River, at Brownsville, Pa. Experience gained on that work has indicated several improvements, all of which are incorporated in the new design. A plant of this type necessarily has limitations to its proper field of use, the imperative requirement being a depth of water for flotation which will not fall below 4 ft.; this depth is about the minimum for operating derrick-boats, sand and gravel flats, and other floating plant commonly used in the construction of large works of river and harbor improvement. The "mixer" is obviously designed with the idea of being supplied with sand and gravel from barges which are moored alongside during the operation of the plant, these materials being hoisted by clam-shell bucket into the storage bins located over the charging hoppers. The mixed concrete is usually removed by a derrick set up between the forms and the floating mixer, or else by a derrick-boat moored within reach of both forms and mixer. The cofferdam must be laid out with this object in view. The plant is designed to operate with a minimum of labor and fuel; and experience has shown that it will continuously supply over twenty 1½ cu. yd. batches of well-mixed concrete per hour for three shifts of 8 hours each daily. The plant used on the Monongahela River never broke down during a year and a half of heavy duty. Such a satisfactory performance speaks well for the Ransome mixer installed.

The equipment will include a first-class stiff-leg derrick with 55-ft. boom, three-drum hoist, and separate steam swinger mounted as far toward one end of the barge as space will permit. A duplicate set of upright boilers of 30-hp. each will furnish steam for the operation of the entire plant, one fireman only being required. In case of repairs to one boiler the other can be worked at overload temporarily. The coal bins are located at the extreme end of the barge to partially counteract the weight of the heavy cement storage shed and to be convenient to the fire doors. Coaling is ordinarily to be done from a coal flat with a second derrick, and requires only a few clam-shell bucketsful to fill the bins.

The importance of installing the best machinery throughout can not be overemphasized, and I would recommend a Lidgerwood or Mundy 8¼x10-in. tandem three-drum hoisting engine, with separate steam swinger. The clam-shell should be operated on a single line for speed, and the 8¼x10-in. engine is none too large. The patent swinging device geared to the main engine can never take the place of a separate steam swinging engine. The mast of the derrick should be mounted with a forward tilt. This arrangement greatly facilitates the swinger in bringing inboard a heavily loaded clam-shell which necessarily gives the barge an appreciable list when first hoisted from the flats alongside. The load and closing lines of the bucket should be rigged about as shown in the illustration, as this puts the least strain on mast and stiff legs. Experience proves that it pays to buy the best extra pliable plough-steel rope for rapid operation over small sheaves, and the eight-strand type of 19 wires each is the best.

The sand and gravel storage bins are so built as to allow the clam-shell operator to see into them from his post at the lever stand, and he is thereby enabled to dump his load without mixing or waste. The bins have a combined storage capacity of about 60 cu. yds. (gravel, 40, and sand, 20), sufficient to allow the mixer to continue operating for over an hour in case of minor repairs to the hoist or derrick. The bins are designed so that all their contents will flow by gravity to the charging hoppers just below. The gravel hopper is filled by throwing a lever, which opens a horizontal door below the gravel bin; when full, this bin holds exactly the proper charge of gravel for one 1½ cu. yd. batch of concrete. Similarly, a second lever fills the sand hopper with the proper charge of sand. No time is thus lost in any rough attempts at measuring, and the scheme insures uniform mixtures. Water is admitted to the mixer proper in the usual manner, but the drip from the sand and gravel bins above makes the quantity of water to be added to each batch quite small.

The following capacities of sand and gravel hoppers are about correct for 1½ cu. yd. batches of 1 : 3 : 6 concrete:

Capacity of gravel hopper, 35 cu. ft.; capacity of sand hopper 17 cu. ft.; six sacks of cement, 95 lbs. each.

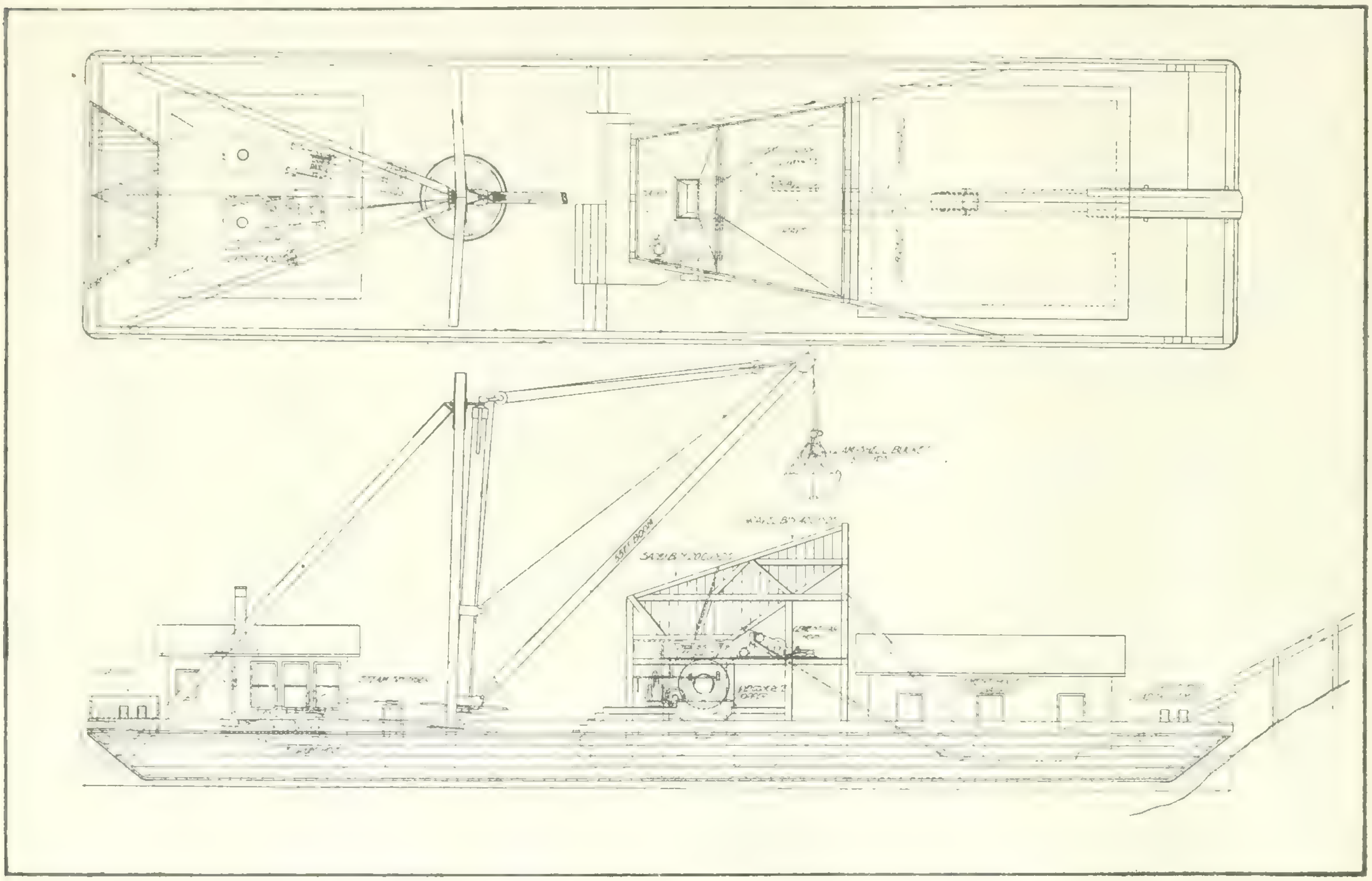

Fig. 1—General Plan of Floating Concrete Mixing and Handling Plant.

[illegible] Engineers, U. S. A., in "Professional Memoirs" [illegible]

Care must be exercised to see that the gravel used does not contain an excess of sand when delivered, as such excess does not increase the volume of gravel and necessitates a reduction of the capacity of the sand hopper. This may be conveniently done by nailing a wooden block of the proper volume within the hopper and removing it when gravel, free from sand, is furnished.

The sand and gravel for Lock No. 5, Monongahela River, was purchased under specifications calling for a price per bushel, and defining a bushel as 1.27 cu. ft. These specifications proved most satisfactory to the Government, but less so to the sand and gravel contractors, because the excess of sand in the gravel was often considerable and only evident from the increased displacement of the flats. The actual cubic contents of each flat was obtained in cubic feet, and this quantity divided by 1.27 was the basis of payment. The result was that the contractor furnished about a third of the sand used on the work without receiving payment therefor.

Cement is supplied to the charging hopper by means of a small car running on double tracks which form an incline from the cement shed to the hopper. The shed shown has a capacity of 1,000 bbls., which is sufficient for the average run. While setting up new forms, the mixer is moved to the proper point and the shed is loaded with cement in bags. Where local conditions permit, a most satisfactory method of loading cement consists in a wooden chute built down a steep bank with a railroad siding at the top of the chute. The cars are side-tracked at the chute and the bags are thrown into it, descending by gravity into the shed on the mixer. This arrangement supposes the cement to have been tested at the manufacturer's and already accepted when it arrives. The small cement car is open at the top and front and is large enough to hold the contents of six bags of cement. It is hauled to the top of the incline by a cord passing around two pulleys near the mouth of the charging hopper and attached to a drum driven by a small reversible steam engine. When the car reaches the top of the incline the front wheels drop between the outer rails, up-ending the car, the small hoisting engine is automatically stopped and reversed, lowering the empty car down the incline to be reloaded.

It is imperative to keep the cement shed and bins as low down as possible for favorable effect on the center of gravity of the whole barge; for this reason the deck is built in two levels, the higher one serving to raise the main hoisting engine so that the clam-shell operator gets a clear view over the gunwales and into the inclined tops of the sand and gravel bins.

Below the spout of the mixer is a concrete hopper with sufficient capacity to hold 1½ cu. yds. of concrete. The object of this hopper is to receive a mixed batch and allow the mixer to continue operating and avoid the delay of waiting for the concrete bucket to receive each batch direct. Such an arrangement also allows the use of a 3-cu. yd. bucket. Placed beneath the concrete hopper, such a bucket receives the 1½ cu. yd. batch already in the hopper, and as the door of the hopper opens, the mixer spout is also lowered, allowing both batches to run into the double-batch bucket simultaneously.

It would be possible to design this plant with a view to using a "continuous mixer" of the Foote type. Such a mixer would not require the measuring of the sand and gravel in charging hoppers, and would permit the heavy sand and gravel bins to be lowered and enlarged if considered desirable. Most of the concrete specifications issued by the Department at present call for the concrete to be mixed in a machine of the "batch type," which, to be consistent, would bar the installation of a "continuous mixer."

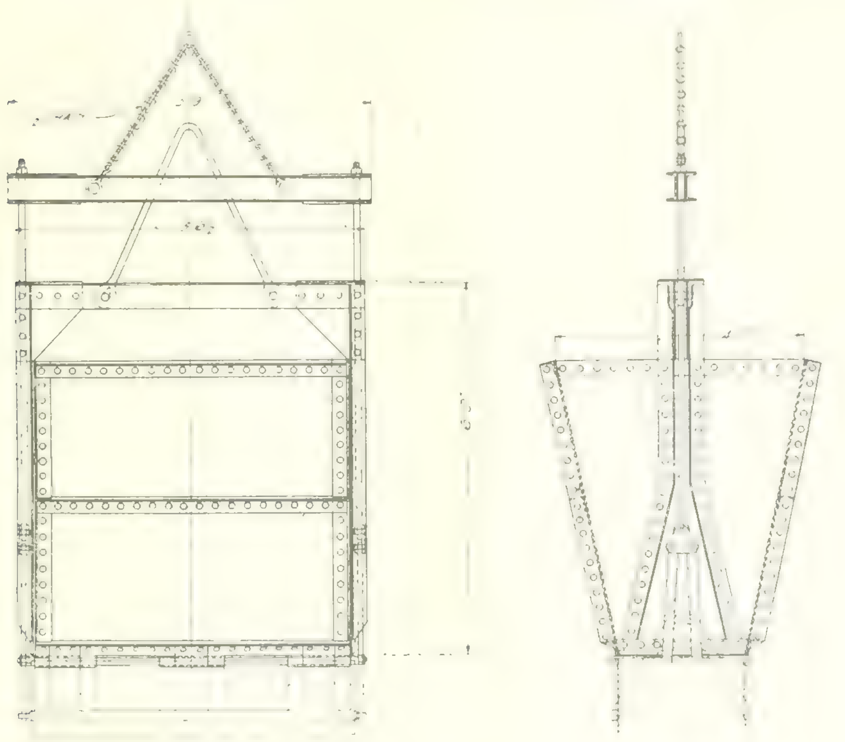

Fig. 2—Bottom Discharge Dump Bucket for Concrete.

It is not practicable to mount a second derrick on the mixer barge to deliver the concrete to the forms, because the listing of the barge from the clam-shell loader would make it very difficult to handle the concrete bucket at the forms. If the bags of cement are to be delivered from a cableway, it would be desirable to have part of the shed roof removable so that the skip could be lowered directly into the shed.

To increase the usefulness of such a plant, a standard Westinghouse railway air-compressing outfit can be installed near the housing for the boilers. The compressed air will be of use in operating pneumatic boring machines, which are a great convenience on heavy timber work.

The most satisfactory concrete bucket ever used on the Monongahela River work is [illegible] are that it is narrow enough to be used with almost any kind of heavy concrete forming. It can be partially dumped at one end of the form, then moved to the other end and emptied. It does not "kick" or recoil in the least, thereby saving much damage to forms and preventing accidents to the laborers in the forms. It is very strong and durable and never fails to open or close instantly, on signal to the engineman. Its only disadvantage is that it requires two lines for operation, one for opening and closing, and a load line. Any first-class machine shop will make one for $175, or less.

The following men would be necessary to operate the whole concrete mixing plant.

	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The amount of soft coal needed for firing boilers to furnish an average of 40 hp., would be two-thirds of a ton for each shift of eight hours.

The first cost of such a plant would be approximately as follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Derrick, complete, with three-drum hoist [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Cement car and hoist	400
[illegible]	[illegible]

Permeability of Concrete. — Studies have been made by the Board of Water Supply of New York city of the effects of various fine materials incorporated in the matrix of concrete in reducing permeability, including clays, hydrated lime and puzzolan and sand cements; these two cements being more finely ground than Portland cement. The conclusion reached was that concrete, practically impervious under 200-ft. head, can be produced with any of these materials, but that equally good results can be secured at no greater cost by using sufficient Portland cement, the latter method having the advantage of securing concrete of increased strength, while the other materials usually reduce strength.

Cost of Engineering.—An investigation of the engineering expenditures on the Catskill Acqueduct work of the New York Board of Water Supply up to Dec. 31, 1909, showed that Headquarters' expense for preliminary work amounted to 1.2 per cent and the expense in the field departments amounted to 1.4 per cent of the value of work put under construction, advertised and ready to advertise; also, that the total cost of engineering for construction work was 8.6 per cent of the amount earned to date under contracts and agreements, the percentage being high for construction because of the relatively large amount of engineering at the beginning. Salaries, rents, equipment and all other expenses are included.

An exhibit at the Chicago automobile show will be a 10-ton truck with an 18-ft. platform—one of the largest motor trucks that is built as a regular model. Ten of these trucks, fitted with steel bodies and side chutes, are in regular service by Burns. Bros. in New York City for delivering coal to hotels, factories, apartment houses and other large consumers. The fleet of trucks has an aggregate capacity of 1,000 tons a day, each truck carrying 10 tons at a load and making ten trips. They are loaded from overhead pockets and spill their loads through the side chutes into coal holes in the sidewalks by gravity, practically no shoveling being necessary.

Lathing and Plastering.—The following data are published by A. Dixon:

Applying metal lath on wooden studs: An expert on straight work will put on 12.5 to 17.0 sq. yds. per hour. On crooked or complicated work the same man will put on 5 to 7 sq. yds. per hour.

Applying metal lath on steel studding: One man will put on from 5 to 9 sq. yds. per hour.

Plastering on metal lath: First coat, from 9 to 14 sq. yds. per hour; second or scratch coat, 6 to 9 sq. yds. per hour; finishing coat, 11 to 14 sq. yds. per hour.

EARTH AND ROCK SECTION

Digging Ditches With Dynamite.

BY ARTHUR E. MORGAN.*

In the lowlands of southeast Missouri, a considerable amount of excavation for drainage ditches is now being made with dynamite, a method of construction discovered by accident in 1909. In blowing large stumps preparatory to digging drainage ditches, it was noticed that where several stumps close together in a line were blown out, a depression remained which had approximately the dimensions of the required ditch. Acting on the suggestion thus offered, efforts were made to blow out a channel by placing a single charge at a time, with results which were not satisfactory. Next charges were placed in the ground 2 ft. apart for a distance of 100 or 200 ft., and an effort was made to discharge them at about the same time by means of fuses. As the explosion of all charges was practically instantaneous, it was apparent that all but the first had been discharged by concussion.

The experimenters continued setting charges 2 or 3 ft. apart for distances up to a quarter of a mile, and found in all cases that it was necessary to set a fuse to only one of the charges, in order for the whole to be exploded. Up to the present this method is in use only for the construction of small ditches 3 or 4 ft. deep and 6 to 12 ft. wide. The dirt removed by the dynamite is thrown onto either side for 100 ft. or more, and does not lie more than 6 ins. or 1 ft. deep along the margins of the ditch. The charges are set by making a hole of the necessary depth with a bar, and then pushing the dynamite into the hole with a wooden stick, tamping dirt on top. nI order to secure a uniform cross section it is found necessary to place the charges at equal distances apart, and at such a depth that they will be on the proposed bottom line of the ditch, and that the charges should be approximately equal in size.

The best of the channels constructed in this manner are as nearly uniform in cross section as they could be made by using teams and scrapers.

One of the ditches examined, which had been constructed about a year, was 6 ft. wide on the bottom, 12 ft. wide on top 3½ ft. deep, and in good order. In digging it two ½-lb. sticks of 50 per cent dynamite were placed 3 ft. apart in the ground and between 3 and 4 ft. deep. Two men will construct a quarter of a mile of ditch in a day.

At a cost of 15 cts. per pound for dynamite, and $20 per mile for placing the charges, the ditch in the condition in which it was examined, after a year of depreciation, had cost about 5 cts. per cubic yard. The ditch had been constructed through the woods without cutting down any of the trees, and in some instances the fallen trunks were lying across the channel.

This method of construction is coming into general use in excavating lateral ditches in the wet muck soils of southeast Missouri. Its advantages lie in its usefulness for digging ditches too small for a dredge, and through ground too wet for economical work by hand or with teams and scrapers. Whether larger channels can be constructed by using larger charges of dynamite, placed at greater depths, remains to be seen. Sandy soils are not handled as readily as clay or muck, and where ditches have been blown out in sand, the cost per yard has been several times as great. Neither does the method work well in dry soil. The use of 60 per cent dynamite has in some cases given better results than 50 per cent. If the success achieved by this method of excavation is repeated in other parts of the country, it will appear that we have added to our construction methods another means of earth excavation, applicable to wet muck and clay soils, under conditions where none of our former methods of excavation were economical for the construction of small channels. The accompanying view shows the earth being blown out as the charge is fired.

View of Blast, Ditch Digging With Dynamite.

Some Progress Data in Driving the Loetschberg Tunnel.

BY EUGENE LAUCHLI.*

The following data may be of interest to readers of ENGINEERING-CONTRACTING, owing to the fact that, on about 50 per cent of the work hereafter described, American machinery and appertunances are being used.

The construction of a new railroad in Switzerland, serving the purpose of connecting the city of Berne directly with the Simplon tunnel involves the driving of some 34 tunnels aggregating 87,000 ft. in length. The longest one, the Loetschberg tunnel, will be, when completed, 47,680 ft. long.

In driving most of the short tunnels, Temple Ingersoll Electric Air Drills are used. The electric current is brought at 5,000 volts and stepped down to 220 volts at the drill; each drill requires from 8 to 10 h.p., and the pressure at the drill piston is about 50 lbs. The material penetrated is gneiss and crystalline schist. So far these drills have proved to be a success, especially where the steepness of the mountain prevented air pipes from being laid conveniently on the ground.

The long tunnel is being driven from two portals. Foreign machinery is used at the north portal, while American machinery is used at the south portal. Here, the material penetrated have been crystalline schist and hard granite. The maximum rock temperature so far recorded has been 94° F. The top and bottom heading method is used; in crystalline schist, the average progress months for months has been 525 ft. or 18 ft. per 24 hours. In granite, the average monthly progress is 500 ft. or 16.5 ft. per 24 hours.

The following record for driving the bottom heading is for the months of April, May and June, 1909. The material penetrated was crystalline schist, hard and rather tough:

Area of Heading, 67 sq. ft. (about 6.5x10 ft.):

Number of working days	85
Total progress	1,400 ft.
Average daily progress	16.5 ft.
Average number of drills used	5
Average number of rounds per 24 hrs.	5
Average number of bore-holes per round	13.7
Average aggr. length of holes per round	58.5 ft.
Average depth of one bore-hole	4.27 ft.
Average progress per round	3.45 ft.
Pressure at the compressor	85 lbs.
Pressure at the drills	73 lbs.
Dynamite used per cu. yd.	8 lbs.
Length of bore-holes per cu. yd.	6.8 ft.
Number of drills dulled per cu. yd.	5.5
Time for drilling per round	2.31 hrs.
Time for mucking 1 cu. yd.	0.31 hrs.
Time for drilling 1 ft. of hole	0.20 hrs.
Amount of dynamite used per cu. yd. in bottom heading	8 lbs.
Amount of dynamite used per cu. yd. in top heading	9.4 lbs.
Amount of dynamite used per cu. yd. in enlargement	1.3 lbs.
Average amount of dynamite used per cu. yd. for whole section	2.6 lbs.

One machine had to be repaired after drilling 365 ft. of bore-holes.

The following data is for driving the bottom heading during the months of April, May and June, 1910. The materials penetrated were granite and quarzporphyr:

Area of heading	63 sq. ft.
Number of working days	90
Total progress	1,500 ft.
Average daily progress	16.7 ft.
Average number of rounds per 24 hrs.	4
Average number of bore-holes per round	14
Average aggr. length of holes per round	67 ft.
Average depth of holes	4.7 ft.
Average progress per round	4.2 ft.
Pressure at the compressor	100 lbs.
Pressure at the drills	95 lbs.
Dynamite used per cu. yd.	6.8 lbs.
Length of bore-holes per cu. yd.	6.8 ft.
Number of drills dulled per cu. yd.	6.5
Time for drilling per round	2.48 hrs.
Time for mucking per round	3.12 hrs.
Total time per round	6 hrs.

One drill shift is composed of 4 drillers, 3 drill helpers, 1 nipper and 1 foreman. There are 8 muckers per shift. The cars are hauled out of the tunnel by compressed air locomotives running at a speed of 8 to 10 miles per hour. An 85 per cent dynamite is used in the headings, and firing is done with fuses. A bonus system of payment has been established for each class of work, and each workman or next of kin receives an indemnity in case of accident or death.

The Use of Turbine Driven and Centrifugal Pumps for Construction Work.

(Contributed.)

The centrifugal pump direct connected to a steam turbine is being put to a great variety of uses, more especially in connection with power house work. There is, however, a field for this unit which has not perhaps been as thoroughly exploited as its virtues deserve, that is for pumping out foundation pits, caissons and coffer dams. In some cases the centrifugal pump is being used for this service belted to an engine, but the efficiency of such a unit must necessarily fall far below that possible with a direct connected set. The principal advantage of these units for work of this description is in their ability to stand hard knocks. Both turbine and pump are so exceedingly simple and strongly built that they are most adaptable to rough and ready installations, such as are not necessarily found in construction work. Heat, cold and dampness do not affect their operation, and it is not necessary to have either very dry steam for the operation of the turbine or water free from grit and small stones for the pump, there being no valves on either machine and the moving parts consisting simply of the rotor of the turbine and the impeller of the pump. There is practically nothing to get out of order in either machine, so that repairs are reduced to a minimum. In construction work it is essential to have machinery which can be moved about with the least amount of labor, and the light weight of the turbine driven pump is a strong argument in its favor.

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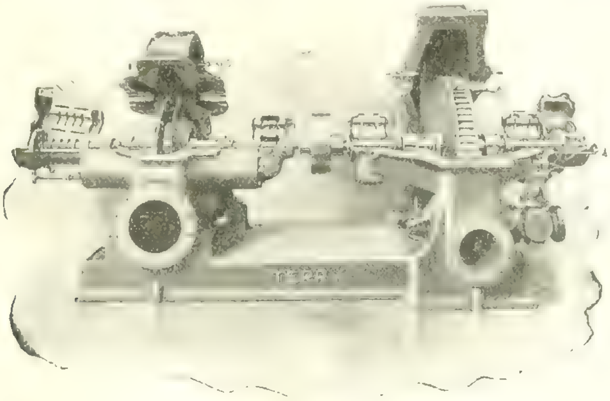
*2 Wall St., New York City.

The high speeds at which centrifugal pumps operate compared to the reciprocating units make it possible to obtain the same capacity with a much smaller pump. The usual practice is to have both turbine and pump mounted on a common base plate, to which each is securely bolted. With a coupling of the flexible type connecting the two shafts it is possible to transport the entire outfit with very little trouble. When set in place it is only necessary to connect up the water pipes for the pump and the steam and exhaust line for the turbine.

Some idea of the capacity of these units may be gathered from the fact that one such unit operating at 1,500 revolutions per minute handles 300 gallons per minute against 55 ft. total head. This pump is known as a 3-in. pump; that is, the diameter of the discharge line is 3 ins. The pump itself stands about 16 ins. in height and the diameter of the impeller is only about 8 ins. Of course for service of this kind a single stage pump would be used, as a greater head than 100 to 150 ft. is practically never met with, and a single stage pump of this kind is capable of operating against a pressure of 60 to 50 lbs. without any trouble. For higher pressures than this it is usual to use double stage or even multiple storage pumps. In such a case there are usually sufficient stages to correspond to one stage for every 50 lbs. pressure.

The accompanying photograph shows a type of single stage centrifugal pump direct connected to a Terry steam turbine. These units are manufactured by the Terry Steam Turbine Co. of Hartford, Conn. The idea is quite prevalent that steam turbines must either run at tremendously high speeds, say 20,000 or 25,000 revolutions per minute, or else they must be multiple stage machines. Of course this idea is due to the impressive speeds which were attained by the first single stage turbines where the entire velocity of the steam was given up to the rotor of the turbine in one passage through the buckets. In the turbines illustrated in this article, however, the advantage of compactness of a single stage machine is combined with the moderate speeds of a multiple stage turbine by means of return chambers.

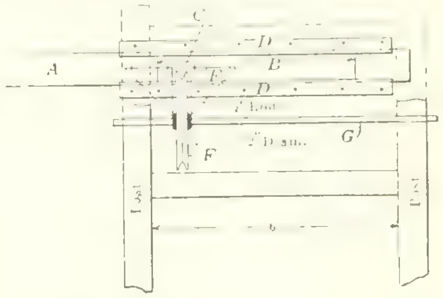

Turbine Driven Centrifugal Pump.

In all kinds of construction work below the ground level the troubles caused by seepage are usually the most important, and the absolute necessity for keeping such work free from water should make the question of a proper pumping outfit a paramount one to the contractor. Already the centrifugal pump is being used largely for dredging work, digging dirt, gravel and stones from the bottom of a water way without the slightest trouble. It is essentially the machine for handling large quantities of water which is laden with foreign matter of various kinds. The lack of valves and the large open passage ways of this type of pump permit it to handle rough and heavy material which could not possibly go through a reciprocating pump without doing a great deal of damage.

Although the electric motor adapts itself to driving centrifugal pumps, in a great many cases, it is entirely out of place in the circumstances obtaining on most construction work, especially where it is liable to dust or rain. The steam turbine is not only an excellent motive power for the centrifugal pump, but it shares with the latter the important qualification of being able to work under most difficult conditions and to withstand many hard knocks.

Device for Closing a Cable Slot in Engine House Wall.

In cold weather, when construction machinery is enclosed, it is often difficult to close out the cold entirely, on account of cables which lead out of the house from the drums on the machines. A cable operating on a wide drum requires an opening as long as the drum is wide. An arrangement used on a cableway plant at the Pabst mine in Ironwood, Michigan, is effective for this purpose. In the accompanying illustration, as given in the *Engineering and Mining Journal*, the opening, *B*, is about 5 ft. long and nearly 1 ft. wide.



Device for Closing Cable Slot.

A board, *A*, with a 2-in. hole, *C*, for the cable slides in grooves behind the boards, *D* The pulley, *F*, revolves on the rod, *G*, traveling back and forward with the cable. Two triangular ¾-in. steel rod braces, *E*, are fastened to the board, *A*, with a fork in the lower end to extend over the rod, *G*. These are in close contact with the pulley, and as the cable moves the pulley along the rod, *G*, the pulley moves the board, *A*, with it. The cable itself does not come in contact with the sliding boards, as it does in some other types which do not use the triangular braces. The sheave used in this particular case is 24 ins. in diameter.

ROADS AND STREETS SECTION

Details of Construction of the County Road System of Morgan County, Alabama.

BY R. P. BOYD*

Morgan County, Alabama, now has under construction a county system of highways embracing some 65 miles of road. Bonds for the construction of this system were voted on June, 1908, and were sold the following month. The bonds are to run for 30 years and are to bear 5 per cent interest. According to the state law the county could be bonded for only one-quarter of 1 per cent of the taxable property, and this gave the county $240,000 for its road system.

Before the bond issue was voted the county commissioners decided upon the roads which were to be improved. These roads were to lead from the main railroad points in the county and were to extend out east and west. The first contract which covered 30.8 miles of road, was let in September, 1908, the second contract, covering 27½ miles of road, was let in April, 1909. The contract prices on these two contracts were as follows:

[illegible]	[illegible]	[illegible]
Earth excavation, per [illegible]	[illegible]	[illegible]
Loose rock, per [illegible]	[illegible]	[illegible]
Solid rock, per [illegible]	[illegible]	[illegible]
Double [illegible] in place, [illegible]	[illegible]	[illegible]
Double [illegible] in place [illegible]	[illegible]	[illegible]
Double [illegible] in place [illegible]	[illegible]	[illegible]
Double [illegible] in place [illegible]	[illegible]	1.55
Box [illegible]	[illegible]	[illegible]
Retaining [illegible]	[illegible]	[illegible]
[illegible] per lin. ft	[illegible]	[illegible]
Road [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Crushed stone, [illegible]	[illegible]	[illegible]
Crushed stone (for repairs left at [illegible]	[illegible]	[illegible]
Lumber in bridges complete, per M. ft. B. M.	36.00	20.00
[illegible]	[illegible]	[illegible]
[illegible] per cu. yd.	....	8.50

Other smaller contracts have been let, the prices being similar to those under the 1908 contract.

The right of way on all improved roads is from 30 to 50 ft. depending on the nature of the work. When necessary borrow pits were secured along the right of way. The county is rich in limestone, and all the roads are built of this material. Good quarries were secured along the roads to be improved and the average haul from the quarries was about two miles. In some cases, however, it was necessary to haul as much as five miles. The limestone is of the upper and lower sub-carboniferous rocks of which there are two varieties: the lower limestone, gray, course grained and crystalline; the upper blue, fine grained, with but few crystals. The latter was used where the haul was not excessive.

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*County Engineer, New [illegible]

The roads were surveyed and cross sectioned in the usual way and stakes placed 9 ft. to the right of the center to avoid being knocked over by the travel. The contractor was furnished a profile showing cut and fill at each station and the size and location of culverts and bridges. Detail drawings were furnished for each culvert or bridge.

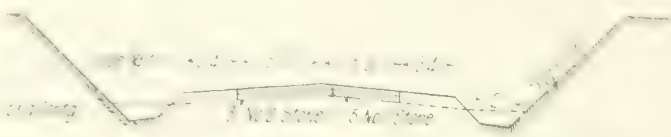

Fig. 1—Standard Cross-Section in Cuts.

The culverts were first put in and the grading done and the travel allowed to pack the grade for a period of not less than two weeks. The grade was then prepared for the macadam by filling all holes with dry material, crowning with a road machine and rolling thoroughly with a 10-ton road roller.

In some cases it was necessary to haul in suitable material for a sub-grade. Where the soil was of such a nature as to need a subgrade drainage trenches 1 ft. wide and 2 ft. deep were cut leading from the center of the subgrade to the side ditches and filled with crushed stone.

The macadam was laid in three courses as follows: The first course of No. 1 stone from 1¾ ins. to 3 ins. in size spread 4 to 5 ins. thick and rolled; second course, No. 2 stone from ½ in. to 1¾ ins. in size spread 3 to 4 ins. thick and rolled; the binder course, No. 3 stone, consisting of screenings from dust to ½ in. stone spread 1 in. thick, well sprinkled and rolled. Each course was spread with the same crown that the finished road was to have when completed, which was ⅞ in. to 1 ft. The above courses gave a thickness of about 6½ ins. when completed.

The standard cross section of roads provided for an 18 ft. roadway with macadam 10 ft. wide. This cross section was adhered to except in cases when a special type of construction was deemed necessary. Figure 1 shows the standard cross section in cuts; Fig. 2 shows the standard cross section in fills. In several places the road led over flat limestone ledges. Two types of construction were used in such places. The first type (Fig. 3) consisted of a curbing of stone cut to size 8 ins. x 12 ins., placed in parallel lines 14 ft. apart. This curbing by its weight serves to hold the macadam in place. The dips and irregularities in the subgrade were filled with spalls of rough stone. The subgrade was raised in the

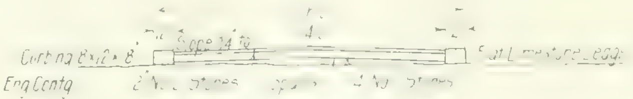

Fig. 3—Standard Cross-Section Over Roads.

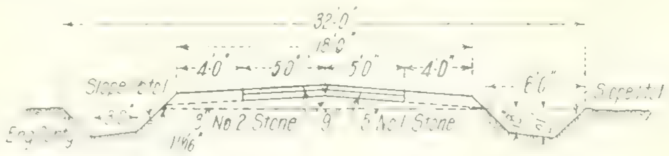

Fig. 2—Standard Cross-Section in Fills.

Another type of special construction was used on the Moulton Road at Mud Tavern Creek and on the Falkville Road at Flint Creek. At these places the creek runs parallel with the road and not ten yards from the nearest edge. In times of high water the creek overflows the road at these places from 4 to 6 ft. deep with a swift current. The soil was a sandy gravel affording a good subgrade for macadam, but poor material for a fill. If a fill was made at these places, it would have been necessary to rip-rap both sides heavily, and even then it was doubtful if it would hold. It was decided to build these places low. The old road bed was leveled up and holes filled and sloped from the creek to the outer edge, slope being ½ in. to 1 ft. Figure 4 shows a cross section of the Mud Tavern Creek Road.

A concrete curbing was put on the outer shoulder of the road and riprap behind the curb to prevent the road from washing out. The water rises gradually, flows over the concrete wall onto the riprap and does no harm at all. The water has been over these places and has not damaged the road, except that a fine coat of mud and silt covers the macadam after an overflow. The water rises rapidly and leaves rapidly and the travel is never inconvenienced long at a time. This method saved a fill over 3,000 ft. long with an average height of 4 ft. and riprap for one side.

The maximum grade established for the system was 6 per cent, but in two cases it was necessary to go over this as it was impossible to secure a right of way for a relocation. As a general rule the surveys follow the old roads, but in a number of instances the roads have been relocated. One example of the benefits of relocation is illustrated by the profile (Fig. 5) of County Road No. 2 East of Hartselle. As shown by the profile, the grades on the old road were 10 and 14 per cent. Seven per cent was the best grade that could be secured on the old road at anything like a reasonable cost. By relocating the road about 100 yds. north of the old road, grades were reduced to 4.8 per cent and 4½ per cent, and the grading was mostly through earth instead of solid rock, although the road was lengthened about 500 ft.

The cost of this improvement was as follows:

2,656.7 cu. yds. earth excavation at 22½ cts.	$ 597.7[illegible]
150 cu. yds. solid rock excavation at $1.00	150.00
131.9 cu. yds. loose rock excavation at 35 cts.	46.17
Clearing and grubbing	107.94
Pipe culverts, etc.	[illegible]
500 ft. of macadam, 135 cu. yds., at $1.75	236.25
Right of way	275.[illegible]
Total costs	$1,768.[illegible]

To reduce the old road to a 7 per cent grade would have cost as follows:

[illegible] cu. yds. earth excavation at 22½ cts.	[illegible]
2,160 cu. yds. solid rock excavation at $1.00	[illegible]
Pipe, culverts, etc.	225.00
Total costs	[illegible]

This gives a saving of $924.42 in construction besides reducing the grades. A new bridge was needed on the old road at Shoal Creek so that the building of one on the new road did not increase the cost of the improvement.

All openings in the road of the system were made as permanent as possible and very few wooden bridges have been put in. Three steel bridges of [illegible], 32 and [illegible] ft. spans have been built from the Road Bond fund. For small drains double strength vitrified sewer pipe with cement joints was used.

Most of the drains are rock culverts of dry masonry with from 1 to 4 ft. openings according to the drainage area. Owing to the close proximity of good ledge rock these culverts were found the best and the cheapest drains for spans up to 4 ft. As an example it may be stated that a rock culvert of an area of 21 sq. ft., being 3½ ft. wide and 6 ft. high inside, cost $194.67. The walls of this culvert are 18 ins. thick, 6 ft. above ground and 1 ft. in the ground, 28 ft long on top and 32 ft. long at the bottom. The cover stones are 5½ ft. long, 12 ins. thick and there are seven stones in the cover. The bottom is paved with 8-in. stone set on ends. This culvert contains 43.26 cu. yds. of masonry. When rock was not available for rock culverts, concrete was used without reinforcing on spans up to 3 ft. These culverts are ornamental and serviceable and have stood the weight of a 12-ton road roller.

For larger openings from 4 to 12 ft. reinforced concrete was used, being the flat slab type reinforced with corrugated bars.

On each road under construction the County keeps an inspector, who acts under the direction of the Engineer. The inspector keeps a check of the number of yards of stone used on the road, sees that the subgrade is in proper shape and that the rolling and sprinkling are properly done. He is in full charge of the work in the absence of the engineer. At the end of the week he turns in a report (see Fig. 6) to the engineer giving the details of each day's work.

On the first of every month the Engineer takes an estimate of the relative value of the work performed the preceding month. The Engineer measures all culverts, bridges, grading, etc., and the amount of macadam put down is taken from the inspector's reports. An estimate is made out in detail and 85 per cent is paid to the contractor on the 10th of the month. Fifteen per cent of the estimate is retained by the County until five miles of road have been completed and maintained for 30 days. Then, upon the recommendation of the Engineer, the road is accepted and the retained percentage is paid to the contractor.

Figure 7 shows a daily statement form kept by the contractor which enables him to know the profit or loss on each day's work.

The cost per mile of some of the roads was as follows:

COUNTY ROAD NO. 2 EAST 10.8 MILES.

	Per mile.
Grading	$ 856.37
Pipe, culvert, bridges, etc.	406.18
Clearing and grubbing	42.50
Riprap	23.50
Force account for ditches, fences, etc.	65.16
Macadam	2,502.41
Repair stone left at quarry	63.40
Cost of construction	$3,959.52
Inspector	39.67
Royalty on stone	18.70
Total	$4,017.89

COUNTY ROAD NO. 3 WEST 5.1 MILES.

Grading	$ 658.94
Pipes, culverts and bridges	203.23
Concrete, curbing and riprap	146.74
Clearing, grubbing and ditching	15.00
Macadam	2,158.39
Repair stone left at quarry	55.20
Cost of construction	$3,237.50
Inspector	45.00
Royalty on stone	14.33
Total	$3,296.83

The Engineers are paid a salary which up to the present time amounts to 2½ per cent of the cost of construction.

On each road the county has a storage pile of crushed stone left at the quarries for repair purposes. The repairs so far have been done by day labor under the direction of the

GOODRICH & CRINKLEY.
DAILY STATEMENT

Cash on hand last report $
Cash receipts Total.
Cash disbursements
Total $
Balance on $

Time Checks outstanding last report $
Time Checks issued Total.
Time Checks redeemed
Time Checks outstanding this report

EXPENSE ACCOUNT—QUARRY.

Foreman @ $ per day $
Men
Driller
Helper
Water Boy
Dynamite
Powder
Total

EXPENSE ACCOUNT—CRUSHER.

Foreman @ $ per day $
[illegible]
Men
Fireman
Blacksmith
Coal
Total $

EXPENSE ACCOUNT—DUMP.

Teams @ $ per day $
......Foreman
Men
Roller Man
Gasoline @ per gal.
Total. $

EXPENSE ACCOUNT—COMMISSARY.

Clerk @ $... per day $
Cook
[illegible]
Merchandise
Total

EXPENSE ACCOUNT—GRADING.

Foreman @ $ per day $
Teams
Men
Total

RECEIPTS.

...yards stone on road @ $... per yard $ Total
...yards stone on cars
...yards [illegible]
...yards grading
...yards [illegible]
Commissary
Total Receipts

Fig. 7.

Engineer. When all contracts are finished the county expects to have a road foreman with one team and two laborers to each ten miles of road. The foreman will be under the direction of the Engineer and will report weekly what work has been done.

At the present date 53.9 miles of road have been finished and there are about 11 miles under contract still unfinished. With the bond issue of $240,000 [illegible] engineers, inspectors, a royalty of 2½ cts. per yard for stone, $2,228.00 for steel bridges, about $1,200.00 [illegible] age and [illegible] struction [illegible] excellent roads. While this is only about one-third of the mileage of the main roads in the county, the [illegible] roads and it will be only two or three years until another bond issue can be made and the road system so well begun in Morgan County can be finished.

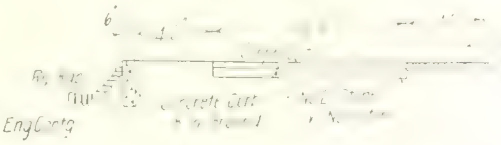

Fig. 4—Cross-Section, Mud Tavern Creek.

Methods of Taking Traffic Census on Highways.*

The inherent value of statistics relative to traffic on state trunk lines and county main roads, obtained previous to construction, is recognized by all engineers who are familiar with the problems of modern highway engineering and who take into careful consideration the economics of the construction and maintenance of highways.

Various classifications of the traffic to which the above classes of highways are subjected have been proposed from time to time during the past few years, but the methods to be employed in securing a satisfactory traffic census have not been made the subject of extended discussion in the technical press.

The principles underlying the essential elements of any classification of traffic may be stated briefly as follows: (a) differentiation between horse drawn vehicle traffic and motor car traffic; (b) a division of each of these classes of traffic into pleasure and commercial traffic; (c) a subdivision of commercial traffic into loaded and unloaded vehicles; (d) the determination of the weight per lineal inch of width of tire of all types of commercial traffic, (a factor of the utmost importance in the design of the substructure of the road); (e) a subdivision of the two classes of horse drawn vehicle traffic dependent upon the number of horses; (f) subdivision of pleasure motor car traffic upon the basis of weight and speed; (in many instances the greatest damage to an ordinary macadam road is caused by seven seat touring cars, limousines or landaulets traveling at speeds of 40 to 60 miles per hour); (g) provision for extraordinary characters of local traffic (for example, in certain localities many saddle horses may use the public road, in others, traction engines hauling trailers may be common, while in others motor bus traffic may be a regular and important feature); as a final illustration, special types of commercial traffic such as ice wagons, mill drays, etc., may be influential features.

As an integral part of the requisite investigation preliminary to economical and efficient design other facts relative to traffic should be obtained, as, for example, the direction of the traffic, the portion of the road occupied by various kinds of traffic, the relationship existing between reduced grades incurring increased distance between two points and probable traffic, the kind of shoes worn by horses at various seasons of the year, the use of non-skidding devices employed by motorists and the enforced traffic regulations governing the use of the road, especially with reference to limitations upon speed and loads to be carried.

In connection with the preliminary investigations, an engineer must always consider the change in the character and amount of traffic that is liable to occur after the improvement of a road. The importance of an estimate of probable traffic cannot be over-emphasized. As an example may be cited the marked change in the character of the traffic resulting from the construction of a bituminous pavement on a trunk line between two towns in Rhode Island. Two trunk lines have been nearly completed between the two towns in question, one of ordinary macadam oiled at intervals during the summer, the other as described above. The route of ordinary macadam is three-fourths of a mile shorter than the new route but nevertheless the longer route of a total of three miles is the more popular with the motorist for several reasons, which may be designated as follows: First, less opportunity of meeting horse drawn vehicle traffic; second, superior road from an esthetic stand-

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*Paper presented before Section D of the American Association for the Advancement of Science at the Minneapolis meeting, Dec. 29, 1910, by Professor Arthur H. Blanchard, Consulting Highway Engineer, Brown University, and Mr Irving W. Patterson, Assistant Engineer, with A. H. Blanchard, Providence, R. I.

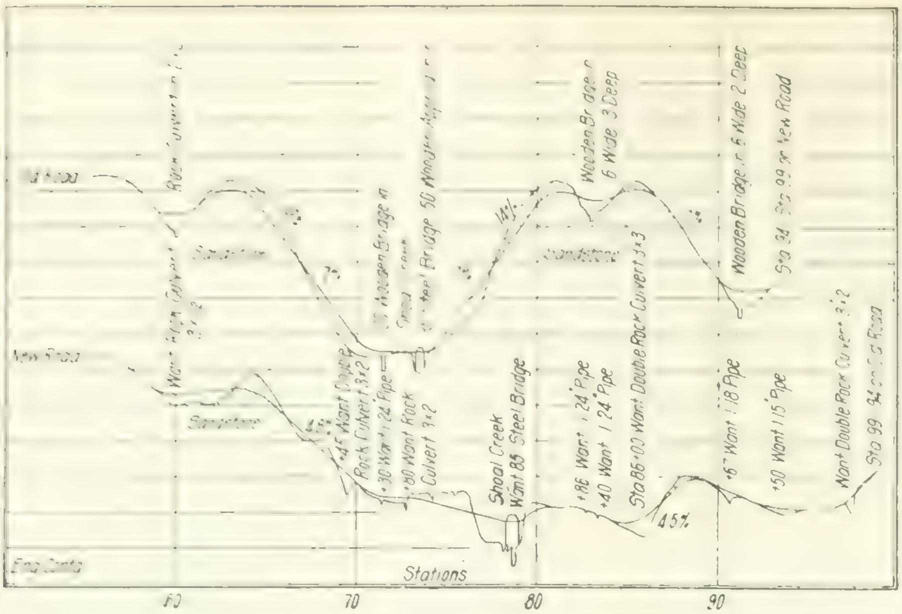

Old Road
New Road
Sandstone
Elevation
Stations
Eng. Contg.
60
70
80
90
Wooden Bridge
Wooden Bridge 6 Wide 3 Deep
Wooden Bridge 6 Wide 2 Deep
Sta 94 Sta 99 on New Road
+45 Want Double Rock Culvert 3x2
+30 Want 1 24 Pipe
+80 Want Rock Culvert 3x2
Shoal Creek Want 85 Steel Bridge
+86 Want 1 24 Pipe
+40 Want 1 24 Pipe
Sta 86+00 Want Double Rock Culvert 3x3
+6 Want 1 18 Pipe
+50 Want 1 15 Pipe
Want Double Rock Culvert 3x2
Sta 99 94 on Old Road
4.5%

Fig. 5—Profile of Old and New Road.

point; third, better road surface. There exist cases where the change in the character of or the unusual increase in traffic after the construction of a road renders unwarranted the securing of comprehensive traffic data previous to construction. By the careful preliminary investigation of such cases the engineer will be able to determine the method to be employed in order to secure the requisite traffic census data for the design of the road.

Before considering the methods by which the necessary traffic census may be obtained, various typical classification of traffic and other detail relative thereto which have been published during the past decade will be given, as a thorough study of the information thus presented will furnish food for thought in connection with local problems.

Before the recognition of the motor car as an important factor in highway traffic, the following classifications were published in this country:

CLASSIFICATION USED BY THE OFFICE OF PUBLIC ROADS INQUIRIES.

Loaded 1-horse wagon.
Unloaded 1-horse wagon.
Loaded 2-horse wagon.
Unloaded 2-horse wagon.
Loaded 4-horse wagon.
Unloaded 4-horse wagon.
1-horse pleasure vehicle.
2-horse pleasure vehicle.
Rubber tired vehicle.
Unharnessed horse or shod ox.
Excessively heavy vehicle (such as carry ore, stone, brick, timber, etc.)

Relative to the method of securing the volume and character of traffic, the following information is given: "less than a week's record is unsatisfactory and it is best that the record should cover as many seasons of the year as possible." The directions also call for each record to cover 24 consecutive hours.

Mr. A. N. Johnson, State Highway Engineer of Illinois, in 1906, employed a classification of horse drawn vehicle traffic based on a distinction between the traffic going towards important towns and traffic going from towns and a subdivision into loaded and unloaded vehicles. A further subdivision of the traffic was based upon the number of horses employed. "In winter the traffic was recorded during the daylight hours, in other seasons of the year from 6:00 a. m. to 6:00 p. m. The days were so selected that if the first count came on a Monday, the next would come on Tuesday of the following week, Wednesday of the next week and so on."

Since the advent of the motor car, the traffic classifications have undergone a transformation. One of the most comprehensive which have been noted is the preliminary form proposed by the new Road Board of England. The classification includes the following list of vehicles:

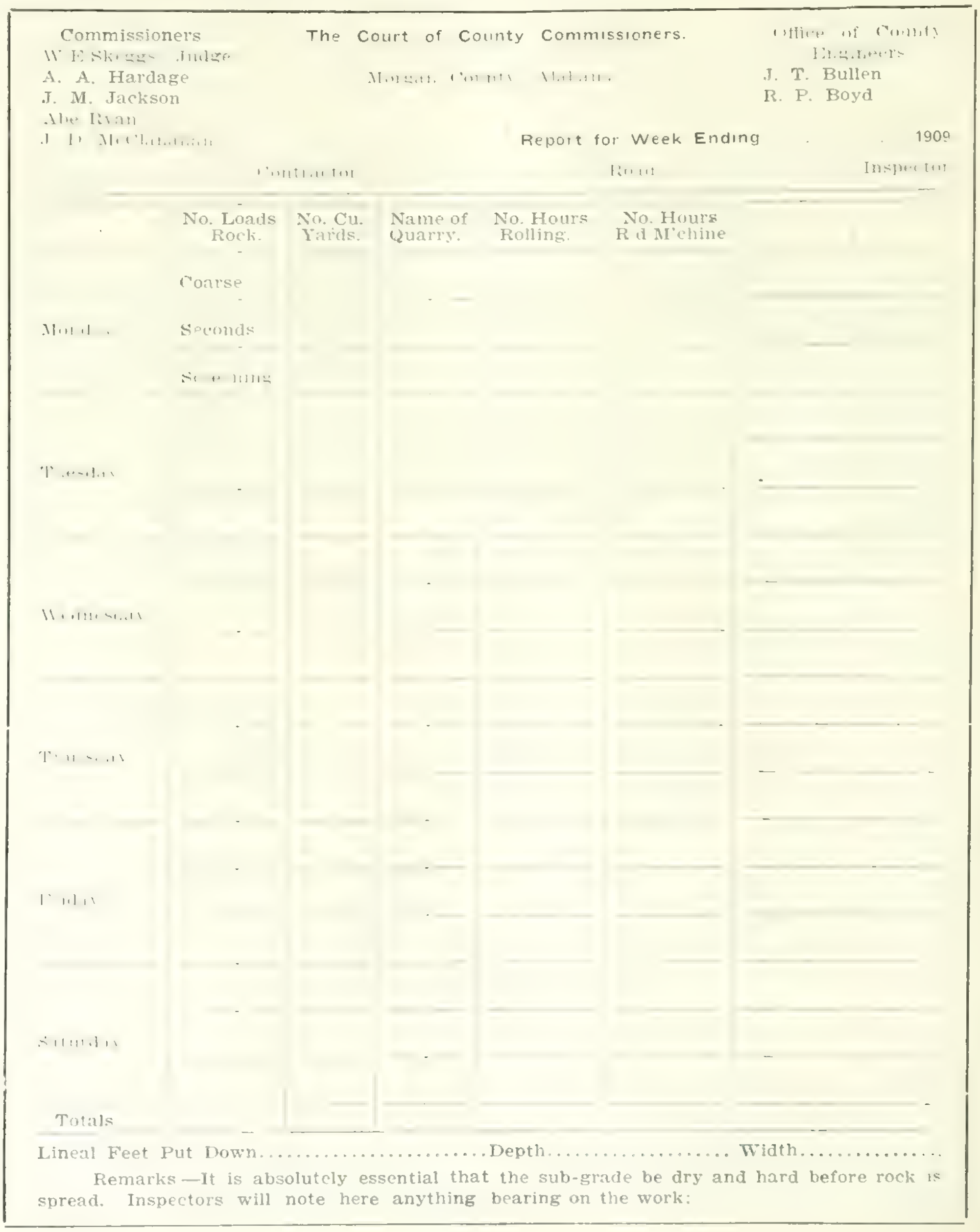
[illegible] (electric, steam or horse).
Motor Vehicles—
Ordinary motor cars (including cabs).
Motor omnibuses.
Motor delivery vans.
Heavy motor lories.
Tractors or traction engines. (Trailers are to be counted as additional vehicles, e. g., a tractor engine with two trailers would be counted as 3.)
Motor bicycles and tricycles.
Any other motor vehicles not included in any of the above heads.
Horse Drawn Vehicles
Omnibus (including public service and hotel).
Two-wheeled vehicles (1-horse).
Two-wheeled vehicles (2 horses or more).
Four-wheeled vehicles (1-horse).
Four-wheeled vehicles (2 horses or more).
Other Traffic
Ordinary bicycles and tricycles.
Herds of cattle (of more than 5 in number) to be entered as 1.
Flock of sheep and pigs (if more than 5 in number) to be entered as 1.
Horses (lead or ridden).

In the United States the following classifications have appeared either in reports or in the technical press.

CLASSIFICATION USED BY THE U. S. OFFICE OF PUBLIC ROADS.

Loaded 1-horse wagon.
Unloaded 1-horse wagon.
Loaded 2-horse wagon.
Unloaded 2-horse wagon.
Loaded 4-horse wagon.
Unloaded 4-horse wagon.
1-horse pleasure vehicle.
2-horse pleasure vehicle.
Motorcycle.
Saddle horse.
Excessively heavy vehicle (such as carry ore, stone, timber, machinery, etc.).
Motor runabout.
Motor touring car.
Loaded motor dray.
Unloaded motor dray.

"The directions state that less than a week's record is unsatisfactory and it is best that a record should cover as many seasons of the year as possible."



Commissioners
W. E. Skeggs, Judge
A. A. Hardage
J. M. Jackson
Abe Ryan
J. D. McClanahan

The Court of County Commissioners.
Morgan County, Alabama.

Office of County Engineers
J. T. Bullen
R. P. Boyd

Report for Week Ending . . 1909

Contractor Road Inspector

		No. Loads Rock.	No. Cu. Yards.	Name of Quarry.	No. Hours Rolling.	No. Hours R d M'chine
	Coarse					
Monday	Seconds					
	Screening					
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Totals						

Lineal Feet Put Down.......................Depth.................... Width...............

Remarks —It is absolutely essential that the sub-grade be dry and hard before rock is spread. Inspectors will note here anything bearing on the work:

Fig. 6.

The classification employed by the State Highway Commission of Massachusetts in 1909 was as follows:

Single horse, light vehicles.
Single horse, heavy vehicles.
Two or more horses, light vehicles.
Two or more horses, heavy vehicles.
Automobiles, touring cars.
Automobiles, runabouts.

In the above classification "light vehicle was employed to cover buggies, democrat wagons, or any other vehicle which is used for pleasure or light business purposes while the term heavy vehicle was used to designate farming wagons, milk wagons, tip carts, grocery or provision wagons, or any other vehicles except autos which are used for carrying heavy loads." The traffic was taken in two hour periods consecutively from 7:00 a. m. to 9:00 p. m. Two sets of observations were made, one covering a week in August, the other a week in October.

In 1909 the New York State Highway Commission had a traffic census taken upon the county highways built by state aid at four different periods. A traffic census was also taken in 1909 on state and county roads which would probably be built in 1910. The classification adopted was as follows, relative weights being given to different types of traffic.

Class of Traffic.	Relative weight.
Horse drawn traffic	
Horse, without vehicle	1
1-horse vehicle, light	2
1-horse vehicle, heavy	3
2-horse vehicle, light	3
2-horse vehicle, heavy	[illegible]
3-horse vehicle, heavy	5
4-horse vehicle, heavy	[illegible]
Motor vehicles:	
Motorcycle	[illegible]
2-passenger car	[illegible]
3-passenger car	[illegible]
4-passenger car	[illegible]
5-passenger car	[illegible]
6-passenger car	[illegible]
7-passenger car	[illegible]
Freight trucks, omnibuses, etc.	10
Miscellaneous:	
Traction engine	[illegible]
2-traction engine	30
Miscellaneous heavy traffic	upward

"The records were made by multiplying the traffic units by relative weights and noting the two subdivisions, horse and motor."

Classification employed by the Rhode Island State Board of Public Roads during 1908 and 1909 was as follows:

Motor car traffic:
Runabouts.
Touring cars, 4 or 5 seats.
Touring cars, 6 or 7 seats, including limousines and landaulets.
Motorcycles.
Horse drawn vehicle traffic:
Commercial traffic:
1-horse wagon, loaded, iron tires.
1-horse wagon, loaded, rubber tires.
1-horse wagon, unloaded, iron tires.
1-horse wagon, unloaded, rubber tires
2-horse wagon, loaded, iron tires.
2-horse wagon, loaded, rubber tires.
2-horse wagon, unloaded, iron tires.
2-horse wagon, unloaded, rubber tires.
Other wagons, loaded.
Other wagons, unloaded.
Pleasure vehicle traffic:
1-horse vehicle, iron tires.
1-horse vehicle, rubber tires.
2-horse vehicle, iron tires.
2-horse vehicle, rubber tires.

In a form covering "Data Concerning the Use of Bituminous Materials in Road Surfacing" used in connection with the work of the Special Committee of the American Society of Civil Engineers on "Bituminous Materials for Road Construction" the following classification was adopted:

Horse drawn vehicle traffic:
1-horse vehicles.
2-horse vehicles.
3-horse vehicles.
4-horse vehicles.
5-horse vehicles.
Six or more horse vehicles.
Motor vehicle traffic:
Motor cycles.
Motor runabouts.
Motor touring cars (four or five seats).
Motor touring cars (six or seven seats), including limousines or landaulets.
Motor wagons or drays.

By means of columns a further division of the above classes of traffic is called for under the headings, empty vehicles, loaded vehicles and passenger vehicles. A column is also provided for an estimate in pounds of the maximum load per inch of tire.

In the new form recently issued in connection with the work of the above Committee covering a "Report on Results of the Use of the Bituminous Materials in Road Construction" two sets of records are called for, one covering the period from November to March, the other from April to October.

After the classification of the traffic has been adopted, the methods of securing traffic data must be considered from many standpoints before a final decision is reached.

The method selected will be influenced by the amount of time at the disposal of the engineer and the character, amount and distribution of the traffic to which the road in question is subjected. In case the location of the roads to be built in a given period is known over a year in advance of construction, a comprehensive plan covering observations throughout the year should be adopted in order to secure complete information. In many cases, however, perhaps only a month will be available in which to make investigations preliminary to design. The above cases will be taken as the extremes and methods will be discussed which are applicable to each. In either case it is essential that as complete information as possible should be secured relative to the nature of the traffic on any given road before a plan is adopted. As the primary object of any traffic census is to secure data covering both normal and abnormal traffic of all classes, it is essential to incorporate in a plan definite provision for securing the above information rather than depending upon a haphazard selection of days to furnish the facts. As an illustration of varying local conditions may be cited: exceptional horse-drawn vehicle traffic, consisting of produce wagons, between the hours of midnight and 6:00 a. m., during certain seasons of the year; market days, fair days and other special events in connection with which both pleasure and commercial traffic may be excessive; periodical heavy shipments by special industries using the road in hauling raw material or in shipping the manufactured article; through traffic at certain periods of the day week or year as, for example, motor car traffic between residential communities or summer colonies and cities. After having obtained all the information of this nature it is possible to glean from local sources, the next step is the consideration of the most economical plans to be adopted in order to secure the essential data.

As a specific illustration, a road in the northeastern part of the United States will be considered, presupposing that a year is available in which to make observations. In many cases it is essential to obtain the following: Normal winter traffic, normal summer traffic and abnormal summer motor car traffic. It should be borne in mind that from the standpoint of the proper design of the road, it is necessary to know approximately the total yearly traffic, which is a function of both the normal and the abnormal traffic, and also the amount of abnormal traffic of various types at different periods of the year.

Three plans for taking traffic census throughout the year covering the usual conditions will be considered. Two of these plans at once suggest themselves, first, to take the traffic in periods of six or seven consecutive days and second, to distribute the recording days throughout a given season by starting on a given day of the week, for example a Monday, then take the traffic on the Tuesday of the following week or at an interval of 15 days, and so on during the season. The merits of the two schemes will be considered from two standpoints, efficiency and economy.

With reference to the season between April and October, the months of April, May, June, September and October may usually be considered as normal while July and August will generally cover the periods of excessive motor car traffic. The adoption of the first plan suggested would necessitate a minimum of one period of six or seven days in the normal months and one period in one of the abnormal months, preferably in August. It should be noted that both the normal and abnormal Saturday and Sunday traffic are ascertained by only one set of observations in each case, a self-evident and unsatisfactory result of this plan if only two periods are to be taken. If more than two periods are advocated the expense entailed would be considered prohibitive. The second plan is open to all the objections raised against the first and would prove more expensive provided enough days were used to secure an equal amount of information.

As a practical, economical and efficient plan the following method is proposed for adoption under average conditions. For the season from April to October inclusive the traffic should be taken during four periods of three days each; one period being in April, May or June, one in July, one in August and one in September or October. As local conditions may dictate, either Friday, Saturday and Sunday or Saturday, Sunday and Monday could be taken, thus ensuring information relative to the usual abnormal Sunday motor car traffic and, in some cases, to traffic above the week day average on Saturdays, while the Friday or Monday traffic would give a fair indication of the normal week day traffic. It is evident that this plan more reliable and essential facts are secured relative to traffic than by the other methods considered. From the standpoint of economy the advantage lies entirely with the proposed method, especially if the lowest paid members of the enginering department are employed on this work. Week end trips involving the use of only one and a half working days for the taking of the census during each period is a particularly satisfactory arrangement from the standpoint of the economical use of office time.

In connection with this method it is of interest to note certain facts which have been ascertained relative to climatic conditions in the three day periods considered. The figures given are based on data furnished relative to Providence, R. I., and cover the years from 1905 to 1909 inclusive. In the periods of the season from April to October in the five years mentioned only one period of three consecutive rainy days occurred or, in other words, one such period occurred in a total of 152 periods. A period with two rainy days occurred once in three periods. Furthermore, with reference to abnormal motor car traffic periods in July and August there was, in the five years considered, no period with either three consecutive rainy days or a period with two rainy days, while a period with one rainy day occurred once in three periods. It is obvious therefore that climatic conditions are favorable to the adoption of the plan proposed.

In the months from November to March inclusive two three day periods would be taken in certain cases; one in November or December, the other in February or March. This distribution of the periods would furnish statistics of the normal traffic in this season and would also afford opportunity for a study of traffic detail and the condition of the road during the winter season.

Instead of having the results of a year's observations upon which to base a design of a given highway, in many cases only a month will be available in which to make all the preliminary investigations. This extreme case will be discussed as a type of a short period investigation. Three plans will be considered: First, a period of nine consecutive days beginning with a Saturday and ending with a Sunday; second, nine days of observations distributed as follows: Saturday, Sunday and Monday of the first week, Tuesday of the second week, Wednesday of the third, Thursday of the fourth, and Friday, Saturday and Sunday of the fifth week; third, a plan of three day periods using three sets, one of Friday, Saturday and Sunday and two of Saturday, Sunday and Monday, one period in the first week, one in the third and one in the last week. It is obvious for the same reasons as in the former comparison that the advantage lies with the third method. From the standpoint of the Saturday and Sunday traffic, the third plan provides an average of three days, the first and second an average of two days without much oportunity for extra periods if the weather should prove inclement on abnormal traffic days. Although the first and second give more complete information relative to normal week day traffic, it is usually unnecessary to take traffic on more than six week days in order to secure satisfactory data relative to normal traffic in a given month.

As the relationship existing between the various methods considered and climatic conditions has an important bearing upon the final selection of a plan, the following information is presented for consideration. The months which will usually be used for short period observations are from March to August inclusive.

The following data for the years 1905 to 1909 inclusive has been ascertained relative to the first method of taking nine consecutive days in the middle of the months mentioned. In a total of 30 periods 25 contained at least one rainy day, thirteen at least two rainy days, four at least three rainy days and one four rainy days. In the 30 periods there were seven rainy Sundays and ten rainy Saturdays, and in two periods both a Saturday and a Sunday were rainy. Hence it is obvious that in order to secure an average of the traffic on two Saturdays and two Sundays, it will be necessary in approximately one out of every two cases to take extra observations upon abnormal days.

For the second method, in which observations on week days are distributed throughout the month, the following data is interesting. In a total of 30 combinations, 25 combinations contained at least one rainy day, 15 combinations at least two rainy days, ten at least three rainy days and three combinations, five rainy days. In the 30 combinations there were 13 rainy Saturdays and 13 rainy Sundays, and in seven combinations two Saturdays, two Sundays, or one Saturday and one Sunday were rainy. Here it is apparent that in 19 cases out of 30 it would be necessary to take extra observations in order to secure an average of the traffic on two Saturdays and two Sundays.

In the third method of three periods of three days each distributed throughout the month, in a total of 30 combinations of three periods, 25 contained at least one rainy day, ten contained at least two rainy days and three contained three rainy days. In the 30 combinations there were 11 rainy Saturdays and 15 rainy Sundays, and in seven combinations two Saturdays, two Sundays or one Saturday and one Sunday were rainy, two referring to two rainy Saturdays and one to two rainy Sundays. In only three instances, therefore, will it be necessary to take extra observations on Saturdays or Sundays to obtain the average of the traffic on two Saturdays and two Sundays. In six combinations out of 30 one rainy Friday occurred but in no case more than one rainy Friday.

In view of the facts presented in the above discussion the third method is preferable both from the standpoint of the data secured and economy of time necessary to secure an average of the traffic on the abnormal days, Saturday and Sunday.

The number of consecutive hours which should be taken during the day will depend upon local conditions and the period of the year when observations are made. In many cases 24 hours will be absolutely necessary, while in certain cases 12 or 15 hours will be satisfactory. The engineer who makes the preliminary investigations will ascertain the number of hours requisite. It must be borne in mind that the facts ascertained are used as a basis for an estimate of traffic and hence minute detail should not be obtained at unwarranted expense.

The Special Meetings of the American Society of Civil Engineers for the Discussion of Matters Relating to Road Construction and Maintenance.

On January 20 and 21 three special meetings were held in New York City under the auspices of the Committee on Bituminous Materials for Road Construction of the American Society of Civil Engineers for the purpose of considering matters relating to road construction and road maintenance. The subjects assigned for discussion at the morning session on Jan. 20 were: (1) "Preliminary Investigations," (2) "Relative Value of Three Methods of Carrying on Work: (a) That in which both labor and material are furnished by the contractor, (b) That in which the material is supplied by the party of the first part and the labor by the contractor, (c) That in which both the labor and material are supplied by the party of the first part;" (3) "Systems of Maintenance."

The discussion on the first topic was opened by Mr. Logan W. Page, Director Office of Public Roads U. S. Department of Agriculture. He mentioned the fact that in past years sufficient study of the problems in question had not been made but that a great deal of progress was being made along the right lines. He stated that the greatest difficulty in arriving at an intelligent decision on the subject is due to the fact that many experiments are not published and if they are the results are either meagerly or indefinitely reported; furthermore, there is no established system by means of which the data obtained may be collected and compared. This may be excused to a certain extent owing to the fact that a sufficient time has not elapsed to enable a comprehensive and conclusive system to be developed. He stated that lamentable lack of knowledge prevails among road engineers as to the properties of dust laying materials and the methods of applying the same. The lack of cooperation in experiments by engineers has resulted in a condition that oftentimes different results are obtained by the use of similar methods without any definite manner of comparing the causes which produce them. Mr. Page in conclusion outlined a method of studying the problem: 1st. All engineers should make a special study of the material, its origin and composition; 2nd, a study of dust preventatives and methods of standardization of the tests and results; 3rd, detailed report of the application and local condition under which the binder is applied; 4th, a report on traffic census; 5th, experiments with various methods of construction, being particular that the results accomplished are obtained under a given set of conditions; 6th, experiments as to the relative economic value of the method in connection with the amount of traffic.

Mr. Page was followed by Mr. W. W. Crosby, Chief Engineer Maryland Roads Commission, who emphasized the importance of the preliminary investigation and stated that there was no one best method or one best material, but that conditions under which the road is to be constructed and used should govern.

Mr. A. H. Blanchard, Deputy Engineer State Board of Public Roads of Rhode Island, stated that the object of a preliminary investigation should be to obtain a result that will be economical and efficient. One method can only become standard within certain limits depending particularly on the amount of traffic. Among the things necessary to consider in a preliminary investigation he mentioned the use of motor trucks, the difference in weight, speed, and kind of vehicles, the grade of the road the relative economy of the various materials, time in which a given highway can be constructed, the time of year, the climatic conditions, and as to whether the penetration or mixing methods should be used.

The discussion on the topic "the relative value of three methods of carrying on work" was introduced by Mr. Harold Parker, Chairman of the Massachusetts Highway Commission, who suggested that work carried on by the method where both labor and material is furnished by the contractor is satisfactory where the contractor can bid intelligently, where the amount and quality of the work can be easily and accurately determined. The method where material is furnished by the party of the first part and labor by the contractor is advantageous where there is a question as to the material to be used, especially where bituminous materials are to be required. He stated that this method was economical and satisfactory and used by the Massachusetts Highway Commission for concrete walls, bridges, etc. He stated that the method where labor and material are supplied by the party of the first part should be used where the conditions are such that the contractor cannot bid intelligently and where there is difficulty in definitely determining the quality, quantity or method of carrying on the work. This method he said is usually not economical or satisfactory.

Messrs. Henry B. Drowne of Rhode Island, J. W. Hunter, Chief Engineer Pennsylvania Highway Commission, P. D. Sargent of the Maine State Highway Commission, W. W. Crosby, F. E. Ellis of Melrose, Massachusetts, S. Whinery of New York City, James Owen, Consulting Engineer of Newark, New Jersey, and W. B. Pullar of Chicago, discussed the question along the lines indicated by Mr. Parker.

The subject of "Systems of Maintenance" was interestingly discussed by Mr. Herbert K. Bishop, Deputy Highway Commissioner of New York State, who outlined the work of maintaining nearly 2,000 miles of road which was in deplorable shape after a neglect of from two to twelve years and which was brought into a very satisfactory condition in two years' time. The system was outlined briefly as follows: The State is divided into six Divisions under a Superintendent of Repairs; these Divisions are subdivided into from five to seven Sections in charge of an Inspector; these Sections are subdivided into patrols of a length averaging five miles which are in charge of a "Patrolman" who is required to furnish a horse and cart. The Patrolmen work about nine months of the year. Each Patrolman reports daily to the Inspector who reports weekly to the Superintendent of Repairs, who in turn reports daily to the Deputy Commissioner. The average cost of each Patrolman for the time worked was given at $106 per year. Mr. Bishop also described at length the various methods of resurfacing and the results noted.

Mr. F. J. Sharples of New Jersey, speaking of the methods to be used to maintain the surface of a road, recommended the use of an asphaltic oil of from 40 to 45 per cent, spread under pressure, and that care should be taken as to the viscosity of the material. He also said that good results were obtained by constructing ordinary water-bound macadam and then treating with a bituminous material to preserve the surface.

The first subject for discussion at the afternoon meeting on Jan. 20 was "The Use of Water, Calcium Chloride, Light Oils, etc., as Dust Palliatives." This subject was introduced by Mr. Samuel Whinery, Consulting Engineer, New York City, who made an appeal for a more systematic, intelligent and careful study of the use of water as a dust palliative and gave figures which indicated that such an application was very economical. In regard to oil he stated that the success depends upon the care and judgment used in applying the same.

Mr. Herbert C. Poore spoke of the success of applying coal tar on roads, under pressure, with two applications of ½ and ¼ gal. per yard, at a cost of from 3 to 5 cts. per sq. yd.

Mr. J. L. Weeks of Baltimore described the use of an emulsion, at a cost of 2 1-10 cts. per yd., giving the specifications for the same.

Messrs. Bishop and L. R. Grabell described experiments in the use of calcium chloride, it being stated that the climatic conditions of the location in which used determined the efficacy of the treatment.

The second subject for the afternoon discussion, "Surface Treatment with Tars, Heavy Oils, etc.," was opened with a paper by Mr. Charles W. Ross, Street Commissioner, Newton, Mass., which was read by Mr. E. M. Rogers. Some of the points mentioned were as follows: With good drainage the asphalt gives a more permanent road In applying the bituminous material the road must be clean and dry. The three divisions into which bituminous materials may be divided were stated to be: (a) Asphalt which can flow of itself; (b) That used for construction by the penetration method; (c) Semi-solid, that which has to be heated and may be used in the mixing method. After experiments covering from one to three years the results may be considered satisfactory. Tar was said not to be as good for gravel roads as asphalt.

Mr. Prevost Hubbard spoke of the necessity of obtaining accurate data as to the traffic, particularly as to whether horse-drawn vehicles or automobiles, citing several cases which showed that roads surfaced with a bituminous mixture were easily maintained when the automobile traffic is in excess of a certain ratio to the horse traffic; where the latter is the greater the surface roughens up and disintegrates. The effect of the automobile is to iron out the road.

Mr. A. W. Deane gave his experience with asphalt treatment, recommending the use of pressure in sprinkling.

Mr. W. W. Crosby, Mr. A. F. Armstrong of the New York Highway Department, and Mr. Bristol of Massachusetts, also spoke of the value of a traffic census and the effect of the different kinds of traffic on the roads.

Prof. Arthur H. Blanchard described the methods used in England to systematize the data on road construction and maintenance.

Mr. Harold Parker described the experiments of the Massachusetts Highway Commission with the use of machines for applying oils under pressure, and expressed the opinion that it is the most satisfactory method to use.

Mr. R. A. Meeker, Deputy Commissioner of New Jersey, emphasized the necessity of putting the road in good condition before any work is done. In reply to a question of Mr. E. P. North, of New York City, Mr. Bishop stated that Kentucky rock asphalt had been used in repairing roads in New York State with good results, although the cost was high, the average additional cost over ordinary macadam being about 50 cts. per sq. yd.

The topics for discussion at the Jan. 21 session were "The Use of Bituminous Materials by Penetration Methods," and "The Use of Bituminous Materials by Mixing Methods."

The first subject was introduced by Mr. W. W. Crosby who spoke in part as follows: The local conditions in Maryland demand the penetration method. The work is carried on the same as for water bound macadam until the top course is reached. The quantity of pitch used varies from ¾ to 5 gals. per sq. yd. The speaker gave the following data in regard to a road constructed in 1908. A refined water gas tar, costing 6 cts. per gallon delivered, was used; this was spread at a rate of 1 gal. per sq. yd. at a total cost, including sweeping, etc., of $.126 per sq. yd. The speaker stated that the results have been satisfactory, there being no repairs up to the present time although the road is subject to a heavy traffic. This he followed with a description of a series of comparative tests which are being made on eight miles of road that have been constructed by twenty different methods. In Maryland the penetration method has been successfully used on oyster shells and gravel.

The next speaker, Mr. A. F. Armstrong, described the work of the New York State Highway Department, stating that in two years about 673 miles of bituminous macadam highways had been repaired or constructed by the penetration method and two miles by the mixing method, the results so far being as a whole satisfactory. Where failures have occurred they may be traced to the following causes: insufficient drainage, poor stone, quality of screenings, the bitumen used and the workmanship. In cases where results are not uniform the trouble may be traced to pockets in the top course caused by variation in the stone so that the penetration is uneven. Data on 78 miles of road constructed during 1909 were given as follows: the average cost per sq. yd. above the cost of water bound macadam was 24 cts., divided as follows: 5 cts. for labor, 17 cts. for material, 1 ct. for equipment and 1 ct. for engineering.

Mr. R. K. Compton of Baltimore described the construction of about 1,800 sq. yds. of road 6 in. thick as follows: The base course 4 in. thick was poured with a bituminous mixture at a rate of ½ gal. to the sq. yd., this being covered with ⅝ in. to ¼ in. stone and thoroughly rolled; the top course was then spread and the binder distributed by hand by means of a linen hose connected to the tank. The cost was $.7295 per sq. yd.

Mr. Shirley of Maryland mentioned a road constructed with a "tarvia" binder and a "gneise" stone metal in 1905 at a cost of $.33 per yd. that is now in good condition with no maintenance charge. He gave his experience with the use of a hand rotary pump in removing the bituminous material from tank cars and its distribution by means of tubs and ladles.

Mr. J. C. Wonders, Highway Commissioner of Ohio, stated that in his locality tar products became slippery.

Mr. R. A. Meeker emphasized that in all construction by the penetration method careful and conscientious work was absolutely necessary, that the stone used in the construction should be clean, a little moisture not being as harmful as a little dirt.

Mr. Clifford Richardson of New York City called attention to the fact that in the penetration method the excess of asphalt formed a reservoir which would replace that destroyed or evaporated, whereas in the mixing method no such result was possible.

The second subject "The Use of Bituminous Material by Mixing Methods" was introduced by Prof. A. H. Blanchard who mentioned two types of mixtures. First, a mixture in which the broken stone and sand are carefully graded as to size and a heavy asphalt used in the mixture, the mixing being done by machinery. The results are satisfactory but the surface may be slippery or dusty. Second, the construction of a road with different standard sizes of stone with or without sand and a fluid or semi-fluid bitumen permitting a hand mixing. After describing several experiments made in Rhode Island he attributed failures to the following causes: poor binder, bituminous material not adapted, mistakes in aggregate, selection of sizes, aggregate covered with dust, aggregate damp, aggregate over heated, excessively heavy three-wheeled roller, coating of aggregate by roadside dust, insufficient bond between the two courses, and incompetent supervision.

The subject was further discussed in a paper written by Mr. F. C. Pillsbury and read by Mr. Fisher. Messrs. Howard of Chicago, W. H. Connell of New York City, Paul D. Sargent of Maine, and F. R. Smith, also took part in this discussion.

The meetings were largely attended and a great deal of interest was shown in the discussions. It was noted that considerable progress had been made during the past year and that the speakers talked with a greater degree of confidence than at a similar meeting a year ago.

Standardizing Pavement Specifications.

The second annual convention of the Organization of City Officials for standardizing Paving Specifications was held in New York City, Jan. 10-13, 1911. The first convention of this organization was held in Chicago on Feb. 21-26, 1910, and at that time preliminary specifications for the various standard pavements were drafted. The recent convention in New York City was held for the purpose of sup[illegible] vention by revising and amplifying the first [illegible] were represented, the total number of delegates being 73. As was the case at the Chicago convention committees were appointed to consider specifications for the following: Ce[illegible] tuminous Concrete, Vitrified Brick, Macadam, Creosoted Blocks, Sheet Asphalt, Stone Blocks, and Bonds, Guarantees and Uniform Bidding Blanks. The committee reports on specifications for the above were adopted by the convention, but it was decided that the specifications should not be made public until they had been printed and copyrighted by the association. The committees did not make many changes in the specifications of the first convention. In the creosoted wood block pavement specification the principal change was that the specific gravity of the creosote oil was defined as between the limits of 1.10 and 1.14, instead of a minimum of 1.10 as in last year's specifications. The committee on brick pavements dropped the absorption test and adopted the standard rattler and short test of the National Paving Brick Manufacturers Association. The committee also provided alternative specifications for asphalt filler and for coal tar pitch filler. The officers elected for the ensuing year are as follows: President, George W. Tillson, New York city; First Vice President, Capt. W. J. Hardee, New Orleans, La.; Second Vice President, L. W. Rundlett, St. Paul, Minn.; Third Vice President, George W. Craig, Omaha, Neb.; Fourth Vice President, J. E. Farris, Kansas City, Mo.; Secretary and Treasurer, John B. Hittell, Chicago. The next meeting of the organization is to be held at New Orleans, La., on Jan. 15, 1912.

Status of Excavation and Concrete Work at Panama.

Excavation for the Panama Canal was commenced by the Americans May 4, 1904. During the remainder of that year 243,472 cu. yds. of material were excavated. In 1905 nearly 2,000,000 cu. yds. were excavated; in 1906, nearly 5,000,000; in 1907, nearly 16,000,000; in 1908, more than 37,000,000; in 1909, 35,000,000 cu. yds. were removed, and last year 31,000,000 cu. yds. were excavated. The total amount excavated up to Jan. 1, 1910 is 126,407,064 cu. yds. There remains to be excavated some 56,000,000 cu. yds., of which 22,000,000 cu. yds. are to be handled by dredges. If the rate of progress which has been made for the past three years is kept up, all excavation for the canal ought to be completed during the year of [illegible]

About 50 per cent of the remaining excavation is in the Culebra cut. The balance is about equally divided between the Pacific and Atlantic divisions.

The concrete work in the three twin locks at Gatun is nearly 50 per cent completed, the exact amount on Jan. 14, 1911, being 1,033,708 cu. yds. out of a total of 2,085,000. About 60 per cent of the concrete work of the Pedro Miguel locks is completed, 497,804 cu. yds. out of a total of 837,400 cu. yds. having been placed.

Operations have reached the point where the maximum output of all four of the berm crane mixers cannot be utilized, and therefore only two of them are kept at work continuously. On the other hand, the installation of the steel work for the lock machinery is assuming greater proportions as the work advances towards the ends of the lock. In the upper part of the lock, the construction of the west wall is being continued to the point of junction with the wing wall, and excavation for the center wall extension has been resumed. Work on the east wall extension is temporarily suspended. At the south end, construction is proceeding on all three walls, and in addition one chamber crane is engaged in placing concrete in the extension of the guide wall to its farthest point north. The placing of the steel castings for the two sluice gates at the south end of the center wall is about completed. These castings form the division and side walls of the gates, the division wall employing three and the side walls two. Each casting occupies a vertical position, is 22 ft high, and weighs a little over 24,000 pounds. In addition two smaller castings are placed a few feet away, one in front and the other in the rear of the gates, which will serve as a cutwater in the flow from the culvert.

At Miraflores about 100,000 cu. yds. of concrete have been placed in the upper lock and the most of it has been used in the floor and floor culverts, and in the east wall.

The concreteing of the locks was started in August, 1909, at the Gatun locks. Here the work has progressed rapidly, as much as 89,000 cu. yds. having been placed in one month. At the Pedro Miguel locks the record month was 64,000 cu. yds., and at Miraflores 23,000 cu. yds. is the best month's record. The concrete work should be finished, at the present rate of progress, in about two years.

WATER-WORKS AND SEWERS SECTION

Methods and Cost of Constructing Water Purification Works at Springfield, Mass.*

[illegible] 113.

Filtering Materials.—As indicated by the title of this paper, the filtering materials employed in the installation of the plant is sand. The contract plans called for a layer of sand of certain specified requirements 3 ft. in thickness, covering the entire area of each filter. For the purpose of properly collecting the filtered water after it has percolated through the sand and for delivering it to the outlet system, a bed of gravel 12 ins. in thickness arranged in three layers of different sizes and surrounding 10-in. split tile lateral drains was deposited over the filter floor in advance of the sand layers. The lower 7 ins. of the bed of gravel consisted of stones larger than 1 in. in diameter and with few larger than 2 ins. The next 2½ ins. of thickness contained stones which had passed a 1-in. screen and had been retained on a screen of ⅜-in. mesh. The top 2½-ins. layer of gravel contained stones which had passed a ⅜-in. mesh and varied in diameter from ⅜-in. size down to that of the coarsest grains of sand. There were, therefore, including the sand, four different grades of material required for this purpose.

The specifications in describing the necessary requirements of the sand provided that grains exceeding 5 mm. should be excluded and that not more than 1 per cent should be less than 0.13 mm., that its effective size should lie between 0.25 mm. and 0.35 mm. and that its "uniformity coefficient" should not exceed 3. For the benefit of those who are unfamiliar (as was the writer previous to this experience) with the meaning of these terms, it may be explained that the "effective size" of sand as here used is the least size of mesh through which 10 per cent by weight of the sand will pass, or is in a sense the measure of its relative fineness or ability to pass the water; and that the "uniformity coefficient" is the ratio existing between the least sizes of mesh which 60 per cent and 10 per cent by weight, respectively, of sand will pass. Thus, if 10 per cent of the sample will just pass a mesh of 0.27 mm. and 60 per cent just passes a mesh of 0.81 mm., the ratio, or "uniformity coefficient," is 3, and is to a certain extent an indication of the variation in size of grains.

If the effective size is low—for example, 0.20—it is an indication of the presence of an excessive amount of fine grains, since 10 per cent of the whole is fine enough to pass a mesh as small as 0.20 mm. This condition can easily be corrected by washing out some of the fine grains, thus lessening the percentage which will pass a 0.20 mm. mesh and consequently increasing the size of mesh required to just pass 10 per cent.

If the effective size is satisfactory—say, 0.30—but the "uniformity coefficient" is too high—say, 3.50—it is an indication of an excessive proportion of large grains in the sand, since 40 per cent of the whole must be larger than 1.05 mm. in the assumed case. This condition may sometimes be corrected by screening the sand through a finer screen, thus removing some of the larger grains and lessening the size of the mesh which still retains 40 per cent of the sample. When this is done it disturbs the "effective size" by lowering it, and new complications may arise.

To secure from natural sources a large volume of sand possesing the required physical characteristics as outlined above proved in the case of this work a difficult task. The city, acting through its engineers, had, prior to the letting of the contract, caused an investigation of the surrounding country to be made with the idea of locating a possible supply of filter sand. Certain test pits on the city's own property, at a distance of about three-quarters of a mile above the location of the work, apparently indicated the existence of a sufficient and satisfactory supply of this material. Laboratory tests of samples from these pits showed the sand to contain an excess of fine grains which could be easily removed by washing. Subsequently, however, when an attempt was made to secure the sand from this locality, it was found to contain only about 1,500 cu. yds. of the 21,000 cu. yds. required, the original indication of quantity proving to have been misleading. No satisfactory material could be found within convenient hauling distance, but a deposit of sand was finally located on private land about one mile below the work, which gave promise of meeting the necessary requirements, provided some way could be devised to eliminate the excess of coarse grains it contained. Arrangements were made with the owner for securing sand from this property, which was situated at an elevation 100 ft. lower than that of the work, requiring an uphill haul of that amount over the mile of highway separating the two points. The 100-ft. difference in elevation was gained mostly in four separate sharp grades of a few hundred feet each in length. The steam shovel previously mentioned as having been used in excavating for the filters and borrow pit was brought down on its own wheels and by its own power and installed in the new pit for use in loading wagons. Considerable selection of material was required, as the bank varied greatly in its character. When, as was frequently the case, the material in front of the shovel was too coarse for the purpose, it became necessary to mix the loads by adding finer material, loading by hand from some other part of the bank. The run of the bank contained a sufficient amount of gravel to supply the needed proportion of that material for the graded layers previously referred to.

Owing to the excessive grades encountered in hauling to the work, the double teams employed could draw only 1 cu. yd. to a trip. They were assisted up the four steepest grades by tow teams, for which purpose two double teams were permanently stationed at each hill. Ten trips were required in good weather of each team hauling from the pit, and this was reduced to nine and sometimes eight when the roads became heavy from rains. Six dollars per day was paid for each double team, and difficulty was encountered in securing a sufficient number for the purpose at that price. Only the heaviest and strongest teams could stand this haul continuously, and even these lost weight rapidly during the hot weather or when the roads were bad. From 35 to 40 teams were employed at times in addition to the tow teams.

Screening and Washing Plant.—There were required for the purpose of filter materials 17,000 cu. yds. of sand and 3,800 cu. yds. of gravel. One cubic yard of gravel, therefore, was necessary with each 4.5 cu. yds. of sand prepared. Since the material from the pit contained a sufficient proportion of gravel, on the average, to supply the desired amount, the screening and washing plant was designed with a view to obtaining both the filter sand and the required sizes of gravel in one operation.

Delays incident to the securing of a satisfactory source of supply and other causes postponed the starting of this work until almost Aug. 1. It was imperative that this work should be completed before the cold weather set in, and, therefore, only three months remained in which to prepare and place the 21,000 cu. yds. of material needed. On a basis of 70 working days for the three months, an output of at least 300 cu. yds. per day was necessary to complete the work in time.

A serious feature which caused much apprehension was the scarcity of water available for the purposes of the plant. Previous mention has been made of a brook which formerly flowed over the site of the filters and which was subsequently diverted to a new channel. Though this brook was of considerable size in the spring of the year, it dried up during the summer months to a small flow of about 20 gals. per minute.

It was estimated by Mr. Hazen that 1,000 gals. of water might be required for each cubic yard of sand washed. Consequently if 300 cu. yds. were to be handled in 10 hrs., at least 500 gals. of water per minute should be available for the purpose. In addition to the small amount supplied by the brook, there was available a slightly larger amount of water representing the leakage in 4,500 lin. ft. of tunnel immediately above the work, and in addition the ground water leakage of the filters, which amounted to about 10 gals. per minute. Altogether, therefore, it was possible to obtain a supply of water when utilizing all possible sources of approximately 50 to 60 gals. per minute, or one-tenth of the required amount.

On the advice of Mr. Hazen and Mr. Lochridge, all of the water diverted either by gravity or by pumping into the aerator, which was used as a storage reservoir. Water once used in washing was returned to this reservoir to be used again, and in this manner a sufficient supply was maintained. The returning water brought with it each time the silt and fine sand it had washed out of the materials, which silt was naturally deposited in the bottom of the aerator. When this deposit had accumulated to such an extent as to cause difficulty, the water was drawn down and the sediment removed. It might be supposed that dirty and roily water such as this soon became would add to rather than remove fine particles from the sand. As a matter of fact, however, this sediment carried by the water remained in suspension throughout the operation and was apparently as effective in cleaning the sand as was clean water. Toward the end of the work it became possible to obtain an unlimited supply of clean water from the river supply, which by that time had been diverted through the tunnel. While much more convenient for the purpose, it cannot be said that it accomplished the result in a more efficient manner than did the dirty water.

The use of the aerator as a storage reservoir for the water influenced the selection of its vicinity as a site upon which to locate the screening and washing plant for preparing the filter materials. Figure 26 shows the details of construction and final arrangement of the plant.

The teams drawing from the sand pit entered from the highway and passed across the top of the filter fill on to a bridge which extended out from the filters and over the aerator to the ground beyond. This bridge passed directly over the boots of two 14-in. bucket elevators, located between the filters and the aerator. A hopper under the bridge received the contents of the bottom-dump wagons as they passed over its opening in the floor of the bridge, and the sand and gravel were fed from this hopper on to the bucket elevators by means of two gates at its base. The second elevator was installed as a precaution against possible delays from breakdowns. The sand and gravel were raised by these elevators to a 42-in. revolving cylindrical screen consisting of an 8-ft. section of ⅜-in. perforation, a 4-ft. section of 1-in. and a 4-ft. section of 2½-in. perforation. A 6-in. centrifugal pump supplied the water used for washing purposes to the various points where it was needed.

A 35-h.p. steam engine operated the elevators and screen, and the 40-h.p. gasoline engine previously used on the crusher operated the centrifugal pump. Provisions were made which permitted the operation of the entire plant by either engine, and in case of breakdowns this feature proved to be of great value in avoiding delays. The 6-in. pump worked against a total head of about 40 ft., and consumed a large amount of power.

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*A paper, by Charles R. Gow, read before the Boston Society of Civil Engineers and published in the Journal of the Association of Engineering Societies for December, 1910.

The elevators were often fed at the rate of a load a minute, and during such periods the 42-in. screen was taxed beyond its capacity for handling sand in a dry state. A large portion of the sand was carried over with the gravel and in addition to the loss of this sand the gravel was also spoiled.

In order to assist the action of the screen, a 3-in. connection from the water supply was introduced into the chute through which the material entered the screen, the idea being to bring the sand into the screen in a state of partial suspension and thus to push it through the ⅜-in. perforations. This method was only partially successful, the water escaping through the first few feet of screen, while the balance of the fine perforations became clogged with wet sand. To correct this action, one, and later two, 3-in. pipes, perforated with ¼-in. holes, were run longitudinally along the top of the screen and adjusted so that the two rows of ¼-in. jets played directly downward against the outside of the screen as it revolved. These jets drove back any sand that happened to lodge in the ⅜-in. openings. In addition, the greater part of the water entered the screen and assisted in flushing the sand out through the bottom of the sand section. It also assisted greatly in cleansing the gravel of sand coatings. So long as a plentiful supply of water under sufficient pressure was maintained in these pipes, good results in separating the materials were obtained. Inside baffle rings between the sections of the screen assisted separation somewhat by retarding the forward motion of the materials. Under each different section of the screen was a wide trough of V-section which collected all of the materials passing through that particular section, while a stream of water entering at the end of these troughs through pipes in the lower part of the V caught the material as it fell and carried it forward. The two troughs under the 1-in. and 2½-in. gravel sections pitched at a steep angle toward storage bins. In passing from the collection trough to the bins, however, the gravel passed over a perforated plate which allowed all water and dirt to drop through into a waste trough leading back to the aerator.

The sand, together with all pebbles less than ⅜-in. diameter, was caught in the trough under the 8-ft. sand section of the screen and carried forward away from the screen by means of the water and a slight pitch given the trough.

The most difficult problem encountered in the operation of this plant was the proper separation of the fine pebbles from the sand needed for filter sand.

While 5 mm., of ⅕ in., was the maximum size of grain allowed in the filter sand under the specifications, the admission of all grains up to that size contained in this material would bring the uniformity coefficiency considerably above 3, which was the maximum allowance. The general tendency of the material was to run too coarse; and investigation showed the necessity of excluding all grains larger than 2.5 mm., or 1/10 in. The grains and pebbles above that size when excluded became available for use in the top 2½ ins. of the gravel layer and were, of course, valuable for that purpose.

To effect this separation, the method of passing the stream of mixed water and sand over a stationary sloping screen of the required mesh was tried, with the expectation that the water, together with all the sand grains small enough to pass the 2.5 mm. holes, would wash through the screen, leaving the larger grains to pass on to their storage bin. The coarser grains, however, constituted such a large proportion of the whole volume of sand that this method failed absolutely.

A revolving screen 30 ins. in diameter and 16 ft. long was then made to order. It was driven by means of an outside band sprocket and contained no inside shaft or arms, but revolved on outside roller wheels bearing against outside track bands. A 3-in. pipe, perforated with a double row of ¼-in. holes, passed longitudinally through its center and supplied a constant force of water against its entire inner surface. Wire mesh screen was used, of the required size, and so fastened as to be easily removable to allow renewals. Outside jet pipes were also employed to keep the holes of the mesh open by playing a strong stream against it. The screen accomplished the desired result admirably and gave perfect separation as long as conditions of water pressure, etc., were kept normal. The mechanical construction of the screen proved faulty and it was subsequently replaced with an improved design which gave more satisfactory results from a mechanical standpoint.

Careful and intelligent supervision was required at all times to obtain the best results from this means of separation, and frequent adjustments of the amount of water were necessary with the varying character of the sand supplied. Too complete a separation at this point tended to injure the acceptableness of the resulting sand, by raising its "uniformity coefficient" and sometimes its "effective size," while incomplete separation wasted sand and caused the rejection of the resulting fine pebbles for the purpose of filter gravel.

It is to be noted that these difficulties were due mainly to the necessity of adapting materials naturally unsuited for the purpose to the requirements of the case in hand, and that much simpler and more economical methods would naturally be followed with sand conforming more nearly to the desired quality.

The small pebbles and large grains of sand, rejected by the fine mesh of this screen, passed out through its end and were delivered into an elevated hopper or storage bin.

The sand water which passed through the mesh of the screen was caught in a trough underneath and discharged into the sand washing box.

This washer was designed by Mr. Hazen, the consulting engineer for the work. It is of a pattern which has been commonly employed by him in the past and has become more or less familiar to the engineering profession. It consists of a simple wooden box rectangular in plan, 13 ft. long and 3 ft. wide. The top of the box is open and level, while the bottom pitches 2 ft. in its length, the depth of the box being 2 ft. at the shallow or entering end and 4 ft. at the deep or delivery end. Three overflow troughs set transversely of the box with the tops of their side boards just below the level of the top of the box received and disposed of the excess water after the box was once filled. A 5-in. header pipe fed by the water system supplied water to five 2½-in. perforated pipes laid longitudinally in the bottom of the box. A shear gate was provided in the lower part of the delivery end of the box for the purpose of drawing off the sand from the box after it had been washed.

The water and sand from the fine separating screen flowed into the washer at the shallow end of the box. Water from the 2½-in. jet pipes in the bottom maintained this sand in a semi-fluid state and in this condition the contents readily leveled itself through the length of the box. The violence of the jet action produced a continual agitation of the sand and the water, passing up through it took into suspension and carried upward the sediment and fine grains which it contained. A valve on the header pipe controlled the pressure, and by its adjustment varying degrees of agitation could be produced in the sand. The jet water, carrying with it the silt and fine sand it had accumulated after passing up through the sand mass, was caught in the overflow troughs and conducted back to the aërator reservoir.

The contents of the box, being in a semi-fluid state, could be easily drawn off by operating the shear gate at its delivery end. The sand flowed out through this gate in a steady stream, which, under ordinary conditions was 90 per cent sand and 10 per cent water, and discharged into a hopper or small storage bin. It was possible by intelligent control to adjust the gate so that a continuous outflow was maintained corresponding in amount with the incoming sand from the screen.

Frequent samples of the washed sand were tested in the laboratory, and the result of these tests determined the acceptance or rejection of the [illegible] The operators soon became familiar with the appearance of the several grades of sand and made necessary adjustments of water or gates to correct any troubles which manifested themselves.

The output of the plant seldom reached its expected capacity of 300 cu. yds. in 10 hours. It is probable that this output could have been averaged easily had it been always possible to keep a steady supply of teams feeding the elevators and had delays from breakdowns been eliminated. The bunching of teams on the road in the case of long hauls is inevitable, due to the varying speeds at which different teams walk, and in this case proved an obstacle in the way of obtaining a steady supply at the washing plant. It was possible under favorable conditions to feed a load per minute through the plant, but when 10 or 12 teams arrived simultaneously they had either to be delayed for from 1 to 10 minutes or allowed to dump their loads on a spoil pile on top of the filter roof and return to the pit. It would, of course, have been economy to hold them even 10 minutes rather than rehandle their loads, but the scarcity of teams and the absolute necessity of obtaining a maximum number of trips from each team working caused the adoption of the latter method. For each such bunching of teams there was a corresponding period during which no teams arrived and during this interval the plant ran empty. Another frequent source of delay was the breaking of some part of the mechanical apparatus, and while repairs were in progress all teams arriving dumped their loads on the spoil piles. As a result of this situation a night shift was organized to dispose of the spoil pile which accumulated during the daytime, the material being rehandled with wheel scrapers. The maximum output attained in any 10-hour shift was 320 cu. yds. of sand and gravel screened and washed, but the average was only 160 cu. yds. Had it been possible to keep the plant supplied and running continuously, there is little doubt that under favorable conditions at least 50 cu. yds. per hour of filter materials could have been produced. It is extremely unlikely that any such complicated plant as this, working under similar conditions, can be kept at work continuously. The main mechanical troubles came from the combination of grit and water which was kept out of the many bearings with the greatest of difficulty and which caused excessive wear and breakage on all portions of the plant with which it came in contact. The fine mesh screening wore out rapidly and required frequent replacing. On the second screen supplied, provision was made for the quick detaching and replacing of this fine wire mesh in small sections and it reduced delays of that nature materially.

Placing the Filter Materials.—In placing the filter materials use was made of the manholes in the filter roof which were provided for this purpose. These manholes were arranged in parallel rows 13 ft. apart, the manholes being 26 ft. on centers in each row and staggered with respect to each adjacent row.

The various grades of gravel were deposited separately, at least one row of manholes separating the edges of two successive layers. The bottom or coarse layer was carefully placed around the 10-in. split tile lateral collecting drains, the open joints of the latter being protected by clusters of large stones placed by hand. When sufficient advance had been made with the placing of this layer, the 2½ in. of 1-in. to ⅜-in. size was started; and it was followed in a similar manner by the fine or "buck-shot" pebbles. Each layer was carefully spread and brought to an accurate grade by the use of rakes.

All gravel was teamed in double or single carts and dumped directly through the manholes to the floor below. The average haul from the washer to the dumping point was about 500 ft.

When the placing of the three layers of gravel had proceeded for a short distance, the depositing of the filter sand was begun. The specifications required that it should be placed in three different layers, each approximately 1 ft. in thickness. It was also provided that the sand should not be allowed to drop from a height on account of the danger [illegible] used, suspended from a bar across the top of the manholes. By turning the bar the chutes could be made to discharge the sand in a circle surrounding the manhole opening. These chutes had to be made especially strong to receive the impact of the loads of wet sand which were dumped upon them. The sand in the two lower layers was spread by hand to an approximate level and the top layer was graded accurately to the required elevation.

The sand was at first hauled in cars or bottom-dump wagons, but, on account of its comparative fineness and the amount of water it contained, great difficulty was experienced in preventing leakage of streams of sand through the small openings and cracks. This not only wasted a large quantity of sand, but the water made the roadways over which the teams had to travel impassable with mud. A system of Koppel cars and portable track was, therefore, introduced, the cars being of 1 cu. yd. capacity each, while the track extended from under the sand hopper at the washer, over the filter roof to the row of manholes being filled. This track was thrown from one row of manholes to another as the filling progressed. On account of a steep grade from the washer location to the roof of filters and a few sharp curves in the track, it was necessary to employ a single horse on each car. Three cars were employed in placing the sand and at times carts were used for short intervals to help out.

There was a total of 19,938 loads hauled from the different pits, each containing approximately 1 cu. yd. bank measure. This gives an average of 1.046 cu. yds. of filter materials per cubic yard hauled. The separation of the gravel and sand naturally increased the total volume, while the washing action removed a substantial amount of sand.

The contract distinguished between filter gravel and filter sand and a separate price was paid for each, but as the two products were obtained in one operation it was impossible to divide the costs between them. Accordingly the following figure shows the average cost for each cubic yard of sand or gravel secured, hauled to the work, screened, washed, delivered in the filter and placed in accordance with the specifications.

COST OR FILTER SAND OR GRAVEL IN PLACE; 20,860 CU. YDS.

Expense at Pit	Per cu. yd.
Cost of labor	$0.2972
Cost of fuel, oil, etc	0.0167
Total cost of teams at pit	$0.3139
Moving shovel from filter to pit and finally from pit to cars at Westfield	$0.0163
Teaming from Pit to Work.	
Cost of teams hauling	$0.6345
Cost of tow teams on hills	0.1373
Total cost of teaming to work	$0.7718
Total cost delivered at work	$1.102
Screening and Washing.	
Cost of labor	$0.138
Cost of fuel, oil, etc	0.0874
Total cost of screening and washing	$0.2254
Placing in Filters.	
Cost of teaming from washer	$0.1077
Cost of labor	0.1425
Total cost of placing	$0.2502
Plant.	
Cost of plant erecting and repairing	$0.0932
Cost of materials used	0.1322
Total cost of erecting and repairing	$0.2254
Removing Plant.	
Cost of labor	$0.0184
Total cost of plant per cu. yd	$0.2438
General expense, 12.9 per cent	0.2347
Grand total cost of this item	$2.06

The item of labor and teams loading includes the expense of the following items of work: (1) Labor and teams building roads to and stripping (2 ft. deep) site of first pit. (2) Loading all teams by hand at first pit. (3) Labor sinking several test pits in various localities while searching for new supply. (4) Labor and teams stripping (2 ft. deep) second pit and building roads. (5) Labor on and around steam shovel used in loading. (6) Labor loading by hand in mixing fine material with coarser loads. (7) Labor and teams rehandling material dumped in spoil pile on filter roof and utilized by the night shift on the washer.

It will be seen, therefore, that this figure of approximately $0.31 per cu. yd. is made up of so many different items of work as to have little significance as a guide for future work. The labor cost of operating the shovel was $10 per day, which for an average of 160 cu. yds. per day would be equivalent to $0.63 per cu. yd. There will naturally be some stripping in all cases, and usually some incidental expense outside the mere cost of loading. A high-priced foreman was deemed necessary in this case to direct the selection of material and to regulate and supervise the teaming work. This item alone added $0.31 per cu. yd. to the cost of loading. All of these expenses would be reduced proportionately by an increased output per day.

The figures for teaming show the effect of the cost of tow teams. These same tow teams could have handled some additional teams at times, although for the most part they were kept busy. One hundred and seventy tows per day was about the limit for one team on these hills.

The unit cost for screening and washing would be cut down with an increased output since the total is fixed.

The cost of teaming from washer to filters includes also the cost of disposing of much surplus gravel, most tailings or stones over 2½ ins. and some of the fine or "buck-shot" grade. This item of expense also covers the cost of cleaning up and regrading the surface of the filter roof fill on the completion of the work.

The cost of plant is very heavy since it includes the cost of experimenting and remodeling as well as a large amount of renewal and repair work.

It is probable that the use of a series of inclined stationary bar screens or gratings for the removal of the tailings, 2½-in. and 1-in. gravel, would have been more satisfactory and economical than the use of the 42-in. revolving screen. The repairs and alterations on this screen formed a large portion of the plant repairs charged.

	Per cu. yd.
The contract price paid for filter gravel was	$1.25
The maximum price bid was	2.10
The minimum price bid was	1.25
The average price bid was	1.715
The contract price paid for filter sand was	$1.00
The maximum price bid was	2.00
The minimum price bid was	1.00
The average price bid was	1.555

The above prices were bid and based upon the assumption that sufficient material suitable for the purpose would be obtained at the site of the first pit, giving a short, downhill haul to the work and of such character as to offer no special difficulties in separating or washing.

Split Tile Drains.—These drains were laid on the floor of the filters at right angles to the 24-in. central outlet drains which ran longitudinally under the center of each filter and connected with them by means of 10-in. tees turned up through the floor every 13 ft. The split tile was of 10-ins. in diameter, laid with open side down and with open joints. Each transverse row was located in a valley of the floor, the rows being 13 ft. apart and passing over the upturned 10-in. tees from the central drains.

The split pipe was hauled from the railroad, unloaded and distributed in the filters by lowering through the roof manholes, and was laid just in advance of the gravel layer.

Large stones were selected from the coarser gravel layer and placed by hand around the open joints of the split pipe in order to prevent smaller stones from entering through them.

The cost of drains was as follows:

COST OF 10-IN. SPLIT TILE DRAINS, 9,360 LIN. FT.

	Per lin. ft.
Cost of pipe and freight	$0.118
Cost of teaming to job	0.015
Cost of labor unloading and laying	0.006
General expense, 12.9 per cent	0.018
Grand total cost of this item	$0.157
The contract price paid for this item was	$0.267
The maximum price bid was	0.48
The minimum price bid was	0.176
The average price bid was	0.273

Cast-Iron Pipe.—In connection with the distribution of the water to and from the filters and other structures, about 318 tons of cast-iron pipe were used, ranging in size from 6 ins. to 36 ins. in diameter. From the nature of the work much cutting and fitting was necessary, and a large part of the work consisted in the setting and fitting of specials and gates. It was in general necessary to lay this pipe in small sections as the work progressed, and this feature added greatly to its cost. Several tons in the basement of the office and laboratory building were laid with flanged joints, but the greater portion of the pipe was of the bell-and-spigot type, with lead joints. The pipe was furnished by the city, and delivered on cars at Westfield. It was possible to handle a small portion with the derricks used in concreting, but the greater part was handled and placed by hand and with ordinary trench derricks. The cost of the cast-iron pipe work was as follows:

COST OF LAYING CAST-IRON PIPE; 317.6 TONS.

	Per ton.
Cost of labor unloading from cars at Westfield	$0.60
Cost of teaming to work	2.10
Total cost on job	$2.70
Cost of labor in handling and laying	$3.46
Cost of teams used in laying	0.35
Cost of miscellaneous supplies	0.02
Total cost of laying	$3.83
Cost of labor calking	$0.83
Cost of lead, etc., on job	1.46
Cost of jute	0.08
Total cost of making joints	$2.37
General expense, 12.9 per cent	1.19
Grand total cost of this item	$10.09
The contract price paid for this item was	$12.00
The maximum price bid was	30.00
The minimum price bid was	6.50
The average price bid was	13.17

Cost of Keeping Horses.—During the first season's work, all teaming and horse work except that used in hauling from Westfield was done by teams either owned by the company or hired and kept by it. The maximum number of horses owned was 43, and the maximum number hired and kept was 10. The hired horses were paid for at the rate of $1 per day per horse. Of the horses owned, five were lost from one cause or another. A stable was constructed 100 ft. long by 30 ft. wide, and accommodations were provided for the above number of horses. Twenty "Troy" bottom-dump wagons were purchased, in addition to 6 wheel-scrapers, caravans, express wagons, etc.

The work was unusually severe on the horses on account of the uphill hauls. All the horses were young, green horses when purchased and cost an average of $230 each. They were acclimated without any serious trouble by giving them light work for the first few weeks.

On completion of the first season's work all of these horses were sold rather than undergo the expense of keeping them over the winter months, and during the second season's work all teams were hired and paid for by the day. The figures here given apply only to the first season and are reduced to cost per horse-hour actually worked. There were usually some horses unable to work due to sickness or other causes, and more or less lost time on rainy days and Sundays, so that a better idea of cost can be obtained from the unit-selected, viz., the horse-hour actually worked.

The cost of owning and keeping these horses, including all expenses connected with the teaming operations, was as follows:

COST OF TEAMING WORK; 72,474 HORSE-HOURS.

Buildings.	Per horse-hour.
Cost of materials used in building stable	$0.006
Cost of labor on same	0.0033
Cost of proportion of materials used in blacksmith shop	0.0001
Cost of labor on same	0.0010
Total cost of buildings	$0.0104

Depreciation and Repairs.		
Cost of depreciation on horses including freight		$0.011
Cost of depreciation on harnesses and repairs on same		0.01
Cost of depreciation on wagons and repair parts for same		0.01
Cost of labor on wagon repairs		0.0036
Total cost of depreciation and repairs		$0.0646
Cost of insurance		0.006
Cost of rent paid for hired horses		0.02
Cost of teamsters and barn men		0.1137
Cost of labor shoeing	$0.0055	
Cost of materials, shoeing	0.002	0.0057
Cost of fodder of all kinds		0.0845
Grand total cost of keeping horses per horse-hour actually used		$0.3067
Cost of single teams per hour		$0.39
Cost of double teams per hour		0.605

The entire cost of the stable and a fair proportion of the cost of the blacksmith shop is charged against this one season's work. Had the horses been kept for the two seasons, the figure would be reduced one half.

The depreciation on the horses represents the value of five horses lost and the shrinkage in value of the remainder after one season's work. This figure would also probably show some improvement if extended through two or more seasons.

The wagons received rather severe usage under the steam shovel, and repair bills were correspondingly large.

The rent paid for hired horses was high, being $1 per day per horse in addition to their care and feed. The total amount so paid was $1,386, but considering the depreciation suffered by these horses due to the severe nature of the work required of them, it cannot be called excessive.

The cost of transporting the hay and grain added considerably to the cost of feeding, and the amount fed to each horse averaged higher than would be the case for horses doing lighter work. During the second season's work all teams were hired outright for $5.50 per day until the middle of the season, when, teams becoming scarce, the rate was raised to $6.

Office and Laboratory Building.—This building is of reinforced concrete throughout, except the roof, which is of wood frame covered with red tile. It is 47x27 ft. in plan, two stories in height with a pitched roof. The floors are of reinforced concrete. On the lower floor is a power room 25 ft. by 17 ft. containing a water turbine operated by the water flowing from the basin to the aërator. This turbine drives a 6-in. centrifugal pump for furnishing water pressure to all parts of the plant, and a dynamo for furnishing electricity for lighting purposes. A second similar room on the lower floor is provided with necessary apparatus for chemically treating the water should it be necessary. The second story contains a large store room and a laboratory. The building is heated by hot water and equipped with a modern plumbing system, including a complete bath room.

The actual cost of the building complete above the foundation, including plumbing and heating, but exclusive of hydraulic [illegible]	[illegible]
The contract p[illegible]	[illegible]
The maximum sum bid was	15,000
The minimum sum [illegible]	[illegible]
The average [illegible]	[illegible]

Reduced to price per cu. ft., the above figures become 31 cts., 37 cts., 18 cts. and 31 cts. respectively.

Regulator House.—This building is 35x35 ft. in plan, of reinforced concrete, one story high, and is covered with a flat gravel roof. Its interior is plastered. The floor is of concrete, but covered only 33 per cent of the area, the remaining space being occupied by open wells. In this building are the controlling valves on pipes from the filters and all recording apparatus of the Venturi meters.

The total cost of [illegible]	[illegible]
The contract price paid for this building above the foundation	[illegible]
The maximum price bid was	6,500
The minimum price bid was	2,000
The average price bid was	3,658

Reduced to price per cubic foot, the above figures become 26 cts., 28 cts., 43 cts., 13 cts. and 24 cts. respectively.

Filter Entrances.—For the purpose of entering the several filters, entrances and stairways were provided over the first, third and fifth division walls, each building admitting to two filters. These buildings are of reinforced concrete 13x13 ft. in plan and covered with pointed, tile roofs. They are plastered on the inside.

The actual cost of [illegible] each	$910
The contract price paid for these entrances was, each	1,000
The maximum price bid was, each	2,000
The minimum price bid was, each	425
The average price bid was, each	943

Reduced to cost per cubic foot, these prices become 46 cts., 50 cts., $1.00, 21 cts. and 47 cts. respectively.

Other Items.—The remaining eleven items of the contract were of a miscellaneous character, and description of the methods or costs as far as they are concerned would probably be uninteresting and uninstructive.

Conclusion.—In the foregoing description an attempt has been made to state clearly the conditions under which the several costs were contracted. There remain, however, some general statements, a knowledge of which is necessary if the figures given are to be used and applied intelligently.

During the first season's work common labor of satisfactory quality was easily obtainable and was paid for a short time at the rate of 15 cts. per hour. A limited number were however, allowed 17.5 cts. and mechanics were paid the customary rates pertaining to their trades—i. e., hoisting engineers, $3.50 to $4 per day; carpenters, $3 to $4 per day; blacksmith, $3 per day; teamsters, $1.75 per day. Foremen received $30 per week in addition to their board. After the first few months of work the rates of common labor were increased to 17.5 cts. per hour and those especially capable were paid 20 cts.

During the second season the rate of 17.5 cts. was maintained for early half, but the supply of good labor then becoming scarce, the rate was later increased to 20 cts. and that for picked laborers 22.5 cts. and 25 cts. per hour.

The weather conditions were exceptionally favorable throughout the period covering the work. Both seasons were far below the average in matter of rainfall, and the small amount of precipitation recorded occurred usually in a few large storms rather than in many small ones. A large percentage of the rains occurred at night or on Sundays, and the total lost time due to weather conditions did not exceed ten days for the two seasons' work.

An important feature to be considered in connection with the analysis of cost data is the character of the engineering and inspecting under which the costs were contracted. It is no exaggeration to say that contract costs on public works may easily vary as much as 10 per cent with the varying degrees of compliance exacted by engineers and inspectors charged with the enforcement of contracts and specifications.

On this work a most liberal spirit was manifested at all times by the entire engineering force in interpreting and applying the specifications. In fact, the co-operation, advice and assistance of the engineers and of the water board were available to the contractor at all times, and were freely used by him to his great advantage. The specifications and contract were rather more liberal and equitable in tone than is customary in similar cases, and in addition great latitude was permitted the contractor in carrying out their provisions. Frequent modifications of specified requirements were made from time to time in favor of the contractor when such changes did not, in the engineer's opinion, affect the ultimate quality of the work. It will be readily appreciated that costs contracted under these conditions will be much less than would be the case if similar work were done under exacting and arbitrary engineering supervision.

It may be charged with some reason that certain of the cost figures are so high as to indicate mismanagement or gross inefficiency on the part of those in charge. It should be borne in mind, however, that bad management is as much a contingency to be expected and provided for as is bad weather or bad ground. The available supply of competent foremen, laborers and mechanics is not sufficient to insure always the obtaining of a satisfactory and well-balanced organization after the contract has been signed; and in contracts involving, as did this one, a great variety in classes of work, it is not to be expected that equal proficiency can be attained in handling the several different kinds of work involved.

DRAINAGE AND IRRIGATION SECTION

A Criticism of a Cellular Dam Design and a Discussion of "Reversed" Dams.

BY R. [illegible] BEARDSLEY*

The writer has read the article, "Design and Computations for a Cellular Reinforced Concrete Dam," by Mr. Bancroft, appearing in your Journal of Dec. 14, 1910, with the greatest interest. The incorrectness of the claims made by the author for the cellular dam appeared to me to justify a more careful analysis, and the computations revealed even greater inaccuracies than were at first suspected. In a general way, these inaccuracies are as follows: The dam has no factor of safety at all, neither as a bow dam, nor as a gravity section. No profile is given, but based on the statement that if the dam were a solid concrete dam, 300,000 cu. yds. of concrete would be required, the cellular dam would contain about twice the reinforced concrete claimed for it, or about 100,000 cu. yds.

The cellular type as shown by Mr. Bancroft is not new, the same being covered by United States patents taken out several years ago by a well known dam builder.

The design of a [illegible] built as an integral part of the river bed, has presented a problem which has thus far proved a mystery to the world's greatest engineers, as was demonstrated in the design of the Lake Cheesman dam. (See Transactions American Society of Civil Engineers, Vol. LIII, p. 89, 1904). Professor Williams eliminated practically all the unknown factors by building a bow dam so that the base was free to move on the foundation. Imagine then the world of unknown and incalculable factors entering into the design of a dam of the cellular type, when acting as a bow dam. It is quite certain that the buttresses would prevent any arch action, as the deflection at the top would be much less than that necessary for the arch to take its load, and the bottom would certainly have no arch action. The dam would therefore fail by crushing the down stream toe and tipping over. However, considering that the author's dam, 1,370 ft. along the crest, and 185 ft. high, could act as a bow dam: The seven vertical longitudinal walls aggregate 23 ft. in thickness at the base and taper off to 2 ft. at the top. Taking a radius of curvature for the bow, as 900 ft. and a safe pressure of 44,000 lbs. per sq. ft. of concrete, the safe thickness of the dam at the base is 900x185x.0014 = 233 ft., or ten times the thickness given to the cellular dam.

It will be seen by the empirical formula, given, that if the radius could be decreased, a much less thickness would be necessary. The radius of Mr. Bancroft's dam, as shown in the sectional view, is about 370 ft. which would only be sufficient to reach 740 ft., or about half the width of the stream. However, for R = 370 ft., the thickness should be 96 ft. which is still four times that given in the design. As examples of bow dams which have been built and tested by time, see Engineering Record for Oct. 8, 1910. Thirteen such dams were built. The highest was 87 ft., and radius of 100 ft. The base thickness was 24 ft. or about the same as that for the cellular dam of nine times the radius and twice the height.

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*Cleveland, O.

The greatest of all bow dams is the "Shoshone dam," with a height of 328 ft., length of 200 ft., and radius of curvature of 150 ft. By the formula, the thickness at the base would be 69 ft., while as a matter of fact it is 108 ft. thick, which gives a pressure of only 20,000 lbs. per sq. ft. Even with the short radius here allowable, the thickness at a depth of 185 ft. is 87 ft. Thus, it will be seen that even though it were possible for the cellular dam to act as a bow dam, it would fail long before the water reached the top.

As a buttressed dam, it is also dangerous. Before a dam tips it crumbles back the down stream toe, if it is too weak, to a point where it has sufficient shearing strength to sustain the combined load of dam, and water pressure.

Fairly exact drafting-board analysis and slide rule computations show that the resultant pressure is 26,500,000 lbs., the overturning pressure (20 ft. of dam considered) is 21,399,700 lbs. and the vertical downward pressure, including the weight of materials, is 16,100,000 lbs. (only counting that earth filling which is shown as supported on a reinforced concrete floor). The buttress is stated to be 3 ft. thick at the toe, and as it is 24 ft. high, there is only an area of 72 sq. ft. to resist the tipping of the dam. The total vertical pressure on 20 ft. of the down stream longitudinal ring is 500,000 lbs. This pressure is transmitted to the second ring through the buttress. Considering the buttress as a cantilever of a length equal to the distance between rings, or 24 ft., the pressure on the upper fibers is 55,000 lbs. per sq. ft., which is too high a value for conservatism. Reducing the thickness to 1 ft. as shown in the drawing, the pressure would be instantly fatal to the life of the structure.

In other words, the toe of this dam is one of the several weak points, and while it could be strengthened so as to give proper safety, it should be apparent that, as shown, the dam would fail by crushing the toe and tipping over. Assuming, however, that the toe is sufficiently strong and the base would remain 165 ft. long, the overturning moment is 1,319,648,000 ft. lbs., and the resisting moment is 2,125,596,000 ft. lbs., giving a factor of safety of 1.7. What conservative business man, or engineer, would risk his money on such a safety factor as that?

The earth or rock filling within the cells will not resist the tipping of the dam unless it is carried by a floor attached to the buttresses.

To those wishing to study the design of such dams, the writer would refer to *Concrete Engineering* for May, 1910, page 110: Engineering-Contracting for March 2, 1910, page 207, and *Engineering News* for April 23, 1908, page 452.

Turning to the item of cost, which next to safety, is of the greatest importance, I find that the cellular dam, as shown by Mr. Bancroft, and as nearly as could be scaled, (and fully as scant as could be safely thought of), contain 140 cu. yds. of reinforced concrete per lineal foot of dam (measured along the dam), 185 ft. high. Figured at $9 per cu. yd. the cost of this dam is $1,260 per ft. The filling amounts to about 600 cu. yds. per ft., which at 30 cts. would cost $180 per ft. of dam, giving a total cost of $1,440.

Referring to the curves in Fig. 4, a solid concrete dam, having a factor of safety of about 1.5, would contain about 425 cu. yds., which at $5, would cost $2,125 per ft., exclusive of foundations. In connection with the factor of safety of solid dams, see pages 238-256 of the writer's book "Hydro-Electric Plants"; that is, a solid dam having a factor of safety of more than unity costs some 47 per cent more than the cellular dam, which has a minus factor of safety. The moral is obvious.

As a substitute for either the solid or cellular dam, the writer suggests the "reversed" dam, a new type for which patents have been applied. In the reversed dam there are no uncertainties of design and actual tests of working models have demonstrated that the formula used gives exact results. The cost of a reversed dam 185 ft. high is only 9x75, (see Fig. 4) or $675 per foot length of dam, or half that of the cellular and has a factor of safety of 3.5.

This dam uses the gravity of the water to hold the structure in place, and is so designed

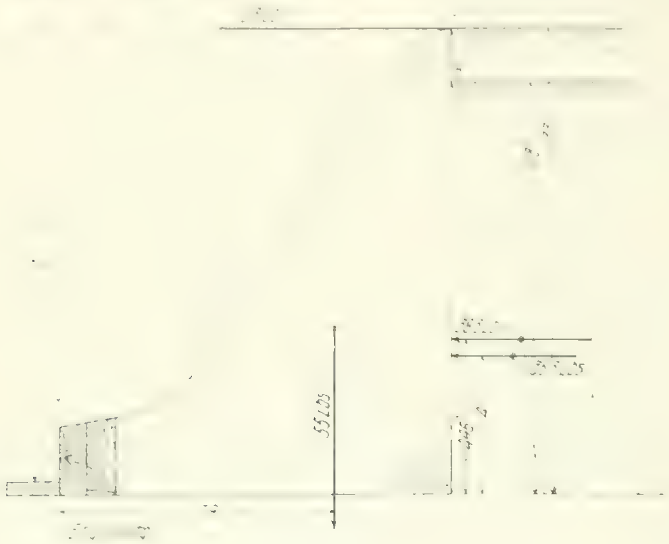

Fig. 1.

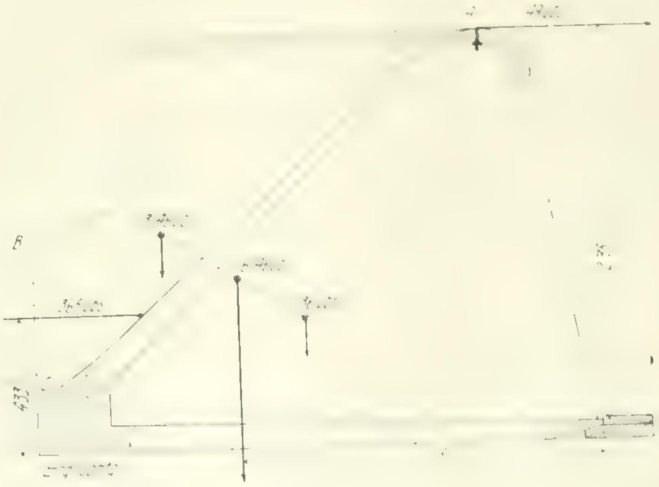

Fig. 2.

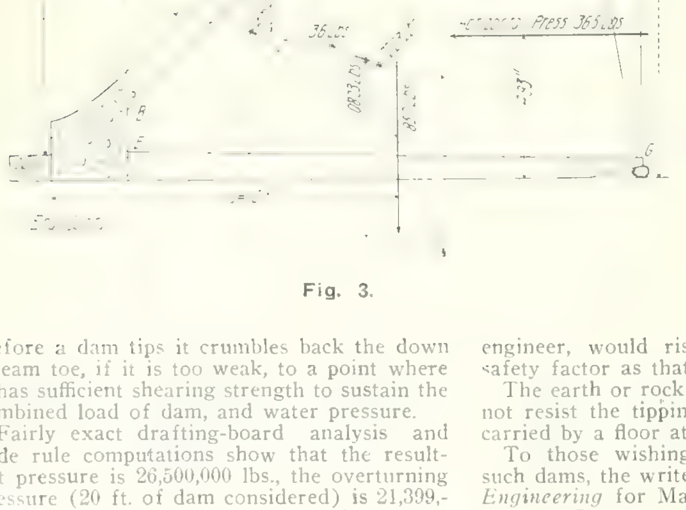

Fig. 3.

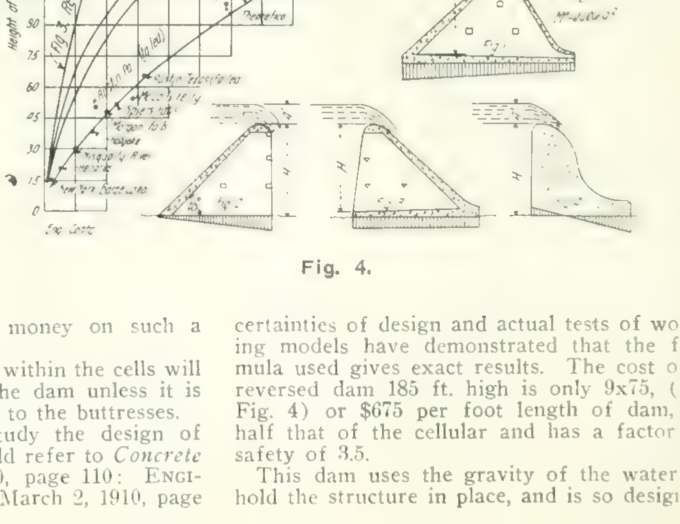

Fig. 4.

that it utilizes more than twice the weight of water sustained by the buttressed or gravity dam. This is accomplished by turning the gravity dam around and providing a base which sustains the full head of water for its whole up-and-down stream length. Thus, instead of a *triangle* of water resting on the *deck*, as in the gravity dam, a *rectangle* of water resting on the *base* is the result. This construction makes the deck perform the double function of deck and apron, and thus cheapens, eliminates vacuums, and gives an ideal spillway and tipping edge. Figure 5 shows a section of a reversed dam 100 ft. high, the calculations for which are as follows:

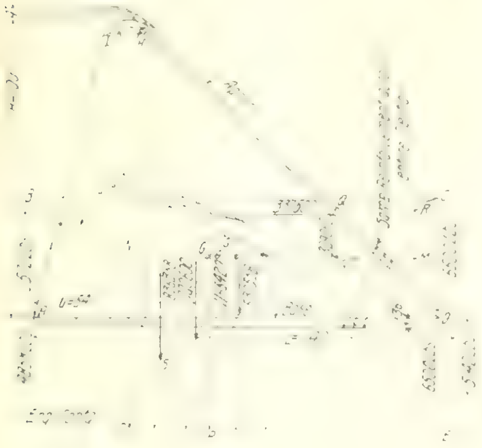

Fig. 5.

The procedure is practically the same as that followed for the gravity dam. First the center of gravity of all concrete is found in the usual way to be at *G*, for *L*= 160 ft. The vertical downward pressure, due to the water, is represented (drawn to scale and in terms of the unit weight of concrete) by the rectangle *A B C D*, the center of gravity of which is at *G'*, and the center of gravity of *all* downward pressure is found to be at *G''*, and equal to 1,165,420 lbs. The total *upward* vertical water pressure is now found by constructing the trapezoid of pressures *E F D H* and the rectangle *H F I K*, the combined center of gravity being at *G'''*. We now have two opposite and parallel forces to resolve into their resultant. Through *G''* and *G'''* pass a straight line and lay off *G'' N* equal to *G''' M*. Erect at *G'''* a vertical drawn to scale and representing the upward thrust of 329,062 lbs. At *G''* drop a vertical representing the total downward force of 1,165,420 lbs. Complete the parallelograms *G'' N O P* and *G''' M R Q* and project the resultant of the latter to meet the resultant of the former at *S*. The vertical erected at *S* is then the resultant of all the vertical forces and equals the difference between the upward and downward pressures, in this case, 836,358 lbs. The distance of this vertical from the nearest edge then gives x in the example, $x > \frac{L}{3}$, therefore indicating that

$$p_h = \frac{2W}{L}\left(2 - \frac{3x}{L}\right) = \frac{2 \times 836,358}{160}\left(2 - \frac{3 \times 62}{160}\right)$$

= 8,756 lbs. per sq. ft. at the heel and 1,698 lbs. at the toe due to *all* vertical forces. Proceeding in the same way as for the gravity dam, the pressure at the toe, due to the *horizontal* water pressure is found to be

$$M = \frac{S\,L^2}{6} \text{ and } 11,667,375 = \frac{160^2 S}{6}\quad S = 2,739$$

lbs. compression at the toe and tension at the heel, giving for the total pressure, 4,437 lbs. at the toe, and 6,017 lbs. at the heel. It will be seen that by making the base about 150 ft., the pressure diagram will be a perfect rectangle, giving a uniform pressure over the entire base.

The base must be designed to resist the entire uplift under the deck. The reinforcing steel is placed at the bottom of the base, and in the apron at the upper surface. The tendency is for the water to force the apron away from [illegible] is taken care of by steel bars, a few of which are indicated in the figure.

On the dam shown, the buttresses being 13 ft. on centers, the force on 12 ins. of the base and apron [illegible] lbs. [illegible] sq. in. is allowed for the steel, 5.25 sq. ins. of steel will be required. These tension bars are bent into hooks at the ends and attached to the reinforcing in the apron and deck. The only office of the buttresses is to sustain the deck before the filling of the reservoir and to protect the steel from corrosion. This buttress concrete may be 6 or 8 ins. thick and struts put in at frequent intervals and lengthwise of the dam to prevent buckling. An enlarged view of one of these struts is given showing the triangle form and a 1-in. tie rod passing through the center of the concrete. Such struts, for a 6-in. buttress would be placed about 10 ft. on centers vertically and horizontally. It is due to the possible thinning of the buttresses that the reversed dam owes its great saving in materials, but as will appear the *safety* [illegible] any other type of dam.

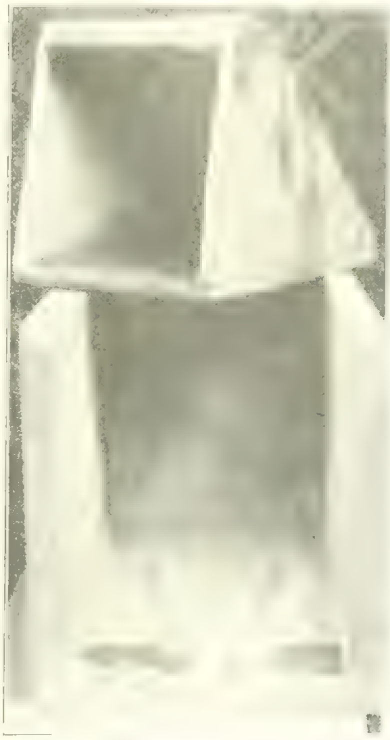

Fig. 6.

For rock bottom the base may be reduced in thickness at the heel as the rock bottom may be made to support it and only sufficient strength provided [illegible] uplift on the apron at that point. In the preceding example, no account has been taken, in designing the apron, of the weight of the apron concrete helping to resist the uplift, but if this is allowed for about 8 per cent less steel will be required in the buttress. In the example, due allowance was made for the floating effect on the submerged base, it being assumed that tail water stands even with its top surface.

It will also be noted that the cost for form work is much less than for the gravity type, as there is no concrete in contact with the forms that is exposed to view when the dam is in use, and the base, which contains over one-third of the total yardage, requires no forms at all.

Another [illegible] reversed dam over either the solid or the gravity dam without a mat is that owing to the low [illegible] much less excavation is necessary, and so long as a water tight shut off wall of concrete or sheet piling is secured along the up-stream edge, this dam may be safely placed on any river bed met with. It is also apparent that the position of the heavily reinforced apron gives this dam a safe toe so that the full resisting moment will be utilized. Safety against overturning may be easily found for the ideal dam; that is, a dam having no ice thrust, no vacuums, no up-lift, and no back water. In the reversed dam Fig. 5 having,

$$L = 160;\quad \frac{98 \text{x} 836,358}{337,500 \text{x} 34.57} = 7.02 \text{ F of S}$$

Having

$$L = 140;\quad \frac{86 \text{x} 799,600}{337,500 \text{x} 34.57} = [illegible] \text{ F of S}$$

Having

$$L = 116;\quad \frac{71 \text{x} [illegible]}{337,500 \text{x} 34.57} = 3.27 \text{ F of S}$$

It, therefore, appears that as regards safety against overturning the reversed dam is safer than even the gravity dam built especially for soft bottom. The same factor of safety would be obtained for the gravity dam for rock bottom, and the reversed dam, when the base is, in each case 150 ft., while the base of the gravity dam for *soft* bottoms is 176 ft. Of course such increased width of base necessitates that much more excavation.

Examining this dam for safety against sliding and for the three different lengths of base, we find the sliding coefficient of equilibrium to be as follows:

$$\text{For } L = 160,\quad \frac{337,500}{836,358} = .40$$

For L = 140, = .48

For L = 116, = .63

An inspection of the equation used in the calculations for the dam will show that if models of several large dams are built to scale, and tested for tipping and sliding, a true comparison of safety factors will be obtained, as all the factors entering into these equations are in direct ratio to the head of water acting on the dam.

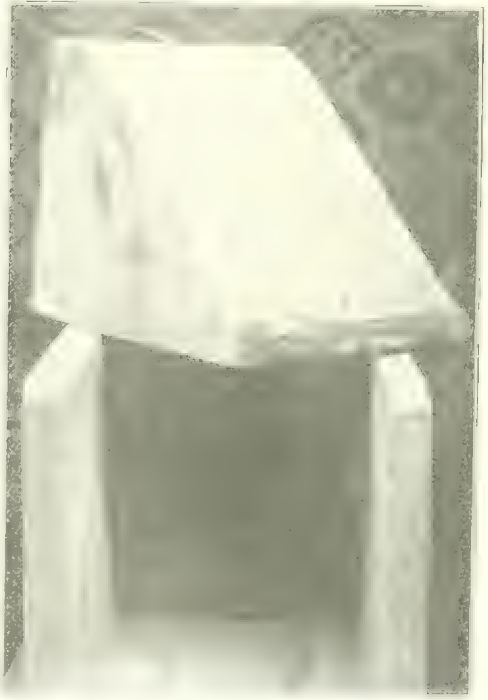

Fig. 7.

In order to convince the directors of a power company which proposed building a 130 ft. dam, that the reversed dam was safer than the proposed solid dam, a model was made of each type. Figures 6, 7 and 8 show these models and Figs. 1, 2 and 3 are exact sections. It will be seen that the model of the reversed dam was much heavier than it should have been. This was due to the impossibility of making the reinforced concrete shell of the thinness necessary. For the purpose of proving the formula, however, this fact is of no consequence, especially as a [illegible] represents 128 ft. of 130-ft. dam, and in the case of the reversed dam, 13 buttresses are concentrated into the two at the ends. It will be seen that by merely turning the re- [illegible] model of the gravity dam and the tests included the three types.

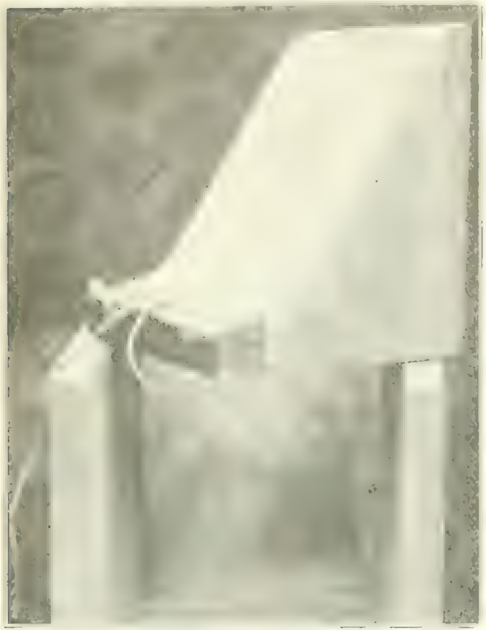

Fig. 8.

The four cuts 6, 7, 8 and 9 show the models and the reinforced concrete testing flume in which the dams were tested. Fig. 1, if a reversed dam is considered, is a down-stream view and shows the base upon which the total water load is carried. Considered as a grav- [illegible] view. Figure 2, considering the dam of reversed type, is an up-stream view, and indicates the massive appearance this dam presents when in opera- [illegible] proposed

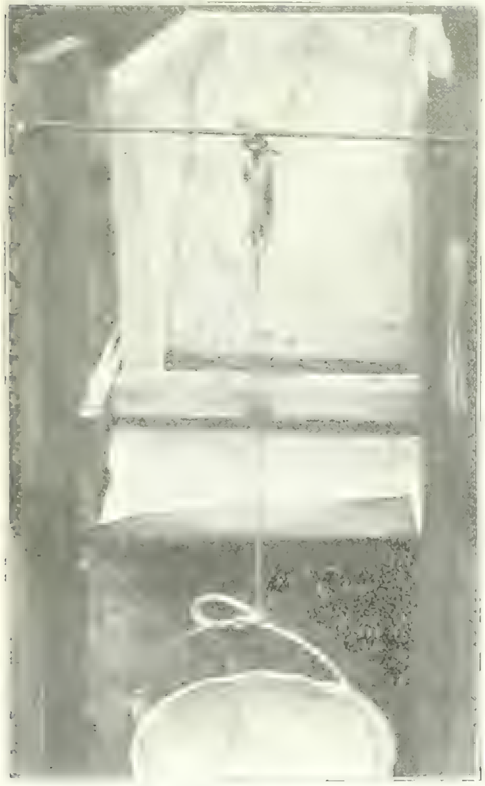

Fig. 9.

solid dam, and Fig. 4 shows the model ready for a test as a reversed dam.

A reinforced concrete testing flume was constructed so as to avoid the swelling and shrinking to which a wooden flume would be subject. This flume is shown in the cuts. The models were made 11.9 ins. long, thus having [illegible] in. clearance. To prevent leakage around the ends and under the dam, a thin rubber diaphragm was attached to the walls and bottom of the flume. Water was fed to the flume through a rubber hose.

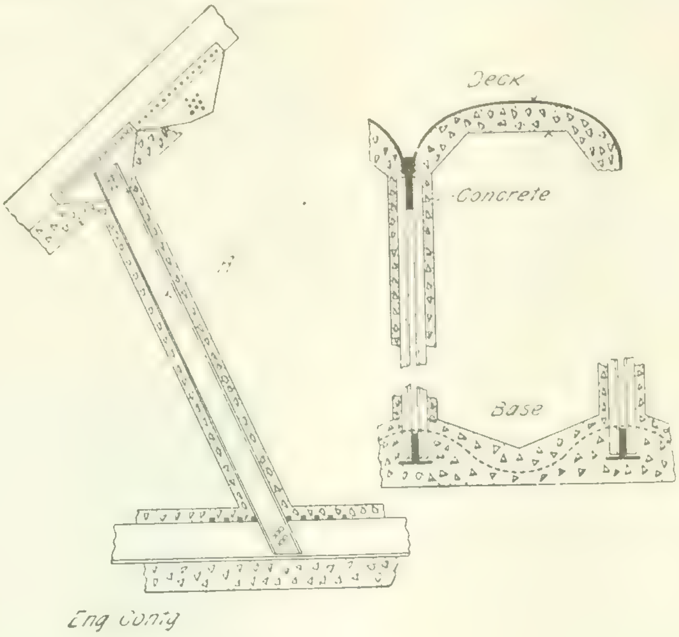

Fig. 10.

In making the tipping tests a cord was attached to the top of the dam, passed over a roller bearing pulley and then fastened to a pail into which sand was put. The weight of the models was obtained by actual weighing and the center of gravity of the dam materials was found by suspending the models at different corners and finding the intersections of the lines of support. For the sliding test a spring scale was used to measure the pull on a cord attached near the bottom of the model.

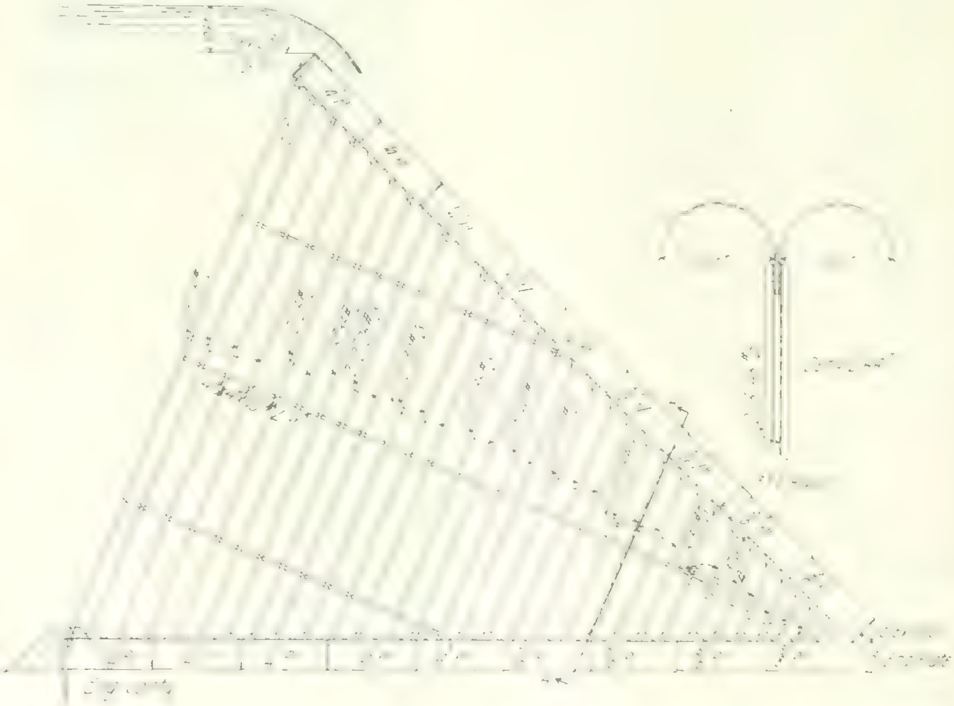

Fig. 11.

The data on Figs. 6, 7 and 8 indicate the results of these tests. In each case the lowest results were taken, as it was found very difficult to eliminate all end friction, and the *least* pull would, of course, indicate the least friction as all the other factors remain constant.

The criterion of all dams, as regards sliding, is the sliding coefficient of equilibrium. That is, the total horizontal down-stream thrust divided by the total vertical downward effective weights. For all dams, no matter what the type, the horizontal thrust is the same (dams being of the same height above tail water) and therefore that dam is safest against sliding which has the greatest effective weight acting upon the base.

The important feature of these tests is that in each case the actual pull required was practically the same as the calculated pull, thus demonstrating that the calculations will hold for the highest dam. The factor of safety against tipping for the three models was as follows:

Solid dam	2.5
Gravity dam	4.9
Reversed dam	5.6

It is customary to assume, in the design of the solid dams, that the toe would break back to a point where the projection of the straight portion of the down-stream face intersects the base. In this test, however, two wooden blocks were bolted to the toe so that the full width of base was used. If the toe blocks had been removed, the factor of safety would have been reduced to 2.

In the tests for sliding, the solid dam slid before the water reached the crest, as indicated in Fig. 1. The sliding coefficient of equilibrium was 0.7 for the solid dam; 0.54 for the gravity dam, and 0.42 for the reversed dam. This coefficient is the coefficient of friction at which the dam would just begin to slide, and it will be seen that the reversed dam is much the safest against sliding. The arrow pointing to a point on the curve of materials for solid dams, in Fig. 4, indicates that this model solid dam was fully as massive as any of the modern solid dams.

Such tests are favorable to the solid dam as the tipping effect of vacuums and buoyancy, due to back water, are not present. As frequently pointed out by the writer and others, the solid dams built without allowing for such factors are actually dangerous.

In addition to its greatly increased safety, the reversed dam is the cheapest of all dams. Figure 4 gives the material curves for the four types indicated. In plotting these curves exactly the same unit stresses were used for all the dams and four feet of water was assumed to pass over the crest. The cross hatched diagrams of pressure under each dam indicate the distribution of pressures, and it will be seen that the pressures are exactly equal at both edges of the reversed dam. This feature makes the reversed dam the ideal structure for soft bottoms. At a very small added cost the base may be extended upstream, getting a comparatively large increase in safety with a very small increase in yardage.

The reversed dam may be built entirely of steel, see Fig. 11, in which case the lowest possible cost is obtained, but many engineers oppose such construction in the belief that the steel will rapidly corrode. The writer contends that the steel will not corrode unless it is in contact with moving water or air. It will be seen that all the water inside the reversed dam is in a state of perfect rest. The down-stream side, or apron, can be painted from time to time during periods when all the flow is passing through the power house.

Figure 10 shows two details of a combination steel and reinforced concrete dam in which the steel inside the dam is protected from corrosion by concrete. The deck consists of plate iron riveted at the edges through gusset plates, to which the channel-iron ties, *a*, are attached. The ties are incased in concrete in the same way as are the columns in an office building. The base is of reinforced concrete as this material gives the greatest coefficient of friction and can be more easily adapted to the inequalities of the river bed. It is also cheaper than steel plates, as there is no form work expense. The reinforcing rods in the base are passed over the angle-irons, as shown, and given a catenary curve downward.

While it is necessary to limit the stress on the reinforcing steel to 12,000 lbs., where the concrete is subjected to water pressure, the ties may be stressed to the usual 16,000 lbs. or higher.

The design of the reversed dam may be executed with a greater degree of safety than can that of an office building. All the stresses are known to a fraction of 1 per cent. There are no wind stresses, no moving or vibrating loads. Practically all stresses are tensional, and carried by steel, a much safer design than concrete in compression.

As a retaining dam for reservoirs, where no spillway is required, the quantities of materials are reduced from 2 to 20 cu. yds. per foot of dam, depending on the height. As a reservoir dam the reversed dam affords a certain added storage capacity, which, in many cases, is of great importance. All the water under the dam is available for this purpose.

In appearance, when the pond is full, the reversed dam looks like an excessively massive solid concrete dam, see cut No. 9, and therefore should satisfy one of the conditions demanded by municipalities and government engineers.

The saving in cost affected by the reversed dam, over that of the proposed solid dam, which [illegible] over a half million dollars.

Tests to Determine the Coefficient of Roughness for Common Tile Drains.*

So far as the authors have been able to determine, there have never been any investigations made to determine the value of the coefficient of roughness, *n*, for common drain tile. The value of *n* enters very largely into the design of a tile drainage system. The common practice seems to have been to assume a reasonable value of *n* and go ahead. The assumed value of *n* is based on the value for *n* for sewer pipe and other surfaces upon which determinations have been made. Since a small change in this factor makes a large change in the value of the constant, *c*, in the formula, $v = c\sqrt{rs}$ thus materially altering the velocity and the quantity of flow in the tile when [illegible] is the quantity of flow, it may easily be seen that a correct valu[illegible] the very greatest importance.

It was the object of this investigation to secure data at first hand, under actual conditions as they prevail in practice, and to carry out the computations necessary to determine the coefficient of roughness *n* in Kutter's formula and in a broad way to try to determine the effect that the size of a tile, the material of which it is made, and the grade and variation in flow, would have on the value of *n*.

The work in the field was done after the following general plan. A weir was put in below the outlet of a tile to determine the quantity of flow. The head on the weir was measured on a stake set at the same elevation as the weir notch and about 15 ft. back from the weir. Then up the line of tile from the weir a series of openings were made down to the tile. A small opening was made at the joints. The depth to the water and the depth of the water were measured with a small cedar stick tipped with a sharpened nail. Several sets of readings were taken. The distances between the openings in the tile were measured and levels taken on the openings. The levels were taken to the .001 part of a foot. The distances between the holes to the .1 of a foot and the depth of water and depth to water from the top of the tile were taken to the .01 in. The readings on the weir were taken to the nearest 1/16 in.

One example will be discussed in full and the computations carried out to illustrate the method of performing the office work. The 18-in. vitrified clay tile at Humboldt, Iowa, will be used [illegible]

The weir notch was 3.02 ft. long. The head on the weir remained constant during the time we took the observations. The head was 3⅝ ins., which, reduced to feet, is [illegible] from Franc's formula, which is:

$Q = 3.33$ [illegible]

Q = cubic feet per second,
b = length of weir notch,

Size	Material.	n
[illegible] x [illegible]"	[illegible]	[illegible]
[illegible] x [illegible]"	[illegible]	[illegible]
[illegible] x [illegible]"	[illegible]	[illegible]
[illegible] x 1[illegible]	[illegible]	.01172
[illegible] x 1[illegible]"	[illegible]	[illegible]
1' x 1[illegible]"	Clay Vit	[illegible]
1' x 16"	Cl[illegible]	[illegible]

h = head over the weir

$Q = 3.33$ [illegible] ft. per sec.

The rod reading on Station 1 was 8.175 ft. The depth of the water was 12.75 ins.; reduced to feet, 1.063 ft. The sum of these two is the water rod or 9.238 ft. In the same way the water rod for Station 2 is 8,968 ft. The difference in elevation between the points is .27 of a foot. The distance between the stations is 55.4 ft. The hydraulic grade will be .27/55.4 or .4873 per cent, or the average hydraulic grade for this section of the pipe is .2337 per cent. The averages were secured for the other sections in the same manner.

The depth to the water was 12.75 ins.; reduced to feet, .613 ft. Next we computed the wetted perimeter and the area of flow from the formulas:

$p = \frac{1}{2} 3.1416 d$ + d int[illegible] the [illegible] $\frac{2d' - d}{d}$

$a = \frac{1}{4} p d + (d' - \frac{1}{2} d)$ [illegible]

Where
p = wetted perimeter,
a = area of flow,
d = diameter of tile,
d' = depth of flow.

We assumed that the tile was circular and of the given diameter at each station.

The wetted perimeter at Station 1 is

[illegible] = 2.0809 ft.

and

$a = \frac{1}{4} \times 2.0809 \times 1.5 + (.613 - \frac{1}{2} \times 1.5)$ [illegible] $= .679359$ ft.

The mean hydraulic radius is the area divided by the wetted perimeter or .6793 ÷ 2.0809 = .3264. The average of these for each station was next secured. Then we figured the velocity of flow in the first section by securing the mean area of flow, which was the average of the two end areas of flow:

[illegible]

Where
Q = cu. ft. per sec.
a = area of flow in sq. ft.
v = velocity in ft. per sec

$v = \frac{[illegible]}{[illegible]} = 2.611$ ft. per sec.

[illegible] $C\sqrt{R}$ [illegible]

Where
C = constant,
R = hydraulic mean radius,
s = sine of the slope,

[illegible] = 72.04

[illegible]

When n = the coefficient of roughness.

[illegible]

We determined *n* for each section and took the average of all the sections as the *n* for that particular tile.

The following table is a summary of the work. It gives the size of the tile, the material of which it is made, the value of *n*, the character of the gradient and depth of flow:

[illegible]

From the table the size of the tile does not seem to influence *n*. The length of the tile may have some influence on *n*, as the two smallest tile have the largest values. This is probably due to the greater number of joints, as the tile over 12 ins. in diameter were 2 ft. long. The depth of flow does not seem to influence *n*. This work seems to indicate that irregularities in the grade have the greatest influence on *n*. The 20 and 18 in. tile have the lowest values of *n* and they were the two best laid tile in the set. It will require much further work to settle these questions, particularly as to whether the depth of flow does really influence the value of *n*. This would require a great many tile of the same diameter laid at different grades flowing at different depths to give sufficient data upon which to base conclusions.

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*By John [illegible] Bulletin No. [illegible] Experiment S[illegible]

Proposed Flood Protection Plans for the Maris des Cygnes River, Kansas, With Estimates of Costs.*

The Maris des Cygnes River watershed comprised in this reclamation plan has an area of 3,610 square miles in Kansas and of 50 square miles in Missouri, located as shown by the map, Fig. 1. Its valley varies from ½ mile to 4 miles in width and terminates in high bluffs. Its tributaries have similar valleys of "lowlands" bordered by bluffs. The river flows in general in long easy bends with connecting straight reaches, but in a few localities the channel is very tortuous. The channel is quite permanent with rock bottom in many places and frequently rock banks. The channel depth is controlled by these ledges. In places the banks have caved and generally the channel is obstructed with draft. The channels of the various tributaries are similar to that of the main stream.

The lowlands along the main river and its tributaries is subject to frequent floods which make them practically worthless for cultivation though very fertile. If protected from floods these lands would be worth from $125 to $150 per acre. The purpose of the plan described is to afford this protection. It provides: (1) The construction of levees; (2) the improvements of the chanel by clearing; (3) the widening of the channel at Ottawa, Kan.; (4) the construction of one cut-off

LEVEES.

The plan calls for the construction of levees on both sides of the main stream and of tributaries so as to give a channel between levees of 1,300 ft. width for the upper stretches and of 1,800 ft. width for the lower stretches. The following specifications are to control levee construction:

Location.—In no case should the levee be located within 200 ft. of the bank of the stream, and it should, in a general way, be parallel with the stream, changing its direction, when necessary, in easy curves rather than by sharp angles. The ground should be carefully inspected to secure the best location. The location may be varied from the lines shown on the maps, whenever, by so doing, advantage may be taken of higher and more stable ground.

Preparation of base.—The base should be cleared of all vegetable growth, stumps and trees, and then be plowed so as to permit the new material placed in the levee to unite with the ground underneath, in order to prevent seepage. Many failures have occurred because this precaution was not taken.

Dimensions.—The height of the levee depends upon the elevation of the ground on which it is located; but in all cases the top should be 3 ft. above the high-water mark of 1909 at that point. This will require a levee of varying height, ranging from 2 or 3 ft. to 15 or 16 ft. The top width should be 4 ft. The side slopes should be 2 on 1 on each side. It is believed that a levee of these dimensions, if well built, will protect the lands from overflow during floods like that which occurred in 1909 (Fig. 2).

How levees should be built.—The levees should be built of clean earth, free from vegetable matter, taken from the side of the levee next the river. The pit from which the earth is taken should have side slopes at least as flat as 1 on 1 and should not be more than 6 ft. deep. A berm, or strip of land, 10 ft. wide, from which no earth is taken, should be left between the pit and the toe of the levee. The material can be most economically handled by a dry-land excavator of some type that will take the material from the pit and place it in the levee, completing the work at one operation. When material is handled in this way it requires no rolling nor tamping to form an impervious embankment. When the required amount of material is in place, the top and sides of the embankment should be smoothed to an even surface and the whole planted in any grass adapted to the soil and climate. In many places Bermuda grass is extensively used for sodding levees, while in others a mixture of orchard grass and white clover does well.

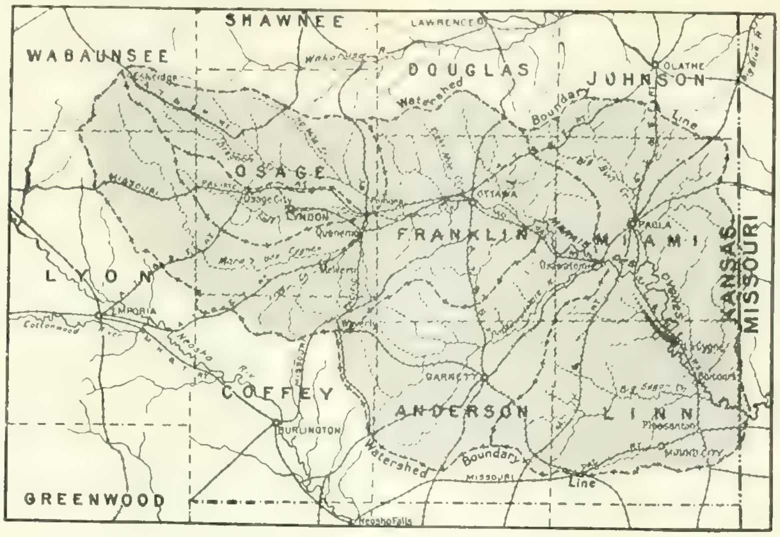

Fig. 1—Maps of Maris des Cygnes River Water Shed.

Interior drainage.—In order to provide for the removal of the surface water that falls on the protected lands within the inclosure of the levees, sluice gates must be constructed at suitable places. Every opening in a levee, however well constructed and protected, is objectionable; hence the least number practicable should be used in providing for the interior drainage. In many places several small drains may be collected into one and discharged through a single sluice. The small sluices should be made of vitrified sewer pipe with cemented joints and finished with a stone or concrete heading at each end of the pipe. The end next the river should be fitted with a steel flap valve held in position by a wrought-iron band which encircles the pipe. This valve should be so constructed as to open readily to allow the water to pass through from within the inclosure and to close automatically against any water that may come against it from the river side. The outer end of this pipe should be protected by a grating of heavy rods to prevent trash and sticks from getting under the valve. The end of the pipe on the inside of the levee should be provided with a sliding valve to be opened or closed by hand during times of high water, should the outer valve get out of order and fail to work. Where the drainage requires a sluice more than 18 inches in diameter, it should be made of concrete, and the ends should be fitted with gates and valves similar to those specified for the vitrified pipe. These sluices should be placed in the ground before the levee is constructed and great care should be exercised to see that they have a firm foundation and that the fresh earth is tamped carefully around them in building the levee.

TABLE I.—SUMMARY OF DETAILED ESTIMATED COSTS OF LEVEE DISTRICTS.

			Estimated cost					
District No.	Lenth of levee in feet.	Acres protected.	Embankment.	Interior drainage.	Right of way.	Engineering and administration.	Total cost.	Average cost per acre.
1	18,250	1,670	$ 25,250	$ 1,500	$ 1,680	$ 4,264	$ 32,694	$19.57
2	40,000	2,610	37,750	3,750	3,600	6,765	51,865	19.87
3	22,500	5,000	42,400	1,875	5,000	7,391	56,666	11.33
4	34,600	4,525	27,660	1,050	3,200	4,790	36,700	8.11
5	22,250	820	26,250	5,625	2,000	5,080	38,955	47.50
6	24,750	960	19,800	1,950	2,200	3,600	27,550	28.70
7	18,250	740	21,000	1,050	1,600	3,550	27,200	36.76
8	26,250	1,340	25,100	3,300	2,400	4,620	35,420	26.44
9	16,300	630	10,750	1,950	1,400	2,115	16,215	25.74
10	17,800	750	25,585	2,925	1,700	4,535	34,745	46.32
11	25,200	1,025	25,560	3,900	2,300	4,764	36,524	35.63
12	9,400	330	12,240	900	900	2,100	16,140	48.91
13	6,700	250	10,800	900	600	1,845	14,145	56.58
14	20,000	1,420	19,560	1,500	1,800	3,430	26,290	18.51
15	23,300	800	12,600	1,950	2,400	2,540	19,490	24.36
16	10,600	350	8,775	1,950	1,000	1,759	13,484	38.51
17	36,400	4,960	*37,290	7,500	3,400	7,230	55,420	11.17
18	47,500	3,140	*38,640	9,000	4,400	7,810	59,850	19.06
19	20,300	625	17,400	2,250	1,800	3,210	24,660	39.45
20	11,500	320	7,200	1,012	1,060	1,391	10,663	33.32
21	12,300	375	8,850	1,050	1,120	1,653	12,673	33.80
22	19,000	725	12,000	2,062	1,720	2,367	18,149	25.03
Total	483,150	$33,365	$472,460	$58,949	$47,280	$86,809	$665,498	$19.95

*Includes cost of excavating cut-off west of Ottawa.

Maintenance.—After being built, the levee system should be placed under the special care and direction of some one charged with the duty of keeping it in perfect order. Although the improvement is of a permanent nature and will require but little expense for maintenance, the works should be carefully inspected, especially just before periods of high water, and should be patrolled during such periods, to see that no damage remains unrepaired.

The entire surface of the levee should be mowed at least twice each year and the vegetable growth removed, or should be pastured. Pasturing the levees has the advantage of keeping the grass short at all times, so that it does not afford covering to burrowing animals. As a result of this treatment the levees will soon become covered with grass and yield a revenue in excess of the cost of mowing.

Clearing land between levees.—All land between levees should be cleared of all trees, brush and stumps, and should be seeded down into pasture or hay land. No estimate of the cost of clearing this land was made, as a very large part of it is cleared land. It should be cleared at a cost of not more than $25 per acre.

Cost.—The cost of the earth work will vary slightly, but it is believed that the levees can be constructed by some type of dry-land, machine for 10 cts per cu yd for the large contracts containing from 250,000 to 400,000 cu. yd., 12 cts. per cu. yd. for contracts from 100,000 to 250,000 cu. yds.; and 15 cts. per cu. yd. for contracts for less than 100,000 cu. yds. The cost of right of way for levees has been estimated at $20 per acre for land used for levees and borrow pits. The cost of clearing the channel of brush, stumps and trees is estimated at $1,000 per mile. Interior drainage channels have been estimated to cost $750 per mile, and concrete work has been estimated at $7.50 per cu. yd. An allowance of 15 per cent of the cost has been made in all cases to cover administration expenses, organization, legal expenses, engineering, etc. No damages have been estimated, and it is not believed that there should be any if the improvement is carried out as planned.

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*Bulletin 234, Office of Experiment Stations, U. S. Department of Agriculture, by S. H. McCrory and D. L. Yarnell.

The cost of clearing the river channel has not been included in the above table as it is purposed to clear the channel, where necessary, throughout its length regardless of whether the land is to be protected by levees or not. It is proposed to make the county the unit for this work, rather than the levee district. The cost of this work is estimated at $1,000 per linear mile. On this basis the total cost of benefiting 79,110 acres of flooded land would be $139,720, or an average of $1.76 per acre.

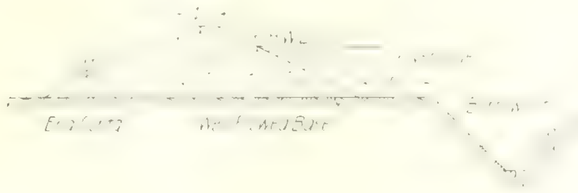

Fig. 2—Details of Levees, Marais des Cygnes River Flood Protective Work.

The channel widening at Ottawa is a separate enterprise, and the cost is not charged against the levee districts. These improvements are estimated to cost from $25,000 to $40,000, depending upon what plan is adopted.

Review and Conclusion.—An examination of the foregoing estimates indicates that the cost per acre of the recommended improvements would range from $8 to $56, the average being $20. The question as to the economy of the improvements in any particular district is one that can best be answered by the landowners themselves. Not only does the cost per acre for protection vary greatly in the several districts, but the productive capacity of the land also has considerable range, and it is the relation between these two that must determine the advisability of reclaiming.

Meeting of the Illinois Society of Engineers and Surveyors.

The 25th year jubilee meeting of the Illinois Society of Engineers and Surveyors was celebrated at the 26th annual meeting of the society at East St. Louis January 25-27. About 70 members and guests were registered.

The meeting was opened by the address of welcome of Mr. Silas Cook, mayor of East St. Louis, who spoke of the rapid increase in the city's population, enumerating various points in the city of interest to the members. He was responded to by Mr. J. W. Doppert, vice president of the society.

Mr. A. N. Johnson, state engineer and president of the society, spoke about the value of advertising the society's achievements, its doings and its value.

A report of the committee on water works was read by Mr. H. M. Ely. The report is very complete, covering the subject as considered in various other states, and in closing recommends that a committee from the society be appointed to act with the State Board of Health and the State Water Survey in securing legislation to maintain the purity and to purify when polluted all streams in the state that are needed for public water supplies.

The report shows that cities are coming more and more to the use of river water for drinking purposes, that 28 cities have septic tanks not always delivering the most desirable water, and that only 18 out of 62 cities (or 29 per cent) using river water have filtering plants.

Mr. E. B. Bartow, director of the Illinois Water Supply Survey, explained the bill now before the legislature, concluding that it was designed to preserve health and prevent a nuisance.

The report on streets and pavements was read by the secretary. It recommended that the present method of pouring asphalt should be abolished, because the high cost of that material was due more to methods of application than to the material itself. In the discussion Mr. J. G. Gableman, engineer of street work in Chicago, expressed himself as in favor of wood block pavement as a first class pavement for city streets on account of its favorability to traffic, noiselessness, and sanitary qualities.

A report of the committee on drainage was read in three parts by Mr. Meluish, Mr. Waddel and Mr. Jas. Harmon, covering a history of the subject and giving details of the cost of a pumping plant recently put in operation on the Mississippi.

Mr. E. E. R. Trotman gave an illustrated paper on "Excavating Machinery for Ditches and Trenches."

Mr. T. R. Agg gave a paper on the "Bituminous Treatment of Roads," which was illustrated with lantern slides showing the various methods and steps in the work.

Mr. A. N. Johnson gave a paper describing the construction of a difficult piece of country roadway, where the unusual method of attracting the drainage to the roadway had to be resorted to instead of diverting it, and explained the construction, showing how the water was taken care of.

The second day of the meeting was taken up with papers describing the various engineering works now under construction in East St Louis. Papers were read on the sewer outlet, the drainage, the water works and the new municipal bridge over the Mississippi.

The afternoon of this day was spent in an excursion to the points which had been covered by the morning's discussions and papers.

The evening was devoted to the election of officer and to several papers. Prof. I. O Baker gave a paper on "The History of the Society." Some little time was spent by the members in talking over the old days of the society, and letters of congratulation from charter members were read. Prof. Baker read to the society a paper showing the general scheme for the Catskill Aqueduct, which was profusely illustrated with views of the construction work now going on.

Prof. W. H. Baker read a paper outlining the new courses of engineering at Northwestern University.

The third day included three sessions. In the morning Dr. Geo. W. Webster read an interesting paper on "Vital Statistics in Illinois" and showed the great need in the state for a law securing a uniform system for registration of births and deaths

The report of the committee on sewers showed that such failures of concrete sewers as had occurred were due to ignorance in the use of cement and of cement machinery Most failures had occurred in rural districts. It was estimated that in the state 26 million dollars' worth of sewer work had been built during the year.

Mr. W. S. Shields had an interesting paper on "Sewage Disposal and Purification."

Mr. L. K. Sherman's paper was a description of the design of the Calumet-Sag channel, wherein he explained methods of determining the section of the channel

Prof. W. H. Burger gave a paper on precise leveling on the U. S. geodetic surveys and described a new precise level now in use by the government.

The report of the committee on surveying recommended narrowing the highways for the purpose of obtaining the use of much land now wasted; that road records be filed with the county recorder; that the present method of keeping records be improved; and that surveyors cooperate for the above purposes.

Mr. Curtis Hill, state highway engineer of Missouri, gave an illustrated talk on road work in Missouri. He outlined the general policy of the state work, the need of state aid in building roads, and their methods of applying local materials for local road work.

Mr. H. E. Bilger gave a paper on highway bridge abutments. The burden of the paper was to show the method worked out by the state highway commission for determining at short notice the cost of any given pair of abutments for a bridge. A series of interesting photographic slides were shown.

The society adjourned at 9 p. m. to a banquet, which was served in the Illmo hotel and was enjoyed by a large number.

The next meeting place of the society was selected for Urbana, Ill.

The officers elected for the coming year are: President, J. G. Gableman, Chicago; vice president, J. A. Harmon, Peoria; trustees, Ernest McCullough and W. A. Thompson, East St. Louis.

Wrecking work is now underway for the new union station to be built at San Luis Potosi, Mexico. The freight house, along with other buildings, both private and public, will be torn down to make way for the new station. The present work shops of both roads will be replaced by large construction shops of the latest class, sufficiently large to require the employment of 4,000 workmen. The cost of the new station and shops is estimated at $4,000,000 and the time required for the work two years. The work is in charge of C. M. Tripp, of Atlanta, Ga. Mr. Tripp was the director of the construction of the Colonia station, Mexico.

Directory of Principal Civil Engineering Societies.

American Railway Bridge and Building Association.—Secy., C. H. Lichty, 215 Jackson Blvd., Chicago, Ill.

American Society for Municipal Improvements.—Secy., A. Prescott Folwell, 239 West 39th St., New York, N. Y.

American Society for Testing Materials.—Secy., Edgar Marburg, Univ. of Pa., Philadelphia, Pa.

American Society of Civil Engineers.—Secy., C. W. Hunt, 220 W. 57th St., New York, N. Y.

American Society of Engineering Contractors.—Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

American Street and Interurban Railway Association.—Secy., B. V. Swenson, 29 W. 39th St., New York, N. Y.

American Water-Works Association.—Secy., J. M. Diven, Charleston, S. C.

Boston Society of Civil Engineers.—Secy., S. E. Tinkham, 60 City Hall, Boston, Mass.

Canadian Society of Civil Engineers.—Secy., Clement H. McLeod, Montreal, Can.

tenance of Way Association.—Secy., E. H. Fritch, Monadnock Block, Chicago, Ill.

Engineers' Club of Philadelphia.—1317 Spruce St., Philadelphia, Pa.

Engineers' Club of St. Louis.—Secy., A. S. Langsdorf, Washington University, St. Louis, Mo.

Engineers' Society of Western Pennsylvania.—Secy., E. K. Hiles, 803 Fulton Bldg., Pittsburg, Pa.

National Association of Cement Users.—Pres., Richard L. Humphrey, Harrison Bldg., Philadelphia, Pa.

New England Water-Works Association.—Secy., Willard Kent, Narragansett Pier, R. I.

Roadmasters and Maintenance of Way Association.—Secy., W. E. Emery, P. & P. U. Ry., Peoria, Ill.

Society for the Promotion of Engineering Education.—Secy., Henry H. Norris, Cornell University, Ithaca, N. Y.

Technical Society of the Pacific Coast.—Secy., Otto Van Geldern, 865 Pacific Bldg., San Francisco, Cal.

Western Society of Engineers.—Secy., J. H. Warder, Monadnock Block, Chicago, Ill.

STEAM AND ELECTRIC RAILWAY SECTION

South Dakota Railroad Appraisal.*

In making this appraisal two methods have been pursued in ascertaining, one being to obtain the actual cost of producing each line of railway in this state in its present location, and the other the actual present value of each line of railway as existed in this state at the time the valuation was made.

In making a physical valuation of railway property many things must be taken into consideration. In the case of Smythe vs. Ames, 18 Sup. Ct. Rep. 418-434, the Supreme Court of the United States specifically pointed out some of the things which must be taken into consideration, in the following language:

> "We hold, however, that the basis of all calculations as to the reasonableness of rates to be charged by a corporation maintaining a highway under legislative sanction must be the fair value of the property being used by it for the convenience of the public. And in order to ascertain that value
>
> the original cost of construction,
>
> the amount expended in permanent improvements,
>
> the amount and market value of its bonds and stock,
>
> the present as compared with the original cost of construction,
>
> the probable earning capacity of the property under particular rates prescribed by statute,
>
> and the sum required to meet operating expenses are all matters for consideration and are to be given such weight as may be just and right in each case. We do not say that there may not be other matters to be regarded in estimating the value of the property. What the company is entitled to ask is a fair return upon the value of that which it employs for the public convenience. On the other hand, what the public is entitled to demand is that no more be exacted from it for the use of public highway than the services rendered it are reasonably worth."

There are many reasons why a physical valuation of railway property should be made, for the value thus obtained not only fixes a standard for the fixing of rates for the transportation of both passengers and freight, but also fixes the value of property for the purposes of taxation, and for any other purpose where it might be desirable to ascertain the value of the property.

There is a widespread opinion that rates are based on the so-called capitalization of the railway companies and that a law regulating the issuance of stocks and bonds is necessary for the protection of the public against excessive rates. To a limited extent only is this true. In determining the lawfulness of a rate, the courts look to the value of the property and not to the capitalization of the company; but in determining the value of the property the amount and market value of its capitalization—that is, its stocks and bonds—is one of the necessary factors that must be considered.

Some high officials of American railway companies claim, and are now urging before the Interstate Commerce Commission, in justification of a widespread attempt to advance freight rates, that rates should not only be high enough to pay a reasonable return upon the value of the property, but also to provide a fund out of which it could pay for permanent improvements, betterments, and extensions, and assert that the surplus earnings of the amount so expended for permanent improvements, betterments, and extensions is not capitalized. Whether it is capitalized or not makes little difference for the result is the same. If rates are fixed at a point high enough not only to pay a reasonable return upon the value of the property but also to create a fund out of which to pay for permanent improvements, betterments, and extensions, these permanent improvements, betterments, and extensions will represent value, and it is upon the value of the property that the railway company is entitled to earn a reasonable return.

After the public has paid from freight and passenger rates, not only a reasonable return upon the value of the property, but for these permanent improvements, betterments, and extensions, they still belong to the railway company, and when it comes to the matter of fixing the reasonableness of a rate, the reasonableness of the rate must be tested by its ability to pay a fair return upon the value of the property, including these permanent improvements, betterments, and extensions, so that the public would be charged a rate high enough to pay a return upon the value of the property built by it.

While the manner and method of issuing stocks and bonds should in all probability be regulated, it is desirable also that it be understood that the amount and value of the stocks and bonds outstanding against the railway company are merely factors to be taken into consideration at arriving at a valuation of its property.

The cost of reproducing new the property of a railway company is changing constantly because of the fact that land values, the price of material and labor, constantly fluctuate, so that it is better to take the land values and cost of labor and material current at the time the valuation is made; but in order to be of any practical use, the physical valuation should be continued from year to year so that in each year the valuation of the property will reflect the actual conditions during that year.

While it may be true that much of the real estate upon which lines of railway have been built in this state was donated to the company, it is also true that the land so donated belongs to the company regardless of the fact that it was donated, and in fixing upon the value of this land it must be taken as of the date of the appraisal. The railway company is entitled to any increase in land values due to ordinary causes to the same extent as it is in the price of rails, ties, or any other physical item.

In arriving at the cost of reproduction new, the land values must be taken as of the date the valuation was made, and in fixing the present value of the property the same cost item for land values must be used because there is no depreciation in real estate.

In making this appraisal, no valuation has been placed upon the good will or intangible assets of any company. We do not believe that the good will of a railway company, the supposed franchise value, the advantage due to strategic location, or the efficiency of the organization of the company as affecting its ability to facilitate the performance of its duties as a common carrier should be taken into consideration for the purpose of arriving at a value of the railway company's property. These are properly matters to be considered in connection with the ability of the company to get business, increase their earning capacity, and perform services to the public at a proportionately lower charge.

The rate charged to the public for the transportation of property should not be based upon any value which takes into consideration any supposed intangible value or any franchise value, nor should it be based upon any charge for the efficiency of its organization of the company to perform its duties to the public.

It must be remembered that the physical

TABLE SHOWING AVERAGE VALUE PER MILE OF MAIN LINE OF THE PHYSICAL PROPERTIES OF RAILROADS OF SOUTH DAKOTA, AS OF JUNE 30, 1909.

	Re-production Value new.	Condition per cent.	Present value.
1 Right of way and station grounds, real estate.	$ 2,821	100.0	$ 2,821
2 Clearing, grubbing, grading and protection...	5,588	99.9	5,583
3 Tunnels	40	99.4	40
4 Truss, plate girder and I-beam bridges	796	90.3	718
5 Pile bridges and timber trestles	893	76.3	682
6 Culverts	450	81.6	367
7 Ties	2,653	70.8	1,880
8 Rails	3,538	79.2	2,800
9 Frogs and switches, R. R. crossings	82	78.4	65
10 Track fastenings and other material	609	78.6	479
11 Ballast	778	99.9	778
12 Track laying and surfacing	451	100.0	451
13 Roadway tools	17	71.5	12
14 Fencing right of way	204	74.2	151
15 Crossings and signs	32	57.2	18
16 Interlocking and other signal apparatus	5	88.8	4
17 Telegraph and telephone lines	51	72.3	36
18 Station buildings and fixtures	494	71.4	353
19 General office buildings and fixtures	0.25	75.9	0.19
20 Shops, engine houses, turntables and cinder pits	242	73.2	177
21 Shop machinery and tools	27	73.5	20
22 Water stations	208	74.3	155
23 Fuel stations	80	69.8	56
24 Grain elevators	3	71.9	2
25 Storage warehouses	4	58.9	2
26 Dock and wharf property			
27 Electric light plants			
28 Electric power plants	8	78.3	6
29 Electric power transmission	2	80.0	2
30 Gas producing plants			
31 Stock yards, snow fences and miscellaneous structures.	408	71.5	292
32 Total items 1 to 31 inclusive	20,483	87.6	$17,950
33 Engineering, superintendence and legal expenses, 4½ per cent of 1 to 32	922	100.0	922
34 Total items 1 to 33 inclusive	21,405	88.2	18,872
37 Steam locomotives	917	47.6	436
38 Electric locomotives			
39 Passenger train cars	376	74.0	278
40 Freight train cars	1,786	66.6	1,189
41 Work equipment	85	62.0	53
42 Floating equipment	5	80.0	4
43 Stores and supplies in South Dakota	16	94.2	15
44 Total items 1 to 43 inclusive	24,590	84.8	$20,847
45 General expenditures:			
Interest during construction.... 3.0 per cent			
Contingencies .... 5.5 per cent			
Other expenditures .... 1.0 per cent			
Total 9.5 per cent of item 44	$ 2,336	100.0	$ 2,336
Grand total	$26,926	86.1	$23,183
Miles first main track			3,453.385
Miles joint main track			1.907
Miles passing and side track			[illegible]
Miles joint side track			8.07
Total			4,458.965

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*Abstract of Report of the Board of Railroad Commissioners of South Dakota, Carl C. Witt, valuation of a railway company by the state or by the nation results merely in the obtaining of a factor to be used in proving what is the actual value of the property, and that in connection with the value so ascertained, there must be taken into consideration the other factors mentioned by the Supreme Court of the United States in the case of Smythe vs. Ames, referred to above.

METHODS AND [illegible] APPRAISAL

The Commission caused to be prepared, printed and distributed to the railway companies a set of blank forms covering in detail all the data required to enable anyone familiar with railway construction to determine the cost of reproducing the physical property new. A space was also provided on these blanks for the present or depreciated value. Only in a few cases did the railway companies return a depreciated value. They were requested to divide their lines into convenient sections not exceeding one hundred [illegible] in length, beginning at one end of each section and noting the items in detail in rotation to the other end of the section. They were also requested to furnish the Commission with profiles and right of way maps of their entire lines in this state. After this data had been received from the railway companies, a field inspection was made by the engineers accompanied by one or more members of the Commission in a special train. Frequent stops were made to inspect bridges, ties and other structures and to measure widths of embankments, count the number of ties to the rails, measure size of station and other buildings, examine carefully the water and coal stations, stock yards, etc. The location of highway crossings, number of planks, cattle guards, signs, etc., and point of beginning and ending and kind of fence were noted on the profile. A check was made of each item shown on the inventory and where discrepancies or omissions were noticed, corrections were made. The actual present condition of each item [illegible] or decay was noticed and a condition per cent based on a new or one hundred per cent condition was placed opposite each item on the inventory. In this manner every mile of railway in the state was inspected.

After the inspection a cost to reproduce each item new at current prices was determined and by applying the condition per cent to the reproduction new cost the present value was determined.

A proper value to be placed upon land for railway purposes is one of the hardest to determine. Fortunately in South Dakota there have been a great many transfers of property within the last few years. A record of all actual transfers for a bonafide consideration that have been made within the last four years for a distance of three miles on each side of the center of the track outside of towns and adjacent to the station grounds in towns was obtained from the records in the offices of the Register of Deeds in each county and although opinions of real estate men, bankers and others all over the state were secured, principal reliance was placed upon the actual average sale value of the property for farm or city purposes. At the time of making the inspection the topography of the country, nature of the soil, etc., was noted and from this data a market value was placed upon the railway company's land. It is a well known fact that the price paid for land to be used for railway purposes on account of damage to the remainder of the property is several times the farm value. After an investigation of the prices paid for right of way by the M. D. & P. R. R. and the C. M. & St. P. Ry. for extensions in this state in 1906 and 1907 and an investigation of the results obtained by investigations made in Minnesota, Wisconsin and other states by various taxing and appraising bodies and also of the sale of public lands in South Dakota and other states for railway purposes, it was determined to use a multiple of 250% throughout the state, both for property for station grounds and right of way, the average outside of towns being somewhat higher and inside of towns somewhat lower.

This question of multiple value for railway [illegible] great care, particularly in large terminals, and requires a separate investigation for each case to avoid vicious results. Fortunately there are no very large terminals in this state, and it is the belief that 250% is a fair multiple.

For the purpose of this appraisal all railroads within the state were placed on an equal basis as regards land values regardless of [illegible] the appraisal being based on a cost of reproduction new and no depreciation for the land values.

Nothing is allowed for the item known as "adaptation and solidification of road bed" except as reflected in the condition of the road bed and ballast at the time of making the inspection. This item has been given considerable prominence recently in values placed by railway companies and others engaged in making railway appraisals and is added because of the work done in repairing the damage to track in line and surface due to settlement of embankments, the cost of clearing out ditches and cuts, etc., etc. While there is no question that such expense is necessary, it is an item properly chargeable to maintenance and is so charged by the operating railway companies and paid for out of the revenues the same as renewing worn out ties, and should not constitute an item of physical valuation. The fact that this work is necessary proves that there has been depreciation in the physical condition of the track, due to the action of the elements and the pounding of the trains, and this depreciation has to be met until the embankment becomes solid. The very most that could be allowed would be that the road bed is maintained at one hundred per cent.

All [illegible] portioned to South Dakota on locomotive division mileage basis. Passenger and freight equipment were apportioned to South Dakota on a car mileage basis. All stores and supplies actually on hand in South Dakota were appraised, deductions being made where material stored in the state was to be used on portions of divisions extending outside the state, as at bridge and building yards and vice versa. No account was taken of coal or commissary supplies.

The per cents used for the items engineering, superintendence, legal and general expenses are an average of actual construction experiences and are practically established by precedent. The items embraced under these terms are those so classed by the Interstate Commerce Commission.

The request for an inventory met with prompt and willing response from the railway companies, but on account of the vast amount of work necessary in securing and compiling the data and the fact that several roads were under construction at that time, a complete report of all railway property in the state could not be made until June 30, 1909. However, in anticipation of such a request from the Commission the C. & N. W. Ry. had already collected the necessary data and were able to return the blanks properly filled out, accompanied by profile and right of way maps in a very short time, so that a complete appraisal of that railway, also the C. R. I. & P., I. C. C., C. St. P. M. & O. and the Wyoming and Missouri River Ry. Co. was made of date June 30, 1908. The appraisal of these properties has been corrected to date for all additions and deductions. Inasmuch as the cost [illegible] a supplemental appraisal should be made as of [illegible]

The cost of making this appraisal to date is approximately five dollars per mile, a very small figure, and as a result of increased taxes received due to the increased valuation of the railway property, the expenditure for this work has already been returned to the state many times and will, of course, continue to be so returned indefinitely. This appraisal has also been used in the litigation now pending in the Federal Court regarding the reasonableness of the 2 ct. and 2½ ct. passenger rate laws.

The [illegible] panying table corresponds as closely as practicable to the "Classification of Expenditures for Road and Equipment as prescribed by the Interstate Commerce Commission for Steam Roads in accordance with Section twenty of the act to regulate commerce."

Depths of Penetration in Wood Preservation.*

[illegible]†

It is obvious that the penetration of a given quantity of preservative to the cubic foot must depend to a great measure on the length, breadth and thickness of the piece of timber treated; that is, to the amount of surface. A pile has the least surface in proportion to its volume; bridge timbers come next, such as caps and stringers, and so on down to planks and boards, where the surface to be treated is very great. It therefore is apparent that as the surface per cubic foot is increased, to get an equal penetration the quantity of preservative must be increased. But often I find this indisputable fact reversed, people wanting eighteen pounds per cubic foot put into piling and eight or ten pounds, sometimes less, put into inch boards, and expecting the same penetration. Now again the kind of preservative comes under consideration, and of these I shall only allude to the two most commonly used: zinc chloride and creosote, of the first, which is generally used in a solution of from 3 per cent to 5 per cent I find that one as easily penetrates wood as the other, and the amount used is from 0.25 to 0.5 pounds per cubic foot; and the object usually is to fill the wood with a certain amount specified of the solution chosen, and the penetration, owing to the low viscosity of the fluid, is usually nearly or quite to the center of many of the ties, which are almost the only timbers treated with zinc chloride. This will require from one to one and one-half gallons to the cubic foot, though I am well aware that more and of a weaker solution is frequently added in very soft wood, because it will take it; but it must be borne in mind that if the same amount of zinc chloride is put in, whether in a small amount or a great deal of water, after the water has evaporated the quantity of zinc chloride in the wood is the same.

In the case of creosote we have an entirely different class of preservative to deal with, and will be compelled to proceed on entirely different lines. Of late, for reasons not connected with this paper, it has become the fashion to use a creosote, or, rather, a mixture of creosote and undistilled tar of higher specific gravity and greater viscosity than that formerly used, and assuming it to be free from any perceptible amount of insoluble matter, it is still, owing to its viscosity, more difficult to force into wood, and will leave more near the surface than lighter oils. But taking an oil of from 1.03 to 1.06 specific gravity, I find that we ought to expect with a ten-pound treatment in piling, an average penetration of about one and one-half inches, and in bridge stringers, caps, etc., with twelve pounds of oil, about the same depth. Now we all know that this will vary a great deal. I am speaking now of the geometrical center of the stick. We will find a considerable difference in different parts of the same stick, sometimes within a foot or two of each other. Of course the ends naturally absorb the most, and it seems to take it while the capillaries become clogged; this and absorption will be as deep sometimes as seventeen or eighteen inches, and in every soft woods more; so, while we know we have a good deal of oil there, it must be left out of the question and borings taken far enough away to be beyond this specie of penetration. Also we will get dif- [illegible] dimension timber, as one side may be heart and the other sap, and much will depend on the way the saw has cut it. Where the saw has cut across the rings, the summer wood, as it is called, consisting of capillaries, will take

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[illegible]

the [illegible] readily than the spring wood, consisting of cells. And again we will often in the same charge examine a large number of pieces and be very much pleased with their appearance, and then come on one having a very inferior treatment. But on the whole I think that the amounts specified per cubic foot in that size of material will be, as a rule, not far out of the way.

I know that at times I have got a greater average penetration with these amounts, and at other times less. I find in treating green wood after the manner I explained in a former paper to this society, only slightly changed in one particular, that the oil penetrated the pores of summer wood and not to any great extent the cells, and I get the same penetration with from two-thirds to three-fourths the quantity of oil. Now, therefore, as we increase the surface per cubit foot, in order to get the same penetration, we must increase the amount of oil, and here is where I am at a loss to specify the ratio of increase, but I think at present the nearest approach to a correct solution would be to increase the oil in arithmetical ratio to the increase of surface.

BY R. [illegible] ALLARDYCE*

No one could say what penetration could be expected unless he could see the material and know its conditions before treatment, and then could not say definitely what the penetration would be.

In my own individual case I would see that the timber was in the proper shape and that the full amount of preservative was injected that was called for and would be satisfied that I had given the results desired regardless of the penetration. You understand that I believe wood should be treated with as much preservative as can be injected—that is, to take care of the mechanical life of same, as the heavy treatments have always proven to have given the best results.

In this paper I shall confine my opinion to the treatment of southern pines treated by the full cell method, as I have had more experience in this class of woods for treatment and will not state positively that they should in every case have the following penetrations, as in some cases difficulties over which a commercial plant has no control may arise; unless the timber was all cut at the same time, seasoned the same and properly grouped a uniform penetration could not be expected. The following is only an estimated average:

On piling for a ten to twelve pound treatment in soft or sap wood a penetration of from ¾ to 1½ ins. could reasonably be expected.

In a fourteen to sixteen pound treatment, from 1½ to 2½ or 3 ins.; for a twenty pound treatment, from 3½ to 4 ins., and in the heaviest treatments, say twenty-two to twenty-four pounds, from 4½ ins. to complete penetrations. This is for the dead oil of coal tar treatment. In the heart wood you would not get as deep a penetration.

For straight zinc or the Burnettized treatment for ties, in using a twenty pound treatment of a light solution on loblolly ties, I should think that you could be able to get a complete penetration or up to the last inch or inch and a half of the center of the tie.

For short and long leaf ties this solution should be strengthened, and in no case would I be satisfied until I got as near a perfect penetration as possible, always getting not less than a hundred pounds pressure to the square inch on the retort.

To go any farther into the subject would be useless, as each operator claims for his particular treatment the best penetration. In this paper I have dealt only with the straight oil and zinc treatments.

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*International Creosoting & Construction Co., [illegible]

Out of the estimated $375,201,000 total cost of the Panama canal $207,000,000 had been expended up to Nov. 30, 1910. This total amount is distributed over the work as follows:

[illegible] Civil Administration	$ [illegible],128,662
[illegible] Sanitation	[illegible],791,741
[illegible] Construction and Engineering	107,[illegible]
[illegible]	$[illegible],967

The Design and Operation of a Modern Classification Yard.*

The constantly increasing freight traffic of the country has carried with it the necessity for improved methods of handling it, and one of the most valuable of these has been the modern classification yard.

Cars of freight destined to various points and accumulating either at original terminals or the various local freight stations along a line of railroad are brought to some point (such as where various routes diverge), the trains are stopped and such cars as are bound to a common destination, or for a certain use, are gotten together. This is termed classifying, and the purpose is, if possible, to secure a train-load of one destination or kind, which, if obtained, of course means that it will not require further stoppage or handling until the destination is reached. This separation of the various units comprising a train, or "cutting up" a train, as it is called, is done in three ways, viz:

1. The original and most common way is by moving the train forward and backward, cutting off the cars during the process, and is commonly called "flat shifting."
2. By "poling," in which the train is handled by an engine at its rear, constantly pushing the train toward the classification tracks, while an engine at the front end on the adjacent track "poles" or pushes off the cars ore "cuts" desired.
3. By the "gravity" or "hump" method, as it is generally designated, in which the train is pushed up to a hump or elevation, at which point the couplings are cut or separated at the proper places and the cars proceed to the proper classification tracks, impelled, after leaving the "hump" or apex, by the more or less steep descending or momentum grade.

A "poling" yard is usually located on a level, or slight grade, where it is necessary to give cars a start, and has the advantage of no backward movement to the whole train being required (as in push and pull shifting), due to the poling engine moving on a track adjacent to the train that is being shifted. In some cases the pole is attached to and pivoted on the pilot beam at the front of the engine, but the more common practice is to pole the cars from a "poling car" attached to the locomotive, and upon which a man rides and operates the pole, which is six or eight feet long, suspended and pivoted at the sides of the car in such a way as to reach the pole socket castings of cars on the adjacent track. A rear engine is generally used to keep the train pushed up to the point of operation where the poler can give the cars the necessary impetus to carry them into the classifying tracks.

THE "GRAVITY" OR "HUMP" YARD

Within the past ten or fifteen years a great number of yards have been built or remodeled for operation by this method, and Mr. C. L. Bardo, in a paper prepared by him and published in the Journal of the New York Railroad Club, December, 1903, gives the relative capacity of the different methods of shifting as follows, based on handling a train of sixty cars of fifty cuts in each case.

Push and pull, or flat shifting, required two hours.
Poling required one hour and fifteen minutes.
Hump method required thirty minutes.

It will readily be seen that if there is any volume of traffic, it can be handled with greater success by the latter method.

It is believed that the first place at which gravity was used as a factor in shifting or classifying was Edge Hill, near Liverpool, England, on the London and Northwestern Railroad. This yard was built in 1875, and is still in active operation. The operation by gravity was not the original purpose of its construction on a grade, but to avoid a very great cost in graduation necessary to obtain a level yard. In fact, as history goes, its proposed operation by gravity was strongly opposed because of the supposed danger to both men and equipment.

The Edge Hill yard can scarcely be classed as a hump yard, which implies a hump or apex (usually artificial) over which the cars are pushed to the momentum grade. At Edge Hill the trains are received at the top of a long grade, from which they are dropped through the various classifying and making-up operations solely by gravity; no engines being used from the time trains are received until they are made up ready to proceed on the road.

It is generally recognized that the first place in this country to which the "hump method" was applied was at the Honey Pot yard of the Pennsylvania Railroad Company, located near Nanticoke. This is the point at which is assembled and classified a large percentage of the anthracite coal shipped from the Wilkesbarre district over the Pennsylvania Railroad. The hump, which is a comparatively low one, was built about May, 1891, and has been used ever since with excellent results.

As to the grades to be used on humps, that is a problem to be decided for each yard and is governed by several factors: viz., whether all loaded, all empty or mixed cars are being handled; whether any portion are weighed, requiring a scale installation; whether the cuts are single cars or composed of four or five cars. The climate also has an effect, there being a decided difference in the running qualities of cars in January and August.

There is practically no difference in the distance traveled by the various cars going to different classifying tracks, as each starts at the hump and leaves the outgoing end of the yard.

In a classifying yard containing thirty tracks, by splitting them up into five or six ladders the farthest switch will not be more than 700 or 800 feet from the hump.

The operation of a typical "hump" yard is as follows: After a train leaves the main track and enters the receiving tracks the crew is relieved, the road engine is cut off, and at once proceeds to the inspection pit, ash pit, coal wharf, and engine storage tracks in the order named, so as to be ready for a departing train when needed, the train thereafter being handled by the yard force until again ready for the road. The movement from and to trains from the engine facilities should always be free, as many serious delays to traffic have been caused by the inability to turn the power promptly.

Having the proper facilities, four hours should be sufficient time in which to clean, make such light repairs or adjustments as are needed, and have an engine ready for the return trip. The storage tracks for engines should be arranged with comparatively short lengths so there will be a minimum of shifting to get at any particular engine that may be required.

Returning to the train that is on the receiving tracks: it is at once inspected and the cars marked for the proper classification tracks, including those requiring such repairs as cannot be made at this point. In some instances very light repairs that can be made quickly are made on the receiving tracks as the inspection progresses. Upon the completion of the inspection and the removal of the cabin from the rear of the train the hump engine gets behind it, and when the proper signal is given proceeds to push it over the hump. The storage tracks for cabins are sometimes arranged so that cabins can be dropped into them in "first in, first out" order as fast at they reach the receiving tracks.

On the ascending side of the hump is stationed a man to cut the couplings between the different classifications. Here also the brakemen, or "riders," as they are termed, take charge of the respective cuts and ride them so as to control the speed down-grade into the classification tracks.

The speed of the cars is controlled by the riders, and the initial momentum must be sufficient to carry a car through the ladders and switches and the full length, if necessary, of a track with a standing capacity of sixty or even more cars, while other tracks may not have a capacity of more than twenty cars. A rider cannot permit the speed for a car going to a track partially filled, that he would when he started to fill the empty track.

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*Abstract of paper by W. A. MacCart read before the Engineers' Club of Philadelphia, Sept. 17, 1910.

In the earlier days the men would ride the cars down the momentum grade, set the brakes to what they thought would permit the car to go to its destination, and then return to the hump. The conditions now are that the men ride the car to a coupling with the car already on the siding, controlling the speed the entire distance. This makes a slower process unless you have a large force of men, as they get farther from the hump and require a longer time to get back.

Classification tracks, as a rule, are assigned to destinations, although in some instances for a specified purpose, such as accumulation of empty cars for the coal or coke regions, refrigerator cars, shop or bad order cars, etc.

The number of cars to a cut varies greatly with the nature of the traffic; in some instances trains are entirely broken up into single-car cuts; at others as many as ten or twelve cars are coupled in one cut. To control its speed each cut, of course, requires a brakeman or "rider," as it has been already stated they are called (in some locations they are termed "car droppers"). In the large cuts it is usual to allow four to six cars to the man.

The prompt and inexpensive return to the hump of the "riders" after taking their cuts to the classification tracks is in itself quite a problem, for upon that, and upon being ready to take another cut, depends largely the speed with which cars can be passed over the hump, without having an unduly large force of riders. This is accomplished in some very long yards by having an engine and car to pick up the "riders" along the classification tracks and bring them back to the hump. In short yards they generally walk back, and either a large force of riders must be kept on hand or the movement must be slowed up. It is really a question of whether the movement is sufficiently large or important to have a force of men who will be idle part of the time, or an extra engine to return them to the hump.

The moving of the switches leading into the classification tracks is done in different ways, the most complete, and of course expensive, method being what is known as the "push button machine." The switches are thrown electro-pneumatically by a man located in a tower near the hump, commanding a general view of the train as it approaches from the receiving tracks, and the ladders and switches leading to the classification tracks, and the various switches are moved by their correspondingly numbered push button, as required to set up a route for the car. In some cases, however, lines of pipe leading to a half dozen or more switches are connected to levers concentrated at one point and operated by a leverman. If there are many classification tracks, of course, more than one leverman is required.

As previously stated, the cars or "cuts," as they are termed, whether there be one or more cars coupled, are marked with chalk as they stand on the receiving tracks, to designate the number of the track to which they are to be sent. This number is placed on the side of the car at the front end, and oftentimes it is the practice to also mark on the rear of a cut the destination of the next following one. This serves as advance information to the leverman. The leverman, or towerman, is also furnished with a slip, similar to that used in marking the cars on receiving tracks, showing the "cuts," number of cars in each and their destination.

The cars are pushed over the hump at the rate of about two and one-half miles per hour, but to prevent their following each other too closely because of running on the same ladder or lead, the tower should be equipped with a large air-whistle by which the towerman can signal to the pushing engine to stop the train, and start again when sufficient separation of the cuts has been obtained. The whistle can also be used in case of accident or other emergencies.

As the classification progresses, so fast as a sufficient number of cars of one or several classifications combined accumulate, they are gotten together, the air-hose coupled and brakes tested, a road crew and engine called for, and the train started on its journey. In some yards this is done by the yard force collecting the cars from the classification tracks into "make-up" or advance tracks, where they are coupled and the air-brakes tested to insure that everything is in proper order before the road crew couples on. At other points the road crews take the cars as directed from various classifying tracks and get them together on a drill or pull-out track.

As can be readily understood, the yarding and classifying of a train means a considerable delay, and it is desirable, therefore, that the yard be so located that the classifications made will permit the longest possible haul without again breaking up the train, so as to avoid this delay, damage to equipment, etc.

As a rule, a yard layout embraces a movement in both directions, and as there are a great many internal movements, such as getting road engines and cabins to and from their trains, getting shop cars to the repair tracks and back into their trains, possibly re-icing refrigerators, caring for stock or weighing certain cars, etc., all of which must be done with the minimum amount of interference with other movements, the importance will be seen of sufficient thoroughfare tracks upon which to make such movements promptly.

Usually the main tracks are spread and the yard placed between them, this being the preferred location for the reason that as soon as an incoming train clears the main track, there is no further interference with it.

Every yard is a problem in itself, for which there are a few general principles that apply. The length of arriving and departing trains, the character of traffic, the number of classifications to be made, whether a large or small percentage of the cars require weighing, and many other features must be considered in each place.

In a paper of this character it is possible to give only a general outline of this method of shifting, for the reason that every yard plan requires a special study to meet the conditions. For instance, the length of trains passing over that portion of the road from which the yard receives and to which it delivers traffic will determine the length of receiving and departure tracks; whether the cars are all loaded, all empty or mixed, affects the rate and length of grades on the hump. These grades are also affected by the number of cars to the cut, whether a scale on the hump is necessary, and all these conditions in turn are affected by climatic conditions, as a car runs more freely in August than in January.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Cost of Running an Automobile.

The following table gives the actual cost of running a four passenger automobile, of the so-called demi-tonneau type, in the vicinity of New York City, from July 4, 1909, when it was bought new, to Dec. 4, 1910, when it was laid up for the winter. The car is of a well known make, and there was practically no engine trouble, it has a 4-cylinder engine, 25.6 hp. A. L. M. rating, shaft driver. Of the 17 months the car was in commission it was in use for driving 15 months. It is estimated that of the total distance driven, namely 8,500 miles, about two-thirds was over so-called good roads, varying from fair to very good. It was used mostly for pleasure, but somewhat for inspection trips to engineering works, when it received some hard usage. The writer estimates that if it had been used for business, under similar conditions, and driven, say, 15,000 miles in the same length of time, items 1, 5, 9, 10 and 11 would be unaffected, though, of course, item 5 is a very uncertain quantity, and might involve the total destruction of the car. Column 3 has been added to the table to show this estimated cost per mile on this basis. The car was driven by the owner, who had had no previous experience in driving, and it was kept at a public garage. It may be noted that no expense is included for additional wearing apparel or for extra expenses at hotels, restaurants, etc., when touring or on all day trips, though these items are not inconsiderable and really enter into the cost:

			Total.	Actual cost per mile, 8,500 miles.	Estimated cost per mile on basis of 15,000 miles.
Original cost of car new	[illegible]				
Accessories	[illegible]				
	$1,772.85			Cents.	Cents.
1 Less present value	[illegible]	Depreciation	$[illegible]	12.622	7.152
2 New tires			128.85	1.516	1.516
3 Tire repairs			[illegible]	.733	.733
4 Ordinary repairs and adjustments			[illegible]	.593	.593
5 Repairs on account of accident			36.80	.433	.245
6 Gasoline			[illegible]	1.480	1.480
7 Oil and grease			[illegible]	.227	.227
8 Batteries and [illegible]			[illegible]	.052	.052
9 Miscellaneous [illegible]			[illegible]	.177	.177
10 Storage [illegible]			225.00	2.647	1.500
11 Insurance [illegible]			143.50	1.688	.956
12 State licenses			7.00	.082	.047
Total			$1,891.13	[illegible]	14.678

Notes in regard to the above items: Item 1. Depreciation: The makers of the car offer $650 cash for it as it stands now, this being their regulation price for 1909 cars, irrespective of condition, that is, of course, within reasonable limits. To put the car in shape to run another season will cost approximately $500, this including complete overhauling, new parts where necessary, four new tires and painting, and at the end of this season it would hardly bring more than $300 or $400, so that the depreciation charge is not too high.

Items 2 and 3: The tires used were 33x4. Including the four tires on the car when it was bought, seven shoes and nine inner tubes have been in use, of which there now remains only one shoe in fair shape and two or three inner tubes which may be used for spare next season. The writer believes the tire expense to be lower than usual. This item increases very rapidly and in much greater proportion as the weight of the car increases, and also is liable to be more on an old car in which some of the parts of the running gear become worn and pressures are not evenly distributed.

Item 4: This item is largely for small repairs and adjustments which might have been made almost entirely or at least half of them by the writer, except for the fact that he did not consider it economy to spend his time in this way, or to get as dirty as would have been necessary had he done so.

[illegible] these items for fuel and oil amount to a very small proportion of the total.

Item 9 is for tips to employes at the garage, and charges for greasing and oiling the car. The writer usually made a point of examining the car all over about once every two months, and at these times greasing everything up, but this took not less than five or six hours and used up a whole Saturday afternoon, so that in between times this work was [illegible]

Item 10: This included washing the car and polishing the brass work as well as storage. This item can of course be cut down where the car is kept in one's own garage. Washing and polishing in this case if done at a public garage costs about $1 each time for a moderate sized car. If the car is run all winter, however, as this car was, the garage must be heated.

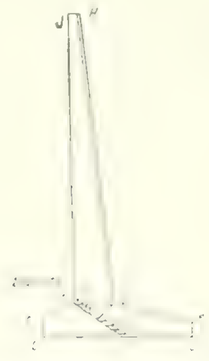
Item 11: This covers a period of two years.

LETTERS TO THE EDITOR.

The Design of Retaining Walls.

S[illegible] up an undue amount of your valuable space, but Mr. [illegible] Jan. 18 makes comparisons between a cantilever and a counterfort retaining wall that are not just or equitable. Some comments on his cantilever design may be of interest to the profession, as this is a common form of design. I think that these comments will show that it is extremely faulty as well.

The fact that retaining walls have been built on these lines and have stood up is no proof of their correct design. The calculated loads on a retaining wall may and may not be realized. A tank on these lines is more of a criterion, since liquids are sure to exert horizontal pressure. Out near San Luis Obispo, California a great oil tank was built with sides like Mr. Bone's cantilever retaining wall, but much better in this respect, that instead of a sharp re-entrant angle joining the side and bottom there was a long curve. When oil was turned into this tank on Nov. 22, last, it failed.



There is no doubt whatever that the counterfort retaining wall which Mr. Bone compares with his cantilever design has a large amount of reserve strength not present in the cantilever design, and that the counterfort wall would stand very much more load under test. There are several objectionable features in Mr. Bone's design. I for one, would reject any design where rods had an anchorage of only 30 or 40 diameters in concrete, no matter what kind of deformities the rods had. Mr. Bone is in error in saying that the concrete in which these rods are anchored is in compression. At the inner corner of this L there is tension both vertically and horizontally, the greatest intensity of tension in the whole wall, and this is just where the rods begin to receive their anchorage. **For more than half of their embedment these rods are in concrete that is subject to tension.** They must stop short of the outer surface of the L, where the compression reaches a maximum, or else they will be exposed. In any event the idea that concrete in compression will hold a rod with greater force than that which is subject to no stress is far-fetched and purely theoretical. Concrete is not like rubber, that it can be squeezed down to take a greater hold on embedded steel.

The stresses in the sharp re-entrant angle of this cantilever wall are uncertain. I know of no tests on anything of this sort. It is certain that a steel beam bent at right angles would not stand anything like its full strength at the bend. If steel would not stand such a test, why invest reinforced concrete with such theoretical strength? It is for this reason that I would have a bevel joining the two cantilevers and an extra set of rods.

But there is a serious weakness in Mr. Bone's design and in a somewhat less degree in the design used by the Panama Canal engineers, shown in the issue of Dec. 21, 1910, that analysts have so far failed to point out. When compressive or tensile stresses must take a sharp turn some provision must be made to take up the resultant stress dividing the angle at which the two stresses meet. The compressive stresses of the two cantilevers meet at the outer corner of this L. What provision is there to take up this component? In this design there is none, excepting tensile and shearing strength of concrete. The accompanying sketch shows Mr. Bone's retaining wall and how and why it could easily fail. The failure would leave all his steel reinforcement intact and would be purely by tension and shear in the concrete. The arrows show the compressive stresses that are not provided for. They act against the concrete block ABCF. In addition to these stresses there is tension on the lower half of the surface AB due to the upward load on the cantilever CB. This would help to break off the block ABCF. Besides this there is a shear on the surface AB amounting to nearly the whole upward force against the base of the retaining wall. This little block of concrete is working against great odds and has large responsibility. It is not much wonder that reinforced concrete has received so many black eyes in horrible failures, when so little attention is given to correct analysis in its design. In my Fig. 4 this block of concrete is purposely left out in figuring the main cantilevers, though it is amply reinforced for its own stress. Also the two cantilevers are joined by a bevel so as to maintain the depth at the corner.

Yours very truly,
EDWARD GODFREY.

Monongahela Bank Bldg., Pittsburg, Pa., Jan. 19, 1911.

Design of Retaining Walls.

Sirs: Replying to Mr. Godfrey's answer on retaining walls, page 93 of your issue of Jan. 18, 1911. The extra reinforcement at the top of the wall will put an additional overturning moment on the wall as a whole on account of the frost. The assumed total overturning moment did not include this consideration. The assumption that the horizontal thrust of the earth is equal to one-sixth of the unit weight multiplied by the square of the height, is really a deduction from some of the complicated theories of earth pressure. The only comparative merit of this, or equivalent assumption, is its simplicity.

Mr. Godfrey's general method of anchorage is applicable to various arrangements of rods.

Yours truly,
J. L. CAMPBELL.

El Paso, Tex., Jan. 20, 1911.

Manure as a Protection of Cement Walks From Frost.

Sirs: We note on page 94 of your Jan. 18 issue an answer to an inquiry on the construction of concrete walks in freezing weather in which you advise the placing of manure on top of sand to preserve the top of a walk. This is not good practice. We have found that in places where this has been done the water coming from rain would wash some of the liquid manure onto the surface of the walk, and if this is done prior to the surface having hardened it will certainly cause it to pit and otherwise disintegrate. Manure has little or no effect upon dense concrete thoroughly hardened, but it will cause green concrete to disintegrate to a serious degree. Straw over the sand in place of the manure will accomplish the same result, particularly if the whole is covered with tar paper.

We are calling your attention to this as we know you do not wish instructions to come out in your paper which are not absolutely correct from an engineering and practical standpoint.

Yours respectfully,
PERCY H. WILSON.

Philadelphia, Pa., Jan. 23, 1911.

(The note mentioned by our correspondent stated that over the manure there should be placed "a covering of tar paper or canvas to shed rain or snow." We should perhaps have emphasized the necessity of this precaution more than we did.—Editors.)

PERSONALS.

Mr. Paul D. Sargent, state highway commissioner of the state of Maine, has been appointed assistant director of the United States Office of Public Roads, at Washington, D. C.

Mr. U. B. Buchanan, until recently assistant resident engineer in the construction of the model city of the American Steel & Wire Co., at Corey, Ala., has opened an office at Huntsville, Ala. He will engage in general engineering practice, directing his attention especially to sanitary works.

Mr. W. H. Penfield, engineer of construction of the Chicago, Milwaukee & Puget Sound Ry., at Butte, Mont., has been made division engineer of the newly organized division extending from Butte to Avery, Ida. Mr. G. W. Osgood, who has had charge of the division work, with office at Missoula, will be transferred to the coast to take charge of terminal construction.

The annual meeting and banquet of the Albany Society of Civil Engineers was held at the Hampton Hotel, Albany, N. Y., Jan. 24. The following officers were elected for the year 1911: President, Russell S. Greenman; first vice-president, James R. Watt; second vice-president. David R. Cooper; third vice-president, Emory E. Brandow; secretary, Rupert Sturtevant; treasurer, Robert F. T. Wilke; librarian, Clark Brown.

Mr. Frederick R. Hutton has been appointed consulting engineer of the Department of Water Supply, Gas and Electricity of the City of New York, succeeding Mr. George W. Birdsall, who died Jan. 22. Mr. Hutton was graduated from the Engineering School of Columbia University in 1876, and is at present professor emeritus of mechanical engineering in that institution. He is a past president of the American Society of Mechanical Engineers, and was secretary of that society from 1883 to 1907.

Mr. George W. Birdsall, consulting engineer of the Department of Water Supply, Gas and Electricity of the City of New York, died at his home in that city on Jan. 22, at the age of 75. He had been connected continuously with the water supply department of the city for 38 years. Entering the service in 1872, he was appointed first assistant engineer by Gen. Fitz-John Porter, then Commissioner of Public Works, in 1875. In 1880 he became chief engineer of the Department of Public Works, but owing to a change in administration he again became first assistant engineer the following year. In 1885 he was made chief engineer of the Croton Aqueduct, and served in that position until 1898, when he became chief engineer of the Department of Water Supply. Since 1902 he has been consulting engineer of that department.

Mr. John Edward Schwitzer, who was appointed less than a month ago to the position of chief engineer of the Canadian Pacific Ry., died of pneumonia at the Royal Victoria Hospital, Montreal, on Jan. 23. He had barely arrived in Montreal to assume the duties of his new position when he was taken ill. He was apparently suffering from typhoid fever, and was taken to the hospital a week before his death. Mr. Schwitzer was born in Ottawa, Ont., in 1870, and after passing through the Ottawa high school entered the engineering school at McGill University. He was graduated from that institution in 1891. For several years he worked on various railway lines in Ontario and Quebec. In 1899 he opened an office for private practice in Rat Portage and at the same time was appointed town engineer of that place. In less than a year he accepted a position as assistant engineer for the Canadian Pacific on the construction of the Rat Portage terminals, continuing with that company until the time of his death. On the completion of the work at Rat Portage, in 1901, he was appointed engineer of maintenance of way at Winnipeg, and was later made resident engineer at the same place. In 1903 he became division engineer of the Central division at Winnipeg, and in 1907 assistant chief engineer of the Western lines of the Canadian Pacific system. He was appointed chief engineer of the entire Canadian Pacific system on Jan. 1 of this year. He was a member of the American Society of Civil Engineers and the Canadian Society of Civil Engineers, and president of the Winnipeg Society of Engineers.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

[illegible] railroad construction con[illegible] of work are shaping up ready for letting. Among the contracts let recently are the following: Grant Smith & Co., 1408 Main St., Vancouver, B. C., for the work in connection with the construction of the Canadian Northern Pacific Ry. for a distance of about 40 miles on Vancouver Island, Canada; James Ireland & Co., Maysville, Ky., for the grade work in connection with 57 miles of second tracking between Lawrence Creek and Foster, Ky., for the Chesapeake & Ohio R. R.; O'Connor & Madigan, Connellsville, Pa., for three miles of grading and concrete work for the West Penn R. R. Co.'s street car line to Vance Mills, Pa.; Foster-Creighton-Gould Co., Nashville, Tenn., for 6,000 cu. yds. concrete in connection with the Kentucky & Indiana Terminal R. R. Co.'s road revision and bridge work at Louisville, Ky.; Curtis, Shumway & Dean, Pittsburg, Pa., for constructing the first 14 miles of the Middle Island Ry. from Clarksburg, W. Va., to Middlebourne, W. Va.

Bids for two good sized pieces of railroad construction in the East are said to have been opened recently. One of these jobs calls for the construction of 30 miles of track between Martin, Pa., and Reevesville, W. Va., for the Monongahela R. R., and the other calls for the construction of the proposed line from near Rivesville, W. Va., via Fairmont to the state line of Pennsylvania. This latter work is to be done for the Buckhannon & Northern R. R., of which S. D. Brady, Morgantown, W. Va., is Chief Engineer.

One of the largest stripping contracts let recently in the iron ore district in the vicinity of Duluth, Minn., has just been awarded to Butler Bros., N. Y. Life Bldg., St. Paul, Minn. The contract calls for the stripping of about 4,000,000 cu. yds. of material at the Longyear mine owned by the Jones & Laughlin Steel Co., Pittsburg, Pa.

The Milwaukee Bridge Co., Milwaukee, Wis., has been awarded the contract for the construction of the new bridge over the Illinois River at Bridge St., Peoria, Ill., the contract price being $166,896. Another large bridge contract let recently was the one secured by the Fruin-Colnon Construction Co., Merchants' Laclede Bldg., St. Louis, Mo., for the construction of a large viaduct at St. Louis for the Terminal Railroad Association. The contract is said to amount to about $300,000.

The cities of Los Angeles and San Francisco seem to be planning to go into the municipal railroad business on a somewhat extensive scale. A preliminary report for a municipal railroad to connect the business districts of Los Angeles with Wilmington and San Pedro has been submitted to the Board of Public Works of Los Angeles by the City Engineer, and a bill is to be introduced in the State Legislature at the request of the San Francisco Board of Supervisors' Public Utilities Committee to give San Francisco the right to build and operate a street railway all around the water front over state property.

The bid of Bryan & Co., Jacksonville, Fla., for bank protection of the Savannah River at Augusta, Ga., has been recommended for acceptance. Bids for the work were opened Jan. 26 by the U. S. Engineer at Savannah, Bryan & Co. putting in a bid of $244,860 for the work.

The Lake Superior & Ishpeming Ry. Co. is to erect a 1,200 ft. long, 54 ft. and 75 ft. high ore dock at Marquette, Mich., at an estimated cost of about $1,200,000. The contract for the steel work has been let to the Wisconsin Bridge & Iron Co., Milwaukee, Wis. About 33,200 cu. yds. of concrete will be used in the construction of the dock

Wrecking work has been started for the new union station to be erected at San Luis Potosi, Mexico. The new station and shops to be erected will cost about $1,000,000. The work is in charge of C. M. Tripp of Atlanta, Ga., [illegible] Colonia Station in Mexico.

18 Miles of Road in 1 Day.

The good roads movement goes on apace. Some [illegible] shaped up and dragged for [illegible] state of Iowa, all in a single day, and last November in Kansas 18 miles of bad road was made into good road in the period from sunrise to sunset of one day. The Kansas work had its inception with Mr. H. G. James, editor and publisher of a newspaper at Independence For many years this man had advocated better highways and had endeavored through the columns of his paper to arouse public sentiment so that some one would take the initiative. But nobody did and finally Mr. James decided, as he expressed it, that he would be the goat. Accordingly he wrote a call for a mass meeting to be held in Independence on Sept. 20. He printed this call in large type on the front page of his paper and it caused considerable comment. The movement had been started and offers of assistance began to pour in. Circular letters were sent out calling attention to the coming meeting and much enthusiasm was aroused. When the day of the meeting came the editor and the state engineer, who was to address the assembled multitude, went to the court house and found nobody there but the janitor. They waited and presently a few stragglers began to wander in. The editor used the telephone and finally they got about 45 people to the court house. This was the beginning. At the meeting the Montgomery Good Roads Association was organized, officers were elected, and it was decided to build a road from Independence to Coffeyville. The association didn't [illegible] even adopt a preamble: it simply organized and went to work. As Mr. James says, it is easy enough to organize a good roads association; but to organize a working force to build good roads is an entirely different proposition. Finally, however, an organization was effected and Nov. 15 was set as the day upon which the road was to be built. The distance between the limits of the two cities was almost 18 miles and this was divided equally, a super[illegible] end and a superintendent for the Independence [illegible] sections, a foreman being appointed for each section. These foremen were farmers living along the route. In Independence cash donations of about $2,700 were received; this was drawn on for the preliminary work. For the work on Nov. 15 everybody donated their labor. In order to arouse enthusiasm and to [illegible] in November. This brought out the farmers [illegible] 15 a legal holiday. In [illegible] the local gas companies, the banks [illegible] merchants closed [illegible] closed for the day and the male students shared in the road work. The county judge agreed to dismiss court and "sentenced" every man at the court house to work on the road [illegible]naries arranged; as to the actual work we will quote from a paper by Mr. James, presented at the recent Kansas Good Roads Convention:

[illegible] clerks were assigned the Clerk Creek hill, seven [illegible] places for the unseasoned men, chiefly to satisfy [illegible] nelly and his lawyer and court house assistants [illegible] steadily until night, blasting and digging the [illegible] stone, cracking rock in the middle of the road and covering it with clay, and filling in the [illegible] magic, an eyesore for half a century was trans[illegible] a way for the road. Some of them swung the axe until they became so sick they let go their [illegible] minutes' rest upon the ground they returned, like true soldiers, to the work. All along the way between these hills were scores of teams and men plowing; scraping, dragging. A great steam traction engine puffed and snorted and tore up the ground and dragged it to the center [illegible] imagine, if you can, men and teams with road-building machinery of every description lining [illegible] cities. Here were lawyers and doctors, preachers and politicians, day laborers and millionaires; bankers and clerks, printers and mechan[illegible] without wage or price, working in a great pub[illegible]

The health departments of large cities are accustomed to receiving complaints that sometimes, to say the least, are unusual. Recently the Chief Sanitary Inspector of the city of Milwaukee received a call over the telephone directing him to remove a bear. The chief thought he had been connected with a long distance telephone by mistake. "This is the Milwaukee Health Department," he said. "Yes," came the reply in a woman's voice. "I know it is, and I want you to come right up and take away that horrid bear. He made a horrible noise this morning. I thought it [illegible] baby I found her sleeping peacefully. Then I heard the noise again. I thought it was my father choking to death and I ran down stairs. But he was all right, too. Each time it was the bear growling that caused me to start. Take that bear away. He is tied up in the barn next door."

RAILWAYS, STEAM AND ELECTRIC

Alabama.

An adjourned meeting of the stockholders of the Cullman Coal & Coke Co. was held Jan. 31 at the office of the company at Cullman, Ala. It is believed that one of the principal matters considered at the meeting was the completion of the company's line of railroad from Cullman to the Bremen coal fields. It is generally believed that the work will be resumed by March 1. The construction of the railroad to the coal fields was begun a year or so ago, but owing to some break in the financial arrangements a stoppage of the work was necessitated. The terminus of the new road will be at what will be known as Juliana.

J. T. Roberts & Son, Montgomery, Ala., have petitioned the City Council of Montgomery to be allowed to lay railroad tracks on Moulton street from the Louisville & Nashville tracks, connecting with the track granted to be laid at a past session of the council. The laying of these tracks will give the Lee St. Terminal Co. facilities for getting cars from the Louisville & Nashville as well as the Mobile & Ohio and other railroads, and is part of the Lee St. development scheme.

It has been announced that the Tombigbee Valley R. R. will be completed from Reform to York, Ala., within 60 days and arrangements are to be made by J. T. Cochrane, Mobile, Ala., president of the company, for connections with the Queen & Crescent Route.

Alaska.

The Copper River & Northwestern Ry. completed its track to Gilhina River bridge, 160 miles from Cordova, Alaska, on Jan. 24.

A bill has been introduced in the U. S. Senate granting the Valdez-Marshall Pass & Northern R. R. Co. a further period of 18 months in which to complete its docks, wharves and terminals at Valdez Bay and the first 20-mile section of its railroad from Valdez into the interior of Alaska.

Arkansas.

The Helena Interurban Ry. Co. has completed surveys and has secured the capital for the construction of 2½ miles extensions at Helena, Ark. It is understood that the work will be done by force account. E. C. Horner, Helena, Ark., is President.

According to recent information from Magnolia, Ark., work on the Gulf & Magnolia Northern R. R. is being pushed since the holidays and more men have been added to the working force. It is proposed to have trains running between Magnolia and Waldo before fall, in time for the transportation of the crops. Henry Nunan is Chief Engineer of the company.

California.

The San Joaquin Light & Power Co., A. G. Wishon, General Manager, Fresno, Cal., owner of the street car system at Bakersfield, is planning to expend $400,000 for improvements, to include new rails, double tracks and new cars. It is also stated that the company plans at an early date to extend its Chester Ave. line northward beyond Kern river to the Kern river oil fields and Waits. This will be an extension of at least eight miles. In Bakersfield there are five miles of city lines.

The Los Angeles Ry. Co., Los Angeles, is planning to extend its car lines in Brooklyn Heights. The line at present terminating at Brooklyn Ave. and Eschandia St. will be extended on Wabash Ave. to the city limits. Another line will be extended from Brooklyn Ave. to Evergreen Ave. and on Evergreen Ave. to Wabash Ave.

A preliminary report for a municipal railroad to connect the business districts of Los Angeles with Wilmington and San Pedro has been submitted to the Board of Public Works of Los Angeles by Homer Hamlin, City Engineer. The preliminary surveys have not been [illegible] as yet, but the route as tentatively adopted begins at San Pedro and Aliso Sts., follows San Pedro to Jefferson, then south on South Park Ave. to the center of Section 17, township 3 south, range 13 west, thence to the east of Nigger slough and then to San Pedro and Wilmington. Entrance to San Pedro will be secured either through Wilmington, around the west basin, or by a line passing to the west of Bixby slough. When San Pedro is reached it is proposed to occupy the harbor front road, now being condemned as far south as Tim's point, and from this position to radiate to all points on the city's frontage on the outer harbor. All the inner harbor can be reached by branches from the main line, so Wilmington will be adequately served. The southern portion of the main line will form a belt line railroad around the harbor which will connect with every important wharf, warehouse and other points.

The entire right of way for the Porterville Northeastern R. R., construction work on which is well along, has now been secured from Porterville to the terminal at Springville. Up to Jan 17 the Utah Construction Co., of Ogden, Utah, and San Francisco, which has the contract for completing the line from Worth to the terminal, had put on 80 teams, with two steam shovels and one train of dummy cars, a total of about 150 men being at work on the line at that date.

A bill is to be introduced in the State Legislature at the request of the San Francisco Board of Supervisors' Public Utilities Committee to give San Francisco the right to build and operate a street railway all around the water front over State property. The purpose is to give the city permission to use the entire embarcadero, better known as East St.

The Nevada-California-Oregon Ry. Co., operating a 146-mile narrow gage railway from Reno, Nev., to a point beyond Alturas, Cal., will, it is reported, let a contract at once for the construction of an extension of its line to Pendleton, Ore., and has already placed an order for a large amount of material, including 3,000 tons of steel rails, which are to be delivered within 60 days. Work will be rushed throughout the remainder of the winter on the roadbed, which, with the bridges and culverts, will be made to accommodate standard gage tracks, and when the entire line is complete, including 500 miles of road, the track will be widened to standard gage. W. A. Dunaway, Reno, Nev., is Superintendent, and George S. Oliver, Reno, Nev., is Chief Engineer.

The San Pedro, Los Angeles & Salt Lake R. R. expects to have its new high line in Nevada completed and ready for operation by March 1. When 84 miles of track was destroyed by flood in the Meadow Valley wash a year ago the company rebuilt the track on approximately the old right of way because of the necessity of restoring traffic as soon as possible. At the same time a new line was surveyed 20 to 30 ft. higher than the old one so as to put it above danger of flood. As soon as this line is completed it will be put in service and the old line abandoned or used as a second line. At the time the contracts for the construction of the high line were let the contractors agreed to have the line ready for service by March 1. They were promised a heavy bonus for every day they cut down the time and agreed to make a substantial forfeit for every day they exceeded the time.

It is reported in San Francisco that the United Properties Co., the $200,000,000 merger recently made by a syndicate of Oakland and other financiers, with F. M. (Borax) Smith at its head, had acquired the East Shore & Suburban Railway Co., an electric road running between Richmond and Oakland. This road, which cost over $1,000,000, begins at the county line, runs to the Oakland Traction road on San Pablo Ave., and in the other direction runs through Stege to the Standard Oil refinery on the bay shore. It is believed that the new owners have acquired it for the purpose of extending the Key Route into Richmond.

The Sacramento Short Line Ry. Co. and the San Jose Short Line Ry. Co. have filed their incorporation papers. Both of these companies are controlled by the recently organized United Properties Co., and were formed for the purpose of extending the Oakland Traction and Key Route systems to Sacramento and San Jose. According to the plans the Key Route system, generally known as the San Francisco, San Jose & Oakland Ry., will be extended 98 miles into Sacramento, there to connect up with the Northern Electric Co. The San Jose extension will be but a continuation of the Oakland Traction Co., whose lines at present terminate in Hayward. A franchise and rights of way have already been secured for the extension of this line to San Jose.

Rumors are afloat in San Bernardino, Cal., to the effect that surveyors of the Salt Lake R. R. are preparing preliminary plans for the tunneling of the San Bernardino Range of Mountains in Devil Canyon. It is also rumored that the Santa Fe is a party to the plan and in the event it is successfully carried out the Santa Fe line over the Cajon will be abandoned. A tunnel through the mountains would cut down running time about six hours. Devil Canyon is six miles east of Cajon

Colorado.

The North American R. R. Co. has been incorporated with a capital stock of $50,000 and proposes to build a narrow gage railroad from the smelter of the North American Smelting & Refining Co. at Golden to limestone quarries 7 miles northwest of that city. The proposed railroad will connect with the Colorado & Southern at Golden. The incorporators are John R. Smith, C. M. Miller and H. B. Woods.

The directors of the Denver, Greeley & Northwwestern R. R., organized some months ago to build an electric line from Denver to Greeley, held a meeting recently to act on the proposition to increase the authorized bond issue from $2,000,000 to $10,000,000. This measure would be to provide for building connecting links to Fort Collins, Loveland, Longmont and other towns in the northern part of the state. Representatives of French and Dutch capitalists have been investigating the project. Ralph Hartzell, Equitable Bldg., Denver, Colo., is attorney for the company. George J. Spears is President.

The Commercial Club of Derby, a suburb of Denver, has applied to the Denver Tramway Co. asking it to extend its Stout St. line into Derby.

The Denver-Greeley Interurban project is said to have been financed by Eastern and north Colorado capital. This road, the promoter of which is E. N. Reaser, was first proposed to run from Greeley directly to Denver by way of Fort Lupton, but recently it was decided to extend the Denver-Fort Lupton line to Estes Park by way of Longmont. Rights of way for the line have been secured from Denver to Greeley, the Weld County Commissioners giving the company rights and privileges over the county roads. This right of way parallels the line of the Union Pacific.

Plans are said to be under way for the placing of $500,000 of bonds for the construction of the proposed railroad into the Plateau Valley, which has been promoted by J. J. Yeckel of Denver. As proposed the road will be 25 miles long, extending from Collbran to Cameo, where it will connect with the Rio Grande.

Surveys have been started from Pueblo for the proposed line of the Pueblo & Southeastern R. R. Co., the incorporation of which was mentioned in our Jan. 4 issue. As proposed

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

the line will be built between Pueblo and the new town of Wilson, 15 miles southeast, circling the tract being handled by the Pueblo-Rocky Ford Irrigation Co. Capt. J. H. Conlin, formerly construction engineer of the Baltimore & Ohio R. R., and for six years with the Rock Island, and W. D. Garwood, formerly with the St. Louis & San Francisco and other lines, are now in Pueblo and will take leading parts in construction of the road. Mr. Garwood will be general manager and in charge of engineering work.

Surveyors are now cross sectioning and setting grade stakes for the construction of the proposed Hudson-Greeley R. R. in Colorado, and the outfit, according to advices from Hudson, Colo., is camped five miles north of that place. MacArthur Bros., contractors, of Denver, Colo., and Chicago, Ill., are reported to have charge of the construction work.

Connecticut.

The Bridgeport & Danbury Electric Ry. Co. is reported to have secured over half the right of way for its projected connecting line between Danbury and Bridgeport. Rails for the entire distance have been purchased. A. William Sperry, C. E., New Haven, Conn., is interested.

Delaware.

The People's Ry. Co., Wilmington, Del., is considering building an extension of its Wilmington line to Richardson Park by way of Clayton St.

The Pennsylvania R. R. is said to be planning extensive improvements for its Delaware line, and is reported to have set aside over $900,000 for this work. The improvements include double tracking of the entire system from Wilmington to Delmar, the eliminating of the great curve at New Castle, the changing of the line near Seaford, and the erection of several new stations.

According to advices from Wilmington, Del., the owners of the Wilmington & New Castle Ry. are contemplating the construction of a line from Guthrie's Corner along the causeway and then along the road to Market St. bridge across the Christiana River.

Florida.

The Atlantic, Okeechobee & Gulf R. R., mentioned in our last issue, is reported to have made provisions for an imediate survey for its projected line from Tampa, Fla., to Miami. H. C. Ferriott, New Orleans, La., is President, and the Board of Directors is composed of former United States Senator W. H. Milton, Robert L. Riley, Walter Graham, A. H. Ward, A. S. Jordan, E. E. West, Broward Land Co., Daniel A. Simmons and J. O. McPherson.

Georgia.

The Georgia, Florida & Alabama Ry., C. G. Barney, Chief Engineer, Bainbridge, Ga., has plans under consideration for extending its line from Richland to Columbus in the near future. The extension will be about 39 miles long.

Grading work and laying of cross ties from Indian Springs to Flovilla for the projected line of the Middle Georgia Interurban Ry. Co. has been started. This company projects a line from Griffin to Social Circle. Capt. W. F. Smith, Flovilla, Ga., is the promoter.

Surveys have been completed for the projected 60-mile line of the Atlanta Northeastern R. R. As proposed this line will extend from Atlanta through Cobb, Milton, Cherokee and Forsyth counties. A considerable part of the right of way has been secured. The officers of the company are as follows: J. M Ponder, of Forsyth, president; J. L. Murphy, of Atlanta, vice president; Robert Jones, of Atlanta, secretary; S. F. West, of Atlanta, treasurer.

J. A. J. Henderson, Ocilla, Ga., president of the Ocilla Southern R. R., has closed a deal for a trackage right or lease to that portion of the line of the Fitzgerald, Ocilla & Broxton R. R. between Fitzgerald and Ocilla and Irwinsville and Ocilla, adding 20 miles of track to the present line. The lease of the property gives the Ocilla Southern a through line from the city of Fitzgerald to [illegible], on the Atlantic Coast Line.

The Atlanta-Carolina Ry. Co. has construction work under way on its projected line from Atlanta to Augusta, via Lithonia, Conyers, Monroe, Athens, Washington and intermediate points. M. Mason, Atlanta, Ga., is President.

Idaho.

It is reported in Ford, Idaho, that either the Chicago, Milwaukee & St. Paul or the Blackwell Ry. will soon commence the construction of a line from Plummer Spur, a short distance west of Coeur d'Alene Lake on the Blackwell logging road to Plummer on the main line of the Chicago, Milwaukee & Puget Sound. Surveys have been completed for such a line, and as planned it would serve a good timber and agricultural section.

Illinois.

Sheppard & Morgan, Engineers, Edwardsville, have completed surveys for the proposed electric railway from Collinsville to Troy.

We are advised that the Chicago, Burlington & Quincy R. R. has made no definite plans in regard to its proposed double track work between Bushnell and Beardstown. Present indications are that the work may not be started this year.

The Illinois Traction System, H. E. Chubbuck, General Manager, Peoria, Ill., is reported to have a somewhat novel plan under consideration for the storage of coal at Riverton and Mackinac. It is said that excavations will be made in the ground and walled in with cement and that these holes will then be filled with coal. After which the supply is to be flooded with water to exclude the air. Each excavation is to hold 12,000 tons of coal.

The Alton, Jacksonville & Peoria interurban line has been granted an extension of 18 months by the City Council of Whitehall, in which to commence work on the road through that city. The line has already been completed as far as Jerseyville, and from that place will be extended to Calhoun County. J. C. McGrath, Jerseyville, Ill., is Secretary.

Officials of the Aurora, Elgin & Chicago Ry. Co., Chicago, have been going over the route of a proposed loop, which the village boards of Maywood, Melrose Park and River Forest have asked to relieve the traction situation in those places. It is probable that no definite action will be taken in the matter for some time.

The Elgin, Joliet & Eastern Ry., according to advices from Joliet, Ill., has under consideration improvements at Joliet and vicinity estimated to cost upwards of $1,000,000. These include new round house, new coal chutes, new turn tables, several miles of additional yard trackage, subway at Charlesworth Ave., viaduct for Jackson St., macadamizing of Meeker Ave. and other thoroughfares, with promise of new car repair plant, doubling size of machine shop and employment of from 1,200 to 1,500 additional men. Arthur Montzheimer, Joliet, Ill., is Chief Engineer of the E. J. & E. Ry.

Indiana.

The Gary & Southern interurban has assured the people of the city of Gary that it will positively build its road if it wins its injunction suit at Crown Point.

Progress is being made with the promotion work for the Wabash & Northern Traction Co.'s line, and it is expected that the road will be constructed. J. A. Barry, 806 Shoaff Bldg., Fort Wayne, Ind., is the promoter.

The construction of an interurban line from Kendallville to Goshen, via Albion and Ligonier, is under consideration. J. M. Kinney, Kendallville, Ind., a railroad contractor, has been looking over the field, and may take preliminary steps to establish such a line.

A bill is now being drafted for presentation to the State Legislature to provide the city of Indianapolis with sufficient revenue to pay its share of the cost of elevating the tracks east and west of the Union station. It is estimated that about three years will be required to complete all track elevation proposed in the downtown district, from Senate Ave. east through the Union Ry. Co.'s yards. The city's share of the expense will be about $1,000,000. Henry W. Klausmann is City Engineer of Indianapolis.

Iowa.

The stockholders of the Charles City Western R. R., recently completed, have voted to extend the road during the coming year either to Hampton or to Elma or some other point to connect with the Great Western. C. H. Parr. Charles City, Ia., is Secretary of the company.

Steps are being taken to secure funds for the building of a railway from Knoxville to Dallas, in the southwestern part of Marion County. The Coal Fields Construction Co., Knoxville, Ia., is interested in this project.

Kansas.

The Metropolitan Street Ry. Co., Kansas City, Mo., has filed its acceptance to build the 13th St. car line at Kansas City, Kan., as provided by an ordinance passed by the city commissioners last November. The road is to be about 1½ miles in length and is to run from 13th and Quindaro Blvd. to 13th and Central Ave.

It is believed that work will be started this spring on the construction of the McKinley interurban line from Atchison to Leavenworth. A line is also to be built to St. Joseph. W. B. McKinley, Champaign, Ill., is President.

The Commercial Club of Wellington, Kan., is taking steps for the organization of a company having for its purpose the securing of a line of railroad from Conway Springs through Wellington to Arkansas City. The company will be comprised of business men of Conway Springs, Wellington and Arkansas City.

The Missouri Pacific Ry. is reported to have purchased the Kiowa, Haidtner & Pacific R. R., a 10-mile line, for a consideration of $128,000.

According to reports from Thayer, Kan., W. M. Nees, the promoter who built the electric railway from Coffeyville to Independence, is now working on a proposition to build a railroad from Fredonia to Parsons by way of Altoona, Thayer and Galesburg, using the Missouri, Kansas & Texas tracks from Galesburg to Parsons. It is stated that the promoter has succeeded in securing all the rights and claims against the old Calico R. R. at the Fredonia end of the line. It is believed that he can construct the 28 miles of line between that place and Galesburg at an estimated cost of $20,000 per mile.

Officials of the Southwestern Kansas & Colorado R. R. have been authorized to issue stocks and bonds to the amount of $1,000,000 and the next step to be taken will be toward securing right of way. This road is projected from Anthony, Kansas, to Raton, New Mex., much of the line being already surveyed. The road as projected passes through Harper, Barber, Comanche, Kiowa, Clark, Ford, Meade, Gray, Seward, Haskell, Stevens, Grant, Morton and Stanton counties, and on into Colorado. The company has been organized with the following officers: R. W. Scott, president; A. L. White, vice president and general manager; J. C. Lewis, second vice president; H. Knecht, treasurer; W. S. Richardson, secretary; E. H. Hurd, general attorney. The general offices are located at Coldwater, Kan.

A vigorous campaign is being carried on in Logan County, Kan., for the construction of the Scott & Northern R. R. extension. E. A. Tennis, Garden City, Kan., is interested.

Kentucky.

•Foster-Creighton-Gould Co., Nashville, Tenn., has been awarded the contract for the construction of concrete work in connection with the Kentucky & Indiana Terminal R. R. Co., road revision and bridge work at Louisville, Ky. The work comprises 6,000 cu. yds. of concrete. H. M. Gould is Vice President and General Manager of the contracting company.

The properties and franchises of the Somerset Water, Light & Traction Co. have been sold by order of the Pulaski Circuit Court to

Joe H. Gibson of Somerset, Ky. Associated with Mr. Gibson are Eastern capitalists and it is announced that $50,000 will be spent in improving the plant and equipments.

The Louisville Traction Co., Louisville, Ky., is to extend its line from [illegible]th and Slevin [illegible] 30th St., Louisville. The extension will cost about $15,000 and work is to be started as soon as the weather permits.

Arrangements are said to have been made for floating the bonds for the proposed new railroad from Cape Girardeau, Mo., to Hickman, Ky., and there is reason to believe that the road will be constructed this year. This is the new line being promoted by Louis Houck, Cape Girardeau, Mo., President of the Chester, Perryville & Ste. Genevieve Ry.

Preliminary surveys have been started for a proposed new railroad from the new town across the river from Evansville, Ind., to Henderson, Ky. As proposed the line will run up the river to the Illinois Central incline and then parallel the Illinois Central tracks into Henderson. It will be a standard gage steam line. Saunders & Saunders, Evansville, Ind., are the Engineers.

The Queen & Crescent Route, C. Dougherty, Engineer Maintenance of Way, Cincinnati, O., is to extend the Overton County R. R., which now runs from Livingston to Altgood, Tenn., where it connects with the Tennessee Central, through Brystown, Monticello and into Somerset.

New York representatives of the proposed interurban railway between Murray, Paducah, Mayfield, Milburn, Arlington and Wickliffe, Ky., are going over the territory in order to make estimates as to the cost of the project. The proposed line carries a right of way from the Tennessee River to Murray. N. Ryan, Murray, Ky., is interested.

Maine.

A bill is to come before the State Legislature at Augusta asking for a charter for a steam railroad to be built from Houlton to Bangor. The proposed road will save nearly 40 miles between Houlton and Bangor, the distance being about 100 miles instead of the present 137 from Houlton to Northern Maine Junction over the Bangor & Aroostook, or a much longer distance by the Canadian Pacific. It is understood that if a charter is granted track surveys would be made in the spring or summer and the work of construction pushed rapidly.

Application may be made at the present session of the Legislature for a charter for an extension of the Grand Trunk to Rumford Falls from either Bethel or Locke's Mills. The proposed road would run a distance of 15 or 16 miles through prosperous farming territory embracing the towns of Greenwood, Bethel and Rumford, and give connection with Rumford Falls to the towns to the westward.

Maryland.

Rapid progress has been made with the tunnel work on the Western Maryland extension to Connellsville, Pa. On the Brush tunnel, which will be 876 ft. in length, the shelf boring up to Jan. 14, had been completed for 70 per cent of the distance. This work is progressing at the rate of 74 ft. a week, at which rate the east and west borings should be broken through in February. In the Borden tunnel, which will be 945 ft. long, 327 ft. have already been completed, leaving 618 ft. still to go. Both of these tunnels are being constructed for double track, as also is the Pinkerton tunnel, 824 ft. in length, which is expected to be completely bored through early this month. In the Big Savage tunnel, which will be the longest tunnel on the extension, measuring 3,274 ft. in length, 1,358 ft. or more than half the distance, had already been bored, at the middle of January. Work on all the tunnels is being prosecuted from both the east and the west headings in day and night shifts. Up to Jan. 14 the lin. ft. of tunnels already excavated aggregated 3,067.

Reports from Baltimore state that the Pennsylvania R. R. Co. has a new plan for taking care of its freight traffic through Baltimore, involving the construction of a tunnel, or two tunnels joined by an open link, in North Baltimore from the junction with the Western Maryland railroad, west of the Wilson St. tunnel through to the York road. The proposed tunnel plan, in brief, is said to be as follows: The tracks of the Baltimore & Potomac, at Lafayette Ave., will be raised to permit the bed of Lafayette Ave. to pass under the tracks, below grade, and the number of tracks will be increased from four to nine. Leaving the line of the Baltimore & Potomac, the new tracks will cross the tracks of the Western Maryland above grade, and will soon afterward enter the first of the tunnels, which will run under the bed of Baker St. crossing under North Ave., and be continued under Ducatel St. to the low country along Jones' falls, east of Druid Hill Park, or Mount Royal Terrace. The falls will be crossed by a bridge, as will the Northern Central R. R. Just east of the falls the line will enter a tunnel, which will extend under 27th St. to the York road, paralleling the Belt Line tunnel of the Baltimore and Ohio. From York road east the new line will have open country and no further tunneling will be required.

Massachusetts.

Engineers of the Berkshire Street Ry. Co., Pittsfield, Mass., have started two new surveys on Greylock Mountain near Adams, Mass., for a railroad from the company's present lines to the summit.

Michigan.

It is again reported that the Pere Marquette R. R., J. F. Deinling, Chief Engineer, Detroit, Mich., is about to begin a survey for a new extension between Honor and Empire, the line to begin at Empire and extend to Glen Haven.

A plan has been launched at Saginaw by Joseph P. Tracy, Secretary of the Merchants & Manufacturers' association and the Board of Trade, for a new $1,000,000 terminal station in that city. The undertaking contemplates the organization of a local terminal company, to be composed entirely of Saginaw capitalists, which will erect, upon a site to be selected, a modern union passenger station which will provide ample facilities for all three railroads entering the city, together with their numerous branches. The building of the union station would involve the construction of terminal facilities, including switches and entrance lines.

A movement is on foot at Sault Ste. Marie looking to the construction of an electric line running between the Soo and Pickford, with the idea of later continuing it to either the Snows or St. Ignace and DeTour.

Minnesota.

The Duluth Engineering Co., Duluth, Minn., has placed an engineering corps in the field at Eveleth to lay out routes for the proposed Range trolley line from Eveleth in the direction of Gilbert. Another crew is at work between Virginia and Mountain Iron.

Location surveys are said to be under way for the proposed electric railway from Albert Lea to Worthington. Eastern capitalists are reported to have been interested in the project, and it is said that construction work will be started in the spring. A. W. Knight, Chicago, Ill., and G. E. Doyle, East Chain, Minn., are the promoters.

Duluth and the Ranges.

BY PETER F. MEAGHER

⊙In my last letter I mentioned that there was to be a large stripping job let in this vicinity, that I would be in a position to announce the successful bidder in the next issue. This contract was awarded to Butler Brothers, New York Life Building, St. Paul, Minn. It calls for the stripping of approximately 4,000,000 cu. yds. of material. The name of the mine is the Longyear Mine owned by the Jones & Laughlin Steel Co., Pittsburg. This mine adjoins the Morris mine on the South and the Webb mine on the East. It was originally opened up as an underground proposition, and has not been worked very much since 1905. Butler Brothers, the successful bidders, are very large contractors in this vicinity, do a great deal of stripping work on the Iron Ranges, and have a very large standard gage plant, consisting of locomotives, steam shovels, dump cars, etc. I understand that this work will be started the first thing in the spring.

Mr. John Dunlavey, General Manager of the Duluth & Northeastern Ry. Co., was a caller at this office a few days ago. They are very busy at the present time finishing their construction work, and do not contemplate any new work at the present time.

Mr. P. G. Pastoret of the Pastoret-Lawrence Co., Duluth contractors, was a caller and stated he had just returned from Albert Lea, Minn., where his firm was awarded a small sewer contract to be started early the coming season. He said the outlook for sewer and water work construction is very bright for the coming season.

Edward Hingston, traveling representative for the Bucyrus Steam Shovel Co., is in the city at the time of writing this letter. He said that steam shovel business was very good with his firm at the present time.

Mr. C. H. Overlien, traveling salesman for the J. I. Case Company, Racine, Wis., spent a couple of days with us here last week. He made a special trip up here looking up automobile prospects.

J. D. O'Connell, Duluth Contractor, is engaged at the present time on three or four small sewer jobs in the city of Duluth.

Mr. C. H. Munger, general manager of the Pickands, Mather & Co.'s mining interests on the Iron Ranges, with headquarters at Duluth, Minn., leaves in a few days to spend a few months abroad. Mr. Munger has been a very busy man and has well earned this vacation.

Mr. F. C. Peabody and R. A. McMenemy, contractors of the firm of Dale & Bumgardner Co., were callers a few days ago. They are not doing anything at the present time, but look forward to a very successful season.

Edward Kimball of Kimball Brothers, railroad contractors, was a caller this week. Not doing anything at the present time but are in the market for some work. They have three traction engines, three grading machines and 30 pairs of horses and a good outfit.

E. C. Brandenberg, team contractor, was a caller last week. Not doing anything at the present time, and are in the market for some work.

Mr. C. A. Baker, the Original Baker, Secretary of the Sterling Wheelbarrow Co., spent a day with us here this week. He was on his way to the Coast. Baker said that they had sold a great many wheelbarrows for 1911 delivery, and the way prospects looked at the present time it would tax the output of their factory to fill all their orders. Of course Baker wanted to know if we were going to the Concrete Show at Chicago. Well, I should smile!

Winston-Dear Co., who have a large standard gage plant stripping at Hibbing, Minn., have closed down their operations owing to the severe weather, and will not start again until the first of April. To give an idea of the work that some of these firms up here are doing would say that Winston-Dear in one mine in 1910 stripped two million cubic yards.

Harry Roberts of the Roberts-Kingston Contracting Co., was in the city this week and stated they were very busy on their contract of stripping near Virginia, Minn., and would continue to work throughout the winter.

Laborers are fairly plentiful at Duluth and vicinity at the present time. Lumber companies and sawmills are operating quite heavily and are employing a great many men. The only railroad work going on at the present time is on the Canadian Northern Extension into Duluth. The men who are working on that line are hanging on to their jobs and not moving around, as is customary.

Contractors and others interested in work pertaining to the vicinity of Duluth can receive any information they desire by writing to Peter E. Meagher, 409 West Mich. St., Duluth, Minn.

Missouri.

Surveys for the proposed Springfield-Joplin electric railway have been completed to Joplin. The route as surveyed from Mt. Vernon to Joplin passes throungh Holberg, Freistatt, Monett, Peirce City, Wentworth and Diamond.

According to advice from Macon, Mo., the reorganization of the North Missouri R. R. is under consideration with Dr. Charles Still, Kirksville, President. Such a move would probably mean the extension of the line to Kirksville.

Application has been made to the city authorities of St. Louis for a franchise granting the proposed St. Louis, Arcadia & Jefferson City electric line an entrance to the city. The franchise is asked over this route: From Grand west on Wyoming to Oak Hill, south to Parker Ave, west to Morganford road, south to Miami St., west to King's highway, south to Pernod Ave., west to Wabash Ave, south to Bancroft Ave., and west to the city limits. The franchise is asked by T. G. Portis, secretary of the Parker-Russell Mining & Manufacturing Co.; Charles F. Vogel, a realty dealer; and E. R. Kinsey, City Surveyor of St. Louis.

A bill is now before the Judiciary Committee of the State Legislature requiring "all railroad, street railway, terminal transfer or electric railway corporations" to incorporate under the laws of Missouri before doing business in the state. The penalty for each offense is put at a fine of $2,000 to $10,000.

The Joplin & Pittsburg Ry. Co., J. J. Heim, President, Kansas City, Mo., is getting in shape for an extension in Joplin east from its present terminal at 7th and Main in that city.

Kansas City, Mo., and Vicinity.

[illegible]

Davidson Bros., contractors of Kansas City, were unfortunate enough to be visited by a bad fire last week. Several large tents were burned. No serious loss outside the tents is reported, but before the fire could be extinguished over $500 worth of canvas was destroyed.

D. S. Gerow, the contractor who has been doing double track work on the Santa Fe near Bosworth Mo., has moved his entire shovel plant to Colorado where he has secured a nice contract on the Colorado Southern R. R.

Wm. Spencer of Kansas City, has about completed his contract on the Santa Fe near Bosworth, Mo. Mr. Spencer has been a partner of J. A. Ware on this work under the firm name of Ware & Spencer. He has a fine shovel outfit and is now in the market for work.

D. J. Allen, of Kansas City, has formed a partnership with Mr. Ramsey of Larned, Kas., and the new firm of Ramsey & Allen has entered the field of grading contractors. They have secured a contract for building a dam in Southern Colorado, involving about 50,000 yds. of earthwork and expects to begin operations without delay.

C. W. Marshall, President of the Ohio Contractors' Co., has moved his office to the Commerce Bldg., Kansas City. Mr. Marshall is just in from Arizona where he has completed a contract on the Santa Fe. He reports that he has enjoyed a very successful season and likes Arizona as a country in which to work. He has not moved his outfit from that point as he is of the belief there may be further work to be done near there during the coming season.

The Terminal Railroad of Kansas has about concluded to expend $750,000 in reducing grades in the city limits of Kansas City. As the grades now stand the approaches to the new station would require the use of a pusher on many of the heavy through passenger trains. It has not been decided whether the work will be let to contract or be done with the company's own forces. As soon as a decision is reached we will report the facts to our readers.

A. W. Farney, the well known River Contractor of Kansas City, is figuring on some large contracts along the Missouri. If he secures the work there will be a large amount of revetment to be done. Mr. Farney conducts his operations under the firm name of A. W. Farney Construction Co., office in the Midland Bldg., Kansas City, Mo.

Norton Bros., grading contractors of Kansas City, have just purchased a traction shovel. In the future they intend to use this shovel moving earth in foundation work. Norton Bros. are certainly a progressive firm of contractors and have a bright future here in Kansas City.

St. Louis Items.

[illegible]

✣The Board of Public Improvements ordered advertisements for lettings for the following streets, bids to be opened Feb. 21: Fassen St., Virginia Ave. to Alabama Ave., brick; Liberty St., Alabama Ave. to Idaho Ave., brick; Leffingwell Ave., St. Louis Ave. to Dodier St., brick; Desyrehan St., Hall St. to Second St., brick; South Dakota St., Compton Ave. to Virginia Ave., brick; Destrehan St., Second St. to 11th St., brick; 18th St., Biddle St. to O'Fallon St., wood blocks; 16th St., Franklin Ave. to Chambers St., asphalt; 23rd St., O'Fallon St. to Madison St., asphalt; 19th St., Washington Ave. to Carr St., asphalt; 17th St., Lucas Ave. to Biddle St., asphalt; 17th St., Biddle St. to intersection with Clinton St., asphalt; Clarence Ave., Natural Bridge Rd. to Farlin Ave., brick; Angelica St., Blair Ave. to 25th St., brick; 19th St., Carr St. to Madison St., brick; 23rd St., North Market St. to Hebert St., brick; Destrehan St., 19th St. to Florissant Ave., bitulithic; 13th St., Cass Ave. to intersection with 11th St., bitulithic; Delmar boulevard, Skinker Rd. to western city limits, wood blocks; 18th St., Washington Ave. to Biddle St., wood blocks; 18th St., O'Fallon St. to Cass Ave., wood blocks; 18th St., Cass avenue to North Market St., wood blocks.

The Universal Construction Co. is getting a good start on their big sewer contract in the southwestern part of the city.

Seventeen street improvement ordinances were sent to the Municipal Assembly by the Board of Public Improvement. Six of these are for widening streets so as to straighten them or to facilitate traffic upon them, and eleven are for paving streets. Among the paving ordinances is one for repaving with wood blocks Pine St. from Fourth to Twelfth Sts., now surfaced with granite blocks. Another ordinance proposed to repave Seventh St. between Market St. and Franklin Ave. with wood blocks. The street is now paved with granite blocks. The ordinances introduced are in detail as follows: To establish, open and widen King's Highway boulevard from Arsenal St. to its intersection with Vandeventer Ave. and Old Manchester Rd. To establish and open Lindell Ave. from the intersection of Locust St. and Leonard Ave. to the intersection of Olive St. and Channing Ave. To establish and open as a high [illegible] at the intersection of the northwest corner of 13th St. and Locust St. To establish, open and widen Channing Ave. from Olive St. to Locust St. To establish, open and widen Palm St. from its intersection with Jefferson Ave. and Farrar St. to Glasgow Ave. To establish, open and widen Carter Ave. from Florissant Ave. to Frand Ave. To repave 7th St. from Market St. to Washington Ave. with wood blocks. To pave Brooklyn St. from Second St. to Broadway with granite. To repave Pine St. from 4th St. to 12th St. with wood blocks. To pave Clark Ave. between Prospect Ave. and Spring Ave. with brick. To pave 12th St. from Hebert St. to Branch St. with wood blocks. To pave Howard St. from 7th St. to Blair Ave. with asphalt. To pave 24th St. from Carr St. to Cass Ave. with bitulithic. To pave 21st St. from Washington Ave. to Cass Ave. with asphalt. To pave 25th St. from Cass Ave. to St. Louis Ave. with bitulithic. To pave Blair Ave. from Biddle St. to Wright with wood blocks. To pave 25th St. from Car St. to Cass Ave. with brick.

A large delegation of Missouri Point farmers went to St. Charles, Mo., last Friday for the purpose of pushing a condemnation suit to compel the Paltzer Brothers to permit the building of a levee across their land, a distance of 300 ft. The Paltzers claim to be obeying the dying command of their father in refusing to allow the levee to be built across a slough which controls the flow of water in flood time. They admit if the levee were built, a large area of farming land could be reclaimed. The farmers offered to buy the land from the Paltzers, build the levee and then deed it back to the brothers. This offer was refused and condemnation proceedings were instituted.

Hannon & Hickey Bros. were awarded the contract for building four reinforced concrete bridges across the drainage ditches north of East St. Louis. They have just finished their work at Mt. Carmel, Ill. and have a 75-ton steam shovel idle. Address them at 406 Navarre Bldg., St. Louis, Mo.

L. W. Winters, the track laying contractor from Joplin, Mo., spent a couple of days in town on business.

The date for letting the contract for building the Forest Park foul water sewer, designed to purify the River Des Peres, and for a pump-house to lift the foul water into the Pine street sewer was set February 14, by the Board of Public Improvements. The work, which is to cost about $71,600, and which is to be paid for out of a bond issue and municipal revenue, is to be pushed with unusual dispatch. The first plans were submitted December 16. The new sewer will take from the River Des Peres between the city limits and Pagoda lake in Forest Park all sewage, which now defiles the little stream and emanating from the rapidly improving district northwest of Forest Park. The pumping plant, which will lift the sewage about 30 feet into the Pine street sewer and start it down toward the Mississippi river, will be located under ground in Forest Park near Pagoda lake. An outfall 900 feet long of 18-inch pipe will carry the sewage under pressure from the pumps to the Pine St. sewer. This will be the first instance in the municipal life of St. Louis, excluding the time of the World's Fair, when the same device was employed, in which sewage is lifted into a new watershed. The apparatus used in the work will be two centrifugal pumps, directly connected with two induction motors. When the water in the sewer reaches a certain low level the pumps will stop automatically. When it rises, first one pump and then the second will be thrown into service, and when it rises still farther both pumps are automatically thrown out of service.

Pat Hickey of Hannon & Hickey Bros. left here the other day with his only son Raymond for Palm Beach, Fla. Raymond has been ill here and the doctors have advised that they think a change of climate would benefit him.

A. W. Nyquist, who formerly was in the contracting business, is here with us. Nyquist is selling pumps at the present time.

◉A contract for the widest and longest viaduct in St. Louis has been awarded to of the Grand Trunk Pacific Ry. in an effort the Fruin-Colnon Construction Co., Merchants-Laclede Bldg., St. Louis, by the Terminal Railroad Association, which will spend $300,000 for the Compton Ave. structure from Manchester to Chouteau Aves. The bridge will be 60 feet wide. Maxime Reber, president of the Board of Public Improvement, received notice Saturday of the Terminal Associations' action.

New Jersey.

The Town Council of Bloomfield, N. J., has taken steps for the vacation of Mechanic St. in that place as desired by the Delaware, Lackawanna & Western R. R. The railroad is planning extensive improvements at Bloomfield and the vacation of the street is necessary as part of the plan.

The Pennsylvania R. R., Geo. P. Miller, Engineer, New Jersey Division, Jersey City, N. J., has forwarded a plan to the Borough Council of Linden, N. J., for the proposed improvement in the way of underground crossings at Stiles St. and Wood Ave. in the Borough. The ordinance granting the railroad the permission to proceed with the work stipulates that the railroad shall build, at its own expense, steel or concrete bridges with masonry abutments, on the house lines and columns on the curb lines to support and carry its tracks and platforms over Stiles St. and Wood Ave., with a clearance of 13 ft. over the proposed grades of these thoroughfares. Also that the railroad shall pay for grading required to change the grades of Stiles St., Wood Ave. and Pennsylvania R. R. Ave.

New York.

The Syracuse & South Bay Electric R. R. Co., C. D. Beebe, President, Syracuse, has completed surveys for the proposed extension of its line northward from Acirco. Construction work will probably be started in the spring.

A committee has been appointed by R. F. Knapp, President Business Men's Association, Saratoga Springs, N. Y., to consider the construction of a trolley line from Corinth to Saratoga. As proposed the line would be 16 miles long and it is believed that it will cost $160,000.

The Syracuse Rapid Transit Ry. Co., W. J. Harvie, Chief Engineer, Syracuse, is planning a number of improvements. These include the following: Extension of the double tracks on the Solvay line to cost $37,000; extension on Willow St., Syracuse, to cost $29,000, and the extension of Court St. line, Syracuse, to cost $8,356. Several other extensions are also proposed in Syracuse.

The Beebe interests of Syracuse, which control the Rochester, Syracuse & Eastern Electric Ry., and the Rochester, Lockport & Buffalo road, are considering extending the line which now runs from Newark to Marion on to Williamson and Pultneyville, a distance of ten miles.

The New York Central & Hudson River R. R. is reported to have plans under consideration for tunneling under Long Island Sound this spring from Montauk Point, L. I., to a point near New London, Conn. This tunnel would be used in connection with the Boston trains.

A meeting was recently held at Oneida, N. Y., by promoters of the proposed electric railway from that city to Rome and it was decided to make an effort to form a stock company to build the road.

The latest subway offer in New York city was the one made last week by the Bradley Contracting Co., of New York city. This company offered to take over the entire interborough subway scheme as planned by the public service commission. The company offers to construct the subways along the interborough route as laid out by the commission, to equip them and to operate them. The company wants $85,437,561 for building the subways. It offers to equip them at its own expense and to operate them upon such terms as the commission may determine to be reasonable. It offers to turn the work over to the city at any time upon the payment of the cost of equipment plus 10 per cent or to operate them for a period of years to be agreed upon.

North Carolina.

An election is to be held Feb. 14 in Graham County, Robbinsville, county seat, to vote on issuing $50,000 of bonds to aid in the construction of a standard gage railroad from Topton to Robbinsville.

A movement has been started at Salisbury, N. C., looking to the building of a trolley line from that city to Coolemee, Mocksville, and perhaps Yadkinville and other points north of Rowan County.

J. B. and B. N. Duke and W. S. Lee have made a proposition to the business men of Charlotte, N. C., Greenville, Anderson and Spartanburg, S. C., looking to the construction of an extensive system of interurban lines. The cities interested are asked to take stock in the proposed lines, and the manufacturers and merchants are to agree to give the trolley line at least 50 per cent of their freight business. To both these propositions the towns thus far approached have agreed. The road is to be built by a syndicate capitalized at $7,000,000.

The Whiting Lumber Co., owning large timber properties in the vicinity of Asheville, N. C., is planning to build a standard gage railroad from Topton, at the top of the Nantahala mountain on the Murphy line of the Southern Ry. to Robbinsville, a distance of 12 miles. The company has already purchased 200 box cars and two engines for use on its lines. The road is to be put through at an early date. At a later date it is proposed to build a line from Robbinsville, along the Cheoah river, to connect with the Knoxville-Bushnell line of the Southern, when that is completed.

North Dakota.

The directors of the Wahpeton-Breckenridge Street Ry. Co., Wahpeton, N. Dak., are considering extending the line to Hankinson and other points southwest of Wahpeton. The street railway has been in operation only four months, but has been so successful that the plan is now to make it an interurban.

Ohio.

⊙A contract is reported to have been awarded by the Chesapeake & Ohio R. R., P. F. C. Cabell, Chief Engineer, Maintenance of Way, Richmond, W. Va., to James Ireland & Co., Maysville, Ky., to grade for double-tracking 57 miles of the Cincinnati Division between Lawrence Creek and Foster, Ky., about 40 miles above Cincinnati. The grading and bridge work for the double-tracking will cost $1,100,000 and the improvement is to be completed by next fall.

The Detroit, Toledo & Ironton Ry., J. Wanbecq, Resident Engineer, Detroit, Mich., is reported to have mapped out a preliminary route for a new line from Jackson to Middleport and Racine, thence through Athens County to Broadwell, on the M. C. C. R. R.

The Columbus, Urbana & Western Electric Ry. Co., Columbus, O., has asked the city of Columbus to waive its rights across the McLaughlin Place and allow it to construct its tracks along the Ohio River bank for the extension to Dublin.

Good progress has been made with the Cincinnati, Hamilton & Dayton work at Sidney, O., and it is believed that the contract will be completed by Feb. 15. Good weather has been favorable to the prosecution of the work. The work among other things, consists of ten miles of track relocation.

The Cleveland, Cincinnati, Chicago & St. Louis Ry., Paul Hamilton, Engineer Maintenance of Way, Springfield, O., is said to be making surveys with a view to double tracking between Dayton and Springfield.

W. R. Hopkins, of Cleveland, O., head of the company which proposes the construction of a system of subways in that city, has gone to Europe, where he will try to interest foreign capital in the subway proposition. He will be gone four or five weeks, spending most of his time in England.

It is expected that the Western Ohio Ry. Co., Lima, O., will start work soon on the elimination of some of the curves on its trackage between Sidney and Pique. The principal curve to be eliminated is at Swift Run where the track will be moved out about 50 ft.

The Dayton, Covington & Piqua Traction Co., Dayton, O., has agreed to construct and maintain double track on North Main St., Dayton, from Fairview Park to the corporation line.

Oklahoma.

The directors of the Cherryvale, Oklahoma & Texas R. R. have authorized the construction of a line from Vinita, Okla., to Siloam Springs, Ark., 65 miles, and of a 50-mile branch from Caney, Kas., to Pawhuska, Okla. The first section of the railroad between the Caney and Vinita has been in course of construction several months. S. M. Porter, Caney, Kan., is President.

The construction of the Belt Line R. R., in Oklahoma City, which will traverse a distance of 4½ miles from the connection of the Katy with the Santa Fe southeast of Grand Ave. to Packingtown, is, according to reports from the city mentioned above, progressing rapidly. The grade has been completed and ties are laid and all bridges have been constructed.

The Beaver Valley & Northwestern R. R. Co. has been incorporated for the purpose of constructing a railroad through the northwest counties of Oklahoma from Beaver City to Oklahoma City, Okla. J. M. Kerns, Beaver City, Okla., is General Manager and J. A. Tack, Wichita, Kan., is interested. It is reported that surveys have been made and right of way secured for 104 miles of line. The original plans of the railroad are to build from Beaver City to La Junta, Colo., a distance of 150 miles, and from Beaver City to Oklahoma City, 250 miles.

It has been announced in Pawhuska, Okla., that work will be started by the first of this month, February, on the east end of the Joplin, Oklahoma & Western R. R., which is projected from Joplin, Mo., through Bartlesville, Pawhuska, Ponca City and on the west to connect with the Orient R. R. at Carmen, Okla. F. M. Overlees, Bartlesville, Okla., is interested.

Secretary of State, Oklahoma City, Okla., has granted amendments to the charter of the Kansas, Oklahoma & Panama R. R. Co., which was incorporated with a capital stock of $1,000,000, with Richard M. Ruffin, F. A. Mosher, J. J. Winton, A. H. Syncox and John E. Du Maso named as the directors for the first year. The charter sets out that the company intends to build a line from the north boundary of Beaver County in a southerly direction to the south boundary of Tillman County, where it will pass into Texas. A second line is proposed from the south boundary of Beckham County in an easterly direction to Oklahoma City. The main office of the company will be maintained in Oklahoma City, while branch offices will be kept at Indianapolis, New York and Boston. The length of the two lines in this state will be 310 miles. The estimated cost of construction is $30,000 per mile.

Oregon.

Construction work is said to have been started at Medford, Ore., on the proposed electric railway through the Rogue River Valley. A. Welch, Portland, Ore., is the promoter.

The Portland Subway Co. has made considerable progress with its plans and is to apply to the City Council of Portland for a franchise giving it the right to enter into a general street railway business and to construct a tube under the Willamette River and through a loop aggregating a mile in length under West Side streets. The company, which was recently incorporated in Oregon, is represented in Portland by A. K. Bentley, L. Y. Keady, A. E. Hammond and A. Clark. It is estimated that it will require fully a year to secure necessary preliminary privileges and contracts and that the construction will demand three years. The plans include the building of 150 miles of surface tracks on East Side streets in addition to their tunnel under the river and under the West Side business district. They do not propose to bring their cars to the surface on the West Side, but will operate through a sub-surface loop, over four parallel tracks, connected with convenient stations on the street level.

The Pacific Great Western Ry. Co., mentioned in our last issue, is stated to have already made its survey for a railroad from Eugene to Mapleton, at the head of tide on the Siuslaw river. The distance between the two points as surveyed by this line is 60 miles. One tunnel 1,100 ft. long will have to be built if the road is put through. On the coast side of the mountains the survey follows the Siuslaw river in a winding course, and crosses the river three times to avoid expensive cuts through solid rock. The incorporators of the company are R. B. Hunt and Jesse Ayers of Eugene, and F. M. DeNeffe, an attorney of Portland. Messrs. Hunt and Ayers are the engineers who made the survey.

A letter from Lowell states that work on the Natron extension of the Southern Pacific was progressing rapidly and that the grading will be completed and possibly the track laid as far as Lowell by March 1. The two smaller tunnels, averaging 400 ft. in length, have been driven through and cut the middle of last month. Only 280 ft. remained to be cut in Tunnel No. 3, which is over 2,100 ft. long. It is expected that this work will also be completed by March 1.

Grading for the construction of the Astoria Southern Railway Company's line is being prosecuted as rapidly as weather conditions will permit, and it is said in Astoria, Ore., that it has been completed for a distance of about 5 miles from the terminus near the mouth of the Claskanine River.

Pennsylvania.

⊙O'Connor & Madigan, 201 First St., West Side, Connellsville, Pa., have been awarded the contract for three miles of grading for the street car line of the West Penn R. R. Co. from Bettmer to Vance Mills. O'Connor & Madigan also have the contract for the concrete work.

It is now said that the Pittsburg & Lake Erie R. R., J. A. Atwood, Chief Engineer, Pittsburg, and the Western Maryland Ry., H. R. Pratt, Chief Engineer, Baltimore, Md., will carry their tracks through the West Side at Connellsville on an earth embankment using concrete walls to hold the fill in place. According to the report the Pittsburg & Lake Erie will build the embankment from Main St. to the connecting point with its tracks in Yowlersville. The tracks will cross Main St. over a steel trestle about 22 ft. high, which will extend only over the street. From there the embankment will be built and steel trestles will be used over all streets that it is necessary to cross. About 300,000 cu. yds. of filling will be required to build the embankment from Main St. to the Pittsburg and Lake Erie tracks. In Yowlersville it is said the embankment will be 35 ft. high owing to the lowness of the land at this point. It will take about five months to complete this part of the work on the north side of Main St.

The extensive improvements planned for this year by the Pennsylvania R. R. along the Philadelphia and Erie Division from Harrisburg to Renovo will probably lead to the New York Central Lines undertaking some work on its own part in these territories. It is known that during the past year the New York Central has had several corps of engineers working between Lock Haven and Keating, the terminus of the river line from Clearfield, with the expectation of completing the line in this section, making connection at Youngdale with the Beech Creek division of the New York Central system.

The Baltimore & Ohio R. R., F. P. Patenall, Signal Engineer, Baltimore, Md., is to at once install 74 miles of automatic block signals and 13 new interlocking switches on the main line of the road. The automatic signals will be three-position upper quadrant in construction of the most improved type. They will be operated by electricity and will replace manual signals. The signal installation will be done on the Connellsville and Pittsburg divisions, double-track sections of the road, and most of the interlocking machines will be installed on the Cumberland division in West Virginia, in connection with the third track the Baltimore & Ohio is building across the Allegheny mountains.

The Pittsburg & Great Lakes Connecting R. R. Co. has had a new survey started between Ellwood City, Lawrence County, and Raymilton, Venango County, by way of Portersville. The company projects a line from Ellwood City to Raymilton, a distance of 40 miles, and the resurvey is being made to see if it is possible to avoid the construction of three tunnels made necessary by the old route. The construction cost of this road is estimated at $100,000 per mile. J. A. Allen, Uniontown, Pa., is Engineer in charge of surveys. J. Rush Snyder, Pittsburg, Pa., is President and Charles D. Armour, Pittsburg, is Secretary.

The Drake & Stratton Co., Penn Bldg., Philadelphia, Pa., has work well along on its excavating contract for the new yards of the Pittsburg & Lake Erie R. R. at Aliquippa. The cut extends from the Woodlawn Borough line almost to Monaca, a distance of about 5 miles and in width it runs from their present tracks back to the edge of the hill. The Drake & Stratton Co. have 21 dinkies and hundreds of small cars already in operation, hauling the earth away as fast as the cars are filled by several steam shovels.

Officials of the Philadelphia & Reading Ry. Co., who inspected the new yards at Pottsville, Pa., which were laid out at a cost of $1,000,000 stated that within a few days the yard would be open for business. The company has awarded a contract for the construction of a coaling station and ash pit at St. Clair. The station will be of double track, concrete, steel and wood construction, 250 ft. long, with bins for sand and coal. The plan calls for a modern structure arranged with 32 chutes for coaling engines.

According to reports from Franklin, Pa., it has been announced by D. T. Murray, Youngstown, Superintendent of the Franklin branch that on account of the opening of the Franklin & Clearfield it will be necessary to lay new tracks to increase the yardage at Franklin. The improvements will, it is estimated require an expenditure of about $50,000.

The Monongahela R. R., D. K. Orr, Engineer, Brownsville, Pa., is stated to have opened bids for the construction of 30 miles of track between Martin, Pa., and Reevesville, W. Va., to connect with the Baltimore & Ohio R. R. The road will go through a new section of the valley and is expected to bring about large developments. The Monongahela is owned by the Pittsburgh & Lake Erie and the Pennsylvania railroads.

The Pittsburg & Lake Erie R. R., J. A. Atwood, Chief Engineer, Pittsburg, Pa., is said to be about ready to have work started on a 9-mile connection between Fayette City and Dickerson Run, Pa. This route will connect the Pittsburgh & Lake Erie and the Western Maryland, and give the former road a new and shorter route to the southern [illegible]

South Dakota.

It is rumored in Aberdeen, S. Dak., that the Chicago, Milwaukee & St. Paul R. R. contemplates the construction of extensive shops in Aberdeen. Some of the reports go so far as to say that the company has already been negotiating for the letting of some of the contracts.

It is pretty generally believed in Perkins County that the Chicago, Milwaukee & St. Paul R. R. is planning to have grading work started in the spring on an 80 mile extension which will reach Daviston. The owner of a grading outfit which is now in winter quarters at Cool Springs is said to have received orders to remain there and prepare to go to work in the spring. Other sub contractors are also said to have been notified that work would be started shortly.

Milwaukee officials are reported to have announced that a branch line will be constructed from Flandreau, S. Dak., to Ortonville, Minn., connecting the Southern Minnesota line with the coast extension. The line will run along the Minnesota-South Dakota border and will pass through a country where there is no north and south line. The survey was made last summer and work from both Flandreau and Ortonville will be commenced early in the spring, it is declared.

Tennessee.

Surveys are now being made for the projected 30-mile line of the Nashville-Gallatin Interurban Ry. The company plans to do its own construction work and will commence this about May 15. H. H. Mayberry, 4th Floor, Stahlman Bldg., Nashville, Tenn., is President.

The South Atlantic Transcontinental R. R. Co. has filed its certified charter in Tennessee. This company proposes the construction of 90 miles of line in Tennessee and 540 miles of line in North Carolina. The purpose of the company is to construct a trunk line of railroad under the control of the state of North Carolina, by state directors in the directory of the railroad company, consisting of the governor, chairman of the corporation commission, and the auditor of the state of North Carolina, and their respective successors. Its purpose is to construct this line of railroad over the shortest practical route from the Tennessee coal fields to Southport. The charter covers the line from the coal fields of Tennessee through Knoxville, Sevierville, and Waterville, Tennessee, thence up the Pigeon River, by way of Waynesville, Canton, Asheville, Hendersonville, Rutherfordton, Gastonia, Charlotte, touching the county seat of every county on the line from Knoxville to Southport, N. C. Grading work on the line in Pigeon River canyon in North Carolina is said to have been started Dec. 31. S. A. Jones, Waynesville, N. C., is President. It is reported that MacArthur Bros. Co., New York and Chicago, has the contract for constructing this road.

Texas.

A committee, of which J. Sanford Smith, Mexia, Tex., is Chairman, has been appointed to confer with the Commercial Club of Waco for the purpose of securing the construction of an electric railway between the two places.

A committee, of which J. Sandford Smith is chairman, has been appointed at Mexia, Tex., to arrange for building an electric railroad from Waco to Mexia.

The State's Attorney General's department has approved an amendment to the articles of incorporation of the Beaumont, Sour Lake & Western Ry. Co. of Beaumont, providing for the removal of the company from Beaumont to Houston. This company is now operating 136 miles of standard gage steam line.

The Gulf, Velasco & Northern R. R., which projects a line from Sealy to Velasco, at a recent meeting at West Columbia completed its organization by the election of D. A. Barr president, C. Davis first vice president, A. C. Bates second vice president, S. L. Crockard treasurer, John S. Bartlett secretary. The amount needed for the chartering of the corporation was paid to the treasurer. No bridges will be required in the construction of this line and grading will be easy.

The Southwestern Railway Co., W. B. Worsham vice president, Henrietta, Tex., has filed an application with the Railroad Commission for permission to issue extension bonds for $122,591. The road extends from Henrietta to Archer City, a distance of 30 miles.

The annual meeting of the stockholders of the Pecos Valley Southern Ry. Co. of Texas is to be held Feb. 6 at the general offices of the company in Pecos. At that time matter of the proposed extension to Alpine, in Brewster County Texas, to a connection with the Southern Pacific will probably come up. W. L. Carwille, Dallas, is President.

Surveys for the Quanah, Seymour, Dublin & Rockport R. R. have been made to the Lampasas River south of Belton. From this point it will be surveyed to Jarrell, via Salado and Prairie Dell. Several surveys have been made from Sparta to Belton in an effort to find a better route than the last one, and in this the chief engineer announces that he has been successful and that a satisfactory line has been selected. The distance from Hamilton to Belton, via this line, is 70 2-100 miles. The first 40 miles out of Hamilton is described as a very light grade; the next 20 miles is rather heavy, and the last ten miles into Belton light.

It is reported in Trinity, Texas, that the Missouri, Kansas & Texas is planning to buy the Texas Central and that the branch of the Katy from Trinity to Colmesniel will be extended from Trinity to Waco at once.

Advices from Odessa, Texas, state that surveyors have started running lines for the proposed route of the new railroad from that city to Tucumcari, N. Mex. Grounds for shops have also been purchased in Odessa.

The Texarkana & Fort Smith Ry. officials are preparing plans for remodeling the yards at Beaumont, Tex., to eliminate switching across College St. G. P. Williams, Port Arthur, Tex., is Terminal Superintendent.

Utah.

Present prospects are very good for the construction of a considerable amount of electric railway extensions in Utah this season. The Utah Light & Ry. Co., Salt Lake City, will probably have work started in the spring on an extension of its line from Twelfth South and Eleventh East Sts., Salt Lake, to Halliday, and for the extension of its West Temple St. Line at Salt Lake to Twelfth South. The company has also completed a survey for a line from Sandy to Draper in the southeastern part of the county and a partial survey for a line to Provo. Surveys have also been made for lines to run to Garfield and Bingham canyon. The Ogden Rapid Transit Co., Ogden, has completed a survey of its road from the Hermitage in Ogden canyon to Hoytsville, and work is expected to start with the opening of spring. Another survey has been made for a line through Brigham City, up Brigham canyon, through Mantua, Wellsville, Hyrum, Providence, Millville to Logan; and still another for a line through Logan, Smithfield, Richmond and Franklin to Preston, Idaho. The Chapman-Knight interests, Provo, are working on a road which is to run from Provo to Salt Lake City, with a later extension to Nephi in Juab County. The Emigration Canyon R. R. has completed surveys for an extension to run from the vicinity of Fort Douglas to Big Cottonwood and further. The Utah Light & Ry. Co. is likewise considering the extension of its line along Thirteenth East past the new high school at Salt Lake.

The Ogden Short Line R. R. has applied to the City Council of Brigham City for a franchise to operate a stub line street car line in that city. The company proposes to use gasoline or electricity as motive power.

The Tooele Valley Ry. Co., C. B. Burke, superintendent, Tooele, Utah, operating seven miles of steam line between Tooele Junction and the International Smelter, will, if the city of Tooele does not extend its franchise for 50 years, build a new line outside of the city limits.

Vermont.

The State House of Representatives has passed the bill granting the Vermont Valley R. R. a subsidiary company of the Boston & Maine R. R., which is controlled by the New York, New Haven & Hartford R. R., the right to construct a line of double track from South Vernon to Brattleboro, a distance of about 10 miles, paralleling the present tracks of the Central Vermont. The Boston & Maine R. R. is also planning to build a line of its own between Windsor and White River Junction, Vt.

Washington.

The Seattle-Tacoma Short Line has completed the first section of its interurban line out of Seattle and on Jan. 2 started grading operations at a point near Youngstown, in King County, from which point the graders are working north towards Seattle and south to Burien Lake. The sub-contractor is under contract with a guarantee bond to have the road fully constructed, cars furnished and in operation from Youngstown to Burien Lake in 12 months. It is expected that other subcontracts will be let soon. Felt, Eastman & Sprague, Bowes Bldg., Tacoma, Wash., have the general contract.

It is reported in Centralia, Wash., that the Northern Pacific R. R. Co. is planning the construction of improvements in that city to cost $500,000. It is understood that the work will include erection of a repair shop to be used jointly by the Northern Pacific and the Oregon-Washington R. R. & Navigation Co. and the Great Northern. It is expected that work will begin early in the spring when the Tenino double tracking is resumed and the plans call for improvements that would give employment to several hundred skilled workmen. A 60-stall roundhouse is another item in the list, while it is expected that yardage facilities will be rearranged and enlarged.

West Virginia.

⊙The Middle Island Ry., which projects a 60-mile line from Clarksburg, W. Va., to Sisterville, W. Va., is reported to have awarded the contract for the first 14 miles to Middlebourne to Curtis, Shumway & Dean, Pittsburg, Pa.

Wisconsin.

The Wausau Street Ry. Co., Wausau, Wis., now operating 8 miles of line, is to double track its line on Main St. in Wausau.

The Milwaukee-Western Electric Ry. Co., Milwaukee, Wis., has secured practically three-fourths of the right of way for its line from Milwaukee to Fox Lake, and is said to be completing plans for beginning construction work as soon as the frost is out of the ground.

Preliminary surveys have been made for an 18-mile extension of the La Crosse & South Eastern Ry. from Viroqua, Wis. Construction contracts will probably be let this pring. Peter Valier, La Crosse, Wis., is General Manager and A. E. Rau, Sparta, Wis., is Locating Engineer.

Wyoming.

Press reports from Cheyenne, Wyo., state that all work on the Chicago, Burlington & Quincy R. R.'s extension through central Wyoming is to stop as soon as a bridge is built across the Big Horn River at Boysen. According to this the completion of the line to a junction with the Chicago & Northwestern at Powder River or Casper probably will not be accomplished before late next fall. The laying of steel through the gorge of the Big Horn River has been completed, but this track will be of little use before the completion of the bridge at Boysen.

The Union Pacific R. R., Otis Thayer, Assistant Division Engineer, Cheyenne, Wyo., is planning improvements at Laramie, Wyo., which will involve the expenditure of about $450,000. Site for a 30-stall roundhouse was laid out on Jan. 26. Laramie will be made a division point on the new Denver-Laramie passenger and freight division, using the Borie cutoff for through service between Kansas City and the West by way of Denver. The improvements will include an icing and watering plant here for all passenger and enlarged switching yards.

Canada.

⊙Grant Smith & Co., 1408 Main St., Vancouver, B. C., have been awarded the contract for the work in connection with the construction of the Canadian Northern Pacific Ry. for a distance of about 40 miles on Vancouver Island.

Further details as to the proposed work of the Canadian Pacific Ry. in Western Canada this year are now available. The improvements include: The construction of 380 miles of new branch lines; the building of 100 miles of double track; the addition of 40 miles to existing sidings to make room for the longer trains drawn by mogul engines; the enlargement, by one-third, of the Winnipeg shops of the company to provide facilities for the handling of locomotives and cars; the laying of 85-pound steel on the old M. & N. W., which is to be a portion of the new main line to Edmonton; the establishment of rock crushing plants in British Columbia and the rock ballasting of hundreds of miles of roadbed to protect it against the effects of heavy rains; proposed extension of Granville street through the existing depot in Vancouver city and the construction of a jetty to accommodate three Pacific steamers. Extensive improvements on False Creek and Burrard Inlet; the establishment of the gravity system for the distribution of cars at the Fort William terminals in place of the poling yard; the replacing of existing steel bridges with heavier ones capable of varrying the largest locomotives; the establishment of new railway yards at Medicine Hat, Moose Jaw and Regina. The new lines for the western provinces will be: From Moose Jaw southwest 35 miles; from Estevan to Forward 35 miles; on the Weyburn extension 20 miles; from Swift Current southeast 45 miles; from Swift Current northwest 35 miles; from Wilkie south on the west side of Tramping Lake, 25 miles; from Wilkie south on the east side of Tramping Lake, 25 miles; from Wilkie northwest through the Cut Knife country, 32 miles; the Lacombe branch eastward, 60 miles; from Golden, south (Kootenay Central), 20 miles; Carmangnay to Aldersyde (Southern Alberta), 27 miles.

Construction work on the Canadian Northern Ry., along the Fraser valley, which had to be practically suspended during the recent cold snap, was resumed on Jan. 15, but rather slow progress is being made at this time of year. Arrangements are being made, however, to rush matters with all the men that can be secured as soon as the spring weather commences.

Two surveys parties for the Canadian Northern Ry. have remained in the field all the winter and will now probably remain at work until spring. This will be the first time since the ante-construction days of the Canadian Pacific that survey parties have remained in the field all winter. One of these survey parties is working in the vicinity of Lytton, where an uncompleted section of the main line survey is being connected up. The other party is at Walhachin, near Savonas, on the Canadian Pacific. Most of the work of both parties is running the line along the sidehills, and this is only accomplished under severe difficulties just now, with so much snow on the hills.

A bill is before the Canadian Parliament to grant a charter to the Montreal & Northern Colonization Ry. Co. The company among other things asks the right to maintain an underground railway in Montreal. The petition asks that the proposed railway run from Montreal northwest to a point to be determined by the Government, or by experts. The capital of the company is mentioned as $10,000,000 and general powers to erect bridges, etc., are asked in addition to underground railway rights in Montreal. Aime Geoffrion, K. C., Montreal, Que., is attorney for the petitioners.

A petition has been presented to Parliament by Aime Geoffrion, K. C., Montreal, Que., and Victor Cusson, K. C., asking for the right to construct a railway to pass through Laprairie, Beauharnois, Huntingdon and Chateauguay counties. The line is to run from Caughanawaga southwest to the boundary line.

A committee from the city of Brandon, Man., has been in conference with officials to have that railway build a branch from the line north of Brandon to that city.

It is expected that the Canadian Northern Ry. will commence to build east from Port Arthur the first thing in the spring, and by December will have trains running as far as Nepigon.

According to reports circulated in Ottawa, Ont., the Canadian Northern R. R. has determined to proceed with its project for the construction of terminals in Montreal. The plan involves the construction of a tunnel under Mount Royal to the heart of the city.

Advices from Winnipeg, Man., state that the Canadian Northern Branch Lines Co., subsidiary of the Canadian Northern, is seek ing power to build lines in Saskatchewan. As proposed one will run from Winnipeg to Grand Rapids, on the Saskatchewan River, one from Yorkton or Craven, to Hudson Bay Junction, and a third from Wassewa to Ethelbert, on the Prince Albert section. The latter two will be feeders for the Hudson Bay Ry.

Mexico.

Wrecking work is now underway for the new union station to be built at San Luis Potosi. The freight house, along with other buildings, both private and public, will be torn down [illegible]. The present work shops of both roads will be replaced by large construction shops of the latest class, sufficiently large to require the employment of 4,000 workmen. The cost of the new station and shops is estimated at $4,000,000 and the time required for the work two years. The work is in charge of C. M. Tripp, of Atlanta, Ga. Mr. Tripp was the director of the construction of the Colonia station in Mexico.

Grading work has been nearly finished for the new branch line of the Vera Cruz & Isthmus railroad, which is being constructed from Rivas to San Andres, Tuxtla, 47 miles, [illegible] completed by Aug. 1. The firm of McGavock & Barrow, of which W. J. McGavock, Tequilla, Jalisco, is a member, has the contract. Another branch line is also being constructed. This will run from Brisbin, this state, to Cosamaloapam, about 40 miles. Track laying on the fisrt twenty miles of the line has been started. These two branch lines will give an outlet to rich and highly developed agricultural sections. The Vera Cruz-Pacific is now operated as a part of the National Railways of Mexico.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣Bids will be received until noon, Feb. 16, by Board of Public Works, Mobile, Ala., for the construction of wood block paving and storm sewers as follows: Approximately 33,000 sq. yds. of wood block paving, including grading and concrete foundation. Approximately 13,426 lin. ft. of cement curbing, including grading. Approximately 10,350 lin. ft. of storm sewers ranging in size from 5x11 ft. concrete canal to 10 in. vitrified pipe, and also 6,000 ft. of 6-in. vitrified pipe house connections. Also manholes, inlets and catch basins. Plans and specifications are on file with Wright Smith, Chief Engineer.

⊙A contract amounting to practically $49,000 has been awarded by the city of Birmingham, Ala., to the Andrews Asphalt Paving Co., covering asphalt to be laid on 18th St., from Avenue A to Avenue K. The City Council at the same time awarded C. M. Burkhalter Contracting Co. the contract for paving and guttering according to ordinance 517 for $2,411.

Funds by popular subscription are being raised by the citizens of Trinity, Ala., for the building of a turnpike road connecting with the Decatur and Courtland turnpike. This proposed turnpike will be about seven miles long, and when built will give direct route to Decatur.

Arizona.

It is reported that Territorial Secretary George U. Young, Phoenix, Ariz., has sent a party of surveyors to the property of the Mammoth mine, located at Goldfield, Ariz., northeast of Mesa, to survey a wagon road to the nearest point on the P. & E. Railway.

California.

✣Bids will be received, it is said, until 2 p. m., Feb. 8, by Board of County Commissioners, Riverside, Cal., for macadamizing another section of the Box Springs Grade, the portion lying in Sections 29 and 33 township 2 south, range 4 west.

⊙The board of supervisors at Los Angeles, Cal., has awarded the contract for the improvement of Road District No. 1 under the Road District Improvement Act, to H. V. Gentry at the following prices: Grading and graveling, $12,516; cement curb, $0.25 per lin. ft.; cement sidewalk, $0.9½ per sq. ft.; cement gutter, $0.13½ per sq. ft. The district to be improved consists of that portion of the country land lying north and east of Bairdstown. City Engineer Ben. F. Dupuy of South Pasadena has prepared the plans and details, and the following estimates: Grading and excavating, 43,230 cu. yds.; cement curb, 8,896 line. ft.; cement walk, 45,435 sq. ft.; cement gutters, 22,290 sq. ft.; cross gutters, 1,900 sq. ft.; oiled road, 18,052 sq. yds.; estimated cost, $22,000.

⊙The county supervisors, Fresno, Cal., have awarded the contract for the construction of the Sand creek road to T. L. Reed for $24,990. The thoroughfare is some 20 miles long, but at one point wanders into Tulare county. It will extend from the Reedley district to a point near Hume, in the mountains. The proposed road will be a 15 ft. thoroughfare. Other bidders were R. F. Ball, $27,500, and John Hanifin, $29,000.

The county supervisors at Los Angeles, Cal., have given Supervisor Struck permission to spend $1,000 in repairing the road across Sycamore Flats in the Santa Ana canyon. This road is on the main highway connecting Orange and Riverside counties.

At a recent convention held in San Rafael, Cal., it was planned to ask the state council to indorse the plan of Senator E. B. Martinelli and Assemblyman George Harlan for an appropriation of $500,000 for a state highway through Mendocino, Humboldt, Sonoma and Marin counties, to follow the line of El Camino Real in Sonoma and Marin counties.

The San Joaquin highway commission, Stockton, Cal., has submitted to the supervisors a set of specifications by which it is proposed to govern all bond road work in the future. Under the new provisions the contractor must pay no less than $2 per day to his employes, must assume all risks for accidents, keep lights burning at night on roads in the process of construction and use every precaution to safeguard the public.

Colorado.

At a recent meeting of the Colorado Good Roads Association in Denver, Colo., a resolution was passed calling upon the legislature to turn over all the internal improvement funds to the highway commission for distribution. J. A. Burnett of Denver is chairman of the association.

The Weld county commissioners have a proposition under consideration providing for the bonding of the county for $1,000,000 to build a modern road system, with 600 miles of it macadam. Greeley is the county seat of Weld county.

District of Columbia.

✣Bids will be received until 3 p. m., Feb. 27, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for paving the alley at the north of the U. S. Post Office and Court House Building at Little Rock, Ark.

✣Bids will be received until 11 a. m., Feb. 11, by R. C. Hollyday, chief of bureau of yards and docks, Navy Department, Washington, D. C., for paving at the navy yard, Norfolk, Va.

Georgia.

The county commissioners of Grady County, Cairo, Ga., W. B. Rodenburg, chairman, Cairo, have begun a systematic campaign for better roads. The commissioners have purchased modern road building machinery and a number of mules

Illinois.

The board of local improvements of Joliet, Ill., has adopted a resolution for the improvement of North Hickory St., from Spring St. to Marble, a distance of a little over half a mile, by the construction of bituminous macadam pavement at an estimated cost of $16,893. City Engineer Harry A. Stevens states that there is to be a 6-in. course of crushed stone filled and rolled, upon which is to be laid a 5-in. course of stone treated in the same manner and on top a binder course of bituminous composition.

The board of local improvements of Freeport, Ill., has decided to pave the following streets next spring: Jefferson St.; High St., from Empire to limits; Float, from Empire to limits; Rotzler lane, from South Galena Ave., to Jefferson. The material to be used is brick.

Indiana.

✣Bids will be received until 1 p. m., Feb. 11, by Board of County Commissioners, Frankfort, Ind., for the construction of a gravel road on the line between Clinton and Tippecanoe counties. C. F. Cromwell is auditor of Clinton county.

✣Bids will be received until 1 p. m., Feb. 18, by Board of County Commissioners, Franklin, Ind., for the construction of a highway on line dividing Johnson and Shelby counties. William B. Jennings is auditor of Jennings county.

✣Bids will be received until noon, March 1, by Board of County Commissioners, Portland, Ind., for the construction of a road on line between Jay and Randolph counties. W. Lea Smith is auditor of Jay county.

✣Bids will be received until 10 a. m., Feb. 9, by Board of Free Turnpike Directors of the County of Vanderburgh, Evansville, Ind., for broken rock and gravel for repair of various turnpikes of the county. C. P. Beard is clerk.

✣Bids will be received until 7:30 p. m., Feb. 6, 1911, by the Board of Local Improvements, Riverside, Ill., for constructing sidewalks as follows: Northwood Rd. along the east side of Block 28, Bartram Rd. on the east side from Delaplaine Rd. to Loudon Rd. and west side of Block 30. Loudon Rd. and Northgate Rd. where they serve as lines for Block 36 and Northgate Rd. from village limits to Loudon Rd. on the south side of Block 12; 8,700 lin. ft. cement sidewalk, 5 ft. wide approximating 43,500 sq. ft. north side of Ogden Ave. from the Desplaines River Bridge to village limits to the east; 2,100 lin. ft. cement sidewalk, 5 ft. wide, approximating 10,500 sq. ft. west side Cowley Rd. from Herrick Rd. to Lawton Rd.; 950 lin. ft. cement sidewalk, 5 ft. wide, approximating 4,750 sq. ft., Lawton Rd., Delaplaine Rd. to a point 145 ft. east on the north side; 145 lin. ft. cement walk, 5 ft. wide, approximating 725 sq. ft. Specifications may be had upon application to Board of Local Improvements, F. S. McClory, Secy., or C. N. Roberts, 97 Clark St., Chicago, Engineer in charge.

⊙The Clinton county commissioners, Frankfort, Ind., have awarded contracts for the construction of two gravel roads in the county to Wm. C. Meneely of Frankfort, for $2,170, and to Jarrell Bros. of Frankfort, for $5,745.

A petition is being circulated in LaPorte County, LaPorte, Ind., for the construction of a macadamized road from LaPorte city south of the Kankakee river where it will connect with the gravel roads in Starke county. The road will be more than 20 miles in length and will be built of the best hard stone.

The city council of Goshen, Ind., has instructed City Attorney E. A. Dausman to draft resolutions of necessity for the paving of North Main St., from the Big Four tracks [illegible] 32 ft.

County Surveyor J. B. Vernon, Huntington, Ind., has taken sections on the Wisner road. This road was advertised some weeks ago, but no bids were received because the estimate was too low. The new estimate is to be filed in a short time and new bids will be asked for.

Two petitions have been filed with the county commissioners at Bluffton, Ind., for the improvement of roads in Jefferson township. One petition calls for the graveling of three miles of road south from the northwest corner of section 5 on Wells-Allen county line. The other asks for the graveling of two miles of road, east from the Union-Jefferson township line, about one mile south of the county line.

Iowa.

Petitions are on file with the city clerk of Vinton, Ia., asking for paving on Washington, Jefferson and Concord Sts., in the residence district of the city. The petitions cover in the neighborhood of 35 blocks. The majority of the property owners favor concrete pavement.

The construction of permanent roads radiating from the county seat towns and adjoining such cities is provided for in a bill introduced into the senate at Des Moines, Ia. It provides for the construction of macadam, gravel, oiled, paved and other permanent roadbeds for streets, boulevards, avenues, lanes and roads not within incorporated towns, and for any distance desired. County bond issues to cover the expense of such road building, the establishing of road districts, and the creation of the office of county engineer are among the features of the plan for the building of the roads.

A petition has been presented to the city council of Keokuk, Ia., by property owners on North D St., from Main St., to Elvin Ave., asking that that thoroughfare be paved.

City Engineer Young of Muscatine, Ia., has prepared a report regarding the proposed paving work, containing the estimate of the cost, for this year. The city council has recommended the most important paving extensions.

The City Council of Cedar Rapids, Ia., has adopted specifications for paving in the city during this year. The amount of paving outlined aggregates [illegible] and the amount of curbing $7,000. The following streets are to be paved: East Side: 15th St., from Fourth Ave. to Fifth Ave.; Fifth Ave., from 14th St. to 19th St.; Sixth Ave., from Sixth St. to Eighth St.; 11th Ave., from Sixth St. to 10th St.; Seventh St., from Fifth St. to Eighth Ave.; Eighth St., from Fifth to Eighth Ave.; Ninth St., from Division St. to Eighth Ave.; 19th St., from Bever Ave. to Fifth Ave.; 16th St., from Bever Ave. to Fifth Ave. West Side: F Ave., west from Seventh to Eighth Sts.; Fourth Ave., west from Sixth to Seventh Sts.; Seventh St., west from Third Ave. to Fifth Ave.; Vernal St., west from F Ave. to First St.; Third St., west from First to F Ave.; Second St., west from E Ave. to F Ave. Parkings are to be located in the middle of the street on Fifth Ave., and on South Seventh St. and South Eighth St., east. They will be eight ft. wide and will be curbed. P. P. Smith is city engineer.

Senator C. H. Van Law of Marshalltown, Ia., has introduced in the legislature at Des Moines a bill providing for road improvement in a systematic way. The bill provides for a state highway commission, a state engineer and state aid in the construction of highways.

Kansas.

Bids will be received soon, it is reported, by City Council of Fort Scott, Kans., for the [illegible] blocks of macadam pavement. J. E. Forester is Secy., Fort Scott Industrial Association.

Kentucky.

[illegible]

Louisiana.

A meeting was recently held at the city hall in New Iberia, La., to discuss ways and means for paving the streets of the city and installing a sewerage system. The submission of a proposition for a tax levy to the voters for the purpose of paving streets, installing sewerage, and cutting a canal connecting the Teche with Grand Lake was favored. An advisory board, consisting of P. L. Renoudet, Lazard Kling, Edward L. Estorge, Jules Dreyfuss and F. M. Welch, has been appointed to assist the city council in carrying out the plans.

Maryland.

It is reported that Governor Crothers of Maryland has announced that as soon as the weather permits road work in every section of the state will be resumed and pushed most vigorously. Work on the Baltimore and Annapolis Blvd. will be started and pushed to early completion. Many new contracts for road work will be let within the next two months.

Massachusetts.

✣Bids will be received until 1 p. m., Feb. 20, by Capt. A. M. Miller, Constructing Quartermaster, Boston, Mass., for the construction of roads, walks, drains, etc., at Fort Andrews, Boston Harbor, Mass.

Michigan.

✣ Bids will be received until 2 p. m., Feb. 14, by Board of County Road Commissioners, at office of the County Road Engineer, Menominee, Mich., for the construction of a gravel road on the Bay Shore road between Beatty's and Arthur Bay. Carl A. Anderson is clerk of the Board.

State Highway Commissioner T. A. Ely has asked the legislature for an appropriation of $250,000 annually for the ensuing two years to conduct the highway department and provide for state rewards on good roads.

Chairman John G. Westover of the board of county commissioners, Muskegon, Mich., has named a committee to draft a resolution to submit to the voters of Muskegon county, probably at the spring election, a proposition to bond the county for $36,000, $32,000 of which is to be expended for widening the North Muskegon road, and $4,000 for a bridge over Norris creek, in Fruitport township.

A petition is being circulated in Hancock, Mich., relative to the proposed improvement to be made on the highway between here and Calumet, under the direction of the county board of road commissioners. The plans as announced will provide for a macadamized roadway 15 ft. in width, four miles to be improved each year.

Senator Leidlein of Saginaw, Mich., has introduced in the senate bills carrying appropriations amounting to $1,750,000 for good roads for the next two years. He will also introduce a bill carrying a number of minor amendments to the state highway law, and another providing for a state highway commissioner, deputy commissioner and engineer of the department.

The citizens of L'Anse township, L'Anse, Mich., have voted in favor of the proposition of bonding the township for $25,000 for the purpose of building new roads. The greater part of the appropriation will be spent to improve the stretch of road west of Nestoria.

Minnesota.

✣Bids will be received until 2 p. m., Feb. 6, by Board of Public Works, St. Paul, Minn., for the grading of Curfew St. from Bayard Ave. to Myrtle St. Plans and specifications are on file at the office of the Board. R. L. Gorman is clerk.

✣Bids will be received until 2 p. m., Feb. 6, by Board of Public Works, St. Paul, Minn., for grading Doswell Ave., from the Country Road to Raymond Ave. Plans and specifications for the work will be seen at the office of the Board, of which R. L. Gorman is clerk.

✣Bids will be received until 2 p. m., Feb. 6, by Board of Public Works, St. Paul, Minn., for the macadamizing, curbing, filling, leveling and improving Linwood Place, from Grotto St. to Avon St. John J. O'Leary is president of the Board and plans and specifications are on file at his office.

St. Louis County Surveyor E. Dyer has made a trip of investigation into the most suitable route for building roads into the country north of Brude. It is expected that work will commence on several new roads the coming summer. Duluth is the county seat.

The street commissioner of the Fifth ward, Minneapolis, Minn., has been authorized by the City Council to purchase in the open market two street flushers, with equipment, at a cost not to exceed $2,000.

Mississippi.

Lauderdale County, Meridian, Miss., county seat, has made a bond issue to the amount of $200,000 for road improvement. The preliminary work is now being done and about 15 miles of it will be ready for contract about the first of March. W. P. Moore, Meridian, is Chief Engineer.

Plans and specifications are being prepared for the construction of about 60 miles of country roads in Lincoln County. The roads will be constructed of gravel with clay foundation and it is estimated will cost from $2,000 to $2,500 per mile. The engineer for the work has not as yet been selected. The highway commissioner of District No. 1, Brookhaven, has charge of the work.

The city of Tupelo, Miss., plans the construction of about four miles of roads, which will consist of about 6 blocks of tar macadam and the rest gravel. City Clerk C. E. Goodlett has estimated the work to cost $25,000. An election will be held some time in March to vote on the proposition.

Plans are under way for the construction of gravel roads in Copiah county, Hazlehurst, Miss., by the board of county commissioners. The roads will have a gravel foundation and it is estimated will cost $75,000. Contracts will be let about March 1, 1911. J. N. Ellis is president of the commissioners.

Nebraska.

Bids will be asked for and contracts awarded within a few weeks, which will call for an expenditure of nearly $200,000 for street improvements in Omaha, Neb. Ordinances have been passed for the improvement of 24 streets, as follows: Harney St., from Forty-first to Forty-second; 14th St., from Davenport to Webster; Burdette St., from 42nd to 45th Grant St., from 42nd to 45th; Erskine St., from 42nd to 45th; 16th St., from Farnam to the viaduct; 24th St., from Cuming to Davenport; 30th St., from Lake to Bristol; Castellar St., from Eighth to 10th; 35th St., from Dewey Ave. to Howard; 35th Ave., from Dewey to Howard; 35th St., from Cuming to Burt; 42nd St., from Cuming to Hamilton; 31st St., from Martha to Castellar; 34th St., from Martha to Arbor; Jackson St., from 38th St. to 38th Ave.; 27th St., from Spalding to Bristol; Sprague St., from 20th to 30th Sts.; Manderson from 27th to 30th Sts.; Pacific St., from Central Blvd., to 38th St.; 45th from Military Ave. to Maple; 25th Ave., from Marcy to Mason; 25th St., from Central Blvd. to the city limits, and Maple St., from Sherman Ave. to 18th St.

The City Council of Omaha, Neb., has been petitioned for the repaving of South 10th St., from Douglas St. to the 10th St. viaduct.

New York.

The State Highway Department of New York has approved the plans prepared for the city of Yorkville for the paving of Whitesboro St., with bitulithic macadam. The estimated cost of the improvement is $48,000, of which $29,000 will be paid by the state and $19,000 by the village.

Two bills carrying appropriations of $2,200,000 for good roads were reported by the Senate Finance Committee at Albany, N. Y., on Jan. 26. One calling for $1,200,000 provides for the improvement of 90 miles of highways for a connecting link of improved roads from New York to Rouse's Point, it being understood that the Canadian Government will pro-

✣ indicates work now open for bids • indicates a contract let recently vide for a good roads system from Rouse's Point to Montreal. The other bill provides for an appropriaition of $1,000,000 for the construction and improvement of parts of state roads beginning at a point on the dividing line between the counties of Broome and Tioga, running through the southern parts of Tioga and Chemung counties to Elmira, running thence northerly to Horseheads and northerly through the counties of Schuyler and Yates by way of Watkins, forming a connecting line in the southern tier of state.

North Carolina.

The Wake County Good Roads Association, Raleigh, N. C., is urging the construction of the trans-state highway from Beaufort harbor to the Tennessee line. The proposed road is to be known as the Central highway and is to run through New Bern, Kinston, Goldsboro, Smithfield, Raleigh, Durham, Hillsboro, Graham, Greensboro, High Point, Thomasville, Lexington, Salisbury, Statesville, Hickory, Newton, Morgantown, Marion, Asheville and Marshall. The state highway commission is to locate the road and each county is authorized by the legislature to appropriate $50 per mile of road within its borders. W. G. Allen of Raleigh, is Wake county road superintendent.

Ohio.

✣Bids will be received until noon, Feb. 24, by Board of County Commissioners, Cincinnati, for resurfacing under Specifications No. 111, of Independence St. in Sayler Park, Delhi township in Hamilton county. All bids must be accompanied by a bond for $500. Fred Dreihs is clerk of the Board.

⦿The board of county commissioners, Cincinnati, O., has awarded the contract to John Nickoson of Delhi, O., for the extension and improvement of Hillside Ave., from Anderson Ferry eastwardly in Delhi township, for $1,039. Bids were opened Jan. 20.

⦿William P. Flynn, Chase Ave., Cincinnati, O., has been awarded the contract by the board of county commissioners at Cincinnati for the improvement under Specifications No. 127 of the Dayton Pike, from Sharon to Butler county line in Sycamore township, for $5,634. Bids were opened Jan. 20.

⦿W. W. Hatch Sons Co., of Goshen, Ind., have been awarded a contract in Akron, O., for the construction of five miles of pavement for approximately $85,000.

⦿State Highway Commissioner, James C. Wonders, Columbus, O., has awarded the contract for the construction of a state aid road in Saybrook to the Buckeye Engineering Co., of Norwalk, O., for $11,720. The road will be macadam, tar top and silica finish and will be 20 ft. wide, and one mile long.

⦿Contracts have just been signed by the county commissioners at Akron, O., for the construction of the Akron-Hudson road to Cleveland. The work will aggregate an expenditure of about $363,531. The road is divided into six sections and the successful bidders are: Sections 1 and 4, E. McShaffrey & Son; Section 3, Wildes & Davidson; Section 5, Paul & Henry; Section 6, Peters & Palmer. Section 2, which is covered by the gorge bridge, will not be improved.

⦿The contract for building the first stone road in Champaign county, one mile extending west toward Urbana from Mechanicsburg, has been awarded by the county commissioners at Urbana, O., to H. B. Stevens of Mechanicsburg, for $7,363. The road is to be leveled, necessitating the excavation of 7,000 cu. yds. of earth. The work will be under the supervision of J. C. Wonders, Columbus, state highway commissioner.

The village council of Pleasant Ridge, O., has instructed Village Engineer James E. Stewart to prepare plans and estimates for a macadam street, curb and gutter in Forest place, and for a sidewalk in Bell and Penn Sts.

The board of trustees of Strongville township, Strongville, O., will sell bonds Feb. 14 in the sum of $4,000 for the improvement of highways leading into the township.

The City Council of Portsmouth, O., has ordered the solicitor to bring in a bond ordinance for the paving of 10 streets the coming spring.

A petition has been presented to the city council of Defiance, O., asking for the paving of lower Perry St., from the point the paving leaves off at Worthington St., and the paving of Fifth St., from the canal lift bridge to the Wabash railroad. City Engineer Carl Smith has presented to the city council estimates of the cost of paving lower Perry, Fifth and East Second Sts. The estimates are as follows: Perry St., from Worthington and Fifth [illegible] ment to be of brick. Perry St., between Fifth and First Sts.: Total cost, $23,617; width, 53 ft.; Fifth St., between Wabash railroad and canal lift bridge: Total cost, $10,623; width, 36 ft.; East Second St., between Auglaize river bridge to Douglas St.; width 40 ft.; East Second St., from Douglas St. to Baltimore & Ohio railroad switch to the Turnbull Wagon Works, and Douglas St., from East Second St., to East Hopkins St., width 30 ft.; total cost, $32,456.

The Ashtabula Railway Traction Co., of Ashtabula, O., is laying plans to do its share of the paving of West Prospect St. The estimated cost of the company's share is $5,000.

The city council of Delaware, O., has passed a resolution directing the city engineer to prepare plans and specifications for the paving of East William St., from Sandusky St., to the Olentangy.

Advices from Cincinnati, O., state that the county commissioners have been requested by the Federated Improvement Association that specifications for road construction include a general term to permit the use of bituminous tar binders.

The city council of Hamilton, O., has been petitioned for the paving of North D St., from Elvin Ave., south to Main St., by the property owners.

Oklahoma.

✣Bids [illegible] by Ira J. Anderson, City Clerk, Sapulpa, Okla., for the construction of approximately 16,000 sq. yds. of sheet asphalt pavement on 5-in. concrete base, including grading, curbing, draining, etc., for the city. Plans and specifications may be obtained of E. D. Kirkpatrick, City Engineer.

The county commissioners of Bryan county, Durant, Okla., have issued a call for a good roads convention to be held in Durant, Feb. 18, for the purpose of discussing the needs of the several sections of the county in the matter of roads and bridges and the best means of supplying them.

Oregon.

The county court at Tillamook, Ore., has made a levy which will amount to $124,508 for road and bridge purposes. The county has purchased three entire road plants, each of which includes a road roller, rock crusher, traction engine, hopper and screens for the gravel.

The Marshfield Chamber of Commerce has taken up the matter of improving the wagon road from Marshfield to Roseberg, over which the mail is carried. It is proposed to plank [illegible] per mile.

A delegation of citizens of Marion county [illegible] of Marion county for a 3 mill tax levy for road improvements. A system of good roads radiating from Salem as a center was proposed. Ex-Mayor George Rodgers is a delegate.

At a recent road meeting of the grangers of the valley and the Commercial club members, held in the latter's club rooms, Hood River, Ore., a resolution was passed ordering the representative in the lower house from that district to vote and work for the passage of the five good roads bills with the modification that the power be taken from the county courts in the distribution of the moneys for roads, and that the roads in the counties be constructed by petition, where the abutting property would be made to share a proportion of the expense. Citizens of the county are in favor of bonding the county in the sum of $1,000,000 for the macadamizing of the entire stretch of roads in the county.

The county court at Roseburg, Ore., has made a general levy of 4½ mills for the purpose of providing for a fund of $142,400 for the construction of good roads in Douglas County this year. In addition, one-third of the 60 road districts in the county have voted special taxes, which will raise an aggregate total of not less than $30,000. Approximately $175,000 will be spent on good roads.

Pennsylvania.

The borough of Springdale, Pa., contemplates holding an election soon to vote on the proposition of increasing the borough indebtedness, $10,000, for the cost of expense of grading public streets and alleys and $12,000 for providing funds to cover the expense of constructing new sewers. Robert M. Sample is president of the borough.

Tennessee.

The county court of Sullivan County, Blountville, Tenn., at its last session recommended the issuance of bonds to the amount of $100,000 for the completion of the roads now under construction. John W. Swadley is secretary of the road commission.

Texas.

⦿The City Council of Wichita Falls, Tex., has awarded a contract of 36,000 sq. yds. of wood block street paving to the Creosoting Wood Block Paving Co., of Gulfport, Miss., for $2.55 per sq. yd., including a 5-in. concrete base and sand filler. Concrete gutters will be built and work on the paving will start as soon as the storm sewers now under construction in the business district can be completed. Bids were opened Jan. 17. T. B Noble is mayor.

⦿The City Council of Bryan, Tex., has entered into a contract with W. P. Wallace for the construction of concrete walks to cost over $1,000. They will be placed alongside the city property and street crossings.

The attorney general's department, Austin, Tex., has approved an issue of $20,000 in bonds by the city of Mexico, Tex., for street improvement and sidewalk construction.

The citizens of Luling, Tex., are taking the preparatory steps to get the commission- [illegible] have bonds issued in that precinct for the construction of roads.

Including the $100,000 bond issue for macadam roads in the Bartlett-Granger justice precinct, Williamson county, Georgetown, Tex., the county will practically spend $500,000 in public improvements in the next 12 months. This includes $125,000 for a court house, $200,000 in the Taylor commissioners' precinct for roads, $100,000 in the Bartlett-Granger precinct, and about $75,000 in the Georgetown and Florence precincts for roads.

The board of municipal commissioners of Dallas, Tex., propose to repave Main St., [illegible] to Central Ave., with wooden blocks.

Utah.

A bill to appropriate $10,000 to improve the state road between Colton and the east line of Wasatch county, and to rebuild other roads in the former Uintah Indian reservation was introduced in the lower house of the state legislature by Representative Rock M. Pope of Theodore. The bill proposes that 63 per cent of the appropriation shall be spent be- [illegible]

Washington.

⦿The commissioners of Tacoma, Wash., have awarded contracts for grading and paving as follows: N. A. Jones, grading South 49th and 51st Sts., between Sheridan Ave., and the east line of Acme addition for $7,317; Anderson & Lijebeck, paving the alley between K and L Sts., from 11th to 13th Sts., for $1,185.

⦿Wilson-Hardy Construction Co., of North Yakima, Wash., has been awarded the contract by the state highway board at Olympia, Wash., for clearing, grubbing, grading, draining and macadamizing State Aid Road No. 99, known as the McDonald Road, in Walla Walla County. Bids were opened Jan. 18.

The board of public works of Spokane, Wash., has entered into an agreement with the Barber Asphalt Paving Co., relieving both the city and the paving company from the maintenance agreements. A similar agreement is being made for the Western Asphalt Co. This is being done so that the streets may be cared for with the city asphalt paving plant.

The following bids were received Jan. 16 by the board of public works of Spokane, Wash., for the paving of Wall St., from Garland Ave., to the north city limits: Boynton, Church & McCoy, $59,500; Mitchell Bros., $57,000, and the Spokane Asphalt Macadam Co., $60,400. The lowest bid is $5,000 above the estimate of City Engineer Morton Macartney. The work will probably be re-advertised.

West Virginia.

✣**Bids will be received until 2 p. m. (eastern time), Feb. 20, by Board of City Commissioners, Huntington, W. Va., for paving alley between Third and Fourth Ave. from Twentieth to Twenty-first Sts., and the alley between Third and Fourth Ave., from Sixth to Eighth Sts. John Coon is commissioner of streets, and A. B. Maupin is city engineer.**

Wisconsin.

The citizens of the town of Plover, Wis., **held an election Jan. 31 to vote on the proposition of raising bonds in the sum of $3,000 to construct a macadamized road nine ft. wide, from the city of Stevens Point to the village of Plover.**

Canada.

✣Bids will be received until 11 a. m., Mar. 1 by M. Peterson, Secy. Board of Control, Winnipeg, Man., for supplying from 1,000 to 1,500 tons of asphalt for street paving for the city of Winnipeg, Man. **Plans and specifications may be obtained of city engineer, 223** James Ave.

BRIDGES—STEEL AND CONCRETE

Alabama.

At Decatur, Ala., the construction of a wagon bridge across the Tennessee river is being advocated. It is suggested that the funds be taken from the proceeds of the dispensary located in the Decaturs.

Arkansas.

Advices from Helena, Ark., state that negotiations are pending for the erection of another steel and concrete bridge in Phillips county similar to the one now under construction over Big Creek near Trenton.

California.

At a meeting of the Board of County Supervisors, San Jose, Cal., J. G. McMillan, county surveyor, was instructed to prepare plans and specifications for the construction of a concrete structure over the San Francisquito creek on the Newell road. An effort will be made to secure the co-operation of San Mateo county, as the bridge will be on the dividing line.

Bridge committee of the Board of Trade, Pasadena, Cal., is to start an active campaign toward the construction of a bridge across the Arroyo Seco at the foot of West Colorado St. The first step to be taken will be the calling of an election in that city to see if the taxpayers are willing to bond the city for its share of the cost. William F. Knight is chairman of the committee.

Actual work has been started by the Pacific Construction Co. on the new bridge over the Eel river, at Eureka, Cal., which, it is stated, will be the largest reinforced concrete structure west of the Rocky Mountains. The cost of the work is $245,967.

District of Columbia.

A bill has been introduced into the senate, Washington, D. C., providing for the extension of one and three years respectively of the time for commencing and completing the construction of a bridge over the Monongahela river, from Brownsville to West Brownsville, Pa.

Bids were received as follows, Jan. 23, by District of Columbia commissioners, Washington, D. C., for strengthening and stiffening the iron bridge over Rock Creek in the line of Calvert St. (1) standing for strengthening and stiffening complete of towers and trusses; (2) same as (1), except for replacing towers and trusses by plate girders; (3) for replacement of the adjustable sway rods in trusses by stiff members: Penn Bridge Co., Beaver Falls, Pa., (1) $19,789, (2) $16,280, (3) $3,409, 6 months; Snare & Triest Co., New York City, (1) $20,980, (2) $16,200, (3) $4,780, 4 months, 15 days; Baltimore Bridge Co., Baltimore, Md., (1) $23,250, (2) $19,280, (3) $3,970, 7 months; Pearson & Goodreich, New York City (1) $28,890, (2) $21,940, (3) $6,950, 4 months; Oscar Daniels Co., New York, N. Y., (1) $22,514, (2) $18,000, (3) $4,900, 5 months; McClintic-Marshall Const. Co., Pittsburg, Pa., (1) $23,400, (2) $17,875, (3) $6,450, 3 months.

Georgia.

✣Bids will be received until 2 p. m., Feb. 1, by Board of County Commissioners, Lawrenceville, Ga., for furnishing the material and building a bridge at or near Rogers ferry over the Chattahooche river on the line of Milton and Gwinnett counties, Georgia. Said bridge is to have a roadway of 16 ft. between trusses and is to consist of one steel span 228 ft. long with steel cylinder piers, about 40 and 44 ft. in height, filled with concrete, together with trestle approaches 115 ft. and 152 ft. long with concrete abutments. The total length of the bridge is 494 ft. The bridge is to be built according to plans and specifications for the same, which are on file for the inspection of bidders at the court house at Lawrenceville and Alpharetta, Georgia. Each bidder must file a certified check in the sum of $1,000, payable to the county commissioners of Gwinnett county and the ordinary of Milton county as a guarantee.

Idaho.

A bill has been introduced into the State Legislature of Idaho, by B. P. Shawhan, asking for an appropriation for the construction of a state bridge over the Snake river within less than a mile of Payette, Idaho. The cost of such a structure is roughly estimated at $25,000.

Advices from Burley, Idaho, state that much detailed work has been done toward securing the necessary funds for the construction of a bridge over the Snake river, connecting the north and south sections of the city. The cost of the work will be about $20,000, it is estimated.

Illinois.

⊙The following bids were received by the Commissioner of Public Works, Peoria, Ill., on Jan. 24, for the construction of the new bridge over the Illinois River at Bridge St. on the site of the structure which collapsed, and for removing the debris of the old bridge, (1) standing for Milwaukee Bridge Co., Milwaukee, Wis., which was awarded the contract; (2) Pennsylvania Steel Co.; (3) Cullen Friestadt Co.; (4) Toledo Bridge & Crane Co.; (5) Midland Bridge Co.; (6) Kansas City Bridge Co.; (7) Joliet Bridge & Iron Co., Joliet, Ill.:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Removal of debris, etc., complete	$ 20,000.00	$ 21,000.00	$ 49,918.00	$ 10,000.00	$ 20,000.00	$ 43,000.00	$ 38,280.00
Removal old piers and bridges, complete	7,400.00	11,700.00	8,000.00	4,300.00	20,000.00	10,500.00	10,780.00
Concrete in bases, 1,830 cu. yds.	17.00	23.00	15.25	20.00	25.00	8.00	28.00
Concrete in shafts and copings, 1,180 cu. yds.	7.50	9.20	8.10	10.00	10.00	8.00	8.00
Timber piling, 185 lin. ft.	.40	1.00	1.15	.70	.80	.75	.60
Concrete removed above water, 475 cu. yds.	2.50	9.20	10.90	9.00	6.00	9.00	8.00
New concrete in old piers, 240 cu. yds.	8.00	8.00	11.25	11.00	10.00	15.00	9.00
Earth to be removed, 380 cu. yds.	.80	1.15	.90	1.50	2.00	1.25	1.50
Navigation fenders, complete	885.00	1,120.00	1,171.00	1,000.00	1,250.00	700.00	900.00
New earth fill, 100 cu. yds.	.80	1.15	1.15	1.00	.50	1.25	1.00
Reinforcing steel, 19,000 lbs.	.03	.05	.056	.03	.03	.04	.031
Cast steel, 45,000 lbs.	.0596	.055	.062	.051	.08	.0725	.09
All other metal, 1,950,000 lbs.	.0333	.045	.0384	.0388	.045	.04	.0485
Pavement on spans, 2,010 sq. yds.	2.10	4.25	2.75	2.00	2.50	2.25	2.60
Pavement on approaches, 770 sq. yds.	1.60	3.00	1.75	1.50	3.00	2.40	2.25
Creosoted timber, 101 M. B. M.	56.00	55.00	80.50	56.00	80.00	65.00	120.00
Concrete in sidewalks, 190 cu. yds.	15.00	15.00	20.70	15.00	17.00	20.00	20.00
Electric lighting system, complete	1,200.00	1,500.00	3,795.00	750.00	1,500.00	2,000.00	1,900.00
Total at schedule prices	$166,896.50	$205,825.50	$206,715.67	$164,440.50	$217,153.00	$187,726.75	$241,433.50
Lump sum bid	$166,896.50	$205,825.00	$206,715.67	[illegible]	$217,153.00	$233,900.00	$248,000.00

Counties of Will and Kankakee, Ill., are to construct a joint bridge over the Horse Creek between Custer and Essex townships. It is estimated the cost of the proposed structure will be about $5,000. Joliet, Ill., is the county seat of Will county.

Property owners are making an effort to induce the city council of Joliet, Ill., to take some action toward the construction of a new bridge to replace the missing structure over the Spring Creek on Ohio St.

A permit has been asked by the Chicago & Northwestern R. R. of the Government, and grading has been started for the construction of a bridge across the Illinois river, to connect the Peoria, Ill. branch from Nelson, Ill., to Girard. The plan will involve the expenditure of about $2,500,000, it is said.

The Decatur Bridge Co., Decatur, Ill., has, according to reports from that city, increased the capital stock from $100,000 to $200,000. On the Board of Directors, H. M. Minton, Carlinville, succeeds J. H. Bunham, Bloomington, Ill. Officers were re-elected as follows: President T. L. Blackburn, Lincoln; vice president, G. A. Caldwell; secretary, E. B. Tyler; treasurer, W. H. Wood

Indiana.

✣Bids will be received until 10 a. m., Feb

6, by Board of County Commissioners, Columbus, Ind., for the construction of a bridge in Rock creek township. P. J. Slater is auditor of Bartholomew county, Ind.

✤Bids will be received until 2 p. m., Feb 7, by Board of County Commissioners, Martinsville, Ind., for the repair of three bridges. J. S. Whitaker is auditor of Morgan county.

✤Bids will be received until 10 a. m., Feb 8, by Board of County Commissioners, Indianapolis, Ind., for the construction of a bridge over Lick Creek. Albert Sahm is auditor of Marion County.

Ordinances have been introduced into the City Council of Indianapolis, Ind., providing for appropriations to cover the cost of constructing bridges now under consideration. The structures are located as follows: Foot bridge across Fall creek at Delaware St., $2,000; Across Pleasant run, Minnesota, $10,000; across Pleasant run, State Ave., $10,000; Highland ave., Pogues run, $5,000; Ohio St., Pogues run, $5,000; Michigan St., Pogues run, $5,000; Holton place, the canal, $8,000; Twenty-fifth St., the canal, $1,500, and Roache Ave., the canal, $5,500.

Advices from Monoquet, Ind., state that plans are being formulated by the Winona Interurban R. R. Co. for the construction of a new iron bridge over the river at that place, and that a bad curve at that point will also be eliminated. R. M. Murray, Warsaw, Ind., is chief engineer.

Kansas.

At Salina, Kan., appropriation is being agitated for the construction of a cement bridge across the river at Iron Ave. Citizens favor a structure the full width of the street.

Kentucky.

• The contract for the construction of concrete abutments in connection with the new bridge and road revision work at Louisville, Ky., by the Kentucky & Indiana Terminal Co., has been awarded to Foster-Creighton-Gould Co., Nashville, Tenn., of which H. M Gould is vice president and general manager. The contract comprises about 6,000 cu. yds. of concrete.

Louisiana.

✤Bids will be received until 2 p. m., Feb. 7, by Police Jury of Terrebonne County, La., at Houma, La., for the construction of a 132-ft. bridge over Bayou Terrebonne

✤Bids will be received until noon, Feb. 4, by committee of the police jury, Alexandria, La., for the construction of a pile bridge across Hosebend Creek, known as the Rembert bridge. George A. Wise is one of the committee.

⊙Latest information received from Natchitoches, La., states that the police jury has awarded Boydston & O'Quin the contract at $1,100 for the construction of two bridges across Flat river, near Powhattan.

The Penn Bridge Co., which has the contract for the construction of the Hagan Ave. bridge in New Orleans, La., has started erecting the steel work of the structure, and it is estimated the improvement will be completed within a short time. The cost of the work is $14,000.

Massachusetts.

Board of County Commissioners have offered but $100,000 toward the construction of the proposed new bridge over the Merrimack river east of the Duck bridge in Lawrence, Mass., leaving a balance of $300,000 for the town to bear.

Michigan.

A meeting was held Jan. 26, by Col. C. Mac D. Townsend, U. S. Engineer, Detroit, Mich., at Saginaw to take action on the application of the Michigan Central R. R. for permission to construct a new bridge over the river at that place. It is announced that steps were taken to induce the company to combine with the Grand Trunk and build a double track structure, doing away with one of the present bridges. As proposed by the M. C. R. R. Co., with the exception of the draw, which will be increased from 69.1 ft. to 72 ft., the new bridge will be a reproduction of the old structure.

J. [illegible] of the Board of County Commissioners, Muskegon, Mich., has appointed a committee on roads and bridges to draft a resolution to submit to the voters of Muskegon county, Mich., at the spring election, a proposition to issue bonds in the sum of $36,000, $32,000 of which will be expended for widening the North Muskegon Road and $4,000 for a bridge over Norris creek in [illegible] township.

Minnesota.

Advices from Duluth, Minn., state that Thompson & [illegible], [illegible] the cement piers and abutments for the Canadian Northern Ry. Company's new bridge at Smithville, have completed their work and have moved their outfit to Munger, Minn., to take up similar work. Two large cement piers and eight small ones will support the spans. It is not thought that the American Bridge Company, which has the contract for the steel bridge construction, will be able to finish the job until spring, on account of the inability to get the steel to the site of operations. It is probable that tracks will be laid from West Duluth to Smithville this winter and that the steel needed at Stuart's creek will then be forwarded to its destination. The American Bridge Company, which now has several crews at work at the head of the lakes, will then rush the bridge to an early completion. Several small bridges and culverts have been constructed along the right-of-way between the tunnel cut at Short Line park and the terminals at West Duluth. The bridge over Stuart's creek, however, will be the only one this side of the tunnel to be constructed of steel, the others being of cement or timber.

Improvement committee of the Park Board, Minneapolis, Minn., has decided to recommend to the board that the bridges No. 3 and No. 4 in the Lake of the Isles District be built of granite and Bedford stone. The use of cement had been suggested, but the committee [illegible] stone would be more artistic. The part of the bridge below and touching water will be of granite, and the superstructure of Bedford stone. Bids for the building of these bridges will be advertised for soon.

The condemnation of a strip of land by the Board of Public Works, St. Paul, Minn., along Early St. removed the last obstacle confronting the proposition to build a bridge over the Northern Pacific and Omaha Railroad tracks at Earl St. to eliminate that grade crossing. A resolution has been adopted by the City Council for the appropriation of $57,000 for the improvement.

Missouri.

Advices from St. Louis, Mo., state that the St. Louis and St. Charles Bridge Co. has elected the following directors for the ensuing year: W. C. Fordyce, William Brown, W. K. Kavanaugh, G. C. Strauss, of Chicago, and C. H. Wilcox of Chicago.

Board of County Commissioners, Troy, Mo., is taking up the matter of constructing a new bridge over the King's Lake east of Elsberry, Mo., in Lincoln county, to replace the structure which was recently wrecked by a traction engine.

In accordance with the recommendation of Judge E. L. Martin, the county court directed R. T. Procter, county highway engineer, to prepare preliminary plans and estimate of cost of the construction of a viaduct over the Chicago & Alton crossing, 2 miles west of Independence, Mo., on the Fifteenth St. rock road, Jackson county.

Nebraska.

⊙County Board of Supervisors, Tekamah, Nebr., has awarded the contract for the Burt county bridge work for the present year to the Standard Bridge Co., and for the culvert work, to the Dodge Corrugating Co.

New Jersey.

At a recent meeting of the bridge committee of the County Board of Freeholders, Trenton, N. J., it was decided to erect two new bridges, one on the South Stockton St., and another on the River road at Titusville, and the county engineer was instructed to prepare plans. The structure over the creek on South Stockton, according to the proposed plans, will be built of concrete and steel and will replace the present wood and iron structure.

New York.

In connection with the construction of the New York, New Haven & Hartford Ry. across Hell Gate, to connect with the Pennsylvania system on Long Island, and in Manhattan, plans have been drawn up for the construction of a large 4-track bridge which, including the approaches, will be about 3 miles in length. W. H. Moore, New Haven, Conn., is engineer of bridges of the system.

The only bid submitted to the town clerk of Southampton, L. I., Jan. 17, for the construction of the proposed Quogue bridge, was that of the [illegible] Bridge Co., which offered to do the work for $8,871.

Ordinances are being prepared for introduction in the Common Council of Albany, N. Y., for the construction of a bridge to the pier, and the widening of State St. from Broadway east.

A report submitted Jan. 16, by the State Barge Canal Terminal Commission, Albany, N. Y., recommends that four of the proposed new canal bridges between Syracuse harbor and the waters of Lake Ontario at Oswego be constructed of a convertible type at an increased cost of $4,000 each, so that when the barge canal and harbor at Syracuse are completed the bridges may be transformed into movable bridges without loss of the money spent in their original construction. No reconstruction is recommended at this time of the seven fixed bridges now completed or under construction. To reconstruct all the bridges at Syracuse harbor to structures of the swing or bascule type would cost $1,000,000, and the State would not be warranted in going to the required expense at this time

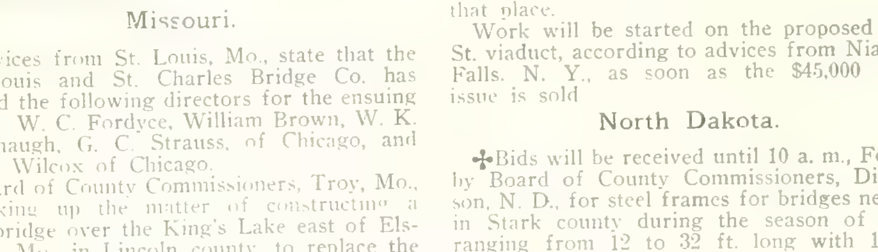
City officials of Fulton, N. Y., are in favor of constructing a concrete bridge at Broadway instead of building a steel structure at that place.

Work will be started on the proposed 11th St. viaduct, according to advices from Niagara Falls, N. Y., as soon as the $45,000 bond issue is sold

North Dakota.

✤Bids will be received until 10 a. m., Feb. 7, by Board of County Commissioners, Dickinson, N. D., for steel frames for bridges needed in Stark county during the season of 1911, ranging from 12 to 32 ft. long with 18 ft. roadway. J. L. Hughes is county auditor.

Commissioners of Pembina county, Pembina, N. Dak., have under consideration the construction of a bridge over the river at Drayton, N. Dak. At point indicated on the profile by "A" a 23-ft. abutment will be constructed; at "B" a 35-ft. pier; at "C" a 48-ft. pier; at "D" a 43-ft. pier; at "E" a 26-ft. pier. The piers are to be of sufficient strength to withstand the ice during the



✤ indicates work now open for bids. ⊙ indicates a contract let recently.

spring floods and it has been suggested that they have steel nosing on south side. As the government requires a channel for navigation, [illegible] between piers "C" and "D." The cost of the [illegible] 000. W. W. Felson, Pembina, N. Dak., is [illegible] effort to secure the co-operation of the Great Northern Ry., the War Department and Williams and McKenzie counties in the proposition to construct a pontoon bridge across the Missouri river at that place.

Ohio.

✣Bids will be received until noon, Feb. 24, by Board of County Commissioners, Cincinnati, O., for the construction of culvert and fill on Mt. Alverno road near Delhi Pike in Delhi township, Hamilton county, O. A bond in the sum of $500 must be filed with each bid. Fred Dreihs is clerk of the board.

Instead of throwing up a temporary structure as at first proposed, Board of County Commissioners has decided to build a permanent bridge on the Wilson Pike, north of Worthington, to replace the structure which was recently washed out by flood. The cost of the work is estimated at $25,000. County surveyor at Columbus, O., has been instructed to prepare plans for the work.

City Council of Dayton, O., has passed an ordinance providing for the issuance of bonds for the construction of the proposed bridge over Wolf creek between Dayton View and West Side and William Orth has agreed to dedicate the necessary land and approaches for the structure. The project was mentioned in the last issue of ENGINEERING-CONTRACTING.

Plans have been prepared by the city engineer of Dayton. O., for the construction of a $40,000 iron bridge with flat roadbed over the Mad River at Keowee St., and an ordinance is being prepared providing a bond issue for the work which will be submitted during a February session.

An ordinance has been passed by the City Council of Cincinnati, O., granting the Cincinnati Traction Co. the right to build a new bridge over Eastern Ave., near St. Andrews St.

It has been recommended by Lieut. Col. John Millis, Cleveland, O., that a draw span be constructed in the bridge over the Ottawa River for the use of the Toledo, Ottawa Beach & Northern R. R. at Toledo.

On account of the officials of the Baltimore & Ohio announcing that the city of Akron, O., must not construct abutments for the proposed overhead bridge on Kelley Ave. over the C. T. & V. tracks in East Akron on the railroad company's right of way it will be impossible to construct a reinforced concrete structure as at first proposed. The change in the plan will probably raise the cost of the work from $5,000 to $15,000.

Board of County Commissioners at the last meeting held at Columbus, O., decided the King Ave. bridge, Williams bridge and Mound St. bridge unsafe and have ordered them replaced by modern structures. The King Ave. bridge is the oldest iron bridge in the county. The Mound St. bridge, over the Scioto, is close to the morgue. The Williams bridge is a mile north of Marble Cliff, among the quarries. By relocating the bridge the main road, which is crooked and hard to travel, can be straightened

Pennsylvania.

The Water Supply Commissioner has approved the application of the Delaware, Lackawanna & Western R. R. Co., for the construction of a steel bridge over Broadhead creek, and of a concrete arch over the West Branch of Broadhead creek, in townships of Stroud and Pocono, Monroe county, respectively.

Scofield Engineering Co., representing the commissioners of Luzerne county, Pa., have applied for the construction of a highway bridge across the North Branch of the Susquehanna river near Plymouth, Luzerne county, Pa.

Borough of Plymouth, Pa., is seeking financial aid for the construction of a viaduct over the Lackawanna R. R. tracks at the approach of the proposed new $300,000 bridge over the Susquehanna river at that place.

Among the improvements contemplated by the Lake Shore & Michigan Southern Railroad, for Franklin, Pa., this spring, is the construction of a new bridge across the mouth of French creek. The plans call for the erection of a structure with concrete piers and abutments and steel girders. It will be wide enough for two tracks, but only one track will be laid at present, although it is rumored that the Pennsylvania R. R. will construct a second track on the structure.

Special Bridge committee of the City Council of Wilkesbarre, Pa., met recently to discuss the matter of constructing an overhead bridge at South St. to replace the present structure. It was decided to employ a consulting engineer to assist in the work, and also to consult various railroad companies as to how much they are willing to contribute toward the necessary fund. It was suggested by some members of the committee that the cost of the improvement would exceed all previous estimates.

County Engineer, Reading, Pa., has selected as assistants in preparing plans for the construction of the new Penn St. bridge, B. Herman Davis, New York City; Paul Kauffman, Reading, and D. L. Nicks. It is expected to have the proposition developed to such an extent by April that bids for the work may be advertised. The cost of the improvement is estimated at about $350,000.

South Carolina.

✣Bids will be received until 3:30 p. m., Feb. 16, by J. C. Spivey, Secy., Building Commission, Conway, S. C., for the construction of a steel bridge across Waccamaw River near Conway. A certified check for $500 must be filed with each bid.

Tennessee.

Advices from Washington, state that bills have been introduced by John A. Moon, representative, authorizing the county of Hamilton to construct two bridges across the Tennessee river at Chattanooga, one of the structures connecting with Hill City.

Ordinances were passed by the City Council of Chattanooga, Tenn., at their last meeting providing for the construction of new bridges and viaducts at that place by the Southern, the Queen and Crescent and the Nashville Chattanooga & St. Louis railroads. The attention of the latter company has been called particularly to the reconstruction of the McCallie Ave. viaduct, which improvement would require an expenditure of $100,000.

Texas.

County Commissioners, Dallas, Tex., have changed the specifications for the construction of the Millers Ferry bridge now being built, providing a heavier floor. Austin Bros. have been allowed an increase from $3.50 to $5.50 per lin. ft.

Utah.

A bill has been introduced into the State Senate, according to recent information received from Salt Lake City, providing for the construction of a bridge across Salmon river in Custer county and appropriating $10,000 therefor.

Washington.

The Commercial club of Woodland, Wash., is to take steps to have the proposed bridge on the Blain-Vancouver state road located at or above that place in order that the large section of Clarke county contiguous to Woodland should be benefited.

North Yakima, Wash., Commercial Club has passed resolutions indorsing the Pasco-Kennewick movement for the construction of a passenger bridge over the Columbia river, somewhere between the mouths of the Yakima and Snake rivers.

The Northern Pacific and the Oregon-Washington Railroad and Navigation Co. are planning to construct a single track bridge over the city channel about 550 ft. south of the Northern Pacific drawbridge in Tacoma, Wash.

Among the ordinances passed by the city commission of Tacoma, Wash., is one authorizing the construction of a bridge across Buckley gulch in North 29th St. The cost of the work is estimated at approximately $2,690.

Wisconsin.

⦿Advices from Hudson, Wis., state that the following contracts were awarded by the county commissioners for the construction of the proposed bridge over the St. Croix river, and for removing the old structure: The S. H. L. Lumber Company, for the lumber and timber; John B. Northey to build the main bridge at $2,998; James T. Teare, for tearing down the old bridge at $1,195; the construction of the pontoon, Edward S. Hill; Edward McGee for the fill and masonry. The entire cost of the bridge will be $16,000.

It was suggested by one of the City Council that the Bridge Committee take into consideration the construction of a concrete bridge over the Menominee at Marinette, Wis. According to estimate of the city engineer the new type of bridge mentiond would cost $20,000.

Plans have been filed by H. E. Briggs, commissioner of public works, and L. J. Klug, superintendent of bridge, Milwaukee, Wis., with Maj. Charles S. Bromwell, U. S. Engineer, for the construction of the one-leaf bascule type bridge proposed for Oneida St. The cost of the work is estimated at $120,000, and bids for the work will be advertised as soon as the government approves the drawings.

A meeting is to be held at Superior, Wis., by the settlers and taxpayers of that vicinity for the purpose of deciding, among other things, upon the construction of a bridge over the Nemadji river on the Black River Falls road near Boylston. The cost of the work is estimated at approximately $2,500.

Canada.

Property owners and residents of St. Vital are now advocating the construction of a bridge across the Red river, between River Park and the end of the car line, to connect Elm Park and the district on the south side of the river with the city of Winnipeg, Man. The cost of such an improvement is estimated at about $120,000.

Charles R. Devlin, Minister of Colonization, Mines and Fisheries, Quebec, Que., and William Pugsley, Minister of Public Works, Ottawa, Ont., are to take up the matter of constructing a bridge over the Ottawa river in Northern Temiscamingue. It is thought that the proposed structure would aid greatly in the development of the district.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Colorado.

The George H. Paul Development Co., Washington, Ia., has purchased 85,000 acres in San Luis valley, south of Alamosa. The land forms part of the Trinchera estate, formerly controlled by the late Gen. William J. Palmer. It is understood that the new owners will spend a large amount of money in placing the land under irrigation and then dispose of it in small tracts.

The Godding Ditch Co., of Longmont, Colo., has been incorporated with a capital stock of $400,000 and will operate the irrigation ditch known as the Highland ditch, which takes water from Boulder creek in Weld county. The ditch has its headgate on a branch of Boulder creek, known as Idaho creek. The company expects to extend and enlarge the canal. The incorporators are Fred W. Smith, S. E. Rinn and G. M. Hall.

Georgia.

Bids were opened Jan. 26 by the U. S. Engineer at Savannah, Ga., for bank protection of the Savannah River at Augusta, Ga., the bids received being as follows: Twiggs, McKenzie & Bowe, Augusta, Ga., excavation of trench, 40,000 cu. yds., 40 cts.; stone for filling trench, 54,000 tons, $1.65; stone furnished for sub-pavement, 16,000 tons, $2.30; stone for top pavement, 48,000 tons, $2.60. Total of bid, $266,700. Bryan & Co., Jacksonville, Fla., excavation of trench, 40,000 cu. yds., 45 cts; stone for filling trench, 54,000 tons, $1.65; stone for sub-pavement, 16,000 tons, $2.25; stone for top pavement, 48,000 tons, $2.12. Total of bids, $244,860. The bid of Bryan & Co. was recommended for acceptance.

Illinois.

⊙John Albrecht, Glencoe, Minn., has been awarded the contract at 9.6 cts. per cu. yd. for ditch work for the Seavey Slough Drainage District in Libertyville and Vernon Township, Lake County. Bids for this work were opened Jan. 21 at Libertyville, Ill. The work consists of the excavation of approximately 8,872 lin. ft. of ditch 6 ft. deep and 15 ft. bottom width, 5,776 lin. ft. of ditch, 14 ft. bottom width and 6 ft. 2 in. deep and 3,104.3 lin ft. of ditch 6 ft. 8 in. deep and 4 ft. bottom width, all with side slopes of 1 to 1, making a total excavation of approximately 75,963 cu. yds., from which 8,484 cu. yds. must be deducted as a credit to property owners for work already done. Windes & Marsh, Winnetka, Ill., are the Engineers.

Iowa.

✣Bids are asked until 1:30 p. m., Feb. 15, by J. L. Hanrahan, County Auditor, Fort Dodge, Ia., for the construction of open work on a ditch and drain in Webster County Drainage District No. 69 in Fulton and Johnson Townships. The work includes the following quantities, the total estimated cost of labor and material being $40,921.

[illegible]	[illegible]	Cu. yds. [illegible]	Bottom [illegible]
1	Main	11,400	16′
[illegible]	Main	[illegible]	[illegible]
[illegible]	Main	[illegible]	[illegible]
[illegible]	Main	[illegible]	[illegible]
[illegible]	Main	[illegible]	6′
1	Lateral 1	140,000	6′
2	Lateral 2	92,500	6′
[illegible]		[illegible]	

The minimum coal haul is ¾ mile and the maximum coal haul is 5 miles. There is no clearing. The work is located 3 miles west of Moorland, Ia., on M. & St. L. R. R. and C. G. W. Ry. and 4 miles south of Barnum, Ia., on Illinois Central R. R. There will be one railroad crossing. G. P. Smith, Fort Dodge, Ia., is the Engineer.

Louisiana.

Some extensive improvement work is planned by the Sewerage Board of New Orleans, La. The most important piece of work is the construction of the Napoleon Ave. canal and auxiliaries. It is estimated that this work will cost about $3,000,000 and will require about three years for completion. This work will not be undertaken until the big issue of bonds is sold. The Sewerage Board, however, has its plans drawn, but they are subject to revision, and, after the bonds are sold, it will take several weeks to perfect all the details in accordance with the amounts appropriated for the various work to be done, and now in contemplation. Various other canals are also to be enlarged and improved in addition to sewerage installation. There are several canals which are now incomplete.

Nebraska.

✣Drainage District No. 2 of Richardson County, Neb., has for sale an issue of $48,000 in drainage bonds, bearing 6 per cent interest per annum, payable semi-annually, running for 10 years, payment of principal to begin after 5 years. Bids will be received for the whole issue up to Feb. 20, 1911, by Frank Snethen, Clerk, at Humboldt, Neb. This issue is to raise money to complete the drainage improvements, which are now 75 per cent completed, and will all be completed by the last of June next. These bonds are a tax lien on the lands in the district. The contract for the drainage work was let on April 4, 1910. The whole improvements are costing about $120,000 in cash, and it will reclaim some of the best lands in this part of the state on the Nemaha River.

New Mexico.

The Territorial Engineer of New Mexico has approved the application of Carter & Phelps of Raton, N. Mex., for the waters of Raton Creek and arroyo to reclaim 1,000 acres at a cost of $22,900. He has also approved the application of R. L. Survant of Trinchera, Colo., for the waters of Trinchera Creek to be diverted in New Mexico and to be used in Colorado for reclamation of 2,000 acres at a cost of $10,000.

Ohio.

Advices from St. Marys, O., state that a plan has been brought forward by Justice J. W. Moverman of Salem Township for dredging the St. Marys River from St. Marys to the Ohio and Indiana state line. It is said that the project would benefit more than 6,000 property holders located in the counties of Auglaize, Allen, Mercer, Shelby and Van Wert. Owing to the river furnishing an outlet for the overflow from the Miami and Erie canal the state is interested and is expected to furnish a portion of the necessary funds.

Commissioners of Clark County, Springfield, O., have authorized the dredging of Mad River from the Tremont City bridge to the Coblentz Road. County Surveyor Bird has been instructed to make a survey of the proposed improvement and report an estimate of the probable cost to the commissioners on April 18. The river will be straightened out, widened and deepened.

Pennsylvania.

The Water Supply Commission of Pennsylvania held a hearing at Harrisburg on Feb. 1 in the matter of the approval of plans for the draining of Pymatuming Swamp, in accordance with the act of 1909.

Texas.

State Levee and Drainage Commissioner Arthur A. Stiles, Austin, has made public the first installment of his preliminary hydraulic calculations for the levee locations along the East work of the Trinity River in Rockwall and Kaufman counties. The space between the opposite levees or between a levee and an opposite hill bank must be not less than 800 ft. The overflowed valley along this section is something over 8,000 ft. wide. The average height of the levees throughout the several districts will be about 9 ft.

Wisconsin.

Steps are being taken for the organization of a drainage district consisting of about 10,000 acres lying in Lowell, Portland and Shields Township in Dodge County, and in Milford and Waterloo in Jefferson County. Hearing will be held by the Dodge County Circuit Court at Juneau, Wis., on Feb. 14.

Washington.

The following bids were received Jan. 19 at the U. S. Engineer's Office, Seattle, Wash., for excavating for the Lake Washington Canal: Holt & Jeffrey, Seattle, Wash., 30 cts. per cu. yd.; Erickson Construction Co., Seattle, Wash., 45 cts. per cu. yd. The work includes 327,000 cu. yds. excavation—steam shovel and dredge work.

WATER-WORKS

Alabama.

The city of Gadsden, Ala., is considering extending the water mains to take in a large amount of new territory. Bonds will be issued for this purpose.

Arkansas.

The city of Conway, Ark., has sold bonds in the sum of $68,000 to the Southern Trust Co., of Little Rock, Ark., for the waterworks improvement district. The contract for the work has been let for some time.

California.

⊙Dunham, Carrigan & Hayden Co., San Francisco, Cal., has been awarded the contract by board of the city of Portland, Ore., for furnishing and delivering at Portland the following gate valves for cast iron water mains: 20 4-in. valves, 350 6-in valves, 250 8-in. valves, 15 10-in. valves to operate horizontally with bevel gear and indicators; 1 32-in. valve to operate horizontally with bevel gear and indicator; 1 52-in. valve, to operate horizontally with bevel gear and indicator. The contract price is $12,332. D. D. Clarke is Engineer of the water board. Bids were opened Jan. 10.

J. B. Coulston, chairman of the subcommittee of the board of trade, Pasadena, Cal., has presented, it is said, a new proposition for the bringing of water from Mojave to the board. This plan calls for 15 miles of tunneling. William Thum is chairman of the board.

The Guaranty Pipe Line Co., of Los Angeles, Cal., proposes to build a pipe line between the Midway oil field and the [illegible] made looking to that end. When this has been completed the company will build a branch from the line to Los Angeles. It is proposed that the initial expenditure for the pipe line and pumping stations will amount to approximately $750,000, and that the outlay eventually will be $2,000,000. Articles of incorporation for the company have been filed at Los Angeles, with a capital stock of $5,000,000. The incorporators are R. L. Cox, Cromwell Simon, Thomas Ball, M. A. Fleming and Drew Pruitt.

Colorado.

The city commissioners of Grand Junction, Colo., have called a special election for March 28 to vote upon the water proposition. The citizens will vote either for the purchase of the Kannah creek water rights or for an artesian water system.

The city council of Boulder, Colo., has approved and adopted the plan of City Engineer Fred Dungan for the construction of a pipe line from Silver Lake to the present intake at the Boulder County ranch. The plan provides for 5.6 miles of 24-in. pipe capable of carrying 21.2 cu. ft. of water per second. It will follow closely the course of the bed of North Boulder creek through which the water now flows. The estimated cost of the improvement [illegible]

District of Columbia.

The Washington, D. C., board of trade at a recent meeting urged the installation of a high-pressure fire protection service in place of the present pumping system. The improvement, it is estimated, would cost $750,000.

The commissioners of Washington, D. C., have been asked by the chief engineers of the army to include in the District Appropriation bill an item [illegible] the sum of $[illegible] to repair the breaks in the aqueduct over the Cabin John bridge. It is estimated that 2,000,000 gals. per day has been leaking through the cracks and breaks in the masonry of the bridge. The work of repairing the bridge and aqueduct will consume nearly a year.

Georgia.

✣Bids will be received until noon, Feb. 6, by M. D. Thompson, Chairman Water Committee, 532 Candler Bldg., Atlanta, Ga., for the materials and machinery required for the construction of water and sewer system for Kirkwood, Ga. Hazlehurst & Anderson, Consulting Engineers.

⊙The General Pipe & Foundry Co., of Atlanta, Ga., has been awarded the contract by that city for furnishing the water department with pipe during the year for $25,000.

Plans have been completed in Waycross, Ga., for the extension of water mains through Gilchrist Park, a suburb of Waycross, and the same have been adopted by the city council. The improvement, together with a sewerage system for the same, will cost $7,000. Work will be started immediately.

Illinois.

Advices from Freeport, Ill., state that a power dam is to be constructed the coming season across the Wisconsin river near the village of Prairie du Sac, to develop 26,000 hp., which will be distributed to Madison, Milwaukee and North Freedom. The dam will be 1,500 ft. long. The material from the Blackhawk's Lookout, which will have to be destroyed, will be used for the construction of the dam.

The Union Stock Yards & Transit Co., of Chicago, Ill., has asked the city council, through its president, John A. Spoor, for permission to undertake the work of building a high-pressure water system for the yards and adjacent property. It is proposed to form a corporation to build the new water works system. It will have a capacity of at least 60,000,000 gals. per day. It is proposed to build a tunnel from the yards out into the lake.

Following are the low bids submitted to B. J. Mullaney, Commissioner of Public Works, City of Chicago, for furnishing gate valves: Rensselear Mfg. Co., 98 Jackson Blvd., 36-in. $440.00, 30-in. $290.00, 24-in. $165.00, 20-in. $90.00, 16-in. $52.00; hydraulic valves, The Darlington Pump Mfg. Co., $745.00.

Following are the low bids submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., by the T. A. Cummings Foundry Co., (low bidder) 1338 Clybourne Pl., for furnishing tapping connections; first bid is unit price without valves, second bid includes valve, 4x3, $6.00, $6.75; 4x4, $6.75, $11.75; 6x3, $7.00, $10.75; 6x4, $7.50, $12.50; 6x6, $8.25; $15.75; 8x3, $7.50, $11.25; 8x4, $9.25, $14.25; 8x6, $9.50, $17.00; 8x8, $11.00, $24.75; 10x3, $11.00, $14.75; 10x4, $12.50, $17.50; 10x6, $13.50, $21.00; 10x8, $14.00, $27.75; 10x10, $16.00, $35.00; 12x3, $13.00, $16.75; 12x4, $14.00, $19.00; 12x6, $15.00, $22.00; 12x8, $16.00, $29.75; 12x12, $17.00, $48.25; 14x4, $18.50, $25.50; 14x6, $19.50, $27.00; 14x8, $21.25, $28.00; 14x12, $23.50, $42.50; 16x4, $21.00, $26.00; 16x6, $22.00, $29.50; 16x8, $23.00, $36.75; 16x12, $24,50; $55.75; 18x4, $22.00, $27.00; 18x6, $24.00, $31.50; 18x8, $27.00, $40.75; 18x12, $30.00, $50.00; 20x4, $23.00, $28.00; 20x6, $24.00, $31.50; 20x8, $26.00, $39.75; 20x12, $28.00, $59.75; 20x16, $29.00, $89.75; 24x4, $32.50, $37.50; 24x6, $34.00, $41.50; 24x8, $36.00, $49.75; 24x12, $37.00, $68.75; 24x16, $38.00, $106.75; 24x20, $40.00, $146.25; 30x4, $42.00, $47.00; 30x6, $43.00, $50.50; 30x8, $44.00, $57.75; 30x12, $46.00, $77.75; 30x16, $49.00, $118.75; 30x20, $55.00, $161.25; 36x4 $55.00, $60.00; 36x6, $55.00, $62.50; 36x8, $60.00, $72.75; 36x12, $64.00, $95.25; 36x16, $70.00, $138.75; 36x20, $76.00, $182.75; 36x24, $80.00, $230.00; 42x4, $60.00, $65.00; 42x6, $65.00, $72.50; 42x8, $70.00, $83.50; 42x12, $75.00, $106.25; 48x4, $65.00, $70.00; 48.6, $70.00, $77.50; $48x8, $75.00, $88.75; 48x12, $85.00, $116.75. Detailed specifications published in ENGINEERING CONTRACTING, Jan. 18.

Following is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing the necessary lead pipe during the year 1911: Gardiner Metal Co., 1374 W. Lake St., 5.04 cts. per lb. Detailed specifications were in ENGINEERING CONTRACTING, Jan. 11.

Following is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing sewer pipe: Wm. E. Die & Co., 108 La Salle St., 30,000 ft. 4-in. 3 2-5 cts. per ft.; 600 ft. 6-in., 5 cts per ft.; 600 ft. 9 in., 10 cts. per ft. Detailed specifications appeared in ENGINEERING CONTRACTING Jan. 18.

Iowa.

The Centerville Water Works Co., Centerville, Ia., has taken an option on 2,600 acres of land on which it will build a reservoir.

Kansas.

⊙The city council of Stafford, Kan., has let the entire contract for masonry work, pumping machinery, laying of water mains, the erection of a power house and pumping station, for the furnishing of various equipments incident to the extension of the water system, and for necessary electric equipment preparatory to taking over the light plant, to Joseph Bortenlanger of Omaha, Neb. The contract for the iron pipe was awarded to the American Cast Iron Pipe Co., of Kansas City.

Louisiana.

At a recent meeting of the citizens of Many, La., it was decided to immediately organize a company to be known as the Many Ice, Water & Light Co., Ltd., with a capital stock of $12,000 for the construction of a water, light and ice plant.

Maryland.

James H. Fuertes, 140 Nassau St., New York City, has practically completed his report on the city of Cumberland's water supply. The engineer will recommend the Savage river as the best source of supply for the future. The plan will include the construction of a filtration plant at a cost of $42,000. The total cost of the improvement is estimated at $500,000. George G. Young is mayor.

Michigan.

The board of public works of Holland, Mich., has purchased a tract of land between 20th and 21st Sts., upon which it is proposed to erect a pumping station. The entire cost of the new station will be from $12,000 to $15,000.

Minnesota.

✣Bids will be received until noon, Feb. 6, by Board of Water Commissioners, St. Paul, Minn., for the installation of a pumping plant at McCarron Lake Artesian wells. John Caulfield is Secretary of the Board.

Missouri.

✣Bids will be received until Feb. 7 by J. S. Buknell, City Clerk, Columbia, Mo., for drilling two deep wells for the city water and light plant—15 in. to 300 ft.; 8 in. to 800 ft.

Montana.

✣Bids will be received until 5 p. m., Feb. 16, by A. M. Brandenburg, City Clerk, Bozeman, Mont., for the excavation required to enlarge the reservoir of the Bozeman city water works and increasing the size of the dam and banks with the excavated material amounting to about 13,000 cu. yds. Each bid must be accompanied by a certified check for $100 on some bank in Bozeman, Mont., payable to the City Treasurer. Work is advertised elsewhere in this issue.

✣Bids will be received until 5 p. m., Feb. 16, by City Clerk A. M. Brandenburg, Bozeman, Mont., for laying concrete on the sideslopes and bottom of the enlarged reservoir of Bozeman city water works, including about 4,840 sq. yds., in accordance with plans on file at Clerk's Office. A certified check for $200 on some bank in Bozeman, Mont., payable to the city treasurer, must be filed with each bid. Work is advertised elsewhere in this issue.

✣Bids will be received until 7:30 p. m., Feb. 14, by E. H. Goodman, Town Clerk, Townsend, Mont., for the construction of a system of water supply for the town, including pumping system, with elevated tank. C. M. Thorpe, Bozeman, Mont., is Engineer.

The city council of Helena, Mont., has adopted resolutions inviting the Helena Water Works Co., to submit an offer for the sale of the existing plant, on or before March 6. In case the company refuses to sell its holdings the council will ask for bids for the construction of a new plant from the bond issue recently voted for that purpose.

Nebraska.

⊙The city council of Superior, Neb., has let a contract for the construction work of the water works extension, for which bonds were voted last summer, to the National Co., of South Bend, Ind. Work will be commenced at once.

The citizens of Gordon, Neb., at a recent election, voted in favor of the proposition of issuing bonds for the construction of a water plant and electric light plant.

The city of Crawford, Neb., has sent City Attorney J. E. Porter to Washington, D. C., to urge the passage of a bill for an appropriation of $25,000 for a city water plant.

New York.

The Endicott Water Co., of Endicott, N. Y., is contemplating erecting a reservoir on Cornell Hill, situated about a quarter of a mile northwest of the village. The capacity of the reservoir will be 1,500,000 gals.

Commissioner F. W. Ward of Buffalo, N. Y., has recommended the acceptance of the bid of the Westinghouse Machine Co., for providing the new pumping station with three steam turbine electric generators for $248,180.

Ohio.

A corps of city engineers of Alliance, O., has been busy since Jan. 1 exploring the Mahoning Valley between Alliance and North Georgetown looking for a location for a storage basin at a point where it could be utilized for the city supply of water.

The city council of Cincinnati, O., at a recent meeting received a communication from the board of waterworks commissioners urging the purchase of a strip of land and the construction of an additional reservoir.

Oklahoma.

⊙The T. C. Brooks & Sons Co. of Jackson, Mich., has been awarded the contract by the city of Heavener, Okla., for the construction of the city's new waterworks for $40,699.

Mayor Boyle and Judge C. C. Black, special attorneys for the city of Lawton, Okla., have been advised by Congressman Scott Ferris at Washington, that the secretary of the interior has granted the city of Lawton deed to the 14 tracts of Indian land desired by the city for a reservoir site on Medicine Creek. The reservoir site includes 2,300 acres, 14 tracts of which is Indian land.

Oregon.

The city council of Marshfield, Ore., contemplates having a municipal water works. The system which now supplies North Bend and Marshfield is owned by a private company. The supply is adequate for the city at the present time, but the city plans to provide for an increase in population.

Pennsylvania.

The Sheffield Water Co., Sheffield, Pa., has complied with the ruling of the State Water Commission and has prepared to extend its mains to supply water in the hill section of Shickshinny.

Preliminary arrangements are being made by Burgess Robert M. Sample and the borough council of Springdale, Pa., for the erection of a municipal water plant and system to supply the community with pure filtered water. It is intended to hold a special election in the near future to give the electors of the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

borough an opportunity to authorize the increase of the indebtedness of the borough $50,000 to cover the cost and expense of erecting a water works.

South Carolina.

The water works commission of Aiken, S. C., in its report, favor the purchase of Shiloh branch for a source of supply. This branch is located 3½ miles from the city, and it is estimated that a permanent supply can be secured within the $78,000 voted for this purpose.

Tennessee.

Chilowee Water Co., of Polk County, Tenn. has been incorporated with a capital stock of $10,000. The incorporators are Charles Seymour, F. S. Mead, R. P. Johnson, James H. Graham, and J. C. Williams.

The city council of Johnson City, Tenn., is considering plans looking to beginning work on the $500,000 water system which is to furnish water for the city and the Mountain Branch Soldiers' Home. Engineer J. Chalkley Hatton ot Wilmington, Del., has advised the council to use wood pipes to convey the water from the Big Blue Springs, from which the water is to be obtained, a distance of 12 miles. About 5,000,000 gals. per day will be brought to the city at this time.

Texas.

✣Bids will be received until noon, Feb. 4, by Thomas E. Ramsey, County Auditor, San Antonio, Texas, for drilling a well at new county poor farm. Also for furnishing one adjustable steel culvert form.

The city of Paris, Tex., contemplates the installation of a waterworks system. It is planned to construct an artificial lake. E. H. McCuistion is mayor.

S. G. Green, chief engineer, and Ed. Foster, foreman of the Neal Engineering Co., of Dallas, Tex., have begun work on the new system of water works of the city of Miles, Tex. There will be required three miles of pipe. Mains will be 6-in. in diameter, the laterals 4-in. The Wykoff wood pipes are to be used. Work will be completed in about 10 weeks.

The Temple Water Works Co., Temple, Tex., will soon construct a first class filtering plant. Col. Pat Bracken is superintendent of the plant.

Virginia.

Superintendent Eugene E. Davis of the water works of Richmond, Va., has asked the water committee of the city council for an appropriation of $196,628 to operate the water works for a year. He also asks that a new main from the new reservoir in William Byrd park down Broad to Bowe St., thence to Marshall and down Marshall to Seventh St., be laid.

Washington.

The city commissioners of Tacoma, Wash., have passed ordinances providing for the construction of water mains in district No. 562 and district No. 565.

Wisconsin.

The city of Manitowoc, Wis., has voted to purchase the present water works plant now being operated by a private company.

Canada.

✣Bids will be received until 5 p. m., Feb. 6, by J. A. Lewis, Town Clerk, Smith Falls, Ont., for the purchase of the following Town of Smith Falls, debentures: Waterworks, $10,000 for 30 years; local improvement, $31,501 for 20 years.

✣Bids will be received until 2 p. m., Feb. 13, by E. A. Dunlop, Chairman of Water Committee, Pembroke, Ont., for necessary labor, etc., in connection with laying about 5,400 ft. of 18-in. lapwelded steel intake pipe and the construction of a concrete pump well. Forms of tender may be obtained and specifications and plans examined either at the offices of T. Aird Murray, No. 303 Lumsden Bldg., Toronto, or at the office of the resident engineer, J. L. Armour, Pembroke. W. L. Hunter is mayor of Pembroke.

✣Bids will be received until 2 p. m., Feb. 13, by E. A. Dunlop, Chairman of Water Committee, Pembroke, Ont., for furnishing labor, etc., in connection with laying about 5,900 ft. of 16-in. water main, together with fixing valves and hydrants. Forms of tender may be obtained and specifications and plans examined either at the offices of T. Aird Murray, No. 303 Lumsden Bldg., Toronto, or at the office of the resident engineer, J. L. Armour, Pembroke, on or after the 30th inst. W. L. Hunter is mayor of Pembroke.

City Engineer C. H. Rust of Toronto, Ont., has recommended to the board of control the construction of a duplicate intake and 6 ft. steel conduit laid between the tunnel and the lake at a total estimated cost of $465,000. The engineer further recommends that they should begin at once with that portion of the work lying between the shore crib or filter pumping station, as it would take two years to complete it. The estimated cost of this improvement is $245,000. Additional pumping mains are required to enable the supply pumped at the main station to be distributed to the various service mains so that the pressure and supply might be kept up, the estimated cost being $161,544. These mains are as follows: 36-in. main from the main pumping station to Front St., and along Front to Simcoe, $37,000; 36-in. main from Wellington St., along John St., Grange Ave. and Beverley St., to College, $70,000; 24-in. main on Sumach St., from Queen St. to Wellesley, $41,688; 12-in. main to feed North Rosedale, $5,829; and a 12-in main on Wilton from River to Broadview Ave., $7,027.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

✣Bids will be received until 8:15 p. m., Feb. 13, by City Council, Uniontown, Ala., for the necessary labor and material for the construction of a sewer system and sewage disposal plant. The work includes approximately 1,840 lin. ft. of 15-in. pipe sewers, 3,000 lin. ft. of 12-in. pipe sewers, 7,500 lin. ft. of 10-in. pipe sewers, 15,200 lin. ft. of 8-in. pipe sewers, lampholes, manholes. Each proposal must be accompanied by a certified check for $200, made payable to the town of Uniontown, Alabama. Plans and specifications may be seen at the office of the mayor, D. P. Coleman, Uniontown, Alabama, or at the office of the engineer, Edgar B. Kay, Tuscaloosa, Ala. J. L. Pope is town clerk.

The city court of New Decatur, Ala., has authorized the expenditure of $17,000 for the construction of new storm sewers. In South New Decatur a storm sewer costing $8,000 will be built, and in West New Decatur a storm sewer costing $9,000 will be constructed.

The mayor and city council of Cullman, Ala., recently visited Decatur, Ala., to investigate the plans and ways by which that town is now installing a sewerage system and extending sidewalks with a view to making the same improvements in that city.

Arizona.

⊙Contracts have been awarded by the city of Tucson, Ariz., for the installation of the proposed sewer system in the southwest section of the city at a cost of approximately $20,000. The contract for the pipe was awarded to the Pacific Sewer Pipe Co., of Los Angeles for $8,000.

California.

⊙The board of trustees of Monrovia, Cal., has awarded the contract for the new sewer system for that town to R. C. Lowell of Los Angeles for $85,744. The work will require 11,000 ft. of 24-in. reinforced concrete mains. Olmstead & Gillelan, 604 Wright & Callender Bldg., Los Angeles, are the engineers.

Town Engineer R. B. Chandler of Los Gatos, Cal., has submitted a profile and plans for the proposed septic tank, filter beds and outlet sewers on the east and west side of the town to the town trustees. The estimated cost of the improvement, according to the engineer, is $30,000.

Plans adopted by the city of Anaheim, Cal., call for 18 miles of pipe, ranging in size from 6 to 14-in. It is planned to run the sewers through the alleys and avoid the streets and private ways as much as possible. A total of 49 flush tanks are provided for and all the sewers will be flushed and cleaned every 24 hours. The location of the sewer farm is not yet determined.

The city trustees of Fresno, Cal., have passed a resolution providing for the construction of sewers in the Russiantown district of the city.

Mayor Earley of Pasadena, Cal., has instructed City Engineer Van Ornum to prepare plans at once for the construction of a sewer to take care of that section of the city lying west of Grand Ave., and including the arroyo drive.

Colorado.

✣Bids are [illegible] 7, by Board of Public Works, Denver Colo., for the furnishing of all materials, supplies, labor, etc., and to sustain all the expense incurred in constructing in place, sanitary sewers, their manholes and appurtenances in and for a portion of Subdistrict No. 6 of the East Side Sanitary Sewer District No. 1 in the City and County of Denver. A certified check for $3,000 must be filed with each bid. Henry Read is President of the Board.

⊙The city council of Fruita, Colo., has let the contract for the installation of a sewerage system to the Westcott-Doan Investment Co., of Denver for $25,259.

District of Columbia.

The commissioners of Washington, D. C., have ordered 485 ft. of sewer pipe laid on the west side of 14th St., between O and P Sts. northwest, at an estimated cost of $2,700, and the construction of a sewer in Morrison St., west of Connecticut Ave.

Florida.

Plans have been prepared by Engineer Geo. Rommel, Jr., of Pensacola, Fla., for the construction of about six miles of sanitary and storm sewer ranging in size from 66-in. to 8-in., with all appurtenances for that city. It is estimated that the work will cost $100,000. Contracts for the work will be let about May 15.

Georgia.

Plans for the extension of water mains and sewerage system through Gilchrist Park, a suburb of Waycross, Ga., have been prepared, and the same have been adopted by the city council. The improvement will cost $7,000, and will be started immediately.

The city council sewer committee of Atlanta, Ga., contemplates laying about 30 miles of new sewers this year. The committee has notified R. M. Clayton, chief of construction, to make plans and draw up ordinances for over 30 miles of new sewers to connect with the main trunk sewers which will become a part of the new system under the bond issue. Councilman Aldine Chambers is chairman of the committee.

The city of Gainesville, Ga., contemplates extending its present sewer system. E. B. Eppes is city engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Illinois.

⦿The board of local improvements of Aledo, Ill., has awarded the contract for the construction of the new sewer extension in the city to Lanyon & Clifford of Waukegan, Ill., for $9,806. The sewer is designed to serve the southeast, east and northeast parts of the city. W. S. Shield, 1201 Hartford Bldg., Chicago, is engineer.

The city council of Hoopeston, Ill., has passed the sewer ordinance which provides for the construction of a modern drainage system for the city.

Engineer Myron Tarble has completed plans for the construction of sewers in District No. 7, located in the southeastern part of the city of Aurora, Ill. The district comprises that part of the city east of Jackson St., and south of Benton St. It is expected that work on the Pigeon Hill sewers will begin within 60 days.

Indiana.

⦿The following bids were received by the city council of New Castle, Ind., Jan. 16, for the construction of two sewer systems in the South Side; both contracts being awarded to James Garvey: Webster and Southern Ave. sewer—James Garvey, $1,025; Lee & Everroad, $1,098; Lon Delaney, Muncie, Ind., $1,154; Charles Minnick, $1,162; M. A. Frye, $1,196. The engineer's estimate was $1,241; South 11th St. sewer—Jas. Garvey, $2,144; M. A. Frye, $2,359; Lee & Everroad, $2,219; Charles Minnick, $2,277; Lon Delaney, $2,258. The engineer's estimate was $2,378.

Iowa.

✣Bids will be received until Feb. 21 by W. E. Gamble, town clerk, Mount Vernon, Ia., for sewer work comprising 7 1-3 miles of sanitary sewers, 6 to 15 in. pipe, with all accessories, and a septic tank and filter beds. Iowa Engineering Co., Clinton, Ia., engineers for the work.

✣Bids will be received until Feb. 14 by A. M. Nees, clerk of the city of Sigourney, Ia., for the construction of approximately 9 miles of sanitary sewers, 8, 10, 12, and 15 in. pipe, and also the sewage disposal works. Hall & Adams, Centerville, Ia., are engineers.

The city council of Nevada, Ia., has employed Sam Steigerwalt of Boone, Ia., to perfect plans and specifications for a sanitary sewer system for the city. As soon as plans have been prepared the city council will let the contract for construction.

Kansas.

The city council of Great Bend, Kan., has recently created two new sewer districts. It is the plan of the present council to extend the system within the next 12 months so as to cover the entire town.

Bids received on Nov. 16, 1910, at Fort Leavenworth, Kan., by Constructing Quartermaster J. E. Normoyle for the construction of the sewer outlet from Fort Leavenworth in the Missouri river have been rejected by the War Department, and the same has been ordered re-advertised. The new sewer is to be about two miles long, running into the river at the south line of the reservation near the North Shaft mine, which is below the intake of the city water. The E. A. Steininger Construction Co., of St. Louis, Mo., submitted the lowest bid.

The city council sewer committee of Garden City, Kan., has submitted its report favoring the installation of a sewer system to that body and the same has been approved. It is probable that a special election will be held to vote on the proposition.

Maryland.

The city of Easton, Md., will hold an election Feb. 23 to vote on the proposition of issuing bonds for the construction of a sewer system. If the proposition carries the city will hold another election to vote for roads and [illegible] M. M. Higgins is mayor.

Massachusetts.

An order has been introduced in the city council of Lawrence, Mass., requesting the city engineer to furnish estimates of the cost of the construction of a main sewer in South Lawrence in the vicinity of South Broadway and Lenox St.

Minnesota.

✣Bids will be received until 2 p. m., Feb. 6, by Board of Public Works, St. Paul, Minn., for the construction of a sewer on St. Anthony Ave., from Snelling Ave to Asbury Ave. Plans and specifications are on file at the office of J. J. O'Leary, President of the Board, and R. L. Gorman, Clerk.

✣Bids will be received until 2 p. m., Feb. 6, by Board of Public Works, St. Paul, Minn., for the construction of a sewer in Western Ave., from Thomas St. to Blair St. Plans and specifications are on file at the office of the Board. R. L. Gorman is Clerk.

Included in the many bond issues recommended for the city of Minneapolis, Minn., is a bond issue for the sum of $500,000 for the construction of sewers.

City Engineer McGilivray, of Duluth, Minn., has submitted the estimated cost of the construction of a storm sewer in 10th Ave., east from Fourth to Eighth St., to be $6,490.

Missouri.

✣Bids will be received until noon, Feb. 14, by Board of Public Improvements, St. Louis, Mo., for the construction of Forest Park Foul Water Sewer, first section embracing 2,800 ft. of brick sewer, 42 ins. inside diameter, and 1,050 ft. of pipe sewer, 18 ins. inside diameter, with sewer inlets, manholes and appurtenances: one concrete pump well, 15 ft. inside diameter and 25 ft. 9 ins. in total depth; 400 lin. ft. of wood piling; 2,500 ft., board measure, of 2-in. sheathing. Deposit required, $690. Second section embracing 3,700 ft. of brick sewer, 42 ins. inside diameter, with sewer inlets, manholes and appurtenances. Deposit required, $793. Third section embracing 3,170 ft. of brick sewer, 42 ins. inside diameter, 1,959 ft. of brick sewer, 30 ins. mean inside diameter, and 350 ft. of pipe sewer, 12 ins. inside diameter, with sewer inlets, manholes and appurtenances. Deposit required, $860. For the work of equipping the pumping plant of the Forest Park Foul Water Sewer, embracing the work of constructing well deck and motor house on pump well and the furnishing and installing duplicate sets of direct connected contrifugal pumps and motors, with valves, pipes, wires, switches, and appurtenances necessary for the efficient working of the motors and pumps. Deposit required, $350. A separate proposal must be made for each letting on a blank form furnished by the Board of Public Improvements. Plans and specifications and forms of contracts may be seen at the offices of the Board of public improvements and the sewer commissioner. Copy of plans and specifications will be furnished upon deposit of $10 in each case, which sum will be returned to depositor upon the return of such plans and specifications. Each bid must be accompanied with a certified check on some bank or trust company in the city of St. Louis, payable to the order of the city treasurer, for the amount of deposit required, as above stated. Maxime Reber is president. W. B. Dryden is secretary.

✣Bids will be received until noon, Feb. 17, by Board of Public Improvements, St. Louis, Mo., for constructing sewers in Baden Sewer District No. 1, embracing sewers of reinforced concrete, of brick and Portland cement mortar, and of vitrified clay pipe, of the following lengths and sizes, to-wit: 235 ft. of reinforced concrete sewer, 14 ft. by 11 ft., 2¾ ins. inside dimensions; 4,750 ft. of reinforced concrete sewer, 12 ft. by 9 ft. 7¼ ins. inside dimensions; 2,642 ft. of reinforced concrete sewer, 10 ft. by 8 ft. ⅛ in. inside dimensions; 969 ft. of brick sewer, 56 ins. inside diameter; 780 ft. of brick sewer, 52 ins. inside diameter; 1,833 ft. of brick sewer, 40x60-in. inside dimensions; 1,269 ft. of brick sewer, 36x54-in. inside dimensions; 199 ft. of brick sewer, 34x51-in. inside dimensions; 921 ft. of brick sewer, 32x48-in. inside dimensions; 602 ft. of brick sewer, 30x45-in. inside dimensions; 1,981 ft. of brick sewer, 28x42-in. inside dimensions; 2,728 ft. of brick sewer, 26x39-in. inside dimensions; 2,552 ft. of brick sewer, 24x36-in. inside dimensions; 1,559 ft. of pipe sewer, 27 ins. inside diameter; 3,205 ft. of pipe sewer, 24 ins. inside diameter; 5,619 ft. of pipe sewer, 21 ins. inside diameter; 8,445 ft. of pipe sewer, 18 ins. inside diameter; 18,088 ft. of pipe sewer, 15 ins. inside diameter; 57,276 ft. of pipe sewer, 12 ins. inside diameter; 361 ft. of pipe sewer, 6 ins. inside diameter. With sewer inlets, catch basins, manholes and appurtenances. Deposit required, $10,725. Plans and specifications and form of contract may be seen at the offices of the Board of Public Improvements and the sewer commissioner. Copy of plans and specifications will be furnished upon deposit of $100, which sum will be returned to depositor upon the return of such plans and specifications. Each bid must be accompanied with a certified check on some bank or trust company in the city of St. Louis, payable to the order of the city treasurer, for the amount of deposit required, as above stated. Maxime Reber is president. W. B. Dryden is secretary.

✣Bids will be received by the Board of Local Improvements, St. Louis, Mo., until noon, Feb. 3, for the construction of Baden Public Eewer—Second Section, from the end of the first section at or near Oberbeck St. westwardly to Florissant Ave., under authority of Ordinance No. 25394, embracing 4,557 ft. of reinforced concrete sewer, 14 ft. x 11 ft. 2¾ ins. inside dimensions, and 3,000 ft. of lateral pipe sewers, 8 in. inside diameter, with inlets and appurtenances. Plans and specifications and form of contract may be seen at the offices of the Board of Public Improvements and the Sewer Commissioner. Copy of plans and specifications will be furnished upon deposit of $50.00, which sum will be returned to depositor upon the return of such plans and specifications. A certified check for $4,750 payable to City Treasurer must accompany each bid. W. B. Dryden is Secretary of the Board.

The city council of Paris, Mo., contemplates submitting a sewer proposition to the tax payers at the April election. Preliminary steps have already been taken toward securing an estimate of the probable cost of the improvement.

The House of Delegates has passed the bills for sewering River Des Peres through Forest Park, city of St. Louis, Mo. The bills divide the work in three sections and provide for the reconstruction of the pump wells which were in service there during the World's Fair. In temperate weather the river will flow through the sewer, but in stormy weather the stream will flow through its channel. Several short cuts will be made in its construction.

Montana.

✣Bids will be received until 8 p. m., Feb. 7, by J. D. Matheson, City Clerk, Billings, Mont., for the construction of a sanitary sewer in Special Improvement District No. 69, created by Resolution No. 362. The work for which proposals are invited consists of approximately 4,360 cu. yds. of excavation, 1,010 ft. of 10-in. sewer and 3,400 ft. of 8-in. sewer, with necessary "Y" branches; seven manholes and two flush tanks, to be completed on or before June 1, 1911. Each proposal must be made upon blanks furnished by the city and accompanied by a certified check on some responsible bank of the City of Billings, for the sum of $500, and made payable to the City of Billings.

Nebraska.

Plans and specifications for the extension of the South Omaha sewer southwest through Hanscom Park to 30th and Woolworth Ave., have been accepted by the city council of South Omaha. The improvement is known as the Hanscom Park sewer and will cost in the neighborhood of $57,000.

Civil Engineer Hershey Welch has submitted his report together with maps showing an approximate location for a sewer system to the village board of Sidney, Neb. The work will include about 2,000 ft. of 12 or 15-in. pipe, and about 6,600 ft. of 10 or 12-in. pipe would constitute the main sewer. The entire cost of the improvement will be between $10,600 and $14,400.

New Jersey.

✣Bids will be received until 8:30 p. m., Feb. 7, by Common Council of Summit, N. J., for the construction of 4,960 lin. ft. of 8 and 10-in. vitrified pipe sewer in Springfield Ave. and Tulip St. and manholes, excavation, etc., necessary. John S. Stiger is city engineer. J. E. Rowe is city clerk.

✣Bids will be received until 3 p. m., Feb. 3, by Building Committee of the Essex County Board of Freeholders, Newark, N. J., for furnishing and installing an ash conveying and automatic stoking system and all the work in connection therewith, in the boiler room of the power house of the Essex County Hospital for the Insane, Overbrook, N. J. Louis E. Voorhees is Chairman of the committee.

The town of Haddon Heights, N. J., will sell bonds Feb. 7 in the sum of $40,000 for the construction of sewers.

New York.

✣Bids will be received until 5 p. m., Feb. 24, by Joseph E. Murphy, village clerk, Hastings-on-Hudson, N. Y., for the construction of sewers on Warburton Ave., from Division St. to the northerly line of the Pinecrest property and thence to the Hudson River; also on Farragut Road from Ravensdale Road to near the Putnam Railroad; also on various streets at Uniontown; also cast iron force main from near the Putnam Railroad to the high point on Farragut Road. Approximately 16,000 ft. of sewer will be laid. Ward, Carpenter & Co., Tarrytown, N. Y., are engineers.

✣Bids will be received until 4 p. m., Feb. 9, by W. Armstrong, clerk, Board of Trustees, Yorkville, N. Y., for the construction of a system of sanitary sewers for the town. The work includes 19,000 lin. ft. of 8 to 15-in. sewer, disposal plant, 33 manholes, 10 flush tanks. Plans and specifications can be seen at the residence of M. C. Copeland, Yorkville, N. Y., and at the office of W. C. Stone, 9 Mann Bldg., Utica, N. Y., engineer.

Bids were received Jan. 10 by the Borough of Richmond, New York City, J. T. Fetherton, Superintendent of Street Cleaning, for the construction of the furnaces, steam boilers and appurtenances of the Clifton Destructor. The bids received were as follows: (1) lump sum bid price for construction, (2) guaranteed cost of incineration per ton; The MacDonald Engineering Co., Chicago, Ill., (1) $50,350, (2) 70 cts.; The Destructor Co., New York, (1) $67,867,, (2) 50 cts. The basis of award—value of plant to city on annual operating basis—was as follows:

[illegible]

Incineration of 12,000 Tons

[illegible]

North Carolina.

✣Bids will be received until noon, Feb. 15, by Board of Commissioners of the town of Wilson, N. C., for the construction of brick storm sewer, from 1,000 to 2,000 ft. of 30 to 48 in. sewer. T. A Hinnant is clerk of the board

Ohio.

⊙J. Winterbottom of Cleveland, O., has been awarded the contract by the director of public service of that city for the construction of a sewer in Chesterfield and Phillips Aves., [illegible]

Oklahoma.

⊙The city council of Checotah, Okla., has let the contract for the construction of its new sanitary sewer to C. R. Nichols of Caney, Kan., for $29,602.

Oregon.

The city council of Elgin, Ore., has considered a petition which ordered the city recorder to draw an ordinance that the city submit to the voters an amendment to the charter whereby the city may be bonded for $30,000 to enlarge the water system, construct a sewer system and a city hall.

South Dakota.

⊙W. C. Fraser of Rochester, Minn., has been awarded the contract in Aberdeen, S. Dak., for constructing 5,600 ft. of sewer the coming spring. The material to be used is 20-in. pipe. The contract involves an expenditure of about $12,000.

Washington.

• Figanilli & Payne have been awarded the contract in Tacoma, Wash., for the construction of a sanitary sewer on North 17th St., between Junett and the west line of Baker's 1st addition for $4,000.

⊙The board of public works of Spokane, Wash., has awarded the contract for the construction of the sewer on Main Ave., Cedar to Ash St., to C. Burgie for $3,050.

West Virginia.

✣Bids will be received until 2 p. m. (eastern time) Feb. 20, by Board of City Commissioners, Huntington, W. Va., for the construction of sewer in Adams Ave. from Thirteenth to Fifteenth St. and from Adams Ave in Fifteenth St. to the alley between Washington and Virginia Aves.; and in alley between Washington and Virginia Aves. from Fifteenth to Eighteenth St.; and in alley between Washington and Adams Aves. from Fifteenth to Eighteenth St. A certified check of $500.00 will be required to accompany each bid made payable to the city treasurer. John Coon is Commissioner of Streets, A. B. Maupin, City Engineer.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

⊙The contract for dredging in front of the first municipal wharf at San Pedro, California, has been awarded to the Pacific Wharf & Storage Co., and the dredger Greater Los Angeles will be taken to Wilmington to do the work. Material for the new wharf is now on the ground. The contract calls for about 25,000 cu. yds. of dredging at 24½ cts. per yd.

The budget submitted to the City Council of Mobile, Ala., provides for an appropriation of $50,000 for the permanent improvement of the city wharves. A steel warehouse is included in the proposed improvements.

California.

✣Bids will be received until 11 a. m., Feb. 4, by Constructing Quartermaster Maj. George McWilliamson, Fort Mason, Cal., for constructing the following buildings (including plumbing, heating, electric wiring and fixtures), one field officers' quarters, plan 235-C; two field officers' quarters, plan 235-D; four double company officers' quarters, one quarters for four company officers, three double non-commissioned officers' quarters, one administration building, one band barrack, one guardhouse, one quartermaster and commissary storehouse and one dispensary at Fort Winfield Scott, Cal.

District of Columbia.

✣Bids will be received until 10:30 a. m., March 24, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for Rack Railway Material for the Panama Canal Locks, including rack, steel crossties, bolts and nuts, tie clips, washers, steel channels, rail bonds, copper conductor rails, steel conductor rails, insulators, bumpers, frogs, switches, etc.

✣Bids will be received until 2 p. m., Feb. 3, by Commissioners of the District of Columbia, Washington, D. C., for constructing a 12-room school building No. 165 at the southeast corner of 8th and T Sts., N. W., Washington.

✣Bids will be received until 10:30 a. m., Feb. 17, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for rod and angle reinforcement material for concrete piles, brake shoe keys and hose.

✣Bids will be received until 10:30 a. m., Feb. 24, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 620, Lock Gate recess covers, including structural material, castings, etc.

Illinois.

✣Bids will be received until 2 p. m., Feb. 2, by Commanding Officer, Rock Island Arsenal, Ill., for furnishing one moist air dry kiln apparatus to be similar to that of the Andrews condensing dry kiln, to consist of two separate kilns, each having a capacity for drying 10,000 ft. of 1-in. thick oak and hickory lumber, 16 ft. long.

✣Bids will [illegible] until 11 a. m., Feb. [illegible], Commissioner of Public Works, City of Chicago, for furnishing and delivering [illegible] (approximate weight) white cotton waste.

✣Bids will be received until 12 m., Feb. 3, 1911, by the Board of Education, City of Chicago, J. J. Magrady, Inspector of School Buildings, Room 700 Tribune Bldg., for furnishing the following lumber:

30,000 ft. 1x4 yellow pine 1-2 clear rough.
[illegible]
16,000 ft. 1x10 yellow pine 1-2 clear rough.
[illegible]
16,000 ft. 1x12 yellow pine 1-2 clear rough.
16,000 ft. 1x1¼ yellow pine 1-2 clear rough.
40,000 ft. 1x12 yellow pine S2S No. 2 com.
20,000 ft. 1x8 yellow pine S2S No. 1 com
40,000 ft. 1x10 yellow pine S2S No. 2 com.
15,000 ft. 1 in. ash common and better, rough.
[illegible] better, rough (for table legs).
15,000 ft. 1½ in. maple, 1-2 clear, rough, 12 ft., 14 ft., 16 ft. lengths, equal quantities.
30,000 ft. 2 in. maple, 1-2 clear, rough
15,000 ft. 1 in. cottonwood, No. 2 all widths [illegible]
15,000 ft. 1 in. elm, all widths and lengths [illegible]
15,000 ft. 2½ in. maple or elm, common and better, rough.
1,000 pieces 2x4x16 S4S No. 1 common hemlock.
100 pieces 2x6x16 S4S No. 1 common hemlock.
300 pieces 2x4x12 S4S No. 1 common hemlock.
300 pieces 2x6x12 S4S No. 1 common hemlock.
300 pieces 2x8x16 S4S No. 1 common hemlock.
100 pieces 2x10x16 S2S No. 1 common hemlock.
400 pieces 2x12x16 S2S No. 1 common hemlock.
200 pieces 2x12x12 S2S No. 1 common hemlock.
100 pieces 3x12x16 S2S No. 1 common hemlock.
100 pieces 3x12x12 S2S No. 1 common hemlock.
100 pieces 3x4x16 S4S No. 1 common hemlock.
100 pieces 4x4x16 rough No. 1 com. hemlock.
100 pieces 4x4x16 S4S No. 1 common hemlock.
[illegible]
5,000 ft. 1x6x16 No. 1 common white pine, D. M. B. 2S and center headed.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] ft. 1x6x12 No. 1 [illegible] D. M. B. and center beaded.

[illegible] ft. 1x4x16 No. 1 white pine S. S.

[illegible] ft. 1x6x16 No. [illegible] white [illegible] D. & M.

[illegible] ft. 1x6x16 No. 1 [illegible] D. & M.

5,000 ft. 1x4x16 yellow pine, clear partition center beaded.

8,000 ft. 1x4x14 yellow pine, clear partition, center beaded.

8,000 ft. 1x4x12 yellow pine, clear partition, center beaded.

25,000 Star A. Star clear shingles per M. Bids must be f. o. b. kiln dried, f. o. b. not kiln dried and delivered at workshop, 748 W. Monroe St.

Kansas.

✣Bids will be received until 10 a. m., Feb. 3, by Capt. F. W. Van Duyne, Quartermaster, U. S. Military Prison, Fort Leavenworth, Kan., for furnishing [illegible] rods woven wire field fence, 500 lbs. galvanized fence staples and 4 barrels [illegible].

Kentucky.

✣As noted in our issue of Jan. 25 bids are being asked until 2 p. m., Feb. 20, by Maj. H. Jervey, U. S. Engineers, Cincinnati, O., for constructing Lock and Dam No. 29, Ohio River, near Ashland, Ky. This work consists of constructing lock, guide walls, river wall power house, the dam, including the navigable pass and the bear trap at the Chanoine weirs, and the abutment, the grading and paving the esplanade, etc. The estimate of quantities is as follows: 16 ft. cofferdam, 4,200 lin. ft.; 10 ft. cofferdam, 1,600 lin. ft.; common excavation, 93,681 cu. yds.; rock excavation, 4,155 cu. yds.; fill, 19,935 cu. yds.; riprap, 2,500 cu. yds.; oak timber, 69,317 ft. B. M.; reinforced concrete, 130 cu. yds.; concrete, 36,868 cu. yds.; concrete paving, 1,200 cu. yds.; structural steel, 1,024,884 lbs.; reinforcing rods, 21,353 lbs.; forgings, 56,582 lbs.; bolts, etc., 73,308 lbs.; iron castings, 277,887 lbs.; steel castings, 183,506 lbs.; bronze, 1,170 lbs.; drilling bolt holes, 4,900 lin. ft.; 5 in. pipe, 370 lin. ft.; 4-in pipe, 2,400 lin. ft.; 3-in. pipe, 570 lin. ft.; 2½-in. pipe, 750 lin. ft.; 2-in. pipe, 800 lin. ft.; tile drain, 850 lin. ft.

Louisiana.

✣Bids will be received until 7:30 p. m., Feb. 21, by Board of Commissioners, New Orleans, La., 200 New Court Bldg., for the fabrication and erection of the structural steel and cast iron for the William A. Kernaghan Shed. J. F. Coleman & Co. are Engineers. A deposit of $1,000 must be filed with each bid. Hugh McCloskey is President.

✣Bids will be received until 7:30 p. m. (instead of 1:30 p. m., as advertised in last issue), Feb. 21, by Board of Commissioners of the Port of New Orleans, 200 New Court Bldg., New Orleans, La., for the fabrication and erection of the structural steel and cast-iron for the William A. Kernaghan Shed. J. F. Coleman & Co., Engineers. Work is advertised elsewhere in this issue.

Maryland.

✣Bids will be received until 11 a. m., Feb. 8, by Board of Awards, J. Barry Mahool, President, Baltimore, Md., for furnishing for the use of the Electrical Commission, cement, sand, stone (crushed), brick, lumber, and for hauling bulk material. Raleigh C. Thomas is Chief Engineer, City Hall.

✣Bids will be received until 11 a. m., Feb. 1, by President J. Barry Mahool, Board of Awards, Baltimore, Md., for erecting a vault on the north side of driveway in front of present city hall annex No. 1. Edward D. Preston is Inspector of Buildings.

Massachusetts.

✣Bids will be received until 11 a. m., Feb. 10, by Commanding Officer, Watertown Arsenel, Mass., for furnishing and installing at the Watertown Arsenal a 15-ton acid tipping open hearth furnace and necessary changes in craneways and buildings.

Michigan.

⊙The Lake Superior & Ishpeming Ry. Co., R. C. Young, Chief Engineer, Marquette, Mich., has awarded the contract for the steel work for its $1,200,000 new ore dock, to be built at Marquette, to the Wisconsin Bridge & Iron Co., Milwaukee. The dock will be constructed of reinforced concrete. It will be 1,200 ft. long, 54 ft. wide and 75 ft. high, and will have 200 pockets of an aggregate storage capacity of 47,000 tons. The dock will require 5,000 tons of steel, 80,000 ft. of maple, 800,000 ft. of earth filling, 8,000 piles 80,000 ft. of lumber, and 33,200 yds. of concrete.

Mississippi.

✣Bids will be received until 3 p. m., March 8, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office at Brookhaven, Miss.

F. Lynn Brown, Chicago, Ill., has applied to the city council of Pascagoula, Miss., for a franchise for the erection of a gas plant, putting down mains, etc. The work is to be completed in two years after the passing of the ordinance.

Missouri.

✣Bids will be received until noon, Feb. 9, by George W. Pipe, Superintendent Police Buildings, 2829 Market St., St. Louis, Mo., for the erection and completion of a one-story Patrol House and stable for the Metropolitan Police Department to be located in City Block No. 4293 at the northeast corner Gimblin Road and Broadway.

New Hampshire.

⊙Williamson Bros. Co., of Philadelphia Pa., has been awarded the contract by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Dept., Washington, D. C., for furnishing and installing one electric motor driven capstan at the navy yard, Portsmouth, N. H., for $2,195. Bids were opened Jan. 7.

New Jersey.

✣Bids will be received until 8 p. m., Feb. 7, by James L. Wolfe, Town Clerk West New York, N. J., for the installation of a heating system in the town hall of the town.

✣Bids will be received until 10:30 a. m., Feb. 23, by Frederic H. Smith, Constructing Quartermaster, Fort Hancock, N. J., for furnishing and installing of door and window screens in public buildings at Fort Hancock, N. J., as per accompanying list. On One Double Set of Non-Commissioned Officers' Quarters—4 doors, 2 ft. 10 in. x 7 ft. 7 in., casing 1¼ in.; 14 windows, 2 ft. 10 in. wide x 2 ft. 6 in. high, wood frames; 2 windows, 2 ft. 10 in. wide x 1 ft. 10 in. high, wood frames; 4 windows, 2 ft. 10 in. wide x 1 ft. 3 in. high, wood frames. On One Double Set of Firemen's Quarters—4 doors, 3 ft. x 7 ft., casing, 1¼ in.; 14 windows, 2 ft. 11¾ in. wide x 2 ft. 1 in. high, wood frames.

New Mexico.

✣Bids will be received until 11 a. m., March 4, by the Quartermaster, Fort Bayard, N. Mex., for furnishing and installing door and window screens in three double sets of Company Officers' quarters.

New York.

✣Bids will be received until 11 a. m., Feb. 18, by Constructing Quartermaster, New London, Conn., for the construction at Fort H. G. Wright, N. Y., of a brick quartermaster's and ordnance storehouse and installing electric wiring and fixtures. Capt. F. T. Arnold is Constructing Quartermaster, New London.

✣Bids will be received until noon, Feb. 7, by State Board of Armory Commissioners, F. A. McNeely, Sec., Albany, N. Y., for the construction of revolver ranges, magazine, pump house and water supply work; property line fence; steel backstops; ice house at the New Work Rifle Range, Blauvelt, N. Y.

Ohio.

✣Bids will be received until 2 p. m., Feb. 28, by H. Jervey, Maj. U. S. Engineers, Cincinnati, O., for constructing four lock tenders' dwellings at dam No. 37, Ohio River.

Oregon.

✣Bids will be received until 4 p. m., Feb. 9, A. L. Barbour, Auditor, Portland, Ore., for furnishing the Fire Department of the City of Portland, Oregon, with 4,000 ft. of 2½ in. hose and 600 ft. of 1½ in. hose, said hose to be in 50 ft. lengths with couplings to correspond to those now in use in said Fire Department.

Pennsylvania.

✣Bids will be received until noon, Feb. 7, by J. F. Hasskarl, Acting Director Department of Wharves, Docks and Ferries, 555 Bourse Bldg., Philadelphia, Pa., for furnishing one deck and derrick scow.

⊙The McClintic-Marshall Construction Co., Pittsburg, Pa., has been awarded the contract at $314,000 for constructing the superstructure of the Vine St. pier for the city of Philadelphia.

Tennessee.

✣Bids will be received until 11 a. m., Feb. 20, by Maj. W. W. Harts, U. S. Engineer, Nashville, Tenn., for furnishing machinery, fittings, etc., for derrick boat Tishomingo.

Texas.

✣Bids will be received until 1 p. m., Feb. 3, by School Board, Brookshire, Texas, for the construction of a 2-story brick school building at Brookshire, Texas. Each bid must be accompanied by a certified check payable to J. W. Edmanson, President of the Board, for $250. F. S. Glover and Son, 324 Mason Bldg., Houston, Texas, Architects.

⊙C. G. Patton, Houston, Tex., has been awarded a contract by the International & Great Northern R. R., O. H. Crittenden, Consulting Engineer, Palestine, Tex., for the construction of wharves and warehouses on the company's property on the channel just below the turning basin. The wharves will be 400 ft. long and the warehouse 50x500 ft. The work will cost about $50,000. This is said to be the beginning of extensive improvements by the railway on its property on the channel.

Virginia.

⊙E. Cross & Son, Portsmouth, Va., have the contract for constructing 1,300 ft. of bulkhead in front of the Portsmouth Co.'s tract at Portsmouth, Va. It is possible that the bulkhead will be extended to 3,000 ft.

Canada.

✣Bids will be received until 11 a. m., Feb. 3, by M. Peterson, Secy Board of Control, Winnipeg, Man., for supplying a quantity of brass goods to be delivered F. O. B. cars City Yards, Winnipeg.

✣Bids will be received until 4 p. m., Feb. 13, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for alteration of the Examining Warehouse, Toronto, Ont. Plans, specifications and form of contract can be seen and forms of tender obtained at the office of Mr. Thos. Hastings, Clerk of Works, Postal Station F, Yonge St., Toronto, and at this Department.

⊙The Advance Machine Works of Walkerville, Ont., has been awarded the contract by the board of control, M. Peterson, Secy., Winnipeg, Man., for furnishing an electric traveling crane for $4,630. Bids were opened Jan. 23.

⊙Siemens Bros. Dynamos Works, Toronto, Ont., has been awarded the contract by the Board of Control, M. Peterson, Secy., Winnipeg, Man., for furnishing two 500 k. w. motor generator sets for $16,410. Bids were opened Jan. 23.

Mexico.

✣Bids will be received until March 1, by Lewis Lukes, Vice President and General Manager of Monterey Railway, Light and Power Co., Ltd., Apartado (P. O. Box 58 Monterey, N. L. Mexico), for the erection of a gas plant to serve the requirements of Monterey, Mexico, a modern city of 85,000 inhabitants, with first-class railroad facilities. Plans and specifications may be seen at the company's offices. Copies of plans and specifications, form of tender and other necessary information will be furnished responsible bidders on request. Separate or supplemental tenders will also be received at the same time for the laying of gas mains and curb connections.

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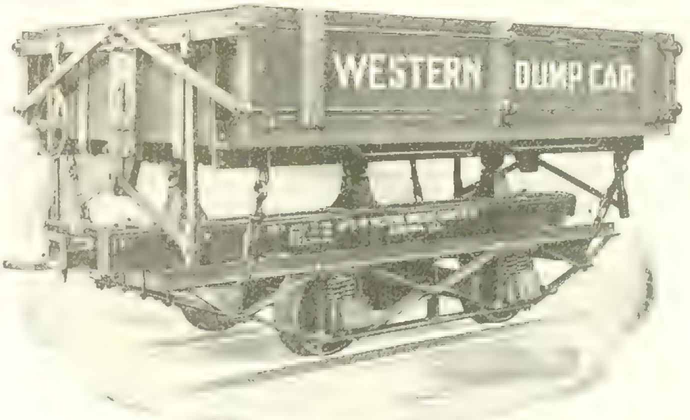

NOTICE TO CONTRACTORS.

Sealed proposals will be received at the office of the undersigned in the City of Bozeman, Montana, until 5 o'clock p. m. on the 16th day of February, 1911, for the laying of concrete on the sideslopes and bottom of the enlarged reservoir of the Bozeman City water works, amounting to about 4,840 square yards in accordance with the plans and specifications therefor on file at this office.

Blank "Proposals," copies of "Specifications," and "Instruction to Bidders" may be obtained of the City Clerk or the City Engineer.

Each bid must be accompanied by a certified check for Two Hundred Dollars ($200.00) upon some bank in Bozeman, Montana, payable to the Treasurer of said city, which check will be forfeited to the said city in case the successful bidder shall fail to furnish satisfactory bond and enter into the proposed contract within ten (10) days from the date of notification of award.

The City of Bozeman reserves the right to reject any and all bids.

A. M. BRANDENBURG,
City Clerk.

NOTICE TO CONTRACTORS.

Sealed proposals will be received at the office of the undersigned in the City of Bozeman, Montana, until 5 o'clock p. m., on the 16th day of February, 1911, for the excavation required to enlarge the reservoir of the Bozeman City Water Works, and increasing the size of the dam and banks with the excavated material, amounting to about 13,000 cubic yards in accordance with the specifications therefor on file at this office.

Blank "Proposals," copies of specifications and instructions to bidders may be obtained of the City Clerk or the City Engineer.

Each bid must be accompanied by a certified check for One Hundred Dollars ($100.00) upon some bank in Bozeman, Montana, payable to the Treasurer of said city, which check will be forfeited to the said city in case the successful bidder shall fail to furnish satisfactory bond and enter into the proposed contract within five (5) days from the date of notification of award.

The right is reserved to reject any and all bids.

A. M. BRANDENBURG,
City Clerk.

New Orleans, La., Jan. 23, 1911.

Sealed proposals will be received by the Board of Commissioners of the Port of New Orleans, at their office, Suite 200, New Court building, until Feb. 21, 1911, at 7:30 o'clock p. m., for the [illegible] and erection of the structural steel and cast iron for the Wm. A. Kernaghan Shed.

Deposit—One thousand dollars ($1,000), cash or certified check.

Bond—In full amount of contract.

Payment — Eighty per cent (80%) monthly.

Plans, specifications, proposal forms, etc., prepared by J. F. Coleman & Co., Engineers, are on file at the office of the Engineer, A. C. Bell, Suite 200, New Court building, New Orleans, La., by whom full sets will be furnished on deposit of twenty-five ($25.00) dollars, the said deposit will be refunded upon the safe return of said set in good order.

THE RIGHT IS RESERVED TO REJECT ANY AND ALL BIDS.

Hugh McCloskey, President.

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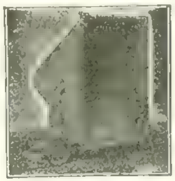

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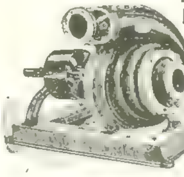

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To How Many Inches of Rainfall Is the Snow Melting Effect of the Sun, of Warm Rains and of Warm Winds Equivalent?

Experimental data collected by Prof. De Volson Wood, and confirmed by Langley, show that the sun delivers 600 B. T. U. (British thermal units) per square foot per hour to the earth's surface, when shining with full force. It requires 142 B. T. U. to melt a pound of ice or snow at 32° F. Hence, $600 \div 142 = 4.2$ lbs. of snow would be melted per square foot of surface per hour, if none of the sun's heat were reflected. Four and two-tenths pounds of water per square foot is equivalent to an amount of water slightly more than ¾ ins. thick produced in one hour. A rainfall of an inch in an hour is unusually heavy, and a fall of 2 ins. in an hour is exceedingly rare north of Texas, Louisiana, Mississippi and Florida.

While a considerable percentage of the sun's heat is reflected by snow, the steady heat of the sun for several hours on a spring day is clearly more effective in causing a great run-off of water than is the heaviest of rains in northern latitudes.

The sun's direct rays are often aided by warm winds, whose effect in melting snow is not readily estimated because of the difficulty of determining the number of cubic feet of air that comes in contact with the snow in a given length of time. The specific heat of air is 0.24. In other words, a pound of air contains 0.24 B. T. U. for each degree of temperature that it has. If the air is 62°, or 30° warmer than the melting snow, each pound of air contains $0.24 \times 30 = 7.2$ B. T. U. capacity for melting snow. Hence a pound of air could melt $7.2 \div 142 = 0.05$ lb. of snow, or 100 lbs. of 62 deg. air have the capacity to melt 5 lbs. of snow. Since a cubic foot of air at 32° weighs 0.08 lbs., it takes 1,250 cu. ft. of air to make 100 lbs. of air. Therefore if every particle of a layer of 62° air 1,250 ft. deep were brought in contact with a layer of snow each hour, the melting effect would be even greater than the direct rays of the sun. It is clear, then, that the combined heat of a warm wind and the direct rays of the sun have an effect far greater than any rain in producing a heavy run-off.

Warm rain has a melting effect that can be readily calculated. Thus, if rain at a temperature of 62° falls on snow, each pound of rain has 30 B. T. U. capacity for melting snow that has a temperature of 32°. Hence one pound of such rain will melt $30 \div 142 = 0.2$ lb. of snow. In brief, each inch of 62° rain will produce 0.2 in. of snow water. This shows quite conclusively that a warm rain is not itself the cause of heavy floods when it falls on snow. It is the warm air accompanying such a rain that produces the very rapid melting of the snow.

Engineers who have lived in the far West are familiar with the "Chinook winds" whose comparatively warm blasts convert acres of snow into water in such remarkably short time. On the Pacific coast the warm winds that come from the region of the Japan current produce thaws that put rivers above their banks in two days time or less.

Mr. J. E. Tupper calls attention, in our issue of Jan. 1, to some of the dangers inherent in using run-off formulas for calculating the size of culverts. We wish to emphasize particularly the danger of using run-off formulas based merely on observations of run-off due to rains. We believe that nearly all, if not all, the commonly used run-off formulas are irrational in that they make no adequate provision for the melting effect of warm winds and the direct action of the sun's rays.

We recall that a prominent hydraulic engineer, the author of a well known run-off formula, once criticised certain run-off data given in a paper written by a Western engineer. The criticism was based on the fact that the data showed a run-off in June far exceeding the rainfall for that month. The critic, however, had overlooked the fact that in the Rocky Mountain region much snow still remains on the ground in June, and that the warm air and sun's rays striking the snow will cause an astonishing run-off even though not a drop of rain falls.

Action of the American Society of Civil Engineers on Licensing Engineers.

A [illegible] published in another column of this issue. This is the [illegible] tion of the American Society of Civil Engineers. In its report to the society the board prefaced its recommendation with the following resolutions:

Whereas, There are national societies of engineers [illegible] which [illegible] nation of [illegible] engineers; and

Whereas, The public has ample protection if they will employ only those who have thus demonstrated their ability; be it

Resolved, That the board of direction of the American Society of Civil Engineers does not deem it necessary or desirable that civil engineers should be licensed in any state; and be it further

Resolved, That if, notwithstanding this, the legislature of any state deems the passage of a statute covering the practice of civil engineering desirable for the protection of the public, the accompanying draft of such a statute, which has been prepared by the board as embodying proper requirements for that purpose, is recommended.

At the annual meeting of the society at which the report of the board of direction was presented a resolution was passed approving its action. The opinions of this journal on the desirability of licensing engineers have been stated repeatedly and we shall not state them here. If engineers are to be licensed, and there is good reason to think that they will be by many states, it is very important that the license laws enacted shall be carefully thought out with all the available evidence and data at hand. It is to this end that we give space to the report of the American Society of Civil Engineers.

Inadequate Salaries of Highway Commissioners and Public Service Engineers in General.

Engineering positions in the public service are notoriously underpaid. We have frequently mentioned the glaring example in New York state where the State Engineer in charge of building the hundred million dollar barge canal receives only $5,000 a year, and until recently this same engineer also had charge of the state highways.

The state of Washington had spent on improved roads $640,000 during the 14 months preceding last October, yet the state highway commissioner in charge of this important work received only $2,500 a year. The governor of Washington appointed a board of engineers (Gillette, Donovan and Beard) to report on the administration of the highway department of the state (see *Engineering-Contracting*, Jan. 25, 1911, for the full report), and among the recommendations of the board of engineers was this:

> The salary of the highway commissioner is $2,500 a year. This is not a sum commensurate with the responsibilities of the position. It is often possible to secure a competent engineer, having executive capacity, without paying a larger sum than $2,500 annually for his services, but it usually happens that such an engineer soon receives more attractive offers, in which event it is more a matter of good luck than of good judgment as to salaries on the part of his employers if the engineer does not resign. It is particularly desirable not to make frequent changes in the staff of the state highway department. Otherwise all the experience that has been acquired by such a staff is lost to the state. One of the reasons why private work is usually better managed than public work is found in the fact that better salaries are paid to, or higher profits are made by, the men in charge of private work. The magnetic pull of the dollars is responsible for the passing of the most competent engineers out of public service into private occupations. While exceptions exist everywhere, the general rule is as stated. Hence the wisdom of paying liberally for brains [illegible] works. The highway commissioner should receive not less than $4,000 a year, and this sal- [illegible] in [illegible]

It seems to us within the rightful province of state engineering societies to present to state legislatures the reasons why engineering employes of the state should be paid larger salaries than they now receive. Indeed, it [illegible] bills providing for specific changes of salaries. Who will doubt that the salary of the State Engineer of New York could have been doubled many years ago had there been any concerted action on the part of engineers to secure an adequate salary for that position?

We have never heard of any organized effort on the part of engineers to secure better salaries for engineers in civil service other than the efforts of the Technical League. This League has concentrated most of its recent efforts, we believe, upon the passage of a law in New York state that will make engineering a "closed profession," similar to the professions of medicine and law. While there is a wide difference of opinion among engineers as to the wisdom of such a step, there should be no two opinions as to the wisdom of organized effort on the part of engineers to secure adequate salaries for civil service positions of an engineering nature.

A moment's thought will demonstrate that only by organized effort will it be possible to secure adequate salaries for engineers in public service. Such salaries are usually fixed by statute, city ordinance, or the like, and can only be changed by political activity on the part of some one. It is fruitless to hope for much change where no organized effort is made, but with such effort, radical changes can be secured *provided* they are economically justified. We contend that it is the fundamental law of business management that "payment for services should be proportionate to performance." The converse of this law is also true; as a rule: *Performance is usually proportionate to payment.* In other words, pay a man inadequately and he will tend to give inadequate service. If he does not, he is almost certain to be of that mental and moral fibre that leads soon to his resignation from the position whose pay is inadequate. The reports of bureau and department heads of states and cities repeatedly contain statements like the following, which we find in the 1910 report of the Public Service Commission of the Second District of New York:

> "The division [of statistics and accounts] has been somewhat hampered in its work through its inability to retain for any considerable period of time the services of many of the employes who have been engaged for its work. Against the competition of other state departments and outside employers it has been unable, with the appropriation at its command, to hold together a well organized force, and the year's work has therefore been accomplished under some difficulties."

In public service the tendency has always been to pay common laborers and "mechanics" much higher wages than are paid by private individuals and corporations. On the other hand, the reverse is true of public positions requiring education and brain power. Hence it is that labor unions usually favor abolishing contract work and substituting direct employment by government. The lower grades of public employes have secured their high compensation because of concerted political action on their part, and for no other reason. Now, it is concededly poor economy to pay a public employe more than he can earn in private life. It is equally poor economy to pay him less. In the former case he has really taken from the public what he is not entitled to. In the latter case the public has robbed him. While many able men continue to hold public places at inadequate salaries, it is undeniable that the general average ability and energy of underpaid men is far below what it would be if they were paid fairly. Of no class of public employes is this more certainly so than of engineers. A good engineer has innumerable opportunities always beckoning him, and he must be more than inordinately timid if he does not leave a public position that pays him meagerly.

Engineers—such as they are—can always be found to "fill" any position at any salary. Hence it is fallacious to assume because plenty of engineers are ready to step into a low salaried public place, that it is unwise to raise the salary. Some want the position on account of the experience to be gained—education at public expense. Others want it because of the notoriety to be gained—advertising at public expense. Others want it since they happen to be "out of a job"—temporary food and lodging at public expense. And all of these are men who will leave the position in due time because it fails to measure up to what they believe themselves worth. Therefore, the men who remain indefinitely in such places at low salaries are either below the average ability and education or belong to the meager ranks of the easily content.

To the Technical League and other organizations of engineers we commend concerted action toward raising, first, the salaries of engineers at the heads of departments, and, later, the salaries of such classes of subordinates as are underpaid. The effort should be made on the broad ground of public economy and not on the narrower basis of self-help. However, hypocrisy should never be practiced. Let it be candidly granted that self-interest exists, but let the fundamental argument be that public interest demands the application of the economic law that *"payment for services should be proportionate to performance."* Then let it be shown that upon the performance of engineers as engineers rests the economy of design, construction, operation and maintenance of public structures and plants costing great sums of money. Let it be shown that the men whose brains create these structures and plants are not to be rated with clerks and mechanics. For one dollar that an inefficient clerk or mechanic can waste, an inefficient engineer can waste hundreds, thousands, or even millions, where the work has sufficient magnitude. Yet we have before us the acme of absurdity in the payment to civil service engineers of salaries often less than the wages of bricklayers and carpenters.

Logic is with the engineering organization that seeks to better the salaries of engineers in public office. It needs but to link this logic with political action to gain the desired end.

Manganese Steel in Street Railway and Steam Railway Track.

The use of manganese steel in street railway track is rapidly becoming standard practice in the larger cities, where traffic is heavy. While the first cost of this metal is high, it is found nevertheless to be an economical substitute for the ordinary girder or T-rail construction. This is because of the remarkable resistance to abrasive wear and the high elastic limit of the metal. While there are several types of construction in common use, the details, owing to the light wheel loads of street railway cars, do not present any serious problems. In fact, a manganese plate of 1½ in. or 2 in. thickness, with proper flangeways, set into a cast steel base at the intersections, is in many cases a sufficiently good form of construction.

The extremely heavy wheel loads of the steam railways make such a construction as this impossible. Here the heaviest construction that is practicable must be employed. The manganese must not only take abrasive wear but must also offer resistance to heavy bending moments. The construction must also be economical in the broadest sense. These requirements make necessary forms of construction entirely different from those employed in street railway work.

Elsewhere in this issue we present a paper illustrating a standard form of construction for steam railway crossings, as developed by one of the leading manufacturers. Because of the increasing importance of manganese construction it is our purpose to illustrate in subsequent issues the forms and standards employed by other manufacturers.

Manganese crossings and rigid frogs are now practicable where heavy service warrants their use. Manganese steel rail is being successfully rolled, but owing to its high cost is not in general use. This objection will doubtless be overcome in time.

Manganese steel must either be rolled or cast to the exact form desired, as it is practically impossible to plane or drill it. Spring rail frogs and switch points therefore must be cast, on account of their irregular section. No generally accepted standards have yet been worked out. Experimental work, however, is being carried on by several manufacturers, and there is no reason why standards should not be developed that will be as satisfactory as those in use in crossing construction.

CONCRETE AND REINFORCED CONCRETE SECTION

Layout and Operation of a Cement Drain Tile Plant.*

The most important items which claim attention in considering the establishment of a cement tile plant are the amount of land needed and its location, the size and kind of building, provision for cement and sand storage, water system, machinery for handling and mixing the materials and making the tile, power for operating sand and facilities for handling the finished product.

The space needed for the plant will depend somewhat upon the stock kept on hand. This usually varies at different times of the year from practically nothing to perhaps 300,000 tile of all sizes; stocks of 250,000 of the smaller size are not uncommon in the dull season with plants doing a good business. Usually from three to five acres of ground is ample, and if not available it is possible to get along with less without serious inconvenience. The location of the site is perhaps more important than its extent. Close proximity to a railroad and a private siding are very desirable, as it is thereby possible to get materials, at least the cement, delivered to the plant cheaper; besides a much wider market for the product is open when the tile can be loaded directly from the yard into the cars. Some factories have in this way opened up a good dealer-trade, which they have found profitable. Better facilities for shipping large size tile are also obtained, making it possible to secure big drainage contracts.

The size and arrangement of the building will depend very much upon the layout adopted. The newer plants manufacturing all sizes of tile have a total floor space of from 9,000 to 15,000 sq. ft., all of which is practically on the ground level, as the nature of the materials and the process of manufacture do not seem to be adapted to buildings of more than one story.

The kind of construction should be at once durable, fireproof, economical, and easily heated in cold weather. That which immediately suggests itself and seems best adapted is a building with steel roof trusses and concrete block walls with reinforced concrete for the sand bins and roofs of the curing room. A frame building may be cheaper in first cost, but would be neither durable nor fireproof, and hence would not be economical. On first thought it may seem superfluous to make a cement drain tile factory fireproof, but several instances may be cited where plants housed in frame buildings that have taken fire have been completely destroyed.

There are few localities where sand and cement storage would not be required; a certain amount is always necessary to guard against a possible shut-down due to running out of material. A water system is required to furnish water for the boiler, for mixing materials and for curing. Screens and elevators or conveyors for taking care of the sand and gravel with the least amount of labor will prove a big saving in operating expenses.

Tile machines are of two classes, those which make tile 12 ins. long in sizes below 16 ins. in diameter and those which make the larger sizes up to and including those 36 ins. in diameter in either 2 or 2½ ft. lengths. The longer length of large tile is preferable since a

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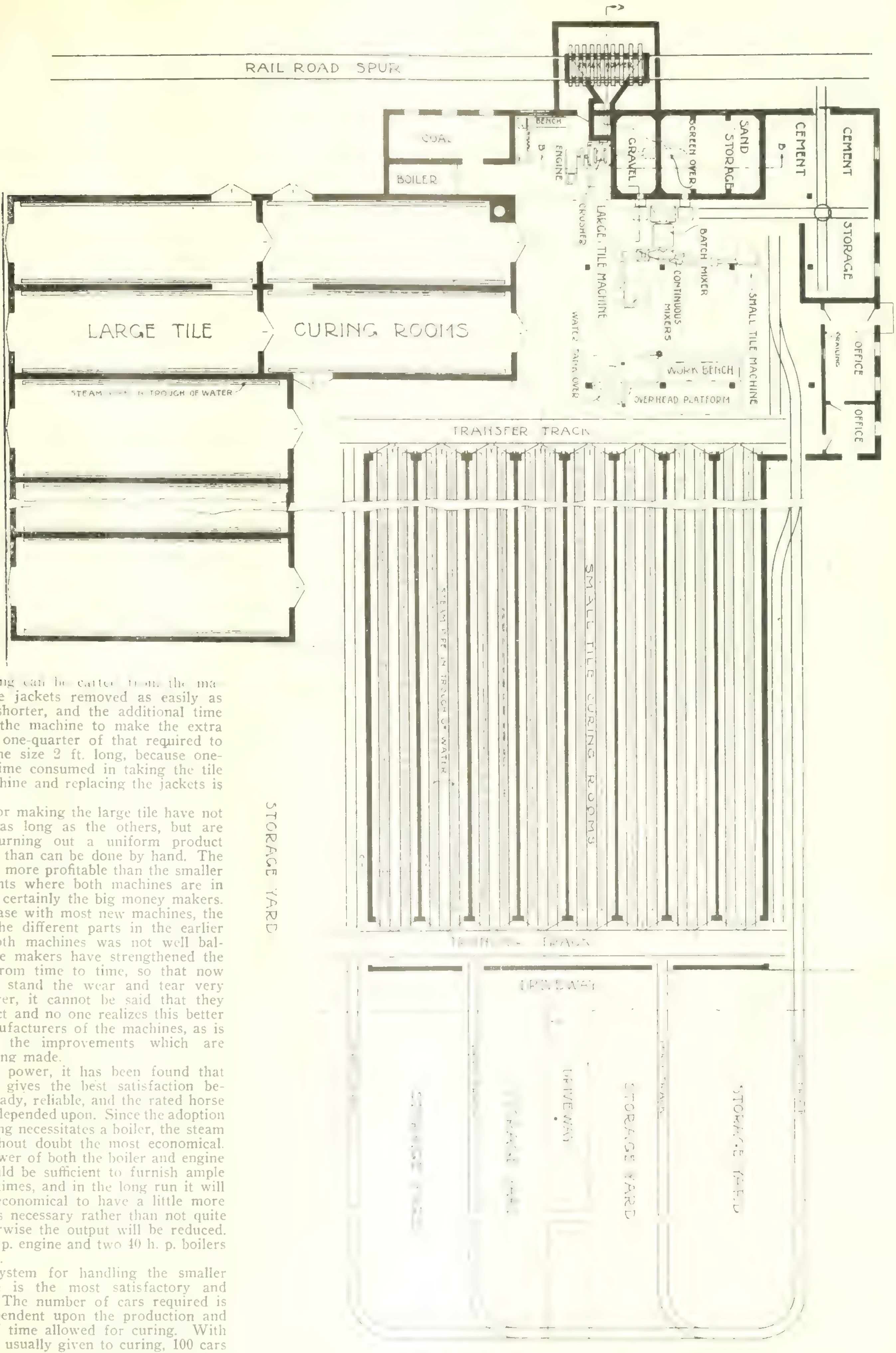
*Paper by C. M. Powell, read before The Na- [illegible]



[illegible] for Cement Tile Factory.

tile 30 ins. long can be taken from the machine and the jackets removed as easily as those 6 ins. shorter, and the additional time required for the machine to make the extra length is not one-quarter of that required to make the same size 2 ft. long, because one-fifth of the time consumed in taking the tile from the machine and replacing the jackets is saved.

Machines for making the large tile have not been in use as long as the others, but are capable of turning out a uniform product much cheaper than can be done by hand. The larger tile are more profitable than the smaller ones and plants where both machines are in operation are certainly the big money makers.

As is the case with most new machines, the strength of the different parts in the earlier models of both machines was not well balanced, but the makers have strengthened the weak parts from time to time, so that now the machines stand the wear and tear very well. However, it cannot be said that they are yet perfect and no one realizes this better than the manufacturers of the machines, as is evidenced by the improvements which are constantly being made.

As regards power, it has been found that steam power gives the best satisfaction because it is steady, reliable, and the rated horse power can be depended upon. Since the adoption of steam curing necessitates a boiler, the steam engine is without doubt the most economical. The horse power of both the boiler and engine installed should be sufficient to furnish ample power at all times, and in the long run it will prove more economical to have a little more power than is necessary rather than not quite enough, otherwise the output will be reduced. A 25 to 30 h. p. engine and two 40 h. p. boilers will be ample.

The car system for handling the smaller sizes of tile is the most satisfactory and economical. The number of cars required is naturally dependent upon the production and the length of time allowed for curing. With the time now usually given to curing, 100 cars is the average number used for one machine. The standard car has a 2-ft. gage and a platform 40 ins. wide and 8 ft. long. These cars are equipped with three decks, though four decks are sometimes used when the capacity of the curing chambers is limited. The disadvantage of the four deck car is that the tile on the top deck receives too much shaking or jarring, which increases the breakage materially. The upper decks are supported on a frame and hinged so as to be swung into a vertical position at one side of the car while the deck immediately below is being filled. The decks should be strong enough to hold the weight of all the tile which can be placed upon them without any appreciable deflection and should be constructed so as to give an even surface on which to set the tile.. They are usually made with a small angle iron frame and a wooden deck of 1-in. lumber laid crossways of the car. The structural steel used in the construction should not be too light, as thin shapes soon rust under the conditions which exist in the curing chambers, weakening the car and shortening its life.

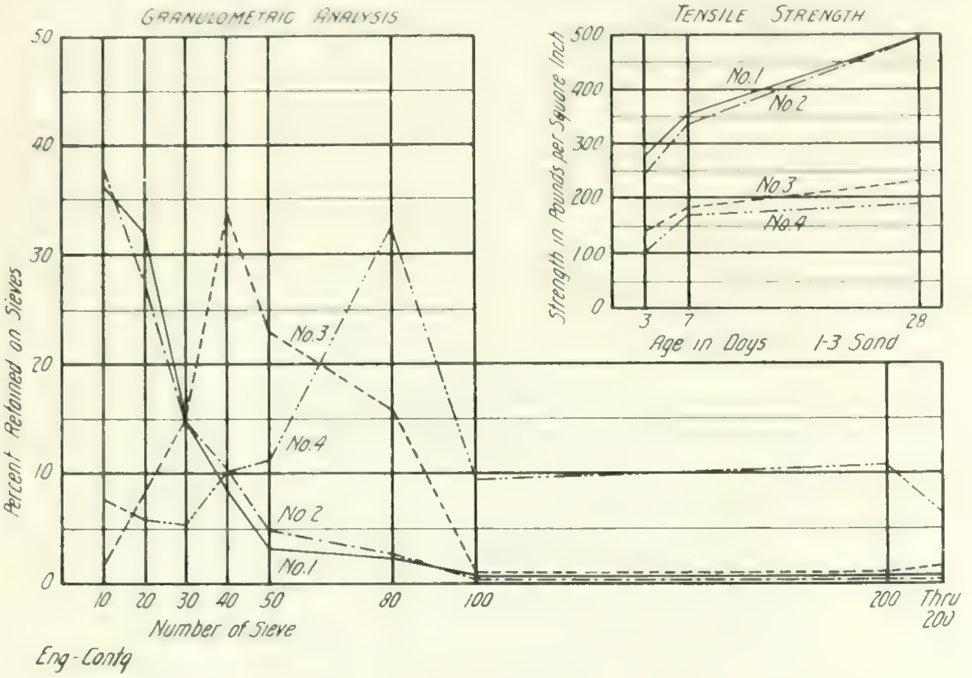


Fig. 3—Diagram Showing Comparative Tensile and Sieve Tests of Sand.

Cars without springs are much used and give good satisfaction provided the track is well laid and the rails are kept clean and free from sand, mortar and the like. However, springs may be used to take up the jolting of the car, but should be strong enough to allow the men removing the jackets to step on the cars without jarring down the tile.

The capacity of a standard three-deck car for the different size tile is about as follows:

4-inch..	314
5-inch..	244
6-inch................	172
7-inch................	112
8-inch................	94
10-inch................	54
12-inch................	49

At least two transfer tables are required to handle the cars to and from the curing rooms. In handling the empties the use of switches, where possible, will save labor in operation.

The object to keep in mind in the layout and equipment of a plant is that which will give the largest production of the best tile at a minimum cost for labor, materials and repairs, with the smallest investment consistent with good construction and equipment.

The relationship of one part of the plant to another should be such that the various operations of manufacture can be properly accomplished with ease and dispatch.

Innumerable layouts are possible in any manufacturing establishment and one seldom finds two exactly alike. In suggesting a tile plant layout it is the intention to combine the good points of the various plants and to introduce a few new principles and ideas, which it is thought will result in increased efficiency. It is believed that the layout suggested is one which can be operated the year round with the minimum amount of help, and produce a maximum output of the best quality at the smallest cost. The type of construction recommended is the one which seems best adapted to the business, though it requires a somewhat larger investment than the tile manufacturer has put into his plant up to this time, but it is in common use for other classes of factories. There was a time when it was thought that the investment of a few hundred dollars was sufficient to house a tile plant, but that time is passing. The tendency today is to build well and operate the plant on business principles.

The main part of the building is 50x75 ft. and in this are located the office and tile making machines. The sand, gravel, coal and cement storage, engine and boiler room are in the lean-to between the main part of the building and the railroad siding. The curing chambers for the small tile are on the opposite side of the building and those for the large tile are in the rear. A row of windows placed under the eaves, together with the windows in the gable ends, will furnish sufficient light.

The walls of the building are made of concrete blocks with the exception of the sand and gravel bins, which are monolithic concrete reinforced. The roof of the lean-to and the roofs of the steam curing chambers are also of reinforced concrete. This type of roof has been selected as embodying more good qualities than any other. Owing to the conditions existing in the chambers, timber roofs last but a few years; besides they are not fireproof. The roof of the main building is carried upon steel trusses which are supported by two rows of columns and the side walls. A concrete tile roof, although a little more expensive than some of the other kinds of roofs, should prove very satisfactory and last indefinitely.

The plan shows the interior arrangement of the plant. The mixing equipment is located directly in front of the sand and gravel bins between the two tile machines, so that concrete may be delivered to either one or both of the machines. The small tile as made are placed on a car at the side of the machine and removed, a carload at a time, over the transfer track to any of the curing chambers. The curing chambers open onto a transfer track inside the building at the opposite end and by means of a transfer table the cars can be taken to the yard through doors at the end of the track or through doors in the end of the building. The empty cars may be returned back to the machine by running them around on the track at the end of the yard or by being transferred.

The large tile are conveyed by two-wheeled carts directly from the machine to the curing chambers provided for them and are removed to the adjoining cars. As it is hardly possible to locate both the large and small tile storage yards next to the railroad track, it is advisable where only one siding is available to store the large tile nearest the track, as the small tile are easily handled and most of them are sold to the local trade.

The entrance to the plant is located so that any one hauling tile must necessarily pass the office. The front entrance to the building, through which all help and others should be required to pass, is through the office, which facilitates time keeping, etc.

In the main room an overhead platform provides a place for the extra jackets, packer heads, repairs and other accessories not in continual use, and may thus be gotten out of the way. A work bench around which there is enough space available for making such repairs as can be made at the plant, is placed directly under the overhead platform. The boiler and engine rooms are placed next to each other so that one man can be fireman and engineer. A dynamo is installed in the engine room to furnish light for the plant. A small steam engine is provided to run the dynamo as lighting is required mostly at night when the large engine would not be running.

All the materials are delivered along one side of the plant preferably by cars. The respective storage bins are separated from each other as much as possible to allow of "spotting" more than one car on the track at a time. The gravel is delivered by car or by wagon and dumped directly into the track hopper, from which it is elevated to the screen over the sand and gravel bins. A gravel bin is provided because it is not economical to make all the sizes of tile with the same aggregate. The sloping sides and bottom of the track hopper delivers all the material to the elevator, which carries the material high enough to spout it over the top of the storage bins to the rotary screen. That part of the material smaller than ¼-in. in diameter passes through the screen and into the sand bin, while that larger than ¼-in. and less than ½-in. in diameter falls into the gravel bin. All the coarser material is discharged from the lower end of the screen into a chute leading to a small hopper over

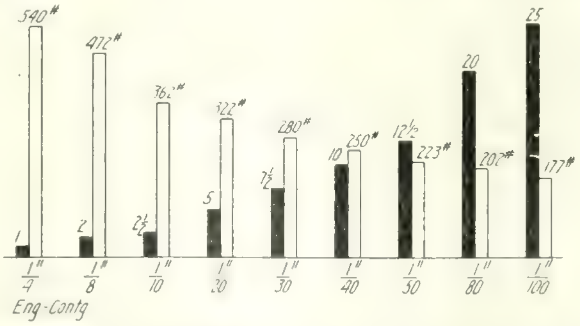


Fig. 2—Diagram Showing Relative Values of Coarse and Fine Sand.

the crusher, which is placed at the end of the bin. The crusher is set to reduce the materials to about ½-in. and discharges the crushed gravel into the elevator, which returns it to the screen. Wet gravel cannot be crushed because it will "ball" up the jaws of the crusher.

The bottoms of the bins are not hoppered or elevated, which allows of additional storage capacity, and the "dead" supply may be shoveled in case the material is required. The aggregates are drawn from the bins through an opening in the side at the floor line into a measuring chute. The flow is controlled by an under-cut gate, placed at the opening in the bin. When the measuring chute is filled the under-cut gate is closed and the charge is allowed to pour out into the loading skip by opening the gate in the lower end. The cement for the batch is placed in the skip with the sand, which is then hoisted and the materials dumped into the hopper of the batch mixer where they are mixed dry. The mixed dry batch is then discharged into a hopper which feeds uniformly into a pug for wet mixing, and as the feed to the pug is practically uniform, the consistency of the mixture can be easily controlled. One man should be able to run the batch mixer, as the only material which he has to actually handle is the cement.

The mixing outfit is standard, with the exception of the one-hoppered pug mixer, which is only a modification of one type of continuous mixer. Tile manufacture has been handicapped up to the present time by lack of a mixer which is adapted to the special needs of tile business. An ordinary continuous mixer which, as a rule, proportions the materials mechanically, is in general use in the majority of plants simply because it mixes the materials in the pug mill or mixing trough so they can be used, but the proportioning is uncertain and inaccurate. One manufacturer says that he believes his mixer is costing him $3 or $4 per day for the extra cement which he uses in an effort to avoid a lean mixture.

Although the batch type of mixer insures absolutely accurate proportions with but little if any extra labor, it is not adapted to mixing properly sand and cement. These materials, unless mixed with sufficient water to make them semi-fluid, tend to roll and ball, rather than be rubbed and mixed together, as they are when coarse aggregate is in the drum or as they are in the pug. Most any of the standard batch mixers will mix thoroughly the dry sand and cement. The combination recommended in the layout, if properly operated, would overcome all the mixing troubles which have heretofore been experienced.

There are many things in connection with the operation of a tile plant which require constant attention, but only a few of the most important ones will be discussed here. One of these, and one which does not receive the consideration which its importance warrants, is the selection of materials. Only the best materials should be used, because the most improved machinery and the best methods of manufacture cannot be expected to produce a good quality of cement tile from anything else. The question of cement may be dismissed with the suggestion that only Portland cement, which will meet the requirements of Standard Specifications, be used.

Too often the consideration of cost plays the important part in the selection of the aggregate, but this is gradually becoming at least partially subservient to those qualities which will produce the required results. Unless the aggregate is from a deposit of known quality, experience has shown that it should be tested. Heretofore there has been too much of a tendency to regard "sand as sand." Natural deposits of sand or gravel may or may not be suitable for cement work and only an investigation of the physical characteristics will determine their relative value.

If only one sand is readily available tests may show that sand obtained from another source at an increased cost will improve the quality of the product sufficiently to justify the extra expense in obtaining it. Again, it is but rarely that any two sands are of the same quality and a study of their physical characteristics will determine which of a number, that may be used, is best suited for the work.

In the selection of sand too much emphasis cannot be placed upon the value of coarse and properly graded particles. It is a well known fact that coarse sands are superior to fine sands for concrete, yet it is surprising how much fine sand is used for making tile. Fine sand has a greater number of particles per unit volume than coarse sand, and consequently more points of contact between the grains, therefore, it requires more water for the same consistency, more cement to coat the extra surface area, and is more difficult to mix properly. The water required is sufficient to separate the particles by surface tension, increasing the voids in the mortar, thus decreasing its density and strength. The relative value of coarse and fine grained sands is clearly illustrated by the diagram, Fig. 2. Assuming the short column (1) represents the surface area of a half bushel of spheres or sand grains, all of which are ¼-in. in diameter, the other column represents the surface area of a half bushel of spheres or sand grains, all of which are of the diameter indicated by the figure over each column. This diagram shows very forcibly that with the same measured amount of sand the surface area varies greatly with the size of the sand grains. The surface area of a quantity of spheres or sand grains, 1-100-in. in diameter, is 25 times greater than in the same quantity of spheres or sand grains ¼-in. in diameter. The open columns indicate the relative strength of test pieces made with one part cement and three parts sand, separated into various sizes. As the various sized particles were separated from the same original sample, it is reasonable to state that the difference in strength is entirely due to the size of the particles. It is interesting to note how rapidly the strength is decreased by the increase in the fineness of the sand.

A sand may contain a sufficient quantity of the smaller sizes to make it suitable for tile and still be scarce. This is illustrated by the results of tensile and sieve tests, as shown on the diagram, Fig. 3. Curves 3 and 4 show that these sands have an excessive amount of material retained on the 50 and 80 sieves with a corresponding decrease in strength of the mortar. Curves 1 and 2 represent good, coarse sand. Sand 1 has too much of the coarser sizes to be entirely suitable for making the smaller sizes of tile, although it is an excellent sand for large tile and general concrete work. Sand 2 is coarse, excellently graded and is an ideal sand for making tile. It is important that the individual sand grains be hard, as the mortar can be no stronger than the sand from which it is made.

An aggregate, either sand or gravel, containing any considerable quantity of shaley particles must be avoided, as such material is weak and may be disintegrated by frost. In the glacial gravel deposits of the Upper Mississippi Valley these soft, shaley pebbles are sometimes found in considerable quantities. In some of the river sands "lignite" proves troublesome. "Lignite" is a poor quality of coal, containing the texture of the wood from which it was formed, black in color, brittle and easily broken between the fingers. The larger sizes may be removed by screening, but even so, the smaller particles remaining expand during the hardening of the mortar, and those near the surface "pop out," disfiguring and weakening the tile.

Sand should be free from clay, loam, mica, or an excess of fine material, even though siliceous. It is not the presence of the clay or loam to a limited extent, but the manner in which it is present, that does the damage. The sand grains, themselves, must be free from a coating of foreign material. A simple and effective test for detecting such a coating on the sand grains is to wash a small sample by shaking it up in a bottle or jar with water, and after pouring off the water and drying the sample, to compare it with some of the untreated sand. If there is any appreciable difference in the color of the two, there is evidently a coating on the grains. Such sand will produce a weak mortar, because the cement cannot form a good bond with the aggregate, and the fracture of the mortar shows that the grains pull out of the cement, leaving little pockets lined with a thin film of clay. The use of such sand is apt to result in failure.

When cement tile was first made by machine very lean mixtures were used, but it was soon learned that this was objectionable, and the best practice now is to use for the tile 10 ins. and smaller, a mortar composed of one part Portland cement and not to exceed three parts of fine aggregate. For the larger sizes it is more economical to use concrete instead of mortar, the diameter of coarse aggregate being limited so as not to exceed one-half the thickness of the tile walls. The proportions for the concrete should be 1 part cement to not more than 2½ parts sand, with as much coarser aggregate, up to 4 parts, as can be used. With some materials the mixers may not carry four parts of coarse aggregate without causing trouble by the green tile falling down when stripped.

One of the most important things to watch in making tile is the consistency of the mix. The amount of water which it is possible to use in the mixture for machine made tile is at the best not sufficient to develop the full strength of the cement, and for this reason the mix should be made as wet as can be used. When the jackets are removed the tile should show water marks on the outer surface, that is, web-like markings, indicating free moisture. Although it is generally recognized among cement tile manufacturers that tile showing water marks are the strongest, this matter is not given sufficient attention. The tile made from a dry mix are not so apt to stick in the jackets as are those made from a wet mix, they stand up better, which probably explains why so many manufacturers use a dry mixture. Sticking to the jackets is easily overcome by holding the tile, before removal of the jacket, horizontally and hitting the end against the table of the machine just enough to loosen the tile from the jacket. The same thing is accomplished by setting the tile down hard on the car, but this thickens the walls at the end and is objectionable.

Because of an insufficient amount of water in the original mixture, every particle must be conserved, which is impossible if the tile are cured under normal atmospheric conditions. The object, therefore, in steam curing is to create an atmosphere saturated with moisture in a chamber sufficiently air tight to eliminate all possible draughts. It is not the intention to supply moisture to the tile, but to protect it perfectly against the loss of any moisture which was introduced when mixing the concrete. As a saturated atmosphere is required, the use of dry steam or steam under pressure is out of the question. Some plants are operated today by the use of such steam, and in parts of the curing chamber fairly good results are obtained, because the steam condenses in these parts, while product placed near the point at which the steam enters the curing chamber is poor, owing to the drying action of the steam. This condition is naturally aggravated in warm weather because the steam does not condense so readily. Only by the use of steam curing is it possible to obtain uniform conditions throughout the year. The safest and most satisfactory way of admitting steam into the curing chamber is through a perforated pipe, which is placed, perforations down, in a water-filled trench in the concrete floor of the room; the steam passing out into the atmosphere through the water naturally becomes saturated. The floor in the curing chambers is sloped toward the trench so that the water in the trough is constantly replenished by condensation. In this way there is little danger of excessive heat, for as long as the steam passes through water the temperature, no matter what it is, cannot have a drying effect. The nearer the temperature approaches the maximum possible with this method, the more efficient does the curing chamber become, for moist heat accelerates the hardening of the tile. With this scheme exhaust steam will not furnish sufficient heat during cold weather, therefore it is best to take live steam direct from the boiler. Tile should be run into the curing chambers as soon as made, but it is not advisable to start the steam until the tile have stood about an hour, especially in cold weather, because condensation will be very great until the chamber and the tile become heated up, and the gathering of moisture on the tile may be sufficient to damage them.

To operate the suggested plant to full capacity on all sizes of tile will require a foreman and about twenty men, distributed as follows: One engineer, one man running the mixer, one man feeding each tile machine and one operator on each machine, one man removing jackets from small tile, one handling cars and four yardmen, who remove the tile to the yard, load wagons and do odd jobs about the plant when not otherwise engaged, two men will always be needed, wheeling the large tile from the machine and sometimes three, one man removes the jackets and two men, with the help of the one man, sometimes used for wheeling tile, can remove the tile to the yard, load wagons and cars; a [illegible] man will be required to keep up steam, clean, repair and change the machines.

In order that no tile may be removed from the curing chambers too soon it is well to have the man handling the cars of small tile to the curing chambers keep a record of the number of tile of each size on each car and the number of cars placed in each chamber. The man removing the jackets from the large tile can keep a record of the number of each size placed in the different chambers, these records to be handed in at the office twice a day. By this practice a memorandum, showing the number of cars and the number and size of large tile in the different rooms, which are to be put in the yard that day, may be given to the yardmen every morning. From these records can be compiled the day's output and the stock on hand. Some allowance must be made for breakage, otherwise the number of tile in the yard will not agree with the number of tile made by the machines.

The arrangement of the stock piles should be such that the wagons may be loaded with any size and leave the yard by crossing the fewest number of tracks. This is accomplished best by piling the tile in long rows, parallel to the track. The distance between tracks may be anything desired. Some prefer not to have a greater distance than 20 ft. between the center line of the track and the center of the roadway. Others have found that a distance of 50 to 75 ft. to be a convenient width. In the latter case, to avoid carrying the tile long distances when unloading the cars, they are rolled down a chute, about 14 ins. wide with 4-in. sides and 20 to 24 ft. long, one end of which is placed on the edge of the second deck of the car. The tile can be rolled 30 to 35 ft., and this method proves very satisfactory for all the small tile larger than 5 ins. If the sales are large during the winter months, it is desirable to place the stock piles on a layer of straw or other material, as it is very often that the lower row of tile freezes to the ground, which prevents the wagon from getting close to the pile, and they cannot be loaded without much extra labor, if something of this kind is not done.

It is the best practice in loading tile either in wagons or cars to lay them horizontally, instead of standing them on end. They should be packed as closely as possible with no play; especially is this true in loading cars. Good cement tile, when properly loaded, can be hauled or shipped a considerable distance with little or no breakage. Switching partially loaded cars will cause excessive breakage. A car load of 30,000 lbs. will contain approximately

4,300	ft	of	4-in.
3,400	ft	of	5-in.
[illegible]	ft.	of	6-in.
2,000	ft	of	7-in.
1,500	ft	of	8-in.
100	ft	of	10-in.
800	ft.	of	12-in.
600	ft.	of	14-in.
500	ft.	of	15-in.
400	ft.	of	16-in.
300	ft.	of	18-in.
250	ft.	of	20-in.
210	ft	of	22-in.
200	ft.	of	24-in.
175	ft.	of	26-in.
150	ft.	of	28-in.
125	ft.	of	30-in.
110	ft.	of	32-in.
85	ft.	of	36-in.

Tests to Determine the Relationship Between Density and Strength of Mortar.*

During the winter of 1908 the writer made an extensive series of experiments to determine primarily the relationship between the density and the strength of a mortar, as well as the effect of gradation of size and the effective size of the sand particles, though no attempt was made to find the strongest mixture possible. It was necessary carefully to eliminate all other possible variables in this work in order to get results from which sound conclusions might be drawn. In order to have the sand perfectly homogeneous, beach sand from the vicinity of Plum Island, Mass., was used, there being three varieties, varying only in coarseness. They were all composed of nearly pure quartz with slight traces of mica. The following shows the granulometric composition of the three, No. 1 being the coarsest and No. 3 the finest. The values given represent the percentage of the sand by weight respectively passing and being retained on the sieves as given:

Sieves	Sand No. 1	Sand No. 2	Sand No. 3
8-10	0.8	0.0	0.[illegible]
10-20	13.3	2.0	2.0
20-30	68.[illegible]	22.0	13.6
30-40	15.[illegible]	34.[illegible]	11.7
40	1.7	26.7	11.2
50-60	0.6	2[illegible].0	26.7
60-80		2.7	15.3
80-100	.	2.1	16.5

In all, mortars were made of 15 different granulometic compositions of sand, all the sand being first mixed together and then sifted to the various sizes, as for instance 10-20, 20-30 30-40, etc. They were then mixed together in the desired proportions, these being shown in Table I. In combining the different sizes equal parts of each variety were used; for instance, in No. 12 one-half of the sand was from 10 to 20 and the other half from 50 to 60. In a case such as No. 11 the 20-50 means that there are equal parts of 20-30, 30-40, and 40-50. In all nearly 2,500 briquettes were made comprising 1-1, 1-2 and 1-3 mixtures, these being ratios of weight. The specimens were tested at the ages of one week, four weeks, three months and one year. Atlas Portland cement was used in all the work and the standard methods followed in making and breaking the briquettes. Varying percentages of water were used, the aim being to have all specimens of the same consistency and consequently the finer sand briquettes received more water than the coarser ones. The values given in Table 1 represent the average of 12 specimens in practically all cases; to each set the method of least squares has been applied to find the probable error of these mean values. There are also given in this table the absolute densities of each set; this is the ratio between the absolute volumes of the sand plus the cement to the measured volume of the mortar after initial set has obtained. The average strength for all ages is also given. Figure 1 shows graphically the relationship between the density and the strengths for all ages for the 1-1, 1-2 and 1-3 mixtures.

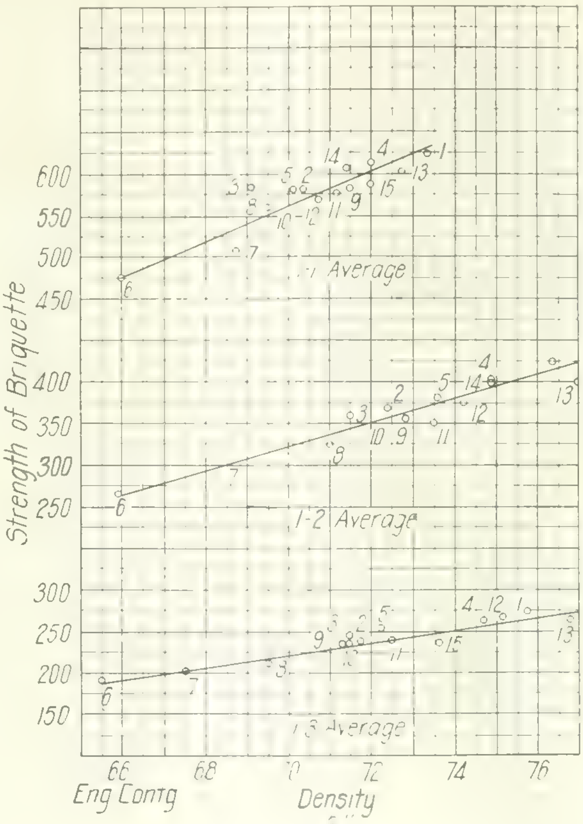


Diagram Showing Relations Between Density and Strength of Concrete.

Nos. 1, 4, 14 and 13 proved the best mixtures for all proportions, showing that coarseness is the most essential element of all. The poorest sand is that which is fine with but little gradation of size, as shown by Nos. 6 and 7. It should be noticed how much better No. 12 shows up relatively to No. 15 in the case of the 1-3 mixture as compared to the 1-1 and 1-2 mixtures; this shows that fine material was here needed for the No. 12, while for the other proportions the fine material was a detriment.

Although in the cases of the individual ages considerable irregularities appear in the relationship of density to strength, yet when the strengths for all ages are averaged, the strength is a very close function of the density, showing that the effect of the size and

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*Extract from a paper by R. P. Davis in the "Cornell Civil Engineer" for January, 1911.

TABLE I

No.	1-1								1-2								1-3								1-1		1-2		1-3	
	1 W		4 W		3 M		1 Y		1 W		4 W		3 M		1 Y		1 W		4 W		3 M		1 Y		Av	Den	Av	Den	Av	Den
1 Coarse	[illegible]	[illegible]	[illegible]	11.4	[illegible]	[illegible]	[illegible]	9.8	[illegible]	[illegible]	412 ±	[illegible]	442	[illegible]	460	[illegible]	[illegible]	3.8	[illegible]	[illegible]	290	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	424	76.4	273	75.7
2 Medium	621	8.5	[illegible]	[illegible]	623	9.1	[illegible]	[illegible]	[illegible]	7.1	371	6.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.6	241	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	580	[illegible]	369	[illegible]	241	71.5
3 Fine	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16.0	[illegible]	[illegible]	274	5.0	354	[illegible]	407	11.3	[illegible]	7.4	161	3.8	224	[illegible]	[illegible]	[illegible]	[illegible]	4.1	[illegible]	69.1	356	[illegible]	241	71.8
[illegible] (10-20)	614	[illegible]	[illegible]	[illegible]	613	[illegible]	[illegible]	[illegible]	352	[illegible]	392	4.6	422	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	212	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	365	[illegible]	[illegible]	73.6
[illegible] (20-30)	[illegible]	7.4	[illegible]	[illegible]	662	10.4	612	[illegible]	[illegible]	[illegible]	[illegible]	9	450	[illegible]	464	[illegible]	[illegible]	[illegible]	275	[illegible]	[illegible]	4.7	284	[illegible]	612	[illegible]	401	71.9	[illegible]	73.7
9 (30-40)	[illegible]	6.7	[illegible]	[illegible]	620	9.6	665	8.1	276	8.0	[illegible]	[illegible]	409	4.7	[illegible]	[illegible]	191	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71.4
8 (40-[illegible])	[illegible]	[illegible]	500	[illegible]	[illegible]	11	609	5.7	[illegible]	[illegible]	[illegible]	[illegible]	380	[illegible]	261	[illegible]	114	3	[illegible]	4.0	[illegible]	[illegible]	240	[illegible]	[illegible]	[illegible]	321	71.0	[illegible]	[illegible]
[illegible] ([illegible]-60)	[illegible]	[illegible]	[illegible]	11	[illegible]	[illegible]	[illegible]	[illegible]	213	4.3	[illegible]	[illegible]	321	[illegible]	319	4.8	140	3.8	196	[illegible]	229	1.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	200	[illegible]
6 ([illegible])	[illegible]	[illegible]	450	[illegible]	406	7.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] (10-[illegible])	[illegible]	8.8	[illegible]	[illegible]	316	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	352	[illegible]	415	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	70.1	[illegible]	73.6	[illegible]	[illegible]
10 ([illegible]-30 [illegible] 0.66)	[illegible]	[illegible]	[illegible]	[illegible]	306	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	344	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71.5
11 ([illegible])	592	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	428	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	251	[illegible]	[illegible]	[illegible]	[illegible]	71.2	319	[illegible]	229	72.5
12 (10-20 [illegible] 0.66)	[illegible]	[illegible]	410	[illegible]	624	[illegible]	600	[illegible]	311	[illegible]	[illegible]	[illegible]	401	[illegible]	424	[illegible]	333	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	371	[illegible]	268	[illegible]
13 (10-20 [illegible])	[illegible]	8.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.7	[illegible]	[illegible]	[illegible]	[illegible]	323	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	600	[illegible]	[illegible]	[illegible]	264	76.7
14 (10-40)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	311	[illegible]	[illegible]	14	[illegible]	11	[illegible]	[illegible]	[illegible]	[illegible]	266	[illegible]	[illegible]	[illegible]	254	[illegible]	606	71.4	401	[illegible]	[illegible]	[illegible]

gradation of size of the sand particles is due simply to their effect on the density. For this reason, density tests may be relied on to give full information concerning the value of a sand, in so far as its granulometric composition is concerned.

Specifications for and Cost of Concrete Sewer Pipe at Bellingham, Wash.

[illegible]

The city of Bellingham, Wash., is using cement and concrete pipe for storm water sewers. This pipe is made under a guarantee by the manufacturers. While the city does not stipulate any process of manufacture as long as the finished product conforms to the specifications, all the cement pipe used is made by one local concern and gives satisfactory results, as compared to the vitrified clay sewer pipe. There are only two vitrified clay sewer pipe manufacturers in the Northwest, and one of those is far below the cement pipe in efficiency and tests. All sizes of pipe from 4 ins. to 24 ins. are machine made. The process is as follows:

A flask made in halves is placed around a cast iron core, in a vertical position. The cement is placed in the annular space thus formed in batches, dry mixed, having 8 per cent to 10 per cent water. As the cement is deposited in the mold it is automatically tamped with a wood tamper running at the rate of five blows per second. The core in the meantime is kept stationary while the pipe is revolved around it, thus giving a smooth glazed effect to the inside. The actual cost to the manufacturer is as follows:

4-in. pipe	[illegible]
6-in. pipe	[illegible]
8-in. pipe	14 cts. per ft.
10-in. pipe	19 cts. per ft.
12-in. pipe	[illegible]
15-in. pipe	[illegible]
18-in. pipe	50 cts. per ft.
20-in. pipe	65 cts. per ft.

The above costs are based upon: Cement at $2.30 per bbl.; sand at $1.10 per cu. yd.; gravel at $1.20 per cu. yd.; labor at $2.25 per day, 8 hrs.; foreman at $4 per day, 8 hrs.

The pipe as sold, delivered upon the line of work at the following rates:

4-in. pipe	11 cts.
6-in. pipe	16½ cts.
8-in. pipe	22½ cts.
10-in. pipe	32ffi cts.
12-in. pipe	40 cts.
15-in. pipe	60 cts.
18-in. pipe	75 cts.
20-in. pipe	[illegible]

The difference in manufactured and delivered price, represents hauling, breakage and profits.

Several laboratory tests were made on cement pipe, and vitrified clay pipe, four samples of each were tested. Six, 8, 10 and 12 in. pipe, cement pipe, burst under about 60 lbs. pressure, although they started sweating at about 7 lbs. pressure. One made of the clay pipe products at 1½ lbs.' pressure, spurted small needle-like streams of water from innumerable pin holes, and at about 35 lbs. pressure would split.

The other make of clay pipe was far better, no loss due to percolation occurred under 16 lbs. The breaking occurred at about 65 to 70 lbs. This latter product of clay pipe was superior in our tests to the cement pipe but the former clay pipe was not to be considered. The following are the specifications upon which bids for concrete pipe are received:

Make.—[illegible] sizes of reinforcement of their different pipes.

[illegible] spects to the samples on record at the City [illegible] der of the City Engineer.

Quality.—When broken the pipe shall appear [illegible] bedded [illegible] the composition.

Composition.—The clearance between the bell [illegible] ample to allow a proper mixture of cement mortar to be placed in the annular space thus formed. The inside diameter of the bell shall not be less than ¾ in. greater than the outside diameter of the spigot. The following table shows what shall be the minimum sizes of pipe and mixtures of sand, [illegible]

TABLE OF MIXTURES AND SIZES FOR CEMENT PIPES.

Size, ins.	Thickness, ins.	Cement.	Sand.	Pea gravel.
[illegible]	[illegible]	One part	Two parts	None
[illegible]	[illegible]	One part	Two parts	None
10	1¼	One part	Two parts	None
[illegible]	1½	One part	Two parts	None
15	[illegible]	One part	Two parts	One part
18	[illegible]	One part	Two parts	One part
21	[illegible]¼	One part	Two parts	One part
24	[illegible]½	One part	Two parts	One part
30	3	One part	Two parts	One part

Cement.—The cement shall stand the prescribed test of the American Society of Civil Engineers.

Sand.—The sand shall be clean and not more than 235 per cent shall pass over a No. 40 screen, and all shall pass through a No. 4 screen.

Gravel.—The gravel used shall be clean and not less than ¼ in. in diameter and not greater than ½ in. in diameter, measured over the greatest diameter. Should any of the above [illegible] it may be all rejected.

Markings.—All pipe shall have marked on it the date of molding and the maker's name. When so requested the contractor shall deliver to the City Hall such samples as the City Engineer may call for.

Tests. Pipe laid upon a compact and even bearing of sand without side displacement shall stand a test of 1,000 lbs. per lin. ft. up to and including 10 in. pipe, 1,300 lbs. for 12 in. and 15 in. pipe; 1,600 lbs. for 18 in. and 20 in. pipe; 1,800 lbs. for 21 in., and 2,000 lbs. for 24 in., applied the whole length of pipe exclusive of bell. Untreated pipes shall show no percolation up to 15 lbs. per sq. in. and shall resist fracture at 50 lbs. per sq. in.

Drop Weight.—Pipe supported on a dry sand bed 2 ins. deep shall withstand without cracking the impact from two blows from a cast iron ball or similar object weighing 6 lbs., falling 18 ins. This test may be applied on the line of work. Any pipe at any time that is deemed unsatisfactory to the City Engineer shall not be used upon the work and the same shall at once be removed and satisfactory pipe furnished in its place. No pipe shall be delivered onto the work within 30 days after being molded.

*City Engineer.

Hand Hammer Drills for "Pop Holes."—On the excavation for the St. Mary's Falls Canal the Marsch-Robbins Co., Contractors, have adopted the use of a small air-operated hand hammer drill for drilling "pop holes" in large fragments of rock too large to be handled by the steam shovel. If the "mud cap" method of breaking these fragments was employed, there would be a heavy damage to the windows in the adjoining city. The present method results in a considerable economy in explosives. A block 5x5x4 ft. in size requires one hole 28 ins. in depth in which ¼ lb. of 40 per cent dynamite is placed with one exploder; "mud capping" would require about 5 lbs. of dynamite in this case. Sullivan type D 19 drills are used.

[illegible] their "trains," hauled by traction engines. The new road was built last fall from the railroad yard at High Falls, New York, to the contract [illegible] aqueduct. The traction engines had been used for about two years, but the different roads in that section caused excessive loss of time due to breakdowns and repairs.

ROADS AND STREETS SECTION

Road Work in Allegheny County, Pa., Including the Detailed Cost of Four Brick Surfaced Roads.

The Legislature of Pennsylvania passed on June 26, 1895, a road bill, which is known as the "Flinn Act." This act opened the way for the improvement of highways outside of city and borough limits by the County Commissioners of any county, either by direct taxation of by the issuing of bonds. Taking advantage of this act, the Commissioners of Allegheny county organized a Road Department in 1897, electing F. W. Patterson chief road engineer. He was succeeded in 1906 by the late George T. Barnsley, who served as road engineer until October 23, 1909, the date of his death. S. D. Foster is the present road engineer, and the Board of County Commissioners consists of I. K. Cambell, J. D. O'Neil and S. J. Toole.

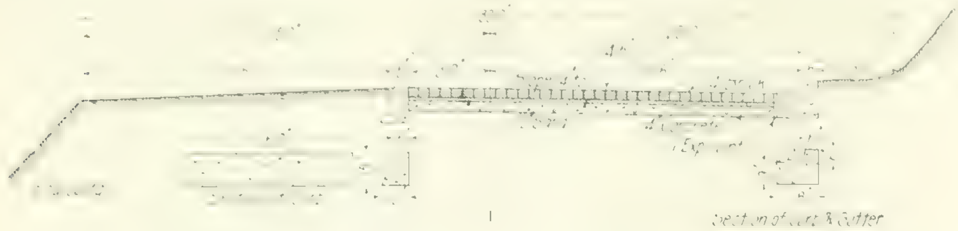

Fig. 1—General Section of Allegheny County Road Department for Brick Roads.

The work started in 1897 has been steadily carried forward until there are at present approximately 425 miles of improved roads within the limits of the county, connections having been made with neighboring counties, as follows: The Three Degree road connecting with State improvement in Butler County at Valencia, the Freeport No. 5 road connecting with State improvement in Butler County at Freeport, the Logans Ferry road connecting with State improvement in Westmoreland County at Parnassus, the Lincoln Way connecting with State improvement in Westmoreland County giving a direct connection with Irwin, and the Library Extension No. 2 road, connecting with Washington County improvement at Library, giving direct connection to Finleyville. Several other direct connections at the county line are in the course of consideration between the County Commissioners of the various adjoining counties and the Allegheny county board.

It is possible today to travel in a continuous circuit almost 250 miles, without encountering a mud road. There are within the limits of the County almost 1,700 miles of road. Thus it will be seen that about one-fourth of the total mileage has been improved. Under the present bonding powers of the Flinn Act the Road Department will be able to complete a total of about 600 miles, but it is hoped that the Legislature will pass an act empowering the commissioners to carry to a completion the good work which is now so far advanced.

The County Commissioners realized some years ago that the advent of the fast traveling automobile had made necessary a change from the old fashioned macadam surface. At the beginning of the present administration the Commissioners decided to investigate and experiment with a variety of materials which might take the place of their present roadway construction. Accordingly, under the supervision of the Road Department, 1½ miles of roadway was built on the Perrysville road, using a combination of coal tar and trap rock, four miles of top surface was put on the Freeport road between Powers Run and Cheswick with "Amiesite," which is a composition of asphalt, the People's road was treated with rock asphalt for 1½ miles, this being a natural product, the sandstone being impregnated with mineral asphalt to the extent of 7 or 8 per cent, and 1½ miles of bithulithic top was placed on the Steubenville Pike beyond Crafton. Experiments were also carried on, using various grades of heavy asphalt oil for the purpose of allaying the dust and as a road preservative. It was deemed, after a very careful investigation, that certain roads would be more economical in the long run if brick construction were used for a wearing surface. Accordingly brick was used on four of the resurfacing propositions and a majority of the new construction lying near the large centers of population was awarded brick construction. The four resurfacing propositions were done by the Maintenance Forces of the County Road Department and detailed costs on this work are given below. During the year of 1910 approximately 30 miles of new macadam road and approximately 10 miles of new brick roads were completed. With the maintenance forces 55 miles of road were reconstructed with macadam and the various experimental top surface and three miles of brick surfacing. The maintenance force also oiled approximately 100 miles of road and maintained and kept in good repair the remaining portions of the road system.

The average cost of resurfacing 389,726 sq. yds. of macadam roadway with 4 ins. of limestone or traprock was 42.91 cts. per sq. yd. For this work it would be fair to assume an average haul of two miles for all material, at a cost of 60 cts. per ton. The average cost of material was $1.10 per ton.

In the accompanying cuts Fig. 1 shows the Allegheny County Roads Department's general section for brick roads and Fig. 2 shows the section for a brick road with tile drain and side drain. The brick pavements are made of vitrified fire clay or shale block, and the standard specifications provides that all pavements of this type shall be laid on a concrete base 4 ins., or more in thickness, and shall have a cushion of river sand or crushed slag sand 1½ ins. in depth and a wearing surface of 4 ins. in thickness, the joints of which shall be filled with Portland cement filler. The bricks are required to be approximately 3¼x4x9 ins. in size and must not have less than two or more than four vertical lugs. It is required that the projections shall not be more than ½ in. wide on one side of each brick. It is further required that the total area of all lugs shall not be more than 3 sq. ins., so that when laid there shall be a separation between bricks of at least ⅛ in. and not more than ¼ in. The two ends of the bricks are required to have a semi-circular groove with a radius of not less than ⅛ ins. and not more than ¼ ins. These grooves are so located that when the bricks are laid together, the grooves shall match perfectly, and shall be horizontal when bricks are laid in pavement. On grades of 5 per cent or over the engineer may if he deems it advisable for the traffic, order the use of a spcial form of brick suitable for steep grades.

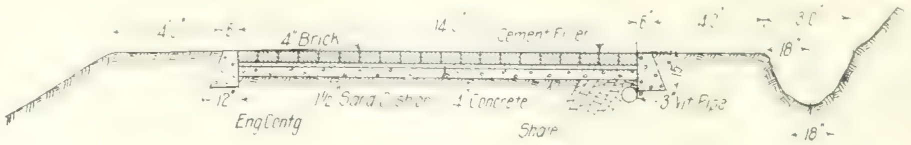

Fig. 2—Section of Brick Road.

The standard specifications provide that the joint grouting for the bricks shall be done in the following manner:

> The mixture shall be removed from the mixing box to the road surface by means of scoop shovels and from the moment it touches the brick, shall be thoroughly swept into all joints by means of push brooms. The work of grouting shall be thus carried forward the entire width of the pavement in line until sufficient time has elapsed for the grout to thoroughly penetrate all joints before the cement has attained its initial set. The entire force will then go over the same portion of the work a second time, using the same mixture of grout, except that it shall be mixed to a somewhat thicker consistency, care being taken in each instance to thoroughly fill all joints flush with the top of the brick. To secure flush joints, a third coat of cement shall then be swept in before the second has attained its initial set.

The standard concrete curb constructed in connection with the brick paved roads, is 6 ins., 12 ins. x 15 ins. as shown in Fig. 1. The curbing is molded in place and cut in sections 6 ft. in length. The concrete is composed of 1 part Portland cement and 4 parts gravel or broken stone, as specified, with a sufficient amount of river sand to fill all voids, in order to make a solid mass. The surface of the curbing, 1 in. in thickness, is composed of 1 part Portland cement and 2 parts sand. The standard combination curb and gutter is 6 ins. x 18 ins. x 15 ins., having a 12-in. gutter, as is also shown in Fig. 1. It is laid in the same manner as the concrete curb.

As previously noted portions of four roads were resurfaced last year with brick by the Maintenance Forces of the Allegheny County Road Department. These roads were the Natrona Road, section of which is shown in Fig. 3, the Evergreen Road, section of which is shown in Fig. 4, the Versailles Road and the Noblestown Road. Detailed cost data on the work on these roads are given below.

NATRONA ROAD.

Concrete combination curb and gutter (2,709 lin. ft.).

	Total.	Per lin. ft.
187 bbls. cement at $1.05	$196.35	$0.07248
58 tons sand at $0.95	55.10	.02034
177 tons gravel at $0.75	132.75	.04900
Ligonier dust for finish	15.38	.00567
Labor making and laying	379.26	.14000
Totals (2,709 lin. ft. curb and gutter)	$778.84	$0.28749

Concrete flush curb 6 in. x 12 in. x 15 in. (2,309 lin. ft.).

	Total.	Per lin. ft.
99 bbls. cement at $1.05	$103.95	$0.04501
692 bu. sand at 4¼ cts	29.41	.01274
1,752 bu. gravel at 4¼ cts	74.45	.03224
Labor making and laying	230.90	.10000
Totals (2,309 lin. ft. curb)	$438.71	$0.18999

Concrete foundations (150 cu. yds.).

	Total.	Per cu. yd.
125 bbl. cement at $1.05	$131.25	$0.8750
1,048 bu. sand at 4¼ cts	44.55	.2970
3,240 bu. gravel at 4¼ cts	137.70	.9180
Labor making and laying	150.00	1.0000
Totals (150 cu. yds. foundation)	$463.50	$2.0900

Concrete in culverts (47 cu. yds.).

	Total.	Per cu. yd.
50 bbl. cement at $1.05	$ 52.50	$1.117
12 tons sand at $0.95	11.40	.243
35 tons gravel at $0.75	26.25	.556
Rail ends for reinforcement	37.69	.802
1,074 hrs. labor making and laying at 17½ cts	188.00	4.000
Totals (47 cu. yds. culvert concrete)	$315.84	$6.718

Four cast iron sewer drops complete.

	Total.
4 cast iron sewer drops at $12.50 each	$50.00
8 lin. ft. 12 in. pipe at 27 cts	2.16
2 elbows, 12 in. pipe, at 81 cts	1.62
1 casting for drop	3.24
27 hrs. labor at 20 cts	5.40
Total	$62.42

Concrete Foundation (45 cu. yds.).

	Total.	Per cu. yd.
26 bbl. cement at $1.13	$ 29.38	$0.6529
Cost of sand and slag and hauling same	87.62	1.9471
Labor making and laying	45.00	1,0000
Totals (45 cu. yds. concrete foundations)	$162.00	$3 6000

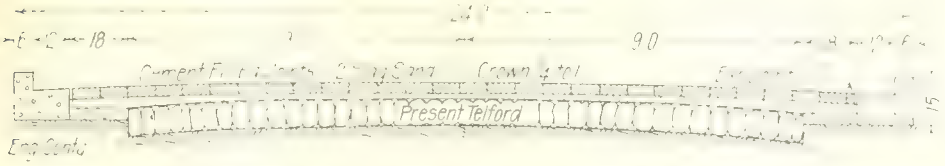

Fig. 3—Section for Brick Paving, Natrona Road.

Brick Pavement (5,288 sq. yds.).

	Total.	Per sq. yd.
230,000 brick at $15 per M	$3,450.00	$0.65253
Hauling 230,000 brick at $1.75 per M	402.50	.07611
7,140 bu. sand for cushion at 4¼ cts	303.45	.05738
Tar for expansion joints	18.76	.00354
95 bbls. cement for grout at $1.05	99.75	.01886
573 bu. sand for grouting at 4¼ cts	24.35	.00460
695 hrs. labor grouting at 20 cts.	139.00	.02629
Use of road roller	150.00	.02836
Fill for expansion	3.30	.00063
Lumber for expansion and templets	9.45	.00179
Labor laying	264.40	.05000
Totals (5,288 sq. yds. brick pavement)	$4,864.96	$0.92008

EVERGREEN ROAD.

Concrete Flush Curb, 6 in. x 12 in. x 15 in. (9,308 lin. ft.).

	Total.	Per lin. ft.
395 bbl. cement at $1.13	$446.35	$0 0479
145 tons sand at 60 cts	87.00	.0093
41 tons slag sand at 90 cts	36.90	.0039
30 tons gravel at 40 cts	12.00	.0013
370 tons slag screenings at 45 cts.	166.50	.0178
Hauling 586 tons sand and slag at 60 cts	351.60	.0377
Cost of team for water wagon erect. concrete	295.85	.0318
Labor making and laying	930.80	.1000
Totals (9,308 lin. ft. curb)	$2,327.00	$0.2497

Concrete Combination Curb and Gutter (3,436 lin. ft.).

	Total.	Per lin. ft.
228 bbl. cement at $1.13	$257.64	$0.0750
89 tons sand at 60 cts	53.40	.0155
107 tons gravel at 40 cts	42.80	.0124
118 tons slag at 45 cts	53.10	.0154
314 tons hauling sand, gravel and slag at 60 cts	188.40	0548
Labor making and laying	481.04	.1400
Cost of water wagon for concrete	143.40	.0418
Totals (3,436 lin. ft. combination curb and gutter)	$1,219.78	$0.3449

Brick Pavement (12,428 sq. yds.).

	Total.	Per sq. yd.
516,000 brick at $14.70 per M	$7,585.20	$0.6103
Hauling 516,000 brick at $2.65 per M	1,367.40	.1100
4,500 brick and hauling same	137.05	.0110
795 tons river sand at 60 cts	477.00	.0384
530 tons slag sand at 90 cts	487.00	.0392
1,325 tons sand, hauling at 60 cts.	795.00	.0639
12 bbl. pitch and pitch kettle	73.48	.0059
3 rolls felt paper	8.90	.0007
108 hrs. heating and pouring pitch	21.60	.0017
156 bbl. cement for grouting at $1.13	176.28	.0142
1,584 hrs. labor cement filling at 20 cts	316.80	0255
Use of road roller	235.00	.0181
Lumber for templets and expansion	26.60	.0021
Labor laying	844.97	.0700
Totals (12,428 sq. yds. brick pavement)	$12,552.28	$1.0108

VERSAILLES ROAD.

Curb, 6 in. x 12 in. x 15 in. (3,407 lin. ft.).

	Total.	Per lin. ft.
144 bbl. cement at $1.13	$162.72	$0.0477
57 tons sand at 70 cts	39.90	.0117
143 tons slag screenings at 40 cts.	57.20	.0168
200 tons hauling sand and screenings at 70 cts	140.00	.0410
Labor and team hire, water wagon, cement	94.20	.0276
Labor making and laying	45.00	1.0000
Total (3,407 lin. ft. curb)	$834.72	$0.2448

Brick Pavement (3,244 sq. yds.).

	Total.	Per sq. yd.
136,000 brick at $15.50 per M	$2,108.00	$0.6498
Hauling 136,000 brick at $2.50 per M	340.00	.1048
95½ tons sand at 70 cts	66.85	.0206
79 tons slag sand at 85 cts	67.15	.0207
Hauling 174½ tons sand at 70 cts.	122.15	.0376
1 roll felt expansion joints	3.25	.0010
4 bbl. pitch, 2,240 lbs., at 75 cts. per 100 lbs	16.80	.0052
68 bbl. cement at $1.13	76.84	.0236
445 hrs. labor for grouting at 20 cts. hr	89.00	.0274
60 hrs. labor heating and pouring at 20 cts	12.00	.0037
Use of road roller	50.00	.0154
Labor laying pavement	259.52	.0800
Totals (3,244 sq. yds. brick pavement)	$3,211.56	$0.9895

NOBLESTOWN ROAD.

Concrete Flush Curb, 6 in. x 12 in. x 15 in. (6,830 lin. ft.).

	Total.	Per lin ft.
242 bbl. cement at $1.17	$283.14	$0.0415
115 tons sand at 75 cts	86.25	.0124
156.4 tons gravel at 55 cts	86.02	.0123
77 tons slag screenings at 45 cts.	34.65	.0051
Hauling 348.4 tons slag material at 60 cts	209.04	.0306
Cost of team and labor unloading cement	19.87	.0029
Cost of water wagon, the use	186.00	.0272
Labor making and laying	683.00	.1000
Totals (6,830 lin. ft. curb)	$1,587.97	$0.2320

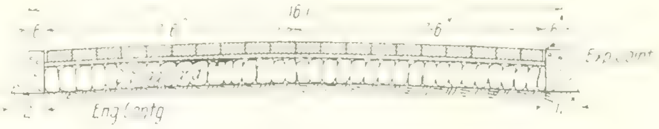

Fig. 4—Section for Brick Paving, Evergreen Road.

Brick Pavement (5,409 sq. yds.).

	Total.	Per sq. yd.
225,000 brick at $14.70 per M	$3,307.50	$0.6115
Hauling 225,000 brick at $3.40 per M	765.00	.1414
1,816 tons sand at 75 cts	136.20	.0251
191.2 tons slag sand at 90 cts	172.08	.0318
372.8 tons sand at 60 cts. for hauling	223.68	.0413
4 bbl. pitch at 75 cts. per 100 lbs.	17.25	.0032
63 hrs. labor heating and pouring pitch at 20 cts	12.60	.0023
128 bbl. cement for grouting at $1.17	149.76	.0277
854 hrs. labor for grouting at 20 cts	170.80	.0315
2 rolls felt paper, expansion, at $2.75	5.50	0010
Use of road roller	70.00	.0129
Labor laying	378.63	0700
Totals (5,409 sq. yds. pavement)	$5,409.00	$0.9999

The above data does not include the cost of excavation for the different classes of work.

Polaris, the north star, is probably the star most familiar to all surveyors and to most other persons. It is interesting, therefore, to know that Polaris is really three stars, though appearing as one, even through ordinary telescopes, but by means of the great Lick telescope on Mount Hamilton, California, it was learned some time since that it is comprised of three distinct stars which revolve about each other.

The Relation Between Modern Traffic and the Alignment and Profile in Highway Design.*

During the past few years, highway engineers have endeavored to find some method of road construction that will economically resist the excessive wear produced by a heavy automobile traffic and at the same time eliminate the dust nuisance. Most of their endeavors have been confined either to incorporating a heavy bituminous binder with the road material or to using a light binder or dust palliative on the surface, and although in a great many instances the results obtained have been successful, they have not always been economical. There is no doubt that some such form of construction is absolutely necessary for a road which is subjected to a heavy motor car traffic and to use the one which will produce the result desired at the lowest cost is the most difficult part of the problem in the design of highways at the present day. Besides the particular method of construction, however, the relation between modern traffic and the alignment and profile of the road is a matter of great importance and a careful consideration of this point will tend to produce roads that will not only be safer to the traveling public but will also be more economical to maintain.

The design of roads suitable for a horse drawn vehicle traffic alone will first be considered. According to theory the maximum grade allowable is the one over which the greatest loads expected can be hauled at the least expense. In practice, however, the maximum grade is also governed by other factors than the loads to be hauled, and in most states a maximum rate of grade is established which is never exceeded except when surrounding conditions and the consideration of cost make it advisable to use a steeper grade. Although the determination of the grade is effected somewhat by the surface drainage, the latter is of much greater importance when taken into consideration with the crown or transverse slope of the road.

It is customary in the design of ordinary roads to make the transverse slope from ½ in. to ¾ in. per foot sloping in a straight line both ways from the center to the sides or else to secure about an equivalent amount of slope by means of a parabolic or compound curve. On the steep grades a greater transverse slope is required than on the flat ones in order to guard against the danger of the water rushing down the grade and gullying out the road.

As far as the alignment of the road is concerned it is desirable of course to obtain the shortest distance between any two points, but in most instances the road to be improved has been laid out for many years and to abandon it for any great length for the sake of shortening the distance would be of little benefit, since usually the cost is increased by the heavy grading encountered and also whatever advantage there might be in having the old road bed serve as a foundation for the new road would be lost. Therefore the old road is generally followed very closely; only the worst of its irregularities in line are straightened out and sometimes short detours are made in order to improve the grade. With horse drawn traffic alone, neither sharp corners nor bad curves are considered detrimental to the road as the speed of the vehicles is not great enough to make it dangerous or to cause excessive wear at these points.

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*Paper by Henry B. Drowne, Assistant Engineer, State Board of Public Roads of Rhode Island, presented before Section D of the American Association of Science at the Minneapolis meeting, Dec. 29, 1910.

In thickly settled communities where roads varying from [illegible] already exist the full width is generally improved. On the trunk lines connecting towns with each other and with the cities a width of from 12 to 16 ft. is found to be ample and to give sufficient clearance between passing teams. The width chosen in any particular case depends upon the amount of money it is advisable to spend on the road, as the cost of the surfacing varies almost directly as the width and only a heavy traffic would warrant the expenditure for a 16 ft. road.

In designing a road that takes either automobile traffic alone or a combination of automobile and horse drawn vehicle traffic, the safety of the traveling public as well as the construction of an efficient surface must be considered. If the speed of the motor vehicle could be limited in the sparsely settled districts a large part of the road builders' troubles would cease but, although ordinances regulating the speed are in effect in almost every state in the Union, as a matter of fact they are disregarded about every time the opportunity occurs with the result that the ordinarily constructed roads go to pieces.

Besides the danger of collision on roads subjected to automobile traffic where sharp curves occur, it is observed that at these points excessive wear takes place, particularly if the road is crowned both ways from the center line. It is natural for all traffic to keep to the inside of the curve as closely as possible and in the case of the motor vehicles, if the speed is not brought down to about 10 or 15 miles an hour, there is a slew to the hind wheels as they pass around the curve which tends to grind out the road material. The half of the road that slopes from the center to the outside of the curve receives hardly no travel at all either from machines or horse drawn vehicles and the writer has observed this fact in several instances, particularly on very sharp curves. Conditions are the same on slight curves except the damage is much less extensive. In order to lessen the wear on the road and to protect the traveling public, it would seem fit that all curves should be eliminated or made as slight as possible consistent with economy. As long as one-half of the road, when it is crowned both ways from the center, is not used, it would be best to make a one way slope on the curve up from the inside edge and to increase the rate of this slope in proportion to the degree of curve. Practically the entire width of road is brought into use by doing this and hence the wear is much more evenly distributed. As far as the alignment of the rest of the road is concerned the straightest road is the best as it gives a clear view and therefore the tangents between curves should be as long as possible.

Perhaps a new location of the road would be of great advantage in some cases when both kinds of traffic have to be considered. Take for instance an old road with many sharp curves; it might be possible to improve such a road by a new layout so that many of the curves would be avoided and at the same time keep the new location near enough to the old so that the surrounding communities would be served just as satisfactorily. The advantages accruing from any such improvement would be a decreased cost of maintenance, a probable decrease in distance, a probable better grade and a safer road to travel. This last item cannot be figured in dollars and cents but its importance and worth should not be neglected in comparing the costs of construction between the old and new locations.

The crown of the road on the tangents should be as flat as the drainage of the road will allow because the flatter the road the more evenly is the traffic distributed over it. The writer believes that a transverse slope of ½ in. to the foot, or its equivalent, is amply sufficient in any case and that if the patrol system of maintenance is employed a slope of even less than ½ in. to the foot can be used.

The width out to out of the average touring car is about 6 ft. and a wider road is required than for the horse drawn vehicle traffic in order to allow the machines to pass each other at a fair rate of speed with the proper clearance and still keep on the improved surface. Even on a 14 ft. road the writer has seen many places where the dirt shoulder has been displaced so that the edge of the road metal is left exposed. This exposed edge is soon broken down by the action of the traffic and sometimes the break is carried several inches into the road. On curves the same condition exists even to a larger extent and the writer knows of places where the curve has been widened as much as 10 ft. on the inside and still the traffic does not keep on the improved surface. Besides the damage done to the road on account of having too small a width, there is also the grave danger of the machines being ditched, due to driving them on the dirt shoulder. In view of the foregoing and in order to provide for the future it would seem advisable to use different widths depending upon the class of highway to be built. The writer will use the classification which has been recommended by Prof. A. H. Blanchard which is as follows: "the first class includes interstate trunk lines, interurban trunk lines and popular routes of travel; the second class includes intrastate trunk lines passing through towns, the highways connecting towns situated within a few miles of each other; the third class includes feeders leading to towns and highways of the first and second classes from sparsely populated parts of the country districts, highways connecting towns which are many miles apart, cross roads and transverse feeders in towns." For the first and second classes a width of improved surface of 20 ft. would probably be none too great, while a width of 12 to 16 ft. would be ample for those of the third class, the smaller width to be used in case of a very light traffic. On curves the road should be widened an amount depending upon the degree of curve and the inside edge should be protected by three or four rows of paving blocks or vitrified bricks laid on edge.

Fortunately the touring automobile is designed so that it is able to climb almost any grade encountered provided that the surface of the road is in good condition, hence the maximum allowable grade will be the same as for horse drawn vehicles. It is observed that on steep rising grades there is serious deterioration near the foot of the hill probably due to the increased speed of the automobile in order to gain impetus or to the changing of gears. Although a reduction in the rate of grade would help conditions, such a procedure would rarely ever be found to be either practical or economical.

There is little chance that the traction engine with its train loads of 30 or 40 tons will ever become as common in this country as it is abroad. There has been, however, a rapid development in the past few years in the use of the motor truck which carries loads of from 1 to 5 tons. Present indications show that this type of vehicle is becoming more popular every day and that before many years a greater part of the trucking of our large commercial houses will be accomplished by this method. Naturally this will effect the traffic on our highways, but there is no reason, as far as the writer can see, why the points already considered in regard to the relation of modern traffic with respect to the alignment and profile of the road will not fully cover the situation.

In concluding, some of the resolutions pertinent to this paper will be given which were adopted by the International Road Congress at the meetings held in 1908 and 1909:

> To have moderate gradients with as small difference as possible between the maximum and minimum, it being understood that in exceptional cases gradients may be sacrificed if necessary to avoid sharp curves.
>
> To have the least camber compatible with the easy running off of rain water.
>
> The radii of curves should be as great as possible, 164 ft. at least, the curves being connected with the tangents by parabolic arcs; the outside of curves should be slightly raised, but so as not to inconvenience ordinary vehicles, no obstructions to the view should be allowed at the curves. A narrow sidewalk bounded by a curb, should be laid on the side of the shorter radius and the depositing of heaps of materials should be forbidden.
>
> That vehicles propelled by mechanical power cannot cause extraordinary damage to the curved portions of roads provided that at these points a sufficient super elevation is given and that the curved portion is not approached or traversed at an unreasonble speed.

Definitions and Discussion of Various Bituminous Materials Used in Road Construction and Maintenance.

So much confusion exists among road engineers and others interested in bituminous road binders concerning the meaning of certain terms applied to these materials that the U. S. Office of Public Roads has thought it advisable to issue a circular presenting in brief form the definitions of such terms as at present used by that office. It is stated in the circular that the definitions given therein are at present more or less arbitrary owing to the wide differences of opinion held by those who are considered authorities on the subject of bitumens. The circular, which was prepared by Mr. Prevost Hubbard, Chemist, U. S. Office of Public Roads, presents in a condensed form a description and discussion of various bituminous materials at present in use in road construction and maintenance. Inasmuch as the matter in the circular should be of much service in clearing up a very general misunderstanding concerning the actual and comparative value of bituminous road materials and the meaning of certain terms, it is given below in full.

Acid Sludge.—A mixture of sulphonated hydrocarbons resulting from the treatment of bitumens with sulphuric acid; usually a waste or by-product obtained in this manner from the purification of tar and oil distillates. When sufficiently concentrated these sulphonated products become viscous and gummy. They are readily attacked by water and are therefore unsuitable for use as enduring road binders.

Anthracene.—A waxy crystalline hydrocarbon having the chemical formula $C_{14}H_{10}$, found in tars, principally coal tars which have been produced at high temperatures. Anthracene is believed to be of no practical value in road binders.

Artificial Asphalt.—See Asphalts and Oil Asphalts.

Artificial Bitumens.—Hydrocarbon distillates and residues produced by the partial or fractional distillation of bitumens, and hydrocarbon distillates produced by the destructive distillation of bitumens, pyro-bitumens, and other organic materials, such as wood, bone, etc. Native bitumens which have been treated merely for the removal of water and extraneous organic and inorganic materials should not be classed as artificial products, but as refined native bitumens.

Asphalts.—Solid or semisolid native bitumens, consisting of a mixture of hydrocarbons of complex structure, largely cyclic and bridge compounds, together with a small proportion of their sulphur and nitrogen derivatives, but free from any appreciable amount of solid paraffins, melting[1] upon the application of heat and evidently produced by nature from petroleums containing little or no solid paraffins. Solid or semisolid residues produced from probably similar oils by artificial processes are sometimes called asphalts, but should more properly be termed oil asphalts. The more common types of native asphalts are known by the name of the locality in which they occur, such as Trinidad, Bermudez, Maracaibo, Cuban, California, etc. Native asphalts with few exceptions contain water, extraneous organic or vegetable matter, and inorganic matter, such as clay, sand, etc. A large proportion of these impurities is removed by a rough refining process without otherwise changing the character of the asphalt. Native asphalts are usually too hard to be used as road binders without first fluxing them with a heavy petroleum residuum and thus producing an asphaltic cement. Artificial asphalts are, as a rule, brought to suitable consistency during the process of manufacture.

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[1] See Bitumens

Asphaltenes.—A term commonly applied to those hydrocarbons in petroleums, petroleum products, malthas, asphaltic cements, and solid native bitumens which are soluble in carbon bisulphide but insoluble in paraffin naphtha. As a rule paraffin naphthas of different specific gravities and boiling points dissolve different amounts of hydrocarbons in a given bitumen and the heavier the naphtha and the higher its boiling point the greater is its solvent action. It is evident, therefore, that the percentage of asphaltenes will vary with the gravity and boiling point of the naphtha, and for this reason it would seem well to substitute for the term asphaltenes, "bitumen insoluble in paraffin naphtha," with a statement of the gravity of the naphtha used and the temperatures between which it boils. The presence of naphtha insoluble hydrocarbons is supposed to give body to the product in which they occur and to be accountable to a great extent for its binding value. They show no binding value, since many of them are hard and brittle, but they produce adhesive mixtures when fluxed with certain heavy oils. As a rule, for a given type of bitumen hardness increases with the percentage of bitumen insoluble in a given naphtha. The so-called asphaltenes are not found to any extent in native bitumens with a parffin base, but occur principally in asphalts, malthas, asphaltic petroleums, and in blown petroleum residues. They vary chemically and physically with the product in which they occur, and, therefore, do not represent definite chemical compounds.

Asphaltic Petroleums.—Asphaltic petroleums or asphaltic oils, are petroleums containing an asphaltic base—i.e., they are capable of producing residues very similar to native asphalts if evaporated or distilled down to the consistency of such asphalts. They contain little or no solid paraffins and are thus differentiated from paraffin petroleums. Native asphalts are probably produced from such oils by natural processes.

Asphaltic Cement.—The term asphaltic cement was originally applied to a product obtained by fluxing an asphalt with a sufficient quantity of heavy residual oil or flux to produce a binder of suitable consistency for paving purposes. In its broadest sense it may be applied to all semisolid bitumens of an asphaltic nature which are of suitable consistency for use as binders in street or road construction, whether prepared by fluxing a solid native or artificial bitumen or by reducing an asphaltic or semiasphaltic petroleum by distillation or other process.

Baumé Gravity—An arbitrary scale of specific gravity or density of liquids, usually expressed as degrees Baumé or ° B. This scale is commonly used in connection with oil products. For liquids lighter than water the scale begins at 10° B., which represents the specific gravity of water, or 1.0000. As the Baumé degrees increase the specific gravity decreases. The following formulæ are used in converting Baumé degrees for liquids lighter than water into direct specific gravity and vice versa:

$$\text{Sp. gr.} = \frac{140}{130 + \text{B}} \text{ at } 17.5^\circ \text{ C.}$$

$$\text{B} = \frac{140}{\text{Sp. gr.}} - 130 \text{ at } 17.5^\circ \text{ C.}$$

For liquids heavier than water the scale begins at 0° B., which represents the specific gravity of water, or 1.0000. In this scale the degrees Baumé increase with the specific gravity. The following formulæ are used in converting Baumé degrees for liquids heavier than water into direct specific gravity and vice versa:

$$\text{Sp. gr.} = \frac{145}{145 - {}^\circ\text{B}} \text{ at } 15.5^\circ \text{ C.}$$

$$\text{B} = 145 - \frac{145}{\text{Sp. gr.}} \text{ at } 15.5^\circ \text{ C.}$$

Benzol.—A volatile colorless fluid hydrocarbon of characteristic odor having the chemical formula C_6H_6. It occurs mainly in crude coal tars and water-gas tars, and boils at 80.4° C., so that it is removed in the first fraction when these tars are subjected to the process of distillation. Benzol is an active solvent for most bitumens. It is sometimes called benzene, but should not be confused with benzine, which is the term applied to the lighter and more volatile fractions of petroleum.

Bitumen.—Bitumens are mixtures of native or pyrogenetic hydrocarbons and their derivatives, which may be gases, liquids, viscous liquids, or solids. If solids, they melt more or less readily upon the application of heat and are soluble in carbon bisulphide, chloroform, and similar solvents. They may be divided into two main classes—(1) native bitumens and (2) artificial bitumens. Bitumens, being mixtures of hydrocarbons, can have no melting point, although this term is often used to denote the temperature at which they soften sufficiently to flow.

Bituminous.—A term applied not only to materials or objects which contain bitumen, such as bituminous rock, bituminous macadam, etc., but also to certain pyro-bitumens, such as bituminous coal, which give rise to the formation of bitumens upon being subjected to the process of destructive distillation.

Blown petroleum.—Blown petroleums, which are often called blown oils, are petroleum residuums through which a jet of air has been passed during or just after distillation. The blowing process causes certain chemical reactions of a complicated nature to take place and results in thickening or increasing the consistency of the oil to an extent depending upon its temperature and the amount of blowing which it receives. Semisolid and solid products are thus often formed from fluid residuums. If the oil is asphaltic or semiasphaltic in nature, asphaltic cements may be obtained in this manner. Blown oils are characteristically short or nonductile when semisolid, although they may possess considerable binding value if not originally of a paraffin nature. Blowing an oil usually increases its percentage of hydrocarbons insoluble in any given paraffin naphtha.

Carbenes.—A term commonly applied to those hydrocarbons in petroleum, petroleum products, malthas, asphaltic cements, and solid native bitumens which are soluble in carbon bisulphide but insoluble in carbon tetrachloride. The presence of an appreciable amount of these hydrocarbons indicates that the material in which they occur has been subjected to unnecessarily high temperatures. Cracked oil residuums show an increase in carbenes in proportion to the extent of cracking and the formation of these products is evidently a near step to coking. But little is known of their effect upon the value of a bitumen for road construction, but they are generally looked upon with suspicion and, in certain specifications for asphaltic cements, their presence has been [illegible]

Carbon Bisulphide.—This substance, sometimes called carbon disulphide, is a volatile and extremely inflammable compound of carbon and sulphur, boiling at 47° C. and having the chemical formula CS_2. Pure carbon bisulphide is a colorless mobile liquid having an ethereal odor. It is one of the most active solvents for bitumens and is commonly employed for this purpose in the determination of total bitumen.

Carbon Tetrachloride.—[illegible] flammable compound of carbon and chlorine, boiling at 76° C. It is a colorless mobile liquid with an odor similar to that of chloroform, to which it is closely related, and has the chemical formula CCl_4. It is an excellent solvent for bitumens, but is not usually as powerful as carbon bisulphide. It is employed in bitumen analysis for the determination of barbenes or hydrocarbons soluble in carbon bisulphide but insoluble in carbon tetrachloride.

Coal Tar.—A mixture of hydrocarbon distillates, mostly unsaturated ring compounds, produced in the destructive distillation of coal, Crude coal tar is a black, more or less viscid fluid having a gassy odor and varying in specific gravity from 1.10 to 1.25 and sometimes higher. It always contains a certain amount of ammoniacal water which makes it unsuitable for use as a road binder. When reduced to proper consistency by distillation, coal tar makes an excellent bituminous road binder, providing it does not carry too high percentages of free carbon and naphthalene. The composition of coal tar varies according to the coal from which it is produced and the method of distillation. Tars produced at high temperatures contain a large amount of free carbon and usually run high in naphthalene, while those produced at low temperatures carry less free carbon and as a rule less naphthalene. Low temperature coal tars are therefore most suitable for the preparation of road binders.[2]

Coke-Oven Tar.—Coal tar produced from by-product coke ovens in the manufacture of coke from bituminous coal. This process of coke manufacture is essentially the same as that of coal gas. Larger charges of coal are, however, carbonized in the former, and as a rule carbonization is conducted at a lower temperature than in the manufacture of coal gas. The resulting tar therefore contains a smaller amount of free carbon, averaging from 3 to 10 per cent, and is better suited for the preparation of road binders than most gas-house coal tars.

Cracked Oil.—The term cracked oil, as applied to road binders, refers to petroleum residuums which have been overheated in the process of manufacture. Overheating causes a breaking down of certain constituents of the oil, which results first in the formation of carbenes and later of coke or free carbon. Badly cracked residuums are believed to be inferior road binders.

Cracking.—The process of breaking down a hydrocarbon molecule by the application of heat. This may result either in the formation of other hydrocarbon molecules, at least one of which is unsaturated and shows a higher ratio of carbon to hydrogen than the original molecule, or else in the disruption of the molecule into its elements, hydrogen and carbon. In the latter case the process is said to be destructive. The more volatile and chemically stable hydrocarbons can be cracked only at temperatures above their boiling points. In the distillation of oils this is accomplished by causing condensation to take place in the still and allowing the condensed oils to fall back into the residue, the temperature of which is considerably higher than their boiling points. In carbureted water-gas manufacture, oils are cracked by vaporizing them at a much higher temperature than their boiling points. The heavier oils will, however, crack at temperatures below their normal boiling points, and this is particularly true of asphaltic oils, which have to be distilled very carefully, sometimes under reduced pressure, in order to produce residuums which are not cracked.

Cut-Back Products.—Petroleum or tar residuums which are cut back, or fluxed, to the desired consistency with a distillate. Volatile distillates are employed for this purpose in the preparation of road binders, when it is desired to have the binder increase in consistency or become harder after application. In such cases a residuum of proper consistency for a road binder is cut back merely for the purpose of facilitating application.

Dead Oils.—Heavy oils distilled from tars at between 170° and 270° C. with a density greater than water. These oils, if free from naphthalene, serve as an excellent flux in the preparation of cut-back road binders from tar pitches, which are too brittle for this purpose.

Destructive Distillation.—A process of distilling organic materials in which the identity of the material distilled is destroyed, resulting in the formation of tarry distillates and a coke residue.

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[2] See Refined tar.

Dehydrated Tar.—Crude tar from which all water has been removed by distillation and mechanical contrivances known as separators.

Emulsions.—Oily substances made miscible with water through the action of a saponifying agent or soap. Petroleums and tars may be emulsified by this means and such emulsions, if properly prepared from good materials, are often serviceable in the treatment of roads. The majority of road emulsions can be considered only as dust palliatives and temporary binders.

Fixed Carbon.—The residual coke obtained upon burning hydrocarbon products in a covered vessel in the absence of free oxygen, according to an arbitrary method. As applied to bituminous road materials, the determination of fixed carbon would seem to be of value in connection with petroleum and asphaltic products only. Paraffin hydrocarbons produce little or no fixed carbon, while those of asphaltic character show a very considerable amount, depending upon the percentage of asphaltic compounds present and the consistency of the material. The fixed carbon determination therefore indicates the mechanical stability and body of such materials. It is not, however, an extremely accurate determination and should not be too strongly relied upon. Since fixed carbon is a product formed by ignition, it should not be confused with free carbon, which is a material already existing in suspension. The presence of any considerable quantity of free carbon vitiates a fixed carbon determination.

Flux.—As applied to road binders, this term covers fluid oils and tars which are incorporated with asphalts and semisolid or solid oil and tar residuums for the purpose of reducing their consistency. Fluid petroleum residuums are commonly employed as fluxes in the preparation of asphaltic cements. A good flux produces an absolutely homogeneous bituminous mixture. Both petroleum and tar fluxes will produce such mixtures with native and artificial asphalts, but most fluid petroleum products will not flux tar pitches satisfactorily.

Free Carbon.—Organic matter in tars which is insoluble in carbon bisulphide. This material is an inert black powder, which is held in suspension by the tar proper, and probably consists, not only of free carbon, but also of hydrocarbons extremely rich in carbon. It has no binding value and serves no useful purpose in a road binder other than to act as a filler. It gives the tar in which it occurs a false consistency, reduces the binding capacity of the tar, and probably interferes with its penetration into and absorption by the road stone or road surface. The maximum allowable limit of free carbon in road binders would seem to be about 20 per cent.

Gas-House Coal Tars .—Coal tar produced as a by-product in the manufacture of illuminating gas from coal. The modern gas-house coal tar is usually produced at high temperatures and therefore carries a percentage of free carbon varying from 20 to 30 per cent and higher. Unless it is produced at low or medium temperatures and contains less than 20 per cent free carbon, it is not well suited for the preparation of a dust palliative or road binder by direct distillation. High-carbon tars may, however, be combined with low-carbon tars in such proportion as to produce, when distilled to proper consistency, excellent road binders carrying less than 20 per cent free carbon.

F*Gilsonite.*—A very pure solid native bitumen possessing many of the characteristics of asphalt. It differs from most of the native asphalts by being more brittle, having a higher melting or softening point, and being much less soluble in 86° B. paraffin naphtha. When fluxed with certain petroleum residuums it produces excellent asphaltic cements. In the preparation of road binders it is extensively used for the purpose of reinforcing blown oils, with which it combines to form rubbery semisolid mixtures. Such preparations are sometimes termed mineral rubber.

Gilsonite.—A very pure solid native bitumen black and brittle, which does not melt readily, but intumesces at high temperatures. It is differentiated from gilsonite and the native asphalts by the fact that it is almost insoluble in paraffin naphtha. It has been produced at high temperatures, as evidenced by the percentage of carbenes which it contains, and some varieties closely approach the pyro-bitumens in characteristics. It has been used to some extent in the preparation of asphaltic cements, but up to the present has been little used in the manufacture of road binders.

High-Carbon Tars.—Tars containing a high percentage of free carbon—above 20 per cent. High-carbon tars are produced at high temperatures during the destructive distillation of coal and are of inferior quality for use as dust palliatives and road binders.

Hydrocarbons.—Chemical compounds composed of the elements hydrogen and carbon. There is practically an unlimited number of such compounds, which vary greatly in physical and chemical characteristics. Complex mixtures of hydrocarbons constitute by far the greater proportion of all bitumens.

Low-Carbon Tars.—Tars containing a low percentage of free carbon—less than 10 per cent. Low-carbon tars are produced at comparatively low temperatures during the destructive distillation of coal, and also by cracking oil vapors during the manufacture of carbureted water gas. As a rule they are more suitable than high-carbon tars for use as dust palliatives and road binders, or for the preparation of such substances.

Malthas.—Malthas are very viscous semi-asphaltic or asphaltic native bitumens holding an intermediate position between the petroleums of an asphaltic nature and the native asphalts. As a rule they possess excellent binding properties. They constitute the binding material of many bituminous rocks or rock asphalts, and in this capacity often serve as valuable road binders. Many malthas have a tendency to harden rapidly when exposed to atmospheric conditions, and this property, while accountable for an increase in binding value, makes them unsuitable for use as a flux in the preparation of asphaltic cements.

Malthenes.—A term commonly applied to those hydrocarbons in petroleum, petroleum products, malthas, asphaltic cements, and solid native bitumens soluble in both carbon bisulphide and paraffin naphtha, but not readily volatile at temperatures lower than 163° C. (325° F.). This class of hydrocarbons serves as a valuable permanent fluxing medium for the so-called asphaltenes or naphtha insoluble bitumen in asphaltic cements, giving the cement any desired degree of softness when present in the right amount. It is evident, therefore, that the consistency of asphaltic bitumens, and particularly stable asphaltic cements, is largely dependent upon the relative proportion of naphtha soluble and naphtha insoluble hydrocarbons. The same objection to the use of the term "asphaltenes"[4] applies to the use of the term "malthenes."

Mineral Rubber.—A term sometimes applied to artificial bitumens of rubbery consistency, usually composed of a mixture of gilsonite and blown petroleum residuum.

Naphthas.—Mixtures of hydrocarbons of low boiling points occurring rarely in nature, commonly obtained from the fractional distillation of certain bitumens. When this term is applied to low-boiling coal-tar distillates, it is usually prefixed by the words "coal tar." The word "naphtha" by itself is generally applied to low-boiling petroleum products. Different grades of naphtha are differentiated not only by their boiling points but also by their specific gravities, which are commonly given in Baumé degrees. Those of very low boiling points and specific gravities are called petrolic ethers. Naphthas vary not only in the two properties above mentioned but also with the type of petroleum from which they are obtained. Those derived from paraffin petroleums are quite different chemically from naphthas obtained from asphaltic petroleums. The former are much less powerful solvents for asphaltic substances than the latter. Paraffin naphtha is used as a solvent for the separation of certain classes of hydrocarbons in asphaltic substances.

Naphthalene.—A solid crystalline highly volatile hydrocarbon occurring principally in coal tars and having the chemical formula $C_{10}H_8$. Its presence in excessive quantities in road tars is believed to be detrimental, as it possesses no binding value and gradually volatilizes from the tar, leaving it hard and brittle.

Native Bitumens.—Mixtures of hydrocarbons occurring in nature, which may be gases, liquids, viscous liquids, or solids, but if solid melting[5] more or less readily upon the application of heat and dissolving in carbon bisulphide, chloroform, and similar solvents. The native bitumens that are of use as road materials are petroleums, malthas, asphalts, and other solid products such as gilsonite and grahamite. Native bitumens often contain impurities such as water, inorganic matter in the form of clay, silt, sand, etc., and extraneous organic or vegetable matter.

Oil Asphalts.—Artificial oil pitches or asphaltic cements produced as a residuum in the distillation of semiasphaltic and asphaltic petroleum. Many of these products are blown and are therefore known as blown oils.

Oil Pitches.—More or less hard oil asphalts.

Oil Tars.[6]—Mixtures of hydrocarbon distillates, mostly unsaturated ring compounds, produced in the cracking of oil vapors at high temperatures. Oil tars are usually by-products of the manufacture of oil gas or carbureted water gas.

Paraffin Naphthas.—Naphthas consisting of a mixture of light volatile hydrocarbons of the paraffin series, ordinarily obtained as light distillates of paraffin petroleum.

Paraffin Petroleum.—Petroleum the base of which is composed principally of the paraffin or open-chain series of hydrocarbons; it is this differentiated from asphaltic petroleums which are composed largely of cyclic or ring hydrocarbons. Paraffin petroleums and the unaltered residues produced by their distillation are of inferior value as dust palliatives and road binders.

Paraffin Scale.—Solid paraffin recovered by distillation and precipitation of the distillates of petroleum and similar materials. The percentage of paraffin in bitumen is usually determined in this manner.

Paraffin.—The term paraffin covers a number of greasy crystalline hydrocarbons of the paraffin series occurring as dissolved wax in certain classes of petroleum. When these products are recovered from petroleum, they constitute the commercial product paraffin. Paraffin is believed to be detrimental to road binders in which it occurs, and it is certain that its presence in excessive amounts indicates inferiority in the binding value of the material. It is probable, however, that heavy liquid hydrocarbons of the same chemical series as solid paraffin exert a much more injurious effect.

Petrolenes.—An ambiguous term sometimes applied to those hydrocarbons described under malthenes, which are soluble in carbon bisulphide but insoluble in paraffin naphtha, and sometimes to hydrocarbons in petroleum and petroleum products valatile at or below 163° C. (325° F.). Owing to misconceptions which may occur, it would seem advisable to eliminate the use of this term.

Petroleums.—Petroleums, or mineral oils, are fluid native bitumens of variable composition, depending largely upon the locality in which they occur. There are three general types of petroleum found in the United States: (1) Paraffin petroleums, (2) semiasphaltic petroleums, and (3) asphaltic petroleums. Paraffin petroleums occur mainly in the eastern part of the United States and are typified by the Pennsylvania oils. The semiasphaltic variety occurs in the southern and middle western parts of the United States. Texas is

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[3] See Coal tar.

[4] See Asphaltenes.

[5] See Bitumens.

[6] See Water-gas tar.

one of the main sources of this type. Asphaltic petroleums occur in the western part of the United States, particularly in California. Petroleums, if of semiasphaltic or asphaltic character, may make excellent dust palliatives and road binders when properly treated.

Petrolic Ethers.—Very light volatile naphthas obtained from petroleum.

Pitches.—Semisolid or solid residues produced in the evaporation or distillation of bitumens. This word is often prefixed by the name of the material from which it is derived, such as oil pitch, coal-tar pitch, etc. As a rule the term pitch is confined to the harder residuums, most of which are too hard for use as road binders unless fluxed with a more fluid product.

Probitumens.—Mineral organic substances which are but slightly acted upon by the solvents for the bitumens, but which, upon being subjected to destructive distillation, give rise to the formation of bitumens. Pyrobitumens are derived in nature both from bitumens and direct metamorphosis of vegetable matter. Among the former class may be mentioned Albertite and Wurtzilite, and among the latter, peat, lignite, and bituminous coal.

Pyrogenetic.—Originating from the action of heat. Coal tar is thus a pyrogenetic bitumen.

Reduced Petroleums or Reduced Oils.—Residual oils produced from crude petroleum by the removal of water and the more volatile oil constituents, without chemically altering the base by cracking or other means. These residues are often made by distilling the crude oil under reduced pressure. Such products are of little value for road treatment unless formed from semiasphaltic or asphaltic oils.

Refined Tar.—A more or less viscous tar which is produced by evaporation or distillation of crude tar until the residue is of the desired consistency. This term also includes blown tars and cut-back products produced by fluxing tar pitches with volatile or nonvolatile distillates. Refined tars are of value both as dust palliatives and as road binders in the treatment of macadam roads. Their binding value is proportional to their hardness within certain limits.

Residual Petroleum or Residual Oils.—Heavy viscous residues produced by the evaporation or distillation of crude petroleum until at least all of the burning oils have been removed and often some of the heavier distillates as well. Residual oils grade into the artificial asphalts and oil pitches as their hardness and viscosity increase. The more fluid products, if obtained from semiasphaltic or asphaltic petroleums, serve as excellent dust palliatives and semipermanent road binders for the surface treatment of roads. The more viscous products are often suitable for the surface treatment of roads if applied hot, but are seldom of value in road construction unless produced from semiasphaltic or asphaltic oils.

Residual Tars.—Heavy viscous residues produced by the evaporation or distillation of crude tar until all of the light oils have been removed. Residual tars grade into the tar pitches as their hardness and viscosity increase. If they do not contain an excess of free carbon, they are as a rule well adapted for use as binders in the construction of macadam roads.

Rock Asphalt or Bituminous Rock.—A term applied to a great variety of sandstones and limestones more or less impregnated with maltha. Deposits of such material are widely distributed over the United States and vary from rock which is friable and wholly dependent upon the bitumen to hold the mineral fragments together to solid rock having merely its interstices filled with bitumen. The former type is of value for use as a surface binder in the construction of roads when the maltha shows good binding value and amounts to not less than 6 per cent of the weight of rock asphalt.

Semiasphaltic Petroleums. — Semiasphaltic petroleums or semiasphaltic oils are petroleums containing a semiasphaltic base, i. e., petroleums whose residues produced by evaporation or distillation, while composed mainly of asphaltic hydrocarbons, contain also a certain percentage of paraffin wax. They thus show a mixed base. If their percentage of heavy paraffin hydrocarbons is not excessive, they may be made to produce good dust preventives and road binders.

Short.—A term applied to bituminous materials which are nonductile.

Tar Pitches.—Semisolid or solid residual tars. Owing to the general brittleness of tar pitches, only the softer varieties are of value in their natural condition as road binders. The harder pitches may, however, be used for this purpose if fluxed to suitable consistency with heavy or dead oil distillates of tar.

Tars.—Tars are artificial or pyrogenetic bitumens produced as distillates by the destructive distillation of bitumens, pyrobitumens, and other organic material.

Water-Gas Tars.—Mixtures of hydrocarbon distillates, mostly unsaturated ring compounds, produced by cracking oil vapors at high temperatures in the manufacture of carbureted water gas. Crude water-gas tar is a thin, oily liquid having a specific gravity lying usually between 1 and 1.10. As a rule it contains a considerable quantity of water, which is, however, largely removed by mechanical devices before the tar is placed upon the market. This water is not ammoniacal, as in the case of crude coal tars. The composition of water-gas tar varies with the character of the oil which is carbureted and with varying conditions attending the carbureting process. It always shows a low percentage of free carbon, usually less than 2 per cent, and contains little or no naphthalene unless previously used for scrubbing coal gas. Crude water-gas tar has practically no binding value and is serviceable only as a dust palliative in the surface treatment of roads. When reduced to proper consistency by distillation, however, it shows certain desirable properties for use as a road binder both for surface treatment and macadam construction. Water-gas tar may also be used in the preparation of road binders from high-carbon coal tars. When this is done, the two crude tars are mixed in such proportion that when distilled to the desired consistency the mixture will contain less than the maximum limit of free carbon allowable.

WATER-WORKS AND SEWERS SECTION

A Recommended Design for and Method of Constructing and Operating a Sewage Disposal Plant for Private Houses.

Studies of sewage disposal plants for private houses were begun in 1904 at the Iowa State College Engineering Experiment Station. Altogether four complete plants were built and worked; each plant was a modification in some particulars suggested by experience from its predecessor. In Bulletin V, recently published by the Experiment Station, Prof. A. Marston and Mr. F. M. Okey describe in detail the several plants and give general criticisms with complete designs for a standard plant based on their experiments. We abstract these general conclusions in the following

In attacking this problem use was naturally made of the experience of engineers in the design and operation of sewage disposal plants for cities. The first plants were designed along the same lines as the large ones required for towns, with simplified details. Early in the work, however, it became apparent that there were many difficulties peculiar to small plants as distinguished from large. The engineer who expects to secure results per unit of area in the case of sewage disposal plants for private houses equal to those obtained in the case of large sewage disposal plants is certain to be badly disappointed. Some of the points of difference are as follows

Extreme Fluctuations in Flow.—The sewage of a city consists of a continuous stream of considerable volume, which, it is true, fluctuates within considerable limits, but which is very much more steady than the flow from any one of the several houses. In the case of the latter, there is a great rush of sewage when any one fixture is discharged, but during much or even most of the time there is no flow at all. In the case of the individual house, the fluctuations of flow are enormously greater in proportion to the size of the tank and area of filter beds than in the case of the city plant.

Small Size of Sewage Tank.—In the case of the city plant, the size of the tank required is so very large that the fluctuations in the rate of flow do not, if the tank is well designed, stir up the deposits and carry them out upon the filters. In the case of the individual house, however, the tank is of very small dimensions. The sudden inrush of sewage at the time of the discharge of any fixture stirs up the entire contents of the tank, disturbing the bacterial conditions and carrying out the suspended matter upon the filtering area, thereby causing it to clog. Several times the area of filter needed in city plants per person will be required in the case of the private sewage disposal plant.

Fresh Character of the Sewage from the Individual House and Fluctuations in Quality.—In the case of the city plant, the sewage has been carried long distances in the sewers. The suspended matter has been macerated and finely divided by mechanical agencies during the flow, and bacterial action has started in the sewers, and in many cases has proceeded so far as to effect a material change in the condition of the sewage. The mingling of the sewage from many houses gives a comparatively uniform composition, although even in the case of city plants the composition of the sewage fluctuates widely.

The sewage from the private house, however, is received directly at the plant, without mechanical maceration or division of the suspended matter, and without bacterial change. Its composition varies from solid fecal matter to pure water. Obviously a much larger tank in proportion will be required in the private disposal plant than in the case of the city plant, in order to provide for the different conditions.

Impossibility of Securing Proper Maintenance of Private Sewage Disposal Plants.—Even in the case of a city with a plant so large that it should receive constant care, it is very difficult to secure proper maintenance. This is reported by all engineers. Most of the failures in sewage disposal plants are due to neglect of the plants on the part of the cities owning them. However, this condition is one which is capable of being remedied on the part of cities, and there is a movement for better conditions. Sanitary engineers are giving especial attention to the subject. The expensive teachings of experience are proving to the cities that they must do better in this particular.

In the case of private plants, however, it is absolutely hopeless to secure other than the most casual care of the plant. The ordinary citizen cannot be expected to possess the knowledge necessary to give scientific care to a sewage disposal plant. It is absolutely certain that he would not give it such care even if he possessed the knowledge. The private plant, to be successful, must be capable of operating at least a year with practically no attention whatever.

Near Proximity of Private Plants to Dwelling Houses.—In the case of the city plant, more or less odor is expected, and provision is made against its being a nuisance by constructing the plant at a considerable distance from the nearest dwelling house. In many if not most cases this would be impracticable in the case of the private plant. It must be built, often, within the confines of the single lot on which the dwelling is placed. It must, therefore, be practically free from objectionable odor.

The authors of this bulletin have read many articles on sewage disposal plants for private houses. In these articles we have not seen proper attention given to the above differences between such plants and those for cities. If the writers of these articles would actually construct their plants and watch their operation closely under actual working conditions for a year or more it would be found that their ideas would be materially modified by difficulties encountered, due to the points of difference enumerated above.

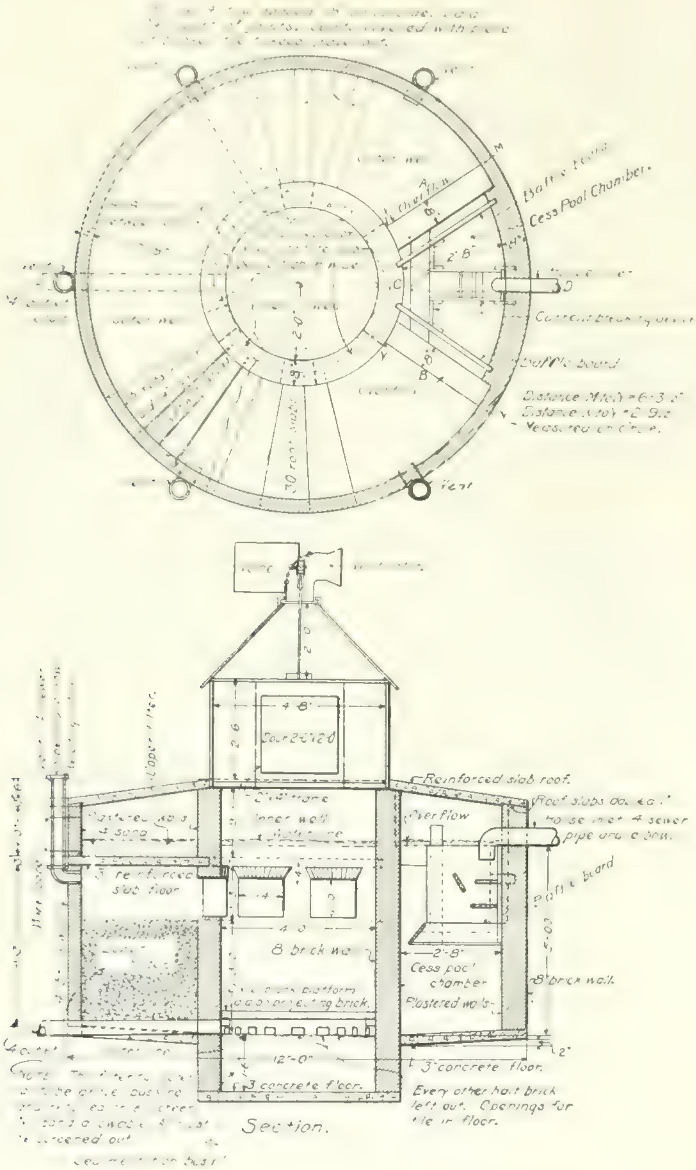

Fig. 1—Plan of Sewage Disposal Plant for Residences.

Conclusions.

Our experience with the four types of private disposal plants already described leads us to the following general conclusions concerning sewage disposal plants for private houses:

Size of Tank.—The size of sewage tank for the private house should be much larger per person than in the case of city plants, on account of the extremely fresh character of the sewage in the former case and its widely fluctuating quality and rate of flow.

Prevention of Disturbing Effect of Inflow Into the Tank.—It is especially necessary in the case of private sewage disposal plants that there should be provided some device for completely destroying the entering current of sewage, which otherwise stirs up the entire contents of the tank, owing to its small dimensions, and disturbs the purifying agencies.

Prevention of Disturbing Effect of Outflow from the Tank.—Similarly, owing to the small dimensions of the private tank, it is necessary to use some special device for taking away the outflow without creating perceptible currents, as such currents will carry away sediment which will clog the filter beds.

Use of Mechanical Apparatus Not Allowable in Private Plants.—We find that the use of any mechanical appliances, such as siphons or other automatic devices, is not permissible in the case of private plants, as all such devices require more or less attention to insure their proper working, and are almost certain not to receive such attention from the average householder. When out of order, they are fatal to the satisfactory operation of the plant.

Area of Filters.—Private plants require several times the area of filter per person needed for city plants because of the lack of corresponding care and because of the extra amount of sediment carried from the tank in spite of all possible precautions.

Care of Plant.—No matter what the design, the householder must give some care to the sewage disposal plant. With the design which will be recommended, it is believed that such care will be confined to overhauling and cleaning once per year.

Purity of Effluent.—So far it has proven impracticable to secure an effluent equal to the high degree of purity obtained from the city intermittent sand filter plants, but the effluent from the plant recommended should be sufficiently purified to prevent further offensive putrefaction.

Design Recommended for Sewage Disposal Plants for Private Houses.

As the result of our experimental work extending over a period of five years, we have prepared the design shown in Figs. 1 to 4 as embodying our present ideas. We recommend this design, but with the caution that no actual plants of the exact details shown have as yet been constructed. We hope and expect to be able to make advantageous modifications of this design from the results of our further work. We ask detailed information from those who build plants according to this design, stating the cost of construction and their experience with the working of the plants. We will warmly welcome intelligent criticism. Hence we ask for full records of unfavorable as well as favorable experience with the plants.

The design recommended consists of an outer well, of brick, 12 ft. in diameter outside, and an inner well, also of brick, 4 ft. in diameter inside. A sedimentation basin is added at the bottom of the inner well and a ventilator at its top. One-sixth of the outer well is partitioned off to serve as a cesspool chamber.

Outer and Inner Wells.—The brick wall of the outer well is 5 ft. 10 ins. in depth and is 4 ins. in thickness, except for one-sixth of the circumference, which is 8 ins. thick. The brick wall of the inner well is 7 ft. 11 ins. deep, its top being 5 ins. higher and its bottom 1 ft. 8 ins. lower than the corresponding parts of the outside wall. The wall of the inner well is 8 ins. thick. These brick walls and all other brick work about the plant must be laid up in cement mortar, composed of 1 part Portland cement to 3 parts of good, clean, coarse sand. No lime whatever must be permitted about the plant. The bottom of each well is composed of 3 ins. of concrete, which must be mixed in the proportion of 1 part cement to 2 parts of sand and 3 parts of broken stone or of pebbles not containing sand. It can be made if desired of 1 part of cement to 4 parts of clean gravel containing a considerable proportion of pebbles.

Sedimentation Basin and Outlet Pipe.—The inner well extends 1 ft. 6 ins. deeper than the outer well and forms a sedimentation basin.

The outlet from this sedimentation basin and from the entire sewage disposal plant is provided by a 4-in. tile drain, laid with its inner end 1 ft. 6 ins. above the bottom of the inner well. This outlet should be extended to the place of final discharge, into some ditch or on a hillside. Just above this outlet tile two 2x12-in. plank must be laid across the inner well, supported on projecting brick at each end, so as to form a platform above the water in the sedimentation basin, on which to stand when examining the plant or working with it from the inner well.

Lower Filter.—The floor of the outer well has a slope of 2 ins. toward the inner well. Radiating out from the inner well are laid 18 straight lines of 4-in. tile, spaced 18 ins. at the outside. The pieces of tile must be laid ¾ in. apart at the joints, and the upper halves of the joints must be covered with broken tile to prevent the entrance of filter pebbles into the tile. The outlets for these tile are provided by omitting every other half brick from the wall of the inner well. The tile serve partly to afford a supply of air to the under part of the lower filter and partly as outlets for the filtered sewage.

The lower filter occupies the lowest 3 ft. of the outer well and must be composed of fine broken stone with no dust, or of pebbles with all the sand screened out. In either case the range of size must be from not less than 1/6 in. up to not more than 1 in. in any dimension. In case pebbles are used, a screen having 1/6-in. mesh can be used to screen out the sand, and all the coarse pebbles in the pile can be broken up with a sledge or hammer. About 8 [illegible] yds of this material will be required for the lower filter.

Space Between Lower and Upper Filters.—Beginning 1 in. above the upper surface of this lower filter, six rectangular openings, each 12 ins. high by 16 ins. wide, are provided in the wall of the inner well. This is to permit free access to the lower filter to examine it and introduce or take out filtering material. They also permit the free passage of air from the ventilator through the space between the lower and upper filters and out through the five vents placed around the outside of the outer well, as shown in Fig. 1.

Vents.—Each of these vents consists of a 2-ft. length of 4-in. vitrified sewer pipe, attached to a 4-in. vitrified elbow, passing through the outer wall in the position shown. The 4-in. sewer pipe are each attached to the outer wall by two wire loops. The upper ends of the vents must be stopped by pieces of wire screen to prevent objects being thrown down the vents, while permitting the free escape of air.

Floor of Upper Filter.—The floor of the upper filter consists of reinforced concrete slabs of the dimensions and other details shown in Fig. 2. These slabs are 3 ins. thick and each is reinforced by two iron or steel rods ¼ in. round by 3 ft. 8 ins. long, placed ½ in. from the bottom of the slab, together with two small cross rods, as shown. The edges of each slab are beveled and there is a beveled slot 2 ft. long. The object of these slots and beveled edges is to permit the passage of the sewage from the upper filter. The beveled slots are to be filled with small pebbles, sufficiently fine to hold up the sand forming the upper filter. These pebbles should not be more than ⅛ to ½ in. in diameter, and in the upper portion should not be larger than ¼ in. in diameter.

Water must be turned upon the surface of the sand in the upper filter during construction, to test it and make sure that the sand does not wash out through any of the slots, and should this occur, finer pebbles must be used and the sand then replaced. This test must be continued until it is certain that the upper filter is perfectly supported, so as not to be in danger of washing out.

The floor slabs are to be constructed in molds, plans for which are shown in Fig. 2. The slabs must be made of 1 part Portland cement to 2 parts sand and 3 parts broken stone or small pebbles with the sand all screened out, or if preferred they may be made of Portland cement and gravel in the proportion of 1 part of cement to 4 parts of gravel containing a considerable proportion of pebbles. By molding these at the surface of the ground, we avoid the necessity of wooden forms or centering to hold the floor during construction.

Upper Filter.—The upper filter consists of 4 ins. of coarse, clean sand. About one good load is required for the filter. The walls of the upper filter must be plastered with 1 to 2 Portland cement mortar, as shown in Fig. 1.

After the plant has been in use for some time, the sewage will entirely cover the surface of this upper filter and finally reach a considerable depth. Under these circumstances the sewage will filter through the upper filter and pass down through the slots in the supporting floor and fall upon the surface of the lower filter in the form of separate drops. These drops will be exposed to the air as they fall and take up oxygen from it. In this way a supply of oxygen for the lower filter will be maintained.

This upper filter will in course of time become so clogged with the sewage that the sewage will reach the height of the outer wall. When this occurs a sufficient amount of the roof should be lifted off to permit the sand of the upper filter to be taken out and replaced with new sand. Only about one load will be required. It is not certain how often this removal will need to be made, but it will probably be not oftener than once in two years.

Roof.—The roof of the outer wall is also made of concrete slabs of the same dimensions as those of the floor of the upper filter, which are to be made in molds in the same way. Plans for the roof slabs and molds are shown in Fig. 2. Like the slabs in the filter floor, each must be made in the proportion of 1 part Portland cement to 2 parts sand to 3 parts of fine broken stone or pebbles free from all sand, or if preferred they may be made from clean gravel in the proportion of 1 part of cement to 4 parts of good gravel containing a considerable proportion of pebbles. The roof slabs differ from the filter floor slabs in that they are not beveled and that they are notched at one end so as to be held in place by the outer wall. They are reinforced by ¼ in. round rods just as in the case of the filter floor slabs. All the roof slabs are removable and one in every six is to be provided with a lifting ring at the small end. This lifting ring can readily be made of twisted wire.

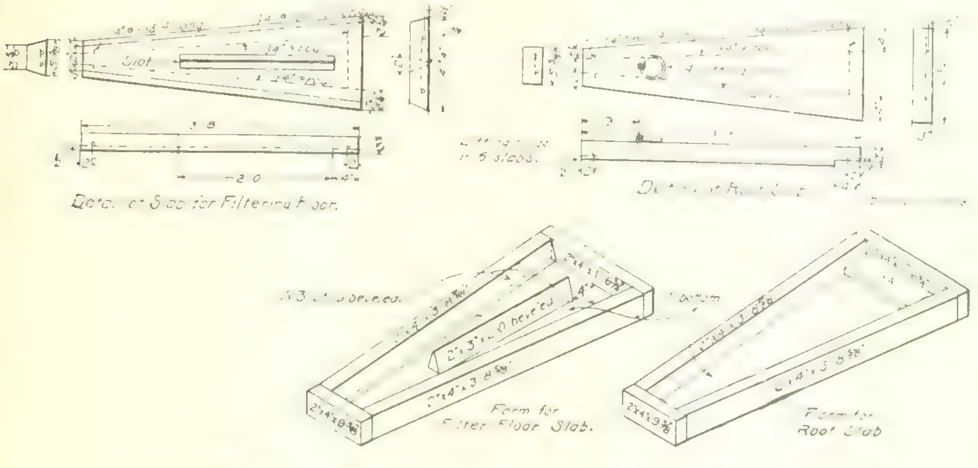
Slot
Detail of Slab for Filtering Floor
Detail of Roof Slab
Form for Filter Floor Slab.
Form for Roof Slab
bottom

Fig. 2—Roof and Floor Slabs and Slab Forms.

Cesspool Chamber.—The sewage entering the tank is first received in a cesspool chamber, as shown in Fig. 1. From outside to outside of walls, this cesspool chamber occupies exactly one-sixth of the circumference of the entire disposal plant. The inner well forms one wall of the cesspool. The radial walls are each 8 ins. thick, made of brick. The outside wall of the cesspool chamber is 8 ins. thick instead of 4 ins., as in the case of the remainder of the outside wall. The interior walls of the cesspool chamber must be plastered with a 1 to 2 Portland cement mortar.

The sewage enters the cesspool chamber by a 4-in. vitrified pipe sewer from the house, as shown. This pipe ends in a 4-in. elbow which serves as a trap to prevent any escape of gas from the cesspool chamber into the house sewer.

The entering flow is broken up and kept from stirring up the sediment by the wooden device shown in Fig. 3. It is important that this device should be constructed exactly as shown in the figure, for without it the entering current will stir up the sediment in the cesspool chamber, disturb the bacterial agencies of purification, and carry the sediment out upon the sand filter.

The sewage from the cesspool chamber overflows along the entire length of each side wall upon the surface of the upper sand filter. To reach the overflows the sewage must pass behind baffle boards, which extend from the roof line down to a point 2 ft. below the entering line of the house sewage, as shown in Fig. 1. These baffle boards must be constructed of 2x12-in. planking.

After the plant has been in operation some time, the sewage will cover the entire surface of the upper filter, as already described, so that the space between the sand of the upper filter and the under side of the roof will constitute an extension of the cesspool chamber. When this occurs, the effect of any sudden inrush of water will simply be to raise very slightly the level of the sewage. The velocity of outflow from the cesspool chamber will then be very slight. Under these conditions we anticipate a maximum retention of solids in the cesspool chamber.

Ventilator.—The ventilator is to be constructed as shown in Fig. 4. Except for the 2x4-in. frames, it is to be made of 1-in. boards. It is hexagonal in shape, just covering the 4-ft. inner brick well. One one side should be placed a 2x2-ft. door with 2x4-in. frame. This door should be hinged and provided with hasp, staple and padlock. It serves to admit entrances to the sewage disposal plant whenever desired.

At the vertex of the pyramidal roof is placed a galvanized iron ventilator, which can be made by any competent tinner. It is 12 ins. in diameter at the point where the air enters and 9 ins. at the elbow. It is kept pointed in the direction of the wind by a vane composed of a sheet of galvanized iron. To the interior of the elbow is riveted a socket composed of a piece of 1-in. pipe, 10 ins. long. In the upper end of this a piece of double strength glass is fastened by Portland cement, so as to afford an anti-friction bearing on which the ventilator is to turn. It is important that this piece of glass be used, as it is otherwise possible that the ventilator might stick and not turn with the wind. The socket is upheld by a piece of ½-in. pipe, stayed at the vertex of the roof by iron wires, and supported by a 2x4-in. foot block, resting on a 2x4-in. cross brace.

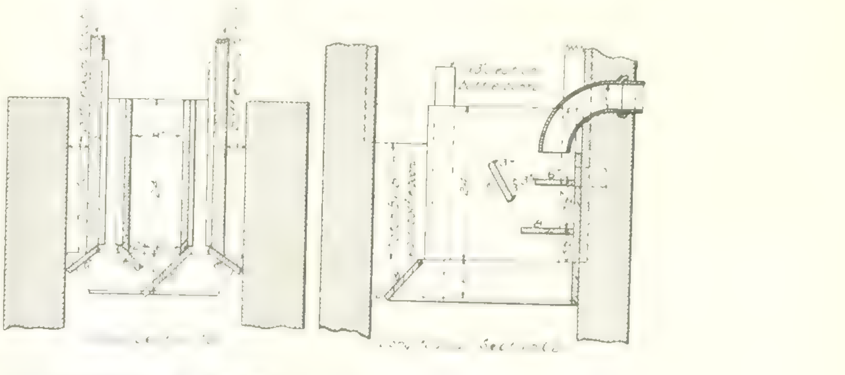

Fig. 3—Details of Baffles for Checking Inflow of Sewage.

At the lower part of the galvanized elbow a 1½-in. galvanized iron flange must be formed, as shown in Fig. 4, fitting into a wooden slot to prevent the escape of air.

The object of this ventilator is to insure a current of air through the disposal plant. The vane keeps the ventilator turned toward the wind, whose force will therefore drive a current of air down into the interior of the inner well. After aerating the falling sewage and the drain tile pipes in the under part of the lower filter, this current of air will escape through the five 4-in. vents spaced along the outside wall. This aeration of the sewage in the lower filter is necessary to the successful working of the plant.

Bill of Material for Design Recommended.—The following is an approximate bill of material for the design of private sewage disposal plant recommended, as shown in Fig. 5. and as just described in detail. We have also added approximate prices, but these will vary in different localities and each person should ascertain the local prices for himself:

BILL OF MATERIAL.

3,000 common brick @ $10.00	$30.00
10½ bbls. best Portland cement @ $2.00	21.00
110 rods, ¼ in. round × 2 ft. 8 in.	
55 rods, ¼ in. round × 0 ft. 10 in.	3.00
55 rods, ¼ in. round × 0 ft. 4 in.	
3 pcs. 2 in. × 12 in. × 16 ft. common lumber	
8 pcs. 2 in. × 4 in. × 12 ft. common lumber	9.00
10 pcs. 1 in. × 10 in. × 16 ft. common lumber	
1 pc. 1 in. × 12 in. × 16 ft. common lumber	
1 pr. hinges	
1 hasp and staple	
1 padlock	.50
1 pc. galvanized screen, 12 in. × 18 in.	
1 galvanized iron ventilator	3.00
6 2 ft. lengths 4 in. vit. sewer pipe	
6 4 in. vitrified sewer pipe elbows	4.00
70 ft. 4 in. drain tile	
6 cu. yd. sand	
11 cu. yd. broken stone or pebbles with all sand screened out, 1/6 inch to 1 inch	
	$73.50

Plus cost of sand and pebbles.

Suggestions for Construction.—Two cases present themselves in connection with the construction of a private sewage disposal plant: First, where the householder is prepared to do his own hauling and assist personally in the construction of the plant, and, second, where he must hire everything done.

In the first case, where the householder is prepared to do his own hauling and assist personally in the work, the method of procedure of constructing a plant might well be about as follows:

1. Purchase and haul all materials, including galvanized ventilator.

2. Construct the reinforced concrete roof slabs and upper filter floor slabs, using the molds shown in Fig. 2, using 1 part of cement to 2 of sand and 3 of pebbles or broken stone. In the bill of materials enough lumber is provided to construct five molds for roof slabs and five for upper filter floor slabs. The concrete must be thoroughly mixed and put into the molds in a condition so wet as to flow freely. The reinforcing rods must be put in place the last thing, and must be imbedded just deep enough to be completely covered by the cement so as to be protected from rusting. Of course, the slabs are constructed upside down. They must be left in the molds one day before being taken out, and should then be wet down and covered so as to prevent injury from drying out. To make enough slabs with this number of molds requires six days, but only a part of the time each day need be given to the work. It may be considered preferable to make a larger number of molds, which can be done for a slight added expense for material.

3. While the roof slabs are under construction, make the excavation for the filter plant. This should be about 13 ft. in diameter, so as to leave ample room for the masonry. It should not be made until all the material is on hand nor until it is certain that a mason can be ready to build the brick walls as soon as the excavation is completed.

4. A skilled mason should have been engaged to assist in the construction of the plant and he should begin work, with the assistance of the householder, as soon as the materials are on hand, the roof and filter floor slabs completed and the excavation made. With the assistance of the householder this mason then proceeds to build the plant.

5. The outlet tile must be laid and the concrete floor first constructed, using 1 part of cement to 2 parts of sand and 3 parts pebbles or broken stone.

6. The inner and outer brick walls must then be built up to a level ready to receive the floor of the upper filter.

Use 1 part cement to 3 parts sand for the mortar for all brick work. Be careful to keep the true circular shape so that the reinforced concrete slabs may fit. Be sure to omit every other half brick at lower filter floor level and to leave projecting brick to carry two plank over sedimentation basin. Be sure to put in place the wooden baffle boards and current breaking device in the cess pool chamber. Be sure to construct rectangular openings from the inner well to the space between the lower and upper filters, and to set in place in the five air vents.

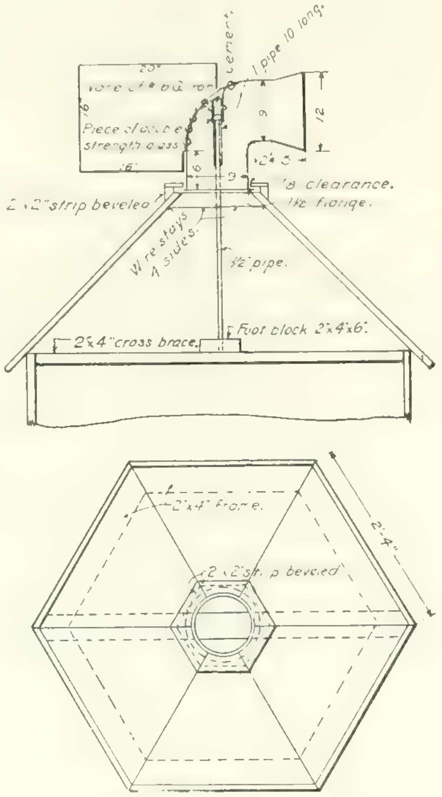

Fig. 4—Details of Ventilator.

7. The pebbles for the lower filter must be put in place.

8. The reinforced concrete slabs forming the floor of the upper filter must be put in place.

9. The construction of the upper part of the brick walls must be completed. Be sure to make the junction of these walls with the floor of the upper filter water tight and to plaster with 1 to 2 cement mortar the brick walls of the upper filter and of the cesspool chamber.

Set in place in the brickwork of the cesspool chamber the inlet sewer, and complete the wooden device for breaking up the current. Note that the baffle boards in the cesspool chamber extend clear up to the roof line, and must be cut to the right slope.

10. Construct the six-sided wooden ventilator as shown in Fig. 4. The galvanized iron ventilator should have been secured from a good tinner in advance of beginning the construction. The wooden ventilator must be neatly painted on final completion of the work.

11. Put in place the sand of the upper filter. Be sure to fill the slots in the floor of this filter with very small pebbles and take especial pains to see that the upper portion of the slots is filled with pebbles small enough to hold up the sand of the upper filter. When the sand of the upper filter is in place, pour water all over it to make sure that the sand will not wash down through the pebbles in the slots. It is very important that this test be made thoroughly, and any defects remedied before the sewage is turned in.

12. Complete the five 4-in. air vents around the outside of the tank.

13. Put the roof slabs in place.

14. Thoroughly clean out the inner well and all other portions of the disposal plant. Place the plank platform over the sedimentation basin.

15. Complete the outlet from the disposal plant to the point of final discharge and the inlet sewer from the house to the disposal plant.

In the second case, where the householder must hire everything done, he may proceed as in the first case, hiring teams and men to do the hauling and excavating and other labor which he cannot perform himself. A second method would be to award a contract to a skilled workman to build the entire plant, the householder furnishing the materials. A third method would be to award a contract for the entire plant, the builder to furnish all the materials. The second of the above methods will often be found preferable, but local conditions must determine the method used.

Instructions for Operation.—The householder is advised to examine his sewage disposal plant from time to time, making sure that it is operating satisfactorily.

About once a year most of the contents of the cesspool chamber should be pumped out. The sediment found therein can be plowed under in any garden or disposed of in the same way as other manure. It will be found to have decomposed to such an extent as not to be very offensive to handle. If a pump is not available, the contents of the cesspool chamber may be dipped out with a pail. Only the bulk of the sediment need be removed. While it is believed that this should be done once a year, yet a roof slab may be removed and the depth of the sediment tested with a sounding rod. If little or no sediment is found, this cleaning out will not be necessary.

In a similar way the sedimentation basin at the bottom of the inner well should be pumped or dipped out whenever the sediment accumulates to any considerable extent. Unless examination should show the absence of sediment, it is advised that this cleaning out should be done once a year.

As already stated, there is danger that the sand of the upper filter might break down through the supporting pebbles in the slots of the filter floor unless these have been carefully placed. Examination should be made from time to time, especially until the sewage has entirely covered the upper filter to a depth of several inches, to make sure that such breaking through has not occurred. Any breaks which do occur must be remedied at once.

At intervals which cannot be foretold, but which it is considered probable will not be oftener than once in two years, it will be necessary to take out the sand of the upper filter and replace it with clean material. About one load of material will be necessary.

The Effect of Hypochlorite of Lime Solution on Metals.*

The Board of Water Supply of the city of New York, in connection with the design of sanitary works for the protection of watersheds through which the Catskill aqueduct is being constructed, has had occasion to seek information regarding the effect of hypochlorite of lime solution upon metals, and in the operation of the works has gained further information. Systematic observations have not been made, and the corrosive effects under apparently similar conditions have differed quite widely; but the data obtained indicate in a general way what to expect.

Wrought-iron pipe is most readily affected. The inverts of 2-in. pipes having a trickling flow of a 1 per cent solution through them have been completely rusted through in about four months. Three-inch galvanized iron pipes, conveying at different times 1 per cent and ½ per cent solutions and flowing full, were replaced after about a year's service, not on account of rusting through, but on account of clogging due to the formation of tubercles and the accumulation of a deposit of lime. These pipes probably lasted longer than would have been the case with the plain wrought-iron pipes, because zinc is quite resistant to corrosion, and, where galvanizing is perfect, would prevent the formation of tubercles long enough to permit the coating of lime to form and prevent further corrosion. The galvanizing of commercial pipe is far from perfect, however, and also in making joints the zinc coating is necessarily injured, so that only a partial protection of the iron results. Galvanized stove pipe has remained in serviceable condition for four months, while plain iron stovepipe in the same place has been ruined. The galvanizing, however, now shows rust specks all over.

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*Harold C. Stevens, Assistant Engineer, New York Board of Water Supply, in the Journal of the New England Water Works Association for December, 1910.

Brass pipe is corroded by hypochlorite of lime solution, but very much less than iron; in fact, very slowly. Tubercles do not form and the pipe becomes coated with a smooth layer of lime that protects the brass from further action. The effect on the flow in this case is due only to the gradual reduction in the size of the duct. It seems reasonable to expect that brass pipe, say 2 ins. in diameter, would last two or three times as long as iron pipe, before renewal or cleaning would become necessary. Moreover, the coating in brass pipes could be cleaned out with acid and the pipe be made as serviceable as originally, with threads uninjured, whereas iron pipe so cleaned would be found rough and a great deal damaged.

At Board of Water Supply plants, where a 2 per cent solution was used for 1 month and a 1 per cent solution thereafter, bronze float valves are practically perfect after four months' service with a trickle of solution flowing through them, but the seats have become coated with lime and consequently do not close properly. On scraping off some of this coating the bronze appears to be intact. A long brass valve stem in a hypochlorite of lime solution tank after three months showed general pitting, but to a very slight depth. A brass screen of about No. 18 wire immersed in the solution was destroyed in less than four months, while another, under almost like conditions, has remained in good condition. The screen destroyed was made of very soft brass.

From such observations as were available at the time of designing certain of the Board of Water Supply plants, it was thought that copper of about 20 gage would be a good material for orifice cans, floats, and for lining small tanks. Its value was much over-estimated, however, for in one case a copper tank lining was eaten through in less than three weeks; and in another case an orifice can become leaky in about three months. Floats made of No. 22 copper have become leaky in about three months, being badly pitted on all the surface in contact with the hypochlorite of lime solution. The leaky orifice can was effectively repaired with solder which has resisted corrosion very well. It has not been pitted and the only effect upon it that has been noted has been a blackening of the surface.

Tin appears to resist the action of hypochlorite of lime solution very well. Two ordinary tinned copper ball floats, in solutions of ½ per cent to 1 per cent strength, lasted for 19 months, and one was still serviceable. A similar larger float, in 2 per cent solution for one month and in 1 per cent solution thereafter, has been in service for four months and appears to be in perfect condition. There is a slight coating on the surface, but if this is scraped off, bright tin appears underneath.

Bronze orifice plates made of "Worthington anti-corrosive metal" have stood well. The edges are not quite so sharp as originally, but the discharge coefficient has increased during nearly two years of service only about 3 per cent. Part of this effect can be attributed to wear rather than corrosion.

The effect of hypochlorite on one large metal supply main was to detach the organic matter, which quickly appeared at the reservoirs. The next gaging of the pipe showed an increase in carrying capacity of about 6 per cent from the previous year, whereas theretofore there had been an average yearly reduction of about 4 per cent in carrying capacity. It is to be expected that similar effects would always be observed in supply mains leading from reservoirs, for in such cases vegetable growths have a large effect on the carrying capacity. No observations have been made on the corrosive effects in metal mains, but a strong hope seems justified that no material damage will result, since the dose is minute and by far the greater part of the applied chemical is taken up by organic matter in the water before it has a chance to come in contact with the pipe. The point of application of the chemical would, of course, have an effect on the results. A relatively long period between the application of the dose and the entrance of the treated water into the pipe would lessen the tendency of action on the pipe.

Wood is readily affected by hypochlorite solution. Mixing tanks of white pine began to show serious damage within a month, the end grain at the rabbet being affected most and so softened that it could be crushed or scraped out. Storage tanks containing 2 per cent solution were not much affected during the same time. All tanks, however, were lined with cement mortar shortly afterwards. Wooden stilling boxes have lasted for nearly two years in solutions of ½ per cent and 1 per cent strength, but at the end of a year and a half the wood was found to be so softened that the edges could be broken off with the hand. Wooden floats boiled in paraffine and coated with a thick layer of paraffine have been used successfully. They appeared to be entirely unaffected after many months of service.

Rate of Acquisition of Income for Domestic Water Service from Different Classes of Residential Property.*

From the standpoint of investment there are always, in connection with water works service, districts which do not contribute their share of income, and these districts must be taken into account in making up a general average or in determining proper rates for domestic service. The writer has selected pipe lines in different districts in the city of Indianapolis, Ind., the income from which is assumed to be about the average, or typical of the assumed classification. In making this study the city naturally divides itself into about the following districts:

(1) The cheap district in the outlying portion of the city.

(2) The district between middle and cheap class in the outlying portion of the city.

(3) The district between middle and cheap residential in the heart of the city.

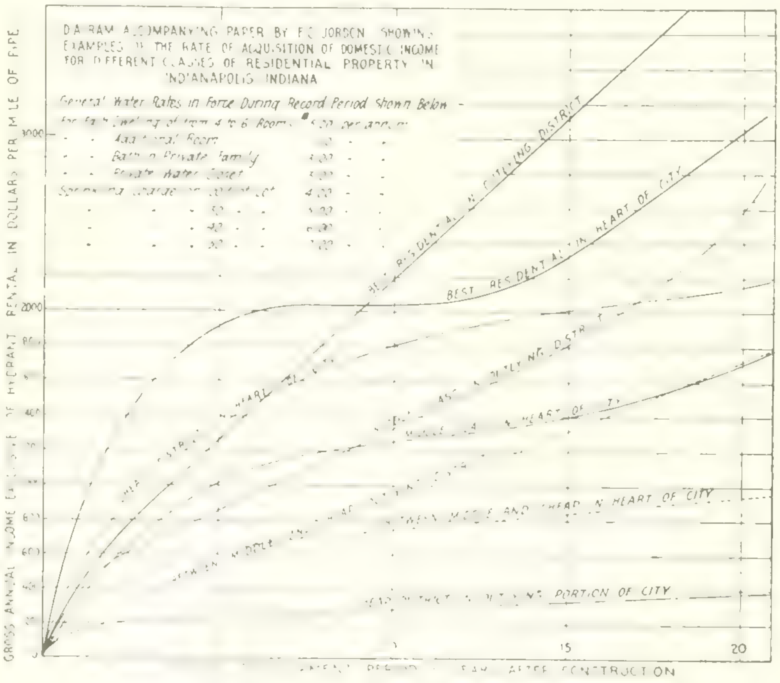
(4) The cheap residential district in the heart of the city.

(5) The high class residential district annexd to the city after the district has been very well built up.

(6) The best residential district in the outlying portion.

(7) The best residential district in the heart of the city.

As before stated, this paper will deal with one city only, viz., the city of Indianapolis, and the Indianapolis Water Co, with which the writer is connected. This company has in its distribution system 325 miles of pipe, the average diameter of which is in excess of 10 ins.; 25,000 taps in service supplying between 29,000 and 30,000 dwellings, business blocks, factories, etc. In this connection we wish also to state that the rates charged for water, which have a direct influence upon income, are somewhat less in Indianapolis than those of the average city of its size supplying water under like conditions. We have on our lines, in round numbers, 55,000 buildings of various kinds, of which 55 per cent are supplied with water by our company. From what we are able to learn from other cities similarly situated, we find that this percentage is lower than in the average city of our class.



On the first district mentioned above, viz., the cheap district in the outlying portion of the city, we found that the revenue per mile of pipe at the end of the first year was $140, at the end of the second year $200, and that there was very little change in this revenue during the fifteen years following the laying of these lines.

On the lines in the second district, viz., that district between the middle and cheap class in the outlying portion of the city, we found that the revenue was $170 at the end of the first year, at the end of the second year $260, at the end of the third year $300, at the end of the tenth year $340, and that this increase of rate was maintained during the years following the laying of these lines.

On the lines in the third district mentioned, that district between the middle and cheap residential in the heart of the city, it was found that the revenue per mile of pipe at the end of the first year was $250, at the end

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*Abstract of a paper by Frank C. Jorden, S[illegible], Ind[illegible] before the New England W[illegible]tion.

[illegible]th year $610, at the end of the tenth year $750, and at the end of the fifteenth year $850.

The growth in income in the fourth district, or the cheap residential district in the heart of the city, was found to be fairly satisfactory The revenue per mile of pipe in this district was $310 at the end of the first year, $560 at the end of the second year, $740 at the end of the third year, $1,020 at the end of the fifth year, after which the growth was not so marked.

On the lines in the high class residential district annexed to the city after having been fairly well built up, we found a satisfactory growth, the revenue being $360 at the end of the first year, $560 at the end of the second year, $860 at the end of the fifth year, and this rate of increase was maintained during the years following the laying of these lines.

These investigations indicate that the best residential district in the outlying portion of the city contributes more than the average share of the expense of supplying water. The revenue on the lines in this district was $400 at the end of the first year, $670 at the end of the second year, $1,260 at the end of the fifth year and $2,200 at the end of the tenth year. These lines show a steady increase from year to year.

The average revenue on lines in the best residential district in the heart of the city at the end of the first year was $800, at the end of the third year $1,570, at the end of the fifth year $1,930, after which the growth was exceedingly slow for the next ten years, during which time the property was changing from a residential district to a district of flats and apartment houses, with some of the better class of boarding houses. Following this transitory period, the revenue began to increase, reaching $3,060 per mile at the end of twenty years.

It will be noted from Fig. 1 that the growth of income on all lines in outlying districts is slow for the first few years, but the growth is fairly constant throughout the periods as shown; also that the growth of income in the central or thickly populated part of the city is rapid in the beginning, but after the first four or five years there is but a slight increase of income. The reason for this will be apparent to the water works superintendent or engineer from the fact that in the outlying district the houses are more or less scattered in the beginning and the income increases according to the increased building along the service line. It will be seen further that the income of but few districts is equivalent to the fixed charges on the lines laid, for the first two or three years; also that the poorer districts do not pay the fixed charges on the lines even after the lines have been laid for ten or fifteen years. This point is frequently overlooked in connection with proposed extensions, as on account of fire protection it is necessary to a certain extent that all parts of the city shall be served.

The variation in the number of consumers on these lines in the districts is an interesting study. In the best residential district we are supplying 87 per cent of the properties adjacent to our lines, while in some of the poorer districts we are supplying only from 8 per cent to 12 per cent.

It has been announced by the Minister of Public Works, Ottawa, Ont., that the matter is seriously under consideration of having surveys made for the projected tunnel under Northumberland Straits, between Prince Edward Island and the mainland. The distance at the most narrow part of the Straits is 9 miles.

Contracts have been let and work started on clearing the townsite of Port Mann, which is to be made the Canadian Northern Ry.'s Pacific terminal. Four thousand acres, with a water frontage of 2½ miles, have been surveyed, and nearly 1,000 men are engaged upon the work of laying out the townsite, which will be completed within four months. The town will be situated on the south bank of the Fraser River, a little east of New Westminster, B. C. The river at this point is over one mile wide, and there is a depth of 40 ft. of fresh water at the docks.

The executive committee of the Harriman Lines on Jan. 31 decided to expend $75,000,000 for improvement work. This work is to include the completing of the double-tracking of the line from the Missouri River to San Francisco, the double-tracking of the Oregon Short Line from the junction with the Union Pacific main line at Granger, Wyo., to Huntington, Ore.; the line along the Columbia River in Oregon is also to be double-tracked to Portland, Ore. The expenditure of the $75,000,000 for this 1,678 miles of track is to be distributed over a period of five years. In addition the executive committee approved plans for the construction of a number of extensions and new lines tributary to the Union Pacific and Southern Pacific in the west and northwest, which for some time have been under consideration. The expenditures for this work are to extend over a period of six years.

STEAM AND ELECTRIC RAILWAY SECTION

Theoretical and Practical Switch Leads.*

The formulas for determining switch leads, as given in the report of the Track Committee, are believed to be as simple in from as it is possible to reduce exact formulas for the functions of a turnout where the split switch is used. The use of these formulas will give a theoretically correct turnout.

However, whether or not the length of the curved lead rail is calculated and adhered to, it will be necessary to cut rails and to make scrap rail whenever a turnout is so constructed.

The labor lost in cutting the rail, handling and shipping scrap, as well as the loss due to the difference between the cost of the new rail and its scrap value, caused one road the writer has in mind to adopt for its standard turnouts a slight modification of the purely theoretical leads.

These modified leads may be termed practical leads, and they are slightly longer or shorter than the theoretical leads. They are so chosen that the rails between the frog and the switch rail, for both the straight and curved rails, are either of commercial lengths or such fraction thereof that, where cutting is necessary, both pieces of the rail may be used, obtaining at once both a minimum of cutting and of scrap.

The difference in length of the theoretical and practical leads and the difference in the degree of the lead curves is small, as shown by Table 1. By using the same length of rails in the straight and curved lead rails, as outlined in Table 1, it is not always possible to maintain the condition that the points of the switch rails shall be directly opposite. This seems to be the chief criticism of the practical leads. Opposed to this criticism it is held:

(a) As the number of the frog increases, the amount the points of the switch rails lack of being directly opposite decreases.

(b) The error may be decreased, if not overcome, by laying the straight portion of the lead with tight joints and the curved portion with open joints.

(c) The slight difference in location of the points of the switch rails make no appreciable error in the adjustments and throw of the points.

(d) As only one side of the lead is in service at one time, and as the switch rods and rails do not form a figure of stability, the practical leads are as safe as the theoretical leads.

For six years the writer was employed by the road mentioned, that used practical leads about as given in Table I. During that time he was engaged in the construction of yards and terminals, and in the maintenance of way department as division engineer, and roadmaster, where he had opportunity of closely observing the performance of the switches. From his observation of the practical leads in service, he believes them equally as easy riding and of as finished appearance as the theoretical leads and more economical both to construct and to maintain.

If it may be assumed that the practical lead is good practice, then it would appear useless to laboriously figure through the exact formulas submitted by the Track Committee in order to determine the length of the lead and the degree of the lead curve. For, by giving the switch rail a number, as we do the frog, we obtain: The number of the switch rail equals

$$N' = \frac{\text{Length switch rail in feet}}{\text{Heel distance in inches}} \times 12,$$

and from a simple figure and by an equally simple proof we obtain the following approximate formula for the length of the switch lead:

TABLE I.—THEORETICAL AND PRACTICAL SWITCH LEADS.

	Theoretical Leads.		Practical Leads		
N=Frog No.	L=Length of Lead.	D=Degree of Lead Curve	L=Length of Lead.	Degree of Lead Curve.	Rails Required.
4	37.20	50° 51′	37.00	50° 57′	2-24
5	43.48	30° 01′	43.00	31° 16′	2-30
6	48.19	21° 03′	48.33	21° 19′	2-24 2-10
7	57.58	15° 00′	58.33	15° 10′	2-30 2-12
8	68.38	11° 21′	70.33	11° 38′	2-27 2-24
9	74.08	8° 43′	76.33	8° 57′	2-30 2-27
9½	79.48	7° 50′	80.83	7° 51′	2-33 2-27
10	82.30	6° 59′	83.83	7° 07′	2-33 2-30
12	95.24	4° 50′	96.00	4° 50′	6-24
15	114.14	3° 02′	114.50	3° 02′	2-33 4-27

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*Abstract of paper by Mr. S. S. Roberts, Bulletin No. 109, American Railway Engineering and Maintenance of Way Association.

$$l = (S + W) + 2\left[\frac{N(17N - W) - SN}{N + N'}\right] \qquad (1)$$

A comparison of the results obtained by the approximate and exact formulas is shown in Table II.

TABLE II. — COMPARISON OF SWITCH LEADS, AS GIVEN BY THE EXACT AND APPROXIMATE FORMULAS.

N = Frog No.	Length of Theoretical Leads. Exact.	Approximate.
4	37.20	37.21
5	43.48	43.48
6	48.49	48.52
7	57.58	57.55
8	68.38	68.31
9	74.08	74.09
9½	79.48	79.48
10	82.30	82.31
12	95.24	95.06
15	114.14	113.98

From Table II it is evident the approximate formula is sufficiently accurate to form a basis for selecting a practical lead.

Having selected a practical lead, which call L', and calling the lead given by formula (1) L, we know

When $L'<L$ there must be a short piece of tangent adjacent to the toe of the frog.

When $L'>L$ there must be a short piece of tangent adjacent to the heel of the switch rail.

When $L'<L$ the distance from the heel of the switch rail to the point of intersection of the switch rail produced with the frog produced is the tangent distance of the lead curve.

When $L>L$ the distance from the toe of the frog to the above point of intersection is the tangent to the lead curve.

To determine the degree of the lead curve of the practical lead:

Let x = the distance from the toe of the frog to the point of intersection of the extension of the wing rail and switch rail.

Let y = the distance from the heel of the switch rail to the said point of intersection.

Let F = the frog angle, a = the switch angle, w = distance from point to toe of frog, S = length of the switch rail and G = gage; then

$$x = \frac{G\cos a - L'\sin a}{\sin(F - a)} - W \qquad (2)$$

and

$$y = \frac{L'\sin F - G\cos F}{\sin(F - a)} - S. \qquad (3)$$

When $L'<L$, then $x>y$ and y = tangent distance to lead curve. The length of tangent adjacent to the toe of the frog and between it and the $P.T.$ of the lead curve is

$$t_t = (x - y) = \frac{G\cos\frac{1}{2}(F + a) - L'\sin\frac{1}{2}(F + a)}{\sin\frac{1}{2}(F - a)} + (S - W) \qquad (3a)$$

When $L'>L$, then $y>x$ and x = tangent distance to lead curve. The length of tangent adjacent to the heel of the switch rail and between it and the P.C. of the lead curve is

$$t_s = (y - x) = \frac{L'\sin\frac{1}{2}(F + a) - G\cos\frac{1}{2}(F + a)}{\sin\frac{1}{2}(F - a)} - S - W \qquad (2a)$$

$$R = T\cot\tfrac{1}{2}(F - a) - \frac{G}{2} = y\cot\tfrac{1}{2}(F - a) - \frac{G}{2} \qquad (3b)$$

or

$$R = x\cot\tfrac{1}{2}(F - a) - \frac{G}{2} \qquad (2b)$$

The offsets from the guage side of outer rail of the lead curve to the gauge side of the rail of the principal track are:

$$Y = \left[H + \left(R + \frac{G}{2}\right)\cos a\right] - \left(R + \frac{G}{2}\right)\cos(\mu + a) \qquad (3c)$$

or

$$Y = \left[(S + t_s)\sin a + \left(R + \frac{G}{2}\right)\cos a\right] - \left(R + \frac{G}{2}\right)\cos(\mu + a). \qquad (2c)$$

The distance measured on the rail of the principal track from a point directly opposite the point of the switch rail of the straight portion of the lead to the foot of the offset Y is

$$X = \left[S - \left(R + \frac{G}{2}\right)\sin a\right] + \left(R + \frac{G}{2}\right)\sin(\mu + a) \qquad (3d)$$

or

$$X = \left[(S + t_s) - \left(R + \frac{G}{2}\right)\sin a\right] + \left(R + \frac{G}{2}\right)\sin(\mu + a) \qquad (2d)$$

Throughout the above formulas the notation used is that used in the report of the Track Committee.

If it is desired to determine approximately the degree of the lead curve, the following formula may be used in connection with formula (1):

$$R = \frac{N(17N - W) + SN}{N + N'} \cdot \frac{4NN' + 1}{2(N' - N)}$$

$$D = \frac{5730}{R}$$

From the writer's experience and the above comparisons he concludes:

(1) That the use of practical leads is good practice.

(2) That the approximate formula (1), herein above given, is sufficiently accurate for a basis from which to select a practical lead.

(3) That, having selected a practical lead by formula (1) or by any exact formula, the determination of the remaining functions of the turnout by formulas (2) to (2d), or by (3) to (3d), herein above given, is good practice.

Floor and Track of the Pittsburg & Lake Erie R. R. Bridge over the Ohio River at Beaver, Pa.*

The general design of the bridge called for two gauntlets of two tracks each to accommodate the four tracks at each end of the bridge, the northward passenger and the northward freight forming one gauntlet, and the two southward tracks making the other. The tracks in each gauntlet have their adjacent rails 1 ft. apart from center to center, both freight tracks being toward the center of the bridge and 13 ft. apart, the passenger tracks, therefore, are 15 ft. apart. The side clearances are 7½ ft. from the centers of the passenger tracks to the trusses, and 7 ft. to the skid girders.

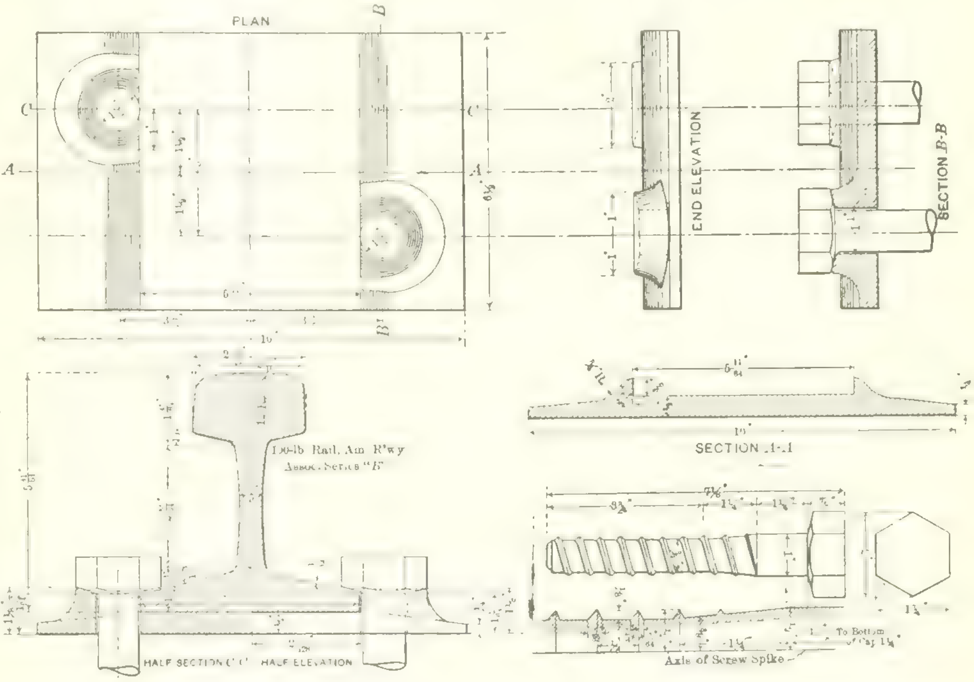

Fig. 1—Intermediate Tie Plate and Screw Spike, Pittsburg & Lake Erie Bridge over Ohio River, Beaver, Pa.

Skid girders, two on each side of the bridge, are provided to prevent cars from running into and damaging the trusses in case of derailment. These are of unusual interest and are a unique means of protection against such a catastrophe. The track faces of these girders are smooth and continuous so that a derailed car will move without obstruction until its momentum is overcome.

There are two horizontal skid girders for each truss, one vertically over the other, 4 and 6 ft., respectively, above the top of the ties. The chords on the track side of the trusses are made up of 6x6x½-in. angles and 12¼x½-in. web plates. The outside chords have 6x6x½-in. angles and 10¼x½-in. plates. These chords are 5 ft. 4½ ins. apart, and are connected by web members made up of 3½x3½x⅜-in. angles. They have expansion joints at the proper locations, with rivets countersunk on the track faces of the chords, and are attached to the main-truss members by angles connecting with the skid-girder chord web-plates.

The floor was designed to be safe, not only when all wheels are on the rails, but also under any probable condition resulting from a derailment on the bridge.

Four stringers, 2½ ft. from center to center, are placed under each gauntlet, and there is a ninth line of stringers under the center line between the trusses to support the inner ends of the ties. Each gauntlet has four main-track rails and two inner-rail guard-rails, making twelve lines of 100-lb. rails on the bridge floor.

The ties are of 7x9-in. white oak, 12½ ft. long, placed on edge and sized to 8½ in. The inner ends of the ties butt on the center line of the center stringers. The ties are 3 ins. apart in the clear. This spacing is maintained by using three lines of wooden-block spacers or separators on each half of the floor, to prevent bunching.

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*From a paper entitled "The Pittsburg and Lake Erie Railroad Cantilever Bridge Over the Ohio River at Beaver, Pa," by Albert R. Raymer. Proceedings, American Society of Civil Engineers, Vol. XXXVII, p. 1.

The tops of the ties are about 1½ in. above the tops of the floor-beams, and are held about ¼ in. away from them by the use of metal plates, in order to allow cinders to be blown off the floor-beams by passing trains.

Wooden guards are not used, as the modern steel-car construction, with drop doors, has forced their location below a plane through the top of the rails within 5 ft. of the center of the track, thereby defeating the object of their use. The spacing of the ties, formerly secured in an indifferent manner by dapping the guard-rails over the ties, is accomplished much more effectively by the block spacers used.

All the ties and the spacing blocks, oak and pine, respectively, have been treated chemically by immersion in an open tank of Carbolineum Avenarius heated to a temperature of 260° F. All track rails are supported on double-shoulder tie-plates secured to the ties by screw-spikes.

The intermediate tie plates are 6½x10 in. and are ½ in. thick between the shoulders. They are of malleable iron with smooth bottom. The screw spikes have hexagonal heads, are 7⅛ ins. long over all, and have ¾-in. shank in the lower 3¾ ins. of their length. Intermediate tie plates and screw spikes are shown in detail by Fig. 1.

The joint tie plates are 6½x13 ins. and are also ½ in. thick. Two screw spikes are used with each plate to hold it in place, but do not come in contact with the rail or angle bar, the joints being left free to move as the rail expands or contracts. No special expansion joints are used in the rails. The bridge expansion provision amounts to a total of 8 ins. at the ends of the suspended span.

The rails are 33 ft. long. The standard rail splices used allow an extreme movement of ⅜ in. at each rail joint, which amount is sufficient to accommodate a temperature change of 140° F. The rails were given the proper spacing when laid, with the assumption that the temperature would vary from 20° below to 120° above zero. The rails were then immediately secured to the floor over the "fixed" points of the bridge, and, on the shore side of the abutment, on the tracks approaching the bridge, by the use of efficient anti-creeping devices. Between these fixed points the rails are free to travel on the tie-plates. All spikes in the vicinity of the joints are located so that they will not interfere with the free travel of the rails, the assumption being that both the rails and the bridge are provided with sufficient freedom to expand and contract between these fixed points, the rails by distributed expansion points, and the bridge at one or two located points; and that the two movements will be adjusted by the rails moving between the fixed points on the tie-plates. No anti-creeping devices are used on the suspended span.

The anti-creeping device is simple in design, and is shown by Fig. 2. It consists of a base plate ⅝ in. thick, 10 ins. wide and 4 ft. 4 ins. long, attached to the rail by means of angles that are bolted to the base plate and the rail. The plate is attached to the ties by means of screw spikes. Further provision against creeping is made by means of angles riveted to the plate and with one leg bearing against alternate ties in the direction of the traffic.

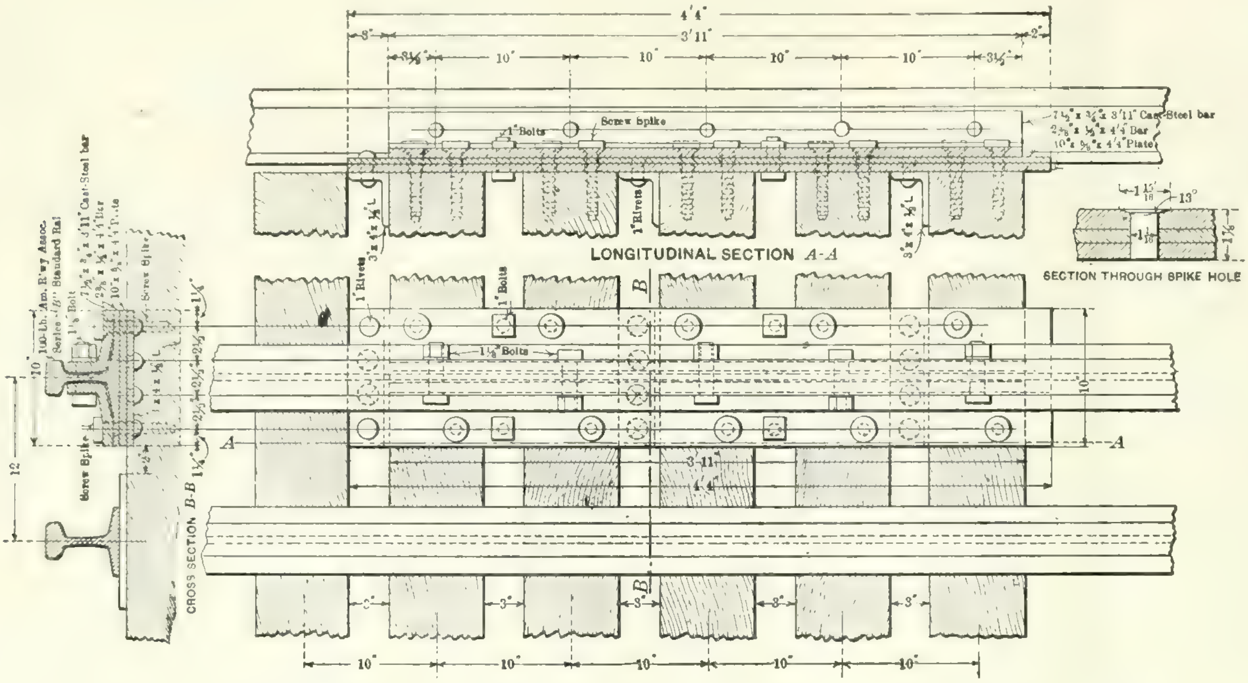

Fig. 2—Details of Rail Anchor, Pittsburg & Lake Erie Bridge over Ohio River, Beaver, Pa.

Manganese Crossings for Steam Railways.

As preliminary to an account of the use of cast manganese steel in crossing construction the following brief outline of the manufacture and properties of this metal is given:

The process of manufacture is being improved continually. Certain details of the process are for commercial reasons kept secret by the manufacturers. This is particularly the case with the treatment of the casting, a treatment that may be applied by heat, by quenching in water, or by both.

A certain percentage of loss in the manufacture of manganese steel castings is unavoidable, and may be caused by errors in mixing, errors due to incorrect treatment in the converter, incorrect temperature at time of pouring or wrong treatment after casting is made. The entire process is, in fact, an extremely delicate one, and a mistake at any stage is likely to result in an inferior or worthless product. An authority on manganese steel made the statement in 1908 that the losses due to these causes, in a well organized establishment, would amount to a trifle less than 10 per cent. Owing to the continual improvement in process the percentage is probably less than that at the present time.

While certain details of the process of manufacture are kept secret, the process as a whole is well known, and has been described repeatedly. It is outlined in standard treatises on the manufacture of steel. In addition to this a number of good papers relating to the subject have been published in recent years.*

Manganese steel is defined as being a metal of the following composition:

	Per cent.
Manganese	11.00 to 15.00
Carbon	1.00 to 1.20
Silicon	0.25 to 0.40
Phosphorus	0.06 to 0.11
Sulphur	0.02 to 0.06

Balance of composition, iron.

A great many variations have been tried, and accidental metals produced, and this steel can best be defined as a steel high in manganese—the percentage being anything between 8 and 35 per cent. For securing the characteristic qualities of manganese steel, however, the range is limited.

The manganese is introduced by means of ferro-manganese, which has a high carbon content. Too great a content of carbon will result in a steel that is stiff and brittle when cold, and unworkable when hot. On the other hand too small an amount of manganese makes a steel that is weak and brittle. It is necessary to secure such a balance of the carbon and manganese contents as will result in a steel having a combination of strength and ductility, and therefore high in resistance to abrasive wear. The most ductile steel that has at the same time a high elastic limit is what is most desired. Commercial manganese steel has, therefore, a narrow range of analysis. Usually it runs about 11 per cent manganese and 1 per cent carbon. An exhaustive series of tests made several years ago on the best specimens of cast manganese obtainable showed an ultimate strength of about 82,000 lbs., elongation 30 per cent, and elastic limit 45,000 lbs.

The steel may be made either in an open-hearth furnace or a Bessemer converter, the latter being the means commonly employed. A mixture of scrap iron and pig, carefully made up according to analysis, is melted in an ordinary cupola, run into the converter, and blown after the manner of Bessemer steel. The process, however, is a delicate one. After being blown this steel is poured into large ladles, and the manganese is added, the manganese being melted in graphite crucibles under intense heat. The mixture is allowed to stand in the ladle for a certain length of time, until the correct temperature for pouring is obtained. For making the mould, the sand is pulverized and mixed with fire clay.

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*The reader is referred to a paper entitled "Manganese Steel," by Mr. W. S. Potter, presented before the Western Society of Engineers on Feb. 17, 1909, and published in the journal of that society for April, 1909; also a paper entitled "Manganese Steel," by Mr. F. E. Johnson, presented before the Association of Engineering Societies on Oct. 21, 1910, and reprinted in the "Roadmaster and Foreman" of December, 1910.

Great care is necessary in casting, on account of the excessive shrinkage. Manganese steel shrinks about 5/16 in. per ft., while ordinary cast iron shrinks only about 1/10 in. per ft. It is practically impossible to drill this steel, and soft steel bushings and inserts are cast into the casting wherever it is necessary to drill or tap the casting for finishing. These are afterwards drilled out with ordinary drills. The after treatment of the casting is of extreme importance, and it is stated that it is this that gives the steel its characteristic toughness. As stated above, this part of the process is kept secret by the manufacturers.

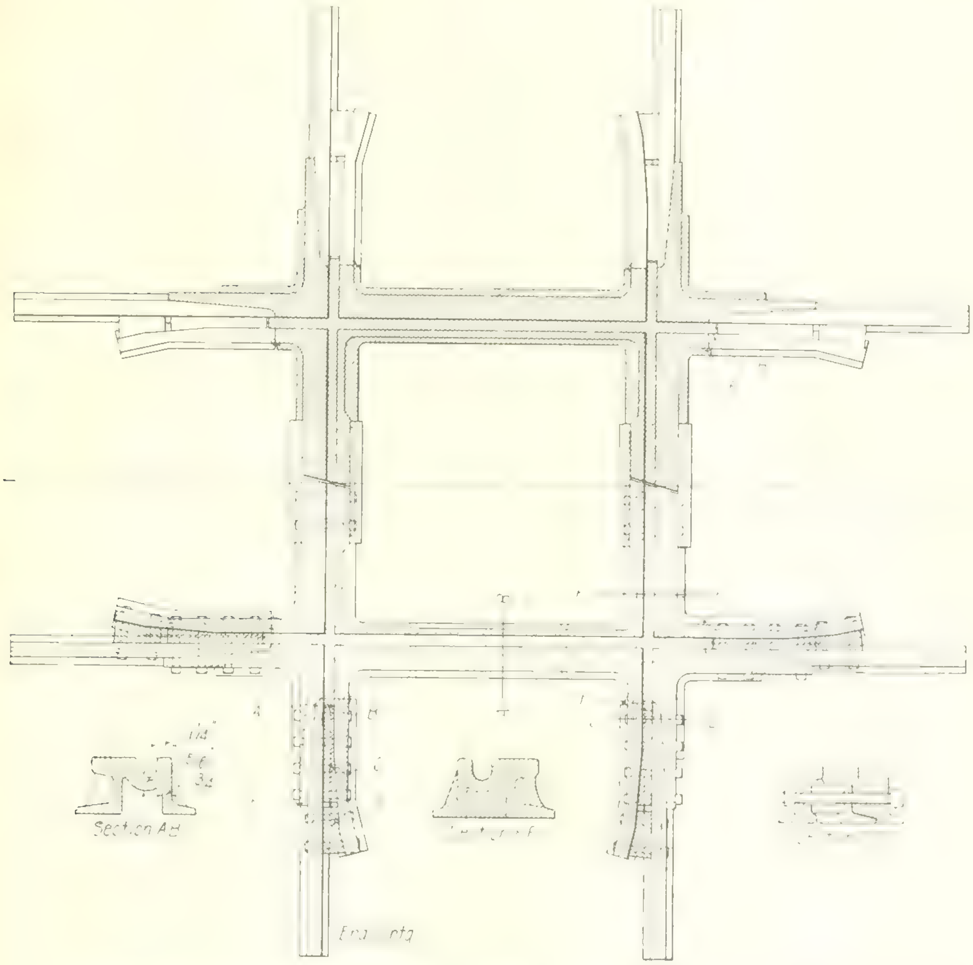

Fig. 1—90 Degree Manganese Crossing, Showing Form of Castings and Details of Construction.

The castings are finished by being ground with carborundum or emory wheels, as no steel tools have yet been made by which manganese steel can be worked.

Strength and toughness are the features of manganese steel that make it especially suitable for frogs and crossings subjected to heavy service. The steel is not excessively hard, the scleroscope showing its hardness to be less than that of cast iron. The skin of the casting is subject to slight flow, but the wear is practically negligible. Flow appears to be confined to the skin, a maximum depth of 1/16 in. only having been observed. Such is the ductility of the metal that it can be hammered or bent back and forth a great many times without showing signs of fracture.

The question as to whether a frog or crossing shall be of manganese or of ordinary construction is an economic one, and is analogous to that of installing any long-lived or permanent construction in preference to a comparatively temporary construction. It is necessary to consider the first cost, interest on investment and ultimate renewal of the manganese construction, and to make comparison with the total cost of the ordinary construction, with its several renewals, during the same period. Some manufacturers guarantee their manganese crossings to outlast four crossings built of open-hearth rail. Such guarantee applies, of course only to the manganese parts. The ratio of cost is from 3 to 4, depending on the type of construction.

Where frogs or crossings are not subject to heavy service, the life of manganese construction might be so great that the possibility of change in the arrangement of tracks, with consequent abandonment of existing frogs and crossings, would enter into the question. In such a case the use of manganese might be uneconomical. In general, manganese construction is only suitable, from an economic point of view, where the service is heavy. With present market prices it is a safe rule that manganese should be used in any case where the life of an open hearth crossing is three years or less.

CROSSINGS OF THE 90 DEGREE CLASS

The details of construction in manganese crossings lead to approximately the same grouping, with reference to angle, as in crossings of the ordinary construction. The three groups in manganese construction are as follows: 90° crossings, with angles varying from 60° to 90°; 40° crossings, with angles varying from 30° to 60°; and 20° or frog crossings, with angles less than 30°.

A typical 90° crossing of manganese construction is shown by Fig. 1.

It will be observed that only a part of this crossing, as well as of the crossings shown by Figs. 2 and 3, is of manganese. In order to make the manganese construction commercially practicable it is necessary to reduce the amount of manganese used to a minimum, consistent with adequate strength and the provision of manganese surface at points of greatest wear. Beyond this the manganese must extend far enough out on the wings to provide a proper connection with the T-rail construction.

The crossing is cast in two halves, the two parts being interchangeable. In the upper half of Fig. 1 the outline of the casting is indicated by the shaded area. In the lower half of the figure the bolting and all details of the connection with the T-rails are shown. The joint between the two halves should invariably be placed in the line of secondary traffic, in this as in other types of crossing. The joint is made in the usual way by means of bolts and angle bars. There are two special features, however, in this joint. In order to secure greater strength in the head and base of the manganese, the fishing in the casting is made smaller than the fishing of a corresponding T-rail.

This is done in such a way that some standard angle bar smaller than the one corresponding to the T-rail will fit. In making a crossing for 85-lb rail, for example, the fishing in the casting would usually be made for a 75-lb. angle bar. It will be noted also that the joint between the castings is made on an angle, and so located that the ends of the joint clear the adjacent bolt holes. This form of joint is entirely practicable where the section is all manganese, and undoubtedly diminishes the force of the blow of the wheels where the joint has been allowed to work loose.

The dotted outlines shown in the lower half of the figure indicate vertical supports corresponding to the web of a rail. This will be understood by reference to Section *AB*. At intervals of from 12 ins. to 15 ins. cross webs are provided, resulting in a solid manganese section as shown at Section *EF*.

In this way is produced a casting of adequate strength with a minimum amount of manganese. The connection between the manganese casting and the T-rails is a matter on which a great amount of study has been expended. The requirements for this connection are rigidity, a gradual transition from manganese to T-rail on the running rail, ease in detaching for renewing the T-rails, and facility in tightening. Great care has been employed in devising this connection so that the blow on the T-rails from passing wheels will be minimized as much as possible, as the renewal of the T-rails, which occurs a number of times during the life of the casting, constitutes practically the whole expense of maintenance of a manganese crossing.

The way in which these requirements are met is clearly shown in Fig. 1. In making the gradual or beveled transition in the running rail the T-rail is placed as nearly to a joint at *A* as is consistent with adequate strength. This rail must be first bent and then planed to shape in such a way as to leave the web of the rail intact. The projection of manganese at *B* fits closely between the main rail and guard rail and is necessary in order to retain continuity of gage line after wear has taken place and bolts have been tightened. A rolled or wrought filler is used at *C*. The block *D* serves only as a separator and foot guard and is of cast iron. The general form of manganese and planing of the T-rails in the wings of the crossing is indicated by Section *CD*. The end of the manganese wing at *E* is sloped to provide a heel riser. At *F* is shown a small lug of the casting that extends under the head and bears against the web of the guard rail. This lug serves to hold the guard rail in correct position at a critical point in case the bolts have become loose.

Plates should be used as in T-rail crossings. They are often furnished loose, and punched for spikes, but preferably should be attached to the base of the casting by rivets. Where this is to be done it is necessary to cast in soft steel bushings and afterwards drill them out to form the rivet holes.

CROSSINGS OF THE 40 DEGREE CLASS

The construction of crossings of this class is in the main similar to that of crossings of the 90° class.

Both for ease in making and for convenience in handling, the manganese in this crossing is cast in four pieces, joints being provided at points intermediate between the frog points.

Interior guard rails are made of T-rail.

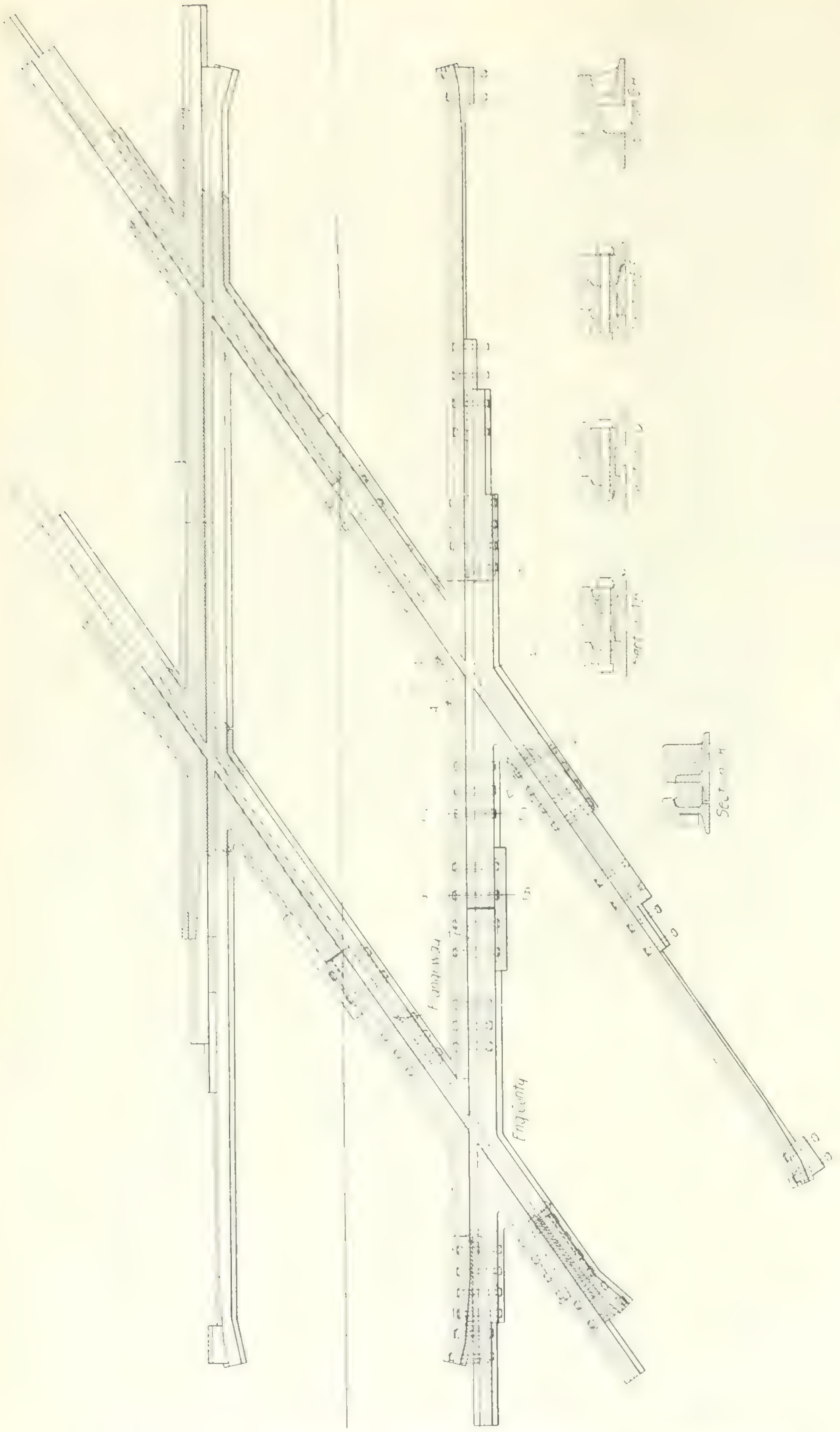

Fig. 2—40 Degree Manganese Crossing, Showing Form of Castings and Details of Construction.

This is a desirable economy since these guard rails are subject to but little wear. As indicated by Section *AB* the full section of the T-rail is used, and therefore no planing is required in making renewals. The guard rail is continuous between frogs. While this feature may add somewhat to the labor of installing, it increases the strength of the joint and is an excellent feature. The lug *A* bearing against the web of the guard rail is of particular importance here since the nearest bolt is necessarily some distance from the end of the guard rail. The outside guard rails of the side frogs are extended past the end of the wing to a point beyond the connection of the manganese and T-rails of the opposite end frogs.

MANGANESE FROG CROSSING.

Figure 3 illustrates the plan of construction of a frog crossing. Here a comparatively small percentage of manganese is used, castings being provided only for the intersections. As in the other figures the form of the castings is indicated by the shaded area in the upper half, and details are shown in the lower half of the figure. The section of the manganese is in general as shown in Figs. 1 and 2.

The side frogs are simple in design. The same method of connection between casting and T-rails is used as in 90° and 40° cross-

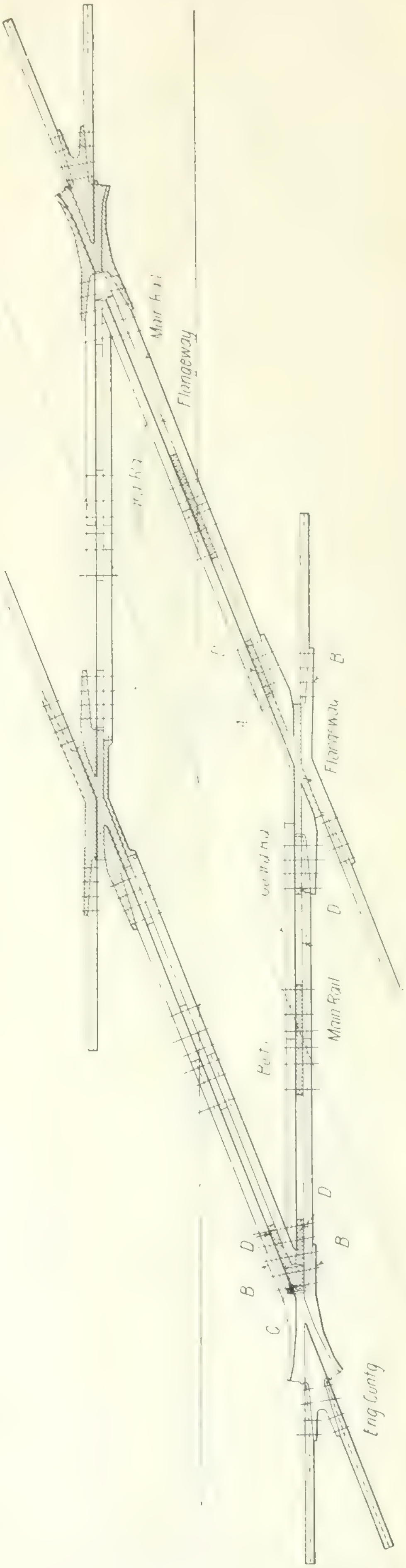

Fig. 3—General Plan, Form of Castings, and Details of a Manganese Frog Crossing.

ings. The maintenance of continuity of gage line is provided for by means of an offset in the casting at *A* into which the guard rail is extended. In the end frogs a serious problem is encountered. In order to secure a proper connection between the casting and the T-rails at *B* the extension of the arms of the casting for a short distance along the outside of the T-rails is unavoidable. The difficulty is not peculiar to manganese castings, but would be encountered in using any casting whatever. Wear between the parts is bound to occur. [illegible] of the casting, enclosing as it does the worn parts, it is impossible to take up the wear by tightening the bolts. In the design shown the cast iron block *C* is made with oval bolt holes and a clearance of from 1 in. to 1½ ins. is provided between the end of the block and the manganese [illegible] the bolts the block [illegible] and the wear taken up in this way. This method, while not all that could be desired, appears to be the most satisfactory solution of the question. Rolled or wrought fillers are used at *D*.

The crossings illustrated in this paper are made in accordance with the standards of the Ajax Forge Co., of Chicago. The standards of other manufacturers will be described in subsequent issues.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Standard License Law for Engineers Recommended by the American Society of Civil Engineers.

The people of the state of ———, represented in senate and assembly, do enact as follows:

Section 1.—After May 1, 19—, no person shall practice civil engineering within the meaning of this act in the state of ——— unless authorized by license from the State Board of Engineering Examiners, as required by this act.

Section 2, *Practice of Civil Engineers.*—Civil engineering, within the meaning of this act, is practice of any branch of the profession of engineering other than military. Said profession embraces the design and supervision of the construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, irrigation works, water supplies, sanitary and drainage works, of works for the development, transmission, and application of power, and of electrical, mechanical, mining, industrial, hydraulic, municipal, sanitary, structural and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation.

The enumeration of any public or private utilities or works in this section shall not be held to exclude from said profession the design and supervision of other public or private utilities or works which require experience and like technical knowledge.

Section 3, *State Board of Engineering Examiners.*—A state board of engineering examiners of nine (9) members shall be appointed by the governor, each of whom, except as hereinafter provided, shall hold office for six (6) years from May 1 of the year in which he is appointed. In constituting the first board to be appointed under this act the governor shall designate three (3) members to serve for two (2) years from May 1, 19—, three (3) members to serve for four (4) years from May 1, 19—, and three (3) members to serve for the full term of six (6) years from May 1, 19—.

Thereafter the governor shall appoint biennially three (3) members for the full term of six (6) years, to fill the vacancies caused by expiration of term of office, and may, at any time, fill vacancies in the board for the unexpired term caused by death, resignation, or removal from office. The governor may remove any member of the Board of Examiners for misconduct, incapacity, or neglect of duty.

Each member of the Board of Engineering Examiners shall be a professional civil engineer at least thirty-five (35) years of age, shall have had at least ten (10) years' active practice, be of recognized standing in the profession, and be licensed under this act. He shall have been a resident of the state of ——— for one (1) year immediately preceding his appointment.

Wherever the words "the board" are used in this act they mean the State Board of Examining Engineers provided for by this section.

Section 4, *Certificate of Appointment, Oath, Powers.*—Every member of the board shall receive a certificate of appointment from the governor, and before beginning his term of office shall file with the secretary of state the constitutional oath of office. Each member of the first board shall receive a license under this act from said board when organized.

The board, or any committee thereof, shall be entitled to the counsel and services of the attorney general, shall have the power to compel the attendance of witnesses, and may take testimony and proofs concerning all matters within its jurisdiction.

The board shall adopt a seal which shall be affixed to all licenses granted, and may make all by-laws and rules, not inconsistent with law, needed in performing its duty; but no by-law or rule by which more than a majority vote is required for any specified action by the board shall be amended, suspended, or repealed by a smaller vote than that required for action thereunder.

Section 5, *Expenses.*—The fees derived from the operation of this act shall be paid into the state treasury, and the legislature shall annually appropriate amounts sufficient to pay all proper expenses incurred pursuant to this act.

Warrants for the payment of expenses incurred shall be issued by the comptroller and paid by the state treasurer upon presentation of vouchers regularly drawn and approved by the president and secretary of the board.

On or before the first day of February in each year the board shall submit to the legislature a written report of its proceedings for the preceding year, and shall file with the secretary of state a copy of said report, together with a complete statement of the receipts and expenditures of the board, attested by the affidavits of the president and secretary, and a complete register of those licensed to practice civil engineering under this act, with their addresses and the dates of their licenses.

Section 6, *Officers, Meetings, Quorum, Committees.*—The board shall biennially elect from its members a president and a vice president for the ensuing biennial term.

The board shall appoint a secretary, who shall not be a member of the board, but who shall have the same qualifications as herein required for members thereof. He shall hold office during the pleasure of the board, and shall receive an annual compensation of —— dollars. He shall give a bond with sureties to be approved by the board conditioned for the faithful performance of his duties and for the accounting and payment over of all moneys received by him.

The secretary shall keep a record on file in the office of the board of all licenses granted, and shall receive and account for all fees derived from the operation of this act. He shall perform all other duties which may from time to time be assigned to him by the board.

The board shall hold at least six (6) stated meetings in each year. Special meetings may be called at other times by the president or by three (3) members of the board. At least ten (10) days' notice of all meetings shall be given.

At any meetings of the board three (3) members shall constitute a quorum.

Section 7, *Admissions to Examination.*—The board shall admit to examination any candidate who pays a fee of —— dollars and submits evidence, verified by oath and satisfactory to the board that he—

(1) Is more than twenty-one (21) years of age.

(2) Is of good character.

(3) Has been engaged actively in civil engineering work, as assistant or otherwise, for at least six (6) years, and has had charge of engineering work for at least one (1) year.

(4) Or is a graduate from a school of engineering of recognized reputation and has been engaged actively in civil engineering work, as assistant or otherwise, for at least four (4) years, and has had charge of engineering work for at least one (1) year.

Section 8, *Licenses Without Examinations.*—The board shall issue a license, upon due application therefor, and the payment of a fee of —— dollars, within one (1) year after this act takes effect, to any candidate furnishing evidence satisfactory to said board that the candidate is qualified for admission to examination as prescribed in Section 7 hereof and has practiced civil engineering for an additional period of not less than four (4) years immediately preceding. After the expiration of said period of one (1) year, the board shall issue licenses only as hereinafter provided.

Section 9, *Examinations.*—Examinations for license shall be given at stated or called meetings of the board, which shall be held at various places within the state, at the selection of the board. The scope of the examination and the methods of procedure shall be prescribed by the board. The examinations may be either oral or written, or partly oral and partly written, but shall be as nearly uniform as is reasonably possible in each specialty covered. As soon as practicable after the close of each examination a certificate shall be filed in the office of the secretary of the board, signed by the members conducting such examination. Said certificate shall show the action of the board upon each application, whereupon the secretary of the board shall notify each applicant of the result of his examination. If a candidate fails on first examination, he may, after an interval of not less than six (6) months, nor more than one (1) year, have a second examination without additional fee.

Section 10, *Licenses.*—Upon the payment of an additional fee of —— dollars any applicant who has been certified as having passed the prescribed examination shall receive a license to practice, signed by the president and secretary of the board, under its seal, which license shall state that the applicant has given satisfactory evidence of fitness as to age, character, education and training, and all other matters required by this act, and that, after examination, he has been found properly qualified to practice.

The board shall from time to time examine the requirements for licenses in other states, and shall register those in which, in the judgment of said board, standards not lower than those provided by this act are maintained. Upon the presentation, by a resident of a state so registered, to the secretary of said board, of satisfactory evidence that he holds a license issued by proper authority in such state, or upon the presentation by a civil engineer resident in a state not so registered of satisfactory evidence that he is qualified as prescribed in Section 7 hereof and has practiced civil engineering for an additional period of not less than four (4) years immediately preceding his application, accompanied in either case by a fee of —— dollars, the secretary shall issue to him a license to practice civil engineering in the state of ———, whereupon the person to whom said license is issued shall be entitled to all the rights and privileges conferred by a license issued after examination by the board.

Before any license is issued it shall be numbered and recorded in a book kept for that purpose in the office of the board, and its number shall be noted on the license. This register shall be open to public inspection, and in all legal proceedings the same or a transcript of any part thereof, certified by the secretary of the board under its seal, shall be entitled to admission in evidence.

No unlicensed person shall qualify as a witness before anv state or municipal court as an expert in civil engineering.

No map, plan, or drawing required by law to be certified or approved by a civil engineer shall be accepted or filed by state or municipal authority, unless the certification or approval is executed by a person duly licensed in accordance with the provisions of this act.

Section 11, *Revocation of License, Annulment of Registry.*—The board shall have power at any and all times to inquire into the identity of anv person claiming to be a licensed civil engineer, and, after due service of notice in writing, require him to prove, to the satisfaction of said board, that he is the person licensed to practice civil engineering under the license by virtue of which he claims the privilege of this act. When the board finds that a person claiming to be a civil engineer, licensed under this act, is not in fact the person to whom the license was issued, the findings of the board shall be reduced to writing and shall be filed in the office of the board. Said certificate shall be *prima facie* evidence that the person mentioned therein is falsely impersonating a practitioner or a former practitioner of a like or different name.

The board may revoke the license of a practitioner and annul his registration, if said practitioner has been guilty of any fraud or deceit in his practice, or has been guilty of any fraud or deceit by which he was granted a license to practice, or has been convicted of crime.

When charges are preferred, the board shall designate six (6) of its number as a committee to hear and determine said charges. A time and place for the hearing shall be fixed by the said committee as soon as convenient, and a copy of the charges, together with a notice of the time and place when they will be heard and determined, shall be served upon the accused or his counsel at least ten (10) days before the date actually fixed for said hearing. Where personal service, or service upon counsel, cannot be effected, and such fact is certified on oath by any person duly authorized to make legal service, the board shall cause to be published for at least seven (7) times, for at least twenty (20) days prior to the hearing in two daily papers in the section of the state in which the accused was last known to practice, a notice to the effect that at a definite time and place a hearing will be had on the charges against the accused upon an application to revoke his license. At said hearing the accused shall have the right to cross examine witnesses and to produce witnesses in his defense, and to appear personally or by counsel. The said committee shall make a written report of its findings and recommendations, and the same shall be submitted forthwith to the board. If the said committee shall by a two-thirds vote recommend that the license of the accused or revoked and his registration annulled, the board may thereupon, in its discretion, revoke said license and annul said registration. If the board shall revoke said license, its action shall be recorded in the same manner as licenses are registered, and the name of the accused shall be stricken from the list of licensed civil engineers.

Section 12, *Certificate Presumptive Evidence: Unauthorized Registration and License Prohibited.*—Every unrevoked certificate and endorsement of registry made as provided in this act shall be presumptive evidence in all courts and places that the person named therein is legally registerel.

No diploma or license conferred on a person, other than by the board or its secretary, shall be lawful authority for the practice of civil engineering within the meaning of this act.

Section 13, *Penalties and Their Collection.*—Any person who, not being then lawfully authorized to practice civil engineering within this state according to the provisions of this act, shall attempt to practice or shall so practice, and any such person who shall, in connection with his name, use any designation tending to imply or designate him as a practitioner of civil engineering within the meaning of this act, and any person who shall have violated the provisions of this act, shall be deemed guilty of a misdemeanor. Any person presenting or attempting to file as his own the license of another or who shall give either false or forged evidence of any kind to the board or to any member thereof, in connection with an application for a license to practice civil engineering, or who shall practice civil engineering under a false or assumed name, or who shall falsely personate another practitioner of a like or different name, shall for each offense be punished by a fine of not less than $100 nor more than $500, or by imprisonment for three (3) months, or by both such fine and imprisonment.

Section 14.—This act shall not apply to engineers working for the United States government, nor to any engineer employed as an assistant to an engineer licensed to practice civil engineering in the state of ———, nor to any engineer coming from another state and employed by the state or any municipality, corporation, firm, or individual therein, until a sufficient time shall have elapsed to permit the licensing of such person.

Section 15.—This act shall take effect on the 1st day of May, 19—.

Annual Meeting of the Kansas Engineering Society.

BY W. S. GEARHART.*

The society held its first annual meeting at Topeka, Kan., on Jan. 20 and 21, 1911. The program listed 30 papers and addresses but it was not possible to present all that had been planned and allow for the discussions. Great interest has been manifested in the society since its organization about a year ago, and over 100 members and visitors were present at this meeting. Although most of the topics discussed were along the line of civil engineering, they were presented in such a way as to be of general interest to all the different branches of the profession.

During the first evening of the convention, Governor Stubbs gave a short address. The Governor was formerly engaged in contracting and is intimately acquainted with many of the older members. During his talk he spoke of engineers he had known, telling of several instances that had occurred while he was engaged in engineering work, and speaking in particular of several prominent men in the profession as the most worthy citizens of our country. He called attention to several fields of investigation wherein the society could greatly benefit the State.

From the Committee on Paving, Mr. J. Smith (Emporia), presented a paper on "Street Paving." Special attention was called to the expense and unsatisfactory system of requiring of the contractor a guarantee for a term of years on paving work. Mr. Smith's plan is to draw up specifications for what you want and see that you get it and take the consequences. The advantages of a combined concrete curbing and gutter were shown in this article, and a discussion of various fillers for brick paving was also given. Mr. Con M. Buck (Manhattan), spoke on "Paving Hints."

Mr. W. H. Jones (Leavenworth), in a paper on "The Evolution of Highway Bridge Construction and the Advantages and Disadvantages of the Use of Concrete in the Construction of the Same" urged that the proportioning and mixing of the aggregates and the placing of the reinforcement were such essential points that unless there was first-class supervision of the work, concrete was a failure in bridge construction.

Mr. J. W. Mavity (Lincoln), presented a paper on "Surveys." This article in the main discussed the general inefficiency of many of the so-called "surveyors" in Kansas, and treated the subject in such a manner that the only comments and discussion were endorsements. Mr. Mavity outlined a plan to insure to the public the surveys of a capable man when so desired. The plan in brief was, that all surveyors should be compelled to place on all maps, plots, plans, estimates, and other similar documents prepared by them and on their business stationery their name and with it in characters of equal size either "licensed surveyor" or "not licensed surveyor," the licensed surveyor being one having secured a license as a result of a rigid and practical examination. This article resulted in the following resolutions by the society: "Resolved, That the President appoint a committee of three active members of the society to investigate and consider the question of qualifications for the practice of engineering and surveying within the State of Kansas and to report these findings and recommendations to the society at its next annual meeting.

From the Committee on Railroads, Prof. B. J. Dalton (Kansas University), gave a very interesting paper on "The Classification of the Graduation on Railroad Construction." Professor Dalton gave the specifications the classifications that are in general use, and in a discussion of these made the point that the classification depended very much on the specifications. Mr. J. M. Meade (Engineer A. T. & S. F.) gave a paper on "The First Transportation." A paper by Mr. A. C. Titus (Topeka), on "Early Reminiscences of Railroad Work," was very interesting.

From the Committee on Highways Mr. W. S. Gearhart, Highway Engineer, spoke on "Needed Changes in Our Bridge Law." The laws of Kansas are extremely complicated and decidedly inadequate on bridge contracts. As was presented in this paper, and mentioned several times in the discussion, it is hardly possible that there has been a legal bridge contract let in Kansas in the past ten years. A plan proposed in this article was that bridge districts be formed the same as for roads or drainage districts to give a more equitable distribution of the cost and the assessments to be made according to the benefits that accrue, the part borne by the county to be 60 per cent of the cost of the work. Where two or more counties were benefited 60 per cent of the cost was to be divided among them in proportion to the benefits that were derived therefrom.

Prof. W. C. Hoad (Kansas University), presented a paper on "Stream Pollution and Sewerage." Special mention was made of Kansas streams and the prevailing conditions. Owing to the number of small streams, Professor Hoad advocates for sewerage disposals in Kansas City. This paper was intended as an introduction to reports on investigation work that is to follow. Mr. N. T. Veatch (Kansas University), gave a paper on "The State Fish Hatchery at Pratt," giving a full description of the Hatchery, its present inadequate system, and showing and discussing the plans of improvement. Mr. E. A. F. Reinisch (Topeka), of the Committee on Landscape Engineering, presented a paper on "Tree Planting on Highways." The plans for tree planting on the highways of Kansas were discussed and the practice in European countries was described quite fully.

Mr. Herbert A. Rice (Kansas University) of the Committee on Materials of Construction and Exhibits, spoke on "Some Tests on Concrete Beams." He outlined briefly a series of tests being made at the Kansas University on the effects of repeated loads on concrete beams.

Mr. R. E. McDonnell (Kansas City) presented a paper on "The Value of Pure Water." This was illustrated by a number of lantern views. Mr. McDonnell spoke of the death rate from typhoid as effected by impure water, and gave some statistics along this line for various cities. That of Kansas City was given as 43 per 100,000 as an average for the past ten years.

A paper by Mr. Herbert S. Tullock (Leavenworth) on "Foundations" briefly outlined the general methods of foundations in bridge work. Mr. R. V. Leeson (Topeka) spoke on "Needed Legislation," discussing in the main laws on bridges, highways and surveys. A paper on "Electric Storage Battery Equipment as an Aid to a Better Power Station Load Factor" was presented by Mr. J. T. Skinner (Lawrence). Mr. Myron R. Bowerman (Topeka) gave an article on "The Shop System of the Capitol Iron Works."

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*Secretary, Manhattan, Kans.

The result of the election of officers for the ensuing year was as follows: President, Prof. W. C. Hoad (Kansas University); vice-president, H. V. Leeson (Topeka); secretary-treasurer, W. S. Gearhart (Kansas State Agricultural College).

It was indeed gratifying to the many engineers present to have with them, both as visitors and members, quite a number of men who are representing some of the leading contractors throughout the state.

Thirty-Second Annual Meeting of the Ohio Engineering Society.

The annual convention of the Ohio Engineering Society was held in Columbus, O., Jan. 24, 25 and 26, 1911. The attendance was slightly below the average. The report of the Secretary Treasurer showed a gratifying increase of membership and a sound financial condition.

The President, Mr. E. G. Bradbury of Columbus occupied the chair throughout the sessions. Much interest was shown in the excellent program, and considerable time was devoted to consideration of the proposed bill providing for the Registration and Examination of Civil and Mining Engineers and Surveyors, which was introduced in the State Legislature following its endorsement by the Society. Hon. H. S. Holton, Director of Public Service, Columbus (himself an engineer) addressed the Society, welcoming its members to the city and referring briefly to its recent great public improvements.

The president, in his address, pointed out some of the causes of unsatisfactory professional conditions, especially calling attention to the frequency with which engineers permit themselves to be handicapped by insufficient force, and the evils of price competition.

The construction of bituminous macadam roads was treated at length in a paper read by Mr. James T. Voshell, Asst. Engineer Office of Public Roads, U. S. Dept. of Agriculture. Mr. Will P. Blair, Secy. National Paving Brick Manufacturers' Association, presented a paper on the manufacture of paving brick and their use in street and road construction. Both of these papers were freely illustrated with lantern slides and were followed by very interesting discussion, led by Mr. Jas. C. Wonders, Col. J. M. Harper, Mr. A. J. Norton and Mr. D. W. Seitz.

Mr. W. J. Watson, Consulting Engineer, Cleveland, entertained the Society with an illustrated description of the famous bridges of history.

Another paper of general rather than technical interest was that of Hon. Andrew Roy, former State Superintendent of Mining, in which was described methods of coal mining in Mexico and the character and habits of the people of the sister republic, and closing with a description of a bull fight.

The Road Laws of Ohio were outlined by Mr. Jas. C. Wonders, State Highway Commissioner, who also described proposed legislation controlling the location, construction and maintenance of township and county roads, prepared by him under instructions of the legislature, and soon to be introduced. The location of roads is to be placed in the hands of the county surveyor and a highway superintendent will be placed in charge of all completed roads, who by the aid of a patrol system, will detect and repair defects. The county surveyor shall act as such superintendent on county roads and an elected official on township roads, under the supervision of the surveyor.

Mr. D. W. Seitz, Assistant State Highway Commissioner, presented a paper on the maintenance and repair of macadam roads.

A novel through arch concrete bridge near Cincinnati was described in a paper by Mr. E. A. Gast. The bridge has a span of 73 ft. with 31 ft. roadway and 50 ft. over all width. The concrete floor slab is supported on transverse reinforced girders hung from two reinforced hingeless arches built entirely above the floor level. Thrust is provided for by tension steel in the floor slab, thus relieving the abutments. The bridge is designed to carry two 40-ton traction cars. The floor and haunches were built on falsework, and the arches constructed last. The cost of the bridge was about $7,200.

Prof. C. E. Sherman of Ohio State University described the methods of the U. S. Geological Survey in determining the area of Ohio, and stated the correct area to be 41,240 square miles, exclusive of water surface in Lake Erie and its estuaries. Inland lakes have an area of 50 square miles. The figures given are projected on sea level.

Mr. Paul Hansen, State Sanitary Engineer of Kentucky, Mr. Wm. H. Dittoe and Mr. R. W. Ferris, Assistant Engineers, Ohio State Board of Health, presented a symposium on the operation of Sewage Purification Works, dealing respectively with general considerations, small sprinkling filter plants and plants comprising intermittent sand filters and contact beds. Mr. Hansen urged the employment of competent men, the keeping of records, the use of measuring devices and careful attention regarding neatness and appearance. Mr. Dittoe discussed in detail the operation of sedimentation tanks and sprinkler nozzles, and called attention to the intelligence and care necessary for their maintenance. Mr. Ferris treated the operation of the intermittent sand filter and contact bed in a comprehensive manner.

"The Province of Disinfection" was discussed in a paper by Mr. Clyde Potts, Consulting Engineer, New York. Mr. Potts considers sodium hyprochlorite preferable to calcium hypochlorite for use in connection with water supplies, but believes that chlorite of lime at $30 per ton is cheaper than sodium hypochlorites where electric currents can be obtained for 1 ct. per KW. hr. The use of hypochlorites is recommended as an emergency measure in case of epidemic, and in small proportions for the treatment of filtered water, thereby avoiding the necessity of overdosing with alum to secure bacterial efficiency. Disinfection of sewage effluents discharged into potable waters, or waters containing shell fish is also advised.

Mr. Philip Burgess, Consulting Engineer, Columbus, O., read a paper entitled "Some Features of the Design of Infiltration Plants" in which he called special attention to the fact that water drawn from sand or gravel deposits beneath the bed of a river frequently proves to be ground water flowing to the river rather than filtered river water and outlined the studies and tests necessary for proper design of a plant of this type. Brief descriptions of several such installations were given. Where a permanent supply can be thus obtained Mr. Burgess considers infiltration plants very satisfactory and economical, assuring that disinfection be resorted to when necessary to produce proper bacterial results.

An interesting and instructive discussion followed the reading of the papers on sewage disposal and water supply in which Mr. A. Elliot Kimberly, Mr. Wm. R. Copeland, Mr. Paul Hansen, Prof. C. E. Sherman and others participated.

Mr. C. E. Bushey of Mansfield, Ohio, presented a paper on concrete building construction, using a new type of iron forms.

An excursion to the Columbus Garbage Reduction Plant and the State Experimental Road was fairly well attended despite the inclement weather. The Society also attended a lecture entitled "The Experiences of an Engineer in the Untraveled Parts of South America," given by Mr. William Alford, Fellow of the Royal Geographic Society, under the auspices of the Department of Civil Engineering of Ohio State University.

The following officers were elected for the ensuing year: President, Hugh K. Lindsay, Columbus; vice-president, Frank R. Landor, Cleveland; secretary treasurer, C. J. Knisely, New Philadelphia; board of trustees, P. P. Evans, Cleveland; J. M. Harper, Cincinnati; F. W. Jennings, Columbus; D. W. Seitz, Columbus, and C. E. Bushey, Mansfield.

Resolutions were adopted as follows:

Resolution No. 1.—Whereas, Numerous local engineering organizations exist within the state of Ohio which are in no way affiliated with the Ohio Engineering Society; and,

Whereas, Numerical strength of this society and the united efforts of all members of the engineering profession are necessary in order to secure better conditions in relation to the practice of our profession; now therefore be it

Resolved, By the Ohio Engineering Society in convention assembled, that the president and secretary be instructed to formulate a plan for the affiliation of such local societies with the Ohio Engineering Society and to correspond with such societies with a view to securing their co-operation, and to report to this society at its next meeting regarding the feasibility of carrying out the sense of this resolution.

Resolution No. 2.—Whereas, The conditions surrounding the practice of civil and mining engineering and surveying in the state of Ohio are such that inexperienced, incompetent or dishonest persons may and do maintain places of business for the practice of the aforesaid professions and further may and do impose upon the public with inaccurate, ignorant and dishonest work, thereby discrediting the entire profession of civil and mining engineering and surveying and causing to the public much inconvenience and loss; and

Whereas, A bill providing for the creation of a state board of registration and examination for civil and mining engineers and surveyors and for the issuance of certificates to competent persons entitling them to practice such professions is about to be introduced into the general assembly of the state of Ohio; now therefore be it

Resolved, By the Ohio Engineering Society in convention assembled that we endorse such measure and respectfully urge its passage, and that a copy of this resolution be transmitted by the secretary to such committees of the general assembly as the above mentioned bill may be referred to.

Resolution No. 3.—Whereas, The new road bill prepared by the State Highway Commission under the provisions of an act numbered 518 has been read before this society and considered by its members; and

Whereas, The Provisions of such bill appear wise and greatly to the interest of the general public; now therefore be it

Resolved, By the Ohio Engineering Society in convention assembled that we heartily endorse the said road bill, and respectfully urge its enactment by the General Assembly of the state of Ohio, and that the secretary be instructed to transmit a copy of this resolution to the State Highway Commissioner and to such committees of the General Assembly as the said bill may be referred to for consideration.

Resolution No. 4.—Whereas, In the conduct of municipal affairs it becomes frequently desirable to employ the services of expert engineers in consultation with the regularly employed engineer of the municipality or for the performance of work for which the office of such regularly employed engineer is not equipped; and

Whereas, It has been brought to the attention of this society that such expert or consulting engineer is frequently employed by city officials without regard to the wishes of the regularly employed City Engineer; and

Whereas, Such condition is contrary to professional courtesy and ethics and to the universal practice among other professions and tends to create discord and an undesirable relationship among the members of our profession; now therefore be it

Resolved, By the Ohio Engineering Society in convention assembled, that it is the sense of this society that the employment of any expert or consulting engineer by any municipality having a regularly employed engineer should be only undertaken on recommendation of such regularly employed engineer, and that the selection of such consultant or expert should be by him, and that the committee on legislation be instructed to consider the feasibility of preparing and introducing such measures before [illegible] within the state.

A Discussion of the Depreciation Problem with Particular Reference To Electric Railways.

[illegible]

[illegible] it is essential to understand clearly what the word depreciation actually represents. There is no universally accepted definition of the term, so far as the writer knows, though the importance of depreciation as a factor in the operating costs of electric railroads has been [illegible] railroad finance and by the commissions having to do with railroad questions. In its most important features, in consequence, there has come to be a generally accepted consensus of opinion as to what depreciation means.

Every part of a properly constructed and well-equipped electric railway can be maintained in good operative condition by current repairs for a period of years; but the time comes with every building and unit of equipment when it, like a suit of clothes, can no longer be kept serviceable by repairs or current maintenance, and when it must consequently be replaced substantially in its entirety. It will thus be seen that two elements enter into the maintenance cost of the unit: One, the current maintenance or repair expense required to maintain it in condition suitable for service, and the other the cost of replacing or renewing it at the end of its useful life. The latter entails the necessity of accumulating, during the life of the unit, sufficient funds to replace it when it must go out of service. Expenditures for current maintenance are naturally distributed more or less uniformly throughout the life of the part, in accordance with the needs for repairs, while expenditure made necessary by depreciation must all be met at the end of the useful life of the unit, and is, therefore, often designated as deferred maintenance. Depreciation results from this quality, found in most parts in electric railway plants, which limits their useful lives and makes their ultimate replacement, as a whole, necessary notwithstanding that current repairs may have been well attended to.

The length of useful life of a unit is determined by one, or both, of two factors: First, the inherent quality of most physical property to deteriorate, on account of the effects of use and of the elements, to a point where it cannot be longer economically maintained in satisfactory operative condition by ordinary repairs—that is, a unit ultimately reaches a point of "decrepitude" when it is either impossible to keep it in satisfactory operative condition by current repairs, or the cost for such repairs becomes so great that it is more economical to replace the old unit by a new one. Second, the effects of changes in the art whereby the character of the service required is so changed, or the efficiency of apparatus for providing corresponding service is so improved, that plant still physically capable of doing the work for which it was designed is no longer able to economically provide the service required, and it is, therefore, obsolete. This second factor is well designated "obsolescence."

A third division called "inadequacy" is sometimes considered in estimating depreciation. This is intended to cover the effect upon the useful life of apparatus or plant of expansion in business whereby otherwise serviceable apparatus is outgrown and must be replaced by larger apparatus. The writer does not consider such a division necessary, for any effect caused by inadequacy which can be estimated may properly be considered under "obsolescence."

These principles apply simply and perfectly in practice. Let us take, for example, a new electric railway and consider for a moment the rails and their fastenings. Current maintenance will keep these in good operative condition for, say, an average of 17 years on the straight track, and for an average of 5 years on the curves. This will be accomplished by the usual track gangs, which will keep the track in alinement, raise low joints when they occur, replace a defective rail as occasion requires, etc. But after a period of years the track gang can no longer keep the rails so that they are safe or suitable for service, and then large sections of track must be replaced as units, for which relatively large expenditures must be made. Such expenditures cannot be provided for in the same manner as expenditures for current repairs. The latter are distributed with reasonable uniformity year by year, and may be cared for from current earnings, but the former are of only periodic occurrence, and require relatively large expenditures of accumulated funds.

These renewals cannot appropriately be paid for from funds charged to capital account, for that would have the ultimate effect of piling up unending capital with only one set of rails to show for it, nor can they appropriately be paid for by the company's notes to be liquidated during the life of the new rails (except under emergency conditions or in case the company had accumulated assets for the specific purpose of carrying such notes), for this would keep the company loaded with floating indebtedness which, when paid, would only have to be renewed when another set of rails was required. The company should accumulate funds during the life of the rails for the express purpose of providing for their replacement at the end of their useful life. The only way to be reasonably assured of having such funds when required is to estimate, when the rails go into use, the average years of service to be expected from them and the net cost of their renewal, and then distribute the charge for their replacement over the estimated useful life. And thereby the annual depreciation of the rails is obtained.

By the same process the requirements for depreciation of each kind of plant in a property may be estimated and the average amount per annum that must be appropriated to care for depreciation or replacements for each kind of plant may be determined. With possession of this information, it is merely a matter of taking the aggregate of these amounts to obtain the annual appropriation to the depreciation account required for the entire property. A knowledge of this amount places the management of an electric railway company in position to have the books of their company so organized that the accounts will show, month by month, and year by year, the amount of appropriation required for depreciation and the amounts of the appropriations actually made for the purpose, together with the amount of the fund that should be in the depreciation reserve and the sum actually accumulated. They are then in a position to know, at all times, the depreciation requirements of their company and its accomplishments in providing for deferred maintenance and depreciation reserve. In the case of many electric railroads the average costs for deferred maintenance are as large, and in some cases are larger than for current maintenance, and their importance should be fully taken into account in a system of accounting that is to show the true operating costs of any property.

To estimate the correct amount of annual depreciation that should be expected in an electric railroad, the factors of "decrepitude" and "obsolescence" must each be given due weight. The effect of "decrepitude" is likely to be physically apparent in a piece of apparatus during a larger portion of its useful life than is that of "obsolescence," but the ultimate effect of either is to determine the useful life of the apparatus. With buildings, power plant apparatus and electrical equipment the factors of "decrepitude" and "obsolescence" are usually both active in determining the rate of depreciation. "Obsolescence" alone determines the rate of depreciation in road bed since there is no physical deterioration that cannot be made good by current repairs, and road bed is only superseded because of abandonment of old locations, owing to requirements for better alinements, lower grades, etc. Depreciation in steel rails may usually be considered as occasioned by "decrepitude" since their replacement is generally made necessary by wear alone; unless the requirements of heavier rolling stock call for the laying of heavier steel, in which case the additional cost of heavier rails may be chargeable to capital.

There is some division of opinion as to whether railroad ties may be considered as coming within the classes of property for which deferred maintenance appropriations should be made. The propriety of making such appropriations on account of ties will be most readily appreciated if considered from the viewpoint of a new property. During the earlier years of a railroad's existence there is no expense on account of ties, further than the renewal of a defective tie from time to time, but after from five to seven years tie replacements become necessary in large quantities, and excessive expenditures for deferred maintenance occur. Thus during the earlier years a misleading cost for the maintenance will be shown unless appropriate consideration has been given deferred maintenance in the depreciation account.

The same considerations apply to almost all parts of an electric railway property. In the case of ballast the dividing line between current maintenance and deferred maintenance is likely to be less marked than with ties, but the propriety of building up a fund to extinguish the cost of ballast on roadbed which may be abandoned owing to improved alinement and gradients following the demands of business is clearly apparent.

An intelligent estimate of depreciation in a property must depend upon a thorough knowledge of the nature of the service demanded by the different kinds of plant, a wide acquaintance with the general experience respecting like kinds of plant, a broad survey of the probable effect of local conditions upon the useful life of the plant, and a wide knowledge of the past and present progress of the art, in order that an intelligent forecast may be made of the influences of "decrepitude" and "obsolescence" upon the rate of depreciation of the plant and the salvage values to be expected; and the estimates should be periodically revised, as time brings forth new developments to influence past conclusions.

The difficulty of arriving at a satisfactory basis for the calculation of depreciation is unfortunately not properly appreciated by the average layman, and by many students of the street railway problem. They are inclined to believe that the depreciation charge upon a large city system is the same as that upon a suburban or interurban railroad. They even overlook the fact that the constant changes in the art of electric traction necessitate continual revisions of the tentative standards adopted for any given property.

If they keep these matters in mind, however, the true significance of the problem and its importance both to the railways and the public should be understood.*

Depreciation requires most thoughtful consideration on account of the insidious nature of its growth. When a well designed and constructed property is new it will operate for some years without any expenditures on account of depreciation, but after a limited period apparatus becomes worn out or obsolete, and its renewal or replacement becomes necessary. Ties, which for the first few years require only the attention of the regular track gangs, become unfit for further use and must be replaced in large numbers; pole lines must be renewed in their entirety; trestles reach a condition when they must be replaced entirely or substantially so; buildings and power plant apparatus become worn out or obsolete; cars and equipment must be replaced; old grades and alinements become inadequate, and old roadbed must be abandoned for new. In fact, depreciation must be provided against every part of the physical property except land.

[illegible] Wm. B. Jackson, Consulting Engi- [illegible] and Chicago.

*For the purpose of illustrating the nature and importance of the charges which should be made to the depreciation account, the allowances made upon three important systems, as reported in the special census Bulletin on Electric Railways for 1907, are here reproduced.

RATES OF DEPRECIATION[2]

ITEM.	Estimated per cent of value to be annually provided for. Adopted by Chicago Union Traction Co.	Adopted by Third Avenue Railroad Co., New York[3]	Adopted for adjusted accounts of Milwaukee Electric Railway & Light Co.
Track and roadway:			
Track, ties, bonding, etc.	7.75	8 to 9	7.5
Special work and installation	7.75		8.0
Rolling stock:			
Bodies and trucks	5.50	5	5.0
Electrical equipment .. [illegible] to	[illegible]	[illegible]	7.5
Fenders, registers, lights, clocks, etc.		[illegible]	10.0
Overhead system:			
Poles	[illegible]	[illegible]	5.0
Wiring, fittings, etc.	10.00 to 11.00		10.0
Underground system:			
Conduits		[illegible]	2.0
Feeders, cables, etc.		[illegible]	4.0
Power-plant equipment:			
Engines	6.66	4	5.0
Boilers	6.66		7.5
Heaters, economizers, pumps, etc.	6.66		7.5
Piping	6.66	[illegible]	5.0
Traveling cranes	6.66		5.0
Belting, shafting, ropes, etc.	6.66		5.0
Coal and ash conveyors and hoist wagons	6.66		5.0
Dynamos	6.66		5.0
Generating apparatus	6.66	[illegible]	5.0
Storage battery	6.66		10.0
Switchboard and cables.	6.66		5.0
Shop tools and machinery	5.00		7.5
Building and improvements	2.00	2	2.0

With a few exceptions, each percentage in the above table refers to a group of two or more parts or kinds of plant and represents the percentage obtained from the aggregate of the depreciations for each part calculated separately. The percentages therefore may not be applicable to any other particular road without modifications. This will be appreciated by referring to the items of track, ties, bonding, etc., which are all shown in one group, though they do not individually have the same rate of normal depreciation, and all engines are in one group without regard to their types or quality.

[2] From table submitted in the case involving the rates of fare in the city of Milwaukee, Electric Railway Journal, April 10, 1909.
[3] Rates quoted in the franchise-tax case.
[4] Iron poles.

But the growth of depreciation or deferred maintenance expense does not necessarily become apparent in the operations of the property until the necessity of relatively large expenditures for replacements is at hand, and there is the possibility of such time arriving without those in charge of the plant realizing its approach. When such replacements become necessary they necessitate expenditures in large amounts which cannot be taken care of by the usual appropriations for current maintenance, and their cost may not be cared for by funds on capital account, for the replacements add nothing to the capital value of the plant except in so far as the replacements may be of a more costly character than the original, in which case the difference in cost may appropriately be charged to capital account.

Where, either through want of foresight or lack of earning capacity of the property those having in charge the well-being of an electric railroad have not seen to it that appropriate assets have been accumulated to care for the depreciation of the plant, it means that one of three conditions will arise when the time finally arrives when the replacements on account of depreciation must be made; money must be borrowed, on the strength of the future earning capacity of the road to cover the cost of the replacements (such borrowings being gradually liquidated from the earnings of the road), while at the same time a keen eye is kept on the care of depreciation for the future; or the property may be forced into the hands of a receiver, or it may be possible to do what is indefensible under the conditions, float additional stock or bonds to take care of expenditure for renewals of plant that is already represented in capital.

Failure to appreciate the inexorable law that apparatus must come to the end of its useful life has resulted in the financing of economically unsound electric railroad enterprises, and in the embarrassment of good enterprises through the distribution of the stockholders of funds that should have been held in reserve for deferred maintenance. Difficulties arising from lack of funds with which to provide replacements are often responsible for poor service—sometimes even for unsafe service—upon roads from which good service should be expected. On the other hand, failure to anticipate all the expenditures that must be expected when the effects of depreciations have become apparent has, in some cases, led to the establishment of rates less than sufficient to provide for all the expenses of the properties and give a fair return on the investment.

The importance of "The Depreciation Problem" as related to electric railway properties has not been fully recognized in the past. This is probably not surprising considering the peculiar nature of depreciation, the limited degree to which its importance has been understood, the conditions under which many railway projects have been financed in the past, and the great magnitude of many of the railroads of the country.

In the financing of early electric railroads the depreciation expenses were frequently ignored either on account of lack of understanding of the necessity for considering such expenses or because of a desire to make a creditable paper showing of projects which, if fairly presented, would be seen to be without merit; and the policy of ignoring depreciation expenses has sometimes continued after such projects were financed, owing to deficiency in funds to care for such expenses. But probably the most fruitful reason for ignoring depreciation expenses in connection with electric railways has been the influence of the example of the large and well established steam railroads. With these it has been the usual practice not to consider depreciation expenses separately from current maintenance expenses. Such procedure has been supported on the grounds that when a railroad becomes large and well established the depreciation expenses become equalized and may be distributed with much the same uniformity as those for current maintenance. The situation is different for electric railways. These are relatively new and comparatively small, and few of them have arrived at the time when the annual expenditure required for replacements has reached its maximum. In most cases, moreover, when expenditures on account of depreciation must be made they are irregularly periodic and relatively large, and cannot easily be distributed so as to be met from day to day by the current earnings. Accumulated earnings are required for their payment.

In the past it has been a not uncommon practice to finance renewals and replacements of plant by issues of stock or bonds. This procedure was frequently sanctioned without thought of impropriety. Such a procedure, however, means the ultimate destruction of any reasonable relation between the expenditures for construction charged to capital account and the actual physical property represented by plant in service. If proper attention has been given to current maintenance and deferred maintenance, an electric railroad should be capable of giving substantially as good service after years of operation as if it were a road newly constructed for the same service. The construction cost appropriately chargeable to capital account should not differ materially in the two cases except as it might be influenced by changes in costs of material and labor between earlier and later dates.

Since funds should be in hand to replace the parts of an electric railroad at the ends of their useful lives, it is evident that such funds should be accumulated gradually during the lives of the parts. The ideal plan would be to make this accumulation by uniform yearly increments. Such a procedure is frequently not practicable, owing to the variations, from year to year, in the balance of gross earnings over current operating expenses, and also from the fact that for the earlier years of operation, during the upbuilding of the business, there is likely to be little or no margin of earnings which may be devoted to such purposes, although the project may have a perfectly sound basis.

Electric railroads must expect lean years when it is difficult to meet all obligations, and prosperous years when the shortcomings of the lean years must be met. The prosperous years should provide surplus for the future if a reasonable operation of the property will permit. The building up of a depreciation reserve is likely to be affected by this condition. From this fact, coupled with the fact that expenditures for renewals are irregular in their occurrence and large in amount, it is clearly seen that this important factor in the necessary expenditures of any electric railroad can only be given suitable consideration if the books of the company show how the annual appropriations made to the depreciation fund agree with the estimated amounts that should have been appropriated, and also how the fund accumulated in the depreciation reserve agrees with the surplus that should be in hand.

It should be recognized that so long as a property is in condition to give as much and as good service as when it was new, its value, as represented by the amount of legitimate earnings to which it is entitled, cannot become reduced owing to depreciation in its plant. But any depreciation that may have occurred should be offset, when practicable, by a reserve carried for that purpose, or, if the property has been unable to make full appropriations to the depreciation account, complete knowledge of the situation should be possessed by the management, and the building up of the reserve in the future should be a most important financial consideration. Since the renewals do not occur at the same time for all parts of a property, an electric railway after beginning operation is never equipped throughout with a new plant. Therefore there is a difference between the first cost of the depreciable plant and a depreciated value estimated for the same plant on the physical condition after years of use. The depreciation reserve need not equal the full amount of this difference.

One of the simplest ways in which the books of a company may be arranged to show the facts in relation to depreciation appropriations and reserves, is to have accounts showing the amount by which the physical property of the company is depreciating month by month, as determined by estimate made in the manner heretofore explained; showing the actual appropriations made to the depreciation fund, and showing the amounts expended for replacements on account of depreciation. Any income derived from the investment of depreciation reserve may be utilized as accretions to the reserve.

An appropriate combination of such accounts will show at all times the relation between the total amount that the property has depreciated and the amount of reserve held to care for this appreciation, as well as the relation of the actual amounts appropriated to care for deferred maintenance to the amounts expended for this purpose.

Since electric railways, and other public service companies, have in many states come under the regulative control of state commissions and municipal authorities, there has been much discussion as to whether, in the case of properties which have paid generous dividends to the security holders, the depreciation account meanwhile being permitted to languish, the security holders should be expected to build up the depreciation reserve to correct proportions from earnings that might otherwise appropriately go into their own pockets. Some findings of the United States courts and rulings of state commissions indicate a tendency toward an affirmative answer, but a difficult phase of the matter is the determination of what may be considered undue dividends for an electric railway company, especially during past years, considering the newness of the art of electric railroading and the relatively unstable state of the business during the past and in the present. Such questions as these do not affect the obligation on the part of the electric railroad managements to have their accounts arranged so that they will be kept informed whether they are protecting the interests of their properties in the matter of depreciation appropriations and reserves; and, if they are not, that they may have the information to enable them to intelligently handle the problem of correcting the situation.

Even if a property is not in a position to care for depreciation as outlined in the foregoing, owing to relatively small earnings, this does not justify ignoring the facts relating to depreciation, since any readjustments of rates that may be found necessary should be undertaken with full knowledge of all matters affecting the real cost of service. Commissions and others, who have given attention to the question of railroad capitalization and rates, agree that deferred maintenance costs should be met as an operating cost and not as a capital charge. Under these conditions it is essential that electric railway companies should accumulate funds from earnings which will place them in position to care for the renewals required by the effects of depreciation.

It should be borne in mind that "The Depreciation Problem" does not represent the only purpose for which funds must be accumulated during the present to care for liabilities maturing in the future. Every company must expect to meet expenditures occasioned by extraordinary occurrences which cannot well be covered by ordinary insurance, such as the effects of unusual storms and conflagrations, the results of strikes, extraordinary accidents, and the like; and every company occupying public ways is confronted with the certainty that they will be compelled to make costly changes of plant owing to changes made in state or municipal regulations. It is proper that a company should make annual appropriations to provide funds to meet obligations arising from such causes.

Where franchises are limited there is the necessity for accumulating sufficient reserve funds to protect the security holders from loss of their capital under the most unfavorable conditions that are likely to arise at the termination of the franchises. Where companies abandon valuable plants, as when they give up their own power plants to buy power from outside sources, the net value of such abandoned property should be gradually extinguished from the capital account by accumulations from earnings. Again, plans for financing electric railroad properties frequently call for accumulations of earnings according to a definite contract; and other legitimate needs for reserve or surplus funds arise.

In the foregoing consideration of "The Depreciation Problem" I have followed principles having general application to all electric railways. The question of rates charged by public service companies is far from being settled. An extensive readjustment is now taking place, and it seems inevitable that rates will be periodically revised in the future. It seems manifest, therefore, that a full understanding of all the elements which make up the cost of railroad service is necessary. An important one of these elements, and one which has heretofore failed of adequate attention is that of depreciation renewals. The renewal expenses required by depreciation should be squarely faced, and not passed on in multiplied ratio to future generations.

BOOK REVIEWS.

Hydraulic Turbines: Their Design and Installation. By Viktor Gelpke and A. H. Van Cleve. McGraw-Hill Book Co., New York and London. Cloth, 7x9 ins.; 293 pp.; plans and illustrations; $4.00.

Prior to the publication of this book it is believed that no work in English has existed covering in a thorough manner the subject of the correct mathematical design of all classes of turbine and impulse wheels. Designers have been driven to the use of German books or have [illegible] compelled to [illegible] the details of design to engineers representing manufacturing concerns. With the growing importance of water power development this book may be said, therefore, to fill a distinct and recognized need.

It is stated in the preface that the book is to a large extent a translation of a work entitled "Turbinen und Turbinen Anlagen," by Mr. Viktor Gelpke, with certain portions rewritten and rearranged and Part III added. The mathematical analysis has also been simplified for the purpose of making the book available for the use of practicing engineers, who as a rule are unable to follow readily the intricate developments characteristic of German works.

No attempt is made to cover the whole field of water-power engineering, the work being limited to such matters as pertain to turbines and their accessories. The subject is treated under four general divisions, as follows:

Part I covers the accessories of turbines, and treats in detail of such matters as the method of regulating water supply, means of conducting water to and from the power station, devices for removing floating or suspended matter from water supply, control of flow to penstock or other form of intake, and design of machinery.

Part II treats of turbine design. Exhaustive mathematical analysis is resorted to in this section, but the development is such as to be readily followed.

In Part III is given an interesting account of various notable turbine installations, with critical comment.

The book as a whole is an excellent one and appears to cover adequately the problems that confront the practical engineer in the design and installation of hydraulic turbines.

Electricians' Operating and Testing Manual.—By Henry C. Horstmann and Victor H. Tousley. Frederick J. Drake & Co., Chicago. Leather, 4¼x6½ ins.; 359 pp.; illustrated; $1.50.

Almost every line of industry now has much to do with electric motors and lights, and this manual is designed for the large class of practical electricians concerned with the management, operation and testing of such electrical devices. The purpose of the book is to familiarize the student with the fundamental principles governing the design of motors, dynamos, arc lamps, etc., rather than to go into the details of particular devices. No catalogue cuts are included, as it is assumed that the reader is familiar with the commercial forms, or can readily secure elsewhere such information of this kind as he needs.

The first three chapters relate to the electric current and magnetism, and are followed by chapters on the various types of electric machines, batteries and lamps, and testing and instruments for testing. There is also a chapter on life and fire hazard in which the matter of safety to workmen and structures is carefully discussed.

This manual will evidently serve well the purposes of the class for which it is intended. It is written in a clear and simple style, contains little mathematical treatment, and is amply illustrated with line drawings and diagrams.

Heat.—By J. Gordon Ogden. Popular Mechanics Co., Chicago. Cloth, 4¾x6¾ ins.; 119 pp.; illustrated; 25 cts.

This book forms one of a series of handbooks on industrial and scientific subjects. The matter is presented in simple style, and is intended to give the general reader a broad view of the nature of temperature and of temperature phenomena.

Being written by a scientist of recognized standing, it is not surprising that the facts and theories advanced are sound and complete from a scientific point of view, although intended for popular reading, and that the book includes the results of recent scientific research. In a popular sense the title of the book is somewhat misleading, since as much space is given to low temperatures as to high temperatures. There is even a chapter on the manufacture of artificial ice.

The book is in fact rather a comprehensive popular treatise on the nature and phenomena of temperature, both high and low. Withal each chapter is interesting. In the chapter relating to the effects of low temperatures on matter some of the phenomena described are little less than fantastic. Sufficient illustrations are provided for making the text clear. The treatment is elementary throughout, only so much of theory being given as is necessary for an understanding of the phenomena described.

PERSONALS.

Mr. Earl Talbot, of Yonkers, N. Y., has been appointed resident engineer by the state engineer of New York, at a salary of $3,000 per year.

Mr. J O'Connor has been appointed special roadmaster of the Minneapolis, St. Paul & Sault St. Marie Ry. He will perform such duties as are assigned to him by the general manager.

Mr. John W. Paxton, a civil engineer connected with the Southern States Engineering and Equipment Co. of Norfolk, Va., has been appointed superintendent of the street cleaning department of Washington, D. C.

Mr. James A. Green, civil and hydraulic engineer, 226 La Salle St., Chicago, announces that he has established a branch office at 509 Overland Building, Boise, Idaho, for practice in irrigation and hydraulic engineering and construction. The Boise office will be in charge of Mr. W. F. Day, who has had extensive experience in irrigation work.

Mr. Robert Zachary, an irrigation engineer who formerly lived in Evanston, Ill., was drowned in the intake ditch of the Jumbo reservoir at Julesburg, Colo., on Feb. 2. He had only recently gone to Julesburg to take charge of the irrigation district. While directing the work of clearing away the ice at the head of the intake ditch he lost his footing and fell into the water. Efforts at rescue failed. His body was finally recovered by a diver. Stockholders of the irrigation district are planning to subscribe a fund of $2,500 for the benefit of his widow.

Capt. Daniel F. Keenan, a railroad contractor well known in the east, died of heart failure at his winter home in Monrovia, Calif., on Dec. 30. He was born in Harrisburg, Pa., in 1845. At the outbreak of the civil war he enlisted as a private in Co. K, 31st Indiana Volunteers, and served until the close of the war, when he was mustered out as a captain. For the past 30 years he has been actively engaged as a railroad contractor, having constructed portions of many of the steam and electric railroads of the east. He was also largely interested in stone quarries in New York and Connecticut.

A number of the leading engineers of South Dakota met at Pierre, the capital of the state, last week and formed an organization to be known as the South Dakota Engineering Society. Membership is to include both engineers and architects. The society will be managed by a board of directors, one from each of the four districts into which the state is divided. The following officers were chosen at the meeting: President, S. E. Lea, state engineer; vice-president, A. B. McDaniel, professor of civil engineering in the University of South Dakota; secretary and treasurer, R. G. Culbertson, of Mitchell; directors, C. A. Primmer, C. C. Witt, B. C. Yates and Stein Range.

Mr. Louis Edwin Hawes, a prominent civil and hydraulic engineer, died of apoplexy at his home in Wakefield, Mass., on Jan. 26. He was born in Springfield, Mass., in 1860, and was graduated from the Worcester Polytechnic school in 1882. After graduation he became assistant superintendent of water works at Northboro. In 1883 he became assistant engineer on the construction of the water works at Wakefield. In 1892 he made surveys and plans for the Wakefield system of sewers, and in 1895 was chosen chairman of the sewerage commission of that city. For the past 30 years he has been prominent in the construction of water works systems throughout New England. He was a member of the American Society of Civil Engineers, the Boston Society of Civil Engineers, and the New England Water Works Association.

At the annual meeting of the Canadian Society of Civil Engineers the following officers were elected for the year 1911: President, C. H. Rust, city engineer of Toronto; vice-presidents, Henry Holgate and Charles Dodwell. Members of the Council were chosen as follows: District 1, Prof. Louis Herdt, McGill University, Phelps Johnson, H. K. Kelley, J. M. Shanley, J. G. Sullivan and H. H. Vaughan; district 2, P. S. Archibald, F. W. W. Doane and R. McColl; district 3, A. E. Doucet, J. T. Morkill and P. R. Parent; district 4, C. R. Cutlee, D. Macpherson and W. J. Steward; district 5, Prof. H. E. T. Haultain, University of Toronto, A. F. Stewart and C. L. Fellowes; district 6, Prof. E. Brydone-Jack, University of Manitoba, J. A. Hesketh and J. G. Legrand; district 7, F. F. Busteed, J. S. Dennis and James H. Kennedy. The nominating committee for next year are J. N. Fairbairn, Prof. E. A. Stone, A. R. Decary, James White, A. C. D. Blanchard, J. A. Hesketh and C. Partell.

It costs the Dolese & Shepard Company $.006 per cu. yd. to transport limestone from its quarry to the crusher. This company uses an automatic electric haulage system controlled by one man from a centrally located tower.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

The announcement of the proposed expenditure of $75,000,000 by the Harriman lines for double track work and the approval of plans for a number of extensions and branch lines of that system is, of course, the principal railroad news of the week. There is good ground to believe that construction work on some of these extensions and branch lines will be started soon. Anyhow bids have already been opened for a 31 mile extension of the Union Pacific from North Port to Gering, Neb.

Quite a bit of new railroad construction work is proposed in the state of Florida. Two new railroads are proposing the construction of extensive lines in that state, and it looks as though both of these would undertake construction work this spring. One of these roads, the Atlantic, Okeechobee & Gulf Ry., proposes a line in southern Florida, and will begin surveys late in March. The other road, the Gulf, Florida & Alabama R. R., is planning a line from Pensacola in a slightly northwesterly direction to reach the coal fields of Alabama.

A number of railroad construction contracts have been let recently, among them being the following: A. L. Anderson & Bros., Inc., Altoona, Pa., for constructing the Black Lick connection and the Elk Creek branch of the Blacklick & Yellowcreek R. R., in Cambria and Indiana counties, Pa., the work including 200,000 cu. yds. earth excavation and 15,000 cu. yds. rock excavation; Wright & Wadley Co., Macon, Ga., large contract on the Florida East Coast extension from Maytown, Fla., to Lake Okeechobee; Roach & Stansell, Memphis, Tenn., a further grading contract for the Kansas City, Mexico & Orient Ry., the work calling for the construction of 24 miles of grade between Eldorado and Sonora, Tex.; the following secured new work on the Cincinnati division of the Chesapeake & Ohio Ry. between Russell and Cincinnati: Louisa Contract Co., Louisa, Ky.; Boxley Bros., Concord, Ky.; P. T. Board, Charleston, W. Va.; W. I. Steele, Charlottesville, Va.; Lane Bros. Co., Altavista, Va.; Langhorne & Langhorne, Lynchburg, Va.; Carpenter & Boxley, Roanoke, Va.; Pitts & Morris, Roanoke, Va.; Rinehart & Dennis, Washington, D. C.; Watson Contract Co., Foster, Ky.; B. R. Cowherd & Co., Columbia, Va.

Track elevation work in Chicago, Ill., has taken a boom with the announcement that the Illinois Central R. R. and the New York, Chicago & St. Louis R. R. have agreed to elevate their tracks from 79th St. south to 115th St., at Chicago, a distance of 5.5 miles, at an estimated cost of $10,000,000.

Tenders for a good sized railroad construction contract are now being asked by the Kootenay & Alberta Ry. The work calls for the construction of 13 miles of its line from Pincher Creek, Alberta, to the Western Coal & Coke Co. mines on Beaver Creek. The estimated cost is nearly $30,000 per mile. It averages more than 40,000 cu. yds. per mile and will require about 2,000,000 ft. B. M. of trestle and culvert timber. Bids have also been asked by the Nashville, Chattanooga & St. Louis R. R. for three miles of new work near Hickman, Ky., embracing about 60,000 cu. yds. of grading.

The largest levee contract for the past few weeks has just been let at Greenville, Miss. This contract called for the enlargement of levees and involved the handling of 672,000 cu. yds. of material. Roach & Stansell, Memphis, Tenn., secured the contract.

Perhaps the most important news of irrigation work of the past week is the announcement that a preliminary contract has been entered into with the state of Wyoming by an English syndicate of capitalists, headed by George E. Roberts of Chicago, Ill., director of the mint, to take over the Wyoming Central irrigation project and complete the same. Several years ago Chicago parties contracted to rent about 250,000 acres of land on the ceded portion of the Wind River Indian reservation, but after constructing one main canal failed to complete the project. The new company is given until June 30 to close the final contract.

Grading on the U. P. in '68.

Jim Parr is dead. Not many even of the older contractors will remember Jim Parr, for he was building railroads before the civil war and retired from active work some 20 years ago. He was engaged in the construction of the Union Pacific R. R. in 1868, when the grading gangs fought Indians with a gun in one hand and worked with a pick in the other, figuratively speaking. In his later years he never tired of telling of these early days on the Union Pacific and some of his reminiscences were highly interesting. At this time the Indians were very aggressive and made much trouble for grading gangs. Every mile of road was built in range of their muskets and the work was pushed forward through the greatest dangers and hardships. Soldiers were stationed all along the route, and pickets stood guard on the hilltops while the graders worked around the foot of embankments, but even with all these precautions many lives were lost and many scalps taken by the Indians. At one time a band of several hundred Indians swooped down on a grading outfit right in sight of a temporary fort. Before the grading gang could reach their guns the Indians cut loose the stock and a stampede followed. Lack of drinking water often caused much suffering as did the extremes of temperature. One day it was 61 below zero and many of the men had their ears, hands or feet frozen. Another time when snow and ice covered the track for days, after the thaw set in, it resulted in the whole train of cars, track and all sliding off into the ditch.

State Government by Commission.

A new development of the commission form of government has made its appear[illegible] been in[illegible] the [illegible] of the state of Washington providing for a commission form of government for that state. This is going Arizona three better and the Arizona constitution is somewhat advanced itself, providing as it does for the initiative, the referendum, the recall and other devices for allowing the people to express their will. The advocates of the Washington plan point to the success of the commission form of government in the many cities in which it has been tried, and claim that once the initiative and referndum have been established firmly the importance of legislatures would diminish and their places could be taken by a few capable men. On the other hand, the opponents of this plan claim that the commission form of state government would not be the republican form of government which under the constitution of the United States is guaranteed to every state. They point out that under the American constitution the powers of government are divided into three distinct departments, legislative, executive and judicial, and that it is provided that no one of these shall trespass on the other. This division of powers of government into three distinct departments, they claim, is one of the vital principles of the republican form of government and to bring the legislative and executive powers into so close alliance as would the commission plan would mean the direct violation of this principle.

Big Work in Prospect.

Quite the most important news of the past week is the announcement that the executive committee of the Harriman Lines had decided to expend $75,000,000 for improvement work. This work is to include the completing of the double-tracking of the line from the Missouri River to San Francisco, the double-tracking of the Oregon Short Line from the junction with the Union Pacific main line at Granger, Wyo., to Huntington, Ore.; the line along the Columbia River in Oregon is also to be double-tracked to Portland, Ore. The expenditure of the $75,000,000 for this 1,673 miles of track is to be distributed over a period of five years. In addition the executive committee approved plans for the construction of a number of extensions and new lines tributary to the Union Pacific and Southern Pacific in the west and northwest, which for sometime have been under consideration. The expenditures for this work are to extend over a period of six years. The announcement is of vast importance for it indicates that the railroads have adopted a change of policy and are going ahead with improvement work irrespective of the outcome of the pending rate case. It is of further importance, in view of the makeup of the executive committee of the Harriman Lines, as indicating the belief on the part of the most important capitalistic interests of the country that a further revival of business is close at hand. The policy of the Harriman Lines, as announced in the statement of President Lovett, is that if the Union Pacific delays improvements until every difficulty is safely out of the way it will eventually find its lines falling behind in efficiency instead of retaining their ability to contribute to the new country which they serve. The policy of keeping up to the need of the times will be clung to in spite of all temporary disturbances. In view of the fact that delayed improvement work means decreased efficiency on most of the other great railway systems of this country, it is not too much to expect that these systems will follow the lead of the Harriman lines and will this spring undertake much needed construction work.

E. H. Harriman.

And while we are writing about the Harriman Lines it may not be out of place to say a few words about [illegible] possible. A mighty interesting man was the late [illegible] Harriman, interesting not so much because he was tremendously wealthy but [illegible] of the big things he accomplished. We know of no clearer description of the man, Harriman, than was given in an address a couple of weeks ago by his friend and finan-

[illegible] Mr. Otto H. Kahn, of Kuhn, Loeb & Co. Mr. Kahn said in part:

[illegible] we preferred not to join in the transaction. He [illegible] osition, and, finally, not having made any headway, he desisted. I thought he had accepted our declination. He got up to go, but turned around at the door and said. "I am tired this afternoon, and no good any more. I have been [illegible] luncheon. I'll tackle you again to-morrow, when I am fresh. I'm bound to convince you, and to get you to come along." He did. He came again next day, and finally we yielded to the sheer persistency of the man and to the lucidity of his arguments. It is worth mentioning, by the way, that his judgment was [illegible] the business turned out very well. * * * Over and over again did I observe him bending men and events to his determination, by the exercise of the truly wonderful powers of his brain and will; powers which accomplished their fullest potentialities because they were united with unwavering loyalty under all circumstances and with a sacred respect for any commitment entered into. A moral obligation to [illegible] of the same force and meaning as a legal contract. Not infrequently he would come to meetings at which ten or twelve men sat around the table with him—men, too, of no mean standing in the business community—a large majority of whom were opposed to the measures he would propose. Yet, I know of hardly an instance of any importance where his views did not prevail finally, and, what is more, generally by unanimous vote. If he did not succeed in what he had set himself to accomplish at the first attempt, or the second, or the third attempt, he would retreat for a while, but he never gave up; he moved on toward the attainment of his object, undismayed, resourceful, relentless as fate, with that supreme patience which, according to Disraeli, is "a necessary ingredient of genius."

RAILWAYS, STEAM AND ELECTRIC

Alabama.

The Louisville & Nashville R. R., W. H. Courtenay, Chief Engineer, Louisville, Ky., is said to be about to take up its plan for building a line from a point near Woodstock on the Birmingham mineral branch to connect with the Pineapple branch into Selma. Such a line would obviate running through freight trains through the city of Birmingham, as the new line would be a shorter route to Pensacola and New Orleans via Boyles, Bessemer and Woodstock. The proposed line has recently been surveyed and will traverse a distance of 70 miles.

The Chattanooga Southern R. R., C. H. Fisk Chief Engineer, Chattanooga, Tenn., is reported to be planning to make surveys for a line to Piedmont. According to the report, the proposed route will be surveyed via Round Mountain, thence to Center, the seat of Cherokee county, now without a railroad, and from that place to the chief city in the northern end of this county.

Surveys have been resumed for the projected railroad up the Cahaba Valley from Selma to Birmingham. At last reports the engineers were in the field between Centreville and Bessemer and expected to reach the latter city by the end of this month. Ernest Lamar, Selma, Ala., is the promoter.

Good progress is said to have been made with the plans for the proposed line of the Tidewater R. R. Co., and it is believed that construction work will be started this spring. It is now reported that MacArthur Bros. Co., New York and Chicago, will be in charge of construction. Previous reports stated that the Degnon Contracting Co. was thought to have this work.

The Seaboard Air Line Ry., W. L. Seddon, Chief Engineer, Portsmouth, Va., is believed in Anniston, Ala., to be perfecting arrangements for beginning work on an extension into that city.

The Seaboard Air Line Ry. is to have work started at once on the concreting of the Divide tunnel. The work will cost about $25,000.

The Montgomery & Chattanooga R. R. Co. has been incorporated with a nominal capital stock of $50,000 and proposes to build and operate a railroad from Montgomery to Anniston. It is stated that the first section to be constructed will be between Montgomery and Alexander City at a cost of $750,000. Benjamine Russell, president of the First National Bank of Alexander City, Ala., is president of the railroad.

It is believed that active construction work will be started out of Demopolis before spring is well advanced on the line from that city to Linden for the proposed Birmingham, Demopolis & Pensacola R. R. Demopolis has practically raised its required $20,000 bonus.

A company is being organized in Birmingham to develop coal lands which were purchased a short time back from the Joseph Bryan estate. The lands are in Walker County and consists of many thousand acres. It is intended to put in side and spur tracks to the various properties and begin development on a large scale. Frank Nelson, Jr., Birmingham, is interested.

Arkansas.

At a mass meeting recently held at De Queen, Ark., it was decided to aid E. H. Cravens, former chief engineer of the Memphis, Paris & Gulf Ry. Co., in promoting the construction of a line to run from Little Rock to Hot Springs, Ark., then to DeQueen, crossing the Frisco tracks at Idabel, Okla., and continuing to Dallas, Texas.

Grading work on the branch road being built to Tontitown from Cave Springs by the Kansas City & Memphis Ry. is now nearing completion and track laying will be started shortly. It is said that as soon as the grade is completed to Tontitown the work of the extension of this road will begin toward Fayetteville. From Fayetteville the road will be extended east to Memphis, with an arm extending to Little Rock. Eleven bridges will be built between Cave Springs and Tontitown. Leo Adamson, Rogers, Ark., has the contract for the bridge work, and has been getting the timber to the sites.

California.

It is reported in Stockton that the control of the stock in the Central California Traction Co. has been acquired by capital represented by Ward Smith. It is also claimed that Mr. Smith already has a company of surveyors and engineers at work between Oakland and Antioch and that a line will be pushed through to that point with all possible speed. From Antioch, Oakland will be reached via the proposed Oakland & Antioch Ry., which is already graded to a point beyond Walnut creek, in the San Ramon valley. It is the rumor that this company will also be acquired by the Ward Smith interests, giving a direct route through to Oakland by way of some of the richest and most productive country in California.

The Nevada-California-Oregon Ry. will let a contract about March 1 for the further extension of its line to Pendleton, Ore. The Hall Construction Co., and Richardson & Neugent, are at present engaged on contracts for this railroad. George S. Oliver, Reno, Nev., is Chief Engineer, and T. F. Dunaway, Reno, Nev., is General Manager.

Promoters are investigating the feasibility of construction of a railroad line to parallel the Colorado River from Calzona on the Santa Fe System to the Gulf of California, passing through the Blythe estate, the Palo Verde and Chucawalla Valleys, the Imperial Valley and the lands below the Mexican border. Paul Mohr is interested in the projectl.

Reports from San Bernardino, Cal., state that the San Pedro, Los Angeles & Salt Lake R. R. (Salt Lake Route) is having surveys made for the construction of a new railroad between Pedley, Riverside County, and San Bernardino, for the purpose of doing away with delays occasioned by using the Southern Pacific and Santa Fe tracks between Riverside and that city. It is proposed to build a track leaving the main line west of the Santa Ana River bridge near Pedley. This line will cut diagonally across the country to Crestmore, the seat of the big cement industry, thence to Bloomington, and then will bear directly east to San Bernardino. Through passengers and freights will be diverted over this line, while the local service between Riverside and San Bernardino, over the old route, will be continued. E. G. Tilton, Los Angeles, Cal., is Chief Engineer.

The San Luis Obispo, Cal., Chamber of Commerce is interested in a plan to build a railroad from Bakersfield and Fresno to the sea. The route will lie between Port Harford and Fresno, by way of Arroyo Grande, north through Morro Pass, across Salinas River to San Miguel, through Polona Pass to Hanford and on to Fresno; thence southward to Bakersfield via the Midway and Maricopa oil fields to San Luis Obispo, going via Bitterwater Pass and meeting the main line at Cholane.

Permanent surveys will be started at once by engineers of the Fresno, Coalinga & Tidewater Co. for the construction of the proposed line from Fresno to Monterey, Cal. As soon as this preliminary work is completed and right of way secured the Fresno, Coalinga & Monterey Ry. Co. will be organized and the work of construction will start immediately. The officers of the promotion company are: T. C. White, president; Charles J. Shaw and Roy Hall, vice presidents; H. H. Alexander, treasurer; Albert Albrecht, secretary.

The Humboldt & Eastern Ry. Co. has filed articles of incorporation, according to information submitted from Eureka, Cal., and proposes the construction of a railroad from Eureka to some point on the Southern Pacific R. R. in the Sacramento Valley, which will be determined by the surveyors. The capital stock of the company is $3,000,000. Engineers will resume the preliminary work in the spring.

The Petaluma & Santa Rosa Ry., E. M. Van Frank, President, Petaluma, Cal., is reported to have completed financial arrangements for the extension of its electric railroad down the west bank of the river at Petaluma to the southern boundary line, the ultimate destination being Point Pedro.

Erbs & Davis are now working 80 men on their sub-contract from Erickson & Peterson, near Auburn, and expect to have their work completed by July 1. The 60-ft. cut on the Beecher ranch, in the Edgewood district, early this month, was within 18 ft. of grade in the deepest place. Erbs & Davis are working two machine drills in this cut and several hand drills. Two dinkies handle the dump-cars loaded by the steam shovel. Work on the smaller cuts is being done by small gangs of men and the dump-cars at these places are handled by horses.

The Sacramento Electric, Gas & Ry. Co. is considering constructing a loop line in East Sacramento.

Colorado.

Grading work is now said to have been started on the Pueblo & Southeastern R. R., mentioned in our last issue. This grading work is being done by Joe Nix, who for the past few months has been engaged in the construction of the main distributing canal of the Pueblo-Rocky Ford Co. This road is to extend from Pueblo to the new town of Wilson, 15 miles, but including sidings and connections and switches will have a total milage of about 40 miles. W. D. Garwood, Pueblo, is General Manager and J. H. Conlin Construction Engineer.

Advices from Denver, Colo., state that contractors are preparing to submit bids for the construction of the new railroad down the valley of the Blue River from Dillon to Kremmling on the Moffat Road, a distance of forty-five miles. Construction of this line with the standardizing of narrow gauge lines in the same region would reduce the distance between Denver and Leadville by seventy-two miles, with an additional reduction in the construction of either the proposed Moffat Road tunnel or the proposed Mount Guyot tunnel, near Breckenridge, and would permit Leadville traffic to be turned over to the Moffat Road at Kremmling without transfer at Dillon. The Colorado & Southern and the Colorado Midland are supposed to be back of the project.

Florida.

•W. H. and W. J. Wright and W. M. Wadley, composing the firm of Wright & Wadley Co., Macon, Ga., have been awarded a large contract for work on the Florida East Coast Ry. extension, running from Maytown to Lake Okeechobee.

The Board of Trade, Tampa, Fla., has adopted a resolution endorsing the proposed Atlantic Okeechobee & Gulf Ry. and promising to support the project. F. C. Bowyer is President of the Board.

The Atlantic, Okeechobee & Gulf Railway Co. will shortly begin grading and building a line of railway in southern Florida. It cannot be stated just now which line will be built first. There is to be a line from Fort Myers to Tampa, another from Tampa to Miami and another from Fort Myers to Melbourne. Surveying will begin in late March and grading and construction follow as rapidly as a large force of men can push it. The total mileage will approximate 600 or 700 miles. The temporary offices of the Atlantic, Okeechobee & Gulf Ry. Co. are at 818 Audubon Bldg., New Orleans, La. Henry C. Ferriot is president and Robert L. Riley first vice president.

Regarding the projected line of the Gulf, Florida & Alabama R. R. Co., we are advised that Megargel & Co., New York city, are arranging the underwriting of the bonds to construct a railroad from Pensacola in a slightly northwesterly direction to reach the coal fields of Alabama. Arrangements have at the present time been completed for the construction of the first 125 miles of road, which will connect with the Southern Railroad, and an ordinance granting the railroad company certain rights is now before the city council of the city of Pensacola. It is the present intention of the builders of this road to run to Jasper, Ala., but this point has not definitely been decided on. The completed road, however, will be at least 250 miles long.

Georgia.

Preliminary affairs are well along for the proposed railroad from Toccoa to Carnesville, and it is believed that grading work will be started next month. Farmers along the proposed line are said to have subscribed largely toward the necessary fund. The road from Toccoa to Carnesville will be 20 miles long; later it is intended to extend the road 30 miles to some point on the seaboard. The promoters of this line are W. S. Erwin, J. H. Hicks and E. S. Hunnicutt, all of Clarkesville, Ga. The latter has active charge of the affairs.

The stockholders of the St. Marys & Kingsland R. R., L. Johnson, President, St. Marys, Ga., have adopted a resolution providing for an amendment to the charter by which the name of the road is to be the "Atlantic, Waycross & Northern." Waycross is designated as headquarters in this resolution. An extension from Waycross in a northwesterly direction is authorized and surveyors are at work on the route now. The extension will be through the counties of Ware, Coffee, Ben Hill and Wilcox to Abbeville. The towns that will be connected direct by this road are Waycross, Douglas, Abbeville, Unadilla and Fort Valley, with Kingsland, St. Marys and Jacksonville on the southeast link. Stock subscriptions for the extension amounting to about $130,000 are said to have already been made. A western extension, touching the Georgia Southern and Florida at some point between Valdosta and Tifton, has been authorized by a charter amendment and some of the road built. This feature will be carried out as originally planned, making quite a system of the new road as well as adding materially to the activity at Waycross. The road at present is 11 miles long, operating between St. Marys and Kingstand.

Idaho.

Steps are being taken by promoters of the proposed railroad from American Falls to Malad City via Rockland, Idaho, to finance the project and it is expected that everything will be ready to start active construction by the spring. W. H. Thomas, Malad, Idaho, is interested.

Illinois.

The city council of Urbana has granted the Danville, Urbana & Champaign Ry. Co., Champaign, Ill., a franchise to build a car line on Cunningham Ave. from a point where it intersects Market St. to the dredge ditch of the Saline Fork drainage district, a distance of half a mile or more. The work will include the construction of a bridge over the Boneyard and a concrete or stone retaining wall along the west side of Cunningham Ave. from Market St. to the Boneyard.

Plans have been completed for the organization of the Corn Belt Interurban Co., which proposes the construction of a line from Delavan to Morton, a distance of 19 miles. The company will have a capital stock of $100,000 and the probable incorporators of the company will be the following: J. W. Crabb, N. T. Nichols and Jas. G. Bailey of Delavan, C. A. Lawson and George Jenks of Tremont, Fred Brenkman of Dillon. A considerable amount of preliminary work has been done for this line and it is said that the prospects are good that it will be financed locally.

The Aurora, Elgin & Chicago Ry. Co., Chicago, Ill., is planning to extend its lines from Yorkville to Plano and Sandwich and Somonauk and probably to Mendota, 66 miles from Aurora. Steps preliminary to the extension of the lines to Plano, Sandwich and Somonauk have been taken by the filing of petitions in Kane, Kendall, De Kalb and other counties, asking that the by-laws of the company be amended to provide for the extension. The petition filed by attorneys representing the railroad describes the plans of the company in extending its lines and names the above named places as the towns to which the company's lines will be extended first. It is said that the company will construct its lines from Yorkville to Plano and then follow the Burlington railroad to Sandwich and Somonauk.

The Illinois Central R. R., D. J. Brumley, Engineer Construction, Chicago, Ill., and the New York, Chicago & St. Louis R. R., E. E. Hart, Chief Engineer, Cleveland, O., have agreed to elevate their tracks from 79th St. south to 115th St., at Chicago, a distance of 5.5 miles, at an estimated cost of $10,000,000. In connection with the Illinois Central work an ordinance has been introduced in the City Council of Chicago providing for the track elevation on a somewhat different plan from the old type commonly used. The plan provides for concrete arches supporting two tracks, the roadbed of which is of regulation rock ballast. Underneath the structure will run an asphalt paved promenade, which will be well lighted, and in stormy weather make an attractive place to walk. The elevation will be 13½ ft. above street level, thus obviating the necessity of depressing any crossings. The proposed elevated line will be 4.3 miles long. It will leave the main line of the Illinois Central at 71st St. and run east in that street to Railroad Ave. From there it runs southeast to Commercial Av., which it follows to 84th St. From the latter street as far as 94th St. the elevation will be on the road's private right of way.

The Chicago & Northwestern Ry., E. C. Carter, Chief Engineer, Chicago, Ill., has opened negotiations with the U. S. War Department for a government permit for a bridge across the Illinois river two miles below Pekin in order that the railway may connect its lines in that city with its holdings of coal properties in Macoupin county. The proposed new line was surveyed 18 months ago and some grading has already been done in Pekin, while in Macoupin county 10 miles of rail have already been laid, and Northwestern locomotives are handling the output from that company's mines there. The estimated cost of the extension, including the bridge, will be $2,500,000, and it is said that work will begin as soon as the requirements of the United States Government relative to crossing the Illinois river are met.

The Cleveland, Cincinnati, Chicago & St. Louis Ry., Geo. P. Smith, Chief Engineer, Cincinnati, had engineers at work near Marshall collecting data for making an estimate for the construction of a second track from Chrisman to a point north of Hutsonville. It is believed that this section of the Big Four, some 50 miles, will be double-tracked this year.

The Belleville & Western Ry. Co., of Belleville, has been incorporated with a capital stock of $2,500, and proposes the construction of a line from the City of Belleville, in the County of St. Clair, Ill., to a point in section 9, township 1 south, range 9 west, St. Clair County, Ill. The incorporators are Victor Adami, Coulterville; John D. Vogt, R. W. Hofheimer, Peter J. Gundlach, Ben A. Gundlach, Belleville.

A project is under consideration for constructing an electric railway from Rochelle to Amboy. The projected line is through a farming country and it is said that $50,000 will be necessary to assure the building of the line. J. J. Burns, Isabella Bldg., Chicago, Ill., is the promoter.

Indiana.

The Indianapolis Traction & Terminal Co., Indianapolis, will probably shortly undertake the extension of its East Michigan St. car line to Emerson Ave., at Indianapolis.

Preliminary work is being advanced for the proposed electric railway from Brazil to Linton. At a recent meeting at Brazil a committee of two was appointed in Brazil, Jackson, Sugar Ridge, Harrison and Lewis Townships, Clay County, and from Wright and Stockton Townships, Greene County, to circulate petitions in each of the townships mentioned, asking the commissioners of the two counties to call special elections to vote the proposed 1 per cent subsidies. This would yield a total of nearly $200,000. A motion was adopted at the meeting that if no company of capitalists could be found who were willing to build the road that a local stock company be organized and the line be financed by the people of Clay and Greene counties. N. A. Harris, Howesville, Ind., is president of the organization.

Iowa.

The Chicago & Northwestern Ry. will, according to reports from Missouri Valley, Ia., construct shops at that place estimated to cost [illegible]

It is rumored in Fort Dodge, Ia., that the Minneapolis & St. Louis Ry. is contemplating the construction of new tracks to connect Ruthven and Terril in northern Iowa, and that new steel will then be laid from Terril clear through to Otho, south of Fort Dodge. R. G. Kenly, Minneapolis, Minn., is Engineer Maintenance of Way.

Kansas.

The Manhattan City & Interurban Ry. Co., Manhattan, Kan., is meeting with good success in securing the right of way for its interurban line from Manhattan to Fort Riley, and it looks now as though grading work for the entire line would be started early in the spring.

The Chicago, Rock Island & Pacific is said to be planning to have grading work started soon on storage yards near Shorey. About 80 acres of land were purchased near Shorey a year ago.

That ranchers along the proposed route of the Scott City Northern Ry. are strongly in favor of the proposed line is shown by the fact that Jim Drain and J. E. Bilby, who own ninety-four quarter sections of land in Scott and Logan Counties, have contributed $20,000 to the bonus fund to secure the building of the new Scott City Northern Ry. Ben L. Allen, Russell Springs, Kan., is Chief Engineer.

The Kansas City Terminal Ry. Co., Kansas City, Mo., has filed plans with the City Commissioners of Kansas City, Kan., for raising the bridge over the Kaw River and the tracks approaching. The bridge and tracks must be raised to conform to the heights of the dikes which are to be erected for flood protection on each side of the river. It will be necessary to change the grades of several streets, including those of Osage and Adams, Baird and Brent Sts. in the Armourdale district.

Grading work has been started by Fred Coe, Cottonwood Falls, on the third link of the Arkansas Valley Interurban Ry. Co. The work was started north from Sedgwick. Mr. Coe's contract covering the grading of two miles of road bed. The first two links are now in operation from Wichita to Valley Center and to Sedgwick. There are about twelve miles of track yet to be constructed to reach Newton. The two links of the line now in operation between Wichita and Valley Center and Sedgwick are 17 miles long.

Kentucky.

The construction of an interurban railway from Scottsville to Fountain Run, near the Barren and Monroe County line, is under consideration. The projected length is 20 miles and it is believed that the line will ultimately be extended to Lafayette, Tenn., by way of Akersville. Advices from Glasgow, Ky., state that the project is being financed locally, among those interested being James Hagan, Edward Grooms and Orion Lawrence.

Steps are being taken for the construction of an electric railway between Shelbyville and Mt. Eden. It is said that sufficient capital to build the road can be secured if the property owners will donate the right of way. Capt. N. B. Waugh, Shelbyville, Ky., is the promoter.

The Nashville, Chattanooga & St. Louis R. R., Hunter McDonald chief engineer, has asked bids on the construction of three miles of new work near Hickman, Ky., embracing about 60,000 cu. yds. of grading, with a small proportion of clearing and grubbing. No mention is made of a classification for loose or solid rock. Work must be begun within ten days of signing of contract and be completed within three months.

Louisiana.

The New Orleans, Fort Jackson & Grand Island R. R., which, according to reports, was recently purchased by a Canadian syndicate headed by Charles D. Warren, president of the Traders' Bank, of Toronto, Canada, Ont., is said to be planning extensive improvements to include an extension of the line to Grand Isle. Surveys for the extensions are said to be already under way. The road at present is 60 miles long, and runs on the other side of the river from Algiers, the west bank suburb of New Orleans, down to Buras, passing through a rich plantation country, connecting with big sugar farms and many of Louisiana's largest orange groves.

Maine.

A bill is now before the state legislature to allow the Aroostook Valley Railroad Co. (electric), Presque Isle, Me., to acquire the line and franchises of the Canadian Pacific Ry. between Presque Isle, in Maine, and Aroostook Junction, N. B., a distance of 33 miles. The Aroostook Valley is operated in connection with the Canadian Pacific getting its power from the electric power station at the foot of the international rapids of the Aroostook River, known as Aroostook Falls. The Canadian Pacific is commonly believed to be the owner of the electric corporation. The latter operates 14 miles of line from the Canadian Pacific yard in Presque Isle to the village of Washburn, in the next township to the northwest.

Further information is now available regarding the proposed railroad from Bangor to Houlton mentioned in our last issue. It is stated that the proposed route is nearly a straight line between the two places, a distance of about 108 miles. The first 20 miles or so of the line from Bangor will be nearly due east. Holden, East Eddington, Clifton and Amherst will be on the line, while Mariaville, Otis and Aurora will be but a few miles away. From a point in Clifton the route swings and heads straight for Houlton. Then comes 40 or 50 miles through the wilderness. The line goes through the Riceville tannery district and skirts the Sisladobsis lakes. Springfield will be on the line, as will Carroll and Prentiss. The new road then swings nearer the line of the Maine Central and will cross its line and also the Canadian Pacific at or near Bancroft station. From there the line will pass through a farming district to Houlton. The route has already been surveyed, and except for the first 25 miles, which will require some cuts and fills, will be comparatively easy to build. The promoters are mostly Maine capitalists with A. L. Lumbert of Houlton the principal attorney.

The State Board of Railroad Commissioners has granted locations for a new branch line through the Allegash Valley from West Sebois, Piscataquis County, to St. Francis plantation in Aroostook County (157 miles) to the Bangor & Aroostook R. R. The proposed new line will cost nearly $8,000,000, and it will extend close to the Canadian border and will open up a hitherto inaccessible district. M. Burpee, Houlton, Me., is Chief Engineer.

Maryland.

Advices from Baltimore state that the Kent Traction Co. has been organized with a capital stock of $200,000, over half of which has been subscribed, for the purpose of building trolley lines on the Eastern shore. The first line to be built will be from Chestertown to Tolchester. All right of way for this line has been secured. A 7-mile branch to Rock Hall is also proposed. The directors of the company are: Frederick G. Usilton, Wilbur W. Hubbard, J. H. Sides, J. D. Bachus, H. M. Klemfetter, W. B. Copper and T. D. Bowers.

Massachusetts.

A joint board of State Commissioners on municipal improvements has submitted its final report to the Legislature. In its report the board recommends that the New York, New Haven & Hartford-Boston & Maine railroad be permitted to construct a tunnel from the North station to the South station in Boston. The board suggests that the city of Boston construct a surface highway between those two points, and points out that probably $2,000,000 can be saved by building the highway simultaneously with the construction of the tunnel.

Michigan.

The Michigan United Rys. Co., Lansing, Mich., has surveys under way for an extension to Chesaning.

Advices from Manistee state that the Buckley & Douglas Lumber Co. has bought from the David Ward estate 40,000,000 feet of timber holdings in Kalkaska and Antrim counties. About 20 miles of track will be laid from Baxter.

The Pere Marquette R. R., J. F. Deimling, Chief Engineer, Detroit, Mich., is said to be considering double tracking its line between Holland and Grand Rapids.

Minnesota.

The Chicago Great Western Ry. is reported to have decided to construct a new line between Nerstrand and Dennison.

Resolutions have been introduced in the City Council of Minneapolis ordering the local street railway company to construct and operate within ten months the following extensions: Emerson Ave. N, between 36th and 43d Aves.; Lyndale Ave. N, between 42d Ave. and the city limits; Penn Ave. N, between 32d and 44th Aves.; 20th Ave. N, from Washington Ave. to 13th Ave. NE and Monroe St.; Bloomington and Cedar Aves., between 34th and 38th Sts.

It is expected that track laying for the Duluth-Winnipeg & Pacific Ry., the Canadian Northern's direct Duluth-Winnipeg line, will begin May 1, and the line be completed by September. Grading and bridge building have continued without a hitch in spite of the cold weather, and the work thus far has been done exactly on the schedule prepared last summer. Grading will be finished by May 1 and track laying will start on that date at both ends of the line. Twenty miles of track already have been completed at Virginia, Minn.

It is rumored in Little Falls, Minn., that the Minneapolis, St. Paul & Sault Ste. Marie Ry. (Soo line) is considering the construction of a line through that place from Cuyuna to meet the other line near Bowlus, giving the company a more direct line from the range towns to the Twin Cites.

Missouri.

The Commercial Club of Canton, Mo., is taking steps for securing the construction of an electric railway from Canton to Memphis, Mo., via Monticello. Two routes are under consideration, either of which can be made ready for the rolling stock at a cost not to exceed $160,000.

A committee of which Frank A. Faxon is chairman, has been appointed at Kansas City, Mo., to consider a proposition for constructing a single track interurban line from Kansas City to Excelsior Springs and to determine the best course to pursue to raise the necessary $1,000,000 for the construction of the line.

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

One of the most important traction deals ever made in Kansas City was consummated here last week, when the line known as the "Strang Road" was sold to the McKinley Syndicate of Illinois. The Strang Road as it now stands does not cover a great amount of territory, running only between Kansas City and Olathe, a distance of 22 miles, but its sale announces the entrance of the powerful McKinley lines in this section of country. Of course, no definite plans for extensions are assured at this writing, but it seems to be clearly understood that a line will be built at once from Olathe to Topeka. In fact the surveys for such an extension have already been made. This new road will run through Lawrence and will be a very direct line between Kansas City and the State Capitol. When one considers that the building of only 100 miles of road to the south of Olathe will connect Kansas City by traction lines to 300 miles of roads already constructed, it is not hard to guess this link will be built as soon as possible. Such an extension will put us in direct touch by electric roads with the great oil, gas and mineral fields of the Southwest. More definite information will be available later and we will promptly report same.

Labor agents in Kansas City report that demands for labor are extremely light, and that there are some excellent foreign gangs in the city ready to go to work. White labor is also plentiful and many "old timers" are out of employment.

J. C. Nichols, who is building what is known as the Country Club District of this city, is doing some of the grading in that section with his own forces. However, as soon as spring fairly opens here, he plans to let some nice grading contracts in that section. There is a large amount of work yet to be done involving some rock.

The weather in Kansas City and vicinity continues ideal and graders who have been fortunate enough to have had uncompleted work from fall have hardly been delayed a day in their operations this winter. As a result many contractors are far ahead of their original plans on their work.

The writer has just returned from Omaha, where bids have been received on 31 miles of new Union Pacific work. This extension runs from North Port to Gering, Nebr., and involves about 600,000 yds. of material. The work will be practically all a team proposition. A large number of contractors bid on the work, including such well known railroad builders as Kilpatrick Bros. & Collins, MacArthur Bros. Co. and Phelan & Shirley. It is pleasing to note the optimistic light in which the contractors, practically to a man, view the coming season. It is now thought that there will be a large amount of work let very shortly. The Union Pacific have given substantial assurance of large plans by appropriating $75,000,000 for betterment work to cover a period of five years. The plan seems to be for a double track from Omaha to the coast and for numerous "feeders." The general ideas as to new work have been boosted a hundred per cent within the last two weeks and everything now points to the fact that 1911 will be one more year of added prosperity to the contracting world. At this writing we cannot say who the successful bidder on the 31 miles above mentioned will be as no announcements have been made by the Union Pacific officials.

Montana.

Maps and blue prints are being prepared, for the proposed Missoula-Hamilton Ry., and it is believed that bids for construction work may be asked shortly. This railroad is reported as backed by the Bitter Root Valley Irrigation Co., 164 Dearborn St., Chicago, Ill.

New Hampshire.

The Boston & Maine R. R. (New York, New Haven & Hartford line) is considering electrifying the railroad now operating up Mount Washington. It is said that a power plant will be located at the base of the mountain.

New Jersey.

Surveys have been under way in Verona Borough from the mountain top to the Caldwell line for a proposed railroad to connect with Morristown by way of Parsippany. It is believed that an old railroad embankment will be followed as near as possible, but in Montclair there is a talk of a tunnel from the present terminal to a point west of the Orange Mountains. The Delaware, Lackawanna & Western is said to be back of the project.

The Wildwood & Delaware Bay Short Line R. R. Co., which is building a new road across the meadows from Wildwood to the mainland to connect with the Philadelphia & Reading Railway Co.'s Cape May line, is said to be arranging to increase greatly its force of workmen employed on the building of the road, in order to rush the work to completion as quickly as possible. At a recent meeting at Wildwood the stockholders elected the following officers: President, Curtis T. Baker; vice-president, George Nelson Smith; treasurer, R. W. Ryan; secretary, Jed DuBois; directors, Warren D. Hann, Oliver I. Blackwell, Evans G. Slaughter, John Newcomb, J. A. Harris, Carl Erickson, H. E. Weir, Thomas S. Goslin.

New York.

The International Traction Rys. Co. is being organized at Buffalo, N. Y., by parties interested in the International Ry. Co., which operates 374 miles of electric railway. The new company is being formed for the specific purpose of constructing and operating a trolley line through Abbott road from Cazenovia Street to the south city line of Buffalo. This will give a connection with the Buffalo Southern Ry. which now comes to the city at South Park Avenue. The new company is to be capitalized at $100,000, and the prospective directors are Morris Cohn of Niagara Falls, Thomas E. Mitten of Chicago, Edmund B. Osler of Toronto, Robert L. Fryer, O. P. Letchworth, Porter Norton, Thomas Penney, Nelson Robinson and Henry C. Zeller. As yet no application for a certificate of necessity has been made by the new company to the public service commission. Formal application to build the proposed new line will be made to the common council in a short time.

The New York Central & Hudson River R. R. has had engineers at Lyons working on plans for track raising at that place. Work on this improvement, which will mean the raising of all the tracks in the local yards, will be started in the spring.

The New York, Ontario & Western Ry., J. E. Childs, General Manager, 56 Beaver St., New York, has applied to the public service commission of the Second New York district at Albany for authority to issue $2,702,000 of its 4 per cent general mortgage bonds.

The State Public Service Commission will hold a hearing at Albany on March 1, when final arguments of counsel will be heard on the application of the Frontier & Western R. R., for permission to build a 3-mile line in the Black Rock district of Buffalo.

The Corning, Keuka Lake & Ontario Ry., mentioned in our Jan. 25 issue, has completed surveys for its projected 86-mile line from Corning to Sodus Bay, and has secured the capital for construction purposes. Construction contracts are to be let soon. J. C. Zimmerman, Bradford, N. Y., is President.

Citizens of Montrose have voted to take $30,000 of construction bonds of the Scranton-Binghamton R. R. Co., which proposes to build a trolley road between the places named. It is stated track construction work at the southern end of the line will be started in the spring.

North Carolina.

The Union Trust Co., Pittsburg, Pa., has purchased the entire issue of $5,000,000 first mortgage 4 per cent 50-year gold bonds of the Winston-Salem Southern Ry. Co., of North Carolina. The bonds are dated July 1, 1910, and are payable July 1, 1960, the interest periods being Jan. 1 and July 1. The Winston-Salem Ry. is jointly owned by the Norfolk & Western Ry. Co. and the Atlantic Coast Line R. R. Co., and runs 89 miles from a connection on the north with the Norfolk & Western at Winston-Salem, N. C., to a connection on the south with the Atlantic Coast Line R. R. at Wadesboro, N. C. The entire issue of $5,000,000 bonds is sold to complete and pay for the construction and equipment of the line.

North Dakota.

Press reports quote H. T. Winter, Construction Superintendent, Morris & Sheppard Co., St. Paul, Minn., which has the contract for the construction of the Great Northern Branch to Stanley, as stating that work will be rushed to completion this year. Work of constructing a round house at that city, depots along the line, laying the rails, etc., for which his company holds the contract, will start early in the spring and will be rushed to completion as soon as possible. It is likely that the work of arranging for permanent water supply stations will be sublet to Fairbank, Morse & Co. Other work will also be sublet and it is pretty certain that trains will be running before the coming summer is over. Eight depots are to be constructed, a few loading platforms, and a four-stall roundhouse. Stanley is the terminus of the new branch which will open up about the richest farming country in the state.

Ohio.

The Northern Ohio Traction & Light Co., Akron, O., has acquired the right of way for double tracking its line between Cuyahoga Falls and Newburg, and it is believed that construction work on the improvement, which will be an expensive one, will be started this spring.

The Ohio Electric Ry. Co., Cincinnati, O., has placed $6,000,000 of 6 per cent notes with Drexel & Co. of Philadelphia. Four million dollars of stock has also been sold. Proceeds from the sale of the securities are to be used in improvements and in extensions to the Ohio Electric Ry. properties. Among the lines the Ohio Electric Ry. Co. controls are the Cincinnati, Dayton & Toledo; the Indiana, Columbus & Eastern; the Columbus, Newark & Zanesville; the Dayton & Western, and the Lima & Toledo.

It is believed in interurban circles that the Youngstown & Lake Erie interurban gasoline-electric line between Youngstown and Conneaut, will be built soon. The line was projected five years ago, but the panic of 1907 prevented the projectors from getting financial assistance. The road recently secured an extension of its franchise in Youngstown and has the right of way and a local franchise. The line plans to run to the harbor at Conneaut, where the road contemplates erection of a summer park.

⊙The following is a list of the contractors who secured new work on the Cincinnati Division of the Chesapeake & Ohio Ry., between Russell and Cincinnati: Louisa Contract Co., Louisa, Ky.; Boxley Bros., Concord, Ky.; P. T. Board, Charleston, W. Va.; W. I. Steele, Charlottesville, Va.; Lane Bros. Co., Altavista, Va.; Langhorne & Langhorne, Lynchburg, Va.; Carpenter & Boxley, Roanoke, Va.; Pitts & Morris, Roanoke, Va.; Rinehart & Dennis, Washington, D. C.; Watson Contract Co., Foster, Ky.; B. R. Cowherd & Co., Columbia, Va.

Stockholders of the Cleveland, Painesville & Eastern R. R. Co. (electric), Cleveland, O., have approved an increase of capital stock from $2,000,000 to $3,500,000. It is said that $500,000 new bonds also will be issued for extensions and improvements.

Directors of the Northern Ohio Light & Traction Co., Akron, O., have decided that the new financing of that company for the purpose of making extensive improvements in the motive power and equipment of the road will be done by means of an issue of preferred stock instead of by a bond issue. It is stated that it will be a 6 per cent cumulative stock, offered in an initial issue of $1,000,000 at a slight discount under par to its stockholders, the remainder to be written by a prominent New York financial house.

Surveys are to be started shortly, it is said, for the extension of the Baltimore & Ohio Southwestern Ry. yards at Mill Creek Valley, near Cumminsville. It is said that the Baltimore & Ohio will spend $1,000,000 in the reconstruction and enlargement of the yards of the B. & O. S. W. in Millcreek Valley. A great deal of land has been purchased by the B. & O. in the vicinity of the present yards at that point, and this will be utilized in the enlargement and improvements which are to be made. The reconstructed yards will be regraded and about twice the number of tracks now in service there will be laid. A large modern roundhouse will be built.

The Cincinnati Union Depot & Terminal Co., Third National Bank Bldg., Cincinnati, is about ready to submit final figures to the interested railroads for the proposed new union depot and terminal at Cincinnati. Some of the figures for the work are as follows: Permanent way from Millcreek to Hartwell: Rail, 8,805 tons; $264,150; structural steel, 122,330 tons, $7,739,800; grading, 1,515,000 yds., $45,450; concrete, 180,200 yds., $1,441,600, total of four items, $9,495,550. The cost of the union depot building will depend upon whether Plan No. 1 or Plan No. 2 is finally adopted, but it will probably not be less than $4,000,000 nor more than $5,000,000.

Three resolutions for grade crossing elimination have been introduced recently in the City Council of Cincinnati, O. Two of them relate to the Ludlow avenue crossing, one declaring intent to appropriate property, and the other approving the plans and specifications. The third resolution directs the Pennsylvania R. R. Co. to proceed with the Rockwood crossing over Eastern Avenue.

Aug. C. Schultz, County Surveyor, Sandusky, O., has made surveys for the elimination of what is known as the "Old Woman's creek crossing," midway between Huron and Vermillion, on the line of the Lake Shore Electric railway.

Oklahoma.

The Oklahoma Ry. Co., A. H. Classen, President, Oklahoma City, has a proposition under consideration for increasing its capital [illegible] The company is building a line to Edmond and also has plans for connecting the principal towns of central Oklahoma—Guthrie, Shawnee, Oklahoma City, El Reno, Norman, Edmond and others.

The city of Ardmore has accepted the proposition of E. R. Sutton of Philadelphia and H. L. Robertson and J. L. Hamon of Lawton, to build a line of road from Lawton by way of Duncan and Oil City and on to Sherman, Tex. The bonus was $100,000 in cash and the right of way and terminal facilities requested. The promoters will next visit Sherman, Duncan and Lawton, having already agreed to raise their bonus.

At a recent meeting of the Chamber of Commerce of Hugo, Okla., definite steps were taken to build the Hugo & Atoka R. R., a distance of approximately 40 miles. A complete survey of the line will be made at once and it is expected grading will start within 90 days. Stock to the amount of $75,000 is said to have been subscribed. A charter will be applied for within a few days. A movement was started to build this road two years ago, but was abandoned. It is now proposed to build and operate the road with local capital.

Good progress is being made on the grading work for the Oklahoma Traction Co.'s line to Red Oak, four miles from Tulsa, and it is expected that everything will be ready for track laying by the middle of this month.

A bill was introduced in the State Legislature on Feb. 2 providing for the construction of a railroad across the state. The proposed line would run from the northwest to the southeast section of the state a distance of 425 miles, opening up new agricultural coal and timber lands. The bill asks for an election to vote on a bond issue of $10,000,000 for the purpose of building the road.

The Cherryville, Oklahoma & Texas R. R., mentioned in our last issue, is reported to have let a contract for the construction of the proposed railroad from Siloam Springs, Ark., to Vinita, Okla. S. M. Porter, Caney, Kan., is President.

According to advices from Ardmore, Okla., S. L. Vandiver, Atlanta, Ga., representing mine owners of Georgia and Tennessee, is planning to improve the equipment of the mines and to construct a line of railroads to the western part of the county, where they are located.

Advices from Guthrie, Okla., state that Eugene Tilleux, Chief Engineer of the proposed Buffalo & Northern R. R., recently chartered, is seeking a connection with the St. Louis & San Francisco for the road which is to be built west of Buffalo across "No Man's Land," to either Enid or Avard. Officials of the company are negotiating with Enid on the proposition of building into that city.

The incorporators of the Kansas, Oklahoma & Panama R. R. Co., mentioned in our last issue as planning the construction of two lines, one starting in Beaver or Harper County, Okla., and running southwest to a point on the Texas line in Love County, the other starting in Beckham, Washita or Kiowa County and running east to Oklahoma City, are Richard W. Ruffin, of Hamilton, O.; F. A. Mosher, of Port, Okla., and John Dumars.

Oregon.

The Grants Pass & Western Ry., a new project reported to be backed by Harriman interests, has engineers in the field working between Grants Pass and Crescent City. Options on right of way property are being secured. It is believed that this is to be an electric line.

The Commercial Club, of Corvallis, has organized a committee with J. F. Allen, chairman, to initiate a vigorous campaign to bring the projected line of the Oregon Electric Ry. Co., of Portland, to Corvallis. It is proposed to induce the company to build the Portland-Eugene line through Corvallis, thus placing that city on main line with direct through service to Portland.

According to advices from Pendleton, Ore., engineers are now in the field preparing for the immediate construction of an additional 16 miles of double track on the Oregon-Washington Railroad & Navigation Co. line between Deschutes and Blalock, which section, with the 30 miles of double track recently completed between The Dalles and Deschutes, will comprise a total of 46 miles of such track, which will eventually extend to Portland. Twohy Bros.' have completed their part of the improvement between Pendleton and Yoakum, Ore., and track laying is under way on both ends. On the Yoakum end three miles have been completed, including the stretch through the tunnel which cuts out Horseshoe curve. The contractors are already at work on the erection of the steel bridge at Coe and state that it will be ready for use within three weeks. The steam shovels have cut into the gravel pit, working trains have been requisitioned and the work of ballasting this three mile stretch will commence immediately so that with the completion of the bridge, all trains will be routed over it.

Officials of the Great Southern R. R., J. G. Heimrich, General Manager, The Dalles, Ore., has been over the route of a projected extension of the line to a point beyond Dufur. Surveys for this extension were made last spring.

Pennsylvania.

⦿A. L. Anderson & Bros., Inc., Altoona, Pa., have been awarded the contract for constructing the Black Lick connection and the Elk Creek branch for the Blacklick & Yellowcreek R. R. The work is located in Cambria and Indiana counties, Pa., and includes 200,000 cu. yds. of earth excavation, 15,000 cu. yds. rock excavation and 10 small concrete and rubble masonry bridges. Work has been started and the contractors now have about 250 men on the job. It is expected that the grading will be completed in six months.

Eastern capitalists are reported to have subscribed the necessary capital to assure the construction of the proposed street car line from Beaver Falls to New Castle, and it is expected that actual construction work will be started early this spring. J. V. Cunningham, New Castle, Pa., is one of the promoters.

The State Water Supply Commission has approved applications of the Lehigh Valley R. R. Co. for a fill along the Lehigh at Cementon and of the Pittsburg & Shawmut along the Allegheny River and Mahoning Creek in Armstrong county.

The Pennsylvania R. R. is said to be planning to expend about $200,000 for new freight transfer facilities in the upper end of Harrisburg. The work is said to involve a large freight station at Maclay Street and the reconstruction of a large part of the Harrisburg yards.

Reports in Harrisburg are to the effect that the Cumberland Valley R. R. is to run four tracks from Harrisburg through Carlisle for the benefit of its parent road, the Pennsylvania, which, it is expected, will then avail itself of the Cumberland Valley tracks in a short cut west to Pittsburg, branching from the Cumberland Valley near Newville. Further currency is given to the reports by the acquisition of large tracts of land adjoining Newville.

The time limit for deposit of the Quakertown Traction Co.'s bonds, in acceptance of the offer of the Lehigh Valley Transit Co., Allentown, Pa., to purchase the line of the former by an exchange of bonds, has been extended to Feb. 9. Thus far the bondholders of the Quakertown corporation have deposited $240,000 of a total issue of $300,000. It is said that unless all the bonds are deposited by Feb. 9, in all probability the negotiations to purchase will be discontinued. In that case the Lehigh Valley Transit Co. will build its own line through the territory in which it uses the tracks of the Quakertown Traction Co. as a connecting link.

Extensive subway work for the city of Philadelphia is advocated by Mayor Reyburn. The tentative plans call for a 4-track subway the entire length of Broad St., which is eleven miles long, to be owned by the city; the extension of the Market St. subway system of the Philadelphia Rapid Transit Co. to Camden, N. J., through tunnels under the Delaware River. All the projected improvements, it is said, are to be made under a $60,000,000 city loan, of which $28,000,000 will be spent on the Broad St. subway. Already the steps necessary to make the loan possible have been taken in the Legislature. The proposed subway under Broad St. is to be controlled by the city, but if built probably will be leased to the Union Traction Co., a subsidiary concern of the Philadelphia Rapid Transit Co., which controls all the street car lines of Philadelphia.

Construction work is stated to have been started on the Lehigh-New England R. R. extension, contract for which was awarded a short time ago to MacArthur Bros., New York and Chicago, as noted in these columns. MacArthur Bros. Co. have opened offices for this work in the Citizens' National Bank Bldg., Slatington, Pa., and the first work will be the construction of the concrete substructure for the large bridge to be built over the Lehigh River at Lehigh Gap.

The Delaware, Lackawanna & Western R. R. is, according to advices from Shamokin, Pa., making preparations for the construction of tracks for its extensive freight terminal siding at Northumberland near the locks of the abandoned canal along the North Branch. The work includes filling in a portion of the old canal. George J. Ray, Hoboken, N. J., is Chief Engineer of the railroad.

Construction work is stated to have been started on the branch line from Kittanning to Butler for the Pittsburg & Shawmut R. R., W. W. Henshey, Chief Engineer, Kittanning, Pa. The new line will open up a large coal trade.

Rhode Island.

Orders have been issued by the management of the Grand Trunk Ry., H. G. Kelley, Chief Engineer, Montreal, Que., to rush all preliminary work for the construction of the proposed new line from Palmer, Mass., to Providence, R. I.

South Carolina.

The Orangeburg Ry. Co. has been chartered and proposes the construction of a railroad from Orangeburg to Springfield, a distance of 30 miles. The capital stock is $50,000 and the officers are: W. C. Wolfe, Orangeburg, president, and Joseph A. Berry, Orangeburg, secretary.

A meeting of citizens was recently held in the court house at Monroe, S. C., to discuss the proposed Salisbury-Monroe R. R. As proposed, the line will run from Salisbury, connecting at Jefferson, S. C., with the Charlotte, Monroe & Columbia R. R., now operating between McBee and Jefferson. T. J. Jerome, Salisbury, N. C., is interested in the project.

South Dakota.

Press reports from Winfred, S. Dak., state that much enthusiasm is being manifested among farmers, land owners and towns of Lake and Miner Counties, through which the new proposed St. Paul, Sioux City and South Dakota Ry. is to pass. C. A. McGee, representing eastern capitalists, has been in the vicinity for the past 30 days, consulting with business men of the several towns interested and also with farmers along the proposed route, with the result that much encouragement has been given the project. The proposed line will run through Canova, Clarno and Madison, S. D., and thence northeast to Marshall, Minn., where it will make direct connections with the Twin Cities. The company has already purchased the old survey made through the section many years ago for a similar road and will follow the old route. No bonuses or donations have been asked by the promoters. It is stated that a contract has already been let for the construction of over 200 miles of road and that work will begin not later than April 1.

It is reported in Chamberlain, S. Dak., that the Chicago, Milwaukee & Puget Sound Ry.

will start active construction on its line between that place and Rapid City as soon as spring opens up. The track is to be raised the entire distance fully two feet, the filling to be of gravel. It will be a big undertaking, and will require a number of construction crews, and even at that it is doubtful if the work will be completed during the coming season. In railroad circles this radical improvement of the roadbed, taken in connection with the very elaborate bridge surveying and sounding at this point last fall, is taken as confirmative evidence of the connection of the Chamberlain and Mobridge lines at some point in Montana, a start for the surveying of which was announced from Rapid City last fall.

Tennessee.

A new plan is now under consideration at Jackson for the construction of the much discussed belt line for that city. It is now proposed that the city construct the line upon its own responsibility as a public improvement, just as it would an electric lighting plant, water works or any other public utility.

It is now said that construction work is to be started at once on the proposed new railroad from Jackson to Dyersburg. Practically all of the subscriptions have been secured and the report of the engineers outlining the final route have been made. This is the project promoted by R. M. Hall of Dyersburg.

A mass meeting has been held at Woodbury to lay plans for securing an interurban railroad from Nashville to that city. Organization was effected and a committee named to confer with railroad people.

The Greenville & Knoxville R. R., W. H. Patterson, President, Atlanta, Ga., has recorded a mortgage for $6,000,000 to secure bonds to be issued for the construction of the line through to Knoxville from the present terminus at Riverview, 25 miles from Greenville. The bonds, it is stated, will aggregate $40,000 per mile for construction. The distance to be traversed by the road is about 200 miles. The road will touch Brevard, Hendersonville, Asheville, Sevierville and other towns between the latter point and Knoxville. It is said that a large force is already at work at Riverview preparing to extend grading work.

Texas.

⊙Roach & Stansell, Memphis, Tenn., have been awarded a contract by the Kansas City, Mexico & Orient Ry. for grading between Eldorado, Schleicher County, and Sonora, Sutton County, a distance of 24 miles. The contractors have started 100 teams and a large force of men on this stretch of work. They also have the contract to grade 200 miles in West Texas for the Orient.

The Rio Grande Ry. Co. of Brownsville, Tex., has filed its articles of incorporation. The company proposes to maintain and operate a line of railroad from Brownsville to Point Isabel, Cameron county, a distance of 22 miles. This is an old established road, but it became involved some time ago and was sold on May 12, 1910, at foreclosure sale in the United States district court for the southern district of Texas at Brownsville, and purchased by the present owners. This road is destined to become a part of the Brownsville road. The capital stock is $25,000 and the incorporators are William E. Guy, St. Louis; Thomas H. West, St. Louis; B. L. Winchel, St. Louis; C. L. Macmanus, Brownsville; Claude Pollard, Kingsville; Frank Andrews, Houston.

Salado has raised its required bonus and announcement has been made that the Q., S. D. & R. Ry., popularly known as "the Middle Buster," will build through that place. Salado is ten miles south of Belton, on the Salado River. From Salado the road will go to Jarrell, the present terminus of the Bartlett & Florence R. R.

Construction work is to be started soon on a railroad to extend from Smitana, a station on the International & Great Northern Ry., six miles from Bryan, for a distance of 20 miles through the Brazos River bottom. The entire distance of the new railroad will be about [illegible] miles, the capital for the construction and completion [illegible] road, which [illegible] raised among citizens of Bryan, who have subscribed to a stock and bond proposition. Trackage arrangements have been made with the International & Great Northern.

The railroads entering Galveston have contracted with the North American Dredging Co. for the [illegible] the Galveston end of the causeway. It is understood that the area to be filled will require the handling of about 200,000 yds. of material, the work to begin at once and be hurried to completion. The North American Dredging Co. has about three months' work ahead of it filling in the mainland side of the protected roadway portion of the causeway and the arch bridge fill, but this work will not be available for some time. During the interval the filling for the railroad companies will be done. The slope to the level of the causeway will extend back onto the tracks of the various companies for about a mile.

The State Attorney General's Department on Jan. 30 approved an amendment to the articles of incorporation of the St. Louis, Brownsville & Mexico Ry. Co., E. C. Burgess, engineer, Kingsville, Texas, providing for the construction of an extension or branch from Buckeye, Matagorda County, to Collegeport, Matagorda County, a distance of 16 miles. This extension has been in contemplation for some time by this road.

A company is being formed which proposes to construct about 100 miles of electric railway in the valley to be irrigated from the Engle dam in the New Mexico and from the greater Texas Rio Grande reclamation project, the power for the line to be derived from the waterfall at the Engle dam. This line is to extend from Engle, N. M., to Sabenz, Texas, a point below El Paso, and is intended to form the connecting link between the irrigated farms of the section and the railroads at El Paso. Richard Burgess, El Paso, Texas, is reported to be interested.

The Texas Traction Co., Dallas, Tex., is said to be planning to have work started shortly on extending its street railway at Sherman into West Sherman.

A bill has been introduced in the Legislature providing for the merger of part of the Pecos & Northern Texas R. R., between Coleman and Sweetwater and the Concho, San Saba & Llano Valley Rys., with the Santa Fe system. The Coleman-Sweetwater line is a part of the Santa Fe's 130-mile cut-off, which is being constructed between Coleman and Texico.

Right of Way Agent C. B. Cunningham, of the Port Bolivar Iron Ore Ry. Co., announced in Longview, Texas, that all the right of way had been deeded to the company, with the exception of two small tracts of land, one in Gregg County, the other in Upshur County, but he thinks terms will be concluded in a short time or arbitration resorted to, as the right of way must be all clear immediately, as contractors are pushing the work all along the road. There are now 15 camps of graders, amounting to over a thousand mules and horses, and 500 men are actively engaged, while perhaps 500 men are clearing the right of way all along the route.

At a meeting of the citizens of Crockett, Tex., a resolution was presented and adopted providing that the senator and representative in the Thirty-second Legislature be instructed that no bill should be passed by the house permitting the St. Louis & Southwestern (Cotton Belt) to consolidate with the Eastern Texas R. R. unless the same be accompanied by a strict requirement and obligation that said road be extended from its present terminus at Kennard to Crockett within twelve months after the passage of such bill.

According to reports it has been announced by N. J. O'Brien, General Manager of the Kansas City, Mexico & Orient Ry., Sweetwater, Tex., that when the Orient finishes building in [illegible] road in this state, there being now 250 miles of completed road. Extensions are now in progress from [illegible] miles, 80 miles from San Angelo to Fort Stockton, and besides this there is the Del Rio extension. On this extension a large steel bridge is being constructed which will span the Concho River. The road now runs from San Angelo to Wichita, Kans., a distance of 570 miles.

According to advices from Wellington, Tex., the grade of nearly 100 miles of the Altus, Lubbock & Roswell R. R. from Wellington to Silverton is finished and the division will soon be ready for opening. Arrangements are being made to construct the extension of the line to El Paso via Roswell, N. M., the survey for the lower divisions of the proposed road being now in progress. It is stated by E. Kennedy, the promoter of the road, that bonuses to the amount of $600,000 have been subscribed in aid of the project and that land for a number of townsites along the line has been donated. The construction of this road will place El Paso within 593 miles of Oklahoma City, which is 247 miles shorter than the present railroad route between the two places. It will also give El Paso and that part of the Southwest a shorter route to Kansas City, Chicago and St. Louis, it is claimed.

The railroad committee of the town of Fredericksburg and Gillespie County have agreed to raise a bonus of $100,000 to be given for the first railroad built and operated into the town of Fredericksburg.

Extensive improvements are planned for the coming season for the Northern Texas Traction Co. of Fort Worth. These improvements will include the construction of several miles of new line and the building of a new substation. The Stone & Webster Engineering Corporation, Boston, Mass., is the owner.

A committee of the Chamber of Commerce, San Antonio, Tex., is planning the organization of a construction company capitalized at $500,000 to construct a railroad from that city to the Rio Grande Valley. According to the plan worked out, 5 per cent of the subscription will be available for bonuses, to determine the route of the road and to make a thorough business investigation of the project, just as soon as the entire capital stock is subscribed. The committee now working on the project is composed of George West, John J. Stevens, Alex Halff, Ernest Steves, Otto Kochler, F. L. Hillyer, C. A. Zilker, Edwin Chamberlain, Henry L. Halff, George C. Vaughan and William Cassin.

Utah.

Utah-Moapa Distribution Co., in which Frank R. Snow, Salt Lake City, Utah, is interested, has requested the Salt Lake Route to construct a spur line 22 miles in length, extending from the Omapa station southward through the valley, and it is believed that the matter will be taken into consideration by the officials of the company. E. G. Tilton, Los Angeles, Cal., is Chief Engineer of the San Pedro, Los Angeles & Gulf R. R. (Salt Lake Route).

It has been announced that as soon as weather conditions are favorable, contracts will be let for the construction of the proposed line of the proposed Utah & Grand Canyon Ry. extending through southern Utah, and in Arizona to the northward from the Grand Canyon of the Colorado. Frank A. Dudley, Salt Lake City, Utah, is president of the company.

Vermont.

The proposed new railroad work in the southern part of this state is still somewhat up in the air. Last week the conference committee of the Vermont Legislature, which had been considering the bill to allow the Boston & Maine to take land and lay a double track through the Central Vermont yards at Brattleboro, in extension of its line from South Vernon to Brattleboro, reported a disagreement. In the closing hour of the legislature the report was accepted and the committee discharged, this action killing the bill. This measure, which was intended to give the Boston & Maine the right to take the land desired by eminent domain, was passed by the house after a contest, but when it went to the senate that body refused to concur, and amended the bill in such a way as to allow the construction of the tracks in the Central Vermont's territory, but not the taking of the land, thus giving the Central Vermont control of the stretch of road. The house, when the bill was returned, refused to accept the amendment and a conference committee was appointed in an effort to effect an agreement. The Boston & Maine has now announced that it will start the construction of its line on the New Hampshire side of the Connecticut River.

Virginia.

The meeting of the stockholders of the Norfolk Southern R. R., called for Jan. 30 to authorize an increase in the company's bonds issue from a present maximum of $12,000,000 to $35,000,000, was postponed to Feb. 7. It is stated that it is not the intention to issue bonds at once to the authorized limit of $35,000,000, if the proposition carries, but simply to arrange for the expansion of the railroad by extension of its own lines or the acquisition of other lines. F. L. Nicholson, Norfolk, Va., is Chief Engineer.

Washington.

Citizens of Lebam, located on the South Bend branch of the Northern Pacific Ry., have organized a commercial club and will make a determined effort to secure the extension of the electric line about to be built from South Bend to Raymond to Lebam.

Information from Port Angeles, Wash., states that two railroad franchises were asked from the city council at the last meeting. One was presented by E. B. Cox, of Seattle, and the other by G. W. Morrow, townsite agent of the Milwaukee. Both were referred to the franchise committee and city attorney. They are practically alike and ask for wharves and right of way along the following waterfront streets: Victoria, Railroad avenue, Front, 1st, 2d, 3d, 5th, 8th, 12th, Francis, Lincoln, Laurel, Oak, Cherry, Pine, Cedar and Tumwater. The conditions of the Cox franchise are the commencement of survey work within 90 days, the beginning and prosecution of construction work within one year and completion within two years to transcontinental connection. A common user clause is incorporated. The conditions of the Morrow franchise are the commencement of construction work and the expenditure of at least $50,000 within one year, the beginning of survey work within reasonable time and the completion of at least 20 miles of road and the guarantee of terminal rates, facilities and connections within two years.

West Virginia.

Col. J. M. Schoonmaker, Pittsburg, Pa., representing the Little Kanawha Syndicate, is reported to have acquired control of the Fairmont & Southern R. R. Co. The closing of this deal is said to mean the early completion of a railroad between Rivesville and Belington, W. Va.; all the complications that have hindered the building of the road are said to have been removed by the recent transaction.

Wisconsin.

There is good ground to believe that the Minneapolis, St. Paul & Sault Ste. Marie Ry. will early this spring start work on building the new cut-off from Mukwonago to Owen, the cut-off from Neenah to Pembine, and also a new piece of track from Mukwonago, which will give the road a southern entrance into Milwaukee. The cut-off from Mukwonago to Owen was decided upon some time ago, and surveys have been made.

An ordinance has been introduced in the City Council of Milwaukee by Alderman Louis A. Arnold, providing that the city establish and operate a railway terminal, the cost of which shall be borne in part by $1,000,000 of terminal certificates, secured by the terminal property. The city will charge for the use of the depot, belt line, side tracks, main tracks and other parts of the terminal what is agreed upon with the lessees, the ordinance says, such compensation as may be fixed by the railroad commission. The budget reported by the finance committee provides for a $50,000 issue of terminal bonds and for $500,000 of terminal certificates. The bond proposition will be submitted to referendum vote at the April election. Charles J. Poetsch is City Engineer of Milwaukee.

The Lake Superior & Transfer Ry., C. P. Brown, Superintendent, Superior, Wis., is said to be planning to lay a number of new tracks at its yards in Superior. The construction of additional round house facilities is also proposed.

Canada.

✣The Kootney & Alberta Ry. is asking for tenders for the construction of 13 miles of its line from Pincher Creek, Alberta, to the Western Coal & Coke Co. mines on Beaver Creek. This short piece of line is estimated to cost nearly $30,000 per mile. It averages more than 40,000 cu. yds. per mile and will require about 2,000,000 ft. B. M. of trestle and culvert timber. Tenders will be received at the office of L. B. Merriam, Engineer, 609 Builders' Exchange Bldg., Winnipeg, Man., until Feb. 10.

The Joliette & Lake Manuan Colonization Ry. Co. has applied to Parliament for leave to construct a line of railway from the town of Joliette, in the province of Quebec, to Montreal.

Extensive construction work is under way at Prince Rupert, B. C. In the business section of the city, public work to the extent of nearly $500,000 is under way. Street grading on the Grand Trunk Pacific calls for much heavy work. On First, Second and Third Aves., near the water front, the rocky bluffs are being dynamited, and the deep fills brought up to grade. Railway construction is advancing rapidly. For more than 100 miles supply trains are operating, and from Kitselas to Hazelton, at least 60 per cent of the grade is in excellent shape. By spring there will be a passenger and freight service from here to Kitselas. Permanent tracks are being laid in the Prince Rupert yards and temporary terminal facilities are being built.

Application is to be made to the Dominion Parliament for an act incorporating a company under the name of the High River, Saskatchewan & Hudson Bay Ry. Co., with power to construct a line of railway from a point in townships 25 to 29, range one, west of the fourth meridian, in Alberta, thence northeasterly to the city of Saskatoon, in Saskatchewan, thence northeasterly to a point in or about townships 52 to 56, on the easterly boundary of the province of Saskatchewan, thence northeasterly to The Pas.

The Canadian Pacific Ry. Co. has filed its plans with the city of Toronto, showing the use that it intends to make of the recently purchased Government House property at Toronto. The plans show that the company proposes to make connection between a branch line and the main line of the Canadian Pacific, immediately west of Tecumseh St. nearly opposite the Cattle Market, and continuing east with a slight ascent of grade to a point about half way between Bathurst St. and Portland St. There a rise will be made to a strip of land south of Front St., and known locally as the Prince Wales walk. Ascending a grade, the branch line will cross Spadina Ave. and continue in a northeasterly direction to the intersection of the properties to a point a little east of Peter St., where diverging sidings commence. The block plan, bounded by John St. on the west, Wellington St. on the south, Simcoe St. on the east, and King St. on the north, shows the use to be made of the block in connection with the handling of freight. On Wellington St. an inward freight house is to be erected. In the center of the block the outward freight shed will be located, and will extend east and west for some distance. At the southwest corner of King and Simcoe Sts. it is proposed to locate a storage warehouse, having a frontage of about 350 ft. on King St. and 100 ft. on Simcoe St. The plans show 14 tracks. Nine tracks will cross John St. The company's offices are to be situated on the west side of Simcoe St., about half way between King and Wellington Sts.

A project is under consideration by several captalists of Vancouver, B. C., for constructing a railway to the crest of Grouse Mountain, which is situated about 12 miles from Vancouver. H. C. Miles, Vancouver, is interested.

Contracts have been let and work started on clearing the townsite of Port Mann, which is to be made the Canadian Northern Ry.'s Pacific terminal. Four thousand acres, with a water frontage of 2½ miles, have been surveyed, and nearly 1,000 men are engaged upon the work of laying out the townsite, which will be completed within four months. The town is situated on the south bank of the Fraser River, a little east of New Westminster, B. C. The river at this point is over one mile wide, and there is a depth of 40 ft. of fresh water at the docks.

It has been announced by the Minister of Public Works, Ottawa, Ont., that the matter is seriously under consideration of having surveys made for the projected tunnel under Northumberland Straits between Prince Edward Island and the mainland. The distance at the most narrow part of the Straits is 9 miles.

On Feb. 1 the steel on the Grand Trunk Pacific Ry. had been laid to Prairie Creek, a distance of about 55 miles from Edson, Alta., or 185 miles west of Edmonton, where the track will end until such time as the bridge over Prairie creek has been completed. As soon as this is done the laying of the steel will be resumed and probably carried on as far as the Athabasca river, where another bridge has to be constructed.

The Railway Committee of the House of Commons has passed a bill incorporating the British Columbia & Dawson Ry. Co., with a capital stock of $10,000,000. Among the incorporators are Belvidere Brooks of the Western Union Telegraph Co.; John W. Kendrick, of the Atchison Railway; William C. Pratt, vice-president of the National Heat, Light & Power Co.; Andrew C. Sullivan, Edmund C. Harris and Charles G. Young of New York and James O. Clifford of Chicago.

The Street Railway Commission of the city of Guelph, Ont., has received tenders for the construction of the new branch of the railway to be built in St. Patrick's Ward. Construction will commence just as soon as the snow is off the ground.

Press reports quote P. Welch as stating that between 1,000 and 3,500 men will be engaged in construction work on the G. T. P. by the firm of Foley, Welch & Stewart of St. Paul, Minn., which has the contract for the building of the road as far west as Tete Jaune Cache. Mr. Welch recently returned to Edmonton, Alberta, from the west, after a trip as far as the head of the steel, near Prairie Creek.

It is now reported in Prince Rupert that the Grand Trunk Pacific may not be the only railway having a terminal within its gates. The Mackenzie & Mann syndicate is credited with the intention to construct and operate a line to Prince Rupert. At the present time and for some considerable time past the Mackenzie-Mann syndicate has had surveyors and prospectors in the field to the north of Kalen Island, and it is currently reported that one of their next announcements will be that they are going to invade Prince Rupert from the north. From the Portland Canal they are at present constructing a line eastward and they are also credited wtih being behind the company ostensibly owning the surveyed road from Stewart down in the direction of Port Simpson.

Mexico.

Work on the construction of the short line between Torreon and Lerdo, which was begun last year, has been abondoned for the present owing to an extension of time having been granted by the government authorities for the completion of this system. Under the concession which this electric line now operates between Lerdo and Torreon the short line was to have been completed by June, 1911, but an extension of 18 months will change this time to December, 1912. As the line is now built, the distance covered between Lerdo and Torreon is 11 kilometers. The new line will follow the present one from Torreon to the baseball park and will then branch off and, passing through the canon, go direct to Torreon. This will require the construction of four kilometers [illegible] and will shorten the line by about four kilometers. It is not yet decided whether two separate lines will be established, but the present line between Torreon and Lerdo, via Gomez Palacio, will not be abandoned.

A concession has been granted by the Mexican government to an English syndicate known as Hudson's Consolidated Ltd., for constructing a railroad through southern Mexico 370 miles long. The subsidy is about $5,000,000.

ROADS, STREETS AND PAVEMENTS

Alabama.

The recent election held in Wetumpka, Ala., to vote the issuance of bonds for road improvement was invalid and a new election will be held Feb. 20. The city called for bids for Jan. 23 from the specifications prepared by the Solomon-Norcross Engineering Co., Atlanta, Ga., for this work. If the proposition carries new bids will be advertised for. M. D. Still is Judge of Probate, Wetumpka.

E. W. James, United States Highway Engineer, with headquarters at Washington, D. C., has been called to Mobile, Ala., for the purpose of giving his aid and information to the county board and its advisory committee in the matter of road building. A section of road will be built as a demonstration in road work. The county plans to expend approximately $500,000 in the building of roads during the year.

The City Council of Aliceville, Ala., has passed an ordinance for the laying of concrete sidewalks from 2nd St., west to the corporate limits along both sides of 3rd Ave. The walk will be 5 ft. wide.

The Southern Asphalt & Construction Co. has been incorporated in Birmingham, Ala., with J. F. Copeland, President and Eugene Fies. Secretary and Treasurer. The capital stock is $5,000. The company plans to erect at once an asphalt plant at a cost of $30,000. The company also plans to take paving contracts and increase the capital stock in the future

California.

Residents of Lankershim petitioned the County Supervisors at Los Angeles, Cal., to construct a highway connecting that city and the present system of good roads with the half million dollar system of boulevards of the Los Angeles Suburban Homes Co.

It is reported from Porterville, Cal., that the supervisors have procured almost all necessary rights of way for a road due south from Porterville which will eventually connect that city with Terra Bella, Ducor and Richgrove, and which will be continued on to the south line of Tulare County. The building of the road will necessitate the construction of a new steel bridge across the Tule River about midway between the Southern Pacific bridge and that which leads to Plano.

Colorado.

The Arkansas, Gunnison and Grand River Highway Association was recently organized in Denver, Colo., to urge the construction of the proposed state highway from Pueblo to the Utah line. The plan is to extend the new Santa Fe trail, already completed from the eastern boundary of the state to Pueblo, to Salida and Leadville, down the Eagle and Grand Junction to the state line. From Salida a branch will extend over the continental divide to Gunnison and Montrose and another will go over Poncha Pass to the San Luis and Uncompahgre valleys. C. R. McClain of Canon City is chairman of the organization.

Delaware.

Commissioners have recommended to the New Castle County Levy Court at Wilmington, Del., that a road be built in Brandywine hundred from the Faulk road to the Boulevard in Wilmington.

Georgia.

⊙Wm. F. Bowe of Augusta, Ga., has been awarded the contract by the Streets and Drains Committee of the City Council of that city for the laying of curbing in the city for the present year at $.34 per lin. ft., for the straight curb, and $.45 for the round curb.

⊙A. A. Hett & Co. has been awarded the contract by the city of Augusta, Ga., for the construction of cement paving on sidewalks and driveways in the city during this year for $.09½ per sq. ft. for sidewalks, and $.05½ per sq. ft. for driveways.

Illinois.

Brick pavement for West State St., Rockford, Ill., from the end of the asphalt at Winnebago St., to the city limits is being planned and petitions are being signed asking for a special assessment for the improvement.

Profiles and estimates of cost of the proposed paving of West Olive St., and East Elm St. have been presented to the Board of Local Improvement of Canton, Ill. The latter street will be paved from 3rd Ave., to 7th Ave., at an estimated cost of $9,170, and the former from Main St., west to Avenue C estimated to cost $11,310.

Indiana.

⊙The County Commissioners at Wabash, Ind., have awarded Lewis Hutshell and I. J. Wolfcale of Markle the contract for the construction of a stone road to begin at Markle and extend north for 6 miles.

⊙The Commissioners of Tippecanoe and Clinton Counties at Frankfort, Ind., county seat of Clinton County, awarded the contract for the Thompson road on the Lauramie township line to Zarrell Bros., for $5,745. At the same time William C. Meneely was awarded the contract for the Milligan road for $2,170.

⊙The board of public works of Gary, Ind., has awarded the contracts for the construction of pavement on 16th St., and Connecticut St., to the Cain Construction Co., and S. A. Smith, respectively. The work also includes curb and walk. Bids were opened Jan. 30

⊙John Glynn of Otterbein, Ind., has been awarded the contract by the Benton County Commissioners, Fowler, Ind., for the construction of the Bertrand gravel road for $2,747. Bids were opened Feb. 1. Lemuel Shipman is county auditor.

The American Construction Co., of Indianapolis, Ind., will probably be awarded the contract by the board of public works of that city for the improvement of Sanborn St., from the south curb line of New York St. to the north property line of Owosso Ave., by grading and paving the roadway. Bids were opened Feb. 3.

Bids received Feb. 6 by Board of County Commissioners, Fowler, Ind., for the construction of a free stone road consisting of seven different highways in the town of Ambia, Benton County, were rejected. The contract will be let some time in March Lemuel Shipman is county auditor.

Iowa.

✣Bids will be received until 8 p. m., Feb. 20, by W. C. Chubb, City Clerk, Corning, Ia., for the construction of the following improvement: For grading, curbing, guttering and paving Davis Ave., from the railroad right of way to the north line of Eighth St. and Eighth St. from alley between Davis Ave. and Adams St. to Grove Ave. The work includes the following approximate quantities: 11,944 sq. yds. of brick, 189 sq. yds. concrete pavement, 2,373 lin. ft. of combined curb and gutter, 1,857 lin. ft. of gutter, 2,650 cu. yds. grading. Theodore S. DeLay, Creston, Ia., is engineer in charge.

✣Bids will be received until Feb. 15 by County Clerk, Marengo, Ia., for the improvement of county roads.

Comprehensi[illegible] roads building, the creati[illegible] county highway engineer, the abolition of that of county surveyor, etc., are provisions of a good roads bill introduced in the senate at Des Moines, Ia.

Resolutions calling for the paving of North Michigan Ave., East 7th, West 5th, West State, West 7th and North and South Washington have been passed by the city council of Mason City, Ia.

The City Council of Hampton, Ia., has decided to pave with brick the following streets, including intersections: Main St., from 4th to 3rd; 3rd St., from Main to Reeve; 6th St., from Reeve to Main and Main St., from 6th to 5th. Alleys 9, 10 and 15 will also be paved with concrete.

The City Council Paving Committee of Muscatine, Ia., has recommended in its report more than a mile of street paving. The committee recommends the following paving to be placed: Lucas St., from Green to Logan St., brick; 6th St., from Cedar to Mulberry, brick; 7th St., from Cedar to Mulberry, brick; 5th St., from Pine to Linn, brick; Green St., from Hershey Ave., to Grandview, concrete; Hershey Ave., from Green to Oregon St., concrete; Poplar St., from 8th to 9th St., concrete; 9th St., from Poplar to Lombard, concrete; Alleys in blocks 151, 145, 120, 97 and 79, concrete.

The City Council of Mason City, Ia., has ordered many blocks of paving for this year. The new pavement includes paving of North Machigan Ave., East 7th, West 5th, West State, West 7th, North and South Washington, North Main, Superior and West 6th.

Maryland.

The city clerk of Annapolis, Md., will receive bids until Feb. 10 for $20,000 bonds for street improvement. J. C. Little is City Engineer.

The city of Annapolis, Md., will pave Second St., Madison St., Washington St. and Clay St. with tar or asphalt macadam. J. C. Little is City Engineer.

Massachusetts.

✣Bids will be received until 2 p. m., Feb. 17, by James H. Bryan, Chairman of the Committee, Westfield, Mass., for laying granite block pavement on Elm St., Westfield, Mass. The work includes the recutting and laying on concrete foundation of about 11,347 sq. yds. of old granite blocks and the furnishing and laying of about 4,185 sq. yds. of new blocks and about 1,200 ft. of curbing. Each bid must be accompanied by a certified check for $1,000. Plans may be seen and blank forms of proposal, contract and specifications obtained at the office of Oren E. Parks, Town Engineer.

Michigan.

✣It is reported that the Board of County Commissioners, Menominee, Mich., will receive bids until Feb. 11 for the construction of a new gravel Bayshore road. The work will require about 12,000 cu. yds. of material.

✣Bids will be received until 4 p. m., Feb. 20, by City Council of Ludington, Mich., for the construction of pavement on Madison, Robert and Danaher Sts. Dean Thomson is City Clerk

A bill has been introduced in the Senate at Lansing, Mich., calling for an appropriation of $50,000 to build a state road from Seney to Grand Marais.

Estimates have been sent to the City Council of Detroit, Mich., for paving work to be done at an estimated cost of $122,688. The estimates include Medina curbing on all the jobs, which are as follows: Beaufait, Kercheval to Mack, $24,816; Willis, Russell to Chene, $21,000; Berlin, Mt. Elliot to boule-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

yard, $17,1[illegible]; Missouri, Grand River to Mc Graw, $9,120; Dearborn, R. R. to Fort, $11,-664; Des [illegible] to Ferndale, $13,464, and [illegible] to Mack, $[illegible].

Minnesota.

✣Bids will be received until [illegible] p. m., March 13, by C. E. Pannell, County Auditor, Worthington, Minn., for the grading of county roads. [illegible] 10,000 yds. of material.

Citizens of Mower County at a recent meeting held in Austin, Minn., organized the Mower County Good Roads Association to urge the construction of good roads in the county. John M. Christgau is President and E. H. Smith of Austin is Secretary.

The Clay County Commissioners, Moorhead, Minn., have ordered the establishment of the fifth state road. This road runs north from Dilworth near the John Lyman place, turning at a point seven miles north and running along ditch No. 25, and terminating at a point northwest of Averill.

A number of Hubbard County farmers living within 10 miles of Cass Lake, Minn., recently attended a meeting at the Commercial Club in that city and requested the co-operation of the Cass Lake business men in getting a road laid out which would make it much more convenient for them to reach town.

Missouri.

Residents on the Bolivar road north of the North Campbell township line, according to advices from Springfield, Mo., have asked the commissioners to macadamize the road for at least three-quarters of a mile.

The City Council of Kansas City, Mo., has passed ordinances to open and establish an extension of Rockhill Road from 55th to 63d Sts., and Ward Blvd., from Mill Creek Parkway [illegible].

Nebraska.

The City Council of Hastings, Neb., has sold bonds to the amount of $50,000 for the purpose of creating paving district in Denver Av.

⦿The Board of Park Commissioners of Omaha, Neb., has awarded the contract for furnishing stone for macadamizing boulevards in 1911 to Hugh Murphy. The amount bid upon was 5,186 cu. yds. of 2-in. stone, 2,442 cu. yds. of 1-in. stone and 802 yds. of stone chips. The bid was $1.58 per ton on 2-in. stone and $1.63 per ton on 1-in. stone and $1.73 per ton on stone chips.

New Jersey.

✣Bids will be received until 8:30 p. m., Feb. 15, by City Council of Elizabeth, N. J., for the [illegible] of pavement on a portion of a number of streets.

⦿Edward English, Englewood, N. J., has been awarded the contract by the Alpine Borough Council, Mahler Bldg., Alpine, N. J., for the construction of a stone road in the Borough of Alpine, N. J., known as Sylvan Ave., Southern Section Blvd., extending from the north line, Borough of Tenafly, to the southern line of lands of McNeil Alpine, a distance of 2,570 ft., for $7,144. The work includes bituminous bound macadam, including all rock excavation, etc.; complete length of road 2,570 ft. Bids were opened Jan. 21.

The Borough of Alpine, N. J., has just let a half mile of macadam road on the top of the Palisades and contemplates the construction of an approximate two additional miles, thus completing a continuous macadam road from the 130th St. ferry, N. Y. C., along the top of the Palisades to the New York City line, from which point is expected that the New York state will connect up with their road No. 11. Watson C. Clark, 30 Church St., New York City, is consulting engineer for Alpine.

New York.

✣Bids will be received until 2 p. m., March 1, by Constructing Quartermaster, Madison Barracks, Sackets Harbor, N. Y., for the con- [illegible]

✣[illegible] Feb. 29, by Lieut. E. H. Wagner, Constructing Quartermaster, Fort Niagara, N. Y., for constructing concrete walks, macadamized and clay roads at Fort Niagara.

✣Bids will be received until 11 a. m., Feb. 15, by Alfred E. Steers, President of the Borough of Brooklyn, Room 2, Borough Hall, Brooklyn, New York City, for 19 contracts for paving, grading and curbing streets and furnishing material for roads, the largest being No. 18, for furnishing and delivering 200,-000 gals. of tar road oil. Oil delivered by rail to be delivered at the following railroad points: East New York, Vanderveer Park, Parkville, Coney Island, 60th St. and 15th Av.; Bay Ridge, Bushwick and Canarsie. Oil delivered by boat to be delivered at the following docks: 69th St., Henjes, Sempkens or at Coney Island. The time for the delivery of the articles, materials and supplies will be on or before Nov. 1, 1911. The amount of security required is $3,800.

✣Bids will be received until 10:30 a. m., Feb. 20, by the Board of County Supervisors, at Mineola, N. Y., for the improvement of the Hempstead and Babylon turnpike running in a northwesterly direction from the Merrick road near Merrick to the Nassau turnpike at Roosevelt and Centennial Ave., running in a westerly direction from the Nassau turnpike at Roosevelt to the Grand Avenue road, in which is included a jog at Woodside Ave. of a distance respectively of 13,750 ft. and 6,900 ft., in accordance with the plans and specifications of William H. Seaman, C. E., County Superintendent of Highways, on file with the clerk of the Board of Supervisors of county.

Senator Murtaugh of Elmira, N. Y., has introduced a bill in the Senate, Albany, calling for an appropriation of $1,000,000 from the highway fund in order to construct 90 miles of macadam road from Geneva, southward to Binghampton.

The Village Engineer of Lestershire, N. Y., has submitted his estimate of the cost of paving Main St., to the board of trustees. It is probable that the work will be advertised and the contract let within a few weeks.

Senator John F. Murtaugh of Elmira, N. Y., has introduced a bill in the Senate at Albany providing for the construction of a road to traverse the southern tier of New York state. The road is planned to connect the central route stretching from Buffalo to Albany with Elmira and other important points along the southern tier. According to the plans the road would join the central route in Geneva and run south from there through Watkins, Montour Falls, Dundee, through Elmira and to Waverly through Tioga county, joining the line at Broome County connecting with the State road to New York.

North Carolina.

The U. S. Department of Agriculture has sent C. C. Ahles, road engineer, to Wadesboro, N. C., to make an inspection of the Charlotte-Wilmington highway preparatory to building the road.

North Dakota.

Property owners in the Third and Fourth Wards of Fargo, N. Dak., at a recent meeting, declared themselves in favor of repaving the streets of the two wards.

Ohio.

✣Bids will be received until Feb. 20, by County Auditor, Defiance, O., for the improvement of 1½ miles of road at an estimated cost of [illegible].

✣Bids will be received until noon, Feb. 8, by Director of Public Service, Cincinnati, O., for the furnishing of necessary labor and material for the improvement of McAlpin Ave. from a point 172 ft. more or less east of Lafayette Ave., to a point 352 ft. east of Lafayette Ave., by grading, laying cement combined curb and gutter, constructing concrete retaining wall, drains and inlets. John J. Wenner is Clerk.

✣Bids will be received until noon, Feb. 8, by Director of Public Service, Cincinnati, O., for furnishing 400 tons of refined asphalt for the use of the street and sewer repair department to be delivered f. o. b. municipal asphalt plant switch, Cincinnati, O. John J. Wenner is Clerk.

✣Bids will be received until noon, Feb. 16, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for the improvement of Midland Ave. from Sunset Ave. to Rosemont Ave., by grading, setting cement combined curb and gutter, macadamizing the roadway with special binder and finishing course and constructing the necessary retaining wall. Plans and specifications may be obtained of the Chief Engineer of Department of Public Service. J. J. Wenner is Clerk. Each bid must be accompanied by a certified check for $500.

✣Bids will be received until noon, Feb. 24, by Board of County Commissioners, Cincinnati, O., for the improvement of Loveland and Madeira Road from corporation line of Loveland to the Miami River bridge in Symmes township, under specifications No. 159. Fred Dreihs is Clerk.

✣Bids will be received until noon, Feb. 10, by Director of Public Service, A. B. Lea, Cleveland, O., for grading, draining, curbing, paving and improving the park driveways along the southerly boundary of Wade Park and a roadway through University Circle. Plans and specifications are on file at the office of the Park Department, 214 City Hall.

⦿The County Commissioners at Cincinnati, O., have awarded the contract for the improvement of the Dayton pike from Sharonville to the Butler County line to W. P. Flynn for $8,570.

The County Commissioners at Steubenville, O., have been petitioned for the construction of a state air road in Island Creek Top, beginning at Center Chapel church and running to intersect the Richmond and Wintersville Pike.

The city of Cleveland, O., contemplates paving 95 city streets, covering in all about 15 miles, this year. The larger paving jobs include stretches of Bolivar and Jennings roads and West 117th St. The total cost will be about $504,000.

⦿H. B. Stephens has been awarded the contract for the construction of the mile of pike on the Urbana pike for $7,364 by the County Commissioners at Urbana, O. Goshen township and Union will continue the rebuilding beginning just east of George Willett's and running west about one-half mile.

Oklahoma.

✣Bids will be received until 5 p. m., Feb. 13, by Bob Parman, City Clerk, Oklahoma City, Okla., for grading and constructing sheet asphalt on Exchange Ave., from Pennsylvania Ave. to Kentucky Ave.; double driveway, each to be 25 ft. wide; 5-inch concrete base, 6x18-in. concrete curb and 3-ft. vitrified brick gutter; also for grading Markwell and College Sts., from Cottonwood to Catalpa Ave.; Avenue C, from Higgins to Blackwelder Ave.; Broadway, from Avenue E to Avenue G; Avenue F, from Robinson Ave. to Shield's Blvd.; Columbus Ave., from Avenue E to Avenue G; Shield's Blvd., from Avenue B to Avenue G, etc.

Oregon.

Louis C. Kelsey, 404-5 Selling Bldg., Portland, Ore., has been retained by the city of Hillsboro, Ore., to design and supervise the construction of proposed street pavements and storm and sanitary sewerage systems.

It is reported that macadam road is to be built from Silverton to Marquam at an estimated cost of $4,000 per mile. Salem is the county seat of Marion County.

The Commercial Club of Myrtle Creek, Ore., has appointed a committee consisting of R. Fate, J. R. Franklin and Dr. R. F. Smick to confer with the Roseburg and Medford Commercial clubs regarding the proposed state roads from Roseburg to Crater Lake and from Medford to Crater Lake. These clubs will present a joint petition to the state legislature for an appropriation this season.

The County Commissioners at Portland, Ore., have been petitioned for the macadamizing of the Columbia Blvd., for a distance of three and one-half miles, and for the opening of St. Johns. Data on the cost is being prepared, and if it is finally decided to improve the highway, work will begin as early in the spring as possible. It is estimated that the work will cost $3,800 per mile.

Pennsylvania.

✣Bids will be received until noon, Feb. 10, Wilkesbarre, Pa., for the improvement of various streets by grading, paving and curbing. F. Gates is City Clerk.

✣Bids will be received until 5 p. m., Feb. 13 by City Clerk, Erie, Pa., for the construction of pavement on a portion of West 20th St.

Texas.

✣Bids will be received until 11 a. m., Feb. 10, by T. E. Ramsey, County Auditor, San Antonio, Texas, for graveling 2½ miles of the Bandera Road.

•Ocklander Bros., [illegible] have been awarded the contract for the construction of Hassam concrete paving and curb and gutter in the city of Hillsboro, Tex., for $1.85 per sq. yd. Bids were opened Jan. 24. E. L. Dalton of Dallas, Tex., is Consulting Engineer.

⊙The County Court at Beaumont, Tex., has awarded Walter A. Myrick the contract for furnishing the county with washed oyster shell at $.75 per cu. yd., f. o. b. at Sabine and at West Port Arthur. The shell will be used to complete the county's system of good roads.

⊙The City Commissioners of Dallas, Tex., have approved the following contracts: Texas Bitulithic Co., on Grand Ave., between Ervay and Holmes; Haskell Ave., between Ross Ave. and the Texas and Pacific tracks, and Holmes St., between Grand and Pennsylvania Aves.; D. J. Grigsby on Griffin St., between Cochran St. and Pacific Ave.; Elm St., between Ervay St. and the Houston & Texas Central Ry.; Market St., between Jackson St. and Pacific Ave.

The Municipal Commissioners of Dallas, Tex., have adopted resolutions ordering the paving of Ross Ave., from Lamar to Austin; Austin from Pacific to Ross, or Carondelet, the same street with names confused in that section; Ross from Garrett eastward to the city limits, and Houston from Main to Elm. On the last named bids will be received on several sorts of paving used in the city. For the East Ross Ave. work the engineer's estimate of the cost is as follows: For bitulithic paving, $19,805; brick, $24,050.

The County Court at Beaumont, Tex., has sold bonds in the sum of $75,000 for the construction of good roads.

The Dallas Automobile Club of Dallas, Tex., is urging the improvement of the Fort Worth pike. It is thought that if the club raises $10,000 the county commissioners will donate a like amount, which together with the $10,000 out of the special district fund, would give the necessary $30,000.

The Texas Commercial Secretaries at a recent meeting held in Fort Worth, Tex., decided to raise a fund of $25,000 for the purpose of carrying on the work of improving public highways.

The City Commissioners of Dallas, Tex., have issued orders instructing City Engineer Preston to prepare specifications for grading preparatory to paving the following: Walton St., between Elm St., and Pacific Ave.; Worth St., between Pacific Ave., and Fitzhugh; Pennsylvania Ave., between Holmes St., and Oakland Ave.

The business men of Grand Prairie, Dallas County, Tex., have decided to co-operate with the business men of Dallas in their efforts to put in thorough repairs and make a model highway out of the Dallas-Grand Prairie pike. J. Thomas Owens of Grand Prairie is interested.

The Texas Terra Cotta Tile & Pressed Brick Co. has been incorporated in Texas with a capital stock of $100,000. The company recently purchased large tracts of lands near New Waverly with the purpose of developing. A specialty will be made of paving brick and the plant will have a capacity of 100,000 brick daily. The incorporators are George Gwilt, Milton McConnell of Dallas and Clement Watson of New Waverly. An office will be established in the Carter Bldg., Houston, Tex., by Milton McConnell.

Utah.

Senator Christopher Burton, Jr., of Davis, Utah, has introduced a bill in the senate increasing the annual appropriation for the state road fund from [illegible].

A bill has been introduced in the Senate at Salt Lake City, Utah, calling for an appropriation of $10,000 for improving the state road between Moab, Grand county, and the San Juan river bridge in the San Juan oil fields in San Juan County.

Representative S. S. Sanderson has introduced a bill in the House of Representatives at Salt Lake City, Utah, providing for an appropriation of [illegible] for improving roads and bridges in Sanpete county. The bill provides that 20 per cent of the appropriation shall be used on the Cottonwood Canyon road and that all of the [illegible] the County Commissioners of Sanpete County, Manti, Utah.

Virginia.

The City Council of Portsmouth, Va., has decided upon the specifications for the paving of the streets of the city this year. The council will, within a short time, advertise for bids for the improvement of the thoroughfares.

Washington.

•The [illegible] Lumber Co. has been awarded the contract by the Board of Public Works of Everett, Wash., for furnishing 50,000 ft. of lumber for street work during the year for $12 per M.

•The [illegible] Co. has been awarded the contract by the Board of Public Works of Everett, Wash., for the improvement of Hoyt Ave., from 19th St. to Everett Ave., for $10,945. The proposed improvement district embraces the territory between California St. and 21st St., on Hoyt Ave., an extension of two blocks over the original plans. Between 19th and 21st St. asphalt will be used, the remainder consisting of grading and sidewalking. The contract for the major portion of the work has previously been let.

•The contracts for the grading of the business section of Pasco, Wash., and a part of the residence section has been awarded to Jordan & Wright of Ellensburg for $.38 per cu. yd., and $.01½ for overhaul. The work will be commenced immediately and it is estimated the cost will be about $30,000.

Ranchers of the Winesap settlement, on the Columbia River, south of Chelan, Wash., have organized the Winesap Improvement Association with C. C. Cole as President and A. H. Miller as Secretary. The energies of the association will be directed particularly toward the improvement of public highways.

The Commercial Club of Hoquiam, Wash., L. H. Brewer, President, will probably ask the legislature for the completion of the state road No. 9, from Puget Sound to the sea, in addition to the building of the proposed state highway.

West Virginia.

The City Commissioners of Huntington, W. Va., plan to construct modern roadbeds on a number of streets of the city at an estimated cost of $170,000 [illegible].

Wisconsin.

Advices from Mehan, Wis., state that a special election was held Jan. 31 to vote on the question of appropriating $3,000 to macadamize [illegible]

BRIDGES—STEEL AND CONCRETE

Alabama.

It has been announced in Birmingham, Ala., that the American Bridge Co., a subsidiary corporation of the United States Steel Corporation, will build a million dollar plant near Corey, on the outskirts of Birmingham. The plant will be completed before the finish of the Panama Canal, and will give employment to over a thousand men.

California.

✣Bids will be received [illegible] 6, by County Clerk, Los Angeles, Cal., for the construction of concrete arches, graveled approaches, curbs, fences, hand railings, pylons, etc., across Arroyo Seco and the extension of Pasadena Ave.

The Southern Pacific Ry., according to advices from Oroville, Cal., has started reconstructing and raising its bridges across the low country in the vicinity of Honcut. When this work is completed the quarter of a million dollars' worth of improvements made on the Oroville-Marysville branch will be completed and the stretch of track will be as mod- [illegible]

Idaho.

Advices from Boise, Idaho, state that three state bridge bills were passed in the state senate. The principal bridge is to be built at a cost of $25,000 across the Snake River between Canyon County, Idaho, and Malheur County, Oregon, within a half mile of Payette. The others are a $10,000 bridge across the Salmon River in Custer County and a $15,000 bridge across the Snake River near Glenn's Ferry. The first named bridge was mentioned in our last issue.

Illinois.

At a meeting of the Board of Supervisors, Watseka, Ill., it was decided to construct a new bridge north of Mike Hodel farm in Pigeon Grove township, in the near future.

Advices from Basco, Ill., state that a new bridge will be constructed across Slater Creek south of that town in the early spring.

Plans and specifications have been received by the city of Batavia, Ill., for the construction of the proposed new Wilson St. concrete [illegible] will be called about Feb. 11 to vote on issuing bonds amounting to the estimated cost of the work. The plans and specifications for the new bridge call for a reinforced concrete structure to be 60 ft. wide, the width of Wilson St., with two 8-ft. sidewalks included. The bridge will have two arches and three spans, one 80 ft. long in the center and two 60 ft. long at the ends. The bridge will measure [illegible] approaches. The total estimated cost will be [illegible]

Indiana.

[illegible] apolis, Ind., has awarded the contract for the construction of the concrete bridge over the canal at College Ave. to Volpp & Fritz at $6,417. As planned the structure will have a 30-ft. roadway.

Iowa.

•Advices from Traer, Ia., state that the contract for the construction of county bridges in Grundy County was awarded to L. F. Volberding.

✣ indicates work now open for bids. • indicates a contract let recently.

[illegible] Ia., is to the effect that surveyors are at work locating a new steel bridge to be constructed across [illegible] Creek.

Steps [illegible] taken by [illegible] Muscatine, Ia., to secure the construction of a new bridge across Mad Creek. Nothing definite [illegible].

Kansas.

⊙J. J. Cox of Lawrence, Kan., has been awarded the contract by the County Commissioners at Lawrence, for removing and erecting and furnishing a certain amount of new material for a bridge for $1,749. Bids were opened Jan. 28 by W. R. Green, County Clerk.

Advices from Medicine Lodge, in Barber County, Kan., state that a concrete bridge over Spring Creek in that county recently collapsed and will be rebuilt shortly.

The Kansas City Terminal Ry. Co. has submitted plans to the commissioners of Kansas City, Kan., for raising the Kaw River bridge and the railroad tracks approaching it to conform to the height of the levee now building for flood protection. According to the drainage board's engineers the terminal company's bridge is to be raised about 5 ft. and its length increased to cover the 734-ft. channel. To provide suitable grades for the approaching tracks a change of the grades of the streets for a distance of about 1,000 ft. is necessary. The principal streets affected are Shawnee and Osage avenues and Adams, Baird and Brent streets, over which the terminal company operates a network of tracks leading to the industries in Armourdale.

Kentucky.

Plans and specifications are being prepared by the city engineer, Louisville, Ky., for the construction of a bridge over Beargrass Creek at Logan St., to cost $15,000. The structure will be of reinforced concrete and it is hoped by the Board of Public Works to have the contract let in time to have it completed by August 1.

Massachusetts.

At a recent meeting of the city officials of Lynn, Mass., and the officials of the Boston & Maine R. R. Co. the former promised to so change the plans that a ballasted bridge will be swung across the square, constructed in such a way that the noise of moving trains will be reduced to a minimum.

Michigan.

A resolution has been introduced into the Common Council of Saginaw, Mich., providing that the city engineer prepare estimates for the construction of a new bridge at Johnson St. to replace the old structure, which is at present closed to traffic.

Minnesota.

✣Bids will be received until 2 p. m., Feb. 20, by Board of County Commissioners, Hallock, Minn., for the construction of three steel bridges, 22 large culverts and 17 small culverts.

Missouri.

⊙The Board of Public Works, Kansas City, Mo., awarded the contract for the construction of the reinforced concrete bridge over the Blue River at 15th St. to the William P. Carmichael Co., St. Louis, Mo., at $60,318. The other bidders on this contract were: S. M. Kerns, Kansas City and Denver, $66,510; Freeborn Engineering & Construction Co., $66,893.70; Kansas City Bridge Co., $84,926; Midland Bridge Co., $91,114.50; and the A. M. Blodgett Construction C., $98,150. Waddell & Harington, Leslie-Orear Bldg., Kansas City, Mo., are engineers. Bids were opened January 30.

H. P. Thompson & Co., San Antonio, Texas, at $14,056, were the lowest bidders Jan. 30 for the construction of the 100 ft. reinforced concrete bridge over Brush Creek at Cleveland Ave., Kansas City, Mo. Other bidders for the work were: Midland Bridge Co., $15,658; W. P. Carmichael Co., $18,114.50; L. Crosby & Son, $21,031.85; A. M. Blodgett Construction Co., $19,904.40; and the Missouri Valley Bridge Co., $21,300.50.

Nebraska.

✣Bids will be received until Feb. 13 by Board of Supervisors of Kearney County, Neb., at Minden, Neb., for the construction of all bridges of wood or steel to be built by the county during the year of 1911. J. H. Jensen is county clerk. All bids must be accompanied by a certified check for $200.

New Jersey.

At a meeting of the committee on roads and assessments of the Board of Freeholders recently at Newark, N. J., Mayor Ernest C. Hinck, Montclair, N. J., urged that they take favorable action toward assisting the Lackawanna Railroad Co. to construct the proposed viaduct across Bloomfield Ave. in Montclair. It was announced that the company would pay $45,000 toward the cost of the improvement if the city and county will assume the remaining $25,000.

New York.

✣Bids will be received until 11 a. m., March 2, by James F. Loughran, County Superintendent of Highways, Kingston, N. Y., for building a steel bridge across the Rondout Creek, at Eddyville, in the County of Ulster, N. Y., and the removal of the present metal structure and enlargement of the present piers and abutments. Each bidder must accompany his bid with a certified check for $1,500 payable to the County Treasurer.

Residents of the Ninth Ward, Schenectady, N. Y., are strongly in favor of the proposition to have constructed a bridge over Cotton Factory Hollow and the matter will be taken up by the city council.

North Dakota.

✣Bids will be received until 3 p. m., Feb. 23, by Board of County Commissioners, Traill County, at Hillsboro, N. Dak., for the construction and material of steel, wooden and concrete bridges to be built and bridge repairing to be done during the year of 1911. Nels O. Lindoas is County Auditor.

⊙Commissioners of Clay County, Moorhead, N. Dak., have awarded the contract for the construction of two culverts to Jardine & Anderson, Fargo, N. Dak.

The Fargo-Moorhead Street Railway Co. is contemplating the construction of a new bridge across the Red River from Fargo, N. Dak., to the east side. It is said that plans for the work have been prepared and that bids will be asked as soon as a bill authorizing the improvement is passed by the House Committee on Commerce.

Ohio.

✣Bids will be received until noon, Feb. 13, by the Board of County Commissioners, Washington C. H., O., according to reports, for the construction of the superstructure of two steel bridges, one over the east fork of Paint Creek and one over Rattlesnake Creek. E. A. Henkle is Auditor of Fayette County.

✣Bids will be received until Feb. 23, it is reported, by County Commissioners, Columbus, O., for the following bridge work in Franklin County; construction of new floors on the Weisheimer and Lockbourne bridge; construction of the west approach to the Lockbourne bridge, two culverts, a new floor system on the Dublin bridge; for grading and graveling a portion of the Bixby Road.

⊙Board of County Commissioners, Akron, O., has awarded the contract for the construction of the Hawk bridge over the canal near Clinton to the Central Concrete & Construction Co., Canton, O., at $1.079. Other bidders were the Home Engineering Company, at $1.187; the E. J. Landor Company, at $1,100; the Crogan Construction Company, at $1,304.82, and the Berger Iron Company, at $1,237.

⊙County Commissioners, Akron, O., have awarded the contract to the Home Engineering Co., for the Thornton St. bridge, which is to be floored with 3 or 4-in. creosote blocks at $1.127 or $1,170, respectively. Other bidders for this job were the Crogan Construction Company, with a bid of $1,215; the E. J. Landor Company, with a bid of $1,182.50; the Central Construction Company, at $1,200; the Berger Iron Company, at $1,176.70, and the O. B. France Company, at $1,138.80.

⊙According to advices from Jefferson, O., commissioners of Ashtabula County have awarded the contract for the construction of the superstructure of the steel bridge over Grand River in Orwell township to the Riverside Bridge Co. at $4,820. Other bidders bid as follows: The King Bridge Co., $5,024.09; Croghan Construction Co., $4,875; Capital Construction Co., $5,119.38; Brookville Bridge Co., $4,868.17; Ortgonia Bridge Co., $5,066.84; Penn Bridge Co., $5,448; Illinois Bridge Co., $7,746.47.

⊙The contract for the construction of the superstructure of the Haulk bridge, one mile north of Clinton, O., in Franklin township, was awarded by the Board of County Commissioners at Akron, O., to the Central Concrete Construction Co., Canton, O., at $1,079. C. L. Wirth is clerk of the commissioners of Summit County.

An ordinance is to be introduced into the city council of Cincinnati, O., for the issuance of $250,000 for the completion of the Gilbert Ave. viaduct. The estimate on the Gilbert Ave. viaduct is $317,000. There is in the fund but $100,000. The land for a right of way has cost about $425,000.

City Council has passed an ordinance appropriating $15,000 for the reconstruction of the Mohawk lift bridge, in Cincinnati, O.

County Commissioners are contemplating the construction of a new bridge over the Licking River to be known as the Keen St. bridge, in the 8th ward, Zanesville, O. The bridge will contain two spans and will be 250 ft. long. It will be built high enough above the high water mark to keep the drift wood from lodging against the floor of it during flood stage of the river.

Advices from Ironton, O., state that director of public service and commissioners of Lawrence County have pronounced the county bridge over Ice Creek leading into Coal Grove unsafe for traffic and steps will be taken immediately toward repairing or reconstructing the bridge. A concrete structure is under consideration.

Board of County Commissioners, according to information received from Amherst, O., has about completed the investigation regarding the necessity of constructing an overhead bridge at Eppley's crossing in that township. Officials of the Lake Shore & Michigan Southern will probably pay a portion of the expense.

City Council of Cincinnati, O., has passed an ordinance authorizing the city and the Pittsburgh, Cincinnati, Chicago & St. Louis Ry. Co. to proceed with the construction of the Rookwood crossing viaduct and subway, which will eliminate the grade crossing of the Pennsylvania tracks over Eastern Ave. The cost of the structural work is estimated at $325,000, while the cost of the property to be acquired will add nearly $300,000 to the amount.

Oklahoma.

⊙The county commissioners of Le Flore County, at Poteau, Okla., recently awarded the contract for the construction of the bridge in District No. 1 to the Missouri Valley Bridge Co. at $9,670. The Kansas City Bridge Co. was awarded bridges in Districts Nos. 2 and 3 at $8,176 and $1,857 respectively.

⊙The contract for the concrete work on the approaches to the proposed $90,000 Rock Island viaduct in Chickasha, Okla., has been awarded to Westlake & Warfield, Chickasha, Okla., at $30,000. Work will be started at once.

A proposition is to be voted upon in Guthrie, Okla., providing for the issuance of $47,000 for the construction of a viaduct on Cleveland Ave. The present plan is for a reinforced concrete viaduct 40 ft. wide and 800 ft. long, with an approach from Cleveland Ave. to Oklahoma Ave., and coming out on 4th St. across the river. The Santa Fe and the street rail-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

way company will probably pay part of expense.

Information from Purcell, Okla., is to the effect that plans are under consideration for combining the cities of Lexington and Purcell, Okla., under the commission form of government, and to bond the city for sufficient money to erect a large steel bridge across the South Canadian River.

Oregon.

A delegation of the Newberg, Ore., Commercial Club recently conferred with the commissioners of Marion County regarding the construction of the proposed new bridge over the Willamette River at that city. The matter will now be placed before the Yamhill County Court.

A resolution introduced into the House of Representatives, Salem, Ore., appropriating $5,000 for an investigation by the state engineer of the feasibility of constructing a bridge across the Columbia River at Portland to connect Oregon and Washington has revived the old project killed at the last session.

Advices from Medford, Ore., state that it is estimated that the reconstruction of the bridge over Bear Creek, near Central Point which was recently destroyed by highwater will require an expenditure of approximately $8,500, $6,000 being for a new structure and $2,500 for the removal of the debris.

Pennsylvania.

✣Bids will be received until 3 p. m., Feb. 27, by Charles Reisfar, Secy., Central Board of Education, Fifth Ave. High School, Pittsburg, Pa., for the erection and completion of the Academic and Schenley District High School building on the site corner Forbes and Boundary Sts. F. J. Osterling, Commonwealth Bldg., is Architect.

At a meeting recently held at Lenape, Pa., which was attended by County Commissioners and officials of the Reading Railway Co., all were in favor of the construction of a new bridge across the Brandywine and Meadow north of the Mill.

Plans and specifications are being prepared by the engineer for the construction of the proposed new bridge across Dry Run in Allentown, Pa., and the matter will probably be submitted to the city council for approval by February meeting.

At a recent meeting of the Board of Viewers of Fayette and Washington Counties, Brownsville, Pa., to select a site for the construction of the joint county bridge over the Monongahela River at that place, it was unanimously decided to recommend the site of the old bridge, which was condemned by the War Department and torn down recently. The report of the viewers to the court will favor that site. The Penn Bridge Company submitted plans showing that a new steel structure can be erected at a cost of $132,000. This, with damages awarded by the board of viewers, will bring the total cost to the two counties up to $112,000.

Plans have been completed for the long proposed Mulberry St. viaduct at Scranton, Pa., and it is believed that bids will be advertised before March 1. An ordinance has been introduced into the city council providing for the issuance of bonds amounting to $150,000 to cover the city's share of the cost. The Scranton Ry. Co. will contribute $90,000 and the Delaware & Hudson Co. $25,000. Director of Public Service, C. V. Terwilliger and W. A. Schunk, Chief Engineer have represented the city in the negotiations. M. W Easby, Philadelphia, Pa., is the architect. The viaduct begins at grade on the westerly side of Mifflin Ave. at the foot of Mulberry St and extends in a northerly direction 1,528 ft to Providence road at its juncture with Carbon St. The structure is to be sixty-three ft. in width.

South Carolina.

✣Bids will be received until noon, Feb. 14, by W S Thomas, Clerk of Board of County Supervisors, Columbia, S C., for galvanized corrugated culverts in carload lots to be used on public highways.

South Dakota.

✣Bids will be received until 7:30 p. m., Feb. 27, by John W. Summers, City Auditor, Yankton, S. Dak., for furnishing all labor and materials connected with constructing and completing ready for travel a steel concrete bridge across the Rhine creek on Walnut St., Yankton, S. D. Bridge to have a clear span of 50 ft. rise of 8 ft. 6 ins., concrete railing, clear roadway of 26 ft. wide; height from bed of creek to arch, 10 ft. 10 ins.; from bed of creek to street grade, 12 ft. 7 ins. Bidders to furnish their own plans and specifications for a bridge designed to carry a 20-ton road roller of 200 lbs. to the square foot. For further information apply to the city engineer. A certified check in the sum of 10 per cent of bid is required, to be returned to unsuccessful bidders immediately on letting contract.

Tennessee.

Plans have been prepared by J. H. Weatherford, City Engineer, Memphis, Tenn., for the construction of a steel and reinforced concrete viaduct at McLemore Ave. over the south yard of the Illinois Central and Yazoo & Mississippi Valley Railroads. According to the plans it is proposed to build a modern steel and reinforced concrete viaduct at least 40 ft. wide, and something like 1,000 ft. long, the idea being to have it extend from Rayburn Blvd., on the [illegible] St. It is to be used by both vehicles and pedestrians. The plans also contemplate a widening of McLemore Ave. to conform to the width of the thoroughfare east of Rayburn Blvd.

Texas.

City Council of Houston, Texas, has passed an ordinance granting the city authority to borrow $500,000 for the building of the Main St. viaduct, connecting the north and south sides of the city.

Utah.

A bill has been introduced into the lower house of representatives, at Salt Lake City, Utah, appropriating $45,000 for the construction of a steel bridge over the Grand River near Moab in Grand County.

Virginia.

✣Bids will be received until noon, Feb. 15 (readvertisement of bids received Jan. 30), by P. St. J. Wilson, State Highway Commissioner, Richmond, Va., for the construction of a bridge over the Meherrin River in Brunswick County, Va., near Hilton.

✣Bids will be received until noon, Feb. 9, by Clerk of Highland County, Monterey, Va., for the construction of a 74 ft. bridge, either of steel or concrete. Plans and specifications may be seen at the office of the Clerk or at the office of P. St. J. Wilson, Richmond, Va., State Highway Commissioner.

The State Corporation Commission, Richmond, Va., has issued a charter to the Southhampton Bridge Corporation for the erection of a private bridge across the James River, three miles west of the city near the grounds of the Virginia Country Club and the proposed site for the new Richmond College The bridge will be 950 ft long and 20 ft. wide, will be of steel and concrete, and will cost from $26,000 to $15,000. The structure will stand 26 ft. above low water, 17 ft. above the riverbank, and may be constructed with a view to the passage of electric cars. The approach from Richmond will be along the river road, beyond Rio Vista. From the Chesterfield side the bridge will connect with roads leading on to Bon Air. The capital stock of the company projecting is placed between $20,000 and $50,000. And inasmuch as the promoters already own all the land necessary for the bridge and its approaches, it is not necessary to make it a public service corporation. It will be a private bridge company and enjoy the right to collect tolls Thomas R. Winston is president of the Southampton Bridge Corporation, William T Reed, vice-president, and Oliver J. Sands, secretary and treasurer. These officers, with George C. Gregory and James H. Fraser, are the directors.

An appropriation of $12,000 for bridge purposes has been recommended to the finance committee of the City Council of Richmond, Va., by C. E. Bolling, City Engineer.

Washington.

✣Bids will be received until 2 p. m., Feb. 9, by Board of Public Works, Spokane, Wash., for the construction of a reinforced concrete bridge across Latah Creek at Chestnut St. between 16th Ave. and 18th Ave. J. C. Argall is Sec'y of the Board. Plans and specifications are now on file at the office of the City Engineer.

Work will be started at once by A. Volk, Pullman, Wash., on the proposed new steel bridge over the South Palouse River on Main St., Colfax, Wash.

City Council of Spokane, Wash., has passed ordinances for a bond issue of $415,000 for the construction of two concrete bridges across Hangman Creek, one at 6th Ave. and the other in Stafford's addition. The bonds are to be dated July 1, 1911, and run 20 years and bear interest at 4½ per cent. It has been announced that the county commissioners have pledged $20,000 toward the cost of the Stafford addition structure and it is believed that they will contribute $50,000 or $100,000 for the other structure.

The Joint Road and Bridge Committee of the House and Senate at Olympia, Wash., has agreed to compromise and report in a bill for the purchase of the Wenatchee bridge from the Washington Bridge Co. at $125,000.

The contract for preparing the plans for the new vertical lift bridges over the city water way and Puyallup River, Tacoma, Wash., has been let to Waddell & Harington, Bridge Engineers, Kansas City, Mo

West Virginia.

✣Bids will be received until 8 p. m., Feb. 23, by C. B. Morrison, President Board of Affairs, Parkersburg, W. Va., for furnishing and installing system of plumbing and steam heating and for furnishing and erecting steel standpipe in connection with construction of new water-supply system. Plans and specifications are on file at office of consulting engineer, Samuel M. Gray, 930 Banigan Bldg., Providence, R. I., or at office of Water Works Commission, Union Trust Bldg., Parkersburg. Frank Good is City Auditor.

The Baltimore & Ohio R. R. Co. has asked permission from the War Department of the United States to construct a double track railroad bridge over the Monongahela River at Gaston Junction near Fairmont, W. Va. It is believed, if the city does not object that the new structure will be built on the piers of the old bridge

Wisconsin.

•[illegible] Superior, Wis., has awarded the contract for the construction of the steel bridge across the Nemadji River between Sections 33 and 34, in Range 18, Township 14, near Boylston, on the new short road to Black River Falls, to the Hennipin Bridge Co., Minneapolis, Minn., at $2,450. The Minneapolis Bridge & Iron Co., bid $2,935 for the work.

At an adjourned meeting of the County Board of Commissioners, Washburn, Wis., it was voted to appropriate the sum of $14,000 for the purpose of paying one-half of the expense of the building of a steel bridge over Iron River in the town of Orienta The work will be done in the spring.

City Council of Chetek, Wis., has given notice that a special election will be held about Feb 10, to vote on the proposition of issuing bonds in the sum of $6,000 for the construction of a bridge across one arm of Lake Chetek.

Plans and specifications are complete for the construction of a new concrete bridge over the Kinnickinnic River at Chicago St., Milwaukee, Wis

✣ indicates work now open for bids. •' indicates a contract let recently.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Illinois.

✣Bids will be received until 2 p. m., Feb. 18, by Drainage Commissioners of Mint Creek Drainage District, Newton, Ill., for the construction of the ditches in Mint Creek Drainage District. The work to be done consists of excavating about three and one-half miles of open ditches, 4 to [illegible] ft. wide at the bottom, 16 to 24 ft. wide at the top, and 5 to 9 ft. deep, estimated at [illegible] cu. yds. of excavating. The location of this work is two miles west of Falmouth, the nearest station, on the I. C. R. R. and seven miles northwest of Newton, the nearest station with livery facilities, and the county seat of Jasper county, Ill. Each bid must be accompanied by a certified check for $500, made payable to J. H. Isley, treasurer. For further information address S. A. Connor & Son, Engineers, Newton, Ill.

✣Bids will be received until 2 p. m., Feb. 11, by County Surveyor, Greenfield, Ind., for the construction of a ditch in Hancock County. C. L. Scott is Drainage Commissioner.

✣Bids will be received until 2 p. m., Feb. 11, by County Surveyor, Greenfield, Ind., for the construction of a drainage ditch in Hancock County. Wright [illegible] is Drainage Commissioner.

Kansas.

Mulvill Bros., Alton, Ill., have been working 50 teams on a 2-mile levee contract at Lane, Kan., for the Bigger Land Co. Work on this contract was started Jan. 1.

Louisiana.

Surveys have been completed by Gervais Lombard of the State Board of Engineers, New Orleans, La., for levee and riverside work near Alexandria which will extend up Bayou Rapides as far as the Armstrong plantation. The line of old levee from the Iron Mountain Railroad crossing to the D. W. Hymsen place will also be raised. The Bayou Rapides job will contain about 60,000 cu. yds. Contracts are also to be let shortly for the Hatch levee along the right bank of Red River. Frank M. Kerr, New Orleans, La., is Chief Engineer.

Michigan.

Hearing was held at Merrill on Feb. 6 to determine on the construction of a drain traversing the townships of Wheeler, Gratiot County; Jonesfield, Richland and Tittabawassee, Saginaw County, and Ingersoll, Midland County. Leonard Alger, Saginaw West Side, Mich., is County Drain Commissioner.

Minnesota.

⦿The Commissioners of Clay County have awarded the contract for constructing ditches Nos. 25 and 26 to Swanson Bros., Moorhead, Minn., at 10.8 cts. and 11.2 cts. per cu. yd. The total length of the ditches is about 11 miles.

⦿O. B. Olson, 1618 Fourth Ave., Minneapolis, Minn., has been awarded the contract at $11,173 for constructing County Ditch No. 8 in Isanti County, Minn. The work includes 112,659 cu. yds. excavation, 12 acres of clearing, two new bridges and three old bridges. Bids were opened Jan. 27, by G. C. Smith, County Auditor, Cambridge, Minn.

⦿The LaCrosse Dredging Co., LaCrosse, Wis., has been awarded the contract for dredging Lake Catherine for the city of Minneapolis. The work includes dredging the lake, building driveway, filling marshes, etc., and involves 900,000 cu. yds. of earth excavation.

Mississippi.

⦿Bids were opened Feb. 1, by the Board of Mississippi Levee Commissioners at Greenville, Miss., for the enlargement of levees involving the moving of 672,000 cu. yds. of dirt. Roach & Stansell, Memphis, Tenn., secured all of the work. The Miles Place enlargement, [illegible] yds. of work was let at 15 cts. per cu. yd. This is just below Rosedale. The Huntington Short Line enlargement, 15 miles north of Greenville, was awarded at 30.2 cts. per cu. yd. There is about 500,000 yds. in this work. The Refuge enlargement, 12 miles below Greenville, with 130,000 yds. was awarded at 21 cts. per yard.

Ohio.

Consulting Engineer John W. Hill, Cincinnati, O., has submitted his report to the City Council of Hamilton on the apportionment of the cost of the proposed city levee from Old River to Lindenwald. The cost is estimated at about $246,400, which is to be distributed as follows: County, $42,106; railroad, $7,532; private property, $26,069, and the city of Hamilton, $169,691. The city will vote at the next election on issuing bonds for its share of the cost.

Oregon.

✣Bids are being asked by the U. S. Reclamation Service, Klamath Falls, Ore., until March 10, for digging a canal ⅞ mile in length, requiring about 35,000 cu. yds. of earth excavation. The work for most of the remaining canal work for this portion of the Lost River diversion portion of the Klamath Reclamation project is being done by W. H. Mason, of Klamath Falls, Ore.; George C. Clark, Everett, Wash., has the contract for the dam and is preparing to begin work.

Memphis and Vicinity.

(REGULAR CORRESPONDENCE.)

Price & Ingram of Murfreesboro, Ky., were awarded the grading contract for the new union station being erected in Memphis. It is understood that their price is 30 cts. per cubic yard. The dirt will be hauled four miles and spread with an air operated machine. According to the terms of contract the work must be completed by May 1. About 150,000 cu. yds. of material is involved.

Roach & Stansell have finished their Hickman, Ky., levee contract, which was the building of an embankment around the city of Hickman for protection from the yearly floods of the Mississippi. The contract being an emergency one, the contractors deemed it best to place an unusually large force on the job, and as a result the work was finished almost a month before contract time.

Sam Bush has completed his contract at Cresno, Mo., and is on the lookout for some good railroad contracts. For the past two weeks Sam has been scouting in Texas, but to date has found nothing to his liking.

P. McCadden passed through Memphis last Friday with his large outfit en route to Tyler, Mo., where he has taken a large United States government contract. Pat has 29 of the best looking teams one ever saw and knows how to get out of them the stuff that makes the owner money.

Lowrance Brothers are about to finish their Sunflower contract and no doubt will concentrate the majority of their forces on the large Upper Tensas contract which they are building for the government near Arkansas City.

C. C. Aderholdt wants to sub some grader work in order that his large forces may not have to go idle this winter. Charlie is a hustler and hates to let any weeds grow under his outfit.

Martin Jennings will finish the Friars Point job in about 90 days and will then be in the market for new work. Martin has a particularly fine outfit and he handles it to good advantage.

Big Bob Leonard has just returned from his Texas levee job and is pleased with the progress his sub-contractors are making along the Brazos River. Bob was one of the interested contractors in the Greenville letting on the 1st

As I told, a Mississippi board levee letting always interests the southern levee builders. This is mainly because the board has always a large amount of work to bid on each letting and also because the work brings top notch prices. Then too the Mississippi levee board work has no eight hour restrictions like the United States work has; this is a big factor in favor of the interest which the board always draws to its lettings. So therefore the letting at Greenville of Feb. 1 was no exception to the rule. All the old time contractors were present and many new comers in the business were there too. Charlie Lowrance wore a broad smile of confidence, while Mike Roach laughed and chaffed the bunch present. Big Bob Leonard wanted to bet odds on certain firms, while L. C. Dulaney was certain his bunch would carry off the honors. Helgason Brothers had come up from Vicksburg to take a hand in the fun and were not backward in their assertions that the contract was practically in their pocket. And so the good feeling ran high when Bill Shackelford, the chief engineer of the board, in all his bigness and good humor announced the result, which showed that Roach & Stansell had secured all the work by a very slight margin. The letting was one of the closest ever held by the Board and the result was in doubt until a very careful tabulation had been made of the bids.

Capt. Clarke S. Smith of the Memphis district has just returned from an inspection trip to his Vicksburg office. The captain, as usual, is kept on the go all the time and spends about eight or ten days of the month at his headquarters.

J. W. Williams has finished all his city work and is patiently awaiting the new work which City Engineer Weatherford promises to local contractors within a short while. Williams' last job was the Carolina street subway.

L. C. Dulaney of Grace, Miss., has taken 130,000 cu. yds. of work from Roach & Stansell out of the last batch secured by the latter firm in Greenville. L. C. will move his own outfit on the work, together with that of Contractor Foote.

Helgason Brothers of Vicksburg, Miss., are reported to have taken 42,000 yards of work from Roach & Stansell out of the Greenville letting on the first of the month, and the same report says the boys will move their outfits from Vicksburg to the new job about the 15th of February.

Chris Collins has moved his outfit to Clarkedale, Ark., where he has tackled a large piece of government levee work. Chris was in charge of the outfit that was detailed to finish the Huntington Short Line near Rex, Miss.

Big Bill Stephenson is laid up at Clay, Tex., waiting for some new work which he can place his outfit on. Bill has been building part of the Brazos River levee for Roach & Stansell.

A. D. Montgomery of this city, who has taken part of Bob Leonard's big levee in Texas, reports excellent progress and hopes to complete his work within sixty days.

The Western Wheel Scraper Co. of Aurora, Ill., will shortly elect a man to fill the vacancy of general manager, caused by the former occupant, Mr. Babb, being elected president of the company. The southern contractors have little doubts but what J. A. Cordeal of St. Louis will be elected to fill the vacant position, as Cordeal has had much to do with making the Western Wheeled Co. what it is in the south. Joe Cordeal, as he is familiarly called by all the contractors in tsi section, has been a friend indeed to the movers of dirt whom he came in contact with. Some of the levee men will today never write the home office of the large scraper company regarding their troubles and grievances, but will first go to Joe and pour out their woes, being sure that

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

he will help them in some way. Report goes that the southern construction firms as a whole have petitioned the board of directors to elect J. A. Cordeal as general manager and no doubt he will be.

The N., C. & St. L. has advertised for bids on the construction of three miles of new work near Hickman, Ky. About 60,000 cu. yds of material is involved. Hunter McDonald is chief engineer at Nashville, Tenn. The work must be started at once and finished within three months of date of contract. The proportion of loose and solid rock is not given.

Roach & Manigan, who were awarded 214,000 sq. yds. of asphalt in Fort Worth and 6,000 sq. yds. of the same pavement in New Orleans, are busily engaged on both pieces. New Orleans, being a rush job, must be completed by the 15th of February, while the Fort Worth contract calls for completing by the 30th of December. Jim Hamilton is in charge at Fort Worth, while Bob Colglazier holds the reins at New Orleans. Ed Manigan travels to both places and [illegible] what's being done.

Texas.

✣Bids will be received until [illegible] p. m., March 2, by the [illegible] of Washington County Improvement District No. [illegible] J. J. Buchanan, chairman, at the office of the County Judge, Court House, Brenham, Tex., for the construction of about 10 miles of levees and the installation of floodgates in the Brazos Bottom in Washington County. A bond issue of $57,000 has been voted. J. M. Howe, 722 First National Bank Bldg., Houston, Tex., is the engineer, and Flint McGregor, Chappel Hill, Tex., is assistant engineer. Official advertisement will be found elsewhere in this issue.

Washington.

The Crate Irrigation & Power Co., Goldendale, Wash., has assigned its contracts for the Carp Lake reservoir site and water rights on Mill Creek and other streams to L. T. Gillett of California, who [illegible] reservoir near Carp Lake, and it is announced that $125,000 will be expended on an irrigation project. C. T. Camplan, cashier of the State Bank of Goldendale, represents Mr. Gillett. The project will be completed [illegible]

Wyoming.

A [illegible] contract is reported to have been entered into with the State of Wyoming by an English syndicate of capitalists, headed by George E. Roberts of Chicago, Ill., director of the mint, to take over the Wyoming Central Irrigation project and complete the same. Several years ago Chicago parties contracted to rent about 250,000 acres of land on the ceded portion of the Wind River Indian reservation, but after constructing one main canal failed to complete the project. The new company is given until June 30 to close the final contract.

Canada.

•Janse, McDonnell & Co., have been awarded the contract for the excavation work and Walker, Fisher & Co., the contract for the concrete work, for the new dam to be built on the Bow River at Bassano, Alberta, for the Canadian Pacific Ry. The water of the dam will be used in connection with the irrigation plans of the company, and an additional 500,000 acres will be brought under the working of the system.

WATER-WORKS

Alabama.

The City Council of Gadsden, Ala., will endeavor to raise several thousand dollars to complete the new municipal water works plant. The original appropriation made by the city for the work through a bond issue was $57,000.

Arkansas.

Plans have been prepared for the construction of a new water works system for the town of Blythville, Ark., estimated to cost $60,000. The work will include about 8 miles of pipe, one 75,000-gal. tank on 125-ft. tower, 50,000-gal. tank on 50-ft. tower, and gasoline and coal oil pumping apparatus. The supply will be secured from deep wells. J. E. Thompson of Blythville has charge of the work.

The city of Conway, Ark., has sold bonds to the Southern Trust Co., of Little Rock to the amount of $68,000 for the construction of a water works system. The contract for the system was recently awarded to Joseph McCoppen of Little Rock, Ark., who will begin work on the system at once. It is planned to construct the pumping station, which is to be located on Cadron creek, six miles west of Conway, first. The pumps are to be driven by motors supplied with current from the city light plant and the transmission line for the electricity will also be constructed before excavating is done.

California.

•The City Trustees of Brawlay, Cal., have made a formal offer to the Brawlay Water Co., of $5,000 for the pipe system, meters and all rights to city parks claimed by the water company. The city is to install its own water system and would take over the private system as part of the new plan. The George A. Rogers Co., of Los Angeles, Cal., has been awarded the contract for installing the new water system for $28,200.

The city of Susanville, Cal., contemplates installing or purchasing a water system for the city.

Officials of the People's Water Co., of Oakland, Cal., are considering the proposition of raising the dam at Lake Chabot in order that water that is now going to waste may be saved. The lake now contains 5,500,000,000 gals. of water and by raising the dam the capacity will be increased to 11,000,000,000 gals.

Georgia.

✣Bids will be received until Feb. 15, it is reported, by the city of Gainesville, Ga., for improvements to the sewer and water works systems, estimated to require an expenditure of [illegible] J. W[illegible]

✣Bids will be received until Feb. 15 by the city of Doerun, Ga., for the construction of a water works plant in that place. The cost of the work is estimated at about $7,000. James Dowling is mayor.

✣Bids will be received until [illegible] Feb. 23, by P. B. Trammel, mayor, and city council of Dalton, Ga., for furnishing material and doing the construction work for the enlargement of the city water works and electric systems and for the construction of the water works pumping station and electrical plant at Dalton, Ga., as follows: For furnishing approximately 225 tons 10, 8 and 6 in. cast iron pipe and approximately 7 tons of special castings; 8 fire hydrants, 26 valves and 15 valve boxes; 1 [illegible] water heater; 2 turbine pumps with direct connected induction motors; 2 compound condensing engines with condensers; 2 150 k. w. a. c. generators with 5 panel switchboard; 1 35 arc regulator; and for laying pipe and taking up old pipe, building reinforced concrete reservoirs and filter, building power house and pumping station, erecting machinery, furnishing material and doing electrical construction work. Plans and specifications may be seen at the offices of the engineers or the office of the city clerk at Dalton, Ga., and specifications can be obtained by writing the engineer, Box 27 [illegible] Engineering Co., is engineer. Box 582, Savannah, Ga.; Box 576, Atlanta, Ga.

Illinois.

✣Bids will be received until 8 p. m., Feb. 28, by George H. Klehm, President Board of Trustees of the Village of Niles Center, Ill., for the construction of a water works, including the necessary buildings, machinery, tower, reservoir, etc., and also including the boring and drilling of a deep well for water supply. Plans and specifications may be obtained of the village clerk or E. A. Rossiter, County Surveyor, Court House, Chicago, Ill.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, city of Chicago, Rooom 705, City Hall, until 11 a. m., February 11, 1911, for furnishing and delivering 2 motor driven centrifugal pumping units; each shall comprise a horizontal shaft, single staged pump, directly connected to an alternating current motor by a flexible coupling, both mounted on the same substantial sub base, all designed for permanence and con[illegible] shall be capable of delivering continuously at the rate of discharge of 20 million gallons or more per 24 hours under a total suction and discharge head of 115 ft. Each pump shall be of the single stage horizontal shaft centrifugal type, with single main suction and discharge pipe connections not less than 24 ins. in diameter, the impeller to be properly balanced against the end thrust. The motor shall be of the synchronous type, designed to operate on three phase, 60 cycles, 440 volts, and designed to start without the use of auxiliary motive power. Besides furnishing pumps and motors the contractor shall furnish, deliver and erect in connection with same the following: bed plates, starting apparatus, switchboard and equipment thereof, exciters, transformers to step down the current from 12,000 volts to 440 volts required at motor terminals, make the necessary connections between the service lines, transformers and switchboard and between the switchboard and the motors, all necessary suction and discharge pipes, etc., as shown on plans and specifications on file at the office of the Commissioner of Public Works. This is the second request for bids.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, city of Chicago, Rooom 705, City Hall, until 11 a. m., February 14, 1911, for furnishing and delivering one open feed water heater and purifier for the Roseland pumping station boilers, 104th St. and C. & W. I. R. R. Prospective bidders must state in their bid name and type of heater proposed, thickness of main plates, kind of material used for all main parts, weight of apparatus, area of pans, dimensions of apparatus, net steam capacity, net water capacity, area and depth of settling basins, area and thickness of filter or size and type of special filter, dimension of chemical tank and nature and location of oil separating device. The heater shall be an open feed water heater capable of heating to 206° and purifying feed water for a rated total of 1,000 boiler horse power or 30,000 lbs. of water per hour, receiving condenser water at 105° and 5 per cent of the total water from drips, etc., at 206° F. Full specifications of dimensions, chemical tank, test, etc., may be had upon application to the Commissioner of Public Works.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, city of Chicago, Room 705, City Hall, until 11 a. m., February 11, 1911, for furnishing and delivering 50,000 lbs. No. 1 red scrap brass to the water works shops, 2301 S. Ashland Ave. All brass accepted under these specifications shall be No. 1 red scrap brass, free from iron, nickel, etc., and must be in crucible shape or size not to exceed 8 ins. in width, 10 ins. in

✣ indicates work now open for bids. (•) indicates a contract let recently.

length and not over 8 ins. thick. Full specification may be had upon application to the Commissioner of Public Works.

⊙The Cook County Board of Commissioners has awarded the contract for furnishing one patent vertical artesian well pumping engine (size 8x36 in. stroke), to be equipped with one pint oil pump and drip valves; also one 5½x36 all brass patented double acting well pump with ¼ in. wall, cylinder, of 100 gallons of water per minute capacity, with 175 ft. of 3 in. standard pipe, 150 ft. of 1½ in. extra heavy pipe for pump rods. Contract price, $600. W. B. Erb & Co., 405 S. Clinton St.

Following is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, city of Chicago, for furnishing and delivering to the various pumping stations 40,000 lbs. No. 1 cotton waste. Crerar-Adams Co., 301 E. Erie St. 10¼ cts. per lb. Detailed specifications in ENGINEERING CONTRACTING Jan. 25

The United States Cast Iron Pipe & Foundry Co., the Rookery, Chicago, Ill., has submitted the low bid to B. J. Mullaney, Commissioner of Public works, city of Chicago, for furnishing and delivering cast iron pipe, to be delivered to the various jobs throughout the city, at a price of $23.75 per ton. The contract consists of 2,300 tons of 36 in. pipe and 1,000 tons of 30 in. pipe.

Plans are being worked out by the management of the Rock Island Plow Co., Moline, Ill., for the laying of pipe to every department of the plant so that artesian water can be supplied. A well is being sunk to a depth of between 800 and 1,000 ft. for this purpose.

The Finance Committee of the City Council of Chicago, Ill., has favorably passed upon an appropriation of $152,556 as asked for by the department of public works for making a pitometer waterway survey of the city. The plan provides for a waterway survey of the city in 40-acre tracts, which will later be surveyed by blocks. B. J. Mullaney is chairman of the Board of Public Works.

Iowa.

The City Council of Marshalltown, Ia., has authorized the mayor to advertise for bids for machinery necessary to install a water power plant at the city pumping station, with the view of utilizing the power of the Iowa River as far as possible. Prof. B. J. Lambert of the state university has prepared the plans which the bids will be called for.

Maryland.

Alfred M. Quick, engineer, Baltimore, Md., is preparing plans for the construction of a dam and filter plant for the city of Baltimore. The estimated cost is between $1,000,000 and $1,500,000. Gunpowder River will be the source of supply. Contracts will be let about April.

Minnesota.

✣Bids will be received until 7:30 p. m., Feb. 10, by Henry N. Knott, City Clerk, Minneapolis, Minn., for furnishing the city with cast iron pipe, hydrants, valves, special castings for water main construction.

Mississippi.

It is planned to extend the water works system of St. Joseph, Minn., at an estimated cost of $2,500. Samuel S. Chute of St. Cloud, Minn., is engineer.

The City Council of Vicksburg, Miss., has adopted a motion favoring the purchase of the Vicksburg Water Works plant

Missouri.

✣Bids will be received until 8 p. m., March 1, by H. C. Hester, city clerk, for the construction of a water supply system at Chaffe, Mo. M. S. Murray, Sikeston, Mo., is engineer.

Montana.

The Libby Waterworks Electric Light & Power Co., of Libby, Mont., will take up the matter of completing the water and light systems in that city as soon as conditions in the spring are favorable. Mayor Thomas Switzer has been informed that the plans for completing the work have all been perfected. The company will install a new water system and complete the electric light and power systems.

Nebraska.

The Town Council of Chappell, Neb., has called a special election for the purpose of voting bonds for a water system and an electric light plant.

North Dakota.

The City of Mandan, N. Dak., plans improvements in the water works system for the early spring, which will cost about $65,000.

Ohio.

✣Bids will be received until noon, Feb. 14, by Director of Public Service, Columbus, O., for furnishing and delivering chemicals for the water department, the contract including: Item 1, lime, 1,400 tons; item 2, soda ash, 800 tons; item 3, sulphate of alumina, 300 tons. David A. Jones is Clerk of the Director.

⊙The Board of Control of Youngstown, O., has let the following contracts for water supply requirements: Water meters, size used in residences, H. R. Worthington Co., New York, $6.60 each. Water pipes and pipe specials, United States Cast Iron Pipe and Foundry Co., 600 tons of pipe at $21.70 a ton. Valves, Darling Valve and Manufacturing Co., 6-in. valves, $10.40 each. Corporation cocks, ⅝ in., Monarch Brass Co., 55 cents each. Hydrants, R. D. Wood Co., $24 each. Curb boxes, ⅝ in., Farnan Brass Co., $265 each. Valve boxes, Morgan Manufacturing Co., $2.75 each. Lead, 25 tons, Wilkins-Leonard Hardware Co., $4.60 a hundred lbs. Hauling pipe and specials, W. S. Dennison, $1.08 a ton. Alum for the year 1911, 90 cts. 100 lbs. in bags, Central Chemical Co. Asphalt cement, 50 tons, The Texas Co., $21.90 a ton.

The Board of Control of Elyria, O., has secured the services of the Aetna Engineering Co., 125 LaSalle St., Chicago, Ill., to look over the waterworks situation.

Plans have been prepared for the installation of a new waterworks system for the city of Niles, O. The estimated cost of the plant is about $40,000.

Engineer B. F. Hewitt of Geneva, O., has submitted his plans for the construction of a waterworks and sewer system to the city council of Chadron, O. The plans provide for the laying of the water and sewer pipes in one trench. The proposition will be submitted to the voters shortly.

Service Director Ray Harbert of Canton, O., has asked the city council for permission to advertise for bids for the purchase of a new street flusher, an auto truck for the water works department, etc.

Akron, O., hydraulic engineers are making surveys preliminary to submitting plans for the construction of reservoirs for a city water supply, subject to the electors of Akron voting a bond issue necessary to carry out the project should the plans be adopted. E. G. Bradburg, Columbus, O., is consulting engineer for the city.

Oklahoma.

Plans have been prepared for the County Commissioners at Tulsa, Okla., for the independent water system to be installed in the new court house at 6th and Boulder Sts.

The City Council of Muskogee, Okla., has adopted the plans and specifications submitted by Dr. Alexander Potter, 114 Liberty St., New York City, for the enlargement of the local water system. The plans embrace also an enlargement of the sewage disposal plant and the garbage disposal plant. A special election will be called to vote bonds for the improvements.

Oregon.

⊙The Water Commissioners of Astoria, Ore., have awarded a contract to Palmberg & Matson for rebuilding 7½ miles of the wooden portion of the 18-in. main conduit leading from Bear Creek to the large reservoir, bids for which were opened Jan. 25. The contract price is approximately $68,117. The pipe is to be built of redwood staves, and the work must be completed on or before Sept. 1.

The citizens of Hood River, Ore., at an election held in that city recently voted against the proposition of buying the local water plant for $39,500.

Pennsylvania.

The Water Commission of Harrisburg, Pa., plans to start work on the construction of the new 1,000,000-gal. reservoir as soon as possible in the spring.

Tennessee.

The city of Marysville, Tenn., contemplates constructing a waterworks and sewer system. In order to construct the waterworks a pipe line some six miles in length would have to be built.

The Memphis Artesian Water Department, Memphis, Tenn., has asked the Board of City Commissioners for permission to sell the $100,000 issue of water bonds. It is said that the money will be expended for improvements.

Texas.

E. B. Blatnon of Gainesville, Tex., has purchased the $150,000 bond issue of that city which was voted on Jan. 10 with which to purchase the local water plant. The City Council plans to begin the improvement at once. A stand pipe will be built and the water mains extended to every part of the city.

A number of citizens of Greenville, Tex., have declared in favor of taking the recent issue of $50,000 in bonds for the waterworks and going east of the city four or five miles to sink a well and pipe it into the city reservoirs.

The Water Commissioners of Temple, Tex., have adopted plans for a $30,000 filtration system and will ask for bids for construction of same, the capacity to be 2,000,000 gals. per day.

The Attorney General's Department, Austin, Tex., has approved an issue of $15,000 city of Sherman street improvement bonds and an issue of $11,500 waterworks bonds of the same city.

Utah.

The City Engineering Department, Ogden, Utah, has begun a survey of the new conduit line from Cold Water canyon. It is expected that enough water can be obtained in Cold Water canyon to fill the old reservoir provided the new conduit can be completed by the middle of June, when the river will be at a high stage. The department proposes to connect the new main with the old where the two meet in Ogden canyon. Bids for the construction of the conduit will be solicited immediately.

Representative B. D. Harshberger of San Juan County, Utah, has introduced a bill into the house of representatives for the purpose of appropriating $15,000 to be expended by the State Board of Land Commissioners in sinking wells to procure subterranean waters in dry farming localities.

Virginia.

⊙Harrison Bros. & Co., have been awarded the contract by the water department of Norfolk, Va., for supplying that department with alum for the next 12 months for $1.13¼ per 100 lbs. f. o. b. at Denny's station.

In a special election held at Lexington, Va., Jan. 31, a bond issue for $75,000 was carried for additional water supply for the town. The plan suggested is to get an abundance of soft water for the town and bring it by gravity from the mountains, a distance of 11 miles.

Washington.

⊙The Board of Public Works of Spokane, Wash., has awarded the contract for furnishing a new unit for the up-river pumping station, to be installed by April 1 and to cost $12,000, to the Allis-Chalmers Co., of Milwaukee, Wis. The new pump will complete the four units of the new station. Each unit can pump 12,500,000 gals. per day.

The City Council of Racine, Wash., will shortly, it is said, demand municipal ownership of the local waterworks system. The plant is owned by the American Filter Works

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

& Guaranty Co., of Pittsburg, Pa. The company recently offered to sell its plant to the city for $1,000,000.

The City Council of Elma, Wash., is investigating the possible routes for a water main from Wenzel Springs, southwest of town, which will be used in bettering the supply of water for the city.

The City Council of Pasco, Wash., has passed an ordinance providing that the matter of purchasing a 500-acre water right from the Pasco Reclamation Co., for domestic and irrigation uses by the city, shall be submitted to a vote of the people at a special election on Feb. 27. The contract calls for the payment of $50,000 for this 500-acre right and an annual maintenance fee of $.35 per acre inch, or $7.10 for the full 24-in.

West Virginia.

For the purpose of supplying Benwood, McMechen and other towns with water, a charter has been issued to the Benwood & McMechen Consolidated Water Co., of Benwood, W. Va., with a capital stock of $200,000. The incorporators are: E. Gates and G. Gelwocks of Steelton, Pa.; W. Dale Sheafer, F. W. Kending and N. J. Happle of Mechanicsburg, Pa.

Canada.

✣Bids will be received until 4 p. m., Feb. 14, by chairman of the Water Works Committee, Ottawa, Ont., for furnishing and delivering brass work, special pipe, castings, hydrants, c. i. pipe, lead pipe and pig lead, valves, oil or grease. N. J. Kerr is city engineer.

The City Engineer of St. Boniface, Can., will prepare plans and estimates of cost for the construction of a 1,000,000-gal. reservoir for the city.

SEWERAGE AND GARBAGE DISPOSAL

California.

⊙The City Trustees of Modesto, Cal., received bids Jan. 25 for the construction of a sewer system as follows: F. C. McIntyre of Stockton, sewers only, $26,209; C. D. Vincent, sewers and tank, $45,983; J. C. Armstrong, tank only, $2,980; Wm. Heafy, tank and sewers, $30,184; W. H. Howell, manholes only, $2,740; Healy-Tibbitts Co., outfall and main sewer, $24,900; Arthur Bent, tank and sewers, $44,640; William Vesler, tank and sewers, $46,867; A. L. Chambers, tank and sewers, $36,123; Bishop & Stevens, sewers only, $23,728, awarded contract for outfall sewer and main sewers. J. C. Armstrong was awarded the contract for the construction of the liquifying tank. The Stanislaus Lumber Co. was awarded the contract for furnishing cement for $2.70 per bbl. in carload lots.

Colorado.

It is stated that bids for the construction of sewers in the district of Park Hill, Denver, will be re-advertised. The work was originally awarded to the Municipal Construction Co., for $17,596, but owing to a clerical error the specifications only called for 65 manholes and 25 flush tanks instead of 90 manholes and 50 flush tanks. Henry Read is President Board of Public Works, of, Denver.

Improvements costing between $25,000 and $30,000, to consist largely of sewers, will be made the next few weeks by the Colorado Springs Co., in Prospect Lake, East End and Cheyenne additions, according to advices from Colorado Springs, Colo.

Georgia.

✣It is reported that the City Council of Atlanta, Ga., will receive bids until March 14, for the construction of the intercepting sewer and disposal plant on Intrenchment creek. R. M. Clayton is Chief of Construction.

The city of Atlanta, Ga., contemplates laying about 50 miles of new sewers during the year. Two new system are planned for the Ninth ward; one for the Tenth ward, and one for the Seventh ward, and one for the Fifth. The total cost will be from $250,000 to $300,000. The new sewers will require three pumping stations, one in the Ninth ward and two in the Tenth. Capt. R. M. Clayton is Chief Engineer of construction

Illinois.

✣Bids will be received until 2:30 p. m., Feb. 23, by Granville Jenkins, Chairman, Sewer Committee, Paris, Ill., for furnishing and laying approximately 710 ft. of 36-in. and 3,834 ft. of 60-in. reinforced concrete or brick sewer. The average cut will be 7 ft. Plans and specifications may be obtained of C. P. Lycan, City Engineer.

The Board of Local Improvements of Chicago, Ill., Chas. A. V. Standish, Sec'y, plans to expend $770,000 on two sewers in the southwest section of the city. Work will be commenced as soon as the city council passes the special assessment ordinances. One sewer will be built in South Albany Ave., from the river to West 30th St., to cost $470,000, and the other will traverse the district between South Central Park Ave., and South 40th Ave., between West Madison and West 26th Sts., and will cost $300,000.

City Engineer Myron Tarble of Aurora, Ill., has completed plans for the two new sewer districts, to be known as District No. 7 and the Pigeon Hill sewers. It is probable that work will be started within 60 days.

Indiana.

A special election was held in Danville, Ind., Feb. 2, to vote on the proposition of issuing bonds for the installation of a sewer system. The estimated cost of the improvement is $25,000

City Engineer Wm. S. Moore of South Bend, Ind., is preparing plans and specifications for the construction of the Bowman and Michigan St. sewers. These improvements call for an expenditure of about $150,000 and will drain Center township and part of Green township.

Iowa.

⊙The City Council of Sioux City, Ia., has awarded the contract for furnishing two carloads of 2-in. service pipe to the Crane Co., for $11.37 per 100 ft.

The City Council of Sioux City, Ia., has adopted a resolution proposing the construction of a sanitary sewer on Hawthorn St., from 29th St., to 30th St.

The City Council of Manning, Ia., has under consideration a proposition to put in a sewer system. A committee of the council recently visited Carroll to investigate the new system in that city.

The City Engineer of Waterloo, Ia., has been instructed to prepare plans and specifications of the cost and nature of construction of the Virden creek storm or dry run sewer in the Third ward of the city. The sewer will be 6 to 10 ft. in diameter. It is planned to run the sewer from 4th St., in North Waterloo to Park road where an outlet is afforded into a slough of the Cedar River, about or nearly a mile in length. The old creek will be leveled up thus doing away with the necessity of constructing 13 bridges at a cost of about $1,000 each

The citizens of Westfield, Ia., contemplate the installation of a septic sewage system.

The City Council of Indianola, Ia., has voted to install during the coming summer between four and five miles of sewer at an estimated cost of $40,000. The proposed work will be mostly in the northern part of the town. The city is also contemplating paving two miles of streets

Kentucky.

⊙The Contract Committee of the Board of Aldermen of Louisville, Ky., has approved of the contract awarded to C. T. McCracken & Co., by the Board of Public Works for the reconstruction of the Preston St. sewer in Preston St., from Fulton St. to a point 60 ft. south of Water St., at a cost of $30,000.

⊙James Ferry & Son of Pittsburg, Pa., have been awarded the contract by the sewerage commission of Louisville, Ky., for the construction of what is known as the Second St. sewer. The system, according to the specifications, will extend from Burnett Ave., straight out S[illegible] distance of 2,430 ft. The improvement will cost approximately $30,000.

Maryland.

✣Bids will be received until 11 a. m., Feb. 23, by Board of Awards, Baltimore, Md., for the construction of trunk sewers in Pratt, Green, Baltimore and Pearl Sts. The work includes the following approximate quantities: 44 lin. ft. 30-in. diameter brick and concrete sewer; 5,050 lin. ft. terra cotta pipe sewer, 12-in. to 24-in. diam.; 3,800 lin. ft. 6-in. house connections and standpipes; 4,100 lin. ft. excavation in tunnel. Plans are on file in the office of Mr. Calvin W. Hendrick, Chief Engineer of the Sewerage Commission. Specifications and plans can be obtained upon application at the office of the Sewerage Commission, Room 904, American Building, Baltimore, Md. A charge of $5 will be made for each specification and blueprint. A certified check of the bidder for the amount of $2,500, on a clearing house bank, made payable to the order of the Mayor and City Council of Baltimore, will be required to be deposited with each bid.

Plans have been prepared by Clyde Potts, 30 Church St., New York City, for the construction of several miles of sewers and two disposal works for the city of Easton, Md., estimated to cost $43,000. The contract for the work will be let about March 15. M. M. Higgins is Mayor.

Residents of Baltimore suburban towns have appealed to the State Board of Health to take steps looking to the establishment of a sewerage system in those towns. The main villages which are interested in the subject are Arlington, Pimlico and Denmore Park. An improvement association will be formed, and it is proposed to request the State Board of Health to assist in keeping the localities as sanitary as possible. Dr. Marshall L. Price is secretary of the board.

Massachusetts.

Information received from Fitchburg, Mass., is to the effect that Timothy J. Sheehan, City Engineer, has recommended to the city council the installation of a trunk sewer system, estimated to cost $1,000,000.

Minnesota.

✣Bids will be received until 2 p. m., Feb. 16, by Board of Public Works, St. Paul, Minn., for the construction of a sewer on Otis Ave., from Somerville St. to Como and River Boulevard, thence on the boulevard, to the Mississippi River. R. L. Gorman is Clerk of the Board.

✣Bids will be received until 7:30 p. m., Feb. 10, by H. N. Knott, City Clerk, Minneapolis, Minn., for furnishing sewer brick, special castings, vitrified clay pipe for sewer construction in Minneapolis.

It is planned to construct pipe sewers in St. Cloud, Minn. Additional sewers and water extensions are also contemplated. Samuel S. Chute is City Engineer

New Jersey.

Lawyer Ralph Kellum, solicitor for the Collingswood, N. J., Board of Health, has applied to Vice Chancellor Leaming for an injunction restraining the Collingswood Sewerage Co.

[illegible] the operation of its disposal plant on the ground that it is a public nuisance.

New York.

✣[illegible] Richmond, New York City, for furnishing all the labor and materials required for the construction of a sanitary sewer trunk line from the pierhead line at the foot of Nicholas Ave. [illegible] Road, and from that point to the New York City Farm Colony Road, at its intersection with the Fort Richmond Road, for the exclusive use of the institutions of the Department [illegible] comprising sewers in Nicholas Ave., from the pierhead line to Hatfield Pl.; Hatfield Pl., [illegible] Ave., from [illegible] Ave. to a point about 160 ft. easterly therefrom, together with all work incidental thereto. The Engineer's estimate of the quantity and quality of the material, and the nature and extent, as near as possible, of the work required, is as follows: [illegible] sewer [illegible] diameter, all complete, as per section on plan of the work; 337 lin. ft. of c. i. pipe sewer, of 16 ins. interior diameter, not less than 135 lbs. per ft., furnished, laid and calked, all complete, as per section on plan of the work; 15 manholes, complete, as per section on plan of the work; 500 lin. ft. of piles, furnished, [illegible] ft. (B. M.) of foundation timber and planking, in place and secured; [illegible] ft. (B. M.) of sheeting retained, 15 cu. yds. of concrete, in place; 2 cu. yds. of brick masonry; 550 cu. yds. of riprap, in place; 120 cu. yds. of riprap, taken up from old crib and placed in the new foundation; 100 cu. yds. of additional excavation; 20 cu. yds. of additional filling; 500 lbs. of additional reinforcing metal, equal and similar to No. 4 and 10, expanded metal, furnished and placed; 200 lbs. of additional reinforcing metal equal and similar to corrugated or deformed steel rods, furnished and placed; 36 sq. ft. of sidewalk relaid; 60 sq. yds. of gutter relaid; 10 lin. ft. of curb reset; 100 sq. yds. of macadam pavement, restored; 20 sq. yds. of granite block pavement on concrete foundation relaid; 1,000 ft. (B. M.) of yellow pine guard rails and clamps, furnished and placed including fastenings, as per section on the plan of the work; 800 cu. ft. of rock-filled crib in place and secured, including anchor piles, as per section on the plan of the work; 80 cu. yds. of steam cinders, furnished and placed. The time for the completion of the work and the full performance of the contract is 150 days. The amount of security required is $9,000. The contracts must be bid for separately, and the bids will be compared and the contract awarded at a lump or aggregate sum for each contract.

✣Bids will be received until 4 p. m., Feb. 9, by W. Armstrong, Clerk, Yorkville, N. Y., for the construction of a system of sanitary sewers including disposal plant for that village to include 19,000 lin. ft. of sewer 8 to 15-in., disposal plant, 33 manholes, 10 flush tanks. A certified check for $500 must be filed with each bid. Plans and specifications can be seen at the residence of M. C. Copeland, Yorkville, N. Y., or at the office of W. G. Stone, engineer, 9 Mann Building, Utica, N. Y., from either of whom plans, specifications and bidding sheet can be obtained. Specifications and bidding sheet furnished and mailed free of cost. Plans, $2.50 per set.

⦿Chas. T. Hookway, 557 Lancaster Ave., Syracuse, N. Y., has been awarded the contract by the Intercepting Sewer Board of that city for the improvement of Harbor Brook and the construction of the Harbor Brook intercepting sewer system under contract No. 10 for $101,014. The work includes the improvement of Harbor Brook south of the present culvert under Erie Canal and the construction of the Harbor Brook intercepting sewer south of the Erie Canal. Bids were opened Jan. 26. [illegible] Board.

⦿The Intercepting Sewer Board of Syracuse, N. Y., received bids Jan. 26 for the construction of two sections of the Harbor brook intercepting sewer and has awarded the contract to the John Young Contracting Co., for the northern section for $88,121, and to Charles T. Hookway for the southern section for $101,014. The northern section is for the intercepting sewer from the Erie canal along the brook to Hiawatha Ave., and then direct to Onondaga creek. At that point the completed system provides for connection with the main intercepting sewer along Onondaga creek. The southern section of the improvement is for the sewer from the Erie canal along the brook to Holden St., near the city limits. The other bids received on the northern section were: C. T. Hookway, $92,216; Gaffey & Byrnes, $99,594, and the Ryan & Reilly Co., of Philadelphia, Pa., $112,928. Bids received on the southern section were: The Young Contracting Co., $103,238; Samuel Bonn, $109,147 and Ryan & Reilly, $141,282. The contracts cover the third largest part of the general intercepting sewer improvement to be undertaken at the present time. The other two contracts were for deepening and laying a concrete bottom in Onondaga creek and the Onondaga creek intercepting sewer, both of which are under way.

North Carolina.

⦿Abec & Hart of Hickory, N. C., have been awarded the contract for the construction of storm and sanitary sewers in Timmonsville, S. C., for $14,185. The work includes 3,250 ft. of 30-in. terra cotta sewer, 1,000 ft. of 24-in. terra cotta sewer, 1,550 ft. of 18-in. terra cotta sewer, 500 ft. of 15-in. terra cotta sewer and 2,050 ft. of 12-in. terra cotta sewer, 20 manholes, 16 catchbasins and 3 6-in. siphons. J. Newton Johnston of Florence, S. C., is Engineer. Bids were opened Feb. 2.

Plans have been prepared by Hazelhurst & Anderson of Wilmington, N. C., for the installation of an entire new sewer system for that city estimated to cost $[illegible]. The contract for the work will be let as soon as the board of health passes upon the plans. The water and sewage commission of Wilmington has charge of the work.

Ohio.

✣Bids will be received until noon, Feb. 28, by H. H. Canfield, Clerk, Village of Cleveland Heights, O., at the town hall of the village or 309 Beckman Bldg., Cleveland, O., for furnishing the material and labor necessary for the improvement of part of Mayfield District No. 1 by constructing sewers therein. Plans and specifications are on file at the office of the clerk of the F. A. Pease Engineering Co., 931 Williamson Bldg., Cleveland, O.

✣Bids will be received until noon, Feb. 27, by B. M. Cook, Clerk, Village of Lakewood, O., for furnishing labor and material necessary for: first, paving of Summit Ave.; second, constructing sewer main in Riverside Road; third, constructing water main in Franklin Ave.; fourth, repair of brick pavement on Alameda, Cohasset and Clarence Aves. In accordance with the form of contract, plans and specifications on file at the office of the Village Clerk, Lakewood, Ohio, and at the office of the William H. Evers Engineering Co., 332 the Arcade, Cleveland, Ohio.

✣Bids will be received until noon, Feb. 9, by Director of Public Service, Cleveland, O., for the construction of the sewers in the following named streets and avenues, to-wit: Barberton Ave., southwest between West 67th St. and West 61st St. Denison Ave., southwest, between Lorain Ave. and West 98th St. West 65th St., between 350 ft. north of Denison Ave., southwest, and Barberton Ave., southwest. Carr Ave., northeast, between East 93d St. and East 96th St. Castlewood Ave., northeast, between Lakeview Road, northeast and East 125th St. Eddy Road, northeast, between St. Clair Ave., northeast, and Woodside Ave., northeast. East 93rd St., between St. Clair Ave., northeast, and Carr Ave., northeast, and that part of West 25th St. between Trowbridge Ave., southwest, and Bradwell Ave., southwest, with an outlet through Trowbridge Ave., southwest, to West 30th St., which lies between Trowbridge Ave., southwest, and Library Ave., southwest, with an outlet through Trowbridge Ave., southwest to West 30th St.

⦿[illegible] & Randall have been awarded the contract by L. B. Johnston, Director of Public Service, Lorain, O., for the construction of a storm water sewer in that city for $47,365. The work includes 3,900 ft. of brick sewer ranging in size from 42-in. to 78-in. in diameter (tunnel job), and 2,500 ft. of pipe sewer from 12-in. to 24-in. in diameter. Bids were opened Jan. 27.

The Collinwood, O., board of trade has protested against the construction of a sewage disposal plant at the end of the intercepting sewer near White City by the city of Cleveland.

Advices from Ashland, O., state that J. E. Yeagley and others have petitioned the county commissioners, Ashland, for the construction of a storm sewer along an open ditch in the vicinity of Ohio St., and the right of way of the Erie railroad.

The city council of West Lafayette, O., is planning the installation of a drainage sewer system.

The Pleasant Ridge, O., village council has instructed Riggs-Sherman Engineering Co., The Nasby, Toledo, O., to prepare plans and estimates for a general sewage system and disposal plant for the village. It is estimated that the work will cost about $150,000. Work will probably begin about May 1.

The city council of Cleveland, O., recently adopted a resolution to proceed with the construction of the West 25th St. main sewer. The sewer will run from Bradwell Ave. to Trowbridge Ave., and tap the intercepting sewer. The city's share of the cost will be $68,529. Bids for the work will be advertised for at once.

Oklahoma.

The city council of Muskogee, Okla., has adopted the plans and specifications prepared by Alexander Potter, 114 Liberty St., New York City, for increasing the size of the municipal water supply plant, an entire new sewage disposal plant, and a garbage disposal plant, at a total cost of $650,000. An election to issue bonds to cover the amount will be held within 60 days.

The citizens of Duncan, Okla., recently voted the issuance of bonds to the amount of $38,000 for the construction of a sewer system. A survey and plats for the system have already been prepared and as soon as bonds are sold the work will be commenced.

Pennsylvania.

✣It is reported that the city of Williamsport, Pa., will receive bids until Feb. 10 for the construction of the proposed East End sewer. The sewer will be constructed down Penn St., and down the natural bed of Grafius run. Plans were prepared by City Engineer Otto.

The council sub-committee on sewers, Pittsburg, Pa., has selected N. S. Sprague, superintendent of the Bureau of Construction, to make a complete study of the sewage problem in relation to the proposed Greater Pittsburg. Allen Hazen, 103 Park Ave., New York City, consulting engineer for Pittsburg, has been making a study of the Saw Mill Run, the Nine-Mile Run and the city sewage basins.

Representative Keister of Harrisburg, Pa., has introduced a bill into the lower house of the Pennsylvania state legislature carrying an appropriation of $250,000 for helping cities of the third class in the state in the construction of sewage disposal plants which the state decrees must be built.

The state board of health of Pennsylvania has ordered the town of Latrobe to install a comprehensive sewage system and disposal plant.

The board of public works of Reading, Pa., has recommended that it be allowed $156,126 for the current expenses of the highway department; $86,832 for the sewer department, and $1,300 for the survey department, a total of $244,258. The board has also asked for

$247,800 for the building of all necessary storm water sewers, making a grand total of $492,058.

Residents of Funston Ave., in the West End of Williamsport, Pa., are preparing a petition asking that councils equip that thoroughfare with a storm sewer.

South Carolina.

Civil Engineer T. P. Cothran of Greenwood. S. C., together with N. G. Walker of Rock Hill, S. C., have begun a survey of Rock Hill preliminary to the installation of a sewerage system. The engineers at present are located in the Peoples' National Bank Bldg.

Tennessee.

Alderman J. L. Nelson of the Tenth ward. Knoxville, Tenn., has taken steps to have a committee named to form some feasible plan either by bond issue or special tax levy, to construct a main sewer from the railroad to the river along Hard creek.

Texas.

The city of Vernon, Tex., has sold bonds to the amount of $12,000 to Sutherlain & Co., of Kansas City, Mo., for the construction of sewer extension and water works. Work will begin at once.

The city engineer of San Antonio, Tex., has prepared plans for the construction of 8-in. mains on the following streets in the Sixth Ward sewer district: Nolan, Lamar, Hays, Burnet, Burleson, Sherman and part of Duval, all entering into a main extending between Pine St. and New Braunfels Ave., varying in size between 10, 12 and 15-in.

Nevada.

Civil Engineer [illegible] C. Kelsey, [illegible] Bldg., Salt Lake City, Utah, has submitted his report to the city council of Sparks, Nev., on the proposed sewer system for that city and the same has been adopted by that body and the mayor. In his report the engineer recommends the reconstruction of the sanitary sewerage system at an estimated cost of $33,476. Bonds will be issued and bids will be asked for the construction of the system shortly. Hon. W. J. Stinson is Mayor.

Washington

The City Council of Davenport, Wash., has passed the sewer ordinance and is about to have the bond issue advertised for the construction of a sewer system throughout the main part of the city. It is estimated that the cost will be about $6,000.

Wisconsin.

Residents of the northwestern part of Sheboygan, Wis., have circulated a petition asking for a sewer system in their section of the city.

Canada.

✣Bids will be received until 11 a. m., Feb. 22, by M. Peterson, Secy., Board of Control, Winnipeg, Man., for the construction of a conduit system including the following items. Specification No. 63—Conduit, 1911; Specifications No. 64, Construction of Conduit Runs, 1911. Smith, Kerry & Chace, Carnegie Library, Winnipeg, Man., Engineers.

Preliminary surveys and plans for an addition to the sewer system of Victoria, B. C., are now being prepared by the city engineer's staff. The scheme calls for an expenditure of about $250,000. The area in which the principal extensions will be undertaken is that lying north of Edmonton road and east of Quadra St., an area comprising the whole of the northeastern section of the city, including the Smith's Hill section. A main sewer will be constructed to run southeasterly past the rear of the Isolation hospital and emptying into Oak Bay. Laterals will drain the whole section into this main trunk sewer.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alaska.

The City of Cordova, Alaska, is to have a bill presented in Congress giving it the privilege of issuing 20-year bonds for $25,000 for the purpose of building a city dock.

Arizona.

✣Bids will be received until [illegible] p. m., March 1, by Department of Interior, Office of Indian Affairs, Washington, D. C., for furnishing materials and labor necessary to construct and complete four cottage dormitories and water and sewer system at Colorado River School, Arizona.

California.

A bill has been introduced in the State Senate of California to provide a series of canals along the river valleys of the state, with branches reaching into tributary districts. The canals are to be 75 ft. wide, 12 ft. deep, with locks 300 ft. long and 11 ft. above the sills. The board of engineers is instructed to determine the feasibility of the scheme, and a sum to be determined by the legislature is appropriated for the expense incident to the work. The canal routes outlined are: West of the Sacramento River, from Colusa to Suisun Bay; from Colusa to Red Bluff. In the San Joaquin valley from Bakersfield to Fresno and thence to Stockton, such canal to have nine branches. Boats with cargo capacity of 1,000 tons are contemplated, and the state board of engineers is instructed to report the proper sort of power to be used.

District of Columbia.

✣Bids will be received until Feb. 9, by Lieut. R. G. Alexander, Quartermaster, Washington Barracks, D. C., for repairing roofs, gutters and down spouts of various buildings at Washington Barracks, D. C.

✣Bids will be received until 2:30 p. m., Feb. 16, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 621A, reinforced steel bars, manganese castings, cold chisels, ingot copper hinges, night latches, steam whistles, water coolers, mop handles and crayons.

Illinois.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, City of Chicago, Room 105, City Hall, for furnishing and delivering 200 tons of pig lead to the various pipe yards, located throughout the city. Each bidder must specify method of delivery, by rail or team and guarantee not less than 99.5% lead in each pig. The pigs are to be distinctly marked with the refiners name. Bids to be opened 11 a. m., February 11, 1911. Full specifications may be had upon application to the Commissioner of Public Work.

Following are the low bids submitted to B. J. Mullaney, Commissioner of Public Works, City of Chicago, for furnishing fire brick during the year 1911: Wm. E. Dee & Co., 108 LaSalle St., F. C., $28.00 per thousand; Aetna, $28.00 per thousand; B. & H. or Simpson, $17.00 per thousand; McLoughlin Building Material Co., 145 LaSalle St., Osceola, $32.00 per thousand; N. A. Williams Co., 138 Washington St., Silver Crown, $25.50 per thousand, wire cut, $15.00 per thousand; Chicago Fire Brick Co, 138 Washington St., Lavage, $25.00 per thousand, Indiana wire cut, $17.00 per thousand; Garden City Land Co., 134 Washington St., Tiger Crown, $29.00 per thousand; Crown, No. 1, $27.00 per thousand, Hillsdale wire cut, $17.00 per thousand, Buckeye, $17.00 per thousand.

The Board of Education, City of Chicago, has been recommended to award the contract for school land surveying during the year 1911 to Alexander Page, the present surveyor. Mr. Page's bids (the lowest) were as follows: School site not occupied, $18.00; school sites occupied, $18.00; surveys for condemnation of property, $25.00, all work to include special plats as asked for in specifications.

Following are the low bids submitted to Wm. Carroll, City Electrician, Chicago, Ill., for furnishing the following supplies: 150 gross mica lamp chimneys, $6.51 per gross, Hibbard, Spencer & Bartlett, 1 Wabash Ave.; mantle burners, Peerless Light Co., $0.28 each; 1,500 boxes glass sides, $2.08¾ per box; 600 boxes glass tops, $1.91¾ per box; 50 boxes glass doors, $1.98¾ per box, Sprague, Smith Co., 167 Randolph St.; 120,000 mantles, $0.06¼, [illegible] St. (Detailed specifications published in Engineering-Contracting, Jan. 18, 1911.)

Indiana.

✣Bids will be received until 2 p. m. Feb. 11, [illegible] Township, Miami County, North Grove, Ind., for the construction of a township high school building.

Kansas.

✣Bids will be received until 10 a. m., Feb. 10, by Capt. [illegible] U. S. Military [illegible] Leavenworth, Kan., for furnishing and delivering at the prison, Fort Leavenworth, a small quantity of hardware, lumber, etc.

✣Bids will be received until 10 a. m., Feb. 28, by R. V. Ladow, Superintendent of Prisons, Department of Justice, Washington, D. C., for furnishing and delivering at the United State Penitentiary at Leavenworth, Kan., 5,000 cu. yds. of best Kaw River sand.

◉Capt. F. W. Van Duyne, Quartermaster U. S. Military Prison, Fort Leavenworth, Kan., has awarded the contract for furnishing 826 rods of woven wire field fence to Richards & Conover Hardware Co., of Kansas City, Mo., for $0.35 per rod. Bids were opened Feb. 3.

Louisiana.

The United Fruit Co., New Orleans, La., is planning to extend its sheds over Water St., from Gaiennie to Thalia, and Erato, from Delta to Pilie St., in New Orleans, so as to establish cooling and heating plants in connection with the cars for shipping fruit. The sheds will be 25 ft. high and steel construction will be used, and in connection with these improvements the company will spend about $250,000.

Maine.

✣Bids will be received until noon, March 15, by Lighthouse Inspector, Portland, Me., for furnishing mooring stones for use in the first light house district for the fiscal year ending June 30, 1912.

The Kennebec Dam & Reservoir Co. has applied to the State Legislature for an act of incorporation. The company asks power to construct, maintain and operate dams on the Kennebec River between Indian Pond and the confluence with Dead River, with all necessary appurtenances for developing power and creating water storage. The incorporators named are Henry Harriman, of Newton, Mass.; Malocke G. Chace, of Providence, R. I., and Samuel W. Philbrick, of Skowhegan, Me.

Maryland.

✣Bids will be received until 11 a. m., Feb. 15, by Board of Awards, Baltimore, Md., for furnishing and delivering to the Water Board at its Gay St. yard, Gay and Wolfe Sts., Baltimore, Md., 50 tons, 2,000 lbs. per ton, of Omaha pig lead. Specifications for the lead may be obtained of the Water Engineer, City Hall, Baltimore, Md.

The Raymond Concrete Pile Co. of New York and Chicago has under way the con-

✣ indicates work now open for bids. ◉ indicates a contract let recently.

struction of some reinforced concrete [illegible] bins for blast furnaces that it designed for the Sparrows Point (Md.) plant of the Maryland Steel Co.

Plans have been submitted to the Harbor Board of Baltimore, Md., by its engineer, Oscar Lackey, for the commissioners' [illegible] and recreation pier to be built in East Baltimore. The pier is to be [illegible] ft. wide and 500 ft. long, and will be located between Broadway and Ann St., with the head on Thames St.

Massachusetts.

✣Bids will be received until Feb. 9, by Lieut. George P. Hawes. Jr., Fort Warren, Mass., for delivering at commercial wharf, Boston, Mass., 100 ft. poplar, 500 ft. spruce, 200 ft. white pine, 100 ft. yellow pine flooring and 10 ft. round pine lumber.

Michigan.

✣Bids will be received until 8 p. m., Feb. 24, by Walter S. Conley, Secy., District of Public Schools of Highland Park, Wayne County, Mich., 18 Richton Ave., Highland Park, Mich., for furnishing the necessary labor and material for the erection of school building on Cortland Ave. in said district. Plans and specifications may be seen at the office of Architect, Wells D. Butterfield, 614 Stevens Bldg., Detroit, Mich.

✣Bids are asked until noon, March 1, by Maj. Chas. S. Bromwell, U. S. Engineers. Milwaukee, Wis., for building crib breakwater, crib and pile piers and concrete superstructure at Manistique Harbor, Mich. The work includes the extension of the existing breakwater on the westerly end by the construction of 400 lin. ft., more or less, of timber cribs; the construction of a new west pier, to consist of 480 lin. ft., more or less, of pile pier, and 600 lin. ft., more or less, of timber cribs, all to be capped with concrete superstructure. The approximate quantities include the following:

No. 1 concrete in place	175 cu. yds.
No. 2 concrete in place	2,720 cu. yds.
Round piles	4,650 lin. ft.
Sheet piles	133,000 ft. B. M.
Timber for cribs	781.000 ft. B. M.
Timber for pile pier	45,000 ft. B. M.
Wrought iron or steel drift bolts, and wrought iron or wire spikes	71,500 lbs.
Wrought iron or steel screw bolts and tie-rods	13,650 lbs.
Stone	19,800 tons

City Engineer Cutcheon, of Grand Rapids, Mich., is making estimates for the building of the east side flood wall along Grand River and trunk sewer from the outlet of the Prescott St. sewer to Lyon St. Rough estimates place the cost at about $385,000.

Minnesota.

The Minnesota & Ontario Power Co., Minneapolis, Minn., is planning to build a dam at Kettle Falls to hold the waters of Mamakan Lake in reserve.

The Minneapolis General Electric Co., Minneapolis, owner of the Nevers Dam, a few miles north of Taylor Falls on the Saint Croix River, has applied to Congress for permission to raise that dam 16 ft.

A bill is before Congress granting to J. D. Markham and others of Rush City, Minn., the right to construct a dam across the St. Croix River at a point nine miles above Nevers.

The Carnegie Fuel Co., C. P. White, Minneapolis, Minn., General Manager, is said to be about ready to let contracts for a new coal dock to be erected at West Duluth. The dock is to be of reinforced concrete and steel construction.

A $750,000 steel and concrete power station is to be erected at Minneapolis for the Minneapolis General Electric Co. to replace the structure recently destroyed by fire. Stone & Webster Engineering Corporation, 147 North St., Boston, Mass., are the engineers.

Missouri.

A bill is to be presented to the State Legislature to empower the city of Kansas City to assess railroads on the Missouri side for the cost of turning Turkey Creek through a tunnel into the Kaw River, south of Rosedale, Kan. The improvement will make possible the prevention of floods in Turkey Creek valley.

Montana.

Bids will be received until 11 a. m., Feb. 8, by Lieut. Roy W. Winton, Assistant Quartermaster, Fort Missoula, Mont., for the construction of a hospital of reinforced concrete complete, including plumbing, electric wiring and fixtures.

Nebraska.

✣Bids will be received until Feb. 15, by L. B. Allen, General Superintendent, Chicago, Burlington & Quincy Ry., Lincoln, Neb., for the construction of a two-story frame building (foundation not included), to be used as a passenger station at Holdredge, Neb.

New Hampshire.

✣Bids will be received until 2 p. m., Feb. 25, by Lieut. John Mather, Quartermaster, Fort Constitution, N. H., for constructing ordnance storehouse at that place.

New Mexico.

✣Bids will be received until 11 a. m., March 1, by Quartermaster, Fort Bayard, N. M., for furnishing and installing door and window screens in three double sets of officers' quarters and one field officers' quarters.

New York.

✣Bids will be received until Feb. 12, by Capt. Harrison S. Kerrick, Post Quartermaster, Fort Wadsworth, N. Y., for putting roof on building No. 3, double set officers' quarters. Also for furnishing in connection with above 566 ft. of galvanized iron gravel stop, 320 ft. of galvanized iron for flashing walls and chimneys, galvanized iron for flashing four vent pipes and 16 outlets.

⊙Michael J. Dady, Brooklyn, N. Y., has been awarded the contract by the U. S. War Department for dredging the upper Hudson. The contract price was $3.21 per cu. yd. for rock and 33 cts. per cu. yd. for shoal dredging. The contract amounts to $281,000 and will be started in the spring.

•Bids were received Jan. 11, by Mayor, Chairman of Armory Board, Hall of Records, Chambers and Centre Sts., New York City, for six supply contracts, the largest being Item No. 1, for furnishing labor and material to install carpenter work, hardware dumbwaiter, iron work, tablet picture molding, etc., in the armory of the Second Battery, Franklin Ave., and E. 166th St., Borough of the Bronx, and contracts were let as follows: Louis Wechsler, Item 1, $8.841; Kelly & Keeley, Item 2, $5,880; Van Doan Iron Works, Item 3, $7,477; H. T. Dakin, Item 4, $13,794; D. J. Barry, Item 5, $1,397, and Howard Peterson, Item 6, $2.873.

All bids received Jan. 20 by Gen. M. Gray Zalinski, Deputy Quartermaster, New York, N. Y., Army Bldg., for electric freight and passenger cars were rejected.

Ohio.

✣Bids will be received until 2 p. m., March 7, by Maj. Jervey, U. S. Engineer, Cincinnati, O., for the construction of Middleport ice piers in the Ohio River at Middleport, O.

✣Bids will be received until 7 p. m., Feb. 16, by Board of Trustees, at the office of the Superintendent of the Girls' Industrial Home, Delaware, O., for the necessary labor and material for the construction and completion of an inter-communicative system of telephones for the home. S. D. Webb is Secretary of the Board.

⊙The Schuemann-Jones Co., 738 Prospect Ave., Cleveland, O., has been awarded the contract for furnishing a steam disinfector and installing the same in the tuberculosis sanitarium, infirmary farm, Warrensville, O., for $1,408. Bids were opened Jan. 26, by C. A. Martin, Secy. of the Directors.

•The Union Wire & Iron Co. has been awarded the contract by the Director of Public Service, Cleveland, O., for furnishing wire fence for deer and elk corrals and erecting the same for $1,339. Bids were opened Jan. 30 by Ira O. Hoffman, Secy. of the Director.

A. C. Kuball, Architect, Lincoln Inn Court, Cincinnati, O., is to draw the plans and specifications and superintend the building of the new jail for Hamilton County, O. The estimated cost is $750,000.

Oregon.

✣Bids will be received until Noon, Feb. 23, by County Commissioners at the office of Whidden & Lewis, Architects, 701 Corbett Bldg., Portland, Ore., for furnishing and installing the electric combination and gas fixtures in their rooms and corridors of the east wing of the new courthouse of Multnomah County, Oregon. T. J. Cleeton is County Judge.

Pennsylvania.

⊙The contract for erecting the superstructure of the Vine St. pier for the city of Philadelphia, has been awarded to W. S. Shields at $539,000. In our last issue we stated that the contract for this work had been let to the McClintic-Marshall Construction Co.

⊙The contract for placing Raymond concrete piles for the foundations of a building for the Westinghouse Air Brake Co. at Wilmerding, Pa., has been awarded to the Raymond Concrete Pile Co., of New York and Chicago.

County Consulting Engineer E. M. Bigelow, Pittsburg, and County Road Engineer S. D. Foster, Pittsburg, have recommended to the Allegheny county commissioners the construction of two tunnels to provide a direct thoroughfare from the Union Station to the South 10th St. bridge at Pittsburg for the purpose of relieving traffic congestion in the downtown streets and over the Smithfield St. bridge to the South Side. The plan provides for a tunnel between 2nd Ave. and Forbes St., under Chestnut St., a distance of about 1,300 ft., and another from 5th Ave. to Grand Blvd., a distance of 1,800 ft. Between Forbes St. and 5th Ave. there would be a surface route and all that would be necessary to prepare that portion would be the purchase of a single lot to widen the thoroughfare. The proposed tunnel between 2nd Ave. and Forbes St. would have a grade of about 3 per cent and a much lighter grade between 5th Ave. and Grant Blvd. The cost is estimated at $500,000.

Texas.

⊙J. P. Nelson, San Antonio, Tex., has been awarded the contract for the erection of a modern wharf, warehouses, switches and aprons on Harbor island for the use of the Aransas Pass Channel & Dock Co.

The Texas Co., Port Arthur, is to lay a 6-in. pipe line from its oil well holdings in the Vinton oil field to a point on Sabine River, near Orange, known as Big Eddy. The oil will be piped to that point, where it will be received in barges.

The citizens of Port Arthur, Tex., have raised the $150,000 required for the construction of a pleasure pier in that city. No definite decision has been reached but it is understood that the improvement will include a 2,000-ft. causeway out into the lake with a 700-ft. island at the end. George M. Bliss, Port Arthur, is President of the organization.

Washington.

The construction of a deep sea dock at Bellingham for the joint use of the Pacific American Fisheries and the Bellingham Cannery is under consideration. The project includes the cutting down of a large hill covering an area of 12 acres. O. A. Welsh, of the Bellingham Cannery Co., is interested.

A. J. Stuckey, shipbuilder, Tacoma, Wash., is planning to build a floating drydock at Quartermaster harbor during the present year. The dock will be 250 ft. in length.

Canada.

A stock company is being organized to build and operate a 600 ft. dry dock at Amherstburg, Ont. Among the stockholders are A. H. Clarke, M. P., South Essex; D. H. Terry and Alfred Woods of Albert Woods & Son, Amherstburg, who own a machine shop that has been doing repair work for dredges on the Livingstone Channel.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

NOTICE.

PROPOSAL.

LEVEES.

Chappel Hill, Texas

Sealed proposals will be received by the Commissioners of the Washington County Improvement District No. 1 until 2:30 p. m., on the 2d day of March, 1911, at the office of the County Judge in the Court House at Brenham, Texas, for the construction of about 10 miles of levees and the installation of flood-gates, in the Brazos Bottom in Washington County, Texas. Specifications, profiles, etc., may be obtained from J. M. Howe, Improvement Engineer, 722 First Nat'l Bank Bldg., Houston, Texas. Copies may also be seen at the office of Buchanan & Stone, Brenham, Texas, and at the residence of Commissioner J. F. Buchanan, Chappel Hill, Texas.

Bidders are to take the bonds of the Washington County Improvement District No. 1 in payment. Bond issue $57,000.00.

Each bid must be submitted upon a form furnished by the Improvement Engineer, and must be accompanied by a certified check, payable to J. F. Buchanan, Chairman, for 5 per cent of the total amount bid.

The Commissioners reserve the right to reject any or all bids.

J. F. BUCHANAN, Chairman,
W. E. BUCHANAN,
J. D. McGREGOR, JR.,
Commissioners.

(Proposal Advertisements Continued on Page 56.)

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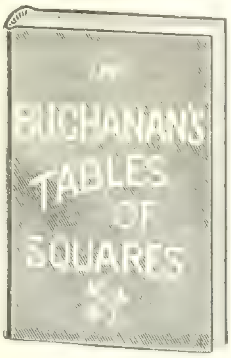

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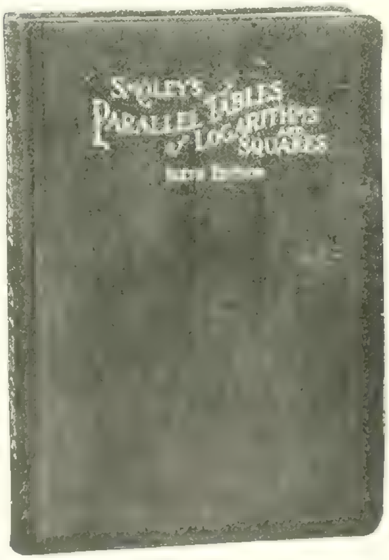

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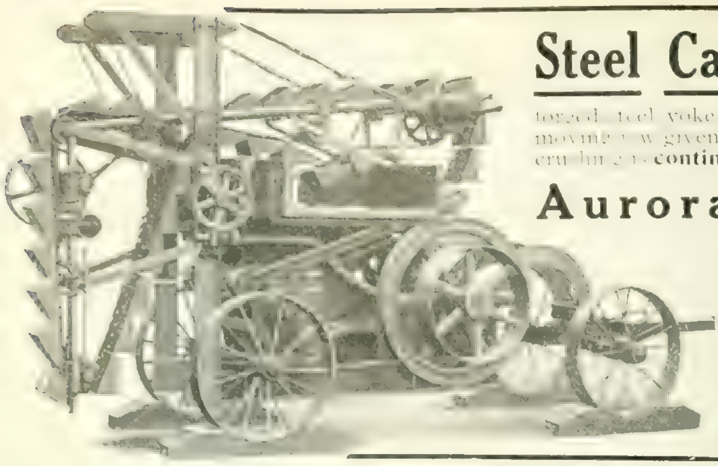

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New Orleans, La., Jan. 22, 1911.

Sealed proposals will be received by the Board of Commissioners of the Port of New Orleans, at their office, Suite 200, New Court building, until Feb. 21, 1911, at 7:30 o'clock p. m., for the fabrication and erection of the structural steel and cast iron for the Wm. A. Kernaghan Shed.

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(Proposal Advertisements Continued on Page 57.)

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Disinfection of Sewage and Sewage Filter Effluents
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The November Issue Contains:

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MATERIAL ECONOMICS, by T. D. Lynch, Research Engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh

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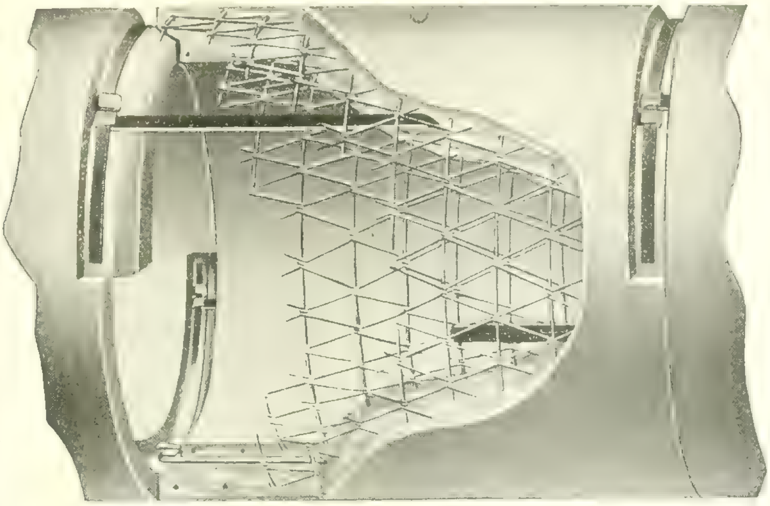

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NOTICE TO CONTRACTORS.

Sealed proposals will be received at the office of the undersigned in the City of Bozeman, Montana, until 5 o'clock p. m., on the 16th day of February, 1911, for the excavation required to enlarge the reservoir of the Bozeman City Water Works, and increasing the size of the dam and banks with the excavated material, amounting to about 13,000 cubic yards in accordance with the specifications therefor on file at this office.

Blank "Proposals," copies of specifications and instructions to bidders may be obtained of the City Clerk or the City Engineer.

Each bid must be accompanied by a certified check for One Hundred Dollars ($100.00) upon some bank in Bozeman, Montana, payable to the Treasurer of said city, which check will be forfeited to the said city in case the successful bidder shall fail to furnish satisfactory bond and enter into the proposed contract within five (5) days from the date of notification of award.

The right is reserved to reject any and all bids.

A. M. BRANDENBURG,
City Clerk.

NOTICE TO CONTRACTORS.

Sealed proposals will be received at the office of the undersigned in the City of Bozeman, Montana, until 5 o'clock p. m. on the 16th day of February, 1911, for the laying of concrete on the sideslopes and bottom of the enlarged reservoir of the Bozeman City water works, amounting to about 4,840 square yards in accordance with the plans and specifications therefor on file at this office.

Blank "Proposals," copies of "Specifications and Instructions to Bidders" may be obtained of the City Clerk or the City Engineer.

Each bid must be accompanied by a certified check for Two Hundred Dollars ($200.00) upon some bank in Bozeman, Montana, payable to the Treasurer of said city, which check will be forfeited to the said city in case the successful bidder shall fail to furnish satisfactory bond and enter into the proposed contract within five (5) days from the date of notification of award.

The City of Bozeman reserves the right to reject any and all bids.

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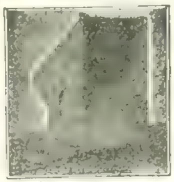

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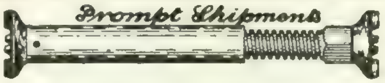

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[illegible] Myron C. Clark [illegible] [illegible] Society [illegible] write of Mr. Clark's work. Now we can [illegible] lost [illegible] courage [illegible] has proved un-availing

A Comprehensive Subway System for the City of Chicago.

After an exhaustive study of the transportation conditions and requirements of the city of Chicago Mr. Bion J. Arnold, chief subway engineer, has submitted [illegible] difficult problem.

It has been stated, in argument against the construction of subways, that the present elevated and surface line systems are not yet operated to their full capacity. While this statement is doubtless true in so far as it relates to the portions of these systems lying outside of the business district, it is a matter of ordinary observation that present transportation facilities within the loop district are inadequate, and are becoming more so each year.

With the increasing congestion, some better solution of the question is needed than is to be found in re-routing the surface line cars or in lengthening the platforms of the elevated station. As stated by Mr. Arnold, "it is taken for granted that on account of the present congestion, at times, of the surface line cars and elevated trains in the business district, as well as the apparent demand for the removal of the elevated loop structure, that subways are desired regardless of whether they can be justified from a financial viewpoint or not." The city of Chicago is, in fact, facing the same situation that sometimes arises in large railroad terminals, where better facilities must be provided, without regard to immediate return on investment, in order to handle the traffic promptly and satisfactorily.

In his report Mr. Arnold submits two plans, or schemes. Plan 1, which plan is the one recommended, is outlined in full elsewhere in this issue. It covers a complete system of subways for the business district, to be built in five stages, and designed for extension to the outlying portion of the city as needed. This system provides subways for all elevated and surface lines entering the business district, but contemplates the retention of surface lines for local transportation within this district. Limited through-routing is provided for in the plan, but any additional through-routing that might in the future be found necessary would be a matter only of the construction of necessary connections. An important feature of the plan is the absence of grade crossings, and these connections would pass under any tracks that it was found necessary to cross.

Plan 2 is [illegible] of congestion within the loop district, and makes provision for the surface lines only. Under this plan the elevated loop structure would be retained. This system would be built before or would be supplemented to the recommended system covered by Plan 1. Plan 2 contemplates the use of all present river [illegible]

A two-track high level subway for North and South Side surface lines, extending from the La Salle St. tunnel south in La Salle St. to Polk St.; thence east in Polk St. to Ply- [illegible] to a portal at 11th St. Also a two-track high level subway branching off of the La Salle St. subway at Lake St. and extending east to Dearborn St., and thence south in [illegible] way in Polk St. These two subways may be used both as loops and as through routes between the North Side and the South Side. Provision for the West Side surface lines is [illegible] way extending from the Van Buren St. tunnel east on Van Buren St. to Michigan Ave.; [illegible] St.; thence west on Washington St. to the Washington St. tunnel. Joint stations to be used as transfer points would be located in La Salle St. at Washington and Van Buren Sts.

It is difficult to see any advantage in Plan 2 that could not be secured by the construction by successive steps of Plan 1. The first step of Plan 1 is estimated to cost $8,000,000 and would comprise a two-track north and south subways in La Salle and Clark Sts., as well as a two-track loop for serving the surface lines entering the business district through the Washington St. and Van Buren St. tunnels. In this way provision would be made for all the important West Side surface lines and for all important North and South Side surface lines except those on State St. and Wabash Ave. This would go far toward securing the immediate relief provided for in Plan 2, and would possess the advantage of being the beginning of a complete system of subways.

The next step, estimated to cost $21,250,000, would provide for all the elevated lines, and would make it possible to remove the elevated loop structure. After this, probably no further development would be necessary for a number of years. As required, or as the finances of the city permitted, successive [illegible]ps of the plan could be constructed.

Discussion will doubtless lead [illegible] changes in the recommended plan. [illegible] it should not be lost sight of that th[illegible] the only plan yet proposed that is base[illegible] exhaustive study of transportatio[illegible]ations and requirements, that provides [illegible] the immediate relief of congestion in the business district at comparatively small expense, and that is capable of expansion by successive steps into a comprehensive system covering the entire city.

A Railway Official's Reasons for Regarding Rates On Mail Carriage As Being Inadequate, Containing Incidental Proof of Lack of Economy in Mail Transportation.

We are in receipt of a communication from Mr. Julius Kruttschnitt, of the Harriman system, bearing upon the editorial in our issue of Feb. 1, 1911, relative to the extravagant administration of the post office contrasted with the express companies, and we print the communication in full in the letters to the editor.

Our readers will remember that we showed that the post office pays the railways $75 per ton of mail whereas the express companies pay the railways $15 per ton of express. Mr. Kruttschnitt regards this comparison as one that is unjust to the railways and we are by no means sure that he is not right; but the data used by him to prove that the railways are underpaid for carrying the mails serve to show in a remarkable manner the correctness of our conclusion that the post office is managed most uneconomically.

As will be seen in Mr. Kruttschnitt's communication, the railways received during November, 1909, less for transporting mail than for transporting express per cubic foot of car space per mile. And it is contended that the cubic foot of car space assigned to mail or express is a better cost unit than the ton. We shall not at this time discuss this particular contention as to units, but shall take the question up in a later issue.

Mr. Kruttschnitt claims that *the railways* [illegible] *ton of mail;* while, to quote him, "On the other hand, the express companies comply with the demands of the railways that express matter shall be economically loaded." Precisely! The postal department does not load the mail cars economically, and that itself is one of the principal reasons why the railways charge five times as much per ton of mail as they charge per ton of express. We have not claimed that the railways are overpaid for the [illegible] not sure as to that point. But we have claimed, and Mr. Kruttschnitt's data substantiate the claim, that the simplest elements of economic business management are conspicuous by their absence in the postal department. *There is no economic reason why* [illegible]

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[illegible] *weight for each ton of mail carried.* If the postal department were run as a business organization like the express companies the enormous item of waste car space for which the railways must be paid would be speedily reduced, and with such a reduction would disappear the entire postal deficit, probably several times over.

Mr. Kruttschnitt incidentally points out that the average revenue per passenger train mile is less than half the revenue per freight train mile, but this has no real bearing upon the subject until it is shown that the actual operating costs per passenger train mile are more than half as great as the costs per freight train mile, which can not be shown. In a future issue we shall give an analysis of these costs, from which it will be seen that there is a great difference between the operating costs of freight and passenger trains, passenger operation costing far less than freight train per train mile.

Mr. Kruttschnitt makes the statement that "average ton-mile rates for mail and express are not far apart," but he cites no data whatever in proof of the contention. The facts are as shown in our Feb. 1 issue, that the ton-mile rates for mail and express are very far apart. But, as pointed out in that issue also, the actual cost of the service is in neither case a direct function of the length of the haul. Fully one-third of railway operating expenses are entirely independent of the length of the haul. The remaining two-thirds of the operating expenses are less affected by distance of haul than is generally recognized even by railway men.

We are glad that the issue is now fairly joined as to what are the actual costs of transporting express and mail; for, regardless of whether the railways are overpaid for carrying the mail or not, the facts all clearly point to the excessive cost to the *public* for carrying the mail. It is wholly probable that a large part of this excessive cost is due to the car space uneconomically used by the postal department, and that this is no fault of the railways themselves, but a condition forced upon them by the postal department. Mr. Kruttschnitt has performed a real public service—even if not intentionally—in pointing out this additional evidence of incompetent postal administration. The whole subject is one that cries for investigation at the hands of a board of cost experts. It is not something that can be decided by President Taft or by Congress without the evidence that can be fully gathered only by such a board of experts. The postal department will certainly furnish no evidence tending to prove its own shortcomings. Nor will it be possible to conduct any satisfactory reform entirely from within that department.

The President acted wisely when, some time ago, he selected "economy experts" to investigate some of the various departments of the federal government. But he made a serious mistake when later he resolved to conduct the reforms entirely from within. One of the fundamental laws of scientific business management is the divorce of planning from performance, and a corollary of this law is the employment of special outside experts to advise the managers of the departments of any large business or governmental organization. Mr. Brandeis announced that the railways are behind the times in that they have failed to apply the laws of scientific management. In the main, he is absolutely sound in this contention. One of the most important laws of scientific management is the one just mentioned.

Great economic reforms rarely originate within any business organization, but come from without. Evidence of this is seen in the fact that important labor saving inventions are proverbially the products of men not engrossed in the details of the business to which the inventions apply. Whitney, a lawyer, invented the cotton gin. And to come right home, a watchmaker—Stephenson—invented the locomotive. Westinghouse, a designer of agricultural machinery, invented the air brake. Westinghouse, if current statements are correct, was unable to get the assistance even of such an astute railway man as Harriman, and only by sheer persistence forced himself and his invention upon Cassatt, late president of the Pennsylvania Ry. Similar examples in the field of invention are to be found without number, pointing toward the fact that the greatest possibilities of labor saving are more evident to the man who scans the whole field than to the man engrossed in the details of his work. Furthermore, too close a knowledge of existing practice and precedent has a peculiar effect upon the inventive faculty in that it makes "what is" seem far better than "what is not." Existing facts ridicule "theories," and daily duties laugh at "dreams."

From whatever angle we view the problem of post office economics, we find it so inextricably mixed with questions of actual costs of railway transportation, costs of express company operation, as well as questions of business economics, that it is imperatively the duty of Congress to have the entire matter investigated by a board of competent analysts of cost and experts on scientific management. For Mr. Julius Kruttschnitt's discussion of the matter from a railway operator's point of view, the reader is referred to the "letter to the editor."

The petition of the Metropolitan Elevated Railway Company in which the Department of War is asked to revoke the order requiring the reconstruction of its bridge over the Chicago river has been denied by Secretary of War Dickinson.

CONCRETE AND REINFORCED CONCRETE SECTION

Concrete Abutments for Highway Bridges; Diagrams for Determining Quantities and Cost.*

The purpose of this article is to discuss the practice of the Illinois Highway Commission in the design of concrete abutments for truss highway bridges, and to develop a ready approximate means of ascertaining the number of cubic yards of concrete in a pair of abutments of a known height and length of wings, as well as to work out a means of making field estimates of the cost of a pair of abutments without calculating the quantities in detail. To design economically a retaining wall and insure stability is a problem that is not susceptible of accurate mathematical solution. A great many formulas have been advanced that deal with earth pressure under different conditions, and, as a rule, they all give results that are safe; but the formulas themselves are necessarily based upon assumptions that are more or less unknown, and consequently for ordinary cases there is little or nothing to be gained in applying a supposedly rational formula to determine the stability of a retaining wall against overturning. For plain abutments up to 25 ft. in height the practice of the Illinois Highway Commission is to make the width of the base 35 per cent of the total height, except where the foundation is to be rock or shale, in which case the base is made 25 per cent of the height. This is in accordance with the practice of the English engineer, Benjamin Baker, who, after a very long experience with retaining walls, concludes that a wall without any surcharge and having a batter on the face of 1 to 2 ins. per foot, will be stable against overturning when the base is 25 per cent of the height, providing that the backing and the foundation are favorable. In ground of an average character the afore-mentioned engineer made the base of retaining walls 33 per cent of the height from the top of the footing. Our plain concrete abutments rest on a concrete footing that is 18 ins. deep vertically and projects 9 ins. horizontally beyond the front and the back of the wall proper. The back of the wall is made vertical, primarily so as to throw the center of gravity of the wall farther away from the toe, and secondarily for the sake of the appearance of the structure.

At the end of the wing the width of the footing is 33 per cent of the total height of the wall at this place, but it will be noted that with a height less than 13 ft., when we use the customary 9-in. horizontal offset for the footing, the width of the wall at the top of the footing will be slightly less than 25 per cent of the height. In these cases the width of the wall at the top of the footing is made 25 per cent of the height above the top of the footing, and the horizontal offset of the footing is adjusted until the width of the footing is 33 per cent of the total height. Wing walls are made 12 ins. wide on top, and the total width of the abutment proper at the top usually varies from 20 to 32 ins. depending upon the size of the shoe that is built for the superstructure. Of this top width 8 ins. is in all cases used for the parapet wall.

For the reinforced, buttress type of abutments it is the practice of the Commission to make the width of the base 33 per cent of the total height for heights up to 30 ft. Needless to say that the stability moment of the buttress wall is somewhat less than that of the plain or solid type of wall. This, of course, being due to the relative amounts of concrete in the two walls, but also because of the center of gravity of the concrete in the buttress wall coming more nearly to the toe of the wall than is the case with the plain or solid wall. True it is that the difference in the weight of the two walls is very largely made up by the weight of the back filling occupying the space between the buttresses; but this compensating factor is not sufficient to make the buttress wall as stable against overturning as the plain wall when the ratio of base to height is the same in each case. Rather than increase the width of the footing of the buttress wall so as to have the design of the two types consistent, it is considered that the anchorage of the wings to the main wall by the horizontal reinforcement is sufficient to make up for whatever difference might exist between the stability of the two types of walls. This anchorage is not considered, however, in cases where the angle between the wings and the center line of the road is more than 45°.

As is the case with plain abutments the width of the footing at the end of the wings is made 33 per cent of the total height at that point. The footing depth is very frequently 18 ins., but this may vary some 6 ins. either way, depending upon the design required for the particular case in hand. The wall proper is arbitrarily made 12 ins. wide at the top, but at the top of the footing it usually varies from 18 to 24 ins. depending upon the resign as required by the conditions. Three buttresses 12 ins thick are used behind the main wall and occupy the full width of the footing that remains back of the wall. In the wings the buttresses are placed some 6 or 7 ft. apart on centers as near as practicable, this depending on the length of the wings, but three buttresses for each wing are the number commonly used.

The bridge work of the Illinois Highway Commission requires a personal inspection of the bridge site with the local officials, and at this meeting the necessary data are obtained for the design of the bridge. Almost invariably the officials will expect that an estimate of the cost of the proposed work be made them at this time. Consequently, to maintain the confidence of the officials it behooves one to be prepared to give an estimate that will closely approximate the one that is made from the detailed drawings. This is usually a somewhat difficult matter to do unless the time is taken to compute the number of cubic yards in detail that will be in the abutment. For the purpose of determining off-hand the approximate number of cubic yards in a pair of concrete abutments, Fig. 1 has been prepared, and is applicable within the limits shown by the specific cases used. For plain abutments 27 different designs were taken from the files of the Commission and the number of cubic yards in the two abutments of each design was plotted against H^2 $(R+2W)$, where H is the total height of the wall, R the clear roadway of the steel superstructure, and W the length of one wing measured on the stream side of the wing. It will be noticed that the number of cubic yards in two abutments varies approximately as the square of the height. R was taken as the clear roadway of the superstructure for the reason that this is the figure that is gotten at the preliminary inspection of the bridge site. It will be noticed that the maximum variation from the line plotted is 8 cu. yds., while the average is about 3½ cu. yds. For a particular bridge site, suppose the distance from the crown of the finished roadway to the bed of stream should be 14 ft., and that the footing should be carried to a depth of 4 ft. below the bed of the stream, making H equal to 18 ft. If the wings are each to be 15 ft. long and the abutments are to carry a superstructure having a clear roadway of 16 ft., we have a value of 14,900 to be read off at the bottom of the figure. It will be seen at once that there are 178 cu. yds. of concrete in the two abutments. The 27 abutments used in making this figure varied in height from 12 ft. 4 ins. to 24 ft. 3 ins., the average being 17 ft. 4 ins. The wings ranged in length all the way from 5 ft. to 17 ft. 6 ins., the average being 12 ft. 2 ins. The width of roadway varied from 14 to 18 ft., but the large majority of them were 16 ft. The total width of the wall at the top varied from 20 to 32 ins., the average being 27 ins. In all cases 8 ins. of this width is used as a parapet wall and comes to the top of the stringers in elevation, the remaining portion of the wall stopping in elevation at the bottom of the shoe. It might at first be thought that the number of cubic yards would be more nearly proportional to the height only up to the bridge seat, because the height of the parapet wall being a constant for any given superstructure and is entirely independent of the height of the abutment. After plotting the quantities both ways it was found that the number of cubic yards varied more nearly proportional to the total height of the wall. The angle at which the wings stood with respect to the main wall ranged in these cases from 30° to 60°. The more nearly the direction of the wing [illegible] parallel with the line of the road the higher [illegible] the wing out at the end, and consequently the number of cubic yards will be somewhat increased; but as the corner formed by the intersection of the abutment proper and the wing is measured twice, these two factors greatly compensate one another.

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*A paper by H. E. Bilger, Assistant Engineer, Illinois Highway Commission, before the Illinois Society of Engineers and Surveyors, January, 1911.

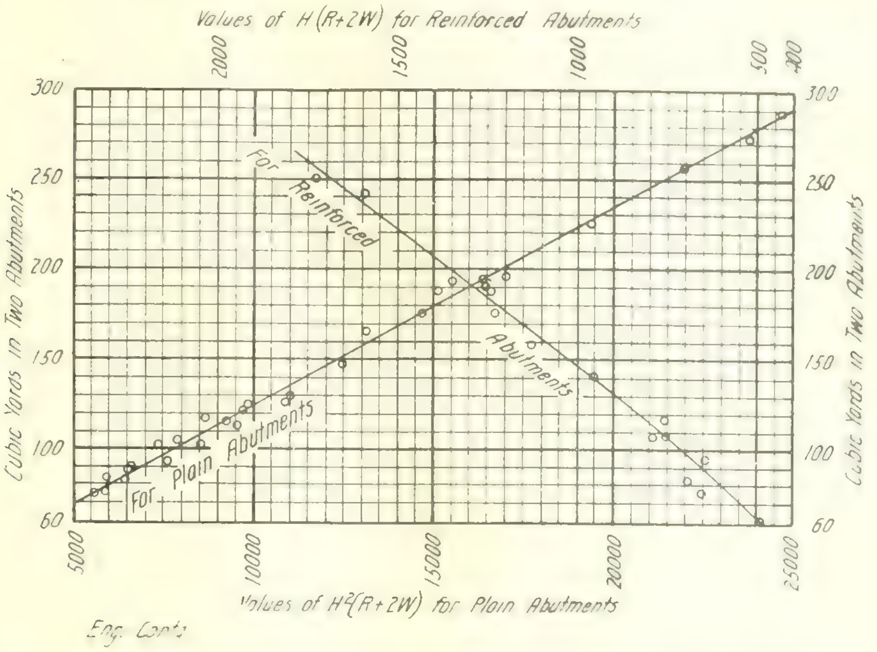

Fig. 1.—Diagram for Determining Quantities in Concrete Abutments.

For reinforced abutments 15 designs were taken from the files of the Commission and the number of cubic yards in the two abutments of each design was plotted against Hx $(R+2W)$, the notation being the same as before. It is to be noted that in reinforced abutments the number of cubic yards varies proportional to the total height, instead of as the square of the total height as is the case with plain abutments. For a particular case, take the same abutments that were considered before, namely, clear roadway 16 ft., height 18 ft., and the length of wings 15 ft., we have [illegible] top of Fig. 1. Getting the intersection with the line for reinforced abutments, we find that the two abutments would contain 120 cu. yds. of concrete. Figure 1 is thus a ready means of ascertaining very approximately the number of cubic yards of concrete in two abutments in terms of the height, roadway and length of wings when the design of the abutments is in accordance with the practice as previously described.

Having found the expression that is a measure of the number of cubic yards in a pair of abutments, the next step is to correlate it with a unit price that we may be enabled to arrive at the approximate estimate. For this purpose Fig. 2 has been prepared.

The actual cost of 1 cu. yd. of concrete complete in place as an integral part of a wall will depend upon quite a number of individual items. For nearly all ordinary highway bridge abutments there are only two or three of these items that have a very large influence in determining what the actual cost per cubic yard shall be. These items are:

(1) The cost at the bridge site of sufficient aggregate to make one cubic yard of concrete.

(2) The cost at the bridge site of sufficient cement to make this cubic yard of concrete.

(3) The cost per cubic yard of concrete to make the necessary excavation to start the concreting of the footings.

There are exceptional cases where the cost of this excavation, which includes also cribbing, sheet piling and pumping, will run as high as $3 or $4 per cu. yd. of concrete. On the other hand in a very few cases this excavation item may fall as low as 75 cts. or even 50 cts. per cu. yd. of concrete. These are both very rare exceptions, however, and for probably as many as 85 per cent of all the cases encountered, the excavation item will not vary more than 30 per cent from a fixed quantity.

The item for mixing and placing concrete might vary from $1.25 per cu. yd. for crushed rock concrete mixed by hand, to possibly as low as 30 or 40 cts. per cu. yd. for gravel concrete mixed by machinery. In spite of this possible wide variation we find that the cost for this item varies but little from a fixed amount. Likewise the item for forms is a more or less fixed quantity for plain abutments and another fixed quantity for the reinforced abutments.

It will be seen that the cost of the cement and the aggregate delivered to the bridge site are the two items that have the most to do with determining what the price shall be per cubic yard of concrete.

For plain abutments the sum of these two items will very seldom fall below $2, and will just as seldom exceed $6. Under the most favorable conditions with respect to location

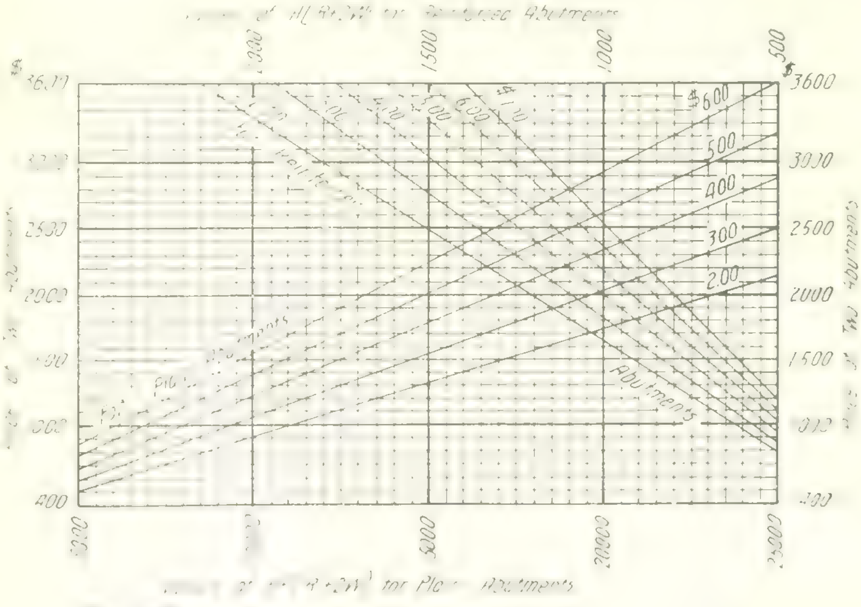

Fig. 2.—Diagram for Estimating Cost of Concrete Abutments.

with reference to the nearest railroad station, the cost of the cement delivered to the bridge site would hardly fall below $1.50 for plain concrete mixed at the rate of 1:3:5. Even if satisfactory gravel is available at the bridge site it would likely cost at least 50 cts. per cu. yd. to haul it to the mixing plant. On the other hand the cost of the cement and the aggregate at the bridge site might even exceed $6. On the light of this Fig. 2 has been prepared to give the price of two plain abutments under conditions where the cost of the cement and the aggregate at the bridge site might vary from $2 by $1 increments to $6. and for reinforced abutments where the cost of these two items range from $2 to 7. The items for forms, mixing and placing concrete, and excavation will be as nearly a constant for the reinforced abutments as they are for the plain abutments.

From the 15 different designs of reinforced abutments which were used in preparing Fig. 1 it was found that the amount of reinforcing steel bars per cubic yard of concrete averaged 70 lbs., and that the widest variation from this average was a rather small per cent. This item for reinforcing steel, as well as the bending and placing of same, has been duly considered in preparing Fig. 2, and likewise all other items that have a material influence on the cost of 1 cu. yd. of concrete in place in the wall. For this reinforced work the mixture is 1:2:½:4 as against 1:3:5 for the plain concrete.

Supposing that the aggregate and the cement at the bridge site for 1 cu. yd. of plain concrete to cost $4, and using the same abutments that were previously considered, we find that 14,900 at the bottom of Fig. 2 intersects with the $4 line for plain abutments at a point showing the price of the two abutments to be $1,770. Similarly, 828 from the top of the figure intersects with the $4 line for reinforced abutments at a point showing the price of the two abutments to be $1,620. This is not actual cost of the abutments to the contractor, but rather the price of the abutments; it being the figure at which the township or county can expect to get the work done by contract. By correlating the expression that measures the number of cubic yards in a pair of plain abutments, it would be possible to work out a diagram that would show graphically by the intersection of lines the economical height for any particular set of conditions, but what is wanted rather than this is to get the absolute figure on a pair of reinforced abutments, both under the same conditions.

It is not the practice of the Commission to select the type of abutment merely upon the relative price of the two; there are important practical considerations that enter into this matter. A case frequently arises late in the season when the abutments must be built before freezing weather. The particular conditions might show that the reinforced abutments are the more economical by say $100 but by the selection of this type the work would be delayed two or three weeks in getting the reinforcing steel from the mills. Again, a condition might be met where the frequency of freshets might make the contractor's cost of pumping, cribbing, etc., exorbitant, and as it would likely require two or three times as long to carry the concreting up to the water surface by using the reinforced type as against the plain wall, the latter should be the design adopted, providing the difference between the cost of the two types would not be excessive. As a third case it might be mentioned that no small part of the concrete work that is done under the supervision of the Illinois Highway Commission is done by men residing in the local community, and these men frequently have had very little experience with concrete. In spite of this fact, for ordinary work they stand on an equal footing at the letting with the experienced contractor even though they are at sea when it comes to reading a plan of a reinforced abutment. This point, however, is not considered by the Commission in selecting the type of abutment, for the reason that the Commission furnishes a competent inspector to superintend the construction of the work, so the complexity of the design is not an embarrassment to the local contractor.

One of the most gratifying phases of this work is the favorable attitude which the township and the county officials throughout the state are assuming with respect to the wisdom of permanent bridge construction as advanced by the State Highway Commission. As late as three or four years ago the officials in many of the communities were rather favorably disposed toward putting small bridges on steel legs resting on a mud sill, and the larger ones on steel tubes filled with concrete. A case very seldom arises now where the officials object to putting their bridge on concrete abutments, and when such an occasional case does come up the objection is invariably due to the shortage of immediate funds, the value of concrete for substructure work never being questioned at all.

The old pile bent originally used to support a bridge gave way to the steel tube, which in turn was supplanted by the stone masonry abutment. Conditions have now changed again, and while it is not claimed that concrete has greater durability than first-class granite stone masonry, yet it is believed that concrete is admirably adapted to the construction of highway bridge substructures. In measuring the justifiable expenditure for a first-class bridge substructure due consideration must be given to the life and safety of the superstructure. A failing substructure is not only a failure in itself, but causes the superstructure to fail with it. Where a shortage of funds requires quality to be sacrificed in some portion of the bridge, the sacrifice had better be made in the superstructure, for while steel superstructures must continue to be some sort of expense for painting, deterioration, etc., a first-class concrete substructure closely approaches the structure in which the first cost is the only cost.

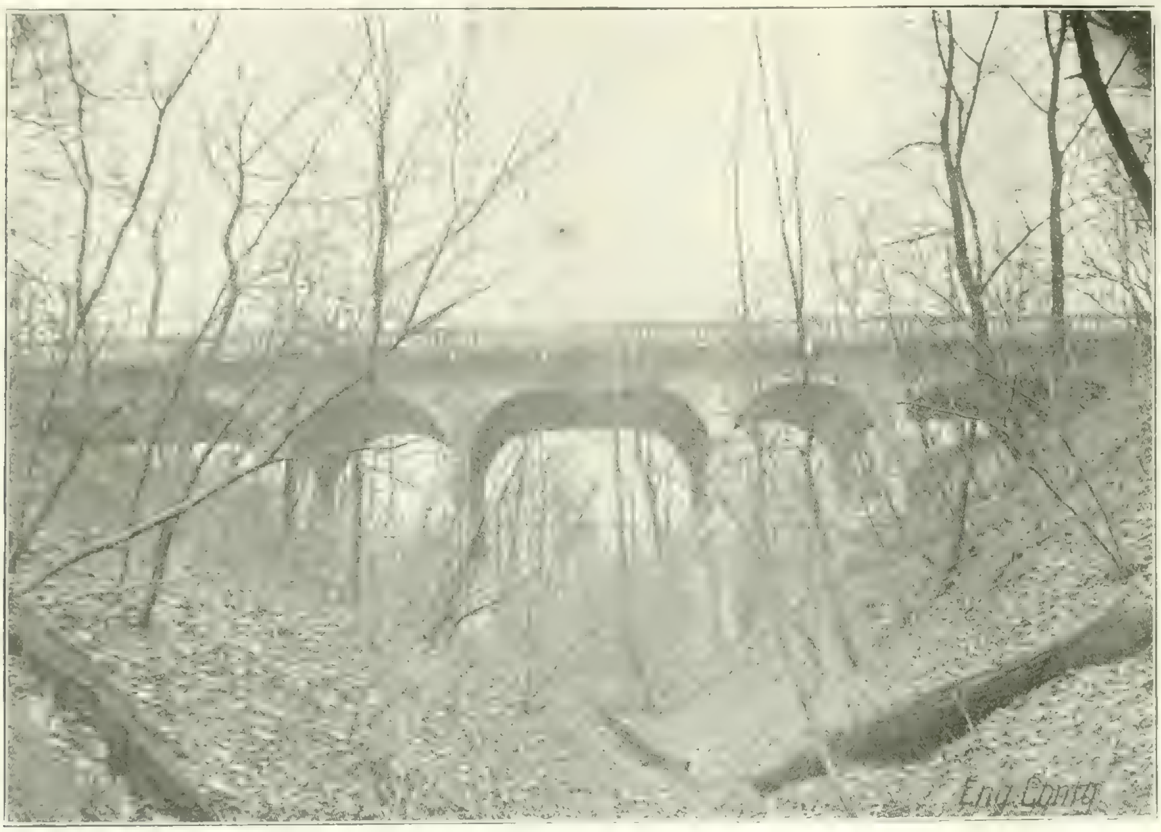

Fig. 1—General View of Reinforced Concrete Viaduct Carrying Street Over a Ravine, Highland, Park, Ill.

Concrete Girder Viaducts for Street Bridges at Highland Park, Illinois.

A tasteful and economic adaptation of concrete to street bridge construction is illustrated in the accompanying engravings. These illustrations show different views of one of four bridges of the same type built at Highland Park, Ill. Highland Park is one of the most attractive of the wealthy North Shore suburbs of Chicago. It is situated on a wooded plateau terminating in a bluff on Lake Michigan. On lines approximately normal to the lake shore the plateau is cut by a number of deep ravines which carry the surface drainage into the lake. These ravines with their sides thickly wooded with shrubs and trees form one of the most striking natural beauties of the suburb, but they also, as may readily be understood, involve numerous expensive structures to accommodate crossing streets.

At Highland Park there are 29 places where the streets cross ravines which vary in width from 100 ft. to 250 ft. and in depth from 25 ft. to 60 ft. At 15 of these crossings are modern bridges, which were built about 18 years ago and which, having nearly outlived their usefulness, must be rebuilt or replaced within the next five years. At present the maintenance charges in these bridges are $6,000 per year. When the Department of Public Works was erected in 1909, one of its first problems was to devise a plan and policy for future bridge work and the following plan was worked out.

The plan was to build all future bridges of reinforced concrete and to employ in so far as practicable a standard charge for all crossings. As the side slopes of the ravines were very uniformly 1½ on 1, the only variables were the width and the depth. It was conceived that by adopting a girder viaduct all variations of depth and width could be met, by making the three center spans always the same and shortening or lengthening the end spans as the width required and similarly varying the bent heights as the depth required. By this plan much of the form work could be used over and over and, as will readily be understood, the advantage of duplication secured in many other respects.

The County line bridge, which is illustrated, is one of the four bridges built during 1910. It is located on the line between Lake and Cook counties, and the expense was shared equally between the city of Highland Park and the Cook County Commissioners. The contract price for this bridge was $3,985, which, owing to its length, would have cost not less than $7,000, if built of the arch type. This bridge is 110 ft. in length, consisting of three 30-ft. and one 20-ft. spans and is 25 ft. in width, having a 16 ft. roadway and a 4½ ft. walk on each side. A live load of 100 lbs. per sq. ft. upon the sidewalk, and a 150 lbs. per sq. ft. upon the roadway, and a concentrated, or test, load of a 20-ton road roller, was the loads upon which the stresses were figured. The upright posts are 18x24 ins. square, supported upon footings 6 ft. square and 9 ft. in depth. The main longitudinal girders are 14x46 ins. with cross girders every 10 ft. 10x14 ins. The roadway slab is 10 ins. thick in the center and 8 ins. at the sides, and the sidewalk slab, which is supported by brackets from the main longitudinal girder, is 5 ins. thick. The cement used in this construction was Universal Portland cement. The proportions of the concrete for all work was 1 cement, 2 good coarse torpedo sand and 4 washed gravel, used in all of the structure except the posts, which was a 1:1:2 mixture.

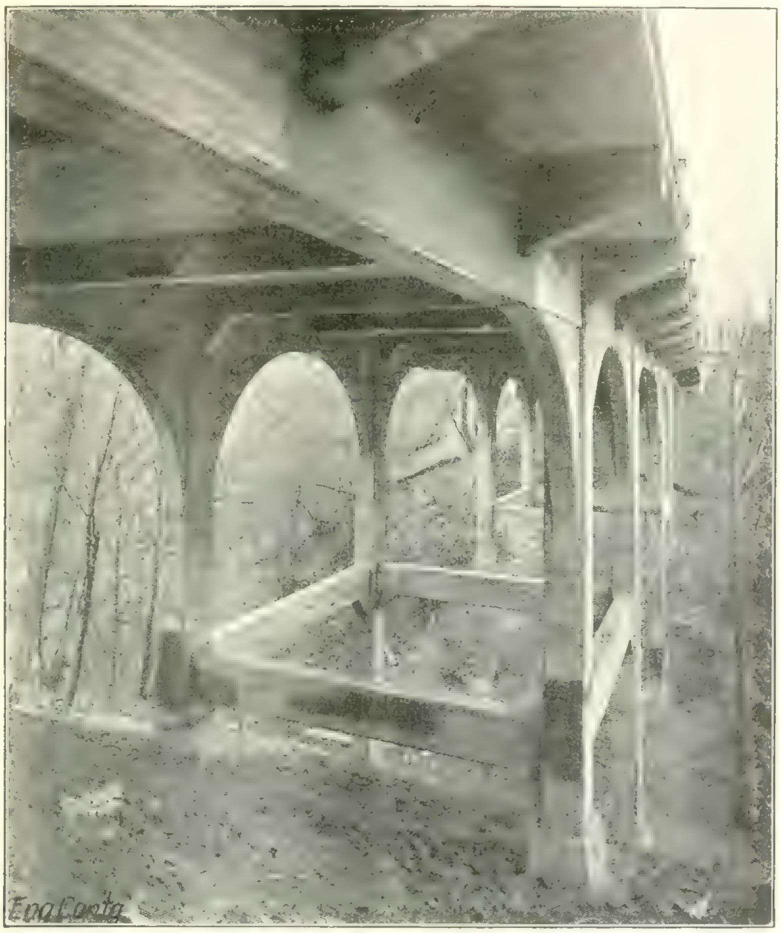

Fig. 2—Detail View from Underneath of Reinforced Concrete Viaduct.

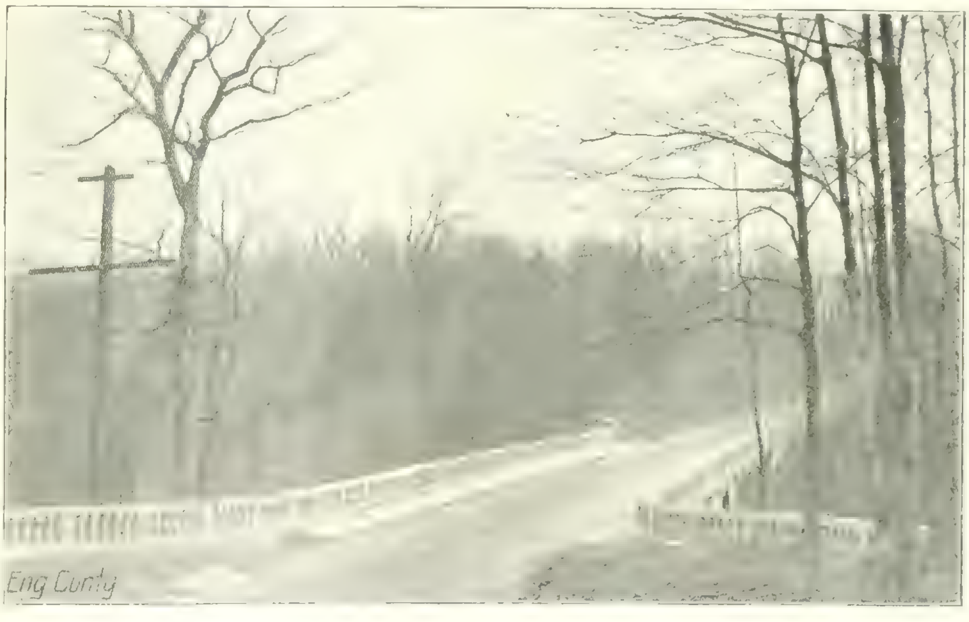

Fig. 3—View of Roadway, Reinforced Concrete Viaduct, Showing Hand Railings.

The Waverly Street bridge, which was the first one to be [illegible] of 130 ft. between abutment walls. The overall measurements, including wing walls are 178 ft. and it is the only one that has the false work [illegible]. The cement used in building the bridge was Lehigh cement.

The Forest Avenue bridge which is practically completed with the exception of removing the false work is 150 ft. between abutment walls and 234 ft. over all including wing walls. It cost about $7,300. The cement used in building the bridge was Universal Portland cement. The Ravine Avenue bridge which is in a similar condition is 118 ft. between abutment walls 190 ft. over all including wing walls and cost about $4,600. Marquette cement was used in this bridge.

The reinforcement used in these bridges was the Kahn system throughout.

These bridges were designed and superintended by H. L. Bowen of the Bahr Bowen Co., Landscape Engineers and Contractors, who was at that time commissioner of Public Works at Highland Park.

An Investigation of the Change in Volume of Concrete During the Hardening Period.*

Many well recognized authorities upon masonry and masonry construction assert, that, during the setting and hardening period, concrete changes a slight amount in volume. This was the conclusion drawn from a number of experiments carried on some twenty years ago. The most extensive and reliable of these experiments were performed in the laboratories of the Massachusetts Institute of Technology in 1887, under the supervision of Prof Swain.

A brief review of these experiments will here be given. The specimens used were 5-in. cubes. Various mixturs were used; some of neat Portland cement; some of neat Natural cement; and others of a 1 cement to 1 sand; 1 cement to 2 sand; 1 cement to 3 sand; also mixture of both natural and Portland cement. Brass tacks were set in the cubes and measurements were taken, by a kind of special caliper, to the nearest .001 in. The cubes were measured at the age of 1 day, 2 days, 2, 4, 6, 8 and 12 weeks. One cube of each mixture was placed in water and one in air. Different brands of cement were used and a large number of specimens made. The results agreed very satisfactorily throughout the experiments. The conclusions drawn by Prof. Swain are as follows:

1. Cement mortars in air diminish in linear dimensions to the end of twelve weeks, usually progressively.
2. In water, mortars increase in like manner, but to a less degree.
3. The richest mixture changes the most.
4. Expansion of quick setting cement is the greatest.

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*Abstract of a paper by C. W. [illegible] and W. H. Leckliter in Bulletin V, Iowa State College Engineering Experiment Station.

5. Contraction for twelve weeks varied from .23 per cent for neat cubes to .08 per cent for the lean mixtures.

6. Expansion varied for a like period from .12 per cent for neat cubes to .04 per cent for lean mixtures.

7. Change in dimensions was the same in all directions for each cube.

There have been, however, no well recognized tests made of concrete with regard to its change of volume during the setting period. The need of such tests has been emphasized lately by building failures, which, it was alleged, were caused by expansion of the concrete floor slabs. In some of these cases it was claimed that rock and gravel concrete slabs did not change appreciably, but that cinder concrete floor slabs would change very noticeably. It was to determine the rate of change in volume of rock, gravel, and cinder concrete that the investigation herein described was undertaken.

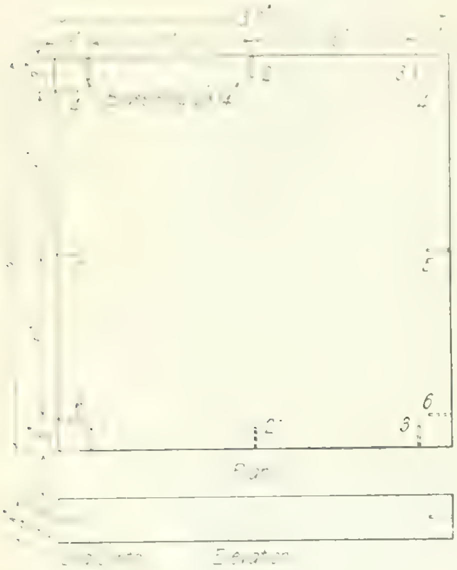


Fig. 1—Diagram Showing Location of Brass Plugs in Concrete Slab.

The specimens used in this investigation were approximately 36x36x4 ins. They were made with varying proportions as follows:

Slab No. 1, 1 part cement, 2 sand, and 4 broken stone.

Slab No. 2, 1 cement, 3 sand, 5 broken stone.

Slab No. 3, 1 cement, 2 sand, 4 gravel.

Slab No. 4. 1 cement, 3 sand, 5 gravel.

Slab No. 5, 1 cement, 2 sand and 4 cinders.

Slab No. 6, 1 cement, 3 sand, 5 cinders.

The cement used was North Western States Portland. The cement was tested according to the standard methods, with the following results: Specific gravity, 3.16; fineness, 20.9 per cent retained on 200 sieve; 4.7 per cent retained on 100 sieve; normal consistency, 25 per cent; initial set, 2 hrs., 10 mins.; final set, 5 hrs.

Tensile strength:

	[illegible] hrs.	7 days	28 days
Neat	110 lbs.	[illegible] lbs.	[illegible] lbs.
1 [illegible]	[illegible]	1[illegible]2 lbs.	[illegible] lbs.

Soundness test, passed both the normal and accelerated tests perfectly.

The sand used was fairly clean and rather sharp. It was passed through a No. 8 sieve to remove all gravel. The gravel used was fairly clean and was of good quality. It was passed over a No. 4 sieve to remove all sand. The crushed rock used was limestone, crushed to about ½ to ¾ in. size. It was passed over a No. 8 sieve to receive all dust. The cinders used were average quality and were taken from the college cinder pile. They had been out but a day and had little chance to disintegrate because of exposure. All fine dust and ashes were taken out by passing the cinders over a No. 4 sieve.

The ingredients of the different mixtures of concrete were proportioned by bulk; and were mixed in the usual manner. The specimens were kept in a room which never varied more than 20° F. in temperature and had an average temperature of 75° F. The specimens were not wet down at any time but were allowed to set with only the water present that was used in mixing the concrete.

The method of measuring change in dimension of the specimens was as follows. In the edge of each slab, three brass plugs were set, as the concrete was being placed in the wooden forms. The location of these plugs is shown in Fig. 1. The special caliper used and method of using it is shown in Fig. 2. As will be noted the large caliper or yoke was made of tool steel and was very rigid. An extensometer, made by the L. C. Starret Co., was used in all measurements. The movement of the micrometer screw was 0.25 ins., but by the use of rods of known length, the extensometer has a range of several inches. This instrument was calibrated for each rod by the use of the extensometer in the Physics Laboratory. A dry cell and sounder were placed in circuit with the yoke and the extensometer by means of short wires fastened to the brass plugs, set in the slabs. Electrical contact was used in all measurements. Each measurement was checked and average readings taken. By use of a long bar of tool steel and the small extensometer, the spread of the large yoke was often tested and remained constant throughout the experiment.

According to the best authority there is little if any difference in the coefficient of expansion due to temperature changes, of concrete and steel. One good authority gives the difference at .0000005 per degree F. Now with a minimum change of 20° and a length of specimen of 3 ft., this gives a correction of less than .0004 ins., which is less than the probable error of observation in the regular measurements of the slab. No corrections were made for change in temperature.

The first measurements were taken as soon as they could be taken with safety, that is without dislodging the brass plugs in the slabs. All slabs were measured at the age of one day, and thereafter, as shown in the following table. In this table there is given the average change per foot for each block along with the corresponding age in days.

For blocks No. 1, 2, 3, and 4 it will be noted that the average contraction is pretty uniform from the beginning for about 20 days, and that for the last two, contraction has been nearly uniform throughout. Also, the contraction of the rock concrete is greater than the contraction of the gravel concrete. The greatest average contraction at the age of 91 days for the four blocks was in the second where a contraction of .0048 ins. per foot is shown, or about ½ in. in a hundred ft. of concrete. The maximum contraction is also found in that block, .0062 ins. per foot. The average contraction for the two gravel blocks, at the same age is about the same, .0035 ins. and .0030 in. per foot, and block No. 3 has a minimum contraction of .0015 in. per foot, which is the smallest contraction for the whole number of blocks.

The next curve sheet has the three curves for the first of the cinder concrete slabs. It will be noted that the expansion is rather slow at the beginning but afterwards expands at an increasing rate until an age or 50 days is reached. It then continues to expand at a decreasing rate until the end. A wide variation in amount of expansion is evident, since the total change per foot at an age of 84 days varies from a minimum of .0022 in. per foot to a minimum of .0240 ins. per foot.

For the last block of cinder concrete the expansion began at once and continued rather uniformly up to the age of 20 days after which it continued to expand at a decreasing rate to the age of 84 days. Here, also, we have a wide variation from expansion at the age of 84 days of .0296 in. for the minimum through an average of .0440 in. to the maximum change per foot of .0532 in. Here is shown then, at the age of 84 days, an expansion per foot that would give a movement of 4 ins. in a concrete floor a 100 ft. long. The difference in the rate of expansion of the two blocks of cinder concrete might be due to one or all of the following conditions: difference in the proportions of the two mixtures of concrete; variability in the character of the cinders; and, difference in the amount of water used in mixing. Block No. 6 was mixed much wetter than No. 5. In this connection it might be well to have a chemical analysis of the cinders, and also a record of the exact amount of water used in the mixing.

Both of the cinder concrete blocks showed numerous checks and cracks, as would be expected, since they had such a great variation in rate of expansion for different parts of each specimen. All of the rock and gravel concrete blocks were perfectly sound. It seems, then, that this unsoundness, these checks and cracks of the cinder concrete blocks, must have been due to the use of cinders as an aggregate. Similarly, it would appear that the expansion of the cinder concrete blocks was due to the cinders. At this point it might be again stated that the cinders used in these blocks were taken from the cinder pile shortly after they were dumped from the furnace, and had not been exposed to the air more than a day.

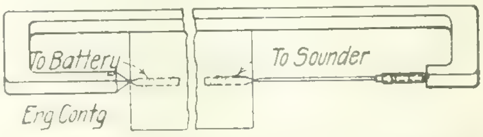


Fig. 2—Special Caliper for Measuring Change in Volume of Concrete.

In summary then, the investigation has brought out the fact that rock and gravel concrete have a slight contraction while hardening in air, and that cinder concrete has a decided and unmistakable expansion while hardening in air. Any further investigation of cinder concrete might well include the following additional items: a chemical analysis of all cinders used; a larger number of specimens; duplicate specimens placed in water as well as in air; the use of weathered cinders as well as fresh ones; exact amount of water used in mixing to be recorded; and a number of reinforced concrete specimens.

The essential point of the whole investigation is the fact, that there is a difference between cinder concrete and concrete having rock or gravel as an aggregate. This fact then would seem to warrant an extensive investigation of the whole subject. Such an investigation might well include all the points mentioned above, points which were of necessity omitted from the present investigation.

TABLE I.—SHOWING CHANGE IN VOLUME OF CONCRETE DURING HARDENING.

—Block No. 1—		—Block No. 2—		—Block No. 3—		—Block No. 4—		—Block No. 5—		—Block No. 6—	
Age in days	Summation change per ft.	Age in days	Summation change per ft.	Age in days	Summation change per ft.	Age in days	Summation change per ft.	Age in days	Summation change per ft.	Age in days	Summation change per ft.
[illegible]	0.0004"	1	0.0000"	1	0.0000"	1	0.0000"	1	0.0000"	1	0.0000"
[illegible]	0.0006"	2	[illegible]	2	—0.0001"	[illegible]	[illegible]	2	0.0000"	2	+0.0012"
[illegible]	[illegible]	[illegible]	—0.0001"	3	[illegible]	3	[illegible]	3	0.0000"	3	+0.0028"
4	[illegible]	[illegible]	+0.0001"	4	[illegible]	4	—0.0001"	4	+0.0003"	4	+0.0032"
5	[illegible]	[illegible]	[illegible]		—0.0007"	5	[illegible]	5	+0.0003"	5	+0.0048"
[illegible]	[illegible]	[illegible]	[illegible]	6	[illegible]	6	—0.0001"	6	+0.0009"	6	+0.0064"
[illegible]	[illegible]	[illegible]	[illegible]	7	—0.0006"	7	—0.0001"	7	+0.0009"	7	+0.0082"
14	[illegible]	14	[illegible]	14	—0.0012"	14	—0.0006"	14	+0.0024"	14	+0.0197"
21	—0.0021"	[illegible]	—0.0020"	21	—0.0014"	21	[illegible]	21	+0.0046"	21	+0.0288"
[illegible]	—0.0029"	[illegible]	—0.0025"	28	[illegible]	[illegible]	—0.0017"	28	+0.0067"	28	+0.0334"
35	—0.0035"	[illegible]	[illegible]	[illegible]	—0.0023"	35	[illegible]	35	+0.0077"	35	+0.0360"
49	—0.0038"	49	[illegible]	[illegible]	[illegible]	49	[illegible]	42	+0.0089"	42	+0.0377"
63	—0.0043"	[illegible]	[illegible]	[illegible]	—0.0030"	63	[illegible]	49	+0.0098"	49	+0.0397"
91	—0.0042"	91	—0.0048"	91	—0.0035"	91	[illegible]	56	+0.0102"	56	+0.0411"
								63	+0.0105"	63	+0.0419"
								70	+0.0109"	70	+0.0431"
								84	[illegible]	84	+0.0440"

Methods Used in Obtaining Concrete of Maximum Density for the Westerly Rhode Island Standpipe.*

It was determined at the very start of the building of the Westerly water tower that we should depend on a very dense mix of concrete to insure water tightness. A large number of tests were made to discover the proper mixture for obtaining maximum density with the aggregate at the disposal of the builders, and then to insure every batch of cement being as nearly as possible of the predetermined density. The first step was to make mechanical tests of the sand and stone available.

Two sizes of sand were tried, one a bank sand of the size commonly known as paving gravel and called No. 4½, and the other a fine bank sand known as No. 5. Crushed gray Westerly granite of all sizes between ½ in. and 1½ ins., as screened at the crusher, was the stone used on this work. For testing purposes 100 ozs. of material were used at a time. Samples were selected from the pile by quartering in order to get as nearly as possible average results. As the screens were not calibrated, values from Taylor and Thompson, page 194, were used. The first sample of sand known as No. 4½, gave the following results, the weights given being in all cases the amounts retained on the screen:

SAND No. 4½

Size sieve.	Percentage retained.
1-in.	1½
¾-in.	[illegible]
½-in.	[illegible]
⅜-in.	[illegible]
¼-in.	26½
3/16-in.	31
⅛-in.	38
No.	
8	[illegible]
20	62
30	[illegible]
50	[illegible]
100	[illegible]
200	100

The fine sand known as No. 5, when screened gave the following results:

SAND No. 5

Size sieve.	Percentage retained.
½-in.	[illegible]
⅜-in.	[illegible]
¼-in.	[illegible]
3/16-in.	[illegible]
⅛-in.	[illegible]
No.	
8	[illegible]
20	[illegible]
30	[illegible]
50	[illegible]
100	[illegible]
200	[illegible]

The fine sand (No. 5) did not seem, however, to be as good quality as the coarse sand, there being a considerable amount of dirt in it so that it was decided not to use this. Three samples of stone were then tested and of these the results obtained with No. 3, the one used, are given below:

SAND No. [illegible]

Size sieve.	Percentage retained.
1½-in.	[illegible]
1-in.	35½
¾-in.	[illegible]
½-in.	67
⅜-in.	[illegible]
¼-in.	[illegible]
3/16-in.	[illegible]
⅛-in.	[illegible]
No.	
20	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

This stone (No. 3) was used with the coarse sand (No. 4½) and Vulcanite Portland cement in the proportion of 1 part cement, 2 parts sand and 4 parts stone, and tested. The curve obtained by this combination is shown by the dotted line on the chart. It was obvious that No. 3 stone and No. 4½ sand as they stood could not be combined into a good curve. It did seem possible, however, to modify this by screening, and after careful consideration it was decided to remove from the stone everything that would pass a ½-in. screen. This screening was done by hand on a small screen. A second trial was then made, using a mixture of 16.9 parts Portland cement and 28.7 parts sand and 53.5 parts of stone by weight. This mixture gave a curve that was practically coincident with the "Ideal" curve recommended by Taylor and Thompson. Trials for density were then conducted.

For this purpose a cylindrical can, made of riveted 7-16-in. steel plate was used. This can was 10 ins. in diameter and 15 ins. in depth. Fifty pounds of material was mixed in a metal box by hand and enough water was then added to make a mix that would barely quake when mixed. The concrete thus formed was then transferred to the cylindrical can and the distance down from the top of the can to the top of the mixture was carefully measured. The densest mix obtained was found to measure 7 ins. down from the top of the can, thus giving a total volume for the 50 lbs. of concrete of 610 cu. ins. It was also determined that a variation of ⅛ in. in height of mixture in the can above the mark set by this densest concrete corresponded to a change in volume of 1.6 per cent, thus giving a handy means of comparing any trial mixture. The density tests showed that the mixture giving a curve most nearly approximate to the Taylor and Thompson "Ideal" gave an excess volume over the best mixture of 6.4 per cent and it seemed also to be lacking in mortar.

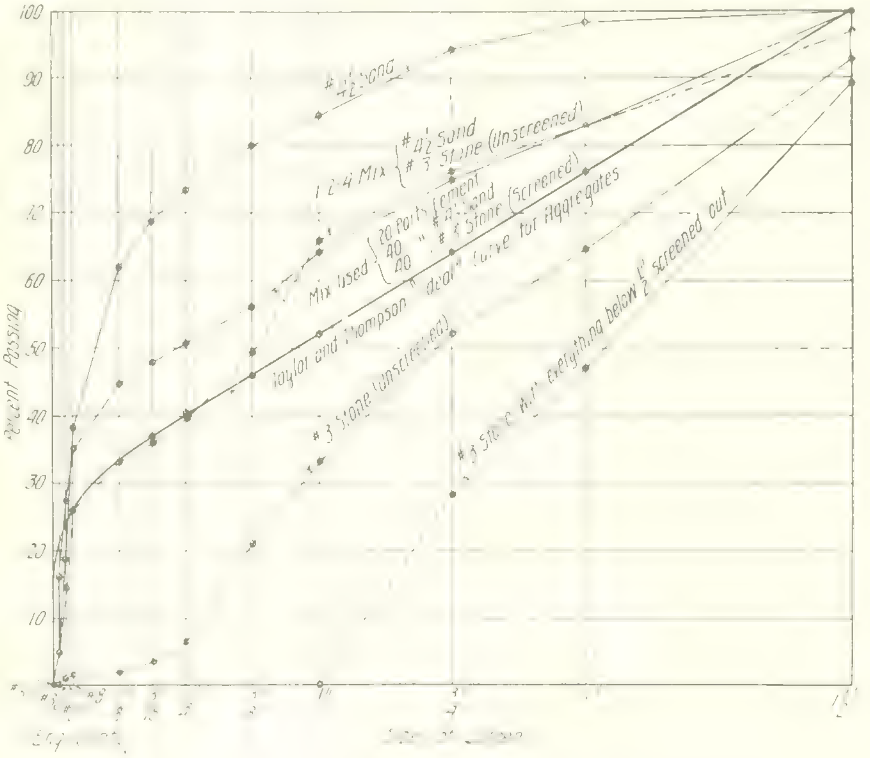
It was then decided that the concrete should be mixed so rich as to make only 12 cu. ft. to a 4-bag batch. The latter result was finally obtained with a mixture of 20 parts by weight of cement, 40 parts of No. 4½ sand and 40 parts of No. 3 stone screened to remove everything below ½ in. This mixture had the maximum density of any that [illegible] in other respects. The curve given by this mixture, however, on volumetric tests, was nearly 10 per cent higher than the "Ideal" of Taylor and Thompson at the point of tangency. In an endeavor to get even greater accuracy, a can of smaller diameter than the first was made and further tests conducted with this. Twenty eight various mixtures were tried, using this small diameter can, but the mixture mentioned above still showed the best results of any tested and it was accordingly [illegible]

Further tests were conducted for the purpose of ascertaining whether or not even greater density might be obtained by the addition of hydrated lime to the mixture. It was found that with the densest mix the addition of hydrated lime increased the volume almost directly in proportion to the amount of lime used, and therefore it was considered of little use to add lime to the concrete.

In the course of actual work on the standpipe volumetric tests were not made every time samples were analyzed, but only when they varied 2 per cent or more from those in use was the curve of the mixture worked out. As the sand and stone used were measured in wheelbarrows the quantity was subject to an unavoidable variation of 2 or 3 per cent so that it was believed to be an unnecessary refinement to carry the curves to any greater accuracy.

The amount of water added was given a great deal of consideration. It was found, I believe, that a paper recently read by Mr. Chapman before the National Association of Cement Users (Engineering-Contracting, Jan. 18, 1911), gave some data on this point—that the percentage of water added to concrete in mixing has a very marked effect upon its permeability and that even vary slight variation from the proper constituency gives much greater variations in permeability, that is, if too much water is added the resulting concrete is much less waterproof than one with the ideal amount of water. This ideal amount varies, however, for different mixtures of cement and aggregate and the nearest approximation that can be made offhand is that enough water shall be added to make a mixture which, under tamping shall show water at the surface and give what we call a dry quaking mix, that is, a mix that will not quake until it has been thoroughly tamped. With any given cement and aggregate, preliminary tests may readily be made to determine the proper amount of water to use in mixing. Once the amount which gives a dry quaking mix has been found it is simply a matter of adding this proportion of water to each batch of concrete.

In the actual mixing of the concrete on this job we followed a method somewhat different from our usual one. One-half of the stone was put in the mixer and some water. The mixer was then revolved for a minute or so and the sand and cement and the rest of the stone and water were added. The concrete was then thoroughly mixed for a total time of about 5 minutes, when the mixture was dumped and hoisted up on to the tower. The tests described were conducted by Mr. W. W. Clifford of the Aberthaw Construction Co.



Curves for Concrete Aggregates Giving Most Dense Mixtures.

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*By Angus B. MacMillan, Engineer, Aberthaw Construction Co.; remarks before the Boston Society of Civil Engineers, Dec. 21, 1910.

ROADS AND STREETS SECTION

Method and Cost of Constructing a Macadam Road in Fine Grained Loose Soil Subject to Erratic Drainage Conditions.

The improvement of a section of the road between Collinsville and East St. Louis, Ill., presented somewhat unusual conditions, which required special treatment, somewhat out of the ordinary. The stretch of road improved, about 1 mile in length, extends from the higher level land to the lower country adjoining the Mississippi bottom lands. Along the line of bluffs dividing the high and low lands are found ridges of loose soil, very fine grained, siliceous material, having rather remarkable and, to the engineer who has to deal with it, aggravating properties. A high bank of this soil will stand with a vertical wall for years, but a small stream of water will cut in an hour or so a trench a number of feet deep. A newly made fill of this soil seems to offer no resistance whatever to the action of water which will cut through and under it in a most surprising fashion.

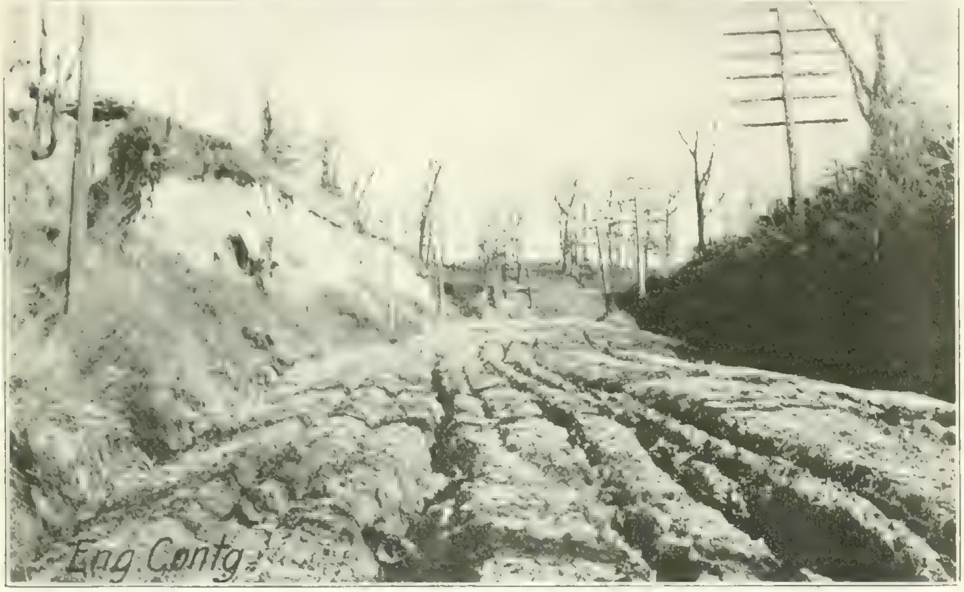


Fig. 1—Collinsville-East St. Louis Road Before Improvement, Showing Sandy Bluffs.

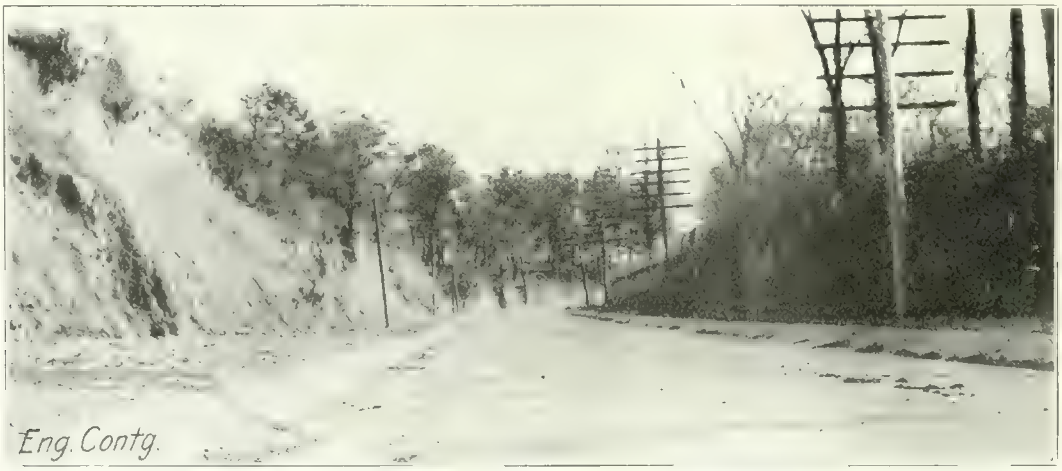


Fig. 2—Collinsville-East St. Louis Road Showing Finished Roadway and Concrete Gutters, Wing Dams Will Be Noticed at the Left.

On this road the grades, through the bluffs composed of this loose earth were 7 per cent which on account of the water main were not materially changed. Some appreciation of the erratic conditions that were encountered will be had from the accompanying illustration, Fig. 1, which shows a portion of the road before improvement. A summer shower would scour ruts and holes in the middle of the road 2 and 3 ft. deep, so that it was always a question of some doubt whether the hill could be traveled in safety after a hard rain. But what was more puzzling was the drainage system that the wash from the high banks had made. When those banks were cut into, water holes were found 15 to 25 ft. deep and a number of feet in diameter, down which water poured, only to reappear at the surface at some unexpected place. If one of the outlets were closed, the water would burst out some other point.

On either side of the road on the hill section, gullies had been scoured from 4 to 8 ft. deep. Thus it was clear that merely to macadamize the center of the road, with gutters provided in the usual way, would be but to invite sure disaster.

The methods adopted for improving this road were described in a paper by Mr. A. N. Johnson, State Highway Engineer of Illinois, presented at the recent convention of the Illinois Society of Engineers and Surveyors, and from Mr. Johnson's paper we have taken the matter in this article.

Contrary to the usual practice, it was decided to attract all the drainage water possible to the road and keep it there. The essential thing to do, as the drainage conditions made clear, was to have a definitely known channel for all water that could find its way to the road. The illustration, Fig. 2, shows the broad concrete gutters into which the water was to be guided. To get the water into the gutters and keep it from under the road, wing dams (Fig. 2) extending at right angles to the road were built across the gullies on either side for a depth of 2 to 3 ft. below the bottom of the gulley and extending well back into the banks. The outer end of the dams are a foot or so higher than the end adjacent to the gutter. Where a wing dam joined the gutter, it was turned at right angles up the hill for about 8 or 10 ft., running parallel with the outer edge of the gutter and flush with it. The first dam was built near the top of the hill and the next one placed so that its top would be about level with the bottom of the one above it. Thus, if the bank washed away or the ditch should scour, it would fill back of a dam level with its top and the water flowing in the ditch be distributed by the dam to the concrete gutter where it could do no further injury.

The construction of the road was begun at the top of the hill and worked downward. From the high banks, material was obtained to widen the road and to fill the gullies. On the road bed, graded in the usual manner, the stone was spread in two layers. The gutters were laid contiguously with the roadway and rolled, except the outer edge, which was tamped. A board served to keep the screenings from filling the gutter. After the screenings were rolled, the gutter was poured with cement grout made one to three. The outer edge of the gutter was kept in line with a piece of two by four held by stakes.

So long as the weather remained fair, all went well, but as soon as a shower occurred nearly all the unfinished portion of the macadam would be practically lost. The work was, therefore, kept as closely finished as possible, but in spite of all precautions it happened, owing to the frequent rains, that not less than 25 per cent of the work had to be done twice. Figure 3 shows a completed road.

The work was all done by day labor under the charge of J. G. Kalbfleisch, supervisor of Collinsville township. Mr. W. E. Howden was resident engineer in charge for the Illinois Highway Commission. The rock was furnished f. o. b. at the Chester prison. The following are the cost items, which are not considered excessive when the difficulties encountered during the construction are considered. That the cost was not much greater is due to the excellent management of those in immediate charge of the work.

The cost of the work is given in detail in the following tables:

Length of road—5,520 ft.
Width of macadam—1,680 ft. 20 ft. wide, 3,840 ft. 16 ft. wide.
Macadam laid—10,560 sq. yds.
Stone in road—3,667 cu. yds.
Stone used for concrete walls and gutters—316 cu. yds.
Stone hauled from storage pile—2,500 cu. yds.
Stone hauled from cars—1,583 cu. yds.
Concrete in walls, etc.—67 cu. yds.
Grouted gutter, 6 ft. wide, 6 in. deep—3,360 lin. ft.
Average haul of stone—2 miles.
Contract price for stone hauling 75 cts. per ton.
Rate of pay: Men, 20 cts. per hour; teams 50 cts. per hour.

COST OF LABOR AND SUPPLIES

Superintendence	$ [illegible]
Excavation	984.25
Shaping roadbed	95.45
Unloading stone to storage pile	533.10
Hauling stone, including reloading	2,446.30
Spreading stone	346.50
Trimming shoulders and side roads	82.75
Rolling and sprinkling	386.00
Watchman and miscellaneous labor	[illegible]
Coal, oil and supplies	105.40
Freight on stone	3,202.64
Cement	[illegible]
Lumber for forms	[illegible]
Tile	[illegible]
Sand for concrete work	104.24
Mixing and placing grout for concrete	572.35
Total	$9,985.16

COST OF GROUTED GUTTER PER LINEAR FOOT

	Total.	Per lin. ft.
Length of gutter, feet	[illegible]	
252 yds. stone at $1.55 on road	$390.60	$0.116
Cement and sand	457.85	.136
Mixing and placing grouting	476.95	.142
Total (3,360 lin. ft. 6 ft. x 6 in. gutter)	$1,321.80	$0.394

COST OF PLAIN CONCRETE WORK

	Total.	Per cu. yd.
64 cu. yds. stone at $1.55	$ 99.20	$1.550
Cement and sand	91.53	1.430
Mixing and placing	95.40	1.490
Total (64 cu. yds. plain concrete)	$286.13	$4.470

COST PER CUBIC YARD FOR PLACING STONE.

	Per cu. yd.
Unloading stone from cars to storage pile	$0.213
Hauling stone including reloading	.661
Spreading stone	.095
Rolling and sprinkling	.105
Watchman and miscellaneous labor	.062
Coal, oil and supplies	.028
Total (3,667 cu. yds.)	$1.167

COST PER SQUARE YARD FINISHED MACADAM

	Per sq. yd.
Superintendence	$0.0374
Excavation	.093
Shaping road bed	.009
Trimming shoulders and side roads	.0078
Placing stone	.383
Freight on stone	.305
Total (10,560 sq. yds.)	$0.8352

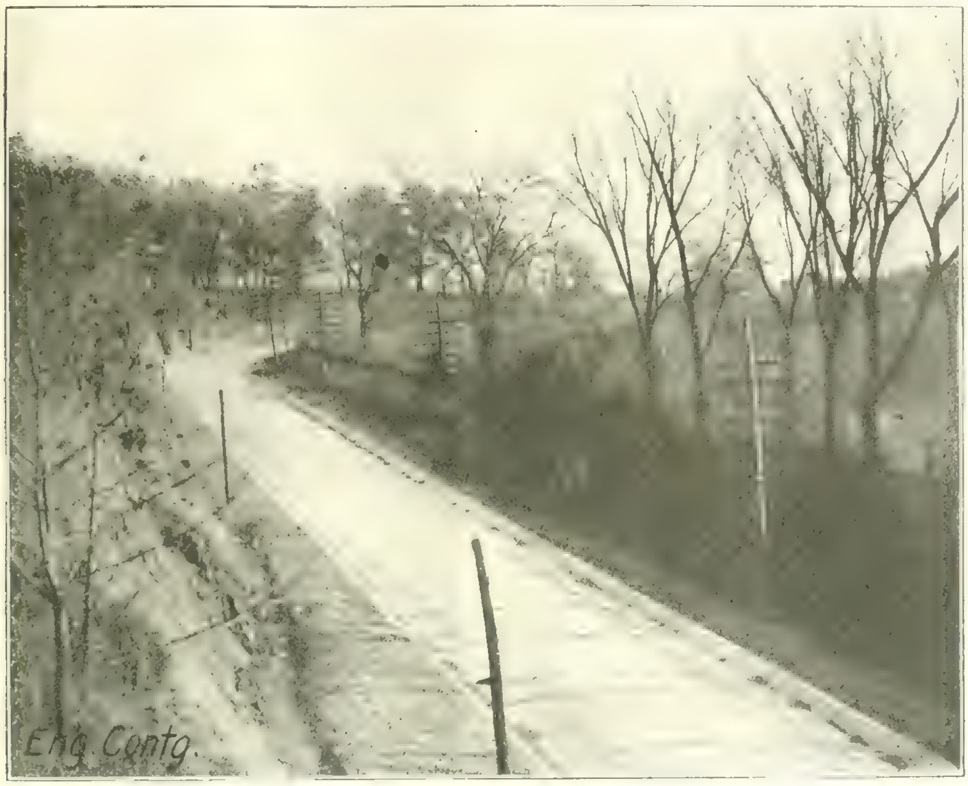
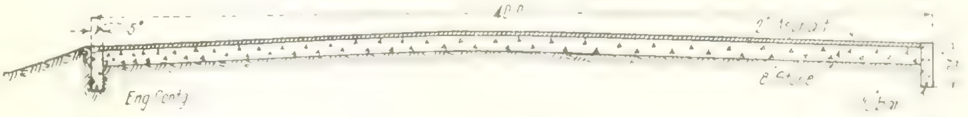


Fig. 3—Collinsville-East St. Louis Road After Improvement, Showing Concrete Gutters.

Methods and Cost of Constructing an Asphalt Surface Drive and Novel Form of Concrete Curb in Lincoln Park, Chicago.

During the spring and summer of 1910 numerous improvements and extensions were made in the drives of Lincoln Park, Chicago. Among these was the construction of a 40 ft. drive, which extended the Sheridan Road pavement for a distance of 4,631 ft. The design of the street is unique in that it is so built as to allow the water to run off the street onto the lawn at the side, which is graded so as to form a hollow [illegible] each side of the road. The road is 40 ft. wide with a 7-in. crown, and has 2 ins. of asphalt on an 8-in. base of crushed stone. At the sides of the drive are reinforced concrete curbs 5 ins. thick, extending from the surface of the street 24 ins. deep [illegible] surfaced with [illegible] ½ lb. of lamp black per bag of cement, for the purpose of giving the top of the curb the same appearance as the asphalt street.



Section of Asphalt Surfaced Drive Showing Sunken Concrete Curb.

The material upon which the road was built consists of a gumbo clay. A stretch of about 300 ft. of this had to be taken out to a depth of from 3 to 5 [illegible] used on the crushed [illegible] produce a satisfactory surface on account of the soft clay. A 15-ton Springfield roller was used for the stone [illegible] asphalt. The stone was brought in barges from the Artesian Stone Co.'s plant on the Chicago Drainage Canal and landed at the park docks. At the docks the barges were unloaded with a clamshell bucket operated by a derrick and the material dumped into an elevated bin of about 10 cu. yds. capacity. Troy wagons were driven under the bin to receive their loads. The road work paralleled the shore line of the lake at only a short distance from it so the length of haul was not great.

Curb.—The concrete curb was formed by 16 ft. panel forms, of which there were about 500 lin. ft. employed. The curb was reinforced with three ½-in. square bars as shown in the accompanying section of the street. These were 20 ft. long and lapped 6 ins. at the ends. They were suspended in the forms in templets made of a ¼-in. piece of pine, which was left in place to form the expansion joint.

The cost of excavation for the curb is included in the cost given for the curb itself, and that for placing the stone includes the cost of the preparation of the road bed for receiving the stone. In this work a large amount of local rubble stone was mixed in with the crushed stone, the object being to fill up the deeper places, as far as possible, with local material.

The building of the concrete curb was started on April 14, 1910, and was completed June 29th. The costs of the 9,263 lin. ft. of curb follow. Foremen's rates are monthly and sub-foremen daily:

Labor.	Time.	Rate.		Total.
Engineering	hrs.	.....		$ 136.47
Foreman	[illegible]	[illegible]	mo.	48.60
Sub-foreman	[illegible]	[illegible]	d.	222.16
[illegible]	343	.66⅔	hr.	228.67
[illegible] wagons	11	[illegible]	[illegible]	14.00
Common labor	24	.38½	hr.	9.20
Common labor	[illegible]	.30	hr.	279.60
Common labor	[illegible]	[illegible]	d.	106.11
Common labor	17,500	.25	hr.	4,395.00
Skilled labor.				
Carpenters	[illegible]	.62½	hr.	157.50
Carpenters	[illegible]	.60	hr.	33.60
Timekeepers	1	55.00	mo.	3.06
Timekeepers	[illegible]	55.00	mo.	20.40
Teamster	[illegible]	2.62½	day	.87
Teamster	320	60.00	mo.	81.56
Tools				19.24
Total cost				$5,881.59
Labor cost per lin. ft.				$0.64

Material.	Quantity.	Price.
Cement at $1.25 per bbl.	495	$ 621.88
Crushed stone at $1.50 per cu. yd.	318	477.00
Torpedo sand at $1.60 per cu. yd.	213	340.80
Lamp black at $0.08 per lb.	124½	9.94
Reinforcement rods at $43.00 per ton	12.64	543.52
Total		$1,993.14
Cost of material per lin. ft.		.21

The cost of form lumber is not included.

Unit Costs of Curb.

	Cost per lin. ft.
Engineering	[illegible]
Foremen	[illegible]
Carpenter labor	.022
Common labor	.517
Transportation	[illegible]
Miscellaneous	.015
Total labor	[illegible]
Material	.21
Total cost per lin. ft.	[illegible]

Crushed Stone Base.—The work of placing stone was carried over from the previous year at which time some stone had been deposited for use at various intervals of time. The stone was placed on the road about 8 ins. thick and covered an area of 23,160 sq. yds. The costs of this work, which follow, include the local rubble stone which was also placed in the work to help fill out.

Labor.	Time.	Rate.		Total.
Engineering				$ [illegible]
Foreman	[illegible]	[illegible]	mo.	[illegible]
Foreman	[illegible]	[illegible]	mo.	[illegible]
Foreman	514	3.00	day	171.50
Sub-foreman	170	2.40	day	51.15
Sub-foreman	99½	2.25	day	27.98

[illegible]	[illegible]	[illegible]		1,019.33
[illegible]	,331	.25	hr.	[illegible]
Single teams......	[illegible]	.12½	hr.	31.31
[illegible]	[illegible]	.38½	hr.	37.94
Common labor....	[illegible]	.30	hr.	17.70
[illegible]	332	[illegible]	[illegible]	92.53
Common labor....	[illegible]	.25	hr.	6,314.25
[illegible]				
[illegible]	[illegible]	.50	hr.	464.25
[illegible]	28	.55	hr.	56.54
[illegible]		65.00	mo.	7.48
[illegible]	153	[illegible]		44.77
Teamster	2,[illegible]	60.00	mo.	619.76
[illegible]	[illegible]	3.85	[illegible]	107.80
[illegible]	[illegible]	4.34	day	217.00
[illegible]	[illegible]	[illegible]		473.88
[illegible]		45.00		[illegible]
[illegible]				564.71
[illegible]				[illegible]

Total labor cost per sq. yd.....................$0.498

Material.	Quantity.	Price.
Crushed stone at $1.65 per cu. yd.	[illegible]	[illegible]
Crushed stone at $1.50 per cu. yd.	3,453.78	5,181.68
Crushed stone at $1.40 per cu. yd.	464.25	649.95
Crushed stone at $1.00 per cu. yd.	167.50	167.50
Crushed stone at $0.70 per cu. yd.	[illegible]	[illegible]
Crushed stone at $1.50 per cu. yd.	[illegible]	[illegible]
Total		[illegible]
Cost of material per sq. yd.		$0.394

Unit Costs of Crushed Stone Base.

	Cost per sq. yd.
Engineering	$0.010
Foreman	.020
Skilled labor	.049
Common labor	.284
Transportation	.089
Miscellaneous	.046
Total labor	$0.498
Material per sq. yd	.394
Total cost per sq. yd. 8" deep.........	$0.892

The 70 ct. stone was that brought by barges from the Drainage Canal and the price is for stone at the quarry. The $1.00 stone was purchased from a material yard and does not include hauling. The other stone items show the prices paid for stone delivered from various material yards at different seasons of the year.

[illegible]—The total amount of asphalt upon the street amounted to 22,318 sq. yds. and was placed 2 ins. thick. The material was mixed in a Link Belt Co. asphalt mixer in the following proportions:

	Lbs.
1 part torpedo sand..........................	168
1 part bank sand..............................	168
[illegible] stone	504
Asphalt	81
Total 7 cu. ft. or 1 box....................	921

The asphalt used was a fluxed Gilsonite. Part of the work was done with Sarco and part with Pioneer asphalt. Although the work has not yet been laid one year, it has nevertheless shown no signs of wear or deterioration under a heavy automobile traffic. The asphalt work was commenced April 29th, and was completed July 9th, 1910. The costs follow:

Labor.	Time.	Rate.		Total.
[illegible]	[illegible]			$[illegible]
[illegible]	[illegible]	$[illegible]	mo.	362.01
[illegible]	[illegible]	[illegible]	[illegible]	1.07
[illegible]	[illegible]	[illegible]	d.	9.33
[illegible]	[illegible]	[illegible]	[illegible]	1.10
[illegible]	[illegible]	[illegible]	[illegible]	159.29
[illegible]	[illegible]	.25	hr.	105.38
[illegible]	[illegible]	.12½	hr.	57.63
Common labor....	1,579	.38	hr.	608.10
Common labor....	18	.35	hr.	5.30
Common labor....	1,510	.30	hr.	[illegible]
[illegible]	[illegible]	2.50	[illegible]	3.61
[illegible]	[illegible]	.25	hr.	4,030.63
[illegible]	[illegible]	[illegible]	[illegible]	25.25
[illegible]	[illegible]	.50	hr.	918.25
[illegible]	[illegible]	[illegible]	[illegible]	153.12
Machine man.....	325	[illegible]	[illegible]	100.17
[illegible]	[illegible]	2.62	[illegible]	2.34
[illegible]	[illegible]	60.00	mo.	224.70
[illegible]				[illegible]
[illegible]				60.00
[illegible]				[illegible]
[illegible]				[illegible]

Material.	Quantity.	Price.
[illegible]	[illegible]	[illegible]
[illegible]		[illegible]
Crushed stone at $1.50 per cu. yd.	371.0	556.50
Crushed stone at $0.70 per cu. yd.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Sarco asphalt at $24.00 per ton	52.91	1,269.84
Pioneer asphalt at $19.44 per ton	239.85	4,663.32
Total cost of material.		[illegible]

Cost of material per sq. yd.....................	$0.394
Cost of labor and material per sq. yd......	$0.746

	Per sq. yd.
Engineering	$0.003
Foreman	.017
Skilled labor	.234
Common labor	.048
Transportation	.026
Miscellaneous	.024
Total labor per sq. yd.............	$0.352
Material	.394
Total cost per sq. yd.	$0.746

SUMMARY OF COSTS.

Labor on stone, per sq. yd...............	$0.498
Labor on asphalt, per sq. yd	.352
Stone for base, per sq. yd	.394
Asphalt material, per sq. yd.............	.394
Total cost per sq. yd.............. ...	$1.638
Labor cost on curb, per lin. ft....... ..	$0.64
Material cost on curb, per lin. ft....	.21
Total cost of curb per lin. ft...........	$0.85

The above figures are based upon a nine hour day.

Plant.—The plant used on the work is the property of the Lincoln Park System. All repairs and operations are charged into the work but no charge for depreciation is made against the work.

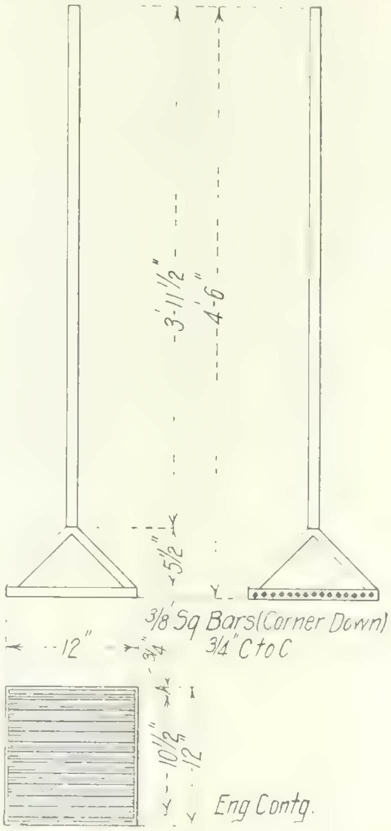
The cost of the plant is as follows:

Link Belt Co., asphalt mixer.............	$ 5,590
Gasoline tractor	1,2[illegible]
6-ton roller	1,8[illegible]
15-ton roller	1,500
Asphalt tanks and tools..................	1,000
Total value of plant.....................	$11,090

We are indebted for information and costs shown in the above description to Mr. W. T. Colman, Engineers of the Lincoln Park Extension and to Mr. M. H. West, Superintendent of the Lincoln Park System.

5-in. Concrete Pavement Laid in One Course.

A considerable amount of concrete pavement is to be constructed this year for the city of Sioux City, Ia., under specifications which are somewhat of a departure from those heretofore used for this type of pavement. The greatest change is that the Sioux City pavement is to be laid practically in one course. Another departure is the use of but 5 ins. of concrete instead of 7 ins. For securing a smooth surface without the use of a top coat, the special bar tamper shown in the accompanying cut will be used. This bar tamper has been perfected by Mr. Keyes C. Gaynor, City Engineer of Sioux City. It is made of ½-in. square steel bars placed ¼ in. apart and set so as to strike diamond wise. This, it has been found, drives down in tamping, everything larger than ¼ in. and everything smaller than ¼ in. comes up between the bars. The result is the securing of practically 4½ ins. of coarser materials and ½ in. of top coat, all made and laid at one operation. Regarding this tamper Mr. Gaynor informs us that there are several minor changes that could be made in the tamper to advantage, such as making the tamper a little lighter and not letting the outside edge project beyond the face of the tamper. The main features of the Sioux City specifications as prepared by Mr. Gaynor are as follows:



Tamper for Concrete Pavement Construction.

Fine aggregates shall consist of sand, crushed stone or gravel screenings, graded from fine to coarse, passing when dry a screen having ¼ in. diameter holes, shall be preferably of silicious materials, clean, coarse, free from loam, vegetable or other deleterious matter, and not more than 3 per cent shall pass a sieve having 100 meshes per linear inch.

Coarse aggregates shall consist of inert material, graded in size, such as crushed jasper, granite or gravel, which is retained on a screen having ¼ in. diameter holes, shall be clean, hard, durable and free from all deleterious matter. Aggregates containing soft, flat or elongated particles shall be excluded. The maximum size of the coarse aggregate shall not exceed that which will pass a 1½ in. ring.

Expansion joints ½ in. wide shall be placed across the street every 50 ft. between the curbs or edge of the gutters. All boards for expansion joints shall be made in the form of a template, cut to the desired shape of the street according to plans for detail of each street, and shall not project above the finished pavement. Contraction joints shall be cut entirely through the pavement on the streets as shown on the plan for detail of each street.

The expansion joint filler shall be a suitable elastic, waterproof compound that will not become soft and run out in hot weather or hard and brittle and chip out in cold weather.

The concrete for the base shall be so proportioned that the cement shall overfill the voids in the fine aggregate by at least 5 per cent, and the mortar shall overfill the voids in the coarse aggregate by at least 10 per cent. The proportions shall not exceed 1 part cement to 7½ parts fine and coarse aggregates.

When the voids are not determined the concrete shall have the proportions of 1 part cement, 3 parts fine aggregate and 4½ parts coarse aggregate.

The ingredients of the concrete shall be thoroughly mixed dry, sufficient water added to obtain the desired consistency, and the mixing continued until the materials are uniformly distributed and the mass is uniform in color and homogeneous.

When the conditions will permit, a machine mixer of a type which insures the uniform proportioning of the materials throughout the mass shall be used.

When it is necessary to mix by hand, the mixing shall be on a water tight platform and the materials shall be turned until they are homogeneous in appearance and color.

The materials shall be mixed wet enough to produce a concrete of the consistency that will flush readily under light tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar and which will not creep towards the curb or sag out of place when deposited and [illegible] tamped.

Retempering, that is, remixing with additional water, mortar or concrete that has partly hardened, will not be permitted.

The concrete shall be deposited in strips extending the full width of the area paved. After the addition of water the mixture shall be handled rapidly to the place of final deposit. Under no circumstances shall concrete be used that has partly hardened.

Concrete shall not be mixed or deposited when the temperature is below freezing, and shall be protected against frost until thoroughly hardened. Concrete shall not be mixed or deposited when the temperature is too high and all work shall be covered as directed by the City Engineer.

Workmen shall not be permitted to walk on freshly laid concrete, and where sand and dust collect on the base it shall be removed carefully before the wearing surface is applied. A practical skilled workman shall do the spreading of the concrete and the finishing of the surface.

After the concrete is deposited it shall be tamped as directed by the City Engineer and his inspector on the job, after the tamping, enough dry mixture, mixed 1 part cement and 1 part fine screened sand, to be spread over the surface in sufficient quantity to take up the surplus moisture. The surface must be then floated to true grade. If the concrete has not been graded to get a surface sufficiently true it shall be brought to a true surface by a mixture of 1 part cement and 1½ parts coarse sand before the dry mixture is applied.

The wearing surface shall be spread on the base immediately after mixing, and in no case shall more than 50 minutes elapse between the time that the concrete for the base is mixed and the time the wearing surface is floated.

The wearing surface shall be finished with a wood float, and before it has completely hardened it shall be roughened by brushing with a stiff vegetable fibre brush or broom.

When the surface is to be corrugated the grooves shall be approximately ⅜ in. deep and ¼ in. wide with the edges neatly rounded to prevent chipping or spalling. The grooves shall be perpendicular to the axis of the street and be approximately 6 in. center to center. After grooving, the surface shall be roughened by brushing as above specified.

The edges of all expansion and contraction joints shall be rounded to a radius of about ½ in.

When complete, the pavement shall be well sprinkled with water for a period of at least three days and shall not be thrown open to traffic until the Engineer so directs and shall be covered with 1 in. of yellow clay, if so directed by the City Engineer.

In laying the pavement work shall be started at the bottom of the hill and carried up.

Cracking of Cement Grouted Brick Pavements—Causes and Remedies.*

The first essential to be recognized in the study of the cause of the failure of cement filled, or "grouted," brick or block pavements, by cracking of the paved surface, is that these failures are due not to a single cause, but to several distinct and widely differing causes. A fairly careful investigation of available literature on brick pavement construction has failed to bring to the writer's attention any competent analysis of these various causes of failure and the corresponding remedies.

The following are causes of cracks in brick or block pavements which the writer has observed; and they are placed, he believes, in the order of their importance and frequency of occurrence, and will be discussed separately in that order:

(1.) Frost.
(2.) Expansion.
(3.) Settling of Sand Cushion.
(4.) Settling of Sub-grade.
(5.) Contraction between transverse expansion joints.

The writer fully appreciates the fact that this is not the order of precedence in which these causes of failure would be placed on information obtained from the preponderance of technical literature on the subject, but he believes that careful observation will prove it to be the correct arrangement, nevertheless.

CRACKS DUE TO FROST.

The writer's observations seem to him to prove beyond doubt that the longitudinal crack along the crown of the pavement (or sometimes several feet to one side of the crown) are nearly always, if not always, caused by frost. This is the cause which the average layman usually assigns, and perhaps that is the reason that the average engineer, in his assumption of wisdom, is convinced that it is the wrong solution. The following observations support the layman's theory:

(a) These longitudinal cracks invariably first appear in the form of a very small and insignificant appearing crack, when the snow goes off in the spring.

(b) Where the sub-soil is clay, the cracks are found where ample expansion joints are provided next the curb, as well as where there are no expansion joints.

(c) Where the sub-soil is sand, or on fills where there is good natural drainage, these cracks are "conspicuous by their absence," even where there are no expansion cushions.

(d) The cracks follow along the line of travel on the street (usually along near the crown), where the snow is packed by traffic during the winter and the frost penetrates deepest. Where there are one or more car tracks on the street, there is usually a crack along the driveway each side of the tracks, if the subsoil is impermeable clay or of such a nature as to retain water. At intersecting streets which cross the paved street, the crack does not continue across the intersection (presumably because the travel across the street and around the corners packs the snow and permits the frost to penetrate over sufficient area to raise the pavement uniformly without breaking it); but where the intersecting street comes in from one side only, the crack runs off toward the opposite curb as it approaches the intersection, and continues across the intersection, coming back to the crown again on the other side.

(e) A careful examination of the concrete foundation under the longitudinal crack will reveal the fact that the foundation is also cracked.

Is this expansion? And yet the specifications of the National Brick Manufacturers' Association, admirable and complete in most respects, make no provision for drainage except the statement that "If the ground is spouty clay, tile drainage should be provided to carry off the accumulation of wet"; and even this meagre suggestion is modified by the statement that "Underdrainage is not absolutely essential, but in wet and spouty clay understratum much is added to the durability of the structure by keeping the sub-foundation dry, and under foregoing wet conditions is the only way to accomplish the best results." No mention of frost! The report of the Asphalt Committee of the Organization for Standardizing Paving Specifications provides for drainage "when the soil is of such a character that it retains an excessive amount of moisture, such as clays subject to swelling or heaving under the action of frost"; but the report of the Brick Committee makes no mention of underdrainage. Technical books also are uniformly vague on this subject, and the inexperienced engineer has little indeed to warn him of the danger of frost.

Inasmuch as it is an established fact that frost has no tendency to swell or heave any kind of soil from which the moisture is thoroughly drained, the writer ventures the opinion that the best way to prevent this form of cracking is to provide a suitable drain under each curb where the sub-soil is clay, and connect same with sewer inlets. Such drains should be placed about 3 ft. below the top of the curb, and the trench over the drain filled up to the bottom of the curb with coarse material such as cinders or small field-stone.

Placing cross-drains under the pavement is probably to be discouraged, as water cannot penetrate through the pavement after it is once built, and there seems to be little necessity for making provision for carrying water from the middle of the pavement toward the curbs; and these cross-drains tend to carry water under the pavement during the wet season, where it may percolate through the sub-grade, rather than to remove it.

Too shallow side drains are also to be guarded against. Also, the writer does not consider his observations sufficiently final to warrant the omission of expansion cushions next the curb, in view of the fact that all modern paving specifications require such expansion cushions. His personal opinion, however, is that they seldom if ever serve any useful purpose except on very wide pavements. It is undeniably true that after the crack is once started it continues to widen from the action of alternate expansion and contraction; but he has never seen a crack of this kind that appeared to have been caused by expansion originally.

CRACKS DUE TO EXPANSION.

Expansion cracks occur on a hot day in summer, usually at a crown in the longitudinal grade of the paved street, when several courses of brick are sometimes thrown into the air with considerable violence, and when the repair gang comes to relay them they find that there is at least one row of the blocks which were thrown out that cannot be relaid. This form of cracking is quite spectacular, but at the same time the damage to the pavement is comparatively slight and easily repaired.

Where there is no abrupt change of grade to permit the pavement to buckle, the observations of the writer seem to indicate that the filler between the brick courses is sometimes crushed in places, and the surface cracked into diamond-shaped or triangular divisions, the cracks following the joints and seldom breaking a brick. If there is a bond or angle in the paved street, the effect of expansion will be carried to this point of weakness, and will shove the angle considerably out of line.

The specifications of the National Brick Manufacturers' Association provide expansion cushions along the curbs only—no transverse joints. The report of the Brick and Granite Block Committee of the Organization for Standardizing Paving Specifications also provides for longitudinal expansion joints only, being practically copied from the specifications of the National Brick Manufacturers' Association. I understand that the secretary of the Association, Mr. Will P. Blair, maintains that the longitudinal expansion, failing to find room to act longitudinally, is in some mysterious manner transformed into transverse expansion, and is then taken care of by the side cushions. This may be true to the extent that the breaking of the surface into diamond-shaped or triangular areas probably has a tendency to force the brick apart and outward toward the curb to some extent; but this is taking care of the expansion after it has done its damage.

These diagonal cracks, zig-zaging along the brick joints, are inconspicuous, and in fact are often not visible except at such times as foggy mornings, when each crack is outlined by a line of moisture. They are not conspicuous like the longitudinal crack caused by frost, and make no spectacular explosion like the failure by buckling of the paved surface; but they extend over the whole surface of the pavement, tending to destroy its waterproof condition, and forming starting points for the jar of heavy traffic to begin its destructive action; and no doubt shorten the life of the pavement much more than the widely advertised buckling, which is all in one place and easily repaired.

It is believed that the most logical method of preventing this form of failure is to provide frequent transverse expansion joints, and that these joints are best formed by laying several courses of brick about ¼ in. apart and filling these ¼-in. joints with a suitable bituminous filler before grouting the balance of the pavement.

The use of single expansion joints ½ in. or more in width is to be condemned for several reasons: It makes a bump for loaded vehicles, causing a hammering action on the adjoining brick which soon loosens them, and the fault thus started spreads rapidly under traffic; the bituminous filler is very apt to run in a wide joint; from the crown toward the curbs; in warm weather the expansion sometimes forces the bottoms of the blocks next the expansion joint together, while the tops are held apart by earth, etc., which has become packed into the joint, causing the brick to heave up next the joint.

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*From a paper by Earle R. Whitmore, City Engineer, Port Huron, Mich., presented at the annual meeting of the Michigan Engineering Society at Lansing, Jan. 10-12, 1911.

CRACKS DUE TO SETTLING OF SAND CUSHION.

This occurs from several sub-causes:

(a) If the sand cushion is spread on a macadam foundation, it is apt to work down into the foundation in places and cause unequal settlement, thereby breaking the paved surface. One or two cities, at least, have had disastrous results from attempting to lay brick pavements on macadam foundation in this manner. It could probably be avoided by filling and rolling the macadam foundation in about the same manner as for a finished macadam pavement, but there would usually be no economy in that. It is believed that a good concrete foundation is the most economical in the long run, except possibly under some very exceptional conditions.

(b) If sufficient care is not exercised in forming the surface of the concrete foundation parallel with the plane of the required pavement surface, the sand cushion will be of varying thickness and therefore liable to settle unevenly.

(c) The foundation having been properly laid, if the cushion is carelessly luted it will still be of unequal thickness; or if spread with a templet, and the templet is not carried back and drawn over the surface several times, the surface will invariably be wavy and cushion of unequal thickness. It is a serious mistake to leave the sand cushion uneven, depending on the rolling to level it. The roller will probably make it appear quite level, but some of the blocks will be well bedded while others will have received practically no benefit from the rolling, and these will naturally settle later under traffic.

(d) If the sand is partly dry and partly moist when spread, it will naturally settle unevenly. If the sand were all uniformly moist, the settlement would perhaps be as uniform as though dry sand were used; but a pile of sand is often dry on the outside and damp inside, or vice versa, and may not be thoroughly mixed in spreading. When such sand is used it should be dried, or if it were moistened uniformly by sprinkling the same purpose might be served.

Cracks caused by settling of sand cushion are usually roughly rectangular, do not break across the bricks, and the inclosed rectangle drops below the balance of the pavement. These rectangles vary in size from two or three bricks to several square yards. They go down under traffic sufficiently heavy to break the bond of the grout, and if the bond does not break an arch is formed, giving rise to the rumbling noise so often complained of. If not repaired at once the fault spreads rapidly, under the hammering action of traffic, over the surface of the adjoining pavement.

The proper thickness of the sand cushion has been the subject of much discussion. The writer believes that any thickness from 1 to 2 ins. is all right, if properly applied. Some have claimed that a mortar-bed, in place of the sand cushion, is the panacea for all these difficulties. It is probable that a mortar-bed properly prepared would give satisfactory results, as it has been extensively and successfully used for creosoted wood block pavements. The sand cushion is probably equally good, or better, if carefully and properly handled.

CRACKS DUE TO SETTLING OF SUB-GRADE.

This form of failure is also due to various sub-causes:

Pavements laid across fills are very apt to settle. It is only with the greatest care that a fill can be made so that it will not settle more or less.

Improperly filled trenches for sewer, water and gas pipes, etc., often cause settlement many years after the pavement is laid. The pavement arch is strong enough, perhaps, to bridge the trench when settlement first starts, but as the earth from the sides of the trench is gradually jarred down the span widens until it becomes too broad to support the load of traffic. Too great care can hardly be exercised in properly backfilling such trenches.

Very wet and undrained sub-grade sometimes is the cause of this trouble. Suitable side drains would usually remedy the matter when moisture is the cause.

CRACKS DUE TO CONTRACTION BETWEEN TRANSVERSE EXPANSION JOINTS.

When expansion joints are placed a considerable distance apart, it is noted that fine cracks appear at intervals, following the grouted joint from curb to curb. Where expansion joints are 50 ft. apart two such cracks appear in the 50 ft., dividing the pavement into sections about one rod in length. These cracks are hardly noticeable, and sometimes can only be observed at certain times when outlined by moisture.

It is believed that they should be obviated by placing the transverse expansion joints only about 15 ft. or a rod apart. It would then be necessary to fill only one or two joints with the bituminous filler at each place.

WATER-WORKS AND SEWERS SECTION

Cost of Constructing Reinforced Concrete Pipe Sewers at Mishawaka, Ind.*

The following data in regard to the cost of two reinforced concrete sewers, which were constructed at Mishawaka, Ind., during the year of 1909, has been compiled from reports of the inspectors on the different contracts and from notes taken by the writer.

In the spring of 1909 bids were received by the city for the construction of the Laurel St. trunk sewer which was 3,480 ft. long and 36 ins. in diameter, the average cut being 10 ft. and the excavation sand and gravel.

The specifications were drawn to include brick, monolithic and reinforced concrete pipe. When the bids were opened it was found the lowest bidder proposed to use the Jackson Reinforced Concrete Pipe Co.'s pipe and was awarded the contract. The cost of construction was about as follows for 3,480 lin. ft. of 36-in. reinforced pipe:

	Total.	Per ft.
1 foreman, 1,740 hrs. at 40 cts. per hr.	$ 696.00	$0.20
2 pipe layers, 3,480 hrs. at 25 cts. per hr.	870.00	.25
1 joint maker, 1,740 hrs. at 20 cts. per hr.	348.00	.10
1 pipe lower, 1,740 hrs. at 20 cts. per hr.	348.00	.10
1 mortar mixer, 1,740 hrs. at 20 cts. per hr.	348.00	.10
2 pipe rollers, 3,480 hrs. at 20 cts. per hr.	696.00	.20
2 sheeters, 3,480 hrs. at 25 cts. per hr.	870.00	.25
1 helper, 1,740 hrs. at 20 cts. per hr.	348.00	.10
6 men excavating, 10,440 hrs. at 20 cts. per hr.	2,088.00	.60
1 team and helper, 1,740 hrs. at 60 cts. per hr.	1,044.00	.30
1 water boy, 1,740 hrs. at 10 cts. per hr.	174.00	.05
Cement, sand and gravel for joints	313.20	.09
City water for flushing trench	69.60	.02
Amount paid the Jackson Reinforced Pipe Co. for the pipe along line of ditch	6,264.00	1.80
Total cost	$14,476.80	$4.16

In the above contract the Reinforced Concrete Pipe Co. made the pipe along the line of the sewer and assumed all risk in regard to the pipe and furnished them to the contractor for $1.80 per lin. ft. measured in the ditch.

In the same year the Common Council also received bids for the Logan Street trunk sewer which has 1,690 lin. ft. of 42-in. and 1,450 lin. ft. of 36-in. pipe. The contract was let with Jackson pipe also, the lowest bid being on their construction.

The average cut was 16 ft. in sand and gravel with a small amount of water bearing gravel in the bottom, but not enough to require a pump. In this contract the contractor built the pipe and furnished all common labor and material and the Jackson Pipe Co. furnished the forms, reinforcement and a competent superintendent to see that the pipe were made properly. Their charge being $1.15 per lin. ft. for the 36-in. pipe and $1.45 per lin. ft. for the 42-in. pipe.

Sand and gravel delivered along the line of the contracts cost 60 cts. per cu. yd., common labor 20 cts. per hour, teams 40 cts. per hour and cement $1.25 per barrel. Calculated on the above basis the cost of construction was about as follows for 1,450 lin. ft. of 36-in. concrete sewer.

	Total.	per ft. Cts.
1 foreman, 725 hrs. at 45 cts. per hr.	$ 326.25	.22
2 pipe layers, 1,450 hrs. at 25 cts. per hr.	362.50	25
1 joint maker, 725 hrs. at 25 cts. per hr.	181.25	12½
1 mortar mixer, 725 hrs. at 20 cts. per hr.	145.00	.10
1 pipe lower, 725 hrs. at 20 cts. per hr.	145.00	.10
2 men rolling pipe, 1,450 hrs. at 20 cts. per hr.	290.00	.20
3 men sheeting, 2,175 hrs. at 25 cts. per hr.	543.75	.37½
8 men excavating, 5,800 hrs. at 20 cts. per hr.	1,160.00	.80
1 team and helper, 725 hrs. at 60 cts. per hr.	435.00	30
1 water boy, 725 hrs. at 15 cts. per hr.	108.75	.07
Cement, Sand and gravel for the joints	130.50	.09
City water for flushing trench	29.00	.02
Total	$3,857.00	$2.65

The cost of making pipe was as follows:

	Total.	Cts. per ft.
5 men 411 hrs. mixing concrete, etc., at 18 cts.	$ 740.00	.12
280 bbls. of cement at $1.25 per bbl.	350.50	.24

INSPECTOR'S REPORT.

South Bend, Ind. 191

Grade, Curb and Walk Improvements on .... Side of

........................Street (Ave.), between

.... Street and .... Street

Amount of Walk laid ....Sq. Ft.

Amount of Curb laid........................Lin. Ft.

Amount of Grading........................Cu. Yds.

Amount of Gravel used........................Cu. Yds.

No. of men employed grading........................

No. of men employed mixing, etc. ....

No. employed finishing ....

No. of teams employed........................

Kind of cement used........................

Method of Mixing—Machine or hand........................

No. of hours worked........................Weather........................

City water used for ....

Signed ....

Inspector

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*A paper by Wm. P. Moore, City Engineer, Mishawaka, Ind., before the Indiana Engineering Society, Annual Convention, January, 1911.

INSPECTOR'S REPORT.

South Bend, Ind., ... 191
Improvement on..........................Street (Ave.).
Amount of .... inch pipe laid .... feet.
Amount of .... inch pipe laid .... feet.
Amount of .... inch pipe laid .... feet.
Amount of .... inch pipe laid .... feet.
No. of men employed on main sewer....................................
No. of men employed on house connections..............................
No. of men employed on storm water connections........................
Manholes (single-ring, double-ring) .... depth .... No. of men ....
No. of men back filling .... No. of teams back filling ....
No. of hours worked...........................Weather...............................
City water used for flushing...
Signed..
Inspector

INSPECTOR'S REPORT.

South Bend, Ind., ...191....
Improvement on .... Street (Ave.) between
.... Street and .... Street
Amount of 6-inch Foundation laid...Sq. Yds.
Amount of Gravel used ....Cu. Yds.
Amount of Cement used...Sacks
No. of men employed wheeling gravel to mixer......................................
No. of men employed taking concrete from mixer....................................
No. of men employed leveling concrete foundation..................................
Kind of cement used...
No. of hours worked .... Weather
City water used ....
Signed
Inspector

INSPECTOR'S REPORT.

South Bend, Ind., ...191....
Sewer Improvement on .... Street (Ave.)
No. of .... in. Concrete Pipe made .... Length of each pipe .... ft.
No. of .... in. Concrete Pipe made; .... Length of each pipe .... ft.
No. of men employed .... Lineal feet laid..................
Amount of Cement used ....Sacks. Size..............................
Amount of gravel used .... Cu. Yds.
Kind of cement used ....
Method of mixing, machine or hand ....
No. of hours worked .... Weather ....
City water used ....
Signed..
Inspector

INSPECTOR'S REPORT.

South Bend, Ind. .... 191..
Macadam (Asphalt) (T.................)
Street from .... to ....
Amount of foundation laid .... Sq. Yds. Depth ....
Amount of grading................ No. of teams .... No. of men ....
Lineal feet of cement curb......................... Cu. Yds. of gravel.........................
Kind of cement .... No. of sacks used ....
No. of men laying foundation......................... Teams hauling ....
No. of men laying .... Teams ....
No. of men pouring............................... Sq. Yds. completed...........................
No. of men employed on storm water connection ....
No. of hours worked...............................Weather...............................
City water used for ....
Signed ....
Inspector

217.5 cu. yds. of gravel at 60 cts. per yd.	130.50	.09
Royalty for forms, reinforcements, supt. paid to the Jackson Pipe Co.	1,667.50	1.15
Grand total	[illegible]	[illegible]

The cost of 1,690 lin. ft. of 42-in. concrete pipe sewer was as follows:

	Total.	Cts. per ft
1 foreman, 900 hrs. at 45 cts. per hr.	$405.00	.24
2 pipe layers, 1,800 hrs. at 25 cts. per hr.	450.00	.27
1 man making joints, 900 hrs. at 25 cts. per hr.	225.00	.11
1 man lowering pipe, 900 hrs. at 20 cts. per hr.	180.00	.11
2 men rolling pipe, 1,800 hrs. at 20 cts. per hr.	360.00	.21
1 man mixing mortar, 900 hrs. at 20 cts. per hr.	180.00	.11
3 men sheeting, 2,700 hrs. at 25 cts. per hr.	675.00	.40
[illegible] men helpers, [illegible] hrs. at [illegible] cts. per hr.	[illegible]	[illegible]
[illegible] men [illegible], [illegible] hrs. at [illegible] cts. per hr.	1,140.00	.67
1 team and [illegible], 900 hrs. at 60 cts. per hr.	540.00	.31
1 team and helper filling, 900 hrs. at 60 cts. per hr.	540.00	.31
1 water boy, 900 hrs. at 15 cts per hr.	135.00	.07
Cement, sand and [illegible] for [illegible]	[illegible]	[illegible]
City water for flushing	[illegible]	[illegible]
Total	[illegible]	[illegible]

The cost of m[illegible] was as follows:

	Total.	Cts. per ft
5 men mixing concrete, etc., 1,400 hrs. at 15 cts.	[illegible]	[illegible]
384.5 bbls. of cement at $1.25 per bbl.	[illegible]	[illegible]
31[illegible] cu. yds. [illegible] at [illegible] per cu. yd.	1[illegible]7	1[illegible]
Royalty, forms and superintendent	2,450.50	1.45
Total	$3,370.93	$1.99
Grand total for 1,690 ft. of 42-in. pipe	9,013.73	5.34

In regard to the use of the above information I wish to advise that data is only approximately correct, as we were in no position to obtain the exact cost. The total number of men employed and the number of hours worked are correct, but necessarily in large contracts men are shifted and it was therefore necessary to take the average number of men working in the different positions.

I have installed a system of reports on postal cards which the inspectors are required to fill out at the end of each day and mail to the office and thinking that these reports might be of interest to the city engineers and possibly other members of the Society, cards for the different classes of work are given by Figs. 1 to 5. These cards are a great help in keeping the records in the office as well as keeping check on the Inspectors and Contractors.

The Sewerage System of Chicago and the Sewerage Disposal Problem.

At an extra meeting of the Western Society of Engineers, held on Jan. 30, 1911, two interesting talks were given on the sewerage question as it relates to the city of Chicago.

Mr. C. D. Hill, engineer of the Board of Local Improvement, addressed the meeting on "The Sewerage System of Chicago." He gave a brief outline of the history of Chicago sewers and called particular attention to the excellent work and sound judgment of the originator of the system, Mr. E. S. Cherbrough. In 1855 Mr. Cherbrough made the first sewerage plans for the city, including a comprehensive system for extension as needed. The sewerage system of the older parts of the city, as it exists today, is practically as planned by Mr. Cherbrough. He also foresaw the ultimate necessity for just such a disposal of the sewage as was afterwards provided by the drainage canal.

An outline was given of the sewerage systems, actual and proposed, of the outlying portions of the city. But the speaker considered the situation in the downtown district the most serious problem. Here the sewers are laid on a flat grade in order to drain the old style shallow basements and at the same time discharge into the river. These sewers are at too high an elevation to drain the modern basements, and in such cases it is necessary to pump the sewage. The present system is inadequate for carrying off storm water.

Mr. Hill recommended the building of two new separate systems: a sewerage system and a system of storm drains. The sewers should be laid at a high level and on a good grade. This would require pumping from all basements, a situation that will be reached ultimately in any event through the replacing of shallow with modern basements. He suggested the installation near the river of purification plants for the sewerage system, and of sedimentation plants for the storm drain system.

Mr. Langdon Pearce of the Sanitary District, spoke on "The Sewage Disposal Problem in This Country and in Europe." Types and developments in Europe were illustrated with reference to the problem as presented in Chicago. Attention was called to differences in quality and nature of the sewage of different cities. These differences are due to the character of the districts served, there being a wide variation in the nature of sewage from residence and manufacturing districts. Even the class of manufacturing must be considered in planning sewage treatment.

The amount of sewage that can be discharged into the drainage canal is limited. It is therefore expected that the Sanitary District will soon have to face the problem of sewage disposal, and extensive experiments are now being conducted in anticipation of that situation. Much of Mr. Pearce's talk was devoted to a description of the experimental station located at 39th St. and the la[illegible]

This being the annual meeting of the

Hydraulic, Sanitary and Municipal Section, the following officers were elected to serve during the year 1911: Chairman, Leroy K. [illegible] executive committee, C. D. Hill and G. L. Clausen.

Valuation of the Physical Property of the Peoria Water Co. with a Discussion of Rate Making and of Reasonable Rates.*

The valuation of the property belonging to the Peoria Water Works Co., and its allied company, the Richwoods Water Co., is primarily based upon an inventory of the physical property, entitled "Statement and Inventory of the Peoria Water Works Properties." Compiled under the direction of John W. Alvord and Charles B. Burdick, and dated Jan. 1, 1908. In addition Mr. Alvord has furnished a statement prepared by the company, giving the outlays for extensions and improvements made during 1908, and an estimate of the cost of contemplated improvements, exclusive of real estate and extension of the distribution system. The inventory referred to is very full and complete. Other data needed in determining the value of the property as a going concern, such as income and operating expenses, were also furnished, and all other needed data have been otherwise obtained by us. The correctness of the inventory has been substantially verified as to the visible property, by personal examination. Estimates of the physical property have been made by us in great detail, following the items and sub-items set forth in the inventory. A grouping of these results is made in Tables I and II.

Historical and Statistical.

It was deemed advisable to search the city records for information relative to the original water plant installed by the city in 1868 and 1869, that a proper understanding of the present situation, and the various steps leading up to it, should be had. The more important results of this investigation are embodied in the following paragraphs:

[illegible]. The matter of building water works in the city of Peoria was taken up by the city council in February, 1868, by the appointment of a committee, which was authorized to employ an engineer to prepare plans. May 25 the committee submitted plans and estimated for a reservoir system to cost $310,059, exclusive of real estate, which had been prepared by an engineer thus employed. The committee reported against these plans, and recommended that what was known as the Holly system be adopted, which would give direct fire service by means of Holly eliptical rotary pumps, having a capacity of 3,500,000 gals. in 24 hours. The cost was estimated at $235,368. This system was authorized by ordinance June 2, 1868, on the site for the works at the foot of Grant Street, was located by ordinance July 21, 1868.

The first water was supplied through the mains June 22, 1869. The works were substantially completed by Dec. 1, 1869, by which time 15½ miles of pipes had been laid and 110 fire hydrants set.

A [illegible] of the water committee Dec. [illegible] shows [illegible] works [illegible]	$[illegible]9,521
Due to [illegible]	1[illegible],612
Total	$[illegible]3,133

By Jan. 1, 1871, over 25 miles of pipe were in the system, with 159 hydrants and 1,180 service pipes which later were increased to 1,453 during 1871. By Jan. 1, 1871, the capacity of the pumps had been exceeded, and an agreement was made with the Holly company for another pump. During the year 1871 the intake pipe at the pumping works was extended 330 ft. Jan. 9, 1872, water works com-

TABLE I.—REPRODUCTION OF PHYSICAL PLANT; STRUCTURAL COST NEW.

Item.		Cost.
[illegible]	Land ...	$ 160,350
	Schedule B; Power house.	
22 (a).	Engine room [illegible], containing 234,58[illegible] cu. ft. brick walls, steel roof trusses and slate roof ...	$ 18,562
22 (b).	Tower 14' 3"x16' 8", containing 17,114 cu. ft. brick walls, etc. ...	5,760
22 (c).	Boiler room, 81' 7"x43', containing 61,389 cu. ft. brick walls; steel roof trusses and slate roof ...	7,879
	Total items 22a to 22c ...	$ 32,201
23.	Brick stack 155' with [illegible] flue	
23 (a).	Foundations ...	$ 2,799
23 (b).	Stack ...	4,433
	Total items 23a to 23b....	$ 7,232
24.	Dry well and pump pit ...	13,614
	Schedule to miscellaneous bldgs. at power house.	
38.	Coal shed over trestle containing 31,295 cu. ft. ...	$ 569
40.	Stock shed containing 8,779 cu. ft. Frame building with galvanized iron roof	484
41.	Barn containing 29,860 cu. ft. Frame building; tar paper and shingle roof; concrete floor ...	752
42.	Miscellaneous outbuildings..	556
43.	Frame buildings at Sandy beach ...	1,561
	Schedule D; yard improvements at power house.	
44.	Fencing, grading, paving, etc. ...	$ 2,175
39 (a).	Coal trestle...	1,766
39 (b).	Switch from trestle to main track ...	1,148
	Total items 39a to 39b ...	$ 2,914
	Schedule E; boilers and appurtenances:	
27 (a).	Three batteries of two 200 h. p. Heine water tube boilers fitted with doors, grate, steam connections, etc. ...	$ 9,300
27 (b, c, d).	Miscellaneous pipes, steam and water...	952
27 (e).	Boiler setting...	3,742
27 (f).	Breeching ...	494
	Total items 27a to 27f.....	$ 14,488
28.	Oil filter, hot well, heater, purifier and miscellaneous	841
26.	Pumps No. 1 and No. 2, boiler feeders ...	324
	Schedule F; miscellaneous machinery and piping:	
26.	Pumps No. 8 and No. 14, with connections...	$ 1,334
30, 31, 32.	Miscellaneous, water, air and steam pipes in station....	2,626
35, 36, 37.	Sewers, water pipes and vaults in station yard.....	2,563
	Schedule G; pumping engines:	
25 (a).	Three Worthington vertical compound condensing duplex engines, 7,200,000 gals. capacity 21.6 millions at $5,000 per million...	$ 108,000
25 (b).	Main suction and discharge pipes, etc...	4,941
25 (c).	Platform and stairs...	1,600
25 (d).	Railways and fittings...	784
25 (e).	Air tanks for balancing cylinders ...	663
25 (f).	Accumulators ...	122
	Total items 25a to 25f.....	$ 116,110
26.	Pumps appurtaining to engines:	
	Pump No. 5: Worthington air compressor 5¼"x3⅜"x5"	350
	Pump No. 4: Worthington air compressor 5¼"x3⅜"x5"	350
	Pump No. 12: Accumulator pump 6"x11½"x8" ...	400
	Pump No. 11: Air compressor New York Air Brake Co., No. 3 Duplex..	225
	Pump No. 3: Jacket steam pump 3"x2"x3"...	75
	Pump No. 7: Jacket steam pump 3"x2"x3"...	75
	Pump No. 9: Condenser pump 6"x8½"x6"...	375
	Pump No. 10: Condenser pump 6"x8½"x6"...	375
	Total item 26...	$ 2,225
	Schedule H; electric plant and wiring:	
29 (a).	Automatic, horizontal Noye engine, 5" piston, 10" stroke; Siemens Halske dynamo, 125 volts, 64 ampere, 1,450 r. p. m...	$ 892
29 (b).	Switchboard instruments...	100
29 (c).	Lights and wiring...	501
29 (d).	Telephone to reservoir...	582
	Total items 29a to 29d....	$ 2,075
	Schedule I; main wells and tunnels:	
46 (a).	Well 34' diameter and 46' deep; brick well house....	$ 23,696
46 (b).	Auxilliary pumping plant and piping ...	15,606
46 (c).	Miscellaneous ...	21
	Totals items 46a to 46c....	$ 39,323
47 (a).	Lower tunnel 9' 2"x6' 2" and 73' long ...	$ 4,610
47 (b).	Upper tunnel 6' 7"x5' and 66' 6" long ...	662
	Total items 47a to 47b....	$ 5,272
	Schedule J; new well No. 2 above station:	
48 (a).	Well 11' 4" diameter 31' deep surrounded with earth bank ...	$ 10,340
48 (b).	Well house, brick...	245
48 (c).	Machinery and piping...	1,980
48 (d).	Measuring vault ...	497
48 (e).	12" c. i. pipe line 3,703' long, 5.6' average depth...	6,892
48 (f).	(1) Tile conduit 24" diameter, 3,300' long, 12.2' average depth...	13,200
	(2) Well No. 2500: Elliptical, 11'x7' and 11' deep and 10' above ground ...	758
	(3) Well No. 1800: Rectangular, 5' 10"x11', 11' deep and 12' above ground	943
	Machinery and piping...	941
	(4) Well No. 1050: Same as well No. 2500...	745
	(5) Manholes, 4' diameter, varying from 8.5' to 17.5' deep ...	2,438
	(6) Miscellaneous machinery, pipes, etc...	813
	Total items 48a to 48f.....	$ 39,792
	Schedule K; well No. 69, below station:	
49 (a).	Well 9' diameter, 37.5' deep, 15.5' fill and house...	$ 9,673
49 (b).	Machinery and piping...	1,741
49 (c).	Pipe lines to wells:	
	(1) 8" steel pressure line 1,285' long, 5.3' deep...	1,966
	(2) 20" wood stave conduit 1,236' long, 8.3' deep...	4,144
	Total items 49a to 49c....	$ 17,524
	Schedule L; reservoir and pipe line:	
10.	30" c. i. pipe line 5,384' long, 5' to 7' deep...	$ 32,347
20 (a).	Reservoir 18,000,000 gals. capacity ...	63,893
20 (b).	Valve well...	950
20 (c).	House on valve well...	143
20 (d).	70 tons cast iron pipe No. 11,780 specials...	4,582
20 (e).	Sprinkling system...	634
20 (f).	Lawns and miscellaneous...	1,386
20 (g).	Vault ...	238
	Total items 20a to 20g.....	$ 71,826
21 (a).	Residence, 2-story frame house, small cellar...	1,200
21 (b).	Cistern ...	194
21 (c).	Miscellaneous buildings and orchard ...	369
	Total items 21a to 21c....	$ 1,763
	Schedule M; distribution system:	
1.	15,179.34 tons cast iron pipe at $28.50 ...	$ 432,611
2.	No. 758,967 of cast iron specials ...	22,759
8.	Reinforcements on 30" mains	360
11.	Street and hydrant stub valves: 15 30", 15 20", 45 16". 51 12", 97 10", 248 8", 596 6", 618 4" valves distributed ...	38,950
12.	1,607 [illegible] valve boxes distributed and set..	7,232
13.	79 valve pits 7' deep and 4' to 2' in diameter...	3,450
14.	Fire hydrants: 10 10", 100 8", 608 6", 527 4" distributed and set...	46,349
3.	Laying pipe:	
	16,180 lin. ft. 30" ...	20,225
	12,555 lin. ft. 20"...	9,416
	29,820 lin. ft. 16"...	17,892
	31,540 lin. ft. 12"...	14,508
	58,783 lin. ft. 10"...	23,513
	68,342 lin. ft. 8"...	23,920
	157,294 lin. ft. 6"...	48,761
	135,898 lin. ft. 4"...	36,692
	120 lin. ft. 10" hydrant pipe	48
	1,200 lin. ft. 8" hydrant pipe	420
	7,296 lin. ft. 6" hydrant pipe	2,262
	6,324 lin. ft. 4" hydrant pipe	1,708
	Total item 3...	$ 199,365
4 (a).	9,484 lin. ft. hand trenches...	948
4 (b).	169,068 lin. ft. braced trenches	16,907
4 (c).	146,981 lin. ft. sheeted trenches	36,745
4 (d).	33,534 lin. ft. wet trenches...	1,677
	Total items 4a to 4d...	$ 56,277
5 (a).	Pavements: 1,674' brick on concrete, cement filler...	627
5 (b).	Pavements: 114,794' brick on concrete, sand filler...	49,065
5 (c).	Pavement: 83,419' brick on gravel, sand filler...	25,695
5 (d).	Pavements: 1,535' brick on sand ...	591
5 (e).	Pavements: 53,699' asphalt on concrete ...	42,638
5 (f).	Pavements: 2,992' asphalt on gravel ...	1,795

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*Condensed and partly rearranged from "Valuation of the Property of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams, "Audit of Accounts of the Peoria Water Works Co.," by Edward A. Pratt & Co., and "Water Rates for the Plant of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams; reports made for the city of Peoria, Ill.

5 (g). Pavements: [illegible] and [illegible]	917
5 (h). Pavements [illegible] gravel	2,468
5 (i). Pavements, 3,0[illegible]	74
Total items 5a to 5i.......$	124,208
6 (a). [illegible] railway [illegible] crossings	[illegible]
6 (b). Miscellaneous crossings	[illegible]
Total items 6a and 6b.....$	4,293
7. 300' street [illegible] crossed	1,8[illegible]
9. Creek and sewer [illegible]:	
9 (a). 10" pipe under Kickapoo creek	466
9 (b). 6" pipe below C. R. I. & P. Ry. under Kickapoo creek	164
9 (c). 10" pipe cemetery road under Kickapoo creek	90
9 (d). 8" pipe Knoxville Ave. under sewers	32
9 (e). [illegible] sewers	10
9 (f). [illegible] pipe Jefferson St. under sewer	[illegible]
Total items 9a to 9f.......$	807
Schedule N[illegible] Service Connections:	
15. 2,254 tons cast iron pipe.....$	642
537,467 lbs. lead pipe........	33,054
2,2[illegible] lbs. [illegible] wrought iron pipe 1" to 4"..............	221
Total item 15.............$	33,917
16. Laying service pipe:	
[illegible] cast iron pipe	16
[illegible] 8" cast iron pipe	28
520' 6" cast iron pipe........	161
[illegible] cast iron pipe	[illegible]
180' 3" cast iron pipe........	45
[illegible] 1" to 4" wrought iron pipe	555
[illegible] ½" to 1½" lead pipe	[illegible]
[illegible] services [illegible]	[illegible]
Total item 16	[illegible]
17. Unusual excavation for services:	
3,250' hard trenches.........	260
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total item 17.............$	19,212
18. Pavements over services:	
408' under brick on concrete, grout	192
42,351' under brick on concrete [illegible]	[illegible]
30,767' under brick on gravel	8,307
582' under brick on sand....	180
19,641' under asphalt on concrete	12,767
1,137' under asphalt on gravel	591
631' under brick, stone block, cobble	114
1,689' under macadam.......	304
6,164' under gravel streets...	801
Total item 18	[illegible]
19 (a). 84 valves 3" to 10".........	1,003
19 (b). [illegible]	[illegible]
19 (c). [illegible]	[illegible]
Total items 19a to 19c	[illegible]
52. 282 Crown meters...........	5,913
3 Herrey meters............	24
[illegible]	[illegible]
1 Union meter.............	210
17 elevator registers.........	340
[illegible]	[illegible]
Total item 52..............$	7,427
Schedule [illegible] furniture and equipment:	
33 (a). [illegible]	[illegible]
33 (b). Testing laboratory apparatus	200
Total items 33a and 33b...$	275
34. Surveying instruments	[illegible]
45. Station miscellaneous.......	823
[illegible] Office furniture..............	3,500
56 (a). Street department stock and tools	8,190
56 (b). Meter department stock and tools	[illegible]
56 (c). Station department stock and tools..................	11,170
Total items 56a to 56c	[illegible]
Schedule P. Old pumping station:	
51. Dismantled pumping station	1,700
Grand total................$	1,681,479

mittee were directed to procure two Holly pumps. Aug. 20, 1872, the committee recommended the purchase of two pumps for the city supply, and one for the Bluff supply, on account of the breaking down of the rotary pumps. In 1875 a Dean and a Cameron pump were paid for, probably the ones recommended in 1872. In 1879 and 1880 two Worthington pumps were installed each rated at 2,500,000 gals. capacity in 24 hours. In 1887 the Dean and Cameron pumps were rebuilt, and the mayor recommended [illegible] with a reservoir, which recommendation was renewed the following year. In 1888 the Worthington pumps were overhauled, and the Dean pump burst during a fire.

On May 4, 1889, the council passed the present water works ordinance, granting Moffitt, Hodgkins & Clarke a franchise and license to rebuild, enlarge and extend the then water works system, and selling to them the then existing works for $450,000, the amount of water works bonds outstanding. This ordinance was amended Aug. 15, 1889, and on Nov. 1, 1889, the old works were turned over to them. In December, 1891, the city was supplied from the new works, which were completed by May 21, 1892, tested June 3 and 4 and accepted by the city sometime in July, 1892. The old city works sold to Moffitt, Hodgkins & Clarke, consisted of about 45 miles of street mains, valves, hydrants and service pipes, as follows:

Diameter of Pipes, ins.	Length, ft.	No. of Valves.
16	[illegible]	[illegible]
12	[illegible]	1
10	[illegible]	[illegible]
8	[illegible]	[illegible]
6	61,647	38
4	101,719	122
Hydrants	[illegible]	
Service pipes	[illegible]	

The pumping station was equipped with the Dean, Cameron and two Worthington pumps.

This plant had cost the city in cash outlay about $200,000 for the pumping station, machinery, inlet and basins, and $420,000 for the distribution system, complete. A total of $620,000 approximately. The first installment of cast iron pipe purchased cost $69 and $70 per ton. The operating data of the old city plant is only complete from 1875 to 1889, inclusive. The revenue and operating expenses so far as obtained being as follows:

Year Ending Dec. 31	Revenue	Operating Expenses
1869.		
1870.		
1871.	15,735	.....
1872.	16,860	16,000
1873.	22,615	
1874.		
1875.	24,641	[illegible]
1876.	24,140	15,747
1877.	23,284	14,985
1878.	21,977	13,277
1879.	[illegible]	13,505
1880.	[illegible]	16,313
1881.	27,598	26,253
1882.	[illegible]	26,816
1883.	29,213	27,060
1884.	29,428	27,687
1885.	31,797	28,960
1886.	34,281	24,900
1887.	35,219	26,928
1888.	31,309	27,630
1889.	32,964	27,242

The operating expenses as given include no interest or discount on bonds.

When the works went into operation in 1869, the intefest charge on $334,000 bonds, was $27,470 per annum, and at the time the works were turned over to Moffitt, Hodgkins & Clarke in 1889, the interest on $450,000 of bonds then outstanding was $25,295 per annum.

Nearly all city bonds were placed at a considerable discount, so that it is safe to say that the average charge for interest and discount for the 20 years that the city operated the plant, was not less than $27,000 per annum. The difference between the approximate cost of the plant, $620,000, and what it was sold for, $450,000, was $170,000. Previous to the installation of the plant in 1869, the city was paying annually for a fire department about $13,000.

The original plant operated under the great disadvantage of being able to supply nothing better than raw river water, and hence city wells taking water from the ground were provided throughout the city. The cost of these, about $10,000 after 1877, enters into the cost of the distribution system, and hence into the total approximate cost of the works, $620,000.

The character of the present plant, the new part of which was installed 1890 to 1892, may be inferred from the statistical items relative to the City of Peoria, and the water works

TABLE II.—REPRODUCTION OF PHYSICAL PLANT STRUCTURAL VALUE DEPRECIATED.

(The sinking fund method of depreciation is used with money at 4 per cent [illegible] fund.)

Item.	Condition per cent new.	Depreciated Value.
[illegible] Land:	[illegible]	[illegible]
22. Power house: Age 17 years; life 70 years...	93	29,947
23. St[illegible]: Age [illegible]; life 70 years..........	93	6,726
24. Dry well and pump pit: Age 1[illegible]	[illegible]	1,[illegible]
[illegible] C[illegible] Age [illegible]	[illegible]	[illegible]
40. Stock shed: Age 3 years; life [illegible]	[illegible]	[illegible]
41. Barn: Age 17 years; life [illegible] years	[illegible]	[illegible]
42. Out buildings: Average age 9 years; life 40 years	[illegible]	[illegible]
43. Frame buildings: Average age 17 years; life 40 years..............	75	1,171
44. Yard [illegible] power house: Age [illegible] years; life 100 years..	98	2,132
39. Coal trestle and switch: Age 17 [illegible] years	54	1,574
27. Boilers, etc.: Age 17 years; life [illegible] years	[illegible]	[illegible]
28. Oil filter, etc.: Age 14 years; life 35 years....	75	631
26. Pumps 1 and 2: Age 17 [illegible]	[illegible]	[illegible]
26. Pumps 8 and 14: Average [illegible]	91	1,294
30, 31, 32. Station piping: Age 17 years; life 35 years....	68	1,786
[illegible]: Age 17 years; life 35 years...	68	1,742
[illegible]	[illegible]	[illegible]
26. Pumps appurtaining to [illegible] Age 17 [illegible] life 30 years..........	58	1,291
29. Electric plant: Age 17 [illegible]	[illegible]	1,[illegible]
46. Main wells: Age 17 years; life 70 years...	93	36,570
[illegible]	[illegible]	[illegible]
[illegible] New well No. [illegible] Age 1[illegible] years; life 70 years....	95	37,802
[illegible] Well No. [illegible] Age [illegible] life 70 years..........	99	17,349
10. 30' c. i. pipe line: Age 17 years; life 100 years...	98	31,700
20. Reservoir: Age 17 years; life 95 years..........	95	70,389
21. Residence buildings: Age 17 years; life 50 years..	85	1,499
1. Cast iron pipe: Age 20 years; life 100 years...	97	419,633
[illegible] Age 20 years; life 100 years	97	22,086
8. Reinforcement 30" mains: Age 20 years; life 100 [illegible]	97	[illegible]
11. Stub valves: Age 20 years; life 65 years....	90	35,055
12. Valve boxes: Age 20 years; life 65 years....	90	6,509
13. Valve pits: Age 20 years; life 65 years..........	90	3,105
14. Fire hydrants: Age 20 years; life 65 years....	90	41,714
[illegible] Age [illegible] years, life 100 years...	97	193,384
[illegible] 20 years; life 100 years	97	54,589
5. Pavements: Age 20 years; [illegible]	[illegible]	[illegible]
[illegible] 20 years; life 100 years	97	4,164
7. Street railway crossings: Age 20 years, life 100 years	97	1,770
[illegible] ings: Age 20 years; life [illegible]	[illegible]	[illegible]
[illegible] years; life 50 years....	87	29,508
16. Laying service pipe: Age 15 years; life 50 years..	87	39,563
17. Unusual excavation for [illegible]	[illegible]	[illegible]
18. Pavements over services: Age 15 years, life 50 [illegible]	[illegible]	[illegible]
19. Valves and boxes: Age [illegible]	[illegible]	[illegible]
52. Meters: Age 10 years; life 25 years..........	71	5,273
33. Laboratory: Age 6 years; [illegible]	[illegible]	[illegible]
34. Surveying instruments: Age [illegible]	[illegible]	[illegible]
45. Station miscellaneous...	70	576
[illegible] Office furniture	[illegible]	[illegible]
56. Stock and tools..........	80	24,072
51. Old pumping station.....	20	340
Grand total		$1,[illegible]

TABLE III—EARNINGS AND EXPENSES PEORIA WATER WORKS FOR FIVE YEARS, 1904 TO 1908.

Revenue.	1904.	1905.	1906.	1907.	1908.	Total.	Average.
Public	$ 44,274.94	$ 45,265.07	$ 46,211.80	$ 46,876.40	$ 47,469.51	$230,097.72	$ 46,019.54
Private	134,923.12	142,826.62	156,770.55	170,876.60	177,537.75	782,934.64	156,586.93
Total revenue	$179,198.06	$188,091.69	$202,982.35	$217,753.00	$225,007.26	$1,013,032.36	$202,606.47
Maintenance of water supply.							
Fuel delivered	$ 7,241.85	$ 6,904.11	$ 8,710.44	$ 9,484.76	$ 10,687.24	$ 43,028.40	$ 8,605.68
Engineers, firemen and oilers	6,429.33	6,538.41	6,494.49	6,685.82	7,736.89	33,884.94	6,776.99
Tools, oil, waste and packing	500.08	707.92	491.87	652.91	1,702.62	4,055.40	811.08
Repairs to machinery	926.30	2,642.74	1,411.32	1,534.45	2,052.30	8,567.11	1,713.42
Grounds and buildings	1,009.60	1,449.21	2,590.21	3,805.08	3,284.01	12,138.11	2,427.62
Miscellaneous	396.22	282.25	329.81	392.66	661.12	2,062.06	412.41
Total	$ 16,503.38	$ 18,524.64	$ 20,028.14	$ 22,555.68	$ 26,124.18	$103,736.02	$ 20,747.20
Maintenance of distributing system							
Service repairs	$ 246.10	$ 570.61	$ 421.79	$ 310.61	$ 338.38	$ 1,890.49	$ 378.10
Flat rate inspection	2,688.09	3,174.28	4,582.76	4,258.44	4,850.72	19,554.29	3,910.86
Main maintenance	1,480.80	1,059.72	1,174.45	736.58	810.47	5,262.02	1,052.40
Hydrant maintenance	1,142.13	773.97	672.80	917.13	922.85	4,428.88	885.78
Meter maintenance	775.61	753.04	672.66	1,138.69	2,219.22	5,559.22	1,111.84
Reservoir maintenance	358.62	847.43	1,243.29	1,217.03	710.73	4,377.10	875.42
Stable maintenance	986.07	876.02	1,258.04	1,167.20	1,212.82	5,500.15	1,100.03
Total	$ 7,677.42	$ 8,055.07	$ 10,028.79	$ 9,745.68	$ 11,065.19	$ 46,572.15	$ 9,314.43
Maintenance of office							
Clerks' pay roll	$ 5,033.35	$ 5,085.00	$ 5,230.00	$ 5,507.33	$ 5,518.29	$ 26,373.97	$ 5,274.79
Rent, light and telephone	1,148.71	1,151.99	1,162.94	1,165.22	1,233.88	5,862.74	1,172.55
Postage and supplies	1,116.72	886.08	967.14	1,050.24	1,466.87	5,487.05	1,097.41
Total	$ 7,298.78	$ 7,123.07	$ 7,360.08	$ 7,722.79	$ 8,219.04	$ 37,723.76	$ 7,544.75
General expenses:							
Salaries of officers and attorneys	$ 10,683.16	$ 9,951.64	$ 9,401.97	$ 11,028.03	$ 13,244.58	$ 54,309.38	$ 10,861.88
Traveling expenses	1,742.11	800.59	817.94	994.74	603.27	4,958.65	991.73
Metropolitan Trust Co.	317.32	499.16	369.76	327.53	515.53	2,029.30	405.86
Insurance	371.77	165.56	160.80	324.47	303.09	1,325.69	265.14
Miscellaneous	3,541.17	2,396.95	2,001.59	4,359.55	4,797.14	17,096.40	3,419.28
Taxes	6,893.80	7,443.82	6,594.50	6,935.42	15,570.44	43,437.98	8,687.59
Depreciation	12,160.00	12,550.00	12,890.00	13,350.00	13,971.00	64,921.00	12,984.20
Total	$35,709.33	$ 33,807.72	$ 32,236.56	$ 37,319.74	$ 49,005.05	$188,078.40	$ 37,615.68
Total expenses	$ 67,188.91	$ 67,510.50	$ 69,653.57	$ 77,343.89	$ 94,413.46	$376,110.33	$ 75,222.06
Net revenue from operation	$112,009.15	$120,581.19	$133,328.78	$140,409.11	$130,593.80	$636,922.03	$127,384.41
Less contingent expenses, electrolysis, rate case, etc.	1,736.09	507.20	4,018.63	5,092.88	18,742.61	30,097.41	6,019.48
Net revenue to surplus account	$110,273.06	$120,073.99	$129,310.15	$135,316.23	$111,851.19	$606,824.62	$121,364.93

properties belonging to the Peoria Water Works Company, which follow:

Population of Peoria, 1909, estimate U. S. Census Bureau	70,383
Population of Peoria, 1907, estimated	67,700
Population of Peoria, 1870, U. S. Census	22,849
Total water pumped year 1907, gallons	2,093,000,000
Daily average, 1907, gallons	5,740,000
Daily average per capita, 1907, gallons	85
Daily average for maximum month (August), 1907, gallons	6,517,000
Daily pumpage for August 9 and 11, 1909, gallons	10,000,000
Total head on pumps—maximum—approximate	315
Total head on pumps maximum – approximate	280
Three - vertical compound duplex Worthington pumps, capacity each, 7,200,000 gallons	21,600,000
Six-Heine 200-h. p. water tube boilers, h. p.	1,200
Storage reservoir capacity, gallons	18,000,000
Length of street mains, 1907, miles	97.2
Length of hydrant connections, 1907, miles	2.8
Length of 30-inch main to reservoir, miles	1.0
Weight of C. I. pipe, 1907, tons	16,143
Weight of C. I. special castings, 1907, tons	390
Number of valves in system, 1907	1,607
Total number of fire hydrants, 1907	1,245
Number of services, total, Jan. 1, 1907	8,571
Number of services, total, Jan. 1, 1908	9,040
Number of services, active, Jan. 1, 1907	6,667
Number of services, active, Jan. 1, 1908	7,129
Number of meters in use, 1907	288

Water supply taken from gravel beds along the Illinois River, northeast of the city.

Value of Plant—The following is a consolidated summary made from Tables I and II as to the physical property, giving our valuation of the Peoria Water Works Company's properties as of Jan. 1, 1908, but based on present prices of labor and material, to which is added the outlay to complete the construction in progress during 1908, bringing the valuation down to Jan. 1, 1909.

Schedule.	Reproduction Physical Plant. Cost.	Value.
A—Real estate	$ 140,650	$ 140,650
B—Power house, stack and and dry well	53,047	49,334
C—Miscellaneous bls. at power house site	3,902	2,929
D—Yard improvements	5,089	3,706
E—Boilers and appurtenances	15,673	10,703
F—Miscellaneous machinery and piping	6,523	4,823
G—Pumping engines and appurtenances	118,335	68,635
H—Electric plant and wiring	2,075	1,203
I—Main well and tunnels	44,595	41,473
J—New well No. 2 with conduit, pipes, etc.	39,792	37,802
K—Well No. 69 with pipes, etc.	17,524	17,249
L—Reservoir and pipe line, with buildings	105,936	103,588
M—Distribution system including valves and hydrants	938,496	903,623
N—Service pipes and appurtenances	153,245	132,134
P—Old pumping station	1,700	340
Interest during construction 7½%	123,492	113,864
Administration engineering, supt., etc., 7½%, exclusive of real est.	112,943	100,816
Total structural elements Jan. 1, 1908	$1,882,997	$1,732,872
O—Personal property, tools, stock, etc.	34,917	27,577
Going concern element of value	340,000	312,000
Total property value as a going concern, Jan. 1, 1908	$2,267,914	$2,072,449
Construction not included in the inventory, and work done during 1908 as per Appendix 11	73,531	73,531
Total	$2,341,445	$2,145,980
Arbitrary addition		4,020
Total estimated value as of Jan. 1, 1909		$2,150,000

The values under Schedule A were made by parties familiar with real estate values and were furnished by the city.

The going concern element of value was carefully determined, and the amount credited taken at not to exceed one half of the full amount. An allowance for this element, which is the potential earning power of the plant which has been acquired through years of operation, much of the time perhaps at a loss, is not akin to franchise value. On the other hand, it is an essential part of the property value. This becomes apparent if it is considered that any public utility plant without earnings would be valueless except to be dismantled.

Physical structure and income are both essential to give value to a plant, and neither can exist as an element of value without the other. Together they determine the value of the property. The property as a whole is a single unit having value.

The Supreme Court of Maine says, in the Brunswick case (Maine 99-371), that structural value should include going concern value.

The going concern part has no existence except as a characteristic of the structure. If no structure, no going concern. If a structure is in use, its value is affected by the fact that it is in use. There is only one value. It is the value of the structure being used.

The property taken is a single thing, to which belongs certain characteristics which affect value. The thing cannot be taken without these characteristics. If it is attempted to value the thing separate from its inherent characteristics, elements which add value to the thing are omitted. If these elements are omitted, the owner fails to receive the full and fair value of the thing, and thereby is denied just compensation.

The following are the statements furnished by Mr. John W. Alvord as noted in the opening paragraph:

Construction not included in inventory.		
Cash expended prior to 1908.		
Reserve well	$10,607.45	
Well No. 4	1,885.38	
		$12,492.83
Cash expended during 1908.		
New services	$ 7,501.52	
Main extensions	13,679.44	
Pump house extension	5,285.23	
Reserve well	11,505.23	
Well No. 4	1,548.82	
Additional water supply	262.74	
Well No. 1800	8.81	
		$39,791.79
Engineer's estimate.		
Cost to complete reserve well	$17,994.77	
Cost to complete well No. 4	3,251.18	
		$21,245.95
Total		$73,530.57

Approximate Estimates of Cost of Contemplated Improvements in Plant of Peoria Water Works Co.—These figures do not include anything for cost of real estate, nor for extensions to distribution system, but represent only the outlays over and above all ordinary extensions, which outlays should be made as soon as possible, and which will add nothing to the revenues of the company:

Additional water supply.	
New well and pumping plant on Griffith tract, well and well house	$12,000.00
100 h. p. motor	1,200.00
One centrifugal pump, 5,000,000 gallons capacity	1,000.00
Shafting and the erection of above machinery	800.00
Suction and discharge pipes and fittings	1,000.00
12,000 ft. 24-inch C. I. pipe	40,000.00
15,000 ft. electric transmission line	3,600.00
100 k. w. generating set at main pumping station, complete with boilers, buildings and accessories	6,000.00
Total, not including real estate	$65,600.00
Pumps for new well, well No. 4 and well No. 5	946.10
Motors for new well, well No. 69, wells Nos. 4 and 5 and well No. 1800	1,684.36
Erection of above machinery	1,500.00
Sinking and completion of well No. 4	3,000.00
Generating set, boilers and buildings	6,000.00
Transmission lines	1,500.00
Total	$14,630.46

Storage shed, coal bins and handling appliances.

A new storage shed and coal bins should be built at once, and their installation should be followed by the installation of automatic stokers, approximate estimate of cost of storage shed, coal bins and stokers 15,000.00

Total $15,000.00

Grand total $95,220.46

Note—From this should be deducted whatever value may have been given to the existing coal bins and to the old frame storage shed.

(To be continued.)

DRAINAGE AND IRRIGATION SECTION

Cost of Operating a Drainage Pumping Plant.*

Description of Equipment.—The pumping plant for this district is a steam driven plant and contains the following principal equipment: One 300 H. P. Erie City Iron Works, horizontal water-tube boiler, equipped with open feed water heater, induced draft apparatus, heater and feed pumps, etc. In addition to the regular boiler gages, a recording pressure gage is mounted in the engine room. There is also a 10 H. P. vertical boiler, which is intended for cleaning the main boiler and for starting up the auxiliaries. The pump room is equipped with two Erie City Iron Works, 250 H. P. horizontal, tandem compound, condensing, 4-valve, steam engines, each one of which is direct connected to a 50-in. Worthington centrifugal pump. While these pumps are called 50-in. pumps, they were made from the regular 45-in. pump patterns, with the exception that the discharge opening of the pump volute is expanded to 50 ins. in diameter. The rated combined capacity of the pumps is 225 cu. ft. per second (100,000 gals. per minute) when working against a static head of 12.5 ft. Each one of the main engines is fitted with a revolution counter. The plant is lighted by a small electric light plant. The oiling system for the main engines is a continuous oiling system, the oil from the bearings being collected and automatically pumped into a filter located above the engines from which it is returned by gravity to the engine bearings.

Method of Operating the Plant.—At the beginning of 1910 the Joint Board of Supervisors turned over the operation of the pumping station to a Committee of Management, consisting of one Supervisor from each county and a Drainage Engineer, who is the executive officer of the committee. This committee was instructed to look after the details of the management of the pumping station and make quarterly reports to the regular meetings of the Joint Board of Supervisors, including a financial report of all expenses incurred during the preceding quarter, and to present a full report for the year at the annual meeting of the Joint Board of Supervisors. A complete set of rules and regulations covering the duties of the Committee of Management, the Drainage Engineer and the Station Engineer was adopted, and with this organization the operation of the pumping plant for 1910 worked out very satisfactorily and will be continued during 1911.

Method of Keeping Records and Description of Tests Made.—The Station Engineer was required to keep complete records of the pumping plant operation and make daily reports to the Drainage Engineer. These reports contain a great deal of varied information and were calculated to keep the Drainage Engineer continuously informed regarding the operation of the plant and also to make a record from which results of operation could be studied and reported. In addition to submitting these reports, the Station Engineer was also required to submit daily the recording steam pressure charts. In addition to keeping these records, the Drainage Engineer made various tests on the pumping plant equipment during the pumping season, including a boiler test, and tests of both engines and both pumps.

Cost of Operation.—The following is the cost of operating the plant for 12 months to Dec. 31, 1910:

	Total	Per cent	Av. per day for the year	Per million cu. ft. water	Per million cu. ft. per ft. head
Fuel	$2,502.34	43	$ 6.86	$3.61	$0.86
Labor	2,158.85	38	5.92	3.12	0.74
Supervision ..	600.12	10	1.64	0.86	0.21
Maintenance .	335.08	6	0.92	0.48	0.11
Oil and waste.	181.12	3	0.50	0.25	0.06
Total	$5,777.51	100	$15.84	$8.32	$1.98

General Remarks.—The pumps were started March 12 and were in operation on 96 different days during the year, a total of 1,519 pump hours. During some of these days the plant was only operated for a few hours. Fourteen days of operation during July and August was due to construction work on the suction bay and lowering of gravity outlet pipe. This operating would not have been necessary for drainage had the gravity outlet pipe been in commission. The data sheets also show that 694,000,000 cu. ft. of water were pumped during the year. This is equivalent to a depth of 0.995 ft. over an area of 16,000 acres, which is about equivalent to the drainage area of the district. This amount of water collected on a section of land would be 24.5 ft. deep. The total amount of water pumped between the 1st of January and 1st of July, which was the active period of pumping for drainage purposes, was 607,300,000 cu. ft., equivalent to 0.872 ft. of depth over an area of 16,000 acres. The rainfall as shown by the average of nine government rainfall stations, surrounding this territory, for the same period was 12.5 ins. or 1.041 ft.

The mechanical efficiency of the plant and the total cost of operation, including fuel and labor, makes a very satisfactory showing. The labor cost at the plant was greater during the first six months of the year than will be necessary again under similar conditions, because it was considered desirable to have an expert, from the factory of the makers of the engines and boilers, to go over the plant in the Spring and to remain in charge of the operation for several weeks.

The Station Engineer is employed for his whole time at a salary of $1,000 per year. The Drainage District owns a house and about six or seven acres of land at the pumping station which is furnished to the Station Engineer free of charge. The total expense of pumping for the first six months amounted to an average of $0.348 per acre based on 13,000 acres, which is approximately the tax-paying area. The total cost of maintaining and operating the pumping station was $0.444 per acre.

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*Extract from Report of Committee of Management of Pumping Plant, Louisa-Des Moines Drainage District, No. 4; Jacob A. Harman, Engineer, S. F. Wilson and E. W. Romkey.

Irrigation By Pumping Individual Wells With Power from a Central Gas-Producer Gas-Engine Electric Generating Station.*

Nearly all of the irrigation work accomplished in the arid west to date has been by gravity. Probably not 4 per cent has been by pumping. Rapid strides have been made in the pumping methods in the last two years, and the future is promising. It takes necessity to develop means to an end, and such is the case for irrigation. Probably not more than one-tenth of the arid land can be reclaimed by gravity irrigation. Many of the rivers are too low and the impounding of some is not practicable. There are many situations demanding the pumping of water, among which are those requiring water lifted from rivers, lakes, wells, underflow in valleys, from irrigated land that has poor drainage and which otherwise would become waterlogged or soured, and for raising water from established canals to higher ground for further distribution. Properly designed pumping projects on relatively large scales are less expensive to construct, and no more expensive to operate and maintain than gravity works.

One of the largest irrigation projects, pumping from underground sources, in this country is that adjacent to the town of Portales, located in the central eastern part of the Territory of New Mexico and but recently completed. The distinctive features of this installation are, pumping from a sub-surface water strata or underflow by electrically driven direct-connected, horizontal, centrifugal pumps, the current being distributed to the various individual pumping plants from a central power station where it is generated by bituminous gas producer gas engines, direct-connected to three phase, alternating current generators.

The power plant has a capacity to deliver 100 second feet of water against a 45-ft. head including friction, or an equivalent thereto, and when operating continuously at the rate of 100 second feet during 151 days of 24 hours each, shall be capable of delivering 3 acre feet of water upon 10,000 acres of land when pumped against the total head of 45 ft., or its equivalent if against a different total head. Each pumping station is provided with a pump and motor of sufficient capacity to provide two second feet of water for each 160 acres. A water duty of 3 acre feet is undoubtedly more than will be needed, 2 acre feet is ample.

Topography.—The Rocky Mountain ranges extend into the north, west and southwestern portions of New Mexico. The eastern, southern and part of middle western portions are on high plateaus or river valleys. Altitude varying from 3,000 to 8,000 ft. above sea-level; that at Portales is 4,050 ft. The soil varies from a reddish, sandy loam to an occasional adobe. It is alluvial in character, derived principally from volcanic rocks, and is fertile, rich in potash and phosphoric acid, and fairly well supplied with humus that is rich in nitrogen. The nitrogen contents can be easily maintained and increased by the use of leguminous crops, such as peas and alfalfa, in a crop rotation. A gyp rock formation occasionally underlies the loam and clay strata.

Rainfall.—The average annual rainfall for New Mexico is from 10 to 20 ins., with the higher averages in the eastern portion. The average for Portales and vicinity during 1905 and 1906 was 21.30 and 21.78 ins. respectively, but 1907-08-09 averaged scarcely 10 ins. per annum; 1910 averaged 14.75 ins. Owing to the wide range in temperature between day and night, the mean yearly temperature is [illegible]

Water Supply.—Because of the broken stratification in the natural formation of New Mexico, a great many small, and some of the larger streams entirely disappear into the underflow. The source of the Portales supply is underground and there is no river flowing within many miles of the project. The theory has been advanced that the contour of the country, the geological formations and the character of the water bearing strata clearly indicate that the source is that of an old-time river, formerly connected to the headwaters of the Brazos River, and that it now flows, the headwaters being in the Rocky Mountains. This theory in all its fullness is

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*Condensed from a paper by Robert P. Woods, M. Am. Soc. C. E., Roswell, N. Mex., before the Indiana Engineering Society, Jan. 14, 1911.

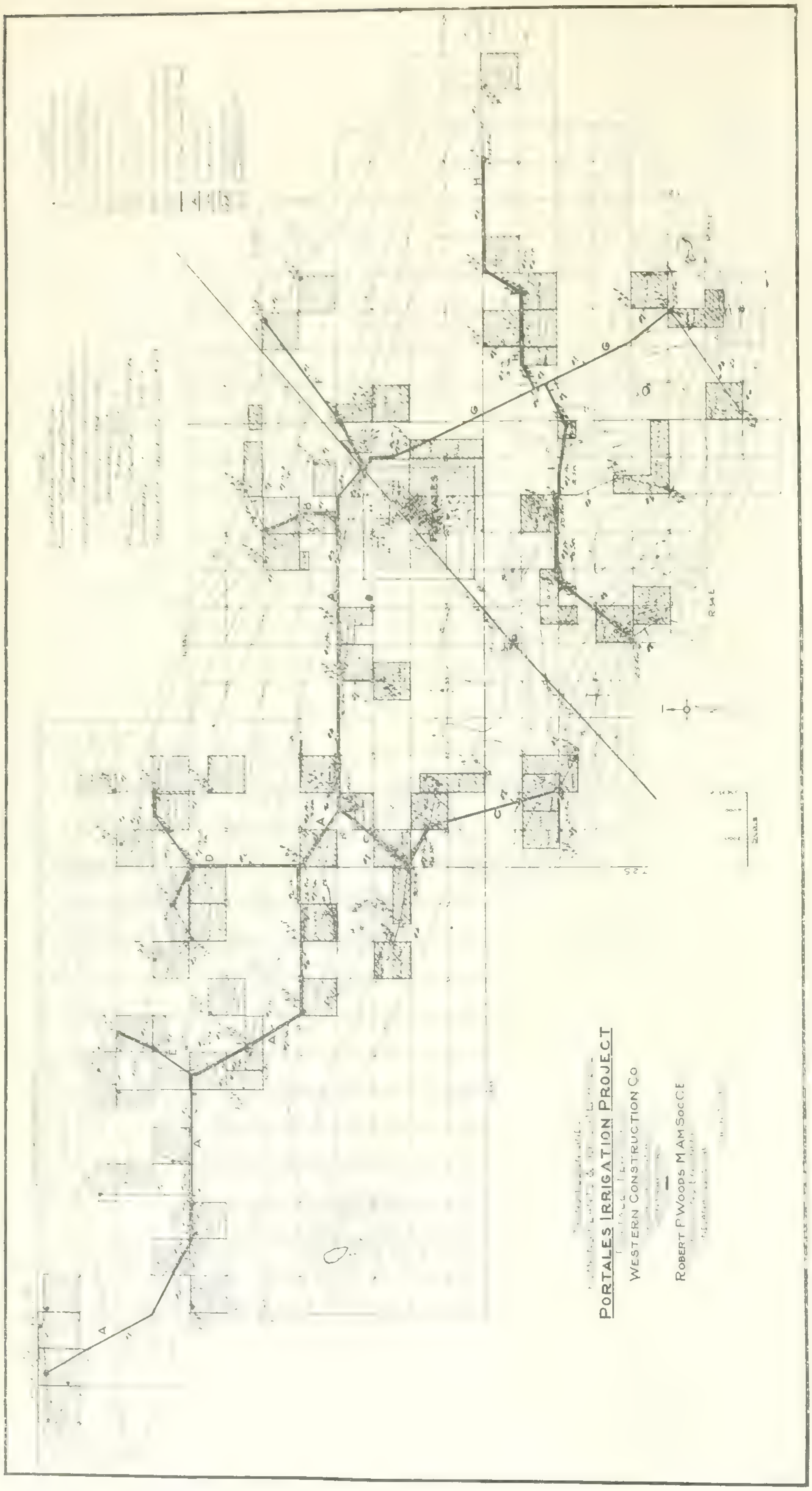
Portales Irrigation Project
Western Construction Co
Robert P. Woods M. Am. Soc. C. E.
Portales
A
B
C
D
E
G
H

Fig. 1—General Map Showing Transmission Lines, Pumping Plants and Irrigated Areas, Portales Irrigation Project.

properly doubted. It may be in part as stated, because located in a broad valley and again in part from percolation over a wide range of country. Lack of investigations requiring time and expense prevents clear analysis at this time.

While the water supply is similar to that at the Garden City, Kan., pumping proposition, it differs somewhat, in that the latter has its source in the valley of a flowing river, the Arkansas. From the point of supply, it has nothing in common with that of the pumping scheme at Williston, N. D., as there the water is pumped direct from the Missouri River, the pumps being placed on barges in the river and the power station on shore adjacent.

There has been no official test of the individual plants as yet, but while developing the wells it was noted that for about six hours one day there were 40 plants in operation and although the power station equipment was operating below full speed, and the wells were yielding much sand, each well was delivering from 400 to 1,200 gals. per minute; a fair average would be 650 G. P. M., or a total of 26,000 G. P. M., a highly satisfactory showing.

POWER PLANT.

The power station (Fig. 1) is located about one mile north from the center of the town of Portales, N. Mex., and adjacent to the Eastern Railroad of New Mexico, a branch line of the Santa Fe System. The building is as plain as it was possible to construct it. The main idea was to secure a good substantial structure and accordingly the foundations are of concrete, all the walls brick, the roof trusses of steel and the roof covering heavy galvanized iron. The plant is for irrigation of farm lands only, and not intended to operate in the winter, hence the gables in the producer room are open and no heating system has been installed. The engine room is 64 ft. by 68 ft. inside dimensions, and 2 ft. in height from the cement floor to the bottom of the roof trusses; the roof has a ¼ pitch. The producer room is 34x64 ft. inside, and 28 ft. in height from the cement floor to the bottom of the steel trusses; pitch of roof same as engine room.

Water Supply at Plant—The water for plant operation is derived from a special well located in a brick pump house adjoining the plant (Fig. 2). The well was drilled about 110 ft. At 21 ft. below the surface of the ground, the first strata of water was encountered and the pumping equipment consisting of two No. 4 horizontal centrifugal pumps, direct-connected to two 20 H. P. motors, was placed 1 ft. above the water on concrete foundations. The pit was made 11 ft. in diameter and cased with concrete. One pump is sufficient, the other being a spare unit. The water is pumped into a steel tank holding 15,000 gals., the bottom of the tank being elevated 50 ft. above the ground; this height was necessary to obtain proper pressure for engine. The main supply pipe is 8 ins., with a 4 in. branch to the producers, and a 6-in. branch to the engines.

Coal Conveyor. — Adjoining the producer room is a coal bin 60 ft. long by 30 ft. wide with average height of 8 ft. The coal is taken from the bin in a bottom dump hopper on a push car operated on a 24-in. gage industrial track. The hopper holds about 750 lbs. of bituminous coal. Immediately inside of the building the hopper is raised about 18 ft. by an electric hoist and conveyed to the coal gallery by a trolley wheel operating along an 8-in. beam suspended over the gallery. This coal gallery or charging platform is along one side of and level with the tops of the producers.

Engines.—There are two 27x36 in. Westinghouse, horizontal, tandem, double acting, single crank, direct-connected 750 H. P. gas engines; revolutions per minute at normal load, 152. Rating as at the altitude of 4,000 ft. above sea level, the engine can be overloaded 10 per cent for 3 hours. (Figs. 3 and 4.) They are governed by automatically controlling the explosive mixture to suit that load on them; the inlet gear is especially adapted for the bituminous gas. The gas has a minimum heat value of not less than 110 effective B. T. U. per cubic foot at 62° F., and 30 ins. mercury; it is supplied to the engine at not less than 2 ins. pressure by water column and at a temperature of about 80° F. The engine foundations are of massive concrete extending to rock formation 14 ft. below the base of the frame. The weight of one of the engines alone is 146 tons, includirng the generator it is 161 tons. Each fly wheel weighs about 41 tons. At least four pieces of each unit necessary to handle in erection was over 20 tons. No crane has as yet been installed.

The pressure of gas going to the engines is

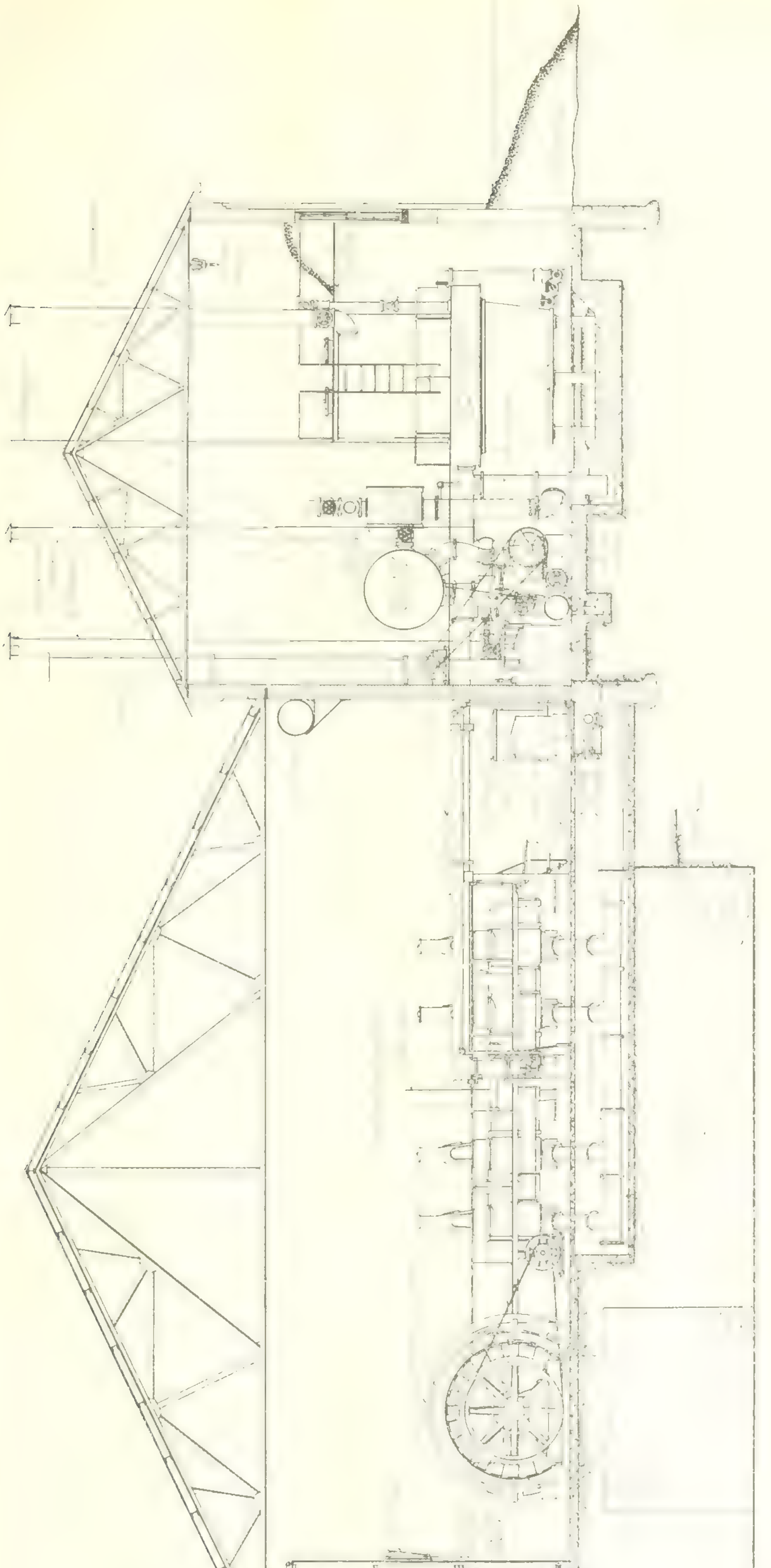

Fig. 2—Plan of Producer Gas Engine Generating Station, Portales Irrigation Project.

regulated by two gas regulators [illegible] two butterfly valves.

Generators.—There are two 600 kilovolt ampere, 3-phase, 60-cycle, 600-volt, 152 R. P. M. Westinghouse alternating current engine type generators; two 25 kilowatt, 125 volt, 1,100 R. P. M. belted type exciters, belted to a pulley on the shaft extension on each generator unit; three 400 K. V. A., 600 to 11,000 volt oil insulated self cooled transformers. The switch board and lightning arresters are the Westinghouse standard make, consisting primarily of a four-panel switchboard, electrolytic lightning arresters, and the necessary ammeters, wattmeters, switches, circuit breakers, choke coils and minor incidentals.

Air Starting.—The engines are started by air pressure, the equipment consisting of an air compressor belt connected to a 20 H. P. gasoline engine. There are five style D air tanks, each about 2 ft. 9 ins. in diameter by 5 ft. in height.

Ignition.—The initial starting is from a storage battery which is charged by a ¾ k. w. generator, this in turn is operated by the gasoline engine connected to the compressor outfit. After starting, the ignition is furnished from a small motor generator set located at the switchboard.

Lubrication.—A continuous pressure oiling system is installed and includes a storage tank placed on a bracket on the division wall about 20 ft. above the floor; two filter tanks located on the floor below the filter.

Producer.—The producer equipment consists of three 500 H. P. Westinghouse double fire zone, center offtake suction type bituminous gas producers (Figs. 3 and 4). Three No. 7 Root exhausters and one No. 4 auxiliary exhauster same type; three dry scrubbers, each about 6 ft. in diameter by 8 ft. in height. Three static washers; three 25 H. P. motors for operation of the three large exhausters; one 12 H. P. gasoline engine for operating the auxiliary exhauster; two gasometers; a gas mixing drum or header 6 ft. in diameter and 52 ft. in length; a 20 in. gas supply header 52 ft. long, together with necessary water supply and discharge pipes, gas and air piping, valves and accessories.

Each producer consists primarily of an upper and lower cylindrical steel sheet of about ¼ in. plate riveted and calked, and lined with 9 ins. of first quality fire brick laid in fire clay and rubbed to close joints; the upper shell or zone is a little narrower than the lower; midway between the two is a hollow annular steel forging called the vaporizer, which is kept filled with water to within several inches of its top, permitting air to mix with the steam from the water. It also forms the gas offtake. The lower zone rests on a cast iron base, the lower part of which extends into the water pan of the foundations, forming a water seal. Suitable poke holes are provided which afford access to all parts of the full bed. Iron stairways, galleries and hand rails are installed for convenience, and safety of operatives. The top, which is water cooled, has four coal charging openings, each about 18 ins. in diameter. Air pipes connect the atmosphere with the vaporizer and top of the upper zone and with the tuyere of air inlet in the center and lower part of the bottom zone. The maximum width of the producer is 13 ft. 6 ins., and height from floor to top is 16 ft. The weight of a producer installed including bricking is about 60 tons.

[illegible] the fuel bed charged with bituminous coal extends from near the bottom of the lower zone up to within a couple of feet of the top of the producer. The process of the production and distribution of the gas which is a carbon monoxide is as follows: Air and a little steam enter above the fire in the top zone and below the fire in the bottom zone; the draft in the upper section is downward and carries the volatile constituents through the fuels, causing their disintegration; but little combustion of the fixed carbon takes place in the upper section, the residue consisting almost entirely of coke; the coke passes down as the ashes are removed from the water seal into

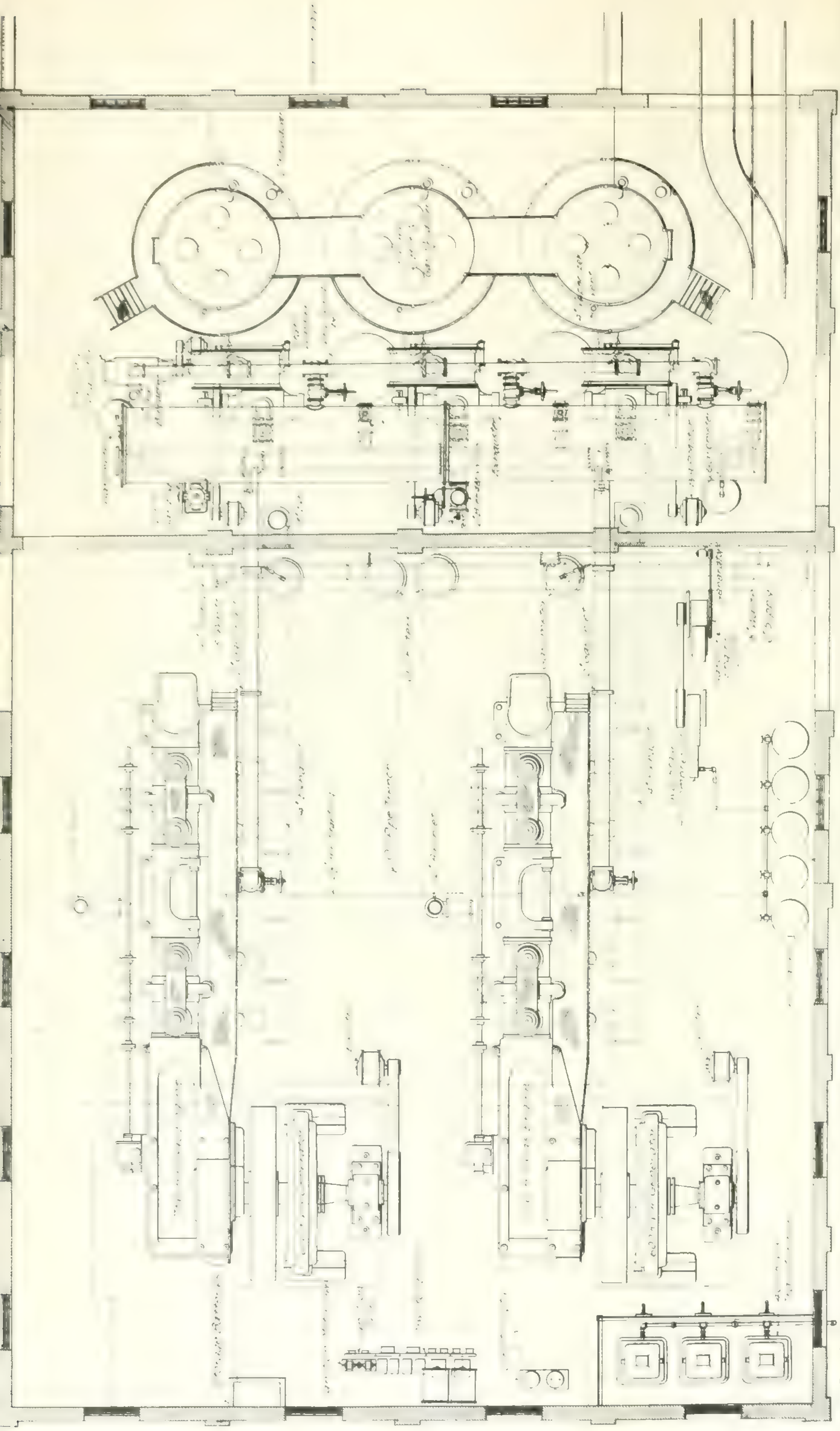

Fig. 3—Sectional Elevation of Producer Gas Engine Generating Station, Portales Irrigation Project.

the lower zone which acts as a simple updraft producer. The coke in its descent becoming hotter causes the change of carbon dioxide into carbon monoxide. The gas collects at the vaporizer, from which it passes through the offtake pipe at a temperature of 500° to 550° F., on to the static washer where it is [illegible] with water then through the dry scrubber which is filled with excelsior for cleaning the gas, and on to the mixing header; from there to the exhauster, and from the exhauster through the 20 in. supply header to the supply pipes leading to the engines. The action of the exhauster is such that it maintains a suction through the mixing header, washer and scrubber, back to the producer so that the air and steam required by the latter are forced in by the pressure of the atmosphere; the exhauster also maintains the required pressure of not less than 2 ins. by water column in the pipe lines leading to the engine. For the purpose of increasing or diminishing the supply of gas to the engines due to fluctuating loads, butterfly valves are installed and regulated by gasometers.

A bituminous coking New Mexico coal containing about 12,500 B. T. U. per pound is used at the plant. The cost in the plant bin is $5.20 per ton; this may be cheapened later. The performance of the gas engines, producers, generators, transformers and motors is such that the cost of the items of fuel, labor, oil and waste for the power plant is less than 1 ct. per kilowatt hour as measured at the bus bars when the engines are operated at full rated capacity, and the cost of the same items is less than 1½ cts. per kilowatt hour measured by the meters at the various individual pumping plants.

TRANSMISSION SYSTEM.

The total length of the transmission lines (Fig. 1) is 73.75 miles, of which the primary or 11,000 volt alternating current line is 38.40 miles and the secondary or 550 volt alternating current line is 35.35 miles; they are numbered from A to 1 inclusive, the longest line leading direct from power station is slightly over 15 miles. All of the lines are of bare copper wire varying in size from No. 8 to No. 3. The total lineal miles of wire used was 225 and the total weight about 100,000 pounds.

Excluding the step-up transformer equipment at the power plant there are 17 transformer stations in the project. These are located as per requirements and uniformly distributed throughout the work; the housing consists of a small frame structure partly closed. Each station has a bank of three 11,000 to 575 volt outdoor type Westinghouse transformers, the size of the several stations varying from two 25 K. V. A. to two 50 K. V. A. units. In six of the transformer stations, primary potential lightning arresters were placed. These were proportioned according to distance of line as nearly as possible.

Wherever primary and secondary lines are on the same poles, a 35-ft. length was used; for the primary lines alone, 30 ft. and for secondary lines only 25 ft. lengths. The poles are cypress having 7-in tops. The cross arms are standard 6-ft. Washington fir. The poles are painted with two coats of carbolineum for a distance of 2 ft. above and 2 ft. below the ground line.

INDIVIDUAL PUMPING PLANTS.

Excluding the pumping plant at the power station, there are 69 individual pumping plants. They are so much alike in their salient features that one may be considered typical of all.

The distance from the surface of the ground at the various wells or plants, to the surface water or water plane varied from 15 ft. to 50 ft. (Fig. 2.) Pits were dug by the farmers around the wells, 6 ft. by 10 ft. down to the water and the pumping equipment of pump and motor was placed in these pits within 6 ins. to 12 ins. of the water plane on a concrete foundation. The walls of the pits were not cased. This has been left to a future prosperity or posterity. In most instances the soil seemed firm enough to stand unprotected for a couple of seasons, but where questionable the sides were shored with timber.

The equipment at each plant includes a special American Well Works 6 in. type E. M. B., horizontal centrifugal pump with an extended base and flexible coupling to receive a motor. The pump has a capacity of 900 gals. of water per minute, when running at a speed of 1,135 revolutions per minute against the total head assumed; the suction of the pump is 6 ins. discharge, 8 ins. diameter, of shaft 1½ ins., with open impeller. Each pump is equipped with a cistern pump, nipple and valve connected in top of volute for priming. There are also an 8-in. vertical check valve with flange connection and a 6 in. to 8 in. increaser flanged elbow for suction on pumps.

The motors at the various plants vary in size from 15 H. P. to 25 H. P., and are the

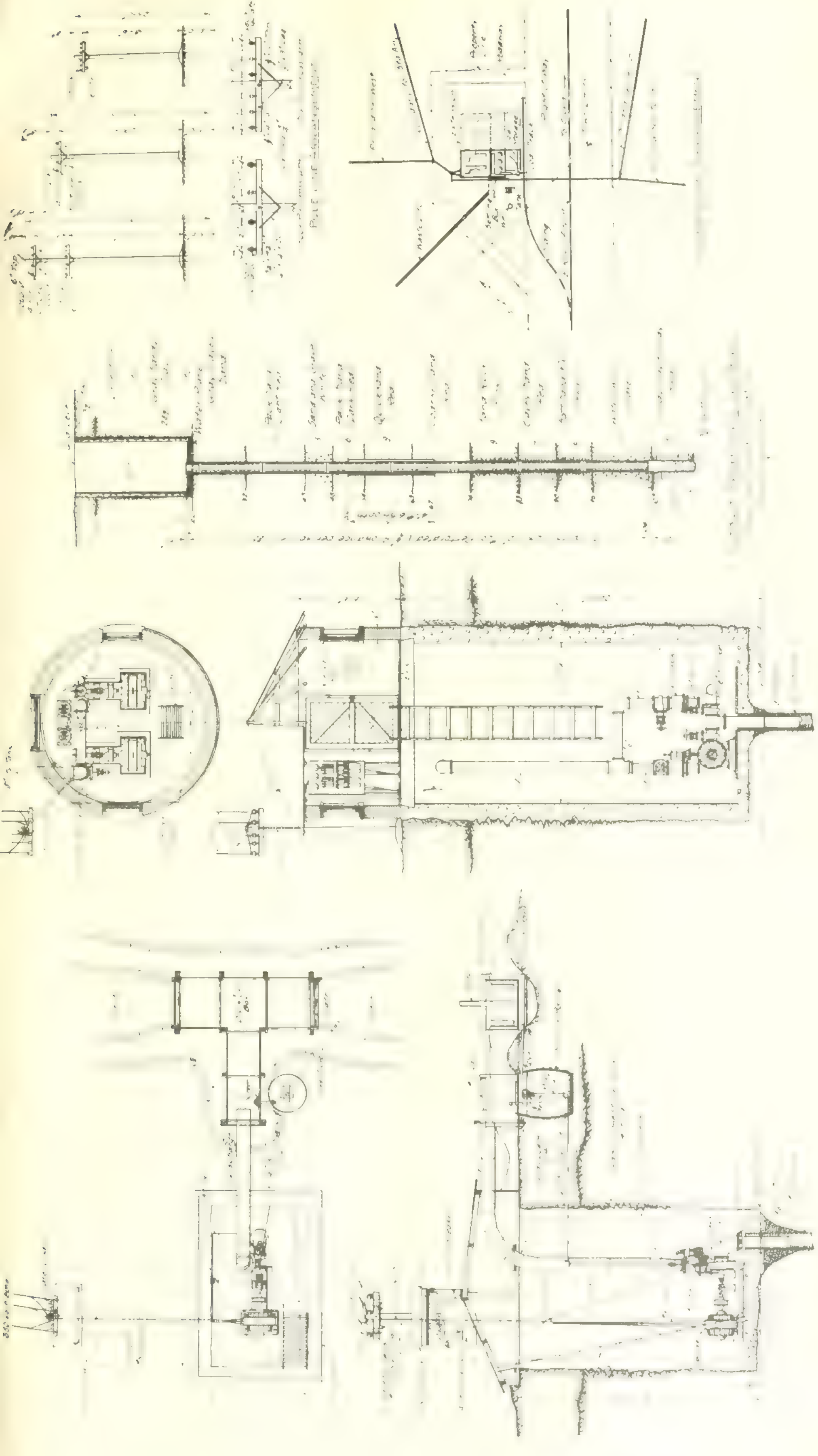

Fig. 4—Sketches Showing Details of Installation, Portales Irrigation Project.

Westinghouse three-phase, 60-cycle, 550-volt, 1,135 revolutions per minute, "CCL" motor, direct connected to the pumps on the extended pump base. The current is carried to the motor on three rubber covered copper wires placed in a small iron pipe conduit, joining the secondary line on a small pole a few feet from the pit.

A 30 ft. length of standard 8 in. steel casing is screwed to the suction elbow and suspended in the well, acting as a suction or tail pipe to exclude air and preserve a vacuum when starting the pump. The discharge pipe is 10 ins. of heavy galvanized iron, increasing from 8 ins. at the [illegible] to 10 ins. in a distance of about 6 ft. and a long radius elbow is placed near the top of the pit.

The covering of the pit is of wood, very simple in design and inexpensive. (Fig. 2.)

The electrical equipment for applying the power is located in a small wooden box fastened to the small pole near each plant. (Fig. 2). It consists of an auto starter, circuit breaker, and a recording wattmeter. Above the box on the cross arm are three safety gaps for lightning protection.

The pumping equipment at the power plant differs from the individual farm plants in that it has two No. 4 pumps, two 25 H. P. motors, wrought iron discharge pipe, a concrete lined pit and a brick pump house, with the starting equipment in the house.

The discharge weirs or boxes were to be built by the individual land owners and vary from concrete and wood to none at all.

WELLS.

The general character of the formation of the various strata at most of the wells is fairly represented by that at the power plant. (Fig. 2.) Beginning at the surface of the ground this well shows 3½ ft. of soil; 28½ ft. of miscellaneous limestone and gray sandy clay and gray clayey sand, with the water table 22 ft. below the level of the ground; 11 ft. of pack sand, light red in color; 5 ft. of sand and gravel, white; 6 ft. pack sand, dark red; 9 ft. quicksand, red; 11 ft. coarse sand, red; 9 ft. sand rock, pink; 7 ft. clayey sand, red; 6 ft. soft sand rock, red; 11 ft. water worn gravel; 8 ft. sandy clay to clay, red. The total depth from surface to bottom of well is 115 ft.

The machines used in drilling the various wells were cable rigs, consisting of a 14 H. P. steam traction No. 5 Keystone machine, a 10 H. P. steam traction No. 3 Keystone, and a 6 H. P. gas engine Axtell No. 10 A machine.

The depth of drilling averaged about 90 ft. below the bottom of the pit or water plane; the depth depending on the apparent sufficiency of the water supply as judged by the character of strata encountered; the desired amount being 2 sec. ft. or 900 gals. per minute. The water plane varied in depth below the surface of the ground from 15 ft. to 50 ft.

The wells were drilled so as to insert a 14-in. 16-gage galvanized iron pipe casing. Whenever a quicksand stratum was encountered if the thickness exceeded 1 ft., it was cased off with either 14 or 16-gage galvanized iron to 3 ft. below the quicksand; all other casing was 20-gage galvanized iron pipe, and at all water bearing strata, excepting quicksand, it was perforated with slots 1 in. in length, ⅛-in. in width, spaced about ⅜-in. centers transversely and 1¾-in. centers longitudinally. The discharge pipe at all plants excepting the one at the power plant was 10-in. galvanized iron; at the latter it was standard wrought iron pipe.

Referring more in detail to the illustrations the four maps are indicated as Figs. 1 to 4. Figure 1 exhibits as noted in the title the "Transmission Lines, Pumping Plants and Irrigated Areas" and also the transformer stations, marked with size of each of the two transformers at the station; primary lightning arresters and hydrographic contours showing depths to the water plane. The transmission lines are numbered with capital letters from A to I inclusive and the individual plants with the letter of the line and a number. The horse power plants with the motor at each plant is indicated. The primary lines are shown in solid heavy lines and the secondary in short dash lines sizes of each are given. The irrigated areas making up the 10,000 acres under the project are the shaded sections. Each plant unit is on the basis of 160 acres each. There are, however, some slight variations more or less from this acreage. The plant at upper left hand corner of the plate is the farthest from the power station; it is about 16 miles distant.

Figure 2 is the plan of power house and shows the location of the various machinery; on the right is the producer room 34x64 ft.; on the left is the engine room 64x68 ft., inside dimensions. Figure 3 shows a Sectional Elevation of Power House; on the right is the producer room; on the left the engine room. Figure 2 shows details of various features of the installation; all have been described in the text and will only be referenced here. On the left is represented a "Typical Individual Pump Installation"; in the center is shown the Power House Pump Installation; to the right of the center is a graphical picture of an "Extract from the Well Log Book," showing typical formation of strata at the power house well; in the upper right hand corner is exhibited the Pole Line Arrangement and below it the Power House Arrangement on which is shown the method of providing for additions to the plant.

The project is controlled by the Portales Irrigation Co., a community corporation of energetic resident farmers, who arranged for the drilling of their individual wells. It was developed and exploited by the Western Construction Co. of Wichita, Kan., and constructed by them under the immediate direction and supervision of the writer. The stockholders of the Irrigation company are individually owners of the numerous parcels of land embraced in the 10,000 acres irrigated in this undertaking, and the subject to an issue of first mortgage 6 per cent gold bonds are the owners of the entire works. Actual construction began in February, 1910, and partial operation was started in August. The work was finished about Jan. 1, 1911.

STEAM AND ELECTRIC RAILWAY SECTION

Recommended Plan and Estimates of Cost for a Passenger Subway System for the City of Chicago.

The formulation of working plans and recommendations for a passenger subway system for the city of Chicago was begun about 12 months ago by Mr. Bion J. Arnold, Chief Subway Engineer. In a report submitted Feb. 6 to the Mayor and the Local Transportation Committee of the City Council, Mr. Arnold outlines briefly the character and scope of the studies made and presents in full his recommended plan for subway location, construction and development. The following is a condensed summary of this report:

The problem of preparing working plans at the present time for a subway system for the City of Chicago is especially difficult, not only because of the physical difficulties introduced by the existence of the present Illinois Tunnel, consisting of about 60 miles of freight tunnel, which, in general, is but 33 ft. below the surface of the streets, but also from the further fact that the policy of the city is not yet settled as to the method of financing subways. A further complication is introduced by the traction settlement ordinances of Feb. 11, 1907, under which the surface lines are operating, having a provision whereby the surface line companies are required, upon the demand of the city, to furnish money toward the construction of subways, provided, however, that these companies have the full use of the subways so constructed, up to the capacity that they require.

In order to produce plans which will meet all reasonable and fundamental objections likely to arise during the discussion and final determination of the city's subway policy, as well as the engineering and operating conditions which will be imposed upon a subway system when built, it has seemed necessary to prepare plans for two distinct systems but to recommend the one which seems the better.

Plan No. 1 is for a high speed, comprehensive system, designed to ultimately cover the entire city, in which could be operated high speed and local trains, independent of any of the present traction companies. This system could be built by the city or by private capital, without the use of any money from the present surface line companies, or by utilizing this money, if the city decided to do so. Upon the tracks of this subway could at first be run the present surface line cars, later the trains of the present elevated roads, and finally, when extended, the trains of a high speed comprehensive subway system covering the entire city, thus making it possible to promptly relieve the present surface line congestion at moderate cost by constructing only a portion of the system at first, and later to eliminate the entire present elevated loop structure, and at the same time have the nucleus of a high speed subway system, which could be extended from time to time, as conditions warranted, until it covered the entire city, approximately as shown by Fig. 3.

Plan No. 2 is for a system designed to be used exclusively by the surface line cars for the relief of present congestion in the business district, utilizing the existing tunnels under the river, and so located that it would not interfere with the ultimate construction of the high speed subway of Plan No. 1. Under this plan the city could allow the surface line companies to construct a subway system, suitable for surface cars, with their own money, or call upon the present surface line companies for the money defined in the ordinances, and construct it jointly with them, or not as it saw fit. Since the system is located upon streets which would not be necessary in the construction of the system outlined in Plan No. 1, the city's interests would not be jeopardized for the ultimate construction of a future independent high speed subway.

Fundamentally, no subway plan should be adopted involving any system of loops, or other methods of construction, which will prevent the building of a high speed subway system ultimately covering the entire city, through which high speed trains could be run, for no extensive subway system can be justified from an investment viewpoint unless it is so designed that ultimately high speed trains each having a capacity of not less than 10 of the present elevated cars could operate through it at times of maximum traffic, as it is only by this method that the cost of operation per car mile of such a system can be brought low enough to justify the heavy investment necessary for long distance subways, and take care of the high fixed charges necessitated in their construction. This does not mean that, aside from financial reasons, it is not advisable to construct at once enough subway in the business district to relieve the present congestion of surface and elevated cars, but it does mean that the ultimate plan to be kept in mind in analyzing the transportation problem of the City of Chicago should be one that will lead toward securing a transportation system that will eventually gather the passengers by means of surface line cars and deliver them to high speed subway or elevated trains which, in turn, will bring them to and through the business district.

The principles upon which such a subway system should be constructed are as follows:

First. Through operation from the southern terminus to the northern terminus, wherever they may be located, and vice versa, upon as straight tracks as practicable, on one or more of the following streets: Michigan avenue, Wabash avenue, State street, Clark street, Fifth avenue, Halsted street, Western avenue, etc., as the future may demand.

Second. Similar east and west subways, with the grades separated where they cross the north and south subways, located, to start with, say, on Madison street, and eventually upon such other east and west streets, north and south of Madison street, as future conditions may demand.

Third. These north and south and east and west subways eventually to be supplemented by diagonal subways upon Milwaukee avenue, Blue Island avenue, Archer avenue and such other diagonal streets, as the future may determine best to locate subways upon.

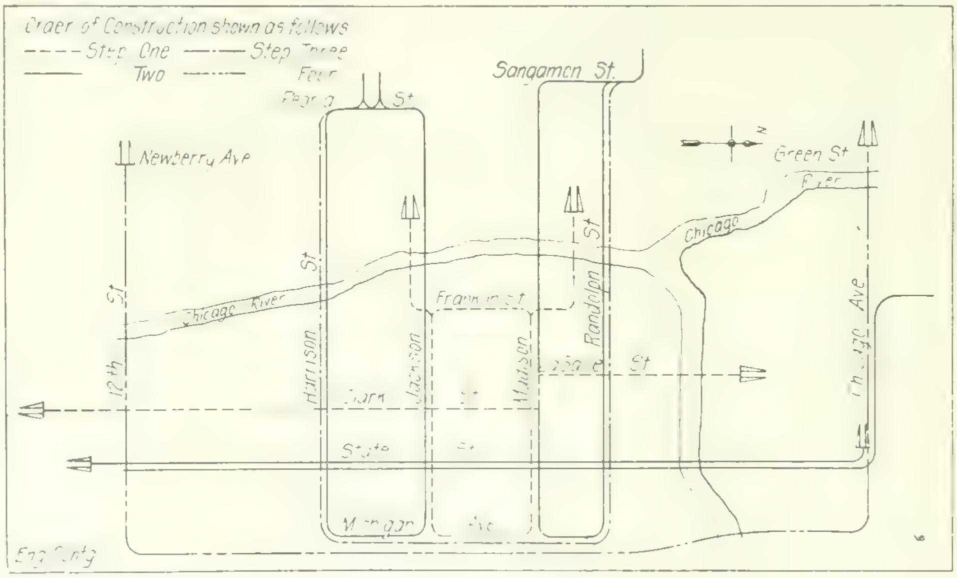

Fig. 1.—Map Showing the Construction, by Successive Steps, of the Recommended Plan, or Plan I, Chicago Subways.

Since the city extends in three directions only it is necessary to return to the west side some of the cars coming from that side, by reversing their direction. This is accomplished in the plan under consideration by loop terminals in preference to stub end terminals, for by the loop method continuous operation is permitted with the corresponding increased capacity and speed, and the elimination of danger in operation.

The east and west subways (with the exception of the one on Randolph street which must run at high level east of the south branch of the river in order to allow the north and south subways to pass under the river at grades not exceeding those of the west side subways) after once having descended to come under the river should remain down and pass under the north and south subways in the present business district, although west of the south branch of the river, the east and west subways could be constructed as high level subways, but dipping to allow the Halsted street and Western avenue subways, or such

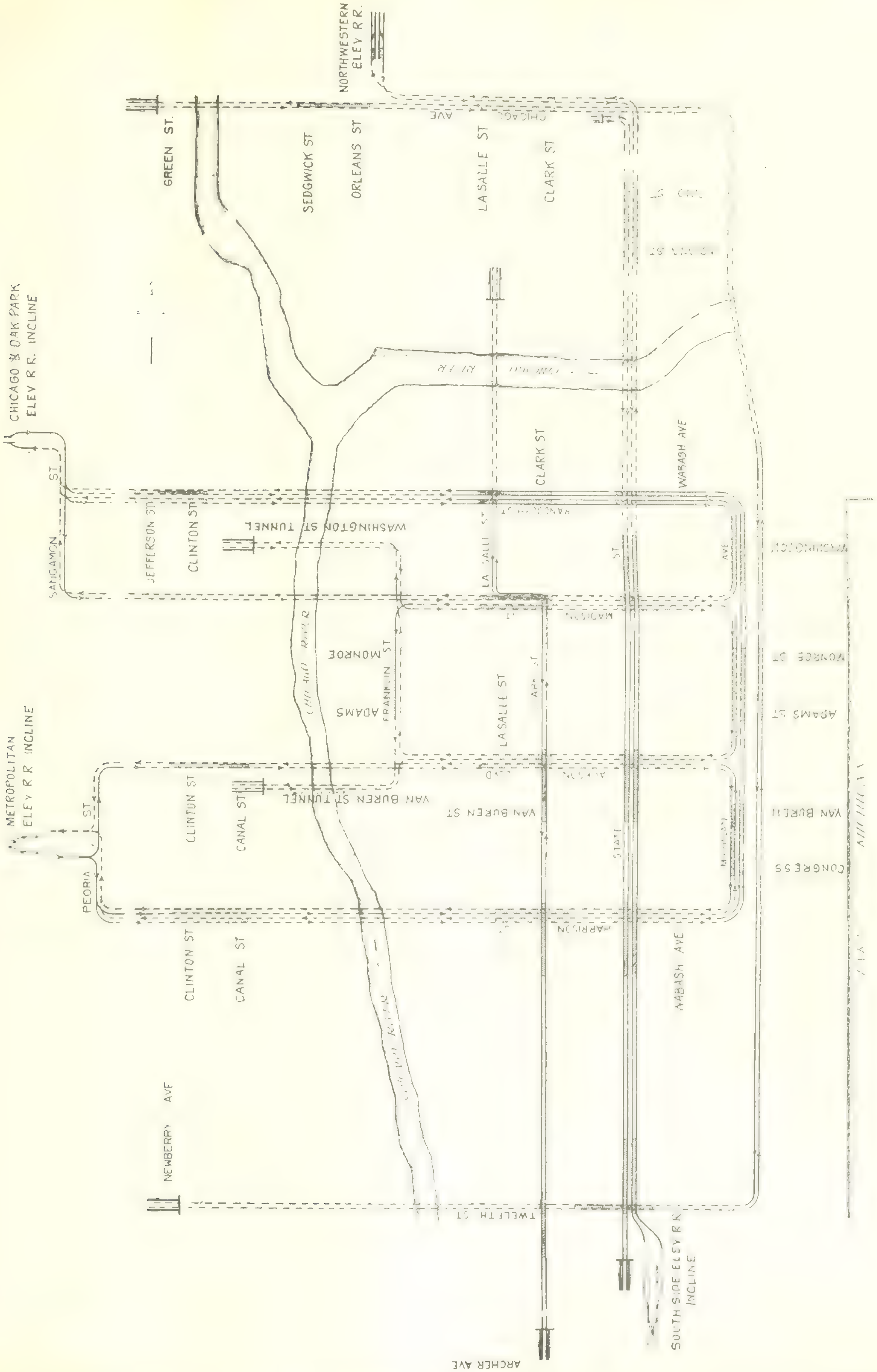

Fig. 2.—Map Showing the Location of High Level and Low Level Subways, Recommended Plan, or Plan I, Chicago Subways.

(High level subways shown by [illegible] subways shown by broken lines.)

other north and south subways as may be constructed upon the west side prior to the construction of the east and west subways, to pass over them.

In such a system no particular business district would be given any permanent advantage, or any advantage which the natural expansion of the system would not rectify, over any other business district, for the present business district, and ultimately the entire city, would be gridironed with subways located at approximately equal distances apart, north and south, and east and west, varying somewhat with the density of population, intersecting each other at right angles, except where the diagonal subways were constructed. Such a system can be constructed and operated more economically and involves less risk in operation than any other subway system suitable for Chicago conditions.

By this system all west side passengers can be carried, without transferring, directly to the lake front, if desired, or, by transferring once, to any north or south point of the city served by the subway system. Passengers from the north and south sides can be carried northward and southward throughout the entire length of the city, without transferring, and, by transferring once, to any western point served by the subway system. If this system were supplemented by the extension of future subways in 22d street, 12th street, Washington street and Chicago avenue to the light house docks shown in The Commercial Club's Plan of Chicago, when it is carried into effect (See Fig. 3) and also by the depression of the streets upon which are now located the present stub end surface car line tracks between Grant Park and Jackson Park, such as 18th street, 22d street, 31st street, 39th street, 43d street, 47th street, etc., the present surface line cars could be carried through under the Illinois Central tracks to the lake front.

Recommended Plan, or Plan No. 1.

The recommended plan, or Plan No. 1, provides through routing from the northern part of the city to the southern part of the city and vice versa, as well as from some of the east and west streets and the diagonal subways, and some of the north and south subways, but makes no attempt at universal through routing. The plan does, however, as thus far outlined, make limited through routing possible, brings the west side citizens to the lake front without transferring, and gives to all passengers the advantage of the universal transfer in numerous sheltered stations.

It should be clearly understood, however, that Plan No. 1, as recommended, does not prevent the necessary connections being made now or in the future for the establishment of many through routes.

In order to make it possible to adopt such a system much consideration has been given to the question of a proper design for the subways to be constructed in the different streets of the city, and great difficulty has been encountered in adopting a design which would give capacity, safety and clearance sufficient to enable cars as large as the present elevated cars to pass through the subways without necessitating grade crossings or greatly interfering with the present structure of the Illinois Tunnel Company. It was deemed advisable that the passenger subways should be built to accommodate, at all points, the present elevated cars, so that if in the future it should seem best to change the routing of these cars from that at present contemplated, or to bring the cars of interurban railways in over the present elevated structures, or through future subways, the subway system could receive such cars. Since these elevated cars are but slightly larger than the present standard surface cars which probably must be operated in the subways the increased cost of making the subways large enough to accommodate the elevated trains is small and this objection is more than balanced by the advantages gained by so building them.

After considerable planning and by adopting reinforced concrete steel construction and in some instances combination I-beam and concrete construction, designs have been developed which if followed will permit the construction of bores of sufficient size to allow such cars to pass through them, and not seriously interfere with the structure of the Illinois Tunnel Company. The general design adopted is one which permits a shallow construction for the high level subways, allows sufficient room for the low level subways to pass under the high level subways and over the Illinois Tunnel Company's structure, and also allows the low level passenger subways to be placed almost as close to the surface of the streets as the single-decked subways of other cities where mezzanine floors are used for the distribution of passengers to the trains.

If Plan No. 1 is adopted, and on the assumption that the first use of a subway system will be for the present surface line cars, the following method of building the system is recommended:

FIRST STEP.

In order to accommodate the north and south bound surface cars, and relieve the congestion upon Clark street, which is the street most in need at present of such relief, it would be advisable to construct at first a two-track subway, so located that two additional tracks could be added when needed, and connect the tracks now constructed with the south end of the La Salle street tunnel, already built for such a connection. From the south end of this tunnel the two tracks at first constructed could proceed southward in La Salle street, rising from the present tunnel terminal on a 5 per cent grade, and reaching the high level grade at Washington street, in order to clear a low level east and west subway which the future may require in Washington street; thence south in La Salle street, at high level, to Madison street; thence east in Madison, at high level, to Clark; south in Clark, at high level, to Archer avenue, where its southern portal would be located at present. Inasmuch as this terminates in a railroad district now well served by the Clark street surface cars, this subway could turn east in Polk street, at high level, to Custom House Place or Plymouth Court; thence south at high level to Fourteenth street, thus opening up a new artery into the downtown district.

The construction of the Clark street subway described would at once give an underground artery through the business district, upon which the surface line cars could be operated at high speed.

In order ultimately to take care of the elevated lines from the west side, and eventually high speed subways from the central business district to the western division of the city, the plan calls for the construction of subways upon four of the east and west streets in the present business district, viz.: Randolph street, Madison street, Jackson boulevard and Harrison street, and later, upon Chicago avenue and Twelfth street, and eventually upon other east and west streets, located to the north and south, as well as additional north and south streets, which locations future conditions might modify.

To facilitate the movement of west side surface cars at present and also to invest such money as is at first expended for subways and have them located so that they will ultimately become part of the permanent high speed subway system, a single track connection could be made at a suitable point, with the existing south track in the east end of the present Washington street tunnel, as this tunnel is now constructed in such a manner as to become part of the future subway system; thence ascending in Washington street with this track on a 5 per cent grade to and curving into Franklin street, and proceeding in the east side of this street at low level to Madison street; thence curving into and continuing eastward in the south side of Madison street at low level to Wabash avenue; thence curving into the west half of Michigan avenue on a grade suitable for the mezzanine floor stations hereinafter described; thence continuing south in Michigan avenue to Jackson boulevard; thence curving west and continuing in the north side of Jackson boulevard to Wabash avenue; thence west in the north side of Jackson boulevard to Franklin street; thence curving north in the east half of Franklin street and continuing to Washington street; thence crossing under the south track, curving and continuing at this level in Washington street to the proper elevation for connecting with the north track in the Washington street tunnel, thence downward at the present established 3 per cent grade and through the tunnel to the west. Thus a complete loop is formed for all cars passing through the Washington street tunnel.

Beginning with a suitable connection with the south track in the Van Buren street tunnel, thence ascending a 5 per cent grade to Franklin street; thence north in Franklin street, continuing the 5 per cent grade upward to low level in Jackson boulevard; thence curving and continuing east in the north half of Jackson boulevard to Wabash avenue; thence curving north into the west side of Michigan avenue; thence continuing north in Michigan avenue to Madison street; thence curving into Madison street and descending to Wabash avenue; thence continuing west in the south half of Madison street to Fifth avenue; thence continuing to Franklin street; thence curving into Franklin street and continuing to Monroe street; thence continuing in Franklin to Adams street; thence descending on a 2 per cent grade to Jackson boulevard; thence descending a 5 per cent grade to and curving into the Van Buren street tunnel; thence continuing downward on a 5 per cent grade west and joining by means of a suitable connection with the present north track in the Van Buren street tunnel, thus forming a complete loop for all cars operating through the Van Buren street tunnel.

When the tracks thus described in Franklin street, Jackson boulevard, Michigan avenue and Madison street become a part of the permanent system, no reconstruction will be necessary except the removal of some temporary curves and inclines in Franklin street at the intersection of Jackson boulevard and Madison street with Franklin street, and interconnecting the two tracks in Franklin street by means of short pieces of straight track at these locations.

Stations should be provided at present under this plan as follows (See Fig. 2):

One at Madison street, extending from La Salle street to Clark street, with entrances at each end.

One at Madison street and State street, with entrances on each side of State street, having platforms extending to Wabash avenue, where entrances will also be provided on each side of the street.

One at State street and Jackson boulevard, with entrances on each side of State street, having platforms extending to Wabash avenue, where entrances will also be provided on each side of the street.

One at Jackson boulevard between Clark and La Salle streets, with entrances at each end.

One at Franklin street, extending from a point near Adams street to a point somewhat north of Monroe street, with entrances at the center.

One at Michigan avenue, extending from Monroe street to Adams street, with entrances at each end, and so constructed as to allow the building of a mezzanine floor extending over the present and future tracks for the distribution of passengers. The adoption of this plan for stations in Michigan avenue would make it possible to construct broad sub-surface passageways or mezzanine floors of ample width at streets where subway stations may be located, viz.: Randolph, Washington, Monroe, Adams, Van Buren, Congress, and ultimately other streets to the south and north, as future subways are built. Pedestrians could then safely and quickly cross Michigan avenue, at any of these streets, below the surface.

It would be necessary to construct now only such parts of these stations as would be required to serve the tracks described.

SECOND STEP.

When conditions have been brought about so that the trains of the present elevated railways can be run in subways, and at the same time continue operating surface cars through the Washington, Van Buren and La-Salle street tunnels, then in order to accommo-

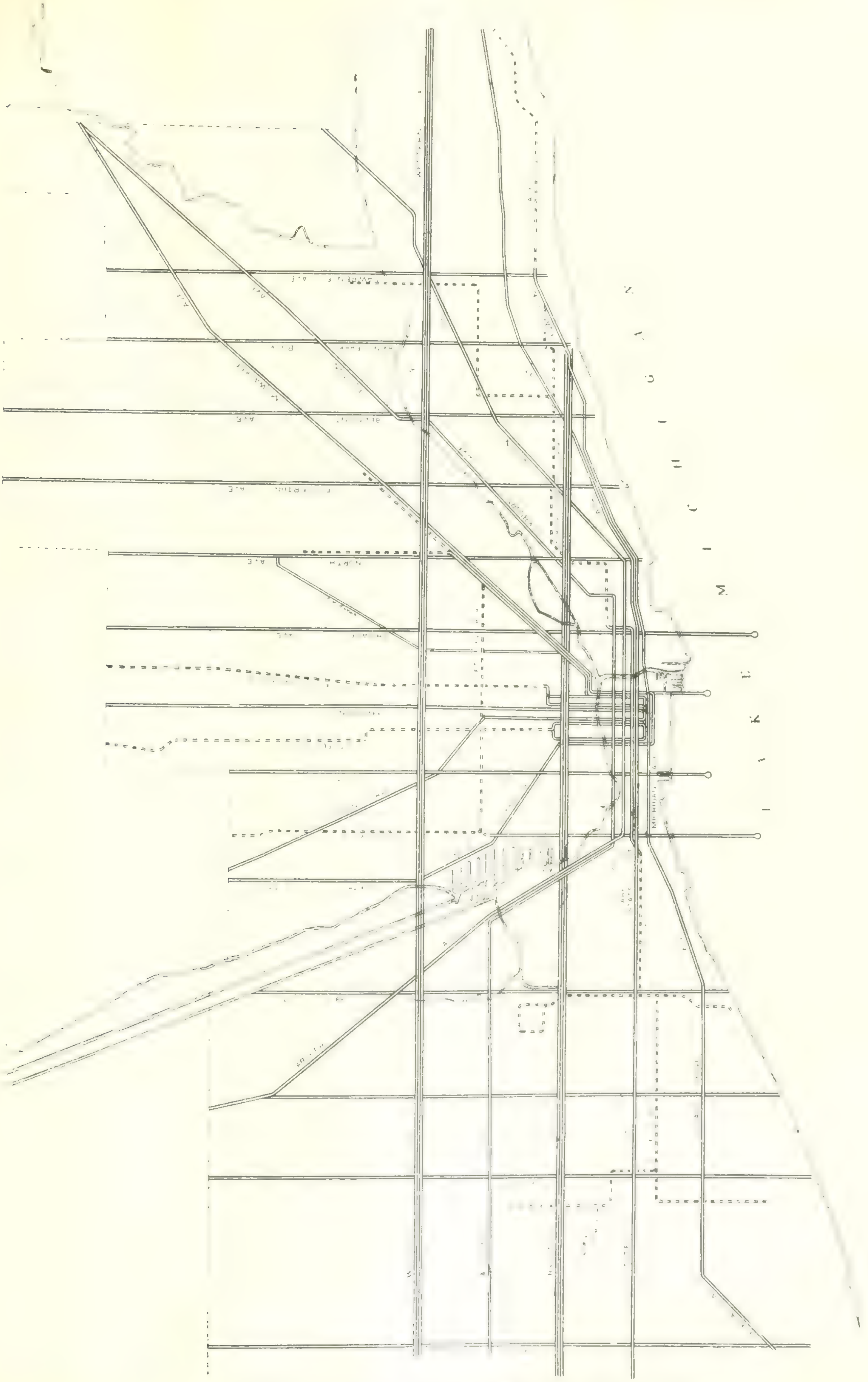

Fig. 3.—Maps Showing Comprehensive System of Subways for the City of Chicago.

[illegible] possible to take down the present loop structure, the next step would be to construct a north and south 4-track high level subway in State street, from 12th street to Chicago avenue; thence west in Chicago avenue with two tracks at high level so located that two additional tracks could eventually be placed in this avenue, to Franklin street, where a connection by means of an incline would be made [illegible] with the tracks of the Northwestern Elevated Railroad Company and the other two tracks of the State street subway connecting at Chicago avenue with the present surface car lines. An inclined connection with the tracks of the South Side Elevated Railroad Company would also be made near 13th street by descending to State street, then into the portal of the subway, while the other two tracks of the State street subway would be connected to the present surface line tracks in State street at 12th street. Upon the two east tracks of the four through tracks in State street would be operated the through route trains of the South Side Elevated and Northwestern Elevated Railroad systems, and upon the two west tracks would be operated, at present, the cars of the present surface line companies. These local surface cars could ultimately be replaced with high speed subway cars when the subway is sufficiently extended, and the surface cars provided for in other subways.

Simultaneously with the building of the State street subway, connections should be made with the west side elevated systems by constructing a suitable inclined connection with the Chicago & Oak Park Elevated Railroad on private property in the vicinity of Sangamon street between West Lake street and West Randolph street, and the construction of a 2-track high level subway from Sangamon street in the south side of West Randolph street to Clinton street, where it would descend under the river, on a grade not exceeding 3 per cent, keeping sufficiently low at Franklin street to pass under two tracks hereinafter described, to be located in Franklin street; thence ascending on a grade not exceeding 3 per cent to La Salle street, and continuing at high level to Wabash avenue, thence descending to Michigan avenue; thence curving and continuing south in Michigan avenue, from Randolph street to Madison street, at a level suitable for the mezzanine floor stations; thence curving into Wabash avenue; thence west in the north side of Madison street to Franklin street, keeping sufficiently low, with grades not exceeding 3 per cent, to pass under the two tracks already located in Franklin street under Step 1; thence west under the river on grades not exceeding 3 per cent to Clinton street, thence at high level in the north side of Madison street to the previously mentioned connection of the Chicago & Oak Park Elevated Railroad in the vicinity of Sangamon street, thus forming a complete loop upon which the trains running over the tracks of this company could be operated.

Also connecting with the Metropolitan Elevated structure in the vicinity of South Peoria street, thence south on private property, with a suitable inclined structure to Harrison street, thence east in Harrison street with a 2-track high level subway so located in the north half of the street that two additional tracks may ultimately be placed in this street, through and under the river on grades not exceeding 3 per cent, to La Salle street; thence east with two tracks at low level to Michigan avenue; thence curving and continuing north in the west side of Michigan avenue, to Jackson boulevard; thence curving into Jackson boulevard, and descending to Wabash avenue; thence extending west at low level in the south half of Jackson boulevard to Sherman street, thence descending on a grade not exceeding 3 per cent to clear tracks referred to in Step 1, located in Franklin street, and continuing west under the river, on grades not exceeding 3 per cent, thence to the high level at Clinton street, and continuing west in the south half of Jackson boulevard, at high level, so that two additional tracks could eventually be installed in the north half of the street, to the vicinity of South Peoria street, thence south to the inclined connection to the Metrooplitan Elevated structure previously mentioned, thus forming a complete double track loop for the trains of the Metropolitan system.

THIRD STEP.

When the capacity of the west side loops is reached, additional subway capacity for elevated or subway trains can be provided by constructing a double track loop, beginning at the inclined structure at Sangamon street, previously described, thence east in the north side of Randolph street to Michigan avenue; thence south in Michigan avenue to Harrison street, thence west in Harrison street to a junction with the inclined connection of the Metropolitan Elevated Railroad at South Peoria street, and following the same grades as the subways previously described in these streets. By the use of these additional tracks the elevated trains of the Chicago & Oak Park and Metropolitan Elevated systems can be through routed with each other and used for express service when so routed, and the loops previously described under Step 2 used for local elevated or subway trains.

This third loop could also be connected with the diagonal subways in Milwaukee avenue and Blue Island and Ogden avenues when these subways are constructed, as well as additional north and south tracks in Michigan avenue, to be hereinafter described, and thus provide through routing from the west part of the city to both the north and south parts of the city and vice versa for all elevated and subway trains operating over these tracks.

FOURTH STEP.

In order to still further extend the business district and to conform to the steam railway terminal plan now under contemplation for locating stations upon 12th street, should this be carried out, and at the same time better serve the north side manufacturing district, a 2-track subway in 12th street from Newberry avenue to Michigan avenue, thence north in Michigan avenue and Rush street, to Chicago avenue, thence west in Chicago avenue to Green street, could be constructed. Then all of the steam railway passenger terminals would be served by subway cars, as the plan thus far developed takes care of the new Chicago & Northwestern station through the Madison street subway, the Grand Central and La Salle street stations through the Harrison street subway, and the proposed Canal street station through either the Jackson boulevard or Harrison street subways.

FIFTH STEP.

By constructing a short piece of subway between 12th street and Chicago avenue in Canal and Townsend streets, a subway loop connecting all of the steam railway stations in the city could then be completed. Since this loop intersects the north and south subways and passes through the mezzanine floor stations in Michigan avenue, it makes it possible for passengers to transfer to any other subway, and would be the first of a series of loops in the city which could ultimately be constructed, as suggested in the Commercial Club's "Chicago Plan."

[illegible] THE FUTURE EXPANSION OF SUBWAYS.

It is impossible at the present time to determine upon what streets future subways will be located, or how the next step in subway construction will be taken, although a suggested plan is shown by Fig. 3.

Subway Stations.

In order to secure the advantage of shallow subways and to make them easily accessible for passengers by means of stairways of ample width it has been found necessary to increase somewhat the width of the sidewalks upon such streets as are occupied by high level subways, with a corresponding decrease in the width of the roadway in these streets. The increase in the width of the sidewalks upon some of these streets seems desirable and almost necessary, on account of the present congestion of pedestrians upon these streets, while the advantages of maintaining the present width of the roadway do not seem as necessary as the advantages gained for pedestrians and subway users by the suggested changes.

The necessity of confronting this condition is due to the difficulty pointed out in the first paragraph of this report, wherein was stated that the problem of designing a subway system for the City of Chicago was made very difficult on account of the present location of the Illinois Tunnel, which is so near the surface that the general use of stations with mezzanine floors is impossible unless the entire passenger subway is lowered about 8 ft.

In order to avoid these excessive costs and depths, with the corresponding inconvenience to passengers, and to adopt the design which the plans call for, it will be necessary, in order to maintain stairways of sufficient width, to change the widths of sidewalks as follows:

	Increasing side-walks from	to	Increasing side-walk space.	Decreasing street width.	Leaving between car and curb.
66' streets...11'		16'	14.3%	10.52%	7' 8"
80' streets ..16'		20'	25.0%	16-⅔%	10' 8"
100' streets...20'		25'	25.0%	16-⅔%	15' 8"

It may be argued that the resulting decrease in the width of the roadwawys would interfere with the free movement of vehicles while passing each other on the space between the curb and the street car. A study of the existing conditions shows that on a 66-foot street with a two-track street railway, the space between the car and the curb is now sufficient for only one vehicle. The proposed change will still leave a free passage for a single vehicle.

In the case of 80-ft. streets, two of the widest vehicles cannot at present pass each other between the car and the curb at the same time that a car is passing, and teams hauling narrower wagons at present rarely attempt to pass each other under those conditions. Thus, in such streets, the proposed changes will make no practical difference in the movement of the vehicle traffic, but will give great advantages to the subway and to pedestrians.

For 100-foot streets, such as State street, there is at present ample space for teams to pass one another between the curb and the car, and the space left if the suggested increase in the width of sidewalks were put into effect, would still be sufficient to allow two vehicles to pass each other between the curb and the car.

DESCRIPTION OF STATIONS.

Figure 4 shows a station designed in accordance with this method of construction, and is recommended as the most desirable form to adopt except on Michigan avenue, where mezzanine floor stations have special advantages, as hereinbefore described, and can be adopted.

This plan of stations is accomplished without the general use of mezzanine floors by utilizing the sub sidewalk space between the present curb line and the property line. The adoption of this design will make the cars of the high level subways easy of access from the streets by the descent of short flights of stairs, and when supplemented by escalators leading to the low level subways, will make the street surfaces easily accessible to all passengers, without excessive exertion.

TRAFFIC CONGESTION AVOIDED.

The general arrangement of the stations provides straight train or car platforms of sufficient width for all traffic, and to or from which passengers may pass expeditiously. Congestion will be avoided by providing that traffic in one direction will not be crossed by traffic in another direction, and at stairways to be used jointly by passengers entering and leaving, railings will be provided where practicable, to separate the traffic going in opposite directions.

In general, the island platform type of stations will be used, which is one with its train or car platform between two tracks, so that passengers may be discharged from or loaded upon trains on either side of the platform. At

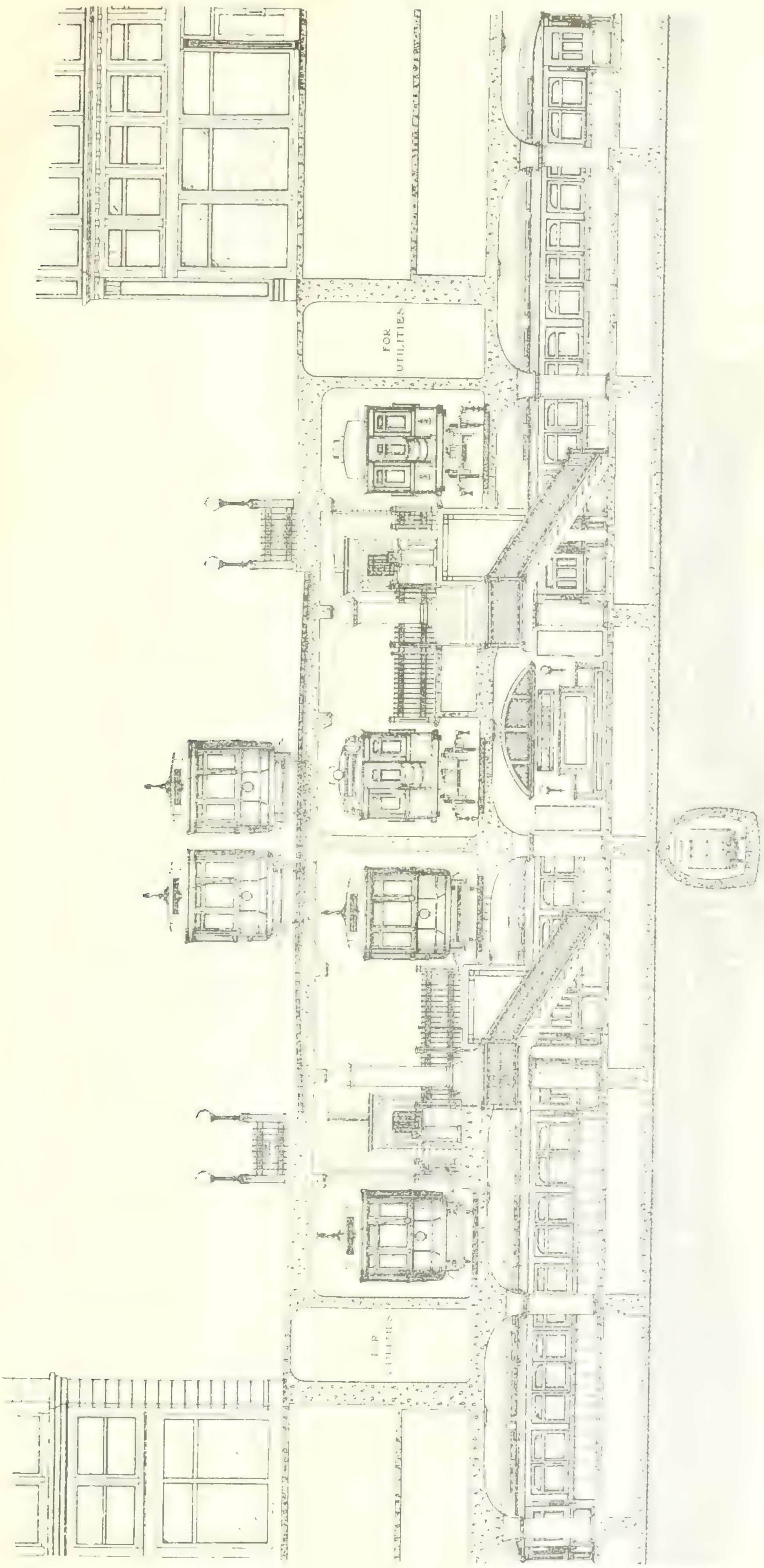

Fig. 4.—Station at Intersection of State St. and Jackson Blvd. Typical Station for Loop District.

certain locations another type of station will be used, which [illegible] the train or car platform only, and is known as the single track type.

[illegible]

As the track can be generally tangent or parallel for any desired distance each side of stations, it will be possible to make the stations any length, to be determined by the amount of traffic at the stations in question, and whether it will be handled by trains or single cars. If the traffic is to be handled by trains, the platforms will be long enough for trains of ten cars, or 500 feet in the clear, which will permit passengers to enter or leave through the vestibules at the end of each car in the train, or through side or middle car entrances. The width of the island station platform is limited by the amount of space available for tracks and stations between the building lines of streets in which the subways will be located, thus limiting the width to 16 ft in most cases.

The stations for passengers using cars of the surface lines not running in trains will have platforms not less than 250 ft. long, to permit the operation of cars in strings of at least four cars, not coupled together but with sufficient space between for safe operation.

STATION PLATFORMS.

The platforms at stations will vary in length as already stated, but will generally be 16 ft. in width, and where for use of elevated or subway trains, will be 3 ft. 6 ins. in height above the top of rails, so as to be about the height of the car floors and thus facilitate the movement of passengers by avoiding the necessity of their climbing up or down car steps. The platform for surface cars will be six inches above the top of rails.

[illegible]

Stairways will be of fireproof material, provided with safety treads, and will be at least 5 ft. in width on the inside, with two stairways at each end of each platform. The entrances to the stairways from the sidewalk will be of simple design, and may be enclosed by hoods or kiosks of cast iron and wire glass, which may be removed at the end of the winter season.

TICKET BOOTHS.

The ticket booths will be constructed of fireproof material, 10 ft. by 5 ft. inside measurement, which will give sufficient space for two ticket sellers. They will be located so as to give a minimum obstruction to the flow of traffic. It is proposed to use but one ticket seller when the traffic is light, and during the night hours, when there is little traffic, to use an adjustable turnstile at the ticket booths for the collection of fares, instead of selling tickets for deposit at the chopper, thus reducing the number of station employes during these hours.

GATES.

The gates at the exits will be metal and during periods of light traffic opened and closed by mechanical means by the attendant at the chopper box. During the periods of heavy traffic, a porter or additional gateman will be in charge of the gates.

[illegible]

Toilet rooms for men and women will be provided at each end of the station platforms, accessible to the general public. There will also be "rest rooms" for women provided with the usual comforts and conveniences.

[illegible]

For the convenience of the subway patrons, news stands of fireproof material will be provided at each end of the station, and so located that they will be convenient of access, [illegible]

[illegible]

The train platform and station floor is to be smooth troweled concrete, divided into squares to represent panels. The finish of the walls and ceilings of the stations, including the platform, will be of simple design and at moderate cost, but selected principally for cleanliness and appearance.

The walls will have a sanitary cover of concrete joining the floors. Adjoining this sanitary cove will be a [illegible] high [illegible] smooth finished concrete, and above this several feet of white or opal glazed tile, with trimmings of colored tile. The walls above the tiling and also the ceiling, to be finished with white cement or concrete. The doors are to be of metal and glass.

The toilet rooms will have slate walls and partitions, above which will be white tile to prevent disfigurement, and the vault light wells will be finished in white cement.

Utilities.

Reconstruction and renewal of utilities, including sewers and water mains, as well as gas mains, electric conduits, etc., have been postponed from year to year, as subway construction has been generally expected.

Utilities are at present occupying more space in many of the streets than their future demands will require, which condition was brought about by the construction of capacious feeders or mains by independent corporations that have subsequently combined. Also by the addition of feeders or mains of small capacity as required from time to time, all of which might be replaced by one feeder of the same or greater capacity than the others combined, and located systematically with respect to the present and future needs.

During subway construction most of the utilities would necessarily have to be temporarily located in the alleys, with the possible exceptions of gas and water mains, which might be elevated above the surface of the street.

The types of high level subways suggested have sufficient space on each side of the subway structure for utilities. There are cases, however, when additional tracks are required for a distance of one or two blocks, to provide for through routing of cars and trains, which will require most of the utilities to be located in the alleys, from which all the buildings concerned may be reached.

The low level type of subways permits the location of the utilities overhead in galleries, either outside or inside the curb line.

HIGH AND LOW PRESSURE WATER SYSTEM

Various designs of utility galleries have been prepared, both for construction in the alleys and as a part of the subway structure, which provide space for house drainage, high and low pressure water supply, fuel and illuminating gas, electric light and power conductors, telegraph and telephone cables, and compressed air or other tubes.

Drainage.

Gutters or drains are provided along the tracks to take care of any water which may find its way into the subway. These gutters will have sufficient grade to cause water to run freely to the low points into sumps of suitable size. A system of automatic pumps or ejectors, operated by electric power or compressed air, will then force the water from these sumps into the city sewers.

Waste water from wash bowls, sinks and toilets at stations will be conveyed to specially constructed sumps, and from there forced to the nearest sewers by similar means.

Ventilation.

The design of subways adopted have the bores or passageways for each track enclosed except at stations, so that the movement of trains or cars through these enclosed passageways will act upon the air very much like a piston, and will push the air ahead and draw it in behind, giving a change of air continuously between stations, and to some extent change the air at the stations, where the train platforms are located.

In order to expel the vitiated air and particularly the excessive heat from the stations and the subways, as well as any gases escaping into the utilities galleries, electrically operated fans or exhausters will be used in connection with large ducts under station platforms, communicating with the several vertical ducts between two contiguous columns along the center of the platforms, opening above the heads of the passengers.

The fans are located in chambers under the subway floors, which communicate with the outside by means of flues into and through the corner of the basement of abutting buildings, rising through the basement and first floor and discharging into alleys.

Sewers.

Temporary connections will be made with existing sewers located in nearby or adjacent streets before the present connections are disturbed by the excavation in the streets where subways are to be constructed.

Conditions will vary in each block along the route of subways, and will require special arrangement, but from the study that has been given to this problem, it is safe to say that there will be no insurmountable difficulties in continuing sewer connections with all buildings during the construction of subways.

As all north and south subways, except river approaches, will be the high level type, and all east and west subways, except those west of the river and adjacent to the main river, will be the low level type, the general arrangement of sewers should fit into any subway system designed with high and low level subways so arranged.

The topography of the business district east and south of the river and its branches and north of 14th street, when considered in connection with the general arrangement of subways, suggests a separate system of sewers north of Harrison street and west of State street, and north of Adams street and east of State street, and combined system sewer south of Harrison street west of State street and south of Adams street east of State street.

The area south of Adams street and east of State street may drain into the South Branch through an existing sewer in 14th street.

The area west of State street and between 12th and Harrison streets may drain into the South Branch through a main sewer to be constructed in Taylor street.

The area north of Adams street between State street and Fifth avenue may drain into the main river, or, as would possibly be more desirable from a sanitary point of view, by means of an intercepting sewer, into the South Branch.

The area south of Adams street and north of Harrison street, west of State street, may drain directly into the South Branch.

The area north of Adams street south of Lake street and west of Fifth avenue may drain directly into the South Branch.

The small area north of Lake street and west of Fifth avenue may drain directly into the main river.

The area east of State street and north of Adams street may drain directly into the main river.

Lighting.

AT STATIONS.

The subway station, for lighting purposes, may be divided into three divisions:

1st.—The stairways from the street.

2nd.—The concourse, embracing passageways from the foot of the stairs to and through the ticket office to the train platform.

3rd.—The station platforms.

Incandescent lamps of varying candle power will be used, the size depending upon the exact finish of the wall and ceiling and the consequent loss of light by absorption therein.

The control of the light of each station will be had from a distributing cabinet, under control of the station agent or porter.

Separate light circuits direct from the primary source of power, and entirely separate from the power supply of the subway will be used, and for insurance to feeders, station transformers will be in duplicate or so subdivided as to give the greatest practicable insurance against failure to provide light.

In the sub-station or stations from which the converted power for the subway will be distributed, static transformers will be used, to which the conductors from the source of primary power will be carried, thus making the installation of power and light feeders separate and independent throughout the entire length of the subway.

BETWEEN STATIONS

The passageways between stations through which trains or cars will be operated in one direction only, will be lighted by a system of moderate illumination with the lights so installed that they will be shaded from the eyes of a motorman on the train or car. The system of illumination will be divided into sections, which will be under the control of the proper employe, with the equipment consisting of incandescent lamps in clear glass globes and so arranged that a faint amount of illumination will be used under normal conditions, for the convenience of motormen in reading signals, but while the degree of illumination may be made greater in an emergency, such as a derailment or the loss of power causing the stopping of the trains and the darkening of the cars.

Power.

The current necessary for the operation of the initial subways will be delivered at the bus-bars of the sub-station or stations, which will be economically located immediately along the line of the subway.

SUB-STATIONS.

Sub-stations will be constructed in the cross streets, immediately adjacent to the subway and on the same level with the subway, so that such stations shall form no greater barrier to the construction of future subways than the subway itself forms.

These sub-stations will be supplied with a three-phase current through underground mains at a high tension voltage.

The sub-station equipment will consist of air-cooled transformers, delivering an alternating current at reduced voltage to rotary transformers of a size approximating 2,000 to 4,000 k. w. each. The current from these rotary transformers will be distributed by a low tension power board, from which the current will be conveyed to the various sections into which the overhead trolley for surface cars and the third rail for elevated trains will be divided. The distribution of these secondary currents will be under the control of a load despatcher. The great importance of continuity of service and the known weakness of feeders will make advisable the installation of a distant control equipment, whereby the load despatcher may change the distant connections between feeders and the contacting trolley or third rail as easily as he may disconnect and rearrange the feeders on the sub-station switchboard.

TRANSMISSION.

It is proposed to supply power from the sub-station to the trolley for surface cars and third rail for elevated trains through underground cables, laid in tile conduits, installed in the walls, floors or available space of the subway. The number of such feeders and their arrangement will, of course, depend upon the plan of operation which it is desired to follow.

METHODS OF OPERATION.

It is proposed to continue the trolley wire of the surface cars and the third rail of the elevated lines through the subway, so that no change may be required in their equipments while operating through the subway. For emergency operation, it might be wise to install a trolley of standard surface car design over those tracks provided for elevated train operation, in order that surface cars may be run over elevated tracks if an emergency requiring such operation arises. It will not be necessary to provide a third rail in the subways devoted to surface car operation, because all elevated trains, except those of the South Side Elevated road, are now equipped with trolleys, and trolleys could easily be added to the cars of this system at much less expense than would be necessitated for installing third rails in the surface car subways.

RETURN CIRCUIT.

It is proposed to make the largest possible use of the electrical conducting capacity of the track by bonding the rails at the joints to their full equivalent cross section, and supplement the rails with return circuit conductors in order to reduce the liability of damages from electrolysis to a minimum.

Summary.

Summarized the advantages of Plan No. 1 are as follows:

(a) A comprehensive system starting with a nucleus involving a small investment but capable of gradual expansion until the system covers the entire city.

(b) No grade crossings.

(c) High speed straight line operation, with few switches or curves.

(d) Least practicable first cost.

(e) Great flexibility, and always tending to enlarge the business district in three directions.

(f) Ease of access to passengers owing to the shallowness of the high level subways which allows the platforms of the low level subways to be within 28 ft. of the surface of the streets.

Estimates.

The estimates of cost of the various steps of the recommended plan, as shown by Fig. 1, are given below. These estimates include care of abutting buildings, but do not include damages to property.

FIST STEP.

North and south subway from southern portal of La Salle street tunnel to Clark street and Archer avenue, including such portions of the station at Clark and Madison streets as it would be necessary to construct, and complete stations at Jackson boulevard, Harrison and Twelfth streets..$3,000,000

(Or a 2-track subway having 4.128 miles of single track and 4 stations, complete ready for operation at $726,710 per mile.)

Or, as an alternative plan, a north and south subway from southern portal of La Salle street tunnel to 14th street, at Custom House place or Plymouth court, including necessary stations or portions of stations, $2,500,000.

(Or a 2-track subway having 3.124 miles of single track and 4 stations, complete ready for operation at $800,250 per mile.)

Terminal loops for West Side surface lines, connecting with Washington street and Van Buren street tunnels, with that portion of stations which it is necessary to construct..........$5,000,000

(Or a subway having 3.663 miles of single track and 6 stations, complete ready for operation at $1,364,950 per mile.)

SECOND STEP.

North and south subway extending from a connection with the Northwestern Elevated R. R. at Franklin street to a connection with the South Side Elevated R. R. at 12th street; this subway also having two other tracks for surface lines extending from a portal in Chicago avenue, near Dearborn avenue, to a portal near 13th street, and including stations $7,750,000

(Or a 4-track subway having 10.184 miles of single track and 5 stations complete ready for operation at $768,550 per mile.)

Terminal loops for the Metropolitan Elevated R. R. and the Chicago & Oak Park Elevated R. R., including stations, as shown by Fig. 1 ....$13,000,000

(Or a 2-track subway having [illegible] miles of single track and 14 stations, complete ready for operation at $1,421,100 per mile.)

THIRD STEP.

Through-route subway connecting the Metropolitan Elevated R. R. with the Chicago & Oak Park R. R., via Randolph street, Michigan avenue and Harrison street, and including necessary stations or portions of stations $6,250,000

(Or a 2-track subway having [illegible] miles of single track and 9 stations, complete for operation at $1,049,710 per mile.)

FOURTH STEP.

Subway extending from portal at Newberry avenue along Twelfth street, Michigan avenue, Rush street and Chicago avenue, to Green street, and including necessary stations or portions of stations..................$9,700,000

(Or a 2-track subway having [illegible] miles of single track and 4 stations, complete ready for operation at $1,104,780 per mile.)

FIFTH STEP.

Subway extending in Canal and Townsend streets, from 12th street to Chicago avenue, including [illegible] in Canal street at Jackson boulevard and Madison street $3,750,000

(Or a 2-track subway having [illegible]976 miles of single track and two stations, complete, ready for operation at $943,150 per mile.)

Total estimated cost of recommended plan $48,450,000

LETTERS TO THE EDITOR.

The Relative Payment Received by the Railways for Handling Mail and Express Matter.

Sirs: A good many papers are publishing some data about the relative payment received by the railroads for handling mails and express that apparently appeared first in your paper. As a mistake seems to have been made that is unjust to the railroads and puts them in a false light before the public, I would invite your attention to the attached memorandum which points out the inaccuracy. I hope you will do the railroads the justice to publish it.

Yours truly,
W. A. WORTHINGTON.

Feb. 9, 1911.

(This statement referred to Union Pacific System, Southern Pacific Company by our correspondent is one made by Mr. Julius Kruttschnitt, Chairman of The Railway Mail Pay Committee of The American Railway Association. We print it below and have commented on its statements in our editorial columns—Editor.)

The assertion was recently made in one of the trade papers and has been given wide publicity in the daily press that the government pays the railways $75 per ton for transporting the mails, whereas the express companies pay the railways less than $15 per ton for handling express. This statement is erroneous, as average ton mile rates for mail and express are not far apart, and is adapted to strengthen the impression which is already quite widespread that the government is paying the railways much more for hauling the mails than they receive for handling express. As a matter of fact, in proportion to the cost incurred by the roads and the value of the service rendered by them, the compensation they receive for handling the mails is not only less than what they receive for handling express, but it is less in proportion than what they receive for any other service that they render. The proof of this is afforded by statistics that have just been compiled by the Railway Mail Pay Committee of the American Railway Association. The forms on which these statistics were made up were prescribed by the Postoffice Department, and the statistics are based on the reports received from 187 railways operating 178,710 miles, on which there are 2,411 mail routes.

Comparison between the amount per ton received by the railways for handling mail and the amount per ton received by them for handling express is entirely unfair, because under the regulations and orders of the Post-Office Department they are unable to load in a given amount of space in a car anywhere near as much mail as express. Because of the presence of racks and post office features and room required for postal clerks to distribute mail en route, railway postal cars are limited to a carrying capacity of only about 3 tons of mail, while express cars, being unobstructed, can easily be loaded to the roof with 20 to 30 tons of express. The dead weight of the average mail car with the post office features and its superior construction is 25 per cent to 30 per cent greater than the dead weight of the average express car. Now, no matter how little of the space in a car may be occupied, the entire dead weight of the car must be hauled. Therefore the only fair way to determine whether the railways are reciving too much or too little [illegible] into consideration the gross tonnage hauled. including both that of the car and of the persons or commodities handled. Suppose a traveler should ask a porter at a railway station to carry 10 lbs. of baggage for him and that the porter, when he went for the baggage, should [illegible] weighing 220 lbs. Would he think he should be paid for carrying only the 10 lbs. of baggage or for carrying that and the 220-lb. box also? Now, the Post-Office Department requires the railways to haul 22 tons of car for every ton of mail. On the other hand, the express companies comply with the demands of the railways that express matter shall be economically loaded.

The weight per linear foot of space in mail cars is because of their construction and post office features are really greater than average passenger train cars. Passengers, mail and express are usually hauled on the same trains. The best measure of whether the railways are fairly paid for handling the mail is the amount that they receive for hauling 1 ft. of car space one mile in the transportation of passengers, mail and express. The investigation made by the Railway Mail Pay Committee of the American Railway Association, under the direction of the Post-Office Department shows that in November, 1909, the railways hauled 1,153,110,245 ft. of space one mile in the transportation of mail; 9,902,370,150 ft. one mile in the transportation of passengers, and 1,320,108,589 ft. one mile in the transportation of express. For these services they received the following amounts: Transportation of mail, $3,721,796; passengers, $43,738,723; express, $5,075,222. The average revenue per 1,000 foot miles, therefore, was as follows: Mail, $3.23; passenger, $4.42; express, $3.86. In other words, the roads received 19 per cent more per foot mile for hauling express and 37 per cent more per foot mile for hauling passengers than they received for hauling the mails. When it is considered that the railways receive much less from their passenger train service than they do for their freight train service—the earnings per freight train mile in the year ending June 30, 1909, were $2.76 and per passenger train mile only $1.27—and that their earnings from mail service are less than from either of the other services rendered by them on passenger trains one gets a fair idea of how low their compensation for handling mails really is. The average passenger train is 300 ft. long, and if it carried mail only in all its cars, would earn only 97 cts.

These figures cover only the revenue and express for transportation on trains. In addition, the railways have to carry the mails between the post office and stations at about six sevenths of the places on their lines, rendering an extra service which the Postmaster-General has estimated would cost the Postal Department, if it rendered it, $4,093,000 annually. They do not render any such service in the handling of express. Furthermore, all postal clerks while on duty in postal cars and mail apartment cars are carried free in accordance with the law. In adition, postal clerks are transported free between the ends of their runs and their homes on the line of the railroads, and commissions which are issued to officers and special agents of the Post-Office Department, post office inspectors, officers of the railways mail service, etc., are honored for transportation by the railways, and this transportation amounts to over $1,000,000 per annum. These persons have the same status as passengers who pay for their transportation, and the railways are therefore required to pay them damages in case of injury, for assuming which liability they receive no compensation whatever. The express companies assume all such liability for their employes. Furthermore, with every increase in the amount of express carried the railways receive increases in revenue. On the other hand, the mails are weighed only once in four years, and for the carriage of the increase in the mail during this four years' period, which average 6 per cent per year, the roads receive no compensation. The result is the rendition by them of about three million dollars worth of service per year for which they receive no pay.

The prevalent belief that the railways are receiving for the service they render to the Postal Department a disproportionate amount of the expenditures made by it is entirely wrong. The Postmaster-General's report shows that the increase between 1907 and 1910 in the total cost incurred by the Postal Department in handling the mail was about $40,000,000. Of this $11,000,000 was for increase in the salaries of postal clerks, $10,000,000 for rural free delivery, $8,000,000 for city delivery service, $4,000,000 for railway postal clerks, $3,000,000 for postmasters' salaries, while the railways, although they handled 22 per cent more mail, received $352,760 less in [illegible] much greater than the total service rendered by all other persons and agencies, and yet while the railways in the year ending June 30, 1910, received for the service rendered by them only $49,340,638, the amount spent for rural delivery was $36,844,969, and the amount spent for city delivery was $31,683,639, a total for rural and city delivery of $68,528,600, or $19,187,970 more than was received by the railways. The volume of mail handled during the last ten years increased 108 per cent. The expense incurred by the Postal Department in handling it increased 111 per cent. The cost of rural free delivery increased 2,000 per cent, while the amount paid to the railways for the transportation of mail increased only 27 per cent. The foregoing figures, it seems to me, prove conclusively that the persistent attacks upon the railways based upon the theory that they receive too much for the service they render to the Postal Department are entirely unjustified. On the contrary, they show that the compensation that is being received by the railways is entirely inadequate. If the Postal Department were as thrifty in handling other parts of its business as it has been in not only holding down, but actually reducing, the compensation to the railways for the service they render there would be a great deal less ground for complaints that it is extravagantly managed.

Dry Mixed Concrete for Curbs and Sidewalks.

[illegible] inquiry about the use of dry [illegible] concrete for curbs and sidewalks, referring especially to a letter in your issue of [illegible] N. F. Hopkins, the writer would like to present his own practice.

Just 14 years ago the writer had some trouble in securing finishers for a big sidewalk contract he was handling and broke in some green men, which was against the rules of the union. Work was stopped but no adjustment was possible for the finishers had a strong union and had the contractor on the hip. After a delay that thre[illegible] end disastrously we concluded as the [illegible] were the only men with whom we were having trouble that we would do without them. The curb was therefore made of concrete somewhat wetter than is customary for that [illegible] wet enough [illegible] allowed to flow next the forms, potato forks being used to spade the coarse material back from the face so the mortar could get to the front. A star shaped tamper, made on the principle of a wire potato masher, was used on top to force the larger pieces down so the mortar could come to the top and be brushed off with a broom, instead of being finished with a wood float or a steel float. The use of [illegible] on the top would [illegible] penalized the contractor. When it came to the sidewalk we made half the thickness in the usual way and for the remainder of the thickness used a somewhat richer mix than is customary and after smoothing it off with a raking board brushed it with a broom to give a uniform surface slightly roughened. The results were so satisfactory that the writer has never done any sidewalk work since that time in any other way provided the specifications permitted it.

The writer differs, as a result of his own experience, with the statement of Mr. Hopkins that the cost of forms is the reason why the dry mix is preferred to the wet mix, when the cost of finishing is taken into consideration. With insecure forms the high priced finisher must be used. With properly constructed forms which permit the use of a medium wet mix there is no added cost for finishing. The offset is in favor of the wet mix both as to cost and appearance, not to include the much better and stronger curb. The real reason why the loosely mixed and compacted curb has remained with us is that this is one of the little items to which engineers have not yet turned their attention generally. The work thus far done has been satisfactory in the main and the workmen have simply been permitted to do the work in the way they learned it according to time honored methods. The cost of either way is so nearly the same that there has seemed no good reason for asking [illegible] wet methods be adopted. When a man gets up against a union, however, as the writer [illegible] forced to adopt some method which renders him independent of the union. No doubt this has been done in other cities and that there are hundreds of men doing this work just as the writer does it.

The writer was employed by a certain city to prepare specifications for sidewalk and curb construction and the local labor unions compelled the adoption of the specifications calling for the work of the finisher. Even in the great city of Chicago an architect cannot specify hydrated lime for plastering because its use will throw out of employment, members of the union of plasterers, helpers and mortar mixers. We can conclude therefore that the labor unions have a great deal to do with the present adherence to old fashioned methods of constructing sidewalks and curbs. In the use of richer mixtures for sidewalks it may be stated that to use a lean mixture in the lower half with the richer mixture on top is economical.

The writer takes issue with the statement of Mr. Hopkins that dry mixed concrete is stronger than wet mixed concrete, especially at first. That idea has been very completely knocked out within the past few years. There are so many data on the subject that it is strange to see a writer make the statement soberly today in a high class technical publication. A dry mix (if not too dry) merely obtains its final strength in a shorter time than wet mixed concrete. Thus when forms are to be removed quickly use less water than is customary. But when less water is used more tamping must be given so the forms must be strong enough to either stand this pressure of wet concrete or be strong enough to stand hard tamping of moist concrete. For the first month the dry mixed concrete is slightly stronger than wet mixed concrete but after that very little difference can be found, but when found it is nearly always in favor of the wet mix. This must be qualified by stating that the strength of the wet mix depends upon the degree of wetness. A dry mix is seldom uniform and is always weaker in the long run than a more moist or even a decidedly wet mix.

Yours truly,
ERNEST McCULLOUGH.

Chicago, Ill., Jan. 29, 1911.

PERSONALS.

Mr. Kahman of the firm of Kahman & McMurray, bridge contractors, died at his home in Kansas City, Mo., on Feb. 6.

Mr. John S. Bates, formerly city engineer of Monmouth, Ill., has been appointed chief engineer of the Fresno-Coalinga—Monterey R. R., a proposed line having its terminus at Fresno, Calif.

Mr. Henry B. Drowne, Assoc. M. Am. Soc. C. E., has resigned as assistant engineer to the State Board of Public Roads of Rhode Island to accept the position of assistant engineer with Arthur H. Blanchard, consulting highway engineer, Providence, R. I.

Mr. George H. Watkins, president of the Ohio State Board of Public Works, died at his home in Portsmouth, O., on Feb. 8, at the age of 51. His death was due to a stroke of apoplexy. Prior to becoming a member of the board he had served for a number of years as canal superintendent.

Mr. H. Morton Stephens has resigned his position as Resident Engineer on the Winston-Salem Southbound R. R., and has accepted a position as Superintendent of Construction for the Purcell Construction Co., which has the contract for constructing 10 miles of line for the Lehigh & New England R. R.

Mr. A. Bickel, formerly contract manager of the Freeborn Engineering & Constructing Co. has accepted the position of president of the Commercial Construction Company, with principal offices at Kansas City, Missouri. This company is engaged in a general line of municipal and private construction work.

Mr. M. L. Newton, a prominent engineer of Waterloo, Iowa, died at his home in that city on Jan. 24. At the time of his death he was consulting engineer for the W. C. F. & N. Ry., an electric system with headquarters at Waterloo. He was a past-president of the Iowa Engineering Society, of which he had been a member for a great many years.

Mr. Orrin E. Stanley, M. Am. Soc. C. E., formerly City Engineer of Pierre, South Dakota and more recently assistant engineer for the Oregon Railway and Navigation Company, announces that he has opened an office for the practice of municipal, railway and topographical engineering at room 1005, Chamber of Commerce Building, Portland, Ore.

Mr. M. J. Roach, senior member of the firm of Roach & Stansell, prominent railroad, levee and paving contractors of Memphis, Tenn., has been appointed a director of the National Rivers and Harbors Congress. His selection was due to his intimate knowledge of the Mississippi River and its navigable tributaries, and to his recognized standing as a levee expert.

Mr. C. L. Bernay, who has been for the past two years assistant city engineer of Houston, Tex., has accepted a position in a selling capacity with the Texas Co., of that city. Owing to his knowledge of paving materials and street engineering, Mr. Bernay will become an important factor in that company's asphalt division. He is a graduate of the civil engineering department of the Texas Agricultural and Mechanical College.

The Republic Engineering Co., of which Mr. W. A. Lewis, formerly president of the Construction Co., is manager, has opened offices in the Patton Building, Milwaukee, Wis., and will engage in the design and construction of reinforced concrete, water works, sewerage, and industrial plants. This company has secured the services of Mr. B. J. D. Blackmoor, a civil engineer well known in the eastern and northern states.

Col. Edwin A. Stevens, a well-known mechanical engineer of Trenton, N. J., has been appointed state road commissioner of New Jersey at a salary of $5,000. He was born in Philadelphia in 1858, and is a son of the founder of the Stevens Institute of Technology, at Hoboken. He is an associate member of the American Society of Mechanical Engineers and a life member of the Association of Naval Architects and Marine Engineers.

Lisle V. Hites and Ray W. Miller, civil engineers, have succeeded to the general engineering practice of Geo. W. Koss, C. E., and have organized under the name of the Des Moines Engineering and Construction Co., with offices at 517-518 Iowa Loan and Trust Bldg., Des Moines, Iowa. The new firm is prepared to make all kinds of surveys, furnish plans, specifications and reports on all kind of municipal improvements and to supervise and inspect construction.

Mr. Charles Marcus Osborn, a railroad attorney who has acted as counsel in recent years for a number of leading railroad companies, died at his home in Evanston, Ill., on Feb. 1. Mr. Osborn was born in Sag Harbor, N. Y., in 1833. He was graduated from the Renssalaer Polytechnic Institute as a civil engineer in 1853. He took up the practice of his profession in Rock Island, Ill., and at the same time studied law. As an attorney he was associated for years with Samuel Linde, vice-president of the Chicago & Northwestern Ry.

While seeking for evidence of fraud in coal deliveries, Mr. James J. McCabe, a reporter for the Chicago Examiner, and Mr. Frederick Fitzpatrick, assistant engineer at the Cook County hospital, were instantly killed in a power house of the sanitary board at Lincoln and Polk Sts., Chicago, on Feb. 11. Mr. McCabe had entered a narrow space between a wall and a powerful electric transformer. It is supposed that, not being aware of the danger of his position, he accidentally touched the transformer and formed a short circuit. Mr. Fitzpatrick lost his life in attempting to rescue McCabe's body before the current had been shut off.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Road and Street Supplies.—3¼x6¼ ins., 16 pp. The Baker Mfg. Co., Chicago, Ill.

Illustrating road drags, scrapers, carts and other apparatus. This booklet is listed by the company as Catalog 376.

Shaking Screens.—6x9 ins., 8 pp. Power & Mining Machinery Co., Milwaukee, Wis.

Describing a plant designed to overcome the difficulties of fine screening. Illustrated.

Hack Saws.—3½x6½ ins., 20 pp. Massachusetts Saw Works, Chicopee, Mass.

An interesting little booklet describing hack saws. It is under the title of "The Gentleman From Missouri." Price lists are given.

Commercial Power Trucks.—8x9 ins., 32 pp. Avery Company, Peoria, Ill.

A catalog of commercial motor trucks, giving complete illustrations and descriptions of trucks and their parts. Prices are given.

Corliss Heavy Duty Engines.—8x10½ ins., 12 pp. Allis-Chalmers Co., Milwaukee, Wis.

A catalog in which is illustrated and described the Allis-Chalmers direct connected Reynolds-Corliss engines. Bulletin No. 1510.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

[illegible] market, while the pig iron [illegible] demand. Steel trade circles report that rail orders for about 200,000 tons will be placed within the next few days, this including 60,000 tons for which the Chicago, Milwaukee & St. Paul R. R. has about closed.

A considerable amount of railroad construction work is projected in Canada for this season. At the present time tenders are being asked on 56 miles of work for a new railroad—the Quebec & Saguenay Ry. This work calls for the construction of the line from Cape Tourmente to Murray Bay wharf. Tenders are to be opened on March 2 at the office of J. F. Guay, C. E., Morin Bldg., Quebec, Que.

Several good sized railroad construction contracts have been let recently. These include the construction of the new line of the Buckhannon & Northern R. R. from Rivesville, W. Va., to the Pennsylvania state line. Bids for this work were opened some time ago, but it was only announced recently that the contract had been let to Patterson, Moran & Luck, Pittsburg, Pa. Another good sized contract, bids for which were opened some time ago, was for the further extension of the Algoma Central & Hudson Bay R. R. in Canada. This contract for this work was also let recently to J. D. McArthur, Winnipeg, Man. Among the other contracts let recently are the following: J. W. Wright, Jr., Union Springs, Ala., good sized grading contract (team work) in middle Georgia; Purcell Construction Co., H. Morton Stephens, superintendent of construction, Tamaqua, Pa., subcontract for 10 miles of work on the Lehigh & New England R. R. in Pennsylvania; E. B. Garrettson & Co., subcontract from the Rinehart & Dennis Co., for grading work on the Cincinnati division of the Chesapeake & Ohio; the Watson Contract Co., Huntington, W. Va., and G. L. Shore, Huntington, W. Va., secured subcontracts from the Rinehart & Dennis Co. for concrete work on the above contract; Joe Nix, Pueblo, Colo., for the grading work for the first section of the Pueblo & Southeastern R. R. from Pueblo to the St. Charles River.

The city of Philadelphia, Pa., is planning extensive improvement work and now has a bill before the state legislature to increase the borrowing capacity of Philadelphia from 7 to 10 per cent, and in addition to permit the borrowing of upward of $60,000,000 for the purpose of building subways and providing for an improved system of wharves and docks. This is the bill which is intended to aid in providing additional revenues for Philadelphia and to prepare for carrying into effect Mayor Reyburn's comprehensive plan for improving transit facilities and the upbuilding of the city's commerce through reclamation of waste lands and the construction of wharves and docks. It is planned to push the bill through as quickly as possible, after which it will be submitted to a vote of the people at the November election.

Bids are now being asked for driving a 6,000 ft. tunnel for the Rawley Mining Co. at Bonanza, Saguache county, Colorado. Plans are at the office of Dorsey & Hodges, Boston Bldg., Denver, Colo., and at the office of Simonds & Burns, consulting engineers, Liberty Tower Bldg., New York city.

A good sized levee job is to be let Feb. 21 by the Board of State Engineers at New Orleans, La. The work calls for the construction of the Mascot levee, containing 402,000 cu. yds., in the parish of Madison, Mississippi River right bank, about 24 miles above Vickburg, Miss. Proposals will be received for the work as a whole or by sections.

Governor Donaghey of Arkansas is advocating the establishment of a state highway commission and a levy of a special tax, which would amount to about $500,000 annually, for road purposes. In the meantime a bill has been introduced in the state legislature of Montana to create a state highway department and establish a state highway commission and the office of state highway engineer.

Practical Politics and Engineering.

[illegible] do with the election of a county surveyor in one of the rural counties of a Pa- [illegible] party, the Democrats being about as frequent as they are in the state of Vermont, so when a candidate secured the nomination of the Republican party, it was equivalent to an election. For some 20 years the same man had been elected county surveyor and he had come to believe that the office was his "until death do us part." A number of attempts had been made to elect a more progressive man, but all these efforts had failed. Finally a young engineer, two or three years out of college, decided that he wanted to be county surveyor. His friends tried to dissuade him, but the young man was not to be deterred. A few weeks before the date of the convention to nominate candidates for offices he started his campaign. He first made a personal call on every civil engineer in the county, stated the case to them, cited his experience and asked their support. With one or two exceptions he secured the endorsement of the 30 or so civil engineers in the county. He had already secured testimonials [illegible] professors in the state university. He next had printed a large number of circulars containing the endorsements of the civil engineers, the testimonials of the professors and his platform and with these as ammunition he began a campaign among the farmers of the county. He called upon as many of the farm [illegible] be reached in this way he sent the circulars. As a result he secured the support of a large part of the rural districts and when the convention was held, he secured the nomination, and subsequently was elected to office. All of which goes to show that practical politics and engineering sometimes go hand in hand.

Woman Suffrage and The Recall.

[illegible] call provision in its city charter; it in common with [illegible] that the city now has a new mayor. Last March the citizens of Seattle elected a mayor by a plurality of 3,500. On Feb. 7 they voted [illegible] out the unexpired term of the recalled mayor took the oath of office. It will be noted that one of the beauties of the recall provision is its quick action. No time is allowed the recalled official to rush through a few large contracts, appoint hold-over officials or expend the remainder of the appropriations, before his successor is appointed. It's a case of you're recalled; here is your hat; good bye. A feature of the Seattle campaign was the activity of the women, who were recently en- [illegible] it is said that their votes were largely responsible for the result of the recent election. Of the 22,000 women who were registered a large proportion cast their votes. In the meantime steps are being taken at Tacoma, Wash., which has a modified form of commission government, to recall the commissioners. Press reports state that preliminary to the circulation of petitions for the recall of the four commissioners charges of incompetence have been filed against them by a committee of the reform element.

Snow Removal In Coal Cars.

Some of the railroads having terminal yards at [illegible] birds with one stone in removing the snow resulting from the blizzard of last week. The Illinois Central had a large number of empty [illegible] cars on hand and accordingly the heavy fall of snow in the yards was shoveled into these cars, trains were made up and the cars started on their way for the sunny south, which in the case of the Illinois Central was Kentucky. In most cases the snow was pretty nearly all melted before it reached the Kentucky coal fields. The cars after reaching their destination were loaded with coal and hauled back to Chicago. It is said that the railroad has found it cheaper to fill the empties with snow than it was to haul the snow by team to the lake front.

Girlie Vassar.

The possession and use of a ladylike manicurist's outfit in a construction camp is not considered *de trop* by authorities on hobo etiquette. Some months ago there drifted into Yuma, Ariz., a young hobo who was the proud possessor of such an outfit, and he used it, causing some little prejudice among his fellow workers in the camp, who promptly named him Girlie Vassar. For a time Girlie was about the most unpopular man in the camp, but this feeling has changed and he is now the most popular man in Yuma. A few weeks ago one of the men in the construction camp lost his balance on a scaffolding upon which he was working and fell down upon a rapidly moving conveyor belt which was carrying him into the crushing machinery. Girlie was working near by and taking in the situation at a glance he rushed out upon the belt and snatched off his fellow workman. The officials in charge of the work reported this act of Girlie and as a result he will be awarded a Carnegie medal.

The Court of Appeals at Frankfort, Ky., has recently decided a case of some little importance to railroads. The case was that of Ellen Riley vs. the Louisville, Henderson & St. Louis Ry. Co., from Daviess county, and the court holds that a railroad can build a spur track to a distillery and condemn private property for the right of way for the track. It was announced that as the spur track was for the sole benefit of the distillery the track was not such as could come under the head of "public use," and that it was unconstitutional for that reason. The court says the spur track does not belong to the distillery, but to the railroad, and the railroad is not restricted in its use to only such things for which the distillery might want it used, but it comes under the clause "public use" and therefore the condemnation proceedings are legal.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

⊙J. A. Purdue & Co. have about finished the first 11 miles of their work for the Tombigbee Valley R. R. and have taken 8 miles more on this line, which runs through Choctaw County, from Silas to York, Ala. A large part of this last work is fine station work.

The Birmingham Railway, Light & Power Co., Birmingham, is planning to make a number of betterments and extensions to its lines in Birmingham.

Arkansas.

Press reports from Conway, Ark., state that plans to build a concrete dam across Cadron Creek at Gleason, five miles from Conway, are in preparation. The dam will protect about 60,000 acres of land from overflow from the Arkansas River. A bridge also will be constructed. As the territory benefited is in Faulkner and Conway counties, a special act of the legislature will have to be passed to organize the benefit district.

California.

✤Bids are asked until 2 p. m., March 1, by the Board of Public Works, Joseph L. McCormick, Secretary, Hewes Bldg., San Francisco, for furnishing and delivering rail bonds, copper wire, tubular steel trolley poles and rail joints and fastenings for the Geary St. municipal railway at San Francisco.

According to an announcement reported to have been made by Paul Shoup, Los Angeles, Cal., Vice President of the Los Angeles Pacific Co., the new extension of the company now in the course of construction in the San Fernando Valley, 23 miles long, will be completed in about three months. The cost of the improvement is estimated at about $100,000. The line extends from Hollywood over Cahuenga Pass into the valley. E. C. Johnson, Los Angeles, Cal., is Engineer.

Assurances have been given the citizens of Colusa that the Southern Pacific Co. will build at once a line from Colusa to Hamilton City, Glenn County. The new line will skirt the Sacramento River. It is believed that this line will be the continuation of a new line the Southern Pacific will build along the west side, and for which surveys have been quietly made.

John S. Bates, 227 Van Ness ave., Fresno, has been appointed chief engineer of the Fresno-Coalinga-Monterey R. R., and will be in charge of surveys for the proposed lines of that company. Mr. Bates was formerly city engineer of Monmouth, Ill.

The railroad committee of the City Council of Oakland has granted a 35-year franchise on Hopkins St., from Fruitvale Ave. to Redwood Road, to the Oakland Traction Co.

The Vallejo & Northern Ry. Co. (electric) is to ask for a new franchise for the company's terminal at Vallejo. The new franchise will be to allow the company to pass for a mile along the deep water at Vallejo and over the streets separating the 25 lots and two tide land surveys which the railroad purchased a short time ago from the Vallejo Land Improvement Co. The old franchise of the company expired a year ago, but no new one was asked until the War Department approved of the plan of the city of Vallejo to extend the deep water line along Mare Island straits for a distance of 200 feet further into the street.

The Harbor Committee of the City Council of Los Angeles, has recommended that Homer Hamlin, City Engineer, be instructed at once to make the necessary surveys for the proposed municipal railroad, mentioned in our February 1 issue, which is to connect the business center of the city with the harbor district.

Colorado.

⊙The contract for the first section of the Pueblo & Southeastern R. R., connecting with the D. & R. G. and C. & S. Rys. at Southern Junction, to the St. Charles River, has been let to Joe Nix, Pueblo. Balance of the line to Wilson has not yet been contracted for on account of the engineers not having completed the survey and permanent location. Contract for the steel has been made with the C. F. & I. Co. of Pueblo. The Miller-Vidor Lumber Co. of Galveston, Tex., secured the contract for the ties. W. D. Garwood, Pueblo, Colo., is general manager.

Tracklaying on the Denver-Cheyenne cutoff of the Union Pacific R. R. will be commenced early in the spring, according to reports from Omaha, Nebr. The grade and bridges are completed between Denver and Fort Collins, Colo. A. L. Mohler, Omaha, Nebr., is Vice President and General Manager of the system.

The Chicago, Burlington & Quincy R. R. has placed an order for $840,000 worth of steel rails, part of which order is to be filled by the Colorado Fuel & Iron Co. It is expected that the greater part of the order will be used to construct the Greeley-Hudson line, planned to be laid this spring.

The Grand Junction & Grand River Valley Ry. Co., E. A. Sunderlin, General Manager, Colorado Springs, Colo., has completed the preliminary surveys for a line to Orchard Mesa. Residents of Palisade have also asked for an extension.

Florida.

⊙As noted in our last issue, Wright & Wadley Co., Macon, Ga., and Oviedo, Fla., have been awarded a contract for work on the Florida East Coast Ry. This work is on the new Kissimmee Valley branch, which is to extend from Maytown to Lake Okeechobee. The contract includes 500,000 cu. yds. of earth excavation, a like amount of embankment and several wood trestles and bridges. A large amount of the work is to be sublet in 30 to 60 days.

Surveys have been partly completed for a new electric line from Fort Myers to Fort Thompson, La Belle and Citrus Center, upriver, and Naples, Punta Rossa, Survey and Estero, down the coast.

The Tombigbee Valley R. R. Co., John T. Cochrane, President, Mobile, Ala., is considering a proposition of business men of Pensacola, Fla., to make that city the deep water terminus of the railway. The proposition is said to include a $250,000 cash offer and deep water facilities. The distance from the present terminus of the Tombigbee Valley R. R. to Pensacola is about 50 miles.

Georgia.

⊙J. W. Wright, Jr., Union Springs, Ala., has a large grading contract (team work) in Middle Georgia, and will sublet a part of it. There will be about six months' work.

The Blakely Southern Ry. Co., of Blakely, Ga., has applied for a charter and proposes to build a line from Blakely to Jakin.

Application has been made to the County Commissioners at Atlanta, for a franchise on Peachtree St., for an electric street railway which is to run from Buckhead to the new Brookhaven Club. John D. Little, Walter P. Andrews, John Aldredge, Walter Pharr, Charles P. Glover, W. T. Gentry of Atlanta, Ga., are interested.

At a meeting recently held at Abbeville, Ga., a company was organized to construct a railroad from that place to Poor Robin Springs and the Ocmulgee River. The new road will be a narrow gauge, steam road, about two miles in length, and will run from the Seaboard Air Line Railway depot here to the boat landing at Half Moon, on the Ocmulgee River, and from thence to Poor Robin Springs, Abbeville's noted pleasure and health resort. At the meeting organization was perfected, and the following officers were elected: N. M. Patten, president; A. J. Boney, vice president; W. A. Cherry, treasurer; M. C. Paxson, secretary; W. L. Harrell, J. L. Bankston and J. R. Monroe, directors.

The Valdosta, Moultrie & Western R. R., Gordon Tillman, Chief Engineer, Valdosta, Ga., has purchased terminal grounds at Valdosta, and this is taken to indicate that that railroad, which now uses the terminals of the Georgia Southern & Florida, will erect its own station when the present contract with the latter road is terminated. The buying of the terminals is also taken to indicate that the Valdosta, Moultrie & Western officials will probably extend their line westward from Moultrie, though no official announcement as to this has been made.

Idaho.

Among the improvements in Idaho for which it is reported the Oregon Short Line will spend $7,000,000, are the following: New track 211 miles in length will be built. Among the extensions are 67.2 miles from Richfield to High Prairie 26 miles on the Buhl-Nyssa line; 60 miles of the Raft river cutoff and a lot of double-tracking between McCammon and Bliss.

The maps and plats of the Idaho Central R. R., recently filed at the U. S. Land Office at Hailey, Idaho, show that the road will run from Owinza in a northwesterly direction to the southern boundary of Richfield, diagonally across two of the city blocks, and on about north northeast to Burns and to a point opposite Willow Creek; thence in a straight line 18 miles to within about two miles of Corral. This line will pass about one and seven-eighths miles south of Soldier. From Corral the road will run southwesterly to within three miles of Taft on county line; thence west 8 or 10 miles to the line between Townships 9 and 10 east, Range 1 south, and about three miles south of Little Camas; thence to Boise in nearly a strait line, and on almost due west to Nampa. While the line may be changed in places, the filing of the map and plats would indicate that it is not the company's intention to run through Boise northwesterly to Ontario, Ore. There is some doubt as to the course of the road at Richfield. About four miles below that town a new station was opened recently—at Johnson's ranch—that is said to be the point at which the Owinza line will cross the Wood River branch. From that point the Marley slough extends northwesterly for 10 or 15 miles, which offers an almost level route, requiring little or no grading; while the route as mapped through Richfield to Burns would require much filling and many cuts. This in a lava formation, where much blasting would be required. It would be more expensive to operate the last mentioned piece of road because the cuts would fill with drifted snow at every storm, while that up the slough could be kept open in any weather.

Illinois.

The Chicago, Ottawa & Peoria Railway Co., which is part of the Illinois Traction System, will have matters in shape within the next few weeks to let contracts for grading, two sub-stations, and concrete and bridge construction work on its 23-mile extension from Morris to Joliet. F. E. Fisher, Superintendent of Construction, Joliet, Ill., is in charge of the work.

According to surveys recently completed by Engineers of the Chicago & Northwestern Ry. for the line between Peoria and Greenridge, Ill., the route will pass within four miles of Springfield. If the road is built it will connect at Greenridge with the Northwestern branch, which leaves Alton, and go through the center of Macoupin county to Benld, through the heart of one of the state's most important coal fields.

Incorporation papers are to be taken out shortly for a company which proposes to build an interurban line from Delavan to Mor-

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

ton. Good progress has been made with the promotion work, and the promoters are said to have secured considerable financial backing. It is proposed to secure power for this line from the Illionis Traction System. Among those interested are J. W. Crabb, N. T. Nichols and J. G. Bailey of Delavan, Ill.; A. Lawson and George Jenks of Tremont, and Fred Brenkman of Dillon.

Indiana.

The Indianapolis, New Castle & Toledo Electric Ry. Co., New Castle, Ind., is said to be planning to have work started at once on a line from New Castle to Indianapolis, with the idea of having it in operation by Sept. 1st of the present year. It is stated that after this is completed a branch will be planned from New Castle to Richmond.

A bill is to be introduced in the Indiana Assembly to amend the railroad corporation rights act of 1852. It is said that the real purpose of the bill is to give the New York Central-Big Four lines the power to condemn property in Northern Indiana, where it is desired to establish a four-track system across the state and into the City of Chicago. Under the present law the company can not condemn a sufficient amount of land to construct its four tracks and the necessary switches.

The Erie R. R., A. Swartz, Division Engineer, Huntington, Ind., is said to be planning to do a considerable amount of double-track work this season on its Chicago division. It is said that stretches of double track and long sidings will be connected up and the entire division will be double-tracked as soon as possible.

Iowa.

Engineers making surveys for the construction of the proposed lines of the Charles City Western Ry. from Marble Rock to Hampton have completed their work past Dougherty, Ia.

Engineers for the proposed Davenport-Muscatine interurban line have reached Muscatine. completing surveys for one of the three routes originally surveyed to that city. The surveyors will go over all three of the lines which were originally surveyed last year and after determining the best route they will start the location survey. The line which has just been completed runs from Blue Grass to Sweetland Center and into Muscatine.

The Commercial Club of Sac City, Iowa. is making efforts to secure an extension of the electric road from Rockwell City to Sac, in order to give connections with Des Moines and Fort Dodge.

The committee of twenty-five named to settle the difficulties between the city of Des Moines and the street car company rejected the company's proposed franchise and asked that it submit a proposition looking toward the purchase of the property by the municipality.

Surveys have been started from Iowa City by Irvin Kettlewell, Chief Engineer of the Ottumwa, Iowa City & Southern Electric Ry. Co., of a new route for the proposed line from Iowa City to Ottumwa. One survey has already been made which takes in the towns of Wellman and Keota. The new route, however, has been recommended by the engineer of the bonding company who has gone over the ground, as being a better route for passenger service, and accordingly a survey of this route is now being made. This will pass through Kinross, Sigourney and Hedrick. The cost of the survey is being met, half by the promoters and the other half by the farmers along the proposed route.

Reports from Des Moines state that the railroads entering that city are planning to erect a union depot between 10th and 12th Sts. According to the reports the new station was to cost $3,000,000. No definite announcement has been made by the railroads as yet.

Kansas.

The citizens of Newton have subscribed for $100,000 bonds to secure the building of the line of the Arkansas Valley Interurban Ry. Co., Wichita, Kan., from Sedgwick. This road is built north out of Wichita through Valley Center to Sedgwick. It was stated that the line would be built into Newton as soon as a franchise had been secured. O. A. Boyle, Wichita, Kan., is general manager.

Steps are being taken by D. H. Siggins, president of the Union Traction Co., J. J. Jones and others to secure a charter for a company for the building of interurban lines in Neosho, Allen and adjoining counties. It is understood that some of the objective points to be reached by this new company will be Chanute, Humboldt and Iola.

Kentucky.

⊙The Louisa Contract Co., Louisa, Ky., as noted in our last issue, has been awarded a contract for work on the Cincinnati Division of the Chesapeake & Ohio Ry. The contract calls for the construction of a concrete viaduct at Louisa, about 350 ft. long. The work calls for 7,000 cu. yds. of earth excavation and 5,000 cu. yds. of concrete.

⊙Langhorne & Langhorne, Lynchburg, Va., as noted in our last issue, have been awarded a contract for work on the Cincinnati Division of the Chesapeake & Ohio Ry. The contract covers four miles of line and is located between Foster and Coontown.

⊙Boxley Bros. Co., Quincy, Ky., have been awarded a contract for work on the Cincinnati Division of Chesapeake & Ohio Ry., as noted in our last issue. The work is located between St. Paul, Ky., and Garrison, Ky., and includes 100,000 cu. yds. earth excavation and 1,500 cu. yds. concrete masonry.

⊙The Rinehart & Dennis Co., Evans Bldg., Washington, D. C., which has a contract for work in the Cincinnati Division of the Chesapeake & Ohio Ry. as noted in our last issue has sublet part of the work to the following: E. B. Garretson Co., Cincinnati, O.; Watson Contract Co., Huntington, W. Va., and G. L. Shore, Huntington, W. Va. The Rinehart-Dennis contract calls for the grading and concrete work for double tracking from Augusta, Ky., to Wellsburg, and from the latter place to Holts Creek, the work including 500,000 cu. yds. of excavation, about 40 per cent of which is rock and four bridges of concrete and concrete culverts, requiring a total of about 14,000 cu. yds. of concrete masonry. Rinehart & Dennis Co., is doing the grading between Augusta and Wellsburg with its own forces, consisting of two steam shovel outfits. It is also understood that Garretson & Co. will put two steam shovel outfits on their subcontract. The Watson Co. and G. L. Shore will construct the concrete masonry.

The Northern Kentucky Traction Co. has applied for a franchise to operate lines in the southern part of the city of Dayton, Ky.

It is understood that a company to be known as the Kentucky Traction Co. is to be formed to take over and operate the Lexington & Interurban Rys. Co., Lexington. Ky., and subsidiary companies. It is thought that the plans of the new company will call for the expenditure of about $1,000,000 for improvements.

Information submitted from Monticello, Ky., is to the effect that promoters are working on a scheme to extend the railroad which was constructed some time ago from Algood, Tenn., to Livingston, a distance of 18 miles, on to Somerset, Ky., making a total mileage of 26 miles. This company has been in the hands of the receiver and it is proposed to reorganize.

Louisiana.

The Gulf, Sabine & Red River R. R., a standard gage logging road, owned by Lutcher & Moore Lumber Co., Orange, Tex., is being extended 4 miles to the turpentine camps of the company in Calcasieu Parish.

The establishment of motor car service between Covington and New Orleans by way of Hammond, over the Baton Rouge, Hammond and Eastern and Illinois Central R. R., is under consideration. It is said that the railroad company will put on the cars if the expense of operating is guaranteed by the three towns most interested—Covington, Hammond and Ponchatoula. The matter is being canvassed at these places, and those behind the move are meeting with encouragement at all the places named.

Maine.

A charter is being asked from the State Legislature for the Farmington & Augusta R. R. Co., which proposes to build an electric line from Farmington, Me., to Augusta, a distance of about 35 miles. Among those interested in the project is Weston Lewis of Gardiner, Me., General Manager and controlling owner of the Sandy River & Rangeley Lakes R. R., which connect at Farmington with the Maine Central. The Sandy River & Rangeley Lakes operates 103 miles of narrow gage steam railroad in a heavily timbered region. It has terminals at Farmington, No. 6, Rangeley, Redington, Mt. Abram and Bigelow. Besides Mr. Weston the list of incorporators of the Farmington & Augusta includes E. E. Richards, A. L. Fenderson, J. P. Wharff, Joseph C. Holman of Farmington, Me.; Frank B. Livingston, Heber Bishop of Boston, Mass., W. J. Gilpatrick of Saco, Me., Levi T. Williams of Augusta, Me. The proposed capitalization is $500,000 which may be increased by permission of the railroad commissioners.

Maryland.

The Frederick R. R., O. B. Cobleintz, Chief Engineer, Frederick, Md., has voted an additional $50,000 for terminal and other improvements. It is believed in some quarters that the Western Maryland R. R. is considering entering Frederick over the Frederick R. R. tracks. Surveys were made last year through the Middletown Valley, and it is generally believed the work was for a low-grade coal line for the Western Maryland. The Frederick road has a traffic arrangement with the Western Maryland now to handle business by way of Thurmont, where it has a steam line that is being changed to electric for passenger business. A connection at Brunswick with the Baltimore & Ohio, by way of the trolley to Jefferson, is contemplated.

Massachusetts.

The Union Street Ry. Co., Henry H. Crapo, president, New Bedford, Mass., has asked the board of aldermen of New Bedford for permission to make several extensions in that city.

At a recent hearing before the Legislative Committee on Railroads considerable information was given out regarding the proposed New York, New Haven & Hartford-Boston & Maine R. R. tunnel under Boston Harbor. As outlined the tunnel would connect the eastern branch of the Boston & Maine and the Revere Beach & Lynn R. R. with the South and Back Bay stations at Boston and allow of trains being run directly on to the New Haven tracks. The proposed tunnel would start at a point near the intersection of Broadway and Albany St. in Boston, run under the right of way to the South station. From there it would run under Atlantic Ave. to a point under Foster's wharf, where it would enter the harbor. It would then be carried under the harbor in a straight line, passing under the old Eastern railroad wharf on the East Boston side, until it reached the intersection of Bremen and Maverick Sts. The tunnel would then follow under Bremen St. to a point near the junction of Bremen and Prospects Sts., where it would turn and pass under the grand junction freight yards of the Boston & Albany, the East Boston portal being located on Neptune St., near an arm of the harbor. From the portal an incline would be built to carry the tracks across the stretch of water and up to the level of the Revere Beach & Lynn tracks, and to a location alongside of them. The plans call for a large, double tracked tunnel, which, including inclines, will be 15,000 ft. in length, and will cost about $12,000,000 and require about two years to complete. It is to run all trains through the tunnel by electric power. This will mean that at least two lines from Readville on the Providence division of the New Haven, two lines from the tunnel to Lynn which will be constructed alongside of the present Revere Beach tracks and the lines of the Revere Beach road will all have to be electrified. This will also cost $12,000,000 and require two

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

years. Two [illegible] tunnel, one at South station, which would be located on the Atlantic Ave. side, and the other under the junction of Maverick and Bremen Sts., Boston. B. T. Wheeler, Boston, Mass., is Engineer of Construction New York, New Haven & Hartford R. R.

Michigan.

The Grand Trunk and the Michigan United Railway Companies have entered into a contract whereby through electric service, both passenger and freight, will be inaugurated at an early date between Detroit and Kalamazoo and Detroit and Lansing. This means that the Michigan United Rys. will give up its plan for building a third-rail system between Detroit and Jackson. The Michigan United Rys. is now building a line from Lansing to Owosso, which will be in operation by spring.

The Grand Trunk Ry. is still considering a plan for extending its line from Owendale to Bad Axe and connecting with the P. O. & N., thus giving a direct route from the Thumb to Detroit.

It is now stated that the first section of the Lansing & Northwestern Ry., Lansing, will be completed from that city to Morrice, and from Morrice to Owasso by June 1. This work is to be completed before work is commenced anywhere else. The line between Lansing and Morrice will be finished first. Ties are being put in place between Shaftsburg and Haslett, and 100 carloads of cinders ordered from the Grand Trunk railroad for ballast, this being used instead of heavier material. In one place the electric line will pass under the Grand Trunk tracks, where there is a natural depression. The Grand Trunk track at this point will have to be raised only about 4 ft. to allow the cars to pass under it. The surveyors at present are working near St. Charles.

The Pere Marquette R. R., J. F. Deimling, chief engineer, Detroit, Mich., has been considering double tracking its line between Holland and Grand Rapids, but nothing definite has been decided and the work has not been authorized. It is stated that the Pere Marquette has not decided to make any extensions of its line from Honor to Empire.

Minnesota.

The St. Paul Railway Promotion Co., Henry C. Struchen, Secretary, St. Paul, Minn., which proposes the construction of an electric railway from St. Paul to Lake City, Minn., has determined on the route of the line as far as Hastings. It is announced that the line will run through Oakland, Highwood, Red Rock and Newport, as planned. From Newport the line will be built between the Burlington and Milwaukee lines, following the line of the Burlington road as closely on the east as possible, passing through St. Paul Park and Langdon to Hastings.

The Canadian Pacific Ry., through a traffic agreement with the Chesapeake & Ohio, is reported to have secured an outlet for the Soo line from the northwest to the Atlantic seaboard at Newport, Va., via Cincinnati. It is also rumored that the Canadian Pacific will either take over the Wabash between Detroit and Chicago, or build an entirely new line between these cities, to connect the eastern C. P. R. and Chicago division of the Soo line with the C. & O.

Grading has been completed by construction forces of the Great Northern for the double tracking of 10 miles of its line between Swan River and Brookston, Minn., and it is expected to have the line in operation by the opening up of the spring. Eventually the company will double track its entire line from the range to the ore yards at Allouez, Mich.

Duluth and the Ranges.

[illegible]

John Meyers, Duluth manager for the Barnett & Record Company, large dock contractors, has returned from a ten days' trip to West Baden. This firm has already started on their contract of erecting an ore dock for the Great Northern Railway Company at Superior, Wis.

Mr. C. J. A. Morris, of Morris & Shepard, contractors, St. Paul, Minn., was a caller in the city this week looking over dock matters.

The Interstate Dredge & Dock Company were the lowest bidders for bridge to be erected by the city of Superior, Wis., amounting to approximately forty-six thousand dollars. They will start on this contract immediately.

Mr. A. S. McDonald, manager of the Zenith Dredging Company, was a caller a few days ago. They have three or four large dredging contracts at the present time, and just as soon as the weather permits will start immediately on the same.

Patrick McDonnnel, Duluth contractor, left this week for a trip to Florida. He expects to be gone about thirty days.

Thomas Higgins, grading contractor on the Canadian Northern Railway near Duluth, has returned from a six weeks trip to his home in Nebraska. He got back here just in time to get in on the cold weather.

Thomas Walsh of the Johnson-Carey Company, who have considerable work on the Canadian Northern near Duluth, was a caller in this city last week. He reported everything progressing very nicely.

Dennis Madden, general superintendent for the MacArthur Brothers Company of Chicago, was a caller at this office yesterday. He was on his way up from Sault Ste. Marie, where his firm has a large government contract. Mr. Madden stated that prospects for railroad construction were very encouraging for the coming season.

Wick O'Connell, who has the contract for the tunnel on the Canadian Northern railroad near Duluth, came in to see us yesterday. Wick has installed electric drills on this work, and is very enthusiastic over the working of the same. They are getting along very nicely on this work and ought to have the same completed by June 1.

J. P. Bains, superintendent for the Drake & Stratton Company on the Iron Ranges, has returned from a month's trip to the south.

C. H. Overlien, traveling representative for the J. I. Case Company, was a caller and reported business looking very good for the coming season.

All of the stripping contractors in this vicinity have closed down their operations for the winter and will not start up until about April 1.

The labor situation in Duluth and vicinity at present is in a pretty fair condition. There is quite a bit of work going on in the woods, saw-mills and other industries, but not very much construction work. The demand for lumber and other forest products in this section has been picking up lately, and the result is that a great many men are given employment getting the stuff out.

Mississippi.

A conference is to be held shortly between City Engineer W. G. Wetmore of Meridian, Miss., and engineers of the various railroads entering the city to decide upon a subway or a viaduct at the south side of the city.

Missouri.

The Manufacturers' Ry. Co., G. F. Moore, President, St. Louis, Mo., is said to be planning to erect an 8-story union freight depot and warehouse at Miller and 3d Sts., St. Louis. It is also rumored that the Manufacturers' Railway has decided to abandon the surface line, and in lieu thereof, to construct a tunnel from some point on 2d St. to a depression just west of Grand Ave. Officials of the company decline to discuss this rumor.

The Metropolitan Street Ry. Co., 1500 Grand Ave., Kansas City, has placed an order for 25,000 bbls. of cement to be used in street work this year. It is said that twice this amount will be required.

Negotiations are said to be under way by L. B. Houck, Shelbyville, Mo., owner of the Shelby County Railroad for funds for the construction of a branch line from a point near Shelbyville north to the county line.

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

It is with sincere regret that we report the death of one of the men whose name for years has been linked with the construction of great railways of this country. George H. Kahmann, senior member of the firm of Kahmann & McMurray, R. R. Contractors, after an illness of fifteen days, died at his home in Kansas City, Feb. 5th, 1911. For several months past he had been in failing health, but his friends hoped he could rally. For a time it seemed as though he would gain a victory in the unequal struggle, then came the final collapse and the end. Mr. Kahmann was born in St. Louis, Mo., Sept. 18th, 1854. As a young man he attended Notre Dame University, then began his business career as cashier of the Washington Savings Bank, Washington, Mo. He was married May 21st, 1881, to Miss Mary Hopkins. In 1885 he became identified in the business world as a bridge builder, but it was not until four years later that he moved with his family to this city. Several years ago he organized the firm of Kahmann & McMurray and continued as a member of that firm until his death. He has been successful, but his success has been earned. Every contract has been done with care and the profits derived were the rewards of merit. Mr. Kahmann is survived by a widow and four children. Thus ends another useful life.

The U. S. District Court has issued an order whereby all work north of Central Ave. on the Kaw Levee is temporarily, at least, stopped. These delays are very exasperating and entail large losses to the contractors doing the work. Amos & Dean and Wood, Bancroft & Doty are among those contractors who will be delayed by the order. Up to this time splendid progress had been made by the Callahan Co. and their force of sub-contractors. Eventually, of course, the order for withholding the work will be lifted, for if one portion of the contract is left undone the entire levee will be useless. Why such delays are just and reasonable is hard to understand. They work hardships untold to contractors and in the end accomplish absolutely nothing.

O. E. Dutcher will shortly move his outfit near the mouth of the Kaw River and start work on about 30,000 yds. for which he has contract.

Reports on excavations on the new station site show that 275,000 yds. have been moved to date. This is about one-third of the entire contract. From now on the work will be slow on account of the fact that rock has been struck. However, the engineers state it is probable that work on the station foundation can start in the spring, or early summer.

It is with pleasure we announce the fact that the Supreme Court of Missouri has confirmed the new boundaries of Kansas City. This is welcome news, as it will open a field for grading operations here that will supply great quantities of work to the Kansas City graders for years to come. Inside of 60 days there should not be an idle outfit in this city and no doubt this will be the case. Every Kansas City contractor is wearing a smile and well he may, for work in plenty is assured for the future.

Mr. George Peck of this city, has formed a partnership with another Mr. Peck—though no relation. The firm of Peck & Peck will do contract work, both in grading and concrete. They have a preference for concrete, however, and probably will only figure on moving such earth as may be necessary on concrete jobs.

The Kansas City Southern Ry. Co. has sold $5,000,000 of refunding and improvement mortgage 5 per cent gold bonds due April 1st, 1950. This is a part of a total of $21,000,000, of which $10,000,000 were issued July, 1909. This money will be used for improvements and additional equipment. Forty-one per cent of the Kansas City & Southern Ry. is now on a grade of 5/10 of 1 per cent, and it is planned to put the entire remainder of the road on practically this same basis, except in the mountain district.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

St. Louis Items.

BY [illegible]

The committee on school buildings of the Board of Education opened bids last Thursday on a contract for building a large addition to the Simmons School on St. Louis Ave. east of Newstead Ave. Twelve bids were received, the lowest being [illegible]. They ranged upward to $161,700. The estimate of the building commissioner of school buildings was $95,000, and the building committee will recommend that all bids be rejected and that new plans be made involving fewer alterations to the old school building. Building Commissioner Toensfeldt said that the estimate probably was too low for the character of building specified in the designs. The committee also opened bids for the purchase of two gasoline runabout automobiles for the building department, on which the estimate for both was $1,700. The bids ranged from $1,300 to $1,650, but a mistake of one of the bidders may necessitate a new letting.

Walter Lonergan left here for Jacksonville, Ill. Walter is idle at present.

J. E. Lyman finished the J. A. Ware Construction Co.'s work at Herman, Mo., on the Missouri Pacific R. R., in record time. Lyman is here idle at present; 5613 Wells Ave., St. Louis, Mo., will catch him.

City Engineer William J. [illegible] of East St. Louis, Ill., announced on Feb. 8 that before the work on the big outlet sewer is completed work will have started on the building of another arm, which will serve Winstandley Park and all of that territory known as the "Winstandley district." Mr. Crocken practically has completed his plans and specifications for this new sewer, and will have them ready to send to the Board of Local Improvements and the City Council next week. His estimate of cost of this particular part of the work is $275,000. The "Winstandley" arm will cover a territory of approximately four square miles, and will take in all that part of the city from the Louisville & Nashville R. R. tracks to the Southern R. R. tracks, and from the Venice & Carondelet Belt R. R. tracks at Twenty-first street east to Fifty-first street. It will serve more than one-third of the total population of the city. Work on the outlet sewer has progressed so favorably within the past three months that the sewer is up to Piggott avenue, a distance of one and three-quarter miles from its starting point at the river. Of the contract price, which is $710,000, $273,100 has been paid, which means that almost one-half of the big sewer already has been completed. According to the contract the work is to be completed by Dec. 1 next. The most expensive single piece of work in connection with the sewer is the building of the great pumping station, which is equipped with seven pumps. It will cost with all machinery installed $147,000.

The passage of the Chouteau Ave. grade crossing bill No. 2 by the House of Delegates virtually completed the victory of Councilman W. C. Schultz over Mayor Kreismann in a fight to establish the policy of whether the city should share the cost of grade crossing elimination with the railroads. There is no doubt of the bill's passage in the Council, and it is thought Mayor Kreismann will sign it. Enough votes were cast for it in the House Friday to pass it over a mayor's veto. Under this bill the Missouri Pacific Ry. will have to pay all property damages, as well as the cost of constructing a viaduct across its tracks between Tiffany and Vandeventer avenues. Mayor Kreismann and President Reber favored a former bill which put the consequential damages, estimated at from $18,000 to $300,000, on the city. It was defeated when Schultz reported against it by a vote of 8 to 2. The House passed a second bill Friday by a vote of 22 to 3, when a minority of the railroads committee—Delegates William L. Igoe (Democrat) and William Samel (Republican)—signed a favorable report. Chairman E. J. Russell of the railroads committee and Delegates Hamilton and Jacobs of the same committee were the only ones to vote against the measure. Speaker Rombauer berated those members of the municipal assembly who were unwilling to spend some of the city's money in co-operating with the roads to save human lives. He pointed out that to force the railroads to bear all the cost meant a long fight in the courts, while to share the expense would have insured the speedy erection of the viaduct, as promised by Vice President C. C. Clarke of the Missouri Pacific. At the close of his speech Rombauer voted for the bill, explaining that unwise action was better, in his opinion, than no action at all.

J. J. McInerney, who is working at Horatio, Ark., up to Feb. 8 put in 36 working days with his outfit this year without losing any time. Pretty good weather down in his part of the country up to the present time.

Capt. A. V. Fetter the river contractor, spent a day in town last week. The captain is going to start on his government shore contracts north of the city as soon as the weather and river will permit. He also informs us that Mr. Crosby, who formerly was associated with him, has regained his health and has quite a number of profitable contracts. We are surely pleased to announce this.

L. J Smith and his superintendent, L. A. Nutter, took a flying trip to St. Louis one day last week. Too busy to call this time, for we failed to see them.

Pat Hickey, who is at present at Palm Beach, Fla., with his young son, Raymond, for his health, informs us that the boy is improving, which all of Pat's numerous friends will be delighted to hear.

Roach & Stansell of Memphis, Tenn., are subletting most of the levee that was awarded them a week ago by the Mississippi State Levee Board of Greenville, Mis.

J. Cole has 700,000 yds. of levee work near Van Buren, Ark., to sublet. This is all slip work, mostly all sand, and teams can average from 60 to 70 yds. per day. Work will last a year. Address him, care of Koenig's Labor Agency, 107 N. Main St., Little Rock, Ark.

The Universal Construction Co., which is composed of Pat Hannon, the Hickey Bros. and the Scott Bros., has seven outfits at work on its large sewer contract in the southwestern part of the city.

J. M. Farley & Co. of Chicago came in with five car loads of machinery and outfits to start work on their sewer contract that they took from the Universal Construction Co.

Montana.

It is claimed in Columbus, Mont., that financial arrangements have been completed by promoters of the proposed Cook City, Columbus & Northern to extend from a point near the National Park north through what is called the Lake Basin Country to join the B. & N. at a point near Lavina, tapping the mining country in the vicinity of Cook City.

Nebraska.

W. B. McKinley, Champaign, Ill., President of the Illinois Traction Co., is reported to have made a proposition to construct an interurban line between Adams and Beatrice, 28 miles. The proposition provides that the company will construct and operate a power plant and railroad if stock in the proposition to the amount of $300,000 is subscribed by the people of Gage county.

Advices from Logan, Neb., in Logan County state that citizens of the county and of Arnold in Custer County are discussing methods to obtain a railroad.

Nevada.

A. W. Goodenough, General Manager of the Lida Valley R. R., Goldfield, Nev., has engaged S. W. Connolly, C. E., to make surveys for the proposed line from a point near Cuprite, Nev., to a point near Hornsilver and thence to Lida. Actual construction work will be started as soon as the surveyors have laid out the route for a distance of about 15 miles. The cost of building and equipping this line will be about $100,000, and according to reports all financial arrangements have been made. The survey about to be commenced will be continued on from Lida into the Bishop country to connect with the road which the Southern Pacific is building up through the Owens River valley. The matter of continuing the line from Lida to Bishop, however, has not yet been financed, but is one of the marked possibilities of the near future.

New Hampshire.

A bill is before the State Legislature asking for a charter for the Walpole & Alstead Street Ry. The incorporators named are: James Barrett, Daniel W. Connors, P. E. Griffin, William J. King, M. H. Murphy, Horace A. Perry, Edward K. Seabury, F. F. Shepard, F. A. Spaulding of Walpole; F. J. Marvin, H. B. Chapin of Alstead; George A. Weston, Bellows Falls, Vt.; Dennis A. Blakslee and Samuel C. Morehouse of New Haven, Conn. This charter, if granted, will give the right to cross the iron bridge to North Walpole and also to cross the toll bridge to Walpole and Alstead. The line between Walpole and Alstead would be about 10 or 12 miles long.

New Jersey.

The Hamilton Township Committee has taken action to have the Trenton & Mercer County Traction Co., Trenton, N. J., extend the Yardville extension beyond its present terminus.

The stockholders of the Elizabeth & Trentor R. R. Co. (Trenton, N. J., electric), voted yesterday, Feb. 14, on authorizing an issue of $750,000 in bonds of the company. It is believed that this money is to be used for completing the company's line between New Brunswick and Elizabeth.

New Mexico.

The Las Cruces Ry. Co., of Las Cruces, N. Mex., has filed its articles of incorporation. The company has a capital stock of $10,000 and proposes to purchase, acquire and construct or lease street railways. C. Merton Haley, Las Cruces, N. Mex., is the largest stockholder.

New York.

A public hearing was recently held in Buffalo, N. Y., before the Street Committee on the proposition of the Delaware, Lackawanna & Western R. R. Co., to erect a new station and to improve its terminals at the foot of Main St.

The State Public Service Commission at Albany, N. Y., has formally closed the taking of evidence on the application of the Buffalo, Rochester & Eastern R. R. Co., for authority to construct a double track railroad from Buffalo to Troy, N. Y., and has advised both sides to have their briefs filed and exchanged with each other by March 1. The final summing up and oral argument will be heard March 15.

The Long Island R. R., J. R. Savage, Chief Engineer, Jamaica, N. Y., is about to begin double-tracking its line between Glen Cove and Locust Valley. This work is to be completed by June 1, when the electrification of the entire branch is to be started.

The Delaware, Lackawanna & Western R. R. is said to be planning to build a new passenger station in Syracuse. The question of changing the grade of the road so as to eliminate grade crossings in the city, it is reported, will not enter into the station plans, as it will be constructed to meet either grade or elevated tracks.

The New York, New Haven & Hartford R. R. Co. and Boston & Maine have placed an order for 63,000 tons of rails. About one-half of this order went to the Pennsylvania Steel Co.

No definite decision has been reached as yet regarding the double tracking of the Buffalo, Lockport & Rochester Ry., mentioned in our Jan. 25 issue. However, possibly two or three miles of double track will be put down this year but this will be done by the company's force. J. M. Campbell, Rochester, N. Y., is General Manager.

The New York Central & Hudson River R. R., has practically secured all right of way for its new double track work between Rochester and Suspension Bridge. It is possible that a complete right of way will have been obtained by the end of the month. At present double track extends from Rochester to the DY tower, about a mile and a half out of Albion, from Medina to Middleport and from Lockport to Suspension Bridge.

The Long Island R. R., J. R. Savage, Chief Engineer, Jamaica, N. Y., has acquired 160 acres of water front at Fort Pond Bay, Montauk, L. I. It was stated that the company had made plans for the erection of piers, passenger and freight depots and other terminal facilities. It is also contemplated to double track the road from Oakdale to Montauk. A natural harbor having an average depth of about 60 ft. at its dock line is formed by Fort Pond Bay. The new property acquired by the Long Island R. R. has about a mile frontage and at least a dozen piers, with plenty of room between them, can be built. Directly south of the harbor is Fort Pond, which will in all probability be connected with the bay as an interior harbor for coal and ice barges.

The Syracuse & South Bay Electric Ry. Co., T. H. Mather, Chief Engineer, Syracuse, is to have permanent locations completed shortly for the proposed extension of its Newark & Marion line from Marion to Williamson. Surveys are also to be made for a proposed line from Williamson to Pultneyville. The work will be in charge of Engineer C. E. Hopkins.

The State Public Service Commission has granted the Syracuse Rapid Transit R. R. Co. permission to extend its double tracks in Willow St., Syracuse, and to abandon its tracks in Lodi St. between Green and Willow Sts.

North Carolina.

Application is to be made for a franchise for a street railway through Rocky Mount. Robert McDowell, Tarboro, N. C., is interested.

A bill is said to have been introduced in the State Legislature to annul the franchise and charter of the Carolina & Tennessee Southern Ry. if the company shall fail to begin the construction of its line of railway from Franklin, Macon county, within six months from the ratification of the act, and shall not in good faith prosecute the work continuously until completion, forfeiting all of its rights if the road is not completed and in operation by August 29, 1912. The bill is intended to complete the railroad that will open up the mountain country between Charlestown, S. C., and the states of the Middle West. The company was granted a charter in 1903.

Ohio.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. has made surveys and has had estimates prepared for double track work between Springfield and Dayton. It has not, however, been definitely decided to go ahead with the work this year. Paul Hamilton, Springfield, O., is engineer, maintenance of way.

The Pittsburg & Lake Erie R. R., J. A. Atwood, Chief Engineer, Pittsburg, Pa. is said to be planning to build new lines to both Midland and East Liverpool. No definite information is obtainable at present regarding this work, but it is understood that surveyors have been at work on the lines for several months.

The Chesapeake & Ohio Ry. of Indiana (Chesapeake & Ohio, F. T. Cabell, Chief Engineer M. of W., Richmond, Va.), has requested the Hamilton County Commissioners to pass the determining resolution providing for the abolition of the Crookshank road and Bridgetown road grade crossings. It is proposed by the railroad to build a road connecting the Crookshank road with the Bridgetown road and abolish the Crookshank road crossing altogether, elevating its tracks at the Bridgetown road. If the commissioners agree to plans that were submitted the railroad proposes to pay all the expenses of the improvement. If, however, it is compelled to build a viaduct at the Crookshank road it will require the county to pay 35 per cent of the cost of the improvement. This crossing would require a viaduct about 500 ft. long and would be somewhat expensive.

The directors of the Southwestern Traction Co. are reported to have practically decided to extend the line from Crooksville to New Lexington during the coming summer. It is now said that the extension instead of paralleling the C. & M. C. R. R., as formerly intended, will probably be over a cross-country route.

City Council of Middletown, O., is considering granting a franchise for an electric street car line. It is proposed to finance the line locally. E. A. Hackett, Middletown, Chief Engineer of the American Rolling Mills, is interested.

Engineers of the Lake Shore & Michigan Southern Ry., Samuel Rockwell, Chief Engineer, Cleveland, O., have been working in Amherst and it is believed that work will be started April 1 for the completion of the unfinished 4-track work in that place. The bridge work in Amherst has been held up for the past two years by the village council which threatened an injunction suit if the company proceeded with its plans. Land for four tracks and the four track road bed is, with a few exceptions, completed east and west of Amherst. It is said that $500,000 will be expended this year.

The Dayton & Troy Ry. is to expend about $150,000 this spring in improving the service. The entire power system of the road will be reconstructed. The road will erect a substation near Piqua, to feed the northern end of the road, while the other substation will be located near Dayton. The central power plant will remain at Tippecanoe City. The road will also be double-tracked its entire length, the present double track extending only from Tippecanoe City to Troy. As the road has many passing tracks it will be an easy matter to fill in the links.

capital. At present the Cleveland and Pittsburg division of the Pennsylvania Company has a clear field in the upper Ohio valley. The right of way of the Ohio River & Northern Railroad Co. has been bought by the P. & L. E., which extends through Beaver County, Pa., and Columbiana County, Ohio.

Engineers are in the field under the employ of the Pittsburg & Lake Erie R. R. Co. running preliminary lines for the construction of a road from a junction point to East Liverpool, O. The object being to secure a part of the tonnage of the Lake Shore and the potteries in East Liverpool. At East Liverpool the Pittsburg & Lake Erie Railroad will have a connection with the Youngstown & Ohio River Road, which is owned by Cleveland

Oklahoma.

According to a statement reported to have been made at the offices of the Wichita, Gulf & McPherson R. R., at Muskogee, Okla., that line, which is the northern extension of the Midland Valley R. R., will be completed into Wichita, Kan., by the first of September. The latter city recently issued $110,000 as a bonus to the Midland to build their lines to that place.

Stockholders of the Oklahoma Railway Co., an electric line, will meet February 24, to authorize an increase in the capital stock from $3,000,000 to $15,000,000, and to approve a $12,000,000 bond issue. Common stock will be increased from $2,000,00 to $10,000,000, and preferred from $1,000,000 to $5,000,000. Of the latter only $631,000 is now outstanding. Funds from the capital increase will be for new construction to connect a number of Oklahoma cities. A. H. Classen, Oklahoma City, is President.

Surveys for the Winnipeg, Salina & Gulf Ry. have been completed from Alva west to Beaver City, nearly 100 miles, routing the road through Buffalo and Gate. Beaver citizens are raising a bonus for the company, as are also the citizens of Alva, who have promised $100,000. Sterling, Kan., has subscribed $10,000, and Sylvia, Turon and Cunningham $5,000 each. The Marine Trust & Security Co. of San Francisco is said to be financing the road. The first line built will be south from Omaha through Salina to Alva, with a branch west from Alva to the New Mexico coal fields. H. Leone Miller, Salina, Kan., is President.

Oregon.

The Lovegren Lumber Co., according to advices from Forest Grove, Ore., has let contracts for the construction of five miles of railroad running from the Southern Pacific tracks near Gaston, and extending into their extensive holdings in the southern section of Washington County. The cost of the work, including the erection of a large sawmill, will be, it is estimated, about $1,000,000.

A project is under consideration by Maj. McIndoe, U. S. Engineer, Portland, Ore., for the construction of a branch railroad from the line of the Oregon-Washington Railway and Navigation line from Megler to Nahcotta, starting from a point near Ilwaco and swinging around Baker Bay to Fort Canby and then to the base of the proposed north jetty at the mouth of the Columbia River. The road will be used for hauling construction material for government work.

Rose City League of Rose City, P. O. Portland, Ore., has adopted a resolution favoring a franchise for the Mount Hood R. R. to enter the city, as it is believed generally that the new road will assist greatly in the development of the Rose City and Montavilla Districts.

The Grants Pass & Rogue River Ry. Co., which filed its charter on Feb. 1, has announced its intention of building a line in the Applegate and William Valleys. The capital stock is $600,000 and the incorporators include A. D. Bowen, H. L. Chapin, J. W. Hefferlin of Portland.

As the result of the action of the executive committee of the Harriman Lines approving plans for extensions of the Union Pacific and Southern Pacific Rys. in the northwest it is expected that much new construction work will be done in this state. Among the works that are almost certain to be done are the closing of the gap between the North and South links of the Natron-Klamath cutoff on the Southern Pacific, that remains to be done after the present contracts are completed, and the line from Redmond, the ultimate terminus of the Deschutes Valley road, and Odell, a convenient point on the Natron-Klamath cutoff. Besides these, the roads that have been receiving the most consideration are that from Grants Pass to a point on the North California Coast, probably Crescent City, and that into the Coos Bay district. The East and West line through Oregon via Malheur canyon, rights of way through which were recently completed by the acquisition of a 70-mile strip held by the Hill interests, also may be included. This track, it is figured, will connect with the Deschutes road.

Pennsylvania.

⊙The Purcell Construction Co., has taken a sub-contract for 10 miles of work on the Lehigh & New England R. R., and has some good grading and concrete work to sublet. H. Morton Stephens, Tamaqua, Pa., is superintendent of construction for the Purcell Co.

The Pennsylvania R. R. is reported to have engineers in the field surveying a route along Ten Mile creek, from the terminus of the Ellsworth branch, to Hackney, along the Waynesburg & Washington narrow gage road, owned by the same company.

It is believed that construction work will be started shortly between Blacksville and Waynesburg on the proposed line of the Pittsburg & Fairmont Traction Co. W. M. Laws, Fairmont, W. Va., is interested in the proposition.

The House Judiciary General Committee has favorably reported the bill increasing the borrowing capacity of Philadelphia from 7 to 10 per cent, and in addition to permit the borrowing upward of $60,000,000 for the purpose of building subways and providing for an improved system of wharves and docks. This is the bill which is intended to aid in providing additional revenues for Philadelphia and to prepare for carrying into effect Mayor Reyburn's comprehensive plan for improving transit facilities and the upbuilding of the city's commerce through reclamation of waste lands, and the construction of wharves and docks. It is planned to push the bill through as quickly as possible, after which it will be submitted to a vote of the people at the November election. The bill, in the form of a resolution to amend the Constitution, passed the last legislature and under the law it must pass this legislature and be approved by the people before it becomes operative. The increase of the city's borrowing capacity from 7 to 10 per cent, forms one part of the proposed amendment, and the other portion relating to borrowing for subways and wharves and docks, virtually gives the city the right to borrow to an unlimited sum, although $60,000,000 is the sum which it has been estimated will be required. The amendment provides for the creation of a sinking fund for the cancellation of the latter character of indebtedness.

The Delaware Street Ry. Co., which has completed part of the proposed line along the Delaware River from Easton to Bangor, is stated to have secured the money for completing the line this spring.

The Pittsburg & Shawmut R. R. Co., has made a survey beginning about six miles south of Kittanning at a point on its main line and has located a line from that point to Butler, a distance of about 25 miles. It is very uncertain, however, whether the line will ever be built. The Pittsburg & Shawmut does not intend opening up any new work soon. W. W. Henshey, Kittanning, Pa., is chief engineer.

The Scranton & Binghamton R. R. Co., of Scranton, Pa., now operating 14 miles of line to Factoryville, proposes an extension from the latter place to Binghamton. As proposed the line will start at Factoryville, going north to Caryls, Bacontown and Nicholson, then along the Horton's Creek Valley to Lindaville, in Susquehanna county, through a divide in the Hopbottom Creek Valley to Brooklyn, through East Bridgewater, Tiffany and Montrose; thence along the Snake Creek Valley to Franklin Forks, Lawsville and Brookdale, entering York state by way of Corbettsville, Conklin and Conklin Center to Binghamton, making a total distance of 60 miles to Binghamton. From Montrose a branch line will run northward along Wyalusing Creek through Fairdale, Rush, Lawton, Rushville, Stevensville and Camptown to Wyalusing, in Bradford county, a distance of 32 miles, where it will connect with the Lehigh Valley railroad. Other branch lines will be built from Franklin Forks to Silver Lake, a distance of six miles and from Corbettsville to Hallstead and Great Bend, a distance of 3½ miles.

Philippines.

The Secretary of War has asked Congress to appropriate $50,000 toward the construction and equipment of a railroad from Camp Overton to Camp Keithley, Mindanao, P. I. It is estimated that the cost of constructing the 19 5-6 miles of track, including sidings, and equipping the same, will be about $400,000. The road will be used for the transportation of the army and its supplies between Camp Overton and Camp Keithley.

South Carolina.

The Piedmont & N [illegible] has been chartered with a capital stock of $5,000,000, the incorporators including J. B. Duke of Somerville, N. J., and B. N. Duke of New York.

Grading work is said to have been started for the proposed line of the Orangeburg R. R. This road is to be built from Orangeburg to North, a distance of about 18 miles, with the view of extension in the near future to Springfield. It is expected that the railroad will be ready for operation some time next fall. Under the charter of the Orangeburg railroad it has the right to construct its lines from Orangeburg into Charleston, Columbia and Augusta, which will ultimately be the route of the railroad. The city of Orangeburg has voted $20,000 in bonds to aid in its construction. Gas electric cars will be used for passenger service and locomotives for hauling freight. William C. Wolfe, Orangeburg, S. C., is President.

South Dakota.

The Chicago, Milwaukee & St. Paul R. R. is reported to have secured the right of way from Faith, its western terminus in Meade County, to Belle Fourche, and will, it is said, run an extension to Belle Fourche, striking the Belle Fourche River at Vale. Ground for railroad yards at Belle Fourche is reported to have been purchased.

Tennessee.

The John Keilman Lumber Co., which owns timber land near Greenville, Tenn., has had surveys made for a line 10½ miles long to extend from a point 1½ miles east of Greenville to Doak's Cabin. It is planned to have the road built by the end of June. Citizens of Greenville have appointed a committee to confer with the managers of the lumber company with a view to having the road extended to Greenville.

It is understood that the receivership of the Overton County R. R. is to be dissolved shortly and the road extended into the coal fields of Kentucky. The road at present is 20 miles long and runs from Algood to Livingston. W. W. Yeatman, Livingston, is General Superintendent.

Texas.

Officials of the Pecos Valley & Northeastern R. R. have announced, it is reported, that construction work will be started soon on a line to Alpine and Boquillas, passing through the center of the Rocilla vicinity.

Citizens of Gillespie County, according to advices from Fredericksburg, Texas, have appointed a committee and have agreed to raise $100,000 bonus to be given to the first railroad constructed and operated into Fredericksburg. Charles H. Nimitz, Jr., is Chairman of the Committee.

Surveys have been completed by the Locating Engineers and nearly all right of way arranged for, and according to a statement reported to have been made by W. F. O'Briant, Louise, Texas, construction work will be started in the near future on the line from Palacios to San Antonio, Texas.

A committee of the Bryan, Tex., Business League and Brazos River R. R. Committee will take up the matter of raising the remainder of the necessary money for the construction of the railroad to that place. J. Webb Howell, Bryan, Tex., is interested.

Morris & Gleason, Engineering Corps, running surveys for the Temple Northwestern R. R. extension from Gatesville to Hico, via Cranfils Gap, has proceeded as far as Turnersville, Texas.

A bonus of [illegible] Mineral Wells, Texas, toward securing the construction of the new Jacksboro Oran R. R. through that city. The plans for the work are progressing rapidly, it is said.

The Houston & Texas Central, I. A. Cottingham, Engineer M. of Way, Houston., according to advices from Sherman, Tex., is planning to start work immediately on the improvement of the yard facilities and the construction of an emergency car shop.

The citizens Ry. Co., of Waco., is considering extending its line up North 9th St. in that city.

The Cotton Belt Ry. is planning to have enacted at the present session of the legislature a Cotton Belt consolidation bill, which provides for the absorption of several small lines already owned by the Cotton Belt system. The company has already purchased the Stephenville North & South Ry. Co., and this road is to be extended by the Cotton Belt from Stephenville to Thurber. An extension is also being made from Hamilton to Comanche, the road just bought operating from Stephenville to Hamilton. The Cotton Belt has also acquired the Eastern Texas Ry., and [illegible] tion scheme. This was formerly a logging road running from Lufkin to Kennard and [illegible]

St. Louis Southwestern System on Feb. 4 completed the 32-mile extension of its main line from Gatesville to Hamilton, Tex., connecting with its recently acquired Stephensville North and South Texas line of 13 miles. Through train service from Waco to Stephensville was inaugurated Feb. 15.

The State Railroad Commission has been advised that the Menard extension of the Frisco System had been completed and that the first train would be operated Feb. 25. This extension is on the Fort Worth & Rio Grande Ry. and extends from Brady to Menard, a distance of 37.45 miles. The intermediate stations between Brady and Menard are Whiteland, Lightner, Callan, Scalp Creek and Menard. Stops will be made at each of these stations.

At the annual meeting of the Gulf, Texas & Western Ry. at Dallas on Feb. 7, J. J. Jermyn of Scranton, Pa., was re-elected president. The following new directors were elected: F. J. Bechley and Oliver Loving, both of Jermyn, Texas. The other directors were re-elected. Ben B. Cain of Dallas continues as vice president and general manager.

The Beaumont Traction Co., J. F. Weed, Receiver, Beaumont, has filed an acceptance of the franchise recently granted the company by the city of Beaumont in lieu of its former franchise. The franchise means the dissolution of the present receivership; it calls for numerous improvements in the physical plant and the equipment of the company and for better schedules for operating the cars. Chief among the improvements will be the laying of a double track on Pearl St. and the concreting of foundations. This will have to be completed within a year. There is also provision for the city acquiring the plant at a reasonable valuation at the end of the franchise terms and other stipulations greatly advantageous to the city.

The Kansas City, Mexico & Orient R. R. is considering building an extension from San Angelo to connect with the San Antonio & Aransas Pass Ry. at Kerrville.

The construction plans of the Santa Fe in western Texas are said to include the extension of its San Angelo line from that city to a connection with its Pecos & Northern division at Pecos. It will be approximately 186 miles long. The extension, it is said, will run almost due west from San Angelo, traversing a ranch region about midway between the Kansas City, Mexico & Orient and the Texas & Pacific. The San Angelo line connects with the remainder of the Gulf system of the Santa Fe at Temple.

Virginia.

The Washington & Barcroft Traction & Power Co. of Barcroft, Va., has been chartered and proposes to build a line 7 miles long from the Government bridge to Bailey's Cross Roads in Fairfax County. The officers are F. C. Handy, president, and W. W. Wright, vice-president, both of Barcroft, Va., and C. P. Munson, secretary, Arlington, Va.

Washington.

Jay D. Crary, Aberdeen, Wash., has filed his acceptance of the electric railway franchises granted him in South Bend and Raymond. Under the terms of the franchise he is given 120 days in which to begin actual construction and must have the electric line completed as far as the city limits of each city within two years. This line will cost about $300,000. Mr. Crary is also interested in a project for the building of an electric line from South Bend to Aberdeen to connect Willapa Harbor and Grays Harbor, and it is said that upwards of $1,000,000 will be put into the line and its equipment. The most likely route lies along the North River, trav[illegible]

Among the extensions believed to have been approved by the executive committee of the Harriman lines are the following: Bi-section of Washington by completion of the North Coast from Spokane to Tacoma via Lewiston; construction of numerous branches of this line to develop the state; an east and west line across Oregon from Ontario on the eastern border through the Harney Valley to the Pacific Coast at Cresent City, Cal., via Lakewood and Klamath Falls; extension of the Northwestern Pacific along the California coast to meet the foregoing line at Crescent

City, east [illegible] tral Oregon from Lebanon on the Southern Pacific via Prineville to connect with the Ontario-Crescent City line near Burns; extension of the Deschutes line south to connect with the Need-Natron division at Odell.

Advices from Hoquiam, Wash., are to the effect that contractors are now at work on the grading for the extension of the joint line of the Chicago, Milwaukee & Puget Sound and Oregon-Washington Railroad & Navigation line from South Aberdeen to Hoquiam. Both companies are anxious to get into this city and the work, which is being done by the Harriman system, is being rushed with all speed that weather conditions will permit. The Northern Pacific "Y" in that city is nearing completion and will be in use within a short time. This will permit trains being turned here without the inconvenience and long pull which has been necessary in the past.

It is reported to have been stated by an Engineer of the Chicago, Milwaukee & Puget Sound Ry., that the matter of securing the right of way franchise through Snohomish, Wash., has been disposed of and construction work at that place will be commenced at once. The first move will be to clear the right of way in Block 1, purchased a year ago for a depot site, after which the half mile gap in the roadbed construction will be filled in

West Virginia.

⊙Patterson, Moran & Luck, Pittsburg, Pa., have been awarded the contract for the grading and masonry work for the new line of the Buckhannon & Northern R. R., S. B. Brady, chief engineer, Morgantown, W. Va., from the Pennsylvania state line to Rivesville, W. Va. The contract is said to amount to $750,000. The contract for tracklaying and bridge superstructures will be let shortly. It is said grading work will be started as soon as certain difficulties over rights of way now in court at Morgantown, W. Va., are adjusted, which will be shortly. The road will be built on the west side of the Monongahela and will connect with the extension to be built by the Lake Erie from Martin, south.

The Rowlesburg & Southern R. R. Co., of Rowlesburg, W. Va., has been chartered with a capital stock of $50,000, and proposes to construct a railroad along Cheat River from Parsons, Tucker County, to Rowlesburg, Preston County. The incorporators own large tracts of timber in that section of West Virginia and are W. H. Gillespie, G. G. Stitzinger, R. A. Stitzinger, A. E. Stitzinger, E. E. Stitzinger and J. E. Stitzinger of New Castle, Pa.

Wisconsin.

The Ahnapee & Western Ry. and the Green Bay & Western Ry. have been purchasing ties this winter and have a considerable amount stored in the yard at Sturgeon Bay. The prices paid are said to be: cedar ties, 40 and 50 cts. for 6 to 8-in stock; for tamarack and hemlock of the same dimensions, 30 and 35 cts. All ties under 6 ins. bring 15 cts. each.

Construction work is to be started early this spring on the interurban line of the Chicago & Wisconsin Valley Street Ry. Co. Steel for line has been ordered for delivery this month. The company has offices at 435 Washington Bldg., Madison, Wis.; J. E. Jones is general manager and Allen T. Russell is president.

It is reported in Milwaukee that the Chicago, Milwaukee & St. Paul Ry. is planning to build a belt line around the city within the next two years. The project, it is said, would mean an expenditure of $10,000,000. The plan is reported to contemplate a line which will rival the Northwestern's belt line, now in course of construction, and which will give the company an opening into the city from every direction. The line, it is said, will connect with the inner belt line which the company now controls, touching all points in the surrounding country and giving the company access to the big industries in the outskirts of the city.

The Illinois Central R. R. is reported to have had engineers in the field for some time working on a proposed extension from the southern part of the state to cross the Wisconsin River at Spring Green and extend to the Freedom mines, taking in also the Baraboo district. Some color to the report is lent by the fact that the Illinois Central is said to have had mine holdings in the Freedom district for several years, secured about the same time the other companies were taking options and buying land in that locality.

Wyoming.

Advices from Laramie, Wyo., state that engineers of the Union Pacific Ry. are at present making surveys in that city for the construction of improvements, including the extension of the yards, building a new roundhouse and coal chutes. It is estimated that the work will require an expenditure of not less than $450,000. A. L. Mohler, Omaha, Nebr., is Vice President and General Manager of the company.

Plans have been completed and it is said that construction work will be started March 1 by the Wyoming R. R. Co., on its 28 mile line from Clearmont, Wyo., to Buffalo, Wyo. Ultimately it is proposed to extend the line south to Casper, where it will connect with the Chicago & Northwestern and the new line of the Burlington to be constructed from Powder River to Orin Junction. Among those interested in the new railroad are Colonel William G. Dows, president of the Cedar Rapids & Iowa City Ry. & Lt. Co., Cedar Rapids, Ia.; Isaac G. Smith of Cedar Rapids; H. G. Latham, J. S. Duncan and W. H. Shellman of Chicago; Fred Hass, W. G. Thon and H. P. Rothwell of Buffalo.

Canada.

✣Bids are asked until 5 p. m., March 2, by J. F. Guay, C. E., Morin Bldg., Quebec, Que., for the construction of about 56 miles of the Quebec & Saguenay Ry. from Cap Tourmente to Murray Bay Wharf, divided up into sections of ten miles. A certified check amounting to $2,000 for each ten mile section tendered for must accompany each tender. Forms of tender may be obtained and specifications and plans examined at the office of Mr. Guay.

⊙The Algoma Central & Hudson Bay Ry., R. S. McCormick, chief engineer, Sault Ste Marie, Ont., is stated to have awarded the contract for its 75-mile extension toward Hudson Bay to J. D. McArthur, Winnipeg, Man. The contract is said to amount to about $1,000,000.

⊙The Winnipeg Electric Ry. Co., Winnipeg, Man., has awarded a contract to the Canadian General Electric Co., for the plant of its new power station, which will be built this summer. The plans call for a plant with a rated capacity of 12,000 H. P. and a maximum capacity of 17,000 H. P., which will be ready for delivery by August 1 next. The generator will be driven by Curtis turbines, and the equipment will be installed in four units of 3,000 kilowatts each.

The Canadian Northern R. R. is planning to have work started in the spring on the construction of the Canadian Northern Ontario Ry. east from Port Arthur to overcome the gap in the system in new Ontario of 500 miles between Sudbury and Port Arthur. Location of the line has been completed, and it is intended to conduct the work from both terminals. It will take about three years to complete construction and have the line ready for traffic.

The Canadian Northern R. R. has completed the grading on the line through the Fraser Valley, and the contractors are now awaiting the arrival of two shipments of steel on the coast to begin tracklaying. The British Columbia section of the system extends through the Yellowhead Pass to Kamloops, and down the Fraser Valley to the coast.

Notice has been given of a resolution authorizing the Canadian Government to lease the St. John Valley Ry., proposed to be constructed from Grand Falls to St. John on a basis of a rental of 40 per cent of the gross earnings. The New Brunswick Legislature has authorized the Government of the Province to guarantee the bonds of any railway company building a railway from Grand Falls to St. John on condition that the said line should be leased by the Dominion Government for 99 years on a basis of a rental of 40 per cent of the gross earnings. It is provided that the contract shall be entered into only upon the condition that the railway be constructed upon plans and specifications to be approved of by the Governor in Council upon the recommendation of the Minister of Railways and Canals, and shall be up to the general standard of the National Transcontinental Ry. through New Brunswick. It is also provided that the Government may enter into a contract for the operation of the road in sections when completed and equipped as follows: (1) From Fredericton to Woodstock. (2) From Fredericton south a distance of 50 miles. (3) Each 25 miles thereafter until the line be completed and equipped from Grand Falls to St. John.

The Canadian Northern Ry., as noted in our last issue, has work under way clearing the townsite of Port Mann, on the Fraser River, British Columbia, and an active race has begun between holders of property adjoining the railway townsite and the company to have the land sufficiently cleared to file plans of the town. It is said that if the company has its streets laid out first and the plans filed, the other holders of property will have to make their streets coincide with those of the railway town. If the outsiders are able to file these plans first, the railway company will have to make its plans conform to those of its rivals. Port Mann will be the site of the car shops of the Canadian Northern and it is intended to make it a model town. Lines will extend from it to Vancouver and to the delta of the Fraser River. When it became known that the company had acquired property for this townsite, real estate agents secured much adjacent property, and put the lots on the market.

The Board of Control of Toronto, Ont., has decided in favor of constructing a subway at Sunnyside Ave. The proposed subway will have a roadway 66 ft. in width. The Grand Trunk railway tracks will be raised about 4½ ft. above their present elevation at the crossing. The estimated cost of construction, exclusive of land damages, he estimates at $145,016.74. Of this, the city will have to pay one-third and the Grand Trunk Ry. two-thirds. C. E. Rust is city engineer of Toronto.

Good progress is being made with the extension of the Algoma Central & Hudson Bay Ry. from the Soo to the C. P. Ry. main line, and it is expected that trains will be passing over this line before the fall. Steel has been laid on the right of way between Michipicoten Harbor and Michipicoten River, a distance of 50 miles, while the grade work is well under way on the branches extending to the Helen, Magpie and Josephine mines, and from Hawk River Junction to a point on the C. P. Ry. main line between Chapleau and White River. The work is being done under the supervision of O'Boyle Bros. Construction Co., assisted by Murdock Bros., Lynch, Gorman & Co. and Hick & Furlong, while the bridge, tie and pile timber is being taken out along the right of way by Henry Day and T. Trombley. Upwards of 1,000 men are employed in the work, and notwithstanding the cold weather health reports from the various camps are excellent.

The Canadian Pacific R. R. is considering double tracking its main line westward from Medicine Hat to Calgary. The reducing of a number of grades along the line is also under consideration.

The Railway Committee of the House of Commons has passed the bill granting the Canadian Northern Branch Lines Co., a subsidiary of the Canadian Northern Ry. Co., permission to construct 18 branch lines which are intended to be feeders of the main line in the prairie provinces, and will add 1,500 miles to the Canadian Northern mileage. The construction of these lines will be begun as soon as weather permits.

The New Ontario & Quebec Ry. Co. has applied to Parliament for permission to build from mileage 946 on the Transcontinental, southerly to the west end of Lake Abitibi and thence to Tisdale township and to junction with the James Bay Railway at Congdon, a distance of 160 miles. It is also proposed to build around the west side of Lake Abitibi to a junction with the first named line, and from Iroquois Falls to a junction with the second named line.

It was stated in the Canadian Parliament that the cost of the National Transcontinental Ry. between Winnipeg and Moncton to the end of last year had been $89,553,740.

The Great Northern Ry., A. Stewart, assistant chief engineer, Seattle, Wash., will, it is said, call for bids in a short time for grading 42 miles of line between the new coal town of Cardiff, west of Princeton and Summit, on the Coaquahalia River. This district lies to the north and just across the boundary line from the American Okanogan. It is also stated that the steel would be laid this year from Princeton to Cardiff and from Abbotsford east to a point in the vicinity of Sumas River. Work is at present shut down at the eastern end of the proposed route between the boundary country and the coast, but it is believed that within a short time construction operations will be resumed. The line has been graded from Princeton on to Cardiff, some thirteen miles, and it is declared that before the end of the season the rails will extend westward from Princeton for at least that distance. The grading contract of J. W. Stewart & Co., from Abbotsford eastward to Chilliwack, about 24 miles, is now almost 75 per cent completed, and will probably be finished by the middle of April.

The Canadian Pacific R. R. Co., according to reports from Calgary, Alta., is considering double tracking its main line westward from Medicine Hat to Calgary and reducing a number of grades along the line.

Application is to be made at the next session of the Ontario Parliament for an act incorporating a company under the name of the Niagara Frontier Ry., with power to construct an electric railway from Fort Erie, through Niagara Falls, to the town of Niagara.

Mexico.

Hudson's Consolidated, Ltd., which was recently granted a concession for a 370 mile railroad, as noted in our last issue, has placed engineers in the field to make surveys for the proposed line. It is understood that its route will be through the mineral and timbered region of the southern portion of the republic. Hudson's Consolidated, Ltd., owns 17 rich mines in Mexico and the syndicate is said to be composed of a group of wealthy Englishmen who are financially able to carry out the construction of the proposed railroad.

The National Rys. of Mexico, Jas. M. Reid, chief engineer, City of Mexico, is making preliminary arrangements for the construction of a branch railroad from Arguelles, a station on the Tampico-Monterey line of the system, to the town and district of Xicotencatl.

There is reported to be a considerable shortage of laborers for railroad construction work in Mexico. The Southern Pacific has a force of about 2,000 men employed constructing the line between the Santiago River and the City of Tepic, and employment would be given to three times this number of men if they could be obtained, it is stated by the contractors. Notwithstanding this labor shortage, it is expected that the road will be finished to Tepic within the next five months. Construction is also in progress on the mountain division of the road between Tepic and Orendain, the latter place being situated on the National Railways of Mexico, 25 miles west of Guadalajara.

ROADS, STREETS AND PAVEMENTS

Alabama.

The court of commissioners, Selma, Ala., will construct five miles of road in the southern part of the county. The commissioners will also let the contract for the building of a road from Marion Junction to Orrville, about 15 miles.

Arizona.

Judge Kibbey and Roy Goodrich, a special committee for the working out of a plan for financing the street paving work which is soon to be started in Phoenix, Ariz., have evolved a system which it is believed by the general committee will be received with satisfaction by the residents of the city. Plans and specifications are being prepared by Engineer Campbell of Riverside, Cal.

Arkansas.

At the annual convention of the Arkansas Good Roads & Drainage Association, which opened in Little Rock, Ark., Feb. 9, Gov. Donaghey urged a state levy of a special tax of one-half mill, county tax of 2 mills, township tax of 1 mill, tax on abutting property, 1 mill and the continuance of this tax until the good roads are completed. Included in the plan is the establishment of a State Highway Committee, to be appointed by the Governor. It is said that the one-half mill tax from the state would amount to $500,000 annually.

The Monte Ne, Ark., Club, of which W. H. Harvey is president, is agitating the construction of good roads, having Vinita, Okla., the center of the system. The plans call for three roads to center at Vinita, one starting at Pawhuska and extending through Bartlesville and Nowata, a distance of 70 miles; the second from Tulsa through Sapulpa and Claremore, 60 miles; the third from Muskogee passing through intermediate points, a distance of 60 miles. The work on the Tulsa division will be looked after by E. R. Kemp of the Tulsa Automobile Club, the Muskogee division by W. F. Moffit, president of the Muskogee Club, and the Bartlesville division by members of that club. It is expected to have the work completed by April 1.

California.

Resolutions of intention to pave six blocks on Sacramento St., and one each on Pine and Elm St., in Lodi, have been passed by the board of trustees. The streets are 80 ft. wide and will be paved with asphalt under the supervision of Engineer Tumelty.

Representatives from the chambers of commerce of Niles, Decoto, Centerville, Newark, Mission San Jose, Pleasanton and Livermore, and a committee appointed by the board of supervisors, has been called by the chamber of commerce of Niles to discuss the most feasible roads to be made a part of the state highways. The Niles canyon road and the Dublin route are favored, as well as the Foothill Blvd.

Colorado.

Senator Stephan of Delta has introduced a bill for an act providing for a public road commencing at the city of Delta and extending to the town of Hotchkiss and thence to the town of Crawford, thence over Black Mesa to Sapinero in Gunnison county. The bill also provides for an appropriation of $25,000 for the work.

The board of public works of Denver, Colo., has received bids for improvements in Capitol district No. 7, which provides for the surfacing of roadways and the installation of gutters. The district embraces the heart of the residence section, and the cost will be $67,776. Bids were received from the following: Gaffy & Keefe Construction Co.; Anderson, Ord & Swope Co.; Denver & Pueblo Construction Co., Westcott-Doan Investment Co., J. Fred Roberts, Commonwealth Construction Co., and the Municipal Construction Co.

Representatives from eight counties of Colorado recently met at Salida and organized the Arkansas, Rio Grande, Gunnison and Grand River Highway Association, to build what will be known as the "Rainbow Route"

District of Columbia.

Gen. Wilder, Representatives Sims and Austin of Tennessee and Candler of Mississippi appeared before the House Military Affairs Committee at Washington in behalf of the bill to construct a macadam road from Shiloh Military Park to the town of Corinth. An appropriation of $50,000 by Congress is asked.

Florida.

⊙The city of Daytona, Fla., has awarded a contract to Fulton B. Smith to deliver shell for the street at $.75 per cu. yd. the same to be delivered by water.

Georgia.

⊙The street committee of the city council of Atlanta, Ga., has awarded the following contracts for street and sidewalk work for the year: R. O. Campbell Coal Co., for cement, $1.36 per barrel, Birmingham Chert Co. (Gate City Chert), $1 per ton; Southern Tile & Stone Co., concrete curbing, $.30 per ft.; Southern Tile & Stone Co., tile sidewalks, $.94 per sq. yd.; Southern Tile & Stone Co., sheet cement driveways, $1.25 per sq. yd.; Georgia Granite Co., brick sidewalks, $.51 per sq. yd.; Pine Mountain Granite Co., granite curb, $.37⅛ per lin. ft.; Atlanta Tile Co., tile for repair work, $.12½ each. The bids received on sand were held up.

An election was held in Upson County, Thomaston, Ga., county seat, on Feb. 13, to vote on the proposition of issuing bonds to the amount of $100,000 for good roads.

Illinois.

⊙The board of local improvements of Moline, Ill., has let two contracts to the Ed Gust Construction Co., of that city, for paving work as follows: Brick paving on 20th St., from First to Third Ave., $3,705, and brick paving on Third Ave., from 22d to 25th Sts., $21,398.

Petitions have been presented to the board of local improvements of Rockford, Ill., by residents of West State St., asking for the paving of that street with brick.

The board of local improvements of Peoria, Ill., is considering a proposition to pave Lydia Ave., from South Adams to Starr St., with brick; the paving of Missouri Ave., between Pennsylvania and Illinois Aves., and the paving of Windom St., in two sections, one from Elizabeth St., to Bourland and the other from Bourland to Elmwood Ave.

Indiana.

✣Bids will be received until 1:30 p. m., March 7, by Commissioners of Parke County, at Rockville, Ind., for the construction of a gravel road in Liberty township. James E. Elder is Auditor.

✣Bids will be received until 10 a. m., Feb. 15, by the Board of Public Works, Indianapolis, Ind., for the furnishing of from 600 to 750 tons of refined asphalt.

✣Bids will be received until 1 p. m., March 6 by the Board of County Commissioners at Fowler, Ind., for the construction of a free stone road, consisting of seven different highways in the town of Ambia, Benton County. Lemuel Shipman is County Auditor.

⊙Sela A. Smith, 1042 Washington St., Gary, Ind., has been awarded the contract for the improving of Connecticut St., for $21,833. The work includes 7,608.5 sq. yds. of brick pavement; 2,775.6 ft. of sidewalk; 5,042.2 ft. of curb; 228 ft. of header; 5,731.9 cu. yds. of grading, and 1,000 cu. yds. of muck removed and refilled. Bids were opened Jan. 30.

⊙The board of county commissioners at Crawfordsville, Ind., has awarded the contract for the construction of a gravel road in Union township to Snyder & Barrett of Frankfort,

✣ indicates work now open for bids ⊙ indicates a contract let recently.

[illegible] Engle, County Auditor, on Feb. 7.

• [illegible] Ind., have awarded the contract for the construction of two miles of gravel roads and one steel bridge in Robb township, Posey County, to S. A. Gano of Mt. Vernon, for $6,791. Bids were opened Feb. 8.

⊙Smith & Pierce of Zionville, Ind., have been awarded the contract for the construction [illegible]

⊙Contracts for the construction of gravel roads in Tipton County, Tipton, Ind., have been awarded as follows: Two to Brown, Hinds & Hinds of Tipton for $7,198; three to Isaac Cox, Tipton, $6,387, and one to J. R. Cochran of Tipton for $3,995.

⊙Barnes & Granel, Logansport, Ind., have been awarded the contract for the construction of a gravel road in Tipton County, Tipton, Ind., county seat, for $5,714.

⊙The contract for the construction of the Hunt road in Ripley township has been let by the County Commissioners at Rushville, Ind., to Bert Smith and Roy Pierce for $9,775.

⊙J. E. Glynn of Terre Haute, Ind., has been awarded the contract by the County Commissioners at Brazil, Ind., for the construction of the new highway known as the J. L. Harris gravel road for $10,494. The road is located in Van Buren township near Lena and the part to be improved is almost three miles in length.

Property owners on Market St., Logansport, Ind., have filed a petition with the Board of Public Works asking that the city repair the asphalt pavement on that street from 2nd to the bridge at the city's expense.

Iowa.

The City Council of Cedar Rapids, Ia., has awarded the contract for the construction of brick pavement on the west and east side of the city to M. Ford. The bids received were as follows: East Side—Dearborn & Jackson. $1.63 per sq. yd.; total. $66,690; M. Ford, $1.59 per sq. yd.; total bid, $64,030. West Side—Dearborn & Jackson, $1.62 per sq. yd.; total bid, $19,058; M. Ford, $1.59 per sq. yd.; total bid, $18,535. Cedar Rapids Construction Co., $1.59 per sq. yd.; total bid, $18,576. Curbing-Concrete Construction Co., $10,634; Dearborn & Jackson. $10,661; Smith Bros., $10,467; Cedar Rapids Construction Co., $10,415. The streets to be paved are as follows: F Ave., from 7th to 8th Sts.; 4th Ave., from 6th to 7th Sts.; 7th St., from 3d to 5th Ave.; Vernal St., from E to I Ave.; 3d St., from 1st to F Ave.; 2nd St., from E to F Ave. East Side—15th St., from 4th to 5th Ave.; 5th Ave., from 14th to 19th Sts.; 6th Ave., from 6th to 8th Sts.; 7th Ave., from 6th to 10th Sts.; 7th St., from 5th to 8th Aves.; 8th St., from 5th to 8th Aves.; 9th Ave., from Division to 8th Sts.; 19th St., from Bever to 5th Aves.; 16th St., from Bever to 5th Ave.

Kentucky.

Advices from Jeffersonville. Ky., are to the effect that Edward Graves, trustee of Owen township. will endeavor to have the contract for building a free pike from the Charlestown line to the Bethlehem township line let as soon as possible. Work, however, will not be begun until spring.

Louisiana.

The Police Jury and Joe Monget, Baton Rouge, La., of the State Board of Engineers, are planning to make a model turnpike 50 ft. wide out of the Bayou Sara road from the city limits of Baton Rouge to Monticello bridge, four miles. Property owners have agreed to donate the right of way.

The City Council of Jennings, La., has awarded the contract to DeJersey & Farnard for the construction of 8 or 10 miles of sidewalk and curbing. a small portion of the amount being curbing. The contract covers all the principal streets in the town, except the cross streets.

Maryland.

✣[illegible] Md., [illegible] furnishing brick or vitrified block for the public parks and squares of that city.

Rhoades & Co., William Solomon & Co., and Parkinson & Burr, all of New York City, have purchased the series of $1,000,000 state of Maryland good roads bonds.

Michigan.

Kalamazoo County Road Commissioner, Bryant, Kalamazoo, Mich., has filed with the state good roads department the necessary petitions for awards for 28 miles of gravel roads, on which the state allows $500 per mile, and four miles of stone roads which the state allows $1,000 per mile. It is proposed to construct during the year 32 miles of good roads in the 16 townships of the county.

A bill has been introduced in the state legislature, Lansing, Mich., by William Leighton of Grand Marais, Mich., providing for state aid in the construction of a 25-mile macadam team road between Grand Marais and Seney. The estimated cost of the improvement is $50,000.

Minnesota.

⊙J. T. Gerard, Temple Court, Minneapolis, Minn., has been awarded the contract by the board of public works of St. Paul, Minn., for the macadamizing, curbing, filling, leveling and improving Linwood Place from Grotto St. to Avon St., for $2,685. Bids were opened Feb. 6 by John J. O'Leary, president of the board.

Senator J. T. Elwell of Minneapolis, Minn., has introduced in the senate a bill which he hopes will give Hennepin county $1,000,000 needed for road construction. The bill provides that any county in the state may issue bonds to the extent of ½ of one per cent of the assessed valuation, for use in building roads.

Bids received Feb. 6 by the board of public works of St. Paul, Minn., for grading Doswell Ave., from the Country Road to Raymond Ave., have been rejected as being too high R. L. Gorman is clerk of the board.

Missouri.

✣Bids will be received until noon, Feb. 21, by Board of Public Improvements, St. Louis, Mo., for 16 street reconstruction and improvement contracts, the largest being letting No. 10,141 for reconstructing 16th St. from Franklin Ave. to Chambers St., by taking up and removing the old pavement and curbing and preparing the roadbed for the superstructure, furnishing granite curbing and setting the same in Portland cement concrete and backed with concrete, laying a roadway pavement to consist of a base of Portland cement concrete, a binder course of bituminous concrete and the wearing surface composed of a mixture of the best quality of refined asphalt, heavy petroleum oil, sand and powdered carbonate of lime, making all proper connections and intersections with other streets and alleys and to guarantee and keep in repair all of the aforesaid work and the materials used in connection therewith for a term of five years commencing on the date of acceptance of the work of reconstruction. Deposit required, $1,099.

The Board of Public Works of Kansas City, Mo., contemplates repaving 15th St., between Virginia and Cypress Ave., a distance of 32 blocks. The street is 100 ft. wide. William Buchholz is President of the Board.

The character and estimated cost of paving included in the total amount of street improvements contemplated for St. Joseph, Mo., for which plans have been prepared, is as follows: Asphalt, $17,191; mineral rubber, $55,360; Hassam, $35,198; brick. $7,919; concrete, $1,005; total, $116,673.

Montana.

Representative MacDonald of Flathead has introduced a bill in the state legislature at Helena, Mont., creating a state highway department, and establishing a state highway commission and the office of state highway engineer; prescribing the duties of each and fixing the compensation of said state highway engineer; authorizing state aid for establishment, construction, maintenance and repair of public highways; creating a fund and making appropriations therefor; and providing for application by the counties for state aid.

Nebraska.

Advices from Lincoln, Neb., are to the effect that the contract recently awarded to Abel & Roberts for the paving of 25th St., from Vine St. to O St., will be relet.

New York.

The Town Board of Pomfret, N. Y., has secured the necessary right of way for a change in the road at the Hunt farm in Laona. The plans for the improved roadway are nearly ready and will be presented to the Board of Supervisors for its approval.

A bill has been introduced in the Senate at Albany, N. Y., providing for an appropriation of $60,000 for the construction of a state road from Kingston to a point on the boulevard to be built by New York city near West Hurley.

Advices from Albany, N. Y., are to the effect that the Senate has passed two bills appropriating more than $2,000,000 for the construction of state highway routes. One of the bills provides for an improved route from New York to Rouse's Point, passing through Saratoga, Lake George, Warrensburg, Schroon Lake, Ausable Forks, Keeseville and Plattsburg. The other provides for a new state road from a point on the dividing line between Broome and Tioga counties to Geneva. The Canadian government is taking steps to build a new highway from Rouse's Point north to Montreal, making a continuous route from New York to Montreal.

Ohio.

City Engineer F. J. Cellarius of Dayton, O., has submitted the following estimates to the director of public service for proposed street improvements: Huffman Ave., from 3d St., to the corporation line at Overlook Ave., brick, $74,451, or sheet asphalt, $118,691; Broadway from Bolender to Miami Chapel Road, brick, $10,663, or asphalt, $13,621; Perry St., from Bayard to the levee, brick, $3,546. or asphalt, $7,438; Lakeview, from Germantown to Florence, brick, $58,648, or asphalt, $63,752, or plain macadam. $51,327.

A bill is pending in the legislature. Columbus, O., to improve the National pike from Columbus to Springfield.

The City Council of Springfield, O., has decided to pave South Center St., from Obenchain alley to Perrin Ave.; South Limestone St., from Rice St., to the old corporation line; East Columbia St.; East Washington St., from Limestone St., to the new station.

The City Council of Cleveland, O., has passed an ordinance providing for the paving of 95 streets covering in all about 15 miles for this year. Among the big jobs to be cared for is the paving of Bolivar Road S. E., from E. 4th St. to E. 9th St.; the paving of Jennings Road S. W., from Brainard Ave., to Valley Road S. W. and the paving of W. 117th St., from Lake Ave., to Madison Ave. S. W.

State Highway Commissioner J. C. Wonders, Columbus, O., has approved the following road improvements for which petitions had been filed with the County Commissioners at Zanesville: Brick paving for half miles of road between corporation lines of Zanesville and South Zanesville, on condition that Zanesville pave to the corporation line, a distance of about one-half mile; half mile in Union township to be improved with double course of waterbound macadam to width of 12 ft.; one mile of road between Trinway and Dresden to be improved with single course macadam, tar bound to width of 16 ft.

New estimates on the cost of paving Spring Grove and Eastern Aves., Cincinnati, O., have been submitted to the director of public service by the engineer's department. For Spring Grove Ave., from Ludlow Ave. to the corporation line, the estimate for wood block is $112,487, for granite, $124,225 and for bitulithic, $100,765; for Eastern Ave., from the present granite pavement to Archer St., with granite, $102,148, with bitulithic, $83,037, and with wood block, $95,046.

The following bids were received by John F. Goldenbogen, clerk of the county commissioners, Cleveland, O., for the grading, draining and improving of the Union Road from the limits of the city of Cleveland to the intersection of the road with Kinsman Road in Newberg township: Concrete curb, Cleveland Trinidad Paving Co., Cleveland, $31,168; stone curb, $31,666. Gould & Maybach, Cleveland, concrete curb, $33,006; stone curb, $32,923. Freshwater Bros. & Co., Cleveland, concrete curb, $30,971; stone curb, $30,888; Enterprise Paving & Construction Co., Cleveland, concrete curb, $33,041; stone curb, $31,962. Wilson & Harper, Barnesville, O., concrete curb, $31,256; stone curb, $30,592. Baldwin Bros., Cleveland, concrete curb, $31,508; stone curb, $33,331

Oklahoma.

The contract to be let by the city of Sapulpa, Okla., on Feb. 7, for the construction of approximately 16,000 sq. yds. of sheet asphalt pavement on a 5-in. concrete base, including grading, curbing, draining, etc., for the city, has not been let. The district is to be enlarged to the amount of 100,000 yds. The work will be re-advertised. Ira J. Anderson is City Clerk. E. D. Kirkpatrick is City Engineer.

The Commercial Club of Tulsa, Okla., has circulated petitions and will present the same to the county commissioners asking for the creation of the first good roads improvement district. The district asked for will center about the city of Tulsa, and will be 39 miles north and south and 18 miles east and west. The commissioners will proclaim the district and will call an election to vote on the proposition of issuing bonds for the building of permanent roads within it. The plan is first to build two pikes, one north and south, the other east and west. Either macadam or asphalt binder will be used. The north and south road is to be a link in the proposed Kansas City-Tulsa pike.

Oregon.

A movement has been started to form a hard surface improvement district on the East Side between Hawthorne Ave., and East Burnside St., Grand Ave., and East 20th Sts., in the city of Portland, Ore. The cost of the pavement of the streets in this district is estimated from $1,000,000 to $1,500,000. In the district there are 225 full blocks, and there will be close to 15 miles of streets to pave. J. W. Morris is City Engineer.

The County Court at Albany, Ore., has made a general levy of 1½ mills for every road district in the county. Besides this 14 of the 33 road districts have made special levies for road improvements and will expend large sums in systematic road building. Albany is the county seat of Linn County.

Pennsylvania.

It is reported that the state road bill, which provides for a system of cross state highways and inter-county seat roads to be constructed and maintained by the Commonwealth, has been introduced in the legislature at Harrisburg, Pa. Joseph W. Hunter is state road commissioner. The bill, as outlined, will designate routes to be cared for. Harrisburg will naturally be the center of a number of roads, as those leading from Lancaster by way of Middletown and Steelton; from Reading by way of Lebanon and Hummelstown; from Chambersburg by way of Carlisle and Mechanicsburg, and from Sunbury by way of Millersbnrg and Dauphin, will be included. The routes will also cover York and Adams counties, so that Gettysburg will be touched. Every section of the State will be cared for as well. The amount of the appropriation has not yet been determined upon, but it is understood that it will cover a period of years.

Tennessee.

In response to an application made some time ago by the county court and the Knox County Good Roads & Park Association to the government for an engineer to survey the proposed route of the Memphis to Bristol highway through Knox and Grainger counties. C. C. Ahles, an engineer in the office of public roads of the department of agriculture, has been detailed for the work. The survey will begin at Knoxville, and go to the eastern boundary of Grainger county, a distance of 50 miles, 18 of which are in Knox, and the remainder in Grainger. A survey will then be started from Rutledge, in Grainger county, to the Claiborne county line at Shelton Ford, on Powell's river, eight miles from Rutledge, for the proposed trunk line, of the Knoxville and Cincinnati Trunk Line highway, which passes through Cumberland Gap and Kentucky. Cyrus Kehr is President of the Knox County Good Roads & Parks Association.

⊙The Cocke County Commissioners, Newport, Tenn., have awarded the contract for the completion of the 35 miles of pike roads in the county to T. L. Peters and J. R. Gibson of Knox County. The bid upon which the contract was awarded calls for the following: South Side of Pigeon river—Earth, $.81½ per cu. yd.; loose rock, $.38 per cu. yd.; solid rock, $.78 per cu. yd. North Side of Pigeon River—Earth, $.19 per cu. yd.; loose rock, $.38 per cu. yd.; solid rock, $.69 per cu. yd., and macadamizing per cu. yd., $1.48. Horace Mann of Knoxville retains his contract to put rock on the road south of the Pigeon River. The work of grading is to be completed by July 15, and the macadam work by Dec. 15.

The Faxon Chert Co. has applied for a charter in the office of the county register, Memphis, Tenn. The company is to have a capital stock of $10,000 and is to deal in gravel and road material. The incorporators are: W. B. Troy, Jr., F. W. Nichols, W. A. Shibley and W. L. Lamar.

Texas.

A Good Roads Improvement Association has been organized in Galveston, Tex., with M. O. Kopperl, President and Bartlett D. Moore, Secretary, and George Sealy, Treasurer. A committee has been appointed to draft a constitution and by-laws.

The County Commissioners at Galveston, Tex., have been petitioned for the construction of a roadway leading from the northwest corner of the Hitchcock Cemetery, running east to intersect the La Marque road at the northeast corner of the Westerlage place.

The City Commission of Galveston, Tex., has granted a request from John Hanna to have an old petition for the shelling of those streets comprised in the section between Market and Postoffice Sts., and 14th and 16th Sts., south to Broadway revived.

The citizens of Grapeland, Tex., have voted the issuance of bonds for the construction of good roads in precinct No. 5.

The Municipal Commissioners of Dallas, Tex., have approved paving propositions involving more than $20,000.

The Board of Municipal Commissioners of Dallas, Tex., has ordered the paving of Bryan St., from Pacific to St. Joseph, a distance of over a mile.

The city of Stamford, Tex., has sold bonds for street paving. The contract for the paving of several more blocks of street will be let at once.

⊙Cullom & Bavoursette have been awarded the contract by the Board of Municipal Commissioners of Dallas, Tex., for the grading of Peak St., from Main to Armstrong. The bid was $.24½ pre cu. yd

Plans have been submitted to the commissioners of Dallas, Tex., by property owners looking to the paving of Forest from Central, eastward to Arza; for the paving of Boulevard, from Central to Arza, and for the opening and improving of the intersecting streets, between Grand and Forest Aves

Civil Engineer L. F. Daniels of Beaumont, Tex., accompanied by a crew of men, has started work at Vinton, La., cutting the right of way for the construction of the Vinton road.

The County Commissioners at Cuero, Tex. have awarded the contract to take charge of the county public road work under the supervision of the commissioners, to begin Feb. 1, to C. D. Peary.

The Commissioners Court at Eagle Lake, Tex., has ordered an election for March 7 to vote on the proposition of issuing bonds [illegible] tion of good roads

The city of Palestine, Tex., will extend Queen St. to Line St., opening up a direct route from West Palestine to the business district. The street will be 50 ft. wide.

The Commissioners Court at Luling, Tex., has been petitioned by the voters of that precinct to authorize the issuance of bonds to the amount of $50,000 for the construction of good roads.

Utah.

⊙The contract for the laying of 1,115 ft. of 5 ft. sidewalk in 9th Ave., between K and M Sts., excepting 165 ft., on the south side running east from K St., has been awarded by the city of Salt Lake, Utah, to L. L. Goddard for $1.03 per front ft.

Senator H. W. Hunt of Iron has introduced a bill providing a total appropriation of $3,500 for roads in Washington County. The distribution of the fund thus appropriated among the various roads of the county is provided for in the bill. St. George is county seat of Washington County.

The State Road Commission of Utah has filed its first biennial report with the governor, which contains a recommendation that the annual appropriation of the legislature for the construction of state roads be increased from $27,000 to $60,000, and that funds be provided for paying the expense of its members and the employment of a road expert. The commission consists of the following: Governor William Spry, Chairman; R. R. Lyman, Vice Chairman; Caleb Tanner, Secretary; David Mattson and J. W. Jensen, Commissioners.

Virginia.

Citizens of Staunton, Va., are circulating a petition which will be presented to the Board of Supervisors asking for an election on a $1,000,000 bond issue to secure the macadamizing of 300 miles of public roads in the county of Augusta.

Washington.

Advices from Cooks, Wash., state that Engineer Miller will take charge of the building of a highway from Collins Hot Springs to the Little White Salmon. This road when completed will connect existing county roads for use of through travel while other divisions of state No. 8 road are being completed.

The Montesano Commercial Club of Washington has begun agitation for the extension of State Road No. 9. At present this road extends west from Montesano to the coast, thence north to the Straits. It is now proposed to build east from Montesano to Olympia, passing through the Elma cut off. The bill for the carrying out of the project will be presented to the state legislature by Representative Minard of Elma.

Petitions have been presented to the city council of Ellensburg, Wash., asking for the paving of the following streets: 6th St., from Pine to Water St.; Pine St., from 5th to 6th, and Water St., from 5th to 6th Sts. Another petition is being circulated asking for the paving of Pearl St., from the end of the present paving at 6th St., to 8th St.; 8th St., from Pearl to B St.; and B St., from 8th to the city limits.

The Oakville, Wash., Commercial Club has appointed a committee to confer with the state authorities relative to opening a road connecting the road now running to the head of Garrison state road from Raymond and South Bend. This connection would necessitate the building of about 10 miles of highway.

Wisconsin.

The City Council of Madison, Wis., contemplates purchasing two street sweepers. John F. Icke is City Engineer.

Canada.

The York County Council has agreed upon a plan of the proposed county good roads system and negotiations are now in progress with the city of Toronto, Ont., looking to the securing of its approval thereof. The estimated cost of the system is placed at $300,000. A third is to be raised by the county, a third is to be raised by the city, and a third by the Provincial [illegible] radiates from the city at eight points, while two other roads run east and west north of the city. The total is about 111 miles. Following [illegible] Yonge St., from the north limit of North Toronto to the north town line between Markham and [illegible] from eastern city limits to West Hill, 2 miles; Kennedy road, from the northeast corner of Toronto limits to Stouffville, 23 miles; Lake Shore road, from Sunnyside to Long Branch, [illegible] miles; Dundas road, from West Toronto to Summerville, 5½ miles; Don Mills road, from the city limits at the Don Valley to the fourth concession line of York and Scarboro townships, 7½ miles; Vaughan Plank road, from St. Clair Ave. north to Maple, 14 miles; Weston road, from West Toronto to Klineburg Station, 18 miles; Malton road, from Weston to Malton, 6½ miles. Markham road, from Langstaff eastward to the town line between Pickering and Markham, 12½ miles. Herbert Lennox is County Solicitor.

BRIDGES—STEEL AND CONCRETE

Alabama.

⊙At a meeting of the Dallas County Commissioners, Selma, Ala., recently, the contract for the construction of 23 bridges over creeks and branches in different parts of the county was awarded to the Converse Bridge Co., Chattanooga, Tenn., at $13,313. The county reserved the right to install the abutments.

Arkansas.

The contract for the superstructure of the free bridge at Van Buren, Ark., has been signed and all matters pertaining thereto completed with the single exception of the delivery of the bond of contractors. The contractors upon the substructure are making rapid progress with their part of the bridge work and are now preparing to sink the last caisson. If the weather permits the contractors to work as steadily as they have done since the landing of their forces at Van Buren, the substructure will be completed by April 1, just three months ahead of the time fixed in the contract.

California.

✣Bids will be received until 11 a. m., Feb. 20, by the Board of Supervisors of Santa Clara County at San Jose, Cal., for the construction of a reinforced concrete bridge over the Los Gatos Creek at the Meridian Road.

The Bridge Committee of the Board of Trade, Pasadena, Cal., has taken up with the Santa Monica Bay Chamber of Commerce the matter of constructing a bridge across the arroyo to make a direct line from Mountain to the sea.

Colorado.

Advices from Grand Junction, Colo., state that a committee has been appointed by the Directors in the Palisade and Orchard Mesa District, to confer with the Commissioners of Mesa County in regard to assistance in erecting a steel bridge across the Grand River. The structure as proposed will be supported by four steel cables and will be 15 ft. wide and 250 ft. long.

Delaware.

Plans and estimates of the cost of the construction of a new bridge across the Christiana north of 3rd St. have been submitted to the Levy Court by Philemma Chandler, Comptroller, and James Wilson, County Engineer, at Wilmington, Del. As proposed the structure will be of Scherzer roller lift type.

Illinois.

⊙The following contracts in connection with the repair department, division of bridges, Chicago, Ill., have been awarded by B. J. Mullaney, Commissioner of Public Works, sectional wood pavement, 2¾ ins. thick, 2,000 sq. yds., $2.35 per sq. yd.; 3½ ins. thick, 2,000 sq. yds., $2.70 per sq. yd., Geo. P. Cullen, 78 LaSalle St. Detailed specifications were published in ENGINEERING-CONTRACTING Jan, 11, 1911.

At the annual meeting of the Quincy Bridge Co., at Quincy, Ill., Feb. 8, the following directors were elected: George B. Harris, T. B. Holland, C. J. Sturgis, C. M. Dawes, W. W. Baldwin.

Indiana.

✣Bids will be received until 10 a. m., Feb. 24, by Commissioners of Marion County at Indianapolis, Ind., for the construction of a bridge over Crooked Creek. Albert Sahm is County Auditor

The County Commissioners, Fort Wayne, Ind., have decided to appropriate $2,950 for the construction of a new bridge on the Decatur Road in Marion township and $2,300 was re-appropriated for the Allen-Adams County Line bridge.

⊙The Board of Public Works, Michigan City, Ind., has awarded the contract to the Phee Construction Co., for replacing the bridge at $14,800. According to the specifications the old material, so far as available, is to be used in the work.

⊙The contract for the construction of the Martinville Bridge in Morgan County was awarded to A. Ferguson, Valley Mills, Ind., at $2,247.

Iowa.

✣Bids will be received until April 3, by the Board of Supervisors, Ida Grove, Ia., for the plans and for the construction of steel bridges in Ida County.

✣It is reported that the Auditor of Story County at Nevada, Ia., will soon receive bids for the construction of reinforced concrete arch bridges to cost $10,000 or more.

✣Bids will be received until 1 p. m., Feb. 20, by Board of Supervisors, Grundy County, Grundy Center, Ia., for the steel bridge material and reinforcing iron for concrete work. E. G. Ensminger is County Auditor.

A petition is being circulated in Eldora, Ia., for the construction of a bridge at the west end of Washington St. in that city.

Kansas.

The House of Representatives, Washington, D. C., has passed a bill authorizing S. G. Guerrier, Atchison, Kan., to construct a bridge across the Missouri River near Atchison.

City Commissioners of Kansas City, Kan., have decided to construct a bridge across Reynolds Ave. at 6th St. The structure will provide a wagon road and sidewalks on each side and will be of concrete.

Steps are being taken by citizens of Independence, Kan., to induce the officials of the Missouri Pacific to replace the old bridge over the company's tracks in the Hawthorne Addition. C. E. Smith, St. Louis, Mo., is Engineer of Bridges.

Kentucky.

It has been announced that plans will be completed in about 30 days for the construction of the proposed bridge over the Beargrass Creek at Logan St., mentioned in our last issue. D. R. Lyman is Chief Engineer of the Department of Engineering, Louisville, Ky.

Louisiana.

Officials of the Queen & Crescent Ry. conferred at Shreveport, La., recently with the representatives of the Bossier Parish Police Jury and the city commissioners relative to plans for the construction of a new bridge for the railroad traffic exclusively. The Parish of Bossier and the City of Shreveport expect to start work soon on the erection of a new vehicular traffic bridge.

Maryland.

The House of Representatives, Washington, D. C., on Feb. 6, passed a bill introduced by Representative Pearre, authorizing Park C. Abell, George B. Lloyd and Andrew B. Sullivan of Indian Head, Charles County, Md., to construct a bridge across Mattawoman Creek near that place, at a point suitable to the interests of navigation. The bill has the approval of the Chief of Army Engineers.

Michigan.

The Houghton County Traction Co. has been authorized by the Bridge Committee of the Houghton County Board, Houghton, Mich., to proceed with repairs on the Portage Lake bridge.

The following bids were received by the City Council of Kalamazoo, Mich., Jan. 30, for the construction of the proposed new concrete bridge at Gull St.: The Herman Tapp Construction Co., Fort Wayne, Ind., $21,500 and $21,000; Carpenter & Anderson, Grand Rapids, Mich., $19,959; Richard Heystek, Kalamazoo, Mich., $20,645; Huron Bridge & Iron Co., Port Huron, Mich., $19,850, $18,600 and $16,900; The LaFayette Engineering Co., La Fayette, Ind., $18,500, $18,050 and $22,071; Henry L. Vanderhorst, Kalamazoo, Mich., arch bridge, $23,600; girder bridge, $21,000; C. Marsman, Grand Rapids, Mich., $21,480 ($100 less if iron rail is used); E. W. Seamans, Grand Rapids, Mich., $24,444; Illinois Bridge Co., Chicago, Ill., 10 plans, ranging from $17,888 to $20,537; The Wynkoop-McCormley Co., $19,900 and $18,990.

Minnesota.

The Board of Aldermen, St. Paul, Minn., received the following bids for the construction of a foot bridge across the Great Northern tracks at Hamline Ave.; St. Paul Foundry Co., $2,301; Iowa Bridge Co., $2,395; Minneapolis Bridge Co., $2,550. The bids were received Feb. 7 and referred to the Committee on Streets.

Missouri.

A public hearing was recently held by the Council Committee on Ways and Means on the proposition of residents of the West End to submit to a vote of the people a proposition for a bond issue of $2,500,000 for the construction of a free bridge at St. Louis, Mo.

The Trafficway Commission's Special Committee has approved the plans of Waddell & Harrington, Oscar Leslie Bldg., Kansas City, Mo., for the construction of the reinforced concrete girder viaduct at 12th St. in connection with the West trafficway. The viaduct is to have two levels. The upper one from Liberty to Summit will have 22 ft. on the north side for street cars, a traffic roadway of 30 ft. on the south side and a sidewalk 4 ft. wide south of the roadway. The lower level will have a roadway 30 ft. in width. The cost of the work is estimated at about $557,425.

Bids received Feb. 6 by J. D. Laughlin, Chancery Clerk, Warren County, Vicksburg, Miss., for the constructon of a steel bridge over the Bayou near John Wright residence, were rejected. The work will be readvertised in March.

Montana.

The Commissioners of Custer County at Miles City, Mont., have decided to construct a bridge over the Powder River at Moorhead and at Broadus. The structure will be of steel.

Nebraska.

A stock company has been organized at Ashland, Neb., to promote the construction of a steel bridge over the Platte River at that city. While most of the money has been raised, a committee consisting of Hugo Wiggenhorn, president of the Farmers and Merchants bank; Senator Alex Laverty and Randall K. Brown, president of the National Bank of Ashland, will visit Omaha and Lincoln to interest a little additional capital in the enterprise.

New Jersey.

According to a communication received recently by the Borough Council of Roselle Park, N. J., the Central R. R. of New Jersey wishes to construct two new steel bridges, one at Walnut St. and the other at Gordon St. J. J. Yates, New York, N. Y., is Bridge Engineer of the Railroad.

The Philadelphia & Reading Ry. Co. is considering the plans for the erection of a new bridge across the Delaware River above Trenton, N. J., on the New York division to replace the one that has been there since 1875.

New York.

At a public hearing before the Finance and City Property Committees of the Common Council, Rochester, N. Y., steps were taken which may result in the construction of a new street and bridge over the Erie Canal at Otis St.

⊙Board of County Commissioners, Elmira, N. Y., has awarded the contract for the substructure and alteration work on the 5th St. bridge to J. W. Hyser, at $3,475. The substructure work consists of all stone work, masonry and repair work for the new bridge. Actual work will be started on the new structure about the 15th of this month. The following firms submitted bids: J. W. Hyer, $3,475.20; J. L. Mercer, $4,395.45; Bock & Henderson, $4,581.00; F. M. Townsend, $4,971.80; F. M. Worstall, $5,661; J. M. Thurston, $6,832.

The Common Council of Fulton, N. Y., at its regular monthly meeting, Feb. 7, took up the matter of settling a date for a special election to vote on the question whether the new bridge shall be constructed over the Oswego River at Broadway.

North Dakota.

A bill authorizing Fargo & Moorhead Street Ry. Co. to construct a bridge over the Red River to the north at Fargo, N. Dak., has passed the House and it is expected that no trouble will be experienced in obtaining the permission of the U. S. Government for the improvement. As planned the movable portion of the structure will be a Scherzer Rolling lift bridge, approximately 55 ft. in length. The east approach will be 150 ft. long and the west approach about 400 ft. long. Prices on both steel and wooden approaches will be received when bids are asked sometime after the first of May. Curtis P. Brown, Fargo, N. Dak., is General Manager.

Ohio.

✣Bids will be received until noon, Feb. 23, by County Commissioners, Columbus, O., for furnishing the necessary labor and material for the following bridge work: Engineer's Estimate No. 195—New floor system on the Weisheimer Bridge, over the Olentangy River, Clinton Township. Engineer's Estimate No. 196—New floor system on the Lockbourne Bridge, over Big Walnut Creek, Hamilton Township. Engineer's Estimate No. 197—Constructing the west approach to the Lockbourne Bridge, over Big Walnut Creek, Hamilton Township. Engineer's Estimate No. 206—Pipe culvert and approaches on the Pontius Pike, at the F. Pontius farm, Madison Township. Engineer's Estimate No. 207—New floor system on the Dublin Bridge, over the Scioto River, in Washington and Perry Townships. Engineer's Estimate No. 208—Reinforced concrete culvert on the Bixby Road, Madison Township. Engineer's Estimate No. 209—Grading and graveling a portion of the Bixby Road, in Madison Township. The plans, specifications and estimates of quantities for doing this work, as per county plans, are on file in the office of the county auditor and county surveyor for inspection by all persons interested in the same, during business hours of each day of the week except Sundays.

✣Bids will be received until noon, March 10, by Board of County Commissioners, Cincinnati, O., for building under Specifications No. 162, a culvert on the Snyder Road, one quarter mile north of Cornell Ave. in Sycamore township. All bids must be accompanied by a check for $500. Fred Dreihs is Clerk.

⊙Gordon Engineering Co., Vine and Opera Place, Cincinnati, O., has been awarded the contract by the county commissioners at Cincinnati for the construction under Specification No. 137, of culverts on the Kirby road, through lands of Ungruhe and Kirby, in Millcreek township, for $12,935. Bids were opened Feb. 3.

Commissioners of Tuscarawas County, O., have published a notice of intention to move the bridge over the Tuscarawas River on the road leading from Zoar to Bolivar, and near Bolivar in Lawrence township of said county and state, about 1,800 ft. further up the river and opposite the village of Bolivar, on the Lebold road; and also make the necessary extensions and approaches, and also build a bridge over the Ohio Canal at the foot of Water St. in said Village opposite said bridge at the place where it is to be moved.

City Council of Youngstown, O., has taken action toward the elimination of grade crossings at Oak St., Valley St. and Hubbard Road. City Engineer has been instructed to draw plans for the work.

Oklahoma.

Board of County Commissioners, Muskogee, Okla., have ordered County Engineer to make new plans, surveys and specifications for the proposed 33 bridges to be erected at various points in the county. Bids for these structures were received but the work will be re-advertised.

An appropriation of $10,000 has been asked of the House of Representatives, Oklahoma City, Okla., for the construction of a wagon bridge across the Canadian River in Blaine County.

City Commission, Tulsa, Okla., has approved plans for the construction of a subway under the St. Louis & San Francisco R. R. tracks at Denver Ave., and it is expected that the contract will be let shortly. The subway will be about 200 ft. in length and will cost, it is estimated, about $10,000.

Oregon.

⊙County Commissioners of Wallowa County at Enterprise, Ore., have awarded the contract for the construction of two steel bridges over Bear Creek and Wallowa River on the lower valley road just west of Wallowa, Ore., to the Coast Bridge Co., at $5,400.

Pennsylvania.

⊙The Reading Ry Co. has awarded the contract for the construction of two bridges on the Reading & Columbia branch to L. H. Focht & Son of Reading, Pa. One of the structures will be at Shreiners and the other near Ephrata. The piers and abutments will be of concrete. The girders will be 150 ft. Active construction work will be started immediately.

Residents of Warminster and Ivyland presented a petition to the County Commissioners at Doylestown, Pa., asking for the construction of a new county bridge over the stream in Ivyland borough.

Commissioners of the county and the Meadville Traction Co. have come to an agreement whereby each party will pay one-half the cost for the construction of a joint bridge over French Creek in Mead Ave. in Meadville, Pa.

Superintendent C. A. Preston, Middle Division of the Pennsylvania R. R., has advised S. M. Hoyer, Mayor, Altoona, Pa., that his company is willing to proceed with the work of building a new bridge at 7th St. according to the original plans, the railroad paying one-third the cost, not to exceed $25,000. According to the plans the bridge will have a width of 50 ft. There will be a walk 8 ft. in width on the upper or eastern side, while that on the eastern side the walk will be 6 ft. wide. The entire span is 168 ft. Of the width of the bridge 36 ft. is given over to the space for trolley line tracks, divided so that between them there is left 15 ft. as a driveway for vehicles.

Bids are being received by George S. Webster, Chief, Bureau of Surveys, Philadelphia, Pa., for the widening of Chestnut St. bridge over the Schuylkill River. There is $90,000 available for the widening of the present bridge, which is said to be one of the most beautiful structures of the kind spanning the Schuylkill, and there is also pending in Councils a bill appropriating a further sum of $30,000 for the work of raising the grade about 4 ft. at the eastern approach to the bridge. The bridge will be widened 12 ft. by the erection of a 6-ft. outspan on solid steel supports keyed into the present structure. This will allow of the present roadway being widened from 34 to 40 ft., while the sidewalks will be increased in width from 6 to 9 ft. each.

An ordinance has been introduced into the City Council of Johnstown, Pa., providing for a loan of $35,000 to be appropriated to the erection and construction of a bridge, together with the abutments and approaches therefor to connect the fourth and fifth wards. Crossing the Stonycreek River from the Northerly Terminus of Haynes St. to the Northerly Side of said river, in the fourth ward near Bedford St.

South Dakota.

Officials of the Chicago, Milwaukee & Puget Sound R. R. have, according to reports from Chamberlain, S. Dak., ordered the construction of a bridge at that place. E. Murray, Miles City, Mont., is Assistant Engineer Bridges and Buildings.

Tennessee.

Plans have been completed by J. E. Thompson, City Engineer, Knoxville, Tenn., for the construction of a bridge across the First Creek on 6th Ave. to replace the present wooden structure over which the street cars now travel. The cost of the improvement will not exceed $2,000, it is thought.

Tentative plans have been completed by J. H. Weatherford, City Engineer, Memphis, Tenn., for the construction of the McLemore Ave. viaduct and the same have been submitted to F. L. Thompson, Chicago, Ill., Engineer Bridges & Buildings, Illinois Central R. R. George C. Love is Commissioner of Street, Bridges and Sewers.

Texas.

City Commissioners have passed an ordinance authorizing the borrowing of $500,000 for the purpose of constructing a viaduct bridging Buffalo and White Oak Bayous and the Southern Pacific and Katy R. R. tracks at Houston, Texas.

According to advices from Cuero, Texas, the $236,000 200-ft. span iron bridge built over the Guadalupe River at Cuero by the San Antonio & Aransas Pass Railway Company, under the supervision of T. T. Terfater, chief engineer, is completed. The work on this bridge was begun on Dec. 18, 1910. The bridge builders have gone to Runge, where a similar bridge, both as to value and size, will be put in by the San Antonio & Aransas Pass Ry. Co. over the San Antonio River.

Virginia.

Bids were received and considered by the Sub Committee of the Streets Committee, Richmond, Va., for the construction of the James River Bridge at that place. The Piedmont Construction Company, of Atlanta, Ga., presented one bid for a bridge to cost $224,000, flat arches on reinforced concrete girders. The piers are to be equidistant, every third pier a large one. Provision is made for ducts, gas and water mains. The Carolina Concrete Co., Greensboro, N. C., presented eight bids for the bridge, ranging in cost from $187,000 to $214,200. Stamper Brothers & Ragland, of Richmond, also presented a plan and bid. It calls for fifteen arches, with 93 ft. between piers. The contractors offer a straight bridge, from shore to shore, a distance of 1,785 ft. The cost is $227,000. The bridge is to carry a weight of 243 lbs. to the sq. ft. and to be completed in 13 months.

Advices from Fredericksburg, Va., state that the Board of Supervisors of Spottsylvania County has taken action on the question of building bridges over streams on the new improved highway from that city to Spottsylvania courthouse. It is also said substantial steel or concrete bridges will be built over Hazle Run

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] the city and near Massapomax Run [illegible] between the two points.

Washington.

A resolution [illegible] the Senate at Olympia, Wash., authorizing the purchasing [illegible]

Walla Walla, Wash., Commercial Club has announced that it favors the construction of the state bridge between Kennewick and Pasco, Wash.

Advices from Spokane, Wash., are to the effect that the North Coast R. R. Co. has let the contract for the construction of the steel bridge across the Spokane River. F. L. Pitman, Spokane, Wash., is Chief Engineer of the railroad.

Wisconsin.

✣Bids will be received until 2 p. m., March 7, by the Street Assessment Committee, Janesville, Wis., for the construction of two plate girder bridges across Rock River, one at 4th Ave., 348 ft. long and the other at Racine St., which structure will be 264 ft. long. C. V. Kerch is City Engineer. W. F. Carle is Chairman of the Committee.

Plans have been completed and agreed upon by the city engineers of Marinette, Wis., and Menominee, Mich., for the construction of the proposed bridge over the Menominee River, estimated to cost $25,000. Concrete is the material has been spoken of and T. R. Hasley of Menominee, Mich., has drawn plans for such a bridge.

⊙The City Council of Superior, Wis., has voted to let the contract to the Interstate Dredge & Dock Co., for the construction of a wooden trestle across the Nemadji River at E. 4th St. at the present grade. The contract price was $41,840. Other bids received for the work were as follows: John Shea & William Walsh, $42,000; Ed Gallagher, $42,500; Barnett & Record, $44,475; B. A. Dahl & Co., $44,990.

Canada.

✣Bids will be received until 8 p. m., Feb. 25, by J. W. Johnston, Town Clerk, for the necessary labor and material for the construction of two reinforced concrete highway bridges at the town of Dauphin. Plans and specifications may be seen at the office of the town clerk, Dauphin, Man., or at the Provincial Public Works Department, Winnipeg, Man.

✣Bids will be received until noon, Feb. 19, by Chairman of the Building Committee at the office of Darling & Pearson, 2 Leader Lane, Toronto, Ont., for all the trades, with the exception of masonry, concrete work, structural steel and terra cotta required for surgical wing in connection with the general hospital.

✣Bids will be received until 6 p. m., March 1, by J. Boyd Caldwell, Chairman of Roads and Bridges Commission, Lanark, Ont., for the erection of a reinforced concrete bridge, single span, over the Clyde River at a point about 3 miles north of Lanark Village. The structure according to plans will be 70 ft. long.

The Grand Trunk Ry. Co. has decided to construct a new and modern swing bridge at the end of Elgin St., Ottawa, Ont., to replace the present railway structure. The improvement will, it is estimated, cost $30,000. J. H. Mitchell, Ottawa, Ont., is an engineer of the company.

Advices from Montreal, Que., state that Engineers have decided on the plan for the construction of the new Quebec bridge and that an announcement of their conclusion will be made shortly by Minister G. P. Graham in Parliament.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

California.

The Southern Pacific Co., G. B. Herington, Division Engineer, Sacramento, Cal., has agreed to raise the north levee at Sacramento between Front and 12th Sts. to a height of 5 ft. above high-water mark, to correspond with the rest of the city's levee-protection system. The crown of the levee will be 26 instead of 30 ft. wide, and where it is necessary to broaden the base the fill will be made on the south or city side instead of the north or river side, so that right of way need not be purchased over land on which to build the embankment.

A number of property owners between Chico and Butte City are projecting the formation of a Union levee district. A levee ten miles long on the Sacramento River, joining the Phelan levee, and to cost $15,000, is a part of the plan. Several thousand acres of land are affected.

Illinois.

✣Bids are asked until Feb. 24 by the Commissioners of Degognia and Fountain Bluff Levee and Drainage District for the construction of 550,000 cu. yds. of earth embankment, four concrete and steel locks, two concrete-steel culverts, 33 steel pipe drains with concrete head walls and all steel doors and 270 cu. yds. of reinforced concrete walls; also for raising and strengthening a reinforced concrete lock with steel doors. R. J. Stephens, attorney, Murphysboro, Ill.; Joel Dunn, engineer, Fordyce, Ill. Official advertisement will be found elsewhere in this issue.

Iowa.

✣Bids will be received until 1:30 p. m., Feb. 15, by County Board, Fort Dodge, Ia., for open work on ditch No. 69, comprising 505,200 cu. yds. of excavation. The cost of the work is estimated at $40,921. G. P. Smith is Engineer.

Louisiana.

✣Bids are asked until noon, Feb. 21, at the office of the Board of State Engineers, Frank M. Kerr, chief engineer, New Orleans, La., for the construction of the Mascot levee, in the Parish of Madison, Mississippi River, right bank, about 24 miles above Vicksburg, Miss. Proposals will be received for the work as a whole, about 402,000 cu. yds., or by sections.

Minnesota.

✣Bids will be received until 2 p. m., Feb. 23, by C. E. Brainerd, County Auditor, Albert Lea, Minn., for the construction of county [illegible] approximately [illegible] cu. yds. of excavation. The cost of the work will, it is estimated, be about $15,010.

✣Bids will be received until 1 p. m., Feb. 21, by H. P. Edwards, County Auditor, Fairmont, Minn., for the construction of judicial ditch No. 10, including approximately 51,977 cu. yds. of excavation, estimated to cost $6,491 and 155,869 ft. of 6 to 24-in. tile estimated to cost $59,268.

✣Bids will be received until 11 a. m., Feb. 20, by C. J. Hemmingson, County Auditor, Hallock, Minn., for the construction of Judicial Ditch No. 32, including approximately 145,909 cu. yds. of excavation. The cost of the work is estimated to cost $16,050.

✣Bids will be received until 1 p. m., Feb. 20, by C. J. Hemmingson, County Auditor, Hallock, Minn., for the construction of Judicial Ditch No. 31, including approximately 197,204 cu. yds. of excavation and estimated to cost about $21,692.

✣Bids will be received until 2 p. m. Feb. 21, by A. G. Lundgren, County Auditor, Warren, Minn., for the construction of Judicial Ditch No. 12. The work will include about 526,427 cu. yds. of excavation and the cost is estimated to be about $52,642.

✣Bids will be received until 1 p. m., Feb. 16, by L. P. Larson, Redwood Falls, Minn., for excavation work including about 28,812 cu. yds. of material.

⊙H. F. Bosworth & Co., Bemidji, Minn., has been awarded the contract at $16,735 for constructing Judicial Ditch No. 3 for Beltrami County, and at $14,050 for Judicial Ditch No. 4 for the same county. Bids were opened Feb. 4 at Bemidji, Minn. Both contracts include excavation, roadwork, bridges and culverts.

New York.

James Stewart & Co., 30 Church St., New York, is now building three new 5-yd. dipper dredges. The hulls are 40x105 ft. by 8½ ft. to 10 ft. deep. These machines with a 20-in. hydraulic and a 2½-yd. dipper dredge will compose the dredging fleet that will be used on contracts Nos. 12 and 39 of the New York barge canal. In addition to the five dredges the company will have a Lidgerwood excavator (scraper bucket), two submarine drill boats, five tugs, six motor boats, and ten dump scows on this work.

Ohio.

The City Council of Dayton has passed the ordinance for the improvement of the Miami River with incidental building of 4½ miles levees and the reclamation of some 400 acres of land within the city limits of Dayton, involving the expenditure of $450,000, for which the voters have already authorized a bond issue.

Tennessee.

Surveys have been completed for a levee on the north side of the Obion Run bottoms near Obion, which is to be built in connection with the plans for the straightening and draining of the Obion River. At a point opposite Obion these levees will be about 1,500 ft. apart and 10 ft. high. P. E. Fletcher, Union City, Tenn., is engineer.

Virginia.

George M. Warren, an engineer of the Drainage Department of the U. S. Department of Agriculture, Washington, D. C., has been making an investigation and report on the feasibility of a project for draining the swamp lands and land subject to overflow in the eastern part of Greenville county. It is thought that if a canal were to be cut through the lowest of the swampy section of the low grounds of the Meherrin River freed from the driftwood which now prevents the water from running off rapidly, and a dike, 2 or 3 ft. of earth built on the sides of the river, it will mean the reclamation of many thousands of acres of land. The cost of the improvement will be borne by the land owners.

Washington.

Albert S. Byers, Pasco, Wash., has secured right of way from the Northern Pacific Ry., which will enable him to go ahead with the work of reclaiming some 35,000 acres lying on the Pasco side of the Columbia River, just north of the project of the Pasco Reclamation Co. Four and a half miles of ditch is all cleared and ready for the water, while an additnonal 17 miles have been located and cleared, the right of way for this piece of work having been granted by the railroad company. The pumping station will be located about 20 miles from Pasco, or about six miles from Richland, on the opposite side of the river. The water will be pumped to a height of 215 ft. from the Columbia. Turbines similar to the ones used on the Kennewick Highlands project have already been arranged for. An auxiliary steam plant of 125 H. P. will be installed, the engine and boiler for which will be shipped up the river from Pasco shortly. It is estimated that this auxiliary plant will take care of at least two square miles of ditches, while the main plant is being completed.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

WATER-WORKS

Arizona.

•The contract for the construction of the municipal water system of Douglas, Ariz., has been awarded by the board of water commissioners to M. F. Discus of that city, the total amount of the bid being approximately $45,000. This work includes the construction of the building, laying of pipe and the reservoirs. The Chicago Bridge & Iron Works secured the contract for the water tower and the power equipment will be installed by the De La Vergue Machinery Co.

California.

The first bonds of the $45,000,000 issue recently voted for the Hetch Hetchy water system for San Francisco, Cal., which were offered for sale Jan. 30, were not sold. The offer was in the sum of $1,125,000. This amount was to complete the purchase of the Ham Hall properties and to begin preliminary work at Lake Eleanor. It is thought that the next time the bonds are offered bids will be received for them as a number of difficulties have been overcome.

The city council for Suisun, Cal., is considering a project for the raising of the dam of the municipal water system reservoir eight ft., and thereby increasing the storage capacity of the lake near the Twin Sisters peaks from 12,000,000 to 25,000,000 gals. of water. The estimated cost is $2,000.

⊙The George A. Rogers Co. of Los Angeles, Cal., has been awarded the contract for the construction of the Brawley water system for $28,200. This will be cut to $22,611 if the system of the Brawley Water Co. is purchased. The contract for the sewer system has been awarded to the California Ornamental Brick Co., of Los Angeles for $13,616.

The Harbor Commission, Los Angeles, Cal., recently sent a communication to the city council recommending that an ordinance be adopted setting apart for municipal purposes that portion of Los Angeles Harbor known as the Hintington fill.

Georgia.

The City Council of Senoia, Ga., contemplates calling an election to vote on the proposition of issuing bonds for the installation of a waterworks system.

Illinois.

✣Bids will be received until 11 a. m., Feb. 16, by B. J. Mullaney, Commissioner of Public Works, city of Chicago, for furnishing and delivering 12,000 lbs. of ingot copper and 12,000 lbs. of copper trolley wire to the water works shops, 2301 Ashland Ave. Specifications may be had upon application to the Commissioner of Public Works, Room 705 City Hall.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., until 11 a. m., Feb. 23, for furnishing and delivering all the necessary labor and material for the setting of boilers and ashpit lining at the Roseland pumping station, 104th St. and Stewart Ave. The work consists of boiler setting and ashpit lining for two batteries, each of two 300 H. P. horizontal water tube boilers. The masonry shall be first class brick work, laid in lime mortar with an admixture of Portland cement. Hydraulic bricks of a specific color costing not less than $16 per thousand shall be used in outer wall. All other brick must be selected sewer brick. Full specification and drawing may be had upon application to B. J. Mullaney, Commissioner of Public Works, 705 City Hall.

✣Bids will be received until 11 a. m., Feb. 16, 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., Room 705 City Hall, for furnishing and delivering cast iron water pipe, as follows: Yard A, Avers Ave. and Wabansia Ave., 2,500 pcs. 6 in., 2,500 pcs. 8 in. and 500 pcs. 12 in. Yard B, 2352 S. Ashland Ave., 1,500 pcs. 6 in., 3,900 pcs. 8 in.; Yard C, 49th St. and Union Ave., 1,500 pcs. 6 in., 1,800 pcs. 8 in.; Yard D, 68th St. and Yates Ave., 1,100 pcs. 6 in., 725 pcs. 8 in.; Yard E, 105th and Harvard Ave., 600 pcs. 6 in., 600 pcs. 8 in. Total, 10,200 pcs. 6 in., 2,040 tons; 9,525 pcs. 8 in., 2,714 tons; 500 pcs. 12 in., 246 tons. Pipe for Yards A, B, D and E to be delivered f. o. b. cars in pipe yards. Pipe for Yard C to be delivered f. o. b. cars at nearest team track. Plans and specifications may be had upon application to Commissioner of Public Works.

⊙The following contracts have been awarded by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill.: Cast iron water pipe, 3,514 tons; 48-in. pipe, 516 tons; 36-in. pipe, 1,333 tons; 30-in. pipe, 3,228 tons; 24-in. pipe, 748 tons; 20-in. pipe, 181 tons; 12-in. pipe, United States Cast Iron Pipe Co., 638 The Rookery, $23.75 per ton for all sizes of pipe; special castings (detailed specifications and sizes in ENGINEERING-CONTRACTING Jan. 4); United States Cast Iron Pipe Co., flange specials, $54.25 per ton; hub and spigot specials, $44.65 per ton; tapping connections, T. A. Cummings Fdy. Co., 1338 Clybourn Ave. (detailed sizes and prices in ENGINEERING-CONTRACTING Feb. 1), lead pipe, one year's supply; Gardiner Lead Pipe Co., 1374 W. Lake St., 5.04 cts. per lb.; sewer pipe, 30,000 ft. 4-in., Wm. E. Dee & Co., 108 La Salle St., 3 2-5 cts. per ft.; 600 ft. 6-in., 5 cts. per ft.; 600 ft. 9-in., 10 cts. per ft., Wm. E. Dee & Co. (Detailed specifications appeared in ENGINEERING-CONTRACTING Jan. 18.)

The citizens of Arenzville, Ill., are agitating the installation of a water and sewerage system for their village. The matter will eventually be submitted to voters along with the electric light proposition at the spring municipal election.

Indiana.

The Water Works Trustees of the city of South Bend, Ind., are contemplating the reconstruction of the city water works system and have a general plan upon which they are working upon, but before they arrive at their final decision, they desire to have a consulting engineer go over the system and make a report on the most practical method to obtain the best results. Wm. S. Moore is city engineer.

Iowa.

✣Bids will be received until 3 p. m., Feb. 28, by Corydon, Ia., for 3 miles sewers and a disposal plant; also 6 miles 4 to 8-in water mains, 70,000 gal steel tank on 100 ft. tower, pumphouse and reservoir, hydrants, valves, etc., triplex pump and deep well apparatus. Plans are on file at the Iowa Engineering Co., Chase Block, Clinton, Ia., who are engineers.

A proposition to issue $12,000 worth of bonds to build a municipal water works system in Zearing, Ia., was defeated Feb. 2.

Kansas.

The city commissioners of Newton, Kan., have ordered about 4,000 ft. of water mains for the northeast part of the city. The mains will be laid in East 10th and East 11th Sts., [illegible]

The city of Smith Center, Kan., contemplates the installation of a water system. It is proposed to construct a large reservoir and concrete dam, thus affording the proper supply for a city system

The citizens of Elk City, Kan., have started a campaign for [illegible] of a water works system.

Louisiana.

The Police Jury of LaSalle Parish, Jena, La., has rejected the recently installed water works system for the new court house. The pump house is to be built larger and a new engine will be put

Massachusetts.

•The [illegible] of [illegible], Mass., have awarded the contract to install the new $15,000 pump at the municipal water plant to Landlaw-Dumand Gordon Co., of Boston, who will manufacture the pump and superintend its installation.

The city of New Bedford, Mass., recently petitioned the legislative committee on water supply for permission to issue bonds to obtain funds for the extension of mains out Acushnet Ave., north of Lunds corner to Nye's lane, and across the west section of the city from Mt. Pleasant to Dartmouth St., for a better supply for the southwest and south sections of the city.

Michigan.

It is proposed to consolidate the pumping stations of Bay City, Mich. If this is effected, E. L. Dunbar, city superintendent of water works, probably will suggest that the city purchase part of the site in the north end of the west side formerly occupied by the Beutel woodenware factory, for the combined plant.

Minnesota.

⊙The city of Faribault, Minn., has awarded the contract to S. Swanson Artesian Well Co., of Minneapolis, Minn., for the drilling of a well and cleaning the old one. The price for drilling is $5.95 per ft. plus the casing, which will cost about $1.30 per ft.

Water board members of St. Paul, Minn., expect to appear before the assembly at an early date to urge the passage of the resolution authorizing the requested $100,000 bond issue for extensions and improvements.

City Engineer Peter F. Huntington of Eveleth, Minn., estimates the cost of a new main from the Iron Range railroad tracks to St. Mary's lake, at $14,000.

Mississippi.

The City Council of Vicksburg, Miss., has adopted a resolution providing for the purchase of the Vicksburg Water Works plant.

Missouri.

⊙The contract for drilling two deep wells for the city of Columbia, Mo., has been awarded to Perry L. Crossman & Son of Joplin, Mo., for a total of $4,428. Bids on each well were: 35 ft., 15 in earth at $1 per ft.; 265 ft., 15 in rock at $3.75 per ft.; 500 ft., 8-in rock at $2.15 per ft. O. D. pipe at cost John S. Bicknell is city clerk.

Montana.

The City Council of Lewiston, Mont., has passed an ordinance calling for a special election to be held Feb. 25, for the purpose of having the proposed bond issue of $100,000 passed upon. The bonds will be issued to rebuild the water works system.

Nebraska.

✣Bids will be received until 8 p. m., Feb. 23, L. V. Douglas, City Clerk, Wymore, Nebr., for the construction of water works improvement, including the following labor, machinery and material: For furnishing [illegible] and jute, except cast iron pipe, valves, [illegible] loading from cars, trenching, laying, back filling, setting valves, valve boxes, hydrants and specials; to finish and complete pipe lines and their appurtenances and refill trenches and restore streets to good condition. C. I. pipes, valves, valve boxes, specials and hydrants will be furnished by the city of Wymore on cars at Wymore or Blue Springs, as follows: 7,350 ft. of 12-in. class B water pipe, 1,000 ft. of 8-in. B water pipe, 1,000 ft. of 6-in. class B water pipe, 1,000 ft. of 4-in. class B water pipe. For furnishing and installing the following machinery and equipment: 1 100 H. P. multiple cylinder solar oil engine, [illegible] electric, 1 50 K.V.A. 2,300

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

volt, 3 phase, 60 cycle, 7,200 alternations 1,200 RPM alternating current generator; 1 5 KW 110 volt 1,375 RPM direct current exciter; 1 14 KW endless double leather belt for generator, drive 25-in. centers for 100 H. P. engine; 1 exciter belt 12-in. centers. Foundations for above engines and generators, unloading and placing on foundation all piping conduit, wiring and installing the same in building furnished by the city; 1 complete switch board for regulating, governing and distributing the current from above described generator; 1 22 KW series incandescent street lighting panel, with 22 KW constant current transformer and regulator; 1 40 H. P. 3 phase 2,300 volt, 60 cycle vertical type motor; 1 extra 2,300 volt oil switch; 1 vertical type turbine pump with sufficient shafting, to be driven by the above described motor, capacity 400 gals. per minute, dinamic head 200 ft. Base of motor will be 9 feet above base of pump; 1 ton of No. 8 triple braid weather proof copper wire; 150 30-ft., 6-in. top telegraph poles; 4 35-ft., 6-in. top telegraph poles; 4 40-ft., 6-in. top telegraph poles; 160 5-ft. 4 pin, cross arms, complete with 24-in. galv. iron braces, bolts and insulators; 12 anchor rods; 500 ft. of stranded cable; 2 steel oil tanks of 6,000 gals. capacity each, erected on good substantial foundations not less than 5 ft. above the ground. The constructing and completing of the electric line from the power house to the motor at the wells. Engineer's estimate of the total cost of labor and material is $13,000.

New York.

✣Bids will be received until noon, March 7, by Board of Water Commissioners, Ogdensburg, N. Y., for the construction of sand filters, pipe lines, steam and electrical pumping machinery, water turbine, electrical equipment, boilers and other appurtenances. Plans and specifications may be seen at the office of Hazen & Whipple, Consulting Engineers, 103 Park Ave., New York City. James M. Wells is chairman of the commission.

✣Bids will be received until 3 p. m., Feb. 20, by Board of Contract and Supply, Albany, N. Y., for the following: 1, oils for the bureau of water; 2, cast iron tapping sleeves and valves for same for the bureau of water; 3, cast iron water pipe and standard special casting for the bureau of water; 4, road oil for the bureau of parks; 5, rubber tires for the four steamer wheels of steamer No. 2. Each bidder must present with his bid for the several items a bond in the following penal sums: For item No. 1, $250; for item No. 2, $600; for item No. 4, $600; for item No. 4, $350; for item No. 5, 100. Isadore Wachsman is Secretary of the Board.

The New York State Water Commission, in its report to the legislature, Albany, urges the construction of water storage reservoirs, developed by the state's water resources, and under state ownership and control. The plan embraces the enactment and submission to the voters of a general law providing for systematic development of water powers upon the principles laid down in chapter 569 of the laws of 1907, and authorizing a self-extinguishing bond issue of not more than $20,000,000 in total amount.

Ohio.

✣Bids will be received until 10 a. m., March 11 (readvertisement), by A. E. Sinks, county auditor, Troy, O., for furnishing the necessary labor and material for the installation of water mains from the intersection of Adams St. to the Miami County Infirmary.

✣Bids will be received until noon, Feb. 27, by F. H. Shoaff, clerk of the village of Euclid, O., for furnishing the necessary labor and material for the improvement of Montclair Road from Euclid Ave. to the northerly end thereof by constructing a 6-in. water main therein. F. A. Pease Engineering Co., 931 Williamson Bldg., Cleveland, O., Engineers.

⊙The United States Cast Iron Pipe & Foundry Co., has been awarded the contract in Cincinnati, O., for furnishing pipe and special castings to the water department for $22.85 per ton for pipe and $60 per ton for specials. The contract includes 4,870 tons of pipe and 200 tons of specials.

Mayor Burkhart of Dayton, O., has suggested that the City Council issue bonds to the amount of $250,000 with which to extend the water supply system of the city.

The village council of Bremen, O., has decided to advertise the sale of $20,000 in bonds for water works purposes as determined by the vote of the villages at the recent election. The money will be used for purchasing a site and equipping the same with an up-to-date water plant.

A delegation of Ironton, O., citizens has protested to Governor Harmon and Attorney-General Hogan against the enforcement of the order of the State Board of Health to compel them to drill other wells for their water supply. The wells now are located on a bar in the Ohio River. The required change would cost the citizens between $75,000 and $80,000.

The town of Sugarcreek, O., has sold bonds to the amount of $12,500 for the construction of a water works system to the Citizens bank of Sugarcreek.

Estimates and plans for the new filtration plant which will be built in Niles, O., are under way. Engineer Brewer is making the plans with a view to the needs of the city for many years.

Oklahoma.

Mayor C. Lamm and Commissioner W. G. Bryson, of Bartlesville, Okla., recently visited Tulsa to look over the Tulsa water works plant. The city of Bartlesville is figuring on voting bonds in April to either build a new water works system or buy the one operating there.

Blue prints for the water works improvements for Guthrie, Okla., have been completed. The water committee has bought material for filtration and will put in the work. A new strainer system and the air pump will be installed. General improvement of the plant is to be undertaken.

Advices from Oklahoma City, Okla., state that Charles Jones, 504 Baum Bldg., has organized a company for the purpose of drilling additional wells at Wright's station, 14 miles southeast of the city, along the Katy line. The company will take over the machinery and equipment of the Chicago Oil, Gas & Development Co., which sunk a test well, looking for gas or oil and found water instead. The wells are to be sunk with a view to making a contract with the city to furnish the water supply.

M. H. Kesler, chief of the fire department, Oklahoma City, Okla., has recommended the construction of about 10 reservoirs or large cisterns placed in the business district of the city for the purpose of storing about 315,000 gals. of water for emergencies.

The citizens of Synder, Okla., have voted the issuance of bonds to the amount of $40,000 for the purpose of extending the water and electric systems of the town.

Oregon.

Mayor L. J. Simpson of North Bend, Ore., has started a movement for a joint municipal water works system to supply both Marshfield and North Bend. A committee of the City Council has been appointed to confer with the Marshfield council relative to the plan. At present both cities are furnished water by a private corporation and as North Bend has been contemplating a new system the mayor advocates one which will supply both of the bay cities.

Civil Engineer Louis C. Kelsey, Selling Bldg., Portland, Ore., has recommended the construction of a gravity water works system at an estimated cost of $22,913, and a sanitary sewerage system at an estimated cost of $23,503 for the city of Gresham, Ore.

Pennsylvania.

⊙The water committee of the city council of Lancaster, Pa., has awarded the contract for furnishing an auxiliary electric pump at the reservoir to the Lancaster Electric Supply & Construction Co. for $4,750. It will be a 10,000,000-gal. pump with 250 horse power.

South Dakota.

✣Bids will be received until 8 p. m., March 6, by O. A. Reitz, City Auditor, Bridge Water, S. Dak., for furnishing all necessary labor and material for the construction of a water tank and tower, capacity 50,000 gals., height 125 ft. D. B. Huston is City Engineer.

Residents of Irene, S. Dak., have inaugurated a movement to have a municipal water works system constructed and are circulating a petition asking that the proposition be submitted to the voters at the annual municipal election to be held in March.

A bill has passed both the senate and the house, giving the University of South Dakota, F. B. Gault, president, Vermillion, S. Dak., a complete water works system of its own. It provides for the digging of a new well, probably artesian, the erection and installation of a pumping plant and the putting in of new pipes.

Tennessee.

Wirt J. Willis, chairman of the city water commission, Memphis, Tenn., has asked the city commissioners for authority to let the artesian water department float bonds to the extent of $500,000. This is to cover the expense of new construction and extensions for the next two years.

⊙The water commissioners of Memphis, Tenn., has awarded a contract to the United States Cast Iron Pipe & Foundry Co., for furnishing 2,000 tons of new pipe for this year. The contract price is $20 per ton.

A meeting was recently held at the city hall, Dayton, Tenn., to discuss plans for the installation of a city water plant. A committee previously appointed by President D. M. Rhea of the Commercial Club to investigate, procure estimates and make recommendations, submitted its report. The report of the committee submitted an estimate that the plant could be erected for $25,000, and recommended a bond issue of that amount, together with a corresponding increase of $0.25 in the municipal tax levy. The report was adopted.

In the construction of a new water main from Bristol to the Frank Preston spring, which affords an addition of practically a million gals. daily to Bristol's water supply, it has been decided to extend the main directly to the source of the spring rather than build a reservoir 625 ft. south of the spring. The extension will add $2,000 to the cost of the line. The work will probably have been completed by March 1.

Texas.

The citizens of Waco, Tex., vote Feb. 14 on the proposition of issuing bonds to the amount of $250,000 for the erection and equipment of a municipal light plant.

The citizens committee, which was appointed by the City Council of LaGrange, Tex., to investigate the waterworks matter, has recommended to that body that the waterworks be again leased out. The system has been leased to J. H. Killough.

⊙The City Council of Ballinger, Tex., has granted a water franchise to J. E. Brown and W. D. Kyser. A company will be formed to install a new waterworks system.

The City Council of Ballinger, Tex., has closed a contract with the American Water Softener Co., of Philadelphia, Pa., for a filtering plant for the Ballinger water works. The plant will supply 750,000 gals. of water per day. The city is also expending $16,000 in extending the water mains and therewise improving the water works plant.

⊙Andrew J. Zilker of Austin, Tex., owner of the Taylor, Tex., water works and service, has contracted with H. B. Seiders of Taylor, for the building of a new water supply reservoir for the storage of water for fire and domestic uses during the time that will be consumed in enlarging the two main reservoirs to four times their present capacity. The supply reservoir will be 300x300 in width and length, and 20 ft. in depth, requiring the excavation and removal of upwards of 25,000 lin. ft. of earth.

The citizens of Gainesville, Tex., are discussing the question of locating the water plant of the city. The Chattahoochee River and several other smaller streams are under consideration. The city officials and engineers favor the location of the plant on the river.

City Council of Bryan, Tex., has closed a deal with the present water company of that city for its entire water distributing plant, consisting of mains, laterals, standpipe, pumps, piping etc. The city is to have possession of the property when ready to connect with its own system recently contracted for. The contract price is $12,625.

Virginia.

The sub-committee of the water committee of Richmond, Va., has recommended the installation of two centrifugal electric pumps, with a capacity of 4,000,000 gals. each, for the standpipe in Burd park. The new pumps will cost $12,000.

The town of Luray, Va., on Feb. 4, voted to spend $10,000 for an additional water supply. A stream near the summit of the Blue Ridge will be tapped and the mountain to the main leading from the present 10,000,000-gal. reservoir. By pressure from an altitude of more than 3,000 ft. the water will be forced to the old reservoir at the foot of the Blue Ridge. The 40,000 gal. daily supply will be increased to 130,000 gals.

Plans are being prepared for an addition to the water supply of Lexington, Va., estimated to cost $71,000. The supply will be obtained from the mountains, springs and creek. The work will require the laying of a pipe line about 8-in. in diameter for a distance of 11 miles. Chas. Pole is chairman of the water committee. Sanuel B. Walmer, Jr., is mayor. A bonds issue of $75,000 will be voted upon.

Canada.

✣Bids will be received until noon, Feb. 28, by Chairman of Water Works Commission for the cast iron pipe and special castings 12-in. to 36-in., gate valves 12- to 36-in., pig lead. Specifications may be obtained of the Commission. City Bldg., St. Catharines, Ont.

The following bids were received Feb. 6 by J. A. Lewis, clerk of the town of Smith Falls, Ont., for debentures of the town amounting to $41,501: Ontario Securities Co., Toronto, $41,057; Brent, Noxon & Co., Toronto, $41,563; Campbell, Thompson & Co., Toronto, $41,711; Aemilius Jarvis & Co., Toronto, $41,779; C. H. Burgess & Co., $41,727, and Dominion Securities Corporation, Toronto, $41,030. The bid of Amilius Jarvis & Co., of Toronto, was accepted. The issue is divided as follows: Water works, $10,000 for 30 years, and local improvements, $31,501 for 20 years.

The city water commissioners of St. Catharines, Ont., has decided to advertise for tenders for the construction of the new $180,000 water main from Decew Falls to this city. The engineer of the department was authorized to make all necessary preparations and to apply for the necessary rights of way under the Welland Canal and the Grand Trunk Railway.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

The New Decatur, Ala., City Council has passed ordinances providing for the building of storm sewers in south and west New Decatur.

California.

✣Bids will be received until 11 a. m., July 3, by Board of County Supervisors, San Jose, Cal., for the construction of a septic tank and sewage disposal system at the County Hospital. W. H. Castner, Jr., is Engineer.

The citizens of Anaheim, Cal., have voted the issuance of bonds to the amount of $90,000 for the installation of a sewer system, and $8,500 for enlarging the municipal electric light plant. A tract of land, comprising 73 acres, situated four miles southwest of this city, has been purchased of J. M. Gilbert, and will be used for the farm.

Plans and specifications for the extension of the Lake Shore storm sewer south to Lake Merritt and from its intake northeast toward Mandana Blvd., are being prepared by City Engineer F. C. Turner of Oakland, Cal., for that city. In accordance with the engineer's plans the upper extension will be made as soon as possible, and will permit completion in time to care for conditions this winter. The extension of about 600 ft. southerly from the present outlet of the sewer to the lake will necessitate pile driving and excavation in deep mud. The upper extension into Indian Gulch, amounting to 700 ft. of storm sewer and ending at Mandana Blvd., is to be started at once. Bids for this work will be advertised for shortly.

⊙The City Council of Chico, Cal., has awarded the contract for the construction of the storm sewers in the town to John Heasey of Oakland for $18,500. The work must be finished within four months.

Advices from Los Angeles state that Charles W. Corbaley, on behalf of the Holly Sugar Co., at Huntington Beach, has applied to the War Department for permission to build a pier at the ocean, to carry the outfall sewer 600 ft. into the ocean.

City Engineer F. C. Turner of Oakland, Cal., has recommended to the city council that the Board of Public Works be authorized to build a storm sewer in the annexed district to prevent flooding during the heavy rainstorm in the neighborhood of East 14th St., and Yoakum Ave. A 200 ft. viaduct will be necessary to carry off the storm waters, and the work, which will be commenced at once, will cost about $1,300.

City Engineer Jessup of Berkeley, Cal., has drawn plans for two storm sewers which, if bonds are decided upon, will probably be constructed at an approximate cost of $100,000 each. The northern arm of the proposed sewer system begins at the corner of Arch and Cedar Sts., and would run along Arch St., to Hilgard Ave., thence to Grant, Francisco, McGee and Virginia Sts., running down the latter to the bay outfall. A similar one is proposed for South Berkeley. A system of five intersecting sewers to extend from West Berkeley to the bay is also proposed to relieve the floods which menace manufacturing plants annually.

Colorado.

Advices from Fort Collins, Colo., state that the Estes Park Sewer Co. has been incorporated to construct a sewer system to be used jointly by Loveland and Estes Park. One-tenth the cost is to be paid by the city of Loveland and upon the understanding that the sewage be dumped elsewhere than in the Thompson River, from which Loveland draws its water supply.

Commissioner A. J. Lawton of Colorado Springs, Colo., is advertising for bids for the construction of the storm sewers proposed. The engineer has prepared the plans and specifications. Bids will be opened about the latter part of the month.

District of Columbia.

✣Bids will be received until 11 a. m., March 3, by Constructing Quartermaster, Vancouver Barracks, Washington, D. C., for the construction of a sewer, manholes, house connections, etc., in connection with the Staff Officers' Quarters, Department Headquarters, etc., at Vancouver Barracks.

Georgia.

✣Bids will be received until 2 p. m., March 7, by Mayor and City Council, Rockmart, Ga., for machinery, material and construction of a water works and sewerage system for which $35,000 in bonds have been voted and sold. Plans and specifications may be obtained of I. F. Mundy, Mayor, or J. B. McCrary Co., 1311-15 Empire Bldg., Atlanta, Ga., Engineers.

Capt. R. M. Clayton, City Engineer of Atlanta, Ga., has sent two of his men to make surveys in the Ninth ward preparatory to the installation of a complete system of relief sewers in that section of the city. The system will comprise about 30 miles of sewers. The lateral lines will be 6 and 8 ins. in diameter, and the trunk lines from 12 to 24 ins.

Illinois.

The Business Men's Association of Assumption, Ill., has passed resolutions urging the city council to act on the question this spring of installing a sewerage system. S. A. Shafer is Mayor.

The citizens of Arenzville, Ill., are contemplating the installation of a sewerage and waterworks for their village. The equestion will probably be submitted to the voters at the spring election along with the electric light proposition.

Indiana.

The citizens of Danville, Ind., have voted to install a sanitary sewerage system. The Board of Trustees will advertise Feb. 23 for bids for the construction of a general system.

Iowa.

✣Bids will be received 3 p. m., Feb. 28, by Corydon, Ia., for 3 miles sewers and a disposal plant; also 6 miles of 4 to 8-in. water mains, 70,000 gal. steel tank on 100 ft. tower, pumphouse and reservoir, hydrants, valves, etc., triplex pump and deep well pump, 15 and 30 h.p. motors and electrical apparatus. Plans are on file at the office of the Iowa Engineering Co., Chase Block, Clinton, Ia., who are Engineers.

The city of Cascade, Ia., is having plans prepared by the Iowa Engineering Co., 123 Sixth Ave., Clinton, Ia., for the construction of a sewer system, estimated to cost $30,000.

The City Council of Sioux City, Ia., has ordered the construction of a sanitary sewer in Hawthorn Ct., from 29th St., to 30th St. Keyes C. Gaynor is City Engineer.

In his report to the city council, City Engineer K. C. Gaynor of Sioux City, Ia., has recommended the installation of curb and gutter on 34 streets on the north side and 18 streets on the west side. He also advocates the construction of a storm water sewer between W. 7th St., and W. 4th St., and between Perry Creek and Center St. Additions to storm water sewers on the north side also are recommended.

Surveys are being made of the town of Cascade, Ia., for the installation of the proposed sewer system. For the present the system is proposed for the business district of the town. It will be approximately 4,012 ft. long, and provides for a purifying tank. The estimated cost is $4,500 per mile.

The City Council of Clinton, Ia., plans to construct the proposed sewer in 2nd St., in the downtown business district.

Maryland.

⊙The Anne Arundel County Commissioners, Annapolis, Md., have awarded the contract for the construction of certain sewers in streets of Brooklyn to Bond & Bates of Baltimore.

Massachusetts.

✣Bids will be received until 1 p. m., March 10, by Capt. A. M. Miller, Constructing Quartermaster, Boston, Mass., for the extension of water mains and changes in sewer at Fort Andrews, Boston Harbor, Mass. Plans and specifications may be obtained at the office, 263 Summer St., Boston, Mass.

Michigan.

✣Bids will be received until 8 p. m., March 1, by Board of Public Works, Niles, Mich.,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

for the construction of a main trunk sewer including [illegible] 18-in. and [illegible] sewer pipe, commencing at the St. Joseph River, running thence east on Sycamore St. to its intersection with Seventh St.; thence south on Seventh St. to its intersection with Broadway; thence east on Broadway to the east side of Ninth St. Hermann Roebeck is City Clerk, H. W. Fogus is Supt. of the Board.

⊙The Board of Public Works of [illegible], Mich., has awarded the contract for the construction of the sewer extensions in West and South Wyandotte to Julius Porath for $55,611. Other bids received were: William Blanck, $59,912; J. A. Mercier, $64,881; Scheibel & Stoddard, $70,723. The city recently voted bonds to the amount of $68,000 for this improvement.

The Sewer Committee of the City Council of Ann Arbor, Mich., has decided to recommend the construction of the sewers petitioned for on North Main St., and on Depot St.

City Engineer Cutcheon of Grand Rapids, Mich., has estimated the cost of the proposed east side trunk sewer extending from its outlet just below the Prescott St. sewer to Lyon St., at $426,600. The cost of the last piece of the sewer extending from the G. R. & I. tracks on Campau St. to Lyon St. is estimated at $63,000, while from the tracks to the outlet of the sewer the cost of construction will be about $363,000.

Minnesota.

✣Bids will be received until [illegible] p. m., Feb. 20, by Board of Public Works, St. Paul. Minn., for the construction of a sewer on portions of a number of streets in that city to be known as the St. Anthony Park North Sewer System. R. L. Gorman is Clerk of the Board.

✣Bids will be received until 8 p. m., March 6, by City Council of St. Cloud, Minn., for the construction of pipe sewers in the city including approximately 1,384 ft. of 24-in. pipe, 1,380 ft. of 20-in. pipe, 2,570 ft. of 18-in. pipe, 3,147 ft. of 15-in. pipe, 2,406 ft. of 12-in. pipe, 6,937 ft. of 10-in. pipe, 816 ft. of 8-in. pipe, 1,800 ft. of 10-in. connecting pipe, 67 manholes, 67 catch-basins, 8 flush tanks. Plans and specifications for said work may be seen at the office of the City Clerk or City Engineer of the City of St. Cloud. Earl C. Scott is City Clerk, St. Cloud, Minn.

⊙P. J. Ryan has been awarded the contract by the board of public works of St. Paul, Minn., for the construction of a sewer in Western Ave.. from Thomas St. to Blair St., for $7,115. Bids were opened Feb. 6.

An ordinance has been introduced in the City Council of Albert Lea, Minn., providing for the construction of a sewer on St. Joseph, 4th and other streets in the Third ward. W. Barneck is City Engineer.

The City Council of St. Paul, Minn., has passed the final order for the construction of the sewer system in St. Anthony Park, north, and appropriated the $30,000 necessary for the work. The entire system will cost approximately $130,000.

New York.

✣Bids will be received until 10 a. m., Feb. 15, by Secretary of the Board of Contract & Supply, Rochester, N. Y., for the first section of the intercepting sewer including rock tunnel starting from Central Ave. and North Water St.

The city of Rome, N. Y., has employed Rudolph Herring, 170 Broadway, New York City, to prepare plans and specifications for the construction of a sewage disposal plant for that city.

The common council of Syracuse, N. Y., has passed a resolution providing for the construction of a sewer on Schuyler St., at an estimated cost of about $4,500. Henry C. Allen is city engineer.

The board of village trustees of Yorkville, N. Y., will sell bonds Feb. 6 to the amount of $22,000 for the construction of a sewer system.

City Engineer John A. Giles of Binghamton, N. Y., has submitted to the city council his estimate of the cost of constructing a trunk sewer down Park creek of sufficient size to care for all the surface water. The cost being estimated at $75,000.

The Board of Trustees of Far Rockaway, N. Y., has been petitioned for the installation of a sewer system in that town.

The city officials of Rome, N. Y., have contracted with Dr. Rudolph Hering, 170 Broadway, New York City, to draw plans and specifications for a suitable disposal plant for the city. The plan tentatively outlined for Rome by Mr. Hering will include the Imholff or Esmcher tank.

The Village Trustees of Lawrence, L. I., have decided to install a system of sewers throughout the village and to erect a disposal works. The matter has been placed in the hands of a committee and if plans can be prepared in time the work will be begun before next summer.

The Village Engineer of Lestershire, N. Y., has submitted his estimate of the cost of constructing the East Main St. sewer extension. the Board of Public Works for the construction of the proposed sewer in Garfield Ave., under the New York Central R. R. tracks and on to the river.

The Board of Village Trustees of New Hartford, N. Y., is considering the advisability of constructing a sewage disposal plant. Engineer A. M. Scripture of New Hartford has given figures and all necessary data on the subject.

Civil Engineer W. H. Bowne has begun work on the map of the proposed new sewer district for Glen Cove, L. I. This map will be attached to the petitions which have been prepared to be presented to the town board. The petitions show, by courses and distances the boundary of the district. The sewer committee has placed the estimated cost of the improvement at $150,000. About 30 miles of sewers will be built.

Ohio.

City Engineer Shipley of Cincinnati, O., has submitted the estimated cost of constructing the proposed sewer in McKeone, Schiff and Lewis Sts. The amount is $34,379.

New plans for a sewer and waterworks system for Chadron, Ohio, have been submitted to the city council by Engineer B. F. Hewitt of Geneva. The plans largely reduce the cost of excavation by providing that the water and sewer pipes be laid in one trench. The plans have been submitted to the State Board of Health for approval after which the proposition will be submitted to the voters.

The vilage of West Lafayette, O., will soon issue bonds to the amount of $20,000 for the construction of a drainage sewer system. As soon as the bonds are sold bids will be advertised for and the work begun as soon as possible.

Oklahoma.

✣Bids will be received until 8 p. m., Feb. 21, by C. G. Welch, Mayor, Clinton, Okla., for the construction of 26,200 ft. of 8-in. lateral sewers of the first quality vitrified pipe, including manholes, lampholes and other appurtenances. Plans and specifications are on file with C. C. Smith, City Clerk or J. L. O'Hearn, City Engineer.

Oregon.

The City Council of Springfield, Ore., has passed ordinances providing for the construction of nine more blocks of main sewer in the near future.

The City Council of Forest Grove, Ore., has resolved to employ an engineer to make a survey and estimate for a trunk sewerage system and to take preliminary steps for paving the business section of the town with hard-surface pavement. O. M. Sanford is head of the Committee on Sewerage.

Among the many sewer improvements projected in Laurelhurst, Portland, Ore., and in other sections of the North East Side for th ensuing year are the Sullivans Gulch sewer that will cost, according to the estimate of City Engineer J. W. Morris, $275,000, and the Laurelhurst system, estimated to cost $153,000. The Alameda sewer system will cost $21,232 This system will cover the entire addition of Alameda and will connect with the sewer on Regents Drive. The Wheeler Addition sewer system includes the streets at the east end of the new railroad bridge, and will cost abo $12,836. Part of this district is to be covered with hard-surface pavements at a cost of $40,000 the coming spring. The East 17th St. sewer extension into East Irvington will cost $16,700 and will be known as the Irvington Heights extension of the 17th St. sewer.

The City Council of Lebanon, Ore., has passed an ordinance providing for the sale of bonds to the amount of $70,000 for the purpose of building a sewer system in the city. Walker & Meager have been employed as engineers to superintend the construction.

Plans for draining the proposed sewer system for the Peninsula, Woodlawn, Piedmont, Vernon and University Park into the Columbia slough for the city of Portland, Ore., are being prepared by City Engineer J. W. Morris. The sewer committee is opposed to the plan of draining into the slough and will probably ask the engineer to change his plans so that the system can drain into the Willamette River near St. Johns.

Pennsylvania.

⊙The contract for the erection of the proposed new Insane Hospital at Schuylkill Haven, Pa., has been awarded by the County Controller, Chas. T. Straughn, to Edward Fay & Son of Philadelphia for $247,934. The contract for the construction of the sewage disposal plant and electric plant was awarded to W. G. Cornell & Co., 4th Ave. & 17th St., New York City, for $114,800.

South Carolina.

✣Bids will be received until noon, Feb. 20, by J. H. Dingle, City Engineer, Charleston, S. C., for the construction of pump pits and appurtenances for the sewerage system at that city. Plans and specifications can be obtained upon a deposit of $10.

Texas.

⊙The City Council of Georgetown, Tex., has let the contract for furnishing 300 tons of cast iron water pipe to the American Cast Iron Pipe Co. of Birmingham, Ala.

The city of Yoakum, Tex., plans the installation of a sewer system. A stock company is to be organized with a capital stock of $20,000 to install the needed improvement. It is proposed by the citizens now organizing the company to sell the sewers to the city as soon as it is in shape to purchase them. Dr. W. W. McVea is interested.

Consulting Engineer F. L. Dormant of Dallas, Tex., has submitted plans and specifications to the city council of Houston, Tex., for the storm water sewer to be constructed on Sawyer St., between Decatur St., and Washington Av.

Information received from El Paso, Tex., is to the effect that as soon as the frost is out of the ground at Cloudcroft the El Paso & Southwestern System will begin the construction of the new sewage system which is to serve the entire Cloudcroft reservation, including the new Cloudcroft lodge. It is expected to begin work on the sewer system by the middle of March and have it installed and ready for use by the time the summer arrives. The plans and blue prints for the sewer system have been drawn in the engineering department of the company. J. L. Campbell is engineer of maintenance of way.

The City Council of Houston, Tex., has approved three projects for the construction of sewers and bids will be asked immediately for their construction. The projects are the Calhoun Ave. storm sewer to connect with the Austin St. bore, the Second ward pumping main from Scott St. near the city limits extending four and a half miles diagonally to the proposed new filtering beds near Sims bayou on the 200-acre tract purchased last summer, and the enlargement of the Washington Ave-Decatur St. storm sewer. Plans for the projects were submitted by Engineer Frank L. Dormant.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

✣Bids will be received between 1 and 5 p. m., Feb 24, by the Board of Public Works, Oakland, Cal., for furnishing the necessary labor and material for the following: (1) For constructing levees in the Key Route Basin at the city of Oakland; (2) for constructing and maintaining a levee along the extension of 14th St. in the Key Route Basin; (3) for dredging a channel along the pierhead line of the western side of the north arm of Oakland Harbor. To secure faithful performance of each contract, a bond in proposition numbered 1 in the sum of $10,000, a bond in proposition numbered 2 in the sum of $2,500, and a bond in proposition numbered 3 in the sum of $2,500, with sureties approved by the Board of Public Works, shall be required, or successful bidder on each of aforesaid propositions shall deposit with the secretary of the Board of Public Works a certified check upon some solvent bank for said amount for the faithful performance of said contract, and except in the case of proposition 3, a bond of 50 per cent of the contract price with sureties approved by the Board of Public Works for the protection of persons furnishing labor and material shall also be required. Work shall be commenced on proposition 1 within 15 days and on proposition 2, commenced within 15 days, and continued as set forth in specifications, and on proposition 3, commenced within 30 days and completed within 60 days from the date of the respective contract.

A project is being discussed for driving a long tunnel from Rush Creek, for the purpose of draining mines in the district between Nevada City and Grass Valley. George Downey, Nevada City, Cal., is interested.

Colorado.

✣Bids will be received until March 15, by the Rawley Mining Co., for driving a tunnel at Bonanza, Saguache Co., Colorado, approximately 6,000 ft. long. Plans and specifications may be seen at the office of Dorsey & Hodges, Boston Bldg., Denver, Colo., or at the office of Simonds & Burns, Liberty Tower Bldg., New York City, N. Y., Consulting Engineers.

District of Columbia.

✣Bids will be received until 3 p. m., Feb. 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete of the money vault for the U. S. Bureau of Engraving and Printing Building at Washington, D. C. Plans and specifications may be seen at the office of the engineer and superintendent, Frederick S. Holmes, No. 2 Rector St., New York City, or at the office of the Supervising Architect.

✣Bids will be received until 3 p. m., Feb. 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete of the Stamp Vault for the U. S. Bureau of Engraving and Printing Building, Washington, D. C. Frederick S. Holmes, No. 2 Rector St., New York City, is Engineer.

✣Bids will be received until 3 p. m., Feb. 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete of the Plate Vault for the United States Bureau of Engraving and Printing Building at Washington, D. C. Frederick S. Holmes, No. 2 Rector St., New York City, N. Y., is Engineer.

Illinois.

✣Bids will be received until 3 p. m., March 7, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the completion, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Paris, Ill.

✣Bids will be received until 7 p. m., Feb. 20, by Charles F. Kruse, City Clerk, Staunton, Ill., for the installation in the municipal electric light plant of a generator and switchboard complete, together with other electrical apparatus. Specifications, form of contract and bond can be obtained of Charles F. Kruse, City Clerk, Staunton, Ill.

✣Bids will be received until 2 p. m., March 14, by C. Keller, U. S. Engineer, Rock Island, Ill., for furnishing and delivering forty steel dredging pontoons complete.

Following are the low bids submitted for furnishing lumber to the bridge division, Department of Public Works, city of Chicago, B. J. Mullaney, commissioner. Bids for white pine, Norway pine and yellow pine were submitted by Edward Hines Lumber Co., Chicago, Ill.; white oak by Thornton-Claney Lumber Co., 2307 Elston Ave.:

EDWARD HINES LUMBER COMPANY.

WHITE PINE.

No. 1 Common.

2,000 ft. B. M. 1x6 ins., 12 to 16 ft. long, s1s, $28.00 per M. B. M.

1,000 ft. B. M. 1x6 ins., 12 to 16 ft. long, s2s, $28.00 per M. B. M.

3,000 ft. B. M. 1x6 ins., 12 to 16 ft. long, s4s, $28.00 per M. B. M.

$25,000 ft. B. M. 1x6 ins., 12 to 16 ft. long, dressed and matched, $2[illegible].00 per M. B. M.

5,000 ft. B. M. 1x12 ins., 12 to 16 ft. long, s1s, $32.00 per M. B. M.

1,000 ft. B. M. 1x12 ins., 12 to 16 ft. long, s2s, $32.00 per M. B. M.

1,000 ft. B. M. 1x12 ins., 12 to 16 ft. long, s4s, $32.00 per M. B. M.

4,000 ft. B. M. 2x4 ins., 10 to 16 ft. long, sized, $22.00 per M. B. M.

1,000 ft. B. M. 2x4 ins., 10 to 16 ft. long, s2s, $22.00 per M. B. M.

4,000 ft. B. M. 2x4 ins., 10 to 16 ft. long, s4s, $22.00 per M. B. M.

5,000 ft. B. M. 2x6 ins., 12 to 16 ft. long, s1s, $23.00 per M. B. M.

1,000 ft. B. M. 2x6 ins., 12 to 16 ft. long, s2s, $23.00 per M. B. M.

3,000 ft. B. M. 2x6 ins., 12 to 16 ft. long, s4s, $23.00 per M. B. M.

1,000 ft. B. M. 2x6 ins., 10 to 16 ft. long, dressed and matched, $23.00 per M. B. M.

1,000 ft. B. M. 2x6 ins., 10 to 16 ft. long, shiplapped, s2s, $23.00 per M. B. M.

3,000 ft. B. M. 2x8 ins., 10 to 16 ft. long, rough, $22.00 per M. B. M.

30,000 ft. B. M. 2x8 ins., 10 to 16 ft. long, s1s, $24.00 per M. B. M.

NORWAY PINE.

2,000 ft. B. M. 2x10 ins., 10 to 16 ft. long, rough, $23.00 per M. B. M.

25,000 ft. B. M. 2x10 ins., 10 to 16 ft. long, s1s, $23.00 per M. B. M.

2,000 ft. B. M. 2x10 ins., 10 to 16 ft. long, s4s, $23.00 per M. B. M.

1,000 ft. B. M. 2x10 ins., 18 to 20 ft. long, rough, $[illegible] per M. B. M.

20,000 ft. B. M. 2x12 ins., 10 to 16 ft. long, s1s, $25.00 per M. B. M.

3,000 ft. B. M. 2x12 ins., 10 to 16 ft. long, s2s, $25.00 per M. B. M.

4,000 ft. B. M. 2x12 ins., 18 to 20 ft. long, s1s, $25.00 per M. B. M.

6,000 ft. B. M. [illegible] $23.00 per M. B. M.

1,000 ft. B. M., 3x8 ins., 12 to 16 ft. long, s4s, $[illegible] per M. B. M.

2,000 ft. B. M. 3x10 ins., 12 to 16 ft. long, rough, $24.00 per M. B. M.

1,000 ft. B. M. 3x10 ins., 12 to 16 ft. long, s1s, $25.00 per M. B. M.

3,000 ft. B. M. 3x10 ins., 12 to 16 ft. long, s1s, $25.00 per M. B. M.

6,000 ft. B. M. 3x10 ins., 22 to 24 ft. long, rough, $[illegible] per M. B. M.

15,000 ft. B. M. 3x12 ins., 10 to 16 ft. long, rough, $25.50 per M. B. M.

1,000 ft. B. M. 3x12 ins., 10 to 16 ft. long, s1s, $[illegible] per M. B. M.

12,000 ft. B. M. 3x12 ins., 18 to 20 ft. long, rough, $26.00 per M. B. M.

7,000 ft. B. M. 3x12 ins., 22 to 24 ft. long, rough, $26.00 per M. B. M.

1,000 ft. B. M. 4x4 ins., 12 to 16 ft. long, rough, $21.00 per M. B. M.

10,000 ft. B. M. 4x4 ins., 12 to 16 ft. long, s4s $22.00 per M. B. M.

[illegible] rough, $21.00 per M. B. M.

3,000 ft. B. M. 4x6 ins., 12 to 16 ft. long, s1s, $21.00 per M. B. M.

8,000 ft. B. M. 4x6 ins., 12 to 16 ft. long, s4s, $22.00 per M. B. M.

5,000 ft. B. M. 4x6 ins., 12 to 16 ft. long, s4s, $21.00 per M. B. M.

1,000 ft. B. M. 4x12 ins., 18 to 20 ft. long, s4s, $27.00 per M. B. M.

1,000 ft. B. M. 4x14 ins., 32 to 34 ft. long, rough, $30.00 per M. B. M.

1,000 ft. B. M. 6x8 ins., 12 to 16 ft. long, rough, $23.00 per M. B. M.

1,[illegible] ft. B. M. [illegible] rough, $23.00 per M. B. M.

1,000 ft. B. M. 6x8 ins., 22 to 24 ft. long, rough, $23.00 per M. B. M.

1,000 ft. B. M. 6x12 ins., 18 to 20 ft. long, rough, $25.00 per M. B. M.

1,000 ft. B. M., 8x10 ins., 18 to 20 ft. long, rough, $23.00 per M. B. M.

2,000 ft. B. M. 10x10 ins., 18 to 20 ft. long, rough, $23.00 per M. B. M.

1,000 ft. B. M. 10x10 ins., 22 to 24 ft. long, rough, $24.00 per M. B. M.

1,000 ft. B. M. 10x10 ins., 26 to 28 ft. long, rough, $24.00 per M. B. M.

4,000 ft. B. M. 12x12 ins., 10 to 16 ft. long, rough, $27.00 per M. B. M.

1,000 ft. B. M. 12x12 ins., 18 to 20 ft. long, rough, $28.00 per M. B. M.

1,000 ft. B. M. 12x12 ins., 22 to 24 ft. long, rough, $28.00 per M. B. M.

4,000 ft. B. M. 12x12 ins., 26 to 26 ft. long, rough, $30.00 per M. B. M.

15,000 ft. B. M. 12x12 ins., 30 to 32 ft. long, rough, $32.00 per M. B. M.

2,000 ft. B. M. 12x12 ins., 34 to 36 ft. long, rough, $33.00 per M. B. M.

YELLOW PINE.

No. 1 Common.

2,000 ft. B. M. 4x6 ins., 18 to 20 ft. long, s4s, $22.00 per M. B. M.

4,000 ft. B. M. 4x6 ins., 22 to 24 ft. long, s4s, $23.00 per M. B. M.

10,000 ft. B. M. 4x12 ins., 12 to 16 ft. long, rough, $25.00 per M. B. M.

10,000 ft. B. M. 4x12 ins., 18 to 20 ft. long, rough, $25.00 per M. B. M.

10,000 ft. B. M. 4x12 ins., 18 to 20 ft. long, rough, $25.00 per M. B. M.

15,000 ft. B. M. 4x12 ins., 18 to 20 ft. long, s4s, $25.00 per M. B. M.

10,000 ft. B. M. 4x12 ins., 22 to 24 ft. long, s4s, $26.00 per M. B. M.

1,000 ft. B. M. 6x10 ins., 12 to 16 ft. long, s4s, $24.00 per M. B. M.

1,000 ft. B. M. 6x12 ins., 12 to 16 ft. long, s4s, $25.00 per M. B. M.

3,000 ft. B. M. 6x12 ins., 18 to 20 ft. long, s4s, $25.00 per M. B. M.

5,000 ft. B. M. 6x12 ins., 22 to 24 ft. long, s4s, $26.00 per M. B. M.

1,000 ft. B. M. 6x12 ins., 18 to 20 ft. long, s4s, $30.00 per M. B. M.

1,000 ft. B. M. 6x16 ins., 22 to 24 ft. long, s4s, $31.00 per M. B. M.

1,000 ft. B. M. 8x8 ins., 18 to 20 ft. long, rough, $23.00 per M. B. M.

1,000 ft. B. M. 8x8 ins., 22 to 24 ft. long, rough, $24.00 per M. B. M.

5,000 ft. B. M. 8x10 ins., 18 to 20 ft. long, rough, $24.00 per M. B. M.

2,000 ft. B. M. 8x12 ins., 22 to 24 ft. long rough, $26.00 per M. B. M.

1,000 ft. B. M. 10x10 ins., 18 to 20 ft. long, rough, $24.00 per M. B. M.

3,000 ft. B. M. 10x10 ins., 22 to 24 ft. long, rough, $25.00 per M. B. M.

10,000 ft. B. M. 10x12 ins., 22 to 24 ft. long, rough, $26.00 per M. B. M.

20,000 ft. B. M. 12x12 ins., 22 to 24 ft. long, rough, $26.00 per M. B. M.

3,000 ft. B. M. 12x16 ins., 22 to 24 ft. long, rough, $31.00 per M. B. M.

10,000 ft. B. M. 4x6, 4x8, 4x10, 4x12 ins., paving blocks, 5 to 7½ M. deep, s4s, $23.00 per M. B. M.

THORNTON CLANEY LUMBER COMPANY.

WHITE OAK

No. 1 Common.

1,000 ft. B. M. 2x8 ins., 12 to 16 ft., s4s, $36.00 per M. B. M.

8,000 ft. B. M. 3x10 ins., 12 to 16 ft., rough, $34.50 per M. B. M.

5,000 ft. B. M. 3x12 ins., 12 to 16 ft., rough, $35.50 per M. B. M.

35,000 ft. B. M. 3x12 ins., 18 to 20 ft., rough, $36.00 per M. B. M.

1,000 ft. B. M. 3x12 ins., 18 to 20 ft., s1s, $37.00 per M. B. M.

5,000 ft. B. M. 3x14 ins., 18 to 20 ft., rough, $[illegible] per M. B. M.

3,000 ft. B. M. 4x12 ins., 12 to 16 ft., rough, $37.00 per M. B. M.

[illegible] $38.00 per M. B. M.

1,000 ft. B. M. 12x12 ins., 12 to 16 ft., rough, $[illegible] per M. B. M.

1,000 ft. B. M. 12x12 ins., 18 to 20 ft., rough, $[illegible] per M. B. M.

1,000 ft. B. M. 12x12 ins., 22 to 24 ft., rough, $42.00 per M. B. M.

Indiana.

✣Bids will be received until March 2, by Trustees of Driftwood township, in Jackson County at Vallonia, Ind., for the construction of two brick school buildings with heating, plumbing and sewering complete. John Hess is Trustee. Plans and specifications may be seen at the office of Dunlap & Van Arman, State Life Bldg., Indianapolis, Ind., the Architects.

⦿Fitzsimmons & Connell Co., 131 LaSalle St., Chicago, Ill., has been awarded the contract at $17.45 per lin. ft., for constructing 800 ft. of timber dock for the city of Michigan City, Ind. Bids were opened Feb. 7. [illegible]

Iowa.

✣Bids will be received until noon, Feb. 20, by O. L. Ingledue, Mayor, Marshalltown, Ia., for installation of machinery and water wheels at the new dam. Plans and specifications may be seen at the office of the city clerk.

✣Bids will be received until 3 p. m., March 14, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for roof over Driveway, including plumbing, gas piping, electric conduits and wiring and lighting fixtures at the United States Post Office at Des Moines, Ia.

Louisiana.

✣Bids will be received until 7:30 p. m., Feb. 21, by the Board of Commissioners, Port of New Orleans, La., for the construction of a wharf in front of the Immigration Station, right bank of the Mississippi River, the materials for which are to be furnished by the board. A certified check for $500 must be filed with each bid. Hugh McCloskey is President of the Board.

✣Bids will be received until 10 a. m., Feb. 17, by Favrot & Livaudais, Ltd., Architects, 839 Gravier St., New Orleans, La., for the erection and entire completion of a two-story and basement fireproof courthouse at Lake Charles, La., for the Parish of Calcasieu.

Maryland.

✣Bids will be received until 11 a. m., Feb. 23, by Board of Awards, Baltimore, Md., for furnishing material and erecting polytechnic institute. Each bid must be accompanied by a certified check for $2,500. Edward D. Preston is Inspector of Building.

Massachusetts.

⦿The Breakwater Co., Cleveland, O., is reported to have been awarded a contract at about $1,000,000 for constructing a breakwater at the north end of the Cape Cod Canal at Barnstable Bay, Mass.

Nebraska.

✣Bids will be received until 8 p. m., Feb. 27, by Secretary Board of Education, Nebraska City, Neb., for the erection of a High School building at Nebraska City, Neb. Fisher & Lawrie, 210 Paxton Bldg., Omaha, Neb., are Architects.

New Jersey.

✣Bids will be received until 8 p. m., Feb. 20, by Board of Education, Hoboken, N. J., for the furnishing of furniture, seatings, etc., for the Auditorium in the New High School building at Hoboken. William A. Kerr is Secretary of the Board.

New Mexico.

⦿Bids were opened Feb. 6 by the County Commissioners at Roswell, N. Mex., for building a steel cage in the new county jail, the contract being let to the Pauly Jail Building Co., of St. Louis, Mo., at $3,713.

New York.

✣Bids will be received until 8 p. m., Feb. 24, by Board of Education, 106 High School Building, White Plains, N. Y., for the erection of fire escapes on the high school building, Railroad Ave., White Plains, N. Y. L. Stutts is Clerk of the Board.

✣Bids will be received until 11 a. m., March 14, by J. G. Warren, U. S. Engineer, 540 Federal Bldg., Buffalo, N. Y., for channel excavation, Black Rock Harbor, Buffalo, N. Y.

✣Bids will be received until 3 p. m., March 3, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for metal vault linings, doors, etc., in the extension to the U. S. Assay Office, New York, N. Y.

⦿Dawson, Pyles & Putschky, Inc., Fulton, N. Y., have been awarded the contract for the building of a dredge 33x100 ft., and three 200-yd. bottom dump scows for the American Pipe & Construction Co., of Schenectady, N. Y., for use on the latter's Barge Canal contract No. 37, just north of Fulton.

Ohio.

✣Bids will be received until 2 p. m., March 8, by Cuyahoga County Building Commission, Cleveland, O., for all the electric light fixtures for the new court house at that city. John J. Boyle is Secretary.

✣Bids will be received until noon, Feb. 28, by Director of Public Service, City Hall, Cincinnati, O., for lighting by electricity the streets, lands, lanes, squares and public places in that city. John J. Wenner is Clerk.

Washington.

✣Bids will be received until 3 p. m., March 23, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, except plumbing, gas piping, heating apparatus, elevator, electric conduits and wiring, of the United States Post Office at Bellingham, Wash.

Canada.

✣Bids will be received until 11 a. m., March 3, by Chairman of the Board of Control, Winnipeg, Man., for the manufacture and delivery of a motor car for use on standard gage railway track. Specifications may be obtained at the office of Power Engineers, Smith, Kerry & Chace, Carnegie Library Bldg., Winnipeg. M. Peterson is Secretary.

✣Bids will be received until 4 p. m., March 1, by R. C. DesRochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of a public building at Ottawa, Ont. Plans and specifications and form of contract may be obtained of the District Engineer, H. J. Lamb, London, Ont., or at the Post Office, Mitchell, Ont.

✣Bids will be received until 11 a. m., Feb. 23, by Chairman, Board of Control, Winnipeg, Man., at the office of M. Peterson, Secy., for the necessary labor and material for the erection of a public bath house to be located in Selkirk Park. Plans and specifications may be obtained at the office of William Bruce, 222 McDermot Ave., Winnipeg, Man., Architect.

✣Bids will be received until noon, March 1, by David Ewing, Chief Engineer Power House, Strathcona, Alta., for engine, boilers and generators. Specifications may be obtained of A. J. McLean, City Engineer.

⦿A. W. Girroir and Kinsman Sweet, Antigonish, N. S., nave been awarded the contract at $35,000 for constructing a breakwater at Burke's Head, N. S., for the Dominion Department of Public Works.

The city of Edmonton, Alberta, has made formal application to the Dominion Government for power rights on the Grand rapids on the Athabasca River. Plans filed with the application show a maximum power, if all the dams are built, of 60,000 H. P. It is hoped to interest the provincial Government so that they may institute some such scheme as Ontario has in Niagara power. If this is impossible the city hopes to be able to reserve rights until able to build a plant and distributing system itself.

Government Engineer Lamb, at London, Ont., has received instructions to prepare plans for a breakwater 1,200 ft. long at Port Stanley. It is estimated that to complete the work now being undertaken will cost $250,000. The sum of $60,000 has been appropriated this year for the work.

TRADE NOTES.

The St. Louis, Mo., office of the Baldwin Locomotive Works, of Philadelphia, Pa., has been removed from 914 Security Bldg., to 1613-14-15 Wright Bldg.

Pawling & Harnischfeger Co., Milwaukee, Wis., builders of cranes, hoists, etc., anounce the opening of a branch office at 533 Baronne St., New Orleans, La., under the management of Mr. T. W. Waddell.

The Power and Mining Machinery Co., manufacturers of rock crushing, mining and smelting transmission machinery, announce the removal of their Chicago office on Feb. 1 from the First National Bank Building to No. [illegible] Old Colony Building.

Mr. Frank P. Sprague has opened an office in the New York Life Bldg., Kansas City, Mo., where he will act as agent for a general line of contractors' supplies, including Millburn lights, Garland steel reinforcing bars, Youngstown fireproofing metal laths, etc.

The J. I. Case Threshing Machine Co., of Racine, Wis., has decided to make an aeroplane and to introduce it to the public, will exhibit it at the county fairs this season. The plane will be flown in competition with other aviators at the fairs and then after its flights will be placed in the Case tent with the other machinery that the company manufactures.

Mr. Howard T. Walsh has been appointed manager of the London office of the Sullivan Machinery Co., Chicago, Ill. Mr. J. C. West, sales engineer at the company's general offices in Chicago for the past ten years, replaces Mr. Walsh as Pacific Coast manager. The San Francisco office of the company is now at rooms 308-309 Sheldon Bldg., No. 461 Market St.

The Glidden Varnish Co., Cleveland, O., has sent a special representative to South America to place its concrete finishes and waterproofings among the Architects and Engineers. Their Mr. Tornero, a native of South America sailed on the 25th of January to locate permanently in Buenos Aires, where he will have entire charge of the development of the concrete coating business of the Glidden Varnish Co., as pertaining to South American countries.

The Sullivan Machinery Co., Chicago, Ill., has opened a branch office at Spokane, Wash., in the Hutton Bldg. Stocks of Sullivan machinery will be carried as at present in Seattle, Wash., and Nelson, B. C., by the United Iron Works and the Nelson Iron Works, respectively. A large stock of rock drills, hammer drills, repair parts and air compressors will also be maintained at Spokane. Mr. Austin Y. Hoy will be in charge of the company's interests in the northwest, with headquarters at Spokane.

Annually between Christmas and New Years day the J. W. Paxson Co., Philadelphia, Pa., gives an exhibition of foundry equipment and supplies, presenting the new articles that have been introduced during the year. Expert molders and craftsmen are employed who show each machine at work. These men are able to demonstrate in detail the how and wherefore. About 300 foundry men (iron, steel and brass) attended the last exhibition. Among the new labor saving machinery shown at the exhibit were the following: The new Whitehead flask bar tucker to tuck the sand under and on both sides of the bars at the same time. This is done while in a standing position and saves the molder from bending over and injuring the ends of his fingers. Another simple device was demonstrated to stop the runouts in foundry ladles were also on exhibition. A complete Paxson-Warren sand-blast outfit with the latest improved sand-blast tumbling barrel and air compressor, also tramrail, hoists, and small capacity overhead cranes, etc., were shown, as were the new Buch hand and foot power jar ramming molding machine and the new Barker rock-over molding machine for air, with vibrator attachment. The Paxson-Colliau cupola under construction with the new side inlets to take the blast pipe more readily, and the new idea of ironing foundry ladles were also noticed.

The Mead-Morrison Manufacturing Co., New York City, reports that the work covered by its contract with the Crown Cork & Seal Co., Baltimore, is nearing completion. This installation consists of conveying apparatus for handling raw material from railroad siding to factory and finished product from factory to railroad. The raw material includes tin plate, cork and general supplies. The finished product are cases weighing about 500 lbs. each. The plant is interesting principally from the fact that the shipping shed, or railroad siding is about 50 ft. below the basement of the factory. The means for conveying material from factory to shipping shed is a shuttle cable road, which runs through a concrete waterproof tunnel passing under Guilford ave. The grades are heavy with a number of curves. Mead-Morrison Co. also has in course of construction for the Cuba Railroad Company at Antilla, Cuba, a large coal and ore handling bridge. Among the contracts recently closed by the following: Contract with the Louisville Cement Co. for furnishing McCaslin Conveyor to handle crushed rock from Gates Gyratory Crusher No. 12. This conveyor will have a capacity in excess of 200 tons per hour. Contract with the Boston Elevated Railroad for installing complete coal unloading and storage plant for the new power house at South Boston. This plant will include unloading towers of the latest design (one-man control) cable road and rehandling and pick-up bridge. Contract with the Edison Electric Illuminating Co., Boston, for equipping their plant at South Boston with coal handling machinery.

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Myron Chace Clark.

To those who knew Myron C. Clark personally, and perhaps to many who knew him only by correspondence, or by name as a publisher, it will be of value to read something of his successful career and of the qualities that contributed to it. Records of lives such as his should be particularly inspiring to other young men who are struggling to accomplish something really worth while. We say other young men, for he was still of those who are counted young, as his thirty-eighth birthday would have been April 20.

Myron C. Clark was born in Elizabeth, N. J., April 20, 1873, and died at Colorado Springs, Feb. 9, 1911, after an illness of two and a half years. The publishing company that bears his name was at first a partnership organization, Mr. Halbert P. Gillette being his partner, and was later incorporated as a stock company. The partnership began in 1904, less than seven years ago, when Clark was thirty-one years of age. Therefore his life's most effective work was crowded into less than five years time—the period preceding the illness that finally culminated fatally. The brevity of this period makes even more marked the success that was achieved. We believe it is quite without precedent that so large a publishing business in the technical field has been created in so short a time.

After having received a high school training Clark took various positions, none of which suited him well until he entered the office of the New York *World* in 1891. From that time he felt sure of his own fitness to succeed in the field of publishing. In 1897 he left the *World* and took a position in the construction news department of *Engineering News,* and later was given charge of the book and subscription departments. It was here that his real ability began to show itself. The writer recalls witnessing an incident that serves to indicate one of his great traits of character—his conscientious thoroughness.

An engineer had come to the sales office to find some book that would give specific detailed information on brush revetments for river bank protection. Clark replied that no book supplied any very satisfactory information on the subject, but that such and such a volume of the transactions of such and such a society contained a paper by so and so on brush protection for river banks. The engineer took down the reference, and then Clark gave him two more references to periodic literature, even naming authors and dates of publication. This incident attracted the attention of the writer less because of the really wonderful feat of memory that Clark had displayed than because of the trait of character that was disclosed. When asked how he came to know about the articles on river bank protection, he replied:

"The same question comes to me quite frequently, and I feel that it is my business to be able to answer our customers on anything that pertains to engineering literature. If I can not refer them to books, then I do the next best thing and refer them to articles, papers and reports. Yes, that involves some work on my part—but what am I here for?"

Most young men in his position would have thought that their pay envelope was a sufficient answer to such a question. Clark did not. His aim was to know in considerable detail the contents of every engineering book published by every firm in America and England, and he did. He probably read more books on engineering than ninety-nine engineers in every hundred. Not a review of any new engineering book escaped his attention. Gifted with a memory that was phenomenal, he had all this information at his tongue's tip. Moreover, as above indicated, he had not stopped with the reading of books, but had searched periodic engineering literature for answers to questions of book buyers seeking specific information. It is not a matter of wonder that [illegible] nected had a remarkable growth, nor is it any [illegible] ject was exceptionally good, even though he himself was not an engineer.

Success often seems to outsiders to be a matter largely of chance, and it can not be denied that chance does send favorable winds as well as unfavorable storms; but the skilled navigator makes the best of both.

Clark early made it his object to become the most efficient seller of technical books in the country, and we believe he has never had a superior—probably never an equal.

In addition to his splendid mental equipment, he was so genuinely interested in every man who came in contact with him that his personality was an important aid in his business affairs. There was nothing affected about him. He loved his fellow man, and he showed it so unconsciously that he created friendships on the instant. The writer met him only a trifle more than eight years ago, but, until something arises to remind him of dates and the passing of time, he finds it hard to realize that Clark was not a boyhood friend—yes, even a close kinsman.

In 1904 Clark opened an office in the Park Row building, New York City. His capital was mainly his knowledge of the technical book business and his courage. The first year of the new publishing firm was one to try the nerves of the members—quite the usual hand to mouth history of most small business organizations having huge hopes and bank balances inversely proportioned thereto. To add more worry to it all the office and salesroom—all in a 12x12 space—was burned out through the carelessness of an office boy. Most of the small stock of books was damaged and the manscript of the "Handbook of Cost Data" barely escaped destruction. As Clark surveyed the sopping ruin left by the firemen he said he guessed the Myron C. Clark Company was not doomed to be snuffed out immediately, for the most valuable asset in the room had not been burned, while the rest was covered by a fire insurance policy taken out but a few weeks previously. He was quite prophetic in his optimism, for a short time later the publication of the manuscript that had escaped the flames marked the turn of the financial tide. With an unflagging zeal and with all the skill he possessed, Clark concentrated his efforts upon the sale of the book. It is doubtful whether any technical book had ever before had the sale that he secured for the "Handbook of Cost Data" in the same period of time. At any rate, no published records of such book sales show the equal of what he effected.

It is a common, but fallacious, opinion that a really good book will sell itself. In these modern days of many books and much advertising, it requires not only a satisfactory book but vigorous and skillful salesmanship to make men take enough notice to buy. Advertising must be honest to be really successful, but there must also be brains put into the advertising to bring great results—brains and energy. It is not merely enough to know how to do a thing—to possess the necessary skill. Energy must be wedded to skill. Clark lacked neither. Indeed his energy was so tremendous that it was often his undoing, and finally was a contributary cause of his early death.

The successful issue of their engineering book business led the Myron C. Clark Publishing Co. to engage in the publication of technical journals. Accordingly on the first of

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January, 1906, the first issue of ENGINEERING-CONTRACTING appeared. It was then a monthly periodical and was temporarily issued in connection with the *Roadmaster and Foreman*, a railway monthly that had just been purchased by the Myron C. Clark Company. Three months later [illegible] News, a weekly paper for contractors, was bought and combined with ENGINEERING-CONTRACTING, and the *Roadmaster and Foreman* was thereafter issued separately. A year later the main office of the Clark company was moved to Chicago, and the *Engineering World*, a weekly periodical for civil engineers, was purchased and combined with ENGINEERING-CONTRACTING. From that time the growth of this journal was very rapid. Another leap forward occurred in the autumn of 1909, when *The Dirt Mover*, a paper having a large circulation among railway and grading contractors, was combined with this journal.

The purchase of these various periodicals required courage and confidence in the ultimate outcome, for debts were incurred. But even the panic of 1907 did not cause Clark to lose heart in the face of possible heavy loss of business. In a letter to the writer he said: "I agree with you that this is no time to go with the crowd. Let us rather spend more money than ever to build up our paper. These hard times may prove to be a blessing to us in disguise."

Courageous optimism Clark possessed to a fault, but he backed his optimism with something more than hopes that good things would "turn up." He plunged in determined to make them turn up. Luck may have aided him, but mainly because luck seems to follow the precept that to him that hath shall be given.

To those engaged in professional, or artistic work only, it may seem strange that men of business affairs have ideals like their own, that business is more than a "sordid struggle to make money." But successful men of all types—literary, military or commercial—have one great motive in common, namely the desire to excel. All aim to be leaders in their respective vocations. The higher type of modern business man is strongly actuated by another motive. He aims to effect economies of production or distribution that will add to the general welfare of mankind. In the field of technical publishing this last named motive often takes precedence of the first. The publisher of an engineering periodical regards it as an instrument of education—a school, college, university, all in one. And the pride that he feels in its growth is not a whit less than that felt by the president of the greatest of universities. Indeed, what university can begin to match a large engineering journal in numbers of students? An engineering college with an enrollment of a thousand men rightly is regarded large. An engineering journal with less than ten times that number of subscribers is scarcely noteworthy as to size. To be instrumental in creating a large technical journal of great educational influence is an ideal worthy of any man's ambition, and this was Clark's ideal.

It has often been said that our real American poets compose their dramas in steam, in steel, in factory and in the products of the press, that our men of imagination write with the great stylus of a business organization far more often than with the pen of the dramatist. We lose and we gain in consequence. We lose many a magnificent march of words. We gain a more magnificent march of events.

Clark worked to accomplish his ideal with all the zeal of a poet at a masterpiece, and with a poet's disregard of self. His own bodily needs were forgotten, so absorbed was he in his dream. And was this done for the profit he hoped some day to secure? We that knew him realize more fully than ever how little money meant to him except as a tool with which to build. He was an idealist as truly as Emerson, although his type of mind was such as to lead him to work with concrete things rather than with speculative thought and preachment. There was so much of heart in the man that he idealized even inanimate things. He saw in the thing created a part of the soul of its creator. It actually gave him pain to see a book maltreated. During his illness a thoughtless nurse set a wet glass on a copy of the "Handbook of Cost Data," which he kept beside his bed. The reprimand she received startled her, for he rarely spoke harshly under any provocation. It was beyond his endurance to witness any defacement even of the cover that bound the work of one of his friends.

Integrity, optimism and kindly consideration of his fellow man were noteworthy traits of Clark's charater. We have mentioned also his idealistic temperament, and have touched upon his moral courage. Nothing could move him from a course that he believed to be right. He was as inexorable as a law of nature. It remained for his last illness to bring into full evidence his physical courage. When an attack of pneumonia developed into tuberculosis two and a half years ago, he telegraphed for the writer, and said that he feared a death sentence had been pronounced upon him. He entertained few of the false hopes commonly ascribed to those afflicted with this disease, but calmly composed himself to meet the worst if it should come, but determined to fight to the end. Although he suffered great physical pain at times, he gave little or no external evidence of it. His fortitude remained unshaken to the last. But a few weeks ago he sent a telegraphic message to the editorial and business staff of this journal. It was his last direct word to them, a cherry word of Christmas greeting.

Kind, true, brave friend, you are gone, leaving the memory of no faults but one—utter disregard of self.

A Successful Local Association of a National Engineering Society.

Sectional associations of members of national societies of engineers generally fall short of full success in America. This is perhaps due to the rather remarkable developments of the local engineering society. Such societies as the Western Society of Engineers, the Boston Society of Civil Engineers, the Engineering Association of the South, the Pacific Northwest Society of Engineers and others too numerous to mention leave very little reason for the local chapter or sectional association of members of the large national societies. The members of the national societies who reside in any section of the country find ready means in the local society of that section not only for association in society work with one another, but also with other engineers not members of national societies. We are reminded of these conditions by the printed statement which lies before us of the year's work of the San Francisco Association of Members of the American Society of Civil Engineers.

This association has a membership of 124 engineers all belonging to the American Society of Civil Engineers and 64 of which are of the grade of full member. During the year six meetings of this association were held with an average attendance of 50 members. Financially the association is prosperous, having accumulated a balance above all expenses of some $2,200. We give these data merely as confirmatory evidence of the success of the association, which is best represented by the papers and discussions it has presented to the transactions of the parent society. To name the papers alone, there were "A Concrete Water Tower for the City of Victoria, B. C.;" "The Failure of the Yuba River Debris Barrier," "Results Obtained by the Coos Bay Jetty," "Study of the Present Water Supply of Sacramento and a Proposed Means of Improvement," and "The Construction of the Lake Arthur Earth Dam in Placer Co." Those who have read the "Proceedings" of the American Society during the past year will recognize in these papers some of the best work done by the Society members in the way of technical writing.

Our purpose in making this schedule of the Association's work is to note the fact that it is within the ability of a local chapter or section of a national engineering society to be a very useful element in the society's work. We suspect that the year's transactions of the American Society will not show from any other center of membership except New York city, within several of as many original papers as are listed from the San Francisco chapter. This may not be because the formal association of the California members into a local section concentrated and developed their activities, but the supposition is warranted that it did. Another point that seems probable is that the success of this national society chapter work in San Francisco comes in a considerable measure from the fact that no local engineering society comparable in vitality with those named in our opening paragraph exists in San Francisco or anywhere on the Pacific coast nearer than the State of Washington. Whether this last opinion be agreed with or not, it stands evident that the San Francisco Association has proved the value of its existence and gives encouragement toward the formation of other chapters in other sections of the country that are centers of membership, and where local engineering society facilities are similarly lacking.

Electrification of Steam Railroad Terminals in the City of Chicago.

During the past six months a systematic investigation of the smoke problem of Chicago has been in progress. This investigation has been thorough, and is the first complete analysis of the kind ever undertaken in any American city. In a paper presented before the Western Society of Engineers, an abstract of which is given in this issue, Mr. Paul P. Bird, chief smoke inspector of the city of Chicago, gives the final results of this investigation. In this paper not only is the total volume and density of smoke given, but definite percentages are presented indicating just what part of the smoke nuisance each class of smoke producer is responsible for.

The steam railroads are found to be by far the worst offenders. It is stated that locomotives use only 18½ per cent of all the coal consumed in the city, but that they produce 43 per cent of the total smoke and over one-half of the dirt. It is shown, further, that this is largely due to the unavoidable conditions under which locomotives operate, and that under the best possible conditions they would still be responsible for 29 per cent of the smoke. It is estimated that 560 tons, or 14 car loads, of fine coal and ash are thrown daily from locomotive smoke stacks within the city limits. For an explanation of the difficulties to be encountered in using other fuel than bituminous coal the reader is referred to Mr. Bird's paper. What is of interest to us now is the conclusion reached in the paper. It is perhaps the only logical conclusion, and is as follows:

The study that has been made along these lines indicates clearly that electrification offers the only final satisfactory solution of the locomotive smoke problem. The use of special fuel for preventing smoke on steam locomotives is only a makeshift and will not satisfy the public.

This conclusion naturally brings up the questions of cost and of practicability generally. Representatives of railroad companies present at the discussion of the paper argued that the cost would be prohibitive; and that the installation of any present system of electrification would result in continual and serious loss of life among the operatives in congested yards. A report of the Metropolitan District Board of Boston was read giving in detail the results of an investigation in regard to the electrification of steam railroad terminals in that city. In this report electrification was found to be impracticable on account of its enormous cost, and objectionable on account of the dangers attending operation. Conditions in Boston are somewhat similar to those in Chicago, and it was pointed out that the magnitude of the problem as presented in Chicago is such as to make electrification practically an impossibility.

The greatest terminal electrification ever undertaken in this country is that of the New York Central terminals in New York city. This was thought to be a difficult problem. But it may be said without exaggeration that it was insignificant in comparison with that of electrifying the railroad terminals of Chicago. In fact nothing comparable with the latter has ever been undertaken.

Within the city limits there are 687 miles of main tracks and 1,512 miles of sidings, making a total of practically 2,200 miles. There are dozens of terminal and transfer yards, many of them being as large as the New York Central terminal, and numerous transfer connections between different yards and main lines.

So far as is known the cost of such an undertaking has never been estimated, nor has the problem of safety in operation been solved. On Dec. 19 the Chicago Association of Commerce, which has had experts working on the problem for the past 18 months, presented a preliminary report to the city council and asked for the aid of the city in continuing its investigations. The details of this report have not been made public.

When these investigations are completed, and not until then, will there be sufficient data available to warrant a definite conclusion.

CONCRETE AND REINFORCED CONCRETE SECTION

Methods and Cost of Reinforcing a Steel Bridge with Concrete.

The use of concrete for stiffening the columns of steel trestles and for making old steel trestles permanent, has been successfully accomplished by the Wabash R. R. On one of the bridges, thus reinforced, the St. Charles Bridge over the Missouri River, the saving has been about $140,000 as compared with the cost of a new trestle. The saving per lineal foot is about $32.20 for this trestle which averages about 40 ft. in height.

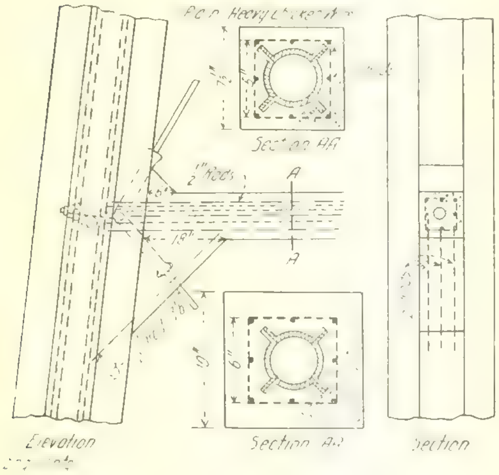

Fig. 1—Details of Reinforcing for Columns.

Before the work was started, estimates were made of the probable cost of a new trestle to replace the present one and also of the probable cost of doing the work as it has now been carried out. Assuming the concrete to cost $6 per cu. yd. and the steel, 4 cts. per lb. in place, it was found that the cheapest new structure that could be built was one consisting of 45-ft. deck girder spans on concrete piers, and the cost of such a structure would be $50 per lin. ft. With the same unit prices, the cost of a new trestle composed entirely of steel with towers 30 ft. in length and intermediate spans of 60 ft., was found to be $53 per lin. ft., and if the intermediate spans were made 30 ft. instead of 60 ft., the cost would be $56 per lin. ft., but if the intermediate spans were made 15 ft. instead of 60 ft., the cost would be $51 per lin. ft.

By way of comparison with the above estimate, the steel columns of the St. Charles bridge approaches have been reinforced with concrete at a cost of $7.30 per lin. ft. of trestle. It is estimated that the cost of steel stringers to replace the old wooden ones will be $10.50 per lin. ft. in place, making the total cost of strengthening the trestle $17.80 per lin. ft. The saving, therefore, over a structure costing $50 per lin. ft. is $32.20 per lin. ft., and as this trestle is 4,342 ft. long, the total saving amounts to about $140,000.

It must be noted that there will be an additional saving, as the amount of salvage that would accrue from the sale of materials in the old trestle would be much less than the cost of removing the trestle. Another fact worth noting is that this kind of work can be done gradually at a cost which would be but little more than the present maintenance expenses. The trestle as now reinforced, as estimated from previous column tests, and inspection of the completed work, will carry any engine that it is possible to build.

Tests.—Tests made upon columns of the type used in the St. Charles Bridge showed that the effect of reinforcing them with concrete was practically to double their strength. These tests were made (1) upon a 5 ft. length of Phoenix column which was cut from a column 27 ft. long. The column was 8 ins. in diameter; the thickness of the metal was 5/16 in.; its area of cross section was 12 sq. ins., and its weight 188.5 lbs. (2) Upon the remaining length of 22 ft. cut from the 27 ft. column and reinforced with a 1:3 mixture, placed inside and outside of the column. Its shape was octagonal, its short diameter being 18 ins. The Phoenix column was not exactly concentric at one end of the reinforced column, being about ½ in. out of center. The test showed that this eccentricity had an appreciable effect. The short piece was tested under an increasing load up to 519,000 lbs. It showed a deflection of about ¼ in. and shortened about 1 in. Scaling began at about 350,000 lbs. The reinforced column showed a slight spalling near the base at 419,000 lbs. At 594,000 lbs. the column had cracked and spalled at all faces near the base and the column had shrotened about 0.001 in. The deflection from the vertical amounted to about .1 in. but increased rapidly to about 3 ins., about 6 ft. above the base before the load was completely removed. After these laboratory tests, which were made at the University of Illinois, a practical field test was made by applying the method to one bent of the bridge and making observations for one year to see whether any deterioration would be caused by vibration due to traffic. No effect whatever was observed and the method was therefore adopted and has been used on two of the Wabash R. R bridges up to the present time.

Construction Work.—The contractor for the work on both bridges was furnished with materials f. o. b. cars at the site, with "deadhead" freight on all lumber, tools and equipment, and [illegible] all of which materially reduced the cost of construction to the contractor.

In the two approaches to the St. Charles Bridge there are 300 columns, 40 to 50 ft. high, tied in groups of four, with transverse and longitudinal struts to form towers. These columns, with the exception of the built-up shapes at the strut crossings, are of the Phoenix section. An 18-in. octagonal section for the Phoenix columns was adopted and a 24-in. square section was used for the sections at the street crossings.

With the exception of the bases, which were poured by hand, each tower was poured monolithically, using a 1:3 mortar reinforced with No. 6 spiral hooping for the Phoenix columns and with 1 in. square bars for those at the street crossings. Despite the excessive length of the columns, the troublesome connecting struts with their knee braces, and the frequent vibrations due to the regular traffic, a remarkably smooth job was obtained, with faces true to line and free from honeycomb or cracks. In placing the reinforcement and the forms, hanging scaffolds were used; the steel gang on one scaffold being closely followed by the carpenter force on another. The scaffolds were used again in the wrecking.

The ⅞-in. forms were cut, in sections of approximately 14 ft. so that they could be used six times, thus reducing the carpenter cost, necessarily high, because of the cutting and framing around the struts and lateral braces. The spiral reinforcement although very effective, was comparatively expensive because of the "cork screw" fashion in which it had to be applied. The experiment of

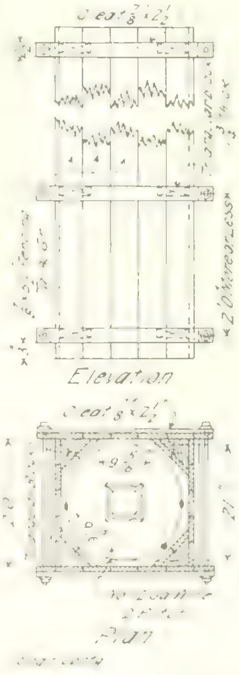

Fig. 2—Details of Octagonal Forms for Encasing Steel Columns.

using wire mesh with equivalent cross sectional area of steel, was made and proved less expensive, in labor. This test was made near the close of the job after all the spirals were on hand, and was intended only for the general information of the contractors.

The concrete was made with a mixer [illegible] were carried in bins upon the car with the mixer. The concrete was poured into the forms through spouts leading from the mixer to the column caps. The work train was frequently interrupted and sidetracked for passing traffic, but this lost time was used, as far as possible, in refilling the material bins.

The cost of the work to the contractor, allowing 90 cts. per bbl. of cement and 50 cts. per cu. yd. for sand, was $12.45 per cu. yd. of concrete or an average of $165 per tower. This cost includes the following items: Material for concrete; material for forms; labor building, placing repairing and removing forms; labor placing reinforcement; labor mixing and placing mortar; labor unloading and rigging; equipment; administration and miscellaneous labor. The contract was let on a percentage basis with a guaranteed maximum which closely approximated the actual cost. The structure was completed in 5 months.

In conclusion we wish to acknowledge our indebtedness for the information used in preparation of this article to the Wm. P. Carmichael Co., Engineers and Contractors of St. Louis Mo., who executed the construction work, and to Mr. A. O. Cunningham, Chief Engineer of the Wabash R. R., under whose direction the entire work was done.

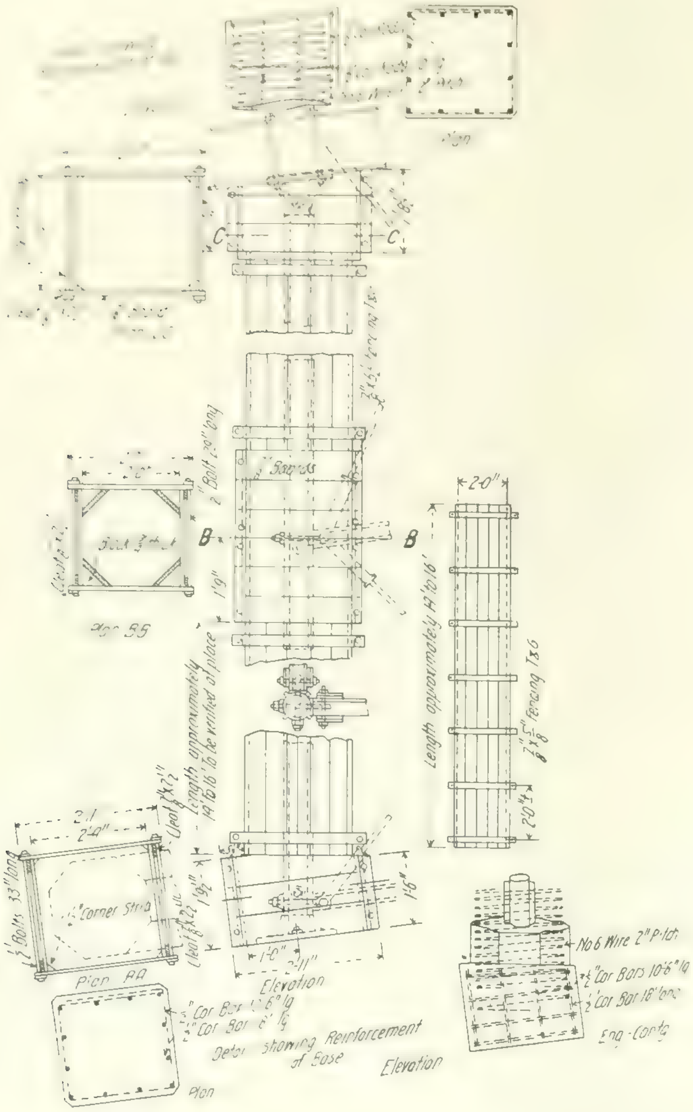

Fig. 3—Details of Column Forms and of Reinforcing in Bases and Caps.

Construction Costs on the Panama Canal for the Last Three Months of 1910.

Construction costs on the Panama Canal for the 15 months ending Oct. 1, 1910, were summarized in our issues of Dec 7, 14 and 21, 1910. Recent figures issued by the Isthmian Canal Commission give the costs for the remaining three months of 1910. We have rearranged these figures here to correspond with the arrangements employed in our preceding articles.

Dam Construction.—The general method of construction of the Gatun Dam was described in our issue of Dec. 21, 1910. Briefly two parallel stone embankments are carried across the valley by dumping from trestles and between these embankments an earth fill is made with material pumped by hydraulic dredges. During October-December, 1910, 695,299 cu. yds. of dry fill was placed at the following cost:

Item.	Per cu. yd.
Excavation	[illegible]
Clearing site	[illegible]
Tracks	[illegible]
Trestle	0.0193
Transportation	[illegible]
Filling	0.0830
Maint. equipment	0.0356
Plant arbitrary	[illegible]
Division expenses	0.0136
General expenses	0.0279
Total	$0.3918

The cost of the hydraulic fill, 853,519 cu. yds., was as follows:

Item	Per cu. yd
Clearing site	$0.0027
Clearing for dredge	0.0170
Dredging	0.0808
Riley pump	0.0050
Pipe lines	0.0213
Wood flume	0.0042
Power	0.0193
Small boats	0.0021
Maint. equipment	0.0587
Plant arbitrary	0.0470
Division expenses	0.0094
General expenses	0.0249
Total	$0.2884

Dry filling for the Miraflores Dam for the same period cost 40.37 cts. per cu. yd.; methods of work are not stated.

Colon Breakwater.—The breakwaters at Colon are rock fill structures rising 10 ft. above mean tide level and being 15 ft. wide on top. One structure is 10,500 ft. long and the other is 5,700 ft. long and both are being built by dumping rock from trestle. The rock is quarried especially for the work and is hauled by train from quarry to trestle. The cost of rock in place for the last three months of 1910 was as follows:

Item.	Per cu. yd.
Surveys	$0.0238
Clearing	0.0443
Drilling	0.0593
Blasting	0.1617
Loading by power	0.0931
Tracks	0.0358
Transportation	0.0975
Maint. of equipment	0.0229
Total quarrying	$0.5384
Trestles	$0.5176
Dumping	0.0365
Maint. of equipment	0.0095
Total filling	$0.5636
Plant arbitrary	$0.1100
Division expenses	0.0678
Tug service	0.0537
General expenses	0.2481
Total general	$0.4796
Grand total	1.5816

Lock Masonry.—Methods of constructing the concrete locks at Gatun, Pedro Miguel and Miraflores were described in our issues of Dec. 7 and 14, 1910, and the Gatun Spillway was described in our issue of Dec. 21, 1910. The following is the itemized cost of masonry on the four structures named for October-December, 1910.

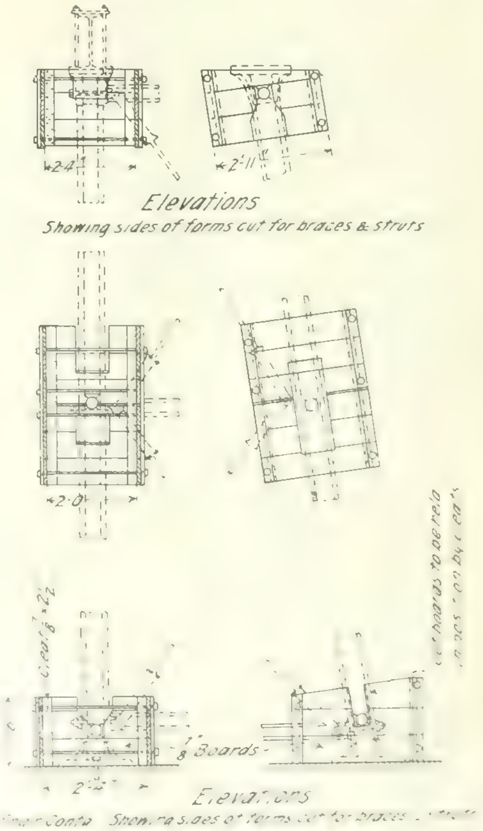
2'4"
2'11"
Elevations
Showing sides of forms cut for braces & struts
2'0"
Cleat 8" x 2"
Boards
2'2"
Elevations
Eng.-Contg
Showing sides of forms cut for braces

Fig. 4—Details of Forms Cut for Braces and Struts.

Item.	Spillway.	Gatun.	Pedro Mig.	Miraflores.
Cement	$1.8012	$1.8433	$1.4124	$1.3930
Stone	[illegible]	[illegible]	[illegible]	[illegible]

Sand	0.4594	0.8693	0.3797	0.3828
Mixing	0.1779	0.1873	0.1661	0.6440
Total concrete	$4.7319	$5.0358	$2.7032	$3.1738
Rubble	$2.7998	$1.9909	$0.8231	$1.1993
Cu. yds. concrete	18,353	220,169	167,768	65,805
Cu. yds. rubble	310	21,872	746	1,758
Masonry	18,663	242,041	168,504	67,563
Cost of Masonry				
Concrete	$[illegible]	$4.5808	$2.6913	$3.0911
Rubble	[illegible]	0.1076	0.0036	0.0312
Wood forms	[illegible]	0.3574	0.3243	0.3754
Steel forms		0.0938	0.0495	0.1245
Placing	0.6817	[illegible]	0.2910	0.2762
Cofferdams	0.0719		...	...
Reinforcement		0.0307	0.0114	0.0106
Pumps		0.0293	0.0356	0.0488
Power		0.0745	0.0418	0.0160
Maint. equipment	0.2141	0.2616	0.1840	0.1750
Plant arbitrary	0.6160	0.6850	0.6619	0.4500
Division exp.	0.1165	0.1050	0.0752	0.1205
General exp.	0.2627	0.2386	0.2721	0.3511
Total	$7.1183	$6.[illegible]	$4.6447	$5.0704

Dry Excavation.—The cost of dry excavation mostly by steam shovel from Culebra cut was for three months as follows:

Items.	
Quantity—Cu. yds.	4,448,488
	Per cu. yd.
Clearing site	$0.000[illegible]
Drilling	.0514
Blasting	.0449
Loading by power	.0503
Tracks	.1263
Transportation	.0973
Dumps	.0530
Pumps	.0012
Maintenance of equipment	.0853
Plant arbitrary	.10[illegible]
Division expense	.0141
Total division cost	$0.6238
Administrative and general expense	$0.0498
Total cost	$0.673[illegible]
Dry excavation—Prism, by contract—Quantities—Cu. yds.	[illegible]
Contract cost	$0.2104
Plant arbitrary	.1000
Total cost	$0.3104
Total dry excavation quantities—cu. yds.	4,471,040
Unit cost	$0.6718

Dredging.—The costs of excavation by dredging on the Atlantic and Pacific divisions were as follows:

	Atlantic Division.		Pacific Division.	
Items.	Quantities, cu. yds.	Unit cost.	Quantities, cu. yds.	Unit cost.
Pipe lines	401,511	$0.0031		
Dikes	401,511	.0297		
Clearing	1,632,866	.0011	1,280,777	$[illegible]
Operation seagoing suction dredge	743,552	.0295	849,519	.0364
Repairs seagoing suction dredge	743,552	.0075	849,519	[illegible]
Operation ladder dredges	316,159	.0885	291,108	.0731
Repairs ladder dredges	316,159	.0752	291,108	.0296
Operation dipper dredges	171,644	.0918	140,150	.0683
Repairs dipper dredges	171,644	.0427	[illegible]	.1639
Operation pipe line dredges	401,511	.0478		
Repairs pipe line dredges	401,511	.0098		
Operation tugs, clapets and scows	487,803	.0833	431,258	[illegible]
Repairs tugs, clapets and scows	487,803	.0531	431,258	.0399
Drilling	152,818	.0581	104,321	.1222
Blasting	152,818	.0669	104,321	.2030
Operation drill barges	...	...	104,321	.1106
Operation rock breakers			104,321	[illegible]
Small boats	1,632,866	.0028	1,280,777	.0033
Repairs miscellaneous equipment	1,632,866	.0019	1,280,777	[illegible]
Plant arbitrary	1,632,866	.0570	1,280,777	.1100
Division expense	1,632,866	.0086	1,280,777	.0172
Total division cost	1,632,866	$0.2088	1,280,777	$[illegible]
Administration and general expense	1,732,866	$0.0194	1,280,777	$0.0219
Total cost	1,632,866	$0.2282	1,280,777	$0.3132
Earth excavation—per cent	1,480,048	.9064	[illegible]	.9185
Rock excavation—per cent	152,818	.0936	[illegible]	.0817

Quarrying and Crushing Stone.—The costs of quarrying and crushing stone at Porto Bello for the Atlantic division and at Ancon for the Pacific division were as follows:

	Porto Bello.	Ancon.
Quarrying—Quantities—cu. yds.	[illegible]	[illegible]
Stripping	$0.0180	$0.0216
Drilling	.0464	.0376
Blasting	.1890	.0380
Loading	[illegible]	[illegible]
Transportation	[illegible]	[illegible]
Tracks	[illegible]	.0217
Power	[illegible]	.....
Maintenance of equipment	.1118	.0367
Plant arbitrary	.3401	.2500
Total	$0.9520	$0.5160
Crushing—Quantities—cu. yds.	225,023	235,894
Operation, crushers	$0.0433	$0.0151
Stone bins and conveyors	.0362	.0042
Power	[illegible]	[illegible]
Maintenance of equipment	.1303	.0082
Plant arbitrary	.1751	.0779
Total	$0.4168	$0.1210
Total cost of production	$1.3688	$0.6370
Towing—Quantities—cu. yds.	225,023	.....
Operation tugs and barges	$0.1659	.....
Maintenance of equipment	.0813	
Plant arbitrary	.2240	.....
Total	[illegible]	.....
Unloading—Quantities—cu. yds.	[illegible]	
Operation, cableways and cranes	$0.1205	
Power	.1097	
Track repairs	[illegible]	
Dumping	[illegible]	
Maintenance of equipment	[illegible]	
Plant arbitrary	[illegible]	
Total	$0.4526	
Rail Transportation to Storage—Quantities	[illegible]	235,894
Operation of trains	$0.0824	$0.0517
Repairs to tracks	.0205	.0100
Dumping in storage	.0003	.0094
Maintenance of equipment	.0734	
Plant arbitrary	.....	.0500
Total	$0.1766	[illegible]
Division expense	[illegible]	[illegible]
Total [illegible]	[illegible]	[illegible]

It is said that articles of iron or steel [illegible] of phosphoric acid and 1 oz. iron filings to 1 gal. of water will form a black non-corroding coating over the surface of the metals, thus preventing oxidation.

Tests to Determine the Strength of Concrete Building Blocks.*

The purpose of the tests described in this paper was to ascertain if the common specification, that the blocks shall have a compressive strength at 30 days age of at least 1,000 lbs. per sq. in. of gross area, is too severe. The tests were made under the direction of the author and constituted the data for a thesis by three seniors in civil engineering in 1909.

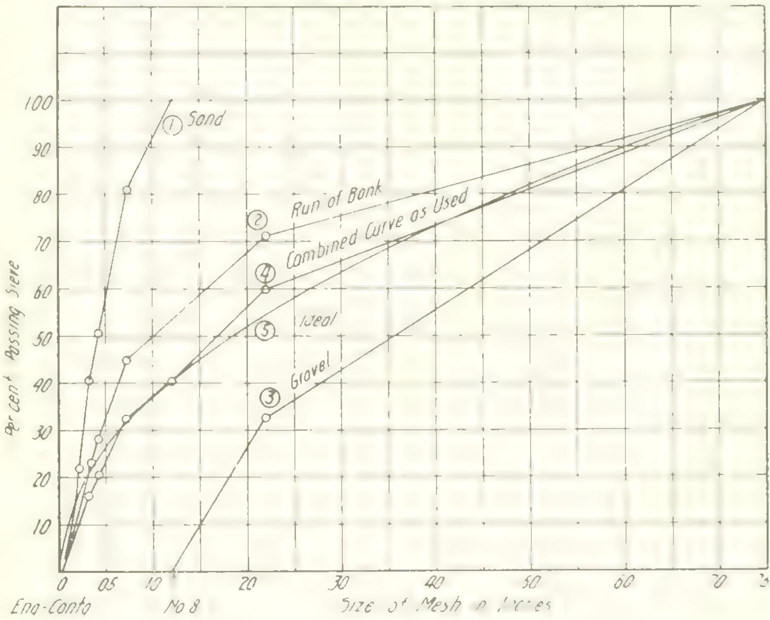

Fig. 1—Diagram Showing Results of Tests of Concrete Blocks.

The materials used in the construction of the blocks were ordinary, no attempt being made to secure qualities above the average. The cement used was Speed Portland manufactured by the Louisville Portland Cement Co. of Louisville, Ky. The cement was tested and satisfactorily passed the specifications of the American Society of Testing Materials. The gravel used was a local Lafayette pit gravel. It was fairly clean and rather well graded for "run of bank" gravel. However, in order to secure as well graded a mixture of aggregate as possible, the gravel was sampled and separated into sizes by the sieve-analysis method. Curve 2 in Fig. 1 shows graphically the gradations of sizes in the "run of bank." This is seen to conform fairly close to the "ideal" gradation of sizes as shown by curve 5. From curve 2 it may be seen that 53 per cent of the run of bank is finer than the mesh of a No. 8 sieve, while curve 5 shows that only 40 per cent is needed, consequently the aggregate was sieved on a No. 8 sieve. Curve 1 shows graphically the part finer than No. 8 and curve 3 the part coarser than No. 8. In recombining, 40 per cent of the part finer than No. 8 as demanded by the ideal curve and 60 per cent of the part coarser than No. 8, were used. Curve 4 shows graphically the [illegible] gate. This conforms as closely to the ideal as it is practical to make it. The aggregate as recombined was used in all of the tests. The percentage of voids in this aggregate packed was 27 per cent. The percentage of silt was within reasonable limits being 4.5 per cent.

[illegible] 8x15.75 ins. gross dimensions [illegible] the best practical mix that could be made with the materials at hand and 1 to 6 was the least proportion of cement to aggregate allowed by the specifications. The percentage

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*A paper by H. H. Scofield, Purdue University, before the Indiana Engineering Society, Annual Convention, 1911.

[illegible] consistency that could be readily handled in [illegible] between wet and dry mixtures, a series of both [illegible] 8-in. diameter by 16-in. cylinder was made from each mix, to give the actual compressive strength of the concrete in the blocks.

Blocks and cylinders were tested in compression in a standard Riehle testing machine. Asbestos and blotting paper pads were used for bedding in the machine, giving a uniformly distributed loading. Load was applied at a uniform speed of 0.039 in. per min., this was constant throughout the tests.

Solid specimens were taken from the 30, 48 and 60-day blocks. These were thoroughly dried and then immersed in water till they ceased to gain in weight.

The results of the tests are summarized and shown in Tables I, II, III and IV. The averages are taken from at least three tests in each case. Table I shows the results of the sieve-analysis tests, giving the actual gradations of sizes in the "run of bank" gravel. In connection with a study of curve 5, the ideal gradation of sizes, it will be seen that the "run of bank" was lacking in the larger sizes [illegible] By sieving on a No. 8 sieve and recombing, this deficiency was remedied to a great extent and by the addition of the larger sizes, the density of the mixture was increased. This is an important item when the waterproof qualities of the resulting concrete is considered.

Table II exhibits the results of compression tests of blocks. It will be seen that the 1:4 blocks decreased in strength from 14 days to 30 days. This is probably due to a change in storage conditions which took place at that time. The compressive strength of the 1:4 blocks is well above the specifications while that of the 1:6 blocks is slightly below. In both cases the dry mixture gave a higher strength than the wet. Considering the per cent of hollow spaces in the block as 30 per cent, the compressive strength of the wet mix 30 day blocks, on the basis of actual cross section, becomes 1,840 lbs. per sq. in. This is a somewhat lower value than that given in Table III for the strength of cylinders of about the same age.

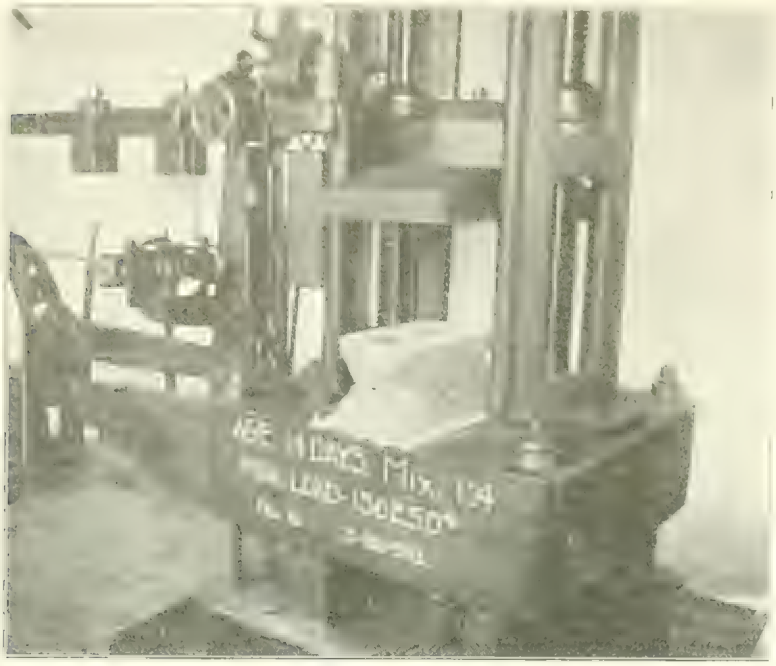

Fig. 2—View Showing Characteristic Fractures of Concrete Block.

Table IV shows the absorption of water of blocks at 30, 48 and 60 days age. It shows that the rich 1:4 mixture has only about 50 per cent of the absorbtion of the leaner 1:6, and is therefore 50 per cent better as a water repellant.

It has been clearly shown that it is possible to make concrete blocks capable of fulfilling the specifications at 30 days. This is easily done with a 1:4 mixture and probably would be with a 1:5, and in a large number of cases with exceptionally well graded aggregate, excellent cement, together with careful treatment and good storage conditions, would be done with a 1:6 mixture of concrete. However, in residences and buildings where moisture must be kept out, the richer mixtures should be used.

TABLE I.—SIEVE ANALYSIS OF AGGREGATE.

Sieve. No.	Size of Mesh (inches).	Pct. Passing (by weight).
	.750	100
4	.220	70,1
8	.120	55.5
10	.073	44.7
16	.042	28.1
20	.034	22.9
30	.022	12.2
40	.015	6.6
50	.011	5.5

TABLE II.—SUMMARY TABLE FOR BLOCKS.

Age (days)	Proportions (by volume).	Water Used (pct.).	Compressive Strength (lbs. per sq. in. of gross area).
7	1:4	7.07	685
14	1.4	7.07	1,240
21	1:4	7.07	1,150
30	1:4 (wet)	7.07	1,210
30	1:4 (dry)	5.58	1,340
48	1:4	7.16	1,795
60	1:4	7.16	1,800
30	1:6 (wet)	7.94	850
30	1:6 (dry)	7.60	920

TABLE III.—SUMMARY OF 8-IN. BY 16-IN. CYLINDERS.

Age (days).	Proportions (by volume)..	Compressive Strength (lbs. per sq. in.).
9	1:4	1,420
14	1:4	1,970
24	1:4	2,240
35	1:4	2,240
49	1:4	2,500
56	1:4	2,600
60	1:4	2,570

TABLE IV.—ABSORBTION OF WATER.

Age (days).	Proportions (by volume).	Absorbtion (per cent of dry weight).
30	1:4 (wet)	5.5
30	1:4 (dry)	4.72
30	1:6 (wet)	10.8
48	1:4	4.56
60	1:4	4.28

EARTH AND ROCK SECTION

Increasing Efficiency of Labor Underground in Transvaal.

The greater part of the physical inertia of men working underground in mines is due to the uncomfortable positions which they must assume to carry on the work. They are working on upward or downward slopes, or else, in driving, they are hampered by an insufficiency of air, too much dirt and too little time to carry out a set round of operations. Yet on every hand the complaint comes from those most qualified to judge, that labor is inefficient.

Mr. Kenneth Austin M. E. in a paper read at a meeting of the Transvaal Institute, Johannesburg, says that all labor operations in mining are mechanical, and suggests a partial mechanical operation for drilling holes now done entirely by hand. Without going deeply into facts regarding efficiency of drilling and explosive operations, it is generally admitted that for some time to come a very large portion of the available hand labor will be used in this field, for drilling the rock, first, because of the lower cost of the labor; second, because of the smaller diameter of the holes drilled by hand; third, because of the dis- [illegible] small holes are used than where large machine holes are exploded.

Under these conditions Mr. Austin suggests the use of a handy self rotating, well balanced hand drill weighing about 18 lbs., for starting the holes to be drilled, to a depth of 4 to 6 ins. This method is designed to secure:

(1) The correct alinement of the hole for guidance of the laborer.

(2) A less number of hand drills necessary for starting the holes.

(3) A saving of time in starting holes.

(4) The use of the laborer's time in drilling rather than the toilsome process of starting a hole on an angular face.

(5) The placing of a hole in its proper place.

It is estimated that 60 holes a day would be started by the machine.

The machine uses a total of 30 cu. ft. of free air per minute. The hose used is only ½-in. internal diameter, and would be wound on a hose-reel with suitable connection to the air main. When not used for air, the hose may be used for conveying water to wet the broken rock before or during shoveling operations.

It is well ascertained that best results are obtained in breaking ground when the amount of burden roughly given to a hole is two-thirds of the length of the hole drilled and according to the width of the stope, and consequently it is more economical to drill a hole from 48 ins. to 52 ins. rather than one of only 36 ins. length. Experiments carefully conducted in certain stopes on the East Rand have been made, and it was found that a 36-in. hole, under the best conditions only provided a total of a half to one ton of broken rock, whereas the longer holes, 42 ins., 48 ins. and over, provided from 1½ to 2 tons and over of rock, dependent, of course, upon the varying conditions in each stope, as before mentioned. This being the case, any scheme for increasing the length of the hole will directly increase the efficiency of labor, as represented in tons broken per laborer, and also increase the efficiency of that laborer, by assisting him to attain the desired definite results without great expense.

Naturally, some system is required which can be readily adopted without disturbing the mine organization too much, or cause difficulty by adoption. It will be a different method to the present one, and one whereby the mines in charge will drill one day's set of holes in one face of stope, and will be followed by hammer boys the next day, while

He prepares another face for subsequent operations. The whole system would be practically one where machinery assisted and developed the efficiency of the hand system of working. It may be said that if machines are used at all, why not use them altogether? This, however, involves the use of more air than required under this method; the setting up of bars to hold drills, and the drilling of larger holes, with the greater consumption of explosive than where the hole is finished for a ⅞-in. diameter gelatine cartridge through the entire length of the hole.

Cost of Air.—The [illegible]-lb. weight automatic rotating machine uses only 30 cu. ft. of free air per minute. Assuming the cost of power supplied to be 1 ct. per kilowatt hour, and that 12½ KW. will compress 100 cu. ft. of air to the desired pressure, namely, 80 lbs. per sq. in. (gage pressure), the cost per air amounts to 1-in. drilled per min. x 6 in. deep x 30 cu. ft. per min. equals 6x30 equals 180 cu. ft. of air, or say 200 cu. ft. of free air per hole. Taking the above factor of 12½ kilowatts per 100 cu. ft. of air compressed the power used would be 2x12½ or 25, say 30 kilowatts.

The advantages obtained by the adoption of the method above described, can be seen if a comparison be made with a first-class mine on the Central Rand where hand rollers are paid 1c per in. if 42 ins. are drilled, plus a bonus of 6 cts., which amounts to 49 cts. per 42 in. hole. Now if this hole can be increased in depth (thus allowing a greater burden to be placed on it) to say 48 ins. or 52 ins. the extra cost of air, etc., would amount to only 1 ct. per hole.

Cost of Plant.—The cost of each automatic rotating drill is $110, and allowing three machines for each miner, the capital cost would be, with hoses and other plant described, say $500 for each set. The machines would wear at least two years and cost $7.50 per month (when working) for repairs. Only one machine would actually be in use, but three have been included in the estimate, so that at any time one could be on the surface for repair, if needed, and one held in reserve by the miner. The daily cost based on the above figures would then be:

Cost of the whole plant, $500.—600 working days in two years equals $0.83 per day for redemption; an excessive figure, because only one machine would be in use.

Repairs per month, $7.50.—26 shifts per month equals 29 cts. per day for repairs. Extra gelatine used, 2 oz. for deeper hole, equals $0.02.

This amounts to a little under 5 cts., total extra cost, to obtain an increase of broken ground amounting to ½ ton or more per hole.

The writer has called attention to the fact that it is not low working costs alone which are to be desired, for it may happen that low working costs do not mean increased profits. It can easily be demonstrated that it is economic folly to strive after low working costs, if the profit is not increased, and he submits that the proposals in this paper will secure all objects, namely, lower working costs, greater efficiency, and last but not least, larger profits

What is said to be the largest rubber suction hose ever made was made for a Philadelphia dredging firm, to be used in a deep water operation. The outside diameter of this hose is 33 inches, while inside it measures 29. The 1,290-pound spiral spring which comprises the foundation of the hose was rolled cold from a rod 1 inch in diameter. The rubber and fabric entering into its construction weighed 3,215 pounds. The rubber and duck were applied in alternative layers with coatings of gum, after which the entire piece was placed in a container and vulcanized with live steam.

In an action brought by the province of Alberta against the Canadian Pacific Ry. testing exemption from taxation of the company's unoccupied lands in Alberta and Saskatchewan, decision has been rendered in favor of the railroad company. The amount involved was $26,000,000.

Transvaal Stope Drill Competition.*

For a number of years there have been attempts on the Rand to determine the efficiency of rock drilling machines with the object of determining the comparative cost of machine drilling and that of hand drilling with the labor there available. The contest for 1909, which lasted nearly a year, is the only one which has really been a thorough test. The other tests were for very short periods of time and carried out on the surface. A test of this kind, drilling holes in the granite blocks, is a very different proposition from that of using a machine for a period covering nearly a year underground. The contest was instituted by the Chamber of Mines, assisted by the Transvaal Government. A first prize of £4,000, and a second prize of £1,000, together with the running expenses of the contest were borne jointly by the Chamber of Mines and the Government.

Nineteen different types of machines were entered for the contest, of which 9 were discarded after the elimination trials made on the surface, and later underground, and ten machines actually entered the trial to continue for 300 shifts. These machines were the Holman 2⅛ in., Holman 2¾ in., Siskol, Climax, New Century 0.0., Chersen, Imperial, Komax, Murphy, Waugh and Westfalia. The stope drill committee decided the contest on the basis of footage costs. Very low costs were obtained in spite of the fact that the men were unfamiliar with the machines at the beginning of the work. The machines not eliminated or withdrawn before the end of the contest were all of about 100 lbs. weight, the lighter machines having proved ineffective. The limits of pressure for compressed air were fixed at from 60 to 75 lbs. per square inch.

In the estimates the cost of drill steel has been taken at 1 ct. per ft. drilled, and the cost of sharpening at 2 cts. per ft. The experience during the competition would point to a much higher figure for the cost of steel, but there is no doubt that a large number of the jumpers provided for the competitors were mislaid and became mixed up with the mine stock. However, the actual cost of steel is a figure which affects both results similarly, and it may therefore be reckoned as an important fact established by means of this competition that machine drilling in moderately narrow stopes costs no more, and perhaps even less, than hand drilling by natives.

The committee having carefully considered the results, made the recommendation that the first and second prizes should be divided between the Holman 2⅛-in. and the Siskol drills. It will be seen that the latter machine drilled more footage, but cost more for spares, but the costs per foot drilled were so remarkably close that it was considered that the machines could fairly be said to have tied.

The points to be noted in connection with the four machines which worked to the close of the competition are as follows:

The Holman 2⅛-in. seemed a little too small, but it drilled well, was easy to handle, and its maintenance was the lowest of any machine, which fact largely assisted in keeping it in the leading position.

Both the Holman 2¾-in. and the Chersen have a [illegible] their valves is very small and easily interfered with by dirt. They also do not drill well in awkward ground and were liable to "fitcher" and stick, thus giving considerable trouble.

The Siskol was of a very convenient size, drilled fast and used a moderate amount of air. Its cradle was faulty in design, as no arrangement had been made for adjustment after wear in the slides, or the feed-screw nut. Its long stroke and length of feed, assisted it in drilling deep holes, often up to six feet. Its maintenance was heavy, especially in the front-head bushing and chuck. The operators found this machine easy to handle, and they liked it. The New Century 0.0 machine, which worked until almost the close of the competition, was, like the Holman 2⅛ in., rather too small and wanting in power. Its feed screw and cradle were too short, necessitating the use of five drills to drill a 4-ft hole, thus making extra cost in transportation and in sharpening drills.

The committee arrived at the following general deductions as a result of the competition: (1) that hammer-drills were not suitable for the general stoping conditions prevailing on the Rand; (2) that hollow steel cannot be recommended, owing to its high cost and difficulty in tempering; (3) no new type of "rig-up" gear submitted or used came up to the Holman type; (4) that any capable miner can efficiently supervise the working of more than two small machines; (5) that five native assistants are necessary to enable a miner to run two machines properly; (6) a good supply of drills should in all cases be available for the miners; (7) five natives being proved as necessary, the machines can be strengthened, as one weighing 125 lbs. can under these circumstances be as easily handled as 100-lb. machines; (8) that under suitable conditions ground can be as cheaply broken with machines as with hammer boys; (9) that machines with long-stroke valve-gears are more efficient than those with short strokes, as they are less liable to get choked; (10) that machines with long piston-strokes proved themselves superior to those with a shorter stroke; (11) that provision of a feed of not less than 18 inches in length appears very desirable.

The following costs of operation are given for the four surviving drills:

Holman 2⅛-in.—	
White labor	$[illegible]
Native labor	647.97
Air	[illegible]
Drill sharpening	[illegible]
Drill steel	129.66
Spares	[illegible]
Stores	111.49
Depreciation of machines	[illegible]
Total	$2,[illegible]
Footage to count	[illegible]
Ft. per shift for 2 machines	59.4
Cost per ft. drilled	$0.19[illegible]
Siskol—	
White labor	$[illegible]
Native labor	[illegible]
Air	[illegible]
Drill sharpening	[illegible]
Drill steel	[illegible]
Spares	[illegible]
Stores	147.31
Depreciation of machines	[illegible]
Total	$[illegible]
Footage to count	14,083
Ft. per shift for 2 machines	65.5
Cost per ft. drilled	[illegible]
Holman 2¾-in.—	
White labor	$[illegible]
Native labor	681.40
Air	[illegible]
Drill sharpening	238.29
Drill steel	119.15
Spares	[illegible]
Stores	119.51
Depreciation of machines	[illegible]
Total	$2,601.24
Footage to count	11.744
Ft. per shift for 2 machines	[illegible]
Cost per ft. drilled	$0.21[illegible]
Chersen—	
White labor	$[illegible]
Native labor	[illegible]
Air	383.36
Drill sharpening	239.05
Drill steel	119.53
Spares	[illegible]
Stores	[illegible]
Depreciation of machines	207.27
Total	$2,855.43
Footage to count	11,781
Ft. per shift for 2 machines	54.8
Cost per ft. drilled	[illegible]

Methods and Cost of Filling by Hydraulic Dredging; Lincoln Park Extension, Chicago, Ill.

The work of increasing the area of Lincoln Park, Chicago, by means of filling in the submerged lands along the shore of Lake Michigan from Diversey Parkway northward, and creating an addition to the present park of 197.54 acres, was made possible by a bond issue in 1903 of $1,000,000. The work includes, besides the area north of Diversey Parkway, a proposed island covering 23.7 acres located off-shore from the present park between Diversey and Fullerton Parkways.

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*Abstracted from [illegible] Committee on the T[illegible]

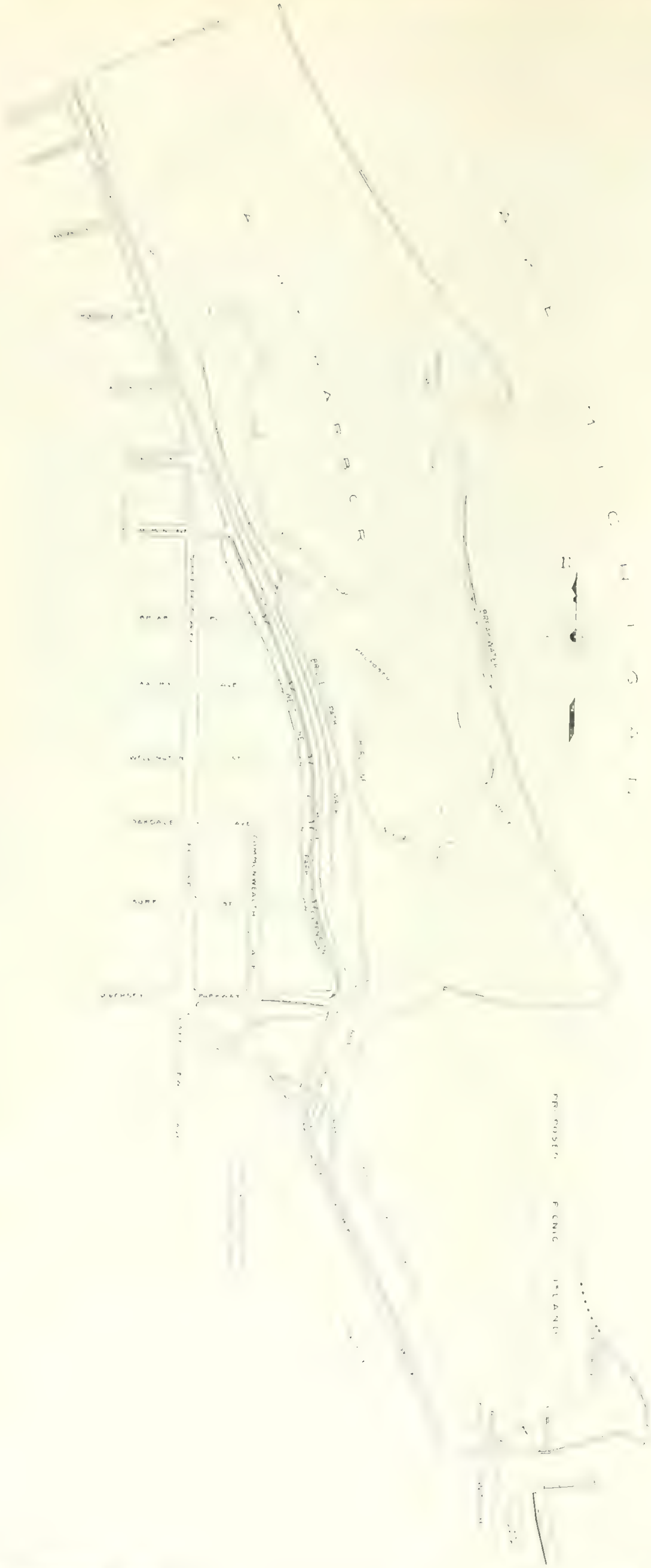

Fig. 1—General Plan Showing the Area Reclaimed for the Extension of Lincoln Park, Chicago.

the general plan of the extension is indicated by Fig. 1.

The work of filling in, which is now about 60 per cent completed, has been done with a 30-in. hydraulic dredge built especially for lake work and its operation and costs afford some interesting information regarding this class of work along the great lakes. The methods and cost of breakwater construction are also of special interest. The area north of Diversey Parkway is a strip about 1,500 ft. wide and about 1 mile long, containing a yacht harbor of about 50 acres in area, and protected by a breakwater described elsewhere in this issue. The proposed Picnic Island is about 2,400 ft. long and varies from 225 ft. to 700 ft. in width. The island will be protected by a breakwater on the outside and ends, leaving a sloping beach on the land side. Aside from the mere filling in and breakwater protection the scheme requires most of the new surface to be graded, covered with loam and seeded; the building of walks and drives, a drainage system and a water system, the planting of trees and shrubs and miscellaneous park necessities, which altogether require a large amount of engineering work.

Dredging.—The 30-in. hydraulic dredge "Francis T. Simmons" was purchased in 1907 for the work of making the fill. It has now been in operation four seasons and has made about 1,800,000 cu. yds. of fill, making a total of 68 acres of new land.

The dredge is of the open end type. The hull is of steel and is 148 ft. long by 38 ft. wide, by 10½ ft. deep. The main pump has 30-in. suction and discharge and the main engines are of triple expansion marine type of 1,200 I. H. P. There are two double ended marine boilers 11 ft. 6 ins. x 18 ft. long with 8 corrugated furnaces. These were fitted at the beginning of last season with eight Jones Underfeed stokers which have eliminated the complaints formerly made on account of the smoke and have brought about a more efficient combustion as may be seen by the accompanying view, Fig. 2, which was taken when the dredge was working to full capacity. The installation of engine room auxiliaries includes condenser, independent air pump, independent circulating pump, fire and bilge pumps, and an electric light outfit. The condenser is of sufficient size to receive the exhaust steam from the cutter engines as well as from the main engines and all auxiliary engines. The rotary cutter is of a type adapted to hard and clay material capable of penetration with a pick and can handle soft and sticky clay without clogging. The cutting edges are of hard steel and are removable. These will probably be changed before beginning next season's work as they have now worn down after two seasons' service. It is likely that manganese steel will be substituted. The dredge is anchored by heavy spuds operated by power. One of the spuds is used as a pivot about which the dredge makes a radial cut 175 ft. wide at one time. The maximum depth of the cut is 35 ft. The dredge is provided with a complete repair shop and with living quarters for the crew. A general drawing of the dredge was given in ENGINEERING-CONTRACTING for Dec. 25, 1907, shortly after it was placed in commission. Considerable comment was made upon the use of a hydraulic dredge in Lake Michigan when this work was started, because it was predicted that it would be impossible to maintain a flexible discharge pipe line in the waves, and that more time would be lost on account of the weather than is the case with other types of dredges. As a matter of fact the proposition has been reversed and with the improved design of the discharge pipe, the dredge suffers less delay on account of weather than a barge loading dredge.

Pipe Line.—The form of pipe line adopted, as shown by Figs. 3 and 4, is that of a central conduit, 30 ins. in diameter carried by two cylindrical air chambers 33 ins. in diameter, the three being rigidly held together by the frame, as shown in the drawing. In this way no bolts or rivets are put into the air chambers and they may readily be taken apart. The sections are 95 ft. long, it having been found that shorter sections did not operate in a rough sea as well as the longer ones. The connections between the sections of discharge pipe are joined with the usual rubber sleeve but the pontoons are connected with an arrangement which embodies the ball-and-socket principal, not in the pipe itself, but in a strong, steel frame above the pipe. This has proved entirely successful and the practical result is that the dredge is capable of continuing at work in all but the heaviest weather. The detail construction of the pipe line joints is illustrated by Fig. 3. The ball end of the joint is solidly bolted to the wood frames on the pipe, while the socket end is fitted to slide in a casing or frame and its movement is resisted by springs, as shown. These springs are heavy car springs, and are two in number. The springs are carried between spring plates in such a manner that they are compressed for either thrust or pull of the drawbar, the whole arrangement is built in the very strongest manner of steel, and each point is strong enough vertically to carry half the weight of an entire pontoon upon it. In other words, should the entire buoyancy be removed from one pontoon for 50 ft. of its length by the trough of a wave, its weight would be supported upon the adjoining pontoon with safety.

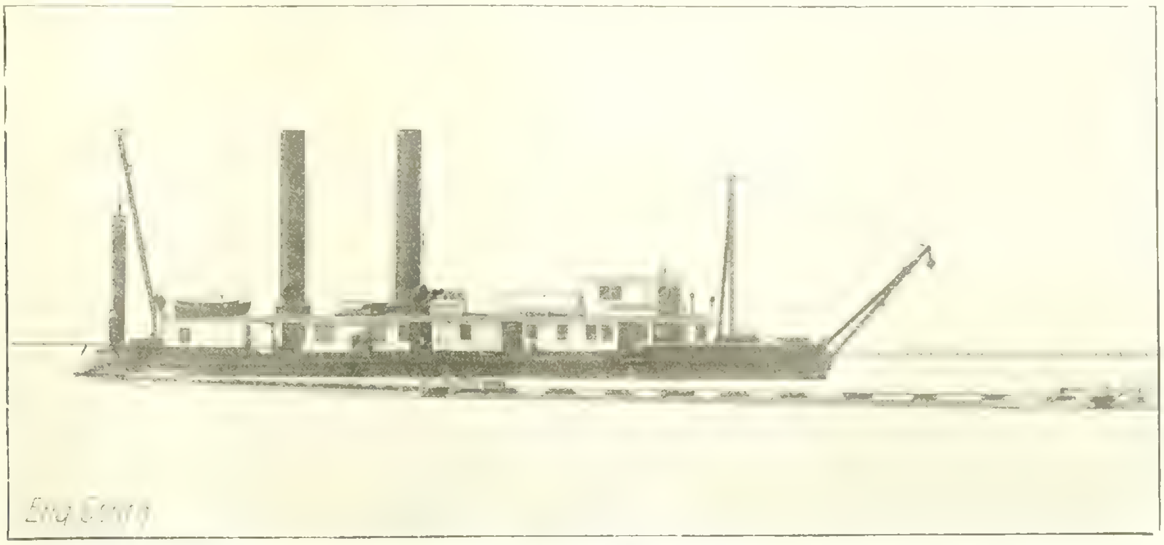

Fig. 2—View of 30-in Hydraulic Dredge "Francis T. Simmons" in operation in Lake Michigan.

In order to provide flexibility of the pipe at the point of leaving the dredge, a swivel elbow is employed and the first length of pipe is short and connected to the elbow by a pair of hinges. The axis of the hinges is horizontal while that of the swivel elbow is vertical; thus the movement of the pipe is universal. The pipe leaves the dredge at the corner in order to permit the pipe to radiate from the dredge at any angle through three-fourths of a circle. The horizontal hinges at the swivel elbow will permit the main pontoons to have a vertical or wave movement of 4 ft. The pipe is attached at one end, to the dredge, and at the land end to a terminal scow which is fitted with a steam winch, by which its own anchorage is controlled. This detail of passing the discharge line onto the land has been worked out in the practice of the last two years so that it is expected in the coming season to profit by the results. The method devised for future use is to anchor the terminal scow at the farthest point of fill, and as the fill is made, to back the terminal scow away, thus eliminating the use of shore pipe entirely, the stopping of the dredge, and preventing a loss of time due to adding shore pipe. The length of the overhang of the discharge pipe beyond the terminal scow has been made 60 ft. in place of 30 ft. This change was made to prevent the scow from grounding on material flowing back under it from the discharge, a trouble which has previously caused some loss of time. Experiments were made of passing [illegible] pipe through the breakwater, as this was a more direct line from the dredge to the fill when the dredge was working in the open lake. At first the terminal scow was tied [illegible] to the [illegible] connected to the land pipe. This was found to be unsatisfactory because the scow was too easily affected by the wave action and was endangered by constantly bumping against the breakwater. A scheme was evolved by which the scow was done away with entirely and the pontoons were connected directly to the pipe projecting through the breakwater from the land side. The first floating pontoon was guyed to the breakwater from the far end, enough slack in the cables being allowed to permit the pontoon to take a reasonable angle to its connection. The cables were fastened together at the middle with a special clip which could be loosed with one blow of a maul [illegible] that a quick release could be obtained in case of necessity. At the time of [illegible]

[illegible]

[illegible] ing dredging work are much greater for work on the great lakes than for work on smaller lakes or upon other inland waters. The time [illegible]

[illegible] compelled to stop work when the sea becomes only so rough as to cause hard bumping between the scow and dredge. The time lost by the "Francis T. Simmons" on account of weather during the past season has averaged 18.2 per cent. In 1909 the average was 9 per cent, [illegible] 11 per cent [illegible] in 1907 it was [illegible]2 per cent. A time report of the dredge operation for 1910 is given in Table I.

TABLE I.—TIME REPORT OF DREDGE FRANCIS T. SIMMONS FOR 1910.

Month	Available Working Time Hrs.	Pumping Time Pct.	Weather Pct.	Mis. Pct.	Total Pct.
April	[illegible]	42	[illegible]	[illegible]	[illegible]
May	600	[illegible]	19.0	[illegible]	[illegible]
June	[illegible]	80.0	1.0	19.0	20.0
July	[illegible]	[illegible]	14.0	17.6	31.6
August	[illegible]	[illegible]	9.0	19.0	[illegible]
September	[illegible]	[illegible]	[illegible]	27.0	[illegible]
October	[illegible]	[illegible]	18.0	28.0	46.0
	[illegible]	60	18.2	21.6	39.8

The above table serves to give an idea as to the percentage of time used for various delays and in actual work during the working season

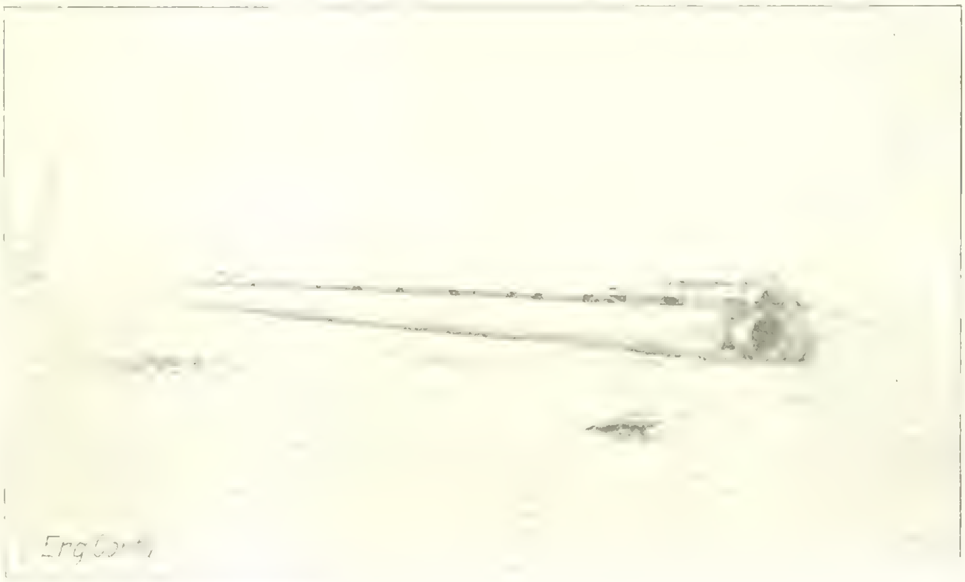

Fig. 3—View of Pontoon Discharge Pipe Used in Connection with the 30-in. Hydraulic Dredge.

[illegible] to give an idea as to the amount of time used for delays caused for other reasons than weather and the distribution of the time lost for various causes. The record sheet for the month of September is chosen for this illustration because, this month, the dredge worked [illegible]

[illegible] than any other month.

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible] the dredge worked 11 days from a position outside the breakwater protection and 11 days in the yacht harbor, the location of which may be seen on the general plan, Fig. 1. The balance of the time was taken up by bad weather, Sundays and holidays.

The cost of the work for the season of 1910 is shown in Table III. The items of tug service are calculated at actual cost per hour of service. The cost of operation of the tugs and other auxiliary machinery is given later.

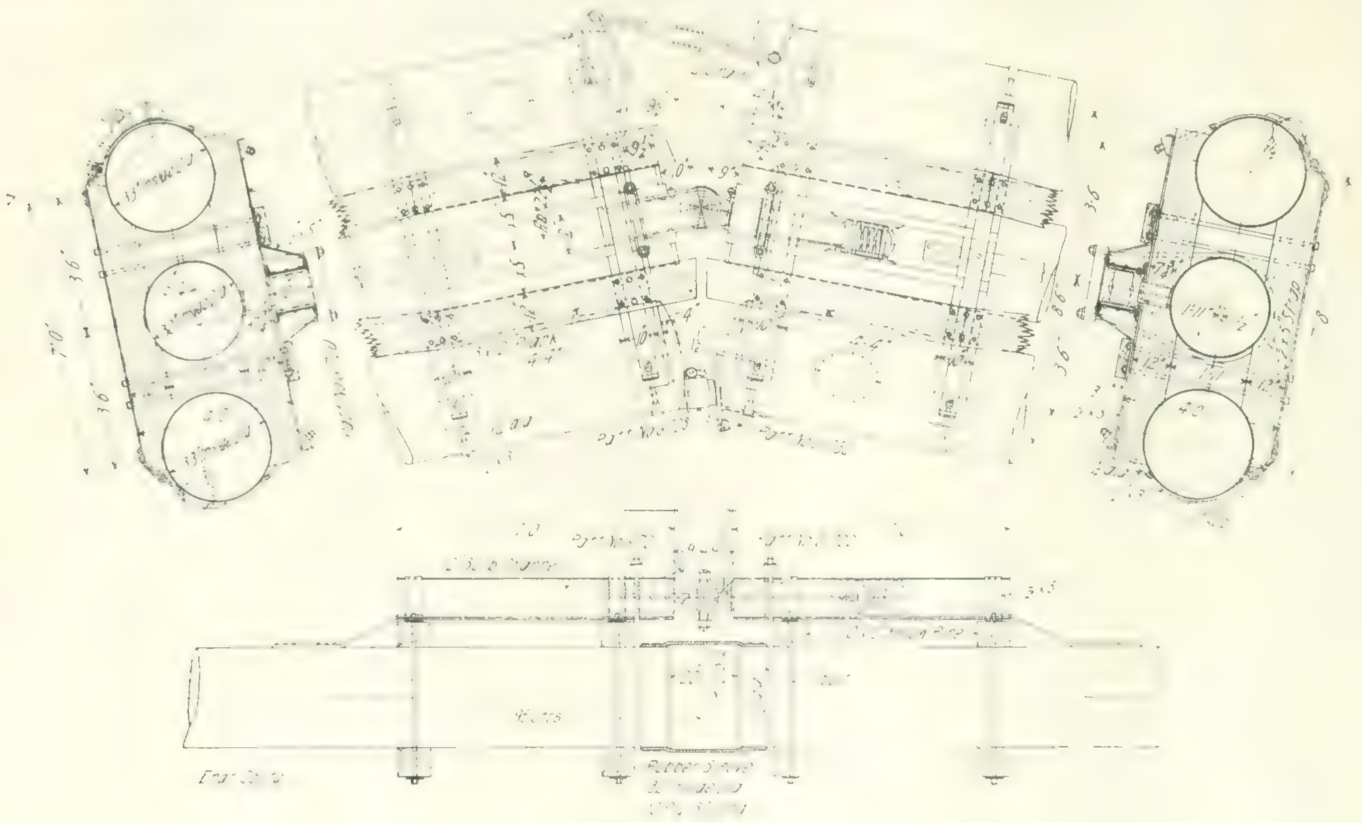

Fig. 4—Details of the Pontoon Discharge Pipe Connections Used in the Work in Lake Michigan.

TABLE III.—COST OF OPERATION AND REPAIRS OF DREDGE, 1910; TOTAL TIME IN COMMISSION, 4,320 HOURS.

Operation:	Totals.	Per hr.	Per cu. yd.
Labor	[illegible]	[illegible]	[illegible]
Fuel	[illegible]	[illegible]	.0300
Supplies, tools, sleeves, and etc.	[illegible]	1.0008	.0076
Commissary labor and supplies	6,010.90	1.3914	.0104
Field repairs, labor and material	[illegible]	1.3983	.0106
Tug service	[illegible]	3.1453	.0238
[illegible]	[illegible]	.0757	.0005
[illegible]	[illegible]	.1352	.0010
[illegible]	[illegible]	[illegible]	.0060
Winter repairs and overhauling:			
Labor	[illegible]	.2194	[illegible]
Material	2,164.25	.501	.0037
Fuel commissary and tools	1,025.41	.2374	.0018
Tug service	753.08	.1743	.0013
Totals:			
Operation	[illegible]	15.0996	.1142
Repairs	[illegible]	[illegible]	.0161

The repairs shown with the operating expenses in Table III include the minor repairs made during operation, which those shown under the head of winter repairs are for repairs made during the winter season in preparation for the work of the summer of 1910. Some of the field repairs included the relining of several pontoon discharge pipes. This work costs [illegible] per pontoon, $1[illegible] for material and $100 for labor. The pipe is relined with a strip of ⅜-in. sheet steel, 36 ins. in width, placed in the bottom of the pontoon to fit the circumference. The pontoons are 95 ft. long. When refined they are expected to last three or four seasons. The winter repairs consisted of overhauling the engines, boilers, furnaces, [illegible] and replacing [illegible] pipe connections. The ergines were relined, the shafts rebabitted and rebushed. The heaviest wear, however, is on the cutter mechanism. The cutter ran two years without renewal of blades. The next blades put in, however, will probably be of manganese steel and are expected to last longer. The centrifugal pump runner lasts about two seasons and costs $600. It is of cast steel with a steel lining on the blades. The other repairs consist of cleaning and scraping the steel hull and painting.

Table IV is a summary of the costs and performance of the dredge for the past four seasons, or since the dredge was built. It must be noted here that the yardage as given for the years 1907-8 and 9 was calculated from the cut, while that for 1910 has been calculated from the total amount in place. For this reason the season of 1910, which is believed to have been the best season's work yet done, does not show well in the comparison.

The operating crew of the dredge is as follows:

	Per mo.
[illegible] Chief operator	[illegible]
[illegible] Assistant operator	[illegible]
[illegible] Chief engineer	150.00
[illegible] Assistant chief engineer	110.00
[illegible] Oilers	[illegible]
[illegible] Firemen	66.00
[illegible] Coal passers	[illegible]
[illegible]	66.00
[illegible] Janitor	[illegible]
[illegible] Deck hands	[illegible]
Commissary:	
[illegible] Steward	[illegible]
1 Second cook	40.00
1 Porter	40.00

The men receive their board in addition to the wages listed. They work two 12-hour shifts. For overtime they are paid time-and-a-half and if worked Sundays (which is extremely seldom), they get double time. All overtime is paid for in addition to and not considering their regular wage. This is in accordance with the union rules on the great lakes.

The dredge was designed by Mr. A. W. Robinson, Consulting Engineer of Montreal, who has previously designed dredges for lake work and for work on the St. Lawrence River in Canada. In a paper by Mr. Robinson, given before the Canadian Society of Civil Engineers in 1904, which describes the type of dredge used on the St. Lawrence River, the output and costs per cubic yard of operation are given for several dredges. The costs per cubic yard run from 1¾ cts. to 5.1 cts. The material handled, however, is soft clay and sand and the output is several times greater than is possible with the material encountered on the Chicago lake shore. The dredge at Lincoln Park is working in a very stiff gumbo

TABLE IV.—FOUR YEARS' OPERATION OF DREDGE.

Cubic yards	[illegible]*	[illegible]*	[illegible]*	570,243†
Cost	[illegible]*	[illegible]*	[illegible]*	$74,440.49†
Cost per cu. yd.	[illegible]	$0.131	[illegible]	[illegible]
Hours in commission	[illegible]	[illegible]	3,291	4,320
Hours pumping	[illegible]	[illegible]	[illegible]	2,599
Hours delayed account weather	[illegible]	[illegible]	[illegible] = 9.0%	[illegible]
Hours delayed miscellaneous	[illegible]	1,100 = [illegible]	[illegible] = 26.7%	933 = 21.6%
Hours delayed total	1,852 = 63 %	1,736 = 39.4%	1,174 = 35.7%	[illegible]
Output per pumping hour, cu. yds.	426	245.8	245	220
Cost of coal	$10,131.04	$16,050.68	[illegible]	$17,000.35
Cost of coal per cu. yd.	$0.022	$0.024	$0.022	$0.03

*Based on calculation of cut measurement.
†Based on calculation of place measurement.

clay which is covered with a layer of from 3 to 5 ft. of sand. The depth of the dredging at Chicago is from [illegible] to [illegible] ft. and the material was deposited through about 2,000 ft. of pipe.

Cost of Dredge.—The following table gives the list of items which together make up the cost of the dredge as it was put in operation in 1910:

Engineering, plans, inspection, [illegible]	[illegible]
Contract [illegible]	[illegible]
Terminal [illegible]	[illegible]
[illegible] Jones underfeed [illegible]	[illegible]
6 Pontoons [illegible]	[illegible]
Miscellaneous	[illegible]
Total	[illegible]

Cost of Tenders.—In connection with the dredging work and other construction tributary to the Park Extension work, a fleet of tugs, derricks and other floating apparatus was employed. The cost of operation of each of these for the past year is given below, together with the original cost, maintenance cost, and a brief description of the apparatus.

The tug "Keystone" has a steel hull, 87½ ft. long, 19 ft. beam, and 11 ft. deep. She is of 94 gross ton weight, and was built in 1891. She contains 1 fore and aft compound condensing engine with 18x34-in. cylinders of 30 ins. stroke, and one fire box marine boiler 14 ft. long by 102 ins. in diameter carrying steam at 125 lbs. The crew is as follows:

	Per month.
1 Captain	[illegible]
1 Engineer	[illegible]
2 Firemen	65.00
1 Deckhand	[illegible]
1 [illegible]	[illegible]
1 Watchman	[illegible]
1 Cook, including supplies	[illegible]

This tug was in commission 12 hours per day. Board was furnished the men in addition to the regular wages. The tug was purchased by the Park Commission in 1905 at a cost of $13,983.19, including improvements, and was fitted with Jones underfeed stokers in 1910 at a cost of $2,025, making its total cost $16,008.19. It has been in commission 2,348 hours. The cost of operation has been as follows:

	Cost.	Cost per hr.
Labor operation	[illegible]	[illegible]
840 tons coal	2,772.50	1.180
Supplies	[illegible]	[illegible]
Insurance	[illegible]	[illegible]
Labor repairs	[illegible]	[illegible]
Material repairs	[illegible]	[illegible]
Total cost of operation	$9,301.19	$3.961

Summarizing we get the following costs:

Total cost of repairs	$1,960.82
Cost of operation per hour	3.961
Cost of operation per day	47.55
Cost of repairs per [illegible]	[illegible]
Cost of repairs per [illegible]	[illegible]
Cost of operation [illegible]	[illegible]
Cost of operation [illegible]	[illegible]

This tug was used mostly for towing scows loaded with loam for park purposes, but 89 hours of its time have been charged to the dredging.

The tug "Richard B," another member of the fleet, is 76 ft. long, 17 ft. beam, and 7 ft. depth. [illegible] at 63 gross tons. She is equipped with one fore and aft compound condensing engine 10x20-in. cylinder with 14 ins. stroke. Her boiler is Scotch Marine type, 14 ft. long by 96 ins. in diameter, and carries 125 lbs. of steam. She was built in 1906. Her crew consists of a captain at $145, an engineer at $120, a fireman and a lineman each at $65. The tug was purchased by the Park Commission in 1905 for $8,744.55, which price included some repairs and improvements made on it. before placing it in commission. The cost of operation and repairs during the season of 1910 were as follows:

Hours in commission	[illegible]
Hours [illegible]	[illegible]
Hours [illegible]	[illegible]

Item.	Cost.
Labor operation [illegible]	[illegible]
Fuel [illegible]	[illegible]
Supplies	104.03
Insurance	[illegible]
Labor repairs [illegible]	[illegible]
Material repairs	[illegible]
Towing repairs	[illegible]
Total operation, 386 hours	991.66
Total repairs, 1,118 hours	1,067.52
Total operation and repairs	2,059.18
Total cost per [illegible]	[illegible]
Total cost per day	42.36

The time of this tug was charged to the dredge work for 139 hours. It was in commission 12 hours a day.

The tug "Hausler," the last of the three tugs belonging to the fleet, is 72 ft. long, 18 ft. beam, 9 ft. deep, and is rated at 61 gross tons. She was built in 1893 of wood. Her machinery consists of 1 vertical non-condensing engine, 22x44 in. cylinder with 24-in. stroke. She has 1 fire box marine boiler, 14 ft. long x 96 in. in diameter, carrying 135 lbs. of steam. Her crew, a double crew, during the past season each consisted of a captain at $165, an engineer at $120, and two firemen and one deckhand at $65. She was in commission 24 hours per day. This tug was purchased in 1908 for $10,500. The cost of operation and repairs for the season of 1910 is as follows, for 5,537.5 hours in commission:

	T[illegible]	Cost per [illegible]	Cost per [illegible]
Labor operation	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Supplies	[illegible]	[illegible]	[illegible]
Insurance	250.00	.045	.54
Labor repairs	1,317.26	.238	2.86
Material repairs	1,897.63	.343	4.12
Towing repairs	14.12	...	.02
Total operation	11,806.57	2.13	25.58
Total repairs	3,224.01	.59	7.06
Total cost	15,035.58	2.72	32.64

This tug devoted nearly all its time to the dredge.

The motor boat which was used for transportation of the men and for other purposes was purchased in 1907 for $1,150 and operated for 7½ months during the season of 1910. Its cost for the season, time in commission 7½ months, was as follows:

Labor operation	[illegible]
Labor repairs	[illegible]
Supplies	[illegible]
Derrick, 2 hours at $1.60	3.20
Total cost	$779.50
Cost per month	103.92
Cost per day	[illegible]

About 146 days of the motor boat's time was charged to the dredgs.

The floating derrick, which was employed for various duties on all the work, was purchased in 1905 at a cost of $5,287.26. Its cost of operation for the past season is as follows:

Hours in commission	1,783.5
Labor operation	$1,871.29
Fuel and supplies	599.07
Insurance	[illegible]
Labor repairs	268.70
Towing	[illegible]
Total	[illegible]
Total cost of repairs	286.32
Total cost of operation	2,570.36
Total cost per hour	1.60
Total cost per day	16.00

The derrick was in commission 10 hours per day and was operated by a crew consisting of an engineer and fireman with a varying number of deckhands—usually about four.

The work of grading the Lincoln Park Extension and of covering the area with loam has been prosecuted with vigor, following upon the completion of the work described in this article. A description of the grading work will follow in a future issue.

The work described is being done under the supervision of Mr. M. H. West, Superintendent of Lincoln Park System, and Mr. A. S. Lewis, Asst. Supt. Mr. C. W. Baggott is engineer in charge of the marine department, which includes the dredge work and breakwater construction. We are indebted to them for the information furnished for the preparation of this article.

ROADS AND STREETS SECTION

Experimental Work of the Illinois Highway Commission in the Use of Bituminous Compounds in Macadam and Earth Road Construction.*

The Illinois Highway Commission has made considerable use of bituminous compounds in road construction during the seasons of 1908, 1909 and 1910. The form of construction involving the use of these compounds was looked upon as entirely experimental and although there has been considerable progress made towards standardizing these materials and the methods of construction involving their use, still it is thought that as yet the use of tars and asphaltic compounds for construction purposes must be considered as more or less of an experimental nature.

The roads that were built by the Illinois Highway Commission were constructed for the purpose of determining one or more of the following questions:

First—The general desirability of the poured asphalt or tar macadam road as regard dustlessness, resistance to wear and comfort of travel.

Second—The relative cost of the waterbound macadam and the tar or asphalt poured macadam.

Third—The relative cost of maintenance of waterbound macadam and the poured asphalt or tar macadam.

Fourth—The suitability of an asphalt oil in the construction of earth roads.

In the construction of the bituminous macadam roads it was decided to confine the experiments entirely to the poured macadam. It is a matter of common observation that on roads which are traveled exclusively or almost exclusively by farm teams, the traffic confines itself to 7 or 8 ft. of the width of the road, the wheel wear coming entirely upon two strips of the roadway which usually do not exceed 2 ft. in combined width. Where tendency because the traffic must necessarily spread out on account of the constant passing

TABLE I.—PROPERTIES OF TARS USED IN 1909 BY THE ILLINOIS HIGHWAY COMMISSION.

Sample No.	Place used	[illegible] Pent'n 5° C. 50 g'ms	[illegible]	Free carbon	[illegible] of Distillation— [illegible]					Pitch residue.
					[illegible]	[illegible]	solids	[illegible]	solids	
101	E. St. Louis, No. 3	[illegible]	[illegible]	24.99	[illegible]*	[illegible]	[illegible]	32.72	[illegible]	60.88
103	Edwardsville		1.240	[illegible]	[illegible]	[illegible]	[illegible]	22.12	70	72.28
104	E. St. Louis, No. 2		1.222	21.03	[illegible]*	[illegible]	[illegible]	24.00	[illegible]	68.64
[illegible]	Bushnell, No. [illegible]		1.236	[illegible]	1.33†	.66		26.67	[illegible]	71.34
106	Mt. [illegible]		1.236	21.10				32.00	[illegible]	68.00
107	E. St. Louis, No. 1	11	[illegible]	20.68	2.67†			20.00	25	77.33
[illegible]	Elburn	[illegible]	[illegible]	20.18	1.33			[illegible]	50	68.00
[illegible]	Mt. [illegible]		1.243	18.55		5.33	[illegible]	28.67	90	66.00
110	Bushnell, No. 3	[illegible]	[illegible]	18.27	[illegible]			24.67	[illegible]	71.33
111	Fl[illegible], No. [illegible]	10	[illegible]	22.13	.67†	2.67	[illegible]	21.33	[illegible]	75.33
112	Flossmoor, No. 1	[illegible]	1.238	22.09		6.67	100‡	21.33	90	72.00
113	Grant Park		1.239	22.24				24.67	40	75.33

*Indicates [illegible]

†Indicates [illegible]

‡Indicates [illegible]

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*Paper by T. R. Agg, Assistant Engineer Illinois Highway Commission, presented at the last annual meeting of the Illinois Society of Engineers. Additional information furnished us by Mr. Agg is inserted in brackets.

TABLE II—COST DATA OF EXPERIMENTAL MACADAM

[illegible]	[illegible]	[illegible]	[illegible]	DeK[illegible]	Effing[illegible]	[illegible]	L[illegible]	H[illegible]ro	M[illegible]	R[illegible] I'land	S[illegible]	Mendota	DeKalb	Carmi—F G	Carmi—Com	[illegible]
[illegible]	[illegible]	1906	1906	1906	[illegible]	[illegible]	[illegible]	[illegible]	1907	1907	1907	1907	1907	1908	1908	1908
Cost per cu. yd. for placing stone—																
[illegible]	.09	.08	.04	.07	[illegible]	.06	.14	.09	.16	.21	.10	.15	05	04	.10	[illegible]
[illegible]	.17	.23	.24	[illegible]	.17	32	.47	.63	18	.69	.22	.31	49	29	.30	[illegible]
[illegible]	10	.04		[illegible]	.10	.06	.13	.08	.08	.07	.12	.09	.06	13	.10	[illegible]
[illegible]	.11	[illegible]	.03	[illegible]	.13	.10	.14	.10	.15	.14	.15	.05	.15	.06	.07	.04
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	c	c	c	[illegible]	c	[illegible]	.04	[illegible]	.04
[illegible]	[illegible]	d	d	d	d	[illegible]	d	d	d	d	d	.02	d	.02	.02	[illegible]
[illegible]	.47	.41	.38	.56	[illegible]	.54	[illegible]	[illegible]	.57	1.11	.59	.62	.75	.58	.55	.50
Labor cost per sq. yd. finished macadam.																
[illegible]		.020	[illegible]		.04	.04	.04	[illegible]	[illegible]	.03	[illegible]	[illegible]	.010	.018	.012	.008
[illegible]		.010	[illegible]	d	[illegible]	[illegible]	[illegible]	[illegible]	.04	.03	.010	.059	.010	.038	.044	.060
[illegible]		.030	[illegible]	.10	.03	[illegible]	[illegible]	[illegible]	.04	.02	.090	.030		.020	.018	.003
[illegible]		.010	.01	d	.01	[illegible]	[illegible]		.03	.04	.060	.025	[illegible]	.001	.005	.005
[illegible]		[illegible]	[illegible]	[illegible]	.15	[illegible]	[illegible]	.35	.20	.36	.240	.260	.090	.164	.201	.159
Applying bit. binder....................															....	
Applying gravel binder.................														.	.	.006
Totals, per sq. yd..........................		.240	[illegible]	.35	.29	[illegible]	[illegible]	.57	.35	.48	.450	.398	.115	.231	.280	.241

[illegible] Inc. in spreading. [illegible] Inc. in hauling. Hauled by engine, cost 66 cts. per cu. yd. when hauled

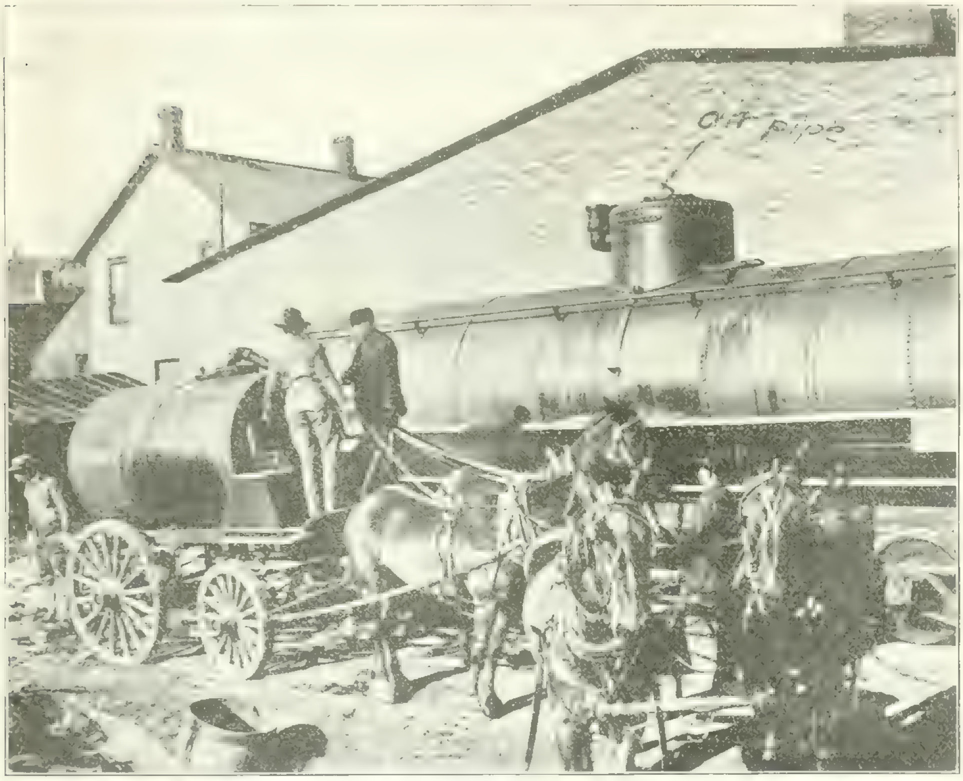

Fig. 1—Unloading Tank Car by Air Pressure.

In general, bituminous macadam roads have been made about 9 ins. thick at the crown line and about 6 ins. thick at the edge after rolling. The stone is placed in two courses, the top course of 3-in. stone being 2½ to 3 ins. thick after rolling and the lower course of 2-in. stone being 6½ ins. thick at the crown line and 3½ ins. thick at the shoulder or curb line after rolling. The lower course is spread, harrowed, rolled and bonded with water and screenings in the manner of an ordinary waterbound macadam roadway. It was learned early in the experiments that an essential part of this form of construction is to have the top course of uniform texture, and it was found that herein lay the greatest difficulty in the construction; unless every detail is carefully watched from the inception of the project, it is certain that there will be a lack of uniformity in this upper or wearing course. In order to insure absolute uniformity in thickness and texture of the upper course, evidently the lower course must be laid very carefuly and finished absolutely true to cross section and grade in every particular. The top course of stone must then be spread with great care so as to insure thickness, it must be harrowed to bring a uniform sized stone to the surface and then be rolled until it is well keyed together. Where the 3-in. stone is used, it has usually been found necessary to sprinkle over the surface after the first rolling a small quantity of 2-in. stone, and to roll this smaller size into the surface, which has the effect of pushing together the large stones in the surface and keying them up tight so that after this rolling has been done, the surface presented is so compactly knit

this concentrated traffic is encountered there is a marked tendency for bituminous macadam to squeeze out along the wheel track, forming a broad depression. The wear also must necessarily be great where the vehicles all follow the same track. This depression will eventually become deep enough to hold water which hastens the deterioration of the road. On village streets there is no such

Where these conditions are encountered, it is essential to design a poured macadam pavement so that the lower course shall give stability and the upper course provide a durable wearing surface so placed that the opportunity for lateral displacement of the stone composing it is reduced to a minimum.

Four sizes of stone as follows are used in the experimental bituminous roads:

Stone passing [illegible] through [illegible] stone

Stone [illegible] through [illegible]

Stone [illegible] through a ¾-in. screen designated as chips.

Screenings that pass through a ¼-in. screen [illegible]

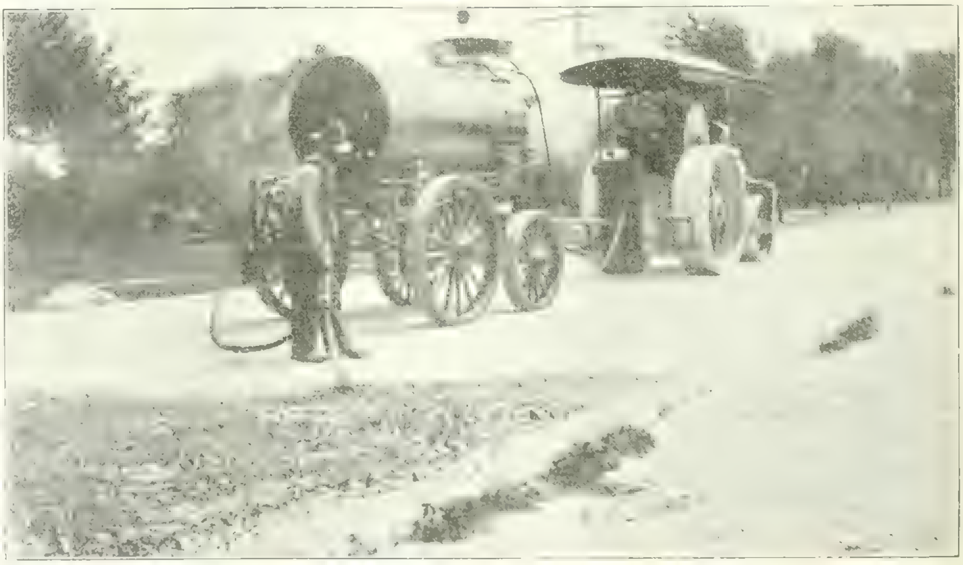

Fig. 2—Spraying Tar by Means of Pressure from Steam Roller.

CONSTRUCTION BY THE ILLINOIS HIGHWAY COMMISSION

Lockport	Highland	Danville	Sheldon	[illegible]	Wheaton	Dwight	Sullivan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Edwardsville	Mt. Sterling	[illegible]	Galena	Sycamore	[illegible] Park B[illegible]	Flossmoor	Watseka	Morris
1908	1908	1908	1908	1908	1908	1908	1908	1908	[illegible]	[illegible]	1909	[illegible]	[illegible]	[illegible]	[illegible]	1909	1909	[illegible]	1909	1909	1909	1909	1909
d	.02	09	04		.12	d	.10	09	d	.15	09	11	d	15	14	10	.12	.13	.37	10	08	.11	.10
14	.27	10	32	.22	53	.48	.50	.34	.33	.37		[illegible]	[illegible]		40	18	[illegible]	.32	.35	10	.28	35	.34
.09	.06	.07	08	04	.07	09	.10	.11	09	[illegible]	11	[illegible]	.11	10	16	[illegible]	11	12	.10	09	09	06	.09
04	.04	.08	[illegible]	[illegible]	08	.05	.11	07	.06	06	08	[illegible]	05	08	03	[illegible]	07	03	02	[illegible]	05	.03	.06
04	c	.06	03	.01	.01	.01	.05	.03	.02	.05	01	.01	[illegible]	07		01	.07		.02	06	07	.07	.05
d	.03	02	[illegible]		.04		.07	.04	02	02	01	[illegible]	05	03	02	02	02	02	.03	04	03	.03	.02
.31	42	.72	[illegible]	43	85	.63	.93	68	.52	.71	[illegible]	[illegible]	73	1 00	75	.42	75	62	89	.75	60	65	.66
.009	.006	.017	[illegible]	[illegible]	033	.013	.010	.013	008	120	[illegible]	014	020	035	012	.013	022	.007	.013	.012	022	013	033
		108			094	.003	[illegible]	.015	.068	056	060			028	005	.042	.035	.020	.012	.023	003	.005	
.009	.023	.012	007	[illegible]	[illegible]	.005	.016	.009		012	.020	007	[illegible]	015	012	.018	120	.009	.010	.013	008	.003	.009
.001	.012	.004	.008	[illegible]	[illegible]		019	.008		024	[illegible]	007	007	007		.011	.033	.015	.007	.007	025		.008
.102	.115	249	[illegible]	[illegible]	285	215	.241	.198	.220	22	[illegible]	190	235	285	.253	.162	.260	.210	.290	.251	.230	.210	.214
...	...								.011				[illegible]		023	.015	.038	.028		.015	.030		
.013	.	.016	.076		016		081	10											.060		.	.016	002
.134	.241	.306	.284	.153	.456	236	370	.253	307	311	[illegible]	[illegible]	241	.370	.305	.261	.508	289	.392	321	.318	247	.566

by team.

together that without the addition of any binder it is possible to haul a loaded wagon over the surface with but slight disturbance to the stone. When this condition is realized it seems that the ideal for a poured macadam has been reached. The upper course of stone now presents a surface which is sufficiently stable to carry the weight of the loads which will come upon it and it only remains necessary to add to it something that will prevent the displacement of the stone.

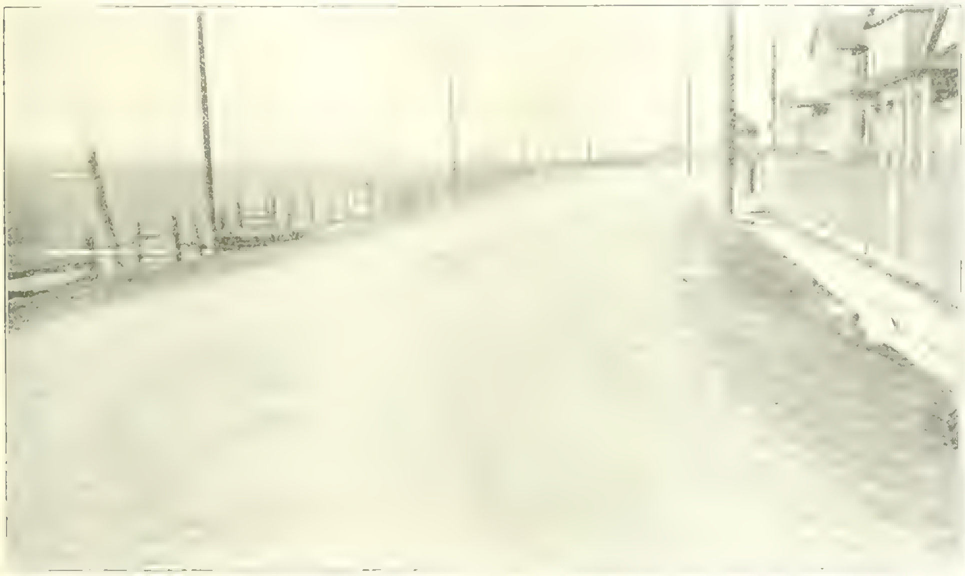

Fig. 3—View of East St. Louis and Tri-City Roads After One Year's Service; Tar No. 101 Used.

It is estimated that this surface layer of stone will contain about 20 per cent of voids after the rolling. Theoretically all of these voids should be filled to prevent any displacement of the stone, which would require a little more than 2½ gals. per sq. yd. of surface for a layer 2½ ins. thick. Practically, however, this may not be essential because the stones composing the surface have been so locked together that there is no opportunity for lateral movement of any stone unless some of them are first removed from the surface. It is the function of the bituminous compound to prevent that, and on the state experimental roads 2 gals. per sq. yd. has been the usual treatment. It will often be found that the surface of the road is so open that a smooth surface cannot be obtained without first filling the surface interstices and the chips are used for this purpose, being whipped into the interstices from the shovel. The surface is then broomed to sweep all chips into the voids, leaving a clean surface. The voids are then poured practically full of the asphalt or tar binder.

In the use of bituminous compounds for this purpose two [illegible] [illegible] taken into consideration:

First, the material which is to be used for this purpose [illegible] be appropriate [illegible] [illegible] it will be applied.

Second, the application must be made [illegible] such a way as to insure that the material will go on the surface in a uniform layer and that the surface will be in such condition as to permit the material to flow into the interstices and to fill practically all of the voids in this upper layer of stone which has been discussed.

If a tar is used as a binder, the following method of application has been found to be very successful: The binder is received in tank car lots and is heated in the car by means of the steam coils provided in the cars for that purpose. In heating the tar, it is necessary that an ample supply of steam be provided and usually it has been secured from some power plant of large capacity. It is possible to heat the material in the tank car by this means to a temperature of 250° F., which is sufficient to make the tars used soft enough for their application. Undoubtedly the temperature at which the material is applied is of great importance, and the temperature which would be correct for one material will not be correct for another. The ideal condition to be reached is that the material shall be sufficiently fluid when it reaches the road to flow into the interstices before cooling. It must not remain as a mat on the top of the stone.

In handling tars, the material is forced out of the tank car into a distributing wagon by means of steam pressure applied to the top of the car. Steam pressure has not been found to be altogether satisfactory on account of the water which condenses and remains in the car, but has been fairly so. However, if pressure may be furnished by means of compressed air from a portable compressor the method is entirely satisfactory. [The il-

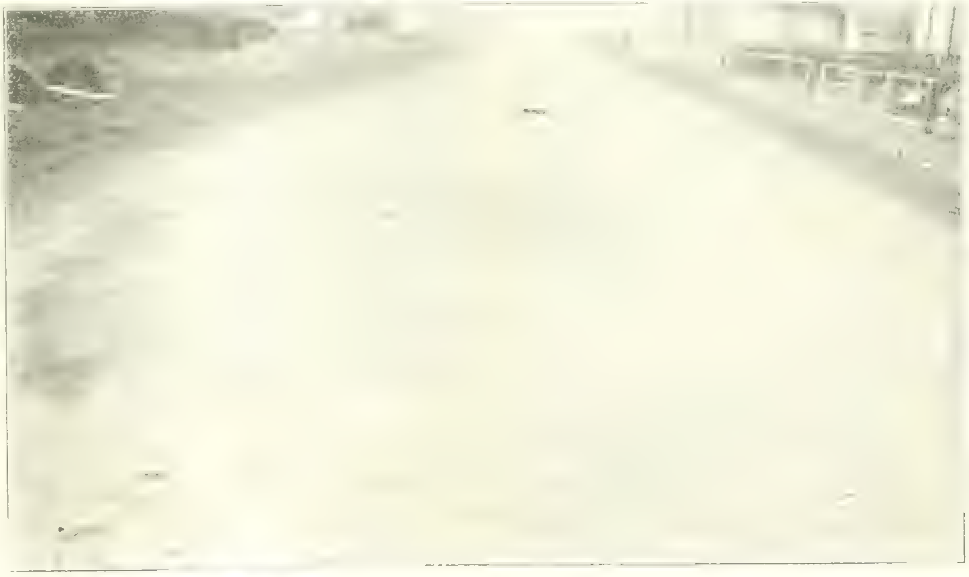

Fig. 4—View of East St. Louis and Tri-City Roads, After One Year of Service; Tar No. 104 Used.

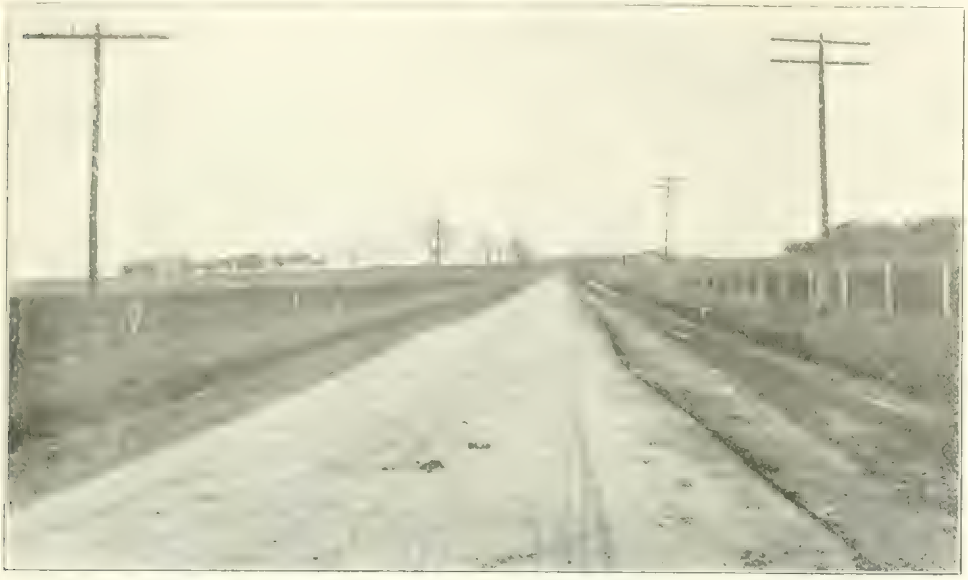

Fig. 5—View Showing Result of Applying Tar in Cold Weather.

lustration, Fig. 1 shows a [illegible] being [illegible] by air pressure. [illegible] in the illustration the air pressure was 15 lbs. and 700 gals. were loaded into the distributing wagon in 5 mins. The discharge pipe was 3½ ins. in size.] The material is then drawn to the road in the distributing wagon and attached to a steam [illegible] connection made from the roller to the top of the distributing wagon; the tar is then forced out of the distributing wagon through a hose and nozzle and is sprayed by means of the nozzle on to the stone. [Fig. 2 shows the method of spraying. A pressure on the tank of 20 lbs. has been found to spray a 500 gal. tank in 30 mins.; the tar can be applied at from ⅓ to 3 or more gals. per sq. yd.] This method of distributing is very satisfactory, it being possible to apply either large or small quantities of the material in a very uniform layer to the stone. The only objectionable feature so far observed is the slight amount of water which condenses in the tank wagon. This water turns into steam as soon as the new batch of hot binder is turned into the wagon and may cause the binder to foam badly.

The same general method of application has been attempted with petroleum residuum compounds, but has not been found satisfactory because it is imposible to heat the binder sufficiently by means of the steam coil to make it flow through a hose. It cannot even be heated sufficiently to spread by means of hand spreading cans filled from the tank wagon. At the temperature to which the material can be heated by steam the method is not satisfactory because the material is not sufficiently fluid to flow into the interstices of the stone; the result is that there are patches on the surface of the road which are unsightly and make the surface uneven to an extent which is perceptible to those who traverse it. In general it is thought that asphaltic compounds should be applied to the road surface at a temperature not less than 400° F., and in some cases the temperature would need to be considerably above that in order to get satisfactory results. The principle mentioned before applies in this case, in that the binder must be sufficiently fluid to flow into the interstics of the stone before cooling. It must not, however, be heated to the flash point of the material if an open kettle is used.

In using an asphaltic compound, the best results have been obtained when the material is heated in kettles, drawn off from these kettles into hand sprinkling cans and poured onto the surface layer of stone.

The first spreading of these compounds will leave the surface of the road slightly rough where individual stones project partly from the surface, owing to the fact that they have been disturbed by the men walking over the surface in spreading the chips and compound. By rolling this surface with a wet roller before a second spreading of asphalt is applied this fault can be corrected. After the first spreading of bituminous compound, the surface of the road should be rolled and then covered with stone chips and thoroughly broomed so that these chips work into all of the interstices and voids that show up in the surface of the road. This is the most important operation aside from the pouring of the compound, but if it is carefully done an extremely uniform surface can be secured. After this spreading of chips has been carefully broomed, a second spreading of compound in the nature of a paint coat is applied to the surface. In this application not to exceed ½ gal. per sq. yd. of surface should be used. In the first application the amount of compound must be determined by the nature of the surface layer of stone. Usually 1¼ to 1¾ gals. per sq. yd. has been used in state work.

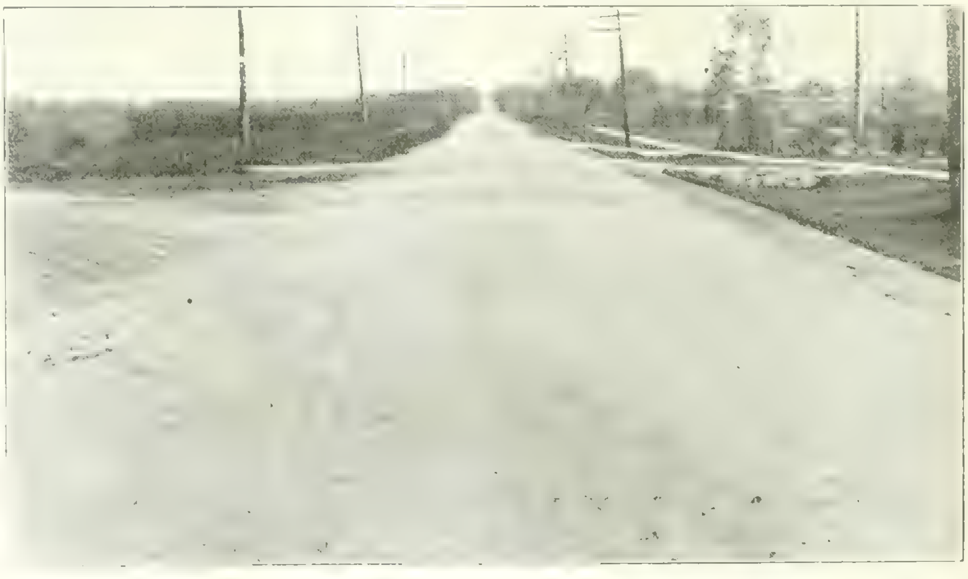

Fig. 6—Tar Macadam at Flossmoor, After 18 Months' Service.

Experience with the use of various bituminous compounds in construction work led to the conclusion that there are some important variations in the characteristics of the commercial preparations sold for use in road construction. In the absence of accepted standard specifications for these compounds, no attempt was made to secure compounds meeting any certain specification except in a few instances, but all materials used in 1909 and 1910 were analyzed according to approved methods and a record made of the results. It is thought that a study of these analyses and a comparison of them with the behaviour of the compounds on the roads will give information that may eventually be incorporated in a set of specifications. [Table I shows the properties of the tar used in 1909 by the Illinois Highway Commission.]

Inspections were made in 1910 of roads built in 1909, and the condition of the various tars is summarized as follows:

Sample 101 gave fair results as a bidder, holding the surface of the road intact and forming a slight mat on the surface which plainly showed the print of the shoes on the horses. During the hot weather the material softened sufficiently to flow out of the macadam on to the earth shoulder at the edge to some extent. The constant kneading of the mat surface seemed to deaden the material so that it began in places to separate from the stone and to become brittle. So far the wear is almost entirely on the mat of tar on the surface of the macadam. [Fig. 3 shows a portion of the East St. Louis & Tri City road in Venice township. Two applications making a total of 2 gals. per sq. yd. of sample No. 101 were used on this portion. The photograph was taken one year after the road had been completed. It was then in excellent condition.]

Sample 103. The same general conditions were found as where the No. 101 was used except to a slightly less degree, with the probability that the life of this material will be somewhat longer than that of No. 101.

Sample 104. This material seemed to work out on the surface to an undesirable extent and became quite soft during hot weather, running out onto the earth shoulders in large quantities. The mat on the surface is dead and brittle and is peeling off from the stone. This seems to be the poorest tar used during the season. So far the mat of tar is taking all the wear. [Fig. 4 also shows a part of the East St. Louis and Tri City roads in Venice township. The surface shown in the view was given two applications (a total of 2 gals. per sq. yd.) of sample No. 104. The 2-course treatment section of this road was in good condition one year after completion, when the photograph was taken.]

Sample 105. This tar was used on a road so situated that large quantities of mud were carried onto it during the winter. The tar now appears to be dead and somewhat brittle and does not seem to have held the chips in the interstices of the upper layer of stone The surface of the road is rough, the wear all coming on the stone.

Sample 106. No report received.

Sample 107. This material has held its life well on a very heavily traveled road. On about 60 per cent of the surface the tar has worn off entirely, the surface presenting a mosaic appearance, each stone being surrounded by the tar, the stone forming the wearing surface. On the remainder of the surface the tar forms a thin mat over the stone and is taking the wear and protecting the stone. This tar is apparently the best one used during the season.

Sample 108. This tar was used in resurfacing work where a considerable quantity of stone dust and mud was found on the road. The tar became brittle and wore off the surface. There has been no loosening of the stone. It is thought that the poor results here were due in part to the fact that the tar was applied in cold weather.

Sample 109. About the same results were obtained with this material as with No. 105, it being used under similar conditions.

Sample 110. This material was used under conditions similar to those where Nos. 105 and 109 were used. The results were better, however, the surface being fairly smooth. The chips held in place in the interstices of the surface. The stone is taking the wear and the surface presents a mosaic appearance.

Samples 111 and 112. With these materials the stone is held in place, but the wear is on the stone. The tars here become slightly brittle during cold weather, but in warm weather seem to regain their life. They did not soften enough to flow.

Sample 113. This tar became brittle and the surface of the road cracked up under traffic, due, it is believed, to the fact that the tar was applied during cold weather, and that the road was not in proper condition for receiving the tar treatment. [Fig. 5 shows the result of applying tar in cold weather. This road, which is located in Yellowhead township, was completed in November. The photograph was taken in the following May.]

In general, it may be said that all the roads were dusty except those that had an excessive mat of tar on the surface, and these were comparatively free from dust. This mat, however, is probably short lived and the conclusion is that all tar treated roads will become dusty within two or three years after construction, and that if the mat surface is not obtained, the roads will be dusty from completion. It may also be said that the surface layer of stone, in all cases, is held firmly in place, but that the finer particles in the interstices are not held in place by brittle tars.

It is probable that when the mat surface wears off one of these roads it can be replaced by applying a proper grade of tar in the mixture of a paint coat and that this will be the cheapest method of maintaining roads of this character.

It seems that some change must be made in the character of the tars available for construction purposes, to insure that they will not soften and flow in hot weather and not get brittle during cold weather. Just how this can be done is not at once apparent, but it is probable that the volatile light oils should be eliminated and the free carbon held as low as possible. There should then be a sufficient quantity of dead oils present to give elasticity to the pitch.

OILED EARTH ROAD CONSTRUCTION

The oiled earth construction was undertaken with the object of determining the durability of this form of construction under the soil and climatic conditions encountered in Illinois. It was desired to accomplish something more than a surface treatment which would merely serve to alleviate the present dusty condition of roads during dry weather and possibly reduce the cost of maintenance on a country road. In order to accomplish these purposes, it was thought necessary to incorporate into the surface layer of earth on the road a sufficient quantity of an asphaltic oil to render this surface layer impervious to water. In accomplishing that purpose, it seems possible that such a large quantity of oil will need to be used that in the hot weather, the oil will soften up sufficiently to make the surface layer of the road plastic. If such is to be found the case to any extent, it is at once apparent that the effect of the concentrated traffic of these roads during the summer months will squeeze out the surface of the road along the wheel track, forming a rut and leaving a slight ridge along outside of the wheel track. If this is the case, it is apparent that the slight depression which is formed by the wheels will hold water and will soften and eventually cut through; but it seems also probable that if the surface be [illegible] a year, and it is believed that if this is done the road will not get muddy to any extent during the winter. It is possible then that the road may be well worth its cost, but until [illegible] made on that point.

[illegible]

This soiled earth road was constructed on a black gumbo soil by mixing with the upper layer of the road an asphaltic oil in such an amount as to give a layer about 5 ins. thick, which was treated with oil in as large a quantity as it would absorb. In general, the method of construction was as follows:

The center of the road for a width of about 15 ft. was plowed up, disked and pulverized as fine as possible. The pulverized earth was then moved to the side of the road and the middle portion or road bed, on which the oil was to be used, was [illegible] and thoroughly compacted with a ten-ton steam roller. Alternate layers of oil and earth were then placed on this foundation, thoroughly mixed with a disc harrow and rolled. The road was finished by putting on a [illegible] earth and rolling the surface.

In the construction numerous difficulties were encountered, particularly in getting proper mixtures of the earth and oil. This mixture when once made was of such a gummy nature that it was almost impossible to get it evenly distributed over the surface of the road. Also the nature of the soil was such that it could not be entirely reduced to dust and there were numerous large clods in the mixture which were not broken up in any of the operations and remained in the surface of the road after its completion. It was found that the oil never impregnated these larger pieces of earth at all.

Subsequent work on this road showed that the earth and oil mix more uniformly if the earth is moistened with water during the mixing process. At first the road is very soft, but as the water dries out the oil apparently takes its place and the surface becomes harder. During this time the road should be rolled and kept smooth.

The experiments have conclusively shown that a poured macadam is a desirable roadway. It has an elastic surface pleasant to travel which is much less dusty than the untreated macdam. While the roads built have not been in service long enough to give accurate data on the life of the macadam, still it is apparent that for some years the wear [illegible] if a proper one is used. In general we may safely state that the life of the road is greatly lengthened, especially if the road has a mixed traffic with a considerable amount of one horse and automobile traffic.

Oil earth construction must be considered as of doubtful value so far as the experiments already made may be interpreted, and while there can be no question but that the roads were greatly benefited, still it remains to be proven that the treatment is worth the 30 cts. per sq. yd. it costs.

As to the relative cost of the waterbound and bituminous macadam, the tar macadam will cost 15 cts. per sq. yd. more than the waterbound at the present cost of tar, and the asphaltic macadam will cost from 15 cts to 20 cts. per sq. yd. more than the waterbound, depending upon the price paid for asphalt.

In regard to the relative cost of maintenance, no data can be given because none of the bituminous roads have been in service long enough to determine this point. It seems probable, however, that a bituminous macadam will maintain its surface at least as long as a waterbound macadam and probably much longer. When necessary it can be repaired by a surface dressing or paint coat of the proper grade of binder at a cost of about 15 cts. per sq. yd. of surface. To properly resurface a waterbound macadam road would cost 30 cts. per sq. yd., so that the maintenance of the bituminous road is probably longer for the plain macadam and the road itself more desirable. [Table II contains cost data on experimental macadam roads constructed by the Illinois Highway Commission in 1906, 1907, 1908 and 1909. Fuller details regarding the roads constructed in 1906 and 1907 were given in ENGINEERING-CONTRACTING, April 10, 1907 [illegible]

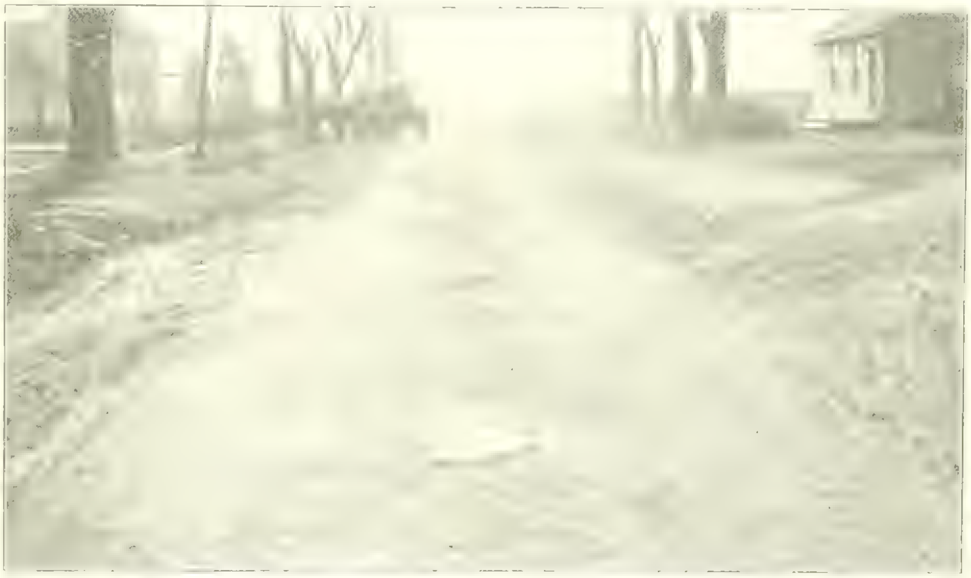
Fig. 7—Typical Appearance of Poured Tar Macadam, One Year After Completion.

Grouting the surface of concrete in order to make it smooth leaves it subject to unequal wear, owing to the lack of uniformity in the degree of hardness in such a thin layer of cement. The set of a thin sheet of cement is not the same as that of a large mass. For this reason the tops of concrete blocks for setting heavy machinery should not be made "true" by grouting, but by dressing down after the block has set, in [illegible] would be finished.

As the result of an ice jam at the Chicago & Northwestern railroad bridge over Galena river at Galena, Ill., on Feb. 14, the entire business section of that city was flooded. Traffic on both the Northwestern and Burlington roads was at a standstill. The gorge was finally broken up by the use of dynamite.

"Meadow" Roads as Constructed in Southern New Jersey Counties.*

[illegible] of low barrier beaches consisting in their orig[illegible] situated many summer resorts. Separating these beaches from the mainland is an expanse of "meadow," varying in width from 2 to 6 miles, which is interspersed with numerous "lagoons" or "bays" which are connected with each other and the ocean by tidal channels known as thoroughfares.

The "meadows" are composed of a crust, usually from 2 to 4 ft. in thickness, formed by the interlacing of roots and decayed vegetable matter, with grass growing on its surface. The surface of the "meadow" is slightly above the level of ordinary high tide, and the entire crust is underlaid with a mass of mud in a semi-liquid condition, and which, in turn, is underlaid with sand, gravel and clay at depths varying from zero to 30 ft. or even more. In times of easterly or northeasterly storms, the water from the ocean is forced by the wind through the inlets between the barrier beaches, and when combined with the tide reaches a maximum elevation of about 4 ft. above the "meadow" surface at high water. It can readily be seen that the construction of roads across this "meadow" at sufficient elevation to maintain travel during these storm tides will be both difficult and expensive.

The first roads built were of corduroy construction, covered with gravel or oyster shells, and depending upon the floatage of the sod construction of the underlying mud for the maintenance of their elevation. Under heavy loads these roads were sometimes depressed below the level of the surrounding "meadow" and as additional weight of materials was deposited on them to maintain their elevation they naturally became still more depressed, requiring continual maintenance to keep them above the elevation of high tide; and, as the surface of the roads was only a few inches above the "meadow" they were frequently inundated during storm tide, causing the suspension of all travel over them for periods ranging from a few hours to one week in exceptional cases. The surface material on roads of this type was also subjected to the wave action caused by high winds accompanying these storms and usually required resurfacing after each storm; oyster shells affording the better material for this purpose because they are affected but little by this wave action.

The more recently constructed roads have been built with solid fill reaching 1 or 2 ft. above the highest storm tides; their construction is substantially as follows:

Banks of meadow sod are built along each side of the road, having a top width of 2 ft., and with the outer face sloped at from 30° to 45° from the horizontal. The sod composing the outer face is laid in regular order, similar to masonry, with the grass side out. The grass growing on the outside of these banks forms a protection against erosion, during the storm tides. The slope of the outside face of banks should never exceed 45° with the horizontal, otherwise the grass will die, and the sods, having nothing to protect them, will dry out and gradually disintegrate, exposing the sand fill to the wave action during storm tides and causing the eventual elimination of the road.

The sod for building the banks is usually taken from within the line of the road, and should not be taken from the outside of the bank line as, when filling is in progress, there will be no lateral resistance against the base of the bank to counterbalance the horizontal component of the resultant pressure on the bank, due to the sand fill. In some instances, where sod has been removed from outside the banks, the bank, including the meadow sod on which it rests, has moved laterally on the underlying mud until the gap caused by the removal of sod has been entirely closed.

When sod is not available along the line of work light wooden bulkheads are built to retain the fill. These are constructed by setting piles on from 3 to 6 ft. centers, their points penetrating into "hard pan" just far enough to insure them against lateral displacement at the [illegible]. The tops of opposite piles are tied together across the roadway with small iron rods through each pile, with washers and nuts for bearing against the piles and having turnbuckles under the middle of the road. Roads thus constructed are left unprotected, the entire construction being considered of a temporary nature. For a bearing, light stringers are placed both along the tops of piles and at the meadow surface, for which surface is used 1-in. pine sheathing, doubled with joints, lapped, and extending to the "hard pan," when it lies close to the surface; or, where "hard pan" lies too deep below the meadow surface to permit its being reached with a single line of sheathing, as is sometimes the case, the sheathing is driven only a short distance below the meadow sod, thus allowing the sand fill to take its natural slope in the underlying mud which is displaced laterally to make room for it. Material for fill is usually obtained by dredging from riparian lands lying under the numerous bays and thoroughfares, some of which are usually close enough to be available. This material which may be either sand of the character found on the beach, or gravel or clay, is pumped by suction dredges, equipped with centrifugal pumps, through a riveted steel discharge pipe to the line of work, which may be located as great a distance as a mile away from the dredge. The solid matter will be only about 10 per cent of the discharge of the pipe, the rest being water, for which suitable openings in the banks must be provided so as to permit it to readily drain off the road and eventually return to the tidal waters. This fill material generally used, when first deposited, is quite similar to quicksand, and requires several weeks to drain off sufficiently to admit of the construction of the roadway surface.

As filling progresses the "meadow" on which it is deposited will be found to have settled more or less, depending upon the solidity of the meadow sod, and the underlying mud. As a rule, this settling amounts to an average of only 6 ins. or a foot, and again, if the meadow is soft, the fill will settle until it finds solid bearing on "hard pan," displacing laterally the underlying mud, which displacement is resisted by a more solid stratum of mud or by an area of "hard pan" lying at a higher elevation than that under the fill, causing a vertical displacement on either side of the road, which is indicated by the rising of the level of the meadow in the form of a wave parallel with the road adjacent to the sides of the fill. This settlement may occur gradually or sometimes occurs in a single night, necessitating continuous filling until equilibrium is established and the proper elevation of fill maintained.

The occurrence of this phenomenon was observed on a section of road, 2,750 ft. long, built at Chestnut Neck, N. J., in 1909. This road was at that time built up to a height of 2½ ft. above the surrounding meadow and has now settled for 2,500 ft. of its length until the surface of the road is practically level with the meadow. The fill material for this road was obtained from borrow pits on the mainland, adjacent to the end of the road. This particular section of road has been improved at two different times with state aid. It was completed about 15 months ago, the work being done in accordance with the standard specifications of the state of New Jersey. Twelve months after the road had been completed and accepted by the Board of Chosen Freeholders, the majority of the Board inspected this section of road for the purpose of final acceptance, and to their surprise they found it in the condition above described. A meeting was called and the existing condition discussed, the questions being asked the writer: "Did the contractor strictly comply with the plans and specifications, including the making of the required amount of fill?" and "If the contractor was responsible for the settlement of the road?" which questions were answered by stating that the road had been constructed, in every respect, in accordance with the requirements of the plans and specifications, and that the responsibility of the contractor for maintaining the roadway at a given level for twelve months guaranty period after completion was a legal question. The liability of the contractor for the settling of the road was then submitted to the county solicitor for his opinion, and the solicitor inquired if the plans and specifications could have been prepared so there would be but comparatively little settlement, to which the reply was made that they could be so prepared, but that the cost would be approximately four times greater than the cost of the construction as specified, but that the more expensive construction would be a saving to the county in the end.

For the better construction the method to be employed would be substantially as follows: Drive piles, of any sound material to penetrate the underlying strata of "hard pan" to a depth of not less than 6 ft., the number of piles necessary to carry the load to be determined by the engineer. After the piles have been driven, stringers are to be fastened to the piling below the meadow level, or to such depth that pile and stringer would be constantly wet. Upon the stringers, either poles or plank should be placed close together, and after this has been done deposit the earth to any height required. This method is only suggested for use in exceptional cases, similar to those which confront Atlantic and Burlington counties at the present time, especially Burlington, on the shore road across the meadows leading from Chestnut Neck to New Gretna.

Referring to the general construction of county roads, the road metal surface may consist, of course, of any material determined upon and placed on the road in the usual manner. The only material thus far used in Atlantic county being gravel, of which there are large deposits and of excellent quality on the mainland. Due to the excessive wear on gravel roads by motor car traffic, and the resulting excessive cost of maintenance, Atlantic county has about completed the laying on "Meadow Boulevard," which is the only highway leading from the mainland into Atlantic City, .6-mile of Warrenite road, a bituminous pavement, laid under the patents of Warren Brothers Co., and which is a modified form of bitulithic pavement and designed for use on state and county roads; the Warrenite road being of similar construction to the bitulithic, except that the latter is designed for use on city streets which are subjected to heavier traffic. If this material proves a success, of which there would seem to be not a questionable doubt, the same material will doubtless be used on the remainder of this driveway for an additional distance of 4½ miles.

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*[illegible] E. [illegible] Engineer of Atlantic County, N. J., presented Jan. 24, [illegible] of the New Jersey State [illegible]

Permissible Exlposives.—A circular recently issued by the Bureau of Mines at Pittsburgh contains the names of permissible explosives and the precautions to be observed when these explosives are used, especially in coal mines. An explosive is called permissible when it is similar in all respects to the sample tested by the national Bureau of Mines and when it is used in accordance with the conditions prescribed by that bureau.

Some of the conditions required are as follows: That No. 6 detonators—preferably No. 6 electric detonators (double strength) —are used of not less strength than 1 gram charge, consisting by weight of 90 parts of mercury fulminate and 10 parts of potassium chlorate (or other equivalents), except for the explosives "Bental coal powder No. 2," "Detonite special," "Hecla No. 2," "Kanite A," "Masurite M. L. F.," "Titanite No. 7-P," and "Titanite No. 8-P," for which the detonator shall be of not less strength than the No. 7 (1½ grams charge of the same mixture).

That the explosive, if frozen, shall be thoroughly thawed in a safe and suitable manner before use.

That the quantity used for a shot does not exceed 1½ pounds (680 grams), properly tamped.

WATER-WORKS AND SEWERS SECTION

Valuation of the Physical Property of the Peoria Water Co. with a Discussion of Rate Making and of Reasonable Rates.*

(Continued from page 195.)

The valuation of the property belonging to the Peoria Water Works Company and the Richwoods Water Company, was intended only as a basis for a [illegible] rates, which we were not asked to enter into at that time. As there stated, other elements, such as operating expenses and an analytical statement of the company's revenue should be had before taking up that subject. Since then, Edward A. Pratt & Co. have made a thorough examination and analysis of the rating cards of the company, a summary of which they have submitted to you under date of July 5, 1910. This summary and the original analysis, have been placed in our hands, with the request that we pursue the subject along such lines as will lead to a thorough understanding of the same, and furnish the proper basis for a fair adjustment of the rate schedule. In doing this, more is needed than the technical details which it may be proposed to embody in a rate ordinance. The reasons for the adoption of any proposed scale of rates, the principles which have controlled in its making, and its probable effect upon the revenue of the company should be clearly set forth.

In a conference with the mayor and committee, that preceded the preparation of this report, a number of citizens, representative of the city's civic life, were present. From certain expressions made at that time, one might infer that they and the people of Peoria questioned the basis upon which the valuation of March 24 was made, being apparently apprehensive that archaic conceptions of the rights and powers of public utility corporations had molded the conclusions. In such a case as the one in hand, about which half a generation of contention has prevailed, with questions still unsettled, some of which are pending in the courts and in the city council, this questioning attitude is most commendable.

The realization that such contentions still exist in the community, and that a wise determination involves a full understanding of the legal and technical principles underlying public utility values, renders it desirable and necessary that such principles should be set forth with considerable fullness.

These considerations will account for the space given to the decisions of courts and public utility commissions, and their bearing upon the questions involved in the Peoria case.

It has also seemed desirable to give a historical outline of the Peoria water plant, covering the 25 years that the city operated the original plant, as well as the 21 years since the original plant passed into the hands of the Peoria Water Co., the antecedent of the present Peoria Water Works Co.

Also, in connection with the plant's history, it is considered desirable to determine the investment that has been made in the plant, on entirely different lines from those followed in the report of March 24.

RIGHTS AND RESPONSIBILITIES OF PUBLIC SERVICE CORPORATIONS AND MUNICIPALITIES.

The broad questions touching the respective rights and responsibilities of public service corporations in their relation to the municipalities which they serve are generally well understood, though many misapprehensions still exist in the public mind which are for the most part a legacy of the past, when a conception of the powers of such corporations prevailed which is fast becoming obsolete.

This conception was based upon the theory, which was also put into practice, that a company operating a public utility under a public franchise was its own master and not subjected to control as to rates or the kind and manner of service rendered.

About fifty years ago courts of Great Britain and a number of the state supreme courts in this country, held substantially, in the case of gas companies supplying gas under a public franchise, that they could choose their customers and make varying rates, as freely as a private manufacturer engaged in a competitive business, and that they could accept or refuse to render service at their pleasure.

The franchises under which such companies operated were considered property, and if the business was profitable it was valuable property. Little distinction was made between what we now know as a public utility and a strictly private industry, and the economic doctrine of *laissez faire* was expanded to embrace one as well as the other.

The modern conception of a public utility corporation is that its paramount function is to serve the public without discrimination, and, following the tenor of the highest court decisions, that it is entitled to sufficient revenue to meet interest, operation, maintenance, depreciation and renewals, and to give a return on the investment represented by a fair valuation of the property employed that will make it an object for private capital to enage in such service. Farther, that the business should be a monopoly, and that a joint responsibility should exist between the public and private agencies that brought it into being, accompanied by governmental regulation of rates, and control as to the character of service rendered.

This conception really turns a public service corporation into an arm of government service, temporarily entrusted with the operation of the public utility.

Besides establishing the public utility as a monopoly under public control, this doctrine gives it a continuing existence as such, with the power of growth and adaption to varying conditions as they may arise, subject to a change of ownership from private to public agencies and the reverse.

This distinction between the old and the new is not always clearly drawn, though the state of New York in part, and the state of Wisconsin as an entirety, have put the modern doctrine into force without reservation. New Jersey has also established a public utility commission.

The Wisconsin public utility law gives a company operating a public utility in that state, the same right to an increase in rates, if those in force are inadequate, that the state or municipality has for a reduction, if the existing ones are more than adequate. Going with this is full protection from competition, and the right of the municipality to buy at any time on the valuation of the public utility commission, which is the railroad commission of that state.

In states where the right exists and is exercised to regulate rates of such corporations, without the protection which such a law affords the investment, it is doubly difficult to determine the question of reasonable rates. Limitations upon municipalities as to long time contracts relative to public and private charges, subjects the property of such corporations to a hazard accumulating as the time for the expiration of existing franchises approaches.

This anomalous situation, which exists in Illinois and many other states, is, no doubt, due to the transition from the old conception of the responsibilities of public service corporations to the new.

It is fair to presume that courts in deciding that rate schedules embodies in franchise grants to public service corporations have no contractural effect, intended merely to affirm the power of legislative control, leaving legislatures to work out a sufficient plan to protect the investment as against possible contingencies on the expiration of their franchises.

But though the laws of this state seem to afford no such protection, the provision in Section 18 of the Peoria water works franchise, that,

> [illegible] expiration of thirty years, said license and franchise shall then continue in full force and effect until such time as said city may purchase said works,

THE INVESTMENT.

The foundation of all fair rate schedules is that sum which should justly be credited to the public utility as representing the capital upon which interest and profits should be based; that is, the reasonable amount upon which a percentage should be allowed as returns to the investor.

At first thought, the determination of this sum seems a simple problem. It is easy to ascertain from the books the cash outlay made in building the plant; or if the books are not accessible, it is only somewhat more difficult to determine the cost of reproducing the physical plant today. Either of these sums corrected for present prices of labor and material and reduced by the amount of deterioration and the wear and tear which the plant has sustained can be, and are often assumed to give the true investment.

The facts are, however, that with public utilities generally, this "first thought" covers only one part of the question involved.

On second thought, it becomes apparent that a public utility that has been in operation for a term of years has acquired a certain amount of revenue from private sources, as distinguished from revenue for public service, but that such revenue is not obtained all at once, and generally not without sacrifice and loss to the owner.

Farther investigation shows that such private revenue is acquired gradually by all public utilities, whether operated by municipalities or service corporations, and with water works plants, more gradually than with any other kind, and that it requires many years to reach a level that approaches the maximum revenue which the city should furnish.

It is found that water works plants that have been built and maintained of adequate size for the cities they serve, will take from five to fifteen years to acquire one dollar of private revenue per capita; they take from ten to twenty-five years to acquire two dollars of private revenue per capita; and to reach a really remunerative stage in revenue, generally requires from twenty to thirty years.

The value of the service which such a plant can render that has been in operation long enough to acquire any considerable private business, cannot be measured by its ability to pump and distribute water only. Its revenue producing power is a most valuable asset, an asset acquired not only because of the existence of the physical plant, in a populated city, but because, as stated, it has usually been operated for years without profit and generally at a loss.

To say that the investment in such a plant shall have suffered diminution because of physical deterioration, and receive no increase for the business which it has created, is inadmissible.

It is erroneous to say that the creation of this business is because of the existence and growth of the city alone, and that the city should derive all the benefit therefrom.

If the course of events had been such that the city had grown to its present size without water works, a new plant just starting therein would not have the business in question, but would have to acquire it through years of work and at a heavy outlay, just as revenue has been acquired by such plants at all times.

Building up of the bsuiness is as necessary a part of creating a utility as the building of the physical structure. The two really consti-

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*Condensed and partly rearranged from "Valuation of the Property of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams, "Audit of Accounts of the Peoria Water Works Co.," by Edward A. Pratt & Co., and "Water Rates for the Plant of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams; reports made for the city of Peoria, Ill.

[illegible]

It follows from this that when a municipality finds a private agency willing and able to become the pioneer in carrying a public utility, and particularly a water works plant, from the time of no private revenue to the time when the acquired revenue brings remuneration, it has secured a service, the value of which is seldom appreciated.

[illegible]

The foregoing considerations suggest two possible methods of determining that sum which at any stage of the development of a public utility may reasonably be taken as the proper investment.

1. To ascertain the fair cash value of the property, based on the cost of reproducing the physical property as of the time of valuation, and as enhanced by the fact of its acquired earnings. That is, to find its value as a going concern and as of the time of valuation on the hypothesis of reproduction.

2. To ascertain the actual outlay in the plant and its business, made up of the original cost of the physical plant augmented by the unremunerated expense incurred in producing or building up its business.

The first method is the one laid down by the courts for fixing the fair price to be paid for a public utility in case of sale and for determining the investment to be used in fixing rates.

CONTROLLING PRINCIPLES OF PUBLIC UTILITY VALUES.

It may be said that the controlling principles of public utility value as defined by the higher courts, recognize the fact that cost and value are not synonymous terms; that cost is not a measure of value, although the structural value of a plant is primarily founded on cost or price, as of some specific time; that finding cost is only a step in finding value, and that the plant must be scrutinized as to its condition and adaptability to the function it is to perform in the future, and proper deductions made for any deficiencies in order to obtain value.

Also, that all value that attaches to a public utility grows out of the physical plant and its earnings, and since earnings, or the rendering of service, is the primary object of the existence of any utility, it is plain that there can be no structural value without earnings or service rendered.

Physical existence alone does not, and can not, bring value. Value emerges only when earnings or services, are rendered by the operating plant. Hence, the value of any plant is necessarily made up of two fundamental and inseparable elements; the value of the physical plant, or "structural value," and the value of its business, the "going value."

The latter element goes with the structural element, and augments the total plant value, just as surely as the cost of constructing or supplying the necessary mechanical parts.

The proposition that a plant without service to perform, and without earnings, present or prospective, would be devoid of value, except to be dismantled and sold as real estate, second-hand machinery and junk, is no more apparent than that its value is due to service to be performed and earnings to be made in the future, and not to what has been done in the past.

It is equally clear that the structural value of an operating plant must be ascertained by comparing it with a similar new or substitute plant, produced as of today, but operating tomorrow, under the limitation of future requirements, and that it is the revenue which the plant in operation can produce in the future, that could not be obtained or produced by such a substitute plant, that constitutes "going value," and measures its magnitude.

It follows from the foregoing propositions, that there is no vital distinction between the controlling principles applicable to determining structural value and going value. In each case a substitute plant is hypothecated, which is a substantial duplicate of the operating plant in function and mechanical detail. The hypothecation is carried to the extent of building it, mentally, not only at the prices of today, but of doing the work under the conditions [illegible] of today. If pavements cover the street pipes, the expense of taking up and relaying them form a part of the cost of the hypothetical distribution system, even though they were not in existence when the pipes were originally laid.

After the structural cost of this hypothetical plant has been thus determined, the structural value of the operating plant is obtained by comparison. The probable future usefulness of the operating plant, and its several parts, are determined upon, and the value fixed by reducing the estimated cost of the hypothetical plant or parts thereof, in proportion to the relation between the service rendered by the operating plant, in the past, and the probable service to be rendered in the future.

In like manner, having the past earnings and cost of operating the present plant, and its probable future net earnings fixed upon, its going value is obtained by a comparison with the probable operating results which the substitute plant could give, if it were to be built today according to the hypothesis.

It is obvious that if the operating plant had not been built before the time of valuation, and had not obtained a business that gives it value, the actual construction of the hypothetical plant of like capacity, and its operation in the same, though a formerly unoccupied field, would furnish the next best alternative for obtaining revenue and rendering service.

It is equally obvious that the limit of the going value element is the difference in the net revenue of these two plants, beginning with the time of valuation and continuing to that time in the future when they shall have acquired equal revenue.

In computing going value as in determining structural value, it is necessary to distinguish between *cost* and *value.*

Generally for many years of a plant's operation deficits are sustained, and if the plant occupies a poor field, or is serving a decaying community, the deficits continue, until they amount to sums greatly in excess of the value of the business which has been acquired.

These deficits, in a sense, represent the cost of acquiring the accrued business of the plant, but as they were incurred in past operations, and going value can only be realized in future operations, it is plain that there is no necessary relation between them. Hence as in the case of the physical plant, cost is not value, and it is necessary to distinguish between them in an appraisement.

One purpose of the foregoing discussion is to make it clear that in appraising a public utility, in accordance with the first method given, it is necessary to distinguish between *cost* and *value,* that though under certain conditions *cost* may be a true measure of *value,* it is not necessarily so; though as relates to the physical elements of a plant it is an essential first step in obtaining value. That considering a public utility in its entirety, its value not only depends upon its physical structure, but on the service it performs, the business it has acquired, and which it can carry with it. The physical plant and its business cannot be separated. Though no service can be rendered without the physical structure, the physical structure without the power and opportunity to render service would be valueless.

Another purpose is to establish the proposition that it is the service which the physical structure will perform in the *future,* not the work it has done in the *past,* that determines its value as an operating mechanism; and that it is the net earnings which it will produce in the *future,* not what it has produced in the *past* which determines its value as a revenue producing agency. In other words, that the value of a public utility is based wholly upon its future power of service, the past and present cost of construction and operating being used only as an aid to forecast the future.

From the foregoing underlying principles of valuation it will be seen that any adequate public utility plant, operating in a growing city, that has been built and developed along lines of adaptability and permanency, and that is kept in effective working condition, does not depreciate in value. All the mechanical parts of such a plant ultimately perish by decay, wear, or obsolescence, and must be restored. But being the only existing agency by which the city, or the people of the city can secure its peculiar kind of service, such changes, occurring with a growing business, must, on the whole, work toward appreciation rather than depreciation.

COURT DECISIONS AND PUBLIC UTILITY VALUES

Though no court, so far as known, has epitomized the principles of valuation in the exact form given, it is believed that the foregoing statement correctly represents the conceptions that the courts had in mind, and which they have in substance expressed, in the decisions which have become the basis for the valuation of public utilities.

The leading opinion that may be said to have laid the foundation for rational methods of valuing public utilities, and that was the first to establish the equity of the going value element where there is no franchise, was the decision rendered by Judge Brewer of the United States Circuit Court of Appeals, in the Kansas City Water Works case, legally known as the National Water Works Co. of New York vs. Kansas City (U. S. Fed. Reporter, 62, 853).

In his brief on appeal, C. L. Krauthoff, one of the attorneys for the Water Works Company, contended that,

> "the original legislative act and contract clearly provide for a valuation based upon the works in operation, and that they were to be mortgaged upon the basis of a going concern. That the contract cannot be construed to have contemplated that the works should be mortgaged on one basis and paid for upon another. The works were to be mortgaged without reference to a limited franchise, and their value thus fixed was to be stationery. The city can get the works for no smaller amount by reason of the absence of the franchise, and the company cannot obtain an additional allowance as for the franchise. The question is: What are the works, completed and in operation, worth? * * * Whenever the purchase was made, the works were to be valued as a going concern. They were to be in operation. They were to be completed, and the operation thereof was to be contingent."

In his brief for the Company, Gardiner Lathrop contended that the controlling idea of the contract relative to purchase is not the cost of the plant as completed; it is not the cost of the theoretical reproduction, but that

> "on the contrary, the provision is that the city must pay the fair and equitable value of the company's works, completed and in operation. It must pay upon the basis of a going concern, the net income of the plant being the controlling element upon which the value is to be estimated."

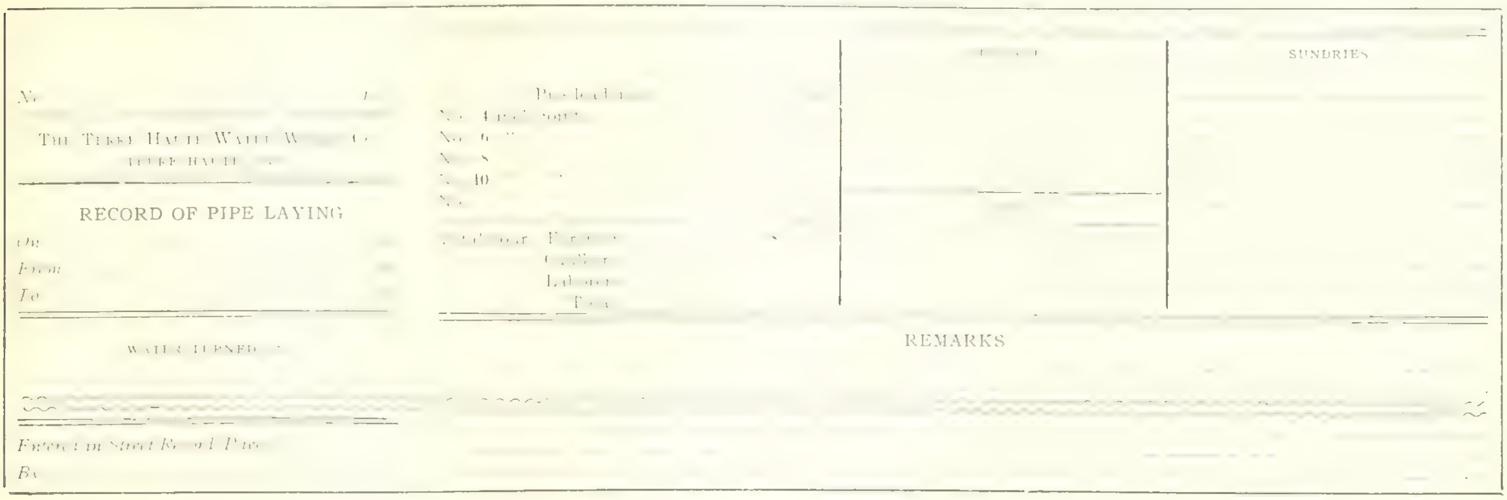
In the course of the opinion the court says:

> "The company insists that the test is to take the income or earnings, and capitalize them. The earnings pay 6 per cent on four millions and and a half. In other words, the company had produced a property which earns 6 per cent on four millions and a half; and that, it is claimed, is the fair valuation of the property, 6 per cent being ordinary interest. On the other hand, the city insists that the franchise has ceased, and that basing a value upon earnings is in effect valuing a franchise which no longer exists, and which the city is not to pay for; that the true way is to take the value of the pipe, the machinery and real estate, put together in a water works system, as a complete structure, irrespective of any franchise—irrespective of anything which the property earns, or may earn in the future. We are not satisfied that either method, by itself, will show that which, under all the circumstances, can be adjudged 'the fair and equitable value.' Capitalization of the earnings will not, because that implies a continuance of earnings, and a continuance of earnings rests upon a franchise to operate the water works. The original cost of the construction cannot control, for 'original cost' and 'present value' are not equivalent terms. Nor would the mere cost of reproducing the water works plant be a fair test, because that does not take into account the value which flows from the established connections between the pipes and the buildings of the city. It is obvious that the mere cost of purchasing the land, constructing the buildings, putting in the machinery and laying the pipes in the streets—in other words,

the cost of reproduction—does not give the value of the property as it is today. A completed system of water works, such as the company has, without a single connection between the pipes in the streets and the buildings of the city, would be a property of much less value than that system, connected, as it is, with so many buildings, and earning, in consequence thereof, the money which it does earn. The fact that it is a system in operation, not only with a capacity to supply the city, but actually supplying many buildings in the city—not only with a capacity to earn, but actually earning—makes it true that 'fair and equitable value' is something in excess of the cost of reproduction."

Judge Brewer's opinion in this case was so obviously just, and the doctrine laid down so unmistakably true, that so far as known, none of the courts of last resort has since rendered an adverse decision on a similar presentation of facts, though a number of them have confirmed and elaborated the doctrines and principles promulgated by Judge Brewer.

(To be continued.)



No.

The Terre Haute Water Works Co.
Terre Haute, Ind.

RECORD OF PIPE LAYING

On

From

To

Water Turned On

Entered in Street Record Page

By

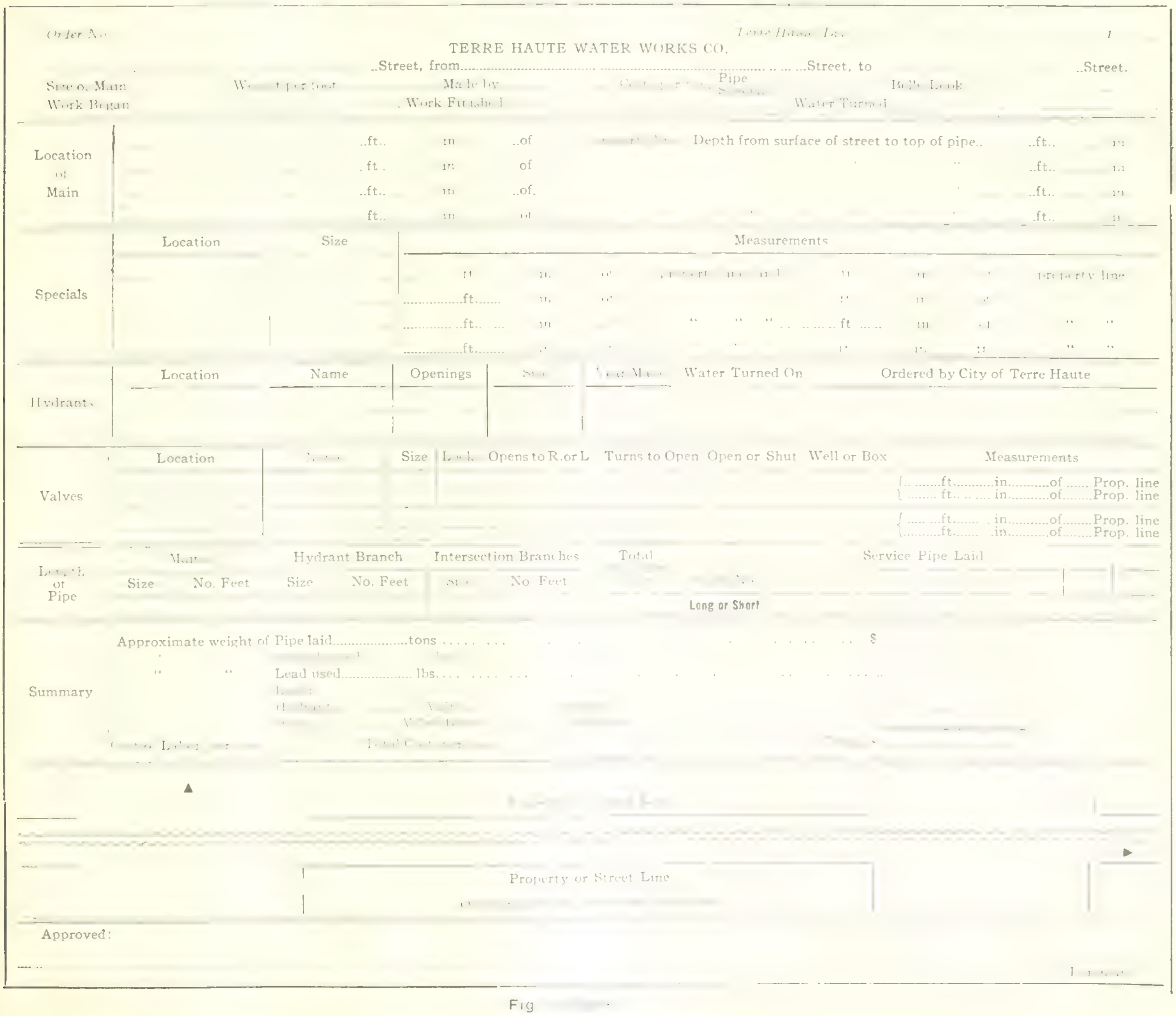
Pipe Laid
No. 4 inch pipe
No. 6 "
No. 8
No. 10
No.

Labor Cost Foreman
Caulker
Laborer
Total

SUNDRIES

REMARKS

Fig. 1—Front.



Order No.　Terre Haute, Ind.

TERRE HAUTE WATER WORKS CO.

..Street, from .... Street, to .... Street.

Size of Main　Weight per foot　Made by　Pipe　Bell's Lock

Work Began　Work Finished　Water Turned

Location of Main
..ft.. in ..of .... Depth from surface of street to top of pipe.. ..ft.. in
.ft. in of .... " ..ft.. in
..ft.. in ..of. .... " ..ft.. in
ft.. in of .... " ..ft.. in

Specials
Location　Size　Measurements
ft. in. of property line ft. in. property line
..........ft...... in. of .... ft. in. "
..........ft...... in .... " " " ....ft ..... in " "
..........ft...... " .... ft. in. " "

Hydrants
Location　Name　Openings　Size　Year Made　Water Turned On　Ordered by City of Terre Haute

Valves
Location　Name　Size　Lock　Opens to R. or L　Turns to Open　Open or Shut　Well or Box　Measurements
{.......ft..........in..........of ......Prop. line
{ .... ft.. ..... in..........of........Prop. line
{ ....ft....... in...........of........Prop. line
{..........ft........ .in...........of........Prop. line

Length of Pipe
Main　Size　No. Feet　Hydrant Branch　Size　No. Feet　Intersection Branches　Size　No. Feet　Total　Service Pipe Laid　Long or Short

Summary
Approximate weight of Pipe laid..................tons .... $
" " Lead used.................. lbs........
Total Cost

Property or Street Line

Approved:

Fig.

Pipe System Records.

[illegible] MANN, TERRE HAUTE, IND.

In addressing a group of practical men engaged in engineering work, it is hardly necessary to dwell upon the necessity of keeping complete and accurate records of a water pipe distribution system. Those who have been called upon to appraise a water works plant without records of the various sizes of mains, valves and hydrants can appreciate the necessity of keeping records. Those who have spent days in winter with several laborers trying to locate a buried pipe of which there is no record have opinions on this subject.

Very few of the men who personally supervise the efforts of uneducated labor and who can cut off a case iron pipe with a chisel or calk a lead joint, are good bookkeepers. Therefore, in order to get satisfactory records of pipe laying, it is necessary to have printed forms and have them filled in as far as possible, before they are given to the foreman.

Record of Pipe Laying.—The writer does not claim to be the originator of the forms that will be presented in connection with this paper; the original suggestion for "Record of Pipe Laying" came to the writer from the Denver Union Water Co. and was adapted to our use. The writer believes in taking and adapting to his business all the good ideas he finds which can be used. Sometimes the ideas come from engineers, often from assistants, including the humble and valuable day laborer.

When it is decided to lay a water main, the order is made on the form "Record of Pipe Laying," Fig. 1. This is printed on light weight cardboard 10x13 ins. and is a convenient size for the pocket when folded twice. First, the headings are entered, showing the street on which the pipe is to be laid, the size, weight, by whom made, cost per ton, dates, etc., then a sketch is made in red ink of the pipe with which connection is to be made, and the proposed line is added in black ink. Locations of existing mains are also written in red ink, for the information of the foreman. Mains, specials, valves and hydrants are shown on the drawing, all but the latter being marked to show sizes. Provision is also made for entering of the distances between valves and specials, etc., by the foreman. A single line is sufficient to show the main and a small circle indicates a valve. No attempt is made to make drawing to scale, but the approximate location is shown.

Locations of Main.—These are taken at street lines and usually at two points between—the points being entered in order, also letters to indicate which property line the location is taken from and the direction. When the foreman takes measurements, it is only necessary to write the figures, the rest having been done in the office.

Specials, Hydrants and Valves.—In making out the order, the general location is written in the proper space, also such other information as can be inserted. The idea is to do as much as possible in the office so that the foreman has a minimum amount of writing to do.

Under the head of "Remarks" is entered anything of an unusual character which the foreman should know, such as the grades of the street. The foreman makes notes of especially hard digging and places where the ground caves badly.

As soon as the work is completed and records made, the foreman sends the report to the office where it is entered in a prepared form similar to the original one, but more complete. It was designed recently and is the result of more suggestions as well as experience.

Permanent Record of Mains, Specials, etc.—These records, Fig. 2, are kept in a loose leaf binder and are printed on both sides, a complete form for each block on each page. The sheets are 13¾x16¾ ins. They are arranged in the book according to streets; for example, the first page would contain the record for the block of pipe farthest north on First St. and each succeeding block on First St. in rotation; then the block farthest north on Second St. After all the numbered streets were placed in the binder, the cross street farthest north would be taken, beginning at First St. and continuing. By this method, with the streets of the city in mind, it is easier to locate a record than it is to look up the index; the latter can be provided if desired. Or, the adjustable tags could be attached to the sheet containing the first block of each street. As gaps are closed up in the pipe system from time to time, sheets can be inserted in proper order.

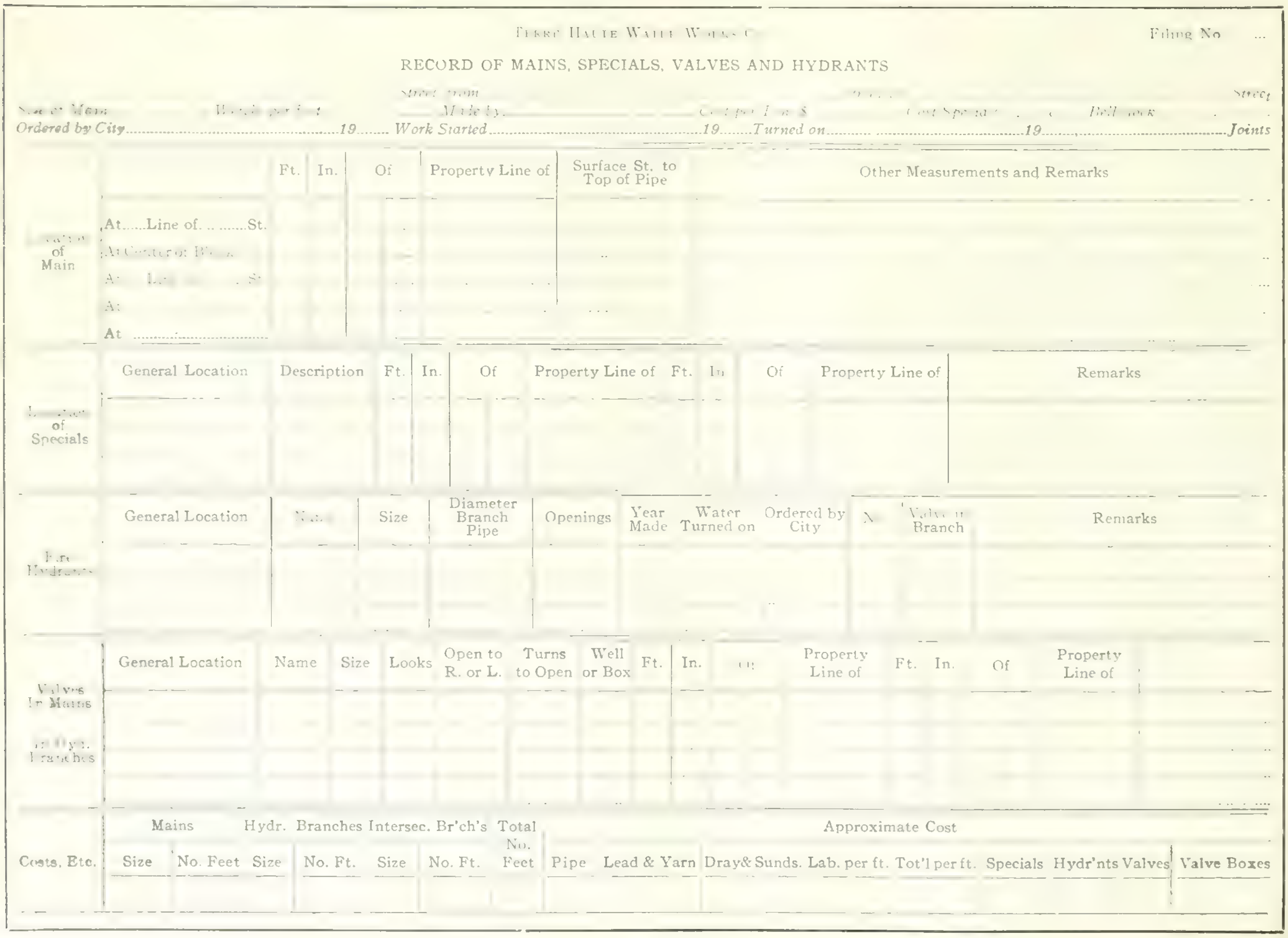
The spaces on the sheet are the same as the double space on a Smith Premier typewriter.

Provision is made for keeping record of the dates when fire hydrants were ordered and when water was turned on. Every fire hydrant has a permanent number and a space is provided for the same in the record, also to show if there is a valve on the branch pipe to the fire hydrant.

The form also provides for keeping cost records of the different items, such as pipe, specials, labor, valves, hydrants, etc.

Envelopes for Pipe System Records.—These are heavy manilla envelopes 4¾ by 11 ins. and they are kept in a vertical file. There is an envelope for each block of pipe in the system, or a part of a block. The envelopes are numbered and contain the following printed matter:

Fire Hydrant Records.—We have a card system for keeping record of every hydrant.



Terre Haute Water Works Co. Filing No. ...

RECORD OF MAINS, SPECIALS, VALVES AND HYDRANTS

Street from ... Street

Made by ...

Ordered by City......19...... *Work Started*......19......*Turned on*......19......,......*Joints*

		Ft.	In.	Of	Property Line of	Surface St. to Top of Pipe	Other Measurements and Remarks
Location of Main	At......Line of......St.						
	At						
	At						
	At						
	At						

	General Location	Description	Ft.	In.	Of	Property Line of	Ft.	In.	Of	Property Line of	Remarks
Location of Specials											

	General Location	No.	Size	Diameter Branch Pipe	Openings	Year Made	Water Turned on	Ordered by City	No.	Valve in Branch	Remarks
Fire Hydrants											

	General Location	Name	Size	Looks	Open to R. or L.	Turns to Open	Well or Box	Ft.	In.	Of	Property Line of	Ft.	In.	Of	Property Line of
Valves In Mains and Hyd. Branches															

	Mains		Hydr. Branches		Intersec. Br'ch's		Total	Approximate Cost								
Costs, Etc.	Size	No. Feet	Size	No. Ft.	Size	No. Ft.	No. Feet	Pipe	Lead & Yarn	Dray & Sunds.	Lab. per ft.	Tot'l per ft.	Specials	Hydr'nts	Valves	Valve Boxes

Fig. 2.

No. ....
On .... St.
From .... St.
To .... St.
Size of Main .... inch.
Length (exclusive of hydrant branch) .... ft.
Ordered by City ....
Entered in Street Record .... Page........

Note.—In this envelope are to be placed all reports and papers connected with the main, gates, specials, and hydrants in this block; together with contracts and other paper. Also all reports of repairs and changes.
Remarks ....

Fig. 3.

As soon as a hydrant is installed, we make out a card for it, giving it a permanent number. These cards are 3x5 ins. and contain the following:

Map.—In order to show the entire pipe system with mains, valves and fire hydrants, we have a white print map mounted on canvass and supported by heavy spring roller. The scale is 250 ft. to 1 in. The spaces for the streets are wide enough for lines showing mains located on either side of the street. A color scheme is used to denote the various sizes. Valves are indicated by short lines in black ink at right angles with the mains. Fire hydrants are shown by a red circle; in order to see them clearly, they are placed just inside the property lines.

This map is for general use and no measurements are given, but the mains are shown on the proper side of the street.

In general.—Our men are instructed to take measurements of any pipe, valve or special, which they may uncover, and file same. Connections for premises along our mains are made by us and the form of order given to the men for such work is arranged for entering the location, size and depth of the main. This is entered in the pipe system record and gradually we are getting records of underground work put in during the early days of the plant.

Public Fire Hydrant, No.
Location
Name Size Diameter Branch.
Opening Year in use Branch Valve? Yes
No
Connected to the .... Inch .... Street Main.
Ordered by City
....

Fig. 4.

STEAM AND ELECTRIC RAILWAY SECTION

Trainshed of the New Northwestern Passenger Station at Chicago.

The new passenger station of the Chicago & Northwestern Ry., which has been under construction for the past two years, is now nearing completion, and it is expected that the terminal will be opened to traffic within the next three months. With the exception of the terminal of the Pennsylvania R. R. in New York city, this is the largest and most important terminal construction ever undertaken in this country. The station, including trainshed, occupies the block between Canal and Clinton streets and extends from Madison St. to a point 180 ft. north of Lake St. The main entrance to the station is on Madison St., and the facade of the building is of an imposing style suited to the magnitude and importance of the station.

The transhed is of a somewhat novel type and is similar structurally to the trainshed built after the designs of Mr. Lincoln Bush for the Delaware, Lackawanna & Western R. R. at Hoboken, N. J. The shed is 320 ft. wide for the greater part of its length and covers 16 tracks. The characteristic feature of the design lies in the use of low arches having a span of approximately 39 ft., each arch spanning two tracks. A longitudinal smoke duct over each track extends the full length of the shed. This type of shed has been highly successful at Hoboken. It is found to be free of smoke and is much cooler in summer than the regulation long-span shed. Furthermore, the sectionalized low-arch type is easier to maintain. It lends itself well to the architectural design of the monumental structure of which it is a part, since it allows the placing, along Canal and Clinton Sts., of an artistic facade that entirely hides the trainshed.

An interior view of the trainshed is shown by Fig. 3. This view is from a photograph taken on Nov. 5, 1910, at which time the structural work had been completed.

Unusual difficulties had to be met in planning the trainshed, as the tracks are placed at second-story level, with subways, baggage rooms, suburban waiting rooms, etc., occupying the space beneath the tracks. For this

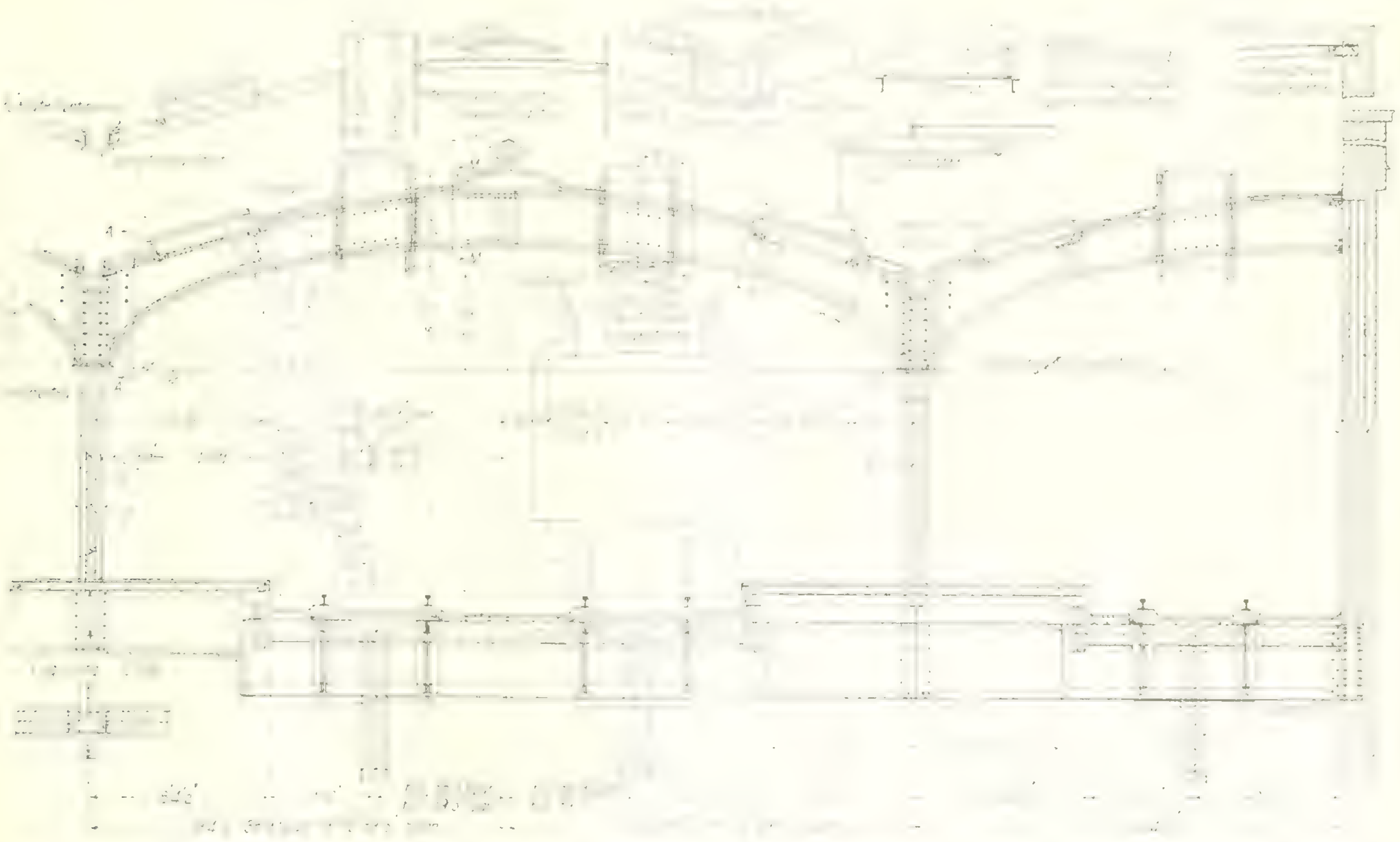


Fig. 1—Section of Train-Shed of the New Northwestern Passenger Terminal at Chicago. Showing Typical Construction of Full Span and Half-Span Arch Girders.

reason it was [illegible] system of [illegible] columns, instead of using an ordinary foundation as in the Hoboken trainshed.

Washington St. and Randolph St. pass through the station by means of subways. This leads to some irregular spacing in the supports. At Washington St. an additional complication was encountered due to the fact that the west approach of the Washington St. tunnel passes under the station, the west or surface end of the incline being at Clinton St.

The standard distance between arch girders, and therefore between the lines of column supports, is 25 ft. 6 ins. The necessity for spanning the areas in the subways led, however, to some irregular spacing. The minimum spacing used is 16 ft. 6 ins., and the maximum is 28 ft.

The trainshed extends north from the north end of the station 31 spaces or bays at the full width of 320 ft., and covers 16 tracks. Beyond this is an extension of 6 bays covering the west 10 tracks only. The tracks are arranged in the usual way, in pairs, the distance between the center of tracks of a pair being either 12 ft. or 12 ft. 6 ins., as required by the location of the supporting columns. The variation of 6 ins. in the spacing of the supporting columns is due to a like variation in length of span of the roof girders, these lengths being either 38 ft. 9 ins. or 39 ft. 3 ins. In the main portion of the shed there are 7 full spans, each covering 2 tracks, and a half span at each side of the shed, each covering 1 track. Platforms are 16 ft. 9 ins. wide, with surface 8 ins. above the top of rail, and are of concrete faced with 1½ ins. of asphalt. A concrete floor is also used between the platforms.

The arrangements within the trainshed have been carefully studied, and are such as to bring about as little interference as possible between incoming and outgoing traffic. Outgoing passenger traffic is admitted through the main gates at the south end of the shed. For incoming passenger traffic, especially suburban traffic, stairways are provided near the north end of the shed, leading to street level at Randolph St. Two baggage rooms are provided, one for incoming baggage under the south end of the shed and reached from Washington St., and one for outgoing baggage facing on Randolph St. Each baggage room is connected with track level by means of 8 elevators.

In this way all baggage is taken from or [illegible] the immediate vicinity of the head end of the train with the least possible amount of trucking along the platform.

STRUCTURAL DETAILS

The structural features of a full span and half span are shown by Fig. 1. It will be seen that the entire structure is carried by the columns placed on the center lines of tracks. These columns support cross girders to which are attached the longitudinal girders that carry the track rails, and they also support the cross girders that carry the platforms and roof columns. All cross girders have double webs, the columns fitting into the spaces between the webs. In this way it is possible to make a simple and satisfactory connection between the columns and the cross girders.

The cross girder and details of connection shown for column 86, Fig. 1, are typical for all interior columns. The details shown at column *C* 85 are typical for all columns adjacent to the half span at the side of the shed.

The general plan and structural details of the arch girders and supporting columns are shown by Fig. 1. Longitudinally the columns are connected by struts built of two 10-in. channels placed 12 ins. apart, and connected at the bottom by a ½-in. plate. In the channel thus provided the concrete gutter is placed. The grade of the gutters is such as to drain to downspouts placed at alternate columns. The rafters, 2 in each bay, for supporting the intermediate section of the roof, are carried by this strut and by the strut placed in the concrete side of the smoke duct. Details of their construction are shown in Fig. 1 and in Sections *AA* and *GG* of Fig. 2.

A characteristic feature of this type of trainshed is the continuous smoke duct. Experience at Hoboken has shown this smoke duct to be entirely satisfactory in the matter of smoke removal. Furthermore the amount of rain or snow entering the shed through this opening is found to be negligible. The sides of the duct consist of the longitudinal latticed strut, shown by Section *AA*, Fig. 2, enclosed in concrete. Protection for the arch girder, where it passes through the smoke

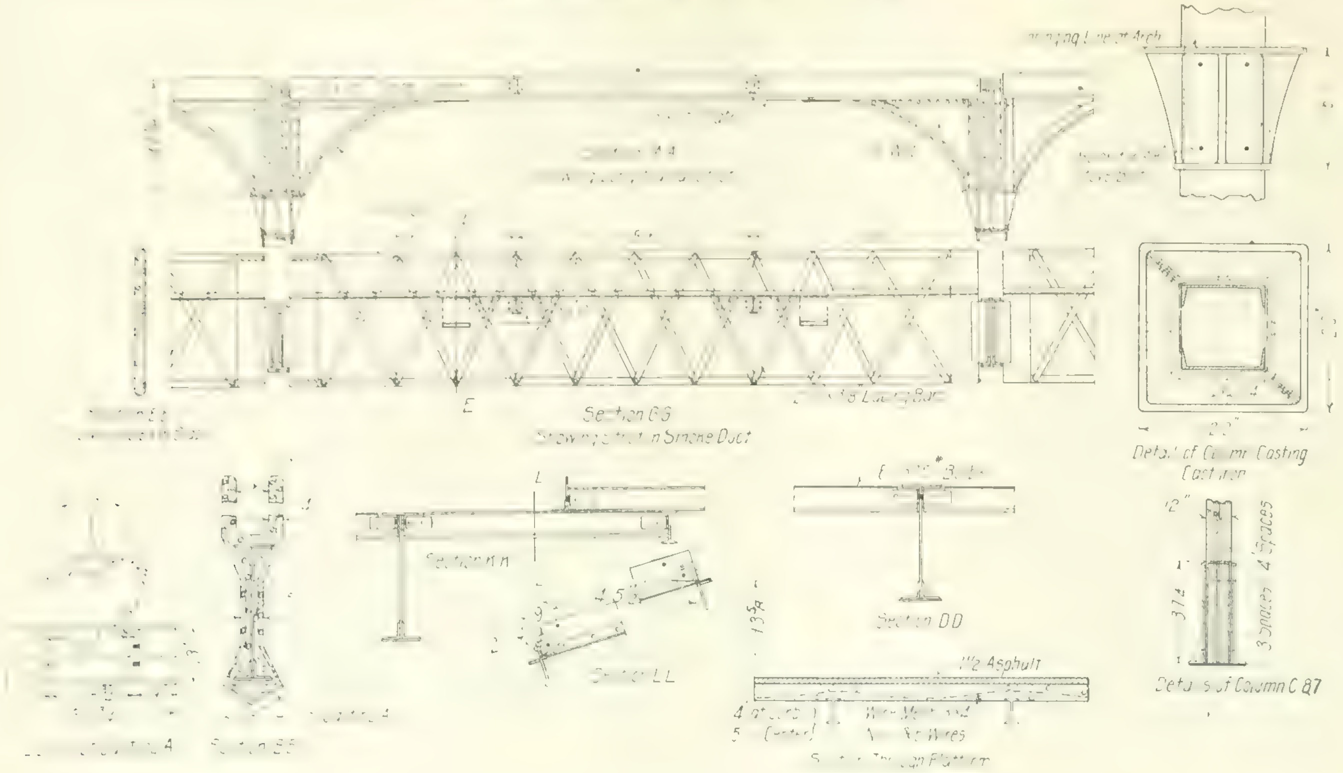


Fig. 2—Structural Details of the Train-Shed of the New Northwestern Passenger Terminal at Chicago.

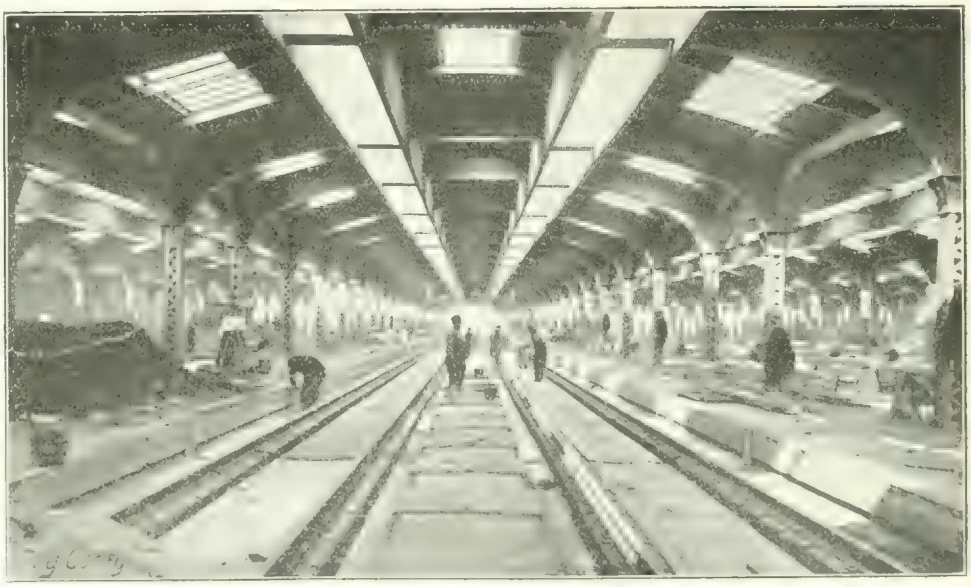


Fig. 3—Interior View of Train-Shed, Showing Completed Structure.

duct, is provided by means of a concrete envelope as shown by Section *BB*, Fig. 1. The bottom of the concrete is protected by a cast iron shoe. This shoe is so placed as to clear the highest engine cab ventilator. In the top of this concrete envelope 7-in. gutters are provided for conveying water from the center of the roof to the longitudinal gutters. Smoke that escapes from the smoke duct will either pass through the ventilator at the center of the roof, or through the small smoke vents placed in the side of the smoke duct, as shown by Section *EE*, Fig. 2.

Skylights and ventilators are placed in the middle of each bay as shown, throughout the structure, except in the two bays at the north end of the shed.

All concrete in floors, platforms and roof was molded in place, and is reinforced with a triangular wire-mesh reinforcement.

The structural work was designed by the firm of E. C. & R. M. Shangland, of Chicago. The general design and arrangement of the terminal was performed under the supervision of Mr. E. C. Carter, chief engineer, and Mr. W. C. Armstrong, terminal engineer of the Chicago & Northwestern Ry. To the latter we are indebted for the information and illustrations given in this paper.

Locomotive Smoke in Chicago.*

For years it has been an open question as to how much of the total smoke of Chicago is made by railroad locomotives. It is often stated by railroad officials that the railroads make a very small proportion of the total smoke, and that from a standpoint of smoke prevention the electrification of railway terminals is unwarranted. During the last few months the Department of Smoke Inspection of the city of Chicago has made an investigation to determine the proportion of the total smoke made by the railroads, and it is the purpose of this paper to describe this investigation.

A SUMMARY OF CONCLUSIONS

The results of this study, the details of which are presented below, may be summarized as follows:

1. Although the locomotives of the city use only 18½ per cent of the total coal, they make 43 per cent of the total smoke and over one-half of the total dirt.
2. The locomotives consume, within the city limits, 5,600 tons of soft coal daily, or about 1,850,000 tons annually.
3. According to the Ringlemann system of judging the density or blackness of smoke, the average density of locomotive smoke in Chicago is 23 per cent.
4. The lowest average density of smoke produced by any one road is about 10 per cent This figure probably represents as low an average as can be maintained with steam locomotives, using soft coal.
5. If all locomotives in Chicago maintained an average smoke density as low as 10 per cent, the locomotive smoke would still form 29 per cent of the total smoke and probably produce over one-third of the dirt.
6. Locomotives in the neighboring towns outside of Chicago make an average smoke density of about 41 per cent.
7. Approximately 10 per cent of all coal fired in a locomotive firebox is discharged from the stack in the form of cinders. Within the city limits of Chicago about 560 tons (14 carloads) of cinders from locomotive smokestacks are dropped every day.
8. There are about 2,200 miles of railway track in the city limits. At all times there are about 1,400 different locomotives working in the city, and during a week as many as 3,740 different locomotives are in Chicago.

CLASSES OF SMOKE MAKERS

In making a study of the different ways by which the total smoke of Chicago is made, the smoke makers of the city have been grouped into seven different classes, as follows:

1. *Central District.* This class includes all stationary boiler plants in the district bounded by Chicago Ave., Twenty-second St., Halsted St. and Lake Michigan, and is composed chiefly of office buildings, hotels, wholesale and warehouse buildings, factories, etc.
2. *Miscellaneous Power Plants.* This class includes all stationary high pressure boiler plants except those in the central district. In this group are placed factories, mills, manufacturing buildings, electrical power plants, packing houses, breweries, gas manufacturing plants, pumping stations, school houses, hotels, hospitals, laundries, etc.
3. *Flat Buildings.* This class includes all low pressure steam-heating plants in flat or apartment buildings, family hotels, etc. No private residences or buildings having three or less flats are included.
4. *Domestic Heating.* This class includes all private residences, cottages, two and three flat buildings, etc., which use soft coal, principally in stoves.
5. *Special Furnaces.* This class includes all special furnaces used in various manufacturing processes other than steam boiler furnaces, such as heating and melting furnaces in steel plants, terra cotta plants, malleable iron plants, forge shops, enameling plants, annealing ovens, baking ovens, china kilns, etc.
6. *Railroad Locomotives.* This class includes all steam railroad locomotives used in the city limits.
7. *Boats.* This class includes all steam vessels used in the city limits, such as tugs, passenger, freight, excursion and canal boats, pile drivers, dredges, etc

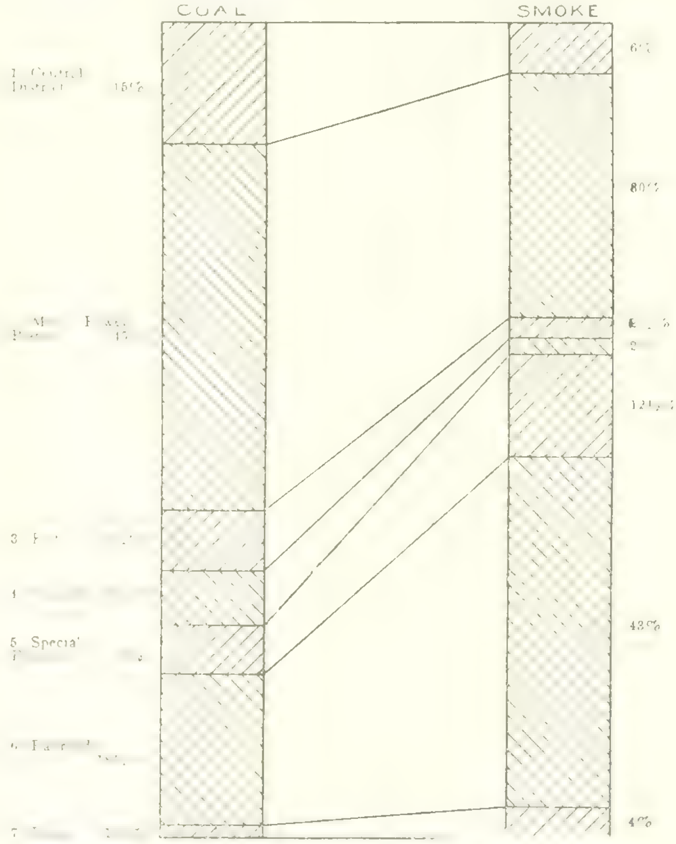


Fig. 1—Diagram Showing Comparison of Coal Consumed and Smoke Produced in Chicago.

As [illegible] incomplete combustion of bituminous coal, the basis of this investigation is a study of the coal consumption of the city. The smoke department has gotten together as much information on this subject as possible, and gives as its opinion that there are burned in the city limits of Chicago annually 10,000,000 tons (2,000 lbs. each) of bituminous coal. A check on this total figure of 10,000,000 tons has been obtained by accounting for its use amongst the different consumers of soft coal.

1. *Central District.* This class is estimated to use 1,500,000 tons of soft coal annually. This figure has been obtained by making a careful census of the boilers in this territory and by considering figures obtained from coal dealers.

2. *Miscellaneous Power Plants.* [illegible] used by the plants in this class has been obtained by computation based on the following data:

The records of the boiler department and smoke department show that there are about 7,000 high pressure boilers in the city and that the average rated boiler horsepower is about 143. A study of the load conditions in hundreds of plants shows that the average load is about 75 per cent of the installed boiler capacity.

After deducting the consumption of coal by high pressure plants in the central district the annual consumption of coal in this class was found by this computation to be 4,500,000 tons.

3. *Flat Buildings.* These plants are estimated to use 750,000 tons of coal per year, most of which is Pocahontas coal.

4. *Domestic Heating.* The coal used for domestic heating is very difficult to estimate. It has been decided that 650,000 tons of soft coal annually for this class of plants is as close a figure as is obtainable.

5. *Special Furnaces.* The plants in this class are estimated to burn 600,000 tons of coal per year.

6. *Railroad Locomotives.* The coal used by the railroad locomotives has been accurately estimated. The smoke department wrote to all the railroad companies and asked for estimates of coal burned by locomotives in the city limits. The returns show a total of 5,601 tons. This is the average for week days. Assuming that the Sunday consumption is one-third of the week day consumption, and that the other holidays in the year do not affect the average, it follows that the annual coal consumption of steam locomotives in the city limits is 1,850,000 tons.

7. *Boats.* This class is estimated to use 150,000 tons per year.

The division of the 10,000,000 tons is therefore as follows:

Class.	Consumer.	Annual Consumption.	Per Cent.
1.	Central district	1,500,000	15.0
2.	Miscellaneous power plants	4,500,000	45.0
3.	Flats	750,000	7.5
4	Domestic	650,000	6.5
5.	Special furnaces	600,000	6.0
6	Railroads	1,850,000	18.5
7.	Boats	150,000	1.5
		10,000,000	100.0

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*From paper by Paul P. Bird, read before the Western Society of Engineers, Chicago, Feb. 15, 1911.

[illegible]

[illegible] ferent classes of plants, it requires a knowledge of the average density of smoke made by each class to arrive at the percentage of the total smoke made by each. For this purpose the department has used the Ringlemann method of estimating the relative blackness [illegible] vented by Prof. Ringlemann, of Paris, and is in general use throughout the world. The U. S. Geological Survey has adopted it as a standard. The Ringlemann method of judging smoke is clearly explained in the transactions of the American Society of Mechanical Engineers, Vol. XXI, Dec., 1899.

For the convenience of those not familiar with this method the following definition of terms are given:

Percentage of Density of smoke is the percentage of light that is prevented from passing through it. For instance, No. 1 must prevent 20 per cent of light from passing through it, and, on the other hand, must allow 80 per cent of light to pass through it; No. 4 prevents 80 per cent and passes 20 per cent light; No. 5 is opaque and prevents all light from passing through.

A Smoke Unit corresponds to one minute of No. 1 smoke or its equivalent. For instance, one minute of No. 2 smoke is equivalent to 2 smoke units; two minutes of No. 3 smoke to 6 smoke units; four minutes of No. 1 smoke to 4 smoke units, etc.

A Stock Minute corresponds to watching one smoke stack for one minute. In any set of observations the stack minutes are obtained by multiplying the number of stacks under observation by the number or minutes during which the observation continues.

Using this method of computing the percentage of density, the smoke department has arrived at the following results:

Class. Consumer	Percentage of Density.
1. Central district	3.75
2. Miscellaneous power plants	6.5
3. Flats	3.0
4. Domestic	3.0
5. Special furnaces	20.
6. Railroads	22.3
7. Boats	25.0

An important part of this investigation of the density of smoke in Chicago has been a study of the smoke made by railroad locomotives. During October and November, 1910, a special observer spent his entire time on the rights of way of the railroads in the city limits. During these two months he made over 11,000 separate observations and watched the locomotives of 30 different railroad companies. The observer was assigned each day to a certain point on the right of way of some road, often at a junction of two or more roads, his instructions being to watch every locomotive coming within his sight, and to record in his memorandum book the number of minutes during which he watched the engine and his estimate of the density of the smoke in accordance with the Ringlemann charts. It is probably unnecessary to say that this work was done with absolute impartiality and that no effort was made to watch the engines of one road more than another.

Locomotives of 30 different roads were observed, but in four cases less than 50 observations were made; therefore these were not considered, because it is felt that not enough observations were made to arrive at a proper average. The list shows the locomotives of the Wisconsin Central Ry. (leased by the Minneapolis, St. Paul & Sault Ste. Marie), as occupying first place with an average density of smoke of 10.76 per cent. The Chicago Junction Ry. occupies the lowest position in the list with an average of nearly 42 per cent. The average percentage of locomotive smoke density in the two months' investigation is 22.3 per cent.

During the month of December, 1910, the same observer who had worked in Chicago on the investigation of railroad smoke was sent to eight different towns outside the city limits to make similar observations. In these eight towns the density of locomotive smoke averaged 41 per cent. This is probably a fair [illegible] the performance of a locomotive using Illinois or Indiana coal with no particular attention paid to preventing smoke.

TABLE I.- TRACKAGE, LOCOMOTIVES OPERATED, AND TONS OF COAL CONSUMED BY LEADING RAILROADS IN THE CITY OF CHICAGO.

		Locomotives.			Coal	
Railroad Company.	[illegible]	Average number in Chicago at one time	Total number of different locomotives in Chicago daily	Total number of different locomotives in Chicago weekly	Tons [illegible] in Chicago daily	Tons burned within city limits daily.
A., T. & Santa Fe Ry	57.10	34	34	54	210	100
Baltimore & Ohio R. R	41.81	25	42	42	260	75
Chicago & Western Indiana R. R	150.03	3	3	3	85	85
Chicago & Alton R. R	46.82	24	33	33	317	143
Chicago, Burlington & Quincy R. R	91.51	93	114	159	450	265
C. & O. R. R. Co. of Indiana	....	5	5	5	33	7
Chicago & Eastern Illinois R. R	....	20	25	25	77	76
Chicago Great Western R. R	16.01	16	25	25	132	63
Chicago, Indianapolis & Louisville Ry	....	7	11	11	8	14
Chicago, Indiana & Southern R. R	....	4	7	7	50	9
Chicago, Milwaukee & St. Paul	[illegible]	94	130	201	770	506
Chicago & Northwestern Ry	303.23	323	323	323	2,000	1,050
Chicago, Rock Island & Pacific Ry	112.93	34	60	388	210	206
Erie R. R	....	13	20	45	113	84
Grand Trunk Ry. system	[illegible]	20	33	33	190	80
Illinois Central R. R	310.63	148	176	176	902	500
Lake Shore & Michigan Southern Ry	85.27	65	74	505	563	309
Michigan Central R. R	50.18	23	35	35	175	90
New York, Chicago & St. Louis R. R	38.21	26	31	31	147	65
Pennsylvania R. R	253.91	145	188	1,316	647	647
Pere Marquette R. R	....	9	10	55	50	30
Wabash R. R	38.52	21	28	40	200	90
Minn., St. P. & Ste. M. Ry., lessee of W. C	....	15	15	15	6	52
B. & O. Chicago Terminal R. R	84.70	25	25	25	76	100
Belt Ry. of Chicago	98.60	82	82	82	425	425
Chicago Junction Ry	10.00	37	37	37	296	296
Chicago River & Indiana R. R	....	4	4	4	32	32
Chicago Union Transfer Ry	....	1	1	1	..	2
Chicago, West Pullman & Southern R. R	10.00	10	10	10	40	40
Chicago & Calumet River R. R	2.29	2	2	2	6	6
Elgin, Joliet & Eastern Ry	19.25	45	45	45	121	121
Indiana Harbor Belt R. R	10.25	.	.	.	...	...
Illinois Northern Ry	12.25	5	5	5	24	24
Manufacturers' Junction Ry	1.16	3	3	3	9	9
Union Stock Yards	146.68	.	..			.
Total	2,192.30	1,381	1,636	3,741	8,624	5,601

For the purpose of comparison a summary of these observations is given below:

Town.	Observations.	Percentage of Smoke Density.
Elgin, Ill	607	31.4
Aurora, Ill	483	32.9
Mendota, Ill	282	42.8
Kankakee, Ill	417	44.5
Harvey, Ill	170	44.9
Hammond, Ind	501	45.4
Joliet, Ill	540	47.3
Streator, Ill	366	51.0
Total	3,366	41.1

DIVISION OF TOTAL SMOKE.

Knowing the division of the total coal burned in the city amongst the seven classes of consumers and knowing the average density of smoke made by each class, it is an easy matter to compute the division of the total smoke amongst the seven classes.

As far as is known, this is the first attempt ever made to sub-divide the total smoke of a city amongst the various classes of plants responsible for its production. The work has been done carefully and accurately and it is felt that the results obtained are very nearly correct.

This sub-division is given in the following table and is shown graphically by Fig. 1.

CHARACTER OF LOCOMOTIVE SMOKE.

Locomotive smoke carries with it quantities of sparks and cinders, while in stationary plants relatively little of such material is thrown out. This is because of inherent features in the design that are unavoidable. On a locomotive there is so little room available that the grate surface of the boiler is necessarily small and there is consequently required a powerful draft for burning enough coal to do the required work. Because of this strong draft there is drawn out of the fire box with the smoke great quantities of fine coal and ash, which in turn are discharged from the stack in the form of cinders. It is a recognized fact amongst railway men that from 8 to 18 per cent of all bituminous coal put into locomotive fire boxes escapes from the stack in this manner. In Chicago about 5,600 tons of coal are burned in locomotives each day. Assuming that 10 per cent of the coal leaves the stack in the form of cinders, it means that 560 tons of cinders are thrown into the air and dropped on the city of Chicago every day. This is equal to about 14 carloads. On the other hand, in stationary plants where there is plenty of room for a larger grate surface and where the coal is burned with a lower draft and with tall chimneys, but few cinders are carried out with the smoke.

POSSIBILITIES OF LOCOMOTIVE SMOKE PREVENTION.

Investigation has shown the lowest percentage of smoke density made by the locomotives of any railroad to be 10.7 per cent. Probably 10 per cent is as low an average as can be maintained with steam locomotives using soft coal. Therefore the very best condition that can be hoped for in Chicago is to have all locomotives average 10 per cent density, which would mean that the locomotive smoke would still be 29 per cent of the total, and probably be responsible for over one-third of the dirt. The modern steam locomotive is such a highly developed machine that it is extremely unlikely that any change will ever be made in its construction which will produce better results than this. A further reduction of the smoke made by locomotives can only be brought about by change of fuel. The possible fuels besides the local soft coals are: First, semi-bituminous coal; second, anthracite coal; third, coke; and fourth, oil. A considerable amount of semi-bituminous or

	Annual Coal Consumption.		Smoke.		
				Per Cent of Total Smoke.	
Class. Consumer	Tons.	Per Cent	Percentage of Density.	As Figured.	Round Numbers.
1. Central district	1,500,000	15.	3.75	5.85	6
2. Miscellaneous power plants	4,500,000	45.	6.5	30.45	30
3. Flats	750,000	7.5	3.0	2.34	2½
4. Domestic	650,000	6.5	3.0	2.06	2
5. Special furnaces	600,000	6.	20.0	12.5	12½
6. Railroads	1,850,000	18.5	22.3	42.9	43
7. Boats	150,000	1.5	25.0	3.9	4
Total	10,000,000	100.		100.0	100.0

Pocahontas coal is now [illegible] burned by some of the railroads in Chicago, and although it makes less smoke than Illinois coal under the same conditions, its use by no means guarantees the entire elimination of smoke. Probably the universal use of semi-bituminous coal would not succeed in reducing the average density of smoke below a point that is considered possible with Illinois coal. The general use of anthracite coal or of coke for locomotives would eliminate smoke, but the other nuisances due to steam locomotives would not be diminished. If coke were used there would be an increase in the quantity of sparks and cinders discharged from the stacks. In either case the volume of furnace gases and their effect in vitiating the atmosphere would not be reduced. Fuel oil makes smoke unless carefully handled, and the smoke that is made is more objectionable than the smoke from soft coal. It is probable that if all locomotives in the city burned oil, the smoke and gases would form more of a nuisance than the soft coal smoke of to-day. The general use of any specially selected fuel would greatly increase the cost of fuel to the railroads, and the practical difficulties involved would make it a very difficult thing to bring about. In order to ensure that all locomotives operating in the city limits used the same fuel, all the engines on an entire division would have to be thus equipped, which of course would greatly increase the cost of operation.

ELECTRIFICATION.

The study that has been made along these lines indicates clearly the electrification offers the only final and satisfactory solution of the locomotive smoke problem. The use of special fuel for preventing smoke on steam locomotives is only a makeshift and will not satisfy the public.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Methods and Cost of Constructing Stone Filled Timber Breakwater, Lincoln Park Extension, Chicago.

In constructing "Picnic I[illegible]" on the Lincoln Park Extension, described elsewhere in this issue, 3,600 ft. of breakwater will be built around the outer side and ends of the island and the interior space filled in by hydraulic dredge. The progress of the work on the breakwater is shown in full lines on the plan, Fig. 1, shown elsewhere. The details of the breakwater construction are shown by the accompanying. drawing. Of the 3,600 ft. of breakwater 604 ft. have been built during 1910. In detail, it consists of two rows of piles, 13½ ft. between centers, the space between piles being 4 ft. There are two waling timbers fastened on the inside of each row of piles to hold the piles to line and to act as guides for the Wakefield sheeting. This sheeting is driven about 7 ft. into the sand and clay and the piles are driven into it about 15 ft. The sheeting on the water side of the break water is made of 3-in lumber and that on the land side is made of 2-in. material. The two sides are tied together with 1¼-in. bolts, as shown, and the space between is filled with stone.

In construction the piles are driven by a floating driver which is equipped with 45 ft. leads and a 2,400-lb. drop hammer. A section of breakwater is completed each day in order to prevent the loss of a partially completed section, due to any storm which might arise. Piles are driven along one side for a short distance and the driver is then swung around to the opposite side to drive an equal number of piles on that side. The derrick scow follows and places the waling timbers and brings the piles to line. The lower wale, which is placed several feet below the surface of the water, is shoved down to its position against the piles by two sticks or boards, each of which is nailed to the wale and, when in position, tacked temporarily to the top wale. In driving the sheeting one of the chief difficulties arises from the fact that the piece being driven gradually works away from the piece adjoining. To overcome this trouble special tapered pieces are kept on hand and used wherever necessary to again bring the edge of the sheeting to a plumb line. When the sheeting is driven the driver places a temporary bulkhead across the end, consisting of 2-in. plank jetted through the sand. In the meantime the dock carpenters have been placing the bolts and this work has been closely followed up with the stone filling. The cost of the 604 ft. of completed breakwater built in 1910 follows:

COST OF PICNIC ISL[illegible] [illegible]AKWATER.

	Totals.	C[illegible]t per lin. ft.
Supt. and engineering	$[illegible]	$[illegible]
Labor	1,180.00	1.9[illegible]
Carpenters, laborers, misc.	151.13	0.[illegible]
Tug service, driver and derrick	577.89	0.9[illegible]
Supplies	[illegible]	0.[illegible]
Material.		
Piles, 30 and 35 ft	[illegible]	[illegible]
Wakefield sheeting	[illegible]	1.3[illegible]
Oak waling and bulkheads	1,200.56	1.9[illegible]
Hardware	[illegible]	0.570
Stone filling	4,182.70	6.92[illegible]
Total cost	$1[illegible]	$31.047

The cost of driving the piles is as follows:

Amount [illegible]	[illegible]
Amount driven 225 35 ft. piles	7,875 lin. ft.
To[illegible]	[illegible]
Pile dr[illegible]	[illegible]
Pile driver fitting [illegible]	[illegible]
[illegible]	163.20
Richard B[illegible] $3.53	[illegible]
Keystone [illegible] $4.80	[illegible]
Derrick, [illegible] hrs. at $1.6[illegible]	11.20
General foreman, 30 [illegible]	18.00
Superintendence	25.00
Total	[illegible]
Cost of driving, per pile	1.914
Cost of driving [illegible]	[illegible]

The piles were driven in 12 ft. of water through 3 to 5 ft. of sand overlying a clay bottom. The penetration of each pile was from 15 to 20 ft. The cost of the piles is given as follows:

Cost per pi[illegible]	[illegible]
Cost per 30 ft. pile [illegible]	[illegible]
Cost per [illegible] ft. [illegible] pile [illegible] on job	1.36[illegible]
Cost per [illegible] ft. [illegible]	.1[illegible]

Wakefield Sheeting.—A large part of the Wakefield sheeting for the breakwater was made by the men from the pile driver and derrick crews, during such weather as did not permit work on the water. The cost of driving the sheeting follows:

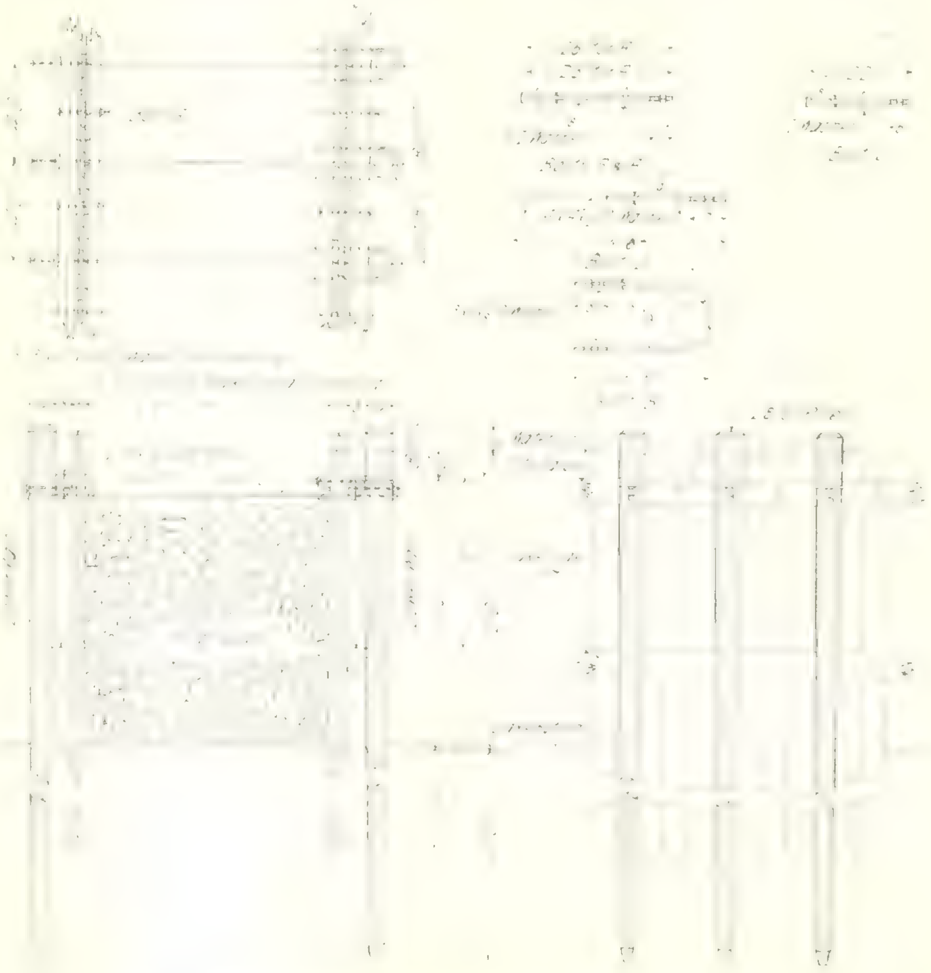
Amount driven
[illegible]
116 pcs. 3x12x20 in. } temporary
[illegible] bulkheads
10 pcs. 9 in. sheeting }

1,356 pcs.

Pile driver, [illegible]	$[illegible]
Pile driver fitting up, 26½ hrs. at $4.744.	125.72
Pile driver [illegible] hrs. at $4.744	71.16
Derrick, loading sh't'g, 38 hrs. at $1.60	60.80
[illegible]	[illegible]
Keystone [illegible] 1½ hrs. at $4.80	7.20
General foreman, 40 hrs. at $0.60	24.00
Superintendence	2[illegible]
[illegible] of pile [illegible]	[illegible]
Total	$1,2[illegible]
Driving sheeting (each)	$0.927
Making [illegible]	[illegible]
Hardware, bolt[illegible] and [illegible] spikes for 1 pc. 6 in. sheeting	0.64
Hardware, bolt[illegible] and [illegible] spikes for 1 pc. 9 in. sheeting	0.9[illegible]
Lumber for 1 pc. 6 in. sheeting	[illegible]
Lumber for 1 pc. 9 in. sheeting	[illegible]
Total cost 1 pc. 6 in. sheeting	4.60
Total cost 1 pc. 9 in. sheeting	6.68

The sheeting was made 24 ft. long.

The balance of the construction of the breakwater consisted of the stone filling. The



F[illegible] f Breakwater Built at Lincoln Park, Chicago.

[illegible] towed on scows to the breakwater, a distance [illegible] were built specially for the purpose of transferring the stone without reloading. They are [illegible] handled by the derrick, by means of threeway chains. One side of each box is arranged as a swing door which releases when the catch is struck with a bar and allows the load to dump. The boxes were made at a cost of $10.93 each. The cost of this work is given in the following table:

Loading at [illegible]	[illegible]	[illegible]
Keeping [illegible]		
$4.50	[illegible]	[illegible]
Derrick [illegible] 194 hrs. at		
[illegible]	[illegible]	[illegible]
Stone boxes, 1/3 of value........	0.626	0.237
[illegible]	[illegible]	[illegible]
Total [illegible]	[illegible]	[illegible]

The pile driver which was used on this work was [illegible] with [illegible] 2400 lb. drop hammer. When driving the Wakefield sheeting an auxiliary pair of leads was used in order that they might be suspended inside the row of piles already driven, and which interfered with the use of the main leads. The cost of the operation of this driver for 1910 was as follows:

[illegible]	[illegible]
[illegible]	[illegible]
Fuel [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total cost	[illegible]
[illegible]	[illegible]

Of the total time 410 hrs. was charged to the breakwater construction.

Recent Motor Trucks; Their Adaptaability to Contractors' Haulage.

The accompanying illustrations show recent American practice in motor truck construction. These trucks were selected from [illegible] on exhibition at the motor [illegible] brought [illegible] this type of power vehicle one of the editors [illegible] time at this show in making observations and collecting data on the trucks exhibited, with the view of learning their adaptability to contractor's haulage. The study proved rather negative in results of very great importance, but some general information was gathered which may well be set down.

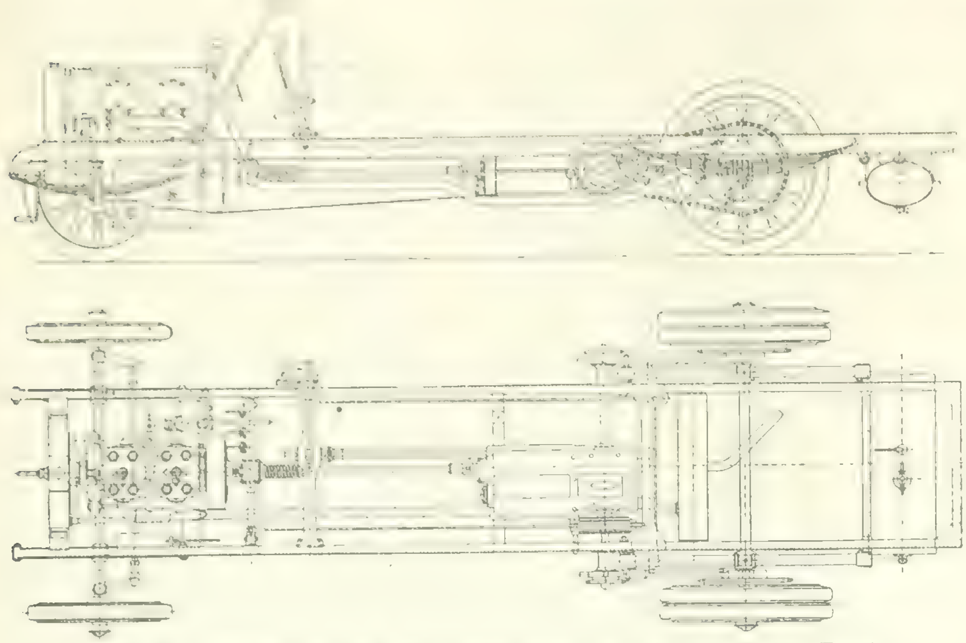


Fig. 1. Diagram Showing the Arrangement of a 4½-ton Saurer Truck.

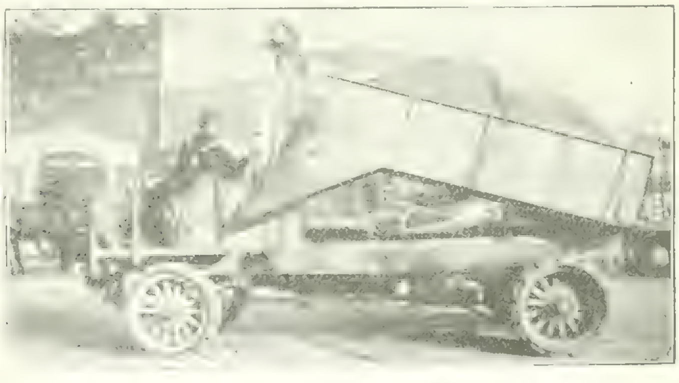


Fig. 2. View of a 7-ton Hewitt Truck Equipped with a Dump Body.

It is evident that manufacturers of motor trucks have had primarily in mind a character and conditions of transportation different from contractors' haulage. The conditions which they have assumed are (1) A volume of business sufficient to keep the vehicle busy for practically all the working days of the year; (2) a favorable character of roadway like city streets or improved roads to suburbs. As to means of loading and unloading it is evident that there has been in mind only loads having value that is loads of merchandise. In a word the designation "commercial vehicle," which the manufacturers use, rather strictly defines the motor truck of to-day. This condition is entirely logical from the motor vehicle business viewpoint, and it shows where the possibilities of motor trucks for contractors' haulage begin and end. Whenever the character and conditions of contractors' haulage fall within the two conditions stated above the motor truck has a possible field.

It is obvious that much contractors' hauling comes within the limits named. The hauling of construction materials for building work in cities, for paving work and for all kinds of conduit work in streets is clearly within the possibilities of the motor truck as at present designed for hauling merchandise. For hauling spoil from trenching, etc., where the material is to be wasted the present commercial vehicle is not so well fitted because of its lack of quick dumping facilities. Here it seems to us is a prime point for the manufacturer to consider who intends to develop motor trucks for contractors' haulage. Contractors' haulage is quite as largely made up of transporting material to be wasted as of transporting construction material and the vehicle in which the hauling is done must be fitted quickly to discharge its load. In horse drawn vehicles the bottom dump wagon is the most favored by contractors, the end dump being used only with one horse carts. Such motor trucks as are provided with dumping bodies are designed for end dumping. This practice has doubtless come about naturally because the handling of coal or broken stone has been had in mind in designing the dumping arrangement and with such commodities the end dump is perhaps best suited to most conditions, and also because there seems likely to be a rather troublesome problem offered in designing a dump bottom. A glance at the frame and mechanism shown by Fig. 1 indicates that a bottom dump may be entirely out of question.

Returning to the main thought, however, it is plain that the motor truck as it now is may be adapted to much of the hauling required for city contract work. For contract work in the country and particularly in rough and untraversed country its possibilities decrease. To be specific, the transportation conditions outlined in the description of the Aziscohos Dam published in our issue of Jan. 4, 1911, were practically impossible for the motor truck. This is true also of the conditions of haulage for the Los Angeles Aqueduct, described in our issue of Dec. 7, 1910 On the other hand it is certain that ordinary country roads can during a considerable season of the year be negotiated by motor trucks with reasonable success, as shown by their use on the Springfield, Mass., water filtration plant, described in our issue of Feb. 1, 1911.

Obviously, considering the motor truck, each case of contractors' haulage is a separate problem to be solved by itself. The distinctive property of the motor truck for haulage is its combination of speed and load capacity. To take full advantage of these the volume of haulage must be considerable; the length of haul must be great enough to make speed count, and the character of the roads must be such as to permit both speed and heavy loading. These requisites may quite readily be integrated into the problem when the costs of motor truck, maintenance and operation are known. Unfortunately such costs of the [illegible] are not free from bias and are for a character and conditions of haulage not common to contract work. From data collected at the exhibition at Chicago we may assume that the cost per day, assuming a 300-day year and including interest, depreciation, insurance, repairs and all operating expenses, averages form about $8 for a 1-ton capacity truck to $15 for a 5-ton truck and to $18.50 for a 10-ton truck. This is a general average of the costs as gathered from various parts of the United States and on various classes of work. The cost per mile

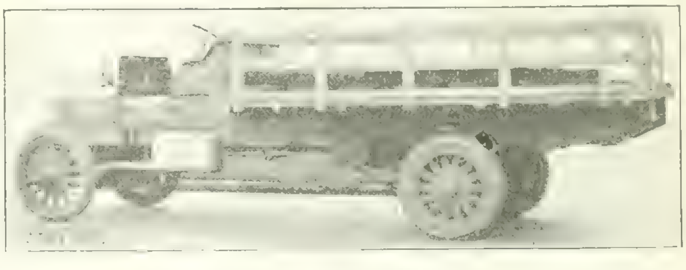


Fig. 3. View of a 3 to 5-ton Stearns Truck with Standard Platform Equipment.

of driving may best be calculated by dividing the cost per day by the number of miles estimated to be made per day on the particular work considered. For a 1-ton truck it may be estimated that the average daily mileage will be from 50 to 60 miles; for a 3-ton truck from 35 to 45 miles, and for a 5-ton truck from 20 to 30 miles. These rates are estimated from actual performances upon firm roads under working conditions.

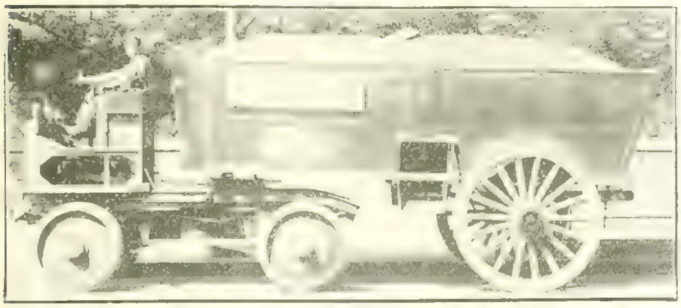


Fig. 4. View Showing a 40-h.p. Couple Gear Truck Equipped with a Semi-Trailer Carrying a 10-ton Load.

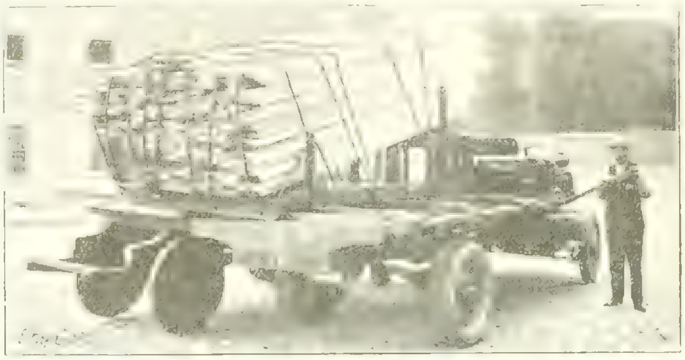


Fig. 5. A 3-ton Packard Truck Arranged for Carrying Lumber, and Showing the Method Used for Quick Loading.

The following costs of motor truck, Table I, operation are given by the Metzger Motor Car Co., and were compiled from the records of Hewitt trucks over a period of 5 years:

TABLE I. COST OF OPERATING HEWITT MOTOR TRUCKS

	10-Ton.	7-Ton.	5-Ton.	3-Ton.	2-Ton.	1-Ton
Chassis cost	$6,000	$5,500	$5,000	$3,000	$2,750	$1,500
With stake body	6,300	5,775	5,250	3,225	2,925	1,700
	Per Year.	Per Year.	Per Year.	Per Year.	Per Year.	Per Year.
Depreciation, 15 per cent, less cost 1 set tires	$ 780	$ 743	$ 695	$ 421	$ 390	$ 225
Interest, 5 per cent	315	289	262	161	146	85
Driver, $16 to $22 per week	1,144	1,092	1,040	936	936	832
Garage	300	300	300	240	240	240
Tires	1,650	1,231	930	620	480	300
Yearly overhaul and current repairs	550	500	450	400	350	300
Gasoline at 12 cts.	450	450	450	375	325	275
Oil at 30 cts.	120	100	90	60	50	40
Insurance	220	210	200	150	140	125
Cost per year	$5,529	$4,915	$4,417	$3,363	$3,057	$2,422
Cost per day	18.43	16.38	14.72	11.21	10.19	8.07

From the figures in Table I it will be seen that the cost of the machine is charged out in about 7 years, thus estimating the life of the truck at 7 years. The tire repair bill is the largest single item of expense, and the manufacturers insist that, for the time being at least, rubber tires are necessary for the best protection of the engine against shock. The Avery Company has on the market, however, a patented wood plug tire which has been successfully used upon earth roads. One of their machines equipped with wood plug tires is shown by Fig. 6. The cost of operation of this type of machine is given below. In this case the owner, Andrew Garrity of Indianapolis, Ind., employed the machine for hauling large cans of milk from the farm into the city. He claims that the machine does the work of three teams, formerly employed, and at a saving of $103 per month. The costs for one month's work as submitted by Mr. Garrity are:

Cost of machine, 3-ton truck	$2,500.00
Depreciation at 20 per cent per year	41.60
Interest at 6 per cent per year	12.50
1 driver at $75	75.00
3 helpers at $45	135.00
Gasoline bill for one month	[illegible]
Lubricating oil [illegible]	.40
Recharging storage battery	.50
Repairs [illegible]	5.00
Wood plug tires	6.00
Painting and relettering at $24 per year	2.00
Total cost per month	$ 321.29

The foregoing data are for gasoline operated trucks. Several meritorious electric trucks have been put upon the market. The first costs of these trucks is about the same as that of gasoline motor trucks and their cost of operation is also about the same.

The following estimates of the cost of maintenance and repair for the Studebaker electric truck is furnished by that company as being an average of records of their machines on commercial work:

TABLE II. COST OF OPERATING STUDEBAKER ELECTRIC TRUCKS

Type of machine	1-Ton.	2-Ton.	3½-Ton.	5-Ton.
Value (variable)	$2,400.00	$2,950.00	$4,225.00	$4,950.00
Interest at 5 per cent and [illegible]				
Depreciation on [illegible] parts	$ 302.11	$ [illegible]	$ 511.44	$ 608.79
Tire upkeep and renewal	[illegible]*	[illegible]	790.00	920.00*
Battery upkeep and renewal	[illegible]*	[illegible]*	[illegible]	[illegible]
Mechanical [illegible]	[illegible]	148.00	[illegible]	[illegible]
Totals per year	$ [illegible]	$1,016.40	$1,[illegible]	$1,6[illegible]
Garaging and [illegible]	$ 70.00	$ [illegible]	$ [illegible]	$ 150.00
Miles per day [illegible]	[illegible]	[illegible]	24	21

*[illegible]

Still another type of electrical machine is that which generates its own current with a gasoline engine which operates a generator furnishing [illegible] wheel. This machine has for its leading feature, however, a couple gear, built by the Couple Gear Company of New York. In turning the machine both the front and rear axles are operated in couple, thus enabling the machine together with its attached body, as shown in Fig. 4, to turn in a [illegible] ft. diameter circle. The feature of attaching the body and rear trucks of an ordinary wagon in the manner shown is also one belonging to this truck and is of considerable advantage because 65 per cent of the load is carried upon the steel tires.

The type of construction employed is indicated by the illustrations. Figure 1 shows the general construction of the Saurer truck, which has taken first place in Europe on account of its economical operation and its strength of design. It is a high priced truck, but is acknowledged by the majority of manufacturers to present the best features for gasoline motor trucks. The greater part of the weight is carried upon the rear axle, thus permitting the use of lighter springs at the front and securing better protection to one of the most expensive and delicate parts of the machine—the engine. This machine contains other features which are generally acknowledged to be the best construction for motor trucks and which have been followed in a large number of other trucks, such as the Sampson, the Mack, Kelly, Peerless, Morgan and White. Some manufacturers have suspended the engine from the truck frame by a special set of springs in order to prevent excessive shock. This is done in the Stearns truck. In the main, most trucks have been designed extra heavy in all parts, which is always a good feature in contractors' machinery.

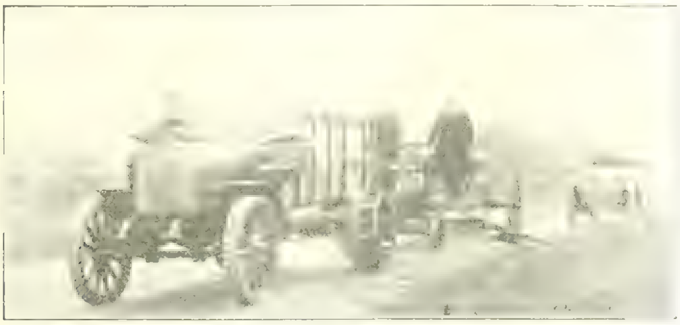


Fig. 6. View of an Avery Truck with Wood Plug Tires.

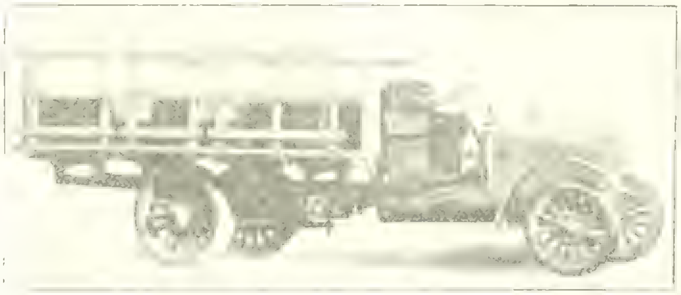


Fig. 7. View of a 5-ton Pierce-Arrow Truck with Load.

The total number of poles reported to the Bureau of the Census as purchased during the calendar year 1909 by the telegraph and telephone companies, steam and electric railroads and electric light and power companies of the United States was 3,739,000, as against 3,249,000 in 1908 and 3,283,000 in 1907.

LETTERS TO THE EDITOR.

Method of Projecting a Transit Line Down a Vertical Shaft.

[illegible] which Mr. Herbert M. Hale describes the projection of a transit line down a vertical shaft, a description of a similar operation in which the difficulties encountered were on a larger scale may prove of interest.

The shaft in question is the main shaft of an anthracite coal mine located near Wilkes-Barre, Pa. The shaft is about 600 ft. in depth, composed of three compartments, each 6x10 ft. inside the timbers. In order not to interfere with the haulage and the ventilation, only one compartment was available and the engineers were further restricted by the necessity of completing the job between 6 p. m. Saturday and 6 a. m. the following Monday.

From the second level down the shaft exuded water in large quantities, so that at the bottom the condition was extremely disagreeable, the water falling in a continuous and heavy downpour. In addition, from the vein level down, at the bottom of the shaft, the water had accumulated in the sump, which necessitated using the cage as a platform for the barrels in which the weights were suspended.

A special form of plumb bob was used, consisting of five metal flanges diverting at equal angles from a center pin, which thus exposed ten equal surfaces to the liquid in the barrels. To further accelerate the plumb bobs to steady, oil was used instead of water.

After the surface surveys were established and checked and the line ready to be projected, preparations were commenced one Saturday afternoon at 5 o'clock. Two pieces of heavy timber were firmly fastened across the shaft about 1 ft. from each end so that the wire suspended on the inside of these would clear all the way down. On the timbers two Y-shaped spads were nailed, so that the notch of the Y just cleared the edge of the timber. The notches of the spads were then adjusted so that they were exactly on line. The piano wires were suspended over these.

Two parties then went below, one to the foot of the shaft and the other to the next vein above, which was connected with the bottom vein by a slope.

Before suspending the plumb bobs, one of the wires was cut at both levels about the height of a transit above the ground and an ordinary key ring inserted between the two ends. By this simple expedient a sight could be taken on each wire separately; first looking through the key ring at the far wire and then elevating the telescope and sighting to the near one.

By 8 o'clock the plumb bobs were in position and between 3 and 4 o'clock in the morning were steady, in spite of the fact that water was splashing down practically the entire length of the wires, and that, in addition, they were in the intake shaft and in a strong current of air.

The surveys of the two parties were tied through the slope, and as a further check a line was projected down another shaft located some 150 ft. distant which was connected underground at both levels with the main shaft. The three separate lines tied up accurately.

It will be seen that the methods used in this case were extremely simple and inexpensive, and in view of the difficulties encountered, were remarkably successful.

Yours truly,
P. L. MATHEWS,
Resident Engineer, Ferrocarriles Nacionales de Mexico.
Estacion del Golfo, Monterrey, N. L., Mexico,
Jan. 20, 1911.

How May Concrete Be Prevented from Sticking to Block Molds?

Sirs: We are having considerable trouble with the concrete sticking to our molds. Our work is the making of a non-absorbing concrete block by the slush concrete method. After the form or mold is filled with concrete it is run into an oven and there it is left 5 hours at 180° of heat, after which it is run out into the piling yard, where it is taken from the mold and piled. Where we have our trouble is in getting the face plate loose. We make both a plain face and a rock face block. The rock face blocks stick worse than do the plain face blocks. What I want to know is something that can be applied to the forms or mold that will stop this sticking. We have used paraffine oil and Anti Stick without much success.

Yours truly,
F. W. CAST STONE CO.,
Per S. J. Callahan.
St. Paul, Minn., Feb. 7, 1911.

The Silting of Reservoirs.

Sirs: Referring to Mr. Campbell's letter with the above title in your issue of January 25, 1911, my paper summarizes as follows: "Sand gates and scouring sluices cost money to build, and waste a lot of valuable water for a very small clearance. The only feasible method is to prevent the silt from entering the system by silt traps, sand boxes or sedimentation basins, which can be cleansed," consequently my paper could hardly be considered an advocacy of the sluice.

The silt question in India and Egypt has been solved for those countries by the Bhatgarh Dam and the Assuan Dam as mentioned in my paper, also in America by the Indian Weir Dam. Of course it is hardly possible to employ these systems in all cases in any country, consequently the reservoirs are silted up and the dams become useless. When this occurs, the question naturally arises whether it is cheaper to cleanse the old one or to build a new reservoir. If the solid dam be pierced by a sluice designed on the principle of the Spanish Gate, quoted in my article, part of the silt could be removed through it by the water remaining in the reservoir, and the remainder could be either shoveled or scraped into the stream or by means of a gasoline pump and a hydraulic giant this silt could be sluiced at very small cost.

I am of the opinion and would be willing to guarantee the cleansing of a reservoir in this manner at a cost of from 2 to 5 cents per yard of deposit.

W. D'ROHAN.
2419 California St., Denver, Colo.
Feb. 1, 1911.

Sound Transmission and Reverberation in Concrete Buildings.

Sirs: The subject of sound transmission and reverberation in concrete buildings has been brought up recently by several of my prospective clients and it seems to be a serious feature and they question the use of reinforced concrete for their new buildings. I have been unable to find anything in text books or engineering periodicals on this subject and have never heard the question seriously brought up before, and I am now quite anxious to run this feature of concrete construction down and see if it is considered serious among present occupants of reinforced concrete buildings; and I am at a loss to know how to proceed in order to secure information on this subject and what to do to overcome same. Will you kindly consider this subject and advise if we can get something started in some way which will enlighten the engineering profession on this subject.

Thanking you in advance for an early reply,

Yours very truly,
G. S. W.
Chicago, Feb. 6, 1911.

(The trouble mentioned by our correspondent has never come to the editors' notice. We shall be glad to hear from those who may have definite information.—Editors.)

PERSONALS.

Mr. V. H. Williams, assistant engineer of the Canadian Pacific Ry., has been selected by the town council of Souris, Man., as resident engineer to superintend the construction of the new water works system in that city.

Mr. Charles H. Markham, who recently became president of the Illinois Central Ry., has also been elected president of the Central of Georgia Railroad and of the Ocean Steamship Co., of Savannah, Ga. He will succeed the late J. F. Hanson.

Mr. R. O. Danenhower, assistant city engineer of Cincinnati, O., has tendered his resignation, effective March 10. The reason assigned for this action is that failing health compels him to seek another climate and to give up all employment for a period of six months or a year.

Mr. T. H. Gatlin, division engineer of maintenance of way of the Southern Railway, with headquarters at Knoxville, Tenn., has been appointed engineer of maintenance of way for the Virginia & Southwestern Ry. His supervision will extend over the new Holston River line.

Mr. Edwin Styring and Mr. Edward J. Govern have been appointed division engineers of the New York State Barge Canal. Mr. Styring is a resident of Syracuse and will have charge of the western division. He succeeds Mr. Guy Moulton. Mr. Govern, who succeeds Mr. Thomas W. Barrally, is a resident of Rochester, and will have charge of the middle division.

Messrs. Myron H. Lewis and J. E. McCoy have formed a partnership to be known as Lewis & McCoy, with offices at 30-34 West 33d street, New York. They will engage in a general consulting civil engineering practice, and will specialize in problems connected with the waterproofing, damp-proofing and preservation of structures and structural materials.

Mr. Frank H. Joyner, division engineer for the Massachusetts Highway Commission, has been appointed by the Board of Supervisors of Los Angeles County, Cal., as engineer in charge of highways of that county, at an annual salary of $6,000. Most of the important highway construction in western Massachusetts in recent years has been carried on under Mr. Joyner's supervision.

Dr. Leonard P. Kinnicutt, a sewage disposal and water works expert of national reputation, died at his home in Worcester, Mass., of tuberculosis and heart disease, on Feb. 6. Dr. Kinnicutt has been for the past eleven years director of the chemical department of the Worcester Polytechnic Institute, and since 1903 consulting chemist for the Connecticut Sewerage Commission. He was born at Worcester in 1854. He was graduated from the Massachusetts Institute of Technology and took post-graduate courses at Bonn and Heidelberg, in Germany, and at Johns Hopkins and Harvard Universities. For several years he was professor in chemistry at Harvard. He was a member of many scientific societies in the United States, England and Germany.

Mr. John Thomas Fanning, a noted hydraulic engineer, died at his home in Minneapolis, Minn., on Feb. 6, from an attack of pneumonia. He was born in Norwich, Conn., in 1837, and secured his early education in that city. At the outbreak of the civil war he enlisted as a private in the Third Connecticut Volunteer Infantry, and at the close of the war he was mustered out as a lieutenant-colonel. He first went to Minneapolis in 1885 to report on the power development of the St. Anthony Falls, and ultimately made his home in that city. He was a member of a number of technical and scientific societies. While prominent as a hydraulic engineer, he was best known to the engineering profession as the author of "A Treatise on Hydraulic and Water Supply Engineering."

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in Engineering Contracting. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Cement Building Construction.—6x9 ins., 16 pp. Lehigh Portland Cement Co., Cleveland, O.

This is the February number of the Lehigh Cement Company's bulletin illustrating and describing various works in which this cement has been used.

Roller Bearing Lawn Rollers.—5¼x6¾ ins., 24 pp. The Dunham Co., Berea, Ohio.

A catalog of rollers and machinery for care of lawns. Prices, sizes and illustrations are given.

Earth Handling and Road Building Machinery.—5¾x8¼ ins., 32 pp. Russell Grader Mfg. Co., Minneapolis, Minn.

A booklet which illustrates and describes various machinery for excavation. Prices are given.

Never Leak Roofing Nails.—4½x7 ins., 1 p. Weatherproofing Nail Co., Baltimore, Md.

A circular describing the Copnal Roofing Nails.

Scientific Publications.—6x9 ins., 8 pp. J. B. Lippincott Co., Philadelphia, Pa.

A catalog of new books on technical subjects.

A leading cement company is experimenting on a cement blow pipe which will work in much the same fashion as a chemist's oxy-hydrogen blow pipe for mixing and applying the cement to a surface. On a truck there are two tanks, in one of which is the water and in the other the sand and cement. Both of these are under pressure and are forced into a long nozzle. They do not meet, however, until within an inch of the nozzle's end. There the mixing is consummated and the thoroughly worked cement is spattered upon the wall, rapidly building up a compact layer.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week.

One of the most important development of the past week is the passing of the control of the Missouri Pacific Ry. system from the Gould family to a syndicate controlled [illegible] It is believed that this change of control will mean vast improvement work to the Missouri Pacific system. Some of those who are well informed of its physical condition say as much as $150,000,000, possibly $200,000,000, will be needed in the course of the next four or five years, if the system is to match in equipment, roadbed and economies of transportation the Harriman or the Atchison system.

Favorable symptoms are also found by business men in the recent marketing of $60,000,000 worth of New York City bonds upon favorable terms, the eager seeking for investment of other bonds, the approach to the market by the railroads for new loans, the contemplated placing in France of a large block of bonds for the Southern Pacific Ry., the condition of the national banks and the encouragement which business all over the country, and especially the iron and steel business, now finds in present and in prospective conditions.

Although bids for a number of large pieces of railroad construction work are now under consideration, no particularly large contracts seem to have been let recently. Perhaps the largest contract is the one reported to have been let to the J. A. Ware Construction Co. of St. Louis, Mo., by the Memphis, Paris & Gulf Ry. for work on the proposed line from Murfreesboro, Ark., to Pine Bluff, Ark.

A large amount of new railroad construction work is planned for the near future in the state of Georgia. The Atlantic, Waycross & Northern R. R. has practically completed arrangements for the sale to French capitalists of $3,000,000 of bonds, the proceeds to be used for construction purposes. The Carnesville Ry. Co. has completed surveys for a projected 20-mile steam railroad, has secured the necessary capital for construction and will let contracts soon. The Ocilla Southern R. R. is also planning to have work started shortly on an extension from Alapaha to Nashville.

Advices from the Pacific Coast indicate that contracts will be let shortly for extensive construction work on the North Coast R. R., which is now the third division of the Oregon-Washington Railroad & Navigation Co.'s lines. This work will include the construction of the line between Spokane and the Snake river and probably terminal facilities at Spokane. The line between Spokane and the Snake river includes much difficult construction work, and it is estimated that the grading alone at several places will cost about $175,000 per mile.

The sale of $30,000,000 of notes has been authorized by the board of directors of the New York Central & Hudson River R. R. The proceeds will be used in continuing construction of the Grand Central terminal and in the electric zone, providing third and fourth tracks on the Hudson River division and for new facilities in Utica and Rochester.

The Santa Fe system is planning quite a bit of betterment work as will be seen by the following appropriations which have been made by the company: $595,000 to cover the cost of ballasting the Kansas district of the Pan Handle division; $325,700 to cover the cost of widening the cuts and banks on the Valley division, and $426,000 to cover the cost of track changes from Amarillo, Tex., to the Texas, New Mexico line, the work consisting of ballasting track with crushed stone, widening road beds and removing sags from track.

New York State Public Works.

There is at the present time [illegible] in New York state over the plan of Governor Dix to abolish the State Highway Commission. In a special message sent to the legislature last week the governor outlines his plan for the reorganization of this commission and other state commissions charged with the construction of new public works. His plan outlined briefly is this: There should in all cases be a single executive head responsible for the preparation and submission of plans and for the execution thereof, after adoption by the board of commission. There should, in all cases, be a deliberative board or commission to consider and determine general methods and adopt detailed plans and specifications. Existing state officers, whose functions are related to the proposed construction work, should be members of the board or commission, having jurisdiction over the adoption of plans and specifications therefor. The superintendent of public works should be a member of each deliberative board or commission having jurisdiction over the construction of new public works or buildings. He would thus take official cognizance of all expenditures by the state for new construction, and would be officially interested in the distribution of such expenditures where they are most needed. The state engineer should be a member of every board or commission having jurisdiction over the construction of public works involving engineering. The single responsible head charged with the execution of the plans should be a member of the board or commission, and should prepare plans and specifications to be submitted to the board for its adoption or rejection. But in the execution of the plan, he should not be subject to the control of the board, but should be responsible directly to the governor by virtue of being subject to suspension or removal by the governor. In the case of the state highway work, the plan proposes that the state engineer and state superintendent of public works should be members of the State Highway Commission, and that the third member, who should be an expert in the construction of good roads, should be the executive head. This man would be designated state superintendent of highway and would be charged with the designation of routes and the preparation of plans and specifications for submission to the commission. When plans and specifications were adopted by the commission and contracts let, the sole responsibility for the execution of the work would be upon the state superintendent of highways, with his own force of engineers and subordinates directly responsible to him. Inasmuch as it is expected that the present legislature will authorize the first practical step in actual construction of the state water storage system, the governor's plan for reorganizing the state water supply commission is of interest. As in the case of the state highway work, he would have the water storage work in charge of a single head who would be responsible for the administration of the department. The deliberative board or commission would include in its membership the state engineer, the state superintendent of public works, the state health commissioners and the forest, fish and game commissioners.

The Wonders of Science.

Science continues to advance. Yesterday we had the atomic theory to explain the formation of the universe; today centers of electric force is the explanation. Today some astronomer discovers a thousand new worlds; tomorrow another astronomer discovers ten thousand. New inventions for making our work easier appear each day. We sow by machinery and by machinery we now reap; our burdens are borne by machinery; we fly through the air and we travel under the water; we telegraph without wires, and we talk with a friend a thousand miles away. Great discoveries come, only to be succeeded by a greater. The Curries discovered radium, Peary discovered the North Pole, and an English chemist discovers a method of producing a dealcoholized beer "free from all intoxicating properties, but in no way different in taste or flavor from ordinary beer." While the "last great discovery" may not be greeted with the enthusiasm it deserves, it may be stated for the benefit of those scientifically inclined, that the dealcoholized beer is made by squirting a brisk current of carbonic acid gas through slightly warmed beer. "My product," states the chemist, "is genuine brewery malt and hops beer, not a manufactured chemical substitute, and the public may disabuse itself of the idea that it is only a watery, aerated concoction, such as now pass for teetotal drinks. I tested this matter, by supplying blank samples of beer and dealchoholized beer to 52 brewers assembled at Sheffield, and of that number of connoisseurs 26 absolutely failed to dectect which was which, while the others discovered some subtle difference unapparent to the ordinary mortal." It will thus be seen that the dealcoholized product had a batting average of .500. But if the 52 "connoisseurs" had been selected from a railroad grading gang it is safe to say that the dealcoholized beer would have had a batting average like Buggs Raymond. Buggs Raymond, it may be explained, played in the big league last year and had a batting average of .089

How They Build a Locomotive.

Writers of popular fiction have of late discovered the possibilities of construction work. As a result many recent magazine stories have contained more or less vivid descriptions of the work of engineers and contractors. In a current magazine the plot of a story hinges on the construction of a large dam. Judging from the description of this work, the authoress must have had as clear an idea of how a big construction job is handled as did the young women who visited the Baldwin locomotive works and then told how a locomotive was made. "You pour," she said, "a lot of sand into a lot of boxes, and you throw old stove lids and things into a furnace, and then you empty the molten stream into a hole in the sand and everybody yells and swears. Then you pour it out and let it cool and pound it, and then you put it in a thing that bores holes in it. Then you screw it together, and paint it, and put steam in it, and it goes splendidly, and they take it to a drafting room and make a blueprint of it. But one thing I forgot—they have to make a boiler. One man gets inside and one gets outside and they pound frightfully; and then they tie it to the other thing and you ought to see it go."

RAILWAYS, STEAM AND ELECTRIC

Alabama.

The Alabama Traction Co. is stated to have started construction work on its new street car lines at Montgomery.

The Dauphin Island Co., George T. Bishop, President, Cleveland, O., has made plans for expending $1,000,000 for improvements at Dauphin Island, near Mobile, Ala. The greatest improvement prior to building the island into a summer and winter resort will be the building of a railroad to the mainland. Application for permission to build a bridge five miles over a portion of the bay has been made.

Surveys are now being made for the projected railroad from Selma to Birmingham. The projected length is 82 miles. The company to build and operate the road will be organized in April. Ernest Lamar, Selma, Ala., is the promoter.

Arizona.

⊙The J. A. Ware Construction Co., 501 Chestnut St., St. Louis, Mo., is reported to have been awarded a large contract by the Memphis, Paris & Gulf Ry., for work on its line from Murfreesboro, Ark., to Pine Bluff, Ark., a distance of 106 miles.

An appropriation of $6,000 has been made by the Santa Fe System to cover the cost of digging a 30-ft. open well at Adamana, Ariz. D. M. Bunker, Winslow, Ariz., is Division Engineer.

The Arizona & New Mexico Ry., J. G. Hopkins, President, Clifton, Ariz., has filed amended articles of incorporation increasing its capital stock from $1,500,000 to $2,300,000. It is stated that the increase in capital stock is made to complete, operate and maintain the road. At present the road has 109 miles of standard gage line.

The Santa Fe System has planned to have an open well dug at Chambers, Ariz. The estimated cost is $11,000. A cistern and water flume to be located at Grand Canon, Ariz., is planned by the Santa Fe System at an estimated cost of $4,100.

The Santa Fe System has planned to install a large air compressor at Galup, N. Mex., at an estimated cost of $8,100.

The Santa Fe System has planned a change of track at Arey, Ariz., at an estimated cost of $2,[illegible], and the construction of a deep well at Holbrook at a cost of $3,700.

Preliminary work has, it is reported, been started by engineers under the employ of the Santa Fe System, in the Mohave Valley, Arizona, across the Colorado from Needles to the holdings of the Cotton Land Co. and it is believed that a branch line will soon be constructed from Topock to Fort Mojave.

According to an announcement reported to have been made by C. D. Reppy, Right of Way agent of the Arizona Eastern, of which L. H. Long, Tucson, Ariz., is Chief Engineer, the company is engaged in making extensive imnrovements in the Gila Valley. The work being principall- the replacing of light with heavv rails between Solomonville and Fort Thomas. Another expensive piece of work now in progress involves an important main line change through the city of Globe. The grade by which Pinal creek is crossed on Broad street will be elevated very materially and the creek will be spanned by a heavy steel bridge so high up that street traffic may be carried on beneath. It will be much safer for the public, more desirable for the company, and as the road runs into the hills beyond the gulch before it serves the mining [illegible] grade will be secured for facilitating the handling of heavy trains. This [illegible] will require the [illegible] of approximately half a million dollars.

California.

✣Bids are asked until 2 p. m., March 8, by the Board of Public Works, Joseph L. McCormick, Secretary, Hewes Bldg., San Francisco, for furnishing and delivering redwood crossties for the Geary St. municipal railway at San Francisco. The estimated cost of the ties is $17,000.

The Fresno, Hanford & Summit Lake R. R. Co. is reported to have made arrangements whereby the Hudson Counties Construction Co. of New York city will build the proposed interurban railroad from Fresno to Kingsbury, with a branch to Sanger. The road will be about 35 miles long and has been projected for about two years. William McLean, Chief Engineer of the Construction Company, is reported to now be in Fresno ready to begin the work. F. S. Granger, Fresno, is Vice President of the railroad.

The San Joaquim Light & Power Co. has not as yet worked out the details of its proposed improvements to the street car system at Bakersfield. These will include the laying of new rails, double-tracking and new cars. A. G. Wishon, Fresno, Cal., is General Manager.

The Santa Barbara Consolidated R. R. Co., Santa Barbara, has offered to re-equip the entire system with high power cars and new extensions if the city will take up the old franchises and issue a new one in single form for a period of 50 years.

The San Francisco, Vallejo & Napa Valley R. R. (electric), Napa, Cal., is reported to have let a contract for the extension of the line to Kellogg, Sonoma county, to connect there with the Santa Rosa & Clear Lake R. R.

The Board of Supervisors of San Francisco will shortly place on the market $600,000 worth of bonds to meet the immediate costs of constructing the Geary St. municipal railroad at San Francisco. The Board of Works recommends this sale for the financial needs in the immediate purchase of lands and cars and the construction of power station, car house and sub-station. For new work $880,000 will be needed. This sum will pe appropriated as follows: Lands for power house, car house and sub-station, $140,000; 30 cars, $300,000; construction of buildings, $80,000; special track work, $60,000, and construction of track and overhead trolley, $300,000. Rails for this line have already been purchased and bids are now being asked for other supplies, as noted in our last issue. M. Marsden is City Engineer of San Francisco.

The City Council of Petaluma has granted to the Petaluma & Santa Rosa Electric Ry. Co. a franchise to operate a line through the city. The company agreed in its franchise that if the road was not completed to Point Pedro within four years from the date of the granting, with ferries running to San Francisco, the franchise will lapse. The object of the railroad company is to build to Point Pedro and connect with San Francisco by fast ferries. The line will be operated on Water St., skirting on the river banks, which the company will improve.

The Santa Fe System has appropriated $5,000 to cover the cost of improvements at Barstow, Cal., including among other things the installation of an oil supply line. A. Ray is Roadmaster at Barstow.

The Santa Fe System has appropriated $5,000 to cover the cost of installing a new engine hoist for their machine shops at San Bernardino, Cal. M. C. Bryan, San Bernardino, is Division Engineer.

An appropriation of $21,300 has been set aside by the Sarta Fe System to cover the cost of constructing new passing tracks and bridges at Laton, Cal. H. C. Phillips, Los Angeles, is Chief Engineer.

Plans have been drawn up for trackage facilities to accommodate the Anaheim Sugar Co. at Anaheim, Cal., on the Santa Fe line. The estimated cost is $11,000.

The Los Angeles Ry. Co. has applied to the City Council of Los Angeles for a franchise for a crosstown car line in that city. The route of the proposed line is as follows: Beginning at 4th St. and Vermont Ave., along Vermont to Jefferson St., along Jefferson St. to Central Ave., along Central to 38th St. and along 38th to the eastern city limits.

B. H. Burton, President of the Colusa County Bank, Colusa, Cal., has been appointed a member of the committee to take steps toward securing the construction of a railroad from Arbuckle, passing through College City, Grimes, Sycamore, Colusa, Kent, Princeton and terminating at Hamilton City.

The Nevada Copper Belt R. R., according to reports from Sacramento, Cal., has completed its line from Waubuska, Nevada, on the line of the Southern Pacific Ry. to Mason and into the Smith Valley. Later the road will be continued on to the Morning Star mine.

In regard to the extension of the North western Pacific R. R. to Eureka, Cal., the following report has been submitted us from Willits, Cal.: The steel is now laid and cars are running on the Eureka extension six miles north of Willits. The long steel bridge across Outlet creek has been completed and the bridge crew moved down to the next bridge site, six miles distant, where there will be a 200-ft. span. The concrete piers for all of the bridges are now finished and the bridge crew can erect the bridges as fast as they can reach the sites with their train. All of the bridge material is now stored in the Willits yards and is ready to put together. There will be several bridges between here and tunnel No. 13, and several more below it. The tunnel crews pierced the headirgs of No. 13 and it will take about a month to complete it ready for the steel. This tunnel will be 870 ft. long."

It is said to have been announced by the officials of the Truckee Lumber Co. that an agreement has been reached with the Western Pacific, whereby that company will build the spur line scheduled to tap the rich lumber land of the Truckee Co., about 20 miles above the city of Oroville, Cal.

Advices from Porterville, Cal., state that the Utah Construction Co., Ogden, Utah, which has the contract for the completion of the line of the Porterville & Northwestern, is making rapid progress with the work and has a large force of men on the job. The camps are located as follows: Camp 1, established at Worth crossing where the first shovel has been set up; this camp will do the first four miles of the work above the crossing on the river. Camp 2 has been put at the Narrows on the river and two miles of work, the heaviest on the road, will be done east from this camp. Camp 3 is the old Campbell place and the shovel and team gangs from this camp will carry the grading on all the wav to the terminal in Springville. For the entire distance from Worth to the terminal the road is to be cut into the bluffs which overhang the Tule river and the roadway will be practically a shelf cut in the hill sides, the ledge being half cut and a half fill for approximately fifteen miles.

Colorado.

Advices from Montrose, Colo., quote Carmen Laten and George I. Burgen, promoters of the Paradox Valley R. R., as stating that work will start on the final survey from Montrose as soon as snow disappears on the Uncompahgre valley plateau. It is said that the Eastern syndicate which is to finance the road has notified Mr. Laten that everything is in readiness to complete the survey and begin grading next summer.

Officials of the Colorado & Southern Ry. Co. are entertaining hopes to have their lines completed from Walsenburg in the southern part of Colorado to Pueblo and from Wellington, in the Northern part of the state to Cheyenne, Wyo., by the end of September. The completion of the new links will give the road [illegible] through route over its [illegible] roads from Orin Junction, Wyo., to Gal[illegible], Texas, and will enable the company to dispense with the use of the Union Pacific and Denver and Rio

The Denver, Greeley & Northwestern R. R. has completed surveys [illegible] part of its projected line. This company proposes to build a loop from Denver to Greeley and Fort Collins and south to Denver again. Geo. J. Spear, Greeley, Colo., is President.

Grande tracks entirely and with the Santa Fe to some extent. The Colorado and Southern has its own line between Denver and Pueblo, but it has a permanent arrangement for running over the Santa Fe, and owing to the better grade on that road the Hill line will continue to use these tracks for its through business. The two extensions built have a total length of eighty-one miles.

Delaware.

The Wilmington & S[illegible] Ry. Co. of New Castle, recently organized to take over the property of the Wilmington, New Castle & Southern Ry., has asked a franchise at Wilmington to locate, construct, operate and maintain its line from a point to or near the intersection of Front and Market Sts. This line is to run south over Market St. bridge, along the causeway to the city line.

Florida.

The Florida East Coast Ry. is preparing to resume construction work at West Summerland, and has had a force of men putting the buildings in shape at the camp. The work of erecting a viaduct to replace No. 5 trestle, between the lower Matacumbie and Long Key, will be started in the near future, as the new temporary trestle has recently been completed at this channel. These viaducts and steel bridges will be at a point three-eighths of a mile west of Maser channel drawbridge, and extend across the bay to Little Duck Key, bridging the channels between Bahia Honda Key, in the middle of which key over one-fourth of a mile of water has to be bridged, this being a bay extending that length. At the west end of the last mentioned key is the temporary approach to the largest and highest over-head steel bridge in Florida, and the most difficult to erect. Work on this bridge will be started shortly. All the false work material and the entire steel work is now on the ground. Engineers Smiley and Cook, located at Boca Chico and Big Pine Channel, respectively, are working large forces, and if they have no serious setbacks they will meet at Sugar Loaf key within six months.

Georgia.

The directors of the Macon Railway & Light Co., J. T. Nyham, General Manager, Macon, Ga., have authorized the extension of the lines at Macon and work will be started at once.

The St. Marys & Kingsland R. R. has a corps of engineers in the field working on the proposed extension to Waycross and West as far as Nashville in Berrien County. The company will go ahead with the work as soon as possible. L. Johnson, St. Marys, Ga., is President and General Manager.

The Carnesville Ry. Co. has completed surveys for its projected 20-mile steam railroad and has partly secured the construction capital. Construction contracts are to be let soon. The road is to extend from Toccoa via Mize and Red Hill to Carnesville, Ga. Alex. W. Wilson, Toccoa, Ga., is Chief Engineer and E. S. Hunsuncutt, Toccoa, Ga., is Vice-President and General Manager.

The Central of Georgia Ry., C. K. Lawrence, chief engineer, Savannah, Ga., is reported to have decided to double track its line from Birmingham, Ala., to Savannah, Ga.

According to an announcement reported to have been made by H. H. Tift, owner and promoter of the proposed railroad extending from near Adel to Pavo, Ga., nothing definite has yet been decided in regard to the prosecution of the actual work. A charter was granted in 1907 to build a line from Thomasville to Pavo and the route for it surveyed but the building of the road was stopped by the [illegible] of 1907.

J. N. Shearouse, President of the Shearwood Lumber Co., Brooklet, Ga., now operating a six-mile railroad south from Brooklet, is said to be planning to extend the line either to Pembroke or Groveland, covering a distance of some 20 miles. After this is completed it is said that the line will be extended northward to Oliver, a distance of 12 miles, and there connecting with the Central of Georgia. At G[illegible] line will connect with the Seaboard Air Line. Four miles of track are to be laid at once and rails for this have already been secured.

The Ocilla Southern R. R., J. A. J. Henderson, President, Ocilla, Ga., is to be extended at once from Alapaha to Nashville. Citizens of the latter place have raised $18,000 to secure the extension.

Surveys are being made for the construction of the Atlantic, Waycross & Northern R. R. to be built from St. Mary's to Atlanta, Ga., a distance of about 300 miles. A portion of this road has been in operation for several years in short lengths. As soon as the reports are completed the sale of the bonds will no doubt be closed with French capitalists. It is contemplated to issue and sell at once $3,000,000 of bonds, the moneys to be used for construction purposes. D. G. Zeigler, Rocky Ford, Ga., is Engineer.

Idaho.

The American Falls, Malad & Salt Lake Valley Ry. Co. projects a 74-mile road, the route being southwest from Malad for a distance of 34 miles, then northwest to Falls. Surveys for the line have been made and the capital for construction secured. Frank Mouch, American Falls, Idaho, is Chief Engineer and W. H. Thomas, Malad, Idaho, is President. A. Y. Watson, Chicago, Ill., and Frank Atkinson, Malad, Idaho, are also interested.

Illinois.

The Central Illinois Public Service Co., M. E. Sampsel, Chicago, Ill., President, has been granted a franchise at Paris, Ill., for the entrance of the projected extension from Charleston. The company is said to be planning to start work in the early spring on the extension of its Mattoon City Ry. from Mattoon to Terre Haute and from Mattoon to Danville by way of Paris.

Surveys have been made for a projected 10-mile line of the St. Louis & Eastern Traction Co. to extend from Collinsville to Troy, Ill. A. W. Crawford, Hilsboro, Ill., is President and Chas. A. Shepard, Edwardsville, Ill., is Chief Engineer.

The Santa Fe System has planned the expenditure of $25,000 to cover the cost of alterations and additions to their grain elevator in Chicago, Ill.

The Santa Fe System plan to construct a new coal chute and sand house at Corinth, Ill., at an estimated cost of $15,000.

The Santa Fe System has appropriated $2,300 to cover cost of installing an interlocking plant at the Illinois River bridge.

The Santa Fe System plans to purchase in the near future a 120-ton wrecking crane for use in their Chicago terminal yards. M. J. Collins, Chicago, Ill., is General Purchasing Agent.

An appropriation of $11,000 has been made by the Santa Fe System to cover the cost of scrap handling machinery which is to be installed in its scrap yard at Corinth, Ill.

It is now stated that track laying on the Alton, Jacksonville & Peoria Railway will be started at Godfrey, March 1, all material being on the ground ready for construction work to start.

It is reported at Watseka, Ill., that material is being distributed along the line of the Toledo, Peoria & Western Ry. in Iroquois County, Ill., preparatory to start the improvement of its track from the end of the new [illegible] by installing 70-lb. rails. R. J. Wilby, Peoria, Ill., [illegible]

Indiana.

[illegible] Bend & [illegible] Indiana Ry. Co., South Bend, Ind., has decided to do a considerable amount of double track work at South Bend. Double tracks will be laid on the South Michigan St. line from the Lake Shore R. R. tracks to Broadway. Other double tracking to be done will be Vistula Ave. from Carroll St. to the intersection of the railway with the Michigan St. line; Jefferson Boulevard from Vistula Ave. to Michigan St. and on the north side Mishawaka line from Eddy St. to the South Bend Watch Co.

At the annual meeting of the stockholders of the Chicago, South Bend & Northern Indiana Ry. Co., South Bend, on Feb. 7, the matter of extending the lines to Buchanan, Mich., was discussed, but definite action was postponed until a meeting of the directors in April. The matter is said to depend largely with action of the Berrien county, Michigan, commissioners, as a new bridge will be necessary over the St. Joseph river at Niles.

It is reported that double tracking of the Indianapolis Division of the Pittsburg, Cincinnati, Chicago & St. Louis R. R. is nearing completion and according to the present indications the initial run will be made over the new tracks about August.

Iowa.

A meeting of the Board of Directors of the Tri-City Ry. & Light Co. has been held in New York city to determine among other things the route for the new interurban line to be built this summer between Davenport and Muscatine. Three surveys have been made. One of the surveys was for a line following the river road between Davenport and Muscatine. The other two lines were run over the bluffs and through the country where several towns of considerable size will be tapped by the proposed line. If either one of the bluff routes is chosen, the new interurban will tap a new territory in which there is neither a steam or an electric road at the present time. It will bisect the territory between the main line of the Rock Island west and the lines of the Rock Island and the Milwaukee along the river. As soon as the route for the road has been definitely selected it is said that the work of preparing for the grading will be started and construction work will be started early in the spring. J. F. Porter, Davenport, Ia., is President of the Tri-City Ry. & Light Co.

Surveys are to be started shortly, it is said, for a new interurban railroad connecting Sioux Falls, S. Dak., and Sioux City, Ia. The route contemplated is through Riverside, over a new bridge on the Big Sioux River, through Elk Point and Beresford to Sioux Falls. The headquarters for the company are to be in the Boyce-Greely Bldg., Sioux Falls, S. Dak. The promoter, O. F. Spaete, and his chief engineer, J. Wolfilm, are now going over the route.

Citizens of Niles, Riceville, Cresco and Osage, Ia., have decided to hold a meeting looking to a move that will induce the Ch[illegible] Western Ry. Co. of Charles [illegible] its proposed line in that direction.

Kansas.

[illegible] ha[illegible]izing the construction of a bridge over the Missouri River at Atchison, Kan. This is the first step toward the building of the electric railway from Atchison to St. Joseph and from Atchison to Leavenworth, there to connect with the Kansas City Western into Kansas City. The bridge franchise was granted in the name of S. G. Guerrier, the secretary of the Atchison Commercial Club, who is acting for the McKinley interests, which own the Atchison street railway and electric light and power [illegible] lines.

It is expected that Santa Fe and Rock Island railways will shortly submit plans to the city officials of Wichita for the elevation of the tracks over Douglas Ave. The elevated tracks and union depot will cost about $1,500,000 and will be built by the Union Depot & Elevated [illegible] Association, composed of the Santa Fe, Rock Island, Frisco and Orient railway companies. The union depot will be located east of the Santa Fe tracks and south of Douglas Ave.

Construction [illegible] by the Scott City Northern R. R. on its line northward across Logan County. In Logan County about a dozen construction camps are now at work on this line, and one camp is yet at work in Scott County on heavy rock work, which will be completed by March 1, when this camp will move on northward. Track is now laid eleven miles out from Scott City to the first crossing of the Beaver. The Midland Bridge Co. of Kansas City has the contract for the bridging which is all pile trestle and will aggregate about 1,500 lin. ft. of structure on the 55 miles from Scott City to Winona. Work on this line averages about 22,000 yards per mile with but two miles of any considerable rock work. Grading contracts are now let to Russell Springs and all but last five miles of work covered. Surveys for location are now being made on last 15 miles and will be ready for contractors about March 10. The contracts call for completion of the line to Winona by July 1 but there are now enough forces at work to complete all grading by June 1. Some of the larger camps on the line are A. J. Canaday who pulls two graders with a 40-h.p. engine, A. W. Harper, Sam Brown and A. L. Sedbrook with good team outfits and Show & Sons with one grader and twenty teams.

The Santa Fe System has planned to widen the banks and cuts on the Valley Division and has appropriated $325,700 to cover the cost. This work is to include ballast and cost of placing same.

The Santa Fe System has appropriated $595,000 to cover the cost of ballasting the Kansas District of the Pan Handle Division. This will complete the ballast work started some time ago. C. F. W. Felt, Topeka, Kan., is Chief Engineer.

The Santa Fe System has planned to install new fuel oil facilities at Arkansas City, Kan., at an estimated cost of $5,000. F. L. Guy is Division Engineer at Arkansas City, Kan.

Plans have been made by the Santa Fe System to cover the installation of automatic protection at Emporia, Kan., at a cost of $7,000.

An appropriation of $27,000 has been made by the Santa Fe System to cover the cost of an interlocking plant at the Winfield Junction, Kan., the crossing of the Missouri Pacific.

The Winnipeg, Salina & Gulf Ry. Co. is now working on final location surveys and has several corps of engineers in the field. The company has placed its entire issue of first mortgage bonds with a syndicate of foreign capitalists and the first money will be ready for construction purposes by May 1. C. A. Slayton is Chief Engineer and H. Leone Miller, Salina, Kan., is President.

Surveys have been started for the proposed line of the Kansas & Southeastern Ry. south from Larned to Pratt. The line has already been established in Pratt County and everything is said to be ready for beginning grading work in the spring. The Kansas & Southeastern Ry. was chartered last spring to construct a north and south road across the state of Kansas. The promoter is S. V. Wordall of Larned.

Kentucky.

The Consolidated Coal Co., according to advices from Bristol, which recently acquired 100,000 acres of coal lands in the Elkhorn district of Eastern Kentucky, is planning to develop its properties, and will, it is said, expend a large sum in the construction of branch railways, tramways, miners' homes, hotels, etc. The construction of a railway line of 35 miles is to be commenced soon.

It is now stated that the construction of the traction line between Glasgow and Hodgenville will be postponed until the spring of 1912. The right of way has been secured along the route of the Louisville & Nashville turnpike, but the promoters of the line want to secure additional rights of way to straighten the course of the road.

Advices from Hickman, Ky., state that the contractors on the new line of the Chicago, Memphis & Gulf R. R. are now working within sight of the city.

Louisiana.

The Kinder & Northwestern R. R. will shortly inaugurate service between Kinder and Timberland, ten miles. This road is to ultimately operate from Kinder in a northwesterly direction for 40 miles. G. P. Payne, Kinder, La., is Secretary.

At the recent annual meeting of the New Orleans Terminal Co. it was brought out that it is the intention of the controlling interest to soon develop the valuable property down near Chalmette. The plans for the future were generally discussed, and while it was decided that something in the way of finishing the big work undertaken some years ago should be done, nothing of a definite nature was decided upon. D. D. Curran was re-elected president, and R. V. Taylor, who succeeded Col. Russell as vice-president of the Mobile and Ohio, was named as vice-president of the board. Mr. Taylor takes the place of R. D. Langford, of New York, who, it is understood, has sold out his stock in the Terminal Company. The following were re-elected members of the board: W. C. Nixon, I. T. Preston, Harry Hall and W. Dufour. Mr. Preston will continue to act as secretary along with his duties as member of the directorate.

Michigan.

The Detroit & Mackinac Ry., J. D. Hawks, General Manager, Detroit, Mich., has secured the last link in the right of way for its proposed branch line to Rogers City.

Surveys for the proposed line of the Michigan United Ry. Co. of Lansing, to connect Saginaw and Owosso are now under way, and it is believed that active construction work will be started shortly. The route from Owosso to Saginaw, as surveyed, passes through or is immediately adjacent to Henderson, Oakley, Chesaning, St. Charles, Swan Creek and Paine and practically parallels the Michigan Central R. R.

The first definite step toward securing the elevation of railroad tracks passing through Kalamazoo, and the consequent elimination of grade crossings within the city limits, has been taken by Mayor Charles Farrell, of Kalamazoo in the naming of a permanent commission who shall have the matter in charge.

Minnesota.

Surveys are stated to have been completed for the route of the proposed range electric railway between Eveleth and Gilbert and Virginia, and it is expected that the promoters of the line will shortly apply for franchises. The Duluth Engineering Co., Duluth, Minn., is in charge of surveys.

The Twin City Rapid Transit Co., Minneapolis, Minn., is reported to be contemplating expending $1,000,000 this year for various improvements.

The Granite City Ry. Co. of St. Cloud, Minn., is to be petitioned to extend its electric railway four miles to Watab.

Missouri.

The Railroad Committee of the House of Delegates of St. Louis has reported favorably the bill granting a franchise to the Southern Traction Co. of Illinois for a double track electric railway on the upper roadway of the municipal free bridge and for a street railway in downtown St. Louis.

The citizens of Philadelphia, Mo., have accepted the offer of the M. C. Connors Construction Co. of Chicago to complete the grade for the Hannibal & North Missouri interurban railway between Philadelphia and Palmyra for $30,000. It is estimated that the cost of the grading will be $58,000, of which $28,000 will be paid by the railroad.

It is believed that the Missouri Pacific will shortly announce plans for the building of a branch from Bognell to the White River branch. It is said that the finances will be provided by Kuhn, Loeb & Co., of New York. It is known that two surveys have been made and if the line is built on either of these, the route to St. Louis from Southwest Missouri will be much shortened as far as the Missouri Pacific is concerned.

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

The contracting firm of McGuire & Brown have been organized within the last week. This firm will shortly be prepared to do grading on quite an extensive scale. They have purchased a new Western Grader, together with Aurora Wagons and Wheelers. Like most contractors in this territory, they will use a traction engine in connection with their machine.

Joyce Bros. & Bagwell are among the contractors here that feel positive the coming season is going to be a good one. At present their large outfits are idle and until such time as they get work they are open to any proposition in the way of dirt moving. Their address is 52nd St. and Troost Ave., Kansas City.

By another week we hope to be able to make an announcement in this column that will be of interest to every contractor in the west. We merely mention the fact now so that every reader can keep close watch on our reports.

Norton Bros. have their new Thew shovel at work at 31st St. and Woodland Ave. They are moving large quantities of dirt with it. Contractors have been quite interested in its operation.

H. H. Hannerkrat is at work on his contract in Kansas City, Kans. He reports everything moving along nicely. Mr. Hannerkrat uses a traction shovel and has just ordered some special Aurora wagons for the work.

Geo. B. Robbins, representing the Armours, and Edward Tilden for Swifts arrived in Kansas City on the 17th inst. for a conference with this city upon the matter of building a trolley line from Kansas City to Liberty and Excelsior Springs, Mo. Members of the Commercial Club, without committing themselves, express the opinion that capitalists will be produced shortly who will be prepared to undertake the construction of the road.

Montana.

The recent visit of L. H. Hill, President of the Great Northern Ry., to Libby, Mont., has given rise to rumors that construction work would be started this spring on the Libby-Kalispell cutoff. This line is about 90 miles long. It has all been surveyed and right of way bought. Its construction would put Kalispel back on the main line of the Great Northern and would save about 30 miles in distance, with approximately the same grade and curvature now found in the line which runs up near the boundary line.

New Hampshire.

The directors of the Boston & Maine R. R., a New York, New Haven and Hartford line, have approved steps recently taken looking to eventual construction of a Boston & Maine line on the New Hampshire side of the Connecticut River, extending approximately eleven miles north of Hinsdale, N. H. This will take the place of the proposed line from South Vernon, Vt., to Brattleboro, Vt., which was blocked by the Vermont legislature. B. T. Wheeler, Boston, Mass., is Engineer of Construction, New York, New Haven & Hartford R. R.

North Carolina.

The County Commissioners of Rowan County have ordered a special election to be held in Salisbury on March 14 for the purpose of voting on the question of issuing $100,000 in bonds for the purpose of building a railroad from Salisbury to Monroe. It is believed the measure will be carried. Other towns along the proposed route are also to hold bond elections for the same purpose.

New Jersey.

The Pine Brook Electric Ry. Co. of Pine Brook, N. J., organized some time ago

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

to build and operate a street railroad for Caldwell to Denville, a distance of 30 miles, is planning to have construction work started shortly. The cars will be operated by storage batteries and orders for six Edison storage batteries have been placed with the Federal Storage Battery Co., of New York. As planned the line will take in the towns of Caldwell, West Caldwall, Pine Brook, Parsippany and Denville. A large part of this route from Caldwell was formerly traveled by a stage line belonging to W. L. Kerris, who is largely interested in the new enterprise. For a part of the trip the line will encircle the Jersey City reservoir at Boonton. The incorporators of the company are Dr. Alexander Dallis, W. L. Kerris and Edward F. Duffy. All the towns to be traversed by the new road have passed the necessary ordinances. The road will be partly built over a private right of way.

The stockholders of the Elizabeth & Trenton R. R. Co. (electric), have voted to authorize a bond issue of $750,000, with which to build a high-speed line between New Brunswick and Elizabethport. The stockholders also authorized the board of directors to execute a lease of their system, which is operated between Trenton and New Brunswick, to the Public Service Railway Co., of Newark, N. J. The link to be supplied, that for which the bond issue is to be made, will be included in the lease. In this way the Public Service Ry. Co. will control and operate a through trolley service between Trenton and Jersey City. It is planned to effect an agreement between the Public Service Ry. Co. and the Riverside Traction Co. whereby the former will control the latter and thus operate a through service between Camden, by way of Trenton and Jersey City.

The Wildwood & Delaware Bay Short Line R. R. Co., of Wildwood, mentioned in our Feb. 8 issue, is now taking steps for financing the proposed road, by the issuance of $562,000 of first mortgage bonds. The company has right of way for a two-track road, one for trolley and one for steam. The steam road will extend from Rio Grande, over the Philadelphia & Reading route, to Wildwood, and so provide an entrance for that line into the seashore resort. The trolley road will extend from Bay Shore, on the Delaware River, to Wildwood. The river terminal connection will be made with boats, which will ply between that point and Philadelphia, stopping at Chester and Wilmington.

New York.

The Board of Directors of the New York Central & Hudson River R. R. have authorized the sale of $30,000,000 of notes. The proceeds will be used in continuing construction of the Grand Central Terminal and in the electric zone, providing third and fourth tracks on the Hudson River Division and for new facilities in Utica and Rochester.

The Public Service Commission has adopted an order extending the time in which the Hudson & Manhattan R. R., J. V. Davies, Chief Engineer, 30 Church St., New York, may complete the 9th St. extension to its tunnel system, from June 15, 1911, to June 15, 1913. The uncompleted portion of this extension is under 9th St. from 6th Ave. to 4th Ave., New York city.

North Carolina.

J. E. Porter & Co. have begun work about two miles south of Weldon, N. C., on their double track contract for the Atlantic Coast Line R. R.

North Dakota.

The Wahpeton-Breckenridge St. Ry. Co. is considering building an extension to Hankinsson, ther oute being Wahpeton, Breckenridge and Lake Regions. The total projected length is 80 miles. Matt Braun, Wahpeton, N. Dak., is President and F. L. Sturm, Breckenridge, Minn., is Superintendent.

Bonds amounting to $6,000,000 have been issued by the Midland Continental R. R. now under construction through the state of North Dakota, for the completion of the work. The Midland Construction Co., of Chicago, Ill., is doing the construction work on the line. Frank K. Bull, Racine, Wis., is President of the corporation.

It is reported in Pierre, S. Dak., that the Chicago, Milwaukee & Puget Sound R. R. is making preparations for the extension of their Isabel line in Perkins county toward Bidon, the county seat, giving the road three parallel lines into the western part of the state north of the Cheyenne River. W. H. Penfield, Butte, Mont., is Engineer of Construction of the road.

Ohio.

The Wabash R. R., A. O. Cunningham, Chief Engineer, St. Louis, Mo., has had a corps of engineers working in the vicinity of Crooksville, and it is not at all unlikely that the company will resume work in the early spring on the proposed Zanesville, Mauretta and Parkersburg route.

The Pennsylvania R. R., H. E. Newcomer, Division Engineer, Cleveland, will, it is reported, award contracts soon for its concrete ore dock at the West breakwater at Cleveland. Between eight and ten Hulett or their equivalent in Hoover-Mason machines and a coal loading machine will be put on the new dock. The present plans call for the completion of the dock with a capacity of 5,000,000 tons of ore by the opening of navigation in 1912 and for the erection of a coal loading machine to replace one now in use at the lake front during 1912. The Great Lakes Dredge & Dock Co., Cleveland, is now engaged in the dredging work.

The Cleveland, Akron & Columbus Ry., R. C. Harris, Engineer Maintenance of Way, Akron, O., has been making surveys for a proposed change in line between Brinkhaven and Danville. As proposed the grades would be reduced and a number of curves eliminated.

The Pennsylvania R. R. is said to be planning to resume work as soon as the weather permits on its four tracking from Mahoningtown to Edenburg. This work was started about a year ago. It is said to have been practically decided that the four-track system will not stop at Edenburg, but that it will be completed the entire distance to Youngstown, work to be started as soon as the track is completed to Edenburg

The Hocking-Sunday Creek Traction Co., E. B. Young, President, Nelsonville, O., is reported to be meeting with much success in placing the bonds recently issued for constructing a new line between Nelsonville and Athens. It is believed that construction work will be started early this spring.

The National Tube Co., Lorain, O., is planning to construct undergrade crossings at the Pearl Ave. and Vine Ave. entrance to its plant at Lorain, so that its employes will not be obliged to cross the Lake Terminal tracks.

The Hocking Valley R. R., according to advices from Beaumont, O., has under construction 6 miles of double track between that city and Emberly. A large force of men are said to be at work on this improvement, for which John T. Adams, Columbus, O., has the contract. William Michel, Columbus, O., is Chief Engineer of the company.

Oklahoma.

The Sand Springs Interurban Ry. Co., of Sand Springs, Tulsa county, has been incorporated with a stock of $20,000. The incorporators are Charles Page, W. E. Rohde, W. E. Page, E. D. Forquer and C. F. Tingley.

The Oklahoma Ry. Co., Oklahoma City, had work started on Feb. 10 on the extension of the interurban line connecting Oklahoma City and Edmond. The company announced that it will have cars running into Edmond by June 1. The cost of the extension between Britton and Edmond will be approximately $140,000.

The Shawnee Short Line Electric Ry. Co. of Shawnee, which proposed to build interurban lines to Denison, Tex., and from Oklahoma City through Shawnee and Muskogee to Joplin, Mo., is now securing right-of-way for the Denison line. The company has purchased a tract of land on Blue River, in Johnson County, [illegible] operate the entire line. It is contemplated also to connect the present interurban lines of Oklahoma and Southern Missouri and Kansas in one system. The officers of the company are: Martin J. Bentley of Shawnee, President; C. C. Wright of Ada, Secretary, Perry Rodkey of Shawnee, Right-of-way Agent, and H. H. Hull of Memphis, Tenn., Chief Engineer.

The Santa Fe System has appropriated $230,000 to cover the cost of improvements to road bed from Waynoka to the Oklahoma-Texas state line. The proposed work consists of removing sags, widening embankments and ballasting. H. W. Wagner, Amarillo, Tex., is Principal Assistant Engineer.

Definite steps were taken by the Commercial Club of Hugo, Okla., recently toward the construction of the proposed line from Hugo to Atoka, a distance of about 40 miles, and stock amounting to $75,000 has been subscribed. A complete survey of the route has, it is said, already been made and it is expected to start grading within three months.

Oregon.

The new line of the Great Northern R. R., between Clark, Ore., and Madras, has been completed and will be opened for traffic March 1. It is 85 miles in length.

An ordinance is now before the City Council of Salem to grant the Salem, Falls City & Western Ry. (steam), S. B. Taylor, Chief Engineer, Dallas, Ore., a franchise to enter that city. The company now has its terminus at West Salem and proposes to construct a bridge over the Willamette River to secure an entrance to Salem.

The Grants Pass & Rogue River R. R. mentioned in our last issue is reported to have secured its right of way and necessary capital for construction purposes. It is now stated that plans have been so far developed that work will begin within the next few months and that the first section of road will be operated before the end of the present year. The incorporators of the company are A. D. Bowen and H. L. Chapin, of Portland, and J. E. Riggs, of Grants Pass.

It is expected that contracts will be let shortly for extensive construction work on the North Coast R. R., which is now the third division of the Oregon-Washington Railroad & Navigation Co.'s lines. This work will include the construction of the line between Spokane and the Snake River and probably terminal facilities at Spokane. The line between Spokane and the Snake River includes much difficult construction work, and it is estimated that the grading alone at several places will cost about $175,000 per mile. In the 12-mile section through the Palouse Canyon six tunnels will be built, the shortest being 800 ft. long and the longest 1,800 ft. Another important piece of work on this line will be the bridge over the Snake River 8 miles below Ayer Junction. It is expected that work on the Snake River structure will be started within the next 60 days. This bridge will be 4,070 ft. in length and will be approached by two steel viaducts, the one on the north side having a length of 2,260 ft. and that on the south side 490 ft., leaving the bridge proper 1,220 ft. long. This will be supported by five steel towers on concrete piers. F. L. Pitman, Spokane, Wash., is Chief Engineer.

The Oregon Trunk Line Ry. has completed tracklaying to the 100-mile post at a point near Kilner Station, according to advices received from The Dalles, Ore. It is expected to have 47 additional miles of double trackage ready for operation by the first of June. It is also expected to have the bridge over the Columbia River at Celilo completed this summer. G. F. Kyle, Portland, Ore., is Vice-President and General Manager of the company.

It is rumored in Vale, Ore., that the Harriman interests are working on a cut-off of 110 miles, which will be built from this city to connect with the Oregon R. R. & Navigation Co. at the mouth of the John Day river where it empties into the Columbia. Julius Krutschnitt investigated the maps and surveys carefully, and it is believed that the through [illegible] a saving of 110 miles in an eight-hour run [illegible] is now the main line between Baker City and La Grande. It will also make that city one of the most important railroad centers of Eastern Oregon, as the proposed line across the state will pass through this city.

Pennsylvania.

The South Cambria Ry. Co., Johnstown, Pa., is said to have its plans well along for [illegible] Fork, Cambria County to connect with the lines of the Northern Cambria St. Ry. at Carrolltown. It is expected that this railway will soon be double-tracked and operated by the third-rail system. P. J. Little, Ebensburg, Pa., is President of the Southern Cambria Ry.

Late advices regarding the Pittsburg & Shawmut R. R. state that that road may build five or six miles of line to its coal property. W. W. Henshey, Kittanning, Pa., is Chief Engineer.

The Baltimore & Ohio R. R. is planning a considerable amount of work at Johnstown, Pa., which it is said will involve the expenditure of about $1,000,000. The first work to be done will be the construction of new receiving and inbound yards near the Sandyvale cemetery. It is said that seven tracks will be put in. A new freight depot and a new passenger depot are also included in the plans.

The Baltimore & Pennsylvania Electric Ry. Co., which is building a new electric line between Reistertown, Md., and Hanover, Pa., is planning to resume grading work on the line from Reistertown to the Pennsylvania state line. This work, it is believed, will require about three months for completion. Thomas F. Degnon, a contractor, of Philadelphia, Pa., was recently over the route.

Tennessee.

A mass meeting has been held at Jonesboro to memorialize the legislature to pass an act enabling Jonesboro to issue $50,000 bonds to be used in constructing an electric car line from that place to Johnson City.

The Lake View Traction Co., Memphis, Tenn., is to have construction work started shortly on an extension from the present terminus at Lake View, Miss., to Walls, Miss. It is said that the original plan of the company to go to Clarksdale, Collierville and Covington will be accomplished later.

Texas.

The M. A. Taylor estate of Austin has sold to the A. Denton Colony Co. 16,000 acres of land near Asherton in South Texas. The Colony Co. is said to be planning to construct a railroad through the property, place the land under irrigation, erect a canning factory and make other improvements involving an expenditure of about $2,000,000.

The Texas Traction Co. of Dallas, now operating an interurban line from Dallas to Denison, is said to be planning to have work started soon on the construction of a line from Waxahachie to Waco. The estimated cost of the line is said to be $1,500,000.

The Beaumont Traction Co., James F. Weed, Receiver, Beaumont, has disposed of $125,000 of receiver's certificates, the proceeds of which will be used for improvement work.

Officials of the Brazos River R. R. Co. have announced at Bryan that the road will be built. The capital stock and bonds are said to have practically all been subscribed. The road will run from Bryan to the Brazos River, cross and run down the bottom through the large plantations on the Burleson county side.

The Miller-Veeder Lumber Co., according to advices from Houston, has made surveys for a new air line railroad from Maitland to Beaumont.

The stockholders of the Paris & Mt. Pleasant R. R., H. P. Mobberly, Chief Engineer, [illegible] bonds for the extension of the road from its present terminus at Bogota to Mt. Pleasant.

Surveys for the Stamford & Eastern Ry. of Stamford have been completed from that city to Fort Worth. The surveying party is at present running additional lines in Throckmorton County. It is believed that construction on this railway will be started this spring.

The Marshall & East Texas Ry. Co., now operating 92 miles of line, has authorized a bond issue of $5,000,000, the greater part of which will be used for betterments. R. J. Lockwood, Marshall, Tex., is Chief Engineer.

The Gulf, Colorado & Santa Fe (Santa Fe System) is to expend $60,000 for the enlargement of its shops at Cleburne, Tex. P. T. Dunlap, Cleburne, is Mechanical Superintendent.

Steps are being taken to finance the proposed extension of the Burr's Ferry, Browndel & Chester Ry. to Burkeville in Tyler County, a distance of 52 miles. J. H. Kirby, Houston, Tex., is President.

The Santa Fe System has appropriated $426,000 to cover the cost of track changes from Amarillo, Tex., to the Texas, New Mexico line. The work consists of ballasting track with crushed stone, widening road beds and removing sags from track. H. W. Wagner, Amarillo, Tex., is Principal Assistant Engineer.

The promoters of the new railroad proposed to be built by Fort Worth capitalists to New Mexico through Jacksboro are to go over the route on horseback. The matter of building this line is in the hands of the following committee: S. D. Lary, I. H. Burney, William Capps, W. D. Reynolds and Ed Farmer, all of Fort Worth.

The Santa Fe System plans to install two 10-in. Otto water cranes with necessary pipe lines at East Dallas, Tex.

Utah.

The Utah Light & Ry. Co., Joseph S. Wells, General Manager, Salt Lake City, Utah, is projecting a 5-mile extension, and if the franchise is secured will build the line with its own forces.

Virginia.

Surveys are said to be now underway for a new and direct railroad line from Hampton Roads to Washington. The proposed route runs up the peninsula from Hampton Roads to Yorktown, where it is proposed to build a drawbridge of steel and reinforced concrete to Gloucester Point, and from Gloucester Point the road will pass through the county of Gloucester in an air line to Saluda in Middlesex county, and from there through the counties of King and Queen, Essex and Caroline into Fredericksburg and thence to Washington. The project is reported to be backed mostly by foreign capital. No definite information as to the promotors of the road has been given out.

Washington.

The Chamber of Commerce of Bellingham, Wash., has started to raise $250,000 in the city and a similar amount in the smaller towns of the northern portion of the county for the purchase of $500,000 worth of the bonds of the Nooksack Valley Traction Co., surveys for which have been completed. The letting of contracts for the construction of 18 miles of grade is said to only await the result of the chamber's work. This road will consist of two lines reaching from Bellingham to the international line at Sumas and at Blaine, tapping every town in the Nooksack valley.

The Idaho & Washington Northern R. R., according to reports, will soon construct branch lines from Newport, Wash., southwest to Diamond Lake to tap the timber resources of that district; and from Dalkena to Davis Lake, the site of the new saw mill recently erected. W. C. Smith, Spirit Lake, Idaho, is Chief Engineer.

West Virginia.

⦿Patterson, Moran & Luck, Fitzsimmons Bldg., Pittsburg, Pa., who have been awarded the contract for the grading and masonry for the new line of the Buckhannon & Northern R. R., as noted in our last issue, have opened local headquarters in the Union Utilities Bldg., Morgantown, W. Va. The work will be in charge of J. E. Moran of the above firm. It is stated that bids for sub-contracts were opened last Saturday.

The Baltimore & Ohio R. R. has started improvements at Ellensboro, W. Va., in the way of making a big cut preliminary to double tracking the local part of the system and placing additional switches.

A special commissioners' sale was held Feb. 11 at Harrisville, W. Va., to auction off the uncompleted Harrisville-Cornwallis R. R. A local company launched the road, graded and built a short section of the road and then abandoned the project for lack of funds.

Wisconsin.

Recent large sales of land in the town of Ludington, Eau Claire County, has caused a revival of the report that the Minneapolis, St. Paul & Sault Ste. Marie Ry. will soon build a cutoff line connecting Greenwood and Chippewah Falls.

Contractors have been over the proposed extension of the La Crosse & Southeastern Ry. from Viroqua and also over the proposed Wilton-Ontario line. It is said that contracts for the construction of the two lines will be let at once. A. E. Rau, Sparta, Wis., is Engineer.

The Duluth-Superior Traction Co., Duluth, Minn., is reported to have made plans for the expenditure of $400,000 on its Superior and Duluth properties, included in which expenditure will be the relaying of several miles of rails in Superior and the purchase of more double truck cars for use on lines not now equipped with them.

Wyoming.

The Sheridan Ry. & Light Co., Sheridan, Wyo., is planning to have construction work started early this spring on its trolley line in Sheridan. The company has also completed surveys from Fort Mackenzie to Dietz for the interurban line and negotiations for right of way are pending. Ernest Boehme is Engineer for the company.

Canada.

✣Bids are asked until noon, March 1, by Frank Lee, Winnipeg, Man., Division Engineer, Canadian Pacific Ry., for the construction of frame buildings on the Manitoba Division. Plans, specifications, and forms of proposal can be seen at the offices of the superintendents at Fort William, Kenora, Brandon and Souris, and the Division Engineer, Winnipeg.

The Ontario Provincial Government has been asked by a deputation from Northern Ontario to build a branch of the Temiskaming & Northern Ontario Ry. from Charlton to Gowganda through the village of Elk Lake, a distance of about 40 miles in a direct line, in order to develop the rich mineral, timber and agricultural resources of that part of the country.

The Railway Committee of the Legislative Assembly has passed the bill to incorporate the Richmond, Magog and Stanstead Ry. Co., with headquarters at Sherbrooke, Que., and a capital stock of $1,000,000. The company proposes to build its railway line from the town of Richmond through the counties of Richmond, Sherbrooke and Stanstead, passing near Magog, to a point near Stanstead Plain, a distance altogether of 50 miles, opening up what is described as a country rich in timber and mineral deposits. Branch lines may be also constructed, agreements entered into with other companies, for running rights over each other's lines.

The Legislative Railway Committee has approved a bill to incorporate the Kamouraska and L'Islet Ry. Co., which proposed to build a railway line from St. Anne de la Pocatiere, Kamouraska, connecting with the Intercolonial Railway, thence south to the Transcontinental Railway at Ste. Perpetue, L'Islet County, to connect with the Quebec Central. The line will also extend northeast from Ste. Anne de la Pecatiere to Riviere Quelle, connecting there with the steamers which run on the St. Lawrence between the North and South shores.

Mexico.

Announcement has been made that the Franco-Espano Bank of Paris and Madrid is financing the proposed railroad that is to be constructed by a French syndicate between Camacho and Mazapil, with branch lines to mining camps and other points in the State of Zacatecas. Charles Carbonneou, City of Mexico, representing the bank and the construction syndicate, is now said to be arranging the details preparatory to starting work on the proposed line. The survey was made some time ago. The road, with its branches, will have about 300 miles of track. It will give a transportation outlet to rich mineral districts of Central Mexico, as well [illegible] ties.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣Bids are asked until [illegible] Feb. 27, by Mayor John W. Cook, Eutaw, Ala., for the [illegible] street paving, 2,850 lin. ft. cement curbing and 2,150 sq. yds. cement sidewalks.

California.

⊙Oscar Ford, Riverside, Cal., has been awarded the contract by the board of county commissioners, Riverside, Cal., for macadamizing another section of the Box Springs Grade, [illegible] ship 2 south, range 4 west, for $17,950. Bids were opened Feb. 8.

The Board of Public Works of Los Angeles, Cal., plans to rush improvements on Alhambra road to connect with the county good roads main artery leading to El Monte. A 50-ft. roadway will be constructed with 25-ft. parkways on either side. Twenty ft. of the 50-ft. roadway will be paved with asphaltum.

The Board of Supervisors at Los Angeles, Cal., has been requested by residents of Artesia, Cal., to complete five miles of their highway system this summer.

Colorado.

A bill was recently introduced in the legislature at Denver, Colo., by Charles R. McClain, president of the Arkansas Gunnison & Grant Rivers Highway Association, Canon City, Colo., asking for $50,000 to aid in the construction of the proposed state highway up the Arkansas and down the Eagle and Grand rivers to the state line, known as the Rainbow route. C. A. Allen, Denver, is chairman of the state highway commission.

Delaware.

The citizens of New Castle, Del., have voted the issuance of bonds to the amount of $30,000 for street improvements.

Florida.

✣Bids are asked by Duval County Commissioners, Gail Barnard, county engineer, Jacksonville, Fla., for paving portions of Lincoln Ave.

A committee of citizens from McIntosh, Fla., has asked the county commissioners at Ocala, Fla., to build the hard road from Lowell to McIntosh, which is the main public road leading from Gainesville to Ocala.

Georgia.

⊙The H. S. Jaudon Engineering Co., of Savannah, Ga., has been awarded the contract by the city council of Palatka, Fla., for the construction of 16,500 sq. yds. of concrete sidewalks for $0.80 per sq. yd. Bids were opened Feb. 7. S. C. Stillings is city engineer.

The city council of Americus, Ga., has ordered the bonds sold, which were recently voted for paving purposes. The entire business district is to be paved at an estimated cost of $130,000.

Illinois.

⊙Nick Metz & Son of Riverside, Ill., has been awarded the contract by the board of local improvements of that town for the construction of sidewalks at $0.14 per ft., as follows: Northwood Rd. along the east side of Block 28, Bartram Rd. on the east side from Delaplaine Rd. to London Rd. and west side of Block 30, London Rd. and Northgate Rd. where they serve as lines for Block 36 and Northgate Rd. from village limits to London Rd. on the south side of Block 12; 8,700 lin. ft. cement sidewalk, 5 ft. wide, approximating 43,500 sq. ft. north side of Ogden Ave. from the Desplaines River Bridge to village limits to the east; 2,100 lin. ft. cement sidewalk, 5 ft. wide, approximating 10,500 sq. ft. west side Cowley Rd. from Herrick Rd. to Lawton Rd.; 950 lin. ft. cement sidewalk, 5 ft. wide, approximating 4,750 sq. ft., Lawton Rd., Delaplaine Rd. to a point 145 ft. east on the north side; 145 lin. ft. cement walk, 5 ft. wide, approximating 725 sq. ft. Bids were opened Feb. 6. C. N. Roberts, [illegible] Clark St., Chicago, Engineer in charge.

The County Court at Rock Island, Ill., has confirmed the paving of 15th St. from 25th Ave., south to the city limits in Moline, Ill. Bids are to be advertised for immediately. The cost will be about $28,000.

Indiana.

✣Bids will be received until 10 a. m., Feb. 25, by Board of County Commissioners at Portland, Ind., for three road graders. W. Lea Smith is Auditor of Jay County.

✣Bids will be received until 1:30 p. m., March 6, by Board of County Commissioners, at Brownstown, Ind., for the construction of a gravel road in Vernon township. H. W. Wacker is Auditor of Jackson County.

✣Bids will be received until 10 a. m., March 6, by Board of County Commissioners, Jeffersonville, Ind., for the construction of a gravel road in Vernon township. H. W. Wacker is Auditor of Clark County.

✣Bids will be received until 10 a. m., March 6, by Board of County Commissioners, Decatur, Ind., for the construction of a macadamized road in Hartford township. H. S. Michaud is Auditor of Adams County.

✣Bids will be received until 10 a. m., March 6, by Board of County Commissioners at Portland, Ind., for the construction of a public highway in Noble township. W. Lea Smith is Auditor of Jay County.

✣Bids will be received until 10 a. m., March 6, by Board of County Commissioners, Franklin, Ind., for the furnishing of 1,000 yds. of crushed stone to be delivered f. o. b. at Whiteland, Ind., and 500 cu. yds. of crushed stone delivered f. o. b. Trafalgar, Ind. Same to be sufficiently small to pass through an inch and a quarter ring and suitable for use on public highway. William B. Jennings is Auditor of Johnson County.

✣Bids will be received until 1 p. m., March 6, by Board of County Commissioners, Williamsport, Ind., for the construction of a gravel road in Warren township. D. H. Moffit is Auditor of Warren County.

✣Bids will be received until noon, March 7, Board of County Commissioners, Winamac, Ind., for the improvement of public highways by grading, draining and graveling the same. W. E. Muchenburg is Auditor of Pulaski County.

✣Bids will be received until 10 a. m., March 7, by Board of County Commissioners, Logansport, Ind., for the construction of gravel roads in Jefferson and Tipton and Jackson townships. [illegible] County.

✣Bids will be received until 2 p. m., March 7, by Board of County Commissioners, Washington, Ind., for the construction of two gravel roads in Steel and Veale townships. Thomas Nugent [illegible] County.

✣Bids will [illegible] March 7, by Board of County Commissioners, Wabash, Ind., for the construction of two gravel roads in [illegible] township and one in Noble township. J. P. Noftzger is Auditor of Wabash County.

✣Bids will be received until 1:30 p. m., March 7, by Board of County Commissioners, Wabash, Ind., for the construction of a public highway in Noble township. J. P. Noftzger is Auditor of Wabash County.

✣Bids will be received until 11:30 a. m. March 11, by Board of County Commissioners, Brazil, Ind., for the construction of a gravel road in Van Buren township. E. A. Staggs is Auditor of Clay County.

✣Bids will be received until 2 p. m., March 17, by Board of County Commissioners, Paoli, Ind., for the construction of gravel road in Paoli township. Alvin B. Ham is Auditor of Orange County.

⊙The Board of Public Works of South Bend, Ind., has awarded Hoban & Roach the contract for constructing a pavement on the first alley west of Michigan St., from Monroe to South Sts., for $1,255.

⊙The County Commissioners at Huntington, Ind., have awarded the contract to William Ruppert for the construction of the Price Foust et al. road extending from Broadway to the Union-Huntington township line for $3,850.

⊙The County Commissioners, Mt. Vernon, Ind., have let the contract for the Hume gravel road extension in Robb township to Stephen A. Gano for $6,791. Other bidders were the Mt. Vernon Construction Co., $7,313, and White & Eigeman, $7,360.

⊙William Williams & Jacob Drook have been awarded the contract by the county commissioners at Marion, Ind., for the construction of the Alvin B. Scott highway in Fairmount township for $4,042.

Wells County Commissioners, Bluffton, Ind., are considering the proposition of repairing the lake road near the Twin lakes in the vicinity of Bluffton.

⊙The County Commissioners at Marion, Ind., have awarded the contract for the construction of the Alvin Scott highway in Fairmount township to William & Jacob Drook for $4,042.

⊙It is reported that George H. Palmer & Co. have been awarded the contract by the Board of Public Works of Logansport, Ind., for the paving of 5th St., at the following bid: Metropolitan brick, $1.79; Postom, $1.76; Indiana block, $1.77. It is probable that the work will be done with Metropolitan brick. Other bids were received from Tripper & Sons, I. N. Crawford, J. A. Beal and Michael Burke of Peru.

The board of county commissioners, Lafayette, Ind., has postponed the date of letting from Feb. 8 to some time in April for the construction of a gravel road in Tippecanoe county. George W. Baxter is county auditor.

Iowa.

The City Council of Carroll, Ia., has decided to install a number of blocks of paving this year. Paving on 5th St., from the Northwestern depot to the Windsor hotel, on Main and Adams from the railroad to 6th, will be put in this year.

Kansas.

Representative Thomas of Wyandotte County, Kan., has introduced a bill in the house of representatives, Topeka, Kan., which provides for the construction of a boulevard between Fort Leavenworth and Kansas City, Kan. The roadway is to be built along [illegible]

[illegible] brick is proposed as the material.

Providing the state legislature enacts a special act empowering it, Kearney and Grant counties, Kan., will join in building a county road from Lakin to New Ulysses, connecting the county seats of these counties. The road would be built through the sand hills and it is estimated that $4,000 will build it. Lakin is the county seat of Kearney county, and New Ulysses is the county seat of Grant county.

Louisiana.

The City Council of Crowley, La., has let an additional cement sidewalk contract for eight miles of 4-ft. walk to DeJersey & Bernard. When this work is completed the city will have 20 miles of new cement sidewalks. It is contemplated to build about 10 miles more.

Maryland.

✣Bids are asked until noon, Feb. 27, by Joseph B. Harrington Club Commissioners of Talbot county, Easton, Md., for grading and macadamizing about .83 mile of Dover Bridge Rd. The work includes a pivot drawbridge and 70-ft. steel span over Choptank River, together with necessary piers, abutments, fender work, etc.

The Board of Estimates of Baltimore, Md., has approved the plan for widening Belair road, submitted by the commissioners for opening streets. The plan is to widen the road from North Ave., to the city limits, changing it from 40 to 80 ft. in width. The cost of the improvement is about $70,000. Plans were also submited by the park board for opening Gwynn's Falls Parkway, to be constructed between that park and Druid Hill Park. This is a part of the proposed boulevard to connect all the parks in the northern part of the city. The cost will be about $80,000. Ordinances for both improvements are before the council. B. T. Fendell is City Engineer.

Massachusetts.

✣Bids are asked until Feb. 27 by J. Edward Mullen, Superintendent of Supplies, Tremont bldg., Boston, Mass., for furnishing 800,000 gals. of road oil.

Michigan.

⦿Zeno & Johnson of Chatham, Mich., have been awarded the contract by the county commissioners of Marquette county, Marquette, Mich., for the construction of one and one-third miles of road between the Marquette county line and Skandia, to unite with the Alger county road to Munising. The estimated cost is $4,000. The road must be completed by July 1.

Robert Rich of Menominee, Mich., submitted the lowest bid to the county commissioners at Menominee for the construction of Road No. 7, known as the Bayshore road from the connecting link to Arthur Bay and thence to Cedar River. The work includes an 18 ft. crown, 12 ft. metal, 9 ft. deep, totaling 13,000 cu. yds. of gravel and covering nearly 7½ miles in length. His bid was $12,634. Bids were opened Feb. 14. K. I. Sawyer is county engineer. The contract has not been awarded.

Minnesota.

✣Bids are asked until Feb. 24, by M. D. Weeks, village clerk, Spooner, Minn., for the laying of 9,600 lin. ft. 5-ft cement sidewalk; 1,800 lin. ft. 10-ft. cement sidewalk; 60 driveways and crossings; 1,800 lin. ft. combination curbing and gutter.

The city council of Crookston, Minn., has referred the bids received Dec. 13 for the construction of Westrumite asphalt macadam on Ash St., from Houston Ave., to Third St., including 7,143 sq. yds. and E. Third St., from Broadway to Elm St., including 2,381 sq. yds., to the street and bridge committee with instructions to report on same at a meeting to be held Feb. 28. It is estimated that the work will cost between $50,000 and $75,000. The contract awarded to the General Construction Co., has been vetoed by the mayor. J. E. Carroll is city engineer. A. M. Childs is city clerk.

City Engineer A. E. Rhame of Red Wing, Minn., has urged the Board of Public Works to take necessary steps to prepare a certain downtown district for paving. The streets recommended for paving are: Main and 3d Sts., between Broadway and east side of Plum St.; Bush St., from railroad tracks to north line of 4th; Plum St., from Main to 4th.

Senator J. T. Elwell, Minneapolis, Minn., has introduced a bill in the senate asking for an appropriation of $1,000,000 for road construction in Hennepin county. The bill provides that any county in the state may issue bonds to the extent of ½ of one per cent of the assessed valuation, for use in building roads.

The Automobile club of Duluth, Minn., has petitioned the county commissioner at that city to improve the Miller-Trunk road from the city limits to the White Face river, surfacing the same and establishing certain passing points at frequent intervals.

Mississippi.

The city council of Columbus, Miss., has instructed the engineer to prepare plans and specifications for about 4,500 lin. ft. of concrete curb and gutter, with storm sewer and catch basins. The matter is to be before the city council at its next meeting in March. C. L. Wood is engineer.

Missouri.

The Board of Public Works of St. Joseph, Mo., has ordered an ordinance for the macadamizing of 22nd St., Garfield Ave., to the south city limits, the improvement to form a conection with an improved country roadway extending north to the city limits by way of the Woodson sanitorium.

Nebraska.

The City Council of Omaha, Neb., has been petitioned for the repaving of Douglas St., from 16th to 20th St.

A plan is on foot to build a road across Merrick county, 40 miles long, in two days. Good roads advocates met in Central City, Neb., to discuss the matter. H. E. Glatfelter and J. A. Hayes of Central City are interested.

A petition is being circulated in Norfolk, Neb., by George N. Beels of that city asking for the paving of 3rd St., from Norfolk Ave. to the Junction.

New York.

A bill has been introduced in the Senate, Albany, N. Y., providing for an appropriation of $1,000,000 for the completion of good roads routes from Watertown to Clayton and Alexandria Bav and through Onondaga and Oswego counties to Watertown.

North Carolina.

A bill is pending in the house of representatives, Raleigh, N. C., to establish a system of state highways in North Carolina. The bill would provide for all the state convicts except what are necessary for operating the state farm, not to exceed one hundred, to be worked on the public roads, state chain-gangs to be provided, one for each judicial district and all the county chain-gangs, half the cost of the maintenance of which shall be met by the counties in the districts by especial tax.

⦿The Board of Aldermen of Elizabeth City, N. C., has awarded the contract for paving Water St., and intersecting streets in the business districts to J. L. Lawson of Norfolk, Va., for granite blocks at $1.60 per sq. yd.

Ohio.

✣Bids will be received until noon, Feb. 28, by Director of Public Service, Canton, O., for furnishing one street flushing machine. Warren L. Barr is Clerk.

⦿The Enterprise Paving & Construction Co., Broadway, Cleveland, O., has been awarded the contract by the board of county commissioners, Cleveland, O., for the grading of Broadview Road No. 3, from Wallings Corners School House to Boston Road in Becksville and Strongsville townships, for $28,568. Bids were opened Feb. 15 by J. F. Goldenbogen, county clerk.

Morgan township citizens, Scioto County, have petitioned the county commissioners at Portsmouth, O., for the improvement of the county roads running through that township.

The County Commissioners at Portsmouth, O., have passed a resolution establishing a county road in Morgan township. The road begins at Bear Creek and terminates at McCulloch.

The County Commissioners at Youngstown, O., received the following bids for the placing of a slag roadway with a top of silica gravel treated with Carbo Via for three-quarters of a mile on the Loveland Hill; the road to be built jointly by the county, Coitsville township and the good roads commission: Oakley & Ensign, Cortland, O., $5,197; John Colucci, $5,920; Coy Bros., Calla, $5,217; Ross Burke, $5,007; L. H. Young, $5,769; M. P. Conley, $5,696; C. J. Chinnick, Warren, $5,648; Ga Graldini & Co., $5,911; McKean Co., $5,457, and Chas. Harris, $5,721.

Plans have been prepared for the paving of Park St., in Ashtabula, O., by the engineering department. The city council will probably order the improvement at its next meeting.

South Side business men and residents of West Mound St., Columbus, O., are circulating a petition providing for the paving of West Mound St., to Central Ave.

The City Council of Canton, O., has passed an ordinance providing for the paving of Virginia Ave., Shorb St., and High St. Phil H. Weber is City Engineer.

A petition has been introduced in the city council of Ashtabula, O., asking for the improvement of Henry and Foster Sts., by draining, curbing and paving, and for the extension of a large water main from a point in the bend of Henry St., to the intersection of that street and Foster St. The service director has been authorized to prepare plans and specifications for the improvement.

The City Council of Ashtabula, O., has passed resolutions providing for the construction of vitrified brick on a concrete foundation, and the same street from Hulbert to High with Medina stone block on a slag foundation. The resolution includes curbing and draining.

County Surveyor L. A. Dillon and the county commissioners, Hamilton, O., have recommended to the state highway department the advertising for bids for the paving of the Venice road. James C. Wonders is state highway commissioner.

Oklahoma.

⦿The Western Paving Co. has been awarded the contract by the city of Oklahoma City, Okla., for grading and constructing sheet asphalt on Exchange Ave., from Pennsylvania Ave. to Kentucky Ave.; double driveway each to be 25 ft. wide; 5-in. concrete base, 6x18-in. concrete curb and 3-ft. vitrified brick gutter. Bids were opened Feb. 15.

City Attorney Burt and City Engineer Kirkpatrick of Sapulpa, Okla., have recommended to the city commissioners the paving of approximately 100,000 sq. yds. of street. The estimated cost of the work is $200,000. Bids will probably be advertised for within a short time.

Oregon.

The County Court at Baker City, Ore., contemplates making a change in that part of the road up McCully's Fork from Granite St., to Downie Diggings, in the city of Sumpter.

A general system of hard-surface streets is proposed for Sellwood, Portland, Ore. Alternate streets will be paved between Leo and Umatilla Aves., including Umatilla Ave. Some of the streets running north and south are included in the improvement program. The Sellwood Commercial club is backing the plan.

The records of City Engineer J. W. Morris of Portland, Ore., show that 105.74 miles of street were improved last year, as follows: Asphalt, 27.960; stone blocks, 1.625; bitulithic, 23.106; hassam, 10.727; macadam, 4.190; gravel, 2.898; earth graded, 35.199, and concrete, 1.049. The following is a summary of

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

street improvements finished up to Jan. 1, 1911: Asphalt, 46.120; stone blocks, 6.606; wood blocks, 1.606; bitulithic, 54.031; hassam, 14.378; macadam, 62.773; gravel, 92.979; plank roadway, 5.043; elevated roadway, 2.927; vitrified brick, .650; graded streets (earth grade), 150.804; bituminous macadam, .152; concrete, .049, a total of 438.593 miles. In addition there is .370 miles of steel bridge and .105 mile of reinforced concrete bridge. The following roadway improvement work was commenced during 1910, but has not yet been completed and accepted, hence is not included in the figures given above: Asphalt, 7.980; bitulithic, 1.514; hassam, 2.483; stone blocks, .495; concrete, .031, a total of 12.503 miles. There was laid during the year a total of 122.539 miles of sidewalk of which 6.759 miles was wood and the balance of cement. Of this 1,730 pieces, all cement, a total of 126,870 lin. ft., were laid by private individuals in accordance with instructions of the city engineer. The total amount of cement walk in place in the city on January 1, 1911, was 513.177 miles. The total cost of roadway improvement work performed during 1910 was $4,091,261.76

The city executive board of Portland, Ore., on Feb. 14 received the following bids for street work: Abernathy St. from Kelly to Corbett, grading and concrete curbs and walks, Nat Costanza, $1,835; Arnold St. from East 34th to East 39th, bitulithic pavement, Warren Construction Co., $12,274; East Couch from East 24th to East 28th Sts., bitulithic pavement, Warren Construction Co., $10,549; Christina Ave., grading and concrete curbs and walks, Giebisch & Joplin, $270; East 11th St. from Brooklyn to Dent, Hassam paving, Oregon Hassam Paving Co., $9,002; Emerson St. district, grading and concrete curbs and walks, Giebish & Joplin, $50,413; G. K. Lundstrum, $51,774, Baker Brothers & Tomlinson, $50,135, Elwood Wiles, $50,025; Grand Ave. from Caruthers to Ellsworth, Hassam paving, Oregon Hassam Paving Co., $11,833; Highland St., from East 23d St. to East 27th, grading and concrete curbs and walks, Giebisch & Joplin, $2,734; Knott St. from East 24th to East 33d, grading and concrete curbs and walks, Joplin & Meeks, $6,659, Elwood Wiles, $6,607, Bechill Brothers, $6,665; East Morrison St., grading and concrete curbs and walks, Bechill Brothers, $1,194; Joplin & Meeks, $1,232; East 19th St. from Broadway to Tillamook, grading and concrete curbs and walks, Baker Brothers & Tomlinson, $5,451; Portland Bd. from Vancouver to Union, grading and concrete curbs and walks, Giebisch & Joplin, $8,011, McSween & Son, $7,640; East 7th St. from Alberta to Wygant, grading and concrete curbs and walks, Bechill Brothers, $1,444, C. A. Akerson, $1,410; East 17th St. from Alberta to Killingsworth, grading and concrete curbs and walks, Coast Construction Co., $3,534, Giebisch & Joplin, $3,609, C. A. Akerson, $3,579, Bechill Brothers, $3,417; East 17th St. from Alberta to Prescott, grading and concrete curbs and walks, Coast Construction Co., $3,045, Bechill Brothers, $3,147; East 22d St. from Highland to Dekum, grading and concrete curbs and walks, Giebisch & Joplin, $3,073, Joplin & Meeks, $2,935; East 23d St. from Alberta to Prescott, grading and concrete curbs and walks, Coast Construction Co., $3,957, Giebisch & Joplin, $2,847; East 24th from Holgate to Gladstone, grading and concrete curbs and walks, Giebisch & Joplin, $2,421, Keenan Brothers, $2,532; East 24th from Holman to Dekum, grading and concrete curbs and walks, Giebisch & Joplin, $3,959, Bechill Brothers, $3,814; East 25th St. from Gladstone to Holgate, grading and concrete curbs and walks, Joplin & Meeks, $2,654, Keenan Brothers, $2,565; East 25th St. from Division to Tibbetts, grading and concrete curbs and walks, Joplin & Meeks, $3,960, Keen Brothers, $3,892; Giebisch & Joplin, $3,940; East 26th St. from Holman to Dekum, grading and concrete curbs and walks, Giehisch & Joplin, $4,099, Bechill Brothers, $3,902, Joplin & Meeks, $3,929; East 27th St from Holman to Dekum, grading and concrete curbs and walks, Bechill Bros., $3,907; Giebisch & Joplin, $3,901, Joplin & Meeks, $3,705; East 30th St. from Division to Clinton, grading and concrete curbs and walks, Giebisch & Joplin, $1,628, Joplin & Meeks, $1,667, Keenan Brothers, $1,880; East Yamhill St. district, grading and concrete curbs and walks, Giebisch & Joplin, $7,984, Bechill Bros., $7,700, Joplin & Meeks, $7,489, O'Neill & Co., $7,474.

Pennsylavnia.

⊙John McCormich & Son have been awarded the contract by the city council of Erie, Pa., for paving 20th St. from Peach to Chestnut St., with asphalt for $0.86 per sq. yd. Bids were opened Feb. 13.

Good roads bills have been introduced in the State Senate, Harrisburg, Pa., providing for the virtual reorganization of the present state highway department. One bill amends the state constitution so as to give the state the right to borrow $50,000,000, provides for a system of trunk lines throughout the state connecting with every county seat and every town of importance. The state is divided into 50 districts, with the state having supervision over all. Various positions are provided which carry salaries aggregating $142,400, as follows: One highway commissioner, $8,000; first assistant commissioner, $6,000; second assistant commissioner, $5,000; chief engineer, $4,000; engineer of bridges, $3,600; fifty superintendents of highways at $1,500 each, $75,000; six assistant engineers, $2,400 each, $14,400; chief draughtsman, $2,400; eight assistant draughtsmen, $1,800 each, $14,000; chief clerk, $2,400; two clerks, $1,200 each, $2,400; two stenographers, $1,200 each, $2,400; two bookkeepers, $1,200 each, $2,400.

Petitions to the county commissioners, Pittsburg, Pa., and to the state highway commissioners, Harrisburg, Pa., are being circulated for the reconstruction of the Puckety Creek road, beginning near the Parnassus Borough line and extending easterly through Westmoreland County into Plum township, Allegheny County.

South Dakota.

The City Council of Mitchell, S. Dak., has decided to construct a boulevard out to Graceland cemetery. The boulevard will start on Wisconsin St., just north of the Omaha right of way. The estimated cost of the improvement is $1,000.

Tennessee.

Plans have been made by S. E. Ayres of Knoxville, Tenn., for the construction of about 10,000 sq. yds. of tar macadam paving for the borough of Mountain View, Knoxville, estimated to cost $9,000. The foundation will be of rolled rock, 3-in. in size, 9-in. thick. About 8,000 cu. yds. of earth and rock excavation will be required at an estimated cost of $5,000. The contract will be let about March 15. C. L. Mabrey, Box 85, Knoxville, Tenn., has charge of the work.

Texas.

✣Bids are asked until March 4, by L. S. Polk, City Secretary, Sweetwater, Tex., for the construction of about 22,000 sq. yds. of macadam-asphalt street paving, according to specifications on file in office of city engineer.

✣Bids will be received until March 4, by L. S. Polk, City Secretary, Sweetwater, Texas, for the construction of about 22,000 sq. yds of macadam-asphalt street paving in the city of Sweetwater, Tex., all bids to be submitted as follows: A. There shall be two bids specifying the price per sq. yd. at which bidder offers to do the work; (1) one to include grading to be figured by the cu. yd., with a haul of 100 to 700 ft.; (2) one without such grading and haul. B Specifications for such work may be obtained at office City Engineer, Sweetwater, Tex. C. Each bid shall be accompanied with a certified check in sum of $500, payable to Mayor of Sweetwater, as a guarantee to city that such bidder will execute satisfactory contract and furnish satisfactory bond, and that work shall be begun within thirty days from the date of such award of contract. D All bids shall be sealed, signed by bidder, mailed to L. S. Polk, City Secretary.

⊙The Cit [illegible] Dallas, Tex. have let the contract for the paving of Market St., from Jackson to Pacific to D. J. Grigsby for $13,500.

⊙The City Commissioners of Dallas, Tex., have let the contract to the Texas Bitulithic Co. for paving of South Hardwood St., from Jackson to Forest Aves., for $2.30 per sq. yd.

Citizens of Eagle Lake, Tex., will vote Mar. 7 on the proposition of issuing bonds to the amount of $250,000 for road improvement.

The Young Men's Progressive League of Jacksonville, Tex., has appointed a committee to aid in working up and arranging for holding an election in the Jacksonville justice precinct, which covers an area of a radius of about five miles adjacent to this town, for the purpose of bonding the precinct to build roads leading into town.

The County Commissioners at Beaumont, Tex., have been petitioned for the improvement of the Concord road between the end of the shelled portion near Rosedale and the terminus of the road at Pine Island bayou, where the Hardin county line begins, a distance of about 3½ miles.

The citizens of Boutell-Granger justice precinct have presented a petition to the commissioners at Georgetown, Tex., asking for an election on a bond issue of $100,000 for roads in that precinct. The election will be called some time in March.

Several paving petitions are being circulated in the northern section of Fort Worth, Tex., for the paving of Ellis Ave., from Central to 14th St., and Central Ave., west to North Houston St.

The Directors of the Chamber of Commerce of Comanche, Tex., at a recent meeting unanimously decided to petition for a $100,000 road bond issue for Commissioners' Precinct No. 1.

A petition is being circulated in Fort Worth, Tex., providing for the paving of Taylor St., from Belknap to the Texas and Pacific tracks.

The city secretary of Dallas, Tex., has been instructed by the municipal commissioners to advertise for bids for the paving of Jefferson St., from 10th to Tyler.

The City Council of Brownsville, Tex., has passed ordinances ordering an election March 14 on the question of issuing bonds aggregating $140,000 as follows: $80,000 for street paving; $35,000 for improvement of city water system, $15,000 for improvement of electric light system, $12,000 for improvement of market place and city hall, and $3,000 for a new slaughter house. It is planned to pave Elizabeth St., and a number of cross streets in the business district.

Several business men of Abilene, Tex., have started a movement whereby there will be several more blocks of bitulithic paving laid in the business section of town than the city's contract calls for. The streets to be extended if successful, will be Pine St., two blocks north of the present paving and in front of the Federal court house and postoffice and others.

Utah.

⊙The Board of Public Works of Salt Lake City, Utah, has awarded the contract for side walk extension No. 153, on 9th Ave., between K and M St., except for 165 ft. on the south side running east from K St., to L. L. Goddard for $1,296.

Virginia.

✣Bids are asked until 12:30 p. m., March 1, by the Board of Control of Norfolk, Va., W. T. Brooke, City Engineer, for regulating and constructing 4,125 sq. yds. of smooth surface pavement on Bank St.

✣Bids are asked until March 6, by Board of Public Works, W. A. Harris, Secretary, Spottsylvania, Va., for constructing 1¾ mile of macadam road.

⊙The Permanent Road Commission of Norfolk County, Portsmouth, Va., has awarded contracts for the construction of a macadam roadway in upper Magisterial district, and for the construction of two miles of macadam roadway in the vicinity of Centerville, on what is known as the Great Bridge road. The Dalby-Nottingham Co., at $4,700 secured the contract for the Glasgow St improvement, and

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] Bridge [illegible]

● [illegible] of Norfolk County, Portsmouth, Va., for hauling stone in the Western Branch magisterial [illegible]

Washintgon.

The State Senate, Olympia, Wash., has adopted a resolution introduced by Senator Arvid Rydstrom of Tacoma, asking the federal government to appropriate $50,000 for the construction of the Mount Tacoma road. The government is asked to complete the roads in the National park up over the Nisqually glacier and the numerous trails and then start work on the road through the forest reserve toward the Big Bottom country.

⊙Tuttle & Maloney have been awarded the contract by the board of county commissioners, Montesano, Wash., for planking 4,000 ft. of road running east from South Montesano. When the contract is finished it is planned to continue the road under contract for a distance of 2,000 ft. and then to connect with the Vesta Creek road.

The County Commissioners at South Bend, Wash., have been asked to set aside $60,000 of the road bonds voted last fall to build the macadam road which has been started from South Bend and runs to Bay Centre and then south to the Nema and Naset.

The Trout Lake Good Roads Club, Trout Lake, Wash., has been organized with Dr. A. G. Belsheim, president, and William Coate, secretary and treasurer. The club has available $2,800 which the committee recommends distributing as follows: $1,600 on the stage road between Guler and the McCracken fruit ranch three miles north of Husum; $300 in repairing the sawmill road; $100 for the Taggart road leading from Trout Lake postoffice [illegible], $50 for repairing the Elmer Wright road, $100 on the Hoke Moore road; $150 on the Byrket road, and $100 on the Ice Cave road. The representatives of Klickitat county in the legislature have been urged to favor bonding of road districts for the purpose of macadamizing roads.

Wisconsin.

✣Bids will be received until 2 p. m., March 1, by J. P. Keating, City Clerk, Neenah, Wis., for 7,500 sq. yds. of pavement. Material to be tar macadam, concrete sarcolithic or creosote block. John Le Tourneus, Engineer.

The citizens of Plover, Wis., have voted the issuance of bonds to the amount of $3,000 for the construction of a macadam road between Plover and Stevens Point. A like amount must be raised by private subscription before the money will be available.

The city of Madison, Wis., is considering the purchase of two mechanical street sweepers for cleaning its asphalt, brick, and oiled macadam streets. The city also has under consideration the buying of a combined auto patrol and ambulance.

The City Council of Racine, Wis., has completed the budget for the year 1911, included in which are the following improvements: Paving—Fourth St., from Main St. to 4th St. bridge, $2,400; 3rd St., from Lake Ave. to Main St., $1,677.80; alley west of Main St., between 4th and 5th Sts., $48; Villa St., from 16th St. to DeKoven Ave., $1,450; North Erie St., from Dodge St. to St. Patrick St., $4,815; North Erie St., from St. Patrick St. to the city limits, $3,052; Erie and Dodge Sts., from State St. to Main St. $4,200; 8th St., from Racine St. to Center St., $450; 9th St., from Washington Ave. to Center St., $901.27; Kinzie Ave., from Kinzie Ave. bridge to Graham St., $11,500; resurface Asylum Ave., south of C. M. & St. P. Ry., $300; West Boulevard, from 12th St. to Cemetery gate, $270; LaSalle St., from Liberty St. to Douglas Ave., $4,500; Milwaukee Ave., from State St. to High St., using present macadam foundation, $5,650 Grading—De Koven Ave., from Wisconsin St. to C. & N. W. Ry., $1,000; LaSalle St., from Wewaunee St. to St. Patrick St., fill in from other sections, no cost; Stannard St., $1,150; Walnut St., $36.50; Cherry St., $33; Elm St., $84.35; fill in right of way C. M. & St. Paul Ry., between 10th and 11th St., same being done by C. M. & St. P. Ry., no cost; Summit Ave., from Albert St. to Kewaunee St., $300; High St., from Charles St. to West City Limits, $550; Race St., $350; Roe Ave., $209; River St., $300; 10th St., from Racine St. to Pearl St., $352; Spring St., $550 Stree Openings—Hilker Pl., $3,000; Davis Pl., $1,800; West 6th St., $1,500; Franklin St., from 12th to 13th St., $500; De Koven Ave., west of Holborn St., $2,000; Quincy Ave., across C. M. & St. P. Ry. right of way, $800; alley east of C. M. & St. P. Ry., between 10th and 11th Sts., no cost. Miscellaneous—Retaining wall on the north side of Kewaunee St., $800; cement curbing on Cliff Ave., adjoining the Jefferson school, $86; building new engine house for Engine company No. 2, $7,500.

Canada.

⊙H. B. Gilmour of Vancouver, B. C., has been awarded the contract by the city of Vancouver, B. C., for furnishing a new road roller weighing not less than 15 tons for $3,470. It is to be a Waterous engine. Bids were opened Feb. 14 by William McQueen, city clerk.

BRIDGES—STEEL AND CONCRETE

Arkansas.

⊙The Vincennes Bridge Co., Vincennes, Ind., has been awarded the contract for the con-Big Yran Bayou, consisting of two 75-ft. spans. The superstructure is to be of concrete. Lake Village, Ark., is County seat of Chicot County.

The Argenta St. Railway Co. has under consideration the construction of a bridge across the Arkansas River to connect the cities of Little Rock and Argenta, Ark. George F. Brockman, Argenta, Ark., is Superintendent of the company.

California.

⊙Information received from Redlands, Cal., state that Anderson & McElvaine, San Bernardino, Cal., have been awarded the contract for the construction of four bridges across the Mission storm ditch in Redlands, Cal.

County Surveyor, Ventura, Cal., is preparing plans and specifications for the construction of a new county highway bridge to be erected over the Saticov, near Oxnard. Steel and concrete will be the material used.

The Santa Fe System, A. F. Robinson, Chicago, Ill., Bridge Engineer, plans on renewing their bridge No. A-26 at Visalia, Cal., at an estimated cost of $7,300.

The property owners of Seventh St., in San Bernardino, Cal., are said to be circulating a petition demanding that the city council construct a concrete culvert over the Town Creek, between D. and Arrowhead Aves., in place of the old wooden structure.

The California Development Board of San Francisco, Cal., has adopted resolutions recommending to the governor and legislature that a state survey be made for a suspension or pier bridge at or about the Carquinez Straits and that a sufficient fund be appropriated to carry out the recommendation.

Bids are being received, it is reported, by the County Supervisors, at Auburn, Cal., for the construction of a bridge across the north fork of the American River on the Auburn and Forest Hill grade.

Florida.

✣Bids are ordered until 9 a. m. Feb. 24, by Duval County Commissioners, Gail L. Barnard, County Engineer, Jacksonville, Fla., for the construction of a 15 ft. span reinforced concrete culvert.

✣Bids will be received until Feb. 27 by Board of Public Works, Jacksonville, Fla., for the construction of a bridge on East Bay St. spanning Hogan's Creek.

⊙The Southern Bridge Co., Birmingham, Ala., has been awarded the contract for the construction of the Lake Worth Bridge Company's bridge over Lake Worth. The cost of the work is estimated at about $30,000. J. McDonald, West Palm Beach, Fla., is Architect.

Idaho.

Advices from McCammon, Ida., state that practically all of the wagon bridges between Bancroft and Pocatello, Ida., have been destroyed by high water in the Portneuf River, and that the construction of bridges to replace the missing ones will necessitate the expenditure of a large amount of money.

Illinois.

The Chicago Great Western Ry. will, it is reported, proceed at once toward the construction of a new main line bridge over the Mississippi River. This improvement has been under consideration by the company for some time and has finally been made possible by the passage of the Stevens Bill by the Senate. C. Chandler, Chicago, Ill., is Engineer Bridges and Buildings of the Chicago Great Western R. R.

✣Bids will be received until 1 p. m., Feb. 25, by Commissioners of Creek Union District No. 1, in the towns of Creek and Friend Creek, counties of Dewitt and Macon, Illinois, for the construction of ten farm bridges having 20 ft. span with 12-ft. roadway. Frank Withers is Chairman of the Commission.

The Santa Fe System has planned to renew several bridges on the Valley Division and bridges Nos. A-978, A-979, D-978, B-978, D-977 and C-977 will be started shortly. A. F. Robinson, Chicago, Ill., is Engineer of Bridges.

Citizens of Fulton, Ill., have under discussion the proposition to remove the wagon bridge over the Cattail slough northeast of the town and replace the structure with a concrete culvert. The cost of the work, including the filling necessary, is estimated at about $1,800

Indiana.

Board of County Commissioners, Muncie, Ind., has been petitioned by taxpayers residing on West Main St. and in Normal City to take some action toward the construction of a bridge across White River on West Main St in that city.

⊙The contract for the construction of the Lick Creek Bridge has been awarded by the Commissioners of Marion County, Indianapolis, Ind., to Charles Hoover, at $1,635.

County Engineer of Vigo County, at Terre Haute, Ind., has completed plans and specifications for the construction of the bridge across Sugar Creek on the State Line road and bids for the work will soon be advertised. The cost of the work will be divided as follows: Vigo County, one-half; Edgar County, Ill., one-fourth, and the township of Elbridge will pay the other fourth.

The County Commissioners at Goshen, Ind., have made an appropriation of $2,000 for the construction of a new bridge over Rock Run on the Fish Lake Road to take the place of the structure removed some time ago to permit the dredging of the stream.

Iowa.

✣Bids will be received until March 6, by Board of Supervisors, Cedar County, at Tipton, Ia., for the construction of concrete culverts. T. C. Moffit is County Auditor.

Kansas.

The County Commissioners at Wichita, Kan., have voted in favor of the erection of three new bridges in Sedgwick County. One

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

of the pile bridges will be erected between section 5 of Waco township and section 32 of Delano township at an estimated cost of $1,049. Another will be erected between sections 16 and 17 of Attica township at a cost of $659. A pile bridge will be erected between sections 13 and 14 of Erie township at a cost of $480. The commissioners voted to advertise for bids.

Kansas City, Kan., and Rosedale are to take up the matter of building a railroad bridge connecting the two places and installing tracks thereon which will be leased to any transportation companies wishing to cross.

◉The Missouri Valley Iron & Bridge Co., Leavenworth, Kan., has been awarded the construction of two steel bridges, one over the Sans Bois Creek near Rock Ford, to be 90 ft. long, and the other over Sans Bois Creek at Bunker Hill, to be 110 ft. long. The cost of the structures will be about $3,000 and $3,474 respectively.

Kentucky.

Advices from Paducah, Ky., state that the commissioners of McCracken County are planning the construction of 12 steel bridges each not to exceed 38 ft. in length.

Bridge Commissioners of Hardin and Jefferson Counties, Ky., have finally succeeded in securing all the necessary right of way for the construction of the proposed bridge over the Salt River between those counties and it is expected that work will start immediately on the improvement which is estimated to cost between $60,000 and $70,000, ten-elevenths of which will be paid by Jefferson county, of which Louisville, Ky., is the county seat.

Louisiana.

◉Advices from Houma, La., state that the Police Jury has awarded the contract for the construction of a steel bridge across Bayou Terrebonne at Presquile to the Leverich Bridge Co., Fort Worth, Texas, at $2,950.

Michigan.

City Engineer of Saginaw, Mich., has been instructed to prepare plans and estimates of the cost of constructing a new bridge to replace the present Johnson St. bridge. It is proposed to erect a structure 600 ft. in length with 20-ft. roadway and two 5-ft. walks. The improvement, it is estimated, will necessitate an expendiutre of about $85,000.

Minnesota.

✣Bids are asked until 1 p. m. March 10, by Peter Backlund, Chairman Town Board, Grasston, Minn., for the construction of a steel bridge across Rice Creek of a span of 50 to 75 ft. Plans and specifications will be on exhibition on day of sale.

A bill is now before the legislative committee authorizing the construction of a bridge across the Mississippi River at 42d Ave. N., Minneapolis, Minn., and the issuance of $200,000 of bonds for the purpose.

Missouri.

✣Bids will be received until March 7, by Board of County Commissioners, Rockport, Mo., for the construction of two steel high truss bridges, 90 ft. long, on steel foundations, to be erected across the new ditch now being constructed by the Phelps City Dyke and Drainage District. Certified check for $500 must accompany each bid. W. E. Shandy is Highway Engineer.

It is reported that the Manufacturers Ry. has under consideration the construction of an additional bridge over the Mississippi River in South St. Louis. John J. Baulch, St. Louis, Mo., is Superintendent of the company.

Nebraska.

◉H. F. Ward & Co., of Tecumseh, Neb., have been awarded the contract by the County Commissioners at Minden, Neb., for the construction of bridges in Kearney county during 1911. Bids were opened Feb. 14.

◉Advices from Beatrice, Neb., state that the County Board has awarded the contract for the construction of bridges to the Standard Bridge Co., of Omaha, Nebr.

In regard to the stock company formed, as mentioned in our last issue, to build a toll bridge across the Platte River near Ashland, we are in receipt of information stating that as proposed the bridge will be 950 ft. long, being built of part steel and pile. Subscriptions amounting to about $11,000 have been made and it is believed that the contract will be advertised within the next two weeks. F. E. White, Cashier Ashland National Bank, Ashland, Nebr., is interested.

◉The Board of County Supervisors, Kearney, Nebr., has awarded the contract for bridge and repairs to W. C. Gibson, Loop City, Nebr. J. W. Higgins is Commissioner of Bridges.

◉The County Commissioners, Plattsmouth, Neb., have awarded the contract for the construction of the county bridges to the Nebraska Construction Co.

New Jersey.

◉The Owego Bridge Co. has been awarded a contract for the erection of a concrete and iron bridge over the Salem Creek at Woodstown, N. J., on the line of the proposed new state road from Mannington Hill to the Borough.

The American Bridge Co., of New Jersey, with a home capital stock of $10,000,000, was recently licensed to do business in Missouri, employing $150,000 of its capital at St. Louis

New York.

✣Bids are asked until 11 a. m. March 6, by Edward A. Forsyth, Chairman Supervisors, White Plains, N. Y., for the construction of two reinforced concrete bridges over the Bronx River, between the city of Yonkers and the villages of Bronxville and Tuckahoe.

At an election to be held at West Seneca, N. Y., in the near future, a proposition will be voted upon to build a new bridge over the Cazenovia Creek on Union Road, cost of which is not to exceed $12,000.

The Town and Village boards of Lancaster, N. Y., have taken up the matter of constructing a new bridge over Cayuga Creek at Aurora St. and the county engineer will be interviewed.

North Carolina.

Commissioners of Mecklenburg County, at Charlotte, N. C., have under consideration the construction of a substantial bridge over the river at Sloan's Ferry and are awaiting the action of the commissioners of Gaston County in regard to the matter.

North Dakota.

◉The Board of County Commissioners, Dickinson, N. Dak., on Feb. 7 awarded the contract for steel frames for bridges needed in Stark County during the season of 1911, to A. Y. Bayne & Co., Minneapolis, Minn. The structures range from 12 to 32 ft. in length with 18 ft. roadways. J. L. Hughes is County Auditor

Ohio.

✣Bids are asked until March 6, by W. H. Nylander, County Auditor, Port Clinton, O., for the construction of a draw bridge.

◉The Board of County Commissioners, Washington C. H., O., has awarded the following contracts for the construction of steel bridges over Paint Creek and over Rattlesnake Creek; bids opened Feb. 13: Oregonia Bridge Co., superstructure, $2,185, and the Champion Bridge Co., substructure, $2,895; Bell & Blade, of Washington C. H., O., substructure, $1,951, and R. M. Byrd, of Bloomingburg, O., superstructure, $994. A. E. Henkle is County Auditor.

The advertising for bids for the removal of old houses on both sides of Lock St. by Director of Public Service, Cincinnati, O., is considered the first step toward the construction of the Gilbert Ave. viaduct

Oklahoma.

The Santa F [illegible] was to renew their bridge No. 51 on the Eastern Oklahoma Division at an estimated cost of $84,000. A. F. Robinson, Chicago, Ill, is Bridge Engineer of the System

Oregon.

It has been rumored in Salem, Ore., that a bill has been [illegible] permission to the Salem Falls City & Western R. R. to construct a $100,000 bridge across the river at Salem, Ore. S. B. Taylor, Dallas, Ore., is Chief Engineer of the company.

Pennsylvania.

✣The work of widening and improving the Chestnut St. bridge over the Schuylkill River, Philadelphia, Pa., consists of removing the present paving and floor plates of the two 185 ft. deck spans, constructing a new deck with buckled floor plates and overhanging sidewalk brackets; also constructing on the west approach retaining walls, each 550 ft. long, reinforced concrete overhanging sidewalks on steel beam cantilever brackets, also repaving with granite block and asphalt; also new cut granite parapets on abutments and piers, and new iron railing throughout. Bids will be opened March 9, at noon. All bids must be for the whole work complete. Bids for separate portions will not be considered. The appropriation for the work is $90,000. George S. Webster is Chief Engineer and Surveyor of Bureau of Surveys, Philadelphia.

◉The contract for replacing the Cherry ford bridge over the Lehigh at Treichler's was recently awarded by the Commissioners of Northampton and Dehigh Counties to Pasco Construction Co., of Easton, Pa., at $36 per M ft. of new lumber.

Advices from Reading, Pa., state that the Pennsylvania R. R. has ordered plans for a concrete arch bridge to replace the present reverse curve steel structure on the Schuylkill Valley Division over the Schuylkill River at Manayunk. There are, however, no prospects for the immediate construction.

Advices from Wyndmoor, Pa., state that the commissioners of Springfield township are to confer with the officials of the Philadelphia & Reading Ry., in an effort to secure the widening of the bridge on Church Road east to conform with the improvement plans now under way.

South Carolina.

An election will be held March 14 by the citizens of Columbia township at Columbia, S. C., to vote on the proposition of issuing bonds amounting to $75,000 for the construction of free bridges.

South Dakota.

✣Commissioners of Davison and Hanson Counties, according to advices from Mitchell, S. Dak., have finally reached a definite agreement in regard to the division of cost of constructing a new county line bridge over the Jim River, whereby Davison County will pay 60 per cent and Hanson County 40 per cent. The structure, which will be of steel or reinforced concrete, will be erected this summer and bids for the work will be received until April 5. Mitchell, S. Dak., is County seat of Davison County.

Tennessee.

Boards of Aldermen and Councilmen, Chattanooga, Tenn., have passed the McCallie Ave. viaduct ordinance and the Mayor and City Attorney are looked upon to push the matter to some definite close.

Utah.

A petition has been received by the State Senate, Salt Lake City, Utah, asking for the construction of a bridge in Washington County. St. George, Utah, is County Seat of the county.

Virginia.

✣Bids are asked until March 6, by Board Public Roads, W. A. Harris, Secretary, Spottsylvania, Va., for construction of four steel bridges with cement head walls. A. F. Brown, Fredericksburg, Va., is Engineer.

◉The Roanoke Bridge Co., of Roanoke, Va., has been awarded the contract by P. St. J Wilson, State Highway Commissioner, Richmond, Va., for the construction of a steel bridge over the Meherrin River in Brunswick County, near Hilton, for $1,955 Bids were [illegible] Feb. 15

The Norfolk & Western R. R. has appropriated $250,000 to cover the cost of converting the bridge at Kenova into a double track

✣ indicates work now open for bids ◉ indicates a contract let recently.

structure. F. P. Turner, Assistant Division Engineer, Norfolk, Va., is in charge of the work.

Wisconsin.

✣Bids will be received until 5 p. m., Feb. 23, by Fred S. Norcross, City Clerk, Menominee, Mich., and John Moore, City Clerk, City of Marinette, Wis., for furnishing the material and doing the work in constructing a bridge across the Menominee River between said cities, from the foot of Hattie St. in Marinette, Wisconsin, to a suitable point on the opposite bank of said river in the City of Menominee immediately east of the west line of Section 3, Township 31 north of Range 27 west, in accordance with plans and specifications therefor now on file with the City Clerk of the City of Menominee and the City Clerk of Marinette. The structure will consist of seven spans and will be 575 ft. long.

City engineer of Chippewa Falls, Wis., is reported to have filed plans and estimates of a bridge to span the river below the dam but the council is delaying the matter to see what action will be taken by the C. L. & B. Co. The plans for the three bridges call for steel or concrete. The line for the lower bridge is through the company's holdings and across the river to A. St., where the old bridge stood before the flood. The cost of the concrete structure is estimated at $90,000 and steel from $56,675 to $65,500.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

A bill is to be presented to the Arkansas Legislature asking for an appropriation of $2,000,000 for the building of an efficient levee system for the St. Francis Basin.

Extensive levee work is proposed for Miller County, Arkansas, and Bowie County, Texas. The work on the Arkansas side will cost about [illegible] and the work on the Texas side will cost about [illegible]. Engineer Geo. McFathton, Texarkana, Tex., is reported to be in charge.

The Crawford County Levee District, E. L. Matlock, Secretary, Van Buren, Ark., has sold the $175,000 bond issue and it is believed that work will be started shortly on the levee. A number of contractors with their engineers have gone over the partially constructed levee and it is expected that the district will be able to let the contract within a short time. By the elimination of all that part of the district east of Frog Bayou by a bill introduced and passed by Representative George Wagoner, the length of the levee has been materially shortened and with the work done two years ago, beginning at the corporate limits of Van Buren, it is expected that the commissioners will have but little trouble in completing the work in time to protect this year's cotton crop.

Illinois.

✣F. C. Morgan, Vincennes, Ind., at 19¾ cts. per cu. yd., was the only bidder Feb. 18 for the construction of ditches in Mint Creek Drainage District. This bid was rejected and new bids will be received until March 15. The work to be done consists of excavating about 3½ miles of open ditches, 4 to 6 ft. wide at the bottom, 16 to 24 ft. wide at the top and 5 to 9 ft. deep, estimated at 50,000 cu. yds. of excavating. The location of this work is two miles west of Falmouth, the nearest station, on the I. C. R. R., and seven miles northwest of Newton, the nearest station, with livery facilities, and the county set of Jasper County, Ill. For further information address S. A. Conner & Son, Engineers, Newton, Ill.

Bids were opened Feb. 3 at Peoria, Ill., by the East Peoria Drainage and Levee District for the construction of 165,500 cu. yds. of levee and muck ditch and 64,700 cu. yds. of drainage work. We are advised under date of Feb. 16 that the Federal Construction Co., Beardstown, Ill., and R. H. & G. A. McWilliams, Steger Bldg., Chicago, Ill., were the bidders on the work. Contract had not been awarded at that time.

Iowa.

⊙Bids were opened Feb. 15 at Fort Dodge, Ia., by the County Auditor, for the construction of open work on a ditch and drain in Webster County Drainage District No. 69, the contract being let to J. W. Boyer at 6.67 cts. per cu. yd. The estimated yardage is 545,646.

Kansas.

⊙Jones Bros., Leavenworth, Kan., have been awarded the contract at $110,500 for constructing the Kaw River dikes at Topeka for Shawnee County. The contractors to whom this work was first let failed to put up the bonds within the time limit and the work was relet as noted above.

Louisiana.

✣Bids are asked until 11 a. m., March 17, by Lt. Col. Lansing H. Beach, U. S. Engineer, Room 325, Customhouse, New Orleans, La., for extending the jetties at Southwest Pass, Mississippi River.

Minnesota.

•Bids were opened Feb 16 by L. P. Larson, county auditor, Redwood Falls, Minn., for ditch work requiring about 28,812 cu. yds. excavation, the contract being let to A. C. Miller, Redwood Falls, at 11.95 cts. per cu. yd.

Mississippi.

⊙Bids were opened Feb. 16 by the Board of Drainage Commissioners of Bolivar County, W. W. Boone, Chief Engineer Northern Drainage District, at Cleveland, Miss., for the excavation of drainage canals, the contract for all of the work being awarded to R. H. & G. A. McWilliams, 1600 Steger Bldg., Chicago, Ill. The work to be done is as follows: Holmes Lake—Length 7.2 miles. Average cut 10.2. Bottom widths 10, 14 and 16 ft. Excavation 388,000 cu. yds.

Mound Bayou—Length 8.7 miles. Average cut 8.3. Bottom widths 10, 15 and 20 ft. Excavation 320,000 cu. yds.

Jones' Bayou Cut-off—Length 0.8 mile. Average cut 11.6. Bottom widths 4 ft. Excavation 34,000 cu. yds.

Goose Lake Cut-off—Length 1.7 miles. Average cut 9.3. Bottom widths 10 ft. Excavation 71,000 cu. yds. The bids received were as follows:

HOLMES LAKE.

	Per cu. yd.
W. S. Coleman & Sons, Paragould, Ark.	$0.1100
R. H. & G. A. McWilliams, 1600 Steger Bldg., Chicago, Ill.	.1099
N. C. McGinnis, Bement, Illinois	.0990
O. O. McDonald, Elaine, Ark.	.0993
J. S. Kochtitzky, Cude, Mississippi	.1200

MOUND BAYOU.

W. S. Coleman & Sons, Paragould, Ark.	$0.1375
R. H. & G. A. McWilliams, 1600 Steger Bldg., Chicago, Ill.	.1099
O. O. McDonald, Elaine, Ark.	.0996
J. S. Kochtitzky, Cude, Miss.	.1200

GOOSE LAKE CUT-OFF.

R. H. & G. A. McWilliams, 1600 Steger Bldg., Chicago, Ill.	$0.1099
O. O. McDonald, Elaine, Ark.	.3000
J. S. Kochtitzky, Cude, Miss.	.1200

JONES' BAYOU CUT-OFF.

O. O. McDonald, Elaine, Ark.	$0.4975
J. S. Kochtitzky, Cude, Miss.	.1200
R. H. & G. A. McWilliams, 1600 Steger Bldg., Chicago, Ill.	.1099

The Riverside Drainage District is now being organized, and as soon as the petition is published, as required by law, and approved by the county, it is expected to advertise for bids. There will be about 40 miles of the main ditch and laterals, and the territory embraced in the district will be about 100,000 acres. It is believed that when this district is completed and the benefits shown to the property owners that it will be only a question of a year or two until the entire Black Bayou basin is organized into districts. George Wheatley, Greenville, Miss., is Secretary of the district.

South Dakota.

The Commissioners of Bon Homme County, Tyndall, S. Dak., have ordered the construction of a 10-mile drainage ditch in the southern part of the county.

Memphis and Vicinity.

(REGULAR CORRESPONDENCE.)

⊙The N. C. & St. L. R. R., Hunter McDonald, Chief Engineer, awarded contract on Feb. 4 to W. Brady of Hickman, Ky., for the construction of three miles of new roadway near the latter place. The work will involve approximately 60,000 cu. yds. of earth, according to revised cross sections of the engineers in charge. Work will be begun at once and completed within three months.

⊙J. S. Nichols of Memphis has taken contract for the construction of 101,000 cu. yds. of levee enlargement work just opposite Memphis on the new Government embankment. Jesse is now preparing to establish his camp near West Memphis and move his force of 25 teams on the work without the slightest delay. Jesse has just completed a long drain ditch for the city of Memphis.

H. W. Brennen was the low bidder on the $10,000 tar macadam work to be done on Barksdale Ave., for which bids were opened by Commissioner Low last week.

Bill Troy, Jr., has the agency for a number of employment houses and has opened offices in the new Exchange Bldg., Memphis, where he is at home to all his old contractor friends. Bill says he don't know if he will ever get back into the construction business or not. He believes that the large amount work to be done in this section will enable him to sell much machinery and make good in his new line.

H. P. Streicher of Toledo, who has been so successful in securing city of Memphis work, says he is prepared to "gobble" up anything which may come his way this season. "Streich" has an excellent plant for tar macadam work and knows how to hustle his contracts through to a rapid completion.

Charlie Lawrence has been forced to move his large forces from his Arkansas River work on account of the encroaching high water. Many contractors were of the opinion that the Mississippi River would not get out of its banks this season, but their predictions seem to have been wrong, for from present indications the gauge at Memphis will go 30 ft., which will place the water over the banks at most points where levee work is being done. It is hard, though, to count on the big river, and those contractors are wisest who take no chances but are always prepared before its first January rise.

Ed White of New Orleans passed through the city not long ago and renewed acquaintance with all his old friends. Lewis Kavanaugh and C. D. Smith saw to it that time did not hang heavy on Ed's hands. Ed, by the way, is the head of the large levee firm of Dameron & White, who have built so many miles of Louisiana levees.

Walker Stansell was in town last week for the first time in a year's time. Walker has been so busy in Texas looking after his firm's interest with the Orient road that he has had but little time to visit headquarters. He is looking as chipper as ever and reports Texas as possessing the finest working climate for all-year grinding in the world. Walker Stansell, Jr., accompanied his father, and the two left for San Angelo on the 8th inst.

Contractors in this section are glad to see that the Mississippi has begun to fall and

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

that indications point to a lack of flood water this season. A few of the levee builders report having had to suspend operations so far this season on account of the water, but not many and those that have laid up will be at work again within a week or two.

C. D. Smith is kept pretty busy running between Memphis and New York looking after his interests at both places. In New York Charlie and Ed. Scott of St. Louis are building a million dollar subway, which contract was secured about a year ago.

Turner & Gill have taken sub-contract from H. P. Streicher for the grading of Madison Ave., Memphis, from Cooper to the Parkway. Streicher will do the concrete work and lay asphalt with his own forces.

T. A. Garvin is making preparations to start the big culvert job at Madison Ave. and Springdale. Tom is now finishing a concrete contract for the Memphis Union Station Company.

City Engineer Weatherford, of Memphis, states that if his present plans do not miscarry, we will improve Union Ave. and Springdale Sts. during early spring. These will be two large contracts involving much grading and the laying of many yards of asphalt.

The outfit which L. F. Slaughter has been working at Hickman, Ky., is temporarily laid up at Mound City, Ark., on account of high water.

Chris. Collins was in the city last week from Clarkedale, Ark., where he is building some government levee.

Big Bill Beach, who is superintendent of J. T. Walsh & Bro.'s at Tiptonville, Tenn., is also laid up at that place on account of the river being out of its bank. Bill does not think he will be able to do any work for some time to come.

Wyoming.

The community of ranchmen in the northern section of Sheridan County, Wyo., have organized the Parkman Irrigation District, under the State Irrigation laws of Wyoming, and have voted to issue $150,000 irrigation bonds. The irrigation project consists of diverting the waters of Tongue River at a point in the mountains to the head of the Pass and Twin creeks, to supplement the water supply for the improved and irrigated farms, together with additional lands, aggregating 10,000 acres. Arnold Tschirgi, Sheridan, Wyo., is Engineer in charge

WATER-WORKS

Colorado.

The City Council of Canon City, Colo., contemplates laying a water main to Orchard Park for the purpose of connecting that place with the city water system.

Hiram Phillips, civil engineer, Third Nat'l Bank Bldg., St. Louis, Mo., has been employed to submit plans for the betterment of the Colorado Springs, Colo., waterworks system. The work contemplated is the enlarging of the reservoirs and strengthening of the distributing system.

Georgia.

✣Bids will be received until noon, Feb. 27, by Bond Commission, Gainesville, Ga., for the construction of the new water works and for furnishing material for the same. Plans and specifications may be obtained of City Engineer E. B. Epps. R. D. Mitchell is Chairman of the Commission.

The city of Senoia, Ga contemplates issuing bonds for the construction of a waterworks system.

An election is to be held in Macon, Ga., on March 18 for the purpose of voting on the proposition of purchasing the Macon waterworks at a cost of $699,000.

The town council of Douglasville, Ga., has sold bonds to the amount of $20,000 to J. B. McCrary & Co., of Atlanta, Ga., for the construction of the waterworks system. Work on the plant is to begin at once.

Illinois.

H. Kramer & Co., 730 S. Canal St., Chicago, have submitted a bid of $.11½ per lb. to the Department of Public Works, Chicago, Ill., B. J. Mullaney, Commissioner, for furnishing and delivering No. 1 scrap brass to the water works shops. (Details of proposal pubished in ENGINEERING-CONTRACTING Feb. 8.)

Following are the low bids opened by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering fire brick as noted in ENGINEERING-CONTRACTING Feb. 1: Chicago Fire Brick Co., 138 Washington St., sarage $25; Indiana wire cut, $16.50; McLaughlin Building Material Co., 145 LaSalle St., Mex. Crown, $24.75; Ajax, $19. N. T. Williams Co., 138 Washington St., S. Crown, $25; Standard, $15. Garden City Sand Co., 134 Washington St., Tiger Crown, $29; Indiana wire cut, $17; Wm. E. Dee Co., 108 LaSalle St., Olive Hill, $29.25; Simpson, $17.

Following is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering 200 tons of 99.5 per cent pure pig lead to the various pipe yards $4.65 cwt.: Gardiner Metal Co., 1364 W. Lake St., Chicago. (Detailed specifications in ENGINEERING-CONTRACTING [illegible]

Indiana.

⊙The National Construction Co., of South Bend, Ind., has been awarded the contract by the city of Superior, Neb., for the construction of extensions and improvements to the water works system in that city for $15,200. Bids were opened Jan. 6 by J. C. Robbins, city clerk.

Iowa.

The town of Lost Nation, Ia., will hold an election March 14 to vote on the waterworks proposition. It is the general opinion of the leading citizens that the proposition will carry.

Kansas.

Plans have been made by Mathew Brown of Emporia, Kan., for the laying of 3,850 ft. of 16-in. water main, estimated to cost $13,000. The work will parallel the water main from pumping station to reservoir with 16-in. cast iron pipe. Work will be done by the city. W. J. Reynolds is supt. of water works, Emporia.

Kentucky.

On recommendations of the Armory committee, the Jail committee and the Court House committee, Louisville, Ky., the Fiscal Court has given authority to the members to install a water softening plant at the well in the jail yard. The plant is to have a capacity of 4,000 gals, per hour.

Louisiana.

The city of Houma, La., has purchased a tract of land immediately north of the corporate limits for the purpose of excavating a reservoir for the storing of water. The tract contains about 25 acres, and it is the purpose of the authorities to construct a reservoir to contain about 30,000,000 gals. of water, with the aim of adding a filtering plant

Maryland.

⊙The board of awards, Baltimore, Md., has awarded Clendenin Bros., foot Caroline St., Baltimore, the contract for furnishing and delivering to the water board at its Gay St. yard, Gay and Wolfe Sts., 50 tons, 2,000 lbs. per ton, of Omaha pig lead for 4.74 cts. per lb. Bids were opened Feb. 15. Alfred M. Quick is water engineer.

Massachusetts.

✣Bids are asked until 1 p. m., March 10, by Capt. A. M. Miller, constructing quartermaster, U. S. A., 263 Summer St., Boston, Mass., for the extension of water mains and changes in sewer at Fort Andrews, Boston Harbor, Mass.

Michigan.

⊙The contract for putting in the waterworks system for the village of Homer, Mich., has been let to T. C. Brooks & Sons Co., of Jackson, Mich. The work is to be completed and ready for acceptance [illegible]

Minnesota.

⊙The water board of St. Paul, Minn., has awarded the contract for pumping equipment for the McCarron's lake wells to the Robinson, Cary & Sands Co., of St. Paul, for $26,812. L. W. Rundlett is city engineer.

City Engineer A. F. Rhame, of Red Wing, Minn., has recommended the enlarging of the water mains from the pumping station to the Sorin Hill reservoir so as to make a continuous 12-in. main between the two points.

At a recent special election held in Madison Lake, Minn., it was decided to establish a water plant. It is proposed to have a 60,000 gal. steel tank erected at about 100 ft. above the village. About 3,000 ft. of water mains are to be laid, a small proportion to be 8-in. mains and the balance 6-in. mains.

Mississippi.

✣Bids are asked until March 7 by J. D. Harrell, City Clerk of McComb City, Miss., for sinking an artesian well.

The City Council of Marks, Miss., has voted to issue bonds to the amount of $5,000 for the construction of waterworks and sewerage.

Missouri.

✣Bids are asked by Board of Fire and Water Commissioners, Kansas City, Mo., until March 6 for the building of two fire stations, one to be located at 15th and Bennington and one at 26th and Prospect.

The fire and water board of Kansas City, Mo., has decided to lay a 12-in. water main from Broadway and 62d St., to 75th St., for the benefit of the residents in the Waldo district.

New Jersey.

✣Bids are asked until 2 p. m., March 10, by E. V. Patterson, Borough Clerk, Spring Lake, N. J., for furnishing, delivering and erecting the complete mechanical equipment of an artesian water works plant, comprising the following: Brick pumping station, with boiler house annexed; radial brick stack and foundation; concrete reservoir; concrete building and machinery, foundations and floors, etc.; five artesian wells; two triple expansion, direct-acting pumping engines; one duplex cross-compound steam, two-stage air compressor; one surface condenser, with combined air and circulating pump; one boiler feed pump; two feed water heaters; three return tubular boilers and stack breeching; suction and discharge mains to pumps and reservoir; piping seven artesian wells; conduit from wells to reservoir; removal and resetting old boiler; removal and resetting old air compressor; steam and exhaust connections to boilers and machinery; one Simplex water meter. Jos. L. Sweigard, Engineer, Betz Bldg., Philadelphia, Pa.

New Mexico.

The City Council of Albuquerque, N. Mex., contemplates laying a number of water mains in different streets of the city.

New York.

✣Bids will be received until 3 p. m., March 10, by the City Clerk of Hornell, N. Y., for the construction of an earthen reservoir embankment with concrete core wall and all accesories, together with about three miles of [illegible]

✣ indicates work now open for bids ⊙ indicates a contract let recently.

23,000 cu. yds. embankment; 1,822 cu. yds. concrete core wall, spillway, etc.; one 44-ft. plate girder bridge with solid floor; gate house and valve chambers; 13,200 ft. 20-in. cast iron pipe; 1,845 ft. 16-in. cast iron pipe; 11,500 lbs. cast iron specials, valves, etc. Plans and specifications are on file in the office of A. F. Bannon, Jr., Superintendent Public Works.

North Dakota.

Plans are being prepared for the construction of a new waterworks for the town of Flasher, N. Dak.

Ohio.

C. H. Venner, of New York City, has sold the Urbana, O., waterworks to the city of Urbana for $100,000.

The City Council of Portsmouth, O., has accepted and approved the water commissioner's recommendation for a natural sand filtration plant.

Oregon.

✣Bids will be received until 4 p. m., March 1, by Water Board, Portland, Ore., for furnishing f. o. b. cars Portland, Ore., 200,000 pounds of the best quality Selby Pig Lead. Frank T. Dodge is Superintendent.

✣Bids will be received until 4 p. m., March 1, by Water Board, Portland, Ore., for hauling approximately 10,000 tons of cast iron pipe, specials, gate valves, hydrants, lead and valve boxes from the railroad depot or tracks to points within the city limits designated by D. D. Clarke, Engineer of the Board. Frank T. Dodge is Superintendent.

✣Bids will be received until 4 p. m., March 1, by Water Board, Portland, Ore., for the furnishing and delivering at the East and West Side Warehouses of the following material: 500 cast iron valve boxes for gate valves. Specifications and form of proposal can be obtained by D. D. Clarke, Engineer of Water Board, Portland, Ore. F. T. Dodge is Superintendent.

Pennsylvania.

✣Bids are asked until 8 p. m., Feb. 27, by P. D. Getz, Clerk of Council, Akron, Pa., for the erection of a water plant. Horatio Sands, Akron, Pa., is Engineer.

✣Bids are asked until 7 p. m., March 1, by the Borough Clerk of Coraopolis, Pa., for the following: One 1,500,000 gal. triplex pump; one 150 H. P. gas engine for driving 1,500,000 gal. triplex pump; two 225 H. P. gas engines, to be direct connected, 3-phase alternating current generators; one 75 H. P. gas engine, to be direct connected to 3-phase, alternating currnet generator; two 3-phase alternating current generators, complete with exciters; one 3-phase alternating current generator, complete with exciter; one 5-panel switchboard, complete; one 50-light series luminous or metallic flame arc lamp equipment, complete.

The citizens of Schuylkill Haven, Pa., on Feb. 14, voted to borrow $50,000 for the building of additional reservoirs on the mountains above the town.

The City Council of Wampum, Pa., is endeavoring to secure spring water for the village. It is probable that a reservoir will be constructed on the hill near the village. The cost of this improvement together with the cost of piping the town will be about $10,000.

South Carolina.

An election will soon be held in Cheraw, S. C., to vote on the proposition of issuing bonds to the amount of $70,000 for the construction of a waterworks and sewerage system.

The city of Rock Hill, S. C., has purchased the plants of Martin Maloney of Philadelphia, Pa., consisting of the waterworks, electric light and street car franchises and other rights in the city of Rock Hill. The city will issue bonds to the amount of $100,000 for the purchase of the same.

South Dakota.

✣Bids are asked until 7 p. m., March 20, by F. M. Wright, City Auditor, Gettysburg, S. Dak., for labor and material for constructing water works. Separate bids will be received for (1) furnishing labor and material (except hydrants, valves and tank and tower), (2) furnishing hydrants and valves, (3) furnishing and erecting tower and tank of 40,000-gals. capacity on 100 ft. tower. Tuttle & Pike, Engineers, Shubert Theater Bldg., Kansas City, Mo.

✣Bids will be received until 2 p. m., March 10, by C. A. Sloan, Secretary of the University, Vermilion, S. Dak., for furnishing necessary labor and materials for drilling and constructing an artesian well, approximately 1,500 ft. deep upon the campus of the State University. Each bid must be accompanied by a certified check for $500 payable to the bonds to the amount of $100,000 to pay for them.

Tennessee.

The town of Kenton, Tenn., is preparing to install a waterworks system. A bill has been introduced in the legislature for enabling acts to vote bonds for the improvement.

The town of Dyer, Tenn., is preparing to install a waterworks system. The legislature has been asked for enabling acts to vote bonds for the improvements.

At a recent mass meeting of the citizens of Arlington, Tenn., it was voted to authorize the mayor and board of aldermen to draw a bill for the legislature authorizing the town to float bonds to the extent of not more than $3,000 for a new water plant. W. A. Taylor is Mayor.

Texas.

The city of Caldwell, Tex., will hold an election March 7 to vote on the issuance of bonds in the sum of $6,000 for improvements to the waterworks system. J. A. Grady is Mayor.

⊙The City Council of Georgetown, Tex., has closed the contract for putting in a new pump, engines, dynamo and other electrical attachments with Briggs-Weaver Co., of Dallas, Tex., for $10,500, to put in by June 1. The total improvements will be about $35,000.

Arrangements have been made to lay a new water main in the southern part of Terrell, Tex. The proposed route for the new main begins on West Moore Ave., near the Central High School, and runs south to West End Ave., thence east one block, thence south on Ann St. to West Newton St., thence east to Rockwall Ave., thence south.

The city of La Grange, Tex., will receive bids March 1 for the lease of the waterworks system of the city. H. W. Speckels is Mayor. Lad. V. Vanek is city Secretary.

The Mayor of Belton, Tex., has sold bonds in the sum of $11,000 to the First National Bank of that city. The money will be used to construct a new standpipe and water mains for South Belton.

Property owners of Brownsville, Tex., will vote March 14 on the issuance of bonds of $145 000 for the following purposes: Paving, $80,000; to extend water system, $35,000; to extend electric light system, $12,000; to repair city hall and slaughter house, $3,000.

The City Council of Brady, Tex., will hold an election March 25 to vote on the issuance of bonds to the amount of $40,000 to extend the water system.

The City Council of Georgetown, Tex., has purchased $10,000 worth of engines, a boiler, dynamos and fixtures for the light plant and $7,000 worth of pipe for laying new water mains. A contract will be let for building a power house and laying the pipe. The improvements aggregate about $35,000.

Utah.

The City Council of Gunnison, Utah, has borrowed $15,000 for the improvements to the waterworks system.

The City Council of Park City, Utah, has been informed by the president, J. W. Thompson, that plans and specifications for the new city water system are complete. Bids for the construction of the new system are to be called for as soon as possible.

Virginia.

The town of Luray, Va., has voted to spend $10,000 for an additional water supply for the town. A stream near the summit of the Blue Ridge will be tapped and the water brought across a small intervening mountain to the main leading from the present 10,000,000-gal reservoir which the town is now using.

Washington.

The City Council of Elma, Wash., has adopted a resolution authorizing the employment of an engineer to make surveys of the lines by which water may be brought to the city and give estimates of cost. The distance to the nearest adequate supply of pure water is about two and one-half miles

Canada.

The citizens of Pincher Creek, Alta., on Feb 13, voted against the proposition of granting a water franchise.

The board of control of Montreal, Que., has adopted the report of Chief Engineer Janin, showing that the cost of preparing the filtration plans for the city will be $31,425. The plant, when completed, will cost $1,257,000.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

⊙Sullivan & Long of Bessemer, Ala., have been awarded the contract by the town council of Uniontown, Ala., for the construction of an up-to-date sewer system and sewage disposal plant for that town. The contract price is $17,965. Dud. P. Coleman is mayor. Edgar B. Kay of Tuskaloosa, is engineer. Bids were opened Feb. 13.

Plans have been completed for extending the sewer of the city of Mobile, Ala., by the engineering department, and the same have been presented to the board of public works. The estimated cost of this improvement will be at least [illegible] and the work will have to be left to the voters of the city because of the necessity for issuance of bonds.

California.

The City Council of Fresno, Cal., has passed a resolution providing for the laying of a 12-in. ironstone sewer pipe on Kern parallel to the existing one and organizing district No. 3 for assessment purposes and defining its boundaries.

⊙The City Council of Fresno, Cal., has awarded the contract for the construction of the Belmont annexed district main sewer to Joseph House for $37,900.

Recommendations for the alleviation of flood conditions in Elmhurst by the construction of a $20,000 storm sewer, part of the cost of which will be paid by interested property owners, have been filed with the city council by City Engineer Fred C. Turner, Oakland, Cal.

Connecticut.

The Board of Aldermen of Waterbury, Conn., has amended the bill asking for $100,000 for the building of a trunk sewer in the Naugatuck river so that the sum placed at the disposal of the city for this purpose will be $300,000

Georgia.

✣Bids will be received until 2 p. m., March 7, by Mayor and Council, Rockmart, Ga., for

✣ indicates work now open for bids ⊙ indicates a contract let recently machinery, material and construction of a waterworks and sewerage system for which $35,000 in bonds have been voted and sold. Plans and specifications may be seen at the office of the mayor or the engineers, J. B. McCrary Co., 1311-15 Empire Bldg., Atlanta, Ga.

⊙The Sewer Committee of the City Council of Atlanta, Ga., has awarded the contract for the 1911 assessment sewer work to the Georgia Granite Co.

Idaho.

✣Bids will be received until 8 p. m. March 9, by the City Council of Pocatello, Idaho, for the construction of trunk sewers in accord with plans and specifications on file in the offices of Hering & Fuller, Engineers, New York, and W. A. Samms, City Engineer, Pocatello, Idaho.

Illinois.

✣Bids are asked until 1 p. m. March 3, by W. L. Day, President Board of Local Improvements, Bement, Ill., for the furnishing of the material and the construction of a system of storm sewers and also an out-flow drain for the said village, as follows: Outflow drain open ditch, length, 2,645 ft.; excavation, 6,166 cu. yds; concrete retaining wall, approx., 9 cu. yds. concrete. Sewer proper: 740 ft. of concrete sewer, wall 6 in. in thickness, dia. 48 in., av. cut 8.20 ft.; 1,312 ft. of vitrified sewer pipe, average cut 6.10 ft. (size 36 in.); 1,295 ft. of 27 in. vitrified pipe, average cut 7.20 ft.; 1,511 ft. of vitrified sewer pipe, average cut 5.50 ft. (size 22 in.); 741 ft. of 20 in. vitrified sewer pipe, average cut 5.80 ft.; 2,822 ft. of 30 in. vitrified sewer pipe, average cut 6.17 ft; 1,720 ft. of 24 in. vitrified sewer pipe, average cut 6.59 ft.; 928 ft. of 20 in. vitrified sewer pipe, average cut 6.10 ft.; 685 ft. of 12 in. vitrified sewer pipe, average cut 4.90 ft.; 951 ft. of 20 in. vitrified sewer pipe, average cut 5.26 ft.; 16 manholes; 85 catchbasins. Engineer's estimate of the cost of material and construction is $23,088.

Plans have been made by Frank Pane, of Danville, Ill., for the construction of a sewer system in Hoopeston, Ill., estimated to cost $71,000. The work will include a disposal plant and about two miles of vitrified sewer pipe. The contract will probably be let in April. H. C. Finlye is Mayor.

The City Council of Freeport, Ill., has adopted two ordinances, one for East Freeport, to include a pumping station at an estimated cost of $15,164, the other for West Freeport south of Stephenson St., at an estimated cost of $32,758.

The City Council of Assumption is considering the matter of installing a sewerage system. J. W. Dappert of Taylorville, county engineer of Christian county, is preparing specifications.

The Board of Local Improvements of Dixon, Ill., has adopted resolutions providing for a vitrified tile pipe sanitary sewer along the middle line of Galena Ave., from 7th to 10th Sts., at an estimated cost of $2,201, and for a vitrified tile pipe sanitary sewer in 1st St., Highland St. and 2nd Ave., at an estimated cost of $816.

Indiana.

⊙The Board of Trustees of Bloomfield, Ind., has awarded the contract for an addition to the sanitary sewer system to Daniel Hunter for $2,595. The sewer will be extended along some of the principal streets, including two sides of the public square.

Iowa.

The City Council of Nevada, Ia., has passed a resolution providing for the construction of a sanitary sewer system at an estimated cost of $25,000. Plans and specifications are being prepared by Sam Steigerwald of Boone, Ia.

The City Council of Wapello, Ia., has been petitioned by property owners on Vernon and Franklin Sts. for the establishment of a sewer district. H. G. Vollmer of Burlington has been appointed as engineer.

The City Council of Belle Plaine, Ia., has passed a resolution providing for submitting to the voters at the city election in March the question of the issuance of bonds for $10,000 for sewer outlet and improved water supply and extension of the waterworks system. Plans for the improvement have already been made.

The City Council of Cascade, Ia., has given the contract to make a survey for the proposed sewer system for the city to the Chase Engineering Co., of Clinton, Ia. A survey of the entire town will be taken in order that future extensions of the system may be taken care of. At present it is proposed to build only 4,012 ft., running through the alleys of the main business section of the town. It is estimated that it would cost approximately $4,500 per mile to build the proposed sewer.

Kansas.

A petition has been filed with the city clerk of Hutchinson, Kan., by property owners on 5th and 6th Sts., asking for the construction of a sewer in the alley between those streets from Monroe to Jackson Sts.

The South End Round Table of Wichita, Kan., is circulating a petition for the construction of a sanitary sewer in the district lying south of Harry St. The city council will be asked to build a lateral sewer system between the Arkansas river and the railway tracks south of Harry St.

Kentucky.

The Highland Improvement Club, Louisville, Ky., is taking steps to urge the sewer commission to construct the main sewer in the Highlands. Chas. W. Wheeler, corner Bardstown road and Bonnycastle lane, is interested.

Maryland.

The Mayor of Baltimore, Md., has introduced an ordinance in the city council providing for an appropriation of $15,000,000 for the completion of the sewerage system and the paving of streets on the Buffalo plan

Michigan.

City Engineer Tabor of Muskegon, Mich., has completed the plans for the new "Brewery hill" sewer, draining the Lakeview district of the city. The sewer will run from Frisbie St. to Laketon Ave., through the alley between Lake and Palmer Sts. It will then follow Palmer St. to Davis St.

Mississippi.

McComb City, Miss., will soon install an up-to-date sewerage system and an electric light system.

Missouri.

Plans are being prepared by City Engineer Joe Broaddus of Chillicothe, Mo., providing for the creation of sewer districts in the city.

The Board of Public Works of St. Joseph, Mo., has recommended to the city council the adoption of a resolution directing the legal department to drop the proceedings instituted for the condemnation of a right of way for a sewer through the Fowler tract, situated south of Atchison St. and east of 6th St.

The Council Committee on Ways and Means of St. Louis, Mo., called a public meeting recently to discuss the proposition of residents of the West End to submit to a vote of the people a proposition for a bond issue of $3,500,000 for a River Des Peres sewer at the same time that the proposition for a bond issue of $2,500,000 additional for the free bridge is submitted.

Nebraska.

The city of Gorden, Neb., has voted to issue sewer, electric light and water bonds.

The town of Neligh, Neb., is agitating the question of sewerage. The town council will probably pass a resolution providing for the construction of a system.

New Jersey.

✣Bids will be received until 8 p. m. March 7, by Jacob B. Jones, City Clerk, Bridgeton, N. J., for furnishing all material and doing all work necessary to complete the construction of a sewage disposal works and pumping station, including the necessary piping, grading, etc., together with two cast iron outfall pipes and a cast iron river crossing. Plans may be seen and specifications and forms of proposals obtained at the office of the City Clerk, Bridgeton, N. J., or at the office of Clyde Potts, 30 Church St., New York City.

The City Council of Elizabeth, N. J., has passed an ordinance providing for the issuance of bonds to the amount of $25,000 to continue the work of constructing the intercepting sewer.

The Board of Public Works of Patterson, N. J., has engaged William F. Jones of Little Falls to make borings in Spruce St., and Little Falls turnpike so that the nature of the land can be ascertained before the contracts are given out for the 2nd and 7th ward sewer.

New Mexico.

The Sewer Committee of the City Council of Las Vegas, N. Mex., has perfected plans which will make it possible for the city to build a modern sewer system. The members of the committee are: Colonel M. M. Padgett, Chairman; F. H. Pierce, D. T. Hoskins, T. W. Hayward and C. C. Robbins. K. D Goodall is Mayor.

New York.

✣Bids will be received March 1 by Department of Public Works, of Buffalo, N. Y., Francis G. Ward, Commissioner, for the construction of the following sewers: Construction of a 36, 33, 30, 27 and 24 in. brick; 20, 18, 15 and 12 in. tile sewer in Connelly St., Olympic, Warwick, and Northumberland Aves., between Bailey and Kensington Aves.; construction of a 5½ ft. x 9 ft. brick and stone sewer in Lang Ave. and Texas St., between Bailey and Delavan Aves; construction of a 27, 24 in. brick and 20 in. tile sewer in west side of Elmwood Ave., between Amherst St. and 810 ft. south; construction of a 15 and 10 in. tile sewer in Wende St., between Ferry and Genesee Sts.; construction of a 10 in. tile sewer in Prairie Ave., between Tonawanda St. and southwesterly end of same.

Representative Fitzgerald of Brooklyn, N. Y., has introduced a bill in the House, Washington, D. C., appropriating $93,000 for the construction of a new sewer in the Brooklyn Navy Yard.

It is reported that the citizens of Dansville, N. Y., on Feb. 14, voted in favor of the proposition of installing a sewer system in Mill and Franklin Sts.

A bill has been introduced in the Assembly Albany, N. Y., by Assemblyman Fred W Hammond, Syracuse, providing for the construction of the intercepting sewers in Syracuse by increasing the bonded indebtedness for that purpose from $750,000 to $1,100,000

Bantel & Hartung and William H. Sours were the lowest bidders Feb. 1 at Rochester, N. Y., for the general street sprinkling for 1911. Both firms submitted bids at 48½ per cent of the estimate of $85,889. The other bidders were William Baker, 71 per cent; August Kimmel, 69 per cent.

Engineer A. M. Scripture of New Hartford, N. Y., has practically completed the plans and specifications for the construction of a sanitary sewer system in the territory north of Sauquoit Creek for the City of New Hartford. The district lies between Sauquoit Creek on the north, the West Shore railroad and the Utica city line on the south and west. It will extend up Prospect St. to Higby Ave., at the crossing of the D. L. & W. R. R., and from that point to the Sauquoit Creek

North Dakota.

Plans are being prepared for the construction of a sewer system for the town of Flasher, N. Dak.

The City Council of Jamestown, N. Dak., has been petitioned for the construction of a sewer from Front St., to 5th St., on North 7th Ave., and from 7th Ave. east along 5th St. to connect with the sewer on 6th Ave., and for a sewer on South 2nd Ave., beginning at Milwaukee St., and running three and one-half blocks north, to the alley between 2nd and Main St., then west through the alley to connect with the present sewer on 3rd Ave

Ohio.

[illegible] tion, Cleveland, O., has urged Director Lea [illegible] for their part of the city.

On account of pollution of the Scioto River by the waters of the Town Run and Mill Creek, the state board of health has ordered Marysville, O., to install a sanitary sewerage system and disposal plant to be completed by July 1. The estimated cost of the plant is about $100,000.

Plans have been prepared for the construction of a sewer in Madison road, between Observatory Ave. and Zumstein Ave.; Douglas Ave., from Madison road to N. & W. railroad, and Mooney road from Madison road 250 ft. south, for Cincinnati, O. Edwin Henderson is City Clerk.

A new sewer system is to be installed in the state penitentiary at Columbus, O. Specifications have been prepared for the same.

The city of Bellefontaine, O., has awarded the contract for $75,000 worth of sewerage bonds to Breed & Harrison of Cincinnati. The money will be expended to install a sewerage system.

The Board of Control of Cleveland, O., has awarded the contract to S. Silberman & Co., and G. L. Silberman for the removal of the city garbage during 1911. All scrap iron, brass, zinc, copper and bottles will be sold to S. Silberman & Co. Waste paper, rags, rubber and lead will be sold to G. L. Silberman. The city will receive $.10 less per ton for its waste paper in 1911 than it did in 1910. The new contracts enable the city to dispose of the refuse in an unbaled condition.

The City Council of Cleveland, O., has passed an ordinance providing for the issuance of bonds to the amount of $175,000 for the construction of sewers on Lakeside Ave., from E. 18th St. to E. 26th St., on E. 93rd St., from Kinsman to Buckeye Road S. E., and on Woodhill Road from Quincy Ave. to Buckeye Road S. E.

Oklahoma.

The City Council of Oklahoma City, Okla., has ordered a special election to vote bonds aggregating $125,000 to be used in improving the sewer systems of Oklahoma City. The construction of a septic tank, a treating station and sewer connections in Packingtown will cost $8,000, and sewer improvements in the north part of the city in which several new additions are situated will cost $45,000. The mayor has authorized to include the election in the bond election on Feb. 14, at which time $1,500,000 water improvement bonds are to be voted.

Oregon.

Citizens of Woodlawn, Portland, Ore., recently held a meeting to discuss the advisability of emptying the sewage of that district into Columbia slough. D. G. Stephens was chairman of the meeting.

The Montavilla Board of Trade has approved the plans for the Sullivan's Gulch sewer system, prepared by City Engineer J. W. Morris of Portland, Ore. William DeVeny is president of the board. The system will be constructed by the city of Portland.

The records of City Engineer J. W. Morris of Portland, Ore., show that there was expended in the laying of sewers during 1910 the sum of $905,718.06. The mileage of sewers constructed was 298,345, made up as follows: Twenty-four-in. circular brick and stone, 487 ft.; 66-in. concrete, 1,318 ft.; 62-in. concrete, 2,566 ft.; 60-in. concrete, 887 ft.; 57-in. concrete, 1,017 ft.; 54-in. concrete, 2,490 ft.; 51-in. concrete, 757 ft.; 45-in. concrete, 3,211 ft.; 36-in. concrete, 2,861 ft.; 33-in. concrete, 2,748 ft.; 32-in. concrete, 3,040 ft.; 30-in. concrete, 6,352 ft.; vitrified pipe ranging in diameter from 6 ins. to 24 ins., 544,457 ft.; 39½ ins. by 26 ins. egg-shaped concrete, 556 ft.; 36 ins. by 24 ins. egg-shaped concrete, 4,380 ft. The total mileage of sewers in place Jan. 1, 1911, was 298,345. During 1910 there were issued from the office of the City Engineer 4,574 permits to open streets for the laying of gas, sewer and water mains, and 144 permits for private grading.

Property owners in the district between Patton Ave. and Commercial St., and north from Killingsworth Ave., Portland, Ore., have asked that special district be formed so they can get sewerage at once. The main conduit is to run to the Willamette river. J. W. Morris is city engineer.

Civil Engineer Louis C. Kelsey, Selling Bldg., Portland, Ore., has recommended the construction of a gravity water works system at an estimated cost of $22,913 and a sanitary sewerage system at an estimated cost of $23,503 for the city of Gresham, Ore. Lewis Shattuck is mayor.

The town of Central Point, Ore., contemplates the installation of a sewer system this summer, also water main extension and street paving.

Mayor Fred T. Sanderson and City Engineer Don J. Zumwalt of Klamath Falls, Ore., recently inspected the city with a view of laying out and preparing for the commencement of work early in the spring on Klamath Falls' third sewer unit. In addition to the construction of the third unit several additions are to be made on the first and second units. The third unit is to extend into the eastern part of the city to what is known as the Hot Springs Addition.

Pennsylvania.

An effort is being made by various organizations of York, Pa., led by the Chamber of Commerce, to arouse public sentiment so that the support necessary will be given the movement to have completed the sewerage system.

Dr. Samuel Dixon, State Health Commissioner, has issued notices ordering the discontinuance of the present system of sewage, which drains into the Tacony Creek, near Jenkintown. This practically means the construction of a new sewerage system for the city, which it is estimated, will cost $100,000.

The Allentown, Pa., Chamber of Commerce has asked the city councils to authorize the people to vote on a $1,000,000 bond issue for sewerage.

Property owners in Grier St. and Erie Ave., Williamsport, Pa., are taking steps to induce the city council to order the construction of a sewer in their streets.

Dr. Samuel Dixon, State Health Commissioner, Harrisburg, Pa., has issued notices ordering the discontinuance of the present system of sewage, which drains into the Tacony Creek, near Jenkintown. The installation of a new sewer system for Jenkintown would mean an expenditure of approximately $100,000.

George W. Rockwell, of Sunbury, Pa., was low bidder Feb. 16 at Williamsport, Pa., at $21,000 for the construction of the Penn St. sewer. John R. Munday is Asst. City Engineer.

Busch & Stewart, of Williamsport, Pa., are the probable contractors for the construction of the proposed East End sewer, known as the Grafius Run sewer, in Williamsport, for which bids were opened by the City Council on Feb. 16. The work includes concrete sewer in old bed of Grafius Run, approximately 1,683 ft. in length. The bid was $20,449. John R. Mundy is Asst. City Engineer.

South Carolina.

An election will soon be held in Cheraw, S. C., to vote on the proposition of issuing bonds to the amount of $70,000 for the installation of a sewerage and waterworks system.

Tennessee.

A bill has been introduced, it is reported, in the city council of Nashville, Tenn., to authorize the city to issue and sell $500, trunk sewer bonds.

Washington.

✣Bids will be received until 11 a. m., March 3, by Constructing Quartermaster, Vancouver, Barracks, Washington, for the construction of a sewer, hanholes, house connections, etc.

Wisconsin.

The Common Council of La Crosse, Wis., has voted against the $100,000 sewer proposition. A trunk sewer was to have been constructed on Mississippi St., from 9th to 17th St., thence south to Winnebago. In addition it was planned to connect this main sewer with smaller sewers covering the entire southeastern part of the city.

Plans and specifications have been adopted by the city council of Marinette, Wis., for the street and sewer work which will be done this year. A sewer will be laid on Dunlap Ave., from Katherine to State St., and a new concrete pavement laid on Upper Main, and new macadam on Marinette Ave.

Surveys have been completed preparatory to the installation of a sewer system in the city of Whitewater, Wis.

The City Council of Racine, Wis., has completed the budget for the year 1911, included in which are the following improvements: Sewers—Lockwood Ave., from 9th St. to 12th St., and 9th St., from Herrick Ave. to Lockwood Ave., $8,000; Kinzie Ave., from Graham St. to west city limits, $2,439; Forest St., from Kewaunee St. to the Rapids Road, $3,129; Green St., from Yout St. to Goold St., $48; Rapids Road, from Forest St. to west city limits, $685; Clark and 18th St., $1,483.45; West Blvd., from Wright Ave. to 16th St., $1,011; 12th St., from present terminus to park lands, $260; Linden Ave., west of Harbridge St., $75; Gertrude Ave., from 17th St. to C. M. & St. P. Ry., $150; 16th St. outlet, $3,000; sewer in gully, from Harriet St. to Root River, $4,774; Marquette St., from English St. to Yout St., no cost; High St., from Milwaukee Ave. to Charles St., $137.60; Grange Ave., from 17th St. to C. M. & St. P. Ry., $103.75.

Canada.

⊙The Board of Control of Toronto, Ont., has awarded contracts for the low level interceptor, Sections 1, 2 and 3, as follows: Section 1—The Godson Contracting Co., of Toronto, $13.10 per lin. ft.; Section 2—The Godson Contracting Co., $13.14 per lin. ft.; Section 3—City Engineer C. H. Rust, $18.30 per lin. ft. A. D. Blanchard is assistant engineer of the main drainage works.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Arizona.

✣Bids are asked until March 14 by Salt River Valley Water Users' Association, Chas. A. Van Der Veer, Secretary, Phoenix, Ariz., for furnishing complete f. o. b. cars shipping point, electrical apparatus for use in a plant to be built at the junction of the South and Consolidated canals on the Salt River Project, Ariz. Particulars may be obtained by application to the office of the Salt River Valley Water Users' Association or the office of the U. S. Reclamation Service, Phoenix, Ariz.

✣Bids are asked until March 14 by the Salt River Valley Water Users' Association, Chas. A. Van Der Veer, Secretary, for furnishing complete f. o. b. cars shipping point, two hydraulic turbines with accessories for use in a power plant to be constructed at the junction of the South Canal and the Consolidated Canal, Salt River Valley, Ariz. Particulars may be obtained by application to the office of the Salt River Valley Water Users' Association or the office of the U. S. Reclamation Service, Pheonix, Ariz.

California.

A bill is to be introduced in the State Legislature to appropriate $1,500,000 for the construction of a system of concrete piers and docks from Lombard St. to Powell, embracing fishermen's wharf and other dockage along North beach, at San Francisco.

⊙D. J. Cushman of Petoskey, Mich., has awarded a contract to Carl Johnson of Rhyolite, Nev., for the driving of a tunnel 300 ft. long on the Flapjack property at Lee, Cal. Mr. Johnson recently finished a contract on the same ground.

Colorado.

T. R. Countryman, C. E., Colorado Springs, is making estimates and preparing report on a project for driving another drainage tunnel 500 ft. below the Roosevelt Tunnel of the Cripple Creek Drainage & Tunnel Co.

Advices from Fort Collins, Colo., state that the Laramie-Poudre tunnel, was advanced through Green Mountain, a total distance of 609 tf. during the month of January. The tunnel is being driven through solid granite. During the last four days of January the tunnel heading was advanced 28 ft. for every 24 hours. The drift has now been driven a total of 7,800 ft., 5,600 ft. being on the eastern side of the mountain and 2,200 on the western side. It will probably be completed in less than six months. J. A. McIlwee, the contractor, is working a force of 50 men on this job.

Florida.

✣Bids will be received until 7:30 p. m., March 1, by the Bayboro Investment Co., H. A. Kellam, Secretary, St. Petersburg, Fla., for dredging 100,000 cu. yds. of material at Rayboro.

Georgia.

The Newton Coal & Lumber Co., Griffin, Ga., at $73,863, was the bidder Feb. 7, for constructing the new court house at Griffin, Ga., for Spalding County.

Illinois.

✣Bids will be received until 10 a. m., March 10, by Treasurer, Danville Branch, N. H. D. V. S., Danville, Ill., for furnishing materials, labor, etc., for steam tunnels and equipment at Danville, Ill., branch of N. H. D. V. S.

✣Bids are asked until 2 p. m., March 14, by Maj. C. Keller, U. S. Engineer, Rock Island, Ill., for building and delivering 40 steel dredging pontoons, complete.

The U. S. House of Representatives has passed a bill giving H. S. Green, Edward A. Smith and John J. Hurlburt of Morrison the right to construct a power dam at Lyndon. The movement for a power dam at Lyndon has been worked on for a number of years. The idea being the generation of electric power to be used in Morrison, Lyndon, Erie, Prophetstown and Tampico. It is estimated that the dam and power plant at Lyndon will cost in the neighborhood of $450,000.

Following are the low bids received Feb. 3, 1911, by J. J. Magrady, inspector of school buildings, Chicago, Ill., for furnishing lumber during the year of 1911, to be delivered at work shop, 748 Monroe St., unless otherwise noted: 30,000 ft. 1x4 yellow pine, 1-2 clear-rough, f. o. b. $25 per M, Shead Lumber Co., 279 Dearborn St.; 15,000 ft. 2x4 yellow pine, 1-2 clear rough, f. o. b. $30 per M, Mears, Slayton, 1237 Belmont Ave.; 16,000 ft. 1x10 yellow pine, 1-2 clear, rough, $29 per M, delivered, Shead Lumber Assn., 279 Dearborn St.; 16.000 ft. 1x6 yellow pine, 1-2, clear-rough, $27 per M, f. o. b., Mears, Slayton Lumber Co., 1237 Belmont Ave.; 16,000 ft. 1x12 yellow pine, 1-2 clear-rough, $30.50 delivered, Schultz Bros., 1225 Old Colony Bldg.; 16,000 ft. 1x¼ yellow pine, 1-2 clear-rough, $30 per M, delivered, Lord & Bushnell Co., 1125 W. 22nd St.; 40.000 ft. 1x12 yellow pine, S2S No. 2 com. $18 per M, delivered, Crandall & Brown, 3300 S. Centre Ave.; 20,000 ft. 1x8 yellow pine, S2S No. 1 com. f. o. b. $18 per M, Mears, Slayton Lumber Co., 1237 Belmont Ave.,; 40,000 ft. 1x10 yellow pine, S2S No. 2 com. $18 f. o. b., Crandall & Brown, 3300 S. Centre Ave.; 15,000 ft. 1½ maple, 1-2 clear-rough 12-14-16 ft. lengths, equal quantities, $36 per M, f. o. b., Hetler Lumber Co., 2601 Elston Ave.; 30,000 ft. 2-in. maple, 1-2 clear-rough, $42 per M, delivered, Keith Lumber Co., 14th & Wood Sts.; 15,000 ft. 1-in. birch, 1-2 clear-rough, $42 per M, delivered, Keith Lumber Co., 14th & Wood Sts.; 15,000 ft. 1-in. cottonwood No. 2, all widths and lengths, rough, $21 per M, delivered, Crandall & Brown, 3300 S. Centre Ave.; 15,000 ft. 2½-in. maple or elm, com, and better rough, $26.90 per M, f. o. b., Gillis & Co., 42 Madison St.; 15,000 ft. 1-in. elm, all widths and lengths, rough, com, and better, $27 per M, delivered. Keith Lumber Co., 14th & Wood Sts.; 1,000 pcs. 2x4-16, S4S No. 1 com. hemlock, $17.75, f. o. b., Lord & Bushnell Co., 1155 W. 22nd St.; 100 pcs. 2x6-16 S4S No. 1 com, hemlock, $17 per M, delivered, Lord & Bushnell Co., 1155 W. 22nd St.; 300 pcs. 2x4-12 S4S No. 1 com. hemlock, $16.50 per M, delivered, Lord & Bushnell Co.; 300 pcs. 2x6-12 S4S No. 1 com. hemlock, $16 per M delivered, Lord & Bushnell Co.; 300 pcs. 2x8-16 S4S No. 1 com. hemlock, $17.75 per M, delivered, Lord & Bushnell Co.; 100 pcs. 2x10-16, S2S No. 1 com. hemlock, $18 per M, delivered, Lord & Bushnell Co.; 400 pcs. 2x12-16 S2S No. 1 com. hemlock, $19.50 per M, delivered, Lord & Bushnell Co.; 200 pcs 2x12-12 S2S No. 1 hemlock, $19 per M, delivered, Lord & Bushnell Co.; 100 pcs. 3x12-16 S2S No. 1 com. hemlock, $20.50 per M, delivered, Hines Lumber Co., 2431 S. Lincoln St.; 100 pcs. 3x12-12 S2S No. 1 com. hemlock, $20.50 per M, delivered, Hines Lumber Co., 2431 S. Lincoln St.: 100 pcs. 3x4-16 S4S No. 1 com. hemlock, $18.25 per M, delivered,, Lord & Bushnell Co.; 100 pcs. 4x4-16 rough, No.1 com. hemlock, $19 per M, delivered, Hines Lumber Co., 2431 S. Lincoln st.; 100 pcs. 4x4-16 S4S No. 1 com. hemlock, $19.50 per M, delivered, Lord & Bushnell Co.; 100 pcs. 6x6-16, S4S, No. 1 com. hemlock, $20 per M, delivered, Lord & Bushnell Co.; 5,000 ft. 1x6-16, No. 1 com. white pine, D. B. 2s and center beaded, $28 per M, f. o. b., Hines Lumber Co.; 5,000 ft. 1x6-12, No. 1 com. white pine, D. B. 2s and center beaded, $28 per M, f. o. b., Hines Lumber Co.; 5,000 ft. 1x6-16, No. 1 com. white pine, S4S $28 per M, f. o. b., Hines Lumber Co.; 5,000 ft. 1x4-16 yellow pine clear partition, center beaded, $25.50 per M, f. o. b., Shead Lumber Assn., 279 Dearborn St.; 8,000 ft. 1x4-14 yellow pine clear partition, center beaded, $25 per M, f. o. b., Shead Lumber Co.; 3,000 ft. 1x4-12 yellow pine, clear partition, center beaded, $25.50 per M, f. o. b., Shead Lumber Co.; 25,000 Star-A-Star clear shingles, $2.25 per M, delivered, Hettler Lumber Co.

Indiana.

✣Bids will be received until 1 p. m., April 3, by Board of County Commissioners, Franklin, Ind., for repairing the court house. William B. Jennings [illegible] County.

✣Bids will be received until April 3, by Board of County Commissioners, Franklin, Ind:, for the construction of a new copper roof on the court house. W. B. Jennings is Auditor of Johnson County.

Kansas.

O. C. Wand and A. W. Bitting, Wichita, Kan., are to have a 12-story office building erected at Wichita to replace the 4-story Bitting Bros. building destroyed by fire New Year's day. Plans for a $350,000 structure have been [illegible] work will begin on the building this spring.

Louisiana.

Following [illegible] the city of New Orleans, La., for the erection of the new high school on Esplanade Ave. Reusch Contracting Co., $193,973; John Minot, $194,000; John O. Chisolm, $185,000; Caldwell Brothers, $203,169, F. A. Noullett & Sons, $184,963; James Stewart & Co., $210,900.

Maine.

The Maine Power Co., has applied to the State Legislature for an act of incorporation. The company is to have a capital stock of $1,500,000, and proposes the expenditure of $500,000 on incompleted plant, near Bangor. The incorporators are Arthur B. Leach of New York and L. C. Taylor of Bangor, Me.

Maryland.

⊙The Raymond Concrete Pipe Co. of New York and Chicago has been awarded the contract for the concrete piles and foundations for the new power house of the J. S. Young branch of the McAndrews & Forbes Co. at Baltimore. C. Montgomery Anderson is architect.

Massachusetts.

✣Bids will be received until 1 p. m., March 16, by Capt. A. M. Miller, Constructing Quartermaster, 263 Summer St., Boston, Mass., for the construction complete of a frame addition to ordnance storehouse at Fort Strong, Boston Harbor, Mass.

✣Bids are asked by Capt. A. M. Miller, Constructing Q. M., 263 Summer St., Boston, Mass., until 1 p. m., March 15, for the construction, plumbing, heating, electric wiring and fixtures of one quarter for Co. officers, two quarters for N. C. officers, one quarter for field officers, one addition to post hospital; for the construction, plumbing, electric wiring and fixtures of one fire station, and for the construction complete of one storehouse and shop building at Fort Andrews, Mass.

⊙E. B. Jones Lumber Co. has been awarded the contract by Lieut. George P. Hawes, Jr., Fort Warren, Mass., for delivering at commercial wharf, Boston, Mass., 100 ft. of poplar, 500 ft. of spruce, 200 ft. of white pine, 100 ft. of yellow pine flooring and 10 ft. of round pine lumber for $43.50. Bids were opened Feb. 9.

The Harbor and Land Commission, George E. Smith, chairman, State House, Boston, has asked an appropriation of $100,000 to commence the improvement of the East Boston flats. No part of the $3,000,000 appropriation for the improvements of the tide flats under the terms of an act of last year will be available until a tenant is in sight. In the meantime it is said that it is highly important that the considerable task of filling in the flats be commenced. The commission has accordingly recommended that a bulkhead be built to retain the filling so that the flats may be made ready for pier construction.

Michigan

Delegates representing marine labor organizations associated with dredging operations on the great lakes have submitted to representatives of the dredging owners' association a request for an eight-hour workday.

A petition is being circulated at Menominee, Mich., asking the City Council to take action toward the construction of a public dock.

Minnesota

The citizens of New Ulm, Minn., desire the installation of a gas plant, and the City Council will grant a reasonable franchise to a responsible party for operating a carburetted water or coal gas plant of sufficient capacity for supplying 500 consumers. H. F. Blomquist is City Engineer.

Mississippi

The Peoples' Gas & Oil Co. of Birmingham, Ala., has applied to the City Council of Columbus, Miss., for a franchise to lay its pipes throughout the city. The company is to build a pipe line from the gas fields in Fayette County, Ala., for the purpose of supplying local consumers with natural gas. The route of the proposed pipe line has been surveyed and the work of construction will probably be undertaken shortly.

New Jersey.

⊙The Edison Storage Battery Co., Philadelphia, Pa., at $2,818, has been awarded the contract for furnishing and installing a storage battery at the United States animal quarantine station, Athenia, N. J.

✣ indicates work now open for b[illegible] indicates a contract let recently.

New York

✣Bids are asked until [illegible] by Col. W. M. Black, U. S. Engineer, [illegible] 39 Whitehall St., New York City, for dredging and rock removal in Bronx River, N. Y., and in East Chester Creek, N. Y.

✣Bids are asked until 11 a. m., March 14, as noted in our last issue, by Lt.-Col. J. G. Warren, U. S. Engineer, 540 Federal Bldg., Buffalo, N. Y., for channel excavation, Black Rock Harbor, N. Y. The section of the channel to be excavated is that part of the Black Rock waterway from Ferry St. bridge, Buffalo, to the new Black Rock Shiplock, a distance of approximately 7,440 ft. The excavation requires the removal of sand, gravel, clay, etc., overlying bed rock, and bed rock; also the removal of 5,200 lin. ft., more or less, of timber-crib and stone wall between Black Rock Harbor and the Erie Canal, from the point of beginning thence northerly; small tree growth on the wall; and sunken wrecks of canal boats and scows, remains of old boathouses, landing platforms, mooring piles and like debris on and along both sides of the wall or adjacent thereto; also the removal of the old New York state shiplock located 600 ft. above the new Black Rock Shiplock. The channel is to be excavated to the project width of 200 to 240 ft. at bottom and to the depth of 23 ft. at mean lake level, from the end and in continuation of the 23 ft. channel about 125 ft. south of Ferry St. bridge to 300 ft. above the south end of the concrete walls of the new shiplock. The channel is to be excavated to the depth of 26 ft. thence to the shiplock walls The total estimated quantity of material to be removed to complete the work to be done is 770,000 cu. yds. of material overlying bed rock, 65,000 cu. yds. of bed rock, and 5,200 lin. ft. of wall.

Bids as follow were received Feb. 7, by the State Armory Commissioners, Albany, N. Y., for improvements to the Blauvelt Rifle Range: Proposition No. 1, revolver ranges, magazine, concrete guard wall, sidewalk and steps, from firing plane to existing butts of 200-yd. range, pump house and water supply work—Robt. W McCready, Tuxedo Park, N. Y. $18,500, Frank Besch, Troy, N. Y., $18,782; E. J Doyle, & Co., $18,870; A. T. Essery, Blauvelt, N. Y., $19,508; Peter Keeler Bldg. Co., Albany, $23,099; Richard Hopkins, Troy, N. Y., $25,933. Property line fences—Peter Keeler Bldg. Co., Albany, N. Y., $8,869; American Wire Form Co., N. Y. City, $8,900; Frank Besch, Troy, N. Y., $9.100; Robert W. McCready, Tuxedo Park, N. Y., $9,900; A. T. Essery, Blauvelt, N. Y., $11,500. Steel backstops—Sharon Boiler Works, Sharon, Pa., $11,825; Frank Besch, Troy, N. Y., $13,708; Peter Keeler Bldg. Co., Albany, $14,099; A. T. Essery, Blauvelt, N. Y., $16,740; Robt. W. McCready, Tuxedo Park, N. Y., $18,200. Construction of ice house—James C. Nolan, Albany, N. Y., $1,418; A. T. Essery, Blauvelt, N. Y., $1,450; Robt. W. McCready, Tuxedo Park, N. Y., $1,600; Frank Besch, Troy, N. Y., $1,850· Peter Keeler Bldg. Co., $1,960.

North Carolina.

The Chamber of Commerce of Wilmington, N. C., is advocating a bill to authorize the citizens of Wilmington to vote for a bond issue of $200,000 for the installation of public wharves and terminals, this being a condition precedent before the government will finally provide the desired 30-ft. channel for the Cape Fear River.

Ohio.

✣Bids will be received until 3 p. m., March 30, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Alliance, O.

✣Bids are asked until noon, March 13, at office of clerk of Board of Education, City Hall, Cincinnati, O., for furnishing all materials and doing all work necessary to complete everything embraced in Branch No. 2, under the caption "Reinforced Concrete Work," contained in specifications and shown on plans of the new school building to be erected on the Fourteenth District School lot, located on the northeast corner of Freeman Ave. and Poplar Sts. in the city of Cincinnati, Ohio. Plans and specifications are on file in the office of the architects, Tietig & Lee, No. 711 Lyric theater, or in the office of C. W. Handman, Business Manager, at No. 511 West [illegible] St. in said city of Cincinnati.

Oregon.

✣Bids will be received until noon, Feb. 25, at the office of Whidden & Lewis, Architects, 701 Corbett Bldg., Portland, Ore., for the following works in the west wing of the new court house for the county of Multnomah, Ore.: The wrecking, excavations and foundations; the structural steel and iron work; the granite, terra cotta, brick and concrete; the Bedford stone work; the roofing and sheet metal work; the metal frames, grilles and sashes; the tile partitions, lathing and plastering; the marble work, scagliola and floors, together with such other work as may be called for in the specifications in connection therewith.

Bids were opened Feb. 15 by Smith, Kerry & Chace, engineers, 611 Commercial Block, Portland, for clearing right of way on the Mount Hood Railway & Power Co.'s transmission line across the Sandy River Valley in the north half of Section 1, Township 2, South, Range 4 East, Willamette Meridian. Work to be done is as follows: Clearing approximatelv 22 acres, of which approximately 3½ acres are to be stumped. Product of clearing to be made into cordwood ties and cedar poles and posts. The work is to be completed May 1, 1911

Pennsylvania.

✣Bids will be received until noon, Feb. 28, by Department of Wharves, Docks and Ferries, 555 Bourse Bldg., Philadelphia, Pa., for the mill and shop inspection and testing of all structural steel required for the superstructure of Vine St. pier. Joseph F. Hasskari is Acting Director of the Department.

South Dakota.

The following bids were received Feb. 9 by James S. Parker, Constructing Q. M., Fort Meade, S. Dak., for furnishing the material and constructing steel fences for troop corrals at Fort Meade: Grams & Schummer, Sturgis, S. D., $2,097; Lowith Bros. Iron Works Co., Denver, Colo., $2,045; Perkins Mfg. Co., St. Paul, Minn., $1,698; The Capital Iron Works Co., Topeka, Kas., $1,858.40; St. Louis Wire & Iron Co., St. Louis, Mo., $2,026.40; The Champion Iron Co., Kenton, O., $1,900

Texas.

✣Bids will be received until noon, Feb. 27, by Sanguinett & Staats, Architects, Houston, Texas, for the construction of a 7-story and basement steel fireproof building in Houston, Texas, for the Southwestern Telegraph and Telephone Co. Each bid must be accompanied by a certified check for $2,500.

City of Waco, Tex., has voted to issue $250,000 of bonds for the erection of a municipal light plant.

Bids as follows were received Feb. 11 by Maj. G. P. Howell, U. S. Engineers, Galveston, Tex., for dredging channel between Brazos River and Matagorda Bay, Tex., requiring the removal of 2,166,800 cu. yds. of material, (1) being price per cu. yd. for beginning at Brazos end of channel, and (2) price per cu. yd. for beginning at Matagorda Bay end of channel: Jno. Jacobson, Texas City, Tex., (1) 8.74 cts., (2) 10 1/5 cts. Bowers Southern Dredging Co. of Texas, Galveston, Tex., (1) 9½ cts., (2) 10½ cts. Southern Dredging Co., Mobile, Ala., (1) 14 cts., (2) 16 cts. L. T. Gaylord, Houston, Tex., (1) 15.4 cts. R. A. Perry, Galveston, Tex., (1) 16 cts., (2) 18 cts. Home Dredging Co., Mobile, Ala., (1) 17 cts., (2) 17 cts.

Wisconsin.

⊙James O. Heyworth, 234 Michigan Ave., Chicago, Ill., has been awarded the contract for a large power dam at Prairie du Sac, Wis.

The Clarkson Coal & Dock Co. is to expend about $25,000 this year for improvements and extensions to its docks at Ashland, Wis.

Canada.

✣Bids will be received until 4 p. m., Feb. 24, by Department of Railways and Canals, Ottawa, Ont., for supply of 200,000 barrels of cement. L. K. Jones is Secy. Department.

⊙Smith Bros. & Wilson, Regina, Sask., have been awarded the contract at $50,000 for building the first part of the new Emmanuel College at Saskatoon, Sask.

The city of Hamilton, Ont., S. H. Kent, City Clerk, will receive applications, accompanied by qualifications and testimonials, until 5 p. m., March 15, from Electrical Engineers, for the purpose of preparing estimates of the cost, plans and specifications for a municipal electric power and light system for the city.

TRADE NOTES.

The following recent decisions of the courts of Minnesota should be of interest to manufacturers: In the case of the International Harvester Company of America vs. Charles Cater, the United States Circuit Court at Fergus Falls, Minn., Judge Willard presiding, on Jan. 28th, held that the defense that a company is a "trust" or "illegal combination" is not a good defense, either under the Sherman anti-trust law or under the laws of Minnesota. Cater was administrator of the estate of F. L. Wilkins, deceased, of Marshall, Minn. Wilkins was an agent for the company, and the proceeding was to compel Cater to turn over the proceeds of sales that had been made by Wilkins pursuant to the terms of a commission agency contract; also to recover property and for implements sold to Wilkins. An erroneous account of what was decided in this case on a previous occasion has recently appeared in certain newspapers. They reported the reverse of what was then decided. It has also been decided recently in Michigan, Ind., and Ohio, that a purchaser of an article cannot avoid paying for the property purchased by undertaking to plead the illegality of the contract of purchase and sale. Mr. Justice Holmes, of the Supreme Court of the United States, in one of his recent decisions, said: "The policy of not furthering the purpose of the 'trust' is less important than the policy of preventing people from getting other people's property for nothing when they purport to be buying it."

PROPOSAL FOR WATER WORKS.

Jonesboro, N. C.

Sealed proposals will be received by the Mayor and Board of Aldermen of the Town of Jonesboro, N. C., until 5 p. m., March 13, 1911, for building water works. The work will consist of:

Furnishing 165 tons 6-in. cast iron pipe and 220 tons 8-in. cast iron pipe, together with hydrants and specials.

Laying 4 miles 6-in. and 8-in. pipe and furnishing and erecting a 75,000-gallon tower and tank.

Plans and specifications will be on file at the office of the Clerk in Jonesboro, N. C., and at the Engineer's office in Durham, N. C., and copies of the specifications, form of proposal, etc., may be obtained from the Engineers at Durham, N. C.

No bid will be considered unless accompanied by a certified check for Five Hundred ($500.00) Dollars, which will be returned if the bidder executes contract should it be awarded to him.

The right is reserved to reject any or all bids.

D. H. ARNOLD, Mayor.
W. S. MURCHISON, Clerk.

Engineers:
WHITE & PIATT,
Durham, N. C.

U. S. ENGINEER OFFICE, Room 325, Custom House, New Orleans, La., Feb. 15, 1911.—Sealed proposals for extending the jetties at Southwest Pass, Mississippi River, will be received at this office until 11 a. m., March 17, 1911, and then publicly opened. Information on application. LANSING H. BEACH, Lt. Col., Engrs.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

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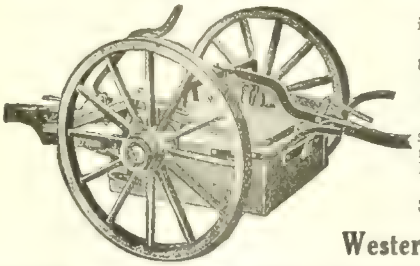

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BIDS FOR SALE AND REMOVAL OF COURT HOUSE BUILDINGS, AT ATLANTA, GA.

Sealed bids will be received and opened by the undersigned at the office of the Commissioners of Roads and Revenues of Fulton County, Ga., at Atlanta, Ga., on Saturday, March 18, 1911, at 10:30 o'clock a. m., for the sale and removal of the buildings belonging to the county, and known as the old Court House, the new Court House and the annex on Hunter street, preparatory to building a new Court House. Bids to cover the removal of all the material used in the construction, as well as the foundations thereof, the ground to be cleared of all the rubbish, debris, etc., within ninety days from the date uopn which the Commissioners notify the bidder that the county is ready for him to begin the work.

Each bid must be accompanied by a certified check made payable to the Commissioners of Roads and Revenues of Fulton County, Ga., for 2 per cent of the amount of bid, the same to be forfeited as liquidated damages in case the bidder fails to enter into contract should the work be awarded to him, and should he fail to make bond as hereinafter provided.

The bidder to whom the contract is awarded shall give bond to said Commissioners, the same to be acceptable to them, in an amount equal to the price of the bid, within ten days after contract is awarded, conditioned upon the faithful performance of contract.

The terms of sale to be cash, or within the time contract and bond is filed and accepted. The right is reserved to reject any and all bids.

Separate bids will be received upon each building upon the same conditions as named above.

All the work to be done under the supervision of and to the satisfaction of A. Ten Eyck Brown and Morgan and Dillon, Associate Architects.

H. E. W. PALMER, Chairman,
CLIFFORD L. ANDERSON,
SHELBY SMITH,
Committee on Public Buildings, Board of Commissioners Roads and Revenues Fulton County, Ga.
H. M. WOOD, Clerk.

Sealed proposals will be received until 12 o'clock noon, March 4, 1911, by Drainage Commissioners District No. 10, F. C. Seiler, Secretary, Mt. Carmel, Ill., R. F. D. No. 4, for constructing a drainage ditch. Excavation 90,000 cu. yds.

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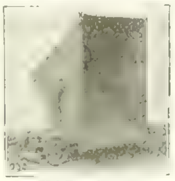

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ARTESIAN WELL.

Sealed proposals will be received by the Regents of Education up to 2 p. m., March 10, 1911, at the office of the Secretary of the University, in Vermillion, South Dakota, for furnishing all materials, tools and appliances, and drilling and constructing an artesian well, approximately 1,500 feet deep, upon the campus of the State University, in the City of Vermillion.

Specifications and forms of proposals may be obtained at the office of the Secretary of the University of South Dakota.

Each bid must be accompanied by a certified check for five hundred dollars ($500.00) payable to the order of Regents of Education, as a guarantee that the bidder will, if successful, promptly execute a satisfactory contract and furnish a bond in the sum of five thousand dollars ($5,000) for the faithful performance of the work. All bids shall be plainly endorsed, stating that bid is for construction of well.

The right is reserved to reject any and all bids.

Dated Vermillion, S. D., Feb. 3, 1911.

IRWIN D. ALDRICH,
Secretary, Regents of Education.

All directions are to be made to C. A. Sloan, Secretary, Vermillion, S. D., and properly marked on outside.

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Some Interesting Examples of the Use of Hydraulic Excavating Methods.

Three interesting examples of the use of hydraulic methods for excavating and moving earth are given in our Earth and Rock Excavation Section this week. The methods described all present some unusual feature, either in the nature of their application or because of their combination with other methods. They all bear testimony of the wide acceptance of hydraulic methods as economic where the conditions are within their limitations. None of the several processes mentioned in the combination as described is new. Hydraulicking is as old as early gold mining in California. Hydraulic pumping is virtually hydraulic dredging and is also old. Screening dredged material is a familiar process in dredging gold-bearing gravels. The combination of these processes and their application to ordinary excavation work as described are the features of novelty.

The account which is given of practice at an Indiana quarry of removing earth overburden by hydraulicking is interesting chiefly for its demonstration that the method may be economic where the quantities handled are not great. The economy of hydraulicking where large volumes of material can be moved has been abundantly proven by works of mining and filling trestles and of dam construction principally in the far West. The cost figures of these works show very clearly how the unit cost decreases as the volume of material to be moved increases. Altogether, it has been natural enough to assume that the economy of hydraulicking exists only in large volume propositions. Truly enough the economy is greater in such large works and where an easily available gravity water supply is had, but they are not the only works where saving is possible. The Indiana quarry work which we describe is an example in proof. The amount of stripping for a season's work in any one quarry cannot be large, but with ordinary good care and protection the life of a hydraulic plant is many seasons and the aggregate of many seasons' work makes a large volume. But aside from any "reasoning out" of the question we have the fact that all through the Bedford-Bloomington quarring district of Indiana hydraulicking has within a few years superseded other methods of stripping and it is general knowledge that the saving possible by the method has made available large areas of quarry rock which formerly it was thought could not be worked profitably because of the cost of removing the overburden.

It is important to note furthermore that the securing of water for this stripping is purely a pumping proposition. Indeed, in the specific quarry described no running water was available—only the ponds formed by the old quarry pits filled by the winter snow and the spring rains. The water of these ponds is used over and over. The supply to the monitors and the pressure is secured by pumping. Truly these facts indicate that the voluminous gravity supplies and the great natural heads which have come to be associated, and [illegible] it may be said, with hydraulicking in the far West, are not inseparable from the successful employment of this process.

In comparison with the work just referred to, the plant for hydraulicking at Panama is of large proportions [illegible] will be observed, is purely a pumping proposition. It is further interesting because of the combination with hydraulicking to break down the material, of [illegible] disposal. To engineers familiar with costs of hydraulicking and hydraulic dredging in the far West, the costs given for the canal work are interesting [illegible] course, that the costs at the beginning of any such work [illegible] has found itself will be higher and the costs [illegible] at Panama [illegible] Pacific Coast, and much Pacific Coast work has been [illegible] Panama.

The third of the articles referred to describes a screening and hydraulic pumping outfit for handling boulder gravel. There are practically no records available of outputs or costs for this plant. The material to be excavated is a mixture of gravel and boulders, and the actual excavation is being done by dipper dredge. The dredge discharges to a screen which removes all stone too large to be pumped, and these large stones are removed by scows. The smaller material is hydraulically pumped to the spoil banks. Obviously all the material, large and small, could be handled by scows, so that the question is: Can the fine material be pumped enough more cheaply than it can be handled by scow to make profitable the introduction of the separate screening and pumping unit? This question can be definitel answered only by actual figures of cost, which are not yet available.

The Railroad Point of View.

After an exhaustive inquiry the Interstate Commerce Commission has decided against the railroads of the East and the Middle West in the matter of a general increase in freight rates. This is the most sweeping decision ever made by that body, and, though it settles for the time being a most important point, it is sure to result in a revival of public interest in the whole railroad question, a question of which the rate case is only a part.

The public as a whole, no doubt, desires to deal fairly with the railroads. It is recognized that there are two sides to the question, and that the whole matter is exceedingly complex. Any fair exposition, therefore, of the railroad side of the question is sure to meet with consideration from the public. In the *Atlantic Monthly* for January Mr. E. P. Ripley, president of the Atchison, Topeka & Santa Fe Ry., discusses the question rather exhaustively. Referring to the criticism to which the railroads have been subjected, and the great mass of railroad legislation, enacted or proposed, Mr. Ripley says:

> Railway managers do not deny that many mistakes have been made and many abuses have grown up in the development and administration of American railways. But they do deny the truth and fairness of many of the counts in the sweeping indictments of the roads that have been made and printed throughout the country, and feel strongly that most of the public hostility to the carriers is unjust. They do not doubt that the public means to be fair. But they feel that it has allowed itself to be misled, to its own injury, by these wholesale charges of wrong-doing. They believe that some of the legislation that has been passed recently is wholesome. But they think that many laws that have been enacted, and many projects for further regulation which are receiving popular support, are unwise, because they aim to do things that are undesirable, or to secure ends the attainment of which would be impracticable even if it were desirable.

As will appear later Mr. Ripley unequivocally supports certain practices of the railroads that have been condemned by the public. But because of the fair-minded attitude assumed in discussing the question we believe his arguments will be of interest to our readers, and for this reason the following brief abstract of his paper is presented:

The constitutional rights of the railways and the constitutional power of the public do not mark the boundaries of their duties to each other. There are many things the railways ought to do for the benefit and convenience of the public that they could not constitutionally be forced to do. On the other hand the public has the constitutional power to compel the railways to do certain things that would not be fair and just to the railways.

The part of the railroad's business that has received the most discussion and regulation is its rates. Both law and sound ethics require rates to be "fair and reasonable"; that is, equitable as between different commodities, shippers and localities, and not exorbitant. As in the case of every general principle, however, the real difficulty is not in the formulation of the principle but in its specific application.

In the matter of rates two widely different theories have been advanced. These theories may be denominated as—

(1) The value of the service.
(2) The cost of the service.

The railroads themselves (and nearly all intelligent students of the question) advo-

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[illegible] There is more difference in the cost of transporting a car of [illegible] and a car of sand, yet it is [illegible] than fair for the automobiles would prohibit the movement of the sand; therefore, the rate on the sand, if moved at all, must [illegible] moving all freight, while the rate on the automobiles must be very largely in excess of the average cost. There is one point regarding this matter that many forget; this is that in all affairs there are two kinds of discrimination. There is the kind which, as the dictionary expresses it, "sets apart as being different," which "distinguishes accurately," and there is the widely different kind which "treats unequally." In all ordinary affairs of life we condemn as "undiscriminating" those who have so little judgment or fairness as not to "distinguish accurately" or "set apart things that are different"—who either treat equally things that are unequal, or treat unequally things that are equal. Now, when the railway traffic-manager "sets apart things that are different," and treats them differently, he simply does what it is the duty of everyone to do. This shows what is meant by basing rates on the "value of the service"—on "what the traffic will bear."

The adjustment of the rates on the various commodities roughly in proportion to the value of the services rendered in hauling them is an imperative condition to the free circulation of the cheaper and bulkier commodities, and in so adjusting its rates the railway simply does its public duty.

Railroad men do not believe that rates ought always to increase in proportion to distance. The policy of the American railways in generally making their rates lower in proportion for long than for short distances—in basing them on the value rather than the cost of the service—has enabled producers throughout a large territory to compete in every market, and consumers to get commodities from every point of production in that territory.

When a railway makes a lower rate for a longer than for a shorter haul, it is usually because it meets controlling competition either by water or by rail at the more distant point, which it does not meet at the nearer point. It could no more afford to make rates proportionately as low to the intermediate as to the more distant point than it could afford to make as low rates on all commodities as it makes on sand. If it quit meeting the competition at the more distant point, the shipper at the nearer point would not be benefited, because he would still have to pay the same rates as before, while the shipper at the more distant point would still be able to get his goods by the competing rail or water line at the same rate as before.

Many discriminations which have consisted in "treating unequally" have been made, and for these the railways deserve condemnation. But unfair discriminations in rates afford the best illustration of the fact that, in order that the railway may do its full duty to the public, the public must do its duty to the railway. Since the original Interstate Commerce Act was passed, there has not been a time when our laws regulating railways have not been so inconsistent and conflicting that railway men could not obey one part of them without violating another part. To abolish unfair discriminations all competing railways must act in concert regarding rates; but under the Sherman Anti-Trust Law any combination of railways in the matter of rates has been held to be an illegal conspiracy.

At the present time less attention is paid to the question of unfair discrimination than to the absolute amount of the rates that should be allowed.

Traffic cannot grow rapidly on excessive rates; and industry and commerce cannot thrive on them. But it is a significant fact [illegible] and industry and commerce have [illegible] in an unprecedented and unparalleled degree on the rates made by American railways. Furthermore, it is conceded by every competent economist who has ever investigated the subject that the rates of our railways are the lowest in the world.

A railway, however, has not discharged its full public duty even when it has made its rates both fair and low. It is also its duty to treat its employes well, and to give good service to the public. That the railways of the United States, while keeping their rates low, have done well by their employes, is amply demonstrated by the statistics regarding the wages paid them. While railway rates have remained almost stationary, railway wages have been increased during the past ten years about twenty-three per cent; and railway employes are today—as, in fact, they have been for years—the highest-paid workingmen in this or any other country.

As to railway service in general in the United States, the great improvements that have been made in it in recent years ought to be sufficient evidence that it will in course of time be made as good as anyone can reasonably ask, if the railways are allowed to charge rates that are reasonably proportionate to the value of the services they render for them.

There are many persons, however, who think that the reasonableness of rates should be measured by some other standard than the value of the services rendered for them. They contend that all a railway is entitled to is a "fair return" on the value of its property; and that a fair return is the current rate of interest.

One of the greatest difficulties in the way of so regulating rates as to limit each railway to a "fair return" is that railways differ as widely as individual men. Some roads are favorably, others unfavorably located. Some managements have great, and others only moderate foresight and ability, and others almost none. To limit the profits of the favorably located and well-managed railways to the current rate of interest would deprive them of the rewards of, and the incentive to, good management.

The railways are beset constantly by demands for improvements in service. The public cannot at the same time get, and ought not to ask, both lower rates and more expensive and better service.

In order to make their service safe, many roads will have to do an amount of work for the strengthening of their tracks which will amount practically to reconstruction of large parts of them, or, in the cases of not a few roads, of all of them. Many other costly improvements ought to be made to render transportation safe.

Railway managers are just as anxious to make their service safe, both for their employes and for passengers, as the public is to have them do so. The main difference between them and those who criticize them is that the railway managers appreciate more keenly the expense that must be incurred, and the difficulties that must be overcome, in making transportation safe.

Many costly improvements are made for the benefit of the public, and not for the profit of the railroads. Such improvements should not be capitalized but should be paid for out of earnings, as they do not produce any revenue. If a railway is allowed to earn nothing over a "fair return" it will have no earnings to invest in such improvements. That the English roads have piled up a capitalization of $314,000 a mile is largely because they have paid for all improvements and betterments out of capital whether they increased earning capacity or not.

If the public can and shall regulate railway profits, it should adopt the policy of letting the railways, or at least the better-managed ones, earn as much to be spent on improvements as they pay out in dividends on a reasonable stock capitalization. If, for example, a road is paying seven per cent on its stock, it ought to be allowed to earn an equal additional amount with which to make improvements. This policy is the one followed by well-managed industrial corporations.*

As for the oft-repeated statements that our railways are over-capitalized. While there are individual cases where this is true, no one can believe that it is generally the case after reading the following figures regarding the capitalization per mile of the railways of our own and other countries: United States, $59,259; Argentina, $59,930; New South Wales, $63,999; Canada, $66,752; Switzerland, $109,000; Germany, $109,788; France, $139,290; United Kingdom, $275,040; England alone, $314,000.

The one point that comes out most prominently in the intelligent discussion of every phase of the railway question is that the duties of the railways and the people, whether in regard to rates, or service, or capitalization, or any other feature of railway policy, are equal and reciprocal. This must always be true while the service of the railways is public and their ownership is private. The public, on the one hand, and the private owners of the railways, on the other hand, have exactly equal rights to demand that each shall give the other a "square deal."

Up to a comparatively few years ago the public did its duty by the railways better than the railways did their duty by the public. The public was amply justified in growing incensed at certain deplorable abuses, and in taking vigorous measures to remedy them. But this does not justify a prejudiced mental attitude, or the passage of numerous laws that are unjust and injurious.

The railways have been bitterly denounced for having at times used corrupt means to prevent the passage of laws injurious to them. The use of such means was ethically indefensible; but the people were largely to blame for it. The people elected corrupt men to the legislatures who introduced measures whose passage would have been injurious to the roads, and the purpose of whose introduction was to blackmail them. The railways all over the country are now trying very hard to avoid entirely the use of improper measures to influence legislation. They have a right to ask that the public shall meet them halfway in this matter. But the blackmailing law-maker still regularly turns up in many of our city councils and state legislatures.

The attitude of the railway managements has been changing. The duty of the railways to the public is now more clearly recognized by their managers, more frankly conceded, and more fully and faithfully performed, than it ever was before. In consequence of these changes, I believe that it can truthfully be said that, whereas up to a few years ago the public did its duty to the railways better than the railways did theirs to the public, the reverse is now the fact; and that the railways have a right to complain that they are now doing their duty to the public much better than the public is doing its duty to them.

Two bills providing for subways in Newark, N. J., are now before the New Jersey legislature. One, known as the Leveen bill, provides for the extension of the proposed high speed line of the Pennsylvania R. R. from Saybrook Place south to the southern apex of Military Park. The other, the McGowan bill, authorizes the city to spend $2,000,000 for subways, without stipulating where they shall be built. It is the understanding, however, they would extend along Market St., between the court house and the Pennsylvania R. R. and along Broad St. from Washington Park to Lincoln Park.

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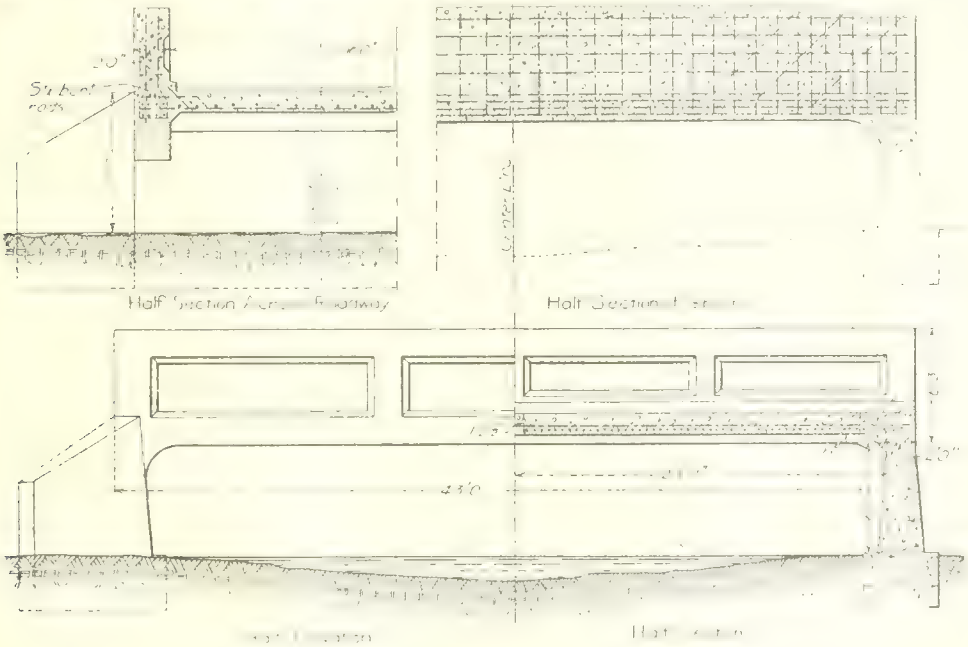
*The reader is referred to an editorial that appeared in "Engineering-Contracting" of June 5, 1910, in which a periodical fixing of rates is discussed.

CONCRETE AND REINFORCED CONCRETE SECTION

An Economical Type of Reinforced Concrete Girder Bridge Used in Clay County, Ind., Highway Work.*

A bridge supported by two reinforced concrete girders to which the floor is hung, has its limitations as to width of roadway and also as to length of span. The usual width of roadway for county highway bridges is from 14 to 18 ft. and I do not think it would be practicable or economy to use this type of bridge for a roadway greater than 20 ft., this bridge is more economical, up to spans of 50 to 60 ft., than arches having the same area of water way and designed to carry the same load. This type of bridge is not so common as the combined slab and beam bridges but it is more suitable for longer spans at locations where it is desired to get as much waterway as possible and not have the grade of the road as high above high water mark as would be necessary with the combined slab and beam bridge.



Details of 40-ft. Reinforced Concrete Through Girder Bridge.

This bridge was designed to replace a steel bridge that gave way under the load of a threshing engine which probably weighed about 7 tons, and it is located across a creek which is in a low, flat valley. The approach or grade is one half mile long. This design was chosen for the location on account of the increased waterway obtained as compared with an arch. The bridge was 16 per cent cheaper and gave 20 per cent more waterway than a 40-ft. span arch which was designed for the same location, using the same loads in each design. The tops of girder bridges are heavier than arches, but as there is no horizontal thrust developed, the abutments do not need to be made as heavy. There is therefore less concrete in the through girder design, than for arches giving the same area of waterway and capable of supporting the same loads. In appearance the girder bridges are massive and well adapted to their purpose and have a pleasing outline.

[illegible] signed for a uniform live load of 150 lbs. per sq. ft. and to be capable of supporting a 20-ton road roller and a dead load of its own weight and a 1-ft. earth fill over the floor slab. The [illegible] obtained by the ordinary principles of mechanics. The girders and floor slab were considered as beams freely supported at the ends. The design is based on ultimate strength with a safety factor of three for the dead load and four for the live load. The elastic limit of the steel was taken as 50,000 lbs. and the ultimate compressive strength of concrete as 2,000 lbs. per square inch. The percentage of reinforcement used was .85 per cent of the area of the concrete.

The specifications provided for any standard brand of American Portland cement which was required to pass the customary standard test, and the gravel used was to be clean and of graded size. The proportions of mixture for the girders and floor slab was 1 part cement to 5 parts gravel, and for the abutments and wing walls 1 to 6. The reinforcing steel was of corrugated bars.

Special care was taken to secure suitable forms and the supports for the girders and floor slabs rested on temporary concrete foundations. The forms were not removed until after a period of 21 days.

The mixing of the concrete was by machine and was what would be called a wet mixture. The placing of the concrete for the girders and floor slab was carried on continuously and completed at one operation in a period of 10 hours.

Design of [illegible] 16 ft. wide, we made our calculations for a slab 12 ins. wide and 16 ft. long. In calculating the dead load we assumed a cubic foot of fill at 100 lbs. and a cubic foot of concrete at 150 lbs.

Weight [illegible]

Weight [illegible]

Total dead load 4,800 pounds

[illegible]

Max. Mom. [illegible]

$=\frac{1}{8}\times300\times16\times16=9{,}600$ ft. lbs.

For the live load on the floor slab we took a 20-ton road roller and assumed that the load was distributed over 8 lin. ft. of the bridge, which gave a load of 5,000 lbs. on the slab considered.

Max. Mom. $\frac{1}{8}Wl$ [illegible]

[illegible] in. lbs.

Using a safety of three for the dead load and four for the live load we had for our designing moment:

Dead load, 3×115,200=345,600 in. lbs.

Live load, 4×120,000=480,000 in. lbs.

Total designing Mom. 825,600 in. lbs

$M=370\ bd^2$ (b=12 ins.).

From said formula we got for *d*, 13.6 ins. Allowing for the concrete below the reinforcement we made the thickness of the slab 16 ins.

Steel reinforcement required=0.0085 *bd*=1.63 sq. ins.

Design of Girders.—The girders calculated for the dead load and a uniform load of 150 lbs. per sq. ft. for the live load which gave a larger moment than a 20-ton road roller. The dead load was,

Girder slab, 2×6.25×40×150=	75,000 pounds
½ floor, 1⅓×8×40×150=	64,000 pounds
Fill, 1×8×40×100=	32,000 pounds
Total dead load	171,000 pounds

Dead load moment=$\frac{1}{8}$W1,=$\frac{1}{8}$×171,000×40=855,000 ft. lbs.=10,260,000 in. lbs.

The live load per lineal foot of girder is 8×150=1,200 lbs. Max. Mom.=$\frac{1}{8}$Wl=$\frac{1}{8}$×1,200×40×40=240,000 ft. lbs.=2,880,000 in lbs

Using the same safety factor as before we had for designing moment

Dead load, 3×10,260,000=30,780,000 in. lbs

Live load, 4×2,880,000=11,520,000 in. lbs

Total designing moment 44,300,000 in. lbs

M=44,300,000=370 bd² (b=24 ins.).

From above d=70.6 ins.

In the design we made d=75 ins.

Steel required=.0085×24×70=14.28 sq. ins.

In the design we used twelve 1¼-in. bars, which gave an area of 14.64 sq. ins.

To take care of the shearing stress in the girders six of the reinforcing rods were bent up in said girders at one-fifth to one-tenth points and U-stirrups were placed in the girders 9 ins. apart at the ends and 18 ins. apart at the center of the girder. In the floor slab every third bar was bent as shown on the plans.

Where the girders join to the abutments the concrete was connected with a circular brace having a 2-ft. radius which gave the girder a better bearing on the abutments and also improved the appearance of the bridge. Large panels 4 ins. deep were placed in the sides of the girder and also at the end. The bridge contains the following amount of concrete:

[illegible]

The total amount of reinforcing steel was 13,658 lbs.

The cost of constructing this bridge was $1,198, which includes the services of a foreman at $5 per day. The gravel cost $1.50 per cu. yd. at the bridge site and the cement cost $1.20 per barrel at the railroad station 5 miles from the bridge site.

We have built five bridges of this type in Clay county during 1910 and they have all proven very satisfactory.

Some Estimates of Cost of Factory Handling of Cement Tile by the Car System.*

The car system of handling cement tile in the factory admits of the highest possible rate of production with the least labor. It is expensive to install, but gives a plant so equipped every advantage

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*A paper before the [illegible] Engineering Society by Frank A. K[illegible] Engineer [illegible] Ind. [illegible]

*A [illegible]

The car system can be installed for about as follows:

100 cars [illegible]	[illegible]
Freight [illegible]	[illegible]
Labor assembling cars, shipped knocked down	[illegible]
Two transfer cars at $25.00	50.00
Freight [illegible]	[illegible]
1,114 ft. of track indoors, 12-lb. rails, for rails, splices and bolts, at 18 cts. per [illegible]	[illegible]
Freight [illegible]	[illegible]
[illegible] ties [illegible]	[illegible]
Labor laying and grading, at $2.00 per [illegible]	[illegible]
One switch, installed	40.00
600 ft. of track in yard, at 18 cts. per ft.	128.00
300 ties, 4"x3'—6", at 7 cts.	21.00
Labor laying and grading, at $2.00 per [illegible]	[illegible]
Freight [illegible]	[illegible]
Superintendence	20.00
Total	[illegible]

Allowing 8 per cent per annum for maintenance and 6 per cent for interest on the investment, we have an annual charge of $41[illegible] against the car system. If we are to compare it with the rack system this charge shows to the disadvantage of the car system. Although the car system requires a larger building, this fact does not operate to further disadvantage because the expense thus involved is offset almost exactly by the cost of the planks, partitions, etc., for the rack method.

Labor—Considering the labor from the time the tile are formed until they are piled in the yard, the car system requires the following number of men:

4, 5 or 6-in., 2 strippers, 1 man to push the filled cars into the curing room and bring up empties, 2 men to unload cars in the yard; total, 5 men.

7 and 8-in. Tile—Above mentioned 5 men and 1 additional to assist with cars and to relieve strippers; 6 men.

10 and 12-in. Tile—Above mentioned 6 men and 1 additional in yard; total, 7 men.

Rate of Production.—A ten-hour run under these conditions should not be attempted on sizes larger than 6 in., for the number of cars here considered is not sufficient unless a small size is run one-half the day and a large size the other half. And, in fact, it would be impracticable to require any crew of men to work on the sizes above 6 in., possibly I might say 8 in., for more than five hours, if the highest rate of production is to be obtained. Under these conditions the following runs have been attained as an average for a season:

	Per Man.
[illegible]	[illegible]
4,[illegible]	[illegible]
4,[illegible]	[illegible]
[illegible]	[illegible]
[illegible]—8" in 10 hours	[illegible]
1,[illegible]—10" in 7 hours	243
1,[illegible]—12" in 5 hours	200

The car system offers a means of accurately counting the tile produced. The man who pushes in the car counts the number of tile on each car and enters it on a card provided him. The count is taken when the car is on the transfer just before it is pushed into the curing room. The record is easily kept if a card 3½x7 in. is ruled off lengthwise into four columns. Head the first column "Number of Tile;" the second column "Track Number;" the third column "Number of Tile," and the fourth column "Track Number." After counting the tile enter the number on the car in column one, and the track number on which it is run into the curing room in column two. Each car can thus be kept on record. At the end of the day the total number of tile manufactured can be footed up exactly and recorded on the office books.

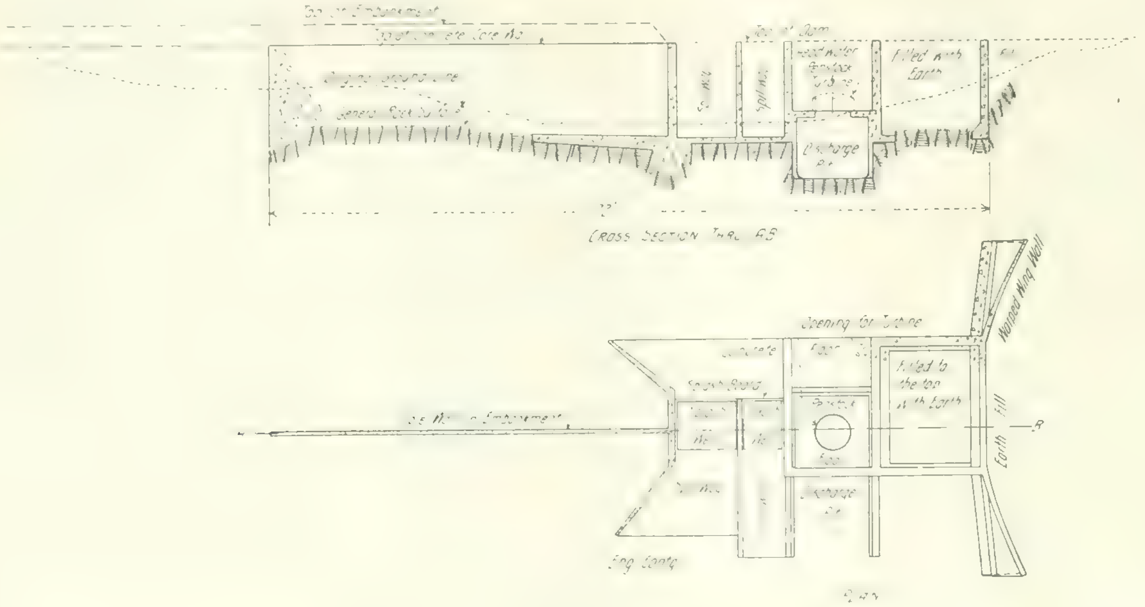
Another advantage of the car system is that the broken tile can be taken off by the man who runs in the cars and the material while fresh returned to the machine.

By recording the position of each car in the curing room it is possible for instructions to be written out each night showing to the yard man just what cars are to be unloaded the next day. With this system there is no danger of running out the tile too green.

Aside from the advantages named we have another of a different type, but one worthy of your attention. It is impossible for a crew of men to work with as good spirit and to accomplish as much in the low ceiling, poorly lighted and poorly ventilated curing rooms, where the rack system is in use, as the same men can do with the car system. In this case the machine is located where the light and ventilation are the best in an open, uncrowded space, and all the heavy work is done there. There is no tiresome walking, no confusion, and all the work is within the superintendent's sight at once. Certainly the greatest efficiency can be attained under such conditions.

The tile once on the car remains untouched until the car is run out into the yard and there it is unloaded. The rack system requires an extra handling of the tile, for it is necessary to take them off the racks and load them onto trucks to be wheeled out to the yard pile. Not only does the car system save this extra handling, but it saves the breakage which goes with it.

The average cost of ocean steamships per ton of capacity is $71. Lake steamers cost $41.50, river towboats and barges suitable for carrying 10,000 tons of freight on 8½-ft. draft, $12, and railway freight cars, approximately $20 per ton of capacity.



General Plan and Section of Small Concrete Dam.

Methods and Cost of Constructing a Small Dam in Nebraska.

Usually the construction of a dam for the purpose of utilizing a 6-ft. head of water at the rate of 60 sec. ft. would not be regarded as being of much interest. The conditions under which just such an installation was made at Hutchison, Neb., however, brought about some features of this class of construction work which made for economy and might be introduced in some larger work with as much success.

The dam makes a 6-ft. head of water at this point and backs up the water in the little stream called "Blue Creek" for a distance of about ½ mile, making a little lake averaging about 300 ft. in width. The dam, which is 72 ft. long, consists of an embankment and a thin concrete core wall about 40 ft. long, and a concrete structure containing the spillway and turbine water wheel compartments. The water wheel is mounted in a wood frame which is supported on the concrete foundation. The spillway was built in two sections, one of which was arranged for controlling the water flow by a flashboard. As the concrete work was of minor importance it will be passed over here.

The location is among the sand hills of northwest Nebraska. The material of which these hills consist is a fine white silicious sand, free from vegetable matter. When dry, the sand drifts before the wind like frozen snow. When it is sufficiently wet it behaves like quicksand. The present stream is fed entirely by springs. Its bed is of quicksand, interspersed with sand and gravel washed by rains from the adjacent uplands, and at some period antedating the sand hills, a river had strewn a mouth of Rocky Mountain gravel over the plain. The entire valley is underlaid with a bed of quicksand which brings all foundation work in water and made it useless to cut a channel for the stream around the site of the dam during construction. The site was located where the stream was underlaid with a stratum of soft magnesian sandstone or solidified quicksand. It was possible to obtain a good concrete sand in a bluff about a mile distant, but no gravel bed was found which was free from the adhering magnesian mud save that in the stream and it was therefore decided to take this material from the stream.

To separate the sand and gravel, a bottomless chute was constructed, 14 ft. long, 4 ft. wide at the discharge end and 8 ft. wide at the upstream or entrance. At the upstream end, panels were fastened at an angle and of sufficient length to confine the flow of the stream and cause a stiff current through the chute. This washed the quicksand from the heavier gravel. It is estimated that from 20 to 50 cu. yds. of sand was washed out to get 1 cu. yd. of gravel. The stream washed out deep holes in this way, piling the gravel up below and washing the sand on down stream. An attempt was made to make the chute move forward automatically, but this was not a success. As soon as the water had washed the sand from the surface of the gravel, erosion stopped and men were put in with rakes to gather the gravel into piles. This method also failed because a large amount of sand was stirred up and the piles of gravel were immediately covered with sand.

A cradle was then devised, consisting of 2x6 in. sides, 2 ft. long and 18 ins. apart. A screen was tacked to the bottom and one end and cross-slats were added to give the necessary strength. Short 6 in. legs were placed near the rear end so as to tilt the screen against the current. The cradle was held in the current, and the gravel was raked in. The operator soon found that a large grain scoop was the best tool for the purpose. He held the screen between his feet and with the long handle of the grain scoop over his shoulder grasped the handle just above the scoop and scraped the gravel into the screen or cradle. Aided by the force of the water he was able to fill the cradle with a single stroke. Then the cradle was rocked a few times on its legs and dumped into a wagon alongside. This method cost about $1.20 per cu. yd. of gravel.

This work was carried on just below the site of the dam and the lowering of the bottom of the stream here materially lowered the water at the dam-site. There still remained at the dam-site, however, some 2 or 3 ft. of material to be excavated to clean off the rock bottom. This rock surface was so rough that it was impossible to scrape it clean, so the hydraulic method was used to wash it clean. Cement sacks were filled with gravel and piled so as partly to dam the stream. In this way a swift current was concentrated on the turbine side of the dam-site and the subsurface rock was washed clear of gravel. Large gravel was washed from cavities 2 and 3 ft. deep and the softer rock was also eroded away leaving the harder rock entirely bare. By rearranging the sacks of gravel the course of the stream was made to cut laterally back and forth so that the washing force cut the surface in all directions. When sufficient area was cleared for the construction of the concrete portion of the dam, the sacks were laid to enclose it. The cofferdam was formed by laying the sacks in a double row to the required height and leaving a space of about 6 ins. between the rows. Alternate pairs of sacks were tied together with wire and the 6 in. space between the rows was filled with turf and peat.

Considerable difficulty was had in finding a suitable water-tight material, as in this district there is no clay, loam, dirt or any of the commonly used water excluding materials. There was finally found in an ancient dried up slough where rushes had grown and fallen into partial decay, material resembling turf or peat. This made a very good watertight joint.

After the concrete work had been completed on this end of the dam the stream was again turned and allowed to go through the narrow spillway while the core wall and embankment section was built. Instead of using the sacks here for the second cofferdam a springy place was found where the sod grew rank and this was used. Removing from 4 to 8 ins. of this sod exposed pure sand. The cofferdam consisted of a double sod wall each 3 sods thick, with the water tight material as a core. The peat gave out before the cofferdam was completed so some of the sod was used. It was chopped up fine and mixed with some of the magnesian muck taken from the bottom of the stream. This made a very good anti-leak compound, and a foot of packing between the sod walls effectively shut out a 6 ft. head of water. All of the sod of the sod cofferdam was left to form a part of the earth embankment except that interfering with the water flow through the larger spillway.

The reinforcing for the concrete work was old tank hoops gathered from the range. There were 183 sacks of Portland cement used. Not including the hauling of material, or the cost of the material itself, the cost of the labor and engineering work was about $150.

Mr. H. A. Mark of Morrill, Neb., was the engineer who designed and had charge of the work and we are indebted to him for the above information.

EARTH AND ROCK SECTION

Methods and Cost of Hydraulic Excavation on the Panama Canal.

The channel of the Panama Canal for a length of about 1½ miles south of the Miraflores Locks calls for the excavation of about 1,500,000 cu. yds. of rock covered with 8,158,000 cu. yds. of earth. To remove these materials by dredging and subaqueous rock excavating methods involved a plant of such size that it could not be assembled for some time and that would be very costly. Investigation indicated that once the rock were cleared of its earth overburden it could be excavated more rapidly by steam shovels than in any other way. Steam shovel plant was not available, however, to strip off the earth as rapidly as the progress required demanded, and, moreover, the swampy nature of the earth made it certain that the maintenance of tracks would be difficult and expensive. To meet the conditions most cheaply and expeditiously it was decided to remove the overburden by hydraulicking and pumping, and then excavate the rock in the dry by steam shovels.

By the method of excavation indicated for removing the overburden two principal operations are involved: (1) Disintegrating the material and washing it to sumps by means of water jets under high pressure; (2) lifting and conveying the loosened material through flumes by means of dredging pumps. The plant required, therefore, consisted of (1) a central pumping station, (2) pipe lines and hydraulic monitors and (3) dredging pumps. Figure 1 shows the layout of the plant and of the various works involved.

Central Pumping Station.—As indicated in Fig. 1, the pumping station is located centrally with reference to the area to be excavated and on the bank of the Rio Grande west of the canal. The building is a light-framed structure divided longitudinally into a pump room 50x100 ft. and a boiler room 40x100 ft. There are four Worthington horizontal, direct-acting, triple-expansion pumping engines with 24-in. stroke, 21½-in. water cylinders, and 19, 30 and 50 in. steam cylinders. Each pump is provided with a surface condenser and a direct-acting, single cylinder 12x20x24 in. vacuum pump. The pumps discharge into a common delivery pipe and are equipped with the necessary check and gate valves.

There are four Babcock and Wilcox standard water-tube boilers arranged in batteries of two each. Each boiler has 4,500 sq. ft. of heating surface and is designed for a working [illegible] heat. They have steel casing and are arranged for using either oil or coal as fuel. A steel smokestack 9 ft. 6 ins. in diameter and 150 ft. high is located between the batteries and connected to them by steel breeching. Fuel oil will [illegible] steel tanks, of 2,000 bbls. capacity each, located on a hill in rear of the station, and will be fed by gravity to the oil burners. Each of the four units is guaranteed to supply 7,500 gals. of water per minute at 150 lbs. pressure, with a boiler efficiency of 95 ft.-lbs. per b. t. u.

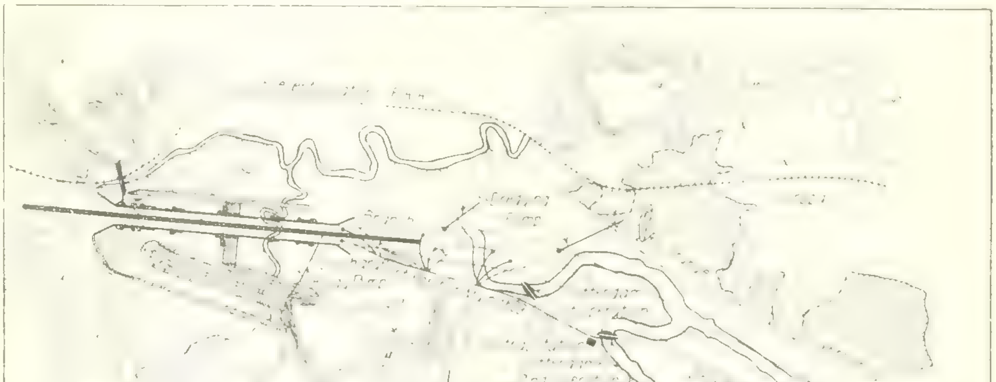


Fig. 1—Map of Section of Panama Canal, Showing Layout of Hydraulic Excavating Plant.

Pipe Lines and Monitors.—The supply main from the pumping station is 3,600 ft. long, made up of 2,000 ft. of 40-in. and 800 ft. of 32-in. lock-bar pipe, and 800 ft. of 24-in. spiral riveted pipe. The pipes are made of Nos. 6, 8 and 10 U. S. gage plates, respectively, in lengths of 30 ft. The main contains five air valves and two [illegible] for connecting the branch lines leading to the monitors; the branch lines are 16-in. spiral riveted pipe, laid in groups of three so that two giants may continue work while the third line is being changed. The hydraulic giants or monitors are fitted with special deflecting nozzles, and are of the improved type manufactured by the Joshua Hendy Iron Works. The main will first be laid north from the station as indicated by the full line on Fig. 1; after completing the work between the locks and pumping station it will be relaid to the south as shown by the broken line.

Dredging Pumps.—There are three 18-in. single-suction, centrifugal dredging pumps, direct-connected to a 655-hp. induction motor. The impellers are made of manganese steel with five blades, and are designed to lift 10,000 gals. per minute of salt water containing 10 per cent of solid matter, and to discharge the same against a head of 60 ft. The motors are Westinghouse standard, designed for three-phase alternating current at 2,080 volts and 25 cycles. Each motor is provided with a starter consisting of seven oil-immersed switches that first connect the motor to a reduced voltage, which gradually increases. Each pump, together with its motor, switchboard, and priming pump, is mounted on a reinforced concrete barge, shown in detail by Fig. 2.

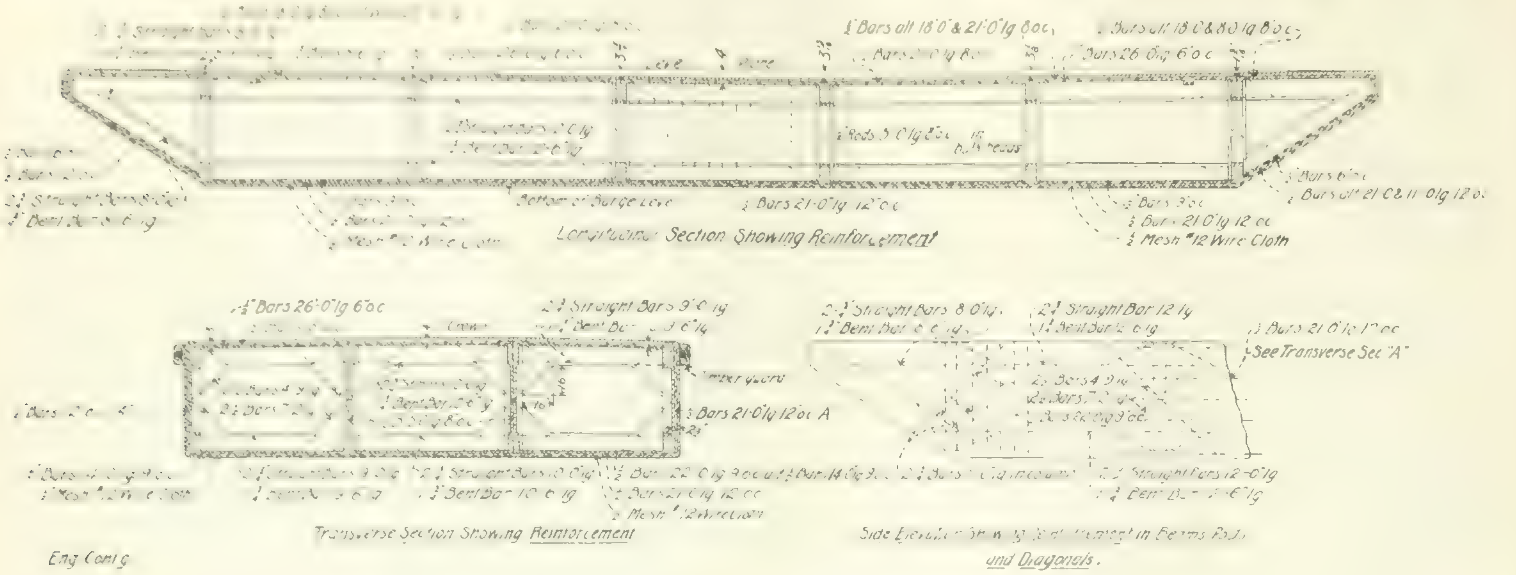


Fig. 2—Details of Reinforced Concrete Barges for Dredging Pumps.

The unusual feature of reinforced concrete construction for the barges was prompted by several considerations. The barges were to be stationed in isolated locations where it was difficult to attend to scraping and painting wooden hulls. Further, materials and facilities were not at hand for wood or steel construction while concrete and reinforcement were available so that less time was required to get concrete barges in operation. Again the building of concrete barges could be done with common labor at 16 cts. per hour under skilled foremen only, while wood or steel would have required skilled men at 54 to 65 cts. per hour. A preliminary estimate indicated that the first cost of a concrete barge would be as follows:

[illegible] bbls. of cement at [illegible]	[illegible]
20 cu. yds. of stone at $1.60	32.00
[illegible] cu. yds. of sand at [illegible] cts.	[illegible]
22,600 lbs. of steel at 3 cts.	678.00
Total	[illegible]

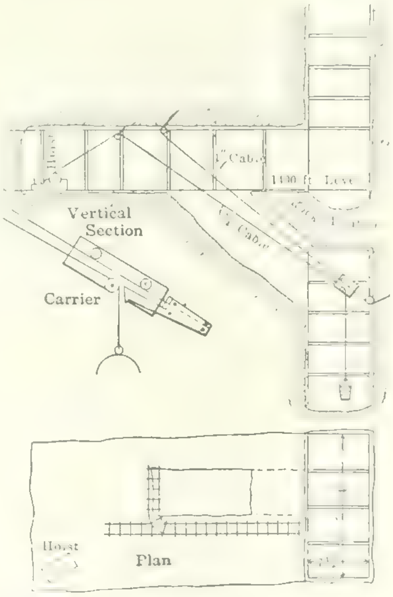
This total compared very favorably with the cost of steel or wood construction under Isthmian conditions.

Method of Operation.—As shown by Fig. 1 a portion of the area to be excavated was originally occupied by the bed of the Rio Grande. The river has been diverted and a dike will be built across the south end to prevent the tide water from flowing up the old bed [illegible] the water remaining in the inclosure will be pumped out until just enough remains to float the barges in the lowest places. The giants will first be operated in the immediate vicinity of the barges so as to lower them to bed rock, thus forming a sump for the suctions of each dredging pump. The regular operation of undercutting and washing the material to the dredging pumps by means of the monitors will then begin, the cutting being extended until there is insufficient slope to sluice the material to the dredging units; the water will then be allowed to rise high enough to float the barges to new positions.

The monitors will have a pressure of 130 lbs. per sq. in. at the nozzle, and there will be three excavating units, consisting of a dredging pump supplied by either one or two monitors as may be found most advantageous for handling the material. The dredging pumps will discharge into flumes and by means of the latter the material will be distributed over the adjacent swamp lands. About 1,000,000 cu. yds. will be pumped into the west dam at Miraflores to form the impervious core, and the elevation is such that a booster pump will be required, which has already been installed. If found advisable after the completion of the dam, this pump may be placed on a barge to form a fourth unit for the channel work.

Cost of Excavation.—During the three months up to Jan. 1, 1911, that the plant described was in operation the amount of excavation and its cost were as follows:

	Oct.	Nov.	Dec.	Total.
Quantities, cu. yds.	40,000	47,444	68,681	156,125
Pumping station	$0.1101	$0.1167	$0.1006	$0.1247
Pipe lines	.0725	.0496	.0495	.0554
Dredging pumps	.0755	.0786	.0873	.0816
Relay pumps	.0002	.....	.0100	.0047
Dykes	.0164	.....	*.0031	.0028
Monitors	.....	.0002	.....	..
Maintenance of equipment	[illegible]	.1805	.0165	.0818
Power	[illegible]	.2384	[illegible]	[illegible]
Plant arbitrary	[illegible]	[illegible]	[illegible]	[illegible]
Division expense	.0132	.0155	.0133	.0140
Total division cost	$0.7971	$0.7595	[illegible]	[illegible]
Admin. and general expenses	.0437	.0625	.0366	.0463
Total cost	$0.8408	[illegible]	[illegible]	[illegible]



Sketch Showing Method of Sinking Underground Shaft.

Method of Sinking an Underground Mining Shaft in Minnesota.

The vertical shaft of the Pioneer mine, Ely, Minn., is being sunk 200 ft. below the 1,400 ft. level, but the work is being carried on, says the *Engineering and Mining Journal*, without interfering with the hoisting of the ore in the main shaft. The accompanying sketch shows the method followed in this work.

A station about 25x60 ft. was cut on the 1,400-ft. level and an inclined winze started near the center of the station. This winze was extended on about a 45° slope until it intersected the line of the main shaft, leaving a rock pentice in the bottom of the shaft just above where the new work was to begin.

After the completion of the winze a 1-in. cable was anchored in the roof of the station and in the side of the shaft extension, as shown. This cable was used as a track upon which a carrier was operated. A small hoist was placed near the farther end of the station, and a 1-ton bucket was used for handling the broken rock.

The bucket is drawn up by a ¾-in. cable until the bail strikes the carrier on the stationary cable. The carrier then conveys the bucket to the station, where it is emptied into a car and trammed by hand to the shaft and hoisted on the man and timber cage, thus not interfering with the hoisting of the ore. The shaft is 7½x24 ft. with four compartments.

The First Rock Tunnel.—The first rock tunnel of which there is any authentic record was achieved about 700 B. C. on the outskirts of Jerusalem. It was built by King Hezekiah and is referred to in II King's XX, 20. It was built through a mass of rock known as Ophel ridge, connecting the spring of Gihon, now known as Mary's spring, with the pool of Siloam. This was the city's only source of water supply and the tunnel was necessary, in time of war, to protect the city from water famine. The distance is 900 ft. on a straight line from the spring to the pool and yet the tunnel is nearly 1,500 ft. long, due to inaccuracies in determining the direction. Many places are to be seen in the tunnel today where headings were abandoned and a start made in a new direction. Both ends were started at the same time and when approaching the middle, the diggers were able to find each other only by the direction of the sound. The workmen had [illegible] of a description now unknown.

A "Turret Nozzle" Monitor for Hydraulicking.

The accompanying [illegible] hydraulic giant or monitor used in stripping rock at the quarry of the Mathers Stone Co., Bloomington, Ind. This quarry is in the famous Indiana oolitic limestone district where within the last few years stripping by hydraulicking has very generally superseded other methods. Incidentally it may be noted that the low cost of this method has made available for quarrying large deposits of rock which the expense of older methods of stripping made it unprofitable to work. At the Mathers quarry the plan of operations is as follows: The depth of quarry stone being 25 ft. an area is cleared sufficient for a season's work, the overlying soil being each year washed into the quarry pit left by the previous season's work. To keep the new and old pits separate a dividing wall of rock is left unquarried. The floor area of the pits is about 100x120 ft.

The equipment employed consists of a 100 hp. boiler delivering steam at 100 lbs. pressure to a compound duplex pump having 10x12-in. and 12x18-in. steam cylinders and 12x18-in. water cylinders, and of 7-in. pipe reduced to 4 ins., with 4-in. flexible joints and a Glazier turret nozzle as illustrated. The location of the plant is clearly shown by Fig. 2. The mode of precedure in stripping is explained by H. A. Woolery, Bloomington, Ind., in a letter as follows:

In front of picture is seen water, it is 30 ft. deep, 120 ft. x 150 ft. and overflows into another hole where is located the pump. Just back of wall, where the channelling machines are cutting the stone, the floor is 120x100 ft. The dirt from this floor was washed into the hole shown in front. Seven feet deep of stone has been cut and quarried off this floor. On the front or face of this floor are seen the openings mad[illegible] The dirt was washed out of these seams at same time it was taken off the top. Back of the floor is the surface of the land. Ten feet from edge of the dirt and over a seam in the rock sets the nozzle at work making the floor larger. It has about finished a section of dirt ready to move back another 10 ft. on the dirt. One man guides the nozzle so as to cut the dirt away at bottom next the stone so that it all falls down into the water and is washed into the hole [illegible]

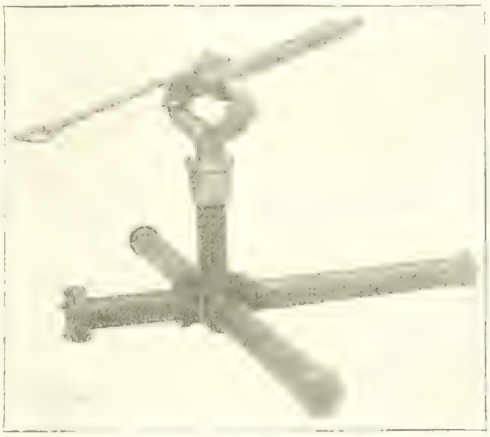


Fig. 1—View of Glazier Turret Nozzle Hydraulic Monitor.

water overflow back to the pump to be used again to knock down more dirt.

The nozzle is moved back each time all the dirt is washed away in front, until all the floor is gone over. Sometimes the seams are not open so as to let the water out. In that case that dirt is left until the stone is quarried away in front then the dirt is washed out. When a floor is quarried off there is left a lot of dirt, spawls used in bedding up a cut of stone in quarrying, cinders, ashes, etc. We get the nozzle behind all this on the floor and sweep all the dirt, spawls, etc., off into the hole making the floor ready for the channellers. The nozzle will push large spawls (some as much as a boy could lift) along the floor until it is all clean. The dirt we have to move is a hard red clay the kind that a man has hard work to drive a pick into. The water knocks it down and beats it up so it washes away in very short time. As is shown, one man is all that is required to guide the nozzle. It takes two to move it with bars. In moving, the pump is shut down, so the engineer helps, to make it easier. The cost of operating is the wages of three men, the coal for boiler and the oil for pump.

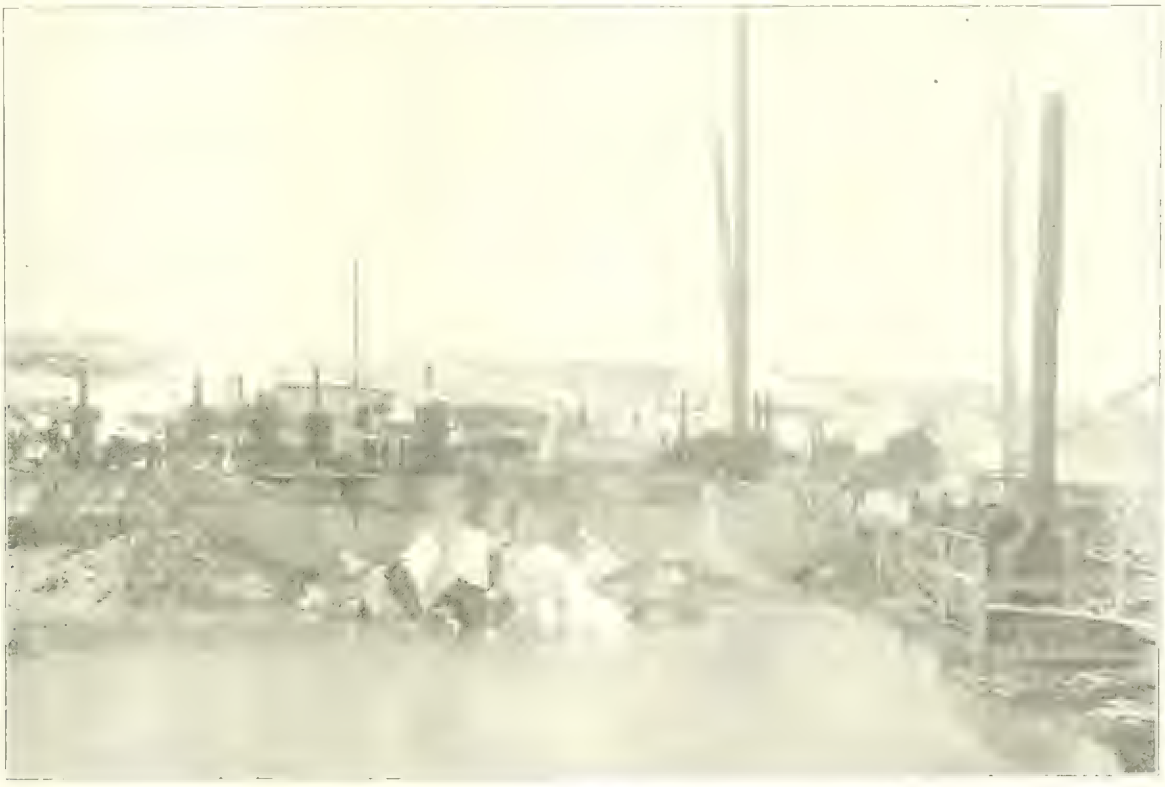


Fig. 2—View Showing Hydraulic Stripping of Quarry Overburden

Some Notes on the Use of Ammonium-Nitrate Explosives.

The use of ammonium-nitrate explosives has, of late years, increased rapidly in Germany and Austria until now their use exceeds that of all others. The reason for this is because most of the German coal mines contain a large amount of fire-damp in which these explosives seem to be the safest. In America their use has not become so universal, but in behalf of new consumers of their explosives who are not well versed in their use and have trouble with misfires, we present some of their peculiarities, and some methods of handling them.

Inquiry shows that misfire is not due to deterioration or unevenness in the quality of the explosive, but to the use of too weak or of poor blasting caps. Deterioration from dampness on account of the hygroscopic nature of ammonium-nitrate can not very well occur if the explosives are packed carefully and are handled with reasonable care. For military purposes where ammonium-nitrate explosives have been in use for a long time for explosive projectile charges, it has been clearly demonstrated that everything depends on the primary activation, and that poor ignition will produce practically no result, whereas good ignition can produce a remarkably high maximum. This is a peculiarity of these explosives, and it depends on the chemical and physical properties of their chief ingredient, ammonium-nitrate. Whereas the smallest spark is sufficient to completely ignite and explode any quantity of ordinary black powder, and dynamite and kindred explosives can be readily and completely detonated by a sympathetic explosion [illegible] due to a slight mechanical impulse, or by heating it too rapidly, ammonium-nitrate explosives proper, act entirely differently.

These explosives are difficult to explode either by impact or friction. When ignited they burn quietly. Their point of ignition is [illegible] all not freeze. The rate of which the explosion wave is transmitted through the explosive increases markedly in these compounds, with the diameter of the cartridge, and for this reason drill holes of greater diameter (1¼, 1½ in. and up) are to be preferred. In drill holes of great length and small diameter, portions of the charge frequently fail to explode. The lowermost cartridges may be powerfully compressed and [illegible] detonated. For this reason also an ammonium-nitrate explosive charge in a drill-hole can rarely be exploded by placing a dynamite cartridge on top of it. On account of the slowness of the ammonium-nitrate compounds, which increase with their density, it is recommended to loosen the charge in the ignition cartridge with the fingers if it has become hard, and not to tamp the main charge in the drill-hole, but to place it loosely.

Up to the present time, fulminate blasting caps are used almost exclusively as detonators for ammonium-nitrate explosives. These are composed either of fulminate with a little potassium chlorate or of a mixture of fulminate and trinitrotoluol. The latter is said to increase the efficiency and at the same time diminish the danger from jar and friction. These caps which are also employed for setting off dynamite must be fairly large (at least 1 g No. 6) for ammonium-nitrate explosives to secure a complete detonation of the charge.

Too much emphasis cannot be laid on the fact that one should not be saving in the size (strength) of blasting caps. Even for dynamite a No. 6 cap is at present used quite frequently instead of No. 3, which was formerly employed. In England a No. 7 cap is generally used for ammonium-nitrate compounds, but in Germany a No. 8 cap is employed almost exclusively. The last number (with a 2 g charge) is to be most recommended; larger sizes offer no aditional advantages. The slight increased cost of the larger blasting caps (the difference in price between caps No. 6 and No. 8 is about $0.21 per 100) is repaid by the better and more certain results and a slight diminution in the weight of the main charge; for larger charges moreover the cost of blasting caps constitutes merely a small fraction of the total cost of the charge. Since the blasting caps are markedly affected by moisture, care must be exercised in storing them in dry places. In practice deteriorated caps are found much more frequently than one would be led to expect; these are still efficient for dynamite, but not for ammonium-nitrate explosives.

There is a very good simple test for blasting caps described in Heyse's book, "Explosives." The blasting caps are placed upright on a piece of soft sheet lead ½-in. thick, and ignited with a Bickford fuse. From the calibre of the hole and the force with which the fragments are driven in a comparative indication of the quality of the blasting cap may be obtained.

Since the initial impact is all-important for ammonium-nitrate explosives, great care must be exercised to see that the uppermost cartridge which contains the ignition cap is absolutely fresh and dry. Even if the main charge should have been damp, it can still be set off by a dry ignition cartridge containing a strong detonation cap, whereas, a moist ignition cartridge or weak detonating cap will fail with a perfect main charge.

Excavating Boulder Filled Gravel by a Combination Process of Dredging, Screening and Hydraulic Pumping.

An unusual combination dipper dredge and hydraulic pumping outfit has recently been put in operation for deepening the Mohawk River, a part of the New York State Barge Canal. The material here contains a large quantity of cobble and boulders which preclude the possibility of handling it entirely by the hydraulic process. To overcome the difficulty a combination of hydraulic and dipper dredging is introduced, an "hydraulic disposal boat" being the medium for separating out the large stones and passing them into scows to be disposed of by the usual dipper dredge method, and at the same time to dispose of the balance of the material through a 20-in. discharge pipe by the usual hydraulic dredging method.

The contractors for the work, S. Pearson & Son, Inc., sunk a series of test pits on the work, as soon as the contract was awarded, to determine the percentage of material which was too large to be handled by the hydraulic method. With this knowledge at hand the Bucyrus Co., of South Milwaukee, designed the plant to suit the purpose. As in the case of some of the ladder dredges installed on the Barge Canal, the builders have adapted to the present use, machinery heretofore employed in gold mining in the West. The mining dredges, however, are usually self-contained, while this disposal boat must be fed by separate dredges.

Two dipper dredges and the "hydraulic disposal boat;"—scows for carrying boulders; a tug for towing the scows; and a small dredge with an orange peel bucket for unloading the scows, constitute the plant, unless one includes the apparatus for building dikes to contain the hydraulic discharge. The dipper dredges are of standard design, having dippers, for this material, of 3 cu. yds. capacity, although the engines are capable of operating 5-cu. yd. dippers in soft clay or sand. The orange peel bucket is of 2 cu. yds. capacity.

The hull of the disposal boat is 110 ft. long, 38 ft. wide and 7 ft. deep. It is intended that the dipper dredges shall operate one on each side, depositing their spoil in a hopper at the forward end of the boat. The hopper consists of two parts, each to receive the output of one of the dredges. Each part is a steel lined table, with raised sides, and sloping toward a central chute. A constant shaking motion, toward and away from the chute, is imparted to the tables and this motion, together with four jets of water at the top of each table, gradually forces the material into the chute, the object being to retard its advance just enough to distribute the load more evenly on the pump that finally puts the gravel and smaller stones ashore. The chute is also steel lined. Here a downward slope and another jet of water moves the material into a revolving screen. This screen is 22 ft. 8¾ ins. long and 6 ft. in diameter, mounted on four friction rollers, two of which are used to drive it. It is made of the best manganese-steel castings, built up of three sections longitudinally, each having five parts to form the circumference. The castings are about 1¼ ins. thick, reinforced by ribs and bolted together. The perforations are 7½ ins. square, with rounded corners. Between the longitudinal sections, baffle rings, 3 or 4 ins. wide, project inward. Beneath the screen is a sump, into which the material passing through the openings falls, aided by a final jet of water introduced at the upper end of the screen. This sump is directly open to the outside water, so that the pump may never suck air, even if its supply of dredged material is too long delayed. The pump itself is set at the extreme stern, connection being made with the sump through a 20-in. suction pipe.

The material rejected by the screen rolls down into a skip, which is suspended from an overhead traveler, the tracks of which extend beyond both sides of the boat the width of the stone scows. One end of this skip may be raised, thus dumping the load from the opposite end into the scows. The dipper arms of the dredges are made long enough to reach the hopper on the disposal boat with a scow between them. The overhang of the dump track for the traveler may be drawn up to a vertical position when not in use.

The boilers are placed amidships. They are of the locomotive type and are three in number, having a combined heating surface of 5,000 sq. ft., each 22 ft. long and 72 ins. in diameter and designed for a working pressure of 200 lbs. Just behind the boilers are the coal bunkers, while the pump and its engine are placed aft. A pilot house stands on the starboard side of the revolving screen. The engineer in this controls the engines beneath him, which operate the shaking tables in the hopper, the screen, and both fore and aft spuds. Another engine, in the house on the opposite side of the screen, runs the 12-in. two-stage, centrifugal pump, which furnishes water for the jets in hopper, chute and screen. Just in front of the boilers and behind the skip there is an engine which operates the skip. By the sides of the boilers are other engines to drive the spools for overhauling scow lines. The chief engine aboard is the one which is directly connected with the large centrifugal pump. This is of the vertical marine type, triple expansion, having cylinders 15, 22 and 36 ins. in diameter and 18 ins. long. It is rated at 750 hp., suitable for 200 lbs. pressure. The boat is also equipped with an electric light plant.

The pump has a 20-in. suction pipe, as has been stated. Its discharge pipe is the same size. The pumping plant is calculated to discharge its material 28 ft. above the water level at a point 1,600 ft. distant, provided no angle in the pipe exceeds 20°. If no more than 5 ft. in elevation is required, the length of the pipe may be increased to 2,400 ft.

The crew for this disposal boat consists of an engineer and an oiler in the pump room, a fireman and a coal-passer in the boiler room, an engineer to run the 12-in. pump, an engineer in the pilot house, another engineer and one or two boys to operate the skip and two or three deck-hands.

It was found that the 7½-in. openings in the revolving screen allowed the fine material to drop through too readily and thus clog these openings, thus overloading the pump for a time and then leaving a period of little or no load. For this reason some large chains were temporarily woven through the openings at the upper end of the revolving screen. It seems probable that the upper third of the screen casting will be replaced by new ones having holes not more than 3 or 3½ ins. square, while those of the lower third will be renewed with casting having openings 10 ins. square. It is considered that the pump will easily discharge any stone to pass these larger perforations.

In designing the several parts of the disposal boat, it was planned to provide capacity for four full dipper loads (12 cu. yds.) every three minutes. As the plant has been in operation but little more than a month, the question of its practical success is still to be answered.

Cost of Mine Haulage.—In the discussion of a paper on mining locomotives before the South African Institute of Engineers Mr. Kenneth Austin, author of the paper says that the cost of operating large European mine haulage systems, which costs include allowance of 10 per cent for depreciation are as follows: (1) electrical overhead wires operating locomotive 1 ct. per ton mile; (2) compressed air locomotive 2.4 cts. per ton mile; (3) benzol locomotive 3.2 cts. per ton mile; (4) electrical accumulator locomotives 3.6 cts. per ton mile. The figures show the electrical overhead wire system to be the cheapest but that it has its disadvantages is apparent, for at Kimberly, the overhead wire system was tried and abandoned in favor of mechanical rope haulages. The electric locomotives gave satisfaction but the total working costs were lower for the mechanical rope haulage on account of the fact that white labor was necessary with the locomotives. The cost of installation of the electric system at Kimberly was about five times as great as for the rope haulage, which was also a determining factor.

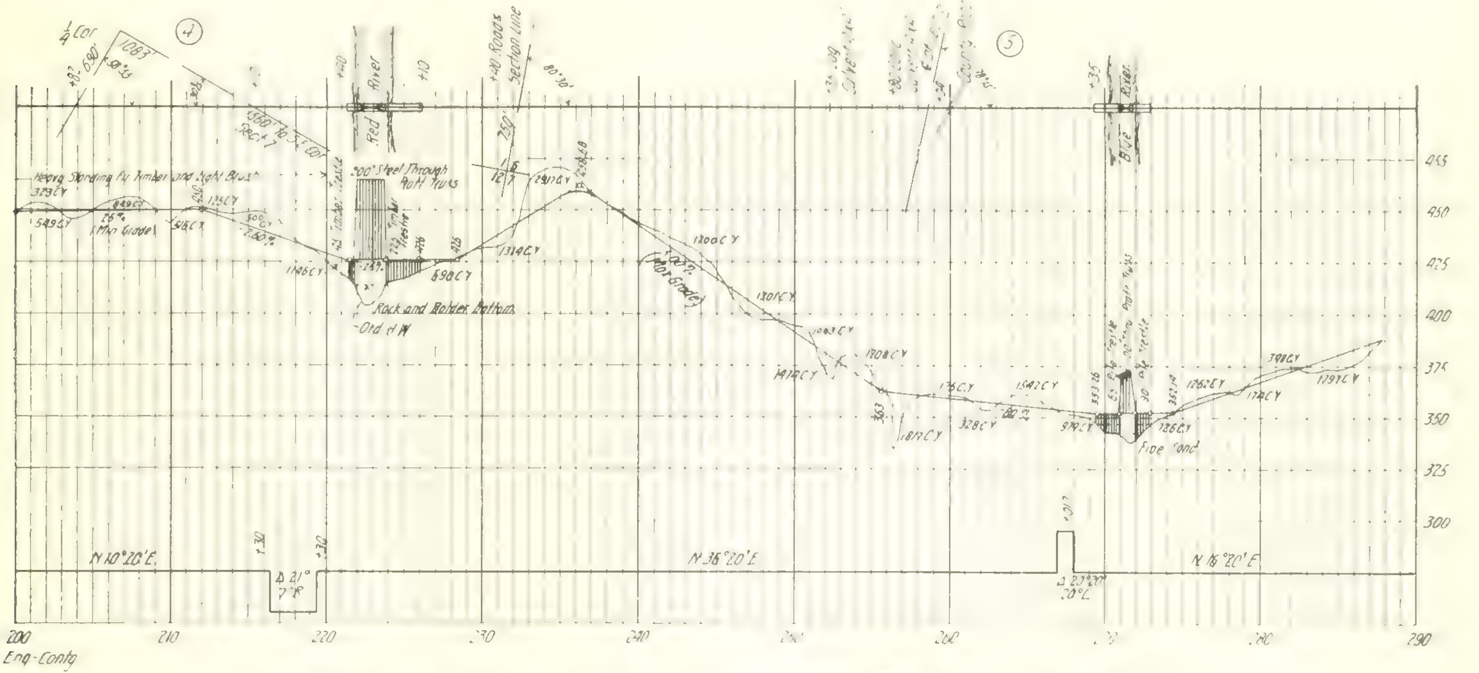
Details of the export trade of the United States in 1910 just completed by the Department of Commerce and Labor, show increases in exports of manufactures in nearly every line, but decreases in nearly all classes of foodstuffs exported.

Natural cement was used by the Egyptians over 4,000 years ago and by the Romans over 2,000 years ago.

ROADS AND STREETS SECTION

Organization of Engineering Department and General Engineering Instructions of the State Highway Department at Washington.

In the days when Washington was a territory all inter-county roads constructed under territorial legislative sanction were under the charge of three officials known as territorial highway commissioners. They were appointed by the legislature from the different counties through which the road passed, and their term of office expired on the completion of the road. The same system was followed for a few years after Washington became a state, the commissioners being known as state highway commissioners. The system proved very unsatisfactory, and in 1903 the legislature passed a law creating the office of state highway commissioner, and designating ten inter-county highways to be known as state roads. The bill was vetoed by the governor, but was passed over veto in 1905. A fund of $100,000 was created for the construction of the ten roads, and $10,000 was approximated for the salaries and expenses of the highway office. Two other roads were added at this time and $34,000 was appropriated for their construction. Under this law the counties were obliged to pay one-third the cost of construction and furnish all necessary engineering, both on location and construction. The roads were turned over to the counties on completion and the state had no responsible charge of maintenance and repairs. In 1907 the law was modified to release the counties from any financial obligations in the state roads, the state furnishing all engineering and bearing the entire cost of construction. An appropriation of $214,000 was made for the construction of the 12 roads already established, $5,000 for a new road which was established at this time, and $6,000 for surveys to determine the feasibility of five proposed routes. In 1909 five more state roads were established and a total appropriation of $620,000 was apportioned between the 18 roads.



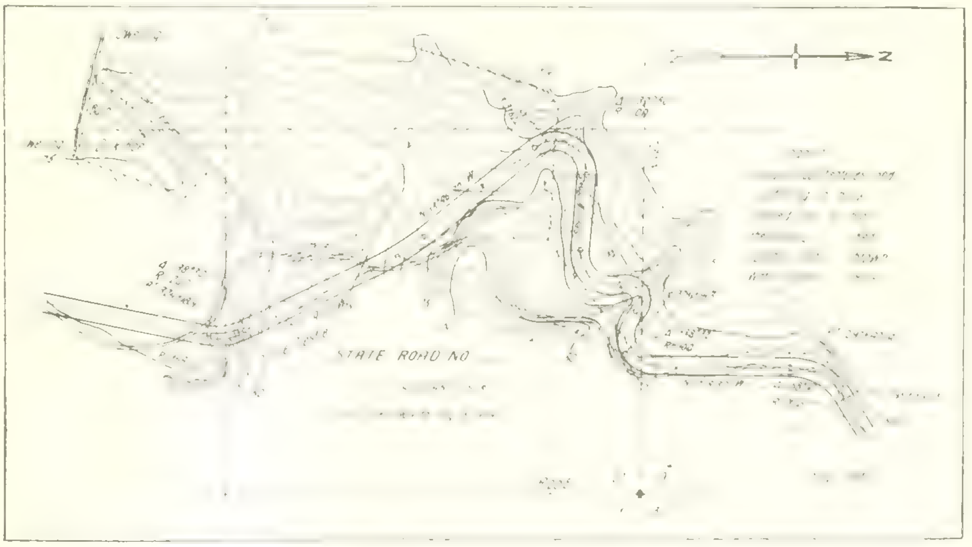
Standard Profile for State Aid Road of Washington State Highway Department.

The 1905 highway law was practically a state aid law, in that it required the counties to pay a part of the cost of engineering and construction. The county had no voice in the selection of the road to be improved, and in 1907 the law was changed providing that all state aid roads should originate by resolution of the county commissioner. Under the 1907 act, the state bore one-half the cost of engineering and construction, while the maintenance was left wholly in the hands of the county officials. In 1907 the legislature appropriated $135,000 for the work and in 1909 an appropriation of $595,000 was made.

The present state highway commissioner, Henry L. Bowlby, came into office in Aug. 1, 1909. The department was completely reorganized, a new system of accounting established in the office and instructions issued for the guidance of employes.

ORGANIZATION OF ENGINEERING DEPARTMENT.

The present organization of the engineering department of the highway commissioner's office is as follows: Chief engineer, division engineers, assistant engineers, resident engineers and inspectors.



Standard Plan for State Road of the Washington State Highway Department.

The chief engineer has control of the engineering of this department, his particular duties being the supervision of the work of preparation of designs and estimates and grades and location for the approval of the highway commissioner. He also has charge of all surveys, and assigns work to the division and assistant engineers. The chief engineer also examines and certifies to the correctness of all drawings.

Division and assisting engineers are assigned their work by the chief engineer and are subject to his instructions. On coming to the office temporarily they report to him. They have the supervision of the resident engineers on work assigned to them, and the latter receive their instructions from them. The division and assistant engineers are held responsible for the proper execution of the contracts and specifications. On being assigned to a location, their permanent residence is chosen, as far as may be, so as to enable them to reach all parts of their work in the most economic and convenient manner. They are allowed their necessary traveling expenses between the office and their permanent residence on such occasions as they may be required to report to the office. Transportation and subsistence is allowed from their permanent residence, to and from each piece of work under their supervision as often as may be necessary to exercise a proper supervision. They are not [illegible] nent residence.

Resident engineers report to the division engineers. They have direct charge of construction work [illegible] as may be assigned to them. While the resident engineer is in charge of work, he shall see that the contractors perform the work in accordance with the plans and specifications. It is understood that the contractor is responsible for the work and that all instructions should be given to him or his representatives. Resident engineers do not have authority to accept work for the highway commissioner. Such acceptance is made by the highway commissioner or someone who is especially authorized by him.

The general instructions for the guidance of members of the engineering department are as follows:

Correspondence.—All correspondence, reports, etc., for the highway commissioner shall be addressed to Henry L. Bowlby, state highway commissioner, Olympia, Wash.; and all letters emanating from the highway commissioner's office shall be signed Henry L. Bowlby, highway commissioner, and if signed by anyone other than the highway commissioner, it shall be so indicated. Each letter, so far as possible, should cover but one subject, to facilitate in filing.

Copies of all correspondence (including all reports) between division engineers and assistant and resident engineers under their direction will be forwarded promptly to the highway commissioner.

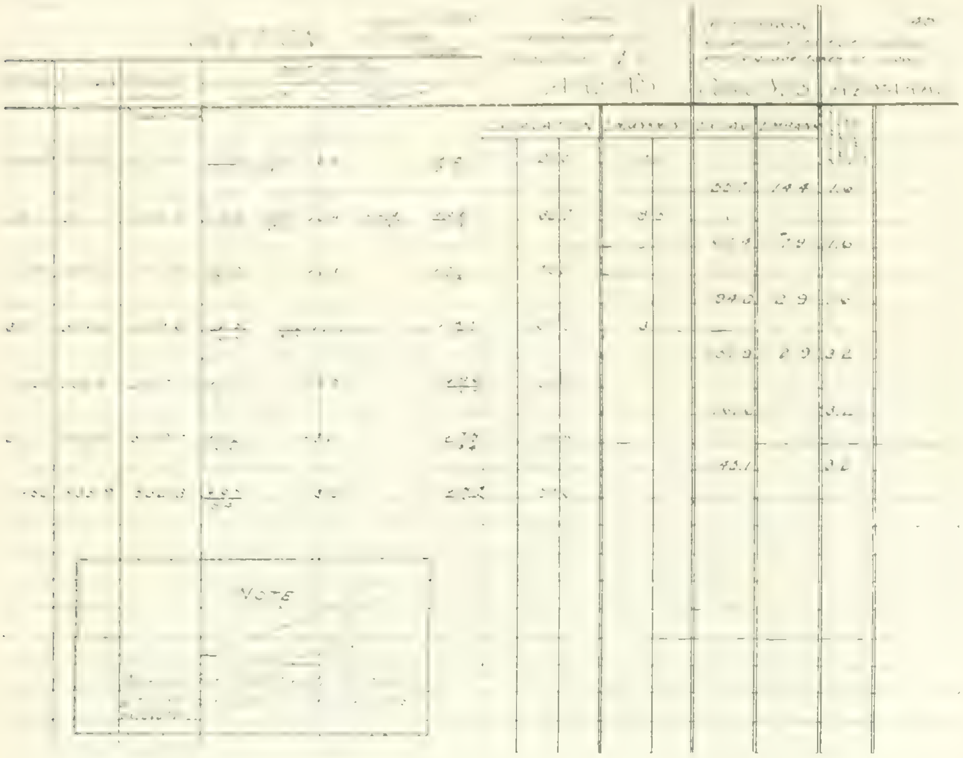
It shall be indicated clearly on all correspondence, bills, vouchers, pay rolls, reports, etc., the road or survey to which they pertain.

Expense accounts shall be confined to only such expenses as cannot be covered by a requisition and purchases made by the highway commissioner. They shall be made up on voucher form in duplicate at the close of each month, submitted to the assistant or division engineer for approval and forwarded to the highway commissioner after being certified to before a notary.

The use of telegraph and long distance telephone must be confined to matters of urgency only, and whenever it is possible, business should be handled through the mail.

All postage and express charges on matter forwarded to the highway commissioner shall be fully prepaid, receipts for same to be taken and included in expense accounts.

At the close of each month engineers or other employes will report, upon a form provided for that purpose, all instruments, tools and equipment belonging to the state, noting such as have been received during the month and such as have been disposed of or consumed. The inventory must be written in copying ink or copying pencil in duplicate, original sent to highway commissioner and duplicate to assistant engineer or division engineer.



Sample Page of Cross Section Book, Washington State Highway Department.

The first report shall be made and dated the day instruments are taken from the office. Subsequent reports shall be made and dated on the last day of each month and show clearly the month covered by the report.

Damage, destruction or loss of state property through carelessness or willfulness must be made good by the individual at fault. Engineers in immediate charge of parties are responsible for all state property in their charge and must prevent extravagance and waste in the use of supplies of all kinds furnished by the state.

Requisitions.—Requisitions shall be made on the highway commissioner for all supplies, materials, instruments, equipment, etc., which will make purchases or authorize engineers to purchase locally. Local purchases are not to be made without such authority, except in cases of absolute necessity. Requisitions for camp supplies should be accompanied by a complete inventory of supplies on hand. All requisitions should state clearly the purpose for which items are ordered.

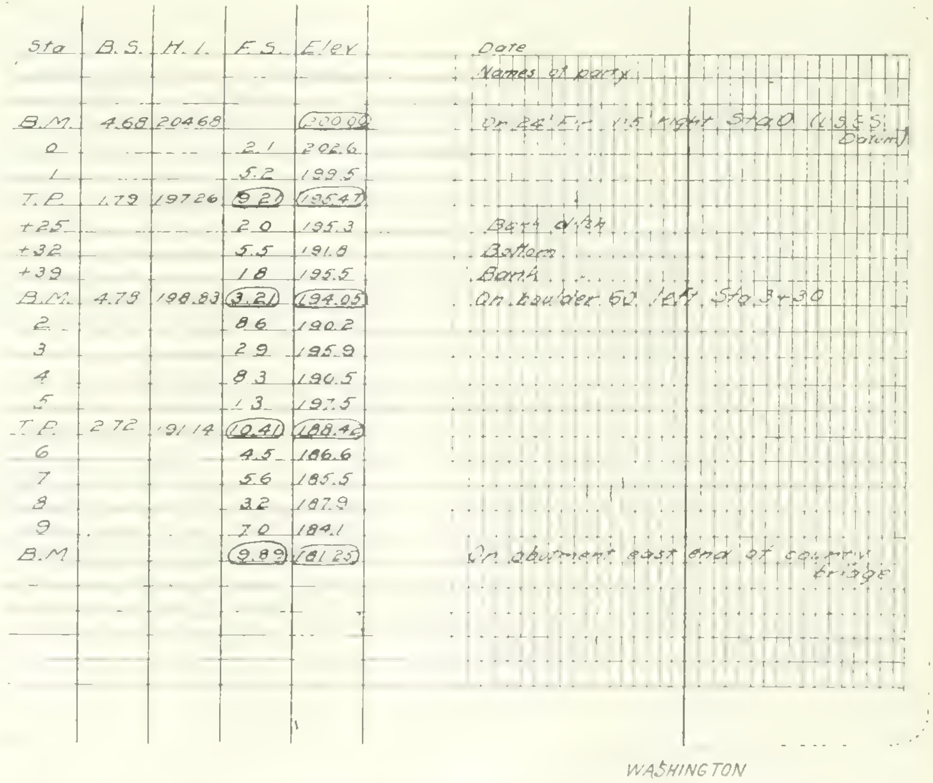
Bills and Vouchers.—All bills, vouchers and sub-vouchers must show full detail of purchases or expense, including dates, quantities and unit prices, and must be fully extended, checked and certified to by the party receiving the goods or incurring the expense. He will show clearly on face of bill or attached slip the particular account to which the items or expense should be charged.

In making up vouchers covering board or expenses for members of parties the name of each individual with the amount incurred by each shall be shown.

In items of board or time worked for the state, give exact dates so that charges may be identified.

Statement of Expenditures.—After the expenditures of each month have been posted, a statement showing appropriation, total expenditures to date and amount still available will be made covering each road, copies of which will be furnished to all engineers concerned, who will see that the expenses shall not in any event exceed the total appropriation. In event that there is danger of such over-expenditure, the engineer will report facts promptly to the highway commissioner.

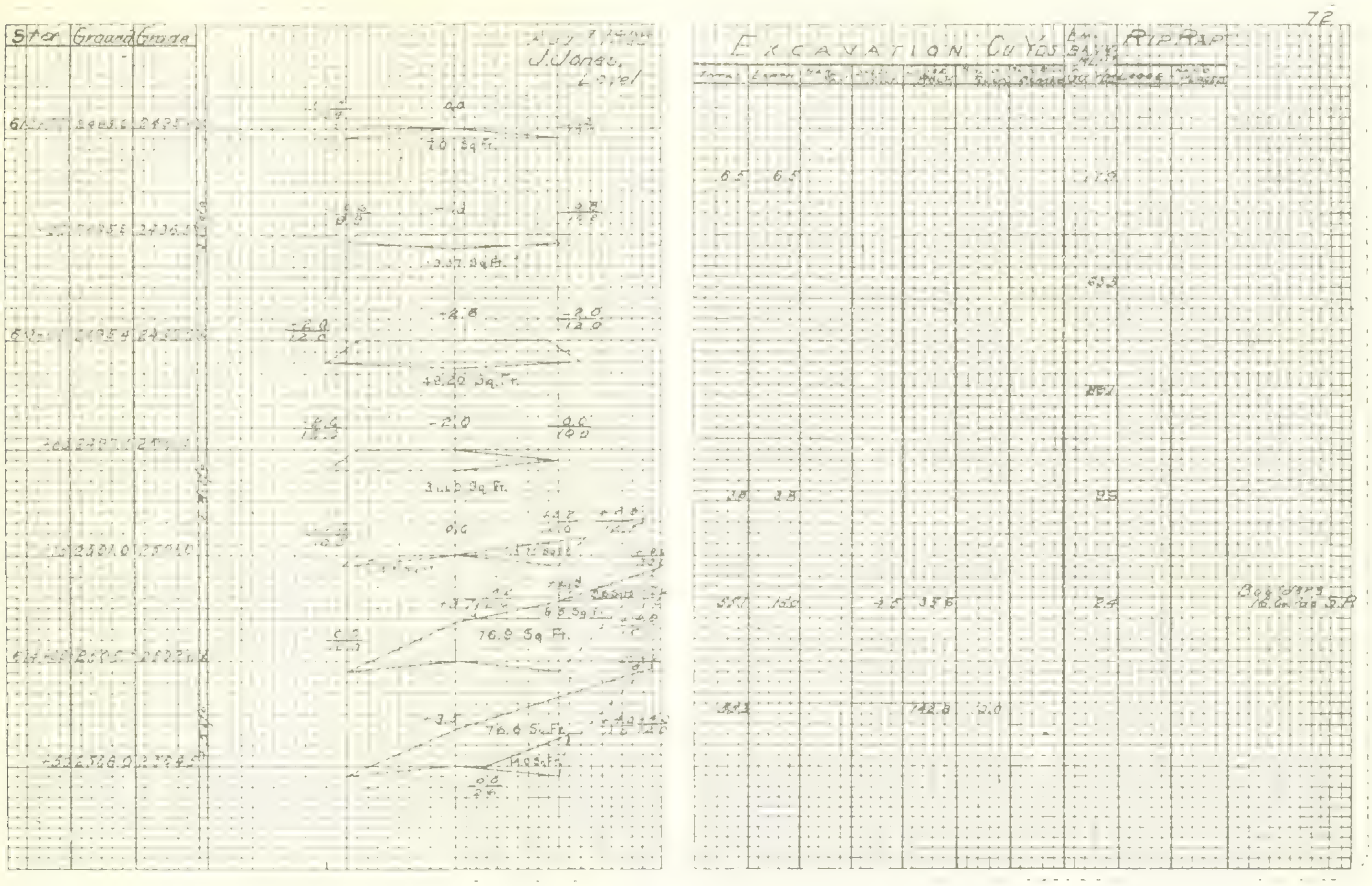
Engineers will not be permitted to leave their work without first having obtained permission, and trips to the office on business must not be made without first having received instructions or permission. Matters of urgency can, as a rule, be handled by telegraph or telephone much more economically than by traveling.


Sta
B.S.
H.I.
F.S.
Elev
Date
Names of party
B.M. 4.68 204.68 200.00
0 2.1 202.6
1 5.2 199.5
T.P. 1.79 197.26 9.21 195.47
+25 2.0 195.3
+32 5.5 191.8
+39 1.8 195.5
B.M. 4.78 198.83 3.21 194.05
2 8.6 190.2
3 2.9 195.9
4 8.3 190.5
5 1.3 197.5
T.P. 2.72 191.14 10.41 188.42
6 4.5 186.6
7 5.6 185.5
8 3.2 187.9
9 7.0 184.1
B.M. 9.89 181.25
On 24" Fir 1.5 right Sta 0 (135.5 Datum)
Bank ditch
Bottom
Bank
On boulder 60' left Sta 3+30
On abutment east end of county bridge
WASHINGTON

Sample Page of Level Book, Washington State Highway Department

GENERAL ENGINEERING INSTRUCTIONS.

The rules governing location are intended *for use in the field*, and it is expected they will be closely followed. The ability of the engineer will be determined by this standard.



Sample Page of Construction Cross Section Book, Washington State Highway Department.

Engineers will furnish weekly reports, stating progress and giving all other items of general interest pertaining to their work.

Strict compliance with the instructions is expected concerning the preparation of maps, profiles, records and estimates.

All maps, profiles, preliminary estimates and general records will be completed while the surveys are in progress, avoiding accumulations at the close of the work.

By making reconnoissances in person, using hand level, pocket compass and "Aneroid," engineers will avoid unnecessary loss of time and money.

A proper reconnoissance report conveys a graphic impression of the features of the region and route traversed, and contains the fundamental elements affecting construction, cost and maintenance. The engineer should separate the routes reported upon into natural divisions of similar characteristics, giving distances, grades and controlling points of each. He should describe, classify and approximately estimate the material to be moved, giving averages per mile and total for each section, and furnish an approximate estimate of the cost per mile and total cost of the completed road, giving in detail data necessary for estimate of bridges, culverts, riprap, retaining wall and similar items.

Grades should be established in even tenths and a maximum grade of 5 per cent will in no case be exceeded. All angle points should be marked according to station numbers. Notes and profiles should show all culverts, drains, bridges, etc., with sizes, indicating whether existing or proposed.

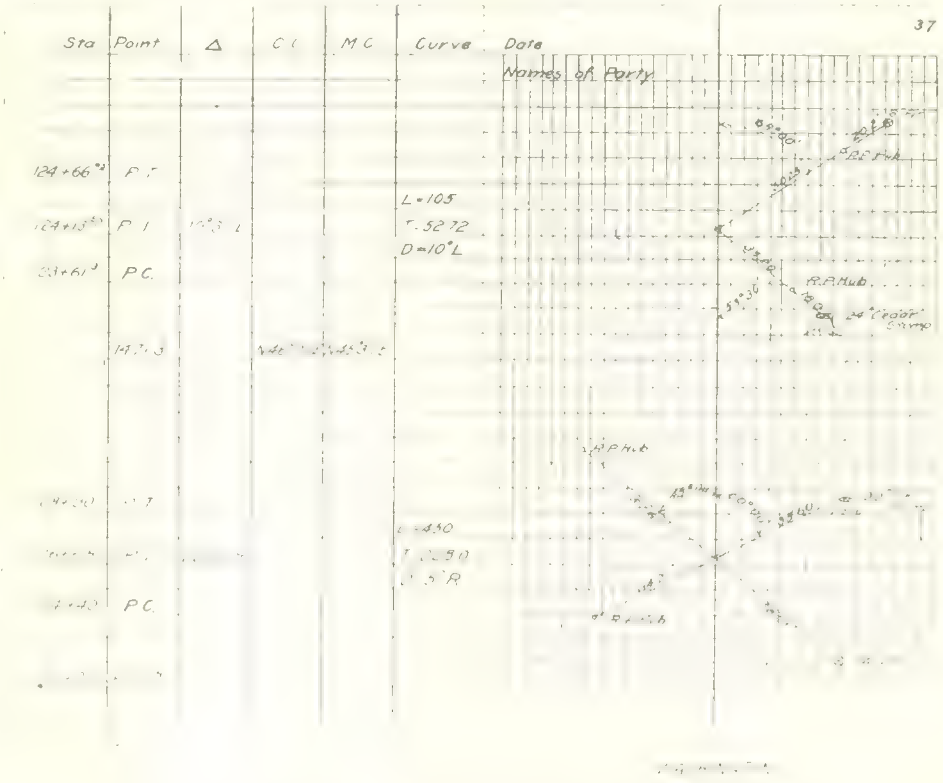
Right-of-way should be at least 60 ft. in width. The fundamental principle of good location is common sense.

SURVEYS AND [illegible]

The highway department will furnish instruments (except drafting) transportation, camp equipage and [illegible] while parties are employed in the field. Each individual will provide himself with all personal articles, such as clothing, blankets, etc.

Stations will be uniformly 100 ft. long each and numbered consecutively. Mark stakes on alternate lines with distinguishing letters A, B, C, etc. Mark stakes on located lines "L." Lines must [illegible] sub-division lines whenever crossed. Give station number of intersection, angle of intersection, distance along the line to the nearest section corner or one-quarter corner. Whenever possible, make the intersection by running through between the two corners.

On the map of the survey do not fail to indicate which of the section corners and quarter corners have been located. If note to



Sample Page of Transit Book, Washington State Highway Department.

this effect is not made, it will be assumed that the location of same has been approximated and the corner not tied.

All section ties must be given with reference to the location center line, and wherever corners are found the ties must be so taken that the necessary right-of-way strip can be described by "metes and bounds."

When the road is located through villages or towns, tie to corners and secure copies of plats, with dates, certificates, etc., and send to the office of the highway commissioner.

Tie in all property and land lines, and locate all buildings, wells, fences, etc., that are within 100 ft. of the line.

Cross-sections or slopes will be taken at sufficient distance on each side of line to allow for necessary changes of line and grades.

Check all angles by needle reading, or by doubling the angle, or both. Angle points should be indicated by station numbers.

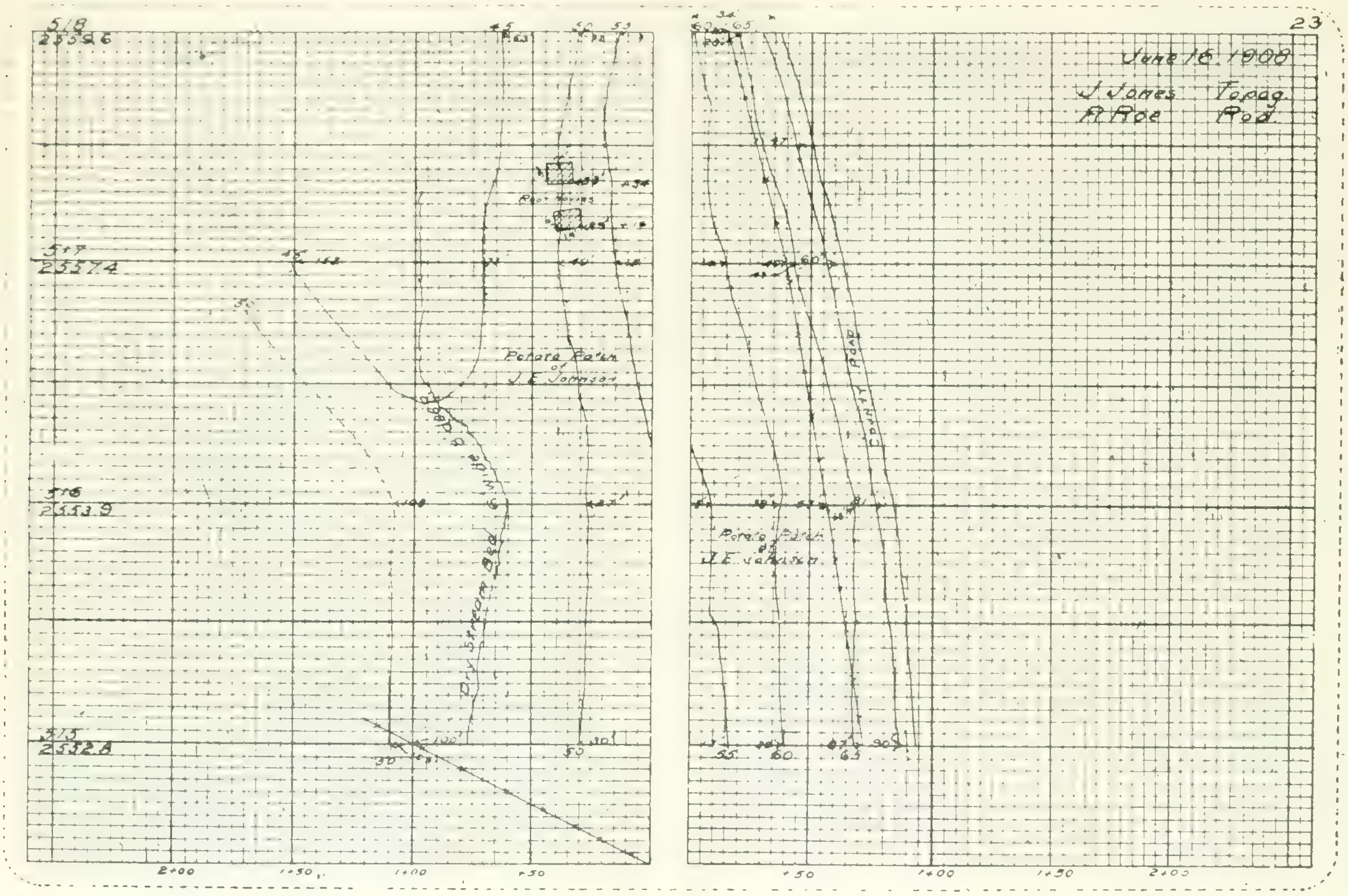
given in reference to the true meridian, and for that purpose an observation of Polaris or of the sun should be taken upon starting the survey and the true course recorded in the field books. An additional observation should be taken for the correction of meridianal convergency whenever the extent of the survey shall attain a departure of one-half degree of longitude.

Curves and bearing of tangents shall be noted on the maps and profiles in the manner shown on the samples furnished. When practicable, give true bearings instead of magnetic. State which is given.

When the degree of curve (D) is less than 10°, the length (L) of the curve may be computed by the formula $L = 100 \frac{\Delta}{D}$. When D is 10° or over, figure the length (L) as the

Field Books.—All field books shall be properly indexed in ink, and where more than one field book is used on a survey, a complete index of all field books shall be made. The book containing this index shall be marked on the back "Index." The state road number or state aid road name and the year shall be given. All field books shall be marked with the state road number and year on the fly leaf (or if state aid road work, they shall be marked with the year and county on the cover), also the name of the engineer in charge of the party, the transitman, leveller and topographer and such other data as will make the notes clear and intelligible. All note books shall be kept according to the standard sheets sent out by the highway commissioner's office.

Final location shall be shown in a clear and distinct manner in both index and on maps.



Sample Page of Topography Book, Washington State Highway Department.

Keep all instruments in proper condition and good adjustment.

Always establish a substantial and permanent bench at the initial point of all surveys, and note whether assumed elevation or sea level datum is used. B. M.'s should be placed frequently and in no instance over 2,000 ft. apart.

All level notes must be checked at the end of each day's work by adding the backsights and the foresights, and ascertaining the difference of elevation.

Use every means at hand to determine high water levels of floods.

Maps.—Maps shall be made in the field to a scale of 100 ft. to the inch, on duplex paper. All data obtained in the field shall be placed on these maps. These maps shall be sent to the office of the highway commissioner. The profiles shall be made with a scale of 400 ft. to the inch horizontally and 20 ft. or 30 ft. to the inch vertically (Plate "A" or "B" paper.) Maps and profiles shall be made in conformity with the standard specimen sheets furnished from the office of the highway commissioner.

Bearings of all courses or lines should be arc of a circle, thus: $L = 2\pi R \frac{\Delta}{360}$

Progress profiles will be sent each month to the highway commissioner's office properly colored to show all work done to and including the last estimate, on the part of the road in charge of the engineer. These profiles must show all work done, not only grading, but details of bridges and culverts built, with their exact location. The depth that piles are driven below the surface of the ground should be indicated by dotted lines, showing the point of lowest pile in bent; the mud sills of trestles should be shown by a short, heavy line, and on steep hills the elevation of each mud sill should be indicated in the same way.

The standard progress colors are as follows:

January	Chrome Yellow
February	Carmine
March	Payne's Gray
April	Deep Chrome
May	Prussian Blue
June	Burnt Sienna
July	Sepia
August	Emerald Green
September	Cobalt Blue
October	Vermillion
November	Indian Red
December	Sap Green

All field books must be sent to the office on completion of survey.

Diaries will be furnished to engineers. Details of each day's work must be entered, giving dates of commencing survey, staking out work, commencing and completion of grading, bridges, etc., rise and fall of streams and other data of future value. These diaries are to be subject to call at any time. During construction full detail of working force, progress, weather conditions, traffic and other items of interest as per instructions.

Engineers on location and construction will forward a weekly report of progress of work on forms furnished for that purpose, and all other items of interest pertaining to the work.

Engineers must make themselves familiar with the conditions of the contracts and specifications for work under their charge. They should attend to any reasonable request of contractors, furnish them elevations, lines, stakes, plans, etc., whenever necessary, and in general do all things requisite to enable contractors to work to advantage and without delay.

During construction each road will be divided into residences, each in charge of a resident engineer provided with such assistants, etc., as may be necessary.

Engineers must prosecute their work economically and shall follow the specifications absolutely.

The usual classification of grading will be earth, hardpan or cemented gravel, shell rock, loose rock and solid rock. If soft rock or other distinctive material exists in considerable quantity, the fact must be reported to the highway commissioner, in order that it may have a proper classification assigned to it.

In staking out grading, have number of station marked on face of center stake, and cut or fill on its back. On slope stakes have cut or fill marked on the face and number of station on the back.

Banks must be made full and regular. Care must be taken to avoid sags between stations.

When embankments are riprapped to protect them from action of water, that part of the embankment upon which the riprap is placed should generally be made with slope of not less than two to one. If the embankment has been finished at a steeper slope, the riprap should usually be so placed that its exterior slope shall be two to one.

Surface ditches must be laid out with great care to prevent water from running down slope of cut, or against embankments, or being carried to any point where it can act injuriously upon any part of the work. The ditches should be made of ample size, not less than 1 ft. wide at the bottom. In few matters is there more opportunity to show good judgment than in judiciously disposing of surface water about cuts. All cuts must have thorough drainage.

In turning streams, care must be taken to make embankments across old channels strong enough to resist the action of currents. It should be borne in mind that it is less costly to build an embankment with excess strength at first than to have it washed out and be compelled to rebuild it.

In turning rapid and turbulent streams take special and full precautions to prevent the new embankments from being washed away while building before they are high and strong enough for effectual resistance.

In building culverts and other waterways of perishable materials, ample allowance in size must be made for reconstructing them at a future time of durable materials. The greatest care should be taken to secure the foundations of all culverts and water conduits.

Thorough drainage is a maxim to be impressed on the mind and practice of everyone engaged in construction.

Construction must be done strictly in accordance with the plans and specifications furnished by the highway commissioner. No deviation will be allowed except upon written instructions or in case of extreme emergency to protect the property or interests of the state. In case of deviation from plans, same must be reported at once in detail to the highway commissioner. When the work on any road is ready for macadam or oil, the resident engineer must notify the highway commissioner in sufficient time to arrange for a representative to be on the work.

Contractors' Estimates.—The estimates of work done by contractors must be made strictly in accordance with the contract, except when particularly instructed to the contrary. Each estimate shall cover total work performed to date, and a per cent will be retained from the voucher to guarantee the completion of the work. Estimates for work performed on state roads should be sent to the highway commissioner in duplicate, and those covering work on state aid roads should be sent in triplicate. All estimates should be written in copying ink or copying pencil and all copies forwarded to the assistant engineer, who will certify to the correctness and forward all copies to the highway commissioner not later than the third day of each month. All estimates for the classification of material shall be based upon new cross-sections taken as different materials are uncovered, and shall be shown in colors in topography book kept for that purpose, as per sample furnished.

Such partial estimates shall be shown only in round numbers or whole units and reserve the fractions, if any, until the final estimate of when any one item is finally measured and estimated.

Detailed Estimate.—Promptly at the close of the month each resident engineer will make up detailed estimates, by stations, on forms furnished for that purpose of all work done by contractors.

Progress Reports.—Progress reports shall be furnished each week on forms provided for that purpose and should be complete in detail. In addition to the regular progress report form, each engineer shall make a letter report to the State Highway Commissioner, covering all work under his supervision, giving general details and condition, making such suggestion as he can regarding the improvement of the work.

In the construction of pile and trestle bridges, the inspector shall keep a record of all piles driven. This record must show length of piles, depth to which each pile is driven, penetration in inches due to the last three blows of the hammer, weight of hammer and fall in feet of same, and amount of piles cut off.

Short sags should be avoided, and in all cases vertical curves should be provided at grade intersections.

Standard plans will be furnished all engineers on construction, showing roadbed and the different structures they may have charge of erecting, and no change will be permissible without the consent of the Highway Commissioner in writing.

The work of the Highway Department can only be successful by the hearty co-operation of all of its employes.

Faithfulness and loyalty to one's superiors must exist not only during working hours, but at all times.

Derogatory criticisms of fellow employes will not be tolerated.

Each Resident Engineer will promptly at the close of each month send to the office of the State Highway Commission, a statement of all expenses incurred on each road under his charge, giving the date, name and amount of each voucher and the amount of each outstanding bill, including pay rolls, expense accounts and contractor's estimates. In this connection each Resident Engineer should be informed at all times as to the amount of money available for each road. This information will be furnished by the Highway Commissioner or Division Engineer. When a contract is nearing completion the accounts must be carefully watched, and the amount of expense kept within the amount available. The amount available must not be exceeded. Any failure to comply with the above will be cause for immediate dismissal.

When contractors do force account work or furnish materials for use on the work, they shall be required to furnish itemized bills showing full detail as to dates, items, rates, and amount due for such work or material. Such bills shall be rendered once each month, shall be carefully checked and O. K.'d by the resident engineer and the total of all such bills for each month shall be entered on the Contractor's [illegible] one item, and bills sent in with the estimate indicating on the face of each bill the estimate number that it pertains to.

Regarding force account performed by contractors, contractors must furnish fully itemized bills showing all force account done to date, and in the future the engineer must require a sufficient number of copies that one may be attached to each copy of the estimate voucher (two on State Roads and three on State Aid R[illegible] up in good form and be checked and O. K.'d by the engineer in charge of the work.

Regarding force account performed by contractors when material is purchased by the contractors for use on State work, the engineer will require them to furnish original bills, from the dealers which must show full detail as to dates, amounts, rates, etc., and must bear receipts showing that the bills have been paid. These bills must be furnished in duplicate or triplicate.

Notes on State Highway Work in 1910.

CALIFORNIA.

Up to the present time California has interested itself solely in roads in the mountainous districts. Some of these roads the state has constructed and some of them have been taken over from the counties by Legislative Action. The Mono Lake Basin State Road, the Trinity State Road, The Kings River State Road and the Sierra State Road are those being constructed by California. The Sonora and Mono State Road, the Lake Tahoe State Road and the Emigrant Gap State Road are those either constructed by the counties or by a toll company and came into the possession of the State through acts of the Legislature.

On the Emigrant Gap State road in the last two years the sum of $15,000 has been expended principally for resurfacing; $30,000 has been expended on the Sonora and Mono State road during the last biennial period for its 80 miles of length, and for its maintenance and the construction of culverts and small bridges $12,000 has been expended.

On the Lake Tahoe State road $30,000 for its 58 miles of length. This money is for maintenance of the road and the rebuilding of culverts and small bridges and for the establishing of a sprinkling plant on the first ten miles of the road. The Kings River road is at present constructed for ten miles and during the past two years $25,000 was expended on construction solely. This work was largely in granite rock.

On the Trinity State highway $50,000 has been expended and about 13 miles of the road has been completed; its length will be 30 miles. On the Sierra State road $11,500 has been expended for survey and location and for the construction of three miles of road. In the road work of the State it is the aim to place such roads at the proper grades and alignment. The appropriations of the State are made every two years and therefore the work is gotten up on that basis.

The money from the $18,000,000 bond issue, which has been voted for a system of State Roads in California, will not be available until about August of this year. It is contemplated under the bonding act to build a system of State Roads completely under the jurisdiction of California. These roads are to be constructed and maintained entirely by the State and they are to connect the various county seats of our State.

Under the bonding act it is provided that the money obtained from the sale of the bonds shall be placed in the state highway fund, and shall be used exclusively for the acquisition of rights of way for and the acquisition and construction of the system of state highways. The route or routes of the state highways are to be selected by the department of engineering and the route is to be so selected and the highways so laid out and constructed or acquired as to constitute a continuous and connected state highway system running north and south through the state traversing the Sacramento and San Joaquin valleys and along the Pacific coast by the most direct and practicable routes, connecting the county seats of the several counties through which it passes and joining the centers of population, [illegible] necessary to connect therewith the several county seats lying east and west of such state highway.

The act provides that the highway constructed or acquired under its provisions shall be permanent in character and be finished with oil or macadam or a combination of both, or of such other material as in the judgment of the department of engineering shall be most suitable and best adapted to the particular locality traversed. The state department of engineering is authorized, under the act, to purchase, receive by donation or dedication, or lease any right of way, rock quarry or land necessary or proper for the construction, use or maintenance of the state highway and can proceed, if necessary, to condemn under the provisions of the Code of Civil Procedure relating to such proceedings any necessary or proper right of way, rock quarry or land. The department of engineering have full [illegible] maintenance of the state highway. With the [illegible] have been permanently improved under county or permanent road division bond issues within three years prior to the adoption of the act, all public highways within this [illegible] state highway as determined and adopted by the department of engineering shall become a part of the right of way of the state highway, without compensation being paid therefor. All highways constructed or acquired under the provisions of the act are to be permanently maintained and controlled by the State of California. N. Ellery, Sacramento, Cal., is State Engineer.

NEW CASTLE COUNTY, DELAWARE.

The roads in New Castle County are built under state appropriations, a regular good roads appropriation of the county, and bond issues authorized by the General Assembly. Up to the end of 1908 there had been built 72.29 miles of improved roads. During 1909-1910 37.94 miles of improved roads were constructed, making a total of 110.23 miles of improved roads in the county built since the passage of the first good roads act of April 14, 1908. The accompanying table which has been compiled from the recently issued report of Francis A. Price, New Castle County State Highway Commissioner, shows the average cost per mile, the per cent of engineering of the total cost, the per cent of the cost of the supervisions for a number of the roads built in 1909-1910. The average of the engineering [illegible] roads shown in the table was 1.63 per cent; the average of the supervision was 2.49 per cent.

AVERAGE COST PER MILE OF ROADS COMPLETED IN 1909-1910 IN WILMINGTON COUNTY [illegible]

Name Material used	Length miles	Width paved Ft.	Av. thickness pavement Ins.	Av. cost per mile	Per cent engineering	Per cent supervision
Taylor's Bridge, granite...	[illegible]	[illegible]	4	$ 3,441	...	2.7
[illegible] limestone	3.87	12	[illegible]	6,244	1.9	[illegible]
St. Anne's, limestone	[illegible]	12	6	6,152	2.8	[illegible]
St. Anne's, limestone	[illegible]	[illegible]	6	5,632	2	3.3
[illegible], local stone	[illegible]	[illegible]	4[3]	8,313	1.6	[illegible]
Rockland, local stone	2.2	16	4[3]	8,951	.73	[illegible]
Grubbs Landing, local stone	[illegible]	12	8	7,711	1.3	3.1
[illegible], workhouse stone	.46	12	8	6,463	2.4	4.8
[illegible] Mill, trap [illegible]	[illegible]	12	6	5,853	3.2	3.6
Baltimore, limestone	[illegible]	12	6	[illegible]	1.6	2.6
Baltimore, limestone[4]	.94	12	6	11,319	1.2	2.7
[illegible], limestone	[illegible]	[illegible]	5	[illegible]	1.8	3.2
New London, trap	[illegible]	12	8	9,261	1	3.1
Mt. Pleasant, trap..........	3.82	[illegible]	6	7,121	1.6	.9
Boyd's Corner, trap.........	1.13	[illegible]	6	6,600	2	1.3
State, limestone	2.01	12	6	7,145	1.5	1.1
Lore Ave., granite..........	.39	16	8	14,400	8	3.9

[illegible] 9 ft. and 16 ft. [illegible] [3] [illegible] and 7 in.

[4] Limestone bottom and Amesite top

No. of towns.	Nature of improvement.	Sq. yds.	Length, ft.	Cost.	1910 Aid.
[illegible]	Block paving	2,920	982	$ 4,794.[illegible]	$ [illegible]
[illegible]	Macadam	79,396	33,374	47,027.95	17,164.15
[illegible]	Bituminous macadam	19,280	6,470	26,661.03	7,417.84
361	Gravel		469,354.5	234,394.14	116,024.14
[illegible]	Earth and drainage		77,921	36,944.05	19,098.21
3	Culverts	......	....	178.00	128.00
1	Bridges	.....	....	775.12	250.00
[illegible]	Data not received	.....	....	1,056.39	306.00
[illegible]	Totals	101,596	588,101.5	$351,831.23	$162,075.34

MAINE.

The road work completed in 1910 in this state was as follows:

	Total miles built	Average width paved. Ft.	Av. thickness of completed pavement. In.	Average cost per mile
Gravel	[illegible]	[illegible]	[illegible]	$ [illegible]
Plain macadam	[illegible]	[illegible]	[illegible]	[illegible]
Bituminous macadam...	1.22	33	7	21,764
Trunk line work........	7.99	..	.	8,086
Earth and drainage	[illegible]	.	.	[illegible]

In addition .186 mile of block paving was [illegible] per mile. [illegible] macadam was constructed principally by [illegible] macadam has. The

following table shows the number of towns that applied for state aid, the nature of the work, its yardage, total cost and amount of 1910 state aid:

The average costs in 1910 were as follows:

Gravel, per sq. yd. in place .... $[illegible]
Broken stone, per sq. yd. in place........ .65*
Bituminous macadam, per sq. yd. .... [illegible]*
Concrete masonry, per cu. yd. .... [illegible]

*Includes grading and underdrainage.

It may be noted that the greater part of the State Highway Department's contract work is done directly with the towns at unit prices estimated by the Department and on a lump sum basis. The prevailing daily wages in 1910 per 8-hour day were:

Common labor .... $[illegible]
2-horse teams and driver 4.00

The state aid appropriation for this year will probably be the same as the one for 1910.

MASSACHUSETTS.

During 1910 the road work completed under the direction of the State Highway Commission consisted of six miles of gravel road, 18 miles of plain macadam and nine miles of bituminous. The gravel roads were paved to a width of 15 ft., the average thickness of the completed surfacing being 6 in. Both the plain macadam and the bituminous macadam had an average paved width of 15 ft., and an average thickness of 6 ins. The average prices in 1910 were as follows:

Gravel, per cu. yd. in place..............$0.93½
Trap rock, per ton in place............... 2.06
Local stone, per ton in place............. 1.70
Bituminous macadam, per sq. yd.......... .90
Earth excavation, per cu. yd. .... [illegible]
Rock excavation, per cu. yd. .. .. [illegible]
Concrete masonry, not including steel rods, per cu. yd..........................10.75

The prevailing daily wages in 1910 per 8 hour day were:

Common labor .... [illegible]
2-horse team and driver .... [illegible]

About $[illegible] will be expended this year for the construction of gravel, plain macadam and bituminous macadam road. A. W. Dean, Boston, Mass., is Chief Engineer of the Massachusetts Highway Commission.

MINNESOTA.

All road improvement work in this state is done by the counties, the State Highway Commission contributing to each county an average of about $1,000. There are 79,300 miles of road in the state, of which 8,000 miles are state roads, over which the State Highway Commission has a somewhat indefinite jurisdiction. New legislation, however, is proposed, under which, if favorably acted on, the State Highway Commission will have a wider jurisdiction and more control over road work. At present the Commission is allowed only $80,000 per annum to distribute among the 86 counties, but measures are now being considered to increase this to $300,000, and later to $1,000,000.

The road work completed in 1910 is about as follows:

	Total miles built	Av. width paved. Ft.	Av. thickness of completed pavement Ins.	Av. cost per mile
Gravel	100	12	6	$ 700
Plain macadam..	10	16	6	5,500
Sand clay.......	50			
Earth	150			

The average unit prices in 1910 were as follows:

Gravel, per sq. yd. in place..................$1.00
Broken stone, per cu. yd. in place........... 2.60
Earth excavation, per cu. yd............... .20
Concrete masonry, per cu. yd................ 6.00

The prevailing daily wages in 1910 per 10 hour day were:

Common labor $2.00
2-horse team and driver..................... 4.00

During the coming year various towns and counties will expend on all roads approximately $1,000,000. George W. Cooley is State Engineer.

OHIO.

The road work completed in 1910 in this state under the supervision of James C. Wonders, State Highway Commissioner, was as follows:

	Total miles built	Av. width paved. Ft.	Av. thickness of completed pavement. Ins.	Av. cost per mile
Plain macadam..	32.41	13	6 to 8	$ 6,190
Bitum. macadam	5.32	15	6 to 8	8,140
Brick	8.3	14	10	10,950

The average unit prices in 1910 were as follows:

Water bound macadam, per sq. yd.. ..$0.79
Bituminous macadam, per sq. yd........... .83
Earth excavation, per cu. yd................ .26

The prevailing daily wages in 1910 per 8 hour day were as follows:

Common labor $1.75
2-horse team and driver......................4.00

The road work projected for 1911 is estimated to cost $600,000 and will include the following classes: Plain macadam, bituminous macadam, concrete and brick.

PENNSYLVANIA.

The following table shows some of the details of the road work completed in 1910 under the supervision of the State Highway Department, Joseph W. Hunter, Commissioner.

	Total miles built.	Av. width paved. Ft.	Av. thickness of completed pavement. Ins.	Av. cost per mile
Plain macadam..	64.2	16	9	$11,646*
Bitum. macadam	4.9	16	9	15,649
Brick ...	1.7	14	10	13,320

*Average per mile without bridges or culverts.

The average unit prices in 1910 were as follows:

Bituminous macadam, mechanically mixed, per sq. yd. .... $[illegible]
Earth excavation, per cu. yd................ .65
Rock excavation, per cu. yd. 1.10
Concrete masonry, per cu. yd.............. 10.00
Stone masonry, per cu. yd. 9.00

The prevailing daily wages in 1910 per 10 hour day were:

Common labor $1.65
2-horse team and driver .... [illegible]

VERMONT.

This state has a total road mileage of 15,000 miles. Out of this mileage about 4,000 miles of the trunk lines at most important radial and connecting roads covering the whole state are being improved under the supervision of the State Highway Office. The towns have about $100,000 apportioned to them on the basis of their highway mileage. In addition to this there was $75,000 annually apportioned to towns in sums of not less than $100 or more than $500 whenever a town would vote an equal amount to the state aid asked for from this fund. The towns last spring voted approximately $65,000, and the balance of the $75,000 fund was used in paying for engineering [illegible] in villages, and [illegible] special work on roads that are of large middle importance, but [illegible] not important to the towns in which they are located, so that the total amount of money spent under state supervision last year was about $250,000, many of the towns having spent somewhat more than they voted. This money is spent in the various towns on a basis of the worst roads to be found on the trunk lines and important roads in widening, straightening, grading, and draining.

In some cases a Telford foundation is laid where the character of the soil seems to demand it, and in all cases the best gravel, or surface material to be had in the locality, is used. In other words the state is improving its earth roads by widening, straightening, grading and draining and coating with a surface of the best gravel obtainable. In the large villages and cities, and a very few towns that are very near large villages and cities that have a large amount of travel, and which are lacking good gravel for road surfaces, crushed stone roads are built in a limited way, put down with a tarvia binder. The appropriation of 1910 has been doubled by the present legislature, so that the amount to be expended [illegible] year will [illegible] $75,000 to $100,000. The state automobile law is yielding a fund of about $40,000, which is spent upon these selected highways in helping to maintain them, the towns furnishing an amount equal to that given to them by this fund.

The road work completed in 1910 included about 23 miles of gravel-Telford, about 110 miles of gravel roads and about seven miles of plain macadam. Charles W. Gates, Franklin, Vt., is State Highway Commissioner.

WISCONSIN.

There is as yet no provision for state aid in Wisconsin and the various localities are still building their own roads principally under the labor system. It is expected, however, that the legislature now in session will pass a state aid bill of some kind. It is probable that this law will provide for state aid for stone and gravel roads, heavy dirt construction and for permanant bridges, and a ⅛ mill tax is proposed for this purpose. This would make available a state fund of about $350,000, which would indicate an expenditure [illegible] of from $1,[illegible]. It is expected that this act will take effect Jan. 1, 1912, so of course there will be no work of this class this year. At present the Highway Division of the Wisconsin Geological and Natural History Survey furnishes engineering advice to the various localities on the construction of highways and bridges. This division, of which A. R. Hirst is Highway Engineer, recently circularized the various county clerks and town chairmen as to the highway work done in 1910 in their localities, and the information given below is based on figures obtained by them. From these figures it would seem that the road work completed in Wisconsin last year was as follows:

	Total miles built	[illegible]	[illegible]	[illegible]
Gravel	[illegible]	[illegible]	[illegible]	[illegible]
Plain macadam	[illegible]	[illegible]	[illegible]	[illegible]
Bitum. macadam	[illegible]	[illegible]	[illegible]	[illegible]
Sand clay	[illegible]	[illegible]	[illegible]	[illegible]

The average unit prices [illegible] 1910 [illegible] as follows:

Gravel, per sq. yd. in place*	[illegible]
Broken stone, per cu. yd. in place	[illegible]
Bituminous macadam, per [illegible]	[illegible]
Earth excavation, per [illegible]	[illegible]
Rock excavation, per cu. yd.	.80
Concrete masonry, per cu. yd.	7.00
Stone masonry, per cu. yd.	[illegible]

*Including grading, etc.

The road work projected for 1911 [illegible] follows:

	Miles	[illegible] total cost
Gravel	[illegible]	[illegible]
Plain macadam	[illegible]	[illegible]
Sand clay	[illegible]	120,000

The prevailing [illegible] per 10-hour day were:

Common labor	[illegible]
Team and driver	[illegible]

Kansas.

The following is a summary of the road work done in 1910 [illegible] of the state:

Amount expended [illegible] for bridges and culverts	[illegible]
Macadam roads [illegible]	[illegible]
Dirt roads [illegible]	[illegible]
Sand clay roads [illegible]	[illegible]
Sand-clay roads in 5 counties, 34 miles	
Brick roads [illegible]	[illegible]
[illegible] improvements in 7 counties, reports on roads, small bridges, culverts and other repairs	[illegible]
Total in [illegible] counties	[illegible]

In 14 counties no expenditures were made by the counties and no records were obtainable as to the amount spent by the townships.

The mileage and average cost per mile of the various kinds of roads completed in 1910 were as follows:

Kind.	Total miles built	Average width [illegible] Ft	Average thickness of completed pavement Ins.	Average cost per mile
Plain macadam	[illegible]	[illegible]	9-12	$4,[illegible]
Brick	[illegible]	[illegible]	[illegible]	[illegible]
Sand clay	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oiled earth	[illegible]	[illegible]	[illegible]	$1,200

*[illegible] per cu. yd. at crusher.

Mr. W. S. Gearhart, Manhattan, Kan., is state highway engineer.

New Hampshire.

The mileage and average cost per mile of the various classes of improved roads completed in 1910 in this state were as follows:

Kind.	Total miles built.	Average width paved Ft	Average thickness of completed pavement Ins.	Average cost per mile
Gravel	[illegible]	[illegible]	[illegible]	[illegible]
Plain macadam	[illegible]	[illegible]	[illegible]	[illegible]
Bituminous macadam	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The average unit prices in 1910 were as follows:

Gravel [illegible] in place	[illegible]
Broken stone per ton in place	1.83
Bituminous binder [illegible]	[illegible]
Earth excavation, per cu. yd.	0.59
Rock excavation, per [illegible]	[illegible]
Concrete masonry, per [illegible]	[illegible]
Stone masonry, per [illegible]	[illegible]

The prevailing daily wages in 1910 per eight-hour day were $1.75 for common labor and $4.50 for two-horse team and driver. Mr. H. C. Hill, Concord, N. H., is state engineer.

WATER-WORKS AND SEWERS SECTION

Extent and Composition of the Incrustation on Some Filter Sands.*

When lime is used in connection with water purification there is a tendency to form an incrustation in the pipes or on the sand grains of the filters. In some cases the sand grains have become so large that it has been necessary to put in new sand. Cases have been reported where the sand near the bottom of the filters has caked into a solid mass.[1]

We have investigated the sand in some filters in Illinois. Samples of sand were sent to us from Danville, Kankakee, Quincy and Moline. We are indebted to H. M. Ely, Danville, C. H. Cobb, Kankakee, W. R. Gelston, Quincy, and to M. Olson, Moline, for information concerning the sand used.

The Danville plant used Red Wing, Minn., sand having an effective size of 0.31 and a uniformity coefficient of 1.8. During periods of low turbidity from 0.27 to 0.7 grain per gallon of lime and from 0.58 to 1.5 grains per gallon of iron sulphate were used. In periods of high turbidity from 0.8 to 2.5 grains per gallon of lime and from 2.5 to 4.0 grains per gallon of iron sulphate were used. Filter No. 8 has been in use 7 years and filter No. 6 5 years. A larger [illegible] was used prior to the last 15 months.

The Kankakee plant uses Mount Tom sand. The size at the beginning is not known. The sand has been in use 9 years, but only during 1 year has 1 grain per gallon of iron sulphate and 2 grains per gallon of lime been used. During the remainder of the time alum has been the coagulant.

The Quincy plant uses Red Wing, Minn., sand having an effective size of 0.38 and a uniformity coefficient of 2.1. While the sand has been in use a long time, it is not possible to tell the exact time, for about two years ago the sand was removed from the filters, screened and the finest replaced. It has undoubtedly been in use more than 7 years, for Quincy was the first plant in the country to use the lime and iron sulphate process. During the last [illegible] grains per gallon of iron sulphate and 2.84 grains per gallon of lime were used.

The Moline plant has been in operation without removal or change of the sand for five years. Alum has been used about nine months; previous to that, lime and iron sulphate were used regularly, 1 grain per gallon of iron sulphate and 3 grains per gallon of lime being used.

The sand received has been examined to determine the relative amount of the incrustation, the size of the incrusted grains and the composition of the incrustation.

In determining the relative amount of the incrustation, we used approximately 250 cc. of each filter sand, which we carefully weighed and treated with hydrochloric acid until all the carbonate was dissolved. The residue was washed and weighed. The rerults are shown in Table I.

As the filter sands are of quartz and are unaffected by acids, this treatment gives quite an accurate means of determining the increase. It is hard to realize what an enormous increase these figures imply. An incrustation amounting to 71 per cent means that there in an increase by weight of 249 per cent, and an incrustation amounting to 84.7 per cent represents an increase of 633 per cent. With this increase in the size of the grains there has been an equivalent loss of sand, which has been carried into the sewers. The increase in the size of the grains is accompanied by loss of efficiency. As the grains increase in size, the interstices between the grains are larger and fine particles more readily pass through.

A sand with an "effective size" above 40 would not be chosen for a filter sand. We can, from the table and by comparison with the original effective size, see that considerable deterioration has taken place. A calculation of the volume of the sand from Quincy before and after the incrustation formed shows a seven-fold increase. This corresponds to the 655 per cent increase by weight shown by treatment with acid

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*A paper by E. Bartow and C. E. Millar in the Journal of Industrial and Engineering Chemistry for February, 1911.

[1] Eng. and Min. J., May 6, 1908; Report of Ohio State Board of Health, [illegible].

TABLE I.

Name of sand	Danville, No. 8.	Danville, No. 6.	Kankakee.	Quincy.	Moline.
Weight [illegible]	[illegible]	[illegible]	383.0	325.0	330.0
Weight [illegible]	[illegible]	238.0	330.0	49.0	94.0
Weight of incrustation removed	112.0	113.0	53.0	276.0	236.0
Per cent of incrustation	32.4	32.2	13.7	84.7	71.4
Per cent [illegible]	[illegible]	47.7	15.9	633.0	249.0

The size of the incrusted grains has been determined by the [illegible] sieve method. The results are shown in Table II:

TABLE II.

	Effective size.	Coefficient of uniformity.
Danville, No. 6	0.52	1.30
Danville, No. 8	0.55	1.50
Kankakee	[illegible]	[illegible]
Moline	0.60	1.90
Quincy	0.77	1.67

The composition of the incrustation was determined by evaporating to dryness a portion of the hydrochloric acid solution and analyzing the residue. The results obtained are shown in Table III:

TABLE III.—COMPOSITION OF INCRUSTATION ON FILTER SANDS.

Determinations made.	Danville, No. 6.	Danville, No. 8.	Kankakee.	Quincy.	Moline.
Insoluble matter	5.89	7.58	1.83	0.32	1.20
Oxides of iron and aluminium, $Fe_2O_3 + Al_2O_3$	2.20	3.15	7.20	0.42	0.94
Magnesium oxide, MgO	1.16	1.00	1.09	0.83	0.12
Calcium oxide, CaO	49.58	47.70	47.75	54.03	53.10
Sulphur trioxide, SO_3	0.17	0.17	0.31	0.14	0.12
Hypothetical combinations:					
Magnesium sulphate, $MgSO_4$	0.26	0.25	0.48	0.21	0.18
Magnesium carbonate, $MgCO_3$	2.23	1.90	2.00	1.63	1.37
Calcium carbonate, $CaCO_3$	88.53	85.17	85.26	96.48	94.83
Ferrous carbonate, $FeCO_3$	3.19	4.57	10.44	0.61	1.37
Insoluble matter	5.89	7.58	1.83	0.32	1.20
Total	100.10	99.47	100.01	99.25	98.95

It will be noticed that calcium carbonate is the predominant substance. This corresponds to the composition of the incrustation found in the pipes at Quincy.[1] The incrustation at Kankakee contains the smallest proportion of calcium carbonate. This may be due to the composition of the mineral content of the water, or to the fact that lime had not been used for some time before the sample was taken. According to the analyses of the mineral content of the river waters,[2] the Kankakee river water contains the least carbonate and the greatest amount of sulphate.

The formation of incrustation on the sand grains is due to incomplete precipitation of calcium carbonate before the water reaches the filters. While the greater part of the calcium carbonate is precipitated quickly, an appreciable quantity remains at the end of six hours. The precipitation will take place more rapidly if the water is agitated. The after-precipitation on the sand grains may be prevented by increased sedimentation, which often cannot be done because of the expense, by agitation of the treated water or by the addition of carbon dioxide. The carbon dioxide can be added directly or can be made by the addition of iron sulphate or aluminium sulphate. Carbon dioxide has been successfully used at Winnipeg. It was prepared by burning coke in the furnace used to run the filter machinery.

Sulphate of iron is being used in some of the newer installation as at New Orleans,[3] where the iron is added after the lime and where the water treated with lime is thoroughly agitated.

The reactions with the sulphates of iron and aluminium are double, for both calcium sulphate and calcium acid carbonate are formed. Neither of these substances will form an incrustation on the sand grains.

Laboratory experiments along the above lines indicate that the action of the iron and aluminum sulphates following lime is immediate, so that very little time need be allowed its addition and the application of the water to the filters.

Experiments with carbon dioxide, either pure or as found in purified flue gases, show there is a removal of the incrustation; blank experiments with air showed no removal. The substitution of purified flue gases for the air now so generally used in washing filters would probably prevent the formation of an incrustation.

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[1] Proc. Am. W. W. Assn., 1908, 172. Univ. of Ill. Water Survey Series, Bull. 7, 35.

[2] U. S. G. S. Water Supply Paper 239, p. [illegible]

[3] [illegible]

Valuation of the Physical Property of the Peoria Water Co. with a Discussion of Rate Making and of Reasonable Rates.*

(Continued from page 227.)

The most notable of such cases being known as the two Maine, water works condemnation cases, before the Supreme Court of that state.

In the Kennebec Water District vs. the City of Waterville case, 97 Maine, 185, Judge Savage instructed the appraisers as follows:

> "The property to be taken, both plant and franchises, are to be appraised, having in view their value as property in itself, and their value as a source of income. There are these elements of value, but only one value of the entire property is to be appraised in the end. These elements necessarily shade into each other." * * * "In estimating even the structural value of the plant, allowance should be made for the fact, if proved, that the company's water system is a going concern, with a profitable business established, and with a present income assured and now being earned."

Also,

> In fixing structural value, including the element of going concern, consider also the present efficiency of the system. * * * Necessary time to construct de novo, and the time and cost needed after construction to develop such new system to the level of the present one, in respect to business and income, and the added net income and profits which would accrue during this period of construction and development.

TABLE IV.—COMPOSITION OF INCRUSTATION ON FILTER SANDS.

Determinations made—	Danville No. 6.	Danville No. 8.	Kankakee.	Quincy.	Moline
Insoluble matter	5.89	7.58	1.83	0.32	1.20
Oxides of iron and aluminum, $Fe_2O_3 + Al_2O_3$	2.20	3.15	7.20	0.42	0.94
Magnesium oxide, MgO	1.16	1.00	1.09	0.83	0.12
Calcium oxide, CaO	49.58	47.70	47.75	54.03	53.10
Sulphur trioxide, SO_3	0.17	0.17	0.31	0.14	0.12
Hypothetical Combinations:					
Magnesium sulphate, $MgSO_4$	0.26	0.25	0.48	0.21	0.18
Magnesium carbonate, $MgCO_3$	2.23	1.90	2.00	1.63	1.37
Calcium carbonate, $CaCO_3$	88.53	85.17	85.26	96.48	94.83
Ferrous carbonate, $FeCO_3$	3.19	4.57	10.44	0.61	1.37
Insoluble matter	5.89	7.58	1.83	0.32	1.20
Total	100.10	99.47	100.01	99.25	98.95

In Brunswick and Topsham Water District vs. Maine Water Company, 99 Maine, 371, Judge Savage says:

> Structural value must include consideration of the facts that the structure is in use, is a going concern.

Further:

> We speak sometimes of a going concern value as if it is, or could be separate and distinct from structural value; so much for structure and so much for going concern. But this is not an accurate statement. The going concern part has no existence except as a characteristic of the structures. If no structure, no going concern. If a structure is in use, its value is effected by the fact that it is in use. There is only one value. It is the value of the structure being used, that is all there is to it.
>
> The property taken is a single thing, to which belongs certain characteristics which effect value. The thing cannot be taken without these characteristics. If it is attempted to value the thing, separate from its inherent characteristics, elements which add value to the thing are omitted. If these elements are omitted, the owner fails to receive the full and fair value of the thing, and thereby is denied just compensation.

Aside from the cases cited, courts of last resort have sustained the principle of going concern value in a number of specific instances.

The City of Galena, Kansas, vs. the Galena Water Works, is one.

In fixing the value of the plant the referee allowed an increase in value on account of this element, which the lower court refused to confirm. On appeal, the Supreme Court reversed the lower court and sustained the referee.

Other cases are Gloucester Water Supply Co. vs. Gloucester, 179 Mass., 365, and Norwich Gas & Electric Co. vs. Norwich, 76 Conn., 565.

The City of Omaha, Petitioner, vs. Omaha Water Co., lately decided by the Supreme Court of the United States, sustains an increase of $562,712.45 in the value of the property of the company on account of the going concern element in a total appraised value of $6,263,295.49.

VALUATIONS FOR SALE AND FOR RATE MAKING

From the foregoing statements and citations there seems to be no doubt about the doctrine that should apply in the valuation of public utilities for the purposes of sale.

Some courts have, in a measure, distinguished between a valuation for sale and a valuation for fixing the investment in rate cases.

The Supreme Court of Iowa, in the case of Cedar Rapids Gas Light Company vs. City of Cedar Rapids, Northwest Reporter, 120-966, in opinion made May 4, 1909, says:

> Where a gas company supplying gas to the inhabitants of a city, laid its mains in unpaved streets, the value of the mains and pipes, in estimating the value of the property in fixing rates, should not be estimated on the basis that it would cost more to place the pipes because the streets have been paved.

In the Consolidated Gas Company case, 212 U. S. Reporter, 19, the Supreme Court of the United States says:

> And we concur with the court below in holding that the value of the property is to be determined as of the time when the inquiries were made regarding rates. If the property which legally enters into the consideration of rates has increased in value since it was acquired, the company is entitled to the benefit of such increase.

Farther,

> The rate proposed must be with reference to the value of the property at the time when the rate takes effect. The company is entitled to the benefit of any increase in value at that time.

Also,

> Rates when fixed by legislative authority for public service corporations, should allow a fair return upon a reasonable value of the property at the time it is being fixed.

The Supreme Court of Maine, in the Brunswick & Topsham Water District vs. Maine Water Company, 99 Maine, 371, says:

> Reasonableness of the rates must be based upon the fair value of the property used by the company for service of the public.

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*Condensed and partly rearranged from "Valuation of the Property of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams, "Audit of Accounts of the Peoria Water Works Co.," by Edward A. Pratt & Co., and "Water Rates for the Plant of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams; reports made for the city of Peoria, Ill.

In San Diego Land Company vs. National City, 174 U. S., 739, 757, Justice Harlan held:

> What the company is entitled to demand, in order that it may have just compensation, is a fair return upon the reasonable value of the property at the time it is being used for the public. The property may have cost more than it ought to have cost, and the outstanding bonds for money borrowed and which went into the plant may be in excess of the real value of the property. So that it cannot be said that the amount of such bonds should in every case control the question of rates, although it may be an element in the inquiry as to what is, all the circumstances considered, just both to the company and to the public.

In Stanislaus County vs. San Joaquin C. & I. Co., 192 U. S., 201, 214-216, it is stated:

> The original cost may have been too great; mistakes of construction, even though honest, may have been made, which necessarily enhanced the cost; more property may have been acquired than necessary or needful for the purpose intended. * * In this case much of the total amount expended in the course of construction of the works was not proved by those who made such expenditures, and the items and total amount of the cost of construction were only proved by the books. What such books did not prove was the reasonableness of that cost, its propriety or necessity. * * * To take the amount actually invested into "estimation" does not mean necessarily that such amount is to control the decision of the question of rates.

The Iowa court in the Cedar Rapids case, appears to have furnished the only dissenting opinion of a high court as to the conclusion that the valuation for fixing rates should be the same as the valuation for sale.

That there is no real distinction becomes apparent if we consider that no public utility can have two values at a given time, and that its fair value at the time of fixing rates, must be its fair value at the same time for any purpose. If its fair value for sale, differed from its fair value for fixing rates, at a given time, then rates should change, merely because of a change of ownership.

To put it another way. If a given sum represents the investment which the owner of a public utility is entitled to have paid over to him in case of a forced sale under the franchise, or law, then he is entitled to a fair income on the same investment in case he is forced to retain it.

It would appear, therefore, that if the first method of determining the investment is to be followed, that there is no reason for considering the value of the property as different, for rate purposes, from its value for sale or condemnation purposes.

The Iowa case seems to be the result of an effort to combine two methods of determining the investment for a given property. Either the reproduction method should be logically followed and the investment based upon the value as of the time of fixing rates, or the second method of determining the investment, the "Original Cost and Deficit" method, should be adopted.

THIS SECOND METHOD of determining the investment by original costs and deficits, divorced entirely from present value, has seldom, if ever, been recognized as sound, so far as known, by courts of highest resort. Though the Wisconsin Railroad Commission at one time seemed to have adopted it as the proper one for valuing the public utilities of that state. Later they encountered such difficulties in its use, that it has been practically abandoned, or, at most, they now advocate only a halting and partial use of the same.

The Wisconsin law provides, that,

> The Commission shall [illegible] of every public utility actually used and useful for the convenience of the public.

Acting under this law, the Commission has made a number of decisions that seek to establish certain rules and doctrines affecting the question of public utility values which may be briefly stated as follows:

In the Cashton Light & Power Co. case, decided in November, 1908, the Commission substantially enunciated the same doctrine found in the foregoing citations, as witness the following statements:

> There is, however, an element of value that must be taken into consideration, and which is sometimes spoken of as a kin to good will, namely, the "going value," and although the franchise of the public utility has expired, its plant is to be taken over by the village as a going concern, and just compensation must be awarded for the property taken as such; that is, as a living and operating entity, engaged in serving the public and not a mere plant without patrons.

Also,

> In placing a value on the physical property of a plant, the units of a plant should not be valued as independent entities, but as units of a going concern performing utility service.

And,

> The element of going value created by the investment made in developing the business, and in addition to the cost of the physical structure, must be taken into consideration in fixing the value.

In the Antigo Water Co. case, decided August 3, 1909, and also in the Menominee and Marinette Light & Traction Co. case, decided the same date, the "Original Cost and Deficit" method of valuation is advanced.

It is held as to the physical plant alone, that the original cost, and the cost of reproduction, appear to be the most equitable as a basis for rate making, but that as to the business valuation alone, the most equitable would appear to be represented by losses during the earlier years, or by deficits from operation during the development period. That as these losses, or deficits, had to be met by the owners, they may be said to constitute the additional investment necessary to build up the business, and are as legitimate and necessary a part of the cost of the enterprise as a whole, as is the cost of the physical plant, and are hence a part of that cost upon which a reasonable amount of interest and profit should be earned.

In the case of E. E. Payne, et al., vs. Wisconsin Telephone Co., also decided August 3, 1909, the same doctrine appears in the following statement:

> Going value is distinguished from going concern value. The uncompensated cost incurred in building up the business must be considered in rate making. The seller of a plant, which is a going concern, may be able to get more, and the purchaser be willing to pay more than for a plant which has no established business. Similarly in expropriation proceedings going concern value may increase the amount of indemnity to be paid, but this "more" is not property which is used and useful for the convenience of the public. Every effort honestly put forth, every dollar properly expended, and every obligation legitimately incurred in the establishment of an efficient public utility business, must be taken into consideration in the making of rates. Collectively, these elements must be characterized by the term "going value."

It is thus seen that in the three cases last cited, decided by the Wisconsin Railroad Commission August 3, 1909, the doctrine that the investment for rate making purposes, should be based upon the original cost of construction and the deficits incurred in operation, as opposed to the doctrine of present value laid down by the courts, and as enunciated by the commission in the Cashton case, is strongly presented. In the text of the decisions, extended arguments are especially directed to showing the fallacy of the "present value" method for rate making purposes.

In the Antigo Water case particularly, nearly twenty pages of the decision are devoted to this end, and to establishing the "original cost and deficit" doctrine.

In these arguments, however, many of the underlying principles and facts that are the support of the present value method of appraisement are clearly recognized, as is shown by the following extracts:

Antigo Water case, page 81:

> A mere physical [illegible] or how well it is adapted to the purpose for which it is intended, amounts to but little unless it [illegible] Without business it is a dead mass instead of a living concern earning profits. To have profits it must have business or customers who avail themselves of the services it renders at rates that yield an adequate income.
>
> But new plants are seldom paying at the start. Several years are usually required before they obtain [illegible] earnings to cover operating expenses, including depreciation and a reasonable rate of interest upon the investment. The amount by which the earnings fail to meet these requirements may thus be regarded as deficits from the operation. These deficits constitute the cost of building up the business of the [illegible] of the cost of building up the business as loss of interest during the construction of the plant is a part of the cost of its construction.

Here there is a clear recognition of the principle that plant value is as surely dependent upon earnings, or business, as upon the physical structure, and of the fact that public utilities generally reach a paying basis only after years of operation at a loss.

EFFECT OF THE APPLETON CASE.

Notwithstanding these decisions of August 3, 1909, so strongly supporting the "Original Cost and Deficit" method of determining the investment for a public utility, as against the "Present Value" method, in the case of the "City of Appleton vs. Appleton Water Works Co.," decided May 14, 1910, the Commission take quite a different position.

They quote with disapproval page 221, two Pennsylvania cases, apparently the only two extant that seem to support the doctrine laid down in the three cases referred to, because, as they contend, the rule adopted by the Pennsylvania courts is subject to serious objections. To quote:

> It would impose upon the public, in some cases, the obligation of paying returns upon extravagant and unwise investments. It can only be accepted as sound when the money sunk in the investment has been prudently expended and is clearly not so excessive in amount, in comparison with the actual present value of the investment, that to pay a return upon it would require the exaction of rates that are unusual, or higher than the value of the service to the customer.

It is to be observed that in this statement the Commission appeals to the "Present Value" to test the correctness of the "Original Cost," which is the same as saying if the "Original Cost" method brings the *"Actual Present Value of the Investment,"** it may be followed, otherwise not.

The following, pp. 276 and 277, Appleton case, is a still further repudiation of the "Original Cost and Deficit" doctrine:

> The entire excess of cost over operating revenues incurred in developing the business and establishing the same upon a self-sustaining basis is not in every instance an inflexible criterion by which the element of going value is measured, for if it were so considered its application would often lead to a reductio ad absurdum. Thus, the longer the period of development necessary to attain the point where the debits and credits balance, the greater might be the going value, and if such period were abnormally or unusually long, it would often result in an unreasonable excessive going value, depending upon the time the appraisement was made and other circumstances of the particular case considered.

The final outcome in the Appleton case is a full justification of the position taken by the courts, and practically leaves the present value method in undisputed control of questions relative to the investment in public utilities for either rate making or for sale purposes.

Even such statements as the following from the Brunswick case, that

> In determining what would be a fair return, undoubtedly the amount of money actually and wisely expended is a primary consideration. Actual cost bears upon reasonableness of rates as well as upon present value of the structure as such. It thus bears upon what is a fair return upon the investment and so upon the value of the property. In estimating structural value, prior cost is not the only criterion of present value, and present value is what is to be ascertained. The present value may be affected by the rise or fall of prices of materials. If in such a way the present value of the structure is greater than the cost, the company is entitled to the benefit of it. If less than the cost the company must lose it. And the same factors should be considered in estimating the reasonableness of returns.

do not invalidate the last conclusion, for Judge Savage distinctly says if the present value of the structure is greater than the cost, the Company is entitled to the benefit of it, and if less the Company must lose it.

"And the same factors should be considered in estimating the reasonableness of returns."

The doctrine contained in this case clearly is that prior costs may be evidence to show present value, but the present value is the only ultimate criterion for determining the investment, whether for sale, or for determining the reasonableness of returns.

The Wisconsin Commission occupies a conspicuouos position, being invested with great powers as affecting public utility values in that state. And because of the recognized ability and fairness of the commissioners, and because their findings are semi-judicial in nature, they will necessarily be quoted, and in a measure relied upon, the country over.

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*Italic not in the original.

For these reasons and because their early decisions run counter to the consensus of the opinions of practically all of the higher courts in the land, we are justified in examining them critically and in testing their soundness in every available manner, so that if the facts assumed by the commission and the reasoning therefrom are faulty, it may be discovered.

The following quotation from the Antigo Water case, pp. 94 and 95, contains a substantial epitome of their argument against the "Present Value" method of obtaining the investment:

> As already intimated, engineers and other ap- [illegible] and have [illegible] plants into consideration. They have held, in substance, that such plants are worth more with than without an established business, and that [illegible] closely dependent upon the cost of establishing the business, as well as upon the earning power of the business so established. In other words, they look upon both the cost and the earnings of a business as proper elements of consideration in determining its value. Many among them, in their appraisals, appear to have attached greater [illegible] to the earnings of the business than to the cost. It is stated above that the net cost of building up the business would seem to be a legitimate item for the capi- [illegible] plant upon which its rates are based. Whether this can also be said of the earning value, appears to us extremely doubtful. Earning values are usually determined by capitalizing net earnings, or by comparisons, which amount to about the same thing, and such values can hardly be equitable for rate-making purposes.
>
> There are many reasons why the earning capacity or earning value of the business cannot be a just basis for rates. Other things being equal, the earnings of a plant depend upon its rates. Under such conditions raises in rates will increase the earnings. The earnings at the time of the appraisal may also be derived from rates that are unreasonably high.

In this the commission confuses methods, and arguments sometimes used and advanced by individuals who may at times be called upon to aid in the appraisement of public utilities, with the settled consistent doctrine expounded by the clearest thinkers that have occupied, or still occupy benches in the highest courts.

As far as appears no appraiser has ever held that the element of going concern value is dependent upon the cost of establishing the business, while at the same time contending that it is dependent upon the earning power of the business so established.

But if such should be the case, it does not discredit the soundness of the contrary view that cost is never as such, a measure of value, and if cost and value correspond, it is more of a coincident, or accident, than otherwise.

It is erroneous to assume, as the commission does, with reference to appraisements, made by engineers and others, that,

> Earning values are usually determined by capitalizing net earnings, or by comparisons, which amount to about the same thing.

If some appraisers inclined to the capitalizing of net earnings before the Brewer decision in the Kansas City case, it was to determine the whole value of the plant, and not merely the element of going value.

This method, however, was removed from controversy by Judge Brewer in holding it inadmissible. With just as such emphasis, however, he held that,

> The original cost of the construction cannot control, for "original cost" and "present value" are not equivalent terms. Nor would the mere cost of reproducing the water works plant be a fair test, because that does not take into account the value which flows from the established connections between the pipes and the buildings of the city.

The principles established by Judge Brewer's opinion as sound in doctrine as well as in law, are that capitalizing net earnings is inadmissible.

Original cost is eliminated, because "original cost and present value are not equivalent terms."

The mere cost of reproduction is not sufficient, "because that does not take into account the value which flows from established connections between the pipes and the buildings."

Now, what is this value which flows from the established connections? In what does it consist? Whence does it come? Judge Brewer did not give it a name, nor did any one in Kansas City case, though some of the attorneys contended that the business, and the plant as a whole must be taken upon the basis of a "going concern."

Obviously it has to do with something that has economic value, that is the object of human desire, that is sought after. Something for which people will make sacrifice. No one will do this for "Deficits and Losses." One may incur "Deficits and Losses" to attain the sought for object, but they are not the object.

The object desired and sought in the case of public utilities is beyond dispute, service. A service whose value is represented, and measured by certain portion of the probable future earnings of the plant.

This certain portion of the probable future earnings is evidently the thing which enhances plant value, and is the thing to be determined. It has been christened "Going Concern Value," and for short, "Going Value." What is the proper conception of this value? Is it properly characterized by the Wisconsin Commission, in the language of the Wisconsin Telephone case? That,

> Every effort honestly put forth, every dollar properly expended, and every obligation legitimately incurred in the establishment of an efficient public utility business, must be taken into consideration in the making of rates. Collectively, these elements must be characterized by the term "going value."

Surely this was not the conception of Judge Brewer, for the uncompensated cost of building up the business of which the commission speaks, the expenses and obligations, are but "original costs," which Judge Brewer held were not the equivalent of present value.

What is it then but the earnings which the operating plant can and will produce in the future, which could not be obtained if such plant had had no existence? that is the difference in the net earnings of the operating plant, and the possible net earnings of a hypothetical plant if it were started today in the same though a new and unoccupied field?

That the Wisconsin Commission are not fully satisfied with their characterization of "going value" has been shown by the fact that while in the three cases decided Aug. 3, 1909, it is conceived of as dependent upon the cost of building up the business; that is, upon the deficits of operation; in the Appleton case this was held not to be an inflexible criterion, because, according to the commission, if the deficits are too large and continue over too long a time, the "going value" becomes too great.

It is pertinent to inquire, how is one to know that it becomes too great? What is the standard of magnitude? If the costs and deficits have been necessary in the conduct of the business, if they could not be avoided, and they are to be the measure of value, why should they be excluded if the theory is sound? If they are legitimately a part of the investment and were properly incurred, their magnitude is of only secondary consequence.

The courts foresaw all of these difficulties and kept clear of them by repudiating the theory that deficits or costs represent value.

To state the proposition that the greater the deficit the greater the value; that is, the greater the loss, or the less business the plant has the more it is worth, is to reduce the "original cost and deficit" theory to a *reductio ad absurdum*.

The difficulties which the commission encountered, and which some other minds encounter, is basing "going values" upon revenue which may be too high, are only imaginary. The discriminating appraiser can determine from the revenue, within small limits, whether the rates are too high as a whole, to give a proper basis for computing going value, and he can always correct the going value to conform to the proper revenue after it has been determined.

(Continued next week.)

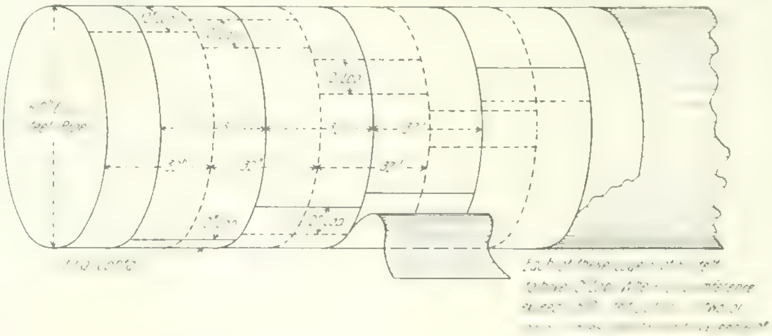
Method of Protecting Steel Pipe Water Mains From Electrolysis, Springfield, Mass., Water Works.

BY WM. S. BABCOCK.

In the new water supply for Springfield, Mass., a 42-in. steel main carries the water from the filter plant* to the city, a distance of some 11½ miles. Although this article deals especially with the insulation, or what might be called the electroproofing, of the pipe, it is the writer's belief that a short description of the dipping of the pipe to prevent tuberculation will be of interest.

Coal Tar Pitch with a softening point of 60° F., and a melting point of 100° F., was used, and to this 3 per cent of linseed oil was added. (Experience in this work shows the linseed oil to be unnecessary.) The pitch was run from barrels into which it was shipped into a small tank, where it received the necessary amount of linseed oil. It was then drawn off into the large vertical dipping tank and kept constantly at the coating temperature of 350° F., by means of steam coils. The pipes were 30 ft. long and 42 ins. in diameter and of the lock-bar type, being heated to a temperature of practically 300° F., before dipping into the bath.

The pipe itself was first cleaned of mill scale by means of wire brushes. This process is, by the way, a most important one as any rough adhering particles tend to cause a spreading of the pitch upon draining, and also to cause the coating to scale and peel, leaving bare spots, the result being a coating of uneven thickness over the area surrounding the particle.



Sketch Showing Manner of Protecting Steel Pipe Against Electrolysis.

Fresh pitch and oil were specified to be added when necessary to keep the mixture at the proper consistency and the vat was to be emptied of its contents and refilled with fresh pitch when deemed necessary by the engineer in charge. However, in actual work it was unnecessary to empty the vat at any time. After being coated the pipe was carefully drained of surplus coating.

All handling of the pipe was done by means of electric hoists. After immersion the excess of coating was allowed to drain off into the tank and the pipe was then stood upright upon an iron plate until the coating was thoroughly set and nearly cold. It was then picked up and swung on to a flat car.

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*Methods and cost of constructing this filter plant were given in our issues of Jan. 18 and 25 and Feb. 1, 1911.

being blocked up free of the floor and protected from the other lengths by means of canvas strips. Five lengths or 150 ft., constituted a carload. With the use of one tank and two hoists about 1,500 ft., or 10 carloads were coated in one day.

The facility and little annoyance from irregularities during the job of coating was quite remarkable. Very little pipe had to go back for further treatment. In the field it was necessary to replace the coating knocked off in riveting the joints with a Coal Tar Paint which was brushed on by hand.

Inspection of the coated pipe showed it to be protected by a uniform layer, bright, smooth and hard enough to resist the shock and wear incident to laying, leaving it still tough and tenacious. A sharp rap with a sledge hammer would not chip off the coating except immediately under the hammer? An attempt to clean off a length of pipe which had been badly dented by falling showed the coating to have penetrated the smallest depressions in the steel and to have fairly become a part of it.

Protection Against [illegible] Owing to the conditions at Springfield, Mass., namely, of the nearness of the electric railroad to the water mains, it was found necessary to use some method for the protection of certain sections of the pipe from electrolysis. The following methods were used as per the sketch, Fig. 1.

The steel pipe was covered with from two to eight plies of felt and pitch, the felt being specification felt, weighing 14 to 16 lbs. per 100 sq. ft. single thickness, and the pitch used was straight run American coal tar pitch, or what is known as Specification Pitch, 30 lbs. being used to each mopping per 100 sq. ft.

The felt was cut in strips 12 ins. longer than one-half of the circumference of the pipe. The pipe was mopped on the top half and the felt immediately applied to the pipe while the pitch was hot. The felt strips were laid single fashion so as to break joints every 16 ins. for as many plies as were required. After the required number of plies of felt and pitch had been applied the pipe was turned over and the bottom half now be- [illegible] way.

Where the pipe was subjected to direct currents of electricity 8 plies were used, and as the electric currents lessened the plies diminished. After the pipes were placed in the ground and riveted, the joints were covered with the same number of plies of felt and pitch as had been applied to the pipes.

The cost of this insulation was 17¼ cts. for one-ply of felt and pitch applied to 1 ft. lineal of pipe 11 ft. in circumference, or practically $1.57 per 100 sq. ft. for one mopping of pitch and one layer of felt.

This work which was commenced in September, 1908, and completed in October, 1909, required some 12 miles of pipe 11 ft. in circumference, and was built under the supervision of Mr. E. E. Lochridge, Chief Engineer of the Springfield Water Works. The work was planned by the firm of Hazen & Whipple. The dipping of the pipes was done by the East Jersey Pipe Co., and the pitch for dipping and the felt for electroproofing were furnished by the Barrett Manufacturing Co.

DRAINAGE AND IRRIGATION SECTION

The St. Francis Valley Drainage Project With Estimates of Cost and Data on Costs of Ditching by Various Methods.*

The St. Francis Valley is situated in southeastern Missouri and northeastern Arkansas. Beginning about 100 miles south of St. Louis, it extends southerly more than 300 miles to the mouth of the St. Francis River near Helena, Ark. It is bounded by the Mississippi River on the east, and by a low narrow rise of land, known as Crowleys Ridge, on the west. At the north the flat valley ends abruptly at the foothills of the Ozark Mountains. (See Fig. 1.)

The area considered, including about 1,600 square miles, or more than 1,000,000 acres, extends from the Arkansas-Missouri state line south into Arkansas for about 65 miles. The greatest width, from Crowleys Ridge to the Mississippi River opposite Jonesboro, is about 50 miles. About 1,500 square miles of land in the district are partially or wholly undrained. A considerable amount of land along the Mississippi River front is now in cultivation, as are smaller areas in the interior, but very little is thoroughly drained. Nearly all land in the entire area upon which a crop can be made in favorable years either is in cultivation or is being cleared for that purpose; and much land is in cultivation which is so wet as to be unprofitable for crops. Perhaps a third of the district remains under water for weeks or months at a time during wet seasons, while the lowest parts are usually submerged for the greater part of the year.

SUMMARY OF THE [illegible]

The plan includes: (1) Provision for carrying through this district the water discharged from more than 4,000 square miles in Missouri and from Clay and Greene counties in Arkansas, 1,500 square miles of which are hilly or mountainous territory. (2) Provision for main drainage channels to carry the drainage water from more than 1,500 square miles within the district. (3) Provision for a complete system of detail drainage. (4) Adjustment of the [illegible] requirements of navigation, power development, and other interests.

The proposed reclamation works may be outlined briefly as follows: A floodway between dikes to carry the water of the St. Francis River is planned to extend from the north line of Craighead County southerly along St. Francis Lake to the south to its south end; thence southwesterly to Big Bay and down Big Bay to the enlarged channel near its mouth. A branch floodway similarly constructed to carry the waters of Little River is planned to begin at the state line and to extend southerly along Big Lake, and thence in a general southwesterly direction to the St. Francis floodway. The bed of St. Francis Lake will form a regulating reservoir, making possible the use of a smaller floodway than would otherwise be practical. In excavating earth for building the floodway levees, large ditches will be constructed outside the floodways, which will be used to their full capacity for carrying the drainage water from the adjacent land. The channels of St. Francis and Tyronza rivers and Little River, being thus relieved from the flood waters of Missouri, will be improved sufficiently to carry the remainder of the waters of the district. A system of lateral ditches averaging 1 mile apart will furnish thorough drainage for every part of the area.

CONSTRUCTION METHODS AND COST.

General Physical Features.—The St. Francis Valley within the proposed district is a flat plain with few local irregularities. The network of bayous and brakes characteristic of alluvial lands farther south in the Mississippi Valley is lacking here. The lateral ditches will be quite uniform in depth, ranging with few exceptions from 7 to 10 ft. Many of the shorter ditches can be dug either upstream or downstream as is more convenient. By a proper planning of the construction sufficient water for floating dredges can be had in nearly all parts of the district. On the other hand, by working upstream from the lower end sufficiently complete drainage can be secured for constructing the levees and ditches along the floodway with land machines. Perhaps 90 per cent of the proposed work is in wooded land. As the main drains and floodways are located on the lowest land, the heaviest timber will not be encountered over a large part of the main system. In the construction of lateral ditches the ordinary timber of the country must be removed.

The numerous railroads afford a means for supplying [illegible] but very few railroads of importance will have to be crossed on the work. The few wagon road [illegible] and October are usually dry. It is customary [illegible] but conditions for work are most unfavorable during July, August and September, and it might be found profitable to stop work during [illegible] to spend those months where sanitary conditions are more favorable. During other parts of the year health conditions are as good as in any other part of the country.

Character of Earth.—Perhaps 90 per cent of the excavation required on this project is in the ordinary alluvial soil of the upper St. Francis Valley, and a description of this type will indicate in general the soil conditions to be encountered. This soil contains absolutely no rock and no hardpan. The partial investigation made and the experience of dredge men indicate that little if any sunken timber will be encountered. The soil itself varies from a stiff clay to a light sandy loam. In some places there are considerable bodies of sand, but as a rule this occurs in thin layers, alternating with loam or clay.

With one or two exceptions which could not be avoided no ditches in the entire system were planned to be more than 10 ft. deep. Perhaps 50 miles of ditches have already been constructed in various parts of the district. Generally the ditch banks remain permanently in about the same condition as they appear a year after construction; during construction, as a rule, they do not cave to a serious extent, and the filling of the ditch during construction is not a serious matter. The waste banks hold their shape with side slopes of 1 or 2 to 1 for indefinite periods.

About the only opportunity in the interior to observe the ability of the ground to hold a fill, such as the levees which are planned along the floodway, is seen where the St. Louis and San Francisco Railroad crosses the St. Francis bottoms. Here a fill of 20 ft. or more extends through the lowest and wettest lands of the district. No tendency to unusual settling or to a bulging of the adjacent ground has been observed on this road. At a point on the Iron Mountain R. R. east of Parkin a fill has caused the adjacent ground to slide and to bulge upward to a height of 6 ft. or more. It is doubtful if this difficulty would have occurred had a fill been constructed with as flat slopes as are planned for the floodway levees. However, it may be that at some points along the line of the proposed floodway this difficulty will be met and a survey for definitely locating the floodway should include a careful examination of subsurface conditions, with the object of avoiding, as far as possible, any construction on an unstable foundation. It is believed that such a location can be made without materially increasing the length of the levees.

Considered as a material for levee building, this soil will compare favorably with that along the Mississippi River front, of which the river levees are constructed. They will not, however, be subjected to as severe tests as the Mississippi [illegible] will occur only once in several years and will last but a few days, so that the levee sections will not become saturated except at the base.

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*Condensed from Bulletin [illegible] Office of Experiment Stations, U. S. Department of Agriculture, by Arthur E. Morgan [illegible] Drainage Engineers.

The fact that most of this area is timbered adds to the cost and difficulties of excavation to such an extent that the contract price will, on the whole, be perhaps 1 ct. a yard higher on account of timber; but, aside from this factor, it is the opinion of dredge men of large experience in this region that no better soil for dipper dredge excavation is found in the United States. For hydraulic dredge excavation the only adverse factor in the soil conditions is the cost of removing stumps and roots, and the same may be said of excavation by drag scraper excavators.

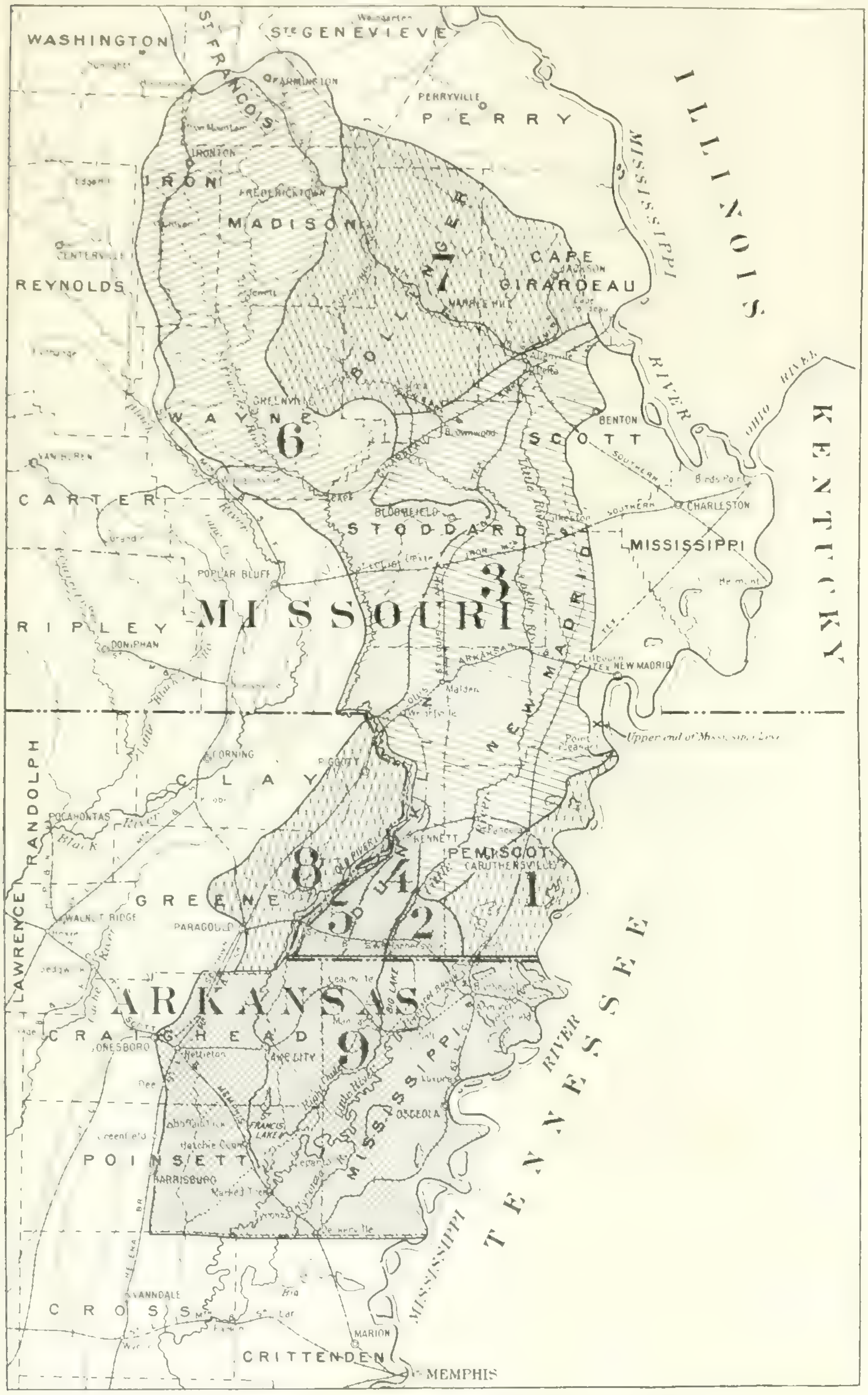

Fig. 1—Map of St. Francis Valley Drainage District.

The Cost of Clearing.—Almost all the proposed work is through wooded land. Over the route of a part of the ditches the trees are small and scattering, and the clearing of right of way will be a small item, over a large area the timber is the usual hardwood growth found in that region, while in a few instances the right of way follows cypress brakes where clearing will be difficult.

It is assumed that in clearing the right of way for the floodways and for the larger ditches, skidding machines or other devices for removing timber will be used. Along the line of the floodway it may prove economical to construct a light temporary railroad for removing timber and facilitating the clearing. The clearing of right of way by cutting stumps low and removing or burning trunks and branches is estimated at $20 per acre for all the work proposed, excepting lateral ditches to be constructed with dipper dredges, in which case the clearing of right of way is included in the cost of excavation. About 25 ft. of the levee base will be cleared of stumps in digging the muck ditch with a dipper dredge. As most of the levee base will be continually wet, and not alternately wet and dry, as is the case with the Mississippi levees, it is not thought necessary to grub stumps for the remaining part, except those of cottonwood and other similar timber which decays most quickly. Other stumps shoudl be cut close to the ground.

It will be necessary to remove stumps from the ditch section in order to operate successfully either suction dredges or drag scraper dredges. Such clearing is estimated to cost $150 an acre in addition to the excavation. Very little cypress will be found along these ditch lines and most of the other trees have shallow roots. Little or no timber is believed to be at a distance below the surface.

In making an estimate of the cost of clearing timber from the right of way, the principal lumbering firms of the district were consulted, and the opinion was expressed by nearly all of them that the work can be done for less than the estimate used in this report.

Fuel.—Wood is available for fuel in nearly all parts of the district, at a cost of 75 cts. to $1.25 a cord, delivered on the right of way. It is expected that wood may be used for fuel in constructing the lateral dredge ditches wherever the work is not so located as to make other fuel readily available.

Coal costs $3 to $3.50 per ton delivered at the stations of the district. In the excavation of the main drains, with proper management in arranging the sequence of the construction, coal can be delivered by barge to nearly all parts of the work. Where it can not be so delivered, some other fuel would probably be used. In all of the work proposed for a hydraulic suction dredge, coal could be delivered to the dredge by barge, and the same is true of most of the larger dipper-dredge work. In the construction of the work upstream by means of drag-line scrapers, some difficulty might be encountered in getting coal to the boat by barge, but it is believed that this would not be serious. Oil is available for fuel from the oil fields of Louisiana, Texas, Oklahoma, Kansas, and Illinois; several oil fields being about equally distant.

EXCAVATING MACHINERY.

Of the many types of excavating machines now in use only a few are especially adapted to the work of this district. Among these are floating dipper dredges, drag-scraper excavators, and hydraulic suction dredges. It is possible that an endless-chain levee-building machine might be adaptable to the construction of the floodway levees.

The Dipper Dredge.—The advantages of the dipper dredge over other types of excavators are: Its adaptability to all conditions of excavation where there is sufficient water to float the boat; its great strength for digging tenacious soil or in removing stumps and roots; and the low cost of excavation by its use. The disadvantages of this type are: Its inability to construct ditches of less than about 100 sq. ft. cross section; the necessity for floating a large boat; the ragged and uneven cross section which is usually left; the practical limitation of the machines to ditches of not more than about 800 ft. cross section; and the insufficient berm which is of necessity left on the larger ditches. Small dredges of light construction are made to float on boats with 10 or 12 ft. hulls, but as they are not adapted to excavation in timbered lands, their use is not advisable in the St. Francis Valley.

No machine is so well fitted as the floating dipper dredge for digging all but the largest of the lateral ditches on this project. It has been adapted by long experience to this class of work.

The cost of construction with the floating dipper dredge varies according to the section to be excavated, the total amount of excavation on a job, the amount of water available, the character of the excavation, the timber to be encountered, and the type of the machine. The actual cost to the contractor of excavating with a high-grade modern dredge in a timbered region where conditions of soil and water supply are favorable, and where a large piece of work is suitable for the machine, should be from 3 to 5 cts. per cu. yd., including clearing of the right of way, repairs, and maintenance. This project furnishes a large amount of work where every feature is favorable for most of the ditches, except the necessity of clearing the right of way, and, in some instances, the difficulty of procuring water during the entire year; and it is believed that under these conditions an estimate of 8 cts. per yd. for this excavation is conservative. Work is now being let in this region for from 7.5 cts. to 8.5 cts. per yd., including the clearing of right of way.

The Drag Scraper Excavator.—This type probably will not be used except in building the levees along the floodway. Where a section of levee is of less than 800 sq. ft. it can probably be used to better advantage than any other excavator after the ditch section is cleared of all large stumps. It is one of the more successful types of excavators used on the New York Barge Canal. The scraper bucket is suspended by cables from the end of a long boom. The entire machine swings on a circular turntable. The bucket is filled by pulling it directly toward the center of the machine by means of a cable, so there is no strain on the boom except that due to its own weight and the weight of the bucket and its load. As a result, the booms of this type of machine can safely be made lighter and consequently longer than is the case with the booms of dipper dredges of similar size and strength. A boom 90 and perhaps 100 ft. long giving a reach of 100 or 110 ft. from the center of the machine to the end of the boom is practicable with this machine. An excavator of this type on the New York Barge Canal which was carefully examined has an 85-ft. boom and a reach of 96 ft. from the center of the machine to the end of the boom. The entire weight is 147 tons. A 2-yd. dipper is used, which, in operation, is usually filled full, and sometimes carries 4 yds. at a load. The engine is of 50-hp. capacity, though the boiler is rated for 54 hp. The runner considered the machinery strong enough for the use of a 3½-yd. dipper. This machine easily excavated earth 90 ft. from the center of the machine on one side and deposited it 100 ft. from the center on the other side. At the time the machine was visited it was digging a channel 25 ft. deep and depositing the material on a waste bank between 15 and 25 ft. high without difficulty. Table I indicates the cost of operating this machine for the season of 1908, and gives the cost per yard of excavation:

In May the items of cost of operation were as follows:

Engineer, at $90 per month	$ 90.00
Engineer, at $95 per month	84.04
Firemen, pump men, watchmen and laborers, at $1.75 per day	363.00
Coal, at $3 per ton	147.00
Repairs	15.82
Total	$699.86

The first cost of this machine was $10,000. It will be noted that the cost per yard for the season, including the expense of setting up the machine, with an estimate for interest and depreciation, amounts to 4.1 cts. per yd. The excavation made during this season was in a cut 25 ft. deep and about 100 ft. wide on the bottom. The material was a stiff clay for the most part, but few, if any, stumps or boulders were removed. The machine is moved forward on the work by means of cables. The cost of moving would have been reduced by an arrangement of gears attached to the axle. Similar machines are stated to excavate earth for levee building in Louisiana at a cost of 3 to 4 cts. a yd. The United States Government is constructing levees near Greenville, Miss., by the use of one of these excavators. On a trial run of ten days it excavated at a cost of a little more than 2 cts. a yd. Most of the work for which it is used, however, is in topping out old levees. Major Walker, of Memphis, states that in doing this work the machine will excavate about half as much earth as when making a new cut and building an entirely new levee. On the work for which he had estimates, the cost for the entire camp, as near as he could determine, in excavating earth, topping out the levees, and putting them in condition for seeding, was between 7 and 8 cts. a cu. yd.

TABLE I.—DRAG SCRAPER MACHINE AT WORK ON NEW YORK BARGE CANAL.

Item.	April.	May.	June.	July.	August.
Fitting up	[illegible]	......	......	......	......
Excavation	[illegible]	[illegible]	$747.77	$ 850.69	$1,118.57
Repairs		15.82	62.60	48.23	75.12
Interest and depreciation, 21 per cent	175.00	175.00	175.00	175.00	175.00
Shifting on work	......	(a)	.....	77.02	.....
Total for month	[illegible]	$875.11	$985.37	$1,150.94	$1,368.69
Average cost per yard	$0.177	$0.048	$0.0388	$0.0348	$0.0289
Yards completed during month	[illegible]	18,365	25,333	33,055	47,363

(a) Machine fell into canal.
Average cost for the season, including all charges, 4.1 cents per yard.

Another [illegible] the Tower excavator. The principal parts of this apparatus are a hoisting engine; a tower 65 ft. high, guyed to cables extending to the ground on each side, where instead of being stationary, they slide on other cables stretched parallel to the ditch and fastened to deadmen, thus giving stability to the tower, while allowing it to move parallel to the ditch; the scraper bucket in which the earth is moved; and cables for operating the bucket. The machine is built upon a platform and is moved on rollers by winding a cable fastened at one end to a deadman. A more efficient provision for moving the machine would doubtless result in considerably reducing the cost of operation. The entire machine as illustrated cost about $1,500. With the strengthening of parts necessary to fit it for extra-heavy work the cost would [illegible] of which $1,200 would represent the cost of a hoisting engine.

In operating the excavator the bucket is loaded by pulling it toward the tower by winding up the cable, which, passing over the lower sheave on the tower, is attached to the front end of the bucket. The bucket is then dumped by winding over the drum the cable which passes over the sheave on top of the tower and which is attached to the back end of the bucket. The bucket is returned to the ditch by further tightening the upper cable and loosening the lower one, when it quickly slides back by gravity to the starting point. The earth is deposited between the ditch and the machine.

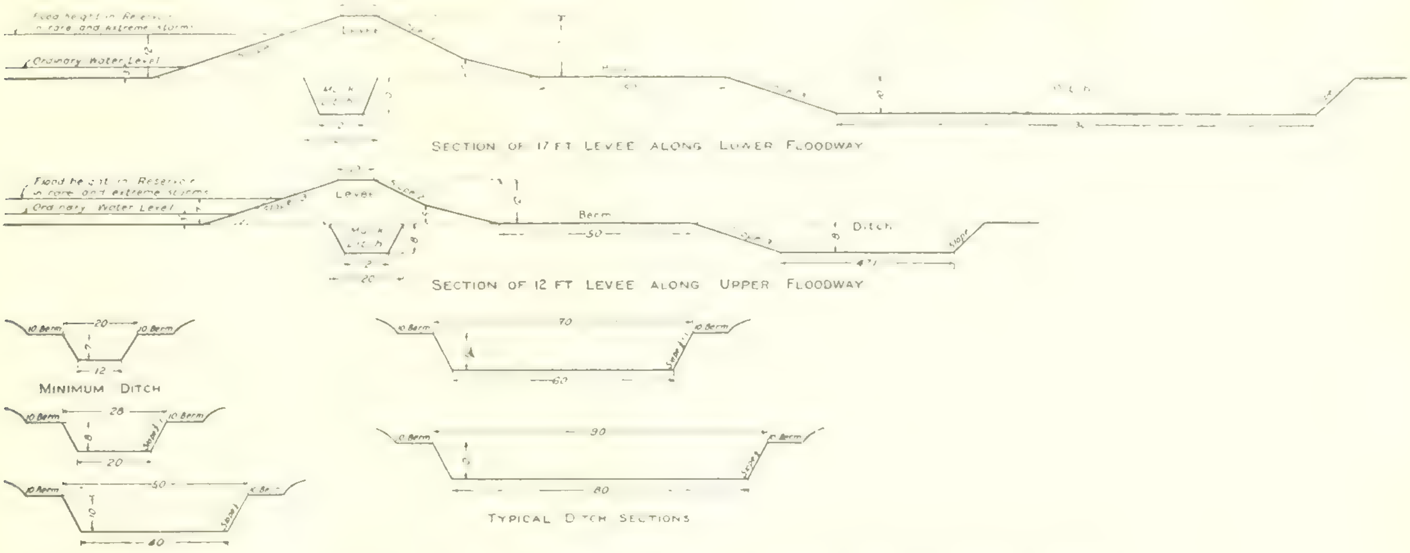
Flood height in Reservoir in rare and extreme storms
Ordinary Water Level
Levee
Muck Ditch
Ditch
SECTION OF 17 FT LEVEE ALONG LOWER FLOODWAY
Flood height in Reservoir in rare and extreme storms
Ordinary Water Level
Levee
Berm
50
Ditch
47
20
SECTION OF 12 FT LEVEE ALONG UPPER FLOODWAY
10 Berm
20
12
MINIMUM DITCH
28
20
50
40
70
60
90
80
Slope
TYPICAL DITCH SECTIONS

Fig. 2—Levee and Channel Sections, St. Francis Valley Drainage District.

The following is the cost for each eight-hour shift in operating this machine:

Engineer	$ 3.00
Fireman	2.00
Foreman	3.00
Signal man	2.00
Cable setter	1.60
Horse and team, moving, etc.	3.00
Laborers, at $1.60 each	6.40
1½ tons of coal to the shift at $3 per ton	[illegible]
Total	[illegible]

If to this is added $1.50 per shift for maintenance, depreciation, interest, and repairs at the rate of 50 per cent per annum on the original cost of the investment, the total cost per shift is $27.

By arranging for the operator to work from a station in the tower, where the work would be in full view, the signal man would be eliminated, and by placing the machine on a track with an arrangement for moving the machine ahead on the work by means of gearing attached to the axles probably two or three more men could be dispensed with, thus further reducing the cost.

The bucket used on this machine had a capacity of about 2 yds., but in ordinary operation at least 3 yds. were carried at each load. While in operation about 1 bucketful was excavated and deposited in each forty seconds. This would make a rate of 4 cu. yds. a min., and the contractor was of the opinion that he could maintain an output of 1,000 yds. per eight-hour shift for an entire season's run on continuous work of a favorable character. The work actually done was not carried on continuously, and the best record made was

100,000 cu. yds. per month for two shifts [illegible] shifts this would amount to [illegible] cts. per yd. for the month's work.

The machine has a reach of 210 ft. from the far side of the ditch to the near side of the waste bank. That is, all the dirt must be excavated and deposited in a space of 210 ft., making a waste bank about 20 ft. high if necessary. The bucket is remarkably well under control.

This machine was in many ways crudely built, and its excellent record is due apparently to the exceedingly simple principle of its operation, and to the economy of power, motion, and time in excavating. The bucket moves on a straight line, across the excavation and up the waste bank and when dumped slides with great rapidity down the tightened cable to the position for digging.

With a construction including modern devices for moving on the work and the improved bucket, it seems that this should be a very important addition to the types of excavating machinery. It is fitted for digging ditches 20 to 100 ft. wide and 2 to 30 ft. deep, though its greatest economy of operation is in constructing the larger sections.

The Hydraulic Suction Dredge.—For the construction of the larger levees the use of the hydraulic suction dredge is entirely feasible in connection with the use of other excavating machines. Figure 2 illustrates sections of the proposed levees and ditches. By the construction of the muck ditch a retaining bank will be built to as great height as the earth can be made to stand. A similar retaining bank will be constructed at the other toe of the levee by depositing earth excavated from the nearest margin of the ditch. The space between these two retaining walls can then be filled by a hydraulic suction dredge, the pipe being supported by a cantilever. This machine, Plate 1, figure 2, in its present state of development probably represents the most economical method now in use for excavating very large channels, unless the ladder dredge be excepted.

Table II indicates the cost of operating a hydraulic suction dredge on the New York Barge Canal in 1908. The dredge in question is of modern construction, has a 20-in. discharge pipe, and cost $115,000. A large part of the excavation was in stiff clay, though a part was in sand. The clay was of such firm texture that after remaining on the ground over winter the pieces had the same shape as when they were discharged from the end of the pipe line, still showing the marks of the cutter. While removing the old rock wall of the canal the dredge was stopped sometimes 20 times a day, it is said, for removing boulders from the pump. Once during the season the dredge was sunk to the bottom of the canal. Otherwise the work was favorable, and the excavation made was representative of the capacity of the machine in ordinary clay soil. The charge against plant is intended to cover interest and depreciation at 15 per cent per annum. Under "Material" are included coal waste, tug hire, and similar items.

An examination was made of several suction dredges on the New York Barge Canal and of the material excavated by them. In only one instance was the material at all comparable with that to be excavated in building the floodway levees, and in that instance the material was being removed at a cost of about 2½ or 3 cents per cu. yd., including all cost of maintenance, depreciation, repair, and interest. The work planned for this type of machine on the St. Francis project is the excavation of large ditches outside the floodways, using the earth for constructing levees, and in dredging the channels of Tyronza and Little rivers. In the former case the work is estimated at 10 cts. per cu. yd. plus the cost of clearing and grubbing the ditch section at $150 per acre. In the second instance the work is estimated at 9 cts. per yard, including the cost of clearing banks to enable the material to be deposited. This dredge can be used to advantage also for constructing two or three of the largest lateral ditches, which empty into ditches along the floodway.

BASIS OF ESTIMATES.

The estimate of cost of excavation was made by determining as nearly as possible the actual cost to the contractor of similar work and by placing the estimate at about twice the approximate actual cost.

An estimate of $150 per acre is considered sufficient for clearing the right of way of the ditch preliminary to using any of these machines. Two of the drag-scraper machines first described, following each other, would be sufficient for building the largest of the levees planned on this project. By working upstream sufficient drainage would be secured for their successful operation, and the levee is planned of such section that there would be no doubt about the material remaining in place. In addition to the cost of clearing the right of way and grubbing the ditch section it is estimated that 9 cts. per yd. is sufficient for excavating the earth and building the smaller levees, and that 10 cts. per yd. in addition to such clearing and grubbing is sufficient in case of the larger ones.

The cost per yard of building levees usually includes the digging of a muck ditch and grubbing the levee base. This method is replaced in the present plan by the construction of a very large muck ditch by means of a dredge, the cost of which is estimated in addition to building the levees. This change would amount to an addition of between 1 and 2 cts. a yd. if the work had been calculated in the usual manner. If the entire cost of digging muck ditches and clearing right of way is considered as a part of the cost of building the levee section, the estimate amounts to between 12 and 13 cts. per cu. yd. In addition the levees are made of large section, and the yardage may be measured in the excavation instead of in the fill, as is usually the case. As 10 per cent shrinkage is usually provided for, this would make an additional difference of about ½ ct. per yd.

The greater part of the Mississippi levees were constructed years ago, when levee-building machinery was not well developed. Many of the jobs let now are for topping our old levees or for building short loops. Quite commonly the separate jobs are not large enough to justify the installation of expensive equipment, and often must be done on short notice when there is not time to install such equipment.

Specifications for levee work nearly always prevent a continuous borrow pit, require a very wide berm, and impose other conditions which make the use of levee-building machinery impossible. The very different conditions under which these levees will be built and the difference in conditions after they are built make unnecessary some of the requirements usually made in levee construction. Some of these favorable conditions are shorter duration of floods against the levees, with correspondingly small seepage, and a perfectly unbroken ground surface in the floodways, with an exceedingly large and deep muck ditch, which also reduces the seepage.

It is seldom that a large piece of levee construction is let in which conditions for the operation of a single type of machine are so uniformly favorable. The estimate on this work is not made as applicable to usual jobs of levee construction.

UNIT PRICES OF ESTIMATE.

For all lateral ditches excavation is estimated at 8 cts. per yd., including the cost of clearing the right of way. The earth usd for building levees should be measured in excavation, and no shrinkage need be provided for, as the levees are planned to be of sufficient size after shrinkage has occurred. This provision will reduce the unit cost of work to the contractor more than 1 ct. per yd. as compared with the usual methods of calculation. No grubbing of the levee base will be required, and the muck ditch, to be constructed by a dredge, will be paid for in addition to the fill. An estimate of $150 an acre is made for grubbing and clearing the ditch section, which will serve as a borrow pit for earth, and $20 an acre for clearing the levee base and berm. It is anticipated that all levee construction will be by machinery. Levees under 12 ft. in height are estimated to cost 9 cts. per yd. and those over 12 ft. 10 cts. per yd. for fill. These prices correspond to 12 and 14 cts. per yard for levee work as ordinarily calculated, including shrinkage, muck ditches, clearing, borrow pits, dressing slopes, and similar items.

Excavation in the channels of Tyronza River and the Right-Hand Chute of Little River is estimated at 9 cts. per yd., including the cost of clearing right of way.

Clearing right of way for the floodways and levees is estimated at $20 per acre, and grubbing the ditch sections along the levees, so that hydraulic dredges or drag-scraper machines may operate successfully, at $150 per acre.

Nearly all ditches are 10 ft. deep or less. The width of right of way is estimated to be three times the top width of the ditch, plus the width of berm, and all right of way on the entire project except that in old channels or meandered lake beds is estimated to cost $20 per acre. Along Tyronza River and Right-Hand Chute a right of way 100 ft. wide on each side of the channel is specified.

It is believed that every construction included in this plan is abundantly sufficient for its purpose, and that where changes are made as the result of a more complete study of the situation they will be in reductions of dimensions. This is especially true in relation to the floodways. A large factor of safety has been used on every phase of the work except in estimating the unit cost of earthwork. The cost of the work to the district is estimated at twice the estimated cost to the contractor if the work is done in a systematic manner and by the use of modern machinery. The estimates represent about the lowest price at which similar work is being contracted for; but it is believed that with a business management and the sale of the work to the best advantage to contractors able properly to equip themselves, the prices here given need not be exceeded. It is seldom that so favorable a piece of work from the contractors' standpoint is constructed.

Mr. Otto Kochtitzky, of Cape Girardeau, Mo., chief engineer of the Little River drainage district and a large drainage contractor, was asked to give his opinion of the probable cost of this work, and stated his opinion as follows:

> Where 15 miles or more of ditch can be constructed by once installing the machine, the cost should be within the following figures.
>
> Ditch 12 ft. bottom, 8 ft. deep, 8 cts. per cu. yd.
>
> Ditch 20 ft. bottom, 8 ft. deep, 6 cts. per cu. yd.
>
> Ditch 40 ft. bottom, 10 ft. deep, 5½ cts. per cu. yd.
>
> Ditch 60 ft. bottom, 10 ft. deep, 6 cts. per cu. yd.
>
> Ditch 80 ft. bottom, 10 ft. deep, 6½ cts. per cu. yd.
>
> For constructing the levee by use of the scraper-bucket machine for the smaller levee, 12 ft. high, the cost will be about 8½ cts. per yd. above cost of grubbing, and for the larger levee I presume it will run to about 10 cts. per yd. besides cost of grubbing. The muck ditches 20 ft. wide will cost about $1,200 per mile.
>
> My estimate for the dredge ditches is based upon three years' experience in this locality as a contractor and eleven years' employment in this locality as an engineer in charge of such work. The levee construction by scraper-bucket machinery is estimated from my observation of the use of those machines, but with which I have had no experience as contractor

TABLE II.—COST OF OPERATION OF HYDRAULIC SUCTION DREDGE ON THE NEW YORK BARGE CANAL FOR THE SEASON OF 1908.

Item	April.	May.	June.	July.	Aug.	Sept.	Oct.
Labor	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$4,993.11	$4,834.14
Plant ...	408.30	1,367.60	[illegible]	[illegible]	[illegible]	1,692.85	1,791.15
Material	[illegible]	[illegible]	2,263.16	[illegible]	[illegible]	2,430.05	2,573.50
Total for month	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$9,116.01	$9,198.79
Yards excavated	[illegible]	[illegible]	263,474	[illegible]	[illegible]	[illegible]	[illegible]

Unit cost for the season 4.63 cts. per yard.

and the prices at which similar work has been lately contracted.

I have no doubt the cost of this week can be reduced by the use of a suction dredge in connection with the scraper-bucket machine. The scraper-bucket machine will possibly handle earth at about the same price as dipper dredges wherever dipper dredges can reach the dumping distance, but where the scraper-bucket is required to pick up the material on one side and swing the full half circle in order to deposit at proper distance from excavation point the cost is somewhat increased, probably 25 per cent above the cost of the shorter distance.

On being asked to define more definitely his meaning of the term "cost," he replied as follows:

The prices given were intended as the lowest reasonable expectation for contractor's prices. I would be willing to undertake that work at this time at those prices if pay were absolutely assured in cash.

TABLE III—ESTIMATE OF COST.

FLOODWAY AND RESERVOIR SYSTEM

Upper St. Francis floodway and reservoir:

Right of way (surveyed land), 7,190 acres, at $20 per acre	$ 143,800
Clearing right of way, 4,600 acres at $20 per acre	92,000
Grubbing and clearing 700 acres, at $150 per acre	105,000
Levees, 2,184,200 cu. yds., at 9 cts. per yd.	196,578
Levees, 3,092,200 cu. yds., at 10 cts. per yd.	309,220
Muck ditch, 29.3 miles, at $2,503.10 per mile (8 cts. per yd.)	73,341
Muck ditch, 22.6 miles, at $2,002.16 per mile (8 cts. per yd.)	45,249
Railroad bridge adjustment at Lake City	5,000
Highway bridge adjustment at Lake City	2,500
	$ 972,688

St. Francis floodway:

Right of way, 9,880 acres, at $20 per acre	$ 197,600
Clearing right of way, 9,050 acres, at $20 per acre	181,000
Grubbing and clearing 830 acres, at $150 per acre	124,500
Levees, 9,041,800 cu. yds., at 10 cts. per yd.	904,180
Muck ditch, 49.4 miles, at $2,503.10 per mile (8 cts. per yd.)	123,653
Passing through Frisco Railroad bridge	2,000
One highway bridge	15,500
One highway bridge	13,200
	$1,561,633

Upper Little River floodway:

Right of way (surveyed land), 140 acres, at $20 per acre	2,800
Clearing right of way, 2,850 acres, at $20 per acre	57,000
Grubbing and clearing 110 acres, at $150 per acre	16,500
Levees, 315,100 cu. yds., at 9 cts. per yd.	28,359
Levees, 660,300 cu. yds., at 10 cts. per yd.	66,030
Muck ditch (on east side), 6 miles at $2,002.16 per mile (8 cts. per yd.)	12,013
	$ 182,702

Lower Little River floodway:

Right of way, 5,825 acres, at $20 per acre	$ 116,500
Clearing right of way, 5,400 acres, at $20 per acre	108,000
Grubbing and clearing 425 acres, at $150 per acre	63,750
Levees, 1,537,400 cu. yds., at 9 cts. per yd.	138,366
Levees, 2,619,400 cu. yds., at 10 cts. per yd.	261,940
Muck ditch, 28 miles, at $2,002.16 per mile (8 cts. per yd.)	56,060
Muck ditch, 13.5 miles, at $2,503.10 per mile (8 cts. per yd.)	33,792
One culvert (under lower end of floodway)	40,000
One highway bridge	11,000
Paragould and Memphis Railroad bridge	42,000
Jonesboro, Lake City and Eastern Railway bridge	35,000
	$ 906,408
Total cost of floodway and reservoir system	$3,623,431

DITCH SYSTEMS.

System No. 1.—West of St. Francis floodway and reservoir (ditches Nos. 1 to 38, inclusive):

Miles of ditch (not including 54.7 miles along floodway and reservoir), 264.1.	
Right of way, 3,400 acres, at $20 per acre	$ 68,000
Excavation (this includes excavation along floodway and reservoir not necessary for levee construction), 13,019,000 cu. yds., at 8 cts. per yd.	1,041,520
	$ 1,109,520

System No. 2.—[illegible] River floodway, except drainage discharged through culvert (ditches Nos. 39 to 69, inclusive):

Miles of ditch (not including 45.5 miles along floodway), 142.7.	
Right of way, 2,300 acres, at $20 per acre	46,000
Excavation (this includes excavation along floodways not necessary for levee construction), 4,069,200 cu. yds., at 8 cts. per yd.	325,536
	$ 371,536

System No. 3.—Mississippi County drainage into upper Little River floodway (ditches Nos. 70 to 75, inclusive):

Miles of ditch, 51.6.	
Right of way, 820 acres, at $20 per acre	16,400
Excavation, 2,117,100 cu. yds., at 8 cts. per yd.	169,368
	$ 185,768

System No. 4.—Between Tyronza drainage area and floodways (ditches Nos. 76 to 142, inclusive). (This estimate does not include district No. 1, now under construction in Poinsett County):

Miles of ditch (not including 60.8 miles along floodways), 276.1.	
Right of way, 2,630 acres, at $20 per acre	52,600
Excavation (this includes excavation along floodways not necessary for levee construction)—	
8,786,300 cu. yds., at 8 cts. per yd.	702,904
2,280,300 cu. yds., at 9 cts. per yd.	205,227
	$ 960,731

System No. 5.—Tyronza River drainage area, ditches Nos. 143 to 185, inclusive (this does not include district No. 8, of Mississippi County):

Miles of ditch, 303.8.	
Right of way, 4,000 acres, at $20 per acre	$ 80,000
Excavation, 9,421,900 cu. yds., at 8 cts. per yd.	753,752
Excavation, 1,658,500 cu. yds., at 9 cts. per yd.	149,265
	$ 983,017
Total cost of ditch systems	$3,610,572

Total miles of ditch (not including 161 miles along floodways and reservoir), 1,038.3.

SUMMARY.

Floodway and reservoir system	$3,623,431
Ditch systems	3,610,572
	$7,234,003
Engineering, legal, and contingent expenses (5 per cent)	361,700
Total cost	$7,595,703
	Acres.
Approximate area of district	1,040,000
The above includes district No. 1, of Poinsett County; district No. 8, of Mississippi County; land occupied by floodways and reservoirs; and land [illegible] not affected by this improvement, aggregating about	200,000
	840,000

Approximate average cost per acre, $9.04.

STEAM AND ELECTRIC RAILWAY SECTION

Freight Train Resistance: Its Relation to Average Car Weight.*

Train resistance varies not only with the train speed, but also with the average weight of the cars of which the train is composed. At a given speed the tractive effort required for each ton of weight of the train will be greater, for example, for the train which is composed of cars of 20 tons average gross weight, than for the train composed of cars which weigh, on the average, 50 tons each.

While this fact has been known for some years, it has found inadequate expression and but little application. In the establishment of their tonnage ratings, many railroads have altogether ignored it. In the tonnage ratings of a few roads, this variation of resistance with car weight is recognized to the extent of allowing a difference in rating between trains composed of loaded cars and those consisting entirely or partially of empty cars. Generally, in such systems, a certain amount is allowed arbitrarily to be added to the weight of empty cars in determining, for the purpose of rating, the weight of the train in which they are found. In such rating no distinction is made between loaded cars of various weights, although such weights vary from 25 to 70 tons. A still smaller group of railroads have fully recognized the significance of the facts above stated in establishing their tonnage ratings, which, in such cases, are usually termed "adjusted" or "equated" ratings. Under these adjusted ratings, the actual weight of the train allotted to a particular locomotive varies according to the number of cars in the train. The ratings for the same locomotive, with trains of 40, 60 and 80 cars, for example, will be different in each of the three cases. This is, in effect, a variation of the ratings with respect to the average car weights. Most of these adjusted ratings have been empirically determined. In the few cases where they rest upon experiments made to determine the variations in train resistance with respect to car weight, the data and results of such experiments have not been fully published. Existing train resistance formulas likewise fail in most cases to take into account these variations of resistance with car weight, and probably much of the divergence among them is properly to be ascribed to this fact.

Purpose of the Tests.—In view of the facts just stated, it has seemed desirable to make the tests whose results are here recorded. They were planned to determine the resistance of freight trains under the usual conditions of operation; and they were designed to disclose at the same time, if possible, the relation existing at any given speed, between train resistance and average car weight. Since the chief use of such information is in the production of locomotive ratings, the conditions of the tests have been made like those which prevail in normal freight train operation. The speed range, for example, is from [illegible] perimented upon were trains in regular service, and usual in their make-up. The track upon which the tests were made is believed to be representative of good main-line construction.

The tests have been conducted by the Railway Engineering Department of the University of Illinois as part of the research work of the Engineering Experiment Station. They were begun in April, 1908, and were completed in May, 1909. All tests were made by means of a dynamometer car, owned jointly by the University of Illinois and the Illinois Central Railroad, and were carried out on the Chicago division of this road.

Throughout this paper, the terms "resistance" and "train resistance" mean the number of pounds of tractive effort required for each ton of the train in order to keep it in motion on straight and level track, at uniform speed, and in still air. The report deals exclusively with the resistance of the train behind the locomotive tender. Locomotive and tender resistance are not discussed [illegible]

Summary.—The report deals with the results obtained from tests of 32 ordinary freight trains, whose chief characteristics were as follows:

	Minimum.	Maximum.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

The trains whose average weights were less than 20 tons or more than 60 tons were com[illegible] uniform weight:

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*Abstract of paper by Edward C. Schmidt, Professor of Railway Engineering, published in Bulletin 43, University of Illinois.

while those whose average car weights were between 20 and 60 tons were either homogeneous or mixed as regards the weight of the individual cars.

The weather during the tests was generally fair. The minimum air temperature during any test was 34° F., the maximum 82° F. The approximate average wind velocity prevailing throughout one test was 25 miles per hour; during all the others it was less than 20 miles per hour.

The tests were made upon well-constructed and well-maintained main-line track, 94 per cent of which is laid with 85-lb. rail, the remainder being laid with 75-lb. rail. Except through station grounds, where screenings or cinders are used for ballast, the track is full ballasted with broken stone.

Conclusions.—The results of the tests are presented in Figs. 3 and 4 by Table III and by the equations 1 to 13.* The curves, the table, and equations are each different expressions of the same facts. It is believed that by their use the probable total resistance of *entire* freight trains at various speeds may safely be predicted, when running upon straight and level track of good construction, during weather when the temperature is above 30° F., and the wind velocity is not more than 20 miles per hour, provided the average weight of the cars composing the train be known.

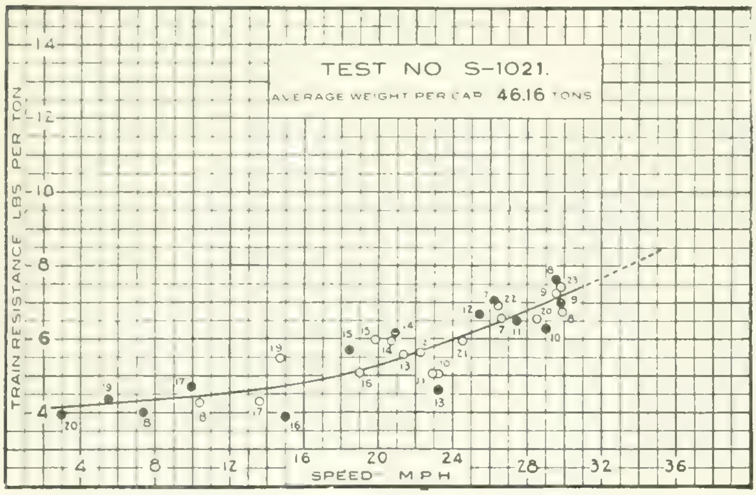

Fig. 1—Typical Diagram Showing Relation of Resistance to Speed.

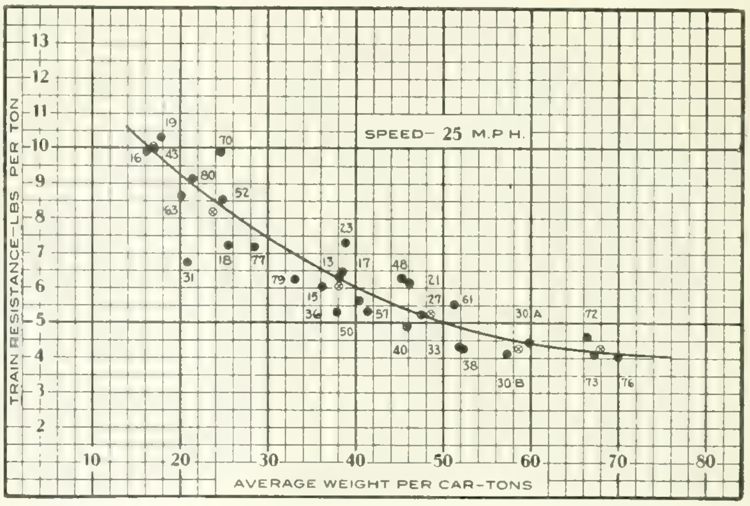

Fig. 2—The Relation Between Resistance and Average Car Weight, at a Speed of 25 Miles per Hour.

The results are applicable to trains of all varieties of make-up to be met with in service. They may be applied, without incurring material error, to trains which are homogeneous and those which are mixed as regards individual car weight.

The results are primarily applicable to trains which have been in motion for some time. When trains are first started from yards, or after stops on the road of more than 20 minutes' duration, their resistance is likely to be appreciably greater than is indicated by the results here presented. In rating locomotives, no consideration need be given this matter, except in determining "dead" ratings for low speeds, and then only when the ruling grade is located within six or seven miles of the starting point or of a regular road stop.

It is to be expected that some trains to be met with in service will have a resistance about 9 per cent in excess of that indicated by Figs. 3 and 4, due to variations in make-up or in external conditions within the limits to which the tests apply. If operating conditions make it essential to reduce to a minimum the risk of failure to haul the allotted tonnage, then this 9 per cent allowance should be made. This consideration, like the one preceding, is important only in rating locomotives for speeds under 15 miles per hour. At higher speeds, the occasional excess in the resistance of individual trains will result in nothing more serious than a slight increase of running time. It should be emphasized that this allowance, if made, is to be added to the resistance on level track—not to the gross resistance on grades.

METHODS AND MEANS EMPLOYED IN CONDUCTING THE TESTS.

The tests were carried on by means of the dynamometer car referred to, which, when not in use, is held at Champaign, a district terminus. The car was operated from time to time in the regular trains leaving this point, and the trains selected were partly in the north-bound, partly in the south-bound, traffic.

The plan was to determine, for each of the trains experimented upon, the relation of its resistance to its speed. This information was to be expressed finally as a resistance-speed curve such as is shown in Fig. 1. The trains were so selected that their average car weights would vary throughout as great a range as possible. As will later appear, this range proved to be from the weight of an empty gondola to that of a fully loaded car of 100,000 lbs. capacity. It was the expectation that when the resistance-speed curves of the individual tests were brought together, their analysis would reveal the relations existing between train resistance and car weight.

During each test the following information was obtained:

(*a*) The drawbar pull of the locomotive upon the train.

(*b*) The train speed.

(*c*) A continuous record of the time elapsed from the beginning of the test.

(*d*) The pressure existing in the brake cylinder of the test car.

(*e*) The direction of the wind relative to the direction of motion of the car.

(*f*) The velocity of the wind relative to the car.

(*g*) A record of the location of the test car upon the road.

(*h*) Air temperatures and other weather conditions.

(*i*) Data concerning the train, such as its weight, etc.

The information cited under items (*a*) to (*g*) was obtained in the form of continuous graphical records upon the chart which is produced by the apparatus of the dynamometer car. By means of this chart any of the quantities mentioned may be determined at any point upon the road.

The curves of the drawbar pull and speed provide the information essential to the investigation. Supplemented by an accurate profile and record of train weight, they enable net train resistance to be calculated at any position of the train upon the road. The time record provides a means of calibrating and checking the speed curve. The pressure in the brake cylinder was recorded merely to make it possible to distinguish those periods during the test when the brakes were applied to the train; it being obviously necessary to ignore such portions of the record when making the calculations. The relative wind velocity and relative wind direction were obtained by means of an anemometer and a wind vane mounted on the roof of the test car. When compounded with the known speed and direction of motion of the car, these data permit the determination of the actual wind direction and wind velocity with respect to the track. It is probable that the wind data are, under some circumstances, subject to a considerable error. Considering the length of the run made with each train and the length of time it was on the road, it is believed that the wind data thus obtained are, nevertheless, more reliable than those which might have been recorded by stationary instruments located at one or two points along the track. Item (*g*), the location of the car upon the road, was defined by marking upon the test car record the position of mile posts and stations at the moment they passed the car. By means of this record, it is possible to correlate any position of the train with the road profile. Data concerning the train were obtained by one or two observers who had no other duties. With the one exception noted beyond, all trains were weighed, to determine their tonnage. In addition to its weight, there was recorded for each train its length,* and for each car its number, kind, stenciled "light weight," gross weight, capacity, and the initials of the owning road.

All test car instruments were calibrated before the tests, and their calibrations were frequently checked during the progress of the investigation. All observers were men experienced in the operation of test cars and many of them had participated also in the work of calculation and were consequently aware of the points at which alertness and care were especially needed.

This report includes the data and results from tests of 32 different trains. For the purposes of this research, tests were made of twelve other freight trains; but their results were, for various reasons, finally excluded from the report.

TEST CONDITIONS AND TRAIN DATA.

The Trains Tested.—The test trains were all of such make-up as naturally resulted from the traffic conditions in the Champaign yards. As the investigation progressed, it became apparent that the accumulated data left certain gaps in the range of average car weights, and the last six or eight trains were therefore made up especially to supplement the data at these points. It should be understood, however, that nothing in this process resulted in a train make-up which was in any respect unusual. All the trains tested are.

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*[illegible]

*Train length was determined by counting, during the test, the number of rail length corresponding to the length of the train and multiplying this number by 30 ft., which is the rail length for this track.

therefore, such as one might expect to find upon any road where the traffic conditions are normal. They include trains made up almost entirely of empty gondolas,* others with considerable variation in both load per car and kind of car, and still others composed almost entirely of loaded box cars or of loaded gondolas.

Test *S*-1018 demands special mention in this connection. The train for this test included 2 Illinois Central Railroad locomotives weighing respectively 145,200 and 223,600 lbs. Their combined weight constituted 13.6 per cent of the total train weight. These locomotives with their tenders were being hauled "dead" and had the main rods disconnected, as is usual in such cases. The first is of the 2-6-0 type, the second of the 2-8-0 type, and they and their tenders had therefore together 17 axles in operation. For the purpose of determining the average car weight for this train, these two locomotives were assumed to be equivalent, in their resistance, to a number of cars having a like number of axles, i. e., 4¼ cars. The results of the calculations warrant the belief that this view of the situation has resulted in no material error. A study of Table I will make clear the diversity of the composition of the trains.

All trains except No. *S*-1016, S-1018, S-1030*A*, and *S*-1030*B* were weighed upon one of the two track scales at Champaign. This weighing was done in the usual manner, by pulling the train over the scales and weighing the cars successively without uncoupling them. These track scales were in good condition and were each inspected four times during the test period. In the cases mentioned either the weights stenciled on the cars were accepted as correct or the cars were weighed at other yards. Obviously no important errors in the total tonnage have resulted from possible inaccuracies in the weights of these cars.

The range over which the train data for all of the tests varied is as follows:

	Minimum	Maximum.
Total train weight, tons.....	747	2908
Average weight of cars composing the train, tons	[illegible]	[illegible]
No. of cars in the train......	26	89
Train length, feet............	1120	3480

The Track.—All tests, except No. *S*-1030*A*, were made over the 91 miles of Illinois Central main-line track lying between Gilman (mile 81.12) and Mattoon (mile 172.38), Illinois.

This track, formerly a part of one of the oldest single track lines in the state, was converted about ten years ago into a double-track road; and the roadbed is now well settled and in good condition. In construction the roadbed has been made to conform as closely as practicable to the standard Illinois Central section for class *A* double track. This section has a 34-ft. crown with a slope of 1½ to 1 for embankments, and a 46½-ft. base with slopes of 1 to 1 or 1½ to 1 for cuts. The drainage of the track is, in general, excellent.

Except on a few short stretches through station grounds, where screenings are used for ballast, both tracks are ballasted with broken limestone throughout this distance. There is not less than 12 ins. of ballast beneath the ties, and the ballast shoulder extends 12 ins. beyond the ties, whence it runs off to the subgrade on a slope of 1¾ to 1. The cross ties are of either treated white oak or treated red oak, and are 6x8 ins. x 8 ft. They are spaced about 20 ins. from center to center.

The south-bound or west track between mile 161+3500 ft. and mile 171 is laid with rail weighing 75 lbs. per yard. The remainder of the west track and all of the east track are laid with rail weighing 85 lbs. per yard. The 75-lb. rail is of the standard A. S. C. E. section, rolled by the Illinois Steel Company, and is further designated as Illinois Steel Company's section No. 7506. All 85-lb. rail is of standard A. S. C. E. section, and Illinois Steel Company's section No. 8504.

All rails are laid with square joints, supported on three ties. The 75-lb. rails are joined with Illinois Central Standard 40-in. angle-bar splices, weighing 76 lbs. per pair; and the 85-lb. rails are joined with similar splices weighing 80 lbs. per pair. In each joint six track bolts are used, which are ¾x4⅛ ins. for the 75-lb. rails, and ⅞x4½ ins. for the 85-lb. rails. Four 9/16x5½ in. track spikes are used in each cross tie. No tie plates or rail braces are used, except through switches.

As regards both its construction and maintenance, this track is such as one may expect to find upon the main lines of first-class railroads.

These 91 miles of track were especially surveyed, immediately preceding the tests, by the Railway Engineering Department of the University for the purpose of this and similar investigations.

The maximum grade against north-bound traffic is 29 ft. per mile, and against south-bound traffic 31.9 ft. per mile. There is a total of 7,850 ft. of curved track.

Weather Conditions.—In Table I the weather prevailing during each test is designated as either fair or wet, wet weather meaning either continuous or intermittent rain. During 7 of the 32 tests the weather was wet. The lowest air temperature recorded at any time during any test is 34° F.; and the highest recorded temperature is 82° F.

The column headed "average wind velocity" in Table I presents the averages of the calculated wind velocities derived for each point or section of the test in question for which the train resistance was determined. The approximate maximum average wind velocity prevailing during any test was 25 miles per hour; the minimum was 4 miles per hour.

It was intended to so select the tests that the weather conditions, the temperatures and the wind velocities would be such as usually prevail in most parts of the country from the middle of spring until the middle of autumn, when the basic or "summer" tonnage ratings are in force—such conditions, in short, as would give rise to no appreciable difficulties in train operation.

METHODS EMPLOYED [illegible]

The immediate purpose in making the calculations was to produce for each test a curve showing the relation between resistance and speed, for as great a variety of speeds as the data would permit. This involves calculating the train resistance at various positions of the train upon the track, and the first step towards this end is the inspection of the test car record in order to select suitable points or sections at which the resistance may be calculated. The considerations of first importance in this selection are that the points represent finally as great a speed range as possible, and that the speeds be approximately evenly distributed within this range. Points and sections were selected only where the entire train was running and continued to run upon straight track; resistance due to track curvature is therefore entirely eliminated. The data essential to the process of calculation are the drawbar pull of the engine, the train speed and its acceleration, the tonnage and the profile. The pull and the speed, as previously stated, are determined from continuous [illegible] Two processes have been used, designated here as Method 1 and Method 2. By Method I the momentary values of pull, speed, acceleration and grade were determined for a particular position of the train upon the road; by Method 2 the average values of these quantities were determined for the period during which the [illegible] determined [illegible]

Method 1[illegible] *Road*[illegible] pull and the speed were found by direct readings [illegible] by the tonnage gives the gross train resistance at this speed, and this gross resistance was next corrected for both acceleration and grade resistances. The acceleration was determined by graphical methods from the speed curve, and the grade was found by correlating the train's position with the profile. The points were all so selected that at the moment under consideration the entire train was on a nearly uniform grade. Method 1 results in momentary values of train resistance at the points considered.

Method 2.—Average Resistance Over a Section.—By this method the average value of train resistance was determined for the period during which the test car at the head of the train was passing a selected section of the track. This track section corresponds to a certain length or section on the test car record. It was so selected that the speed of the car when entering was nearly equal to its speed at exit, and further so that no considerable variations in speed occurred during transit over the section. The sections chosen have varied in length from about ¼ mile to 1 mile. The variations in speed in passing the section have generally amounted to less than 2.0 miles per hour, and the maximum variation over any selected section is 11.7 miles per hour. In only 58 cases out of a total of 560 does this speed variation exceed 5.0 miles per hour. These portions of the chart having been chosen, the average pull was next found by determining the average ordinate of the curve of drawbar pull, and the average speed was found by means of the section length and the time record. Gross resistance in pounds per ton was next derived by dividing the value of pull by the tonnage, and this gross resistance was then corrected for the resistances due to acceleration and grade, as in Method I.

In this case the average acceleration is found by consideration of the speeds at entrance to and exit from the section. In order to correct for grade, the elevation of the center of gravity* of the train was determined for that position of the train at which the test car entered the section, and again for the position at which the car left the section. The difference between these elevations establishes the effective average grade, which either helps or opposes the locomotive while the train passes the section. These elevations of the center of gravity of the train may not be determined with sufficient accuracy unless the train at the moment is on a practically uniform grade. The section limits were therefore so chosen.

Method 2 results in a value of average train resistance for the average speed at which the train passes the section under consideration. It would be rigidly correct if train resistance varied uniformly with speed—in other words, if the curve showing the relation of resistance to speed were a straight line. This, of course, is not the case, and the process therefore gives results which are slightly in error. However, as stated above, the section was so chosen that the difference between the speeds at entrance to and exit from the section was small; and for the speed range represented by this difference, the curve of train resistance deviates but little from a straight line. Such error as does result from the process is, therefore, very small and is of no moment whatever when compared with variations, due to natural causes, which occur in the resistance itself.

[illegible]—The two methods are fundamentally alike. Although the first is the less laborious, it requires the determination of acceleration at a point on the speed curve, which it is sometimes difficult to make accurately. For this reason the second method is generaly preferable. Method 2 is also to be preferred because it deals with average values and therefore tends to eliminate from the results the incidental momentary variations which occur in the resistance itself. Consequently, the second method has been employed wherever possible, and the first method has been resorted to, as a rule, only in those cases where the limitations im

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*In all parts of the report [illegible] designated as box, stock, gondola, flat, and tank cars. The term box car is made to [illegible] refrigerator cars, the test car and the caboose. The term gondola includes all unroofed cars with sides, such as coal cars, hopper [illegible]

[illegible] of its center of [illegible]

TABLE I—A SUMMARY OF TEST CONDITIONS AND TRAIN DATA

Test No.	Weather Conditions.							Train Data.							
	[illegible]	Average [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total number of cars in the train.	Number of empty cars.	Number of loaded cars.	Loaded cars in percentage of total number.	Box cars, per cent	Gondola cars, per cent	Flat cars, per cent	Tank cars, per cent
S-1013	Wet	4	19	+	2,784	[illegible]	38.04	67	10	[illegible]	85	82	13	0	[illegible]
S-1015	Fair	1	[illegible]		2,520	[illegible]	36.08	69	8	61	88	[illegible]	[illegible]	16	10
[illegible]	Fair	[illegible]	10		[illegible]	[illegible]	16.12	72	72	0	0	[illegible]	[illegible]		0
[illegible]	Wet	[illegible]	16		[illegible]	2,532	38.44	[illegible]	13	53	80	[illegible]	[illegible]	0	0
[illegible]	Fair	4	11	[illegible]	2,130	1,353	[illegible]	[illegible]	34	15	31	61	6	16	17
S-1019	Fair	[illegible]	25	[illegible]	[illegible]	[illegible]	17.72	89	[illegible]	14	16	34	58	7	1
[illegible]	Wet	68	17	—	2,400	2,908	[illegible]	[illegible]	10	53	84	32	60	[illegible]	3
[illegible]	Fair	68	17	—	2,320	2,213	38.72	[illegible]	17	41	71	45	52	0	3
S-1027	Wet	[illegible]	14	[illegible]	1,710	2,185	47.44	46	3	43	94	22	76	2	0
[illegible]	Fair	64	6	+	[illegible]	2,036	59.88	34	2	32	94	6	94	0	0
S-1030B	Fair	[illegible]	7	+	1,650	[illegible]	57.12	41	3	38	93	20	80	0	0
S-1031	Fair	[illegible]	5	+	1,425	[illegible]	20.72	36	30	6	17	94	3	3	0
S-1033	Fair	74	12	+	1,710	2,275	51.70	44	2	42	95	5	95	0	0
S-1034	Fair	[illegible]	4	[illegible]	3,015	1,259	16.56	76	76	0	0	1	99	0	0
S-1036	Fair	51	6	0	2,010	1,961	37.72	[illegible]	8	44	85	73	25	2	0
[illegible]	Fair	65	16	—	1,650	[illegible]	52.28	41	3	38	93	22	78	[illegible]	0
[illegible]	Wet	[illegible]	11	+	1,830	2,151	45.76	47	2	45	96	49	49	0	2
S-1043	Fair	[illegible]	8	+	2,580	[illegible]	16.92	66	65	1	2	24	74	0	2
[illegible]	Fair	38	[illegible]	+	[illegible]	[illegible]	[illegible]	[illegible]	8	46	85	37	63	0	0
					b2,100	2,355	45.24	52	8	44	85	38	62	0	0
S-1050	Fair	[illegible]	8	—	[illegible]	1,618	40.44	40	16	24	60	[illegible]	25	0	0
S-1052	Wet	38	11	+	[illegible]	1,514	24.80	61	44	17	28	61	38	1	0
S-1057	Fair	37	10	—	[illegible]	2,107	41.32	51	8	43	84	49	43	6	2
[illegible]	Fair	40	7	—	1 785	2,252	51.20	44	3	41	93	[illegible]	84	11	0
S-1063	Wet	40	12	+	[illegible]	[illegible]	20.04	74	70	4	5	7	93	0	0
S-1070	Fair	64	4	—	2 400	1,622	24.60	66	49	17	26	58*	42	0	0
S-1072	Fair	36	17	+	1,200	[illegible]	66.40	28	1	27	96	4	96	0	0
S-1073	Fair	58	10	+	1,200	1,880	67.16	28	1	27	96	4	96	0	0
S-1074	Fair	52	10	—	3,180	1,340	16.56	81	81	0	0	2	98	0	0
S-1076	Fair	59	16	+	1,120	1,818	69.92	26	1	25	96	4	96	0	0
S-1077	Fair	67	13	—	2,145	[illegible]	28.40	53	35	18	34	74	26	0	0
S-1079	Fair	66	18	—	2,070	1,685	33.04	51	14	37	73	90	10	0	0
[illegible]	Fair	[illegible]	11	—	[illegible]	1,347	21.40	63	57	6	10	16	84	0	0

[1]A wind any component of whose velocity helps the train forward is marked +, winds with opposing velocity components are marked —.

a. From Champaign to Rantoul; b. from Rantoul to Gilman.

posed in the selection of sections for Method 2 would have resulted in too few values from which to plot the resistance curves. Of all the individual resistance values incorporated in the report, only 32 per cent were determined by Method I. The care exercised in the calculations, and a study of the plotted values obtained by both processes, seem to warrant the conclusion that their results are equally reliable.

General Considerations.—Even in freight train operation the tractive effort required to produce acceleration in the speed is frequently greater than that required to overcome all other resistances combined. To produce, for example, an acceleration of 0.1 mi. per hr. per sec., requires a tractive effort of about 9 lbs. per ton, in addition to that required by net train resistance and grade resistance. Since the acceleration resistance may constitute so large a proportion of the gross resistance, it is important that its determination be made with great care. This fact has been impressed upon all who were concerned with these tests. In calculating the acceleration resistance, both the force required to produce acceleration in the rotation of the wheels and axles and the force required to produce the acceleration in the motion of translation of the train as a whole were determined.

The test car records make it possible to distinguish those portions of each test where the brakes were applied. Such places, few in number, were of course avoided in selecting points and sections for determining resistance. The records also show where hot-boxes and unreleased brakes were discovered in the train, and such defects were given consideration in making the calculations. They occurred infrequently and their effect could not be distinguished in the results.

[illegible] Selection of Points and Sections.—Early in the progress of this work, when low air temperatures were first encountered, it became apparent that when the train was first started from rest, its resistance, calculated for a number of points at which the speed was the [illegible] these portions of the run made immediately after leaving the yards, but also for those portions immediately following stops on the road. In a certain test, for example, the values of net resistance, calculated at various points, at all of which the speed was 20 miles per hour, varied between 6.8 lbs. and 5 lbs. per ton—a difference of 27 per cent—for points selected within the first 9 miles of the run; whereas values of resistance at the same speed, determined later in the test, differed by only 10 per cent. The air temperature during this test (not included in the report) varied between 22° and 26°.

For a number of tests such resistance values were plotted with respect to the distances from the yards of the points to which they apply. This process disclosed a surprisingly regular decrease in the resistance until a distance of approximately ten miles was reached, after which the resistance had settled down to a fairly uniform value. Similar variations were found to occur to some extent during tests when the air temperature was as high as 50° or 60°. This study led to the conclusion that this difference in resistance was due to variations in the conditions of lubrication of the car journals, and that such variations were chiefly caused by changes in journal temperature. All of this, of course, is in accord with the common belief of those experienced in train operation. The reason for discussing it in this place is that the facts stated have influenced the procedure in making calculations for this series of tests.

Since the variations in resistance are so great during the early part of the run, no point or section has been selected for calculation within about the first ten miles of any test. If other points or sections, located farther from the start, were near stops, such points were rejected unless further investigation proved that at these places the train resistance had become nearly uniform in value. Fortunately, the operating conditions were such as to entail few stops on the road, and the selection of points and sections for the calculations has not been unduly limited on these accounts.

The effect of these limitations is to make the results of this investigation primarily applicable to trains which have been in motion for some time. Since, however, stops are not usually made upon ruling grades, and since if stops are made at other places on the road, the locomotive has available tractive power in excess of the requirements, the results of these tests are generaly applicable in the solution of tonnage rating problems, except where the ruling grade occurs near a yard or other point where the trains are made up. In such cases the tonnage determined from the resistance curves here presented may prove to be somewhat too great.

The Derivation of the Resistance Curves.—The calculations result, for each test, in a series of values of net train resistance at a variety of speeds. These values of resistance were plotted with respect to speed, and gave such a diagram as in Fig. 1. The curve, such as is shown there, was next drawn to express, for the test in question, the relation existing between resistance and speed. In order to draw this curve, the plotted points were assumed to be arranged in a number of groups, and for each group the averages of the values of speed and of resistance were determined. By these averages a new point or "center of gravity" of the group was then plotted. The curve was drawn by confining attention to the few points thus determined. The groups of points were arbitrarily selected so that the resulting "centers of gravity" would be distributed nearly equidistantly throughout the speed range.

All reasonable precautions have been taken to attain accuracy in the calculations. In determining each value of resistance, each step in the process was duplicated at a different time and generally by a different person. The transcription of all tables, the plotting of points and the drawing of curves have been similarly checked.

(To be continued.)

Method and Cost of Street Railway Track Reconstruction with Carnegie Steel Ties in Concrete.

BY J. C. LATHROP.*

During October and November of last year the Springfield Ry. Co., of Springfield, O., a subsidiary company of the American Railways Co. of Philadelphia, found it necessary to reconstruct several miles of track, owing to street improvements on Yellow Springs St., McWreight Ave. and East High St. Heretofore all street railway substructure in that city, on both paved and unpaved streets, consisted of wooden ties resting upon gravel ballast. The concrete foundation for the paving, in the case of paved streets, was brought only level with the bottom of the ties. On this occasion, however, the city officials insisted upon a 6 in. layer of concrete underneath the ties, because the original charter stated that the company should pave their portion between the rails in like manner to the pavement, placed in the remainder of the street by the city.

For this reason the company adopted an entirely different construction consisting of Carnegie steel ties on 5 ft. centers, each tie being entirely embedded in concrete. This construction is shown on the accompanying plan. The rails were bolted to the ties and the track brought to the proper line and surface and blocked up at suitable intervals by the company's forces, before the concrete was placed. It was thought desirable to use a richer mixture than that ordinarily used in street foundations and the materials were used in the proportion of 1 cement, 3 sand and 5 broken stone.

The concrete work on the three above mentioned streets was let by contract, and the writer was able to collect some exceptionally interesting cost data, as the work was carried on by three different methods, viz.: hand mixing, a continuous mixer which moved along the track and a batch mixer, which moved along the track. A fourth method, which was tried later on McWreight Ave., consisted of a stationary batch mixer, the concrete being discharged from the latter into carts and hauled to the track. The results obtained by this method were so uncertain and expensive that cost data of any value could not be obtained. The actual labor costs of mixing and depositing the concrete in the track and tamping it under the ties and rails is given in detail in the accompanying tables. No exceptional delays or accidents of any moment were encountered on this work and weather conditions through-

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*1 Forrest Ave., Jackson, Mich.

TABLE I—COST OF CONCRETE FOUNDATION HAND MIXING, 1 CEMENT [illegible] SAND [illegible] BROKEN STONE.

Date.	Foremen	Laborers	Hours	Daily labor cost	Lineal feet single track	Cu. yds. concrete placed	Cost of mixing and placing per cu. yd.
Sept. 30			[illegible]		1[illegible]		
Oct. 1...	1	18	10	$ [illegible]	16[illegible]	1[illegible]	[illegible]
Oct. [illegible]		[illegible]4	10	[illegible]5.00	[illegible]	[illegible]	1.1[illegible]
Oct. 4....	1	[illegible]	1[illegible]	[illegible].00	[illegible]	[illegible]	1.1[illegible]
Oct. 7.....	[illegible]	26	10	[illegible]	[illegible]	1[illegible]	1.[illegible]1
Oct. [illegible]....		[illegible]	6	[illegible].80	[illegible]	[illegible]	1.[illegible]
Total				$231.80		174.04	$1.33

TABLE II—COST OF CONCRETE FOUNDATION, AUSTIN CUBE MIXER—CHARGE, 1 BAG CEMENT, 3 CU. FT. SAND, 5 CU. FT. BROKEN STONE.

Date	Engineer	Foreman	Laborers	Hours	Daily cost of labor	Lin. ft. double track and dummy	Cu. yd. concrete placed	Cost mixing and placing, per cu. yd.
Oct. [illegible]	1		1[illegible]	5½	$ [illegible]	1[illegible]	[illegible]	[illegible]
Oct. [illegible]	1		19	9½	16.[illegible]8	19[illegible]	[illegible]	[illegible]
Oct. 2[illegible]	1		[illegible]	9½	[illegible].68	1[illegible]	[illegible]	[illegible]
Oct. 31	1	2	2[illegible]	9½	[illegible].68	2[illegible]	[illegible]	[illegible]
Nov. 1	1		2[illegible]	7	39.[illegible]	[illegible]	[illegible]	1.[illegible]
					$[illegible]17.[illegible]	7[illegible]	2[illegible]	[illegible]

Note.—Laborers, 20c per hour, engineer, 35c per hour; foreman, 40c per hour; foreman, 30c per hour.

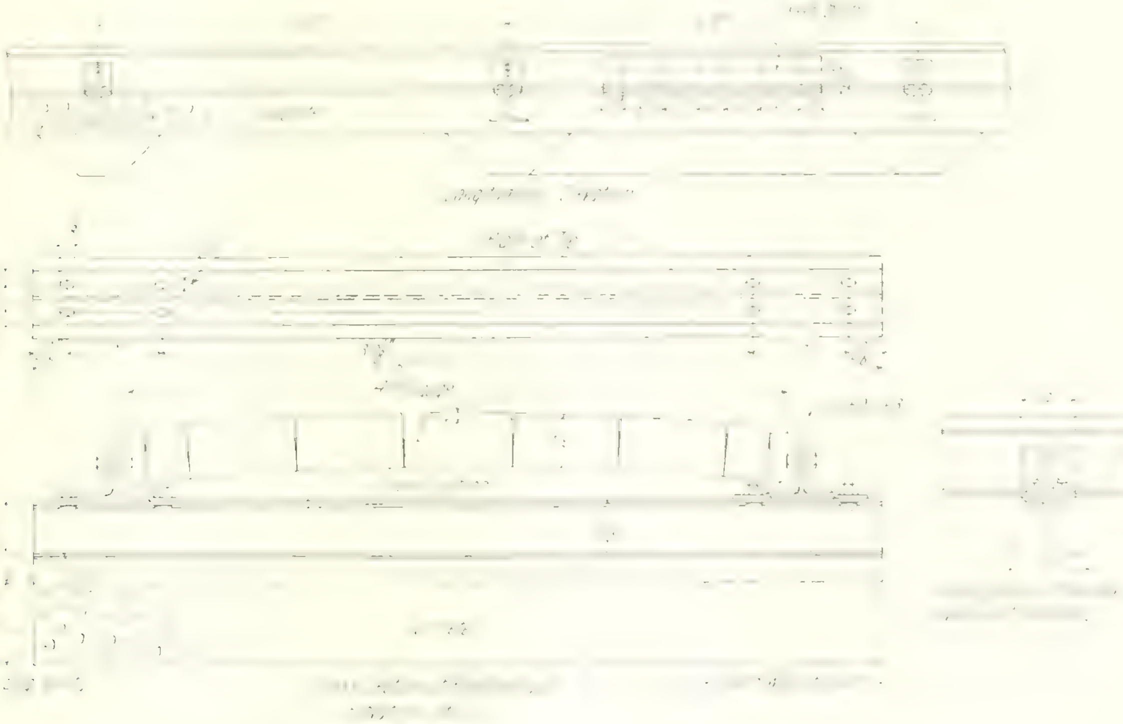
out the entire period were all that could be desired.

In the first 1,500 ft. of Yellow Springs St., where the concrete was mixed by hand, the materials were dumped at [illegible] points on one side of the street. Two large mixing boards were used, the materials being hauled to the boards, and the concrete being hauled to the track in wheelbarrows. Rough forms were used consisting of old ties laid against the end of the steel ties. Detailed costs of mixing and placing concrete by this method are given in Table I, the average cost per cubic yard being $1.33. Where either the batch or continuous mixer were used, the sand and stone were [illegible] sides of the street, while the cement was piled along the curb. The mixers were moved along the tracks on a wooden track, so arranged that [illegible] or ties.

An Austin [illegible] Mc Wreight Ave. and the [illegible] for the first 780 ft. of double track are given in Table II, the average cost per cubic yard being $0.913, or about two-thirds the cost of hand mixing. For the remainder of McWreight Ave. the same machine was used in a stationary position, but as the foundation for the balance of the street was poured at the same time and results were uncertain, no record of costs were kept by the writer.

For the balance of the work on Yellow Spring St., consisting of 1,040 cu. yds., and all the work on East High St., consisting of 1,123 cu. yds., a Foote No. 2½ Continuous mixer, such as is shown in the accompanying view, Fig. 2, was used and its performance was excellent as compared with other methods.

This machine was moved along the double track with two wheels in the dummy and the other two as close to the inside rail of one track as possible. A wooden track blocked up clear of the ties was used which kept the wheels about 1 ft. above the surface at the sides of the track where the stock was piled. This also made it necessary for the men, shoveling sand and stone, to throw the material across the track in addition to the extra foot in height. This proved to be such severe labor that the contractor found it necessary to put two shifts of men on the stone side of the machine. A large wooden chute was attached to the rear of the machine in such a manner that it could be swung from side to side of the double track, as the work proceeded. The usual organization of the working gang was as follows:



Details of Street Railway Track; Carnegie Steel Ties on Concrete.

[illegible]
[illegible]
[illegible]
Man pouring cement into hopper............. 1
[illegible]
[illegible]
[illegible]
Men pushing concrete down chute............ 2
[illegible]
[illegible]
[illegible]

Tables III and IV give the details of the cost of work with this machine, the cost of fuel being omitted, as it was indeterminate, and in no case would amount to over 1 ct. [illegible]

From a study of these tables it would seem that concrete can be mixed and placed with this machine for the lowest unit cost when a force of from 10 to 16 laborers are used. The unit cost increased when 20 laborers were used and decreased when 4 more were added

TABLE III—COST OF CONCRETE FOUNDATION, NO. 2½ FOOTE CONTINUOUS MIXER SET FOR 1:3:5 MIXTURE

Date	Foremen	[illegible]	[illegible]	[illegible]	Daily labor cost	Lineal feet single [illegible]	Lin ft [illegible]	Cu yds [illegible]	Cost of mixing & [illegible]
Oct. 17	1	10	1	10	[illegible]				.469
Oct. 18		[illegible]		[illegible]	16.23			47.32	.343
Oct. 19		[illegible]		10	47.50		[illegible]	80.29	.592
Oct. 20		[illegible]		10	47.50				
Oct. 21		[illegible]		[illegible]	40.38			79.22	
Oct. 22		[illegible]		[illegible]	[illegible]				
Oct. 25	1	18	1	10	[illegible]				
Oct. 26		[illegible]		10	55.50			91.59	.606
Oct. 27	1			10	53.50				
Oct. [illegible]	1			[illegible]	53.50				.522
Oct. [illegible]	[illegible]			[illegible]	41.20				
Nov. 1	[illegible]				25.75			47.32	.544
Nov. 2	1	22	1	1	5.15			9.16	.562
Nov. 3				[illegible]	55.50			76.33	.727
Nov. 4		[illegible]		[illegible]	20.13			21.37	.912
Total					$570.37			1,040.54	

*Add 13.4 cu. yds. under special work.
†Add 20.8 cu. yds. under special work.
Note.—Laborers, 20c per hour, engineer, [illegible] per [illegible], foreman, [illegible]

TABLE IV.—COST OF CONCRETE FOUNDATION, NO. 2½ FOOTE CONTINUOUS MIXER SET FOR 1:3.5 MIXTURE.

Date.	Fore-men.	Labor-ers.	[illegible]-neer.	Hours	Daily [illegible] cost	Lin. ft. single track	Lin. ft. double track & dummy.	Cu. yds. concrete placed.	Cost per cu. yd.
Nov 11...	[illegible]	[illegible]	1	[illegible]	$ [illegible]		135	41.22	.576
Nov. 12...	1	[illegible]	1	10	47.50		308	94.03	.505
Nov. 13...	[illegible]	[illegible]	1	[illegible]	39.15		250	76.33	.513
Nov. 14...	[illegible]	20	1	[illegible]	42.75		310	[illegible]	.452
Nov. 15...	[illegible]	25	1	[illegible]	51.75		340	[illegible]	[illegible]
Nov. 16...	1	[illegible]	1	[illegible]	55.35		345	105.33	[illegible]
Nov. 17...	1	[illegible]	1	[illegible]	49.95		330	[illegible]	.496
Nov 18...	1	25	1	[illegible]	2.88		5	1.53	1.88
Nov. 19...	[illegible]	[illegible]	[illegible]	[illegible]	51.75		335	102.28	[illegible]
Nov. 20...	[illegible]	24	[illegible]	9	49.95		260	79.38	.629
Nov. 21...	1	24	1	[illegible]	26.36		165	50.37	[illegible]
Nov. 22...	[illegible]	[illegible]	1	[illegible]	49.95		344	105.02	.476
Nov. 23...	1	[illegible]	1	9	51.75		305	93.12	[illegible]
Nov. 24...	[illegible]	[illegible]	1	[illegible]	23.51		164	50.07	[illegible]
Nov. 24...	1	21	1	1½	7.43	72		8.44	[illegible]
Nov. 25...	[illegible]	[illegible]	1	[illegible]	8.33	5	52	16.46	.507
Total					$582.11			1,122.77	[illegible]*

11.72 cu. [illegible] per 100 ft. single track [illegible] ft wide.
30.53 cu. [illegible] per 100 ft. double track and dummy [illegible] ft. 10 ins. wide.
Note—Laborers, [illegible] per hour; [illegible], [illegible] per hour; foreman, 40c per hour.

as a second shift on the stone side of the machine. Without doubt, however, the force of 24 men proved the most profitable to the contractor, the machine then being used to its approximate capacity.

These records of $0.518 and $0.548 per cu. yd. seem rather high when compared with unit costs of 26 cts. given in "Concrete Construction Methods and Cost" for ordinary street foundation, but may be partially explained by the increase of 33⅓ per cent in wages, the extra height and distance the men had to shovel the sand and stone and the labor required to build and remove the wooden track. Another factor may be the number of hours the men worked, which were 8 hours per day in the example quoted and 9 and 10 in this instance.

The contractor for this work was Mr. Edw. Ryan, the work being carried on under the direct supervision of Mr. George C. Towle and the writer, being respectively general manager and superintendent of construction for the Springfield Ry. Co.

Cost of Tracklaying.—The following costs of laying track, as given in the *Canadian Engineer*, were taken from the report by A. L. Farquharson on the Fort William, Ontario, street railways:

The increase in the cost of laying flat stone in 1910 was due to the fact that the stone had to be taken from an old sidewalk and transported some distance from another street. The material, however, cost the street railway nothing, so that the total cost of this material in place was much cheaper than it had been in previous years.

	1908.	1909.	1910.
Labor laying flat stone, per cu. yd.	$0.29	$0.28	$0.35
Labor laying crushed stone, per cu. yd.	0.38	0.48	0.48
Labor surfacing per ft. double track	0.68	0.59	0.48
Labor ties and steel	0.68	0.69	0.69
Labor and material bonds, per bond	0.97	0.90	0.93
Labor and material concrete, per sq. yd.	1.32	1.05	1.23
Labor and material paving and sand cushion	2.59	2.38	2.49
Labor and material overhead equipment	0.32	0.20	0.23

GENERAL ARTICLES AND CLASSIFIED ITEMS

Tests of Percentage Variation of Manila Rope in Size, Weight and Strength.

(Contributed.)

In order to determine the extent to which Manila rope samples such as might be bought in the open market might be expected to vary in quality, The Plymouth Cordage Co. of North Plymouth, Mass., has recently conducted an interesting series of tests on various brands of rope. To arrive at a reasonably accurate conclusion as to what might be expected from an average piece of rope as regards size compared to the normal size, weight per unit of length and tensile strength, 22 samples of rope, nominally 3 ins. in circumference and the product of various manufacturers were put through a careful series of tests at the works of this company. The results obtained were plotted as shown on the accompanying diagram on a percentage basis, this being found to be the most satisfactory method of showing graphically the variations found.

An average Plymouth Cordage sample was used as a standard and from this the variations, plus or minus, as the case might be, in size, weight and strength were plotted as percentages of the standard taken. It would naturally be supposed that in an investigation of this character, considerable deviation would be found in such a large set of samples; but the actual results show variations so wide as to be actually startling. Not only are these variations large but a glance at the chart will make clear the apparent lack of consistency among the variations of the same samples. Furthermore, the averages give but little idea of what may be expected from single samples. For instance, it will be noted that the strength variation average is 14.6 per cent below the standard, yet one sample is nearly 45 per cent below and another one nearly 40, while two samples are higher than the standard assumed and therefore are credited with the plus variation. The remaining specimens are scattered promiscuously all over the territory represented between these two extremes, and it therefore seems evident that it would be extremely difficult to judge the amount of load that an ordinary piece of manila rope of this size would bear even with the results of these tests at hand. The maximum failed under a load of 9,010 lbs., while the minimum was only able to stand 4,946 lbs., and between these figures it would be difficult indeed to say where any sample would fall.

While the strength variations were much wider than the size or weight, the two latter show sufficient discrepancies to give cause for serious thought as to the advisability of promulgating some sets of standards to which rope will measure up. It will be seen that in several cases where the size curve showed a decided rise the weight curve dips. It would naturally be supposed that where the size was considerably greater than standard, the weight would increase correspondingly, but this seems not to be the case and must indicate that some brands are much more loosely twisted than are others. Certainly it is a surprising to find the weights varying between minus 9.61 and plus 22.6. That 3 in. rope is by no means 3 ins.' in circumference is obvious from a perusal of the figures obtained in this investigation as to size variations. The maximum was plus 10.3 per cent greater than the standard, while the minimum fell 7.3 per cent below it.

The actual sizes, weights and tensile strengths matter but little in comparison with the variation figures which these curves show. If all the different samples fell within a few per cent of the average it would really matter but little what figure this average represented, for then it would be possible to predict from the kind of rope under consideration within reasonable limits what its physical characteristics would be. The facts thus brought out should warrant serious consideration from the cordage manufactures.

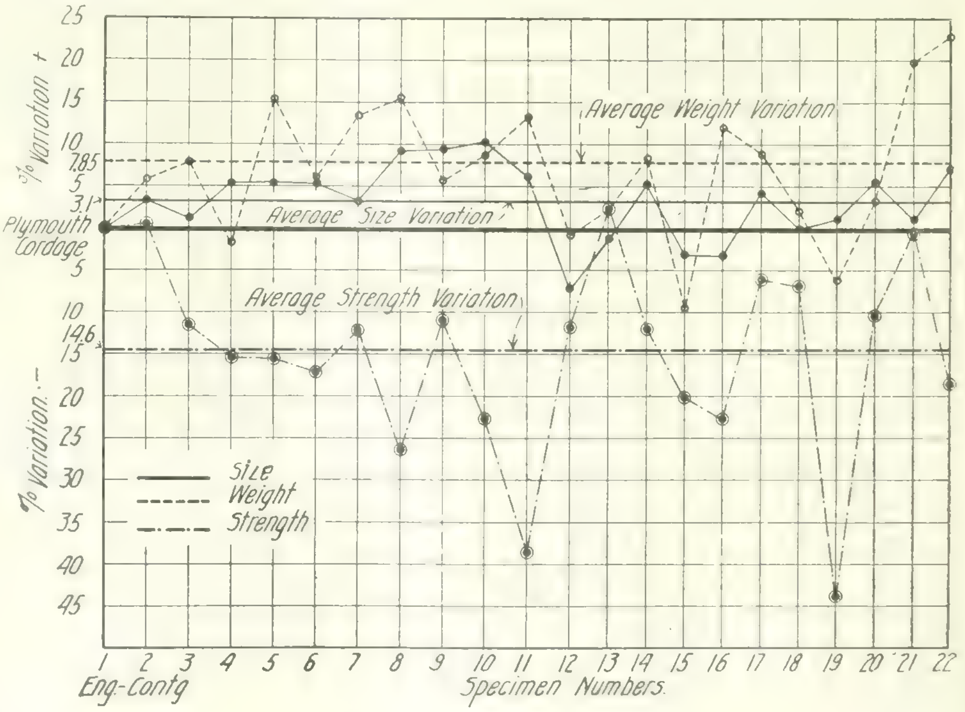


Diagram Showing Results of Tests of Rope

LETTERS TO THE EDITOR.

The Design of Retaining Walls.

Sirs: I beg some further space in your valued journal to answer some of the statements made in Mr. Godfrey's letter of Feb. 1 in which he says my letter of Jan. 18, giving comparisons between cantilever and counterfort retaining walls is not just or equitable.

Mr. Godfrey himself can hardly claim to be just when he refers to the failure of the San Luis Obispo oil tank and says that the sides were like the cantilever wall shown in my letter. The owners and contractors who built the oil tank refused to give out any information as to how it was really built; therefore, how can he justly say it is a better design than mine, or that it was not the fault of workmanship or omissions instead of design that caused the failure?

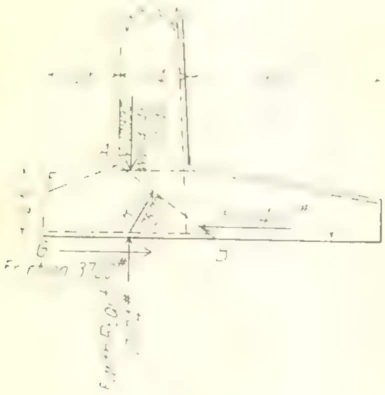


Fig. 1.

Mr. Godfrey points out that liquid pressure is more of a criterion than earth pressure. There are cantilever walls here in Cincinnati that stand a hydrostatic pressure of 40 ft. head with no signs of trouble.

Mr. Godfrey argues that the compression of concrete does not increase the grip on the rods by stating that concrete is not like rubber. However, concrete has elastic properties. It compresses from 10 to 20 times as much as steel under the same stresses. But this point is not dependent on theory. The data given were from actual published tests of rods pulled from concrete under compression.

Mr. Godfrey gives much attention to what he alleges is a serious weakness in cantilever walls, and accuses the designers of such walls of paying but little attention to analysis. He then gives an analysis that is incorrect. His is really no analysis. He does not make a single calculation nor give the value of a single stress, but asserts in an offhand way that the design is weak and could fail. He conceives that there is danger of the block ABGF (Fig. 1) breaking off on the line AB caused by the forces V and H. He starts out with a false premise when he states that there is nothing to resist the forces mentioned except the shearing and tensile strength of the concrete. Mr. Godfrey completely overlooks the reaction of the earth and the friction acting under the wall. The direction of the resultant of these two forces is shown by R. Before the forces H and V can exist or come into action there must be provided a force to act in about the direction of R.

It will be shown by the following calculations, however, that the unit stresses in that region are but about one-half that allowed by the most conservative authorities. Using Mr. Godfrey's formula for earth pressure gives 4,500 lbs. acting horizontally against the vertical part of the wall. This produces a bending moment of 34,900 lbs. The percentage of reinforcement being such that the neutral axis is approximately in the middle, the total compression force, V, caused by the bending moment is 18,000 lbs. To this must be added the weight of the wall acting on the compression side of the neutral axis, which is 4,045 lbs. This makes the total downward force on the block ABGF 2,204 lbs., the position of which is shown at V. The reaction of the earth for the part in front of B is 17,174 lbs., acting upward against the block practically opposite V. The difference, 4,811 lbs., is the vertical component of shear. Dividing this by the vertical section at A, 360 gives less than 13 lbs. per sq. in. as the unit stress. This is spoken of as shear, but is actually a combination of diagonal tension and shear. However, it is not considered necessary to use stirrups or diagonal reinforcement in beams unless the amount of simple shear is more than 25 lbs. per sq. in.

The horizontal shear is found in the same manner considering the weight of the earth above the heel at 100 lbs. per cu. ft., and the weight of the heel itself we have 18,000 lbs. acting downward on the heel. This gives a positive bending moment on the heel of 6,000 lbs. The negative bending moment caused by the reaction of the earth under the heel is 36,750 lbs., leaving a net positive moment of 23,250 lbs. This makes the compressive force at H 10,400 lbs. The total friction acting on the bottom of the wall is 5,600 lbs., the same as the outward earth thrust. This friction is proportional to the reaction at every point. For the part under the block ABGF the friction is 3,700 lbs. Subtracting this from the 10,400 lbs. at H gives 6,700 lbs. the net shearing stress acting horizontally. Dividing this by area of the horizontal plane that resists the shear gives a unit shear stress of 15 lbs. per sq. in. So that one of the "horrible failures" which Mr. Godfrey insinuates will result from such designing will hardly happen from this "serious weakness" that he claims to be the first to point out.

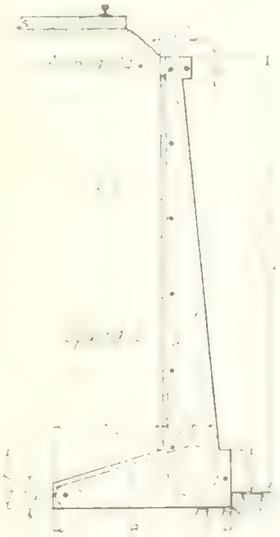


Fig. 2.

If there was any danger of rupture on the line AB it could be easily provided for in such reinforcement as shown in Fig. 2, which gives a section of a wall 1,300 ft. long built by the Cincinnati Northern Traction Co. along the Miami River.

Mr. Godfrey says there is great stress at the change of direction and speaks of the "re entrant angles," etc., in the cantilever walls. But there are twice as many corners and angles in the counterfort walls for the stresses to travel around.

He says that the fact that a wall stands is no proof of correct design. This is true, but when a counterfort wall fails it is proof that something is wrong. Figure 3 shows the failure of a counterfort wall at the Cincinnati Hospital grounds as it appeared a few weeks after its completion. The other end of this wall is of the cantilever type and is now after four years standing perfect and plumb.

It is justice to say that these walls were designed by one of the largest and most reliable engineering firms in the country, and that they were built by a contractor who had built many important reinforced concrete structures.

I know that good walls can be made using either type. My only argument is that the cantilever type is the [illegible] cheapest, and that the stresses therein are more direct and correctly arrived at, and therefore more reliable.

Yours truly,

EVAN P. BONE,

Jr. U. S. Engineer.

Cincinnati, O., Feb. 18, 1911.

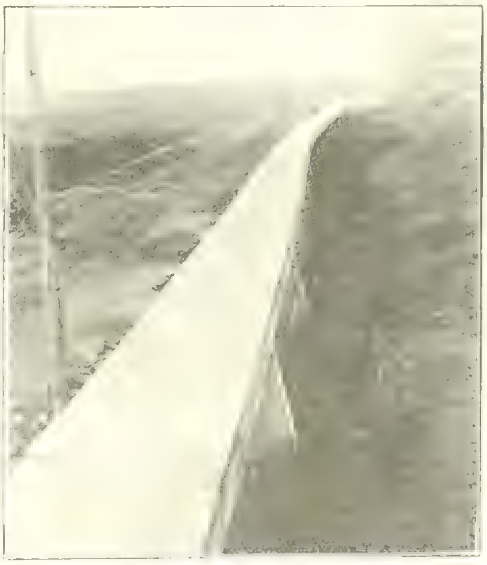


Fig. 3.

General Formula for the Most Economical Size of Pipe.

Sirs: Referring to the general formula derived through differential calculus for the most economical size for a pipe carrying pumped water, appearing on pages 113 and 114 of your issue of Jan. 25, 1911:

Three years ago the writer designed and constructed a water supply system to deliver by pumping 1,150,000 gals. per 24 hours through a pipe line 198,455 ft. long, divided into two lifts, the total static head being 955 ft. The first section contains 53,168 ft. of 12-in. cast iron pipe and 25,631 ft. of 11-in. wood pipe. The second section contains 49,156 ft. of 12-in. cast iron pipe and 70,500 ft. of 11-in. wood pipe. On the first section the static head on the lower end of the iron pipe is 257 ft. and the like head on like end of wood pipe is 233 ft. On the second section the like heads are 317 and 143 ft. respectively. The estimated maximum pumping pressure on the first section, figuring the iron pipe as a rough pipe and the wood pipe as a smooth pipe, was 304 lbs. The actual maximum on test run was 270 lbs. In like manner, the estimated and the actual maxima on the second section were 310 and 278 lbs., respectively.

Applying the formula above mentioned to the first section, the rate of pumping is 383,300 gals. per 8 hours, and the required diameter of the iron pipe is 9.73 ins., or say 10 ins.

The 12-in. cast iron pipe laid complete cost $39.34 per ton. Allowing for the higher resistance in the 10-in. pipe, it would still be 663 tons lighter and its first cost would be $26,082 less than the 12-in. pipe. The smaller pipe would increase the friction head 147 ft., calculated from the observed resistance in the larger pipe. This requires 37.5 additional horsepower, allowing 25 per cent for internal resistance in pumping plant. The latter complete, including buildings, cost $139.40 per horsepower. The net excess first cost of the 12-in. pipe is, therefore, $21,855, carrying, at 5 per cent, an annual interest charge of $1,093 and $437 for up-keep at 2 per cent.

The operating cost of the plant for all items [illegible] per horsepower hour, or $2,025 per year, chargeable to the 10-in. pipe. From this it appears that the 12-in. pipe is probably a little the more economical, especially as the increasing roughness of an iron pipe due to age would increase the cost of pumping to a greater degree in the smaller pipe. It is evident, however, that the formula applied on the 8-hour shift approximates very closely the minimum cost.

There appears to be something wrong with [illegible] the square root of 1.15 millions gives a diameter of 20 ins. The latter, under the high pressures of the service herein considered, would have been 3,650 tons heavier and the first cost would have been $143,591 more than the 12-in. pipe. The 20-in. pipe would reduce the friction [illegible] calculated from the observed resistance in the 12-in. pipe, saving thereby 22 h. p. and reducing the excess first cost to $140,524, carrying, at 5 per cent, an annual interest charge of $7,026. Excess up-keep at 2 per cent would be $2,810. Reduction in operating cost would be $1,156. The net excess annual charge against the 20-in. pipe would thus be $8,780.

It is interesting to note that the observed resistance in the 12-in. pipe was equal to a static head of 91 ft., while Weisbach's general formula gives 109 ft. On this basis the resistance in the 20-in. pipe would be 7 ft. and 11 ft., and in the 10-in. pipe 238 ft. and 251 ft., respectively.

In Kutter's formula, the observed resistance in the 12-in. iron pipe makes "n" equal to 0.0105. The pipe had a smooth interior coat of asphaltum.

Yours truly,
J. L. CAMPBELL.

El Paso, Tex., Jan. 28, 1911.

(Attention should be called to the fact that our formula contains a factor that is a function of the cost of the pipe in place, and that, for the purposes of illustration, we assumed a pipe designed to carry a pressure due to a head of 100 ft. However, quite considerable changes in head should not materially affect the result.—Editors.)

Drainage Areas and Areas of Waterways.

Sirs: In answer to the letter of Mr. J. E. Tupper, of Pomeroy, Washington, relative to my paper on "Drainage Areas and Areas of Waterways" in your issue of Jan. 4, I beg leave to submit the following note from the A., T. & S. F. Ry. Co. tables:

Column A in this table is prepared from observations of streams in southwest Missouri, eastern Kansas, western Arkansas and the southwestern portions of the Indian Territory. In all of this region steep, rocky slopes prevail and the soil absorbs but a small percentage of the rainfalls. It indicates larger waterways than are required in western Kansas and the level portions of Missouri, Colorado, New Mexico and eastern Texas. These tables are based on data gotten from different western railroads and from actual surveys and on a 6-in. rainfall in 24 hours, taken from government satistics, with the understanding that most of it falls in 6 or 8 hours with a runoff of 172 cu. ft. per second and a velocity of 4 miles per hour, or 6 ft. per second.

There is no question but that the tables are applicable for this section of Kansas, for 6 ins. of rain in 6 to 8 hours is not uncommon and 4 ins. in 45 minutes was recorded within the last year.

Mr. Tupper is right in that the above tables could not be used outside of the area where these determinations were made.

I am familiar with the culvert conditions in the middle West and, as stated in my paper, "practically all of the culverts are too small to carry the water that comes to them."

My object in presenting these data was to impress upon the delegates the importance of this subject and to suggest where such information might be obtained [illegible]

Very truly yours,
W. S. GEARHART.
Highway Engineer.

Manhattan, Kan., Feb. 6, 1911.

PERSONALS.

Mr. C. J. Taylor, an assistant engineer of the New York Central & Hudson River R. R., was struck and instantly killed by a freight train near Fonda, N. Y., on Feb. 16.

Mr. F. J. Van Zuben, who has been for several years assistant city engineer of Ft. Worth, Tex., has been appointed to fill the vacancy caused by the resignation of the present city engineer, Mr. Trammell.

Mr. F. L. Fellows, city engineer of West- [illegible] post of Vancouver, B. C., at an annual salary of $8,000. The appointment is for a period of five years, beginning May 1, 1911.

Prof. George L. Cooley, who was sent to Louisiana recently by the Department of the Interior to supervise the building of good roads, will become head of the State Department of Highways that is now being organized in that state.

The following appointments are announced by the Chicago Great Western R. R.: Mr. C. E. Carson is appointed superintendent of the Western Division, with headquarters at Clarion, Ia. He succeeds Mr. M. Dailey, resigned. Mr. W. P. Causey is appointed superintendent of the Southern Division, and Mr. J. A. Gordon superintendent of the Eastern Division, each being transferred to fill the position of the other.

Mr. Jeremiah W. Boynton, a street and interurban railway promoter, died of apoplexy at his home in Grand Rapids, Mich., on Feb. 18, at the age of 73. During a long and active career he built a number of important electric railways in western Michigan, among them being the local street railway systems of Grand Rapids and Kalamazoo, the South Bend & Mishawaka line and the Lowell & Hastings line, which is now a part of the Pere Marquette R. R.

Mr. Oscar Claussen, a prominent consulting and contracting engineer, has been appointed city engineer of St. Paul, Minn., for a term of three years. He will succeed Mr. L. W. Rundlett, whose term expires on March 14. Mr. Claussen was for some years connected with the engineering department of the Northern Pacific Ry. and the Chicago Great Western R. R., and has had extended experience in municipal work. Since 1893 he has devoted most of his time to consulting practice in the design and installation of municipal water, light and sewerage plants, and street paving, with office in St. Paul.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Southern Blue Book.—Paper, 6x9 ins., 64 pp. Manufacturers' Record, Baltimore, Md.

Annual Blue Book of the South's resources and progress.

Conduit Products.—Paper, 6x9 ins., 40 pp. Sprague Electric Co., 527 W. 34th St., New York.

A catalog of electric conduits and fittings. All fittings are illustrated and accompanied by a table of dimensions. Prices are given.

Gas Furnace.—Paper, 9x12 ins., 4 pp. Rockwell Furnace Co., Fisher Bldg., Chicago.

An illustrated description of a gas furnace which is called a combination tool room furnace, as it is made to serve eight purposes.

Steel Bars for Reinforcing Concrete.—Paper, 6x9 ins., 50 pp. Monolith Steel Co., Washington, D. C.

A complete illustrated description of the Monolith Bar with formulas and examples for [illegible]

Elevator Controllers.—Paper, [illegible] ins., 64 pp. The [illegible]

A booklet describing the line of electric elevator controllers developed by the J. L. Schurman Co. Illustrations, diagrams and price lists are given.

Railroad Pile Driver.—Paper, 9x12 ins., 16 pp. The Browning Engineering Co., Cleveland, O.

This new catalog gives an illustrated description of a new and unusual pile driver mounted on a railroad flat car of special design. The driver is designed to drive batter piles up to 3 ins. per foot, and also to drive piles ahead of and at the side of the car.

Ditchers.—Paper, 9x12 ins., 32 pp. The Browning Engineering Co., Cleveland, O.

A catalog which gives illustrations of the operations and various work to which the Browning combined steam shovel and locomotive crane may be put.

Concrete in the Country.—Paper, 6x9 ins., 112 pp. Marquette Cement Manufacturing Co., Marquette Bldg., Chicago.

A useful book for anybody using cement in rural districts. Contains special directions for the construction of numerous standard buildings, outhouses, sidewalks, etc. Estimates of construction costs are given.

McCaslin Conveyors.—Cloth, 8½x12 ins., 156 pp. Mead-Morrison Mfg. Co., New York, Boston and Chicago.

Illustrating and describing various installations of conveying machinery in manufacturing plants of all descriptions.

Road Machinery.—Paper, 6x6½ ins., 28 pp. The Austin Western Co., Ltd., Chicago, Ill.

Illustrating and describing various classes of machinery for road building.

Lime Kilns.—Paper, 6x9 ins., 40 pp. The Improved Equipment Co., 60 Wall St., New York City.

Bulletin No. 4, showing the company's line of lime kilns and lime producing equipment, which contains, besides a description of the company's apparatus, a discussion of the principles and economies of lime manufacture.

Rock Drill Accessories.—Paper, 6x9 ins., [illegible] pp. Ingersoll-Rand Co., 11 Broadway, New York City.

This bulletin describes and illustrates the complete line of drill equipment which the Ingersoll-Rand Co. is prepared to furnish. It also includes tables giving sizes, weights, prices, etc., of the equipment described.

Concrete Reinforcement.—Paper, 9x11½ ins., 32 pp. Monolith Steel Co., 1435 First National Bank Bldg., Chicago.

A catalog illustrating various structural details and methods of placing monolith steel reinforcement.

Hydraulic Dredges.—Paper, 6x9 ins., 48 pp. Ellicott Machine Co., Baltimore, Md.

Illustrating various types of hydraulic dredges in use. Also some dredge machinery.

Stainless Cement.—Paper, 6½x9 ins., 12 pp. The Atlas Portland Cement Co., New York City.

A bulletin describing Atlas-White Portland cement.

Rock Crushers.—Paper, 6¾x10 ins., 20 pp. Western Wheeled Scraper Co., Aurora, Ill.

An illustrated catalog describing jaw crushers and portable crushing and screening plants.

Steel Flumes.—Paper, 6½x9½ ins., 32 pp. Ideal Bldg., Denver, Colo.

Catalog No. 6, illustrating various installations of Maginnis steel flumes for power and irrigated canals. Made without rivets.

Traction Engines.—Paper, 6x9 ins., 112 pp. Port Huron Engine & Thresher Co., Port Huron, Mich.

A complete catalog of traction engines as well as threshing machinery. Illustrations, specifications and descriptions of parts are given.

Keithsburg Bridge.—Paper, 9x6 ins., 8 pp. Marquette Cement Manufacturing Co., Marquette Bldg., Chicago.

An illustrated description of the Keithsburg, Iowa, bridge.

Grading Wagons.—Paper, 7½x4½ ins., 16 pp. Watson Wagon Co., Canastota, N. Y.

An attractive booklet on wagons of 1½ and 2-yard dump wagons for contractors' use. Detailed descriptions are given.

Motor Trucks.—Paper, 11x8½ ins., 96 pp. Packard Motor Car Co., Detroit, Mich.

This is the general catalog for the Packard truck and contains illustrations, descriptions and specifications of every type of truck made

Peerless Road Rollers.—Paper, 10x6¾ ins., 16 pp. The Geiser Mfg. Co., Inc., Waynesboro, Pa. A catalog of road rollers and traction engines. Descriptions and illustrations of various types are given.

Marion Dipper Dredges.—Leather, 9x6 ins., 80 pp. Marion Steam Shovel Co., Marion, Ohio.

A catalog of dipper and elevator dredges of various types. Line drawings and specifications are given, together with a series of illustrations of various types of dredges in actual use.

Steam Shovels.—Leather, 9x6 ins., 142 pp. Marion Steam Shovel Co., Marion, Ohio.

This is a complete catalog of Marion shovels, containing illustrations, line drawings of various types of shovels and other excavating machinery. Specifications for each type of machine are given and also a considerable number of illustrations of digging machinery in actual use.

Dump Cars.—Board, 9x6 ins., 22 pp. Continental Car and Equipment Co., 45 East 17th St., New York.

This catalog gives the specifications and illustrations of dump cars, both steel and wood, of the sizes in most general use.

Motor Trucks.—Paper, 9x12 ins., 20 pp. Saurer Motor Trucks, 1876 Broadway, New York.

The story of the Saurer truck, with illustrations, diagrams and descriptions of the various types and parts of trucks.

Motor Truck Tires.—Paper, 6x9 ins., [illegible] pp. B. F. Goodrich Co., Akron, O. A discussion of the possibility of the motor truck in any business. Illustrations of various types are given, together with prices.

Motor Trucks.—Paper, [illegible] ins., 12 pp. Metzger Motor Car Co., 6 E. 31st St., New York City.

Containing considerable information on the life of truck tires, a description of the new removable type and a list of sizes and prices.

Electric Trucks.—Paper, 6x9 ins., 8 pp. Studebaker Automobile Co., South Bend, Ind.

A description of the Studebaker truck and a discussion of the adaptability of electric trucks, together with an estimate of the costs of operation.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

[illegible] the most important news of the week is the refusal of the Interstate Commerce Commission to grant the general increase of freight rates sought by the railroads in the east and middle west. What will be the effect of this decision of the commission on the pending railroad construction work of the older roads is a question. It seems likely, however, that many of the railroads will go ahead with their immediate construction plans, possibly holding up for the present such extensions and branch lines as do not promise immediate returns on the investments. This will be the case of the Chicago, Rock Island & Pacific, for it has already been announced that that road will go ahead with its extensive improvements planned in Iowa. The Chicago, Milwaukee & St. Paul will also construct its branch lines already planned for the Puget Sound District. The placing of a $50,000,000 bond issue in France for the Central Pacific Ry. also seems to assure the carrying out of the extensive construction plans of the Harriman lines, which it will be remembered were announced some weeks ago.

The largest electric railway contract of the year was closed on Feb. 18 at Kansas City, Mo. This contract called for the construction of the first line of the Kansas City-St. Louis Electric Ry. and was secured by the L. J. Smith Construction Co., Kansas City. The contract calls for the construction of 140 miles of double track road from Kansas City to Columbia, Mo., and involves the moving of 11,000,000 cu. yds. of earth and 2,000,000 cu. yds. of rock. Among the other railroad contracts let recently are the following: J. E. Porter & Co., Weldon, N. C., for about 35 miles of double track work for the Atlantic Coast Line between Weldon and Pleasant Hill; Mac Donald, Gzowski & Co., Vancouver, B. C., for the second 30 mile section of the Kettle Valley R. R. in British Columbia; Witherspoon-Englar Co., 98 Jackson Blvd., for the construction of shops, terminals and other buildings at Slaton Junction and Sweetwater, Tex., on the Coleman cutoff of the Santa Fe system; subcontracts for work on the new line of the Buckhannon & Northern have been awarded to the following: G. T. Fogle, St. Albans, W Va.; Hunter & Hines, Washington, Pa.; Zerely & Co., Morgantown, W. Va.; Pennsylvania Contracting Co., Pittsburg, Pa.; Gilmore & Weaver, Morgantown, W. Va.; A. Panarella, Pittsburg, Pa.; Alfieri & Co., Morgantown, W. Va.; Flynn Bros., McKeesport, Pa.; R. T. Martin, Parkersburg, W. Va.; Hamilton & Huffman Construction Co., Fairmont, W Va.

The New York State Highway Commission is again calling for bids for extensive road construction work. This work was advertised some months ago, but was held up by the governor, and is consequently now being readvertised. The bids are to be opened at Albany, N. Y., on March 20, 22 and 24.

Bond issues have been voted for the proposed extension of the Midland Valley R. R. from Arkansas City, Kan., to Wichita, Kan., 50 miles, and it looks now as though grading work would be started shortly and the line completed this summer.

A good sized levee contract was let last week by the Board of State Engineers of Louisiana, Clark & Helgason Bros., Vicksburg, Miss., being the successful contractors. The contract calls for the construction of 402,000 cu. yds. of new levee in Madison Parish, La., about 24 miles above Vicksburg, Miss.

Bids were opened last week by the U. S. Engineer at Cincinnati, O., for a large lock and dam contract. The work is to be done on the Ohio River near Ashland, Ky. The bidders on this work were as follows: Dravo Contracting Co., Pittsburg, Pa., $682,674; Bates & Rogers Construction Co., Chicago, Ill., $677,753; Sheridan-Kirk Contract Co., Cincinnati, $644,842.

A bill is to be introduced in the Illinois legislature granting the trustees of the Sanitary District of Chicago authority to extend, widen and deepen the main channel of the sanitary canal and to remove dam 1 and lock 5 at Joliet. A similar bill was introduced at the last legislature, but withdrawn owing to opposition from interests at Joliet; but the trustees are notified that this opposition has been withdrawn. The bill, if passed, will enable the trustees to complete the main channel from Lockport to Brandon road, a distance of about one mile.

The Qualifications of a Contractor.

In the course of a speech at the annual dinner of the Contractors' Protective Association of New York, Capt. D. L. Hough, president of the United Engineering & Contracting Co. of New York, summed up in a few words the qualifications required of a contractor. He said:

> [illegible] first, of that most uncommon thing, common-[illegible] lies the center of gravity; the sense that tells a man values without estimating; the sense that tells a man quantities without measuring. He [illegible] men about him. He must have a reputation for justice in order to hold them. He must be force-[illegible] field-marshal. He must be a diplomat, and he [illegible]

The Field of the Engineer.

A few years ago it was thought that the graduate of an engineering school had a somewhat restricted field of action—he could either follow his profession or he could go to farming. That this restricted field was more imaginary than real reference to the alumni lists of any technical school will show. For instance, take the case of the Rensselaer Polytechnic Institute, which graduated its first civil engineer in 1826. Of the 620 living graduates of the classes of 1880 to 1904 inclusive, a rough classification of the present occupation as given in the register of the institute shows the following:

Civil engineering	311
Contracting	[illegible]
Manufacturing	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Other occupations	[illegible]

In the above table the head "Civil Engineering" covers all graduates whose present occupation is given as such as to warrant the assumption that they are engaged in civil engineering proper. The head "Contracting" covers all graduates engaged in that line of work either as engineer for the contractor or as member of the firm. "Manufacturing" covers all those in any way connected with a manufacturing concern either as an official or engineer. "Other Occupations" includes all occupations from envoy extraordinary and minister plenipotentiary to attorney and counsellor at law. It is worthy of note that under the last head the occupations of two graduates are given as "capitalists."

Science Notes.

It is with no desire to reopen the wordy controversy regarding the discovery of the north pole that we write these few lines. Rather it is our intention to make known the surprising discoveries in the field of science of a statesman from Arkansas. These discoveries were given to a waiting world in an oration before Congress in which the statesman attempts to disprove Peary's claim as a discoverer. Our esteemed contemporary, the Congressional Record, with commendable zeal for the interests of science gives the oration in full, but lack of space permits us to quote only the most important discoveries:

> I am advised by one school of scientists that [illegible] reach the north pole, for the diminishing centrifugal action of the earth, and in proportion the increasing center of gravitation, near the pole, cause a complete failure of human and animal [illegible] that causes the loss of power of motion, sensation, or function in any part of the body, including the exercise of the faculties of the mind. * * * I stated that it was one school of scientists. That is what I stated. In support of this contention any school child will remember to have read of the inhuman drubbings that travelers in frozen zones have been forced to alternately administer to each other in order to keep their human energies sufficiently aroused to prevent them from falling into a sleepy stupor, that in [illegible]
>
> Scientists tell us that such mighty mountain chains as the Rocky mountains of our own country are nothing more nor less than volcanic upheavals of the earth, but common reason teaches that they are as much of the original creation as Mount Ararat, upon which Noah's ark was permitted to rest; Mount Sinai, upon whose lofty heights was sung, by stainless lips, that grand refrain, "Peace on earth good will to man."

Rapid Building Construction.

Building contractors have undoubtedly made much progress in the rapidity with which they erect buildings, but we have some doubts as to whether a building goes up with quite as much speed as is claimed by the New York contractor below. It seems that two contractors were discussing the methods of building work in New York and Chicago. The contractor from the latter city claimed that they put up buildings much faster there than in New York. "Sure," said the Chicagoan, "they will be digging for the foundation of a 52-story building today and in two weeks it will be finished." "Well, that's nothing to the way they do things here," the New Yorker retorted. "To give you an idea how fast we are let me tell you that the day before yesterday they began building a 20-story apartment on our block and this morning they were dispossessing some of the tenants for being behind with their rent."

RAILWAYS, STEAM AND ELECTRIC

Alabama.

It is expected that the Louisville & Nashville R. R., W. H. Courtenay, Chief Engineer, Louisville, Ky., will shortly announce plans for additional double track work on its main line from Nashville to Mobile. This company already has a large amount of double track work under way and it is expected that the new work will call for the expenditure of an additional [illegible]

A project is under consideration in Decatur and Huntsville for the building of an interurban line to connect the two places. The plan includes a highway toll bridge over the Tennessee River. The Business Men's Club of Huntsville, Ala., is reported to have taken up the matter.

The Pensacola, Mobile & New Orleans Ry., now being constructed across Baldwin County by Henry McLaughlin of Pensacola, Fla., has made arrangements with the New Orleans, Mobile & Ohio R. R. for a connection at Mobile. It is expected that the Pensacola, Mobile & New Orleans Ry. will have its line completed from Pensacola to Mobile by midsummer. Arrangements are now being made for the construction of a drawbridge across the Mobile river about one mile north of Mobile, authorized recently by Congress.

The Elmwood Cemetery Corporation, Walter Puckett, manager, Birmingham, Ala., has had surveys made for a street car line from Elmwood Station, corner of Canal St. and Tuscaloosa Ave., down the Mantevallo road to Elmwood cemetery. The cost of building the line will be borne by the cemetery corporation.

O. D. Smith and C. W. Zimmerman, Mobile, Ala., are planning to construct a lumber railroad to open up a tract of timber land in Choctaw County for their new mill now being built at Womach Hill.

Representatives of New York capitalists have been over the Union Springs & Northern Ry., with a view to financing the completion of the road to Milstead. W. M. Blount, Union Springs, Ala., is President.

Arizona.

The Phoenix Street Ry. Co., S. H. Mitchell, manager, Phoenix, is planning to relay its tracks from 9th St. to 13th Ave. when the city starts to pave those streets.

Officials of the El Paso & Southwestern System, Walter Douglas, Vice President, Bisbee, Ariz., are reported to have made definite announcement that the line will be extended from Benson to Tucson, paralleling the Southern Pacific.

The Phoenix & Eastern R. R. (Arizona Eastern R. R., L. H. Long, Chief Engineer, Tucson, Ariz.) has work underway relaying 12 miles of Phoenix & Eastern track, between Kelvin and Hayden, and the removal of about 3½ miles of road, from Hayden to Winkelman, from the present roadbed to higher ground, about 200 yds. to the northward.

Arkansas.

The State Board of Railway Incorporators has granted a one-year extension to the Missouri, Arkansas & Southwest Ry. to complete 20 per cent of its line. The work on this road has been tied up by one of the stockholders, who had brought suit in the federal court to have the road thrown in the hands of a receiver. This suit was recently dismissed and the Board of Directors have stated that there is now nothing to prevent the work going forward rapidly.

California.

J. S. Bales, Fresno, Chief Engineer of the Fresno, Coalinga & Tidewater Co., has started surveys for the projected route of the proposed Fresno, Coalinga & Monterey R. R.

The Southern Pacific is contemplating the immediate extension of its electric system in the east shore district of Oakland, and the residents along the right of way have already been ordered to vacate that the work may start at once.

It has been announced unofficially in Princeton, Cal., that the Southern Pacific Ry. Co. will, this year, construct the branch from Arbuckle to Hamilton City through Colusa and Princeton. William Hood, San Francisco, Cal., is Chief Engineer.

A crew of surveyors is working for the Southern Pacific between Suisun, Cal., and Benicia along the present right of way and it is understood that they are laying out the stakes for the double tracking of the road from Benicia to Sacramento. The culverts and bridges across the tule and sloughs between Suisun and the other city are already completed to accommodate double track. The company is to build a third track between Oakland and Port Costa to accommodate freight trains only. The freight track will be extended as far as Antioch, and will serve all of the big shipping and manufacturing plants along the Contra Costa bay shore line.

Information from Loomis, Cal., states that sub-contractors on the Southern Pacific cutoff in Placer County, between Rocklin and Colfax, are shipping large quantities of construction materials from Loomis to Truckee, and Laughton to be used in double tracking the main line from Laughton to Winsted, a distance of 28 miles. The line is already double-tracked from Reno to Laughton, a distance of seven miles, and from Truckee to Winsted, a distance of three and one-half miles, and the work now to be undertaken will mean the doubling of the track all the way from Sparks to Truckee, which is a part of the big project for doubling the system all the way from Ogden to the coast.

Ties and other materials have been stored at Hawthorne preparatory to the beginning of construction work on the 7 mile cutoff of the Pacific Electric Co., of Los Angeles, between Hawthorne and Watts.

Information has been received from Mecca, Cal., to the effect that it is expected that active construction work will be started on the proposed railroad from Mecca to the iron mines in Eagle Mountains.

The Southern Pacific R. R. Co. has purchased several strips of land between Santa Clara, Cal., and College Park on the west side of the present tracks and now has an abundance of room for the contemplated improvements to San Jose.

The status of plans for supplies for the construction of the Geary St. municipal street railway in San Francisco was as follows on Feb. 11: Contract No. 1.—For furnishing and delivering steel rails. Contract awarded to the Penn Steel Co. by the Board of Public Work on Nov. 30, 1910, at the following prices f. o. b. factory: Steel grooved girder rails, $34.24 per gross ton; steel guard rails, $44.25 per gross ton. Three hundred and ninety-nine tons of rails have been shipped. Contract No. 2—For furnishing and delivering joints, plates and rail fastenings. Plans and specifications prepared and cost estimated at $18,000. Bids received on March 1, by the Board of Public Works. Contract No. 3—For furnishing and delivering rail bonds. Plans and specifications completed and cost estimated at $5,000. Bids received on March 1, by the Board of Public Works. Contract No. 4—For furnishing and delivering wire. Plans and specifications completed and cost estimated at $8,000. Bids received on March 1, by the Board of Public Works. Contract No. 5—For furnishing and delivering special track work. Plans and specifications completed. Cost estimated at $60,000, which amount the Board of Supervisors have been requested to set aside. Contract No. 6—For furnishing and delivering trolley poles. Plans and specifications completed and cost estimated at $17,000. Bids received on March 1, by the Board of Public Works. Contract No. 7—For furnishing and delivering cast-iron trimmings for trolley poles. Plans and specifications 20 per cent completed. Contract No. 8—For furnishing and delivering redwood railroad ties. Specifications completed and cost estimated at $17,000. Bids will be received on March 8, by the Board of Public Works. Contract No. 10—For furnishing and delivering tie bars and nuts. Plans and specifications completed and cost estimated at $3,000. Bids received on March 1, by the Board of Public Works. Contract No. 11—For furnishing and delivering street cars. Plans and specifications 30 per cent completed. Contract No. 12—For furnishing and delivering line material. Specifications 15 per cent completed. Contract No. 13—For hauling rails. Cost estimated at $6,000. Bids received on Feb. 17, by the Board of Public Works. M. Marsden is City Engineer of San Francisco.

Colorado.

The Colorado Midland Ry., F. F. Mallon, Chief Engineer, Colorado City, Colo., is reported to be having estimates made of the cost of electrifying the middle division, in which Hagerman Pass is situated.

The Laramie, Hahn's Peak & Pacific R. R., which is building southwest from a connection with the main line of the Union Pacific at Laramie, Wyo., toward Colorado, is said to be making preliminary plans to extend its line entirely across the northwestern part of the State to a connection with the Denver and Rio Grande and Colorado Midland lines at Grand Junction.

Florida.

The city of Pensacola, Fla., has granted a franchise to Megargel & Co., 5 Nassau St., New York City, giving the proposed Gulf, Florida & Alabama R. R. rights in that city. This road, as noted in our Feb. 8 issue, is to be constructed from Pensacola to the coal fields of Alabama.

Georgia.

⊙R. M. Walker, Atlanta, Ga., has been awarded the contract by the Southern Ry. for the construction of the new inbound freight station and office building to be built on its property fronting on Madison Ave. and running from Mitchell St. to Peters St., at Atlanta. The three-story portion of the building, which will be 464 ft. in length and 50 in width, will be constructed entirely of reinforced concrete, while the six-story office building, 232 ft. in length and 50 ft. in width, will be of steel skeleton, concrete floors and pressed brick finish.

The Tennessee, Alabama & Georgia R. R., which is composed of the Chattanooga Southern and several other lines, has issued $5,000,000 of bonds to provide for the extension of the road. The first issue will be for $1,500,000, and this money will be used in improving the road and making all necessary repairs to put it in first-class shape. The balance of the bonds, $3,500,000, will be issued later, and will be used for building the new road contemplated by the management of the road. C. H. Fisk, Chattanooga, Tenn., is Chief Engineer.

Citizens of Millen have appointed a committee to confer with a committee from Sylvania in regard to the building of a railroad from Millen to Sylvania to connect with the Brinson road.

The promoters of the Hawkinsville & Western R. R. have applied to the State Railroad Commission for permission to issue $300,000 in stocks and bonds to build the proposed 22-mile line to connect Hawkinsville and Perry. The promoters will utilize an old roadbed of a former venture to Grovania in Houston county, and which crosses the Georgia Southern and Florida at that point. At

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Hawkinsville the new road will connect with the Southern and Wrightsville & Tennille, and at Perry with the Central.

Illinois.

Negotiations between the citizens' committee and officiais of the Rock Island & Southern Ry., W. W. McCullough, General Manager, Monmouth, Ill., with reference to the construction of a belt line into the heart of Rock Island, Ill., are still pending.

Surveyors for the branch line of the Chicago & Northwestern Ry. from Peoria to the railroad company's coal fields in Macoupin county, were recently working in the vicinity of Sweetwater.

Residents of Maywood, River Forest and Oak Park, suburbs of Chicago, are advocating a double loop of the Metropolitan and Chicago & Oak Park elevated roads to relieve the traction situation in the western suburbs. The proposed plan is to extend the line of the Metropolitan so as to run through Forest Park and Maywood and return through River Forest and Oak Park. The plan for the Chicago & Oak Park line is to extend it and construct a loop at River Forest, turning north near the Desplaines River and returning to the main line by way of Chicago and Lombard Aves., Chicago.

The Galesburg & Great Eastern Ry. Co., 347 Main St., Galesburg, Ill., is reported to be making good progress with the preliminary work for the construction of its proposed interurban line to connect Galesburg with Wataga, Victoria and other eastern points.

The St. Louis, Peoria & Northwestern Ry., a subsidiary company of the Chicago & Northwestern Ry., has filed its articles of incorporation. The capital stock is $25,000. The company has been organized to build the proposed C. & N. line, which is to run from a point in or near Peoria in a southerly direction through the counties of Peoria, Tazewell, Mason, Menard, Sangamon and through Macoupin to a connection with the Macoupin county railway at a point 2½ miles south of Girard in the county last named. The incorporators and the board of directors are Marvin Hughitt, Chauncey Kepp, Byron L. Smith, John V. Farwell, William A. Gardner and John D. Caldwell, all of the Chicago & Northwestern Ry.

Indiana.

The Lake Shore & Michigan Southern Ry. has been making surveys at Fort Wayne, with the view, it is reported, of enlarging its yards at that city.

Iowa.

The Iowa Falls Commercial Club, Frank E. Foster, Secretary, Iowa Falls, Ia., is taking preliminary steps to ascertain the feasibility of constructing an interurban line from Iowa Falls to Jewell, and on to Sioux City, and thence southwest to Boone.

The Iowa City, Ottumwa & Southwestern Interurban Ry., Iowa City, has completed its second survey, and the engineers have returned to Iowa City. The new line takes in the cities of Kinrose, Sigourney and Hedrich. The promoters of the line have been in conference with the construction company and the bonding house, and it is said that as soon as a choice is made of the two lines surveyed, construction work will be started.

Good progress is reported as being made with the promotion work for the new electric railway from Forest City to Mason City, via Fertile. This project is being promoted by Harry J. Folts of Minneapolis, Minn.

The Chicago, Rock Island & Pacific Ry., through a subsidiary company—the St. Paul & Kansas City Short Line—has acquired the St. Paul & Des Moines R. R., which operates a line from Des Moines to Mason City, Ia. At the latter point connection is made with the Chicago-St. Paul line of the Rock Island. From Allerton on its Chicago-Kansas City line, the Chicago, Rock Island and Pacific will build a new line 68 miles long northerly to Carlisle, near Des Moines. By the purchase of the St. Paul & Des Moines R. R. and the construction of the new line the Rock Island will secure the shortest route between Kansas City and St. Paul. It is believed that the construction of the Allerton-Carlisle line will be started shortly. J. B. Berry, Chicago, Ill., is Chief Engineer C., R. I. & P. Ry.

Kansas.

The Midland Valley R. R. is preparing to begin work on the construction of its extension from Arkansas City to Wichita. Bond issues for this extension were voted on Feb. 14 by Sedgwick County, the City of Wichita and various towns along the route. It is believed that grading work will be started shortly, and the 50 miles of line completed this summer. It is stated that the company will do most of the work itself, with the exception of some of the most difficult grading. The construction of the line will be in charge of Charles Kaighn, Chief Engineer, Beacon Bldg., Wichita, Kan.

The city of Kinsley held an election on Feb. 20 to vote on issuing bonds for $50,000 to aid the construction of the Wichita, Kinsley Scott City & Denver Air Line Ry. This road has construction work under way and expects to have 30 miles of line completed from Turon to Fillsburg by harvest time. To earn the $50,000 bonus the railway must have in operation a line of railway from Turon to Kinsley, 60 miles and must expend $50,000 for terminals in Kinsley. The date set for the accomplishment of these things is December 31, 1912.

The Missouri River, Great Bend & Western R. R. Co., of Great Bend, Kan., has been organized with a capital stock of $5,000,0000 and proposes to construct railroads as follows: From the Missouri River to Great Bend, Kan.; from Great Bend to Denver, Colo., and from Great Bend to Panhandle, Tex. estimated length of line from the Missouri River to Panhandle, Tex., 700 miles; from Great Bend to Denver, 400 miles

The City Council of Chanute, Kan., has granted a franchise in that city to D. H. Siggins of Warren, Pa. This franchise is to be used in connection with the proposed interurban system from Cherryvale to Iola. The franchise provides that cars must be in operation within two years. Mr. Siggins is the head of the Union Traction Co., which built a line connecting Coffeyville, Independence and Cherryvale, in Montgomery county, and of the company which has a line connecting Arkansas City and Winfield in Cowley county.

Kentucky.

Surveys are to be started shortly, it is stated, for the projected route of the Mt. Sterling Short Line R. R. This road is reported as being backed by Judge H. Clay McKee, of Mt. Sterling, Ky., and O. G. Wales, of Toledo, O. It is to extend from Mt. Sterling to either Paris, Carlisle or Cynthiana, Ky.

The Louisville & Nashville R. R. is said to be working out plans to extend the Frankfort & Cincinnati Ry. from Paris along the route originally surveyed for the old Kentucky Midland to unopened territory in Morgan County.

The Louisville & Nashville R. R., W. H. Courtenay, Chief Engineer, Louisville, Ky., has for some time been planning to double track its line through Newport, Ky. The company is now said to have secured the necessary land to permit of the [illegible]

The route of the projected electric railway between Shelbyville and Mt Eden has been outlined as follows by the promoter, Capt. N. B. Waugh of Shelbyville: Along the Mt. Eden pike to Doss Payne's residence, then down the Ravine to Jeptha Creek, through the Payne and Jeffs farm, across Ed Wise's to Beech Creek, then through George Mahuron's, striking the pike again at James Carpenter's, and following it from that point to Mt. Eden. At no point does the propected line leave the pike more than a quarter of a mile. A considerable part of the right of way has been promised.

The Kentucky Midland R. R., M. M. Wheeler, Chief Engineer, Central City, Ky., is considering building a 13 mile extension so as to reach Madisonville, Ky. Mass meetings have been held at Madisonville to take steps for securing the extension.

Track laying on the Kentucky Highlands R. R. has been started and will probably be completed by March 15. It is expected that the road can be placed in operation from Frankfort to Versailles by April 15.

Advices from Bristol, Tenn., state that the Consolidated Coal Co., in furtherance of its plan to develop 100,000 acres of coal lands in the Elk Horn region of eastern Kentucky, near the Virginia and Tennessee border, has recorded at Whitesburg, Ky., a mortgage for $40,000,000. The money realized on this mortgage will be used in developing the properties of the company. The works, as previously noted, include the construction of 35 miles of railway, the opening of a number of mines, the construction of an extensive coke plant and the building of numbers of miners' houses.

Louisiana.

Construction work is to be started this spring at Donaldsonville for the proposed new motor car line, and it is expected that this line will be in operation to Thibodaux by October. Charles Maurin, Donaldsonville, La., is Treasurer of the company.

The New Orleans, Mobile & Chicago Ry., W. F. Owen, General Manager, Mobile, Ala., is reported to be planning to soon begin construction work on the extension of its line through Tennessee to the Ohio River at either Paducah or Evansville.

Maine.

The Railroad Committee of the House has favorably reported the bill to permit the Bangor & Aroostook R. R., M. Burpee, Chief Engineer, Houlton, Me., to construct a 157-mile extension from West Sebois to St. Francis. There is not much doubt but that the legislature will pass the bill.

Maryland.

The City Council of Frederick, Md., has granted the Frederick R. R. Co. authority to make a number of extensions in the southern part of the city.

The Commissioners of Montgomery County, have granted to the Washington, Westminster & Gettysburg R. R. Co. a permit to construct a railroad through Montgomery County and to cross the public roads wherever necessary, the understanding that all crossings, wherever practicable, be carried overhead or underground. The road through the county will extend from below Four Corners to Burnt Mills, to Colesville, to Sandy Springs. The surveys have been completed and the work of grading was started several months ago, but was stopped by the Public Service Commission because of the failure of the company to comply with certain requirements. It is understood the work of construction will be resumed soon.

Michigan.

The Detroit, Bay City & Western R. R., Wm. N. Boyd, Chief Engineer, Bay City, has several routes under consideration for an extension and it is believed that surveys of one of these will be undertaken shortly.

The injunction proceedings brought against the Grand Trunk Ry. have been settled and that road can now proceed with the construction of tracks south of Kalamazoo to Grand Rapids.

We are advised that the grading work on the Rogers City branch of the Detroit & Mackinac Ry. is very light and that the company it doing work itself. The branch will be 14 miles long and is to be placed in operation by June 1. J. D. Hawks, Detroit, Mich., is Vice President and General Manager.

The City Council of Lansing has extended the time limit for the Michigan United Rys. for double tracking Michigan Ave east from the Michigan Central R R to the city limits, until Jan. 1, 1912.

The Duluth, South Shore & Atlantic Railroad is planning the expenditure of a large [illegible] power and rolling stock. It is said that the work under [illegible] includes the relaying of a large amount of the system with heavier steel. V. D. Simar, Marquete, Mich., is Chief Engineer.

Minnesota.

The citizens of Bricelyn, Minn., have raised [illegible] bonus for the proposed interurban line from Albert Lea to Worthington which is being promoted by W. H. Knight, of Chicago, Ill.

The St. Paul Railway Promotion Co., W. L. Sonntag, General Manager, St. Paul, Minn has completed the survey for its projected line, the St. Paul Southern Electric Ry., from St. Paul to Lake City, with an extension to the state camping grounds, a few miles beyond. As projected, the new electric line will cross the Mississippi River at Nininger, about three miles above Hastings, traversing Freeborn Island. A bill authorizing the St. Paul Railway Promotion Co. to build a bridge across the Mississippi River at this place is now before Congress.

Duluth and the Ranges.

BY PETER A. MEAGHER.

C. H. Vaughan of the [illegible] department of the Dan Patch Electric Ry. was a caller a few days ago. He stated that they were progressing very nicely with the construction of their road and hope to have the same completed in the near future.

[illegible], representing the Bucyrus Steam Shovel Co., was a caller. Business is [illegible] in the shovel line at the present time.

P. G. Pastoret of the Pastoret-Lawrence Co. was a caller a few days ago and stated that they had already secured one or two contracts for the coming season and that their work for last year turned out very nicely. They built last year 58,500 ft. of sewers, 72,000 ft. of water mains and 10,000 ft. of gas mains. They expect to do a great deal more than that the coming year.

C. J. A. Morris of Morris & Shepard was a caller and he stated that at the present time he had nothing definite to announce regarding their coming season's operations.

C. Fredricks, railroad contractor, who has some work on the Canadian Northern near Duluth, was in the city recently. He said he had one shovel working on the Canadian Northern at the present time, and he was in hopes of completing this work before the 1st of June.

H. A. Lewis, assistant general passenger agent of the Soo Railway Co., was a caller at this office recently and mentioned the fact that he thought that their company would do a great deal of construction work this season.

Fred Halliday of the Winston-Dear Co., stripping contractors on the range, has returned from a six weeks' visit in the south.

John Dunlavey, general superintendent for the Duluth & Northeastern Ry. Co., was a caller at this office a few days ago. They are not doing any construction work at the present time and do not contemplate any.

H. A. Conolly, superintendent for Butler Brothers Co., one of the largest stripping contractors on the Iron Range, was a caller a few days ago. They are going to start on one of their new contracts about April 1. This work consists of stripping the Longyear Mine, amounting to about 4,000,000 cu. yds.

Thomas Walsh of the Johnson-Carey Co., contractors, was a caller at this office a few days ago. He reported that all of their contracts were in very good shape and that the coming season looked pretty good to them.

The Interstate Dredge & Dock Co. of Duluth, which was awarded a contract by the city of Superior for constructing a viaduct amounting to about $50,000, has already started on the same.

The Roberts-Kingston Contracting Co. of Duluth, which has a large stripping contract at the [illegible] Mine near Virginia, was awarded a very nice contract the other day by the Republic Iron & Steel Co. for the loading of about 300,000 tons of ore. This amount is to be loaded during the coming season.

L. J. Micka, purchasing agent for the Winston-Dear Co., was a caller at this office recently. He was here on a few days' visit and left for their work on the range.

It has been rumored around Duluth recently that the Duluth, Missabe & Northern Ry. Co. had awarded a contract for railway construction to the Winston-Dear Co. At the time of writing this letter this rumor cannot be confirmed, but it would not surprise the writer very much but what it is true.

There are also some rumors up here that the Canadian Northern Ry. Co. is going to build a line from Port Arthur to Tower, Minn., to tap the iron country there. This rumor sounds feasible and would give the Canadian Northern a large ore haulage out of that territory. If this road is built it will be started this spring.

Men are quite plentiful in Duluth at the present time, and from now on will continue to increase, as a lot of the small lumber camps will be closing up, and men will be flocking to the city looking for railroad and city work.

Missouri.

Tentative plans are under consideration for the building of an interurban line from Chillicothe and Trenton. J. A. Dawson, Chillicothe, Mo., is interested.

The Manufacturers R. R. Co. of St. Louis has purchased a site on Barton St., St. Louis, for a freight depot, thus making four freight yards which this company will have between Dorcas St. and Chouteau Ave.

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

One of the most important contracts ever let in Kansas City was awarded Feb. 18 when the L. J. Smith Construction Co., Commerce Building, Kansas City, secured the work of building the Kansas City-St. Louis electric railroad. This is the work that has been mentioned in our columns several times in the past few weeks. The first line of road will be from Kansas City to Columbia, Mo., 140 miles, and will be constructed immediately. A double track the entire distance, a splendid road bed and a low grade insure the very best of service. While the contract figures are not available, it is stated they are not far from $10,000,000. There are nearly 11,000,000 cu. yds. of earth to be moved, besides 2,000,000 cu. yds. of solid rock. Two bridges are to span the Missouri, one at Arrow Rock and the second at St. Charles. The route of the road is through Independence, Blue Springs, Odessa, Higginsville, Marshall, crossing the Missouri River at Arrow Rock, New Franklin, Columbia, Stevens' Store, McCredie, Williamsburg, Mineola Springs, New Florence, Warrenton. From the latter place there are two surveys to St. Louis, one by way of St. Charles and the other by Weldon Springs. That part of the route is to be decided later. Work is to start just as soon as weather permits and by March 15 the scene along the right of way should be one of great activity. More detailed news will no doubt be available shortly, when we will report the same to our readers.

St. Louis Items.

BY A. B. KOENIG.

L. J. Smith and L. A. Nutter of the L. J. Smith Construction Co. spent a couple of days in town with us last week. They are going to resume work on their ballasting contract on the Missouri Pacific R. R. in Kansas as soon as the weather permits. They would have started last week if the blizzard that swept the central states had not come up.

The contract for the construction of the Baden sewer No. 1 was awarded by the Board of Public Improvements to the Fruin-Colnon Contracting Co., St. Louis, Mo., the lowest bidder. The contract price is $134,354.64. About twelve bidders competed.

C. F. Nagel will finish his rock work on the [illegible] line at Godfrey about March 20 and begin getting out rip-rap for the government shore protection work on the Mississippi River north of St. Louis.

The Chicago, Burlington & Quincy R. R. has made arrangements with the Louisville & Nashville whereby the road from Nashville, Ill., to Belleville will be double tracked. The Burlington will come from Sesser, Franklin county, via Du Bois to Nashville and join the Louisville & Nashville at Nashville, Ill., just west of the Illinois Southern crossing. At Belleville the Burlington will take the O'Fallon branch to Alton, where it has its own line to the west. The Louisville & Nashville road intends to eventually double track the entire St. Louis division.

Costello Bros. secured the contract for 150,000 yds. of street and municipal work in Indianapolis, Ind.

The funeral of Captain John F. Hinckley, who was for 40 years chief engineer of the Frisco R. R. system, was held at 10 o'clock last Wednesday morning from the residence of his sister, Mrs. Howard Watson, 5819 Cates Ave., where he died Monday morning of pneumonia. Services were conducted by Rev. Dr. Lichliter of Maple Avenue Methodist Church. Captain Hinckley was born in Boston in 1848. After he was graduated from the Massachusetts School of Technology he came to St. Louis and was chief engineer for the Frisco for 40 years, with the exception of three years, when he was sent to the Gould system to assist in building the Cotton Belt During the time he was with the Frisco he practically built most of its track. He enjoyed a wide acquaintance throughout the southwest. Captain Hinckley was very fond of books, Mark Twain being ihs favorite author. He was unmarried and is survived by his sister, Mrs. Howard Watson; his niece, Miss Martha Watson of St. Louis, and two nephews, Clinton Fisk of Cattanooga, Tenn., and Charles Fisk of Amarillo, Texas. Three years ago Mr. Hinckley resigned from the Frisco and he has since maintained a private office, where he was consulted by some of the most prominent engineers in the country.

A. B. Koenig returned from a week's trip north and found more snow in St. Louis than any place north of it.

The new union station directors of Kansas City, Mo., expect to call for bids for the main buildings by March 15. W. S. Skinner of Kansas City, Mo., is president.

Tom Keating of Keating Bros. is here looking for work for their 25 team outfit, which is idle at Mt. Carmel, Ill.

The Edwardsville Commercial Club has extended a formal welcome to the newest interurban electric line leading through central Illinois, and the members have voted to assist the projectors of the line in every way possible. The road is the Springfield & Central Electric Railway Co. and the advance work is in charge of I. A. Smith of St. Louis. He appeared before the Commercial Club at a meeting Wednesday night and explained the plans of the company and the proposed route, which is from Springfield south through the central part of the state. From Greenville the line runs through Highland, Marine, Alhambra and Grantfork to Edwardsville, where connection will be made with the McKinley Allen and East Side electric lines. The Springfield & Central Illinois is opening up new but populous territory, which has had heretofore to depend principally on steam transportation. The Edwardsville Commercial Club appointed C. Boeschenstein, Dent E. Burroughs, E. A. Keller, W. R. Crossman and Thos. Williamson a committee to co-operate with the new line.

Chas. W. Grant writes us from Paris, Ill., that his team outfit is idle at that point. 242 W. Court St. will catch him.

The contract was awarded for building an electric line between Kansas City and St. Louis by the St. Louis-Kansas City Electric Railway Co. to the L. J. Smith Construction Co. of Kansas City. The contract calls for the building of 240 miles of road at an approximate cost of about 10 million dollars. The contract was awarded on what is known as the unit system, the paying of a certain price for each yard of construction. "I shall begin work on the contract as soon as the weather permits," Mr. Smith said. That probably will be some time in March. The road should be finished and in operation in two years, D. C. Nevin, president of the St. Louis-Kansas City Electric Railway Co., said. The general offices of the road are in the Commerce building. John H. Berkshire is vice-president, B. L. Dorsey second vice-president, H. E. Insley secretary and auditor, Henry V. Johnson treasurer and C. A. Loomis general counsel. "The work will begin at Columbia, Mo.," Judge Nevin said, "and will extend from there to Kansas City, 128 miles. The first work is to be done with a view to opening and developing 18,000 acres of coal land that the company owns in Boone county. A 10 mile branch is to be built from Columbia to Harrisburg, in the middle of the coal field. With the coal from the mouth of the mines the electric power is to be manufactured at low expense, and our plan is to build a power line and wholesale electric power to all the towns on the road. We hope to be shipping coal into Kansas City over this end of the road by next fall. The part of the road from Columbia to St. Louis will be built later. It all should be finished in two years, however. Our plan is to extend the Harrisburg branch to Moberly eventually. The route is to be through Independence, Blue Springs, Odessa, Higginsville, Marshall, crossing the Missouri River at Arrow Rock, New Franklin, Columbia, Stevens Store, McCredie, Williamsburg, Mineola Springs, New Florence and Warrenton. From the latter place there are two surveys to St. Louis, one by way of St. Charles and the other by Weldon Springs. That part of the route is to be decided later. At this time I cannot say how we are to get into St. Louis or Kansas City. That is to be announced later. To build and equip the road will cost about $50,000 a mile. The bonds were sold to a syndicate of capitalists in Paris. The financial arrangements are finished. Trains for local business will run hourly, stopping at all stations. Four express trains daily will stop only at the larger towns. Those trains will carry dining and sleeping cars. They will be drawn by big electric motor engines. The road will carry mail, express, passengers and freight, the freight train to be operated principally at night. Two bridges are to be built across the Missouri River at Arrow Rock and another near St. Charles." During Mr. Smith's visit in St. Louis last week he informed us that his contract calls for the removal of 11,000,000 yds. of earth, 700,000 yds. of loose rock, 700,000 yds. of solid rock, 146,000 yds. of concrete, 12,000 yds. of reinforced concrete, about 6,000 yds. of trestle timber, also all the fencing and track laying. Road will be double tracked its entire length with 70 ton steel, 3,000 ties to the mile.

A union depot of two stories is to be erected in Granite City, Ill., at a cost of $15,000. The site selected is Twentieth and Railroad streets. The main building will have a train shed nearly 200 feet long, covering ten tracks. Bids were advertised for last week. The structure will be of stone and brick and fire proof, with all modern conveniences. The Chicago & Alton, Big Four, Chicago & Eastern, Frisco and allied lines will use the central station. Work on the contract will begin this summer and will be completed by next January.

A contract was awarded by the Board of Public Improvements last Friday to the W. F. Riley Construction Co. for the second section of the Baden public sewer. There were eleven bidders and the price named by the successful bidder was $162,015.80.

Two petitions were submitted to the council last Friday by Councilman Schneiderhahn, which were sent to him by citizens, urging improved street car facilities in certain portions of St. Louis. One petition urged the extension of the Grand car line to Carondelet Park and another urged action by the municipal assembly to give the residents of Arloe, Gratiot and Lindenwood street car service. The petition stated a district two miles square and containing a population of 4,000 was dependent on the Frisco R. R. for transportation. An application for a franchise for an independent street car line to serve this district, under the name of the St. Louis, Arcadia & Jefferson County Railroad, is pending in the House of Delegates and has met with great opposition from residents on Wyoming street, which the road plans to use.

Judgments in the cases of the Kaw Valley drainage district of Wyandotte County, Kansas, against the Metropolitan Water Co. and other defendants were reversed here last Friday in an opinion by the federal court of appeals. The Kaw Valley organization sought to get right of way for levees, drainage and other uses through the land of the defendants by condemnation proceedings. The defendants applied to the United States circuit court at Kansas City and got temporary injunctions against the drainage company restraining it from further proceedings. By the decision of the court the injunctions were dissolved.

Montana.

The Julius Neils Lumber Co. has acquired the holdings of the Dawson Lumber Co. at Libby. By the purchase of the logging railroad the Julius Neils Lumber Co. has acquired a right-of-way for 14 miles. In order to reach all its timber, this road will have to be extended for about 20 miles further.

Nebraska.

Proposition has been made by Arnold S. Durant to build a railroad from Broken Bow to Tyron in McPherson County, a distance of 60 miles. The plan proposes the raising of $375,000, of which $100,000 is to be raised in Arnold township, $100,000 in Broken Bow and vicinity, $100,000 in Logan county, and $75,000 in McPherson county. At a recent mass meeting at Broken Bow, a committee consisting of H. Lomax, L. H. Jewett, Judge Reese, F. C. Kern, C. W. Bowman, O. H. Conrad and R. A. Hunter, all of Broken Bow, was appointed to consider the matter.

New Jersey.

Two bills providing for subways in Newark are now before the State Legislature. One, known as the Leveen bill, provides for the extension of the proposed high speed line of the Pennsylvania R. R. from Saybrook place south to the southern apex of Military Park. The other, the McGowan bill, authorizes the city to spend $2,000,000 for subways, without stipulating where they shall be built. It is the understanding, however, they would extend along Market St., between the Court House and the Pennsylvania R. R. and along Broad St. from Washington Park to Lincoln Park.

Nevada.

It is believed by the Superintendent of the Nevada United Mines Co., according to recent advices from Salt Lake City, Utah, that a line will be constructed between Ely and the mines at Ward early in the spring. An issue of $300,000 in bonds for the construction of the railroad and the further development of the mines has been underwritten. The terminal of the proposed road, according to the preliminary lines run last year, will be about one mile below the mines.

New Mexico.

A project is being promoted to build a rail road between Farmington in San Juan County, New Mexico, and Albuquerque, a distance of 200 miles. W. M. Danburg, City Clerk, Farmington, N. Mex., is interested.

New York.

The State Public Service Commission has approved the franchise granted by the city of Amsterdam to the Fonda, Johnstown & Gloversville R. R. (steam) company for an extension of its lines in that city. The crossing of the Amsterdam, Chuctanunda & Northern R. R. tracks is to be at grade and the company is authorized to issue [illegible] construction bonds to the amount of $83,000. F. A. Bagg, Gloversville, N. Y., is Chief Engineer.

Track laying on the Corning end of the Elmira, Corning & Waverly Ry. will be started by the middle of March, weather permitting. If the present plans carry, the road should be in operation by June 1.

The Syracuse Rapid Transit Co., Syracuse, will have work started early this spring on its Willow St. extension at Syracuse. An appropriation of about $22,000 has been allowed for this work. Estimates and recommendations for other improvement work will be ready about March 15.

It is reported that the Central R. R. of New Jersey is planning the establishment of a new terminal near the foot of Broadway in New York city. The new scheme involves the acquirement of the important waterfront between South 8th and South 9th Sts., adjacent to the ferries at the foot of Broadway, which is South 7th St. The point at which the proposed new terminal would be placed is about midway between the North 6th St. terminal and that adjacent to the Wallabout Market, and is most conveniently situated for a region in which are many important manufacturing plants and eligible sights for many more. Surveyors have recently been at work on this water front property.

North Carolina.

It is expected that construction work will be started shortly on the projected interurban line from Charlotte, N. C. It is understood that final plans for this work have been approved by the Dukes interests, which are backing the project. The first actual work will probably be at Charlotte, where the Charwick-Hoskins line will be extended to the river, which will be bridged for an entrance to Mount Holly. This bridge will be of the latest steel construction, and will be sufficient for the present for the company to gain a crossing of the Catawba River for its lines. It is not improbable, however, that another bridge will be erected in accordance with the original plans to run a line from here directly to Great Falls, S. C., the seat of the power development of the company. The interurban will be for the present in the hands of a syndicate, composed of J. B. and B. N. Duke, Samuel McRoberts, of the National City Bank of New York, Ellison A. Smythe and Lewis W. Parker of South Carolina and W. S. Lee, Jr., Charlotte, N. C., Vice President and Chief Engineer of the Southern Power Co.

Reports from Elkin, N. C., state that grading work for the Elkin-Allegheny R. R., has been completed to that place. The proposed road from Winston-Salem through Yadkin County, known as the Forsyth & Yadkin Railroad, will tap the Elkin & Allegheny at Elkin.

Information received from Greensboro, N. C., is to the effect that a plan is on foot by promoters to construct a railroad from Winston-Salem to Raleigh to connect with the Norfolk and Western at Winston-Salem and the Raleigh & Southport at Raleigh. The road will strike highpoint from Winston, thence on to Greensboro and Burlington, diverging there on its route to Raleigh, making a shorter route from Greensboro to the capital city.

The Mount Mitchell R. R. Co., of Woodlawn, McDowell county, has been chartered with a capital stock of $100,000, of which $10,000 has been subscribed, and proposes the construction of ten miles of railroad from Servier, on the Carolina, Clinchfield & Ohio R. R., to a point at the head waters of Turkey Coke creek, also in McDowell county. T. T. Adams, Richmond, and J. E. Adams, Woodlawn, and others are interested.

A movement has been started to secure the construction of a railroad from Charlotte to Norwood, a distance of 40 miles; later it is planned to extend the road eight miles to Mt. Gilead. The line to Norwood would require little [illegible]

[illegible] that a committee was appointed by Clarence O. Kuester, President of the Greater Charlotte Club, Charlotte, N. C., to take up the matter. The Business Men's Club of Norwood, N. C. [illegible] taking steps to secure the road.

Ohio.

The Lake Erie, Alliance & Wheeling R. R. (Lake Shore & Michigan Southern Ry., Samuel Rockwell, Chief Engineer, Cleveland, O.), which is planning to build an extension from Piney Fork at Martins Ferry, has made surveys for a tunnel near Rayland. The construction of the tunnel would save about ¾ mile.

The Ohio Electric Ry. Co., Cincinnati, O., is said to be planning to have work started this spring on a number of improvements. The first of these to be undertaken will probably be the change in the line from Trenton to Middletown. This change contemplates following of the C., H. & D. right of way north of Trenton to near Elk Creek where the traction line will turn almost directly east, cross the Miami River on its own bridge and enter the lower end of Middletown.

The Toledo, Port Clinton & Lakeside Ry. Co. (electric), Toledo, is to build an extension this season on the south side of the peninsula so that it can operate its own boats to Cedar Point and Sandusky.

Ordinance has been introduced in the City Council of Cleveland, providing terms and conditions under which the group of Pennsylvania railroad crossings from E. 26th St. to Central Ave., S. E., are to be separated. The ordinance marks the final step prior to the beginning of actual work. Under the state law 60 days must elapse before proceedings can go forward. Meantime the railroad will prepare to receive bids for the work, so that by May 1 actual construction may begin. The ordinance provides for an expenditure of about $2,000,000 by the railroad. Robert Hoffman is City Engineer of Cleveland; H. E. Newcomer, Cleveland, O., is Division Engineer Pennsylvania R. R.

A company has been organized by J. H. Litteral, Dr. F. P. Barr, C. W. Rowlee of Lancaster, D. L. Mauger of Basil, E. E. Haskins of Granville and George Ruffner and Clark Sutphen of Baltimore, to build a traction line between Buckeye Lake and Lancaster. It is reported that construction work will be started in the spring on 20 miles of road. The line is to run from Summerland Beach on the south shore of the lake to Millersport, then to Thurston and Pleasantville and in a direct line from that village to Lancaster.

A special meeting of the Northern Ohio Traction & Light Co. of Akron, may be called shortly to authorize the issue of 6 per cent preferred stock for development purposes. The capital stock now authorized is $10,000,000, all one issue, of which $9,000,000 is outstanding.

Negotiations are reported under way for the consolidation of the Steubenville & East Liverpool Ry. & Light Co., operating the Ohio Valley Scenic Route and the Tri-State Traction Co., operating between Steubenville and Wellsburg. It is possible that the consolidation may mean the completion of a single track from Steubenville to Weirton, the new mill town on the West Virginia side of the river.

The Tri-State Railway & Electric Co., of East Liverpool, has been incorporated with a capital stock of $10,000 and proposes to operate an electric line between East Liverpool and Steubenville. The incorporators are W. I. Phelp, F. J. Brady, W. R. Griffin, B. E. Pollock and W. B. Moore.

It is reported that the Columbus Belt Line Co., Stanley D. Pugh, Chief Engineer, Columbus, O., will have construction work started this summer on the southern half of its proposed belt at Columbus.

It is understood that the Oakwood Street Ry. Co. of Dayton and the Troy electric line will build a [illegible] power house near Dayton [illegible] the present power house will be used as a car barn.

Oklahoma.

An election has been held at Tulsa, Okla., to vote on the question of granting a franchise to the West Tulsa Belt Ry. Co., the proposed line of which will give the city connections with a number of large railroads.

At a mass meeting at Pawhuska, a committee of five was selected to solicit funds to pay for a preliminary survey from Okesa to Pawhuska to Wynona, about 16 miles, the surveyors to make estimates about the probable cost of building the proposed 16 miles so that Pawhuska will be on the main line of the Missouri, Kansas & Texas Ry. instead of being six miles from it as at present. The survey will cost from $900 to $1,100 and it is thought that the proposed changing of the main line will cost from $250,000 to $500,000.

Muskogee parties have bid in all properties of the St. Louis & Southern R. R., which was sold on Feb. 22 at Tahlequah by order of the U. S. Court. The road, which is partially graded, was located to run from near Southwest City, Mo., via Tahlequah to Fort Gibson. Work on the road probably will be resumed soon.

Oregon.

According to reports from Eugene, Ore., the Utah Construction Co., Ogden, Utah, which is building the Southern Pacific Natron extension up the Willamette River eastward from Eugene, will not complete the work, owing to serious delays caused by severe weather, until some time in the summer. The big tunnel near the eastern end of the contract is nearing completion. This tunnel is 1,200 ft. long. The other two tunnels further toward Eugene, one 400 ft. long and the other 600 ft., have been completed.

Promoters of the Modoc Northern R. R. are working with the Chamber of Commerce of Merrill, Ore., securing deeds on the right of way contracts which had been made between land owners and the company and it is believed that work will be started soon.

Press reports quote David Eccles, Ogden, Utah, as stating that the Mount Hood Railway, running from Hood River, Ore., to Parkdale, a distance of 22 miles, will be extended 5 miles this summer.

The headings of the United Railways tunnel through Tualatin Hill at Cornelius Gap met on Feb. 12. The tunnel is 4,103 ft. long and work progressed from each end. Porter Brothers, Spokane, Wash., the contractors, began work on the tunnel May 1, 1910. The tunnel reduces the grade of the United Railways road and cuts a mile off the present route. The grade through the tunnel is one-tenth of one per cent and the bore is 16 by 24 ft.

Pennsylvania.

Plans are said to have been perfected for the extension of the trolley line from Skippack to Schwenkville and thence to Green Lane and Pennsburg.

The Reading Traction Co., Reading, Pa., is reported to be planning to ask for the privilege of building two tracks on the new Penn St. bridge, and to extend them to Wyomissing in order to afford better accommodations to the people living in West Reading and Wyomissing. It is reported that a branch will be built from a point on the Mohnton line to connect with the Womelsdorf road in the vicinity of Wyomissing, and thus open up a new section.

The West Penn Ry. Co., Pittsburg, Pa., is taking steps for financing two extensions. One extension is to be 12 miles long and is to run from Masontown, up along the Monongahela River and parallel to it to Point Marion. The other extension is planned from Fairchance to Point Marion, whence it will connect with the first mentioned extension.

Commissioners of North Versailles Township have granted a franchise to the Highland Grove Traction Co., McKeesport, Pa., for use in connection with the proposed extension from its present terminus in North McKeesport to the Turtle Creek Valley. This franchise will enable the company to reach East Pittsburg, its immediate objective, from whence it will build to Wilmerding.

The John A. Kelly Construction Co. is reported to have resumed work at Cementon on the Lehigh Valley work. This work is being done in connection with the laying of two additional tracks. A wall will be built up from the river bed near Spring Mill but the great part of the roadbed near that place will have to be blasted out of the solid rock of the mountainside.

The Pottstown & Reading Street Ry. Co. is reported to have closed a deal for taking over the trolley line joining Spring City and Phoenixville, which is operated by the Montgomery & Chester Electric Co. The combination means the joining of Pottstown with the borough of Spring City and Royersford by trolley. The link from Spring City to Pottstown will be built this spring, and it will connect with the Pottstown & Reading Company line at Sanatoga. The route, however, is not definitely fixed.

The Pennsylvania R. R. has notified farmers along the line of the road at points between Lewiston and Altoona, and in the vicinity of Birmingham, that it will take up at once options held on land along the line. This is taken to mean that the Pennsylvania contemplates more big improvements, including additional trackage for the Middle division during the coming year.

South Dakota.

Farmers in the vicinity of Platte, S. Dak., along the proposed line of the railroad from that city to Marshall, Minn., have subscribed $40,000 toward the project.

The Chicago & Northwestern Ry., W. H. Finley, Assistant Chief Engineer, Chicago, Ill., has filed in the State Land Department at Pierre, S. Dak., a plat of its proposed extension from Iroquois to Doland.

It is believed that the Chicago, Milwaukee & St. Paul is planning to have work started this season on its extension from Mitchell north through Canova, Madison and Watertown to some point on the Huron & Dakota division near Webster. Should this extension be started it will probably hasten the plans of the South Dakota Central Ry. for building its extension from Watertown, S. Dak., into North Dakota.

Tennessee.

⦿J. W. Bye, Knoxville, Tenn., has the contract for the trestle work on the new Harriman, Knoxville & Eastern R. R. now being constructed by the McDonald Construction Co., of Knoxville, between Harriman and Oliver Springs. The contract will include six large trestles and one bridge which will be over the Little Emory River and will have a 60-ft. steel span.

Location work will be started about March 1 for the projected line of the Birmingham & Northwestern Ry. from Dyersburg, Tenn., to Jackson, Tenn., as a present terminus. Preliminary lines were run the latter part of 1910. Following closely upon completion of location, construction work will be started. The main offices of the company are at Dyersburg, Tenn. Mike Harvey is chief engineer.

Preliminary surveys for the proposed Nashville-Gallatin Interurban Ry. have been completed to Gallatin. This survey was made along the lower Nashville turnpike, and another survey is being made along the Long Hollow Turnpike. H. H. Mayberry, Franklin, Tenn., is the promoter.

The Illinois Central R. R. will probably have work started in the spring on the construction of a new passenger station in Memphis. The station will be erected on the site of the old one and will cost about $600,000. Re-arrangement of tracks will cost an additional $150,000.

The Memphis & Rugby Ry. Co. has been organized with a capital stock of $50,000 and proposes to construct and maintain an independent street car line from Chelsea Ave., Memphis, to the proposed new suburb, Rug-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

by, in North Memphis. The incorporators are E. H. Coapman, Washington, D. C., Vice President and General Manager of the Southern Railway Co.; Charles T. Doerr, Birmingham, Ala., purchasing agent of the Birmingham street railway; Henry Wetter, Luke Seawell, James H. Malone and W. J. Francis. Work will be started in the near future on the road, and it is expected to have it completed in the early fall.

Promotion work is under way for the construction of a railroad from Algood to Somerset, a distance of 92½ miles. E. C. Knight, Livingston, Tenn., Secretary of the Overton County R. R., is interested.

Memphis and Vicinity.

(REGULAR CORRESPONDENCE.)

The railroad contractors who make Memphis their headquarters are as a whole greatly disappointed with the recent decision of the Interstate Commerce Commission preventing the railroads from increasing their freight rates in certain sections. They all seem to take the decision to mean that but little railroad work will be done in the immediate future. While some say that railroad retrenchment for the time being will be but a bluff on the part of the railroads and while the raise in rates may not be necessary to continue construction work which will improve certain roads and open up new business, the impression exists pretty generally that the contractors will suffer for the time being. There are roads in this section, however, which can't hold up certain improvements much longer and some Cotton Belt officials and officers of the Rock Island believe that work will open up this spring in the vicinity of Memphis.

Another report of the Frisco railroad building better terminal facilities in Memphis has come to light and it is said now that $1,000,000 will be expended at once on Bellevue Yards, a station six miles southeast of Memphis. This report, however, is denied by a prominent Frisco official, who states that just now his road contemplates no new improvements, and he further points out that with the recent unfavorable report of the commerce commission his road will do good to even keep up the maintenance end of the game. The report of the $1,000,000 Bellevue Yards has been circulated so often and nothing came of it that local contractors think the late rumor no more serious than those that have gone before. Some of the larger construction firms who would be likely to receive invitations to bid on the work state that they know nothing of the proposition.

The Price Construction Co., which is building the yards of the new Memphis station, met with a serious accident last week. A train of loaded 12-yd. cars was standing on a trestle when without a moment's warning one of the bents gave way, precipitating the entire train into a bayou underneath. At a late hour Saturday the cars had not been removed. The Price Construction Co. has asked the Union Station Co. for more time in which the complete the contract, and owing to the accident no doubt its request will be granted.

Jimmie Omberg has about completed all his concrete work on the new union station, while the Foster-Creighton-Gould Co., Nashville contractor, which is building pipe lines, states it will finish its part of the work within a few weeks. This puts the union station work in pretty good shape and all indications point to its being ready for use about Sept. 1, 1911.

Turner & Gill have been awarded contract for the spreading of dirt on the Cole east end subdivision, involving the movement of about 15,000 cu. yds. of earth.

Carey Brothers of this city were awarded a contract for approximately 500,000 cu. yds. of levee work and about 25,000 cu. yds. of concrete retaining walls by the Degonia Levee Board of Murphysboro, Ill. The work must be started at once and completed by Dec. 1, 1911. Bonds will be taken in payment of the work.

G. E. Carlyle, president of the Carlyle Paving Brick Co. of Portsmouth, O., came to Memphis last week and closed with the Memphis Street Railway Co. for 1,000,000 paving blocks. The brick will be shipped from Portsmouth on barges and will be unloaded at Memphis by electricity at the Telpherage plant of the Illinois Central railroad. According to President Tutwilder of the street railway, it is his intention to use only vitrified block between rails on asphalt street, for he says no matter how well you may sink ties in concrete, the vibration of the cars will loosen the rail and cause serious detriment to an asphalt pavement. The Carlyle block is considered by many in Memphis as the best block that was ever laid in this city, and Mr. Tutwilder says this fact decided him to use the brick.

H. W. Brennan has protested against the action of Commissioner Love in rejecting his bid for tar macadam on Barksdale street, and the matter is now before the city council for action. According to Mr. Brennan he is being discriminated against and sees no reason why his bid should not be accepted, inasmuch as it was the low one.

Ed Manigan returned last week from Fort Worth, where he was looking after the interests of Roach & Manigan at that place. Ed says his firm is doing very good work and the people of Fort Worth are delighted with the excellent asphalt work which the local firm is doing. Fort Worth people, according to reports, were pretty sore on the asphalt work done by another firm and were somewhat skeptical at first as to what Roach & Manigan were going to do. But their fears have been set at rest and all are well pleased.

S. S. Morris, general superintendent of the Yazoo & Mississippi R. R., returned last week from an inspection trip of his road and reports good work being done on the improvements under way. He was accompanied by President Markham of the Illinois Central and A. S. Baldwin, chief engineer.

A. S. Baldwin, chief engineer of the Illinois Central railroad, was in the city last week, but could not state just what his company was going to do in regard to bettering its lines this season.

President Markham states that the Illinois Central road will start construction work on its $1,000,000 station this spring. According to officials of the road there will not be much grading in connection with the new station.

Sam Bush blew in from Texas, looking happy and well groomed. Sam has an excellent outfit, which he is anxious to put on some good railroad work.

Lou McClavey, the husky levee builder from Omaha, but who has made Memphis his headquarters for some time, has taken a subcontract from Wm. Brady at Hickman, Ky., where he is to build some railroad work for the N., C. & St. L. And, by the way, it is locally reported that the N., C. & St. L. will do a great deal more work in the vicinity of Hickman within a short time. The work will be necessary on account of the government having raised its levees near that city.

Jake Baxter was seen on the street last week, but as he was in a hurry he did not have a chance to tell of any late contracts which he had secured from the I. C. R. R. Old Jake is a hustler and has made many friends in I. C. and Y. & M. V. circles. Jake makes Jackson, Miss., his headquarters.

Texas.

⦿Witherspoon Englar Co., 98 Jackson Blvd., Chicago, Ill., has been awarded the contract by the Santa Fe system for the construction of shops, terminals and other buildings at Slaton Junction and at Sweetwater on the Coleman cutoff. The shops at Slaton, where the Lamesa division of the new line leaves the Coleman cutoff, will consist of a 12 stall roundhouse and turntable, a powerhouse, machine and blacksmith shops, a roundhouse foreman's office and supply building, hose house, concrete oil reservoir, pumping plant and tank, coal chute and sand house. Buildings similar, but much larger, are to be constructed at Sweetwater, in addition to a storehouse, car repair plant and a wood machinery and carpenter shop. The cost of the construction has not been made public, but it is supposed that the two shops will aggregate an expense of nearly $500,000. In addition to this $1,500,000 is to be expended by the Santa Fe during the spring and summer in improving the other trackage on the Panhandle and Southwest Oklahoma. It is reported that at Sweetwater the Santa Fe will construct about ten miles of siding.

Advices from Georgetown, Tex., are to the effect that the survey for the Quanah, Hamilton & Belton R. R. has been completed to Jarrel, the present terminus of the Bartlett & Florence R. R.

City of Rockport, Tex., will begin construction work at once on the railroad which is to be built across a chain of islands to connect that city with Harbor Island, the site of the deep water to which ships are brought through Arkansas. E. A. Luke, Rockport, Tex., is interested in the project.

The new Coleman-Texico extension of the Santa Fe on Feb. 15 was ready for traffic as far as Pyrone, a point about 23 miles north of Sweetwater. The construction company in charge of the work is pushing the extension as fast as possible and it is now stated that the whole road will be ready to turn over by June 1.

Press dispatches from Fort Worth quote Robert S. Lovett, head of the Harriman system, as announcing that the Houston & Texas Central R. R., T. Fay, General Manager, Houston, Tex., will be extended north into Oklahoma. No definite time was given for beginning work on the extension.

The National Railways of Mexico has begun the work of laying off the new yards in Matamoras, about a mile from the end of the International bridge at Brownsville, Tex. The new passenger and freight depots are to be built without delay preparatory to the opening of through passenger service.

According to the 1911 budget of the San Antonio Traction, Gas and Electric Companies adopted on Feb. 15, a sum of $250,000 will be spent at San Antonio for ten new trolley cars, extension of double tracks and new machinery in the power house.

City Commissioners of Fort Worth have granted the Northern Texas Traction Co., of Fort Worth, a franchise over the streets to be used in the Texas Christian University Extension. The extension will be about 4,800 ft. long.

The Galveston, Harrisburg & San Antonio Co., according to advices from Cuero, Texas, is ballasting the Victoria Division and relaying the line with 75-lb. steel rails. A. V. Kellogg, Houston, Texas, is Engineer Maintenance of Way.

A contract, according to reports from El Paso, Texas, has been signed providing that the El Paso & Southwestern R. R. extend its line from Benson to Tucson, Ariz. J. L. Campbell, El Paso, Texas, is Engineer Maintenance of Way.

The State Railroad Commission has granted the application of the Bryan & College Interurban Railway Co. for authority to issue and register its bonds amounting to $72,000 on the line between Bryan and College, in Brazos county. The commission also approved the mortgage securing the bonds. It is shown in the commission's order that the inspection of the property by the commission's engineer disclosed the value of the property to be $94,257.39, including the equipment, and the capital stock amounts to $20,000. The bonds are numbered 1 to 144, and are for $500 each, payable Jan. 1, 1941, at 6 per cent.

The Engineer of the State Railroad Commission has recently completed an inspection of the South & Western Ry., which runs from Henrietta to Archer City, a distance of 30 miles. This inspection was made in connection with an application now pending before the commission by this company to issue bonds at the rate of $15,000 per mile, or a total of $450,000.

Utah.

The Uintah Ry., M. W. Cooley, General Manager, Mack, Colo., is reported to be [illegible] this spring [illegible]

Vermont.

[illegible] Vermont Valley R. R. Co., a subsidiary company of the Boston & Maine R. R. [illegible] half interest in the Rutland R. R. The acquisition of this interest extends the line of the Boston & Maine practically to the great lakes at Ogdensburg, N. Y., and by a connection with steamboat lines controlled by the Rutland R. R., operating on the lakes to Chicago and the west, thus enabling the Boston & Maine to assure to the port of Boston a larger percentage of the grain-carrying trade. While the figures are not given out officially, it is reported that the actual cost of the half interest in the Rutland was $2,500,000. The common stock is $199,400, and the preferred stock seven per cent cumulative, $9,057,600, making a total of $9,257,000. The road has paid no dividends since 1907, when it paid one-half per cent on preferred stock. The preferred stock carries accumulated dividends through many years past, which now amount to nearly 200 per cent. The funded debt is $11,402,000. The earnings of the latest available year, 1909, were $3,102,432 gross and $839,071 net. The fixed charges of the road are about $635,000.

Preliminary surveys will be completed next month for the proposed new line of the Grand Trunk Ry. from Windsor to Brattleboro, a distance of some 40 or 50 miles. The line will follow the course of the Connecticut River as closely as practicable, passing through the townships of Windsor, Weathersfield and Rockingham. It is probable that the construction engineer's office will be located at Bellows Falls, Vt., when actual work is started. The surveys are being made under the direction of H. C. Estep of Southbridge, Mass. H. G. Kelley, Montreal, Que., is chief engineer of the Grand Trunk Ry.

Some time ago we noted in these columns that preliminary surveys had been completed by R. P. McCormick of the Harrison Engineering Co., New York city, for the proposed cross state railroad to be known as the Montpelier & Rutland R. R. Further details as to this proposed line have now been made public. The survey and report were obtained at an expense of about $15,000 and the estimated cost of construction, etc., as compiled by the engineers is $3,381,056 for 89 miles at an average cost per mile of $37,988, this including cost of nine miles of sidings. The details are as follows: Excavation of earth necessary, 831,495 cu. yds.; excavation loose rock, 561,660 cu. yds.; of solid rock, $525,360; borrow, 2,010,331; total, 3,928,847 cu. yds., at a cost of $1,502,056. Bridges will total an expense of $336,000; culverts, $96,000; viaducts, $60,000; total for bridges, culverts and viaducts, $492,000. Two tunnels, one at Granville, costing $170,800, and one at Mendon, costing $109,800, total an estimated expense of $280,600. Water tanks at Montpelier, Rutland and three others, $8,500; road crossings, $4,550; telegraph lines, $44,500; round houses at Montpelier and Rutland, $40,000; stations, $20,000; engineers' and legal expenses, $115,000; estimated cost of 13 miles of main line and two miles of siding at Rutland, $420,910. The estimated cost of equipment is $274,000, including three passenger, four freight and two six-wheel switching locomotives at $141,000, two passenger trains of five cars each at $61,000, and flat, box and gondola cars at $72,000. Stations will be located as follows, at the distance in miles from Montpelier: Montpelier, station; Montpelier Junction, 2; Middlesex, station 7; Moretown station, 13.5; Waitsfield, station, 19; Warren, station, 24.5; Granville Summit, 31.5; Granville Tunnel, 33.8; Granville P. O., station, 36.3; Hancock, 39.625; Rochester, station, 43.8; Stockbridge, station, 51.33; Pittsfield, station, 54.75; Tweed and Quechee rivers, divide, 60.33; William Giffard, divide, 63.8; Mendon [illegible] Gap, 67.5; Upper head Rutland [illegible] L., 72.5; Lower End (spillway), 78.5, Mendon, station, 81; Rutland, station, 89.

Virginia.

Plans and specifications have been prepared for a proposed electric or steam railroad to run from West Point, Va., to Urbanna, a distance of 16 miles. It is estimated that the road can be built for about $250,000. Dr. A. C. Farmer, Urbanna, Va., is interested.

It is expected that construction work will be started about June 1 on the projected Richmond & Northern Neck R. R., and it is hoped to have the road in operation about a year thereafter. Channing M. Ward, C. E., Lyells, Va., is interested.

Washington.

Promoters of the proposed Lake Burien electric railway, franchise for which has been asked of the city of Seattle by W. H. Coughlin and others of Seattle, are said to have raised $100,000 for the construction of the line. It is stated that Fred E Sander will construct the line. The franchise asked is for a line from Oxbow bridge on First Ave. south to the extreme southern limits of the city, a distance of about three miles. From the city limits it will be extended another three miles to the Lake Burien district, opening up a large amount of property owned by Seattle men that has been undeveloped because of a lack of street car facilities.

The Twin City Light & Traction Co., Chehalis Wash., now operating between Chehalis and Centralia, is to extend its street car line at the latter place to connect with the Milwaukee R. R.

Right of way arrangements are being completed for the projected 26 mile railroad to be built by the Washington Water Power Co., Spokane, Wash., between Springdale and the site of the new power house on the Spokane River.

The Chicago, Milwaukee & Puget Sound R. R. is reported to be about ready to let contracts for the construction of its line into Spokane. The cost of this work will amount to about $2,000,000, and it is said that orders to begin construction will be issued as soon as a grade separation question is settled. A. G. Holt, Spokane, Wash., is Terminal Engineer.

West Virginia.

⦿Patterson, Moran & Luck Co., Morgantown, W. Va., who have the general contract for the grading and masonry work for the new line of the Buckhannon & Northern R. R. from Riverville to the Pennsylvania state line, have given sub-contracts to the following: G. T. Fogle, St. Albans, W. Va.; Hunter & Hines, Washington, Pa.; Zerely & Co., Morgantown, W. Va.; Pennsylvania Contracting Co., Pittsburg, Pa.; Gilmore & Weaver, Morgantown, W. Va.; A. Panarella, Pittsburg, Pa.; Alfieri & Co., Morgantown, W. Va.; Flynn Bros., McKeesport, Pa.; R. T. Martin, Parkersburg, W. Va.; Hamilton & Huffman Construction Co., Fairmont, W. Va.

Wisconsin.

Construction work on the new extension of the Superior & Southeastern Ry., J. E. Glover, President, New Richmond, Wis., has been somewhat retarded by the deep snow. As soon as warm weather comes in the work will be rushed to completion.

Canada.

⦿Macdonald, Gzowski & Co., Vancouver, B. C., are reported to have been awarded the contract for the second 30-mile section of the Kettle Valley R. R. in British Columbia.

A recent report to the House of Commons by the Dominion Department of Railways shows that 53.75 miles of the Atlantic, Quebec & Western Ry. have been completed and that there remains to be constructed 48.65 miles. The department estimates that the cost of completion will be $769,508. W. L. Browne, New Carlisle, Que., is Chief Engineer.

The Railway Committee of the House of Commons has approved the routes for additional lines for the Alberta Central Ry. This company, which has its headquarters at Red Deer, Sask., had previously been authorized to build from Red Deer to Yellow Head Pass. Approximately 110 miles of the route have been approved, and are under construction. The company now asks for power to build from Saskatoon to the Hudson Bay, from Moose Jaw to the international boundary, from a point between Red Deer and Cygnet Lake to Lacombe, and three branch lines of 30 miles into Big Horn range, between the North Saskatchewan and Brasault rivers, and two branch lines 25 miles long northerly and north-easterly near where its already authorized line crosses the Brause River.

Surveys for the main line of the Canadian Northern Ontario Ry., extending from Ottawa to Port Arthur, have been completed, and the exact location of the road, decided upon. It is believed that the work of construction will be commenced this year and that the road will be open for traffic at the end of three years.

It is reported that the Hill interests have broken off all negotiations for the use of joint terminals in Winnipeg with the Canadian Northern R. R. It is said that a $1,000,000 station will be built in Winnipeg this spring for the Great Northern, Northern Pacific and Midland Railways. Three years ago the Hill interests purchased a right of way into the heart of the city at a very high figure. They will now construct a line from Emerson, where the lines enter Canada to Winnipeg.

The Canadian Pacific Ry., J. G. Sullivan, Assistant Chief Engineer, Montreal, Que., is reported to have plans for work in and around Toronto which will call for the expenditure of $6,000,000.

The Railway Committee of the House of Commons has been considering the bill granting a federal charter for the Western Central Co., which proposes a line from Toronto to Windsor, via London. The company has held a Provincial charter without proceeding to the work, and it is said that the promoters found it impossible to finance the road on a Provincial charter.

It is reported in Montreal that the Canadian Pacific Ry. will have work started in the spring on a line parelleling the Grand Trunk to Toronto. It is said that the new line will commence at Bathurst, ten miles west of Smith's Falls, and proceed southwesterly to Belleville. The whole of this line, it is said, will be double-tracked, and as the line between Smith's Falls and Montreal is double-tracked already, the C. P. R. will have a double track all the way between Montreal and Toronto, and an alternative route between Smith's Falls and Toronto and will reach all the important industrial communities between Montreal and Toronto now served by the Grand Trunk alone.

The Railway Committee of the House of Commons has approved the bill to incorporate the Niagara, Welland & Lake Erie Ry. The bill calls for authority to run a main line from Niagara Falls to Welland and on to Port Dalhousie, with branches to Dover and Fort Erie. All the lines are to be operated by electricity.

The Canadian Pacific Ry., F. P. Busteed, general superintendent, Vancouver, B. C., has taken tenders for the construction of 30 miles of the Kootenay Central south from Golden, B. C. Ten miles of the grade out from Golden were completed several years ago and the new section will be an extension through the Columbia River Valley. The southern terminus will be Galloway station, on the main line of the Crow's Nest Pass railway, near Cranbrook. The contract for building 30 miles of this line north from Galloway was awarded last year to Foley, Welsh & Stewart and this work is nearing completion.

ROADS, STREETS AND PAVEMENTS

Alabama.

Plans are being pr[illegible] W. A. M[illegible] Decatur, Ala., for the construction of four or five miles of cement paving in Cullman, Ala., on a concrete foundation at an estimated cost of $15,000. The contract for this work will be let as soon [illegible] completed. M. L. Robertson is Mayor.

⊙The board of public works of Birmingham, Ala., has awarded the contract for the paving of Broad, Water, Eslava and New Jersey Sts., with asphalt to the Andrews Paving Co. Bids were opened Feb. 16.

The city council of Cullman, Ala., has let the surveying contract for the paving of the streets of the city to a Decatur engineer. Bids for the construction work will be asked for soon. The city also contemplates the installation of a sewer system. M. L. Robertson is mayor.

Arizona.

The executive committee of the city council of Phoenix, Ariz., has requested that the city council instruct the city engineer to prepare plans and profiles of the following district for paving: On Washington St., from Third St. to Fourth Ave.; Adams St., from Second St. to Second Ave.; on Center St. from Monroe St. to Jefferson St.; on First St., from Adams St. to Jefferson St.; on First Ave., from Monroe St. to Jefferson St. A report and specifications were prepared by City Engineer A. P. Campbell of Riverside, Cal., for the contemplated paving in Phoenix this year. Eugene Hacket is chairman of the executive committee.

California.

Assemblyman Chandler, chairman of the committee on roads and highways, according to reports from Sacramento, Cal., has completed plans for a state highway act, under which the $18,000,000 will be expended in building good roads. It is proposed to increase the engineering board by the addition of three members, to be appointed by the Governor. The chairman will select an engineer to conduct the work.

The state representative from Placer, Cal., has asked the House for an appropriation of $15,000 for construction work on the Lake Tahoe wagon road.

The board of supervisors, Martinez, Cal., has appointed viewers to lay out a route for a wagon road between Martinez and Bay Point.

The Development & Securties Co. of Long Beach, Cal., has purchased 200 acres of land between Redlands and Highlands on the Santa Fe loop line, and will erect a $100,000 rock crusher and artificial stone works. The erection of the plant will be commenced in a short time.

A bill has been introduced in the senate, Sacramento, Cal., providing for the construction and completion of the Trinity-Humboldt state highway at an approximate cost of $50,000. The road would connect the counties of Trinity, Tehama and Shasta with the road system of Humboldt county.

Colorado.

Plans are under way for the construction of a turnpike road from Collbran, Colo., to connect the Plateau valley with Palisades and the rest of the Grand valley. Ranchers will donate labor. Grand Junction is the county seat of Mesa County.

A bill has been introduced in the state legislature, Denver, Colo., which provides for an appropriation of $10,000,000 for a round the circle road in Colorado.

The citizens of Weld County, Greeley, Colo., are agitating the construction of better roads. A bill has been introduced in the legislature providing for the creation of road districts on a petition of 20 per cent of the land owners.

Delaware.

Reports from Wilmington, Del., state that T. Coleman Dupont, president of the Dupont Powder Co., Wilmington, has offered to donate $2,000,000 to the state of Delaware for the construction of a highway the entire length of the state. The highway is to be from 60 to 100 ft. wide, and approximately 103 miles in length.

Florida.

The city council of Pensacola, Fla., has adopted the recommendations of the board of bond trustees, giving its approval to a system of street paving which will mean an outlay within the course of the next 12 months of $500,000. In all about 25 miles of paving will be done, most of which will be in the northeastern section of the city.

Illinois.

⊙The Capital City Concrete Construction Co., 214½ S. 6th St., Springfield, Ill., has been awarded the contract by the city of Corning, Ia., for the construction of the following improvements: For grading, curbing, guttering and paving Davis Ave., from the railroad right of way to the north line of Eighth St., and Eighth St., from alley between Davis Ave. and Adams St., to Grove Ave. The work includes the following approximate quantities: 11,944 sq. yds. of brick, 189 sq. yds. concrete pavement, 2,373 lin. ft. of combined curb and gutter, 1,857 lin. ft. of gutter, 2,650 cu. yds. of grading. The contract price is $1.93 per sq. yd. Bids were opened Feb. 20 by W. C. Chubb, City Clerk. Theodore S. De Lay, Criston, Ia., Engineer.

⊙The board of local improvements of East St. Louis, Ill., has awarded the contracts for the improvement of Wimmer place and of Alexander St., to the O. T. Dunlap Co., of Edwardsville, for a total of $33,790. W. J. Crocken is city engineer.

Senator Frank A. Landee, of Moline, Ill., has introduced three bills in the state senate, Springfield, Ill., which aim to put all state road making on a centralized, systematic, scientific basis by putting it under state supervision.

A petition has been circulated in Sycamore township, Sycamore, Ill., asking that there be submitted to the voters of Sycamore township at the township election in April next, the question of continuing the construction of hard roads which has been in progress for the last two years. The petition calls for a levy of $.30 on each $100 of assessed valuation.

Indiana.

✣Bids will be received until noon, March 7, by Board of County Commissioners, at Winamac, Ind., for the construction of highways in Jefferston township. W. E. Muchenburg is Auditor of Pulaski County.

✣Bid[illegible] Works, Indianapolis, Ind., for the furnishing [illegible]

✣Bids will be received until 10 a. m., March 10, by County Commissioners, Lafayette, Ind., for the construction of the free gravel road petitioned for by Carrel F. Higley, et al. in Tippecanoe county. George W. Baxter is County Auditor.

✣Bids will be received until March 2, for the construction of 3,600 yds. pavement on North D. St. in Richmond, Ind. Fred R. Charles is City Engineer.

✣Bids will be received until March 9, by the city of Richmond, Ind., for the construction of 8,250 yds. pavement on North E. St. Fred R. Charles is City Engineer.

The county commissioners at Huntington, Ind., have been petitioned for the construction of two roads in Warren township. Both roads asked for are to run south and to join the Maple Grove road on the Warren-Dallas township line. Gravel or stone is to be used.

The Fountain county commissioners, Covington, Ind., have been petitioned for the construction of a road beginning at the intersection of the Coal Creek-Covington road with the old state road and extending south two and five-eighths miles to the Troy-Wabash township line. The road is to be constructed of screened gravel obtained in the vicinity of Covington, bound with pure asphalt and rolled. The cost is estimated at $26,000. Bruce Short is surveyor of Fountain County.

Iowa.

The city council of Carroll, Ia., has decided to pave Fifth St., from the Northwestern railroad depot to the Windsor hotel and Adams and Main Sts., from the railroad, north to Sixth St.

⊙George Gabler has been awarded the contract in Mason City, Ia., for laying 37 blocks of paving at the following bids: $2.40 and $2.45 for laying flint brick; $4.38 for uncorrugated cement, and $4.39 for corrugated cement, and $.38 for curbing.

⊙Bids were opened Feb. 20 by the city of Corning, Ia., Theo. S. Delay, consulting engineer, Creston, Ia., for paving and curbing. The work consists of 12,000 sq. yds. of brick paving constructed of vitrified paving brick, which shall pass a 24 per cent rattler test and 3 per cent absorption test, laid on 1:3:4 or more Portland concrete base 4 ins. thick, with 2-in. sand cushion and sand filler, sub grading to go with paving; 2,373 lin. ft. of combined curb and gutter 42 ins. over all, built of 1:2:4 or more Portland concrete, 10 ins. deep on street side, 6 ins. on property side, laid on cinder base; 1,857 lin. ft. of gutter to be laid to old curb, constructed in same way as combined curb and gutter; 189 sq. yds. of concrete alley paving 6 ins. thick of 1:2:4 or more Portland concrete. The contract was awarded to the Capital City Concrete Construction Co., Springfield, Ill. The bids received on the work were as follows:

[illegible]

The city council of Muscatine, Ia., has passed an ordinance creating improvement district No. 29 for paving purposes. It is proposed to construct concrete pavement, estimated as follows: 18,475 sq. yds. of pavement at $1.30; 8,528 lin. ft. of combination curb and gutter at $.60; 3,526 ft. of brick pavement in car tracks, 7 feet wide, $1.26; publication, inspections, engineering, etc., $3,332; 7,674 cu. yds. of excavation at $.35; total $39,597. T. H. Brennan is city recorder.

The city council of Muscatine, Ia., has cre-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] bitulithic pavement, including sub-grading, $1.81; 12,678 lin. ft. of combined curb and gutter, including sub-grading, $.60; 300 lin. ft. of combination curb and gutter, 18-in., including sub-grading, $.55; 300 lin. ft. of 18-in. gutter built to old curb, including sub-grading, $[illegible] yds. of extra grading, $[illegible]; 3,600 cu. yds. of extra grading, $.35; 4,894 lin. ft. of brick pavement in car tracks, seven ft. wide, $1.26; publications, engineering, inspections, etc., $4,807; total, $59,900. T. H. Brennan is city recorder.

Kansas.

A public meeting was recently held in Minneapolis, Kan., for the purpose of devising a plan for the construction of a highway between that city and Salina, Kan., a distance of 20 miles.

Louisiana.

It is reported that the city commissioners, Shreveport, La., will soon call a special election to vote on the proposition of issuing bonds for paving.

Michigan.

⦿[illegible] for the construction of pavement on Madison, Robert and Danaher Sts., in Ludington, Mich., for which bids were opened Feb. 20 by Dean Thompson, City Clerk, has not been awarded. All bids were rejected and instructions were given to readvertise. The contract for grading and building cement curb and gutter was let to Frank Shepperd of Ludington.

Four townships of Saginaw County, Saginaw, Mich., county seat, are preparing to vote on the proposition of issuing bonds to the amount of $46,000 for the improvement of highways, as follows: Brant township, $10,000; Bridgeport township, $6,000; Spaulding township, $10,000; Birch Run township, $20,000. John W. Ederer is County Road Commissioner.

Minnesota.

✣Bids will be received until 2 p. m., March 6, by Board of Public Works, St. Paul, Minn., for the construction, relaying and repairing of such cement sidewalks as the council may order constructed. R. L. Gorman is Clerk of the Board. A bond in the sum of $5,000 is necessary.

✣Bids will be received until 2 p. m., March 6, by Board of Public Works, St. Paul, Minn., for the construction, relaying and repairing of such wooden sidewalks as the Common Council may order reconstructed, relaid or repaired during the year of 1911. A bond of $5,000 is necessary. R. L. Gorman is Clerk of the Board.

The county commissioners at St. Paul, Minn., will readvertise for bids for road rollers with double-speed engines. P. J. Ryan is assistant county attorney.

The board of public works of St. Paul, Minn., has passed a resolution setting aside $5,000 to aid in paving Jackson St., from University Ave. to Valley St.

The city council of Minneapolis, Minn., has authorized the street commissioners of the Eighth ward, the Tenth ward, and the Twelfth ward, to purchase in the open market, a street sprinkler for their ward at a price not to exceed $248, $250 and $250 respectively.

The Commercial club of Eveleth, Minn., is agitating the construction of a new road out of Eveleth. The proposed road would cross the Missabe tracks near the Spruce mine, and take a southerly direction, probably along the D. M. & N., thence crossing that road somewhere near Spruce and continuing down into the farm lands that are there to be opened.

Mississippi.

The board of road commissioners, Charleston, Miss., has employed Civil Engineer A. P. Smith to survey the public roads, preparatory to making plans and specifications for working the same. Robert L. Barnes is assisting in the work.

Missouri.

The majority of property owners on 15th St., between Virginia and Cypress Aves., Kansas City, Mo., which is to be paved this year, are said to favor the use of asphalt. L. R. Ash is city engineer

New Jersey.

✣Bids will be received until 2 p. m., March 7, by Township Committee, Bernardsville, N. J., for stone roads, asphaltic binder, to be constructed at Bernardsville and Far Hills. Total length of both roads, 1,790 feet. Total macadam, 3,599 sq. yds. Specifications, maps and profiles may be seen at the office of Anthony Schumacher, township engineer, at Bernardsville, N. J. Joseph B. Kronenber is Township Clerk.

✣Bids will be received by the Town Council of Irvington, N. J., until 8 p. m. March 6, for laying telford pavement in the following streets: Myrtle Ave., from Springfield Ave. northerly to Avon Ave.; Park Place from Park Ave. southerly to Lyon Ave. Plans and specifications can be seen at the office of I. J. Casey, Jr. & Co., Town Engineers, Glorieux Bldg., Irvington, N. J.

✣Bids will be received until 3:30 p. m., March 7, by County Park Commission, 800 Broad St., Newark, N. J., for grading at Weequahic Park addition, Newark, N. J. Plans and specifications may be seen at the office of the engineers, 60 Clifton Ave., Newark, N. J. The work will include approximately 50,000 cu. yds. of material and a certified check for $500 must be filed with each bid.

New York.

✣Bids have been readvertised and will be received until 1 p. m., March 20, by New York State Highway Commission, Albany, N. Y., for the improvement of the following highways:

County.	H'way No.	Name.	Approx. Miles.
Albany	790	Cohoes City Line-Boghts Cor.	2.11
Albany	879	Shakers-Watervliet	6.40
Broome	858	Whitneys Point-Upper Lisle	4.27
Cattaraugus	695	Otto-Cattaraugus	1.21
Cattaraugus	697	Otto-E. Otto, Section II	2.27
Cayuga	687	Fair Haven-Sterling-Martville	5.30
Chautauqua	873	Brockton-Stockton	2.93
Chenango	666	Plymouth-Kirk	4.90
Clinton	777	Plattsburg-Cadyville	4.33
Columbia	763	Hollowville-Craryville	7.14
Columbia	5072	Livingston - Hudson, Part I	3.60
Columbia	5073	Livingston - Hudson, Part II	5.10
Columbia	5074	Schodack Ctr.-Valatie, Part IV	4.30
Dutchess	712	Amenia-Sharon Sta.	2.29
Franklin	884	Malone-Fort Covington, Part I	3.58
Franklin	885	Moira-South Bombay	8.58
Franklin	5076	Malone-Moira	5.22
Jefferson	625	Theresa - Antwerp, Part II	5.37
Jefferson	626	Burrs Mills-S. Champion	4.56
Rensselaer	659	Brunswick Ctr.-Lansingburg	5.07
Rensselaer	679	W. Stephentown-Stephentown Ctr.	4.14
Rensselaer	680	Stephentown Ctr.-Massachusetts	3.92
Rensselaer	5084	Schodack Ctr.-Valatie, Part III	2.90

Alternate proposals will also be received at the time and place above mentioned for State Highways 5072 and 5073 combined in one contract and also alternate proposals for State Highways 5074 and 5084 combined in one contract as follows: County—Columbia. Road number—5072-Ext. Name of road—Livingston-Hudson. Parts 1 and 2. Approximate length—8.70 miles. Counties—Columbia and Rensselaer. Road number—5074-Ext. Name of road—Schodack. Ctr.-Valatie. Parts 3 and 4. Approximate length, 7.20 miles. The Commission reserves the right to award contracts for State Roads 5072, 5073, 5074 and 5084 in the manner which shall be deemed most advantageous for the State, namely: Either on separate proposals for Roads 5072 and 5073, or on proposals for these two roads combined, and in the same manner on separate proposals for roads 5074 and 5084 or proposals for these two roads combined.

✣Bids have been readvertised and will be received until 1 p. m., March 24, by the State Highway Commission, 55 Lancaster St., Albany, N. Y., for the improvement of the following highways:

County	H'way No.	Name.	Approx Miles.
Ontario	639	Cheshire -McJennetts Hill	7.04
Ontario	5081	Lima-E. Bloomfield, Part II	5.26
Otsego	833	W. Exeter-W. Winfield	5.44
St. Lawrence	875	Elmdale-Gouverneur	5.88
St. Lawrence	876	Brasles Corners-Elmdale	3.32
St. Lawrence	878	Ogdensburg - Morris-Town, Part I	6.74
Saratoga	741	Saratoga-Corinth	4.06
Saratoga	815	Corinth-Hadley	6.22
Schenectady	793	Schenectady-Vischers Ferry	2.34
Schenectady	880	Schenectady-Duanesburg, Part I	2.79
Schoharie	5086	Gallupville-Vrooman	5.00
Seneca	321	Center Road-Fayette, Part I	3.19
Seneca	5087	Geneva-Waterloo	5.95
Warren	5088	Riverside - Wevertown, Part II	1.58
Washington	802	Smiths Basin-Hartford	5.26
Wayne	5089	Clyde-Savannah, Part I	4.55
Cortland	881	Blodgetts Mills-Cortland	1.79
Cortland	882	Scott-Spafford	2.55
Cortland	5075	Cortland City - Clinton Ave.	0.53

Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the office of Division Engineer Spencer J. Stewart, Columbus Hall, Poughkeepsie, N. Y., for the road in Dutchess county; at the office of Division Engineer Harry P. Willis, Humane Building, Albany, N. Y., for roads in the counties of Albany, Clinton, Columbia, Greene, Montgomery, Rensselaer, Saratoga, Schenectady, Schoharie, Warren and Washington; also at the office of Division Engineer Guy H. Miller, Cleveland Building, Watertown, N. Y., for roads in the counties of Franklin, Jefferson, Hamilton, Lewis, Oneida and St. Lawrence; also at the offices of Division Engineer Fred W. Sarr, So. Clinton and West Jefferson Sts., Syracuse, N. Y., for roads in the counties of Cayuga, Chenango, Cortland, Madison, Onondago, Ontario, Oswego, Seneca and Wayne; also at the office of Division Engineer M. W. Wilbur, 423 Cutler Bldg., Rochester, N. Y., for roads in the counties of Cattaraugus, Chautauqua and Genesee; and also at the office of Division Engineer Paul McLoud, Press Bldg., Binghamton, for roads in the counties of Broome and Otsego.

✣Bids have been readvertised and will be received until 1 p. m., March 22, by New York State Highway Commission, 55 Lancaster St., Albany, N. Y., for the improvement of the following highways:

County.	H'way No.	Name.	Approx Miles.
Greene	886	Lexington-Prattsville	4.19
Greene	887	So. Cairo-Cairo	3.15
Genesee	5090	E. Pembroke - Pembroke, Part II	4.77
Hamilton	874	Nobleboro - Morehouseville	5.00
Lewis	5077	Martinsburg-Turin	3.08
Madison	883	De Ruyter - Otselic, Part I	2.14
Madison	5078	Wampville - Oneida Castle	2.56
Montgomery	409	Fort Plain-Starkville	6.22
Oneida	837	Waterville-Deansville	4.77
Oneida	838	Saquoit	0.50
Oneida	839	Augusta-Knoxboro	1.21
Oneida	840	N. Brookfield-Waterville	4.37
Oneida	877	Clinton Village	0.97
Oneida	5079	Clayville Village	1.44
Onondaga	556	Manlius-Chittenango	3.22
Onondaga	557	Vesper-So. Onondaga	6.19
Onondaga	655	Jordan-Cross Lake	1.78
Onondaga	669	Pompey-Jamesville	5.97
Onondaga	5080	Elbridge Village-Camillus, Part I	3.01
Oswego	772	Fulton - Hannibal, Part I	3.67
Oswego	825	Fulton-Oswego	4.51
Oswego	826	Pulaski-Orwell	5.94
Oswego	5082	Mexico-Union Square, Part II	2.92
Oswego	5083	Union Square-Pulaski, Part I	2.61

Julius Friedrich Co. submitted the lowest bid to the board of contract and supply.

Rochester, N. Y., on Feb. 15, for the making of repairs to asphalt pavement at $1.12 a sq. yd., for asphalt and 39 cts. a sq. yd. for cement.

A bill has been introduced in the state senate, Albany, N. Y., by Senator Walters, of Onondaga county, calling for the construction of improved highways from Binghamton to Alexandria Bay

⊙The village trustees of Kenmore, N. Y., have awarded the contract for paving Knowlton Ave. with asphalt to the German Rock Asphalt C[illegible] for $[illegible]

North Carolina.

According to advices from Asheville, N. C., county seat of Buncombe county, an effort will be made to allow that county to vote on an issue of $100,000 or more of bonds for the improvement of the roads in all parts of the county. The Buncombe County Good Roads Association is interested.

Boonville township, Boonville, N. C., expects to vote on a proposition to issue bonds to the amount of $15,000 or $20,000 for improvements to the roads of the township. A. S. Spe[illegible] township board.

According to information received from Raleigh, N. C., the Sykes-Boyden highway commission bill has been adopted for favorable report by the joint committee on roads and turnpikes as a substitute for the Sykes bill, to encourage road building in North Carolina, and the Boyden bill for a highway commission. It is to have the combined strength of both bills in pressing its passage through both houses. The substitute bill provides for a state highway commission to have the supervision of road building in the state and issues of state bonds, $200,000 every six months.

Ohio.

✣Bids will be received until noon, March 24, by Board of County Commissioners, Cincinnati, Ohio, for the improvement, under Specifications No. 166, of the Broadwell road, from Round Bottom road to a point ½ mile east of the N. & W. R. R., in Anderson township. Bids must be accompanied by a bond for $500. Fred. Dreihs is clerk.

✣Bids will be received until noon, March 7, by H. S. Holton, Director of Public Service, Columbus, Ohio, for three two horse street sweeping machines, equipped with eight-foot brooms, for use of the street cleaning department, delivery f. o. b. Columbus, and each proposal to be accompanied by complete specification and description of machine.

✣Bids will be received until noon, March 11, by Louis Brill, Village Clerk, Trenton, O., for furnishing necessary labor and materials for grading and regraveling State St. in said village, from Miami St. westwardly to the west corporation line of said village, and for constructing curbing and gutters therealong, according to the plans and specifications on file.

The board of county commissioners, Athens, O., have been petitioned for the construction of a road on the line beginning at a point on the Athens, Sugar Creek and Chauncey public road known as the Lancaster road, and running to intersect Central Ave., on the north end.

A petition is to be presented to the county commissioners, Bryan, O., at its first meeting in March, providing for the locating and construction of a county road on the following line: From the southeast corner of the northeast quarter of section 19, Brady township, to the public highway running through Brady township, a distance of about 200 rods.

The city council of Ashtabula, O., contemplates paving North Park St. with asphalt macadam. Plans for the improvement have been completed by the engineering department. C. F. Brotherton is service director.

Oklahoma.

The Choctaw County Good Roads Association, Hugo, Okla., will apply to the good roads division of the agricultural department at Washington, D. C., for experts to build four miles of demonstration road between Hugo and Grant. The enterprise has been endorsed by the county commissioners.

Oregon.

Stannard & Richardson, civil engineers of Portland, Ore., have been engaged by the city council of Forest Grove, Ore., to prepare maps and estimates and make surveys for the area to be paved during the summer.

It is reported from Jacksonville, Ore., that the county court of Jackson County has employed a road engineer for that county who will have complete charge of the road work throughout the county.

Hard-surface pavements costing more than $500,000 are to be laid in the district south of Division St., Portland, Ore., this year. One contract of $140,000 has been let and others are to be let in the near future. Three districts have been formed between Division St. and Powell Valley road, East 26th and East 41st Sts., in which hard surface pavements are to be laid this year at a cost of $350,000. Another district is between Elsworth St. and Powell Valley road, and between East 41st St., in Waverleigh Heights. It is estimated that it will cost $200,000 to pave all the streets in this region. East 26th St. also will be paved between Division St. and Powell Valley road as soon as the widening of the street has been accomplished. Division St. will be paved between East 41st and East 60th Sts. The hard-surface district east on East 21st St., between Clinton and Division, will cost about $30,000. J. W. Morris, city engineer.

The city council of Grants Pass., Ore., has been petitioned for various street improvements. An effort is being made by property owners to decide upon the style of roadway, some favoring a 36-ft. roadway of a light water bound macadam, while others are contending for a 30-ft. roadway of macadam with a bitulithic waterproof surface. Plans and specifications are being prepared by City Engineer Hobson.

Pennsylvania.

✣Bids will be received until noon, March 6, by Commissioners of Allegheny County, Pittsburg, Pa., for hauling ballast and screenings from railroad stations and sidings to points on the various roads to be resurfaced by the road department of the county. Specifications on file at the office of S. D. Foster, County Road Engineer, 312 Court House. R. J. Cunningham is County Controller.

✣Bids will be received until noon March 6, by Board of County Commisioners, Pittsburg, Pa., for furnishing the road department in accordance with specifications on file at the office of S. D. Foster, County Road Engineer, 312 Court House, the following: 36,000 tons, more or less of ballast and screenings for the various improved roads that are to be resurfaced, as per schedule on file in the road engineer's office; bids to be made per ton, railroad weight, f. o. b. cars destination; approximately 10,000 barrels of Portland cement, all or any part of same to be for delivery during year 1911, and to any point in said county. Also for the furnishing and delivery on the Hulton and Verona extension roads (delivery to be as required by road department, and as covered in the specifications), of binder and mixing of "Amiesite" pavement, or "Warrenized" pavement, for 23,655 sq. yds. of surface for the Hulton road, and 16,976 sq. yds. of surface for the Verona extension road, said quantities being approximate. Delivery of ballast and screenings to commence within 15 days after the award and execution of contracts and to be completed on or before August 1, 1911. Delivery of cement and the "Warrenite" or "Amiesite" pavement to commence within 10 days after receipt of instructions from the county road engineer, and to be furnished in strict accordance with his instructions, as furnished from time to time.

The city of Harrisburg, Pa., plans to start active work as soon as spring opens, on the contracts for the laying of 300,000 sq. yds. of paving Within a short time City Highway Commissioner, William D. Caldwell, will advertise for bids for some streets, including a readvertisement for brick for the paving of Berryhill St. The other streets include those recently authorized to be paved by the Koons' ordinance as follows: Sections of 15th and 16th Sts., from Berryhill to Catharine; 17th from Berryhill to the P. & R. railroad; Naudain and Catharine Sts., from 15th to 17th; Peffer St.

The city council of Scottdale, Pa., has ordered the paving of Fourth Ave. The council was also petitioned for grading, curbing and paving Loucks ave., from Grant St. to Homestead Ave.

The viewers appointed by the county commissioners, Washington, Pa., to inspect the proposed route of a new road in Carroll township, have reported favorably. The road as laid out begins at a point on the Ginger Hill-Pigeon Creek road, and extends to a point in the Pigeon Creek road from Monongahela to Bentleyville.

The common council of Harrisburg, Pa., has passed the following ordinances for paving: Paving Summit, from Bailey to King St.; Balm St., from Bailey to State St., and Linden St., from Bailey to State St.; Peffer St., from Second to Seventh Sts.

Tennessee.

✣Bids will be received until March 6, by City of Memphis, Tenn., for the construction of 2,400 ft. of tar macadam pavement and 2,370 ft. of concrete curb. The work which is estimated to cost $15,223, will include 4,500 cu. yds. of excavation. J. H. Weatherford, Memphis, Tenn., is Engineer.

Senator John C. Houk and Representatives J. C. Groner and J. W. Hudson of Knox County, Knoxville, Tenn., have introduced three good roads bills in both houses at Nashville; one, the general highway department, and administration bill; a bill to provide revenue, including county bonds, and a bill providing that convicts may be used for aid to any county.

Property owners of Union Ave., Memphis, Tenn., have petitioned Commissioner of Streets, Bridges and Sewers, George C. Love, for an ordinance providing for the widening of Union Ave., from Wellington St. west to a point where that thoroughfare merges into regulation width.

Texas.

The Central Third Ward Improvement club of Houston, Tex., has petitioned the city commissioners for the following improvements: Sanitary, sewerage, electric lights, storm sewerage and brick pavement on the following streets in their order named: Pave Leeland Ave. with brick, from Crawford St. to railroad tracks. Pave Hamilton St. with brick, from McKinney to Leeland Ave. Pave Dallas Ave. with brick, from Chartres to Hutchins St. Pave Clay Ave., with gravel or shell, from Chartres to Hutchins St. Pave Jefferson Ave., with shell, from Crawford to St. Emanuel St. Pave Gray Ave., from Chartres to St. Emanuel St. Ask that the sanitary sewerage system as planned by the city be installed at their earliest possible moment. R. Frank is chairman of the club.

The commissioners of Calhoun County, Port Lavaca, Tex., and the Calhoun County Cattle Co., are planning the construction of a 60-ft. shell automobile roadway from Port O'Connor and Port Lavaca to San Antonio.

The Young Men's Progressive League of Jacksonville, Tex., has appointed a committee to aid in working up and arranging for holding an election in the Jacksonville justice precinct, which covers an area of a radius of about five miles, adjacent to Jacksonville, for the purpose of bonding the precinct to build roads leading into town.

A petition has been filed with the city secretary, Houston, Tex., requesting the city to pave Webster Ave., from Main to Crawford Sts., with brick. The street is 10 blocks in length.

The city commissioners of Dallas, Tex., have ordered the paving of Grand Ave., from

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Ervay St. to Exposition Ave.; Exposition Ave., from Grand Ave. to Parry Ave.; Parry Ave., from Exposition Ave. to Haskell Ave., and Forest Ave., from the Houston & Texas Central Railroad to Arza St.

Plans are to be prepared by Engineer G. B. Gurley of Stamford, Tex., for the construction of three blocks of Hassam pavement in that city. The contract will be let about March [illegible] is Mayor.

Plans are to be prepared by J. W. Crook, Engineer, for the construction of about 20,000 sq. yds. of creosoted pine block pavement on a 6-in. concrete foundation for the city of Paris, Tex. The work will include a Sarco filler, 7,000 cu. yds. of excavation. The estimated cost is $40,000. The contract will be let about May. Ed. H. McCuistion is Mayor.

Utah.

Representative B. D. Harshberger has introduced a point memorial in the lower house, Salt Lake, Utah, petitioning Congress to build a good road from Green River, Utah, to the most feasible railroad point, for the use of automobiles and stages.

Virginia.

The James City & Williamsburg subcommittee of the general committee on roads, of the Peninsula Good Roads Association, has been organized at Williamsburg, Va., to urge the construction of the Newport News-Richmond highway. The board of supervisors has been asked to appropriate $2,500 for the work.

Washington.

✣Bids will be received by the State Highway Commissioner, Tacoma, Wash., it is said, until March 15, for the construction of three and one-half miles of state aid roads. Bids for asphaltum macadam road are asked in pursuance with the specifications on file with the Lewis County Engineer, at Chehalis, Wash.

The city council of Olympia, Wash., has been petitioned to gravel Main St., from Second to A Sts.

The city council of Chehalis, Wash., has directed specifications prepared for the construction of a hard-surface roadway from the new high school building, east on Market St. to the city limits; also Main St., to the Chehalis River bridge.

West Virginia.

⊙John Coon, Commissioner of Streets, Huntington, W. Va., has awarded the following contracts for approximately 124,500 sq. yds. of street paving and 60,100 lin. ft. of curbing, for which bids were opened Feb. 6, as follows: Harrison & Dean, 38,000 sq. yds., at $1.40 per sq. yd.; Freshwater & Son, 16,000 sq. yds. at $1.45 per sq. yd.; Geo. Hinkle, 22,000 sq. yds., at $1.35 per sq. yd.

Wisconsin.

✣Bids will be received until noon, March 7, by Committee on Streets and Sidewalks, Monroe, Wis., for furnishing of the materials and constructing approximately 5,057 sq. yds. of paving on North Jefferson St., running north from Russell St., to George St. William Dunwiddie is City Clerk. W. G. Kirchoffer, Madison, Wis., is Engineer.

The committee on streets and alleys has recommended to the city council of Milwaukee, Wis., the purchase of four street flushing machines to clean the city streets. It is estimated that the machines will cost $1,000 each. J. J. Handley is supt. of streets.

The roads and bridges committee of the county board, Superior, Wis., plans to build three miles of permanent road on the Bardon Ave. road, and three miles on the 18th St. road, to improve all other roads in the county which are in need of repair, and to construct four bridges during this year.

The Citizens' Business League of Milwaukee, Wis., has started a plan to construct an automobile road from Milwaukee to Chicago. It is reported a Milwaukee newspaper will pay the cost of dragging the proposed road from Milwaukee to the south county line, a distance of about 15 miles.

BRIDCES — STEEL AND CONCRETE

Arizona.

Advices from Globe, Ariz., state that it has been decided by those interested in the Good Roads Movement to ask Congress for an appropriation of $100,000 for two new concrete bridges—one over the San Carlos and the other over the Gila. Those bridges will form part of the proposed extension of the territorial highway from Globe to the Arizona-New Mexico line by way of Pima, Thatcher, Safford, Solomonville and Clifton. The bridges if built will be concrete and so constructed as to withstand the force of any flood.

California.

Advices from Modesto, Cal., state that the recent high water caused damage to the county bridges, which will require an expenditure of about $15,000 to replace.

Advices from Jackson, Cal., state that the supervisors of Calaveras County have decided to construct a wire bridge for foot passengers at the Middle Bar on the Mokelumne river.

Colorado.

City officials of Denver and the Denver City Tramway Co. are negotiating for the construction of a new bridge across the Platte river at Alameda avenue. The proposed bridge will carry the extension of the car line to Valverde, and will be in line with the Alameda subway. The cost of the work is estimated between $30,000 and $50,000.

Florida.

President Henry McLaughlin, of the Pensacola, Mobile & New Orleans R. R. Co., which has under construction a line from Pensacola, Fla., to Mobile, Ala., is making arrangements for the construction of a draw bridge over the Mobile river, just north of Mobile. Congress recently passed a bill authorizing this improvement.

The Board of Trade of South Jacksonville, Fla., has petitioned the Board of County Commissioners to build a wagon bridge across the St. John's river.

A proposition has been submitted to the city council of St. Augustine, Fla., which may result in the construction of a permanent concrete bridge across the San Sebastian river to replace the present wooden structure.

Georgia.

⊙The Road Commissioners, according to advices from Lawrenceville, Ga., have awarded the Roanoke Bridge Co. the contract for the construction of a steel bridge across the Chattahoochee river at Rogers Ferry near Duluth, in Gwinnett county.

Idaho.

Information received from Grangeville, Idaho, states that a bill has been passed by the legislature, appropriating $15,000 for the construction of a wagon bridge where the state road crosses the Salmon river at Goff. The new structure will replace the present ferry system.

Illinois.

⊙The contract for the construction of the proposed bridge over the Salt Fork river at a point 5 miles northwest of Fairmount, Ill., has been awarded to R. C. Spandau, Danville, Ill., at $6,995. Other bidders were: Attica Bridge Co., Greenberg Iron Co., Paris Bridge Co., C. J. Lewis. The new bridge is to be built entirely of concrete, girders and all. It will be fifty feet long, with a 300-foot approach on the north side of the river. No fill for an approach will be necessary on the south side of the river, the bridge terminating in a precipitous hill.

City of Lacon, Ill., has decided to give up the project of building a steel bridge across the river at the present time and will build a temporary pontoon, costing about $10,000.

Supervisors of Lake county have appointed a committee to take up with the city of Cuba, Ill., the matter of building a new bridge over Flint creek, near Klingenburg place, the county paying half the cost.

Upon investigation, it has been decided by the city officials of Earlville, Ill., that it will soon be necessary to build a new bridge over Indiana creek on Ottawa street, to replace the old structure. A structure 60 ft. in length will be necessary, and it is estimated that the cost of the improvement will be between $3,000 and $3,500.

A movement has been started in the Eighth ward of Peoria, Ill., toward inducing the Chicago & Northwestern, the Iowa Central, and the Chicago, Burlington & Quincy railroads to construct a viaduct over their tracks on the extreme southern end of Adams street. The structure would necessarily be 500 feet long.

Indiana.

✣Bids will be received until 2 p. m., March 7, by Board of County Commissioners, at Petersburg, Ind., for the construction of a steel bridge in Pike county. John D. Gray is County Auditor.

✣Bids will be received until 2 p. m., March 7, by Board of Morgan County Commissioners, at Martinsville, Ind., for the construction of a number of arches. J. S. Whittaker is the auditor of the county.

Commissioners of Allen and Whitley counties, according to advices from Fort Wayne, Ind., met recently to make arrangements for the construction of the bridge to be built over the Solon Ditch, which flows between the two counties.

Iowa.

✣Bids will be received until 2 p. m., March 6, by Board of Scott County Supervisors, Davenport, Ia., for the construction of steel bridges, concrete bridge, concrete arches and concrete culverts. Plans and specifications are on file at the office of Edward Collins, County Auditor. Proposals to be accompanied by a certified check for $1,000 on a bank in Scott County, made payable to the County Auditor, unconditional, as a guarantee that successful bidder will enter into contract and furnish bond for the sum of $2,500, within ten days after receiving notice of the award.

Plans have been agreed upon by engineers of the Minneapolis & St. Louis and Iowa Central Railroads for the construction of the Third avenue viaduct in Marshalltown, Ia., and the matter will be considered at once by the city council. According to the plans drawn the viaduct would be 1,324 ft. in length, and cover the tracks of the Chicago Great Western railway as well as the Northwestern and Central. In crossing the Great Western the tracks of that road would have to be lowered eight and one-half feet. The original plans as furnished by the city engineer only included the Northwestern and Iowa Central. Both the Northwestern and Central say that they would object to building any viaduct that does not include the third road.

It is reported that the commissioners of Benton County at Vinton, Ia., are seriously considering the construction of a number of concrete and steel bridges and culverts, and that a large contract for the work will be let in the near future.

At a recent meeting of the township trustees and Road Superintendents, held at Ida Grove, Ia., it was voted to adopt concrete as the material for bridge construction, and a mixing machine will, it is believed, be purchased.

Officials of the Chicago, Rock Island & Pacific will probably take immediate steps toward the construction of a new steel bridge to replace the old structure on the Cedar Rapids branch, between Buchanan and Plato, which was recently washed out by high water in the Shannon Creek.

Kansas.

Board of County Commissioners, John Collins, chairman, Columbus, Kan., have decided to appropriate $5,600 for the construction of new bridges, the two largest structures being in Shawnee and Sheridan, costing $1,900 each.

◉A. M. Blodgett Bridge Co. has been awarded a contract at $8,000, for the construction of four bridges in Neosha County, of which Erie, Kan., is county seat. The structures are located as follows: One across the Neosho river at Austin; one across Rock Creek; one just west of Erie, and one just east of St. Paul. W. M. Clover, Erie, Kan., is chairman of the Board.

The Commissioners of Kansas City, Kan., have passed a resolution requesting the Chicago, Rock Island & Pacific and the Union Pacific R. R. Companies to build a foot bridge across their tracks south from a point near Muncie Blvd. and Valley St. in Kansas, City.

Kentucky.

All the necessary land has been secured by the Commissioners of Hardin County at Elizabethtown, Ky., for the site of the proposed bridge over the Salt River at West Point, thus removing the last obstacle preventing the immediate construction of the bridge. The new structure will cost, it is estimated, about $60,000, and will be located at a point between the Illinois Central and Henderson Route bridges over the Salt River. It will be 6 ft. higher than either of the latter structures, and will be built of steel and concrete. The plans provide for a walk for foot passengers, besides the wagon way. It is also expected that in the future the Louisville Railway Company, whose tracks are already extended to Orell, may extend their lines across the bridge and possibly through Elizabethtown to Hodgenville, and the Lincoln Farm.

Michigan.

✣Bids will be received until noon, March 15, by City of Ypsilanti, Mich., for a single arch reinforced concrete bridge at Congress St. in accordance with plans and specifications on file in the office of Frank Joslyn, City Clerk, or Benj. Douglas, Consulting Engineer, 814 Ford Bldg., Detroit, Mich. Each bid must be accompanied by a check for $1,000. Official advertisement will be found elsewhere in this issue.

◉The Joliet Bridge & Iron Co., Joliet, Ill., has been awarded the contract at $5,200, for the construction of a steel bridge over the Sturgeon River in Section 21, 53-34 in Baraga township. The structure will be on the road between Baraga and Pelkie, Mich., and will be 163 ft. in length.

The following bids were received by the cities of Menominee, Mich., and Marinette, Wis., on Feb. 23, for the construction of the bridge across the Menominee River between the cities: Marinette Boiler Works, Marinette, Wis., $29,650; Central States Bridge Co., $42,000; John Brogan, Green Bay, Wis., $35,535; Milwaukee Bridge Co., Milwaukee, Wis., $31,100; Joliet Bridge Co., Joliet, Ill., $32,200; Wausau Iron Works, $24,468; Worden-Allen Co., $27,742. The above being for steel structure. The following for concrete bridge: Illinois Bridge Co., $35,000; Thomas Hasley, $33,000. F. S. Norcross is City Clerk Menominee, Mich.

Information received from Benton Harbor, Mich., is to the effect that a petition has been filed with the City Council, asking for the erection of a viaduct across Ox Creek, connecting all the territory that lies between Highland and below Britain.

Minnesota.

◉County Auditor, Warren, Minn., on Feb. 4, awarded the contract for 200 culverts to the Northern Culvert Co., Thief River Falls, Minn., and the Duluth Culvert Co., Duluth, Minn., at $12,000. The first company will furnish one-half the culverts and haul same 40 miles inland while the latter company will furnish the other half and deliver same at Thief River Falls. W. R. Hoag, C. E., 1320 S. E. 7th St., Minneapolis, Minn.

A bill has been passed by the House of Representatives providing for the construction of a wagon and trolley car bridge over the St. Croix River, between Wisconsin and Minnesota, from a point suitable to the interests of navigation on the east bank of said river between the north line of section 25, township 29 north, range 20 west, and the east and west quarter line of said section in St. Croix County, Wis., to a point on the west bank of said river almost due west from the place of beginning in Washington county, Minn.

◉The Board of County Commissioners, Hallock, Minn., on Feb. 20, awarded to Isak Helseth, Donaldson, Minn., the contract for the construction of three steel bridges; also a contract to N. D. Metal Culvert Co., Fargo, N. Dak., for the construction of 22 large culverts and 17 small ones.

Missouri.

✣Bids will be received until noon, March 7, by Board of County Commissioners, Shelbyville, Mo., for furnishing the material and erecting the following steel bridges, plans for which are on file at the office of W. Mitchell, County Highway Engineer: 36 ft. span near Chinn School House, Jefferson township; 36 ft. span near A. B. Maupin farm, Jefferson township; 36 ft. span near Carlton Smith, Jefferson township; 24 ft. span east of Union, Jefferson township; 30 ft. span south of Walkersville, Salt River township; 30 ft. span west of J. R. Smith's, North River township; 18 ft. span near Jas. I. Green, North River township; 40 ft. span east of Emden, North River township; 16 ft. span near McPikes, Bethel township; 32 ft. span near Jno. Tolle's, Bethel township; 40 ft. span near McCabe's, Taylor township; 16 ft. span west of Cherry Box, Taylor township; 8 ft. span north of G. W. Crawford's, Clay township.

Montana.

County Commissioners at Virginia City, Mont., have been petitioned for the construction of a bridge over the Jefferson River, near Silver Star, in Madison County.

Nebraska.

✣Bids will be received until March 20, by Commissioners of Dund County, at Benkelman, Neb., for the construction of a wooden wagon bridge across the Republican River, where public road No. 106 crosses said stream, in Township 1, Range 38, West 6th P. M. Said bridge to be a three-pile bridge, 12 feet wide, spaced for 18 feet stringers, 2x123—8 stringers to section, 8x10x12; caps to be used and stringers to be fastened with one bolt and two spikes at top. One cap pile, braces to be bolted on to piling with one bolt at each bearing and also spiked. Flooring 3x12x12. Railing 4x4x4, bolted to the outside of stringers with 2 bolts at lower end; and four 2x6 and two 2x4, 18 feet long, to each section, to be used as railing properly put on. All material will be furnished and on the ground at bridge site.

✣Bids will be received until noon, March 9, by A. P. Young, County Clerk, Nebraska City, Nebr., for the construction of bridges and concrete abutments and wings in Otoe County during the year of 1911. A certified check for $500 must be filed with each bid.

It has been announced by officials of the Mason City & Fort Dodge Ry. Co., a subsidiary concern of the Chicago, Great Western Ry., that actual construction work will be started on the proposed 18th St. viaduct in Omaha, Nebr., on March 6. The structure will replace the temporary one, which now spans Mason St. at 19th St., and will be built of steel. C. Chandler, Chicago, Ill., is Bridge Engineer of the Chicago Great Western Ry.

The railroads are willing to build the proposed viaduct at Fifteenth and Nicholas Sts., in Omaha, Nebr., and to dismiss all litigation growing out of the long controversy providing they are given possession of the land under the viaduct between Fourteenth and Fifteenth Sts. F. A. Brogan is Attorney for the Missouri Pacific.

New York.

✣Bids will be received until noon, March 21, by Charles E. Treman, Superintendent of Public Works, Albany, N. Y., for Contract No. 87, Erie Canal, Section 4, for constructing a new farm bridge over the Erie Canal at Station 4078+00, near Rock Rift dam on Contract No. 20-A, Sheets 1 to 5 inclusive. Plans may be seen and detailed specifications, engineer's estimate of quantities, proposal blanks, form of contract and bonds required and other informatinon for proposers may be had at the office of the Superintendent of Public Works at Albany, N. Y., at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N. Y.; at the office of the Assistant Superintendent of Public Works for the Western Division at Rochester, N. Y.; and at the canal office, Spaulding's Exchange, Buffalo, N. Y. Copies of detailed plans or drawings may be obtained from the State Engineer and Surveyor at Albany, N. Y., upon payment to him of the cost of producing them.

City Engineer of Fulton, N. Y., made plans for the proposed new bridge at Broadway, but nothing definite has been decided upon. The structure will be of reinforced concrete or steel, and will cost, it is estimated, between $130,000 and $176,000.

North Dakota.

◉The contract for the construction of the county bridge over the Red River of the North at Drayton, Pembina County, N. Dak., mentioned in a recent issue of ENGINEERING-CONTRACTING, has been awarded to the Minneapolis Steel & Machinery Co., at $9,965. The bridge proper will be 590 feet in length and with approaches will be some 900 feet long. It is of the direct Smith span type, with spans 140 feet in length, provision being made for navigation on the river. Work on the structure is to begin in the near future and will be hurried along as rapidly as possible.

Ohio.

✣Bids will be received until noon, March 24, by Board of County Commissioners, Cincinnati, O., for the construction under Specifications No. 165, of a concrete bridge on Sheed Road, near the Hanley Road in Colerain township. Bids must be accompanied by a bond in the sum of $500. Fred Dreihs is Clerk.

Oregon.

The first step toward the construction of the proposed Broadway Bridge at Portland, Ore., was taken when the Union Bridge & Construction Co., Kansas City, Mo., which has the contract for the sub-structure, started the demolition of the Albers Bros. dock on the West Side.

Pennsylvania.

The Central Railroad of New Jersey and the Lehigh Coal & Navigation Co. have decided to make improvements in Northampton, Pa., estimated to cost upwards of $100,000. The principal improvement will be a bridge over Dry Run, to open up the main streets

Plans have been approved by the State Railroad Commission for the construction by the Butler Passenger Ry. Co., of a single pier trolley viaduct in Center Ave., to span the tracks of the Baltimore & Ohio R. R. tracks, and to connect the main sections of the city, of Butler, Pa. W. H. Pape, Butler, Pa., is General Manager of the Butler Passenger Ry.

Tennessee.

Citizens of Chattanooga, Tenn., have petitioned the Legislature, County Court and Congress to take the necessary steps to secure the construction of a steel bridge at the foot of Market St., over the Tennessee River. As

✣ indicates work now open for bids. ◉ indicates a contract let recently.

proposed, the structure will have a concrete driveway with walk on each side.

Texas.

◉A large contract has been awarded to J. W. Yarborough, Templex, Tex., for the erection of depots and bridges on the new Chicago, Weatherford & Brazos Valley R. R., which is building out of Weatherford, Tex.

The Commissioner's Court at Wichita Falls, Tex., has authorized the County Clerk to call a special election to vote on the issuance of bonds for the construction of a new wagon bridge across Wichita River, east of the old wagon bridge at Wichita Falls. The cost of the improvement is estimated at $15,000.

The proposition to issue $20,000 of bonds was carried by the voters of Menard County at the recent election, and plans will be considered at once for the construction of the proposed bridge, for which the bond issue is to provide funds. The structure will be 1,121 ft. in length, including the approaches. Menardville, Tex., is the county seat.

The approving of the $500,000 bond issue by the Attorney General's Department has removed the last obstacle in the way of the construction of the concrete and steel viaduct across Buffalo Bayou, at the foot of Main St., in Houston, Tex.

South Dakota.

✣Bids will be received until [illegible] p. m., March 22, by Board of County Commissioners, Vermillion, S. Dak., for the construction of 8 steel or concrete highway bridges for the Vermillion Valley Ditch No. 1, in Clay County, S. Dak. A certified check for $1,000 must be filed with each bid. Theodore Anker is County Auditor. Official advertisement will be found elsewhere in this issue.

Utah.

Advices from Richfield, Utah, state that the Road Commissioner has been instructed to build a bridge over the Sevier River, between the towns of Redmond and Salina.

The following bridges have been recommended by Representative Morris of Washington County, Utah, and a bill has been introduced into the House, appropriating $6,500 for their construction: $5,000 for a bridge over Shoal creek, on the main road west of Enterprise; $1,000 for a bridge over Ash creek, on the main road west of Toquerville; $500 for a bridge over the Santa Clara creek, on the main road near Chadburn's ranch. Montpelier, Utah, is county seat.

City Council of Salt Lake, Utah, has been petitioned by the citizens to build a viaduct over the railroad tracks at the intersection of Seventh South St. and Third, Fourth and Fifth West Sts.

Virginia.

◉The Virginia Bridge & Iron Co., Roanoke, Va., has been awarded the contract at $50,000 by the Richmond Henrico Ry. Co., for the construction of the steel work of the new viaduct of the company. It will be about 50 ft. high and will span 1,200 ft. from Marshall St., and the National Cemetery Road to Nicholson St., Fulton. The concrete work will be started at once.

◉The contract for the construction of the bridge over Strait Creek in Highland County, Va., was awarded Feb. 9, at Monterey, Va., to the Virginia Bridge & Iron Co., Roanoke, Va., for $1,640. The structure is to be 74 ft. long, consisting of 2 cement spans.

Washington.

Advices from Woodland, Wash, state that the county commissioners have appropriated $15,000, to be applied on the construction of a steel bridge across Lewis River at Woodland. Cowlitz County, through its board of commissioners, appropriated a like sum. Either through the state or through private subscription another $15,000 will be raised until the estimated $45,000 has been secured.

Wisconsin.

At a special meeting, held recently by the City Council of Milwaukee, Wis., the matter of building a new structure to replace the old bridge across the Kinnickinnic River, which was washed away by flood, was taken up. A concrete span could be erected at a cost of about $6,000, it is believed.

Roads and Bridge Committee of the County Board of Commissioners, Superior, Wis., according to reports, is receiving bids for the construction of four bridges on the county's highway system. Two of the bridges are to be steel construction with concrete decking and the other two all concrete construction. The first named two structures are to span the Nemadji River near the Greenwood Cemetery, and the other the Middle River in Amnicon. The concrete structures are to be built, one over the Middle River near A. N. Young's farm, and the other at Black River Falls.

City Council of Milwaukee, Wis., has passed an ordinance authorizing an issue of $120,000 bonds for the construction of the Oneida St. bridge, but it will probably be some time before any active steps are taken toward the erection of the new structure.

Canada.

✣Bids will be received until April 15, by Joseph Armstrong, Sec.-Treas. Municipal Council, Swan River, Man., for one 94 ft. centre to centre of end bearings steel-riveted Pratt Truss Bridge, and two concrete piers, with (steel) stringers, and 3 in. tamarack plank floor. To be erected over the Woody River, east side of Section 36, Township 37, Range 27 west of the Principal Meridian in Manitoba, in accordance with the specifications which can be obtained from the Provincial Department of Public Works, Parliament Buildings, Winnipeg, Manitoba. The bridge site is within 1 mile of Bowsman Station on the Canadian Northern Railway.

✣Bids will be received until April 15, by E. Widmeyer, Secy-Treas., Municipal Council, Minnitonas, P. O. Manitoba, for the supply and erection of a steel Warren truss bridge and two concrete piers. Bridge to be 60 ft. centre to centre of end bearings, with steel stringers and 3 in. plank floor, in accordance with Plan (No. F 10) and specifications on file at the office of the Chief Engineer, Department of Public Works, Parliament Buildings, Winnipeg, Manitoba. Tenders, under seal, to be delivered to the undersigned on or before the 15th day of April, A. D. 1911.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

The Commissioners of Drainage District No. 8 of Clay County, Arkansas, have indefinitely postponed the letting of contracts for constructing the drainage system. Bids for this work were to have been opened March 16, as noted in our Jan. 25 issue. The work was to include 24 miles of main ditch and 30 miles of laterals, the total amount of excavation being 1,850,000 cu. yds. J. D. Mitchell, Rector, Ark., is Chief Engineer.

A bill is to be introduced in the State Legislature by Representative Thweatt, of Devalls Bluff, Ark., calling for the improvement of 100,000 acres of land in that part of Prairie county known as the Grand Prairie, in order that it may be better adapted to the cultivation of rice. The bill would mean a large expenditure of money and will probably meet stubborn opposition in the legislature.

A bill has been introduced in the State Legislature of Arkansas providing for the removal of the offices of the St. Francis levee board from Memphis to some city or town in one of the counties making up the St Francis levee district.

California.

Plans are being made for the installation of a large irrigation system for the Dominquey Estate Co. of Los Angeles. The plant will consist of steam driven cross-compound condensing air compressors, a cross compound condensing Corliss pumping engine, reservoirs, pipe lines, etc. Chester B. Loomis, Los Angeles, is the Engineer.

Jas. A. Green, Engineering-Construction, 226 La Salle St., Chicago, Ill., has been appointed consulting engineer for the Madeline Meadows Land & Irrigation Co., which is developing a 45,000 acre irrigation project in Lasson county, California. I. B. Jones, Madeline, Calif., is Chief Engineer.

Colorado.

Construction work is to be started shortly on the new canal of the Uncompahgre irrigation project, which will take water from the south canal and convey it along the side of the Uncompahgre valley as far as Delta, to water a large amount of land above the present irrigation system. This is made possible by the recent appropriation of $1,500,000 for the Gunnison project. The concreting of the remainder of the Gunnison tunnel is progressing rapidly, with men working from both ends, and it is believed before the water is needed in the spring the entire tunnel will have been concreted. C. T. Pease, Montrose, Colo., is Project Engineer.

Illinois.

A bill is to be introduced in the State Legislature granting the Trustees of the Sanitary District of Chicago authority to extend, widen and deepen the main channel of the sanitary canal and to remove dam 1 and lock 5 at Joliet. A similar bill was introduced at the last legislature, but withdrawn owing to opposition from interests at Joliet, but the trustees are notified that this opposition has been withdrawn. The bill, if passed, will enable the trustees to complete the main channel from Lockport to Brandon road, a distance of about one mile.

Indiana.

◉The Sheron Drain Tile Co., Marion, Ind., has been awarded the contract at $995 for constructing the Futrell-Miles Ditch in Washington township.

The Commissioners of Gibson County, Princeton, Ind., have been petitioned to construct the proposed Stunkel drainage system. The estimated cost is about $75,000.

Petitions for the cleaning and dredging of Little Lick creek from its source in Jackson township to the county line southwest of town, has been filed in the circuit court at Hartford City, Ind. The petitioners ask that the work begin at a point 1,882 ft. north and 17 ft. east of the northeast corner of the southeast quarter of section 4, township 23 north, range 11 east, thence in a southeasterly direction 1,400 ft., thence southwest 2,600 ft., thence west 13,200 ft., thence in a southwesterly direction through Hartford City and to the county line southwest of town a distance of 43,000 ft. In all the improvement would be 60,200 ft. in length.

Iowa.

◉The address of J. W. Boyer, who was awarded the contract for 545,646 cu. yds. of ditch work in Webster County, noted in our last issue, is Fort Dodge, Ia.

Louisiana.

◉Clark & Helgason Bros., Vicksburg, Miss., have been awarded the contract for constructing 402,000 cu. yds. of new levee in

Madison Parish, Louisiana, about 24 miles above Vicksburg, Miss. The work is located in the 5th Louisiana Levee District and bids were opened Feb. 21 by the Board of State Engineers, G. W. Lawes, Secretary, New Orleans, La. The contract price was 15.4 cts. per cu. yd.

Minnesota.

✣Bids will be received until 2:30 p. m., March 15, by County Auditor J. L. Johnson, Olivia, Minn., for the construction of Judicial Ditch No. 9. The approximate amount of the work of construction of said ditch is as follows:

Stations	Branch	Average ft.	Yardage	Estimated cost
0 to 425x29	Main	6.30	140,576	$ 9,840.33
0 to 2x96	Lat. No. 1	4.00	293	38.14
0 to 109x34	Lat. No. 2..	5.30	24,240	1,696.80
0 to 12x74	B. I. Lat. 2.	4.00	1,166	151.58
			166,275	$11,726.85

Main ditch to be 6 ft. bottom, Station 0 to 160—7 ft. to 248 and 8 ft. to terminus. Lateral No. 1, 3 ft. bottom. Lateral No. 2, 6 ft. bottom and branch of lat. No. 2. 3 ft. bottom.

⦿Forrestal & Feyen, St. Paul, Minn., have been awarded the contract at 11.85 cts. per cu. yd. for constructing Judicial Ditch No. 31 and at 12.98 cts. per cu. yd. for constructing Judicial Ditch No. 32 in Kittson County, Minn. Bids for the work were opened Feb. 20 by C. J. Hemmingston, County Auditor, Hallock, Minn. Judicial Ditch No. 31 includes 197,204 cu. yds. of excavation and Judicial Ditch No. 32 includes 145,909 cu. yds. of excavation.

⦿Bids were opened Feb. 16 by L. P. Larson, County Auditor, Redwood Falls, Minn., for constructing Judicial Ditch No. 9 requiring 28,812 cu. yd. dredge work, the contract being awarded to A. C. Miller, Redwood Falls, Minn., at 11.95 cts. per cu. yd.

Hearing has been held in the District Court of Norman County, at Ada, Minn., on a proposition for controlling the overflow of the Wild Rice River. The proposition includes the clearing from the Wild Rice River all obstructions, constructing ditches so as to eliminate bends in the river, thus increasing the rapidity of its flow, and constructing a ditch of large carrying capacity running east and west through the county and emptying into the Red River of the North. It is stated that an engineer will be appointed, a survey made and work done requiring an outlay of many thousands of dollars.

Commissioners of Hennepin County, Minneapolis, Minn., have ordered the straightening of Bassett creek from Medicine Lake to a point two miles from the city limits of Minneapolis.

All bids received Feb. 21 by H. P. Edwards, County Auditor, Fairmont, Minn., for the construction of Judicial Ditch No. 10 in Martin County were rejected and the work will be readvertised. This work called for 51,977 cu. yds. of excavation, estimated to cost $6,491, and 155,869 ft. 6 in. to 24 in. tile, estimated to cost $59,268.

Mississippi.

The Homochitto Swamp Land Commission of Adams County, according to advices from Natchez, is considering dredging the canal which runs from Gailard Lake to the Mississippi River, in the southern part of the county, which is to drain Homochitto River and reclaim 30,000 acres. The canal has been widened and deepened at various points by recent freshets, but it must be deepened to answer the purpose for which it was intended. Captain J. S. Codifer, of Port Adams, Miss., will probably submit a bid for the work.

Nevada.

✣Bids will be received until noon, April 15, by the Pacific Reclamation Co., at the office of George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah, for the construction of storage dam about 15 miles north of Wells, Nev. The dam will be of earth and rock fill with reinforced concrete facing on the up-stream side, including 20,000 cu. yds. earth excavation; 3,000 cu. yds. rock excavation; 71,000 cu. yds. earth embankment; 6,000 cu. yds. dry rubble wall; 1,250 cu. yds. Portland cement concrete; 85,000 lbs. steel reinforcing. A certified check for $2,500 must accompany the bid, and a bond of $15,000 will be required for the faithful performance of the contract. official advertisement, is found elsewhere in this issue.

Ohio.

The Swan Creek Commission, appointed to recommend a method for the improvement of Swan Creek and Ten Mile Creek, in a preliminary report to Mayor Brand Whitlock, of Toledo, recommends the employment of an engineer to secure necessary data for an intelligent consideration of the problem, and also recommends that the city take immediate steps to acquire title to the southeast bank of the stream, now held by the state of Ohio. As the question of diverting Swan Creek into the Maumee or Ottawa River is to be considered, the commission, further urging the selection of an engineer, indicates that topographical surveys, as well as the compilation of much data, will be necessary. It suggests that an engineer can be secured for $3,000.

WATER-WORKS

Alabama.

The citizens of New Decatur, Ala., have voted the issuance of bonds to the amount of $10,200 for waterworks improvements.

California.

Citizens of Riverside, Cal., have signed a petition, which will be presented to the city council, asking that body to establish or acquire by purchase a municipal water system for domestic and fire use.

⦿The city trustees of Turlock, Cal., have awarded the contracts for the extension of the city sewer and water works system as follows: William Heafey of San Francisco, water works improvement, $16,431; Edward E. Paxson, Turlock, sewer improvement, $8,668.

The citizens of Long Beach, Cal., have circulated a petition for presentation to the city council asking that body to reconsider the question of buying the water system of the city. Stephen G. Long is city attorney.

The water committee of the city trustees of Redlands, Cal., is investigating the project for municipal ownership of the Redlands water system. The committee is authorized to employ a competent engineer to investigate the various systems and proposed supply systems.

Colorado.

R. P. Hilleary has been appointed engineer in charge of the construction work on the new water works systems being installed at Collbran, Colo. The town has purchased 10-ins. of water from Hoosier creek to supply the city in the future.

The Union Pacific Railroad has under consideration the construction of a four-mile pipe line from Evans, Colo., to La Salle, Colo. It is probable that the railroad will purchase the water plant at Evans and supply the city by contract.

Florida.

✣Bids will be received until 3 p. m., March 15, by Trustees for the Water Works and Improvement bonds, Jacksonville, Fla., for furnishing materials and laying about 250 ft. of 12-in. and 940 ft. of 10-in. cast-iron sewer pipe; laying 600 ft. of 10-in. and 13,400 ft. of 8-in. terra cotta sewer pipe, together with "Y" branches, and building manholes; also for furnishing materials and building 500 ft. of 30-in. and 300 ft. of 24-in. circular brick drains, laying 765 ft. of 12-in. and 2610 ft. of 15-in. pipe drains, and building manholes; certified check, $600, payable to W. M. Bostwick, Jr., chairman, to accompany each bid; plans and profile can be seen and specifications obtained at office of board. For further information apply to R. N. Ellis, C. E., Jacksonville.

Councilman C. B. McClung, chairman of the water works committee of St. Petersburg, Fla., is having plans made for a reservoir to be constructed west of the pumping station near the lake. The basin will be 50 ft. long, 75 ft. wide and eight ft. deep. It will have a capacity of 225,000 gals.

At a recent election held in Titusville, Fla., the issuance of bonds to the amount of $30,000 for the construction of a water works system was carried.

Georgia.

The city council of Pelham, Ga., has ordered a special election authorizing an issue of $25,000 in bonds to be used for improvements of water and light, sewerage and for a city building for the fire department, jail and stables.

A company has been organized at Butler, Ga., to construct a water works system, with B. B. Rawls as president and W. C. Steed, chairman of the board of directors.

An election will be held in Summerville, Ga., soon to vote on the proposition of issuing bonds to the amount of $30,000 for the construction of a water works and sewer system.

Illinois.

✣Bids will be received until 11 a. m., March 2, by the Department of Public Works, Chicago, Ill., for furnishing and delivering to the City of Chicago at the meter mechanical-shops, located at 1330 Indiana Ave., approximately 300 1-in. and 400 2-in. brass bibb cocks, according to plans and specifications on file in the office of the Department of Public Works of said city, City Hall. B. J. Mullaney is Commissioner of Public Works.

✣Bids will be received until 8 p. m., March 7, by Board of Trustees, Lyons, Ill., for constructing a pumping station, including machinery and appurtenances. A. E. Depew is Village Clerk. W. B. Ewing, 1208 Chamber of Commerce, Chicago, Ill., is Engineer.

✣Bids will be received until 7 p. m., March 1, by George Guy, Village Clerk, Apple River, Ill., for the construction of a system of water works.

Indiana.

✣Bids will be received until 1 p. m., March 25, by J. W. Sanderson, Treas., Marion Branch, N. H. D. V. S., National Military Home, Grant Co., Ind., for the installation of machinery and materials for the improvement of the water supply at the Marion Branch.

The board of public works, through City Controller Harry R. Wallace, has asked the city council, Indianapolis, Ind., for an appropriation of $6,000 to be added to the $125,000 appropriated in the budget for the water expense of the city in 1911. The board contemplates the installation of about 80 new hydrants.

Iowa.

✣Bids will be received until 2 p. m., March 8, by the City of Atlantic, Ia., for improvements to the water and lighting system at that place, including the construction of a building, smoke

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible] nected units, and improvements in the wir- [illegible] tained of W. K. Palmer Co., Engineers, 717- [illegible]

A special election will soon be held in Afton, Ia., to vote on the water works and electric light question.

The city of Boone, Ia., is advertising for bids for the laying of about 30,000 ft. of 18, 16, 14 and 8-in. water pipe, in connection with the proposed water works for that city, the estimated cost of which will be about $180,000. The city will furnish all material. Plans and specifications are on file with the City Clerk. Karl C. Kastberg is City Engineer. Sam Steigerwald, 327 Sixth St., Boone, is Asst. Engineer.

Kansas.

✣Bids will be received until 3 p. m., March 8, by city of Hoisington, Kan., for furnishing necessary labor and material for the construction of improvements to the water works sys- [illegible] Westover, Consulting Engineers, Beal's Bldg., Kansas City, Mo., include the following approximate quantities: 2,750 lin. ft. of 8-in. wooden pipe; 4,800 lin. ft. of 6-in. cast iron pipe; 19,060 lin. ft. of 4-in. cast iron pipe; 7,250 lbs. of cast iron specials; 24 4-in. double nozzle hydrants; 6 6-in. gate valves and boxes; 21 4-in. gate valves and boxes; 2 75 G. P. M. deep well pumps, with motors; 1 500 G. P. M. duplex steam pump.

Michigan.

✣Bids will be received until 7:30 p. m., March 9, by Village Board, St. Charles, Mich., for all machinery and materials for power and electric lighting plant and system of water works, f. o. b. cars St. Charles and delivered on the ground. C. H. Clipper is Clerk. Official advertisement will be found elsewhere in this issue.

The village of Burnips Corners, Allegan County, Mich., has decided to install a water works system.

The bill to authorize the Detroit water board to increase its bonded indebtedness from $1,500,000 to $3,000,000 passed the house under suspension of the rules and without a dissenting vote. The senate will take it up at once

Minnesota.

✣[illegible] received until March [illegible], by F. B. Knoff, Clerk, Madison Lake, Minn., for furnishing the necessary labor and material for tower, tank, well, mains, engine, pump, etc., for water works. The well is to be 8-in. diameter and 200 to 300 ft. deep. John Wilson, Mankato, Minn., is Engineer.

A bill has been introduced in the state senate, St. Paul, Minn., by Senator Fosseen of Minneapolis providing for an artesian well supply of water for Minneapolis.

Plans and specifications are being prepared by the Oscar Claussen Engineering Co., 514-515 Nat. Ger. Am. Bank Bldg., St. Paul, Minn., for the installation of a water works system in the town of Arlington, Minn.

The Oscar Claussen Engineering Co., 514-515 Nat. Ger. Am. Bank Bldg., St. Paul, Minn., is preparing plans and specifications for the construction of a water works system for the town of Clara City, Minn.

Mississippi.

✣Bids will be received until March 7, by Board of Mayor and Select Men, McComb City, Miss., for sinking an artesian well. J. Dock Harrell is City Clerk.

It is reported that the city of Tupelo, Miss., will issue bonds to the amount of $50,000 for improving and enlarging the water works, paving streets and for the erection of a city hall.

Xavier A. Kramer, civil engineer, Magnolia, Miss., has submitted a proposition to the city of Tylertown, Miss., whereby that city can install a water works system.

Missouri.

The following bids were received by the Webb City-Carterville Water Works Co., Webb City, Mo., recently for the building of the new reservoir: Joe Williams, Aurora, Mo., $7,400; Joe Schneider, Monette, Mo., $8,495; F. W. Caulkins, Webb City, $9,676; Webb City Granolithic Co., $9,975; S. M. Kerns, Denver, Colo., $9,990; J. C. Barr Co., Joplin, Mo., $11,445; Oklahoma City Construction Co., Oklahoma City, Okla., $11,450; F. W. Keller, Webb City, $11,995; O. B. Vanderpool, Joplin, $12,200; Redmond, Putnam & Co., Webb City, $14,850. The contract will call for the construction of a reservoir with a capacity of 1,500,000 gals. It is to be built in two sections, each 100 ft. sq. and 9½ ft. deep.

Montana.

The American Goldfields Co., Twin Bridges, Mont., has decided to complete the reservoir planned two years ago on which a small amount of work has been done. Frank C. Lavigne is manager of the company.

Nebraska.

✣Bids will be received until 3 p. m., March 9, by B. Z. Millikan, City Clerk, Fairbury, Neb., for furnishing the necessary labor and material for the construction of a water works system. Plans and specifications for the work can be obtained of Burns & McDonnell, Engineers, Scarritt Bldg., Kansas City, Mo.

Plans are being drawn by W. E. Donner for the construction of a water works plant in Chappell, Neb., estimated to cost $13,000.

The Dundee Improvement Club, village of Dundee, Omaha, Neb., recently held a meeting to discuss the matter of issuing bonds in the sum of $50,000 to secure an adequate and pure supply of water. It is proposed to dig wells to produce a water supply.

New York.

✣Bds will be received until 3 p. m., March 10, by City Clerk, Hornell, N. Y., for the construction of an earthen reservoir embankment with concrete core wall and all accessories, together with about 3 miles of water mains. The work includes the following approximate quantities: 23,000 cu. yds. embankment; 1,822 cu. yds. concrete core wall, spillway, etc.; 1 44-ft. plate girder bridge with solid floor; gate house and valve chambers; 13,200 ft. 20-in. cast-iron pipe; 1,845 ft. 16-in. cast-iron pipe; 11,500 lbs. cast-iron specials, valves, etc. Plans and specifications on file in the office of the Board of Public Works, Hornell, N. Y.

A tax proposition will be submitted to the citizens of Bath, N. Y., in March providing for the extension of water mains in East William, Steuben, Morris and Haverling Sts.

The village board of Lyon, N. Y., has passed a resolution requesting the clerk to communicate with the Lyon Water Works Co., informing the company that the board was investigating the advisability of installing a water system and requesting the company to submit to the board a statement as to whether it was willing to dispose of its plant.

The board of aldermen of Buffalo, N. Y., has adopted a notice of intention to equip the new water plant. A bill has been presented by the corporation counsel for a $1,000,000 bond issue.

North Carolina.

✣Bids will be received until 5 p. m., March 13, by Mayor D. H. Arnold and Board of Aldermen Jonesboro, N. C., for building water works, the work including: Furnishing 165 tons 6-in. cast-iron pipe and 220 tons 8-in. cast-iron pipe, together with hydrants and specials. Laying 4 miles 6-in. and 8-in. pipe, and furnishing and erecting a 75,000-gallon tower and tank. Plans and specifications may be seen at the office of the City Clerk, W. S. Murchison, or White & Piatt, Engineers, Durham, N. C.

The city council of Rockingham, N. C., is considering the issuance of bonds to extend the water works system.

North Dakota.

⊙S. Beich & Sons Construction Co., of Fargo, N. Dak., have been awarded the contract by the city of Bozeman, Mont., for the excavation required to enlarge the reservoir of the Bozeman city water works and increasing the size of the dam and banks with the excavated material, amounting to about 13,000 cu. yds., for $6,972. Bids were opened Feb. 18 by A. M. Brandenburg, City Clerk.

Ohio.

✚Bids will be received until noon, March 28, by H. H. Canfield, Clerk, Cleveland Heights, Ohio, for furnishing the material and labor necessary for the improvement of Crest Road from the south line of Mayfield Road to Wood Road by constructing a 6-in. water main therein, according to the plans and specifications on file at the office of said Clerk at the Town Hall and at the office of the F. A. Pease Engineering Co., at No. 931 Williamson Bldg., Cleveland, Ohio.

✣Bids will be received until noon, March 13, by A. B. Lea, Director of Public Service, Cleveland, O., for furnishing pig lead for the water department. Ira O. Hoffman is Secretary.

The superintendent of the water works department of Springfield, O., has asked the city council for authority to spend $10,000 in making extensions to the water mains of the city.

The city of East Liverpool, O., has employed the firm of Chester & Fleming, Engineers, Union Bank Bldg., Pittsburg, Pa., in connection with the proposed improvements to the water system and the installation of a new pumping station.

The city of Akron, O., has entered suit against the Akron Water Works Co., to throw said company into the hands of a receiver on account of alleged failure to furnish an adequate and pure water supply. The firm of Chester & Fleming, Engineers, Union Bank Bldg., Pittsburg, Pa., has been employed by the Water Works Co. as hydraulic experts in connection with the suit.

Oklahoma.

The taxpayers of Heavener, Okla., on Feb. 14 voted the issuance of bonds to the amount of $50,000 to construct and operate a municipal water works plant. The contract will be let at once.

Consulting Engineer Alexander Potter, 114 Liberty St., New York City, has reported that the only feasible way of securing an adequate water supply for the city of Oklahoma City, Okla., is by the construction of a dam and reservoir and securing water from the Canadian River. A bond election held recently to vote the issuance of bonds to the amount of $1,500,000 was defeated.

The city of Dustin, Okla., is considering the installation of a water works system.

The Osage-Cherokee Corporation has been incorporated at Skiatook, Okla., with a capital stock of $100,000 to acquire franchises to contruct water works, electric light systems, etc. C. H. Cleveland, A. W. Lucas, J. H. Craig and others are the incorporators.

Pennsylanvia.

✣Bids will be received until noon, March 20, by Borough Council, Bristol, Pa., for furnishing necessary labor and material for the construction of a water works and filtration plant comprising the following: Bulkhead and intake; pump well; pumping station; mechanical gravity filter plant, capacity 2,000,000 gallons; pumping machinery and boilers; water tower, capacity 150,000 gallons; about 10 miles of 4-in. to 14-in. cast-iron pipe; fire hydrants, stop valves, special castings, etc.; pipe laying. Bids will be received for the entire work or any portion thereof. Plans may be seen and specifications and blank forms of proposal procured by applying to the office of the Borough Surveyor, No. 209 Radcliffe St., Borough of Bristol, Bucks County, Pa. A certified check for $500 must accompany each bid. Jay M. Whitham is Engineer, 607 Bullitt Bldg., Philadelphia, Pa.

South Dakota.

⊙The city commissioners of Huron, S. Dak., have awarded contracts aggregating about $40,000 for the improvement of the water works system of the city as follows: E. J. Markel of Kansas City, Mo., for building the pumping station; Frank Jaehns of Huron, for building a brick pump house; the Des Moines Bridge Co., for the construction of the steel tower and tank, and W. D. Lovell of Minneapolis, for the construction of the cement reservoir.

The city council of Carter, S. Dak., will issue warrants to the amount of $7,000, which will be used for the construction of a municipal water works system.

Tennessee.

A bill has been introduced in the state senate, Nashville, Tenn., to amend the water works act of the city of Chattanooga. The bill permits the issuance of $1,250,000 in bonds for the purpose of buying or building a municipal plant.

⦿It is reported that the United States Cast Iron & Foundry Co. has been awarded the contract by the board of public works of Nashville, Tenn., for furnishing water pipe, estimated to cost $20,000

Texas.

✣Bids will be received until April 3 by Board of City Commissioners, Galveston, Tex., for furnishing all material and doing all work on complete installation of water main, ready for use, along Causeway from Virginia Point to Galveston Island; approximately 10,766 lin. ft. cast-iron pipe; work to be done in accordance with plans, details and specifications prepared by and obtainable from A. T. Dickey, City Engineer, City Hall, on deposit of $10 with City Secretary; bond for 30 per cent of amount of contract price required.

The citizens of Harlingen, Tex., have voted the issuance of bonds for the installation of a water works.

Mayor H. C. McClure of Jacksboro, Tex., has sold bonds to the amount of $28,000 for establishing a water works system. Consulting Engineer Werenskiold of Dallas will give final instruction for proceeding with the installation of the plant.

⦿Little & Judson have been awarded the contract in Fort Worth, Tex., for four artesian wells for the South Side water supply at $5,500.

⦿The board of municipal water commissioners of Temple, Tex., has awarded the contract for building a modern filtration plant at the city water works to W. C. Rettiger of Belton and the Pittsburg Filter Manufacturing Co., of Pittsburg, Pa., the former to perform all concrete, excavation and physical work, and the latter to supply all equipment. The contract price is $27,190. It will have a capacity of 2,000,000 gals. every 24 hours.

Utah.

Consulting Engineer Louis C. Kelsey, 402 Dooly Bldg., Salt Lake City, Utah, has been engaged to design and supervise the construction of the proposed new water works system for Burley, Ida. The work will include pumping plant and water tower. J. E. Miller is Mayor.

Washington.

The town of Rockford, Wash., will improve its water system this spring by laying about 1,600 ft. of new iron mains.

Wisconsin.

✣Bids will be received until 8 p. m., March 7, by Electric Light and Water Works Commission, at the office of D. E. Wescott, City Clerk, Shawano, Wis., for furnishing and laying water pipes and for furnishing and placing hydrants.

Plans and specifications are being prepared by the Oscar Claussen Engineering Co., 514-515 Nat. Ger. Am. Bank Bldg., St. Paul, Minn., for the construction of a water works, consisting of 100,000-gal, concrete reservoir, about three miles of pipe, pump and motor for the city of Prescott, Wis.

The Hiawatha Water Co., Janesville, Wis., has increased its capital stock to $1,250,000 and will expand its operations accordingly.

Engineers of the state rate commission of Wisconsin have filed a report on a tentative valuation of the Manitowoc, Wis., water works plant, which the city is to purchase, the value being fixed at $222,222

Canada.

✣Bids will be received until noon, March 14, by G. R. Geary, Chairman Board of Control, City Hall, Toronto, Ont., for 3,400 lin ft. of 60-in. reinforced concrete pipe; 9,728 lin. ft. of 66-in. reinforced concrete pipe Plans and specifications may be seen and forms of tender obtained from the Main Drainage Department, at the office of the City Engineer, Toronto.

At a recent mass meeting of the citizens of Battleford, Alta., it was decided to immediately install a water works and sewerage system, and the erection of a new $30,000 town hall and opera house.

The water commissioners of Welland, Ont., are considering the placing of the main pumping station for the water works system of Welland on the east side of the canal. The citizens recently voted the issuance of bonds to the amount of $52,000 for this improvement.

James C. Kennedy, 412-413 Pacific Bldg., Vancouver, B. C., was recently called upon to investigate and report upon a new 6,000,000-gal. reservoir at Vernon, B. C., which was found to be leaking. The city is now awaiting the engineer's recommendation as to what treatment should be adopted, when the case can be dealt with during the coming spring or summer.

Civil Engineer James C. Kennedy, 412-413 Pacific Bldg., Vancouver, B. C., has received bids for about 25 miles of wood-stave pipe for a domestic water supply system for the municipality of Coldstream, B. C. The estimated cost of the work is $100,000, for which sum a by-law was passed last November. The works will have a gravitation supply, and trenching and pipe laying will commence as soon as spring opens.

SEWERAGE AND GARBAGE DISPOSAL

Arkansas.

The city council of De Queen, Ark., has been petitioned for an improvement district for the purpose of building and maintaining a sewerage system.

The city council of Arkadelphia, Ark., has passed an ordinance for the putting in of a sewerage system under the improvement district plan. Bids will be advertised for immediately. E. D. Hall is member of the sewerage board

California.

The city trustees of Fresno, Cal., have passed a resolution providing for the construction of nine blocks of sewers in "Russiantown." Chris P. Jensen is city engineer.

The finance committee of the city council of Los Angeles, Cal., has recomended that $3,675 be appropriated for protecting the outlets of two storm sewers reported in a dangerous condition from recent storm waters in the Los Angeles River bed.

The city trustees of Sisson, Cal., have adopted a resolution of intention to construct a sewer system for district No. 1, embracing all that territory in the city of Sisson bounded by Alma St. on the north, Cold Creek channel on the south, city limits on the east, and the railroad tracks on the west. Harvey J. Starter is city engineer.

Plans are about completed for the construction of the High St. sewer, Oakland, Cal., extending from the tidal canal to the Rose Park tract, a distance of more than two miles. The sewer will be 20 in. in diameter. Frank Thompson is city clerk. Fred C. Turner is city engineer.

Colorado.

⦿The board of public works of Denver, Colo., has awarded the contract for the construction of a sewer in sub-district No. 3, of East Side Sanitary Sewer district No. 1, to the Denver & Pueblo Construction Co., for $16,103. Other bids received are as follows: Dillon Stone Co., $16,145; National Construction Co., $16,654; Municipal Construction Co., $16,947; S. M. Kerns, $17,082, and the Gaffey & Keefe Construction Co., $17,781.

Preparations are being made to open bids for the construction of a modern sewerage plant at Fort Logan, costing approximately $40,000. Capt. Chase Doster, quartermaster, will have charge of the award of the contract and supervision of the work

Connecticut.

The city of Bridgeport, Conn., contemplates installing the sewer system for which plans were made about three years ago by Civil Engineer Rudolph Herring, 170 Broadway, New York City. Mr. Herring recently visited Bridgeport to confer with the city officials in regard to the system. It is planned to construct the system at the expenditure of about $100,000 at a time.

Georgia.

The bond commission and the sewer committee of the city council of Atlanta, Ga., are considering a plan to extend eight of the most important trunk sewers in Atlanta to the city limits as trunk sewers, instead of intercepting sewers. The sewers, which it is proposed to extend, are as follows: From Highland Ave. to Tenth St., a distance of about a mile, cost $130,030; Butler St. to Highland Ave., about one-quarter of a mile, $51,600; Orme St. to the Southern railroad, about a mile, $111,760; South Blvd. to Oremwood Ave., about three-quarters of a mile, $30,600; Capitol Ave. to the Atlanta and West Point belt line, about one-half a mile, $73,200; in West End, from Greensferry Ave. to the Louisville and Nashville railroad, about a mile, $41,250; Proctor creek extension, from Ashby St. to the L. & N. railroad, about one-fourth of a mile, $67,900. R. M. Clayton is chief engineer of construction.

Idaho.

✣Bids will be received until 8 p. m., March 9, by City Council of Pocatello, Ida., for the construction of trunk sewers in accordance with plans and specifications on file in the offices of Herring & Fuller, Engineers, New York, and W. A. Samms, City Engineer, Pocatello, Idaho.

Illinois.

✣Bids will be received until 11 a. m., March 3, by the Department of Public Works, Chicago, Ill., for furnishing and delivering to the various sewer pipe yards Portland and natural cement during the term ending December 31, 1911. B. J. Mullaney is Commissioner of Public Works.

[illegible] tract by the sewer committee of the city council of Paris, Ill., for furnishing and laying approximately 710 ft. of 36-in. and 3,834 ft of 60-in. reinforced concrete or brick sewer with 10 manholes, for $14,980. Bids were opened Feb. 23, by Granville Jenkins, chairman of committee.

⦿The contract for constructing the new outlet sewer for La Grange, Ill., was awarded to H. McNichols, 217 La Salle St., Chicago, Ill., for $95,107.

The board of local improvements of Galva, Ill., has recommended the installation of a sewer system. Civil Engineer W. S. Shields, 140

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Dearborn St., Chicago, Ill., recently addressed a mass meeting of citizens regarding the pro[illegible]

Indiana.

✣[illegible] Raymond St. to Belt R. R.

✣Bids will be received until 10 a. m., March [illegible] Ind., for the construction of a local sewer in and along the alley north of Roosevelt Ave. and alley west of Rural St., from Bloyd Ave. to Roosevelt Ave.

✣[illegible] 1, by Board of Public Works, Indianapolis, Ind., for the construction of a sewer in and along the alley north of 32d St., from Clifton St. to Barnes Ave.

✣Bids will be received until 10 a. m., March 1, by Board of Public Works, Indianapolis, Ind., for the construction of a local sewer in and along Olive St., from Palmert St. to Minnesota St.

✣Bids will be received until 8 p. m., March 13, by Trustees of the town of Woodruff Place, Ind., for the collection and removal of ashes and garbage. Carrol E. Swaine is Town Clerk.

✣Bids will be received until 7:30 a. m., March 13, by Common Council of Lebanon, Ind., for the graveling, sewering, etc., of Baronne St. Edmund Connor is City Clerk.

⦿Henning, Vineyard Co., Evansville, Ind., has been awarded the contract by the town of Mt. Vernon, Iowa, for sewer work comprising 7⅓ miles of sanitary sewers, 6 to 15-in. pipe, with all accessories, and a septic tank and filter beds, for $28,540. Iowa Engineering Co., Clinton, Ia., Engineers. Wm. E. Gamble, City Clerk. Bids were opened Feb. 22

⦿The board of trustees of Bloomfield, Ind., has awarded the contract for an addition to the sanitary sewer system to Daniel Hunter, for $2,595. The sewer will be extended along some of the principal streets, including two sides of the public square.

The city of South Bend, Ind., plans the construction of a number of sewers during this year, which will cost approximately $300,000. William S. Moore is city engineer.

City Engineer Frank Randall of Fort Wayne, Ind., has forwarded to Supt. Carroll of the Indiana school plans for changing the sewer system from the point on the Maumee below the city. The cost will be in the neighborhood of $1,000.

Iowa.

The city council of Clinton, Ia., is working on the preliminaries of an extensive system of lateral sewers. The plans include a sewer on Second St., the main business thoroughfare of the city. R. C. Hart is city engineer.

The city council of Manning, Ia., has secured the services of a surveyor to make the preliminary plans for a complete sewer system for the city.

Plans and specifications are being completed by Engineer Sam Steigerwald, 327 Sixth St., Boone, Ia., for the construction of a sanitary sewer and disposal plant for Nevada, Ia., estimated to cost $40,000. The work will be ready for advertising about April 1.

The Cascade, Ia., city council has let the contract to make the survey for the proposed sewer system in the business section of the city to R. S. Chase of Clinton. A survey of the entire town is to be taken in order that future extensions of the system may be made. It is proposed at present to install about 4,000 ft. running through the alleys of the main business section of the town.

[illegible] of Belle Plaine, Ia., will be asked to vote on the proposition of whether or not bonds for $10,000 shall be issued and the proceeds used to install a sewage system.

A sewer system is to be installed in the city of Indianola, Ia., consisting of a disposal [illegible] sewers of 12 and 30 ins. in diameter. Clint L. Price is mayor. W. A. Graves is city clerk.

The city council of Davenport, Ia., has been petitioned by the property owners on Vernon, Franklin and Fourth Sts., for the establishment of a sewer district. The council has appointed H. G. Vollmer of Burlington as engineer.

Kansas.

Guy Hall, city engineer of Abilene, Kan., has presented plans and specifications to the city council for the construction of a storm sewer of concrete to the river. The work will be advertised at once.

Petitions have been circulated for a new sanitary sewer district in the south part of Wichita, Kan. The petitions ask the city commissioners to establish a new sanitary sewer district south of Harry St., with an outlet into the present main sewer at Levy St.

Louisiana.

The board of sewer commissioners of the first sewerage district, Lake Charles, La., will receive bids until 8 p. m., March 11, for the issuance of $125,000 of bonds for sewer purposes. As soon as bonds are sold the work will be advertised. Walter G. Kirkpatrick of Jackson, Miss., Engineer.

Plans are being prepared by I. W. Sylvester, Alexandria, La., for the construction of a sewer system in Donaldsonville, La. Clem Mollen is City Clerk.

Plans are being prepared by C. M. Robinson of Mansfield, La., for the construction of a sewer system for that city. W. E. Singleton is City Clerk.

Maryland.

✣Bids will be received until 1:30 p. m., March 20, by Constructing Quartermaster, Fort Washington, Md., for the construction of 8-in. sewer and sewer outlet and iron outfall. R. H. C. Kelton, Captain, is Constructing Quartermaster.

✣Bids will be received until 11 a. m., March 15, by Board of Awards, Baltimore, Md., for building storm water drains, Storm Water Contract No. 12, as shown on plans on file at the office of Calvin W. Hendrick, Chief Engineer Sewerage Commission. A certified check for $3,000 must be filed with each bid. The work includes the following approximate quantities: 1,270 ft. 87-in. horseshoe drain, 450 ft. 14'x7'6" rectangular drain, 28 ft. 96-in. horseshoe drain, 1,640 ft. 36-in. to 30-in. concrete and brick drains, 4,100 ft. 24-in. to 15-in. T. C. pipe drains, 1,690 ft. inlet connections, 71 inlets, 39 manholes, 2,875 cu. yds. concrete, 230 cu. yds. brick masonry, 110,000 lbs. steel reinforcement.

Michigan.

⦿Julius Porath, of Detroit, Mich., has been awarded the contract in Wyandotte, Mich., for the construction of the sewer extensions in West and South Wyandotte. The city recently voted the issuance of bonds to the amount of $68,000 for this improvement.

Minnesota.

⦿O'Neil & Preston, East Sixth St., St. Paul, Minn., have been awarded the contract by the board of public works of that city for the construction of a sewer on portions of a number of streets in the city to be known as the St. Anthony Park North Sewer System, for $91,400. The sewer will be about seven miles long. Bids were opened Feb. 20.

The city council of Virginia, Minn., has approved the plans and specifications for a trunk line sewer to cover nine blocks in the southern part of the city. Bids for this work will be advertised for immediately.

Albert Zimmerman, city plumbing inspector, Minneapolis, Minn., has recommended to the city council, the installation of an entire new sewer system on Nicollet island.

The board of public works of St. Paul, Minn., recently received the following bids for the construction of the Otis Ave. sewer: J. J. Connolly, $6,816; John Lind, $8,000; P. J. Ryan, $9,127; Thornton Bros., $9,427; O'Neil & Preston, $9,999. The contract has not as yet been awarded.

Mississipi.

The mayor and board of alderman of Brookhaven, Miss., have accepted the proposition of Civil Engineer R. C. Huston of Memphis, Tenn., to make a survey and prepare plans for a system of sewers for Brookhaven.

Missouri.

Consulting Engineer Hiram Phillips, Third National Bank Bldg., St. Louis, Mo., will prepare plans and estimates for a system of sewers for Unionville, Mo., estimated as follows: Trunk sewer, $20,000; district sewers $10,000.

The board of public works of St. Joseph, Mo., had instructed the city engineer to prepare estimates and report on the advisability of constructing a 36-in. sewer in 18th St., from Garfield Ave. to Commercial St., to connect with the new Whitehead sewer.

The civil service board of Kansas City, Mo., has employed Paul M'Geehan, 4323 Charlotte St., Kansas City, as engineer to supervise the construction of sewers.

The board of public improvements of St. Louis, Mo., recently received the following low bids for the construction of the River Des Peres sewer from the western city limits north of Forest Park, to its connection with the Pine St. sewer. First section, R. D. Salisbury, $18,079; second section, W. Riley, $21,960; third section, $27,259, and the pumping station, Reeves & Skinner, $4,776.

A number of citizens of Cameron, Mo., have asked the city council to order a special election to vote upon the installation of a system of sewers in Cameron.

⦿The board of public works of St. Joseph, Mo., has awarded the following contracts for the construction of district sewers: John Marnell, two contracts, $.95 for 10-in. sewer pipe, and the other at $.98; D. B. Kelly, one contract, $.84 for 10-in. pipe, and $.94 for 12-in. pipe; E. F. Mignery, one contract, $.67½ and $.77½, respectively.

Nebraska.

The city engineer of Omaha, Neb., is preparing plans and specifications for a sewer to drain what is known as the "bottoms." The plans call for a rectangular sewer 10 ft. wide and 4½ ft. high. The terminus will be in the neighborhood of 11th and Webster Sts. The sewer will drain all that part of Omaha east of Sherman Ave., and lying between Webster St. on the south, and Pratt St. on the north. The estimated cost of the improvement is $100,000.

City Engineer Charles Shannon of Nebraska City, Neb., has completed the plans for the sanitary sewer covering the south and western portions of the city and has submitted the same to city council. The estimated cost of the system is $80,000.

New Jersey.

✣Bids will be received until 8 p. m., March 7, by City Council, Bridgeton, N. J., for furnishing necessary labor and material for the complete construction of a sewage disposal works and pumping station, including the necessary piping, grading, etc., together with two cast iron outfall pipes and cast iron river crossing. Jacob B. Jones is City Clerk.

Plans have been prepared by McClare & McClare of Cliffside, N. J., for the construction of new sewers for that town, estimated to cost $80,000. The plans have been submitted to the state board of health for its approval. An election will be held to vote on the sewer proposition. The work will include main line, laterals, and disposal plant. It will be three or four months before the town will be ready to advertise for bids for this work. S. Wood McClare is Mayor.

New Mexico.

The city council of Las Vegas, N. Mex., has adopted a resolution approving and adopting the report of the Citizens' sewer committee and ordering that maps and specifications and estimates of cost of sewer constructon in the district recommended by the committee be prepared.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

New York.

City Engineer [illegible] W. Sayles of Watertown, N. Y., is working on the plans for the north side trunk sewer, which, when completed, will extend from the East plant of the Brake shop nearly to the county home.

An ordinance has been introduced in the common council of Binghamton, N. Y., declaring its intention to construct a sewer in Seminary Ave., from Laurel Ave. to the Fourth ward sewer, a distance of 1,500 ft.

The village trustees of Yorkville, N. Y. recently received the following bids for the construction of sewers in the village: Samuel Bonn, Syracuse, $21,000; C. T. Hookway, Syracuse, $24,000; J. W. Johnston, Utica, no lump sum given; Haden & Corbin, Oxford, $23,970; A. T. Darrow, Canandaigua, $25,182; Frank George & Co., Rome, $23,302; Albert Gaffney, Syracuse, $23,239; Eddy & Colonglo, Rome, $18,108; J. B. O'Rourke & Co., Boston, no lump sum given; Antonio Reinzo, Rome, $24,545. The estimated cost of the work was $16,000 or $17,000. The work will be awarded to the lowest bidder. W. G. Stone, Utica, N. Y., Engineer.

Thomas Holahan, at $147,980, was the low bidder for the construction of the first section of the new sewage disposal system for Rochester, N. Y., for which bids were received by the board of contract and supply, Feb. 15. The first section of the system, the Kulchling plan, begins at North Water St. and Central Ave., tunnels beneath the river, proceeds to Mill St., and thence northerly nearly a mile to the northern side of the R. W. and O. bridge, across the river.

North Carolina.

Plans have been prepared by Hazlehurst & Anderson, engineers, Wilmington, N. C., for the construction of new sewers in that city, estimated to cost between $150,000 and $200,000. The contract for the construction of these sewers will be let as soon as the plans have been adopted by the board of health. R. C. Cantwell of the water and sewerage commission of Wilmington has charge of the work.

Ohio.

✤Bids will be received until noon, March 21, by John Hinterschied, Clerk of the village of Grandview Heights, Franklin County, O., for the necessary labor and material for the construction of a sewer system within the village.

The department of public service, Cleveland, O., recently received the following low bids for the construction of sewers: William Lehmann, W. 25th St., sewer, $27,880; Hoag & Zullo, E. 93rd St., sewer, $21,[illegible]

The city council of Struthers, O., has sold bonds to the amount of $2,500 to the Security Savings & Trust Co., of Toledo, O., for sewerage purposes.

Oklahoma.

The citizens of Oklahoma City, Okla., have voted against the proposition of issuing bonds to the amount of $125,000 for the extension of the sewerage system to Capitol Hill and adjoining properties. It is probable that another election will be called shortly. Dan. V. Lackey is mayor. Bob Parman is city clerk.

A bond election will be called in the near future at Britton, Okla., to vote on the issuance of bonds [illegible] $20,000 to provide [illegible] water and sewer systems for the College Park addition [illegible] town.

Oregon.

The city council of Forest Grove, Ore., has engaged Stannard & Richardson of Portland, Ore., as engineers to make estimates and maps for the sewerage system to be installed during the summer.

The city council of Pendleton, Ore., has adopted resolutions to extend the outlet of the Pendleton sewer system one mile southwesterly of the present outlet.

Pennsylvania.

A bill has been introduced in the House of Representatives, Harrisburg, Pa., by Representative William Conner of Braddock, which appropriates $100,000 for deepening, straightening, widening and otherwise improving Turtle Creek from the western boundary line of Westmoreland county, to its mouth at the Monongahela River. Retaining walls are to be constructed if necessary, and there is provision for dredging and removal of obstruction from the bed of the stream.

The voters of Carlisle, Pa., have voted to authorize the proposed increase of the bonded indebtedness of the borough in the sum of $99,000 for the purpose of constructing a sewer system. Election was held Feb. 21.

The city council of North Wales, Pa., is considering plans for a new sewer system.

Dr. Samuel G. Dixon, state commissioner of health, Harrisburg, Pa., has given the city of Glassport, Pa., permission to construct two sewers in Ohio Ave., from Plum Ave. to Broadway, and in Fifth Ave., to Third Ave.

South Dakota.

The citizens of Wessington Springs, S. Dak., are agitating the construction of a sewer system. It is probable that the matter of voting bonds for the purpose will be submitted to the voters at the regular municipal election in the spring.

Texas.

✤Bids will be received until March 15, by D. L. Wilson, City Secretary, Cameron, Tex., for the construction of a sewer system in that place.

⊙The city commissioners of Dallas, Tex., have awarded the contract for the construction of the sanitary sewer through South Dallas, to John C. Underwood, for approximately $32,000. This provides for the 24-in. main that is to extend from the Trinity River to Fourth Ave., with branches to Nellie, Carl,

The Texas City Sewerage Co., Texas City, Tex., has been incorporated with a capital stock of $50,000. The incorporators are: William Dorsett, R. C. Trube, F. N. Danforth, Clyde Amburn and Harver A. Thomas.

Jeffries and Warren.

The sewer system of Cleburne, Tex., which is owned by a private corporation, will be extended to several sections of the city that are now without sewerage connections.

The attorney general at Austin, Tex., has approved the city of Fort Worth's bond issue of $2,000,000. The bond issue carries $95,000 for fire halls and sites; $120,000 for storm sewers; $35,000 for police stations and sites; $165,000 for streets; $50,000 for city warehouses; [illegible] funding debt of water works, and $1,350,000 for surface reservoir and other water works improvements.

The municipal commission of Dallas, Tex., has instructed the city secretary to advertise for bids for laying a storm sewer in South Harwood St., from Jackson St. to Grand Ave. The estimated cost is $14,020.

Virginia.

The city of [illegible], Va., [illegible] to the amount of $15,000 for the [illegible] of a sewer system, which was voted upon Dec. 6. H. F. Barrow [illegible] finance committee.

Wisconsin.

✤Bids will be received until [illegible] March 7, by Committee on Streets and Alleys, Board of Public Works, City of Evansville, Wis., for the construction of sanitary sewers and appurtenances: The work comprises approximately: 7,936 lin. ft. of 8-in. sewer, 5,941 lin. ft. of 10-in. sewer, 450 lin. ft. of 12-in. sewer, 223 lin. ft. of 15-in. sewer, 3,302 lin. ft. of 18-in. sewer, 42 manholes, 2 septic tanks and inverted siphon. All proposals must be accompanied with cash to the amount of $1,000, or a certified check for that sum made payable to the order of the city treasurer.

✤Bids will be received until 8 p. m., March 7, by City of Shawano, Wis., for the construction of main and minor sewers, manholes and catch basins, in system of sewerage in Sewer District No. 1 and Sewer District No. 2. D. E. Wescott is City Clerk.

Plans and specifications are being prepared by the Oscar Claussen Engineering Co., 514-515 Nat. Ger. Am. Bank Bldg., St. Paul, Minn., for the construction of a sewer system for Prescott, Wis. This system will not be installed at the present time.

West Virginia.

•Bids will be received until March 21, at 8 p. m., by city of Moundville, W. Va., for the construction of new sewers in that place estimated to cost $166,900. C. F. Collins is Engineer.

Canada.

✤Bids will be received until 6 p. m., March 20, by J. W. Breakey, Sec.-Treas. Souris, Man., for the following work to be done during the season of 1911: Excavation, laying and back filling for approximately 31,500 ft. of Standard Vitrified Sewer Pipe (8-in. to 20-in.), and all necessary tees, wyes, etc. Excavation, laying and back filling for approximately 31,500 ft. of Standard cast iron water pipe (4 in. to 12 in.), and all necessary tees, reducers, etc., also setting gate valves and valve boxes. Excavation, setting and back filling for 70 Standard fire hydrants. Construction of approximately 75 manholes, and setting covers and frames of same. The construction of a brick building, 60 ft. by 40 ft. by 14 ft., on concrete foundation, together with all necessary machinery, consisting of compression tanks, gasoline engines and pumps, etc. Interested parties desiring to tender on any or all of the above work can obtain further information and forms for tender by applying to the Town Engineer or Secretary-Treasurer. Plans, profiles and specification may be seen at the office of V. H. Williams, Town Engineer, Souris, Manitoba.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

Bids were received Feb. 20 by Maj. Wm. W. Harts, Corps of Engineers, U. S. Army, Nashville, Tenn., for furnishing and delivering the machinery, fittings, etc., for the dredge boat "Tishamingo." The bid of the Vulcan Steam Shovel Co., Toledo, O., of $16,225, was recommended for acceptance.

The Alabama Power Development Co., R. A. Mitchell, President, Gadsden, Ala., is planning extensive improvements. Engineers from New York have been going over the plans, which are said to call for establishment of a plant at Jackson shoals on the Choccolocco Creek to furnish power for the cities [illegible]

California.

[illegible] lic works, the finance committee recommended to the city council, Los Angeles, Cal., that $4,200 be appropriated for purchasing a drill for testing the bottom of the inner harbor [illegible] Angeles.

The Oakland Gas Light & Heat Co., Oakland, is to expend $100,000 for laying hot water and steam pipes in Oakland. The material is said to have already been ordered.

✤ indicates work now open for bids. • indicates a contract let recently.

[illegible] odore A. Crane Sons Co., Brooklyn, N. Y., were recently at Los Angeles, Cal., inspecting property at the Los Angeles Harbor, San Pedro, with a view, it is said, of securing a location for a dry dock to be located at that point.

District of Columbia.

✣Bids will be received until 10:30 a. m., [illegible] by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for Rack Railway material for the Panama Canal Locks including: Track, steel crossties, bolts and nuts, tie clips, washers, steel channels, rail bonds, copper conductor rails, steel conductor rails, insulators, dumpers, frogs, switches, etc.

Indiana.

✣Bids will be received until 10 a. m., March 3, by Board of Public Works, Indianapolis, Ind., for the construction of fire escapes and porches for the city hospital.

✣Bids will be received until 10 a. m., March 9, by Trustee B. F. Hubbard, Noble township, Wabash County, Wabash, Ind., for the construction of a 6-room high school building.

✣Bids will be received until March 10, by Trustee John Hess, Driftwood township, Jackson County, at Vallonia, Ind., for the construction of two brick school houses.

Kentucky.

Bids were opened Feb. 20, by Maj. H. Jervey, U. S. Engineers, Cincinnati, O., for constructing Lock and Dam No. 29, Ohio River near Ashland, Ky., the bids being as follows: (1) standing for bid of Dravo Contracting Co., Pittsburg, Pa., (2) for Bates & Rogers Construction Co., Chicago, Ill., and (3) for the Sheridan-Kirk Contract Co., Cincinnati, O.:

Items.	Designation.	Quantity	(1)	(2)	(3)
Cofferdam, 16-ft.	lin. ft.	4,200	$ 30.00	$ 26.90	$ 20.00
Cofferdam, 10-ft.	lin. ft.	1,600	15.00	16.40	15.00
Common excavation	cu. yds.	93,681	1.00	.70	.60
Rock excavation	cu. yds	4,155	4.50	3.75	5.00
Fill	cu. yds	19,935	.20	.45	.60
Riprap	cu. yds.	2,500	4.00	3.75	5.00
Oak timber	M. ft. B.M.	69.3	110.00	90.00	100.00
Reinforced concrete	cu. yds.	130	15.00	13.45	15.00
Concrete	cu. yds.	36,868	7.00	7.10	8.00
Concrete paving	cu. yds.	1,200	7.00	7.50	10.00
Structural steel	pound	1,024,884	.07	.0725	.065
Reinforcing rods	pound	21,353	.07	.045	.055
Forgings (include W. I.)	pound.	56,582	07	.139	07
Bolts, etc.	pound.	73,808	07	078	055
Iron castings	pound	277,887	.07	.122	05
Steel castings	pound.	183,506	09	.145	10
Bronze	pound	1,170	.80	.75	1.00
Pipe, 5"	lin ft	370	3.00	1.85	2.00
Pipe, 4"	lin. ft.	2,400	2.00	1.35	1.50
Pipe, 3"	lin. ft.	770	1.50	1.35	1.00
Pipe, 2½"	lin. ft.	750	1.00	.75	80
Pipe, 2"	lin ft	800	.75	65	60
Tile drain	lin ft	850	.50	.65	80
Drilling bolt holes	lin. ft.	4,900	.50	75	75
Totals			$682,674	$677,[illegible]	$644,842

Louisiana.

⊙J. E. Gibson Construction Co., Webb City, Mo., at $156,796, has been awarded the general contract for the construction of a 2-story and basement fireproof court house at Lake Charles, La. Bids were opened Feb. 17 by the Architects, Favrot & Livaudais, Ltd., 839 Gravier St., New Orleans, La.

Bids as follows were received Feb. 21 by the Board of Commissioners of New Orleans, La., for the steel and iron work for the new W. A. Kernaghan wharf shed to be erected from Terpsichore to Market St., New Orleans; the first figures are the bid per lb. of steel, the second the bid per lb. of cast iron, and the third the number of days to complete the work: H. F. Grimm, New Orleans, 2.93 cts., 2.93 cts., 205 days; McClintic Marshall Construction Co., Pittsburg, 2.87 cts., 2.87 cts., 130 days; Virginia Bridge & Iron Co., Memphis, 2.79, 2.79, 130 days; Louisiana Bridge Co., New Orleans, 3.12, 2.84, 127 days; Elkhart Bridge & Iron Co., Elkhart, Ind., 2.97, 3.50, 400 days; Massillon Bridge & Structural Co., Massillon, O., 2.90, 3.20, 150 days; Indiana Bridge Co., Indianapolis, Ind., 2.85, 4, 160 days; Central States Bridge Co., St. Louis, 2.72, 3.55, 135 days; Toledo Bridge & Crane Co., Toledo, O., 3.17, [illegible] days; Schatter Manufacturing Co., Birmingham, 3.23, 2.65, 210 days; Van Dorn Iron Works, New Orleans, 3.25, 5, 250 days; Moravia Construction Co., Chicago, 2.76, 3, 110 days; Joliet Bridge & Iron Co., Joliet, Ill., 3.06, 3.60, 325 days; Midland Bridge Co., 3, 3, 240 days; Noelke-Richards Iron Works, Indianapolis, 2.87, 3.75, 120 days; Fort Pitt Bridge Co., Pittsburg, 2.6, 2.6, 120 days. It is estimated that the steel portion of the wharf will cost about $100,000.

The following bids were received Feb. 21 by the Board of Port Commissioners of New Orleans, La., for the new wharf at the immigration station; the first figures are the bid for piling, the second the bid for lumber and the third the time of executing the contract: Eskard & Alexander, 9½ cts., $13.25, 60 days; A. L. Patterson, 21 cts., $10, 40 days; Doullut & Williams, 8½ cts., $16, 45 days; W. M. Wren, 12 cts., $17, 40 days.

Michigan.

✣Bids will be received until 3 p. m., March 31, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Ionia, Mich.

The Reid Wrecking Co., of Port Huron, Mich., will at once commence the construction of a 600 ft. addition to its drydock in Port Huron.

City Council of Marquette, Mich., has authorized the light and power commission to submit to the electors a proposition to bond the city for $100,000 to build two new dams on the Dead River to increase water power of the public light and power system

Minnesota.

✣Bids will be received until noon, March 15, by Ramsey County Board of Control, St. Paul, Minn., for the excavation, grading of lots and erection of a laundry building and other work. Clarence H. Johnston is Architect. Oliver J. Tong is Secretary of the County Board.

The principal equipment for the new power station of the Minneapolis General Electric Co., at Minneapolis, to replace the station destroyed by fire on Jan. 7, 1911, has been ordered by the Stone & Webster Engineering Corporation, Boston, Mass., who have charge of the design and construction. There will be two 6,000 kw. Allis Chalmers turbo-generators generating current at 2,300 volts, which will be stepped up to 13,000 volts by 2,500 kw. Allis Chalmers transformers of which six will be installed. The boiler equipment consists of ten 600 hp. Babcok & Wilcox boilers supplying steam at 180 lbs. working pressure. The steam will be superheated to 125° by Foster superheaters. The turbine room will be supplied with a 4-motor Cleveland Crane & Engineering Co., traveling crane with a 60-ton main hoist and a 15-ton auxiliary hoist. The building will be of steel frame and brick construction and the stacks will be of steel.

Missouri.

The city of Kansas City, Mo., is to expend $75,000 for the construction of a wharf and warehouse on the river front. The wharf will cost about $50,000 and will require about 475 55-ft. creosoted pine poles. Louis R. Ash is City Engineer of Kansas City.

Nebraska.

✣Bids will be received until 3 p. m., March 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the low pressure steam heating apparatus in the United States Post Office at Plattsmouth, Nebr.

✣Bids will be received until 3 p. m., March 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for a conduit and wiring system in the U. S. Post Office at Plattsmouth, Nebr.

✣Bids will be received until 3 p. m., March 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for a plumbing and drainage system at the United States Post Office, Plattsmouth, Nebr.

New Hampshire.

⊙S. F. Bowser & Co., Fort Wayne, Ind., at $1,980, has been awarded the contract for six oil tanks with pumps, meters, gauges, piping, etc., for the U. S. Navy Yard, Portsmouth, N. H. Bids were opened Feb. 11 by the Bureau of Yards and Docks, Washington, D. C.

New Jersey.

✣Bids will be received until 3:30 p. m., March 7, by A. Church, Secy., Essex County Park Commission, Newark, N. J., for grading at Weequahic Park Addition, to include 50,000 cu. yds. of excavation. A certified check for $500 payable to the commission must be filed with each bid. Plans and specifications can be obtained of the engineer, 60 Clifton Ave., Newark, N. J.

⊙Walter Bryant has been awarded the contract for enlarging the lake on the property of H. J. Foskett at Bernardsville, N. J.

New York.

✣Bids are asked until noon, March 15, as noted in our last issue, by Col. W. M. Black, U. S. Engineer, Room 710, 39 Whitehall St., New York, for dredging and rock removal in Bronx River, N. Y., at East Chester Creek, N. Y. The work to be done in Bronx River calls for the removal of about 185 cu. yds. of ledge rock to secure a depth of 6 ft. and about 28,000 cu. yds. of other material to secure a depth of 4 ft. The work at East Chester Creek calls for the removal of about 1,500 cu. yds. of ledge rock to secure a depth of 6 ft. at mean low water, and about 25,000 cu. yds. of other material than ledge rock to secure a depth of 5 ft. at mean low water.

The State Water Supply Commission, Albany, N. Y., has adopted a report of its Consulting Engineer, Walter McCulloh, on the regulation of the flow of the upper Hudson River. The report recommended the construction of a storage reservoir on the Sacandaga River, with a dam at Conklingville, which would impound 29,000,000,000 cu. ft of water at an estimated cost of $4,650,000 The commission directed the engineer to complete the maps, plans, specifications, estimates and lists, together with such information as may aid the commission in determining the percentage of the cost to be borne by the various counties, cities, towns and villages and by the individual properties benefited.

Ohio.

The contract for the necessary labor and material for the construction and completion of an inter-communicative system of telephones for the Girls' Industrial Home, Delaware, O., for which bids were opened Feb. 16 by the board of trustees, S. D. Webb secretary, has not been let.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Pennsylvania.

✣Bids will be received until noon, March 6, by Department of Wharves, Docks and Ferries, 555 Bourse Bldg., Philadelphia, Pa., for the furnishing of 1 deck and coal scow, Schedule "A"; for 1 still leg derrick to be furnished and erected on board deck scow belonging to the department, Schedule "B." Specifications and blank forms upon which bids must be made can be obtained upon application to the office of the Department of Wharves, Docks and Ferries, 555 Bourse Bldg., Philadelphia. No bid will be considered unless accompanied by a certificate from the City Solicitor of the city of Philadelphia that the provisions of an ordinance requiring proposal bonds on all bids exceeding in amount $500. Joseph F. Hasskarl is Acting Director of the Department.

Tennessee.

✣Bids will be received until noon, March 22, by Capt. Clarke S. Smith, U. S. Engineer, 20 Custom House, Memphis, Tenn., for furnishing 40,000 cu. yds of rip rap stone delivered on Government barges and on contractor's barges. Official advertisement will be found elsewhere in this issue.

Texas.

The city of Corpus Christie, Tex., will vote on March 16 on issuing $50,000 of bonds for constructing a municipal wharf.

The Southern Pacific Co. is contemplating a number of improvements to its terminal facilities at Galveston, Tex. these including the rebuilding of Pier C., which was destroyed by fire last fall.

Utah.

H. A. Strauss, vice president and chief engineer, Falkenau Electrical Construction Co., Chicago, Ill., has been appointed consulting engineer of the Merchants' Light & Power Co. of Ogden, Utah., to design a complete system for electric lighting and power for the city of Ogden, Utah. The Merchants' Light & Power Co. has recently been granted broad and general franchises covering the entire city of Ogden, and has obtained the city contract for arc lighting.

Washington.

◉The Stone & Webster Engineering Corporation has awarded a contract to the Willamette Iron & Steel Works, Portland, Ore., for the pipe for the two main lines for the hydro-electric plant being erected by Stone & Webster at Beringer, Wash., for the Pacific Coast Power Co. The pipe lines will be 2,116 ft. long each, and will have a diameter of 8 ft. at the forebay and 6½ ft. at the wheel. The contract for a third pipe line 24 ins. in diameter was also let to the above firm.

Wyoming.

✣Bids will be received until 3 p. m., March 21, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the basement excavation and filling of tunnels under the site of the United States Post Office at Rock Springs, Wyo.

The Wyopo Pipe Line Co. has filed its articles of incorporation with a capital stock of $10,000,000 and according to the incorporators will engage in the immediate construction of pipe lines for the conveyance of oil from central Wyoming fields to the railroad, and ultimately will build pipe lines from these fields to Omaha and Denver to compete with the Standard Oil Company. The incorporators are Colonel E. H. Power of London, England; former Governor Fennimore Chatterton, of Cheyenne, and George S. Walker. The backing is English capital and it is said the plans in full already have been successfully underwritten. The company's first work will be to construct a pipe line 66 miles in length from the Lander oil field to the Burlington at Boneville, thus giving this oil an outlet to northwestern markets, and the construction of a second pipe line 50 miles in length from the Salt Creek field to the Chicago & Northwestern between Casper and Orin Junction. The trunk lines planned for later construction will include stations at a majority of important Nebraska and northern Colorado towns en route.

Canada.

✣Bids will be received until noon, March 6, by Storey & Van Egmond, Architects, Regina and Saskatoon, Sask., for the erection of a bank and office building at Regina for the Bank of Ottawa.

✣Bids will be received until noon, April 4, by Board of Control, Toronto, Can., for delivery of 1,340 tons of open hearth steel rail, 80 lb. sections; also 30,000 untreated wood ties, white cedar preferred, although other woods considered. Official advertisement will be found elsewhere in this issue.

STORAGE DAM.

Salt Lake City, Utah.

Sealed proposals will be received by the Pacific Reclamation Company, at the office of their Consulting Engineer, George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah, until noon of Saturday, April 15, 1911 for the construction of a Storage Dam about fifteen miles north of Wells, Nevada.

The dam will be of earth and rock fill with a reinforned concrete facing on the up-stream side. The principal quantities are:

20,000 cu. yds. earth excavation.
3,000 cu. yds. rock excavation.
71,000 cu. yds. earth embankment.
6,000 cu. yds. dry rubble wall.
1,250 cu. yds. Portland cement concrete.
85,000 lbs. steel reinforcing.

A certified check for $2,500.00 must accompany the bid, and a bond of $15,000.00 will be required for the faithful performance of the contract.

Form of proposal, contract and specifications may be had by applying to George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah.

PACIFIC RECLAMATION COMPANY,
Joseph Gutman, President.
George M. Bacon,
Consulting Engineer.

BRIDGES.

Sealed proposals will be received by the Board of County Commissioners of Clay County, South Dakota, up to 2 p. m., March 22, 1911, at the office of the County Auditor of Clay County, in Vermillion, S D., for the construction of eight (8) steel or concrete highway bridges for the Vermillion Valley Ditch No. 1, in Clay County, South Dakota.

Requirements and [illegible] may be obtained at the office of the County Auditor of Clay County, South Dakota

Each bid must be accompanied by a certified check for one thousand dollars ($1,000), payable to the order of the Board of County Commissioners, of Clay County, as a guarantee that the bidders will, if successful, promptly execute a [illegible] of the sum of ten thousand dollars ($10,000) for the faithful performance of the work. All bids shall be plainly endorsed, [illegible] tion of bridges over the Vermillion Valley Ditch No. 1.

[illegible] all bids.

[illegible]
County Auditor,
Clay County, South Dakota.
Dated Vermillion, S. D., Feb. 10, 1911.

Sealed proposals will be received until 12 o'clock noon, March 4, 1911, by Drainage Commissioners District No. 10, F. C. Seiler, Secretary, Mt. Carmel, Ill., R. F. D. No. 4, for constructing a drainage ditch. Excavation 90,000 cu. yds.

REINFORCED CONCRETE BRIDGE.

Bids will be received by the City of Ypsilanti, Mich., for a single arch reinforced concrete bridge, at Congress street, in accordance with plans and specifications on file in the office of the City Clerk and the office of Benj. Douglas Consulting Engineer, 814 Ford Bldg., Detroit, Mich.

Bids to be sealed and in the hands of the City Clerk, Ypsilanti, Mich., on or before 10 p. m., March 15, 1911.

Each bid to be accompanied with a certified check in the sum of $1,000.00.

A good and sufficient bond for the faithful performance of the contract will be required of the successful bidder. Also a bond indemnifying the city against all suits, and claims, for labor and material.

Right to reject any and all bids reserved.

Aldermen
FRANK A. NORTON,
ARTHUR AMENT,
WM. McDERMOTT,
A. G. HUSTON,
E. A. MELLENCAMP,
Committee on Bridges.
FRANK JOSLYN, City Clerk

SEWER.

Sealed bids for the construction of a sewerage system at the City of Stoughton, Dane County, Wisconsin, according to plans and specifications now on file with the City Clerk, will be received by the undersigned to the 3d day of March, 1911, at 10 o'clock noon.

Each bidder must submit separate bids as follows:

1. For the main sewers and septic tank
2. For sewerage district No. 1.
3. For sewerage district No. 2.
4. For the entire sewerage system complete.

Each bid must be accompanied with a certified check for 5 per cent of the bid for the entire sewerage system.

The successful bidder must execute a bond to the city of Stoughton in the penal sum of 25 per cent of the bid, to be approved in the manner provided by law, and conditioned for the faithful performance of his contract.

Plans and specifications are on file with the undersigned and specifications may be had upon request.

The right is reserved to reject any and all bids.

L. C. CURRIER.
Clerk of Street Assessment Committee
[illegible] of the City of Stoughton
[illegible]

TENDERS FOR RAIL AND TIES.

CITY OF TORONTO
CIVIC CAR LINES

[illegible] post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, April 4, 1911, for delivery of thirteen hundred and forty (1340) tons of open hearth steel rail, 60-lb. section, also thirty thousand [illegible] considered.

[illegible] be obtained upon application to the office of the City Engineer, Toronto.

The lowest or any tender not necessarily accepted.

G. R. GEARY, Mayor,
Chairman, Board of Control
City Hall, Toronto, February 23, 1911

✣ indicates work now open for bids. ◉ indicates a contraot let recently.

PROPOSAL FOR WATER WORKS.

[illegible] Town of Jonesboro, N. C., until 5 p. m March 13, 1911, for building water works The work will consist of:

[illegible] and 220 tons 8-in. cast iron pipe, together with hydrants and specials.

Laying 4 miles 6-in. and 8-in. pipe and [illegible] tower and tank.

Plans and specifications will be on file at the office of the Clerk in Jonesboro, N C., and at the Engineer's office in Durham, N. C., and copies of the specifications, form of proposal, etc., may be obtained from the Engineers at Durham, N. C.

No bid will be considered unless accompanied by a certified check for Five Hundred ($500.00) Dollars, which will be returned if the bidder executes contract should it be awarded to him.

The right is reserved to reject any or all bids.

D. H. ARNOLD, Mayor.
W. S MURCHISON, Clerk

Engineers:
WHITE & PIATT,
Durham, N. C.

Sealed proposals will be received by the President and Village Board of St Charles, Mich until 7 30 p. m. March 9, 1911, for all machinery and materials of every kind required for power and electric lighting plant, and system of water works, f. o. b. cars St Charles, and delivered on the ground, and for any and all parts of the work, according to plans and specifications therefor now on file in the office of the Village Clerk in St. Charles, and of Geo. C. Morgan and Arthur H Morgan, Engineers, 169 Jackson Blvd., Chicago, where full information can be obtained.

Proposals must be accompanied with certified checks for 5 per cent of the amounts thereof, made payable to F. G Goodrich, Village Treasurer, as a guaranty of good faith.

Proposals must be enclosed in envelopes, sealed and addressed to Hon. Chas. Krause, President, and Village Board, care Mr. C. H. Clipper, Clerk, St. Charles, Mich., and marked plainly "Proposal for ——." with reference to part, division or complete work, bid upon.

Proposal must be delivered to the Village Clerk at his office in St. Charles, on or before the time stated above, when said proposals will be opened publicly by the Board.

The President and Board of said Village reserve the right to accept or reject any and all of said proposals.

By order of the Village Board of St Charles, Mich.

CHAS. KRAUSE, President.
C. H. CLIPPER, Clerk.

MISSISSIPPI RIVER COMMISSION. 1st and 2d Dists., U. S. Engineer Office, Room 20, Custom House, Memphis, Tenn., Feb. 23, 1911.—Sealed proposals for furnishing 40,000 cu. yds. of rip rap stone delivered on government barges and on contractor's barges will be received at this office until noon, Mar. 22, 1911, and then publicly opened. Information on application. CLARKE S. SMOTH, Capt. Engrs.

U. S. ENGINEER OFFICE, Room 325, Custom House, New Orleans, La., Feb. 15, 1911.—Sealed proposals for extending the jetties at Southwest Pass, Mississippi River, will be received at this office until 11 a. m., March 17, 1911, and then publicly opened. Information on application. LANSING H. BEACH, Lt. Col., Engrs.

ARTESIAN WELL.

Sealed proposals will be received by the Regents of Education up to 2 p. m., March 10, 1911, at the office of the Secretary of the University, in Vermillion, South Dakota, for furnishing all materials, tools and appliances, and drilling and constructing an artesian well, approximately 1,500 feet deep, upon the campus of the State University, in the City of Vermillion.

Specifications and forms of proposals may be obtained at the office of the Secretary of the University of South Dakota.

Each bid must be accompanied by a certified check for five hundred dollars ($500.00) payable to the order of Regents of Education, as a guarantee that the bidder will, if successful, promptly execute a satisfactory contract and furnish a bond in the sum of five thousand dollars ($5,000) for the faithful performance of the work. All bids shall be plainly endorsed, stating that bid is for construction of well.

The right is reserved to reject any and all bids.

Dated Vermillion, S. D., Feb. 3, 1911.

IRWIN D. ALDRICH,
Secretary, Regents of Education.

All directions are to be made to C. A. Sloan, Secretary, Vermillion, S. D., and properly marked on outside.

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1—No. 5 K. Gates Crusher.
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5—Morris & Gould 8" Centrifugal Pumps.
3—36 ft. cap. Petler Side Dump Concrete Buckets.

[illegible]

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BOOK REVIEWS [illegible]
PERSONALS [illegible]

A Method for Determining Freight Train Resistance.

Although the question [illegible] has been, since the early days of railroading, a subject of continual study and investigation no very definite results have yet been secured. Many formulas have been proposed, some based on theory and some on experiment, but none of them satisfactory or conclusive. It has been a common experience to secure from formulas equally authoritative widely different results.

Before the time of Wellington it was recognized that train resistance varies not only with the speed, but with the average weight of cars of which the train is composed. This fact, however, has been more or less ignored by many railroads in establishing their tonnage ratings, or has been applied in an arbitrary and inadequate manner. Until Wellington proposed his formula there were no formulas in existence that were generally accepted by engineers and railroad officers as furnishing any sort of a satisfactory basis for determining train resistance. It has long been recognized that the weakness of Wellington's formula lies in the fact that it is not based on a sufficiently wide range of tests.

Since then a great deal of experiment and compilation has been undertaken. Numerous dynamometer tests have been made, but few of them have been subjected to the kind of analysis necessary for making them available for general use. Where analysis has been attempted too much energy has been expended, it would seem, in attempting to give a specific value to air resistance, the most elusive and indeterminate, and at low speed the least importance, of all theresistances to go to make up the total. Grade resistance may be calculated definitely by a simple mathematical process. Curve resistance has been determined within narrow limits by means of dynamometer tests. What is needed, then is a reliable method for determining the resistance of a train running on a straight, level, and well-maintained track. With this determined it is possible to compute train resistance under any conditions of grade or curvature.

During the fall of 1908 and the spring of 1909 a series of tests was made under the supervision of Prof. Edward C. Schmidt, of the University of Illinois, for the purpose of determining the resistance of freight trains operating under normal conditions. These tests were made with trains in ordinary service and over track that is properly constructed and well maintained.

We present in our Steam and Electric Railway Section of this issue the second installment of an abstract of Prof. Schmidt's report, the first installment having appeared in our issue of March 1. This report covers tests made with 32 freight trains, and the data is therefore sufficient to furnish adequate basis for analysis. This data has been subject to careful analysis and interpretation. From them practical formulas have been developed for determining freight train resistance. This report is by far the most important advance that has yet been made in devising a rational method for dealing with this difficult question.

The definite character of the results of these tests is due in great part to the restrictions placed on the conditions. Prof. Schmidt observes that by the use of the final curves, table and equations, "the probable total resistance of entire freight trains at various speeds may safely be predicted, when running upon straight and level track of good construction, during weather when the temperature is above 30° F., and the wind velocity is not [illegible] provided that the average weight of the cars composing the train be known." In tonnage rating correction for ruling grade must be made, with due [illegible]

It is thus [illegible] result is secured in terms of entire train resistance, and that proper consideration is given to the vital question of average car weight.

It w[illegible] tests to temperatures practically above the freezing point. There is needed, therefore, another series of tests to determine resistance under winter conditions, as freezing weather affects train resistance greatly. Abnormally low temperatures bring about abnormal conditions of such a complex nature that it is impossible to estimate their effect and tests under such conditions would be of little value. But a series of tests made in normal winter temperatures would supply a valuable supplement to the tests already made. There would then be available the means for determining resistance of freight trains operating under all normal conditions.

It will be noted that no attempt has been made by Prof. Schmidt to separate train resistance into its component parts.

This, no doubt, is wise, not only on account of the difficulty of securing such a division of the total resistance, but because of its doubtful value as applied to operation, if secured. What the operating officer needs in rating his trains is the total resistance under given conditions. Separate values for journal friction, air resistance, etc., would be interesting in a technical way, but would be at the present time, of little value practically. Referring to the influence of wind velocity, Prof. Schmidt states that the data do not permit this element "to be differentiated from the other elements affecting resistance," but that "they do warrant the conclusion that this influence is small." This statement, no doubt, can be taken as applying only to low wind velocities. Of the magnitude of the resistance due to high wind velocities there can be no question.

The final results of the tests are embodied in formulas which are simply the equations of porabolas so chosen as to correspond closely with curves giving the mean values of the tests. Separate equations are given for average tonnage of cars from 15 tons to 75 tons. In addition to this a general empirical formula is derived expressing the value of the resistance in terms of speed and average car weight. It is stated that this formula, when compared with the results of the tests, results in a maximum error of 9.5 per cent. and that this maximum error occurs when $S = 21$ and $W = 55$.

In applying this method it is undoubtedly best to use the parabolic equation corresponding to the given car weight. But for the sake of comparison, we give below this general formula and two other representative formulas; that of Wellington and the one recommended by the American Railway Engineering and maintenance of Way Association:

Prof. Schmidt's general formula is,—

$$R = \frac{S + 39.6 - 0.031\,W}{1.08 + 0.152\,W}$$

in which R is train resistance in pounds per ton, S is the speed and W is the average weight per car.

Wellington Formula for loaded trains is,—

$$R = 4 + .005\,V^2 + (28 - .3\,N)\frac{V^2}{W}$$

in which R is train resistance in pounds per ton, V is the velocity in miles per hour, N is the number of cars, and W is the weight of the train in tons of 2000 lbs.

The American Railway Engineering and Maintenance of Way Association formula is,—

$$R = 2.2\,T + 121.6\,C,$$

in which R is the total train resistance, T is the total weight of train, and C is the total number of cars.

Wellington's formula is based on tests that would be thought at the present time to be inadequate. The American Railway Engineering and Maintenance of Way Association's formula is an excellent one, but is the result largely of discussion and compilation. Prof. Schmidt's formula, on the contrary, is based on an adequate series of tests made on freight trains operating under normal conditions, and followed by a careful analysis and interpretation.

A Tunnel Distribution Main for the Catskill Water Supply of New York City.

America would compare rather unfavorably with a similar record of European work. To speak more plainly, the great Alpine railway tunnels have no counterparts in America if the measure of length be the standard of comparison. If subaqueous tunnels be compared the positions of Europe and America are fairly reversed. In no European country are there subaqueous railway tunnels at all comparable with those under the Hudson and the East rivers at New York city. In a comparison of tunnel work for other than railway

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[illegible] of subaqueous water supply tunnels for Great Lakes cities, and its Los Angeles, Croton and Catskill aqueduct works.

These comparisons are called to mind by the [illegible] under city tunnel planned to distribute the new Catskill water supply to the five boroughs of New York city. Without doubt this tunnel ranks as one of the most remarkable tunnels of the world. We use the present tense for, although the tunnel is yet to be built, the assurance of its construction is practically certain. The Under City Tunnel will have a length of 18 miles and a diameter decreasing gradually from 15 ft. to 11 ft. It will be the longest continuous rock tunnel in the world. It will have a greater amount of shaft work than any other tunnel. It will be one of the deepest tunnels in the world, if we consider depth as a dimension sought for a definite purpose and not as one resulting incidentally from the configuration of the earth's surface.

With these physical features the Under City Tunnel clearly deserves high rank structurally, but it is quite as notable as a unique form of distribution system. This tunnel is not a conduit like the aqueduct which it continues but is a distributing main. The manner in which it serves this purpose is clearly explained in the article referred to above. Its economy as compared with pipe lines as usually employed is discussed there also. Briefly the tunnel as planned is estimated to cost about one-half the cost of a pipe line distribution system.

A Deep Pneumatic Caisson Foundation.

The foundation work for the new bridge across the Mississippi river at St. Louis, Mo., which is described elsewhere in this issue, is notable chiefly for the great depth to which the caisson for Pier IV was sunk. As will be seen from the description, the depth reached was 108.74 ft. of immersion. This is within a foot of as deep as the east abutment caisson of the Eads bridge which was sunk in 1870, and this foundation is at the present time the deepest ever made by the pneumatic process. The pneumatic foundations exceeding 100 ft. in depth are as follows:

Eads Bridge	109.7 ft.
Municipal Bridge	108.7 ft.
Williamsburg Bridge	107.5 ft.
Memphis Bridge	106.4 ft.

A more important feature of the municipal bridge work than its depth is that it is one of the foundations where high air pressures were used. According to the description an air pressure of about 50 lbs. was reached. Since in pneumatic foundation work the amount and duration of the air pressure are more nearly the criteria of the difficulties of the work than pier depth, it may be interesting to compare the four foundations named above on that basis.

The east abutment of the Eads bridge was sunk through sand and gravel to rock at a depth of 107.9 ft. of immersion. When at an immersion of 97.3 ft. the air pressure carried was 43 lbs. Nine days later at an immersion of 101.1 ft. the pressure had reached 46 lbs., when work was stopped for eight days because of storm. After resuming work 12 days were required to reach rock, 109.7 ft. deep, when the pressure was 49 lbs. Two days later concreting was begun and required 17 days. It will be seen from the above figures that during a working period of 40 days operations were carried on under an air pressure of from 43 to 49 lbs. In the east pier caissons for this same bridge, which reached a slightly less depth, the pressures were higher and their duration even longer. Briefly, concreting was carried on for 53 days, in two periods of 38 and 15 days, under pressures ranging from 45 to 50 lbs.

At the Memphis bridge also heavy pressures of long duration were employed particularly at Piers II and III. Briefly at Pier II the immersion was from 93 to 104 ft. for 50 days with pressures of from 40½ to 44½ lbs.; at Pier III, the immersion was from 94 to 106.4 [illegible] to [illegible] lbs. Altogether perhaps, the work at Memphis is the most notable example existing of protracted work under heavy air pressure.

Turning to the Williamsburg bridge work, where the maximum depth reached was only about a foot more than at Memphis and only about 2 ft. less than at the Eads bridge and where, theoretically, the pressure per foot head should have been greater than at the other bridges named because the work was in sea water, the highest actual pressure ever used was 38 lbs. The theoretical pressure for sea water for the depth of immersion, 107.5 ft., is 48 lbs. As a matter of fact the pressure of 38 lbs. was not employed at this maximum depth but at an immersion of 90 ft. From this last depth on the caisson was in a firm clay and the water was handled with pressures much less than the head called for theoretically. Actually the pressures used from 90 ft. down ranged from 33 to 37 lbs., the variations being irregular and not increasing with the depth. Also it may be noted that the extreme depth of 107.5 ft. existed for less than an hour. Altogether the Williamsburg bridge foundations, while ranking among the deepest of pneumatic caisson foundations, are not comparable in intensity or duration of air pressures with the foundations of the Eads and Memphis bridges or even with those for Pier IV for the Municipal bridge described in this issue.

Development Expense as a Factor in the Valuation of Public Service Property.*

Development expense is the deficit in "fair return" on the investment during the early years of operation, while the business is being developed to a point that will yield a "fair return" on the investment. Unless this development expense is charged to the capital account as fast as it occurs each year, it should draw compound interest up to the end of the development period. Development expense might be regarded as a part of the non-physical value of a plant, and a few years ago the writer so regarded it. Latterly, however, he has come to see that it does not differ one iota in principle from "interest during construction," and, therefore, is properly a part of the cost of production or of reproduction of the property. During the construction period, interest on the investment is charged, and properly so, as a part of the physical cost. Does this interest cease the day after operation begins? Not a whit. The owners of the property are entitled to a fair interest —a "fair return"—on their money, from the day it is invested. At first they receive it in the form of "interest during construction," which is charged to capital account. After operation begins they must either be allowed to earn more than a "fair return" during the fat years following the development period, or the deficit below a fair return incurred during the development period must be treated exactly like "interest during construction" and added to the capital account. If public service corporation managers have chosen the first of these two methods, it does not relieve the appraiser of the duty of adopting the second method; for the object of appraisals for rate-making purposes is to limit capital to a "fair return" on the investment. In brief, if there are to be no "fat years," then every "lean year" must be credited with its deficit as fast as it occurs.

This, the writer concedes, is a radical departure from such precedent as already exists, but we must not overlook the fact that we of today are establishing the precedents for appraisals in the future. The whole matter of valuations for rate-making purposes is still in a nebulous form, as far as the public, and indeed, as far as the Courts, are concerned. In the end it will devolve upon engineers to establish logical methods of appraisals. To do so, they must be able to look on the problem both as engineers and as jurists. Up to the present, however, this broadness of vision has not characterized most engineering appraisers, nor is it to be wondered at when the Courts themselves are in a maze.

A great deal has been heard lately about "going concern value." Ultimately, the Courts will hold that, as far as rate-making is concerned, there is no such thing as "going concern value" in the present meaning of the term. "Going concern value," in the final analysis, consists of two elements: First, development expense (as previously defined), and, second, capitalized surplus earnings. Surplus earnings are ascertained by deducting from net earnings both taxes and a low rate of interest on the investment, equivalent to interest on bonds. Many factors may affect surplus earnings; but, that "going concern value" consists largely of capitalized surplus earnings, cannot be denied. What are surplus earnings? The public replies that they are mainly the result of extortionate charges. This is doubtless correct in many cases; hence, any investigation of costs which has for its object rate-making must inevitably lead to repudiation of that part of "going concern value" which is based on surplus earnings, if the surplus is at all large. In a word, we reason in a circle if we capitalize surplus earnings, calling the result "going concern value," and then undertake to use "going concern value" as one of the factors in judging the fairness of rates. To express the problem mathematically, we cannot solve for a variable when the variable is allowed to exist on both sides of the equation. Yet that is precisely what some rate-making bodies are trying to do, and it is precisely what the Courts have often attempted to do.

To escape this confusion there is but one possible step, and that is to eliminate "going concern value" entirely. We must first determine the element of cost which the writer terms development expense, and we must regard this item as a part of the cost of reproduction. We must next cease to consider small rates of interest as being a "fair return" on this cost of reproduction. When first-class mortgages draw 5 per cent, it is folly to talk of 6 per cent as being a "fair return" on capital invested in a business enterprise, especially when this 6 per cent is figured on the actual cost of reproduction of the property. It may be that 7 per cent is an ample "fair return" in some case, but in others 10 per cent will be found none too much, considering the small size of the business and the risks involved.

The writer will not at this time discuss methods of determining how a "fair reurn" should be estimated, but, in general, the process should be as follows: From the gross earnings deduct the operating expenses and taxes to obtain the net earnings. From the net earnings deduct a small rate of interest (equivalent to interest on bonds) on the cost of reproduction. The remainder is profit, and should be expressed as a percentage of the gross earnings. This percentage of profit can be compared with similar percentages made by merchants, manufacturers, farmers and other capitalists, and then it can be determined logically by comparison whether or not the profit made by a public service corporation is "fair." We must adopt this method of attacking the problem or we shall inevitably drive capital away from railway and other fields of public enterprise.

The writer estimates roughly that a profit of 10 per cent on gross earnings, as above deduced, is about the same as a direct return of 7 per cent on the cost of reproducting the average steam railway.

In a recent appraisal of a street railway system, the writer determined the actual development expense of the property, deducing it from the accounting records. It was an astonishingly high sum, even assuming only 7 per cent on the cost of reproduction as being a "fair return." During his appraisal of all the railways in the State of Washington, for the Railroad Commission, the writer made a similar study of development expense, but this was not included in his estimate of the cost of reproduction, as it was then regarded as being a part of the "going concern value" and he was not commissioned to ascertain the "going concern" value of the railways. Not a single railway, as far as he knows, has ever presented to a State Railway Commission, or to the Interstate Commerce Commission, an estimate of its development expense along the lines indicated. Instead, the railway companies have talked in general terms of long construction periods—often claiming 20 years or more—and of great expense incurred in building up the business, and of franchise value, and of a score or more of non-provable costs. The consequence is that they have frequently lost entirely the one great item that they are clearly entitled to, namely development expense, which is an item which can be absolutely proved from their accounting records, and, therefore, rests not on the "hot air" testimony of experts, but on facts that are incontrovertible. In like manner, other public service corporations have often signally failed to prove the full worth of their properties, because their claims for "going concern value" have been ignored entirely. When a franchise expires, the "going concern value" is usually looked on by the public as worthless, nor is this view to be wondered at.

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*Remarks by Halbert P. Gillette, Editor Engineering-Contracting before the American Society of Civil Engineers in a discussion of Valuation of Public Service Property. Proc. Am. Soc. C. E., Vol. xxxvii, p. 261.

Mr. Riggs proposes adding to the physical value a minus "going concern value," and he is logical in doing so, if it is conceded that values for rate-making rest on profits; but this the writer does not concede for an instant. Values for rate-making cannot rest on the very thing that it is aimed to regulate, to-wit, the rates charged. Until engineers and public service commissions and Courts free themselves from this confusion of cause and effect, there can be no rational theory of rate-making.

Values for rate-making must rest primarily either on the actual costs of the production of a property or on estimated costs of reproduction, including therein both interest charges during construction and the sequel thereto—development expense.

Of almost as great moment as the item of development expense is the question of depreciation. The author, in common with most engineers, holds that depreciation should be deducted. This is a consequence of regarding a public service plant as if it were a machine bought in a second-hand store. A public service plant is a device which is intended to perform a given service forever. It is true that its parts are subject to wear, and must be renewed from time to time; but the plant as a whole is everlasting, or practically so. Managers of public service corporations, perceiving this fundamental truth, have rarely established sinking funds for the redemption of any considerable part of the plant. In a great railway system the renewal of a freight car is not a proportionately larger item of expense than is the renewal of a tooth in a steam shovel bucket owned by a contractor. This fact, coupled with the permanence of the railway plant as a whole, has led railway owners to make no provision for a return of the money lost in depreciation Railway ties in a large railway system inevitably reach a condition such that their average age is exactly half the life of the average tie. Shall a sinking fund be provided for ties? If not, where does logic place a line of demarcation? When does an element of the railway plant attain a condition of sufficient importance to warrant "writing off" some of its value from the capital account? The facts are that railway managers have not "written off" anything worthy of mention for depreciation, and, in the writer's opinion, they have been perfectly logical. Consequently, the operating expenses have been much less than they would have been during the early years, had a sum been placed annually in a sinking fund. Therefore, the development expense, as deduced from the accounting records, is less than it would be if a sinking fund were provided; and the amount of this difference is precisely the amount of the depreciation. In other words, if depreciation is to be deducted from the cost of reproduction, it must be added to the development expense ascertained from the accounting records; so that, in the final analysis, depreciation should be ignored entirely in any appraisal of a public service corporation where the object is either rate-making or purchase of the corporation by the public. One qualification to this statement is needed, however, and that is that the depreciation shall not have gone far enough to result in an average age of plant less than half the life of the plant—that being the ultimate normal operating condition.

Engineers have a duty to perform, in making an appraisal of the sort under consideration, which is judicial in its character and should not savor in the least of the pawnshop. The engineer engaged by a public service commission should not for an instant make it his object to "beat down the price," no matter by what far-fetched theory he may effect the result. Nor are engineers inclined to do this, except when they regard themselves merely as agents of the public by whom they are employed. Unfortunately, many appraisers have as yet failed to realize that there is a vital distinction between the dealings that should exist in public affairs and those that actually exist in private matters involving the purchase and sale of property. In the latter case, the buyer usually takes every possible advantage of the helplessness of the seller. Is the seller ignorant? See that he remains so. Is the seller hard-pushed for money? Grind down the price accordingly. Does the seller offer goods which are a bit shop-worn? Dwell on that fact, to the exclusion of all else. Such are the tradesman's arts, and such, the writer fears, have been the arts of some appraisers of public service property.

The writer believes that, under one form of agreement or another, nearly every kind of public service can be more economically and better performed by a public service corporation than by the public itself through employes directly hired. But if America is not to pass speedily into Government ownership and operation of all public utilities, there must be a pronounced change of attitude on the part of the public toward capital now invested in public service corporations. Even as engineers, we are apt to be unconsciously influenced in our attitude toward public service corporations, not only because of the present public attitude, but because we are often put to great inconvenience by the ill-considered resistance of the corporations whose property we are called on to appraise for the public Our duty plainly consists, first, in regarding a public service corporation as a public agent, and, second, in allotting such values that this public agent will receive a full and fair return for every dollar judiciously and honestly spent in building and developing its property. In carrying out this plan, the writer finds it wise to study the entire financial history of a corporation, going carefully through both the construction accounts and the operating accounts from the beginning.

The desirability of analyzing the actual costs of construction, betterment, and operation of public service corporations, preparatory to estimating the cost of reproduction, cannot be too strongly urged upon appraisers. Unfortunately, many corporations refuse access to their records, or claim that the records are too incomplete to be of value. However, when they realize that from those very records can be deduced one of the largest items of cost of reproduction, namely, the item of development expense, they are certain to show as much willingness as they now show aversion to disclosing their records.

The writer has recently completed an appraisal of a street railway system, the managers of which placed at his disposal the entire accounting and engineering records. From these the development expense was deduced, and forms an item which can be demonstrated in Court, if need be, instead of being the subject of unsupported "expert testimony." As far as the writer knows, this is the first time that a street railway corporation has voluntarily opened all its books for use in an appraisal which may be made public. May it not be one of the harbingers of a far-sighted action on the part of public service corporations, which will result eventually in eliminating entirely the hostile attitude of the public toward its accredited agents?

Reverting again, and finally, to the question of development expense, it will be seen, after study, that the method of deducing it from the accounting records provides for every possible item. The cost of advertising, the cost of colonization, and canvassing by agents engaged in building up the business tributary to the corporation, the cost of developing an efficient business organization and an efficient plant—every possible item of developing the business finds accurate record in the development expense deduced from the accounting records as outlined. This may not be apparent at first glance, but a little consideration proves it to be so. If, for example, $20,000 has been spent annually for ten years in advertising to secure business, the operating expenses have been increased exactly $20,000 for each of the ten years. Consequently, the annual deficit below a "fair return" on the investment has been made $20,000 greater each year than it would have been had no expense for advertising been incurred. In other words, the deficit below a "fair return," which is the development expense, shows automatically the amount spent for every such item as advertising. The writer regards this automatic register of development expenses as being one of the most important features of his method for determining such expense. It removes the entire problem from the realm of guesswork and expert testimony, and makes it a problem in engineering economics. It involves no question as to whether or not the existing rates charged for freight, or for any other service, are fair.

EARTH AND ROCK SECTION

Methods and Progress of Drilling at the Wabana Iron Mines; Construction of the Submarine Tunnel.*

On the eastern coast of Newfoundland lies Bell Island, the site of the Wabana Iron Mines. Forty years ago the presence of the iron ore deposits was revealed by accident, but it was not until 1893 that any attempt was made to explore or develop them. Investigation was begun at that time by the Nova Scotia Steel & Coal Co., Ltd., which resulted in the lease and eventual purchase of the deposits. In the course of the work it was gradually established that the iron which outcrops on the Island was only the fringe of great deposits under Conception Bay To open these deposits a submarine slope was started in 1906, which has been driven nearly 7,000 ft. from high water mark and has shown that the iron improves in quality and thickness as it gets deeper.

Land Work.—The work of the company begun in 1895 was at first only open cut mining, but in 1902 two slopes were begun. Both slopes were sunk at a considerable height above tide water, and one was driven out on the shore, thus forming an adit. The slopes were carried from 8 to 10 ft. in height, and 17 to 20 ft. wide, in two sections, a 14-ft. heading and a side slice 6 ft. wide. The sketch shown in Fig. 1 indicates the method of drilling in the 8-ft. ore. Another line of holes is put in when the ore is 10 ft. high. The center cut holes are about 7 ft. deep, and the rib holes 6 ft. All holes are bottomed [illegible] per cent dynamite is used for blasting.

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*Re-arranged from a [illegible] W. Baker in Mines and Quarry.

The ground drilled is red hematite iron ore and the seams or beds are interstratified with sandstones and shales of the formation with a [illegible]

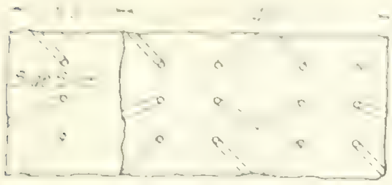


Fig. 1.

[illegible] The ore breaks up in "blocky" or rhombohedral shapes and causes trouble in drilling uppers, since the hole has a constant tendency to run out of line, requiring frequent changes in the position of the drill on the column. There is just enough moisture in the ore to make the cuttings ball up and pack behind the bit. The wet or down holes, however, are fairly easy to drill. Sullivan UD, 3-in. differential valve piston drills are used exclusively by the Scotia company, and fifty are now in operation.

In the Scotia vein the drills are mounted on single screw columns without arms, but in the submarine slope and in the 14-ft. bed of the Dominion company, the double screw column with arm is preferred. Tripods are used in open cut work, and in driving raises or break-throughs underground.

Engineering-Contracting for February, 1906, contained an account of the bonus system used on this work, and comparative reports of the efficiency of drilling under the bonus system and under the ordinary day labor system which had previously been in force. The rate paid the drillers was 13 cts. per hour and for the helpers 12½ cts. per hour. Following are the records for the months of October, 1904, and August, 1905:

	Oct., 1904.	Aug., 1905.
Drill days [illegible]	340	372
Total ft. drilled	19.943	25,711
Ft. per day	58.6	69
Output (long tons)	8,911	16,571
Tons per ft. drilled	.44	.64
Tons per drill per day	26.2	44.5
Dynamite used	13,816	13,696
Tons per lb. dynamite	0.64	1.20
Drill repairs total	$20.76	$169.15
Drill repairs av. per day	$ 0.061	$ .454
Drill repairs per mo	$ 1.586	$ 12.26

Note: 1 ton of this ore equals about 1.57 cu. yds.

The average cost of drill repairs was $5.35 per month per drill for the year. One man at $1.75 per day repaired the 25 drills in use.

Comparing the drill sheet for October, 1904, with that for August, 1905, we see that each drill averaged 58.6 ft. per day in October, 1904, as compared with 69 ft. in August, 1905. This is an increase of nearly 18 per cent, but, excellent as this increase is, it is not so striking as the increase in the number of tons of ore broken down by each drill. In October, 1904, each drill averaged 26.2 tons per day, while in August, 1905, each drill averaged 44.5 tons per day—an increase of nearly 70 per cent. The increase in output was not obtained at the expense of more dynamite, for in 1904 only .64 tons of ore were broken per lb. of dynamite as compared with 1.2 tons in 1905. This has been accomplished by requiring the drillers to pay more attention to placing the holes as accurately as possible, to give the dynamite the best leverage; i. e., to cut holes to meet within about 20 ins. and not overburden the side holes.

The records of this work 4 years later, for 1909, shows how uniform the work has been under the bonus system.'

	Mine No. 1.	Mine No. 2.
	1909	1909
Drill days	3,458	4,739
Total ft. drilled	[illegible]	[illegible]
Av. ft. drilled per day	[illegible]	68.2

Output, long tons	[illegible]	[illegible]
Tons per ft. drilled	[illegible]	[illegible]
Tons per drill per day	[illegible]	[illegible]
Drill repairs	$ [illegible]	$[illegible]
Drill repairs per day	[illegible]	[illegible]
Drill repairs per ft. drilled.	.0021	.0024

The drill repairs shown here are more uniform than shown in the previous records, and average less per month per drill than the previous figure, $5.35.

Before being sent underground, all drills are tested to determine the force of the blow, so that an efficiency rating can be assigned each machine. The testing machine is the invention of Mr. A. R. Chambers of the Scotia company. It consists of a Sullivan 3-in. drill, to the piston of which, the piston of the drill under test is clamped. A system of pipes and gages shows the relative efficiency of the new drill.

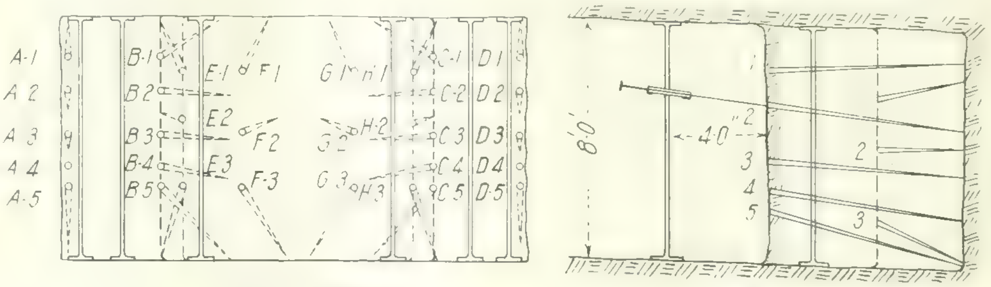
All drill steel is sharpened in a drill sharpening machine whose striking parts are made up of two Sullivan "UD" drills. This and the testing machine are located in the company's very complete machine shop, near the No. 2 mine.

Air pressure for the drills is 80 lbs at the receivers, but at the ore faces is actually about 70 lbs.

Submarine Work.—About 1905 the possibilities of developing the submarine areas, began to attract the attention of the Scotia company. Further additions to its underwater holdings were secured, until it owned 35 sq. miles of submarine areas

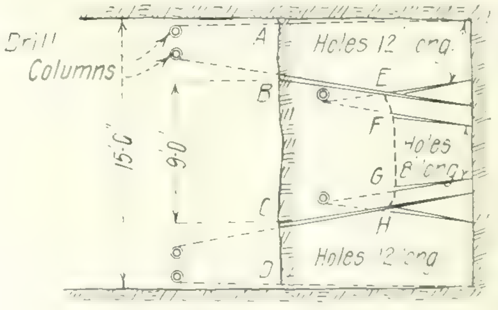
The company decided to drive a pair of slopes to these areas and the work was commenced in May, 1906. It was known that at distances of about 250 and 1,000 ft. respectively, serious faults would be encountered, so it was not considered advisable to make any expenditure for plant until these had been passed successfully. The following description of the first 4,000 ft. of this slope is abstracted from a paper presented by Messrs. R. E. and A. R. Chambers before the Canadian Mining Institute, early in 1909.

In August the first fault was encountered. Fortunately, although this dislocation amounted to an upthrow of 29 ft., with only 85 ft. of strata intervening between the workings and the bottom of the ocean, the volume of water was trifling. From a study of the rock structure on the land it was fairly evident that this upthrow would be followed by a corresponding downthow running N. E.—S. W., after driving about 800 ft. approximately at right angles to the first fault encountered. It was consequently decided to continue the slope in the strata underlying the ore in order to maintain as uniform a grade as possible. The wisdom of this course was verified by encountering the ore beyond the second fault at the distance and height expected, and of greater thickness. This fault was more serious, containing 7 ft. of clayey decomposed rock and an increased flow of water. The soft ground was handled by careful spiling and the water was easily handled by two No. 6 Cameron pumps. The quantity did not exceed 50 gals. per minute.



End Elevation

Side Elevation



Plan

Fig. 2.

Beyond this second fault no serious difficulties were encountered for a further distance of 1,800 ft., at which point a downthrow fault of 26 ft. was reached. The cover had increased to a total of 293 ft. and in consequence a greater feeling of security was felt in providing against any difficulties which might occur. With the increased depth, however, a corresponding increase in firmness was found and the clay encountered in previous faults was not met here. The slope was continued in the strata overlying the ore, but on an increased grade for 400 ft. where ore was again entered, having a normal thickness and a normal dip of 12 per cent. The grade was made 20 per cent, by which trimming will subsequently be reduced to 18 per cent. For this 400 ft. the effects of the fault were noticed in the increased tenderness of the roof, necessitating timbers being placed skin to skin; and in the amount of water dripping from above. The total quantity of water, however, was in no way formidable.

Method of Working.—Three 8-hour shifts were worked on the submarine slopes. When the air was cleared of smoke from the last shot, the drillers and loaders proceed to the face. The drillers and their helpers assemble the drills and columns, while the loaders throw back the ore from the face. The drills, of which there are two on this shift, are then set up 4 ft. from the face and about 20 ins. from the rib or side, and each driller puts in five 12-ft. center cut holes, B-1, 2, 3, 4, 5 and C-1, 2, 3, 4, 5 respectively (see Fig. 2), completing the round in about 6 hours. The holes are blown out with compressed air when the shift is completed. After having cleared away the face for the drillers the six loaders clear off the track, run in a trip of three cars and load the ore thrown up the slope by the previous blast, which sometimes is 100 ft. from the face.

When the ore is reduced to a heap behind the drillers, one car only is used, and the loaders relieve each other, car about, three at a time. The loaders generally finish at the same time as the drillers and 40 to 50 tons is an average shift's work.

The blasters then load the holes drilled with 7 lbs. of 50 per cent dynamite in each, tamping them securely with paper cartridges of clay prepared for the purpose. After the wires and blasting machinery are tested for strength and circuit the round is fired. If the work has been done correctly, the center cut will be taken out as shown in the sketch, and the ore thrown well up the slope. Owing to the heavy burden on these holes they will be only about half shot out. A little high pressure air is turned on at the face immediately after the blast, and the exhaust fans speeded up. In the course of a short while, the air at the face is quite clear, and while still a little warm, work can be resumed.

The next shift then begins, loaders clearing face as before. The regular drillers now set their bars 4 ft. back from the face and as close to the rib as possible, and drill holes A-1, 2, 3, 4, 5, and D-1, 2, 3, 4, 5, 12 ft. deep. In addition to these, two spare drills are set up in the cut and drill holes E-1, 2, 3, and F-1, 2, 3, and G-1, 2, 3, H-1, 2, 3, respectively 6 ft. deep. As the extra drills do not come on the same shift each time, there are two spare drillers on each shift who, when not at this work, repair and advance ventilating pipes, swinging Sampsons, and other odd jobs.

The order of blasting is now more elaborate than on the previous shift, and on the care taken in this work greatly depends the advance to be gained.

They first load and fire holes F-1, 2, 3, and G-1, 2, 3, three pounds to a hole. Next they fire the old bottoms of holes B-1, 2, 3, 4, 5, and C-1, 2, 3, 4, 5, with 3 to 5 lbs. each, according to necessity. The third round is E-1, 2, 3, and H-1, 2, 3, 5 lbs. to a hole, and finally A-1, 2, 3, 4, 5 and D-1, 2, 3, 4, 5, are fired, 5 lbs. to a hole. This makes a total of about 200 lbs. of 50 per cent dynamite to an advance of 8½ to 9 ft. according to the success of the work done.

The method of using short bars and setting up the drills on top of the ore heap was at first tried and practiced for some considerable time, but it was found that while saving a good deal of time in handling the ore, in the long run it did not pay.

The storage, thawing and distribution of the explosives for both the mines and the submarine slope are carried on at a central station which comprises a small magazine, thawing house, with detached boiler room, and a shed for testing detonators, located at convenient distances apart.

The thawing is carried on in a small stone building brick lined and wood faced inside, with an air space between the brick and stone, and the building is provided with a large entry for the reception and disposal of the explosive. It is heated by the ordinary hot water system, but the radiators are closed in wooden boxes to prevent accidental contact with the explosives.

The various blasting crews, wiremen, thawers, magazine storekeeper, and detonator tester, are all under the supervision of an explosive inspector, who constantly inspects all operations connected with the use and disposal of all explosives, and who immediately reports to the underground manager any unusual occurrence, and if possible, the cause of the same.

Plant.—Sullivan "UD" rock drills are used in the slope. Compressed air at 80 lbs. receiver pressure is supplied to the drills and pumps in both the slope and in the working mines by two cross compound steam two-stage air compressors and one straight line compound steam and two-stage compressor, having a total capacity of 7,200 cu. ft. of free air per minute. This plant also drives small hoists underground, and the fan engines.

The air pressure which, as stated, is 80 lbs. at the receiver, is only about 60 lbs. at the present distance to the face—between 7,000 and 8,000 ft.

The cars used are of 30 cu. ft. capacity and carry about 1.7 to 1.8 of ore. They are run on 28 lb. rails, except near the face, where a temporary track of 18 lb. rails is used. The gage is 2 ft.

The ventilating plant consists of one 4-ft. and two 3-ft. Sturtevant fans. The 4-ft. fan is direct connected to a vertical air driven fan engine, and is located near the upper part of the slopes, just at the bottom of the present workings of the No. 2 Mine, of which the slopes are a continuation. This fan is placed in the air course, and is operated exhausting. The two 3-ft. fans are placed as described below.

The intention was to sink the slope by double entry. In practice, however, it was found that the tendency was to place chief importance upon the slope farther advanced, with the result that it finally exceeded the secondary or ventilating slope by a distance of 2,900 ft. To provide for ventilating this, long, single slope, spiral riveted, galvanized pipe was used, and was connected with two blowers so they could be used either as blowers or exhausters. One of these was placed at the upper end of the pipe and the other, reinforcing it, about 1,000 ft. further down. This first pipe used was 15 in. inside diam. and was found to be too small to give entirely satisfactory results. Below the lower fan 18-in. pipe was installed, which still continues to give a plentiful supply of air at 7,000 ft. to the face of the slope. On account of the blasting the pipe cannot be laid nearer than 150 ft. of the face, but not inconvenience whatever is felt.

The air line is 8 in. in diam. as far as the workings in No. 2 mine and to the large Jeanesville pump, and 5 ins. for the rest of the submarine slope. The water discharging line is 6 ins., being double from the large pump to the surface. The pipes are periodically tested as follows: All pipe ends are carefully closed as near to the drills as possible, and a pressure gage is connected to the section to be tested. The section is then filled from the mains, and the supply valve closed. The air in the line is then released until the gage reads 50 lbs. The time is taken and the pressure allowed to drop by leakage until it reaches 40 lbs., when the time is again taken. The loss in cu. ft. of air will be approximately half the volume of the pipe tested. This divided by the time will give the loss per minute. As the amount of pipe in each section is not often changed this information is readily available. The conditions with the exception of the time will be practically constant. The pipe fitter is thus constantly familiar with the condition of his pipes. Corrections for temperature would be necessary for accurate results but in practice are not needed.

Dams.—To protect No. 2 Mine from possible inundation, sites for dams were constructed at a point situated vertically below high water mark. When approaching this point the face was narrowed to 6 ft. and then gradually widened again, forming a V. No reduction was made in the height. The sides, top and bottom were lined with concrete. A small pipe was placed in the roof as an outlet for air when the pressure should come on the lower side of the dam, and capacious air and water pipes were built in the floor. Timbers to fill the opening were made of 10x10-in. pine, tapering to 6x6-in. and piled at the mouth of the slope—in the same position that they would occupy in the dam—and carefully protected from the weather.

Telephones are installed in the slopes connecting, through a central office, with all parts of the works.

Efficient and modern electric pumps, fans, hoists, and other devices are installed and the equipment of these mines is considered unsurpassed.

The progress of the submarine tunnel work, up to December, 1910, was as follows:

Slope commenced May 21, 1906	Feet
Distance driven to Dec. 31, 1906	794.6
Distance driven to Dec. [illegible], 1907	1,916.1
Distance driven to Dec. 24, 1908	3,965.0
Distance driven to Dec. 30, 1909	5,400.4
Distance driven to Dec. 17, 1910 (At a depth of 1,300 ft. below the surface of the ocean.)	6,915.62
The month of least advance was Nov., 1907, in passing first fault, of	[illegible]
The month of greatest advance was Nov., 1908, of	[illegible]
In the 4 weeks from the 16th of Nov. to the 14th of Dec., 1910, an advance was made of	270.1
In week ending Jan. 23, 1909, an advance was made of	74

This gives a record of 11¼ ft. per day for a month and of 12.1 ft. per day for a week. The size of excavation for this driving was 13 to 15 ft. wide by 8 ft. high.

As the work proceeded it was ascertained by diamond drilling that the lower bed had increased very greatly in both thickness and richness. At the outcrop, this seam was about 11 ft. high, but it increased gradually, and after passing the faults had more than doubled.

ROADS AND STREETS SECTION

The Development of a Road Maintenance System for Menominee County, Michigan.*

The County Road Commissioners of Menominee County, Michigan, started the development of a maintenance system in the spring of 1909 which promises, when all details have been worked out, to be an economical method of doing the repair and minor improvement work on the county road system.

The Commissioners have under their charge 150 miles of road open to traffic. Of this about one-fifth is of gravel road or better; the remainder is of various grades of earth roads and offers problems in maintenance of every kind of bed from loose yellow sand to a clay-sandstone hardpan. The county is, roughly the shape of an Indian arrow head and the road system lies on the major axes and parallels the edges of such shape. The county seat is at the lower end of the county, which, as will be seen, makes a bad lay out to handle work from the county officers headquarters.

In the inception the system of maintenance was intended to do away with the large organization and camp expenses and the expenses incurred in sending men a long distance to do repair work; to this end in the year 1909 the county was districted and a foreman appointed for each six miles or thereabout. No attempt was made the first year to change the character of the work done or the methods generally used in maintaining roads, but all foremen were so selected that they could work on any part of their district, put in full time and live at home. The foremen in all instances picked their own crews and were directly responsible to the engineer, who in turn was under the Board of County Road Commissioners.

In 1909 each foreman turnpiked his section with a road machine, raked and otherwise repaired the road bed in his district and the organization was such that two such crews were at work all the time, the machine being passed from section to section. It took the entire spring to repair the road bed and the machines were kept busy until the middle of July by which time in several districts the road bed was so thoroughly baked that the work should at least be called questionable. Besides this method on the earth roads, on one stretch of the macadam the foreman did repairing by the patch method. All bridges and culverts were kept in repair during the season by the district foremen. Below are given a summary of costs taken from the maintenance report for 1909.

[illegible]

road bed including culverts, etc. 34.73

[illegible]

In 1909, no attempt was made to have such work cover the road sides and ditches. It will appear from the above figures that of the entire amount spent for maintenance of the road bed more than three-fourths was for road machine work, or to put it plainly, for work of a purely temporary nature and having

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*A report of K. I. Sawyer, County Road Engineer.

[illegible] was [illegible] system was [illegible] organized with the intent to eliminate as big [illegible] as pos- [illegible] to be partly of an experimental character, only the more important roads were included in the system. [illegible] so included were divided into "sections" which varied in length from four to eight miles, an attempt being made to have a section cover only a certain class of road bed; for example, section one was all clay hardpan, section nine all macadam, etc. A foreman was appointed for each section, supplied with tools and given the general plan of work for the season before the road work started. Each foreman on an earth or gravel section was supplied among other tools with a drag or float. Immediately, on the melting of the snow, all sections of the road were dragged, getting the general shape of the bed while it was soft from the melting snow. A few days later the dragging was repeated so as to keep the road to proper shape as it settled and hardened, and thereafter each foreman dragged his section after every rain which rendered the roadbed soft. No attempt was made to rake the road until it had dried, this allowed traffic to break up any lumps formed and remove any earth sticking to stones. The work in the early spring took from two to four turns (round trips of the drag) for each dragging but during the summer one turn was sufficient. None of the sections required more than an occasional raking of a few patches after the second dragging.

The sections covering the macadam road were handled by the patrol method. The repair material for all work over three miles from the crushing plant being placed in stock piles along the roadway and off the bed.

Besides the roadbed work, each foreman kept the culverts and bridges on his section in good repair, replacing such as were dangerous. Painted all bridges, cut the brush and weeds over the right of way and on two of the sections overhauled and completed the drainage system. This drainage work is to be extended a few sections each year as the county can stand the outlay and all systems completed are to be kept up by the section men. Besides this most of the sandy sections were graveled with a light coat of gravel and an attempt made to improve the system as a whole by the maintenance work. A few figures taken from the report for 1910 are given below.

Total cost of work handled by section system	$3,623.15
Miles covered by section system	72.5
Maintenance other roads	1,058.74
Miles covered in maintenance of other roads	30.0
Total cost of maintenance of road bed by section system	2,060.61
Miles covered on maintenance of road bed by section system	72.5
Average cost per mile of maintenance of road bed by section system	28.42
Average cost per mile raking and dragging for season	8.65
Average cost per mile dragging per turn	0.95
Average cost per mile raking per time	1.29
Brushing and cutting weeds on sectional system	1,161.28
Miles covered brushing and cutting weeds on sectional system	72.5
Improving drainage system on sectional system	421.31
Graveling, patching, etc., on sectional system	816.21

The organization for handling the work in 1910 was practically the same as for 1909; that is the foreman picked his own crews, was answerable direct to the Engineer, who in turn was under the Board of County Road Commissioners. In addition to the inspections of the Engineer and as an aid in such work, each foreman was required to submit a weekly time and report card. These reports were on blanks printed on the back of an addressed post card and so arranged as to file in accordance with a nomenclature adopted for the system.

Previous to 1910 the right of way along most of the roads had been allowed to clog with brush, a large portion of the ditches were obstructed with elder and willow brush and it will be seen by reference to the above figures that a considerable part of the work fell to the road sides. It should not be necessary to expend any considerable sum to keep the right of way mowed out hereafter as it was thoroughly cleared up in 1910.

It will also appear from the figures that the temporary work for 1910 cost but $8.65 per mile as compared with $26.17 for 1909 and that such work was but one-third of the repairs on road bed in 1910 as compared with three-fourths for 1909. The roads were kept in equally as good shape on the average and in most instances the new system seemed to give an improved cross section of the bed at the end of the season. Observation of the work, however, seems to indicate that a class of section intermediate to the two classes used in 1910 should be used on such sections as are covered with gravel or a natural hardpan and the layout for 1911 includes several sections which will be floated immediately after the spring thaws and be kept up during the summer months by the patrol system.

The arrangements for continuing the system are partially completed for 1911 and it will be extended to include seven of the nine roads in the county system. The two roads not covered being connecting links open to traffic but not complete and not at present subject to heavy traffic.

The drags were supplied by William L. Baker & Co., Indianapolis, Ind. The Board of County Road Commissioners is composed as follows: G. H. Haggerson, Menominee, Chairman; A. A. Juttner, Menominee and L. Nadeau, Nadeau, and the engineer for the board is K. I. Sawyer, Menominee, Mich.

Methods of Construction and Experience of California Cities With Oil Macadam.

During the past three or four years oil macadam has come into quite extensive use in a number of cities in California. The city of Riverside has some 60 miles of this kind of pavement, and a considerable amount has also been constructed in Pasadena, Alameda, Stockton, Richmond and Sacramento. The city of Los Angeles has likewise adopted oil macadam specifications for the outside streets. At the 13th annual convention of the League of California municipalities, held at San Diego last November, an informal discussion of street pavement was conducted by the Department of Engineers, Councilmen and Street Superintendents, during the course of which much interesting information as to the experiences of various cities in the construction of oil macadam was brought out. This discussion was reprinted in full in Pacific Municipalities, the official organ of the League, and from that source we have obtained the notes that follow.

A considerable amount of oil macadam has been constructed in Pasadena and is said to have proved fully successful. In this city the specifications are embodied in the notice of intention, where it is specified how the work is to be done. The thickness of the base, for instance, is controlled by the resolution of intention. The method of constructing the oil macadam in Pasadena was then described by Mr. John Beyer of that city:

> We first bring our sub-grade to grade, roll it thoroughly, and put on the base. We know from experience that the base will roll down about 35 per cent. Then, if a 7-in. pavement is to be made, we fill it with a base clear to the top of the 6-in. space, knowing it will roll down as I stated about 35 per cent, which will allow for your No. 2 rock and your finish. While the base is being rolled, we have screenings at hand up to 1¼-in. size, and as the rolling progresses, the screenings are thrown on the surface to fill all the voids and make it as dense as possible; however, not so dense that it would make a finished street when the oil is applied, because we still calculate that we want to make it one homogeneous mass, so the second course will readily unite with this base rock. We then apply ¾ gal. of oil per sq. yd. to the base after the first rolling has been done before the second capping goes on. It is rolled again after the oil is applied, and then you put on your No. 2 rock (¾-in. to 1¼-in. in size), after which you run over it with a grader; we grade it perfectly, so as to get a smooth surface, then we apply ¾ gal. of oil to the sq. yd. It is again rolled when the finished top of ¾-in., is put on, and then gone over with the grader again to true up the street. If you have a competent man on your grader, he can make almost as true a surface of the street as the board run through a planer in a mill. Then we put on ¼ gal. of oil—(that is what our specifications call for, but I find it is not enough—you ought to use [illegible] on a finish) and add screenings, after which it is again rolled. The street is now ready for traffic. We have had very good success in building our roads in that way. In the outlying districts we build a lighter pavement. Our present specifications call for 1 in. of broken stone, put on the roadway; then we bring it to sub-grade, except if the street is rough, and it nearly always is, in which case we plow and regrade. We put the roadway in shape for the contractor, and then he puts on ½ gal. of oil to the sq. yd., followed by 1 in. of rock and 1 gal. of oil with screenings; after which he rolls it down. We have put down a number of miles of that street, and it has given very good satisfaction in the outlying districts where there is not a great deal of travel.

The rock used in the Pasadena work is obtained near the city and consists of ground up boulders. The oil used is furnished by the contractor and is in all cases given laboratory tests. The specifications for the oil call for 10 or 11 gravity, and that it shall carry not less than 75 per cent of asphalt. In construct- the oil macadam the oiled surface is sprinkled with water, the advantage of this being that the roller can go on it without picking up the material.

Mr. Beyer stated that oil macadam on a 6-in. base had been laid on one of the streets in Pasadena on which there was considerable heavy traffic. It was found that during the erection of a church 8,500 tons of material went into one driveway without leaving a wheel mark on the street. The pavement has been down about four years and has required no repairs.

The 6-in. oil macadam at Pasadena costs about 10 cts. per sq. ft., the 1-in work costs about 1¾ cts. per sq. ft. The broken stone delivered on the street costs $1.90 per cu. yd.

In the discussion Mr. Campbell of Riverside described as follows the oil macadam work in that city:

> Our first extensive macadam pavement was put down in 1896. It was a strip of light stone macadam, 20 ft. wide, 6 ins. in depth, and as soon as it was finished we had to start sprinkling the street. There was some 7½ miles of it constructed for the main artery. There was always either a little surface mud on these streets, or dust, one of the two. That continued until about 1903, when we tried a little oil on a piece of it. It worked very nicely, and when we got hold of the Sunset oil, which was heavy oil, about 10½ gravity, we swept all those streets very carefully and went over them with oil, using 1 gal. of oil to the sq. yd., and leaving the street right down to a hard basis, with no dust patches or anything of the kind. After putting on that amount of oil, we spread it over with screenings from the quarry; not screenings without any dust, but just as it would naturally come without specifying the size, probably not to exceed ½ in. in size. That immediately rolled right down to a carpet and practically we have done nothing since to those streets, with possibly some exceptions in different portions. Some of it has not been touched at all, and to other portions we have sent a surfacing man over it and filled in small defects. We have, of course, had to have the pavement cut in a number of places, and my judgment would be that 6-in. pavement, by the time we put on the oil, had worn down to less than 4 ins. But at the present time there has been no wear on the macadam itself since the oiling—the wear has come on the oil. Perhaps in one or two places we have had to send a patching crew around where the oil has worn off. That gave us a clue as to how to work in the future. Our next set of streets were constructed of 4 ins. of macadam and 2 ins. of decomposed granite on top of it. We took those streets and put oil onto the

surface, dusted them over with screenings again, bringing it up from 2 ins. to possibly 2½ ins. or 3 ins. on top. Those streets worked nicely, but they kept buckling on [illegible] going into waves. So we invented a machine to cut those waves off, and filled up the hollows. Up to the present time that form of street has given us the most trouble. It showed that we required just as little top surface as we could get, that the oil should be right next to the hard macadam base. All our late streets, those built within the last four years, have been constructed with oil right on the macadam, and perhaps that little finishing coat of oil next to the macadam does not exceed ¾ in. in thickness. To speak about macadam as we construct it today, I would say that we probably construct it in the ordinary method, and when we come to the last course, after we have filled it in the ordinary way, we bind it. We do not put excess of binder on top, but rather keep the surface of macadam so that you can just see the binder; as if the street had been pounded. Then we put on probably about ½ gal. of oil to the sq. yd.; we dust that with limestone screenings and smooth it over. Then we come back again with the remaining ½ gal. of oil, put screenings on that, and smooth and roll it some. Such a street, when first done, is rather tender and will show up a little excess oil in some places and not enough in others, but we send a man there, and where he finds an excess of screenings, he will push them over onto the oil. After a while, the whole surface dries down so that it looks like an asphalt pavement. That class of streets have had practically no repair, while the streets that we have had to repair, as I say, are the ones on which we had an excessive thickness of oil coat over the macadam. That is where we used 2 ins. of decomposed granite, which was practically sand at best, and added another inch by putting on the topping. All of our streets treated in that way buckled and went into waves. I want to call attention to the fact that the oil macadam used in Riverside is entirely the surface method, not having the oil all the way through. The oil goes down somewhat. We have taken up samples which have shown us that it penetrates 1½ ins., anyway, downward, as well as going upward.

The macadam at Riverside has been constructed of rough granite from the city quarry which makes a satisfactory street and of limestone. The latter is being used at the present time. It is thought that the oil mixes best with the limestone screenings. On the heaviest traffic streets a 6-in. macadam is used, of which the city quarry granite is the base. On these streets 3½-in. rock is used instead of the ordinary 2½-in. rock. The cost of the oil macadam work at Riverside, constructed under the Vrooman Act, has been about 6 cts. per sq. yd. for the 4-in. macadam and from 8 to 8½ cts. per sq. yd. for the 6-in. macadam. Most of the work has averaged between 7 and 8 cts. per sq. yd.

At Richmond the Standard Oil Co. has made some extensive experiments in oil macadam. The following description of these experiments was given in the discussion by Mr. Garrard, an employe of the company:

A few years ago we did some oil macadam work, and having lots of oil, they put on plenty of it, not measuring it at all. Then they put on the screenings. It was found that that was a terrible mistake. It made a regular mush, and would not settle at all; it has not settled yet, and sticks up in one place and down in another. Their first experiment not being successful, they next put down a piece of regular macadam, and oiled it and watered it, after which they rolled it and let it lay. Then they went over it and applied another small coat of oil and let it lay quite a while. It was done in the summer time, and finally they rolled it again and then opened it for traffic. That street has so far been very good, although it has not been used long enough to tell exactly how it will turn out, since it was only put down the summer of 1910. But they had a good base of hard rock to bond naturally though the oil seemed [illegible] we. In fact, it now is well bonded apparently. Then they went on, and in another piece of about 300 ft., they put down 3 ins. of rock, and then rolled it and oiled it. Then on top of that, they put 2½ ins. of No. 3 or 1 in. rock, which they oiled and then finished up with screenings. If anyone were to examine that without making too close an inspection they would think it an asphalt street. They found that it was a mistake to use too heavy a roller on the finish as a light roller would bind and not break the bond—it appeared, as it passed over it, to merely tie it together. That street has very heavy traffic over it. I don't think there is any city street that has much worse traffic—heavy loads with rocks hauled from the quarry, and [illegible] vehicles at that. Yet it has apparently not been affected at all by wear thus far. In the city itself, we have done a great deal of oil macadam work this last summer, but they do not use the same method, and contractors do not seem to understand exactly or do not want to, I do not know which. At any rate, we do not get as good satisfaction in our oil macadam streets as we should, in the city. I examined the streets of Stockton last winter, and find they have some very fine oil macadam roads there. I believe our roads in Richmond will turn out all right later on. But at the present time they do not look as nice and smooth as the roads of Stockton. Another thing. We have a little machine called a slicker, which is a fine thing to smooth out a road, and prepare it for a roller. It is about 10 ft. long, made of [illegible] boiler plate; the back end of it, called the shoe, is about 2 ft. wide and runs on the ground. In front there is a blade that cuts off any ridges and smooths them down, and I believe that is the principal reason why we obtain such smooth surfaces. It is a very cheap little machine—any boiler shop could build one, as we made ours. With such a machine, which can be easily adjusted, if you want to shove your rock off to one side, you merely slip the chain, and thus are enabled to move the rock around in any way you desire. It is also useful to spread the rock around in any way you desire. It is also useful to spread the rock and make a flat surface of it after it is dumped. In conclusion, I would like to impress the fact that one of the worst features of all, is to get too much oil. Be careful and do not use too much. There is another point. We find it a great mistake not to get the oil on evenly. You take the common, ordinary sprinkler, and perhaps you will get 1 gal. on this yard and 1½ gals. on the next yard. We put ours on with a large, special sprinkling apparatus, with the oil very hot. We put a straight edge [illegible] street, and as the oil boat [illegible] if they go along at a steady gait they get it on very evenly. The straight edge is set every 3 ft., and we do that 3 ft. before we take the next one —all by hand. The results [illegible] this way seem to be very good. I think it is a very important point, too, if you use a sprinkler, to have one that will put [illegible] even. I am inclined to think that [illegible] macadam roads is in great measure due to the fact that the oil is not put [illegible]. There is one other point I forgot to note, in reference to our last experiment. In this case the oil was put upon a 2½-in. top layer, and after it lay for a while, they plowed it with a disk plow and thoroughly turned it over, so that instead of [illegible] sides of the stones only, with probably the under side not having any oil at all, by this method the stones were enveloped in oil. It appears to be a very good plan. The plowing is very simple.

[illegible] Oil Co. [illegible]

The experiences of Stockton with oil macadam were described as follows by Mr. R. C. Tomalty of that city:

We use the ordinary rock that runs from 2½ ins. to 1½ ins. for the lower grades in Stockton, and the next course consists of rock that will pass through a 1½-in. ring, while the top course is what we call ¾-in. rock, ranging in size from ¾ in. to dust. We have good results in our macadam streets. I want to say this about oiled streets. We put in 42 blocks of oiled streets over a gravel base. We used a pretty good kind of gravel for the purpose, one that cements very well, and we made our streets an average of 7 ins. in thickness, rolling the street in two layers and making it perfectly compact with nothing but a water bound gravel. When we finished them and got the surface packed we oiled it with an application of ½ gal. to the sq. yd. The oil is an asphaltic oil, that is, very rich in asphalt. I believe it runs as high as 80 per cent, a natural oil just as it comes from the ground, without being treated to any distillation whatever. On this oil we spread rock screenings (decomposed granite or broken concrete) and we found that the broken concrete gave us the very best results. We put just enough screenings on to take up the surface oil and no more. A few days later we treated the street to another ½ gal. of oil to the sq. yd. of surface, and this was taken up as before. I believe these specifications are like those used in Riverside. Our streets have been down for three years, and they have never cost us one cent for repairs. They have been subjected to two floods, and I have walked over the crown of one street in particular with gum boots on, and the water 18 ins. high on the top of the street, but the water didn't seem to hurt it. In places, the oiled surface would rise up, but it did not crack, and after the flood subsided, the oil went right down to its level without cracking at all, and the pavement, although it has been down three years, is in good condition throughout. However, I think the most necessary thing about building an oiled street is to make a foundation. If you can't make a good foundation there is no use in trying to build an oiled street. The trouble about oil has been because many people have thought that if they merely put oil on the street, all their difficulties are over, and that it is a panacea for all the ills of street making. But that is not right at all. Oil is only useful for two or three things. It is useful to make a surface that will shut out the water, for one thing; it presents an excellent surface, for another thing, because it does not grind up and cause dust, and gives you a dustless surface. Those are about the principal advantages you get from the use of oil. If you decide to take a pavement and bind it with oil all the way through you are apt to find out that you will spoil it.

Notes on Road and Street Work.

Applying Asphalt Filler in Brick Pavement Construction.—In its report at the last annual convention of the Illinois Society of Engineers and Surveyors the Committee on Roads and Pavements stated that the pouring method, as has been very commonly used, of applying the asphalt filler for a brick pavement should be abolished, as it was both wasteful and inefficient. It was stated that by using a wide fan-shaped snout to the can from which the filler is poured, keeping the asphalt very hot and working from the gutters up to the crown the material may be cheaply and quickly applied. Following the application of the hot asphalt a squeegee in the hands of a competent workman should be used to remove the surplus of material and in such a manner that the chilled material is not worked over any brick which had not been previously coated direct by the flow from the pouring can. It was stated that in this way all joints are more perfectly filled than in any other way and no cold material can get into them or bridge them. The snout of the pouring can should be not less than 6 in. wide and not more than ¼ in. in the clear opening between sides. This admits of very rapid pouring of hot material, but will not pass any that is chilled. It has the further advantage of being a definitely fixed rule for inspectors to follow and absolutely precludes any possibility of there being a misunderstanding about the proper temperature of the filler when it is applied.

Grey Soil Roads in Virginia.—[illegible] southern portion of Virginia and northern part of North Carolina very satisfactory and inexpensive roads for the light travel of the country districts have been constructed from a light grey, sandy soil found in considerable quantities in the fields along the roads. The specifications prepared by P. S. J. Wilson, State Highway Commissioner of Virginia, for one of these grey soil roads in Mecklenburg County, contract for which was let last January, are as follows:

The [illegible] is to be furnished by the county in beds. The [illegible] place upon the road in accordance with the [illegible] Should any objectionable material be used, he [illegible] soil is to be placed upon the road in two layers of equal thickness and each layer is to be thoroughly rolled and solidified with a 10-ton steam roller until it is consolidated and approved by the engineer. The soil shall be 10 ins. in thickness in center and 6 ins. deep 6 ft. from center, tapering to a feather edge at 10 ft. from center, when it is thoroughly compacted and approved, unless otherwise directed by the engineer, and shall be 20 ft. in width. Should any depressions appear, these are to be carefully filled with soil, so that the finished road will conform to the approved cross-section. The contractor shall be paid by the cubic yard measured in the excavation, which shall include finishing the road as above specified. The contractor is to place sufficient soil on the road to allow it to shrink 33 per cent in rolling and settling.

Wear Resistance of French Road Stones.—At the last International Road Congress at Brussels a report, presented by A. Mesnager, Chief Engineer Roads and Bridges Department, and Director of the School of Civil Engineering, Paris, contained some interesting data on the wear resistance of French road stones. The following translation of this portion of the report, is taken for our English contemporary, the Surveyor: It has been sought to make a rapid determination of the coefficient of quality fixed in France for roadmaking materials in the following manner: The unit of wear is taken as that produced by the daily passage of 100 horses and carts (denoted generally under the name of "yoke"). Taking *n* to be the number of cubic metres of broken stone or gravel required to be placed annually on one kilometre of the road to compensate for the wear produced by the passage of 100 "yoke," the coefficient of quality of these materials is $Q = \frac{300}{n}$; thus, if only 15 metres of a certain broken stone are required per kilometre and per 100 "yoke" daily, its coefficient of quality is 20. As an example the following coefficients of quality can be given frequently vary, however, with the origin of the material:—

Diorite	19
Porphyry	12 to 18
Quartzite	12 to 19
Amphibolite	12 to 15
Syenite	11 to 13
Gneiss	7 to 15
Granite	8 to 12
Sandstone	10 to 13
Basalt	11 to 14
Limestone	5 to 12

It is easy to find materials of superior quality which exceed the limits given above. The following are given as an example:—

Quenast porphyry	30 to 32
Blue trap rock from Raon l'Etape (Vosges)	26 to 30
Quartzite from the Ardennes	23 to 26
Basalt from l'Aveyron	21 to 27
Vosges granites	16 to 19.5

The above experiments do not distinguish between good and bad materials, but they allow of the classification of materials relatively to one another as materials which should serve better or worse than others. They permit of the choice, according to local necessities and current prices, of the materials which are the most advantageous for each individual case.

Straw Surfaced Roads.—In certain parts of Eastern Washington and Oregon straw is sometimes used as a surfacing for loose soil roads. A new plan for strawing roads is proposed by Mr. L. W. Loehr, Engineer of Walla Walla County, Wash. The plan, as outlined by him is as follows: The road should be plowed and graded, and brought to a crown. If this has already been done, plow the center of the road up about 15 or 16 ft. wide, and plow it good and deep. Harrow it and get it level and in good shape. Then put on the straw. Put it on 6 ins. deep and by the use of a straight disc cutter, cut it into the loose soil. If this all goes in, put on more, and cut that it; and then even more if necessary. Then you have the ends of the straw sticking up, and travel is not on the sides of loose straw. Then put on the steam roller. Roll it good and hard, and keep rolling it until it is hard. An excellent substitute for straw is Jim Hill mustard, and other weeds, thistles, etc., that grow along the roadside. These should be cut down and destroyed, and the road is the best place for them.

WATER-WORKS AND SEWERS SECTION

Valuation of the Physical Property of the Peoria Water Co., with a Discussion of Rate Making and of Reasonable Rates.*

(Continued from page 254.)

LIMITATION OF THE INVESTMENT.

The principle that the investment sum must not exceed the fair present value of the property is a fundamental deduction from the foregoing discussion. Also that the value found must primarily be fair to the municipality. By this it is meant that under no condition is the municipality to be called upon to pay more than the present value of a public utility as a going concern.

Hence the importance of finding this limit, and hence the fallacy of the "original cost and deficit" theory of valuation.

Any method if consistently applied, that gives more than the actual present value of the property, is liable to be unfair to the municipality. And if, as in the Appleton case, the result must be compared with the value ascertained in another way, then the method fails as a complete instrument of valuation.

It is the insistency of the courts that appraisements shall not exceed the present value, that protects the public interests, and it is the requirement that the plant shall be valued as a going concern that insures the owner in at least a part of the uncompensated service which has been rendered.

To speak of insuring the owner against uncompensated service may appear in effect as appealing to the "original cost and deficit" method. But this appearance vanishes when the compensation is limited to the present value of the property.

That the owner should receive compensation for his outlays so long as it does not exceed this value, is manifestly just.

It is obvious also that to hold that the owner should be thus compensated, within the limits of value, is very different from holding or allowing, that the compensation shall exceed these limits if the costs are in excess.

This distinction is fundamental. In one case the municipality always gets value received, and the risks are carried by the owner. In the other case, the municipality is made to shoulder the risks of a business for which it is only remotely responsible.

These distinctions are in full harmony with the doctrine laid down by Judge Savage in the Brunswick case in the paragraph quoted above, page 23, which is in substance that present value must govern, though original cost is legitimate evidence to be considered as bearing upon value.

Some confusion in the methods of valuation, as with the rights and responsibilities of public service corporations, are perhaps inevitable during the transition period from the old to the new conception of a public utility.

No one can reasonably deny that if the public utility being valued was brought into being as the joint product of public and private agencies, and if during all of its past existence it has been operated under strict governmental control, with a scale of rates which furnished proper remuneration to the operator, that the actual original cost of the physical property, increased by the outlay in creating the business, might reasonably be considered the fair investment sum sought.

But there are no such public utilities in existence today. Those now being operated by semi-private and quasi-public agencies, were created by such agencies under contract with the municipalities which they serve.

By the theory of their creation the risks were assumed by the owners. If they made money it was theirs, if they did not, they would have to bear the loss.

The public could not be called upon to make them whole, either directly or indirectly, except so far as the value of the property will affect that result. To this value they are entitled at least as far as is necessary, to proper remuneration. But they have no right to compensation beyond that given by the value of the property.

It should not be assumed that in all cases the value of the property should be enhanced by the full amount represented by the difference of the net earnings of the operating plant compared with the hypothetical plant, that is, by the full amount of the going value.

After the revenue of the operating plant has been developed substantially to the level of the city it serves, it may be found that an enhancement of even less than one-half of the full going value will give an investment adequate to afford proper compensation to the company. In such event, the city becomes a large beneficiary from the past operations of the plant.

It is thus seen that an equitable valuation of a public utility involves a careful consideration of many variable elements.

It is little wonder then that the Wisconsin commission should find that different cases present different aspects, and that conclusions that seem justified in one case, are not consistent and just in another.

Difficulties will arise, whatever theory of valuation is adopted, but that theory which follows the true economic principles of value will be found to be the simpler and freest from embarrassments.

So long as the appraiser keeps within the limits of actual values he is not likely to go far astray. But if he attempts to deal in "original costs and deficits," except as a mere check, as evidence to educate his judgment, nothing but confusion will follow.

Herein lies the contrast of the two methods of valuation.

"Original costs and deficits" consistently followed may lead to great injustice, and without a resort to present value for comparison, the appraiser may often be unable to get his bearings.

But so long as logically determined present values are dealt with no serious injustice can result.

Such being the case it is evident that the doctrine of valuation laid down by the courts, is the only one which will safely guard the rights and interests of the public, as well as of the owners of the utility.

Being convinced of the correctness of this position, it has been the endeavor in this case to find that sum for the investment, which being, by a wide margin, within present values, will bring to the owners of the Peoria Water Works, substantial compensation for the service they have rendered the city.

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*[illegible] condensed from "Valuation of the [illegible] of the Peoria Water Works Co.," by Benezette Williams and C. B. [illegible] "Valuation of the Peoria Water Works Co.," by Edward A. Pratt & Co., [illegible] the Plant of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams, reports made for the city of

TABLE II.—SHOWING RELATION BETWEEN POPULATION, WATER PUMPED, MILES OF MAINS, REVENUE AND NUMBER OF SERVICES.

Year ending.	Population.	Total [illegible] pumpage [illegible] of gallons.	Average daily pumpage [illegible]	Gallons per capita per day.	Number of miles of main.	Population per mile of main.	Number of services.	[illegible] lation.	Gallons per service per day.	Revenue [illegible]	Revenue Private.	Total.	Private revenue [illegible] million of gallons.	Total revenue [illegible] million of gallons.	[illegible] revenue service.
Oct. 31															
1889	40,660	.....			45.0	900				$47,060	$[illegible]	$80,173			
1890	41,920	1,023	[illegible]	67	—	—	2,084	[illegible]	1,340	15,350	40,816	56,166	$40	$55	$20
1891	[illegible]	1,260	[illegible]	80			2,563	[illegible]	1,350	23,712	44,500	68,212	35	54	17
1892	44,760	1,141	3.1	70	76.8	580	2,881	[illegible]	1,080	31,016	51,169	82,185	[illegible]	72	18
1893	[illegible]	[illegible]	2.7	[illegible]	[illegible]	590	3,268	[illegible]	830	[illegible]	53,578	[illegible]	[illegible]	[illegible]	16
1894	47,590	1,065	2.9	61	78.6	600	[illegible]	[illegible]	[illegible]	41,900	69,349	111,249	65	104	18
1895	49,010	1,119	3.0	63	78.8	620	4,245	[illegible]	[illegible]	41,920	74,011	115,731	[illegible]	103	17
1896	50,430	1,171	3.2	63	79.1	640	4,797	[illegible]	670	41,950	73,060	115,010	[illegible]	[illegible]	15
1897	51,850	[illegible]	[illegible]	68	79.4	650	5,074	98	690	41,950	79,088	121,038	[illegible]	94	16
1898	54,090	1,229	3.4	64	79.7	680	5,278	[illegible]	630	41,950	82,807	124,757	67	[illegible]	16
1899	56,350	1,277	3.5	62	82.1	690	5,436	[illegible]	640	41,953	89,579	131,532	70	103	17
1900	58,600	1,292	[illegible]	60	83.0	710	5,702	98	[illegible]	42,171	92,362	134,533	71	[illegible]	16
1901	[illegible]	1,497	[illegible]	68	[illegible]	720	6,048	101	680	42,319	105,799	148,118	71	[illegible]	17
1902	61,480	1,461	[illegible]	65	87.7	700	6,365	103	630	42,371	122,625	164,996	[illegible]	113	19
Dec. 31.															
1903	62,920	1,834	4.3	68	88.8	710	6,768	107	640	49,979	151,789	201,768	[illegible]	110	19
1904	[illegible]	1,635	4.5	69	89.2	720	7,100	110	630	44,275	134,923	179,198	83	110	19
1905	[illegible]	1,709	4.7	71	91.6	720	7,492	114	620	45,265	142,827	188,092	84	111	19
1906	67,240	1,919	5.3	78	93.4	720	7,956	[illegible]	660	46,212	156,770	202,982	82	106	20
1907	[illegible]	2,093	[illegible]	83	96.7	710	8,571	125	[illegible]	46,876	170,877	217,753	81	104	20
1908	70,120	2,171	[illegible]	84	99.3	710	9,040	329	660	47,470	177,538	225,007	[illegible]	104	20
1909	[illegible]	—	[illegible]	[illegible]	101.2	710	9,679	135	730						
June 30															
1910	73,000	2,714	7.4	[illegible]	102.6	710	10,239	[illegible]	710	[illegible]	*183,171	*230,671	67	[illegible]	18

*Private revenue obtained by auditor from rating cards for the year ending June 30, 1910. As no analysis was made for water furnished to business establishments through meters, and there has been no increase in hydrant rental, the total revenue given is probably several thousands of dollars less than the actual. Figures given for population include territory served outside the city.

THE INVESTMENT FOR THE PEORIA WATER WORKS.

In the general discussion of methods of valuation, found on pages 10 to 29 of this report, the first method considered, viz.: the finding of the plant value as a going concern, and as of the time of valuation, on the hypothesis of reproduction, was held to be the proper one.

In this valuation the plant value was enhanced, in two items, $316,020 in all, because of its acquired business, that is, for the going value element.

The manner of estimating this element was not gone into, nor did the report contain anything indicating its actual total amount as determined, although it had been approximately estimated as amounting to more than twice the sum given.

For the purpose of this report, a more extended and careful estimate has been made, and the total amount found to be $856,096, based on an investment of $1,950,000, the reproduction cost of the property, as given in the report of March 24.

But with an investment sum of $2,150,000 for the present plant, its going value would be reduced by $200,000, the difference between $1,950,000 and $2,150,000, making it $665,096.

On this basis there is left $665,096 less $316,020, equal to $349,076, of the going value element, which is unused, that is, it remains to the credit of the plant, which if taken over at the price of $2,150,000, would have $349,076 of surplus value.

The details of the computation of this going value is given in a table, which is accompanied by a diagram containing the revenue and population curves, upon which the computation is based. They are both filed Table III.

RETURNS.

The investment, or that sum which should be credited to a public utility, having been determined, the question arises as to what per cent should be allowed for returns on the investment, that is, for interest and profits, after operating expense, maintenance, taxes, the depreciation and renewals, have been provided for.

In seeking an answer to this question, we properly turn to court decisions, and the decisions of officials clothed with semi-judicial functions.

In Wilcox, et al., representing the Public Service Commission of New York vs. Consolidated Gas Co., 212 U. S., the Supreme Court of the United States says:

> There is no rule as to any particular rate which any corporation subject to legislative control in the [illegible] legislative interference. It depends upon circumstances and locality. In this particular case, with reference to risk attending the business, and the locality where it is carried on, the complainant is entitled to a return if it is possible, of 6 per cent upon the fair value of its property actually used in its business of supplying gas.
>
> The less the risk, the less the right to any unusual returns upon the investment.

The Court points out that in the valuation of the plant the lower court had allowed $12,000,000 for franchise value, which was reduced to $7,781,000 by the Supreme Court, being the amount which had been added to the capitalization of the plants at the time of consolidation. Also that the seven constituent companies down to the time of consolidation in 1884 had been free from legislative regulation of rates. They had been prosperous and divided very large earnings in dividends. Several of the companies had averaged from their creation over 16 per cent dividends. Six of them in 1884 upon a capital which had been increased by earnings, paid 18 per cent dividends, and upon the money in it would have been 25 per cent.

As to the question of risk in that case the court holds that it was reduced to a minimum, having a monopoly of the gas business in the largest city in America.

The Urbana Ohio Water Works furnishes another case where the rate of return was adjudicated.

In an opinion filed Nov. 8, 1909, in the U. S. Circuit Court for the Southern District of Ohio, deciding two cases in equity, viz.: No. 5773, C. H. Venner Co. vs. The Urbana Water Works, and No. 5805, Robert W. Kirby, Receiver, vs. The City of Urbana, Judge Thompson allowed on the value of the plant, in addition to operating expenses and taxes, one per cent for depreciation, one and eleven one-hundredths per cent for administration, and six per cent for interest, or interest and returns. This is in addition to operating expenses and taxes, there was a total allowance of 8.11 per cent. The value of the property which was being operated without a franchise was in the judgment of the Court, $180,000, of which $25,000 was an allowance for going value.

In considering the question of returns, under the heads of "Interest and Profits," page 129, Antigo Water Case, the Railroad Commission of Wisconsin say:

> A mere [illegible] or [illegible] which it is intended, amounts to but litttle unless it has or can obtain a paying business. Without business it is a dead mass instead of a living [illegible] it must have business, or customers who avail themselves of the services it renders at rates that yield an adequate income.

After discussing the question of interest on the investment, and pointing out that with public utilities generally it may legitimately vary over a range of 4 to 7 per cent according to the circumstances of the case, the Commis-[illegible]

> In addition to the operating expenses, including depreciation and the amount actually paid as interest on the investment, there must also [illegible] sponsibilities connected [illegible]. This allowance is usually called [illegible] and represents compensation [illegible] ness, for the risks involved, and for certain other efforts.

Speaking of the Antigo Water Works plant specifically the conclusion is:

> But while the plant under investigation has to pay rather high rates of interest, its financial condition seems to us fairly sound, and there is every reason to believe that it will greatly improve in the near future. Its earnings are on a comparatively sound basis and its securities would seem to be fairly well protected. It appears to us, that for interest and profits, when taken together, a surplus of about 7 per cent on the value of the plant and its business as here given, is probably sufficient to secure both the capital and the business capacity required, and this amount we therefore, at this time, regard as a reasonable return for these factors in this particular case.

In the case of "State Journal Printing Co., et al., vs. Madison Gas & Electric Co.," decided March 8, 1910, the Railroad Commission concludes, after an extended discussion of the subject of returns, page 647:

> In view of the facts that have thus been represented in relation to this subject, it may be said that the witnesses for the respondent placed that part of the return on the investment which might properly be termed profits at rather high figures; and that under the circumstances in this case it is not unreasonable to limit the profits to from 1½ to 2 per cent on a fair valuation of the electric plant. Such rates, in addition to an allowance of 6 per cent on each case for interest, would seem to be fair to the present owners, as well as sufficient to secure both the business capacity and capital that are required in this particular case. It would not be unreasonable to limit the returns for both interest and profit to not less than 7½ to 8 per cent on a fair valuation of the gas plant, and to not less than 3 per cent on a fair valuation of the electric plant.

In view of the foregoing decisions, and in consideration of the circumstances and conditions under which the Peoria Water Works Company operates, and has operated its property, for twenty years, there would seem to be no warrant for concluding that less than 7 per cent on the fair investment value of the Company's property would be admissible to cover the allowance for returns, under interest and profits.

In considering the weight that should be attached to the decisions of courts touching specific rates of return, it must be considered that the questions which they are called upon to answer are quite different from those presented to an administrative body such as the Wisconsin Commission, or to a legislative body, as a City Council, engaged in making a schedule of rates.

The courts are not properly rate makers; their function in rate cases is generally to decide the constitutional question as to whether a specific rate fixed by some proper agency, is or is not, confiscatory. The view which a judge takes under such circumstances is dependent, to a large extent, upon the doctrines which he holds relative to the freedom which courts should exercise in interfering with legislative acts.

If he is a close constructionist he will be

TABLE [illegible].—STATISTICS OF THIRTY NINE MUNICIPAL WATER WORKS PLANTS, SUPPLIED BY PUMPS IN VARIOUS CITIES HAVING POPULATION OF [illegible]

Municipality	Date of report	Age of plant	Population	Water Consumption. Millions of gallons per year	Water Consumption. gals per capita daily	Head on pumps in feet	Number of miles of mains	Number of services	Number of meters	Investment Total	Investment Per mile of main	Investment Per capita	Private Re[illegible] Total	Private Re[illegible] Per [illegible]	Private Re[illegible] Per [illegible]	value [illegible]	[illegible]	[illegible]
[illegible] City, Mo.	1908	[illegible]	[illegible]	[illegible]	100	[illegible]	393.0	[illegible]	15,948	$7,[illegible]	$1[illegible]	$29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1909	44	[illegible]	[illegible]	[illegible]	[illegible]	373.[illegible]	33,731	2,642	8,891,01[illegible]							[illegible]	
[illegible], R. I.	1908	[illegible]	211,600	[illegible]	7	211	372.6	[illegible],321	23,180	7,[illegible],941	20,395	35	717,752	27	[illegible]		[illegible]	
St. [illegible], Mo.	[illegible]	[illegible]	[illegible],600	4,387	56		324.[illegible]	28,063	13,628	[illegible],160,[illegible]			[illegible]			[illegible]		
[illegible], Ohio	[illegible]	[illegible]	164,700	5,942	99	210 195	[illegible]	[illegible],987	19,016	3,294,926	14,650	20	[illegible]	[illegible]	[illegible]		[illegible]	
[illegible], Ga.	[illegible]	[illegible]	141,800	[illegible]	[illegible]	230	197.0	17,717	16,436	3,065,012	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Memphis, Tenn.	1909	[illegible]	136,400	5,117	[illegible]		[illegible]	18,105	7,183	3,077,[illegible]	[illegible],199	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible], N. [illegible]	1909	[illegible]	[illegible]	[illegible]	114	122	135.4	18,[illegible]	12,146	2,667,[illegible]	19,996	24	210,411	1[illegible]	[illegible]		[illegible]	
Fall River, Mass.	[illegible]	[illegible]	[illegible]	1,949	[illegible]	186	109.6	8,516	8,197	2,216,[illegible]	[illegible]	21	[illegible]		[illegible]	[illegible]		
[illegible], Ohio	[illegible]	38	[illegible]	[illegible],024	78	[illegible]	167.8	21,270	16,217	3,577,[illegible]	[illegible]	[illegible]	140,44[illegible]	[illegible]			[illegible]	
Grand Rapids, Mich.	[illegible]	[illegible]	[illegible]	[illegible]	144	116 [illegible]	175.0	17,125	6,328	1,[illegible]	11,067	18	175,290	[illegible]	[illegible]		[illegible]	
Nashville, Tenn.	[illegible]	[illegible]	10[illegible],900	[illegible]	111	[illegible]	111.6	[illegible]	7,440	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Lowell, Mass.	[illegible]	[illegible]	[illegible],100	1,913	[illegible]	164	113.4	12,307	9,46[illegible]	[illegible]	21,980	32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Wilmington, Del.	[illegible]	57	89,000	3,514	108	112 [illegible]	127.2	17,920	7,685	2,637,[illegible]	20,654	30	213,963	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lynn, Mass.	1909	[illegible]	[illegible]	2,334	76	118	111.0	14,876	5,827	2,366,946	[illegible],042	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	
New Bedford, Mass.	1908	42	81,700	2,740	92	107	111.0	11,516	3,628	3,453,054	[illegible]	42	218,[illegible]	[illegible]	[illegible]		[illegible]	
Lawrence, Mass.	[illegible]	[illegible]	[illegible]	1,282	48	324 186	[illegible]	6,970	6,220	2,269,698	24,[illegible]	31	122,[illegible]	[illegible]	1.67		[illegible]	
Houston, Texas	1909	31	[illegible]	[illegible]	120	138	94.6	6,726	1,641	1,211,494	12,80[illegible]	16	[illegible],841	[illegible]	[illegible]		[illegible]	
Yonkers, N. Y.	1908	34	69,800	[illegible]	101	[illegible]	122.0	7,492	7,492	2,636,818	21,613	28	204,649	17	[illegible]	[illegible]	[illegible]	
Manchester, N. H.	[illegible]	[illegible]	68,[illegible]	1,265	[illegible]	117 [illegible]	117.4	6,737	4,947	1,962,198	16,714	[illegible]	131,023	19	[illegible]	[illegible]	[illegible]	
Erie, Pa.	1909	42	[illegible],600	[illegible]	200	293 [illegible]	130.6	[illegible],763	438	2,61[illegible]	20,[illegible]27	41	154,548	10	[illegible]		[illegible]	[illegible]
Brockton, Mass.	[illegible]	[illegible]	[illegible]	831	36	[illegible]	110.9	7,879	7,817	1,874,851	17,044	31	109,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Harrisburg, Pa.	[illegible]	[illegible]	[illegible]	3,658	171	[illegible]	67.2	15,728	12,240	1,[illegible]	18,973	[illegible]	189,18[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ft. Wayne, Ind.	[illegible]	[illegible]	[illegible]	1,438	74	112	102.0	11,834	4,078	1,288,[illegible]47	26,300	24	91,200	[illegible]	1.72		[illegible]	
Saginaw, Mich.	1909	37	51,900	3,332	176	110 132	104.8	7,412	334	987,929	9,427	18	83,754	11	[illegible]	24,476	[illegible]	[illegible]
Allentown, Pa.	1909	[illegible]	50,300	2,741	138	157 [illegible]	67.0	11,884	159	1,004,613	15,000	20	109,120	9	2.16	17,445	[illegible]	41
Pawtucket, R. I.	1909	[illegible]	46,700	3,311	194	264	171.1	10,309	8,679	2,442,017	14,272	[illegible]	242,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
McKeesport, Pa.	1908	26	45,300	1,979	117		60.1	6,090	1,628	604,880	10,064	13	63,877	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Binghamton, N. Y.	1909	42	[illegible],900	[illegible]	142	168	86.7	9,537	2,472	1,083,112	12,493	[illegible]	123,293	[illegible]	[illegible]		47,193	[illegible]
Topeka, Kan.	1908	[illegible]	43,800	880	[illegible]		78.6	5,229	[illegible]	756,505	12,910	17	80,911	15	[illegible]		[illegible]	[illegible]
Newton, Mass.	1908	38	38,800	894	63	245	143.5	7,900	6,908	2,314,691	16,120	60	132,[illegible]19	17	3.42	[illegible]	28,642	[illegible]
Rockford, Ill.	1909	34	38,000	1,318	95		90.7	7,215	3,109	819,926	9,391	22	68,470	[illegible]	[illegible]		[illegible]	[illegible]
Woonsocket, R. I.	1909	[illegible]	35,400	538	42	246	55.8	3,326	2,878	1,024,[illegible]	18,000	[illegible]	85,717	26	[illegible]	[illegible]	[illegible]	[illegible]
Taunton, Mass.	1909	33	30,900	793	70	161	86.0	[illegible]	2,630	1,391,[illegible]	16,182	45	78,[illegible]	17	[illegible]		[illegible]	42
Hamilton, Ohio	1909	25	28,900	883	83	248	66.3	5,068	3,053	1,193,731	[illegible]	41	45,147	[illegible]	1.56	[illegible]	[illegible]	[illegible]
Waltham, Mass.	1909	36	28,500	869	83	215	54.0	[illegible],800	320	787,010	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Aurora, Ill.	1908	[illegible]	27,800	[illegible]	[illegible]	175	59.3	5,212	4,521	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Madison, Wis.	1909	27	27,600	617	61	231	78.6	4,601	4,538	[illegible]	[illegible]	[illegible]	41,12[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Poughkeepsie, N. Y.	1909	36	26,000	[illegible]	44		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14	[illegible]		[illegible]	
Totals and means			[illegible]	[illegible]	94		[illegible]	[illegible]	266,466	$94,987,711	$18,[illegible]	[illegible]	$7,947,848	$16	[illegible]		[illegible]	[illegible]
Averages		[illegible]	[illegible]	2,924		[illegible]	[illegible]	12,760	[illegible]	[illegible]			[illegible]				[illegible]	

likely to let a much lower rate pass without interference than otherwise.

And the fact that he may refuse to interfere in a particular case is no indication that he sustains the rate as being fair, or even as being proper from the standpoint of the official or legislator charged with initiating it. Such a judge is likely to hold that the burden of fairness must be borne by the legislator or official, and that he, the judge, should only decide the question whether the property is being destroyed.

Hence, if one is seeking precedents as to the proper rate of return, the highest, and the ones which should be given the greatest weight, are those originating with a body such as the Wisconsin Commission, who are not only specifically charged by the legislature to perform such functions, but who are also charged with the investigation of all public utilities of the state, and who reach their decisions after a full hearing of the facts involved in particular cases, and class of cases.

The conditions are reversed when it comes to questions of principles which should control in finding the value of the property. It is pre-eminently the function of the courts to say whether the present value of the property should be found, or whether it should be the original cost.

Also as to whether if costs are considered, it should be only as evidence, bearing on present values, or as constituting the values themselves.

In some cases, as in the Urbana Water Works case, above referred to, the court is called upon to stand in the position of the maker of rates. Here the plant was in the hands of a receiver of the court finding the rate of return, and the fairness of the rate was in question rather than the constitutional one of confiscation.

NEEDED IMPROVEMENTS.

A summary of these needed improvements is as follows:

9.25 miles of main trunk feeders	$220,000
20 miles of subsidiary mains	130,000
One 12,000-gallon pump	40,000
12,000 meters set	150,000
2,000 service pipes	30,000
Total	$570,000

While this estimate can only be considered approximate, it may be assumed to substantially represent the improvements that ought to be made to the Peoria water plant by the end of the year 1913.

WATER CONSUMPTION AND METERS.

The Peoria Water Co. took over the city plant Oct. 31, 1889, and operated it until the early part of 1892, after which the supply came entirely from the new works.

These were officially tested June 3 and 4, 1892, and accepted July 25 following.

During 28 months, Oct. 31, 1889, to Feb. 21, 1892, while the old works were in operation, the average daily supply as shown by the pumping records, was 3,330,000 gals.

For the year June 30, 1892, to June 30, 1893, the first year of operating the new works, the average daily supply was 2,628,000 gals., which for a population of 46,000 gives a consumption of 57 gals. per capita per day.

For the year June 30, 1909, to June 30, 1910, the last year of operation, the average daily consumption was 7,435,000 gals. With a population of 73,000 as representing Peoria and the adjacent villages, supplied by the Peoria Water Works Co., the consumption was 102 gals. per capita per day.

This increase of water used per capita from 57 gals., to 102 gals. daily in 18 years, is not indicative of increased waste, or even of increased consumption, rated on the actual users of water.

The daily average consumption for each service pipe in the system, Jan. 1, 1893, was 804 gallons, and for Jan. 1, 1910, it was 718 gals., which tend to show that relatively to the number of actual users of water, a reduction is taking place in consumption.

A diagram giving a graphic representation of water consumed, service pipes, and miles of street mains, with reference to population, shows that though after July 1, 1892, the pipe mileage has not kept pace with population, the number of services have grown from 70 per one thousand of population to 142. The same law appears from an inspection of Table II.

It is then a demonstrated fact, that notwithstanding the average daily supply of water has increased in seventeen years from 2,628,000 gals. to 7,435,000, and the daily per capita consumption from 57 to 102 gals., there has been no actual increased wastage relatively, or increase in the use of water per actual consumer.

This does not signify, however, that there is not a large unnecessary wastage and use, which may be greatly reduced by the general use of meters.

The consumption at the present time is about as follows, as shown by the latest records:

	Gallons.
Daily average for the year ending June 30, 1910	7,435,000
Daily average for month of maximum consumption (June, 1910)	9,046,000
Maximum consumption for a single day (June 30, 1910)	10,688,000
The maximum consumption for a single day to August 12, 1910, was for July 9	12,178,000

The effect of a general metering of all water services cannot, of course, be foretold exactly, but that it would profoundly affect the consumption and waste of water cannot be doubted.

Meters have been introduced extensively in many cities of comparatively large size, and the results have been beneficial to such a degree, that the advisability of their use in the most of water works plants is no longer seriously questioned.

It is not to be inferred, however, that the advantage derived from their use is equal in all plants, and that there are not cases where the time has not arrived for their general introduction. There are, however, no cities where they should not be used for certain classes of service.

In this connection it should be observed that there are other causes operating in many cities to keep down the water consumption, the results of which are often erroneously attributed to meters. The very low consumption in many European cities and in some American cities is sometimes largely due to a [illegible] number of consumers being supplied through a single service pipe, and without discrimination in drawing inferences from water works data, meters may be given the credit for a low rate of consumption for which they are only partially the cause.

Though meters have come into general use in water works of a certain class, they are not supplied universally in the largest cities, such as New York, Chicago, Philadelphia, St. Louis and Boston.

In some intermediate sized cities, such as Cleveland and Milwaukee, they have been generally installed.

The best evidence of their effect in these and other smaller cities, is a comparison of water consumption before and after they have been generally installed.

Milwaukee—	Years 1892.	1909.
Population	[illegible]	[illegible]
Total number of service pipes	12,212	61,589
Total number of meters	871	51,120
Per cent of services metered	7.1	83.0
Number of service pipes per 1,000 of population	73	169
Daily average consumption of water, thousands of gallons	17,900	36,100
Daily average consumption of water per capita gallons	106	99
Daily average measured by meters per capita gallons	...	59
Daily average consumption of water per service gallons	1,464	586

In seeking for the effect of meters in Milwaukee, it will be observed that though only 7.1 per cent of the services were metered in 1892 as against 83 per cent in 1909, there has been but a small decrease in the water consumed per capita, while under nominal conditions with meters there should have been a reduction of nearly one-half.

This is accounted for by the fact that in 1892 there were only 73 services for 1,000 of population, and a consumption of 1,464 gals. of water per service, while in 1909 there were 169 services per 1,000 of population, and a consumption of only 586 gals. of water per service. This indicates that if there had been as many services for 1,000 of population in 1892 as in 1909, the amount of water per capita in 1909 would have been at least twice what is was, or to express it in another way, if meters had not been introduced, it is probable that the consumption of water in 1909, instead of being but 99 per capita, would have been in the neighborhood of 200 gallons per capita.

Cleveland—	Years 1901.	1908.
Population	[illegible]	[illegible]
Total number of service pipes	55,130	74,490
Total number of meters	3,540	69,733
Per cent of services metered	6.4	93.6
Number of services per 1,000 of population	134	143
Daily average consumption of water, thousands of gallons	69,600	52,000
Daily average consumption of water per capita gallons	169	100
Daily average measured by meters, per capita gallons	...	77
Daily average consumption of water per service gallons	1,263	698

As will be observed in the case of Cleveland, the effect of meters is clearly marked, a reduction in consumption of 69 gals. per capita or nearly 41 per cent having occurred in seven years, notwithstanding the fact that the number of services per 1,000 population has increased but slightly.

The apparent difference between Cleveland and Milwaukee in this regard is obviously due to the fact that the Cleveland plant was 48 years old in 1901, and hence had developed its business nearly in proportion to the size of the city at that time, while the Milwaukee plant was but 18 years old in 1892 and had not developed its business in such proportion.

In the latter case the development of business in proportion to population was in progress while meters were being introduced, while in the former this was true in only a minor degree.

Columbus, O.—	Years 1900.	1907.
Population	[illegible]	[illegible]
Total number of service pipes	14,556	24,975
Total number of meters	4,656	19,016
Per cent of services metered	10.2	76.5
Number of services per 1,000 population	116	[illegible]
Daily average consumption of water, thousands of gallons	24,400	16,300
Daily average consumption of water per capita gallons	194	99
Daily average measured by meters per capita gallons	...	
Daily average consumption of water per service gallons	1,676	652

Columbus shows a reduction in seven years in the per capita consumption of 95 gals., or over 49.0 per cent, notwithstanding the fact that there was considerable development of business relative to population occurring while meters were being introduced.

Minneapolis—	Years [illegible]	[illegible]
Population	[illegible]	[illegible]
Total number of service pipes	26,444	33,500
Total number of meters	11,044	25,193
Per cent of services metered	[illegible]	76.1
Number of services per 1,000 of population	[illegible]	[illegible]
Daily average consumption of water, thousands of gallons	[illegible]	[illegible]
Daily average consumption of water per capita gallons	[illegible]	[illegible]
Daily average measured by meters per capita gallons	21	32
Daily average consumption of water per service gallons	[illegible]	[illegible]

For an American city, Minneapolis has a small number of service pipes per 1,000 population in both years compared, which partly accounts for the comparatively low water consumption per capita. Meters must be given credit for a considerable part of it, however.

St. Paul—	[illegible]	[illegible]
Population	[illegible]	[illegible]
Total number of service pipes	[illegible]	[illegible]
Total number of meters	[illegible]	[illegible]
Per cent of services metered	[illegible]	[illegible]
Number of services per 1,000 of population	[illegible]	[illegible]
Daily average consumption of water, thousands of gallons	8,600	11,700
Daily average consumption of water per capita gallons	[illegible]	[illegible]
Daily average measured by meters per capita gallons	[illegible]	[illegible]
Daily average consumption of water per service gallons	[illegible]	[illegible]

The effect [illegible] consumption in St. Paul is shown by the fact that the water used per capita remained prac[illegible]

time the number of services per 1,000 of population was increased more than one-third, the metered service in 1909 being less than 50 per cent.

Lowell, Mass.—	Years 1898.	1909.
Population	91,500	95,100
Total number of service pipes	10,396	12,307
Total number of meters	4,865	9,465
Per cent of services metered	46.9	76.9
Number of services per 1,000 of population	[illegible]	[illegible]
Daily average consumption of water, thousands of gallons	6,700	5,200
Daily average consumption of water per capita gallons	73	55
Daily average measured by meters per capita gallons	20	28
Daily average consumption of water per service gallons	644	426

The effect of meters is very marked in Lowell, as a material reduction in the water consumed per capita has taken place, while a material increase of services per 1,000 of population was occurring.

Fall River, Mass.—	Years 1880.	1909.
Population	48,900	106,400
Total number of service pipes	2,685	8,216
Total number of meters	1,583	8,197
Per cent of services metered	59	98.5
Number of services per 1,000 of population	[illegible]	78
Daily average consumption of water, thousands of gallons	1,100	5,300
Daily average consumption of water per capita gallons	28	50
Daily average measured by meters per capita gallons	...	24.5
Daily average consumption of water per service gallons	508	642

Fall River is an example of a city that used meters in considerable numbers from the beginning. In 1874, the first year of operation, there were 7.5 per cent of the services metered, and in 1876, the third year of operation, there were 35 per cent of the services metered.

In 1880 the business of the plant was in an undeveloped state, and there were very few services to each 1,000 population, hence the low consumption per capita.

By 1909 the number of services per 1,000 of population had increased 42 per cent, but still remains at the extremely low number of 78, which represents about 12.9 of population to the service.

The low consumption per capita which has always obtained in Fall River, considering that it is a large manufacturing city, is not altogether due to meters. A considerable part of it must be ascribed to the large number of consumers for each service pipe.

Madison, Wis.—	Years 1890.	1908.
Population	[illegible]	[illegible]
Total number of service pipes	[illegible]	4,601
Total number of meters	411	4,538
Per cent of services metered	[illegible]	[illegible]
Number of services per 1,000 of population	[illegible]	[illegible]
Daily average consumption of water, thousands of gallons	520	1,700
Daily average consumption of water per capita gallons	[illegible]	[illegible]
Daily average measured by meters per capita gallons	[illegible]	[illegible]
Daily average consumption of water per service gallons	[illegible]	[illegible]

Madison shows a low consumption of water per capita, particularly in 1890, considering the [illegible] 1,000 of population.

And considering the character of the city, with thousands of inhabitants attending the university that do not appear in the census returns, the consumption per capita in 1908 shows the effect of meters in keeping it down.

This case furnishes a marked example of the effect of an increase of services per 1,000 of population to carry with it increased rate of consumption per capita.

Here the services per 1,000 of population grew in eighteen years nearly 63 per cent, in spite of which and in spite of a large percentage increase of meters relative to service pipes, the water consumption per capita was 60 per cent greater in 1908 than in 1890.

The foregoing eight cities comprise all at present available that permit of a comparison of the progressive effect of meters on the consumption of water. Other data, however, confirms and reinforces the results shown.

A comparison of Cleveland and Milwaukee with [illegible]

[illegible]

City.	Year.	Population	Per cent [illegible]	Daily av. [illegible] capita
Cleveland .	[illegible]	[illegible]	93.6	[illegible]
M[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chicago ..	[illegible]	[illegible]	3.9	[illegible]
Detroit ...	[illegible]	[illegible]	9.0	[illegible]
Buffalo ...	[illegible]	[illegible]	4.0	[illegible]
[illegible]	[illegible]	[illegible]	2.3	100
[illegible]	[illegible]	50,000	4.5	177

W[illegible] Milwaukee are large manufacturing cities, certainly as much so in proportion to population as Detroit and Buffalo, it is fair to conclude that their consumption of water would have been twice what it is, if meters had only been used for say, 4 per cent of the services.

The Under-City Tunnel for Delivering Catskill Water to the Distribution Mains of New York.

The construction of an 18-mile rock tunnel from 11 to 15 ft. in diameter forms one of the [illegible] construction of New York city's improved water supply. This the reasons for adopting a tunnel, the conditions governing its location and construction and the general structural details.

The Catskill aqueduct has a capacity of 500,000,000 gals. of water per 24 hours. To distribute this supply in New York city through pipe mains in such a way as to economize the available gravity pressure would require the equivalent of 16 pipes 66 ins. in diameter or of 30 pipes 48 ins. in diameter, which, for cast iron pipes, would cost $47,000,000. But the laying of so many miles of great pipes would necessitate digging up many busy streets, with all the attendant annoyances and dangers, and the unavoidable direct losses to business along the routes. Furthermore, the streets are already so occupied by pipes, sewers and conduits, and by subway, surface and elevated railways, or have been so pre-empted for future subways and other sub-surface structures, that to obtain locations for even a few large new water mains was scarcely practicable. Fortunately, the geology of the city offered a much safer, more convenient, far more permanent and more economical solution of this difficult waterworks problem through the most congested portions of the metropolis. In other words, the underlying rocks, for the most part sound and strong, made feasible one great conduit—a pressure tunnel deep in the rock—from Hill View reservoir, just north of the city line in Yonkers, to the heart of Brooklyn, traversing the Boroughs of The Bronx and Manhattan, and passing under the Harlem and East rivers. Extensive explorations with core drills demonstrated that such a tunnel was practicable, and other studies indicated that it, with large pipe lines extending from its Brooklyn termini into Queens and Richmond boroughs, could be constructed for but little more than half the cost of the all-pipe delivery system.

In the exhaustive studies more recently made for planning the interborough delivery, the speed and general success with which 17½ miles of pressure tunnels are now being built north of the city for the Catskill aqueduct emphasized the desirability of this type of conduit.

The governing factor in the tunnel's general location, as well as in its adoption, was the existence of tunneling rock at reasonable depth. The rock formations of New York City are mostly well known types in which tunneling has been extensive and successful. To be sure, there are difficulties to be overcome, as in all tunneling. In The Bronx and Brooklyn the prevailing types of rock are gneiss, and on Manhattan island schist. At the Harlem River and the old location of the East River, in the Bowery district of the lower East Side, Manhattan, dolomitic limestone is found in relatively narrow beds, and, at the latter place, interbedded with gneiss formations. The distance to which the tunnel was projected in Brooklyn was determined mainly by two considerations: first, beyond the locality chosen for the termini, the quantity of water to be carried in any one conduit was too small to make tunnel construction economical; second, the surface of the ledge rock had descended to such depth that it was not feasible to sink shafts to it through the overlying drift materials since with the exception of the upper 20 to 50 ft., approximately, the shafts are below tide level. Hence compressed air or similar highly expensive construction becomes necessary, and the depth to which pneumatic work can be carried is limited by human endurance.

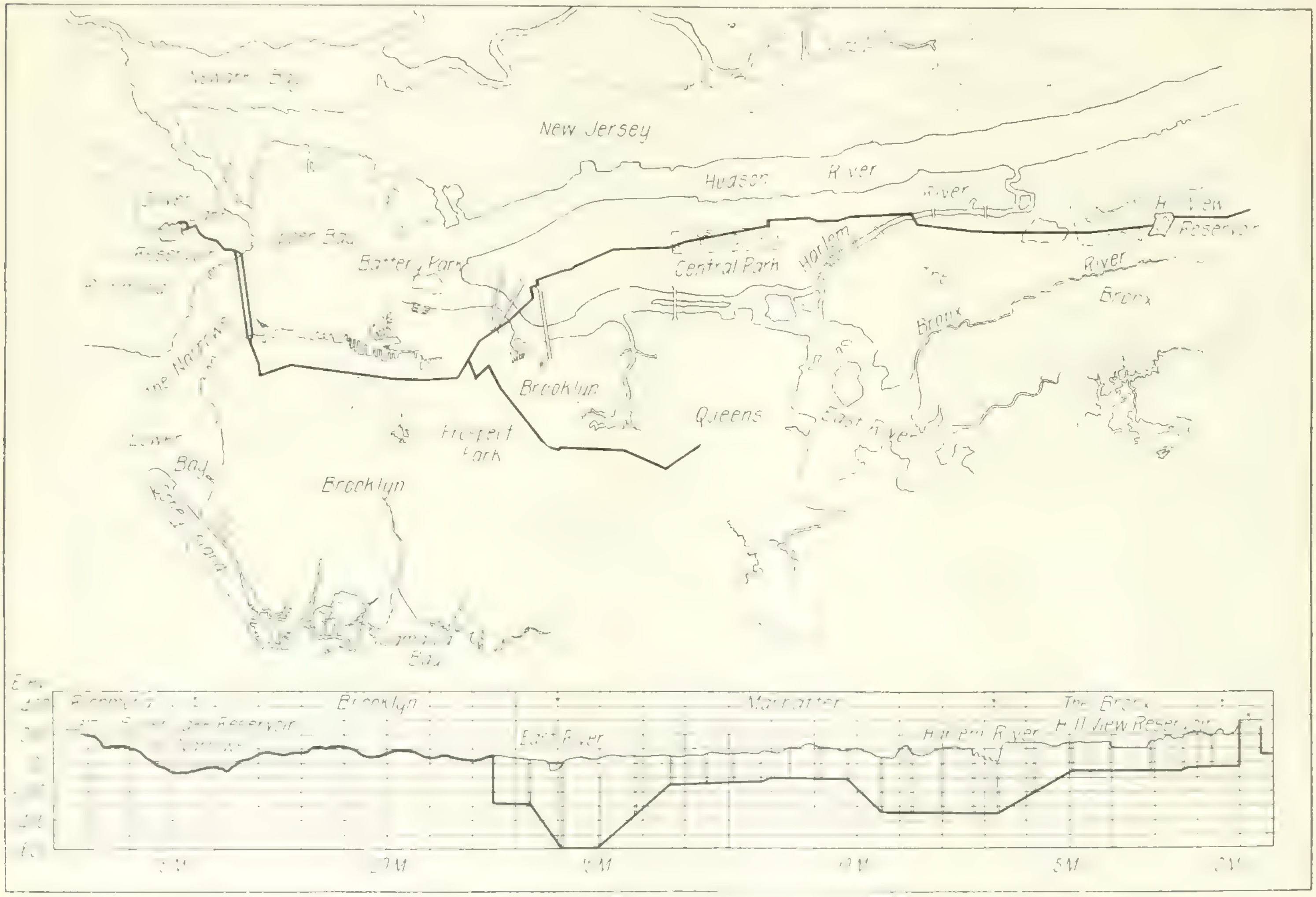

Fig. 1—Map and Profile of Under-City Tunnel, Catskill Water Supply for New York City.

The tunnel is shown in plan and profile by the map Fig. 1. Beginning at Hill View Reservoir the lengths and diameters of the several sections are as follows:

Length, Ft.	Diameter, Ft.
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
15,000	11

The final section of 15,000 ft. includes the 1,800-ft. branch tunnel in Brooklyn. A standard cross-section of the 12-ft. tunnel is shown by Fig. 2, and similar sections are used for the other diameters. Where the work may have to be timbered variations from Fig. 2 are provided for but these need not be given here where it is proposed merely to state briefly

For constructing the tunnel 24 shafts will be sunk, ranging in depth from 200 to 750 ft. The most northerly, Shaft 1, will be sealed after the tunnel is completed and not further used. Shafts 11 and 21, in the depressions in the profile just mentioned, will be equipped as drainage shafts, by means of which the tunnel, or parts of it, can be unwatered for inspection or repairs, if, in the distant future, the latter should become necessary. At Shafts 13 and 18 (see map and profile), all-bronze, hydraulically-operated gate valves will be placed across the tunnel, thus dividing it into three sections; these two valves have consequently been named: section valves.

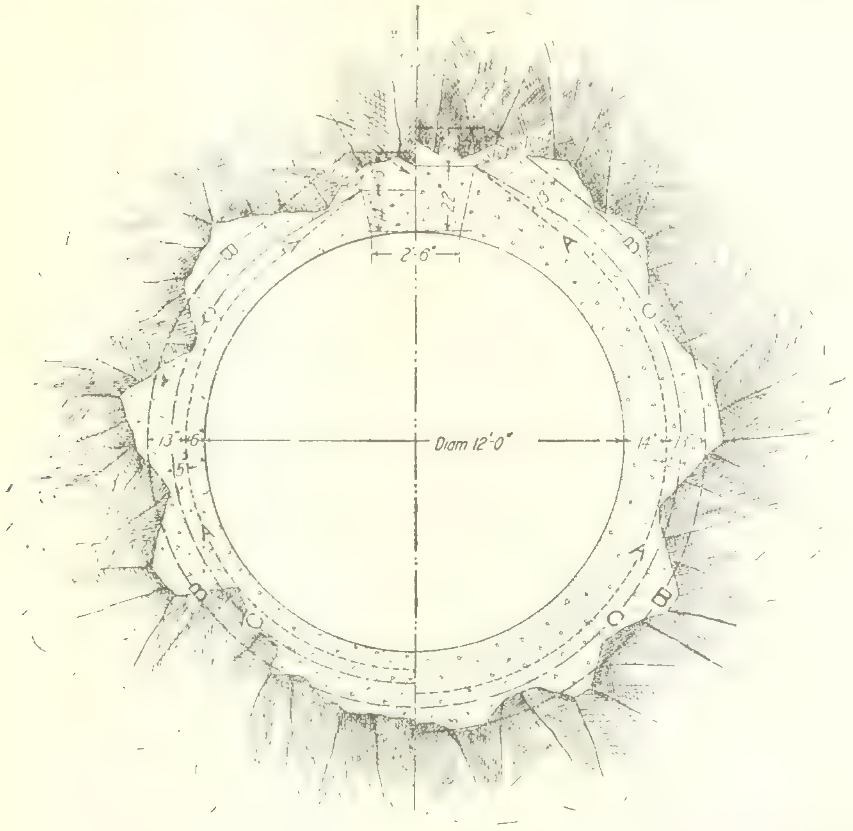

Fig 2—Standard Cross Section of Under-City Tunnel, Catskill Water Supply for New York City.

Into all shafts, except Numbers 1 and 11, one or two steel pipes, designated as risers, are to be built, imbedded in and lined with concrete, thus affording connection from the tunnel to the distribution mains in the streets. Each riser will be covered at its top with a bronze casting, termed a shaft cap, and shaped much like a pipe cross, the bottom being fastened to the top of the steel riser and the top covered by a domed cover bolted on. The two horizontal outlets, usually 30 ins. in diameter, each will have an all-bronze, screw-operated gate valve bolted to its flange, beyond which other valves, Venturi meters, pressure regulators, etc., will make up the connections to the distribution pipes.

The valves and meter registers at each shaft will be contained in a large concrete chamber. At Shaft 3, for connection to Jerome Park reservoir, and in Shafts 23 and 24, the Brooklyn termini, the risers will be 72 ins. in diameter inside their concrete linings; all the other risers will be 48 ins. in diameter. By removing the domed cover from each shaft cap access can be had directly into the tunnel whenever the latter is unwatered.

As a safeguard against the serious result of an accident to the works at the head of a shaft, and for convenience in certain operations, a special valve is to be placed at the bottom of each riser. These have been named riser valves and will be wholly of bronze and so designed as to work either automatically, or by manipulation in the valve chamber, or at a distance by means of electricity.

The shafts are spaced from 2,300 to 5,200 ft. apart. Fortunately, it has been possible to locate the tunnel so as to bring most of the shaft sites in public parks or large open spaces at the intersections of avenues and streets. In only three cases are shafts located on private property which will have to be bought, although, in one or two other cases, private property will be secured for temporary use during construction. With the exception of a few hundred feet, the tunnel is located beneath public property. Such location results in great economy, avoiding purchase of easements in expensive real estate, and also avoiding the possibility of having plunger elevator shafts, artesian (!) wells, or similar borings sunk into the tunnel, with the consequent trouble.

Throughout its length the tunnel will be lined with dense, strong Portland cement concrete, and the rock will be thoroughly grouted under pressure back of this lining. The object of this treatment is to render the tunnel as watertight as feasible. Smooth lining, of course, also greatly enhances the hydraulic capacity of the tunnel and makes its cleansing easier. The diameters of the hole in the rock will be roughly 4 ft. greater than those of the finished tunnel bore.

To withstand, with an abundant margin of safety, the unbalanced bursting pressure due to the elevation of Hill View reservoir above the ground water table over the tunnel it was decided that the minimum depth of sound rock above the tunnel should be 150 ft. As a matter of fact the depth of the tunnel in sound rock is everywhere greater than this minimum, and, for a large part of its length much greater, as shown by the profile. The depths below the surface of the ground range from 200 to 750 ft. Two deep depressions in the profile were necessary. The northerly drop passes beneath the Harlem river and Manhattanville valleys, and the southerly, beneath the old bed of the East River. At both places geologic faulting and the action of the water have weakened the rocks to great depth.

The riser valves are so designed that each can be readily disengaged from its settings, without staging, and lowered to the tunnel or [illegible] shaft can be quickly cleared for access to the tunnel, after unwatering. The hydraulic cylinders for operating the section valves will be in the chambers at the tops of their shafts.

Each drainage shaft is located about 75 ft. from the tunnel and is connected with it by a horizontal drift which contains a hinged, dome-shaped, elliptical bronze door, or valve. It is thus possible to shut the shaft off completely from the tunnel and to empty it while the tunnel is in service. A steel float, shaped like a huge milk can, will be placed in each drainage chamber. Electrically driven centifugal pumps, with their motors, will be installed in the float whenever the tunnel is to be unwatered and will descend with the water level during pumping until the float rests on the bottom of the shaft. After the work in hand is completed, the bronze door and other valves can be closed and the tunnel refilled. By refilling the drainage shaft through a pipe provided for the purpose the float is returned to the surface, permitting the machinery to be dismantled and suitably stored.

From each chamber a drain will extend to a nearby sewer or water course, thus keeping the floor free from water. Each chamber will have electric lights and a ventilating fan which can be set in operation as soon as the attendant enters the chamber. The tendency of various noxious gases to accumulate in such deep chambers and manholes renders ventilation imperative. Access to each chamber will be by means of a trap door opening on to a stairway. Frequent visits to these chambers will be necessary.

By reversing the normal direction of flow in the pipe lines and tunnel it will be possible to draw upon the Brooklyn system and the 400,000,000-gal. terminal reservoir in Richmond and thus to send water to The Bronx and Manhattan. The new city aqueduct thus incidentally inter-connects all the important water supply systems of Greater New York.

The many advantages of the deep under-city tunnel over sub-surface mains of equal capacity are perhaps specially prominent in New York, where urban pressure tunnel construction originated in the Harlem river crossing and adjacent portions of the new Croton aqueduct, placed in use in 1891 and uninterruptedly in service since that time. Through this new city tunnel it will be possible to deliver Catskill water by gravity to the twentieth stories of tall buildings in the downtown districts, after the necessary changes have been made in the distribution pipes. This high-pressure gravity supply, it has been estimated, will permit the elimination of public and private pumping now costing about $2,000,000 per annum. It will afford better fire protection. It is anticipated that construction will begin next spring and that about 4½ years will be required for the work.

Messrs. John A. Bensel, Charles N. Chadwick and Charles A. Shaw are the Commissioners of the Board of Water Supply, and Mr. J. Waldo Smith is Chief Engineer, and Mr. Merrit H. Smith is Deputy Chief Engineer. Mr. Walter E. Spear, Department Engineer, is to have charge of the City Aqueduct construction, and for some time has had immediate charge of the surveys. The preliminary studies and surveys and the preparation of the designs and specifications have been carried on under the direction of Mr. Alfred D. Flynn, Department Engineer, with Mr. Thomas H. Wiggin as senior designing engineer and Mr. Percy C. Barney as principal assistant engineer.

The information from which this article has been prepared was taken from the 1909 report of the Board of Water Supply, New York City, and from a paper by Mr. Flynn in the Harvard Engineering Journal for January, 1911.

Colorado Roads Make Trackage Agreement.—Fruitless competition between the Denver & Rio Grande and the Colorado & Southern is to be abolished by a trackage agreement just made by these roads. The Denver & Rio Grande gets trackage rights over the Colorado & Southern between Gunnison and the Baldwin coal mines, Ohio City and Pitkin; while the Colorado & Southern gets trackage rights over the Denver & Rio Grande from Leadville to Dillon. The two roads own parallel lines between the points mentioned, and the owning road will retire in each case from the operation of the track in question.

STEAM AND ELECTRIC RAILWAY SECTION

Freight Train Resistance: Its Relation to Average Car Weight.*

[illegible]

[illegible] shows for the train under consideration the relation existing between train resistance and speed. Fig 1† is fairly representative of the entire group of curves, and such discussion of it as follows is general in its application.

The plotted points show unmistakably an increase in resistance as the speed increases, and the curve drawn represents the mean relation between resistance and speed. In Fig. 1 the maximum variation from this mean of any calculated value of resistance is about 20 per cent; the next largest variation is 16 per cent and other calculated values of resistance differ from the values determined from the curve by generally less than 10 per cent. In a majority of the tests the maximum variation is less than in Fig. 1, and the general agreement between the calculated values of resistance and the ordinates of the curve is better than in the test chosen for illustration.

It has been thought desirable to express more specifically this variation between the calculated values of resistance and the mean values as derived from the curves drawn. To this end, for all tests, all calculated values of resistance for speeds between 8 and 12 miles per hour were compared with the ordinates of the curves at the corresponding speeds and the percentage difference was determined in each case. These percentages were then arranged in two groups and averaged. The one group included the results from all points lying above the curve, the other from those lying below it. The whole process was next repeated for speeds between 28 and 32 miles per hour. For speeds between 8 and 12 miles per hour, the average deviation (for all tests) of calculated resistance from the mean values derived from the curves, expressed in percentage of the mean values, were 6.4 per cent above the mean, and 7.6 per cent below the mean. For speeds between 28 and 32 miles per hour these percentages were 5.6 per cent above the mean and 6.6 per cent below the mean. Such variation seems not unduly great for this class of experimental work.

These differences may be due in part to accumulated errors in instruments or in the calculations. In all cases, however, where the calculated value of resistance varied by an unusual amount from the mean, all calculations leading thereto were repeated a second time and errors thus discovered have been eliminated from the report. The explanation for such differences need not be sought further than in the variations which actually occur from time to time, in the resistance itself. Variations in such components of train resistance as flange friction and wind resistance are probably sufficiently great to account for the differences discussed above. The data do not permit the influences of such components of resistance to be differentiated.

The curve drawn for each test has been accepted as representing the average values of net train resistance with a degree of accuracy sufficient for the purpose of rating locomotives. Such temporary excess of resistance as may be expected to occur will generally be absorbed in that reserve in the tractive effort of the locomotive which must be allowed in any system of tonnage rating.

Results of All the Tests.—The resistance curves for the individual tests were then brought together on one sheet, displaying the immediate results of the whole research. The lower curves gave values of resistance varying from 3 lbs. to 5½ lbs. per ton, while the upper curves gave resistance values varying from 7 lbs. to 14 lbs. per ton. Resistance values at the lower speeds differ by 100 per cent, and values at higher speeds differ by as much as 200 per cent.

The explanation of this variation has been sought in the test conditions enumerated below, each of which, it was conceived, might have contributed in some degree to bring about the differences disclosed.

(*a*) Weather and temperature conditions.
(*b*) Wind velocity and direction.
(*c*) Kind of cars composing the train.
(*d*) Position of the loaded cars in the train.
(*e*) Defects in train equipment.
(*f*) Average weight of the cars in the train.

The first five conditions are either uncontrollable or were purposely not controlled during these experiments. Attempts to explain the differences between the results by reference to one or the other of these five factors have been altogether unsuccesful. While it is true that difference in wind velocity, for example, might be accepted as a plausible explanation of the differences between two or three tests selected at random, such explanation will not hold when applied to two or three other tests similarly chosen; and it fails altogether to explain such differences when it is applied to the whole group.

Item *f*, however, has furnished the clue whereby the apparent confusion in the results of the tests has been explained. It may be stated at once that the difference in train resistance for various tests is believed to be due chiefly to differences in the average gross car weights existing during the tests. An explanation of the process which led to this opinion follows immediately below. As was stated at the outset, this conclusion was anticipated when the work was begun, and the average car weight was therefore controlled during the experiments, and made to vary through the widest possible range.

The Effects of Car Weight on Resistance.—If from each of the tests the value of resistance is determined at one speed, say 5 miles per hour, these values of resistance may then be plotted with respect to their corresponding values of car weight; and, since the speed is common, its influence is eliminated and the resulting diagram may be expected to reveal the relation existing between train resistance and average weight per car. Table II was prepared to facilitate this process. In it the tests are arranged in the order of the average car weights. Table II therefore presents the values of the coordinates of seven points on each of the curves and hence summarizes the immediate results of all tests.

In Table II the second and third columns present a series of values of average car weight and of train resistance at 5 miles per hour. Each pair of these values represents the results of one of the 32 tests. Using these pairs of values as coordinates, a series of points was plotted to form a new diagram for each series, of which Fig. 2 is an example. For example, the point marked 21 in Fig. 2 is derived from the curve of test S-1021. The curve of resistance for this test (see Fig. 1) shows that at 5 miles per hour the mean resistance is 4.21 lbs. per ton. During this test the average weight of the cars in the train was 46.16 tons. Table II also exhibits both of these values which, when plotted in Fig. 2, determine the point there marked 21. The other points of Fig. 2 were similarly determined. Each point represents the value of resistance at 5 miles per hour derived from a particular test train.

Although there is considerable variation among the points of Fig. 2, they indicate clearly a decrease in the resistance as the car weight increases. The curve drawn in Fig. 2 represents, for the trains tested, the mean relation which existed between resistance at 5 miles per hour and the average car weight. As has been previously explained, the curve is drawn by finding the "centers of gravity" of several groups of points.

The variation in resistance represented by the points in the different diagrams is sufficient to warrant further discussion. Such discussion will, however, be postponed until later in the report. The conclusion reached is that these variations are largely caused by factors which are uncontrollable in ordinary train operation. If this be admitted, it is clear that the discussion of such variations may enter into the solution of tonnage rating problems only as an argument for reserve tractive effort in the locomotive.

These curves were accepted as representing, for these tests, the mean relation which existed between train resistance and the average gross weight of the cars composing the trains. They exhibited this relation at seven different speeds, 5, 10, 15, 20, 25, 30 and 35 miles per hour. For convenience in use and to make comparison easier, these seven curves were brought together in one diagram, which is reproduced in Fig. 3.

Fig. 3 presents the final results of the whole research. Each of the curves there drawn shows the mean relation, which existed during the tests, between car weight and resistance at a definite speed.

It is believed that the curves of Fig. 3 are generally applicable to ordinary American freight trains, provided the conditions surrounding their operation are like those which prevailed during these tests. The curves of Fig. 3 enable one to determine the probable

TABLE II.—VALUES OF TRAIN RESISTANCE AT VARIOUS SPEEDS.

		Train Resistance—pounds per ton.						
Test No	Av. weight per car tons	5 m. p. h.	10 m. p. h.	15 m. p. h.	20 m. p. h.	25 m. p. h.	30 m. p. h.	35 m. p. h.
S-1016	16.12	7.35	7.40	7.62	8.37	9.91	12.22	...
S-1034	16.56	8.10	8.70	9.92	11.90	14.30	...	...
S-1074	16.56	6.92	8.23	10.10	12.32	14.70	.	....
S-1043	16.92	8.50	8.61	8.85	9.30	10.00	10.95	12.04
S-1019	17.72	7.30	7.47	7.90	8.85	10.32	...	
S-1063	20.04	6.98	7.13	7.43	7.90	8.63	9.63	.
S-1031	20.72	.	6.24	6.30	6.40	6.73	7.60	8.94
S-1080	21.40	4.40	5.57	6.75	7.94	9.15	10.35	11.55
S-1070	24.60	5.93	6.63	7.47	8.57	9.90	.	....
S-1052	24.80	7.55	7.63	7.80	8.10	8.55	9.20	10.05
S-1018	25.40	5.80	5.95	6.20	6.63	7.22	8.26	10.02
S-1077	28.40	4.32	4.91	5.58	6.34	7.15	8.01	8.96
S-1079	33.04	3.66	4.30	4.92	5.60	6.22	6.89	7.55
S-1015	36.08	5.20	5.36	5.52	5.70	6.02	6.71	7.95
S-1036	37.72	4.98	5.03	5.12	5.15	5.31	5.88	7.15
S-1013	38.04	...	5.40	5.65	5.95	6.32	6.90	7.68
S-1017	38.44	5.90	5.95	6.02	6.20	6.48	7.01	8.03
S-1023	38.72	4.16	4.80	5.56	6.40	7.30	8.25	
S-1050	40.44	...	5.10	5.25	5.40	5.62	5.90	6.33
S-1057	41.32	3.40	3.88	4.35	4.83	5.31	5.80	6.30
S-1048	45.24	4.05	4.35	4.80	5.48	6.30	7.23	...
S-1040	45.76	4.22	4.30	4.40	4.58	4.90	5.52	6.53
S-1021	46.16	4.21	4.41	4.72	5.29	6.15	7.20	8.40
S-1027	47.44	4.31	4.48	4.67	4.90	5.22	5.79	6.55
S-1061	51.20	3.50	4.00	4.51	5.01	5.51	6.01	6.53
S-1033	51.72	4.10	4.15	4.20	4.25	4.32	4.40	4.65
S-1038	52.28	3.30	3.50	3.71	3.95	4.25	4.60	5.08
S-1030B	57.12	3.73	3.80	3.82	3.90	4.10	4.50	....
S-1030A	59.88	3.84	3.88	3.92	4.10	4.45	4.95	..
S-1072	66.40	3.40	3.50	3.70	4.10	4.61	5.27	6.00
S-1073	67.16	2.52	2.90	3.30	3.70	4.10	4.50	4.90
S-1076	69.92	2.97	3.13	3.37	3.70	4.04	4.49	4.95

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*Abstract of paper by Edward C. Schmidt, Professor of Railway Engineering, University of Illinois, published in Bulletin 43, University of Illinois Experiment Station.

†[illegible] Engineering-Contracting of March 1, 1911.

mean resistance of any such train, at speeds between 5 and 35 miles per hour, provided the average weight of the cars composing the train be known.

The Results Expressed as Resistance-Speed Curves.—While Fig. 3 presents the main results of the experiments, the form in which these results are there expressed is unusual. Ordinarily, train resistance is expressed either as a curve or equation which defines the relation between resistance and speed, instead of the relation between resistance and car weight as in Fig. 3. Obviously, to express the results of these experiments in the usual form, a single curve will not suffice, since the influence of car weight cannot be thereby made evident. A number of curves will be required for this purpose, each of which will apply only to a definite average car weight. Fig. 4 presents such a group of resistance-speed curves, which have been derived directly from the curves of Fig. 3.

TRAIN RESISTANCE FORMULAS.

When $W = 15$ tons; $R = 7.15 + 0.085\ S + 0.00175\ S^2$ .... (1)
When $W = 20$ tons; $R =$ [illegible] $+ 0.087\ S + 0.00126\ S^2$ .... (2)
When $W = 25$ tons; $R = 5.60 + 0.077\ S + 0.00116\ S^2$ .... (3)
When $W = 30$ tons; $R =$ [illegible] $+ 0.066\ S + 0.00116\ S^2$ .... (4)
When $W = 35$ tons; $R = 4.49 + 0.060\ S + 0.00108\ S^2$ .... (5)
When $W = 40$ tons; $R =$ [illegible] $+ 0.041\ S + 0.00134\ S^2$ .... (6)
When $W = 45$ tons; $R = 3.82 + 0.031\ S + 0.00140\ S^2$ .... (7)
When $W = 50$ tons; $R = 3.56 + 0.024\ S + 0.00140\ S^2$ .... (8)
When $W = 55$ tons; $R = 3.38 + 0.016\ S + 0.00142\ S^2$ .... (9)
When $W = 60$ tons; $R =$ [illegible] $S +$ [illegible] S^2 .... (10)
When $W = 65$ tons; $R = 3.06 + 0.014\ S + 0.00130\ S^2$ .... (11)
When $W = 70$ tons; $R = 2.92 + 0.021\ S + 0.00111\ S^2$ .... (12)
When $W = 75$ tons; $R = 2.87 + 0.019\ S + 0.00113\ S^2$ .... (13)

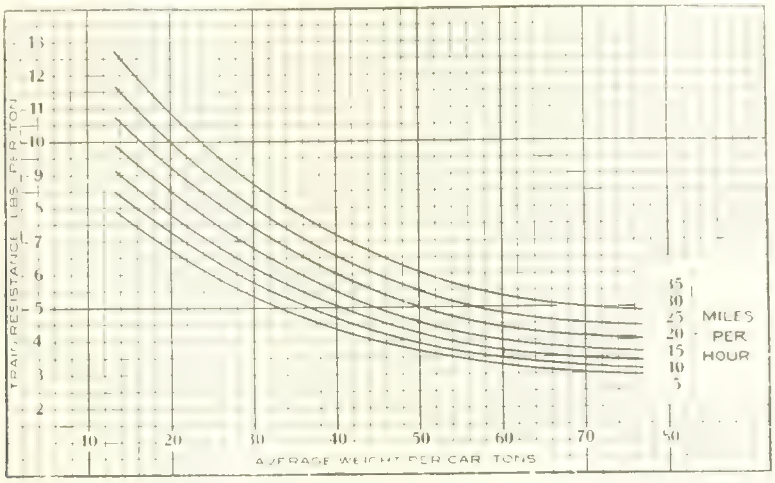

Fig. 3—The Relation Between Resistance and Average Car Weight, at Various Speeds.

The relation between the two figures may be made clear by explaining the derivation of the upper curve in Fig. 4—the one applying to a car weight of 15 tons. In Fig. 3 the ordinate corresponding to an average car weight of 15 tons cuts the seven curves there drawn at 7 points, at which the mean resistance values are 7.62, 8.20, 8.81, 9.56, 10.37, 11.24 and 12.25 lbs. per ton, corresponding to speeds of 5, 10, 15, 20, 25, 30 and 35 miles per hour, respectively. These values are the coordinates of 7 points on a resistance-speed curve applying to a car weight of 15 tons. These 7 points have been plotted in Fig. 4 and the upper curve there shown has been passed through them and extended to 40 miles per hour. The other curves of Fig. 4 were derived by a like process.

The Results Expressed in Tabular Form.—From each of the curves of Fig. 4 the values of resistance at various speeds have been determined and set down in Table III. Table III also includes the coordinates of the resistance curves corresponding to 55, 65, and 70 tons per car, which are omitted from Fig. 4.

The Results Expressed As Equations.—The relation between resistance and speed shown by each of the curves of Fig. 4 may also be expressed in the form of an equation. Formulas 1 to 13 below are such equations, by means of which resistance may be calculated for any speed and for various car weights. In the formulas, R is the resistance expressed in pounds per ton, S is the speed expressed in miles per hour, and W is the average weight of the cars in the train expressed in tons. The formulas are purely empirical, and are simply equations of parabolas so selected as to correspond very closely with the curves of Fig. 4. The correspondence between the formulas and the curves is such that the maximum difference between any value of resistance obtained by the formulas and the corresponding value obtained from the curves of Fig. 4 is ½ of 1 per cent. Since these are empirical equations, their use should not be extended byeond the speed limits shown on Fig. 4.

The results of the tests may also be approximately expressed by the following single empirical equation in which R is expressed in terms of both S and W.

$$R = \frac{S + 39.6 - 0.031\ W}{4.08 + 0.152\ W} \qquad \text{............} (14)$$

When compared with the results of the tests as shown in Fig. 4, this equation results in a maximum error of 9.5 per cent. This error occurs when $S = 21$ and $W = 55$. For all other values of S and W the error resulting from the use of the equation is 9.0 per cent or less.

Final Results.—The final results of the research are presented in Fig. 4, in Table III, and in formulas 1 to 13. It is believed that by means of the figure, or the table or the formulas, the resistance of ordinary freight trains may be fairly accurately predicted; provided the conditions surrounding their operation are similar to those which prevailed during these tests. It should be born in mind that the results apply to trains running at uniform speed, on tangent and level track of good construction, during weather when the temperature is not lower than 30° F., and when the wind velocity does not exceed about 20 miles per hour.

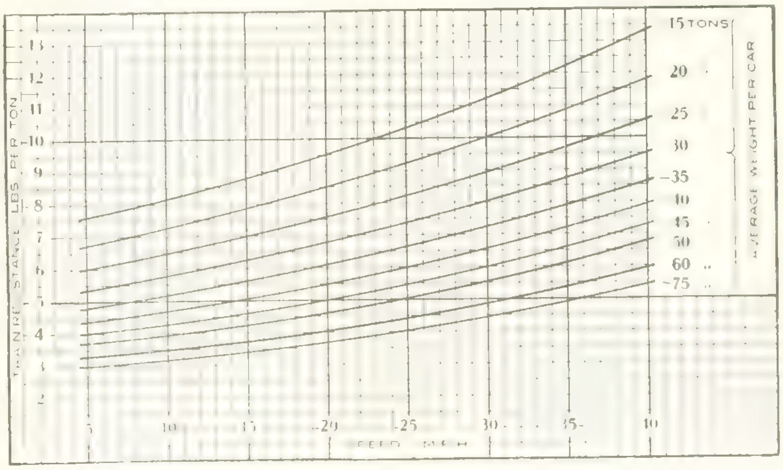

Fig. 4—The Relation Between Resistance and Speed, for Various Average Weights per Car.

DISCUSSION OF THE RESULTS.

Variation in Resistance of Different Trains.—Reference has been made to the variations among the points of Fig. 3 and similar diagrams. In each figure about one-half of the points lie above the curve there drawn, and their resistance values vary from those of the curve by different amounts. It should be borne in mind that, in these figures, each point represents the average resistance which prevailed throughout a particular test, and differences among the points represent, therefore, differences in the mean resistance of the different trains.

Among those trains which are regarded as normal there are two or three whose resistance at some speed varies from the mean, as expressed in the curves, by as much as 23 per cent. The great majority, however, vary from this mean by about 10 per cent or less.

The data present no satisfactory general explanation for these differences in the resistance of different trains of like average weight per car. They may be due to difference in external conditions or to difference in train condition and make-up. Whatever may be the explanation for these differences it is significant that about one-half of the trains experimented upon developed a resistance about 9 per cent in excess of the mean resistance which would be predicted by the use of Figs. 3 and 4. Obviously a similar excess may be expected with any train, and it is suggested therefore that, in determining the resistance of trains on level tangent track for the purpose of rating locomotives under operating conditions which demand conservative ratings, 9 per cent be added to the resistance values obtained from the curves, tables, and equations presented. Such considerations are of little practical importance in rating locomotives for speeds above 15 miles per hour. In such cases an excess in resistance over that expected can result in nothing more serious than failure to realize the expected train speed.

It should be understood that this 9 per cent allowance is intended to cover probable variations in the resistance of different trains under normal operating conditions. It in no way takes the place of that additional reserve which must be allowed to cover unusual variations in resistance due to low temperatures or high winds, or of that reserve in tractive effort of the locomotive which is necessitated

TABLE I[illegible] VARIOUS SPEEDS AND FOR TRAINS OF DIF[illegible]HTS PER CAR.

[illegible] Headings Indicate the Average Weights per Car

Speed miles [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	55 tons	60 tons	[illegible]	[illegible]	[illegible]
5		6.8	6.0	5.4			4.0	3.7	3.5	3.3		3.1	3.0
6	[illegible]	6.9	6.1	5.5		4.4	4.1	3.8	3.5	3.3	3.2	3.1	3.0
7	[illegible]	[illegible]	6.2	5.5		[illegible]	4.1	3.8	3.6	3.4	3.2	3.1	3.1
8	8.0	7.1	6.3	5.6		4.6	4.2	3.9	3.6	3.4	3.3	3.2	3.1
9	[illegible]	7.2	6.4	5.7		4.6	4.2	3.9	3.6	3.4	3.3	3.2	3.1
10	8.2	[illegible]	6.5	5.8	5.2	4.7	4.3	4.0	3.7	3.5	3.3	3.2	3.2
11	8.3	7.4	6.6	[illegible]	5.3	4.8	4.3	4.0	3.7	3.5	[illegible]	3.3	3.2
12	8.4	7.5	6.7	6.0	5.4	4.8	4.4	4.0	3.8	3.6	3.4	3.3	3.3
13	8.6	7.6	6.8	6.1	5.5	4.9	4.5	4.1	3.8	3.6	3.5	3.4	3.3
14	[illegible]	7.8	6.9	6.2	5.5	5.0	4.5	4.2	3.9	3.7	3.5	3.4	3.4
15	8.8	7.9	7.0	6.3	5.6	5.1	4.6	4.2	3.9	3.7	3.6	3.5	3.4
16	9.0	8.0	7.1	6.4	5.7	5.1	4.7	4.3	4.0	3.8	[illegible]	3.5	3.5
17	9.1	8.1	7.2	6.5	[illegible]	5.2	[illegible]	4.4	4.1	3.9	3.7	3.6	3.5
18	9.3	[illegible]	7.4	6.6	5.9	5.3	4.8	4.5	4.1	3.9	3.7	3.7	3.6
19	9.4	8.4	7.5	6.7	[illegible]	5.4	4.9	4.5	4.2	4.0	3.8	3.7	3.6
20	9.6	8.5	7.6	6.8	6.1	5.5	5.0	4.6	4.3	4.0	3.9	3.8	3.7
21	9.7	8.7	7.7	6.9	6.2	5.6	5.1	4.7	4.3	4.1	3.9	3.9	3.8
22	9.9	8.8	7.9	7.0	6.3	5.7	5.2	4.8	4.4	4.2	4.0	[illegible]	3.8
23	10.0	9.0	8.0	7.1	6.4	5.8	5.3	4.9	4.5	4.3	4.1	4.0	3.9
24	10.2	9.1	8.1	7.3	6.6	5.9	5.4	4.9	4.6	4.3	4.2	[illegible]	4.0
25	10.4	9.3	8.3	7.4	6.7	6.0	5.5	5.0	4.7	4.4	4.2	4.1	4.0
26	10.5	9.4	8.4	7.5	6.8	6.1	5.6	5.1	4.8	4.5	4.3	4.2	4.1
27	10.7	9.6	8.5	[illegible]	6.9	6.2	5.7	5.2	[illegible]	4.6	4.4	4.3	4.2
28	[illegible]	[illegible]	[illegible]	7.8	7.0	6.3	5.8	5.3	4.9	4.7	4.5	4.4	4.3
29	11.1	9.9	[illegible]	7.9	7.1	6.5	5.9	5.4	5.0	4.8	[illegible]	4.5	4.4
30	11.3	10.0	9.0	[illegible]	7.3	6.6	6.0	5.5	5.1	4.9	4.7	4.5	4.5
31	11.4	10.2	9.1	8.2	7.4	6.7	6.1	[illegible]	5.2	5.0	4.8	4.6	4.5
32	11.6	10.4	9.3	[illegible]	7.5	6.8	6.2	[illegible]	5.3	5.0	4.9	4.7	4.6
33	11.8	10.5	9.4	8.5	7.6	7.0	6.3	[illegible]	5.4	5.2	5.0	4.8	4.7
34	12.0	10.7	[illegible]	8.6	7.8	7.1	6.5	6.0	5.5	5.3	5.1	4.9	4.8
35	12.3	10.9	9.7	8.8	7.9	7.2	6.6	6.1	5.7	5.4	5.2	5.0	4.9
36	12.5	11.1	9.9	8.9	8.0	7.4	6.7	6.2	5.8	5.5	5.3	5.1	5.0
37	12.7	11.2	10.0	9.0	8.2	7.5	6.9	6.4	5.9	5.6	5.4	5.2	5.1
38	12.9	11.4	10.2	9.2	8.3	7.6	7.0	6.5	6.0	5.7	5.5	5.3	5.2
39	13.1	11.6	10.4	9.4	8.5	7.8	7.1	6.6	6.2	5.8	5.6	5.4	5.3
40	13.4	11.8	10.6	9.5	8.6	7.9	7.3	6.8	6.3	6.0	5.7	5.6	5.5

by operating conditions which reduce the efficiency of the locomotive itself.

[illegible] Abnormal Resistance Values.—Tests S-1034, S-1074, S-1080 and S-1031 show a persistent and great variation from the mean at various speeds. Examination as to average car weights, composition of train, and wind and weather condition failed to reveal any reason for these variations, and they must be accepted as unexplained by the data at hand.

Car Weight as a Basis of Expression.—Objection may be made to the form of expression adopted in Fig. 3, in which the resistance is expressed solely in terms of average car weight, to the apparent neglect of the influence of those elements of resistance, such as air resistance, which are independent of weight and which probably vary only with the number of cars in the train. The neglect is only apparent, however, for the process by which Fig. 3 was derived involves, although indirectly, the recognition of the influence of the number of cars. It is quite likely that, if Fig. 3 were applied to determine the total resistance of a single car, the result would be in error.

Whatever objection may be urged against the form of expression adopted, it remains true that Fig. 3 rests upon experimental results obtained with trains of usual length and that in practice one is not likely to encounter trains which present in this respect any extreme variation from the test data. The form of expression will not lead to error unless misapplied and it was chosen because it permits the results to be conveniently used in establishing tonnage ratings.

It might likewise have been more rational to express the resistance in terms of load per axle instead of load per car, since the latter can operate to cause variations in resistance only in so far as it affects the former. Since, however, all American freight cars have four axles, the expression in either form would be identical. Convenience in application warrants the choice made in this respect also.

Effect of Variety in Car Weight upon Total Train Resistance.—In Fig. 3 those portions of the curves which apply to average car weights below 20 tons were derived from trains which were quite homogeneous in their make-up as regards weight per car. These trains were necessarily composed almost exclusively of empty cars, since an average car weight of 20 tons or less cannot be obtained with cars of current design unless they are empty or nearly so, and being empty they will be uniform in weight. Similarly for average car weights above 55 or 60 tons, the test trains were necessarily uniform in make-up. For trains of average car weights below 20 and above 60 tons, the curves of Fig. 3 are accepted, therefore, as valid and applicable to any train to be met with in practice.

In Fig. 3 those portions of the curves corresponding to car weights of from 20 to 60 tons were, on the other hand, derived from trains which presented considerable diversity in make-up as regards weight per car. Some of these trains were composed almost entirely of loaded cars, others contained large proportions of both empty and loaded cars. In presenting the results in the form adopted in Figs. 3 and 4 the assumption is that the curves there drawn will be used throughout their entire range of average car weight to determine the total resistance of both homogeneous and mixed trains, and that, when so applied, they will lead to no material error. In view of the facts just stated it is pertinent to inquire whether this assumption is justifiable.

Assume two trains of equal tonnage, and of the same average weight per car. Assume further that one is composed of cars uniform in weight, and that the other is composed of cars of different individual weights. Now if such trains are to have equal total resistance, it can be shown that the variation in the resistance per car of the individual cars must be directly proportional to their weight. This implies that the curve showing the relation between total car resistance and car weight at a given speed must be a straight line, if homogeneous and mixed trains are to have equal total resistances at this speed. From Fig. 4 there have been derived curves showing this relation between car resistance and car weight. These curves (not shown in the report) correspond quite closely, but not exactly, with straight lines; and the correspondence is especially close for those portions of the curves which apply to car weights between 20 and 60 tons. From these facts we may conclude that the curves of Fig. 4 are not quite, but are nearly equally applicable to mixed and homogeneous trains, and that, if the curves are applied to both kinds of trains, we may expect a slight error in the resulting total train resistance. The amount of such error is indicated by the following examination of a specific case.

Assume two trains, *A* and *B*, the first homogeneous, the second mixed, as regards car weight. Train *A* is composed of 60 cars, each weighing 45 tons, and its total weight is 2700 tons. Train *B* is composed of 30 cars of 70 tons each, and 30 cars of 20 tons each; its total weight is 2,700 tons and its average car weight is 45 tons. Train *B* presents about as great a diversity in car weight as may be encountered in current practice. Both trains have equal tonnage and the same average weight per car. Assume that the total resistance of these two trains at a speed of 5 miles per hour is to be determined. By the procedure, which it is intended shall usually be followed in using Fig. 3, the resistance for an average car weight of 45 tons, at 5 miles per hour, is found to be 4 lbs. per ton; and the total resistance of either train *A* or train *B* is 2,700 x 4 = 10,800 tons.

Train *B*, however, may be considered as made up of two shorter homogeneous trains of average car weights of 20 and 70 tons respectively and resistance of each may be determined from those portions of the curves of Fig. 3, about whose validity no question is raised. From Fig. 3 the resistance at 5 miles per hour for a car weight of 20 tons is found to be 6.8 lbs. per ton and for a car weight of 70 tons, 3.1 lbs. per ton. By the use, therefore, of these portions of the curves of Fig. 3, the total resistance of train *B* is found to be $30 \times 20 \times 6.8 + 30 \times 70 + 3.1 =$ 10,590 lbs., which differs from the resistance previously found by 2 per cent. If a similar analysis be made for a speed of 40 miles per hour, the corresponding difference is found to be 4 per cent. If these differences be accepted as a measure of the maximum error likely to result from the indiscriminate application of the curves of Fig. 3 to mixed and homogeneous trains, we may conclude that for purposes of rating locomotives the results of the tests as expressed in Figs. 3 and 4 and Table III may be so applied without material error.

The Influence of Speed on Resistance.—Within the last two years the opinion has been expressed in some quarters that train resistance between speeds of 5 and 35 miles per hour is constant. It is proper to point out that there is nothing in the data here presented to support such a conclusion.

The Influence of Wind Velocity on Resistance.—The wind velocities prevailing during the tests were generally less than 20 miles per hour. The data do not permit the influence of such winds to be differentiated from the other elements affecting resistance; but they do warrant the conclusion that this influence is small. In the introduction, train resistance was defined as the resistance in still air, whereas throughout the report the term is used to apply to the test results from

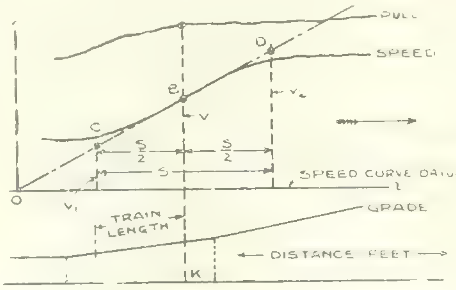

FIGURE 5

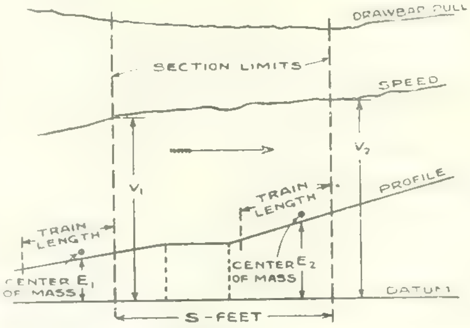

FIGURE 6.

Fig. 5—Diagram for Method 1.
Fig. 6—Diagram for Method 2.

which the influence [illegible] not been eliminated. This inconsistency has been deliberately incurred to avoid unwieldy expression and is partially justified by the facts just stated.

Comparison [illegible]—There is no point in comparing the results of these tests with formulas in which the influence of car weight is given no consideration, nor with those which are not derived from tests with American cars of recent design. The results obtained on the Chicago, Burlington and Quincy R. R. and on the Pennsylvania R. R., as outlined in a paper by Mr. F. J. Cole, take into consideration the influence of car weight and they apply to cars of recent design. They are therefore selected for comparison.

The results obtained on the Chicago, Burlington and Quincy road (curve No. 1, for temperatures above 30° F. and no wind) apply to a speed of 20 miles per hour. Compared with the curve for 20 miles per hour in Fig. 3 they show resistance values which are from 35 to 60 per cent lower than the corresponding results of these tests. The Pennsylvania R. R. results are claimed to be equally applicable at all speeds between 5 and 30 miles. When plotted on Fig. 3 of this report they show very close corespondence with the curve there drawn for 10 miles per hour, for car weights from 25 to 70 tons; while for car weights below 25 tons they indicate resistance values as much as 20 per cent in excess of the results obtained during these tests.

[illegible]

A detailed explanation of the processes used throughout this investigation in deriving the results of the tests is presented below. Two methods of calculation have been employed. By one method resistance was determined at a point on the road; by the other, the average resistance was determined for the period during which the test car passed over a certain track section. The former is termed Method 1, the latter, Method 2. A general statement and comparison of the two methods and an explanation of the general limitations imposed upon the selection of points and sections have been given. Whatever is said under "Methods Employed in Calculating the Results" is to be considered as supplementary to the following:

The Elements of Gross [illegible]—The various elements which make up gross train resistance are:

1. Net resistance on straight, level track, at uniform speed, in still air.
2. Resistance due to wind, (as distinguished from still air resistance).
3. Resistance due to grade.
4. Resistance due to acceleration.
5. Resistance due to track curvature.

Item 1 is always in operation to retard a moving train. One or more (or none) of the others may also be acting with item 1 to form gross resistance.

The dynamometer car records directly the gross resistance or drawbar pull as here defined. The purpose of the calculations has been to determine net resistance (item 1); or more strictly speaking, the purpose, by force of circumstances, has been to determine the sum of net resistance (item 1), and wind resistance (item 2), since it has been impossible to differentiate the latter from the other elements. Curve resistance has been entirely eliminated from consideration by selecting for calculation only those points and sections where the train was on tangent track. Grade resistance and acceleration resistance may always be determined by calculation; and in order to find the net resistance, it is necessary only to subtract these two items (3 and 4) from the gross resistance recorded on the test car chart.

Since the process employed implies the ability to calculate the grade and acceleration resistances, their determination will be explained before proceeding with the explanation of the two methods by which net resistance was derived.

The following general notation is used throughout. Other special notation needed in the development of the analysis is given as the necessity arises.

Notation:

P = Total gross resistance = drawbar pull.—pounds.

R = Net resistance on tangent, level track, at uniform speed.—pound per ton.

R_g = Resistance due to grade.—pounds per ton.

R_a = Resistance due to acceleration.—pounds per ton.

W = Total train weight.—tons.

V, V_1, etc. = Train speed.—miles per hour.

G = Grade.—feet per mile.

A = Acceleration of the train speed.—miles per hour per second.

a = Acceleration of the train speed.—feet per second per second.

E_1 and E_2 = Elevations of the center of mass of the train.—feet.

[illegible] Length [illegible] 2.—feet.

N = Number of cars in the train.

Grade Resistance.—If the train be on a uniform grade of G feet per mile, the grade resistance in pounds per ton is at the moment:

[illegible]

If it be desired to find the average grade resistance during the period in which the test car passes a certain section of track, we must determine the elevations of the center of mass of the train at the moments the car enters and leaves the section. If we call these elevations E_1 and E_2 respectively, and the length of the section S (in feet), then the average grade in feet per mile is:

[illegible]

and

[illegible] . . . (16).

G and $(E_2 - E_1)$ in these equations may be found directly from the profile; and S may be calculated from the profile or from the dynamometer chart. To give correct results, the entire train must be on uniform grade at the moments for which G, E_1 and E_2 are determined.

Acceleration Resistance.—The total force needed to produce acceleration is made up of two parts. The first is the force needed to produce accelerations in the motion of translation of the train as a whole; and the second is the force needed to produce acceleration in the rotation of the wheels and axles. This total force is the total acceleration resistance [illegible]

Let

R_a = Acceleration resistance due to both translation and rotation.—pounds per ton.

F = Total drawbar pull needed to produce the acceleration.—pounds.

T = Drawbar pull needed to produce acceleration in the translation of the whole train.—pounds.

f = Drawbar pull needed to produce acceleration in the rotation of all wheels and axles.—pounds.

Then

[illegible]

and

[illegible]

therefore

[illegible] . . . (17).

T and f in this equation are found as follows:

[illegible]

but

[illegible]

hence

$T = \frac{W \times 2{,}000 [illegible]}{32.2}$ [illegible]

To find f:

Let

p = Drawbar pull required to produce the acceleration in the rotation of one pair of wheels and their axle.—pounds. This is to be considered as a force applied at the wheel rim.

p_1 = Force which, applied at the end of the "radius of gyration," would produce the acceleration in rotation produced by p.

r = Wheel radius.—any unit.

k = Radius of gyration of one pair of wheels and axle.—same unit as r.

w = Weight of one pair of wheels and their axle.—pounds.

a = Acceleration in the linear velocity of a [illegible] per second. This equals the acceleration of the train.

This equals the acceleration of the train.

[illegible] point at the end of the radius of gyration.—feet per second per second.

w is taken as equal to 1,950 lbs.* which is the approximate mean between the weight of a 4¼x8 axle and its wheels and the weight of a 5x9 axle and its wheels. k is found to be about 0.64 for various axles and wheels.*

Since cars have 4 axles, we have:

[illegible]

$$p_1 = \frac{w}{32.2} \times b = \frac{1{,}950}{32.2} \times b \text{ [illegible]}$$

[illegible]

$$p_1 = 60.56 \times 1.466\,A \times \frac{k}{[illegible]} \text{ [illegible]}$$

[illegible] $= 88.82\,A \times$ [illegible]

36.38

and

$$f = 4 \times N \times 36.38\,A = 145.5\,A\,N \quad \ldots. (19).$$

From equations 17, 18 and 19

[illegible]

Hence

[illegible]

Formula 20 may be applied to find the momentary acceleration resistance at a point on the road, or to determine its average value while the train passes a certain section. In the former case A denotes the momentary acceleration, and in the latter case A denotes the average acceleration over the section. N and W are derived from the train data. In either case A may be found as explained below.

In determining the net resistance by Method 1—at a point on the road—the momentary value of A in formula 20 has been determined as follows. In this discussion it should be remembered that all curves on the dynamometer chart are drawn on a distance base, i. e., to some scale their abscissas represent distances, in feet.

On the speed curve in Fig. 5 let B represent the point on the road which is under consideration. At B draw the tangent $O\,D$ to this curve, and select on this tangent the points C and D *equidistant* from B. This tangent may be considered as a speed curve which at B represents the same acceleration as the actual speed curve. By direct measurement the ordinates of the tangent at C and D are determined as v_1 and v_2, respectively. Similarly the distance S may be determined. The speed at B is called v. The acceleration

---

*The [illegible] variations is therefore about one per cent. It would [illegible] gondolas equipped with [illegible] journals and wheels weighing [illegible] lbs. each.

[illegible]

a = Acceleration.—feet per second per second

Then

[illegible]

and

[illegible] dl [illegible]

The equation of the tangent referred to the [illegible]

[illegible]

whence

$$dv = \frac{[illegible]}{[illegible]}\, dl$$

and

[illegible]

[illegible], since [illegible] is the mean between [illegible] and [illegible]

$$v = \frac{v_1 + v_2}{2}$$

therefore

$$[illegible] = \frac{v_2^2 - v_1^2}{2S}$$

[illegible]

$$a = 1.466 A$$

and

$$v = 1.466 V,$$

hence

$$A = \frac{(1.466)^2 \times (V_2^2 - V_1^2)}{1.466 \times 2S} = 0.733 \frac{V_2^2 - V_1^2}{S} \qquad (21).$$

Formula 21 is used to determine the momentary acceleration at a point B on the speed curve. V_1 and V_2 are ordinates at the two points, C and D, located on the tangent drawn at B and equidistant from B. To draw this tangent with sufficient accuracy, the speed curve must be nearly a straight line for a small distance on either side of B.

In determining the net resistance by Method 2—while the test car passes a certain track section—the average value of A in formula 20 has been determined as follows. The conditions are represented in Fig. 6.

Let a = the *uniform* acceleration which, acting during the passage of the car through the section, would have caused a speed change the same as that actually produced.—feet per second per second.

A = The same, expressed in miles per hour per second.

v_1 and v_2 = Speeds at entrance and exit.—feet per second.

V_1 and V_2 = Speeds at entrance and exit.—miles per hour.

S = The length of the section.—feet.

t = The time elapsed in transit over the section.—seconds.

Then

$$v_2 = v_1 + a t$$

and

$$S = v_1 t + \frac{a t^2}{2}$$

whence, by the elimination of t,

$$a = \frac{v_2^2 - v_1^2}{2S}$$

and, since

$$a = 1.466 A$$

and

$$v = 1.466 V$$

$$A = 0.733 \frac{V_2^2 - V_1^2}{S} \qquad (22).$$

This equation is identical in form with equation 21. It is used to determine the average acceleration over a given track section. In it A is to be understood as that hypothetical uniform acceleration which, acting during transit over the section, would have caused the absorption of the same energy as was actually expended to produce acceleration under the prevailing speed changes. V_1 is the speed at the moment the head of the train enters the section. V_2 is the speed at the moment the head of the train leaves the section. S is the length of the section.

Formula 22 is correct for all cases, regardless of the shape or variations of the speed curve. However, for reasons which are entirely unrelated to the accuracy of the acceleration determination, and which have been explained, the sections were so chosen that V_1 and V_2 varied but slightly, and that the speed curve between the section limits presented no great speed variations.

The Determination of Net Resistance.—Net resistance on straight, level track, at uniform speed is termed R, and is expressed in pounds per ton. In both methods of calculation its value was derived from the equation:

$$R = \frac{P}{W} - R_g - R_a \qquad (23)$$

In which P is determined from the test car chart, W from train data, and R_g and R_a as previously explained.

Method No. 1.—To detrmine R at a point on the track, equation 23, 15, and 20 may be used; these when combined give us:

$$R = \frac{P}{W} - 0.3796 G - (91.05 + 145.5 \frac{N}{W}) \times A \qquad (24)$$

If the train is on a down grade the sign of the second term should be changed to plus. The value of A should be found by means of equation 21, and, as there explained, by drawing a tangent to the speed curve. The other quantities in the equation,—W, N, P, S, and G, may be found directly from the train data, or the dynamo-meter chart, or the profile. Fig. 5 represents the conditions which prevailed at points chosen for the calculations by this method. In Fig. 5 the line K B represents the point on the road which is under consideration. All values of momentary resistance included in this report have been found by means of formula 24.

In the selection of points for the application of Method 1, the following precautions must be and have been observed:

1. The entire train must be on tangent track and on a uniform grade.
2. The speed curve must be nearly straight for a certain distance either side of the point chosen, in order to permit the tangent to be accurately drawn.
3. The acceleration should preferably be low. The maximum acceleration at any point chosen for the calculation of values included in this report was 0.106 miles per hour per second.

Method No. 2.—To determine the mean value of R over a certain track section, equations 23, 16 and 20 may be used; these when combined give:

$$R = \frac{P}{W} - \frac{2000 \times (E_2 - E_1)}{S} - (91.05 + 145.5 \frac{N}{W}) \times A \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots)25).$$

In this case the value of A should be found by means of equation 22. The quantities to be determined in order to use formula 25 are N are derived from the train data. P is the mean drawbar pull over the section, and is found by determining by the use of planimeter the mean height of the pull curve between the section limits. S is the section length and may be found directly from the dynamo-meter chart. V_1 is the speed as the train enters the section. V_2 is the speed as the train leaves the section. V_1 and V_2 are determined directly from the dynamometer chart. E_1 is the elevation of the center of mass of the train, at the moment its head end enters the section E_2 is the corresponding elevation at the moment the head end of the train leaves the section. The quantity $(E_2 - E_1)$ is found from the profile. R in this case corresponds to the mean speed over the section. This mean speed is determined by means of the records of time and distance. Fig. 6 represents the conditions which prevailed at sections chosen for the calculations by this method. All values of mean resistance included in this report have been found by formula 25.

In the selection of points for the application of Method 2, the following precautions must be and have been observed:

1. The track must be straight over the section and also for a distance (equal to the train length) before the entrance to the section.
2. The entire train must be on a uniform grade at the moment its head end enters the section, and again at the moment it leaves the section. These grades need not, however, be alike.
3. For reasons which have been explained the speed curve between the section limits should not present great speed variations nor should the difference between V_1 and V_2 be greater than ten or twelve miles per hour.

Congress of Technology.—A Congress of Technology will be held in Boston on April 10-11 in celebration of the fifteenth anniversary of the granting of the charter of the Massachusetts Institute of Technology. In line with this idea, the 50 or more papers which will be presented at the congress will be written by graduates of the institute, and will thus serve to record the part the alumni of the institution have taken in the development of scientific industry. As the titles of these papers are sent in by the writers it is becoming evident that the managers of the congress will succeed in their effort to make the proceedings of the congress show from another point of view the general industrial advance that has taken place during the past 50 years under the guidance of trained engineers. The papers will cover a wide range of subjects, from architecture to sewage purification, and the names and professional standing of the writers show that they will together discuss authoritatively every important problem of modern industrial technique and management. It is already clear that this record is not limited to any narrow activity within merely technical lines, but that it covers the broader problems of the relations of science to industry, the place of the engineer in creating a more efficient type of industrial management, and the general shaping of material conditions to serve alike the changing conditions of business and the improving conditions of labor.

Civil Service Examinations.—Announcement is made by the U. S. Civil Service Commission of examinations for editorial assistant in the Bureau of Mines, on March 29, and for engineer-physicist in the Bureau of Standards, on March 31. Appointment as editorial assistant will be made at a salary of from $1,200 to $1,500 per annum. Applicants must be graduates of a college or technical school and must have taken courses in chemistry, physics, and mathematics beyond plane trigonometry. Appointment as engineer physicist will be made at an annual salary of $3,000, and as associate engineer-physicist at salaries ranging from $2,040 to $3,000. It is stated that it is desired to secure persons who are fully able to initiate and carry on independent research in the field of engineering physics. Training and experience in the investigation and testing of engineering and structural materials, the operation of testing machines, and the interpretation of the results of investigations, is required. There will be no educational examination for these positions, but it is essential that applicants should have made and published some contributions of recognized merit in engineering knowledge.

GENERAL ARTICLES AND CLASSIFIED ITEMS

The Substructure of the St. Louis Municipal Bridge.

BY S. W. BOWEN.*

The Municipal Bridge now under construction at St. Louis crosses the Mississippi River about a mile below the celebrated Eads Bridge. The location, which was determined by ordinance passed by the Municipal Assembly of the City of St. Louis, is shown on the general map, Fig. 1.

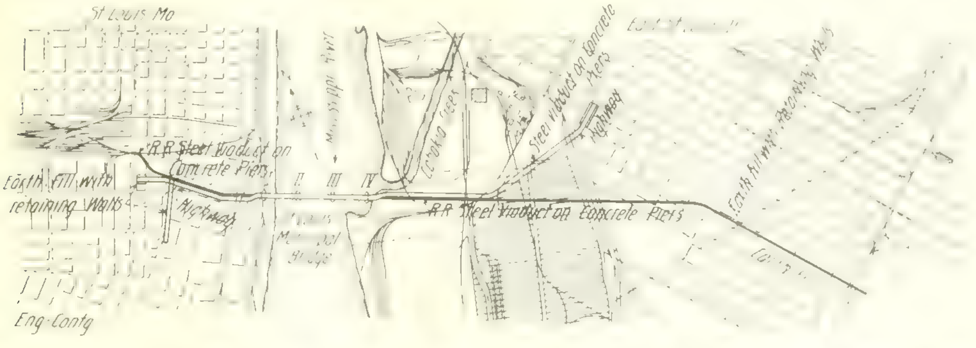
St Louis Mo
R.R. Steel Viaduct on Concrete Piers
Earth Fill with retaining Walls
Highway
II
III
IV
Mississippi River
Steel Viaduct on Concrete Piers
Highway
R.R. Steel Viaduct on Concrete Piers
Earth Fill with retaining Walls
Eng-Contg

Fig. 1—General Plan, Showing the Location and Layout of the Municipal Bridge Now Under Construction Over the Mississippi, About One Mile South of the Eads Bridge, St. Louis.

As this structure has been mentioned and briefly described from time to time in the engineering magazines, only a short description of the bridge as a whole will be given, followed by a more detailed account of the engineering and construction methods employed in building the substructure of the river crossing. The superstructure of the river crossing and the approaches as a whole will be described in articles to be published as the work progresses.

The bridge is designed to carry both railway and highway traffic; provision being made for two railway tracks, two trolley tracks on a 30-ft. paved roadway and two 6-ft. sidewalks.

The river crossing is a double deck structure, carried on pneumatic foundations sunk to bed rock; the upper deck being for highway, and the lower deck for railway traffic. The general appearance and size of the structure is shown by Fig. 2.

The approaches consist of steel viaducts supported on concrete pedestals and end in earth fills between concrete retaining walls. The railway and highway approaches are carried side by side for about two-fifths of a mile from the main crossing on each side of the river; from these points they diverge as shown by Fig. 1. The maximum grade on the railway approach is 1.38 per cent, while that on the highway is 4.24 per cent; these maximum grades extending only over short distances.

The total length of the structure from end to end of steel railway approaches is about 2¼ miles, while the length over all, including the above mentioned retaining walls, is about 2½ miles.

The substructure of the river crossing, known as "Section One," consists of four masonry piers, founded by pneumatic caissons on bed rock. The piers are numbered from west to east, Pier I being on the west bank just inside the inner harbor line, while Pier IV is correspondingly placed on the east bank.

The span lengths and clearances above high water were made to conform with the requirements of the War Department. As shown on Fig. 2, the rock dips rapidly toward the east. Pier IV is one of the deepest piers ever sunk by the pneumatic process.

On July 28, 1909, the contract for "Section One" was awarded to the Missouri Valley Bridge & Iron Co. or Leavenworth, Kan., and shortly thereafter the contractor began laying out a material yard on the Illinois side of the river, and bringing in material for barges, caissons, etc. During the late summer and fall of 1909, a large amount of preliminary work was done. Buildings for offices, commissary, cement storage, etc., were built, a water supply system was installed, several barges were constructed and launched, timber for caissons and pontoon was framed and on Dec. 20, 1909, the cutting edge for the first caisson, that of Pier IV, was riveted up.

As the ground at the sites of Piers I and IV is above the ordinary stage of the river, the caissons for these piers were constructed on blocking at the pier sites and excavation started by hand. The caissons for Piers II and III were built in a pontoon from which they were launched and towed to position. The work of sinking was begun in the following order: Piers IV, I, III and II, one pier being sunk at a time. Owing to high water, Pier IV was temporarily abandoned when a few feet above bed rock, and work was started on Pier I, which was landed and sealed before returning to Pier IV, the next one sealed. Piers III and II were sealed in the order named.

The construction of the caissons and surmounting cribs is shown by Fig. 3, and needs no detailed description. The caissons, it will be seen, contain comparatively little timber; the necessary strength being obtained by reinforcing the concrete filling with steel rods.

The pontoon from which the caissons for Piers II and III were launched was about 40x100 ft. in plan and had sides 8 ft. high. Sides and bottom were built of 4-in. plank braced and calked. The pontoon was divided into halves lengthwise, the two parts being bolted together from the inside.

After the caisson was built up to a height of about 17 ft. above the cutting edge and the calking of the air chamber and friction planking completed, the halves of the pontoon were unbolted, plugs removed from holes in the bottom, and water allowed to enter. The pontoon slowly filled and sunk, the buoyancy of the timber holding the two halves in position up against the cutting edges of the caisson. One-half of the pontoon being anchored to clusters of piles, a tug pulled the other half from under the caisson which settled into the water clear of the pontoon. The caisson, now floating free, was built up to the full height, and towed out to the pier site by means of three tugs, where it was anchored in approximate position to clusters of piles arranged as shown by Fig. 6. The pontoon was meanwhile towed to shore and the halves bolted together in readiness for the next caisson.

It might be said in passing, that the pontoon possesses some advantages over "ways" as a means of supporting and launching caissons. The pontoon can be used on any shore and in places where "ways" would be difficult to construct and maintain. Where a pontoon is used, work on the caisson is not interfered with by the rise or fall of the river. This is especially important on rivers like the Mississippi where there is a continual change of stage, sometimes amounting to several feet in 24 hours. As the estimated cost of the pontoon in this case was about the same as that of "ways," the former was considered to be the better means of the two.

Work on one of the river piers will now be described in chronological order.

The river bed around the up stream end of the caisson and for some distance down each side was first covered with sacks of sand, to prevent the bottom from scouring out from under the caisson. The sacks were deposited through a section of supply shaft 24 ins. in diameter and long enough to reach the bottom.

Concreting was then started and the caisson gradually sank as the filling progressed, until the river bed was reached. Air was turned on, the caisson raised slightly, moved into proper position by means of the cables shown on Fig. 6 and the air released, allowing it to settle to the river bed. In placing the caisson in position, care was taken to bring their axes parallel to the true axes, although they might not exactly coincide. As the tendency of the caissons was to creep upstream and toward the east, they were set

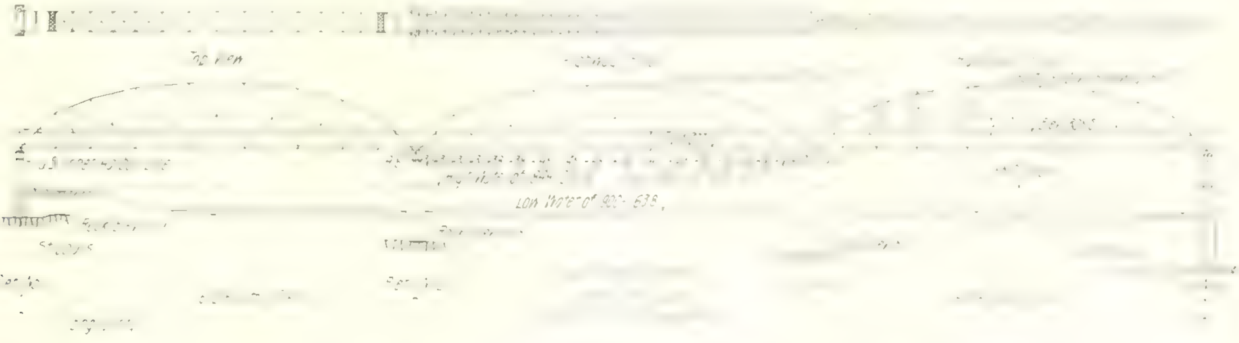

Fig. 2—Diagram Showing the River Spans of the Municipal Bridge, and the Main Dimensions of the Spans

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*Resident Engineers, Fullerton Building, St. Louis, Mo.

[illegible] accomplished by listing the caisson in the desired direction.

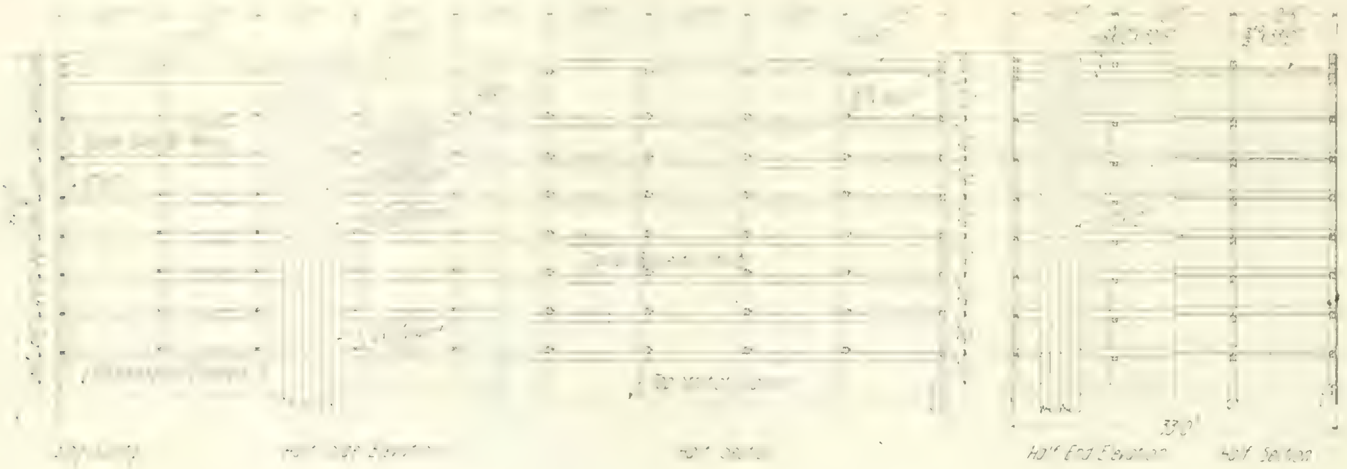


Fig. 5—Plans Showing Cribbing Surmounting Caissons.

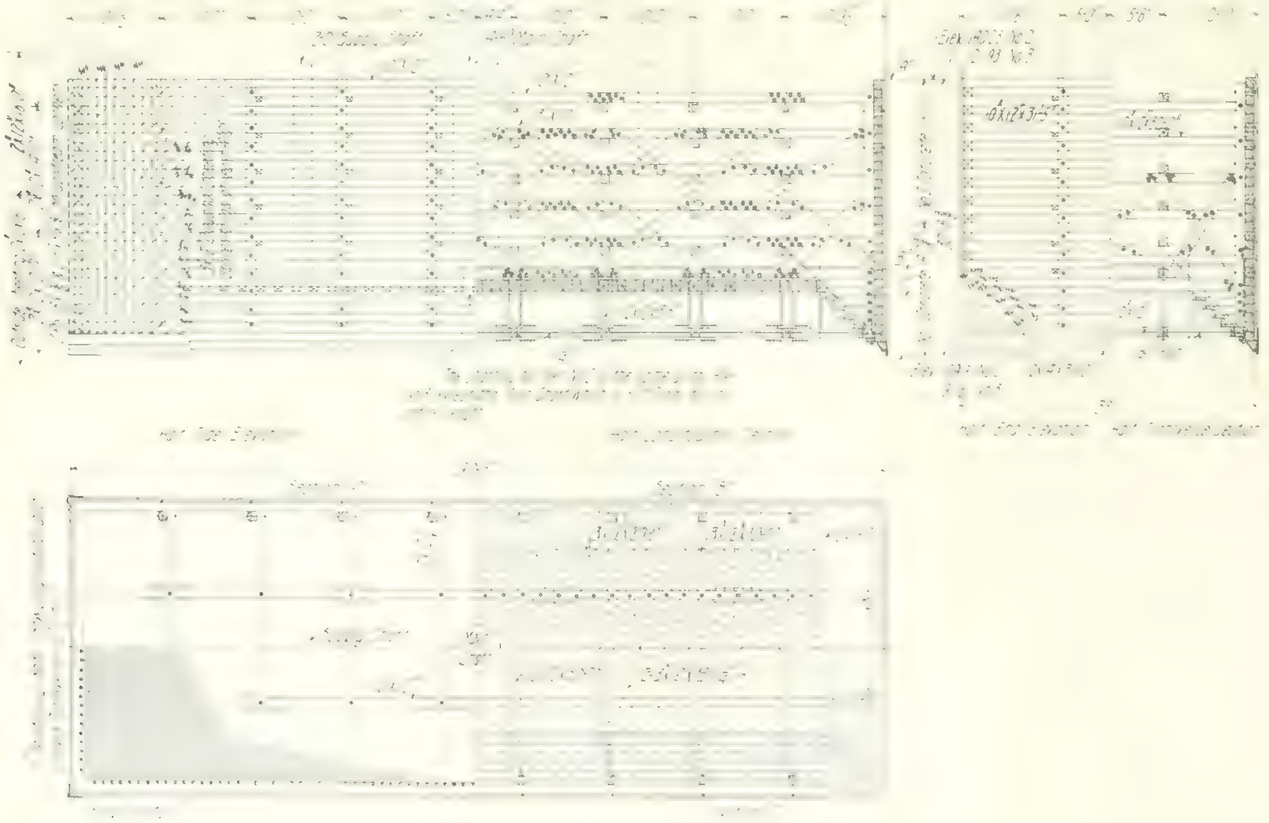


Fig. 3—Plan of Caissons for River Piers.

After the caisson had settled well into the mud, the anchorage and adjusting cables were released, air was turned on and the first gang entered the air chamber, leveled up the caisson and brought it to a uniform bearing by excavating the material from under the cutting edge at the high points. Owing to the low stage of the river when sinking was started on Piers II and III, there was but 15 to 17 ft. of water at the pier sites. The caissons therefore grounded before sufficient concrete could be placed to render them rigid, and great care was required to prevent them from warping. Levels were taken several times a day with a view to detecting this warping, and when discovered, it was corrected by loading the diagonally opposite high corners, and excavating under same until the four corners returned to a plane. After the caisson was well filled, no further trouble was experienced from this source. Sinking was carried on continuously and concreting was kept up during the day time until the caisson and crib were filled nearly to the top of the latter. A timber cofferdam was then started on top of the crib and built up as the sinking progressed.

No masonry was laid until bed rock was reached and sealing completed; thus enabling the masonry to be started in the correct position. The surface of the concrete was kept somewhat below the top of the crib in order to provide for the possibility of finding rock at a higher elevation than that shown by borings previously made at each pier site.

As the rock was approached, frequent soundings were made in the air chamber to determine the distance to it. When but 2 or 3 ft. of sinking remained, the slope of the rock was accurately determined by soundings taken at close intervals all around the caisson as close to the cutting edge as the slope of the roof would allow. The caisson was then tilted very slightly and allowed to settle slowly until the low cutting edge was landed on the side where the rock was highest. By doing this, any further slight settlement in coming to a bearing tended to level the caisson. The surface of the rock was then cleaned off, and all loose pieces removed preparatory to sealing. In general, the caissons landed along the west side and a portion of the north and south ends, the slope of the rock being downward toward the east, with local irregularities north and south. The rock was sufficiently uneven to give an excellent bond with the concrete. No attempt was made to level off the rock so as to bring the caisson to a bearing throughout; but where depressions occurred, sacks of concrete were deposited on the rock and tamped under the cutting edge. A wall was thus formed inside of which concrete was deposited in the usual manner. Where the cutting edge and rock were not in contact, the distance between them was, in general, only a few inches and in no case more than 2 ft., so this sacking was readily accomplished as follows: The sand was first excavated from under the edge for a space about the width of a sack. The sack loosely filled with concrete was then slid down a plank to the cavity and thrust out under the cutting edges, one end projecting entirely outside the latter. The water jet was then thrust under the sack and the sand washed out from under it, allowing the sack to rest directly on the rock. This process was repeated until a number of sacks had been placed on the rock. When necessary, a second tier was placed on the first and in some cases a third was added. In all cases concrete was thoroughly tamped under the shoulders of the cutting edge, and the sealing was immediately followed by a bench of concrete carried up under the shoulders of the roof and well tamped.

In sealing, double gangs were used, working during the day time only. Concrete was locked in through each material shaft, the lock being located at the extreme top of the shafts and being equipped with a hopper into which the concrete was dumped. The upper door of the lock was then raised, the lock equalized and the lower door dropped, allowing the charge of concrete to fall down the shaft to the air chamber, where it was shoveled back and tamped under the shoulders and roof of the air chamber. Toward the end of the sealing, only a small tunnel was left, connecting the main and nearest material shaft; this was filled as full as possible with loose concrete by two men, there being no room to tamp, and after no more concrete could be placed in this manner, the size of the cavity was measured and the men left the air chamber, closing the lower door and equalizing the entire shaft. Sufficient grout was then locked in to fill the cavity, plus about 100 per cent. This was followed by a charge of about 1 cu. yd. of concrete and the sealing was completed. The concrete used in sealing was a 1:2:4 mix, with 1 in. coarse aggregate. Air was left on for 12 to 15 hours after sealing was finished in order to give the concrete time to set and was then released at the rate of about 5 lbs. per hour.

The cofferdam was next pumped out, the main shaft unbolted just below the lock, and the shaft and lock hoisted out. The material locks were removed, together with the portion of shafts extending above the concrete. The surface of the concrete in the crib was then brought up to the proper elevation, the material shafts and the boxed space occupied by the main shaft were filled with concrete, the outline of the first course of masonry was laid out and masonry started.

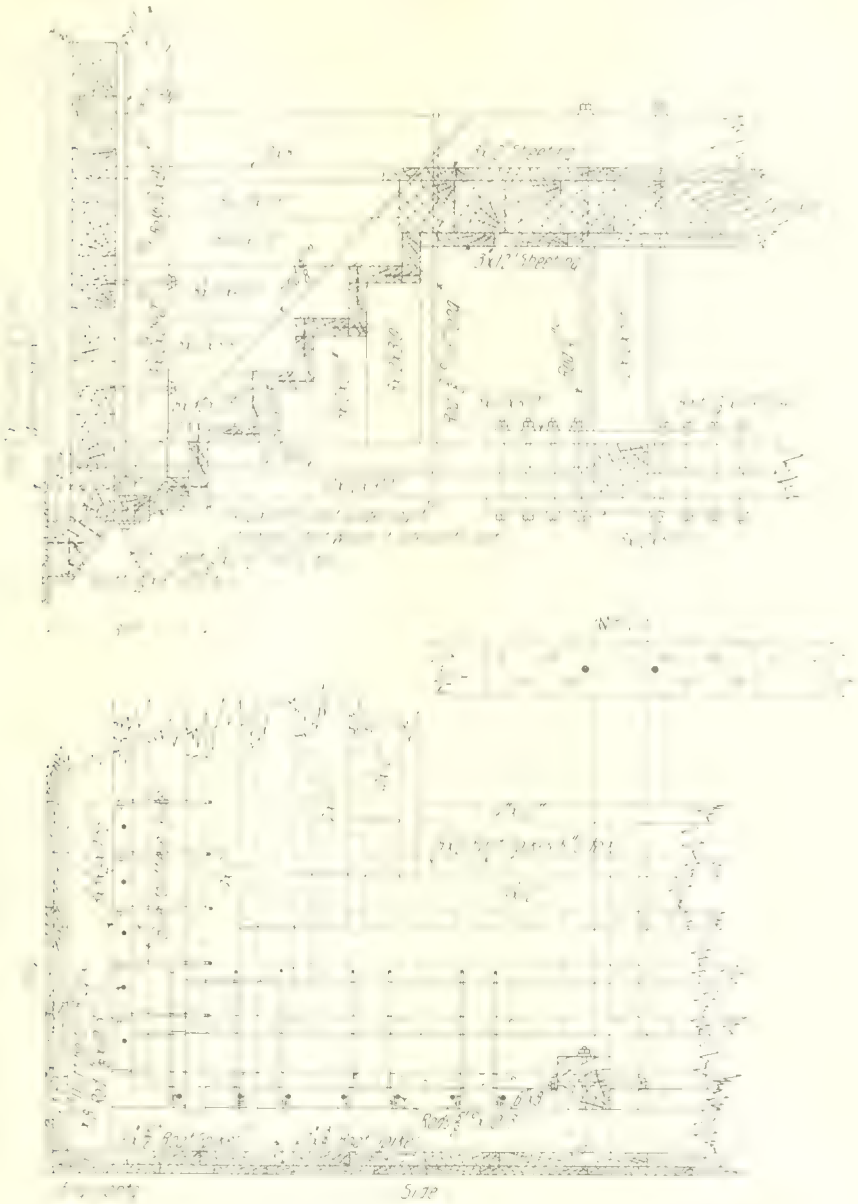


Fig. 1—Details of Cutting Edge and Stepped Roof of Caissons.

As shown on the drawings of the pier, Fig. 7, the piers above the top of the crib are faced with Bedford stone in 2-ft. courses, backed with concrete, of which there are two classes, No. 1 being a 1:2:4 and No. 3 a 1:2½:5 mix. The up stream nosing stones and the coping and bridge seat stones are of Georgia granite. The stone was brought from the material yard in cars by a locomotive crane and loaded onto barges. Stones were handled at the pier by means of a floating derrick with a 90-ft. boom.

The contractor's floating equipment consisted of a pressure barge on which was a battery of four boilers, three air compressors, a dynamo, a hospital lock, pumps, etc., a mixer barge for mixing and handling concrete, one large derrick barge, a derrick and pile driver barge, two cement barges, the "Hog House" barge and a number of barges for sand, gravel, stone and coal. There was also a steam tug for towing and a gasoline launch for ferrying. On land there was a 20-ton locomotive crane for handling material; also derricks, hoisting engines, etc.

The hospital lock, for use in treating cases of "Caisson Disease," was equipped with bunks, an electric battery and medical supplies. An attendant was in charge, and the company physician could be summoned at short notice. The treatment consisted first in the application of air pressure about equal to that in the working chamber, then in massaging, rubbing with liniment and applying hot cloths and stimulants. In cases of paralysis, the battery was used. The air when released was let out slowly. The treatment given in the lock was found to be very effective in cases of paralysis, but sometimes gave only temporary relief to cases of the "Bends."

The mixer barge was equipped with two derricks independently operated. One of these handled a clam shell bucket of 1 cu. yd. capacity for transferring sand and gravel from barges to a double elevated hopper. This hopper discharged the material into separate measuring boxes, from which it was shot into the mixer where the cement and water were added. The mixer dumped into 1 cu. yd. bucket handled by the other derrick, which deposited the concrete in the work. The capacity of this rig was about 300 cu. yds. per day of 10 hours, with a crew of about 25 men.

Some of the difficulties encountered in sinking the caissons will now be briefly described.

On Jan. 12, 1910, when excavation for Pier IV was about to be started and while the caisson was still on blocking at the pier site, an ice gorge formed below the bridge, the river rose 10 feet in a few hours and an enormous quantity of ice was forced onto the shore. The power barge, pontoon and several barges were carried about 200 ft. inland, the caisson was forced off the blocking and carried east and south nearly its own length.

Fig. 6—Diagram of Method of Anchoring Caissons and Arrangement of Fleet Around Pier.

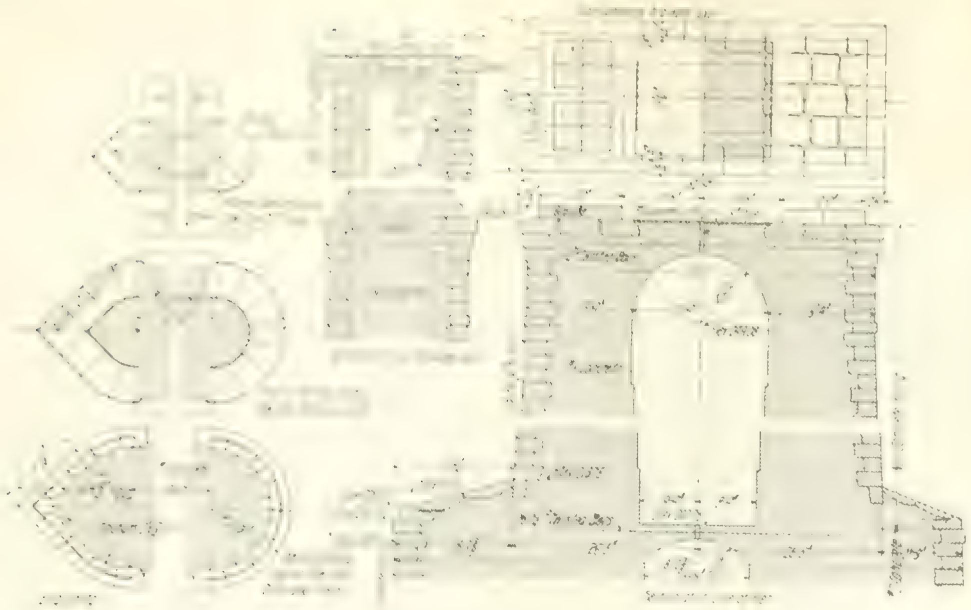


Fig. 7—Plan Showing the Details of Upper Portion of Pier.

The derrick and hoisting engine at the pier was wrecked and a great deal of minor damage was done. The gorge broke the next day, the water immediately fell and left this mass of ice and wreckage jumbled together on the shore. The contractor at once set about clearing up the wreckage; the power barge was jacked up and placed on blocking, where it was left until spring. The pontoon was left until floated by the next rise of the river, while the barges were moved back to the river and the caisson jacked back into position. Excavation was started on Feb. 21, 1910, after a delay of over a month.

In sinking the caisson for Pier IV, a number of sunken barges were encountered. These had been towed into the cove, scuttled and sunk from time to time and were piled on top of each other about three or four deep. Progress through this mass of wreckage was necessarily slow; 6x12 in. and 12x12 in. oak timbers had to be cut off and locked out. Light charges of dynamite were used to break up the worst of the wreckage. Again, when 4 or 5 ft. above bed rock, in the same pier a mass of boulders and gravel mixed with sand was encountered. These boulders were of all sizes from that of a base ball to those having a volume of about 1 cu. yd. They were without exception rounded and worn smooth. Most of these boulders were locked out through the material shaft, being hoisted by the locomotive crane. Those left in the air chamber were bedded in the concrete. Three inches per day was considered very good progress through this material. Rock was finally reached after much trouble. The high pressure under which the men worked and consequent shortening of shifts added greatly to the difficulty and expense of the work. At one time the pressure in the air chamber reached 50 lbs. per sq. in., about the limit of human endurance.

When Pier III had nearly reached rock, the coffer dam sprung a leak and filled up. After sealing was finished, a diver was sent down to locate the leaks. They were then battened up from the outside with 1-in. boards and the boards were covered with a strip of canvas securely battened down. All this work was done by a diver standing on the river bottom. After this the cofferdam was pumped out without difficulty and the masonry started. Aside from the above, no unusual difficulties were met with and the sinking was completed in good time. The following notes taken from

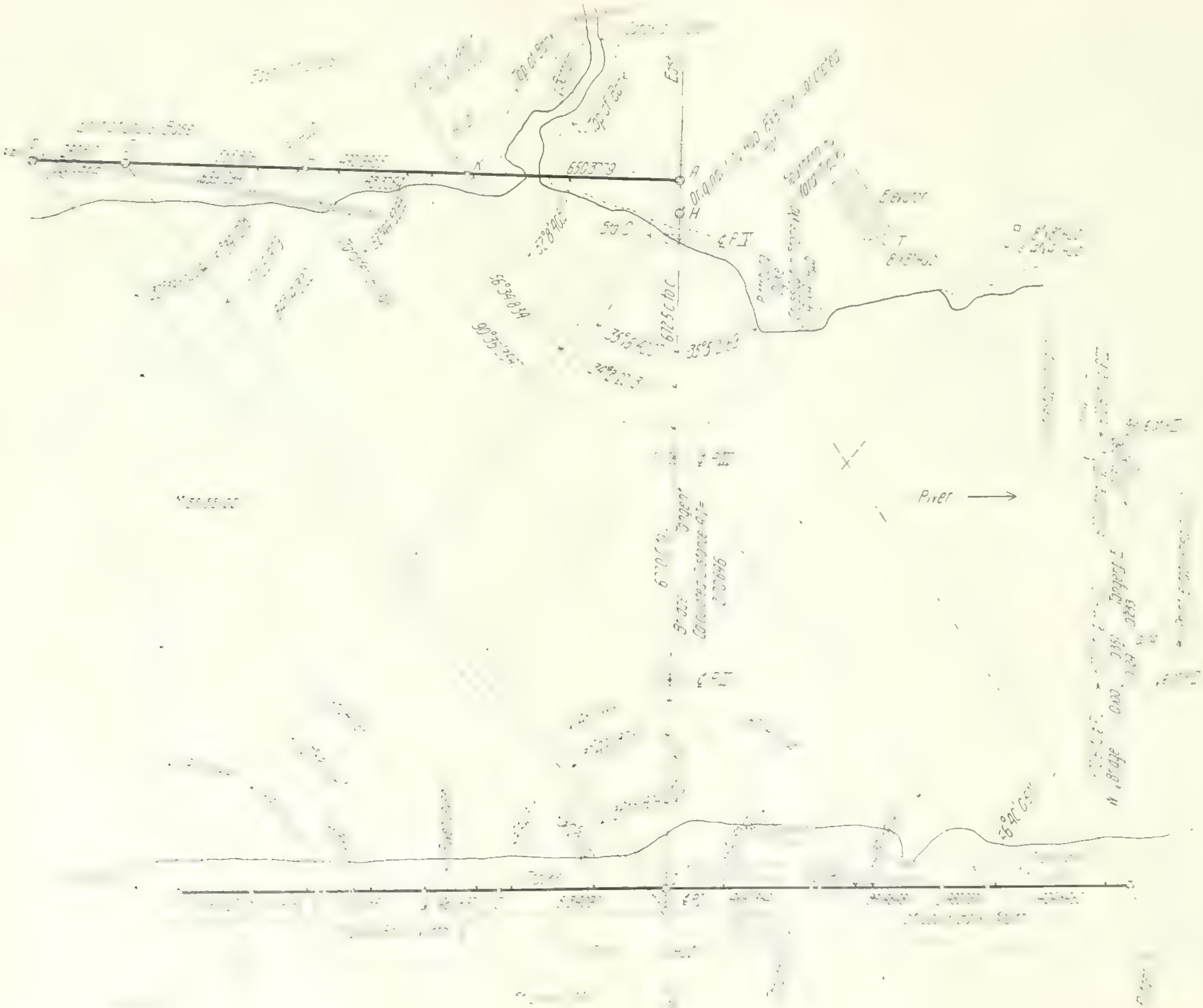


Fig. 8—Triangulation System for Locating Piers of Municipal Bridge.

the sinking records may be of interest as showing the progress of the work:

PIER IV.

Laid cutting edge	Dec. 29, 1909
Ice gorge	Jan. 12, 1910
Started jacking caisson back into position	Jan. 26, 1910
Finished jacking caisson back into position	Feb. [illegible], 1910
Started concreting	Feb. 14, 1910
Started excavation by hand	Feb. 21, 1910
Air turned on	Feb. 27, 1910
Struck first wreckage	Feb. 28, 1910
Passed through last wreckage	Mar. 12, 1910
Laid first course of [illegible] (top cofferdam)	April 20, 1910
Work stopped by high water	May 8, 1910
Work resumed	June 3, 1910
Work stopped by high water	June 10, 1910
Work resumed; found first boulders	July 15, 1910
Landed and started sacking under cutting edge	Aug. 1, 1910
Finished sealing	Aug. 11, 1910

The total sinkage was 108.67 ft., in a total of 161 days, including layoffs, or an average of 0.68 ft. per day.

PIER I.

Laid cutting edge	April 21, 1910
Started excavation by hand	May 3, 1910
Started concreting	May 16, 1910
Air turned on	June 15, 1910
Landed and started sealing	July 9, 1910
Finished sealing	July 12, 1910

The total sinkage was 50.27 ft. in a total of 67 days, or an average of 0.75 ft. per day.

PIER III

Laid cutting edge	June 27, 1910
Launched caisson	July 30, 1910
Towed to position	Aug. 5, 1910
Started concreting	Aug. 15, 1910
Caisson grounded and air turned on	Aug. 18, 1910
Work stopped by sudden rise of river	Aug. 21, 1910
Work resumed	Aug. 26, 1910
Work stopped again by a rise	Sept. 4, 1910
Work resumed	Sept. 10, 1910
Landed and started sacking	Sept. 24, 1910
Finished sealing	Oct. 1, 1910

The total sinkage was 77.9 ft. in a total of 40 days, including layoffs, or an average of 1.95 ft. per day.

PIER II.

Laid cutting edge	Sept. 23, 1910
Launched caisson	Oct. 3, 1910
Towed to position	Oct. 19, 1910
Started concreting	Oct. 25, 1910
Caisson grounded and air turned on	Oct. 28, 1910
Landed and started sacking	Nov. 23, 1910
Finished sealing	Nov. 27, 1910

The total sinkage was 48.14 ft. in a total of 29 days or an average of 1.66 ft. per day.

The rate of progress in sinking Piers I, II and III is in striking contrast to that of Pier IV. In sinking the first named piers, no obstructions were encountered. The material passed through was, in general, clean river sand with some gravel; and good progress was made. The best sinking record made on this work was on Pier III, being 34 ft. in one week of 7 days, with a maximum of 5 ft. 2 ins. in 24 hours. The size of the caisson was 33 ft. x 90 ft. 3 ins., requiring at least 110 cu. yds. of material to be blown out for each foot sunk. The caissons, except for Pier IV, followed down by their own weight, until but a few feet above rock.

While preliminary construction work was going on, the triangulation system was being laid out. Base lines were located on each side of the river; their position being determined largely by certain railroad tracks along the St. Louis Levee, and by the configuration of the east shore. As shown by Fig. 8, the west base line is about equally divided by the bridge tangent, while the east base line lies wholly north of this line. It was not practicable to extend the east base line to the south of the bridge tangent, owing to the fact that the Pittsburg Dyke is much higher than the surrounding ground and would have prevented an uninterrupted sight from one end of the base line to the other.

Levels were run across the Eads Bridge connecting the U. S. Government Benches at each abutment of same, and complete circuits were run down each side of the river, establishing benches near Piers I and IV. Later levels run across the river on the piers checked the last named benches within 0.03 ft.

The atmospheric conditions along the St. Louis river front are far from being ideal; especially in the winter. On some days smoke and fog hung over the water so thick that it was impossible to see from one bank to the other. The work was further complicated by the movements of trains and wagons across the west base line which lies along the top of the levee. In spite of these annoyances, the base line and angles were all measured with great care and the results obtained from the various triangles, after making the necessary corrections and adjustments, were highly satisfactory.

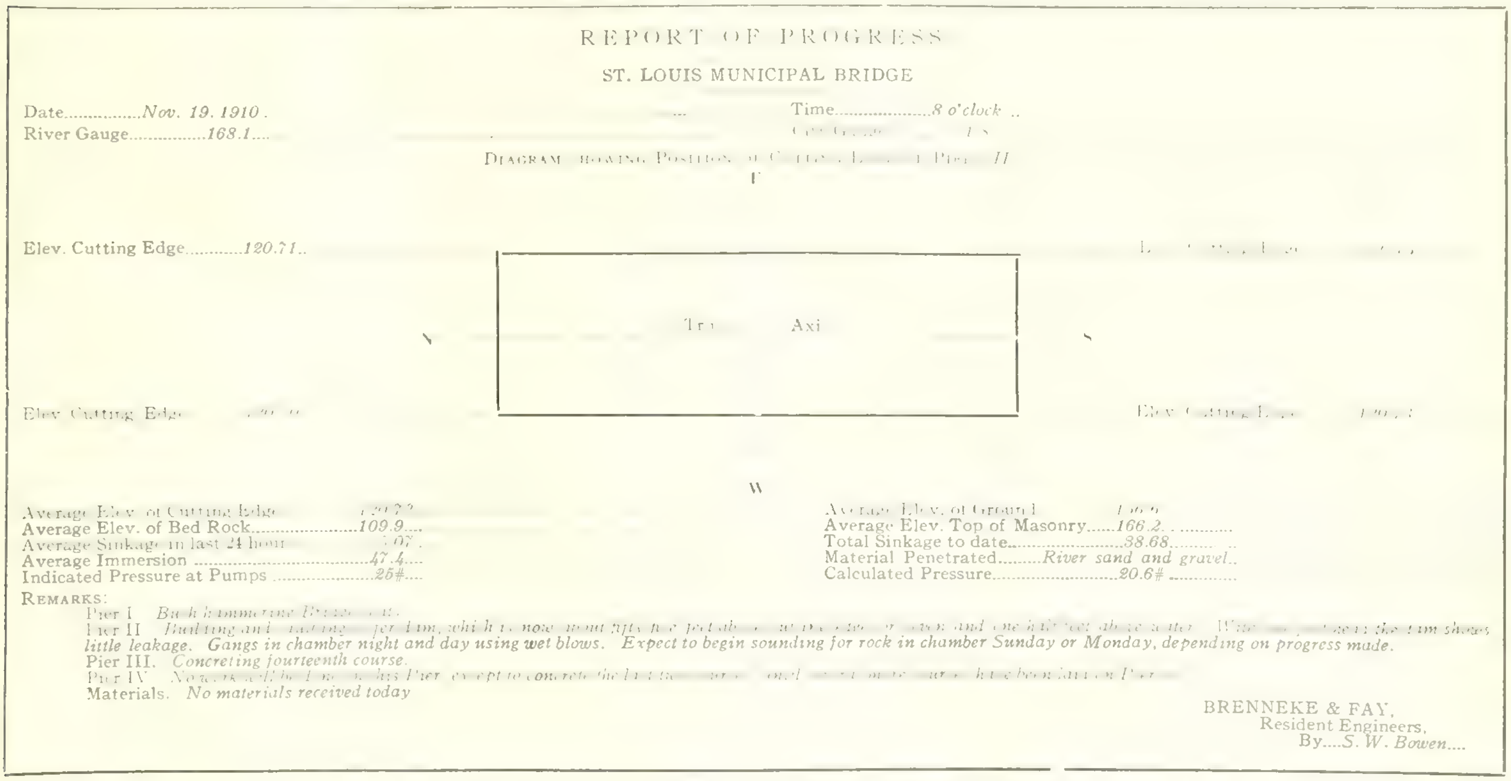
During the January of 1910, the river at St. Louis was frozen over for several days, an unusual occurrence. Advantage was taken of this to locate the centers of Piers II and III on the ice by measuring out along the bridge tangent. A transit was set up at these centers and range lines thrown to each shore. These lines are indicated by the letters *J-K*, *S-T*, *M-N* and *O-U* on Fig. 8. These range lines were then rigidly tied in with the triangulation system by measuring the distance to each intersection point and the angle at each point between the range and base line. After this was done, the intersections of the two pairs of range lines with the bridge tangent were carefully computed and found to be small triangles instead of points. These small triangles are shown on the right of Fig. 6.

Piers II and III were located by the intersection of three lines, the bridge tangent and two range lines; the latter intersecting at nearly 90°. Pier III was located from the east side of the river, while Pier II was located from the west side. Targets were placed on buildings at the west ends of the lines for Pier III and on high timber tripods at the east ends of the lines for Pier II. As the distance from the instrument station to the target was three or four times the distance from the instrument station to the pier, any error in setting on the target would be divided by three or four at the pier.

As the caisson and crib was built up, the center lines were carried up each of the four sides by striking arcs with steel tapes from each corner. By means of these center lines, the axes of the caisson were established and their intersection, or the "built center," of the caisson was marked on a plank from time to time as the caisson was built up. The intersection of the range lines with the bridge tangent was struck on this plank every morning and the position of the "built center" with respect to the axes through the true center thus established was recorded.

Levels were taken daily on nails at the four corners of the caisson whose distance above the cutting edge had been obtained by measuring with a steel tape. From these levels, the elevation of each corner of the cutting edge and the list of the caisson in each direction was obtained. From the position of the caisson at the top, and the list, the position of the cutting edge with respect to the true axes was computed. The information thus obtained was entered in the daily report, a copy of which is shown by Fig. 9.

After the masonry of Piers II and III was well above the water the range lines were struck on each pier with great care. The small triangles formed by the intersection of the three lines were adjusted to the computed size and the pier centers established. Angles were then read to each pier center



REPORT OF PROGRESS

ST. LOUIS MUNICIPAL BRIDGE

Date.........*Nov. 19, 1910*. Time.........*8 o'clock*
River Gauge.........*168.1*.... [illegible]

DIAGRAM SHOWING POSITION OF CUTTING EDGE [illegible] PIER *II*

E
Elev. Cutting Edge.........*120.71*
Elev. Cutting Edge [illegible]
True Axis
Elev. Cutting Edge [illegible]
Elev. Cutting Edge [illegible]
W

Average Elev. of Cutting Edge.........[illegible]
Average Elev. of Bed Rock.........*109.9*....
Average Sinkage in last 24 hours.........[illegible]
Average Immersion.........*47.4*....
Indicated Pressure at Pumps.........*25#*....

Average Elev. of Ground.........[illegible]
Average Elev. Top of Masonry......*166.2*. ....
Total Sinkage to date.........*38.68*.........
Material Penetrated.........*River sand and gravel*..
Calculated Pressure.........*20.6#*..........

REMARKS:
Pier I. *[illegible]*
Pier II. *Building and [illegible] dam, which is now about [illegible] feet above [illegible] and one half feet above water. [illegible] the dam shows little leakage. Gangs in chamber night and day using wet blows. Expect to begin sounding for rock in chamber Sunday or Monday, depending on progress made.*
Pier III. *Concreting fourteenth course.*
Pier IV. *[illegible]*
Materials. *No materials received today*

BRENNEKE & FAY,
Resident Engineers,
By....*S. W. Bowen*....

Fig. 9—Form for Daily Report of Work on Bridge Piers.

[illegible] with the calculated values with which they were found to differ by from 2" to 9". The pier centers were then shifted a slight amount in the required direction and the angles re- [illegible] close to the computed values that this location of the centers was taken as final.

As a rough check on the spacing of the piers, right angles were turned at each pier center, with the bridge tangent and points were established on the upper deck of the Eads Bridge. Each right angle was turned twelve times, two men being at the instrument, turning alternate angles. The average of the twelve points was taken and a mark established on the sidewalk planking. In establishing these points, a cloth covered target, 2 ft. 6 ins. square was used, fastened to a rod with a plumb bob attached. The angle between the two structures, and the distances between pier centers established on the sidewalk, were then carefully measured. The measured distances were corrected for temperature and grade and finally multiplied by the cosine of the angle between the two bridges. The results obtained are given below:

	West span. Ft.	Center span. Ft.	East span. Ft.
M[illegible]	[illegible]	[illegible]	[illegible]
Plan dist........	672.50	677.00	672.50

As the distance between the two bridges is about a mile, the results obtained are surprisingly close to the plan dimensions—much closer in fact, than was thought possible when this method of checking was determined on.

Foresight targets were then placed on the side of each pier, one on each range line and one on the bridge tangent and the centers carried up from course to course by sighting on these targets from the instrument stations on shore. As these centers were established on the forms of the central void of the pier, they could also be carried up from course to course by plumbing. This was done as a check on the intersection of range lines.

For obtaining the elevation of each course, a bench mark was established on the forms of the central void by leveling from shore and elevations carried up by means of a steel tape.

On Dec. 31, 1910, work on the piers was stopped for the winter and was not resumed until Feb. 27, 1911. The present state of the work is as follows: Pier I completed, Piers II and III and IV completed below water, and masonry laid for about 30 ft. above low water. Piers III and IV will be finished first, to allow the erection of the east span after the high water, which usually subsides early in June.

The cost of the four piers complete, exclusive of engineers' fees is about $170,000 or an average of about $12 per cu. yd.

The structure was designed by Boller & Hodge Consulting Engineers, of New York, who were appointed by the president of the Board of Public Improvements of the City of St. Louis. Local matters are under the direction of Brenneke & Fay, of St. Louis, as Resident Engineers, the writer being Engineer in Charge.

Dams on Sand Foundations: Some Principles Involved in Their Design, and the Law Governing the Depth of Penetration Required for Sheet-Piling.*

All textbooks on the subject of dams which the writer has had occasion to examine emphatically discourage the idea of attempting to construct permanent dams on any kind of foundation other than solid rock bottom, although most of them contain one or more illustrations of the types which are generally designed for construction on alluvial soils, such as firm beds of clay, or deep strata of cemented gravel (commonly called "hardpan"), or on sand, provided the conditions are such as to permit the construction of a curtain, or cut-off wall, of sheet-piling, or a core-wall of masonry or of clay puddle, so as to penetrate a firm stratum of denser material.

The frequent failures of sheet-pile dams, on the "bottomless" sand beds of Western streams, have served merely as the basis for warnings, and not as incentives to study and investigation, on the part of the authors of the standard books on the subject of dams, which the practising engineer consults for information and precedents.

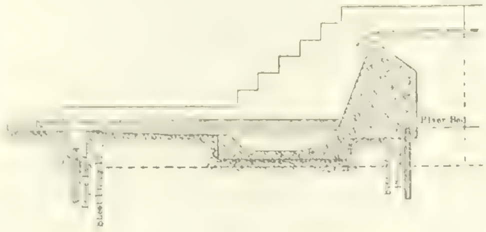


Fig. 1.

Many crude brush and log dams were constructed, and maintained successfully for long periods of years, on these "bottomless" sand beds, by practical and resourceful pioneers who had no theories or precedents other than the example of the beaver.

The operations of British engineers in contending with sand, during the construction of the large Government irrigation works in India, furnish some expensive precedents for the expenditure of unlimited funds; but, our pioneer Western irrigation surveyors were confronted with the problem of coping with streams having apparently bottomless beds of shifting sands, with funds which were generally limited to the few dollars which the pioneer settlers could borrow on their personal characters and future prospects, because their "desert" homesteads, which now rank among the finest farms in the country, were in those times practically worthless as collateral security.

The writer has spent most of his life in the sandy regions of the West, and has had occasion to seek information on practical methods of dealing with treacherous sand, as a young engineer whose ambitions were involved in the successful solution of such problems; therefore after several years of professional familiarity with it, the term, "quick-sand," has less terror for him than it ordinarily arouses.

The following paper is submitted for the consideration of those who have occasion to deal with such problems, not in the sense of establishing authoritative rules, but with the hope of arousing discussion, from which it may be the writer's privilege to learn things which have not been brought out in his own experience.

Seepage, Percolation, and the Movement of Underground Waters.—The velocities of flow which occur in seepage, percolation, or in the forced flow of water through sand, gravel, clay, loam, or other pervious materials, are affected by coefficients of capillary attraction and frictional resistance.

The effects of these forces are co-existent, but not identical, and they vary inversely as the sizes and proportion of the interstices between the particles of the alluvium. In fine clay, therefore, in which the interstices are of infinitesimal size, it is almost impossible to force an appreciable flow of water through a thickness of a few feet. If water finds passage, however, through any point of variable density, or any fissure or shrinkage crack, a barely appreciable trickle, under pressure, will rapidly disintegrate and abrade the clay, and, as the stream thus increases in volume, will quickly undermine or destroy any structure which may be dependent on the density of the clay for its stability.

In the case of sand or gravel, with relatively large interstices, the forces of friction and capillary attraction offer less resistance, and therefore water may be forced through them with an appreciable velocity of flow.

In any alluvial soil in contact with, or subject to the pressure of, water, a movement of water through it is inevitable, whether it be the infinitesimal progress of seepage through fine clay, percolation through sand, the flow through an embankment of broken stone, or the rush of water through the crevices and open spaces between large boulders, the safe, permissible velocity of flow must be confined to that which the material will stand without the movement, displacement, or abrasion of the particles which compose it.

Turneaure and Russell* refer to numerous experiments which have been carried out at various times to determine the velocity at which water will flow through sands and gravels of different grades of fineness. These experiments were made for various purposes, such as to determine the dimensions of sand filters, the probable supply of water from wells, etc.

D'Arcy, Hagen, Hazen, and others, found that for grades of sand varying from very fine sand to fine gravel, the velocity of flow closely followed the law of flow through capillary tubes.

In considering the flow of seepage, or ground-waters, we are not concerned in refinements of experimental data which indicate the influence of temperature on the rate of flow; therefore, after eliminating these, the result of the experiments is the following formula

$$V = 8{,}200\ d^2 s$$

In which V = the velocity of flow, in feet per day;

d = the effective size of the sand grains (varying from 0.1 mm., which is very fine sand, to 3 mm., which is fine gravel); and

s = the slope of the groundwater surface (hydraulic-gradient).

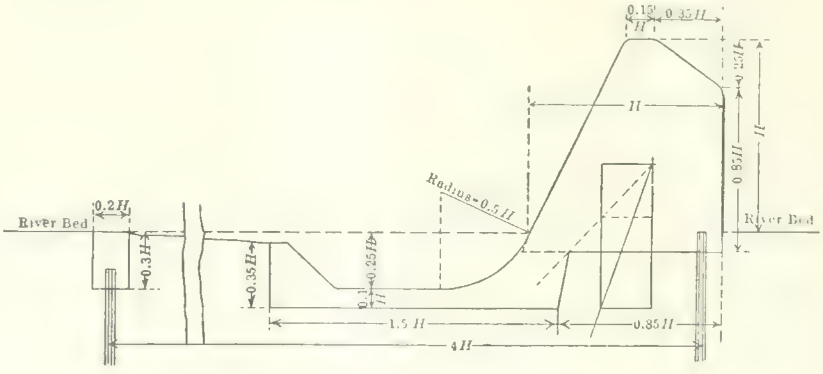


Fig. 2.

According to this formula, the velocity of flow of ground-water, through fine sand having an effective size of grains of 0.1 mm. and a general slope of ground-water surface of

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*A paper by Arnold C. Koenig, Proceedings American Society of Civil Engineers, Vol. XXXVII. p. 32.

*In "Public Water Supplies."

5 ft. per mile [illegible] would be:

[illegible] ft. per day.

The velocity of flow through gravel having an effective diameter [illegible] of 3 mm. and a general slope of water surface of approximately 50 ft. per mile (hydraulic gradient = 0.01) by this formula would be:

$V = 8{,}200 \quad d^2s = 8{,}200 \times 9 \times 0.01 = 738$ ft. per day = approximately 0.0085 ft. per sec.

The Report of the Massachusetts State Board of Health for 1902 contains the results of a series of experiments to determine the velocities of flow of water which it is possible to obtain through screened gravel, of various grades of fineness, assuming 40 per cent porosity. These results are shown in Table I.

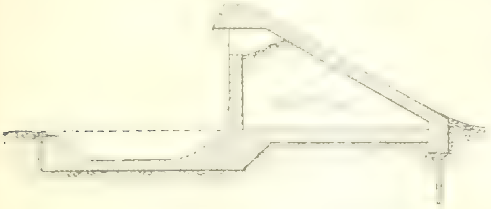


Fig. 3.

From an examination of the figures in Table I, it becomes evident that all the foregoing experimental data are, at best, only rough approximations [illegible] 8,200 d^2s, which was determined from experiments with various grades of sand, gives much larger results than the quantities in Table I for screened gravel. To modify the formula so as to produce the results given in that table would involve a variation of the coefficient (8,200) between 6,222 (for $d = 3$ mm. [illegible] and $s = 0.01$).

For many years the water supply of the Citizens Water Co., of Denver, was secured from about a mile of timber crib, 30 ins. square in section, and about a mile of perforated 30-in. pipe both submerged in the sands of the Platte River at depths varying from 14 to 22 ft. The timber crib was open at the bottom, so that, with the openings in the cribbing, perhaps one-half of its superficial area was open for the inflow of water, while, for the pipe line, the net area of the perforations would probably bear a much smaller ratio to the circumferential area of the pipe. It may be assumed, therefore, that on the 2 miles of combined crib and pipe line the total area of inlet openings would approximate 25 per cent of the surface area exposed to contact with the water-bearing sand, thus affording a total net area of inlet openings of 26,000 sq. ft. The water was led away through pipes, by natural flow, and the supply thus secured was between 400,000 and 450,000 cu. ft. per day, which is equivalent to 13 cu. ft. per day per square foot of inlet opening, or a velocity of inflow of 0.00015 ft. per sec.

Being submerged under the bed of the river at depths varying from 14 to 22 ft., these cribs are entirely surrounded by water-bearing sand; therefore, as the water may approach radially from every direction, it must be assumed that the maximum velocity of flow through the sand is less than one-fourth of the velocity of inflow through the perforations and openings.

Assuming an average head of 16 ft. as acting on these cribs, the spouting velocity of water entering the pipe through one of the perforations from a free body of water under the pressure due to a 16-ft. head ($V = \sqrt{2gh}$) would be 32 ft. per sec., while the actual average velocity of inflow is only 1/200000 of such rate.

All formulas for the velocity of flow of water, under special conditions, are modifications of $V = \sqrt{2gh}$, with coefficients introduced to provide for the special conditions of frictional resistances encountered. In working backward from the results indicated above, so as to determine the special coefficient which must be applied to the formula to adapt it to this special case, we obtain the following:

[illegible]

The lack of harmony in the results indicated in all the foregoing data makes it impractical to devise even an approximate formula for the determination of the magnitude of the force produced by the flow of seepage water under a line of sheet piling. Even if it were possible to determine the relative effects of frictional resistance and capillary attraction on the flow of water through interstices of such an infinite variety as is afforded by the range of materials from fine clay to large boulders, such "hair-splitting" refinements of calculation would have very little practical value for this purpose, on account of the uncertainties which attend the determination of the variations of actual conditions to be met.

[illegible]

Failures in sheet-pile dams have generally occurred in those of the spillway or overflow type, which are commonly called diversion weirs. The seepage water which finds its way under a line of sheet-piling tends to buoy up the particles of sand on the down-stream side, while the surface of the river bed is frequently subjected to a variable degree of scouring action from the current of water which spills over the crest. These two forces combined move the finer particles of sand first, then, as the interstices in the sand gradually increase in size, the upward flow of seepage water increases, both in force and volume, and the destruction of the dam is in progress.

It is customary with many engineers to make the length of sheet-piling such that the depth of penetration below the bed of the stream will be approximately equal to the head of water to be impounded by the dam or weir, and it is likely that many of the failures of such structures, which have been attributed to "unknown" causes, were due to the inadequacy of the cut-off wall under the structure—more often, however, on account of carelessness in driving and faulty alignment than from insufficient depth of penetration.

Length of Sheet-Piling Required.—Capillary attraction and surface friction, in the interstices between the grains, are forces of such magnitude in retarding the velocity of seepage flow through sand, or other pervious materials, that, with reasonable depth of penetration of a curtain-wall of sheet-piling, the direct pressure which may result from any reasonable head of water impounded by the dam cannot produce a velocity of seepage flow sufficiently rapid to move the fine particles of sand without the added force of the overflow current flowing on the surface of the river bed; therefore, in designing the dam or diversion weir, adequate provision must be made to counteract the effects of both of these forces.

Assuming that the force of capillary attraction effectively resists the pressure head of the impounded water, in its natural function of producing an acceleration of seepage flow, then the body of sand on the down stream side may be [illegible] held together by the force of capillary attraction, and that the pressure due to the head of water on the up-stream side passes under the line of sheet-piling and acts on a wedge shaped mass of sand on the down-stream side.

The hydrostatic pressure at the bottom of the sheet-piling is exerted equally in all directions, but, we are here concerned only with the force which acts in an upward direction. The tendency of this force to buoy up the mass of sand is resisted by the excess weight, or specific gravity, of the solid particles which compose the body of sand, after deducting the percentage of voids which are taken up by the water.

Let h = Maximum head of water on up-stream side,

d = Depth of penetration of sheet-piling,

[illegible] trated,

x = Proportion of solids.

[illegible] = 0.6.

[illegible] h [illegible] h [illegible] h [illegible]

0.629 h, which is the theoretic penetration.

This equation provides for the depth of penetration at which the excess hydrostatic pressure on the up-stream side is theoretically counterbalanced by the specific gravity of the depth of material on the down-stream side, in sand of such size and porosity that the combined effect of friction and capillary attraction is a maximum.

A length of sheet-piling which provides for a depth of penetration equal to the maximum head at flood-stage, therefore, involves a factor of safety of only 1.59 (with a tight wall of sheet-piling in perfect alignment) applied to the theoretic minimum. This is manifestly inadequate for such variable and uncertain conditions as are likely to be encountered.

Where the workmanship, alignment, and depth of penetration of a curtain-wall of sheet-piling are such as to ensure that there will be no marked "leakage" flow through openings, or places of variable density, silt and matter carried in suspension by the current of the stream will settle in the quiet pool of water impounded by the dam, and gradually seal up the interstices in the sand, until the bed of the stream becomes practically impervious. This has been thoroughly demonstrated in irrigation canals constructed in sandy soil, and by the fact that the graded sands used in the filter beds of many of our larger cities require frequent renewal, or removal, for the purpose of washing out such accumulations, in order that even the customary slow rate of percolation may be maintained.

No material, other than solid bed-rock, offers a more secure support than sand which is properly confined; therefore, to make it serve as a safe fundation for a permanent dam is entirely a problem of making adequate provision against the only disturbing element—a current of flowing water.

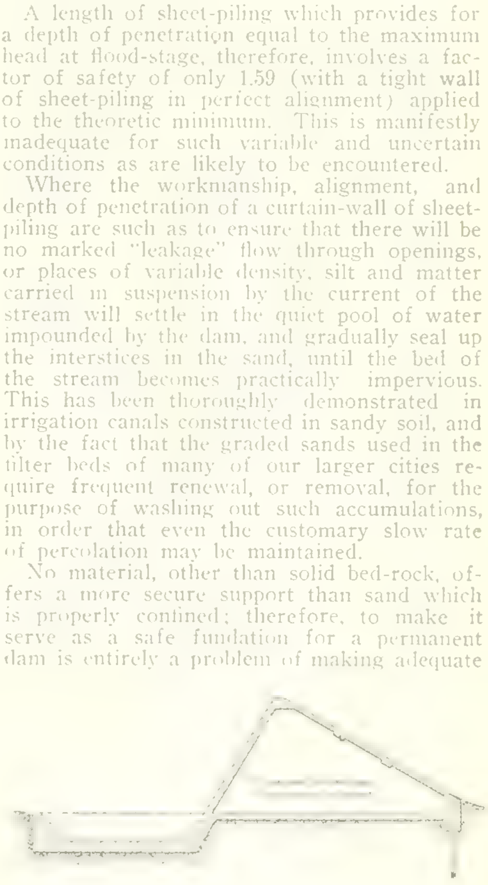


Fig. 4.

For dams which are to be constructed on a sand foundation, and embody the special features of construction recommended in a subsequent part of this paper, the writer suggests the following empirical rules:

$d = 2.5\,h$. For heads up to 8 ft. .... (I)

$d = 2\ \ h$. For heads up to 15 ft. .... (II)

$d = 1.6\,h$. As the minimum, in any case. (III)

Equation (III) uses the proportion of excess weight, due to the specific gravity of the sand, as a coefficient instead of as a divisor. It provides a factor of safety of 2.5 under

TABLE I.—[illegible] ASSUMING [illegible] SETTS STA[illegible]

Slope, s.	[illegible]	[illegible]	[illegible]	10	15	20	[illegible]	[illegible]	[illegible]	40
[illegible]	[illegible]			[illegible]	410	[illegible]	902	1,280	1,640	2,050
0.001	[illegible]	172	335	475	820	1,210	1,680	2,250	3,030	3,690
0.002	115	[illegible]	[illegible]	[illegible]	1,550	[illegible]	3,030	3,930	4,830	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,870	[illegible]	5,000	6,060	7,130	[illegible]
0.006	[illegible]	[illegible]	1,690	2,250	3,690	[illegible]	6,390	7,620	8,930	10,100
[illegible]	[illegible]	[illegible]	2,060	2,780	[illegible]	5,900	7,380	[illegible]	10,400	11,800
[illegible]	[illegible]	[illegible]	2,160	[illegible]	5,000	6,800	8,440	10,000	11,500	[illegible]

[illegible] of the head, the factor of safety is correspondingly increased for higher heads.

[illegible] zontal distance through which seepage water must flow, after passing under a line of sheet-piling, before it reaches an outlet at the surface, is an important element in retarding its force to such extent that there will be no erosion, or movement, of the sand composing the surface of the river bed. It is especially important below spillways, or dams of the overfall type, where the velocity of current from the overflow of the dam may already be such that erosion of the finer particles of sand takes place; therefore, the added impetus of upward percolation would produce a dangerous condition of erosion and the inevitable destruction of the dam.

An apron below a dam serves, not only to resist the shock or abrasion of falling water, but also to seal the bed of the stream, so that the seepage water which finds its way under the curtain-wall of sheet-piling, must flow diagonally upward beyond the limits of the apron before issuing. The width of such apron, therefore, is an important element in fixing the practical factor of safety of the structure, and should not be overlooked.

Aprons for spillways, diversion weirs, and dams of the overfall type, should be submerged, so as to form a water-cushion to absorb the shocks of falling water, ice, and debris. Such water-cushion should have a depth equal to one-quarter, and preferably one-third, of the total height of overfall, and a down-stream width of not less than 1½ times the total height of overfall, with the outer edge forming an apron, sloping upward, and extending down stream for a distance of not less than 1½ to 2 times the length of sheet-piling used in the main curtain-wall, ending with, and supported on, a secondary line of sheet-piling of from one-third to one-half the depth of penetration of the curtain-wall.

A special feature of construction, which provides for considerable economy in the quantity of concrete required for a wide apron, and, at the same time, provides a greater element of safety against the force of seepage flow than a solid concrete apron of the dimensions stated above, is illustrated in Fig. 1.

The submerged apron should be constructed in the form of a trough, with a depth of not less than one-fourth, and a down-stream width of 1½ times the height of the overfall, and the outer edge should be finished off at, or slightly below, the elevation of the bed of the stream. At a point down stream, a distance of about twice the length of the main sheet-piling used (or 4 or 5 times the head), there should be driven a second cut-off wall of tight sheet-piling with a depth of penetration of about one-half that of the main curtain-wall, parallel to the line of the dam, to support a substantial concrete curb which should be finished off at the elevation of the bed of the stream.

The writer wishes to emphasize the statement that: One of the most serious problems involved in the design and construction of dams for rivers with beds of shifting sands is that of providing adequate protection against dangerous erosion of the river bed for some distance below the dam where the erosive action of the current is dangerously magnified by reason of the upward force of seepage flow, under the variable hydrostatic pressure communicated from the head of water impounded on the upper side of the dam.

In the design suggested in Fig. 1, the open space between the edge of the trough forming the water-cushion and the concrete curb supported by the secondary line of sheet-piling provides an open space for the escape of the seepage flow which finds its way under the curtain-wall, while the concrete curb prevents the erosion and removal of the sand, which, in this confined section of the river bed, is subject to the combined forces of upward and horizontal currents.

The approximate general dimensions suggested apply to low dams of the diversion-weir class, such as are used to divert water [illegible] shallow streams for purposes of irrigation and power; and the importance of careful and conscientious workmanship on every detail of construction in sand is so self-evident that special mention seems to be unnecessary.

Every dam or diversion weir should be designed in accordance with the practical demands of the exact local conditions which prevail. This involves modifications of any set of general rules, especially for higher heads, that is, for dams which, in sandy rivers, will raise the level of the water more than 12 or 15 ft. For low dams there is a variety of shapes, or cross-sections, from which to choose; but, for higher heads, economy in the matter of the materials involved narrows down the choice in the direction of the curved or ogee form of cross-section.

Under the general rules previously stated, a dam which is designed to raise the level of the water 50 ft., in a river having a bed of sand of unlimited depth, would require a curtain-wall of sheet-piling having a depth of penetration of not less than 80 ft. below the bed of the stream, as the minimum. A dam of this height would probably be designed with an ogee form of curved cross-section. The impracticability of driving a line of wooden sheet-piling to such depth in sand and gravel, and the expense of providing a curtain-wall of steel sheet-piling to such lengths, would suggest a careful analysis of modifications, for the possibility of eliminating a portion of such construction without impairing its stability and permanence.

Ample assurance of safety could be attained by using a line of steel sheet-piling of such length as to provide a depth of penetration of 50 ft. under the up-stream side of the dam, and a secondary line of sheet-piling with a depth of pentration of about 15 ft. under the extreme toe, which should be curved up so as to form a trough at a depth of about 5 ft. below the bed of the river, for a water-cushion. Then, at a point about 200 or 250 ft. down stream, construct a smaller dam, about 15 or 16 ft. in height, with a line of main sheet-piling having a depth of penetration of 30 ft., and embodying all other features of design in accordance with the special features outlined in this paper, to back up the water against the main dam for a proper depth of water-cushion. The seepage flow, which would probably find its way under the main dam in considerable quantities, would issue from the section of confined river bed between the two dams, where the depth and length of the water-cushion thus provided prevents the removal of any sand, because, even during periods of storm flow, the violent abrasive force of the flood passing over the dam would be effectually broken by the extra depth of water-cushion which is provided by the concrete trough at the toe of the dam.

In calculating the proportions of a dam which is to be founded on sand, there is involved the consideration of the hydrostatic pressure against the under side of the dam.

The calculations for the cross-section of a masonry dam founded on bed-rock are based on the assumption of an absolutely water-tight contact between the footings and the bed-rock, therefore the entire cross-sectional weight of the dam may be used in calculating the moment of resistance to overturning.

In a dam of such proportions that the resultant of forces passes close to the toe, the effect of water working its way under the footings at points of defective contact, or through defective joints in the lower courses of masonry, might produce a change in the direction of the resultant such that it would pass outside of the toe. That section of the dam would then be in unstable equilibrium, and, unless restrained by other forces, would overturn.

In considering the forces which may act on a dam resting on sand, saturation of the foundation, with upward hydrostatic pressure, is an accepted fact, and, therefore, must be considered as a definite element in the calculations.

As stated previously, the combined effect of friction and capillary attraction offers such marked resistance to the flow of water through sand that the velocity which results from any head, or inclination of surface, is infinitesimal, in comparison with the velocity which would result under similar conditions of head in a body of free water, flowing in an open channel, or through a pipe. The transmission of hydrostatic pressure through a similar medium is similarly resisted, to a slight degree, as will be shown.

The removal of the soil above a stratum of dense clay, which in turn overlies a stratum of water-bearing sand or gravel under artesian pressure, will disclose a moist degree of saturation of the clay such that water will accumulate in small pockets, or sumps, which may be bored or dug to shallow depths of 1 or 2 ft. into the clay. The seepage flow which is thus indicated is absorbed by the soil above by capillary attraction, and is evaporated from the surface; however, no hydrostatic pressure, of measurable magnitude, would be exerted against the footing of any structure resting on such a stratum of clay.

Hydrostatic pressure is directly proportional to the head of water, and time is not a factor in determining its magnitude, hence the coefficient of friction becomes zero. Clay contains a relatively large proportion of voids of infinitesimal size, and, while a high head of water pressing against the under side of a stratum of clay which is confined between two porous strata would undoubtedly transmit hydrostatic pressure of measurable magnitude through such stratum of clay, it is evident that, under moderate heads, the force of capillary attraction (in interstices of such infinitesimal size that they would almost warrant an assumption of molecular friction), is of sufficient magnitude to counteract and practically nullify the effect of hydrostatic pressure.

It may be concluded, therefore, that the force with which hydrostatic pressure is transmitted through alluvial soils is modified by a coefficient which varies as the square, cube, or perhaps "*n*th" power of the effective size of the interstices, or, inversely as such function of the effective size of the grains.

For the practical purposes of this paper, the probable existence of such a coefficient may be disregarded, because, for the interstices of the sizes which are ordinarily found in sand of 40 per cent porosity, its probable value becomes so small as to be negligible.

The hydrostatic pressure against the under side of any dam of the type and general dimensions illustrated in Figs. 1 and 2 is governed by the head of water on the down-stream side of the dam, because the pressure which is transmitted under the curtain-wall of sheet-piling, from the head of water above the dam, is afforded lateral outlet, therefore its intensity is limited to the depth of resistance, or head, opposing such outlet on the down-stream side.

The hydrostatic uplift per square foot of surface against the base of a dam of the type and general proportions recommended in this paper, therefore, will vary between 25 and 40 per cent of that which would result from the head of water on the up-stream side.

Figure 2 illustrates the general proportions of the spillway section of a dam of the type discussed herein, with all dimensions given in terms of *H*, the height of the crest above the bed of the river, and assuming a length of spillway such that the maximum height of overflow will not exceed $\frac{1}{5}H$.

The resultant, which is obtained when the calculated weight of the section of concrete is reduced by the total amount of hydrostatic uplift due to a down-stream head $= 0.3\ H$, intersects the base practically in the center, as is shown by the solid line. This would indicate that the design may be modified so as to involve less concrete, but the quantity to be thus saved, in the total cost of a low dam, will not outweigh the desirability of such a factor of stability in a structure of this class.

The dotted line indicates the resultant which would be obtained if the weight of the concrete were reduced by an amount equal to the full hydrostatic uplift which would result from a head equal to the maximum up-stream head $= 1.3H$. This resultant intersects the base outside of the middle third, but well within the toe.

The sloping portion of the top of the dam, on the up-stream side of the crest, is desirable to facilitate the passage of ice and floating debris over the crest, and to reduce the moment of ice thrust during periods of extreme cold when the entire flow of the stream may be diverted for power purposes.

Any increase in the width of the base, with the additional material on the up-stream side of the dam, so as to lengthen the inclined portion, affects the moment of stability of the structure, on the principle of the well-known "gravity" type of dam.

Dams to be constructed on alluvial foundations should be designed with the maximum width of base which is consistent with economy; therefore, the gravity type of dam, constructed of reinforced concrete, is especially adapted to the requirements.

In low wooden structures of the gravity type, there is danger that they may float during a period of storm-flow of such depth that the gravity head, on which such dams depend for their stability, may be destroyed. By the use of reinforced concrete, however, this source of danger may be eliminated.

Figures 3 and 4 indicate two variations of design for gravity dams of reinforced concrete which permit of removing the forms and filling the compartments with sand or other heavy material, in order to give additional weight to the structures, or, if suitable air vents are provided, the compartments may be allowed to become filled with water.

From the simple inclined platform to the large hollow structures of the Ambursen type, the gravity dam of reinforced concrete offers a sufficiently wide range of variation to meet the requirements of almost any locality, or any individuality of taste in engineering design.

LETTERS TO THE EDITOR.

Inadequate Salaries for Engineers.

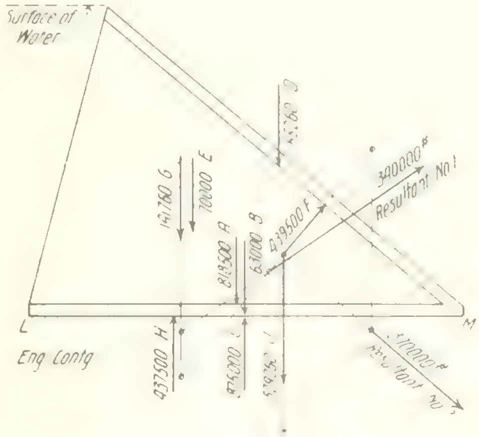
Sirs:—Will you allow criticism? In your issue of Feb. 8 you have an editorial on inadequate salaries for engineers in state highway work in which you say $2,500 a year is not enough and $5,000 a glaring example of underpay in the case of the man engaged in squandering the hundred millions for the barge canal.

In reading, or looking through, the pages of an English statistical work I was really surprised a few days ago to note that the average compensation of railway employes in England is only $1.02 a day. Now why are the state highway engineers worth so much more? True, the employes mentioned are [illegible] the engineers are, or are supposed to be, brain users. What are the engineers doing that is so difficult? I have compiled from various sources statistics of the travel or traffic on highways in this country, as follows: New York state, 4 roads, average 131 vehicles per day (Eng.-Contr., Apr. 21, 1909); Illinois, 8 roads, average 251 vehicles per day (Eng. Rec., [illegible], p. [illegible]); Massachusetts, 2 roads, average 250 vehicles per day; Ohio, 1 road, 248 vehicles per day (Eng.-Contr., Nov. 2, 1910). These four instances may fairly represent country road travel or traffic. In the last instance the kind of vehicles is given, and from it I have computed that wagons constitute only 28 per cent of the total, the rest being pleasure vehicles, buggies, carriages, automobiles, motorcycles, etc., and of this 28 per cent only 8 per cent are two-horse wagons, i. e., 20 per cent of the total is one-horse wagons, and 8 per cent two-horse. Applying this percentage to an assumed traffic of 250 vehicles per day, there would be 50 small and 20 large wagons a day. Half of these may be considered as going from town practically unloaded, returning home after having carried a load to town. The other half, or 25 small and 10 large, may be estimated to have loads ranging from zero to one ton or two tons, respectively, averaging ½ and 1 ton for the two sizes, or 27 tons total load a day. Considering that during bad weather, 100 days a year, there would be a substantial saving in favor of hard roads over earth roads, and counting that saving at 5 cts. per ton-mile, there would be 2,700 ton-miles a year per mile of road at 5 cts., equal to $135, which, capitalized at 10 per cent (5 per cent for interest and 5 for maintenance) would make $1,350 justifiable cost of building such country roads per mile. But these state engineers are spending $2,200 to $10,000 and more building these roads, and if their salaries were increased would spend $10,000 to $15,000 to build "adequate" roads. The average cost of state-built roads from the article in your issue of Dec. 23, 1908, being $5,289 per mile, what great feat are these state engineers accomplishing in building roads worth $1,350 (judged by their use) for $5,280? But if you say this is simply the opinion of the writer as to the saving and the time of year it applies to, then the reply is that so is your expression merely one of opinion and there is more than one viewpoint on such things.

Respectfully, A. C.

Nashville, Tenn., Feb. 13, 1911.

(Whether the expenditure of $100,000,000 for a barge canal or of $5,000 per mile for a state road system is justifiable has absolutely no bearing on the adequacy or inadequacy of the salaries paid the engineers who are designing and directing these works. This is plain logic and not at all a matter of opinion. To assume that the commercial productiveness of a canal, railway, power plant or any other engineering work should determine the amount of compensation to be received by the engineer employed to design and construct the work leads to absurdity if reasoned to its logical conclusion. The task of building the New York Barge Canal would be just as great and the skill and responsibility required of the engineer would not be a whit less were the canal never to float a boat, after completion. We insist that a salary of $5,000 a year is ridiculously inadequate for directing the engineering work of a $100,000,000 canal.—Editors.)



A Comment on "Reversed" Dams.

Sir: Kindly permit me to make some comments on the article on dams by Mr. R. C. Beardsley in your issue of Feb. 1, 1911. It is a matter of greatest surprise to me that Mr. Beardsley should suggest a design of a dam such as he proposes for serious consideration, in view of the fact that his own book would utterly condemn it.

In the sketch herewith is shown the cross section of his dam, somewhat simplified in outlines. This dam is 100 ft. high and has a base of 140 ft. The slabs are assumed uniformly 3 ft. thick and the counterforts 1 ft. thick, spaced 13 ft. The forces that act on one foot of the dam are shown. A is the weight of the water on the upper side of the slab LM. B is the weight of the slab LM. C is the upward pressure of water under the slab LM, with a head of 100 feet. D is the weight of the slab MN. E is one-thirteenth of the weight of a triangular counterfort. F is the normal water pressure on the under side of the slab MN. G is the resultant of A, B, C, D and E. The load of 340,000 lbs., marked Resultant No. 1 is the resultant of G and F, or the total resultant on the dam for the condition assumed, which will be explained [illegible] this dam would have a very substantial inducement to float away.

The reason for taking the force C into consideration may be found in Mr. Beardsley's book "Hydro-Electric Plants," page 247, where I read the following: "Mr. J. B. Francis held that solid concrete deposited on bed rock would be lifted or floated, and to prove this placed pipe provided with a pressure gage in the concrete of a dam, and found that the gage registered the full pressure." Taking this principle, that Mr. Beardsley informs us is proven, and applying the pressure gage along the line LM we should expect to see it register the pressure of 100 ft. head of water. Then Resultant No. 1 shows the direction that the dam would take when water reached the height N and had time to seep into the foundation.

Or suppose that while the water seeps in at L it is escaping at M and that the pressure diminishes to zero at M. This triangle of upward force would have its resultant in H. The resultant of all vertical forces is then J and Resultant No. 2 shows what this combined with F amounts to. This strikes outside of the middle third of the base and would mean tension at L, which in turn means freer access of water under the base and a tendency to reach the condition of Resultant No. 1, at least so long as the dam would remain in place.

It is seen by the above that Mr. Beardsley's dam would be quite unsafe unless it could be perfectly sealed against the admission of water beneath it. This is practically impossible.

Mr. Beardsley states that the floating tendency of 3 ft. of water below his dam has been allowed for in his calculations. This is totally out of agreement with his book, where he recommends that the effective weight of a gravity dam be diminished by one-third above the level of the tail water. This would be about 50 lbs. per cu. ft. of upward force in the triangle LMN, which he ignores.

I have stated a number of times publicly that no book on dams makes any mention of the upward force of the water that works its way below the base of a dam or into horizontal joints. This has caused the failure of many dams. Mr. Beardsley in Concrete-Engineering some months ago called my attention to the fact that his book (which, however, is not a book on Dams) mentions this force. His new design practically ignores it.

The stability of a dam is of too great importance to be trifled with by suggestions of designs such as the dangerous one proposed by Mr. Beardsley.

The writer has on his files four letters which he wrote condemning the design of a great dam during its construction, because principles of stability were violated. The dam failed shortly after it was built, with enormous loss.

Yours very truly,

EDWARD GODFREY

Monongahela Bank Bldg., Pittsburg, Pa., Feb. 4th, 1911.

BOOK REVIEWS.

Smolley's Parallel Tables of Logarithms and Squares.—By Constantine Smolley, C. E. Engineering News Pub. Co., New York. Leather; 5⅞x7 ins.; 500 pp. India paper.

This is the sixth edition of this work. The table of Natural Functions contained in this edition gives the sine, cosine, tangent, cotangent, secant and cosecant by intervals of one minute, instead of by ten minutes as in the old edition. The additions comprise tables of squares, cubes, square roots, cube roots, and reciprocals of numbers from 1 to 1,000; also tables of areas and circumferences of circles with diameters from 1 to 1,000. While the plan of covering a larger field of theoretical as well as practical work necessitated the addition of the new matter, the volume of the book is not so great as to detract from its value as a handy pocket manual.

Power Gas and the Gas Producer.—By [illegible] Miller, M. E. Popular Mechanics Co., Chicago. Cloth, 5½x8⅛ ins.; 184 pp.; illustrated. $1.00.

This is an elementary treatise on gas producer plants. It contains an abundance of information on the subject, written in a non-technical way, and is suitable for beginners and for the technical man, who wishes to obtain a clear elementary knowledge of producer gas and [illegible] relative values. All the various types of pro- [illegible] grams. Several chapters are devoted to the [illegible] to the costs of both steam and gas plants. The last chapter contains various information on the [illegible] observed in setting up such plants. Incidentally the book attempts to prove in a general way, that gas power is the best economy in the line of fuel consumption; can handle any low grade fuel; requires less space for installation than a steam plant; requires less attention in operation and is more reliable in operation than a steam plant.

Popular Hand Book for Cement and Concrete Users.—By Myron H. Lewis and Albert H. Chandler. The Norman W. Henley Publishing Co., New York. Cloth, 6x9 ins.; 430 pp.; illus- [illegible]

This is not a treatise for engineers and its authors, as their preface shows, do not classify it as such. Were it a book for engineers we should know better how to appraise it. It is not an easy matter to decide what of engineering art and science should be included in and what omitted from a popular treatise on any branch or kind of engineering work and all will not agree with the authors' decisions in this instance. Personally we should have omitted Chapter XVIII in The Theory of the Design of Reinforced Concrete Beams and Slabs and considerable parts of the matter on computations in designing in other chapters. These mathematical analyses, however simplified, serve small purpose if any to the non-technical student of concrete construction. For the technical student there are other books both simple and profound which serve as well or better. Why not merely have stated the nature of the problem of designing a beam or a column with some indication of the requirements for its solution and then have stopped? Essentially this method was followed in the chapter on arch design. The non-technical man has no more business with designing a reinforced concrete girder or column than he has with designing a steel girder or column. If the foregoing comment is severe it is prompted by the fact that in other respects the book before us is much the best popular treatise on concrete construction that we have seen.

Beginning with a description of the nature of hydraulic cements the book tells how they are manufactured, tested and used. Concrete materials and their proportioning and mixing are described. Forms and molds, surface finish, water-proofing and inspection are described, and finally a chapter of cost data for various classes of concrete work is given. An important feature of the book is the description of concrete specialties such as building blocks, ornamental work, fence posts and pipe. There are chapters describing the manner of using concrete for residences, bridges, walks, walls, conduits, railway structures, etc. Altogether the field of concrete construction is well covered and with the exceptions noted the matter given is well within the understanding of any intelligent person.

Railroad Traffic and Rates.—By [illegible] D. Appleton & Co., New York and London. [illegible]

With the growth of railroad traffic in the United States rate making has become an exceedingly complex art. Much of the present public distrust is doubtless due to imperfect understanding of the problems in traffic and rate making with which the railroad manager has to deal, and a clear exposition of the subject is at the present time particularly valuable.

This work has been written mainly for the purpose of providing railway men with information of as complete and reliable a nature as possible. It will prove equally valuable, however, to the general reader who wishes to inform himself on these subjects. The authors state that the work "is not the result of a few months' labor," but that "it has grown up during the past five years alongside of a course given each year to advanced students in the University of Pennsylvania." The amount and completeness of the information given, with the continual evidence of care in details, testify to the fact that the work was not hastily prepared.

All chapters of a technical nature were submitted before publication to traffic and transportation experts for criticism and correction, [illegible] suggestions were made by other officials. The list of these officials given in the preface is a list of the representative traffic men of the day. The work is therefore an authoritative exposition of the intricacies of traffic and rate making on American railways.

The first volume is devoted to a treatment of "The Freight Service." Three introductory chapters on the characteristics, sources and volume of freight traffic and the earnings of American railroads, are followed by a complete and detailed explanation of the organization and management of freight service. This leads logically to an excellent series of chapters on the most important railroad question of the day, freight classification and rates.

The second volume covers the organization and management of passenger service, classification and fares, and the express and mail service. The law as it affects rate making is touched on in chapters giving the provisions of the Railway Rate Act of 1910 and the decision of the Interstate Commerce Commission in the Reno, Nev., rate case.

The work is amply illustrated with maps and with typical forms used in traffic service and contains an unusually good index.

Notes On Irrigation Works.—By N. F. MacKenzie. D. Von Nostrand Co., New York. Cloth, 5½x8½ ins.; 111 pp.; maps and illustrations; $2.50.

The most extensive irrigation work of modern times is that of British engineers in Egypt and India, and American engineers interested in irrigation projects in this country cannot fail to find much of value in a book dealing with their methods and accomplishments.

This book consists of a series of lectures delivered at Oxford University in the winter of 1909, and addressed to students of engineering and geography. No attempt is made to deal with all the problems in engineering and economies that must be solved by the irrigation expert. But enough is given to indicate the methods employed by British engineers in solving such problems. With the exception of an introductory chapter of a general and historical nature, the book is confined almost entirely to irrigation in Egypt and India. As stated by the author, these countries contain, probably, the most interesting object lessons in modern scientific irrigation.

In a book of this size, the Assuan dam and other famous irrigation projects are necessarily treated briefly. What is of most value is the discussion throughout the book of the principles of good practice, and of the questions, economic and physical, that must be given first consideration in developing any irrigation project.

As a whole the book gives a broad view [illegible] the best work of British irrigation engine[illegible]

Municipal Chemistry.—Edited by Charles Baskerville. McGraw-Hill Book Co., New York and London. Cloth, 6x9¼ ins.; 526 pp.; illustrated; $5.00.

The work of the chemist has become recognized as an essential factor in the solution of a large class of municipal problems. Sanitation, water supply, food inspection, sewage disposal and numerous other problems, are becoming increasingly complex with the growth of our cities. The chemist must inform us of existing conditions and specify the means to be employed for the improvement of these conditions.

Much of the chemist's work is, necessarily, unintelligible to the layman. But it is best that the intelligent citizen should, without going too much into detail, possess a broad knowledge of the municipal problem in which the science of chemistry is involved, and know something of the methods employed in the solution of such problems.

It is evidently for the purpose of supplying the unscientific reader with such information that this volume of lectures has been prepared. The lectures are popular in style and form easy and interesting reading. It is stated that one purpose of the book is to "tell of the application of enlightened common sense where people congregate and form cities."

In the spring of 1910 a series of lectures was given by distinguished experts at college of the City of New York. With a few exceptions, in which cases special papers were prepared, the book is composed of these lectures. All the usual problems that have to do with questions of health are discussed; but the book goes farther than this, and takes up questions in which economic consideration of importance to the municipality occur, such as the manufacture of illuminating gas, the smoke problem, textile materials, combustibles and explosives, paint, cement and concrete, and the corrosion of iron and steel. There is also a short but interesting chapter on parks, gardens and playgrounds. The book is well illustrated with maps and half-tones.

PERSONALS.

City Engineer Clement, of Vancouver, B. C., has tendered his resignation, to take effect March 31. He went to Vancouver from Toronto five years ago, and has served as city engineer continuously since that time.

Mr. D. K. Colburn, engineer of bridges and buildings of the Sunset lines, was appointed engineer of maintenance of way on March 1, succeeding Mr. A. V. Kellogg, who died a short time ago. It is stated that the bridge and building and the maintenance of way departments will be consolidated and will be under the direct charge of Mr. Colburn.

Mr. Frank Koester, formerly with the Interborough Rapid Transit Construction Co., J. G. White & Co., and other leading engineering and construction firms of New York, has opened an office at 115 Broadway, New York City, and will engage in practice as a consulting engineer. He is the author of a number of books, among them being "Steam Electric Power Plants" and "Hydroelectric Developments and Engineering."

The report that Mr. H. E. Vaultelet, chairman of the Board of Engineers, for the Quebec bridge, had resigned, has been confirmed during the past week. His resignation is said to be due to serious differences of opinion among the members of the board as to which bid for the construction of the bridge should be accepted. Although no official award has yet been made, it is understood that the contract for building the superstructure will go to the St. Lawrence Bridge Co.

The engineering organization has been completed and work is now under way on the Buckhannon & Northern R. R., a new line 30 miles in length in West Virginia. The following resident engineers have been appointed: Mr. J. M. C. Forquer, with headquarters at Maidsville; Mr. Z. T. Rogers, with headquarters at Morgantown; Mr. James V. Howe, with headquarters at Little Falls, and Mr. H. Tiffany, whose headquarters have not yet been determined.

Mr. Jackson Bolton, assistant city engineer of Richmond, Va., committed suicide by inhaling illuminating gas on Feb. 27, after having brooded for several days over a censorious report made by a committee of the city council that investigated his department. Mr. Bolton was 61 years of age and it is thought that the charges against his management of the department had unbalanced his mind. City Engineer Bolling praises his assistant's integrity and ability, and states that under the clumsy organization of the department the faithful man was "made a pack-horse and worked to death."

Mr. Donald Hendrie, assistant superintendent of the Barber Asphalt Co.'s plant at Philadelphia, died at the University Hospital in that city on Feb. 27, at the age of 27. Death was due to injuries received in an explosion at a plant in Guanco, Venezuela, about a year ago, of which he was at the time assistant superintendent. He was educated at the University of Pennsylvania and was prominent in college athletics. For some years he taught in the Brown Preparatory and Philips Brooks schools. He later entered the mechanical department of the Baldwin Locomotive Works, leaving that company to go with the Barber Asphalt Co. It was in the service of the latter company that he met with the injuries that resulted in his death.

Mr. John Merven Carrere, one of the leading architects of New York City, died at the Presbyterian Hospital in that city on March 1. Death was caused by injuries received in a collision two weeks ago between a trolley car and a taxi-cab in which he was riding. He was born in Rio Janeiro in 1858, and received his only education in Brazil and Switzerland. Entering the school of architecture of the Ecole des Beaux Arts, Paris, he early attracted the attention of leading French architects by his energy and originality. After finishing his studies in Paris he came to America in 1882 and was for three years connected with the firm of McKim, Mead & White. In later years he became one of the leaders of the brilliant group of architects that represented the French tradition in this country. Many well known buildings in the east and southeast are of his design. The Public Library and the New National Academy of Design, in New York City, are among his masterpieces. He was a member of many clubs and a past president of the New York Chapter of the American Institute of Architects, and of the Beaux Arts Society of New York.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

The largest railroad construction contract of the year was let recently in the state of Washington. This contract calls for the construction of 40½ miles of line from Spokane to Ayer Junction for the North Coast R. R. The contract amounts to about $4,000,000, the successful bidders on it being: George Chew, Spokane, Wash., 7½ miles of roadbed; G. A. Carlson & Co., Spokane, Wash., 22½ miles; W. L. Trible, Spokane, 3½ miles; Eschbach-Bruce Co., North Yakima, Wash., 7 miles. Another large contract which was let early last month was for the construction of 45 miles of line for the Manitoulin & North Shore Ry. in Canada. This work will cost about $1,500,000. The Superior Construction Co., Sault Ste. Marie, Ont., secured the contract. Among the other railroad construction let recently are the following: W. D. Lovell and E. C. Bowman of Minneapolis, Minn., for constructing 3½ miles of grade at Sheridan, Wyo., for the Sheridan Street Ry. & Electric Co.; Grover C. Holbrook, for constructing bridges and trestles for the Cullman Coal & Coke Co.'s line from Cullman, Ala., to Bremen; M. Tansey, San Saba, Tex., for grading the road bed for the Wichita, McPherson & Gulf Ry. (Midland Valley) from Wichita, Kan., to Arkansas City.

At a meeting at Chicago on March 1, 35 western railroads decided to make no appeal from the recent decision of the Interstate Commerce Commission denying the roads the right to increase freight rates. They will accept the decree of the commission as final. The decision was reached at a meeting of representatives of the roads at the Western Trunk Line Association headquarters. The opinion was advanced by many that the roads would be unable to make any stronger showing before the new commerce court than they had before the commission and that once the new court had ruled, its decree would be binding for two years. It also was argued that if the roads comply with the decree without objection and withdraw the advanced tariffs before March 10 there will be an opportunity at a later date to submit advances on certain rates, some of which may meet with favor.

The government of Panama has announced that it will receive proposals for the construction of the railroad from Panama to David and a branch to Los Santos until June 30. The conditions for the contracts will be placed in the hands of the Panama consuls general in the United States and Europe. The railroad will be 362 miles long. The Panama government has consul generals at New Orleans, New York, and San Francisco.

Bids have been opened at Belle Fourche, S. Dak., for a fair sized irrigation contract for the U. S. Reclamation Service. The bids were taken on the construction of 22.8 miles of canal and will be found elsewhere in this issue.

About the largest piece of levee work now being advertised is the one for which the Board of State Engineers, New Orleans, La., is now taking bids. This contract calls for the construction of about 250,000 cu. yds. of levee in East Carroll and Madison parishes, the work being located about 21 miles above Vicksburg, Miss.

A good sized ditch contract in Marshall and Beltram counties, Minn., has just been awarded to the J. B. Arpin Dredging Co. of Grand Rapids, Wis. This contract calls for 526,127 cu. yds. of earth excavation at 12.85 cts. per cu. yd.

The Railroad Construction Outlook.

[illegible] celled its rail order, nor [illegible] announced the holding up of any construction work which had been definitely planned to be done this year. On the contrary several of the railroads have announced that they would go ahead with their immediate construction plans. It may be too early to prophesy but it seems at present that the rate case decision will have no effect on the railroad construction work which had been mapped out for this year. Indications of this are seen in the placing of $50,000,000 of bonds in France by the Harriman Lines. These roads, to be sure, had announced even before the rate case decision was made public, that they would go ahead with their improvement work no matter what was the action of the Interstate Commerce Commission. The placing of these bonds, however, seems to make certain that much work will be done this year by these lines. Indeed a $4,000,000 contract on the North Coast R. R. has just been let, and bids on other large contracts are under consideration. The Chicago, Milwaukee & St. Paul Ry., one of the railroads which announced that it would go ahead with the construction of its lines in the Puget Sound District, has also recently sold a large bond issue. The amount of this issue was $25,000,000 and as the present plans of the St. Paul for additions and betterments to its own property and its Puget Sound line are said to call for the expenditure of about $12,000,000, it would appear that the railroad was looking ahead to the extent of perhaps two years. The Chicago, Rock Island & Pacific Ry. has also announced that it would go ahead with the construction of a new connecting line in Iowa and the Chicago & Northwestern Ry. is understood to be taking steps for the construction of a new line from Peoria, Ill. The acquirement of the Pere Marquette R. R. by the Morgan interests has brought out the statement that a large sum would be expended for improvements, and the passing of the control of the Missouri Pacific from the Goulds to the Kuhn-Loeb syndicate makes available the necessary capital for the rehabilitation of that road. In New England a great deal of railroad construction work is planned. Most [illegible] Grand Trunk Ry. for securing an entrance to Providence, R. I., by the construction of a new line from Palmer, Mass. Plans for this [illegible] begun this spring. This project of the Grand Trunk met with bitter opposition from the New York, New Haven & Hartford Ry. and [illegible] Grand Trunk Ry. will also have to build a [illegible] Vt., 40 or 50 miles, as it can no longer use the [illegible] those points. Surveys for all of these lines have been made and announcements have [illegible] Hampshire and Vermont [illegible] of no particular importance, but when it is considered that the total mileage of [illegible] line constructed in the last ten years in these two states, is about enough to make a good sized switch, any new work is worthy of note. Reports from the southern states, particularly Alabama, Georgia and Tennessee, also indicate that the outlook for new construction work this season is very good. The older roads, such as the Seaboard, the Atlantic coast Lines and the Southern, are all reported to have extensive betterment plans under consideration; in addition many new projects have been financed and the companies are planning to go ahead and construct their lines. All in all the present indications are that there will be more railroad construction work this year than there was in 1910.

Reversing the Process.

In these days of many commissions to safeguard the interests of the people from the grasping corporations it is somewhat of a reversal of the usual process for a corporation to appeal to a commission for protection from the people. But this is exactly what has been done by a Canadian company. Some months ago the control of the Montreal Street Railway passed from the hands of the former directors into those of a new group of capitalists. Immediately after the new directors took charge of the street railway bitter attacks were made upon the service which they were furnishing the citizens, although up to that time the press and citizens of Montreal had made few, if any, complaints regarding the service. These complaints became very pronounced. The new board of directors then went to the City Council and the Board of Control and asked for suggestions regarding the improvement of the service. They went into the question of extending present lines, of adding new routes, the percentage to be paid the city by the Street Railway company, the cost of removing snow, and their share in maintaining the up-keep of the streets on which their lines were laid. At the same time they requested an extension of their franchise, as it related to the newly-annexed wards. The company pointed out that it was unfair to ask them to extend their car lines into sparsely-settled suburban districts without granting them some compensation for the outlay. For several months negotiations have been going on between the company and the city, but nothing has come of the conferences. The Street Railway Co. declare that the City Council has been blocking all their efforts to improve the service, and have been making exorbitant demands upon it which it is unable to meet. This deadlock now appears to be on the verge of being broken. Recently a bill was introduced into the Quebec Legislature seeking to incorporate the four car lines now operating on the Island of Montreal into one company, to be known as the Montreal Tramways Co. These four lines are all owned and operated by the Montreal Street Railway Co., some of the [illegible] Montreal. The franchises for these various lines expire at different times, so the Montreal Street Railway desires to reincorporate all the lines under a new name and with a new charter and also the whole matter of franchises and charters. At the same time the bill provides that if within five weeks of the incorporation of the Montreal Tramways Co. the City Council and the Street Railway Co. fail to come to an agreement regarding the particular points in dispute, the whole matter shall be turned over to the Public Utilities Commission, its decision to be final.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

Residents of Austinville, a suburb of Decatur, are to petition the North Alabama Traction Co., New Decatur, Ala., to build a 1-mile extension of its line to Austinville.

Preliminary construction work has been started near Corey on the proposed line of the Tidewater Interurban Ry. This work is being done in compliance with the requirements of the franchise granted by Bessemer. It is expected that the actual construction work will be started as soon as the city council of Birmingham approves the plans. This line is to connect East Lake with Bessemer, and will pass through the business section of Birmingham. The construction contract is reported to be held by the MacArthur Bros. Co., New York and Chicago, as previously noted in these columns.

The Tuscaloosa Mineral R. R. Co., which projects a 20-mile line from Tuscaloosa to the Birmingham mineral district, is now purchasing the right of way and terminals. It is believed that actual construction work will be started in the near future. The road will cost about $650,000. F. G. Blair, Tuscaloosa, Ala., is president.

The Cullman Coal & Coke Co., Cullman, Ala., has awarded the contract to Grover C. Holbrooks for the construction of trestles and bridges on its new railroad from Cullman to Bremen. Work on this railroad was started some time ago and after it was about 80 per cent completed the work was stopped. It is now said that the Cullman Coal & Coke Co. is planning to have work resumed and the road completed.

It is reported that the Mary Lee R. R., now operating 7 miles of line, is to be extended to Gadsden, to a connection with the Tennessee, Alabama & Georgia Ry. C. P. Ludwig, Birmingham, Ala., is General Manager, Mary Lee R. R.

Arizona.

Location surveys for the extension of the El Paso & Southwestern system, Walter Douglas, Vice President, Bisbee, Ariz., from Benson to Tucson, are now under way.

Two carloads of scrapers are reported to have been sent to Sasco for use in constructing the road bed of the proposed Port Lobos R. R.

California.

⦿The Board of Works, San Francisco, Cal., has awarded to McNab & Smith at $2 per ton, the contract for hauling the first consignments of the Geary St. railway rails. The delivery is to be made to points along the route in Richmond from the wharf, and the commissioners expect to have actual construction work in progress within a few weeks.

The Vallejo & Northern Ry. Co., a subsidiary company of the Northern Ry. Co. (electric), of Chico, Cal., has started surveys over a proposed right of way from Suisun to Benicia. This is the first step toward changing its proposed route southward from Sacramento to the bay. It is stated that citizens of Benicia have assured the railway company of a private right of way and terminal facilities upon deep water, shortening the route to San Francisco by over an hour. It was the original intention of the company to create its terminal in Vallejo, building by way of Cordelia, Napa Junction and Vallejo. The road as now planned will tap the rich section of tule lands between Suisun and Benicia, where reclamation projects are already under way.

A bill has been before the State Legislature to grant the city of San Francisco a franchise to build a municipal railroad on East St. from Hunter's Point to the Presidio.

S. N. Griffith, of Fresno, is organizing a company for the purpose of putting in an electric interurban railroad, to cover a greater portion of the Turlock irrigation district. [illegible] put through it is said that the company will spend not less than $1,000,000 in and around Turlock in improvements.

No definite decision has been given as yet by the Southern Pacific Company on the construction of a branch from Arbuckle to Hamilton. The company will probably build the branch as assurances have been given of sufficient freight to make the investment a paying one.

Construction work is to be resumed this month on the line of the Hanford & Summit Lake Ry., Charles King, President, into Hanford, Cal. It is expected to complete the road by May 1.

Advices from Tulare, Cal., state that city trustees have passed an ordinance granting to the Santa Fe System the right to lay and maintain tracks along certain streets in the northern part of the city.

Advices from Mason, Cal., state that the Copper Belt R. R. has been completed to Hudson, the point that will be the terminus for the next six months and the basis for supplies for the grading and construction crews on the last lap from Mason to the Nevada Douglas mine.

It has been announced by G. D. Armstead, Los Angeles, Cal., that with the exception of the city of Hemet, all rights of way have been secured for 65 miles of the proposed railroad extending from San Bernardino to Rainbow, north of Fallbrook on the line between San Diego and Riverside counties and steps are to be taken now to secure right of way to the terminus of the proposed line at San Diego, a distance of 75 miles from Rainbow. The first step will be to determine the most feasible route for reaching Escondido from Rainbow. This practically is decided upon as far south as the pumping plant on the Monseratte ranch, on the San Luis Rey river, a short distance from Bonsall, and there are several routes to choose from leading out of the San Luis Rey valley. It is said that if everything goes well he will have the dirt flying within a year and will have the road in operation for the Panama-California exposition in 1915.

Colorado.

Advices from Denver quote Lee N. Long of that city, western representative of the Automatic Transportation Co. of Buffalo, as stating that his company had completed arrangements to begin the construction of an elevated electric railroad from Montezuma to Keystone in Summit county as soon as frost shall leave the ground. The road will be 12 miles long and will cost $250,000. It will connect with the Colorado & Southern at Keystone. The company will use elevated tracks so that snowstorms and blizzards cannot stop operations in the winter. Feeders will be constructed to the various mines so a company can load from its ore bin direct into the cars.

The Unitah R. R., which is to start construction work in the spring on an extension of its line to Rangely, Colo., and the Rangely oilfields, will be asked to enter Grand Junction, Colo., and the Chamber of Commerce of the city is making strenuous efforts toward that end.

Connecticut.

The Shore Line Electric Ry. Co., New Haven, Conn., which is constructing a part of its main line between Guilford and New Haven and operating the rest of its system east of Guilford, has purchased a tract of land 500 ft. square on Middletown avenue in New Haven for a terminal building which it will shortly build. This is near the junction with the line of the Connecticut company at State and Ferry streets, which the new company will make to run its cars to the center of the city. The Shore Line Company has all the rails on the ground for this extension, has graded six miles out of Guilford and is now grading between North Branford and New Haven, having nearly reached the city line.

Florida.

The Seaboard Air Line Ry., W. L. Seddon, Chief Engineer, Portsmouth, Va., is to enlarge its yards at Tampa, Fla., and will lay 9,000 ft. of trackage on Sedden Island.

The Atlantic Coast Line R. R., E. B. Pleasants, Chief Engineer, Wilmington, N. C., has been making a survey on its branch line between Thomasville, Ga., and Monticello, Fla., with a view to straightening out the curves in the road and improving the roadbed. It is reported that the road has a plan on foot to extend the line from Monticello to Perry, Fla., a distance of about 30 or so miles, and there connect with the road on to High Springs. If this is done it would give the road a through line from Chicago to Tampa and western Florida via southwest Georgia.

Georgia.

The Blakely Southern R. R. Co., mentioned in our Feb. 15 issue, has been incorporated with a capital stock of $220,000. The company proposes the construction of a 22-mile line from Blakely, Early County, to Jakin. The incorporators are: W. C. Snodgrass, W. I. McIntyre, W. D. Hargrave, J. S. Montgomery, W. M. Coon, J. H. Herberner, E. R. Jerger, R. A. Jones, A. T. Snodgrass, T. H. McNeil, all of Thomasville, Ga.

The first stage of the preliminary surveys of the Atlantic, Waycross & Northern has been completed, and the surveying parties have started northwest of Waycross towards Abbeville, the next objective point.

The Macon, Dublin & Savannah R. R., J. T. Wright, General Manager, Macon, Ga., is reported to have plans underway for building an extension from Macon to Atlanta. Negotiations are reported underway for terminals at Macon; a survey to Atlanta has already been made. It is reported that the new line is to cross over the Ocmulgee River and go up the east side, and then reach a point north of Macon, where a crossing can again be perfected, giving such right-of-way as will be needed. It is also planned to have a new bridge over the Ocmulgee near the present Southern Ry. depot. The Seaboard Air Line is reported to be backing the extension.

Idaho.

It is reported in Salmon City, Idaho, that work will be started by the construction forces of the Gilmore & Pittsburg R. R., on the line to Twin Bridges, Mont., within 30 days.

Advices from Saint Maries, Idaho, are to the effect that the Chicago, Milwaukee & Puget Sound Railway Co. has under consideration, among other improvements, the construction of a freight depot and the enlarging of the yards at that city. E. J. Pearson, Seattle, Wash., is chief engineer of the company.

Officials of the Oregon-Washington Railroad & Navigation Co., it is said, are considering the extension of the Idaho Northern line from Enaville to the Jack Waite property, near Murray. The extension would be made from Eagle, a distance of 10 miles, and work will probably commence early in the spring. J. F. Barnes, Nampa, Idaho, is superintendent of the Idaho Northern R. R

Illinois.

Promotion work is well along for the proposed Petersburg & Pekin Interurban Ry. The route is outlined by the promoters, J. E. Melick, Springfield, Ill., as follows: The line will start from the 2d St. line in Pekin, running south across the Mackinaw, on through Sand Prairie township and to Mason county's line, thence to Mason City, thence to Sweetwater, Athens and into Springfield. There will be a connecting line run from Mason City to Petersburg, with a loop between Sweetwater and Beardstown. A line will also be run to connect Green Valley, Delavan, Hopedale and Armington, and a line will be run from Green Valley over to Manito.

Representatives of English capitalists have been over the projected route of the proposed Mattoon-Shelbyville-Hillsboro interurban line. I. B. Craig, Mattoon, Ill., is one of the promoters.

The Chicago & Northwestern Ry. has made surveys at Elgin with a view to building a short double track spur from Cherry st. to the A. Y. Reed sand pits.

The Illinois Central R. R. is reported to be planning to enlarge its yards at Centralia at a cost of $500,000.

Two surveys have been made for the proposed line of the Milwaukee, Peoria & St. Louis R. R., according to announcement recently made by P. Cherry, promoter of the project. The road will be completed first between Peoria and Rockford and later the ends will be extended to St. Louis and Milwaukee.

Indiana.

The Fort Wayne & Northern Indiana Traction Co. has been incorporated with an authorized capital stock of $10,000,000. This company has been formed to take over the city street railway systems of the Fort Wayne & Wabash Valley Traction Co. The general offices of the company will remain in Fort Wayne. Extensive improvements and betterments will be made.

Iowa.

The Waterloo, Cedar Falls & Northern Ry. Co. (electric) T. E. Rust, Chief Engineer, Waterloo, Ia., is said to have decided to abandon for the present its plans of building an extension from Waterloo to Dike, and to concentrate all its energy in building a line from Waterloo to Cedar Rapids. The preliminary survey has been made and many farmers along the route have offered to donate land for right of way.

The Albia Interurban Ry. [illegible] is reported to have interested a St. Louis bonding firm in its proposed extension to Buxton, and it is believed that the necessary capital will be secured to assure the building of the line this summer.

Directors and promoters of the Red Oak & Northeastern R. R. have been, for some time, working on a project to extend the new line south, connecting with the Wabash R. R. at or near the town of Imogene in Fremont county, Iowa. Details of the route have not yet been worked out, and only a small portion of the right of way has been secured for the new line.

All right of way has been secured, it is said, and arrangements made for the early construction of the proposed new 80-mile line of the Forest City, Fertile & Mason City Ry. Co. Arthur L. Sherin, Watertown, S. Dak., is vice president of the company.

Kansas.

•[illegible] Coe, Cottonwood [illegible] has been working on a contract for grading a section of the Interurban electric ry. line from Sedgwick to Newton and Hutchison, Kan., has been awarded another 2-mile stretch. Wet weather, according to reports, has caused a little delay in operations.

⦿Recent reports submitted from Wichita, Kan., are to the effect that the contract for grading the roadbed of the Wichita, McPherson & Gulf Ry., from Wichita to Arkansas City, was awarded M. [illegible] Texas. By the agreement work will be started at once and finished ready for ties and steel by July 1. As soon as the roadbed is graded the Midland Valley, which will absorb the Wichita, McPherson & Gulf as soon as it completes the line into the city, will begin track laying. Officials say that it will take 50 days to lay the steel. This will place the road in shape for operation of trains. Specifications for the roadbed require all embankments to be 16 ft. wide and the berms must be 10 ft. wide each. All cuts must be 20 ft. wide at the bottom and properly ditched. All grading must be what is known as one-way work. Dirt from cuts must be taken to embankments and used as material for their construction. Maximum grades must not exceed 30 ft. to the mile. Tansey agrees to have 120 teams at work and expects to have more than this number in the work, necessitating the use of from 200 to 300 laborers. Construction work will begin at Arkansas City, and practically all the right of way has been secured to Wichita. The Midland Valley has its tracks built to the northern city limits of Arkansas City. From this point the road will take a course northwest up the Arkansas river, on the eastern bank, until almost due east of where a bridge will be built and the road will enter the Springs by making a turn west across the river until it reaches a point near the southwestern part of that town. Through Geuda Springs the line will follow the river to Slate Creek. A short distance north of the town Slate Creek will be bridged. The road will follow the course of the Arkansas river to Oxford, going through that town in the western part. North of Oxford the Ninnescah river will be bridged. From that city the new road will practically parallel the Missouri Pacific into Belle Plaine. The Cowskin will be crossed north of Belle Plaine and from that crossing the road will make a direct shoot to Wichita. It will cross the Santa Fe's Englewood branch about half way between Mulvane and Peck. The Rock Island crossing will be about a mile north of Haysville. Seventy-five pound steel will be used on the extension. Ties and rails have been ordered for the work and will be delivered when needed. Practically all the bridges will be constructed of steel, with the possible exception of the one across the Arkansas river. [illegible] Arkansas City [illegible] pile bridge will be put in at this crossing, as the company does not want to wait until a new steel bridge can be constructed. Charles Kaighn, Beacon Bldg., Wichita, Kan., is Chief Engineer.

The Southwestern Interurban Ry. Co., D. H. Siggins, President, Coffeyville, Kan., is considering a plan for extending its city street car lines at Arkansas City, Kan. The principal extension proposed is on 4th St.

Farmers and ranchmen in the southern part of Kiowa county, of which Greensburg, Kan., is county seat, are advocating the construction of an east and west railway through that section of the country. A. L. Sooter is chairman of a committee to take charge of the matter.

[illegible] county, Kan., according to advices from the county seat, Coldwater, Kan., to the amount of $62,000 for aid of the Southwestern Kansas & Colorado Ry. Co., which proposes the construction of a line through that county. The road is projected to be built from Anthony west across Barber, Comanche, Clark and Meade counties and on to Trinidad, Colo. The headquarters of the company are in Coldwater. Cattlemen and farmers are largely interested and have subscribed for stock [illegible]

At the [illegible] of the Wichita, Kinsley, Scott City & Denver Air Line R. R. Co., held Feb. 17, the following directors were elected: M. J. Cudney, Belpre; O. P. Jewett, Dighton, and F. C. [illegible] graded from Turon six miles into Edwards county, with the exception of a mile or so in Stafford, where they were unable to secure the right of way from one man, that has [illegible] miles of road bed ready for ties. It is expected to have cars running between here [illegible]

Kentucky.

The Northern Kentucky Street Ry. Co., of Newport, Ky., has been incorporated with a capital stock of $10,000, the incorporators being J. M. Dawson, Edward F. Kelly and Gwynne Dennis.

A company has been organized to construct a new railroad from Webbville in Lawrence county to a point in Harlan county, where the projected line of the Louisville & Nashville R. R. will terminate. Surveys for the new road will be started on June 30, and the route will extend from Webbville, on the extension of the Eastern Kentucky R. R., thence to Paintsville, on to Saylersville and Hindman, Knott county and to Poor Fork, Harlan county. The sum of $250,000 has been subscribed. Roy Wilhoit, rate clerk of the Kentucky R. R. Commission, Frankfort, Ky., is reported to be interested.

Louisiana.

It has been reported that the St. Louis Southwestern Ry. Co. (Cotton Belt) has purchased the Louisiana, Arkansas & Gulf Railway for $1,500,000, operating from Hamburg, Ark., to Monroe, La., a distance of 60 miles. The road will be extended from Monroe to South Alexandria. C. D. Purdon, St. Louis, Mo., is chief engineer of the St. Louis-Southwestern.

Maryland.

The Baltimore & Ohio R. R. Co., in response to a petition, has expressed willingness to comply with the request to resurvey its track between Baltimore, Md., and Frederick, to eliminate curves and reducing the mileage between Frederick and Relay. R. N. Begien, Baltimore, Md., is assistant chief engineer.

Massachusetts.

Public hearings have been held in Monson, Mass., on the petition of the Southern New England R. R. for a new layout for the proposed new line known as the Palmer and Providence line. The layout of the new line petitioned for is much different from the first one proposed, which brought the line to the old North Monson factory in Monson. The one asked for is from the latest survey which was made to reduce expense, the officials claiming the new plan would make the expense $100,000 less. The layout asked for is from the Palmer station on the east side of the Central Vermont tracks to near the road from the epileptic hospital, crossing on the south side of the Fay farm and the north corner of the Cornelius Foley farm to the main road from Palmer to Monson where it crosses overhead, the road to be lowered five feet. It is to pass on the south side of the Quaboag leather company's factory and the Hawkes & Ford shoddy company's factory, and then on a trestle over the river, trolly and Boston and Albany tracks into Palmer, entering at the east end of the electric light station on property known as the Hancock place. The road, according to the layout petitioned for, will run a little less than 1½ miles in Monson. This is part of the proposed Grand Trunk Ry. line from Palmer, Mass., to Providence, R. I. H. C. Estep, Southbridge, Mass., is the engineer in charge of surveys.

Michigan.

The Detroit, Flint & Saginaw Ry. (electric), Detroit, Mich., has completed surveys for a proposed extension to Vassar, Mich.

The Detroit United Ry. Co., Detroit, Mich., which was recently granted the right by the State Railroad Commission to issue $1,078,000 of bonds, is reported to be planning to expend this amount for betterments.

Andrew Fyfe of Detroit, promoter of the Detroit, Lansing & Grand Rapids Electric Ry. Co., has applied to the Village Board of East Grand Rapids for a franchise through that village. It is said that with the exception of rights through East Grand Rapids and one other village, the right of way for the new road is complete from Grand Rapids to Detroit, and part of the distance over two routes. One route is to Lansing by way of Ionia and Lowell, and the other by way of Grand Ledge, following the Pere Marquette.

The State Railroad Commission has authorized the Pere Marquette Ry. to make a new bond issue of $8,000,000. It is understood that J. P. Morgan & Co. will dispose of the bonds and the money will be used to liquidate outstanding indebtedness and inaugurate a scheme of improvements and extensions costing [illegible] Chief Engineer of the Pere Marquette R. R.

Missouri.

The St. Louis & San Francisco R. R., C. B. Spencer, District Engineer, Joplin, Mo., has received concessions from the city council of [illegible] the railroad will at once have work started on a 9-story station and office building to cost [illegible]

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

⦿J. F. Williams of Scotts Bluff, Neb., writes that he has secured a Government contract near Minatare, Neb. The work is light.

⦿The Commissioners of Kansas City, Kan., on the 2nd inst. let a contract for the grading of a public Athletic Field. There were 40,000 yards of earth in the work, beside about 2,000 ft. of pipe for which pipe the contractor was not to receive any money other than the price he made on earth. The work went to W. Ross, of Kansas City, Kan., at 19 7/10 cts. per cubic yard. Mr. Ross is now the owner of the outfit familiarly known among grading contractors as the "Mahoney outfit." It is large and a complete team outfit in every way. The work on the Athletic Field will be started at once.

Mr. Sten Lund of Chicago was a Kansas City visitor recently. Mr. Lund is at the head of the Lund Contracting Co., 1340 Old Colony Bldg., Chicago, and is planning on extensive contracts for the coming season.

Mr. E. C. Hingston, of the Bucyrus Co., called at our office on the 1st inst. Mr. Hingston sees nothing ahead but a successful season. He states he finds but very few who are pessimistic over the outlook and in making this statement he covers the wide range of territory over which he travels.

It is stated that the Kansas City Southern Ry. will let 1,500,000 cu. yds. on the 15th of March. About 1,000,000 cu. yds. of this will be steam shovel work. The letting presumably will be here in Kansas City. A. E. Rust, Kansas City, Mo., is Resident Engineer.

The Supreme Court of Missouri has denied the right for a rehearing of the Kansas City Boundary case. This will probably end the long controversy over the new boundries and open a field for large operation within our city limits. The case of course could be carried to the U. S. Supreme Court but the general opinion is that this will not be done.

There are a number of team outfits in Kansas City idle and looking for work. Anyone desiring to secure the service of a good grading outfit should communicate at once with M. T. Babb, 1020 Commerce Building, Kansas City, Mo. Specifications and general description of the work should accompany the communication.

Minnesota.

Representatives of capitalists are, early this month, to go over the route of the projected Moorhead, Duluth & Leed Lake R. R. with a view to financing the proposed line. W. J. Bodkin, Moorhead, Minn., is President.

The Canadian Northern Ry. is reported to have engineers in the field to ascertain the feasibility of extending the line, now built into the state from the direction of Port Arthur, to within a short distance of Ely, to Ely, Tower, and west to a connection with its line near Cook. The building of such a line would furnish an outlet for the iron ore now being mined at many of the recently developed properties. One of the surveys is said to carry the line over Pine island in Lake Vermilion, and the longest bridge required in crossing an arm of the lake would not exceed 500 ft.

Rapid progress is being made on the Canadian Northern tunnel which is being driven through a hill twelve miles west of West Duluth. The Wick O'Connell Co.'s crews of Houghton have been working on the approaches for some time, and since the first of the year actual tunneling has been going on under the direction of Bert Milano of Houghton. It is believed that the work will be finished in May. From 80 to 100 men are employed. The tunnel will have a curve of 7 degrees and will be 550 ft. in length.

Plans have not been fully matured as yet for the improvements proposed by the Turn City Rapid Transit Co., at Minneapolis, Minn. The company will do the work with its own forces. It was reported that this company was planning to expend $1,000,000 this year for improvements. Willard J. Hield, Minneapolis, Minn., is Vice President.

It is reported in Tower, Minn., that the Canadian Northern Ry. is considering the feasibility of extending its line from the direction of Port Arthur to within a short distance of Ely to Ely, Tower and west to a connection with its line near Cook. Engineers are already in the field running preliminary lines, it is said.

Nevada.

The Southern Pacific Co., Wm. Ashton, Chief Engineer, Salt Lake City, Utah, is reported to be planning to have work started shortly on the construction of a spur track from Thorne to Hawthorne, in Mineral county. The new road will be constructed for the greater distance along the old roadbed of the Carson & Colorado. The company will operate either electric or gasoline motors over the new road. The line will later be extended to Lucky Boy.

It is reported at Reno, Nev., that the Goroux Consolidated Mining Co. is considering the construction of a railroad from Salt Lake City to Goldfield by the way of Ely. It is said that in case the new road is built the Giroux company will concentrate its copper output on the ground at Ely and will ship the concentrates to Salt Lake City. The proposed new road will pass through the copper district and open the mines between Salt Lake and Ely.

Press reports from Goldfield, Nev., state that the final survey of the proposed Cuprite & Lida R. R. has been completed and grading work is expected to start within the next 30 days. There will be no heavy work in the construction of the road with the exception of about two miles near Lida. Construction crews will begin work at Cuprite and will build a spur to Hornsilver. The spur is to be constructed before the main road to Lida is completed. The road will be standard gage.

New Hampshire.

It is now said that the Boston & Maine R. R., a New York, New Haven & Hartford line, B. T. Wheeler, Engineer of Construction, Boston, Mass., will build 10 miles of road at a cost of $2,000,000 from Hinsdale, N. H., to Brattleboro, Vt. The Boston & Maine has a branch line from South Vernon, Vt., to Hinsdale and by building from that latter place to Brattleboro, Vt., it would avoid using the Central Vermont line from South Vernon to Brattleboro.

New York.

The Black River Traction Co., Delos M. Cosgrove, Secretary, Watertown, N. Y., is planning to extend its lines in that city. If property consents are secured to the construction of additional lines the company will make application to the Public Service Commission for an order permitting a bond issue, by means of which it is proposed to build the contemplated extension.

The Westchester & Northern R. R. Co. has applied to the Supreme Court for an order allowing it to cross streets in different towns with an electric rapid transit road from White Plains terminal of the New York, Westchester and Boston Railroad Company northward through Westchester county, Brewster and Danbury.

The State Public Service Commission held a hearing at Albany on March 1 on the application of the Frontier & Western R. R. Co., which proposes to build a steam railroad from the terminus of the Buffalo, Frontier & Terminal Railroad Co. to the International bridge.

The Emporium Lumber Co., Buffalo, N. Y., is planning to construct a railroad from a point on the St. Lawrence & Adirondack R. R., probably either Childwood of Piercefield, running to the mill in Cranberry Lake region and through to Cranberry Lake, a distance of about 15 miles. The whole length of the railroad will be through the Emporium Co.'s property, and it is stated that the work of constructing the road bed will commence as soon as spring arrives.

The New York, Ontario & Western Ry., C. E. Knickerbocker, Engineer Maintenance of Way, Middletown, N. Y., is about to commence work on the enlargement of its yards at Oneida.

The Delaware & Hudson Co., Geo. H. Burgess, Chief Engineer, Albany, is reported to have completed arrangements for the establishment of a coal transfer and storage plant at the Glenville yards near Schenectady. The capacity of the plant will be about 8,000 tons and efforts will be made to have it in operation on July 15. The railroad company will deliver coal at this place in gondola cars, there to be screened and loaded again into box cars for western shipment. It is said that the work will be done by free account with about 100 men under Foreman William Donaldson.

The State Public Service Commission has granted the Buffalo Creek Ry. Co., S. M. Kielland, Engineer, Buffalo, N. Y., permission to issue $5,000,000 in bonds. The issue is to refund the 50-year gold bonds to secure the mortgage held by the E. P. Wilbur Trust Company of Philadelphia. The mortgage is for $1,000,000 and that amount will be issued immediately. The remainder will not be issued, but the amount was made $5,000,000 so that in future when issues are desired, it will not be necessary to go to the commission for authority. The road will issue bonds later for improvements, which are planned. The Erie R. R. and the Lehigh Valley R. R. are lessees of the Buffalo Creek Ry.

A bill has been introduced into the Senate at Albany, N. Y., providing for the extension until May 1, 1914, of the time for the completion of the Troy, Rensselaer & Pittsfield Railroad.

North Carolina.

The Salisbury Ry. Co., is projecting a 60 or 75 mile line from Salisbury, N. C., to Faith, Mt. Pleasant and Monroe, or some point on the Seaboard or the Coast Line railroad. The promoters are W. H. Ragland, W. H. Miller, and N. B. McCandless, all of Salisbury, N. C. As noted in our Feb. 22 issue an election will be held at Salisbury on March 14 to vote on issuing $100,000 of bonds to aid in building the railroad.

The Laurel River Logging Co. is planning the construction of a 10-mile railroad from Runnian to Allanstand.

North Dakota.

The matter of securing the construction of an extension of the Chicago, Milwaukee & Puget Sound Ry. to Valley City, N. Dak., is being agitated. C. J. Lee, of that city, is interested in the proposition.

Ohio.

The Westinghouse Electric & Manufacturing Co., Pittsburg, Pa., is reported to be preparing plans and specifications for the construction and complete electrical equipment for the proposed electric railway between Lancaster and Buckeye Lake, mentioned in our last issue. The Westinghouse Co. will furnish the equipment for the 20 miles of line. It is said that Eastern capitalists have been interested in the line and that plans are under way which probably will result in its extension to Bremen and also an extension east from the lake to a connection with the Ohio Electric Ry. Dr. F. P. Barr, Lancaster, O., is one of the promoters.

The city council of Lima has granted a franchise to the Ohio Electric Ry. Co., Cincinnati, O., to build a 1½-mile extension in Lima.

The directors of the Ohio Traction Co., Traction Building, Cincinnati, O., have approved the proposed bond issue of $2,500,000, soon as the final surveys are completed.

The Gallipolis & Meigs Electric R. R. Co. of Gallipolis, O., has been incorporated with a capital stock of $50,000 and proposes to construct, own and maintain an interurban rail way, with termini at Kanauga and Middleport. The incorporators are T. W. Jackson, S. H. Eagle, J. S. Howard. J. V. Lea and E. D. Davis.

The Erie R. R., W. J. Harahan, Vice President, New York, is reported to have decided to spend for improvements all the surplus earnings above fixed charges during the calendar year. The carrying out of the comprehensive plan of improvement may be accepted as meaning that the management does not intend to put into effect a rigid retrenchment policy because of the rate decision. Among the improvements to be made is the double tracking of the Erie lines westward from Salamanca through Ohio. Over this division the traffic has increased to such an extent that this improvement is said to be now absolutely necessary.

The Pennsylvania R. R. is reported to be planning to resume work in the spring on its double tracking between Ashtabula and Austinburg. Nine miles of track will be laid, a pump house built, an overhead bridge constructed at Munson hill, and several small trestles erected. In addition there will be some track-laying in the Austinburg yards.

The Pennsylvania R. R. has plans under consideration, according to reports, for a cut-off from Enon, O., near the Pennsylvania-Ohio boundary, on the eastern division of the Fort Wayne, to Red Bank, Pa., on the low grade route of the Buffalo & Allegheny Valley. The route is approximately 50 miles long and would be easy of construction as the grade is low all the way.

It is reported in Warren, Ohio, that steps are being taken looking toward the immediate construction of the proposed belt line railway on the North Side. Norman McD. Crawford is interested in the work.

According to an announcement reported to have been made by officials of the Chesapeake & Ohio R. R., at Richmond, Va., the company has decided to proceed with the improvements outlined for that road and its subsidiary, the Hocking Valley Road, several months ago. The plan contemplates an expenditure of $500,000 on the Hocking Valley's dock property, just north of the east approach of the Cherry bridge, in Toledo; enlargement of the local yards and terminal facilities; double tracking of the entire road between Toledo and Columbus, and the expenditure of hundreds of thousands of dollars on yards and terminals in Columbus. It is further planned to build a connecting link for the Hocking Valley and the Chesapeake & Ohio near the Ohio river. The proposed improvements of most importance to Toledo will be the construction of a new concrete dock, after the manner of the C., H. & D. docks, above Fassett St. bridge.

Oklahoma.

The Kansas, Oklahoma & Panama R. R. Co., incorporated late in January, has completed surveys for its projected lines. The company proposes the construction of two lines, one starting in Beaver or Harper county, Okla., and running southwest to a point on the Texas line in Love county, the other starting in Beckham, Washita or Kiowa county and running east to Oklahoma City. Moore & McClure, Oklahoma City, Okla., are the engineers and Richard W. Ruffin, Hamilton, O., is President.

The Fort Smith & Western R. R., W. M. Bushnell, General Manager, Fort Smith, Ark., will shortly take out a state charter in Oklahoma for the purpose of building a line southwest from El Reno, the present western terminus, to a connection with the Kansas City, Mexico & Orient R. R., near the Red River.

St. Louis parties are reported to have offered to finance the project for the construction of a railroad northwest from Chickasha, west to Anadarko and Weatherford, and thence northwest to Woodward to a connection with the Panhandle Division of the Santa Fe system. It is reported that work on the permanent survey will be resumed at once. This is the project promoted by Maj. James Gordon, of Atlanta, Ga.

The committee recently appointed at a mass meeting, held at Pawhuska, Okla., has collected enough money to defray the expenses of making a preliminary survey and estimate of changing the Missouri, Kansas & Texas R. R. from Wynona to Okesa. The surveyors will be put in the field at once.

Oregon.

Surveys have been completed and the engineers are working up their estimates for the proposed line of the Pacific Great Western Ry. Co., from Eugene to Mapleton, Ore. R. B. Hunt, 14 East 8th st., Eugene, Ore., is Chief Engineer.

The Metolius & Prineville R. R. Co. has filed its articles of incorporation and proposes to build a railroad to connect Metolius and Prineville. The capital stock is $50,000 and the principal office is at Portland. The incorporators are Harrison Allen, of Salem, Ore., G. C. Frisbie and E. McCulloch.

The Oregon-Washington Railroad & Navigation Co. has placed an order with the Lewis River Ties & Lumber Mills association, for a large amount of ties. Deliveries will begin this month and will extend over a period of five months. Shipments will all be made by rail from Ridgefield, Wash. The ties are all to be used on the lines of the O.-W. R. & N. in Eastern Oregon. The tie contract is reported to amount to about $300,000.

The Portland Railway, Light & Power Co., Portland, is reported to have received bids for the construction of the upper power plant on the Clackamas River. The company is also making preparations for the construction of its new car shops in southeastern Portland and the steel power transmission towers along the Estacada line. The completion of these projects will mean the expenditure of several hundred thousands of dollars.

The construction of a railroad from Madras to Prineville is now under consideration and steps are being taken to incorporate a company for this purpose. The promoters of the line are F. S. Forrest and George Nelson, officials of the Inland Empire Development Co., of Portland, Ore. Mr. Forrest was formerly chief engineer of the North Bank road and after severing his connections with that road joined forces with V. D. Williamson, one of the original promoters of the Oregon Trunk Line. They now control the townsite of Metolius and have under the title of the Inland Empire Development Co. large real estate holdings all through the country that is being tapped by the Oregon Trunk and which would be reached by a Prineville branch.

Right of way agents of the Oregon Trunk Ry., Ralph Budd, Chief Engineer, Portland, Ore., have served notices on property owners in Klamath Falls for rights of way through the reservation. The road will run south from Crescent to the east side of Agency Lake and then cross the straits between Agency and Upper Klamath Lakes and, after running south along Short creek for a few miles, will turn west along the Dead Indian road to Medford. The serving of the notices indicates that work on the construction of the road will begin this spring.

City Council of Salem, Ore., has granted a 35-year franchise to the Salem, Falls City & Western R. R. Co. By terms of the agreement the company is obliged to have the line completed within two years, and work upon it will likely begin at once. The councilmen as a whole favored the road at any cost, believing that it means considerable to the business interests of Salem.

We are advised that the Grants Pass & Rogue River R. R. is now in active building operation. The line is to be built a distance of 30 miles through the Applegate and Williams valleys, with the Josephine County [illegible] rangement with the Southern Pacific and has formed a junction with that line. A. D. Bowen, 108 Spalding Bldg., Portland, Ore., is president and general manager.

Pennsylvania.

The Philadelphia & Reading Ry. is building a coaling station at its new $1,000,000 yard at Port Clinton. It will be double track, of concrete, steel and wood construction, 250 ft. in length and have bins for coal and sand. There will be 32 chutes for coaling the engines. The contracts for the engine house, car shop and other buildings at St. Clair will be awarded in the spring.

The West Penn. Rys. Co., Pittsburg, Pa., is reported to be planning to expend a large sum for extensions and improvements. These, it is understood, include the laying of 50 miles of new track and the building of a number of new power-houses.

Grading work has been started on the double tracking of the Pittsburg, Harmony, Butler & New Castle Ry. (electric), Pittsburg, Pa., between the latter city and Bradfordswood, a distance of 12 miles.

In order to be able to handle available business without abrogating the trackage arrangement with it which the New York Central enjoys between Karthaus and Avis for the hauling of coal out of the Clearfield district, the Pennsylvania's Philadelphia and Erie division is to be provided with a third track.

The Pittsburg & Lake Erie R. R. Co. is reported to be contemplating an increase of its capital stock to the extent of $4,200,000, making the outstanding stock $25,200,000 and allowing present holders rights in the new issue to 20 per cent of their holdings. The rights will accrue in the form of a 20 per cent dividend declaration.

South Carolina.

The managers of the Greenville, Spartanburg and Anderson Interurban Electric Ry. have authorized the letting at once of contract for grading from Greenwood, S. C., to Greenville and locating permanent line from Greenville to Spartanburg, preliminary to letting contract. The line from Greenwood via Greenville to Spartanburg (about 90 miles) will ultimately go to Charlotte, there connecting with the lines of the Piedmont Traction Company, covering the territory from Charlotte to Durham via Greensboro.

Tennessee.

The Railroad Committee of the County Court at Memphis has reached an agreement with the Memphis & Rugby Ry. Co., mentioned in our last issue for rights of way for an electric railway to be built from Chelsea avenue and Payne street northward through the county to the land of the proposed residence subdivision of the company. The incorporators of the Memphis & Rugby Co. are as follows: E. H. Coapman, Washington, D. C., Vice President and General Manager of the Southern Railway Co., Charles T. Doerr, Birmingham, Ala., purchasing agent of the Birmingham street railway; Henry Wetter, Luke Seawell, James H. Malone and W. J. Francis.

The Fidelity Investment Co. has been organized at Nashville, Tenn., and will have for its object the development of interurban railways, power projects and other industrial undertakings in all parts of the country, but particularly the South. The company will, it is understood, handle every detail, from preliminary organization, through financing and construction to complete operation, of the various projects which it undertakes. Among the organizers of the new company are H. H. Mayberry, promoter of the proposed Nashville-Gallatin Interurban Ry., Paul Roberts, Judge John A. Pitts, J. H. Carpenter, R. A. Bailey, Jr., George M. Ingram and F. M. Smith of Nashville and H. U. Wallace and E. F. Wheaton of Chicago.

Texas.

President Taft has approved the bill authorizing the Secretary of the Interior to lease for 50 years instead of for ten years as now provided, electrical power generated by the Engle dam on the Rio Grande. This makes possible the construction of about 100 miles of electric railway in the valley to be irrigated from the Engle dam in the New Mexico and from the greater Texas Rio Grande reclamation project, the power for the line to be derived from the waterfall at the Engle dam. This line is to extend from Engle, N. M., to [illegible] intended to form the connecting link between the irrigated farms of the section and the railroads at El Paso. Richard Burgess, El Paso, Texas, is reported to be interested.

The Glenrose & Walnut Springs Ry. Co., which projects a line for Walnut Springs on the Texas Central to Fort Worth, via Glenrose, has surveys under way. T. M. Simpson is the chief engineer of the project with headquarters at Glenrose. The officers of the company are: J. H. Farr, president and general manager, with headquarters at Glenrose; M. W. Shaler, vice president, Utica, N. Y.; W. D. Morton, treasurer; F. E. Johnson, secretary; A. L. Sadler, J. A. Rushing, J. M. Goldstein, W. M. Davis and J. M. Montgomery, directors.

Advices from Waco state that following the recent announcement by R. S. Lovett, head of the Harriman system, that the line from North Texas to San Antonio would be shortened, the opinion is general that the route proposed will be to build from Ross, 11 miles above Waco, the terminus of the Houston & Texas Central, to Ennis, connecting there with the Texas Midland for Paris, where connection would be made with the Frisco for St. Louis; also connecting south of Ennis with the main line from Corsicana to Dallas, Fort Worth and Waxahachie. From Waco the Sap could be used to Flatonia and the Southern Pacific to San Antonio, furnishing a through short line.

The Fort Worth, Panhandle & Western Ry., the chief promoter of which is Charles E. McSweeney, of Sweetwater, is reported to have been promised financial aid by Texico, Graham, Matador, Throckmorton and other West Texas towns. If plans for this line mature, the track will occupy the territory directly west to New Mexico from Fort Worth.

The Burrs Ferry, Browndel & Chester Ry. Co. has no plans for the immediate construction of an extension to Bushville, Tex. It was previously stated that the company was taking steps to finance the proposition. A. A. Brooks, Houston, Tex., is Auditor.

Citizens of Simmons City have started to raise a bonus of $50,000 to be given to the first railroad building through that place. A bonus of $50,000 in cash was posted by the late Dr. Simmons some time ago.

The directors of the Marshall & East Texas Ry. Co., as noted in our issue of Feb. 22, have authorized a bond issue of $5,000,000. This bond issue was authorized for the purpose of making extensions and reconstructing the line between Marshall and Winnsboro. No decision has been reached as to when this work will be undertaken. A. T. Perkins, 401 Locust St., St. Louis, Mo., is President.

Reports from Brenham state that J. E. Carter, promoter of the proposed railroad from Brenham to some point north of this place, has succeeded in financing the proposed road from Sealy to Hico via Brentham, to include the Temple Northwestern R. R. from Temple to Gatesville. It is stated that the contracts for financing and constructing are now in the hands of New York bankers for final disposition pending the approval of arrangements by the Texas railroad commission.

A meeting is to be held at Belton, Tex., on March 21 and 22 by the representatives of the towns along the proposed route of the Quanah, Seymour, Dublin and Rockport railroad, popularly known as the "Middle Buster." A committee of arrangement has been appointed, consisting of W. C. Rylander, E. E. Upshaw, Thomas Yarrell, Jr., Robert James and C. W. Meyer, all of Belton.

The first block of the projected line of the American Rys. Co., from Vernon, Tex., to Hoover, a distance of 165 miles, has been surveyed and finally located and construction work will be started in the early summer. The construction of this line will require a large amount of earth excavation, a small amount of rock excavation, seven or eight bridges, a small amount of wooden trestle work and some concrete masonry. The bridges over the Pease River, Red River and the North fork of the Red River will be large ones. Maj. Geo. W. Angle, New York City, is Chief Engineer.

Utah.

The Salt Lake & Utah Interurban R. R. Co., organized last summer by Simon Bamberger, Salt Lake City, and others, has started surveys in the northern section of Utah county. The company proposes the construction of a line from Salt Lake City to Payson. Practically all right of way has been secured and it is said that construction work will be started as soon as the final surveys are completed.

The Utah Light & Ry. Co., Wm. Ashton, Construction Engineer, Salt Lake City, has planned for the expenditure of $1,500,000 in track extensions, new substations, new power transmission lines, and other improvements the coming season.

The Eastern Utah R. R. Co. has been incorporated with a capital stock of $500,000 and proposes to construct a 60-mile railroad in Eastern Utah. Of the capital stock 10 per cent is paid in by the transfer to the company of certain property purchased by it for right of way, terminal and other necessary usages of a railroad and certain property deeded by Edgar Thayn and others to the Denver & Rio Grande R. R. Co. Part of the route selected is said to follow closely the survey made many years ago by the Rio Grande Western for the Salina cutoff. The Rio Grande Western Co. did no little work in the grading of that part of the proposed line, but finally abandoned the work. The officers of the company are Henry Wade, Price, Utah, President; Orange Seely, Castle Date, Utah, Vice President; M. V. Maloney, Price, Utah, Secretary, and I. R. Parsons, Price, Utah, Treasurer.

It is reported that the Salt Lake & Ogden Ry. is contemplating the construction of double track from Salt Lake City to the Lagoon at Farmington this summer, at a cost of about $150,000. E. A. Vail, Salt Lake City, is chief engineer.

Vermont.

The Rutland Railway, Light & Power Co., Rutland, Vt., is planning to have work started in the spring on its extension to Poultney and Granville.

The recent acquirement by the Boston & Maine R. R., of a half interest in the Rutland R. R., will probably mean that extensive improvements will be made to the latter road.

Virginia.

The Southern Ry., D. W. Lum, Chief Engineer, Washington, D. C., has placed an order for 25,000 tons of rails to be used in construction along the line.

The survey of the proposed Roanoke & Mt. Airy R. R. on March 1 had been completed within 12 miles of Floyd Courthouse. The line as now located gives a grade of less than one and a half and only 26 miles is covered from Roanoke city to the top of the Blue Ridge mountains to reach an altitude of 2,600 feet.

Stockholders of the Virginia Railway & Power Co., Wm. Northrop, President, Richmond, Va., will vote on March 14 on authorizing a mortgage supplemental to that securing an authorized issue of $15,000,000 first and refunding mortgage bonds; to refund certain other bonds secured by underlying mortgage liens mentioned in the first and refunding mortgage, and to authorize the sale of $2,000,000 first and refunding mortgage bonds, being a part of the bonds reserved for refunding and retiring underlying bonds and for improvements, additions and extensions and other corporate purposes.

The directors of the Norfolk & Southern Ry. Co., have approved a proposition to increase the capital stock of the road from $12,000,000 to $35,000,000.

Washington.

⦿The Oregon-Washington Railroad & Navigation Co., F. L. Pitman, chief engineer of the 3d district, Spokane, Wash., on Feb. 23 let contracts calling for approximately $4,000,000 worth of work on the construction of 40½ miles of new line of the North Coast R. R between Spokane, Wash., and Ayer Junction on the Snake River. According to the contracts the work will all have to be completed in 18 months and some of it in less time than that. Because of the exceptionally difficult construction work the 40½ miles of line was divided into sections, and the contractors bid on each section. The 40½ miles of construction work starts at Marengo, where the new line will cross the main line of the Chicago, Milwaukee & Puget Sound tracks, and goes southwest to Ayer Junction. The sections were numbered upwards toward Ayer. The contracts were awarded as follows: Section 1, embracing 8 miles of roadbed; section 2, embracing 14½ miles of roadbed, to G. A. Carlson & Co. of Spokane. The work on these two sections will amount to $1,400,000. Section 3, embracing 3½ miles of roadbed, W. L. Trible, Spokane, amounting to $275,000. Section 4, embracing 7 miles of roadbed, which will occupy the Palouse canyon, where the construction is exceptionally difficult, was let to the Eschbach-Bruce Co. of North Yakima, its work costing close to $1,500,000. Section 5 also embraces the cost of the bridge over the Snake River, which will be the highest railroad bridge over any river in the United States. It will be 4,070 ft. long and 275 ft. over the surface of the water. The bridge will be approached by two steel viaducts, the one on the north side having a length of 2,260 ft. and that on the south side 490 ft., leaving the bridge proper 1,320 ft. This will be supported by five steel towers on concrete piers. The structure is to cost $625,000, of which $350,000 will be required for the spans and $270,000 for the steel approaches. Section 5, embracing 7½ miles, was awarded to George Chew of Spokane for about $1,000,000. The above figures include the cost of the five steel bridges, which will be built in the 40½ miles, but not by the contractors executing the roadbed work. The contracts only call for the preparing of the roadbed. There will be nine tunnels in the distance. The bridges and tunnels will be constructed in the following sections: Two tunnels and two bridges in sections 1 and 2, one bridge and one tunnel in section 3, five tunnels and one bridge in section 4, one tunnel and one bridge in section 5. The Eschbach-Bruce Co. has the most difficult section to build, for the roadbed to be constructed is nearly all in the Palouse canyon, a sheer precipice, rugged in character, from 200 ft. to 600 ft. in depth. The road will follow the canyon through rock-ribbed tunnels and along high precipices. The track in some instances will be supported by steel viaducts spanning the distance from tunnel to tunnel or extending from one side of the main gorge to the other, with hundreds of feet from the water surface to the railroad bridge above. The tunnels through this distance will vary from 800 to 1,800 ft. in length. The road will cross directly over the brink of the Palouse falls. When completed the Spokane and Ayer Junction connection with the present line of the O.-W. R. & N. will shorten the rail distance of the Harriman system between Spokane and Portland by 54 miles. It will also greatly reduce the grade and curvature. Bids are now being received by the local officers of the Harriman system for the construction of the roadbed between Cheney and Spokane, 18 miles. This will bring about more railroad construction through Marshall canyon, which will require a large expenditure of money, for the new road has to move the Northern Pacific tracks and pay all expenses for changes.

The Tacoma Ry. & Power Co., L. H. Bean, General Manager, Tacoma, has an application before the city council of that city for a franchise to build a street railway line to Bismarck.

The Spokane & Inland Empire R. R. Co., Terminal Bldg., Spokane, Wash., will have work started early this spring on two miles of extensions out North Howard St., Post St. and Cable Addition.

Advices from Hoquiam, Wash., state that grade of the Oregon & Washington road, between Hoquiam and Aberdeen, Wash., is well under way and that the trestle has been constructed across Fry creek, and all smaller creeks have been bridged.

Engineering corps of the Chicago, Milwaukee & Puget Sound Ry. Co. is reported to be laying out a line from the main line at Ranier, Wash., to the Union Mills, below Lacey, and it is rumored that later the line will terminate at Olympia. The preliminary survey of the line, which will be about five miles long, connecting with the line owned by the mill company on [illegible] shores of Long lake, has been finished and construction will start in the near future.

Wisconsin.

The La Crosse & Southeastern [illegible] has completed preliminary surveys for its projected 16 mile line to Veroqua and to Retreat. The capital for construction is now being secured and construction contracts will be let in May or June. A. E. Rau, Sparta, Wis., is chief engineer.

Wyoming.

⊙W. D. Lovell and E. C. Bowman of Minneapolis, Minn., have been awarded the contract by the Sheridan Street Ry. & Electric Co., for constructing the grade for the projected street railway system from the city limits of Sheridan, Wyo., to Fort Mackenzie. The contract calls for constructing the grade for about 3½ miles of line. Grading material and lumber have already been ordered and Mr. Bowman is now in Sheridan to superintend the work. A trestle bridge, 300 ft. long and 35 ft. high will be built over the Glenn Draw and a 3-span bridge will be required over Soldier Creek.

The Laramie, Hahn's Peak & Pacific R. R., R. D. Stewart, Chief Engineer, Laramie, Wyo., is reported to have financed its project for extending its line from Fox Park, Wyo., across northwestern Colorado into eastern Utah, terminating in the asphaltum beds of Wasatch county. The road at present runs 55 miles southwest of Laramie, where it connects with the Union Pacific, to a point near the Colorado-Wyoming line. Surveys have been made to extend it down the Elk River valley into Steamboat Springs, the present terminal of the Moffat road, thence west to Rangely, from where one branch will cut through the heart of Uintah and Wasatch counties towards Salt Lake, and the other will run south to Grand Junction to connect with the Colorado Midland and Denver & Rio Grande systems. Land estimated to contain 250,000,000 tons of coal is controlled by the men behind the Laramie, Hahn's Peak & Pacific R. R., and arrangements for the sale of $8,500,000 of securities to provide funds for construction work have been made. In addition to this amount, $10,000,000 is said to have [illegible] in Boston.

Canada.

⊙The Superior Construction Co., Sault Ste. Marie, Ont., has the contract for constructing 45 miles of line for the Manitoulin & North Shore Ry., R. S. McCormick, chief engineer, Sault Ste. Marie, Ont. This contract was let on Feb. 3 and amounts to about $1,500,000.

The city of Regina, Sask., has awarded the contract for the cars for its municipal street railway to a Montreal firm. The cars will be manufactured in England.

The Grand Trunk Pacific Ry., B. B. Keliher, Chief Engineer, Winnipeg, Man., is to build a branch line from Harte to Brandon, Man., 30 miles. The terms which the railway has accepted are that the Government shall contribute $6,400 a mile for the 30 miles of the road's construction, and 25 per cent of the cost of building a bridge across the Assiniboine river. The railway company's estimate of the bridge's cost is $200,000.

The Canadian Northern R. R. has made application to the Dominion Board of Railway Commissioners for approval of the plans for its line running through North Toronto immediately north of the C. P. R. The C. P. R. opposed the application, as it is claimed the C. N. R. wishes to cross property purchased by the C. P. R. and which it shows by a plan to be intended as a railway yard.

A report received by the House of Commons from the Dominion Minister of Railways shows that up to Dec. 31 last a total of $89,553,740 had been spent on the National Transcontinental Ry. construction. It is estimated that it will take $55,785,999 more to complete the road between Winnipeg and Moncton. The total mileage of track laid is 1,236.

The Town Council of Selkirk, Man., has reached an agreement with the Winnipeg, Selkirk & Lake Winnipeg Ry. (electric) by which the railway line will be extended from Eveline St. into Red River park. Active work upon the railway bridge over the west slough will, it is announced by Supt. G. Pettingill, of Selkirk, of the W. S. and L. W., begin at once, and the entire extension will be completed in the early spring.

The Canadian Pacific Ry. is reported to have placed orders for about $3,300,000 worth of rails, 100,000 tons going to the Consolidated Lake Superior Company and about 10,000 tons to the Dominion Steel Co.

The House of Commons Railway Committee has reported with some minor amendments the bill chartering the Lake Erie & Northern Ry. Co., with power to build from Port Dover to Simcoe, Waterford, Brantford, Paris, Galt and Ayr, and to operate a steamship and collier line across Lake Erie. Lloyd Harris, M. P. for Brantford, had charge of the bill.

The Council of St. Vital, a suburb of Winnipeg, has granted the Manitoba Rural Rys. Co., Winnipeg, permission to run an electric line through the municipality. This agreement, which was placed before the council about a month ago, calls for the construction of electric railways through the municipality from Winnipeg and St. Boniface southward on both sides of the river. These lines as to be carried through to the southern boundary of the municipality, and as soon as possible they are to be extended through the adjoining municipalities and on to Emerson. Construction is to start at once and a section of the line is to be in operation within a year.

It is now semi-officially announced that the Transcontinental Ry. will be opened from Levis to Moncton by July, 1912. The key of the situation is in the completion of the Davis section, a very difficult piece of work extending for 200 miles from the Chaudiere to the New Brunswick boundary line. The delay has been caused by the great amount of filling on the eastern end of the contract, but the bridge work will be in an advanced state next summer.

Announcement has been made at the offices of the Canadian Northern Ry., at Toronto, that construction work has commenced on the Vancouver Island section of the Canadian Northern railway's Pacific division. The new line will extend from Victoria to Alberni, and form the final link of the C. N. R.'s transcontinental system. The right-of-way runs southwest from Victoria to Pedder Bay, then north through the practically untouched timber and mineral districts of Malahat, Cowichan Lake and Alberni. It was also stated that all sections of the Canadian Northern Pacific division would be under contract within three years' time.

Advices from Niagara Falls, Ont., state that the Port Colborne branch of the Niagara, St. Catharines & Toronto Ry. is now open and cars are making trips on the line on schedule. The new branch is about 9 miles long.

Advices from Medicine Hat, Can., state that the following improvements have been outlined by officials of the Canadian Pacific Ry. for that city: 110-ft. extension to Medicine Hat station, $29,000; double tracked steel bridge, $314,000; extension to switching yards, $60,000; new boilers in machine shops, $11,400; new station at Redcliff, $5,000; 3,000-ft. passing trackage, 3.3 miles west of city, $5,000; gas connection and light for Dunmore yard and fencing of terminals, $6,000. Total, $430,400. R. C. Harris, Medicine Hat, Alta., is resident engineer.

ROADS, STREETS AND PAVEMENTS

Alabama.

⊙The city council of Birmingham, Ala., has let the contract for the paving of Avenue F, from 18th to 27th Sts., with bitulithic, to the Southern Bitulithic Co.

Advices from Wetumpka, Ala., state that the road surveyors have surveyed the road from Tallassee to Elmore station, and work has been stopped for the present. The bond election for good roads was held Feb. 20.

California.

City Trustees W. H. Baldrige, F. H. Chapin and W. N. Bradbury, Escondido, Cal., have been named as a committee of the board to make an investigation as to what streets should be included in a general improvement proposition, including grading, sidewalking and curbing, and in some instances, paving.

Reports from Santa Barbara, Cal., state that the county surveyor is surveying the proposed route of the upper Carpinteria valley road. This road is to be constructed this summer.

The state senate [illegible] has passed a bill providing for the construction of a scenic highway, costing $25,000, from Jackson in Amador county to Junction in Mono county, to connect with the Lake Tahoe highway.

District of Columbia.

Representative [illegible] that the house of representatives, Washington, D. C., agree to a senate amendment to the district appropriation authorizing the building of a municipal asphalt plant at a cost of $50,000.

Georgia.

At a recent mass meeting of citizens of Franklin county, Carnesville, Ga., a resolution was passed requesting the ordinary of that county to call an election on an issuance of $[illegible]

Idaho.

The city council of Coeur d'Alene, Idaho, plans the construction of pavement on the following streets: Sherman, from Seventh to Twelfth; Fourth, from Coeur d'Alene to Summit; Lakeside, from Second to Fourth; Third, from Lakeside to Coeur d'Alene; Garden, from Second to Lincoln Way; a part of Lincoln Way, and all of Park Drive.

Illinois.

✣[illegible] Ill., for the construction of 23 street improve[illegible] the Board.

✣Bids will be received until 8 p. m., March 14, by Board of Local Improvements, Upper Alton, Ill., for the grading, curbing and guttering, draining, paving and improving of the roadway of Brown St. The work includes the following approximate quantities: 19,615 sq. yds. vitrified brick pavement on 4-in. concrete base and 2-in. sand cushion and 12,748 lin. ft. of concrete curb and gutter. L. L. Yerkes is Secy. of the Board. B. B. Stakemiller, 302 Commercial Bldg., Alton, Ill., is Engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] coe, Ill., Granville D. Hall, Secretary, is con- [illegible] estimated cost of which is $169,600. The detailed estimate of this work is as follows: 69,750 sq. yds. of three course macadam pavement, average thickness 9½ ins., foundation courses bonded with limestone screenings and the top course bonded with 2 galls. of bituminous cement per square yard, the remaining voids filled with granite chips, at $1.30 per sq. yd., $90,675; 46,100 cu. yds. of excavation, including grading, at 40c per cu. yd., $18,440; 15,350 sq. yds. of sod for edging, at 25c per sq. yd., $3,837.50; 5,251 lin. ft. of cement concrete combination curb and gutter, 2 ft. wide, set on 6 ins. of cinders, at 70c per lin. ft., $3,675.70; 18,895 sq. ft. of cement concrete sidewalk approaches 4½ in. average thickness, laid on 6 ins. of cinders, at 18c per sq. ft., $3,401.10; 7,870 sq. ft. of 4-in. tile drain, laid complete, trenches back-filled with cinders, $2,361; 7,910 lin. ft. of 6-in. tile drain, laid complete, trenches back-filled with cinders, $2,951.50; 18,565 lin. ft. of 8-in. tile drain, laid complete, $9,183.75; 15,655 lin. ft. of 10-in. tile drain, laid complete, $8,610.25; 2,200 lin. ft. of 12-in. tile drain, laid complete, $1,430; 1,510 lin. ft. of 15-in. tile drain, laid complete, $1,283.50; 2,260 lin. ft. of 18-in. tile drain, laid complete, $2,691; 1,050 lin. ft. of 24-in. tile drain, laid complete, $1,512.50; 101 manholes with cast iron covers and rims, laid complete, at $40 each, $4,040; 117 catch basins with cast iron cover and rim, complete, at $40 each, $4,680; 10 cu. yds. of Portland cement concrete, at $7 per cu. yd., $70; 696 lin. ft. of plank headers, set complete, at 20c per lineal foot, $139.20; Adjusting present sidewalk approaches, manholes, water mains, gate boxes and fire hydrants, $1,017.60; cost of making and collecting assessment, $9,600. Total, $169,600. Another extensive piece of macadam work, which has been approved at public hearings and will be advertised shortly, calls for the improvement of Washington ave., and other streets. Some of the principal items in this work are as follows: 33,470 sq. yds. of 3-course limestone macadam, average thickness 9½ ins., top course bonded with 2 galls. of bituminous cement per square yard, the remaining voids filled with granite screenings, at $1.30 per sq. yd., $43,511; 31,100 lin. ft. of cement concrete gutter, 2 ft. wide, 6 ins. in depth, laid on a 6-in. cinder foundation, at 50c per lin. ft., $15,550; 22,640 cu. yds. of excavation, including grading, at 40c per cu. yd., $9,056.

The village board of Silvis, Ill., has passed an ordinance providing for the pavement of First Ave., from the western village limits at Warner's Crossing, east to the eastern limits or the east side of 16th St. The plans include a system of storm drains. The total estimated cost of the improvement is $61,685.

A petition has been circulated in the town of New Boston, Ill., to present to the town clerk, for him to submit to a vote at the coming April election, a proposition to build six miles of hard road under the state law. The road specified is two miles north of town, extending up along the bay, and four miles from the city limits.

The board of local improvements of Dixon, Ill., has passed resolutions providing for the macadamizing of McKenney St., in North Dixon, from Crawford Ave to Jefferson Ave.

Indiana.

✤Bids will be received until 2 p. m., March 17, by Commissioners of Orange county at Paoli, Ind., for the construction of gravel road in Paoli township. Alvin B. Ham is auditor of the county.

✤Bids will be received until 10 a. m., March 20, by Commissioners of Madison county at Anderson, Ind., for the construction of seven gravel roads in that county. William T. Richards is auditor.

✤Bids will be received until 1 p. m., April 4, by Board of County Commissioners, Madison, Ind., for the construction of a road in Madison township. Andrew M. Taff is auditor of Jefferson county.

⊙The board of county commissioners of Shelby county, Shelbyville, Ind., and the board of commissioners of Johnson county, Franklin, Ind., have awarded the contract for the improvement of the Ira L. Pritchard road to C. W. Folger & Co., of Columbus, Ind., for $10,950. Bids were also received from T. H. Gilbert & Son, of Morgan county, $10,963, and R. G. Porter, of Edinburg, $10,962. The proposed improvement is on the road between Blue River township, Johnson county, and Jackson township.

⊙Wallace & Schlechty of Portland, Ind., have been awarded the contract by the board of county commissioners at Portland, for the construction of a road on the line between Jay and Randolph counties for $17,749. Bids were opened March 1.

⊙The Schung-Mettler Co., has been awarded the contract by the board of county commissioners at Portland, Ind., for furnishing Jay County with three road rollers for $540. W. Lea Smith is county auditor. Bids were opened Feb. 25.

⊙The California Asphaltum Sale Agency, Railway Exchange Bldg., Chicago, Ill., has been awarded the contract by the board of public works of Indianapolis, Ind., for furnishing asphalt for the city asphalt plant at $24 per ton. Bids were opened Feb. 15.

Iowa.

✤Bids will be received until 8 p. m., March 15 by City Council of Red Oak, Ia., for approximately 6,000 cu. yds. of grading in cut; 25,411 yds. brick block; 3,312 yds. concrete paving; 9,368 ft. curb and gutter; 600 ft. of straight curb. Richard Roberts is City Clerk. Official advertisement will be found elsewhere in this issue.

A bill has been introduced in the house, Des Moines, Iowa, providing for an appropriation of $15,000 for the purpose of paving, curbing and building sidewalks on the main traveled roads from the depots to the grounds of the state hospitals for the insane at Clarinda, Mount Pleasant and Independence.

The city council of New Hampton, Iowa, has decided to put in a large amount of cement paving during the year. A. F. Kemman is city engineer.

The city council of Red Oak, Iowa, has passed resolutions of necessity providing for the paving of 38 blocks of city streets with brick. The paving ordered covers three blocks on Prospect St., four on Valley, two on Boundary, about 13 on Eighth, five on Fourth, one on Fifth, four on Coolbaugh, five on Washington Ave., and one on First, total of about 38 blocks. Bids for the work will be asked in a short time.

The city council of Villisca, Iowa, has decided to construct brick pavement in the city, amounting to 16,505 sq. yds.; 4,953 lin. ft., of combined curb and gutter, and 1,195 lin. ft. of curb. Geo. B. Sexton is city clerk. Thos. S. DeLay, Creston, Iowa, engineer.

The city council of Colfax, Iowa, has decided to pave 20 blocks of streets during the present year. Bids for this work will be received at once.

Kansas.

⊙The contract to construct the new sand-clay road through the sand hills in North Hayes township, Kan., a distance of six miles, has been let to the Wheeler Construction Co., of Garden City, Kan., for $3,590. The road will run along the section just a mile south of the Rice county line, east and west across the township and connecting with the east and west road across Walnut township at Thurber. It will have a 30-ft. base and a 20-ft. top.

Louisiana.

The Caddo parish authorities, Shreveport, La., are arranging to construct a road to connect with the De Soto road.

Michigan.

⊙Robert Rick, at $12,634, has been awarded the contract by the road commissioners of Menominee county, Menominee, Mich., for the construction of the bay shore road. The road is to be constructed of gravel and will be seven miles and 2,000 ft. long. K. I. Sawyer is county engineer.

⊙The county road commission, Bay City, Mich., has awarded contracts to A. E. Sheltraw for gravel at 80 cts. per yd., and to the Wallace Stone Co. for crushed stone at $1.20 per coarse, $1.30 for medium and $1.05 for fine grades. The board has also decided to get prices on road rollers.

It is planned to build about 10 miles of state reward road in Wexford county, Cadillac, Mich., during the coming summer. Fred Usewick is highway commissioner.

The city of Cadillac, Mich., has purchased 750 cords of stone to be used for building city roads next summer.

Minnesota.

✤Bids will be received until March 20, by city clerk, Mankato, Minn., for two 600-gal. sprinklers.

Mississippi.

Road District No. 3, Covington county, Miss., has sold bonds of recent issue, and has funds in hand for highway improvement and expects to let contracts for a section of same about the last of March. J. M. Russ, chairman, R. E. Snowden, highway engineer, Collins, Miss.

Missouri.

The city council of Kansas City, Mo., has passed ordinances providing for the opening and widening of 18th St., from Broadway to Woodland Ave., and of 19th St., from Maine to McGee Sts.

Montana.

Petitions are being circulated in Wallace and other cities of the county asking the commissioners to take steps for the construction early in the spring of a wagon road along Big creek.

Nebraska.

A petition has been circulated in Fremont, Neb., asking for the paving of the alley running north and south in the blocks between Main St. and Park Ave.

New Mexico.

The commissioners of Bernalillo county, Albuquerque, N. Mex., have appropriated $6,000 out of the general road fund for the construction of the Camino Real, or scenic highway, through that county, north to the Sandoval county line. The territorial roads commission has appropriated $4,000 for the work.

It is reported that the cities of Clovis and Portales of New Mexico are planning to take immediate steps toward the construction of an automobile and wagon road between the two cities.

New York.

The Nassau county board of supervisors, Mineola, N. Y., has granted the town board of North Hempstead authority to bond the town for five separate issues of bonds for the purpose of carrying out highway improvements voted upon at the last biennial town meeting. The aggregate sum, which it is proposed to raise is $46,500, and the issues and the purpose for which the bonds are raised are as follows: $9,000, Prospect Ave. and Webster Ave. improvement bonds, for the purpose of macadamizing and otherwise improving Prospect Ave., from the Shore road to Carlton Ave., and Webster Ave., from Carlton Ave. to Mackey Ave., at Port Washington; $10,000, Stonington road improvement bonds, for the purpose of macadamizing Stonington road from the Manhasset-Port Washington road to the Middle Neck road to Port Washington. $10,000, Lakeville road improvement bonds, for the purpose of macadamizing the Lakeville road, from the North Hempstead turnpike at Manhasset to the I. U. Willets road at Lakeville. $10,000, Grace Ave. improvement bonds, for the purpose of macadamizing Grace Ave., from the Middle Neck road at Great Neck

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

to the East Shore road at Manhasset. $7,500, Manhasset Ave. improvement bonds, for the purpose of macadamizing Schenck's lane (or Manhasset Ave.), from the Middle Neck road at Great Neck to the North Hempstead turnpike at Manhasset.

The common council of Buffalo, N. Y., will ask for bids during this month for the paving of King St., from Lion to Denton, and E. and W. Sixth from Maple Ave. to Brigham road. Francis W. Ward is commissioner of public works.

North Dakota.

The city council of Grand Forks, N. Dak., has created three new paving districts, Nos. 15, 16 and 18, which will be paved this year. Paving District No. 15 comprises Chestnut, Walnut and Cottonwood Sts., from First Ave. to the eastern line between Fourth and Fifth Aves. and all intersecting Aves. Paving Distric No. 16 comprises Third St., from Ione to Skidmore Ave., Skidmore Ave., from Third St. to L'Hiver Ave. and intersecting Sts. and Aves. Provision is further made that Third St. within this district, together with Hill Ave., from Third St. is the alley between Third St. and Second St. be paved 30 ft. wide. Paving District No. 18 comprises Lewis Blvd., the drive from Hill Ave. to Skidmore Ave., part of Skidmore Ave. and other intersecting Sts. and Aves., Lewis Blvd. and the above mentioned drive to be paved.

Ohio.

✣Bids will be received [illegible] 3 p. m. March 13, by Commissioners of Road District No. 1, Mahoning county, Youngstown, Ohio, for the improvement by brick, slag, limestone or bituminous macadam of the following roads, located in Youngstown township, viz, the "Powers Way" road, a distance of 4,900 ft.; Division St., from the city limits to the Salt Springs road, a distance of 872 ft., and the Shady Run road, a distance of 8,405 ft. Each separate proposal must be accompanied by a certified check for $500 by a bank located in Mahoning county and made payable to the order of Frank Agnew, secretary of said road commissioners, and mailed or delivered at their office, Room No. 420. Dollar Bank Bldg., at time all bids will be opened. Plans and specifications will be on file at the office of the county auditor, and will be furnished to bidder on application to E. S. Smith, engineer, No 419 Dollar Bank Bldg., Youngstown, Ohio.

◉Peters Bros. Paving Co., 135 Adams St., Chicago, Ill., has been awarded the contract by the board of control of Springfield, Ohio, for the paving of East High St., between Limestone St. and the bridge, for $13,861, sheet asphalt to be used. The work is to be completed by April 1. M J. Bahin is chief engineer.

◉The board of control of Youngstown, Ohio, has awarded the following contracts for paving: Turner & Olson, repairs to crosswalks and sidewalks; Charles Harris, $6,383, paving of Griffith St.; H. A. McCarron, $10,343, paving of Millicent Ave.; H. A Miller, $3,453, paving of Williamson Ave.; Joseph P. Morrison, $11,499, Jefferson St., paving; J. M. McGraw, $12,424, paving of Hillman St.; M. P. Connelly, $1,190, paving of Gladstone St.; Hannon Bros., $1,090, paving of Homewood Ave., and S. H DeGroodt, $1.85 per sq. yd., paving of Spring Common bridge approaches.

◉Jas. Brynes of Cincinnati, O., has been awarded the contract by the director of public service of Cincinnati for the improvement of McAlpin Ave., from a point 172 ft. more or less east of Lafayette Ave., to a point 352 ft. east of Lafayette Ave., by grading, laying cement combined curb and gutter, constructing concrete retaining wall, drains and inlets. Bids were opened Feb. 8.

◉A. Goodman of Cincinnati, O., has been awarded the contract for the improvement of Midland Ave., from Sunset Ave., to Rosamont Ave., Cincinnati, O., by grading, setting cement combined curb and gutter, macadamizing the roadway with special binder and finishing course and constructing the necessary retaining wall. Bids were opened Feb. 16.

◉H. C. Hall of Loveland, O., has been awarded the contract by the board of county commissioners, Fred Dreihs, clerk, for the improvement of Loveland and Madeira Road from corporation line of Loveland to the Miami River bridge in Symmes township, under specifications No. 159 for $1,900. Bids were opened Feb. 24.

◉The board of control of Cleveland, Ohio, has awarded the contract for the University circle paving improvement to J. R. Bentley. Euclid Ave. is to be cut straight through the circle and this part of the open space will be paved with Medina stone

John Nickoson of Delhi, O., submitted the lowest bid to the board of county commissioners, Cincinnati, O., for the construction of culvert and fill on Mt. Alverno road near Delhi Pike in Delhi township, the bid being $1,323. Bids were opened Feb. 24.

John Nickoson of Delhi, O., submitted the lowest bid to the board of county commissioners at Cincinnati, O., for resurfacing under specifications No. 111, of Independence St., in Sayler Park, Delhi township, the bid being $2,013. Bids were opened Feb. 24.

The city of Geneva, Ohio, contemplates spending about $80,000 this year for paving Main St., from Cowles creek, and Broadway, from Water St. to the Nickel Plate tracks.

Property owners along East Erie Ave., in Lorain, Ohio, have asked for the paving or macadamizing of that thoroughfare.

The board of trustees of Olmsted township, Olmsted Falls, Ohio, will sell bonds April 3, in the sum of $7,500, for the purpose of improving highways leading into the township. F. R. Gallagher is clerk of the board

The state highway department and the commissioners of Vinton county, McArthur, Ohio, have signed all papers for the building of a pike from McArthur to Hamden, a distance of seven miles. The preliminary work has been begun by S. R. Walker, county surveyor.

Oregon.

A paving district is projected for the South East Side, Portland, Ore. It takes in the territory between Division St., Powell Valley road, East 26th and East 41st Sts. A contract has been let for part of the work, estimated to be $140,000 worth. The remainder of the district is between Woodward Ave. and Powell Valley road in Waverleigh Heights, in which there are 13 miles of streets to be paved. The total cost will aggregate $500,000. J. W. Morris is city engineer.

It is proposed to lay hard-surface pavements on all the streets between Grand Ave. and East Third, East Clay and East Lincoln Sts., in Portland, Ore., at a cost of about $30,000. J. W. Morris is city engineer.

The following bids were recently received by the county court, Salem, Ore., for the building of the Silverton-Marquam road: J. E. Flynn, Silverton, $47,287; C. A. Gray, Portland, $43,998.

The county court of Klamath county, Klamath Falls, Ore., will spend about $50,000 on roads in the county during the year

Douglas county, Roseburg, Ore., county seat, has raised $192,000 for the construction of good roads and road improvement for this year. The work will be done under the direct supervision of M. R. Ryan, county road roadmaster.

Following low bids were received by the City Executive Board of Portland, Ore., for street improvements:

East Glisan St. district, asphalt pavement, Barber Asphalt Paving Co., $163,719

East Thirty-first St., grading and concrete curbs and walks, Pioneer Educational Society, $1,551.

East Forty-third St., grading and concrete curbs and walks, Pioneer Educational Society, [illegible]

Thirtieth Ave., grading and concrete curbs and walks, Pioneer Educational Society, $1,619.

East Alder St., from East Thirty-second to East Thirty-third, asphalt pavement, Oregon Independent Paving Co., $2,707.

Broadway, from East Forty-fifth to East Forty-seventh Sts., grading and concrete curbs and walks, Bechill Bros., $1,492.

Congress St. district, grading and concrete curbs and walks, M. J. Conley, $31,786

Ella St., from Washington to Everett, asphalt pavement, Barber Asphalt Paving Co., $4,824.

Dawson St., grading and concrete curbs and walks, R. J. Debuhr, $900; Bechill Bros., $852

Edward Ave., grading and concrete curbs and walks, Peninsula Feed & Fuel Co., $464.

East Eighteenth St., from Alberta to Killingsworth, grading and concrete curbs and walks, Baker & Tomlinson, $3,191.

East Forty-first St. district, Hassam paving, Oregon Hassam Paving Co., $10,627.

East Forty-seventh St., from East Stark to Belmont, grading and concrete curbs and walks, Bechill Bros., $2,530.

Gladstone Ave., from the S. P. barns to East Twenty-sixth, grading and concrete curbs and walks, Joplin & Meeks, $2,383.

Hawthorne Ave., from East Fifty-fifth to East Sixtieth, bitulithic pavement, Pacific Bridge Co., $7,039.

Linn Ave., from East Thirteenth to the river, grading and concrete curbs and walks, Joplin & Meeks, $3,859.

Liberty St., from East Twenty-second to East Twenty-seventh, grading and concrete curbs and walks, Giebisch & Joplin, $3,510.

Lombard St., grading and concrete curbs and walks, W. Musgrove, $755.

East Thirty-second St., from East Morrison to Crescent, Hassam pavement, Oregon Hassam Paving Co., $1,486.

East Morrison St., from Union to Water, wood blocks, Montague-O'Reilley Co., $24,691.

Madison St., from Chapman to Seventeenth, grading and concrete curbs and walks, P. H Flynn, $875.

Mason St. district, bitulithic pavement, Warren Construction Co., $107,977.

East Second St., from Oak to Hawthorne, gravel fill, Pacific Bridge Co., $46,214.

Marion Ave., from Gladstone to Oatman, grading and concrete curbs and walks, Joplin & Meeks, $1,652.

Swinton district, grading and concrete curbs and walks, Kern & Field, $31,809.

East Twelfth St., from Alberta to Webster, grading and concrete curbs and walks, Bechill Bros., $909.

East Thirteenth St., from Division to Clinton, bitulithic pavement, Pacific Bridge Co., $34,327.

East Twentieth St., from Alberta to Killingsworth, grading and concrete curbs and walks, Baker & Tomlinson, $4,189.

East Twenty-first St., from Alberta to Killingsworth, grading and concrete curbs and walks, Baker & Tomlinson, $3,523

East Twenty-second St., from Broadway to Weidler, bitulithic pavement, Pacific Bridge Co., $1,683

East Twenty-sixth St., from East Burnside to East Stark, asphalt pavement, Oregon Independent Paving Co., $9,188

East Thirtieth St., from Clinton to East Portland Heights, grading and concrete curbs and walks, Warren Construction Co., $2,004

East Thirty-second St., from East Morrison to Belmont, asphalt paving, Oregon Independent Paving Co., $3,038

East Twenty-fourth St., from Hawthorne to East Main, Hassam pavement, Oregon Hassam Paving Co., $3,670

East Seventy-fourth St., grading and concrete curbs and walks, G. K. Howlett, $2,565

Williams Ave., from Morris to Alberta, bitulithic pavement, Pacific Bridge Co., $70,535

West Park and Ninth Sts. district, bitulithic pavement, Warren Construction Co., [illegible]

Tennessee.

✣Bids will be received until noon, March 14, by City of Memphis, J. H. Weatherford, City Engineer, for paving with brick, tar macadam and wood block, portions of 12 streets. Official advertisement will be found elsewhere in this issue

The citizens of Greenfield, Tenn., at a re-

[illegible] for the graveling of its streets

Texas.

✣Bids will be received until [illegible] March 21, by G. Sutton, city secretary, Beaumont, Texas, for any portion of the following work: Repaving Pearl St., from Bonham to Milam Sts., with vitrified brick, asphalt, bitulithic, creosoted blocks or any other material as may be determined by the city council, [illegible] approximately [illegible]. Also paving Main St., from Forsythe St. to Washington St.; College St., from Main to Pearl Sts., and Washington St., from Main to Pearl Sts., including all intersections, comprising approximately [illegible] sq. yds. Also Milam St., from Pearl to Park Sts. and Park St., from Milam St. to Austin St., comprising approximately [illegible] sq. yds., including intersections. Also approximately 6,000 lin. ft. of curbing. A certified check in the sum of $1,000 on some Beaumont bank will be required to accompany said bid. For specifications or any other information apply to C. L. Scherer, city engineer.

Citizens of Colorado county, Columbus, Texas, have petitioned the county commissioners for an election to be held for the purpose of determining whether or not the bonds of Colorado county shall be issued for $250,000 for the purpose of improving public roads.

The city council of Mexia, Texas, has decided to spend $10,000 on the streets and $[illegible] on the cement sidewalks of the bond issue recently voted. The city has bought a large grader and several large mules which will be used in this work.

The city commissioners of Dallas, Texas, have authorized the grading of streets in South Dallas aggregating a length of 1½ miles; also the paving of Live Oak, from Cantegral to Munger Blvd.; Cochran, from McKinney to Lamar.

⊙The Texas Bitulithic Co. has been awarded the contract in Abilene, Texas, for an additional block of paving to intersect the present paving on Pine St. and extend on North Third St. in front of the postoffice and court house for the distance of a block. A movement is on foot for the paving of several more blocks.

The city commissioners of Dallas, Texas, have authorized the city attorney to secure the necessary titles and data with a view to opening Ray St., from Jackson to Wood Sts.

The county commissioners' court at Houston, Texas, has adopted the report of the jury of view relative to the construction of the Sylvester road. The report provides for a first-class road in precinct No. 1. The road is designated as the Houston Ave. road, being known as the "air line road." It runs in an easterly direction to White Oak bayou, following the direction of the private lane, known as Sylvester Ave.

The county court, Beeville, Texas, has ordered the survey of the San Antonio-Corpus Christi road, as recommended by the government agent, Fay McClure. Precinct No. 1 of Bee county has voted $100,000 in bonds for making roads, and the Normanna precinct, adjoining it on the north, voted $25,000 for the same purpose.

The commissioners' court at Georgetown, Texas, has set March 29 as the date of the election in the Granger-Bartlett justice precinct for a vote on the proposition to levy $[illegible] bonds for macadam road purposes.

The commissioners' court of Calhoun county, Port Lavaca, Texas, has granted a petition calling for the opening and improving of a 60-ft. wide road from Port Lavaca to the Victoria county line.

The county commissioners' court at Beaumont, Texas, has been petitioned to shell 3½ miles of the Concord road leading from the end of the present shell road, near Rosedale, to the Hardin county line at Pine Island bayou.

The county commissioners' court at Beaumont, Texas, has granted an application of J. E. Broussard and J. J. Burrell and others to build a new road bisecting the Lawhon league in the western part of the county. The road will run 3½ miles from a connection with the Frank Burrell road, the taxpayers to furnish right-of-way free to the county.

The commissioners' court, Columbus, Texas, has postponed the date of the election to be held to determine if the county should levy a tax of 15 cts. to issue bonds to the amount of $250,000 to improve the public roads from March 7 indefinitely.

The city council of Wharton, Texas, has ordered an election for April 4 to decide whether or not the city shall adopt a law permitting the construction of permanent street and walk improvements.

The county commissioners of road precinct No. 1, Lockhart, Texas, have ordered an election for March 30, to vote on the issuance of bonds to the amount of $50,000 for building roads in the southeastern portion of the county.

The commissioners' court, Wharton, Texas, has ordered the opening of a public road, beginning just above Hungerford on the Houston road to intersect with the East Bernard and Eagle Lake roads.

Members of the Beaumont Retail Merchants' Association, Beaumont, Texas, have urged the county commissioners' court that the county grade and improve a road extending to Mansfield Ferry on the Neches river, Orange county, to provide a good road from Orange to the ferry. The road will be 171 miles long. John N. Gilbert, of Beaumont, represented the association.

Utah.

The board of public works of Salt Lake City, Utah, in its report to Mayor J. S. Bransford, has urged the erection of and the purchase of machinery for a municipal asphalt plant. The estimated cost of such a plant being $20,000.

Virginia.

✣Bids will be received until 10 a. m., March 21, by Capt. R. B. McBride, constructing quartermaster, Fort Monroe, Va., for constructing concrete walks, macadam roads, etc., around new buildings.

✣Bids will be received until noon, March 20, by L. P. Slater, City Clerk, Portsmouth, Va., for the improvement of London St., from Water to Hatton Sts.; Dinwiddie St from Boulevard to a point about 135 ft. south of Clifford St.; Effingham St., from Glasgow to County St., parked in the center, with roadway each side; Harrison St., from Washington to Fourth St.; Fifth St., from Harrison to Fayette St.; Fayette St., from Fifth St. to West Gate of Navy Yard; First St., from Causeway to Navy Yard Gate; Hatton St., from London St. to Naval Ave.; Naval Ave., from Hatton St. to Linden Ave.; Riverview Ave., from Naval Ave. to North end; Ann St., from Hatton to Owens St., and from Hatton to Chestnut St.; Villa St., from West Park View bridge to Hospital Gate; and Green St., from North St., to the line of U. S. Naval Hospital property, in the City of Portsmouth, Va. An approximate schedule of the work is shown on the blank form of proposal attached to the specifications, which may be obtained on application to the City Engineer, V. O. Cassell, Jr. Bids will be received for the following classes of pavement: 1st. sheet asphalt, on concrete foundation, with and without brick gutters, per sq. yd. Street railway track paving on above, per sq. yd. 2d. Vitrified brick, on concrete foundation, per sq. yd. Street railway track paving on above, per sq. yd. 3d. Vitrified brick, on sand and gravel foundation, per sq. yd. Street railway track paving on above, per sq. yd. 4th. Bitulithic, on concrete foundation, per sq. yd. Street railway track paving on above, per sq. yd. 5th. Filbertine, on concrete foundation, per sq. yd. Street railway track paving on above, per sq. yd. 6th. Granite Curbing, per lineal ft. 7th. Old broken curbing taken up and replaced by Curbing furnished and delivered by the city, per lineal ft. 8th. Concrete curbing, per lineal ft. Bids must be made out for completed work as per schedule; no partial bids will be considered. A certified check on some solvent local bank must accompany each bid to the amount of a sum equal to two and one-half per cent (2½%) of bid, and under the conditions expressed in the blank form of proposal.

The city council of Richmond, Va., has asked the city engineer, Charles Bolling, for an estimate on the cost of curbing and guttering every street in the south side. The council recently appropriated $59,000 for streets in this district.

Washington.

Representative McMillan, of Bellingham, Wash., has asked the house of representatives, Olympia, Wash., for an appropriation of $50,000 for state road No. 6, connecting the city of Bellingham with Skagit county.

Wisconsin.

The city council of Superior, Wis., has authorized the purchase of two sanitary street sweepers for use on Winter and Broadway Sts.

The La Crosse, Wis., Automobile Club has raised $5,000 to improve the public highways between La Crosse and La Crescent, Minn.

Canada.

The British Columbian government has appropriated $4,107,400 for road building purposes during the year, extending from April 1, 1911, to March 31, 1912. The money will be spent on the Canadian highway, the Pacific highway and the Vancouver island roads. Thomas Taylor, Vancouver, B. C., is minister of public works.

The York County Council has named Warden R. J. Bull and ex-Warden George S. Henry as two of the three commissioners to co-operate with the city and Ontario government in the expenditure of $300,000 on good roads in York county. The sum is divided equally between city, county and government. Another by-law will be passed setting apart certain leading highways of the county as a county road system. These roads extend from the east to west limits, and to the northerly limits of Vaughan and Markham townships. The highways are Yonge St., Kingston road, Lake Shore, Dundas St., Weston road, Vaughan road, Kennedy road and the concession of Markham.

The British Columbia government is undertaking to build a turnpike road from Banff to Windermere, through the Rocky mountains, so as to make it possible for autoists to run from Calgary to the coast.

BRIDGES—STEEL AND CONCRETE

Alabama.

City officials of Montgomery, Ala., and Montgomery Traction Co., have completed arrangements for the construction of bridge at north end of Ripley St. According to plans the structure will be of reinforced concrete and will be about 75 ft long and 40 ft wide. A. E. Gilchrist is City Engineer.

Arkansas.

Citizens of Warren, Ark., are very much interested in the proposition of a new free bridge across the Saline River at Reddings Ferry, about 5 miles north of that city. The structure, it is estimated, will necessarily be 200 ft. in length.

California.

A bill has been passed in the Assembly authorizing the city of Los Angeles, the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

county of Los Angeles and the city of South Pasadena to join in the construction of a bridge across the Arroyo Seco at Garvanza to cost $150,000.

⊙The Newton Construction Co., according to advices from Corono, Cal., has been awarded the contract for the construction of the necessary concrete piers of the two bridges in the wash on the road that is being extensively repaired from Ontario Ave. to Magnolia Ave.

⊙The Board of Supervisors, Santa Clara County at San Jose, Cal., on Feb. 20, let the contract for the construction of a reinforced concrete bridge over the Los Gatos Creek at the Meridian Road to William Radtke, San Jose, Cal., at $4,780.

Colorado.

Officials of the Denver & Intermountain Ry. running between Denver, Colo., and Golden have signified their willingness to assist in building the proposed West Colfax viaduct at Denver, providing they be allowed to operate cars over the structure. The cost of the improvement is estimated at $700,000.

Connecticut.

The Saybrook & Lyme Connecticut River Bridge Commission has had all working plans for the new steel toll bridge completed and the erection of the structure will start about April 1. It is hoped to have the bridge ready for traffic by September. The bridge commission includes: Lieutenant Governor Dennis A. Blakeslee of New Haven, Colonel Andrew N. Shepard of Portland and ex-Senator James H. Day of Old Saybrook County.

District of Columbia.

Plans have been completed by order of the District Commissioners for the construction of the new bridge across Rock Creek at Q. St. in Washington, D. C. and it is hoped that included in the District Appropriation Act will be an item of $275,000 for the improvement.

Illinois.

The Wabash Ry., according to information received from Danville, Ill., is planning the construction of a new bridge over the Little Wabash River between stations of Shumway and Effingham. The old bridge that spans the river at that point is in such condition that it is said to be practically useless to the railroad company. It is proposed to throw a series of concrete arches across the stream proper and fill in the old bridge. More than $25,000 and probably as much as $30,000 will be needed to replace the old structure with a new one. F. V. Marshall, Decatur, Ill., is Assistant Chief Engineer.

City Engineer of Peoria, Ill., is preparing a report on the estimated cost of building a viaduct at the foot of South Adams St. over the tracks of the Chicago, Burlington & Quincy, Iowa Central R. R. and the Chicago & Northwestern R. R. This project was mentioned in our last issue. George F. Simmons is Commissioner of Public Works.

A bill has been passed by the house of representatives at Washington, D. C., providing that the Tri City Railway Co., Davenport, Ia., be authorized to construct an electric railway and free wagon bridge across the Mississippi River between Watertown, Ill., and Campbells Island.

Indiana.

✣Bids will be received until 10 a. m., Mar. 9, by commissioners of LaPorte County at LaPorte, Ind., for the construction of three bridges with concrete abutments. F. A. Hausheer is County Auditor.

✣Bids will be received until 10 a. m., March 11, by commissioners, Randolph County, Winchester, Ind., for the construction of concrete steel, concrete beam girder, steel truss and Portland cement bridge, 12 in all. H. F. Wood is County Auditor.

✣Bids will be received until 10 a. m., March 20, by commissioners of Hancock County at Greenfield, Ind., for the construction of a number of bridges in that county of which C. H. Troy is Auditor.

✣Bids will be received until 10 a. m., March 11, by commissioners of Randolph County at Winchester, Ind., for the repair of eight bridges. H. F. Wood is County Auditor.

The County Commissioners, Indianapolis, Ind., received the following bids for the construction of the bridge over the Crooked Creek in Walnut St., east of Old Augusta: A. W. Moore & Co., $3,150; Hackedorn Construction Co., $3,427; Volpp & Fritz $3,249; J. E. Sullivan $2,949.

County Commissioners, Vincennes, Ind., have approved plans for the construction of a bridge along the right of way of the Evansville & Terre Haute R. R. and bids for the work will soon be advertised. The plans call for a 10-ft. culvert arch with parallel concrete walls, 80 ft. long, the space between the walls to be filled with earth. The cost of the work is estimated at $1,900.

Plans and specifications have been prepared by Hugh O'Neall, and submitted to the city council of Washington, Ind., which will soon take action toward the construction of the proposed new bridge at North East First St.

Iowa.

✣Bids will be received until 10 a. m., March 15, by City Council, Cedar Rapids, Ia., for furnishing labor and material for the construction of a reinforced concrete bridge on the site to replace the present Third Ave. structure at that city. The structure is to be of concrete and steel. L. J. Storey is City Clerk.

⊙The commissioners of Grundy County, Grundy Center, Ia., on Feb. 22, awarded the contract for furnishing all steel bridge material for 1911 to the Clinton Bridge & Iron Works, Clinton, Ia. E. G. Ensminger is County Auditor.

⊙The County Commissioners on Jan. 23, awarded the contract for the construction of all concrete bridges built in Story County, Iowa, to N. M. Stark & Co., Des Moines, Ia. C. A. Bateman, Nevada, Ia., is County Auditor.

City Council of Cedar Rapids, Ia., has adopted a resolution approving the plans and specifications of the new Third Ave. bridge and ordering the present structure moved to Eighth Ave. T. F. McCauley, City Engineer, estimated the cost of removing the old bridge and constructing a new cement structure at $140,000 and the cost of placing the old structure in [illegible] Eighth Ave. at $10,000.

Kansas.

An agreement has [illegible] Jones, Mayor of Independence, Kan., and the officials of the Missouri Pacific Ry. whereby the company will bear one-third the cost of constructing a new bridge on the South Side Boulevard in that city, where the drive crosses the main line track. The cost of the improvement is estimated at about $3,000.

Louisiana.

It has been announced in Shreveport, La., that plans have been perfected for the construction of the traffic bridge over Red River, 1,000 ft. below [illegible] combination railroad and traffic bridge, which is largely owned by the Vicksburg, Shreveport and Pacific Ry. The new structure will land on a high bluff between Jones and Lake Sts.; the estimated cost being $225,000.

Maryland.

⊙Commissioners of Talbot and Caroline Counties, according to advices from Easton, Md., have awarded the contract for the construction of a pivot drawbridge and 70 ft. steel span over Choptank River to Nelson-Meredith Co. [illegible]

Massachusetts.

City Council of Worcester, Mass., has been petitioned by the officials of the Worcester Bleach & Dye Works, for permission to construct a bridge across Fremont St. at its plant.

Michigan.

Citizens of Benton Harbor, Mich., have petitioned the City Council to take steps toward the construction of a viaduct connecting West and East High Sts. A structure 825 ft. long and 28 ft. wide providing a 20 ft. roadway and two 4-ft. walks could be built, it is estimated, for $18,000.

⊙The contract for the construction of the bridge across the Menominee River between Menominee, Mich., and Marinette, Wis., has been awarded to the Wausau Iron Works at $24,468. A list of the bidders was published in the last issue of Engineering Contracting. F. S. Norcross is City Clerk, Menominee, Mich.

The Cheboygan Bridge Co., of Cheboygan, Mich., has been incorporated with a capital stock of $50,000 and will engage in bridge construction.

Minnesota.

Advices submitted from Minneapolis, Minn., state that the Chicago, Milwaukee & St. Paul R. R. will build a bridge over the channel now under construction joining Lake Calhoun and the Lake of Isles. The structure will cost, it is estimated, $15,969. N. H. LaFountaine, Chicago, Ill. is Engineer Bridges & Buildings of the railroad.

Missouri.

⊙The County Commissioners, Springfield, Mo., have awarded the contract to the Canton Bridge Co., Canton, O., at $4,620, for the construction of three bridges in Greene County. One structure is over the James River near Gates station, another near Caldwell ford and one across the Sac River at Hackney.

Information from Joplin, Mo., has been received to the effect that a new steel bridge will be constructed at once to replace the old wooden structure on North Main St. The new bridge will span a net work of railroad tracks and including the approaches will be 350 ft. long. J. B. Hodgdon is City Engineer. The work will be done, however, by the Union Depot Co.

Nebraska.

✣Bids will be received until noon, March 11, by Board of County Commissioners, Wahoo, Nebr., for reinforced concrete culverts for sizes from 18-in. to 5 ft. in diameter; also for corrugated steel and American ingot iron culverts from 18-in. to 5-ft. diameters. J. D. Frahm is County Clerk.

✣Bids will be received until noon, March 11, by Board of County Commissioners, for the necessary labor and material for the construction of steel superstructures and steel and concrete substructures ordered by commissioners during the year ending Dec. 31, 1911. Plans and specifications are on file at the office of J. D. Frahm, County Clerk, Wahoo, Neb.

✣Bids will be received until noon, March 11, by Board of County Commissioners, Wahoo, Nebr., for a yearly contract for the repairs of all bridges and approaches to bridges, which may be ordered repaired and maintained by the County Commissioners. All of such bridges shall be what is commonly called a pile and stringer bridge, to be built in accordance with the plans and specifications heretofore adopted by the county commissioners and now on file in the office of J. D. Frahm, County Clerk of said county at Wahoo, Nebr.

✣Bids will be received until noon, March 11, by commissioners of Saunders County, Wahoo, Nebr. for the necessary labor and material for the erection of the following wooden bridges or so many there of as may be ordered built during the year ending Dec 31, 1911. One bridge between secs. 29 and 30, Union precinct. One bridge between secs. 17 and 20, Marietta precinct. One bridge between secs. 20 and 21, Clear Creek precinct. One bridge between secs. 8 and 9, Marble precinct. One bridge between secs. 29 and 30, Cedar precinct. One bridge between secs. 2 and 3, Pohocco precinct. One bridge between secs. 10 and 11, Pohocco precinct. One bridge [illegible] bridge between secs. 11 and 12, Chester precinct. One bridge between secs. 21 and 22, [illegible] 18, Morse Bluff precinct. One bridge between secs. 20 and 21, Chapman precinct. One bridge between secs. 19 and 20, Newman precinct. [illegible] Newman precinct. One bridge between secs. 5 and 6, Oak Creek precinct.

New York.

✣Bids will be received until 2 p. m., March 15, by Town Board, Ellicott, Chautauqua [illegible] the following bridges: An iron bridge, 20 ft. [illegible] daga Creek, in said town, on the main road leading from Falconer to Kennedy, and two concret bridges, each 52 ft. wide, on South Work St., in said village of Falconer, one over the race leading to the factory of the American Manufacturing Concern, having a span of 30 ft., and the other over the outlet [illegible] ft. each, all in accordance with the directions and the plans and specifications approved by the Chautauqua County superintendent of highways and now on file with said town clerk. Proposal sheets may be had at said town clerk's office. A certified check for $250 must accompany the proposal for each contract, and a surety company bond for 50 per cent of the contract price will be required of each of the contractors. Samuel Ely, town superintendent.

The following bids were received March 2, by James F. Laughran, County Supt. 44-46 Main St., Kingston, N. Y., for the construction of a steel bridge across the Rondout Creek at Eddyville and the removal of the present metal structure and enlargement of the present piers and abutments: E. J. Doyle & Co., 30 State St., Albany, N. Y., $24,500, additional concrete or reduction $13 per cu. yd.; Owego Bridge Co., Owego, N. Y., $21,245, additional concrete, $10 per cu. yd., concrete under water, cost plus 15 per cent; York Bridge Co., York, Pa. $20,551, additional concrete, $12, reduction $10; Lupfer & Remick Co., 592-94 Ellicot Sq., Buffalo, N. Y., $24,290, additional concrete $20, reduction $6; United Construction Co., Albany, N. Y., $25,152, additional concrete $20, reduction $14; Penn Bridge Co., Beaver Falls, Pa., $20,361, additional concrete $15, reduction $10; Lane Bridge Co., Painted Post, N. Y., $16,950 additional concrete $6.

A conference in regard to the matter of the proposed Jackson St. bridge at Watertown, N. Y., was recently held and attended by John N. Carlisle, Public Service Commission, Francis M. Hugo, Mayor, Earl W. Sayles, City Engineer and B. Clifford Martin, District Engineer, New York Central. The plans and specifications of the proposed bridge over Black river were examined and discussed in considerable detail and the question of the contribution to the project by the New York Central. It is the intention to determine at once what amount of money will be available from other sources than the bond issue, which will be necessary to make, and then submit the question to the taxpayers of the city.

North Dakota.

✣Bids will be received until 1 p. m., April 4, by Frank Shanley, County Auditor, Cando, N. Dak., for the construction of 150 ft. more or less of steel and concrete bridges. A certified check for $500 must accompany each bid

Ohio.

✣Bids will be received until 10 a. m., March 11, by J. E. Brate, County Auditor, Hamilton, O. for the construction of sub and superstructure of a bridge and fill to the same at the Conrad farm in Section 26, Reily township., Butler County, O.

The latest announcement made in regard to the proposed construction of the new high level bridge at Cleveland, O., was that of County Commissioner Harry L. Vail, to the effect that actual work will be started in June or July. Although the kind of bridge to be built has not been determined, it will clear the river with a 600-ft. span and probably be 100 ft. wide and will have four tracks for rapid transit. At a meeting with government officials the question of clearance will be taken up.

Advices from Cleveland, O., state that the Lake Shore & Michigan Ry. is contemplating the construction of a bridge eliminating the Madison Ave. grade crossing.

An effort is to be made to induce the city Council of Cincinnati, O., to authorize a bond issue of $250,000 for the completion of the Gilbert Ave. viaduct.

Plans and specifications for the new bridge over Twin Creek on the Dayton and Germantown pike near Germantown, were approved by the County Commissioners at Dayton. The structure will be of concrete and steel. Edward Moritz is County Surveyor.

As a result of a recent inspection the Lake Shore & Michigan Southern R. R. will replace the old bridge over its tracks at Junction Ave., Toledo, O., with a new structure.

Oklahoma.

Advices from Guthrie, Okla., state that the Oklahoma Bridge & Culvert Co., was recently organized in that city at the office of Chas. Griswold, clerk of the district court, with Bart Murphy, president; Edward B. Henry, secretary and C. H. Griswold, A. H. Houston, C. C. Smith, John Golobie and Bart Murphy directors. The capital stock of the company will probably be $20,000 at the outset and preparations will be begun in the near future to build a factory there.

Advices from Guthrie, Okla., state that city officials and engineer, J. M. Meade, of the Sante Fe. Eastern Lines, and Frank Guy, division engineer, have decided upon changes in the plan for the proposed Cleveland Ave. viaduct and drawings to that effect have been submitted to the chief engineer of the system.

Oregon.

Included in the work, for which contracts amounting to $8,000,000 will be let shortly by the Oregon-Washington Railroad & Navigation Co., is the construction of a large bridge over the Snake River. It will be 4,070 ft. in length and will be approached by two steel viaducts, the one on the north side being 2,260 ft. long and that on the south side 490 ft., leaving the bridge proper 1,220 ft. long. This will be supported by five steel towers on concrete piers. F. L. Pitman, Portland, Ore., is chief engineer of the railroad.

Included in the franchise granted by the city officials of Salem, Ore., to the Salem, Falls City & Western R. R., is the right to build a bridge over the Williamette River at Marion St.

It has been announced in Athena, Ore., by the County Commissioners that three new steel bridges will be built in that vicinity in a short time. One at the south end of Third St., another at the reservation road east of Athena and the third on the same road one half mile further out. Pendleton, Ore., is county seat of Umatilla County.

Pennsylvania.

✣Bids will be received until March 13, by City Comptroller, Pittsburg, Pa., for the construction of the three main river piers for the North Side Point bridge across the Allegheny River. The cost of the work is estimated at $210,000. Joseph G. Armstrong is Director of Public Works.

✣The County Commissioners, York, Pa., will, it is reported, receive bids until March 16, for the construction of a concrete bridge across Furnace Creek near Hanover. The structure is to have a span of 32 ft.

Citizens of Allentown, Pa., recently held a meeting in an effort to organize in favor of the Shingiss St.-Haberman Ave. project for bridge and tunnel site. William J. Brennan and John A. Martin are interested.

Preliminary plans and report have been prepared by Torrance & Taylor, Consulting Civil Engineers, 39 Cortlandt St., New York, for the proposed reconstruction of the South St. viaduct over the Pennsylvania Railroad, Lehigh Valley Railroad and Central Railroad of New Jersey's property and tracks at Wilkesbarre, Pa. The viaduct would extend from Washington St. to Welles St. or to Park Ave. and will be of reinforced concrete or structural steel. Report not yet made public, includes estimates of cost. Mr. T. L. Welles, M. A. I. M. E., 1003 Coal Exchange Building, Wilkesbarre, Pa. is chairman of special bridge committee and Mr. B. K. Finch is City Engineer. The special bridge committee has not yet made its report or recommendation to the Ctiy Councils.

South Carolina.

⊙Advices from Conway, S. C., state that the contract for the construction of the steel highway bridge over the Waccamaw River at Conway was awarded to the Southern Bridge Co., Birmingham, Ala., at $8,176. The bids filed were as follows: Southern Bridge Company, of Birmingham, $8,176; Austin Brothers, Atlanta, $8,700; Carolina Engineering Company, Burlington, N. C., $8,875; Roanoke Bridge Company, $9,500; Porter & Boyd, Charlotte, $10,575.

Tennessee.

A contract will be submitted to the County Court at its regular April session by the attorney of the St. Louis & San Francisco R R., providing for the erection of a long viaduct over Otey Ave. in Memphis, Tenn.

City of Nashville, Tenn., has under consideration the issuance of bonds amounting to $100,000 to provide funds for the widening of Charlotte Ave. bridge. W. Southgate is City Engineer.

Texas.

Advices from Marlin, Texas, state that bonds amounting to $18,000 for the construction of a bridge near Highbank in Falls County, Texas, have been approved.

Judge and commissioners of Llano County, according to advices from Burnet, Texas, have been formulating plans with the commissioners of Burnet County, for the construction of the bridge across the Colorado River between the two counties.

Advices from Smithville, Texas, state that the City Council ordered an election to be held April 4 to vote on an issue of $3,000 of bonds to build a concrete bridge across Gazley Creek on Second St.

Virginia.

A proposition has been submitted the City Council of Norfolk, Va. providing for the construction of a steel bridge across the Eastern Branch connecting Norfolk and Berkley to cost $400,000. According to the rough plans, the bridge would be 1,600 ft. long, landing at the east end of Main St. in Norfolk and the north end of Main St., Berkley. Its width would be sufficient to afford ample room for street car tracks and all kinds of vehicular traffic, with sidewalks for pedestrians.

Boards of supervisors of New Kent and Charles City Counties at a recent meeting held at Charles City, Va., failed to reach an agreement in regard to the location for the proposed new bridge over the Chickahominy River to replace the old Long Bridge.

Washington.

Citizens are petitioning the County Commissioners at Spokane, Wash., to build a bridge across the Spokane River on the county road at a point north of Liberty Lake Junction of the railway.

⊙Board of Public Works, Spokane, Wash., has awarded the contract for the reinforced concrete bridge over Latah Creek to C. F. Graff, Seattle, Wash., at $42,900. Among the other bidders were J. E. Cunningham, $43,900 and International Contract Co., $53,320

West Virginia.

The Baltimore & Ohio R. R., according to reports, has completed plans for the construction of a double track bridge across the Monongahela River in West Virginia, and an application has been filed with the War Department for permission to proceed with the work.

The Harrisville & Cornwallis Ry. Co., according to advices from Harrisville, W. Va., will construct in connection with its 6-mile line between those cities, two bridges.

Wisconsin.

✣Bids will be received until 10:30 a. m., March 8, by Department of Public Works, Milwaukee, Wis., for the construction of a reinforced concrete highway bridge across the Kinnickinnic River at Chicago Ave. in the 17th ward of the city of Milwaukee. H. E. Briggs is Commissioner of Public Works and C. P. Dietz is Comptroller.

The War Department has approved plans for the one-leaf bascule bridge which the city of Milwaukee, Wis., will erect at Oneida St. over the river. L. J. Klug, Supt. Bridge Department prepared the design.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Illinois.

✣The Board of Trustees of the East Side Levee and Sanitary District, East St. Louis, Ill., are calling for bids for the construction of the first section of the Front Levee. This will be three miles in length and will contain 150,000 cu. yds. of earth. T. N. Jacobs, Room 20, Sexton Bldg., East St. Louis, Ill., is Chief Engineer of the District.

⊙As noted in our last issue under Memphis, Tenn., Notes, the contract for levee work and concrete locks on the Degognia and Fountain Bluff Levee and Drainage District, of Murphysboro, Ill., has been awarded to Carey Bros., Memphis, Tenn., at $107,451. The other bids received on this work were: Roach & Stansell, Memphis, Tenn., levee, $80,773.54, did not bid on locks; McCann Brothers and John L. Cox, of Murphysboro, concrete locks, $48,896, did not bid on levee; R. Z. Gill, of Murphysboro, concrete locks, $48,659, no bid on levee; R. H. McWilliams, of Bloomington, levee, $81,848.60, concrete $38,223.75, total $120,071.75; Elmer Gant, of Chester, Ill., levee, $79,750, concrete $43,846, total, $123,596; McCann Brothers, of Murphysboro, levee, $87,941.70, no bid on locks; Murphysboro Construction Co., locks, $46,615.50, no bid for levee work. The work includes four new locks, 33 steel tube culverts, two reinforced cement culverts, repairing and raising one lock and 550,000 cu. yds. of levees and exploration trenches.

Indiana.

✣Bids will be received until 2 p. m., March 18, by Drainage Commissioners at Hancock County surveyor's office, Greenfield, Ind., for the construction of a drain. John Spurry is Drainage Commissioner.

Petition has been filed in the Circuit Court of Knox County, at Vincennes, by land owners in Decker Township, asking for the construction of a ditch, some six miles in length which will start in the eastern part of Decker Township, pass through and drain considerable low level land and empty into White River below Claypool Hills. The proposed ditch will pass through Swan Pond and will reclaim a large area of farm land

The Commissioners of Pike County, Petersburg, Ind., have been petitioned to straighten Patoka River from a point near Winslow to a point near Dongola. The distance between Winslow and Dongola is 21 miles by the course of the stream and the straightening of the river by the means of a canal 70 to 80 ft. wide at the top will shorten the stream 14 miles with a direct course of seven miles. The river where the contemplated change is to be made is very crooked, affording a number of horseshoe bends, which will be utilized in the building of the canal by connecting with the original channel wherever it comes in alignment with the proposed course.

Iowa.

✣Bids are asked until 2:30 p. m., March 17, at office of J. L. Hanrahan, County Auditor, Fort Dodge, Ia., for constructing Drain No. 70-95. The work is located 2½ miles south of Roslyn, Ia., on C. G. W., and 3 miles east of Somers, Ia., on C. G. W., and C. R. I. & P. The total estimated cost of the work is $27,406 and it includes the following:

	Length ft.	Size tile.	[illegible]
SECTION 3.			
Branch 1.	1,700 ft.	24 in	10.4 ft
	2,000 ft.	[illegible]	9.8 ft
	1,100 ft.	[illegible]	[illegible]
	800 ft.	14 in.	7.5 ft
	450 ft.	12 in.	6.4 ft
Branch A of Branch 1.			
	1,500 ft.	14 in.	
	100 ft.	[illegible]	[illegible]
Branch B [illegible]			
	2,400 ft.	24 in	8.3 ft.
	1,600 ft.	20 in	6.5 ft.
	2,300 ft.	18 in.	5.6 ft.
Branch [illegible] 1.			
	1,400 ft.	14 in	5.0 ft.
Branch [illegible] Branch B.			
	500 ft.	12 in.	
SECTION NO.			
Branch [illegible]	1,000 ft.	18 in.	5.7 ft.
	2,000 ft.	22 in.	8.7 ft.
	800 ft.	18 in.	6.2 ft.
	1,100 ft.	14 in	6.1 ft.
SECTION NO. 5.			
Branch [illegible]	2,200 ft.	24 in.	6.4 ft
	1,100 ft.	[illegible]	6.7 ft.
	1,800 ft.	16 in	6.9 ft.
	800 ft.	14 in	8.1 ft.
	2,000 ft.	14 in.	7.2 ft.
	800 ft.	[illegible]	6.5 ft.
SECTION NO. 6.			
Branch [illegible]	1,000 ft.	[illegible]	6 [illegible] ft.
	700 ft.	[illegible]	[illegible] ft
SECTION NO. 7.			
Branch [illegible]	3,850 ft.	16 in	6.5 ft.
	950 ft.	12 in	8.5 ft.
Branch A of Branch 5.			
	1,100 ft.	12 in	7.3 ft.
SECTION NO. [illegible]			
Branch 6.	1,400 ft.	14 in	5.9 ft.
	2,850 ft.	12 in.	6.8 ft.

Plans and specifications are on file in the county auditor's office at Fort Dodge, Ia., or Rockwell City, Ia. G. P. Smith of Fort Dodge, Ia., is the engineer who will have charge of the construction of the drain.

Louisiana.

✣Bids will be received by the commissioners of the 5th Louisiana Levee District, Tallulach, La., at the office of the Board of State Engineers, 213 New Orleans Court Bldg., New Orleans, La., until noon, March 16, for the construction of the Villa Vista Levee in the parishes of East Carroll and Madison, Mississippi River, right bank, about 24 miles above Vicksburg, Miss. Proposals will be received for the work as a whole, about 250,000 cu. yds., or by sections, as follows: Section No. 1, parish of East Carroll, from about station 2,860 to about station 2,965+75; Riverside enlargement; contents about 100,000 cu. yds.; deposit required, $325; bond required, $5,000. Section No. 2, parish of Madison, from station 2,965+75 to station 2,998+40; new levee; contents about 150,000 cu. yds.; deposit required, $450; bond required, $7,500.

Surveys are now underway for the reclamation by drainage of some 80,000 acres of wet prairie south of Gueydan, La. This land is to be reclaimed by artificial drainage, the water to be pumped from a series of large dredge canals which will act as a reservoir basin. Two dredges are now at work on the first block of nine sections or about 5,000 acres and it is intended to push the work as the plans and surveys are completed. Chas. D. Babbit, Gueydan Bank Bldg., Gueydan, La., is the Engineer.

Minnesota.

✣At 3 p. m., March 28, J. L. Johnson, county auditor, will sell at his office in Olivia, Minn., the jobs of digging and constructing County Ditch No. 46, the work including the following: 1,401 cu. yds. of open scraper work, estimated cost $690; 1,000 cu. yds. of cleaning of present channel, estimated cost $130; one retaining cement wall, estimated cost $25; and furnishing and laying the following tile: 4,100 ft. 18 in., 1,700 ft. 15 in., 800 ft. 12 in., 4,692 ft. 9 in., 1,000 ft. 7 in., 2,610 ft. 5 in., 1,300 ft. 16 in., 1,300 ft. 14 in., 1,354 ft. 10 in., 7,178 ft. 8 in., 1,015 ft. 6 in. Bids will be entertained for either hard burned clay tile or standard make cement tile. The estimated total cost of the work is $10,565.

⊙J. B. Arpin Dredging Co., Grand Rapids, Wis., has been awarded the contract at 12.85 cts. per cu. yd., for constructing Judicial Ditch No. 11 in Marshall and Beltram Counties, Minn. Bids were opened Feb. 21 at Warren, Minn. The contract includes 526,427 cu. yds. earth excavation and the leveling of about 27 miles of road. This latter work will be done at $120 per mile. The contract is to be completed Dec. 1, 1912.

Missouri.

⊙The A. V. Wills & Sons Dredging Co., of Pittsfield, Ill., has secured the contract for a large amount of work near Charleston, Mo.

New Mexico.

M. M. O'Shaughnessy, civil and consulting engineer, 14 Montgomery St., San Francisco, Cal., has work under way for Thompson & Meloche at Raton, N. Mex., on an earth fill dam of about 200,000 cu. yds. This work is about 30 per cent completed and should be finished in six months.

New York.

The New York State Barge Canal Terminal Commission has submitted its final report. Recommendation is made by the commission that the State appropriate $16,500,000 for terminal construction and equipment in New York, Albany, Troy, Whitehall, Schenectady, Utica, Oswego, Syracuse, Rochester, Tonawanda and Buffalo. It is estimated that this appropriation will suffice to construct and equip the barge canal public terminals. Recommendation is made that the State Engineer shall prepare the plans for the terminals and supervise their construction and that afterward they shall be turned over to the State Superintendent of Public Works for administration. That the State Superintendent of Public Works shall fix a schedule of charges for use of the terminals also is suggested, with reservation that before the schedule goes into effect it shall be approved by the Canal Board.

The T. A. Gillespie Co. has started work at Newark on its $3,000,000 barge canal contract, extending from Newark to Palmyra. One steam shovel is working at Newark and another is to be started at Palmyra near Lock 19. Offices have been opened on East Union St., Newark, for this work.

Ohio.

The Commissioners of Champaign County, Urbanna, O., held the first hearing on March 2 on the petition to dredge and improve Kings Creek.

Memphis and Vicinity.

[illegible]

⊙J. H. Weatherford was awarded the contract for grading the new Frisco Yards about six miles southeast of Memphis. The con [illegible] of about 15,000 cu. yds. of gravel ballast. The [illegible] to the terms of contract must be finished within 45 days from the date of contract. Mr. Weatherford has an excellent organization and is amply prepared to carry on the contract to a very successful close.

Helgason Brothers & Clarke are preparing to move outfits on the U. S. levee work which they were awarded last spring by Maj. M. L. Walker. The contract is in the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible]

M. L. Byers, chief engineer of the Frisco Ry., was in Memphis Friday, looking over the local lines of his company. Mr. Byers went out to Bellevue where the new yards of his road are to be built and stated that in all probability the buildings and track would be turned over to his company in time for the fall rush of business.

Capt. Clarke S. Smith arrived in Memphis Thursday from Vicksburg where he has been for the last few weeks. Capt. Smith seems well pleased with the progress being made [illegible]

[illegible] Roper, as [illegible] says he will place about [illegible] teams on the work [illegible] Roper & McFeely [illegible] this year and have been successful [illegible]

[illegible] is in town waiting for Roach & Stansell to start their large Huntington Levee job near Greenville, where Tom will be in charge of the locomotives. And talking of this Huntington contract, according to all reports levee construction will be revolutionized if the present plans of the contractors do not go amiss. Roach & Stansell propose to build the large embankment with steam shovels and cars instead of with teams. They intend to cut the contract time of two years exactly in half by the use of new methods and modern machinery and it looks as if their plan will be a winner too.

Hodges & Downing are hard at work with their steam shovels on the Helena & Arkansas City branch of the Iron Mountain railroad where they are filling bridges.

Lou McClavey reports that he will finish the Reelfoot Lake contract about the 10th of this month and then Lou wants another piece of work from some firm who has lots of [illegible] on hand. Lou was not bothered very much by the river this season and hurried the Reelfoot job through in remarkably quick time.

Lee McCanless has 25 good teams which he is anxious to place at work within the very near future. Lee is a great dirt mover and one won't make a mistake in letting him work.

South Dakota.

Bids were opened Feb. 24 at the office of the U. S. Reclamation Service, Belle Fourche, S. Dak., for the construction of the North Canal, Belle Fourche Project. The 22.8 miles of canal is divided into eight schedules of an average length of 2.8 miles so as to divide the yardage into lots of 100,000 cu. yds. as near as may be. Bids are to be accepted separately on each schedule. The canal is nearly all grade line location, averaging 5 ft. in cut. The bottom width is from 30 to 16 ft. The classification will run about 80 per cent first, 15 per cent second and 5 per cent third, all light gumbo and shale. The bids received were as follows:

	Price per cu. yd. in cts.				
	1st class.	2d.	3d	Totals	On schedules
A. F. Burke, Bellefourche, S. Dak	22	50	175	$194,755.00	1 to 8 inclusive
Hayes Bros., Janesville, Wis	21½	40	80	192,025.00	1 to 8 inclusive
Hay & Elzy, St. Paul, Minn	1	50	150	193,350.00	1 to 8 inclusive
J. W. McNeil, North Platte, Neb	19 to 23 no class			165,460.00	1 to 8 inclusive
Maney Bros., Oklahoma City, Okla	18	45	70	162,200.00	1 to 8 inclusive
Hilton & Fadlow, Powell, Wyo	19½		[illegible]	146,325.00	1 to 8 inclusive
Knowlton & Balon, Pueblo, Colo	18	48	40	62,540.00	sch. 5, 6 & [illegible]
W. B. Gems, Sturgis, S. Dak	19	35	70	81,675.75	2, 3, 4 & 5
Seitz & Shevling, Nisland, S. Dak	**19½**	**19½**	**19½**	**56,350.00**	**4 & 5**
Matt Olson, Nisland, S. Dak	18	36	72	83,970.00	2, 3, 4 & 5
Cornelius Cole, Orman, S. Dak	18	18	18	37,130.00	2 & 3

A number of capitalists owning land in the vicinity of Belle Fourche, S. Dak., have under consideration a project for the diversion of water for irrigation purposes from the Belle Fourche River. A falling sluice gate dam is to be built in the channel of the stream and the water diverted through about 4,000 ft. of 36 in. pipe line and four miles of open canal. About 1,500 acres of land is to be reclaimed. Carl C. Adams of Belle Fourche, S. Dak., is Engineer.

Texas.

⦿R. L. Leonard, Memphis, Tenn., has been awarded the contract at 14.84 cts. per cu. yd., for constructing 200,000 cu. yds. of levee at Chappel Hill, Tex., for the Washington County Improvement District. Bids for this work were opened March 2.

Waldo & Ruth, Contracting Engineers, Mercedes, Tex., have the engineering contract for the proposed Llano Grande canal system which W. T. Adams, of Corinth, Miss., is planning to build on his 10,000 acre tract at Llano Grande, Tex.

The $204,500 bond issue of Cameron County Drainage District No. 1, Brownsville, Tex., has been submitted to the State Attorney General for his approval. As soon as this is received the bonds will be offered for sale.

Utah.

The Green River Irrigation District, S. J. Neer, assistant secretary, Green River, Utah, is having plans drawn for a considerable amount of work, and will call for bids at a later date. This work includes the completion of a dam across the Green River and widening and deepening of the raceway from the headgates to the intake, the construction and installation of a pumping plant to lift water from the raceway to the 90-ft. canal and the completion of the 90-ft. canal. In our issue of Jan. 25 we stated that bids for this work would be received March 1. The district, however, changed its plans and will advertise the work at a later date.

Washington.

✣Bids will be received until 10 a. m., April 15, by Department of the Interior, United States Reclamation Service, Washington, D. C., for the construction of the Kaxhess Dam and accessory structures near Easton, Wash. The work involves the excavation of approximately 345,000 cu. yds. of material, the placing of about 240,000 cu. yds. of embankment, 15,000 cu. yds. of riprap and paving, 8,000 cu. yds. of concrete and 300,000 pounds of reinforcing steel, and other items necessary to complete the work. For particulars address the United States Reclamation Service, Washington, D. C., or North Yakima, Wash. R. A. Ballinger is Secretary. Official advertisement will be found elsewhere in this issue.

Canada.

Henry Bose, Reeve T. J. Sullivan and Bion B. Smith of New Westmister, B. C., have been appointed Commissioners to have charge of the building of two dams across the Nicomekl and the Serpentine Rivers at a cost of about $150,000. By these dams it is expected to drain about 14,000 acres of land in Surrey. The building of the dams will prevent the water backing up from Boundary Bay, congesting the streams and flooding the lands with salt water.

WATER-WORKS

California.

The citizens of Dorris, Cal., have voted bonds to the amount of $12,500 for the installation of a municipal waterworks system.

Plans and specifications have been prepared by Engineers Olmstead & Gillelen, Wright & Callender Bldg., Los Angeles, Cal., for the construction of a municipal waterworks system for the town of Kingsbury, Cal. The work will include a 60,000-gal. elevated steel tank pumping station, reservoirs and the laying of 28,500 ft. of 4-in. and 2,600 ft. of 8-in. pipe. The estimated cost is $36,000. Bids for the improvement will soon be asked.

Plans and specifications for the construction of a new earthen reservoir with a capacity of 5,700,000 gals. of water have been submitted to the city council of San Luis Obispo, Cal., by the city engineer. Bids for this work will be received at once.

Plans are being prepared by Haviland & Tibbets, consulting engineers, Alaska Commercial Bldg., San Francisco, Cal., for the raising of the reservoir dam of the municipal water system 8 ft.

The pipe and reservoir system for the Port Costa Water Works, near Martinez, Contra Costa County, Cal., is under way and will be completed in about two months. M. M. O'Shaughnessy, consulting engineer, 14 Montgomery St., San Francisco, Cal., has charge of the work.

Colorado.

At a recent mass meeting of the citizens of Fort Lupton, Colo., it was decided to take steps necessary for the construction of a waterworks system for the town, at a cost of $25,000. The plan is to sink wells which it is expected will provide an ample supply of soft water. Bonds will probably be sold for this improvement.

Connecticut.

The board of public works of Waterbury, Conn., has authorized John R. Walker, superintendent water works, to purchase 20,000 ft. of water pipe of various sizes.

Georgia.

The city of Marietta, Ga., will vote May 1 on the proposition of issuing bonds to the amount of $15,000 for water and sewer improvements.

John W. Ash, Austell, Ga., has received the contract for the engineering work at Dalton, Ga., for water works, reservoirs, coagulating basin, clear water well, filter, power house, pumping station, installing machinery, etc. All work is to be of reinforced concrete.

Illinois.

⦿The village trustees of Kingston, Ill., awarded the contract for the construction of a waterworks system in the town to Bellis & Gale, of Oregon, Ill., for $3,855. The work includes: 1 10-h.p. gasoline engine, 1 4x6-inch compressor, 1 6-in. pump, 1 8x36-ft. pressure steel tank, 3,200 ft. of 4-in. water pipe with 9 hydrants containing two openings, 1 2½-in. and 1 2-in., to be placed at each street crossing.

The town of Flora, Ill., plans the installation of a waterworks and sewer system at an estimated cost of $87,000. J. S. Spoker of Vincennes, Ind., has been retained as engineer.

Following is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., Room 400, City Hall, for furnishing and delivering one open feed water heater and water purifier to the Roseland pumping station, 104th st. and C. & W. I. R. R. (Detailed specifications published in ENGINEERING-CONTRACTING): Exeter Machine Co., $549.

Following are the low bids submitted to B. J. Mullaney, Commissioner of Public

Works, Chicago, Ill., for furnishing the necessary labor, tools and material for setting boilers and ash pit linings for the Roseland pumping station, 104th St. and C. & W. I. R. R. Detailed bids published in ENGINEERING-CONTRACTING. The work consists of setting boilers and ash pit linings for two batteries, each consisting of 2,300-h.p. boilers: Jos. T. Dorgan Co., $4,195; J. A. De Laby, $4,875; Jno. Maloney, $4,933.

The following is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering 600 tons clean screenings to the boiler plant of new City Hall. Bids opened March 1: D. Rutter & Co., 98 Dearborn St., $2.35 per ton.

Folowing is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing a steam tug complete for service as directed from the 16th of March to 15th of December, inclusive, and shall be used for any purpose enumerated in the specifications: Jas. Rolson, $543 per month. Bids opened March 2.

Folowing is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, City Hall, Chicago, for furnishing and deliving brass bibb cocks, as follows—300 1-in., 300 1½-in., 400 2-in. bibb cocks to the water meter shops, 1330 Indiana Ave., as directed: J. J. Ryan & Co., 104 S. Jefferson St., Chicago, Ill. Bids opened March 2.

Following is the low bid submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., City Hall, for furnishing and delivering cast iron water pipe, as follows: Yard A, Avers Ave. and Wabansia Ave., 2,500 pcs. 6-in., 2,500 pcs. 8-in. and 500 pcs. 12-in.; Yard B, 2352 So. Ashland Ave., 4,500 pcs. 6-in., 3,000 pcs. 8-in.; Yard C, 19th St. and Union Ave., 1,500 pcs. 6-in., 1,800 pcs. 8-in.; Yard D, 68th St. and Yates Ave., 1,100 pcs. 6-in., 725 pcs. 8-in.; Yard E, 600 pcs. 6-in., 600 pcs. 8-in. All pipe to be delivered F. O. B. pipe yards except Yard C.: United States Cast Iron Pipe Co., The Rookery, Chicago, $23.85 per ton. Detailed specifications published in ENGINEERING-CONTRACTING.

Following are the low bids received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering 12,000 lbs. of ingot copper and 12,000 of copper trolley wire to the Water Works Shops, 2301 So. Ashland Ave.: H. Kramer & Co., 730 So. Canal St., Chicago, Ill., ingot copper, 13¾ cts. per lb.; trolley wire 13.3 cts. per lb. Detailed specifications published in ENGINEERING-CONTRACTING.

Indiana.

✣Bids will be received until 10 a. m., March 10, by Board of Public Works, Indianapolis, Ind., for the construction of a local sewer in and along Princeton and Trenton Aves. from New Jersey St. to 30th St.

Iowa.

✣Bids will be received until 7:30 p. m., March 20, by R. A. Davis, City Clerk, Nevada, Ia., for the construction and completion ready for operation of extensions to the water works system, comprising 1,170 ft. of 6-in. mains, 5,530 ft. 4-in. mains, 18 hydrants, one 6-in. and three 4-in. gate valves and fittings as required. R. A. Davis is City Clerk. Official advertisement will be found elsewhere in this issue.

The Citizens Water Co., of Burlington, Ia., contemplates making improvements at its plant this summer that will aggregate over $13,000. The improvements consist in installing a new pumping engine to pump the water from the river to the settling tanks and the placing of two new filters. The engine will cost about $7,711, and the filters about $5,830.

The City Council of Ogden, Ia., is considering the proposition of an extension of the present water system and an additional bond issue for a sewer system.

Kansas.

An election is to be held in Waterville, Kan., at an early date to vote on the proposition of issuing bonds in the sum of $25,000 for the purpose of erecting a new and up-to-date water works system.

Kentucky.

The United Water, Light & Traction Co., has been incorporated with a capital stock of $100,000 and will operate in the city of Somerset, Ky. William Waddle, of Louisville, Ky., is interested.

Maine.

✣Bids will be received until 11 a. m., April 15, by Capt. J. F. Yohn, Constructing Quartermaster, 655 Congress St., Portland, Me., for the construction and installation of a chemical water softening plant of 15,000 gals. per hour at Fort McKinley, Me.

Maryland.

The mayor and aldermen of Frederick, Md., have appointed William H. Boardman, of Philadelphia, as hydraulic engineer to go over the water situation in the city and make recommendation for an increase of the water supply. An investigation will be made of the two reservoirs and distribution system, and an estimate made of the cost of the improvement.

Michigan.

It is proposed to bond the village of East Grand Rapids, Mich., for $40,000 for the installation of a waterworks and sewer system. Benjamin S. Hanchett is president of the village.

Minnesota.

The city of Duluth, Minn., will expend about $25,000 during the coming summer in the West End in the installation of new water mains.

Missouri.

Hiram Phillips, consulting engineer, Third National Bank Bldg., St. Louis, Mo., has been employed by the city council of Milan, Mo., to draw plans for the construction of a water works. The estimated cost is $25,000. J. W. Bingham is mayor.

Montana.

✣Bids will be received until 5 p. m., March 16, by A. M. Brendenburg, City Clerk, Bozeman, Mont., for laying concret on the side slopes and bottom of the enlarge reservoir of the Bozeman city water works, including approximately 4,840 sq. yds. of material. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 8 p. m., March 24, by city of Lewistown, Mont., for furnishing fire hydrants, valves, lead, jute and other materials. P. A. Chase is City Clerk and O. F. Wasmansdorff is City Engineer.

✣Bids will be received until 8 p. m., March 24, by city of Lewistown, Mont., for furnishing approximately 50,000 ft. of cast iron pipe of 130 lbs. pressure. P. A. Chase is City Clerk. O. F. Wasmansdorff is City Engineer.

Nebraska.

A petition is being circulated in Bridgeport, Neb., asking the town board to submit to the vote of the people at an election to be held the first Tuesday in April a proposition providing for the issuance of bonds to the amount of $18,000 for the construction of a water works. R. H. Willis of Bridgeport is engineer.

New Jersey.

✣Bids will be received until 2 p. m., March 15, by Borough Council, Spring Lake, Monmouth County, N. J., at the office of E. V. Patterson, Borough Clerk, for furnishing, delivering and erecting the complete and mechanical equipment of an artesian water works plant comprising the following: Brick pumping station, with boiler house annexed; radial brick stack and foundation; concrete reservoir; concrete building and machinery, foundations and floors, etc.; five artesian wells; two triple expansion, direct acting pumping engines; one duplex cross compound steam, two stage air compressor; one surface condenser with [illegible] pump; one boiler feed pump; two feed water heaters; three return tubular boilers and stack breeching; suction and discharge mains to pumps and reservoir; piping seven artesian wells; conduit from wells to reservoir; removal and resetting old boiler; removal and resetting old air compressor; steam and exhaust connections to boilers and machinery; one Simplex water meter. O. H. Brown, Mayor, E. V. Patterson, Borough Clerk, Borough of Spring Lake, N. J.; J. L. Sweigard, Engineer Betz Building, Philadelphia, Pa.

New Mexico.

Consulting Engineer M. M. O'Shaughnessy, 14 Montgomery St., San Francisco, Cal., has under way for Thompson & Meloche at Raton, N. Mex., an earth-fill dam of abgout 200,000 cu. yds. This work is about 30 per cent completed, and should be finished in about six months.

New York.

✣Bids will be received until 11 a. m., March 21, by Board of Water Supply, 165 Broadway, New York, for Contract 58 for furnishing and installing a complete drainage equipment for unwatering the shafts and tunnel of the Rondout siphon of the Catskill aqueduct. The work is located near High Falls station on the New York, Ontario & Western R. R., in the town of Marbletown, Ulster County, N. Y.

✣Bids will be received until 11 a. m., March 20, by Board of Water Commissioners, Westbury, N. Y., for the construction of water works. Work will embrace furnishing approximately 630 tons cast iron B. and S. pipe, 23 tons special castings, 100,000 gallon tank and steel tower 164 ft. high, 76 double-nozzle fire hydrants, 58 gate valves and boxes, two deep well triplex power pumps, 1,000,000 gallons capacity; two 35-horse power multiple cylinder vertical gas engines with gas producer, concrete pumping station, and laying about seven miles of pipe, and drilling two 12-inch wells. Plans will be on file and may be obtained from the engineer on receipt of five ($5.00) dollars, or may be seen at the office of the engineer, or at the office of Thos J. McCord, at Westbury, N. Y. Specifications will be on file at the office of the engineer and at the office of Thos. J. McCord, and will be forwarded free upon application. All inquiries must be addressed to Walter E. Sexton, Mineola, N. Y., the engineer.

A bill to bond the city of Buffalo, N. Y., for $1,000,000 to equip the new pumping station has been approved by the aldermen.

The committee of water supply of the City Council of Schnectady, N. Y., of which W. A. Stearns is chairman, has recommended in its report to that body the construction of a reservoir for the city water system.

An ordinance has been introduced in the City Council of Schnectady, N. Y., by Alderman W. A. Stearns which provides for the issuance of bonds to the amount of $300,000 for the purpose of erecting, constructing, enlarging and improving the waterworks system, and to include the purchase of necessary lands therefor.

The citizens of Mount Morris, N. Y., are urging the installation of a municipal water works system.

North Carolina.

The citizens of Rutherfordton, N. C., have voted the issuance of bonds to the amount of $35,000 for the construction of a waterworks and electric light plant.

Bonds to the amount of $55,000 have been voted by the city of Smithfield, N. C., for the installation of a waterworks, electric light plant and a sewer system.

North Dakota.

✣Bids will be received until March 27, by board of City Commissioners, Minot, N. Dak., for the construction of 4 miles of sewers. E. J. Thomas is City Engineer. R. H. Emerson is Commissioner of Waterworks and Sewers.

Ohio.

◉Gould & Maybach of Cleveland, O., have been awarded the contract by the village of Euclid, O., for the improvement of Montclair Road from Euclid Ave., to the northerly end thereof by constructing a 6-in. water main therein for $1,177. F. A. Pease Engineering Co., 931 Williamson Bldg., Cleveland, O., engineer. Bids were opened Feb. 27.

✣ **indicates work now open for bids.** ◉ **indicates a contract let recently.**

⊙Isaac Winkler & Bro. of Cincinnati, O., have been awarded the contract by the director of public service, Columbus, O., for furnishing [illegible] tons, to the water department, for $17.50 per ton. The American Stone & Lime Co. of Tyrone, Pa., was awarded the contract for furnishing 1,400 tons of lime. D. A. Jones is city clerk. Bids were opened Feb. 14.

Consulting Engineer H. L. Maddocks, 504 Trust Bldg., Newark, O., has been employed by the village council of Centerburg, O., to prepare plans and specifications for the installation of a water supply system.

The City Council of Urbana, O., is preparing to issue and sell $100,000 worth of bonds to purchase the Urbana waterworks.

The engineering force of Dayton, O., has surveyed a new route for the proposed new water supply conduit. The conduit will run from the city waterworks pumping station to the site of the reservoir, recommended, near Tate's Hill, a distance of two miles from Dayton. F. J. Cellarius is City Engineer.

Oklahoma.

The citizens of Stonewall, Okla., have voted bonds to the amount of $30,000 for the installation of a waterworks system.

The city of Boynton, Okla., contemplates the installation of a waterworks system.

The citizens of Lamont, Okla., have voted bonds in the sum of $20,000 for the installation of a waterworks.

Oregon.

The City Council of Toledo, Ore., has employed engineers to make plans for the proposed water system. As soon as estimates of cost are prepared an election will be held to authorize the issuance of bonds.

A special election was held in Medford, Ore., March 2 to vote on the proposition of issuing bonds to the amount of $30,000 for improvements to the water system and for paying for the installation of a storm and sanitary sewer system.

Pennsylvania.

⊙R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa., have been awarded the contract by the city of Fall River, Mass., for furnishing 17,200 ft. of 6-in., 8-in., 10-in., and 12-in., water pipe for $20.80 per ton.

The citizens of Schuylkill Haven, Pa., recently voted the issuance of bonds to the amount of $50,000 to build additional reservoirs.

The Myerstown Water Co., of Myerstown, Pa., has placed an order for 8-in. iron pipe for the construction of the proposed new pipe line. Work on placing the new line will be started as soon as the pipe is received.

The City Council of Scranton, Pa., has passed a resolution giving the Consolidated Water Co., the privilege of extending their water mains over the Salem and Eighth Ave bridges.

South Carolina.

The City Council of Rock Hill, S. C., has decided to re-build and extend its water and electric light plants which were recently obtained from Martin Maloney of Philadelphia, Pa., for $100,000. Plans have been prepared by Thomas W. Cothan of Greenwood, S. C. Rudolph Hering, 170 Broadway, New York City, is consulting engineer.

Tennessee.

A plan has been submitted [illegible] council of Lonsdale, (P. O. Knoxville, Tenn.), to install a waterworks system in the town. A map has been made of the streets on which mains would be laid, running from the Wallace spring to Johnson St.

The city of Chattanooga, Tenn., has decided to increase its bond issue for a waterworks from $900,000 to $1,250,000. Robert Hooke is city engineer.

Texas.

The City Council of Grand Saline, Tex., has ordered a new 30 H. P. boiler installed at the city waterworks pumping station.

The citizens of Winters, Tex., have voted the issuance of bonds to the amount of $2,000 for waterworks construction. Plans and specifications have been prepared by the O'Neil Engineering Co., of Dallas, Tex.

The Water Works Co., of Sequin, Tex., plans to extend its system. The company will lay 1,000 ft. of 8-in., 6,000 ft. of 6-in., and 2,000 ft. of 4-in. mains.

It is planned to install a waterworks system in the city of Electra, Tex. An election will probably be called to vote bonds for this improvement.

The town Council of Archer City, Tex., contemplates holding an election some time during this month for the purpose of voting on the proposition of issuing bonds for a waterworks.

Utah.

Mayor J. H. Anderson, of Logan, Utah, has named the special committee, which will plan means to secure money for the improvements desired for the proposed water system. Dr. George Thomas is chairman.

Washington.

Advices from Tacoma, Wash., state that it will cost approximately $30,000 more to build the 100,000,000-gal. storage reservoir for the Green River gravity water system than was at first anticipated. The spillway and the concrete necessary to anchor it had not been included in the original estimate for the reservoir. About 2,000 cu. yds. of concrete will be necessary to place around the spillway. Bids for the construction of the reservoir and the other units comprising the system will be called for shortly. The estimated cost is $133,000. Nicholas Lawson is commissioner. W. C. Raleigh is City Engineer.

West Virginia.

The City Council of Wheeling, W. Va., will probably issue bonds in the sum of $300,000 to erect a filtration plant. C. B. Cooke is City Engineer.

Canada.

✣Bids will be received until 11 a. m., March 29, by M. Peterson, Secretary Board of Control, Winnipeg, Man., for supplying a quantity of cast iron water pipe, to be delivered f. o. b. city yards, Winnipeg. Further information can be obtained of city engineer, [illegible] James Ave.

✣Bids will be received until noon, April 4, by W. H. Stewart, secretary-treasurer, Rouleau, Sask., for the following: "Contract E," electrical machinery, pole line, etc.; "Contract F," pumping machinery, compressed air system; "Contract G," producer gas plant. Cast iron or steel water mains, as follows: 12,000 ft. 6 in. C. I. water main, tested to 300 pounds hydrostatic pressure; 1,000 ft. 4 in. C. I. water mains, tested to 300 pounds hydrostatic pressure; 1,400 ft. 2 in. C. I. water mains, tested to 300 pounds hydrostatic pressure. Special castings, tees, etc., at per pound. Hydrants, valves, etc., as follows: 22 6 in. hydrants, one steamer nozzle, and 2 2¼ in. nozzles; 8 ft. 0 in. bury; 47 6 in. left handed gate valves; 47 6 in. valve boxes extending 7 to 9 ft. Plans and specifications may be seen at the secretary-treasurer's office, Rouleau, or at the office of the engineer, Regina. Copies of the plans and specifications will be forwarded from Regina on receipt of an accepted check for $10, said check to be refunded upon return of the said plans and specifications. J. Darlington Whitmore is consulting engineer, 104 Willoughby & Duncan Blk., Regina, Sask.

Bids will be received by T. A. Dinsley, secretary-treasurer, town of Wilkie, Sask., until March 20 for the drafting of plans and specifications for, and giving a detailed estimate of, the cost of electric lighting and water works systems for the town of Wilkie.

The town Council of Ridgetown, Ont., has instructed Civil Engineer F. W. Farcombe of London, Ont., to prepare plans and estimates for the installation of a waterworks system for Ridgetown.

A waterworks system will be installed in Battleford, Sask., during the spring at an estimated cost of $100,000.

Plans are being prepared for the installation of a waterworks system for the town of Melville, Sask. J. L. White, of Sioux City, S. Dak., has charge of the work.

The water commission of Welland, Ont., has secured from the Ottawa government a water power privilege on the east side of the canal below the aqueduct and will build a large and modern waterworks plant there. The new plant will have a 3,000,000-gal. pump and two water wheels. The old pumping station on the west side will undergo slight repairs and be used as an auxiliary.

SEWERAGE AND GARBAGE DISPOSAL

Arizona.

Plans for a complete sewer system for Phoenix, Ariz., are under way; $400,000 is to be spent on this work. The city has voted bonds for the purpose and purchased the present system at an additional cost of $60,000.

California.

The [illegible] trustees of Dixon [illegible] are [illegible] the question of building [illegible]

The board of city trustees of Willows, Cal., has created two sewer districts so as to allow the residents of the outlying districts of the city to construct sewers. Bonds will probably be issued to cover the cost of these improvements.

The [illegible] Improvement Association, Arlington (P. O. Riverside, Cal.), has been formed for the purpose of building a storm drain, and paving Jefferson St. The officers are: H. P. Spencer, president; Charles Wagner, vice-president; John M. Ferguson, secretary, and G. S. Cutudal, treasurer.

City Engineer Dupuy, of South Pasadena, Cal., is working on a plan for the disposition of sewage from South Pasadena, Pasadena and Alhambra, by the installation of a septic tank many miles to the south of Alhambra, and by discharging the effluent from the tank into the San Gabriel river.

The drainage and sanitary committee of the city council of Oakland, Cal., has recommended the creation of three sanitary districts for the annexed districts of the city. The sewers will be constructed this summer. F. C. Turner is city engineer. Frank Thompson is city clerk.

City Engineer Dewey, of Long Beach, Cal., has completed his estimate [illegible] extending the city sewer system to cover all of the city, except the lowlands on the west and a part of Belmont Heights. About 130 miles of pipe will be needed, and the cost will be in the neighborhood of $400,000. In addition, the outfall sewer will be changed so as to empty into the inner harbor, instead of the ocean, as at present.

Connecticut.

✣Bids will be received until 8 p. m., March 20, by J. H. Provost, City Clerk, Stamford, Conn., for furnishing the necessary labor and material for the construction of certain sewers. The proposed work consists approximately of about [illegible] vitrified pipe sewers, 8 ins. to 18 ins. laid complete with manholes and flushtanks, about one thousand feet of iron pipe sewer and forcemain 8 ins [illegible] Each bid must be accompanied by

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

a certified check for $[illegible] as a guarantee that the bidder, if his bid be accepted, will enter into contract and execute the required bond.

The Silver Street Sewer Co., of Middletown, Conn., has been organized with a capital stock of $3,000. Ernest S. Davis is president; Frank H. Frissell, vice president; Charles L. Williams, secretary and treasurer.

Florida.

The board [illegible] of [illegible], Fla., has prepared a plan providing for the expenditure of [illegible] for sewerage in the near future. It is the intention of the board to lay about [illegible] of sanitary sewer pipes and about [illegible] miles of storm sewerage. The estimated cost of the sanitary sewerage is $[illegible] and [illegible] storm sewerage $[illegible].

Illinois.

Bids were opened Mar. [illegible] by [illegible] Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering sewer pipe as follows: Chicago Ave. bridge yard, 75 pieces 6 in., 2 ft. long; 400 pieces 9 in., 2 ft. long; 150 pieces 12 in., 2 ft. long; 75 pieces 15 in., 2 ft. long; 25 pieces 18 in., pipe, 2 ft. long [illegible] double strength, 2 ft. long; 30 9 in. half traps; 100 pieces curved pipe (mostly 9 in.), 2 ft. long; all pipe to be straight unless otherwise specified; to be delivered to yard at 69th and Peoria Sts. 100 pieces 6-in. pipe, 600 pieces 9-in., 75 pieces 12-in., 25 pieces 18-in. double strength, 60 9-in. half traps, 150 pieces curved pipe (mostly 9-in.), and small quantities of "Y" junctions, rings, elbows, slants, etc., and larger pipe as required. N. A. Williams Co., [illegible] Bldg., Chicago, submitted [illegible] 78% off. Western price lists in effect [illegible] 1911, double strength pipe at a discount [illegible] 5% less than the discount bid. Bidders were requested to submit bid with reference to Western price lists.

The board of local improvements of Mt. Carmel, Ill., has instructed the city engineer to make plans and profiles for a lateral sewer on East St. Johns St., from Montgomery Ave. to Clay St.

The board of local improvements of [illegible], Ill., has adopted plans for the construction [illegible] the [illegible] State St. sewers.

The board of local improvements [illegible], Ill., has passed resolutions providing [illegible] the [illegible] sewer [illegible] Seventh St.

Plans have been prepared [illegible] Consulting Engineer Hill for the construction [illegible] Chicago, Ill. The sewer will begin at Main St. [illegible] into the lake. The work will include a septic tank. The estimated cost is $60,000. Martin C. Decker is city attorney.

The board of local improvements of Joliet, Ill., has adopted resolutions and engineer's estimates for the construction of a sewer [illegible] Ave. to a point 370 ft. [illegible] cost of $1,479. Harry Stevens is city engineer. [illegible] is mayor.

Iowa.

• Bids were opened [illegible] by the city of Sigourney, Ia., for constructing sanitary sewers, the contract for all of the work being awarded to Bash & Gray, Joplin, Mo., at $39,741. The estimated cost of the engineers for the city, Hall & Adams, Centerville, Ia., was $44,539. The itemized bids received were as follows, (1) standing for W. J. Lane, Harlan, Ia.; (2) John W. Scott, Ottumwa, Ia.; (3) Zitteral & Sullivan, Webster City, Ia.; (4) Henry Rees, Quincy, Ill.; (5) J. W. Turner Imp. Co., Des Moines, Ia.; (6) Blackhawk Const. Co., Waterloo, Ia.; (7) M. A. Camery, Harlan, Ia.; (8) Hamilton Bros., Chicago, Ill.; (9) Omaha Const. Co., Omaha, Nebr.; (10) Bash & Gray, Joplin, Mo.; (11) Dearborn & Jackson, Cedar Rapids, Ia.; (12) McGuire & Stanton, Leavenworth, Kan.; (13) C. R. McKay, Omaha, Nebr.; (14) Geo. M. [illegible], Des Moines, Ia.; (15) [illegible] Const. Co., Burlington, Ia.

BIDS RECEIVED [illegible] AT SIGOURNEY, IA., FOR CONSTRUCTING SANITARY SEWERS.

[illegible]

✣ indicates work now open for bids. • indicates a contract let recently.

Iowa.

[illegible] tem, and an extension of the present water [illegible]

D. H. Keeler & Co., of Davenport, Iowa, submitted the lowest bid to the board of [illegible] for the construction of the Seventh Ward sewer. The bid was a little more than $50,000.

[illegible] the [illegible] a sewer for Dry Run and to drain the Virden creek.

Indiana.

✣[illegible] Board of Public Works, Indianapolis, Ind., for the construction of a local sewer in and along McLain St., from Morris St. to Wilkins St.

The board of trustees of Danville, Ind., has taken preliminary steps toward letting the contracts for a sanitary sewer system, recently voted by the people. John O. Kain, of Danville, and Curtis Goss, of Martins[illegible] engineers, and ordered to make preliminary surveys and profiles, with estimates of probable cost, on which to base publication for bids on the work. It is intended to let the contract this month.

Plans for the proposed sewer in the southwest section of South Bend, Ind., which would take the place of Bowman creek, have [illegible] the board of public works and the county commissioners. The proposed improvement would cost in the neigh[illegible] Wm. S. Moore is city engineer.

[illegible] Danville, Ind., has voted to construct a sanitary sewer system.

The board of public works of South Bend, Ind., has been petitioned for the construc[illegible] La Salle Ave. to Cedar St., two blocks in length. Wm. S. Moore is city engineer.

Kansas.

◉The city council of Abilene, Kan., has awarded the contract for the construction of a storm sewer to Snyder & Peterson. Guy [illegible]

Kentucky.

✣Bids will be received until noon, March 24, by Commissioners of Sewerage, 605 Equitable Bldg., Louisville, Ky., for the construction of the Fourth St., 28th St., and Cedar St. sewers. Contracts 78, 79 and 80. The work of the several contracts, briefly stated, is as follows: "Fourth St. Sewer—565 ft. of 34-in. pipe sewer, in trench from 4 to 12 ft. deep, and 35 cu. yds. of concrete. "28th St. Sewer"—1,280 ft. of pipe sewer from 15-in. to 24-in. in diameter, in trench from 6 to 12 ft. deep, and about 90 cu. yds. of concrete. "Cedar St. Sewer"—710 ft. of 60-in. concrete sewer, in [illegible] plans and specifications may be seen at the office of the Commissioners and at the office of Metcalf & Eddy, 14 Beacon St., Boston, Mass. J. B. F. Breed [illegible] Commission.

Maryland.

Following bids were received by the board of awards of Baltimore, Md., on Sanitary Contract No. 62, Pratt St. Trunk Sewer, and Sanitary Contract No. 63, Lateral Sewers in District 15; Calvin W. Hendrick, Chief Engineer, Sewerage Commission. Sanitary Contract No. 62—McCay Engineering Co., 9 E. [illegible] $82,751.73; [illegible] W. H. & C. F. Thompson, Baltimore, Md., [illegible] Philadelphia, Pa., $85,036.20; B. F. Sweeten & Sons, 820 Sharp St., Baltimore, $107,427.05; The Whiting-Middleton Constr. Co., Baltimore, Maryland, $115,585.10. Sanitary Contract No. 63—Wm. McCarthy & Co., Baltimore, Md., $75,187; M. J. Beach, Baltimore, [illegible] Sons, Sharp St., Baltimore, $95,524; David M. Andrew Co., Baltimore Md., $96,804.25; W. H. & C. F. Thompson, 627 Law Bldg., Baltimore, $100,654.25; The Whiting-Middleton Constr. Co., Baltimore, Md., $108,689.

The sewerage commission of Easton, Md., composed of Gen. Joseph B. Seth, T. Hughlett Henry, Ulysses F. Carroll and William H. Withgott, has organized by electing Mayor Higgins president and T. Hughlett Henry, secretary. The commission will at once commence laying its plans for building the sewers and disposal plant, estimated to cost $30,000. The city voted, Feb. 23, the issuance of bonds for the improvement.

The Arlington Sanitary Sewerage Co., Arlington, Md., has been incorporated at Towson, Md., with a capital stock of $25,000. The company is organized for the purpose of providing Arlington and vicinity with a sewerage system. The incorporators are Mortimer W. West, Thomas J. Flannery and Thos. B. Marshall.

◉The board of awards of Baltimore, Md., has awarded the following sewerage contracts, which carry an appropriation of about $165,000: McCay Engineering Co., $85,752, for the trunk sewer on Pratt St.; William McCarthy & Co., $75,187, for the lateral sewers in district No. 15; Louis F. Andrea Co., $3,052, for water piping and steam heating to be done at the sewerage pumping station.

Massachusetts.

Metcalf & Eddy, consulting engineers, 14 Beacon St., Boston, Mass., have been retained by the city of New Bedford, Mass., in connection with its intercepting and outfall sewers. This work will probably be started this year.

Harrison P. Eddy of the firm of Metcalf & Eddy, 14 Beacon St., Boston, Mass., is consulting engineer to the sewage disposal commission of the city of Fitchburg, Mass., which is making studies and plans for a sewage disposal system and intercepting sewers. It is probable that some construction work will be done on this system during the present year. David A. Hartwell of Fitchburg is Chief Engineer of the work.

Michigan.

◉The board of public works of Niles, Mich., has awarded the contract to the Heystek Co., of Kalamazoo, Mich., for the construction of the main trunk sewer in that city, for $18,879. The work will include 1,735 ft. of 36-in. reinforced concrete pipe, 1,660 ft. of 48-in., 995 ft. of 60-in., and 60 ft. of iron piping, the latter to be used at the outlet in the river. The work will be commenced as soon as the weather permits. H. W. Fogus is supt. board of public works.

It is proposed to bond the village of East Grand Rapids, Mich., for $40,000, for the installation of a system of sewers and water works. Benjamin S. Hanchett is president of the village.

Minnesota.

◉The city council of Melrose, Minn., has awarded the contract for the construction of a sewer system in that city to M. V. Dueber, of St. Cloud, Minn., for $11,418. S. S. Chute, of St. Cloud, is engineer. Other bids received were: Illstrup & Olson, Minneapolis, $17,136; Cook Construction Co., Des Moines, Iowa, $15,550; C. H. Perett, Fargo, N. Dak., $15,811; William B. Bosworth, Ada, Okla., $14,684; F. E. Kaminski, Watertown, Wis., $13,309; Frazier & Danforth, Rochester, $14,920; Pat. McDonald, Duluth, Minn., $13,146; Pastoret Lawrence Co., Duluth, $14,960; L. W. Schruth, Fargo, $15,205; Thos. E. Woolley, La Crosse, Wis., $15,794, and D. S. Redmon, Pipestone, $17,852.

◉It is reported that J. J. Connolly has been awarded the contract by the board of public works of St. Paul, Minn., for the construction of the Otis Ave. sewer for $7,912.

Missouri.

A bill submitting to a vote of the people of St. Louis, Mo., April 4, a proposition for a bond issue of $2,500,000 for the construction of a sewer to carry the River des Peres in a tunnel under Art Hill in Forest Park, has been introduced in the city council by E. V. P. Schneiderhahn.

◉The board of public improvements of St. Louis, Mo., has awarded the contract for the construction of the Baden sewer No. 1 to the Fruin-Colnon Contracting Co., of that city, for $434,355. The W. F. Riley Construction Co. was awarded the contract for the construction of the second section of the sewer for $162,016.

Nebraska.

The citizens of Stanton, Neb., recently held a meeting with the city council to discuss the proposition of installing a sewer system. The question of issuing bonds for the improvement will probably be submitted at the spring election.

The citizens of Pawnee City, Neb., are agitating the proposition of installing a sewerage system in that town.

Plans and specifications for draining the north bottoms of Omaha, Neb., have been approved by the committee of the whole, and an appropriation, not to exceed $6,500, ordered. The drainage system will consist of cylindrical tiling, starting near Carter park and running diagonally to a point six blocks north to Fort St. Geo. W. Craig is city engineer.

New York.

A bill has been introduced in the state senate, Albany, N. Y., which provides for the issue of additional bonds to the amount of $500,000 to cover the expense of installing a plant for the treatment of the sewage to be discharged into the Hudson near Yonkers.

The board of contract and supply of Rochester, N. Y., has instructed its clerk, Frank X. Pifer, to advertise for bids for the construction of a rubbish disposal plant, on the site secured by the city some time ago, on the river flats near the garbage reduction plant. The appropriation for the new plant is $100,000, of which $15,000 has been expended for the site.

The board of contract and supply of Rochester, N. Y., has decided not to award the contract for the construction of the first section of the new sewage disposal system, for which bids were received Feb. 15, and for which Thomas Holahan at $147,980, was low bidder. Clerk Frank X. Pifer has been instructed to advertise for new bids. The clerk was also directed to advertise for bids for the construction of the third section of the disposal system, which begins at Avenue B, and at the Deaf Mute Institution passes to St. Paul St., along which it runs to Strong St. and up that thoroughfare to Hollenbeck St. The estimated cost is about $125,000.

The bill authorizing an additional bond issue of $300,000 to complete the work undertaken by the Syracuse intercepting sewer board has been passed by the Assembly. It was introduced by Assemblyman F. W. Hammond.

Ohio.

◉The board of control of Springfield, Ohio, has awarded the contract for the laying of a sanitary sewer in Race St., from Main St. to Jefferson, to M. J. Cooney for $1,733.

◉It is reported that Huonker & Williams have been awarded the contract for laying the chain of sanitary sewers in the southeast section of Springfield, Ohio. The sewers are to be laid in the following streets: Pearl St., from Rice to Fremont Ave.; Fremont Ave., from Pearl to Clifton Ave.; Clifton Ave., from Prairie Ave. to Rose St.; Rose St., from Pearl St. to Clifton Ave.; Catherine St., from Clifton Ave. to Pearl St. The bid was as follows: For 6-in. pipe, 25 cts. per ft.; 8-in. pipe, 48 cts. per ft., and 10-in. pipe, 50 cts. per ft.

The citizens of the village of New Boston, Ohio, at a recent election voted against the proposition of issuing bonds to the amount of $35,000 for the installation of a sewerage system.

The village council of Reading, Ohio, has approved the plans and specifications of Village Engineer Hosbrook for a sanitary sewerage system for the village, and has submitted the same to the state board of health for approval. If the plans are approved by the latter a special election will be held to authorize a bond issue of $50,000 for the improvement.

The Kennedy Heights (P. O., Cincinnati, Ohio), council has passed an ordinance providing for the construction of District 1 of its sewerage system, and directed Engineer James Stewart to complete the plans for District 2 and part of District 3. Each district will cost about $[illegible]

Oklahoma.

City Engineer Hocker, Guthrie, Okla., has completed plans for the West Side sewer, running on 14th, 15th and 20th Sts., and Logan and Mansur Aves.

Oregon.

E. T. Johnson, at $10,972, submitted the lowest bid to the City Executive Board of Portland, Ore., for the construction of the Salmon St. sewer district.

City Engineer J. W. Morris, of Portland, Ore., has been instructed by the sewer committee of the city council to make surveys of the peninsula district to ascertain if it is feasible to construct a sewer in that district which will empty into the Williamette river.

The city council of Portland, Ore., has been asked to create a new sewer district, to obtain a sewerage system along Killingsworth Ave., and between Killingsworth Ave. and the Portland Blvd. It embraces the territory between Union Ave. and the Williamette river, and between the Riverside sewer district south of Killingsworth Ave and either the Portland Blvd. or Bryant St. It includes Walnut Park, Piedmont and North Albina. J. W. Morris is city engineer.

Pennsylvania.

✣Bids will be received until noon, March 20, by Borough Council, Bristol, Pa., for furnishing materials and constructing a complete system of sewerage and disposal plant comprising the following: The system consists of approximately 10 miles of sewers, 8 ins. to 24 ins. in diameter, pump house, engines, pumps, pump well and disposal works. Bids will be received for the entire work or any portion thereof. Plans may be seen and specifications and blank forms of proposal procured by applying to the office of the Borough Surveyor, No. 209 Radcliffe St., Borough of Bristol, Bucks County, Pennsylvania. A certified check for $500, pay[illegible] order of the Borough Clerk of Bristol, Pa., must accompany each bid. Wm. H. Boardman is Engineer, 426 Walnut St., Philadelphia, Pa.

Director of Public Works Joseph G. Armstrong, of Pittsburg, Pa., will advertise for bids at once for the re-construction of the Try St. trunk sewer, which drains all the territory between Bluff St. on the south, Center Ave. on the north, Dinwiddie St. on the east, and Ross St. on the west. The estimated cost of the improvement is $141,000. This is the first sewer re-construction work to be done under the $400,000 bond issue, voted at the last election for this purpose. It will be of concrete and brick and will be 5½ ft. in diameter.

The Eighth Ward Municipal Improvement League has been formed in McKeesport, Pa., for the purpose of hurrying the construction of sewers in that section of the city.

The village trustees of Colwyn, Delaware county, Pa., have passed an ordinance to create a loan sufficient to build an independent sewage plant, as ordered by the state health authorities.

The city council of Williamsport, Pa., has rejected all bids received for the construction of the Grafius run sewer, and has ordered the highway committee to advertise again for bids upon the same specifications. Bids were opened Feb. 16. The work includes concrete sewer in old bed of Grafius Run, approximately 1,683 ft. in length. The lowest bid received on the 16th was that of Busch & Stewart, of Williamsport, being $20,449. John R. Mundy is assistant city engineer.

South Dakota.

✣The city council of Gettysburg, S. Dak., has accepted plans and specifications for the new municipal water works system, which is to be constructed in that city. Bids for the work will be opened March 20, and it is expected the contract will be awarded soon thereafter.

The city council of Woonsocket, S. Dak., contemplates making some extensive sewer improvements during the present year

The city council of Aberdeen, S. Dak., has taken steps to secure the service of Benezette Williams, consulting engineer, 9 Randolph St., Chicago, Ill., to work with City Engineer R. B. Easton in the construction of the $200,000 worth of sewer extensions and the building of the sewage disposal plant by the city.

Tennessee.

The city council of Nashville, Tenn., has passed the bill appropriating $2,000 for a sewer in [illegible]

Texas.

✣Bids will be received between April 1 and 15 by city of Caldwell, Texas, for the construction of a steel standpipe, with or without concrete foundation. The estimated cost of the work is $4,500. J. A. Gray is mayor.

✣Bids will be received until 2 p. m., March 15, by city council, Jacksboro, Texas, for furnishing materials and constructing system of water works. N. Werenskiold, Dallas, Texas, is engineer. H. C. McClure is mayor The cost of the work is estimated at $27,500

✣Bids will be received until March 21, by city council of San Augustine, Texas, for the following material, required for the construction of a water work system: Electric motor or gasoline engine, triplex pump and steam pumps, boilers, heater, water-works pipe, valves and hydrants, tank and tower. Also for drilling of a deep well. Quantities and specifications may be had by addressing O'Neil Engineering Co., constructing and supervising engineers, 1503-8 Praetorian Bldg., Dallas, Texas.

The city council of Cameron, Texas, has authorized the committee to advertise for bids for putting in the sewerage system

Dr. McVea, secretary of the Yoakum, Texas, Commercial Club, has called a meeting of citizens to perfect organization and take the final steps toward installing a sewer system in the city.

Washington.

✣Bids will be received by city of Snohomish, Wash., according to reports from that city, until March 21, for the construction of a pipe line.

Plans for the Fourth Ward trunk sewer No. 4, to cost $44,115, authorized by resolution of the city council of Spokane, Wash., have been completed by City Engineer Morton Macartney and submitted to the city council for approval, with the recommendation of the engineer and the board of public works that they be adopted. The sewer will run from Adams and Gardner Sts. to the alley between Knox and Shannon Aves

Wisconsin.

The city of Antigo, Wis., will hold an election to vote on the proposition of issuing bonds to the [illegible] sewers

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until 2 p. m., March 14, by Bureau of Mines, at Room 25, Potter Bldg., Birmingham, Ala., for the erection of a mine rescue station building on a lot situated in the west end of Birmingham.

◉The Southern Structural Steel Co., San Antonio, Tex., has been awarded the contract at about $25,000 for constructing a new county jail at Gadsden, Ala.

California.

The Board of Public Works of Los Angeles has approved specifications for dredging an area in the Wilmington basin, the material to be used to fill a portion of Fries St. The work is necessary in order to provide a proper approach to the proposed municipal wharf, to be constructed at the end of Fries St. Homer Hamlin is City Engineer.

A local company is being organized in Turloch to install a gas plant in that city. It is understood that work on the plant will be started soon.

Delaware.

✣Bids will be received until 11 a. m., March [illegible] by Maj. R. R. Ra[illegible] U. S. Engineer [illegible] Wilmington, Del., [illegible] Bogue Bay

Florida.

◉The Southern Ferro Concrete Co. of Atlanta, Ga., has closed contract for the erection of the reinforced concrete skeleton frame for the Hillsboro Hotel at Tampa, Fla. The structure is to be 100x115 ft., eight stories high, the plans having been drawn by F. M. Curtis, architect, Tampa, Fla. The work is to begin immediately.

◉The Southern Ferro Concrete Co. of Atlanta, Ga., has been awarded the contract for the construction of all the reinforced concrete work in a warehouse to be built on Riverside avenue, Jacksonville, Fla., for Delcher Bros. The W. T. Hadlow Co. of Jacksonville is the general contractor. The building will be 72x170 ft., and is to be used for warehouse and storage purposes. It will be erected with a view of carrying the building to a future total height of ten stories. The construction is to begin immediately.

All bids received March 1 by the Bayboro Investment Co., H. A. Kellam, secretary, St. Petersburg, Fla., for dredging 100,000 cu. yds. of material at Bayboro were rejected.

Idaho.

C. A. Reid of Spokane, Wash., is to build a dam at Bruces Eddy, in Clearwater River, to cost $350,000, and a power plant below the dam, generating a minimum of 4,000 H. P. and which will cost approximately $500,000. The same interests will also construct a cement plant at Orofino to cost about $600,000. It is stated that W. C. Weeks, who built the East River pier in New York, will have charge of construction.

The Clearwater Timber Co. is reported to be planning to expend about $1,000,000 in the construction of sawmills at Orofino, a power plant at the mouth of Whisky creek, three miles above Orofino, and auxiliary plans in the white timber belt. Thomas J. Humbird, Spokane, Wash., is an official of the company.

Illinois.

[illegible] Mullaney, commissioner of public works, Chicago, Ill., for furnishing and delivering natural and Portland cement as follows: Chicago Ave. bridge yard, 600 bbls. of natural and 100 bbls. of Portland cement; yards at 69th and Peoria Sts., 1,000 bbls. of natural and 20

[illegible]

[illegible] to the Board of Education, Chicago, Ill., J. [illegible] for furnishing and delivering lumber to the [illegible] ing contracts are recommended and probably will be awarded: J. S. Benedict Lumber Co., [illegible] poplar 1 and 2 clear, $32.00 per M.; McFarland Hardwood Lumber Co., 15,000 ft. ⅞" [illegible] ⅞" poplar, $54.00 per M.; Keith Lumber Co., [illegible] ⅝" oak quarter sawed, $34.00 per M., 15,000 ft. ⅞" oak quarter sawed, $65.00 per M., 10,000 [illegible] Gillis & Co., 42 Madison St., 10,000 ft. ¼" basswood, $19.20, [illegible] basswood, $29.20, 150,000 ft. ⅝" basswood, $34.20, 15,000 ft. ⅞" basswood, $41.70 per M.; Shead Lumber Co., 279 Dearborn St., 10,000 ft. ¼" cottonwood $18.00 per M., 10,000 ft. [illegible] per M., 15,000 ft. ⅝" cottonwood $31.00 per M., 15,000 ft. ⅞" cottonwood, $35.50 per M.

The Economy Light & Power Co., Charles A. Munroe, General Manager, Joliet, Ill., and its allied company, Illinois Valley Gas & Electric Co., is to expend $500,000 this year for the improvement of its various plants and systems. The work will include the following: Rebuilding and extending lines at Coal City, Braceville, Gardner, Streator, Ottawa, Sparland, Chillicothe, Dwight, Odell and other Illinois towns; building water tower and laying new water mains at Chillicothe, laying and improving gas mains and gas systems at Ottawa, Marseilles and Morris; generally improving electric, gas and water plants in all cities included in zone of company's operations.

Indiana.

✣Bids will be received until 3 p. m., April 14, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Postoffice at Brazil, Ind. Drawings and specifications may be obtained of the custodian of site, Brazil, Ind.

✣Bids will be received until 10 a. m., March 10, by Board of Public Works, Indianapolis, Ind., for the reconstruction of the west entrance of Tomlinson hall.

✣Bids will be received until 10 a. m., March 20, by Commissioners of Hancock county at Greenfield, Ind., for the excavation and making grade at Jackson's Hill, in Sugar Creek township. C. H. Troy is county auditor.

✣Bids will be received until 1 p. m., April 3, by Board of Johnson County Commissioners, Franklin, Ind., for the new copper roof on court house.

The City Electric Lighting Co., of Vincennes, Ind., is about to erect a new steel chimney, 5 ft. by 110 ft.; also to install a new direct connected engine-driven unit of about [illegible] Metcalf & Eddy, 14 Beacon St., Boston, Mass., [illegible]

Kentucky.

✣[illegible] 10, by James Knox Taylor, supervising architect, [illegible] and wiring of the U. S. Post [illegible] Sterling, Ky.

Louisiana.

✣[illegible] will be received until noon, March [illegible] Clarke S. Smith, U. S. engineer, [illegible] Miss., for furnishing about 8,400 [illegible] light and heavy riprap stone for [illegible] River, La. and Ark.

⦿The Fort Pitt Bridge Works, Pittsburg, Pa., has been awarded the contract, at $96,122, for the fabrication and erection of the structural steel and cast iron for the William A. Kernaghan shed for the city of New Orleans, La. The contract for a wharf in front of the U. S. Immigration Station at New Orleans was let to Doullut & Williams, New Orleans, La., at $3,955.

Parties from Houston, Tex., represented by C. L. Dwyer, have been negotiating for the purchase of the large gravel pit belonging to the Brasher estate, located in the pine woods north of Pineville. It is said to be the purpose of the company to at once build a railroad spur track from Tioga, on the Iron Mountain Railroad, to the gravel pit, and install modern machinery and an outfit for screening and washing gravel, to be used for concrete work, and also for getting out sand for building purposes.

Maine.

✣Bids will be received until noon, March 23, by Lieut. Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for dredging in Camden Harbor, Me.

Maryland.

⦿Charles L. Stockhauser, Baltimore, Md., has been awarded the contract by the Board of Awards of that city for the construction of the polytechnic school building. The contract price was $348,200.

Michigan.

✣Bids will be received until 11 a. m., March 17, by Lieut. Col. Lansing H. Beach, U. S. Engineer, 325 Custom House, New Orleans, La., for extending jetties at Southwest Pass, Mississippi river.

⦿The Lake Superior & Ishpeming Ry. Co., R. C. Young, Marquette, Mich., Chief Engineer, has awarded the contract for the concrete work and substructure of the new ore dock at Marquette, Mich., to the Raymond Concrete Pile Co., 135 Adams St., Chicago, Ill. The work includes the driving of 9,700 piles and 1,175 ft. M ft. B. M. sheet piling; also the placing of about 34,000 cu. yds. of plain and reinforced concrete.

A special committee has reported to the City Council of Big Rapids, Mich., urging the construction of a lower dam to be located about a mile below the site of the old Donley dam, which went out about six years ago. The site was recommended by engineers from Chicago and an option on the land has been secured. The dam will be of concrete and have a 22-ft. bed, and will develop 2,000 H. P.

Bids were opened March 1 by Maj. Chas. S. Bromwell, U. S. Engineers, Milwaukee, Wis., fror building crib breakwater, crib and pile pier and concrete superstructure at Manistique Harbor, Mich., the bids received being as follows: (1) Muskegon Construction & Engineering Co. and Columbian Construction Co., Muskegon, Mich., (2) Hugo & Tims Co., Duluth, Minn.; (3) Robert Love & Co., Muskegon, Mich.; (4) Greiling Bros. Co., Green Bay, Wis.; (5) Burk, Smith & Nelson, Muskegon, Mich.; (6) Great Lakes Dredge & Dock Company, Chicago, Ill.:

Minnesota.

The Minnesota & Ontario Power Co., Warren Curtis, Chief Engineer, International Falls, Minn., is reported to have surveys underway at Kettle Falls for a new dam which is to be erected at an early date.

New York.

✣Bids will be received until 3 p. m., April 8, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction, including the drainage system, plumbing, pumps, etc., of the United States Barge Office, New York, N. Y., in accordance with drawings and specifications on file at the office of the engineer and superintendent, etc., United States Public Bldg., 727 U. S. Customs House Bldg., New York, N. Y.

✣Bids will be received until 3 p. m., March 15, by State Commission on Lunacy, Capitol, Albany, N. Y., for electric generating plant, for feeders and transformers, series outside lighting; motors and power house lighting at Hudson River State Hospital. T. E. McGarr is Secy. of the Commission.

The city of Buffalo, N. Y., F. W. Ward, commissioner of public works, will shortly call for bids for completing the Buffalo river dredging work, the new section carrying the work to the city line. The specifications on which bids will be invited will provide for about 4,000,000 cu. yds. of excavating.

Ohio.

Following bids were received Feb. 28 by Maj. H. Jervey, U. S. Engineer, Cincinnati, O., for constructing four locktenders' dwellings at Dam No. 37, Ohio River, Fernbank: Chas. Rosensteil & Son, Cincinnati, O., $23,448; D. Meinken, Cincinnati, O., $22,687; Ohio Building & Construction Co., Cincinnati, O., $26,619; Henry Fischer, Cincinnati, O., $26,372; West End Carpenter Shop, Cincinnati, O., $24,019; M. Marcus Building Co., Cincinnati, O., $26,012; McMiller & Taft, Cincinnati, O., $24,990; John R. Steele, North Bend, O., and Harry W. Balsley, Cleves, O., $25,903; Wm. Miller & Son, Cincinnati, O., $24,600; Chas. D. Keyser, Bellaire, O., $23,000; Fred H. Drucker, Sayler Park, O., $23,900. Fred H. Drucker also made an alternate bid of $13,866 on the work with certain items furnished by the U. S.

Oregon.

The Rogue River Electric Co., of Medford, Ore., expects to build a new hydro-electric plant this season. This work will include rock tunnel 800 ft. long and 8 ft. diameter, a great deal of rock excavation, concrete foundation, rock filled timber crib, etc. The company wishes to communicate with good construction firms who will handle this work on cost plus fixed sum basis. The plant will have a capacity of 20,000 hp. H. C. Stoddard, Medford, Ore., is Superintendent.

Pennsylvania.

✣Bids will be received until 3 p. m., April 10, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits, and wiring of the United States Postoffice at Connellsville, Pa.

⦿J. J. Williams Co., Inc., Chester, Pa., has been awarded contract by the city of Chester for the construction of a wharf at Market St.,

	(1)	(2)	(3)	(4)	(5)	(6)
155 cu. yds. No. 1 concrete in place, per cu. yd......	$10.00	$17.00	$15.00	$15.00	$14.00	$ 9.80
2,720 cu. yds. No. 2 concrete in place, per cu. yd.	8.00	12.50	13.00	12.00	11.00	9.75
Furnishing and driving 4,650 lin. ft. round [illegible] piles, per lin. ft.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.4[illegible]
Making and driving 133,000 ft. B.M. sheet piles, timber furnished by U. S., per M. ft.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Framing [illegible] ft. B.M. timber for [illegible] furnished by U. S., per M. ft. B.M.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Framing 45,000 ft. B.M. timber for pile pier, timber furnished by U. S., per M. ft. B.M.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] drift bolts and wire [illegible] spikes, per lb.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.05
13,650 lbs. wrt. iron or steel screw bolts and tie-rods, per lb.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.06
[illegible] per ton	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.90
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$84,1[illegible]

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

and a bulkhead at the foot of Edgmont Ave. The bid of the J. J. Williams Co., for the wharf was as follows: Piles of long leaf yellow pine and other construction in accordance with the specification, $32,045.84; Maryland or Virginia yellow pine, $29,904.37; additional long leaf yellow pine piles, $18.34, Maryland or Virginia piles $11 each; additional timber, $55 per 1,000 ft.; pile shoes, $3.75 each; additional reinforced concrete, $17 per cu. yd. The contract was awarded on Maryland of Virginia yellow pine [illegible] contract for the bulkhead was also awarded on Maryland or Virginia pine piling, the price being $9,996.

A bill has been introduced in the State Legislature calling for an appropriation of $1,500,000 from the State to the Department of Docks, Wharves and Ferries in Philadelphia. The bill stipulates that the money is to be expended for dredging the Delaware and the Schuylkill Rivers within the limits of the State and for the general improvement of the water front of Philadelphia, including the building up of the docks and the reclamation of the waste lands in South Philadelphia.

⊙The Raymond Concrete Pile Co. of New York and Chicago has been awarded the contract for placing Raymond concrete piles in the foundations of an elevated railway siding for the Cudahy Packing Co. at Philadelphia. J. E. Otis, Jr., architect.

Tennessee.

✣Bids will be received until noon, April 5, by Capt. Clarke S. Smith, U. S. Engineer, Memphis, Tenn., for furnishing and delivering seven steel barges. Official advertisement will be found elsewhere in this issue.

Texas.

✣Bids will be received until 1 a. m., March 21, by P. W. Guiney, constructing quartermaster, Fort Sam Houston, Texas, for furnishing and installing, complete and in working order, one compound or triple expansion pumping engine, capacity 1,000,000 gals. in 24 hrs.

⊙Advices from Beaumont state that a contract has been awarded to J. A. Andrews & Son to build a 6-in. pipe line from the Vinton oil field to Toomey station on the main line of the Southern Pacific railway, a distance of five miles from the Vinton field. Those behind the new pipe line company include C. L. Smith and George W. Norman of Beaumont; J. M. Abbott of Seguin and capitalists of Orange. The construction of the new line will give three lines out of Vinton, the existing pipe lines being owned and operated by the Gulf Refining company of Louisiana and the Producers Oil company.

Washington.

✣Bids will be received until 3 p. m., March 28, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction of additional rooms in the attic of the United States Postoffice, Court House and Custom House at Spokane, Wash.

Canada.

✣Bids will be received until 4 p. m., March 20, by L. K. Jones, Sec., Department of Railways and Canals, Ottawa, Ont., for supply and delivery of British Columbia or Douglas fir dimension timber and also for other lumber and timber, required for use of Rideau Canal for the year 1911 1912.

✣Bids will be received [illegible] March 10, by Secretary, School of Mining, Kingston, Ont., for the several trades works required in the erection and completion of the Nicol Building for the Governors of the School of Mining. Power & Son, Merchant's Bank Chambers, Kingston, are architects.

⊙The board of control of Winnipeg, Man., M. Peterson, secretary, has awarded the contract for the construction of a conduit system, including the following items: Specifications No. 63, conduit, 1911; specifications No. 64, construction of conduit runs, 1911, as follows: H. B. Camp Co., 217 La Salle St., Chicago, Ill., conduit, at $7.104 per duct ft.; G. M. Gest of Montreal, construction. The estimated cost of the entire work is $35,000. Smith, Kerry & Chace, Carnegie [illegible] Winnipeg, Man., engineers. Bids were opened Feb. 22.

The Dominion Department of Public Works, Ottawa, Ont., will call for bids shortly for the construction of a dam at the foot of Quinz Lake, about 18 miles distant from the head of Lake Temiskaming. Tenders will also be called this spring for the new dam at the head of Gordon Creek, which it is expected can be rebuilt from the present Lumsden estate dam, for a cost of about $5,000.

TRADE NOTES.

The Ohio Tractor Mfg. Co., Marion, O., has recently received [illegible] from the Sawyer-Massey Co., Ltd., of Hamilton, Ont., for [illegible] gasoline tractors.

James P. Sp[illegible] has opened an office in the New York Life Bldg., Kansas City, Mo., where he will act as agent for a general line of contractors' supplies, including Millburn lights, Inland steel reinforcing bars, Youngstown fireproofing, metal lath, etc.

The Iroquois Iron Works of Buffalo, N. Y., has just received [illegible] order for [illegible] steam rollers for [illegible] Manila. At the same time [illegible] government ordered [illegible] roller for delivery at Washington, D. C.

The Berger system of Reinforced Sidewalk Lights, manufactured by the Berger Manufacturing Company of Canton, O., were installed in the new Onondaga hotel in Syracuse, N. Y. The hotel is an 11-story building of brick and stone and is [illegible]. It was completed last year, Esenwein and Johnson of Buffalo being the [illegible] and Jas. Stewart & Company of New York general contractors. Sidewalk lights were installed in all of the courts.

Chas. T. Main, mill architect and engineer of Boston, Mass., has been retained by the Millville Manufacturing Co., of Millville, N. J., to revamp the power system of their cotton bleachery. The original equipment consisting of simple condensing engines driving line shafting and return tubular boilers is to be replaced by a non-condensing steam turbine and a battery of high-pressure water tube boilers. Induction motors will be used to operate the entire bleachery. The exhaust steam from the turbine is to be utilized for various bleaching processes for which live steam has heretofore been required. The contract for the turbine and electrical equipment [illegible] Co.

Messrs. Cammell Laird & Co., Ltd., steel workers and shipbuilders of [illegible] by the British Government for one of the new dreadnaughts—they are also building five other vessels [illegible] formed [illegible] company to handle their business in this country. This new corporation is known as Cammell Laird & Co., of New York, and its main office and warehouse will be in the four-story building just completed at No. 34 Cliff St., New York City. The company will occupy the entire building and will carry a larger stock than ever of English tool and high-speed steel. Cammell Laird & Co., Ltd., were among the first experimenters and developers of high-speed tool steel, and especial attention will be given by their American company to this branch of the business. Among their other specialties are nickel and chrome nickel steel for automobile parts, heavy forgings for ships, rolling mills, sugar mills, etc. The new corporation takes over the affairs of Cammell Laird & Co., Ltd., on this side of the water. The interests it represents include all the allied interests of the parent concern: The Cyclops Steel & Iron Co. of Sheffield, The Yorkshire Steel & Iron Works, the Grimesthorpe Ordnance, Steel Tyre & Spring Works, and the Shipbuilding Works at Birkenhead. Cammell Laird & Co., Ltd., have been established in this country for the past three years with headquarters at No. 25 Cliff St., in charge of Lionel Samuel, who has acted as their general agent. From the beginning they have carried a considerable stock of steel, not only in New York City, but in their branches in the United States and Canada. The business has outgrown its old quarters and the new building and the organ- [illegible] a necessity for its proper development. Leonard Munn, of Sheffield, England, is the president of the new company, Lionel Samuel its [illegible] Alexander Muir, who was the Canadian manager of the English company, treasurer and director.

[illegible]

1st and 2d Dists., U. S. Engineer Office
Room 20, Custom House, Memphis, Tenn.,
[illegible]
contractor's barges will be received at
[illegible]

BRIDGES.

Sealed [illegible] the Board of County Commissioners of Clay County, South Dakota, up to 2 p. m., March 22, 1911, at the office of the County Auditor of Clay County, in Vermillion, S. D., for the construction of eight (8) steel or concrete highway bridges for the Vermillion Valley Ditch No. 1, in Clay County, South Dakota.

Requirements and forms of proposals may be obtained at the office of the County Auditor of Clay County, South Dakota.

Each bid must be accompanied by a certified check for one thousand dollars ($1,000), payable to the order of the Board of County Commissioners, of Clay County, as a guarantee that the bidders will, if successful, promptly execute a satisfactory contract and furnish a bond of the sum of ten thousand dollars ($10,000) for the faithful performance of the work. All bids shall be plainly endorsed, stating that the bid is for the construction of bridges over the Vermillion Valley Ditch No. 1.

The right is reserved to reject any or all bids.

THEODORE ANKER,
County Auditor.
Clay County, South Dakota.
Dated Vermillion, S. D., Feb. 10, 1911.

REINFORCED CONCRETE BRIDGE.

Bids will be received by the City of Ypsilanti, Mich., for a single arch reinforced concrete bridge, at Congress street, in accordance with plans and specifications on file in the office of the City Clerk and the office of Benj. Douglas, Consulting Engineer, 814 Ford Bldg., Detroit, Mich.

Bids to be sealed and in the hands of the City Clerk, Ypsilanti, Mich., on or before 10 p. m. March [illegible], 1911.

Each bid to be accompanied with a certified check in the sum of $1,000.00.

A good and sufficient bond for the faithful performance of the contract will be required of the successful bidder. Also a bond indemnifying the city against all suits, and claims, for labor and material.

Right to reject any and all bids reserved.

Aldermen
FRANK A. NORTON,
ARTHUR AMENT,
WM. McDERMOTT,
A. G. HUSTON,
E. A. MELLENCAMP.
Committee on Bridges.
FRANK JOSLYN, City Clerk.

TENDERS FOR RAIL AND TIES.

CITY OF TORONTO
CIVIC CAR LINES

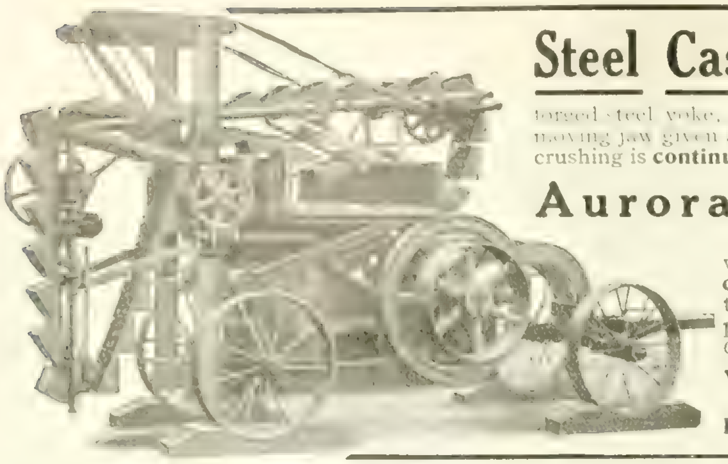
Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto Canada, up to noon on Tuesday, April 4, 1911, for delivery of thirteen hundred [illegible] rail, 60-lb. section, also thirty thousand (30,000) untreated wood ties, white cedar [illegible]

[illegible] plainly marked on the outside as to contents.

[illegible] of the City Engineer, Toronto.

The lowest or any tender not necessarily accepted.

[illegible]
Chairman, Board of Control.



Steel Castings and No Lost Motion

forged steel yoke, cross bars on yoke remove all strains from main frame, moving jaw given a compound oscillating and reciprocating motion so that crushing is **continuous,** are features of the

Aurora Steel Rock Crusher

Its compact form combines great strength with light weight, making it very portable and **specially adapted for contractors' use.** Strongest and most durable crusher on the market combining maximum product with minimum power. Adjustable to various sized stone. *Get our Special Crusher [illegible]*

Western Wheeled Scraper Co.

Earth and Stone Handling Machinery **Aurora, Ill.**

TIP CARS FOR CONTRACTORS

(Hunt's "Industrial" Patent)

Easy to Load

Light and Smooth Running

TIP CAR

THIS car is built with the body hung between the wheels and is nearly a foot lower than the ordinary tip car making it much easier to load. Six sizes, 12 to 40 cubic feet, kept in stock.

Write us for Further Information and for Bulletin.

C. W. HUNT COMPANY
WEST NEW BRIGHTON, NEW YORK
New York City, 45 Broadway
Chicago, 1616 Fisher Building
Atlanta, Ga., 1607 Rhodes Building
Richmond, Va., State Bank Building
San Francisco, 865 Monadnock Bldg.

CONCRETE.

Sealed proposals will be received at the office of the undersigned in the City of Bozeman, Mont., until 5 o'clock p. m. on the 16th day of March, 1911, for the laying of concrete on the side slopes and bottom of the enlarged reservoir of the Bozeman City Water Works, amounting to about [illegible] square yards, in accordance with the plans and specifications therefor on file at this office.

Blank "proposals," copies of "specifications" and instructions to bidders may be obtained of the City Clerk or of the City Engineer.

Each bid must be accompanied by a certified check for two hundred dollars ($200.00) upon some bank in Bozeman, Mont., payable to the City Treasurer of said city, which check will be forfeited to the said city in case the successful bidder shall fail to furnish satisfactory bond and enter into the proposed contract within ten (10) days from the date of notification of award.

The City of Bozeman reserves the right to reject any and all bids.

A. M. BRENDENBURG,
City Clerk,
Bozeman, Mont.

U. S. ENGINEER OFFICE, Room 325, Custom House, New Orleans, La., Feb. 15, 1911.—Sealed proposals for extending the jetties at Southwest Pass, Mississippi River, will be received at this office until 11 a. m., March 17, 1911, and then publicly opened. Information on application. LANSING H. BEACH, Lt. Col., Engrs.

WATERWORKS.

Notice.

Sealed bids will be received at City Hall in Nevada, Iowa, until 7:30 o'clock p. m., March 20, 1911, for the construction and completion, ready for operation, of extensions to the water works system, comprising about 1,170 feet six-inch mains, 5,530 feet four-inch mains, 18 hydrants, one six-inch and three four-inch gate valves and fittings as required.

Plans and specifications on file in my office.

City Council reserves the right to reject any or all bids.

R. A. DAVIS, City Clerk.

SANITARY AND SURFACE DRAINAGE SEWERS.

Sealed bids will be received by Oscar B. Bonar, City Clerk, until the twenty-first (21) day of March, at the hour of 10 o'clock a. m., 1911, and then publicly opened and read, for the furnishing of all materials and laying complete, including trenching, backfilling, etc., 26 miles of sewers, varying in size from 6-inch to 36-inch in diameter, together with 420 manholes, 6 lampholes, 8 flush tanks, 115 inlets and catch basins, and 22 tons of cast iron pipe.

Bids will be received for both vitrified pipe and monolithic concrete for all sewers, 24 inches in diameter and larger.

The depths of trenches vary from 5 feet to 32 feet.

Specifications, instructions to bidders and blank forms of bidding sheets may be obtained, and plans and profiles may be seen at the office of Oscar B. Bonar, City Clerk, Moundsville, W. Va., or at the office of Chas. E. Collins, Consulting Engineer, Drexel Building, Philadelphia, Pa.

All proposals shall be made on the blank forms furnished by the city for this purpose and shall be accompanied by a certified check upon the First National Bank of the City of Moundsville, W. Va., and drawn to the order of Oscar B. Bonar, Clerk of the City of Moundsville, W. Va., for the sum of one thousand dollars ($1,000).

The City Council reserves the right to reject any and all bids.

OSCAR B. BONAR, City Clerk.
J. M. WILLIAMSON, Mayor.
Moundsville, W. Va.

MISSISSIPPI RIVER COMMISSION, 1st and 2d Districts, U. S. Engineer Office, Custom House, Memphis, Tenn., March 7, 1911.—Sealed proposals for constructing and delivering seven (7) steel barges will be received at this office until noon of April 5, 1911, and then publicly opened. Information on application. CLARKE S. SMITH, Capt., Engrs.

PAVING.

Memphis, Tenn., Feb. 28, 1911.

Bids will be received by the City of Memphis until noon, Tuesday, March 14, 1911, for paving as follows:

Florida St., from Trigg to Kerr, brick, 3.85 sq. yds.

Miss. Blvd., from Trigg to Kerr, brick, 4.790 sq. yds.

Barksdale St., from Union to N. C. & St. L., tar macadam, 10.700 sq. yds.

Cooper St., from Central to Parkway, tar macadam, 28,084 sq. yds.

Walker Ave., from Miss. to College, tar macadam, 6.320 sq. yds.

Oliver Ave., from Rembert to Cooper, tar macadam, 3.735 sq. yds.

Dunlap St., from Poplar to Jackson, tar macadam, 10.000 sq. yds

College St., from Parkway to Kerr, tar macadam, 1.275 sq. yds.

McNeil St., from Union to Jefferson, tar macadam, 3.850 sq. yds.

Bellevue Blvd., from Autumn to Jackson, tar macadam, 7.100 sq. yds.

Springdale St., from Madison to Central, tar macadam, 9.625 sq. yds.

Jefferson Ave., from Main to Lauderdale, wood block, 10.000 sq. yds.

Specifications may be had from J. H. Weatherford, City Engineer.

ARTESIAN WELL.

Sealed proposals will be received by the Regents of Education up to 2 p. m., March 10, 1911, at the office of the Secretary of the University, in Vermillion, South Dakota, for furnishing all materials, tools and appliances, and drilling and constructing an artesian well, approximately 1,500 feet deep, upon the campus of the State University, in the City of Vermillion.

Specifications and forms of proposals may be obtained at the office of the Secretary of the University of South Dakota.

Each bid must be accompanied by a certified check for five hundred dollars ($500.00) payable to the order of Regents of Education, as a guarantee that the bidder will, if successful, promptly execute a satisfactory contract and furnish a bond in the sum of five thousand dollars ($5,000) for the faithful performance of the work. All bids shall be plainly endorsed, stating that bid is for construction of well.

The right is reserved to reject any and all bids.

Dated Vermillion, S. D., Feb. 3, 1911.

IRWIN D. ALDRICH,
Secretary, Regents of Education.

All directions are to be made to C. A. Sloan, Secretary, Vermillion, S. D., and properly marked on outside.

STORAGE DAM.

Salt Lake City, [illegible]

Sealed proposals will be received by the Pacific Reclamation Company, at the office of their Consulting Engineer, George M. Bacon, [illegible] Ave., Salt Lake City, Utah, until noon of Saturday, April [illegible] 1911, for [illegible] Storage Dam [illegible] of [illegible] Nevada.

The dam will be of earth and rock fill with a reinforned concrete facing on the up-stream side. The principal quantities are:

[illegible] cu. yds. [illegible]

[illegible] cu. yds. [illegible]

71,000 cu. yds. earth embankment.

6,000 cu. yds. dry rubble wall.

[illegible] cu. yds. [illegible] concrete.

85,000 lbs. steel reinforcing.

A certified [illegible] must accompany the bid, and a bond of $15.000.00 will be required for the faithful performance of the contract.

Form of proposal, contract and specifications may be had by applying to George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah.

PACIFIC RECLAMATION COMPANY,
Joseph Gutman, President.
George M. Bacon,
Consulting Engineer.

Washington, D. C., [illegible] 1911.

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Red Oak, Iowa, [illegible] 1911.

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RECENT RETAINING WALL PRACTICE, CITY OF PITTSBURGH, by Charles M. Reppert, Division Engineer, Bureau of Construction, D. P. W., City of Pittsburgh
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Standard Tests for Drain Tile.

It is accepted engineering practice that construction materials should be purchased on specifications. A notable exception to this practice is the purchase of clay or cement drain tile. This material, like all others used in construction, is sometimes poorly made. Much poor quality drain tile has been and is still being used. It must continue to be used until some means are adopted which will enable the user readily to determine it and to throw it aside. Such means are provided only by purchase of drain tile on specifications embodying tests for quality.

In another section of this issue we publish two articles describing simple machines for testing drain tile. These articles both argue the necessity of standard specifications and tests and one of them gives a draft of a proposed specification. The move for standard specifications has gone much farther than this. The American Society for Testing Materials has authorized the appointment of a special committee to study the subject thoroughly and to report a set of specifications and tests for drain tile. This committee may be expected to follow the general practice of the society and to seek the co-operation of other societies of engineers and manufacturers in its work. This co-operation should be afforded and both tile makers and drainage engineers should see that the personnel of the committees by which their societies are represented shall be of their best men.

It has been our purpose [illegible] a comparison here between cement and clay tile for drainage, but recognition of the rivalry between the two materials is necessary, for it presents one of the strongest of arguments for standard tests. Cement drain tile have come well into the field only within a few years. Their advent has resulted in trade rivalry which has not only been unusually keen but which has been to a degree vicious with misrepresentation. The outcome has been that the purchaser has bought one or the other kind of tile on salesmen's arguments or has simply followed tradition and chosen the material familiar to him. He has had no guarantee that the material he chose was the better of the two or even that he got a good quality of tile of the chosen material. This guarantee will come with the general adoption of a standard specification.

As the newer material, with its success to demonstrate, cement tile has everything to gain by the adoption of standard tests. This point is well stated in a recent discussion before a leading association of cement tile manufacturers as follows:

According to the best available information there were made last year in this country some 124,000,000 cement tile, 12 in. and less in size, valued at approximately $4,000,000. Certainly the expenditure of this sum annually justifies the user in insisting upon some guarantee of satisfactory quality. The general practice of purchasing cement drain tile on a specification would benefit the manufacturer who turns out a first-class product and free him from the unjust reflection which the inferior product of the unscrupulous or unqualified manufacturer throws upon his business. It would relieve the drainage engineer of a lot of responsibility, because the quality of the tile would not be left to his judgment, but would be a matter of satisfying certain definite requirements. A set standard of quality for cement drain tile would reduce the failures to a minimum and leave nothing upon which the other tile interests could base their claim that cement tile is not adapted for drainage purposes.

Deep Pneumatic Caisson Foundations.

We commented last week on the seemingly deep caisson work accomplished in building one of the pier foundations for the new Mississippi Bridge being built across the Mississippi at St. Louis. Our comparison of this foundation with other deep pneumatic caisson foundations was based on figures of depth given in an article by the engineer in charge of the work. We are now informed that the depth of 108.67 ft., noted, was the depth from surface to bed rock and not the depth of immersion, which was somewhat greater. The facts are given as follows in a letter from Mr. S. W. Bowen, the author of the article mentioned:

> I would [illegible] from bedrock to the surface of the ground on which the caisson was started. The ground at this point was afterward submerged by a rise of the river [illegible] air chamber. The immersion or distance from the cutting edge to the water surface when the last gang left the air chamber was 113.5 ft., the calculated pressure for this immersion being 49 [illegible] per sq. in. [illegible] gauge [illegible] at the [illegible] Under this pressure the men worked 2 hours per day, 1 hour on and 5 hours off, the actual time in the working chamber being about 30 minutes. The elevation of the bed rock on which Pier IV is founded is 70.8 ft. Bridge Datum, which is 2.2 ft. lower than the deepest pier of the Eads Bridge.

It would appear from the above figures that the foundation referred to is probably the deepest pneumatic foundation ever built.

Costs of Reinforced Concrete Street Lamp Posts.

We publish in another section of this issue the itemized cost of 43 concrete street lamp posts erected in Lincoln Park, Chicago. The very tidy sum of $165 each given as the cost of these posts will be remarked. Lest it also should be misleading it will be noticed that this $165 includes not only the cost of the posts themselves and of their erection, wiring and lamp equipment, but also the cost of the conduit transmission line along the street from lamp to lamp. We are also told that the work of installation was performed under conditions which made the labor costs unusually high. The prices paid for materials were obviously high.

The item of general interest is the cost of the posts, for, obviously, the lamp equipment, transmission line work, etc., may be of any character and cost chosen and will be closely the same whether concrete or iron posts be used. The parts referred to above cost $12 each cash and furnished ready for erection. The illustration shows the above ground portion of the post only; below ground there is an extension 12 inches square and about 5 ft. long. The reinforcement consists of four corner bars starting just below the grill, which sets over the post top and reaching nearly to the bottom of the base and of four other bars which extend up the base and swing outward to curve up into the ribs forming the foot of the shaft. The 2-in. gas pipe which runs the full length of the post at the center is further reinforcement. The curved ribs at the bottom and the entire outer shell of the shaft are of rich crushed granite concrete and the inner core and the base are of gravel concrete. In molding the granite concrete is placed by plastering the inside of the mold with a trowel, after which the reinforcement is placed and the core concrete tamped in. When set, the surface of the shaft is finished by etching with acid.

We have been somewhat particular in describing the post construction, because it is obviously not a cheap construction. As will be seen, the labor cost runs nearly $5 per post. This is doubtless due largely to the requirement of an outer shell of special mixture and to the perfection of workmanship demanded. For most conditions a much cheaper construction would serve, and we believe that generally lower costs would be possible throughout.

It will be noted that the cost of $12 given is simply the cost at the molding yard. The figures which we publish do not permit of giving the cost of transportation and erection. As the posts weigh a full ton, transportation will obviously be a considerable item and so will be erection.

In connection with the above work note may be made of some similar costs of concrete lamp posts or rather arc light poles constructed for the Sault Ste. Marie canal.* These poles were 11 ins. square at the bottom, 6 ins. square at the top and 35 ft. long with champered corners. The reinforcement consisted of 12 longitudinal rods and a 1¼ in. gas pipe was molded in the center of the pole. The concrete was mixed 1⅛ bbls. of cement, 7 cu. ft. river sand and 14 cu. ft. 1-in. crushed limestone and was finished by scouring with a sandstone or carborundum brick. The contents of the pole were 15 cu. ft. [illegible] 42 [illegible]

[illegible] 1911.

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[illegible] To erect each pole with something like a cubic yard of concrete around its base cost $24.11. This does not include transportation [illegible] per pole. Wiring and fitting cost $25.67 more per pole, making the total cost in place $89.88 per pole.

[illegible] of the big pier of the Ontario Exploration Co. at Kingston, Ontario, Can. The company is anxious to [illegible] in the season of navigation as possible, so that ore from the Wilbur mines may be shipped. Advantage is being taken of the ice to begin the work.

Reduction in Pullman Charges.—In accordance with an order issued by the New York Public Service Commission, the Pullman Company has revised its tariff of sleeping car charges within the state of New York. Where the lower berth rate is $1.50, the rate for the upper berth between the same points will be $1.25. Where the lower berth rate is $1.75 or more, the rate for the upper berth between the same points will be 80 per cent of that for the lower berth. No change is to be made in the price for lower berths unless such change is in the nature of a reduction from the rate now in force. The result of this order reduces the charge for upper berths fom $1.50 to $1.25, from $2.00 to $1.60, and from $2.50 to $2.00. These reductions in rates became effective Feb. 1.

Protection for Workmen in the Hoosac Tunnel.—Because of the smoke emitted by locomotives operating through the Hoosac tunnel of the Boston & Maine R. R., the workmen who are installing overhead equipment for electrical operation work in the tents set up on the roofs of cars. They are supplied with fresh air by compressors taking their supply from a point near the floor of the tunnel. The workmen protect themselves with large hats and wear goggles; and before going into the tunnel they rub their faces with grease paint. The conductor in charge of the train maintains constant communication by telephone with the train despatcher's office at North Adams.

CONCRETE AND REINFORCED CONCRETE SECTION

Cost of Constructing a Small Concrete Dam.

The accompanying view and sketch show a concrete dam some 70 ft. long and 4 ft. high built at East Earl, Pa. The sketch shows the essential dimensions and it will be noted that the concrete structure is hollow, is divided into compartments by interior cross walls of dry masonry and that the compartments are filled with gravel. The concrete used was a 1 : 2½ : 5 mixture plastered with a 1 : 1 mortar. The amount of concrete is not recorded but estimating from the sketch and from the amount of concrete used it was about 40 cu. yds. The cost of the dam, which was built with day labor by the owner, Mr. H. L. Bauman, is given by him as follows:

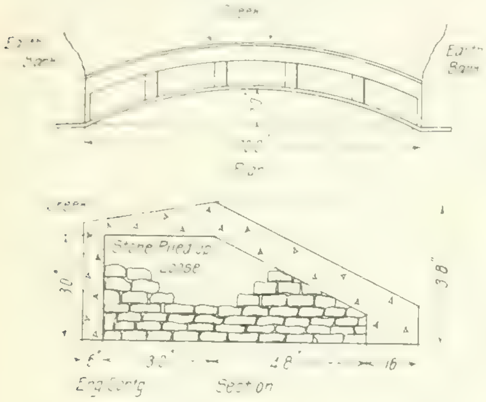

Fig. 1—Plan and Section of Concrete Dam.

Item.	Cost.
Hauling gravel (3 men 3 days at $1.75)	$ 15.75
Hauling gravel (2 men and team 1 day at $3.00)	6.00
Hauling gravel (2 men, horse and cart, 3 days at $2.25)	13.50
Screening sand from gravel (1 man 3 days at $1.75)	5.25
Washing gravel (6 men 1 day at $1.75)	10.50
Pump and pumpman (1 day at $5)	5.00
Cofferdam (3 men 4 days at $1.75)	21.00
Cofferdam (2 men, horse and cart, 2 days at $2.25)	9.00
Excavation (6 men 2 days at $1.75)	21.00
2,000 ft. B. M. from lumber at $20 per M.	40.00
Delivering lumber	5.00
Setting forms (2 men 2 day at $1.75)	7.00
Placing concrete (7 men 3 days at $1.75)	36.75
2 hp. gasoline mixer engine 3 days	3.00
Removing forms and cleaning (two men 1 day at $1.75)	3.50
Plastering (4 men 1 day at $1.75)	7.00
Pump 20 hrs. at 40 cts	8.00
Charges on borrowed pump	7.50
10 tons Atlas cement at $8 delivered	80.00
Total	$304.75

A [illegible] was [illegible]

Belt Conveyor Plants for Handling Concrete Materials.*

A concrete plant on the large [illegible] or [illegible] will work, must have a capacity of from 20 to 30 cu. yds. per hour, so that one man's time does not materially affect the concreting cost, say not more than 1 ct. per cu. yd. Therefore, as it is easy to increase the handling or depositing capacity by adding more cars or more chutes, the problem usually is, how to handle the material to the mixer, so as to absolutely maintain the figured or theoretical capacity of the whole plant.

Without dwelling on the faults or unreliability or wheelbarrows, bucket conveyors or apparatus which hoists, wagons, or small cars, we will say that experience, gained from the operation of three comparatively large plants, shows the canvas conveyor belt to be the best and most flexible method for bringing materials to the mixer cheaply, and as needed. (Understand that in this we are considering bridge work, not buildings.) Such a conveyor is practically fool-proof, and its simple adjustments, together with the greater advantage of being able to increase its speed (and consequent capacity) in only a few minutes' time, make it almost ideal.

One of the plants referred to was that of the Colorado River Bridge at Austin, Tex. The conveyor consisted of a main belt, about 400 ft. long, in a fixed position, and a branch belt, about 250 ft. long, pivoted onto the main belt, the branch belt swinging through a complete circle, in order to reach the necessary amount of material. It carried gravel, sand and boulders which were washed, screened, crushed and deposited in their proper bins above the mixer. Eighteen men at $1.50 per day loaded onto this belt the raw materials for 200 cu. yds. of concrete per day. The cement was carried to the mixer from the shed by another belt, about 100 ft. long.

To handle the concrete to the bridge there was a double track tramway above the arches, with rotary dumping cars. The concrete was transported a maximum distance of about 800 ft. from the plant, the tracks having a fall of 7 ins. in 100 ft., which is sufficient. This track has been used again on a structure 1,900 ft. long, with the plant in the center.

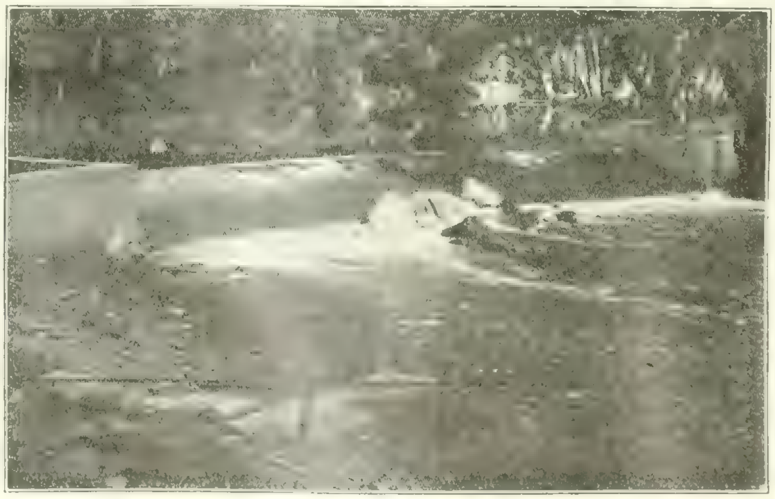

Fig. 2—View of Concrete Dam.

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[*] Extracts from a paper by H. M. Cryder, St. Louis, Mo., before the National Association of Cement Users.

Water Required to Reduce Quicklime to Paste and to Cream.

In considering the matter of coating surfaces in various ways, the committee on Treatment of Concrete Surfaces of the National Association of Cement Users, Mr. L. C. Wason of the Aberthaw Construction Co., chairman, had conducted a series of experiments in order to determine the relation between hydrated lime and quicklime in Portland cement mortars and concrete, a series of experiments were conducted upon samples of quicklime obtained from local dealers in lime. These experiments consisted of adding sufficient water to weighted quantities of quicklime to produce a paste. In another series of experiments sufficient water was added to slake the lime and reduce it to the consistency of cream, or to such a consistency that when a stick is immersed in the lime, then withdrawn, the cream will drip from the end of the stick. This seems to be a very definite consistency. It is easily determined and seems to be a good consistency for the purpose.

It was found that the amount of water required to make a paste varied from 54 to 84 gals. of water per barrel of quicklime of 300 lbs. The following represent the variations on eight samples of lime tested, the individual figures running: 54, 59, 69, 71, 73, 73, 75 and 84 gals. of water per barrel of lime. It is apparent from the above that five samples out of the eight required between 69 and 75 gals. per barrel, and that 72 gals. per barrel would be a very fair average for these five samples.

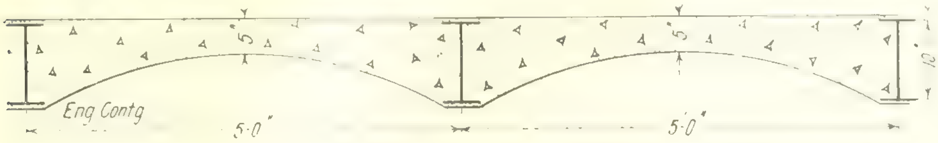
To reduce these same samples to cream required a total of from 100 to 234 gals. of water per barrel of lime, the individual figures being as follows: 100, 138, 149, 159, 161, 230, and 234. It is interesting to note that the lime which required the least water to make a paste, namely 54 gals., required the most water to reduce the lime to cream, namely 234 gals.

These great variations in quantities of water required to reduce quicklime to a paste or cream render it difficult to draw a specification that would apply to any lime. It would seem therefore that such a specification can only state that where quicklime is used in place of hydrated lime ¾ of the quantity of quicklime shall be used. This is on the basis that 100 lbs. of quicklime will produce 135 lbs. of hydrated lime.

Cost of Concrete Arch and I-Beam Cost of Power House Floor.

The following is the itemized account of the cost of a floor built in a power house in Lincoln Park, Chicago, in 1909.

The floor was 20x25 [illegible] and was made of 10-in. I-beams, spaced 5 ft. on centers. The concrete was 11 ins. thick at the beams and was arched between the beams so that the thickness of the concrete was 5 ins. at the crown of the arch. The area of the floor was 500 sq. ft., but a stair space reduced the area of concrete placed to 475 ft. The costs follow:



Concrete Arch and I-Beam Floor.

	Totals	Per Sq. ft
Labor		
2 days engineering at $3.70	[illegible]	$0.0156
1 day superintendent at [illegible]	[illegible]	0.0069
15 days labor at $2.... ...	[illegible]	0.0631
13½ hrs. finishers at 28 cts	[illegible]	0.0079
64 hrs. carpenters at 60 cts	38.40	0.0808
4 hrs. mason	[illegible]	0.0053
Total	[illegible]	$0.1796
Materials:		
Lumber	[illegible]	$0.0526
10-in. I-beams .	[illegible]	0.1453
17½ bbls. cement at [illegible]	[illegible]	0.0479
10 cu. yds. gravel at $1.65.........	16.50	0.0347
6 cu. yds. torpedo sand at $1.35..	8.10	0.0170
Total	[illegible]	$0.2575
Grand total	[illegible]	$0.4371

Conditons Affecting the Choice of Type of Highway Bridges—The Economics of Concrete.*

The duty of the municipality with respect to its bridges is in effect that of a business corporation which is called upon to provide for the public safe and perpetual facilities for the passage of our streams at a reasonable annual cost to its shareholders, in this case, the public themselves. There should be the same effective management as characterizes a high-class private enterprise, and not only should there be the greatest possible amount of return realized on the money invested in the form of service to the people, but provision should be made for adequately meeting the needs of those who will make use of the highways in the future as well as at the present.

This undertaking on the part of a municipality is one of great importance. Many conditions surround the problem and affect the final decision as to the type of structure and the manner of carrying on the work, and since a bridge costs many times more than an equal length of roadway and its construction requires a higher degree of skill and is always attended with more difficulty and a greater element of risk the necessity of going carefully is evident. With the aim of affording some assistance to municipal councillors and bridge commissioners who have the general direction of the bridge work in their municipalities, the speaker proposes to discuss briefly the various conditions affecting the character of the investment of public money in highway bridges. Some typical cases with which the municipal bridge commissioner has frequently to deal with will be given special consideration.

Bridge projects generally involve a consideration of the following questions:

(1) The availability of funds for the project in hand

(2) The relative first costs of various types of bridges for the situation in mind.

(3) Probable future changes in the traffic requirements of the bridge.

(4) The relative length of life of various classes of bridges.

(5) Relative maintenance charges on various types of bridges.

(6) The provision of a structure of pleasing appearance as well as one possessing strength and permanence.

Availability of Funds.—The solution of any bridging problem must always be largely determined by the amount of money available for the constructing of the particular bridge in question. In a sparsely-settled and undeveloped region where the municipal revenues are small, but where certain bridges are sorely needed, or even in an urban municipality where extensive work must be undertaken and but little money is available, it would be unwise to inconvenience the people and retard the development of the community by deferring the construction of bridges until such time as permanent structures could be built. Sound judgment would demand the erection of comparatively cheap bridges to last for a limited term of years and then be replaced by more durable structures. An illustration of this is to be found in the case of a certain Canadian city where a long and high viaduct is required for the proper utilization of its railway facilities, but where the great difficulty of financing the scheme can only be overcome by constructing a comparatively light steel bridge with a wooden floor and then rebuilding and strengthening it when the people have come to appreciate the great value of the service rendered and can no longer do without it. The folly of saddling a community with an expense which it is not at present in a position to bear is apparent to all, but it may be said that the opposite mistake of constructing light, cheap bridges where permanent ones could be afforded and would prove a much more profitable investment, is only too common.

Relative First Costs.—Naturally the question which looms up largest to the Roads and Bridges Committee in its consideration of a given project is the amount of immediate outlay of funds required—that is the first cost. Unfortunately this element of the investment is often the only one given any consideration, although in the case of well-to-do municipalities such a short-sighted policy is obviously very poor business. A broad view of the problem would disclose some features of quite as great importance as the initial expenditure.

So many factors enter into the determination of the relative costs of different types of bridges that it is impossible to state figures which can be used for any other set of conditions than those assumed in preparing such statements [illegible] procedure [illegible] municipality to follow if it wishes to secure reliable information as to the relative costs of different types of bridges for a given crossing is to employ an engineer who is able to thoroughly investigate the particular situation and prepare accurate comparative estimates of cost, taking into account all the local conditions, prices of material, labor, etc. The following observations concerning the relative costs of different types of highway bridges for Central Ontario may prove of interest for comparative purposes and possibly of some value to those who have to do with bridge work in other portions of the province where similar conditions obtain.

So seldom is timber now used for highway bridge construction that no consideration will be given to its use for entire bridges, but since the question of building bridges with timber floors instead of those with concrete floors is sometimes brought up, a few words with respect to the latter may not be amiss.

Bridges with timber joists and flooring are, of course, only practicable for comparatively light floor loads, such as a heavily-laden wagon or a threshing engine of 7 or 8 tons weight. For 10 and 15-ton road rollers which weigh when carrying their full supply of fuel and water about 11½ and 16½ tons respectively, a wooden floor is expensive to construct and maintain since the wooden joists must be placed close enough together to make practically a solid wooden floor from 12 to 15 ins. thick. Assuming traffic light enough to warrant the consideration of a bridge with wooden joists and floor plank, the cost of the superstructures (i. e. everything above the abutments and piers) of steel bridges with wooden floors would be from 50 to 60 per cent of the cost of the superstructures of steel bridges with concrete floors. It should be pointed out, however, that this comparison of cost is not wholly just to the latter type of bridge for the reason that the advantage of its employment does not arise for such light traffic. A small additional expenditure would enable it to accommodate a 10-ton or a 15-ton roller, whereas the bridge with a wooden floor could be made to carry heavy concentrated loads only at considerable expense. If the substructure, or abutments, were included in this comparison, the total cost of complete steel bridges with wooden floors and concrete abutments would be 70 or 80 per cent of the cost of similar structures with concrete floors. The great advantage which the lighter structure possesses in first cost therefore largely disappears when the entire bridge is taken into consideration.

A comparison of the first costs of steel bridges carrying concrete floors and all concrete bridges is of interest, but it should be clearly understood again that these observations do not apply to situations where the local conditions and unit costs are materially different from those in mind in making the comparison. Since concrete is a material possessing a high compressive resistance and is of comparative low cost in most parts of Ontario, it is to be expected that in certain forms of structures where it could be extensively employed to take compressive stresses it might reduce the cost of construction below that holding for steel bridge work. The structures in which it may, in general, be economically employed are viaduct posts or bents, beam or girder spans and arches. Thus, in the design for the bents of a steel viaduct with the roadway on an average 48 ft. above the level of the ground, it was found by the speaker's firm that the steel trusses could be supported on concrete bents for 70 per cent of the cost of steel bents. Short girder spans can frequently be constructed of concrete for 10 or 15 per cent less than of steel with concrete floors, especially if the deck type, that is, where the girders lie wholly underneath the floor. In this case the floor slab performs the double service of transferring the superimposed load to the main girders and of acting as the compression flange for these girders. On account, however, of the fact that the volume of concrete capable of carrying a given load weighs over seven times as much as the volume of steel required to perform the same service, the weight of girder spans becomes very great when they exceed about 50 ft. in length and they can no longer be successfully built in competition with steel. The relative costs of steel bridges with concrete floors and concrete arches are to a large extent determined by the character of the foundation materials encountered. If the foundation bed is of soft clay or sand, the special treatment necessary before an arch can safely be built will generally offset any advtnage in first cost which the arch might have over a steel span. Assuming that no piling is necessary in either case, however, and also assuming that sufficient rise is available for an arch, the latter form of structure can often be constructed at no greater cost than a steel bridge of the same capacity. There the length of the span much exceeds 100 ft., the advantage in first cost is generally with the steel structure, though it is but small and the bidding may often result in a lower price for the concrete bridge.

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*From an address delivered before the Ontario Good Roads Association, Toronto, March 1, 1911, by C. R. Young, A. M. Can. Soc. C. E., of Barber & Young, Bridge and Structural Engineers, Toronto.

Increased Traffic Requirements.—The growth of a community and the reaching out of our towns and cities into the country will, because of the increased traffic demands, often seriously overtax our highway bridges unless they have been built for the future as well as for the present. While heavier road rollers than are now in common use may become quite common, the loading to be most feared in the future is the heavily-laden motor truck. These vehicles are particularly trying on the floor system of a bridge because of the large portion of the load which is concentrated on the rear axle, and since motor vehicles weighing when loaded anywhere from 15 to 40 tons will probably be in common use within a few years, it is seen that the investment of the public money in highway bridges should be to a large extent governed by the future probable traffic of the road. A form of structure which is well suited to resist these increased concentrated loadings is the earth-filled concrete or masonry arch. The kind of loading which taxes this form of arch most severely is a uniformly distributed load covering either a portion of the structure or the entire bridge, depending upon the part of the ring under consideration, and the effect of a 10 or 15-ton roller is ordinarily trifling in comparison with that of the uniform load of 100 lbs. per sq. ft. generally assumed in the design of arch bridges for country highway traffic. For this reason, most well-constructed spandrel-filled arches, except those under about 40 ft. in span, can support heavier rollers or trucks than are in common use at the present hime.

In addition to the growth in weight of the traffic, there is also the matter of the increased width of roadway and the provision of sidewalks which may be required in the case of bridges in urban localities or those which from the growth of population may become town or city bridges.

Length of Life.—The length of life of a bridge may be determined by its destruction by accident or by the gradual deterioration or corrosion of the material and the loss of rigidity due to the wear and the breaking down of the joints. In the case of structures composed wholly or partially of wood, the liability always exists of either total or partial destruction by fire. Structures of all types may also be subjected to the pressure and scour of flood waters, and the undoubted ability of a bridge to resist such action contributes a valuable element of certainty to the investment. In soft soils the use of piles, although they increase the cost of the structure considerably, constitutes a justifiable insurance against accident, for the majority of cases of bridge failures due to floods have been due to the short-sighted policy of attempting to do without piling where is was unquestionably necessary. An all-concrete bridge because of its great weight possesses greater immunity from destruction by floods than a steel structure, and if it be built on proper foundations no harm is at all likely to result from flood waters, since it is able to resist water pressure quite as effectively as a dam of the same height with an opening through it.

The length of life of timber in bridge floors varies greatly with the traffic, being as short as a year or two in the case of city bridges carrying a dense traffic and as much as seven or eight years for some country highway bridges which are but little traveled and where the floors are in a dry condition most of the time. Probably the average term of life reached by floor planking and wooden joists in highway bridges in this province would be about five years.

Some steel bridges have been in general use only 15 or 20 years; the length of life of steel when exposed to the elements is conjectural, and must be based on the durability of the older and similar material—wrought iron. A number of fairly old iron bridges are in existence in the province, and give evidence of doing duty for some time yet. One of these is the Hunter St. bridge, Peterborough, built in 1875, and two others built in 1877 across the Grand River at Paris, Ont. It must be admitted, however, that steel is not as satisfactory a material as wrought iron in resisting corrosion, and therefore a shorter life under service is to be expected of it. However, since wrought iron bridges in this country have defied the elements for from 30 to 40 years with no very serious loss of section, it seems probable that steel structures, if given a fair degree of care in maintenance, will be serviceable for a period of 50 years.

Concrete, like steel, is a material which has had only a few years of extensive use in this country in bridge construction, and its length of life is also a matter of conjecture. In other lands, ***plain*** concrete has been employed as a material of construction in important works for upwards of 2,000 years. In ancient Rome, concrete bridges and domes built at the beginning of the Christian Era are still standing, but little impaired by time. *Reinforced* concrete is a comparatively new form of construction, having found its first employment in France about the middle of the last century. The first bridge constructed in America of reinforced concrete was an arch span erected in Golden Gate Park, San Francisco, in 1889. It has proved eminently satisfactory, and many thousands of the same class of structures have followed it. It may be urged that since this structure is located in a less trying climate than ours, its length of life is no guide to the durability of a similar structure in Canada, but, on the other hand, we have ample evidence that structures of stone masonry, a material offering greater opportunity of attack for the elements than monolithic concrete have been in existence for well over a century in this country. It would seem reasonable, therefore, to predict for well-constructed concrete bridges a life of at least a hundred years.

Maintenance.—While the annual outlay for maintenance may not in any case be very large, this element is a very important one, for the total expenditure entailed during the lifetime of the bridge may amount to as much as several times the original cost of the bridge.

In steel bridges carrying wooden floors, a large part of the expense of maintenance arises from the necessity of frequent renewal of the floors. On the basis of a life of five years and assuming that the cost of providing and laying timber in floors is $35 per M, the annual outlay on this account would be from 2½ to 6 per cent of the first cost of the superstructure—that is, of the steel work and the original wooden floor. The higher charge is, of course, for short spans and the lower for long spans. If the lifetime of the bridge were 50 years, the expense of renewal of the timber floors for that period would in the average case be nearly 200 per cent of the original cost of the superstructure, assuming the price of timber were to continue throughout the 50 years the same as at present.

The painting of steel structures constitutes a large item of expense to the municipality, unless the latter is willing to economize in this direction and meet the correspondingly heavy expense of frequent renewals. Climatic conditions and the proximity to towns and cities where corrosive gases may come in contact with the metal largely determine the durability of preservative coatings. In most cases a steel bridge requires careful painting every three or four years, and if the longer interval is adopted, two coats should be applied, preceded by a thorough brushing and scraping to remove all rust and old paint. On the assumption that steel bridges are painted in this way every four years, the annual cost of painting would be from 2 to 2½ per cent of the cost of the superstructure for bridges with wooden floors and from 1½ to 2 per cent of the cost of the superstructure for bridges with concrete floors.

For properly constructed all-concrete bridges there should be no maintenance charges whatever beyond the graveling of the roadway over such bridges as carry fills and perhaps the re-caulking of expansion joints at long intervals. These two items combined would constitute but a very small amount of expense per annum, probably not more than 0.5 per cent of the first cost.

Appearance.—But little attention is ordinarily paid to the matter of appearances in highway bridge construction. This is to be regretted, for nowhere is there a better opportunity for the expression of good taste and the exhibition of neatness and tidiness in engineering work. A bridge is generally constructed for a long time to come, and because of the prominent feature which it forms on the highway, an effort should be made to make each bridge at least a good example of strong, well-proportioned and well-finished construction. It must be remembered also that the traffic over many bridges will have increased many fold before their natural life has expired, and in building some attention should be given to the appearance which the bridge should have when the district may have become much more populous than at present.

Some Typical Cases Considered.—Certain type problems from the investment point of view frequently arise in dealing with bridge projects, and a consideration of a few of these may be of interest in illustrating the general principles already discussed.

A simple problem in bridge economics which requires consideration in fixing the lengths of viaducts is the determination of the points where the earth fill should end and the bridging proper should begin. Under ordinary cost conditions existing in Central Ontario, the first costs per lineal foot of earth fill and of steel highway viaduct coincide for a height of about 20 to 25 ft. This does not mean that the economy of employing earth fill ceases when this depth has been reached, however, for the maintenance charges on an earth fill are limited to resurfacing, while on a steel viaduct they would be considerable, as has already been pointed out. Further, the life of an earth fill is perpetual, but that of any form of built viaduct must be of finite duration and of a steel viaduct probably not over 50 years. The limit of economic depth for an earth fill is, therefore, not 20 or 25 ft., but something greater.

The relative advantages of steel superstructures with wooden floors and with concrete floors are often the subject of much serious study by municipal bridge commissioners. Properly, no fair comparison can be made between them, since the structure with a concrete floor does not find its economical application in the field to which the bridge with the wooden floor must be confined—light country highway traffic. If a steel superstructure with a concrete floor were therefore designed to provide for only the 6 or 8-ton concentrated load which is the maximum loading which a steel bridge with a wooden floor will ordinarily accommodate, it would be found that at the end of the natural life of the heavier structure it might have cost as much as the lighter structure with the wooden floor. Such a development would happen, in general, for spans of about 100 ft. in length. For shorter spans the lighter bridge would have entailed the greater expenditure in first cost and maintenance at the expiration of 50 years, but for spans over 100 ft. the monetary outlay would be greater for the heavy structure. The reason for this somewhat startling fact is that while the cost of renewal of wooden floors in the lighter bridges is very great, the cost of painting the heavier structure is much greater than for the light structure, because of the much greater tonnage of steel in the bridge with the concrete floor.

This advantage which the lighter bridge possesses for spans over 100 ft. in length is, of course, only of importance where the bridge will never be required to accommodate rolling loads of greater weight than a heavily-laden wagon or a light traction engine. Should it be necessary to provide for much heavier loads at the outset, the bridge with the wooden floors [illegible] any advantage which it might possess when employed in its own particular field.

Within the last few years the economic problem in highway bridge work which has most frequently presented itself for solution is the question whether a steel bridge with a concrete floor or an all-concrete bridge would be the better investment in a given situation. From what has been said already, it is self-evident that where the physical conditions existing at the bridge site will permit of a concrete bridge and where the first cost is at all comparable with that of a steel structure with a concrete floor, the former is the much better investment. Because of the almost negligible [illegible] much greater life of the concrete structure, the annual cost of perpetually providing and maintaining concrete bridges at any typical crossing, assuming a life of 100 years for these structures, is from one-half to one-third as much as it would be if steel bridges were perpetually employed at the same site.

In conclusion, it should be repeated that the determination of the relative advantages of different types of bridges from the investment point of view can only be correctly arrived at by the application of sound technical knowledge and clear business perception to a close study of local conditions, and the only one whose qualifications along both these lines entitle him to deal with such a matter is the trained engineer.

EARTH AND ROCK SECTION

The Boom Method of Tunnel Driving in Loose Ground.

The ordinary method of advancing a drift in soft ground is by the poling board method. When the breast will not stand, two settings of the breast boards are required for advancing the distance between sets of timbers, the first setting being just beyond the false set and the second setting just beyond the regular set. The false set is placed under the poling boards when they are driven half way in. They may all be driven in and the false set erected under them for the entire width of the drift, depending upon the firmness of the ground.

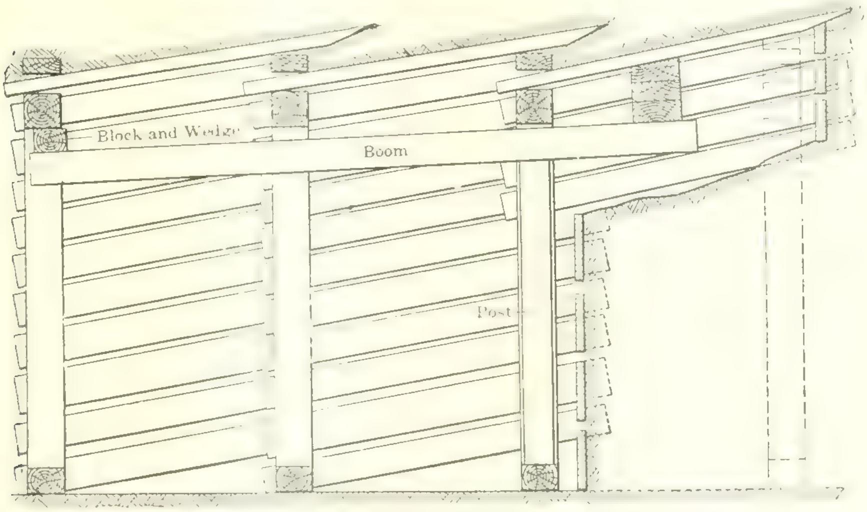

Fig. 1—Arrangement of Boom in Timbering Through Loose Ground.

A modification of this method which eliminates the regular false set has been used with success in the Comstock mine in Nevada and has been explained by Prof. George J. Young in the *Engineering and Mining Journal.* In the Comstock modification the top boards are driven one-half their length and the loose ground scraped back at such an angle as to prevent it from running into the drift. A "boom" is then erected in the center of the drift. It is simply a lever (in this case an 8x8-in. timber 9 to 10 ft. long), resting upon a post which acts as a fulcrum. The top and upper side poling boards are then driven forward to their full length and the upper breast board placed in position. The remaining side boards are then driven successively and the face boards placed in position. On the completion of the advance the next regular set is placed. A single setting of the breast boards thus secures an advance of one regular set. **Fig. 1** shows the method of rigging the boom and **Fig. 2** shows a still further modification which is suggested. In this a heavy iron hanger is used which acts as a fulcrum and takes the place of the post. It has the advantage of giving more working space in the breast.

Relative Economy of Deep and Shallow Holes in Driving Tunnel Headings.

By JOHN [illegible]*

The tunnel under discussion is part of the work under a contract for the construction of a portion of the New York Aqueduct, and is a trifle over a mile in length, 18 ft. 9 ins. high and 15 ft. 2 ins. wide. The tunnel was driven to the *C* line, which lay eight inches inside the *B* line. The *B* line (the limiting pay line of excavation), gave 10.22 cu. yds. to the foot, while the *C* line ran six-tenths of a yard less. The rock encountered was very hard granite Gneiss, the strata dipping to the south and west.

Three straight line compressors, each with a capacity of 1,100 cu. ft. of free air a minute, at 100 lbs. pressure and 112 R. P. M. supplied sufficient air to operate two batteries of seven 3⅝-in. drills, located in two working faces: four drills on columns in the heading and three on tripods on the bench.

At first the deep hole method was used in driving the heading. We drilled 19 holes, 10 ft. deep for the "dry," "side," and "breakdown" holes, and six holes 9 ft. deep for the "cut" holes. Three working shifts of 8 hours each were employed during the 24 hours. Shift 1 beginning at 8 a. m., completed "set up" (if necessary), and started to drill, at 4 p. m., shift 2 relieved them and continued the drilling, at midnight shift 3 replaced 2 and finished the drilling, tore down, loaded, shot and mucked out heading, preparatory to "set up." As drilling took almost two shift periods, and the other operations together about 5½ hours, it was impossible to have any working schedule, so that the work for a [illegible] was different for the same shift the next day.

The disadvantages of this deep hole system were as follows: (a) Having no working schedule the men were inclined to lag; (b) Drill holes were so deep that the dynamite could not pull to the bottom of them, resulting in a loss of 25% of the holes; (c) A great amount of dynamite was used in trying to pull the "cut"; sometimes it was necessary to shoot the "cut" three and four times before it would come away; (d) Many holes and much time lost because of the longer steel sticking, usually after hole was eight feet.

Hoping to overcome these faults and reduce the ultimate cost, we experimented with different depth holes; deciding to use holes of 6 ft. round and 5 ft. cut; calling it the shallow hole method. We were able with this change to get two rounds during the 24 hours; while before we could get only one and a portion of a round. We now had a working schedule, and the men performing the same operations day after day, became very efficient and more desirous of completing the work that fell to their shift. They drilled a hole which netted a maximum yardage per foot drilled and a minimum of holes wasted. Note in the tables that the reduction of feet drilled per yard was 15½ per cent, and that the reduction of feet of holes lost a yard was 46 per cent. The amount of dynamite was cut 0.42 lbs. a yard. The fact that we reduced the final cost $0.69 a yard, and increased the yardage 11 per cent, is sufficient proof that the shallow hole is more economical than the deep hole in driving headings.

The great advantages of [illegible] working schedule are, that it almost does away with soldiering, a large amount of unnecessary work is eliminated, and the number of men is reduced. In the deep hole method there was no working schedule, so that it was necessary to carry three full shifts daily; as it was impossible to tell at what time the drilling or the shooting would come. Hence, there was considerable time that all the men were idle, and frequently drillers did the work of laborers.

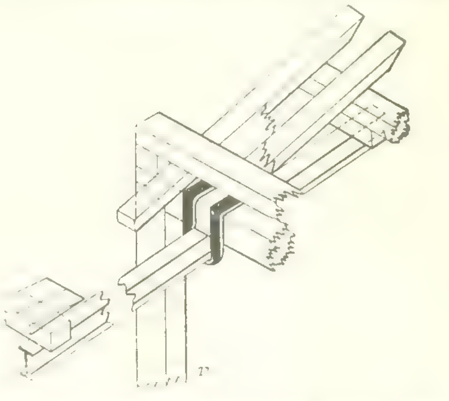

Fig. 2—Scheme for Supporting Boom with Hanger.

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* [illegible] N. J.

[illegible] ingly we reduced the number from 21 to 16, arranging them in two drilling shifts of 7 drill- [illegible] two half shifts, as follows:

[illegible]

(a) 6 p. m. to 10 p. m., erecting shift of [illegible]

[illegible]

The same men working on (a) as on (b); [illegible] over the reduction of $0.69 mentioned above. We were also able to lay off one blacksmith and helper; formerly it was necessary to have three blacksmiths in order to keep the steel supplied, but now one blacksmith sharpened all the steel at night for the day, and another blacksmith sharpened in the day all the steel used at night. This change reduced the cost [illegible]

Below I have made comparative tables. The data were collected during the best month for the deep hole method, and during the first [illegible] shallow hole.

	Deep Hole.	Shallow Hole.
[illegible]	9 ft. 10 in.	5 ft. 6 in.
[illegible]	30	31
Yards of rock	2,280	2,738
Feet of completed tunnel	228	248
Heading driven in feet	230	263
No. of shots in heading..	31	54
Feet of heading pulled per shot (average)	7.41	4.87
Feet of holes drilled per shot	244	138
Ft. of holes lost per shot.	58.74	21.12
Per cent of holes lost per shot	24%	15%
Total No. hours drilling..	427	381
Total No. hours shooting	54	72
Total No. hours "setting up"	107	189
Total No. hours "tearing down"	23	39
Total No. hours actual work	611	681
Total No. hours delayed.	109	63
Yards per driller.........	4.23	4.36
Yards per mucker	1.89	2.43
Yards per driver.........	12.66	18.50
[illegible] of dynamite	.266	.291
Yards per ton of coal....	9.43	11.62
Yds. per ft. of hole drilled	.168	.200
Lbs. of dynamite per yd.	3.76	3.34
Time drilling per yd......	11 min.	9 min.
Pounds of coal per yard.	212	172
Drillers per yard	.23	.20
Muckers per yard	.53	.43
Drivers per yard.........	.09	.09
Feet of holes drilled per yard	6.58	7.66

COST PER YARD.

Drillers and helpers	$1.15	$0.99	$0.16
Foremen in heading	0.16	0.14	0.02
Water boys and nippers	0.16	0.14	0.02
Blacksmith	0.18	0.18	0.00
Dynamite	0.46	0.41	0.05
Payroll at compressor	0.16	0.10	0.06
Coal	0.32	0.26	0.06
Muck foremen	0.14	0.13	0.01
Muckers	0.88	0.73	0.15
Drivers and dumpmen	0.18	0.17	0.01
Administration	0.44	0.39	0.05
Incidentals	0.21	0.11	0.10
Total	$4.44	$3.75	$0.69
Reduction that could have been made in this first month of the shallow hole, by cut in drillers and blacksmiths already mentioned			$0.16
Making a total reduction of			$0.85

Some Data on Fuel Consumption and Traction Efficiency of Traction Engines.*

The data which I have on the performance of tractors are largely from two sources, the agricultural motor competitions which have been held at Winnipeg and Brandon, Manitoba, and investigations which I conducted among every-day operators in connection with the United States Department of Agriculture. The former should be thoroughly reliable, but in some cases are open to doubt, the tests having been conducted hastily and without adequate facilities. The latter source is reliable only in that it averages the testimony of a large number of operators, few of whom had exact records. The tests conducted in the four motor competitions have been on the brake, first for economy, then for maximum power; in plowing, over firm, level prairie sod; and in hauling, over a half-mile circuit which presented almost every possible road condition from block pavement to loose gravel and mud. The various averages hereinafter presented are offered merely as a basis for rough comparison with the performance of motors used in other service.

Coal and Water Consumption.—Table I shows the average coal and water consumption in the economy brake tests of steam tractors in Canada. It is not to be supposed that the load in every case was exactly at or even near the point of greatest economy, though this condition was usually aimed at. There was but one test of a compound engine on the brake, against six single and eleven double cylinder engines. In plowing there were four single and six double; and in hauling one single and three double.

TABLE I.—LBS. OF COAL AND WATER USED PER DELIVERED H.P. PER HR.

	Single Cylinder		Double Clyinder		Compound	
Test.	Coal.	Water.	Coal.	Water.	Coal.	Water.
Brake	3.72	30.11	4.43	32.43	4.56	24.94
Plowing	5.46	52.8	8.87	69.0		....
Hauling	14.18	114.6	12.84	91.1		....

Steam tractors as a rule use from 7 lbs. to 8 lbs. of water per pound of coal. Reports from 333 plowing engines of all types in the United States and Canada indicate an average of 7.67 lbs. Twenty-four public brake tests show a mean of 7.78 lbs.; 16 plowing tests 7.08 lbs.; and 4 hauling tests 7.4 lbs., or a mean of 7.42 lbs. for the 44 tests. Single cylinder engines show a range of from 5.78 lbs. to 9.97 lbs., and double cylinder from 3.3 to 10.3 according to the official reports. Conditions were such, however, as to arouse doubts as to the accuracy of such extreme figures. By making enough assumptions we can compare these data with those furnished by operators of 11 oil-burning steam engines in California. These men report the use of 9.4 gals. of water per gallon of oil. Assuming the oil to be of 20° Baumé and to contain 20,000 B.t.u. per lb. they use 1,990 B.t.u. in evaporating 1 lb. of water. The ordinary run of coal used contains not over 13,000 B.t.u. per lb., hence 1,700 to 1,740 B.t.u. would be furnished per 1 lb. of water.

Gasolene Consumption.—Table II gives an average of gasolene consumption in all public economy tests to date.

TABLE II.—GASOLENE CONSUMED PER DELIVERED H.P. PER HR.

	1 Cylinder.		2 Cylinders.		3 and 4 Cylinders,	
Test.	No. tests.	Lbs. fuel	No. tests.	Lbs. fuel	No. tests.	Lbs. fuel.
Brake	11	0.567	4	0.836	12	0.965
Plowing	6	1.273	4	2.676	9	1.778
Hauling	5	1.536	1	3.97	6	1.88

The average consumption for 27 brake tests is 0.747 lbs., or a trifle over a pint per horsepower hour, the gasolene used being of 70 specific 64 Baumé gravity. Nineteen plowing tests average 1.67 lbs., and 12 hauling tests 1.91 lbs. per drawbar horsepower hour. These averages are not comparable, but the matter of tractive efficiency will be discussed later.

The amount of water required per brake horsepower-hour by the internal-combustion motors depends largely on the cooling system. In these tests it ranged from 0 to 2.55 lbs. per h.p. per hr., averaging in the neighborhood of 1⅓ pints. A kerosene tractor, using water in the cylinders, consumed less than a pint of water per horsepower-hour. The consumption by the evaporative type of cooler would in several instances have necessitated replenishment of the water supply after from two to three hours of heavy work.

Thermal and Tractive Efficiency.—No analyses have been made of fuels used at the motor contests, hence the thermal efficiency of the various engines is in doubt. It probably ranges from 4 to 6 per cent for the steam tractors, and from 6 to 25 per cent for the internal-combustion type. Neither have tests been made of the boiler, mechanical or real tractive efficiency.

The fuel consumption in the brake tests bears direct relation to the number of cylinders. In the plowing and hauling tests the efficiency of the traction parts is brought also into play. Tests bringing out comparisons of the traction mechanism only have never been conducted, hence we are forced to use a crude comparison of fuel consumed and horsepower developed in the various tests. This topic deserves extended discussion, and Table III will serve to bring out only in a rough way the influence of various factors on tractive efficiency.

The small, single-cylinder motors had wheels much larger in proportion to total weight than the other classes, but more weight, also, per brake horsepower developed in the economy test. Comparing only the brake and drawbar horsepower they appear to have greater tractive efficiency than the larger and heavier machines. From the comparative fuel consumption, however, we may assume that this was due rather to harder work of the engine, i. e., more brake horsepower was being developed during the plowing than during the economy brake tests. As previously stated, the road conditions were severe, every class developing in the hauling tests a lower percentage of the brake horsepower at the drawbar, and using more fuel per tractive horsepower-hour than the plowing tests.

The light high-wheeled tractors with four-cylinder high-speed engines seemed to be much less affected by the adverse conditions, developing in either plowing or hauling about half as much tractive horsepower as brake horsepower, with approximately twice the fuel consumption per unit. The steam engines, with only a trifle more weight per brake horsepower than the four-cylinder gasolene tractors, and about the same height of drivers, but over 40 per cent more weight per inch in width of drivers, were able to turn this weight to good account in plowing on firm footing. Over the hauling course power dropped and fuel consumption rose in nearly the same proportion.

The drawbar pull of the gasolene tractors averaged about 17 per cent of the total weight in the hauling test and about 24 per cent in plowing. One horsepower was developed for 922 lbs. of total weight. The drawbar pull of the steam engines was approximately 11 per cent of the total weight in hauling and 22 per cent in plowing. Averaging the two tests, the steam tractors have credit for 1 tractive horsepower for each 1,033 lbs. of weight.

This year the steam tractors delivered in plowing from 50 to 77 per cent of their economy load on the brake and from 37 to 58 per cent of their maximum. The dynamometer showed a mean resistance of 26 per cent of the total weight and 36 per cent of the weight on the drivers. The latter weight is probably only approximate. A mean of percentages indicates that 73.5 per cent of the weight is borne by the drivers.

Seven internal-combustion tractors had a mean resistance of 25 per cent of the total weight and 35 per cent of the weight on the drivers, the latter carrying 70 per cent of the total. Data on a motor truck which overcame a resistance of 33 per cent of the total weight and 79 per cent of the weight on the drivers are excluded. This motor carries only 42 per cent of its weight on the drivers, and in the plowing test was loaded with human ballast to increase the percentage.

TABLE III.—TRACTIVE EFFICIENCY TESTS DETERMINED BY COMPARING FUEL CONSUMED AND HORSEPOWER DEVELOPED AT WINNIPEG, MAN., JULY, 1909.

Type of Engine.	Total weight per 1 in width of driver.	Weight per economy B.h.p.	Drawbar h.p. B.h.p. Plowing.	Hauling.	Fuel per B. h.p-hr. Fuel per drawbar h.p-hr. Plowing.	Hauling.
Single-cylinder, gasolene, low wheel......	299	535	0.614	0.508	0.441	0.355
Four-cylinder, gasolene, high wheel......	407	416	0.531	0.499	0.538	0.533
Steam	585	456	0.566	0.293	0.499	0.344

Note.—This table includes four single-cylinder gasolene engines, three 4-cylinder, and four steam engines.

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*Abstract from a paper by L. W. Ellis, La Porte, Ind., in the Journal of the American Society of [illegible] Engineers, March, 1911.

The rating of tractors is far from uniform, but steam ratings are more conservative than for internal-combustion engines. The brake rating of steam tractors is seldom less than three times the tractive or nominal rating. In tests this year every steam tractor not only exceeded both brake and tractive ratings, but devloped a greater percentage of its maximum brake horsepower at the drawbar than was indicated by the ratio of tractive to brake rating.

Only two internal-combustion engines equaled their brake rating on the maximum test and only one its drawbar rating in plowing. The class averaged only 86.5 per cent of the brake rating on a maximum test, 80.9 per cent of the tractive [illegible] on a semi-economy test in plowing and 80.9 per cent of their brake rating on an economy load. The steam engines exceeded the specified horsepower by 32 per cent, and the tractive rating 95 per cent, besides carrying 97 per cent of the rated brake horsepower on the economy load.

The daily capacity of a tractor depends on the width of the strip plowed or otherwise treated and the distance traveled. The former depends largely on tractive power. The character of machine drawn affects the distance traveled by governing somewhat the number of stops. Stops, however, are due more often to the necessity for taking supplies or making repairs.

The steam tractor formerly required a large amount of time for taking on supplies, but it is now easy to take water on the move, and, the transfer of coal, if sacked, is a small item. The internal-combustion tractor can usually travel a much greater distance without replenishing supplies than the steam tractor, though apparently little effort has been made to balance the capacity of fuel and water tanks. Were it possible entirely to empty either tank, nearly every internal-combustion tractor could travel 10 to 15 miles under full load without stopping, while the average steam tractor requires a supply of water approximately once every 2 miles and of coal every 5 or 6 miles.

ROADS AND STREETS SECTION

Methods and Costs of Constructing an Asphalt Street With Concrete Walks, Curb and Lamp Posts.

The work was a half-mile extension of a street bordering Lincoln Park, Chicago. It comprised the removal of an old pavement and the preparation of the subgrade for the new pavement 27 ft. wide with a 6-in. concrete base, a 2-in. wearing surface of asphalt, a combination curb and gutter, an 8-ft. cement sidewalk and the installation of street lamps. All construction was done by force account by the Lincoln Park commissioners and the following costs are compiled from these records:

Design of Street Crown.—In designing the crown of the road the standard rule of the commission for all park roads was followed. This rule is as follows:

Rule: From the center of the road to the gutter, divide the distance into four equal parts and number the chord points 1, 2, 3 and 4. Then the number of the chord points, squared, multiplied by 0° 7′ equals the deflection at the center of the road.

The tangents of these angles will be:

No. 1 tan, 0° 7′ = 0.002036
No. 2 tan. 0° 28′ = 0.008145
No. 3 tan. 1° 3′ = 0.018328
No. 4 tan. 1° 52′ = 0.032591

Multiplying by the distance from the center of the street to the corresponding chord point gives the fall of the surface from the level of the street center.

At street intersections the practice is to carry the regular half cross section around the corner, leaving a level place at the center of the intersection. This is done by describing an arc with a radius equal to that of the curb radius (10 ft.) plus half the width of the street. This arc is struck on all four corners and marks the line from which the street surface is sloped toward the gutters. By this method a sort of rectangular figure, with concave sides, is left at the center. This is leveled off at the elevation of the street crown.

Curb and Gutter.—The concrete curb and gutter work was commenced Sept. 29 and completed Dec. 1, amounting in all to 4,708 lin. ft. The cost was as follows:

Labor.	Totals.	Cost per lin. ft.
Engineering	$92.20	$0.0196
Foreman, per mo. $75	127.28	0.0270
Double teams, per hr. $0.66⅔	42.66	0.0091
Single teams, per hr. $0.33⅓	3.00	0.0000
Common labor, per hr. $0.25	898.34	0.1908
Skilled labor, per hr. $0.30	435.71	0.0925
Timekeeper, per mo. $75	8.89	0.0019
Total labor	$1,608.08	$0.3416

Material.	Totals.	Cost per lin. ft.
117 cu. yds. gravel at $1.50	$175.50	$0.0373
98 cu. yds. torpedo sand at $1.60	156.00	0.0331
24 cu. yds. stone at $1.50	36.00	0.0076
273 bbls. cement at $1.35	368.55	0.0782
Lumber	37.23	0.0079
Steel	81.00	0.0172
Lamp black	21.25	0.0045
Tools	7.22	0.0015
Total material	$882.75	$0.1873

Excavating Subgrade.—The excavation and preparation of the subgrade was not begun until the curb and gutter work was about half completed on Nov. 1. The preparation of the subgrade involved the removal of old macadam and some old cedar block pavement. It is estimated that the entire area was excavated about 6 ins. deep. The surplus material was loaded by hand into wagons and was carted about ½ to ¾ mile to the lake front. A 15-ton roller was used to finish the subgrade. The costs of this work were as follows:

	Totals.	Cost per sq. yd. pavement.
Engineering	$26.37	$0.0035
Foremen	107.11	0.0144
Skilled labor	92.22	0.0124
Common labor	1,023.67	0.1378
Teams	986.34	0.1328
Timekeeper	11.11	0.0015
Steam roller, 20 days	90.00	0.0122
Total	$2,336.82	$0.3146

Concrete Base.—Following upon the preparation of the subgrade the 6-in. concrete base was placed. This work was started Oct. 31 and completed Nov. 22. The materials were distributed along the street and the mixer was moved forward as the work progressed. One of the interesting parts of this work was the use of the wood template which is shown by Fig. 2. It was with difficulty that the men were induced to use this template in beginning the work, but after a few days the men found it indispensable. [illegible] from Fig. 2 that the template [illegible] the boards used to shape the pavement are arranged to be raised and lowered by means of thumb screws. By this means the [illegible] concrete base were shaped up, and later the asphalt. During the construction [illegible] base, each day's work was covered with manure and canvas as it was feared that freezing weather might suddenly [illegible] of the concrete work follows: There were 7,427 sq. yds. 6 ins. thick or 1,238 cu. yds.:

Labor.	Totals.	Cost per sq. yd.
Engineering	$131.00	$0.018
Foreman	125.66	0.017
Double teams	30.00	0.004
Single teams	56.67	0.007
Common labor	988.75	0.133
Skilled labor	131.56	0.018
Totals	$1,463.64	$0.197

The cost per cubic yard for labor was thus $1.182.

Materials.	Cost.	Cost per sq. yd.
Cement at $1.35 bbl.	$1,528.50	$0.206
Stone at $1.40 yd	2,183.00	0.294
Torpedo sand at $1.50 yd	30.00	0.004
Lumber, expan. joints, etc.	49.24	0.007
Wood template	27.00	0.004
Tools and sundries	24.02	0.003
Mixer, rent $162, hauling $15, fuel $12	189.00	0.025
Canvas	50.00	0.007
Oil and waste	2.93	0.0004
Totals	[illegible]	[illegible]

The cost per cubic yard for materials was $3.30.

Asphalt.—The asphalt used consisted partly of Sarco brand and partly of Pioneer brand. A Link Belt Co. asphalt mixer, which was purchased by the park at a cost of $5,590, was used. It was operated by belt from a gasoline traction engine. A 6-ton roller was used in the asphalt, giving a compression of 266 lbs. per sq. in. The asphalt work consisted of 7,427 sq. yds. of 2-in. surface. It was started on Nov. 7 and completed Dec. 1, 1910. The costs were as follows:

Labor.	Totals.	Cost per sq. yd.
Engineering	[illegible]	[illegible]
Foremen	[illegible]	[illegible]
Teams	[illegible]	[illegible]
Common labor	[illegible]	[illegible]
Skilled labor	[illegible]	[illegible]
Timekeeper	[illegible]	[illegible]
Totals	[illegible]	[illegible]

Materials.	Total.	Cost per sq. yd.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Asphalt, "Sarco," at $24 ton	1,402.06	[illegible]
Asphalt, Pioneer, [illegible]	[illegible]	[illegible]
Lumber for exp. joints	18.00	0.002
Brooms	[illegible]	[illegible]
Coke	249.07	0.033
Gasoline	[illegible]	[illegible]
Engine oil, waste, etc.	11.02	0.002
Tools	[illegible]	[illegible]
Steam roller	[illegible]	[illegible]
Link Belt mixer	200.00	0.027
Total	[illegible]	[illegible]

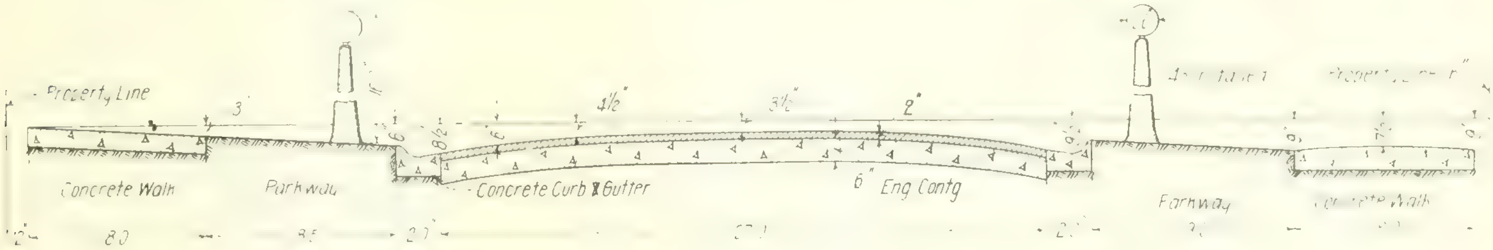

Fig. 1—Sketch Showing Cross Section of Street, Gutter, Walks and Lamp Posts.

[illegible] work [illegible]

[illegible]	$[illegible]
Material per sq. yd. concrete base	0.55
[illegible]	0.34[illegible]
[illegible]	[illegible]
[illegible] per sq. yd.	[illegible]
Total	$1.[illegible]

[illegible]—In addition to the concrete work on the road some 7,722 sq. ft. of 8-ft. sidewalk was laid. This is shown by Fig. 1 at the left of the drawing. The sidewalk on the opposite side has not as yet been laid. The expansion joints in the walk were filled with asphalt. An additional feature was the laying of steel bars about 18 ins. long across the expansion joint. This has been practiced for some time on Lincoln Park walks and wherever it has been used there has been no unequal settlement of the slabs.

The cost of the sidewalk work follows:

Labor.	Totals.	Cost per sq. yd.
Engineering	$ 15.50	$0.0020
Foremen	41.91	0.0054
Teams	40.34	0.0052
Common labor	422.44	0.0547
Skilled labor	86.46	0.0112
Timekeeper	3.05	0.0004
Total	$ 609.70	$0.0789
Material.		
Cement	$ 208.57	$0.0270
Stone	182.00	0.0236
Torpedo sand	108.00	0.0131
Lumber	25.79	0.0033
Straight edge	1.75	0.0002
Steel, 620 lbs.	13.75	0.0018
Lamp black	5.00	0.0007
Total	$ 544.86	$0.0697

The total cost per sq. ft. of sidewalk is $0.1486. The lamp black was mixed with the cement to give the sidewalk a slate color.

Concrete Lamp Posts.—The installation of the concrete lamp posts was carried on at the same time as the street construction. This work was done intermittently on account of the fact that it was interfered with by the sewer work which was being carried on by the city just ahead of the street work. The concrete posts were molded at the park shop and allowed to remain there some time, for curing, before being set up in place. They are molded in wood forms and surfaced with a coat of granite screenings. After setting, a coat of acid is applied and the surface is brushed, leaving an excellent finish. The content of the post is 15 cu. ft. Its weight is 2,010 lbs., and its height, measured from the curb to the top of the 20-in. globe, is 16 ft.

The following list shows the amount of material required for one post:

Cement, [illegible] sacks	$ 1.86
Gravel, 8.63 cu. ft.	0.55
Granite, 1.51 cu. ft.	0.14
Torpedo sand, 1.21 cu. ft.	0.05
Steel, 82 lbs., 2¼ cts.	1.85
Pipe, W. I., 21 ft. 2 ins.	1.44
Labor	4.75
Tools, molds, etc.	1.25
[illegible]	$11.8[illegible]

Below is given the cost of making and installing the 43 posts along Lincoln Park West. The cost of building all conduit, wiring and completing the work is taken into account. The posts were set in pairs, 112½ ft. apart, with one conduit manhole between each pair. Before setting the posts, a hole 30x30 ins. square and 52 ins. deep, is dug and 4 ins. of concrete is placed in the bottom and allowed to set. The post is then plumbed up in line on this base and the hole filled with concrete. The costs of the work follow:

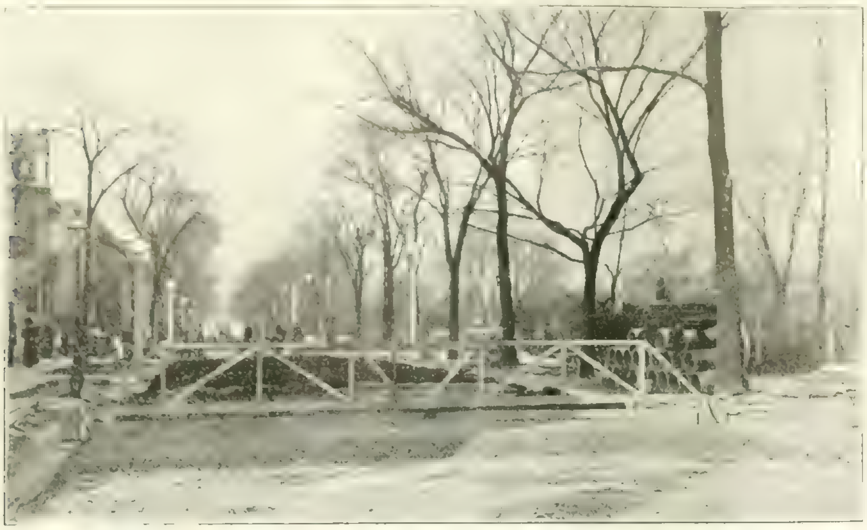

Fig. 2—View of Work of Laying Concrete Base, Adjustable Template Used for All Layers of Material Placed.

Labor.	Totals.	Cost per post.
Engineering	$ 339.54	$ 7.89
Foreman	62.38	1.45
Teams	171.00	3.98
Common labor	650.08	15.12
Electrician	268.69	6.25
Bricklayer	57.30	1.33
Painter	4.05	0.10
Totals	$1,553.04	$ 36.12
Materials.	**Totals.**	**Cost per post.**
3-in. fiber conduit at 4½ cts. per ft.	$ 427.30	$ 9.94
2-in. fiber conduit at 4 cts. per ft.	29.40	.68
Cement at $1.80 bbl.	180.00	4.19
No. 2 stone at $1.50	130.98	3.05
Sand at $1.65	89.10	2.07
Brick at $8 per M.	92.00	2.14
Manhole road covers at $22	506.00	11.77
Caps and grills at $9	387.00	9.00
Jandus 20-in. globes at $6.40	275.20	6.40
Jandus lamps at $23.50	1,010.50	23.50
Paper cable, 11,346 ft.	1,316.14	30.61
Rubber cable, 1,705 ft.	451.83	10.51
Concrete posts, 43	516.00	12.00
E. C. covers, 5	24.50	.57
Splicers and misc.	141.40	3.28
Total material	$5,577.35	$129.71
Total labor per lamp		$ 36.12
Total material per lamp		129.71
Total labor and material cost per lamp		$165.83

All the work referred to above has been done by the Lincoln Park System, of which Mr. M. H. West is Superintendent. Mr. Fred Howitt is Engineer of Parkways and Mr. E. C. Rutz is in charge of the electrical department. We are indebted to these gentlemen for the information furnished.

Cost of Tarvia-Macadam at Fredericton, N. B.

During the past season two blocks of tarvia-macadam were laid by the city of Fredericton, N. B. The pavement was laid on Queen St., from St. John St. to Regent St., and from York St. to Westmoreland St., the total amount laid being 5,582 sq. yds.

The broken stone used in the work was nearly all 1½ to 2-in. trap rock, though a small amount of sandstone was of necessity used. The stone was purchased from the city roads and streets department at a cost of $1.30 per ton for crushed trap rock at $1.00 per ton for sandstone.

The binder material used was Tarvia X, manufactured by the Barrett Manufacturing Co., Boston, Mass. This binder was applied hot, the penetration method being used. Two applications of the binder were used on the wearing course and also on the top dressing. The amount of Tarvia used per sq. yd. of surface was 3.07 U. S. gals. Of this amount, 2.4 gals. were used on the wearing course and .67 gal. on the top dressing. The Tarvia was obtained from the Maritime Provinces of the Barrett Manufacturing Co., and cost $5.25 per cask of 48 U. S. gals., delivered in Fredericton. The total amount of Tarvia purchased was 378 casks. Of this amount, 357 casks were used in constructing the two blocks of pavement, leaving 21 casks now in stock for this season. Of the empty casks, 345 were returned to the company, this netting the city $94.15. Thus the total net cost of the Tarvia used in this work will be seen to be $1,780.10, or about 10.4 cts. per U. S. gal.

Sand was spread on the finished surface of the pavement, the amount used per 100 sq. yds. of surface being 1.55 cu. yds. The total amount of sand used was 45 loads. The cost of the sand was $1.25 per load.

The following tabulation shows the cost of material and labor for constructing the macadam, this work including a small amount of grading:

	Total.	Per sq. yd.
1,603 tons crushed trap rock at $1.30	$2,083.90	$0.372
130 tons sandstone at $1.00	130.00	.023

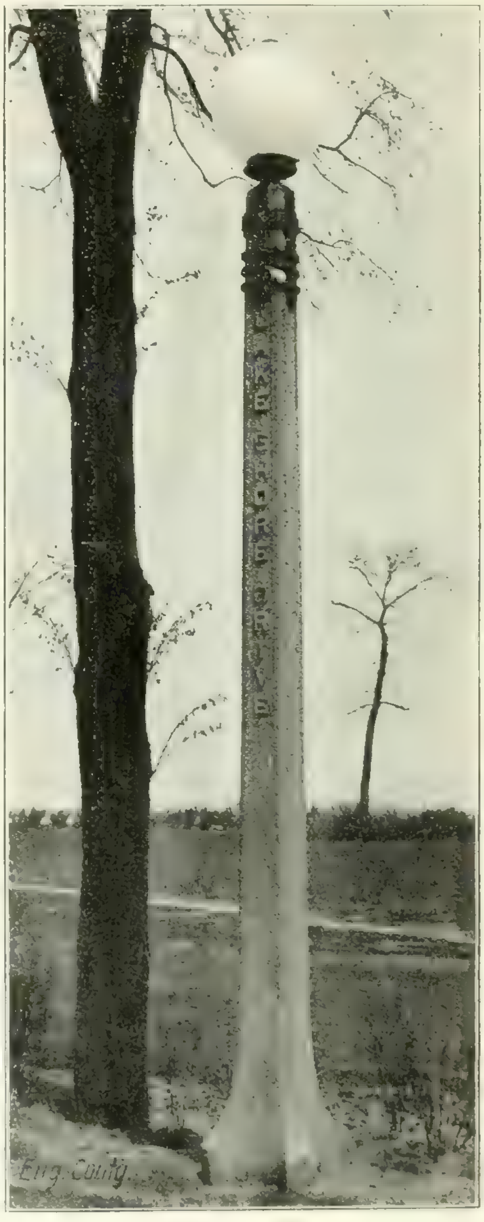

Fig. 3—View of the Concrete Lamp Post Used by the Lincoln Park System.

Labor	459.75	.083
Teaming	412.51	.074
Rolling	114.99	.021
Engineering and superintendence	303.78	.054
Sundries	44.33	.008
Totals (5,582 sq. yds.)..........	$3,549.29	$0.635

The following is the average organization of the gang engaged in grading and constructing the macadam proper:

11 laborers at $1.50 per day	$16.50
2 double teams at $3.50 per day	7.00
2 single teams at $2.25 per day	4.50
Total	$28.00

This force placed on an average 200 sq. yds. of macadam per 9-hr. day.

The cost of the Tarvia treatment was as follows:

	Total	Per sq. yd.
17,136 gals. tarvia at 10.4 cts.....	$1,780.10	$0.319
Labor, heating, applying, etc....	315.22	.057
Cost of piant, tools, etc..........	133.30	.024
45 loads sand at $1.25 per load..	56.25	.010
Totals (5,582 sq. yds.)	$2,284.87	$0.410

The gang employed in heating and spreading the binder was as follows:

6 laborers at $1.75 per day................	$10.50
1 single team at $2.25 per day	2.25
Total	$12.75

With this force the binder was applied to about 185 sq. yds. of macadam each 9-hr. day. The total thickness of the completed Tarvia macadam and was 7 ins. and its total cost was $1.04½ per sq. yd. This is a rather low cost when it is considered that this Tarvia-macadam work was the first attempt in the city in the construction of this kind of pavement. The cost of the Tarvia was also somewhat high, being 12½ cts. per imperial gallon, whereas the same product can be obtained at less cost in New England cities. The essential features in the low cost of construction were the comparatively low cost of crushed stone, the short haul (the cost of hauling amounted to 31 cts. per ton mile) and the small amount of excavation necessary.

The Tarvia-macadam was constructed in the nature of an experiment. It has given such satisfaction that it is planned to lay a large quantity during the present season. The work was done under the direction of J. L. Feeney, City Engineer, to whom we are indebted for the above information.

The Canadian Klondike company has just installed a dredge at Dawson, on the Yukon, which is a monster, and it is already at work taking up the bottom gravel and sifting it at the rate of 10,000 cu. yds. a day. The construction was begun in August and completed in November and the boat is 130 ft. long by 91 ft. wide. The machinery of the dredge is operated by electrical power.

Gravel Road Building in Michigan.

BY FRANK

At the close of the first fiscal year of the Michigan State Highway Department, June 30th, 1910, there had been completed 545.5 miles of road on which state rewards were paid. Of this mileage 54.5 per cent, or 297.2 miles were gravel roads. Under the present Michigan law, the state pays a reward or bonus of $500 a mile for all gravel roads that are built in accordance with its standard specifications, provided that not more than two miles shall be aided in any organized township during the same fiscal year. However, should a township desire to build more than two miles in one year, application may be made for reward on the entire distance that it desires to build, and it will receive pay for two miles of road each year until all the road built has been rewarded.

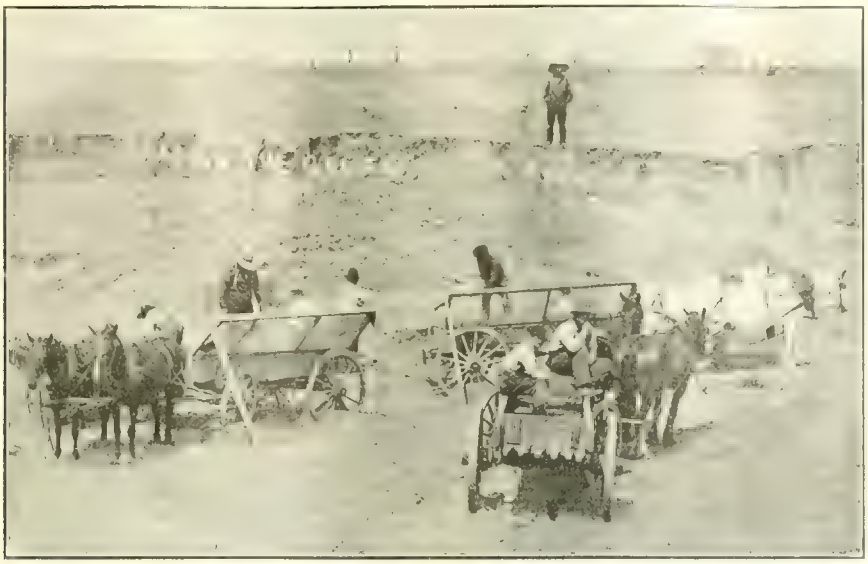

Fig. 1—View Showing Wagon Screen.

The gravel road is popular in Michigan for several reasons. It is relatively cheap in first cost. It requires less skilled labor to construct than any other type of improved road and very little machinery. In fact, one can go into any farming community and find all the labor and teams really required to construct a first class gravel road. To be sure, the construction cost could be slightly lessened, but the finished road not materially bettered, by the use of more or less improved machinery. Finally, the gravel road is a labor proposition from start to finish and, if local gravel can be had, all the money entering into its construction remains at home. This is not true of the macadam road where stone has to be imported, for in such cases from 30 per cent to 60 per cent of the cost goes out and away from the neighborhood to pay stone and freight charges, and, so far as that community is concerned, it is poorer by the loss of the money sent away.

A well built gravel road is a good road. It will hold up under the traffic of rural sections away from large and populous centers surprisingly well, and when repairs are necessary, they can be made at small expense.

Michigan is extensively engaged in the growing of sugar beets and no farm traffic is harder on roads than that of the beet growing sections. There the weight of crops to be hauled over the country roads to market ranges from 10 to 15 tons for the entire acreage on which the beets are grown. Compare this with the tonnage to market in the corn and wheat growing states, where from one to two tons per acre are the maximum crops, and the difference in the wear on the roads will be apparent. Michigan is also a large potato growing state and this crop furnishes a larger tonnage to market than any other crop except beets, it often reaching six tons per acre.

Our gravel roads bear up well under the beet and potato traffic, in fact, it can be truthfully said that the gravel roads of Gratiot county withstand the beet traffic about as well as the limestone macadam roads of Bay and Saginaw counties, and the percentage of the tillable land devoted to beet growing does not vary much in any of these counties, particularly on the farms contiguous to the improved roads.

Considering the ease with which the gravel roads can be smoothed up and new material added, and the expense required to make a really good job of repairs to a macadam road, the gravel road has many points in its favor. However, Saginaw and Bay Counties have neither gravel nor stone, and it is the writer's experience that where either gravel or stone has to be shipped in by rail, it is more economical to ship in the stone and build the macadam road, for, under such conditions the saving on cost of the gravel road over the cost of macadam is not enough to recommend it from an economic standpoint. It must be remembered that the cost of a road to a community does not end with its first cost, but is the cost of building plus the cost of keeping the road perpetually in a satisfactory state of repair, and no particular kind of road

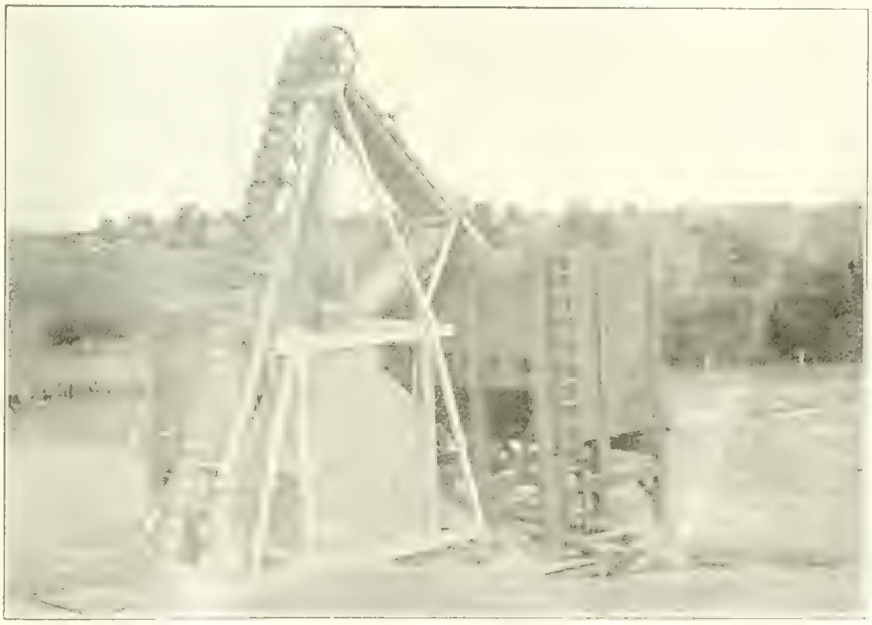

Fig. 2—Gravity Gravel Screen and Ordinary Bucket Elevator.

Deputy Commissioner Michigan State Highway Department [illegible] principles ever in mind.

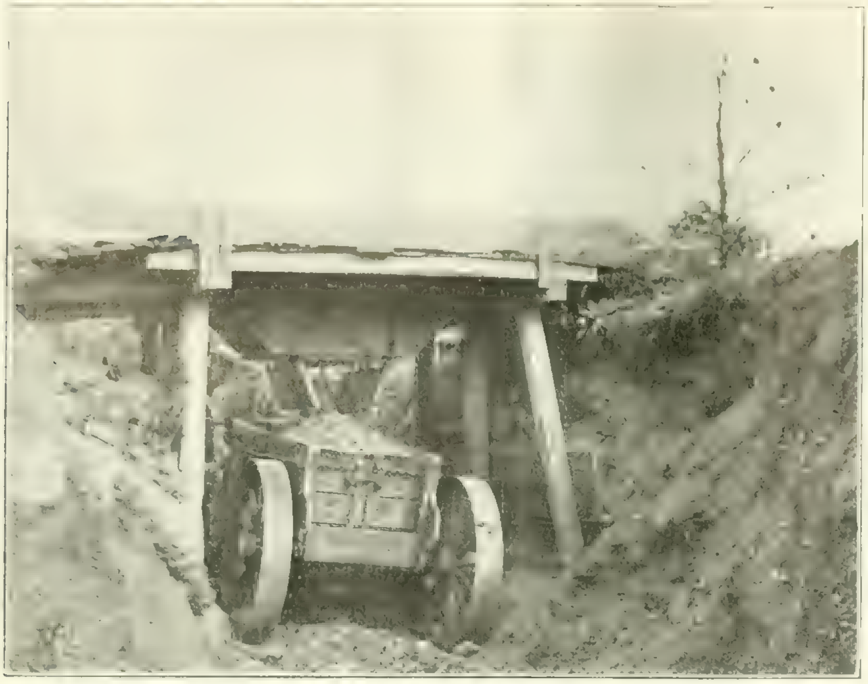

Fig. 3—View Showing Wagon Being Loaded from Hopper.

Michigan [illegible] all of glacial origin. They range from the dune [illegible] black clay loams of Saginaw Valley and on through the stiff yellow clays and gravels of some of the more elevated portions to the rocky hills of the upper peninsula. Gravel roads have been built on these varying soils with good success, wherever gravel of good quality could be found.

The bank gravels of Michigan being of glacial origin vary widely in their character, both as to the kinds of rocks of which the pebbles are rounded fragments and the kinds of earth with which they are mixed. This variation is most marked when the gravels from different sections of the state are compared. The rims of limestone ledges that surround the northerly ends of Lakes Michigan and Huron and outcrop at intervals on the adjacent shores of both peninsulas have influenced the gravels in those parts and for some distance southward by contributing a large proportion of limestone pebbles. Farther south, and especially in the interior of the lower peninsula, the pebbles are found to contain a larger percentage of igneous rocks, such as granite and trap, also much quartzite. It is probable that these harder rocks came from the north of Lake Huron and that a considerable quantity of the softer pebbles were ground to powder in the transit. The same variation, even to a greater extent, is apparent in the cobbles or field stones covering these areas.

Before building any state reward road in Michigan, an application accompanied by a plan and profile of the proposed road must be filed with the State Highway Department. The profile must show the proposed grade line and also the cuts and fills in figures. No grades can exceed the statutory limit of 6 per cent.

As most of the roads that are improved are old earth roads now in use, and that have been in use for many years, the stakes are set along the sides, one row on each side parallel to the center line, and preferably 20 or 25 ft. therefrom, so as to place them on the outer margins of the ditches or gutters where they will not be destroyed by ordinary traffic, nor so easily by the grading teams.

The plans should show: (a) the center cuts and fills; (b) the depth of each ditch or gutter from the hub stake adjacent thereto and (c) the vertical distance, plus or minus, from each side stake to the established center grade. Nothing less complete is satisfactory for, in most cases, the work of grading is placed in charge of a highway commissioner or his foreman without the assistance of an engineer.

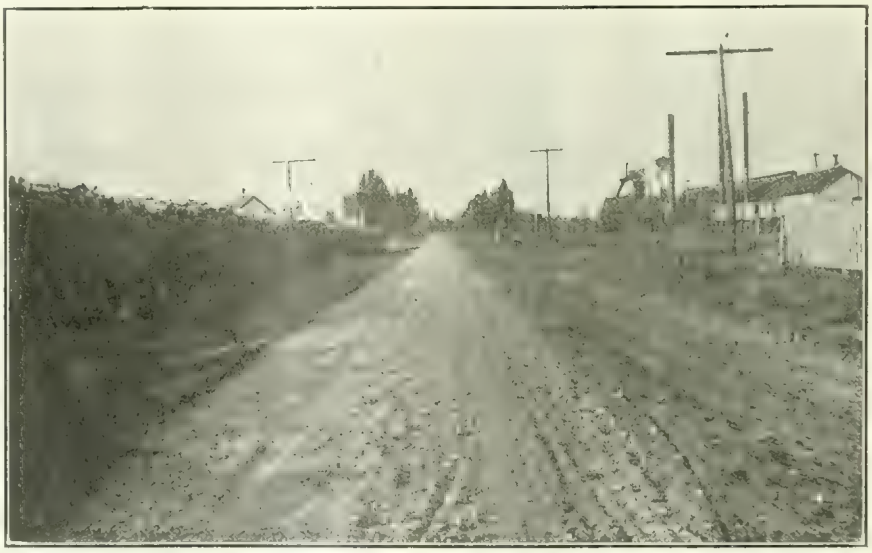

Fig. 5—Partly Compacted Screened Gravel Road at Mancelona, Mich.

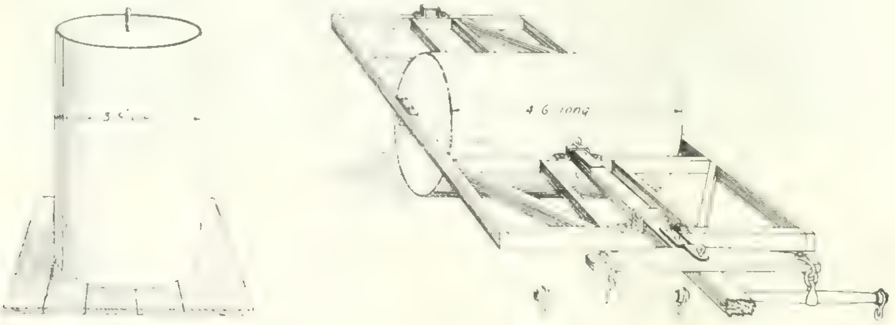

Fig. 4—Concrete Road Roller.

The work of grading is sometimes contracted, but more often is done by the commissioner with day labor. After the road bed, gutters and shoulders have been graded and formed in accordance with the profile and the state specifications*, the work of applying gravel begins.

In Michigan the law requires that the graveled portion shall be not less than 9 ft. in width nor less than 8 ins. of compacted depth, and that the gravel shall be put on in not less than two layers, each layer being compacted separately.

Experience has taught us that Michigan gravels are valuable for road purposes as follows:

(1) Almost in direct proportion to the percentage of pebbles constituting the mass.

(2) In direct proportion to the value as road metal of the rock fragments constituting the pebbles.

(3) In direct proportion to the value as a cementing material, under all conditions of weather, of the finer particles of earthy matter constituting the filler or binder.

Conforming to these principles, the only requirement in our specifications is, that at least 60 per cent by weight of the gravel shall be pebbles above ⅛ in. in size, with no pebbles in the bottom layer that will not pass through a 2½-in. screen, and in the top layer that will not pass through a 1½-in. screen, and that not more than 20 per cent of the mass shall be clay uniformly mixed and having no free lumps.

While these requirements seem very easy, they at once reject or call for screening of the gravel in more than one-half of the pits formerly in common use in our state.

Many devices have been used for screening, ranging from the ordinary mason's hand screen to power driven elevators with rotary screens attached which deliver the graded pebbles into different pockets of elevated bins.

Hand screening with the ordinary mason's screen at Mancelona cost, on the average, about 44 cts. per cu. yd. for the screened product when shoveled into the wagons. About one-third of the material handled was waste.

*These specifications were printed in part in Engineering-Contracting December 28th, 1910.

The wagon screen shown in Fig. 1 reduced the screening cost to full one-half the above amount. This screen is 3 ft. wide and the length of a dump wagon usually 9 ft. The frame is made of 2-in. x 4-in. scantling with two cross braces of the same material. The frame is covered with screen wire of a size, usually ¼-in. to ⅛-in. mesh, required to give a satisfactory product. The angle at which the screen is set will vary the product to a considerable extent. The lower edge of the screen is provided with hooks to hang on to the side boards of the wagon, and the screen is supported at the desired angle by posts bolted to the upper end of the frame, or as in later screens, the posts fit in iron hoops attached to the upper side of the screen. This device is quite popular in Antrim and Kalkaska Counties.

Some gravel is partially screened when loaded with drag scrapers by allowing it to slide over a chute screen placed on an incline between the dumping platform and the wagon. This screening costs less than it does to shovel the gravel into wagons by hand, but it is not very thorough and cannot be recommended, except where the filler is fine dry sand.

A similar chute screen is sometimes used in connection with an ordinary bucket elevator driven by a gasoline engine, which is housed in between the elevator and the gravel bins. This arrangement is shown in Fig. 2. The bins are sufficiently elevated to permit of drawing the gravel by gravity directly into the wagons, thus saving any further cost for loading. In such cases the gravel is delivered to the elevator boot by means of single horses hitched to drag scrapers. With such an outfit, it is easy to screen from 60 to 75 cu. yds. of gravel per day, and to keep the cost of screened gravel in the bins at from 20 cts. to 25 cts. per cu. yd. The force required is: Three single horses on drag scrapers, each with man; one team and man with wheel scraper to remove sand; one superintendent who acts as engineer and handy about the plant.

Rotary screens, already mentioned, are often used instead of the chute screen and with better results when the gravel is moist or contains any clay loam. If much clay is present, it is impossible to screen gravel without placing a water jet in the screen, which is generally not desirable in producing road gravel. This has not been done in Michigan, except in commercial pits where most of the product is sold for concrete purposes.

Where it is not necessary to screen the gravel, it is usually loaded by hand, though the drag scraper is frequently used for hauling the gravel up a plank incline by means of rope and pulleys so arranged that the loading team travels in a path, the direction of which is approximately at right angles to the incline.

In other cases, wheeled scrapers are used to place the gravel into hoppers, which are large enough to hold a wagon load, and high enough to permit dumping directly into the wagon when filled, as is clearly shown in Fig. 3.

There are no unusual features employed in delivering the gravel to the roads. Traction hauling has been employed only to a limited extent. For the most part, teams with slat bottom dump wagons are used, the price for man and team ranging from $3.00 to $5.00 per day in different parts of the state. Experience has taught us that a team should travel 20 miles for a day's work, where the haul is ½ mile or more, so that too much time is not consumed loading and dumping. The roads hauled over are such that the loads vary from 1 to 2 yds.; the average probably is not greater than 1¼ yds. Thus, given the length of haul, the size of loads that can be drawn and the rate of wages in any community, it is a simple matter to estimate the cost of delivering gravel to the roads. The cost of hand loading varies between 10 cts. and 15 cts. per cu. yd., depending upon the ease with which gravel can be handled and the wages paid. The spreading varies from 2 to 5 cts. per cu. yd., according to methods used.

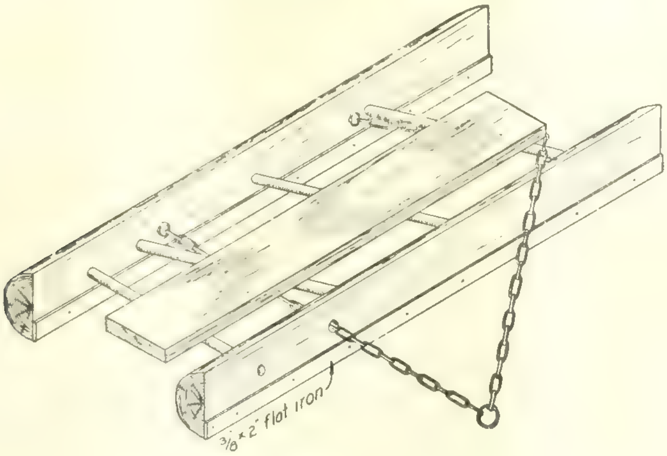

Fig. 1—Split Log-Hone.

The state law requires that the gravel shall be applied in two layers, and that each layer shall be compacted separately. It has been found that 10 ins. of loose gravel are required to make 8 ins. of compacted gravel, a shrinkage of 20 per cent, where the gravel is not driven into the subgrade nor wasted away on the sides. Usually 6 ins. of loose gravel is put on for the first layer and 4 ins. for the second layer. A spike-tooth farm harrow, preferably one of the lever type with teeth tilted slightly backward, is the first compacting tool used, and the most efficient in the early stages, not excepting a power roller. The gravel is usually placed on the road commencing at the end nearest the pit, so that the gravel teams do a large part of the compacting. To save cost, rolling is seldom done until after rains have thoroughly wet the gravel. In some instances power rollers are used, but on most roads the rolling is done with horse rollers.

Many concrete rollers are used for this purpose. It has been found that a very cheap and efficient concrete roller can be built of old boiler shells after the plan shown in Fig. 4. The dimensions are given except for the shaft, which should be about 3 ins. in diameter, and no further description is necessary. The cost of such rollers has been, in most cases, between $50 and $60 and their weight is nearly 4 tons. Complete rollers with steel shells ready to be filled with concrete are on the market and cost about $110. Quite a number of these rollers are also in use on Michigan roads.

No matter how painstaking the work of spreading, harrowing and rolling the gravel, on the ordinary country road, the final set will come only under travel, and to insure a good surface the road must be kept smooth during this formative period. For this purpose, the most effective tools are the log and plank drags, or some of the various types of steel drags which accomplish the same purpose. If the former tools are systematically used after rains, when the gravel is in packing condition, no other scraping tools will be necessary, but the road must be kept smooth during this time, even though it be necessary to use the four-wheeled grader at times. When once compacted in this manner, and with a cross section that gives perfect surface drainage, there is less trouble to maintain a good gravel road surface than any other where the volume of traffic is not beyond its capacity.

Maintenance of Earth and Gravel Roads in New York State by Road Honing.

The proper maintenance of earth and gravel roads is one of the most important problems which confronts the highway engineer. Much has been written and many theories have been advanced as to the proper means for preserving the crown of earth and gravel roads, and of filling the ruts and depressions. In New York state many devices to secure these ends have been tested, and according to Bulletin No. 1 of the Bureau of Town Highways, from which these notes have been taken, it has been demonstrated that the most economical and effective way of preserving the crown of earth and gravel roads and filling ruts and depressions is by systematic road honing. It is stated that in many instances for terms varying from one to six years and under varying conditions of soil and traffic, by a systematic use of road hones in districts varying from three to six miles each, earth roads have been maintained and kept in good condition at an average cost of less than $6 per mile per year.

The road hone most commonly used in New York state is the device heretofore known as the split log drag. A sketch of this hone is shown in Fig. 1. A hone of this kind is made by splitting a log 8 or 9 ft. in length, and 10 or 12 ins. in diameter, in halves, which parts are placed about 30 to 36 ins. apart, with the flat sides to the front so that the sharp edges will act as scrapers, and be fastened in this position by crossbars. These hones can be constructed at a cost of about $2 or $3 each.

Two pieces of railroad rail fastened by iron bars in the same manner make a better and

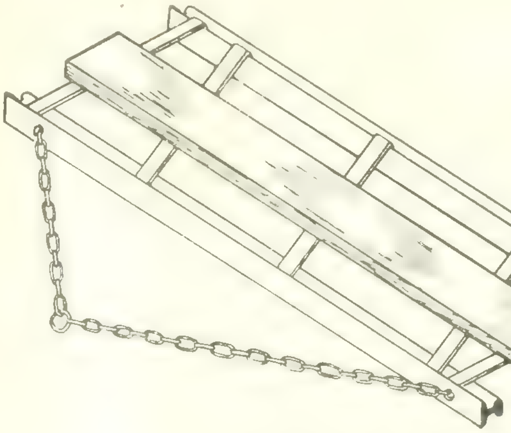

Fig. 2—Railroad Road Hone.

more durable hone. See Fig. 2. Plank may be placed on crossbars on which the driver may ride, if necessary. To use it the horses are hitched so that the hone has a slant of about 45° to the direction of the pull of the team.

What is claimed to be a still better and more effective hone is shown in Fig. 3. This is made of oak plank 4 ins. thick and 10 ins. wide faced with a cutting edge of steel or iron, and beveled on the back. A heavy stick of timber to smooth and compact the road may be fastened to the back by means of chains about 30 ins. in length. The hone is hauled by a tongue fastened rigidly to the face of the plank. There are several holes through this half circle spaced at equal distances, and in a position to receive a bolt passing through the tongue. By changing this bolt any desired slant may be given to the scraper. Other types of road hones used in New York state are shown in Figs. 4 and 5.

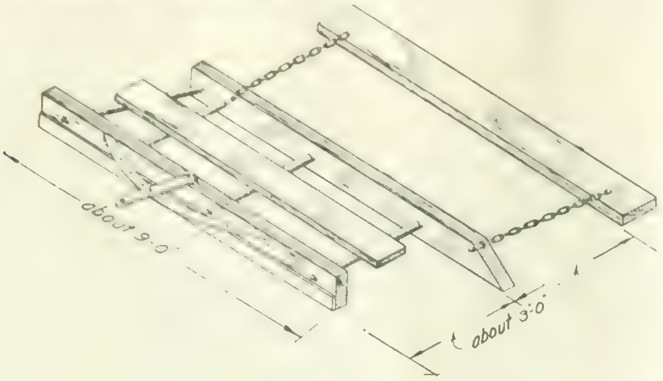

Fig. 3—Oak Plank Hone.

Before undertaking to use the hones the road must be thoroughly drained, shaped and crowned by the use of a road machine for grading and scraping. The loose stones, sod and organic matter must be removed and the ditches and culverts made free and clear. Then the hones must be used while the road is wet from recent rains, and should be honed its entire length. It is important that the road hones should not be used after the surface has become dry. It is time and money worse than wasted as actual damage results from their use at such times because it is productive of a dusty condition and tends to destroy hardened particles of earth which might otherwise resist wear. The earth must be handled while it contains moisture if a solid earth surface is desired. Consequently the only time when it is proper to use a hone is while the surface of the road is actually wet, or, at least, moist. A gravel road must be wet at the time of honing, a clay road can not be honed wet, but must be moist.

By using the hones while the road is yet wet or moist it finally becomes a series of practically waterproof layers of puddled earth, and almost imperceptibly the center is elevated to a smooth grade that is not easily affected by the bad weather. One point which must not be lost sight of is the fact that the puddling effect of the hone when used upon a wet surface is fully as important in its results as the smoothing which is accomplished. This implement should be used when parts of the road might seem altogether too wet, but usually it is impossible to commence this work too soon after a rain. While the road is in this condition it is better to drive down one wheel track and back on the other. This will work the earth toward the center of the wagon track, fill the depressions and gradually widen the road as the work progresses.

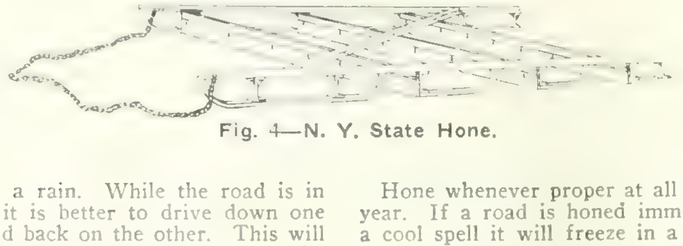
Fig. 4—N. Y. State Hone.

It will be found that in honing roads, the soil conditions of which are more particularly clay, while the roads are moist that the ruts will be filled with mud or soft earth, which must have proper time to settle or harden before the passage of vehicles in the same track or rut can properly be permitted. It is desirable to provide at convenient places by the side of the road wooden blocks, or hardheads, ranging in size of from 6 to 8 ins. or thereabouts, and as the road is being honed on one side to place these blocks, or hardheads, at intervals of 100 to 200 ft. along the rut, thus forcing the travel out of the ruts and giving them an opportunity to harden and cure. These blocks, or hardheads, should be removed as soon as practicable and not later than 24 hours after honing. The use of these blocks applies only to such cases where a road has become deeply rutted. This practice will force the automobile or the heavily laden vehicle to seek passage over other portions of the roadbed which cannot be easily destroyed by once traveling over it. It must be borne in mind that a practice of this character will inflict a temporary inconvenience upon the user of the road, but if a road has been standardized to a width of 24 ft. between ditches with a crown of 1 in. to the foot there is no good reason why travel should not be temporarily diverted over certain portions of the road to the end that the most excellent results desired may be attained.

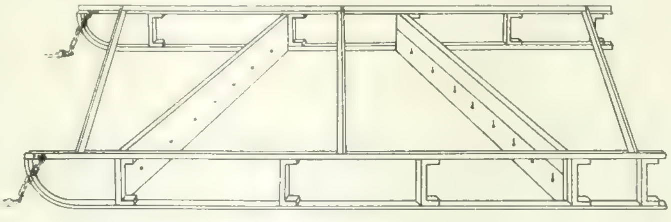
Fig. 5—Vermont Hone.

The following points should be borne in mind in honing a road:

Make a hone which can be hauled over the road at an angle so that a small amount of the earth is pushed to the center of the road.

Drive a team at a walk, and let the driver ride on the hone.

Begin at one side of the road or wheel track, returning on the opposite side.

Hone the road as soon after every rain as possible but not when the mud is in such a condition as to stick to the hone. Do not hone a road when dry.

Hone whenever proper at all seasons of the year. If a road is honed immediately before a cool spell it will freeze in a smooth condition.

The width of the traveled way to be maintained by the hone should be from 18 to 24 feet; first hone a little more than the width of a single wheel track, then gradually increase until the desired width is obtained.

Always hone a little earth toward the center of the road until it is raised, forming a crown of at least one inch fall to the foot. If the hone cuts too much, shorten the hitch.

The amount of the earth that the hone will carry along can be very considerably controlled by the driver accordingly. When the roads are first honed after a very muddy spell wagons must drive, if possible, to one side until the roadway has a chance to freeze or dry out.

The best results from honing are obtained by a repeated application. Constant attention is necessary in order to maintain an earth road in its best condition.

American Society of Mechanical Engineers.—The sixty-third meeting of the American Society of Mechancal Engineers will be held in Pittsburg, Pa., from May 30 to June 2, inclusive. The society has not met in this city since 1884. An executive committee consisting of E. M. Herr, chairman, George Mesta, J. M. Tate, Jr., Chester B. Albree, D. F. Crawford, Morris Knowles and Elmer K. Hiles, secretary, will have charge of the Pittsburg meetings. It is expected that from 300 to 400 members and ladies will be in attendance. There will be professional sessions when papers will be read and discussed. There will also be inspection trips through the leading local industrial establishments, besides automobile trips through the parks, a visit to Carnegie Institute, Memorial Hall, etc.

New York, New Haven & Hartford Appraisal.—The report of the appraisers appointed by the Massachusetts legislature to examine the property of the New York, New Haven & Hartford R. R. shows that the value of the property is 44 per cent greater than the securities issued against it. The total value of the property, not including intangible assets, is $496,000,000, while the total obligations of the company are $340,000,000.

The New York State Barge Canal Terminal Commission has submitted its final report. Recommendation is made by the commission that the state appropriate $16,500,000 for terminal construction and equipment in New York, Albany, Troy, Whitehall, Schenectady, Utica, Oswego, Syracuse, Rochester, Tonawanda and Buffalo. It is estimated that this appropriation will suffice to construct and equip the barge canal public terminals. Recommendation is made that the state engineer shall prepare the plans for the terminals and supervise their construction and that afterward they shall be turned over to the state superintendent of public works for administration. That the state superintendent of public works shall fix a schedule of charges for use of the terminals also is suggested, with reservation that before the schedule goes into effect it shall be approved by the canal board.

The legislature of Kansas has passed the workmen's compensation act. The act will apply only to hazardous employment at which 15 or more persons are working. The act provides that if a workman dies from injuries his dependents shall receive three times the amount he earned the preceding year, but not to exceed $3,600 and not less than $1,200. In case he leaves no dependent the expense of medical attendance and funeral shall be paid by his employer.

WATER-WORKS AND SEWERS SECTION

A Sewer Cleaner with Motor Operated Cutters; Costs of Operation.

A new type of sewer cleaner with motor operated cutter has recently been extensively used in Kansas City, Mo., and is being introduced into other cities. The cleaner is shown by Fig. 1 and Fig. 2 is a diagram indicating the method of using it. Referring to Fig. 1 it will be seen that the cleaner consists of a barrel provided with four runners on which it rides when moving through the sewer. Within the barrel is a water motor, the shaft of which extends out of the front end and carries a series of hook-shaped cutting blades. The rear end of the barrel is provided for a hose connection by means of which the water for operating the motor is delivered. Finally there are rope connections in front and rear.

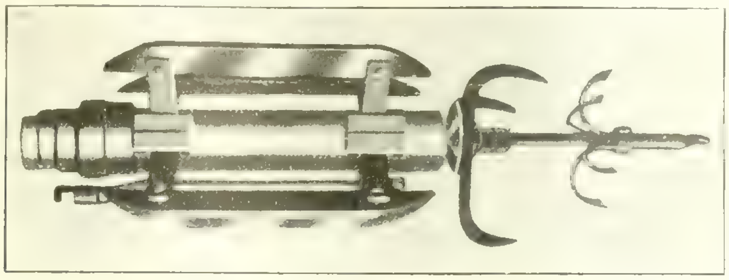

Fig. 1.—View of Sewer Cleaner.

In operation a hose from the nearest hydrant is attached to the barrel and the cleaner is hauled through the sewer between manholes by windlasses as indicated by Fig. 2. As the cleaner advances the cutting blades operated by the motor cut and grind away the sediment which is carried away by the stream of waste water from the motor. The hose has, of course, to be long enough to reach from the hydrant down the first manhole and through the sewer to the second manhole. Four men nominally operate the cleaner, two ahead operating the second windlass to pull the cleaner and two at the first manhole to feed in the hose and back rope.

As indicating the efficiency and cost of operating the cleaner we give the following excerpts from a report by Theodore N. Aish, Engineer in Charge of Comprehensive Sewer System, Kansas City, Mo., of a test run made Dec. 7, 1910: The sewer was an 18-in. pipe sewer and the length cleaned between manholes was 371 ft. At 12:20 p. m., the crew, consisting of 4 laborers, 1 foreman and 1 team began the work of stringing hose to the nearest fire plug, 1,250 ft. distant, and getting rods through the stretch of sewer between manholes No. 1 and No. 2, preparatory to running the machine through. All preparatory work was done, water turned on and the machine started from manhole No. 2 at 3 p. m. A few minutes after the machine was started a length of hose burst, which caused a delay of 12 minutes while a new length was being put in. The machine was taken out at manhole No. 1 at 3:42 p. m. having traversed the 371 feet of pipe in 42 minutes, or deducting the 12 minutes delay for repairing hose, the actual time of cleaning the sewer was 30 minutes. The hose was then taken up and rolled and everything cleaned and put away by 5:30 p. m. That this sewer was actually cleaned was shown by running a Shannon bucket through the sewer after the machine had gone through. In the whole length of this sewer only about ⅓ cu. ft. of dirt was gathered in the bucket. The cost of the cleaning was as follows:

Foreman, 5 hours at 37½	$1.85
Team, 5 hours at 50 cts	2.50
Labor, 20 hours at 25 cts	5.00
Total labor cost	$9.35

The length of sewer cleaned being 371 ft., the cost per foot was 2.52 cts. Another report gives the cost [illegible] days' work cleaning 7,801 ft. of sewer as 3.15 cts. per ft., including cost of shifting machine from job to job.

The sewer cleaner described is made by the Sieben System of Sanitation Co., Kansas City, Mo.

Cost of Laying Cast Iron Pipe for the Water Works of Monterey, Mexico.*

In constructing the new water works for Monterey, Mexico, some 66¼ miles of cast iron distribution mains were laid, the great bulk of which was 4-in., 6-in. and 12-in. pipe. There were 1,126 gate valves on the line.

The pipes were all cast according to the British Standard Specification, in 3.65-m (12-ft.) lengths, and were supplied by Messrs. D. Y. Stewart & Co., and Messrs. Dick, Kerr & Co., of Kilmarnock and London. The valves were all of standard design, faced with gun-metal, and were supplied by Messrs. Glenfield & Kennedy, Limited, of Kilmarnock, Scotland.

The pipe was laid by Mexican labor, which proved efficient after the gangs were once trained. The following shows the rates of laying and the cost per lineal foot, excluding lowering and testing, for the several sizes. In figuring these costs, which are given in Mexican pesos, we have taken the value of the peso at 50 cts., which is 1 to 1½ ct. high, in order to reduce the amount of computation. Those who desire more exact figures can readily make their own computations from the figures given. The records are all for a 10-hour working day:

30-in. Pipe:	Per day.
1 foreman at 4.50 pesos ($2.25)	$ 2.25
4 caulkers at 3.00 pesos ($1.50)	6.00
2 lead pourers at 2.00 pesos ($1)	2.00
1 lead miller at 1.50 pesos ($0.75)	0.75
1 pipe cutter at 2.00 pesos ($1)	1.00
12 laborers at 1.00 pesos ($0.50)	6.00
1 water boy at 0.50 pesos ($0.25)	0.25
Total	$18.25

Gang averaged 20 pipes, or 240 ft. of pipe per day, which gives a cost of 7.6 cts. per ft.

24-in. Pipe:	Per day
1 foreman at 4.50 pesos ($2.25)	$ 2.25
5 caulkers at 3.00 pesos ($1.50)	7.50
2 lead pourers at 2.00 pesos ($1)	2.00
1 lead melter at 1.50 pesos ($0.75)	0.75
1 pipe cutter at 2.00 pesos ($1)	1.00
10 laborers at 1 peso ($0.50)	5.00
1 water boy at 0.50 peso ($0.25)	0.25
Total	$18.75

Gang averaged 25 pipes per day, or 300 lin. ft., which gives a cost of 6.25 cts. per lin. ft.

20-in. Pipe:	Per day.
1 foreman at 4.50 pesos ($2.25)	$ 2.25
4 caulkers at 3.00 pesos ($1.50)	6.00
2 lead pourers at 2.00 pesos ($1)	2.00
1 lead melter at 1.50 pesos ($0.75)	0.75
1 pipe cutter at 2.00 pesos ($1)	1.00
12 laborers at 1.00 peso ($0.50)	6.00
1 water boy at 0.50 peso ($0.25)	0.25
Total	$18.25

Gang laid 35 pipes per day, or 420 lin. ft., which gives a cost of 4.35 cents per lin. ft.

18-in. Pipe:	
1 foreman at 4.50 pesos ($2.25)	$ 2.25
4 caulkers at 3.00 pesos ($1.50)	6.00
2 lead pourers at 2 pesos ($1)	2.00
1 lead melter at 1.50 pesos ($0.75)	0.75
1 pipe cutter at 2.00 pesos ($1)	1.00
8 laborers at 1.00 peso ($0.50)	4.00
1 water boy at 0.50 peso ($0.25)	0.25
Total	$16.25

Gang laid 40 pipes per day, or 480 lin. ft., at a cost of 3.38 cts. per lin. ft.

15-in. Pipe:	Per day.
1 foreman at 4.50 pesos ($2.25)	$ 2.25
4 caulkers at 3.00 pesos ($1.50)	6.00
2 lead pourers at 2.00 pesos ($1)	2.00
1 lead melter at 1.50 pesos ($0.75)	0.75
1 pipe cutter at 2.00 pesos ($1)	1.00
8 laborers at 1.00 peso ($0.50)	4.00
1 water boy at 0.50 peso ($0.25)	0.25
Total	$16.25

The gang laid 45 pipes per day, or 540 lin. ft., at a cost of 3 cts. per lin. ft.

12-in. Pipe:	Per day.
1 foreman at 4.50 pesos ($2.25)	$ 2.25
4 caulkers at 3.00 pesos ($1.50)	6.00
2 lead pourers at 2.00 pesos ($1)	2.00
1 lead melter at 1.50 pesos ($0.75)	0.75
1 pipe cutter at 2.00 pesos ($1)	1.00
8 laborers at 1.00 peso ($0.50)	4.00
1 water boy at 0.50 peso ($0.25)	0.25
Total	$16.25

The gang laid 60 pipes, or 720 lin. ft. per day, at a cost of 2.25 cts. per lin. ft.

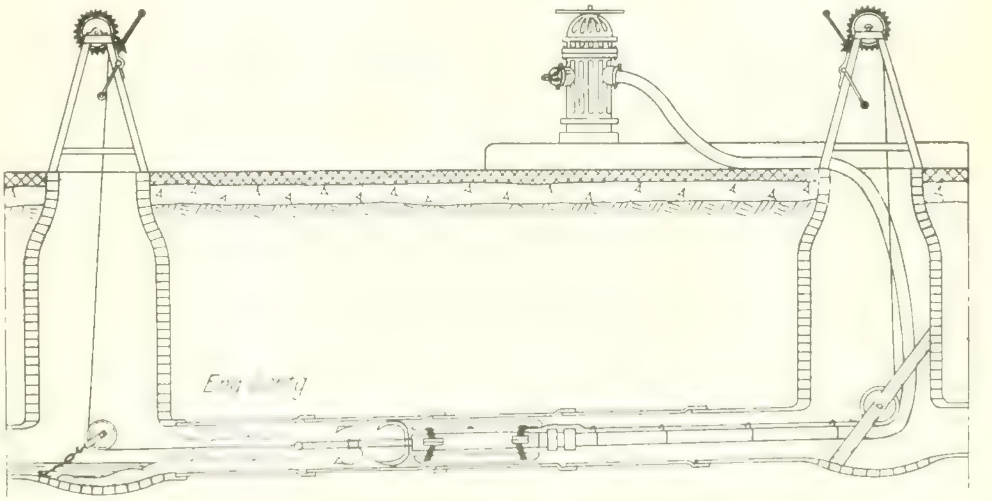

Fig. 2—Method of Using Sewer Cleaner.

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*Rearranged from [illegible] Water-Works and Sewerage of Monterey, N. L., Mexico," by G. R. G. Cireway, Proc. Am. Soc. C. E., Vol. XXXVI, p. 1683.

[illegible] in Pipe	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
1 water boy at [illegible]	[illegible]
Total	$[illegible]

The gang laid 100 pieces or 1,200 ft. of pipe per day, at a cost of 1.27 cts. per lin. ft. Exactly the same gang laying [illegible] laid 150 pipes, or 1,800 ft., per day, at a cost of 0.85 ct. per lin. ft.

Valuation of the Physical Property of the Peoria Water Co., with a Discussion of Rate Making and of Reasonable Rates.*

(Concluded from page 478.)

APPLICATION OF METERS TO PEORIA WATER WORKS.

As has been seen, the average daily consumption of water at Peoria was 7,435,000 gals. per day for the year ending June 30, 1910, or 102 gals. per capita per day, allowing 73,000 as the population of the city and adjacent villages supplied with water.

The services January 1, 1910, were	10,239
Meters in use	371
Per cent of services metered	3.6
Number of services per 1,000 of population	142

Experience shows that cities of the class of Peoria, if supplied with a full quota of water mains, with its business well developed, would have on an average probably 170 or more services per 1,000 population, and with the present relative amount of meters the consumption would have been greater than 102 gals. per capita.

The question is, what consumption per capita would Peoria have had if it had been generally metered? And what is it likely to have in the future if meters should be installed?

The Des Moines, Iowa, water plant, owned by a public service company, has 139 miles of street mains, and on Jan. 1, 1910, had 13,906 service pipes and 13,008 meters, giving 93.5 per cent of metered services. The consumption of water was 52 gals. per capita for the year 1909, with an estimated population of 86,415. On a corrected estimate based on the 1910 census, it was 54 gals. per capita.

The water is furnished to the city with about the same pressure as at Peoria.

In the report on the New York supply made to Bird S. Coler, Comptroller, by John R. Freeman, in March, 1900, such data with relation to the effect of the use of meters on the consumption of water as was then available, was collected and analyzed. From this data a curve was constructed which was intended to represent the mean consumption of water per capita with varying ratios existing between the number of meters installed and the number of service pipes. The second column in the following table, represents the gallons per capita per day taken from Freeman's curve, while the third is intended to be applicable to Peoria, after mains have been extended.

Per cent of metered services.	Gallons per capita daily.	Estimated gallons per capita per day, Peoria.
0	250	155
2.5	180	135
5.0	150	120
7.5	130	112
10.0	115	105
15.0	100	98
20.0	90	94
25.0	82	90
30.0	78	86
40.0	70	81
50.0	65	78
60.0	62	74
75.0	58	70
90.0	56	67
100.0	55	65

The Freeman curve can only be expected to represent the law of variation in a general way, and is very little aid in determining the water consumption in any particular case.

As has been seen, the meters in use in Peoria are 3.6 per cent of the total number of services. This would represent a consumption of about 160 gals. per capita by the Freeman curve, but, as a matter of fact, the consumption is only 102 gals. per capita.

If the water service was developed to the amount of 170 services or more to 1,000 of population, the present consumption instead of being 102 gallons, might have been at least 125 gals. per capita.

Making all the comparisons possible with the foregoing data, and particularly comparing with Des Moines, where the consumption was 54 gals. per capita in 1909, on a population corrected for the 1910 census, it is believed that if the Peoria works were now metered to the extent of 95 per cent of the services that the consumption would not have exceeded 60 gals. per capita per day, and that after the mileage of street mains is brought up to 132 and the business well developed, that the consumption is not likely to exceed 65 gals. per capita per day under a condition of 100 per cent of services metered.

In the third column of the foregoing table, giving the relation between the per cent of services metered and the consumption of water per capita per day, is an estimate of this relation for the Peoria Water Works based upon the meter data collected, which is intended to apply to Peoria after its business shall have been developed commensurately with a distribution system of not less than 132 miles of street mains, and with approximately 170 services per 1,000 population.

On the basis of the relation shown, the following table gives the population it is possible to serve, and the year when an average available supply of 6,500,000 gals. of water per day will be exhausted:

Per cent of services metered.	Population which can be served.	Year when present supply will be exhausted
25	72,200	1911
50	83,300	1917
75	93,000	1924
100	100,000	1930

The limit of the present daily supply is fixed at 6,500,000 gals. per day to guard against a year of excessive drought.

The actual average daily consumption for the year ending June 30, 1910, was 7,435,000 gals., and for the year ending Dec. 31, 1910, it is likely to be over 7,500,000 gals. The maximum daily consumption for the year being probably that of July 9, when it reached 12,458,000 gals.

A new well will be put into operation soon, which is likely to increase the supply for such a year as the present one, in excess of 500,000 gals., bringing the total daily average supply to more than 8,000,000 gals.

In using 6,500,000 average daily supply for a year of drought a 20 per cent reduction is made over such a year as the present one.

For these reasons and because the water consumption is increasing rapidly at present, being 20 per cent greater per capita for the year ending June 30, 1910, than it was one and one-half years earlier, there seems to be no question that meters should be applied promptly and universally in Peoria.

The special conditions affecting the water supply seem to render this policy imperative.

COST OF INSTALLING AND MAINTAINING METERS.

In 1904 Edward W. Bemis, Superintendent of the Cleveland Water Works, in a paper before the American Water Works Association, gave the experience in Cleveland in setting and maintaining meters as follows:

Total number ⅝-inch meters set to date, 13,407.

Average cost of meters and connections	$ 6.50
Average cost of setting, including vaults and basins	6.87
Total in place	$13.37
Average cost of maintenance:	
Reading and clerical work	$ 1.10
Repairs	.10
Interest and depreciation, 8 per cent on $13.37	1.07
Total maintenance	$ 2.27

Data contained in the report of the Cleveland Water Department for 1908, shows that the average cost of setting 64,148 ⅝-inch meters to that date, and the cost of maintaining them for the year 1908 was as follows:

Average cost of meters and connections	$ 6.49
Average cost of setting, including vaults and basins	8.75
Total in place	$15.24
Average cost of maintenance, 1908:	
Reading	$ .57
Repairs	.11
Interest and depreciation, 8 per cent on $15.24	1.22
Total maintenance	$ 1.90

No clerical work other than the mere reading of the meters is included in the maintenance account for 1908.

Considering this data as a whole, it is fair to take the cost of maintaining ⅝-inch meters in Cleveland at $2.00 per meter per annum.

In the report on the New York water supply heinbefore referred to, John R. Freeman estimates the cost of furnishing and setting meters for that city, with a force of men working systematically, for domestic sizes ⅝ and ¾-inch, at $12.50

Average cost all sizes 15.00

Cost of maintenance all sizes, including interest, $2.50 per meter per annum.

This estimate is not very different from the Cleveland experience.

In Cleveland they use many large brick basins outside of the houses, which makes the cost of setting much higher than it would otherwise be.

Peoria would doubtless get along with less expensive housing for the meters, so that the cost of installation would probably be less than in Cleveland. On the other hand, the reading and clerical work, and the repairs, are likely to be somewhat higher in Peoria than for Cleveland.

A safe price for Peoria is believed to be $12.50 for setting all sized, and $2.00 per annum to cover all expense of reading, repairs, renewals and interest.

REASONABLE RATES.

Under the head of returns, the conclusion was reached that 7 per cent per annum on the proper investment value of the plant would be a minimum to allow for interest and profits, or more properly, interest and compensation for use of capital and services in caring for the capital, and the risks incurred in the conduct of the business.

It has also been determined that the fair value of the property of the Peoria Water Works Company as of Jan. 1, 1909, was $2,150,000.

This brings us to the concrete problem of reasonable rates, as specifically applied to the Peoria Water Works. There are four phases to this question:

1. As to whether the earnings of the Company as a whole yield an excessive profit, considered with reference to the investment and the operating charges, and as compared with the cost incurred by municipalities which furnish their own supply.

2. As to matters of fair rate adjustment between private consumers, and the proper proportion of the whole revenue which should be derived from private sources, compared with that paid by the municipality for public service.

3. As to questions of reasonableness to the consumer, viewed abstractly, and as compared with the cost of individual service in other cities, but without regard to the amount of the investment and cost of operation.

4. As to reasonableness of the Peoria rate ordinance, as affecting the income of the Company if applied literally.

The first phase of the question is best covered by a comparison between the revenue of the Company and the operating expenses plus the proper return, as follows:

Revenue for Year Ending December 31, 1908.		
Revenue from city	$ 47,470	
Revenue from private sources	177,538	$225,008
Expenses and Fixed Charges.		
Operating expenses, 1908, exclusive of taxes and depreciation, and reduced $8,016 because of unusual contingent expenses	$ 75,600	
Depreciation being that annual sum which placed at compound interest at 4 per cent equals $1,650,000 in 46 years	15,000	
Taxes	15,000	
Returns, being 7 per cent for interest, administration and profits on $2,150,000	150,500	$256,100
Deficiency		$ 31,092

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*Condensed and partly rearranged from "Valuation of the Property of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams "Audit of Accounts of the Peoria Water Works Co.," by Edward A. Pratt & Co., and "Water Rates for the Plant of the Peoria Water Works Co.," by Benezette Williams and C. B. Williams; reports made for the city of Peoria.

This showing is on the plant as it existed on Jan. 1, 1909. Since that time considerable money has been expended in extensions of water mains and improvements at the pumping station. Just how much is not known.

As appears under the head of "needed improvements," there should be expended $570,000, more or less, upon the water plant, within the next three years.

There are other tests that can be profitably applied to determine whether the earnings of the company as a whole are excessive, and as to whether the city is being better or worse served with a public service corporation than other cities who operate their own plants.

Appendix I is a tabulation of the operating and investment data of thirty-nine water works plants owned and operated by municipalities that are supplied by pumps, in cities that range from approximately 25,000 population to 240,000 population. The average population being 85,000 per city, as compared with 73,000 population served by the Peoria water works.

The following table contains the consolidated mean operating data of these thirty-nine water works plants compared with the Peoria water works plant.

	Means and averages of the Peoria Water Works plant, Dec. 31, 1908	Means and averages of 39 Municipal Water Works plants
Age of plant in years	17	33
Population	70,100	84,995
Water pumped, millions of gallons per annum	2,171	2,924
Gallons, per capita, per day	84	94
Head on pumps in feet	315	212
Miles of street mains	99.3	133.6
Number of services	[illegible]	12,760
Number of meters	288	6,832
Total investment	2,150,000	2,435,582
Investment per mile of mains	21,651	18,226
Investment per capita	31	28
Private revenue, annual	177,538	205,073
Private revenue per service	20	16
Private revenue per capita	2.53	2.41
Operating expenses, without taxes	[illegible]	79,172
Operating expenses, per cent of revenue	[illegible]	38
Cost to city of public service $47,500 hydrant rental less $15,570 taxes, equal	31,930	
Cost to cities of public service, 6 per cent on $2,435,582 = $146,135, plus $79,172 operating expenses, less private income $205,073, equal		20,234
Cost to city for public and private service	209,468	225,207
Cost to city for public and private service per capita	2.99	2.65

In stating the cost of public service to the city of Peoria the taxes paid by the Water Company are deducted from hydrant rental, on the theory that this is necessary to compare with municipal plants, upon which no taxes are paid.

To obtain the cost of public service rendered by the municipal plants, 6 per cent has been allowed on the investment, to cover interest, depreciation and renewals, as also any expenses which are incurred by the cities in connection with the water works, that does not appear in the operating expenses.

When it is considered that the Peoria water plant has lagged behind in the amount of pipe mileage, that it pumps the water twice, and to a total height averaging 50 per cent greater than the plants with which it is compared, and that in comparing the cost of the service for the thirty-nine plants only 6 per cent, including depreciation, interest and contingencies have been charged, the comparison is favorable to the Peoria plant. With municipal plants the consumer almost invariably pays for services, and generally meters. If these outlays in construction were added it would bring the investment for the municipal plants to over $32 per capita.

Such detail comparisons of individual plants operating under varying conditions of water supply, prices of fuel and material, and having different rate schedules, may be often misleading and seldom conclusive. But they are always interesting and instructive, and if the investigation has been given sufficient scope and covers a sufficiently wide field, conclusions of great value can be drawn.

They are desirable as tending to discover some standard by which the fairness of the income of a plant can be approximately determined in advance, and serve as a steadying and standardizing element in matters of this kind.

The second phase of the question of fair rates is important only as it may affect some new schedule which it may be proposed to adopt, and in aiding in the proper adjustment of revenue from private sources, and from the city. Speaking generally, it is believed that the proportion paid by the city at the present time is as nearly equitable as any that can be designated.

As between private consumers there are two cases of discrimination which appear plainly on the face of the analysis made by the Pratt Company.

One is the free list.

It appears that in accordance with the provisions of the franchise, free water is furnished to a large number of public and private institutions. In a new schedule of rates this free list should be abolished, and the service put on a reasonably paying basis.

Appendix VI is a list of institutions, public and private, that pay no revenue. The Company's estimate of the amount and value of the water consumed per annum, at present meter rates, is given as $14,000 a year.

On a properly adjusted scale of rates, there is little doubt but what this free supply would amount to considerably more than that sum. While such a free list prevails, the lowest rates cannot be looked for by private consumers.

If one set of consumers get their water free, another set must eventually bear the expense, or it must be done by the city in its official capacity.

Another apparent discrimination is in the case of 198 residences furnished through meters. By the showing of the auditor the income from these residences that are metered, if put on the flat fixture rate basis, would be $6,360, while as a matter of fact, they are only paying about $2,970, the differences being the measure of the advantage which these few resident owners derive which is not participated in by the householders generally.

The data is not at hand to show whether other cases of unfairness between private owners exist or not.

The income of $33,612 derived from 173 metered business establishments was not analized by the auditor, so that questions of discrimination in this list cannot be raised, if they exist.

During the year 1908 the water sold through meters in the business establishments then having meters was 425,101,845 gallons, or an average of 1,164,000 gallons per day. The total metered water for that year, including 191 residences, was 439,678,000 gallons, an average of 1,204,600 gallons per day.

It is not important that questions of unjust and unequal rates should be extensively gone into, if the purpose of this investigation bears fruit in a new schedule and new regulations.

The third phase of the question of reasonable rates involves an inquiry into the rates and amounts paid by individual consumers.

The audit of the rating cards made by Edward A. Pratt & Co., show that the Company's domestic service consists of supplying water to 8,394 residences, which are classified as follows:

748 residences paying an average of $4.00 per annum.

71[illegible] residences paying an average of [illegible] per annum.

544 residences paying an average of $6.00 per annum.

1,110 residences paying from $6.01 to $10.00 per annum.

1,947 residences paying from $10.01 to $15.00 per annum.

1,219 residences paying from $15.01 to $20.00 per annum.

1,913 residences paying over $20.00 per annum.

[illegible] residences [illegible] of $15.00 per annum.

Same 198 residences at fixture rates would pay an average of $32.00 per annum; 8,394 residences all at flat fixture rates would pay an average of $14.69, or a total of $123,307.

The average number of rooms charged for in the 8,394 residences is 6.42.

In a paper presented to the American Water Works Association, [illegible] meeting, on water rates charges in 375 cities, D. R. Gwinn gives the leading detail domestic fixture rates for 162 privately owned water works plants, and 213 publicly owned water works plants.

The rates given cover baths, water closets, wash basins, sprinklers, and the basic charge for a 6-room house, 5 persons, or first faucet. Also the maximum and minimum meter rates.

Accompanying these tables is a summary of the averages for each group. These averages omitting meter rates are given in the following table with the corresponding Peoria rates.

Summary of Average Fixture Water Rates for 375 City Plants, Compared with Peoria Rates.

	Peoria plant	162 privately owned plants	213 publicly owned plants
Domestic use in 6-room house, or 5 persons, or first faucet	$ 6.00	$ 6.83	$ 6.04
Bath additional	3.00	3.88	2.99
Water closet additional	3.00	3.69	3.12
Wash basin additional	1.50	1.94	1.55
Sprinkler for lot 50x140 feet, not including street and sidewalk in front		6.17	4.37
Sprinkler for lot 50-140 feet, including street and sidewalk in front	6.00		
	$19.50	$22.51	$18.07
Average population (1900)	56,100	25,437	85,382

When it is considered that the larger the city, everything else being equal, the less the rate should be, and the less it generally is, the rates for the 162 privately owned plants do not average out of proportion to the 213 publicly owned plants. The average population of the latter group being more than three times the population of the first group.

Giving consideration to the same factors, the Peoria rates are seen to be about the same as for the municipal plants and less than for the private plants.

The group of cities having municipal plants given in the paper referred to, contains nearly all the cities found in Appendix 1. And since these cities have been used for a comparison in a broader way, it is instructive to compare them with Peoria in the matter of rates in the same manner as the foregoing 375 cities. The fixture rates for only 31 of the 39 cities referred to are available, so the following table contains details and averages of this number only.

A summary of averages is given at the foot of the table and compared with Peoria on the basis of populations corresponding to the dates in Appendix I. for the 31 cities, and with 1910 for Peoria.

It will be observed that considering differences of population the rates at Peoria are as low as for the 31 cities contained in the table.

The Peoria rate ordinance provides that the minimum fixture rate for dwellings shall be $4.00. This should be considered in connection with the foregoing comparisons with other cities, which are on the basis of a six-room house, which is the minimum probably in the majority of cases.

The foregoing comparisons show that as relates to flat or fixture rates, the private consumer has nothing to complain of and that these rates are reasonable viewed from any standpoint personal to the consumer.

The fourth phase of the subject relates to the reasonableness of the water works ordinance as affecting the income of the Company.

The Peoria ordinance provides, concerning meter rates, as follows:

> When the daily consumption is 1,000 gallons or less, the charge to be at the rate of 20 cents per 1,000 gallons.
>
> When the daily consumption is more than [illegible]

The minimum meter rate for a single premises is $3.00.

As stated above, the 198 residences under meter, which are among the largest in the city, are getting their water service for about $2,970, which at the flat or fixture rate, would cost $6,360, and it is pretty well settled that the fixture rate is none too high.

If meters were generally applied under the present ordinance the revenue from residences would be enormously reduced.

With a minimum rate of $3.00 many of the houses now paying from $4.00 up to probably $15.00, would be reduced to the minimum reve-

[illegible] per annum, and the Company would have the meters to maintain besides.

Many other houses would also sustain a large reduction, no one can tell how much or how many, except as indicated by the rates for the 198 houses now having meters.

If the Peoria plant had been completely on a meter basis in 1908, it is estimated that the average consumption would have been 4,500,000 gallons per day approximately, or say 1,642,500,000 gallons per year.

The question is, what proportion of this water consumption would have been measured, and sold, if the plant had been metered 98 to 100 per cent? That is, stating it in reverse order, what would have been the combined waste and unmeasured consumption, compared with that measured?

There are many ways for water to disappear, or to apparently disappear.

For the most part, the amount of water alleged to have been consumed in water plants is ascertained by pump measurement. The amount reported may be based on pump displacement, or on pump displacement less some assumed percentage allowed for slip.

Either method introduces an unverified factor at the beginning.

There may be, and generally is, a material quantity that passes through the meters that is not recorded. Sometimes this becomes a large item, amounting to several per cent.

Leaky street mains, and service pipes, particularly the latter, are a fruitful cause of wastage.

In all cities a considerable quantity of water is used in flushing sewers, for watering troughs, sprinkling streets, flushing hydrants, and mains, and other purposes, particularly in the building trades, and for extinguishing fires.

Considering how variable these factors must necessarily be in different cities, it is no wonder that there is a widely varying ratio between the water metered and unmetered.

The following statement furnishes some information relative to the ratio between the total water consumed and that which is recorded by meter for a number of cities:

	Year.	Daily consumption per capita.	Per cent of services metered.	Per cent of water metered.
Yonkers, N. Y.	1908	101	100.0	51.2
Brockton, Mass.	1909	36	99.2	72.2
Madison, Wis.	1909	61	98.6	42.6
Fall River, Mass.	1909	50	98.5	49.0
Cleveland, Ohio	1908	100	93.6	77.0
Milwaukee, Wis.	1909	99	83.0	60.0
Lowell, Mass.	1909	55	76.9	50.9
Lowell, Mass.	1898	73	46.9	27.4
Minneapolis, Minn.	1908	60	76.1	53.5
St. Paul, Minn.	1909	56	48.6	34.0
St. Paul, Minn.	1896	57	10.5	17.7
Detroit, Mich.	1908	178	9.0	30.0
Buffalo, N. Y.	1909	323	4.0	20.3
Peoria, Ill.	1908	84	3.6	20.2

The great lack of uniformity of ratios for different cities shows disturbing elements that make it practically impossible to deduce any law which can be said to express the relation between the water measured by meters, and the total water consumed, as compared with the number of services having meters and the total number in use. Taking the five cities having over 90 per cent of the services metered and obtaining a mean of the ratios in each of the two columns of ratios, and it appears that for a mean of 98 per cent of services metered, there is corresponding mean of 54.4 per cent of water measured through meters.

Yonkers, N. Y., Fall River, Mass., and Madison, Wis., are three cities with a high ratio of services metered, but with a low ratio of water metered.

It is fair to assume that the amount of water supplied is in error in these cases.

The record of water consumed in Peoria is believed to be more carefully determined than is usual. Also the consumption per capita is small for a city with so few meters. It is noticeable that there is over 20 per cent of the water metered, while only 3.6 per cent of the services have meters. All these facts indicate no unusual waste for an unmetered plant.

It is believed that it is safe to assume that if the plant was metered, two-thirds of the consumption would be measured through the meters.

That is, for every two gallons measured and sold, three gallons would have to be pumped, and that of the foregoing 1,642,500,000 gallons per year, only 1,095,000,000 gallons would have been revenue producing.

The operating expenses for 1908, not including fixed charges, but including taxes and depreciation, would be, allowing 9,000 meters at $2.00 per annum, about $123,000 per annum. To pay this will take approximately 12 cents per 1,000 gallons.

Less than one-half of these operating expenses would be influenced by the amount of of water pumped, so that it is safe to say that if no additional investment should be needed. 5 cents per 1,000 gallons would prevent an actual loss. But even 10 cents per 1,000 gallons would contribute nothing to fixed charge, and would not carry its full proportion of operating expenses.

An 8-cent minimum rate could only be defended in case there was a large business which could be had for this rate, which would be lost otherwise, and the Company had more water than could be used by other consumers.

The 6-cent rate of the ordinance is entirely too low under any condition.

Speaking generally, no water plant similar to the Peoria one, can operate on the meter rates as they stand in the ordinance, hence they may be said to be not only unfair, but impossible.

PROPOSED CHANGE OF WATER RATES.

In the foregoing discussion of reasonable rates, it has become apparent that the fixture rates, or the so-called flat rates, of the Peoria Water Works Ordinance, are not too high, and cannot be considered unreasonable from any point of view. The conclusions with regard to the effect of meters on the consumption of water, in view of the necessity that the Company faces, of either curtailing the waste of water, or of increasing the supply, has led to the farther conclusion that the policy of putting all the Company's business on a meter basis should be adopted, and the shift from flat or fixture rates, to meter rates, made as rapidly as possible.

The final adoption of this policy, with the prompt application of meters at a rate to put the whole city on the new basis by the end of 1913, will do away for an indefinite period with the necessity of an increase in the water supply, or of the pumping capacity, except as relates to a duplicate equipment.

Such a program also renders a revision of the fixture rates in the ordinance unnecessary, except as may relate to certain deficiencies or omissions which experience has shown to exist. Nor will a general reassessment, or relisting of the consumers be necessary, except as it accompanies the proposed change to a meter basis.

Notwithstanding the material and permanent advantages which will undoubtedly be derived from the general adoption of meters, the change cannot be made without danger to the revenue of the Company, if the rates are based wholly upon the quantity of water measured through the meters themselves.

Nor can any scale of meter rates based wholly on quantity give justice between different classes of consumers, or even between individual consumers of the same class. Indeed, it must be confessed that no schedule of rates that can be devised, will in all cases bring exact justice. The best that can be done will be but an approximation. The approximation may, however, be closer, if certain principles are followed than if they are ignored.

SOME CONTROLLING PRINCIPLES IN RATE MAKING.

Many of the early and present advocates of the use of meters, urged as one reason for their adoption that it would enable water to be sold at a uniform price to all consumers, thus preventing, as was alleged, any discrimination. The argument being, that to have different rates for different quantities used, was in effect to discriminate between individuals and classes of consumers.

Water, it was contended, is a commodity, and one consumer should not be charged more for a like quantity than another. This reasoning led to the adoption of what may be termed "Flat Meter Rates," as in the cities of Cleveland and Milwaukee, where there is only one price per unit, for whatever purpose water is used, or in whatever quantity served.

Notwithstanding such fallacies have controlled in the shaping of rates in some cases, the analogy instituted between the product dealt out by a public utility, and ordinary commodities sold in the open market, does not hold on critical examination.

The product of a public utility does not consist of a disengaged thing or commodity. It

TABLE IV.—FIXTURE RATES OF THIRTY-ONE MUNICIPAL WATER WORKS PLANTS COMPARED WITH PEORIA.

Cities—	Domestic use, 6 rooms or 5 persons or 1 faucet.	Bath, hot and cold.	Water closet.	Basin.	Sprinkling 50 ft. x 150 ft. lot and street.	Total.	
Louisville, Ky.	$1.80	$4.00	$2.40	$0.80	$6.00	$18.00	
Kansas City, Mo.	5.05	3.90	3.70	....	7.50	20.15	
Providence, R. I.	6.00	5.00	5.00	2.00	5.00	23.00	
St. Paul, Minn.	4.00	2.00	3.00	....	3.00	12.00	
Columbus, Ohio	5.00	5.00	4.00	....	5.00	19.00	
Memphis, Tenn.	6.00	5.00	5.00	....	10.00	26.00	
Richmond, Va.	5.00	3.50	3.00	1.50	9.60	22.60	
Dayton, Ohio	4.00	2.00	2.50	2.00	5.00	15.50	
Nashville, Tenn.	9.00	4.00	5.00	....	2.31	20.31	
Fall River, Mass.	5.00	5.00	5.00	2.50	6.00	23.50	
Grand Rapids, Mich.	5.00	2.00	4.00	....	5.00	16.00	
Lowell, Mass.	6.00	3.00	4.00	1.00	3.00	17.00	
Wilmington, Del.	5.00	3.00	2.00	1.00	5.00	16.00	
Lynn, Mass.	5.00	3.00	3.00	1.00	4.00	16.00	
New Bedford, Mass.	2.50	2.50	2.50	1.25	2.50	11.25	
Lawrence, Mass.	5.00	3.00	4.00	....	3.75	15.75	
Houston, Tex.	12.00	3.00	6.00	3.00	....	24.00	
Manchester, N. H.	4.50	2.00	2.50	.75	5.00	14.75	
Erie, Pa.	4.00	3.00	3.00	1.00	3.45	14.45	
Brockton, Mass.	5.00	4.00	4.00	1.50	...	.....	
Harrisburg, Pa.	8.00	4.00	4.00	2.50	4.00	22.50	
Ft. Wayne, Ind.	4.40	3.20	2.40	...	2.40	12.40	
Allentown, Pa.	3.75	1.25	2.00	....	2.00	9.00	
Saginaw, Mich.	7.00	2.00	3.00	....	3.00	15.00	
McKeesport, Pa.	8.00	7.50	7.50	...	8.00	31.00	
Binghamton, N. Y.	3.00	3.00	3.00	1.00	3.00	13.00	
Topeka, Kan.	6.00	5.00	3.00	....	7.50	21.50	
Rockford, Ill.	5.00	2.00	2.50	...	5.00	14.50	
Taunton, Mass.	5.00	3.00	5.00	2.00	5.00	20.00	
Waltham, Mass.	5.00	2.00	3.00	1.00	6.00	17.00	
Poughkeepsie, N. Y.	3.50	1.50	2.00	.75	5.00	12.75	
Mean of 31 cities	$5.37	$3.30	$3.58	$1.48	$4.90	$18.63	93,484 Pop.
Peoria rates	$6.00	$3.00	$3.00	$1.50	$6.00	$19.50	73,000 Pop.

*Mostly metered.

is not gas, or water delivered in a bushel measure that is sold, but gas or water delivered, continuously or intermittently, at the will of the user, at a particular spot, under pressure. When no draught is being made it is at hand ready to be drawn on the instant. This "being always at hand," and "ready for use," is the larger part of the service rendered by a public utility. In other words, paradoxical as it sounds, the principal service of a public utility is being ready to serve.

When a city contracts with a public service corporation for fire protection, it is not for a given amount of water delivered on order, as so much coal, but it is for a given amount to be given under pressure on momentary demand, without notice. This can only be done by an expensive plant conducting the water to all parts of the city, and always kept under pressure. Though it were not called into use for weeks at a time, the fixed charges and expenses would remain practically the same.

So completely does the "service of being ready to serve" overshadow the direct product furnished for extinguishing fires, that if the water actually used was paid for by the gallon at what it costs, the price would be astounding.

As a matter of fact, when conditions are analyzed, the most valuable of service is rendered for long periods without the use of a drop of water.

Automatic sprinkling systems installed where there are valuable goods and other property to protect, may run, and do run for years without any water escaping therefrom. But they are rendering service just the same, by furnishing protection, and by the reduction of insurance rates. Many business establishments put in expensive systems of their own, and maintain pumping plants at continuous expense, for no other purpose than to secure a reduction in fire insurance rates.

Then who shall say that the "Readiness to Serve" may not, in many instances, be the most valuable service rendered?

The same reasoning applies in a considerable degree to all kinds of service rendered by a public utility. There is scarcely an exception.

If all water works plants had been built solely for fire protection, as have a number of special systems of late years, water would not have been sold by quantity. The service would have been gauged in some other manner.

Water works, however, were and are usually built to meet a great variety of needs, with some of which the quantity is a large if not a controlling element. But even with these at first, consideration of quantity did not wholly control, for the fixture rate, made without regard to quantity, is more of a readiness to serve charge than otherwise.

It was only with the development of a successful meter that the element of a quantity charge was emphasized.

The first tendency of meter advocates was to get as far away as possible from the original practice. Hence the flat meter rate based upon enthusiasm rather than any well considered plan.

Such rates have not secured general favor, being obviously unsuited to the most of water works plants. Only in large cities, where the cost of supplying water is relatively small, or where the plant has mostly been paid for by taxation or past earnings, so that rates can be fixed as low, or lower than the usual minimum scale, are flat meter rates possible.

And even then they are only possible by making one class of consumers pay for service rendered to another class, or by the municipality as a whole meeting the inequality.

This statement is well illustrated by the experience in Cleveland, which is the most conspicuous example of the application of flat meter rates on a large scale.

After the process of setting meters had been in progress from two to three years, and 25,000 meters were in use, in 1904, Edward W. Bemis, Superintendent, presented a paper to the American Water Works Association, containing an analysis of the results they obtained as relates to the use of metered water. He found after taking out 3,000 business meters and those that had not been in use more than a year, that there were left 16,820 house meters. Of these, 5,770, or about one-third, were using water at the average of [illegible] gallons per day, and 5,550, also about one third, were using water at the average rate of 155 gallons per day, and 5,550 were using water at the average rate of about 660 gallons per day.

Another analysis made the following year and contained in the New England Water Works Association for 1905, of 26,000 meters, not including business meters, showed a consumption per meter as follows:

¼ of the total number, [illegible] residences, averaged.......... 62 gals. per day
½ of the total number [illegible] residences, averaged [illegible]3 gals. per day
And ¼ of the total number or 6,500 residences, averaged [illegible] gals. per day

With the Cleveland minimum readiness to serve rate of $2.50 per annum, and a meter rate of 5⅓ cents per 1,000 gallons, the following would be the yearly charges for houses using varying quantities of water:

50 gallons per day.	$[illegible]47	per annum
100 gallons per day............	4.45	per annum
150 gallons per day............	5.42	per annum
200 gallons per day............	6.39	per annum
300 gallons per day............	8.34	per annum
400 gallons per day............	10.27	per annum
500 gallons per day............	12.22	per annum

In the same paper Mr. Bemis gave the cost of setting and maintaining 16,800 ⅝-inch meters in use at that time, the details of which will be found on page 62 of this report.

From the 1908 report of the Cleveland Water Department, the cost of setting and maintaining 64,149 ⅝-inch meters has been obtained, which will also be found on page 62.

These data show that $2.00 per annum covers all meter costs in Cleveland, including interest.

Two dollars taken off of the revenue for each metered house leaves the contribution of that house toward the operating, depreciation and interest fund, on all of the plant except meters.

The minimum rate of $2.50 applies to all houses using ⅝-inch meters, whose annual assessment rate is under $9.00, but just what numbers would be included in this rate, out of 64,149 houses, is not known, though it must amount to many thousands.

If the water used in such houses remains the same as in 1905, then there would be many thousands of houses that would contribute less than $2.00 a year apiece to this fund.

The works had cost to the end of 1908, $11,876,195, the bonded debt was $5,091,000, at 4 per cent interest, and the operating expenses, interest and sinking fund amounted to $588,327 per annum, to which, if 1 per cent depreciation is added, gives a total annual charge of $677,089. Total income from water rents, $953,055.

It is evident that the occupants of these thousands of houses were not paying for their water service by a wide margin, and that some other group of consumers, or other agency, was.

Instead of a uniform meter rate great varieties of schedules have been devised and put into operation, so that it is scarcely an exaggeration to say that no two plants in the country have the same scale, or use the same basis for a scale. Meter rates, impossible as it may seem, being much more variable, and less harmonious than schedules of fixture rates.

As it would take much time with no corresponding benefit, to go into the details of meter rate schedules now in use, it will be sufficient to say that maximum rates vary from 4 to 60 cents per 1,000 gallons, and minimum rates from 2 to 30 cents, with all conceivable intermediate combinations of rates, and unthinkable annual minima.

This babel of rates and the lack of any consistent guiding principle in their making has been recognized for years by water works managers, and efforts have been made to develop some plan that makes an approach to uniformity, and that can be made generally applicable.

Probably the most intelligent effort in that direction was made by the New England Water Works Association, which resulted in a report of a committee of which Freeman C. Coffin was chairman, made in 1905, and published in the proceedings of the Association for that year.

The report as finally submitted takes the form mainly of certain suggestions to be observed in fixing meter rates. The committee concluded that it was undesirable to attempt to fix a scale of rates because it would be impracticable to devise a scale that would meet with general adoption or adaptability. It was thought possible, however, to arrive at some basis for a scale that would be applicable to any particular plant, due consideration being given to the special conditions prevailing with the plant.

The more important requirements of a method for arranging meter rates the committee held were:

That it should insure a sufficient revenue to meet the operative and financial demands of the plants.

That it should be flexible so that the rates may be easily changed in case of a deficiency or surplus of income.

That the method should allow of the use of meters upon services with a single faucet without increase over the faucet rate, except for actual use or waste of water.

That it should secure from large houses with a full line of fixtures, a sufficient amount to meet the proportional fixed charges of the plant even if little water is used.

The committee suggested two methods that it was thought would measurably meet these requirements.

One of the methods proposed, called the "Frontage Assessment" method, is based upon the frontage of the lot or premises occupied by the buildings being served.

The other, called the "Multiple Minimum Rate" method, is founded on rates giving the right to the installation of the various kinds of fixtures or apparatus to be used on the premises.

Each method is expected to provide a revenue, not affected by the amount of water used, and which will cover a material part of the necessary annual outlays, and is really in effect the establishment of a "Readiness to Serve" charge accompanied by a quantity meter rate.

Something akin to the "Frontage Assessment" plan was adopted by Chicago when the water works were put into operation. It combined frontage assessment with fixture rates, as well as with meter rates.

The fixing of a minimum rate based upon some feature of the plant or premises served, has been, and is used extensively in various plants, particularly for the purpose of bridging over the hazardous period of change from a fixture to a meter rate basis.

When Cleveland began in 1901, the radical policy of universal metering, at the most rapid rate ever known, minima, or readiness to serve rates, were adopted to lessen the risk involved.

For all premises supplied by meters larger than ⅝-inch a minimum charge at the rate of $10.00 per annum was made.

For premises having ⅝-inch meters, there were four minimum charges.

When the annual charge under the old fixture rate assessments was $4.00 and under, the minimum was $2.50 per annum; when it was $4.00 to $6.00, the minimum was $4.00 per annum; when it was $6.00 to $10.00 it was $6.00 per annum, and when it was over $10.00 the minimum was $8.00 per annum.

The flat meter rate additional to these minima was 40 cents per thousand cubic feet, or 5⅓ cents per thousand gallons to all classes and kinds of customers. Since that time, these minima for ⅝-inch meters have been abolished and others substituted, except the lowest one of $2.50 per annum, which has been made to apply to all cases where the annual assessment rate does not exceed $9.00.

Some water works managers advocate, and some have adopted a varying scale of minima, based on the size of meter.

It is very common for water companies to make an annual charge for installing and maintaining meters, based often on the size of the meter. Some municipalities do the same, as for instance, Milwaukee charges one dollar a year.

This charging for meters can serve no purpose that cannot be served by establishing minimum rates [illegible] the water expense [illegible] so that the consumer does not realize that it is a part of the water rates.

[illegible] reason given for minimum rates where water is furnished [illegible] charge and the almost universality of their use, in one form or another, amounts to a unanimous [illegible] meter rate schedules that does not vary with the quantity of water.

METER RATE SCHEDULE FOR PEORIA.

The concrete problem at Peoria is to devise a plan which will minimize the risk of the revenue attending a radical change from fixture rates to meter rates, and that will the most equitably and automatically apportion this revenue among the consumers, and be as simple as possible in its application and operation.

No plan that has been proposed or suggested commends itself as being entirely adapted to the conditions.

Out of a total of 9,454 residences and small business houses, only 198, all residences, have meters, 9,256 of them being on room and fixture rates, which are probably as fairly scaled as is practicable. We have a detailed analysis of the fixtures and rooms for which charges are made in each of these 9,454 houses, with a classified summary of the same.

In view of the information contained in the foregoing discussion, and much that it was not practicable to introduce, there seems no fairer way than to use "rooms and fixtures" as a basis for a scale of "readiness to serve" minima.

In effect this would take into account that element which the committee of the New England Water Works Association sought to introduce by the "Frontage Assessment" method. The rooms of any house being the substantial equivalent of the lot frontage, and the kinds of fixtures used, measurably representing the character of the improvement.

DRAINAGE AND IRRIGATION SECTION

The Proposed Drainage Canal and Levee Work for the Protection of East St. Louis from Floods.

Construction has been begun on a $[illegible] work of flood protection and land reclamation for the city of East St. Louis, Ill. This city, as indicated by the map, Fig. 1, is located on the bottom lands embraced by a crescent shaped range of bluffs on the east and the Mississippi River on the west. The main stream of these bottom lands is Cahokia Creek, which drains an area of some 259 square miles to the north and east of the city. This creek leaves the bluffs northeast of the city and follows a somewhat tortuous channel to its mouth at the Mississippi near the southern city limits. The floods of this stream and the backing up into it of the river floods result in frequent overflowing of the bottom lands and the city and its surrounding towns.

In 1909, in response to a general demand for flood protection, a drainage board was organized to formulate plans. The plans as worked out include changing the course of Cahokia Creek from the point where it emerges from the bluffs through a diversion channel directly west to the Mississippi; the construction of levees along this channel south along the Mississippi and then east along the southern boundary of the district back to the bluffs; and the construction of an interior drainage system with an outflow through the southern levee. These several features of the plan will be considered separately in so far as practicable.

Diversion Channel and Levees.—Where Cahokia Creek emerges from the bluffs it is joined by its main tributary, Indian Creek. It is at this junction point that the diversion channel begins. This channel is 4½ miles long, 100 ft. wide at the bottom, with side slopes of 1 on 2, and has an average depth of from 12 to 18 ft. A half section of the channel is shown by Fig. 2. As will be seen, there will be a levee on each side of the channel with a 50-ft. berm between it and the channel edge. The wide berms are provided to give a large waterway between levees in times of overflow of the channel proper. The levees are being built of earth taken from the channel and will range from 12 to 18 ft. in height, with a top width of 10 ft. and side slopes of 1 on 3. The waterway between levees will have a section of 3,958 sq. ft. The channel has a slope of 1 ft. to the mile.

As will be seen from the map, Fig. 1, this diversion channel permits the handling of the lower stretches of Cahokia Creek and its tributary waters as a separate drainage problem. To insure this separation the levee on the south side of the diversion channel is extended east into the bluffs, so as to make a complete barrier against both floods from the north and back water from the south. This south levee will have no openings, but the north levee will be pierced by valve controlled pipes for the drainage of Grassy Lake.

River Front Levees.—The levee along the Mississippi River front is divided into two sections by the embankment approach to the Merchants' Bridge, opposite Venice. Considering the north section first, the old levees will be used in forming the new structure wherever such use is practicable. The plan is to carry the levee at least 3½ ft. higher than the flood of 1844 and 7 ft. higher than the flood of 1903.

The general specifications recommended by the engineers for all levee construction are as follows: Levees to be constructed of earth taken from the river side, leaving a berm of 40 ft. in width between toe of levee and borrow pit. The top of the levee will have a crown of 8 ft., with side slopes of 1 on 3 on both sides (except where concrete facing is applied, river slope will be 1 on 2). These dimensions, beginning at 8 ft. wide on the top will increase in width 6 ft. to every foot in depth and will give a thickness of 43 ft. at an elevation equal to the high water mark of 1903. Floods higher than that are of brief duration, hence it is believed that the top width of 8 ft. is ample.

An extra fill will be placed on top to allow for settlement and shrinkage, and the levee will be covered with a sod of grass to prevent washing. In cases where the levee is exposed to the force of the current or to wave wash, a concrete facing will be laid on river slope, extending from top to bottom and 2 ft. into the ground. This treatment will also prevent the embankment becoming saturated and in a great measure prevent seepage. This facing, however, will not be laid until bank has thoroughly settled. Figure 3 shows the levee section with concrete facing.

The section of levee from the Merchants' Bridge south to the original mouth of Cahokia Creek will have generally larger dimensions than are given above for the section north of the bridge. Generally the levee will have a crown of 25 ft. and side slopes of 1 on 8.

It became apparent early in the investigation that the work in this section was of the greatest importance to the district. At present the only protection afforded is the tracks of the C. & A. and Terminal railways, and in 1903 the breaking of these embankments caused the inundation of Granite City, Venice, Madison, Brooklyn and National City, and threw the direct current of the river against the hastily constructed levees at East St. Louis. The weak points in these embankments become dangerous at a flood stage of 36 ft. The ground level is extremely low and on account of the character of the soil, grave danger from seepage and boiling is apparent. For this reason a levee of great height and thickness is necessary. The railroad embankments referred to are retired from 1,000 to 3,000 ft. from the present established shore line. The construction of the levee along the shore line is desirable in order to straighten the channel, thus preventing eddies and cross currents, which are destructive to levees and dangerous to navigation.

To insure increased safety for the levee in this location arrangements are being made with the land owners to fill in the low ground inside the levee an average of 17 ft. or to an

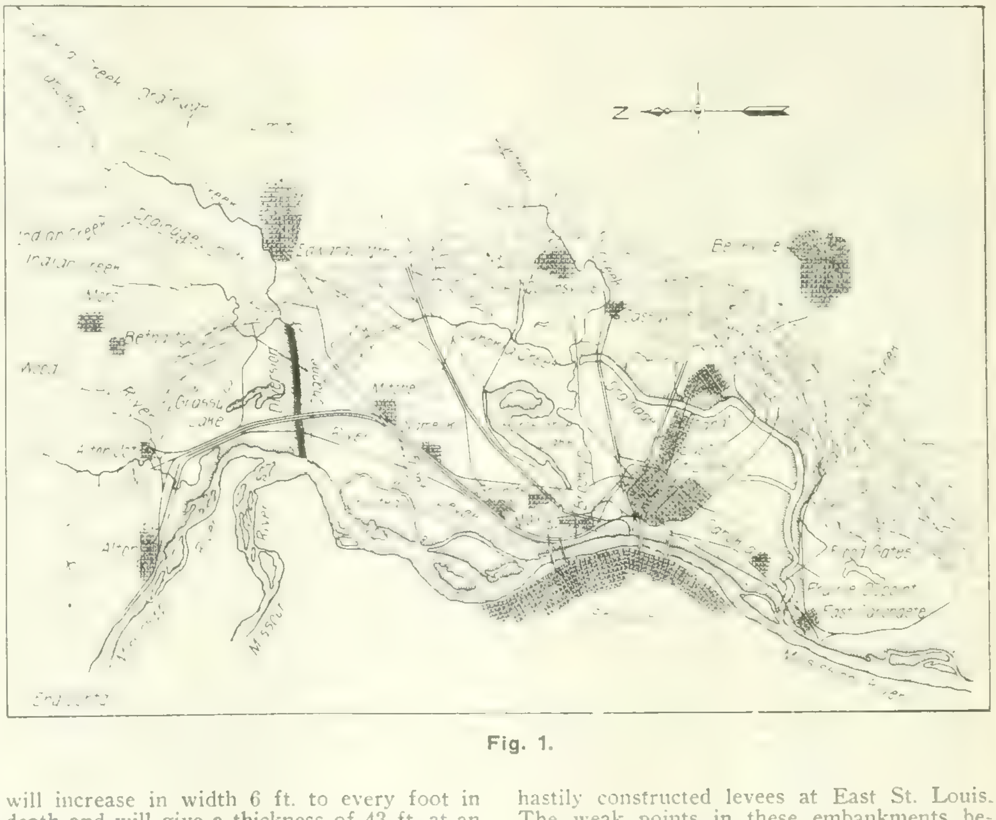

Fig. 1.

elevation equal to the height of the flood of 1903. This is a strip about 1,500 ft. wide containing 400 acres to be filled from the river by hydraulic dredging. This will be done simultaneously with the construction of the levee.

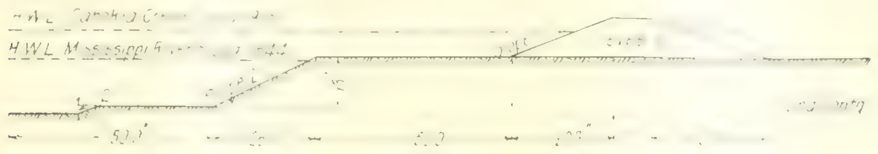

Fig. 2.

The land will then be only 7 ft. below the top of the levee, giving easy access to the river. The project of filling in also contemplates another 200 acres farther south, which in all will cover between 600 and 700 acres, making a total of about 15,000,000 cu. yds. of fill.

The southerly portion of the levee will be a concrete wall along a line to be determined by the engineers far enough back from the present shore line to be safe and as near the district line as practicable. This will be a heavy wall of dimensions not yet decided upon. It will have openings where necessary, which will be arranged for closing at extreme stages of the river.

From the mouth of Cahokia Creek to the connection with the levee on the north bank of Prairie du Pont Creek, near the village of the same name, the route of the levee will follow the district boundary line, and in section will conform to the standard dimensions as shown by Fig. 3. There will also be a south cross levee near the village of Prairie du Pont, running along the north bank of the Prairie du Pont Creek from the village to the bluffs.

Main Drainage System.—The main channel of the interior drainage system draining the area inclosed by the levees, begins with Cahokia Creek at the south levee of the Cahokia diversion channel near the village of Poag.

The present bed of Cahokia Creek from the diversion channel to Canteen Creek will be cleaned of drift and other obstructions to permit the proper discharge of waters received from the smaller branches, county ditches and lateral canals, which will be constructed to drain the low ground within the district.

Beginning at the junction of Canteen Creek with Cahokia Creek, a new channel will be excavated through the ridge near the county line extending in a southerly direction through a chain of lakes and low ground to an outlet into Prairie du Pont Creek. This canal will have a bottom width of 80 ft. Through Spring Lake and Pittsburg Lake the bottom of the canal will be about 12 ft. below the bed of the lakes. The material excavated will be deposited not less than 30 ft. from the canal, in order to prevent the sliding of the earth back into the canal. This canal will receive and discharge all the water falling in the watershed between Prairie du Pont Creek and Cahokia Creek diversion channel.

A suitable pumping plant will be designed and built in the canal and flood gates will be installed. Prairie du Pont Creek below the outlet of the canal will be enlarged to sufficient capacity to discharge the water received from the drainage canal, and the necessary levees will be constructed to prevent damages to property.

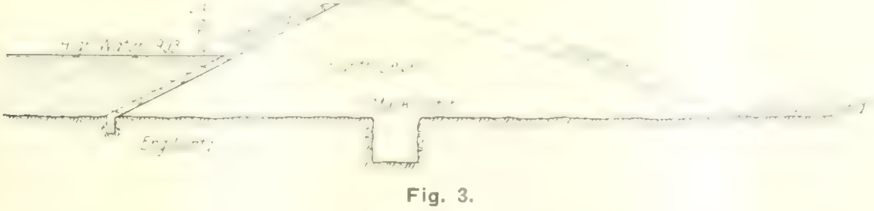

Fig. 3.

Lateral Drainage System.—This system consists merely of the tributary streams and drains to the main drainage system. All existing ditches, sloughs, and small drains will be cleaned out and straightened, and some new drains will be put in, thus completing the entire drainage of this area inclosed by the system of levees.

The cost of the work of construction of the diversion channel and levees is estimated at about $3,000,000, and of the entire work about $6,500,000. Of this amount $1,200 000 is now available, and the balance is to be made available by bond issues.

The work is in charge of Mr. J. A. Ockerson as consulting engineer and Mr. T. N. Jacob as chief engineer.

Oregon Society of Engineers.—The Oregon Society of Engineers has been organized with a charter membership of 160. All branches of the engineering profession are included in the membership. The territory has not been limited to the state of Oregon but includes all the Greater Northwest. Mr. D. C. Henny, 605 Spaulding building, Portland, Ore. (Consulting Engineer for the U. S. Reclamation Service), has been elected president and G. L. Bliven, 407 Buchanan building, Portland, Ore., is secretary.

Western Union to Limit Free Messages.—The railways have been notified by the Western Union Telegraph Co. that messages other than those that relate to railway business must not be sent free because of the liability of incurring the penalties of the interstate commerce law. This notice is said to include messages in which the railways order tickets and sleeping car berths for passengers. The railways reply that such messages are railway business and are not prohibited by the law.

A Portable Testing Machine for Making Field Tests of Cement Drain Tile.*

Recent developments in the manufacture of farm drain tile have emphasized the importance of having a simple standard portable testing machine which may be used for making tests of drain tile in the field or at the plant. The increasing use of tile of large size in farm drainage districts is well known. The competition between the clay tile and the concrete tile has brought up new questions. What strength shall be required for tile of a given size in order that they may be considered to be commercially first-class tile? In the case of concrete tile, what thickness, richness of concrete, method of curing and age at laying are necessary to fill the requirements for a first-class article?

A number of elements enter into the choice of a suitable method of testing for physical properties of drain tile. (1) A definite and important quality should be determined by the test. (2) The test should be simple, easily and quickly made, and should not require the services of an expert laboratory man. (3) The test should be of such a character as not to give unduly diverse results for test pieces of the same grade. (4) The machine to be used should be simple and inexpensive, easily adjusted to different sizes of specimen, and easily transported from point to point and easily made ready for use.

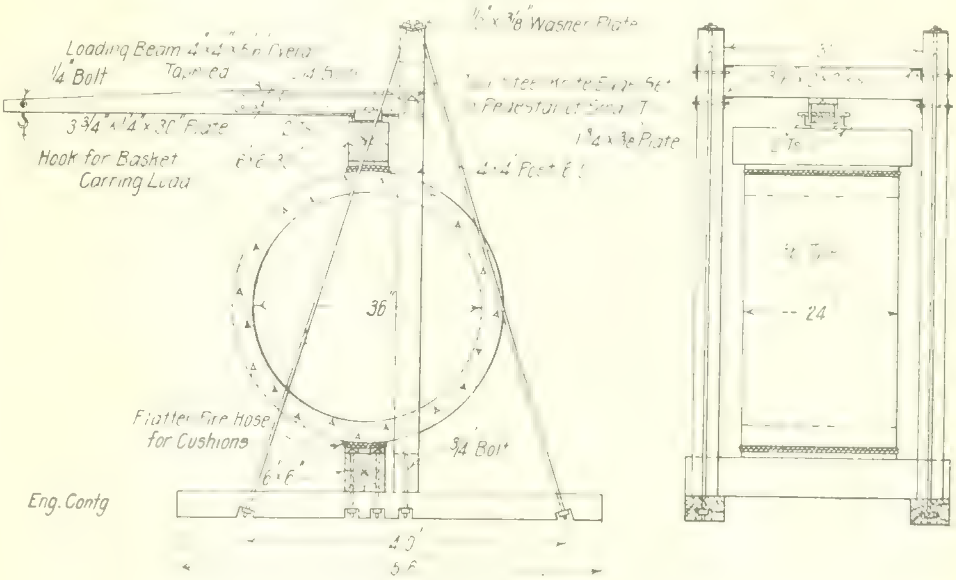

Fig. 1—Plan of Machine for Testing Drain Tile.

It is believed that the machine described fulfills the requirements for making field tests of drain tile satisfactorily. This machine was designed by D. A. Abrams for use in the Laboratory of Applied Mechanics of the University of Illinois.

The machine consists essentially of a simple framework and a lever for applying the load by means of dead weight. The load applied through the loading lever may be blocks of iron, or stone, sand or other suitable material. After the test the dead load is weighed. To obtain the load on the tile, this weight is multiplied by ten, and a constant quantity due to the weight of the loading lever (about 100 lbs. in this particular machine) is added.

The accompanying sketch, Fig. 1, gives the principal dimensions of the different parts. The view, Fig. 2, shows the machine with a 30-in. clay tile in place ready for loading. The machine measures 30-ins. between uprights and will take tile up to 42-ins. inside diameter.

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*A paper before the Interstate Cement Tile Manufacturers' Association by Arthur N. Talbot, Professor Municipal and Sanitary Engineering, in charge of Theoretical and Applied Mechanics, University of Illinois, and Duff A. Abrams, Associate Engineering Experiment Station, University of Illinois.

The main members are of timber; metal [illegible] used at points of [illegible] load and for connection.

Metal knife edges are provided for the bearing of the loading lever on the top loading block and for taking the upward thrust against the top cross block. The knife edge bearing on the block over the test tile are 5 ins. c. to c., and a single knife edge takes the end thrust. This gives considerable freedom to the top loading block and allows the load to be fairly central, although the tile may be conical in outline.

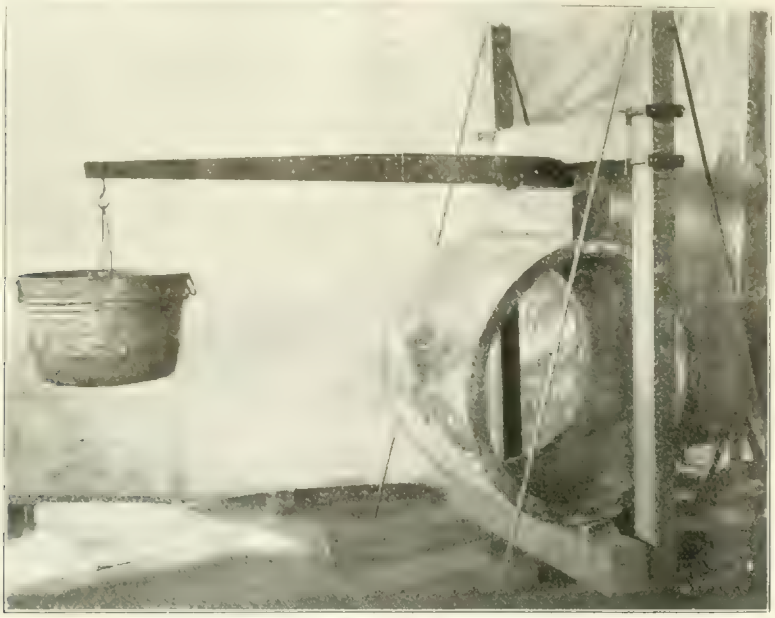

Fig. 2—View of Machine for Testing Drain Tile.

The bottom loading block is provided with two small half rounds of hard wood placed about 2 ins. apart, which allow the tile to seat itself in place. The load is applied at the top along a single element. Cushions consisting of short lengths of flattened rubber-lined fire hose serve to distribute the load along the length of the tile and prevent any local concentration of the load due to irregularities in the top and bottom surfaces.

The top cross block can be placed and held in any position along the uprights to accommodate the machine to any diameter of tile up to about 42 ins. By this means the machine is adjustable to the greatest variation in the size of the test tile and will apply the load to all sizes under uniform conditions.

In order to check the dimensions of the loading lever, it was calibrated by setting a pair of platform scales in the machine and loading up to about 500 lbs. on the machine. It was then placed in a 10,000 lbs. testing machine and loaded up to 4,000 lbs. The greatest error observed for this range of load was less than 1 per cent.

This machine weighs 225 lbs. It should not cost more than $15 to $18 in a shop equipped for wood and metal working.

Up to the present date about 60 tests have bgeen made on this machine on concrete and clay tile in sizes 12 to 36 ins. inside diameter. The breaking loads varied from 1,400 to 5,000 lbs. per tile.

An examination of this testing machine will show that it is simple in operation and that it is easily adjustable for different sizes. Tile which are out-of-round in different ways at the two ends will be easily taken by the machine and there is little chance for an unfair distribution of the load. The strip of hose gives some cushioning effect, and the load is practically distributed over the whole length in all cases. The method of loading along a line at the top and bottom was selected because of its simplicity. The arrangement of the machine allows a tile to be rolled into place and to be easily made ready for test. It is believed that the results obtained by different operators will agree quite closely.

If desired the modulus of rupture of the material may be determined from the bending moment developed and the dimensions of the pipe. For general purposes it will be preferable to report the load per foot of length of pipe for a given size. Possibly for some purposes it may be interesting to divide this load by the diameter of the pipe in inches and thus compare the results per inch of diameter for a pipe 1 ft. long.

It has seemed the simplest way to fix at a definite distance apart the two strips on which the tile rests. An analysis of rings shows that when the bearing on these strips are 2 ins. apart the formula for the bending moment will be but 2½ per cent different from that of a single support for tile 6 ins. in diameter and sion for the formula for the bending moment for all sizes of tile to be tested. It would seem that 0.16 Qd is a satisfactory expression for the bending moment where Q is the concentrated load applied at the crown and d is the mean diameter of the tile. For the modulus of rupture f of the material the formula would be

$$f = 0.96 \frac{Qd}{lt^2}$$

where l is the length and t the thickness of the tile along the top and bottom elements.

This method of testing was selected in preference to a method involving the bedding of the tile in sand or other material, because of the difficulty in embedding large tile in sand in such a way as to obtain a fair distribution of pressure and in securing the same distribution of pressure in different tests and because the method of concentrated loads will give a more definite index of the strength of the material.

In tests of materials it is not essential that the material shall be subjected to the same action in the process of testing that it will receive in service. The cold bend test of steel is one of the most useful and instructive of tests, but it differs radically from any condition of service in which the steel will be placed. The value of a test will depend upon the properties determined. In testing drain tile the method of applying concentrated loads has many advantages over that of applying distributed loads. Whatever the method of testing used, it will be necessary finally to ¼ of 1 per cent for a tile 12 ins. in diameter, while for larger sizes this variation will be much less. Under the conditions of such tests it would seem better to fix the distance for these strips and use a common expresdetermine the relation between strength of the test piece and the strength which is needed in the structure. In the case of tile to be used in a ditch of a given depth and a given soil the necessary test strength will have to be determined. Since the tests will have to be translated into the working conditions, it would seem not necessary to attempt to make the conditions like the conditions in the ditch. It is of much more importance that the tests should be simple, direct and fairly uniform under varying conditions of tile and with different machines and different operators. Our own experience with this machine leads us to think that it would make a satisfactory means of determining the quality of drain tile.

Standard Tests of Drain Tile and Sewer Pipe.*

It has been apparent that there is great need of standard test requirements for sewer pipe and drain tile. Occasional notices appear from time to time in the engineering periodicals showing that inspections of old pipe sewers frequently show a considerable percentage of cracked pipe. During the past year an especially disastrous failure of large cement drain tile occurred in Sac County, Iowa, the damage running up to several thousand dollars. Following this failure, intelligent and reliable experts have made examination of a number of large tile drains in the northern part of the state and they report that many of the pipes in such drains are found cracked when the depth of earth filling exceeds 7 or 8 ft.

It is of great importance therefore that the strength of sewer pipe and drain tile should be carefully investigated, and that standard tests should be devised and standard strength specifications adopted which will insure against failure. In the absence of standard specifications for tests, great differences in the methods of making tests have developed in practice, with the result that our knowledge of the strength remains extremely deficient, and that it is as yet impossible to make a reasonable standard strength specification. It is exceedingly important that uniform methods should be adopted and used by all.

The cardinal qualities of drain tile and sewer pipe are (1) the quality of the material and (2) the strength of the pipe.

The quality of the material is a cardinal quality, because the pipe will disintegrate and go to pieces unless the material of which it is made is of such durable quality as to resist all disintegrating agencies. A cement tile must be made of hard, dense, uniform, and comparatively impervious concrete in order to resist the action of destructive agencies and to prevent their ready penetration into its pores. In the same way soft and underburned sewer pipe or clay drain tile are unsatisfactory, since such pipe cannot resist the action of freezing and thawing, and may disintegrate from other agencies; also a laminated structure in clay drain tile or sewer pipe prevents resistance to frost and causes failure. High bearing strength of the pipe as a whole is not a satisfactory indication of the quality of the material from which the pipe is made, for high strength may be secured by using thick walls. Drain tile or sewer pipe with thick walls may be strong enough and yet may be porous and disintegrate.

Two simple tests may be made to determine the quality of the material of which drain tile or sewer pipe are made, the absorption test and the determination of the modulus of rupture. The absorption test is of great importance for cement and clay tile. In the case of cement tile, the agencies tending to destroy concrete cannot act with much rapidity unless they obtain access to the interior of the concrete walls. In the case of clay tile, the action of freezing would not be of much importance unless water could obtain access to the interior of the walls. Hence the absorption test has a greater importance in testing drain tile and sewer pipe than in the case of most other materials of construction. For this reason and because it is simple and easy to make, we advocate it as one of the standard tests for drain tile and sewer pipe.

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*A paper read before the Iowa Engineering Society by A. Marston, Dean of Engineering, Iowa State College, Ames, Iowa, and A. O. Anderson, Assistant Engineer, Engineering Experiment Station, Iowa State College.

By the modulus of rupture is meant the tensile breaking strength of the material of the pipe wall, as calculated from the results of the bearing strength test. The determination of the modulus of rupture requires no independent test of the material, and it will probably give an important indication of the quality of the material. The modulus of rupture for drain tile and sewer pipe, calculated as above, exactly corresponds to the modulus of rupture of paving brick calculated from the results of transverse tests.

Hence we recommend three standard test requirements for drain tile and sewer pipe: (1) The per cent of absorption, (2) the modulus of rupture, and (3) the bearing strength of the pipe. These three test requirements involve two standard tests, the absorption test and the bearing strength test.

Methods of Making Absorption Tests.—The making of absorption tests has been standardized for paving brick, but not for other materials. The standard method for paving brick can be used as a basis from which to start in determining the standard method for drain tile and sewer pipe. Studying these standard requirements, there seems to be no reason for varying the process in any material point except in the case of the time of immersion. In the case of paving brick, the standard time of immersion is 48 hours. Our tests of drain tile and sewer pipe, as well as those of brick, indicate to us that it will be safe to reduce the standard time of immersion to 24 hours for drain tile and sewer pipe. As this cuts the time required in half, we recommend this change. Our full standard specifications will be found given in detail below.

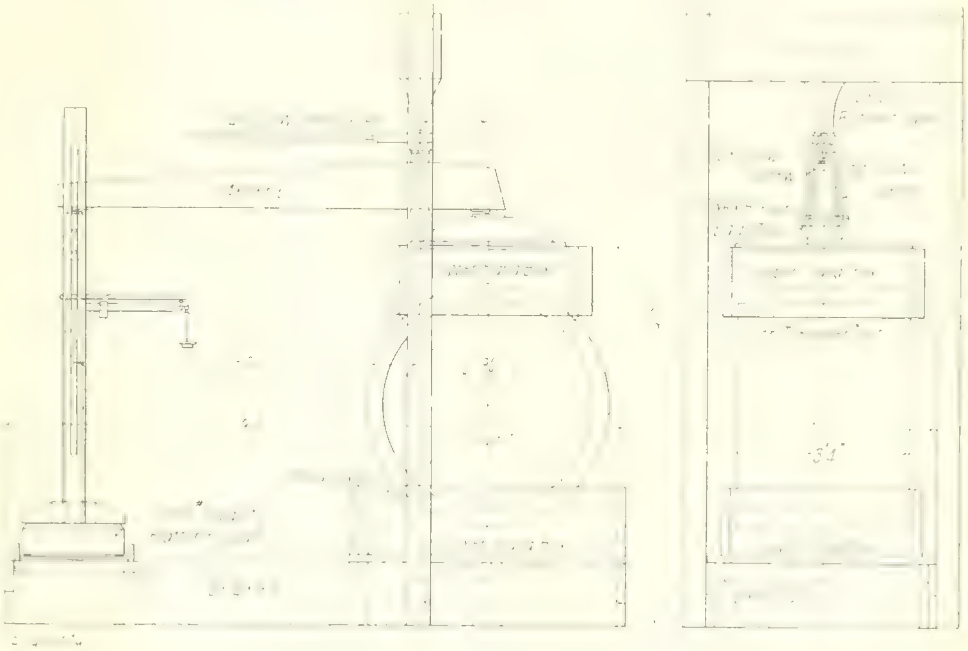
Methods of Testing Bearing Strength.—In tests of bearing strength of drain tile and sewer pipe great difference in practice has developed. It will be unnecessary to discuss all of these. For example, it has been the practice of some to completely surround the pipe, during the test, with sand inclosed in heavy framework, but this method is no longer used, so far as the knowledge of the authors extends. Three methods have survived to such an extent that they are worthy of further discussion.

(1) Concentrated Loading.—In this method the test load is applied along a line or a very narrow strip at the top and bottom of the tile. Some plan must be used for insuring comparatively uniform distribution of the load, and for this purpose it is considered necessary to introduce a packing material of some kind between the bearing block and the pipe. Prof. Talbot (University of Illinois) uses a piece of fire hose; Mr. Boynton (Universal Portland Cement Co.) uses a strip of rubber packing.

There are numerous objections to this method: (1) The test does not subject the pipe to forces approximating those which it must stand in the ditch. (2) Even when packing is used, there is no method of securing very uniform distribution of the load upon the pipe, especially if the pipe is slightly warped, which is very apt to be the case with hard burned clay pipe. (3) The method does not admit of satisfactory distribution of pressure on the bells of sewer pipe, as well as on the straight pipe. (4) The packing used must, by its yielding, introduce splitting stresses. The use of packing has been abandoned for crushing tests of building mtaerials for this reason. The splitting stresses would be of especial importance in a strength test of drain tile or sewer pipe, in which failure must occur by tension.

As a variation of the method of concentrated loading, Mr. Boynton has proposed supporting the pipe on two half rounds at the bottom, spaced 2½ ins. apart, and applying the load by one half round at the top, using strips of rubber packing at both top and bottom. The authors consider this method open to all the objections already stated and to the further objection that it introduces a method of loading which varies for different sizes of pipe. If the 2½-in. spacing of the lower half rounds is adopted for 6-in. pipe, then to obtain the corresponding loading for a 12-in. pipe the spacing should be 5 ins., 10 ins. for 24 in., 12½ ins. for 36-in., and so on. If this so called three point method were adopted, therefore, the strength of any particular diameter of pipe would depend upon the method of testing, as well as the quality and dimensions of the pipe.

(2) The Combined or Brooklyn Method.—For many years the engineers of the borough of Brooklyn, N. Y., have provided regular strength tests and requirements in their specifications for sewer pipe. At first they surrounded the pipe by sand in their test, but now apply a concentrated load along the upper part of the straight portion of the sewer pipe, while bedding the pipe in sand at the bottom. No load is applied to the bell. This method undoubtedly gives more nearly the actual strength of the tile in the ditch than the method of concentrated loading. But we believe it will give materially less loads than a sewer pipe or drain tile will carry under actual average ditch conditions, if they are laid with proper precautions. Moreover, it is open so far as the top loading is concerned, to the other objections raised to the method of concentrated loading.



Plan of Machine for Testing Drain Tile.

(3) Recommended Standard Method for Testing Bearing Strength.—The engineering experiment station of the Iowa State College has been making tests of drain tile and sewer pipe for several years. When this work first began, we made a careful study of actual ditch conditions, and devised a standard method which reproduced these conditions as far as practicable in a laboratory test which could be carried out with uniformity by different experimenters in different laboratories. The engineering experiment station is just publishing a bulletin upon standard tests of drain tile and sewer pipe, describing this standard method in detail, giving plans for inexpensive testing machines by which it can be carried out, and giving the results of several hundred standard tests of cement and clay drain tile and sewer pipe.

In this method the pipe is bedded for one-fourth its circumference at both top and bottom in sand, and the load is uniformly distributed over the upper surface of the top bedding of sand. This method has proved very satisfactory during several years of use. We have opportunity to make comparison of lieve it will give materially less loads than a the results with the actual loads of earth filling which have caused failure of large pipe in drainage ditches, and our standard method seems fairly to indicate the strength actually developed in the ditch under average actual conditions.

Our standard method enables the load to be uniformly distributed over the pipe, regardless of unimportant irregularities in the shape. It avoids all splitting stresses due to packing material in the bearings. Sand is a material which can readily and cheaply be obtained in any community for the standard test. By marking the pipe in quarters before testing, accurate bedding in the sand is readily insured both above and below, and the method is therefore accurate.

The method permits the testing of pipe with bells as readily as those without, since the bells (as well as the straight pipe) can be embedded in the sand bearing. We have made numerous tests of sewer pipe with bells and find no difficulty in such work. It can be adopted for field tests without any testing machine whatever, by simply piling brick, sacks of cement or earth, or other convenient material upon the pipe.

The method is equally fair to cement pipe and to clay pipe. It is a simple method which can be carried out by any competent engineer or by any competent superintendent of a factory. It does not require translation to enable its results to be understood by people who are not engineers or manufacturers, which is not the case when such tests are made with concentrated loads, since these do not give the actual strength of the pipe as used in the ditch. For all these reasons therefore we strongly recommend the adoption of this method as the standard method for testing the bearing strength of drain tile and sewer pipe.

Testing Machines for Bearing Strength.—To enable the standard strength test to be made where drainage or sewerage work is in progress, we have devised home made testing machines which are within the reach of every city, county, drain tile or sewer pipe factory, or even the means of the drainage or sewerage engineer. Our "Ames Junior" testing machine consists of an ordinary platform scale of 2,000 lbs. capacity, placed in a wooden framework, with an ordinary jackscrew to apply the pressure. We find that the 2,000-lb. scale can readily be loaded to 5,000 lbs. without injuring it. In addition we have devised a lever by which, using a longer framework, the same machine can be used for tests up to 10,000 lbs. without loading the scales beyond the 2,000-lb. rated capacity. We designate this larger machine the Ames standard testing machine. Either of these machines can be built at a cost of $50 to $60.

Prof. Talbot of the University of Illinois [illegible] the load, would probably cost little if any more than those which we have devised. Mr. C. W. Boynton has devised a machine similar to our Ames "Junior" machine which could probably be made for $75, including scales. Although [illegible] called "three point" bearing, yet his machine could be used with our standard method by a slight variation in its construction.

Specifications for Standard Absorption Tests.

1. The specimens shall be approximately [illegible] broken.

2. Five [illegible] tests shall constitute a standard test, the average of the five, and the result for each specimen, being given in the report of the test.

3. Each specimen shall be dried in an oven or by other application of artificial heat, until it ceases to lose further appreciable amounts of moisture when repeatedly weighed.

4. All surfaces of the specimens shall be brushed with a stiff brush before weighing the first time.

5. The specimens shall be weighed immediately before immersion, on a balance or scales capable of accurately indicating the weight within 1 per cent.

6. The water employed shall be pure soft water, at the air temperature of a room which is artificially heated in cold seasons of the year.

7. The specimens shall be completely immersed in water for a period of 24 hours.

8. Immediately upon being removed from the water, the specimens shall be dried by pressing against them a soft cloth or a piece of blotting paper. There shall be no rubbing or brushing of the specimen. The reweighing shall be done with a balance or scales capable of accurately indicating the weight within 1 per cent.

[illegible] of each absorption test shall be calculated by taking the difference between the [illegible] dry weight and the final weight and dividing the remainder by the initial dry weight.

Specifications for Standard Tests of Bearing Strength.—1. The specimens shall be unbroken full sized samples of the pipe to be tested. They shall be carefully selected so as to represent fairly the quality of the pipe.

2. Five individual tests shall constitute a standard test, the average of the five and the result for each specimen being given in the report of the test.

3. The specimens shall be dried by keeping them in a warm, dry room for a period of at least two days prior to the test.

4. Each dried specimen shall be weighed on a pair of reliable platform scales just prior to the test.

5. Each specimen shall be accurately marked, with pencil or crayon lines, in quarters, prior to the test. Specimens shall be carefully bedded above and below in sand for the one-fourth circumference of the pipe, measured on the middle line of the tile wall. The depth of bedding above and below the tile at the thinnest point shall be equal to one-fourth the diameter of the pipe, measured between the middle lines of the tile walls.

6. The top bearing frame shall not be allowed to come in contact with the tile or with the test load. The upper surface of the sand in the top bearing shall be carefully struck level with a straight edge, and shall be carefully covered with a heavy, rigid top bearing, with lower surface a true plane, made of heavy timbers or other rigid material capable of uniformly distributing the test load without any appreciable bending. The test load shall be applied at the exact center of this top bearing in such a way (either by the use of a spherical bearing, or by the use of two rollers or rods at right angles) as to leave the bearing free to move in both directions. In case the test is made without the use of a machine, and by piling on weight, the weight may be piled directly on a platform resting on the top bearing; provided, however, that the weight does not touch the top frame holding the sand, and that the weight is piled in such a way as to insure uniform distribution of the load over the top surface of the sand.

7. The frames for the top and bottom bearings shall be composed of timbers so heavy as to avoid any appreciable bending by the side pressure of the sand. The frames shall be dressed on their interior surfaces. No frames shall come in contact with the tile during the test. A strip of soft cloth may be attached to the inside of the upper frame on each side along the lower edge to prevent the escape of sand between the frame and the tile.

8. The sand used for bedding the tile at top and bottom, shall be washed sand which has passed a No. 8 screen. It shall be dried by keeping it spread out thin in a warm, dry room.

9. The test load shall be applied gradually and without shock or disturbance of the tile. The application of the load shall be carried on continuously, and the tile shall not be allowed to stand any considerable length of time under a load smaller than the breaking load

10. The total breaking load shall be taken as equal to the total top load, including the weight of top frame, sand for top bearing, top bearing timbers, etc., plus five-eights of the weight of the pipe. This total load shall be divided by the length of the pipe in feet so as to give the bearing strength per linear foot of pipe.

Specifications for Calculating the Modulus of Rupture.—The modulus of rupture for drain tile and sewer pipe shall be computed from the results of the standard test for bearing strength, according to the following rule:

Divide the bearing strength per linear foot by 12, multiply the quotient by the radius of the middle line of the tile wall expressed in inches, and divide this product by the square of the minimum thickness of the tile wall at top or bottom, also expressed in inches. This quotient will be the modulus of rupture of the pipe expressed in pounds per square inch.

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*Described elsewhere in this issue.

STEAM AND ELECTRIC RAILWAY SECTION

Methods and Cost of Constructing Piers and Foundations for the Chicago, Milwaukee & Puget Sound Ry. Bridge Across the Columbia River.*

The bridge shown in diagram by Fig. 1 crosses the Columbia River about 420 miles from its mouth. At this point the river has a width at low water of 1,050 ft., at average high water of 2,800 ft., and at extreme high water of 4,500 ft. The bridge as shown by Fig. 1 is 2,898.84 ft. long; its approaches are timber trestle on concrete pedestals and are [illegible] ft. and [illegible] ft. long respectively. The principal dimensions of the piers are given in [illegible]. All piers have a [illegible] of ½ in. to 1 ft. on the sides and downstream end of 3 ins. to 1 ft. on the cutwaters. The footings vary in width from 13 to 32 ft. and in length from 32 to 60 ft.

Transportation of [illegible] Materials.—About 14,000 tons of material and supplies were required for the construction of the bridge substructure and of the line near the river. The cost of freighting material across country by wagon from the nearest railroad, a distance of about 35 miles, was estimated at $12 per ton. This cost and the character of the service, with its delays and uncertainties, made this impracticable, and it was determined to handle all freight by river if possible. Navigation between the site of the bridge and a supply point on the river below the Cabinet Rapids, about one-half mile from Vulcan Station on the Great Northern R. R. and 8 miles below the Great Northern bridge, was considered to be practicable for light draft river steamers. Arrangements were made with Davies & Goggins of Wenatchee for the construction of a stern wheel river steamer of the type generally used on the upper Columbia River, and the steamer St. Paul was built by them at Trinidad and placed in commission on October 30, 1906. The principal dimensions of the steamer are as follows:

Length of hull	115 ft.
Beam	22 ft. 6 in
Beam over guards	25 ft.
Draft light ...about	18 in.
Draft loaded ...about	3 ft.
Gross tonnage ...about	200 tons
Actual freight capacity	112 tons
Engines, high pressure, non-condensing, with cylinders, 10 inches diameter, 48 inches stroke, boiler pressure	200 lbs.

This steamer cost about $11,000 to build and was used not only for handling materials and supplies but also for towing and tending at the bridge, handling barges, etc. The operating expense for a period of about 27 months was as follows:

Fuel	$10,200
Wages of crew and charter of steamer	28,800
Total	$39,000

The cost of unloading and handling freight from the cars at Vulcan to the steamboat landing, about one-half mile distant, by wagon, was about $2 per ton. The cost of handling by steamer from Vulcan to the bridge, a distance of about 36 miles, ranged from about $1 to $4 per ton, varying at different stages of the river, averaging approximately $1.80 per ton, making the cost of freight from the cars to the bridge about $3.80 per ton.

Contract.—A contract was entered into on Oct. 10, 1906, with the Bates & Rogers Construction Co. of Chicago, on a percentage basis, for the construction of the substructure and trestle approaches, and for the erection of the falsework for the superstructure.

Under this contract the contractor furnished all tools, outfit, machinery and equipment necessary for the doing of the work, with the exception of equipment of a nature not generally used by the contractor and of a character peculiarly required by the nature of the work to be done, which latter equipment was furnished by the railway company. The plant furnished by the contractor included the following:

6 hoisting engines.
5 stationary engines.
1 rock crusher and engine.
2 concrete mixers.
2 eight-inch centrifugal pumps.
2 six-inch centrifugal pumps.
4 steam pumps.
3 steam boilers, 40, 60 and 80 h. p.
2 steam drills.
6 derricks.
2 pile drivers.
1 steam hammer.
1 electric light engine and dynamo.
12 dump cars, 1½ cu. yds.
6 flat cars.
11,000 feet steel rails.
12 steel hoisting buckets.
5 skips.
2 orange-peel dredges.
1 clam shell dredge.
37 coils of Manila rope.
10,000 lineal feet of ½" wire rope.
14,000 lineal feet of ⅝" wire rope.
12,700 lineal feet of ¾" wire rope.
900 lineal feet of 1" wire rope.
Small tools and fittings as required.

The total value of this plant was approximately $48,000. The contractor's plant was inspected on arrival at the work, valued and inventoried. On shipment away from the bridge the plant was again valued and the depreciation in value charged to the work. The special equipment furnished by the railway company, in addition to the plant furnished by the contractor, was as follows:

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*Condensed from paper by R. H. [illegible] before the Pacific Northwest Society of Engineers. Proceedings Vol. IX, No. 3, December, 1910.

6 barges—24'x60'.
2 barges—12'x36'.
1 gasoline launch.
1 hoisting engine.
2 orange-peel dredges.
Row-boats and skiffs.

These barges were fitted up so as to give the following floating plant:

1 pile driver barge.
3 floating derrick barges.
1 pumping barge.
3 material barges.

The construction camp buildings cost $4,100.

LAND PIERS.

The land piers, comprising all but piers 8, 9, 10 and 11, were with the exception of No. 7 founded on gravel and boulders at depths of from 7 ft. to 24 ft.

Excavation.—Work was begun on excavating for the piers on the west side of the low water channel as soon as the necessary plant and equipment arrived. This material consisted of gravel and boulders ranging from 1 to 10 cu. ft. in size at piers A-1, 2 and 3, in the high water channel, and of gravel filled with sand and occasional small boulders up to 1 or 2 cu. ft. at piers 4, 5, 6 and 7. Excavation was carried down in the dry to about the low water level of the river. This material was all handled by hand, loaded into wheel barrows or skips and wheeled out of the shallow pits and handled by derricks from the deeper pits. Some of this material was frozen. The excavation for the piers on the east side of the river was in boulders ranging from 1 or 2 cu. ft. to 2 or 3 cu. yds., with finer material and boulders beneath. The cost of excavating ranged from 90 cts. to $2.46 per cu. yd., averaging $1.35 per cu. yd. This included some excavation about 2 ft. below the river level.

Excavation was continued during December, 1906, January and February, 1907. Work on construction of piers was delayed on account of ice in river, which prevented operation of steamer for a period of seven weeks, from Jan. 10 to Feb. 26, and prevented delivery of materials and supplies. During this time work was carried on at excavating, quarrying and crushing stone and handling sand for concrete, testing foundations, building barges, etc. The foundations were tested with a well drill, using the ordinary churn drill in a 5-in. casing. What appeared to be bed rock was found on the west side of the river at depths ranging from 25 to 40 ft. below the average low water level of the river. On the east side it was found to be impracticable to penetrate the bed of large boulders with the appliances at hand. In the river, test piles and steel rails were driven to depths of 70 ft. below the river bed and a 10-in. casing was sunk to a depth of 79 ft. below the river bottom, but bed rock was not located at any point in the bed of the river.

Concrete Materials.—Sand of very excellent quality was found in considerable quantity at points on the east and west sides of the river, about two miles from the bridge. Sub-contracts were let for hauling this to the bridge site at $1 to $1.15 per cu. yd. The average weight of this sand was 89¼ lbs. per cu. ft. Voids about 33 per cent to 38 per cent. The material from the bar above pier 4 and from the excavation for the foundation of pier 4, consisting principally of cobblestones and small boulders, was run through a stone crusher, crushed to a size which would pass through a 2-in. ring, and stored in stock piles. The average weight of the crushed stone was 104.4 lbs. per cu. ft., as determined from a number of tests. Percentage of voids 44 per cent. The cement used in this work was principally Alpha, Medusa, Marquette and Universal brands of domestic Portland cement, shipped from Chicago or points east. The average cost of freight per barrel was $2.06 and the cost per barrel delivered on the work $4.17. The average gross weight per sack as computed from the freight bills, was 94 lbs., the weight of the sack itself 1 lb., and the net weight of the cement 93 lbs. per sack.

Concrete Work.—The proportions used in this work were as follows:

For all concrete deposited in or under water	1:2:4
For footings and for shafts of piers	1:3:6
For copings	1:2½:5
For mortar finish of copings	1:2½

Concrete placed in running water, as when exposed to currents caused by pumping, was 1:2:4 in bags or sacks.

One sack of cement was considered as equivalent to 1 cu. ft. in volume. Sand and gravel were measured in wheel barrows. Mixing was done generally by machine, using Smith and Ransome mixers. Concrete was mixed by hand when necessary to do this in order to save time. The amount of water used varied according to the amount of moisture contained in the sand and gravel and according to the weather. A wet or sloppy mixture was used and very little tamping was done. The consistency of the concrete was such that the men generally sank about ankle deep into the freshly placed mass. The amount of concrete placed per day generally built up the pier from 3 to 7 ft., depending upon conditions. On one occasion a height of 12.6 ft. was completed in one day. No spreading of the forms was observed.

Large oblong stones were placed in the last layer of concrete put in on each day, and were embedded with the long axis of the stone in a vertical position to a depth of about one-half of their length in the fresh concrete. These stones served the purpose of dowels, uniting the layers of concrete placed on separate days. On the completion of the day's work and after the upper layer of concrete had received its initial set, the surface was brushed over with a wire stable broom for the purpose of removing the smooth and slick coating which is formed on the surface and leaving the surface rough. On the resumption of work the old surface was thoroughly washed and swept, lightly grouted, and covered with a thin layer of cement mortar mixed in the same proportions as the mortar in the concrete, and then followed with concrete. Care was taken to prevent the formation of pockets of coarse gravel on the older layer of concrete.

The weight of the concrete as determined by weighing sample blocks containing 4 cu. ft. each, was found to be from 152 to 154 lbs. per cu. ft. No mortar facing was used on the face of the piers. A satisfactory finish was obtained by spading and working the material back from the face of the forms.

The approximate weight of the 1:3:6 concrete as determined from the weight of the cement, sand and gravel per cubic foot, and the total amount of these loose materials used in the construction of the neat work for the piers, amounting to 9,394 cu. yds. of concrete, was found to be 153 lbs. per cu. ft. of concrete in place. The proportions of the materials used in 1:3:6 concrete were as follows:

Cu. ft. of Loose Material.	
Cement	[illegible]
Sand	[illegible]
Stone	[illegible]46
Percentage of Total Volume of Concrete in Place.	
Cement	[illegible]
Sand	46.[illegible]
Stone	[illegible]
Cu. ft. of concrete in place	253,638

In other words, 1 cu. yd. of 1:3:6 concrete in place required 4.199 cu. ft. (or 1.05 bbls.) of cement, 12.6 cu. ft. of sand and 25.2 cu. ft. of gravel. The actual labor cost of mixing, handling and placing concrete ranged from 90 cts. to $1.50 per cu. yd.

Forms.—Forms were constructed of 2x6-in. and 2x8-in. matched lumber for sides and of vertical lagging of varying widths for the ends of the piers. Posts were of 2x6-in. or 2x8-in. lumber, lapped as the forms were carried up, and tied together by ¾-in. round iron rods and by No. 8 galvanized iron wire, extending through the body of the pier and through longitudinal horizontal timbers, generally 6x8 ins., on the outside of the posts. The cost of the form work was as follows:

Material	$ 4,019.00
Labor	7,694.00
Total	$11,713.00

The cost per cubic yard of concrete was 89 cts. The concrete work on all of the land piers was completed in May, 1907, with the exception of some work on piers 12 and 13, which was later completed with the floating concrete plant.

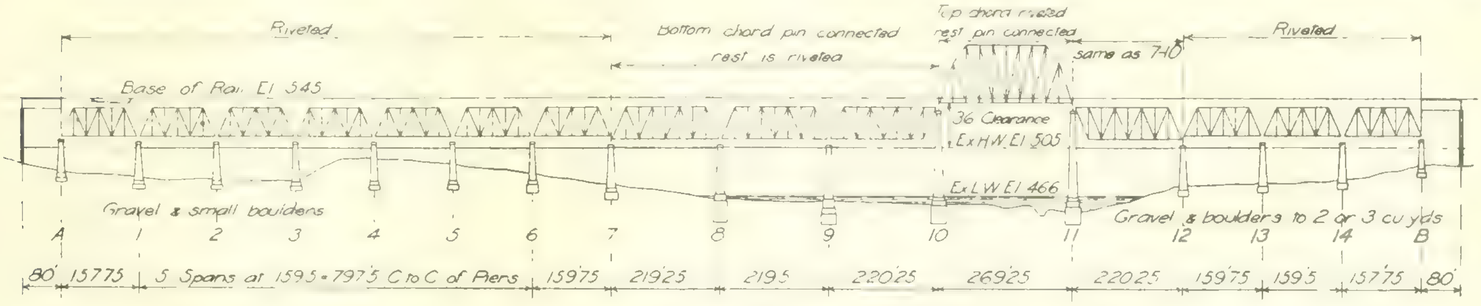


Fig. 1—Diagram Elevation of Columbia River Bridge of the Chicago, Milwaukee & Puget Sound Ry.

LAND PIERS.

Work was carried on during the high water period in the summer of 1907, with a small force on construction of concrete pedestals for trestle approaches, framing and raising bents for trestle approaches, quarrying stone for riprapping and for use in breakwaters for protecting cofferdams, making segments for forms for river piers, etc. During this time forecasts and diagrams were made in order to plan the work on the river piers; four barges were constructed, and floating derricks rigged and equipped. It was decided to plan the work on the river piers substantially as follows:

Single cofferdams to be used for all piers, sufficiently large to permit enlarging the footing if the nature of the material composing the foundation should require it, so that the maximum load upon the foundation should not exceed 3 tons per sq. ft.

Wooden sheet piling to be used for cofferdams for three of the piers and steel sheet piling for the fourth.

Excavation to be carried down to a depth of from 10 to 15 ft. below the natural river bottom.

Excavation to be carried down to within 3 or 4 ft. of the desired elevation before beginning work on the cofferdam, in preference to excavating inside of the cofferdam.

Concrete footings to be put in under water to a thickness sufficient to seal the cofferdam and to afford stability.

Cofferdam then to be pumped out and remainder of concrete work to be put in in the dry.

Breakwaters to be built above the sites for the piers, in advance of work on the cofferdams, for the purpose of protecting the cofferdams from the current and from ice, and for placing derricks upon if necessary.

Concrete to be mixed on west side of river and handled in buckets on cars running out on a trestle between the breakwaters and the cofferdams.

Sufficient floating plant to be provided to permit work being carried on at all piers at the same time if necessary.

It was considered absolutely necessary to complete the river piers during this low water season, in order to prevent delay in final completion of structure and of the road. Study of hydrographs prepared from data covering a period of some twelve years indicated that all piers should be well above water on April 15, 1908. Working backward from this date, allowing an average rate of progress which could reasonably be expected to be maintained, approximate dates were fixed for the time at which the pile driving for breakwaters, cofferdams and temporary bridges should be completed, for the completion of the excavation for the foundations at each pier, the completion of the cofferdams at each pier, and of the concrete work. These average lines of progress are shown on the diagram herewtih (Fig. 2). It was intended that the actual work of construction should not fall behind this average, and if it should prove to be falling behind this average then steps should be taken to increase the equipment or the working force, or to work extra shifts.

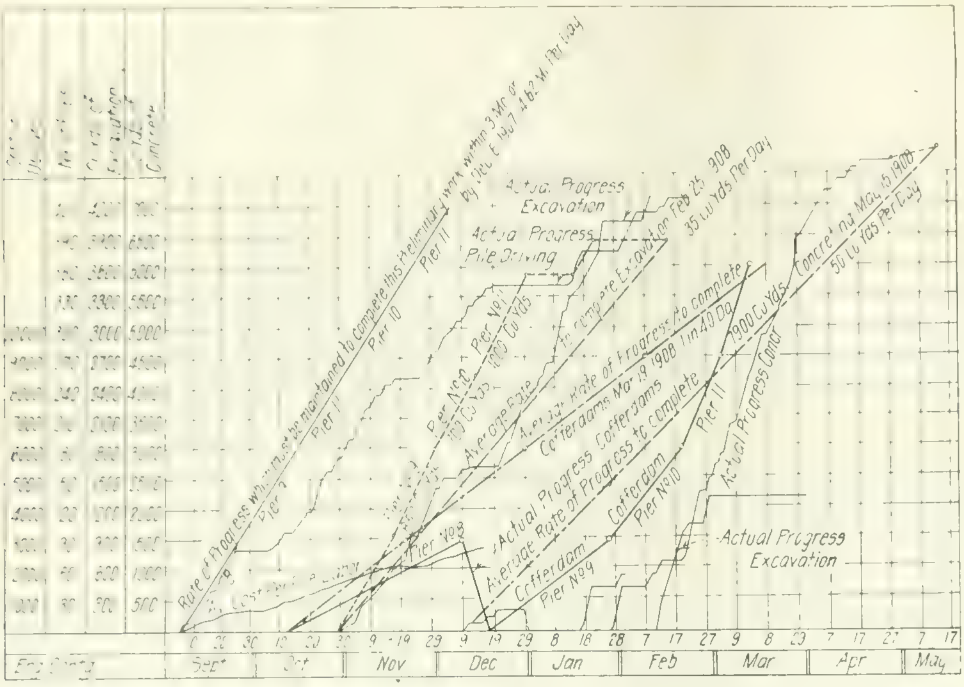


Fig. 2—Diagram Showing Progress of Substructure Work, Columbia River Bridge.

The line representing the actual progress was platted each night, and blue prints showing the result were sent in each week.

In order to secure the greatest efficiency, it was necessary to work each tactical unit of the plant continuously or as nearly so as possible. In order to show at a glance whether or not this was being done, a diagram was prepared showing the work which was being done by each unit each day, and the time lost by each unit was shown on this diagram. This was kept up to date and blue prints furnished the contractors and others interested.

Pile Driving.—Work was begun at driving piles on Sept. 4. The first work consisted in driving a six-pile dolphin or cluster 500 ft. upstream from pier 8. Wire cables were rigged leading from the pile driver barge to three deadmen—one on the west side of the river about 1,000 ft. above the piers, a second for a swinging or pendulum line to the point of a bar about 2,000 ft. upstream and above pier 10, and a third on the east side of the river about 1,000 ft. upstream. With these lines the pile driver barge could be swung across the river and held in position against the current. The cost of driving this dolphin was about $13.30 per pile for labor, including driving, drawing piles together, wrapping with wire cable and attaching a mooring line buoyed by a float. Cost of pile, including freight, handling, point, etc., about $9.50; total cost of pile in place, about $22.80.

Penetration about 10 ft., in heavy gravel, cobblestones, and small boulders; depth of water about 16 ft.; current about 4 miles per hour; piles 35 ft. long, of red or yellow fir, with cast iron points, driven by 2,500-lb. drop hammer, using a Casgrain pile cap or follower; gang, thirteen men; wages as follows:

	Per day.
1 foreman	$5.00
2 carpenters	4.00
1 engineer	4.00
1 fireman	3.00
8 pile driver men	3.25

A 6-pile dolphin was then driven 500 ft. upstream from pier 9, at a cost of $25.50 per pile. Penetration about 10 ft. Depth of water, 19 ft. Current, 4¼ miles per hour.

Forty-five piles were then driven for the breakwater at pier 8, at an average rate of 7 to 8 piles per day; cost per pile for labor, driving, cutting off and capping was $7.10; average penetration, 10½ ft.

Twenty-four piles were then driven for a bridge or trestle from the west shore immediately above pier 7 to the breakwater at pier 8, at a cost of about $7.80 per pile for labor, driving, cutting off and capping. These piles were braced by 3x10-in. planks bolted to the pile before it was hoisted in the leads at a point which would be several feet above the bottom of the river after the pile was driven, held in place by a lashing around the pile and braces until the driving was completed, and then bolted to the other pile in the bent. These braces stiffened up the bents so that there was very little weaving or swaying caused by the current.

The breakwater was then cross capped, upper and lower wales for 6x12-in. sheeting put in place, sheeting driven around breakwater, and two barge loads of rock dumped in breakwater.

The driving of this close sheeting proved to be detrimental in causing strong cross currents, whirls and eddies, and in increasing the difficulty in holding barges in position below the breakwater. As an instance, three days were consumed in driving three piles for cofferdam at pier 8, at a cost of about $150 for labor.

Twelve piles were driven for the cofferdam at pier 8, at a cost of $292, and the pile driver barge was then moved to pier 9, where 55 piles were driven for the breakwater in ten days, or at an average rate of five to six piles per day, and costing about $8 per pile for labor, driving, cutting off and capping; penetration from 8 to 10 ft.

The dolphin and breakwater piles were then driven at pier 11. Forty-eight piles were driven at a cost of $366 for labor, or at a rate of $7.60 per pile, in about 20 ft. of water; current, 4 miles per hour. Penetration reported to be from 8 to 12 ft. in gravel and boulders, but examination of piles which were dug up later indicated that in many cases the points of the piles were broomed, crushed and split, and that the actual penetration was considerably less than indicated.

At pier 10 45 piles were driven in dolphin and breakwater, at a cost of about $304, or an average of about $6.80 per pile.

The average labor cost of driving piles for the entire work was $7.80 per pile. This cost is largely due to the difficulty in moving the barge from place to place, in handling the lines and in holding the barge in position, caused by the strong current and by the violent winds prevailing at times.

Excavation.—The original plan for excavating before placing the cofferdams was modified at pier 8 in accordance with the recommendation of the contractor, and the excavation was done after the cofferdam was in place, using an orange peel dredge of 1 cu. yd. capacity. This handled the cobblestones, gravel and small boulders easily and rapidly; but the work of excavating, driving sheet piles and lowering the frames of the cofferdam necessitated holding the floating derricks at this pier for a considerable time. The sheet piles could not be driven far in advance of the excavating on account of the nature of the material, and the gravel and boulders from under the sheet piles had to be removed by divers working with a water jet and hoe. A peculiar feature of this compacted river gravel is that the sides of the excavation maintained a nearly vertical slope, and only occasionally caved in, when jarred by the driving of the sheet piles. The tendency of the sheet piling is always to work in at the bottom and spring away from the frames at the top. This narrowing of the area at the bottom frame made it increasingly difficult to drive down the frames, and increased the expense of the work. The excavation at Pier 8 was carried down to a depth of about 18 ft. below the river bed, or 26 ft. below average low water. Actual cost of excavating alone was 80 cts. per cu. yd.

Work at this Pier 9 was begun early in November and carried on with an orange-peel dredge, changing later on to a drag scraper operated by a double drum hoisting engine on one of the barges moored down stream from the pier. The pull back line was rigged through a block attached to the breakwater. This method of excavating was very successful and the excavation was completed to a depth of about ten feet below the bottom of the river. The material encountered consisted of gravel and boulders ranging up to one cu. yd. After completion of cofferdam, the excavation was carried down to a further depth of about 6 ft., using an orange-peel dredge and cleaning out material from under sheet piles and frames with water jets handled by divers. Cost of excavating at this pier, including the cost of experimenting with drag scraper and repairs to orange-peel dredge, was $1.30 per cu. yd., for the 1295 cu. yds. removed from the area covered by the cofferdam.

The material encountered at Pier 10 consisted of gravel and boulders ranging up to 5 or 6 cu. yds. This was handled almost entirely by the drag scraper, and was carried to a depth of about 10 ft. below the river bed before beginning work on cofferdam. After completion of the cofferdam, the excavation was carried to a further depth of 4 ft. The total cost of excavation at the pier was 62 cts. per cu. yd. for the 1,935 cu. yds. removed.

The material encountered at Pier 11 consisted of large boulders, up to about 15 cu. yds., with small boulders and fine gravel. The orange-peel dredge was first tried at this pier, but was unable to handle the boulders. The drag scraper proved to be well adapted to this work, and the excavation was completed to a depth of 10 ft. below the river bed before beginning work on the cofferdam. After completing the cofferdam, a very small amount of work was done in leveling up the foundation. Some large boulders uncovered in excavating were built into the footing of the pier. The cost of excavating a total of 1,140 cu. yds. was 55 cts. per cu. yd.

Cofferdams.—The principal dimensions and materials used for construction of cofferdams, are as follows:

Pier 8; dimensions 23x57 ft. inside of sheet piling; sheet piling—triple lap, Wakefield, 30 ft. long, made of 3 pieces of 4x12 fir lumber, surfaced four sides, with special steel points ¼ in. thick.

Pier 9; dimensions 27 ft. x 54 ft. inside of sheet piling; Friestedt steel sheet piling—of steel channel and Z bar sections 30 ft. in length, was used; weight of channels 35 lbs. per lin. ft.

Piers 10 and 11, dimensions 32 ft. x 60 ft. inside of sheet piling. Triple lap, Wakefield sheet piling, 36 ft. in length, made of 3 pieces of 4x12 fir lumber, with ¼-in. steel points, were used for these cofferdams.

The general method of construction was as follows: The first step after the completion of the excavation to within a few feet of the desired elevation, was to drive bents of five piles each, transversely to the long dimension of the cofferdam; three of the piles in each bent being spaced to come within the inside timbers of the cofferdam frame and the end piles of the bents to come outside of the outer wales. These bents were spaced so as to clear the struts, which divided the cofferdam into three or four panels or bays. Sash-braces of 6x12 ins. were then bolted to these bents, a few inches above the water level and all at the same elevation; 12x12 in. timbers (60 ft. in length in the case of the cofferdams at Piers 10 and 11), were then placed on the sash-braces, and the outer faces of the timbers lined up to the line fixed for the inside of the sheet piling.

End timbers and struts of 12x12 ins. were then put in place, forming a lower frame for the cofferdam and upon this lower frame at each corner and at each strut were set up 12x12 in. posts of the proper length to space the next frame at a distance of 4½ ft. vertically above the lower frame. Successive sets of horizontal timbers, and posts, were then built up on the lower frame, each set the same as the lower frame except that the spacing or vertical distance between frames increased successively from 4½ ft. to 7 or 8 ft. for the upper frame. The structure so formed was braced thoroughly. Vertical guide timbers of 6x12 timbers, extending to the bottom of the river, were bolted to the sash-braces for use in keeping the frame in position during lowering. Wire cables were then attached to eye-bolts in the lower frames and several turns taken around sash-braces or caps which had been placed near the tops of the piles. The sash-braces were then cut away at the points of support where the lower frames rested on these sash-braces, throwing the whole weight of the frames upon the wire cables. These cables were then slacked away carefully lowering the frames, which were kept in a vertical position by the guide timbers, until the lower frame rested on the bottom of the river. In some cases this lowering was done before the full number of frames were put in position, and were lowered down only as far as the buoyancy of the timber permitted, and additional frames built up on these frames. As soon as the frames were lowered into contact with the river bed, preparations were made for setting up the sheet piling. Short blocks of wood, a trifle thicker than the sheet piles which were to be used, were placed at intervals along the outside of the first frame, above the water level, and 12x12 in. timbers or wales on the outside of these blocks. Holes were then bored through wales, blocks and frames, and the whole thing bolted together. Similar blocks and wales were placed upon the upper frame, the whole being intended as a guide for use in setting up the sheet piling. The next step was to set up the corner sheet pile and then place sheet piles along one side of the cofferdam to a point near the middle of the side. The opposite corner pile was then put in place and the sheet piles placed from that towards those already set up. The space between the two sections was closed by a special pile made in a taper or wedge shape and sufficiently full to insure closing up the joints as far as possible. The same method was followed in working on the other sides.

The cost of the cofferdams was as follows:

Pier 8: Labor and materials	$3,627.00
Pier 9: Labor and materials	6,897.00
Pier 10: Labor and materials	2,964.00
Pier 11: Labor and materials	2,752.00

The above is the net cost after deducting the value of the timber recovered from the cofferdam and used later for false-work and permanent work on the main line.

Concrete Work for River Piers.—The lower footing consisting of 1 :2 :4 concrete, was put in place under water, using a tremie or bottom dumping buckets. It was considered necessary to use this method of placing the concrete under water on account of the porous nature of the material composing the foundation, making it impossible to pump out the cofferdam without first sealing the bottom. This concrete footing varied from 10 to 14 ft. in thickness. It was made of this thickness in order to give sufficient weight to resist the upward pressure of the water acting upon the bottom of the footing when the cofferdam was pumped out, making a reasonable allowance for a possible rise in the river during the operation, and the necessity for taking care of the increased head caused by that rise. It was considered of great importance to proceed with this work on the first footing without interruption, as a lack of bond between horizontal sections of the footing would form a plane of weakness and would probably result in a separation along this plane, caused by the film or sheet of water which would probably be forced in along this plane. The space in the cofferdam was divided into three sections by bulkheads driven across the cofferdam, and each section was put in separately as one continuous operation, working night and day.

The volumes of concrete put in under water in this way at Piers 9, 10 and 11, was 714 cu. yds., 917 cu. yds. and 1,006 cu. yds. respectively. This was put in at the rate of from 175 to 273 cu. yds. in a working day of 20 hours, or at an average rate of from 9 to 14 cu. yds. per hour. The average cost for labor, mixing and placing this concrete was about 90 cts. per cu. yd. The weight of this concrete in place, as determined from the weights of the materials and the number of cu. yds. of loose material used, varied from 128 to 139 lbs. per cu. ft. This is approximate, but should be reasonably close to the actual weights. The average amount of cement used per cu. yd. of concrete in place was: 1.35 bbls. at Pier 9, 1.37 bbls. at Pier 10 and 1.37 bbls. at Pier 11.

The temperature of the water at the time this concrete was placed in Pier 9 was 32° F., but even at this low temperature the concrete set sufficiently hard within four days to permit pumping out the cofferdam.

After this lower footing had set for four or five days, the cofferdams were pumped out, the footings cleaned off, and the concrete work above this elevation was brought up in the dry. An examination of the concrete which was placed in water, made after the cofferdams were pumped out, showed that this concrete was of remarkably good quality and to all indications entirely satisfactory for the purpose. When the concrete had been carried up above water in all of the piers, the remainder of the work was simply routine work. Double shifts were worked for a period of about three months, covering Sundays and week-days, and the concrete in the river piers was completed on the same day that the spring flood forced the discontinuance of the concrete track and trestle.

Riprapping.—All of the river piers were riprapped, using large angular derrick stone and stone of two and three-man size, which was obtained from the quarry on the right bank of the river, a little above the bridge. The amount and cost of this riprapping is given below:

		Per cu. yd.
At Pier 8:	930 cu. yds.	$0.85
At Pier 9:	1,090 cu. yds.	.77
At Pier 10:	2,130 cu. yds.	.89
At Pier 11:	1,860 cu. yds.	1.17

This includes cost of quarrying stone, loading on barges, handling by steamer, and unloading at the piers. This riprap was brought well up to extreme low water level and was placed below the piers, as well as above and on each side.

The moving and transporting power of the whirls caused by the obstruction presented by the pier and the riprap is far greater than that of the direct current, and the scour occasioned by these whirls is greatest at points in the line of the sides of the mound of riprap, and a short distance downstream from the lower end of the pier. For this reason a large amount of riprap was placed near these points.

Cost.—The total cost of the piers is given in Table I.

TABLE I. TOTAL COST OF THE PIERS DISTRIBUTING ALL GENERAL AND INCIDENTAL EXPENSES.

Pier.	Width under coping.	Length under coping.	Height overall.	Cu. yds. of concrete.	Total cost.	Cost per cu. yd. of concrete.
"A"	6′ 6″	25′ 6″	34.[illegible]	290	$5,458.62	$18.82
1	8′ 0″	30′ 5⅛″	39.1′	500	9,933.79	19.86
2	8′ 0″	30′ 5⅛″	[illegible]	498	9,709.65	19.49
3	8′ 0″	30′ 5⅛″	39.1′	500	9,644.64	19.29
4	8′ 0″	30′ 5⅛″	38.[illegible]	490	11,391.38	[illegible]
5	8′ 0″	30′ 5⅛″	39.2′	503	10,953.16	21.77
6	8′ 0″	30′ 5⅛″	40.1′	572	11,692.62	20.44
7	8′ 6″	31′ 7⅜″	43.3′	622	16,369.79	26.32
8	9′ 0″	32′ 9½″	59.6′	1,404	42,792.03	30.48
9	9′ 0″	32′ 9½″	64.0′	1,506	42,283.20	28.07
10	10′ 0″	30′ 1″	[illegible]	2,363	58,078.26	24.58
11	10′ 0″	30′ 1″	92.4′	2,452	63,925.50	26.07
12	8′ 6″	31′ 7⅜″	41.[illegible]	584	13,328.93	22.82
13	8′ 0″	30′ 5⅛″	41.[illegible]	528	11,139.24	21.09
14	8′ 0″	30′ 5⅛″	38.[illegible]	487	9,685.11	19.89
"B"	6′ 6″	25′ 6″	29.[illegible]	240	5,133.13	21.38
Total				13,539	$331,519.05	$24.49

For 12 land piers [illegible] cu. yds.; average cost per cu. yd. of concrete..........$21.40

For 4 river piers [illegible] cu. yds.; average cost per cu. yd. of concrete.......... 26.81

Records of Treated Ties.

In a paper read before the recent annual convention of the Wood Preserver Association, Mr. F. J. Angier, timber treating engineer, expresses doubt as to the value of records of treated ties, as such records have been kept in the past. The following is a brief abstract of Mr. Angier's paper:

Perhaps more reliable results could be obtained if we would ignore the records entirely and rely upon the memories of men of observing minds who, for many years have made a study of the life of timber, but who have neglected to keep book records. I mean that nearly all records of treated cross-ties kept for a period of eight or more years, are more or less inaccurate, or at least have so many uncertainties hanging over them as to be wholly unreliable. This may be illustrated by the record the writer attempted to keep for a railroad company for a period of ten years.

After all the trouble and expense of keeping this record, the results showed that only 102,000 ties out of a total of more than five and one-half million—less than 2 per cent—had been removed for all causes. On one division this record shows five ties removed in ten years, although 435,000 had been put in track. You say this is absurd; then of what use is this record? It is needless for me to say that it was discontinued and another method adopted to ascertain the life of treated ties.

METHOD EMPLOYED BY THE BURLINGTON

For ten years it was the practice on the Burlington Railroad to drive a dating nail in every treated tie. The first eight years the nails were driven by the section men after the ties were laid in track, and the last two years the nails were driven at the treating plant after the ties were treated. The head of the nail bore the imprint of the year in which the ties were treated, and was for the express purpose of enabling the [illegible] to keep a record of treated ties. Without a nail or mark of some kind, there is no practical way of knowing at any future time whether the tie was treated or untreated, or whether it had been treated [illegible] two or more years.

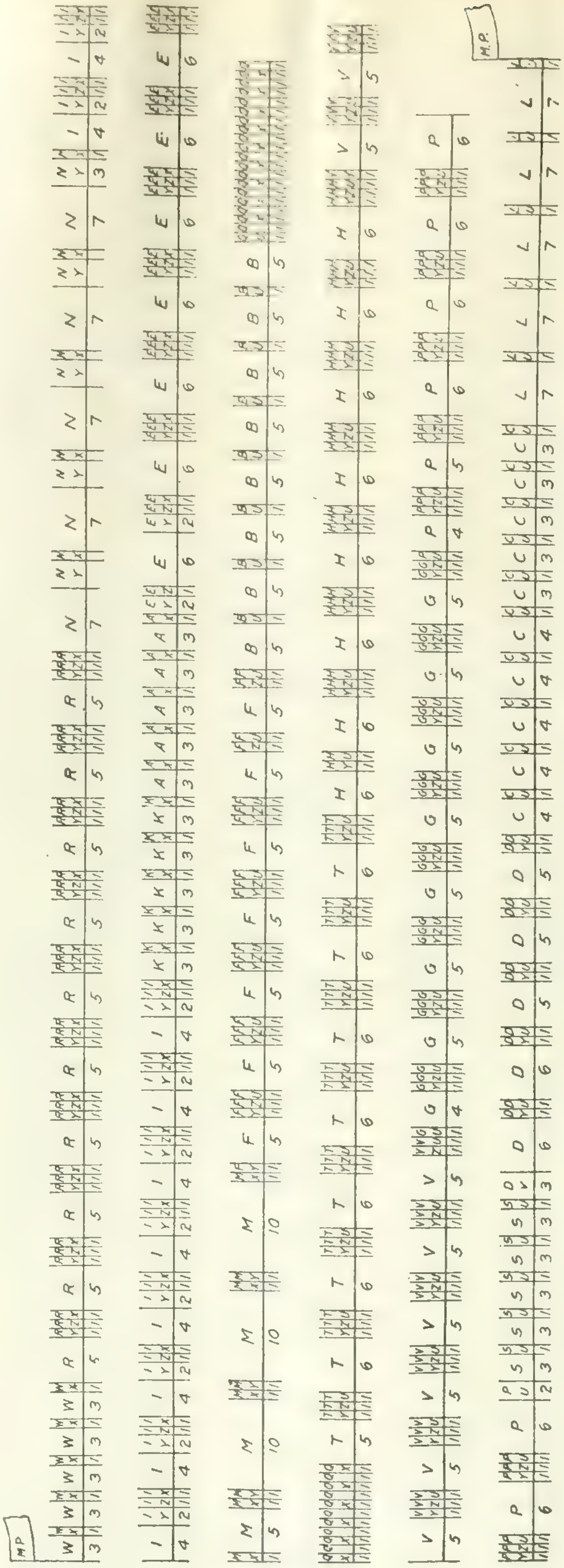
There are nearly 1,500 sections on the Burlington System, and each section has a foreman in charge. In keeping this record, every section foreman was required to make a monthly report showing the number of ties put in and taken out of track. They were obliged to show the year treated by examining the dating nail, and [illegible] they were removed, whether because of decay, rail cut, burned or broken.

From the foregoing it can be readily seen that, for a correct and complete record, everything depended absolutely upon 1,500 section foremen. The average section foreman is not a clerk, and not much dependence can be placed upon him to give in reliable data. Even were he able to make the finest kind of a report, he will be unable to decipher the figures on the heads of thousands of rusty and battered dating nails, and he either guesses at the correct date, or writes on his report "illegible." Then again, no matter how many letters of instructions are written, or how often you talk in person to these men, there will be thousands of ties placed in the track without dating nails in them, and other thousands of untreated ties bearing dating nails which should not be driven in them.

For the sake of argument, we will assume that every section foreman sends in reports absolutely correct; that whenever he removes a tie he puts in another, and in every case he shows the year treated correctly. Under such conditions, what kind of a record have you when every tie contains a dating nail? A tie is a tie, it matters not whether it is made of oak, pine, chestnut, cedar, maple, beech, or any one of fifteen or twenty other kinds of wood. Your record then cannot show which kind of wood is giving the longest life. There may possibly be some particular kind of wood that is giving only one-third, or one-half the life of other treated wood, but how are you going to know from the record? Your record shows that so many ties are taken out each year, some for decay, others for rail cut, breakages, etc, but does your record show that gum ties are breaking in greater numbers than elm, or that maple ties are being destroyed much more by rail cutting and spiking than beech or ash ties? Does it show whether zinc-chloride will preserve a tie as long as creosote, or that five pounds of creosote per cubic foot of timber is as economical as eight or twelve pounds? These are some of the questions you want answered, and they never can be answered by simply putting a dating nail in every tie, and depending on the nail and the section foreman to give you a correct report.

After an experience of ten years with such a record, the Burlington abandoned it and adopted the following method:

On each of the 19 divisions there are placed from 1,000 to 5,000 specially treated ties. The ties are marked with letters showing the kind of wood and the treating process used. In general 1,000 treated ties are used in a mile, and are so distributed as to furnish a ready comparison with the untreated ties. For keeping account of the tie renewals a diagram similar to the accompanying illustration is made for each test mile. With this record it is believed that reliable data as to the value of different woods and processes of treatment can be secured.



Record of Location of Test Ties; Chicago, Burlington & Quincy.

NOTE.—*Letters above the line indicate the kind of wood, and the process of treatment; the figures below indicate the number of ties.*

Kind of Wood. *A*, Ash; *I*, Beech; *B*, Red Birch; *Q*, Chestnut; *D*, Cottonwood; *C*, Cypress; *E*, White Elm; *H*, Hemlock; *K*, Pignut Hickory; *P*, Loblolly Pine; *M*, Hard Maple; *F*, Soft Maple. *W*, White Oak; *R*, Red Oak; *N*, Pin Oak; *L*, Poplar; *G*, Red Gum; *S*, Sycamore; *T*, Tamarack; *V*, Tupelo Gum.

Process. *No letter*, Card; *Y*, Straight Creosote; *Z*, Burnettizing; *X*, Untreated Hardwood; *U*, Untreated Soft.

Each kind of wood is designated by a letter stamped on the head of a nail driven into top of tie, about 3½ inches from one end. When marked only by the letter designating the kind of wood the tie has been treated by the Card process.

Pennsylvania Sets Record for Safety to Passengers.

According to an official statement issued by the Pennsylvania R. R. not a single passenger out of 136,000,000 carried by the system east of Pittsburg and Erie was killed in a train accident during the calendar year. This includes the Pennsylvania railroad proper, the Philadelphia, Baltimore and Washington, the Northern Central, the Cumberland Valley, the Maryland, Delaware and Virginia, the Baltimore, Chesapeake and Atlantic, the West Jersey and Seashore, and the Long Island, leaving out of consideration the lines west of Pittsburg, which are operated separately.

Combining the statistics for 1908, 1909, and 1910, the statement shows that in that time the number of passengers carried on the lines east of Pittsburg and Erie was 371,858,277, more than four times as many persons as there are in the United States, and only one of them was killed as the result of a train wreck. In other words, the chance of a passenger losing his life in an accident on the Pennsylvania was one out of about 370,000,000.

During 1910 the lines east of Pittsburg carried 14,180,288 more passengers than in 1909, but the total number of passengers injured in train accidents was only 84, a reduction of exactly 50 per cent as compared with 1909. These figures include every case requiring surgical or medical attention, however trivial, according to the statement. The number of passengers carried one mile during 1910 was practically three billion, so that for each passenger carried one mile the proportion was 35,000,000 carried in safety to 1 injured.

Steam Shovel Record for Florida.—The following table shows a record for steam shovel work during nine months near Ft. Mead, Fla. It is considered one of the best records made in Florida or the south and is especially notable because of the fact that the work has been done in a rainy season and in 11 hrs. work per day. The work is stripping phosphate beds and the haul averages about 1 mile. A 70-ton Bucyrus shovel and 12-yd. Western dump cars are used. The average actual yardage per car, hauled during the entire time was 12.68 cu. yds., thus exceeding by more than ½ cu. yd. the rated capacity of the car. The record of the work follows:

1910	Days	Cars [illegible]	Cu. yds. Total
May*	11	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]
August	27	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]
October	26	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]
January, 1911	[illegible]	[illegible]	[illegible]
	219	34,073	432,162.0

Mr. J. H. Hall is the contractor on the work.

LETTERS TO THE EDITOR.

The Silting of Reservoirs.

Sir: Referring to Mr. [illegible] on "Silting of Reservoirs" appearing in [illegible] Feb. 22, 1911, issue: The Elephant Butte Reservoir of the Rio Grande project of the Reclamation Service will be [illegible] 175 ft. deep at the dam and will hold 2,500,000 acre feet of water, which, in 75 years, will be replaced by mud. Where [illegible] Mr. D'Rohan put the latter if its removal was practicable? The reservoir is surrounded by precipitous mountain slope. The valley below is occupied by valuable farming land. While the Elephant Butte Reservoir is the largest now projected, others approach it in magnitude and it is typical of the work being done by the Reclamation Service.

The annual flow of the Rio Grande is about 1,000,000 acre feet. The water carries from 3 to 5 per cent of silt ordinarily. The maximum is not less than 10 per cent. Every drop of water is required for irrigation. There is no surplus available to be wasted in futile efforts to scour mud out of the reservoir. All of the water must be drawn from the latter in regulated quantities generating velocities absolutely incapable of removing silt. The latter was brought into the reservoir by flood volumes and velocities. Its removal by scouring requires the passing in contact with it volumes and velocities of water as great as those bringing it in. Such conditions in any reservoir of considerable magnitude are quite impossible. Even the exceptional sluice gates of the Assuan dam do not remove the silt deposited any considerable distance above that dam. The silt problem as herein considered has not been solved there. As a regulating work, the sluice gates of the Assuan dam will enable the latter to perform such a function indefinitely.

Mr. D'Rohan's silt traps, sand boxes and sedimentation basins, if cleanable, are merely very small reservoirs of such limited capacity in respect to the volume of water that they are in no sense storage reservoirs for the conservation of water. If the sedimentation basin is large enough to prevent the silt from passing into the reservoir for a time, it is, in fact, then merely a part of the storage capacity, and the latter is still steadily and permanently being destroyed by accumulation of mud. When one reservoir becomes filled with silt it is, of course, entirely proper to consider the advisability of creating another one provided another reservoir site is available. The Elephant Butte Reservoir as described exhausts the storage possibilities for that site.

Referring to the sluicing arrangement of the Assuan dam, Mr. D'Rohan says: "It is hardly possible to employ these systems in all cases in any country, consequently the reservoirs are silted up and the dams become useless." The inference is that, in nearly all cases, it is practicable to keep the reservoirs clean by sluicing. On the contrary, it is a rare exception indeed in any country where dependence must be placed on storage to find a surplus of water that could be used for sluicing, granting, contrary to established fact, that a large reservoir could be kept free from mud by sluicing gates.

Mr. D'Rohan says: "If this solid dam be pierced by a sluice designed on the principle of the Spanish gate, part of the silt could be removed through it by the water in the reservoir and the remainder could be shoveled or scraped into the stream." With a full reservoir, a small quantity of silt [illegible] is removed by that process. But, in so doing, it will be found that the water for one irrigating season has been wasted and that practically all of the silt remains in storage. In irrigation by stored water, such a plan is utterly suicidal. Nobody is committing suicide in that way, notwithstanding the efficacy of the method as a means to financial ruin.

Mr. D'Rohan implies that the silt left in the reservoir after the latter is emptied by the outrush of water through the open sluice can be readily and economically shoveled into the stream flowing through the reservoir site and thereby be carried out of the reservoir. But no water is being stored during such an operation and, again, there is an inadmissible waste. Moreover, such a plan is untenable both in theory and in practice when applied to the prevailing conditions under which water is stored and used for irrigation in the arid West. The silt in the reservoir is brought there by flood volume and velocity of flow. The stream is already laden with all the silt it can carry. It is useless to dump more silt into it. There is nothing in the laws of gravity and dynamic energy that can give to water an additional carrying capacity merely because it happens to be flowing through a reservoir site. In the torrential streams of the arid West, there is no low or medium clear water flow into the upper ends of reservoirs great enough to pick up and remove the silt from the reservoir.

If it requires 75 years for the normal flow of the silt laden waters of the Rio Grande to deposit 2,500,000 acre-feet of mud in the Elephant Butte reservoir, it will require no less time for the same normal flow, minus the silt, to pick up and remove the deposited mud. But the normal flow of the Rio Grande will never come minus the silt, consequently, it can never clean the Elephant Butte reservoir. For millions of years the rivers have been filling the valleys with earth and debris from the hills. They never [illegible].

[illegible]

El Paso, Texas, Feb. 24, 1911.

Bending in Rivets.

Sir: [illegible] through your paper valuable information on the subject of structural steel design and details. Will you kindly favor me by solving the following problem: How many ¾-in. rivets are required to connect the gusset plate to the column for the eccentric loading as shown in sketch below? Kindly give solution in figures.

Respectfully yours,

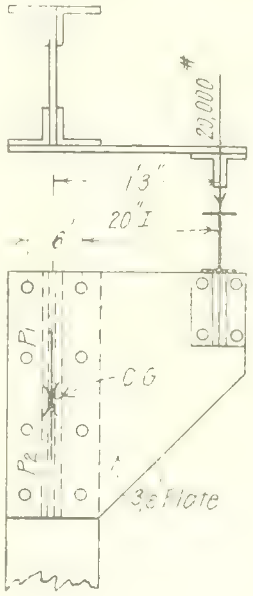
[illegible]

Chicago, Ill., Feb. 27, 1911.

[Although our correspondent asks for a numerical result, we believe the space necessary for [illegible] of the analysis of this and similar problems. The following analysis is substantially that in standard text-books treating this problem. Having assumed a certain number of rivets to begin with, find their center of gravity. Through this center of gravity take two forces P_1 and P_2 equal in amount but opposite in direction, each equal and parallel to the given eccentric load. Our original eccentric load is then replaced by an equal and parallel load P_1 acting in the same direction through the center of gravity of the rivets, and by a couple whose moment M is equal to the value of the eccentric load times the perpendicular distance from the center of gravity to its line of action (in this case 20,000 lbs. × 15 ins. = 300,000 in.-lbs.).

The effect of P_1 is to cause a shear in each rivet of (in this case) 20,000 lbs. divided by the number of rivets [illegible] $\frac{P}{n}$ = Sd (the subscript d denoting direct).

The effect of the couple is to tend to turn the gusset plate about the center of gravity of the rivets. This turning tendency must be equalled by the [illegible]



and this resistance constitutes the shear due to turning moment. The shear in any rivet due to this turning moment will vary directly as the distance, and the resisting moment exerted by any rivet will vary as the square of the distance of the rivet from the center of gravity of all the rivets.

If we let K denote the resultant shear due to this turning moment on a rivet at a unit's distance from the center of gravity, this relation obtains:

$M = Kd^2$ [illegible] $= K\Sigma d^2$,

where the various d's are the distances from the rivets to the c. g. of all the rivets.

Solving this equation, $K = \frac{M}{\Sigma d^2}$.

Then multiply the distance to a given rivet, the distance being measured in the same unit as K, by the value of K, and the product is the value of the shear on that rivet due to moment = Sm. The line of action of this shearing force Sm, due to moment, is at right angles to the line joining the rivet with the c. g. Then the total shear on any rivet is [illegible]

Cast Iron Culvert Cost Data Wanted.

Sir: [illegible] on (a) hauling cast iron culvert pipe per ton mile; (b) hauling and placing same, and (c) placing only? Also can you give costs of placing concrete about the ends of pipe culverts, making the molds, etc., in cases where the company furnishes the materials? Also cost of concrete culverts under the same conditions? Also can you give cost of [illegible] bridge timber and piling creosoted, non-creosoted, oak, cedar, etc? Labor costs are chiefly wanted.

RAILROAD CONTRACTOR.

Omaha, Neb., March 1, 1911.

(We shall be glad if any of our readers can give information answering any or all of the above questions.—Editors.)

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*The shovel was cut into [illegible] and started digging May 18, 1910.

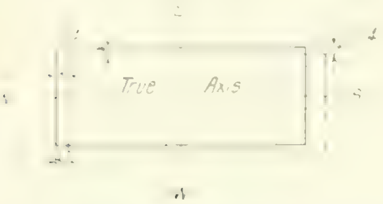
Progress Report Form, St. Louis Municipal Bridge.

Sirs:—In the article on the St. Louis Municipal Bridge, the writer finds that, through an oversight on his part, the Form of Report is incomplete in that the actual position of the cutting edge is not shown. It is of course too late to remedy this matter. The enclosed report shows, however, what should have been given.

The writer would also be greatly obliged if in your next issue you will mention the fact that the work of laying out the triangulation system was done by Mr. Philip Aylett.

Yours very truly,
S. W. BOWEN.

St. Louis, Mo., March 9, 1911.



(The accompanying figure shows the exact position of the cutting edge in dotted lines, and the true position in full lines. Reference to page 289 of our last issue will show the complete form of the report of which this diagram is a part.—Editors.)

Express and Parcels Post Rates Compared.

Sirs: The writer is very much interested in the discussion of the Postoffice Department that is appearing in current issues. A while ago he had occasion to send a package to Davis Creek, a small town in California, about 26 miles beyond Alturas, on the N. C. & O. Ry. The express rate to deliver a package at this point becomes 14 7/12 cts. a pound, as it is necessary to bill the package through to Lakeview, Oregon, and place instructions on the package to drop it off the stage at Davis Creek. Otherwise it is necessary to send the package to Alturas for 12½ cts a pound and pay the stage rate to Davis Creek, about another 12½ cts. a pound, and take the change of the package never arriving at its destination.

To send the same package to Kirkintilloch, a small town in Scotland similarly situated, it costs 12 cts. a pound by parcels post. The package in the latter case is carried across the continent in a train, across the Atlantic in a ship, in a train to Glasgow, in a car across the town, and in a boat on the Forth and Clyde Canal to Kirkintilloch.

The bare fact stands out that all this is done in spite of the remarkably amazing inefficiency of the Postoffice. The express rates in this country have influenced the postal rates on merchandise by powerful lobbying and clever argument to such an extent that the postal rates are higher than the express rates for merchandise to Davis Creek mentioned before, but the present rates enable the express companies to cut a melon of 100 per cent every once in a while.

The writer is of the opinion that the Postoffice should probably be put on a more efficient basis, but that the express companies should be taken over by the Postoffice department and the rates reduced to a point comparable with the service rendered.

Yours very truly,
DAVID W. DICKIE.

San Francisco, Cal., Feb. 18, 1911.

(This journal holds no brief for the express companies and has offered no defense of the rates charged by them. Its purpose has been merely to show that the express companies are doing a business comparable to the postal service at a cost to themselves many times smaller than the cost of postal service. The admitted advantages of parcels post find their strongest opponent in the United Staes in the extravagant methods of the Postoffice Department.—Editors.)

PERSONALS.

T[illegible] Construction Co., of San Francisco, announces the removal of its offices from No. 717 Kohl building to No. 26 Montgomery street.

Mr. E. N. Layfield, chief engineer of the Baltimore & Ohio Chicago Terminal R. R., has been appointed a member of the Grade Separation Commission of Grand Rapids, Mich.

Mr. Arthur H. N. Buce, of Ottawa, Can., has been appointed chief engineer of the Quebec & Saguenay Ry. This road is planning to extend from its present terminus to a point ten miles east of Murray Bay, a distance of 65 miles.

Mr. Robert V. Massey, division engineer of the New York division of the Pennsylvania R. R., was appointed superintendent of the New York, Philadelphia & Norfolk R. R. on March 7. He succeeds Mr. Elisha Lee, recently appointed assistant to the general manager.

In recognition of his services in finding the North Pole, Capt. Robert E. Peary, civil engineer, U. S. N., has been retired with the rank and pay of a Rear Admiral. In addition to this, he receives the privilege of the floor of the Senate and House of Representatives.

Mr. Charles H. Bodkin, formerly one of the leading railroad contractors of the south, died at his home in Memphs, Tenn., a week ago. He had taken an active part in the construction of railroads in Tennessee, Kentucky and Arkansas, and was identified with several of the biggest construction projects of the Frisco and Iron Mountain roads.

Work has been started on the construction of the new $13,000 bridge over the Okanogan River at Omak, Wash., under the supervision of Mr. C. S. Crow. This structure will consist of a 170-ft. steel draw span and two 112-ft. combination steel and wood approach spans, resting on pile piers. It is planned to finish the work by April 1, at which time Mr. Crow will go to Portland in the interest of the Coast Bridge Co.

Mr. H. D. Judson, general superintendent of the Illinois district of the Chicago, Burlington & Quincy R. R., died of heart disease at Rockport, Tex., on March 11. He had been ill for several months and was on his way to the southwest in search of health when he was compelled to go to the hospital at Rockport. Mr. Judson entered the railroad service as a telegraph operator with the old Chicago & Iowa R. R. in 1872. Later he became station agent at Mount Morris, Ill. In 1881 he was appointed superintendent of the Chicago & Iowa, with headquarters at Rochelle, Ill. That road was absorbed by the Burlington in 1882. Mr. Judson remained as superintendent at Rochelle until 1890, when he became superintendent of the Chicago division of the Burlington, with headquarters at Aurora, Ill., that division having been extended to include the Chicago & Iowa. About the year 1902 he was appointed superintendent of the Illinois district, with headquarters at Galesburg, Ill., succeeding Mr. F. C. Rice, who became general superintendent. On the reorganization of the Burlington in 1905, Mr. Judson became general superintendent of the Illinois district. He was 57 years of age at the time of his death.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Motor Trucks.—Paper, 5x8 ins., 8 pp. Peerless Motor Car Co., Cleveland, Ohio.

Illustrating and describing the Peerless 3 and 4-ton truck. Prices are given.

Motor Trucks.—Paper, 8x11 ins., 30 pp. Alden-Sampson Mfg. Co., Detroit, Mich.

Giving a complete description of the Sampson truck and all its parts. Illustrating application of trucks for various purposes.

Motor Trucks.—Paper, 5x8¼ ins., 16 pp. F. B. Stearns Co., Cleveland, O.

Illustrating and describing 3 and 5-ton trucks.

Motor Truck and Tractor.—Paper, 8x9 ins., 48 pp. Avery Company, Peoria, Ill.

Illustrates various applications of motor trucks, especially those with wood tires. Detailed descriptions and illustrations of parts are given, together with prices.

Motor Trucks.—Paper, 6x9 ins., 16 pp. Pierce-Arrow Motor Car Co., Buffalo, N. Y.

Contains illustrations and descriptions of various types of trucks, with prices of same.

Motor Trucks.—Paper, 8x11 ins., 32 pp. American Locomotive Co., 2501 Michigan Ave., Chicago.

The catalog for the Alco truck shows illustrations of various designs of heavy trucks with some records of performance.

Curb Conduit.—Paper, 9x11 ins., 8 pp. James C. Marriott, Park Row Bldg., New York.

An illustrated description of a combined curb and conduit.

Dustoline.—Paper, 5x7¾ ins., 16 pp. John S. Lamson, Jr., Summit, N. J.

An illustrated booklet describing the advantages and economy of using this preparation for a dust preventative on roads.

Cement Plant.—Paper, 6x9 ins.; 68 pp. Chicago Portland Cement Co., Chicago, Ill.

An illustrated catalog in which is given a complete description of the new plant at Oglesby, Ill.

Rivet Heating Furnaces.—Paper, 9x12 ins.; 8 pp. Rockwell Furnace Co., Fisher Building, Chicago.

A catalog of oil and gas burning furnaces for rivet heating, both portable and stationary. Dimensions, illustrations, fuel and air consumption for each furnace are given.

Moyer Tramrail.—Paper, 9x12 ins.; 8 pp. Rockwell Furnace Co., Fisher Building, Chicago.

An illustrated description of the Moyer Tramrail transportation system for factories and industrial establishments. An I-Beam tram. Details of curves and switches shown. Also prices and specifications.

Concrete in the Country.—Paper, 6x9 ins.; 112 pp. Universal Portland Cement Co., 115 Adams St., Chicago.

A book of instructions for mixing and handling concrete, and for the use of concrete in the rural districts. Plans and illustrations of many structures are given with instructions for building. A useful book.

Headgates and Headgate Lifts.—Paper, 6x9 ins.; 36 pp. C. D. Butchart, 501 Mercantile Building, Denver Colo.

This is a catalog of Northwestern Headgates and Headgate Lifts for irrigation reservoirs and ditches. All types of gates and lifts are illustrated, sizes, weights and prices are given

Sidewalk Paving.—Paper, 6x9 ins.; 32 pp. Vulcanite Portland Cement Co., Fifth Ave. Bldg., New York.

A booklet containing a paper by Albert Moyer on Cement Sidewalk Paving, Suggestions as to Methods of Construction. Illustrated.

Alco. Lava Burners.—Board, 8½x8 ins.; 40 pp American Lava Co., Chattanooga, Tenn.

A catalog of gas jets including all types made. Many are of unique design. Prices are given. Illustrated.

Electric Riveters.—Paper, 7x9¼ ins., 8 pp. Hanna Engineering Works, 2059 Elston Ave., Chicago.

These pages, consisting of Bulletins R1 and R2, illustrate and describe Ajax Electric Riveting Machines of motor or belt drive, and also the semi-portable-yoke and hold-on types. This is the first line of electrical machines to do work in the field of pneumatic tools. Prices, sizes and costs of operation are given.

Air Compressors.—Paper, 6x9 ins., 16 pp. Thos. H. Dallett Co., York and 23d Sts., Philadelphia, Pa.

These pages comprise bulletins Nos. 200, 201 and 202, which describe and illustrate Dallett Air Compressors in detail. Line drawings and dimensions are given.

Cement.—Paper, 6x9 ins., 16 pp. Lehigh Portland Cement Co., Indianapolis, Ind.

Some photographs and descriptions of factory buildings and residences in the construction of which Lehigh Portland Cement has been used.

Wire Rope Blocks and Sheaves.—Paper, 6x9 ins., 16 pp. Harold L. Bond Co., 27 Coenties Slip, N. Y.

A catalog of wire rope blocks and sheaves, illustrating various types and giving sizes, dimensions and prices of each.

Metal Windows.—Paper, 6x12 ins., 20 pp. United States Metal Products Co., Metropolitan Bldg., New York.

A catalog illustrating and describing various forms and types of Rapp Rolled Steel Windows. Tables of standard sizes given. Eight pages are devoted to diagrams of windows with 2, 3 and 4 units and showing the overall dimensions for these in various types.

Cross-Ties Purchased in 1909.—According to a bulletin just issued by the Bureau of the Census, the total number of wooden crossties purchased by the steam and electric railroads of the United States in 1909 was 123,751,000. This represents an increase of 11,285,000 ties, or 10 per cent, over the number purchased in 1908, but a decrease of 29,952,000, or 19.5 per cent, from the number reported for 1907. The year 1907 was one of great activity in the railroad world, while in 1908 the railroads felt the effect of the general business depression and curtailed their expenses accordingly. From a comparison of the figures for 1909, 1908, and 1907, it is evident, however, that the cross-tie industry is rapidly regaining the prosperity enjoyed in 1907.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week.

One of the most interesting features of the past week is the letting of a large number of construction contracts for electric railway work. The principal contract of this kind was secured by Stewart & Jones of Baltimore, Md. This contract calls for the grading and masonry work for the first section from Charlotte, N. C., to Kings Mountain, of the Piedmont & Northern Traction Co.'s line. The contract covers 35 miles of line and is said to amount to $400,000. Another good contract which has been let, was for the 23-mile extension of the Chicago, Ottawa & Peoria Ry., from Morris to Joliet, Ill. Andrew Ward & Son, Oak Glen, Ill., secured the grading work and Driscoll & McCalman, Decatur, Ill., secured the concrete work. Other electric railway contracts reported to have been let recently are as follows: S. F. Hobler, Sanger, Cal., for grading for the projected line of the Fresno, Hanford & Summit Lake Interurban in California; Burton Construction Co., Richmond, Va., for building a new electric railway from Hagerstown, Md., to Clear Spring; Skipp & Wickersham, Pittsburg, Pa., for extending the double track of the Pittsburg, Harmony, Butler & New Castle Ry., a distance of 3,700 ft.; E. P. Arbogast, for a 5-mile extension of the Stroudsburg & Water Gap Ry., from Delaware Water Gap to Portland, Pa.

The principal feature of steam railroad construction has been the awarding of contracts by the Canadian Pacific Ry. for grading, concrete, culvert and bridging on new branch lines and second track on main line for 344 miles of work in the west. The contract went as follows: To Foley, Welch & Stewart, St. Paul, Minn., two lines out of Swift Current, 80 miles, one line out of Moose Jaw, 35 miles, one line east from Lacombe, 60 miles. To W. A. Dutton, three branches out of Wilkie, 82 miles. To Janse, Macdonald & Co., Calgary, Alberta, two lines in British Columbia, 54 miles. To J. G. Hargrave, second track from Moose Jaw west, 23 miles, east from Moose Jaw, 10 miles. Among the other railroad construction contracts let recently are the following: Grant Bros. Construction Co., Los Angeles, Cal., for changing this line of the Arizona Eastern R. R., near Hayden and Winkelman, Ariz.; The Edwards Construction Co., Tampa, Fla., for constructing 9,000 ft. of sidetracks on Seddon Island near Tampa, for the Seaboard Air Line; Columbia Bridge Co., Portland, Ore., for bridge work on the Grant's Pass & Rogue River, R. R., in Oregon; T. L. Campbell, 801 N. Kansas Ave., Topeka, Kan., for all bank widening on the Kansas Division of the C., R. I. & P. Ry.; Kilpatrick Bros. & Collins, Beatrice, Neb., for building a 50-mile section of the Laramie cutoff of the Union Pacific from Northport, Neb., northwest to Gering; Grant, Smith & Co., Spokane, Wash., for constructing the 13-mile line of the Kootenay & Alberta Ry., from Pincher Creek, Alberta; sub-contracts for work on the new 50-mile line of the Midland Valley R. R., from Arkansas City, Kan., to Wichita, Kan., have been awarded to the following by the general contractor, M. Tansey, Arkansas City, Kan.: John Howell, C. J. Martin, J. C. Leathers, Wm. Hall, Pat Foley, G. L. Carey & Son, F. M. Abbott and Jack Howell.

There is a considerable amount of railroad construction work in view at the present time. Perhaps the most important in this section of the country is the new line of the Chicago, Rock Island & Pacific Ry., between its Iowa Division in the vicinity of Des Moines and its Missouri Division in the vicinity of either Seymour or Allerton. The last we heard the C., R. I. & P. had not definitely decided on the location, nor as to when work would be started. The matter, however, was to be settled very soon.

All bids received Feb. 20 by Maj. H. Jervey, U. S. Engineers, Cincinnati, O., for constructing Lock and Dam No. 29 in the Ohio River, near Ashland, Ky., have been rejected and new bids are being asked until 2 p. m., March 21. The lowest bid received on Feb. 20 amounted to $644,842.

Chinese Railroad Construction.

The three stages of the plan usually adopted by western nations for advancing "civilization" in a so called heathen country have been: 1st, send missionaries; 2d, send battleships; 3d, build railroads. China is now in the third stage, and during the past five years over 5,000 miles of railroad have been constructed in that country; during the next five years it is expected that over 4,000 miles additional will be built. But all of these railroads are not being built by foreign nations. China, thanks to the colleges of this country and England, now has engineers of its own, and they have demonstrated that they are capable of building railroads without foreign assistance. The first line of railway in China, built by native engineers without foreign advice and with exclusively native capital, was completed in the fall of 1909. This railway runs from Peking 135 miles northward beyond the great wall to the city of Kalgan. With the exception of the rails, which were imported from England and Belgium, and the locomotives, which were brought from the United States, this railway is entirely a native production. Both the freight and passenger cars were built in Chinese shops by Chinese workmen, in imitation of rolling stock imported from England, many years ago. This railway is now being extended from Kalgan northward toward the Russian boundary, with local capital, and under the direction of Chinese engineers. Several other railways are also under construction by native engineers with native capital. The most important of these is the Szechuen Hupeh Ry., which is being built from Tohang, the head of navigation on the Yangtse River, via Kuichow and Wan-Shein, westward toward Chunk-King, 1,000 miles. This road, which involves the most expensive and difficult engineering and construction work ever attempted in the Chinese empire, is being undertaken exclusively by Chinese engineers and native capital, without any foreign assistance or advice whatever. The route is through a very mountainous country and the construction requires much heavy work. There will be 22 rock tunnels, the longest of which will be 6,200 ft. There will also be two tunnels each more than 1,000 ft. long and several tunnels will each be between 700 and 800 ft. long. All of the tunnels are being driven by hand drilling. On this line there will be 50 bridges of concrete and steel requiring 300,000 bbls. of cement, which has already been imported from England. Grading work was started in the spring of 1910, and on Jan. 1, 1911, all grading, bridges, culverts, etc., had been completed for a distance of 35 miles and track laying had been started. The rails are being made in China by Chinese workmen, as are the cars. The locomotives, as usual, will come from this country. The work on the railroad is all being done by contract, the line having been divided into 11 sections.

A Hobo Pome.

Signs of spring have begun to appear—"old subscriber" writes to the newspaper telling of his thrilling discovery of the first robin, the hurdy gurdy is on the street, the bock beer sign is is in the window, and the spring poet is tuning up his lyre. Here is the latest effusion—not a spring poem, by the way—of the poet lariat of the hobo kingdom:

Well, we comes to Pumpkin Center,
  That's a town in Kansas state,
And the brakey finds us hiding
  So he chucks us off the freight.

And we watched her tail lights gleaming
  Down the track a mile away,
And it set my pate box rattling
  That we'd come to town this day;

For this burg was sure a station
  Where the rattlers seldom stop,
So my side kick puts it to me
  That we find a place to flop.

Well, we does; we find a barn loft
  Filled with soft and smelly hay,
And we pounds our ears inside it
  'Til the whistles blew next day;

Then I tells my pal, "Let's beat it;
  Guess we'll have to throw our feet,
For my backbone's in my stomach
  And I needs a bite to eat;

Meet me down above the depot
  When you've hit 'em up a bit;
I'll be there if I'm in hunky,
  And we'll divy what we git.

Well, we splits, he takes the main stem
  And I does the rural scout,
And the seventh door I batters,
Bim! da dame just bawls me out

Something awful; calls me lazy,
  Calls me bum and calls me shirk;
Says a great big tramp like I was
  Orta surely go to work.

Say, her talk was sure a cuckoo,
  And the fire flashed in her eyes,
But I "passed" her well on going
  And I swipes two custard pies.

Big and round was dey, and juicy
  Pretty fat for such as we;
So I beats it down to meet pal
  Where I tells him I would be.

He was there. We chews that swell food
  With our whiskers full of crumbs,
And I said she gave 'em to us
  If we'd sure fetch back the tins.

"You go take 'em to her, pal
  Set 'em down inside the door."
Now that husky, hungry hobo
  Ain't my partner any more.

County Road Superintendents.

Systematic construction of improved roads in Illinois is proposed by a bill now before the state legislature for the creation of the office of county superintendent of public highways. The bill provides that the county superintendent is to be appointed by boards of supervisors and county commissioners, and that all road and bridge work in the county will be placed under his direct control. He will be charged with the duty of making plans and specifications for the work, but in all bridge work costing more than $300 plans and specifications must be submitted to the state highway commission for approval. It will be the duty of the superintendent of highways to establish first, second and third class roads in each county, the first class being the main traveled roads to the [illegible] tance. Before appointment by the board of supervisors or county commissioners the su[illegible] tory examination by the state board of high[illegible] tificate of proficiency. County superintendents of highways can be removed for inefficiency and can only be reappointed under the same condition as first selected. The com[illegible] hold office for two years. The [illegible] fixed by the county board in the same manner and at the same ratio as the salary of other county officers is fixed. A nonresident [illegible] appointed superintendent of public [illegible] but he shall remove to the county and become a legal resident of it. The county board may appoint such assistants to the su[illegible]dent of highways as he indicates in writing are absolutely necessary for the work of his office. One of the most interesting sections of the bill now before the legislature provides that the county superintendent of public highways shall make annually to the state highway commission a complete detailed report of all work done under his charge, both as to bridges and highways. This report must show definite location of the work, its nature, character of materials, together with complete cost data, which shall show, if any work is done by day labor, the cost for labor and material separately, also showing the amount of work done by contract as distinguished from day labor.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

⊙The Elliott Naval Stores Co. of Florala, Ala., has let to J. N. Gillis & Son, Brewton, Ala., the construction of 10 miles railroad from a point on Black Water Bay near Milton, in direction of Brewton, Ala.

A new short line railroad to be built from Cuba, Ala., to connect with the line of the Mississippi Eastern now built out from Quitman to a point below Yantley, Ala., is proposed. B. A. Griggs, Yantley, and C. G. Abercrombie, Montgomery, Ala., are interested.

The Tuscaloosa Mineral R. R. mentioned in our last issue, is planning to have construction work started next month. Contractors have been over the line preparatory to submitting bids. The line will be 18 miles long and will require the construction of but one bridge of any size. E. D. Sloan, Tuscaloosa, Ala., is Engineer.

Surveys have been completed for the route of the proposed railroad up the Cahaba Valley from Selma to the Birmingham District, and the engineers are now engaged in preparing their reports. This is the railroad being promoted by Ernest Lamar of Selma, Ala.

Arkansas.

The St. Louis Southwestern Ry. Co. has sold to the Guaranty Trust Company and Rhoades & Co., $800,000 Central Arkansas and Eastern Railway first mortgage thirty-year 5 per cent bonds. These bonds are a first mortgage on the 45-mile new extension under construction from Stuttgart to Hazen, Ark., and from England to Stuttgart, on the St. Louis Southwestern's main line. All of the grading for this new extension has been completed and 30 miles of track have been laid. The remaining 15 miles will be completed by the end of the month.

Arizona.

⊙Grant Brothers Construction Co. of Los Angeles has been awarded the contract for changing the line of the Arizona Eastern R. R. near Hayden and Winkelman and has started work with a large force. The road will be changed to a shorter line along the foothills, taking it out of the reach of possible floods on the Gila River and permitting the unobstructed dumping of tailings from the great concentrator of the Ray Consolidated Copper Company. The present rails between Kelvin and Hayden are to be replaced with 90 lb. steel, both for the hauling of the heavy ore cars of the Ray Co. and for the traffic that is [illegible] line is complete[illegible] through the Gila Canyon to San Carlos.

California.

✣No bids were received March 8 by the Board of Public Works, Joseph L. McCormick, Secretary, Hewes Bldg., San Francisco, for furnishing and delivering redwood crossties for the Geary St. municipal railway at San Francisco. New bids will be received March 22. The estimated cost of the ties is $17,000.

⊙S. F. Hobler, Sanger, Cal., has been awarded a contract for the grading for the projected line of the Fresno, Hanford & Summit Lake Interurban railroad. The contract will amount to about $75,000 and work has been started. It is stated that track work will not be taken up until the grading is completed from Fresno to Kingsburg and Sanger.

In the course of a short address at Reno, Nev., on March 7, Robert Lovett, President of the Harriman Lines, is quoted in press dispatches as saying: "The tunnel under the Sierras will not be undertaken at once on account of its cost being too great, coupled with other expense, but there will be some tunneling done in connection with the double tracking. Practically the first double tracking to be done will be across the state of Nevada."

Bids are to be opened next month by the U. S. Government for 1,000,000,000 ft. of matured timber in the Trinity forest reserve. In consideration of the special concessions made in this sale in stumpage rates, the large amount of timber involved and the length of time allowed for its removal, the successful bidder will be required to construct and operate a standard gage railroad, which shall be a common carrier, through Trinity county, California, either from some point on tide water to Wildwood, California, on the headwaters of the Hay Fork of the Trinity river. It will follow the general course of the Hay Fork of the South Fork of Trinity river from Hyampom village to Wildwood. Such road must be in operation between the point selected on tide water and Hay Fork village in Trinity county, California, on or before April 1, 1916, and be extended to Wildwood, California, and in operation at least two years before the date on which the contract of sale expires. It may also be built from some point on the Sacramento Valley connecting with a railroad having transcontinental connections and running to Wildwood, California, on the headwaters of the Hay Fork of the South Fork of Trinity river and thence following the general course of the Hay Fork of the Trinity river from Wildwood to Hyampom village and through to the western boundary of the Trinity national forest in the headwaters of Grouse creek.

The Committee on Municipal Terminal Rys. of the City of Los Angeles, has been authorized to secure an engineer for the purpose of investigating and reporting on a general plan for the proposed municipal terminal railway. T. E. Gibbon, Los Angeles, is chairman of the committee.

The Turlock Traction Co. has been incorporated with a capital stock of $500,000, of which $20,000 has been subscribed, and proposes to construct an electric or other railroad from Turlock to Denair, a distance of 3½ miles, and from Turlock to Newman by air line, through Hilmar and other colonies in the irrigated district, a distance of 47 miles. The incorporators and directors are S. N. Griffiths of Fresno, A. M. Morton of Turlock, Lloyd Griffiths of Turlock, A. G. Chatom of Turlock and D. R. Shafer of Turlock.

Bids were opened March 1 by the Board of Public Works of San Francisco for several contracts for furnishing the materials that will be needed for the municipal Geary St. electric railway. The bids opened included such materials as rail joints and fastenings, copper wire, steel rods and nuts and rail bonds. No offers were received for furnishing steel trolley poles as the Eastern manufacturers declined to take the responsibility for their delivery at San Francisco in undamaged condition. The Rail Joint Co. of America, New York, submitted the lowest bid for rail joints and fastenings in the sum of $18,660. The lowest figure on rail bonds was $4,420, given by Eccles & Smith of San Francisco city. The Standard Underground Cable Co. offered to supply copper wire at $14.07 per 100 lbs. and the Payne Bolt Works of San Francisco was lowest on steel rods and nuts.

Colorado.

The Crown Hill Ry. Co. has been organized at Denver, Colo., and will have work started shortly in the construction of a car line from the Jefferson county line to Crown Hill cemetery at Denver. The officers and directors of the company are George W. Olinger, president; Joseph P. Havlick, vice-president; J. A. Beeler, treasurer; S. H. Foreman, secretary, and V. J. Davis, manager, all of Denver.

Work is reported to have been started March 1 on the completion of the double tracking of the Union Pacific main line from North Platte to Julesburg, Colo. It is expected that the work will be completed in two or three months. The distance is 81 miles. About 30 miles already has been double tracked. The line from Denver to LaSalle is double tracked, so that when the new contract is completed the line from Denver to Chicago will be double tracked with the exception of the 150 miles between LaSalle and Julesburg.

Connecticut.

The Connecticut Co., New Haven, Conn., is considering building an extension to Stafford. The work would require the construction of about four miles of line.

Florida.

⊙The Edwards Construction Co., Tampa, Fla., has been awarded the contract for the work of constructing 9,000 ft. of sidetracks on Seddon Island near Tampa for the Seaboard Air Line. This work was mentioned in our last issue.

⊙The Choctawhatchie Lumber Co. has awarded to J. N. Gillis & Son of Brewton, Ala., the contract of building 10 miles of standard gage railroad complete from Point Washington in direction of Chipley.

A proposition is under consideration for the construction of an electric railway from St. Petersburg to Tampa, Fla. C. W. Alton, Anderson, Ind., has been investigating the matter.

Advices from Key West, Fla., under date of Feb. 28 give the following information regarding the status of work at that time on the Florida East Coast Ry. extension. The work at Boca Chica is rapidly nearing completion and it is thought that within two or three weeks that the track will be laid across that viaduct ready for the trains to cross. The last five piers' forms are being filled in and the arches of these will be placed in a few days. In the meantime the ties are being laid on the approach at the Boca Chica side and on the completed portion of the viaduct. It is expected to finish the south approach early this week (March 4) and the work of laying the steel rails will shortly follow. After the completion of this piece of work, Division Engineer Smiley's main force will be moved farther up the line, and a new camp will probably be opened soon in the vicinity of Sugar Loaf. Two large barges are being built at Boca Chica for the purpose of transporting

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

the pier forms and other material to Pine channel and other points where needed. Number two excavator will be repaired at Key West, and the tug Sybil will bring pile driver number five. L. A. Bostwick has arrived at Boca Chica to take the place of Assistant Engineer Noble who was recently transferred to Pine Channel. Harry Barlow has also been transferred to the latter place. The work on the line between Pigeon Key and Boca Chica will probably occupy two-thirds of the working force on the extension for some months. Considerable work has been done in the past between these points which will greatly facilitate the progress of the present force. The points which will receive the most attention now will be Bahia Honda, Spanish Harbor, Pine Channel, Kemp Channel, Myles Channel and Bow Channel. The cofferdams have already been placed at Pine Channel and as soon as the plant is moved to the front, the concrete work will commence. The form of construction will be arches on the same plan as the Boca Chica Channel viaduct. The old trestle across Myles Channel is in good repair and will probably be used at least for some time. The trestle at Spanish Harbor was injured during the last hurricane, though not seriously, and a small amount of work will make it as good as ever. This will enable the engineers to place construction trains on Big Pine Key within a very short time; while the injury to the grade work on Big Pine Key was quite extensive, it was not of a serious nature, and a grading gang can quickly remedy this defect. It is understood that a marl pit will be established at the lower end of Big Pine Key. This will be a convenient point for a marl supply as great quantities of this material will be needed to fill the approaches to and from the abutments of the many trestles and viaducts which will be necessary between this point and Boca Chica. A large camp is now being established at Bow Channel. The commissary and camp supplies have already been shipped and it is expected that this camp will be working in full force within a very short time. Most of the plant and a number of the dredges are now working double crews and the progress made under these new arrangements speaks well for the management. The grading work at Bahia Honda is progressing very rapidly, the grade now reaching well back from the Bahia Honda abutment, the force is now working on the grade across the lagoon which occupies the center of the island. The buildings at West Summerlin are being rapidly put in condition by Foreman Raney by his gang of carpenters.

The first shipment of 15,000 tons of rails for the Pensacola, Mobile & New Orleans Ry., which is now under construction by Henry McLaughlin, Pensacola, Fla., has reached that city.

The Citrus Southern Ry. Co. has surveys under way for its projected 50 mile line from Sanford to Kissimmee. Land for terminal purposes has been purchased in Sanford. Practically all right of way for the 50-mile line has been secured. The company has a capital stock of $500,000, all but $75,000 of which is said to have been paid in. The officers of the company are: T. K. Miller, president; J. J. Brophy, vice-president and general manager; Moore Kelly, treasurer; J. M. McCue, secretary, all of Pittsburg, Pa.

Georgia.

The Moultrie, Fort Gaines & Western Ry. Co. has been chartered with a capital stock of $100,000 and proposes to build a line from Moultrie, Colquitt county, through Mitchell, Baker, Early, Calhoun and Clay counties to Fort Gaines. The incorporators of the new company are as follows: Frank Roberts, A. L. Davis, W. L. Roberts, D. C. Ashley, Walter E. Davis, A. F. Langford, Giddens and Di Ingram, of Valdosta, Ga., and W. P. Roberts, of Jacksonville, Fla.

Plans are under way for the construction of a railroad from Metcalfe, Ga., to Havana, Fla., about 60 miles. The projectors of this road are the Messrs. Upchurch of Raleigh, N. C., who have large milling interests in Raleigh and are also owners of mills near Metcalfe. It is said that the ultimate destination of this road is to St. Andrews Bay on the Gulf coast, but at present the idea is only to build as far as Havana.

The Lawrenceville Branch R. R., J. R. McKelvey, Manager, Lawrenceville, Ga., which extends from Lawrenceville to Suwanee, a distance of 10 miles, is being widened to standard gage.

Illinois.

⦿Andrew Ward & Son, Oak Glen, Ill., have been awarded the contract for excavation and grading work for the 23 mile extension of the Chicago, Ottawa & Peoria Ry. (electric) from Morris to Joliet. Driscoll & McCalman, Decatur, Ill., secured the contract for the concrete work.

It is reported that the Macomb Western Illinois R. R. of Macomb, now operating 22 miles of line, may be sold to a new company. If the deal goes through it is said that the new owners will electrify the line and extend it to Rushville and Mt. Sterling.

Indiana.

The Wabash R. R. has purchased a site for its proposed new freight depot at Wabash, Ind. The depot will be 475 ft. long.

The Evansville, Chrisney & Eastern R. R. Co., of Evansville, Ind., has been incorporated with a capital stock of $50,000, and proposes to build an interurban line from Evansville to Chrisney. The directors are E. E. Watts, J. F. Bergman, J. P. Chrisney, M. A. Abbott, and S. E. Gwaltney.

The Buffalo, Rochester & Pittsburg Ry., E. F. Robinson, Chief Engineer, Rochester, N. Y., has had engineers at work lately on its Indiana branch and it is believed that the company is planning to have work started this summer in double tracking as far south as Homer City.

The Capital Circuit Traction Co., organized by O. W. Johnson, of Cleveland, O., and Hoover Holton and L. E. W. Holton, to construct an Indianapolis circuit railroad forming a belt line to pass through seven adjacent county seats, is said to have placed practically all of the capital stock. Franchises through all cities and towns, complete right of way and surveys of the line have already been obtained by the company, it is said. The proposed line would be operated by the latest type of gasoline motor cars, supplying both passenger and freight service. Plans for the beginning of construction work contemplate the first operations near either Danville or Lebanon. From Danville the proposed line would run south through several towns to Martinsville, east to Franklin and Shelbyville, north to Greenville, Fortville and Noblesville and west through Sheridan to Lebanon and south through Advance and North Salem to Danville. The proposed circuit would lie entirely in the counties surrounding Marion County and touching each county seat and the larger towns of the different counties.

A committee from the Commercial Clubs of Richmond, Liberty and Brookville, have been over the route of a proposed new traction line from Richmond to Cincinnati. As soon as this committee reports, a meeting of the general committee will be held for the purpose of deciding whether a company should be organized for the purpose of building the line or an effort made to interest other companies in the project. The latter course is regarded as [illegible]

Iowa.

The Chicago & Northwestern Ry., H. Pettinghouse, Division Engineer, Boone, Ia., is reported to have issued orders for the commencement of [illegible] Boone. These will include new yards, a new round house and a new repairing department.

The Charles City & Western R. R., which last year completed its line from Charles City to Marble Rock, now proposes to build about 25 miles of road northeast from Charles City and if the farmers of the New Haven district meet the proposition made them, the road will touch [illegible]. The plan is to build through New Haven, Riceville, Alta Vista and Elma.

The Chicago, Rock Island & Pacific Ry. is reported to be planning to make extensive additions to its yards in Des Moines. Land for this purpose is now being acquired.

The Fort Dodge, Des Moines & Southern R. R., J. L. Blake, General Manager, Boone, Ia., is said to be planning to have work started shortly on an extension from Lundgren to Lehigh.

Kansas.

• All of the 50 miles of grading work for the new line of the Midland Valley R. R., from Arkansas City, Kan., to Wichita, Kan., mentioned in our last issue, has been covered, and among the sub-contractors on the work are John Howell, C. J. Martin, J. C. Leathers, Wm. Hall, Pat Foley, G. L. Carey & Son, F. M. Abbott and Jack Howell. M. Tansey, Arkansas City, Kan., has the general contract.

⦿T. L. Campbell, General Contractor, 801 N. Kan. Ave., Topeka, Kan., has been awarded the contract of all the bank widening of the C. R. I. & P. Ry. Co., on the Kansas Division. Mr. Campbell is arranging to start several outfits at work at once.

The Atchison, Topeka & Santa Fe Ry. is reported to have begun to purchase the right of way for a cut off from Dodge City to Colmar, New Mexico. It is reported that the line will follow the old railroad grade from Dodge City due southwest to Santa Fe, county seat of Haskell county, then run on in almost an air line southwest along the valley of the Cimarron through Ulysses, county seat of Grant county and Richfield, county seat of Morton county.

At a recent meeting at Kinsley, Kan., of the stockholders of the Wichita, Kinsley, Scott City & Denver Air Line Ry., it was reported that 60 miles of right had been secured and 40 miles of grading had been completed ready for the ties and rails. The following directors were elected: M. J. Cudney, Belpre; O. P. Jewett, Dighton; C. F. Field, Pretty Prairie; N. C. Adams, St. Joseph, Mo., and E. E. Goffin, Scott City.

Kentucky.

The Henderson Interurban R[illegible] of Henderson, Ky., has filed its articles of incorporation. The company has a nominal capital of $10,000, which is to be increased later. The charter provides for the construction and operation of electric railways in Kentucky. It is proposed if engineering reports develop the feasibility of so doing to build standard gage electric railways for the conveyance of both passengers and freight between Henderson and Dixon, Henderson and Uniontown via Morganfield, and Henderson and Owensboro. The aggregate length [illegible] lines will be about 85 miles.

The Licking River R. R., J. B. Shaw, Yale, Ky., General Manager, is to have work started as soon as the weather permits on a 15 mile extension from Yale to Frenchburg, Ky., along Beaver creek, which it will cross. The extension will be narrow gage, but the ties will be placed wide enough to permit its conversion to the standard type.

The Kentucky & Indiana R. R., & Terminal Co., Wm. R. Mitchell, Chief Engineer, Louisville, Ky., has purchased a 6-acre tract of ground, three miles north of New Albany, Ind., [illegible] for the high fill to be made on the Indiana [illegible] end [illegible].

Citizens of Independence, Ky., have raised the necessary $50,000 to secure the extension of the C., L. L. & N. traction line through that place. W. T. S. Blackburn, Dry Ridge, Ky., is President of [illegible].

Maryland.

• [illegible], Va., is reported to have been awarded the contract for building the new electric railway from Hagerstown, Md., to Clear Spring.

The Baltimore & Ohio R. R. is to have work started at an early date on the remodeling and enlarging the roundhouse and shops at Cumberland, Md. The [illegible] will

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible] and will [illegible] with [illegible] repair and [illegible] a large [illegible] a blacksmith and forge shop. O. C. Cromwell, Baltimore, Md., is Mechanical Engineer, Baltimore & Ohio R. R.

The Western Maryland R. R. is reported to have decided to locate its main shops near Cumberland. The location, it is understood, will be at Ridgeley, on the West Virginia side of the Potomac river, where the division shops now are, though a site at Cumberland race track, on the Maryland side, is said to have been under consideration.

Announcement has been made that the Cumberland Valley R. R., G. C. Koons, Engineer, Chambersburg, Pa., has plans for the expenditure of $500,000 or $750,000 in building its proposed high line through Hagerstown, the erection of a new passenger station and the building of roundhouses, yards and terminals in the southern suburbs, where the company last year purchased several large tracts of land adjacent to its right of way. The company purposes removing the present tracks from Walnut street. The new depot will be built on a site west of Walnut street. The site was bought several years ago. The tracks through the city will be elevated. Embankments will be erected on the railroad's property and the streets will be crossed by bridges of ornamental design. It is said it will require 18 months to make the improvements. In order that the Cumberland Valley may build its high line it is claimed it will be necessary to raise its tracks at North Crossing, where the Western Maryland Ry. intersects, but if this is done, the company claims, the building of the high line will be impractical. The solution, it is said, will be in the Western Maryland's lowering its tracks at North crossing 10 ft., a plan which the Western Maryland is said to oppose.

Michigan.

Chicago parties have made a proposition to the Board of Trade of Walkerville, Mich., offering to complete the electric line from Pentwater to Walkerville by April 1, 1912, providing a bonus of $50,000 was subscribed by people along the line and at the terminals.

The proposed betterment work of the Pere Marquette Ry., mentioned in our last, issue is believed to include the following: double-tracking 75 miles of the road between Chicago and Grand Rapids, and three divisions, between Grand Rapids and Holland, Fennville and New Buffalo and Grand Junction and Porter.

Minnesota.

Special Council Committee of the City of Minneapolis has recommended the following extensions of the local street railway system: Johnson St. NE to 29th Ave.; southern end of route to be decided later; length about two miles. Bloomington Ave. extension to 37th St. to 28th Ave. to 50th St., and thence to Minnehaha Falls, length about three miles. Grand St. NE, from 25th Ave. to 37th Ave., length about one mile. Bryant Ave. S extension of Monroe-Bryant line to 50th St. and thence to Penn Ave., length one mile.

The Canadian Northern Ry. is said to be considering building a line into the Vermillion iron range. Engineers have been in the field running lines from Cook on the Rainy Lake division to Pine Island and east. The company's agents have also been getting data concerning the range, with reference to prospective tonnage. This data embraces the prospective product of new mines. It is probable that the new line will continue north and east to connect with the old Port Arthur, Duluth and Western road, which is owned by the Canadian Northern, and which runs southwest from Port Arthur to near the Minnesota line.

The Minneapolis & St. Louis R. R. has recently sold $2,100,000 6 per cent, one-year, colateral notes.

Duluth and the Ranges.

BY PETER E. MEAGHER

⊙A. S. McDonald, General Manager for the Zenith Dredge Co., of Duluth, who has some very nice dredging contracts for the coming season, left for a business trip to New York. One of the recent contracts they received was for the Lake Superior & Ishpeming Railway Co., at Marquette. This contract amounts to about $150,000.

Mr. E. Crane, of the Western Wheeled Scraper Co., was here on a visit and left for the West. He stated that their company was expecting a very good year, and were running their plant to full capacity.

Barnett & Record Co., Duluth, Minn., large dock and concrete contractors, are getting their outfit in shape for the coming season. They already have several nice contracts, and are busily engaged on two of them at the present time. They look forward to a very successful season.

Frank A. Watkins, Secretary of the S. G. Taylor Chain Company of Chicago, Ill., paid us a visit a few days ago, and stated that their business was very encouraging, and, as far as he could see, the coming year ought to be a good one.

C. H. Overlin, traveling salesman for the J. I. Case Co., spent a couple of days with us here recently.

Patrick McDonnell, the Duluth contractor, left for a trip to Florida and from there was going to the Panama Canal. The stories that he will tell about the Canal will certainly be immense, but most of his friends will ask him to have them sworn to before a notary.

J. P. Bains, Superintendent for Drake & Stratton Co., in their stripping operations on the Iron Range, spent a couple of days with us here recently. They have ten steam shovels, are busy overhauling them at the present time, and expect to start work about April 15. I believe that Bains will remember his trip to Duluth for some time. The reason—(Oh, very well, we will not talk about that).

G. A. Nordeen, team contractor, was a caller at this office this week. He has a wheeler outfit, and is in the market for some work.

Mr. R. C. Young, of Marquette, Mich., Chief Engineer of the Lake Superior & Ishpeming Railway Co., spent a couple of days in Duluth recently. His company is contemplating doing quite a bit of work the coming season.

C. J. A. Morris of Morris & Shepard, General Contractors, St. Paul, Minn., spent a couple of days here this week. When asked about their contracts for the coming season, Mr. Morris stated at the present time he did not have any information to give out.

Andrew Perrin of Carl Hall & Co., Contractors, was a caller this week. He just returned from a week's trip to Kansas City and Chicago. They are not engaged in any work at the present time.

P. G. Pastoret, of the Pastoret-Lawrence Co., general contractors, was a caller this week. He had just returned from ten days' trip, bidding on contracts. He was not successful in landing any of them. Judging from the prices that the work went at, I presume he did not want them very bad.

A. B. Nelson, team contractor, was a caller at this office this week. He has a Fresno outfit and is in the market for some work.

There are quite a few rumors in the air up here regarding extensive railroad work to be started very shortly, but, at the time of writing this letter, I do not know if there is anything to these stories or not. Personally, I believe there is going to be quite a bit of work in this section.

Men are quite plentiful at the present time, as a great many of the lumber camps are breaking up. They are all looking for railroad work, but we have not got any for them just now.

Contractors and others when in this vicinity, are cordially invited to make the Equipment and Employment Offices of Peter E. Meagher, 409 West Michigan St., their headquarters while here.

Missouri.

A plan is under consideration for extending the Saline Valley line from its present terminus at Coffman, Ste. Genevieve county, into Farmington, a distance of 12 miles. It is proposed that the people of Farmington and of the section through which the road passes shall secure the right of way and turn it over to the railroad. The route of the road is along the roadbed of the old Cole road, which was built about 1870. Practically the whole of this roadbed was graded in 1870 and made ready for the ties, with the exception of a very few cuts. Giboney Houck, Cape Girardeau, Mo., is interested.

J. B. Quigley, Mansfield, Mo., Chief Engineer, the Kansas City, Ozarks & Southern Ry. (electric) has been making a trip through Taney county, with a view it is said of securing a suitable route for an extension to Forsyth and Hollister. An extension of the Ava line would give almost a straight line between Mansfield and Hollister, touching Brown Branch, Bradleyville, Kisee's Mills, Forsyth and Kirbyville. It would follow Beaver creek and cover approximately 35 miles of territory.

The sale of the St. Louis, Oklahoma & Southern R. R. has been approved and the company will be reorganized and the road completed. E. A. Peters of St. Louis, and Masterson Peyton, trustees for the bondholders bought in the road. This is the railroad being built from Southwest City, Mo., to Tahlequah, Muskogee and Honey Grove, Tex. The road had been graded to Tahlequah and part of the ties laid when the panic of 1907 caused the work to be stopped. The bondholders have agreed to let the reorganized company complete the road. The northern terminus will be Joplin, Mo. Following are the directors of the new company: J. B. McDonald, New York; C. E. Thomas, St. Louis; Silas Cook, East St. Louis; John D. Walls, E. A. Peters, St. Louis; A. D. Marshall, Dover, Del.

A project is under consideration for the construction of an electric railway from Williamstown to Gorin. The promoters are considering the possibility of using an old grade which runs a short distance from Gorin. Henry Weber, Gorin, Mo., is reported to be interested.

The Chicago, Milwaukee & St. Paul Ry., C. F. Loweth, Chief Engineer, Chicago, Ill., is to increase the capacity of its grain elevator at Cobing, a suburb of Kansas City, from 1,250,000 to 1,700,000 bushels. It is stated that fourteen additional cement tanks will be necessary to make the desired increase. The work will be completed by July 1.

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

⊙W. A. Ross of Kansas City, Kan., has secured about 20,000 yds. of street work in that city. This is in addition to the work mentioned in the last issue of the paper. He will put a machine outfit on this just as soon as possible and hurry it through to completion.

Horace S. Clark, Kansas City, representative of the Macomber & Whyte Rope Co., has returned from an extensive trip through the South. He reports the conditions to be good with the contractors throughout his territory. While many of them are now idle, yet the prospects are that contracts will soon be let to take care of practically every outfit in that section. Many drainage projects are planned besides levees and railroad betterment.

J. J. McCaughry of Chicago was a Kansas City visitor this week. The supposition is that "Big Jack," as he is familiarly known, is interested in the profiles of the Kansas City Southern work, which will be open for bids on the 15th inst.

W. A. Ross of Kansas City, Kan., secured an additional 20,000 yds. of work this week. This contract is street grading and is mostly earth.

It is reported here that there will be a drainage contract let at Paragould, Ark., in the near future involving about three million yards. For detailed information the County Clerk, Paragould, Ark., can be addressed.

There was some lively bidding at the city hall the other day, when a number of street jobs were let. As a rule the prices were low. James Dowd & Son were the successful bidders on the largest portion of the work. Dowd & Son is a Kansas City firm. Their address is 51st and Holmes Sts.

The letting of the Kansas City Southern work here on the 15th inst. is attracting wide attention, and it is presumed that a number of bids will be submitted. There will be about 1,500,000 yds. in the contract—mostly a shovel proposition. In our next letter we hope to be able to advise who the successful bidder is.

Mr. Nicholas of the Lorimer & Gallagher firm, Rookery Bldg., Chicago, was in Kansas City this week.

⊙A contract for rebuilding the Kaw River Bridge has just been let by the U. P. railroad to the Foundation Co. of New York. This was made necessary to conform with the plans of the Kaw Valley Drainage Board and the U. S. Engineers. It is said that the bridge improvements, together with the raising of the railroad yards on both sides of the river, will cost more than half a million dollars. The bridge, which was built after the flood of 1903, is to be rebuilt under the new plans. Each one of the piers are on one hundred and eighty piles, driven into the bed of the river. The spans of the present bridge are to be used if available and a new span 180 feet long is to be inserted, so the bridge will cover the 734-foot channel.

J. C. Nichols has returned from an extended trip to California. Mr. Nichols will, it is said, let some extensive grading contracts in the Country Club district of Kansas City return with considerable intrust.

We note that C. H. Sharp, the well known contractor, has just purchased an elegant home in Los Angeles, Cal. It is stated that the purchase price was $100,000. Mr. Sharp has been in California for about six weeks on his present trip. We sincerely trust the move on his part does not mean that he will take up his permanent residence in California.

⊙T. L. Campbell of Topeka, Kan., has secured 200,000 yards of C. R. I. & P. work in Kansas. The work is widening embankment and is all short haul. Wheelers and slips only can be used to advantage on this. Mr. Campbell can be addressed Care of Citizens' State Bank Bldg., North Topeka, Kansas, and he would be glad to hear from small wheeler and slip outfits. There will be free transportation on the C., R. I. & P. R. R. for outfits and men.

St. Louis Items.

BY A. B. KOENIG.

⊙Bob Leonard of Memphis, Tenn., got in on about 10 miles of levee and concrete work on the Brazos river in Washington county, Texas. Work is to be completed by Jan. 1, 1912. He has sub-let about half of this and will finish the other half himself.

⊙The contract for building an addition to the Horace Mann School was awarded to the Hiram Lloyd Building & Construction Co., its bid of $75,800 being the lowest of those submitted. The addition will consist of eight class rooms, a kindergarten and a gymnasium in the basement, the heating contract will be awarded to the Modern Heating Co., at $17,-659, and the plumbing to Edward C. E. Reisel at $9,529.

Cairo will make an effort to annul the franchise issued to the Cairo & Thebes R. R., which is now transferred to the Iron Mountain R. R. An ordinance was introduced at the council meeting for the annulment of the franchise which carried with it valuable privileges to the Cairo & Thebes road.

A. B. Koenig returned from a ten days' trip through the southwest. The labor market in this part of the country does not look very encouraging for the railroads and contractors during the coming year, for the insurrection in Mexico will not allow the usual number of Mexican laborers to come into the United States this spring and summer, who in former years were in the habit of spending the winters in Mexico and the summer months in the United States on railroad work.

J. W. Skinner has finished his bridge work at Mt. Carmel, Ill., and expects to finish his work on the Iron Mountain R. R. at Beebe, Ark., this month. Skinner is in the market for some more concrete, bridge or trestle work.

L. J. Smith and L. A. Nutter of the L. J. Smith Construction Co., spent two days in town last week on business.

Scott Mitchell, vice president of the L. J. Smith Co., 1111 Commerce Bldg., Kansas City, Mo., informs us that he will be ready to sub-let a part of the grading on their new St Louis & Kansas City Electric Line work about the 16th or 17th of March. He expects to start about 20 machine outfits and six steam shovels before the end of this month. Work will begin at Higginsville, Marshall and Columbia, Mo. He is not quite ready to sub-let any of the rock work, but will be shortly. A party of Paris bankers are financing this road and the bonds have all been placed.

With the end in view of having at least one thoroughfare in the city running from Lansdowne to Alta Sita, the extreme northern and southern boundaries, the Missouri Avenue Improvement Association of East St. Louis last week unanimously adopted a resolution asking the Board of Local Improvements to improve Twenty-sixth St. from State St. to the southern city limits. Twenty-sixth St. already is improved from State St. north to Lansdowne, and the Missouri Ave. business men want to join that street to Twenty-sixth at State St., as there is only a slight difference at that point, and in that way make a straight thoroughfare from Lansdown to Alta Sita. Judge William P. Launtz, president of the association, was instructed to prepare the proper petition and have it signed by the property owners and residents and presented to the Board of Local Improvements as soon as possible. In another resolution, which also was adopted unanimously, the association voted to petition the Board of Local Improvements and the City Council to have grade crossings established at the Relay Station, which is regarded as the most dangerous railroad crossing in the city. Although this proposition has been up before the Commercial Club and other organizations several times, no resolution in connection with it thus far has been adopted. Carl J. Vogel, real estate dealer, who will build a new hotel on Missouri Ave., announced he will be ready to give out all plans as soon as operating company is provided.

Cary Bros. have started on their levee work near Raddle, Ill.

L. E. Hamblet, the hustling manager of the Petersen & Fell Boarding & Commissary Co., has been out of town the past week looking after their various camps.

Harry Fell of the Petersen & Fell Boarding & Commissary Co., who has been under the weather for some time, is up and around again. We met Fell while in Kansas City the other day. Never saw him looking better in our lives, and no one around ever would believe that he has been sick from the looks of him now.

The Kansas City Southern is going to let a lot of work on the 15th inst. Kansas City has been full of contractors the past week, looking over this work. We will announce the name of the successful bidder in the next issue.

George C. Smith is busy with his work at Prairie Du Rocher, Ill.

Hugh Burns, whom all the old contractors in this part of the country will well remember, died in San Antonio, Texas, on March 11. At the time of his death Burns was 67 years of age. He had been interested in building very nearly every railroad in the state of Texas. He is survived by a widow and six children.

The warm weather during the past week in this part of the country has started up all of the outfits who have been waiting for the frost to get out of the ground. No frost left anywhere in this part of the country.

Sam M. Bush writes us from Crosuo, Mo., that his outfit, which consists of 40 teams, is idle at that point. Sam is in the market for any kind of grading.

Jessie Nichols got in on a nice contract in Arkansas, opposite Memphis, Tenn.

Carlson & Short are making rapid progress with their concrete work on the D. & R. G. R. R. at Granerous, Colo.

McCabe & Steen are doing fine at Granerous, Colo., on the D. & R. G. R. R.

Big Jack McCaughey and his son were in Kansas City the other day looking over the Kansas City Southern work.

Capt. J. A. Ware has been out of the city the past week. We may report something new about him in the next issue.

Wm. O'Connor left here for Carrolton, Mo., where he is finishing a piece of work on the Santa Fe R. R.

Cary Bros., 14 N. Front St., Memphis, Tenn., have 500,000 yds. of levee work skirting the east bank of the Mississippi river from Fountain Bluff to Corey, Ill., to sub-let. Average height of bank 7 ft., berme 10 to 15 ft., crown 5 ft., slope 3 to 1. All in fields. Will let work in quantities to suit outfits.

H. H. Marsh of ENGINEERING-CONTRACTING was with us a day last week. He left here for the west, promising us another call shortly.

Montana.

Surveys have been made and right of way has been secured for the proposed electric railway between Alder and Virginia City. An eastern trust company has undertaken to place the bonds, and if it is successful construction work will be started shortly so that the road can be placed in operation by fall. Carl Elling, Virginia City, Mont., president of the Virginia City Southern Electric R. R. Co., is reported to be interested. L. H. Leber and R. J. Watson are the promoters.

Nebraska.

The Nebraska Central & Western Ry., Broken Bow, or Arnold, Neb., is calling for bids on 690,000 cu. yds. of earth work out of Broken Bow, west to Arnold, Gandy and Tryon on its new proposed railroad. It is stated that grading is to be started in the next 90 days.

The Callaway & Western R. R. Co. has been organized by residents of Callaway, Nebr., and proposes to build a railroad west through the Loup Valley, thence west through Logan and McPherson counties.

New Mexico.

The Farmington, Albuquerque & Gulf R. R. Co. has been organized at Farmington, N. Mex., and proposes to construct a railroad from Farmington to Albuquerque. Five directors were elected in Farmington and four more will be elected by the Albuquerque Commercial club, including the president and treasurer of the company. Work on a preliminary survey and securing rights of way will be started soon.

New York.

The third track from Rensselaer to Pittsfield on the Boston & Albany R. R. was completed on March 5 and placed in operation the next day. This track has been in the course of construction for two years and the company has met and overcome many obstacles in the building of it. This track will be used for the east bound freight trains and the main east bound track will be used exclusively for the regular trains, thus avoiding the delay caused by the freight trains being in the way.

The Board of Estimate, of New York city has granted a franchise to the Nassau Electric R. R. Co. of Brooklyn to construct a line along Georgia Ave., Brooklyn, between

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Liberty and Atlantic Aves. [illegible] lines [illegible] Atlantic [illegible] Aves. A franchise [illegible] New York [illegible] tracks across the Madison Ave. bridge from Madison Ave. and East 136th St. to East 138th and Exterior Sts., the Bronx.

A bill is now before the State Legislature having for its purpose the development of sections of the state which now have no steam or street surface railroad connections. It provides a plan for the giving of state aid for building railroads in sections where they would not otherwise be constructed on account of the fact that it would be unprofitable for a private company to undertake such a venture. It is said that about one-third of the 933 towns in the state are without railroad transportation facilities.

North Carolina.

⊙The Piedmont & Northern Traction Co., W. S. Lee, Chief Engineer, Charlotte, N. C., is reported to have awarded the contract for the first section of its line to Stewart & Jones, Baltimore, Md. This section extends from Charlotte to Kings Mountain, a distance of 35 miles, and the contract calls for its completion in 120 working days. The bid was $400,000. The contract for the third link, from Greenwood to Greenville, S. C., a distance of 90 miles, is to be let shortly.

The Graham County R. R. Co. has completed surveys for its projected 13 mile line from Lupton to Robbinsville, N. C. Duff Merrick, Asheville, N. C., is President, and D. B. Burns, Asheville, is Chief Engineer.

The Durham & Danville Ry. Co., which is being promoted by capitalists of Durham, N. C., has applied for a charter in Virginia. A charter has already been granted the railway by the North Carolina legislature. The charter in Virginia is to allow the company to operate from the North Carolina border to Danville.

Arrangements are being made for securing a charter for the proposed railroad from Charlotte, N. C., to Norwood, N. C., mentioned in our Feb. 1 issue. It is probable that a survey will be started shortly. J. F. Shinn, secretary, Norwood Business Club, Norwood N. C., is interested.

Ohio.

We are advised that the rumor that the Lake Erie, Alliance & Wheeling R. R. was to be extended from Piney Fork to Martins Ferry is absolutely unfounded.

Contracts have been awarded for the Columbus terminals of the Ohio Traction company to subcontractors and the supervision of the completion of the contracts has been given Harry Maetzel of the Columbus firm of architects. Maetzel, Tresselt & Bassett.

The Cleveland, Akron & Columbus Ry., R. C. Harris, Engineer Maintenance of Way, Akron, has placed an order for 10,000 tons of steel rails.

Advices from Fostoria state that the council of the recently incorporated village of Burgoon has granted a franchise to The Fostoria & Fremont Railway Co. for the use of such streets as it may require for its tracks. The company will now negotiate with the Pennsylvania Ry. Co. for a crossing over their tracks in the village.

The Steubenville, Wellsburg & Weirton Ry. Co. has been chartered with a capital stock of $10,000, the incorporators being Frank D. Sinclair, Nelson D. Miller, Albert G. Lee, J. G. Wheaton and Michael Kane. The company proposes the building of an extension of the present traction line to Steubenville, from the West Virginia end of the Steubenville bridge to Weirton.

The Cincinnati, Hamilton & Dayton R. R. is understood to have plans under way for a considerable amount of improvement work between Dayton and Toledo. This is thought to include a large amount of double-tracking and the construction of new yards.

[illegible] Pittsburg & Lake Erie R. R. on March 8, adopted a resolution authorizing the issue of $1,200,000 of new stock.

The Cleveland Heights Realty Co., Cleveland, O., is considering the construction of a street car line to its holdings in Cleveland Heights. The company is said to be considering using either storage battery cars or gasoline cars.

Grade stakes have been set for the new electric line from Alliance to Ravena for the Stark Electric R. R. Co., of Alliance, and it is planned to have construction work started this month.

Oklahoma.

The Ardmore Chamber of Commerce has signed the contract guaranteeing the required bonus for the construction of the Ardmore, Duncan & Lawton railroad into the city. The shops of the proposed road will be located on a tract of land recently donated. J. L. Harmon, Lawton, is the promoter.

The Colorado, Oklahoma & New Orleans R. R. Co. has been chartered in Phoenix, Ariz., with a capital of $55,000,000 and with Oklahoma City as the headquarters. The company proposes to build a line 1,700 miles in length from Trinidad, Colo., through the Texas Panhandle, Oklahoma, Arkansas and Louisiana, to New Orleans. The incorporators, all of Oklahoma City, are W. J. Thompson, W. L. Peck, S. A. Horton, C. F. Woodward, L. T. Poole, D. J. Grigsby and Eugene Scharr.

Promotion work is reported well along for the proposed railroad from Chattanooga to Frederick, Okla. J. L. Mosby, Frederick, Okla., is reported to be interested.

A company has been organized with a capital stock of $200,000, to build an electric interurban line from Muskogee to Fort Gibson, a distance of ten miles. Ex-Governor C. N. Haskell, Muskogee, Okla., is interested.

Oregon.

⊙The Grant's Pass & Rogue River R. R., now under construction as noted in our last issue, has awarded a contract for bridge work to the Columbia Bridge Co., Portland, Ore.

The Corvallis & Alsea R. R. is reported to have been merged with the Portland, Eugene & Eastern and it is said will be extended from Monroe to Eugene and be electrified. The Willamette will be crossed at Corvalis and the line be continued northward to Albany and Salem.

The new Hill line between Clarke, Wash., on the north side of the Columbia river and Madras, Ore., a little more than 100 miles up the Deschutes valley, was opened to passenger and freight service on March 1. The new line opens up a fertile and hitherto undeveloped territory comprising 5,000,000 acres of government land that will be made immediately accessible.

Pennsylvania.

⊙Skipp & Wickersham, Pittsburg, Pa., have been awarded the contract for extending the double track of Pittsburg, Harmony, Butler & New Castle Ry. (electric) a distance of 3,700 ft.

⊙Advices from Allentown state that E. P. Arbogast has been awarded the contract for the extension of the Stroudsburg & Water Gap Ry. from Castle Inn, at Delaware Water Gap, to Portland, Northampton county. This stretch, five miles long, will be the last link of a through trolley route from Philadelphia to Delaware Water Gap.

⊙The Emery Contracting Co. of New Bethlehem, Pa., have taken a sub-contract from the Purcell Construction Co. for all the masonry included in its contract, which extends from Tamaqua to Libbyville, a distance of about 11 miles on the line of the Lehigh & New England R. R.. The Emery Co. expects to place three complete plants on the work and have already started operations.

The Northern Electric Street Ry. Co., Scranton, has purchased the controlling interest in the Lake Winola Association. The Lake Winola Park Co. was sold outright to the railway company. The total consideration is said to be $30,000.

It is reported at Punxsutawney that the New York Central Lines are planning to build a branch to that place. It is known that engineers have been at work surveying in the vicinity of McGees Mills and Rossiter and the report has the branch extending from McGees Mills to Punxsutawney by way of Rossiter and connecting with the Franklin & Clearfield R. R. to the south.

The property of the defunct and partially constructed Pittsburg, Binghamton & Eastern R. R. has been sold in two lots for $75,000 at Towanda. The first lot, comprising the right of way in Clinton and Clearfield counties, was sold for $25,000 to J. S. Fisher for the Beech Creek Extension Ry. Co., a subsidiary of the New York Central. The second lot was sold for $50,000 to John P. Wright, of Boston, for the bondholders' committee. This lot comprised all the rolling stock and other property in Susquehanna, Bradford, Tioga, Lycoming, Clinton, Center and Clearfield counties.

The Lock Haven & Jersey Shore R. R. Co., recently chartered, has applied to the City Councils of Lock Haven and Jersey Shore for a franchise in these places. The company proposes to build an electric railway, the route to follow the Susquehanna River to its terminus at Jersey Shore, passing through Lower Lockport, Dunnstown, Charlton, Woolrich, Liberty and Avis. The right of way over all this territory from the Lock Haven bridge to the borough lines are Jersey Shore has already been secured with the exception of Woodward township, with whose supervisors negotiations are still in progress. The promoters of the line also propose the construction of a power house on coal land on the 'Scotac Mountain, seven miles from Lock Haven. Archibald Hoagland, Williamsport, Pa., and Luther M. Patterson, Lock Haven, Pa., are interested.

It is believed that the Baltimore & Ohio R. R. will, within a few weeks, make definite announcement regarding its plans for a new station in Pittsburg. An appropriation of something like $1,000,000 has been set aside for a new station and other improvements, and it is thought that if the city makes certain concessions work may be undertaken this year. The present plan of the railroad is said to call for the closing up of Water St. between Grant and Ross Sts., and the erection of the new station near the freight station.

The stockholders of the Northwestern Pennsylvania Railways Co., which recently purchased the Meadville & Connecticut Lake Traction Co., the Peoples Incandscent Light Co., the Meadville Traction Co., and Oakwood park, near Meadville, held a meeting in Pittsburg last week to perfect an organization. H. W. Thornton, superintendent of the E. & A. division of the Pennsylvania Railroad, with headquarters in Newcastle, was elected president. Thomas D. Rhodes, vice president of the New York, Westchester & Boston R. R., was made vice president. Rhodes also is president of the Brunswick Terminal & Securities Co. George A. Gaston of Cleveland, O., was elected a director and general counsel for the company. Charles Fahr, president of the First National bank of Meadville, was elected treasurer. F. J. Lindman and William Good, New York bankers, were placed on the board. Arrangements have been made with the Pennsylvania R. R. to exchange services at Linesville, Pa., the present western terminal of the railway system. Freight cars will be carried to Meadeville over the traction company's tracks, and electric cars will discharge passengers in the railway company's depot.

The Mahoning & Shenango Valley Ry. & Light Co., New Castle, Pa., is reported to be planning the expenditure of $500,000 this year for improvement work. These improvements are to be made over the entire system from Leavittsburg to New Castle and Youngstown, and include double tracking some of the existing lines.

The Northern Central Ry. Co. (Pennsylvania Lines), F. Duane, Division Engineer, Baltimore, Md., is stated to have completed plans for the purchase of 39 acres of land east of York for the purpose of further enlargement of its local yard.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

South Carolina.

The Bennettsville & Cheraw R. R., H. A. Page, General Manager, Bennettsville, S. C., has had surveys made for an extension from Brownsville to Sellers, a distance of about 12 miles. Cross ties for the extension have been secured and it is believed that it will be completed by this fall.

Tennessee.

The Greenville & Nolashucky R. R. Co., of Greenville, Greene county, has been chartered with a capital stock of $100,000 and proposes to build a railroad from a point on the Southern railway, two miles east of Greeneville to Walton, Cocke county. The incorporators are John Heilman, Joseph B. Heilman, E. F. Layberger, W. W. Layberger and John G Reading.

Surveys have been completed and actual construction started at Stack House, N. C., on a projected 42-mile railroad to run from that place to Greeneville. Anderson Betts, a lumberman of New York, is said to be financing the project. The new road is said to pass through virgin forests of Madison county and after crossing the Tennessee line, will traverse a section said to be rich in iron ore and zinc.

The Louisville & Nashville R. R. is reported to be preparing to build a cut off from Madison station to Brentwood, where it would rejoin the main line, crossing the Cumberland river near the city pumping station. From Brentwood to Decatur, Ala., an additional track will be laid, providing a double track from Madison to Decatur. It is planned to haul through freight over the new track from Madison to Brentwood, a distance of some ten miles, obviating the necessity of bringing these trains through the Nashville terminals.

Texas.

The Texas Traction Co., Dallas, Tex., will probably have work started early next month on the construction of a line in Sherman to the West Hill cemetery.

Roach & Stansell, Memphis, Tenn., who have the contract for constructing the grade of that part of the Del Rio line of the Kansas City, Mexico & Orient between El Dorado and Sonora, Tex., have placed 100 teams and a large force of men at work. This firm also has the contract to grade 200 miles of the main line of the road through West Texas. The Del Rio branch starts from San Angelo and will run almost due south to Del Rio, on the Rio Grande, where it will connect with the branch line of the National Railways of Mexico to be built from Allende, on the Mexican International division of that system. The completion of this branch line of the Kansas City, Mexico and Orient during the present year will give that system an entrance to Mexico and also a connection with the transcontinental line of the Southern Pacific.

The Crystal City & Uvalde R. R. is to be extended from Gardendale, Tex., to a point about 3 miles east of there. A contract to that effect has been signed by J. E. Franklin, of St. Louis, president of the road, with several ranch owners through whose properties the road will pass. E. Breaker, Crystal City, Tex., is Chief Engineer

Grading work has been resumed on the San Antonio, Rio Grande & Tampico R. R., which is projected to run from San Antonio to Tampico, Mexico. The grade is finished between Jourdantown and Hindes, 25 miles, and work is now in progress on that part of the line between Jourdantown and San Antonio. The right of way has been secured for about 90 miles from San Antonio, and this first division of the road will be finished during the present year, it is stated. The proposed road will strike the Rio Grande at some point above Rio Grande City. J. F. Edwards of St. Louis, Mo., is the promoter of the road.

The Paris & Mt. Pleasant R. R., H. P. Moberly, Chief Engineer, Paris, Tex., has applied to the State Railroad Commission for authority to register $500,000 first mortgage bonds, also for certification of certain stock, on 25 miles of completed road from Paris to Bogata, Red River county. The line is in operation from Paris to Bogata and the proceeds from the bonds is for the purpose of completing the line to Mount Pleasant, which will make a total of 54 miles.

Preliminary surveys are being made for a proposed new north and south railroad through the eastern part of Texas. The road is to be known as the Houston & Red River R. R. and is being promoted by J. H. Soery of New York, who is said to represent large iron and steel interestes which own extensive iron ore lands in this part of the state. The proposed road will be about 350 miles long, and will run from Houston to some point on the Red River, passing through the iron ore fields. It is stated that the project is independent of any of the existing railroad systems in Texas and that it has large financial backing. One of its chief purposes is to bring about the development of the iron ore deposits of this region and to afford a transportation outlet for the ore. The erection of large iron and steel works at Houston is said to be a part of the general plans.

Levy & Owens, Rochelle, Tex., have been asking for bids for bridging, cattle guards and culverts on 28 miles work in San Saba and McCulloch counties, Texas; work to be put up under Gulf, Colorado and Santa Fe railroad specifications. The work is to begin by April 1, 1911.

The Commercial Club of Clarksville has received a proposition for the construction of a new independent line of railway from Atoka through Hugo to Clarksville. Pledges involving right of way, titles and bonus funds have been made by other cities and towns along the route. It is the desire of the promoters to begin construction work by the first of June on the southern end of the line. It is proposed that this road shall connect with another line to be built by the same company extending from a point beyond Oklahoma City to Dallas, through Sherman.

Location surveys for the Bryan & Brazos Valley R. R. have been started. The line will run from Bryan into the Burleson county Drainage District No. 1. The necessary capital to construct the road is reported to have been secured.

City Council of Beaumont is considering a franchise, granting the Beaumont Wharf & Terminal Co. the right to construct and operate a track from Austin St. on Main to Washington.

J. H. Soery, Houston, and associates, who are interested in the promotion of a railway from Houston to Henderson, via Rusk, to tap the ore beds, have arranged to take over the roadbed of the road promoted some years ago to East Texas, securing the eight miles of graded work out of East Houston.

A committee of the Commercial Club of San Antonio began work March 7 raising $250,000 to complete the amount of $500,000 required for building a railroad to Brownsville. The committee expects to raise the money by April 1.

Necessary capital is reported to be practically assured for the extension of the San Diego interurban line to Santa Maria. The new road will parallel the Fordyce branch of the St. Louis, Brownsville & Mexico, between it and the river and in all probability will be extended to Mission. R. H. Kern of St. Louis, Mo., a large land holder at Santa Maria and at Laferio, is interested.

Utah.

Officials of the Harriman system in New York city have received estimates for 50 miles of double tracking to be done this summer on the Oregon Short line in Utah and Idaho. The work is expected to cost $1,000,000 and will come out of the $75,000,000 that it has been decided to spend for improvements. Wm. Ashton, Salt Lake City, Utah, is Chief Engineer, Oregon Short Line R. R.

The Union Coal Co. has been organized at Provo, Utah, to develop coal lands in Carbon county. The project includes the construction of a railroad to run from Helper to a point [illegible] miles [illegible] part of the Castle Gate coal field. A. M. Holdaway, Provo, Utah, is the promoter.

Vermont.

The New York, New Haven & Hartford interests have purchased the Montpelier & Wells River R. R. and leased lines. The Montpelier & Wells River operates from Montpelier, Vt., and has about 45 miles of track.

Virginia.

The Southern Ry.'s new cut-off around Lynchburg, which is ten miles long, and cost $4,000,000, was opened to freight traffic March 1. Passenger trains will use the new line about March 15.

A company is to be organized with a capital stock of $600,000 for the purpose of building a railroad from Washington, Rappahannock county, Va., to Culpepper to a connection with the Southern Ry. This line will be 30 miles long and it is also proposed to build a short line through Madison county. Mrs. A. M. Moore, Cleveland, O., is the promoter.

It is expected that the promoters of the proposed new railway from Norfolk to Washington, D. C., will shortly make a definite announcement as to their plans. The company is reported to have secured considerable financial backing. The plan includes the construction of a drawbridge near the York river near its mouth and the use of the rails of the Virginian Ry. from Sewells Point for an entrance to Norfolk. Richard Armstrong, Hampton, Va., is one of the promoters.

The Norfolk Terminal Ry. Co., L. E. Johnson, President, Roanoke, Va., will hold a meeting March 20 to take steps for raising funds for the erection of the $2,000,000 Union depot in Norfolk. This depot is to be occupied jointly by the Norfolk & Western Ry., the Virginian Ry. and the Norfolk Southern Ry., and will be erected by the Norfolk Terminal Railway Co., as a holding corporation. It is hoped to have construction work started by May 1.

Washington.

A construction camp has been established south of Sedro-Woolley, Wash., and work has been started on the proposed railway, south of the Skagit River, which is to extend from what is known as the Sam Nerdrum stone quarry on the Northern Pacific Ry. right of way, thence east up the south bank of the Skagit, a distance of ten miles.

C. D. Moore proposes to build a steam railroad from the North Branch R. R. to White Salmon, a distance of 1½ miles. He is reported to have secured the right of way and is said to have obtained $50,000 to finance the line.

West Virginia.

The Hampshire Southern R. R., W. Trapnell, Chief Engineer, Romney, W. Va., now operating 38 miles of line, is to build an extension of about 30 miles to reach a new truck farming and fruit district between Morefield and Petersburg, W. Va. It is stated that the extension will be built by railroad company forces.

It looks as though steps would be taken soon for building the proposed electric railway from Sistersville to Middlebourne. A bill was recently passed by the State Legislature for counties to extend aid in the construction of railroads, and it is probable that the two districts interested in the above road will now vote $200,000 for the line. If this is done, it is said, that Henry W. McCoy, Sistersville, will guarantee the construction of the road

Wisconsin.

The City Council of Milwaukee has adopted the ordinance providing for a $1,000,000 mortgage certificate issue for the proposed terminal station. Two resolutions providing for a special election to pass upon this issue and a $50,000 bond issue to take care of the preliminary expenses were also adopted.

It is probable that the Milwaukee Western Electric Ry. Co., Milwaukee, will start work on its proposed line from 48th St. to Fox [illegible] distance of [illegible] this summer, regardless of the hostile attitude of the city administration to granting the road a franchise.

Wyoming.

C. I. Manners, Pueblo, Colo., is to ship his outfit to Laramie, Wyo., where he has a grading contract on the Laramie, Hahn's Peak & Pacific R. R. extension.

Canada.

✣Bids will be received until noon, March 25, by A. L. Heitberg, Division Engineer, Canadian Pacific Ry., Union Station, Toronto, Ont., for a 22-stall engine house, with machine and boiler shops, to be constructed at London, Ont. Plans and specifications can be seen in the Division Engineer's office, Toronto, and also in the Resident Engineer's office, London, Ont.

✣Bids will be received until noon, March 22, at the office of the Division Engineer, Canadian Pacific Ry., Calgary, for the construction of the following buildings: C. P. R. Standard No. 4 Section House, at: Bowell, Langdon, Magarg, Cheneka, Gap, Anthracite, Sawback, Stephen, Cathedral, Airdrie, Wessex, Innisfail, Penhold, Labuma, Menaik, Mile 6.7 Wetaskiwin, Subd., Stowe, Lumbreck, Frank, Coleman, Galloway, Eager, Sandstone, Azure. C. P. R. Standard No. 5 Station, Western Lines, at: Tomkins, Redcliff, (with 50-ft. freight-shed), Suffield, Bow Island, Burdett. C. P. R. Standard No. 10 Station, at: Gleichen, Bassano, Hosmer. C. P. R. Standard No. 1 Bunkhouse, at: Calgary and Red Deer. C. P. R. Standard Plan "A" Station, with 50-ft. freight shed, at: Canmore and Bittern Lake. Locomotive Foreman's Cottage: Red Deer. Six stall addition to Standard No. 2 Engine House: Red Deer. Plans, specifications and forms of tenders can be seen at the office of the Assistant Chief Engineer, Winnipeg; Division Engineer's Office, Moose Jaw, Calgary and Vancouver; Resident Engineer's Office, Medicine Hat and Cranbrook.

⦿The Construction Department of the Canadian Pacific Ry., at Winnipeg, on March 7, awarded contracts for grading, concrete, culvert and bridging on new branch lines and second track on main line for 344 miles of work in the west as follows: To Foley, Welch & Stewart, St. Paul, Minn., two lines out of Swift Current, 80 miles, one line out of Moose Jaw, 35 miles, one line east from Lacombe, 60 miles. To W. A. Dutton, three branches out of Wilkie, 82 miles. To Janse, Macdonald & Co., Calgary, Alberta, two lines in British Columbia, 54 miles. To J. G. Hargrave, second track from Moose Jaw west, 23 miles, east from Moose Jaw, 10 miles. In all, the Canadian Pacific had invited tenders on the building of 380 miles of new grade, and for the construction of a considerable amount of second track. The engineers of the company completed their consideration of most of the tenders on March 7, but there were several to which further consideration was given. Among these latter are the building of the line from Estevan to Forward, 35 miles, the line from Weyburn westward, a distance of 20 miles from the present terminus, and the line from Carmangay to Aldersyde, in the southern Alberta, 27 miles. It is believed that a considerable portion of this work will be done by the firm of Janse, Macdonald & Co.

⦿Grant Smith & Co., Spokane, Wash., have been awarded the contract for constructing the 13-mile line of the Kootenay & Alberta Ry., mentioned in our Feb. 8 issue. Bids for this work were received Feb. 10 by L. B. Merriam, Engineer, Winnipeg, but the contract has just been awarded. The contract calls for the construction of 13 miles of its line from Pincher Creek, Alberta, to the Western Coal & Coke Co. mines on Beaver Creek. This short piece of line is estimated to cost nearly $30,000 per mile. It averages more than 40,000 cu. yds. per mile and will require about 2,000,000 ft. B. M. of trestle and culvert timber.

⦿F. W. Downs of Winnipeg, has been awarded a contract by the Canadian Pacific Ry. for the erection of a number of railway stations and houses for section men. The new buildings will be located at various points on the lines of the company between Port Arthur and Broadview on the main line and the various branches radiating from this city. In former years the railway company constructed these buildings through its own agency by day labor. In time it was found that the work could be done for the corporation in a more satisfactory manner by private contractors and since that time the contract method has been adopted.

Notice has been given in Ottawa that the Hudson's Bay, Peace River & Pacific Railway Co. will change its first announced route for the construction of the line and will build a branch from Winnipeg easterly and northerly to Fort Churchill up the east shore of Lake Winnipeg.

The Canadian Northern Ry. has so far this year placed orders for 90,000 tons of 80 to 90-lb. steel rails for delivery this year. They will cost above $3,000,000. A great proportion of the rails came from Sydney, C. B. These will be laid in Ontario and the prairie provinces. Last season 548 miles of steel were laid in Manitoba, Alberta and Saskatchewan. Grading for 520 miles of rails more in those provinces has been completed, and this work will be continued this coming summer.

The Quebec & Saguenay Ry. is to extend its line from the present terminus to a point 10 miles east of Murray Bay, a distance of about 65 miles. Arthur H. N. Bruce, Ottawa, Ont., was recently appointed Chief Engineer of this road.

It is now believed that the Canadian Northern Ry. Line to Ottawa will be in operation to Belleville inside of the next five months. This is a stretch of about 120 miles. The section between Deseronto and Ottawa is considered the hardest for construction on the line.

Phelan & Shirley, Omaha, Neb., are making good progress with their contract for constructing the branch line of the Grand Trunk Pacific south of Edson, and the line will probably be ready by next fall. The branch will require two tunnels and about 24 bridges. The bridge contracting firm of Creelman & Verge, which has the contract for all the bridges on the branch line, as well as the big Prairie creek and Athabasca river bridge on the main line, has gangs at present working on the concrete of the big Prairie creek bridge, 65 miles west of Edson on the main line.

Canadian timber contractors have been very busy the past winter and reports indicate that they have beaten all former records in the quantity of ties, timber, poles, posts, cord wood, pulp and logs, which have been cut. From 15,000 to 20,000 men have been employed at this work continuously, and over $500,000 paid in wages. At Fort Frances the estimated cut of pulpwood is 200,000 cords, this large amount being due to bush fires which swept throughout the Rainy River country last fall. The number of ties cut will reach nearly 4,000,000 in the several camps located along the C. N. R. and C. P. R. Telegraph and telephone poles will reach nearly 250,000, while the logs cut for lumber companies will reach 150,000,000 feet.

The Quebec Legislature has granted an extension of franchise for 42 years to the Montreal Street Ry. and has passed the bill authorizing the company to amalgamate all lines under its jurisdiction under the name of the Montreal Tramways Co., with a capital of $20,000,000.

The Grand Trunk Ry., during the present season, is to lay 100-lb. steel rails on its double-track line between Niagara Falls and London, Ont., in place of the 80-lb. rails now in the track. The heavier rails were put down last year on the entire Montreal-Toronto line. The other line will probably be equipped with automatic block signals. Extensions are planned of the telephone system for train dispatching, 250 or 300 miles to be added between Toronto and Sarnia, and so completing the service in the northern division. The line between Montreal and Toronto will also be rock-ballasted.

Application has been made to the Manitoba Government for a charter for the Bird's Hill & Springfield railway. The men who are asking for this charter are farmers of the municipalities to the east and north of Winnipeg, who are not satisfied with the service at present being given by the steam railways.

The Canadian Pacific Co., acocrding to a statement of Thomas G. Shaughnessy, its President, contemplates spending about $34,000,000 the coming year on improvements and extensions.

The Hamilton Street Ry. Co. has agreed to make the following improvements at Hamilton, Ont., this year: Relay tracks on King St. east from Sanford Ave.; renew the H., G. & B. tracks on Main St.; repair roadway on Maple Ave., and improve the service on the Main St. branch of the Radial line. No decision has been agreed upon as to relaying the Herkimer St. tracks or extension of the system.

Construction work is to be started next month on the Canadian Pacific extension from Guelph Junction to Hamilton. J. E. Beattie is Engineer in charge and will have his office at Guelph Junction.

Mexico.

Americans interested in the Oaxaca Coal & Iron Co., Oaxaca, Mexico, have their plans well advanced for construction of an extensive system of railways in southeastern Mexico. The company owns extensive deposits of high-grade iron ore in the State of Oaxaca, and in the same region there has been found large beds of coking coal. The proposed railroad is intended to bring the iron and coal within close touch of each other in order to bring about the development of these resources. Involved in the railroad construction scheme for the state of Oaxaca is a line to run down the Pacific Coast for more than 300 miles, connecting the port of Acapulco with Salina Cruz, the latter place being the Pacific deep-water terminus of the Tehuantepec National Railroad. The system of railways is also to embrace a new north and south line that will extend from Puebla to a connection with the Pacific Coast road, passing through Oaxaca and traversing the Rio Verde Valley.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣Bids will be received until 11 a. m., April 4, by Commissioners of Elmore County, Wetumpka, Ala., for grading and surfacing about 30 miles of sand-clay road to be built between Elmore, Wetumpka and Tallahassee, together with necessary drain pipe and concrete culverts. Bids will be received on yardage and mileage basis. Plans profiles, and quantities on file at courthouse, Wetumpka, Ala., and in office of Solomon-Norcross Co., engineers, 1622 Candler Bldg., Atlanta, Ga.

The city of Decatur, Ala., is making arrangements for the building of more sidewalks and the paving of more streets. An ordinance has been passed by the city council for the building of sidewalks on Davis, Cherry, Lafayette and Line Sts. Estimates have been asked for by the city council on macadamizing of Ferry St., with tar, asphalt and gravel.

Arkansas.

Efforts are being made by residents of Crittenden county, Ark., and many others interested in the matter to have a modern highway constructed from Augusta, Ark., to Memphis, Tenn., a distance of about 70 miles. A bill is to be introduced in the Arkansas legislature making necessary provisions for the highway. Marion is the county seat of Crittenden county.

The towns of Vinita and Grove, Okla., have raised $5,000 and $1,500 respectively to build bridges and culverts on the 90 miles of road that is to be built in a single day from Vinita to Monte Ne, Ark., by the farmers.

California.

✣Bids are asked until March 21, by A. M. Pence, City Clerk, Covina, Cal., for the construction of 74,000 sq. ft. of asphalt concrete, 140,250 sq. ft. oil macadam, 29,250 ft. of concrete gutter, and 2,700 lin. ft. of cement curb.

A bill has been passed by the Assembly, Sacramento, Cal., which provides for the carrying out of the terms of the highway act by the department of state engineering. The bill provides for the appointment by the department of an expert engineer, whose salary may not exceed $10,000, to superintend the building of the new $18,000,000 highway system. The road engineer is to appoint two assistants, one state architect, one architectural designer, and as many draughtsmen and clerks as may be needed.

A number of residents of Siskiyou county, Yreka, Cal., will meet with the board of supervisors to devise ways and means of raising money to properly survey and plat the roads of the county in April. The supervisors will be asked to have plans and estimates of the cost of providing good roads for the main thoroughfares of the county prepared.

The state senate, Sacramento, Cal., has passed a bill which provides for the appropriation of $25,000 for a boulevard from Meyers station, in El Dorado county, to McKinleys, in Placer county. The road provides a link in the chain of highways along the California side of Lake Tahoe between Emigrant Gap and the Placerville state highway.

The state senate at Sacramento, Cal., has passed a number of bills making appropriations for the improvement and extensions of mountain roads. Among these was a bill for $50,000 for the completion of a state highway connecting the counties of Trinity, Tehama and Shasta with the road system of Humboldt county. Another was a bill appropriating $25,000 for the construction of a road from Meyer's station in El Dorado county to McKinley's in Placer county. This road will be along the border of Lake Tahoe on the California side. Still another bill passed calls for an appropriation of $30,000 to provide for the construction of a state highway from Mariposa through Bear Creek, Missouri Gulch and Stockton Creek to Yosemite Valley railroad at Bear Creek station.

The county supervisors at Oroville, Cal., have ordered the construction of a new road near Swede's Flat. The road will cut off a steep hill on the present highway and reduce distance. The work will necessitate the removal of a bridge at an estimated cost of $350.

Colorado.

The Plateau Valley Good Roads association has been organized at Collbran, Colo., with J. E. Harris of Mesa as president; A. A. Wood of Collbran, treasurer; and F. F. Carnahan of Plateau City, secretary. The association will build a pike road from Collbran to Palisade, 35 miles and intends to ask the county to call a bond issue election. The cost is estimated at $75,000 to $100,000.

District of Columbia.

Subscriptions are now being taken among Washington, D. C., business and financial men for the construction of five miles of pike from the Chain bridge toward Leesburg, Va. The Washington & Leesburg Good Roads' association is interested.

Florida.

The Polk County Board of Trade, Bartow, Fla., is working up a plan to build 200 miles of hard road.

The board of county commissioners at Jacksonville, Fla., have rejected all bids for the grading of a portion of the Mandarin road as being too high. The county engineer has been instructed to advertise for new bids.

Georgia.

The Solomon-Norcross Co., Engineer, Atlanta, Ga., is advertising for contracts for 30 miles of roadway and roadway structures, for Elmore County, Elmore, Ala. This work will consist of grading, building sand clay filler roadways and concrete and rubble culverts of the box type. Later on there will be additional work in Elmore county.

Idaho.

The citizens of Moscow, Ida., will at the city election, which will be held in April, vote on a proposition to pave the streets of the city.

Illinois.

✣Bids will be received until 11 a. m., March 21, 1911, by the Board of Local Improvements, City of Chicago, Chas. A. V. Standish Secretary, 2d floor City Hall, for constructing 6 ft. cinder sidewalks with wood curbing on the following streets: S. E. side of Archer Ave; both sides Belden Ave.; N. side W. 59th St; both sides S. Homan Ave; both sides of Kingston Ave.; both sides of E. 102d St.; both sides of E. 106th St.; both sides S. St. Louis Ave.; N. side of W. 38th St.; both sides Cornelia Ave.; S. side of Roscoe St.; N. side of Belmont Ave.; S. side of Melrose St.; E. side of N. 44th Ave.; W. sides of N. 44th Ave.; W. side of N. 45th Ave.; both sides of N. 45th Ct.; E. side of N. 46th Ave.; both sides of W. 37th Pl.; S. side of W. 112th St.; both sides of W. 113th St.; N. side of W. 114th St.; both sides of Princeton Ave.; both sides of Harvard Ave.; both sides of E. 76th St.; N. side of E. 77th St.; both sides of Vincennes Ave.; both sides of Vernon Ave.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., until 11 a. m., March 22, 1911, Chas. A. V. Standish, Secretary, 2d floor City Hall, for paving the following streets and alleys: Alleys bounded by Jackson Blvd., S. Leavitt St., W. Van Buren St. and S. Irving Ave., 15 ft. roadway, 1,400 lin. ft. wood curb, 1,200 sq. yds. brick pavement on 6 in. Portland cement, concrete foundation with 2 in. sand cushion; alleys bounded by W. Adams St., S. Jefferson St., W. Jackson Blvd., S. Des Plaines St., 1,000 lin. ft. wood curb, 900 sq. yds. granite pavement on 6 in. Portland cement concrete foundation with 2 in. sand cushion, 1 new catch basin, 1 old manhole to be adjusted, 2 new covers with cover lids, 10 lin. ft. 9 in. tile pipe, 1 cast iron grating; alley bounded by W. Division St., Haddon Ave., N. Ashland Ave., N. Marshfield Ave., 11 ft. roadway, 625 lin. ft. concrete curb, 350 sq. yds. brick pavement on 6 in. Portland cement concrete foundation with 2 in. sand cushion; alleys bounded by W. Congress St., W. Harrison St., Aberdeen St. and S. Center Ave., 14 and 18 ft. roadways, 1,400 lin. ft. concrete curb, 1,300 sq. yds. brick pavement on 6 in. Portland cement concrete foundation with 2 in. sand cushion; alley bounded by W. 18th St., W. 19th St., S. Sangamon St. and S. Morgan St., 14 ft. roadway, 700 lin. ft. concrete curb, 200 cu. yds. earth cutting, 600 sq. yds. brick pavement on 6 in. Portland cement concrete foundation with 2 in. sand cushion; alleys bounded by W. Jackson Blvd., W. Van Buren St., S. Irving Ave. and S. Oakley Ave. (exceptS., E. & W. alley), 900 lin. ft. concrete curb, 700 sq. yds. brick pavement on 6 in. Portland cement concrete foundation with 2 in. sand cushion; alley bounded by N. Homan Ave., N. St. Louis Ave., Fulton St. and Walnut St., 15 ft. roadway, 1,210 lin. ft. sandstone curb, 230 cu. yds. earth cutting 1,030 sq. yds. brick pavement on 6 in. Portland cement concrete foundation with 2 in. sand cushion; Bauwan St., from N. line Elk St. to S. line Blackhawk St., 3[illegible] roadway, 624 lin. ft. gravel concrete curb and gutter, 1,110 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 2 new catch basins to be built, 1 old manhole to be adjusted, 2 old catch basins to be adjusted, 1 new cover with iron lid, 4 lin. ft. of 9 in. tile pipe, 1 cast iron grating, all to be furnished and set; N. California Ave., from N. line of W. Chicago Ave. to the S. line street railway in Division St., 30-32 ft. roadways, 820 lin. ft. of old curb to be reset, 4,390 lin. ft. sandstone curb (new), 60 lin. ft. of old curb wall to be plastered, 9,780 sq. yds. granite block pavement on 6 in. Portland cement concrete foundation with 2 in. sand cushion, 6 new catch basins to be built, 2 old manholes to be adjusted, 27 old catch basins to be adjusted, 21 new covers with iron lids, 20 lin. ft. 9 in. tile pipe, 15 cast iron gratings, all to be furnished and set; Costello Ave, W. line of Kimball Ave. to E. line of N. Lawndale Ave., 30 ft. roadway, 3,740 lin. ft. concrete curb and gutter, 360 sq. ft. concrete sidewalk, 100 cu. yds. earth cutting, 2,500 cu. yds. rock excavation, 5,930 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 10 new catch basins to be built, 15 old manholes to be adjusted, 8 old catch basins to be adjusted, 2 new covers with iron lids, 10 lin. ft. 9 in. tile pipe, 4 cast iron gratings, all to be furnished and set; W. Congress St., W. line of 40th Ave. to E. line 45th Ct., 30 ft. roadway, 4,000 lin. ft. granite concrete curb and gutter, 200 sq. ft. concrete sidewalk, 600 sq. yds. Portland cement concrete to be removed, 11,400 sq. yds. asphalt pavement to be resurfaced, 2 new catch basins to be built, 30 old manholes to be adjusted, 30 old catch basins to be readjusted, 10 new covers with iron lids, 50 lin. ft. 9 in. tile pipe and 10 cast iron gratings to be furnished and set; Cottage Grove Ave., S. line street railway right of way to S. line of 79th St., 29 ft. roadway, 5,600 lin. ft. granite concrete curb and gutter, 600 sq. ft. concrete sidewalk, 4,000 cu. yds. earth cutting, 9,540 sq. yds. brick pavement on 6 in. Portland cement concrete foundation with 2 in. sand cushion, 1 new catch basin to be built, 24 old manholes to be adjusted, 26 old catch basins to be adjusted, 20 new covers with iron lids, 400 lin. ft. 9 in. tile pipe, 26 cast iron gratings, all to be furnished and set; Drexel Ave., S. line E. 65th St. to N. line E. 67th St., 2,420 lin. ft. granite concrete curb and gutter, 100 sq. ft. concrete sidewalk, 3,090 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 4 new catch basins to be built, 10 old manholes to be adjusted, 10 old catch basins to be adjusted, 6 new covers with iron lids. 100 lin. ft. 9 in. tile pipe, 10 cast iron gratings to be furnished and set; Ewing Ave., S. line of 106th St. to N. curb line of 107th St., 26 ft. roadway, 1,260 lin. ft. sandstone curbing, 3,000 cu. yds. earth filling, 1,820 sq. yds. macadam pavement, 1 new catch basin to be built, 1 old manhole to be adjusted, 6 old catch basins to be adjusted, 6 new covers with iron lids, 60 lin. ft. 9 in. tile pipe, 6 cast iron gratings, all to be furnished and set; Fullerton Ave., S. W. line of Milwaukee Ave. to E. line of Kedzie Ave. Blvd., 44 ft. roadway, 2,880 lin. ft. sandstone curb, 580 lin. ft. old curb to be reset, 8,630 sq. yds. creosoted wood block pavement on 6 in. Portland cement concrete foundation with 1 in. sand cushion, 10 new catch basins to be built, 1 old manhole to be adjusted, 13 old catch basins to be adjusted, 2 new covers with iron lids, 10 lin. ft. 9 in. tile pipe, 2 cast iron gratings, all to be furnished and set; Greenwood Ave., S. line E. 61st St. to N. line E. 65th St., 4,980 granite concrete combined curb and gutter, 200 sq. ft. concrete sidewalk, 7,540 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 1 new catch basin to be built, 21 old manholes to be adjusted, 18 old catch basins to be adjusted, 30 new covers with iron lids, 320 lin. ft. 9 in. tile pipe, 14 cast iron gratings, all to be furnished and set; Haddon Ave., W. line N. Robey St. to E. curb line N. Leavitt St., 30 ft. roadway, 2,610 lin. ft. granite concrete curb and gutter, 60 sq. ft. concrete sidewalk, 3,970 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 4 new catch basins to be built, 9 old manholes to be adjust-

[illegible] with [illegible] 9 in. tile pipe, 8 cast iron gratings, all to be furnished and set; Indiana Ave., N. line [illegible] St. to N. line of E. 120th St., 30 ft. roadway, 1,390 lin. ft. sandstone curb, 1,000 cu. yds. earth cutting, 2,[illegible] basins to be built, 5 old manholes to be adjusted, 8 old catch basins to be adjusted, 4 new covers with iron lids, 100 lin. ft. 9 in. tile pipe, 8 cast iron gratings, all to be furnished and set; Jackson Ave., N. line E. 65th St. to S. line E. 67th St., 27 ft. roadway, 2,420 lin. ft. concrete curb and gutter, 100 sq. ft. concrete sidewalk, 3,630 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 1 new catch basin to be built, 10 old manholes to be adjusted, 16 old catch basins to be adjusted, 6 new covers with iron lids, 100 lin. ft. 9 in. tile pipe, 16 cast iron gratings, to be furnished and set; [illegible] Ave., S. line of Oakwood Blvd. to N. line Hyde Park Blvd., 38 ft. roadway, 16,600 lin. ft. granite concrete curb and gutter, 150 lin. ft. concrete gutter, 1,000 sq. ft. concrete sidewalk, 34,410 sq. yds. creosoted wood block pavement, 20 new catch basins to be built, 75 old manholes to be adjusted, 65 old catch basins to be adjusted, 20 new covers with iron lids, 600 lin. ft. 9 in. tile pipe, 20 cast iron gratings, all to be furnished and set; Lawndale Ave., N. line W. Fullerton Ave. to S. line of George St., roadway 30 ft. less gutters, 6,460 lin. ft. concrete curb and gutter, 500 sq. ft. concrete sidewalk, 2,950 cu. yds. earth cutting, 9,980 sq. yds. asphalt pavement, 16 new catch basins to be built, 25 old manholes to be adjusted, 16 old catch basins to be adjusted, 2 new covers with iron lids, 40 lin. ft. 9 in. tile pipe, 6 cast iron gratings, all to be furnished and set; N. Lincoln St., N. line Armitage Ave. to S. W. line of C. & N. W. right of way, 2,420 lin. ft. concrete curb and gutter, 150 lin. ft. concrete gutter, 5,155 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 4 new catch basins to be built, 9 old manholes to be adjusted, 10 old catch basins to be adjusted, 6 new covers with iron lids, 8 lin. ft. 9 in. tile pipe, 10 cast iron gratings, all to be furnished and set; E. Superior St., E. line St. Clair St. to E. line of Rush St., 34-30 ft. roadways, 1,380 lin. ft. granite concrete curb and gutter, 100 sq. ft. concrete sidewalk, 2.250 sq. yds. asphalt binder and top, 4 new catch basins to be built, 3 old manholes to be adjusted, 5 old catch basins to be adjusted, 1 new cover with iron lid, 40 lin. ft. 9 in. tile pipe, 1 cast iron grating, all to be furnished and set; W. 33d Pl., W. line S. Halsted St. to E. line E. Morgan St., 30 ft. roadway, 2,540 lin. ft. granite concrete curb and gutter, 200 sq. ft. concrete sidewalks, 3,850 sq yds. asphalt pavement on 6 in. Portland cement concrete foundation, 8 old manholes to be adjusted, 10 old catch basins to be adjusted, 18 new covers with iron lids, 200 lin. ft. 9 in. tile pipe, 10 cast iron gratings, all to be furnished and set: S. Wabash Ave., S. line E. Garfield Blvd. to W. line E. 63d St., 34 ft. roadway, 9,880 lin. ft. concrete curb and gutter, 500 sq. ft. concrete sidewalk, 17,470 sq. yds. asphalt pavement on 6 in Portland cement concrete foundation, 16 new catch basins to be built, 44 old manholes to be adjusted, 32 old catch basins to be adjusted, 10 new covers with iron lids, 600 lin. ft. 9 in. tile pipe and 32 cast iron gratings to be furnished and set; West End Ave., W. line Belt Ry. right of way to E. line of N. 48th Ave, 2,825 lin. ft. gravel concrete curb and gutter, 60 sq. ft. concrete sidewalk, 3,500 cu. yds. earth cutting, 5,700 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 8 new catch basins to be built, 1 old manhole to be adjusted, 10 old catch basins to be adjusted, 1 new cover with iron lid, 80 lin. ft. 9 in. tile pipe, 6 cast iron gratings, all to be furnished and set; N. Whipple St., N. E. line of Elston Ave. to N. curb line of Waveland Ave., 30 ft. roadway, 3,850 lin. ft. sandstone curbing (15 in. x 30 in.), 400 sq. ft. concrete sidewalk, 6,780 sq. yds. macadam pavement, 4 new catch basins to be built, 14 old manholes to be adjusted, 18 old catch basins to be adjusted, 1 new cover with iron lid, [illegible] lin. ft. 9 in. tile pipe, 18 cast iron gratings, all to be furnished and set. System of streets as follows: S. Hermitage Ave., S. line W. 59th St. to S. line. W. 61st St.; S. Paulina St., S. line W. 59th St. to S. line W. 61st St.; S. Marshfield Ave., S. line W. 59th St. to S. line W. 61st St.; W. 60th St., W. line Ashland Ave., to W. line S. Hermitage Ave.; W. 61st St., W. line S. Ashland Ave. to W. line S. Hermitage Ave., 11,680 lin. ft. concrete curb and gutter, 600 sq. ft. concrete sidewalk, 4,800 cu. yds. earth filling, 7,350 sq. yds. asphalt pavement on 6 in. Portland cement concrete foundation, 2 new catch basins to be built, 39 old manholes to be adjusted, 42 old catch basins to be adjusted, 30 new covers with iron lids, 800 lin. ft. 9 in. tile pipe, 40 cast iron gratings, all to be furnished and set; 108th St., W. curb line of Michigan Ave. to E. line of Wentworth Ave.; Perry Ave., S. line of 108th St. to N. line 109th St., 5,120 lin. ft. sandstone curb, 2,500 cu. yds. earth cutting, 7,600 sq. yds. macadam pavement, 1 new catch basin to be built, 18 old manholes to be adjusted, 20 old catch basins to be adjusted, 6 new covers with iron lids, 200 lin. ft. 9 in. tile pipe, 20 cast iron gratings, all to be furnished. Concrete foundations to be composed of 1 part cement to 3 parts sand or screenings to 6 part limestone. All curb and gutter to be of the combined type with cement, granite screenings and crushed granite as their constituents unless otherwise noted. All sandstone curbing to rest on limestone blocks. All brick pavements to have a coal tar filler and a top dresser of sand. Full specifications on file at office of Board of Local Improvements.

✣Bids will be received until 8 p. m., March 20, 1911, by J. S. Thacher, president Board of Trustees, Village of Hodgkins, Ill., for the grading of the street known as Polk road, for a distance of about one-half mile. Plans and specifications on file at the office of the President and Clerk of the village.

The board of local improvements of Canton, Ill., has instructed the city engineer to make up an estimate for the paving of West Chestnut St. The city received bids March 14 for the paving of the blocks about South Park, and one block north in First Ave., comprising paving district No. 38. The estimated cost of the improvement is $14,000.

Following are the low bids received by the Board of Local Improvements, Chicago, Chas. A. V. Standish, secy., 2d floor, City Hall, for constructing sidewalks as follows: 5 ft. cement sidewalk south side of Addison St., 150 sq. ft. average fill 2 ft., 19c per sq. ft., H. P. Larsen, 1542 N. Rockwell St.; 8-ft. cement sidewalk on the west side of S. Ashland Ave., 5,600 sq. ft., average fill, 1 ft., lin. ft. 700, average depth, 1 ft. 12⅜c per sq. ft., Thos. D. Joy, 3911 W. Van Buren St.; 6-ft. cement sidewalk, both sides of Birchwood Ave., 1,600 sq. ft., average fill 2 ft., 13c per sq. ft., Bairstow Supply Co., 6084 Ridge Ave.; 6-ft. cement sidewalk on both sides of N. Campbell Ave., 6,600 sq. ft., average fill 1½ ft. .139c per sq. ft., Siewert-Collsen Co., 3865 Milwaukee Ave.; 8-ft. cement sidewalk on both sides of N. Carpenter St., 1,200 sq. ft., average fill 5 ft., street sweepings to be removed, 16.7 cts. per sq. ft. Skafgard Concrete Construction Co., 4024 W. North Ave.; 6 ft. cement sidewalk on both sides of Elliott Ave., 1,600 sq. ft., average fill 1½ ft., 16c per sq. ft., H. P. Larsen, 1542 N. Rockwell St.; 7 ft. cement sidewalk on both sides of Gardner St., 350 sq. ft., average fill 8 ft., 14.4 cts., Jas. J. Ferry, 92 Siegel St.; 6-ft. cement sidewalk on both sides of Houston Ave., 1,500 sq. ft., average fill, 1½ ft., 16.4 cts., A. P. Larson, 11322 Indiana Ave.; 6-ft. cement sidewalk on the northeasterly side of Howard Ave., 300 sq. ft., average fill 1 ft., 16.5 cts. per sq. ft., A. P. Larson, 11322 Indiana Ave.; 6-ft. cement sidewalk on the west side of South Kedzie Ave., 6,500 sq. ft., average fill, 2 ft., 11.74 cts., Thos. D. Joy, 3911 W. Van Buren St.; 6-ft. cement sidewalk on the north side of Lyndale Ave., 1,200 sq. ft., average fill, 1 ft., 11.7 cts.; Demling & Wendt, 84 LaSalle St.; 14-ft. cement walk on both sides of Milwaukee Ave., 4,800 sq. ft., average fill 14 ft., 12.9 cts. sq. ft., General Cement Construction Co.; 6 ft. cement sidewalk on the south side of Milton Place, 1,800 sq. ft., average fill 2 ft., 11¾c sq. ft., Thos. D. Joy, 3911 Van Buren St.; 6-ft. cement sidewalk on the north side of W. 60th St., 1,600 sq. ft., average fill 4 ft., 14 cts. per sq. ft., Jas. Petersen; 8-ft. cement sidewalk on both sides of W. 63d st., 4,600 sq. ft., average fill 2 ft.; 12⅜ cts per sq. ft., Thos. D. Joy, 3911 Van Buren St.; 12-ft. cement sidewalk on both sides of W. 69th St., 8,000 sq. ft., average fill 2 ft., 16 cts. per sq. ft., Jas. Petersen; 6-ft. cement sidewalk on the north side of E. 71st St., 966 sq. ft., average fill 1 ft., 11.74 cts., Thos. D. Joy, 3911 Van Buren St.; 6-ft. cement sidewalk on the north side of E. 71st St., 1,000 sq. ft., average fill 4 ft., 12.74 cts., Thos. D. Joy, 3911 Van Buren St.; 6-ft. cement sidewalk on both sides of N. Sangamon St., 1,350 sq. ft., average fill 5 ft., 11.4c per sq. ft., General Cement Construction Co., 162 Washington St.; 14-ft. cement sidewalk on both sides of N. Superior St., 2,500 sq. ft., average fill 7 ft., 11.4 cts., General Cement Construction Co., Jas. J. Ferry; 6 ft. cement sidewalk on the north and northeasterly sides of 34th St., 1,800 sq. ft., average fill 3 ft., 13.74 cts., Thos. D. Joy, 3911 Van Buren St.; 4-ft. cement sidewalk on both sides of Uhland St., 390 sq. ft. average fill 1½ ft., 17.84 cts., H. P. Larsen, 1542 N. Rockwell St.; 6-ft. cement sidewalk on both sides of Wrightwood Ave., 120 sq. ft. average fill 1 ft., 17½ cts., H. P. Larsen, 1542 N. Rockwell St.; 6-ft. cement sidewalk on a system of streets including both sides of Phillip Ave., 1,920 sq. ft., average fill 3 ft., 13.9 cts., Bairstow Supply Co., 6084 Ridge Ave.; 16-ft. cement sidewalk on a system of streets, including south side of W. 12th St., 12,000 sq. ft., average fill 1½ sq. ft., 11.98 cts. per sq. ft., Thos. D. Joy, 3911 Van Buren St.; 6-ft. cement sidewalk south side of Armitage Ave., 9,000 sq. ft. average fill 3 ft., 400 lin. ft. of cut, 13.5 cts. per sq. ft., Skafgard Concrete Construction Co., 4024 W. North Ave.

Indiana.

✣Bids will be received until 10 a. m., April 5, by Horace Blakely, County Auditor, Bloomington, Ind., for the construction of a stone road in Clear Creek Township.

✣Bids are asked until 2 p. m., April 4, by Alvin B. Ham, County Auditor, Paoli, Ind., for the construction of a gravel road in French Lick Township.

✣Bids will be received until 2 p. m., March 29, by Geo. Griffin, County Auditor, Noblesville, Ind., for the construction of six gravel or macadamized roads.

✣Bids will be received until 10 a. m., March 20, by Wm. T. Richards, County Auditor, Anderson, Ind., for the construction of three gravel roads.

✣Bids are asked until April 4, by E. R. Bringham, County Auditor, Kentland, Ind., for the construction of a macadam road on line between Washington, Iroquois and Jefferson townships.

◉Mathew McGeehie has been awarded the contract by the County Commissioners, Washington, Ind., for the construction of the Alexander road for $8,940. The commissioners also awarded a contract for the construction of the Blaufordstal road to L. S. Honall for $4,280. Bids were opened March 7.

◉Conover & Tabor of Wabash, Ind., have been awarded the contract for the improvement of the Laketon road for $19,480. The work includes grading, paving, culverts, and bridges. The paving will consist of crushed limestone with Bermuda asphalt binder. Bids were opened March 7 by J. P. Noftzger, County Auditor.

◉H. R. Ferner, Portland, Ind., has been awarded the contract by the County Commissioners, Portland, Ind., for the construction of a one mile gravel road for $3,858. Bids were opened March 6.

◉The County Commissioners at Wabash, Ind., have awarded contract for the construction of two roads in Chester Township, one in Paw Paw Township, and one in Noble Township, as follows: Dr. McGreeny & Son, of Wabash, road in Noble Township; Kilty & Nech, road in Chester Township, and Frank Murphy, road in Chester Township. J. P.

Noftzger is County Auditor. Bids were opened March 7.

⦿J. B. Thomas & Co., Kingman, Ind., have been awarded the contract for the construction of a road in Liberty Township for $4,375, by the County Commissioners, Rockville, Ind.

⦿The Board of County Commissioners, Logansport, Ind., awarded the following contracts for gravel and stone roads during their March term as follows; J. E. Wallace, County Auditor: F. H. Null & Co., Windfall, Ind., at $6,580, for the Allen Price road in Jefferson Township; Harry Barnes & Son, Logansport, at $8,000, for the John Miller road in Jackson Township; James Vernon, Logansport, at $2,616, for the Oscar Wilson road in Tipton Township.

The county commissioners of LaPorte county, LaPorte, Ind., are planning the construction of six new macadam roads of an average length of 10 miles.

The county commissioners at Frankfort, Ind., have been petitioned to gravel or stone the road connecting Sedalia with Gettingsville.

A petition for the construction of a gravel road in Eagle Creek township, Lake county, is being circulated to be presented to the board of county commissioners, Crown Point, Ind. The petition calls for about 12 miles of road.

A petition is being circulated in Huntington and Huntington township, Ind., for the improvement of what is known as the river road, under the three mile road law, by grading and paving with crushed stone. The road extends from the Etna road, just west of the bridge across the Wabash on Etna Ave., to the Range Line road at what is known as Favorite's Corners. The petition will be presented to the board of county commissioners, Huntington, this month.

⦿Haynes & Waymin of Independence, Ind., have been awarded the contract by the county commissioners at Williamsport, Ind., for the construction of a gravel road in Warren township for $11,439. Bids were opened March 6 by D. H. Moffit, county auditor.

⦿Bert Smith & Ray Pierce of Zionsville and Spiceland, Ind., have been awarded the contract by the county commissioners at Rushville, Ind., for the construction of a macadam road in Ripley township, Rush county, for $9,775. Bids were opened Feb. 7 by J. M. Stone, county auditor.

Iowa.

✣Bids are asked until 7:30 p. m., March 16, by the City Recorder, Muscatine, Ia., for the following work: 23,283.9 sq. yds. of bitulithic pavement, including sub-grading, 12,678.6 lin. ft. of combined curb and gutter, 24 in., including sub-grading; 3,008 lin. ft. of combined curb and gutter, 18 in., including sub-grading; 3,008 lin. ft. of 18-in. gutter built to old curb including sub-grading; 4,000 cu. yds. of extra grading; 3,600 cu. yds. of extra grading; 4,894.5 lin. ft. (7 ft. wide) of space occupied by Citizens Railway & Light Co. of brick pavement. C. H. Young is city engineer.

✣Bids are asked until 9 a. m., March 25, by E. O. Wesley, Superintendent of Streets and Public Improvements, Sioux City, Ia., for all material and labor necessary for paving Virginia St. from the south line of First St. to the south line of Third St., including intersections of streets and alleys and spaces opposite alleys, with brick block laid on a 5-in. Portland cement concrete base, including re-setting or curbing and construction of new curbing where necessary, in accordance with plans and specifications prepared by the city engineer and on file in the office of the city clerk. Paving is to be completed on or before July 1, 1911.

✣Bids will be received until noon, April 3, by H. H. Omstot, clerk, Bronson, Ia., for roadwork in Floyd township.

The city council of Fort Dodge, Ia., has passed a resolution of necessity providing for the extension of Park Blvd., for one block and the laying of cement paving on several other blocks. The streets to be paved are: 17th St., between Third and Fourth Ave., north; 18th St., between Second and Fourth Aves., north; Third Ave., between 17th and 18th Sts.; 18th St. and 19th St. and Fourth Ave. north, between 15th and 18th Sts.

Plans have been prepared by Engineers Hall & Adams of Centerville, Ia., for the construction of four blocks of brick pavement in Hampton, Ia., at an estimated cost of between $13,000 and $15,000. Cement curb will be laid, and the work will require about 150 cu. yds. of excavation. The contract will be let some time in April. W. H. Lecky is city clerk.

Kansas.

⦿John Ritchie & Sons of Topeka, Kan., have been awarded the contract by the board of public works of Wichita, Kan., for the construction of 25 blocks of brick pavement with cement and asphalt filler. The contract aggregates $46,000. The contract price is $1.93 and $1.83 per sq. yd.

Kentucky.

⦿Bids were received from the following on March 1, by the board of public works of Louisville, Ky., for the laying of 75,000 sq. yds. of asphalt, most of which will be done in the Third Ave., from Ormsby Ave. to 233 ft. south of Brandeis Ave.: The American Standard Asphalt Co., the G. W. Gosnell Co., and the Barber Asphalt & Paving Co., of Louisville; the Marion Construction Co., Indianapolis, and the S. S. Saxton Co., of Richmond, Ind. It is reported that the contract has been awarded to the S. S. Saxton Co., for $0.87 per sq. yd.

The city council of Mayfield, Ky., contemplates building a brick street on West Broadway, from Eighth St. to the railroad.

Petitions are being circulated in the magisterial districts of Greenup county, Greenup, Ky., which will be presented to the county court, to submit the question of issuing $250,000 bonds to provide for the building of four turnpikes across the county.

Louisiana.

The city commissioners of Shreveport, La., have ordered an election for April 4 for the purpose of voting on the issuance of bonds to the amount of $250,000 for paving purposes.

The Commissioners of Shreveport, La., have called an election for April 4 to vote on the issuance of bonds to the amount of $250,000 for improving and paving streets. J. H. Eastham is Mayor.

Maryland.

✣Bids are asked until 11 a. m., March 22, by Wm. S. Manning, General Superintendent of Parks, Baltimore, Md., for furnishing vitrified blocks for the public parks. Certified check for $200 required with bid.

✣Bids are asked until 11:30 a. m., April 7, by the Constructing Quartermaster, Fort Howard, Md., for constructing concrete walks.

Michigan.

✣Bids will be received until noon, March 17, by John F. Barlow, County Clerk, Muskegon, Mich., for furnishing and delivering 14,200 cu. yds. of road building material.

✣Bids are asked until 8 p. m., March 20, by John Mawdsley, City Clerk, Adrian, Mich., for furnishing and delivering 550,000 first quality re-pressed paving blocks.

Preliminary steps are now being taken by the county good roads commission, Kalamazoo, Mich., preparatory to the construction of the 32 miles of roads proposed to be built during the coming spring and summer, and the necessary repairs to be made. F. H. Bohnet is commissioner.

Massachusetts.

The board of supervisors of Hampden County, Springfield, Mass., and the city council of Springfield are calling for bids for material needed for use in the street department for construction during the coming year. The amount is based on the estimate for last year, the amounts being much the same as in 1910. The material required is as follows: One mile of granite curbing, six miles of vitrified clay pipe four to 24 ins. in diameter, including two miles of six-inch pipe for house connections, 25,000 tons of trap rock, 60 tons of castings, including manholes and wellhole covers, 300,000 sidewalk, sewer and well brick, 4,000 barrels of cement, one gross of street hoes and one gross of shovels. Charles M. Slocum is city engineer.

Minnesota.

⦿O'Neil & Preston, East 6th St., St. Paul, Minn., have been awarded the contract by the Board of Public Works of that city for the construction of wooden sidewalks for $14,000. Bids were opened March 6.

⦿The St. Paul Cement Works, East 4th St., St. Paul, Minn., has been awarded the contract by the Board of Public Works of that city for the construction of cement sidewalks for $30,000. The work will include 200,000 sq. ft. of cement walk. Bids were opened March 6.

The city council of Minneapolis, Minn., has ordered new paving laid at an estimated cost of $400,000. Providing the legislature authorizes a new bond issue requested by the city council an additional $200,000 worth will be laid. Andrew Rinker is city engineer.

Missouri.

✣Bids will be received until March 20, by L. A. Walker, City Clerk, Webb City, Mo., for constructing asphalt macadam on Madison St.

The city council of St. Joseph, Mo., has adopted petitions asking for the paving of three streets in Hansen Heights, the total cost being estimated at $23,000.

Nebraska.

The city council of Norfolk, Neb., has been petitioned to pave Norfolk Ave., from Seventh St., to Ninth St., thence north to Prospect Ave.

New Jersey.

✣Bids are asked until 8 p. m., March 20, by Raymond F. Davis, Town Clerk, Bloomfield, N. J., for constructing Telford roads as follows: Roosevelt Ave., 5,525 sq. yds. of 8-in. Telford road; 8,600 cu. yds. of grading (fill); two catch basins; 160 lin. ft. of 20-in. vitrified tile pipe. Crown St., 400 sq. yds. of 8-in. Telford road; 200 cu. yds. of grading. Clearfield Ave., 1,500 sq. yds. of 8-in. Telford road; 1,500 cu. yds. of grading. Evergreen Ave., 2,150 sq. yds. of 8-in. Telford road; 50 cu. yds. of grading. Ashland Ave., 600 sq. yds. of 8-in. Telford road; 50 cu. yds. of grading. Clinton St., 535 sq. yds. of 8-in. Telford road; 10 cu. yds. of grading.

✣Bids are asked until 8 p. m., March 20, by Raymond F. Davis, Town Clerk, Bloomfield, N. J., for five contracts for constructing concrete sidewalks and combination concrete curb and gutter. Total amounts are 32,520 sq. ft. of concrete sidewalks and 8,390 lin. ft. of curb and gutter. Ernest Brechlin, Town Engineer, Bloomfield, N. J.

⦿The township committee, Bernardsville, N. J., has awarded the contract for stone roads, asphaltic binder, to be constructed at Bernardsville and Far Hills, total length of both roads 1,790 ft., to A. C. Denahan of Yardley, Pa., for $5,070. Bids were opened March 7 by Jos. B. Kronenberg, Township Clerk.

Joseph McCrystal, chairman of the board of public works, of Paterson, N. J., has presented the following list of streets to the board of finance, which that board desires to permanently improve this year: Mill St., from Van Houten to Market St., 2,750 yds.; Ellison St. and Spruce St., from Mill St. to the Spruce St. bridge, 3,640 yds.; Elm St., from Mill St. to Cross St., 1,875 yds.; Cross St. from Market St. to Oliver St., 2,300 yds.; Marshall St., from Oliver to Grand St., 1,800 yds.; Main St., from Grand St. to Weiss St., 14,000 yds.; Market St., from Straight St. to Madison Ave., 10,500 yds.; East 33rd St., from Broadway to Park Ave., 7,800 yds.; Governor St., from Graham Ave. to East 18th St., 4,200 yds.; Harrison St., from River St. to Paterson St., 675 yds.; Lake St., from Hamilton Ave. to Broadway, 750 yds. Total number of yds. 50,290. Approximate cost, $159,922.

New Mexico.

The reconstruction work on the proposed road between Santa Fe and Albuquerque, for which Bernal [illegible] 000, and for which the territory will raise $1,000, will [illegible] days Charles D. Miller, Santa Fe, is territorial engineer.

New York.

✣Bids will be received until 2 p. m., March 21, by George McAneny, President Manhattan Borough, New York city, [illegible] tracts. The largest contract calls for widening the roadway of 23d St., from 2d Ave. to 8th Ave., as hereinafter specified; for repaving said roadway as widened, as well as the present roadway between 8th Ave. and 10th Ave., all with wood block pavement, together with all work incidental thereto. The engineer's estimate of amount of work to be done being 23,460 sq. yds. of wood block pavement, including sand cushion, except the railroad area; 3,030 sq. yds. of wood block pavement, including sand cushion, in the railroad, area (no guarantee); 100 sq. yds. of sheet asphalt pavement, including binder course; 5,100 cu. yds. of Portland cement concrete; 11,120 lin. ft. of new bluestone curbstone, furnished and set; 2,000 lin. ft. of old bluestone curbstone, redressed, rejointed and reset; 300 lin. ft. of platform flags, to be cut to line; 660 lin. ft. of new header stone; 400 cu. yds. of filling, to furnish; 40 noiseless heads and covers, complete, for sewer manholes, furnished and set; 10 new corner catch basins, to be built; 3 corner catch basins, to be rebuilt; 3 side catch basins, to be rebuilt.

⊙The board of contract and supply of Schenectady, N. Y., has awarded the contract for furnishing a new flushing machine for the street department to Charles Hvass & Co., of New York for $850.

⊙The Austin Western Co., has been awarded the contract by the board of contract and supply of Schenectady, N. Y., for furnishing a new machine for sweeping streets for $224.

⊙The board of contract and supply of Rochester, N. Y., has awarded the contract for the asphalt repairs in the city for 1911 to the Barber Asphalt Co., for $0.89 per sq. yd., for 42,000 sq. yds. of asphalt work, and $0.50 per sq. yd., for 200 sq. yds. of concrete repairs; total bid, $37,480.

North Carolina.

✣Bids are asked until noon, March 31, by Louis S. Belden, Chairman Commissioners of Streets, Wilmington, N. C., for constructing 2,740 sq. yds. of brick pavement on a 5-in. concrete base, 1 in. sand cushion filler grout, and 1,160 lin. ft. of 5-in. by 13-in. granite curb.

The Board of County Commissioners, Wadesboro, N. C., has ordered an election for May 2 to vote on the issuance of bonds in the sum of $300,000 for road construction in the county. Should the bonds carry the work will be let by contract by the Commissioners. Bonds will be sold as needed. H. B. Allen is Chairman of the Commissioners.

Ohio.

✣Bids will be received until noon, March 24, by James C. Wonders, state highway commissioner, at office of County Commissioners at Hamilton, O., for grading and macadamizing 2.10 miles of road in St. Clair township. Specifications, plans and profiles are on file in the office of the county commissioners in Hamilton, Ohio, and at the state highway department, Columbus. Copies of specifications may be obtained at the latter office. Estimated cost of construction is $16,329.51. Certified check for $300 required.

✣Bids are asked until 11 a. m., April 1, by County Commissioners, John F. Goldenbogen, clerk, Cleveland, O., for the improvement of Som Center road (Ledge Hill). Specifications with Frank R. Lander, county surveyor. Certified check for $100 required with bid.

✣Bids are asked until March 29 by the city of Montpelier, O., for constructing about 25,500 sq. yds. of pavement on Main and Empire Sts. Riggs & Sherman, The Nasby, Toledo, O., are the Engineers.

✣Bids will be received until 1 p. m., March 28, by F. W. Toan, County Auditor, Bowling Green, O., for grading, draining and macadamizing three roads.

⊙The Williams Contractor Supply Co., Columbus, O., has been awarded the contract for furnishing three street sweepers for the city of Columbus, O., for $195 each. Bids were opened March 7 by H. S. Holton, Dept. of Public Service.

⊙The city council of Wapakoneta, O., has awarded the contract for the paving of Mechanic St., to J. E. Conley & Co., of Dayton, O., for $38,066. Work will commence at once.

Bids were opened March 7 by the city of Lorain, O., C. M. Osborn, City Engineer, for sidewalk work for 1911. The bids received were as follows: (1) standing for H. A. Shallon, Lorain, O., (2) for A. Granner, Lorain, O., (3) for H. N. Oberlander, Bucyrus, O., (4) for M. L. Jackson, Lorain, O., (5) for Aaron Best, Lorain, O., and (6) for McHugh Bros., Springfield, O.:

		(1)	(2)	(3)	(4)	(5)	(6)
New stone:							
Per sq. ft. stone laid, 2-in., incl. base....	61,000	$0.09¾	$0.10½	$0.11	$0.09½	$0.10½	$0.10⅝
Per sq. ft. stone laid, 3-in., incl. base....	100	.13¾	.15	.14½	.15	.15	.15¾
Per sq. ft. stone laid, 4-in., incl. base....	400	.17	.20	.19⅔	.17	.19	.21
Per sq. ft. stone laid, 5-in., incl. base....	20	.22	.24	.21¼	.24	.22	.23⅔
Per sq. ft. stone laid, 6-in., incl. base....	6,100	.25	.26	.24½	.24	.26	.29½
Relay.							
Per sq. ft. stone relay, 2-in., incl. base....	50,000	.03¼	.02¾	.02½	.03	.03	.03½
Per sq. ft. stone relay, 3-in., incl. base....	2,000	.03½	.03¼	.03½	.03½	.03½	.04
Per sq. ft. stone relay, 4-in., incl. base....	400	.04	.04	.04	.05	.04	.04¼
Per sq. ft. stone relay, 5-in., incl. base....	20	.05	.04½	.04	.06	.04½	.05½
Per sq. ft. stone relay, 6-in., incl. base....	6,700	.06	.05	.04	.06	.05	.06½
New concrete walk:							
Per sq. ft. 4½-in., laid, incl. base..........	1,000	.16	.20	.14¼	.14½	.20	.11½
Per sq. ft. 5-in., laid, incl. base............	1,000	.17	.22	.14¼	.15	.23	.11½
Vitrified pipe:							
Per lin. ft. 8-in. pipe, laid................	100	.16	.12	.12	.15	.15	.25
Per lin. ft. 10-in. pipe, laid................	100	.22	.18	.18	.22	.20	.35
Per lin. ft. 12-in. pipe, laid................	100	.30	.21	.20	.17	.25	.50
Per lin. ft. 15-in. pipe, laid................	50	.37	.30	.25	.40	.40	.60
Per lin. ft. 18-in. pipe, laid................	50	.50	.45	.38	.57½	.45	.75
Per lin. ft. 24-in. pipe, laid................	20	.80	.70	.60	1.00	.85	1.25
Extra grading, per cu. yd..................	3,500	.40	.33	.30	.60	.40	.35
Placing old stone, team, per hour..........	100	.45	.50	.50	.50	.50	.50
Placing old stone, labor, per hour..........	100	.22½	.25	.30	.25	.25	.25
Totals		$11,597	$11,635	$11,912	$11,943	$12,032	$12,524

The Cleveland Heights Realty Co., Cleveland, O., has sold bonds to the amount of $225,000, the proceeds of which will be used for the construction of boulevards, pavements, sidewalks and a new sewer system through a great section of Cleveland Heights village, bounded by Cedar Ave., Euclid Heights Blvd., Coventry Road, and Lee Road.

The trustees of Clay township, Scioto County, Portsmouth, O., county seat, has decided to authorize a new survey of the road up Munn's Run.

The Riggs & Sherman Co., Consulting Engineers, 613 The Nasby, Toledo, O., has completed plans for the paving of several streets for the city of Grand Haven, Mich.

The county commissioners at Columbus, O., have been petitioned for the establishment of 20 miles of roadway, as follows: In Norwich and Prairie townships, for six miles in length from the corporation limits of Hilliard to Rome; a road four miles in length from the intersection of the Center College road with the Sunbury pike, east with the Clymer road to the state road between Park and James, and south to the Wayne Taylor pike; a road from the Hilliard and Darby creek, and Amity pikes on a line with the Carby pike south to the National road; a road about two miles long between the intersection of the Cole and National roads, north to Geyer pike; west and south to the Dublin and Olentangy free pike, a distance of one mile.

County Surveyor B. M. French of Columbiania County, Lisbon, O., has completed his survey of the proposed road in Center Township to connect Hephner Hollow and Dungannon roads. The county commissioners will probably establish the road.

The county commissioners at Hamilton, O., are planning road improvements for the coming summer. Under the new road rate, the county has about $30,000 for road work. About $10,000 of this will be spent for the improvement of the Venice river road under the good road laws.

The City Paving Construction Co., of Cleveland, O., has been incorporated with a capital stock of $10,000. The incorporators are: Fred F. Klingman, T. J. Ross, C. T. Kirkbride, Lindley Fogg, Thomas S. Dunlap and others.

The county commissioners of Columbiana county, Lisbon, O., have been petitioned for the improvement of the Damascus road, leading into Salem from the west, by the citizens of Perry township.

The city council of Toledo, O., has approved the ordinances providing for the paving of East Broadway from Starr Ave., to Front St., and Kelsey Ave., from East Broadway to Sixth St.

Oklahoma.

The Oklahoma Engineering Co., 120 Broadway, Anadarko, Okla., has work in progress on the grading of two miles of country road under the supervision of the government, at Carnegie, Okla., also building one small concrete bridge and several culverts.

Pennsylvania.

✣Bids are asked until 8 p. m., March 20, by Simon George, Clerk Borough Council, Youngwood, Pa., for 41,400 sq. yds. paving, 27,500 lin. ft. curbing and 13,800 cu. yds. grading. Warren Mitchell, Coulter Bldg., Greensburg, Pa., is Engineer.

A bill authorizing the levying of a special state tax for road building has been presented to the House, Harrisburg, Pa. The bill fixes the tax at one mill on the dollar of actual value of all property now subject to taxation for state purposes, including personal property, capital stock and bonds, manufacturing and brewing companies are included.

The county court at Wilkes-Barre, Pa., has decided to build a new county road. Officers of Duryea borough, Fairview and Dennison townships have petitioned the county commissioners requesting that work on the new road be started immediately. These roads aggregate over 30 miles and will cost about $300,000. The Duryea road will be built first, part of the thoroughfare through the center of the borough will be constructed of brick. One of the other roads will extend from Fairview through White Haven to Freeland, and the other from Fairview to Hazleton, by way of Alberts and Drums.

An ordinance has been introduced in the common council of New Castle, Pa., calling for the repaving of Long Ave., from South Mill to Moravia St.

A committee of the city council of Philadelphia, Pa., has recommended as part of the projects for the development of the city, the construction of more than 133 miles of additional park drives or boulevards traversing the city in every direction, and especially in the northwest and northeast sections.

South Carolina.

The city of Sumter, S. C., is making investigations relative to paving its streets. A bond issue of $25,000 was voted upon Feb. 14. L. D. Jennings is mayor.

Tennessee.

⊙A contract has been awarded to French Bros. of Knoxville, Tenn., for the construc-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

tion of a new pike road for Hamblen county for approximately $15,000. The new road will extend from Morristown to Brights Mill. A new stone crusher has been purchased for the work. C. M. French, formerly of the Kreis & French firm of railroad contractors, will be in charge of the work.

The county court at Chattanooga, Tenn., has adopted a resolution providing for a bond issue of $500,000 for road improvements and a new criminal court and jail building.

Texas.

✤Bids will be received until 11 a. m., March 27 by John M. Murch, county auditor, Galveston, Tex., for grading, regrading, paving with gravel, mud-shell or crushed rock and building of culverts, etc., on road from La Marque to Texas City, a distance of about 4⅓ miles. Plans and specifications on file in office of county auditor.

Property owners of Lockhart, Tex., will soon vote on the issuance of road improvement bonds to the amount of $50,000.

The Boosters club of McGregor, Tex., is working to secure a bond election for that precinct for the purpose of building graveled roads in the McGregor country.

Virginia.

✤Bids will be received until noon, March 20, by Committee on Highways and Sewers, Newport News, Va., F. A. Hudgins. city clerk, for excavating and constructing concrete curb and gutter on both sides of 23d St., between Roanoke and Chestnut Aves.; also for furnishing 300 cu. yds. ¾-in. trap rock.

At the request of the board of supervisors, Harrisonburg, Va., Clerk J. Frank Blackburn of Rockingham county, has written State Highway Commissioner in Richmond, Va., to send an expert engineer to make a survey and map of the county roads for the purpose of aiding in a general system of good roads building throughout the county. The supervisors will add 5 cents to the present county road levy and start in the construction of good roads. About $20,000 has already been provided for county roads for 1911, including the state fund, and with the levy added the total will be about $35,000.

A resolution has been introduced in the city council of Norfolk, Va., to build a macadam roadway through Villa Heights to Lafayette river connecting there with the old Cottage Toll bridge road to Ocean View, of which Norfolk county is now making a free boulevard.

⊙The U. S. Wood Preserving Co., has been awarded the contract by the board of control of Norfolk, Va., for regulating and constructing 4,125 sq. yds. of smooth surface pavement on Bank St., for $2.85 per sq. yd. W. T. Brooke is city engineer. Bids were opened March 1.

Washington.

The legislative sub-committee on roads and bridges Olympia, Wash., has appropriated the state's highway fund to the roads as follows: Road No. 1, $60,000; No. 2, $15,000; No. 3, no appropriation; No. 4, $15,000; No. 5, $60,000; No. 6, $75,000· No. 7, $350,000; No. 8, $90,000; No. 9, $40,000; No. 10, $10,000; No. 11, $46,000; No. 15, $8,000; No. 16, $4,000; No. 18, $60,000; No. 19, for survey, $10,000. Henry L. Bowlby is state highway commissioner, Olympia, Wash.

⊙J. A. Wallach has been awarded the contract by the county commissioners, Seattle, Wash., for the construction of 4,000 ft. of the H. G. Brace road, tributary to Richmond Beach for $3,750. County Engineer James R. Morrison will have supervision of the work.

A sub-committee composed of G. E. Dickson of Kittitat, James McNeely of Pierce and W. C. McCoy of Whitman, has been appointed to distribute the $820,000 among the various state roads of Washington. It is probable that state road No. 7, which is to extend from Seattle to Spokane by way of the Snoqualmie Pass, Ellensburg, and Wenatchee will be completed at an estimated cost of $420,000. Henry L. Bowlby, Olympia, Wash., is state highway commissioner.

The state legislature at Olympia, Wash., has appropriated $75,000 for the completion of the work on the Bellingham-Shagit waterfront road and for the beginning of the work on the road northward from Bellingham.

The city council of Spokane, Wash., will be petitioned for the paving of Fifth Ave., between Spokane and Arthur Sts.

West Virginia.

Plans and specifications for the improvements on the Glendale county road have been completed by County Engineer S. Howe Bonar, Moundsville, W. Va. An appropriation of $15,000 was made at the January term of court for this work. The work will be advertised at once.

Wisconsin.

✤Bids are asked until 10 a. m., April 1 by Board Public Works, P. H. Connolly, chairman, of Racine, Wis., for all materials and performing all the labor for the following public work: Grading and paving Erie St., from State St. to Prospect St., and Dodge St., from Erie St. to North Main St., approximating the following quantities: 5,616 sq. yds. of brick paving, 2,746 lin. ft. cement concrete curb, 1,836 cu. yds. of excavation, 2,680 cu yds. filling.

✤Bids are asked until [illegible] p. m., March 24, by Board Public Works of Burlington, Wis., P. J. Hurtgen, city engineer, for the labor and materials for brick paving, cement paving, cement curb, combination cement curb and gutter and grading on certain streets The work includes 12,645 sq. yds. of cement paving on a 5-in. concrete base, 2,220 sq. yds. of brick paving on a 6-in. concrete base, 5,875 lin. ft. of combination curb and gutter, 5,970 lin. ft. of cement curb, 5,460 cu. yds. of excavation.

✤Bids are asked until 2 p. m., March 25, by Board of Public Works, Watertown, Wis., for constructing 7,500 sq. yds. vitrified brick pavement.

⊙The city of Neenah, Wis., has awarded the contract for 7,500 sq. yds. of pavement, material being tar macadam, concrete sarcolithic or creosote block, to Chris. Johnson of Oshkosh, Wis. The pavement will be laid on S Commercial St. J. P. Keating is City Clerk

Canada.

✤Bids are asked until noon, March 28, by John H. Jackson, superintendent Queen Victoria Niagara Falls Park, Niagara Falls, Ont., for the construction of (a) steel concrete bridges, and (b) a macadam roadway, with the necessary drainage, being Section 4b, 5,182 ft. commencing at Miller's Creek, and extending to the southerly limit of the shipyard. according to plans and specifications for the several works on file at the Administration Building, Queen Victoria Park, Niagara Falls. Ont.

BRIDGES—STEEL AND CONCRETE

Arkansas.

Advices from Pocahontas, Ark., state that the Frisco system plans the construction of a new bridge across Black river, near that city, this year. The total length of the proposed bridge will be 1,425 ft. and the draw spans will be the largest on the Frisco line and one of the largest in the United States. The bridge will be located in the bend of the river and because of the difficult navigation at this point the United States war department required a clear channel of 200 ft. The height from the water to the highest point is 90 ft. Work on the construction will begin early in the spring. F. S. Rice, St. Louis, Mo., is engineer of bridges for the Frisco lines.

The House of Representatives, Washington, D. C., has passed an act authorizing the Argenta Railway Co., J. P. Clark, owner, Little Rock, Ark., to construct a bridge across the Arkansas River between the cities of Little Rock and Argenta.

California.

⊙J. Fred Kessing of Porterville, Cal., has been awarded the contract for the construction of the bridge across the Kings River at Kingsbury

Civil Engineer C. Blackmore has submitted plans for a suspension bridge connecting San Francisco with the Alameda shore to the several commercial bodies of San Francisco and the transbay cities, and the Southern and Western Pacific railroads. The project is for a bridge resting on three concrete piers, making four spans of 2,005 ft. each, from Telegraph hill to Goat island, and two spans between Goat island and Oakland. It is proposed to grade off the top of Telegraph hill. The bridge according to the plans would be a double decker, with passageways for teams, pedestrians and trains. The elevation from tidewater to the lower floor would be 165 ft.

Mayberry & Parker, Pacific Electric Bldg., Los Angeles, Cal., have been retained as designing and consulting engineers by the board of supervisors of Ventura County, Ventura, Cal., to design 11 reinforced concrete bridges and act as consulting engineers for the erection of nine steel structures. The bridges are to be built in connection with the highway system and will be constructed across the Santa Clara River and various other streams and washes. The concrete bridges will range from one to three spans and the steel bridges will range from 100 to 1,200 ft in length. The estimated cost of the work is $232,000.

Connecticut.

Reports from New London, Conn., are that estimates for a new railroad bridge to span the Thames river at a point 400 ft. north of the present structure have been completed, and construction will begin during the present year. The estimates reach $2,500,000 for a two-track bridge with piers adaptable to four tracks similar to the new Connecticut river bridge.

A bill has been presented to the committee on roads, rivers and bridges of the state senate, Hartford, Conn., providing for the granting of the governor power to raise a committee of three build a bridge over the Connecticut river between the towns of East Haddam and Haddam, the cost not to exceed $225,000

Delaware

A bill has been introduced in the House. Dover, Del., authorizing the New Castle County Levy Court to borrow $150,000 with which to construct a modern bridge across the Christiana River to replace the 3rd St. bridge

Idaho.

⊙The county commissioners at Sandpoint. Ida., have awarded the contract for the erection of a steel bridge across Pack River, between Sandpoint and Hope, to Wheaton McNichols of Sandpoint for $2,850. The specifications call for an all steel structure with a 90 ft. span and concrete tubular piers. It will be constructed on the proposed road which will run from the Montana line to Spokane.

The Commissioners of Idaho County Grangeville, Ida., it is reported, are calling for bids for the construction of the new bridge across Salmon River at the Goff ferry for which the Idaho legislature about a week ago appropriated $15,000.

✤ indicates work now open for [illegible] • indicates a contract let recently

Illinois.

✣Bids will be received until 11 a. m., March [illegible], 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, 4th floor, City Hall, for making such repairs to the S. Western Ave. bridge as are enumerated in specifications and plans on file in the above office. The work consists of furnishing all labor, tools, material, etc., necessary to complete the following items, reinforcing all intermediate floor beams by inserting web plates, cutting out lattice diagonals and adding cover plates to top and bottom flanges. Adding and connecting two new lines of stringers to main and secondary floor beams; connecting end floor beams to curved track beams beneath by steel frames; connecting secondary floor beams and street car tracks by brackets and plates; adding knees braces between top lateral struts and intermediate truss posts; adding new subplanks, wheel guards, chord covers and Shumah pavement or one equally as good; painting entire structure. All work to be carried on without interruption to traffic. All timber used shall be free from injurious defects and subject to inspection. All yellow pine shall be of a grade equal to No. 1 common and oak shall be good sound white or burr oak of a grade equal to No. 1 common oak. All street car rails and fastenings shall be furnished by street railway company. The roadway floor shall be constructed of 6-in. yellow pine planks surfaced four sides, 6 and 8 ins. wide, and nailed to secondary floor beam with 8-in. wire spikes. Guard timbers shall be (6x8) in oak, bolted with ¾ bolts on 3-ft. centers. All steel used shall be uniform in quality and made by the open-hearth process according to manufacturers' standard for structural steel. The structure shall be scraped, cleaned and then painted with one coat of red lead and boiled linseed oil, mixed in the proportion of 25 lbs. of dry lead to 1 gal. of oil. Certified check for $300 required with bid.

⊙The Illinois Steel Construction Co. of Jacksonville, Ill., has been awarded the contract for the construction of the Crabb bridge in Macomb township, McDonough county, by the county commissioners, Macomb, Ill., for $3,190. The bridge will have a 70 ft. span and will be supported by reinforced concrete pillars. The wings will be of concrete and the approach graded between.

⊙The Paris Bridge Co., of Paris, Ill., has secured the contract for the construction of the new bridge to be built over Sugar Creek in Elbridge township on the line between Edgar and Vigo counties. Paris is the county seat of Edgar county.

⊙The Board of Supervisors of La Salle County, La Salle, Ill., has awarded the contract for the construction of a bridge over Indian Creek, near Leland, in Adams township, to the Decatur Bridge Co., of Decatur, Ill., for approximately $3,000.

According to advices from Danville, Ill., the Wabash railroad will shortly expend a considerable sum of money in a new bridge over the Little Wabash river between the stations of Shumway and Effingham. It is proposed to construct a series of concrete arches across the river proper and fill in the old bridge. The estimated cost of the bridge is between $25,000 and $30,000.

According to reports from Moline, Ill., President Taft has signed the bill granting a franchise for the construction of a bridge from the Illinois shore at Watertown across the river to Campbell's island. W. H. Gully, Moline, is superintendent of the Tri-City Railway Co., which will construct the bridge.

Indiana.

⊙Earl O. Gilbert has been awarded the contract by the county commissioners, Martinsville, Ind., for the construction of a number or arches for $8,349. Bids were opened March 7 by J. S. Whittaker, county auditor.

The Commissioners' Court at Fort Wayne, Ind., has rejected all bids received for the construction of the new bridge over the Ohio River. The work will be re-advertised.

The Board of Public Works of Anderson, Ind., has ordered the bridge petitioned for across Green's branch on 6th St., built. The bridge will be of wood.

Iowa.

⊙The Clinton Bridge and Iron Works, Clinton, Ia., has been awarded the contract by the Scott county supervisors, Davenport, Ia., for the construction of steel and iron bridges with concrete abutments and floors in the county during 1911. Bids received on concrete arches and culverts were rejected, the county deciding to do the work itself. The contract ranges from $16.40 per lin. ft. for 12 ft. span to $38.40 for 150 ft. span. Price per cu. ft. without reinforcements, 45 cts.; price per cu. ft. with reinforcements, 58 cts. Bids were opened March 6 by Edward Collins, county auditor.

⊙Grant Baker and F. Mitchell, Cedar county, Tipton, Ia., have been awarded the contract by the county commissioners, Tipton, for the construction of concrete culverts. Bids were opened March 6 by T. C. Moffit, county auditor.

Kansas.

⊙The Brookville Bridge Co. of Brookville, Kan., has secured the contract for the construction of the Dover bridge from the county commissioners, Salina, Kan. The structure will be built of steel joists and an oak floor and will cost $1,298.

The house of representatives, Topeka, Kan., has passed a bill providing for the levying of a special tax by the county commissioners of Leavenworth county for the purpose of building new bridges and repairing such old ones as are worth repairing.

The county commissioners of Shawnee county, Topeka, Kan., intend to do considerable bridge work on the Kansas River the coming summer. V. R. Parkhurst, Topeka, is county engineer.

Louisiana.

It has been announced at Shreveport, La., that plans for the building of a traffic bridge over Red River, 1,000 ft. below the site of the present combination river and traffic structure have been completed. The estimated cost of the bridge will be about $225,000.

Maryland.

⊙The Commissioners of Caroline and Talbot Counties, Denton and Easton, Md., county seats respectively, have awarded the contract for building the Dover bridge, which spans the Choptank River connecting the two counties, and .83 of a mile of road on the Caroline side to the Nelson Meredith Co. of Chambersburg, Pa., for $29,810.

Massachusetts.

Plans have been drawn for the construction of a $125,000 steel bridge over the Saugus River on the Newburyport turnpike, near the Lynn and Saugus line, to replace the Fox Hill bridge, Lynn, Mass. The county commissioners, Lawrence, Mass., will pay 40 per cent, the street railway 35 per cent, and the city 25 per cent of the cost.

William H. Ellis submitted the lowest bid to the board of public works of Boston, Mass., for the construction of a temporary Meridian St. bridge, the bid being $63,541. The bids were made on proposals calling for 60 per cent of the work. The draw of the bridge is to have an opening of 70 ft. instead of 59 and it will carry double tracks for street cars.

Michigan.

⊙Richard Heystek of Kalamazoo, Mich., has been awarded the contract by the city council of that city for constructing the new concrete bridge over the Kalamazoo River for $17,999. The plans of the structure call for a bridge of three 59 ft. spans. Other bids received were: Carpenter & Anderson, Grand Rapids, $19,335; Albion Lumber Co., Albion, Mich., $23,654; E. W. Seamans, Grand Rapids, $19,889; Illinois Bridge Co., Chicago, Ill., $18,200; Wyncoop & Gormeley, Toledo, O., $23,994; Henry L. Vanderhorst, Kalamazoo, $22,600, and E. W. Buckley, Kalamazoo, $20,900.

Minnesota.

⊙The Security Bridge Co., P. O. Drawer 1004, Minneapolis, Minn., has been awarded the contract by the town of Grasston, Minn., for the construction of a 60 ft. steel span with concrete floor and concrete backing and wings, for $2,632. Bids were opened March 10 by Peter Becklund, chairman, town board.

Nebraska.

⊙H. T. Ward & Co. of Tecumseh, Neb., have been awarded the contract for the construction and repairing of all bridges in Otoe county, Nebraska City, Neb., during the year 1911. Bids were opened March 9 by A. P Young, county clerk.

Plans for the new 11th St. viaduct have been presented to the city council of Omaha, Neb. The new structure will extend one block farther south than the old one and will have a broader driveway and narrower sidewalks. It is expected to cost about $100,000. Geo. W Craig is City Engineer.

New York.

✣Bids will be received until 2 p. m., April 1, by Henry Peterson, Fredonia, N. Y., superintendent of highways of the town of Pomfret, N. Y., for the construction of a concrete arch over Candaway Creek at Hunt's, in said town, according to plans and specifications on file at the office of Frank H. Moir, town clerk, Fredonia, N. Y. A certified check for $250 must accompany each proposal.

⊙The Town Board of Waverly, N. Y., has awarded the contract for the construction of the new bridge to replace the old suspension bridge over the river to the Climax Road Construction Co. of Marothan, N. Y., for $12,461, superstructure with plank floor, and $5,336 for substructure. Other bids received were: The Owego Bridge Co. of Owego, N. Y., superstructure with plank floor, $11,720; with block floor, $12,920; Seneca Engineering Co., of Montour Falls, N. Y., for bridge complete, $19,985; Lane Bridge Co. of Painted Post, N. Y., superstructure with plank floor, $12,678; York Bridge Co., York Pa., superstructure, concrete floor, $21,422; with plank floor, $14,336; Horseheads Construction Co., Horseheads, N. Y., superstructure, $8,493 and $100 for each aditional 4-in. in depth of foundation down to 18-in. lower; United Construction Co., Albany, N. Y., superstructure, plank floor, $12,333; with block, $15,000; J. J. Higgin & C. H. Reimard, Waverly, N. Y., substructure, $9,130.

⊙The new bridge across Rondou creek at Kingston, N. Y., will be constructed by the Lane Bridge Co., of Painted Post, N. Y., for $16,950, the lowest bid received by the Ulster county superintendent of highways, Kingston. Other bids received were: United Construction Co., Albany, $25,152; York Bridge Co., York, Pa., $24,551; E. J. Doyle & Co., Albany, $24,500; Lumpfer & Remmick, Buffalo, $24,290; Owego Bridge Co., Owego, N. Y., $21,245, and the Pennsylvania Bridge Co., Beaver Falls, Pa., $20,361.

Plans have been prepared by Torrance & Taylor, Engineers, 39 Cortlandt St., New York City, for the construction of the reinforced concrete approach spans for the bridge which will connect the mainland portion of Long Island with the Great South Beach at the new city of Tangier, N. Y. The contract for the work has been awarded to a private construction company, organized by parties interested in the Tangier Development Co. Bids for the 75 ft. bascule draw span required by the U. S. Government for the channel span of this bridge were all rejected as being too high. New bids will be asked for at an early date.

The citizens of Fulton, N. Y., have voted in favor of the proposition of constructing a concrete steel-reinforced bridge across the Oswego River, connecting East and West Broadway, to take the place of the old structure. The sum of $125,000 was voted at the election. The estimated cost of the bridge is $80,000.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

North Carolina.

The bill which the county commissioners at Charlotte, N. C., had drawn for adoption by the legislature authorizing the building of a bridge over the Catawba River at Sloan's ferry in conjunction with the similar board from Gaston county, has passed the House of Representatives.

North Dakota.

✣Bids are asked until 2 p. m., April 5, by Henry Albertson, county auditor, Rugby, N. Dak., for furnishing the county with metal culverts and road machinery for the year 1911.

Ohio.

✣Bids will be received until noon, March 24, by county commissioners, Frank Munger, chairman, Dayton, O., for constructing a steel bridge over Wolf Creek in Brookville.

✣Bids will be received until 11 a. m., April 5, by county commissioners, John F. Goldenbogen, clerk, for construction of bridge work, per report No. —, storm sewer, Elmyra Road, Warrensville township. Frank R. Lander, county surveyor, New Court House, 3d St., Cleveland, O.

✣Bids will be received until noon, March 24, by the county commissioners, Fred Dreibs, clerk, Cincinnati, O., for the following county work: Under Specifications No. 164—For new superstructure of bridge on the Springfield Pike, near the Allen Hoffman Farm, one-quarter mile north of Springdale, in Springfield township. Plans and specifications now on file in the office of the board of county commissioners. Certified check for $500 required with bid.

✣Bids will be received until 11 a. m., March 22, by county commissioners, John F. Goldenbogen, clerk, Cleveland, O., for the construction of bridge work per report No. 2769, concrete bridge, Anderson road, Euclid township; report No. 2770, extension of roadway, Broadview road, Brecksville-Royalton townships; report No. 2771, concrete arch, station road, over Chippewa Creek, Brecksville township; report No. 2772, concrete arch, Irish road, over Plum Creek, Olmsted township; report No. 2774, culvert extension, Broadview road, Brecksville-Royalton townships, in accordance with the form of contract and specifications to be furnished by Frank R. Lander, county surveyor, new court house, 3d St., Cleveland, O.

⊙The county commissioners at Port Clinton, O., have awarded the contract for the construction of a draw bridge at Port Clinton, as follows: Modern Construction Co. of Fremont, O., $6,975, for substructure; the Home Engineering & Contracting Co. of Canton, O., $7,887, for the superstructure. Bids were opened March 6 by W. H. Nylander, county auditor.

⊙The county commissioners, New Philadelphia, O., have awarded a contract for placing new plank and joists in the Tuscarawas river bridge, according to plans and specifications recently made by the county engineer, to Virgil Starker, for $25 per M. for materials and $4.50 per M. for labor in removing and replacing plank and joists.

The City Council of Cincinnati, O., has passed a bond issue of $250,000 for the construction of the Gilbert Ave. viaduct. The plans have been completed and the service director will ask for bids for the construction of the bridge within a few days.

Pennsylvania.

✣Bids are asked until noon, March [illegible], by the commissioners of Lycoming county, Williamsport, Pa., for constructing foot walks on two bridges at Williamsport, and for furnishing and placing steel stringers on one bridge.

South Dakota.

✣Bids are asked until 2 p. m., April 5, by T. C. Young, county auditor, Huron, S. Dak., for building all bridges, both steel and wood, and repairs to all county bridges, and all concrete work that may be ordered by said board during the ensuing year. Each bid must be accompanied by complete plans and specifications showing size of and stress in all members, and a certified check, filed in a separate envelope, for the sum of $1,000.

Utah.

The House Committee on Highways and Bridges, State Legislature, Salt Lake City, Utah, has passed a bill appropriating $35,000 providing for the construction of a steel bridge across the Grand River at Moab.

Virginia.

✣Bids are asked until noon, March 28, by J. O. Magruder, City Engineer, Danville, Va., for constructing a 1,000 ft. long, 20-ft. roadway, reinforced concrete arch bridge over Dan River on Union St., Danville. Wilbur J. Watson, Consulting Engineer, Cleveland, O.

The Norfolk & Western and the Chesapeake & Ohio railroads will contribute to the construction of a concrete bridge over the James river in Lynchburg, Va., in order to get rid of grade crossings.

City Engineer Charles Bolling of Richmond, Va., has submitted an estimate of $500,000 to the sub-committee on James River bridge, providing the approaches are to be raised above the high water record. The estimated cost of the bridge proper is $225,000.

The King William and Hanover County Supervisors, King William and Hanover, Va., county seats respectively, have decided to build an iron bridge across the Pamunky River at Hanover town, at a cost of $4,000, Hanover to pay one-fourth and King William three-fourths of the amount.

Washington.

City Engineer Morton Macartney of Spokane, Wash., has submitted a plan to the city council for consideration for the construction of a viaduct from Front Ave., along Sheridan to a new East Olive Ave., bridge. The estimates, including the viaduct, the bridge and approaches, aggregate $367,000, a part of which will be borne by the railways concerned—the Milwaukee and the Inland Empire systems. The plan provides for grade separation at a congested part of the city.

According to advices from Olympia, Wash., the legislature will probably make an appropriation for the construction of the proposed bridge across the Lewis River near Woodlawn, which will cost $60,000. Clark and Cowlitz counties have each voted $15,000 for the bridge. It is proposed to locate the bridge at a point where it will aid the Pacific Highway movement.

A bill has been introduced in the senate at Olympia, Wash., by Senator Wesley L. Jones, to procure the consent of Congress to the building of a bridge by the city of Northport, Wash., over the Columbia River. The estimated cost of the structure is $125,000. The county commissioners have already appropriated $20,000 toward the construction of the bridge.

Mayor A. V. Fawcett of Tacoma, Wash., has signed the contract retaining Waddell & Harrington of Kansas City, Mo., as engineers to prepare plans for a bridge across the city waterway and the one across the Puyallup River. Plans will be ready in about a month for the construction of both structures involving a total expenditure of $615,000. The waterway bridge will cost $475,000 and the Puyallup River bridge will cost $140,000

Wisconsin.

⊙The City Council of Menominee, Wis., has awarded the contract for the construction of the bridge to connect this city and Marinette to the Wausau Iron Co., Wausau, Wis., for $24,168.

A petition has been circulated to rebuild the present wagon bridge, connecting the east and west sides of the city of Grand Rapids, Wis., with concrete piers, and wide enough for the street car line and the proposed extension of the interurban service to Stevens Point

Canada.

✣Bids are asked until noon, March 28, by John H. Jackson, Superintendent Queen Victoria, Niagara Falls Park, Niagara Falls, Ont., for constructing steel concrete bridges For further particulars see Roads and Streets this issue.

⊙The Grand Trunk Ry. has awarded the contract for the construction of all the bridges on the branch line at Edson, Alta., to Creelman & Verge.

It is reported that the Grand Trunk railway will build two steel bridges on its line west of Edmonton, Alta. H. G. Kelley is Chief Engineer, Montreal, Que.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

California.

The Sutter-Butte Canal Co. has filed its articles of incorporation at Oroville. The capital stock is $1,250,000. The directors and stockholders are: M. Rowlands, Berkeley; Thomas H. Breeze, Fairoaks; E. M. Kent, San Francisco; G. H. Kellogg, Berkeley, and Gordon Hall, San Francisco.

Advices from Auburn, Cal., state that H. C. Whitman has filed an appropriation of 100,000 in. of water, 4-in. pressure, in the American river in El Dorado and Placer counties at a point on the left bank where the Middle Fork and the North Fork of the river join. It is reported that he proposes building a dam at that point 200 ft. high.

Illinois.

✣Bids are asked until March 16, by T. James Allen, Commissioner of North Fork Special Drainage District, Broughton, Ill., for ditch work amounting to about 1,900,000 cu. yds., estimated to cost 7 cts. per cu. yd. Specifications are on file at the office of the County Clerk at McLeansboro, but letting will be held at Broughton, Ill. Certified check for $5,000 required with bid. W. W. Stokes, Carmi, Ill., is Engineer.

✣Bids will be received until March 18 by H. C. Phillips, Town Clerk, Cerro Gordo, Ill., for furnishing the following drain tile and constructing ditches, etc.: 3,100 ft. 18 in., 2,100 ft. 16 in., 3,900 ft. 15 in., 4,100 ft. 14 in., 4,100 ft. 8 in., the 8 in. to be red shale tile. Larger sizes to be vitrified. Work is to be done for Union Drainage District No. 6.

Indiana.

✣Bids will [illegible] Harley, County Surveyor, Hartford City, Ind., for constructing the James Chapman ditch, the [illegible] requiring excavation of 4,341 cu. yds., and the following red drain tile: 900 ft. 10 in., 1,100 ft. 12 in., 3,278 ft. 14 in., 2,090 ft. 18 in., maximum cut 7.28 ft.

Petition has been filed with the Commissioner of Cass County at Logansport, asking for certain rights and privileges for the construction of a concrete dam and power house on the Wabash River at Georgetown in Cass County. Plans and specifications for the dam are said to have already been prepared. Judge Quinch A. Meyers, Logansport, Ind., and O. H. Binns of the Casparis stone quarries, are said to be interested.

Commissioners of Clay County, Brazil, Ind., have appointed W. S. Rawlay as drainage commisioners to have charge of the work of improving Eel River by taking out some of the curves and putting in a system of drainage for southern Clay and western Owen counties.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Iowa.

✣[illegible] V. A. Burley, County Auditor, Sibley, Ia., for [illegible] work will include as follows: 3,200 ft. 16 in., 1,000 ft. 14 in., 8,400 ft. 12 in., 6,500 ft. 10 in., [illegible] received on either clay or cement tile.

Kansas.

[illegible] Topeka, is progressing. Concrete work has [illegible] possible speed. Jones Bros., of Leavenworth, Kans., are the General Contractors with an [illegible]

Preliminary report has been made by the Commissioners for a 5-mile drainage ditch between Rossville and Silver Lake in Shawnee County. V. R. Parkhurst, Topeka, Kan., is the Engineer.

[illegible] constructed for drainage purposes at Silver Lake in Shawnee County. V. R. Parkhurst, Topeka, Kan., is engineer in charge.

Preliminary report [illegible] made for the construction of drainage work at Maple Hill in Wabaunsee County. V. R. Parkhurst, Topeka, Kan., is the engineer in charge of the work.

Minnesota.

✣[illegible] until March 28 by J. L. [illegible] Auditor, Olivia, Minn., for constructing county ditch No. 46. The work [illegible] cu. yds. open scraper work, 1,000 cu. yds. of cleaning present channel, and furnishing and laying the following tile: 4,100 ft. 8 in., 1,300 ft. 16 in., 1,700 ft. 15 in., 1,300 ft. 14 in., 800 ft. 12 in., 1,354 ft. 10 in., 4,692 ft. 9 in. 7,178 ft. 8 in., 1,000 ft. 7 in., 1,015 ft. 6 in., 2,610 ft. 5 in. Bids on either hard burned clay tile or standard make cement tile will be considered. Total estimated cost $10,565.

✣Bids will be received until April 7 by J. L. George, County Auditor, Bemidji, Minn., for constructing Judicial Ditch No. 5 and branches. The work includes a ditch approximately 15 miles long, 4 and 5 ft. wide at bottom, average denth 4 ft., slopes 1 to 1, requiring excavation of 72,496 cu. yds. There will also be 14.71 miles of highway to be constructed and 20 corrugated iron culverts.

⊙Two contracts for furnishing brush for government river improvement work have been awarded as follows: George Holshammer of La Crosse, for cutting 25,000 yards for delivery at various points north and south of La Crosse; Charles Ott of Genoa for 25,000 yards for delivery at the lower end of the district.

Missouri.

The State Legislature has passed the bill and it has been signed by the Governor allowing Kansas City to build dikes across the Kansas line to the Kaw river along the banks of Turkey and O. K. creeks. The bill also gives the city the right, on all the watershed to the Kaw, to condemn land to build any sewer, dike or levee it deems necessary, with or without the co-operation of the public corporations of Kansas. The right to amend the city charter to any form of taxation also is included in the bill.

Ohio.

Commissioners of Marion County will hold a hearing at 10 a. m., March 20, at the office of the County Auditor, Marion, O., on the petition for deepening, widening and straightening the Seegar-Merrit County ditch.

Oregon.

A syndicate of Ontario, Ore., capitalists including some of the members of the Ontario Land & Townsite Co., has secured the 800,000 acre holdings of the Willamette and Cascade military road lands in township 18-47, being the township in which Ontario is located. The new owners have engineers at work platting the land, and will install an irrigation plant that will water every acre. This plant will be located about three miles south of Ontario on the Snake River, from whence a pipe line 10,000 ft. long will take the water to the high bench adjoining Ontario.

WATER-WORKS

Alabama.

A bond election is to be called in Gadsden, Ala., to authorize the issuance of bonds in the sum of $50,000 for the completion of the new waterworks plant. W. G. Ballinger is mayor.

California.

⊙The City Trustees of Ontario, Cal., have made the following awards of the contracts for the installation of the new municipal water system in three parts to the lowest bidders on the various sections of the work, as follows: The Western Pipe Co., of Los Angeles, new steel riveted pipe $16,398; the Crane Co. of Los Angeles, special screw pipe and joints, $79,375; Joe Chutuck of Los Angeles, digging ditches and laying pipe, $18,882. The total cost of the system is $175,000.

The Union Water Co., of Alameda, Cal., will lay water mains in the city within the next two months which will bring water from Mount Hamilton and Roberts Landing, about 12 miles beyond San Leandro, into the city and Berkeley and Oakland to supply the consumers of the company. G. E. Gilman, Asst. Engineer of the company, will be in charge of the work.

The Committee on Outside Supply of the Board of Trade Water Committee, Pasadena, Cal., plans a $9,000,000 water project to divert 7,000 miners inches of water from the Mojave River to Pasadena and towns and cities along a route from San Bernardino here. The committee sent J. B. Coulston, its chairman, Judge W. S. Harbert, and Engineers T. D. Allin and Ezra Scattergood to investigate the Mojave project. It is planned to construct an aqueduct through the desert.

Georgia.

⊙The City Council of Gainesville, Ga., has awarded the contract for the erection of a brick pumping station, etc., in connection with the water works system to Prater & Loden of Gainesville. W. B. Eppes is City Engineer.

An election will be held in Albany, Ga., shortly to vote on the proposition of issuing bonds in the sum of $12,500 to extend the water and sewer mains.

An election is to be held in Americus, Ga., [illegible] the purpose of voting on the issuance of bonds to the amount of $65,000 for extending the waterworks and sewer systems.

The plant of the Columbus, Ga., Water Works Co. has been sold under a decree of the federal court, for $392,000. The city can now proceed with the construction of a municipal waterworks system.

Georgia.

Plans and specifications have been prepared by J. B. McCrary & Co., of Atlanta, Ga., for the construction of a water works system for Titusville, Fla., estimated to cost between $25,000 and $30,000. The work will include power house, elevated tank, reservoirs, piping, iron hydrants, etc.

Illinois.

✣A $7,000 bond issue has been voted by the Village of Odell, Ill. The proceeds of the bond issue will be used for improving the waterworks system. It is stated that bids will be opened March 27.

✣Bids will be received until March 18, 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering valves for standard water pipe from 4 to 24 ins. in diameter inclusive, and for 2½ and 4-in. double and single hydrants. They are to be made of the form, dimension and details as shown by specimen castings at the water works shops, 2304 S. Ashland Ave. The contract shall also include not more than 2 tons of such minor repair parts, not to exceed in weight 500 lbs. each, as may be ordered by the Commissioner. Patterns for castings will be loaned to the contractor by the city and shall be used exclusively for castings required by this contract. Approximately 250 tons of castings will be required by the city and contractor will be required to furnish all the castings necessary to complete any four of the following eight items if ordered by the Commissioner, but deliveries need not exceed five tons per day. Ten 2½-in. double hydrants complete, four 4-in. double hydrants complete, four 4-in. valves, four 6-in. valves, four 8-in. valves, one 12-in. valve, one 16-in valve, one 24-in. valve. All castings are to be of tough gray iron, free from defects and subject to inspection as to material weight, a test by hydrostatic pressure of 150 lbs. per sq. in.

✣Bids will be received until 11 a. m., March 17, 1911, by B. J. Mullaney, Commissioner of Public Works, City Hall, Chicago, for furnishing and delivering two 30-in. Venturi meters for use at the 22nd St. pumping station. Each meter shall consist of cast iron Venturi tubes which can be placed in the main line of the pipe in which the flow is measured. The inlet section of the tubes shall have flanged connections. The inlets and outlets shall have spigot and bell end respectively of suitable size for connection to the standard 30-in. pipe. Each meter shall include one graphical recorder showing continuously the rate of flow in million gallons every 24 hours, one counter dial showing total quantity of water in gallons passing through the meter, one indicator dial showing the rate of flow in milion gallons per 24 hours at the instant of observation.

✣Bids will be received until 11 a. m., March 18, 1911, by B. J. Mullaney, Commissioner of Public Works, City Hall, Chicago, for furnishing and delivering approximately 200 tons of cast iron valve basin and fire cistern covers to be delivered as follows: Yard A., Avers Ave. and Wabansia Ave., 30 per cent; Yard B, 2352 S. Ashland Ave., 35 per cent; Yard C, 49th Pl. and Union Ave., 20 per cent; Yard D, 60th St. and Yates Ave., 15 per cent. The castings are to be made of the best quality of gray iron and shall be free from blow holes, cold shuts and other defects. All castings are to be made from drawings furnished by the City of Chicago and are to be subject to tests, inspection and approval of the Commissioner. The standard weight of curb is 390 lbs. and lid 150 lbs. A certified check drawn on a responsible bank doing business in Chicago must accompany all bids.

✣Bids will be received until 11 a. m., March 21, 1911, by B. J. Mullaney, Commissioner of Public Works, 4th floor, City Hall, Chicago, for furnishing and delivering to the city's pipe yards at 2352 S. Ashland Ave., corporation ferrules as follows: 7,500 ¾-in. ferrules approximate unit weight 2 lbs. 3½ oz.; 300 1-in. ferrules, approximate unit weight 2 lbs. 12-9/16 oz.; 200 1¼-in. ferrules, approximate unit weight 4 lbs. 12 9/16 oz.; 200 1½-in. ferrules, approximate unit weight 8 lbs. 2¾ oz.; 300

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

2-in. ferrules, approximate unit weight 13 lb. 11 5-16 oz. The composition of the finished ferrule shall be as follows: 82 parts copper, 6 parts tin, 10 parts zinc, 2 parts lead, each metal to be of good and satisfactory quality and properly mixed. The castings shall be free from all injurious defects and of uniform thickness. Drawings and specifications must be strictly adhered to and may be had upon application to the Commissioner of Public Works. Proposals must be accompanied by cash or certified check on a responsible Chicago bank for $[illegible].

✣Bids are asked until [illegible] March 23 by Board of Local Improvements of Wheaton, Ill., for an extension of the water mains in Harrison Ave. Arthur L. Webster is City Engineer of Wheaton, Ill.

✣Bids are asked until 5 p. m., March 17, by the Board of Public [illegible], for two 230 h. p. Babcock & Wilcox type boilers to be installed at the city pumping station. Bids are also asked for constructing a 160-ft. [illegible] brick chimney.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, Chicago, 4th floor, City Hall, for furnishing and delivering special castings to the various pipe yards as follows: 200 tons of special castings for cast iron water pipe, to be 4 ins. to 12 ins. in diameter (inclusive) with the exception that a certain amount of large castings may be ordered (16 ins. to 48 ins. in diameter, inclusive), provided such large castings shall not exceed 10 tons in weight. Castings are to be delivered in such quantities as the Commissioner of Public Works may direct as follows: Yard A, Ayers Ave. and Wabansia Ave.; Yard B, 2352 S. Ashland Ave.; Yark C, 49th Pl. and Union Ave.; Yard D, 68th St. and [illegible]; Yard E, 104th St. and Howard Ave. All castings shall be sound and fully up to specifications on file at office of Commissioner of Public Works. Proposals must be accompanied by cash to the amount of $400 or a certified check for the same amount.

⦿The City Council of Joliet, Ill., has awarded Hill-Tripp Pump Co., of Anderson, Ind., the contract for furnishing and installing the pump complete for the new artesian well at Canal and Division Sts., for $5,985.

The citizens of Deland, Ill., recently voted against the proposition of issuing bonds for the installation of a water works.

Plans have been prepared by J. S. Spikes of Vincennes, Ind., for the construction of a new water works for Flora, Ill., at an estimated cost of $7,000. The water supply will be secured from deep wells. Contracts will be let shortly.

Indiana.

✣Bids are asked until [illegible] March 25 by J. W. Sanderson, Treasurer Marion Branch, N. H. D. V. S., National Military Home, Ind., for machinery and materials for improvement of water supply at the Soldiers' Home.

Iowa.

⦿The contract for the [illegible] and electric lighting improvements for Adair, Ia., has been awarded to the Des Moines Bridge & Iron Co., of Des Moines, Ia., for $28,460. The W. K. Palmer Co., 717-720 Dwight Bldg., Kansas City, Mo., Engineers.

⦿The contract for the water works and electric lighting improvements for Atlantic, Ia., has been let to the Joseph A. Bortenlanger Co., of Omaha, Neb., for $43,000. The W. K. Palmer Co., Dwight Bldg., Kansas City, Mo., Ergineers.

Louisiana.

The city of Houma, La., plans the construction of a reservoir and filters in connection with water works. The city is desirous of knowing what a plant with 150,000 gals. daily capacity will cost. Lucius Tucker is City Engineer.

Maryland.

⦿The Board of Contract and Supply of Schenectady, N. Y., has awarded the contract for furnishing 180 tons of cast iron pipe and specials to Charles Miller & Co., of Utica, N. Y. [illegible] also awarded the contract for furnishing two tons of pig lead at $97 per ton.

Consulting Engineer J. H. Fuertes, 140 Nasseau St., New York City, has submitted his report as to the plan to abandon the Potomac River as the source of water supply for the city of Cumberland, Md. The engineer recommends Evitts creek as the best source of supply. The estimated cost of a system providing 12,000,000 gals. daily is $538,428. For a 6,000,000 gal. daily system the estimated cost is given as $469,900. The act of the legislature calls for a vote on a $500,000 bond issue for a new water supply [illegible] the plan [illegible].

Massachusetts.

✣Bids will be opened at 4 p. m. [illegible] by the Water and [illegible] Commissioner, No. 52 Swan St., Medford, Mass., for furnishing the City of [illegible] 130 tons of cast iron water pipe and about 13,[illegible] ft. of [illegible] salt glazed [illegible].

Michigan.

Langley & Jeynes submitted the lowest bid for the construction of the inlet and outlet [illegible] the new Fairview pumping station just west of the water works, Detroit, Mich., their [illegible] being $19,1[illegible].

Mississippi.

The City of Byhalia, Miss., will probably issue bonds in the sum of $10,000 for the purpose of installing a water and electric light plant.

Missouri.

✣Bids will be received [illegible] by the Board of Fire and Water Commissioners, Kansas City, Mo., for the construction of a self-contained, vertical triple-expansion crank and flywheel pumping engine of 20,000,000 gals. capacity in 24 hours.

An election will be held in Cole Camp, Mo., [illegible] on the issuance of [illegible] $10,000 for water works.

A bill was recently introduced in the Missouri legislature at Jefferson City, Mo., by Representative Willeford of Ray County, calling for the preservation of a pure water supply for cities which are obliged to depend on the Missouri River [illegible] proposes to prevent Kansas City, St. Joseph and all cities along the Missouri River from dumping sewage into that stream and applies also to St. Louis and other cities along the Mississippi.

Nebraska.

⦿The City Council of Wymore, Neb., has awarded the following contracts for the construction of a municipal water and lighting plant in that city: Elkhorn Construction Co. of Fremont, laying water mains, $3,150; Frank Wheeler of Havelock, Neb., constructing electric line, $1,150; St. Mary's Machine Co., of Ohio, machines for general power, $4,250.

⦿Marshall Bros., Las Animas, Colo., have been awarded the contract by the city of Fairbury, Neb., for furnishing the necessary labor and material for the construction of a water works system and electric light extension for $9,778. The work includes hauling and laying pipe, hydrants, valves, erecting one 150 K. W. generator, one 100 steam turbine set, heater, condenser, steam piping power house, flooring and pump pit. Burns & McDonnell, Scarritt Bldg., Kansas City., Mo., Engineers. Bids were opened March 9 by B. Z. Millikan, City Clerk.

The City Officials of Fairbury, Neb., are making arrangements to spend $20,000 on the water and light plant during this month and April. Among the improvements specified is a new 2,000,000 gal. [illegible] standpipe in the highland addition.

The citizens of York, Neb., at a special election held recently defeated the proposition of granting a new franchise to the York Water Co. At a special election held last December the citizens defeated the proposition to issue bonds for the purchase of the water plant.

New York.

✣Bids [illegible] Board of Water Commissioners, J. B. Mace, President, Keeseville, N. Y., for laying water mains and constructing a reservoir and standpipe. W. G. Stone, Utica, N. Y., is Engineer.

City Engineer E. A. Fisher of Rochester, N. Y., has informed the city council that to continue the water distribution system according to plan, larger water pipes in about 23 miles of streets were necessary. The estimated cost is $175,000.

The citizens of Mount Morris, N. Y., recently voted in favor of the proposition of issuing bonds to the amount of $100,000 for the installation of a municipal waterworks system.

The Board of Estimates and Apportionment of New York City is planning extensive improvements in the water supply system of Brooklyn and Queens Borough, calling for an expenditure of more than $10,000,000. Deputy Water Commissioner Parsons has completed a survey of the proposed local development, which covers the departmental needs for the next five years, and which will be included in the annual corporate stock budget. This year $100,000 is to be spent in extending the high-pressure fire service system in Queens, and in 1912, it is estimated that $300,000 will be needed for general improvements. In 1913 $325,000 is to be expended in the borough. The Bayside system will be generally improved and $190,000 used for new distributing mains throughout the borough.

North Carolina.

The City Officials of Black Mountain, N. C., contemplate issuing bonds to the amount of $15,000 for the construction of waterworks and a sewerge system.

Ohio.

✣Bids are asked until March 20 by W. E. Wynne, Village Clerk, Feinbank, O., for furnishing and laying 14,125 ft. of 4-in., 6-in. and 12-in. water pipe, placing 34 fire hydrants, 504 6-in. and 12-in. valves and boxes, and 16,500 lbs. special castings.

✣Bids will be received by A. B. Lea, Director of Public Service, 104 City Hall, Cleveland, O., until noon, March 24, for furnishing valves for the Water Department of the City of Cleveland. Each bid must be made in accordance with the specifications, which may be obtained of the Superintendent of the Water Department.

✣Bids are asked until noon, March 24, by A. B. Lea, Director of Public Service, 104 City Hall, Cleveland, O., for furnishing hydrants for the Water Department of the City of Cleveland. Each bid must be made in accordance with the specifications, which may be obtained of the Superintendent of the Water Department.

✣Advices from Columbus, O., state that bids are being asked by John Hinterschied, Clerk of Grandview Heights, Franklin County, O., for material and labor for laying water mains.

Construction Superintendent Heffernan of the waterworks, Dayton, O., has notified Service Director Ely that the present supply of cast iron pipes for the water department is low, and that the city should advertise for bids for furnishing 625 tons of pipe of various sizes within the next few weeks. Bids will be received some time this month.

Plans and estimates for the erection of a sterilization plant and a turbine power station at the California waterworks, Cincinnati, O., have been completed. The city council has been asked to authorize contracts for the work, which is estimated to cost $25,000. Superintendent Laidlaw's estimates submitted to Director Sundmaker were: For the sterilization plant, $6,500 [illegible] $6,000; two water turbines with electric generators, $5,500. The sterlization plant will be built in connection with the filtration plant. An estimate was also submitted for a turbine generator at the Western Hills pumping station, of $[illegible].

The following submitted bids to the Board of Control of Hamilton, O., on fire hydrants, water pipes and valves for the city water de-

[illegible] United States Cast Iron & Pipe Co., the Columbian Iron Works, and the Bourbor Copper & Brass Co.

Plans are being prepared by [illegible] & Sherman Co., 613 The Nasby, Toledo, O., for [illegible]

[illegible] gaged in the preparation of plans for remod- [illegible] gon, Mich.

Oklahoma.

✣Bids will be received until March 27, by F. T. Stackpole, City Clerk, El Reno, Okla., for constructing water works, estimated to [illegible] & [illegible] Bldg., Kansas City, Mo., are the Engineers.

•The City of Cherokee, Okla., on March 3 received bids and awarded contracts for water and light extension as follows: Ludlow Co., for furnishing hydrants and valves; The Oklahoma Engineering Co., Anadarko, Okla., for the general construction; E. J. Merkle, representing the Skinner Engine Co., [illegible]

Plans and specifications have been prepared by the Oklahoma Engineering Co., 120 Broadway, Anadarko, Okla., for the installation of a water works for the city of Bridgeport, Okla. Bonds to the amount of $8,000 have been voted. This is an extension to the old system.

The Oklahoma Engineering Co., 120 Broadway, Anadarko, Okla., has prepared plans and specifications for the construction of a water works for the town of Carnegie, Okla. Bonds to the amount of $20,000 have been voted.

Oregon.

✣Bids will be received until noon March 20, by the Board of Trustees of the Eastern Oregon State Hospital, at the Capitol Building, Salem, Ore., for the following labor and materials for the Eastern Oregon State Hospital: Laying pipe line, approximately 4,500 ft., for water supply to the hospital.

The Oregon Foundry Co., Portland, Ore., is the probable contractor for furnishing the water board of Portland 500 cast iron gate boxes for $1,375. D. D. Clarke is Engineer of the Board. Bids were opened March 1.

The Read-Angell Auto Transfer Co., Lewis Bldg., Portland, Ore., is the probable contractor for hauling cast iron pipe, specials, etc., from the railroad depot or tracks to points within the city limits designated by D. D. Clarke, Engineer of the Water Board, Portland, Ore., for $12,830. The work includes approximately 10,000 tons of cast iron pipe, specials, gate valves, hydrants, lead and valve boxes. Bids were opened March 1.

The Crane Co., 14th and Irving Sts., Portland, Ore., is the probable contractor for furnishing the water board of Portland, f. o. b. cars Portland, 200,000 lbs. of the best quality Selby pig lead for $9,660. Frank T. Dodge is superintendent. Bids were opened March 1.

An election will be held in Pendleton, Ore., early in April to decide whether or not the city is to have a gravity water system which will give Pendleton a supply of pure spring water from the Blue Mountains. The board of water commissioners has decided to submit the question of bonding the city in the sum of $200,000 for this purpose. The water will be brought from the Thorn Hollow Springs at the foot of the Blue Mountains. The system as planned includes the construction of two reservoirs, one each on the hills on either side of the river which runs through the city.

Pennsylvania.

The Borough Council of Breckenridge, Pa., has passed an ordinance granting the Allegheny Valley Water Co., a franchise.

•The [illegible] Council of Coraopolis, Pa., has awarded the following contracts for machinery and other work in connection with the water works of the town: The Buckeye Engine Co., for an engine of 225 h. p.; the Struthers Wells Co., for two engines, one of 150 and the other of 175 h. p.; the Crocker Wheeler Co., of New Jersey, for three generators; the Westinghouse Electric & Manufacturing Co., for a switchboard, and the Reineke-Wagner Co. for a pump with a capacity of 1,500,000 gals. of water daily. The citizens recently approved a $50,000 bond issue for these improvements.

Tennessee.

The City Council of Clarksville, Tenn., has ordered a bond issue of $60,000 for improving the waterworks system of Clarksville. A new pumping station, new reservoir, installation of meters and duplicating mains are some of the improvements contemplated.

The Artesian Water Department of Memphis, Tenn., has filed with the board of city commissioners a formal request for approval of a bond issue of $1,000,000 as the amount needed in the next five years. The estimated needs are as follows: Extension on sewered streets, $135,000; extension on other streets, $250,000; service connections, $125,000; meters, $150,000; increase of water supply, $175,000; new boilers, lowering mains and miscellaneous construction, $165,000.

Texas.

✣Bids will be opened March 21 by the Mayor and City Council at San Augustine, Tex., for the purchase by the city of all material required in the construction of a water works system, electric motor or gasoline engine, triplex pump and steam pumps, boilers, heater, waterworks pipe, valves and hydrants, tank and tower; also for drilling of a deep well. Quantities and specifications may be had by addressing O'Neil Engineering Co., Constructing and Supervising Engineers, 1503 Praetorian Bldg., Dallas, Tex.

✣Bids will be received until noon, March 24, by Mayor C. N. Humason, Lufkin, Tex., for the following material: 2 100 h. p. return tubular boilers, 2 boiler feed pumps, 1 200 h. p. open type feed water heater, 2 comp. duplex pumps, 1 condenser and wet vacuum pump, 2 75 h. p. motors. Specifications can be had by addressing the City Clerk at Lufkin, Tex., or O'Neil Engineering Co Dallas, Tex.

The proposition of issuing $30,000 in bonds for the construction of a water works in Polytechnic Heights, Polytechnic, Tex., will be submitted to the voters of that city on April 4.

An election will soon be held in Timpson, Tex., for the purpose of voting on the issuance of bonds in the sum of $20,000 for the installation of a water works.

The State Attorney at Austin, Tex., has approved a bond issue of $8,000, issued by the city of Shiner, Tex., for waterworks improvements.

The City Council of Denison, Tex., has sold the Shawnee Lake pipe line bond issue of $50,000. It is reported that construction work will be started shortly.

The City Council of Beaumont, Tex., contemplates purchasing the water works plant of the Beaumont Water Works Co. The council is inquiring into data which has been obtained from Texas cities having to do with the operation of municipal owned water works.

The City Commissioners of Dallas, Tex., received the following bids for furnishing water meters to the water department, ranging from 100 to 10,000 in number: Pittsburg Meter Co., Keystone and Eureka, ⅝-in., $8.40 each; 1-in., $16; 6-in., $375; 12-in., $900, guaranteed for two years. For 5,000 or more meters 15 per cent off, for 7,500 or more 20 per cent off, for 10,000 or more 25 per cent off; B. M. Stoller, district manager. Crane Co., Enarc meter, ⅝-in., $6.75; 1-in., $13.20; 2-in., $41; J. E. Ludlow, manager. Gamer Co., American water meters, ⅝-in., $8; 1-in., $16; 2-in., $50; for 100 to 500 meters, discount 10 per cent; 500 or more, discount 20 per cent. D. J. Mahoney, local manager. Standard Waterworks Co., Sapphire meters, ⅝-in., $8.87½; 1-in., $22.50; five-year guarantee; William H. Garrettson, president. National Meter Co., Crown meters, ⅝-in., $12.60; 1-in., $30.80; 2-in., $65; 6-in., $500; Empire meter, ⅝-in., $10.60; 1-in., $23.30; 2-in., $60; 6-in., $400; Nash meter, ⅝-in., $8.60; 1-in., $16.80; 2-in., $50; 6-in., $375; Charles H. Ade, engineer. Union Water Meter Co., King disc meters, ⅝-in., $6.18; 1-in, $13.48; 2-in., $40.48; Columbian meter, disc, ⅝-in., $6.02; Union rotary meter, ⅝-in., $11.88; 1-in., $22.48; 2-in., $53.98; 6-in., $375.68; Nilo velocity meter, 2-in., $35.98; 6-in., $268.98. Neptune Meter Co., Trident disc meter, ⅝-in., $8.40; 1-in., $16.80; 2-in., $50; 6-in., Trident-Crest, $350. A. M. Lockett Co., Worthington disc meter, ⅝-in., $6.25; 1-in., $12.50; Turbine meter, 2-in., $37.50; 6-in., $300; all parts guaranteed for two years, even against hot weather and freezing; N. W. Finch, representative. Thompson Meter Co., Lambert meter; for 5,000 meters, ⅝-in., $7.80; 1-in., $15.12; for 7,500 meters, ⅝-in., $7.60; 1-in., $15.12; for 10,000 meters, ⅝-in., $7.40; 6-in., $15.12; any number of meters, 2-in., $45; 6-in., $337.50.

Utah.

⊙The J. P. O'Neill Construction Co. has been awarded the contract by the city of Ogden, Utah, for the construction of the conduit from Cold Water canyon to the new city reservoir through Ogden canyon for $67,463, about $1,000 below the city engineer's estimate. Other bids received were: Lynch-Cannon Engineering Co., $68,988; Moran Construction Co., $73,830; P. J. Moran, $76,747; Wheelwright Construction Co., $78,914; McKay & Reed, $82,547, and Strange & Maguire, $85,519. There will be four tunnels, averaging 100 ft. each in length, which will necessitate a considerable amount of rock work. William M. Bostaph is City Engineer.

Washington.

An election was held in Pasco, Wash., on March 6, for the purpose of determining whether the city should issue bonds to the amount of $50,000 for the purpose of purchasing a 500-acre water right for irrigation purposes from the Pasco Reclamation Co.

Representative Fred Straub has introduced a bill in the legislature at Olympia, Wash., asking for a joint municipal water system for the cities of Aberdeen and Hoquiam. A rough estimate of the cost of the project places it at $500,000, the plan including the purchase of the Hoquiam Water Co.'s property.

Wisconsin.

✣Bids will be received until March 18 by the Board of Water Commissioners, Wm. F. Voss, Secretary, Watertown, Wis., for drilling and casing a deep well.

The question of a water works for the village of Clear Lake, Wis., is being considered by the business men of that village.

⊙F. M. Gray, Jr. & Co., of Milwaukee, Wis., have been awarded the contract by the city of Madison Lake, Minn., for drilling an 8-in. well in connection with the waterworks for $4.16 and $3.25 per ft. Bids were opened March 6.

Canada.

✣Bids are asked until 8 p. m., March 27, by T. J. Godfrey, Town Clerk, Chapleau, Ont., for furnishing and erecting duplex steam pumping engine, with a capacity of 800 gals. per min., and one return tubular boiler. Chipman & Power, Engineers, 204 Mail Bldg., Toronto.

✣Bids are asked until noon, March 31, by Mayor James Clinkskill, and W. B. Neil, City Commissioners of Saskatoon, Sask., for the installation of a mechanical water filtration plant for the city. All information may be obtained on application to the city engineer.

The Canadian Government has decided to construct a dam across the ravine, just south of the town of Kindersley, Sask., for the purpose of forming a reservoir for Kindersley's water supply.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

SEWERAGE AND GARBAGE DISPOSAL

Arkansas.

Plans and [illegible] days for the construction of a sewer system in De Queen, Ark., at [illegible]. The work will include [illegible] main sewer and laterals. Petitions [illegible] improvement are now being circulated [illegible] De Queen is engineer.

California.

Plans are being prepared [illegible] Stew[illegible] of [illegible], Cal., [illegible] construction of a new sewer system for that town at an estimated cost of $90,000. The work will include 52,800 ft. of 6-in., 14,800 ft. of 8-in., 8,300 ft. of 10-in., 5,200 ft. of 12-in., and 15,000 ft. of 4-in. pipe, 191 manholes, [illegible] flush tanks, and concrete septic tank. The contract will be let in about two months.

The city of Winters, Cal., has awarded the engineering work for the construction of a sewer system to Haviland & Tibbet, Alaska Commercial Bldg., 310 Sansome St., San Francisco, Cal. An election will probably be held in the near future to vote the issuance of bonds for this improvement. R. Morrison, Winters, is in charge of the work.

City Engineer Althouse of Porterville, Cal., has completed plans for the construction of a modern system of sewerage disposal for the town of Terra Bella, Cal. Two large septic tanks are planned, and all of the mains, tanks and disposal works are being drawn on a scale to handle the sewage for a city of 2,000 people.

The drainage and sanitary committee of the city council of Oakland, Cal., has recommended the creation of a sewer district to be known as the Elmhurst sewer district. It is probable that an election will be called shortly to vote on the issuance of bonds to the amount of $100,000 for the construction of the sewers.

Colorado.

◉The Westcott-Doan Investment Co. of Denver, Colo., has been awarded the contract by the city council of Colorado Springs, Colo., for the construction of the storm sewers in the recently created paving district for $31,561.

The city council of Colorado Springs, Colo., has instructed Commissioner Lawton to advertise for bids for the extension of the sanitary sewer in the business district. The work will cost approximately $[illegible].

Connecticut.

✣Bids will be received by the highway committee, Putnam, Conn., until 4 p. m., March 24 for Sewer Contract No. 5, the work including 600 ft. of 24-in. pipe, 300 ft. of 20-in. pipe, 1,080 ft. of 15-in. pipe, 600 ft. of 12-in. pipe, 1,700 ft. of 10-in. pipe and 7,900 ft. of 8-in. pipe. Geo. W. Perry, engineer of sewers, Putnam, Conn.

The board of apportionment of Bridgeport, Conn., has adopted a resolution providing for the issuing of not more than $100,000 in bonds for sewer improvements. Plans for these improvements were prepared by Engineer Rudolph Hering, 170 Broadway, New York City. The first part of the sewer construction will include building a trunk sewer in the East End and another sewer in the West End, the purchase of sites for pumping stations and the building of a trunk sewer in the North End. It is planned to add to this system each year.

Georgia.

Plans have been prepared for the construction of new sewers in Camilla, Ga., at an estimated cost of $150,000. The contract will be let some time this summer. T. B. Perry is mayor.

Illinois.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, City Hall, Chicago, until 11 a. m., March 18, for furnishing and delivering manhole and catch basin [illegible].

The following is the approximate quantities of the castings that will be required, to be delivered to the Pipe Yard located at the west end of the Chicago avenue bridge: 70 manhole [illegible] 7,[illegible] lbs.; 300 manhole lids, 45,000 lbs.; 20 manhole lids, 22½ ins. in diameter, 3,000 lbs.; 20 catch basin curbs, 8,200 lbs.; 20 catch basin lids (perforated), 2,800 lbs.; 10 lawn cover curbs, 980 lbs.; 40 lawn cover lids, 1,680 lbs.; 40 inlet grate boxes, [illegible] 6,300 lbs.; 10 curved grates, 800 lbs.; to be delivered to the city's pipe yard located at 69th and Peoria streets; 40 manhole curbs, approximate total weight [illegible] lids, 1,500 lbs.; 10 manhole lids, 22½ ins. in diameter, 15,000 lbs.; 20 catch basin curbs, 8,200 lbs.; 20 catch basin lids (perforated), 2,800 lbs.; 10 lawn cover curbs, 980 lbs.; 10 lawn cover lids, 420 lbs.; 10 inlet grate boxes, 1,600 lbs.; 60 standard grates, 5,400 lbs.; 10 curved grates, 800 lbs. Approximate totals for both yards, 64 7/10 tons manhole and catch basin covers or their parts, 2 tons lawn covers or their parts, 10 6/10 tons inlet grate boxes and standard and curved inlet grates. Quantities less than, or not to exceed 150 per cent, of the above may be required and are to be furnished at contract price. The castings shall be of tough [illegible] and free from [illegible]ing defects, shall be true to form, thoroughly clean and shall conform strictly to specifications. The castings shall be subject to inspection and test at any time required by Commissioner of Public Works. Contractor, after the award of contract, shall be allowed 15 days to prepare patterns and 10 days after requisition shall deliver such castings as are called for up to June 30, 1911. Full plans and specifications may be had upon application to the Commissioner of Public Works. Cash to the amount of $500 or certified check on a responsible bank doing business in Chicago must accompany proposal.

✣Bids are asked until 8 p. m., March 23, by the board of local improvements of Wheaton, Ill., for an extension of the sewer system from a point in the center of College Ave. to Howard St. A. L. Webster, city engineer, Wheaton, Ill.

✣Bids will be received until 7:30 p. m., March 16, by the board of local improvements of West Dundee, Ill., Ernest Luther, secretary, for the construction of a system of sanitary sewers.

◉Frank Payne of Danville, Ill., has been awarded the contract by the city of Paris, Ill., for the construction of a storm sewer for $14,980. The sewer will be of reinforced concrete. Other bids received were: Goodwin & Ryan, of Springfield, Ill., $15,709, and the Fehr Construction Co., Chicago, Ill., $26,787.

Consulting Engineer H. D. Hallett, Aurora, Ill., has completed plans and specifications for the installation of a sewer system in the town of Plainfield, Ill. Bids will probably be received the latter part of April.

The board of local improvements of Wheaton, Ill., has passed an ordinance for the construction of a larger outlet for the present drainage system and for the extension of the system. The estimate of cost is as follows: 2,890 ft. of 60-in. cement pipe, at $5.50 per ft., $15,895; 642 ft. of 42-in. cement pipe, at $3.95 per ft., $2,535.90; 2,790 ft. of 36-in. cement pipe, at $3.40 per ft., $9,486; 2,744 ft. of 30-in. tile (taken from Main St.), $1 per ft., $2,744; 900 ft. of 24-in. tile (to be taken up), at $1 per ft., $900; 142 ft. of 21-in. tile, new pipe, at $2 per ft., $284; 22 manholes, $25 each, $550; extra labor crossing tracks, $500. Cost, including digging trench, constructing or laying pipe to grades, hauling, back filling and all other labor, $32,894.90. A. L. Webster is city engineer.

The board of local improvements of Joliet, Ill., has passed ordinances providing for the construction of a sewer in Seeser St., and Raynor Ave., from Marion St. to Washington St.

The board of local improvements of Galva, Ill., advises the installation of north and south side sewers and laterals. Lloyd Z. Jones is city engineer.

Indiana.

The board of public works of Muncie, Ind., has adopted a resolution calling for the construction of a local sewer in Howard St., from the intersection of Franklin and Howard Sts., to within 70 ft. of High St.

Iowa.

◉The city council of Corydon, Ia., has awarded the water and sewerage contract to Basch & Gray of Joplin, Mo., for $40,000. The work is to be completed within 60 days.

The city council of Cascade, Ia., has awarded the contract to make the survey for the proposed sewer system in the business section of the city to R. S. Chase of Clinton, Ia. The survey of the entire town is to be taken in order that future extensions of the system may be made. It is proposed at present to install about 4,000 ft. running through the alleys of the main business section of the town.

The city council of Waterloo, Ia., has appointed a committee to go over the proposed route of the Virden Creek sewer, preparatory to calling of a special election to vote on the bonds for the work. It is estimated that the proposed sewer will cost around $12 per ft., and will figure up in the vicinity of $100,000 completed.

Kansas.

✣Bids are asked until noon, March 31, by Capt. J. E. Normoyle, Constructing Quartermaster, Fort Leavenworth, Kan., for the construction of a 24-in. outfall sewer, approximately 8500 ft. long, of which approximately 2,400 ft. is to be c. i. pipe. Plans and specifications may be seen at Fort Leavenworth, also at Depot Quartermaster's Office, St. Louis, and Quartermaster's Office, Scarritt Arcade, Kansas City, Mo.

The city of Salina, Kan., contemplates building about two miles or more of sewer this spring at a cost of about $12,000. The following extensions are being considered by the council: On Park from 10th to College; on Baker, Walnut to Spruce; on 11th, south to Washington; on Highland, Crawford to Claflin; on Claflin, Santa Fe to Fourth; on Johnstown, Front to Penn Ave.; on Penn, Iron to Ash; on Ash, between blocks 6 and 7; down alley in block 6, from Ash to a point north of Elm St.

Maryland.

Following bids were received by the Sewerage Commission, Calvin W. Hendricks, chief engineer, Baltimore, Md., on Sanitary Contract No. 64, Water Piping and Steam Heating in the Sewage Pumping Station: Louis F. Andrae Co., 10 E. Perry St., Baltimore, $3,052 (informal); Wanner Steam & Hot Water Heating Co., 112 South St., Baltimore, $3,100; Crook, Kries & Co., Baltimore, $4,061; Enterprise Steam & Hot Water Heating Co., 407 N. Howard St., Baltimore, $4,968.

The citizens of [illegible], Md., [illegible] voted the issuance of bonds to the amount of $40,000 for the construction of a sewer system. The work includes a disposal plant.

Michigan.

City Engineer Ed. F. Johnson of Virginia, Minn., has completed plans and specifications for the construction of a trunk sewer in the southern part of the city of Ishpeming, Mich. This district will cover about nine blocks. Bids for the construction of this sewer will be called for within a short time.

The city council of Allegan, Mich., has decided to lay a sewer on Depot Hill on the north side.

✣ indicates work now open for bids. ◉ indicates a contract let recently.

Missouri.

[illegible] trict. The new district will include all prop- [illegible] railway The estimate made from the preliminary survey shows the cost will not exceed [illegible]

The citizens of Paris, Mo., will be asked to vote on the proposition of issuing bonds to the amount of $15,000 at the April election, for the purpose of constructing a sewerage system.

A bill has been introduced in the city council of St. Louis, Mo., by Councilman Schneiderhahn, to submit to the people at the spring [illegible] district north of Forest Park.

The North St. Joseph Improvement club, St. Joseph, Mo., recently held a meeting in Gleaves' Hall St. Joseph and Shady Aves., to take up the question of district sewers, extension of the street lighting system and other [illegible]

Nebraska.

City Engineer Adna Dobson of Lincoln, Neb., has estimated the cost of laying the 8-in. sewer in the alley between M and N Sts. [illegible]

New York.

•The [illegible] supply of Rochester, N. Y., has awarded the contract for the construction of Section 1, of the intercepting sewer, to be built in connection with the new sewage disposal system, to F. A. Botsch, Jr., for $142,370. This contract includes the construction of a tunnel under the Genesee River at Central Ave.

The assembly committee on affairs of cities of the state senate, Albany, N. Y., has reported favorably on the bill providing for the building of a sewer system in Oswego, N. Y. The bill was amended to provide that the work be done by contract; that the bonds are not to be sold until the contract is let, and that an expert engineer be employed to plan and supervise the building of the sewer. John Fitzgibbon is mayor.

The intercepting sewer bill, which authorizes an additional bond issue of $350,000 to complete the improvements undertaken by the Syracuse Intercepting Sewer Board, Syracuse, N. Y., has been passed by the state senate, Albany, N. Y. The contract for the northern section of the Harbor brook intercepting sewer will be awarded as soon as the bill becomes law.

The board of public works of Watertown, N. Y., plans to call for bids soon for the construction of the First Ward trunk sewer so that construction work can be started by May 1. Earle W. Sayles is city engineer.

City Engineer John A. Giles of Binghamton, N. Y., has made plans and estimates at $8,500 the cost of the proposed storm water sewer in the First ward. The sewer would drain Mygatt and Elm Sts.

Ohio.

Plans are being prepared by Riggs & Sherman, the Nasby, Toledo, O., for the construction of a sewer system and sewage disposal for the city of Pleasant Ridge, O.

Riggs & Sherman, consulting engineers, the Nasby, Toledo, O., have prepared plans for the installation of a sewage disposal plant for Delaware, O.

[illegible] state board of health has just approved the plans prepared by Riggs & Sherman, 613 the Nasby, Toledo, O., for a sewage disposal plant for the city of Bucyrus, O., and construction will be undertaken this summer.

Plans have been completed by Riggs & Sherman, consulting engineers, 613 the Nasby, Toledo, O., for the construction of a sewer system and sewage disposal plant for the city of Bryan, O. Bids will be received during the early summer.

The Riggs & Sherman Co., consulting engineer, 613 the Nasby, Toledo, O., has prepared plans for the construction of a sewage disposal plant for the city of Bellefontaine, O., for which bids will be received about June 1. The contract for the two sections of sewers, about 12 miles in length, has already been let.

The city engineer of Findlay, O., has been instructed to prepare an estimate for plans and specifications for the sewer which is to be constructed west on Sandusky St., to Floral Ave., thence north to Lauren Ave., and west to Wilson Ave., thence north to High St., and from there west to connect with the Blanchard St. sewer.

The city council of Springfield, O., has authorized the issuance of bonds to the amount of $41,825, and also for the starting of laying sewers in other sections.

The mayor and service director of Cincinnati, O., are securing data in an investigation of the advisability of constructing a municipal reduction plant, when the present contract with the Cincinnati Reduction Co. expires in June, 1913.

Oklahoma.

⊙The Chickasha Extension Co., of Chickasha, Okla., has awarded the contract for the extension of the water and sewer service to University Heights addition and sewer service to University Heights addition to Hamilton Bros. The contract calls for 3,000 ft. of water mains and 3,500 ft. of sanitary sewer. The work will cost approximately $5,000.

Oregon.

Louis C. Kelsey, Selling Bldg., Portland, Ore., has been engaged as consulting engineer in the designing and construction of a sanitary sewerage system for the city of Newport, Ore. F. B. Davis is city engineer.

Plans have been completed for the Laurelhurst extension of the Sullivan Gulch sewer district, in Portland, Ore. This branch starts at East 39th St., in Sullivan's Gulch and passes through a tunnel to the southwest corner of Laurelhurst. The sewer will be 6 ft. 6-in. by 5 ft. 7½ in. It will be of concrete, with vitrified brick invert, and will cost $153,000. The first section of the Sullivan's Gulch sewer district will be built between the Williamette river and East 39th St., and will cost $250,000. The conduits of the district will cost about $1,000,000. J. W. Morris is city engineer.

Pennsylvania.

Dr. Samuel G. Dixon, state health commissioner, Harrisburg, Pa., has given the borough authorities of West Chester, Pa., permission for the construction of the proposed disposal plants and the laying of outfall sewer mains leading thereto. The work will begin as soon as possible.

Director of Public Service Joseph G. Armstrong, of Pittsburg, Pa., will advertise for bids at once for the improvement of the Try St. sewerage system. The sewer will be 5½ ft. in diameter, and will be constructed of concrete or brick. It will drain all the territory between Bluff St. on the south, Center Ave. on the west, Dinwiddie St. on the east and Ross St. on the west. The council recently authorized a bond issue of $144,000 for this work.

Chester & Fleming, of Pittsburg, Pa., have been employed by the Liggett Spring & Axle Co., of Monongahela, Pa., to prepare plans and specifications for the installation of a sewage disposal plant for the company's works and houses at Monongahela.

The citizens of Carlisle, Pa., on Feb. 21, vote the issuance of bonds to the amount of $99,000 to begin installing sewerage and north and south side drainage.

South Carolina.

The ways and means committee of the city council of Charleston, S. C., has sold bonds to Guild & Co., of Chattanooga, Tenn., in the sum of $40,000 for the immediate extension of the new sewerage system into the northeastern section of the city. Guild & Co. will also construct the sewers.

Texas.

The town of Rockdale, Tex., contemplates issuing bonds for the construction of a sewerage system.

The city council of Cameron, Tex., has authorized the committee to advertise for bids for putting in the sewerage system.

The city council of Cuero, Tex., will probably install a sewerage system at an estimated cost of $10,000. F. R. Perkins in interested.

Wisconsin.

✣Bids will be received until 2 p. m., March 24, by board of public works, Burlington, Wis., P. J. Hurtzen, City Engineer, for furnishing all the labor and materials necessary to make and fully complete the following: Storm sewers, together with all necessary manholes, street inlets, etc., and sanitary sewers. The work includes 1,250 lin. ft. of 15-in vitrified pipe sewer, 338 lin. ft. of 12-in. vitrified pipe sewer, 478 lin. ft. of 10-in. vitrified pipe sewer, 290 lin. ft. of 8-in. vitrified sanitary sewer, 7 manholes, 18 10-in. ¼ bends.

✣Bids will be received until 10:30 a. m., March 18, by the department of public works of Milwaukee, Wis., H. E. Briggs, commissioner, for (1) constructing brick and pipe sewer in Rogers St., (2) brick and pipe sewer in Burnham St., (3) pipe sewer in 24th Ave., (4) pipe sewer in 23d Ave., (5) pipe sewer in 25th Ave., and (6) pipe sewers in Lincoln Ave.

⊙John Brogan has been awarded the contract by the city of Shawano, Wis., for the construction of about 14,000 ft. of 8, 10, 12 and 15 in. sewers, for $7,600. Bids were opened March 7 by D. E. Wescott, city clerk.

⊙E. R. Harding Co., Racine, Wis., has been awarded the contract by the board of public works of Stoughton, Wis., for the construction of a complete sewerage system, containing 13¼ miles of sewer, varying from 6-in. to 18-in. pipe, and a septic tank 9x28x100 ft. The main sewer crosses the Yahara river through two cast iron inverted siphons. The contract price is $69,999. Bids were opened March 3.

Canada.

✣Bids are asked until noon, April 14, by Mayor James Clinkskill and W. B. Neil, City Commissioner, of Saskatoon, Sask, for following work in connection with an intercepting sewer: Contract No. 78, pipelaying; Contract No. 79, furnishing concrete sewer pipe; Contract No. 80, furnishing cast iron sewer pipe and specials.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Arkansas.

•L. [illegible] at $11 [illegible] constructing [illegible] jail at Bentonville, Ark.

California.

⊙Bids were opened Feb. 24 by the Board of Public Works of Oakland, for dredging a channel alongside the pier head line, west side of the north arm of the Oakland harbor, Charles Nelson, at [illegible] being awarded the contract. For the construction of a levee extension along 14th St. in the Key Route basin, the California Reclamation Co. was the low bidder at 23 cts. per cu. yd., excavated and placed. For the construc-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

tion and maintenance of levee alongside the extension of 14th St. in the Key Route basin the following bids were received: California Reclamation Co., $3,900; Marshall & Harris, $4,300.

A bill will probably be passed by the State Legislature to appropriate $80,000 for the purchase of a dredger and the opening of a [illegible] channel in the Sacramento river as far north as Red Bluff. N. Ellery, Sacramento, Cal. is State Engineer.

City officials of Vallejo have plans for a new municipal wharf to cost $30,000 to be built at South Vallejo, near the point at Carquinez straits. The wharf will be built within the next 90 days.

Colorado.

✣Bids will be received until 10 a. m., April 3, at the office of the U. S. Reclamation Service, Denver, Colo., for furnishing 130,000 bbls. of Portland cement f. o. b. cars at the works of the bidder. For particulars address the U. S. Reclamation Service, Washington, D. C., or Denver, Colo.

Connecticut.

◉[illegible] P. Cummings Construction Co., [illegible] Milk St., Boston, Mass., has been awarded a contract for remodelling and putting on additions to the mills of the Wauregan Cotton Co., at Wauregan, Conn.

District of Columbia.

✣Bids are asked until 10:30 a. m., April 10, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 625, cross and switch ties.

✣Bids will be received until 10:30 a. m., April 5, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 624, lubricating oils and greases.

Florida.

✣Bids will be received on March 29 by W. J. Snell, Architect, Lake City, Fla., for a 2-story brick bank building 95 ft. by 95 ft. to be erected for the First National Bank at Lake City.

Georgia.

✣Bids will be received until 10 a. m., April 7, by R. V. Ladow, Superintendent of Prisons, Washington, D. C., for furnishing and delivering at the U. S. penitentiary at Atlanta, Ga., plumbing, pipe, fittings, etc.

✣Bids are asked until 3 p. m., April 20, by James Knox Taylor, Supervising Architect, Washington, D. C., for the construction, complete (including plumbing, gas piping, heating apparatus and electric conduits and wiring) of the U. S. post office at LaGrange, Ga.

Illinois.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, 4th floor City Hall, for furnishing and delivering to the Bureau of Sewers the following bill of lumber (all quantities approximate only): [illegible] ft. B. M. 3x10 in. [illegible] rough; 1,000 ft. B. M. 2x12 in. [illegible]; 1,000 ft. B. M. [illegible] x16 ft.; 1,000 ft. [illegible] x16 ft.; 1,000 ft. B. M. 4x6 in. [illegible]; 1,000 ft. B. M. 6x6 in. x12 ft.; 2,000 ft. B. M. 2x4 in. x16 ft.; 3,000 ft. B. M. 1x6 in. [illegible] ft. B. M. [illegible] 1,000 ft. B. M. 1x2 in. x16 ft. S. 1 S.; 4,000 ft. B.M. 2x6 in. x16 ft. D. 2 S. and M.; all Norway pine, No. 1 common, 2,000 ft. B. M. 3x3 in. x 16 ft. long; Norway pine clear, 8,000 ft. B. M. 3x12 in. x 16 ft. long, rough, and 3,000 ft. B. M. [illegible] x16 ft. [illegible] hemlock No. 1 common, and red oak No. 1 common as follows: 2,000 ft. B. M. 3x14 in. x10 to 16 ft. long, rough; 6,000 ft. B. M. 3x12 in. x10 to 16 ft. long; 6,000 ft. B. M. 3x10 in. x10 to 16 ft.; 1,000 ft. B. M. 3x8 in. x10 to 16 ft.; 1,000 ft. B. M. 3x12 in. x10 to 16 ft. S. 1 S. to 2¾ in.; 5,000 ft. B. M. [illegible] S. 1 S. to 1[illegible] in.; 5,000 ft. B. M. 1¼x12 in. x 10 to 16 ft. S. 1 S. to 1 3-16 in.; 1,000 ft. B. M. 1½x8 in. x10 to 16 ft. rough; 1,000 ft. B. M. 1½x8 in., 12 ft. long, rough. All lumber shall be delivered as required and shall be graded according to standard adopted by lumber associations, and Norway pine and hemlock according to rules adopted by Northern Pine Manufacturers' Association and Northwest Hemlock Manufacturers' Association and oak according to National Hardwood Lumber Association rules governing same. Proposal must be accompanied by cash or certified check on some responsible bank doing business in Chicago, to the amount of two hundred dollars.

✣Bids will be received by Wm. Carroll, City Electrician, Chicago, Ill., until 11 a. m., March 23, 1911, for furnishing and delivering to the Department of Electricity 2,270,000, more or less, arc light carbons for electric use. The contract consists of the following approximate quantities: 1,500,000 14x⅝ in. copper coated carbons, 250,000 12x½ in. copper coated carbons, 5,000 12x⅝ in. plain forced carbons, 50,000 10x½ in. plain forced carbons, 180,000 12x.510 in. to .520 in. cored carbons, 180,000 12x.510 to .520 in. solid high grade carbons, 60,000 12x.510 solid high grade carbons, special gage. Proposals must be accompanied by five hundred dollars ($500.00) in money or a certified check on some responsible bank doing business in Chicago for the same amount.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., until 11 a. m., March 23, for furnishing and delivering ten steel storage tanks at the various ward yards and loading platforms. Cash or a certified check for $200 must accompany bid.

✣Bids will be received until 11 a. m., March 18, 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, 4th floor City Hall, for furnishing, delivering and unloading at the various pumping stations, pipe yards, docks and other places throughout the city, white pine, Norway pine, yellow pine, hemlock, white or burr oak, Oregon fir, maple, white wood shingles, laths, cedar posts, D. & M. flooring, siding and ceiling as shall be required for the term ending June 30, 1911. All lumber delivered shall be according to specifications on file and shall be graded according to standards adopted by the various lumber associations governing the species kind of lumber. Bids will be compared on the basis of the following approximate quantities, and the Commissioner reserves the right to award the contract as a whole or to the low bidder for each different kind of lumber. Each bidder must submit a unit price for each size of specified lumber with the understanding that the sum of the different items will not be needed in full: White pine No. 1 common boards and strips and joists, scantling and timber 1,000 ft. B. M. 1x1 in., 12 to 16 ft. long ground S. 1 S.; 2,000 ft. B. M. 1x2 in. 12 to 14 ft. long, fur strips rgh.; 2,000 ft. B. M. 1x4 in., 12 to 16 ft. long, rgh., S. 1 S., S. 2 S., S. 4 S.; 1,000 ft. B. M. 1x6 in., 12 to 16 ft.; 1,000 ft. B. M. 1x8 in., 12 to 16 ft.; 2,000 ft. B. M. 1x12 in., 12 to 16 ft.; 2,000 ft. B. M., 2x4 in., 10 to 16 ft.; 1,000 ft. B. M., 2x4 in., 18 to 20 ft.; 1,000 ft. B. M. 2x6 in., 10 to 16 ft.; 1,000 ft. B. M. 2x6 in., 18 to 20 ft.; 1,000 ft. B. M., 10 [illegible] to 16 ft.; 8,000 [illegible] 16 ft. Norway pine joists, scantling and timber No. 1: 1,000 ft. B. M. 1½x8 in., 12 to 16 ft. long, S. 1 S.; 1,000 ft. B. M. 1½x10 in., 12 to 16 ft. long, S. 2 S.; 1,000 ft. B. M. 2x8 in., 8 to 20 ft. long rgh., S. 1 S., S. 2 S., S. 4 S.; 1,000 ft. B. M. 2x10 in., 18 to 20 ft.; 4,000 ft. B. M., 2x12 in., 10 to 16 ft.; 1,000 ft. B. M., 2x12 in., 18 ft.; 1,000 ft. B. M. 2x14 in., 10 to 16 ft.; 1,000 ft. B. M. 2x14 in., 18 ft.; 1,000 ft. B. M. 3x6, 16 to 20 ft.; 1,000 ft. B. M. 3x8 in., 18 to 20 ft.; 1,000 ft. B. M., 3x10 in., 12 to 16 ft.; 6,000 ft. B. M. 3x12 in., 10 to 18 ft.; 1,000 ft. B. M., 3x12 in., 18 ft.; 1,000 ft. B. M. 3x14 in., 16 ft.; 2,000 ft. B. M. 3x14 in., 18 ft.; 1,000 ft. B. M., 4x4 in., 16 ft.; 1,000 ft. B. M. 4x4 in., 18 ft.; 1,000 ft. B. M. 4x6 in., 12 to 16 ft.; 1,000 ft. B. M. 4x6 in., 18 ft.; 1,000 ft. B. M. 4x12 in., 18 ft.; 2,000 ft. B. M. 6x6 in., 12 to 16 ft.; 2,000 ft. B. M. 6x6 in., 18 to 20 ft.; 2,000 ft. B. M. 6x8 in., 12 to 16 ft.; 2,000 ft. B. M. 6x8 in., 18 to 20 ft.; 1,000 ft. B. M. 6x8 in., 24 ft.; 12,000 ft. M. B. 8x8 in., 12 to 16 ft.; 4,000 ft. B. M. 8x8 in., 18 to 20 ft.; 2,000 ft. B. M. 8x8 in., 22 ft.; 1,000 ft. B. M. 10x10 in., 10 to 16 ft.; 1,000 ft. B. M. 10 [illegible] mouldings; 300 lin. ft. 1 [illegible] in. crown moulding, 300 lin. ft. white pine 1¾x1¾ in. bed moulding, 300 lin. ft. red oak 1½ in. E. & D. crown moulding, 100 lin. ft. red oak [illegible] in. E. & D. crown moulding, 100 lin. ft. 2½ [illegible] red oak E. & D. crown moulding, 100 lin. ft. ¾ in. red oak core moulding, 300 lin. ft. ⅝x5¼ in. maple thresholds, 300 lin. ft. ⅞x⅞ ¼ round yellow pine, 300 lin. ft. ½x⅞ in. yellow pine parting strips, 500 lin. ft. 1⅜ in. yellow pine and red oak window stops, 500 lin. ft. 1¾ in. red oak and yellow pine window stops, 100 lin. ft. 1⅜ in. red oak nosing. No. 1 common hemlock: 2,000 ft. B. M. 1x4 in., 12 to 16 ft. long, rgh.; 2,000 ft. 1x6 in., 12 to 16 ft. long, rgh.; 10,000 ft. B. M. 1x12 in., 12 to 16 ft. long, rgh.; 10,000 ft. 2x10 in., 16 ft. long, rgh.; 2,000 ft. B. M. 2x12 in., 16 ft. long, rgh.; 10,000 ft., 2x4x16 ft. long, rgh.; 1,000 ft. B. M. 2x6 in., 16 ft. long, rgh.; 1,000 ft. B. M. 2x4 in., 12 to 14 ft. long, rgh.; 6,000 ft. B. M. 4x4 in., 16 ft. long, rgh.; 1,500 ft. B. M. 6x6 in., 12 to 16 ft. long, rgh.; 10,000 ft. B. M. 3x12 in., 16 ft. long, rgh.; 5,000 ft. B. M. 1x12 in., 16 ft. long, rgh. Clear White wood. 1,000 ft. ½x12 in. and wider, 12 to 16 ft. long, clear, S. 2 S.; 1,000 ft. 1x12 in. and wider, 12 to 16 ft. long, clear, S. 2 S., clear maple; 1,000 ft. 6x6 in., 12 to 16 ft. long, clear S. 2 S.; 1,000 ft. 2x8 in. and wider, 12 to 16 ft. long, clear. Bids are also asked for furnishing 40,000 ft. B. M. of various sizes of No. 1 common white oak or burr oak, 108,000 ft. B. M. of No. 1 common pine, 8,000 ft. B. M. of clear Oregon fir, and a considerable quantity of other timber.

✣Bids will be received until 10 a. m., March 23, 1911, by Chas. F. Seyferlich, Fire Marshal, Chicago, for furnishing and delivering 40,000 ft. more or less of 2½ best quality of seamless mildew proof rubber lined cotton fire hose with couplings attached. Proposals must be accompanied by a 50 ft. sample of hose to be furnished.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, 4th floor City Hall, Chicago, Ill., until 11 a. m., March 18, for furnishing and delivering pine lumber to each of 35 ward yards located throughout the city. All lumber shall be of best quality, rough, common No. 1 Norway pine lumber, live and sound, free from wind shakes, worm holes, loose and decayed knots, and have square straight edges. Grading shall be according to rules adopted by standard lumber associations. Following is the approximate quantity of lumber required: 12,000 ft. B. M. 2x4 in., 25,000 ft. B. M. 2x6 in., 25,000 ft. B. M. 2x8 in., 50,000 ft. B. M. 2x10 in., 25,000 ft. 2x12 in., 5,000 ft. 4x4 in., 5,000 ft. B. M. 4x6 in., 25,000 ft. B. M. 1x4 in., 6 in., 8 in., 10 in. or 12 in. All lumber to be delivered in 10, 12, 14, 16, or 18 ft. lengths as required. All lumber to be delivered before June 30, 1911, unless the Commissioner of Public Works elects to extend the contract 90 days. Proposal shall be accompanied by cash or certified check on a responsible Chicago bank to the amount of $[illegible]

✣Bids will be received until 12 m., March 23, 1911, by Chas. F. Seyferlich, Fire Marshal, Chicago, for furnishing and delivering 18 steam fire engines, more or less, to the City of Chicago. Bidders shall enclose in their proposal complete drawings of engine in all its parts, showing clearly the construction and setting of boilers, pumps, grates, pattern of grates and all details of appurtenances, openings connections and operating parts. The boiler of engine shall be designed for an ordinary working pressure of 140 lbs. of steam gage pressure and shall be tested under hydrostatic pressure of 275 lbs. per sq. in.; boilers shall be of sufficient capacity to operate continuously pumps of a sufficient capacity to pump 700 U. S. gallons of water against a pressure of 160 lbs. per sq. in. and maintain a steam pressure of 140 lbs. per sq. in. The engine shall have 2 steam cylinders, size to be stated in bid. Pumps are to be cast in 1 piece and to be double acting, to be 4¾ ins. in diameter, 8-in. stroke, to be of double leather cup type and made of bronze. Axles to be made of best quality open hearth steel and to be 3 ins. in diameter. Wheels to be of best qual-

✣ indicates work now open for bids. ◉ indicates a contract let recently.

[illegible] engine 9,700 lbs. and minimum not less than 9,000 lbs. Equipment for engine shall include various and sundry articles, usually furnished with such. Each engine must be accompanied [illegible] the engine will show when tested out under [illegible] Full specifications may be had upon application to Fire Marshal, Chicago, Ill.

Surveys have been completed for a dam on the Fox River at Millhurst, Ill., and plans [illegible] Hallett, Aurora, Ill., is the engineer

Kentucky.

✣[illegible] vey, U. S. Engineers, Cincinnati, O., for con-[illegible] River, near Ashland, Ky., have been rejected and new bids are being asked until 2 p. m., [illegible] were given in our issue of March 1.

Lousiana.

✣Bids will be received until noon, March 21, by Capt. Clarke S. Smith, U. S. Engineer, Vicksburg, Miss., for furnishing 4,300 bbls of cement delivered near Monroe, La.

✣Bids are asked until 11 a. m., April 6, by Maj. H. Burgess, U. S. Engineer, for furnishing about 60,000 tons of rock for bank revetment.

Maryland.

✣Bids are asked by James Knox Taylor Supervising Architect, Washington, D. C., until 3 p. m., April 6, for the painting and decorating of the U. S. Post Office, Court House, etc., at Baltimore, Md.

New York.

✣Bids are asked until 2:30 p. m., March 21, by Mr. J. Drummond, Commissioner of Charities, foot of E. 22d St., New York City, for furnishing all the labor and materials required for the erection and completion of bridge connecting main hospital building with the annex (west of main building); also complete heating, ventilating and plumbing systems in the annex, Kings County Hospital, borough of Brooklyn, the city of New York. Blank forms and further information may be obtained at the office of Frank J. Helmle, Architect, 190 Montague St., Borough of Brooklyn, the City of New York.

✣Bids will be received until 2 p. m., March 20, by Henry S. Thompson, Commissioner of Water Supply, Gas and Electricity, New York City, for furnishing and delivering rubber goods, lumber, valves, charts, bolts and nuts, brass goods, gauges, electrical supplies, drafting room supplies, hardware, cotton waste, rope, forage, chloride of lime, sulphate of copper, etc.

✣Bids are asked until 11 a. m., March 20, by C. B. Snyder, Superintendent of School Buildings, Park Ave. and 59th St., New York City, for alterations, repairs, etc., at public schools 4, 13, 14, 19, 20, 25, 35, 40, 47, 50, 63, 79, 91, 104, 122, 140, 160, 161, 174, truant school and Stuyvesant high school, Borough of Manhattan.

✣Bids are asked until 10 a. m., March 27, by Lieut. J. J. Thomas, Constructing Quartermaster, Fort Adams, R. I., for the construction of a set of quarters for four officers at this post (lump sum bids including plumbing, heating, wiring and fixtures). Plans and specifications can be seen at Fort Adams and in office of chief quartermaster, Governor's Island, N. Y., or will be sent on deposit of $5 at Fort Adams to insure safe return.

✣Bids will be received until 11 a. m., April 10, by Lt. Col. J. G. Warren, U. S. Engineer, 540 Federal Bldg., Buffalo, N. Y., for channel excavation, Niagara River.

South Dakota.

✣Bids are asked until March 18 by the Farmers Co-Operative Co., Henry Kurtenbach, Secretary, Ethan, S. Dak., for building a 30,000 bus. capacity grain elevator and flour house attached size 18x28, and coal sheds, 7 bins 10x14.7 ft. posts, at Dimock, S. D. Plans and specifications can be seen or procured of Henry Kurtenbach, secretary, Ethan, S. D. Bids not to include grading and gravel and sand hauling.

Texas.

✣Bids are asked until 10 a. m., March 23, by R. L. Daniels, Victoria, Tex., for the erection of a brick church building at Victoria. Hull & Praeger, Architects, Victoria, Tex.

✣Bids are asked until noon, March 23, by by Edgar Odell Lovett, President, 1110 Scanlan Bldg., Houston, Tex., for the following contracts, connected with the administration building and mechanical laboratory and power house of the William M. Rice Institute, at the site of the Institute on Main St. in Houston, Texas: First, for the plumbing and gas piping. Second, for the electrical wiring and electrical installation. Plans, details and specifications may be obtained upon application at the office of the architects, Messrs. Cram, Goodhue and Ferguson, Scanlan Bldg., Houston, Texas. Every application must be accompanied by a deposit of $50 in favor of the architects, which will be refunded upon the return of the drawings and specifications.

✣Bids are asked until noon, March 31, by Maj. G. P. Howell, U. S. Engineer, Galveston, Tex., for dredging Galveston Channel, Tex.

✣Bids are asked until 2 p. m., March 22, by the School Board of Conroe, Tex., for the construction of a 2-story brick school building. Plans and specifications can be seen or secured from school board, Conroe, Tex., and in the office of Taylor & Wolf, architects, Fort Worth, Tex. Certified check for $300 required with bid.

Canada.

✣Bids are asked until 1 p. m., March 18, by D. McNaughton, President Bruce Municipal Telephone System, Underwood, Ont., for the construction of a telephone system in the townships of Bruce, Saugeen, Greenock, Kincardine and Elderslie, in the county of Bruce, Ont. Plans and specifications may be seen and forms of tender obtained at the office of W. L. Bland, Kincardine, Ont., and at the office of the Engineer, George J. Beattie, 72 Victoria St., Toronto.

SANITARY AND SURFACE DRAINAGE SEWERS.

Sealed bids will be received by Oscar B. Bonar, City Clerk, until the twenty-first (21) day of March, at the hour of 10 o'clock a. m., 1911, and then publicly opened and read, for the furnishing of all materials and laying complete, including trenching, backfilling, etc., 26 miles of sewers, varying in size from 6-inch to 36-inch in diameter, together with 420 manholes, 6 lampholes, 8 flush tanks, 115 inlets and catch basins, and 22 tons of cast iron pipe.

Bids will be received for both vitrified pipe and monolithic concrete for all sewers, 24 inches in diameter and larger.

The depths of trenches vary from 5 feet to 32 feet.

Specifications, instructions to bidders and blank forms of bidding sheets may be obtained, and plans and profiles may be seen at the office of Oscar B. Bonar, City Clerk, Moundsville, W. Va., or at the office of Chas. E. Collins, Consulting Engineer, Drexel Building, Philadelphia, Pa.

All proposals shall be made on the blank forms furnished by the city for this purpose and shall be accompanied by a certified check upon the First National Bank of the City of Moundsville, W. Va., and drawn to the order of Oscar B. Bonar, Clerk of the City of Moundsville, W. Va., for the sum of one thousand dollars ($1,000).

The City Council reserves the right to reject any and all bids.

OSCAR B. BONAR, City Clerk.
J. M. WILLIAMSON, Mayor.
Moundsville, W. Va.

WATERWORKS.

Helena, Mont.

Sealed proposals will be received at the City Hall, Helena, Mont., until 8 p. m., Thursday, April 20, 1911, for furnishing of all material and the construction of a waterworks system, reservoir pipe line, and distribution system for the City of Helena, Mont., all according to plans and specifications.

The work involves headworks with concrete core wall, and approximately 11 miles of 18-in. wooden conduit, 7.4 miles 24-in. wood conduit, 0.8 miles 24-in. steel conduit, 43.4 miles of cast-iron mains, 260 hydrants, 283 gate valves, specials, etc., and a storage reservoir, lined with concrete, to hold approximately five million gallons, together with all appurtenances, using about 2,800 cu. yds. of concrete, and requiring about 79,000 cu. yds. class (A) excavation, 12,000 cu. yds. class (B) excavation, 222,000 lineal feet class (A) trenching, and 16,000 lineal feet class (B) trenching.

Plans and specifications, also forms of contract and proposals, may be seen at the office of the City Clerk, J. A. Mattson; also at the office of the City Engineer, Charles W. Helmick, and copies thereof obtained upon payment of $5.00.

Each bid must be accompanied by a certified check for $20,000.00, payable to the Mayor of Helena, Mont., as a guarantee that bidders will, if successful, promptly execute a satisfactory contract and bond, as specified and required, with satisfactory surety in the sum of one hundred and fifty thousand dollars, for the faithful performance of the contract.

The right is reserved to reject any or all bids, and also to waive any technical defects.

Bidders are invited to be present. Proposals must be marked "Proposals for Construction of Water Works System for Helena, Mont.," and must be made out in the form within, and be accompanied by the printed specifications.

By order of the City Council.

J. A. MATTSON,
City Clerk.

Dated, 1911.
First publication, 1911.

PAVING AND SIDEWALKS.

The undersigned will receive sealed proposals until 5 o'clock p. m., March 20 1911, for constructing the following:

35,319 sq. ft. of concrete sidewalks, to be let in five contracts. Each bid to be accompanied by a certified check for $50.00.

4,718 lin. ft. of combined concrete curb and gutter. Each bid to be accompanied by a certified check for $100.00.

15,226 sq. yds. of asphalted macadam pavement, to be let in two contracts. Each bid to be accompanied by a certified check for $100.00.

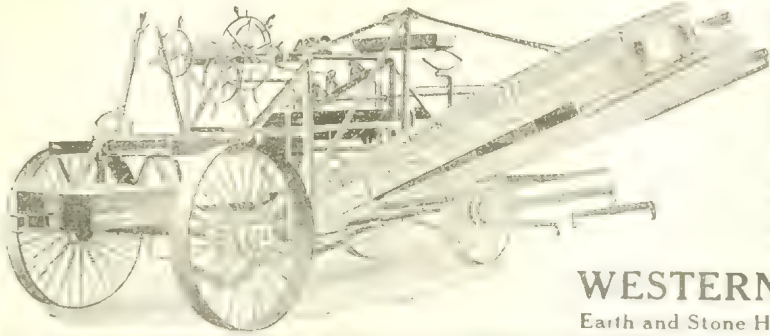
All work to be done according to the plans and specifications on file in the office of the City Clerk. All work to be paid for in special tax-bills issued against the lots and parcels of ground liable therefor.

A. J. McKENZIE,
City Engineer.

Webb City, Mo.

Washington, D. C., Feb. 25, 1911.

Sealed proposals will be received at the office of the U. S. Reclamation Service, North Yakima, Wash., until 10 o'clock a. m., April 15, 1911, for the building of Kachess dam and accessory structures near Easton, Wash. The work involves the excavation of approximately 345,000 cubic yards of material, the placing of about 240,000 cubic yards of embankment, 15 000 cubic yards of riprap and paving, 8,000 cubic yards of concrete, and 300,000 pounds of reinforcing steel, and other items necessary to complete the work. For particulars address the United States Reclamation Service, Washington, D. C., or North Yakima, Wash. R. A. BALLINGER, Secretary.



Dependable in The Hardest Kind of Service

Greatest strength, [illegible] requires only one man besides the driver.

These are strong assertions but they are proved facts in reference to the

Western Elevating Grader

[illegible] standard for efficiency [illegible]

Let us tell you about these proved quality Graders. They will save you money. Complete catalog for the asking.

WESTERN WHEELED SCRAPER CO.

Earth and Stone Handling Machinery AURORA, ILL.

STORAGE DAM.

Salt Lake City, Utah.

Sealed proposals [illegible] the Pacific Reclamation Company, at the office of their Consulting Engineer, George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah, until noon [illegible] April 15, 1911, for the [illegible] Storage Dam about fifteen miles north of Wells, Nevada.

The dam [illegible] with a reinforned concrete facing on the up-stream side. The [illegible] are:

20,000	cu. yds. earth excavation
3,000	cu. yds. rock excavation.
71,000	cu. yds. earth embankment
6,000	cu. yds. dry rubble wall.
1,250	cu. yds. Portland cement concrete.
85,000	lbs. steel reinforcing.

A certified check for $2,500.00 must accompany the bid, and a bond of $15,000.00 will be required for the faithful performance of the contract.

Form of proposal, contract and specifications may be had by applying to George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah.

PACIFIC RECLAMATION COMPANY,
[illegible]

George M. Bacon,
Consulting Engineer.

PAVING.

Red Oak, Iowa, Feb. 28, 1911.

Sealed proposals for approximately six thousand [illegible] in cut, twenty-five thousand four hundred and eleven (25,411) yards, brick block paving, three thousand three hundred and twelve (3,312) yards of concrete paving, nine [illegible] three hun[illegible] straight curb, will be received by the City Clerk of the City of Red Oak, Iowa, up to 10 o'clock a. m., on the 15th day of March, 1911, at which time the proposals received will be opened and will be acted upon at 8 o'clock p. m. the same day. City Council reserves the right to reject any or all bids. Plans and specifications can be had [illegible] of Red Oak, [illegible]

RICHARD ROBERTS, City Clerk.

CONCRETE.

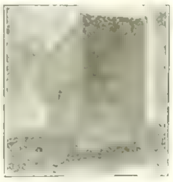
Sealed proposals [illegible] at the office of the undersigned in the City of Bozeman, Mont., until 5 o'clock p. m. on the 16th day of March, 1911, for the laying of concrete on the side slopes and bottom of the enlarged reservoir of the Bozeman City Water Works, amounting to about 4,840 square yards, in accordance with the plans and specifications therefor on file at this office.

Blank "proposals," copies of "specifications" and instructions to bidders may be obtained of the City Clerk or of the City Engineer.

Each bid must be accompanied by a certified check for two hundred dollars ($200.00) upon some bank in Bozeman, Mont., payable to the City Treasurer of said city, which check will be forfeited to the said city in case the successful bidder shall fail to furnish satisfactory bond and enter into the proposed contract within ten (10) days from the date of notification of award.

The City of Bozeman reserves the right to reject any and all bids.

A. M. BRENDENBURG,
City Clerk,
[illegible]



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Easy to Load

Light and Smooth Running

Tip Car

THIS car is built with the body hung between the wheels and is nearly a foot lower than the ordinary tip car making it much easier to load. Six sizes, 12 to 40 cubic feet, kept in stock.

Write us for Further Information and for Bulletin.

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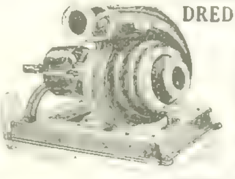
New York City, 45 Broadway
Chicago, 616 Fisher Building
Atlanta, Ga., 10? Rhodes Building
Richmond, Va., State Bank Building
San Francisco, 865 Monadnock Bldg.

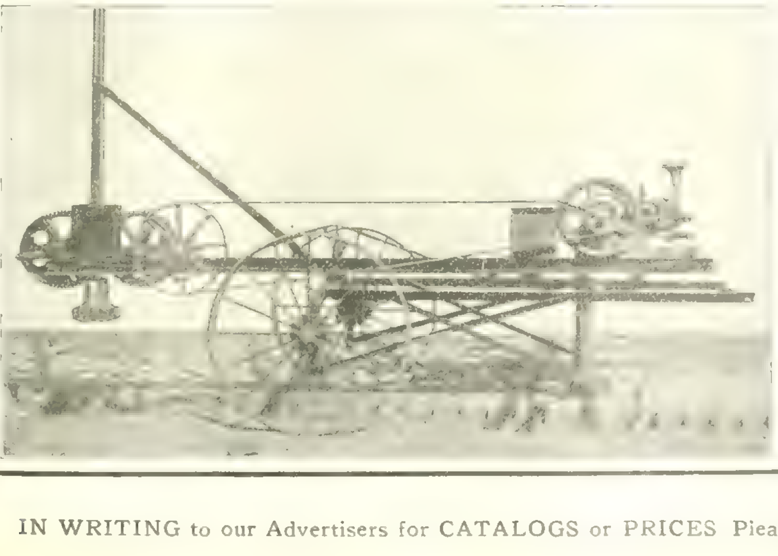


DREDGING—IRRIGATION

Write [illegible] the BUSH IMPROVED CENTRIFUGAL PUMPS used by some of the biggest contractors and dredging companies.

Greaves Specialty Mfg. Co.
154 Nassau St., N. Y City

MISSISSIPPI RIVER [illegible] Engineer Office, Room 20, Custom House, Memphis, Tenn., Feb. [illegible], 1911. Sealed proposals [illegible] this office until noon, Mar. 22, 1911, and then publicly opened. Information on application [illegible] CLARKE S. SMITH, Cont. Engrs.



This Tamping Machine will do the Work of 6 to 10 Men

The STALEY Power Tamping Machine

obviates all controversy about back-filling. No more sinking of trenches. Pavements can follow immediately over trenches that have been tamped by this machine without danger of future depressions. [illegible] concrete construction, paving, sewer work, etc.

[illegible]

R. H. STALEY

Box 229 Springfield, Ill.

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WANTED [illegible] Guy F. [illegible] Ky. 11-2t

WANTED—Position as experienced time-keeper and commissary clerk combined. Expert accountant and pay-roll man. Location no object. F. J. Keenan, 1439 Chestnut St., Terre Haute, Ind. 11-2t

GENERAL CONTRACTING and civil engineer with extensive New York, Canadian and English experience seeks position where energy, tact and ability will be recognized. Expert estimator, supervisor and designer. Box S, care of Engineering-Contracting, New York, N. Y 11-3t

YOUNG I. C. S. STUDENT wishes position with surveying corps. Not experienced, but a willing worker. Situation immaterial. Roy Hannums, State Hospital, Norristown, Pa. 11-2t

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An [illegible] young man (29) would [illegible] $2,500 [illegible] has present experience with large firm he could point out cheaper methods of construction or leaks in your business.

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WANTED—Competent building superintendent for reinforced concrete work in South. Answer with references stating the size and character of last three or four jobs handled and system of reinforcement used therein, and salary expected. Address Box 652, care of Engineering-Contracting, 355 Dearborn St., Chicago. 11-4t

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WANTED — Information regarding Tommy Lee age, 14. Last heard from in Salt Lake His father is very sick. Address Jas. J Lee, St. Margaret's Hospital, Kansas City, Kans 9-4t

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WANTED—To know the whereabouts of my father, John Mansfield (called Jack). Last heard from him about a year ago. Was working for Maney & Wells Bros. at Palisade, Nev. Address W. H. Mansfield, Ashland, Kans. **11-1t**

TO LET—About 40,000 yards of ditch excavation. For particulars wire or write Mulville Bros, Alton, Ill. 11-8t

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A Collateral Item of Engineering Society Work.

The very large amount of useful practical work being done by the American Railway Engineering and Maintenance of Way Association is well known to railway engineers. We wish to call attention here to a collateral, perhaps a minor, item of this work which is of wide general service. We refer to the careful bibliographies of books and articles which are published in connection with the society's technical reports. The character of these bibliographies is perhaps best indicated by referring to a specific example. The report of the association's committee on roadway for this year contains an indexed bibliography of books and articles on waterways for culverts. There are 8½ pages of this index and upward of 200 books and articles are named. This bibliography is perhaps a little exceptional in size among those published by the society, but they are all remarkably complete. It is not necessary, we think, to insist on the usefulness of these lists of references. They are of just the character of information for which engineers are constantly asking. There is hardly a passing week that does not bring such an inquiry to this journal which more often than not cannot be answered with satisfaction. Sometimes there is no literature bearing on the specific subject inquired about, but more often there are articles and books which would be a great service could they be named without a long search through scores of volumes of periodic publications. So far as its interests extend the American Railway Engineering and Maintenance of Way Association is conducting these searches. We believe that it is not the least useful of its excellent technical work.

The Present Status of Litigation Involving the Cameron Septic Process.

While the present tendency in the East is to break away from the Septic Tank method of sewage purification, either with or without subsequent filtration of septic effluent, such tanks are still being extensively built in the West and Middle West. Due to the commendable activity of the various State Boards of Health it is likely that more sewage purification plants will be constructed during the present year than in any preceding year. If one may accurately judge from advertisements of new constructions that have so far appeared, the majority of the smaller cities expect to use so-called septic tanks as important parts in their methods of sewage disposal. To all engineers contemplating the recommendation of such tanks to their clients this question will naturally occur: "How about the Cameron patent?" Probably few engineers have followed this famous litigation in detail, although a great deal has been printed in the technical journals concerning it. Accordingly we are giving the following very brief review of the chief points in the case.

The Cameron patent was taken out in the United States Oct. 3, 1899, for "Process of and Apparatus for Treating Sewage." The ordinary term of life of seventeen years would have kept this patent in full force and effect until Oct. 3, 1916. However, the British patent for the septic tank expired Nov. 9, 1909. Under section 4887 of the Revised Statutes the patent expired in the United States at the same time it did in England. The Cameron Company, however, point out that the International Treaty of Brussels, which went into effect Sept. 14, 1902, abrogated the older statutory provision and freed every then existing United States patent from dependence, as to duration, on any foreign patent. The validity of the patent was first contested and later its duration.

The validity of the patent was contested in the Saratoga Springs case in which the Cameron Company sued the village of Saratoga Springs, N. Y., for infringement of patent. This case was tried before the United States circuit court of appeals, second circuit. The defense was that the patent was invalid, first, because the process was not entirely new and, second, because the process was a natural one and therefore not patentable. The court ruled against the defense on both of these points, the opinion on the second point being that "the process involved the use of one of the agencies of nature for a practical purpose," and was therefore [illegible] the validity of the patent.

Now as to the life of the patent. Before Nov. 8, 1909, the Cameron Company brought suit in the U. S. Circuit Court for the Southern District of Iowa against the city of Knoxville. The defense in this case was that the U. S. patent expired Nov. 9, 1909, because the British patent for the same invention expired on that day. The Cameron Company contended that the Brussels treaty applied to this case. The plea of the defense was sustained by the court and the suit ordered dismissed. From this order an appeal was taken to the supreme court of the United States and is still pending in that court. This case will not reach a hearing until the October term of court in 1912 and the decision may not come until some time in 1913. Since the supreme court is the final arbiter of all matters involving the application of an international treaty, the question of whether or not the Cameron patent in the United States expired Nov. 9, 1909, or is to expire Oct. 3, 1916, will not be answered until the supreme court decides on that point some time in 1912 or 1913.

Meanwhile new suits for infringement of this patent are not being started. The Cameron Company asks 5 per cent of the gross cost of plant for future use during the life of the plant, and 3 per cent of the gross cost of plant for each year of past use. The cost of plant includes contact beds where they are used in connection with a septic tank.

In case the supreme court decides that the patent will not expire until Oct. 3, 1916, the validity of the patent may again be tested. However, since the court of appeals held that the patent is valid, there would seem to be small chance of proving it invalid unless new evidence not introduced in the Saratoga case can be found.

It seems that the object of the Cameron Company in asking 3 per cent for each year of past use and only 5 per cent for all future use is to force municipalities to settle up early so as to avoid the danger of constantly increasing liability for past infringement. In the event that the supreme court's decision is favorable to the Cameron Company they can very likely collect the 5 per cent for future use since enough cities have already paid that to establish it as a measure of damages. It is very unlikely that any such amount as 3 per cent per annum for past infringements can be collected since such a measure of damages has not been established by a sufficient number of such payments.

The Value of the Engineering Experiment Station.

Not a great many generations ago our principal industry,—farming,—was carried on with primitive methods. People lived off the soil and did not have more than they could individually produce. The necessities of today were then luxuries, possessed by few. The education of the farmers came gradually with the increase in transportation facilities, with the co-operation from other sources of activity, with the Agricultural Schools and Agricultural Experiment Stations.

Engineering has progressed in a somewhat similar way. The College of Engineering is the outgrowth of a need for scientific building and operation, and the Engineering Experiment Station is an index which points out the correct methods to follow as we move along.

The Engineering Experiment Station is, however, a comparatively new institution. The only institution in connection with a state university is the one at the University of Illinois, which has been in existence eight years. Its work in the past eight years has been of incalculable value to the engineering profession and to the people as a whole.

From the experiments in reinforced concrete carried on at the Experiment Station the public now has accurate and valuable data which had not heretofore been obtainable. One of the great railroads operating in the middle west, which is spending many hundreds of thousands of dollars in concrete work, has recently been able, by the aid of the data secured through the work of the Experiment Station, to adopt a more economical form of construction. This form, although new, is adopted with full assurance as to the ultimate result.

The experiments carried on in the interests of manufacturers have served equally as well. A large [illegible]

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for coal, was able to make a more economical purchase, in securing a grade of coal better suited to their purpose because of data developed at the Experiment Station. These economies, it must be noted, affect the individual business concerns first, but whatever economy is effected in manufacturing or in transportation or in any line of business, will ultimately be enjoyed by the people.

Again if it is possible for the Experiment Station to show to the satisfaction of coal mine operators the value of a proposed improvement in operation whereby mine wastes will be reduced and the output per man be increased, it would be an immediate benefit to the miners, but the ultimate effect would be to reduce, or at least to keep down, the cost of fuel.

In its work of making accurate tests of bridges and other engineering structures in the field the Experiment Station is performing a service which will ultimately result in greater safety to the public. Its experiments along the lines of gas for power purposes are very useful and its experiments in pneumatics and aeronautics will provide new and authentic data for scientific use.

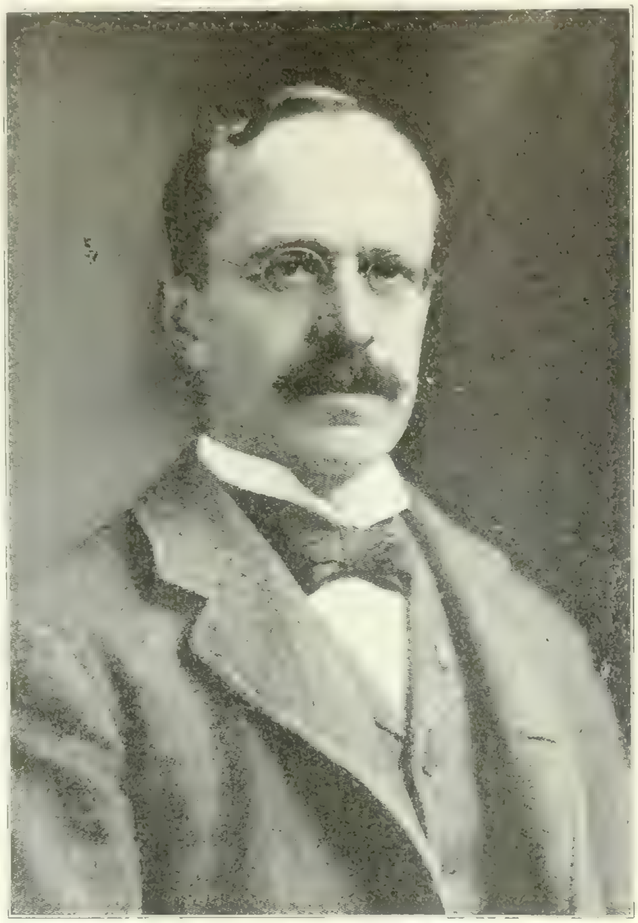
The Engineering Experiment Station not only renders its services to the engineering profession directly, and to the public, but it renders a great service to the university with which it is connected. While the student works at his routine tasks his professor works beside him on problems of greater significance, and though the student may not understand all he sees, he is in a wholesome atmosphere of industry. The professor cannot continue day after day to impart knowledge to his students without carrying on a systematic inquiry for knowledge on his own behalf. The Experiment Station, then, means as much to the professor as to the student and to the university as much as it does to the public. The Experiment Station not only develops the information which it seeks but distributes its bulletins to the public and in this way the university becomes immediately profitable and useful to the people who support it. The use of the equipment of the engineering laboratories and shops for experiments with practical problems, which would otherwise be in service only a portion of the time, increases the efficiency of the equipment. The cost of performing the valuable work done by the Experiment Station is reduced to a minimum. In no other way could it be done as cheaply, and it is doubtful if, under other circumstances, a large part of the work could be done at all. The work done is of such a nature that it would not be required in specific cases. The cost of doing the work for any specific case would prohibit it. That is why the Experiment Station should continue to devote itself, as it has in the past, to things of general use,—to subjects which would not be undertaken by any individual or firm, but which will be of benefit to all.

The Experiment Station deserves credit for the work it has accomplished. It has made its way into a permanent existence and it has, without ever having been a luxury, become a necessity to the engineering profession.

Never cut a shaft so small that all work to be done in it cannot be readily accomplished without being cramped for room. The manway and pump-compartment particularly should be of liberal size, as it must contain the ladders, the compressed-air and ventilating pipes, water column, and sometimes also a steam-pipe. The pump must also be handled in this compartment, and to have to work in a cramped position is far from economical. It were better by far to make the shaft an additional two feet in length.

William C. Cushing.

William Channing Cushing, the incoming president of the American Railway Engineering and Maintenance of Way Association, was born at St. John, New Brunswick, on March 18, 1863. He was graduated from the University of New Brunswick with the degree of Bachelor of Arts in 1884. In the following year he entered the Massachusetts Institute of Technology, graduating from that institution in 1887 with the degree of Bachelor of Science. In the same year the degree of Master of Arts was conferred upon him by the University of New Brunswick.



W. C. Cushing

Mr. Cushing entered the service of the Pennsylvania Lines West of Pittsburg in 1887, becoming assistant on engineer corps on the Louisville division, and has served continuously in various capacities with that system until the present time. In January, 1889, he was appointed division engineer of the Cincinnati and Muskingum Valley division, and in August, 1890, was transferred as division engineer to the Indianapolis division. He remained in this position until June, 1894, when he became division engineer of the Pittsburg division.

After serving for six and a half years in this capacity Mr. Cushing was promoted in January, 1901, to the superintendency of the Pittsburg division. In January, 1902, he became superintendent of the Eastern division. In January, 1903, he was appointed to his present position, that of Chief Engineer of Maintenance of Way of the Southwest System. In this position Mr. Cushing has executive charge of all maintenance of way and engineering work on this system, and many important improvements have been carried out under his supervision.

A large part of Mr. Cushing's work has been that of an executive officer. But in spite of this fact, he has found time to take an active part in the work of engineering societies, particularly that of the American Railway Engineering and Maintenance of Way Association, of which he has been a member since its organization in 1899. He has contributed largely to the technical journals and to the publications of the technical societies. His most notable writings have been on subjects relating to maintenance-of-way work and materials. In this line he has done a great amount of original investigation and research, and his writings on these subjects are recognized as being of the greatest value.

Important among his contributions to technical literature are the following, published by the American Railway Engineering and Maintenance of Way Association: "Protecting and Water-Proofing Solid Floor Bridges," Bulletin 64; "Comparative Value of Cross Ties of Different Materials," Bulletin 75; "A Study of the Stresses Existing in Track Superstructures and Rational Design Based Thereon," Bulletin 80; "The Track Superstructure of American Railways"; "Stresses in Track Fastenings"; "The Question of Screw Fastenings to Secure Rails to Ties," and "A Study of Failed Rails" (1911). Two years ago his translation of M. Cuenot's work on "Track Deformations" appeared.

Mr. Cushing is a charter member of the American Railway Engineering and Maintenance of Way Association, and has served continuously on various committees and in official capacities. He has been a member of the Signal, Rail, Tie and other committees. In 1905 he was vice-chairman of the Committee on Signals and Interlocking. Later he became chairman of the sub-committee on Rail. In 1906 he was elected a member of the Board of Directors of the association, serving in that capacity for three years. In 1906 he was elected second vice-president; and in 1910 first vice-president.

In 1910 he was appointed by the Pennsylvania company as a delegate to the International Railway Congress, and took an active part in the proceedings of the congress.

Mr. Cushing is also a member of the American Society of Civil Engineers, the American Society for Testing Materials, the International Society for Testing Materials, the New York Railroad Club and the Société des Ingénieurs Civils de France.

Railroad Electrification in Chicago and in New York.

In our issue of Feb. 22, 1910, we reviewed a paper by Mr. Paul P. Bird, chief smoke inspector of the city of Chicago, giving the results of an exhaustive investigation and analysis of the smoke nuisance in that city. In this paper it was shown that railroad locomotives are responsible for 43 per cent of the smoke produced in the city, and that they produce over one-half of the dirt. The conclusion reached in the paper was to the effect that electrification offers the only final and satisfactory solution of the smoke problem.

Since that time an ordinance has been introduced into the City Council by the Local Transportation Committee, designed to force immediate action in the matter of electrification. Fortunately for all concerned no definite action was taken on this ordinance. Its scope can be judged from Section 1, which is as follows:

> Be it ordained by the City Council of the city of Chicago, that after the first day of January A. D. 1913 every railroad company shall operate and propel any and all cars or trains of cars along, across, over or under any and all streets within the city of Chicago by other power than that of steam or in a manner that will not produce smoke or any noxious gases that injuriously

affect the public health, comfort or convenience.

It will be noted that electrification is not specifically mentioned. It is evident, however, and, in fact, it is well understood, that city-wide electrification is the purpose of this ordinance. An astonishing feature of the ordinance is the time allowed the railroads for getting into position to operate electrically. The date of the ordinance is Feb. 6, 1911, and the date after which the terminals are to be operated "by other power than that of steam" is Jan. 1, 1913. No precedent exists for such an undertaking in electrification as this. Actual construction would necessarily be preceded by an immense amount of preliminary investigation and planning, and even of experiment, as the requirements of such an undertaking are far in advance of the present state of the art. Construction would require a period, not of months, but of years. For accomplishing all this the ordinance allows 23 months.

For the purpose of illustrating the extent and intricacy of this problem of electrification we publish elsewhere in this issue a paper describing the terminal situation in Chicago, with a map showing the principal yards, main lines, belt lines and transfer tracks that lie within what is known as the Chicago Switching District. It is no exaggeration to say that this district is the greatest and most complex railroad center in the world. On account of the numerous joint ownerships and trackage agreements that involve this entire district, and because of operating requirements, electrification could not end at the city limits. It would be necessary to include the entire switching district. This would mean the electrification of nearly 5,000 miles of track, or the equivalent of a single track railroad from Boston to San Francisco. Engineers would regard the electrification of such a transcontinental main line as a formidable undertaking. That would be a simpler problem, however, than the electrification of the Chicago Switching District. Nor could electrification end at the limits of this switching district. As a matter of operating necessity every railroad entering Chicago would be compelled to operate its entire terminal division electrically.

The success of the New York Central electrification in New York City has been used as an argument to prove the feasibility of electrification in Chicago. That improvement, with necessary reconstruction and changes in track arrangements, cost in the neighborhood of $75,000,000. Large as this undertaking was, it was about equivalent to electrifying the Chicago terminal of the Illinois Central, assuming that the Illinois Central had no freight yards, did no transfer business with other roads, and did not operate over the St. Charles Air Line and other transfer lines—in short, assuming that it did nothing but a straight in-and-out passenger business. Only the passenger terminal of the New York Central is operated electrically. Its freight line, extending along the Hudson River as far south as 29th St., with two yards and a freight house, is operated by steam.

The electrification of the New York Central was brought about, not to eliminate the smoke nuisance in the city, but for the safety and comfort of passengers in passing through the Park Ave. tunnel. Tunnel operation has been, in fact, the reason for every important railroad electrification yet attempted.

Operating requirements have made necessary in each case of electrification, the establishment of a terminal division operated electrically, and the same thing would be necessary for every railroad entering Chicago. The New York Central is operated electrically to North White Plains on its Harlem division, and to South Croton on its Hudson division, division points situated respectively 24 miles and 32.7 miles from the Grand Central Station.

The terminal situation in New York City is a simple one as compared with that in Chicago. The real railroad terminal system for New York City is located in Jersey City, and in adjoining cities lying along the west side of the Hudson. From these terminals freight destined to New York City is transferred by car ferry to docks along the Hudson or East River, and then teamed to its final destination. The fact that New York City has no smoke problem, as such a thing is understood in Chicago, is due to this favorable condition, and not to the electrification of the New York Central passenger terminal.

Electrification in Chicago would be mainly a matter of electrification of freight terminals. But no important freight terminals have ever been electrified. There is no precedent, no accumulated experience to serve as a guide in carrying out the undertaking. No one knows what it would cost; but it would undoubtedly cost in the hundreds of millions. Ultimately the public would have to pay for it; for, aside from their earnings, the railroads have no means of paying. Whatever tentative plans may have been proposed, no one knows for a certainty how it would be done, or whether it could be done at all in the present state of the art.

At the present time there are only three types of electric installation to be considered: storage battery locomotives, third rail transmission, and overhead transmission. Storage battery locomotives have not yet been developed to the point where they can be depended upon to meet the heavy requirements of terminal operation. The third rail, even though protected as in the New York Central installation, would be a constant menace to the lives of switchmen working in busy yards. For overhead transmission intricate net works of conductors would be necessary that would be exceedingly dangerous in case of breakage. Furthermore, it is more than doubtful if it would be commercialy practicable to transmit in this way sufficient power for operating busy freight terminals.

We call attention to these difficulties for the reason that hasty action would be exceedingly unfortunate. It would be an impossibility to meet the requirements of the ordinance. If the railroads were compelled to attempt it, the result would be a crippling of the terminal service, a thing of vital importance to the industrial life of the city. Before definite action can be taken, a great amount of investigation and experiment is necessary. After all other details are worked out, the cost must be determined, and the question as to whether it is worth the cost decided. Before taking definite action it would also be well, from an operating point of view, to experiment for a time on some terminal or system of terminals smaller than the Chicago Switching District.

CONCRETE AND REINFORCED CONCRETE SECTION

Cost of Concrete Work on Three Small Tanks at Lincoln Park Playground and Zoo, Chicago.

The work considered is the construction of concrete pits or tanks, two of which are used for the animals in the zoo and the other being a wading pool for children, with a small wall enclosing a sand court adjacent to one end of the pool.

The work at the sea lion pit consisted in the construction of a new concrete floor and small walls. The total amount of concrete in the work was 40 cu. yds. The cost follows:

Labor		Per cu. yd.
Engineering	[illegible]	[illegible]
Foreman [illegible]	[illegible]	0.106
Teams, [illegible] at $4.00	[illegible]	[illegible]
Common labor, [illegible] days at	[illegible]	[illegible]
Carpenters, [illegible]	[illegible]	[illegible]
Total labor	[illegible]	[illegible]
Material:		
Lumber	[illegible]	[illegible]
Cement, [illegible] bbls. at [illegible]	[illegible]	[illegible]
Sand, [illegible] yds. at [illegible]	[illegible]	[illegible]
Gravel, 18 yds. at $1.50	[illegible]	[illegible]
Expanded metal [illegible] at $0.02½	[illegible]	[illegible]
Total material	[illegible]	[illegible]
Grand total	[illegible]	[illegible]

The concrete work done in the coon pit amounted to 30 cu. yds. and the den was faced with granite. The cost of the work follows:

Labor.	Total.	Per cu. yd.
Engineering, 5 days at [illegible]	[illegible]	[illegible]
Engineering, 11 days at [illegible]	[illegible]	[illegible]
Foreman, 5 days at $3.25	16.25	0.542
Teams, 3 days at $4.00	12.00	0.400
Common labor, 97½ days [illegible]	[illegible]	[illegible]
Carpenters, 24 days at $4.80	[illegible]	3.840
Mason, 1 day at $4.50	4.50	0.150
Blacksmith, ½ day at $5.00	2.50	0.083
Total labor	$398.65	$13.288
Material:		
Cement, [illegible] bbls. at [illegible]		
Cement, hydrolithic, [illegible] bbls. at $6.00	$ [illegible]	$ [illegible]
Gravel, 24 cu. yds. at $1.50	36.00	1.200
Torpedo sand, 12 cu. yds. at $1.65	19.80	0.660
Granite, 2 cu. yds. at $6.00	12.00	0.400
Steel	15.20	0.507
Acid, brushes, etc.	5.25	0.175
Tools	11.02	0.367
Total material	[illegible]	[illegible]
Grand total	$561.92	$18.73

The wading pool consisted of a concrete elliptical basin of 62 ft. and 49 ft. diameters, with an area of 2,386 sq. ft. The floor was built 6 ins. thick and contained 43.2 cu. yds. The floor was sloped to a depth of 2 ft. in the center. The concrete in this work was mixed with a Cube mixer. The costs of the work were as follows:

Labor.	Total.	Per cu. yd.
Engineering	[illegible]	[illegible]
Foreman	[illegible]	[illegible]
Common labor, 39⅝ days at $2.	79.25	1.834
Total labor	[illegible]	[illegible]
Materials:		
Cement, [illegible]	[illegible]	[illegible]
Gravel, 27 cu. yds. at $1.65	44.55	1.032
Sand, 18 cu. yds. at $1.65	29.70	0.688
Lumber	4.50	0.104
Expanded metal and pipe	45.00	1.042
Tools	5.80	0.134
Total material	$199.75	$ 4.625
Grand total	[illegible]	[illegible]
Total cost per sq. ft.		[illegible]

Some time later in the season the above wading pool was improved by the building of a small irregular shaped wall enclosing a sand court at one end of the pool. The wall was built rectangular in cross section (6"x15") and 57 ft. in length. Its cost was as follows:

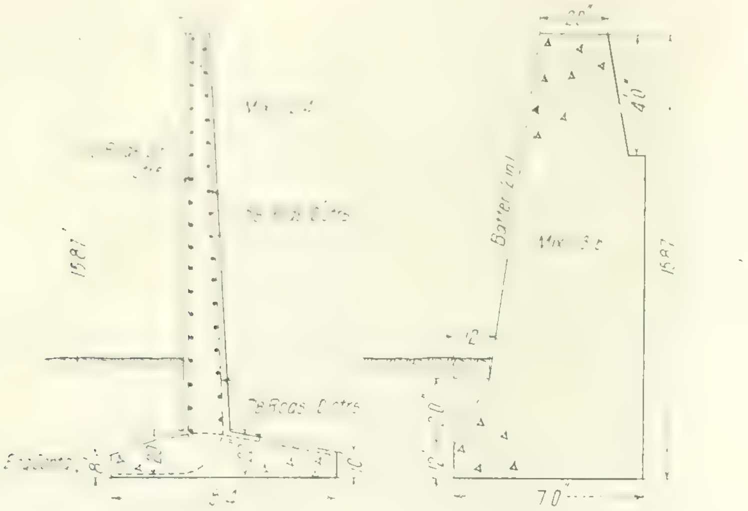
Labor:	Total.	Per lin. ft.
Foreman, 1 day at $3.00	$ 3.00	$ 0.054
Common labor, 8 days at $2.00	16.00	0.281
Finisher, 2⅛ days at $2.25	4.80	0.084
Carpenters, 2½ days at $4.80	12.00	0.210
Total labor	$ 35.80	$ 0.629
Material:		
Lumber, 250 ft. B.M. at $25	$ 6.25	$ 0.110
Cement, 6¼ bbls. at $1.35	8.44	0.149
Sand, 3 yds. at $1.65	4.95	0.087
Gravel, 5 yds. at $1.60	8.00	0.140
Tools	1.21	0.021
Total material	$ [illegible]	$ [illegible]
Grand total		$ 1.136

The work was done for the Lincoln Park System, of which Mr. M. H. West is superintendent, and Mr. Fred Howitt, engineer in charge of construction. We are indebted to them for the costs furnished.

Boring of the several tunnels on the Western Maryland's new extension from Cumberland, Md., to Connellsville, Pa., is progressing rapidly. The Pinkerton tunnel, 825 feet in length, has been completely bored through. The east and west headings were connected within the past week. The Brush tunnel, 872 feet in length, has also been opened up for its entire length. The big Savage tunnel, which will be 2,275 feet long, has been bored for 1,474 feet of this distance, while in the Borden tunnel 400 feet of the 850 feet have already been excavated. Work is being prosecuted in night and day shifts. Track laying is expected to commence by the first of April.

The Cost of a Reinforced Concrete Retaining Wall.

The Saco-Pettee Company have recently completed some additions to their shops at Newton Upper Falls, Mass., which made necessary the erection of a concrete retaining wall to sustain an earth fill 250 ft. long and some 16 ft. deep. In deciding upon the type of wall to be used, the question of cost entered largely, and the company's engineers, Messrs. Lockwood, Greene & Co., Boston, Mass., prepared estimates of cost for two different types—a reinforced concrete cantilever wall and a plain concrete wall with gravity section, Fig. 1. The cost estimates favored the cantilever design, this type promising a net saving of nearly $700.



Comparative Sections of Plain and Reinforced Concrete Retaining Walls.

The wall having been completed, the actual figures have been computed and are given below. The gravel and sand, which were of excellent quality, where hauled from a bank about one-half mile from the site of the work. Because of the large percentage of sand in the gravel, it was necessary to screen all of the latter, which resulted in a rather high cost for this material of $1.70 per cu. yd. The number of yards of concrete placed is based on the actual number of bags of cement used, the figure obtained being slightly greater than that figured for the wall itself, because of excess concrete placed in the footings over and above the actual cross sections. This yardage was allowed as follows: Actual yards of wall, 272.27; bags of cement used, 1,525; yards concrete, based on cement used, 277.27.

The actual costs of labor and material are given in the appended table. These figures include a sand floated surface which was applied to the wall after the forms had been removed.

Materials:		
1,525 bags cement at $1.70 per bbl		$ 647.13
249.54 yds. of gravel at $1.70 per yd		424.22
124.77 yds. sand at $0.50 per yd........		62.39
16.5 tons reinforcing steel at $33 per ton.		544.50
12,894 ft. B.M. lumber at $25 per M. ft..		322.35
600 lbs. wire at $4 per 100 lbs..........		24.00
Labor:		
Superintendent, 14 days at $5.33........$		74.67
Foreman, 10 days at $4.00..............		40.00
Steel helper, 4½ days at $2.50..........		11.25
[illegible]		[illegible]
[illegible], 11 days at $3.50		38.50
Carpenters, 200 days at $3.82		764.00
Laborers, 171½ days at $2.00.......		343.00
Masons, 7 days at $4.80......		33.60
Total cost		$3,336.61
Cost per yard.....	$\frac{3336.61}{277.27}$	$12.03

In connection with the actual figures obtained it is interesting to note how closely these approximated the original estimate. The total cost as figured by Lockwood, Greene & Co. for this type of wall was $3,542.50, a figure but 6 per cent higher than the actual results show. The contractors for this work were the Fiske-Carter Co., Worcester, Mass.

Simplified Reinforced Concrete Mathematics.*

BY MELVIN D. CASLER.†

ECONOMY OF PROPOSED METHOD.

The main operations involved in reinforced concrete design may be performed as rapidly as those for designing members of homogeneous material, without sacrificing in the least the accuracy of the work and without resorting to curves or tables. The equations may be simplified and made easy of application and, at the same time, mathematically correct, as is demontracted in the following pages. The methods hereinafter developed effect an enormous saving of time over the prevalent methods of computation, even when the latter are aided by the multitudinous tables and diagrams which are being offered for that purpose almost weekly by the engineering press and by trade interests.

Of equal importance with the question of time, however, is that of simplicity. The long and confusing reinforced concrete formulas with which we have become familiar lose their formidable appearance and we have no longer occasion to refer to any of the various special tables and diagrams which, in order to be complete, must cover all the various assumptions met with in current practice under varying conditions and circumstances. Such a set of tables or curves attempts too much to be easily understood except by engineers having occasion to use them quite frequently; and often leads to confusion and erroneous results if followed blindly without a true conception of the limitations of such curves and without first checking the accuracy of their construction. Moreover, much time is always lost in finding the curves applicable to any given case.

DERIVATION OF FORMULAS.

Figure 1 represents a portion of a reinforced concrete beam or arch before applying load. Figure 2 represents the same member as deflected by bending moment; the sections AB and LN, which are perpendicular to the neutral surface, KK, taking the positions $A'B'$ and $L'N'$ respectively, assuming $A'B'$ and $L'N'$ to remain plane sections after deflection. Let us assume, for simplicity, that the sections AB and LN are 1 in. apart, so that the deformations indicated by $A'B'$ and $L'N'$ will be unit deformations. Also, said deformations may be considered as being produced by the stresses developed at section AB; that is, the stresses are considered as being constant through the distance $A'L'$ and $B'N'$. A is on the tension side of the member and B is on the compression side.

In order to make the following discussion general it is first applied to a reinforced concrete member subjected to a direct longitudinal stress in conjunction with bending moment. The bending moment may be produced by a transverse loading or by an eccentric longitudinal force, F, acting at a distance, H, from the center line of the reinforcing steel as indicated in Fig. 3, or by a combination of such loadings. If F does not act at right angles to the section investigated, as is the case with F_a in Fig. 3, it is to be resolved into the forces F, acting normal to the section, and F_v acting parallel thereto and producing shear.

The following nomenclature and assumptions will be observed throughout the discussion:

D_c = unit deformation of concrete $= BN - B'N'$.

D_s = unit deformation of steel $= A'L' - AL$.

C = maximum unit stress in concrete at section AB in lbs. per sq. in.

S = unit stress in steel at section AB in lbs. per sq. in.

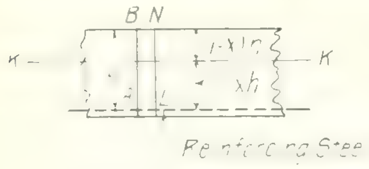


Fig. 1—Portion of Reinforced Beam or Arch Before Applying Load.

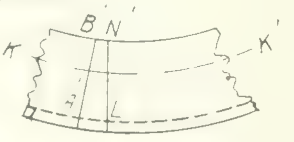


Fig. 2—Portion of Reinforced Beam or Arch After Applying Load.

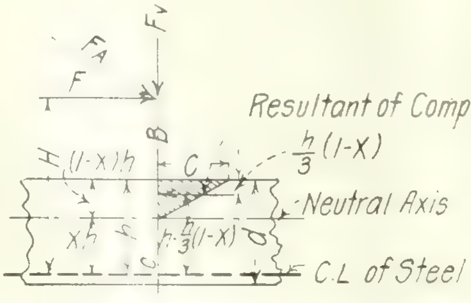


Fig. 3—Forces Applied to and Dimensions of Sec. 1.

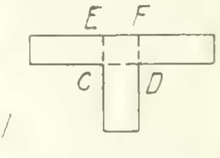


Fig. 4—Cross-Section of T Beam.

M = transverse bending moment at AB in inch lbs.

E_c = coefficient of elasticity of concrete.

E_s = coefficient of elasticity of steel.

K = $E_s \div E_c$.

b = width of beam in inches.

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*Mr. Casler has developed these designing methods as a result of several years of miscellaneous reinforced concrete work done under his direction on the new Catskill Aqueduct being built by the Board of Water Supply of New York City.—Editors.

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h = depth of beam to steel in inches as indicated in Fig. 3.

d = total depth of beam in inches as indicated in Fig. 3.

[illegible] = percentage [illegible] reinforcement = area of steel in section AB in sq. in. ÷ bh.

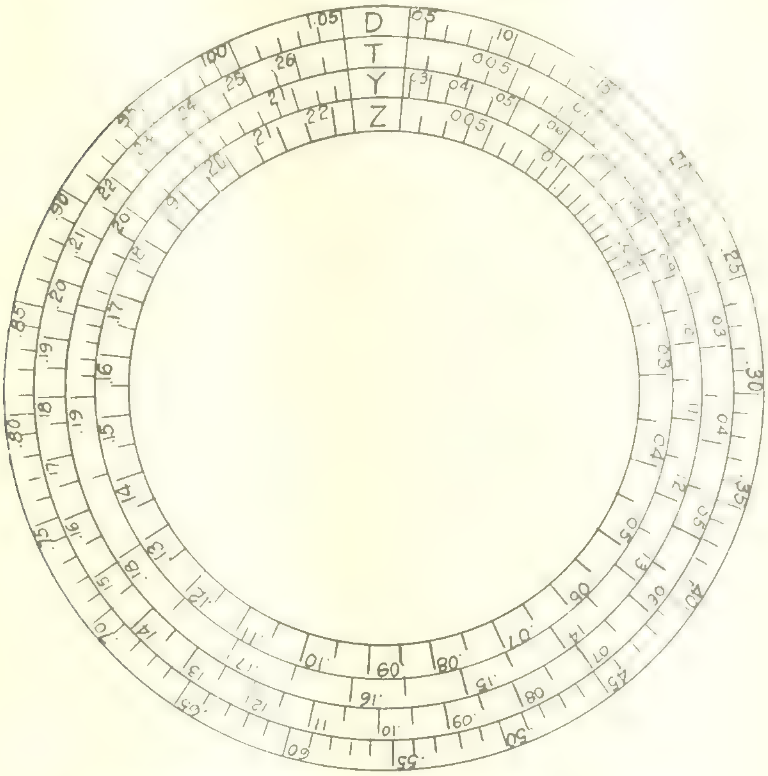


Fig. 5—Diagram Showing Ratio of D to T, Y and Z.

A = cross-sectional area of steel = pbh.

F = total direct stress normal to section AB in pounds.

H = perpendicular distance in inches between the force F and the intersection of center line of reinforcing steel with section AB.

x is a decimal coefficient as indicated in Fig. 3.

The unit concrete stress is assumed to decrease uniformly from the maximum value, C, at the compression side of member to 0 at the neutral axis.

Concrete tensile resistance below neutral axis not considered.

Plane cross-sections before deflection remain planes after deflection.

Observe the following rules as to signs: F is + when compression and — when tension. External moments tending to produce tension in the steel are considered as + moments; opposite moments are —. We will then give H the proper sign to make the sign of FH satisfy the above assumptions. Referring to Fig. 3, it is seen that these conditions give H the + sign when measured from O toward the compression side of the member and — when measured in the opposite direction.

FUNDAMENTAL [illegible]

Let us first review the fundamental relations existing between the compressive stress in the concrete and the tension in the embedded steel.

[illegible] C [illegible] and [illegible] D_s [illegible] and [illegible] $E_sC/E_cS = R\ C/S$.

Referring to Figs. 1 and 2, KK and $K'K'$ represent the neutral axis, on which $A'B'$ and $L'N'$ are the same distance apart as AB and LN. Hence it is seen that $D_c/D_s = (1\text{-}x)h/xh = 1\text{-}x/x$ ∴ $1\text{-}x/x = RC/S$ (a). This relation holds, whatever the system of loading.

NECESSARY CONDITIONS OF EQUILIBRIUM

To produce equilibrium on section AB the algebraic sum of the vertical forces acting on section AB must = 0, the algebraic sum of the horizontal forces = 0, and the algebraic sum of the moments about any point = 0. We will refer to these equilibrium conditions as conditions [illegible]

Equilibrium Condition A.

Equilibrium condition A is taken care of in the subsequent consideration of the shear [illegible]

Equilibrium Condition B.

Referring to Fig. 3 and using the nomenclature indicated above, the total compression in the concrete on section $AB = Cb\ (h\text{-}xh)/2$ [illegible]

Total tension in steel on section AB = S pbh [illegible]

Then [illegible] when tension [illegible] $Spbh$ (I).

Substituting [illegible] of S as given [illegible] $S\ R\ bh$ [illegible]

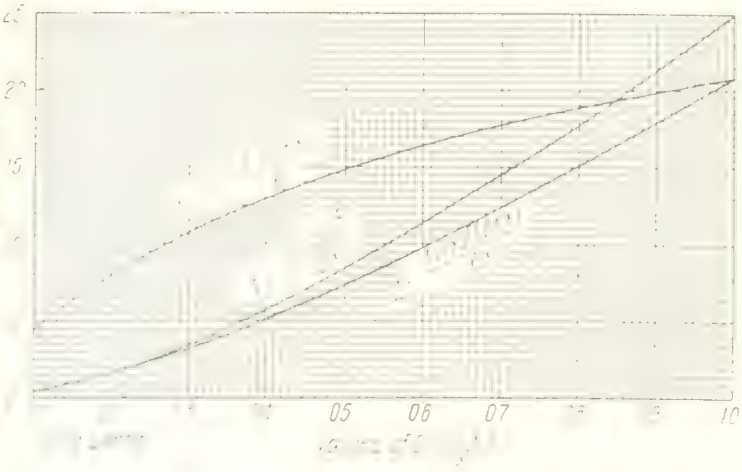


Fig. [illegible]—Diagram Showing Ratio of D to T, Y and Z.

[illegible] (III)

$(1\text{-}x)^2/2Rx = p + F/Sbh$ (IV).

Equilibrium Condition C.

Taking moments about point O, Fig. 3, and ignoring all possible tensile stress in the concrete, it is seen that the resisting moment = the total concrete compression times the arm $[h - h/3\ (1\text{-}x)]$.

[illegible] $= Cbh^2(1-x)/2\ [1-(1-x)/3]$ (VI) [illegible]

As stated before, the total external moment about the point, O, may consist of the transverse bending moment, M, or the moment, FH, or a combination of M and FH. Observing the above rules as to moment signs, as given under Table I, we may equate the external moment and the resisting moment as follows:

[illegible] (VII)

from which

[illegible] (c)

If $(M + FH)$ should be negative the steel must be placed in the opposite side of the member, all moment signs must be reversed, and the distance, H, must be correspondingly corrected by the amount $(2h - d)$.

In computing the vertical and horizontal shear and web reinforcement the shear due to transverse loading must be increased or diminished, as the case may be, by F_v.

We now have the three fundamental formulas as follows: [illegible] $(2 + x)/6 = (M + FH)/Cbh^2$ (c). Every design must satisfy all three of these formulas. Substituting in (c) the value of C in terms of S as given by (a) we have $(1 - x)$ $(2 +$ [illegible] (IX), from which $(1 - x)^2\ (2 + x)/6x = R(M + FH)/Sbh^2$ (d). For simplicity let us represent the above four functions of x as follows: [illegible] $= D$ (X), [illegible] (XI), [illegible] $= Y$ (XII) [illegible] $x)/6x = Z$ (XIII);

Then from (a) we have $D = RC/S$ (1)

from (b) we have $T = Rp + (RF/Sbh)$ (2)

from (c) we have $Y = (M + FH)/Cbh^2$ (3)

from (d) we have $Z = R(M+FH)/Sbh^2$ (4)

From these four equations we derive the following:

(5) $C = DS/R, = (M + FH)/Ybh^2$

(6) $S = RC/D, = R(M + FH)/Zbh^2$

(7) $bh^2 = (M + FH)/YC, = R(M + FH)$ [illegible]

(8) $M + FH = YCbh^2 = ZSbh^2/R$

(9) [illegible]

(10) $A = pbh$.

The above formulas apply equally to rectangular beams and T-beams if the neutral axis of the latter lies in the compression flange; b being width of flange; b, however, should not exceed ¼ of beam span. If the neutral axis of the T-beam lies in the web of same the above formulas must be altered accordingly. In the design of T-beams care must be taken to keep the unit horizontal shear on [illegible] limits.

The above equations (1) to (10) are the general equations applying to a reinforced concrete member subjected to direct stress in conjunction with bending moment. If there is no transverse moment, the term, M, vanishes. If $H = 0$ we have the direct stress acting in line with the reinforcing steel and the term FH vanishes. If there is no direct stress, $F =$ [illegible] following:

[illegible]

Fig. 7—Beam and Girder Floor System.

[illegible]

(9′) $p = T/R$

(10′) $A = pbh$.

The above equations are seen to involve operations of multiplication and division only, [illegible] enabling the work to be rapidly performed on the slide rule.

CHANGE OF STRESS QUALITY

One possible combination of loadings may call for steel on one side of a reinforced concrete member at some particular section, as AB, while another possible loading may call for steel at the other side of the section; but in the investigation of the section for either of these loadings the presence of the steel due to the other loading is usually ignored, since it is on the compression side of the member as regards the loading in question and hence can act only in compression as far as that loading is concerned. The only error involved in this treatment is a slight one on the side of safety since the steel on the compression side, instead of taking the same amount of compressive stress as an equal cross-sectional area of concrete, takes R times that stress; but the area of steel in compression is such a small fraction of that of the concrete that the error is neglible. If it is desired to take this compression steel into consideration, let A' represent the area of the steel in compression. Then RCA' = total compression taken by this steel. CA' = compression taken by an equal area of concrete. Then $CA'(R - 1)$ = compression added by the steel. Moment of this force about the point, O, Fig. 3. $= CA'(R - 1)(2h - d)$. Then $YCbh^2 + CA'(R - 1)(2h - d) = M + FH$ and equation (2) becomes $Y = (M + FH)/Cbh^2 -$ [illegible] $(R - 1)(2h - d)/bh^2$ (2c); also, equations (3) and (4) are correspondingly altered as are all those equations derived from (2), (3) and (4).

LABOR SAVING DEVICES.

Figure 5 represents the application of an idea recently conceived by the writer, which greatly facilitates the mathematical operations involved in reinforced concrete design. The device is nothing more than a series of four concentric circular scales, the graduations of which represent values of the four functions of x represented in formulas (1) to (10) by D, T, Y, and Z; viz: $(1 - x)/x$; $(1 - x)^2/2x$; [illegible] $(2 + x)$ [illegible] and [illegible] $(2 - x)/6x$, respectively. The scales of Fig. 5 are lettered to indicate the function represented by each and are so graduated that the corresponding values of the functions represented are radially opposite each other; that is, any radial line drawn from the center O will cover the corresponding values of these functions. In practice, a straight line scratched on a piece of transparent sheet celluloid serves very nicely to define this radial line. It is seen from the above that upon evaluating any one of the functions, D, T, Y, Z, the other three become known at once. The graduations of scale D in Fig. 5 are uniformly spaced. By letting the graduation of scale D represent values of the function D, the correct location of the graduations of the scales T, Y and Z are determined from Table I, the results of which are plotted in Fig. 6.

It is seen from the scales T and Z, as plotted in Fig. 5, that the corresponding values of these two functions do not differ very much from each other. For instance, when $T = .25$, $Z = .2083$; and when $T = .0045$, $Z = .0044$. It is thus apparent that we can, without very great error, assume that $T = Z$ for all values of the same and substitute one scale in place of the scales T and Z, using for the graduations of this scale the graduations of the present scale T, or those of the present scale Z, or an average of the corresponding values of T and Z. Or, taking notice that when $T = .25$, $Z = .833T$, and when $T = .0045$, $Z = .978T$, we can plot the present scale T only, and assume that Z = an average value of, say, 0.9T; or plot the present scale Z only, and assume that T = an average value of, say 1.1Z.

Figure 5 may of course be enlarged if desired, more scales may be added to represent other functions of x than the ones there shown, and the scales may be drawn to a larger scale than used in Fig. 5 and further subdivided, or extended at either end or both ends of same to increase the range of values shown.

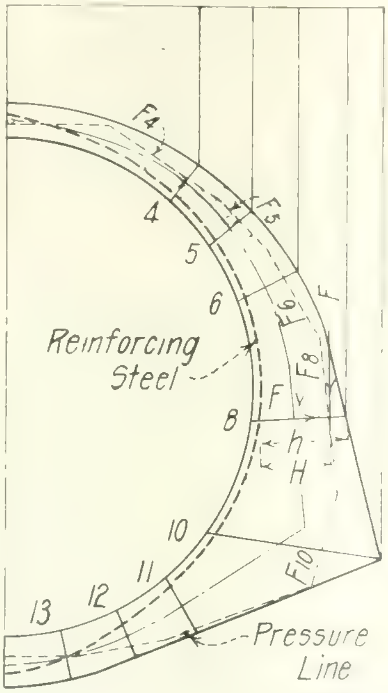


Fig. 8—Reinforced Concrete Pressure Conduit for Water.

We have here a device, perfectly general in its application, by the aid of which reinforced concrete members may be designed for any desired stresses in the concrete and steel and for any co-efficients of elasticity, without performing any mathematical operations other than those which may be rapidly read from a slide rule. It not only affords a rapid, simple means of design but with it any existing reinforced concrete member subjected to a known loading may be quickly investigated with reference to the stresses developed; and the amount of reinforcement required in a concrete beam of known dimensions can be told in a moment. The scheme can be applied not only to beams, but also to any member subjected to direct stress in conjunction with bending moment, as hereinafter demonstrated.

There are no arbitrary assumptions made in the construction of the scales, the graduations of which are located by means of exact mathematical formulas as deduced above.

The ease and rapidity with which reinforced concrete computations may be performed with the aid of these scales are apparent from the specimen problems solved below.

Table II is a great aid in the selection of the proper values of b and h to satisfy any given value of the quantity bh^2. It may also be used to advantage in the computation of bending moments produced in the various members of a floor system as demonstrated below. The construction and properties of the table are fully explained thereon.

SPECIMEN PROBLEMS.

If we wish to design a beam completely for a given moment, we of course first adopt the values of C, S and R, upon which the design is to be based. Compute D by means of equation (1). Then the corresponding values of T, Y and Z are found on scales, T, Y and Z, respectively, of Fig. 5, opposite this value of D as given by scale D. From (7) compute bh^2 by slide rule or otherwise. Knowing bh^2 select b and h from Table II. From (9) compute p. Area of steel = pbh. The beam is designed.

Let us solve the following examples of reinforced concrete beams subjected to transverse bending moment only:

Example 1.—

$M = 60{,}000$ in. lbs.
$S = 16{,}000$ lbs. per sq. in.
$C = 500$ lbs. per sq. in.
$R = 12$

Required, b, h and pbh.

Example 2.—

$M = 100{,}000$ in. lbs.
$b = 8$ ins.
$h = 12$ ins.
$R = 12$.
S is not to exceed 16,000 lbs. per sq. in.
C is not to exceed 500 lbs. per sq. in.

Required, the amount of steel reinforcement necessary, $= pbh$.

Example 3.—

$M = 80{,}000$ in. lbs.
$b = 10$ ins.
$h = 12$ ins.
Area of steel reinforcement = 1 sq in.
$R = 15$.

Required, the stresses developed in the concrete and steel.

Example 4.—

Same assumptions as for Example 3, except as to the value of M.

Required, the transverse bending moment which will stress the concrete to 500 lbs. per sq. in.; also the transverse bending moment which will stress the steel to 16,000 lbs. per sq. in.

SOLUTIONS OF SPECIMEN PROBLEMS.

Example 1.—

From (1′) $D = 12 \times 500/16{,}000 = .375$.
Hence, from Fig. 5, $Y = .124$ and $T = .051$.
From (7′) $bh^2 = 60{,}000/.124 \times 500 = 968$; whence, from Table II, $b = 7''$ and $h = 12''$.
From (9′) $p = .051/12 = .00425$
From (10′) Cross-sectional area of steel $= .00425 \times 7 \times 12 = 0.36$ sq. in.

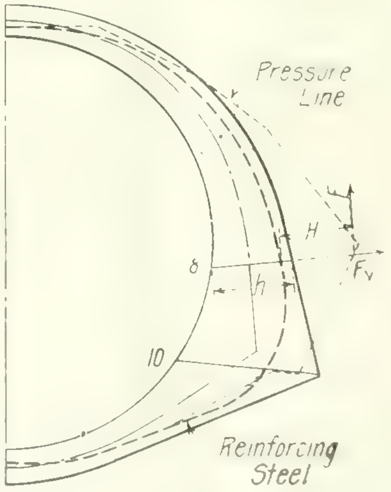


Fig. 9—Reinforced Concrete Pressure Conduit for Water.

Example 2.—

From (1′) $Z = 100{,}000 \times 12/16{,}000 \times 8 \times 144 = .065$.

TABLE I.—VALUES OF D, T, Y AND Z AS FUNCTIONS OF X

1-x	(x=1)	1/x	x	(1-x)	(2+x)	$(1-x)^2/2x = T$	$(1-x)(2+x)/6 = Y$	$(1-x)^2(2+x)/6x = Z$
.05	1/20	21/20	20/21	1/21	62/21	.0012	.0234	.0012
.1	2/20	22/20	20/22	2/22	64/22	.0045	.0441	.0044
.15	3/20	23/20	20/23	3/23	66/23	.0098	.0624	.0094
.20	4/20	24/20	20/24	4/24	68/24	.0167	.0787	.0157
.25	5/20	25/20	20/25	5/25	70/25	.0250	.0933	.0233
.30	6/20	26/20	20/26	6/26	72/26	.0346	.1065	.0320
.35	7/20	27/20	20/27	7/27	74/27	.0454	.1184	.0414
.40	8/20	28/20	20/28	8/28	76/28	.0571	.1293	.0517
.45	9/20	29/20	20/29	9/29	78/29	.0698	.1391	.0626
.50	10/20	30/20	20/30	10/30	80/30	.0833	.1481	.0741
.55	11/20	31/20	20/31	11/31	82/31	.0976	.1564	.0860
.60	12/20	32/20	20/32	12/32	84/32	.1125	.1641	.0984
.65	13/20	33/20	20/33	13/33	86/33	.1280	.1711	.1112
.70	14/20	34/20	20/34	14/34	88/34	.1441	.1776	.1243
.75	15/20	35/20	20/35	15/35	90/35	.1607	.1837	.1378
.80	16/20	36/20	20/36	16/36	92/36	.1778	.1893	.1514
.85	17/20	37/20	20/37	17/37	94/37	.1953	.1945	.1654
.90	18/20	38/20	20/38	18/38	96/38	.2132	.1994	.1795
.95	19/20	39/20	20/39	19/39	98/39	.2314	.2040	.1938
1.00	20/20	40/20	20/40	20/40	100/40	.2500	.2083	.2083
1.05	21/20	41/20	20/41	21/41	102/41	.2689	.2124	.2230

From (5′) let us see what stress this value of S puts upon the concrete.

From Fig. 5, D = 0.46.

From (5′) C = .46x16,000/12 = 613 lbs. per sq. in.

One of the conditions of this example being that we are not to stress the concrete above 500 lbs., it is apparent that we cannot use 16,000 for the steel stress for the present combination. In other words, we must use equation (3′) instead of (4′) to obtain the proper values of D, T, Y and Z.

From (3′) Y = 100,000/500x8x144 = .174.

From Fig. 5, D = .672, T = .136; Z = .117.

From (9′) p = .136/12 = .0113.

From (10′) steel = .0113x8x12 = 1.085 sq. ins.

(6′) the stress produced in the steel = 12x500/.672 = 9,000 lbs. per sq. in.; or 12x100,000/117x8x144 = 9,000.

The conclusions of the above example are, of course, that we cannot reinforce the beam in question under the conditions imposed, so as to stress the steel to more than 9,000 lbs. per sq. in. tension without compressing the concrete to more than 500 lbs. per sq. in.

Example 3.

p = 1/10x12 = .00833.

From (2′) T = 15x.00833 = .125.

From Fig. 5, D = .64; Y = .169.

From (5′) C = 80,000/.169x10x144 = 329 lbs. per sq. in.

From (6′) S = 15x329/.64 = 7,711 lbs. per sq. in.

Example 4.—

As before, T = .125; whence, D = .64 Y = .169, Z = .108.

From (8′) M = .169x500x10x144 = 121,700 in. lbs.; or .108x16,000x10x144/15 = 165,355 in. lbs.

If M = 121,700 we have from (6′) S = 15x500/.64 = 11.720 lbs. per sq in.

If M = 165,355 C = .64x16,000/15 = 680 lbs. per sq. in.

BEAM AND GIRDER FLOOR SYSTEMS.

The application of Table II to the design of a slab, beam and girder floor system will be demonstrated by a study of the example illustrated in Fig. 7.

Assumptions: Live load = 250 lbs. per sq. ft. Slabs = 50 lbs. per sq. ft.

Use c. to c. spans and neglect weights of beams and girders as applied to themselves.

Bending moment for slabs and beams = $wl^2/10$; (w = load in lbs. per lineal foot of slab or beam).

Bending moment for girders = $WL/8$; (W = total load on girder — at center); S = 16,000 lbs. per sq. in.; C = 650 lbs. per sq. in.; R = 15.

From equation (4′) D = RC/S = 15x650/16,000 = 0.609.

From Fig. 5, Y = 0.165, T = 0.115.

Slabs.—

Span = 6½ ft. Spacing = 1 ft.

From Table II M = 42.00

⅕ M = 8.40; 42.00 + 8.40 = 50.40

50.40 x 300 = 15,120 in. lbs.

From equation (7′) $bh^2 = M/YC$ = 15,120/.165x650 = 15,120/107.3 = 140

b = 12 ins. From Table II h = 3½ ins.; hence d = 4½ ins.

From equation (9′) p = T/R = .115/15 = .0077.

Steel (in top of slab over beam) = .0077x12x3½ = 0.323 sq. in. per lineal ft. of slab.

Beams.—

Span = 20 ft. Spacing = 6½ ft.

From Table II, M = 2,600

⅕ M = 520

312,000 x 3 = 936,000 in. lbs.

From equation (7′) bh^2 = 936,000/107.3 = 8723.

From Table II, b = 15 ins.; h = 24 ins.; hence, d = 26 ins.

Steel (in top of beam over girder) = .0077x15x24 = 2.77 sq. ins.

Girders.—

Span = 13 ft. Spacing = 20 ft.

Load is concentrated at center.

Weight of beam = 15x27/144x20x150 = 8,438 lbs.

Load on beam = 300x6½x20 = 39,000 lbs.

Load on girder = 47,438 lbs

M = 47,438x13x12/8 = 925,041 inch lbs.

From equation (7′) bh^2 = 925,041/107.3 = 8621.

From Table II, b = 15 ins.; h = 24 ins.; hence, d = 26 ins.

Steel (in bottom of girder at center of same and in top of girder over column) = 2.77 sq. ins. as for beams.

DESIGN OF ARCHES AND SECTIONS INVOLVING DIRECT STRESS.

Figures 8 and 9 represent a reinforced concrete conduit for carrying water under pressure. The dotted lines thereon represent the pressure, or resistance lines of same, while the heavy solid lines represent the theoretical location of the steel reinforcement as dictated by the assumed resistance lines. We will not here go into the question of the proper location of these resistance lines. A general treatment of this question with reference to both external loading and temperature stresses will be found in Van Nostrand's Science Series No. 42, Theory of Steel-Concrete Arches and of Vaulted Structures, by William Cain.

The pressure line of Fig. 8 is constructed from the following loading: External ground water pressure; earth cover on crown of arch; weight of masonry; no internal water pressure.

The pressure line of Fig. 9 is constructed from the following loading: Internal water pressure; weight of masonry; no external ground water; no earth cover.

These loadings result in the usual arch compression line in the case of Fig. 8, but in Fig. 9 the pressure line represents tensile forces as is indicated by the arrows at the crown and invert.

Let us investigate the imaginary joint, 8, with reference to the amount of steel reinforcement needed therein for each of the above loadings, keeping the concrete compression below 500 lbs. per sq. in. and the tension in the steel below 12,000 lbs. per sq. in. Let R = 12, [illegible] ins. The force acting on joint 8 is F.

Suppose it is found from the force diagram for Fig. 8 that F_s = 14,020 lbs. for a portion of the conduit one foot long. Then F_s is resolved into F = 14,000 ± lbs. producing [illegible] and H [illegible] F [illegible] lbs. producing shear on joint 8.

H in Fig. 8 = 28 ins., while h = 34 ins.

In like manner, supposing that F_s in Fig. 9 = 7,000 lbs.; F for this case = 6,000 ± lbs., while F_v = 3,600 ± lbs.; H = 35 ins. and h = 34 ins.

There being no transverse bending moment to be considered, M in formulas (1) to (10) disappears.

Let us first compute the steel called for by the assumptions of Fig. 8. Assuming that C = 500 lbs., we have from equation (3), $Y = FH/Cbh^2$ = 14,000x28/500x12x(34)² = .057; whence, from Fig. 5 we have D = .134. From (6) $S = RC/D$ = 12x500/.134 = 44,780 lbs. per sq. in. This is far too high for S. Hence we will be unable to stress the concrete as high as 500 lbs. per sq. in.

Let S = 12,000 lbs. Then from (4) $Z = RFH/Sbh^2$ = 12x14,000x28/12,000x12x(34)² = .028. From Fig. 5 D = .277, Y = .10, T = .03. From (5) $C = DS/R$ = .277x12,000/12 = 277. From (9) $p = T/R - F/Sbh$ = .03/12 — 14,000/12,000x12x34 = .0025 — .0029 = — .0004

It is thus seen that no steel is required in joint 8 for this loading. This result is brought about by the compressive effect of the direct stress. If there is no steel in the section the above computations based on its presence are erroneous. To get the concrete stress if there is no steel present we must consider the center of gravity of the concrete resistance diagram as being opposite the force, F. Disregarding any tensile resistance in the concrete we have the center of gravity of the concrete compression triangle opposite F. The area of

TABLE II

Values of bh^2 for various values of b and h, and bending moment [illegible] for load of 1 lb. per sq. ft. of floor space from formula, $M = \frac{wl^2}{12} = \frac{Lsl^2}{12}$ ft. [illegible] table w = uniform load per lineal foot of slab or beam; L = load in lbs. per sq. ft. of floor space, [illegible] For $M = \frac{wl^2}{10}$ add 1/5 of quantities given in table. For $M = \frac{wl^2}{8}$ add ½, etc., etc. For floor load of L lbs. per sq. ft. multiply these quantities by L. [illegible] slabs, figure slab as beams 12" wide spaced 1 ft. c. to c.

Effective depth of beam in inches. [illegible] feet [illegible]

	3	3½	4	4½	5	5½	6	6½	7	8	9	10	12	14	16	18	20	22	24	26
*1	9	12	16	20	25	30	36	42	49	64	81	100	144	196	256	324	400	484	576	676
*2	18	24	32	40	50	60	72	84	98	128	162	200	288	392	512	648	800	968	1152	1352
*2½	22	31	40	51	62	76	90	106	122	160	202	250	360	490	640	810	1000	1210	1440	1690
*3	27	37	48	61	75	91	108	127	147	192	243	300	432	588	768	972	1200	1452	1728	2028
*3½	31	43	56	71	87	106	126	148	171	224	283	350	504	686	896	1134	1400	1694	2016	2366
*4	36	49	64	81	100	121	144	169	196	256	324	400	576	784	1024	1296	1600	1936	2304	2704
*4½	40	55	72	91	112	136	162	190	220	288	364	450	648	882	1152	1458	1800	2178	2592	3042
*5	45	61	80	101	125	151	180	211	245	320	405	500	720	980	1280	1620	2000	2420	2880	3380
*5½	49	67	88	111	137	166	198	232	269	352	445	550	792	1078	1408	1782	2200	2662	3168	3718
*6	54	73	96	121	150	181	216	253	294	384	486	600	864	1176	1536	1944	2400	2904	3456	4056
*6½	58	80	104	132	162	197	234	275	318	416	526	650	936	1274	1661	2106	2600	3146	3744	4394
*7	63	86	112	142	175	212	252	296	343	448	567	700	1008	1372	1792	2268	2800	3388	4032	4732
*7½	67	92	120	152	187	227	270	317	367	480	607	750	1080	1470	1920	2430	3000	3630	4320	5070
*8	72	98	128	[illegible]	[illegible]	242	288	338	392	512	648	800	1152	1568	2048	2592	3200	3872	4608	[illegible]
*9	81	110	144	[illegible]	[illegible]	272	324	380	441	576	729	900	1296	1764	2304	2916	3600	4356	5184	6084
*10	90	122	160	202	250	302	360	422	490	640	810	1000	1440	1960	2560	3240	4000	4840	5760	6760
*11	99	134	176	[illegible]	[illegible]	332	396	464	539	704	891	1100	1584	2156	2816	3564	4400	5324	6336	7436
*12	108	147	192	[illegible]	[illegible]	363	432	507	588	768	972	1200	1728	2352	3072	3888	4800	5808	6912	8112
*13	117	159	208	263	325	393	468	549	637	832	1053	1300	1872	2548	3328	4212	5200	6292	7488	8788
*14	126	171	[illegible]	[illegible]	350	424	504	591	686	896	1134	1400	2016	2744	3584	4536	5600	6776	8064	9464
*15	135	184	[illegible]	304	375	454	540	634	735	960	1215	1500	2160	2940	3840	4860	6000	7260	8640	10140
*16	144	196	256	324	400	484	576	676	784	1024	1296	1600	2304	3136	4096	5184	6400	7744	9216	10816
*17	153	208	[illegible]	344	425	514	612	718	833	1088	1377	1700	2448	3332	4352	5508	6800	8228	9792	11492
*18	162	220	288	[illegible]	[illegible]	544	648	760	882	1152	1458	1800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Width of beam in inches, "b," and spacing c to c in feet.

[illegible] lbs., whence $C = 130$ lbs. per sq. in. While steel reinforcement is not necessary in this joint for the present loading as a means of strength, it may nevertheless be advisable as a means of preventing the formation of leakage cracks in the concrete.

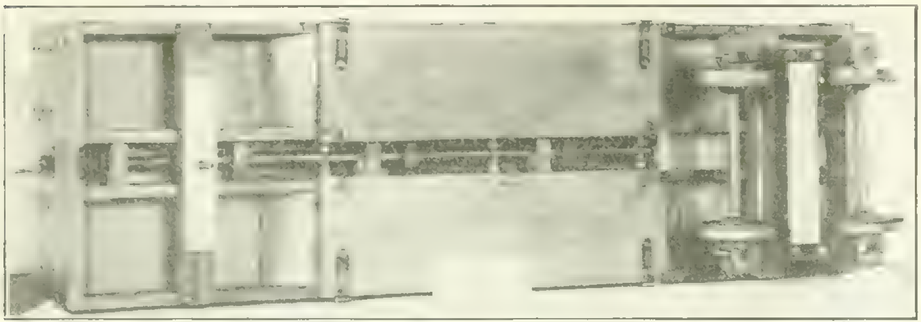
The steel required at joint 8 for the loading [illegible] $S = 12{,}000$; then from (4) $Z = RFH/Sbh^2 =$ [illegible] $C = DS/R = .195 \text{x} 12{,}000/12 = 195$ lbs. per sq. [illegible] $p = T/R + F/Sbh = .016/12 + 6{,}000/12{,}000 \text{x} 12 \text{x} 34 = .0013 + .0012 = .0025$. $A = pbh = .0025 \text{x} 12 \text{x} 34 = 1.02$ sq. in.; say 2, ¾ in. square twisted rods per lineal foot of conduit. The above method of analysis applies equally well to the design of eccentrically loaded columns.

Suppose we have to design a reinforced concrete beam subjected to transverse bending moment of 60,000 in. lbs. in conjunction with a direct tension of 3,000 lbs. applied on the compression side of the beam at a distance of 10 ins. from the center line of the steel. Let $R = 15$, $S = 15{,}000$, $C = 400$. Then from the rules for signs given previously, we have $M = +60{,}000$ in. lbs., $F = -3{,}000$ lbs., $H = +10$ in., from which $M + FH = 60{,}000 - 30{,}000 = 30{,}000$ in. lbs. From (1) $D = 15 \text{x} 400/15{,}000 = 0.4$, whence from Fig. 5, $Y = .129$, $T = .057$. From (7) $bh^2 = (M + FH)/YC = 30{,}000/.129 \text{x} 400 = 581$, from which we choose $b = 7$ ins., $h = 9$ ins., as given by Table II. From (9) $p = T/R + F/Sbh = .057/15 + 3{,}000/15{,}000 \text{x} 7 \text{x} 9 = .0038 + .0032 = .007$. $A = pbh = .007 \text{x} 7 \text{x} 9 = 0.441$ sq. in. cross-section of steel.

EARTH AND ROCK SECTION

A New Convertible Narrow Gage Dump Car.

A convertible car which embodies improvements in the general construction of dump cars, especially in the mechanism, for lowering and raising the discharge doors, has recently been put upon the market in the [illegible] dump car by the Ernst Wiener Co., of New York. In its construction the usual locking and latching devices used on dump cars are dispensed with. This car is so constructed that the mechanism is always covered, either when the car is used as an ordinary flat bottom car or as a hopper bottom car, and the mechanism does not interfere in any way with the load. When used as a dump car the hopper may be opened slowly, allowing the load to dump gradually, or to be stopped until the car is moved to another point for continuing the discharge of the load.



Bottom View of Convertible Narrow Gage Dump Car.

One of the principal advantages of this car lies in the simplicity of its dumping mechanism, which is shown in the accompanying illustration. A threaded shaft is operated under the bottom of the car by a crank or hand wheel at one end. Upon the shaft three metal blocks are carried, which work back and forth along the shaft as this is turned. These blocks each have two chains fastened to them, which lead to the drop bottom doors over small idlers. The movement of the traveling blocks, as will be noted, controls the opening and closing of the doors.

As the operating device is placed between the center sills, it is so well protected that it cannot be damaged either when the car travels or during the operation of dumping.

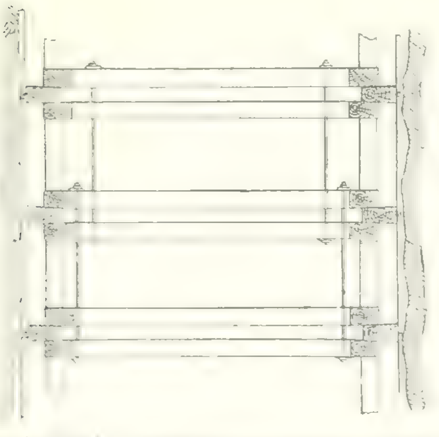


Fig. 1—Shaft Timbering in Swelling Ground.

A Method of Timbering Shafts and Drifts in Swelling Ground.

In driving a shaft or tunnel at right angles to the stratification the ground will often stand without timbering, but when the shaft or drift parallels the strata, double setting is often required; ground that is heavy because the rock is loose and full of slips often comes down in large masses, and where a couple of sets break, the fall may bring down adjacent sets. On the other hand, in a drift in swelling ground, the timbers may be crushing and binding, and when a broken set is knocked out, only three or four wheelbarrow loads may come down.

For replacing broken sets the form of timbering shown in Fig. 1 was devised by Mr. Geo. C. McFarlane of Denver, Colo., and described by him in the *Engineering and Mining Journal*. This style of timbering will stand fully as much squeezing before breaking as a double set and it does not require as much excavation. Two sets of 6x10-in. timbers with a 6x12-in. filler between the wall-plates are used. One side of the 6x10-in. piece and both sides of the filler are sawed on a bevel of ½ in., as shown. In placing the sets, the posts must be put in tight, using two or more jackets to bring the plates and filler to a solid bearing at each post. In sinking a mine shaft with this kind of timbering the set is gripped together by hanger bolts until a set of dead logs is placed. As the walls of the shaft swell, the filler is of course forced in between the plates, causing the posts to sink into them. If the plates and filler grip tighter on one side, the set will be crowded toward the slack side as it takes the squeeze. In an hour or so between shifts this can be remedied by jacking in a couple of extra posts on the slack side, and in this way the guides can be kept in good alinement. This form of set allows the walls of the shaft to swell four inches without breaking the timbers. Should the swelling force the filler flush with the plates, pieces of lagging can be removed, a few at a time, the wall cut back a few inches and the lagging reset by inserting blocks between it and the wall plates. The posts can then be removed and the filler jacked out with a couple of pipe jacks, the posts reset and the temporary blocking between the lagging and the wall plates removed. One set of posts will have to be chopped out to release the fillers of the first set; after that, many of the posts and part of the lagging can be recovered in shape to use again.

Figure 2 illustrates the same principle applied to a drift or tunnel set. A couple of bolts would have to be used in each leg to clamp the filler; as the sets took weight the bolts could be removed, then the thrust of the collar and the toe braces between the set would throw enough pressure on the filler to bind it. If the breast set were solidly braced with "rakers" it might not be necessary to use bolts at all.

Method of Determining Slopes in the Bench System of Steam Shovel Operation.

It is often the tendency in steam shovel operation to work the shovel alongside of a bank which is sloped at the steepest angle at which it will stand. This often results in small slides which cover the loading track and the ground behind the shovel. Even if the formation should be of stratified or hard material, as would be the case in limestone or granite, the necessity for loosening the banks in order that the shovel may work in loose material, would so shatter the bank as to prevent it from standing at a steeper slope than 0.66 to 1. The recent failure of some slopes of this ratio at Panama would indicate that, in the end, slopes of flatter angle are more economical. The angle at which a bank should be carried in this class of work has been the subject of much discussion. In an article in the *Mining and Scientific Press*, Mr. E. C. Baker gives the results of a study of actual slopes occurring in the open cut mining work in Nevada by which he has determined upon a general slope which will fit most conditions and which furnishes a basis for calculations. As the slope of a bank depends upon the depth to be excavated and the structure and formation of the material, no general rule can be made. But in any

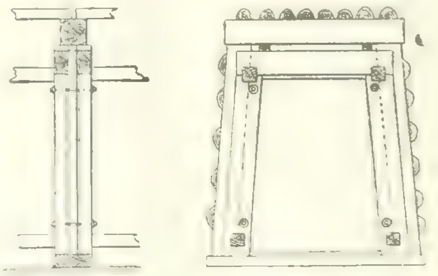


Fig. 2—Drift Sets for Swelling Ground.

formation the failure of a steep bank may be caused by a surface flow, disintegration, or a structural break, and this gives good reason for stoping the bank to a safe angle. In the case of Nevada open cut mining, the material mined is monzonite-porphyry, which breaks up into pieces rarely larger than 6 ins. [illegible] will pass a ½-in. screen, making the sloping of a bank steeper than 1 on 1 almost impossible.

[illegible] factor in the slope. Mr. Baker has arbitrarily taken, for purpose of illustration, a height of 50 ft. between benches. This distance has been found to be the most advisable for all purposes, including the horizontal distance between benches, and safety in operating the machines. The blasting of the bank is usually done by the springing and firing of well drill holes, from 8 to 12 ins. in diameter, drilled on each bench by the ordinary portable well drilling machine. With this height the shovel is seldom in danger of being buried by a slide, and with a horizontal bench of 50 ft. the loading track is not so likely to be buried by the blast, thus avoiding serious and costly delays. Higher banks can be carried—a height of 200 ft. or more being possible—but this would necessitate tunnel blasting, requiring a heavy tonnage of explosives, and naturally a much wider bench. So in working by benches or terraces the reason for the rejection of this method is obvious, to say nothing of the care necessary to avoid exposing the shovel and crew to danger from a treacherous bank. The shovel on the upper bench should be worked slightly in advance of the one below to avoid danger of accident to the lower shovel.

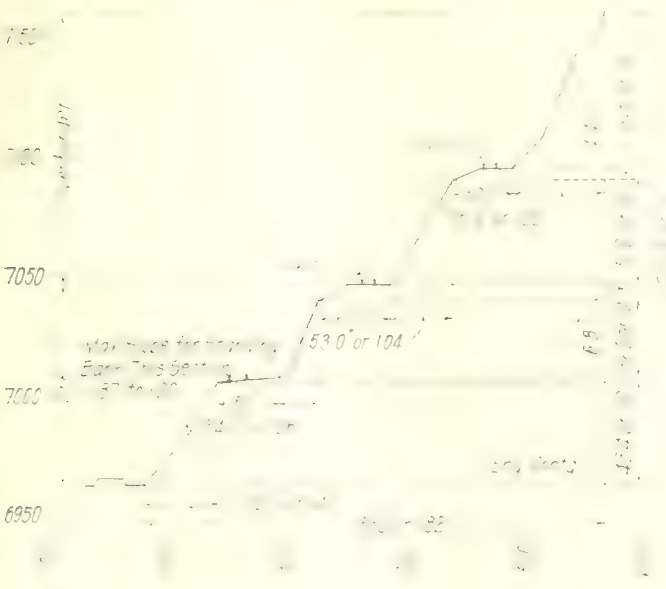


Fig. 1.

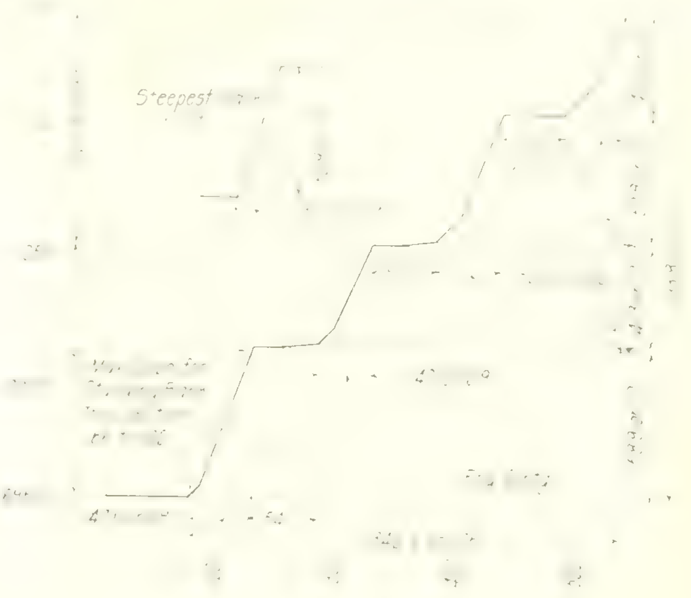


Fig. 2.

A study of an actual section through the bank of a steam shovel ore pit at Ely, Nevada (Fig. 1), shows that the slope between the benches from the upper edge to the toe of the talus below is a little greater than 1 to 1, varying between 1.04 and 1.43, or an average of 1.18 to 1. The talus, or broken material, that has become loose and has fallen to the bench below, as shown in the diagram, will always be found at the foot of a bank, the quality varying in amount according to the condition of the standing ground.

[illegible] shown in Fig. 2, the ratios of the corresponding banks are somewhat less, varying between 0.8 and 1.18, or an average for the four banks of 0.99 to 1. The steepest bank in the shovel-pit is one in the zone of sulphide ore, 52.9 ft. high and standing at a ratio of 0.6 to 1. This bank is freshly cut and will stand at this ratio for only a short time, when disintegration will cause it to crumble. It will be seen, then, that an average slope for this height of bank and material will average closely the ratio of 1 to 1, a little steeper in the zone of sulphides and a little flatter in the oxidized material above.

Leaving the discussion of the banks between the benches, we proceed to the question of real moment, the general slope from the bottom to the upper edge of the excavation. This ratio is, of course, much larger since the added width of the bench on which the shovel operates nearly doubles the horizontal distance. In Fig. 1 this ratio over all, from the top to the toe of the bottom bench, will be seen to be 1.92 to 1, and in Fig. 3, 1.76 to 1 for 4 benches. With the addition of more benches the ratio will not remain the same, but will grow larger by a decreasing amount. Using the ideal section Fig. 3, with 1 to 1 slopes, 50 ft. benches and 50 ft. heights, the table below is given to show the ratios of the horizontal to the vertical heights for 2, 3, 4, 5 and 6 benches.

Fig. 3.

[illegible]	H[illegible]	Vertical	[illegible] of slope
[illegible]	150	[illegible]	1.50 to 1
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	200	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	300	[illegible]

From [illegible] de-[illegible]

[illegible] or, substituting

[illegible] to 1

Let S equal the slope ratio; a equal the base of the individual slope triangle; b equal the width of bench; c equal the vertical height of bank; n equal the number of benches.

[illegible] 50 [illegible] ft.; $n = 6$, we have

$$\frac{6 \times 50 + 5 \times 60}{6 \times 60} = \frac{600}{360} = 1.66 \text{ to } 1$$

In the selection of the width of bench, the deciding factor is the slope taken by the blasted bank. Ordinary broken material will repose at a slope of about 1½ to 1, but the impetus given the broken rock in a blast usually causes the slope to form at approximately the ratio of 2 to 1. Since the drill-holes are placed about 10 ft. from the edge and the blast loosens the ground for about 10 ft. more, the bank, when blasted, lying at a slope of 2 to 1, assumes the position of the dotted line at the top of Fig. 3, still leaving 20 ft. clear on the bench below, which gives ample room to safely accommodate the loading track without danger of being covered. From the data at hand and with conditions as given above, the section of minimum bench and the maximum height and slope for economical operation, is the one shown in Fig. 3, with a general slope of 1:75 to 1, or a corresponding ratio for the number of benches required.

Equipment for Jacksonville Station.—The type of construction and equipment of the new power station of the Jacksonville Electric Company have been decided by the Stone & Webster Engineering Corporation, who have charge of the design and construction. The building will be of steel frame and brick construction and the stack will be of reinforced concrete. The principal power equipment will be 2-1,800 Kw. maximum-rated General Electric direct current generators coupled respectively to 2-2,400 Hp. cross compound engines to be built by the Nordberg Manufacturing Company. There will be three 600 Hp. boilers from the Edge Moore Iron Works. The condensers will be of the barometric column type and will be supplied by the Mesta Machine Co. The principal coal-handling ap-[illegible] locomotive crane.

Canada has been a center of remarkable railroad activity during the past year. The Canadian Northern led with the construction of 484 miles of road. The National Trans-Continental built 437 miles; the Canadian Pacific 367 miles, and the Grand Trunk Pacific 335 miles. In addition to this, 3,101 miles are in course of construction.

ROADS AND STREETS SECTION

Some Instructions from Actual Practice for Making Surveys and Plans and Superintending Construction of Highway Improvements.

SURVEYS.

[illegible] in general surveys should follow the line of the existing highway. The width [illegible] always be between existing fences, and all other measurements of the survey within the right-of-way, should be made with sufficient accuracy at least to within the nearest foot to make the map of the road of value as a permanent record of the location of the road at the time the survey was made.

Where a marked improvement in line or grade can be made, where the cost of maintenance in after years can be decreased, or where the grade of the old highway is so steep that a maximum grade of 7 per cent cannot be obtained with reasonable amount of excavation and embankment, a new location of portions of the road is often advisable.

Special notes should be made as to the character of the soil on the line of the proposed new location, and the subject shall be specially studied as to the existence of rock or of unstable or sliding material, borings to be taken where necessary.

Field Notes.—Separate note books should be used for the surveys on each road. Except on very short roads, the transit and level notes should be kept in separate books.

The inside cover of each note book should have plainly marked on it:

1st. The name of the county in which the road is located.

2nd. The name of the road and its petition number.

3rd. Transit or level notes, as the case may be, and the stations included within the book.

The inside of the cover or the first page should also contain the names of the party making the survey; an index should be placed at the beginning of each book and an explanation of abbreviations used.

It is advisable to have the bench marks, transit stations, culverts, ditch crossings, and the character of the soil in tabulated form. At the beginning of each day's notes, the date should be given, the names of the members of the party, the duties performed by each, and the condition of the weather.

The dates of those working days on which no notes are taken should be recorded and the reasons why no work was done should be noted in the proper order in the book.

Surveys for New Right of Way.—The notes of surveys for new right-of-way to be acquired should be placed in the original survey field-book or some other book for permanent record if so ordered. So far as possible the maps should be plotted by the field party before the books are returned to the office. Separate tracings should be made of each piece of land to be acquired.

Surveys for new right-of-way are of two kinds: First, surveys of parcels of land along the sides of existing highways, and second, surveys of entirely new right-of-ways.

Plans and descriptions of parcels of land along the sides of the existing highway will in most cases be prepared in the office from the data of the original survey. The duty of the survey party will then be to place 1-in. gas pipe rods at the points indicated on the plans by laying off the correct right angle distances for the indicated stations of the original base line where the parcel of land to be acquired is of such irregular shape as to make its computation difficult, a survey of the same should be made in the following manner.

An enclosing transit line is run around the piece of land along the new boundary line and the existing highway line. A magnetic bearing is taken at some angle where the needle will not be subject to local attraction, and the bearings of all the sides are deduced from this magnetic north, the needle reading of each line being recorded as a check. The starting point of each survey is referenced to the base line by station number and offset distance, and also to some permanent reference point, if one is near by. The angle points of the new right-of-way line shall be monumented with 1-in. gas pipe rods 3 ft. long.

In the case of surveys of an entirely new right-of-way the new center line of the proposed road is run by transit, using circular curves and their connecting tangents. Opposite to the points of curve, points of tangency, etc., gas pipe rods should be set, to locate the bounds of the right-of-way. These are usually placed 30 ft. distant from the center lines, on either side, the distance being measured along the lines of the radii of the curves or at right angles to the tangents. Where necessary, a less or greater width may be marked to be acquired, as at a junction with an old highway. Where not too complicated these irregularities are referred by offset distances to the center line, but where this method is not advisable, the bearings and lengths of the irregular sides are recorded, as in the closed transit line survey. The bearings and plus distances of intersecting property lines and the highway lines are also taken. The points beginning on the center line are referenced for each parcel of land, where permanent reference points are available.

In the description accompanying the map of entirely new right-of-way, the center line is first described by giving the bearings and lengths of tangents and the radii and lengths of curves. After the center line has been described throughout its length, the outer boundary lines are described as parallel to and so many feet distant from the center line, if the width be uniform. When the outer boundary lines are irregular, they are described separately with reference to their distances from the center line by bearings and lengths.

Location Notes.—Surveys should be based on transit lines and the azimuth of each line given.

All transit points should be referenced to as permanent objects as possible by at least three measurements, so that they can be found again if wanted. The base line should follow the approximate center of the road. Where defined by walls or fences, the center may be obtained by measuring between them: where there are no visible boundary lines of the location, as far as possible, use the center of the traveled way.

Locate all walls, fences, ditches, etc., which indicate boundaries of the road or of abutting property, giving correct names of owners; also all buildings within 100 ft. of the center line of the location, and all cross streets or roads for a distance of 200 ft. from the line of location. No more time should be spent in locating buildings than is necessary to give their approximate size and position. The size and location of objects beyond the fence lines or beyond the probable location of the finished road may be estimated, but the estimate is to be made in the field and recorded in the notes. The magnetic bearing of each property line and the station at which it intersects the base line should be recorded. Where property lines or intersecting roads are indefinite, their apparent location should be recorded and not left for the draftsman to locate from the sketch. All places should be noted where the Engineer in charge considers that ditch crossings will be required, and a tabulated list of these crossings should be made, showing their character, whether house, barn or field entrances.

Where it is evident that the road will have to be widened a note should be made of which side the land should be taken, giving reasons.

Locate all bridges, take a cross-section on each side of a bridge where the calculations for earth work begins or ends, give the dimensions of the openings, the nature of construction, dimensions and conditions of the abutments and superstructures; height of stream at time of freshets; direction of flow of stream and elevations on bed of stream at both ends of the bridge and the grade of the bed of the stream at least 100 ft. above and below the structure. Give the approximate area of watershed, where it may be readily obtained and note whether there are indications that the water overflows the road. Locate gutters, ditches, curbing, catch-basins, and trees valuable as shade trees.

Where a line for a new location is run so as to form a closed circuit with the base line in the highway, the azimuth should be taken with a transit along both the base line and the side line; and the fact that the circuit will close should be ascertained before the field books are returned to the office. Where a survey joins a previous road survey, the base line and bench marks should be tied on to the old survey.

Cross-Sections.—In general, objects located by cross-section measurements should not be located by transit measurements or vice versa.

Elevations should be referred to tidewater datum of a canal, railroad or geological survey bench-mark where it can be found and connected at small expense and check levels should be run where such permanent benches cannot be found near the end of the road.

Assumed elevations taken from the U. S. Geological Survey contour maps should be used where no better information is obtainable.

At each 100-ft. station, at each change of grade, and at cross roads, elevations should be taken on the base line, and at such other points on either side of the base line as may be needed to plot a true and accurate profile and cross-section of the road.

In all places where there are cuts or fills on the present road and where the roads are narrow, cross-sections should extend beyond the fences also where there is a probability of heavy cutting or filling. Usually the slopes beyond the fences may be merely indicated as, down 1 in 10, level, etc., giving the approximate distance, the rise or the fall continuous. The locations of the edge of beaten track, the edge of sidewalk, line of trees, fence line, etc., are to be shown in cross-section notes by the use of letters written under the distance figures. All elevations upon the outcropping rock should be noted and if it is evident that a cut will be made the surface should be cross-sectioned.

The stations of the beginning and ending of rock out-crops should be given, and at places where the rock is near the surface, soundings or borings should be made of the depth of overlying earth. The character of the soil should be recorded, in the form of a tabulated list by stations, giving character at least every 1,000 ft. whether or not the character of the soil changes. Care should be exercised in taking cross-sections where there are marked changes at the sides of the road, even though there be no great changes of grade in the beaten track.

Elevations of the ground, and of the bottom of sills should be taken at the front corners of buildings where the same are within 50 ft. of the base line, and where a cut or fill on the new road is probable.

All existing culverts and drains should be located; the size and condition noted and elevations taken at both ends on top and bottom. Where streams enter or leave the highway at places not opposite the culverts, their location should be noted. A profile should be taken far enough up and down the stream or ditch to give the required information for lowering the ditch to drain from the new culvert which is usually placed lower than the old one. A cross-section showing the elevation of the road and the surrounding land should be taken as near each culvert as possible in addition to the regular culvert section. All information necessary for [illegible] a complete drainage scheme should be recorded.

All elevations should be worked out and checked, and as far as possible, all maps, profiles and cross-sections must be plotted as the work progresses in the office of the Engineer-in-charge of the survey, during inclement weather. All measurements are to be taken to the nearest tenth of a foot except the elevations of turning points and bench marks where they will be taken to hundredths of a foot. A bench mark should be established at least every 1,000 ft.

Structures.—In note books, all culverts should have put two classifications—"good" and "bad." When a culvert or other structure is described as "good," the understanding will be that the structure is likely to meet all the requirements for at least five years after the new road is finished. When a bridge, culvert or other structure is designated as "bad" the understanding will be that it is likely to utterly fail within five years from the date of the completion of the road.

In case the structure is designated as "good" and any additions, alterations or changes are necessary, the Engineer will recommend such changes as he sees fit and secure all necessary data for preparing plans and estimates for these changes. In case the structure is designated as "bad," the Engineer should obtain all data which may be necessary to prepare plans for a new structure.

In case there is a small camera in the survey party, it is of great assistance in the office to have a photograph of structures that require changing or rebuilding, and also a photograph of road intersections where a large cut or fill is probable.

The Survey Party.—When a party consists of six men, an advantageous arrangement is to make a location party of two men and a cross-section party of four men.

After the zero station is established, a line is located along the center of the road and a flag set forward or some fence post or other mark is taken as a foresight. The man acting as rear chainman keeps the location notes and sights the front chainman by eye, putting a nail temporarily for the use of the cross-section party, at every station locating all points while the chain is on the ground. When the foresight is reached, the permanent transit point is located at the end of some even foot, and referenced and a new foresight taken and the base line carried along as above described. Toward the end of the day, the location party takes with a transit the azimuths of the lines run during the day, borrowing one man from the cross-section party to assist. At station zero the magnetic north line is established and all azimuth readings are referred to this established north line. The magnetic bearing of each line should be read and recorded as a check.

The cross-section party consists of a recorder, an instrument-man, rodman and tape-man.

The rodman first holds the rod on the station and then reads rod to tenths; after the first reading he moves to the left, giving readings at characteristic points, the tape-man meanwhile standing over the station and calling the distance for every rod reading until all the readings have been taken. The rodman then comes back and goes to the right with the rod. These points should be selected so straight lines connecting them will accurately represent the surface of the ground.

The instrument man first calls the rod reading, next the tape man calls the distance and then the rodman calls the nature of the point on which he held his rod. The rodman estimates the slopes beyond the last reading taken as level, down 1 in 3, up 1 in 10, etc., and calls this information to the recorder.

On turning points after the instrument-man has called to the recorder the rod reading, the rodman checks the instrument-man's reading by sliding a card or a slip of paper held by a rubber band along the rod to the reading called; then holding the rod again the instrument-man checks the reading. The rodman should keep the rod on the turning point until the back sight is taken

The rodman should keep separate notes of rod readings on [illegible] marks he holds on and compute the elevations of the same.

Before the survey party leaves the road all bench marks should be checked.

General Information in Survey Notes.—The following general information should also be given, fully and concisely, in survey notes:

Quality and nature of the soil, the station where the changes occur, specially noting the existence of unstable sub soil and of clay or loam which is peculiarly affected by water. Inquiry should be made of highway officials and occupants of adjoining lands regarding spots that break up badly in the spring and their location should be noted.

The location of quarries, or rock suitable for road metal, of gravel pits in the vicinity of the road to be improved, the samples of the same collected and properly labeled, giving the place and the name of the owner from whose land the samples were taken.

Description of the field stone in the vicinity of the road to be improved.

The most advantageous location for a crushing plant.

Distance to the nearest side-track where stone might be delivered by rail to the proposed road to be improved, giving name of railroad.

Available places for procuring water for roller and watering-cart.

Where stone for gutters and culverts may be obtained.

State in notes whether there exists a line of telegraph, telephone or trolley poles along the line of road, and give name of company owning same.

Prices of laborers and teams.

Where telford, gravel base, side-drains, cobble-stone gutters, etc., are needed.

The above information as above required should be put in the notebook on the pages immediately following the survey notes.

PLANS, SPECIFICATIONS AND ESTIMATES

The plans should include a map, profile and cross-sections showing the old and new roads; also plans of all old structures to be changed or repaired, and plans of all new structures to be built.

The sheet should be of tracing cloth of standard size, 24 ins. by 36 ins. outside dimensions, with border of 1½ in., except on left, where 2-in. border shall be placed. Each sheet should show map and profile with cross-sections placed, as nearly as possible, opposite the stations they represent on map and profile The stations should run from left to right on the sheets. The maps should be plotted to a scale of 1 in. equalling 100 ft.

The profiles should be plotted to a horizontal scale of 1 in. to 100 ft., and a vertical scale of 1 in. to 10 ft. The cross-sections are to be plotted to a scale of 1 in. to 10 ft., both horizontally and vertically. In plotting the cross-sections, the numerals indicating the elevations and distances out from the base line, on each side, may be omitted, except that the old and new elevations at the center of the new road should be given.

The thickness of road metal should be adapted to the condition of the soil and the amount and character of the traffic. The drainage plans for the road and the thickness of macadam should be so planned as to prevent holes, ruts or depressions forming in the macadam, by displacement of the stone, or from any cause except the wear caused by traffic.

INSTRUCTIONS [illegible]

The first duty of the engineer in taking charge of the work should be to carefully check over from one end of the contract to the other, the levels, the length of the road and to mark on the adjacent fence, telegraph pole or other permanent object in white lead paint each full station number where this may be done without damage to private property. If the even station does not come opposite the permanent object the plus station must be marked on the object.

A careful study of the drainage of the entire road, as modified by the new plans, should be made in advance of the grading and culvert construction. This can be often done advantageously during and after a heavy rain storm. Any portions of the road that in the spring or during wet seasons are usually in bad conditions, by reason of defective drainage or on account of the character of the soil, should be especially studied with the view to remedy the defects by some special drainage plan, such as deep side ditches, ditches or pipes to carry water to channels adjacent to the road, tile under-drains, etc., or by telford foundation, by a base of gravel or by additional thickness of macadam.

The cross-sections of the road should be as shown on the plans, and the grade and line shall be given in the following manner:

Set stakes at every station, and at as many plus stations as may be necessary, with the number of the station marked plainly on them, on both sides of the road and opposite each other near the fence or at some point where they are not likely to be disturbed. Then prepare two small notebooks in ink, giving the horizontal distance from each stake to the center line of the macadam, and the vertical distance from the top of each stake to the crown of the finished macadam. After these notebooks are checked and compared, one should be retained by the engineer in charge and the other should be given to the foreman in charge of the grading, so that he may get his own grades by means of a long straight edge and spirit level, a string stretched between the two opposite stakes level with the top of the higher one, measuring up or down from the string the distance called for on the higher stake. These grade and line stakes can be set at times when stone, masonry or concrete is not being laid, leaving the engineer and his assistants free to devote their time to the inspection of the work while in progress. Before bottom stone is laid, the elevation of the sub-grade should be checked by the engineer or his assistant.

Following Sub-Grade.—On clay or other soils that are muddy when wet, stone should not be laid until the sub-grade is dry enough to permit a firm, hard foundation being formed by the roller. The result necessary to be obtained when forming the sub-grade is a firm and solid foundation upon which to place the macadam; one that will not weave under the action of the roller, and upon which the stone may be bound and locked together.

It often occurs that a sub-grade of stable material which has become wet during loosening and handling will not consolidate under the roller. Should this occur, the soft or temporarily unstable material should be entirely removed and replaced with suitable material, otherwise be left until dried out. If the sub-grade is plowed or otherwise loosened up, the drying out of the same will be greatly hastened.

In dry weather, if the sub-grade has already been formed into the desired shape and becomes ground into dust, it should be well sprinkled, or wet down the latter part of each day, and left until the next morning before rolling, when it should consolidate under the roller. Very little benefit can be obtained by sprinkling and rolling immediately afterward. If the surface is dusty it should be well sprinkled before fine grading.

Before any sub-grade is prepared for the macadam, all embankment and excavation should be made for the full width of roadway; on embankment the portion outside the macadam should be thoroughly rolled before the shoulders are formed therein. Where the shoulders are formed of loose material, as in embankment, the same should be consolidated with rammers, or otherwise, so as to form a stable shoulder to retain the macadam.

In excavation, the gutters should be sufficiently excavated before placing of macadam, in order to thoroughly drain the work during the construction.

In forming the sub-grade for the macadam, stakes should be set by the contractor or by the engineer, if he has the time, every 50 ft., or oftener if necessary, along the edge of the macadam and the finished grade marked thereon. Lines should then be stretched from one stake to another, and the sub-grade formed the proper distance below the same. The center crown should be obtained either by use of [illegible] the sides.

Care should be taken to give the sub-grade a sufficient amount of crown, so that after the road is rolled and completed it will have the full crown shown on the plans. This result can best be obtained by raising the center of the sub-grade two or more inches to allow for settling while the stone is being rolled, leaving the sides as indicated on the plans.

Should the contractor object to this method, he should be informed that if the finished road has not the desired crown, it will have to be supplied with additional macadam. This precaution is specially needed upon a yielding or plastic soil which is likely to flatten under the action of the roller and traffic.

Crushing.—The engineer in charge should frequently note the working of the crusher, in connection with the inspection of the crushed stone. If the product seems to run smaller than the screen should give, it may be due to the section of the screen being too short, or more likely the screen turns too fast, or it may have too great an inclination. The bins are often allowed to get too full and stone from one bin will run over into another.

Stone Quarries.—If the quarries, after being developed, should contain layers of slate, shale, thin layers of soft stone or undesirable stone of any kind, the contractor should be required to select from the quarry, or furnish from other sources, only such stone as will comply with the requirements of the specifications and contract.

Where "local stone" is permitted by the contract and the contractor proposes to use field stone rather than stone from quarries, it is often necessary to observe the following directions:

The stone should be selected from the general run of stone found in the fields and stone walls or fences; those used should be hard, durable and of compact texture, and all disintegrated stone, as well as soft sandstone, shale and slate, should be rejected. Where the field stone are of the flat variety, the minimum thickness acceptable 2 ins., and where the stone are round cobbles, the minimum diameter should be 5 ins. It will therefore be seen that old walls or fences can not be cleaned up entirely in crushing for macadam.

Courses of Stone.—The thickness of the courses of stone can be regulated by the use of several hard wood blocks, laid on the subgrade or the bottom course, as the stone is being spread. For courses of stone 2 ins. thick after rolling, blocks must be 2 11/16 ins. thick. For courses of stone 4 ins. thick after rolling, blocks must be 5⅜ ins. thick. For courses of stone 3 ins. thick after rolling, blocks must be 4 1/16 ins. thick.

Rolling and Finishing Macadam.—In the preliminary rolling of both courses, in running forward, the large wheel of the roller should lap out onto the shoulder about 8 ins., should cross the road and in running backward lap 8 ins. onto the other shoulder; this should be continued until the same is well rolled. Avoid crossing from one side to the other on unrolled portions. The rolling of the bottom course should be continued until the stones appear to be firmly locked together, and do not weave to any extent ahead of the roller, and that, in walking over the macadam, the stones adjacent to those covered by the feet do not move. Any hollows or depressions in the rolled surface should be promptly filled and brought to true grade, using the same kind and size of stone of which the course is formed.

In rolling and filling the bottom course, only so much water should be used as is necessary to prepare the bottom course to sustain the travel of hauling the top course thereon, without cutting up or raveling it. In most cases it will not be necessary to use any water.

In cases where imported stone is used for the top course, and the bottom course is laid a considerable distance in advance, the latter should be well filled and rolled to sustain the travel of hauling the top stone over it.

The stone for the top course is often delivered faster than the same can be rolled and puddled. This may be spread, rolled and filled with screenings, but under no circumstances should any driving be allowed over the stone after the screenings have been spread, until the section has been given the first puddle.

It is seldom feasible to get any portion of the road thoroughly filled and puddled at the first operation. If, after the greater portion of the surface is filled with "grout," so that when sprinkled the water will run off the surface, the road be left for several days to partially dry out, and then is rolled well and more screenings added, a final result can be obtained with less rolling and wetting than if continued with the first puddling.

Often when too much water has been sprinkled on the road, the sub-grade becomes softened and the stones weave and loosen, which lets the screenings work down between and separate the fragments, the section should then be left to dry out as above described, and again rolled and puddled. It may be necessary to stop the second time to let the road dry out, and then give it a third, or even several additional puddles, to obtain the desired result.

It sometimes becomes desirable where the sub-grade is of clay or wet or unstable material, not to saturate the stone with water as specified. In this case, if the stone be sprinkled about twice over, or just sufficient to wet the stone without reaching the sub-grade, and is then rolled several times, and left until the next day, and the operation repeated from day to day, a fairly good result may be obtained in the course of a week.

Any depressions or hollows developed in puddling should be filled with top course stone, and the same thoroughly incorporated with the top course before the final puddling.

In dry weather it is desirable to open sections of the road to travel as soon as completed, but in wet weather, when the travel brings on mud, the road should not be opened in short sections, and the number of places where mud is carried onto the road thus reduced to a minimum.

Final Note Books.—For the purpose of making final and monthly estimates and for permanent record after the work is completed, all quantities of the different classes furnished except excavation, embankment and macadam, should be recorded as the work progresses in separate notebooks of uniform size.

It is desirable to keep the items and quantities of each structure by themselves. Head the top of the left-hand page with the name of the structure, and the station below on the same page, give the dimensions and computations of the items, such as third class masonry, flagging, etc., making up the structure. On the right-hand page show plan, elevation and section of structure drawn to approximate scale giving all dimensions.

A detailed summary of the different items should be made as follows: Head each left-hand page with the name of the item, as paving, ditch crossings, etc., and below show station or stations at or between which the item was used and the amount used at each station. If the item was used in a structure, besides giving the station and amount, refer to the page in the book where the structure is shown. On the right-hand page show section of the item with necessary dimensions.

In the detailed summary show the item of work in the following manner:

Masonry and Concrete: Put only one structure or piece of work on a page. Show plan, elevation and cross-section of structure drawn to approximate scale giving all dimensions.

Telford: Plot a plan and section showing length, width and depth of pavement.

Gravel Base: Show location and dimensions of gravel base in same manner.

Paving and cobble gutter: In culvert paving, give dimensions of paving and page on which culvert is shown. In cobble gutter, show section of paving, giving width, thickness and length by stations.

Flagging: Give width and length of flagging and the page on which corresponding culvert is shown.

Pipe: In a culvert, plot section of culvert showing length, diameter and kind of pipe. Also give page on which the head walls of the culvert are shown.

Underdrains: Plot plan and sections showing the diameter and kind of pipe, depth of pipe below surface of road and character and dimensions of materials, broken stone or gravel around pipe.

Steel: Give dimensions and total weight and number of pieces of steel used in each structure and location of same by stations.

Timber and Plank: State the kind of timber and show sketch of work done by giving dimensions. In case of standard ditch-crossings give station at which crossing is used. Also amount of lumber in each.

Guard Rail: Give stations between which standard guard rail is used.

When the work is completed make a general summary of each separate item in the back of the book and compile final estimate showing the exact quantity of each item which was actually furnished on the road. The final notes should be printed in ink in a neat, legible and clear manner so that they can be easily understood by anyone, at any time, after the work is completed.

Notes on Road and Street Work.

Oil Macadam Construction in Washington.—In the construction of an oiled macadam road in Kent County, Washington, all broken stone was brought to the road over the Northern Pacific R. R., the contractors establishing their mixing plant at the tracks Three bunkers, with a capacity of 70 cu. yds each, were erected for the stone, and a 12,000 gal. wooden tank was built for the crude oil A No. 2 Foote concrete mixer was installed for mixing the materials, the oil being pumped from the tank directly to the mixer. There was considerable difficulty in getting the oil to flow through the pipe from the pump to the mixer, as the oil thickened in the early morning and on cool days. This pipe was put in a steam jacket, and no further trouble was experienced. The oil was delivered to the mixer at a temperature of 180° to 200° C., and the stone was put in cold. Two yards of stone could be coated in about 25 min., using a force of seven men and a foreman. The coated stone was hauled to the road in an automobile truck, holding about 2½ cu. yds. It was placed on the road after the bottom course had been laid and filled with screenings, and spread to a depth of 3 ins. loose, making 2 ins. after rolling. In cool weather it was found possible to turn traffic over the road within a few hours after this stone had been put in place, but in warm weather it was found advisable to wait two days. Hand sprinkling was tried on a 700-ft. section of this road. The oil was hauled to the kettles in barrels, heated to 212° C., and poured on the road surface from ordinary sprinkling cans, fitted with a V-shaped spout. This method, according to the last biennial report of the Washington State Highway Commission, was found to be unsatisfactory, as it can only be carried on when both the weather and the stone are warm and dry; it also only coats the top and sides of the stone, and a much less permanent pavement results. In the construction of an oiled macadam road in Lewis County the stone was bound with a mixture composed of 88 per cent tar, 10 per cent pitch and 2 per cent resin. The top course was first placed on the road uncoated, and rolled dry. A 90-gal. tar-spraying machine was fastened to the back of the roller and connected to the boiler. The roller mixed and heated the materials to a temperature of 200°, pumped the mixture into pipes and forced it through a fine sprayer onto the surface of the road under steam pressure. The stone was thoroughly coated by the use of about ¾ gal. to the square yard, and the road gives every evidence of making a first-class permanent pavement at low cost.

Some English Costs of Repairing Macadam.—The following data on the cost of road repairing were given by Mr. William Ransom in The Surveyor. The following are typical figures of the cost of repairs for a road nearly 1,000 [illegible] long and about 8,000 yds. [illegible] the gutters):

	Per sq. yd. Cents.
Cost of [illegible]	[illegible]
Cost of sand	[illegible]
Cost of [illegible]	[illegible]
Cost of [illegible]	[illegible]
Hauling material	[illegible]
Total	[illegible]

The stone that was used was 2-in. Rowley rag, at a cost of $2.16 per ton, and the average thickness placed on the road was 2.44 in. The roller was [illegible] about 270 sq. yds. per day. In the case of another road of about the same length, but nearly 9,000 sq. yds., the analysis came out as follows:

	Per sq. yd. Cents.
Cost of stone	[illegible]
Cost of sand	[illegible]
Cost of scarifying	[illegible]
Cost of rolling	[illegible]
Cost of [illegible]	[illegible]
Hauling material	[illegible]
Total	[illegible]

The difference of cost is accounted for by the increase of metal that was put upon the road, for it amounted to 3.3 in. The road was also hilly, and the hauling was therefore more expensive. The roller was only able to roll 153 yds. per day. The total cost of labor per sq. yd. was analyzed in the latter case as follows:

	Per sq. yd. Cents.
Labor for scarifying	[illegible]
Labor for rolling	2.02
Labor for spreading	1.86
Total	[illegible]

It will be noticed that no item has been given for superintendence or for the wear and tear of tools. In the cost of rolling and scarifying an allowance, however, has been made for depreciation of the engine.

[illegible] Planting Along [illegible].—In Germany a practice of planting shade trees along country highways has been followed for many years. Many of these German highways are laid out about 100 ft. wide, having a ditch on each; along the inside of these ditches are planted trees—mostly fruit trees. The roadway proper is divided into two roads of equal width, one surfaced with macadam, and one a dirt road. The latter is top dressed with gravel and is called the summer road. This is used mostly for light traffic and for heavy loads going down grade. The highways of less importance, connecting smaller cities and towns are laid out with the summer roads, but with an equally good 30 ft. macadam section. The German road is graded the full width to the lines of the adjacent property, the slopes falling on the latter. This enables them to plant the trees on the same grade as the road instead of placing them lower on the side of a fill and higher next to a cut. The accompanying cut shows a cross section of a model German road and for comparison a section of a Kansas country road. The fruit trees planted along the roads and highways of European countries are not only an ornament but they are also a source of revenue. In a paper presented at the first annual meeting of the Kansas Engineering Society, Mr. E. F. A. Reinisch, Landscape Engineer, Topeka, Kan., states that cherry trees are mostly used in Germany when planting fruit trees on highways. These trees grow quite large, about 30 ft. high, with a crown spread of equal dimensions and remain sound many years after having reached full growth. Apple and pear trees, like the cherry, grow to a good height and spread and would therefore be suitable for avenue planting, but it is desirable to use trees with persistent fruit, which the wind does not shake off, hence the preference for the cherry. Mr. Reinisch states that in Kansas fruit trees are too short lived and do not grow high and wide enough for shade trees. The average life of a fruit tree in the average Kansas soil and climate is probably less than 20 years. Nut trees, like walnut, pecan or hickory, might possibly yield a small profit a few years after planting. Of the forest trees those would be preferable that attain large size, but [illegible] winds and grow symmetrical without being trimmed into shape every year to two; this would include the oak, hackberry, linden, sycamore, varieties of hard maple, etc. To insure success in planting trees care must be taken in their selection. [illegible] will grow in almost any soil, like the oak, locust and cottonwood, while the elm and sycamore must have a deep loam, free from alkali, to develop into perfect specimens and attain a long life.

The Minnesota [illegible].—[illegible] accompanying illustration shows a home-made planer devised by Mr. George W. Cooley, State Engineer of Minnesota. This type of planer has been used for several years, and it is said to be an improvement over the split log drag, as it does not skid sideways and has a greater tendency to cut off the high places and fill the depressions. It is made of 2x12 in. plank for runners and blades and 2x6 for cross pieces. The most convenient length is 12 ft. long and 5 ft. wide with blades set at an angle of about 30°. The face of the blade should be shod with a strip of iron.

Minnesota Road Planer.

State Highway Work in 1910.—In our issue of March 1, we gave a summary of the state highway work in 1910 in a number of states. We have since received information as to the work done in Maryland and Washington.

MARYLAND

The mileage and average cost of the various kinds of state roads completed in Maryland in 1910 were as follows:

Kind.	[illegible]	Ft.	Ins.	[illegible]
Gravel	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bituminous [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Brick	[illegible]	[illegible]	[illegible]	[illegible]
Shell	[illegible]	[illegible]	[illegible]	[illegible]
Earth	8	11	..	3,900

The average unit prices in 1910 were as follows:

Gravel [illegible]	[illegible]
Broken stone [illegible]	[illegible]
Bituminous [illegible]	[illegible]
Earth excavation [illegible]	[illegible]
Rock excavation [illegible]	[illegible]
Concrete masonry, per cu. yd.	9.00
Stone [illegible]	[illegible]

The road work projected for 1911 is as follows:

Gravel	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Bituminous [illegible]	[illegible]	[illegible]
Brick	[illegible]	[illegible]
Shell	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

The prevailing daily wages in 1910 per 8 hour day were: Common labor, $1.60; 2 horse team and driver, $4. W. W. Crosby is Chief Engineer Maryland State Roads Commission.

The total mileage of the various kinds of roads completed in Washington in 1910 was [illegible]

Kind.	Built.	Ft.	thick- Ins.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

The average unit prices in 1910 were as follows:

Gravel [illegible]	[illegible]
Broken stone, per cu. yd. in place	2.16
Bituminous macadam, per sq. yd.	0.40
Earth excavation, per cu. yd., haul not to exceed [illegible]	[illegible]
Rock excavation, per cu. yd., haul not to exceed [illegible]	[illegible]
Concrete masonry, per cu. yd.	10.42
Stone masonry, per cu. yd.	5.97

The prevailing daily wages in 1910 per 8-hour day were: Common labor, $2.75; 2-horse team and driver, $6.20. Henry L. Bowlby is State Highway Commissioner.

Soap-Concrete.—Soap-water, instead of ordinary water, has successfully been used for the purpose of making reinforced concrete water-tight. The case is reported in *Beton und Eisen*, of January 3rd, and concerns a grain-elevator built on the Danube, exposed to inundation. The concrete was provided with two coatings, also of concrete. The outer coating, 3½ in. in thickness, consists of fine-grained concrete containing 400 kg. of cement and 120 litres of water per cubic metre of mass, and the inner layer, ½ in. in thickness, consists of cement mortar prepared with fine river sand. The water is replaced by a solution of common soft soap (potash soap), about 4 kg. of soap being added to 1 cu. in. of concrete. The building has stood one inundation well, while another building of the same material, without the soap, did not quite keep the water out. Subsequent tests were also favorable. The soap concrete is very cheap compared with other means used to render the concrete impermeable to water. The action of the soap seems to be that the lime of the cement is bound by the fatty acids of the soap.—*[illegible]*

An Instance of the Value of Concrete in Reducing the Cost of Insurance.—At a recent meeting of the National Association of Cement Users of America, Mr. Emile G. Perrot gave the following particulars of the value of concrete in reducing the cost of insurance: "The large steel sprinkler tank and tower of the Victor Talking Machine Co., Camden, N. J., is an instance of the beneficial result derived from the use of concrete from an insurance standpoint. This tank holds 100,000 gallons of water, the bottom of which is 125 ft. from the ground. The total height of tank and tower is 174 ft. The diameter of the tank is 20 ft. The tower is erected on filled ground near a river, and the foundations of the four legs are supported on concrete piles. By reason of the close proximity of buildings belonging to other owners, the Victor Talking Machine Co. desired to take out indemnity insurance on the structure as originally designed—that is, without any concrete protection, so that in case of a fire in the buildings adjacent, and the collapse of the tower, the damage to adjoining property would be covered. This, they were informed, would cost $500 per annum. It was finally decided not to put any insurance on the structure, but instead to invest about $4,000 in fireproofing the tower with concrete. A little reflection will show that the investment fully pays for itself, not only financially, but by practically making the tower immune from fire and the destructive agencies of the atmosphere, which it would not be if left unprotected. If we charge against the tower the interest on $4,000 at 6 per cent per annum we have $240 as the carrying charge for the absolute protection against fire, instead of a $500 charge for no absolute protection to person or property, but simply to cover any damages for which the company might be liable in case of a collapse of the tower. This clearly shows how it pays to carry your own insurance by taking precautions to avoid damage to persons or property by making a building fireproof. Further, the saving on the insurance premium will pay for the fireproofing [illegible] time the original cost of the fireproofing will be wiped out. This, of course, is based on the assumption that insurance would be carried on the tower if it were not fireproofed."

WATER-WORKS AND SEWERS SECTION

Method and Cost of Constructing a Wide Open Storm Water Inlet, Dixon, Ill.

[illegible] Ill. [illegible] trouble was experienced with the ordinary forms of gutter inlets. During heavy rains the storm water collected so rapidly, and in such large volumes, that the ordinary inlets were inadequate to handle the run off, most of the water passing on over the inlet. To overcome this difficulty Mr. L. B. Neighbour, City Engineer, introduced a wide-open inlet.

Figure 1 shows the drainage plan at street intersections where these inlets are used. The slopes of the street surfaces are to the south and east. *A*, *B*, *C* and *D* show the location of the wide open inlets in this drainage layout. Where not troubled with silt the catch basin does not extend below the inverts of the pipes connecting with it, and the basin in such cases becomes merely a gathering chamber. A catch basin is built only at the corner that requires two inlets.

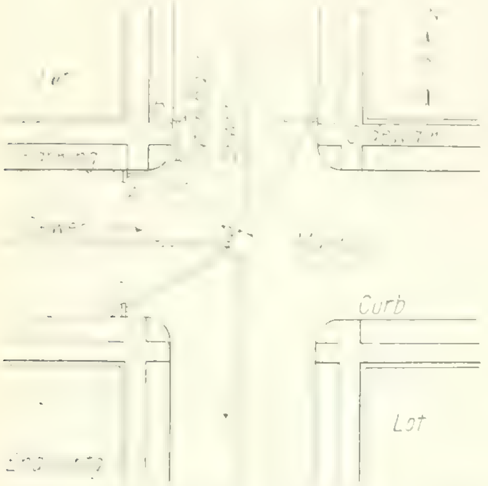


Fig. 1—Plan Showing Locations of Wide Open Storm Water Inlets.

Figure 2 shows the form of the inlet. The open end of the 10-in. or 12-in. storm water tile comes to the surface at a depression in the gutter, and is imbedded in and protected by a concrete bulkhead.

In constructing this inlet the pipe is first placed so that its upper surface is at least 6-ins. below the top of curb. The bulkhead is then easily constructed between two forms of the shape and dimensions desired. One form is set in front of the open end of the tile and staked to place. The other form is hollowed out to fit around the tile and is staked to place at from 8 ins. to 12 ins. from the first form, according to the desired width.

After the forms are taken from the bulkhead the basin or apron in front of it is constructed. The ground in the gutter is hollowed out and rounded to the desired shape, allowing for a depth of concrete of from 4 to 6 ins.

A well made bulkhead and apron of this type requires not to exceed 5 cu. ft. of concrete. It can be easily built by anyone at all familiar with concreting. Two dollars is a liberal estimate of the cost of the inlet.

The outlet pipe of the catch basin may be trapped either with a hood at the upper end, or with a running trap near the manhole. Where the inlet connects directly to the manhole the running trap near manhole is used. The storm water usually reaches the manhole at about 4 ft. above the main sewer invert. These inlets have been used on streets from 36 to 40 ft. in width between curb lines, and have been used in connection with combined as well as storm water sewers. They have been used on both paved and unpaved streets. No trouble has been experienced from careless driving against the bulkhead. On account of the comparatively deep basin in front of the inlet, and the resulting steep side slope of the street at this point, teams seem naturally to pull away from the bulkhead. This tendency also protects the curb at the turn, and keeps teams off that part of the street where the inlet pipes have the shallowest covering.

Besides low cost of construction and effectiveness, another advantage of this simple type of inlet lies in the height to which cross walks may be kept at the curb end, since they may be made flush with it if so desired.

Cost of Laying Six-Inch Cast Iron Water Mains, North Toronto, Ontario.

The municipality of North Toronto lays, each year, about 5 miles of water main and the cost of these works has been decidedly variable. Some of the work has been done by contract at from $1.05 to $1.10 per linear foot. The cost of laying, of course, varies with the conditions of the soil, and with weather conditions, as well as the price of labor and the price of material. The material met with here was clay, about one half of the material requiring to be loosened with picks. On streets Nos. 5 and 10, however, the entire length had to be loosened with picks. The 14 mains upon which the costs are given below, were laid by day labor, under town foremen, the laborers being paid at the rate of 25 cts. per hour.

Street No. 1, 2,046 lin. ft.—	
68 12-ft. pipe at $6.50 each	$1,092.00
7 tees, each 200 lbs., at 3 cts. lb.	12.00
21 cwt. lead at $3.65	76.65
3 plugs, each 15 lbs., at 3 cts. lb.	1.35
1 sleeve, 30 lbs., at 3 cts.	0.90
5 hydrants at $33.50 each	167.50
1 gate at $10.00	10.00
90 lbs. yarn at $6.65 a cwt	5.99
2 gals. oil at 20 cts.	0.40
Total material	$1,396.79
Total labor	489.18
Cost of material per lin. ft.	0.68
Cost of labor per lin. ft.	0.24
Total cost per lin. ft.	0.92
Street No. 2, 2,154 lin. ft.—	
178 12-ft. pipe at $6.50.	$1,157.00
7 tees at $6.00	12.00
26 cwt. lead at $3.65	94.90
3 plugs at 45 cts.	1.35
1 sleeve at 90 cts.	0.90
5 hydrants at $33.50	167.50
1 gate at $10.00	10.00
100 lbs. yarn at $6.65 cwt	6.65
3 gals. oil at 20 cts.	0.60
Total material	$1.480.90
Total labor	418.97
Cost of material per lin. ft.	0.68
Cost of labor per lin. ft.	0.20
Total cost per lin. ft.	0.88
Street No. 3, 840 ft.—	
70 12-ft. pipe at $6.50	$ 455.00
3 tees at $6.00	18.00
9 cwt. lead at $3.65	32.85
1 plug at 45 cts.	0.45
1 hydrant at $33.50.	33.50
1 gate at $10.00	10.00
50 lbs. yarn at $6.65 cwt	3.33
2 gals. oil	0.40
Total material	$ 553.52
Total labor	154.53
Cost of material per lin. ft.	0.66
Cost of labor per lin. ft.	0.19
Total cost per lin ft.	0.85
Street No. 4, 300 lin. ft.—	
25 pipe at $6.50	$ 162.50
3 cwt. lead at $3.65	10.95
1 sleeve at 90 cts.	0.90
20 lbs. yarn at $6.65 cwt	1.33
1 gal. oil at 20 cts.	0.20
Total material	$ 175.88
Total labor	63.85
Cost of material per lin. ft.	0.59
Cost of labor per lin. ft.	0.21
Total cost per lin. ft.	0.80
Street No. 5, 1,548 lin. ft.—	
129 pipe at $6.50.	$ 838.50
6 tees at $6.00	36.00
17 cwt. lead at $3.65	62.05
3 plugs at 45 cts.	1.35
3 hydrants at $33.50	100.50
2 gates at $10.00	20.00
75 lbs. yarn at $6.65 cwt	5.00
2 gal. oil at 20 cts.	0.40
Total material	$1,063.80
Total labor	385.59
Cost of material per lin. ft.	0.68
Cost of labor per lin. ft.	0.25
Total cost per lin. ft.	0.93
Street No. 6, 1,296 lin. ft.—	
108 pipe at $6.50	$ 702.00
4 tees at $6.00	24.00
14 cwt. lead at $3.65	51.10
1 plug at 45 cts.	0.45
4 hydrants at $33.50	134.00
1 gate at $10.00	10.00
70 lbs. yarn at $6.65 cwt	4.65
3 gals. oil at 20 cts.	0.60
Total material	$ 926.80
Total labor	253.56
Cost of material per lin. ft.	0.71
Cost of labor per lin. ft.	0.20
Total cost per lin. ft.	0.91
Street No. 7, 1,092 lin. ft.—	
91 pipe at $6.50	$ 595.50
3 tees at $6.00	18.00
11 cwt. lead at $3.65	40.15
2 plugs at 45 cts.	0.90
1 sleeve at 90 cts.	0.90
2 hydrants at $33.50	67.00
2 gates at $10.00	20.00
70 lbs. yarn at $6.65 cwt	4.65
3 gals. oil at 20 cts.	0.60
Total material	$ 747.70
Total labor	275.95
Cost of material per lin. ft.	0.68
Cost of labor per lin. ft.	0.25
Total cost per lin. ft.	0.93
Street No. 8, 264 lin. ft.—	
22 pipe at $6.50	$ 143.00
3 cwt. lead at $3.65	10.95
1 sleeve at 90 cts.	0.90
1 gal. oil at 20 cts.	0.20
Total material	$ 155.05

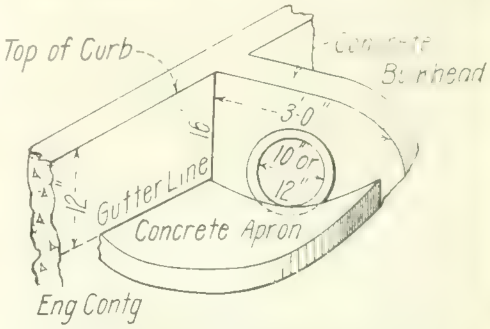


Fig. 2—Sketch of Wide Open Storm Water Inlet.

Total labor	44.63
Cost of material per lin. ft.	0.59
Cost of labor per lin. ft.	0.17
Total cost per lin. ft.	0.86
Street No. 9, 600 lin. ft.—	
50 pipe at $6.50	$ 325.00
7 cwt. lead at $6.00	42.00
1 plug at 45 cts.	0.45
1 sleeve at 90 cts.	0.90
1 gate at $10.00	10.00
30 lbs. yarn at $6.65	2.00
2 gals. oil at 20 cts.	0.40
Total material	$ 380.75
Total labor	144.90
Cost of material per lin. ft.	0.63
Cost of labor per lin. ft.	0.24
Total cost per lin. ft.	0.87
Street No. 10, 840 lin. ft.—	
70 pipe at $6.50	$ 455.00
4 tees at $6.00	24.00
10 cwt. lead at $3.65	36.50
2 plugs at 45 cts.	0.90
1 sleeve at 90 cts.	0.90
3 hydrants at $33.50	100.50
1 gate at $10.00	10.00
50 lbs. yarn at $6.65 cwt	3.33
3 gals. oil at 20 cts.	0.60
Total material	$ 631.23
Total labor	180.62
Cost of material per lin. ft.	0.75
Cost of labor per lin. ft.	0.22
Total cost per lin. ft.	0.97
Street No. 11, 1,488 lin. ft.—	
124 pipe at $6.50	$ 806.00
4 tees at $6.00	24.00
15 cwt. lead at $3.65	54.75
1 plug at 45 cts.	0.45
4 hydrants at $33.50	134.00
1 gate at $10.00	10.00
75 lbs. yarn at $6.65 cwt	5.00
4 gals. oil at 20 cts.	0.80
Total material	$1,035.00
Total labor	330.22
Cost of material per lin. ft.	0.71
Cost of labor per lin. ft.	0.22
Total cost per lin. ft.	0.93
Street No. 12, 864 lin. ft.—	
72 pipe at $6.50	$ 468.00
2 tees at $6.00	12.00
9 cwt. lead at $3.65	32.85
1 plug at 45 cts.	0.45
1 sleeve at 90 cts.	0.90
1 hydrant	33.50
1 gate	10.00

40 lbs. yarn at $6.65 cwt	2.66
3 gals. oil at 20 cts	0.60
Total material	$ 560.96
Total labor	184.01
Cost of material per lin. ft	0.65
Cost of labor per lin. ft	0.21
Total cost per lin. ft	0.86
Street No. 13, 666 lin. ft.—	
55 pipe at $6.50	$ 357.50
2 tees at $6.00	12.00
7 cwt. lead at $3.65	25.55
1 plug at 45 cts	0.45
2 hydrants at $33.50	67.00
1 gate at $10.00	10.00
25 lbs. yarn at $6.65 cwt	1.66
1 gal. oil	0.20
Total material	$ 474.36
Total labor	133.45
Cost of material per lin. ft	0.71
Cost of labor per lin. ft	0.20
Total cost per lin. ft	0.91
Street No. 14, 1,056 lin. ft.—	
87 pipe at $6.50	$ 565.50
4 tees at $6.00	24.00
11 cwt. lead at $3.65 cwt	40.15
3 plugs at 45 cts	1.35
3 hydrants at $33.50	100.50
1 gate at $10.00	10.00
50 lbs. yarn at $6.65 cwt	3.33
2 gals. oil at 20 cts	0.40
Total material	$ 745.23
Total labor	210.67
Cost of material per lin. ft	0.70
Cost of labor per lin. ft	0.20
Total cost per lin. ft	0.90
Summary	
Total lin. ft. laid	15,054
Total pieces 12-ft. pipe	1,249
Total weight of lead used, lbs	16,300
Lbs. lead per pipe laid	13.05
Total yarn used, lbs	747
Lbs. yarn per pipe	0.6
Total cost of material per lin. ft	$0.673
Total cost of labor per lin. ft	0.214
Total cost of labor and material per lin. ft	0.887

The above data is exclusive of the material for 14 manholes, which cost $611.36 or $43.67 per manhole.

We are indebted to Mr. E. A. Jones, town engineer of North Toronto, for the information furnished.

The Hydraulic Ram.*

The principles underlying the construction and operation of the hydraulic ram were recognized as early as 1775 by John Whitehurst, who in that year communicated to the Royal Society a paper describing a machine of a simple type in which the overflow or waste valve was operated by hand. The next improvement was made by a Frenchman, Joseph Michael de Montgolfier, the first to see that the variable pressure produced by changing velocity of a column of water could be utilized to operate the valve. Since that time numerous improvements have been made in the way of producing quick action of valves by aid of springs and weighted levers, but the ram is essentially the same as in its earliest form.

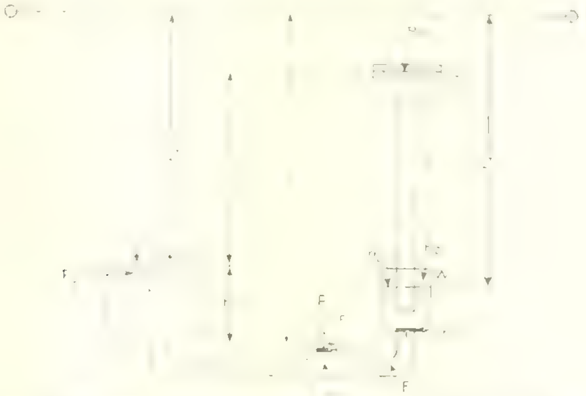


Fig. 1—Diagram Illustrating Operation of Hydraulic Ram.

A drive pipe, *A*, (Fig. 1) takes water from a source of supply *H*, to a chamber which contains the valve V_1. This valve, which opens inwardly, is called the waste or overflow valve. In another part of the same, or a communicating chamber, is a check valve V_2, which leads to the tank into which water is being forced and which has a water level considerably above that of the supply tank. When V_1 is opened the column of water in the drive pipe is set in motion and will finally attain a velocity which builds up a pressure under V_1 sufficient to close the waste valve. The energy of the moving mass in the drive pipe cannot immediately be dissipated, so that the pressure in the chamber rises and lifts the check valve, allowing some of the water to enter the air chamber *W*, compressing the air and forcing [illegible] of water into the tank *C*. When the water in the drive pipe comes to rest, V_2 closes, V_1 opens and the cycle is repeated. The pressure may for an instant be slightly less than atmospheric and advantage is taken of this to introduce a small amount of [illegible] This air replenishes any part of the supply in the air chamber which may be carried out with the water.

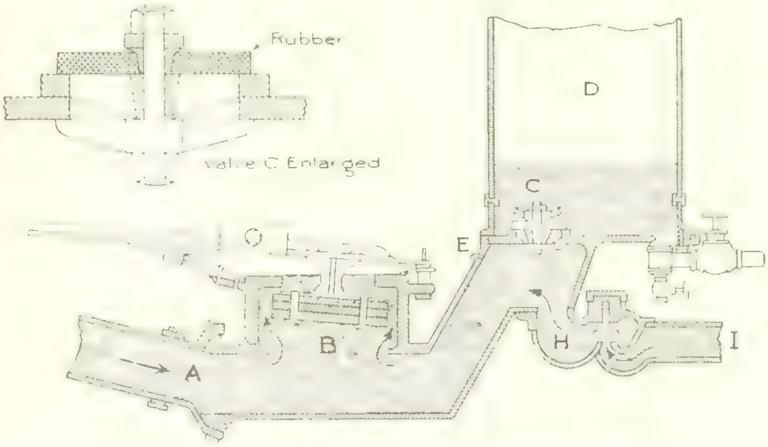


Fig. 2—Section of Double Supply Hydraulic Ram.

Although the ram may have a high efficiency, it is wasteful of water, and the form shown in section in Fig. 2 has been devised to pump pure water with a minimum of waste. *A* is connected to the source of waste water, which may be any polluted water available. *I* is the connection to the potable water which should preferably come from a source under slightly greater head than the impure water. In this ram the waste water consists mainly of that entering at *A* but, in part from that entering at *I*, and if the capacity of the space between the waste valve *B* and the check valve *C* in greater than the amount of water delivered per pulse, no impure water can enter the chamber *D*. In this ram the air valve is placed at *E*.

The theory of the ram which follows is taken, in the main, from a series of articles by Dr. H. Lorenz,[1] and its presentation at this time is justified by the fact that to the author's knowledge it is the first analysis which "renders possible in advance of design of the ram, its operation, computations of useful water work, water required, number of pulses per minute, from which the efficiency can be directly computed." Furthermore, there has been recently a marked tendency toward the installation of large units, and the discussion has an immediate bearing on modern practice as well as furnishing an interesting mathematical analysis.

If g = acceleration due to gravity,
w = density of the liquid,
p = water pressure in pounds per square foot,
t = time in seconds,
f = coefficient of frictional resistance,
d[illegible] = element of height fallen through for,
ds = element of space measured from cross section of F_1,
v = velocity of the water,

then the energy equation takes this form—

$$\frac{dz}{ds} - \frac{g}{w}\frac{dp}{ds} = \frac{dv}{dt} + [illegible]\frac{dv}{ds} + f\frac{v^2}{2}$$

This equation expresses the fact that the difference between the change in head and of potential energy between two section ds distance apart is used in producing a change of velocity from steady flow at one section, in producing a change of velocity head between the two sections and in overcoming friction resistance. If the first term of the right hand side be omitted, the equation reduces to that of continuity of flow.

Assume that the level of F_0 (figure 1) remains at a constant depth below the datum 00, take the cross sections of the pipe and of the valve as F' and F_1, p_0 atmospheric pressure, p' the variable pressure under the valve and f' the mean coefficient of friction while the velocity from v_0 to v', then the energy quotation becomes

$$[illegible]\ \frac{g}{w}(p' - p_0)\ [illegible] \int \frac{F'\,dv}{F\ [illegible]}\ [illegible]\ \frac{v_1^2}{2}\ [illegible] \qquad (1)$$

[illegible] approximately

$$[illegible]\ \frac{v_1^2}{2}\ [illegible]$$

$$[illegible]\ (p' - [illegible]) = [illegible]\ \frac{[illegible]}{dt}\ [illegible] \int_F^{[illegible]}\ [illegible]\ (1+f')\ [illegible]$$

[illegible]

$$[illegible] \int [illegible] \left([illegible]\right)$$

[illegible] lowing substitutions:

$$[illegible] \int [illegible] \qquad [illegible] \int [illegible] \left([illegible]\right)$$

[illegible]

---

*A paper by Leo Loeb in "The Polytechnic" [illegible] February, 1911.

[1] [illegible] 1911.

$dt =$ [illegible] .(2)

In this differential time there passes through the valve V_1 a quantity of liquid

$dV' =$ [illegible]

....(3)

so that during the time the water starts from rest and [illegible] there is discharged through the valve

$V' =$ [illegible]

[illegible]

which [illegible] $\frac{2gh_1}{u' + u_1}$ [illegible] the exit velocity can never reach that of a uniformly flowing stream.

$c_1 = 2g$ [illegible] $u's_1 + u_1 s'$

As long as the waste valve is open

$F_1 (p' - p_0) \leq P$ or $p' - p_0 < \frac{P}{F_1}$

This will give for limiting values of P

[illegible] $> P >$ [illegible] .... (5)

and for the time of overflow

$t' =$ [illegible] $\log \frac{\sqrt{2gh_1} + c_1 \sqrt{u' + u_1}}{\sqrt{2gh_1} - c_1 \sqrt{u' + u_1}}$ .... (6)

If F_2 is the area of cross section of the air chamber

p_2 is the pressure in the air chamber

$$s'' = F_0 \int_{F'}^{F} \frac{ds}{F}$$

c_2 velocity at which valve closes.

$u'' = F_0^2 \left(\frac{1 + f''}{F_2^2} - \frac{1}{F'^2} \right) \frac{p_2 - p}{w}$ [illegible]

[illegible] $= h_2$ .... (7)

there results for the volume discharged through the check valve

$$V'' = \frac{F_0 (s' + s'')}{u' + u''} \left[\log \left(\frac{2gh_2}{u' + u''} + \frac{c_1^2 s'^2}{(s' + s'')^2} \right) - \log \frac{2gh_2}{u' + u''} \right]$$ ....(8)

and for the time during which the valve is open

$\frac{2(s' + s'')}{\sqrt{2gh_2 (u' + u'')}}$ [illegible] .(9)

[illegible]

The formula for efficiency $\left[\frac{\text{output}}{\text{input}} \right]$ [illegible]

[illegible]

(a) Rankine's formula which considers that the water was lifted through the difference of head of supply reservoir and storage tank by the energy in the waste water so that

$\epsilon =$ [illegible] ....(10) and

(b) D'Aubisson's formula which considers that the water was lifted from the waste valve to the storage tank by the energy in all the water coming to the ram.

$\epsilon = \frac{V''(h_2 + h_1)}{(V'' + V')h_1}$ ....(11)

The Rankine formula (10) will give the lower result and is preferred by most engineers, since it is not considered just to credit any increased efficiency to the apparatus, due to the fact that a certain quantity of the water falls through a height and is immediately raised through the same distance; or in other words the water would rise in the tank h_2 feet below the upper surface if the ram mechanism were absent.

To illustrate the application of the above take the following installation:

Area of surface of storage reservoir (F_0) = 20 square feet.

$h_1 = 13$ ft.

$h_2 = 53$ ft.

Nominal diameter of drive pipe (D) 2 in.

Area of drive pipe (F_1) .0233 sq. ft.

Net section of waste valve passage (F') .0233 sq. ft.

Length of drive pipe (l) 160 ft.

Length of valve passage (l_1) 0.32 ft. Net section of passage between valves ....(F') = .0233 sq. ft.

Length of passage........(l'') = .75 ft.

Area of air chamber......(F_2) = .8 sq. ft.

$\frac{F_0}{F'} = \frac{F_0}{F_1} = \frac{20}{.0233} = 858$

$s' =$ [illegible] $= 137,200$ ft.

$s_1 =$ [illegible] $= 274$ ft.

Assume friction coefficient .02.

[illegible] .02 [illegible] 18.5

Assume $f_1 = 2$.

$u' = 19.5 \times (858)^2 = 14,400,000$.

$u_1 = 2 \times (858)^2 = 1,480,000$.

The limiting values of weight of valve are

1.76 lbs. $> P >$ .038 lbs.

If the valve be loaded to a weight of 1 lb., the velocity in the supply tank when the waste valve closes is

$c_1 =$ .00542 ft. per second

which corresponds to a drive pipe velocity of $858 \times .00542 = 4.55$ ft. per second. Volume discharged through the waste valve and time of discharge are

$V' = .139$ cu. ft. per stroke.

$t' = 2.32$ seconds.

Taking $f'' = 2$, $u'' = -736,000$ $s'' = 615$ ft.

Then the velocity in the supply reservoir during the pumping stroke is

$\frac{s' c_1}{s' + s''} =$ .00540

practically the same as during the overflow part of the stroke.

The volume of water pumped and the time of pumping are

$V'' = .0221$ cu. ft.

$t'' = .42$ seconds.

Number of pulses per minute are

$\frac{60}{2.32 + .42} =$ [illegible]

The efficiency is

$$\frac{.0221 \times 53}{.139 \times 13} = .649 \text{ or } 64.9\%$$

The capacity of the ram is

$.0221 \times 22 \times 60 \times 7.5 = 218.8$ gals. per hour.

The values given in the following Table I and plotted in Fig. 3 are the results of simi-

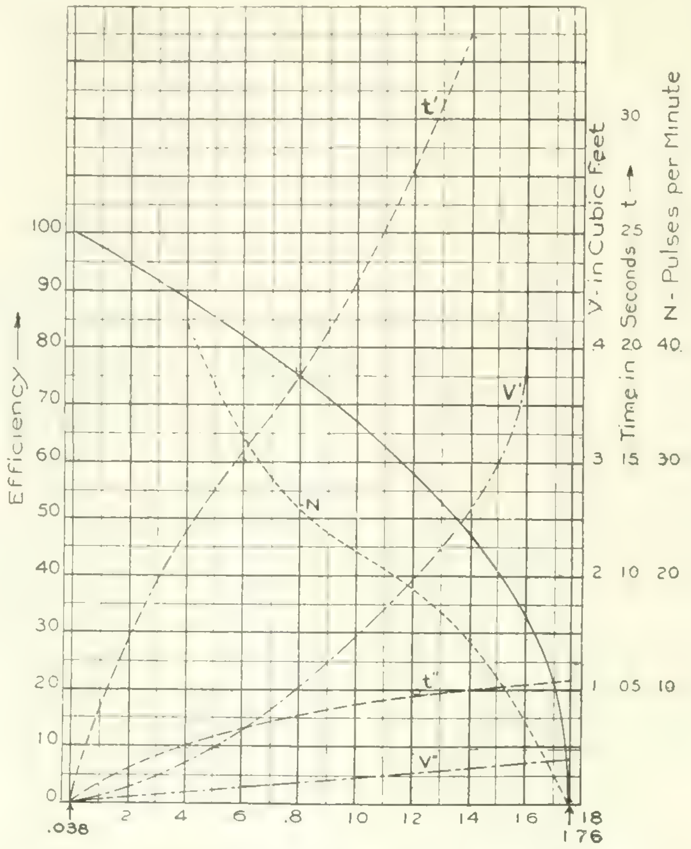


Fig. 3—Diagram Showing Capacity and Efficiency of Hydraulic Ram.

(Figures along bottom represent load on valve in pounds.)

TABLE I.

Load on valve, pounds.	C₁=C₂ feet per second.	[illegible] per [illegible]	t' sec-[illegible]	V'' cubic feet per stroke.	t'' seconds.	t'+t'' seconds	N pulses per minute.	Efficiency.	Capacity gallons per hour.
[illegible]	0		0				∞	1.00	0
.4	[illegible]	.040	1.17	[illegible]	.26	1.43	[illegible]	.89	[illegible]
.6	.00415	[illegible]	1.55	[illegible]	.33	[illegible]	32	.79	190
[illegible]	[illegible]	.101	1.91	[illegible]	[illegible]	2.29	26	.75	218
1.0	[illegible]	.139	2.32	.0221	[illegible]	2.74	[illegible]	.65	219
1.2	.00595	.191				2.95	[illegible]	[illegible]	238
1.4	[illegible]	.261	3.36	.0306	.50	3.86	16	.48	220
[illegible]	.00691	.405		.0340		[illegible]	8	.34	122
[illegible]	.00725	[illegible]	[illegible]	.0372	.55	[illegible]	[illegible]	0	0

lar computations at various valve loads:

The number of strokes increases rapidly with decreasing P and the efficiency, which is zero for the maximum limit of pressure increases with decreasing load on the valve, reaching unity at the maximum limit of $P = 1.76$ lbs. This result can at best be considered a limit of most economical operation as under the conditions that would give maximum efficiency, the delivery becomes zero, as the waste valve opens immediately following its closing.

This discussion does not consider the friction loss in the stand pipe B, which lowers the efficiency somewhat. In spite of this it has been possible to construct rams of high efficiency when operated under best conditions. In 1905 there were installed at the naval coaling station, Bradford, R. I., two Foster rams, each with a capacity of 200 gallons per minute. Each drive pipe was 275 ft. long and 12 ins. in diameter. Water was delivered through one 8-in. pipe to a stand pipe 52 ft. high and 30 ft. in diameter.

The guarantee of the builders was a delivery of 200 gals. per minute at an efficiency of 80 per cent, which was more than met by the two acceptance tests given below.

Test	1	[illegible]
Total water to ram in gallons per minute	[illegible]	[illegible]
Water delivered in gallons per minute	[illegible]	[illegible]
Power head on ram, feet	[illegible]	[illegible]
Falling head [illegible]	[illegible]	[illegible]
Strokes per minute	[illegible]	[illegible]
Efficiency (Rankine) [illegible]	[illegible]	[illegible]
Efficiency (D'Aubuisson) per cent	[illegible]	[illegible]

The ram lends itself readily to variable demand, which can be met by either changing the weight of the waste valve or adjusting the stroke of that valve. The ram has its greatest field in the water supply for small towns where it is important to keep the cost of maintenance and attendance as low as possible. A recent installation in a town of 1,600 supplanted a steam pumping outfit where the daily cost of operation was $25.00. The only attention which the ram required was occasional renewal of valve discs.

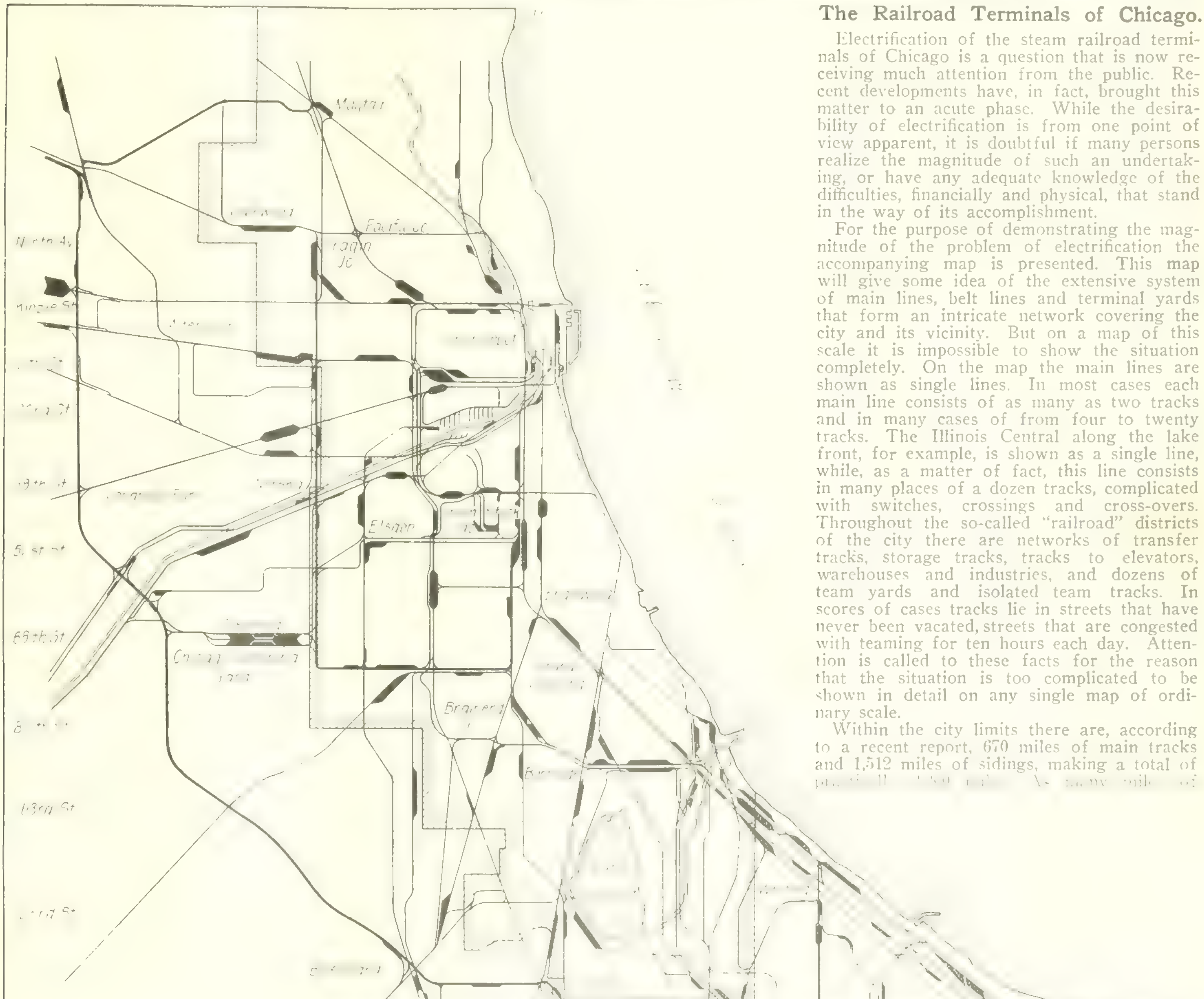
STEAM AND ELECTRIC RAILWAY SECTION

The Railroad Terminals of Chicago.

Electrification of the steam railroad terminals of Chicago is a question that is now receiving much attention from the public. Recent developments have, in fact, brought this matter to an acute phase. While the desirability of electrification is from one point of view apparent, it is doubtful if many persons realize the magnitude of such an undertaking, or have any adequate knowledge of the difficulties, financially and physical, that stand in the way of its accomplishment.

For the purpose of demonstrating the magnitude of the problem of electrification the accompanying map is presented. This map will give some idea of the extensive system of main lines, belt lines and terminal yards that form an intricate network covering the city and its vicinity. But on a map of this scale it is impossible to show the situation completely. On the map the main lines are shown as single lines. In most cases each main line consists of as many as two tracks and in many cases of from four to twenty tracks. The Illinois Central along the lake front, for example, is shown as a single line, while, as a matter of fact, this line consists in many places of a dozen tracks, complicated with switches, crossings and cross-overs. Throughout the so-called "railroad" districts of the city there are networks of transfer tracks, storage tracks, tracks to elevators, warehouses and industries, and dozens of team yards and isolated team tracks. In scores of cases tracks lie in streets that have never been vacated, streets that are congested with teaming for ten hours each day. Attention is called to these facts for the reason that the situation is too complicated to be shown in detail on any single map of ordinary scale.

Within the city limits there are, according to a recent report, 670 miles of main tracks and 1,512 miles of sidings, making a total of [illegible] As many miles of



Map Showing Principal Yards, Main Lines, Belt Lines and Transfer Connections in the Chicago Switching District.

[illegible] but in the immediate vicinity of the city. Within the Chicago switching district there are, therefore, close to 5,000 miles of tracks. Approximately 4,000,000 loaded cars per year, or an average of 11,000 per day, are received and handled in this district. Of the 4,000,000 cars, 775,000 are destined to points beyond Chicago, and an equal number are interchange business destined to points within Chicago.

On the map there are shown 69 important yards within the city limits. The lumber district of the Burlington, with its complication of tracks, is not included in the count, nor is the Union Stock Yards, which contains in itself an enormous railroad terminal.

Outside the city limits, but so intimately connected with the track system of the city that electrification of one would necessarily mean electrification of the other, are 46 important terminal and transfer yards. Among these, with its eastern end at the city limits, is the Clearing Yard of the Chicago Union Transfer Ry., one of the largest and most important transfer yards in the world. There are also over 20 junctions, over which hundreds of trains pass daily. Electrification of the terminals within the city would bring about electrification of these outlying junctions as a matter of operating necessity.

An examination of the map will show that, aside from the extreme northern part of the city, there is within the city and its immediate vicinity a network, not of railroad tracks, but of railroad systems. The magnitude of the task of electrification is apparent, especially when it is considered that electrification, if attempted at all, must be extended into Indiana far enough to include the whole "Calumet" manufacturing district. This would be necessary on account of the intimate operating relations existing between this district and the railroads within the city.

THE BELT LINES

The city of Chicago is encircled by three belt lines. Each one of these intersects all railways and is intended to divert through or transfer freight, and to prevent its entry into the congested central portion of the city. Much traffic is diverted in this way. But, owing either to the insufficiency of these facilities or to considerations of financial and operating policy, an enormous amount of through traffic is still transferred in yards that lie in the central part of the city. In addition to these belt lines, certain railroads, of which the Chicago, Indiana & Southern R. R. is an example, act as connecting lines between eastern and western trunk lines and handle a heavy transfer business that never comes near the city limits of Chicago.

The Elgin, Joliet & Eastern R. R., or what is known as the "outer belt," extends completely around the northern, western and southern sides of the city. It intersects every railroad entering Chicago and has facilities for the transfer of cars at every junction. It touches the lake at Waukegan and South Chicago, and thus furnishes direct connections between the railroads and lake docks for such traffic as requires trans-shipment. This line extends from Waukegan in a wide curve through Spaulding, West Chicago, Normantown, Joliet and Chicago Heights, and has its eastern terminus at Porter, Ind. It has a branch to Aurora, a branch connecting with the Wilmington coal fields, and one at Griffith, Ind., connecting with South Chicago and railroads and industries in that vicinity. This line lies mainly beyond the limits of the accompanying map. With the exception of the branch to South Chicago, it also lies beyond any reasonable limit of electrification. It would be exceedingly inconvenient, however, to operate one part of a belt line by electricity and the remainder by steam, and the electrification of the terminals of Chicago would probably result in the electrification of the entire outer belt, with the possible exception of the branch to the Wilmington coal fields.

The middle belt comprises a number of connecting lines owned by several companies, and operated by the Chicago Terminal Transfer Co. and the Indiana Harbor Belt line. It extends from Mayfair through Franklin Park, La Grange, Blue Island, Dalton, Gibson and Indiana Harbor to Pine Junc., Whitney and South Chicago.

The inner belt extends south from Cragin Junction to the vicinity of 75th St.; thence east to Halsted St., and thence north and west to the Union Stock Yards. The Clearing Yard of the Chicago Union Transfer Ry. is so located as to form a connection between the Middle and Inner Belts; but it is only one of many such connections. The Middle and Inner Belts are shown by heavy lines on the accompanying map.

These belt lines not only serve as transfer connections for through traffic, but also do an extensive interchange business in traffic destined from one railroad to local yards of other railroads. For this purpose there are numerous transfer lines throughout the central and southern portions of the city. Some of these transfer tracks are used by trunk lines for reaching their passenger stations and terminal yards. Probably in no other railroad center in the world is there such a complication of joint ownerships and trackage agreements as exists in Chicago.

FREIGHT HOUSES AND TEAM YARDS

Of greater importance than the transfer business between trunk lines is the handling of freight originating or terminating in Chicago. This business necessitates the operation of a great number of freight houses and team tracks, is responsible for the existence of the Illinois Tunnel Co. with its 50 miles of tunnel under the loop district, and requires the operation of an extensive lighterage service on the river. A reliable list of the freight stations within the district covered by the map gives a total of 235. When it is considered that each one of these freight stations is served by from 6 to 30 tracks, it is easy to see what a problem this feature alone would furnish in the way of electrification. At 61 of these freight stations interchange freight in less-than-car-load lots is handled.

At 36 freight station connections with the Illinois Tunnel Co. exist, and a great volume of freight is transferred to and from the business district by this means.

There are 8 docks at or near freight stations for transferring freight from the railroads to and from the lighters that serve the warehouses and wholesale houses along the river. When, in addition to these facilities for the distribution of local freight, consideration is given to the constant conjestion on the streets caused in great part by teams engaged in the same work, the great amount of railroad activity necessary for handling local freight into and out of the city will be realized.

Within the city and in its immediate vicinity there are, as indicated above, many different phases or divisions of railroad activity, no one of which, on account of operating conditions, could be electrified without necessitating the electrification of all the others. Any one of these divisions would furnish alone a problem in electrification greater than anything that has yet been attempted.

Some Notes on Piles and Pile Driving Practice in Railway Construction.*

Principles of Practice.—(1) A thorough exploration of the soil by borings, or preliminary test piles, is the most important prerequisite to the design and construction of pile foundations.

(2) The cost of exploration is frequently less than that otherwise required merely to revise the plans of the structures involved, without considering the unnecessary cost of the structures due to lack of information.

(3) Where adequate exploration is neglected, it may result in the entire loss of the structure, or in greatly increased cost.

(4) The proper diameter and length of pile, and the method of driving, depend upon the results of the previous exploration.

(5) Where the soil consists wholly or chiefly of sand, the conditions are most favorable to the use of the water jet.

(6) In harder soils containing gravel the use of the jet may be advantageous, provided sufficient volume and pressure be provided.

(7) In clay it may be economical to bore several holes in the soil with the aid of the jet before driving the pile, thus securing the accurate location of the pile, and its lubrication while being driven.

(8) The water jet should not be attached to the pile but handled separately.

(9) Two jets will often succeed where one fails, in special cases a third jet extending a part of the depth aids materially in keeping loose the material around the pile.

(10) Where the material is of such a porous character that the water from the jets may be dissipated and fail to come up in the immediate vicinity of the pile, the utility of the jet is uncertain, except for a part of the penetration.

(11) A steam or drop hammer should be used in connection with the water jet, and used to test the final rate of penetration.

(12) The use of the water jet is one of the most effective means of avoiding injury to piles by overdriving.

(13) There is danger from overdriving when the hammer begins to bounce, provided the head of the pile is not broomed. Overdriving is also indicated by the bending, kicking or staggering of the pile.

(14) The brooming of the head of a pile dissipates a part, and in some cases all, of the energy due to the fall of the hammer.

(15) The weight of the hammer should be proportioned to the weight of the pile, as well as to the character of the soil to be penetrated.

(16) The steam hammer is more effective than the drop hammer in securing the penetration of a pile without injury, because of the shorter interval between blows.

(17) Where shock to surrounding material is apt to prove detrimental to the structure, the steam hammer should always be used instead of the drop hammer. This is especially true in the case of sheet piling which is intended to prevent the passage of water. In some cases also the jet should not be used.

(18) In general, the resistance of piles, penetrating soft material, which depend solely upon skin friction, is materially increased after a period of rest. This period may be as short as fifteen minutes, and rarely exceeds twelve hours.

(19) In tidal waters the resistance of a pile driven at low tide is increased at high tide on account of the extra compression of the soil.

(20) Where a pile penetrates muck or soft yielding material and bears upon a hard stratum at its foot, its strength should be determined as a column or beam; omitting the resistance, if any, due to skin friction.

(21) Unless the record of previous experience at the same site is available, the approximate bearing power may be obtained by loading test piles. The results of loading test piles should be used with caution, unless their condition is fairly comparable with that of the piles in the proposed foundation.

(22) In case the piles in a foundation are expected to act as columns the results of loading test piles should not be depended upon unless they are sufficient in number to insure their action in a similar manner, and they are stayed against lateral motion.

(23) Before testing the penetration of a pile in soft material where its bearing power depends principally, or wholly, upon skin friction, the pile should be allowed to rest for 24 hours after driving.

(24) Where the resistance of piles depends mainly upon skin friction it is possible to diminish the combined strength, or bearing capacity, of a group of piles by driving additional piles within the same area.

(25) Where there is a hard stratum overlying softer material through which the piles are to pass to a firm bearing below, the upper stratum should be removed by dredging or otherwise, provided it would injure the piles to drive through the stratum. The material removed may be replaced if it is needed to provide lateral resistance.

(26) In general, timber piles may be ad-

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*Extract from report of Committee on Wooden Bridges and Trestles, American Railway Engineering and Maintenance of Way Association.

vantageously pointed to a 3 in. or 4 in. square at the end.

(27) Piles need not be pointed when driven into comparatively soft material.

(28) Shoes should be provided for piles when the driving is very hard, especially in riprap or shale, and should be so constructed as to form an integral part of the pile.

(29) The use of a cap is advantageous in distributing the impact of the hammer more uniformly over the head of the pile, as well as to hold it in position during driving.

(30) The specification relating to the penetration of a pile should be adapted to the soil which the pile is to penetrate.

(31) It is far more important that a proper length of a pile should be put in place without injury than that its penetration should be a specified distance under a given blow, or series of blows.

Overdriving.—In an endeavor to tabulate the general indications of overdriving, in order that it may be avoided as much as possible, the following suggestions are given:

(1) In the majority of instances, overdriving is indicated by the behavior of the pile.

(2) The use of a drop hammer instead of a steam hammer and the absence of a water jet often lead to overdriving.

(3) Splices, unless made with great care, are a possible cause of overdriving.

(4) A gradual decrease in the penetration per blow, followed by a sudden and large increase, is often caused by overdriving.

(5) Brooming, shattering, or buckling, of the pile may all be indicative of overdriving.

(6) The bouncing of the hammer is often an indication that further hammering will result in overdriving.

(7) The dull sound of the blow during overdriving is said to be of sufficient difference to be readily distinguishable.

The Water Jet.—The first authentic use of the water jet was in 1852, during the construction of a wharf at Decrous Point, Tex. The jet was in general use during the Civil War and tradition gives the early forties as the date of its discovery. It is said that a government engineer standing in the soft mud around a pile-driving operation could not extricate his feet, and that on turning a hose on them he sank deeper and kept sinking as long as he applied the water. After he was extricated, he tried his discovery on the piles, reasoning that if he sank into the mud when a jet of water was applied at his feet, the piles should sink likewise or offer less resistance to driving.

In the late fifties or early sixties a civil engineer named Stevens applied this method in driving screw piles. In order to facilitate the work of screwing the piles into place he attached a pipe to the side of the pile, passing the nozzle through a hole cut in the disc, thus bringing the water to the point of the pile, the idea being merely to loosen the material and facilitate the screwing down of the pile. On the application of the water it was found that the pile sank readily into place by the action of the jet alone without the use of the screw point.

The Missouri River Commission performed a valuable service, by their investigations and use of the water jet, showing its great value in pile-driving. It is said that under a later engineer the Commission found that similar results could be secured more economically and quickly by using a steam hammer instead of a water jet and drop hammer. The obvious inference is that both the water jet and steam hammer used either together or separately will often prove economical.

The water jet is essentially a stream of water forced through a pipe or hose alongside the pile. The flow of water loosens the material, and either washes it out, leaving a depression into which the pile sinks, or by lubricating the surface of the pile reduces the side friction. The use of two jets is generally advantageous in securing a more accurate direction or control of the pile.

Water simply poured on the ground around a pile while driving, not applied as a jet, will in some soils materially facilitate the driving, in one instance on record reducing the number of blows to the hammer nearly 50 per cent. Piles driven this way showed a bearing power equal to those driven on the same work without the use of water.

The jet may be used alone or in conjunction with some other method of driving, or, when the material is suitable, a hole may be jetted, the jet removed and the pile dropped into it and brought to bear by hammering.

On the Missouri River the water jet has been used extensively in sand. It was found there that the greatest penetration that could be obtained with the jet alone was between 12 and 16 ft.; a considerably greater penetration was obtained by forcing the pile down by means of a line attached to the head of the pile and passing through a block to the drum of the pile-driver. Penetrations of 38 ft. were obtained when a steam hammer was used with the jet.

When the jet has been used in rather dry, light soils it has been shown by tests that the action of the water tends to puddle the [illegible] the water has been absorbed by the surrounding earth or has been drained away, the jetted piles show a greater skin friction than piles driven in the same material without the use of the jet.

In driving wooden piles, in medium sand, for bridge foundations on the Platte River, two 2-in. jets were used in conjunction with a 6,500-lb. steam hammer.

The jets consisted of 40 ft. of 2-in. gas pipe, 50 ft. of 2-in. rubber-lined hose (pressure 300 lbs. per sq. in.), and a line of 4-in. wrought-iron pipe leading to two duplex 12x7x12-in. steam pumps with 6-in. suction and 6-in. discharge, operated by two 40 hp. upright boilers.

The distance from the pumping plant varied from 50 to 1,000 ft. and for the greater lengths a 6-in. pipe was used between the 4-in. pipe and the pumps.

It was found that the first 15 to 20 ft. of penetration was obtained within 5 minutes af-

PILE RECORD FORM

Pile Record of Bridge
LOCATION ....
Weight and Kind of Hammer.. Date..................10..
Bents Numbered from North or East End. Piles numbered from Left to Right.

Date	Bent No.	No. of Pile	[illegible]			[illegible]	[illegible]	Cut Off	[illegible]	Total Penetrat.	[illegible]		Kind of Soil	[illegible]
			Tip End	[illegible]	Length						Drop of Hammer	Penetrat.		

[illegible]

The jets were at first fastened to the pile and bent slightly at the tip, but this method was discontinued on account of the times required to connect the jets and because on the completion of the driving the jet pipes were frequently broken, a portion remaining in the ground.

The best results were obtained by churning the jets up and down, keeping the points of both jets at the bottom of the pile. This was done by means of a line attached to the top of the jet pipe and leading over the top of the driver to a point on the ground, or trestle, where it was operated by handpower.

An improvement upon the foregoing equipment would be to operate the jet hoist from a niggerhead of the engine. This method has been used successfully in a number of instances.

There is a difference of opinion upon the part of engineers as to the relative merits of keeping one or all of the jets near the foot of the pile, or of having at least one jet between the surface of the ground and the foot. In either method the jets should be kept moving in order to facilitate the flow of the water around the pile and to prevent the so-called "freezing" or sticking fast.

In some cases two jets have been used placed on opposite sides of the pile, in order to obtain sufficient volume of water and to keep the pile in alinement. In other cases a single jet, slightly in advance of the pile, has given satisfactory results.

In sand, where the jet acts for some distance, a number of piles may be sunk together. It is claimed that in sand the volume of water is the principal consideration, but that in gravel, etc., a considerable pressure is also required and that holes can be jetted near the foot of the pile into which a boulder will roll out of the way of the pile. On the other hand, it is also stated that in coarse gravel the jet washes out the sand and allows the boulders to roll to the foot of the pile and impede its progress.

In the replies to the committee it was found that of ten users of the jet, six employed it as an aid to the hammer and obtained the final penetration by the hammer alone. In general, a 2-in. pipe was operated by handpower alongside the pile, though in some instances two pipes were used. The pressures recommended were as high as 200 lbs. per sq. in.; and the material penetrated, usually sand, fine gravel or soft clay.

There appears to have been very little development in the water jet since its first introduction, and but two U. S. patents; the improvements which have been made are in the method of handling. One of the patented devices uses the water pressure to handle the jet pipe, which acts as a movement of the plunger or jet pipe is controlled by valves at the lower end plunger inside of a pipe suspended from a derrick or pile-driver; the vertical of the suspended pipe.

It does not seem desirable to use a jet pipe smaller than about 2 ins. in diameter, on account of the loss of head, due to friction, in the smaller sizes, but this should be reduced at the nozzle in order to increase the velocity, as it is the velocity which loosens the material; the quantity, however, is necessary to bring the material to the surface.

Satisfactory results have been obtained with pressures ranging from that furnished by a single hand pump up to a pressure of 200 lbs. per sq. in. at the pump. The quantity of water supplied at the nozzle runs as high as 500 gals. per minute, 250 gals. per minute giving satisfactory results in compact sand.

Desirable Features of a Track Pile Driver.—(1) Steam hammer. To secure greater rapidity in driving and with less injury to the pile than that secured by the drop hammer.

(2) Water jet apparatus.

(3) Turntable allowing practically a complete rotation. In most cases the work can be done from either side, and in many of the remaining cases it is possible to foresee the nature of the work and to head the driv- [illegible] direction [illegible] turntable. Sometimes, however, turning facilities may be far distant, or a pile-driver may be caught between two washouts when it becomes essential to be able to turn the machine to perform the work at both places.

(4) Swinging leads. The leads require an efficient rigging to permit driving piles with a batter in either direction. When driving across the track on such work as driving bents for an adjacent track, it is convenient to be able to drive with the leads not fully raised, so as to secure the proper batter.

(5) Self-propelling mechanism. The greater the tractive force and speed the more independent is the pile-driver from locomotive service. They should preferably be sufficient to dispense with a locomotive except for long hauls.

(6) Restricted projection on the side opposite the leads when swung across the track and without unnecessary weight.

(7) High-speed power device for raising the leads. On a main line it is frequently possible to drive only one or two piles before running to a siding. In some cases the character of this apparatus to raise the lead determines whether a single pile can be driven between trains or delaying a train.

(8) Adequate overhang. To enable machines to drive piles as far ahead of the leading wheels and as far sidewise as possible. On work for double-tracking the sidewise reach should be sufficient to drive a bent on the new track from a position on the old track.

(9) Facilities for driving below the track.

(10) Ability to shift the hammer when the leads are down.

(11) No obstructions in the view of the engineman and niggerhead operator.

(12) Length of leads. To accommodate the longest piles practicable.

(13) Strength and rapidity of supports for leads and hammer. They should be adequate to handle the hammer and the heaviest wooden pile without damage. It is now becoming important to be able to handle concrete piles.

(14) Stability. The driver, while standing on its own wheels, without any jacks or special supports, should be able to pick up and drive a pile in any position within its reach.

(15) Flush ends. For convenience of transportation in freight trains, no part projecting beyond the drawheads. Otherwise an idler is required, which then may be used as a tool car.

(16) No lengths of steam hose that might be replaced by pipe.

Strength of Sheet Piling.—The magnitude of the stresses in sheet piling, due to bending, depends upon the kind of material retained by it. Sheet piling is generally held in place by a wale at the top, one at or near the bottom of the excavated trench or area, and sometimes by one or more at intermediate points.

In deriving the following formulas all weights are expressed in pounds per cubic foot, all distances in feet, and all bending moments in pound-feet. A vertical strip of piling 1 ft. wide is considered for the sake of convenience.

1. Pressure Due to Water.—Let the upper wale be assumed at the water surface and the lower wale at the bottom of the excavation, or at a distance D below the surface of the water, both wales being properly braced. By the methods of mechanics the greatest bending moment occurs at a distance 0.577 D below the surface, if the piling be treated as a simple beam. This point is farther from the middle of the unsupported length than in any other case where one or more additional wales are employed. The eccentricity may, however, be regarded as offset by the partial continuity of the lower end which penetrates the soil, and thus the greatest bending moment may conveniently be taken at the middle of the unsupported depth. The value of the greatest bending moment is $3.91\ D^3$, the weight of a cubic foot of water being taken as 62.5 lbs. If an additional wale be located at a height C above the bottom one, the greatest bending moment between them is $3.91\ (2\ C^2D - C^3)$. In case both the top and intermediate wales be omitted the bending moment at the bottom is $10.42\ D^3$. If the fluid material retained by the sheet piling is heavier than water the pressures and bending moments are proportionately increased.

2. Pressure Due to Dry Sand.—According to Coulcomb's theory the horizontal pressure expressed in pounds per square foot for material which assumes a slope of 1.5 to 1 is $W\ H\ \tan^2\ (45° - \frac{1}{2}R)$, in which W is the weight per cubic foot of the material, H the depth at which the pressure occurs, and R the angle of repose expressed in degrees. This indicates that the pressure varies directly with the depth as in hydrostatic pressure, but that the unit weight of the material is $W\ \tan^2\ (45° - \frac{1}{2}\ R)$ instead of W. In the material under consideration it observed that the trench may be excavated a foot or more below the bottom of sheeting without causing any flow, and hence it may be assumed that the pressure is zero at the bottom as well as at the top.

It has also been observed that the center of pressure against sheet piling is not at one-third of the depth from the bottom, but more nearly two-thirds of the depth. It seems, therefore, that the angle of repose for any given material is not constant but varies in some manner, although not directly as the depth. In conformity with these facts R may be taken equal to $90°\ (H/D)^{0.6}$. The exponent 0.6 is based on the result of observations.

For material having an angle of repose of 33° 40′, which corresponds to a slope of 1.5 to 1, Coulcomb's formula gives a horizontal pressure equal to $0.12\ W\ D^2$, and the overturning moment about the base of $0.04\ W\ D^3$, which is claimed by Sir Benjamin Baker to be double the true value. From the results of Trautwine's experiments on overturning moment, due to dry sand, it is computed to be $0.019\ W\ D^3$. By plotting the horizontal pressures derived from the values $W\ H\ \tan^2\ [45° - 45°\ (H/D)^{0.6}]$ for different depths, the total pressure for dry sand is found to be $0.029\ W\ D^2$, and the center of pressure is approximately two-thirds of the depth of the excavation from the base, making the overturning moment $0.019\ W\ D^3$, as before.

For sheet piling resisting the pressure of dry sand when held in position by wales at the top and bottom of the excavation, the greatest bending moment occurs at a distance $0.43\ D$ from the top and equals $0.0045\ W\ D^3$. When an intermediate wale is placed at a height C above that at the bottom, the bending moment becomes $0.0045\ W\ C^2\ D$.

3. Pressure Due to Wet Slipping Material.—There remains to be considered the wet slipping material which exerts a much greater pressure than dry sand but a smaller pressure than water. Such material produces a considerable pressure at the bottom of the excavation. To meet this condition it may be assumed that the depth at which the horizontal pressure becomes zero is $2\ D$ instead of D. When this change is made in the previous value for horizontal pressure the results agree closely with those of observation. The total pressure above the bottom of the excavation is $0.08\ W\ D^2$, and the center of pressure is at $\frac{1}{2}\ D$. The overturning moment about the base is then $0.04\ W\ D^3$.

The greatest bending moment on sheet piling supported at the top and bottom only and retaining wet slipping material is $0.013\ W\ D^3$ and occurs at half depth. When an intermediate support is placed at a distance C above the bottom the bending movement is $0.013\ W\ C^3\ D$.

Mechanical Protection of Piles Against Marine Wood Borers.—On the Louisville & Nashville R. R. the methods most extensively used are:

(1) Encasing the piles in a rich mixture of Portland cement and sand, or Portland cement, sand and fine gravel filled between the piles, and removable flasks of wood, or wood and iron.

(2) Filling sand between the piles and vitrified clay pipe slipped over the tops of the piles (after heads of piles have been freed) and left in that position, pitch being mixed with the sand at the top.

The cost of the first method is reported to have been in the neighborhood of $1.50, and of the second about $1.10 per lin. ft. of pile protected. Better results were obtained from the use of Portland cement concrete than from a mixture of cement and sand.

The mortar or concrete filled between the flask and the pile mixed with the mud at the bottom to such an extent that the lower part of the protection often broke off. It was found impossible to overcome this entirely. A more serious fault was the cracking and breaking off of the upper part of the encasement. The second method was adopted to avoid these weaknesses. It is reported that this method gives fairly good results, and has been in general use on the Louisville & Nashville R. R. since 1893. When a section below the top fails it is removed and the upper sections are lowered, after which a new section is formed at the top by fastening cast iron casings (which come in two halves) around the pile and filling as before.

On the Louisville & Nashville R. R. the protection was applied to creosoted piles, which Mr. Courtenay, Chief Engineer, states had been standing in sea water for a sufficient length of time to be no longer immune from the teredo.

In 1902, the Port Arthur Canal & Dock Co., a subsidiary of the Kansas City Southern Ry. Co., protected a large number of untreated pine piles at Port Arthur, Tex., by placing a 24-in. sewer pipe around the piles and filling a mixture composed of 1 part Portland cement and 1 part sand between the piles and the sewer pipe. Part of the decks of the wharves were renewed at the same time. In case the pile to be treated came under a portion of the deck that was renewed, the sewer pipe was dropped over the head of the pile. In case the cap was not displaced, the sewer pipe was cut into halves longitudinally, and after being placed around the pile was fastened together by means of wire. The protection extended from a foot or two below mud line to a little above high tide.

On account of the burning of division offices the cost of this work is not available. Complete protection was afforded the piles against the teredo, but these piles have decayed above the water line to such an extent that it will soon be necessary to replace them in whole or in part.

Manganese-Steel Frogs and Switch Points.

In our issue of Feb. 8, 1911, we presented a detailed description of standard practice in the design and manufacture of manganese steel crossings for steam railroads. While that paper described the practice of one manufacturer, the forms of construction described may be taken as typical of up-to-date practice, as there is a striking similarity in design and manufacture among the different makers. This is surprising in view of the short time that has elapsed since manganese began to be used for frogs and crossings.

According to the best information obtainable the first manganese steel frog for steam railroad use in America was made in the shops of Wm. Wharton, Jr., & Co., about twelve years ago. Four years ago the Morden Frog & Crossing Co., of Chicago, became the pioneers in the west, and made frogs from manganese steel furnished by the American Brake Shoe & Foundry Co. Since that time a large percentage of the frog and crossing manufacturers of the country have entered the field, and the resulting development has been rapid. Improvements are being made constantly; but the fact that practice among the different manufacturers is so nearly uniform is an indication of the high state of perfection to which the manufacture of this class of track material has been brought. The mechanical features of manganese construction have been developed to a satisfactory stage. Economically this construction is adapted only to cases where the service is heavy. As bearing on the question of economy we quote the following paragraph from the paper on manganese crossings:

> [illegible] to that of installing any long-lived or permanent construction in preference to a compara- [illegible] to consider the first cost, interest on investment, and ultimate renewal of the manganese construction, and to make comparison with the total cost of the ordinary construction, with its several renewals, during the same period.

In case of a crossing or special frog it is also necessary to consider the possibility of changes in track arrangement by which the crossing or special frog in question might be abandoned and rendered useless. This consideration does not apply, however, to standard frogs and switch points, since such material may be transferred and used at other points on the road.

The earlier forms of manganese frogs and crossings were mainly of a type in which manganese inserts were used at the intersection of flangeways, the manganese being extended a distance of from 6 ins. to 1 ft. in each direction from the intersection in order to take the blow of the wheels in jumping the flangeway. In this construction, as in other manganese construction, the manganese rests on the base plate, the abutting rails being planed to fit the casting. Arms of the casting extend as fillers in each flangeway a sufficient distance to make possible a good connection with the T-rails. Manganese is thus provided only at points of greatest wear. This type of construction, in which a minimum of manganese steel is used, is still widely employed on account of the high cost of this metal.

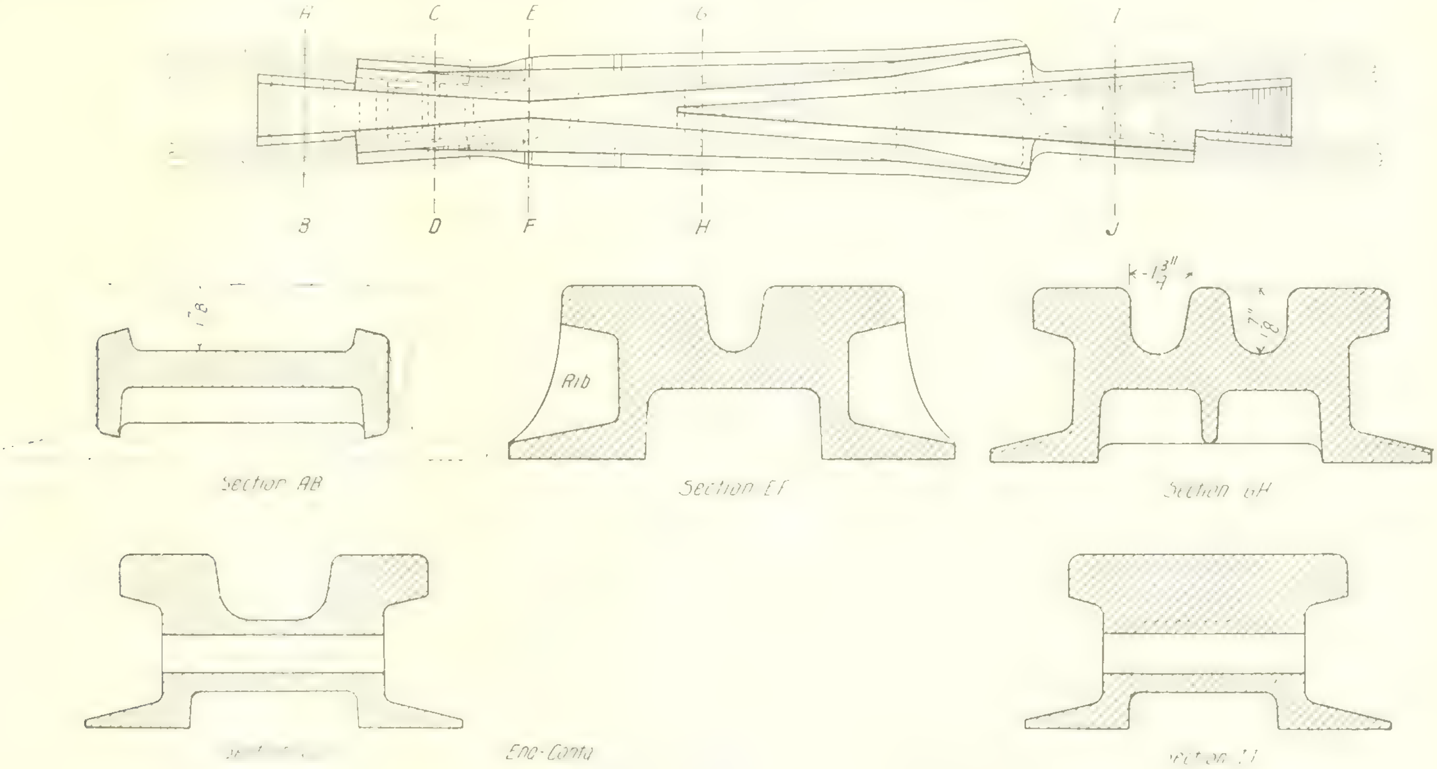

Fig. 1—Manganese-Steel Rigid Frog of the Solid Type.

The present tendency is toward frogs and crossings either of the solid or of the built-up type, both of which are described below. These have been found to be more satisfactory than the "insert" type from a mechanical point of view and are thought to be better economically where the service is heavy.

Owing to the fact that it is impossible to work manganese steel as ordinary steel is worked, it is necessary to use castings for all the manganese parts in frogs, crossings and switch points. It is practically impossible to drill this steel, and soft steel bushings and inserts are cast into the casting wherever it is necessary to drill or tap in finishing. These are afterwards drilled out with ordinary drills. The following designs, though representing the practice of a specific manufacturing company, may be taken as typical of good practice generally.

[illegible]

Rigid frogs are of two types: the solid frog and the built-up frog. A typical solid frog is shown by Fig. 1. On account of the high cost of manganese steel these frogs are made as short as is consistent with good practice, the tread rails of the one shown being 8 ft. in length. This frog is cast in one piece. In all manganese castings irregularities are removed by grinding with emory or carborundum wheels, as no steel tools have yet been made by which manganese steel can be

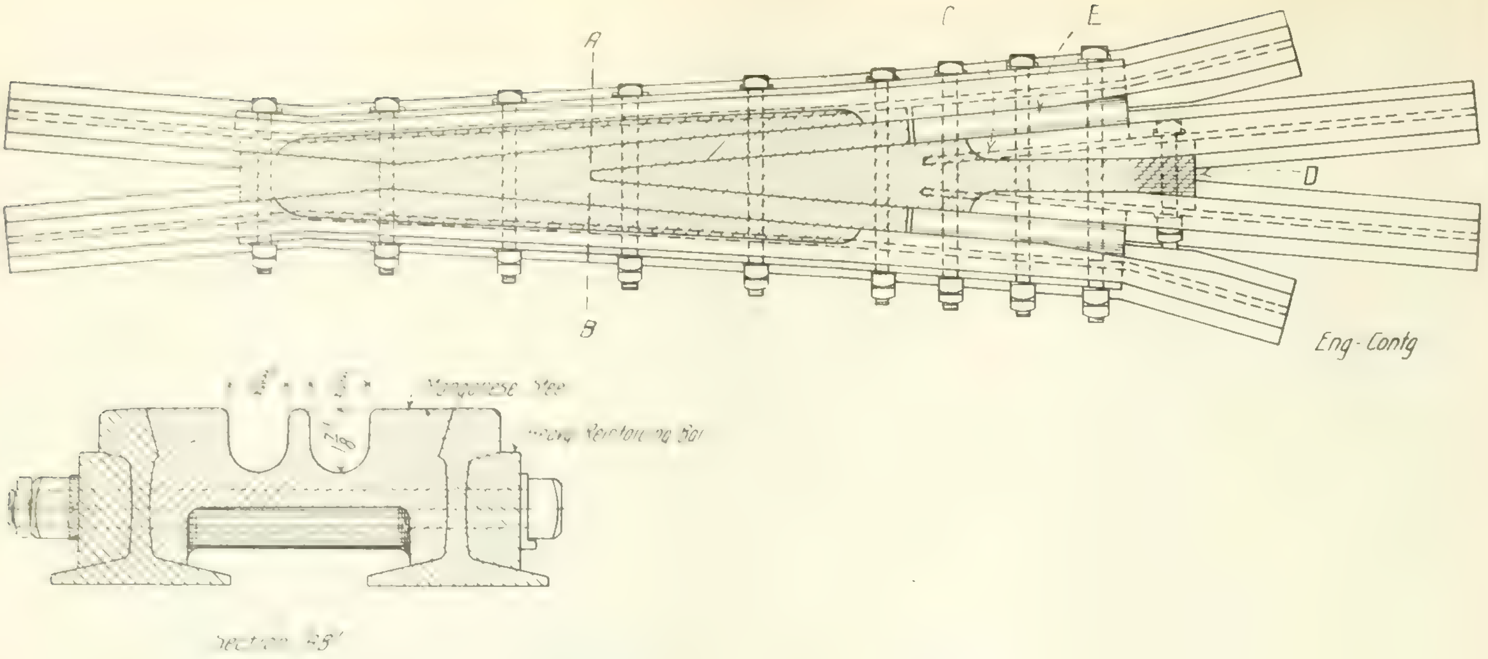

Fig. 2—Manganese-Steel Rigid Frog of the Built-Up Type.

Such a frog as this requires no repairs, as it will last indefinitely if the roadbed is kept well surfaced. The most serious, if not the only, defect in a frog of this type is the square joint between the frog and the track rail. In a joint of this kind wear of the head of the track rail is likely to occur. This, however, is unavoidable with a solid manganese frog, as it would be exceedingly inconvenient to saw the end of the track rail on an angle each time a renewal is necessary. The evident advantages of a solid frog more than offset this objection. A rigid joint is secured by means of a standard angle bar and the extension of the manganese at the ends of the frog. As shown by Section *AB*, the manganese in these extensions is so shaped as to form a fishing fit with the track rail. Adequate support is provided as shown by the sections and by the dotted outlines in the drawing of the frog.

An essential feature of good practice in all built-up manganese work is a rounded or beveled joint between the casting and the T-rail. Such a gradual transition minimizes the blow from the wheel as it passes from the rigid surface of the manganese to the relatively soft surface of the T-rail. This and other features of a typical built-up frog are shown by Fig. 2.

As in the solid frog the manganese is made as a single casting. Manganese is provided only for areas of heavy wear. The general form of construction is shown by Section *AB*. In good construction great care is taken in planing the T-rail to fit the casting, as any slight movement in the parts causes rapid wear on

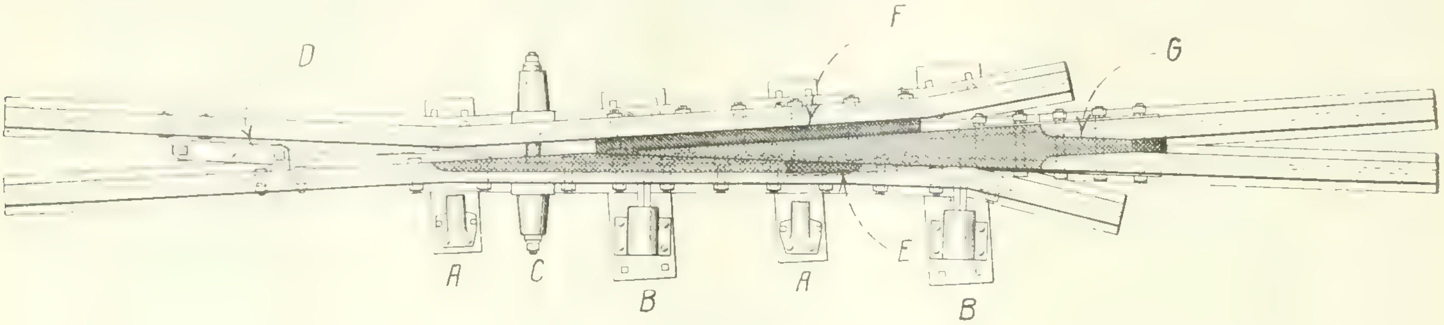

Fig. 3—Typical Spring Rail Frog of Manganese Steel.

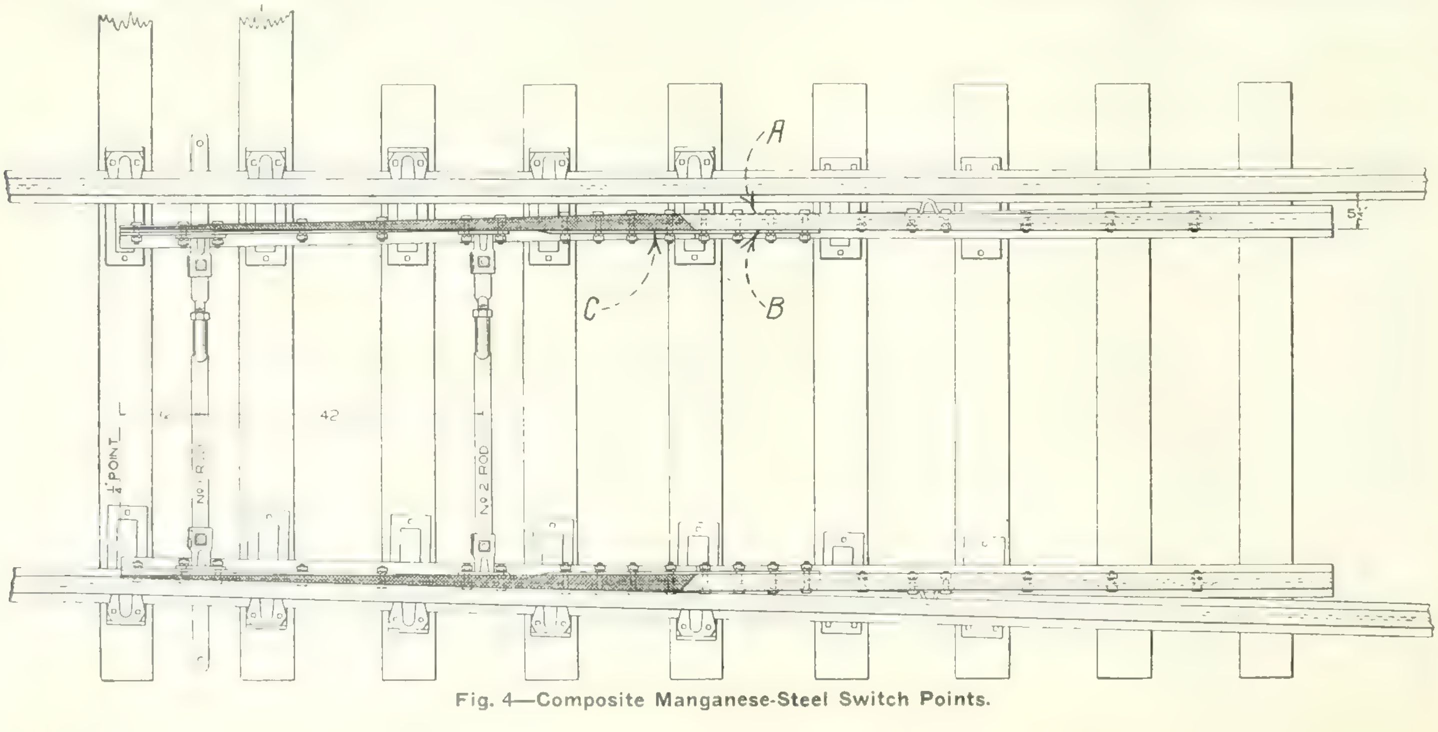

Fig. 4—Composite Manganese-Steel Switch Points.

the T-rail. The casting is extended to form a heel riser as shown at *D*. An excellent feature of this design is the manner in which the parts are interlocked at *C* by extending the web and base of the T-rail into an opening provided in the casting. At *E* an ordinary wrought or rolled filler is used.

MANGANESE SPRING RAIL FROG.

The frog shown by Fig. 3 is an example of the best practice in the design of manganese spring rail frogs. This frog is built along exactly the same lines as an ordinary spring rail frog of the best construction, manganese being used for areas of greatest wear, as indicated by shaded outlines in the figure. In spring rail frogs it is, of course, necessary to use two castings, one for the spring rail and one for the point.

The planing of the T-rail portion of the spring rail is similar to that of the side rail of the built-up rigid frog shown by Fig. 2. Standard rail stops, hold-down devices, springs and anchors are used, as shown respectively at *A*, *B*, *C* and *D* of Fig. 3. In the casting used in the spring rail a riser is provided at *E*. The filler shown at *F* is a part of the main casting, and forms a fishing fit with the side rail. The form of junction between casting and T-rails at the heel end of the frog is the same as that in the built-up rigid frog. It will be observed that in this frog manganese is used only for protection against wear in the main track portion of the frog. This in the majority of cases is sufficient. Where it is necessary to protect the turnout portion of the frog, manganese is inserted in the side rail in the manner shown by Fig 2.

MANGANESE SWITCH POINT.

A great deal of experiment has been expended in the development of a satisfactory manganese switch point. The casting of an entire switch point is a simple matter and offers no more difficulties than the making of other manganese castings. As nearly all the wear on a switch point occurs on a short portion at the point end, however, this would result in the use of an excessive amount of manganese. This consideration has led to several forms of composite switch point, one of the best of which is shown by Fig. 4.

The necessity for a thoroughly strong and rigid joint between the manganese and the T-rail introduces a serious difficulty in the making of a composite point. In the switch point shown this requirement is met in an ingenious and economical manner. The usual reinforcing plate, ⅜ in. in thickness, is placed on the side next to the main rail. This plate forms a fishing fit with both the casting and the T-rail. To this plate, and extending about 18 ins. each way from the joint, is welded a ¾-in. plate. This detail is indicated at *A* of Fig. 4. At *B*, on the opposite side of the rail, a projection of the casting extends along the side of the T-rail and forms a fishing fit with it. To make the joint still more rigid the web and a portion of the base of the T-rail extends beyond the joint, as shown at *C*, fitting closely into an opening in the casting. It will be noted that the joint is made on an angle, and that ordinary standard practice is followed in the matter of rod connections and other details.

The frog and switch point described above are in accordance with the standards of the Morden Frog & Crossing Co., of Chicago, to whom we are indebted for the illustration and information given in this paper.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Some Notes on the Design and Construction of Trestle Bents With Particular Reference to Resistance to Vibration.

In designing trestles for coal tipples particular attention has to be given to their resistance to vibration since they must carry shaking screens, conveyors, etc. In a recent article* by Mr. A. T. Shurick we find a number of notes on tipple trestle design and construction which will be found useful to others than designers of colliery works. We abstract freely as follows:

The variety of designs for bents is almost innumerable and the personal equation of the designer enters largely into the selection of the one for any particular purpose. To the inexperienced on this class of construction the amount of vibration that will be developed on a high capacity tipple is a continual source of surprise and experience has shown that every possible precaution should be taken to provide for this vibration. One of the simplest methods of securing a tipple from lateral vibration is the use of batter posts having a batter from 1:4 to 1:12. While the plumb post is still used and recommended by some engineers, it is not generally considered in keeping with the best practice and for this reason is not considered here. Thirty feet is usually taken as the maximum height for single bents, and when it becomes necessary to exceed this height, special designs are necessary. In Fig. 1 is shown what is by far the most popular, and probably on the whole, the simplest and most rigid bent used. The ease of framing and erecting this type makes it adaptable for unskillful labor, such as is often used on this work.

With material of the dimensions shown, this bent is applicable for ordinary tipples 30 to 40 ft. in height when the bents are placed 15 ft. on centers and the capacity of the cars is 25 tons; when the tipple has heavier loads or carries machinery, the posts should be increased to 12x12 ins. The sill shown is amply sufficient when good foundations are used, but when the reverse obtains a sill of the same sectional area as the posts should be used. The sill should project at least 6 ins. beyond the toe of the post, for the reception of which it is usually clapped ½ in. to ¾ in., although in the case of plumb posts this is entirely unnecessary. In some cases a mortise and tenon joint is used here as well as on top of the cap, but this adds materially to the cost of labor and is liable to failure, due to rotting. The best method of securing the posts to the sills is by means of dowels, and for the construction here shown two ⅝x6 in. round iron dowels projecting 4 ins. into the post and 2 ins. into the sill should be used with 12x12 in. posts, ¾x8 in. dowels should be used.

When using dowels trouble is sometimes experienced in erecting the bents, due to absence of rigidity in the joint when not under compression, and for this reason it is customary to doubly secure the joint by toe-nailing with 60d nails. The plumb posts should be set true and accurately and the batter posts battered from 1:4 to 1:12, the former batter being very common.

When it becomes necessary to splice the posts, as often happens, Fig. 2 shows one of the simplest methods of splicing members under compression. The length *L* for hard woods, such as ash, oak or hard pine, should be 2 or 2.5 times the depth *D*, while for soft woods *L* should equal D. The bolts will vary from 4½ ins., for 6x6-in. timbers, to 8⅞ ins. for 12x12 ins., and should be given a driving fit. The keys should be of hard wood, the difference of ⅛ to 1/16 in. in the dimensions *a* and *b* insures a neat snug fit when the cuts are true and accurate. When using a large car, of say 2.5 tons capacity, and with a double track tipple, the cap should be 20 ft. long to insure plenty of room for dumping and handling cars. The cap should be dapped ½ or ¾ in. for all posts. The batter posts are set from 9 to 16 ins. from the ends and for the construction here shown each post should be secured with a ⅝x18 in. round iron drift bolt, well pointed and driven in a ½-in. hole. With 12x12-in. posts and caps a ¾x20-in. drift pin should be used.

Figure 3 shows another method of framing. This is a very strong, rigid five-post bent, which is adopted equally well for a two, three or four-post bent. The framing of this bent will require more labor than for the one shown by Fig. 1, although not necessarily a better class of labor, and when the material runs close to dimensions (as to width and thickness), the result is usually a very neat and satisfactory job.

Owing to the introduction of the fifth post and the strong rigid method of securing the joints, this construction may be safely used under the same conditions noted for Fig. 1 and for heights up to 60 or 65 ft. The method of securing the joints at the sill makes this construction especially adaptable for concrete piers, one of which should be located under each post. The sill timbers should project not less than 8 ins. beyond the posts and the bot-

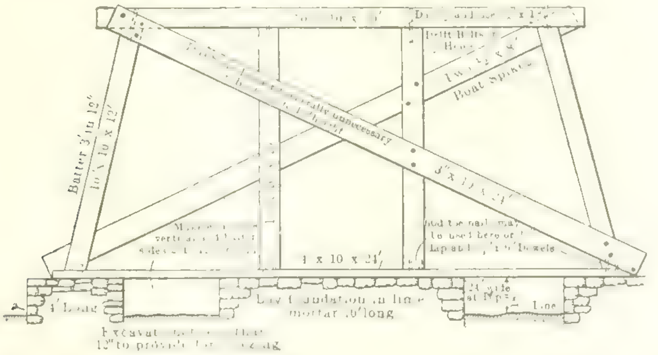

Fig. 1—Showing a Simple and Rigid Type of Bent, Widely Used.

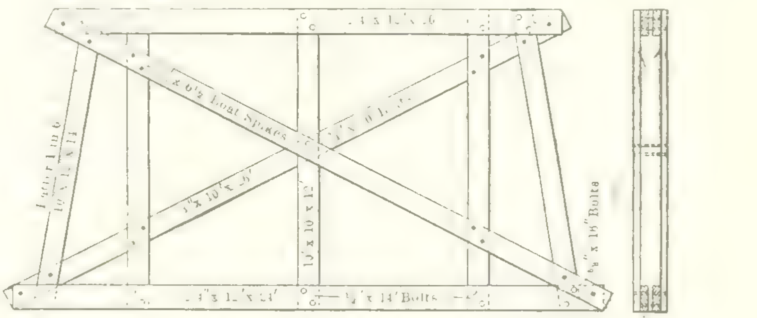

Fig. 3—Method of Framing a Strong Self-contained Five Post Bent.

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*Engineering and Mining Journal.

tom of the tenoned portion of the post should [illegible] sill to provide against pressure being brought on the tenon. The entire load on the posts should come on the sills, the tenon being designed merely to secure the post against any lateral movement. Care should be taken with these tenon cuts to insure a true, even bearing for the posts. All joints are secured with two ½-in. through bolts, and other details as to length of cap, batter of posts, etc., are the same as mentioned for Fig. 1.

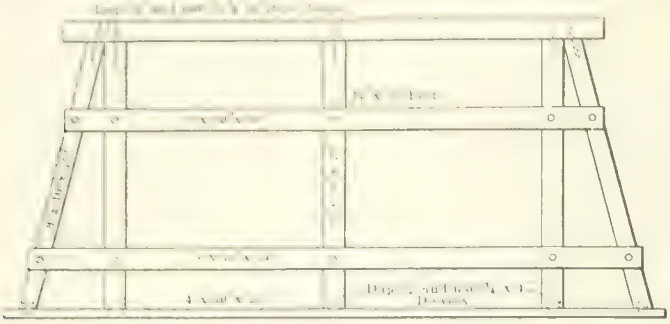


Fig. 4—Modified Form of Bent Shown in Fig. 1, and Best Adapted for a Trestle.

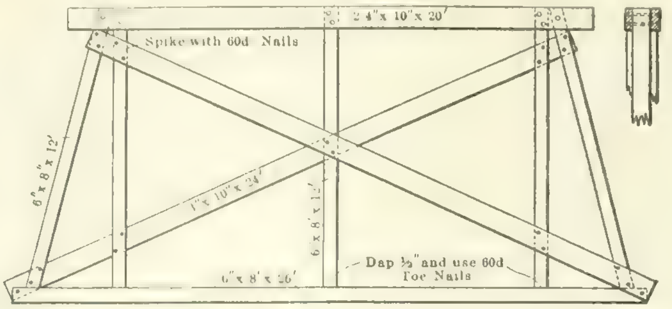


Fig. 5—A Style of Bent Built of Light Material and Adapted for Ordinary Tipples.

Figure 4 shows a modified form of Fig. 1 and one adapted essentially for a trestle bent, rather than for use in a tipple. The distinctive feature of this form is the use of a light batter post, which is introduced to secure additional rigidity, and as an aid to the method of bracing employed. The safety of a design of this form is largely dependent on securing good joints at both ends of all posts, hence both cap and sill should be dapped for the posts and care taken to see that the framing is neat and accurate. The general details as to drift-pins, dowels, etc., are the same as for Fig. 1, with which it will compare favorably as to simplicity of design and ease of erection. This type is attaining considerable popularity, but aside from a small economy of material in the method of bracing, it has nothing in particular to recommend it, and should never be used under trying conditions.

Type of Bent for Ordinary Tipples.—In Fig. 5 is shown another form very similar to Fig. 4, but of much lighter material and with a different arrangement for the cap. This bent is adaptable for ordinary tipples 30 or 35 ft. high when cars of 1.5 or 2 tons capacity are used, and the bents spaced 16 ft. on centers. The feature of this design is the arrangement of the cap, which is simple and requires little or no framing when the material runs well to prescribed dimensions. The particular advantage of this cap lies in securing a broader bearing for the girders which, with cap material of small dimensions, is a decided advantage and especially so when the bents are laid on a curve.

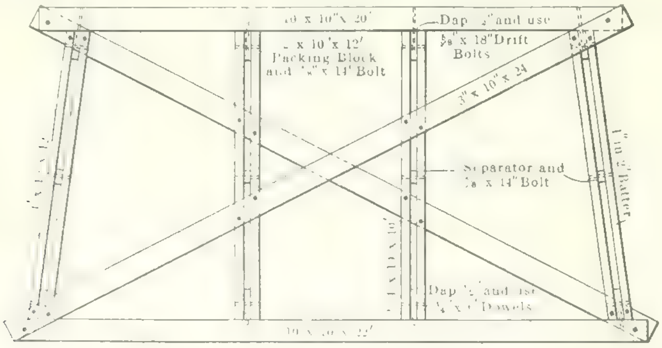

10"x 10"x 20'
Dap ½" and use ⅝"x 18" Drift Bolts
2"x 10"x 12' Packing Block and ⅝"x 14" Bolt
3"x 10"x 24'
Separator and ⅝"x 14" Bolt
1 in 3 Batter
Dap ½" and use ¾"x 4" Dowels
10"x 10"x 22'

Fig. 6—Showing a Type of Composite Framing Largely Used in Tipple Construction.

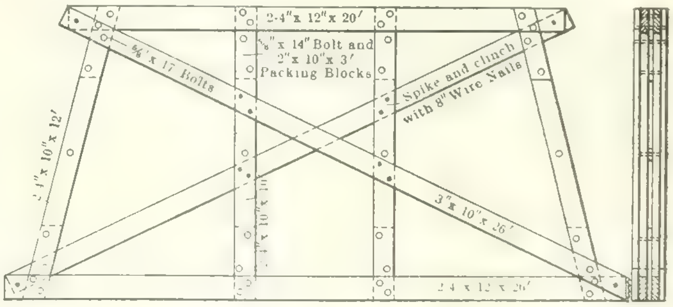
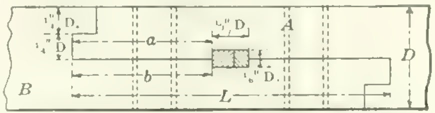


Fig. 7—A Type of Bent in which Light Material Can Be Used in a Composite Construction.

Since the projection of the cap does not make it possible to secure an effective joint of this with the sway-bracing, a weakness in the design appears at this point, which is offset in a measure by the rigidity of the cap and post joint. The sill should be dapped for the posts, and particularly for the batter posts, and the latter secured with two ⅝x5-in. round iron dowels, while the plumb posts may be toe-nailed with 60d nails. The posts are notched for the caps only enough to secure a neat, snug fit, and the plumb posts are secured to the cap with two ⅝x18-in. through bolts, only one being used for the batter posts.

Composite framing is meeting with considerable favor for use on tipple construction, and Fig. 6 shows an example of this style. The principal advantage of composite framing, as is well known, lies in the ease of securing a strong, rigid splice, the susceptibility of the smaller size material to more thorough inspection, and less probability of containing rotten centers, shakes, etc., which are not perceptible in timber of larger dimensions. On the other hand the labor and iron account will run higher with this method, and a skillful class of labor is essential to insure good results. While this method of framing has been adopted by some of the larger companies as their standard method of construction, it is principally adapted to conditions where the reliability of the structure is of ultimate importance, or the ease and facility of making repairs is an important consideration.



Make *a* on Timber *A* 1/16" to 1/8" longer than *b*.

Fig. 2—A Simple Method of Splicing Members Under Compression.

Built Up Posts.—With respect to the caps, sills, batter and number of posts, this type is essentially a reproduction of Fig. 1, the radical difference being in the use of the built-up post. The posts here illustrated are made with two 4x10-in. pieces, giving a total cross-section equal to a single 8x10, or 80 per cent of a 10x10. Since to secure absolute reliability of construction, it would be necessary when using a solid 10x10, to allow an excessive factor of safety to provide for any imperfections in material, the final working value of the 10x10 will not greatly exceed that of the two 4x10 pieces.

When using a solid post there is always the possibility of the timber warping to such an extent as to make the joints of the sills or caps with the posts dangerous and exceedingly difficult to secure; in composite construction, where the grain of the two pieces is laid opposite, this seldom happens. In the construction here shown the pieces are separated 2 ins. with 2-in. packing blocks of 2x12-in. planks, used at the ends to provide for the dowels and drift pins, and 2-in. cast iron separators at intermediate points, not to exceed 5 ft. apart. When splicing becomes necessary this is easily accomplished by introducing a packing block 3 to 6 ft. long and securing with four to eight ⅜ or ½-in. bolts, care being taken to see that the butt joints have a true, even bearing. With batter posts, or others carrying excessive loads, the two members of the post should be spliced at different points, which provides one solid piece of each splice.

The engineer is sometimes limited as to the size of the material he can use, it being advisable for some reason—such as the excessive cost of large dimension stuff, or the wish to use up material on hand—to use composite construction throughout. Fig. 7 illustrates an exceedingly strong and durable example of this class of construction and one in which repairs and renewals are easily made. The posts are essentially the same as shown in Fig. 6, but of somewhat heavier material and turned in right angles in order to secure a better joint with the cap and sill. These latter are both made of the same material as the posts and joined to them by an extension of the packing blocks, all being secured and drawn up tight with ⅝ in. bolts, as shown. It is not usual to dap either the sills or caps for the post timbers, although this may be done for the batter posts, but the joints should be made true and even to insure against any compressive stress being thrown on the packing blocks, which are of lighter material and would be easily ruptured.

This construction is in many respects similar to Fig. 6, and much that has been said for it will apply equally well here. The chief point of difference lies in the joint of the post with the cap and sill, the one here shown being generally considered the best and most rigid joint attainable, and one that is particularly adaptable to the broken floor arrangement made necessary by the different elevations of the loaded and empty tracks.

Sway bracing.—This is a point often seriously neglected and one requiring good judgment and careful attention on the part of the engineer. Tipples are sometimes built of excessively large timbers, and yet so lacking in proper bracing as to swing and vibrate in a most alarming manner when working full capacity.

While it is impossible to lay down any set rules to govern the amount of bracing necessary, generally speaking all tipple bents and all trestle bents exceeding 10 ft. in height, should be braced with the single cross bracing, as shown in Figs. 1, 3, 5, 6 and 7; for bents 20 to 40 ft. in height, two cross braces, separated by horizontal braces, should be used. Fig. 4 shows a style of bracing adaptable to less trying conditions than the cross bracing, and where it is desirable to effect economy of material; the effectiveness of this bracing is largely dependent on making a good firm joint of the posts with the caps and sills. The cross braces, when of sufficient length, should extend to the extreme ends of the caps and sills, and while most drawings show them neatly trimmed to fit around the caps and sills at the ends, this only adds to the cost, may decrease the strength, and is entirely unnecessary when the corners do not interfere.

With 6x6-in. and sometimes 8x8-in. posts, 2x8 or 2x10-in. braces, fastened with 60d nails, are sufficient, and with 8x8 or 10x10-in. posts, 3x10-in. braces, fastened with ½x8-in. boat spikes or ⅝-in. through bolts, should be used; boat spikes are cheaper, but more detrimental to salvage, and less satisfactory when making repairs. With 12x12-in. posts, 3x10 or 4x10-in. braces are used, fastened with ½x8-in. boat spikes or ¾-in. through bolts, given a driving fit; the 4x10 in. is used only for trying conditions. When using boat spikes they should be driven with the edge of the point approximately perpendicular to the direction of the grain of the timber in the post, the efficiency being nearly 25 per cent greater than when driven with the edge parallel.

It often happens the diagonals of a bent are too long to be reached with a single length of plank, in which event it is customary to bring the braces in at the bottom. If the bent is to be subjected to heavy or eccentric loading, it is advisable to divide it into two units, and single cross-brace each unit.

Foundations.—The kind of footing to be used will depend largely on the proposed life of the structure, and to a certain extent on the character of the ground.

When the probable life is short, and the ground comparatively firm and solid, it is customary to use a simple timber sill having a cross-section equal that of the posts of the bent. The ground is first leveled off and the sills placed in position and leveled up with short timber blocks or preferably with flat stones; the sills should never be permitted to rest directly on the ground for in this position they are liable to rapid decay. The topography of the ground is sometimes such as to make a continuous level sill impossible without excessive excavating. When such a contingency arises, the ground is leveled up in steps, and short sub-sills put down upon which rest plumb posts supporting the main sill. Should it be necessary to splice the sills, the simplest form of an ordinary lap splice should be used, care being taken to have the splice as far as convenient from any post.

When greater permanency is desired, it is necessary to resort to some form of masonry or concrete for the footings. The commonest form of foundation usually met with consists of low rubble masonry walls from 18 to 24 ins. wide, and extending the entire length of the sill. With a good quarrying stone and skillful labor, an 18-in. wall, battered 1:6 on both sides, will sometimes be sufficient, but ordinarily a 20-in. wall with the same batter is used, while under some conditions a 24-in. wall is advisable. When the sill is very long, as is liable to be the case in a high tipple constructed with batter posts, there is a considerable waste of masonry when the wall is made continuous, and with no appreciable gain in strength. Thus with [illegible] ft. high, having a 20-ft. cap and a batter of 1:4, a saving of nearly one-third of the masonry will be effected by having one pier 10 ft. long under the center posts and one 4 ft. long under each of the outside posts.

These walls are built of rough rubble masonry laid in either lime or cement mortar; ordinarily lime will suffice, but in the presence of much moisture, or for bents carrying heavy machinery or otherwise liable to any considerable jar, cement should be used. If the ground is only moderately damp, a mortar composed of 1 cement, 1 lime, and 3 sand may be used with good results, but for important work it is advisable to use a straight cement mortar composed of 1 cement to 3 sand. The wall should project from 6 to 12 ins. beyond the end of the sill, and the best practice dictates the use of a 1:6 batter on the sides; for low walls this is often omitted, and is entirely unnecessary on the ends as the walls seldom fail there. In the colder climates, the ground should be excavated from 1 to 2 ft. to prevent the masonry from being heaved by hard freezing. Care should be taken to see that the stone is laid on its natural or quarry bed, the joints properly broken, and that a header or through stone occurs not less than every 4 ft. in length and 3 ft. in height.

Lateral Displa[illegible] [illegible] provide [illegible] any lateral displacement of the sill, from three to five anchor-bolts varying from ½ to ¾ in. in diameter, are sometimes set in the masonry thus giving a means for securing the sill rigidly in place. These bolts should be sufficiently long to pass through the sill and reach nearly to the bottom of the foundation except when for any reason the wall is excessively high, a projection into it of from 2 to 3 ft. being then sufficient. To secure the bolt in the wall the bottom end of it is threaded for a short distance and passed through a hole drilled in the web of a piece of rail and the nut attached; short pieces of from 16 to 30 lb. rail can be used for this, but a single long piece to which all the bolts in the pier may be attached is preferable.

During the past few years concrete has come rapidly into favor as a material for footings, especially where greater permanency is desired. Owing to its much greater strength and reliability it is mostly used in the form of square piers instead of a continuous wall, thus effecting a considerable economy of material.

The size of these piers will of course vary with the size and importance of the structure they support, and the character of the foundation soil. For the ordinary tipple, they are commonly made 24 ins. square with vertical sides battered 1:6 or 1:4, eliminating the danger of the corners being broken. Usually a 1:3:5 concrete will suffice, but in the presence of any abnormal condition, a 1:2:4 mixture should be used. Where a large number of piers are being built, the forms, which are simply square boxes, may be used over repeatedly, and since the cost of forms, especially on small jobs, is an important item, a decided economy is thus effected.

Methods and Cost of Making a Topographical Survey and Its Economic Value in Logging Operations.*

Civil engineers specialize in dydraulics, irrigation, municipal and other branches of the profession, and why not the civil engineer who has specialized in logging and timber engineering? As a prominent lumberman puts it, it is more of a question of engineering in this rough western country than of anything else to get the timber to the mill. No question but what the field is broad enough and the problems involved deep enough to please and fatigue the mind and ingenuity of the most profound student if given the proper consideration.

Logging [illegible] every dollar you can in railroad expense and equipment. Anyone with plenty of money can go through a mountain, but it takes a genius [illegible] line that will show a profit, especially when [illegible] the case in so many logging roads.

With regard to the differences which have and do exist between the loggers and lumbermen and engineers, and the fear of the first two mentioned for the latter, I will say that in nine cases out of ten it has been the engineer's fault. This may sound very strange, coming from an engineer, but it is true, nevertheless; and it is true because more prominent engineers have, and some do yet, consider the location of a logging railroad of minor importance and a matter not deserving very grave consideration; and most of the younger engineers are inclined to follow in the footsteps of their seniors, and, as a result, are termed technical fools by the loggers, and even stronger termed expressions than that at times.

The engineer who hopes to make a success of logging engineering should at all times take into consideration the amount of traffic in the way of timber that is to come over his line, and necessarily the life of the line and whether it has any future possibilities as a connecting link between main lines or as a part of a main line.

Very few engineers have the faintest idea of what a logging operation is, and when a piece of work is given them they go at it with a feeling that any old line will do, when, as a matter of fact, $10,000 wasted to get a line with maximum curves of 10° to 12° when maximum curves of 16° to 24° will do just as well, and the life of the line is only four or five years, is a great deal more expensive and there is less chance for recovery than where the life of the line is for all time. This is undoubtedly self-evident to you. Even though a line has mainline possibilities, it is not always good judgment to build along those lines as long as it is used as a logging road, but make a proper mainline location and then go back and put in sharp curves which can be eliminated when the proper time comes, or from time to time after the road is in operation, and there is some source of revenue.

It seems to be a very grave reflection on the engineers of the western country that when a logging concern decides to have a line located it generally sends the woods superintendent or foreman to look up the probable line and blaze it out so that the engineer will get in the right country. An engineer, to be entirely capable of properly planning a logging operation, should not only be an engineer, but a cruiser and practical logger.

More are engaged in logging a tract of 20,000 acres than there are less, and some are even engaged in logging tracts as high as 100,000 acres. How much do you know about your entire holdings and the relation one part bears to another? I hope you know all about it and have the logging of your entire tract planned out, at least in a general way, but I know that this is not so. Why have you not had it done? It certainly is not because it would cost too much, because, how do you know that if you were working along a set line the logging cost could not be cut down 50 cts. or $1 a thousand on the entire operation? Have you the least idea what you logs are going to cost you each year for the next four or five years, or, in case the price of certain grades of the finished product drops, where you can go and get logs on your lands that will make lumber with the highest percentage of the more profitable product? I think you will agree with me that these are questions that you should all be able to answer to yourselves. What kind of maps of your holdings have you? What does a blue print with the creeks marked on it and the lands owned colored up spell to a man when he takes charge of an operation? There may be mountains, hills and dales between these creeks, but the map does not tell you anything about this, and a man can not carry it all in his head. The answer to nearly all these questions is "topographical surveys and maps."

The first question that comes to mind is, how much is it going to cost? By the use of a borograph, an ordinary self-recording aneroid barometer, a hand level, a tape rod and a Jacob staff compass, a very accurate topographical map of a country can be made in the fir districts for 15 cts. an acre, and in the pine districts for about half that price. This is not guess data, for I have done this kind of work for even less money than that.

A borograph is a self-recording atmospheric pressure instrument, which is left at headquar-

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[illegible]

[illegible] place. This eliminates the objection raised against [illegible] difference how much the aneroid has run off during the day's work, it is very easily corrected upon the return to camp at night, and the contours platted in the proper places.

It is surprising how close elevations can be obtained in this manner. In one instance where the ends of a line were separated four miles, with a low summit intervening, the elevation at the initial point was 5,725 ft., both actual and barometer. The corrected aneroid elevation at the summit was 5,880, and the actual elevation 5,882, at the terminal end the aneroid elevation was 5,675, and the actual elevation 5,681, or only a difference of 2 ft. at the summit and 6 ft. at the end of the line.

You can satisfy yourself with regard to the accuracy of this method of making topographical surveys by setting a borograph and carrying [illegible] pocket [illegible] day or two, making notes from time to time as to any change you note in the elevation on your aneroid, and the time of the day these notes are made; and upon making comparison with your borograph you will find that the changes will compare very closely with those noted, if both instruments are in adjustment.

The manner in which these surveys are made is nearly identical with those used by a cruiser in looking timber. If the country is at all open and the contours at all regular, a man can cover over 160 acres a day without any trouble in the fir country, or 320 acres in the pine districts, the distance being measured by pacing and the line run with an open sight Jacob staff compass. After covering in this manner the district in which you are interested, and platting it up, then you have something to figure from as to where you can go with railroads, and, as a matter of fact, plan the entire operation. This is where land level work becomes of value. As you begin to work out your main lines and spurs, you would probably encounter places where it is just a question whether or not you could make a given point or not.

Two men can run about two miles of peg line a day with a Locke level, so that it is only a small matter to ascertain whether you are on the right course or not. If there are any angles in the canyons or on the side hills that you might be afraid were impossible on account of heavy work, you can take these with the compass, and when you get these data together and mapped up you have a birdseye view of the entire country before you and something to work from, without having driven a stake or spent any great amount of money.

You can now begin the real study of the topography of your country and lay prospective and possible main lines and spurs covering your whole country; and, of course, as you all have an accurate cruise on your holdings, it is possible to know how much timber will come out over every road built, and from that arrive at what the railroad cost will be per thousand.

The one question that confronts every business man's mind is, what is it going to cost, and this is the only way to arrive at it with any certainty. You know how much timber you have and how you can reach it, and about what it will cost to reach it, and as you have a record of several years of actual cost of falling, bucking, swamping, hauling and loading on cars or putting into a stream—or your logging engineer can furnish you with these figures—you are in a position to begin to figure profit, and that is what we are all after. Profit; the only question is, can we make it?

You may have a very good plan for working your tract, but have you it on paper, or does anyone else know anything about it? You know that none of us have any assurance of our term on this earth, and when the time does come, will your successor have to take up broken threads or will he go ahead with plans already laid out?

[illegible] superintendent of a logging operation can not work on the basis of "let your next year take care of itself" and be [illegible] or make money for himself or his associates.

LETTERS TO THE EDITOR.

Reversed Dams.

Sirs: Will you kindly permit me to answer Mr. Godfrey's criticism of the "reversed dam" suggested in the March 8 number of your journal?

The writer invites criticism of the reversed dam, and is "delighted" that Mr. Godfrey has so clearly stated the why and wherefore of his objections. After a careful analysis of Mr. Godfrey's criticism two points stand out most prominently. First, he contends that a dam cannot be under-drained so as to prevent all uplift due to the pressure of the impounded water; and, second, he still claims priority in publishing a warning against a possible uplift under dams, in spite of the fact that the writer has called his attention to the fact that this danger is treated quite fully in "Hydro-Electric Plants," published in 1907. The latter evidences he meets by saying that "Hydro-Electric Plants" "is not a book on dams"; there being but two books published entirely on dams, namely, Wegmann's and Burr Bassell's (the latter treating only the earth dam) the colon is all his. "Hydro-Electric Plants," however, does treat the subject fully, and, further than that, it shows on page 254 the proper method of under-draining such dams. This book also shows on page 250 a buttressed wall very similar to the one which Mr. Godfrey has recently patented and offered for sale as an original and valuable invention.

Now taking up the first point in the criticism: If a dam cannot be under drained and the full static head must act upon the entire base, why has Mr. Godfrey so frequently, as he says he has, "publicly" proclaimed the danger? No dam ever built would be a safe dam if the water did react in such a way. It is true that many dams have failed, due to this cause (see the writer's article in Engineering-Contracting for March 2, 1910), and the writer in an experience with more than fifty dams has many times suffered from a failure to use under drainage, but for the last ten years has under drained every dam that he has built, so that there is no uplift at all. Floating, due to immersion, and uplift, due to seepage, must not be confused.

The reference made by Mr. Godfrey to page 247 of my book is misleading. The paragraph he quotes was put there to emphasize the fact that there will be an up-lift due to the floating effect of the water, and has nothing at all to do with the up-lift under the base of the dam, due to static pressure, the latter being fully treated on page 249, where it is pointed out that drains should be placed under the dam. Many dams have since been built with just such drainage.

All buttressed dams placed on soft bottoms are so drained, otherwise they would not stand for an hour, and no experienced engineer would expect them to.

In my article in "Engineering-Contracting for Feb. 1, 1911, it is clearly stated that the floating effect was provided for by assuming that the water covered the base. No up-lift, due to seepage under the base, was allowed for as there would be none. On a rock bottom a seepage trench is excavated along the up-stream edge and filled with concrete and the seepage—what little there would be—carried off in drains. On soft bottom a row of steel sheet piling would serve as a cut-off and drains placed to catch all seepage.

The writer has made no mistake in the calculations, nor has he contradicted a single statement contained in any of his publications. The reversed dam has been approved by a great number of college professors, army engineers and civil engineers, and there is no safer and cheaper dam, built of steel or concrete, than the reversed dam. The writer will gladly ship a set of models to any reputable engineer so that he may test the truth for himself.

It is a truism that the design "of a dam is of too great importance to be trifled with," and I shudder to think of a man attempting such design who claims that the up-lift under the dam cannot be eliminated.

Tests [illegible] on wooden models [illegible] reversed dam in which case the submerging of the base would have a maximum effect, and the factor of safety developed exceeded 3. The quantity of concrete in a reversed dam is so small that the floating effect, due to back water, is negligible. Calculations made, assuming the entire dam submerged, have verified this and Mr. Godfrey can, no doubt, satisfy himself on this point.

The up-lift under the base is a chimera which has no part in a well designed dam.

How has Mr. Godfrey taken care of such static uplift under his retaining wall? No triangle of uplift is mentioned, or shown, and no drainage provided for, and therefore the critic has surely committed dangerous engineering practice.

While on the subject of retaining walls the writer would like to make a few remarks which he was tempted to make some months ago. In 1908, he built a retaining wall at Newton Falls, O., for the Hydro-Electric and Gas Company of Warren, O., exactly like the Godfrey patent wall shown in "Engineering-Contracting" for Jan. 11, 1911, except that the useless steps shown in the angle between the base and the vertical wall were omitted. The same counterfort reinforcing was used, the ends being hooked around the reinforcing in the wall and base. The writer has been building such walls for four or five years.

In "Concrete Engineering" of May, 1910, the writer treated the subject of cantilever walls, as compared with the buttressed dam for rock bottom, as a water retainer, and curves were given showing that the cantilever wall is practically on an equal footing as regards safety and cost, but not, of course, equal for a spillway dam. The buttressed retaining wall—see "The Design of Retaining Walls," page 93, "Engineering-Contracting" for Jan. 11, 1911—is more costly than a cantilever wall having the same unit stresses and the reversed dam is far cheaper than either, and the safety is practically twice as great against sliding and tipping, always assuming proper drainage. The unit pressure under the toe of either Mr. Godfrey's wall or the cantilever wall will be from 25,000 to 50,000 lbs. per sq. ft., while under the toe of the reversed dam it will only be 2,000 or 3,000 lbs.

While the writer does not call the reversed dam a "wall," it should be of interest to know that it is cheaper and safer than even a wall.

Yours respectfully,
R. C. BEARDSLEY.

Cleveland, O., March 11, 1911.

The Conditions Pertaining to Licensed Architects and Engineering Practice in Illinois.

Sirs: Referring to the recent discussion in the technical press and among engineering societies in regard to the licensing of engineers, we would like to contribute a word as to the situation existing in Illinois, and which doubtless exists in other states.

About fourteen years ago the architects secured the passage of an architectural license law in which an architect was defined as "any person who shall be engaged in the planning…… ……..of buildings for others and to be constructed by other persons than himself," and a building is defined "any structure having foundations, walls and roof, with or without other parts." It was necessary under the constitution to admit to practice all persons practicing architecture at the time of the passage of the law but it was provided that all future applicants for license should be examined by a board of architects to be appointed by the governor.

This law leaves the engineering profession high and dry, except to provide that a civil engineer who plans and supervises buildings shall be regarded as an architect, thus compelling the engineer to carry on an important part of his work under the name of another profession, if indeed he is fortunate enough to pass an "architectural" examination, very proper for an architect in general practice, but wholly beside the point if required of a person designing engineering structures.

The Western Society of Engineers, through its Legislative Committee, has taken up this question of the legal disability of engineers in a very active way. It was attempted to find some way to amend the present law in order to give immediate relief to our profession, and a number of joint meetings were held between our committee and a similar committee from the Chicago Architects' Business Association.

It was decided that there were no practical methods for affording immediate relief, but the committee agreed unanimously that legislation should be sought for the following purposes:

1. To entitle structural or building engineers to make plans for and supervise engineering structures which were defined tentatively as follows:

"Structures of a strictly engineering character such as boiler houses; structures designed solely for the generation of electricity or for screening, storing or sizing coal, cement, sand, gravel, metals or similar materials; blast furnaces; rolling mills; gas producers and receivers; foundries solely for casting metal; smelters and similar plants where the support or housing of heavy machinery is the principal consideration."

and

2. That certain kinds of buildings to be designed by architects, such as large office buildings and buildings with difficult foundations, should require the services of an engineer unless the architect should be also licensed as an engineer.

3. That those classifications should be established by law, and structural or building engineers should be licensed in order to bring them under state control.

The situation in Illinois is somewhat different from the situation existing in states where no architects' law exists. We have no desire to attack or attempt to repeal the architects' license law, as we believe that it gives the public a certain measure of needed protection. We feel that public safety is our first duty, and since a structural engineers' license is a condition precedent to any enabling legislation, we believe that such a law in Illinois is not only logical but necessary, and we believe that the engineering profession should accept it as an important step in advance.

As to the best method of securing these results, it was decided by the committee to have a bill introduced at the present session of the Legislature providing for the appointment of a commission of engineers and architects to codify the state building law, and recommend suitable legislation to the next Legislature as to carry out their finding. (Such a bill was introduced on March [illegible], by Senator Oscar [illegible] Senate Bill No. 332.)

Such a commission should be able to consider the entire question in a broad constructive way, to define and classify engineering structures, to decide which classes of buildings should be planned by engineers, and which other classes of buildings should require their co-operation. We feel that engineers can well afford to wait a year or two for the sake of having the question settled right.

We also feel that the architectural and engineering professions should work hand in hand to this end. There have been no important differences of opinion on our committee, and the architects have shown the greatest desire to consider the whole question in a fair and broad way. We believe that [illegible] can be secured by such co-operation.

Now as to the situation in states where no architects' license law exists. The architects have had bills similar to the Illinois law introduced in many legislatures, and it seems to us that the engineers' [illegible] will in these states or the local [illegible] engineering societies should continue to oppose the passage of such laws. Then [illegible] what we are now doing [illegible] "get together" with the architects and [illegible] laws as will effectively protect [illegible] everywhere from incompetent design and flimsy construction, and will regulate the sister professions of architecture and engineering in the interest of the public and of the standing and dignity of both professions.

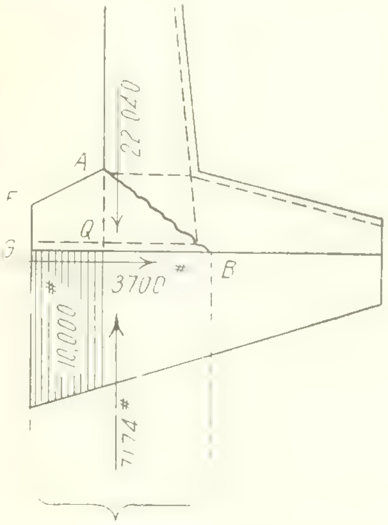
Very respectfully,

ANDREWS ALLEN, Chairman,
JOHN [illegible],
F. E. DAVIDSON,
EDGAR D. MARTIN,
W. C. ARMSTRONG.
Legislative Committee,
Western Society of Engineers.

Chicago, Ill., March [illegible], 1911.

Discussion of a Cellular Dam Design.

Sirs:—I have read with interest the criticisms of Mr. R. C. Beardsley in your issue of Feb. 1, 1911. Mr. Beardsley brings out some very good points and emphasizes the necessity of great caution and careful calculations in designing high dams. Unfortunately, Mr. Beardsley shows a spirit of trade rivalry in the matter and ends his article with such a boost for his own type of dam that his paper is robbed of much of the value that would attach to it had it been written with less evident feeding of competition. I think from reading Mr. Beardsley's comments that he did not send for a full copy of my paper, which was read before the Colorado Scientific Society, but relied on the extracts published in Engineering-Contracting, hence it is a [illegible] adhered to [illegible] original text.



Mr. Beardsley makes one statement, however, which is definite, and his meaning is clear. He says: "The earth or rock filling within the cells will not resist the tipping of the dam unless it is carried by a floor attached to the buttresses."

For those who have not read the original article, I will say that this discussion is with reference to a dam composed of rows of vertical cells, made of reinforced concrete, and filled with earth and rock. Mr. Beardsley's idea is that if this dam were tipped over the earth and rock would fall out at the bottom the same as though one took a bottomless box filled with earth and tipped it over. The error in Mr. Beardsley's conception results in overlooking the fact that the resultant of the water pressure and weight of dam falls in the middle third of the dam. The dam cannot tip over unless the buttresses crush. Imagine the liquid in the reservoir to be made heavier in some way, as by substituting sulphuric acid for water, then the resultant would approach nearer and nearer the toe of the dam, but as the resultant of the pressure may be considered as applying itself two-thirds the distance down the water line, the dam would yield by shearing rather than by overturning.

To illustrate [illegible] were made [illegible] sandstone and white sandstone. The cell walls of red sandstone and the filling of white sandstone. Then Mr. Beardsley's contention amounts to saying that the red sandstone would strip away from the white sandstone and that the latter will not resist the overturning of the dam unless carried on a floor of red sandstone.

Another way of showing this error in conception is to call attention to the fact that a floor at the bottom could be of no possible use unless tension were induced in the face wall. So long as the dam remains intact no possible tension can come in the face wall.

As Mr. Beardsley started out with at least one erroneous conception, it was not to be wondered at that he arrived at quite different results from those of myself and my associates.

After all, the best test is the test of use, and the cellular dam is simply an improved log-crib dam, and there are hundreds of log-crib dams in continual use and none of the terrible things which Mr. Beardsley figures would hap[illegible] granted that a crib of reinforced concrete is better than a crib of logs. If a log-crib dam is a useful dam, a reinforced concrete crib dam should be a better one.

The question of relative cost is almost entirely a question of locality and availability of materials.

I was much interested in Mr. Beardsley's description of his own type of dam, and it is evident that he has put much thought and attention on his own designs. It is through just such earnest work as this that the science of construction progresses.

The presentation of my paper on a cellular concrete dam was for the purpose of calling forth criticism and availing myself of that camaraderie of intelligence which is such a valuable asset of our American engineering field. I have learned much through the criticism provoked, particularly those in the Colorado Scientific Society, where such men as State Engineer Comstock, John E. Field and Victor G. Hills lead the discussion.

Mr. Comstock brought out a very important matter in connection with figuring the vertical shearing strains in the toes of dams, and I note that this matter is rather fully discussed in the Columbia School of Mines Quarterly for January, 1911.

Yours very truly,
GEO. J. BANCROFT.

Denver, Colo., March 15, 1911.

The Design of Retaining Walls.

Sirs: Without intending to prolong the discussion of retaining walls unnecessarily, I should like to have space enough in your valuable journal to point out two serious objections to Mr. Evan P. Bone's analysis of a cantilever retaining wall.

Mr. Bone takes the bracketed portion of the upward force of the soil against G. B. and gathers it into one force of 17,174 lbs. This is assumed by him to be opposed by the force of 22,040 lbs. as indicated, and the difference only is then assumed to act in shear on AQ. To the left of the line AQ, in the shaded portion of the trapezoid, is about 10,000 lbs. of upward force that must all act on the surface AQ in shear. This is more than double the shear found by Mr. Bone. His analysis is then over 100 per cent in error.

Another error is his assumption that the 3,700 lbs. of friction is going to help out the strength (or weakness) of the internal structure of his retaining wall. By this analysis slabs used as footings could be made with little or no reinforcement, depending on the friction of the ground to take the tensile stresses; also the dirt fill over an arch could be counted upon to carry a large part of the stress in the arch. Sound engineering is not advanced by any such assumptions.

If Mr. Bone wishes to know something about the San Luis Obispo oil tank, he will find a dimensioned drawing of the wall and several good photographs showing how the reinforcement was put in in the "Architect and Engineer" of California, the December number of last year.

Yours very truly,
EDWARD GODFREY.

Monongahela Bank Bldg., Pittsburg, Pa., March [illegible], 1911.

Sirs: On page 265 of your March 1, 1911 issue Mr. Evan P. Bone closes [illegible] the design of retaining walls by saying that the cantilever is less expensive than the counterfort type of reinforced concrete wall.

Taking his Fig. 2, on the page mentioned, and replacing the earth fill with water level with the top of the wall, in order to remove all difference of opinion as to actual pressures, the overturning moment at the top of the foundation [illegible] counterfort wall with counterforts 10 ft. c. to c., the maximum moment on the lower 12 ins. of [illegible]

[illegible] moments [illegible] the counterforts are economically spaced, consequently, the sections of the former must be [illegible]

[illegible] the required thickness of the bottom foot of [illegible] cantilever in the foundation slab.

[illegible] ft. of longitudinal length of wall. It is found that the cantilever design requires an excess of [illegible] greater simplicity in the forms for the cantilever design would reduce this difference somewhat, but I am of the opinion that a properly designed counterfort wall will always be less expensive than the other.

Yours truly,

J. [illegible] CAMPBELL.

[illegible] 1911.

PERSONALS.

Mr. T[illegible] B. Ford, of the firm of Goodell & Ford, [illegible] of Bridgeport, Conn., has [illegible] of the Connecticut State Railroad Commission.

Mr. Lewis E. Ashbaugh, hydraulic engineer, with J. G. White & Co., of New York, formerly in charge of their office at Seattle, Wash., has been transferred to London, England. He will assume charge of this company's hydro-electric developments in foreign countries.

Mr. W. H. Sheeley, for eleven years general roadmaster of the Iowa Central Ry., has resigned and will engage in the development of his farm properties near Edmonton, Can. Mr. Sheeley built the Illinois Central between Du[illegible] and Sioux City, and was for years roadmaster of the Sioux City & Northern and the Sioux City & Western, now parts of the Great Northern Ry.

Announcement is made of the retirement of Mr. Charles L. B. Anderson from the firm of Hazlehurst & Anderson, consulting engineers of Atlanta, Ga. Mr. Anderson will become chief engineer of the Clarendon Construction Co., of Wilmington, N. C. Mr. James N. Hazlehurst, senior member of the firm will continue in practice at Atlanta, and will complete all engagements for which the firm is obligated.

The following appointments have been made in the recently organized Bureau of Locomotive Boiler Inspection: Chief, Mr. John F. Ensign, of Denver, Colo., for years a locomotive engineer on the Denver & Rio Grande Ry., and recently Safety Appliance Inspector under the Interstate Commerce Commission; assistant chief, Mr. Frank McManamy, of Portland, Ore., a locomotive engineer and recently Safety Appliance Inspector under the Interstate Commerce Commission, and assistant chief, Mr. Garland P. Robinson, of New York City, a graduate of De Pauw University and Chief Inspector under the New York State locomotive boiler inspection laws.

The following promotions and transfers in the maintenance of way department have been announced by the Pennsylvania R. R.: C. H. Niemeyer, formerly division engineer of the Conemaugh division, becomes division engineer of the Pittsburg division; he will be located at Pittsburg. F. W. Smith, Jr., formerly supervisor of the Philadelphia terminal division, becomes division engineer of the Conemaugh division, and will be located at Pittsburg. C. I. Leiper, formerly division engineer of the Pennsylvania Tunnel and Terminal Railroad Company, becomes division engineer of the New York division; he will be located at Jersey City. J. H. Harris, formerly division engineer of the Delaware division, becomes division engineer of the New York Terminal division; he will be located at New York. W. F. Greene, formerly division engineer of the Philadelphia terminal division, [illegible] of the Delaware division; he will be located at Wilmington, Del. W. T. Covert, formerly division engineer of the Williamsport division, becomes division engineer of the Philadelphia terminal division; he [illegible] West Philadelphia. C. R. [illegible] of the Philadelphia division, becomes division [illegible] Susquehanna [illegible] Williamsport. S. I. [illegible] of the Philadelphia terminal division [illegible] located [illegible] West Philadelphia. R. R. Nace, formerly as[illegible] M[illegible] division, be[illegible] D. C. Baird, formerly assistant supervisor on the Pittsburg division, becomes supervisor on the Schuylkill division; he will be located at Reading. M. J. Jones, formerly assistant supervisor of the Bellwood division, becomes assistant supervisor on the Pittsburg division; he will be located at Pitcairn. L. R. Fleming, formerly transitman in the office of the engineer, maintenance of way, becomes assistant supervisor on the Conemaugh division; he will be located [illegible] supervisor on the Monongahela division, becomes assistant supervisor on the Maryland division; he will be located at Chester. W. T. Bevan, formerly transitman in the office of the engineer, maintenance of way, becomes assistant supervisor on the Monongahela division; he will be located at Dravosburg.

Catalogs Worth Having.

[illegible] and contractors should have on file the latest catalogs of machines, tools and [illegible] that they use. In sending for catalogs [illegible] or advertised in the paper, you [illegible] on us if you will write direct to the advertisers and state that you [illegible] the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Texaco.—Paper, 6¼x9¼ ins., 29 pp. The Texas Co., Houston, Tex.

Illustrations and descriptions of roads and methods of treating them with Texaco.

Concrete in Bridge Construction.—Paper, 6x9 ins., 14 pp. Lehigh Portland Cement Co., Mitchell, Ind.

An illustrated description of a reinforced concrete bridge in Newcastle, Pa., where Lehigh cement was used.

Ross Valves.—Paper, 3½x6 ins., 12 pp. Ross Valve Mfg. Co., Troy, N. Y.

Illustrated by diagrams and containing sizes and prices of various types of valves.

Feed Water Filters.—Paper, 6¼x9¼ ins., [illegible] pp. Ross Valve Mfg. Co., Troy, N. Y.

Describing feed water filters for land and marine boilers. Illustrations, diagrams, sizes, dimensions and prices given.

Intermittent Flush Tanks.—Paper, 6x9 ins., 23 pp. Pacific Flush Tank Co., 108 S. La Salle St., Chicago.

This is catalog No. 12 illustrating and describing automatic intermittent flush tank siphons, without moving parts. Dimensions and prices are given.

Traction Steam Shovel and Crane.—Paper, 9x8 ins., 12 pp. Avery Co., Peoria, Ill.

Illustrations and descriptions of this combination machine showing its application in construction.

Road Oil.—Paper, 3½x6 ins., 10 pp. Texas Company, Houston, Tex.

Describing Texaco Road Oil for cold application. Methods of handling are illustrated.

Road Rollers and Contractor Engines.—Paper, 9x8¼ ins., 48 pp. Huber Mfg. Co., Marion, Ohio.

Containing illustrations and detailed descriptions of road rollers and traction engines.

The Pedestal Pile.—Paper, 6x9 ins., 61 pp. MacArthur Concrete Pile & Foundation Co., New York.

Containing several articles descriptive of the advantages of this type of pile and an amount of useful data resulting from tests of bearing capacity.

Road Construction Wagons.—Paper, 8½x15½ ins., 20 pp. Briggs Labor-Saving Specialty Co., Waterloo, Iowa.

Illustrations of concrete carts, motor dump wagons, motor street cleaners, etc.

The Holman Rock Drill.—Paper, 8½x11 ins., 7 pp. Holman Bros., 114 Liberty St., New York.

A pamphlet entitled, "Some Interesting Proof of Low Drill Repairs," being remarks on the South African stope drilling contest in which this machine won first prize.

Conveying Machinery.—Paper, 8x10¾ ins., 31 pp. Conveying Machinery Co., 50 Church St., New York.

This catalog illustrates and describes a number of installations of conveying and handling machinery for varied purposes. General descriptions and details are given.

Syracuse Barrows, Scrapers, Plows and Trucks.—Paper, 6x9 ins., 24 pp. Syracuse Chilled Plow Co., Syracuse, N. Y.

A catalog of wood and steel wheelbarrows, contractors' plows, drags, road and wheel scrapers. This is catalog No. 14.

Syracuse Plows.—Paper, 6x9 ins., 77 pp. Syracuse Chilled Plow Co., Syracuse, N. Y.

A catalog of plows, giving weights, dimensions and general descriptions, showing the purposes to which each is adapted.

Wheeling Metal Ceilings.—Paper, 3½x6¼ ins., 8 pp. Wheeling Corrugating Co., Wheeling, W. Va.

An illustrated pamphlet.

Star Dump Wagons.—Paper, 9x6 ins., 12 pp. Glen Wagon Co., Seneca Falls, N. Y.

A catalog containing illustrations and descriptions of various sizes and classes of bottom dump wagons.

Milwaukee Locomotives.—Paper, 7x10 ins., 23 pp. Milwaukee Locomotive Mfg. Co., Milwaukee, Wis.

Bulletin No. 101 illustrates and describes gas driven locomotives of the mining type for mines, tunnels, yards, industrial plants and for contractors' service. Tables of data and specifications given.

Wire Glass.—Paper, 6x9 ins., 8 pp. Mississippi Wire Glass Co., 72 Madison St., Chicago; 115 Broadway, New York, and 4100 N. Main St., St. Louis.

Illustrating the safety of wire glass where explosions and fires have occurred.

Boundary Wall, 7,500 Ft. Long, Built of Concrete Blocks.—Hitherto boundary walls have generally been constructed with stone or bricks, and have always proved expensive to erect and maintain, the most flimsy wall being 9 in. thick if in brickwork, and of no great height, and they are of much greater thickness, with buttresses, if of any height exceeding, say, 7 ft. Stone walls are of still greater thickness. It has remained for one of our government departments, *i. e.,* the Prison Commission—to introduce a method of erecting boundary walls which meets all requirements in a manner at once economical and structurally sound. The wall described has been erected at the Borstal Institution, Feltham, under the superintendence and to the design of the Surveyor of Prisons (Major H. S. Rogers, R. E.). The wall is 7,500 ft. long. It is 4½ in. thick, with piers at intervals. The height is 7 ft. 7½ in. to top of coping, and 9 ft. 9 in. to top of barbed wire. Work was commenced on April 28, 1910, and was completed on October 5, 1910, the total cost being £2,591. A view of the completed wall is shown on page 227. It is built with reinforced concrete piers at intervals of 13 ft. 8½ in., the piers being 12 in. by 9 in. in plan by 12 ft. 10½ in. long over all, and twice rebated to receive the 4½-in. hollow concrete blocks. The piers are set 2 ft. 6 in. in the ground on a bed of concrete 1 ft. 9 in. by 1 ft. 9 in. by 1 ft. The upper portion is diminished so as to become an upright post to carry 5 lines of barbed wire. In the sides of the rebates are embedded steel wire mesh spaced so as to fit into the bed joints of the 4½-in. hollow concrete blocks. The bed joints are also reinforced with steel wire netting. The blocks are 28½ in. long, 9 in. high, and 4½ in. thick, with recessed end joints. Each block has two hollows and they are made two at a time in the machine. Six men made and stacked 400 of these blocks per working day of 10 hours, and one bricklayer and two laborers erected in one day 16 ft. by 8 ft. of wall, one pier and 2 ft. foundation blocks. The proportions used in making these blocks were 4 parts of clean ½-in. gravel to 1 of Portland cement.—*Concrete and Constructional Engineering.*

A convenient and reasonably accurate rule for estimating the safe working strength of a chain is to express the diameter of the wire or bar of which the links are made in sixteenths of an inch; to square this, and multiply by 80. This result will give the safe working load in pounds. This, a chain of ½-in. wire would give the following computation: 8 × 8 = 64; 64 × 80 = 5,120. A proof test of ½-in. chain is 7,500 lbs., or about 50 per cent over the safe working load.

An injection of cement was the novel method lately adopted to make strong and serviceable two crumbling stone railway bridges at Hamburg. The arches—51 ft. in span—were cracked in all directions, and shall holes were bored partly through the masonry at the sides of the cracks, and thin cement mortar was forced into the apertures at a pressure of five atmospheres. When this had hardened, the stonework was found to be thoroughly consolidated.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week.

The largest government contract of the week appears to have been the one for extending the jetties at Southwest Pass, Mississippi River. Two bids were received March 17 for this work, Christie & Lowe, New Orleans, La., bidding $670,183, and Doullut & Williams, New Orleans, La., bidding $737,666. Another good-sized government contract, bids for which were opened last week, was for channel excavation in Black Rock Harbor, N. Y. The bids received for this work were as follows: Great Lakes Dredge & Dock Co., Chicago, Ill., $369,625; Empire Dredging Corporation, New York, $427,365; Buffalo Dredging Co., Buffalo, N. Y., $353,825. Breymann Bros., Toledo, O., and the Great Lakes Construction Co. also bid on portions of the work.

The U. S. Reclamation Service is now calling for bids for the construction of the Kachen dam and accessory structures near Easton, Wash. The work includes some 345,000 cu. yds. of excavation, 240,000 cu. yds. of embankment, 15,000 cu. yds. riprap and 8,000 cu. yds. concrete.

In the line of municipal work in the west, about the largest job of the week appears to be the work of constructing a water works system for the city of Helena, Mont. Bids for this work are to be opened April 20. The work includes a 5,000,000 gal., concrete-lined storage reservoir, headworks with concrete core wall, 21.4 miles 18-in. to 24 in. wood conduit, and 43.4 miles of cast iron mains.

There has not been much during the past week in the way of levee work. The largest contract of the week appears to have been the one awarded Clark and Helgason Bros. of Vicksburg, Miss. This contract calls for the construction of the Villa Vista levee in East Carroll and Madison Parishes, La., the work involving 126,000 cu. yds. of levee enlargement and 170,000 cu. yds. of new levee. Bids are being asked until March 30, for a good sized levee job in Desha county, Ark. This work calls for the construction of the Lucca levee, which is to be located about 12 miles above Arkansas City, Ark. The approximate contents are 350,000 cu. yds.

The bill providing for the issue of $5,000,000 of bonds by the State of Colorado for the construction by the state of the Moffat tunnel through the Continental Divide west of Denver, has been favorably reported to the House of Representatives and the indications are that the bill will be passed. It is possible, however, that the sudden death Saturday in New York city of David N. Moffat, President of the Denver, Northwestern & Pacific Ry., which would have been benefited by the construction of the tunnel, may cause the state legislature to hold up the bill.

Ordinances are now before the City Council of Chicago, Ill., providing for 120 miles of track elevation to cost approximately $10,000,000, to cover the tracks of seven railroads on the South Side, the Illinois Central, Chicago & Western Indiana, Chicago, Rock Island & Pacific, Michigan Central, Nickel Plate, Pullman railway and the Kensington & Eastern. The ordinance provides that work to the amount of $7,500,000 shall be completed within five years.

At the annual meeting of the stockholders of the Pennsylvania R. R. the recommendation in the annual report that the capital stock be increased from $500,000,000 to $600,000,000 was approved. This increase will be made from time to time, when in the judgment of the directors money may be required for the needs of the company.

The principal railroad construction contract of the week appears to have been the one secured by [illegible] of Lynchburg, Va. This contract calls for the construction of a 28-mile railroad in Kentucky for the Consolidation Coal Co. The line is to extend from a connection with Chesapeake & Ohio Ry. at the mouth af Shelby Creek to the head of Elkhorn Creek.

Bids were opened last Wednesday at Kansas City, Mo., by the Kansas City Southern Ry. for 1,500,000 cu. yds. of excavation. A number of contractors bid on the work. The contracts were to be signed up on the 20th The Kansas City Southern has also asked bids on a considerable amount of betterment work in Arkansas and Kansas.

"A Man Who Died Recently."

John B. McDonald held high rank as a contractor. His most notable work was the building of the first underground railway in New York, but [illegible] one of several others of his contracts entitled him to the degree of Master Builder. Courage, energy, far-sightedness and administrative ability aided him in winning eminence in that most difficult of all professions—contracting. Quiet and reserved in manner he was not a conspicuous figure in a crowd, but those who knew him best knew that within his short, thickset frame there dwelt a real man. His death last week removes a notable figure from the field of contracting. In its March 18 issue the New York Times pays the following tribute to this builder of the first subways in New York city.

> So long [illegible] that [illegible] New York [illegible] B. McDonald will be [illegible] as [illegible] first [illegible] another [illegible] what [illegible] blest to accomplish. The poor Irish lad, with little [illegible] of [illegible] liberal [illegible] It is doubtless [illegible] could not have been built without him, but the fact is indisputable that he is the man whom the conditions evolved [illegible] task. He [illegible] est view of his job, which he said was nothing more [illegible] end. But the cellars had to be built in streets, and many thought that the buildings would tumble in. There were others who thought the work could not [illegible] were [illegible] work [illegible] operations [illegible] native [illegible] searchlight, but they remain for others. Despite what he did, and the enormous simplification of the problem through his demonstration of it, the next [illegible] scure as before. The highest official authority, with [illegible] routes and plans which even he shrunk from attempting. It is a demonstration that the wisdom of the schools is inferior to native intelligence developed by practical experience. The man who never studied engineering died a Doctor of Science [illegible] the benefactor of the city in its bitterest need, although he has to his credit a long list of considerable [illegible] of profession.

Commission form of Government.

All the modern improvements are to be included in [illegible] urban city of Beacon, which is to be formed this summer by the consolidation of Matteawan and Fishkill Landing, two suburbs of New York city. The charter provides for the commission form of government, modeled after the Des Moines plan, together with the initiative, referendum and recall. The city, which will have a population of about 15,000, will be ruled by five commissioners, all elected at large for a period of four years. There will be no mayor, the Commissioner of affairs practically assuming all the duties of chief executive. His salary is to be $300 per year. The Commissioner of accounts will be the ex-officio city clerk and purchasing agent for all departments. There will also be Commissioners of public safety, public works and finance. The charter provides that every officer of the city shall establish certain office hours and that he must be at his office during such hours. He is also required to make periodic reports to the citizens through the newspapers. In the meantime several states have taken up the initiative and referendum movement. The Illinois legislature is now considering a bill to amend the state constitution so as to allow the use of the initiative and referendum, and the house of representatives of the state legislature of Wisconsin has voted in favor of giving the cities of the state operating under a commission form of government, the right to adopt the principle of the initiative and referendum and the recall. The Wisconsin bill also provides for reducing the schedule of salaries for commissioners, and this is expected to induce a considerable number of cities in that state to adopt the Commission form of city government.

Fiftieth Anniversary of M. I. T.

The [illegible] of [illegible] is to be celebrated next month at Boston, Mass. On April 10th the Massachusetts Institute of Technology is to hold a Congress of Technology, the primary purpose of which is to mark the 50th anniversary of the chartering of that institution. One of the main features of the congress will be the presentation of a series of papers which promise to be a remarkable and striking record of the place of science in modern industry. There are older technical schools in this country than the Massachusetts Institute of Technology but none have played a more prominent part in the application of science in the industries. The progress of this institution and of its graduates, therefore, is a pretty good indication of the development that has taken place in industrial science in this country. Papers dealing with the various aspects of the country's industrial problems are to be presented at the congress by a large number of Technology graduates who have been conspicuoulsy successful in varied lines of engineering. It is intended to have the whole body of papers constitute a survey of engineering and industrial science as a whole, from a body of men who speak from first hand experience with industrial nroblems all over the country. It is safe to say that no similar discussion of the industries has been attempted on such a scale and the record should be of unique suggestive value to the industrial concerns of the country.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

[illegible] & Northern R. R. W. M. Blount, President, Union Springs, Ala., is [illegible] New York capitalists to assure the completion of [illegible] the Western Railway of Alabama. It is probable that a meeting of the stockholders of the road will be held in the near future to vote on increasing the bond issue from $500,000 to $3,000,000. It is the purpose to reach Tallassee on the north and then build southward to Pensacola, or some other point on the gulf.

The recent joint inspection of the properties of the Alabama Consolidated Coal & Iron Co., and the Southern Iron & Steel Co., by the officials of the companies, has given rise to a rumor that a plan to merge the interests is under consideration. The plan is said to include the construction of a railway line connecting all of the properties of the companies and extending to the navigable waters on the Warrior River, and the securing of a barge and water route to New Orleans. Joseph H. Hoadley, New York city, is President of the Alabama Consolidated Coal & Iron Co.

Arkansas.

The England & Clear Lake R. R. Co., operating a line extending from England, Ark., to Lester's Landing, on the Arkansas River, will, according to a statement recently made by W. J. Locke, England, Ark., President of the concern, probably be extended either up or down the stream.

It is understood in Jonesboro, Ark., that a deal has been closed by which R. E. Lee Wilson and associates acquired the entire capital stock of the Jonesboro, Lake City & Eastern Ry. Co. The former owners, A. J. Kerfoot, E. F. Brown and J. E. Jones, disposing of their entire interests. While the terms of the contract have not been made public, it is understood that the new purchaser has paid the sum of $225,000 and assumes the bonded indebtedness of the road.

California.

⊙A contract has been recorded at Fresno between the Fresno, Hanford & Summit Lake Interurban Ry. Co. of Fresno, owner, and the Hudson Counties Co. of New York, contractor for the construction of depots, car barns, etc., and the construction and equipment of an electric railroad from Fresno to Kingsburg, thence to Sanger and back to Fresno. The contract price is $1,089,500. The Hudson Counties Co. has sublet the entire contract to the Pinkerton Construction Co. of Philadelphia. As noted in our last issue the grading contract on this road has been let to S. F. Hobler, Sanger, Cal.

The City Council of San Jose is considering an ordinance granting the San Jose R. R. a franchise for the construction and operation of an electric railroad on Fifth St. from St. John to St. James and on St. James from Fifth to Sixth.

City Trustees of Valleyjo have passed the ordinance granting the Northern Electric Co. of Chico a franchise to enter Valleyjo with its electric railway and to run along the water front to a connection with steamer for San Francisco. It is stated that work on the road will be begun soon.

City Council of Long Beach, Cal., has instructed the Board of Public Works to advertise for bids for the construction of 3,700 ft. of standard double track railway across and leading from the city docks.

The Chamber of Commerce, San Diego, Cal., is to meet shortly for the purpose of taking up the proposition to induce the Santa Fe Railway System to reopen the Temecula Gap of the road between Fallbrook and Temecula, which was discontinued after the washout in 1896. The distance which it is proposed shall be rebuilt is 13 miles and with its restoration the route to Temecula would be but 33 miles in length instead of 150 miles as by the present arrangement.

Colorado.

✣The Lookout Mountain Park Development Co., 620 Empire Bldg., Denver, Colo., is asking bids until March 26 for grading roadbed for incline railroad from base of mountain near Golden to the top, approximately 2,600 ft.

The Colorado Springs Interurban Ry. Co., Colorado Springs, is considering building a ½ mile extension from its present terminal at Evergreen Cemetery.

The Judiciary Committee of the House of Representatives at Denver, has reported with a favorable recommendation, the Allen bill providing for the issue of $5,000,000 in bonds for the construction by the state of the Moffat tunnel through the Continental divide west of Denver. The only amendment to the bill was the striking out of the clause permitting convict labor to be employed in the tunnel work. The bill was introduced by Representative Gainer M. Allen, of Denver.

Connecticut.

The New York, New Haven & Hartford R. R. has changed its plans for its new railroad station at New Haven, Conn., and it is now said that the station will be located on Chapel St. on the site of the old public market. The tracks and platform of the proposed new station will be underground.

Florida.

⊙J. M. Willis, Millville, Fla., is building 13 miles of new railroad for the G. A. Lumber Co., and is also retieing and resurfacing 30 miles of main line for the company. He is likewise constructing 4½ miles of road for the St. Andrew Development Co. Mr. Willis can use station men and tie men.

Information concerning the Georgia & Florida R. R. is to the effect that the line from Sparks to Moultrie, Ga., will be completed April 15 and that a line will be built from Sparks to Adel connecting with the South Georgia road from points in Florida. W .A. Swallow, Augusta, Ga., is Chief Engineer.

The Southern Colonization Co., Graystone Hotel, Kissimmee, Fla., opened bids March 14, for clearing railroad right-of-way in Osceola County, Fla. Work is to progress at such rate as will insure completion on or before Sept. 30, 1911. C. H. Armstrong is Engineer.

The Atlantic Coast Line R. R. has placed an order with the Carnegie Steel Co. for 1,600 tons of steel rails, delivery to begin in the early spring. The company proposes a 30-mile extension from Monticello to Perry, Fla.

Idaho.

Information received from Emmett, Idaho, is to the effect that the Idaho Northern R. R. will have actual construction work started April 4 on the extension from that city into the Long Valley Country. E. H. Dewey, Nampa, Idaho, is President and General Manager of the company.

Information received from Stites, Idaho, is to the effect that the Northern Pacific Ry. Co. will construct a road from that point to Elk City, a distance of 46 miles. The line, according to the estimates, will necessitate an expenditure of $2,500,000. The Northern Pacific Railway Co. already has a line surveyed into the Elk City district. It runs up the south fork of the Clearwater River to the mouth of Elk Creek, and follows the latter stream into Elk City. In addition to the ore tonnage the new road would tap 2,000 square miles of the pine timber land. W. L. Darling, St. Paul, Minn., is Chief Engineer.

Illinois.

⊙Driscoll & McCalman, Citizens' Title & Trust Bldg., Decatur, Ill., as noted in our last issue, have been awarded the contract for the concrete work on the extension of the Chicago, Ottawa & Peoria Ry. (electric) from Joliet to Morris, Ill. The contract includes about 3,000 cu. yds. of concrete masonry in arches and abutments. Teams are wanted for hauling 1,800 cu. yds. of material.

The Illinois Central Electric Ry., Canton, Ill., has decided to extend its line to Farmington. The proposition includes the securing of $35,000 of stock subscriptions by residents of Canton, Farmington and other places along the extension. The extension will be built from Norris and would be about 6¼ miles long. It is estimated that the work will cost $100,000.

Track elevation ordinances as follows are now before the City Council of Chicago: Ordinance providing for 120 miles of track elevation to cost approximately $10,000,000 and cover the tracks of seven railroads on the South Side, the Illinois Central, Chicago & Western Indiana, Chicago, Rock Island & Pacific, Michigan Central, Nickel Plate, Pullman railway and the Kensington & Eastern. Of this elevation the ordinance provides that work to the amount of $7,500,000 shall be completed within five years, this covers the elevation on the Illinois Central, Chicago & Western Indiana, Kensington & Eastern and the Michigan Central. The Illinois Central tracks are to be elevated from 103rd St. to Kensington Ave., an ordinance providing for the elevation of the tracks on the Panhandle & Englewood connecting track, involving an expenditure of $5,000,000, is also before the council.

Representatives of the 28 railroads coming into Chicago are reported to be considering forming an association to take over the old clearing yards near Argo and transfer it into a distributing yard where all incoming freight would be sorted. The Argo tract is four miles long by a quarter of a mile wide, already contains 100 miles of switch track, and is large enough to take 200 miles of additional trackage. The clearing yards are at present held by the Chicago Union Transfer Ry. and are used for a small amount of switching.

The Sterling-Moline Traction Co., of Sterling, Ill., is reported to be planning to have construction work started next month on its proposed line from Sterling to Moline. Early in May it is planned to have work started on the line from Sterling to Princeton. The route of the first line is from Sterling and Rock Falls to Prophetstown, Lyndon, Morrison by way of Denrock, Hillsdale to Moline. The Sterling-Princeton route is from Sterling and Rock Falls by way of Van Petten to Walnut, to Ohio and by way of Kasbeer to Princeton. The directors of the company are Joseph Wright, Rock Falls; C. E. Windom, Attorney N. G. VanSant, A. G. Van Petten, G. A. Allen, Sterling; Geo. W. Burch, Galt; Wm. H. Shaw, Lyndon; Wm. McNeil, Jas. H. Mosher, Geo. E. Paddock and Chas. W. Fenn, Prophetstown; Wm. E. Tuller, A. R. Lewis, Chas. D. Gallentine, Morrison, and C. P. Sturtevant, Erie. Joseph E. Wright of Rock Falls is Secretary.

It is believed that steps will soon be taken by promoters who had surveys made about 5 years ago for the construction of a railroad from Rockford to Peoria, Ill., to revive the project. Under the original surveys the road would have passed two miles west of Sublette, but a change is now proposed whereby the line will pass through that town. The principal object of the road is to reach the Northern Illinois coal fields.

The St. Louis & San Francisco R. R. Co. has leased the Cairo & Thebes R. R. for a period of 99 years and the company will take immediate steps toward rebuilding with 75-lb. rails the Cairo branch of the Iron Mountain, between Dexter Junction and Charleston, and when this work is finished the road to Charleston will have been relaid in the heavy steel which is the same weight that is used on the main line to St. Louis.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Indiana.

The Indiana Harbor Belt R. R., B. B. Seymour, Chief Engineer, Gibson, Lake County, Ind., is reported to be planning to issue $12,000,000 more bonds to complete its double tracking and better its terminal facilities.

The Indianapolis & Delhi Traction Co. incorporated early this month with a capital stock of $100,000, proposes to build a traction line from Indianapolis to Delphi, through Marion, Hamilton, Clinton, Tipton, Howard and Carroll counties. This proposed line has been considered by a number of Indianapolis promoters for the last three years, but prior to the incorporation of this company no active steps had been taken to build it. The present plan is to build to Sheridan and extend the line eventually to Delphi. No franchises have been asked, and it is said the preliminary survey has not been completed. The incorporated company expects to proceed at once with the survey and requests for franchise. The directors are Ed Thistlewaite, Sheridan, Ind.; Milton C. Beals, Westfield; Morris E. Cox, Westfield; E. Johnson and Henry L. Smith, of Indianapolis, Ind.

Board of Public Works of Indianapolis is considering a resolution for elevating the rail road tracks from Senate Ave. to Massachusetts Ave., a step preliminary to work that may cost upward of $5,000,000. Following the adoption of the resolution, the city engineer will then begin the preparation of detailed plans which will include the disposition of Pogue's Run in the downtown district in some manner yet to be decided. It will require at least one year to prepare the track elevation plans. The Legislature, at the session just closed, amended the track elevation law so that any complete elevation scheme may be ordered in one year and also raised the maximum track elevation tax levy from 4 to 6 cts. With the increased levy and bond issues, the city expects to have no difficulty in meeting its part of the cost. Henry W. Klausmann is City Engineer.

The Terre Haute, Indianapolis & Eastern Traction Co., T. F. Grover, General Manager, Terre Haute, is to rebuild two miles of its track at Terre Haute this spring.

Iowa.

N. W. Harris & Co., Chicago, Ill., owners of the majority of stock and controllers of the bonds of the Des Moines City Ry. Co., have purchased the other interests in the system and will rehabilitate it spending $500,000 at once. It is stated that J. D. Harrigan, heretofore Manager of Columbus, Delaware & Marion Ry., of Columbus, O., will become active manager of the Des Moines system.

The Chicago & Northwestern Ry., according to advices from Cedar Rapids, Ia., will expend $200,000 in improvements in this city if the City Council will give the road the right to double-track its lines through the town. At present there is only a single track through Cedar Rapids connecting Otis and Beverly, although the cut-off, which is the short cut between the two stations named, is double-tracked. E. C. Carter, Chicago, Ill., is Chief Engineer.

The Chicago, Milwaukee & St. Paul Ry., according to reports from the vicinity of Manila, Ia., has purchased the Atlantic North & South R. R. and will build from Kimbleton east, of Irwin, to Manilla. C. B. Judd, Atlantic City, Ia., is Chief Engineer.

Work has been started on the grade of the proposed new freight track of the Waterloo, Cedar Falls & Northern R. R., across the Virden slough, parallel with the present right-of-way. T. E. Rust, Waterloo, Ia., is Chief Engineer.

Kansas.

Advices from San Junta, Colo., state that the Santa Fe System is making preparations to ballast the roadbed between Garden City, Kan., and Holly, Colo., a distance of about 75 miles, with clay.

The Wichita Interurban Ry. Co., O. A. Boyle, General Manager, Wichita, has plans well along for an extension to Hutchinson, through Burrton, running along the south side of the Santa Fe line. The extension will probably cross the Santa Fe at a cut just east of Mission. The junction will be probably about one mile south of Mission. The road will run directly west from the junction to Halstead, thence west on the south side of the Santa Fe right of way to Hutchinson.

The Village Council of Cherryvale has granted a franchise to D. H. Siggins, Coffeyville, Kan., for a proposed interurban extension. Franchises have also been secured in Chanute and Humboldt and Iola votes at the spring election on granting a franchise.

The Arkansas Valley Interurban Ry., O. A. Boyle, General Manager, Wichita, Kan., has let contract for 10,000 ties to be used on the extension from Sedgwick to Newton and from Newton to Halstead.

The recently chartered Arkansas City, Wellington & Northwestern R. R., which purposes to build a road from Arkansas City northwest, through Wellington and Conway Springs to Hutchinson, has effected a permanent organization, with State Senator Geo. H. Hunter, of Wellington, as president, and Roy W. Hitchcock, secretary. A construction company has been organized with T. J. Garland of Wellington president and Roy W. Hitchcock secretary.

Kentucky.

It seems likely that the Tennessee Central R. R., L. F. Lonnbladh, Chief Engineer, Nashville, Tenn., will soon take up its proposed extension from Hopkinsville, Ky., to Paducah, Ky., a distance of 40 miles. This extension was permanently located about a year ago.

Langhorne & Langhorne, Lynchburg, Va., have been awarded the contract for constructing the Sandy Valley & Elkhorn Ry. for the Consolidation Coal Co. The line will extend from a connection with Chesapeake & Ohio Ry. at the mouth of Shelby Creek to the head of Elkhorn Creek and will be 28 miles long. F. E. Englar, Pikeville, Ky., is Chief Engineer.

It has been announced by R. W. Riggins, promoter of the proposed railroad from Brownsville, Tenn., to Paducah, Ky., that actual construction work will be started at an early date, and that surveyors will be put in the field at once to repair the old grade which was made 40 years ago and has been lying idle ever since. It was completed between Brownsville and Friendship, a distance of 22 miles, but has been badly washed in some places. Land owners have deeded this grade to the new company. Crockett County is asked to make a donation of $30,000 and the right-of-way. A committee was appointed to raise the money and they are having no trouble. All of the farmers along the proposed road having agreed to give from $2 to $5 per acre on their land to aid the building of the road. The citizens of Brownsville are very much interested in the building of the road. They are asked to make a donation of $40,000 and right-of-way. C. L. Clifton, a prominent real estate dealer of Brownsville, notified Riggins that the money was ready, and also the right-of-way. It was further stated that they would be in a position to let contracts on the grading in the next few days.

Louisiana.

It is believed that construction work is to be started shortly on an extension of the new river branch of the St. Louis & San Francisco R. R. from Irwinville up to new river country past Lakeland. The Frisco last year built the new river road to Lakeland, a distance of about seven miles. The new line has proved such a good territory, not only a good feeder for the road, but has opened a heretofore closed territory to the Baton Rouge merchants, that the Frisco officials decided to make an extension of the line, and also to more than double the mileage. The new road, when completed, will be over 15 miles long.

Plans are under consideration for the improvement of the terminal facilities at Covington, La., of the Baton Rouge, Hammond & Eastern Ry.

The Police Jury of Calcasieu has granted an extension of one [illegible] time to the Lake Arthur, Jennings & Northern R. R. Co. in which to complet [illegible] original time in which the road was to [illegible] was May 1 of the present year.

Maryland.

The State Public Service Commission has approved the plans of the Towson & Cockeysville Electric Ry. Co. and the line will be built over a private right of way to connect with the electric cars at Towson and the Northern Central Ry. at Cockeysville. It is proposed to have the line in operation by Sept. 1. According to the maps of the company, the line will start from a point near the Courthouse, at Towson, and will proceed to the northern boundary of the town, whence it will take a direct route to Lutherville; then to follow a line east of the Northern Central Ry. to Timonium and Texas and to cross the Northern Central at a point south of Cockeysville. The line will then run west of the Northern Central and the York road to Marble Hill. The directors of the company are: President, J. Alexis Shriver; vice-president, William H. Wight; secretary and treasurer, James S. Nussear; William H. Griffin, Charles E. Rieman and David G. McIntosh, Jr.

Massachusetts.

The State Railroad Commission has approved the plans of the Boston Elevated Ry., Geo. A. Kimball, Chief Engineer, Boston, Mass., for the location of its extension from North Station to Lechmere square in Cambridge.

Michigan.

The Michigan United Rys. Co., Lansing, Mich., which proposes to build an electric line from Lansing to Saginaw completed its surveys from St. Charles to the latter city early this month. It is understood that the company has acquired the franchise of the Michigan Southern, which was given free to that line seven years ago. The route from St. Charles to Saginaw is through one of the best agricultural sections of the state.

The City of Ionia will vote on April 3 on granting a franchise to Andrew Fyfe, Detroit, for the proposed Detroit & Grand Rapids Electric Ry.

The Pere Marquette Ry., according to information received from Port Huron, Mich., will remove the round house in that city from the present site at Sixteenth St. to Court St. The cost of the work will, it is estimated, be about $50,000.

Minnesota.

The Arctander Railway Promoting Organization has been organized by citizens in the territory northwest of Willmar, Minn., in an effort to secure railroad facilities, either steam or electric. At present an electric line to be built from Willman is proposed and there is talk of organizing a local company to build such a line. Ben Halvorson, Norway Lake, Minn., is Secretary of the Promoting Organization.

Missouri.

A railroad club has been formed at Frestoe with E. E. Trippe as president, and is now securing subscriptions to make a preliminary survey from Warsaw to Cross Timbers for the proposed electric line from Warsaw to Springfield. B. Orlando Taylor, Bosworth, Mo., is interested in the proposed line.

The St. Louis & San Francisco R. R. is reported to have taken over the Houck railroad lines, and will, it is said, immediately construct another line from Capt. Girardeau to Hickman, Ky., passing through Charleston, Mo. Some credence is placed in the story, as it is well known that the Frisco has long wanted to reach Blodgett, Mo., and Charleston, Mo. It is also known that Mr. Houck recently had a survey made from the Cape to Hickman with the end in view of extending his lines to that point.

The List-Gifford Construction Co., Joplin, Mo., according to advices from Joplin, have finished their contract for building the Missouri, Kansas & Texas Ry. grade from the main line to the new Union depot and is preparing to move their outfit to other work in the East.

✣ indicates work now open for bids. indicates a contract let recently.

Kansas City and Vicinity.

[illegible]

[illegible] of work on its line and this has proved to be an attraction that none seemed to be able to [illegible] work only and some on the entire line; others were content to look on without bidding. At this writing the bids are all in but the awards will not be made until Monday the 20th.

William List, of List & Gifford, Davenport, Iowa, is one of the bidders on the Kansas City Southern work and has been stopping at the Baltimore for several days past. Mr. List says his company has a large amount of work [illegible] year.

Norton Bros. of Kansas City are doing a nice piece of excavating at 14th and Baltimore Sts. Their revolving shovel is attracting a great deal of attention and the amount of earth that is loaded out every day is really surprising.

Newt. Wilcoxson was here this week. Newt. is one of those remarkable men who seem to grow younger as the years pass. The contracting business seems to agree with him physically and we learn from reliable sources that it has also been agreeable to him from a financial point of view.

On account of several minor changes along the right of way of the Kansas City-St. Louis electric road, the L. J. Smith Construction Co., general contractors for the road, has not as yet sub-let the work. However, Mr. Scott Mitchell of that company thinks all obstacles of this kind will be removed within a few days, when the profiles will be open to team and shovel outfits desiring work.

J. H. Flick of Chicago was among those with us this week. It is understood he is one of the bidders on the Kansas City Southern work. Mr. Craig of the J. H. Flick Co., was also here.

Mr. Geo. Gist was down from Chicago this week. Mr. Gist was surprised with the amount of work that is going to be done in and around Kansas City this season and it would not be surprising if he decides to land an outfit on some good contract in this vicinity.

Dave Griffith is one of the busy ones. Dave is a contractor farmer. While he resides in Kansas City, yet just south of here lies 1,000 acres of fine Missouri land that he owns. By a curious coincidence the largest shovel cut in the profiles of the K. C. Southern work lies directly on Dave's farm. Now, if we should happen to announce that Mr. Griffith is going to do this particular piece of work no one should be surprised. Of course Dave has been what is known as a "team man" all his life, but we predict a big success for him if he should decide to tackle the steam shovel and cars. Dave Griffith is a real contractor.

Mr. Hannon of Hannon & Hickey, St. Louis, is at the Baltimore and will remain in town until after the letting—perhaps longer.

The writer had a pleasant hour this week with Colonel J. H. Hampson of Mexico City, Mexico. Colonel Hampson is in the best of health and spirits. He says that while the insurrection in his country has temporarily stopped the wheels of progress, yet it is only a question of a short time until everything will be settled. He says 2,000 miles of railways will be built in Mexico within a very short time. The many friends of Colonel Hampson will be glad to know he is looking and feeling so well and is optimistic over the future of his chosen country.

Mr. E. S. Johnson, President of the Davenport Locomotive Works, was in town a few days ago. He ran down from Excelsior Springs to shake hands with his many friends in town this week. Mr. Johnson thinks that although work over the country is not opening with the same rush as in former years, yet there will be a great amount let within a short time.

St Louis Items.

[illegible]

⊙Contracts for paving and sewering 25 blocks of Belleville streets were awarded by the Board of Improvements. Hoeffken Brothers of Belleville were awarded the Jarrot and C street work for $37,697.55 and Reeb Brothers of Belleville got Douglas avenue and Sycamore streets for $28,683.

⊙The contract for the erection of the Jefferson Memorial, to be built at the De Baliviere entrance to Forrest Park, on the site of the main entrance to the Louisiana Purchase Exposition, with the surplus from the Exposition was awarded to James Stewart & Co., at a contract price of $360,000. The award was made by the subcommittee of the Executive Committee to which the supervision of the erection has been assigned. This subcommittee consists of David R. Francis, A. L. Shapleigh, Charles W. Knapp, W. K. Bixby and L. D. Dozier. The bids were opened in the office of Mr. Francis. There were eleven bidders, all St. Louis concerns except one, the Fuller Construction Co. of New York. The contract price is exclusive of the commission paid to the architect, Isaac S. Taylor, and of the sculpture and the mural painting which will form a notable feature of Jefferson Hall, which will occupy one wing of the structure, the other wing taken up with the exhibition rooms of the Missouri Historical Society. The letting of the contract followed the signing of the ordinance authorizing the construction of the monument by John H. Gundlach, acting mayor. Under the terms of this ordinance the care of the structure will be under the jurisdiction of the Park Department. The assigning of quarters in the structure is given to the park commissioner. In its passage through the Municipal Assembly the ordinance was changed to eliminate the board of control which the original bill provided. Sets of blueprint plans of the structure were sent by the contractor to sub-contractors, who will bid on separate portions of the work. The construction will begin early this spring and present plans are to complete the building in time for its dedication on the ninth anniversary of the dedication of the Louisiana Purchase Exposition, which took place April 30, 1903. The contractor for the monument had only one small contract on the World's fair, the construction of the exposition power house, which was located just west of machinery hall, near Skinker road. The plans for the structure have been changed slightly as a result of the co-operation of city officials. The public comfort station, which will occupy a large portion of the basement, was greatly enlarged. Miss Charlotte Rumbold, secretary of the Public Recreation Commission, conducted in connection with the Park Department, made many of the suggestions for changes which were introduced. Miss Rumbold has studied such conveniences in many cities. The plans also were changed so as to accentuate the central pavilion which separates the wings of the structure. The flat dome which forms a feature of this pavilion will be made more visible. This central pavilion will be open to the weather and will display at its center the seated statue of Thomas Jefferson by Karl Bitter, which is now being designed. The material for the building is buff Bedford limestone, this being the highest grade of this famous building stone. None of this grade has yet been used in St. Louis buildings, the blue grade having been used exclusively.

The figures given are for supplying engine houses. The period covered by the contract is March 20 to June 26.

Columbus S. Jones wants Matt Connor's address. Address him care of Koenig's Labor Agency, St. Louis, Mo.

Frank McCaughey, a son of Big Jack's stopped off a day here on his way back to Chicago from Kansas City, where he looked over the Kansas City Southern work. They have 80 teams idle which they can place on work immediately. 5402 Magnolia Ave., Chicago, Ill., will catch them.

T. W. Blythe of Blythe Bros., Tama, Ia., was with us a day last week. Blythe informs us that they have finished their work on the Northern Pacific and are looking around for a grading contract.

P. J. McGraw reports his outfit which consists of 9 teams, idle at Palmyra, Mo.

J. H. McFarlin, Springfield, Ill., is in the market for any kind of grading or concrete work.

Wm. Ogle has finished his work at Clayton, Mo. Ogle wants work for a 7-team outfit.

A heavy drop in the price of forage was shown in bids just opened by the supply commissioner of St. Louis. The bidders offer to supply all city departments that use horses, the principal one being the fire department. The following table shows the price at the last letting, the price at the previous letting, and the price at the corresponding letting last year.

Kind of forage.	Present quarter.	Last quarter.	Corresponding quarter, 1910.
No. 1 timothy hay....	$15.80	$17.20	$18.35
Choice prairie hay....	14.50	15.10	15.45
Clover hay	13.40	16.00	18.00
No. 2 white oats.....	.35¾	.37⅞	.53⅛
No. 2 mixed oats	.36⅛	.37⅞	[illegible]
No. 2 corn............	.53	.49	.73

Mike Conroy took a flying trip to Kansas City last week. Looked over some work there and returned to his work at Godfrey, Ill., which is nearing completion.

Wm. O'Connor is here waiting for some new work to turn up.

The two Pats, Hannon and Hickey, left here for Kansas City to put in a bid on the steam shovel work that the Kansas City Southern R. R. Co. is going to let.

Cary Bros., R. F. D. No. 1, Cora, Ill., still have about 250,000 yards of levee work to let. This work is all in fields. Height of levee 4 to 8 feet. Will let work in quantities to suit outfits.

Sam Bush has taken 200,000 yards of Cary Bros.' levee work in southern Illinois.

Tom Keating of Keating Bros. is here looking for work for their 25-team and machine outfit which is idle at Mt. Carmel, Ill.

T. J. Morris writes us from Palmyra, Mo., that he has finished work at that point and is in the market for any kind of grading.

Nebraska.

Engineers have been over the route of the proposed electric line betwen Beatrice and Adams to make a rough estimate of the cost of construction. W. H. Robins, Beatrice, Neb., is interested.

The County Supervisors at Oakland have granted the proposed new line of railroad a right of way between Tekamah and Decatur, along the main traveled public road. Decatur has already granted a franchise for the road and all that remains is the right of entry into Tekamah. This project is backed by eastern capital. McKeen motor cars will be used on the line.

New Jersey.

Surveys are being made for the proposed electric railway between Millville and Ocean City.

The Ocean City Electric R. R. Co., Ocean City, N. J., has completed plans for a branch line from 34th St. to Beesley's Point. It is expected the work will be completed before summer.

The Delaware, Lackawanna & Western R. R., G. J. Ray, Chief Engineer, Hoboken, N. J., will soon complete plans for its improvement work through Glen Ridge to Montclair. Work on the Bloomfield end of the improvements is now underway.

New York.

The Rutland Railway, Light & Power Co., Rutland, Vt., is planning to build a 9-mile extension from Fairhaven, Vt., to Whitehall, N. Y.

Good progress is being made with the construction of the line of the New York, Westchester & Boston Ry. During the week ending March 11 several bridges in the Bronx section of New York were completed and some 2,000 ft. of subway steel placed. In Mount Vernon the large cut as far north as East Fifth St., was completed, and on the north end

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

to a point about 200 ft. south of Fulton Ave. Piers and abutments for the viaduct from Columbus Ave. to the north side of the New Haven R. R. were practically completed, and the erection of the steel work will be started in a short time. Ninety per cent of the concrete work for the viaduct on the Hutchinson River is completed, and the abutments and retaining walls in North Pelham are nearing completion. A steam shovel is at work on the line between North Pelham and New Rochelle, and the material being loaded by it is being used in making the embankment between that point and Second Ave. and North Pelham. Another shovel is at work on the Gannon property just south of New Rochelle Ave., on the White Plains branch. An additional steam shovel plant has been shipped to start work between Quaker Ridge Road and Palmer Ave., and three more shovels are at work between Palmer Ave. and White Plains and making rapid progress.

The Lehigh Valley R. R., E. B. Ashby, Chief Engineer, New York, N. Y., is stated to have plans under consideration for the construction of new iron ore and coal docks at the Tifft Farm in Buffalo. The plans are said to include the erection of concrete docks, to be equipped with electric unloaders. The improvements will cost $500,000.

North Carolina.

⦿Stewart & Jones, who have been awarded the contract for grading the line of the Piedmont & Northern Ry. (electric), between Charlotte and Kings Mountain, as noted in our last issue, have opened offices in the Lebovitz Bldg., at Gastonia, N. C., where they will have their headquarters for the work. Two steam shovels have been ordered sent to Gastonia, and will be placed at work this week. Several grading camps are also being located. R. J. Bingham, Gastonia, has been awarded a sub-contract for the concrete and masonry work on this portion of the line.

The North Carolina Interurban R. R. Co. (formerly the Isothermal Traction Co.), which proposes the construction of a railroad from Rutherfordton through Polk County, has made a proposition to Columbus for entrance to that city. Wm. M. Peyton, Rutherfordton, N. C., is Chief Engineer.

The Carolina, Clinchfield & Ohio Ry., M. J. Caples, General Manager, Johnson City, Tenn., is reported to have started surveys for its new coal storage yard at Bostic, N. C.

Surveys have been started for the proposed trolley line between Abbeville and Centreville. Cothran & Cothran, Engineers, Greenwood, N. C., are the engineers.

The Seaboard Air Line, W. L. Seddon, Chief Engineer, Portsmouth, Va., is preparing plans for a new freight station at Raleigh, N. C.

Advices from Elkin, N. C., under date of March 6, state that work on the Elkin & Alleghany R. R. is progressing nicely. The grading is all done from the foot of the Blue Ridge Mountains, near Roaring Gap, to the corporate limits of Elkin, a distance of 15 miles. The convicts, who are doing the work, are all stout, able-bodied men, and do good work. The force is now at work inside the corporate limits of the town and are engaged in making a cut through a bluff, which is almost solid rock. The cut is about an eighth of a mile in length and will be from 5 to 20 ft. in depth. When this is finished, the roadbed will be ready for the ties and rails.

The Charlotte & Norfolk Ry. Co. has applied for a charter to construct a railroad from Charlotte, N. C., to Norwood, the project mentioned in our last issue. The charter provides that work may be started when $25,000 has been subscribed although the authorized capital is $2,000,000 and will allow the proposed road to touch at Troy, Mount Gilead, Fayetteville, Norfolk, and other points. It also contains provisions with reference to counties, towns, townships and cities voting bonds for the help of the road. Among those signing the paper are M. C. Mayer, D. P. Hutchison, N. S. Alexander, C. G. Creighton, J. A. Hathcock, A. Little, J. F. Shinn and others.

North Dakota.

The Wahpeton-Breckenridge Street Ry. Co., Breckenridge, Minn., is having plans and estimates prepared for its proposed interurban electric line, the route of which is as follows: Southwest to Hankinson following section lines through Great Bend, and the most thickly settled portions from Breckenridge to Barnesville, following what is known as the old grade, one mile south of Manston, a branch line will run east through Rothsay into Otter Tail county and that magnificent Park and Lake region, the pleasure and pride of Minnesota; thence between Star Dead Lake, northeast to Perham on the N. P. railway. The company is considering a plan to construct its own power plant at some points and on the line in Otter Tail county, enabling it to furnish its own power and also supply Rothsay, Barnesville and other points as well, and farmers along the line.

Citizens of Minot, N. Dak., have decided to support the Commercial Club in its efforts to induce the Grand Trunk Pacific R. R. to construct a line to that city.

Work is to be resumed early in the spring on the Great Northern cut-off between Ayer and Williston, N. Dak., under the supervision of Gus Hensel of Spokane, Wash. The new line will be about 175 miles long and will cost $5,000,000. It will shorten the main line about 35 miles.

Rumors are in circulation in the Cheyenne River Reservation country that the Minneapolis & St. Louis R. R. has underway preliminary work on a bridge across the Missouri River at Mobridge, with the intention of building a line northwest through Perkins County. R. G. Kenly, Minneapolis, Minn., is Chief Engineer.

Reports have been received to the effect that the Northern Pacific will extend the Fargo Southwestern branch from Edgeley to Cannon ball with the new line from Mandan to Mott. S. J. Bratager, St. Paul, Minn., is Principal Assistant Chief Engineer.

Ohio.

It is rumored in railroad circles that the Cincinnati, Hamilton & Dayton R. R. is preparing to join in the elevation or depression of the tracks at Washington St., Dayton, as proposed by the Big Four System. The city of Dayton will bear its portion of the expense if the improvement is undertaken. M. V. Hynes, Dayton, O., is Resident Engineer.

The Toledo Western R. R., John Dieter, Roadmaster, Sylvania, O., has, according to reports, under construction approximately $100,000 of improvements. The road, running from Toledo to Pioneer and Arian, Mich., mileage of 84 miles, is being thoroughly overhauled in order to meet the heavy demands made upon it.

The Cleveland Chamber of Commerce Traction Committee, at the request of the city and the Cleveland Ry. Co., has taken up the matter of getting five new street railway routes and extensions. The routes proposed are: Connection of the Harvard Ave. and Denison Ave. tracks across the valley to make a new East Side to West Side line; an extension of the West Madison Ave. line to give a new route to Rocky River; an entirely new route from Superior Ave. and West Third st., southeasterly through the flats; a route in Perkins Ave. from E. Ninth St. to E. Fortieth St., and the extension of the Superior Ave. line to connect with Euclid Ave. New territory would be opened to business, manufacturing and residence by the construction of these routes. They are estimated to cost between $950,000 and $1,000,000.

Engineers of the Lake Shore & Michigan Southern Ry. and the City of Cleveland have agreed on plans for the elimination of the Madison Ave. grade crossing at Cleveland. Legislation for the improvement, which is to cost $300,000, will be introduced in council soon. The plans provide for a curve in Madison Ave. which will lessen the angle of the crossing and thus reduce the length of the bridge span. The new plan saves something like $100,000 [illegible] The railroad will start work on a new bridge over Lake Ave. at the same time work at Madison Ave. is begun. B. R. Leffler, Cleveland, O., is Engineer of Bridges for the Lake Shore & Michigan Southern Ry.

The Dayton, Covington & Piqua Traction Co., Dayton, O., is considering extending its line to Versailles.

The State Legislature has defeated the Geleerd bill, authorizing municipalities to own and operate street railway systems. The bill was brought up at the instance of Toledo citizens, where it is desired to obtain possession of the street railways.

The Buckeye Lake Traction Co., Lancaster, is said to have secured options on practically all of the right of way for its proposed line from Lancaster to the lake. John H. Littrell is President and Dr. F. P. Barr is Secretary.

The special meeting of stockholders of the Northern Ohio Traction & Light Co., Akron, O., which was to have been held March 15, for shareholders' approval of the proposed $1,000,000 preferred stock issue, was postponed one week because of lack of sufficient proxies.

The Cincinnati, Hamilton & Dayton Ry., M. V. Hynes, Division Engineer, Dayton, O., has acquired 70 acres of land at Dayton. The company is said to be planning much betterment work between Dayton and Tippecanoe City. It is generally believed that the course of the road through Parson's and Johnson's Station will be changed, thus obviating a bad bend. Double tracking is also possible by the acquisition of the acreage.

As a result of a recent inspection of the Scioto Valley Ry. lines by President Frank A. Davis of Columbus, and Secretary E. R. Sharp, it is said that a number of improvements are projected.

Oklahoma.

Chamber of Commerce of Pawhuska, E. Sams, President, has notified its engineers to go ahead with surveys for a proposed line into Pawhuska from the Katy. Funds for the surveys were raised by the citizens.

Advices from Shawnee state that the preliminary survey of the Rapid Transit Interurban Company, from Tecumseh, to Sulphur, Murray county, 58 miles south, has been completed, and that work is to be commenced within a short time. The road is to be financed by Eastern capital, it is said.

The property and franchise of the Lawton & Fort Sill Electric Ry. Co. has been purchased at a receiver's sale at Lawton by M. A. West for $25,000. It is understood that the road will be placed in shape for operation at the earliest possible moment.

It is believed here in Muskogee, that the proposed Muskogee & Fort Gibson R. R. will be extended to Tahlequah, a distance of 35 miles, and to Tulsa, a distance of 55 miles. A special permit is being sought of the government to build a bridge over the Arkansas River. Charles Haskell, Muskogee, is promoter of the project.

Oregon.

The Oregon Short Line Ry. has engineers in the field cross-sectioning the survey from the Buhl extension to Nyssa. This extension has been contemplated for some time.

Articles of incorporation have been filed by the Tillamook & Bayocean R. R. and Navigation Co., with a capital stock of $100,000. As outlined in the articles of incorporation, the purpose is to build a railroad which will connect Tillamook, Ore., Bayocean and Netarts Bay. A steamship line will be operated between Tillamook Bay and Portland. Bayocean lies across the bay from Bay City, and Netarts Bay lies to the south, and the proposed railroad will have to touch Bay City, thus giving that rapidly growing town more and better railroad facilities. The incorporators are T. Irving Potter, John K. Zollock and M. A. Zollinger.

Work has been resumed, according to advices from Eugene, Ore., on the Natron extension of the Southern Pacific, and a crew of men have commenced laying rails out of Natron. The tracklayers crew was taken off in November on account of bad weather, and [illegible] during the winter. With [illegible] weather it is expected that trains will be running into Lowell by April 20, and to Oakridge, the end of the present contracts, by the middle of August. The work will be delayed to some extent by many slides that have almost obliterated the right-of-way between Natron and Oakridge, but the crew expects to lay an average of 2,000 ft. of track per day. Two of the three tunnels have been completed, and the big 2,200-ft. tunnel at North Fork will be finished in about six weeks.

Pennsylvania.

Right of way has been secured between Butler and Grove City for the first section of the proposed line of the recently chartered Pittsburg, Butler, Slippery Rock, Grove City & Northern Street Ry. Co., and it is believed that actual construction work on this section will be started in June. The total length of the line will be 66 miles and its completion will make possible the linking of Pittsburg with Buffalo, Cleveland and intermediate points continuously by trolley. The plans provide for the building of a spur between Butler and Grove City, Pa., from which it will be projected to Meadville, Pa., where it will join with the existing lines, having a connection with Erie, Pa., which is a terminus of a trolley system running to Cleveland and Buffalo. On the other side the railway will connect at Butler with lines plying that point and Pittsburg. Charles Gibson, Jr., who put through the Pittsburg & Butler Electric Ry. pioneer short line route in Western Pennsylvania, is president of the new company. J. H. Barrett of Pittsburg will be the engineer in charge of the work.

The Philadelphia & Reading Ry., Wm. Hunter, Chief Engineer, Philadelphia, Pa., is to replace the old trestle at Gibralter with a concrete structure.

We are advised that there is no truth in the reports that the Buffalo, Rochester & Pittsburg Ry. is to double track a portion of its Indiana branch

An ordinance is before the City Council of Lansdowne to grant the Terminal Street Ry Co. a franchise through the borough The plans propose that the tracks be connected to those of the Darby and Lansdowne division of the Philadelphia Rapid Transit Co., which will make a direct line from Sixty-ninth St. terminal at Philadelphia.

Preliminary surveys have been started for the proposed electric railway from Lock Haven to Jersey Shore, mentioned in our last issue. G. Roberts, Harrisburg, Pa., is the engineer

At the annual meeting of the stockholders of the Pennsylvania R R, the recommendation in the annual report that the capital stock be increased from $500,000,000 to $600,000,000 was approved. This increase will be made from time to time, when in the judgment of the directors money may be required for the needs of the company.

A state charter has been issued to the United Rys. Co. to operate a line seven miles long between Humbert and Barronsvale, Somerset county, the capital being $70,000. The incorporators are I. W. Seamans, Uniontown, president, and T B Palmer, B A Smith, L W Fogg, J. H. Palmer, D. D. Johnson and Harold W. Seaman, Uniontown.

The Bloomsburg & Millville Electric Ry has been sold at trustees' sale to W. A Hughes, of Berwick, for $6,100 clear of all liens. The new owner will organize a company and complete the road The projected length of the line is 10 miles.

South Carolina.

The Charleston Terminal Co, Charleston, S C, is considering establishing a freight yard in that city.

South Dakota.

An amendment to the articles of incorporation of the Chicago, Sioux Falls & Pacific Ry. Co. has been filed in the office of the secretary of state at Pierre, S. Dak., increasing the capital stock of the company from $8,000,000 to [illegible] The proposed track of this road in the state is from Sioux Falls west to Wheeler in Charles Mix county.

We have received the following information regarding the proposed line of railroad from Chamberlain, S. Dak., which is being promoted by the Missouri River & Northern Ry. Co., a company duly incorporated under the state laws of South Dakota. A complete survey of the line was made last fall, being completed about the later part of November. The survey was made by the Missouri Valley Engineering Co. of Mitchell, S. Dak., the Chief Engineer being Robert M. Fulweiler who had personal charge of the field work, he being under the direct supervision of R. G. Culbertson, Secretary of the Company. Complete maps, estimates, profiles and Engineer's reports have been made and are in care of E. E. Dye, the Vice-President of the Missouri River & Northern Railway Company at Chamberlain, S. Dak. The distance is 82 miles, traversing a rich agricultural country the entire distance at present entirely without railroad facilities for a distance of from 20 to 35 miles on either side for a greater part of the distance. It connects two progressive cities of South Dakota, and gives a large territory direct communication with St. Paul, Minneapolis and Duluth by connecting with the Great Northern at Huron. The maximum grade exclusive of the first five miles out of Chamberlain is 1 per cent. A part of the first five miles reaches a 2 per cent grade. The maximum curvature is 3°. The estimates of the principal items of construction and equipment are as follows:

Grading	$417,633
Culverts	4,881
Bridges, piling and timbers	89,029
Steel	321,153
Ties	171,352
Grounds, terminals, stations, yards, etc.	150,000
Equipments	273,000

Tennessee.

The Chicago, Burlington & Quincy R R is reported to have plans under consideration for the construction of a connecting line between Metropolis, Ill, and Middleton, Tenn. It is thought that the new road will pass through Mayfield, Ky; Martin, Kenton, Eaton, Alamo, Maury City, Brownsville, Bolivar, Tenn, on to Middleton to connect with the Gulf & Ship Island R. R. to Gulfport, Miss.

A movement has been started at Union City, Tenn., to build an electric railroad from that city to Gibbs to connect with the Illinois Central R. R. Business men of Union City are reported back of the project.

The Tennessee & North Carolina R. R., now operating from Newport, Tenn., to Crestmont, is understood to have permanent location surveys underway for an extension to Canton. At last reports the engineers were working on the Canton end of the line, the other end having already been completed

Texas.

The Hearne & Brazos Valley R. R., J. W. Greene, General Manager, Hearne, Tex., is reported to have surveys under way for an extension to Brenham.

The surveying corps of the Beaumont & Great Northern R. R., is now working in Madison County.

At a recent meeting at Temple of the stockholders of the Temple Northwestern Ry. it was unanimously voted to place the matter of negotiations for a sale or lease of the railroad in the hands of the citizens' trustees, F. F. Downs, Charles M. Campbell and A. F. Bentley. With this plan in operation, the trustees will be at liberty to make such deals or contracts as will be for the best interests of the stockholders without being compelled to secure ratification of every proposition in advance.

A plan is reported under consideration at Victoria, Tex., for building an 18 in gage railroad from the town to the ball park, about one mile distant.

A proposition has been submitted to the Citizens' Club of Georgetown, Tex., by President L. E. Walker of the proposed Quanah, Hamilton, Belton & Gulf Ry., to bring the road via Georgetown, Belton and Austin on its way to deep water at Rockport. The survey has been completed from Quanah to Jarrel, 16 miles north of Georgetown.

The Belton-Temple Traction Co. has been acquired by A. F. Bentley and associates, of Temple. The system includes the interurban electric line to Belton and street car service in Temple and Belton.

M. J. Healy, Pecos, Tex., writes that he has sold his interest in the Rock Island, Texico-Farwell & Southern Ry. and is now arranging to build the Rock Island, Pecos & Rio Grande Ry., which is projected to extend from Tucumcari to Pecos, Tex., via Melrose, Portales and Knowles, N. Mex. A line to Midland, Tex., and Nurrville is also proposed. Mr. Healy would be pleased to hear from construction parties.

A delegation of citizens including R. L. Downs and Joseph Childress, Temple, Tex.; Judge Pennington, Brenham; Charles F. Carter, New York; S. P. Hadley, Galesville, recently met the railroad commission at Austin, Tex., to confer with that body in regard to the extension of the Temple & Northwestern R. R. It is proposed to extend the road to Hico southeast and make connection with the Katy, a distance of about 80 miles from Houston. There has been some talk of selling this road, but the above named gentlemen seemed determined to extend the line to the point given above. The delegation discussed the matter with the commission but no application has been filed.

Utah.

The Utah & Grand Canyon R. R. Co., has filed a first mortgage bond for $25,000,000 in Parowan, the county seat of Iron County, to cover a bond issue for building two new railroads. The Utah & Grand Canyon R. R. Co. has taken over all of the holdings including the surveys and right of way of the Utah & Southern. One of the proposed lines will run from Marysvale, Piute county, the southern end of the Denver & Rio Grande in Utah, through Grand and Kane counties into the Grand canyon of the Colorado. The second line will run from Lund on the Salt Lake route through Iron and Washington counties on to southeastern Nevada to Searchlight, where it will connect with the Santa Fe. Frank A. Dudley is the promoter. H. C Edwards, Salt Lake City, is local counsel for the company.

The Oregon Short Line has been making surveys at Brigham City, with a view to increasing its track facilities there. About $30,000 will be expended.

According to an announcement reported to have been made by Joseph Bailey, Ogden, Utah, Superintendent, Ogden Rapid Transit Co, the line from the present Main St terminus at Brigham City to the Oregon Short Line R. R. station will no doubt be built at once The line will be laid along Forrest Ave, where a franchise is now held.

Further details now at hand concerning the Union Coal Co., mentioned in our last issue, state that articles of incorporation have been filed at Provo, Utah, the principal place of business by the corporation, the object being to engage in the coal and coke business, build and operate railroads, etc. The capital stock is $1,500,000, in shares of the par value of $1 each, of which 500,000 shares are classed as preferred stock on which dividends of 6 per cent per annum shall be paid, but the preferred stock has no voting power and is to be retired on or before July 1, 1921. All of the preferred stock and 815,000 shares of the common stock are held as treasury stock by F L Copening, as trustee, to be disposed of by the Board of Directors. The company takes over, as a basis of its capitalization, 800 acres of coal land situated near Castle Gate, into which a branch railroad 8 miles in length will be built from Helper. W. J. House of Denver is President; A. N. Holdaway of Provo, Vice-President; Frank L. Copening, Secretary and Treasurer, and these, with George M. Smoot, Joseph Brobogile, George W. Craig, M. E. Kartchner, Robert Howard and James A. Loveless, form the directorate.

Vermont.

The Brattleboro & Vernon R. R., chartered in 1908, has completed its organization by the election of the following officers: George L. Dunham, President; L. E. Holden, Vice President; C. O. Robbins, Treasurer; M. J. Moran, Auditor, and Clarke C. Fitts Clerk, all of Brattleboro, Vt. A location has been filed for line and branches. It is understood that the Boston & Maine R. R., will use this charter for bringing its new line to [illegible] from the state line at South Vernon, Vt.

The Rutland R. R., now controlled jointly by the N. Y., N. H. & H. and the N. Y. Central lines has notified the "committee of fifteen," composed of Burlington business men having in hand the movement for adequate station facilities at that city, that the Rutland is willing to build an adequate passenger station at the foot of Main St. The Rutland R. R. [illegible] heretofore used the [illegible] Vermont [illegible]

Virginia.

A company has been securing [illegible] of way along the New River and the Bluestone, and it is thought in some quarters that this right of way is being secured for the Virginia Ry., for the purpose of building a line into Bluefield, and thus get a share of the traffic from the Pocahontas coal field.

Washington.

◉The contract awarded George Chew, 415 Mohawk bldg., Spokane, Wash., for work on the Spokane-Ayer Line of the Oregon & Washington Railway & Navigation Co., includes 400,000 cu. yds. earth excavation, 400,000 cu. yds. rock excavation and 750 ft. of rock tunnel. This work is located at Ayer Siding, Wash., and portions of it are to be sublet only to station men. The work is to be completed in 18 months. The general contractors on the Spokane-Ayer line, as previously noted in these columns, are as follows: George Chew, eight miles; Aschbaugh-Bruce Co., North Yakima, Wash., 7½ miles; Tribble Bros., Cheney, Wash., 3½ miles; G. A. Carlson & Co., Fernwell Bldg., Spokane, Wash., 22½ miles.

Advices from St. Paul, Minn., state that it is reported that the Chicago, Milwaukee & St. Paul System will make improvements the coming year estimated to cost $9,000,000, most of which will be on the Puget Sound extension. It is said about $2,000,000 will be expended on the [illegible] of the line into Spokane, but it is not yet known whether this sum will be provided this year. It is also proposed to spend about $1,000,000 jointly with the Oregon-Washington Railroad & Navigation Company in building a union station at Seattle.

Citizens of White Salmon, Wash., have under discussion the proposed railroad running from the North Bank Road at the foot of the bluff, to White Salmon, a distance of 1½ miles. The plan of the promoters, C. D. Moore of White Salmon, and Mr. Chapman of Portland, is to incorporate for about $40,000 and build the combination steam and auto truck line, if White Salmon will raise $15,000 in stock. A locomotive with four cars and a 5-ton capacity auto truck will constitute the rolling stock. Messrs. Dean, Jewett, Reckers, Moore and Haynes were appointed to investigate the matter. Ten thousand tons of freight was last year's haul up the hill by team, and it is increasing annually 25 per cent.

The Wenatchee Valley & Northern Ry. will resume the construction of its road to Wenatchee, according to reports from that city, and it is expected that the work will be completed by the end of the year. This line is being used principally as a logging road at present and is controlled by the Lamb-Davis Lumber Co., of Leavenworth. There are 20 miles of main line and 10 miles of spur tracks. There are 6 miles more to finish before the road is completed. D. Mackey, Leavenworth, Wash., is General Manager of the company.

According to advices received here in Bellingham, Wash., the Chicago, Milwaukee & Puget Sound R. R. System has appropriated $2,000,000 for the [illegible] proposed line between that city and Everett, Wash. E. J. Pearson, Seattle, Wash., is Chief Engineer of the system.

West Virginia.

The Buckhannon & Northern R. R. Co., S. D. Brady, Chief Engineer, Morgantown, W. Va., which had grading work started last week on a 50-mile extension, is now said to be planning to build its other projected line down the Cheat River this year. This line begins at Rowlesburg, and will connect with the Western Maryland extension at Connellsville, Pa. Rights of way are now being secured for this line. The line at present under construction extends to Fairmont, W. Va.

The Baltimore & Ohio R. R., F. L. Stuart, Chief Engineer, Baltimore, Md., is to spend something like $4,000,000 in the next year or two on the improvement of its lines in this state. It is stated that the improvements on the Fairmont and Wheeling coal division would be made at once, while the Grafton improvements are now being started. About $1,000,000 is to be spent [illegible] Grafton to Clarksburg.

Wisconsin.

The Wisconsin & N[illegible] bier, Chief Engineer, Oshkosh, Wis., has resumed work on its right of way for its proposed new extension. It is probable that the road will be [illegible]

Wyoming.

Application has been [illegible] cil of Casper, Wyo., for a franchise to operate an electric street railway here. The promoters of the enterprise propose to build a trolley line connecting Casper with the asbestos mines near town, and wish to operate the line in the city.

Canada.

The Canadian Northern [illegible] to be running location surveys for a railway line from Winnipeg to Fort Alexander on the east side of Lake Winnipeg, where it is proposed to establish a summer resort. It is not known whether the line will be a continuation of the C. N. R. Bird's Hill branch or of the electric line that runs out of Bird's Hill road to the limits of Kildonan. The survey stakes are said to be set from the end of the latter road direct to a point between the river and East Selkirk. From that point it will run direct to the Fort, but a spur will be built to connect with the beaches.

Tracklaying on the V., V. & E. Ry., northwest from Princeton, B. C., will be started in about two months. At the present time the line is graded from Princeton, 16 miles to Tulameen and it is understood that when the tracklayers begin on the Princeton end to put the rails on the grade, other gangs will continue the grading. Work is being pushed at the western end of the V., V. & E. J. W. Stewart at present has about 150 men on grading operations between Abbotsford and Sumas river. This contract which originally extended to Chilliwack, but which, it is understood, is being cut off at Sumas river to permit the railway company to use Canadian Northern tracks between the river and Hope, is over 60 per cent completed. It will probably be done in about two months.

A syndicate, represented [illegible] Toronto, Ont., has purchased the Nipissing Central Ry., which was constructed about a year ago. C. F. Beams, of the Cobalt Power Co., has been appointed manager of the railway.

The Ontario R[illegible] has ordered the double tracking of the Metropolitan Ry. of Toronto [illegible] golf links at that city.

It is now expected that 200 miles of the Grand Trunk Pacific Ry., east of Prince Rupert, B. C., will be ready for operation by the end of the year. At Prairie Creek, on the main line, 200 miles east of Edmonton, a large gang of men is now at work building the steel bridge which is to cross over the Prairie Creek gulch. Prairie Creek is the dividing line between the prairie and the mountain. It has taken nearly five years to build this section of the road, stretching from Winnipeg to the end of the foothill country at Prairie Creek, the total distance being 990 miles. It will take another three years at least to complete the line over the mountains to the coast. One hundred miles of this line has already been completed east from Prince Rupert. This year another 100 miles will be finished from that end, while through the mountains, Foley, Welch & Stewart will build 100 miles from Prairie Creek to Tete Juan Cache, 40 miles west of the summit of the Rockies.

The Canadian Northern Ry. is planning to undertake much work this season and hopes to complete about 600 miles of grade this season. A brief resume of the work planned for this season follows: In Manitoba additional grading will be done on the Wakopa branch. This line runs southwest from Greenway and serves the country close to the international boundary. This year it will reach Deloraine, and in future years it will be built through to join the Maryfield branch, probably at Bienfait. In southern Saskatchewan, work will be done on the line into Moose Jaw. This road is a continuation of the Maryfield branch, and Moose Jaw will be reached by it from the south. Farther north in Saskatchewan the company will do work on the Rossburn branch. This line runs through Russell and will be built to join the main line of the Canadian Northern at or near the town of Canora. North of the main line the company will do grading on the Thunderhill branch. This line runs west from Swan River and it may be continued into Prince Albert. If the line is not built directly into that city it will strike the line running south from Prince Albert to Regina and connection will thus be made with the northern city. The important branch from Prince Albert to Battleford will probably be completed, and much work will be done on the line running from Battleford northwest to Jack Fish lake. This branch runs through the country north of the Saskatchewan river, where a large settlement has already taken place. Southwest from Saskatoon progress will be made in the construction of the line from Delisle. This road will, it is said, eventually be built through to Swift Current, and from that point onward to join the line which the company is building between Maryfield and Lethbridge. In Alberta work will be done on four branches. Two lines will be completed into Calgary, one from Saskatoon and one from Vegreville. A large force will be employed west of Edmonton on the road from that city to Vancouver, and further south a large amount of grading will be done on the line to the Brazeau coal fields. This road begins at Stettler, crosses the Canadian Pacific at Red Deer, and continues due west to the Brazeau. Large expenditures for betterments will be made on the various branch lines in the three provinces and on the main line. Special attention will be paid to the line between Regina and Prince Albert where ballast trains will be at work during the entire summer. Heavy steel will be laid on about half this branch, the portion to be covered being that from Disley to Warman, a distance of 145 miles. East of Winnipeg an important work will be done at Rainy Lake, where a grade of rock will be built across the lake. The yards of the railway will be enlarged and improved at many points, and many miles of new sidings will be constructed. Heavy steel will be laid from Beaver to Grandview, a distance of 132 miles.

The Midland Ry., the Hill line in Canada, has submitted its plans for entrance into Winnipeg to the Board of Control of that city. The plan submitted shows the Midland tracks coming in from the south end of the city on the level, crossing the Assiniboine on a bridge as near to the C. P. R. bridge as possible and continuing parallel to the C. P. R. tracks to the east of McPhillips. The plan shows Ellen St. closed altogether, between Ross and Pacific and the tracks continuing into the station. The passenger station is to occupy the whole space between Ross and Pacific, and its east- [illegible] of Paulin St., leaving a clear space of 150 ft. in front of the station building from street to street. Mail, baggage and express platforms and rooms are shown facing Ross Ave. directly behind the station, and loading platforms and tracks fill in the balance of the space behind this to Pacific as far west as [illegible] to Isabel, the plan shows stores with trackage in the rear. A. H. Hogeland, St. Paul, Minn., Chief Engineer of the Great Northern Ry., was one of the representatives of the Midland Ry.

In connection with the presentation of the annual railway budget to the House of Commons, George P. Graham, Minister of Railways, announced that the government has definitely decided to construct the Hudson Bay Ry. itself, and that when the road is built a plan for the operation of the road will be submitted to parliament; also that arrangements will be entered into for the construction of elevators and terminal facilities and for a steamship service to ply between Hudson Bay and Great Britain. Mr. Graham estimated that, including terminal elevators and other facilities, the road would cost from $25,000,000 to $30,000,000. Mr. Graham said that the first 170 miles from The Pas Mission to Split lake could be proceeded with at once, pending the final choice between the Fort Churchill and Port Nelson routes. From a railway standpoint he was inclined to consider Port Nelson as the most likely terminal of the road.

It is reported on good authority that the Canadian Pacific has acquired the West Shore Ry. and will have a branch from Goderich to Kincardine and up to Southampton and Wiarton.

The Canadian Northern Ry. has location surveys underway for a cut-off from the main line, running across the country from Fort Saskatchewan, 20 miles east of Edmonton, to St. Albert, ten miles to the northwest of Edmonton. The new cut-off will connect with the line of the Canadian Northern now building west of St. Albert and it will save a run of about five or six miles on the through line. The cut-off is to be used for through freight. The construction of this cut-off will require the establishment of sorting yards at St. Albert and Fort Saskatchewan.

It is expected that steel will be laid on the main line of the Canadian Northern R. R. west of St. Albert to Lac Ste. Anne, a distance of 40 miles west, by the end of July. It is understood that the railway company is preparing to put a track laying machine on the grade very soon.

Macdonnell, Gzowski & Co., 3 Bank of B. N. A. Bldg., Vancouver, B. C. will begin work about July 1 on their contract for constructing the second 30-mile section of the Kettle Valley Ry.

Mexico.

The Mexican Union Ry., Ltd., C. L. Reed, Chief Engineer, Torres, Sonora, Mexico, which is now extending the Torres & Priestas narrow-gage line from Represo through Minas Priestas to Ures, has completed tracklaying for a distance of 10 kilometers. Work of putting down the next 20 kilometers will be rushed, when the line will be extended to the first point where a good water supply can be obtained. Thence into Ures is a distance of 40 kilometers, additional, and it is expected that the track will be completed and trains running into Ures by Jan. 1, 1912.

Commissary supply stores have been erected at Agua Prieta preliminary to the beginning of construction work on the extension of the Mexican Northwestern line from Pearson station to Agua Prieta. This railroad will branch off at Pearson from the connecting line partially constructed between Madera and Terrazas, and run northwesterly to Agua Prieta, the little Mexican village over the international line from Douglas, Ariz. B. H. Bryant, Casas Grandes, Chia, Mexico, is Chief Engineer of the Mexico Northwestern Ry.

Advises from the City of Mexico state that William Prim Wood and W. Hocker, concessionaires and engineers of the work of construction of the railroad from Santa Luerecia to Campeche, have gone to Pichucalco after making an inspection of the country around Teapa and Tacotalpa.

ROADS, STREETS AND PAVEMENTS

Alabama.

The Board of Revenue, Birmingham, Ala., has issued orders to the Jefferson county road men for the construction of about 15 miles of new roads between various parts of the county, with instructions that the work be begun at once and finished as early as possible. The roads which have been ordered constructed will be as follows: Six miles of dirt road between Williamsburg and Short Creek; two miles of macadamized road in the New Jasper road between Adamsville and Gointown; one-half mile of macadamized road on the Kimble road; one mile extension on the Irondale road; two miles of macadamized road near Warrior; two miles of road at Flat Top and Gintown on the Bessie road, and an extension of one mile of macadamized road on the 4th Ave. road out of Bessemer.

The County Officials at Scottsboro, Ala., have agreed to supplement a private subscription to build a pike road joining the main pike at W. J. Tally's residence six miles west of Stevenson, and running to the state line near Anderson, Tenn. The road will connect Anderson, South Pittsburg, Jasper, Tenn., Bridgeport and Stevenson, Ala., by a system of roads.

California.

✣Bids will be received until 8 p. m., April 3, by M. J. Desmond, City Clerk, Sacramento, Cal., for a street roller of modern and approved type weighing not less than 12 tons and propelled either by steam or gas.

Colorado.

✣Bids will be received until 11 a. m., March 27, by Board of Public Works, Denver, Colo., for furnishing all materials, supplies, labor, etc., and to sustain all the expense incurred in the construction of cement concrete sidewalks in and for the South Denver Improvement District No. 6. A certified check for $2,000 must be filed with each bid. Henry Read is President of the Board.

✣Bids will be received until 11 a. m., March 27, by Board of Public Works, Denver, Colo., for furnishing materials, supplies, labor, etc., and to sustain all the expense incurred in grading, the construction of concrete curb and gutter and surfacing the roadway areas in the North Side Improvement District No. 14. Henry Read is President of the Board.

Mesa County, Grand Junction, Colo., county seat, is considering the proposition of issuing $400,000 worth of bonds on its own account to build good roads.

At a recent meeting in Molina, Colo., it was decided to start soon upon the construction of two miles of modern road five miles down the Plateau canon from Mesa. The sum of $3,000 will be raised for the improvement.

District of Columbia.

✣Bids will be received until 11 a. m., April 1, by R. C. Hollyday, Chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for macadam road gutter, catch basins, granolithic walk, concrete curb and resurfacing macadam road at the U. S. Naval station, Narragansett Bay, Newport, R. I.

Florida.

Plans are under way for a considerable amount of street grading at the taking up and replacing of about ½ mile of brick paving for sub-divided land near Tampa. Contracts are to be let soon. Benjamin Thompson, Tampa, Fla., is Engineer.

The Board of Trustees of Pensacola, Fla., has been authorized to call for bids for the construction of almost $500,000 worth of paving, which is to be done at an early date on plans previously approved by the council.

The Board of County Commissioners, Macclenny, Fla., has adopted the route of west to east improved highway across the county.

Georgia.

✣Bids will be received until 3 p. m., April 3, by Mayor and General Council, Atlanta, Ga., for paving North Blvd. from Ponce de Leon Ave. to near 10th St., with creosoted wooden blocks, approximately 8,250 sq. yds. being included in the work. R. M. Clayton is Chief Engineer of Construction.

Illinois.

⊙The Highland Marble Works has been awarded the contract at Highland, Ill., for the construction of 7,600 ft. of macadam road on the upper Sebastopol road for $10,644.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing 40,000 sq. yds. of sectional wood pavement to be delivered and used as directed for repaving bridges to Geo. P. Cullen & Co., 78 LaSalle St., Chicago. Contract price 2¾-in. pavement $2.35 per sq. yd., 3½-in. pavement $2.70 per sq. yd.

⊙The following contracts for sidewalk construction have been awarded by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Secy.; Addison St., H. P. Larsen, 1542 N. Rockwell St.; S. Ashland Ave., Thos. D. Joy, 3911 W. Van Buren st.; Birchwood Ave., Bairstow Supply Co., 6084 Ridge Ave.; Campbell Ave., Siewert Callson, 3865 Milwaukee Ave.; N. Carpenter St., Skafgard Concrete Construction, 4024 W. North Ave.; Elliott Ave., H. P. Larsen, 1542 N. Rockwell st.; Gardner St., Jas. J. Ferry, 92 Sigel St.; Houston Ave., A. P. Larson, 11322 Indiana Ave.; Howard Ave., A. P. Larson, 11322 Indiana Ave.; S. Kedzie Ave., Thos D. Joy, 3911 W. Van Buren St.; Lyndale Ave., Demling & Wendt, 84 LaSalle St.; Milwaukee Ave., General Cement Concrete Construction; Milton Pl., Thos. D. Joy & Co., 3911 W. Van Buren St.; W. 60th St., Jas. Petersen; W. 63rd St., Thos. D. Joy, 3911 W. Van Buren St.; W. 69th St., Jas. Petersen; 71st St., Thos. D. Joy & Co., 3911 W. Van Buren St.; N. Sangamon St., General Cement, Concrete Construction, 162 Washington St.; W. Superior St., Jas. J. Ferry, 92 Sigel St.; 34th St., Thos. D. Joy, 3911 Van Buren St.; Uhland St., H. P. Larsen, 1542 N. Rockwell St.; Wrightwood Ave., H. P. Larsen, 1542 N. Rockwell St.; Phillips Ave., Bairstow Supply Co., 6084 Ridge Ave.; W. 12th St. System, Thos. D. Joy Co.; Armitage Ave. System, Skafgard Concrete Construction Co., 4020 W. North Ave.

The Board of Local Improvements of Rock Island, Ill., has adopted a motion made by City Engineer Wallace Treichler that 34th St. from 7th to 10th Aves., and 10th Ave. from 30th to 34th Sts., be paved with asphalt.

The People's Municipal & Highway Paving Co., has been incorporated at Springfield, Ill., with a capital stock of $50,000 for the purpose of carrying on a general contracting business in Chicago. Walter J. Spengler, John W. Bechwith, and Thomas Evans are the incorporators.

Petitions are being circulated in Sargent Township, Douglas County, Ill., to call a special election to vote on the proposition to build 16 miles of rock roads. The proposed roads are to be made 14 ft. wide and the estimated cost is about $2,500 per mile. Tuscola is the county seat of Douglas County.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Indiana.

✣Bids will be received until 1 p. m., April 3, by Lemuel Simpman, Auditor of Benton County at Fowler, Ind., for the construction of a free gravel road in the town of Ambia.

✣Bids will be received until 2 p. m., April 3, by Board of County Commissioners, Kentland, Ind., for the construction of a system of macadam roads in Beaver Township. E. R. Bringham is Auditor of Newton County.

✣Bids will be received until April 3 by Board of County Commissioners, Kentland, Ind., for the construction of a macadam road on line between Washington, Iroquois and Jefferson Townships. E. R. Bringham is Auditor of Newton County.

✣Bids will be received until 2 p. m., April 3, by Board of County Commissioners at Washington, Ind., for the construction of three gravel roads in Elmore Township. Thomas Nugent is Auditor of Daviess County.

✣Bids will be received until noon, April 4, by Board of County Commissioners, Monticello, Ind., for the construction of a stone road in Monon Township. A. G. Fisher is Auditor of White County.

✣Bids will be received until noon, April 4, by Board of County Commissioners, Monticello, Ind., for the construction of a gravel road between West Point and Round Grove Townships. A. G. Fisher is Auditor of White County.

✣Bids will be received until 10 a. m., April 4, by Board of County Commissioners, Logansport, Ind., for the construction of a gravel road in Eel Township. John E. Wallace is Auditor of Cass County.

✣Bids will be received until 10 a. m., April 4, by Board of County Commissioners, Danville, Ind., for the construction of a road in Union Township. W. H. Nichols is Auditor of Hendricks County.

✣Bids will be received until noon, April 4, by Board of County Commissioners, Winamac, Ind., for the improvement of four public highways. W. E. Muchenburg is Auditor of Pulaski County.

✣Bids will be received until 1:30 p. m., by Board of County Commissioners, Wabash, Ind., for the improvement of a highway in La Gro Township. J. P. Noftzger is Auditor of Wabash County.

✣Bids will be received until 1:30 p. m., April 4, by Board of County Commissioners, Brownstown, Ind., for the construction of a gravel road in Owen Township. H. W. Wacker is Auditor of Jackson County.

✣Bids will be received until 1 p. m., April 4, by Commissioners of Lawrence County, Bedford, Ind., for the construction of two gravel roads. Ezra W. Edwards is County Auditor.

✣Bids will be received until 2 p. m., April 4, by Board of County Commissioners, Bloomfield, Ind., for the construction of two macadamized roads in Stockton Township. Caswell H. Jennings is Auditor of Greene County.

✣Bids will be received until 1 p. m., April 5, by Board of County Commissioners, Wabash, Ind., for the construction of a gravel road in Chester Township. J. P. Noftzger is Auditor of Wabash County.

✣Bids will be received until 1 p. m., April 7, by Board of County Commissioners, Brookville, Ind., for the construction of two highways in Ray Township; one on line dividing Bath and Springfield Townships; one in Springfield Township; one on line dividing Bath, Springfield, Fairfield and Brookville Townships. Charles A. Miller is Auditor of Franklin County.

✣Bids will be received until 10 a. m., April 5, by Board of County Commissioners, Muncie, Ind., for the construction of a highway in Center Township. Francis M. Williams is Auditor of Delaware County.

✣Bids will be received until 3 p. m., April 8, by city of Goshen, Ind., for the improvement of North Main St. in that city. George H. Rimpler is City Clerk.

⊙Geo. F. Miller of Lebanon, Ind., has been awarded the contract by the city of Lebanon for graveling, sewering, etc., of Baronee St., for $4,651. Bids were opened March 13.

⊙Elwood Johnson of Orleans, Ind., has been awarded the contract by the county commissioners at Paoli, Ind., for the construction of a gravel road in Paoli township. Bids were opened March 17.

⊙Trippier & Son of Peru, Ind., have been awarded the contract for the paving of North D St., by the city of Richmond, Ind., for $1.89 per sq. yd. Bids were opened March 2. Fred. R. Charles is City Clerk.

⊙L. P. Meredith of Richmond, Ind., has been awarded the contract for the paving of N. E. St., in Richmond, Ind., for $21,851. Bids were opened March 14.

⊙The Board of County Commissioners, Jeffersonville, Ind., has awarded the contract for building a free gravel road in Owen Township to W. Walter Taggart for $5,868.

Snyder & Barnett of Frankfort, Ind., are the probable contractors for the construction of the Carrel F. Higley et al. road in Tippecanoe county by the county commissioners, Lafayette, Ind., for $6,995. Bids were opened March 10.

A petition has been started among the residents of Huntington Township, Ind., for the improvement of two miles of road leading from the Greenwood church on the Mt. Etna road to the Range Line road, by grading the same and improving with crushed stone or gravel. The petition will be presented to the county commissioners at Huntington, Ind.

Iowa.

✣Bids will be received until noon, April 3, by H. H. Onstot, Clerk, Bronson, Ia., for road work in Floyd Township.

✣Bids will be received until April 1 by Edward Stinton, Township Clerk, Merrill, Ia., for grading roads either by day or contract in Johnson township, Plymouth County.

⊙Wm. Horrabin, Iowa City, Ia., has been awarded the contract by the city of Muscatine, Ia., for the following work: 23,283.9 sq. yds. of bitulithic pavement, including sub-grading, 12,678.6 lin. ft. of combined curb and gutter, 24 in., including sub-grading; 3,008 lin. ft. of combined curb and gutter, 18 in., including sub-grading; 3,008 lin. ft. of 18 in. gutter built to old curb, including sub-grading; 4,000 cu. yds. of extra grading; 3,600 cu. yds. of extra grading; 4,894.5 lin. ft. (7 ft. wide) of space occupied by Citizens Railway & Light Co. of brick pavement. C. H. Young is City Engineer. Bids were opened March 16.

City Engineer Reuben C. Hart of Clinton, Ia., has been instructed to make plans, specifications and an estimate for paving 5th Ave., from 2nd St. to 5th St., with creosoted wood block paving. This improvement will require 12,000 sq. yds. of paving.

Kansas.

✣Bids will be received until March 29, by City of McPherson, Kan., H. A. Rowland, Engineer, for 19,000 yds. of paving and 6,100 ft. of curb and gutter. Specifications include asphalt, asphaltic concrete, bitulithic, brick and concrete paving.

The State Senate, Topeka, Kan., has passed a bill directing the warden of the penitentiary to co-operate with Leavenworth and Wyandotte counties in constructing a boulevard along the Missouri River from Lansing to Kansas City, Kan.

Kentucky.

Survey of the right of way of the Louisville and Nashville pike through its entire course in Hardin County, Elizabethtown, Ky., has begun as a part of the construction of a model road from Louisville to Mammoth Cave by way of Lincoln farm.

Louisiana.

At a recent mass meeting of the citizens of Alexandria, La., a resolution was adopted calling on the Police Jury of Rapides Parish to call an election on th [illegible] $300,000 bonds—$200,000 for good roads and $100,000 to purchase the Alexandria Pineville traffic bridge, now a toll bridge, and make it free.

Maryland.

✣Bids will be received until 11 a. m., April 6, by Cambridge Street Improvement Commission, Henry Lloyd, Chairman, Cambridge, Md., for the grading, paving and curbing of certain streets. The work includes the following approximate quantities: 16,876 sq. yds. vitrified fire clay or shale block pavement; 2,600 sq. yds. granolithic or concrete gutter; 6,400 lin. ft. straight concrete curb; 4,150 lin. ft. reinforced straight concrete curb (corner bar); 733 lin. ft. reinforced curved concrete curb; 32 storm water inlets. Each proposal must be accompanied by a certified check in the sum of $2,000, drawn on some bank doing business in the town of Cambridge and made payable to The Cambridge Street Improvement Commission, with this exception, that where a proposal is made covering only the concrete curb and gutter, a check in the sum of $250 will be required to accompany such proposal. Specifications and blank forms of proposals can be obtained upon application to Henry Lloyd, chairman of The Cambridge Street Improvement Commission, or to Herbert W. Hatton, Consulting Engineer, and a complete set of plans can be seen at the engineer's office, Y. M. C. A. Bldg., Wilmington, Del., or at the office of the Commission, Dorchester National Bank, Cambridge, Md.

The County Commissioners, Cambridge, Md., have decided to issue bonds to complete shell roads from Cambridge to points in lower Dorchester, main arteries being selected in both cases. One road to be improved is that by way of Shorters wharf, where the Black Water River will be bridged, to Crapo. The other is the road from Cambridge via Church Creek to a point near Bishop's Head.

The city of Baltimore, Md., contemplates submitting a proposition to the voters at the municipal election in the spring for the issuance of $5,000,000 paving bonds. B. T. Fendall is City Engineer.

The Commissioners for opening streets, Baltimore, Md., have filed with the city register a report on the widening of Pratt St. to provide for the new bridge over Jones' Falls, which places the cost at $47,000. The street will be widened from East Falls Ave. to President St.

Michigan.

✣Bids will be received until 11 a. m., April 10, by Capt. T. A. Baldwin, Jr., Quartermaster for the construction of concrete sidewalks, gutters, curbing, etc., at Detroit, Mich.

✣Bids will be received until 11 a. m., April 10, by Capt. T. A. Baldwin, Jr., Quartermaster, Detroit, Mich., for the construction of a concrete sidewalk, gutters, curbing, etc., at that post.

Minnesota.

⊙W. C. Wyatt of Bigelow, Minn., has been awarded the contract by the county commissioners at Worthington, Minn., for the construction of county road No. 3. The work will involve about 10,066 yds. of material. The contract price is $.24 per cu. yd. Bids were opened March 13 by C. E. Pannell, county auditor.

The City Engineer of Duluth, Minn., has been directed to prepare plans and specifications for the so-called Getchell road.

The State Senate, St. Paul, Minn., has passed a bill introduced by R. C. Dunn, providing for the appropriation of $150,000 for the employment of expert engineers to give demonstrations in road making. Geo. W. Cooley, St. Paul, Minn., is state engineer.

Mississippi.

The Mayor and Board of Aldermen of Aberdeen, Miss., have called an election for April 11 to vote on the issuance of bonds in the sum of $50,000, of which $20,000 will be for the paving of streets.

The County Commissioners of Hinds County, Jackson, Miss., have received bids from the Worthington Construction Co., of Brookhaven, Miss., A. L. Patterson, Macon, Ga., and the Southern Bitulithic Co., of New Orleans, La., for the construction of 21 miles of good roads. The commission plans to build a good road a little over four miles out the Terry road; five miles out the Livingston road, seven miles toward Pocahontas, and five miles toward Clinton. The work will cost

✣ indicates work now open for bids. • indicates a contract let recently.

[illegible] drained on each side. As soon as this contract is completed, it is contemplated to spend [illegible] tions out of the city.

Civil engineers have begun making the surveys preliminary to advertising for bids for the improved gravel roads in Loncoln County, [illegible]

Missouri.

✣[illegible] Fulton, Mo., until April 6 for the construction of 5,000 sq. yds. macadam with a binder [illegible]

The city council of Fulton, Mo., has submitted to the property owners of Fifth St. a [illegible] with a binder. There will be 8,000 sq. yds. of macadam and 3,800 ft. of curb. Bids will be received about the last of April. P. D. Thurmond is city engineer. R. H. Fowler is mayor.

The city council of Fulton, Mo., has submitted to the property owners on Court, Market, Fourth and Fifth St., in the business sec- [illegible] pave with brick. About 12,000 sq. yds. of paving and 4,000 ft. of curb would be required. Bids will be received about the last of April. W. R. Pemberton is city clerk. P. D. Thurmond is city engineer.

The State Senate, Jefferson City, Mo., has approved the trans-state highway bill. It provides a state road from St. Louis to Kansas City on which $500,000 is to be spent.

A movement has been inaugurated by the Gravois Ave. Property Owners' Association, St. Louis, Mo., to pave St. Louis County's public highways. It is proposed to issue bonds, not to exceed 5 per cent of the taxable wealth of the county.

At a meeting of the Pettis County farmers [illegible] in Sedalia, Mo., March 14, for the purpose of discussing good roads, it was decided to petition the Pettis County Court to call a special election for the purpose of voting an issue of $400,000 in bonds to build ten rock roads, radiating from Sedalia.

Montana.

Plans and specifications for sewer extensions in special improvement districts No. 3 and No. 4 will be presented to the city council of Glasgow, Mont., for its consideration in the near future. The estimated cost of the improvement is $25,000. It is expected to let the contract the first part of May. E. S. Severance is city engineer. John E. Dawson is mayor.

Nebraska.

M. Ford at from $1.89 to $2.10 per sq. yd., and C. E. Fanning at from $2.15 to $2.40 per sq. yd., submitted the lowest bids to the city council of Omaha, Neb., for the construction of three and one-half miles of asphalt and [illegible] block pavement respectively.

New Jersey.

✣Bids will be received until 11 a. m., April 6, by Board of Chosen Freeholders, Middlesex County, New Brunswick, N. J., for repairing the Cranbury South River Turnpike. Plans and specifications are on file at the office of the County Collector, 40 Paterson St., New Brunswick, and F. F. Simons, County Engineer, Roosevelt, N. J.

✣Bids will be received until 6 p. m., March 27, by William C. Burroughs, City Clerk, Asbury Park, N. J., for furnishing and laying 10,500 sq. yds. of creosoted wood blocks, vitrified brick or bitulithic as laid under the patents of Warren Bros. Co. on Main St. from the southerly line of the city to the northerly line of Summerfield Ave.

New York.

✣Bids will be received until 2 p. m., April 10, by Constructing Quartermaster, Madison Barracks, Sackets Harbor, N. Y., for the construction of about 28,000 sq. ft. of macadam road and 800 sq. ft. of concrete walk.

[illegible] Department of Highways, Albany, N. Y., has submitted plans to Harry D. Waldo, Orleans County Superintendent of Highways, of Albion, N. Y., for two more proposed county highways, which will likely be constructed during the summer of 1911. The roads that it is proposed to improve are section No. 3 of road No. 393, beginning at the Gaines-Carlton town line, north of the village of Childs, and running northerly through Carlton Station to the bridge crossing Marsh Creek in the [illegible] of Two Bridges, a distance of 3.4 miles, and the Medina-Alabama highway, No. 395, beginning at the corporation limits of the village of Medina in South Main St., and running south on the old toll turnpike through Shelby Center to the Orleans-Genesee County line, a distance of 5.4 miles.

The Board of Estimates of New York City has given the five borough presidents $3,000,000 to repave the streets as follows: Manhattan and Brooklyn, $1,000,000 each; Bronx and Queens, $350,000 each; Richmond, $300,000. This money is for relaying all kinds of pavements and not for repairing work.

Plans for the proposed strip of macadamized highway from Whitney Point to Glen Aubrey have been received by Asa L. Bonnell, Clerk of the Board of Supervisors, from the Albany office of the State Highway Department. The plans provide for a road 5.30 miles in length, between those two points, and to build which will cost probably about $60,000. An appropriation has been asked for with which to construct the road. Binghampton is the county seat of Broome County.

Ohio.

✣Bids will be received until noon, March 23, by Director of Public Service, Youngstown, O., for furnishing the necessary labor and materials for paving of Breaden St. between Market St. and Hillman St. W. H. McMillin is Clerk of the Directors.

✣Bids will be received until noon, March 23, by Director of Public Service, Youngstown, O., for furnishing the necessary labor and material for the paving of Logan Ave. between Broadway and the city limits. W. H. McMillin is Clerk of the Directors.

✣Bids will be received until noon, April 3, by Director of Public Service, A. B. Lea, Cleveland, O., for furnishing, laying, relaying and repairing stone and cement sidewalks in the city of Cleveland for a period of one year. Four contracts to be awarded are as follows: One contract for furnishing, laying, relaying and repairing stone sidewalks on the streets west of the Cuyahoga River. One contract for furnishing, laying, relaying and repairing stone sidewalks on the streets east of the Cuyahoga River. One contract for furnishing, laying, relaying and repairing cement sidewalks on the streets west of the Cuyahoga River. One contract for furnishing, laying, relaying and repairing cement sidewalks on the streets east of the Cuyahoga River. Each bid must be made in accordance with the specifications which may be obtained at the office of the Superintendent of Sidewalks, Room 317, City Hall.

⦿The County Commissioners at Port Clinton, O., have awarded the following contracts for the building of stone roads in Harris Township: Brough & Zesing, Genoa, one and one-half miles on Ansted road, at $1.48 per cu. yd., and one mile on the Brandau road at $1.14 per cu. yd.; Rockyridge Lime & Stone Co., one mile on river road from Ryar road east at $1.24½ per cu. yd.

D. W. Seitz, Assistant Highway Commissioner, Columbus, O., has approved the building of a brick highway as petitioned for by Chester land owners to the Geauga County Commissioner, Chardon, O. The highway will be built from the east Cuyahoga County line to Scotland Station. The distance to be improved is over a mile and the road will be built this year.

The County Commissioners at Hamilton, O., have named viewers for the proposed road from the Collinsville pike south of Collinsville and east to connect with an existing road.

The County Commissioners at Mt. Gilead, O., have been petitioned for the improvement of a number of county highways, approximately 100 miles in length.

The Improvement Committee of the city council of Dayton, O., has been asked to take immediate steps for the paving of Springfield St., from the old to the new corporation line.

Engineer Beckler of Athens, O., has been instructed by the city council to amend his plans for the paving of Elliott St., so that they will include the alley running from Stimson Ave. to Morris Ave., between the D. C. Cornwell and George Mansfield properties.

The County Commissioners at Ironton, O., have been petitioned for the improvement of the Salida Creek road.

The City Council of Perrysburg, O., has voted to pave 2nd St., from Hickory to Pine, seven blocks at an estimated cost of $48,000. Brick will probably be used.

Property owners on Vine St., in Ashtabula, O., have petitioned the city council for the paving of that street with suitable material at the time Park St. is paved.

The County Commissioners, Canton, O., have granted a petition for the construction of a new road in Plain Township.

The Trustees of Delaware Township, Hancock County, O., have been ordered by the county commissioners, Findlay, to open a country road commencing at the northeast corner of section 21, township 2, range 11, east, running west on section line to northwest quarter of section 21 and there terminating.

Oregon.

The City Executive Board of Portland, Ore., received the following bids for street improvements: Beaumont district, bitulithic pavement, Elwood Wiles, $157,413. Stanton St. district, bitulithic pavement, Warren Construction Co., $157,752. East Everett St. district, asphalt pavement, Barber Asphalt Paving Co., $149,195. Abernathy St. from Kelly to Corbett, grading and concrete curbs and walks, Nat Costanza, $1,801. Forty-second Ave. from 42nd to 52nd Sts., grading and concrete curbs and walks, Joplin & Meeks, $10,242; Stephens Bros., $10,719; Giebisch & Joplin, $10,263; Bechill Bros., $10,137; G. K. Howlett, $9,938. Hood St. district, grading and concrete curbs and walks, Nat Costanza, $2,359; Joplin & Meeks, $1,902. East Washington St. from East 16th to East 20th, asphalt pavement, Barber Asphalt Paving Co., $7,575; Oregon Independent Paving Co., $7,569. Grand Ave., from Broadway to Schuyler, grading and concrete curbs and walks, R. J. O'Neill, $2,955; J. W. Lamar, $3,068. Myrtle St., from 16th to 17th, Hassam pavement, Oregon Hassam Paving Co., $2,191. Vista Ave., retaining wall and Hassam pavement, Oregon Hassam Paving Co., $23,685.

Arrangements have been completed by the County Commissioners, Klamath Falls, Ore., for the construction of a boulevard and automobile highway from the California state line, on the southern edge of the county, to the Jackson County line, on the northeastern border. Elmer Smith has been given the supervision of the work from Klamath Falls to the California line on the south. This road will run from Klamath Falls to Merrill, down the east side of Tule Lake through the new Bohemian town of Malin and to the line at what is known as the Carr tract. The road is to be graded up and kept in repair. Its length is about 40 miles.

Pennsylvania.

✣Bids will be received until 4 p. m., March 23, by Borough of Avalon, Pa., at the office of McBride Surveying & Engineering Co., Ltd., Borough Engineers, 331 4th Ave., Pittsburg, Pa., for the grading, curbing and paving of Forest Ave. from Birmingham Ave. to 2nd St. The approximate quantities are as follows: 6,000 cu. yds. of excavation; 3,500 lin. ft. of dressed curbing (sandstone); 50 lin. ft. of dressed curbing (granite); 150 lin. ft. of rough curbing; 50 lin. ft. of old curbing to be redressed and reset; 30 sq. yds. repaving; 2 manholes complete; 5 storm inlets complete; 60 lin. ft. of 24-in. d. s. storm sewer; 100 lin. ft. of 15-in. d. s. storm sewer; 50 lin.

ft. of 12 in. storm sewer, 120 lin. ft. of French drain; 6,000 sq yds paving.

⊙The County Commissioners and Controller, Pittsburg, Pa., have awarded contracts for county road work as follows: The Universal Portland Cement Co., for furnishing cement at $1.41 a barrel, and $1.01 if delivered in sacks; the Standard Bitulithic Co., at $.87 per sq. yd. for resurfacing the Hulton road; the Pittsburg Amisite Co., at $.85 per sq yd., for resurfacing the Verona road; Clydesdale Stone Co., Morrison & Son, Booth & Flinn and the Bope Stone & Brick Co., secured the contracts for ballast, and James Creese, Edward Vero, Seebolt & Skiles, H. F. Caley, Hodel & Brown, Wolf & Thompson, and W. S. Bedell, secured the contracts for delivering ballast.

The Legislature Committee of the State Grange, Harrisburg, Pa., has adopted resolutions indorsing the proposition of intercounty roads as proposed in the Sproul highway bill, and protesting against issuance of state bonds for construction of roads.

The Municipal League Committee, Harrisburg, Pa., has circulated a petition for the paving of 2nd St., and has presented the same to the city council. The street will probably be paved from Adams to Chestnut Sts.

Tennessee.

The City Commissioners of Memphis, Tenn., have mapped out street paving plans for the next 12 months, the aggregate cost being estimated at nearly $2,000,000. Estimates call for improvements to 36 miles of street and the following table shows the streets, portions of which the commissioners contemplate improving, and the material. J. H. Weatherford is City Engineer: Union Ave., asphalt or wood block; Union Ave., tar macadam; 2nd St., brick or block; Ayers St., tar macadam; Kney St., gravel; Breedlove St., gravel; Decatur St., gravel; Decatur St., brick; Vance Ave., asphalt or wood block; 2nd St., brick or wood block; Trigg Ave., tar macadam; Dixon Ave., curb and gutter, regular; Washington Ave., gravel; Jefferson Ave., gravel; Court Ave., gravel; Monroe Ave., gravel; Vinton Ave., tar macadam; Diana St., gravel; Cooper St., tar macadam; Tunis St., gravel; Edith Ave., gravel; Courtland Pl., gravel; Linden Ave., gravel; Lucy Ave., shells; Idlewild St., gravel; Lumpkin St., tar macadam; Central Ave., tar macadam; Pauline St., gravel; E. Coward Pl., tar macadam; Pearce St., gravel; East St., old stone; Nelson Ave., tar macadam; Nelly Bly St., gravel; Court Ave., gravel; Williams Ave., tar macadam; College St., tar macadam; Butler Ave., stone; Iowa Ave., brick or stone; Wellington St., tar macadam; Georgia Ave., brick or block; Georgia Ave., tar macadam; Cummings St., tar macadam; Dudley St., tar macadam; Lamar St., asphalt or block; Evelyn Ave., tar macadam; Colorado St., brick; Colorado St., gravel; Waldran Blvd., tar macadam; Bellevue Blvd., asphalt; Bellevue Blvd., asphalt or block; Central Ave., asphalt or block; Lemaster St., gravel; Claybrook St., gravel; Grove St., tar macadam; Harbert Ave., tar macadam; Richmond Ave., gravel; Huling St., old stone; S. Leach Pl., gravel; Beale Ave., asphalt or block; Union Ave., asphalt or block, widen; Walker Ave., tar macadam; Leon Pl., gravel; Regent Pl., gravel; Linden Ave., foundation only; Muller Pl., gravel; Trimble Pl., gravel; Auction Ave., brick; Montgomery St., gravel. Curbs and gutters are contemplated for the following: Park St., Kendal Pl., Maiden lane, Crystal Palace alley and Boyd Pl. (gutters only).

According to reports issued from the headquarters of the Memphis-to-Bristol Highway Association, Nashville, Tenn., about 1,000 commissioners along the highway have been appointed to solicit contributions of labor to the movement, and so far over 15,000 men have signed up agreeing to work two days on the proposed road.

The New Road Commission of Hamilton County, Chattanooga, Tenn., which will have full charge of expending the $500,000 realized from the sale of bonds authorized by the county court, has organized by the election of Senator Ed. Bass as chairman, and E. E. Betts as engineer. The road commission consists of Squires Bass and Cummings, R. B. Cooke and Judge Joe V. Williams.

Texas.

The citizens of Brownsville, Tex., on March 14, voted the issuance of bonds to the amount of $145,000 for municipal improvements as follows: Street paving, $80,000; to double the capacity of electric light and waterworks, $12,000; to improve city hall and market and $3,000 for a new slaughter house.

The citizens of Cameron, Tex., are planning the issuance of bonds to the amount of $200,000 to grade roads in commissioners precinct No. 1, in which Cameron is located.

Utah.

The North Fields Road Co., of Panguitch, Utah, has been incorporated at Salt Lake City, with a capital stock of $500, divided into shares of $1 each, to keep certain road in repairs. The incorporators are: William T. Owen, Jr., Thomas Haycock, John E. Myers, J. A. Worthen and L. C. Sargent.

Virginia.

✣Bids will be received until noon, March 29, at the clerk's office of Rappahannock County, Washington, Va., for the construction of about 7½ miles of macadam road from Flint Hill to the Warren County line. A certified check for $500 must accompany each bid. P. St. J. Wilson, Richmond, Va., is State Highway Commissioner.

⊙The Board of Control of Norfolk, Va., has awarded the contract for paving Bank St., between Freemason and Queen Sts., with wood block to the United States Wood Preserving Co., of New York City, for $2.85 per sq. yd.

The Board of Control of Norfolk, Va., has approved a budget estimate for the street cleaning department amounting to $108,104. This is an increase over last year by approximately $10,000

The promoters of the Washington and Leesburg highway have raised more than $23,000 toward the fund for constructing the road.

Steps have been taken by the Board of Supervisors of Henrico County, Richmond, Va., looking towards the establishment of a road to connect the Horse Ten and Broad St roads.

West Virginia.

✣Bids will be received until March 24 by Henry A. Gentry, County Road Engineer, Fayetteville, W. Va., for the [illegible] Sewell Mountain District at Corliss.

✣Bids will be received until March 25 by H. A. Gentry, County Road Engineer, Fayetteville, W. Va., for the improvement of the Nuttall District at Winona.

✣Bids will be received until March 27 by H. A. Gentry, County Road Engineer, Fayetteville, W. Va., for the improvement of Mountain Cove District at Victor.

✣Bids will be received until March 29 by Henry A. Gentry, County Road Engineer, Fayetteville, W. Va., for the improvement of roads in Kanawsha District at Page.

✣Bids will be received until March 30 by Henry A. Gentry, County Road Engineer, Fayetteville, W. Va., for the improvement of the Falls District road at Smithers.

The County Commissioners at Clarksburg, W. Va., have been petitioned for the construction of a road from Barton to Blaine.

Wisconsin.

⊙The City Council of Ripon, Wis., has awarded the contract for street sprinkling for the season of 1911 to C. A. Kuehn for $775.

⊙The Lake Shore Stone Co., of Milwaukee, Wis., has been awarded the contract by the city of Muskegon, Mich., for furnishing crushed stone for road building for $18,319. Bids were opened March 17 by John B. Barlow, city clerk.

The City Council of Watertown, Wis., has given authority for the purchase of 8,000 gals. of crude oil at a cost of $280, to be used this summer on the streets of the city as a preventive of dust and contagion.

The Common Council of Oconomowoc, Wis., has decided to open Market St. as a public highway. This street will cross the Holland property, will extend from Summit Ave., to the Milwaukee road tracks.

Public Works Commissioner Briggs of Milwaukee, Wis., has asked the common council to appropriate and let his department expend, without the intervention of formal contract, funds totaling $46,500. Among some of the larger items asked are the following: Sum of $10,000 for street repairing tools; $10,000 for steam rollers, $7,000 for portable concrete mixers, $3,500 for portable stone crusher, $3,500 for portable asphalt repair plant, $10,000 for asphalt mixing plant.

BRIDGES—STEEL AND CONCRETE

California.

The Board of County Supervisors, Los Angeles, Cal., received the following bids for the construction of the concrete bridge over the Arroyo Seco near the Ostrich Farm: T. J. Shea, $146,700; Mercereau Bridge and Construction Co., $169,600; J. F. Hall-Martin Co., $157,500; Charles Stansbury, $153,964; F. O. Engstrum Co., $248,239;; and J. D. Kneen Contracting Co., $149,000. None of the above bids include pilings and hand rails. The Cement Products and Construction Co. bid $5,171 for constructing the railings and placing pilings. The bids were taken under advisement and will be submitted to the engineers for each of the parties before any action is taken.

An application has been filed with the War Department by W. S. Collins, for permission to construct a wooden bridge from Balboa Island in Newport Bay to connect with the main land on the north. The address of the engineer for the work is 723 Central Bldg., Los Angeles, Cal.

Plans and specifications have been adopted by the Board of Placer County Supervisors at a recent meeting, for the construction of a steel bridge over the North Fork of the American River near Auburn, Cal. The structure will be on the road leading to Forest Hill and the mining districts of the country.

Florida.

A committee of citizens of St. Augustine, Fla., and County Commissioners, recently held a conference in regard to the construction of a bridge over the San Sebastian River at King St., connecting with New Augustine, replacing the old [illegible] has been suggested by the committee that the city council have plans and specifications prepared by an engineer at an early date.

The United States Engineering Department has instructed the Board of County Commissioners, Fernandina, Fla., to make certain changes in the draw bridges over the Amelia River in Nassau County. Steps will be taken toward the work at once

Georgia.

As the result of a bill passed at the last legislature authorizing a bond issue, citizens of Bibb County voted at an election March 10, upon issuing bonds to the extent of $375,000 for bridge, road and courthouse improvement. Macon, Ga., is the county seat.

Illinois.

⊙The County Commissioners, Morris, Ill.,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

have awarded the Joliet Bridge & Iron Co., Joliet, Ill., the contract for the construction of a bridge over the [illegible] between sections [illegible] County [illegible]

⊙The contract for the construction of the reinforced concrete bridge in the town of Nora, Ill., has been awarded to William H. Shons, Freeport, Ill.

⊙The Decatur Bridge Co., Decatur, Ill., has been awarded the contract at $3,000 for the construction of a new bridge over Indian Creek near Leland, in Adams Township, Ill. The county will bear one-half the expense.

Plans and specifications have been received by the city council of Batavia, Ill., of the State Engineer for the proposed new bridge at that city. The cost of the work is estimated at $30,000 and the work will probably be advertised soon.

Upon the recommendation of the State Highway Commissioners the County Officials have decided to replace the present bridge over Sugar Creek at the western edge of Woodland, Ill., with a new structure estimated to cost $10,000. Watseka, Ill., is the county seat.

Indiana.

✣Bids will be received until 10 a. m., April 5, by Board of County Commissioners, Rockport, Ind., for the construction of 25 bridges in Spencer County, of which John T. White is Auditor.

✣Bids will be received until 2 p. m., April 4, by Board of County Commissioners, La Grange, Ind., for the construction of five concrete and iron bridges and one wooden pile bridge. C. S. Willard is Auditor of LaGrange County.

✣Bids will be received until 11:30 a. m., April 4, by Board of County Commissioners, Brazil, Ind., for the construction of a bridge at Clay City. Edgar A. Staggs is Auditor of Clay County.

✣Bids will be received until 10 a. m., April 5, by Board of County Commissioners, Shelbyville, Ind., for the construction of four reinforced concrete bridges in Shelby County. G. B. Huntington is Auditor.

⊙J. E. Sullivan of Indianapolis, Ind., has been awarded the contract by the commissioners of Marion County, Indianapolis, for the construction of a bridge over Crooked Creek for $2,949. Bids were opened Feb. 24. Will T. Brown is county clerk.

⊙The Commissioners of LaPorte County, LaPorte, Ind., on March 9, awarded to the Rochester Bridge Co., Rochester, Ind., the contract for three iron bridges and to William A. Steigely, LaPorte, Ind., the contract for building the concrete abutments.

⊙Advices from Kokomo, Ind., state that the county commissioners have awarded the contract for raising and repairing the Gordon Bridge to E. S. Mendenhall and R. E. Newcomb at $1,045.

Among the appropriations passed by the County Council, Goshen, Ind., at a recent meeting were the following for bridges: Bridge No. 87, over tail race on Beardsley Ave. extension in Elkhart, repairs, $1,500; Bridge No. 88, new bridge over Christian Creek on Beardsley Ave. extension in Elkhart, $4,000; Bridge Repair fund, $500. Bridge No. 85 in Elkhart township, over Hoover ditch, repairs, $600. Bridge No. 86, in Jefferson township, over Hoover ditch, new iron bridge, $700.

Iowa.

✣Bids will be received until 8 p. m., April 11, by City Council, Clinton, Ia., for furnishing the necessary labor and material for the construction of a concrete bridge wall at the water way on Main St. and Fountain St. in town of Lyons. W. E. Hayes is City Clerk.

✣Bids will be received until 8 p. m., April 11, by City Council, Clinton, Ia., for the construction of three tubular concrete culverts in the Manufacturers' addition, one at 11th Ave. near 14th St.; one at Sunnyside Ave. and between 15th and 16th St. at 15th St. near Stockholm St., including 90 ft. of 48-in. corrugated [illegible] culverting, and 3 pair head walls.

✣Bids will be received until 8 p. m., April 11, by City Council, Clinton, Ia., for furnishing the necessary labor and material for the construction of a concrete steel culvert or bridge at the waterway on 4th and Lumber Sts. in Lyons. The work includes 160 yds. of excavation to elevation of 12, 140 cu. yds. of excavation from elevation of 12 to 6, 222 cu. yds. of gravel concrete, 3,870 lbs. Deformed steel, 210 ft. pipe railing, 1½ in., 20 ft. 12-in. sewer pipe inlets, 5 ft. 15-in. sewer pipe inlets. All are to be located and constructed as set forth in the plans and specifications now on file with the city clerk, W. E. Hayes.

✣City Council of Clinton, Ia., proposes the construction of a number of bridges and culverts and the preliminary reports on these propositions were made by the city engineer at a recent meeting. The following structures are included: Concrete bridge at Main and Lumber Sts., Lyons, $2,214; concrete bridge and wall at Main and Fountain Sts., Lyons, $361; steel culvert on Elvira Road at City Limits; three tubular culverts in Manufacturers' addition, $625. One is to be in 11th Ave. near 14th St.; another in Sunnyside Ave. between 15th and 16th Sts., and the third at 15th and Stockholm Sts. On the proposed bridges and culverts at Main and Lumber Sts., Main and Fountain Sts. and in Manufacturers' addition, the city clerk was ordered to advertise for bids to be opened on the evening of April 11, 1911.

⊙Advices from Davenport, Ia., state that the Board of County Commissioners has awarded the Clinton Bridge & Iron Works, Clinton, Ia., the contract for the construction of the Scott County bridges this year.

Preliminary report of the city engineer has been presented to the city council of Clinton, Ia., for the construction of a proposed bridge on the Bluff Blvd. over Mill Creek and on motion same was referred to the committee of the whole.

City Council of Waterloo, Ia., recently took for discussion the matter of constructing a bridge across the cutoff at San Souci Park.

Kentucky.

At the annual meeting of stockholders of the Louisville Bridge Co., Louisville, Ky., March 6, the following directors were elected: John W. Barr and Charles H. Gibson of Louisville; Joseph Wood, J. J. Brooks and J. J. Turner all of Pittsburg. J. J. Morris, 601 Louisville Trust Bldg., Louisville, Ky., is Secretary of the company.

The court has instructed County Attorney, Elizabethtown, Ky., to take active steps toward building the Salt River bridge at West Point and to take legal action if necessary. J. W. Boyd is Attorney.

Massachusetts.

Executive Council of the Committee composed of Cambridge and Brighton, Mass., citizens interested in the reconstruction of the Boylston St. bridge over the Charles River known as the Stadium bridge recently met at the office of Richard H. Dana, 19 Congress St., Boston, Mass., to discuss initial steps for securing the structure. The plans discussed call for a bridge of reinforced concrete faced with stone and brick, in general keeping with the style of the buildings in the Harvard yard, and with the entrances to the Stadium. The matter of raising funds to aid an appropriation by the cities of Boston and Cambridge was taken under consideration by the committee.

Michigan.

A resolution has been introduced into the city council of Saginaw, Mich., submitting to the electors of Saginaw the proposition of taking up the matter of building a new bridge across Johnson St. to replace the old structure at that point.

City Council of Benton Harbor, Mich., has at the petition of the citizens taken up the matter of constructing the proposed High St. viaduct and it is believed that at the spring election the proposition of issuing bonds for the purpose will be voted upon.

The Grand Trunk Ry. Co. has, according to information received from Bay City, Mich., made another move toward building the proposed bridge across the Saginaw River from the west side to a point touching the foot of 13th St. in that city. An application has been filed with the War Department for permission to build the structure and the matter will be taken up by Col. C. McTownsend, Detroit, Mich.

Missouri.

⊙The Union Pacific Ry. Co. has awarded the Foundation Co., New York City, the contract for rebuilding its Kaw River bridge to conform to the plans of the Kaw Valley Drainage Board and the United States Engineer. It is estimated the raising of the railroad yards on both sides of the river and the bridge improvements will necessitate an expenditure of close onto $500,000.

Nebraska.

⊙County Commissioners, Wahoo, Neb., on March 13, awarded to the Canton Bridge Co., Omaha, Neb., the contract for all wood and steel bridges, while the contract for all cement culverts during the year was awarded to the Wilson Reinforced Concrete Co., Nebraska City, Neb., and the contract for all metal culverts was awarded to the Nebraska Culvert Co., Wahoo, Neb. J. D. Frahm is County Clerk.

⊙H. T. Ward & Co., Lincoln, Neb., has secured the contract for the construction of bridges and cement work for Otoe County for the ensuing year. Eleven other contractors filed bids for the work.

New Jersey.

The freeholders of Passaic and Bergen Counties, according to advices from Passaic, N. J., have decided to start work in the near future on a new drawbridge ordered by the War Department three years ago and which will span the Passaic River at Rutherford Ave. The cost of the work will be about $80,000 and will be defrayed by both counties interested.

New York.

⊙The Owego Bridge Co., Owego, N. Y., has been awarded contracts for the construction of three new barge canal bridges in Wayne County at a cost of about $30,000.

⊙The board of supervisors, White Plains, N. Y., has awarded the contracts for the construction of reinforced concrete bridges over the Bronx River, between the city of Yonkers and the villages of Bronxville and Tuckahoe to E. J. Doyle & Co. of Albany, N. Y., and the O'Rourke Construction Co. of Yonkers, N. Y., for $7,742 and $8,887 respectively. Bids were opened March 6 by Edward A. Forsyth, chairman of supervisors.

⊙The town board of Ellicott, Chautauqua County, N. Y., has awarded the contracts for the construction of the following bridges to George Holcomb of Kennedy, N. Y., for $6,500: An iron bridge, 20 ft. wide, having a span of 100 ft. over the Cassadaga Creek, in said town, on the main road leading from Falconer to Kennedy, and two concrete bridges, each 52 ft. wide, on South Work St., in said village of Falconer, one over the race leading to the factory of the American Manufacturing Concern, having a span of 30 ft., and the other over the outlet of Chautauqua Lake, having two spans of 35 ft. each, all in accordance with the directions and the plans and specifications approved by the Chautauqua County superintendent of highways. Samuel Ely, town superintendent. Bids were opened March 15.

Special Committee appointed some time ago by the city council of Utica, N. Y., to confer with the Utica & Mohawk Valley Ry. Co., relative to its proposition for the bridge over the new river channel in North Genesee St. decided upon nothing definite. C. Loomis Allen, Utica, N. Y., is General Manager of the electric railway company.

City of Niagara Falls, N. Y., has after three unsuccessful attempts carried the proposition to build a new bridge across the Cayuga creek at LaSalle. The structure which will require an expenditure of not more than $3,500 will be of concrete with reinforced concrete floor and will cross the creek at the point where the Buffalo-Niagara Falls Blvd. will intersect it. The state will fill and pave the approaches at a cost of about $2,500.

City Engineer, Syracuse, N. Y., is preparing estimates of the cost of constructing a hoist bridge over the Erie Canal at Beach St. to replace the old structure. The matter will be taken up with the State Superintendent of Public Works.

North Dakota.

⊙The contract for the construction of bridges in Grand Forks County, N. Dak., for the coming year has been awarded to Jardine & Anderson, Fargo, N. Dak. Other bidders for the work were Ibbings Bridge Co., Minneapolis Bridge & Steel Co., A. F. Turner, Beach Manufacturing Co. and the Hennepin Bridge Co.

Ohio.

✣Bids will be received until noon, March 24, by Board of County Commissioners, Cincinnati, O., for the construction under Specification No. 165 for concrete bridge on the Sheed Road near the Hanxley Road in Colerain Township. A certified check for $500 must be filed with each bid. Fred Dreihs is Clerk.

⊙John Hiatt, South 4th St., Hamilton, O., has been awarded the contract by the county commissioners, Hamilton, O., for the construction of sub and superstructure of a bridge and fill to the same at the Conrad farm in Section 26, Reilly township, Butler County, O., for $1,143. Bids were opened March 11.

⊙The contract for the construction of the culvert on the Snyder Road north of Cornell Ave. in Sycamore Township was on March 10 awarded by the Board of County Commissioners to William Keller, Madisonville, O., at $1,426. Fred Dreihs is Clerk.

The Commissioners of Marion and Morrow Counties, according to recently received information from Marion, O., have decided to build a bridge over the middle fork of the Whetstone River at the east line of Tully Township. County Surveyor Edward S. Ault estimates the cost of the improvement at $2,000. The Morrow County surveyor will draw plans for the abutments and approaches while E. S. Ault will prepare plans for the bridge which will be of 60 ft. span, 14 ft. wide with concrete floor.

According to an approximate estimate furnished the County Commissioners, Marion, O., by E. S. Ault, County Surveyor, it will cost $25,000 to build three new bridges and remove, replace and dismantle five others made necessary by the Scioto River Improvement. For removing and replacing the Marion-Kenton-pike bridge, $276; dismantling the Holland pike bridge and placing it along the road for future use, $122; removing and replacing the bridge on the Prendergast road, $598, removing and replacing the Marion-Agosta pike bridge, $282; removing and replacing the Keener bridge, $240; dismantling and placing the Marion-Green Camp pike bridge along the road for future use, $146; dismantling the Radnor pike bridge, $72; dismantling the Morris pike bridge and placing it across the new channel of the Little Scioto on the Holland pike, $386. The surveyor estimates the total cost of this work at $2,122. Three new bridges are to be built but estimates on the cost of this work will not be submitted until the plans are more fully matured. A new bridge with a 100-ft. span will replace a 73-ft. span on the Marion and Green Camp pike; a 48-ft. span on the Radnor pike will be replaced by a 110-ft. span and on the Morris pike a 120-ft. span will replace a span of 84 ft.

. County Commissioners, Marion, O., and A. Schwartz, Huntington, Ind., Engineer, Cincinnati Division, Erie R. R., recently met to discuss the matter of replacing the bridge over the Scioto River between Holland and the Marion and Agosta pikes.

Oklahoma.

At a recent meeting of the County Commissioners, Claremore, Okla., it was decided to build five new bridges in Rogers County, one in 29-22-14, one in 27-24-17, one between 21-28-21-16, one east of Caney River bridge, and one on Sweetwater creek. The county clerk was ordered to advertise for bids and the county surveyor to survey same and make estimates.

Pennsylvania.

Viewers have recommended the construction of three new bridges in Wharton Township, according to information submitted from Connellville, Pa. Two structures will be over Meadow Run, and one over Stoney Creek. They will be at Seaton's dam, Hunter's mill and at the residence of Asbury Carroll.

Bids for widening the Chestnut St. bridge, Philadelphia, Pa., are considered too high and to proceed with the work will necessitate either an extra appropriation or a change of specifications. The bidders for the work included the American Paving and Construction Co., whose bid was $101,900, the work to be completed in 12 months; M. & J. B. McHugh, $108,600, ten months; Owego Bridge Co., $119,930, eight months; Stoekel Steel Co., $136,000, ten months, and John McMenemy, $135,000, ten months.

It is reported that the Pennsylvania Lines are planning the construction of a 900-ft. concrete bridge at Wampum, Pa., over the Beaver River. As planned the structure will have three 300-ft. spans. H. R. Leonard, Philadelphia, Pa., is Engineer Bridge and Buildings of the railroad.

Plans have been signed by Joseph G. Armstrong, Director, Department of Public Works, Pittsburg, Pa., for the construction of the proposed new bridge over Negley Run and it is believed that specifications will be prepared in time to let the contract in the early part of April. The bridge will connect two portions of Larimer Ave., and will cost $180,000.

Advices from Vernon, Pa., state that a new bridge is to be constructed across the Okaw River west of that place this summer.

Board of County Commissioners, West Chester, Pa., has decided upon the construction of a bridge over Doe Run Creek near Springdale in Chester County.

Tennessee.

The County Court at a special meeting held in Athens, Tenn., adopted a resolution asking an enabling act for the issuance of bonds in the sum of $25,000 for bridge purposes. It was also voted to apply $16,000 of this amount to McMinn County's half of the construction of the Hiwassee bridge.

Negotiations between the city officials and those of the N. C. & St. L. and the C., N. O. & T. T. R. R. companies concerning the restoration of the McCallie Ave. viaduct, Chattanooga, Tenn., have reached a stage which gives rise to belief that work will be in progress within 30 days.

Utah.

County Commissioners at a recent meeting held at Brigham City, Utah, approved the plans submitted by James Burke for the construction of the proposed new steel bridge at the mouth of Box Elder Canyon. Bids for the work will be called for at once.

City Council of Salt Lake City, Utah, has taken under consideration the petition of the residents for the construction of a viaduct over the railroad tracks at the intersection of 7th and South with 3rd, 4th and 5th West Sts.

Washington.

Plans have been completed for the construction of the proposed new bridge over Hangman Creek in Spokane, Wash., and the city council has provided for a bond issue to cover the cost of the structure, estimated at $415,000. As soon as the Commissioner of Finance places the bonds on the market work will be started without delay.

Plans have been completed for the construction of the proposed reinforced concrete bridge over Latah Creek between 6th and 7th Aves., Spokane, Wash. The cost of the work is estimated at $400,000. The bridge will be over 1,000 ft. long, and at a point over the creek bed will be 145 ft. high. It has an overall width of 63 ft. 8 ins., which provides for two 7-ft. sidewalks and a 45-ft. roadway, to be paved with creosoted wood blocks. Arrangements are made for two car tracks, and at any given point the structure will carry a live load of two street cars on each track. In all, there are seven spans. Two spans are 150 ft. long, two 135 ft. long, one 128 ft. long and two 54 ft. long. The handrail will be of concrete construction, and lights are stationed every 50 ft. along each side of the structure.

At a township election held recently in Espanola, Wash., citizens voted in favor of an appropriation of $2,000 as a bridge fund.

Wisconsin.

✣Bids will be received until 4 p. m., April 15, by Street Assessment Committee, Kenosha, Wis., for the necessary labor and material for the construction of a reinforced concrete bridge known as the Middle St. bridge in Kenosha.

⊙The lowest bid submitted for the construction of the proposed stationary concrete bridge across the Kinnickinnic River at Chicago Ave. near the flushing tunnel pumping station was that of the Czaropata Construction Co., 772 Garden St., Milwaukee, Wis., at $5,750. The city's estimate of the cost of the improvement was $7,000, and it was decided to award the contract to the above company.

Canada.

✣Bids will be received until noon, March 27, by Frank Lee, Engineer, Manitoba Division, Canadian Pacific Ry., Winnipeg, Man., for the construction of substructures for bridges and culverts on the Manitoba Division and for subway at Main St., Kenora.

Deputation representing the city of Toronto, Ont., and the townships of York and Etobicoke have filed a protest against the plans for the proposed four-track Grand Trunk Ry. bridge across the Humber River at the Lake Shore Road on the grounds that the large pier would cause ice jams in the spring and the flooding of adjacent lands.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arizona.

President Taft has signed the bill authorizing the Greeley-Arizona Irrigation Co. to construct a diversion dam across the Colorado River at Parker, Ariz., for the diversion of water for 100,000 acres of land. It is understood preliminary plans and specifications have already been approved. The land lies between Yuma and Parker. The diversion ditch will be 55 miles long. The plans are said to contemplate the expenditure of $1,000,000 for a dam 12 ft. high to extend across the river. The officers of the company are W. W. Sullivan, President, Los Angeles, Cal.; Alexander Mead, Greeley, Colo., vice-President, and A. A. Edwards, Fort Collins, Colo., Secretary.

Arkansas.

✣Bids will be received by the Tensas Basin Levee District at the office of the Board of State Engineers, Rooms 213-215 New Orleans Court Bldg., New Orleans, La., until noon, March 30, for the construction of the Lucca Levee, in Desha County, Arkansas, Mississippi River, Right Bank, about 12 miles above Arkansas City, Ark. New Levee, about 7,300 ft.; average height, about 19.0 ft.; approximate contents, 350,000 cu. yds.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

California.

The State Legislature has passed the bill permitting [illegible] deed w[illegible] under the Oakland estuary. It authorizes the Board of Supervisors of Alameda County, Oakland [illegible] the probable cost of the tunnel before the question of issuing bonds is submitted to the electors. Under this enactment any county or city may take steps to build tunnels, tubes and subways under navigable bodies of water, and the counties on San Francisco Bay will have the right to co-operate in such undertakings.

Colorado.

An order has been issued on the application of Joseph Standley, receiver of the Denver Reservoir & Ditch Co., making it possible immediately to enlarge Barr Lake, one of the reservoirs of the system. This will necessitate a change in the course of the Chicago, Burlington & Quincy R. R. tracks for several hundred feet. A stipulation has been entered into with the railroad providing for the change.

Illinois.

✣[illegible] April 1[illegible], by Board of Trustees, East Side Levee and Sanitary District, Sexton Bldg., East St. Louis, Ill., for the construction of an earth levee having [illegible] length [illegible] 3 miles, being Construction Project No. 2, Section One of Front Levee. The work will include the following approximate quantities: 200,000 cu. yds. of earth embankment, 130 lin. ft. of 30-in. cast iron pipe, 10 cu. yds. of concrete and 1 automatic flood gate, one hand gate and 1 acre of grubbing. Official advertisement will be found elsewhere in this issue. R. W. Sikking is Clerk.

Iowa.

✣All bids received March 17 by J. L. Hanrahan, County Auditor, Fort Dodge, Ia., for constructing Drain No. 70, estimated to cost $27,406, were rejected, and new bids will be received April 26. Fuller information as to this work was given in our March issue.

Louisiana.

⦿Clark and Helgason Bros., Vicksburg, Miss., have been awarded the contract at 14.48 cts. per cu. yd. for constructing the Villa Vista levee in East Carroll and Madison Parishes for the 5th Louisiana Levee District, the work including about 126,000 cu. yds. enlargement and 170,000 cu. yds. of new levee. Bids were opened March 16 at New Orleans, La.

The Caddo Levee Board, S. A. Dickson, President, Shreveport, La., has appointed a committee to appear before the Secretary of War and Chief of Engineers to urge authority for the Caddo Levee Board to enlarge its levee system by diverting the channel of Twelve-Mile Bayou. A large area will be reclaimed if this authority is granted.

Minnesota.

The Senate Committee on General Legislation of the State Legislature has recommended for passage, the bill providing for the organization of a company composed of officials of St. Paul, Minneapolis, and the State university to develop power at the proposed government high dam.

Montana.

The Buell Land Co., Bozeman, Mont., is considering building a rock dam on Taylor's Fork about ½ mile from the West Gallatin River in Gallatin County. The main purpose of the dam would be for the conservation of water for irrigation purposes.

New York.

Bills are now before the State Legislature appropriating $12,000,000 for carrying on the barge canal improvement, $2,000,000 of which is to be expended on the Cayuga and Seneca canal.

Memphis and Vicinity.

(REGULAR CORRESPONDENCE.)

⦿Bob Leonard, the successful bidder on the 200,000 cu. yds. recently let at College Station, Texas, has his contract well covered and will finish well within the time limit. The dirt, according to all reports, is working to good advantage and Bob states that the weather conditions have been all that one could desire.

Supt. Meehan, the popular superintendent of the Y. & M. V. R. R. at Greenville, Miss., was in Memphis last week shaking hands with all the boys. He reports good progress being made by all those doing work on his division.

The Kansas City Southern has asked bids on a large amount of new work in Arkansas and Kansas. It consists mostly of grade reduction and several Memphis contractors have submitted bids on same.

J. H. Weatherford, the City Engineer, returned Saturday from St. Louis, Chicago and the East, where he has been inspecting various kinds of pavements. Heiskell recently awarded a large batch of tar macadam streets to local street builders and is congratulating himself on the extremely low prices at which the work went.

Turner & Gill have about finished the grading of Madison avenue and are now on the lookout for some new street work. Roper & McTighee will also finish Latham Ave. soon and this will put another outfit in the field for local grading contracts.

Big Lou McClavey has just finished Reelfoot Lake contract and is preparing to move on some U. S. government work at Tyler, Mo. There was just 51,000 cu. yds. in the contract which Lou has finished and the work was done long before contract time.

Jesse Nichols was moving his large outfit across the river to Mound City last week, where he begins a large Government levee job. Jesse has a well equipped camp and some of the best mules one would care to look upon.

⦿Charlie Lowrance has been awarded contract by Polk & Boyle, local real estate dealers, for the grading of a sub-division involving about 150,000 cu. yds. of earth. Charlie has placed two of his large traction engines on the work and about 40 teams. With this force and the Lowrance energy, it won't take long to knock the sox off the work.

When it comes to moving dirt, Pat McCadden is there with the goods. He has just moved on a large contract near Tyler, Mo., which everyone said was too tough for them. But Pat has gone in and with his nifty outfit has rolled up a huge estimate for the first 15 days worked.

There is no more popular superintendent on the I. C. system than J. R. Rison, the young Assistant General Superintendent of the Yazoo & Mississippi Valley Railroad at Memphis. A contractor always likes to go into his office, for whether he can tell them of any new work coming up or not, he makes them feel like he wished he could give them a million dollars contract "right now." Jack was in Chicago last week, but had nothing new to tell on his return, of new work coming up.

Carey Brothers moved their outfit of teams, wheelers, graders, etc., from Memphis to Murpheysborough, Ill., on the Ferd Herold last trip and have now started in earnest on the large levee which they will construct at the latter place.

G. C. Weathers has taken a piece of L. & N. work in southeastern Kentucky, to which contract he has already moved a great deal of his outfit.

Lee McCanliss, commonly known as "Lee, The Hustler," is looking for some railroad work for his 25-team outfit.

George Miller has moved his forces from the St. Francis levee contract, having completed all his yardage on that job. Harry Rodgers is still at work, however, and is battling hard against a sinking levee. Just as fast as Harry gets his top on, it sinks again at night and this has gone on now for about 60 days. This trouble is frequently met with in places where the levee is built over a bayou. When it finally stops sinking, however, it has been seldom known to settle afterwards.

Virginia.

⦿C. W. Hancock & Sons, of Lynchburg, Va. have been awarded the contract to build a reinforced concrete milldam on the Oak Ridge estate of Thomas F. Ryan in Nelson County, to cost $5,000.

Wisconsin.

✣Bids will be received until April 15 by Commissioners of Shepard Drainage District, Bank of Marshall, Marshall, Wis., for doing the work of the said district. Specifications can be obtained of W. H. Tasker, Marshall, Wis.

Washington.

✣Bids will be received until 10 a. m., April 15, by Department of Interior, United States Reclamation Service, Washington, D. C., for the building of Kachess dam and accessory structures near Easton, Wash. The work involves the excavation of approximately 345,000 cu. yds. of material, the placing of about 240,000 cu. yds. of embankment, 15,000 cu. yds. of riprap and paving, 8,000 cu. yds. of concrete and 300,000 pounds of reinforcing steel and other items necessary to complete the work. For particulars address the United States Reclamation Service, Washington, D. C., or North Yakima, Wash. R. A. Ballinger is secretary.

WATER-WORKS

Alabama.

The City Council of Gadsden, Ala., has called an election for April 24 for the purpose of authorizing $50,000 bonds for the completion of the water works plant and extending the mains.

Hazlehurst & Anderson, Candler Bldg., Atlanta, Ga., are engineers for the rehabilitating of the water works plant at Gadsden, Ala., for which $75,000 is required.

California.

✣Bids will be received until 11 a. m., April 4, by Maj. George McK. Williamson, Quartermaster, Fort Mason, Cal., for reconstructing pump house, installing machinery, laying 6-in. water main and erecting steel water tank at Fort Baker, Cal.

On or about the first of April Consulting Engineer F. E. Trask, 412-425 Homer Laughlin Bldg., Los Angeles, Cal., will advertise for bids upon three reinforced concrete reservoirs for the town of Ontario, Cal., one to have a capacity of 400,000 gals., another 1,000,000 gals., and another 2,000,000 gals. This work will complete the work for the development of the town's domestic water system.

Contracts for the construction of a municipal water works system for the town of Ontario, Cal., have been awarded as follows: F. E. Trask, 421-425 Homer Laughlin Bldg., Los Angeles, Cal., consulting engineer: Western Pipe & Steel Co., for steel pipe and specials; Crane Co., for screw pipe and specials; Joe Chutuk, labor. The total cost will be about $105,000. Contracts for the pumping plant and reservoirs will be awarded later.

Colorado.

According to advices from Arvada, Colo., the town of Mountain View will vote at the coming election on the proposition of bonding the town for a waterworks.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Georgia.

An election is to be held in Oglethorpe, Ga., on April 12 to decide whether the city shall issue bonds in the sum of $18,000 to install water and lights.

The City Council at McDonough, Ga., has given an order for plans for a waterworks system and electric light plant. The plans will be prepared by the J. B. McCrary Co., of Atlanta, Ga.

The plant of the Columbus Waterworks Co., Columbus, Ga., has been sold at public auction to the Mercantile Trust & Deposit Co., of Baltimore, Md., for $392,000. The bondholders' committee has given the city an option on the plant at their bid, which will run for 60 days.

The city of Macon, Ga., contemplates issuing bonds to the amount of $1,275,000 for improvements. On March 18 the citizens voted on the proposition to issue bonds in the sum of $900,000, with which to purchase the waterworks.

The city of Rome, Ga., has employed the firm of Hazlehurst & Anderson, Candler Bldg., Atlanta, Ga., as consulting engineers for water works, sewer and pavement construction. Bonds in the sum of $280,000 have been sold for this work.

Engineers Hazlehurst & Anderson, Candler Bldg., Atlanta, Ga., are constructing a water works and sewer system at Kirkwood, Ga., for which $[illegible] bonds have been sold.

Illinois.

✣Bids will be received until March 28, 1911, 11 a. m., by B. J. Mullaney, Commissioner of Public Works, Chicago, for furnishing and delivering 9 duplex steam pumps to the Bureau of Streets, to be delivered as follows: 2 pumps to ward at 6109 Cottage Grove Ave., 2 to yard at Fillmore St. and Central Park Ave., 1 to yard at Lake View Pumping Station, 2 to yard at Ashland Ave. and Byron St., 1 to Chicago Ave. loading station, and 1 to Oakley Ave. loading station. The pumps shall be duplex steam pumps, with a capacity of 100 gallons per minute, working against a pressure of not less than 8 lbs. per sq. in. They are to be used for pumping hot road oil at a temperature of 250 degrees F. or less. Proposals must be accompanied by drawings or plans showing complete measurements and details of pump to be furnished. One hundred dollars in cash or certified check for same must accompany proposal. Detailed specifications [illegible] above office.

✣Bids will be received [illegible] B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., fourth floor City Hall, for constructing a reinforced concrete floor in boiler room of the Roseland pumping station, 104th St. and Stewart Ave. Bids to be opened March 27, 1911. Contract consists of furnishing all materials, labor, tools, etc., for constructing a floor 55 ft. by 120 ft., with an average thickness of 7 ins., with openings as follows: Two finished openings for stairs, 4 reinforced openings to ash pit, 4 reinforced openings to smoke flue, 1 reinforced opening for coal conveyors, etc.; furnishing and setting 8 ash doors with spouts, 4 ash chutes under boilers, 6 floor drains with removable strainers, thimbles for steam, water and various other pipes. All steel beams, etc., to fulfill all conditions enumerated in specifications on file at the above office. Cash or certified check for $200 must accompany proposal.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded to H. Kramer & Co., 730 S. Canal St., Chicago, the contract for furnishing and delivering to the Water Department shops, 2352 S. Ashland Ave., 12,000 lbs. ingot copper, at $13.75 per cwt., and 12,000 lbs. copper trolley wire at $13.30 per cwt.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded to the Gardiner Metal Co., 1374 W. Lake St., Chicago, the contract for furnishing and delivering 200 tons pig lead to the city water department: contract price $[illegible]

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing 2,300 tons, 36-in., and 1,000 tons, 30-in. cast iron water pipe to the United States Cast Iron Pipe and Foundry Co., Rookery Bldg., Chicago. Contract price, $23.75 per ton; total $78,000.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing and delivering 50,000 lbs. No. 1 red scrap brass to the water department repair shops, 2352 S. Ashland Ave., to H. Kramer & Co., 730 S. Canal St.; contract price, 11½ cts. per lb.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing and delivering to the water department 15 tons (approximate) lead pipe at $5.04 per cwt., to the Gardiner Metal Co., 1374 W. Lake St., Chicago.

⊙B. J. Mullaney, Commissioner of Public Works, fourth floor City Hall, Chicago, has awarded the contract for furnishing and delivering 9 36-in gate valves to the Roseland pumping station, 104th St. and C. & W. I. Ry. to the Ludlow Valve Mfg. Co., 217 La Salle St., Chicago; contract price, $710 each.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing and erecting smoke flues for the Roseland pumping station to John Mohr & Sons, 349 W. Illinois St. Contract price, $4,558.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing and delivering cotton waste to the various pumping stations to Crerar, Adams & Co., Chicago, Ill.; contract price 10.5 cts. per lb.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing cast iron water pipe of various sizes to the city to the United States Cast Iron Pipe & Foundry Co., The Rookery, Chicago, at $23.85 per ton; total $119,000.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, has awarded the contract for taking borings in Lake Michigan to the Great Lakes Dredge & Dock Co., Tacoma Bldg., Chicago; contract price $5 per lin. ft.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing and delivering gate valves as follows, to the Rensselaer Valve Co., 98 Jackson Blvd., Chicago, 6 36-in., at $440; 4 30-in., at $165, [illegible] at $90, 10 16-in., at $52.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing tile pipe to the water department to Wm. E. Dee & Co., 108 La Salle St., Chicago, contract price as follows: 30,000 lin. ft. 4-in., 3 2-5 cts. per ft., 600 lin. ft. 6-in., 5 cts. per ft., 600 ft. 9-in., 10 cts. per ft.

Iowa.

⊙Jos. A. Bortenlauger Co., of Omaha, Neb., has been awarded the contract for the water and lighting improvements for Atlantic, Ia., for $43,000. The work includes erection of building and stack, furnishing and erecting one corliss and two high speed direct connected generating units, two boilers, and other station equipment; also work on pole line. Bids were opened March 8.

The citizens of Columbus Junction, Ia., at a recent election voted the issuance of bonds to the amount of $3,000 to improve the local water works system. The money will be expended for a new pump, [illegible] a direct water pipe from the pumping station to the railroad water tank to save pumping the water to the elevated tank on South Hill and running it back again.

Hawaiian Islands.

✣Bids will be received [illegible] April 1, by Capt. M. N. Falls, Constructing Quartermaster, Honolulu, H. T., for the construction of a pump house and installing water mains at Fort Ruger.

⊙The Cosmopolitan Well-Boring Co., of Honolulu, Hawaiian Islands, has been awarded the contract by M. N. Falls, Captain and Quartermaster, [illegible] 12-in. well for $2,6[illegible]. Bids were opened Jan. 21.

Kansas.

The city of Liberal, Kan., contemplates the installation of a waterworks system.

The citizens of Mound City, Kan., at a recent election voted the issuance of bonds for the purpose of putting in a water system.

Kentucky.

A resolution has been introduced in the city council of Latonia, Ky., to offer $26,342 to the directors of the Kenton Water Co., who now are supplying water to the citizens of former Latonia, for their entire plant.

Maryland.

The Water Board of Baltimore, Md., has approved the plans of Engineer W. M. Quick for new equipment for the Mount Royal pumping station. The specifications call for an expenditure of more than $175,000. The new equipment will double the capacity of the station and will enable the city to take care of the high-pressure service that is being developed on the northern outskirts of the city. The capacity of the station will be 60,000,000 gals. daily.

Massachusetts.

A bill has been introduced in the legislature, Boston, Mass., asking that the Cherry Valley-Rochdale water district be given the right to lay 4,000 ft. of pipe line into Oxford, the terminus being at Rochdale. The plans of the new district were prepared by Nathan E. Craig of Spencer.

Michigan.

The City Council of Hastings, Mich., has decided to submit to the voters a proposition to bond the city for $120,000 to establish a water power plant which will operate a municipal electric plant and pumping station.

The City Council of Grand Rapids, Mich., has turned down the offer of $1,512.50 on the $200,000 filtration bond issue and ordered a re-advertisement of the bonds.

Minnesota.

A bill has been passed by the legislature, St. Paul, Minn., permitting the city of Stillwater and other cities of its class to provide by ordinance for a water commission to have independent control of waterworks without interference by the city council.

Missouri.

✣Bids will be received until 7:30 p. m., March 28, by City Council, Columbia, Mo., for supplying hydrants, valves, valveboxes and special castings for the extension of water mains in the city. John S. Bicknell is City Clerk. J. Russell Ellis is Engineer.

Hiram Phillips, Consulting Engineer, Third National Bank Bldg., St. Louis, Mo., has made a report that to increase the water pressure in certain parts of the city of Colorado Springs, Colo., will cost $130,000.

Montana.

✣Bids will be received until 8 p. m., April 20, by J. A. Mattson, City Clerk, Helena, Mont., for all labor and material for the construction of a water works system. The work involves headworks with concrete core wall, and approximately 14 miles of 18-in. wooden conduit, 7.4 miles 24-in. wood conduit, 0.8-mile 24-in. steel conduit, 43.4 miles of cast-iron mains, 260 hydrants, 283 gate valves, specials, etc., and a storage reservoir, lined with concrete, to hold approximately five million gallons, together with all appurtenances; using about 2,800 cu. yds. of concrete, and requiring about 79,000 cu. yds. class (A) excavation, 12,000 cu. yds. class (B) excavation, 222,000 lin. ft. class (A) trenching, and 16,000 lin. ft. class (B) trenching. Plans and specifications, also forms of contract and proposals may be seen at the office of the City Clerk, J. A. Mattson; also at the office of the City Engineer, Charles W. Helmick, and copies of all thereof obtained upon payment of $5.00. Each bid must be accompanied by a certified check for $30,000, payable to the Mayor of Helena, Montana.

Nebraska.

✣Bids will be received until [illegible] March

✣ indicates work now open [illegible] ⊙ indicates a contract let recently.

30, by C. A. Currie, City Clerk, Havelock, Neb., for sanitary sewer laterals, consisting of three districts. The cost of the work is estimated at $6,900. Grant & Hetton, Lincoln, Neb., are Engineers. O. W. Barnes is City Engineer.

The Village Board of Bridgeport, Neb., has called a special election for March 21 [illegible] works in the village. W. H. Ellis is clerk of the board.

New Mexico.

The City Council of Tucumcari, N. Mex., has decided to submit to the vote of the people, whether or not the local water works [illegible]000 should be purchased. An extra $10,000 will be voted to improve the system, a larger main being laid in the downtown districts, a water tower being erected for use in case of [illegible] being added.

New York.

✣Bids will be received until 11 a. m., March 31, by Board of Contract & Supply, Troy, N. Y., for building the Martin-Dunham reservoir on the Quackenkill in the town of Grafton, 12½ miles east of Troy, and 2 miles west of Centre Grafton. The work includes furnishing all the tools, machinery, labor and materials required and the building of the dam, spillway, gate houses, valve wells, outlet pipes, roadway, bridges, culverts, etc., and the clearing, grubbing and cleaning of the reservoir site, and all necessary appurtenances for the Martin-Dunham dam, in the town of Grafton. Plans, specifications, proposal blank, form of agreement and other information can be obtained at the office of the Commissioner of Public Works, City Hall, Troy, N. Y. W. H. Shields is Commissioner of Public Works, Edwin L. Grimes is City Engineer, and John Flynn, Jr., is Constructing Engineer.

✣Bids will be received until 11 a. m., March 31, by Board of Contract & Supply, Troy, N. Y., for furnishing 492 lin. ft. of 24-in. class C, bell and spigot cast iron pipe, 53 lin. ft. of 24-in., class C, specials with flanged, bell or spigot ends, as shown on the plans, 60 ft. of 12-in., class C, cast iron bell and spigot pipe, and 33 ft. of 12-in., class C, specials as shown on the plans. The faces of all flanges shall be faced true and smooth. A price per net ton will be stated in the proposal for the bell and spigot pipe and also a price per net ton for the specials. The price bid for the specials shall include the cost of the drilling of the flanges as shown on the plans. The approximate number of net tons required is as follows: 68 tons of class C 24-in. bell and spigot pipe, 8 tons of class C 24-in. specials, 6 tons of class C 12-in. bell and spigot pipe, 1.5 tons of class C 12-in specials. Plans, specifications, proposal blanks, etc., can be obtained from the Commissioner of Public Works at his office in the City Hall, Troy, N. Y. James M. Riley, Secretary.

✣Bids will be received until 11 a. m., March 31, by Board of Contract & Supply, Troy, N. Y., for the furnishing, free on board cars or at shops in the city of Troy, N. Y., the valves, etc., required in the construction of the "Martin-Dunham Reservoir." A separate price will be stated on the various items, which are as follows: Four 24-in. valves, 2 12-in. valves, 2 24-in. flap valves, 1 12-in. flap valve, 1 24-in. sluice gate, 2 1¾-in. extension rods, 2 valve standards with indicators, 3 5-in. I-beams with steady brackets. Plans, specifications, proposal blanks, etc., can be obtained from the Commissioner of Public Works, at his office in the City Hall, Troy, N. Y.

⊙Gary & Miller of Hornell, N. Y., have been awarded the contract by the city of Hornell for the construction of an earthen reservoir embankment with concrete core wall and all accessories. The work includes about 23,000 cu. yds. of embankment; 1,822 cu. yds. of concrete core wall; spillway, etc.; one 44-ft. plate girder bridge, with solid floor; gate house and valve chambers. The contract price is $39,420. Bids were opened March 10.

The City Council of Buffalo, N. Y., has approved the $1,000,000 bond issue for the equipment of the duplicate waterworks.

An election was held in Lyons, N. Y., on March 14 for the purpose of bringing the question of a municipal board of water commissioners before the people. If carried the board of trustees will appoint five men to act as a board of water commissioners to bring the question of a pure water supply and the construction of a new waterworks plant before the people for their consideration at some future time.

North Carolina.

The Board of Aldermen of the town of Thomasville, N. C., has decided to bond the town to the amount of $75,000 in the beginning for the purpose of building a waterworks and sewer system.

Engineers Hazlehurst & Anderson, Candler Bldg., Atlanta, Ga., have just completed the water works construction for Wilmington, N. C., for which $250,000 was appropriated. The engineers will commence the construction of sewer work at that point. Designs for this work have recently been prepared. The estimated cost is between $150,000 and $200,000.

Ohio.

✣Bids will be received until noon, April 4, by E. R. Lieblein, Clerk, Board of Trustees Public Affairs, Lakewood, O., for the building of a 12-in. cast iron service main in Detroit Extension and Gridley St., in accordance with the form of contract, plans and specifications on file at the Town Hall, City of Lakewood, O., and at the office of The Wm. H. Evers Engineering Company, 332-334 The Arcade, Cleveland, O.

✣Plans have been prepared by L. E. Chapin, Canton, O., and Pittsburg, Pa., for the construction of a new water works for Sugar Creek, O., at an estimated cost of $12,500. The works will include pipe and special castings, hydrants, valves and valve boxes, pipe laying, tank and tower. The water will be secured from supply wells. Bids for this work will be received until April 4. W. O. Hahn is Clerk of Sugar Creek.

⊙The United States Cast Iiron Pipe Co., of Pittsburg, Pa., has been awarded the contract by the service department of Zanesville, O., for supplying the city with about 225 tons of water pipe and special castings for $22.50 per ton for the pipe, and $2.50 per 100 lbs. for the special castings.

⊙The Board of Control of Canton, O., has awarded the contract for furnishing wrought iron pipe for the Water Works Department for $2,137. D. Muller & Co. secured the contract for furnishing water works supplies for $764.

⊙The County Commissioners of Miami County, Troy, O., have awarded the contracts for furnishing the necessary labor and materials for the installation of water mains from the intersection of Adams St., to the Miami County Infirmary, as follows: James B. Clow & Son, Chicago, Ill., at $3,995, for materials; U. S. Construction Co., Columbus, O., at $2,298, for labor. Bids were opened March 11 by A. E. Sinks, County Auditor.

⊙J. J. Brown has been awarded the contract in Cincinnata, O., for laying a water main in the North Bend road, from Cheviot to College Hill, for $14,274.

The citizens of Lowellville, O., on March 10 voted in favor of the proposition of installing a water works system. The cost of the system will be between $60,000 and $70,000. Capitalists of Pittsburg, Pa., and Lowellville will finance the proposition.

Oregon.

D. M. Roberts, recorder of the town of Gresham, Ore., will sell bonds April 4 in the sum of $20,000 for the installation and construction of general water works and a water system and a sewer and drainage system.

The City Commissioners of Baker, Ore., have instructed the city engineer to prepare estimates and cost for installing a municipal pipeline from Elk Creek to replace the old flume. The plan also includes the construction of a new reservoir of 3,000,000 gals.

The Dallas, Ore., Water Commissioners will expend $10,000 on improvements in the city reservoir and $10,000 on the pipelines from the Meadows as soon as work can begin. The commissioners will also advertise for bids for relining the open reservoir in the city and will build a parapet three ft. in height with a railing on that around the whole of the reservoir. Four miles of 20-in. wooden pipe will be laid at the Meadows.

Pennsylvania.

✣Bids will be received until 8 p. m., April 7, by Borough Council of Chambersburg, Franklin County, Pa., for the construction of dam, intake, reservoir and standpipe for Birch Run Water Supply. W. A. Laird, Jr., is Engineer of the Borough. Official advertisement will be found elsewhere in this issue.

The Clarion Water Co., Clarion, Pa., has employed the firm of Chester & Fleming, consulting engineers, Pittsburg, Pa., to design and install a water filtration plant.

The International Land Co. of Scranton, Pa., has been incorporated with a capital stock of $3,000,000 to deal in real estate, grow orchards, operate packing and canning factories, water works, furnish electric power, etc., in Fresno County, Cal. The incorporators are: David Cottle, C. U. Krause, E. A. Poole and J. Foster Davis of Scranton, Pa., and John Downing of Wilkesbarre, Pa.

South Dakota.

⊙Norbeck & Nicholson have been awarded the contract at Vermillion, S. Dak., for sinking a deep well for $4 per ft. Bids were opened March 10.

Tennessee.

⊙The Board of Public Works of Nashville, Tenn., has awarded to the United States Cast Iron & Foundry Co., of Chattanooga, a contract for supplying the city nearly five miles of additional water mains. Of this amount 45,000 ft. is to be of 6-in. pipe and 3,100 ft. of 12-in. pipe. The contract price was $20.95 f. o. b. per ton.

Plans have been prepared for the construction of a new water works for Dyer, Tenn,. at an estimated cost of $20,000. The water will be secured from wells and reservoir. An election is to be held on March 23, to vote on a bond issue for this purpose. R. C. Houston, Memphis, Tenn., is Engineer.

Consulting Engineers Hazlehurst & Anderson, Candler Bldg., Atlanta, Ga., will plan and supervise the erection of buildings for a water works for the town of Clarksville, Tenn., at an estimated cost of $15,000. The water works will require two turbine centrifugal pumps and steel standpipe of 290,000 gals. capacity. S. J. Love is Supt. of the city water works.

Texas.

It is planned to hold another election in Hearne, Tex., to vote on the issuance of bonds for the installation of a water works. J. W. Pinkerton is mayor.

The following bids were received by the municipal commissioners of Dallas, Tex., recently for the erection of the White Rock standpipe, 70 ft. high and 20 ft. inside diameter: Dallas Boiler Works, by J. F. Thrash—For the erection of the standpipe, $4,615, with 45 cts. a cu. yd. for earth excavation, $2.50 for rock and $7.60 for the concrete work. O. J. Gorman—For the erecting of the standpipe $5,200, with $1,680 for the foundation work and $2.60 a cu. yd. for the rock excavation. Memphis Steel Construction Co.—For the erecting of the pipe $4,340, with earth excavation at 30 cts. a cu. yd., $1.60 for rock excavation and $6.60 to $7.00 for concrete. F. B. Godley—For the standpipe erection $5,559, with $1 for earth work, $2 for rock and $6 for concrete, or a lump sum for the foundation work of $1,360. Smith & Whitney—For the erection of the standpipe $5,375, with $1 for earth work, $2 for rock and $6 for concrete, or a lump foundation sum of $1,350. Chicago Bridge and Iron Works—For the standpipe erection $6,795, with rock excavation at $1 a cu. yd. As an alternate bid the company offered to erect a steel tank holding 165,-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

000 gals., 12 ft. to the first expansion joint and 42 ft. to the maximum water line, for $5,900 with a deduction if a valve is used of $800.

The citizens of Caldwell, Tex., have voted the issuance of bonds for the erection of a city standpipe at the waterworks plant. The new standpipe will be of steel and 100 ft. high.

The City Council of Eagle Lake, Tex., has called an election to determine whether or not the city shall issue bonds in the sum of $30,000 for putting in a waterworks plant and sewerage system.

Bonds have been voted at Olney, Tex., to the amount of $10,000 for the installation of a new water works. The work will include 2,000 ft. of 8-in. mains, 3,500 ft. of 6-in. mains, 10 fire plugs, well, pump, boiler, pumping station and tower 100 ft. high. M. P. McCrocken is Mayor.

An election is to be held in Brady, Tex., on April 25 to vote on the issuance of bonds for the construction of three dams in connection with the water works. Two of the dams are estimated to cost $7,000 each, and one $2,000. The water supply will be secured from Brady Creek. Machinery is also to be installed. S. A. Conley is Mayor.

Plans have been made for the construction of a new water works for Archer City, Tex., estimated to cost $12,000. The water supply will be secured from an artificial lake. An election is to be held March 25 to vote on the proposition. W. C. Young is Mayor.

The City Council of Timpson, Tex., has employed an engineer to survey the town and make an estimate on the cost of a system of waterworks for Timpson. The mayor will order an election to vote on the issuance of $20,000 bonds to put the system in.

Utah.

The City Council of Park City, Utah, has named a committee to open negotiations with the Park City Water Co., with a view of purchasing the old water system.

Virginia.

The city of Norfolk, Va., has secured from the North Carolina state corporation commission a charter for the Norfolk-Carolina Water Supply Co., which is empowered to obtain water from rivers and streams in North Carolina and furnish the same not only to Norfolk, but any other city in this or any other state.

N. Wilson Davis, Civil Engineer, has been awarded the contract to design and superintend the proposed new waterworks for Lexington, Va., which will be installed at a cost of $75,000.

An election is to be held in Graham, Va., on April 18, to vote on the issuance of bonds for the extension to the water works, estimated to cost $15,000. V. F. Sextion is Mayor.

Washington.

The citizens of Pasco, Wash., at a special election held recently voted against the proposition of bonding the city for purchasing 500 water rights at $100 each to irrigate the streets and residence property of the city.

West Virginia.

The city of Wheeling, W. Va., contemplates the construction of a filtration plant.

Wisconsin.

✣Bids will be received until 2 p. m., March 30, by City of Prescott, Wis., for the construction of a gravity water works system including 100,000-gal. reinforced concrete reservoir; 20,000 ft. of 4, 6, 8 and 10 in. cast iron water pipe with hydrants, valves, specials, etc.; concrete or brick pumphouse; system of 2½-in. drive points for water supply. Plans and specifications are on file at the office of R. H. Price, City Clerk, or at the office of Oscar Claussen Engineering Co., St. Paul. Minn., Engineers.

Wyoming.

Tentative plans have been made for new water improvements at an estimated cost of $55,000, and sewer improvements at an estimated cost of $15,000. Bonds will be voted in the near future. W. B. Schilling is City Engineer, Laramie, Wyo.

⊙James Kennedy of Fargo, N. Dak., has been awarded the contract at Aberdeen, Wyo., for the construction of 8,694 ft. of 10-in. and 6,550 ft. of 14-in. water mains for $24,850. Bids were opened March 6.

Canada.

✣Bids will be received until 11 a. m., March 29, by M. Peterson, Secy., Board of Control, Winnipeg, Man., for laying approximately 5,000 ft. of 18-in. water pipe from Well No. 7, Lot 19, Kildonan. Plans and specifications are on file at the office of the engineer, 223 James Ave.

✣Bids will be received until 11 a. m., April 19, by M. Peterson, Secy., Board of Control, Winnipeg, Man., for supply of labor and wooden stave conduit for extension of water pipe line northerly from Well No. 7, Lot 19, Kildonan.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

⊙The board of public works of Mobile, Ala., has awarded the contract for laying storm sewers in the eighth paving district and also for paving to Sullivan & Long of Bessemer, Ala,. for $26,019, and $65,760 respectively. Wooden block pavement will be laid.

Georgia.

⊙Following contracts have been awarded by the City Council of Atlanta, Ga., for the construction of the Intrenchment Creek disposal plant and the intercepting sewers leading thereto, for which bids were received March 14; Capt. R. M. Clayton, Chief Engineer: Chester A. Dady, New York city, at $192,577, for disposal plant; Nichols Contracting Co., Atlanta, Ga., $7,170, for the DuBose aqueduct; Dysard Construction Co., Atlanta, Ga., $5,400, for the Parker aqueduct; Noll Construction Co., Chattanooga, Tenn., $36,634, for section 3 of the intercepting sewer; Noll Construction Co., $28,630, for section 4 of the intercepting sewer; Mackle-Crawford Construction Co., $7,400, for constructing Collier's bridge.

Illinois.

✣Bids will be received until 8 p. m., March 25, by City Clerk E. O. Engstrand, Galva, Ill., for the necessary labor and materials for constructing a sewage disposal plant consisting of some 1,250 ft. of 10-in. outlet tile sewer, a concrete and brick tank with sludge pipes, valves, dosing tanks and trickling filter. Plans and specifications are on file at the office of the city clerk or W. S. Shields Co., 1201 Hartford Bldg., Chicago, Ill., Engineers.

⊙Schuyler Vandewalker has been awarded the contract by the street and alley committee of the City Council of Belvidere, Ill., for the construction of storm sewers in connection with the paving about the city park and other streets in the improvement plan for $3,000.

⊙The Board of Local Improvements of Rock Island, Ill., has awarded D. Keeler Co.,. of Davenport, Ia., the contract for the construction of the west section of the Seventh Ward sewer for $55,698

Indiana.

✣Bids will be received until 10 a. m., March 27, by City of Elkhart, Ind., for the construction of about 2½ miles of 12, 24 and 30-in. sewers. The cost of the improvement is estimated at $45,000. A. M. Smith is City Engineer.

Iowa.

✣Bids will be received until 9 a. m., March 25, by City Clerk, Sioux City, Ia., for digging and filling trenches for water pipes to be laid in the city from April 1, 1911 to April 1, 1912. G. B. Healy is Superintendent of Public Property.

✣Bids will be received until 8 p. m., April 4, by W. E. Hayes, City Clerk, Clinton, Ia., for the construction of main and lateral sewers in Clinton consisting of 300 ft. 48-in. 2-ring brick sewer; 500 ft. 48-in. 1½-ring brick sewer; 400 ft. 42-in. 1½-ring brick sewer; 1,343 ft. of 30-in. 1½-ring brick sewer; 765 ft. 36-in. pipe sewer; 1,988 ft. 30-in. pipe sewer; 2,452 ft. 24-in. pipe sewer; 1,544 ft. 20-in. pipe sewer; 3,560 ft. 18-in. pipe sewer; 2,993 ft. 15-in. pipe sewer; 11,515 ft. 12-in. pipe sewer; 7,165 ft. 10-in. pipe sewer; 5,513 ft. 10-in. catch basin pipe; 14,880 cu. yds. rock excavation; 76 manholes; 62 catch basins; 122 inlet basins. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 9 a. m., March 25, by City Clerk, Sioux City, Ia., for furnishing labor and material for the construction of a storm water sewer in West Fifth St. from Center St. to Perry Creek of 920 ft. 12-in. pipe, 765 ft. 15-in. pipe, 990 ft. 18-in. pipe, 195 ft. 22-in. pipe, 410 ft. 30-in. pipe, 1,260 ft. of 33-in. pipe, 14 manholes, 32 catch basins, in accordance with plans and specifications prepared by the city engineer and on file in the office of the city clerk.

⊙The City Council of Sac City, Ia., has awarded the contract for the construction of a sewer system to the C. F. Lytle Construction Co., of Sioux City, Ia., for $5,205. The following bids were received for the work: L. W. Tyler, Sac City, $8,423; Wm. Welsh, Sac City, $10,237; N. Jensen, Newell, $8,618; Tibey Bros., Dubuque, $6,362; Moeller Bros., Knierim, $9,594; H. M. Scharle & Co., Dubuque, $6,495; Blackhawk Construction Co., Waterloo, $5,774; C. R. McKay, Omaha, $8,954; Wm. Fitch, Omaha, $9,435; Guy E. Smith, Indianola, $6,696; King Construction Co., Des Moines, $7,886; C. B. McNamara Co., Dubuque, $6,845, and the I. W. Turner Improvement Co., Des Moines, $5,998.

Massachusetts.

✣Bids will be received until 4 p. m., March 24, by City of Putnam, Mass., for Sewer Contract No. 5, comprising approximately 600 ft. of 24-in. pipe, 300 ft. of 20-in. pipe, 1,080 ft. of 15-in. pipe, 600 ft. of 12-in. pipe, 1,700 ft. of 10-in. pipe, and 7,900 ft. of 8-in. pipe, all in accordance with specifications, maps and detailed drawings on file in the office of George W. Perry, Engineer of Sewers.

Minnesota.

⊙John Lind has been awarded the contract at St. Paul, Minn., for the construction of a storm sewer on Grove St., for $12,500.

Ohio.

✣Bids will be received until noon, March 31, by A. B. Lea, Director, Public Service, Cleveland, O., for furnishing two side dump standard gage cars suitable and complete for handling and transporting garbage for Cleveland and Garbage Disposal Plant. Plans and specifications may be seen at the office of Garbage Dept., 426 City Hall.

⊙D. E. Sullivan & Son have been awarded the contract of constructing the Dry Run cutoff on the Haldy farm, west of the city limits of Columbus, O., by the Board of Control. The sewer is an extension of the Dry Run storm water sewer. The estimated cost was $2,000.

⊙The Board of Control of Canton, O., has let the contract for the construction of the Liberty St. storm sewer, which will form the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

basis for the sewage [illegible] southeastern part of the [illegible] to Turnbull & [illegible], $2[illegible]. Other bids [illegible] Downs, $2[illegible] [illegible] Skeels & [illegible] Downs, $25,813; W. H. Ralston, Mt Vernon, $[illegible]

•The Board of Public Works [illegible] is reported to have [illegible] the construction of the Main trunk sewer in Niles to C. H. Defrees of South Bend, Ind., [illegible]

Pennsylvania.

✣Bids [illegible] 10, Borough of Chambersburg, Pa., W. A. Laird, Jr., Engineer, for constructing system of sanitary sewers, main out-fall sewer and a sewage disposal plant. Official advertisement will be found elsewhere in this issue.

Wisconsin.

✣Bids will be received until 2 p. m., March 30, by Board of Public Works, Appleton, Wis., for furnishing all labor and material for the construction of sewers in the following streets: Brucke St. from the center of Owaissa St. to east end of Pacific St. bridge, and from east end of Pacific St. bridge southwesterly to connect with large sewer manhole in Bellaire Park; also on Pacific St. from Meade St. west 145 ft.; and on Pacific St. from Center St. [illegible] and on Pacific St. from Bateman [illegible] ft., in accordance with plans and specifications on file in the office of the Board of Public Works. E. L. Williams, City Clerk.

✣Bids will be received until 5 p. m., April 6, by John H. O'Connel, City Clerk, South Milwaukee, Wis., for furnishing all the equipment [illegible] labor and material for the construction of 7,299 ft., more or less, 8 to 24-in. tile pipe sewers and appurtenances in the Second Sewerage District in the city of South Milwaukee. Plans and specifications are on file at the office of the city clerk or Alvord & Burdick, Hartford Bldg., Chicago, Ill., Engineers.

✣Bids will be received until 5 p. m., April 6, by John H. O'Connell, City Clerk, South Milwaukee, Wis., for furnishing all the equipment and materials and for doing all work required to construct complete sewage purification plant composed of a settling tank, dosing chamber, sand filter beds and appurtenances in the city.

✣Bids will be received until 2 p. m., April 15, by Street Assessment Committee, Kenosha, Wis., for material and labor for the construction of a main trunk sewer in that city, including the following approximate quantities: 5,000 ft. of 99-in. or 120-in. circular concrete or brick sewer; 1,200 ft. of 78-in. circular concrete or brick sewer; 1,200 ft. of 66-in. circular concrete or brick sewer, and 20 manholes; also one reinforced concrete outlet, and breakwater for said proposed trunk sewer.

⊙G. E. Zimmerman, 3, 102 McKinley Blvd., Milwaukee, Wis., has been awarded the contract by the board of public works of Milwaukee, Wis., for (1) constructing brick and pipe sewer in Rogers St., (2) brick and pipe sewer in Burnham St., (3) pipe sewer in 24th Ave., (4) pipe sewer in 23d Ave., (5) pipe sewer in 25th Ave., and (6) pipe sewers in Lincoln Ave., for a total of $3,111. Bids were opened March 18.

⊙The city of Oconomowoc, Wis., has let contracts for two and a half miles of sewerage construction to Mulholland & Son of Kaukauna and the J. Nelson & Co., of Oconomowoc was awarded the contract for city paving.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Arkansas.

✣Bids will be received until noon, April 14, by Capt. Clarke S. Smith, U. S. Engineer, Vicksburg, Miss., for furnishing about 307,000 lbs. of structural metal, for use at Locks and Dams Nos. 4 and 8, Ouachita River, Ark., and La. Official advertisement will be found elsewhere in this issue.

A drainage district has been organized at Gould, Ark., for the purpose of reclaiming 50,000 acres in Lincoln County. Pine Bluff business men are interested in the project.

District of Columbia.

✣Bids will be received until 11 a. m., April 22, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for dry kiln at the United States Navy Yard, Norfolk, Va.

✣Bids will be received until 2 p. m., March 24, by Commissioners of District of Columbia, Washington, D. C., for the construction of an engine house No. 24, on Georgia Ave., next to the northwest corner of Rock Creek church road northwest of Washington, D. C.

✣Bids will be received until March 25, by Capt. A. S. Cowan, U. S. Army, Signal Corps, Washington, D. C., for furnishing under proposal No. 512 for furnishing 4,125 iron cross arms, 50 iron poles and 10,000 insulator plugs.

✣Bids will be received until 11 a. m., April 3, by Lieut. Col. C. L. McCawley, Quartermaster, Department U. S. Marine Corps, Washington, D. C., for supplying the Marine Corps with 65,000 yds. 12-ounce, 36,000 yds. 10-ounce and 28,000 yards 8-ounce khaki tent canvas. The tent canvas to be delivered at the depot of supplies, 1100 South Broad St., Philadelphia, Pa., by the successful bidder.

✣Bids will be received until 10:30 a. m. April 14, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for dynamite, blasting caps, detonators, safety fuse, insulating tape, connecting and lead wire.

Illinois.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, has awarded to the Edward Hines Lumber Co., Chicago, the contract for furnishing No. 1 common pine, Norway pine and yellow pine lumber to the repair dept. of the bridge division and to the Thornton Cleaney Lumber Co., Chicago, the contract for oak lumber. Details of sizes, quantities, prices, etc., in Engineering-Contracting Feb. 15, 1911.

Indiana.

✣Bids will be received until March 27, by Capt. J. V. Heidt, Quartermaster, Fort Benjamin Harrison, Ind., for furnishing 24 hay fork handles, 120 lights, 300 charts, 2 cocks, 2 valves, 21 globe valves, 2 closet bowls, 1 do, 500 Fuller balls, 24 T's, 48 unions, 24 ells, 24 stops, 24 plugs, 2 hydrants, 1 lavatory, 24 tank trimmings, 48 float balls, 24 levers, 24 rests, 24 weights, 4 toilet shelves, 100 rubber stoppers and 48 washers.

✣Bids will be received until 10 a. m., April 4, by Board of County Commissioners, Paoli, Ind., for the construction of closets, lavatories, etc., in Orange County Court House. Alvin B. Ham is Auditor of the county.

✣Bids will be received until 10 a. m., March 29, by Quartermaster, Jeffersonville, Ind., for furnishing 38,000 lbs. mild, round 16 to 20 ft. steel bars.

✣Bids will be received until March 25, by Maj. J. T. Davidson, Depot Quartermaster, Jeffersonville, Ind., for furnishing the following: 135 aparejos, 100 ambulance collars, 50 buckboard collars, 72 seat cushions, 200 single sets harness, 84 housings, 10,000 pounds black leather, 4,320 harness ornaments, 50 riding saddles, 500 saddle blankets, 500 yards canvas duck and 200 wagon paulins.

✣Bids are asked until 10 a. m., April 7, by Jos. T. Davidson, Depot Quartermaster, Jeffersonville, Ind., for building new stable, complete, at the Fort Donelson National cemetery, Dover, Tenn.

The Indianapolis, Columbus & Southern Traction Co., of Columbus, Ind., is reported to have plans for a power development near Columbus, which will require the building of a canal seven miles long, 6 ft. deep and 60 ft. wide. The canal together with a powerhouse will cost about $200,000.

Iowa.

✣Bids are asked until 3 p. m., April 17, by James Knox Taylor, Supervising Architect, Washington, D. C., for the constructing, complete (including plumbing, gas piping, heating apparatus and electric conduits and wiring), of the U. S. post office at Ames, Ia.

Kansas.

✣Bids will be received until 2 p. m., April 5, by T. H. Slavens, Constructing Quartermaster, U. S. Military Prison, Leavenworth, Kan., for furnishing and delivering f. o. b. cars Normoyle Junction, Kan., certain plumbing fixtures for the prison. Normoyle Junction is on the Missouri Pacific Ry.

✣Bids will be received until 10 a. m., March 30, by H. W. Morris, Secretary Board of Education, Oswego, Kan., for the erection of a 2-story brick school building with finished basement. Plans and specifications are on file at the office of H. W. Morris, secretary school board, Oswego, Kan., and H. H. Hohenschild, architect, 309 Navarie building, St. Louis, Mo., to whom all communications regarding applications for plans must be addressed. Bids will also be received on the wrecking of an 8-room 2-story brick building now on the premises.

Maine.

✣Bids will be received until noon, April 11, by Lieut. Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for rock excavation in Kennebec River at South Gardiner, Me.

Maryland.

⊙The contract for the foundations, including Raymond piles, for an apartment house to be erected at the corner of North Charles and Reade Sts., Baltimore, by the Riggs Building Co. has been awarded to the Raymond Concrete Pile Co. of New York and Chicago; E. H. Glidden and C. N. Fritz, architects.

⊙Sanford & Brooks, Baltimore, Md., have been awarded the contract by the U. S. Navy Department, for building the new dock at the Naval Academy, Annapolis, for which an appropriation of $75,000 was made by Congress in the recent Naval Appropriation bill. The dock will be constructed of creosoted piles, with wooden superstructure. The site chosen is at the northeast corner of the sea wall about the new parade ground. It will extend 400 ft. out into the river, and another section will run at right angles up the river for a distance of 250 ft.

⊙W. J. Lauer, Baltimore, Md., has been awarded the contract for the steel structural work on the new athletic stand to be erected at the Naval Academy, at Annapolis. Work on the concrete foundations for the stand, which has been under way for several weeks, is being pushed as rapidly as possible by the contractor, W. N. French, of Annapolis. It is expected the stand will be available for use by fall. The cost of construction will be about $22,000.

Missouri.

✣Bids will be received until April 5, by Maj. W. M. Culling, Depot Quartermaster, St. Louis, Mo., for miscellaneous hardware, tools, pipe fittings, bolts, nuts, brushes, burlap, fire clay, clocks, files, lantern globes, etc.

✣Bids will be received until 2 p. m., March 30, by Fire and Water Board, Kansas City, Mo., for one combination automobile fire engine, chemical and hose wagon and one combination chemical and hose wagon. Information may be obtained of J. C. Egner, Fire Chief.

SEWERS.

Sealed bids will be received by W. E. Hayes, City Clerk of the City of Clinton, until the 4th day of April, 1911, at 8 o'clock p. m., and then publicly opened and read, for the construction of main and lateral sewers in said city consisting of

300 ft. 48-in. [illegible] ring brick sewer.
[illegible] ft. 48-in. 1½ ring brick sewer.
400 ft. 42-in. 1½ ring brick sewer.
1,543 ft. 30-in. 1½ ring brick sewer.
765 ft. 36-in. pipe sewer.
[illegible] ft. 30-in. pipe sewer.
2,452 ft. 24-in. pipe sewer.
1,544 ft. 20-in. pipe sewer.
3,560 ft. 18-in. pipe sewer.
2,993 ft. 15-in. pipe sewer.
11,515 ft. 12-in. pipe sewer.
7,165 ft. 10-in. pipe sewer.
5,513 ft. 10-in. catch basin pipe.
14,880 cu. yds. rock excavation.
76 manholes.
62 catch basins.
122 inlet basins.

Said work is divided into four (4) districts. Work to be commenced by May 15, 1911, and completed by May 15, 1912. Cost of improvement to be paid for by special assessment on abutting property, not in excess of special benefits, balance, if any, from bonds of the district issued in anticipation of collection of taxes. Improvement to be done under a written contract.

Proposals or bids must be in sealed envelopes accompanied by a sealed envelope containing a certified check on a responsible bank in the City of Clinton, in the sums of $500.00 for District "A"; $1,000.00 for District "B"; $200.00 for District "C", and $200.00 for District "D", or the sum of $1,500.00 for all districts combined.

In considering bids the checks will be first examined and if not according to these conditions or if the proposal is conditioned it will be declared illegal. Bond will be required when contract is let in the sum of 50 per cent of the amount of bid. Council reserves the right to reject any and all bids and advertise for new bids.

W. E. HAYES, City Clerk.
Clinton, Iowa.

DAM, INTAKE, RESERVOIR AND STANDPIPE FOR BIRCH RUN WATER SUPPLY.

Chambersburg, Franklin Co., Pa.

The Borough Council of Chambersburg, Franklin County, Pa., will receive sealed proposals up to 8 o'clock p. m. of April 7, 1911, for the construction of a diversion dam and intake chamber, a reservoir of 2,200,000 gallons capacity, a stand-pipe ten (10) feet diameter and forty-five (45) feet high, all in accordance with plans and specifications.

Bids for the stand-pipe to be in a lump sum, covering the construction and erection complete upon foundations.

Bids for the dam and intake, for the [illegible] pipe may be in lump sums covering the [illegible] excavated and placed in embankment, or otherwise disposed of, for borrowed clay, for puddle lining in place, for rubble masonry, or for concrete in place. Also for [illegible] laid in cement, for rip-rap per square yard, for fence per lineal foot, and for placing in position, jointing and securing the necessary influent, effluent, drain and overflow pipes, with appurtenances connected therewith.

Each bidder must accompany his proposal or proposals with a certified check, drawn to the order of the Treasurer of the Borough of Chambersburg, in the sum of $300.00.

A date for the completion of the work bid for to be stated in each proposal.

The borough reserves the right to reject any or all bids.

Plans and specifications are available at the City Hall, Chambersburg, and at the office of John Birkenbine, Consulting Engineer, Parkway Building (Broad and Cherry Sts.), Philadelphia.

By order of the Borough Council.
[illegible] Woods,
Chairman Water Committee.

TENDERS FOR RAIL AND TIES.

CITY OF TORONTO
CIVIC CAR LINES.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, April 4, 1911, for delivery of thirteen hundred and forty (1340) tons of open hearth steel rail, 60-lb. section, also thirty thousand (30,000) untreated wood ties, white cedar preferred, although other woods will be considered.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications and forms of tender may be obtained upon application to the office of the City Engineer, Toronto.

The lowest or any tender not necessarily accepted.

G. R. GEARY, Mayor,
Chairman, Board of Control.
City Hall, Toronto, February 23, 1911.

CONSTRUCTION PROJECT NO. 2, SECTION 1, OF FRONT LEVEE.

OFFICE OF BOARD OF TRUSTEES,
THE EAST SIDE LEVEE AND SANITARY DISTRICT.
SEXTON BUILDING.

East St. Louis, Ill., Mar. 1, 1911.

Sealed proposals, in duplicate, for the construction of an earth levee having a crown eight (8) feet wide and a length of about three (3) miles, being Construction Project No. 2, Section 1 of Front Levee, and other auxiliary or incidental improvements, in accordance with Ordinance No. 13 of The East Side Levee and Sanitary District, and the plans, profiles and specifications for the same, now on file in the office of the Clerk of said District and known as Construction Project No. 2, will be received at this office until 12 o'clock [illegible] and then publicly opened.

Proposals to be based on the following estimates:

200,000 cu. yds. of earth embankment, 130 lineal feet of 30-inch cast iron pipe, 10 cu. yds. of concrete, 1 automatic flood gate, 1 hand gate and 1 acre of grubbing.

Proposals for said work must be accompanied by a money deposit in the form of a certified check upon some satisfactory banking institution in the City of East St. Louis, Ill., or St. Louis, Mo., and [illegible] The East Side Levee and Sanitary District, for five per centum (5 per cent) of the amount of the proposal.

The [illegible] will be required to enter into a written contract with The East Side Levee and Sanitary District, with good and approved security in the amount of the contract, within ten (10) days after being notified of [illegible]

The contract which the bidder promises to enter into is fully set forth in the blank forms which can be inspected at this office, and will be furnished, if desired, to parties proposing to put in bids. Parties making bids are to be understood as accepting the terms and conditions contained in such form of contract.

Payments will be made monthly on estimates of work fully completed, as prescribed by the engineer in charge and by the specifications therefor, ten per cent of each payment to be retained until all work contracted for has been fully completed and accepted.

The work proposed is in accordance with Ordinance No. 13 of The East Side Levee and Sanitary District, and the plans, profiles and specifications therefor are on file in the office of The East Side Levee and Sanitary District, where they can be inspected by prospective bidders.

LOCATION.

Section 1 of the Front Levee will extend from Cahokia Creek Diversion Channel in a southerly direction to Mitchell, Madison County, Ill., a distance of about three (3) miles.

H. D. SEXTON,
President, Board of Trustees, The East Side Levee and Sanitary District.

SEWERAGE AND SEWAGE DISPOSAL.

Borough of Chambersburg.

Proposals for constructing a system of sanitary sewers, a main out-fall sewer, and a sewage disposal plant, will be received by the Borough Council until 8 o'clock, Monday evening, April 10, 1911, at Council Hall.

Bids will be opened the same evening.

The sanitary sewer system comprises approximately:

69,000 feet 8-inch terra cotta pipe.
4,000 feet 10-inch terra cotta pipe.
1,500 feet 12-inch terra cotta pipe.
2,500 feet 15-inch terra cotta pipe.
3,600 feet 18-inch terra cotta pipe.
4,100 feet 24-inch terra cotta pipe.

Manholes, Y branches, and other accessories.

The main out-fall sewer comprises approximately:

460 cu. yds. concrete of stone retaining walls.
1,400 feet 20x30-in. concrete sewer.
72 feet 24-inch cast iron pipe.

The disposal plant comprises:

900 feet 16-inch force main.
960 feet 12-inch cast iron siphon line.
1 pump [illegible] equipped with three electrically driven centrifugal pumps, capacity 1,000 gallons per minute.
5 concrete settling tanks.
1 sprinkling filter bed, 160 ft. x 125 ft.
[illegible] other work.

Plans and specifications may be seen at the Borough Engineer's office, and at the office of Albright & Mebus, 908 Land Title building, Philadelphia, or may be secured from the Borough's Engineer, R. M. Huber, upon payment of $25.00, which sum will be refunded when the plans and specifications are returned in good order.

Bids must be made out on blanks furnished by the Borough's Engineer.

Each bid must be accompanied by a certified check for at least 5 per cent of the total amount of the bid.

Borough Council reserves the right to [illegible] contract as may be deemed to the best interest of the Borough.

By order of Borough Council.
[illegible],
Chairman Sewer Committee.

IN WRITING to our Advertisers for CATALOGS or PRICES Please mention ENGINEERING-CONTRACTING

BANKRUPT SALE.

[illegible] signed, as Trustee, will proceed to sell, to [illegible] p. m., on Monday, the 3rd day of April, 1911, one 45-ton six-wheeler engine, which [illegible]

The undersigned will sell at Nashville, Tenn., on Tuesday, the 4th day of April, 1911, between the hours of 11 a. m. and 3 p. m., to the highest bidder for cash, be- [illegible] the following described property:

One 70-ton Bucyrus steam shovel.

1 35-ton Rhode Island 6-wheeler Mogul engine.

1 10-ton horsepower upright boiler.

2 U. N. Sullivan steam drills.

1 U. A. Sullivan steam drills.

1 blacksmith shop outfit, consisting of one No. 7 hand drill, ratchet, one anvil, one small forge and certain tools, stock, drill, hammers, etc.

[illegible] pipe.

2 35-ton Buda ball bearing jacks.

1 crank shaft for swinging engine.

1 washer for center casting.

1 band and blocks for hoisting drum.

1 set of maple blocks for lowering band.

600 feet ⅞ rope block and falls.

Supplies for drills.

Packing for shovel and engine.

Tools, shovels, picks, claw bars, hammers, etc.

Tents, eight 9x12, one 12x14.

Two galvanized iron water tanks.

Six second-hand cooking stoves for shanties.

One 16-ton dinkey in bad shape.

1 spreader car.

8 12-yard Oliver dump cars.

1 12-horsepower upright boiler.

1 duplex pump, medium size.

1 2500-gal. wood tank.

2,000 feet second-hand pipe, 1x1½ and 2.

Also camping outfit, consisting of one tent, one stove, beds and bedding.

Said last described property is now in Nashville, and any information concerning the same can be obtained by writing to the undersigned or his attorneys, and the [illegible] be inspected at Nashville, Tenn., and its location will be pointed out either by J. H. Orr, of Orr & Jackson, or Walter Keith, of Keith-Simmons Hardware Company of such place.

Under the order of the Court I will receive written bids for such property until the day of said sale, which can be mailed to me at Talladega, Ala., for any or all of such property, and a public sale of the remainder will be made if not sold prior to such time, such sale to be made subject to the orders of the Court.

This March 15, 1911.

C. G. KERSHAW,
Trustee Talladega Construction Co.
By KNOX, ACKER, DIXON & BLACKMON, Talladega, Ala., his Attorneys.

MISSISSIPPI RIVER COMMISSION, 1st and 2d Districts, U. S. Engineer Office, Custom House, Memphis, Tenn., March 7, 1911.—Sealed proposals for constructing and delivering seven (7) steel barges will be received at this office until noon of April 5, 1911, and then publicly opened. Information on application. CLARKE S. SMITH, Capt., Engrs.

PROPOSALS FOR METAL.—U. S. Engineer Office, Vicksburg, Miss., March 15, 1911. Sealed proposals for furnishing about 307,000 pounds of structural metal, for use at locks and dams Nos. 4 and 8, Ouachita River, Ark. and La., will be received at this office until noon, April 14, 1911, and then publicly opened. Information on application. CLARKE S. SMITH, Capt., Engrs.

WATERWORKS.

Helena, Mont

Sealed proposals will be received at the City Hall, Helena, Mont., until 8 p. m., Thursday, April 20, 1911, for furnishing of all material and the construction of a waterworks system, reservoir pipe line, and distribution system for the City of Helena, Mont., all according to plans and specifications.

The work involves headworks with concrete core wall, and approximately 14 miles of 18-in. wooden conduit, 7.4 miles 24-in. wood conduit, 0.8 miles 24-in. steel conduit, 43.4 miles of cast-iron mains, 260 hydrants, 283 gate valves, specials, etc., and a storage reservoir, lined with concrete, to hold approximately five million gallons, together with all appurtenances using about 2,800 cu. yds. of concrete, and requiring about 79,000 cu. yds. class (A) excavation, 12,000 cu. yds. class (B) excavation, 222,000 lineal feet class (A) trenching, and 16,000 lineal feet class (B) trenching.

Plans and specifications, also forms of contract and proposals, may be seen at the office of the City Clerk, J. A. Mattson; also at the office of the City Engineer, Charles W. Helmick, and copies thereof obtained upon payment of $5.00.

Each bid must be accompanied by a certified check for $20,000.00, payable to the Mayor of Helena, Mont., as a guarantee that bidders will, if successful, promptly execute a satisfactory contract and bond, as specified and required, with satisfactory surety in the sum of one hundred and fifty thousand dollars, for the faithful performance of the contract.

The right is reserved to reject any or all bids, and also to waive any technical defects.

Bidders are invited to be present. Proposals must be marked "Proposals for Construction of Water Works System for Helena, Mont.," and must be made out in the form within, and be accompanied by the printed specifications.

By order of the City Council.

J. A. MATTSON,
City Clerk

Dated, 1911.
First publication, 1911.

STORAGE DAM.

Salt Lake City, Utah.

Sealed proposals will be received by the Pacific Reclamation Company, at the office of their Consulting Engineer, George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah, until noon of Saturday, April 15, 1911, for the construction of a Storage Dam about fifteen miles north of Wells, Nevada.

The dam will be of earth and rock fill with a reinforned concrete facing on the up-stream side. The principal quantities are:

20,000 cu. yds. earth excavation.
3,000 cu. yds. rock excavation.
71,000 cu. yds. earth embankment.
6,000 cu. yds. dry rubble wall.
1,250 cu. yds. Portland cement concrete.
85,000 lbs. steel reinforcing.

A certified check for $2,500.00 must accompany the bid, and a bond of $15,000.00 will be required for the faithful performance of the contract.

Form of proposal, contract and specifications may be had by applying to George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah.

PACIFIC RECLAMATION COMPANY,
Joseph Gutman, President.
George M. Bacon,
Consulting Engineer.

DRAINAGE WORK.

The Commissioners of the Shepard Drainage District will, until April 15, 1911, at noon of said day, receive, at the Bank of Marshall, Marshall, Wis., sealed bids for doing the work of the said district, to be done in accordance with its plans and specifications now on file in the office of the Clerk of the Circuit Court for Dane County, Madison, Wis., and also on file at the Bank of Marshall, in the Village of Marshall, Dane County, Wis.

A copy of said specifications will be sent by mail upon request made to W. H. Tasker, Marshal, Wis., upon payment of $1.00.

Dated March 15, 1911.

MATHIAS LINDAS,
F. G. SCHERNECKER,
W. H. TASKER,
Commissioners.

Washington, D. C., Feb. 25, 1911. Sealed proposals will be received at the office of the U. S. Reclamation Service, North Yakima, Wash., until 10 o'clock a. m., April 15, 1911, for the building of Kachess dam and accessory structures near Easton, Wash. The work involves the excavation of approximately 345,000 cubic yards of material, the placing of about 240,000 cubic yards of embankment, 15,000 cubic yards of riprap and paving, 8,000 cubic yards of concrete, and 300,000 pounds of reinforcing steel, and other items necessary to complete the work. For particulars address the United States Reclamation Service, Washington, D. C., or North Yakima, Wash. R. A. BALLINGER, Secretary.

U. S. Engineer Office, Duluth, Minn., March 20, 1911. Sealed proposals for dredging at Superior Entary, Duluth-Superior Harbor, will be received at this office until noon, April 20, 1911, and then publicly opened. Information on application. Graham D. Fitch, Lt. Col. Engrs.

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State Supervision of Operation of Sewage Disposal Works.

It is gratifying to note that a movement is on foot in various States to give the State Boards of Health control over the construction, maintenance and operation of sewage disposal plants. Naturally this movement is beginning in our Eastern States, where the Boards of Health first were given control over the design of such works. The powers heretofore granted the Boards by the Legislatures have resulted in so much good to all concerned that it seems certain that additional powers will be granted.

It was, perhaps, something of an experiment to place the Engineer of the State Board of Health in the position of judge of the fitness of proposed designs. At first the idea of having their designs investigated was distasteful to some well established engineers, but experience has shown that only the inexperienced or incompetent Engineers were affected by the law. Very often Engineers of the latter classes were set right by the advice and instructions freely given by the State Engineer.

Not long after the original power was vested in the Boards of Health it became apparent that additional powers were advisable and even necessary to make purification plants in small cities and towns of any value either to the towns building them or to neighboring towns down stream. Very frequently, for lack of proper supervision, plants became worse than useless, since they merely served to hold sewage long enough to make the emitted odors a great nuisance without actually producing any purification worth mentioning.

Too often it has been taken for granted by city officials that plants once installed and placed in operation require no further attention except at long intervals. Just how bad conditions sometimes became may be illustrated by the following account of an actual experience.

A consulting engineer visited a small town to inspect the disposal plant. Being a stranger in the city he called on the Mayor and asked where the plant was located. The Mayor replied, "You'll have to ask somebody on the former Council. I have been Mayor only a year and I don't know where it is." When the visiting Engineer finally found the plant he found the inlets to all but one compartment of a large septic tank blocked up. The sewage was running through that compartment at a high velocity. The other compartments were, of course, full of stagnant sewage which "smelled to the high heavens."

The population of the town in question was something like four thousand people. The sewer commissioner was a worthy and faithful man, but lacked even an elementary knowledge of sewage purification. In towns of that size is where the chief danger of inefficient operation exists. Since the Boards of Health in several States have the power to require such towns to purify their sewage, it seems logical that they should be given additional power sufficient to enable them to see that cities continue to purify their sewage. Should any modification of the requirements of the Board be desired in any specific case the city affected always has the opportunity to present its case in court.

A Commission for the Study of Railroad Electrification in Chicago.

Definite action looking to electrification of the railroad terminals of Chicago has been taken during the past week by the appointment of a commission for the study of this question. This commission is composed of seventeen representative business and professional men. In the matter of personal reputation and public standing of the members its composition is beyond criticism. When one considers the purpose of this commission, however, its personnel is surprising, if not disappointing. The commission would seem, in fact, to be better suited for the study of almost any problem other than that of electrification. If some question of public health, or of public policy, for instance, or the city beautiful, or any one of half a dozen other things, were to be investigated we would have no criticism to offer.

But electrification of Chicago terminals is purely a technical problem—the biggest technical problem that any city has ever had to deal with. It is only to be solved, if it can be solved at all at the present time, by trained engineers. It is, in short, a problem for the best electrical and civil engineering talent that can be secured. Of what use, then, is a commission which, while admirable in every other way, is largely deficient in the one essential qualification—an expert knowledge of the engineering problems involved in electrification.

In a published statement the purpose of the investigation is outlined in the following words:

> The problem of [illegible] the complex freight and passenger [illegible] of Chicago railroads is of such great importance, and the question has been found to present so many difficulties [illegible] impartial, trustworthy and authoritative.

It is stated further that the inquiry is to be broad, and will comprise a thorough study of every feature of the vast network of the freight and passenger terminals of Chicago; that it is to extend to all phases of the question, engineering, financial and operating.

This is an excellent purpose. With this purpose in mind, it is interesting to consider somewhat in detail the personnel of the commission to whom its accomplishment is entrusted.

The municipal government is represented by four members. It is announced that these members are chosen, not by virtue of their present offices, but because of "qualifications and experience that equip them to deal with the problem of electrification in the capacity of public representatives." The four members who are thus to deal with this problem of electrification are the chief smoke inspector, the chairman of the smoke commission, the commissioner of public health, and the chairman of the local transportation committee of the city council. The latter committee alone should probably be represented on the commission because of its special interest in every transportation problem within the city.

The railroad interests are represented by four railroad presidents. This, perhaps, is the most logical feature of the commission. It might be suggested, however, that considering the special function of the commission, the chief engineers of the railroads represented would better serve the purpose.

The representation of the general public, or what is termed the "association at large," is composed of nine members. Of these one is an engineer. Among the remaining eight members are a representative of a leading architectural firm, an attorney, and representatives of six manufacturing, mercantile and financial companies.

This, then, is the composition of a commission appointed to study the tremendous technical problem of electrification. Considering the commission as it is we may be pardoned for suggesting, perhaps, that a serious omission has been made. Hull House and the Law and Order League are entitled to representation.

It is well to consider separately the two possible purposes of such an investigation. If the desirability of electrification is to be considered, then the commission is an excellent one. But admitting, as all interests do admit, that electrification is desirable if practicable, the problem is now, and will be for a long time, purely an engineering problem. What is needed for its solution is a commission, not of representative business and professional men, but a commission of engineers. The announcement is made that in order to insure the highest degree of technical skill in studying the situation a chief engineer and staff of assistants will be engaged to work out the engineering problems that the investigation will involve.

It may be asked what problems there are other than engineering problems involved in this investigation; and what work the commission itself will have to do. The investigation must, in fact, be conducted by electrical and civil engineers. To electrical engineers and inventors will fall the work of devising a means of electrification that will be both practicable and safe. Extensive rearrangements and relocations of terminals will be necessary. Railroad civil engineers must plan all that. The cost is to be determined and [illegible] is the work of engineers. Until all this is completed it is difficult to see what purpose will be served by the representation of various "interests" in the investigation.

While the appointment of a commission is a step in the right direction, and is better in any event than mandatory action by the city council, it is somewhat disappointing that the special function of such a body was not given more consideration in the selection of its membership.

EARTH AND ROCK SECTION

Methods of Sinking a Shaft [illegible] Ft. Through Very Wet Gas Bearing Material.*

[illegible] water bearing strata and the preliminary drill [illegible] places with sufficient head to rise 20 ft. above the surface of the ground where the shaft was sunk.

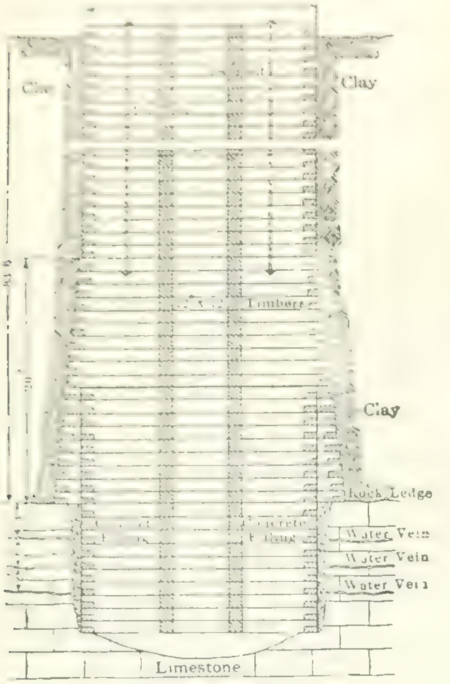

Fig. 1—Section of Drop Shaft from Surface to Bed Rock.

The first 83 ft. of over burden contained enough water to cause some trouble, most of which, however, was in the lower 20 ft. Below this depth there were four water bearing strata, the first of which was from 83 to 90 ft. below the surface. The second, at from 155 to 168 ft. was a porous dolomite conglomerate furnishing a large flow of water. At a depth of 191 ft. there was a horizontal opening, 1 ft. thick, in the delomite strata, extending entirely across the bottom of the shaft. This contained water, which on the pressure gage showed 90 lbs. per sq. in. At a depth of 420 ft. there was a porous layer of sandstone through which it was impossible to sink in the ordinary way.

[illegible].—One or two attempts had been made to sink an ordinary hanging shaft from the surface to bed rock. No trouble was encountered in this work until within 10 ft. of the bottom. Here the water, sand and soft clay, flowed in almost like quicksand, and it was impossible to maintain the timbers in place. It was found necessary to sink a drop shaft.

The shaft finally decided upon was 6x16 ft. in the clear, with three compartments. The bottom timbers of the drop shaft formed a cutting edge which was protected by sheet steel. This cutting edge was about 2 ft. larger than required for the shaft and was tapered for a distance of 20 ft. from which point the timbers were placed vertically to the surface. This framework was sunk to bed rock by digging from under the cutting edge and building on the top and settling with weights.

Water Bearing Strata.—The upper part of the limestone ledge contains three small veins of water, as shown by Fig. 1, and in order to seal these it was necessary to build cribbing similar to the drop shaft and fill in behind it with concrete. To run the 90-ft. to the 145-ft. level no trouble was experienced in sinking.

At a depth of 155 ft. a stratum of conglomerate 13 ft. thick was encountered. This is shown by Fig. 2. The dolomite both above and below this conglomerate was somewhat porous, allowing more or less water to enter. The method of passing through this conglomerate is illustrated by Fig. 4. In all this sinking it was necessary to keep a drill hole well in advance to determine accurately the kind of strata ahead, although the original drilling gave a good idea of the formation.

When within 5 ft. of the conglomerate, 3-in. drill holes were put down all along the edge of the shaft and in the bottom as shown by Fig. 4. Before the drill struck the water bearing formation a 2-in. pipe, as shown, was wrapped with cotton-flannel packing, giving it a slight taper. This packing is more or less spongy and serves the purpose better than a harder packing. The flannel was thoroughly coated with tallow to make it waterproof. On the top of this pipe was placed a gate valve by which the flow of water could be controlled after the pipe was inserted. A smaller drill bit was then used and drilling carried on through the 2-in. pipe until the conglomerate was penetrated. About 100 drill holes were put down and thus controlled.

Cementing the [illegible].—After the drilling was completed two or three valves were opened at a time, and the pressure of the water was such that a large amount of the sand and small pebbles were ejected through the pipe, leaving a large percentage of void. After all the valves had been opened and the sand run out, the void was filled with neat cement. Figure 4 shows the porous conglomerate and the cemented conglomerate. The cement was placed by a Cameron pump at the surface with sufficient pressure to overcome the hydrostatic head, which at this point was about 75 lbs. per sq. in. The 2-in. cement-carrying pipe was connected to the pipe in the rock at the gate valve. When no more cement would pass through the gate valve, the valve was closed, and the cement pipe connected at another valve.

After the cement had thoroughly set and the flow of water through the gate valves had ceased, the work of sinking was simply a matter of drilling and blasting out the concrete as though it were the original rock in the shaft. This cementing, however, did not entirely stop the water, and it was necessary to line this portion of the shaft with concrete.

Concrete Forms.—The dolomite both above and below the conglomerate being more or less porous, the concrete lining extended from 145 to the 200-ft. level. In this section of the shaft steel timbers were used, around which the concrete forms were built. The concrete was reinforced with 1-in. Gabriel bars 8 ft. long. Figure 2 shows the steel work in section. The walls are 18 ins. thick. On account of the water coming from the porous dolomite it was necessary to make some provision for this, as the cement could not be kept in place until it set. This was taken care of by placing strips of boards vertically next to the wall rock. These boards were covered with oilcloth or canvas and each vertical stick thus covered left a small channel for water to flow down behind the concrete. This was drawn off through tap holes as shown at *A* in Fig. 2. After the concrete had set, neat cement was forced in through the tap valves which finally sealed this portion of the shaft.

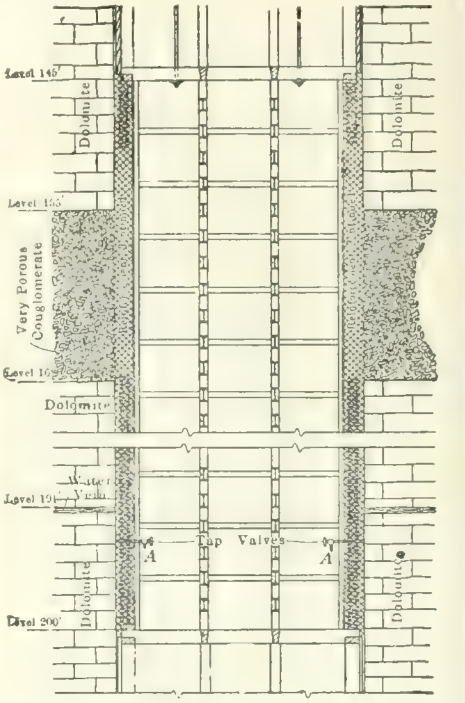

Fig. 2—Shaft Section in Water Bearing Strata.

At a depth of 190 ft. there was a cavity in the dolomite which gave a stratum of water 1 ft. thick extending entirely across the shaft. Here again drill holes were sent ahead of the work and plugged with pipe and valve as above. Neat cement was pumped in until the entire area was free from water. This required several carloads of cement, one hole alone consuming more than one carload. The water evidently carried the cement a long distance from the shaft. After the cement had set thoroughly, the shaft was blasted through in the usual manner. From the 200-ft. level to the 420-ft. level no water was encountered.

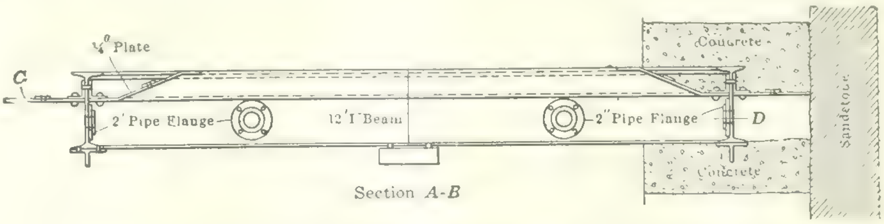

Fig. 3—Foundation Frame Supporting Concrete Lining.

At the 420-ft. level 10 ft. of porous sandstone presented another obstacle, which was created as shown by Fig. 5. Holes were drilled about 1 ft. apart into the sandstone from the edge of the shaft as shown. These were then taken in groups of four or five and cemented separately. The group of holes No. 1 would be charged with dynamite and exploded. This would shatter the sandstone and the water pressure would bring out a large amount of sand produced, leaving a large cavity in the sandstone, without breaking through the dolomite. All of these holes were plugged with pipe and valve as in the work above. After the sand had run out, neat cement was pumped into these four holes until the cavity was completely filled. The valves were then closed and the cement allowed to set. While this cement was setting group No. 2 would be treated in the same way and then No. 3. By this time Nos. 1 and 2 would be sufficiently set so that No. 4 could be blasted and cemented. This process was continued entirely around the shaft until it formed a cofferdam which shut out most of the water.

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*[illegible]

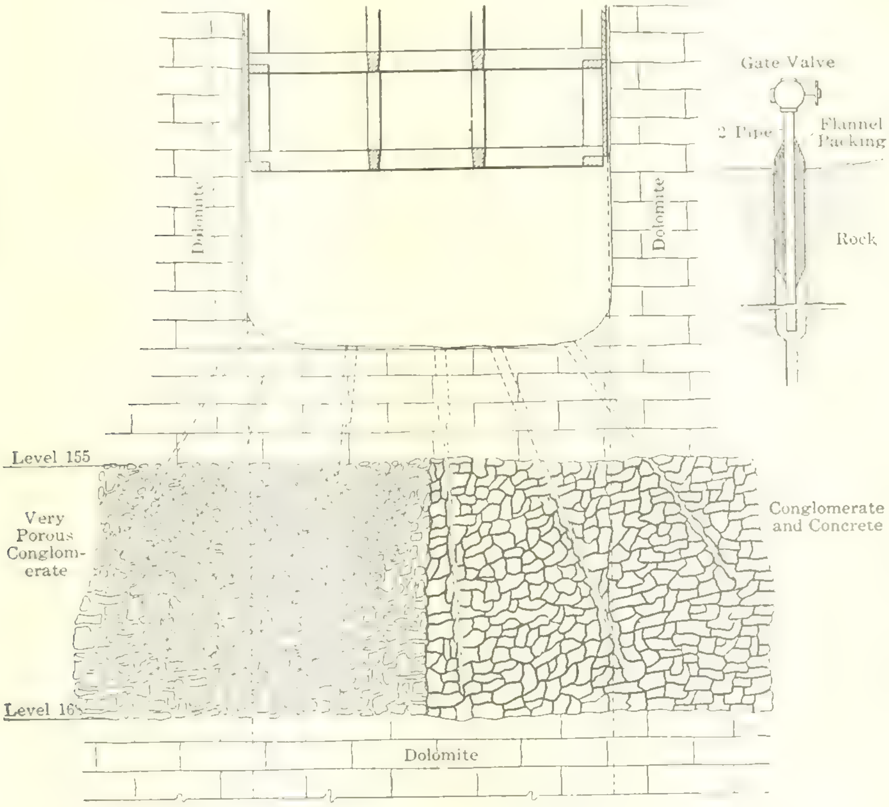


Fig. 4—Showing Method of Preparing Porous Ground in Advance of Sinking.

Second Lining.—All of the sandstone from the 415-ft. level to the 480-ft. level contains some water, and in order to keep this out a concrete lining was used. This lining varied from 24 to 30 ins. in thickness. It was put in in a similar manner to the first except that steel timbers were not used on account of the acidity of the water. At the 480-ft. level there is an almost impervious sandstone stratum containing but little water. The concrete lining extends 5 ft. above and 5 ft. below the water-bearing stratum in order to seal the shaft properly.

Figure 3 shows the foundation frame upon which the concrete was placed. It is constructed of 12-in. I-beams to the web of which ¼-in. steel plates *C* are riveted about 4 in. from the top of the I-beam. The concrete was then built on top of this, and thoroughly inclosed the upper portion of the I-beams as shown by Fig. 3. This framework also forms a joint for connecting the concrete when built up from below. The forms were built up to this frame from the 480-ft. level and concrete filled in, leaving only the space *D*. This space was filled by forcing cement through the 2-in. holes in the web of the I-beam.

Shaft Dry Below 533 Feet.—A small amount of water enters the shaft between the 480 and 533 ft. [illegible] en-countered below 533 ft., and at the 634-ft. level a station was cut and a pumping plant installed. The actual amount of water handled does not exceed 300 gals. per minute. No water of any consequence passes below this point. The shaft is now down 1,060 ft. and the 20-ft. salt bed which is being worked is dry—almost dusty.

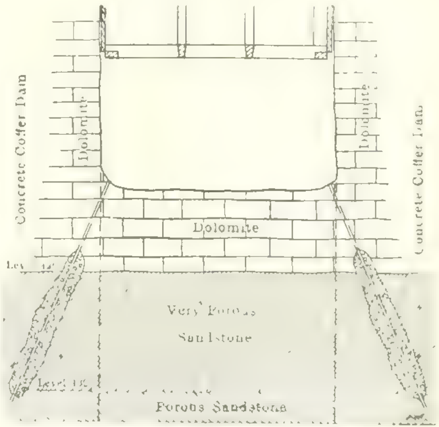
All of the water entering the shaft was heavily charged with hydrogen sulphide, which added greatly to the difficulty of working. The dolomite and sandstone contain pyrites and gypsum in various amounts and in one case a large piece of native sulphur was found. The men worked alternate 2-hour shifts. The gas seemed to affect their eyes, and a number of cases occurred where the men were blind for two or three days at a time from its effect. It produced a smarting intense pain for the time being, yet did not seem to affect the eyes permanently. The gas also produces unconsciousness if inhaled in too large quantities. When a man was taken out in this condition, usually 5 or 10 minutes in the fresh air revived him.

Ventilation.—A waterproof canvas pipe was used for the ventilating flue. It was made in 50 ft. lengths, 4½ ft. in diameter. Each length was independent of the others and was suspended from the timbers by ropes. The lengths were not sewed together but the lower end of one was simply slipped 4 or 5 ft. into the upper end of the other. While this flue occupied practically an entire compartment, it was found better than to have one boarded compartment as a downcast. The flue was flexible and the men could work around it easily, pushing it to one side when necessary. Again, if an excess of air was wanted at one portion of the shaft the joints could easily be separated. A 120-in. American blower fan, furnished 18,000 cu. ft. of air per minute.

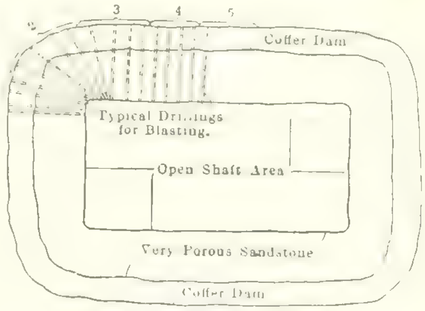
On account of the water being so heavily charged with hydrogen sulphide it was necessary to keep the shaft as cool as possible. Heat will liberate a large amount of this dissolved gas. This is being overcome by sinking 10-in. drill holes 30 or 40 ft. from the shaft and thoroughly casing them. One will be used as a steam line to the pump, one as a water column, and still another for electric wiring. This will leave the third compartment of the shaft free for a ladder.

Power Plant.—The power plant consists of four vertical boilers, 300 h. p. each; one boiler is provided with an automatic stoker, and the other three are to be thus equipped in the near future. The hoist is a 20x40 Thompson-Greer machine, with drum 7 ft. in diameter and capable of operating to a depth of 1,500 ft. at a speed of 1,800 ft. per min. Two 2½ ton skips will be operated in balance [illegible] planned to put in an additional drum, tandem connected, and operated by the same engine for deeper work. At present only one skip is being used, pending the completion of the second compartment of the shaft from which steam, air and water pipes are being removed. The three compartments of the shaft are yet to be lined with boards so as to prevent water from dripping down the shaft. The board lining will conduct the water down the walls of the shaft to the pump station, and in this way it is hoped that the hoisting compartments will be comparatively dry. At present the hoist and boilers are housed in temporary buildings, which will be replaced in the near future by a substantial steel and concrete building.

The main pump station is on the 630-ft. level, and is equipped with two six-stage centrifugal pumps, 700 gals. capacity, electrically operated. Only one of these pumps is used at a time, and then it is not required to run continuously. There are also two steam pumps of like capacity which were used during the sinking below this level. These will be held in reserve for emergency use. A 4-in. steam line through one of the drill holes connects these pumps with the boiler plant.



Cross Section at Concrete Coffer Dam.



Plan at Concrete Coffer Dam.

Fig. 5—Cofferdam Method of Protecting Porous Ground in Advance of Sinking.

According to a progress report on the Ottawa River Storage Work submitted to the Minister of Public Works at Ottawa, Ont., by C. R. Coutlee, the engineer in charge, the storage so far in sight, and for which controlling dams are either under construction or sites fully surveyed and contract plans under way, will have a most beneficial effect on the water of the river, both as to its flow at certain seasons and its potability. In Lake Temiskaming, Lake Kipawa, Lake Quinze and Lake Expanse, which have so far been dealt with, there is a maximum storage of 56 billions of cubic feet each, or a total of 168,000,000,000 cu. ft. of water, which will be pent up in the reservoirs and gradually let out during the low period.

The Canadian Northern Ry. is building a [illegible] clay Sound, on Vancouver's Island, B. C., north and west, via Esquimault, Pedder Bay and Mathiesen Lake to Sooke Harbor, thence up Sooke river.

Cutting Off Steel Sheet Piling With an Oxy-Acetylene Flame, La Salle St. Tunnel, Chicago.

[illegible] served by the writer where 12-in. U. S. short [illegible] piled from various sources are given. As instances frequently occur in construction work [illegible] interest. A brief account of the apparatus used and the general method of operating it will be given first.

The apparatus made by the National Pneumatic Co. for cutting steel consists of a torch which has a tip containing two pairs of small holes for the oxy-acetylene heating flame and [illegible] which supplies the oxygen [illegible] after it is heated. The presence of oxygen in contact with the heated steel oxidizes or burns it up rapidly. The oxygen used with the acetylene flame is merely to increase the temperature of the flame. This [illegible] temperature of about 6300° F. The two gases are supplied in the ratio of about [illegible] parts oxygen to 1 part of acetylene.

In operation, the torch is moved along the cutting line and the metal is heated white-hot, then the main oxygen valve is opened and a small stream of oxygen at 50 lbs. pressure is blown upon the hot surface. The oxygen unites rapidly with this steel at this temperature forming oxide of iron which runs molten from the cut. It requires 0.38 oz. of oxygen per ounce of iron to form the oxidized iron. The tanks of oxygen are supplied with 100 cu. ft. of oxygen at atmospheric pressure, but when compressed into the tank the pressure is run up to 300 lbs. Each tank, therefore, contains about 143 ozs. of oxygen or enough to oxidize 376.3 cu. ins. of metal, provided no oxygen is wasted. This amount wasted depends to a large extent upon the care taken by the operator and also upon the accessibility of the cut.

Cast iron cannot be cut by this method, apparently because of the high percentage of carbon contained. The rate at which steel can be cut has been found, under shop conditions, to be about as follows:

½-in. steel at the rate of 15 ins. per minute.
¾ to 1¼-in. steel at the rate of 1 ft. per minute.
2-in. steel at the rate of 6 ins. per minute.
6-in. steel at the rate of 1 ft. in 3½ minutes.

In cutting the steel it is always desirable to have a cut running clear through the material as it is difficult to cut a channel out of which the molten metal cannot run freely. This condition existed at the LaSalle St. tunnel, Chicago. It was decided to leave the 12-in. 35-lb. U. S. Steel piling in place to protect the adjoining property. The piles had to be cut off below the strict level, and it was impossible to get at the piles from both sides. The difficulty lay in having a bank of dirt against the opposite side thus preventing the flame and force of the oxygen from blowing the metal through to the other side. It was always running back and covering the surface which should have been exposed freely to the flame. On this work about 35 piles were cut per 9-hour day, using two outfits and five to six tanks of oxygen. The amount of oxygen used was five or six times that necessary to oxidize the steel cut out.

In this work the two cutting outfits were each handled by one man. Two laborers were used to pull out the short sections of pile after they were cut loose.

An example of great saving by the use of this apparatus was that of the wrecking of Pier 14 on the North River, New York, after its destruction by fire on July 9, 1910. The pier extended about 700 ft. into the stream and carried a steel structure 50 ft. wide by 700 ft. long, containing some 2,000 tons of steel. A Philadelphia firm contracted to wreck it in 30 days, or forfeit $300 a day for each day in excess of that time. It had been estimated that 35 men would be required for the work in the usual way, but it was found that by using the oxy-acetylene apparatus the force could be reduced to 18 men, and the work was completed in 23 working days.

In [illegible] for the foundations of the Boston Store, Chicago, the cutting flame was employed to clear the way of the old steel grillage foundations encountered. Here the method saved a good many hundreds of dollars as it would have been practically impossible to get in with hacksaws.

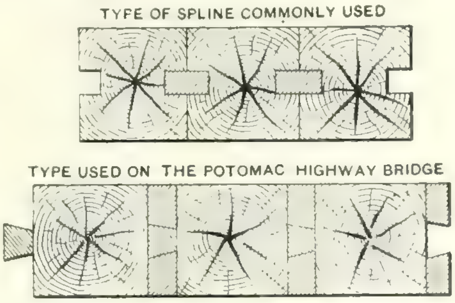
The method was also employed by the Geo. W. Jackson Co. in cutting away members from the elevated railway structure, where changes were being made. The oxy-acetylene flame not only cuts about one-third faster than is possible to cut by hand, but in this case the hand process would have been the slow process of cutting a large number of rivets.

Figuring the labor at 30 cts. per hour, the oxygen used at 2½ cts. per cu. ft. and the acetylene at 1 ct. per cu. ft. it is estimated that the cost for ordinary work is 9 cts. per sq. in.

The outfits for cutting are supplied with different sized tips to suit the class of work, and a trial will soon show the best tip to use. The outfits cost from $650 for the small size to $800 for the largest size.

Method of Constructing Wooden Sheet Pile Cofferdams for the Pier Foundations of the Potomac River Highway Bridges at Washington, D. C.*

The Potomac River at the site selected is 2,800 ft. wide, at ordinary level, with a current of three miles per hour, a tidal rise of 3 ft. and a maximum flood rise of 13 ft. The bridge has eleven 216-ft. fixed spans, and one swing draw span of 290 ft., having two openings of 100 ft. each.


TYPE OF SPLINE COMMONLY USED
TYPE USED ON THE POTOMAC HIGHWAY BRIDGE

Details of Wooden Sheet-Pile Cofferdams.

The small piers for the fixed spans are 8 ft. wide and 50 ft. long under the coping, battered on both sides and extended at each end by cut waters and ice-breakers. All the piers were built of rock-faced granite ashlar, backed with concrete, above elevation 2 ft. below low water, resting on a solid concrete foundation, supported on piles, the tops of the piles extending into the concrete for the distance of 5 ft. The small piers being built within a cigar-shaped cofferdam 17 ft. wide in the clear, and 83 ft. long. The Pivot pier is of similar construction, but is circular in plan, 47 ft. in diameter, built inside of an octagonal cofferdam 51 ft. between sides without any cross bracing to interfere with the construction operations, the cofferdam being braced by an extra set of octagonal bracing, the points of which met the center of the octagonal rangers.

The method adopted for the construction operations in one pier was typical of all—first, the site of the pier was dredged 2 ft. below the depth called for on the plans to allow for the squeezing up of the material caused by the pile driving, this allowance was found to be about right with the class of material found in the river bottom.

Three pairs of temporary pile bents were then driven in the pier site, one pair near each end and one in the center, at right angles to the long axis of the pier; these were capped with 12x12-in. timbers extending well beyond the exterior line of the cofferdam, the tops of the caps being set at elevation plus 4. On these caps a frame of 12x12-in. timbers, its exterior dimensions of the exact size of the inside of the coffer, was assembled, and on the outside another frame was built, whose interior dimensions was of the exact size of the outside of the proposed cofferdam, the two frames being kept apart the proper distance (the thickness of the sheet-piles), by means of fillers; these two constituted the upper frame, which was carefully set for position in each direction and secured in place. An exactly similar frame was then built and hung by chains beneath the upper frame, being weighted with rails, etc., to retain its position, and also braced to the piles, this being done by the aid of a diver, to prevent any deviation from alinement. A floating pile driver, with an auxiliary set of leads placed at right angles to the ordinary leads, then drove the sheet-piles at all the corners, to hold the two frames more securely in place, and then drove each side of the coffer, working from each corner to the center of each side, making a closure pile to fit the final opening, the measurements of which were taken by the diver.

The sheet piles were joined to each other by dove-tailed splines, as shown by Fig. 1, the male spline being nailed to the center of one pile, and the two parts of the female spline to its neighbor, the work of attaching the splines was done in the yard of the contractors' plant on shore, and the finished piles towed to the pier site when needed. The lower end of the pile was also chamfered to assist in keeping the piles together in driving. The net result of all these preparations was a very tight cofferdam, even in the case of the pivot pier, where the bottom of the excavation was 30 ft. below low water, there was practically no leakage, as all the water was easily taken care of by a moderate-sized pulsometer.

The driving of the cofferdam being completed, two land pile drivers were mounted on the top of the coffer, Plate 10, and the foundation piles driven. This method of driving was more rapid and produced better results than to attempt to drive the piles first, and then drive the coffer, as under the last condition some of the piles are sure to be out of line and give trouble when the coffer is driven.

On the completion of the driving of the foundation piles, the sand scows were brought alongside and the bottom of the coffer leveled up, to the grade of the bottom of the concrete. On this was then placed a 3-ft. layer of concrete, deposited under water by means of a long cylindrical bucket 18 in. in diameter, which could be worked between the piles and was tripped by a hand line when ready to open. This concrete was allowed to set, and the dam pumped out by a centrifugal pump, installed at the down-stream end of the coffer. The pumping being stopped as the level of each brace was reached, permitted the brace being placed in position. By this procedure, no undue strain was placed on the cofferdam. The piles were then cut off by hand and the work of placing the base concrete started.

Anchor rods were inserted in the concrete to hold a waling strip at elevation minus four, that kept the upper ends of the sheet piles in position after they were sawed off by the saw boat, a circular saw being mounted on a vertical shaft that could be adjusted to allow for the variation of the water due to tidal changes.

Method of Jetting Circular Steel Caissons to Rock.*

In the construction of the foundations for the Johnson Building on the corner of Broad St. and Exchange Place, New York City, circular steel caissons were jetted to rock, the enclosed earth was excavated in the open and the cylinder filled with concrete and brick to the grade of the grillage. This was the first foundation of several installed by this method in New York City, but the method has not been extensively used on account of the possible injury to adjacent property. As the method exists, it is ideal for the excavation of bridge foundations below water, but when used near adjacent buildings not founded on solid rock a disturbance in their foundations is possible.

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*From a paper by Howard J. Cole before the American Society of Engineering Contractors, Nov. 7, 1910.

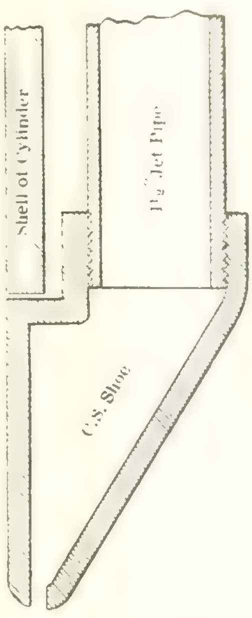
*Abstract of discussion before the American Society of Engineering Contractors.

Forty-four of these cylinders were jetted to rock or the overlying hardpan, 28 ft. below the cellar bottom of the Johnson Building by the Hydraulic Foundation Co.

The cylinders from 5 ft. 6 in. to 13 ft. in diameter. They were built up of medium sized sheets, ¼ to ⅜ in. thick and about 6 ft. high, lap jointed and delivered on the job in handable-sized sections. Before being placed in position, they were fitted with vertical jet pipes 1½ in. in diameter, attached to the shell with U bolts at each horizontal joint of the shell. The lower end of the pipe terminated in a jetting shoe of cast steel, which in plan was the arc of a circle, and of the section shown by the accompanying sketch. Each jet shoe served only one pipe, the number of which varied with the size of the cylinder from 8 to 16. The casting had lugs, on each side of the 1½ in. pipe, by means of which it was bolted to the shell of the cylinder, and the pipe was also bolted to the shell at every horizontal rivet seam. The jet holes in the cutting edge were about 1 in. apart and were ¼ in. in diameter. The upper end of the jet pipe was passed over the top of the shell by a U bend of pipe of the same size as the jet pipe, the other end of the bend being connected by a rubber hose, with a 6 in. diameter manifold where it was controlled by a quick acting lever valve. The manifold was directly connected with a Worthington pump, capable of delivering water at a pressure of 50 to 150 lbs.

When the cylinder was fully equipped with jet shoes and pipes, it was carefully set in position and loaded on the top with several tons of kentledge and pig iron to give weight and assist in the sinking. The pump was then put into commission and the pressure turned into the pipes, the cylinder being kept vertical by the manipulation of the valves, by means of which the pressure could be shut off from any of the shoes if that side of the cylinder was sinking too fast, or vice versa. Attendants are stationed on each side with spirit levels, and manipulate the valves according to the directions of the superintendent. The actual time consumed in sinking was small, one cylinder 9 ft. in diameter went down 5 ft. in 10 minutes. Others went down at the rate of 1 ft. per minute. Probably the entire time consumed on the average cylinder, between the starting of the machinists to attach the jetting apparatus to the time that the cylinder reached rock, would approximate 24 hours. The shell was assembled in lengths of 15 ft.

The water ascending from the jets kept close to the shell of the cylinder and rarely disturbed the material [illegible] 18 inches away, thus leaving a core of undisturbed material in the center. The water used in the work was led to a settling well and used over again, thus reducing the cost somewhat, as the water was metered.



Cast-Steel Jetting Shoe.

The cylinders were pumped out by steam syphons and were braced each 5 ft., as the excavators reached the level [illegible] material being hoisted to the surface in small tubs by means of a portable tripod that straddled the excavation. A line was led to the hoisting engine by one or more snatch blocks and operated on the niggerhead. One engine could thus take care of two or more cylinders, and at the same time do other work.

In case the shell struck a boulder a pilot tube was put down, and, if the boulder extended more inside than outside of the caisson, the ground would be washed away on the inside to let the boulder drop inside; if it projected more outside than inside the ground on the outside would be washed away to allow the boulder to fall outside.

When the shell reached hard pan there was always some difficulty in sealing it. Usually the hard pan sloped off to one side, so that the vertical shell was above the hard pan on the low side, while it rested upon hard pan on the opposite side. In this case some wood sheathing was driven in on the low side to prevent the soft material from flowing in.

At one time on the work, the pumping out of a cylinder was started and no bracing was put in and the pressure resulted in changing the shape of the cylinder to an eclipse.

The largest cylinder which has been put down in New York City was about 15 ft. in diameter and was sunk to about 50 ft. below the curb. Some rectangular caissons, 4 ft. wide and 18 or 20 ft. long, did not work as satisfactorily as the circular ones and resulted in a loss to the contractor, whereas under the same conditions the circular wells had made him a profit.

In regard to the danger to adjacent buildings on account of a disturbance of the soil upon which they rest, these buildings can be supported temporarily on some other form of foundation and afterward the load can be let down on the new foundation.

Aside from the rapid sinking of this type of caisson, the principal advantage is in the cost of the plant required to handle the work, as compared to the plant required for pneumatic work. Here the plant consisted of 2 derricks, 2 hoisting engines, pumps and boiler plant to operate them, and planking to make a scaffolding over the lot, representing an investment much smaller than would be required to do the work by the pneumatic process.

ROADS AND STREETS SECTION

Method and Cost of Constructing Tar Grouted Macadam.

The Urban District of Turton in Lancaster County, England, has had an extended and successful experience with the use of tar grouted granite macadam on two of its main roads. The experience of this district with this type of road surfacing is described in a recent issue of The Surveyor and from that paper we have taken the matter in this article. The first stretch of tar grouted macadam in the district was laid in 1901 in the Belmont Road, mainly as an experiment. This experimental stretch covered a length of 144 lin. yds. and proved so satisfactory that the work was continued from year to year until the total area placed on the two roads amounted to 57,981 sq. yds. The two main roads thus improved are the Belmont Road and the Blackburn Road. The traffic on these roads is exceptionally heavy, consisting of coal and stone carting, cloth carting on lorries (drawn sometimes by four or five horses), traction engines and 5-ton motor wagons. The following table gives a list of heavy traffic observed year by year on the Blackburn Road, during working hours by the road foreman, to which figures at least 30 per cent must be added for traffic passing during the evening and at night:

Year	Heavy [illegible] Wagons	Traction engines
1903	[illegible]	31
1904	[illegible]	96
1905	[illegible]	72
1906	[illegible]	78
1907	[illegible]	[illegible]
1908	[illegible]	[illegible]
1909	[illegible]	[illegible]
1910	[illegible]	[illegible]

Nearly all the traction engines using this road are employed in handling boilers. During 1910 the average weight of each boiler hauled over the Lancastershire County roads was 26 tons, and the total weight of engine, boiler and truck averaged 52 tons.

The subsoil of both of these roads is mostly of a soft peaty character, and previous to 1901 the roads had for some time been repaired with Penmaenmawr granite, bound with water, a class of repair which had superseded limestone or grit-stone macadam. It was found, however, that the granite macadam was quite incapable of carrying the increased weight; deep ruts were formed, and the granite was often pushed through the subsurface of the road till the underlying peat came up to the surface.

In the construction of the tar macadam several experiments were tried in the way of varying sizes of stone, etc., but the most important innovation was the mixing of sand with pitch and creosote oil. As the outcome of these experiments the following method was selected as giving the most successful results:

The granite used is 2⅜ in. gage Welsh granite from the Penmaenmawr quarries. It is laid to give a 4-in. coat when consolidated. The granite is laid down on the road-bed, 5 ins. thick, and rolled down with an Aveling & Porter compound 15-ton steam roller, to 4 ins. thick, in lengths of about 20 yds. by 4 yds. wide—that is, half the width of the carriageway. When the granite has been rolled until it ceases to creep under the roller, it is ready for grouting with the pitch and creosote oil and sand mixture, which is made as follows: Pitch and creosote oil, in the proportion of 1 ton of pitch to about 40 gals. of creosote oil, are melted together in a 320-gal. tar boiler, and when the mixture boils it is tested for the temper or elasticity. The proportion of pitch and creosote oil often varies and requires modifying, as they vary in quality, and so it is necessary to test the mixture when boiling by samples being taken out of the boiler and cooled to a temperature of about 60° F., and tested for elongation of about 36 in. and bending double without fracture. If the mixture is too brittle (and a very little carelessness in tempering the pitch will make the road a complete failure), more creosote oil is added, about 2 gals. at a time, and stirred in till the required temper is obtained. If the mixture is too soft, more pitch is added, but it is better to have the mixture too soft than too hard. One hundredweight of this mixture is now run out of the tar boiler into an 18-gal. bucket, which is 18 ins. in diameter and 20 ins. deep, and 1 cwt. of the mixture fills this bucket 11 ins. deep from the bottom. To this quantity of the mixture is added 1½ cwt. sand, which must be clean and free from dust, river or sea sand being the most suitable. It is dried and heated to about 120° F. in a sand-drying machine. One and a half hundredweights are then measured in a sand box, measuring 24 ins. by 12 ins. at the top and 12 in. by 12 ins. at the bottom, and 13 in. deep, and the sand and box are wheeled away in a barrow to the [illegible] or paddle. Care must be taken not to have the sand too hot or it will give off a greenish [illegible] hot enough, it will not amalgamate with the pitch. When, however, the mixture has been properly made, it will permeate the whole 4 ins. of granite and render the road surface absolutely watertight.

[illegible] poured with scoops or ladles into the granite [illegible] to the surface. A top dressing of ¾-in. dry granite chippings is next applied about ½ in. thick, and the whole is then consolidated [illegible] is obtained.

[illegible] the road for about 24 hours after laying, but not absolutely necessary. During the time the road is being laid it is a great advantage to cover the parts under construction with corrugated-iron sheets, and so keep out both rain and dust until the final grouting has taken place.

It should be noted that the weights and measures mentioned in the article are the English standard. The English ton is equivalent to the long ton, 2,240 lbs., of this country; the hundred weight is 112 lbs. The English gallon is equivalent to 1.2 U. S. gals.

The following figures show the cost of laying about 4,600 sq. yds. of tar macadam, including resetting curbs and channels, and raising road level and cinder footpaths 4 ins. The prices are based on the area of the carriageway between the curbs for a coating 4 ins. thick:

	Per sq. yd.
Manual labor	$0.1388
Steam rolling and hauling materials 3 miles up hill from station at $6 per day	.2266
Tar boiler and sand dryer hire at 60 cts. per day	.0226
Pitch at $7.26 per ton	.1308
Creosote oil at 6 cts. per gal.	.0318
Granite macadam at $2.[illegible] per ton	.3730
¾-in. granite chippings at $3.14 per ton	.0366
River sand at $1.94 per ton	.0426
Coal for tar boiling and watching	.0316
Sundries, tools, repairs, etc.	.0022
Total	$1.0366

The cost of materials above include delivery at the station.

The materials worked out as follows:

	Sq. yds.
Pitch, 1 ton used to	54.7
Creosote oil, 1 gal. used to	1.9
Granite macadam, 1 ton used to	7.4
¾-in. granite chippings, 1 ton used to	85.0
Sand, 1 ton used to	36.0

The plant required for a gang of 12 men is as follows:

Three 320-gal. tar boilers at $194.40	$ 583.20
Two 10-ft. sand dryers at $218.70	437.40
Two hand carriages and 18 gal. buckets at $23.04	46.08
Two sand gage boxes at $3.72	7.44
Screens and sundries, etc.	14.58
Total	$1,089.70

The organization of the gang is as follows:

Foreman.
Tar boiler.
Sand dryer.
Roller driver.
Paver for gutters.
7 laborers

The road in some cases [illegible] a foundation of pitching of 10 ins. or 12 ins. in thickness, made of stones packed in on edge, and in others the existing macadam was the only foundation, but the former has proved the more durable. The usual cross fall or camber allowed has been 1½ ins. per yard. The steepest gradient attempted at Turton is 1 in 22; on any incline severer than this there is [illegible]

Both the road metal and the sand must be absolutely dry and clean, or failure is assured. The percentage of sand used may be varied, provided that the grouting penetrates to the foundations of the road, waterproofing being a *sine quâ non.* Ground chalk is sometimes mixed up with the pitch, but the advantage is perhaps problematical, the tar being [illegible] is likely to boil up over the [illegible] the hot weather, with the risk, [illegible] of it becoming too brittle. It must [illegible] be remembered that a fair amount of [illegible] precision on the workmen's part are required for grouting road surfaces successfully.

[illegible] generally, the application of the same process to the roads in Turton has been very satisfactory. The same Welsh (Penmaenmawr) granite which, when untarred, was being worn out in 18 months' time has, when treated with tar, lasted from six to nine, and even ten, years' time, with the aid of a little occasional patching, while the extra prime cost was only some 30 per cent above the cost of an untarred road, largely owing to the great cheapening of the process by the admixture of sand; while, curiously enough, the nature of the pitch seems to be very little altered by the addition of so large a proportion of sand, excepting, perhaps, a slight loss of ductility. Generally speaking, it may be quite safely claimed that the increase of 30 per cent in the prime cost of laying the road which is entailed by the tar-grouting prolongs the life of the road five or six times over.

The surface produced is very smooth, especially where small stone is used as a top coating, the scavenging and sweeping expenses are small, and the roads are fairly free from dust, though no watering is done in the Turton district. The comparative absence of dust and mud proves that the wear and tear is very small; in fact, paradoxical as it may seem, it is difficult to find any actual wear of road material. If a piece of untarred road is excavated, the stones from top to bottom are found to be rounded at the edge as if by attrition, proving that the whole mass of stones forming the coating of the road has been kept in a constant state of movement, while in a tar-grouted road all the stones retain the same sharpness of edge which they had after being first broken. Very few ruts are formed, but chock-holes are not unfrequent, not so much owing to wear and tear, as to the pitch losing its nature or the under bed giving way. These, however, are easily repaired, the weak places being swept thoroughly clean, and then grouted afresh with tar and chippings, a small 8 gal. tar boiler being kept for this purpose. As an instance, it may be mentioned that an area of 625 yds. laid in 1901 was patched for the first time in 1907, only 64 yds. of patching being necessary, at a cost of 54 cts. per sq. yd. of patch, or 6 cts. per sq. yd. of total area of macadam, or 28 cts. per sq. yd. per annum, equal to $145.80 per mile of road 8 yds. wide.

Under frostly conditions tar-grouted macadam has its *pros* and *cons*, being, as a rule, rather more slippery than grit setts when the frost is in the ground, but absolutely free from slip when frost is coming out, when grit pavement is usually very treacherous.

It must be freely admitted, however, that tar-grouted macadam has its limitations and disappointments, has drawbacks peculiar to itself and has partial failures very difficult to explain. The most numerous of these are failures of pitch. The pitch may be unsuitable, or mixed with water, badly tempered, or mixed with dirty sand, or sand at the wrong temperature. It may be made brittle by the fire-box of the steam roller standing too long over it, or the watchman's crate of fire, or a motor wagon breaking down and being stopped for some hours on one spot with its fires still burning. On the other hand, the pitch mixture is equally susceptible to dampness, e. g., if the road bed is wet, or if the rain has caused the macadam to be splashed with mud, or even such a trifling affair as a leaky injector, or a badly packed pump gland in the roller may cause a weak spot in the finished surface to develop even several months after the work has been completed.

A bill has been passed by the California state senate, Sacramento, providing that automobiles shall pay a graduated annual license fee into the state treasury to be used in the maintenance and improvement of the state roads.

The Present Status of the Use of Bituminous Materials in the Construction and Maintenance of Roads in the United States.*

The development of the use of bituminous materials in the construction and maintenance of roads in the United States since 1908 is worthy of careful consideration and critical analysis.

The bituminous materials which have been used in the United States during the past three years may be classified as follows: Fluxed native asphalts, oil-asphalts, residual asphaltic and semiasphaltic oils, light oils; coke-oven tars, coal-gas tars, water-gas tars, and combinations of coal-gas and water-gas tars; combinations of asphaltic materials and tars.

The nomenclature used to designate the various kinds of tars is self explanatory. In order to avoid misunderstanding the terms used in connection with asphaltic materials will be defined, the definition given being abstracts of those proposed by Prevost Hubbard, Chemist, United States Office of Public Roads.

Fluxed native asphalts are native asphalts fluxed with a heavy petroleum residuum. Native asphalts are solid or semisolid native bitumens, consisting of a mixture of hydrocarbons of complex structure, free from any appreciable amount of solid paraffins, melting upon the application of heat and evidently produced by nature from petroleums containing little or no solid paraffins. Unrefined native asphalts with few exceptions contain water, vegetable matter, clay, sand, etc.

Oil asphalts are solid or semisolid products produced by the distillation of semi-asphaltic and asphaltic petroleums.

Residual asphaltic and semi-asphaltic oils are heavy viscous residues produced by the evaporation or distillation of crude asphaltic and semi-asphaltic petroleums until at least all of the burning oils have been removed and often some of the heavier distillates as well.

The term light oils includes crude and partially refined paraffin petroleums, semi-asphaltic petroleum and asphaltic petroleums.

Paraffin petroleum is an oil the base of which is composed principally of the paraffin hydrocarbons.

Semiasphaltic petroleums are oils containing a semiasphaltic base, i. e., oils whose residues produced by evaporation or distillation, while composed mainly of asphaltic hydrocarbons, contain also a certain percentage of paraffin wax.

Asphaltic petroleums are oils containing an asphaltic base, i. e., they are capable of producing residues very similar to native asphalts if evaporated or distilled down to the consistency of such asphalts. They contain little or no solid paraffins. Native asphalts are probably produced from such oils by natural processes.

As typical of the practice in the United States will be cited the work of seven State Highway Departments which have used bituminous materials extensively. The writer wishes at this time publicly to thank the Highway Departments of the States mentioned below for their co-operation in collating the following information. The figures given refer to the total amount of work of the various types indicated which has been accomplished in 1908, 1909 and 1910 by the State Highway Departments of the States of Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania and Rhode Island. The work has been classified on the basis of the method employed and the kind of material used. Three general methods are referred to; namely, superficial treatment of roads constructed of ordinary macadam or gravel, the construction of bituminous pavements by penetration methods, and the construction of bituminous pavements by mixing methods. The bituminous materials employed have been classified in three groups: First, tars and tar-asphalt compounds; second, fluxed native asphalts, oil-asphalts and residual asphaltic and semiasphaltic oils; third, light oils.

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*Paper presented before Section [illegible] of the American Association for the Advancement of Science at the Minneapolis meeting, Dec. 29, 1910, by Professor Arthur H. Blanchard, Consulting Highway Engineer, Brown University, Providence, R. I.

The following tables give the amount in square yards of surfaces treated and bituminous pavements constructed by the State Highway Departments mentioned above during the years 1908, 1909 and 1910:

SUPERFICIAL TREATMENT OF ROADS.

	Tars and tar-asphalt compounds. Sq. yds.	Fluxed native asphalts, oil-asphalts and residual oils. Sq. yds.	Light oils. Sq. yds.
1908..........	57,700	[illegible]	....
1909..........	95,500	[illegible]	4,125,900
1910..........	123,400	[illegible]	[illegible]

BITUMINOUS PAVEMENTS CONSTRUCTED BY PENETRATION METHODS.

1908..........	37,800	25,200	....
1909..........	170,200	2,077,400	....
1910..........	339,300	4,840,200	[illegible]

BITUMINOUS PAVEMENTS CONSTRUCTED BY MIXING METHODS.

1908..........	52,100	4,400	....
1909..........	136,000	219,500	....
1910..........	[illegible]	[illegible]	....

It is interesting to note from the standpoint of the general increase in the use of bituminous materials in the states cited that in 1908 bituminous materials were employed in the construction and maintenance of 416,000 sq. yds. of road surface, in 1909 of 7,734,000 sq. yds. and in 1910 of 18,244,000 sq. yds. Although the construction of bituminous surfaces and bituminous pavements is in its infancy in the United States, remarkable progress is being accomplished in certain sections. For instance, by the close of the construction season of 1911, if the plans of the State Highway Commission are carried out, the State of New York will have a trunk highway with a bituminous surface extending north from New York City to Albany and thence west to Buffalo aggregating over 400 miles in length.

In the surface treatment of macadam and gravel roads, several lines of development have been especially noticed: First, a more general use of refined coal-gas and water-gas tars in place of crude tars; second, an extraordinary increase in the various kinds of heavy asphaltic oils, combined with sand, gravel or stone chips to form a carpet wearing surface; third, an increase in the use of light oils for the purpose of allaying dust on state roads and thus, to a certain extent, preserving the surface of the road by the retention of the top dressing; fourth, a substitution of mechanical distributors of both the pressure spray and gravity flow type in place of hand application methods.

The practice of the past three years has amply demonstrated that the success of superficial tarring is dependent upon the recognition and adoption of those fundamental principles which were laid down by the French engineers in 1903. As those principles have not been adopted in many instances in the United States, they will be given here in brief. First, superficial tarring should be done only during dry and warm weather in order to obtain efficient and economical results; second, the road must have a dry, smooth and durable surface; third, all dust must be thoroughly brushed off in order to facilitate the adherence of the tar; fourth, after the distribution of the coat of tar it is necessary, in order to avoid a slippery surface, to apply a dressing of sand, gravel or stone chips. The practice of some prominent English engineers does not include the adoption of the fourth recommendation cited, as it is maintained that a top dressing is not an essential element of a non-slippery tarred surface.

A well developed plan of annually treating certain roads of a system with a thin coat of bituminous material is being adopted in certain states. This practice embodies the recognition of the fundamental principles of economy and efficiency in modern highway construction; namely, the adaptation of method and material to local conditions.

In connection with the use of bituminous materials by penetration methods certain noteworthy tendencies are apparent. Most important are the employment of distributing apparatus and the formation of broken stone courses in such a manner as to endeavor to secure the maximum uniformity of distribution of material and the definite limitation of penetration.

The average size of stone employed varies from ½ in. or ¾ in. in longest dimension to 1¼ in. to 1¾ in. In exceptional cases, however, engineers have adopted the English and French practice of using larger and more uniform sizes of stone for the top course. The unfortunate delays in the application of the penetration method due to damp stone have been overcome in some instances by the employment of mechanical surface heaters.

A modification of the penetration method is known as the "puddling method." The top course in this case is filled with screenings, puddled by watering, and thoroughly rolled. After the surface drys out it is picked up. The bituminous material is then applied, a coat of chips is spread and the surface rolled. After the surplus chips are brushed off, a flush coat of bituminous material is applied. The application of another coat of chips and a final rolling completes the process.

Another modification of the regular penetration method has been employed during 1910. In this method the foundation is thoroughly filled and rolled. A layer of sand is spread upon the foundation course to a depth of about one inch. Refined tar heated to about 250° F. is then applied to the coat of sand. The top course composed of broken stone varying from ¾ in. to 2¾ ins. in diameter is spread and rolled, the lower voids being filled with the bituminous mastic. After consolidation a second coat of refined tar is applied. As soon as possible after spreading the second coat of tar a layer of stone chips is spread and rolled. A third coat of refined tar is then applied and the surface finished by rolling a covering of screenings or sand.

In the reconstruction of old roads there has been a general employment of the method of picking up the old surface to a depth of 2 ins. to 4 ins. by the use of mechanical scarifiers, placing a thin coat of new road metal on the loosened surface, and then constructing a bituminous pavement by the penetration method.

In both the construction and reconstruction of roads by penetration methods the surface is finished in various ways. One method is to spread a coat of chips or sand after the first coat of bituminous material is applied, roll thoroughly and after the road has set up sufficiently open it to traffic. Another method is to apply a second coat of bituminous material before the application of a layer of chips. The bituminous material for the flush coat may or may not be the same as used for the first coat. A layer of chips or sand is then spread over the flush coat and thoroughly rolled. A third method is essentially the same as the second method cited except that a layer of chips is applied to the first coat of bituminous material, thoroughly rolled and the surplus chips brushed off before the application of the flush coat of bituminous material.

From the standpoint of the character of bituminous material used it is of especial interest to note the increased use, particularly in 1909 and 1910, of fluxed natural asphalts and oil-asphalts especially manufactured for application to unheated crusher run stone.

In the construction of bituminous pavements by the mixing method a number of improvements and developments should be noted. Some attention has been paid to having the stone dry and reasonably clean. Although the advantages accruing by using clean and dry stone are recognized, the practice has been far from satisfactory, only very crude methods having thus far been employed. The practice of heating stone on plates has been used to a certain extent with deleterious results. In a few cases mixing machines and tar coating machines have been employed in connection with the construction of bituminous pavements which are to cost not over $0.90 to $1.00 per square yard. The types of the mixers which have been used to date are more or less unsatisfactory, especially when bituminous materials are used which are solid at ordinary temperatures or which flow with considerable difficulty when cold. During the season of 1911 considerable development should take place in the heating of stone by mechanical dryers and also in the use of new types of mixers especially manufactured for the purpose of mixing bituminous materials with a mineral aggregate.

The mixing of broken stone or other aggregate with bituminous materials at a central plant and shipping the finished product by rail has not been developed to any extent in this country. The product of one company, however, has been used quite extensively in three or four states. In another case refined asphaltic petroleums have been mixed with sand and gravel and molded into blocks at a central plant. The blocks have been laid as the wearing surface and rolled.

Bituminous pavements constructed by mixing methods have been finished in different ways. In certain instances satisfactory results have been attained by applying a coat of chips or sand to the surface of the course of mixed aggregate and thoroughly rolling the same. In other cases a flush coat of bituminous material has been applied before the layer of mineral matter is spread over the surface. The bituminous material used for the flush coat in many bituminous pavements is not the same as was used in the mix.

In the above discussion of the mixing method it should be noted that the remarks do not in general apply to bituminous pavements constructed by mixing a carefully graded aggregate and bituminous materials, and hence do not refer to many types of bituminous pavements which have been used to a considerable extent in the construction of streets in municipalities.

In various parts of the United States sand, gravel and earth have been mixed in place by various processes with bituminous materials in the endeavor to form an impervious, dustless and durable road surface. This work is being watched with considerable interest, as the utilization of local materials for the aggregate in many instances reduces the cost of construction materially. The limitation in the weight of traffic to be carried throughout the year under all climatic conditions is one of the most important points under discussion at the present time in connection with the above methods.

A new type of construction recently introduced by Logan Waller Page, Director of the United States Office of Public Roads, is known as oil-cement concrete. In this process fluid residual petroleum is added to the usual ingredients composing concrete.

From the standpoint of the nature of the material used, again it is noted that there is an increase in the use of refined tar, considerable employment of heavy asphaltic compounds and also the employment of combinations of tar and asphalt, the most noticeable increase, however, being in the use of heavy asphaltic oils which can be mixed readily with broken stone as it comes from the crusher.

There has been a marked tendency on the part of highway engineers during the past three years to appreciate more fully the importance of the various chemical and physical properties of bituminous materials. Many engineers and manufacturers now wisely advocate using different grades of the same type of bituminous material for varying local conditions and for different methods of bituminous construction. During 1909 and 1910 bituminous materials for use in the construction and maintenance of roads have been purchased in two ways; namely, by buying direct from the manufacturer a product known under a trade name and by purchasing the material under specifications. The old cus-

[illegible] of the material which are considered essential; third, to provide a standard by which it is hoped that a satisfactory material may be duplicated on other contracts. The effect of the various physical and chemical properties [illegible] their value as road binders is being investigated by a spe- [illegible] of Civil Engineers. Standard methods of testing bituminous materials is the subject of in- [illegible] can Society for Testing Materials.

In this country, as well as in Europe, considerable confusion results due to the lack of [illegible] manufacturers relative to the nomenclature of bituminous materials. Until a recognized nomenclature is adopted it will be advisable to define methods and materials in order to avoid misinterpretation of information furnished relative to the construction and maintenance of bituminous surfaces and bituminous pavements.

Notes on Road and Street Work.

Sprinkling for Steam Roller and Use of Coke as Fuel.—The use of a water sprink- [illegible] the steam road roller has effected a considerable saving in road work in the Uxbridge Rural District, England. In his annual report the engineer of the District states that before fixing the sprinkling apparatus on the roller it was nec- [illegible] for the water cart the whole time the roller was working, at a cost of never less than $1.68 per day. The engineer also states that the substitution [illegible] for the steam roller has resulted in a saving. He has found that a chaldron of coke (2,500 to 2,900 lbs.) at $3, lasts as long and does as much work as a [illegible]

Oil and Sand for Preventing Slipperiness. A [illegible] treatment of oil and sand is being used by Mr. James C. Traville, Street Commissioner of St. Louis, Mo., to prevent slipperiness on wood block and asphalt pavements. The oil is applied hot by means of a specially designed tank wagon fitted up with fan sprays [illegible] pump for producing [illegible]. It has been found that with a pressure of 10 to 15 lbs. to the inch an 18 to 20° B oil at a temperature of 250° to 350° F. can be spread with no difficulty at the rate of 0.15 gals. per sq. yd. at an air temperature as low as 150° F.

Concrete Paved Roads in Ohio.—Portions of two state highways in Ohio are being surfaced with reinforced concrete, according to the last annual report of James C. Wonders, State Highway Commissioner. A length of 1¼ miles is being constructed in Harrison County, and ¼ mile in Pike County. In both cases this work is located on roads that are subject to overflow, and it was partly on this account that concrete was selected. The concrete will be 14 ft. wide and 6 ins. thick, made in the proportion of 1 part cement, 2½ parts sand, and 5 parts gravel, and it will be reinforced with No. 11 wire, woven in a 6-in. mesh. The reinforcing will be placed midway between the upper and lower surfaces, and the work will be cut in sections 50 ft. in length The joints will be at an angle of 45° with the line of the road. The concrete will be a wet mixture, and it will be rough floated with a plank template, so as to leave a safe footing for horses. A section of this class of construction was built last year in the experimental road work of the State Highway Department. This section is now in perfect condition after a year's use and its surface has been very satisfactory. The specifications for these new contracts provide for more careful construction than that of the experimental road

Some Data on Telford-Macadam Construction. A length of telford macadam was constructed last year on a section of the Falls road from Broadway to Beaver Dam Run in Baltimore County. The work was done by the county's own forces.. The road was constructed of local flint stone, except the binding course, which was blue limestone. The first course was of telford construction the field stones being set on end close together, then sledged over and thoroughly rolled. The thickness of this course was about 10 ins. Upon the first course was placed 3 ins. of broken flint stone from 1 to 2 ins. in size and rolled, then another 3-in. layer was spread and rolled until firm and hard. Over this course was spread limestone screenings, and watered and rolled until firm and well bound together. All the stone was purchased from the farmers living along the road or near by. Of the total cost of $10,976.02 for the work only $1,595.72 was paid outside of the neighborhood of the section of the road. The work of laying telford was done by men from the neighborhood who had not had any experience in this class of construction and at first the work progressed very slowly, but the men soon became familiar with the work and more speed was made. The cost for setting telford base was about 7 cts. per sq. yd., the cost of sledging about 3 cts. per sq. yd. and the cost of rolling about 2 cts. per sq. yd. This does not include the cost of delivering the stone to the setters, but is purely for the setting of the stone, sledging and rolling until they are well bedded and solid. The cost of the top course was about the same as the usual cost of macadam

Macadam with Asphaltic Binder.—In the construction last year of the Regal Road in Spokane County, Wash., the contract involved 2.18 miles of grading and macadam. The contract covered two separate pieces of road, the Regal road proper having a length of 1.47 miles, and the extension 0.71 miles. These two pieces are separated by a strip 1,325 ft. in length, which was improved a number of years ago. The grading was almost all sand. easily handled, but hard to keep in place while finishing the road. The stone used was entirely local material, crushed with an Aurora No. 3 crusher, with a capacity of 100 yds daily. The power was obtained from an old 36-h. p. Case steam road roller, which was belted to the crusher. The stone used on the Regal road proper was a basaltic talus, being found in sizes which could be handled by the crusher. On the extension the stone was a rather coarse-grained micacious granite, found in a quarry near the road. Considerable blasting and quarrying was necessary to fit these stones for the crusher. The stone on the Regal end made much the best road, being finer grained, and not grinding up so badly under traffic. The binder was an asphaltic oil manufactured for this special purpose. On the Regal road proper this oil was applied to the road through a tar sprayer attached to the roller. This did not work out very well, and a considerable portion of the surface was oiled without pressure. On the extension, the oil was heated in a tank car by means of a small 20-hp. steam boiler, 48 hrs. being required to heat 4,000 gals. The oil was spread from a Baldwin Patent oil spreader, spreading to a width of 6 ft. The flow of oil can be controlled by the operator, and ¾ gal. to the sq yd. gave good results. Screenings were applied by hand and the road rolled as soon as possible after oiling. Loose rocks have been placed on the shoulders to keep traffic off the soft spots and to prevent erosion. The road according to the last biennial report of the State Highway Commission, is hard and dustless, and gives every promise of wearing well

WATER-WORKS AND SEWERS SECTION

A Method for Determining the Going Value of Water-Works.*

In any engineering project involving ultimate return to the investor in the shape of revenues, there must be considered not only the expenditures necessary to build the physical plant—with which, of course, the engineer is most directly concerned—but also the investment necessary to put the plant into successful operation and to create the revenues that justify its construction. This portion of the cost of a project has been termed by the Courts, the "Going Value," or the "Going Concern Value."

Too often the promoters or investors in a legitimate enterprise have either overlooked the importance of providing the necessary funds to cover this cost of the Going Concern, which it will be seen is made up largely of the deficits occurring in the early operation and development of the business of completed plants, or they have under-estimated their amount. In the same way, also, the engineer has failed sometimes to call the atten- [illegible] such deficits will inevitably be encountered in the early days of operation. Such costs not being properly chargeable to physical construction, the engineer, called in by his client to design and supervise the building of the plant, but not concerned with its operation or with the upbuilding of its business thereafter, has naturally considered these costs to be outside of his domain or responsibility.

There are circumstances, however, which compel the engineer to give attention to this part of the investment, and which raise the question whether, after all, he is not better fitted to determine these expenses intelligently than is the promoter, the financier, or the owner; for the study of such added values involves primarily knowledge of plant operation, as well as business promotion, a class of information which the consulting and supervising engineer must have, in order to design plants which may be operated economically. The engineer, well versed in such matters, therefore, should be as fair and competent a judge of the going value of a project as of the design and cost of its physical structure.

The necessity of estimating going value has been forced directly on the attention of the engineer engaged in constructing and operating public utilities by the fact that he is often called on to value the plant and property of a "going" concern. The work of estimating the physical part of the property is not difficult, and usually lies well within the domain of his acquired experience, but when it comes to estimating the value of an already acquired income, involving, as it does, a working knowledge of operating costs, hypothetical growth, estimates of semi-developed revenues, and the like, the engineer finds himself confronted with a problem which demands—in addition to such experience—some knowledge of the law, a judicial attitude of mind, and logical thinking of the highest order.

In the last dozen years or so, the frequent demands for the appraisal and valuation of water-works properties in America, for the purpose of purchase or for rate-making, have compelled the attention of engineers to this difficult subject to a degree perhaps greater in water-works than in any other class of public utilities, so that, while going value is common to almost all forms of human enterprise, and will inevitably be more and more clearly recognized in all cases where complete preliminary estimates or scientific revaluation are required, yet, up to the present time, water-works valuations have been re-

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*[illegible]

TABLE I.—GENERAL STATISTICS RELATING TO ASSUMED WATER WORKS PLANT
—THE EXISTING PLANT

Year ending Dec. 31.	1910.	1915	1920.
Population	300,000	330,000	365,000
Miles of pipe, all kinds	480	520	570
Population per mile of pipe	625	635	[illegible]
Taps in service (live)	40,000	45,000	51,000
Per 1,000 population	133	136	140
Per mile of pipe	83	86	88
Persons per tap	7.5	7.3	7.16
Consumption, annual, in millions of gallons	10,950	13,250	[illegible]
Daily, in millions of gallons	30	36.3	43.8
Per capita, in gallons per day	100	110	120
Per mile of pipe, in gallons per day	62,500	69,800	76,900
Per tap, in gallons per day	750	[illegible]	859
Hydrants (number)	3,840	4,420	5,130
Per 1,000 population	12.8	13.4	14
Per mile of pipe	8	8.5	9
Gross income (total)	$1,050,000	$ [illegible]	$1,296,000
Per capita	[illegible]	3.61	3.55
Per mile of pipe	2,190	2,290	2,270
Per tap	26.25	26.40	25.40
Per million gallons consumption	95.90	[illegible]	[illegible]
Gross income, exclusive of hydrant rentals	$ [illegible]	$1,013,200	$1,192,320
Per capita	2.99	3.07	3.26
Per mile of pipe	1,870	1,950	[illegible]
Per tap	22.40	22.50	23.40
Per million gallons	81.90	76.50	74.60
Cost of operation, exclusive of fixed charges and depreciation	$ 360,000	$ [illegible]	$ [illegible]
Per capita	1.20	[illegible]	[illegible]
Per mile of pipe	750	[illegible]	754
Per tap	9.00	8.94	8.44
Per million gallons	32.90	30.30	26.90
Percentage of gross income	[illegible]	[illegible]	[illegible]
Net income, exclusive of fixed charges and depreciation	$ 690,000	$ [illegible]	$ 866,000
Per capita	2.30	[illegible]	2.37
Per mile of pipe	1,440	[illegible]	1,520
Per tap	17.25	17.50	16.97
Per million gallons	63.00	59.40	64.20
Percentage of gross	65.7%	66.2%	66.8%
Hydrant rental (total)	$ 153,600	$ [illegible]	$ 205,200
Per hydrant	40	40	40
Per mile of pipe	380	340	360
Taxes (annual)	84,000	[illegible]	103,680
Percentage of gross income	8%	[illegible]	[illegible]

Note.—The units have been computed by slide-rule.

sponsible for most of the effort which has been made to systematize logical investigation of this subject.

Methods for properly estimating going value have been discussed in water-works valuations for more than a dozen years, and many minds have contributed valuable suggestions which have modified early views and systematized its computation, until now certain general principles, concepts, and courses of procedure for determining going value, have come to be recognized as sound and helpful.

It is not strange, however, that estimators new to the subject, who from time to time find themselves obliged to give it attention, are temporarily involved in some of its complexities, and originate suggestions which have already been well discussed and perhaps shown not to stand the test of reason. This, of course, tends to confuse the discussion. It is desirable, therefore, that what has already been accomplished should be recorded, so that further progress can be made.

Fully recognizing that lack of specific information and discussions have given rise to honest differences of opinion as to the details of going value determination, the writers offer this paper as a further contribution to the subject, with particular reference to a certain phase of it, namely, the consideration to be attached to the interest account. This item, though of comparative insignificance in the valuation of small plants, is of very substantial importance in its bearing on the going value of large plants.

DEFINITION OF [illegible]

Going value may be defined as the value of a created income, or—from the reproduction point of view—the cost of acquiring a given income. Commonly, though erroneously, considered as an intangible value, it is none the less a real element of cost, which must be taken into account.

The "going value" [illegible] of a quasi-municipal corporation is somewhat analogous to the "good-will" of the business corporation. It requires time and investment to build up good-will in business. The operator of the public service corporation knows that, under ordinary circumstances, he cannot hope to meet the operating expenses and fixed charges of his corporation in the first few years of its existence. It must pass through a formative period during which the losses in operation and fixed charges must be carried until its gross income is sufficient, not only to meet the operating and maintenance expenses, but also to leave a margin sufficient to cover depreciation and fixed charges.

Going concern cost, therefore, is as much a part of the reproduction cost of a public service corporation's property as is the reproduction cost of its physical plant. It appertains, however, to the business, rather than to the physical part of the plant.

As a fundamental principle, it must be clearly understood that cost is not synonymous with value. What a property has cost in the past may be of use in determining what its present value is, but clearly past cost is not necessarily identical with present value; therefore, in determining past cost one should confine oneself to that line of inquiry alone until it is completed, and in reproducing a plant it is only proper and logical to consider similarly what it would cost to rebuild it under present conditions. The two should not be confused. Both may aid in determining value. Neither is value of itself alone.

The Wisconsin Public Service Commission, in one of its recent decisions, has taken as a measure of going value, in a reproduction of the property, the past cost to the company, in operating deficits, advertising, and other expenses incident to building its income up to the point where it is sufficient to carry the depreciation and fixed charges, as well as the operation and maintenance expenses of the project. As applied to the reproduction method, this interpretation of going value is erroneous, because it deals with the "original" cost, and not the "reproduction" cost, of developing the present income of the plant; and because, while admitting that original cost is significant in a determination of the value of the corporation's property, the Courts hold that it is not of controlling importance, and have laid down the precept that the reproduction cost, as of the date of valuation or taking of the plant, shall be accurately determined as one of the standards of present value.

If such is the case with reference to the physical plant, why not with reference to the business of the corporation? Obviously, it should be so, for a moment's reflection will make clear that, with growth in population, the company has to face constant demands for new capital, to meet the growing needs of the community, and this new capital passes through a period when it does not earn an adequate return, in exactly the same way as occurred in the case of the capital originally put into the plant. The going value of the plant, therefore, under normal conditions, should increase with the lapse of time, and with increasing investment in plant and business.

The Measure [illegible] is the measure of this going value, and what elements influence its amount?

Without going too minutely into a history of the development of the methods for the determination of going value, already fairly well established, suffice it to say that in a general way it has been found necessary to measure this element by a hypothetical comparison. This is done by determining the difference in earning capacity between the existing plant and a hypothetical new plant, which, for convenience, may be called "The Comparative Plant." This comparative plant is assumed to be built, beginning with the date of valuation, or taking, and to acquire business up to the level of the existing company as rapidly as possible. The sum of the present worths of the annual excess in net return of the existing plant over the hypothetical or comparative plant, in the period of years from the date of taking to the time when the earnings of the comparative plant are assumed to become identical with those of the existing plant, represents the going value of the existing plant.

The sum thus obtained represents the additional amount which a purchaser could afford to pay to the owners of the existing plant for its established income, over and above the cost of its physical property.

This method of arriving at going value may be termed the "Comparative Method."

The Investor at the Parting of the Ways.—In the case of a large plant, in which the period of years required for the reproduction or building of its physical property would be long, it will be helpful, in analyzing its going value, to place oneself in the position of an assumed capitalist, who stands, on the date of valuation, in the position of having in hand the necessary capital, so that he could either buy the existing going plant with its established business, or build a new hypothetical or comparative plant to replace the existing one under non-competitive conditions. In brief, this imaginary capitalist may be considered as standing at the parting of the ways, with a choice of two paths, and as desiring to know from his engineer their relative financial desirability. This requires the engineer to determine for both cases the probable return which the capitalist would receive on his investment, during the period of years assumed as fairly necessary for a comparative plant [illegible] the growing business [illegible] ing plant.

Knowledge of operating conditions and growth of plants under different circumstances allows this comparison to be made with greater certainty than might be supposed. It is necessary, however, to be strictly judicial and thoroughly logical, in order to produce reasoning which will stand the test of cross-examination.

Some of this reasoning will be followed.

Should the capitalist take the first path, and buy the existing plant, he will evidently receive as return on his investment the net income indicated by its past history, modified by such circumstances as will be likely to influence its net income during the period when a new comparative plant can reasonably hope [illegible]

[illegible] build the new hypothetical, or comparative plant, he must be assumed to have in hand at the date of taking, a capital sum equal to the [illegible] and its business. This capital he must keep [illegible] expenses as they arise.

Obviously, on this second path, as a builder [illegible] full amount of his capital at first, but will make only such expenditures as may conform to the reasonable construction requirements from year to year, until the end of the construction period of his comparative plant, and thereafter, such additional expenditures, up [illegible]

TABLE II.—INTEREST DURING CONSTRUCTION AND PROGRESSIVE AMOUNT OF INVESTMENT "THE COMPARATIVE PLANT"

Date (1)	[illegible] (2)	[illegible] (3)	[illegible] (4)	[illegible] (5)	[illegible] (6)	Total net physical value, exclusive of going value and interest during construction. During year. (7)	To date. (8)
Jan. 1, 1910							
	$ [illegible]	$400,000	.	....	....	$ 800,000	
Jan. 1, 1911.							$ 800,000
	[illegible]	[illegible]	$ [illegible]	$ 100,000	$ 100,000	1,700,000	
Jan. 1, 1912							2,500,000
	900,000		500,000	400,000	300,000	2,100,000	
Jan. 1, 1913							4,600,000
	[illegible]		300,000	300,000	400,000	1,900,000	
Jan. 1, 1914							6,500,000
	[illegible]		......	200,000	300,000	1,300,000	
Jan. 1, 1915.							7,800,000
	500,000		.	100,000	200,000	800,000	
Jan. 1, 1916							8,600,000
Totals	...$4,400,000	$700,000	$1,100,000	$1,100,000	$1,300,000	......	$8,600,000

period, as may correspond to the cost of developing the business or going value of a newly starting company.

The capitalist then finds himself, in this second path, in the position of still having in hand at the end of the first year, a considerable proportion of his capital, on which portion he will be able to earn a rate of interest commensurate with the need of keeping it in convertible form. For comparative purposes, however, he will lose the return on the money expended during the first year for construction requirements.

Similarly, for the second, third, and additional years of construction and development of going value.

Clearly, if the existing plant is small, so that the construction period of a comparative plant will not exceed one year, the amount of unemployed capital on which interest can be earned, pending its use for construction purposes or acquirement of business, will be small, perhaps negligible, and will have little effect on the going value of the property in question.

In the case of a large plant, however, it becomes an element of importance, substantially reducing the amount of the going value which would obtain, were this return on unemployed capital neglected, and, therefore, it must be given careful consideration.

It remains, then, to compare these two paths in terms of returns on the two plants, through the period required for the development of the comparative plant. To do this, first find the differences in the return, under proper accounting methods, on the existing plant, in the light of its past history, and on the comparative plant, under reasonable assumptions as to development of income, including allowance for depreciation in both cases, but excluding consideration of the interest charges; then, to the sum of the present worths of these differences, add the sum of the present worths of the annual return on the unemployed capital. The result thus found should logically measure the going value.

It is evident that interest should not be included as an operating charge, for the reason that the relative return on the two plants, of which interest is a part, is the thing sought. To include interest or profit on capital (invested in plant, in contradistinction to unemployed capital) as an operating charge, would be to charge to operating expenses a portion of the very return which it is desired to value, instead of crediting it to the capitalist as a part of the return to be derived on the two comparative investments.

It is of importance at the beginning to understand clearly that all accounts with the capital under consideration must be begun at the date of taking, or at the parting of the ways, as it has been called, because the discussion of return is wholly a comparative one from this point of view. Some confusion has resulted, even on the part of those familiar with the subject, due to lack of appreciation of this fact.

The writers, therefore, will proceed to discuss more in detail this question of return, by which is meant, in the case of the existing plant, the difference between gross annual income and operating, maintenance, and depreciation charges, excluding interest charges, however, and in the case of the comparative plant the same difference plus the income derived from the unemployed capital.

In discussing the development and operation of the comparative plant, the following considerations are of importance:

(1)—The rate of interest for readily convestible capital is low. It will vary with the length of the period of construction, and to a lesser degree with the length of the period of acquisition of the business of the existing plant by the new comparative plant. For the bulk of the unemployed capital, held in readily convertible form, but awaiting use for construction purposes, 5 per cent is too high a rate in most cases. Probably 4 per cent, more or less, depending on local conditions, is a fairer rate. For that portion of the unemployed capital which is to be used for construction purposes during the year, unless its amount is very substantial, 2 per cent a year, or thereabouts, on the average balance in bank, would seem to be a fair allowance.

(2)—Bankers will charge a discount, or brokerage, for the service of holding funds in readiness for use as required by construction needs, which will tend to decrease the net rate of return on the unemployed capital.

(3)—While this discount for keeping funds in readiness would reduce the average rate of interest, if the amount on deposit during the year is substantial, a portion of the bank balance can be kept in the form of certificates of deposit, on which a rate of interest higher than 2 per cent should be earned. If the anticipated annual expenditures in plant construction are very large, a careful analysis may be made of the probable bank balances as affecting the rate of interest which might be allowed thereon by bankers. Under these assumptions, the average rate of interest which would be earned by the capitalist on his unemployed capital, less discount, would probably vary between 3½ and 4 per cent.

(4)—The larger the rate of interest allowed on this unemployed capital, the smaller the resulting going value of the existing plant. The actual effect (in percentage) on going value is of lesser importance than would perhaps appear at first thought, for the reason that the period during which there is unemployed capital on hand is small, as compared with the total going value development period.

In its more general aspect, the comparative method of computing going value may be said to conform to the actual experience of the investor in public service properties, and, to some extent, to the condition which he would have to face were he to build a rival plant, rather than to buy an existing plant. Such is the case when a city, desiring to duplicate a public utility, rather than to purchase the existing property, overlooks or wilfully neglects the fundamental economic conditions which it must meet, assuming that a reproduction of the physical property is all that is necessary, without allowance for going value. Under such circumstances the property is reproduced under competitive conditions (contrary to the non-competitive fundamental hypothesis of the "comparative" method), which inevitably builds up the going value to large proportions. This has been the actual experience of certain cities such as Mobile, Ala., Sioux Falls, S. Dak., Newark, Ohio, and others.

The general theory of going value conforms strictly to the reproduction cost theory, and makes no assumption as to what the existing plant should earn on its investment, but is based on the actual past return derived by the existing plant and the probable return in the immediate future.

Furthermore, the results obtained by the application of this comparative method appear to comport with the range of going values, common in enterprises of this sort.

PRINCIPAL FACTORS AFFECTING GOING VALUE.

What, it may be asked, are the factors most affecting going value?

In the comparative method, aside from the relative gross earnings, and operating and maintenance expenses, the factors influencing most the magnitude of the going value are:

1. The period of construction required for building the assumed new hypothetical, or comparative plant;
2. The going value development period, or the period from the date of taking to the time at which it is assumed that the comparative plant may overtake the growing business of the existing plant;
3. The rate of acquisition of income by the comparative plant, during the going value development period; that is, from the date of taking to the time when the comparative plant is assumed to have reached the same stage of development of business as the existing plant;
4. The stage of development of the existing plant; that is, whether it may be said to be in a condition where its income is truly commensurate with the degree of development of its physical plant, instead of being either over-built or under-built;
5. The difference in annual depreciation charges assumed for the two plants;
6. The rate of return on the unemployed capital to be used in building the comparative plant, estimated as reasonable for capital which must be kept in a readily convertible form for application to construction.

Period of Construction.—The period and rate of construction of any comparative plant

TABLE III.—COMPARATIVE PLANT. INTEREST DURING CONSTRUCTION.

Date (1)	Total net physical value, exclusive of going value and interest during construction. During year. (2)	To date, Dec. 31 (3)	Average amount on which interest is chargeable for one full year to capital account. (4)	Interest on amounts in Column 4 at 6%. (5)	Total net physical value and interest during construction, exclusive of going value. During year. (6)	To date. (7)
1910-1911	$ 800,000	$ 800,000	$ 400,000	$ 24,000	$ 824,000	$ 824,000
1912	1,700,000	2,500,000	1,650,000	99,000	1,799,000	2,623,000
1913	2,100,000	4,600,000	1,550,000	83,000	2,183,000	4,806,000
1914	1,900,000	6,500,000	2,650,000	159,000	2,059,000	6,865,000
1915	1,300,000	7,800,000	1,450,000	87,000	1,387,000	8,252,000
1916	800,000	8,600,000	500,000	30,000	830,000	9,082,000

Total allowance for lost interest-during construction item...$482,000

TABLE VII.—FIRST TRIAL GOING VALUE COMPUTATION AS OF JANUARY 1, 1910.

Year ending December 31st. (1)	Total Net Return. Existing plant. (2)	Total Net Return. Comparative plant. (3)	Total Net Return. Excess of existing plant. (4)	Present Worth of Excess Earnings of Existing Over Comparative Plant. Period of years. (5)	Factor at 6%. (6)	Amounts. (7)	Cumulative amounts. (8)
1910	$600,000	$410,000	$190,000	1	0.9434	$179,000	$179,000
1911	619,000	275,000	344,000	2	0.8900	306,000	485,000
1912	638,000	249,000	389,000	3	0.8396	326,000	811,000
1913	659,000	261,000	398,000	4	0.7921	315,000	1,126,000
1914	676,000	316,000	360,000	5	0.7473	269,000	1,395,000
1915	693,000	392,000	301,000	6	0.7050	212,000	1,607,000
1916	708,000	490,000	218,000	7	0.6651	145,000	1,752,000
1917	724,000	581,000	143,000	8	0.6274	90,000	1,842,000
1918	737,000	666,000	71,000	9	0.5919	42,000	1,884,000
1919	751,000	727,000	24,000	10	0.5584	13,000	1,897,000
1920	766,000	762,000	4,000	11		2,000	1,899,000

Resulting going value.......................$1,899,000
Assumed going value....................... 1,800,000

Error on first trial computation......$ 99,000

will be determined by the ability to plan and build wisely and economically. Experience has shown that, except in cases where the work is scattered as to make possible its subdivision into a large number of contracts, the annual expenditure of a sum in excess of $1,000,000 is not an easy matter. On the other hand, it must be admitted that the desire to earn a return on the investment at the earliest possible moment constitutes a strong incentive to push the work to completion as rapidly as possible after its inception.

Order of Construction.—The order of construction will be influenced largely by the desire for the early development of income, and it is even reasonable to assume in some cases that temporary structures may be built, with this end in view, and abandoned after the completion of the permanent plant. The recent experience in building the water-works for the new city of Gary, Ind., furnished a striking example of this, for there some temporary pipe lines, temporary wells, and a temporary pumping plant were built to serve the city during the construction of the permanent water-works. These temporary structures were afterward abandoned, but they had served not only the economical purpose of making more convenient the work of the builders of this magic city, but also of reducing the cost of the going value of its water-works.

Going Value Development Period.—Obviously, the longer the period assumed as necessary for the development by the comparative plant of the growing business of the existing plant, the greater will be the going value of the existing plant. The effect of this factor is less marked than that of the rate of acquisition of income during this period, for the reasons that the differences in income decrease rapidly, and that the going value is not determined by taking the sum of the annual differences in net income, but of their present worths brought back to the date of taking or valuation, and the present worth factors become less and less as the period of years required for the development increases.

The past history of water-works, many of which were built during the Eighties, is not a fair criterion for the period required for the acquisition or development of business by water-works today, principally for the reason that the public is now educated to higher standards of living, and to the use of water under pressure, which would result in much more rapid development of income by water-works now than formerly. While some have urged that a water company is entitled to be credited with the cost involved in educating the public up to modern standards, was not this cost rather in the nature of an operating cost, than of a capital expenditure, inasmuch as this advantage immediately accrues, without cost, to any newcomer in the field, and cannot be held as a monopoly or asset by the existing company? It is usually assumed, therefore, that the public is educated to the use of water, and that the cost of that education is lost to the existing plan.

Rate of Acquisition of Income.—The rate of acquisition of business by a comparative plant is of the greatest importance, and especially so is the rate of development assumed for the first two or three years of its operation.

Several theories bearing on the rate of acquisition of the business of the existing plant in the comparative method have been advanced, the most important of which are as follows:

(1) The theory that as soon as a portion of the comparative plant is completed, the portion of the existing plant corresponding to it goes out of use.—Thus when the first stretch of distribution pipe system is laid, after the completion of the water supply system, the corresponding part of the existing company's system is assumed to be out of service. The abutters on this pipe line have then the option of taking water from the new company, or of making other arrangements for obtaining their own supply.

Obviously, under such a drastic assumption, logical, but purely hypothetical, the rate of acquisition of business would depend substantially on the rate of construction of the plant, and, in the business section of the city at least, the income of the existing company would be derived by the comparative company very rapidly. In residential portions of the city it is conceivable that the existence of wells and other facilities for obtaining water might result in a slower rate of acquisition of business.

(2) The theory that on the date of valuation, or taking, the existing company is notified that the city will build a new plant to replace the old, and that on the completion of the new system, the franchise and contract rights of the old company will be terminated—Under such an assumption, the income of the old company would be much more gradually developed by the new company than under the first theory, as many takers would continue to support the old company, as long as it was in business. Many of the old takers, however, would connect with the new company's mains and give up the old supply.

(3) The theory that the community now being served by the existing plant is without public water supply, and has never enjoyed the service of water-works.—Under such an assumption, substantialy no service connections exist, and only those houses have water-works and plumbing fixtures as are assumed to have had their own individual water supplies. In substance, therefore, it is assumed that the comparative or starting plant is built in a new field, though the people of the community are assumed to be educated to the value of public water service under pressure, and may reasonably be expected to make connections with the mains of the comparative company and take water therefrom, as soon as they can prepare their houses for it. While this theory recognizes that the education of the public to the advantages of a public water supply has cost the existing company a substantial amount, it does not recognize that this cost should accrue to the company as an asset which it can hope to retain.

(4) The theory that the limiting rate for the acquisition of business by the comparative company is the speed with which service connections can be made and pumping fixtures introduced.—This theory has little to commend it logically.

It will be observed that under none of these theories is the competitive theory developd; and with reason, for such an assumption would imply conditions entirely foreign to those under which the existing company, the going value of which is under determination, is operating, and would therefore not be a correct gauge or standard for determining its going value. Moreover, whether the danger of competition be eliminated by the character of the franchise, or whether it be prevented by the strength of the position of the existing company, or by the past experience of cities which have built competitive water-works, the water-works business in a large community is in fact virtually a controlled monopoly, and the best interests of the public dictate that this should be so. It might be added that control by an intelligent and honest public service commission is to be preferred, alike from the quasi-municipal corporation's point of view and that of the public, which it serves.

Monetary Stage of Development of Old Plant.—The going value of the existing plant will be somewhat affected by the relative stage of its financial development, or amount of its income, as compared with its monetary physical development. It must, therefore, be noted whether the existing plant is in what might be termed a "normal condition" or ratio of earnings to value of property, or whether it is in effect "over-built" or "under-built"; that is, whether, on the one hand, the company has recently incurred construction expenses in improving its facilities to which its income has not yet grown, or, on the other hand, has failed to make necessary improvements to keep the plant in first-class condition, thoroughly up to modern standards and the reasonable needs of the community which it serves.

Thus, one may recognize three conditions in which a plant may find itself:

(1) That of the "over-built plant," which finds itself in a position unable to earn operating and maintenance expenses, depreciation, and full interest charges and return upon its value, as a result of recent heavy capital or construction expenditures, unless perchance the return earned on the value of the plant prior to these construction expenditures was so unreasonable as to make the rate reasonable when the return is applied to the greater capitalization. In the final analysis of value, weight should be given to this condition of the over-built plant, as well as to the past financial history of the company and existing conditions which may bear on the ability of the company to grow in income to the new capitalization; but it cannot be recognized in computing the cost of reproducing the income, or going value, of the existing plant.

(2) That of the "normally developed plant," in which the financial return is commensurate with the value of the property and the security or hazard of the business.

(3) That of the "under-built plant," the physical condition of which is obviously below a reasonable standard for the community which it serves, in which it is fair to assume that the existing net income will be substantially reduced by the expenses incident to the additional capital expenditures required to bring the plant to a rational standard of water-works construction or service. Here, again, the past history and present conditions, referred to above, are of importance.

Effect of Difference in Annual Depreciation Charges.—As regards the effect on going value of the relative annual depreciation estimated for the two plants, it is reasonable to assume depreciation to begin, in the case of the new comparative plant, on the completion and beginning of operation of its several component parts, which constitute workable units. In the case of a small plant, requiring not more than one year for construction, the contribution to the depreciation account or fund will not begin until the end of the first year after the completion of the construction of the entire comparative plant. In the case of a large plant—such, for instance, as that in which a period of constructon of from 5 to 10 years would be required—it is reasonable to assume that contributions shall be made to a depreciation fund by the several portions of the plant as they are completed and put into operation; thus, assuming that a driven-well system, or pond intake, and a portion of the distribution pipe system had been completed as rapidly as possible, in the interest of developing an early income, depreciation should [illegible] might follow several years later.

[illegible]

The reasonable rate of return on the unemployed capital, which the builder of the comparative plant is assumed to have in hand, has [illegible] cent, more or less, was assumed to constitute a reasonable return, in the eastern part of the United States, on capital invested in sound, [illegible] or thereabouts, on full calendar months, on unemployed capital carried on deposit in the bank subject to draft at all times during the course of the year. The obvious effect of the magnitude of the rate of return on the unemployed capital is to reduce the going value of the existing plant. The higher the possible return on such convertible investment, the lower the going value

[illegible]

In making comparison between the operations of the existing and the comparative plants there must be considered:

(1) The relative income derived both from public and private sources;

(2) The relative operation and maintenance expenses; and, under this item, taxes and repairs are to be included, as well as the other items generally covered by the operation and maintenance accounts, omitting interest or return on capital invested in plant;

(3) The relative depreciation;

(4) The relative net revenue

In determining the financial operations of the existing plant [illegible] development period of the comparative plant, the past financial history and the conditions under which the plant is to operate must be analyzed carefully.

In determining the corresponding figures for the comparative plant, due weight must be given to the studies made of the operation of the existing plant, as well as of the conditions surrounding the comparative plant. The net reproduction cost estimate of the existing plant (after deducting accrued depreciation) will detrmine the construction cost to be assumed for the comparative plant.

[illegible]

In the construction cost of the comparative plant, as of the existing plant, there must be included an allowance for loss of interest during construction quite independent from the interest "return" which will be earned later on the property of the company.

This apparent duplication of interest has been the source of some confusion in the minds of those who approach this subject for the first time. It will clear up the seeming paradox, however, to remember that interest-during-construction payments are inevitable in all projects; they cannot be avoided; they constitute a forced expenditure, alike with the cost of the bricks and mortar, the pipes and the pumps, and cannot be recovered in any way except by addition to capital account or floating debt. Interest during construction, therefore, is logically not a "return" or income in any such sense as one speaks of return, in comparisons for determining going value, but essentially a construction cost. The confusion has resulted only because the word "interest" has a different significance in the two cases.

The dividing line between interest chargeable to the item "interest loss during construction," which is added to construction cost, and "interest" which is return on the investment of the company, is drawn at the point where the several parts or units, making up the plant as a whole, are completed and put into operation, and thus begin to earn some income or return, instead of being a dead load to the company. On the other hand, it must be borne in mind that the plant cannot be expected to earn the full amount of the fixed charges, in addition to operating, maintenance and depreciation charges, immediately on beginning the operation of the several parts of the plant, and that the losses during such formative period must therefore be carried to capital account, through going value, in precisely the same way that interest during construction must be carried to construction account. There is no other means of compensating the builder or investor for these early losses.

It would be as unfair to the owners of the public service corporation to fail to permit them to recover these early losses as to make the public pay, through the agency of the rates, an annual return forever after the completion of the works, on excessive, wasteful, and foolish construction.

It is clear, therefore, that, after operation has begun, the early losses in interest on the investment or value of the plant form a con-[illegible] part of the going value and that loss of interest during construction, up to the point of operation, must be credited to capital account as a construction expense.

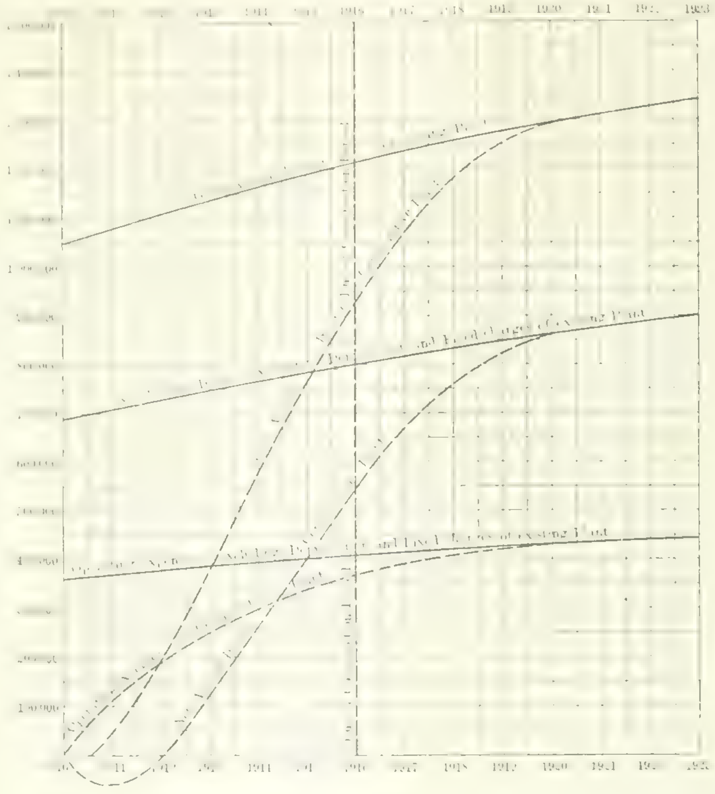

Fig. 1.—Probable Gross Annual Income, Net Annual Income, and Operating Expenses of Assumed and Comparative Plants.

APPLICATION OF PRINCIPLES [illegible] PLANT

Assumptions as to Existing Plant.—For the sake of illustration, and to make clear the principles which have been discussed, the writers have assumed a typical case in order to show the steps necessary to determine the going value of a large property on the comparative method herein outlined.

The plant which has been taken for illustration is an imaginary one, supposed to serve a population of 300,000 persons, but care has been taken to make the data consistent and conformable to figures found in operation. This statement is made, however, that the reader may not be misled into supposing that the figures have been copied directly from the report of any public or private water-works.

In Fig. 1 is shown a forecast of the assumed probable gross annual income, net annual income (excluding depreciation and fixed charges), and operating expenses (excluding depreciation and fixed charges), of the assumed plant, called "the existing plant," which is supposed to be based on the past financial history of such plant, and the assumptions contained in Table I.

It is further assumed that the investment in the physical part of the existing plant amounted to $8,600,000.

The problem, therefore, consists in determining, first, the interest loss during construction, and second, the going value.

Date of Valuation.—The valuation of this plant is assumed to be made as of January 1st, 1910.

Construction Period Required.—It is assumed that a period of 6 years—say from 1910 to 1916—would be reasonably required to build a new comparative plant identical with the existing plant, as of the date of taking in 1910.

Going Value Development Period.—It is assumed that a period of 10 years (or, in other words, 4 years in addition to the period of construction) will be required by the comparative plant to develop an income identical with that of the existing plant.

Beginning of Operation.—In spite of the fact that a 6-year period has been assumed to be required to build the comparative plant, it is assumed that a prudent investor would plan his order of construction so as to make available at the earliest possible moment certain parts of the comparative plant, such as the water supply and distribution pipe system, so that the latter could be put into commission and become a source of revenue at as early a date as practicable. Obviously, the magnitude of the interest charges on the comparative plant, during the construction period, would be a strong incentive to such a course of action.

Character of Plant and Order of Construction.—For purposes of illustration, it is assumed that the plant under question consists of a pond or driven-well supply, of limited extent, supplemented by a filtered river-water supply derived through large impounding or storage reservoirs, involving the construction, not only of a filter plant, but of expensive impounding reservoirs, dam, and conduits, two pumping stations, one to care for the small pond or driven-well supply, the other to care for the main supply from the impounding reservoirs.

The assumed order of construction is shown in Table 2, grouped under:

1. Distribution pipe system;
2. Pond or driven-well supply, and sterilizing plant, with pumping station;
3. Filter plant, conduits, etc;
4. Pumping station for enlarged supply and extension of same after the year 1913 by the installation of additional pumping units;
5. Storage dam and impounding reservoirs.

TABLE IV EXISTING PLANT ANNUAL INCOME AND EXPENSE

Year ending Dec 31 (1)	Gross Income (2)	Operation, maintenance and taxes (3)	Net income [illegible] charges (4)	Depreciation (5)	Net income applicable to fixed charges and dividends (6)
1910.	$1,050,000	$360,000	$690,000	$90,000	$600,000
1911..	1,080,000	370,000	710,000	91,000	619,000
1912..	1,110,000	380,000	730,000	92,000	638,000
1913..	1,140,000	388,000	752,000	93,000	659,000
1914.	1,165,000	395,000	770,000	94,000	676,000
1915..	1,190,000	402,000	788,000	95,000	693,000
1916..	1,213,000	409,000	804,000	96,000	708,000
1917..	1,235,000	414,000	821,000	97,000	724,000
1918..	1,255,000	420,000	835,000	98,000	737,000
1919..	1,275,000	425,000	850,000	99,000	751,000
1920..	1,296,000	430,000	866,000	100,000	766,000

The real estate, water rights, and rights of way are assumed to be distributed in the several divisions to which they appertain.

The cost of engineering and contingencies is also included under the several individual items cited above.

The interest during construction, however, as well as the going value, remains yet to be determined.

Beginning of Operation of Different Portions of Comparative Plant.—It is assumed that by Jan. 1, 1912, the small supply from pond or driven-wells will be available. The filter plant and main pumping station is assumed to be completed and ready for service as of Jan. 1, 1914, the additional pumping units installed thereafter being ready for service between Jan. 1, 1915 and 1916. It is assumed that on or about Jan. 1, 1915, the storage dam and impounding reservoirs can be put into service, though not finally completed until January 1, 1916, and that the pipe distribution system built in any year is available for service the following year

Loss of Interest During Construction.—In Table 3 has been computed the loss of interest during construction on this plant, based directly on the assumptions made as to the order of construction shown in Table 2 and the discussion following, and on the further assumption that the dividing line for the charges for loss of interest on construction account and on operating account is drawn at the point of completion and putting into service of any revenue-producing unit of the plant.

Thus, loss of interest during construction is allowed on the average amount of investment during the year 1910 at the rate of 6 per cent, on the assumption that the work built during that year cannot be revenue producing until after the year 1911, pending completion of the water-supplying works Similarly, interest is allowed during the year 1911, not only on the investment during the year 1910, but on the investment during the year 1911. After January 1, 1912, however, the interest on the investment in pond or driven-well supply is assumed to be charged to operating cost as fixed charges, and not to capital account under the head of interest lost during construction, for the reason that it is assumed that this portion of the plant, being available through the agency of the pond or driven-well supply and the distribution pipe system built up to that date, is now in the revenue-producing class. Similarly, interest lost during construction is charged to capital account on the filter plant, during the years 1912 and 1913, and thereafter to the operating account as fixed charges, for the reason that the filter plant is assumed to be in revenue-producing operation after January 1, 1914, when it is assumed to have been completed, although the water-works plant as a whole is not assumed to be finished until January 1, 1916.

New Construction Required During Development Period Ignored.—No consideration is taken of the new construction required during the construction and going value development period, 1910 to 1920, for the reason that, whatever profit or loss is involved thereby accrues alike to both plants in the comparative method, and so has no effect on the going value under determination.

OPERATION [illegible]

In Table IV are shown the assumed operating statistics for the existing plant.

Income on Unemployed Capital.—In Table VI is shown the first trial computation relating to the income on unemployed capital. It will be remembered that it was suggested that, in this method of computing going value, one should consider himself at the parting of the ways, with an amount of capital in hand sufficient to buy the existing plant—covering in the cost thereof the value of the physical plant, interest during construction, going value, and franchise value—and follow through the steps, relating to investment in the comparative plant, which the capitalist would take, and the return which he would get in the form of interest on his unemployed capital.

Let it be assumed that he could place idle funds at a 4 per cent rate, except as to the funds required for the year's construction, on wrich the bank rate of interest is assumed to be 2 per cent. For simplicity, let it be further assumed that on the money expended during one year, 6 months' interest at 2 per cent can be obtained from the bank corresponding to a 2 per cent rate on bank balances during the year

Obviously, the first difficulty with which one is confronted is that the going value has not yet been computed. The comparative physical plant was assumed to have a value of $8,600,000; the loss of interest during construction was found, by Table III, to amount to $482,000; the total investment in physical plant, including loss of interest during construction in the assumed existing plant and hence also in the comparative plant, is therefore $9,082. The going value, however, is not yet known, and, therefore, must be determined by a series of approximate computations. The franchise is assumed herein to have nominal value only.

As a first trial, assume a going value of $1,800,000. Under this assumption, the total value (or cost to the investor) of the existing plant would be as follows:

Physical plant	$8,600,000
Loss of interest during construction	482,000
Assumed going value..................	1,800,000
Total value	$10,882,000

Therefore, the investor who has concluded to build a new hypothetical plant, instead of to purchase the old plant, is assumed to have in hand the sum of $10,882,000, as of January 1, 1910. He is assumed further, to adopt the same order of construction for the new comparative plant as shown in Table II. Under these assumptions, Tables VI and VII result

Resulting Going Value under First Trial Computation.—In Table VII is shown the result of the first trial computation of going value. It will be noted therein that the going value, which was assumed to be $1,800,000, was found to be approximately $1,899,000, involving an error in assumption of $99,000.

Were a going value of $1,900,000 assumed in the second trial computation, the resulting going value would be found to be somewhat less than that sum, on account of the greater amount of interest accruing on the unemployed capital, which tends to reduce the going value, the other items remaining substantially the same.

Probably closer results would be obtained by assuming for the second trial computation a going value of $1,880,000.

[illegible] of This Paper.—As going through the somewhat laborious process of recomputating Tables VI and VII would not shed any additional light on the principles enunciated, it is unnecessary, for the purpose of this discussion, to follow through this recomputation Enough has been said to illustrate the principles involved by the method of computing going value suggested by the writers.

For the second trial, assume a going value of $1,880,000. The total value of the plant under discussion would then be:

Physical plant	$8,600,000
Interest during construction..........	482,000
Assumed going value [illegible]	1,880,000
Total value	$10,962,000

In the second trial computation, therefore, it [illegible] comparative plant starts, as of January 1, 1910, with the sum of $10,962,000 in hand.

Method [illegible] Included.—Attention may be called to the fact that no allowance has been made for franchise value, on the assumption that the franchise has nominal value only, in the works under question, and that, under the forms of franchise enjoyed by many works, and with the present-day tendency of the courts and public service commissions, water-works are approaching a condition where they may be limited in earnings to an amount which will pay dividends substantially only on the net physical and going value of the property. This has the effect of reducing franchise value to the mere right to do business.

If, on the other hand, the plant under question had been assumed to have a substantial franchise value, as is the case in many works, this franchise value should have been added to the sum of the physical value, plus interest during construction, plus going value, to make up the amount of the unemployed capital which the investor is assumed to have in hand, before making his comparison between the existing works and a hypothetical works.

The preliminary costs of promotion, organization, etc., and other kindred items, are assumed to have been included in the physical valuation.

Effect of Assumptions as to Order of Construction on Loss of Interest During Construction Item.—It will be apparent, from the foregoing discussion, that the larger the allowance for the loss of interest during construction item, the smaller will be the resulting going value, for the reason that the gross income and operating expenses remaining the same, the amount of unemployed capital in the hands of the builder will be increased. This, in turn, increases the interest accretions on unemployed capital, which have to be deducted from the net income of the existing plant in determining going value. The effect, therefore, of these deductions is to decrease the going value. It is obvious, however, that the decrease in going value is not equal to the increase in interest charges, for the reason that the interest allowances on unemployed capital are assumed at a lower rate than the loss of interest during construction item, and the present worths of the annual differences in net income are taken in determining going value as of any given date, instead of the arithmetical sum of those differences

REVIEW OF GOING VALUE

Having determined the going value of any works by the comparative method, it remains to review the matter in a broad way, for it must be remembered that cost is not always synonymous with value.

Thus, on the plant assumed herein, the resulting going value of $1,880,000 amounts to 20.7 per cent of its estimated net reproduction cost, meaning thereby the reproduction cost less accrued depreciation to date of taking, including the early organization expenses, engineering and contingencies, interest during construction, etc.:

TABLE V.—COMPARATIVE PLANT. ANNUAL INCOME AND EXPENSE

(From Operation, Exclusive of Interest on Unemployed Capital.)

			Depreciation		
[illegible] (1)	[illegible] (2)	[illegible] (3)	[illegible] (4)	[illegible] (5)	[illegible] (6)
1910					
1911	$[illegible]	[illegible]			[illegible]
1912	195,000	[illegible]		......	[illegible]
1913	385,000	255,000	[illegible]	$21,000	109,000
1914	575,000	[illegible]	3,106,000	31,000	239,000
1915	760,000	341,000	6,065,000	61,000	365,000
1916	923,000	372,000	7,152,000	71,000	480,000
1917	[illegible]	[illegible]	[illegible]	91,000	578,000
1918	1,175,000	[illegible]	9,082,000	98,000	667,000
1919	1,250,000	422,000	9,082,000	99,000	729,000
1920	1,296,000	430,000	9,082,000	[illegible]	766,000

TABLE VI.—FIRST TRIAL COMPUTATION OF NET ANNUAL INCOME (FROM OPERATION AND FROM INTEREST ON UNEMPLOYED CAPITAL) OF COMPARATIVE PLANT.

[illegible] Jan. 1, 1910

Value of physical plant	$ 8,600,000
Interest during construction (Table 3)	482,000
Assumed going value (first trial)	1,800,000
	$10,882,000

—Determination of Interest on Unemployed Capital of Comparative Plant—

[illegible]	[illegible]	[illegible]	Going value*	Total [illegible] Column 3 plus Column 4	Amount invested, which is earning 4% interest	Amount withdrawn for construction during the year†	One Year's Interest on Column 6 at 4%	 Half of Column 7 at 2%	Total Interest. Column 8 plus Column 9.	Total annual income or return on comparative plant. Column 2 plus Column 10.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
[illegible]	[illegible]	$ 824,000	0	$ 824,000	$10,058,000	$ 824,000	$402,000	$ 8,000	$410,000	$410,000
[illegible]	$ [illegible]	2,623,000	$ 179,000	2,802,000	8,080,000	1,978,000	323,000	20,000	343,000	275,000
[illegible]	[illegible]	4,806,000	485,000	5,291,000	5,591,000	2,489,000	224,000	25,000	249,000	249,000
1913	109,000	6,865,000	811,000	7,676,000	3,206,000	2,385,000	128,000	24,000	152,000	261,000
[illegible]	[illegible]	8,252,000	1,126,000	9,378,000	1,504,000	1,702,000	60,000	17,000	77,000	318,000
[illegible]	[illegible]	9,082,000	1,395,000	10,477,000	405,000	1,099,000	16,000	11,000	27,000	392,000
[illegible]	[illegible]	9,082,000	1,607,000	10,689,000	193,000	212,000	8,000	2,000	10,000	490,000
[illegible]	[illegible]	9,082,000	1,752,000	10,834,000	48,000	145,000	2,000	1,000	3,000	581,000
[illegible]	[illegible]	9,082,000	1,842,000	10,924,000	—42,000	90,000	—2,000	1,060	—1,000	666,000
1919	729,000	9,082,000	1,884,000	10,966,000	—84,000	42,000	—3,000	1,000	—2,000	727,000
[illegible]	766,000	9,082,000	1,897,000	10,979,000	—97,000	13,000	—4,000	0	—4,000	762,000

*These items are determined most easily by carrying the computations involved in Tables 6 and 7 along simultaneously. It is thus assumed that the new plant develops its going value gradually.

†To cover physical plant, interest during construction, and going value.

Operations of Comparative Plant.—In Table V are shown the assumed financial operations of the new comparative hypothetical plant, without allowances for the income from unemployed capital.

17.1 per cent of the total net reproduction cost, including in the latter the reproduction cost of the business of the company, or, in other words, the going value;

1.8 times the amount of the gross annual income of the old plant for the fiscal year ending January 1, 1910;

3.1 times the amount of the net income, as of January 1, 1910, meaning by "the net income" the difference between gross income and the sum of the operating expenses, maintenance, taxes, and depreciation.

It remains then to consider whether the plant is, at the moment:

(1) "Over-built"; that is, at the end of a reconstruction period, so far as the physical plant is concerned, and at the beginning of a recuperative period, so far as its financial condition is concerned, inasmuch as some of the construction work has been built for future rather than present needs, and the rates are therefore at the moment incommensurate with the character of the service being furnished;

(2) "In a normal stage of development" where the rates may be said, broadly speaking, to be commensurate with the character of the service furnished;

(3) "Under-built," that is, where the plant is outgrown, or where it is collecting rates which are excessive for the character of the service being furnished by it, in which case the plant may be said to be rapidly approaching a reconstruction or recuperative period physically and a reformative period financially.

Effect of Size of Plant.—It is obvious that in the case of a small plant, the construction of which can be executed in one season's work, no such complication in regard to the interest on unemployed capital nor necessity for refinement in computation exists.

The writers have felt it might be of interest, however, to call attention to the difference in the nature of the problem when dealing with a large plant requiring a period of several years for its construction, and to point out a method for the detrmination of the going value in such cases.

GENERAL APPLICABILITY OF PRINCIPLES.

The principles enunciated herein, if sound, should find general applicability in the valuation of all forms of business enterprises. Good will in general business enterprises should be susceptible of similar analysis to that herein outlined for public service corporations, when the theory of reproduction is utilized as the basis of appraisal, provided due weight be given to the modifying conditions or circumstances under which the property under valuation is operating.

RECAPITULATION.

Going value is defined as the value of a created income. While it pertains to the business rather than to the physical plant, it is nevertheless true that in any just determination of the reproduction cost of a property it is as real an element in this reproduction cost as is the cost of reproducing pipe lines, pumping stations, or any other part of the physical plant.

As a means of determining going value, the "comparative method" is suggested. This consists in an analysis of the relative net earnings or return to be derived from the existing plant as compared with that from a hypothetical "comparative plant" which is assumed to be built on the date of valuation and to acquire the business of the existing plant, in the territory served by it, as rapidly as possible, under non-competitive conditions. The sum of the present worths of the annual excess in net earnings, or return, from the existing plant, as compared with those from the comparative plant, in the period of years from the date of valuation to the time when the earnings of the comparative plant can reasonably be assumed to equal those of the existing plant, is then the measure of the going value of the existing plant. It represents the amount which a purchaser could afford to pay for the existing property with its established income, in excess of the value of its bare physical plant.

In analyzing the going value of any public service corporation, it is suggested that the investigator place himself in the position of an investor having in hand the necessary capital, either to buy the existing going plant with its established business, or to build a new comparative plant to replace it and its established business under non-competitive conditions, and then determine the return which he would receive upon his capital in both cases.

The principal factors affecting going value are:

1. The period of construction required for building the comparative plant;

2. The going value development period;

3. The rate of acquisition of income by the comparative plant;

4. The stage of development of the existing plant, whether over-built, normally developed, or under-built;

5. The difference in annual depreciation charges for the two plants during the going value development period;

6. The rate of return assumed upon the unemployed capital of the builder, up to the time of completion of the comparative plant.

The application of these principles is illustrated in the solution of a hypothetical problem, involving the determination of the going value of a water plant in a city assumed to have 300,000 population.

In the case of small plants, requiring but a year, more or less, for construction, all the refinements suggested in this paper are not necessary.

The principles outlined in the "comparative method" suggested, if sound, would seem to settle the controversy which has arisen as to the propriety of including interest or fixed charges as an operating expense. Clearly, if the principles enunciated are sound, the fixed charges should not be so included.

In conclusion, the writers dissent from the view taken by the Wisconsin Public Service Commission as to the nature and method of computing going value in determining the reproduction cost of a public service property.

STEAM AND ELECTRIC RAILWAY SECTION

Results Obtained With and Costs of Various Methods of Waterproofing Masonry in Railway Work.*

Tables I and II summarize the replies required from railways in 1909 and 1910. The last column contains certain information as to cost. The 1909 replies included very little information upon this subject. It was thought that its publication might lead to unwarranted conclusions. More replies have been received for 1910, but the conditions are so widely different that hardly any two replies cover the same conditions. Under these circumstances an average cost for any one type of waterproofing would likely be far from the true cost. It is also evident that several of the figures are erroneous, square foot and square yard having been confused. Each figure should be considered in connection with the particular example to which it refers.

The masonry structures usually waterproofed are the floors of solid-floor bridges

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*[illegible] Committee [illegible] Masonry, American Railway Engineering and Maintenance of Way Association.

TABLE I.—SUMMARY OF REPLIES.

Character of Structure.	Materials Used.	Results.	Costs.
Roof of car barns	Reinforced against shrinkage	8 leaks in 3 acres; 3 years	
Roof walls of subway	Walls, reinforced against shrinkage	No leaks except at bad joints; 5 years	
	Roof, rock asphalt mastic	No leaks; 5 years	
	Bad work repaired with Wunner's bitumen emulsion	No leaks	
Culvert tops	Medusa compound and truss-con.	No leaks; 1 year	
Brick wall	Mortar mixed with soap and alum.	No leaks; 3 years	
Reservoir	Crushed dust	No leaks; 3 years	
Reservoir, 4	1 soap and alum and elaterite	No measurable leakage	Two coats soap and alum 43c per 100 sq. ft.
	3 soap and alum and asphalt	No measurable leakage	Asphalt $1.64 per 100 sq. ft., elaterite $1.52 per 100 sq. ft.
Arches, retaining walls, bridge floors	5-ply burlap, pitch and asphalt	Good results	
Arches, bridge floors	2-ply burlap and pitch	No leaks; 2 years	Placed by contractors; approximately 20c per sq. ft.
Roof of magazine	Rich mortar plastering	Not perfect	
Bridge floor	6-ply felt and pitch	No leaks except along webs of girders	Approximately 6c per sq. ft.
Bridge floor	1-2 mortar	Just as good; 2 years	
Bridge floor	Sarco and burlap	Good	About 8c to 38c per sq. ft.
Bridge floor	4 or 5-ply felt and pitch or asphalt	Few leaks; 8 bridges, 2 leak, 6 O.K.	About 5c per sq. ft.; protection over waterproofing about 7½c per sq. ft.
Bridge floor	Sarco and burlap	One leak	15c per sq. ft.
Bridge floor	Asphalt	Some leaks around rail joints	24c per sq. ft. including labor and material.
Trough bridge floor masonry arch.	5-ply felt and asphalt	Practically water-tight	9.1c per sq. ft.
	Young's mixture	No leaks	Chemical cost $290.85; concrete, including chemical cost $10.23 per cu. yd. or 6.3c per sq. ft.
Bridge floor concrete arch	Mastic	9 bridges; 2 tight, few leaks in 7	Natural rock asphalt mastic 45c per sq. ft.; Hydrex felt with brick 25c per sq. ft.; positive Seal felt 23c per sq. ft.; Special asphalt mastic 30c per sq. ft.
	5-ply felt and asphalt	9 bridges; 2 tight, few leaks in 7	Natural rock asphalt mastic 45c per sq. ft.; Hydrex felt with brick 25c per sq. ft.; positive Seal felt 23c per sq. ft.; Special asphalt mastic 30c per sq. ft.
Retaining walls	Asphalt paint	Can be scraped off	
	Cement and coal tar	Penetrates	
Bridge floors	Felt and pitch	Difficult to handle, abandoned	
	Mastic	Cracked, abandoned	
	3-ply burlaps saturated with asphalt	Good results, expensive	
	3-ply plain burlap, asphalt and mastic	Few leaks; tore over columns	About 16c per sq. ft.
Masonry arches with concrete backing cellar wall	Young's mixture	Leaks	
	Sarco mixture	O. K., 1 year	15c per sq. ft.; including material, tools and labor.
	Young's mixture	Failed. N. B.—Conditions different.	
	Winslow's compound	O. K. 18 mos.	
Stone and brick arch	Tar paper and pitch	Leaked badly; waterproofing cracked; 1 year	
	4-ply felt and asphalt	No leaks; 4 years	40c per sq. ft.
Reinforced concrete arch	Anti-hydrine damp-proofing	Leaked badly	
	4-ply felt, asphalt and brick	No leaks; 2 years	31½c per sq. ft.
Reinforced concrete arch	Cerian paint and ½-in. asphalt	No leaks	
Reinforced concrete arch	Cerian paint and 1-in. asphalt	No leaks; 5 years	10c per sq. ft.
Bridge floor-plate	2-ply felt, 1 burlap and mastic	Leaks along webs of girders	
Bridge floor-plate	Hydrex felt	Small leaks over columns; 1 year	
Bridge floor-trough	Asphalt concrete and ½-in. mastic	No leaks in waterproofing	
Cellar	3-ply tar paper and asphalt	No leaks; 3 years	About 6c per sq. ft.
Concrete wall	3-ply Barrett felt and asphalt	No leaks; 3 months	5.8c per sq. ft.
Subway—Plate roof	5-ply felt and asphalt; also red lead paste and brick in asphalt on roof	No leaks; 6 years	
Basement	6-ply felt and pitch	No leaks; 6 years	5c per sq. ft. for 3-ply; 10c per sq. ft. for 6-ply; contract price.
Retaining walls	⅛-in. pitch	Fairly satisfactory	3.18c per sq. ft.
Dust line	3-ply tar paper and pitch	Unsuccessful; expansion causes cracks	5.91c per sq. ft.
Subway walls	4-ply felt and pitch; hollow tile	No leaks	Hollow tile 18.5c; waterproofing 5c per sq. ft.; total 23.5c per sq. ft.
Roof—Concrete arches	3-ply felt and pitch brick	No leaks	Waterproofing 3.82c per sq. ft.; brick protection 9c per sq. ft.; total 12.82c per sq. ft.
Trough bridge floor	Iron bark	Failed	
	5-ply Hydrex, 3 tracks	1 dry, 2 leak, 2 years	95c per sq. yd.
	4-ply Barretts, 2 tracks	1 dry, 1 leaks; 4 years	16½c per sq. yd.
	Iron bark, 2 tracks	No leaks; 4 years	
	5-ply Hydrex, 1 track	No leaks; 3 years	
Trough bridge floor	4-ply Barrett, 1 track	Leaks badly; 3 years	
	Iron bark, 1 track	Failed; 1 year	
	5-ply Hydrex, 1 track	Leaks badly; 2 years	
	5-ply Hydrex, 3 tracks	Leak badly; 3 years	
	4-ply Barrett, 1 track	Leaks badly; 3 years	
	Iron bark, 1 track	Failed; 1 year	
	5-ply Hydrex, 1 track	Leaks badly; 2 years	
	Iron bark, 5 tracks	Removed; 1 year	
	5-ply Hydrex, 5 tracks	Leak badly; 2 years	
	5-ply Hydrex, 1 track	Leaks badly; 3 years	
	4-ply Hydrex, 1 track	Leaks badly; 3 years	71½c per sq. yd.
	4-ply Barrett, 2 tracks	Leak badly; 3 years	
	3-ply Hydrex, driveway	Leaks badly; 3 years	57c per sq. yd.
	4-ply Hydrex, 3 tracks	2 dry, 1 leaks; 3 years	
	4-ply Barrett, 1 track	Leaks badly; 3 years	
	Iron bark, 1 track	Removed; 1 year	
	5-ply Hydrex, 1 track		
	Iron bark, 5 tracks	Removed; 1 year	
	5-ply Hydrex, 5 tracks	Leak badly; 2 years	
	4-ply Hydrex, 3 tracks	Leak badly; 3 years	
	4-ply Barrett, 1 track	Leaks badly; 3 years	
	3-ply Hydrex, driveway	Leaks badly; 3 years	
	6-ply Barrett, 1 track	No leaks; 3 years	21½c per sq. yd.
	4-ply Barrett, 1 track	Leaks badly; 3 years	
	4-ply Hydrex, 2 tracks	Leak badly; 3 years	
	Iron bark, 1 track	Removed; 1 year	
	5-ply Hydrex, 1 track	Removed; 1 year	
	Iron bark, 5 tracks	Removed; 1 year.	
	5-ply Hydrex, 5 tracks	2 dry, 2 leak, 1 leaks badly; 2 yrs.	
	4-ply Hydrex, 2 tracks	1 dry, 1 leaks	
	4-ply Barrett, 2 tracks	No leaks	
	6-ply Barrett, 1 track	No leaks; 3 years	
	4-ply Hydrex, 2 tracks	1 dry, 1 leaks badly; 3 years	
	Iron bark, 2 tracks	Removed; 1 year	
	5-ply Hydrex, 2 tracks	1 dry, 1 leak	
	6-ply Barretts, brick protection	No leaks; 1 month	13.2c per sq. ft.
	5-ply Hydrex	1 leak; 1 year	95c per sq. yd., including material, tools and labor.
Plate floor	Pitch	Leaks through bolt holes	
Train shed floor	Mastic	Cracked and leaks	
Concrete slab; bridge floor	5-ply felt, 1 burlap and pitch	No leaks; 15 months	15½c per sq. ft., including 10 yr. guaranty.
Floor slabs	3-ply burlap, Sarco		Floor slabs, L. 7.7c; M. 12.5c per sq. ft. back of walls, L. 1.0c; M. 1.0c per sq. ft.
Floor slabs	Mortar, pitch	No leaks	Between 10c and 30c per sq. ft.
Floor slabs	Felt and pitch	Small leaks; 2 years	Maximum cost about 30c per sq. ft.

TABLE I. [illegible]

[illegible]	[illegible]	Cracked and [illegible] year	M. [illegible] L. 10c per 100 sq. ft.
	[illegible]	Wore off 1 year	M. [illegible] L. 30c per 100 sq. ft.
	[illegible]		M. [illegible] L. 10c per 100 sq. ft.
[illegible]	[illegible]	Leaks along girders [illegible] crack	[illegible] per sq. ft. in place
[illegible]	[illegible]	[illegible]	[illegible] per sq. ft., including removal of fill and supporting of tracks during work.
Subway	[illegible]	Bottom and sides 1 leak per 100 sq. ft.	13c per sq. yd., including brick encasing.
	[illegible]	Roof leaks a little, [illegible] years	
Cellar	[illegible]	No leaks, 1 year	[illegible] per sq. ft. labor and material
Bridge floors	[illegible]	No leaks	
	[illegible]	3 out of 7 bridges show leaks along girders	
[illegible]	Asphalt	Good results	
[illegible]	4-ply felt and slag or [illegible]	Many leaks	[illegible] per sq. ft. for felt and slag only, done under traffic
[illegible]	[illegible]	No leaks, 1 month	
Reservoir	[illegible]	Reduced leakage, 1 month	[illegible] per sq. yd.
Bridge floors	[illegible] sheet flooring [illegible]	Failed after about [illegible] years	
	[illegible]	Failed second winter	60c per sq. ft.
Bridge floors	[illegible] burlap and Sarco	4 bridges, no leak; one bridge leaks slightly; 1 year	11.4c per sq. ft.

and arches over city streets, to prevent the [illegible] walls of [illegible] ground [illegible] walls, concrete roofs of buildings and retaining walls, to prevent the leakage of rain or ground water; reservoir and tank walls, to prevent loss by leakage.

The subject of waterproofing may be considered from two points of view. It may be an investigation as to the imperviousness of various substances or it may be an investigation of the methods of treating certain masonry structures so as to prevent the leakage of water through them. The first is a laboratory problem and has not been touched by the committee. The second is a practical problem and is the one considered by the committee. There is involved, in a report upon the condition of a structure from this point of view, the element of suitability to use and also the personal equation of the person making the examination. A reservoir wall may be permitted to leak a few gallons daily; a bridge floor must not allow water to drip; in some situations a stain or discoloration would be objectionable and must not be allowed. Different observers might report compliance with any of these conditions as "perfectly satisfactory." In comparing different methods of waterproofing this element must be eliminated. This has been kept in mind in making the analysis in Table II.

The items in Table II have been grouped in four general classes, according to the method of waterproofing employed. Class I has been designated as "Exterior Envelopes." This includes all those processes of waterproofing by which the masonry is covered with a thick coating of more or less impervious material, generally applied in several layers and generally including tarred felt or similar fabric or burlap. The waterproofing materials used are coal tar pitch, asphalt or bituminous products of petroleum. The felt is laid in overlapping layers with a coating of the waterproofing compound between the layers. The whole is then protected from abrasion by a layer of sand, mortar or brick. Sometimes the masonry is first swabbed with the compound, causing the felt to adhere, and sometimes not. It has been supposed that where the fabric is bonded to the masonry it cracks from expansion and contraction more readily than where it is not so bonded. The reports do not indicate whether or not this is true. Whatever material is used for the exterior covering must have considerable elasticity and strength to resist the effects of continual expansion and contraction of the masonry. Burlap has been used in some instances and some felts have been prepared with a canvas back.

The items of Class I have been grouped under four subheads, "a," "b," "c" and "d"; "a" includes all examples of the use of felt and coal-tar pitch; "b," felt and asphalt; "c," burlap and either pitch or asphalt; "d," mastic. Mastic is a bituminous material mixed with sand and applied in one or more thick layers, generally without the use of fabric. Under each subhead are shown the number of separate layers of fabric, as two-ply, three-ply, etc.

Under Class II have been grouped all examples of [illegible] mixed with concrete. The [illegible] [illegible] under various trade names. The committee is not advised as to the nature of these compounds, and from the few examples reported no conclusion can be drawn.

Class III has been designated "Exterior Coatings" and includes all those coatings of the nature of washes or paints. Some of these coatings are heavy, but differ from Class I in thickness and in being used without fabric.

Class IV includes those examples in which no waterproofing material was used. The number reported is too few to warrant any conclusion.

TABLE II.

	No leaks	Leak slightly	Leak badly	Total
I. Exterior Envelopes				
(a) Felt and Pitch				
[illegible]-ply	[illegible]			1
3-ply	1		1	[illegible]
4-ply	[illegible]	1	[illegible]	1[illegible]
5-ply	[illegible]			4
6-ply	3	1		[illegible]
Total	1[illegible]	[illegible]	[illegible]	[illegible]
(b) Felt and Asphalt				
3-ply	[illegible]	1	[illegible]	[illegible]
4-ply	[illegible]	[illegible]	[illegible]	17
5-ply	[illegible]	[illegible]	2[illegible]	33
Total	16	[illegible]	[illegible]	
(c) Burlap and Pitch or Asphalt.				
1-ply	[illegible]	3		[illegible]
4-ply			[illegible]	4
5-ply		1		1
Total	5	[illegible]	[illegible]	1[illegible]
(d) Mastic	1			[illegible]
Total, Class I	31	16	14	9[illegible]
II. Substances Mixed with concrete		[illegible]	[illegible]	[illegible]
III. Exterior coatings	6	9		4[illegible]
IV. No waterproofing material	1	3		[illegible]
Total examples	[illegible]	[illegible]	...	14[illegible]

TABLE III.

[illegible]				
1-ply				
2-ply	1			1
3-ply	[illegible]	1	[illegible]	[illegible]
4-ply	10	[illegible]	19	
5-ply	1[illegible]	[illegible]	20	[illegible]
6-ply	[illegible]	1		[illegible]

*Includes bridges to cost $48,000.

A study and analysis of the replies by the committee indicate:

(1) No method of waterproofing has proved entirely satisfactory.

(2) Some cases are reported in each class showing no leaks.

(3) The difference in efficiency between the various classes does not appear to be great. It does not appear to what extent success is due to the quality of the masonry.

(4) Failures are due to faulty details, poor workmanship, poor materials and the formation of cracks in the masonry.

(5) To secure dry work, it is necessary that details should be carefully designed; this includes the details of the masonry as well as of the waterproofing. The materials must be carefully placed by skilled workmen. The supervision must be constant and efficient. Shrinkage and temperature cracks should be prevented by reinforcement.

(6) Concrete masonry designed and placed as above indicated, with properly designed temperature and shrinkage reinforcement, may be made waterproof without the addition of special waterproofing materials.

The Principal Formulas Proposed for Determining Run-Off and Waterways for Culverts.*

The following compilation of formulas for culvert areas and for the determination of run-off is believed to include all the better known formulas besides several not customarily used by American railroad engineers. The references indicate as a rule the date and place of first publication, the brief explanatory comments for the most part being roughly quoted from the original articles. The nomenclature is taken without change from the original sources.

The Myers Formula[1]

$$A = c\sqrt{M}$$

where A = the area of waterway required, in square feet.
M = the area drained, in acres.
c = 1 as a minimum for flat country.
c = 1.6 for hilly compact ground.
c = 4 as a maximum for mountainous rocky country.

As already stated, Major Myers recommended this formula as applying well to the water courses which he had been able to examine, which lay chiefly on the line of the Richmond, Fredericksburg & Potomac Railroad.

The Talbot Formula[2]

$$A = C\sqrt[4]{M^3}$$

where A = the waterway area necessary, in square feet.
M = the area drained, in acres.

This formula is not intended for use for drainage areas of more than 400 square miles. It was derived with especial reference to areas under 77 squire miles in size.

For rolling country subject to floods at times of melting snow, and with length of valley three or four times the width, let c be one-third. For valleys with stream longer in proportion to the area, decrease c. In districts not affected by accumulated snow and where the length of the valley is several times the width, one-fifth or one-sixth or even less may be used. For steep side slopes, especially where the upper part of the valley has a much greater fall than the channel at the culvert, c should be increased.

This formula is used very generally in the

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*Condensed from a thesis by A. F. [illegible] and G. W. Chamberlain, University of Wisconsin, and printed as a part of the report of the Committee on Roadway of the American Railway Engineering and Maintenance of Way Association.

[1]Proceedings Engrs. Club, Phila., Vol. I, p. 146, April [illegible], 1879.

[2]Selected Papers, Civil Engrs. Club, Ill. Univ., No. [illegible], p. 14, May [illegible], 188[illegible].

[illegible]stern and western portion of this country and appears to give excellent results for the smaller areas.

The Peck Formula[1] (better known as the Missouri-Pacific formula):

$$\text{Area of waterway in sq. ft.} = \frac{\text{Drainage area in acres.}}{c}$$

c varies from 1 to [illegible], depending on the country.

In very mountainous country, where slopes of hills and mountains are steep and abrupt, c is equal to 4. In ordinary flat rolling country, such as is found in good agricultural sections, c is equal to 6.

The Wentworth Formula

$$a = d^{2/3}$$

where a = the sectional area of the waterway, in square feet.

d = the drainage area, in acres.

This formula was derived in connection with work on the Norfolk & Western Railway and is especially fitted to the conditions along that line, and in general to the conditions in the southeastern states. In cases of less rainfall, or if the ground be quite flat, the author states that the two-thirds power of the drainage area is too great for the square feet of area needed in the waterway. In the observations of Mr. Wentworth, 60 per cent of the resulting area may be taken as the lower limit.

The Murphy Formula

$$A = \frac{Q}{V} = \frac{Q}{c\sqrt{RS}}$$

where A = area of waterway, in square feet

V = mean velocity, in feet, per second.

R = hydraulic radius = range in stage in time of flood. (See explanation below.)

$$c = \frac{a + \frac{l}{n} + \frac{m}{S}}{1 + \left(a + \frac{m}{S}\right)\frac{n}{\sqrt{R}}}$$

where a, l, and m are constants, and n is the coefficient of roughness of the bed.

S = slope of surface.

"It can be shown that the hydraulic radius

$$R = \frac{d}{l}\left(\frac{l + 2d\,X}{l + 2d\sqrt{1 + X^2}}\right)l \qquad (3)$$

in which l is the bottom width of a trapezoidal section, d is the depth and X is the slope of the sides. It can be seen from equation (3) that for any given values of d and X, R approaches d as l increases; for the case of floods, therefore, it may be assumed that R = the difference in stage between high and ordinary low water."

"This method of finding the waterway at a given place on a stream consists in finding the drainage area in square miles above the place under consideration, the greatest change in stage of the stream at this place and the slope of the surface. By multiplying the drainage area M by q (the maximum discharge in second-feet per square mile that is to be expected in that portion of the country), we find Q; dividing Q by V using for R the maximum range of stage and for S the measured slope of surface of the stream, we have the necessary area of waterway. The greatest error in the use of this method will result from an incorrect measurement of the slope. The formula calls for the slope of surface, and surface slope of a stream is not necessarily the slope of the bed. The slope is not the same at all stages nor always the same for a given stage. If the place under consideration is near the mouth of a large tributary the slope of the main stream will be affected by the stage of the tributary. Overflow and flooding of lowlands is frequently the result of backwater, due to reduction of surface slope. The smaller the slope used the greater will be the computed waterway. If there is a possibility of the waterway becoming partly clogged with drift, [illegible] influence of backwater from a tributary, the computed area must be increased by a liberal amount."

The Dun Data.[1]—A reproduction of the 1906 table may be found in the accompanying Table I. This data was derived principally from observations made along the lines of the Santa Fe Railway in Missouri, Kansas, Indian Territory and Texas.

The C. B. & Q. Formula

$$Q = \frac{3000\,M}{3 + \sqrt{M}}$$ or [illegible]

where Q = the total discharge from the area in cubic feet per second.

M = the drainage area, in square miles.

A = the waterway in square feet, using the velocity through the culvert as 10 ft. per second.

The [illegible] Formula

No. 1. $Q = 200\,M^{2/3}$, or [illegible] $M^{2/3}$;

No. 2. $Q = 180\,M^{2/3}$, or [illegible] 18 $M^{2/3}$.

Notation is the same as for the C. B. & Q. formula.

The [illegible] Formula[4]

[illegible] M

where M = area of drainage watershed in acres

A = Neat area of waterways, in square feet.

"Where the stream has a flat fall, add 30 per cent; where double openings are used, add 20 per cent to total cross-section area."

The El Paso & Southwestern [illegible] Formula

$$Q = [illegible]\sqrt{\frac{8000}{A}}$$

where Q = the maximum run-off per square mile of drainage area.

A = the total drainage area in square miles.

This is practically the formula by Mr. Joseph P. Frizell, which he worked up from the records of flow over the Holyoke dam, Massachusetts, for a period of 50 years, and it appears in the original form in his book on hydraulics.

As a check on this formula the following table is used. It follows Dun's data very closely and appears to have been worked up from the Santa Fe table:

Drainage area, sq. miles	Waterways,* sq. feet	Drainage area, sq. miles	Waterways,* sq. feet
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
0.70	74.0	9.5	628
[illegible]	[illegible]	[illegible]	[illegible]
1.55	134.0	15.8	878
2.00	170.0	19.9	978
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

The Lauterburg Formula

Average discharge [illegible]

[illegible]

where [illegible] average [illegible] discharge [illegible] second

[illegible] meters

[illegible]

c = 0.20 for marshy soil

0.25 for level plains.

= 0.30 for rolling ground

[illegible] Eifel.

= 0.55 for the Black Forest and the Vosges.

0.70 [illegible]

Lauterberg endeavored to frame a rational estimate as to the probable discharge of streams by means of the above formula, which is based upon data collected in Switzerland.

The Fanning Formula[3]

$$Q = 200\ M^{5/6}$$

Where M is the area of watershed in square miles and

Q is the volume of discharge in cubic feet per second

The [illegible] Formula

[illegible] M [illegible] $L^{2/3}$

Notation the same as in the Fanning Formula.

L = the length of drainage area in miles

The Dickens Formula

[illegible] $M^{1/2}$

Q = 200 $M^{3/4}$, for Madras Presidency, India.

Q = 500 $M^{3/4}$, for Central Provinces India.

Q = 825 $M^{3/4}$, for Bengal and Bahar, India.

Q = 1,200 $M^{3/4}$, for Upper Kaveri, India.

Q = 2,200 $M^{3/4}$, for Gadamatti, India

The [illegible] Formula[5]

$$Q = \frac{1421\,M}{0.311 + \sqrt{M}}$$

This formula is best adapted to small districts.

The notation is the same as that of the Fanning formula.

The Kutter Formula[1] (derived by Ganguillet and Kutter in 1869).

$$Q = 458\ [\sqrt{(640\,M + 4.58)} - 45.8].$$

This formula is adapted to Swiss streams. This notation is the same as that of the Fanning formula.

The Herring Formula.[5]

$$Q = \frac{D\,M\,v}{L} \text{ or } \frac{D\,M}{t}$$

where Q and M are the same as those of the Fanning formula and

L = the length of the river.

v = the mean velocity of the stream.

D = the entire depth of rain flowing off during a storm.

t = the time taken for a drop of water falling near the periphery of watershed to reach the culvert.

The Posseuti Formula.[6]

$$Q = \frac{c_2 R_2}{L_1}\left(M_2 + \frac{M_1}{3}\right)$$

c_2 = a coefficient with an average value of 1,010.

R_2 = the depth of rainfall in inches for 24 hours.

M_2 = the area of hilly or mountainous part of watershed, in square miles.

M_1 = the area of level or flat part of watershed, in square miles.

L_1 = the length in miles of the stream from its source to the point of observation.

This formula applies especially to mountain streams of moderate size in the Appenines

[illegible]

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[1] Proceedings Amer. [illegible] E. & B. [illegible], 1897, pp. 86-100.

[2] Letter to the editor of the Ry. Gaz., 1903, p. 57.

[3] "Destructive Floods in the United States, 1904," by E. C. Murphy, pp. 189-193. U. S. Geol. Surv. Water Supply Paper No. 147, 1905.

[1] [illegible] Sci. [illegible] p. 140.

[2] [illegible] Mr. [illegible] Engineering [illegible] Vol. [illegible] p. 139.

[3] Jour. Wes. Soc. Engrs., Vol. 11, p. 139

[4] [illegible] Engineering and Contracting [illegible]

[illegible] 1876

*Waterways [illegible] rocky [illegible] absorbed. To be multiplied by co-efficient c greater [illegible] country [illegible] and [illegible] C may vary from 0.50 for flat country with por[illegible] mountain gorge."

[1] [illegible] p. 66.

[2] [illegible] p. 66. Taken from the "Indian Professional Papers."

[3] Fanning's "Water Supply Engineering," 1873.

[illegible]

[5] Proceedings Inst. C. E., Vol. 71, 1883.

[6] Markus, "Meliorationswesen in Italien," Vienna, 1881.

[7] [illegible] Hering in 1881. See Report National Board of Health [illegible] 10, [illegible]

[illegible] ing heaviest fall in cubic feet per acre per second.

s = the general grade of the drainage area in feet per hundred.

a = the area drained, in acres.

c = a coefficient, for average areas it equals 0.625.

The observations extended up to slopes of 10 ft. per 100, but were limited to small areas of less than 50 acres. This formula is especially appliacble to sewer design.

[illegible]

where P = the inches of rainfall discharged by stream.

t = a coefficient for time, the value of which is governed by the length of time the freshet lasts.

c = a [illegible] of rainfall varying with the quantity of rain.

R = the average daily rainfall in inches during the freshet.

This formula is applicable to drainage districts of moderate size in New South Wales. The following values of t and c are given by the author:

Length of freshet in days, [illegible]. Value of t in inches, 2.6.
Length of freshet in days, [illegible]. Value of t in inches, 2.5.
Length of freshet in days, 250. Value of t in inches, 2.4.
Length of freshet in days, 200. Value of t in inches, 2.2.
Length of freshet in days, 150. Value of t in inches, 2.1.
Length of freshet in days, 100. Value of t in inches, 2.0.
Length of freshet in days, 50. Value of t in inches, 1.9.
Length of freshet in days, 25. Value of t in inches, 1.8.
Rainfall in ins., 0.40. Value of c in ins., 0.95.
Rainfall in ins., 0.35. Value of c in ins., 0.90.
Rainfall in ins., 0.30. Value of c in ins., 9.85.
Rainfall in ins., 0.25. Value of c in ins., 0.80.
Rainfall in ins., 0.20. Value of c in ins., 0.75.
Rainfall in ins., 0.15. Value of c in ins., 0.70.
Rainfall in ins., 0.10. Value of c in ins., 0.65.

[illegible] Formula.

$$Q = 440 \times P \times N \text{ hyp log} \frac{8L^2}{B}$$

of discharge.

Where Q = the total discharge in cubic feet per second

$N = c\,v\,i$, where v = the velocity towards the culvert in feet per second.

i = the number of inches of rainfall.

c = the coefficient of discharge.

L = the extreme length of the drainage area.

[illegible] the mean width of the drainage area.

[illegible] Formula.[1]

$$Q = c\,r\,\sqrt[5]{S A^4} = A\,c\,r\,\sqrt[5]{S/A}$$

where c = the proportion of rainfall that reaches sewers.

r = the number of cubic feet of water falling upon an acre of surface per second during the period of greatest intensity of rain. It is practically the same as the rate in inches per hour.

s = the mean surface grade in feet per thousand.

A = the area drained in acres.

Q = the discharge in cubic feet per second.

This formula was derived with especial reference to St. Louis conditions.

The Chamier Formula.[2]

$$Q = 640 \times R \times C \times M^{3/4}$$

where Q = the discharge in cubic feet per second.

R = the average rate of greatest rainfall anticipated in inches per hour for such duration as will allow the flood water flowing to the outlet from the farthest extremity of the catchment area.

c = a coefficient of surface discharge, giving the proportion of rainfall that may be expected to flow off the surface.

The above formula has been tested by Mr. Chamier on streams in India having drainage areas of from 20 acres to 400 square miles.

The Cramer Formula.[3]

$$Q = \frac{c_3 R_3\, m\, M\, (S_3)^{1/3}}{9 + (0.0658\, m\, R_3 M)^{1/3}}$$

where Q = the discharge in cubic feet per second.

R_3 = the mean annual rainfall in inches.

$S = \frac{e_1 + e_2}{l}$ = the mean slope and declivity of the whole basin; e_1 being its average altitude in feet, e_2 being the altitude of the point of discharge, l being the average distance in feet traveled by the water from the boundaries of the watershed to the point of measurement.

c_3 = variable coefficient.
= 186 for rough natural basins of rivers.
= 697 for smooth, comparatively level and impervious areas like well-built cities.

m, depends on the total area M, the flat area F, which is likely to be inundated in freshets, and the mean annual fainfall R_3, such relation being expressed by:

$$m = 1 - \sin\left(-\tan^{-1}\frac{709\,F}{M R_3}\right)$$

for the simple case when F is distributed in an approximately uniform manner throughout the whole basin, whereas if F is concentrated only at the lower end of the basin we must place

$$m = 1 - \sin\left(-\tan^{-1}\frac{1418\,F}{M R}\right)$$

The Italian Formulas.[1]

$$Q = \frac{1819\,M}{0.311 + \sqrt{M}} \quad (1)$$

$$Q = \frac{2600\,M}{0.311 + \sqrt{M}} \quad (2)$$

The notation in these formulas is the same as that of the Fanning formula. No. 1 is applicable to streams in northern Italy, and No. 2 to small brooks in the same region.

The Kuichling Formulas.[2]

$$q = \frac{44{,}000}{M + 170} + 20 \quad (1)$$

$$q = \frac{127{,}000}{M + 370} + 7.4 \quad (2)$$

Here q = the discharge in second feet per square mile, and M = the drainage area in square miles. These equations were derived from conditions similar to those in the valley of the Mohawk River. They were obtained from a great amount of flood data on both American and European streams. Equation No. 1 gives the discharge during floods which may occur occasionally. Equation No. 2 gives the discharge during floods that occur but rarely.

The Murphy Formula.[1]

$$q = \frac{46{,}790}{M + 320} + 15$$

The notation here is the same as that of the Kuichling formulas. The equation was derived from a large amount of flood data on streams of the northeastern United States which Mr. Murphy had collected.

The Gray Formula.

$$Q = 5.89\,A^{3/4}$$

where Q = the discharge in second feet per acre, and

A = the drainage area in square miles.

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[1] Proceedings Inst. C. E., Vol. 80, p. 211, 1884 to 1885.

[1] Trans. Amer. Soc. C. E., Vol. 16, p. 179, 1886. "Determination of the Size of Sewers," R. E. McMath.

[2] Proceedings Inst. C. E., Vol. 134, p. 313, 1897.

[3] Proceedings Engrs. Club of Phila., Vol. 1, p. 146, 1879.

[1] Rheinhard's "Kalendar für Wasserbau Ingenieure," Wiesbaden, 1898. N. Y. Assn. Doc., 124th Session, 1901, Vol. 23, No. 70, pt. 1, pp. 614-964.

[1] Zeitsch. Oester. Ing. & Arch. Verein, 1900.

[2] N. Y. Assn. Doc., 124th Sess., 1901, Vol. 23, No. 70, pt. 1, pp. 641-964.

[3] U. S. Geol. Surv. Water Supply Paper, No. 147, p. 189, 1905.

GENERAL ARTICLES AND CLASSIFIED ITEMS

An Investigation of Built Up Columns Under Load.*

At the time of the Quebec bridge failure so much was written about the lack of experimental data on the strength of uncommonly large, built-up steel compression members that one would naturally infer that there was an abundance of such authoritive data relating to similar members of ordinary lengths and cross sections. However, in summing up the main points brought out in the discussion of the results of an elaborate series of field and laboratory tests at the University of Illinois, the statement is made that still more experimental results are needed before better and more nearly satisfactory column formulas may be established for compression members of very ordinary structures.

Investigations of this kind have been long delayed owing partly to the belief that it was impracticable to make tests to determine the actual stresses which are developed under working loads and up to the elastic limit of the material in the members of a column, throughout its length and over its cross-section. One very important conclusion drawn in the bulletin is that such tests are practical in well-equipped engineering experiment stations.

PURPOSE AND METHODS OF THE INVESTIGATION.

The purpose of the investigation was to determine (1) the way in which compressive stresses in built up columns vary over the cross-section of the component parts and throughout their length; (2) the amount and distribution of stress in the lattice bars of columns, and also the action of similar bars under separate tests with similar conditions of fastening and eccentricity; and (3) the general relation which exists between the component parts and the column as a whole. In several respects these tests may be said to be pioneer tests, since the usual tests of columns are for the purpose of determining only the ultimate strength and the effect of length.

Materials.—The principal tests were made on the following compression pieces: (a) Column No. 1, a steel column built up of angles, plates and lattice bars, all the parts being light with respect to the size of the column; (b) Columns No. 2, 3, 4 and 5, four wrought-iron bridge posts which had seen long service in a bridge truss; and (c) three

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*Abstract of Bulletin No. 44, University of Illinois Experiment Station, by Arthur N. Talbot and Herbert F. Moore.

TABLE I.—STRESSES IN COLUMN NO. 1.

Stresses are given in pounds per square inch.

	North Channel.						South					
	West Side.			East Side.			West Side.			East Side.		
Panel	Outer fiber.	Center of gravity.	Inner fiber.	Outer fiber.	Center of gravity.	Inner fiber.	Outer fiber.	Center of gravity.	Inner fiber.	[illegible]	[illegible]	Inner fiber.
TEST NO. 5.												
½	12,100	10,400	9,300	11,000	9,500	8,700	9,700	10,500	10,900	10,400	10,800	10 900
1	9,800	11,100	11,800	10,000	10,200	10,500	12,200	10,400	[illegible]	13,500	11,300	[illegible]
1½	7,900	8,500	8,600	5,800	8,200	8,900	7,300	[illegible]	8,900	7,400	7,900	8,300
2	11,800	11,400	11,100	10,900	10,600	10,600	8,500	8,600	8,700	9,800	10,200	10,400
2½	10,700	11,000	11,100	10,800	10,200	10,200	11,800	11,900	11,800	9,700	9,700	9,600
3	5,800	7,500	8,500	7,800	8,000	8,500	8,300	[illegible]	[illegible]	7,700	9,100	9,700
3½	8,000	8,100	8,500	7,400	8,100	8,500	7,800	8,600	9,000	7,500	7,600	7,700
4	15,400	13,000	[illegible]	13,500	13,000	12,800	11,600	11,800	11,800	[illegible]	[illegible]	9,900
4½	12,200	[illegible]	10,300	12,200	10,200	[illegible]	9,900	9,900	[illegible]	9,800	9,800	9,700
5	9,400	9,500	9,600	11,000	10,100	9,600	9,700	9,500	9,500	8,900	9,800	9,900
5½	9,900	10,700	11,100	10,500	10,900	11,000	10,900	9,100	8,300	8,700	8,800	8,900
6	7,400	7,300	7,200	8,100	9,200	9,700	13,800	11,900	11,100	11,100	10,600	10,200
6½	10,900	10,200	9,700	10,200	10,300	10,500	8,600	[illegible]	8,900	8,500	8,600	8,600
7	12,100	11,700	11,400	11,400	10,900	10,400	8,300	8,800	8,900	5,900	7,900	8,700
7½	9,900	9,200	8,900	9,600	9,400	9,500	6,500	7,600	8,300	4,600	6,400	6,900
8	9,800	8,600	8,300	8,100	9,700	10,400	11,400	9,500	8,500	12,700	10,800	10,100
8½	9,200	9,700	10,000	9,700	9,500	9,300	20,200	15,400	13,100	15,400	14,000	13,200
9	6,500	7,600	8,300	9,700	9,700	9,900	12,900	13,200	13,100	9,400	9,900	10,200
9½	[illegible]	10,400	10,600	12,900	9,500	8,100	4,600	[illegible]	8,900	4,600	7,300	8,500
10	16,400	[illegible]	11,200	17,000	14,400	12,900	8,000	8,600	8,700	6,800	8,000	[illegible]
10½	[illegible]	10,700	10,400	9,900	10,000	9,700	10,500	[illegible]	11,300	7,400	8,900	[illegible]
11	7,000	8,400	8,900	8,100	9,100	9,600	12,600	11,100	10,800	9,800	10,800	11,000
11½	9,700	8,900	8,600	11,900	10,500	9,700	8,200	11,100	11,700	8,900	9,700	9,800
12	14,000	12,400	11,600	11,900	11,000	10,400	6,900	7,500	[illegible]	8,100	8,800	9,400
12½	9,700	8,900	8,600	10,500	12,100	12,700	10,800	11,800	12,400	11,900	11,000	10,800

posts and a top chord member in a railroad bridge under service. The tests of (a) and (b) were made in a testing machine; for (c) a locomotive and cars formed the load. The auxiliary tests, which were made on lattice bars and other parts, have an important bearing in connection with the design of columns.

Column No. 1 was specially designed for the purpose of these tests, and was of a much less stocky section than are the built-up columns ordinarily used in bridge and building construction. The section of this column was chosen because it seemed to offer better opportunities than a less flimsy column for the study of distribution of stress, lateral and longitudinal, under the conditions of the test, and also because the stresses developed in the latticing could better be studied. It was thought that the variation of stress due to methods of fabrication, handling in shipment and conditions of applying the load would be more pronounced than in a stocky column, and hence that the flimsy column would be capable of more accurate study. In this connection it should be noted, however that the chord members of large bridges are sometimes built up of parts relatively as thin as the parts of this test column.

Column No. 1 was composed of 2 plates 20x⅜ ins., 13⅛ ins. back to back; 4 angles 2x2x¼ ins.; single lacing bars 1x¼ ins., and 1¼x7/16 ins.; area of section 18.76 sq. ins.; length c. to c. of pins 21 ft. 0 in. First $\frac{l}{r}$ (axis parallel to lacing), [illegible]; second $\frac{l}{r}$ (axis perpendicular to lacing), 37.2.

Columns No. 2, 3, 4 and 5 were wrought-iron columns from an old bridge of the C., B. & Q. R. R. They were composed of 2/10-in. 30-lb. channels, 11½ ins. back to back; double lacing bars 2½x⅜ ins.; area of section 17.64 sq. ins.; length c. to c. of pins 15 ft. 10 in. First $\frac{l}{r}$, 43.5; second $\frac{l}{r}$, 41.2

Columns 2a and 4a were the same as 2 and 4 in cross-section. Area of section 17.64 sq. ins.; length c. to c. of pins, 14 ft. 7 in. First $\frac{l}{r}$, 40.1; second $\frac{l}{r}$, 38.0. Lacing as on 2 and 4.

The bridge posts under service were composed of 2 12-in., 20-lb. channels, 13¼ ins. back to back; double lacing bars 2¼x⅜ ins. riveted at intersection; area of section, 12.02 sq. ins.; length c. to c. of pins, 25 ft. 0 in. First $\frac{l}{r}$, 66.1; second $\frac{l}{r}$, 41.0.

The top chord member of the bridge under service was composed of 1 cover plate 21x9/16 ins.; 2 web plates 1x11/16 ins., 14 ins. back to back; 4 angles 3½x3½x7/16 ins.; double lacing bars on bottom 2¾x⅜ ins., riveted at intersection; area of section 48.67 sq. ins.; length c. to c. pins, 19 ft. 10 ins. First $\frac{l}{r}$, 40.7; second $\frac{l}{r}$, 29.6.

Determination of Stresses in Laboratory Tests.—Both in the laboratory and in the field the stresses in the various sections of the columns tested were determined by measuring the deformation over short spaces by means of extensometers. The elastic limit was not exceeded in the tests of stress distribution, so in the interpretation of the data the stress in the piece is assumed to be proportional to the deformation, using for the modulus of elasticity 28,000,000 lb. per sq. in. for steel and 26,000,000 lb. per sq. in. for wrought-iron, these values checking closely with the total shortening of the columns and with the average deformations observed throughout their length. The stresses in the lattice bars were also determined and, as might be expected from the irregular variation of stress along the flange members of the columns, the stresses in the lattice bars were found to vary greatly.

Two methods of loading were used, central and oblique. In all cases the load was applied to the end of the column through the pins, and in a plane passing through the nominal axis of the column and parellel to the lacing. In central loading the pin was adjusted to an even bearing on the machine. In oblique loading the top and bottom pins bore against narrow blocks, the block at the top being on the opposite side of the axis from the one at the bottom. The horizontal distance between the two blocks is referred to as the "arm."

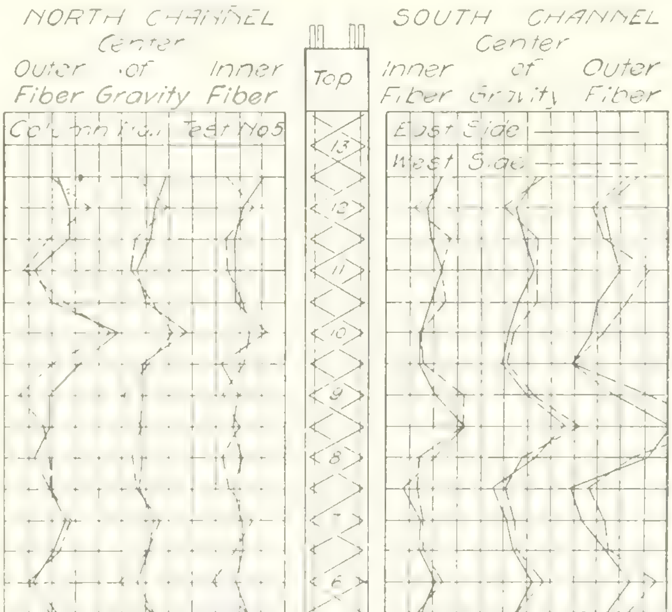


Fig. 1—Stress Distribution in Channels of Column No. 1, Test No. 5.

Results of Laboratory Tests.—The following Tables I to IV and the diagrams, Figs. 1 and 2, are given as typical results observed. It will be interesting for the reader to compare the variation in stresses from end to [illegible] as actually determined, with the rate and order of variation the Rankine and Euler methods of analysis would lead one to expect.

[illegible] pression members of an eight-panel, single- [illegible] the Illinois Central R. R.—at White Heath, Ill. The span of the bridge is 158 ft. 6 in. [illegible] shows the truss dimensions, and Fig. 4 the wheel concentration of the test train.

In the field, as in the laboratory, stresses were calculated from measured deformations, using a modulus of elasticity for the bridge members of 30,000,000 lb. per sq. in. The stress noted is the average stress over a space of 4½ ins. on either side of the point indicated.

The method of procedure in the field tests was as follows: Instruments were placed on some portion of the column to measure the deformation over a short gage length, and a reading was taken. The test train was then run upon the bridge to a given position (one approximating the maximum load on the member under test), and the instruments were ready again. The train was then run off the bridge, and the instruments were again read. This procedure was repeated several times, at least three applications of the load being made, and frequently several more. These tests covered a period of eight days.

TABLE II. STRESSES IN WROUGHT IRON BRIDGE POSTS.

	North Channel.						South Channel.					
	West Side.			East Side.			West Side.			East Side.		
Panel	Outer fiber	Center of gravity	Inner fiber	Outer fiber	Center of gravity	Inner fiber	Outer fiber	Center of gravity	Inner fiber	Outer fiber	Center of gravity	Inner fiber
					COLUMN NO. 3, TEST NO. 7.							
1	9,300	9,000	9,000	8,400	9,500	10,000	10,000	9,000	10,100	8,200	8,000	7,900
2	10,200	10,000	9,900	10,200	11,500	11,900	8,400	9,100	10,000	9,100	8,700	8,500
3	8,800	8,700	8,600	9,800	10,000	10,000	10,000	9,700	9,600	9,400	9,600	9,600
4	10,700	9,100	8,600	[illegible]	[illegible]	9,900	8,600	9,800	10,200	9,300	7,500	6,900
5	10,200	10,400	10,500	8,800	9,600	9,900	10,100	9,800	9,700	10,400	10,200	10,200
6	10,600	10,000	9,800	10,300	10,000	10,000	10,400	10,400	10,400	10,000	9,900	9,900
7	10,300	9,900	9,700	9,600	9,900	10,000	8,700	9,500	9,700	10,900	10,000	9,700
8	9,800	9,600	9,500	10,200	10,900	11,000	7,600	9,600	10,300	7,800	9,900	10,600
					COLUMN NO. 5, TEST NO. 9.							
½	11,000	11,700	10,800	12,600	11,700	11,400	7,400	8,100	8,400	7,400	7,900	8,000
1	11,300	12,000	12,300	11,100	10,000	9,600	6,700	8,500	9,200	5,100	6,800	7,500
1½	11,300	11,100	11,100	11,100	10,800	10,700	5,700	6,200	6,300	6,600	6,900	7,100
2	13,100	12,600	12,400	12,900	12,400	12,200	8,000	8,000	8,000	7,800	8,200	8,300
2½	12,700	12,000	11,700	13,100	11,500	11,100	9,300	9,200	9,200	8,700	8,400	8,300
3	11,800	12,000	12,200	11,400	12,200	12,400	8,200	8,400	8,400	6,300	8,000	8,600
3½	13,500	10,500	9,300	[illegible]	10,700	10,400	8,200	8,200	8,200	8,400	8,300	8,200
4	14,300	13,100	12,700	14,300	12,300	11,500	7,300	7,400	7,500	7,400	8,700	9,200
4½	11,600	11,600	11,500	12,300	[illegible]	12,300	9,000	9,000	9,000	8,700	8,700	7,800
5	12,600	12,400	12,300	11,700	10,400	10,000	8,300	8,400	8,400	7,400	8,500	8,100
5½	13,700	12,100	11,500	13,500	12,100	11,400	8,300	8,300	8,300	8,400	8,400	7,600
6	12,600	12,700	12,700	13,500	12,500	12,200	7,600	7,600	7,600	7,200	7,000	7,100
6½	13,100	11,900	11,500	11,400	11,400	11,500	8,400	8,400	8,400	10,500	9,000	8,500
7	11,100	11,300	11,500	11,200	12,300	12,600	7,900	8,000	8,000	6,500	8,100	8,600
7½	10,600	10,100	9,900	11,000	10,300	9,900	8,000	8,200	8,200	5,900	7,900	8,700
8	10,300	12,300	12,800	11,300	12,300	12,400	8,500	8,600	8,600	10,800	11,800	12,200

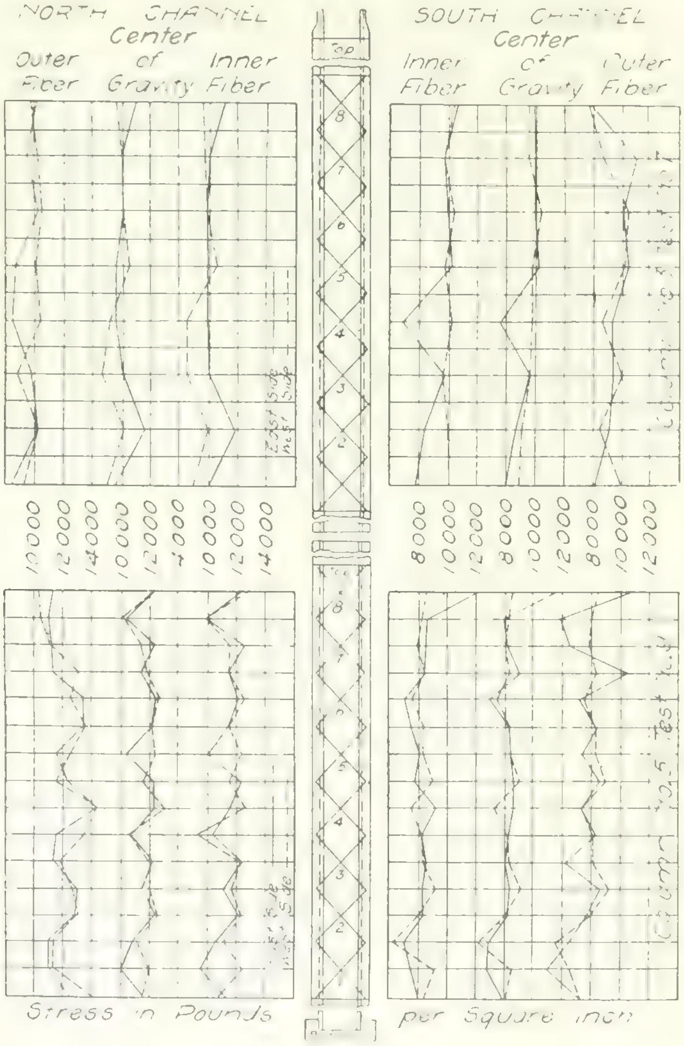


Fig. 2—Stress Distribution in Channels of Columns Nos. 3 and 5, Tests Nos. 7 and 9.

Tests were made on the batten plates at the top of one of the posts, and under load a slight bending of the plates between channels was found. The bending took place in a horizontal plane. In one post the change in stress was observed as the locomotive and train moved across the bridge. Extensometers were placed on both main members of the post, and the changes in reading were noted as the train moved across the bridge. In the inner channel of the post tension was set up as the locomotive came opposite the post. The maximum amount of tension observed in the inner channel when the locomotive was opposite the post was about three-quarters of the compression in the outer channel. Figures 5 and 6 show graphically the stress distribution and variations. In Table V are given a number of the highest observed fiber stresses. The excess of the maximum fibre stress is given as a percentage of the average stress. At most sections the maximum stress was in the outer fiber of the channel, but in some cases it was found at the inner fiber.

In the tests of the bridge posts an attempt was made to determine the stresses in a few of the lattice bars. These stresses were very small, and the precision of the extensometer was not sufficient to measure them with any great degree of accuracy. It should be noted that the lacing of the posts in this bridge was double, and the bars were riveted together at their intersection. In several cases it was found that a lattice bar under load bent in the shape of a very flat S curve, the point of attachment to another lacing bar, at the middle, being a point of inflection.

Laboratory Tests of Lattice Bars.—Many of the lattice bars in a column, as they transmit stress from one flange member of the column to the other, are under compression. To study the action of lattice bars under compression, a series of tests on single lattice bars was made. The load was applied with an eccentricity approaching that to be expected in a column for the lattice bars which are next to the flange member (here designated "under" bars). The other lattice bars are here designated "over" bars. The stress distribution across the section of the "over bars, which are under compression, is probably more uneven than the stress distribution found in these tests. However, these tests give some idea of the relative behavior of lattice bars of various proportions, and of the large eccentricity of loading of all lattice bars.

Lattice bars of the following cross-sections were tested: Flat bars 1½x¼ ins., 1x⅜ ins., ⅞x7/16 ins., angles 1½x1½x⅛ ins., channels 1½x¾x⅛ ins. Bars of the following lengths between centers of rivet holes were tested: 8½ ins., 13½ ins. and 20 ins. The rivet holes were ½ in. in diameter. Table VI shows the results of compression tests of lattice bars.

Laboratory Tests of Columns to Failure.—Two tests to failure were obtained with Column No. 1. In the first test, the lattice bars (1x¼ in.) failed by buckling suddenly and without warning under a preliminary load of 8,060 lb. per sq. in. of cross-section. The alternate lattice bars in the upper half of the column buckled.

For the next test Column No. 1 was fitted up with 1¼x7/16-in. lattice bars, and the column as a whole was tested to failure. Failure occurred under a load of 23,450 lbs. per sq. in. of section. It was caused by the local buckling of the north flange in panel 8, the panel in which the greatest stress had been found in Test No. 5. The failure of the column was much more sudden than were the failures of the wrought-iron columns. One lattice bar on each side was buckled by the crippling of the channel member.

After the wrought-iron bridge posts had been tested for stress distribution under working loads, they were loaded to failure. Deformations were measured in the flange members of that part of the column on which the previous test had given the heaviest stress. Table VII gives the result of the tests to failure. For all the tests of wrought-iron bridge posts, whether loaded centrally or eccentrically, the failures were very gradual. Final failure occurred near the middle or at the end. In the former case, high stresses in one channel had been shown by the deformation measurements at working loads. In the latter case, a bending in one channel at working loads was noted by the instruments at the panel nearest the end of the column. In two of the three columns in which failure took place in the end of the column, as the instruments did not show overstress in the laced portion of the column, the injured ends were removed, new end connections were put on, and the columns were retested as No. 2a and 4a.

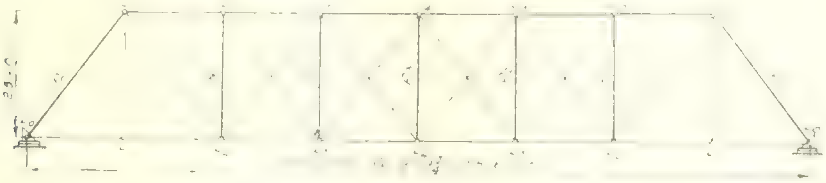
DISCUSSION

"In the process of fabrication of built-up columns kinks and bends are formed in the component pieces. This condition produces initial stresses and also gives local bending action under load in these pieces. During the process of fitting and riveting in column fabrication the material may be stressed locally beyond the yield point. The foregoing tables and diagrams of results show that a column may have a much different distribution of stress throughout its members than would be expected in an ideal column, which would be perfectly straight and [illegible] and which would have its integrity of cross-section preserved under load.

The tests throw some light on the question of integrity of cross-section under load. The individual channel, of course, acts as a unit to resist bending action, though there are indications of twisting. The integrity of the whole section with reference to a plane parallel to the lacing seems probable, except as twisting action exists. With reference to a plane through the axis perpendicular to the plane of the lacing, this unity of action is not so certain. The tests on the distribution of compressive stress and likewise the cross-bending tests of the columns indicate that these built-up columns did not in all cases act as a unit, but rather as two members not fully restrained by the lacing. The stresses in two channels at points in the same cross section do not give the regularity of variation which would exist if the column bent as a unit. To be in accord with the principles of column formulas of the Rankine type, there should be from end of column to middle a regular increase in the stress in one channel or in one flange of a channel and a corresponding decrease in the stress in the other. Verification by an agreement between the distribution of stress and the theory would be important. This verification was not obtained.

Effect [illegible] Columns upon Distribution of Compressive Stress.—The effect of crookedness or other irregularities of a constituent member of a built-up column may be realized if a rough analysis of the case be made. Consider a part of one of the channels forming a column, taking the length between the connections of two adjacent lattice bars. This member is under [illegible] terial, the load on this short piece is not evenly distributed over the section; that is, it is not centrally loaded, but may be considered to have an eccentricity with respect to the gravity axis. Call this eccentricity *e* (Fig. 28). Neglect any deflection of the piece under consideration due to the load. Call the compression load coming on this piece *P*; *A* its area of cross-section; *I* its moment of inertia about YY, and *r* the corresponding radius of gyration; and *c* the distance from YY to remotest fiber. Then the bending moment due to the eccentrcity is *Pe*. The maximum stress will be

[illegible]



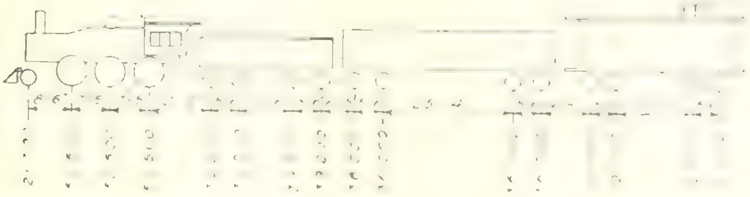


Fig. 3—Diagram of White Heath Bridge. Fig. 4—Diagram of Test Train

TABLE IV.—[illegible] LATTICE BARS UNDER LOAD [illegible] COLUMNS OF 10,000 LBS. PER SQ. IN.

c denotes compressive [illegible]

Lattice Bar.	Test [illegible] Front.	Back
1	[illegible]	[illegible]
[illegible]	[illegible]	600t
[illegible]	0	600c
4	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	300t
[illegible]	100c	[illegible]
8	[illegible]	[illegible]
[illegible]	0	300c
10	[illegible]	[illegible]
11	100c	[illegible]
[illegible]	0	100t
[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]
[illegible]	[illegible]	300c
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
18	200t	100t
[illegible]	[illegible]	0
[illegible]	[illegible]	[illegible]
21	0	600c
[illegible]	100c	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	200c	800t
[illegible]	[illegible]	[illegible]
[illegible]	200c	[illegible]

The excess of the stress in the extreme fiber of the piece over the average stress, [illegible] produced by the eccentricity [illegible] [illegible] gives the approximate excess of stress in the extreme fiber This value is applicable to the channel, or to one flange of the channel, or it may be applied to the column as a whole by using the properties of the whole section. In the single channel under consideration, *c* is relatively [illegible] relatively small, and the excess of maximum stress for a given eccentricity *e* may be expected to be relatively large. It will be seen that for an excess of 50 per cent in the extreme fiber of a channel of Column No. 1, *e*, by this formula, would be 0.045 in., and, in the wrought-iron columns, 0.057 in. A slight variation from straightness in a channel will account for considerable increase of stress.

[illegible] of Maximum [illegible] Average Stress in Channel Members.—The diagrams and data show that the compressive stress is unevenly distributed over the cross-section of the columns tested, and also that there is great variation in this distribution at various sections along the length of the column. It will be noted that in a number of sections the excess of stress was from 40 to 50 per cent. In one test of Column No 1, an excess of 67 per cent was found, and in the White Heath bridge [illegible] per cent. Possibly these values were unusual or the observations were erratic, but the indications of a fiber stress of from 40 to 50 per cent in excess of the average stress were not uncommon.

It may be seen that among the causes to which the high fiber stress may be attributed are (a) non-straightness of the column as a whole, (b) non-straightness of the component channels, or eccentricity in the delivery of stress to them by the lacing, and (c) unknown eccentricity in the application of the load. It [illegible] the increase of stress may be due to any one of these conditions. A study of the tests of Column No. 1 shows that generally only a small [illegible] straightness of the column [illegible] but few cases is it found to be more than, say, [illegible] per cent [illegible] the excess attributable to this may be estimated to be between 20 and 25 per cent. The effect of non-straightness of the individual channels seems to be greater. At several points the excess of stress attributable to this cause appears to be from 30 to 50 per cent. As already noted, a kink in the channels of 0.045 in. would give, by the analysis made, an eccentricity sufficient for a 50 per cent increase in stress. Not all of this crookedness [illegible] between [illegible]

TABLE III.—MAXIMUM OBSERVED FIBER STRESSES IN FLANGE MEMBERS OF COLUMNS

No.	Test No.	Feature of lacing	Method of loading	Excess of maximum fiber stress over average stress per cent highest five values
1	1	1¼x7/16 in. bolted	Central	42, 41, [illegible], 31, [illegible]
1	2	1¼x7/16 in. bolted	Slightly eccentric	[illegible], 64, [illegible], 49, [illegible]
1	3	1¼x7/16 in. bolted	Slightly eccentric	50, 41, 35, 32, 19
1	4	1x¼ in. bolted	Central	[illegible]
1	5	1x¼ in.	Central	67, 55, 49, 29, 27
2	6		Central	31, [illegible], 23, 21, 17
3	7		Central	20, [illegible], 12, 11, 9
4	8		Central	41, [illegible], [illegible], 22, 19
5	9		Central	43, 43, [illegible], 35, 35
4a	10		Central	53, 43, [illegible], 40, 37
2a	11		Central	21, 16, 13, 12, 11
2a	12		Oblique Arm 1 in.	[illegible], 42, 24, 23, 20
2a	13		Oblique Arm 2 in.	35, 34, 22, 21, 21

TABLE V.—MAXIMUM OBSERVED FIBER STRESS IN FLANGE MEMBERS OF COLUMNS IN WHITE HEATH BRIDGE

[illegible]	[illegible]	U_3L_3 North [illegible] Double 15° riveted at crossing	U_3U_4 South F 3 Cover plate on top. Double 45° on bottom
[illegible] stress in an extreme fiber, lbs. per sq. in.	[illegible]	[illegible]	6,200
[illegible] over average, per cent	73	64	20
	[illegible]	48	19
	[illegible]	41	17
	[illegible]	31	17
Highest five values.	[illegible]	31	17

[illegible] of [illegible] application of the load, will vary with the construction. In Column No. 1 the effect of undetermined eccentricity of application of load appears to be not nearly as great as the effect of non-straightness of the component channels.

In the wrought-iron columns, which are much stockier, the lack of straightness in individual channels has less effect, seemingly less than 15 per cent, and much the larger part of the high fiber stresses appears to be due to general column eccentricity or to eccentricity of loading.

The results for the posts of the White Heath bridge are of interest in this respect. It is evident that the effect of non-straightness of channels was not large, and also that the effect of non-straightness in the column as a whole was relatively small. There is, however, an evident bending in the direction of the web of the channels. For example, in U_3L_3 South, the back side of the channels has the maximum stress at the top and the front side at the bottom. The bending moment producing this may be due to obliquity of end pressures or to a bending by the connecting floor-beam and top cord. A twisting action is also apparent. Posts U_3L_3 North gave quite similar results.

Effect of Cover-plates and End Connections.—In the tests of the White Heath bridge, the effect of the cover-plate seems striking. The upper chord, U_3U_4, composed of two built-up channels with one cover-plate, gave an excess fiber stress of 20 per cent at the worst section, while the post, composed of two channels laced on both sides, gave a maximum of 73 per cent. The high value in the posts may be due to other causes, but it seems reasonable to expect that the cover-plate will act to reduce the irregularities in fabrication. Engineers have stated that columns having a cover plate are fitted into their places during erection with less labor than is required for columns with lacing on both sides. Tests on the stress distribution of such columns would be valuable as affording a basis of definite comparison.

The connections of the ends of posts evidently exerted a very noticeable effect on the stress distribution. In one of the posts tested, the stress was greatest at one corner of the post at the top and at the diagonally opposite corner at the bottom. It will be remembered that the posts were riveted to the top chord, and were conneced with the lower chord by pins. The floor-beams were riveted to the sides of the posts, and this connection affects the stress distribution. Readings of deformations taken on the floor-beams and posts show that the loaded beam was partly restrained at the ends of the post, though this restraint introduced a bending moment at the end of the post only about one-quarter as great as at the center, and that there was an appreciable bending in the post.

Stresses in Column Lacing.—It is evident from the tests that the relative stress in the two channel members varies considerably from end to end and that the stress in the lattice bars also varies. It seems probable that the transverse shear developed may be traced largely to irregularities in outline, or at least that these irregularities may be expected to cover up other causes of stress in the lacing of centrally-loaded columns, if we include in such irregularities all unknown eccentricity. The futility of attempting to determine analytically the stresses in column lacing, using as a basis either a bending moment curve which varies regularly from end to middle or an assumed deflection curve, is apparent from a study of the variation of stress in the columns of the tests and in that of the lattice bars.

The Values Given in Table 6.—Values obtained in these experiments indicate maximum average stresses in the bars such as would be caused by a transverse load ranging from 2 per cent to 6 per cent of the central compression load or of a transverse shear of 1 per cent to 3 per cent of the load.

Compressive Strength of Lattice Bars.—The results of tests to destruction of individual lattice bars (flats) are fairly well represented by the formula:

$$\frac{P}{A} = 21{,}400 - 45\,\frac{l}{r}$$

where P = load at failure in pounds, A = area of cross-section in square inches, l is the distance in inches from center to center of rivet holes, and r is the radius of gyration, in inches, of the cross-section of the lattice bar. The results of the tests were adjusted so that this formula applies to material having a yield point of 40,000 lbs. per. sq. in. These results may be considered to be applicable to "under" lattice bars. For "over" bars it seems probable that the average stress at failure would be considerably less. If $\frac{l}{r}$ is 0 in the above formula, that is, if we have a very short lattice bar, the average stress over the bar at failure would be 21,400 lbs. per sq. in. If the extreme fiber stress in this short bar is 40,000 lbs. per sq. in., the yield point of the material, the equivalent eccentricity of loading (e) which would produce this, may be found from the equation

$$40{,}000 = 21{,}000\ (1 + \frac{e \times \frac{1}{2}t}{r^2}),$$

where t is the thickness of the bar. The resulting e is found to be very nearly $\frac{t}{7}$. We may then regard the lattice bar to have been loaded with an initial eccentricity equivalent to $\frac{1}{7}$ the thickness of the bars.

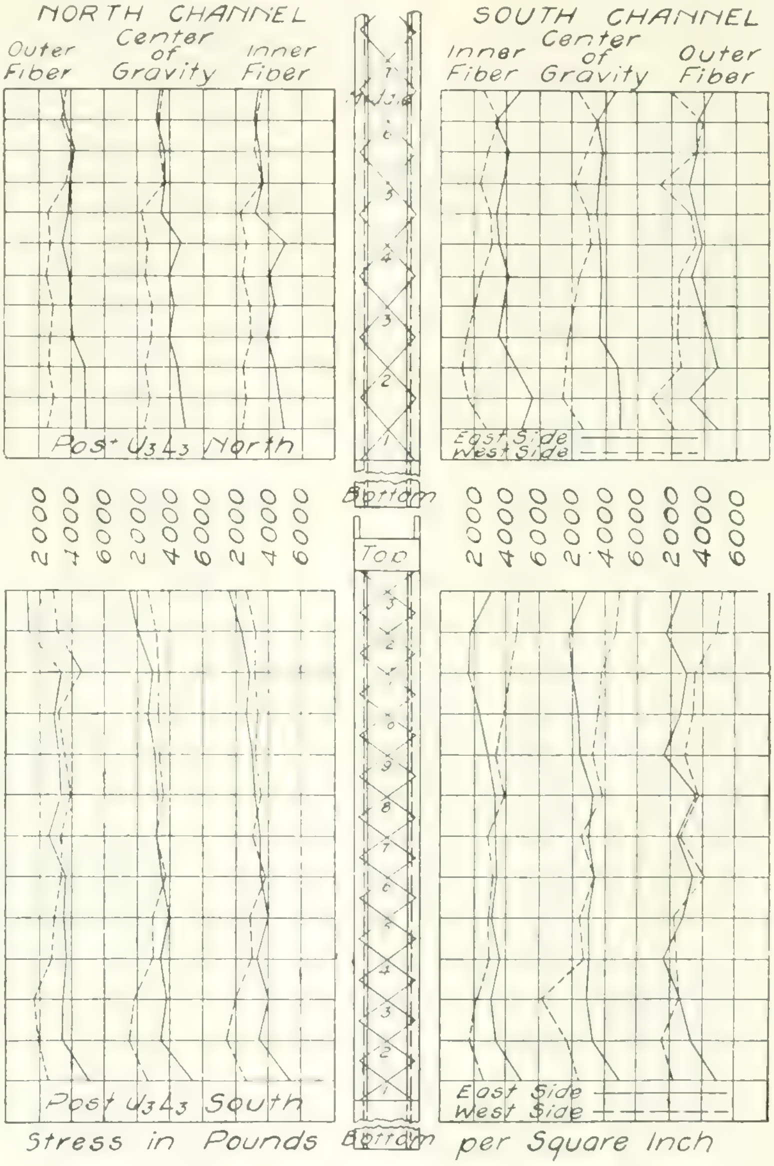


Fig. 5—Stress Distribution in Channels of Posts V_3 L_3, North and South, of White Heath Bridge.

Effect of Form of Section.—The large variation in stress over a cross-section of the column and the marked changes in stress from section to section along the column are evidently due to local crookedness, local eccentricity, lack of rigidity of lacing, and other variations which may be independent of the general flexural curve usually assumed in de-

TABLE VI.—COMPRESSION TESTS OF LATTICE BARS.
Average of two specimens.

Section of bar, inches.	Distance c. to c. of rivet holes, inches.	$\frac{l}{r}$	Stress at failure lbs. per sq. in.	Stress at failure for steel of 40,000 lbs. per sq. in. yield point* lbs. per sq. in.
1½x¼ flat	20	277	[illegible]	8,900
1x⅜ flat	20	184	12,900	12,200
⅞x7/16 flat	20	158	14,500	15,000
1½x¾x⅛ channel	20	90	20,800	19,400
1½x1½x⅛ angle	20	43	22,600	20,100
1½x¼ flat	13½	187	15,400	13,800
⅞x7/16 flat	13½	107	[illegible]	16,800
1x⅜ flat	13½	124	[illegible]	15,900
1½x¾x⅛ channel	13½	61	bolt sheared	..
1½x1½x⅛ angle	13½	29	bolt sheared	...
1½x¼ flat	8½	118	17,300	15,500
⅞x7/16 flat	8½	67	18,100	18,700
1x⅜ flat	8½	78	18,300	17,200
1½x¾x⅛ channel	8½	38	bolt sheared	..
1½x1½x⅛ angle	8½	18	bolt sheared	

*The values in this column were obtained by multiplying the observed strees at failure by $\left(\frac{40{,}000}{\text{yield point determined from tests}}\right)$

riving the usual formulas for column strength. It would seem that the form of section (including in this term the relation of the thickness of the metal to the section as a whole) has a bearing on the strength. The thinner and flimsier component angles and channels are more liable to receive kinks, bends and distortions before and during punching and riveting in the shop, and in the later transportation and erection than are the stockier sections. The value $\frac{ec}{r^2}$ of the formula above may be expected to vary with the form of section used. Besides, some sections are better fitted to withstand lateral twisting or diagonal distortions and to preserve the integrity of the cross-section than others. The wrinkling tendency in plates and thin parts under compression, heretofore referred to, is another element affecting the strength of columns. It may be expected, then, that differences in section, in type of component parts, in method of relating and tying the parts together, and for the same type of section differences in relation of thickness of parts to extreme dimensions of sections, will have an important influence upon the compressive strength of columns. It follows, therefore, to give the best results, that the section of the column, and its web construction, should be chosen so that (1) the shop processes shall leave the component parts of the column in the best condition (giving the minimum of bending, buckling, twisting and interior eccentricity), and (2) the section will be adapted to resist local lateral bending and twisting action. Evidently, different forms of section may be expected to give considerable difference in strength. This difference has been recognized heretofor in formulas which have been proposed and used for certain types of columns.

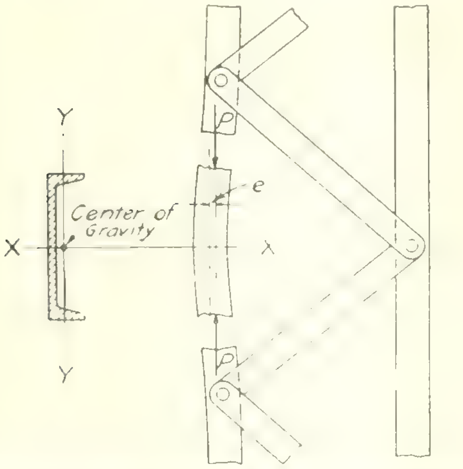


Fig. 7 Typical Irregularity in a Component Part of a Built Up Column.

Effect of $\frac{l}{r}$.—A study of the tests does not show any relation between the stresses actually observed and the stresses computed by column formulas. The high stresses do not come where the curve of flexure used as the basis of formulas of the Rankine type would place them, and the position and amount of the maximum stresses are very irregular. Although there is little range in the slenderness ratio ($\frac{l}{r}$) of the columns tested, no effect is noticeable for what the value of $\frac{l}{r}$ would seem to have much influence. This view seems to be in disagreement with theoretical considerations. The lengths for which Euler's formula may be expected to govern column strength are much greater than the length tested, and probably are higher than is generally assumed in engineering literature. Within the critical length at which Euler's formula governs, the general flexure of the column as a whole under load has less influence upon the strength of the column than is ordinarily assigned to it, and therefore the influence of $\frac{l}{r}$ is not as great as is represented in the usual column formula. Of course, the longer the column the more the amount and influence of its defects may be. The recent tests of columns at the Watertown Arsenal indicates that, within the range of lengths tested ($\frac{l}{r}$, 25 to 175), the reduction in strength at elastic limit with increased length is relatively small, perhaps not much more than may be due to increased variation from straightness and homogeneity. In this connection it should be noted that the column formulas in common use give altogether too high strengths for short columns, if the elastic limit is to govern. So far as ultimate strength is concerned, tests show the strength of short columns to be considerably above their elastic limit, but beyond a limit of, say, 35 for $\frac{l}{r}$, there is much less difference between elastic limit strength and ultimate strength.

Column Formulas.—That the column formulas in common use have limitations, has been well understood, but the effect which the conditions of the component parts of a compression member exert on the distribution of stress over the section has not been appreciated, nor has that of eccentricity of connection of latticing, and of the possible non-integrity of section. It would seem quite probable that, for columns of the same length and containing the same amount of metal, one which is of stocky form and in which the metal is distributed so as to resist local flexural and torsional action will be much stronger and more satisfactory than a column of more flimsy form, which has its metal spread in thinner sections, even though the slenderness ratio, $\frac{l}{r}$ of the former may be considerably more than that of the latter. It seems reasonable to expect that a form of section which resists lateral bending, torsional and collapsing stresses will be much more satisfactory than a more flimsy type of column, for the lengths most common in ordinary bridge construction. If these statements are trustworthy they express an important principle. For the longer lengths, the slenderness ratio must exert a

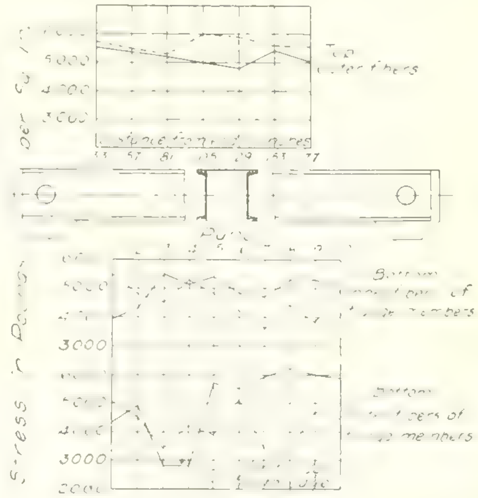


Fig. 6—Stress Distribution in Upper Chord V_3 V_4 of White Heath Bridge.

TABLE VII.—RESULTS OF TESTS TO FAILURE.

Column No.	1	1	2	3	4	5	2a	4a
Test No.		17	6	7	8	9	13	10
Material	Steel	Steel	W. I.	W. I.	W. I.	W. I.	W. I.	W. I.
Method of loading	Very slight obliquity	Central	Central	Central	Central	Central	2-in. oblique (Fig. 6)	Central
Load at failure, pounds	150,000	440,000	466,000	480,000	[illegible]	492,000	475,000	475,000
Average stress at failure, lbs. per sq. in.	8,060	23,450	26,400	27,200	25,700	27,900	26,900	26,900
Average stress at failure in tests of short pieces of flange members, lbs. per sq. in.	....	....	36,800	36,800	36,800	36,800	36,800	36,800
Percentage of excess of ultimate strength of short pieces over column strength	...	...	[illegible]	35.5	43.5	32.0	37.0	37.0
Load at first sign of yielding, lbs.	150,000	225,100	317,000	264,000	256,000	264,000	.	..
Average stress at first sign of yielding, lbs. per sq. in.	8,060	12,000	18,000	15,000	14,500	15,000	.	...
Method of failure and remarks	Very sudden buckling of lacing bars in upper half	Sudden buckling of flange between adjacent lacing bars	[illegible] failed	End failed	End failed	Bowed at middle in plane perpendicular to lacing	Buckled near bottom in plane parallel to lacing	Bowed at middle in plane perpendicular to lacing

[illegible] component angle, channel, or other structural [illegible] provision that the slenderness ratio of the component member shall be less for the length between the points of attachment of lacing than the slenderness ratio for the column as a whole, and have given little attention to the possible non-integrity of the section or to the probable effect of imperfections of manufacture. Fortunately, the large influence of the slenderness ratio in column formulas has given sections with which failures have not occurred. Whether a column formula should include a factor depending on the form of the section and the relative thickness of the metal, or whether the allowable stresses for any form of column should be based on experimental data for the section used, will depend on future developments.

Bituminous Roofing Materials and Built Up Roofs of Felt and Pitch.*

THE BITUMINOUS ROOFING MATERIALS

Information concerning the relative value of the bituminous materials for roofing is not easily available. The detailed knowledge held by the leading concerns preparing the materials has been acquired by expensive experience and is regarded as a valuable asset not to be shared by possible competitors and the ignorant purchaser. Those supposed to be expert in the matter, the manufacturers and the engineers, differ widely in their statements as to essential details.

The quality of the salesmanship is often below that of the roofing. The roofing advertisements are generally full of buncombe and the representative is sent out with a stock of talking points, many of which are misleading, to say the least.

Those who have listened have been filled with confusion. We have endeavored to present some points which might help to clear up this confusion.

The bitumens are compounds of many different hydrocarbons with different chemical formulas and widely-varying melting points. They are always accompanied by greater or less amounts of impurities, and are obtained either naturally or as the heavier distillates or residues of coal, petroleum or other organic substances. Their distinguishing characteristics are their elasticity and binding power or adhesiveness, their considerable immunity from action by water and their solubility in oils and certain other organic compounds. The bituminous substances vary so, and the knowledge concerning them is so limited and new that considerable confusion in regard to nomenclature and classification exists.

In the commercial preparation of the different bitumens obtained from coal and petroleum, distillation is used to mechanically divide them into classes of compounds having similar physical qualities. When in this process sufficient heat is applied to cause a chemical breaking down of some of the hydrocarbons, which ordinarily tends to separate them into their constituents, the operation is termed cracking.

Asphalt.—The term asphalt is ordinarily considered as referring to bitumens found naturally in the solid state and will be so used in this discussion. These are obtained all over the world with widely-varying qualities. Mention will be made of those most important commercially in this country.

The asphalts are generally stable in the atmosphere. As found naturally, they are not commercially available, even after the impurities are removed, being too hard and brittle for most purposes. This is ordinarily remedied by softening or fluxing with various oils, an operation requiring skill. The character of the fluxes has a most important effect upon the finished product. Petroleum products are ordinarily depended on for this purpose. The fluxes should be sufficiently stable to insure against too rapid hardening of the fluxed asphalt. They should be free from deleterious constituents and should be of such a character that they will combine with the asphalt to be fluxed so as to make a homogeneous and perfect solution. Certain fluxes which work well with certain asphalts are not at all suitable for use with other asphalts. Poor results are sometimes supposed to be due either to chemical action in the fluxes or to chemical action between the fluxes and the asphalts. Tars are sometimes employed for fluxing purposes, but they do not mix easily with the asphalt. As asphaltic compounds age they tend to become brittle and hard, losing their elasticity and binding power. Poor fluxing hastens this process.

Commercial refined asphalts intelligently and honestly refined should and do run very uniform. When they are compounded, however, brand names have very little significance, and less value, and should not be taken in themselves as indicative of the character or value of the compound. Some types of asphaltic compounds properly prepared and used have qualities which make them almost indispensable for some classes of roofing.

The asphalt which has been most widely exploited in the United States is that which comes from the Island of Trinidad. This occurs in a large deposit and has the valuable feature of being unusually uniform in quality. As mined it contains large percentages of water and of mineral matter in a finely divided state. There are also some soluble salts present in small quantity which possibly may help to explain the fact that it is acted upon by standing water, and is not suited for use in underground waterproofing and at points where it does not have a chance to dry out. This is not so serious a defect in a street pavement where the surface coating is made dense and where the pavement is covered by water for short periods only, although where depressions collect standing water deterioration soon results. Sunlight affects it somewhat but it is not volatile in the atmosphere. Perhaps thirty per cent may be considered as a fair average of the amount of flux necessary to add to it for the preparation of an asphaltic roofing cement. To prepare it for use the water and what vegetable matter may be present are removed. Over a third of the refined product is mineral matter.

Bermudez asphalt comes from Venezuela, is not quite so uniform as the Trinidad and is softer than the other widely-known commercial solid asphalts. It contains but little mineral matter, but otherwise possesses many characteristics similar to those of the Trinidad.

In Colorado and Utah occur gilsonite and elaterite which have some characteristics in common and which are often nearly pure bitumen. Gilsonite is hard and brittle, requiring considerable quantities of flux to make it available for use. It is not always uniform in its qualities. It is to some extent exported and is used for varnish. It is claimed as the base of many of the asphalt roofings but is not a good saturant. Elaterite is more expensive, is softer than gilsonite and is not found in such large quantities. Some manufacturers of roofing claim to use it. We have not heard of its having any special superiority.

Grahamite or "Choctaw" which comes from Oklahoma is not much used for roofing. It does not dissolve readily in the ordinary fluxes and in its physical characteristics is more like soft coal.

Southern California has deposits of asphalt of excellent quality but their cost of mining and the excellent character of the California oil residuals has driven them out of use. When California asphalt is mentioned the oil residuals are ordinarily referred to.

Rock Asphalt or Mastic Rock.—Sandstone saturated with bitumen is found naturally in various places in the country, principally in California. It is sometimes known as mastic rock, and is more valuable for paving and floors than for roofing or waterproofing, where is is rarely used.

Maltha.—Maltha, in this country found mainly in California, is a semi-liquid asphalt containing light oils which tend to evaporate upon exposure to the atmosphere, leaving what is practically an asphalt. It grades into the California petroleum and deposits are not extensive enough to be of importance commercially. There are underground deposits of this material so heavy that they cannot be pumped and for which no practicable schemes of extraction has been devised.

Petroleum Residuals.—The petroleums found in the United States vary in quality according to their location. Hubbard* divides the important deposits into six fields, as follows:

Appalachian—From western New York through western Pennsylvania, eastern Ohio, northwestern West Virginia into eastern Kentucky and Tennessee.

Lima-Indiana—Northwestern Ohio and eastern Indiana.

Illinois—Southeastern Illinois.

Mid-Continent—Southeastern Kansas, eastern Oklahoma and northern Texas.

Gulf—Louisiana and all of Texas except the northern portion.

California—Southern California.

The Pennsylvania oils are rich in the paraffines and in the lighter and more valuable illuminating oils and naphthas. Most of the California oils are practically free from paraffines and have comparatively small quantities of the illuminating oils. They are darker in color, have a greater specific gravity and have what is known as an asphaltic base. The oils found in the intermediate fields have qualities varying between the two extremes in the order named.

Eastern oils are largely made up of compounds of the paraffine series. These vary in consistency from comparatively thin oil to hard scale paraffine. While most of the paraffine compounds are useless as binding materials, many of the fluid paraffines are excellent solvents for certain asphalts and are in every way suitable for use as a flux. In the early days of the asphalt industry almost all the pavements were laid with an asphalt cement in which the refined asphalt was fluxed with a residuum high in paraffine, and the fact that these pavements gave excellent results shows that reasonable quantities of even scale paraffine are not necessarily destructive to the value of asphalt cements. The state in which the paraffine exists in an asphalt cement, i. e., whether in complete solution or not, is of much more importance than the amount present so long as this is kept within reasonable limits.

The heavy residue from the distillation of the California oils is a substance with many of the desirable qualities of the best asphalts. The crude oil is distilled down to the required density and a product obtained with even and valuable qualities. Very large quantities of California oil asphalt have been used throughout the United States for paving and roofing purposes. Its use has not been at all confined to the Pacific Coast. It is probably true that more asphalt roofing felt has been saturated with California oil asphalt than with any other kind of asphalt. This oil asphalt when melted becomes very liquid at comparatively low temperatures, and, for this reason, is especially suitable for saturating felt.

The heavy residuals of the Gulf, Mid-Continent and Illinois petroleums are used in large quantities as substitutes for asphalts, frequently under that name. They are ordinarily less expensive than the natural asphalts. As compared with the California residuals, they contain more paraffine, are lower in ductility and adhesiveness and, except that some of the residuals of the Texas oils are very stable, are in most ways inferior for roofing. Sometimes they are used as adulterants with better materials. To make them more stable and less affected by heat and cold, air is blown through them while hot. This reduces their ductility and adhesiveness as well as their susceptibility to temperature changes. The blown oils are not as good saturants as an untreated residual, but for the protective coating of ready roofings they have considerable value as they are stable and are not readily affected by the heat of the sun. They are not selected for stone-surfaced roofings because of their lack of adhesiveness.

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*Extracted from the report of the Committee on Buildings of the American Railway Engineering and Maintenance of Way Association.

*Dust Preventives and Road Binders. Wiley & Sons 1910.

THE TARS.

Coal Tar.—From the distillation of bituminous coal, either in a plant for the production of illuminating gas or in a by-product coke oven the products may be roughly divided into four classes, the gas, the ammoniacal liquor which is the scrubbing water with the materials which it has absorbed from the distillates and which it holds in solution, the coal-tar, a heavy liquid containing the distillates insoluble in water which have settled away from the ammoniacal liquor and the coke.

The coal-tar contains some water, various impurities and free carbon which after the water has been removed, is ordinarily from five to thirty-five per cent of the total. This is carbon formed by the cracking of the hydrocarbons and is in a very finely divided condition. The percentage varies with the method of manufacture. The distillates or bitumen are composed of hydrocarbons which have widely-varying melting points and degrees of volatility. These may be roughly classified into light oils, creosotes and pitches. The character of the tar varies with the coal used and the manner in which the process is carried on. The tar from each plant has its individual characteristics. The greater the heat, the more the hydrocarbons are cracked into their constituents and the greater the amount of free carbon and of gas found and the less the amount of coal-tar. By carrying the process to its theoretical limit the final products of distillation would be gas and carbon.

The question of the relation between free carbon and coal-tar is one of considerable importance. It is generally considered to be a valuable adjunct to roofing tars and pitches. Free carbon makes the material less affected by changes in temperature. Comparing two pitches of similar consistency at normal temperatures the one having the greater amount of free carbon must have to neutralize it a greater per cent of the lighter, more elastic and to some extent more volatile hydrocarbons and less of the heavy ditches. When it is cold the pitch is less brittle and when it is hot it does not flow so readily because of the carbon present. Thus a tar of a given consistency may notwithstanding the fact that it contains large quantities of an inert material apparently have more life than another with less of the free carbon.

To determine the probable action of any tar or pitch under different temperatures its percentage of free carbon must be known as well as its melting point. The free carbon does not interfere with the saturating power in felt, although it is liable to be largely deposited on the surface of the felt.

When coal-tar pitch is exposed to the weather there is found upon its surface a thin layer, hard and brittle, the residue after the drying out of the volatile oils. This acts as a sort of protective coating to what is underneath. As soon as it is disturbed exposing fresh pitch, the process is repeated. High carbon tars seem to weather better than low carbon tars, the increased amounts of free carbon seeming to aid in the foundation of the skin or protective coating.

The amount of free carbon in the commercial product is often regulated by combining coke oven tar, which because of the design of the stills is low in free carbon, with gas-house tar. The coke oven processes where much attention is given to the by-products can be made very uniform. It cannot be said that gashouse coal-tar is better than by-product oven tar or vice versa.

The statement frequently made that tar roofing material suffers in quality because it has been robbed of constituents desired in the manufacture of chemicals is not true. The lighter constituents are distilled off to leave a pitch of a certain desired consistency. In this process air or steam is frequently blown into the still. This prevents the deposit of free carbon on the sides and bottom of the still and to some extent aids the escape of lighter oils which would otherwise be held in solution. These oils if present in the pitch would tend to gradually evaporate, making the pitch unstable. The other way to remove them is to use a heat where danger of damaging the tar exists.

Watergas Tar.—Watergas is made by passing steam over hot coke or anthracite coal, which, decomposing the steam, forms carbon monoxide and hydrogen. This does not possess sufficient illuminating power, and to enrich it, there is added a gas produced from petroleum which leaves a tar often used in place of coal-tar. In the process which it undergoes the oil residues are so changed by the high heat as to lose many of their characteristics and to acquire some of those of the compounds found in coal-tar. Compared with coal-tar, its oils have less antiseptic properties. As obtained from the gas manufacturers it is thinner, containing more water, more light oils and less of the pitches and no free carbon. It is distilled down and treated much as is coal-tar and its pitch is very similar in appearance to that of coal-tar.

Watergas tar decomposes easier than coal-tar. It often contains some paraffine though ordinarily not in sufficient quantities to affect the product. The crude watergas tar is also much more affected by water and is capable to a considerable extent of forming an emulsion with it. Good coal-tar is practically unaffected by water, and it deteriorates from the surface only. Oil tar products like the oil fluxes used with asphalts are liable to undergo chemical changes which may tend to make the entire mass hard and brittle.

Watergas is now made practically everywhere and ordinarily mixed with coal gas. In one large plant from the same amounts of gas the watergas produces about a third of the amount of tar that coal gas does. The coal gas considering its by-products is under favorable conditions the cheaper, but the watergas requires less of a plant and allows greater flexibility of operation. The prices of materials and the demand for coke affect the relative outputs. In the large plant previously spoken of the proportions of coal and watergas made vary between two and three of watergas to one of coal gas.

In the larger illuminating gas plants the two sorts of tar are generally separated, but in many of the smaller plants they are mixed together. There is no reason why they should not be kept separate except for the cost of separate receptacles. In this country, the by-product oven and gas-tars, both coal-tar and watergas tars, are bought by a comparatively limited number of concerns who closely guard their processes. They compound the different sorts possessing varying characteristics, endeavoring as far as possible with their supply and their desire for maximum profits to meet the needs and demands of the consumer. The consumer in his ignorance does not know what he is getting and probably usually does not know what he needs. The detection of oil-tar in coal-tar products is a difficult and uncertain matter, especially when it is under twenty-five per cent of the total. We are not sure that it has been proven that a reasonable amount of watergas tar seriously injures a coal-tar for roofing purposes, especially when [illegible] generally in disfavor.

Not long since practically the only use of tar was for roofing and the entire supply came from the manufacture of illuminating gas from coal. The situation has been changed by the increasing supply from by-product ovens, by the manufacture of water gas in large quantities, by the great demand for creosote oils and other by-products, by the use of coal-tar for waterproofing masonry, by its use for briquetting coal slack and by its adoption for use as a road binder as a protection against the ravages of the automobile.

We would sum up the remarks on the bituminous materials as follows:

With skill in compounding, based on a thorough working knowledge of the materials [illegible] natural asphalts and oil residuals with valuable qualities for many different roofing needs, whose durability under known conditions can be foretold with considerable accuracy. The same can be said, perhaps with more certainty as to results, of the different tars. Either can suffer from adulteration and poor preparation. Considering first-class materials the coal-tar is cheaper, more easily affected by temperature changes, and is not acted upon by water nor is it liable to internal chemical changes.

From these compounds the only definite information that can be furnished by laboratory tests as to probable life and weathering properties is negative in its nature and quite inconclusive. Specifications to be enforced must include factory inspection and knowledge of materials used.

In preparing this information, we have had assistance from many sources. We are especially indebted to Messrs. Dow & Smith, Chemical Engineers, New York City. Dust Preventives and Road Binders by Prévost Hubbard (Wiley & Sons, 1910) gives a review of the different bitumens, with considerable information about them, which should be of value to all interested in the subject of roofing though in some points his statements do not obtain general approval. The qualities essential to a good road binder are to a certain extent those valuable in a roofing material.

FELTS

The felts used with almost all bituminous roofings play a very essential part in the final product.

The desirable qualities of the felt vary with the saturating material to be used. With asphalt, saturating power is the main desideratum. For coal-tar which under heat is much more liquid, this quality is not so necessary. All must be strong enough to avoid damage in handling before saturation. The strength of the finished product is due to a great extent to the saturation.

The felts are mainly made of rag stock which is chiefly cotton rags. Notwithstanding the statements of many manufacturers, all-wool felt is never used for roofing, because of its expense and because it would be too soft and tender to work. A certain proportion of wool rags helps to make a felt which is open and spongy with considerable saturating power. The best felts for saturation by asphalt rarely contain more than 25 or 35 per cent of wool, and those for use with coal-tar contain much less. As ordinarily used the term wool-felt applies to a soft open felt with very little wool in it.

Sometimes paper stock, which is ordinarily wood pulp, though it may contain an appreciable percentage of straw, is used in small quantities if the felt is getting too soft. It has practically no saturating power but it can add to the cheapness of the material. If used in anything over two or three per cent it is an adulterant to cheapen the product when it is made to sell roofing manufacturers, or to make it less absorbent, as in the case of slaters' felt or hard felt for making up into two and three ply coal-tar felt.

The felt materials ordinarily come to the factory in large bales already sorted with fair accuracy and are bought according to different grades. These are used together in varying proportions to get different results and to meet variations in the materials. But little sorting is done at the plant except to watch for specially undesirable constituents.

The methods of manufacture have a considerable effect on the quality of the material. The felt must be well beaten to avoid large lumps, which are sources of weakness. The felt is made on a machine similar to that used for making ordinary paper and variations in its operation determine the quality of the finished products.

The dry felts are sold by weight. The standard is the amount which would lay 480 sq. ft. If a felt weighs 28 lbs. to 480 sq. ft., it is known as No. 28. For this reason felts sometimes have their weight increased by the addition of a mineral filler. This is nothing [illegible] with the saturating power. Some specifications which require a certain weight of felt get around such adulteration by requiring that the ash in the unsaturated felt must not exceed 5 per cent.

[illegible] roofings. These are poor saturants and are more in the nature of protection to the asphalts. They will not burn or decay.

Jute woven in the form of burlap or canvas is used in some roofings to add strength. Its value is debatable. It is not a saturant like the felts and its fibers are not so thoroughly protected, making it liable on exposure to rot.

BUILT-UP ROOFS.

The main use of tar for roofing has been in the construction of built-up roofs where layers of felt saturated with tar are nailed down and by the use of a tar pitch protected and cemented together.

The following specification accompanied by the necessary diagrams gives what is considered as good practice in the construction of a flat built-up roofing on wooden sheathing.

SPECIFICATION FOR FELT, PITCH AND GRAVEL OR SLAG ROOFING OVER BOARDS.

Incline—

This specification should not be used where roof incline exceeds three (3) in. to one foot. For steeper inclines modified specifications are required.

SPECIFICATION.

Roofing—

First, lay one (1) thickness of sheathing paper, or unsaturated felt, weighing not less than five (5) lbs. per hundred (100) sq. ft., lapping the sheets at least one (1) in.

Second, lay two (2) plies of tarred felt, weighing fourteen (14) to sixteen (16) lbs. per hundred (100) sq. ft., lapping each sheet seventeen (17) in. over the preceding one, and nail as often as is necessary to hold in place until remaining felt is laid.

Third, coat the entire surface uniformly with straight run coal-tar pitch.

Fourth, lay three (3) plies of tarred felt, lapping each sheet twenty-two (22) in. over the preceding one, mopping with pitch the full twenty-two (22) in. on each sheet, so that in no place shall felt touch felt. Such nailing as is necessary shall be done so that all nails will be covered by not less than two (2) plies of felt.

Fifth, spread over the entire surface a uniform coating of pitch, into which, while hot, imbed not less than four hundred (400) lbs. of gravel, or three hundred (300) lbs. of slag, to each one hundred (100) sq. ft. The gravel, or slag, shall be from one-quarter (¼) to five-eighths (⅝) in. in size, dry and free from dirt.

Flashing—

Flashings shall be constructed as shown in detailed drawings.

Labels—

All felt and pitch shall bear the manufacturer's label.

Inspection—

The roof may be inspected before the gravel or slag is applied by cutting a slit not less than three (3) ft. long at right angles to the way the felt is laid.

N. B.—To comply with the above specifications, the materials necessary for each one hundred (100) sq. ft. of roof are approximately as follows: 100 sq. ft. sheathing paper, 80 to 90 lbs. tarred felt, 120 to 160 lbs. straight run coal-tar pitch, 400 lbs. gravel, or 300 lbs. slag.

In estimating felt, the average weight is practically 15 lbs. per 100 sq. ft., and about 10 per cent extra is required for laps.

In estimating pitch, the weather conditions and expertness of the workmen will affect the amount necessary for the moppings, and to properly bed gravel or slag.

The sheathing paper or unsaturated felt is placed on the bottom next to the roof boards, mainly to keep any pitch which might penetrate the two-ply felt above it from cementing the roofing to the sheathing. It also is of value in preventing the drying out of the roof through open joints from below. The saturated felts should be nailed where there is any chance of disturbance of the roof from underneath by wind and also enough to hold it in place while laying. The practice in regard to nailing varies in different parts of the country but the fewer nails the better so long as the roof is held in place.

For a concrete roof the practice is similar except that a dry sheet is not necessary, there is no nailing and the concrete is first coated with pitch. Special care should be taken in regard to flashing and to prevent the roofing from being loosened at the edges either by wind or fire. Most leaks occur around flashings and openings.

The two layers of saturated felt first laid are necessary in order to carry and give full value to the amount of pitch which must be handled in one mopping. One of the troubles with built-up roofing as ordinarily laid is the difficulty in getting thorough moppings between the felt layers.

The felts are saturated with tar about as it comes from the gashouse with the water and other impurities removed. Oil-tar with its liquid qualities is said to be much used for this purpose. This is more permissible than it would be if the felt were to be exposed.

After the original two layers of saturated felt are used, the additional layers are merely to give additional thickness of wearing material, and with a roof properly laid, the greater the amount of felt and pitch used the greater the life of the roof. Ten-ply roofs have been laid. If too much pitch on top it used, it will run.

The pitch, much stiffer than tar, is made by distilling off the lighter oils and part of the creosote oils from the tar. The melting point of the pitch, a very important matter, depends upon the point to which the distillation is carried and the amount of free carbon. This should be varied somewhat to suit climatic conditions. Pitch for use in the fall in Winnipeg would be very difficult to work in New Orleans in the summer. The melting point of the pitch is not definite and in defining it a special specification is necessary. The use of a pitch with a melting point too high to allow satisfactory working and requiring the addition of fluxes on the work, giving a "cutback" pitch, is very liable to give uncertain results and should not be allowed. Worse than this is the use of tar or soft pitch stiffened by the use of land plaster, Portland cement or similar materials. This not only is uncertain in its results, but it gives a product liable to have short life. The best practice allows the use of nothing but straight run pitch.

The coating of gravel, crushed stone or slag helps to hold the pitch in place, protects it from wear and from the action of the elements and has considerable fire retardent value. If the material be too fine its holding power is lessened. If it be too large the stones are more apt to roll off and to damage the roof when it is walked upon and the pitch is not properly protected. Crushed material with its rough, sharp edges has a much better holding power than rounded gravel. It can be used to help get results on a steep roof. Sand or dirt with the gravel is objectionable, as it tends to prevent the gravel from bedding in the pitch and sometimes it mixes with the pitch, the resultant being more inert and liable to crack than the clean pitch.

In the final coating of a coal tar roof the effort is to get the maximum amount of pitch coating which can be kept in place. The flatter the roof the greater the amount of pitch that can be used and the better both pitch and gravel will stay where put. The best results are obtained when the slope of the roof is only enough to allow it to thoroughly drain. When it gets above two inches to the foot many object to its use, but the above specifications are considered by others as good practice up to three inches to the foot. Above that amount a built-up coal-tar roof, using these specifications, is of doubtful economy on permanent buildings, though fairly good results have been obtained from roofs steeper than this without special precautions. One method which gives good results is the addition of some asphalt to the pitch which is used for the top coating. This must be carefully done, as an intimate mixture of the asphalt and tar pitch is not easily obtained. The tar is often prepared for use on steep slopes by the addition of some finely-ground inert material which, as previously stated, is liable to give uncertain results. Actinolite is preferred for this purpose by some of the best roofers. Portland cement and land plaster are used but do not do as well, having chemical action on the other materials. Pitches prepared in this manner are perhaps to be preferred to stiff straight-run or asphalt pitches where skilled workmen are not available, as with the latter more skill is required in application. Slag is better than rounded gravel for steep roofs.

Where thorough inspection is not provided during construction the roof can be inspected by cutting a strip three feet long at right angles with the way the felt is laid before the gravel is applied. This can be readily repaired so that no damage is done to the roof.

When a built-up roof is in need of repair it can frequently be kept tight for a considerable time by patching and recoating, as may be necessary, with pitch and gravel. When the original roof was well laid it can be repaired by scraping off the coating of gravel and laying a new two or three ply roof on top.

Tile or brick can be substituted for the gravel or slag where the roof is liable to have much wear and when the structure warrants the expense. The tile are sometimes grouted in Portland cement, but a bituminous cement is usually considered better. Properly built this makes almost an ideal roof.

The built-up coal-tar roofs have shown by many years' trial their value for protecting flat roofs. Instances where a life of from twenty to thirty years has been obtained are not at all rare, but poor results due to poor workmanship and poor materials are not new. The claim that at the present time the ordinary purchaser cannot be sure of getting coal-tar of the quality of the best of that formerly produced would seem to have justification. At the same time, the oil-tar may be no worse than the fluxes and residuals frequently used with competing materials. Pure coal-tar and coal-tar pitch are still made, and the dealers in roofing materials can, if they desire, furnish materials as good as any which have been sold in the past. Such materials, of course, are not the cheapest and where competition is severe the quality is liable to suffer. About all that can be done to get the desired results is to be willing to pay the price and trust to the dealers.

The chances for poor workmanship are many and the most thorough inspection is very desirable. The moppings between the felts can be slighted, the flashing and work around gutters and openings neglected, the materials may be adulterated on the work and the quantities of pitch and gravel cut down. The cost of materials and the cost of laying for any job can be estimated within close limits and no contracts should be let which will require a slighting of the work to avoid a loss.

As an indication of what can be done in territory adjacent to Chicago and St. Louis the following figures may be of interest. They show the actual costs on a roof of about five hundred squares laid according to the specifications given above. The work was 75 miles from the gravel supply and 175 miles from the headquarters of the contractor, who paid all freight and fare. This work was done close to a railroad track, so that nothing was necessary for hauling to the work. Nothing is included for overhead or fixed charges or for profit.

Cost per square:

5 lbs. sheathing paper	$ .12
155 lbs. pitch at 60c per cwt	.93
85 lbs. felt to square at $1.40 per cwt	1.19
Nails and caps	.05
Cleats for flashing	.05
Gravel (about one-seventh of a yard)	.23
Labor, including hauling, board and railroad fare	1.15
Total	$3.72

Where, for temporary buildings or other

causes, a cheaper roof than the standard specifications call for is desired, a saving in the quantities of material can be made by reducing the number of plies. From this fair results can be obtained.

Plastic Roofing.—This is a sort of built-up roof used especially on steep slopes, where in place of using ordinary roofing pitch we have a compound of some fine inert substance with tar or some other bituminous material which is plastic when warm and which can be applied with a trowel. It is not extensively used and its application is mainly confined to the eastern part of the country. Except for steep slopes it has little value, as it lacks elasticity and because it requires considerable skill to get the proper proportions.

Built-up Asphalt Roofing.—Built-up asphalt roofs have been used with considerable success. Asphalt is much less affected by temperature changes. For a roofing cement it must have considerable proportions of flux to make it easy of application. Coal-tar felts are often used with asphalt roofing cements. With asphalt, the dry sheet can ordinarily be avoided. Where first-class material is used it is ordinarily expensive and it is harder to handle. Except for steeper slopes than are suitable for coal-tar, its use is not recommended unless unusual conditions make it more economical.

Asphalt coatings on a concrete deck are liable to lose their adhesion to the concrete, due possibly to destruction of the top surface of the concrete by acid in the asphalt flux. Asphalt used on a built-up roof is very liable to have a short life and the builder of built-up roofs avoids it ordinarily.

Built-up Asbestos Roofing.—There is on the market materials for a built-up asbestos and asphalt roof. The asbestos, besides its well-known fire-resisting value, has the advantage that, being mineral, it will not decay. It is not as absorbent as felt and acts more as a protection to the bitumens than as a saturant. This roofing is ordinarily applied only by the manufacturers. The fire-resisting value of the asbestos is perhaps overrated and the wearing qualities of the top layers are questioned.

This roofing should have its best value on comparatively steep roofs. We are unable to express any opinion as to its value but should judge that its expense is not justified for ordinary conditions.

PREPARED OR READY ROOFING

To compete with it and to meet some of the conditions where a built-up roof is not satisfactory or too expensive, innumerable prepared or ready roofings have been put on the market. These ordinarily come in rolls accompanied by the nails and cement necessary to apply them. They vary from a very light felt with the cheapest possible saturant and enough sand or soapstone coating to prevent sticking in the rolls, to a sheet so heavy that it cannot be rolled, built up of heavy felts and strengthening materials and saturated and protected by carefully prepared compounds, possibly protected also by a coating of crushed stone. The durability and fire-resisting value vary to as great a degree. Ordinarily the ready roofings are cheaper than other types, but some brands sell at prices considerably above the cost of a good built-up roof. To a certain extent the weight is designated by the ply, but there is no uniformity of practice among the different manufacturers. A two-ply roofing may mean a heavier weight than a one-ply, or it may mean two separate felts stuck together.

The saturant should be liquid enough at workable temperatures to thoroughly impregnate the felt. The protective coating should be stable and not easily affected by the elements. The saturation of the felt is a very vital feature. This must retain its life and elasticity to keep the roofing efficient. A protective coating of material similar to the saturation is often used with the idea of helping to maintain the life of the saturating material. In any event, the coating must be elastic like the saturated felt.

With a coal-tar roofing made to be rolled, it is impossible to use nearly as much material as is found necessary for a good built-up roofing and such a roofing, even if made in the very best manner, cannot be expected to have a life comparable with that of a first-class built-up roof. Tar is not considered the best material for a high-grade ready roofing.

To successfully saturate with most asphalts a felt much more open than that necessary for coal-tar must be used. Asphalt must be heated to a much higher degree than ordinary coal-tar to successfully saturate, and care must be taken to avoid charring the felt in the operation. Trinidad is but rarely, if at all, used for this purpose, it containing too much mineral matter and requiring too great a heat. California oil residuals are especially suitable for saturation purposes. At a temperature of 300 degrees Fahrenheit they are almost as limpid as water and at this temperature there would be no danger of charring the felt. They come between the so-called natural asphalts and coal-tar in their saturating properties and their susceptibility to changes in temperament.

The objections to asphaltic compounds for built-up roofings do not all apply for ready roofings made in the factory. Since the amount of material used is less, its cost is not of such great importance. None of the asphalts have all the desired qualities and to produce certain results compounds of several different asphalts, residual pitches and fluxes are frequently used together. It is our understanding that Trinidad asphalt is seldom used as a protective coating, except in combination with other asphalts. Tar is sometimes used as a flux. Wax tailings, a residual obtained from petroleum in the manufacture of paraffine wax, and other similar substances are common ingredients. Resin, which gives better saturating power to many asphalts, making the solution more liquid, is also used. It must not form too large a proportion of the total, as it tends to make the final product brittle. Stearine pitch is used in the coating for some of the smooth-surfaced roofings. It is an animal by-product obtained from stearic acid used in the manufacture of candles. It is said to be very stable and to be practically unaffected by the action of the sun. Some say that the amount claimed to be used in roofings is considerably greater than the total product.

The cement for use in laying, which is furnished with the roofing, ordinarily contains some naphtha or something similar which serves as a drier.

Some ready roofings are adjusted by the manufacturer to suit the climate at the point of application. One concern selling all over the world keeps careful records of the temperature at its different markets and makes shipments accordingly.

The prepared roofings may be divided into two general classes—smooth and stone-surfaced. The stone-surfaced roofings are to a certain extent an adaptation of the built-up roofings. They frequently have at least two felts cemented together. The gravel or slag used must be uniform in size and finer than that available for a built-up roof. The steeper the roof the more chance they have to lose their stone coating. The amount of material that can be used in the heavier brands is limited to the amount that can be successfully rolled. If the stone be too large, the stone may damage the felt in rolling; if too small, the amount of pitch is limited.

The smooth-surfaced roofings are usually coated with some finely divided material to prevent sticking in the roll. Tar is not suitable for their protective coating, as it cannot easily be held in place in proper quantity without the stone coating. The protective coating must be stable and not easily affected by changes in temperature. Blown oils are frequently used for this purpose. The smooth-surfaced roofings, as a general proposition, have less insulating and fire-resisting value than the heavier stone surfaced materials. For the smooth surfaced roofings a regular painting or recoating is usually necessary in order to get the best life.

Tarred felts in which there are two or three plies of felts cemented together with pitch are sold all ready to be laid. They must be covered with a tar coating upon laying and at frequent intervals to show any value at all.

The asbestos roofings are made to include one or more plies of asbestos felt, with possibly a jute center. They are cemented together by asphaltic cements. In the heavier brands they are expensive. The asbestos felts are poor saturants. These roofings have given promise of good results and are widely used. The asbestos will not burn, but the amount used is so small that its insulating value is not great, and the value of these roofings from the standpoint of fire protection is probably frequently over-estimated.

Burlap or jute canvas is used in ready roofings as a strengthening material. It is not a good saturant and must be kept thoroughly coated, as otherwise it goes to pieces readily. It is employed in conjunction with either felts or asbestos sheets. We question its value, feeling that better results can be obtained from a proper quantity of ordinary felt.

The ready roofing is weak in that with the narrow lap and a large part of the roof covered with but one layer of material a single defect can cause a leak. The fact that on a flat roof water is liable to back up under the upper layer is a chance for trouble. Care should be taken that a nail is not driven into a crack in the roof sheathing, as the nail will work out, leaving a hole in the felt for entrance of water. The exposed nailing, where it is used, may rust out and can cause a tear or leak around the nail hole. This exposed nailing is avoided in various ways. Some of the manufacturers of stone-surfaced roofings finish the upper part of the sheet, which is to be covered by the next sheet, without any stone coating. The next layer is cemented on this strip. The only nailing necessary is thus done on the covered strip, where it is covered up by the sheet above.

The use of tin caps under the head of nails to secure prepared roofing should be avoided. When used, they must be kept constantly coated to prevent the rapid disintegration of the steel plates of which they are composed. If this occurs the nail head stands clear of the roofing, which is then an easy prey to wind storms. Care should be taken in the flashing and around the edges of the roof to have it thoroughly fastened down. Nails of a No. 12 gage wire with a cap made of cold-rolled hoop steel welded on in the factory are used for this purpose. Some recommend nailing every two inches, but with large-headed nails every three inches is usually considered enough.

One of the chances for trouble with many of the ready roofings is their tendency to stretch and wrinkle and the difficulty in laying them absolutely tight and flat. As the roofing grows older and brittle the wrinkles become danger spots which are liable to crack if walked on. The roofing should be as thoroughly stretched as possible in laying. Knot holes should be covered before applying the roofing. In cold weather it is well to warm the rolls to avoid any chance of cracking.

To secure architectural effect on steep roofs a prepared roofing may be applied in various ways. For instance, by running the felt with the pitch of the roof, the joints and roofing nails can be covered with a molded batten of wood about ⅞-in. by 1½-in., the under side of which should be rabbeted out to a depth of an eighth of an inch to make room for the heads of the roofing nails. The recess or rabbet is filled with cement accompanying the roofing and then securely nailed. This not only protects the nail heads driven to secure the roofing itself but adds stiffness and further protection against high winds getting under the seams and blowing off the entire covering. Roofs so prepared have the appearance of a standing seam tin roof and the otherwise plainness of this roofing material is relieved. This adds to the cost by increasing the amount of waste as well as requiring the battens.

In order to avoid the single thickness and narrow lap the ready roofings can be used in various combinations. A two-ply tarred felt laid under a two-ply stone-surfaced roofing or two layers of smooth-surface roofing give what is practically a four-ply roof, not as good as a five-ply built-up roof in all de-

[illegible] slate and sometimes a prepared roofing is laid [illegible]

[illegible] show deterioration after they have been kept in stock for three or four months. In purchasing care should be taken to avoid old material.

The ready roofings are of value for small and isolated buildings where the cost of laying a built-up roof would be excessive and for temporary structures where a roof of long life is not necessary. They can be laid without the expert help required for a built-up roof and most brands can be used on any slopes, although on flat slopes extra precautions must be taken to prevent leaking. They can be obtained at almost any desired price, but ordinarily cheaper than a good built-up coal-tar roof.

So many inferior roofings have been sold, so many have been poorly laid or used in the wrong places, so much has had to be learned by bitter experience and there is such a chance for fraud that the ready roofings are shunned altogether by many builders who want good results. But experience is being gained gradually, and they fill many needs so well that their use is bound to increase in their proper field.

Most of the ready roofings are sold under a five or ten years' guarantee, and many contracts for built-up roofs are similarly prepared. To depend upon these guarantees alone does not give satisfactory results even though the manufacturer be financially responsible. He can expect more immediate profit by preparing a roof which he is sure will last six or seven years and selling it under a ten years' guarantee than by preparing a roof which he is sure will last for ten years. At best the life will be uncertain and with good luck a roof built for six or seven years or even less might last twice as long. If it should need extensive repairs before the guarantee runs out there is considerable chance that the manufacturer will not be called on to make the repairs, and if he is, the loss is not great. Guarantees are liable to be so worded as to afford various loopholes for avoiding expense and they should, if relied on, be carefully scrutinized. A good roofing should last much longer than any possible guarantee can provide for. If the guarantee is made good, there still may be nothing left at its expiration.

New and untried brands are constantly being put on the market. In some of the older ones which have gained a reputation inferior products are substituted. Many of the best ready roofings are made of compounds whose composition is kept secret. The only way now of being fairly sure of good results is to use a brand which has been shown by long tests to meet the desired conditions and which is made by a concern with a reputation for fair dealing. The same course would seem to be desirable in the awarding of contracts for built-up roofs, though with them track can be kept of the weight of material used and the work on the roof can be inspected.

This is not a satisfactory condition, and as indicated in the earlier part of the report it is hoped that before many years specifications can be devised which, coupled with the necessary tests and with efficient factory inspection, such as that the Underwriters Laboratories is furnishing for some materials, which is explained below, will do away with the ignorance and fraud now enveloping the bituminous roofing industry. We should then be able to buy roofing with as much certainty of quality as we can now expect in ordering steel rail. To this end our Association, working in conjunction with other [illegible] should [illegible] in part [illegible]

PERSONALS.

Mr. A. J. Fisk, Jr., assistant engineer in the U. S. Reclamation Service, and located at St. Ignatius, Mont., has resigned. He will open an [illegible] and will engage in a general civil and hydraulic engineering practice.

[illegible] past 18 years the eastern agency of the Canton [illegible] connection with that [illegible] agent of the York [illegible] with offices at [illegible] State St., Albany, N. Y.

Mr. W. Fred Mann of the Chicago Portland Cement Co., and one of the best known salesmen in the middle west, died at his home in Chicago after a brief illness on March [illegible]. He was born in Chicago in 1855, and was educated in the schools of that city. His first work was with the Republic Fire Insurance Co. At about the age of [illegible] he formed a partnership with Joseph R. Payson and others, he embarked in the hardware specialty business in Chicago. On the death of Mr. Payson in 1902 Mr. Mann sold his interest in this business and became connected with the Chicago Portland Cement Co. as salesman. He was a member of the Chicago Athletic Club, the Illinois Club and a number of associations connected with the cement and lumber trades.

Mr. David H. Moffat, widely known as the chief owner and president of the Denver, Northwestern & Pacific Ry., commonly spoken of as the "Moffat Road," died in his apartments in the Hotel Belmont, at New York City, on March 18. His death was unexpected, as he had been ill only a few hours. He was born in Orange County, N. Y., in 1839. At the age of 15 he became a messenger in a New York bank. Later he went to Des Moines, Ia., Omaha, Neb., and finally to Denver, Colo. His first enterprise in Denver was in the stationery business. Several years later he engaged in mining and real estate, and gradually accumulated a large fortune. He was one of the promoters of the Denver & Rio Grande Ry., and its president for seven years. In 1891 he severed his connection with that road to promote the Denver, Northwestern & Pacific Ry., a work that gave him a national reputation as a railroad builder.

Mr. Frederick Livingston Hart, an electrical engineer and operating officer well known in the east, died at Jamaica, N. Y., on March 23, after a long illness. He was born in Brooklyn, N. Y., July 3, 1861. He was a graduate of the Boston Polytechnic Institute. Following his graduation from that institution he secured practical experience by working for a number of years in various machine shops and electrical plants. He then became engineer in charge of the installation and operation of the electric plant of the Brooklyn bridge. Later he was connected with street railway companies in New York City, Baltimore and Washington, in the capacities of superintendent, chief engineer and general manager. For two years he was associated with the firm of Thomas Basshor, contracting engineers. About two years ago his health began to fail, and he was forced to abandon his professional work. He was a member of the American Society of Mechanical Engineers.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catlogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that yau saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Barrett Specifications.—Card 10¾x10¾ ins. Barrett Mfg. Co., New York City.

A card containing the Barrett specifications for roofing and a diagram showing the increasing cost of roofing as the angle to the horizontal is increased.

Trus-Con Structural Steel Slotted Insert.—Paper 8½x11 ins. 1 p. Trussed Concrete Steel Co., Detroit, Mich.

A circular describing and illustrating the above named insert which has recently been placed on the market. This insert is installed in concrete ceiling construction for attaching shaft hangers, sprinkler systems, etc.

Wood and Steel Filing Equipment.—Paper 6½x9½ ins. 8 pp. The Globe-Wernicke Co., [illegible] S. Wabash Ave., Chicago, Ill.

A reprint from the World's Work on "The Application of the Unit Idea to Business Conservation."

Lawrence Pumps.—Paper 9x5¾ ins. 39 pp. Lawrence Pump & Engine Co., 90 West Street, New York.

A centrifugal pump catalog containing illustrations and descriptions of numerous types of centrifugal pumps, giving tables in each case of sizes, capacity, hp. weights and prices. A large amount of useful information is given.

Universal Cement.—Paper 6x9 ins. 20 pp. Universal Portland Cement Co., Chicago-Pittsburg.

Being the March number of the company's bulletin, which describes and illustrates various cement and concrete construction.

No-Co-Ro Metal.—Paper 3½x6 ins. 16 pp. The Canton Culvert Co., Canton, Ohio.

A description of rust resisting material as used with Acme culverts. Contains results of tests made for corrosion.

Sargent Machinery.—Paper 6x9 ins. 16 pp. C. E. Sargent, M. E., Chicago.

An illustrated catalog showing gas engines and accessory machinery.

Concrete Mixer.—Paper 6x9½. 4 pp. Elite Mfg. Co., Ashland, Ohio.

An illustrated description of a "low down, forced feed, concrete mixer."

Alkali-Proof Cement.—Paper 4x6½ ins. 36 pp. Colorado Portland Cement Co., Denver, Colo.

A catalog describing very completely, a Portland cement made for use in alkali soils and sea waters. Much useful information is given.

An Ohio court has decided that a railroad company is responsible for the return of money deposited with one of its agents for transportation, if the money is handed to the person the deposit was made for instead of furnishing a ticket as requested by the depositor.

A flight of stairs has been erected in Paris over which 14,000,000 persons have shuffled without so much as scratching the surface. These steps are almost as imperishable as if they had been built of huge diamonds, for in the concrete of which they are constructed a generous proportion of carborundum has been introduced, and since carborundum is almost as hard as the diamond, it has given the concrete a wearing quality which no marble or granite could possibly approach.

According to a recent announcement by the Chicago, Rock Island & Pacific Ry. Co., a committee has been appointed the function of which will be to investigate, standardize and systematize office work and methods throughout the entire system of the road, with the object of increasing their efficiency. The appointment of the committee is in accordance with a policy of standardization adopted by the road over a year ago, and the new committee, which is officially called the "accounting committee," is the third which has been established since that time. Le Roy Kramer, assistant to the second vice-president, is chairman of the committee, and the other members include F. D. Reed, assistant to the vice-president, in charge of purchases; L. K. Luff, auditor of disbursements; E. S. Gentle, district accountant, and F. J. Easley, superintendent.

German enterprise and the German knack of systematizing everything with which a German has to do are also shown in the cautious and methodical system they have adopted in colonizing their possessions. In every case where a new territory is opening up the government makes a particular study of the physical characteristics of the land and the possibility of a German living in the climate in reasonable happiness and health. All the findings are published in open reports and every provision made to insure a successful colonization. "The Climate of Samoa," by Tetens and Linke, has just been issued by the Royal Society of Gottingen as a guide to prospective settlers in the South Sea islands, and is by far the most complete report on the Samoan climate that has ever appeared. Germany has maintained a meteorological station in Apia for a number of years, and many of their branch stations are scattered throughout the Pacific groups.

By a recent act of congress the building of an irrigation dam near Parker, Ariz., to cost $5,000,000, was authorized. By the same act the opening of the Colorado Indian Reservation was provided for. As soon as the plans are approved by the secretary of the Interior, work will begin on the project. The building of the dam will open 200,000 acres of agricultural land for settlement. The dam proper is to be 1,150 feet long and the main irrigation canal will be 75 miles long.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week.

Railroad Construction work has opened up in good style and the past week has seen the letting of a considerable number of good-sized contracts. One of these contracts was for 1,500,000 cu. yds. of work on the Kansas City Southern Ry. This contract was let to Porter Bros. of Spokane, Wash. Several contractors have already taken sub-contracts on the work, among these being List & Gifford, Davenport, Ia.; Hannan & Hickey, St. Louis, Mo., and the Lund Contracting Co., Chicago, Ill. Another good-sized contract let recently, calls for the construction of double track on the Pere Marquette R. R. between Detroit, Mich., and Toledo, O., some 40 miles. W. E. Trench & Co., Detroit, Mich., secured this contract. Another large contract which has been let recently is for the 76-mile Frederick extension of the Minneapolis, St. Paul & Sault Ste. Marie Ry. Foley, Welch & Stewart, St. Paul, Minn., were the successful contractors. In Canada the Canadian Northern Ry. has awarded contracts amounting to nearly $3,000,000 for the construction of new lines. These contracts cover a line from a point near Red Deer, Alberta, to Calgary, and 200 miles of main line west of Edmonton. The Cowan Construction Co., Winnipeg, and the Northern Construction Co., Winnipeg, received the contracts. Among the other contracts let recently, are the following: T. H. Sater, for the grading for the first two miles of the extension of the Memphis, Dallas & Gulf from Murfreesboro, Ark.; L. and G. B. Baker, for grading for the Florida Ry. from Live Oak, Fla., to White Springs, a distance of 18 miles; Charles and Robert Southern, Bulls Gap, Tenn., for grading 10½ miles of line for the Heilman Co.; William Love, Indianapolis, Ind., for the construction and equipment of the first section of the Oklahoma & Golden City R. R.; on the Sandy Valley & Elkhorn R. R., a new 28-mile line in Kentucky, Langhorne & Langhorne, Lynchburg, Va., the general contractors have awarded contracts as follows: Section 2, Pitts Co., Scottsville, Va.; Section 4, Ryan & Co., South Portsmouth, O.; Section 5, [illegible] & Waugh, Cincinnati, O.; Section 6, Bollard & Herring, Cincinnati, O. In the line of interurban railway construction several large contracts have been let. William J. Oliver, Knoxville, Tenn., secured the contract for the construction of the roadbed of the Piedmont & Northern Ry. from Greenwood to Spartanburg, S. C., a distance of 90 miles, the contract being reported to amount to $900,000. A large contract, amounting to about $500,000 and calling for power house extensions and improvements to the systems of the Augusta Railway & Electric Co., and the Augusta-Aiken Ry. Co., of Augusta, Ga., has been awarded to J. G. White & Co., New York.

An interesting development in the steel trade last week was the perfecting of arrangements for furnishing 60,000 tons of American steel for the Quebec bridge in Canada. The general contract has been awarded the St. Lawrence Bridge Co., Montreal, Que.

The State Railroad Commission of Michigan has authorized the Grand Trunk R. R. to issue mortgage bonds of $30,000,000 for the purpose of extending and improving the service and to permit the western division to purchase the Pontiac, Oxford and Northern branch. The company will have jurisdiction over the expenditure of $23,000,000, and the remaining $7,000,000 will [illegible] consent of the commission.

The Pennsylvania State Senate has passed finally the Reynolds-Breitinger resolution for a constitutional amendment that would allow Philadelphia practically unlimited moneys for the construction of subways, wharves and docks and to reclaim waste lands. The amendment would further permit that city to float a bond issue for general municipal improvements provided that the city's income from the improvements exceeded the interest on the loans. The approval of the governor, now, is not necessary. The bill will be submitted to the voters at the coming November election, and if then accepted the money can be obtained by floating a bond issue in 1912. This, too, would necessitate the consent of the voters.

A bill has been passed by the California state senate, Sacramento, providing that automobiles shall pay a graduated annual license fee into the state treasury to be used in the maintenance and improvement of the state roads. The state will receive an additional revenue of approximately $400,000 per year under the law. The machines are to be taxed according to their motive power.

A large dredge ditch contract has just been awarded by the commissioners of the North Fork Special Drainage District of Broughton, Ill. Colman & Sons, Paragould, Ark., secured the contract at 6¾ cts. per cu. yd. The contract calls for 38 miles of ditch and involves the moving of about 1,900,000 cu. yds. of material.

100 Miles of Turnpike In a Day.

[illegible] quickness with which they [illegible] uncommon in these days. A [illegible] was built in Waco, Tex., in a single day. Everything was in readiness for the job, all arrangements for timber and men having been made. On the morning of the day that the church was to be built not a [illegible] o'clock the teams began to arrive and the un[illegible] fall the church was erected and a prayer meet[illegible] sunrise and sunset of one day. This last feat of highway construction is in a way to be [illegible] it is now proposed to build 100 miles of turnpike between Monte Ne, Ark., and Muskogee, Okla., in a single day. The prime mover in this turnpike job, it may be noted, is "Coin" Harvey, who came into prominence during the 16 to 1 silver agitation of '96. Judged from the way he ripped things up at that time the road will be built in the specified time. This [illegible] equalled by a piece of railroad re-making which took place many years ago. This latter [illegible] the line of railway from Salamanca, N. Y., to Dayton, O., in a few hours on a Sunday. This line of railway is now a part of the Erie system. All of the preparations for the work were, of course, made in advance, the ties being trimmed off for the shifting of the rails and the spikes driven partly in on the inside. When the day came, men were stationed along the entire line from Western New York to Southwestern Ohio, and they did their work with the clock, everything being accomplished without a hitch. The work was simple, requiring the setting over of the rail and the driving of the spikes outside and inside.

Compulsory Compensation Act Un-Constitutional.

The highest court of New York city, the Court of Appeals, has declared unconstitutional the workmen's compulsory compensation law. This law affected practically every contractor doing business in the state. The main features of the law were that it required employers of labor in certain occupations such as bridge building, operators of elevators, work on scaffolds, work on electric wires, work with explosives, work on railroads and in tunnels and work carried on under compressed air, which were declared dangerous occupations, to compensate their employes for any injury occurring during the course of the work, although such injury occurred solely through the negligence of the workmen. The law was modeled by the Workmen's Compensation Act of 1897 of Great Britain. It was passed by the State Legislature last year. The Court of Appeals held that the act would deprive the employer of his property without due process of law in violation of the state and federal constitutions. The opinion, which was concurred in by all the members of the court, points out that the effect of the act is to abrogate what is known as the "fellow servant" doctrine and also to "contributory negligence" rule, both of which have heretofore been well settled in the jurisprudence of the state and country.

The Long Green and Friendship.

William S. Devery, the "best Chief of Police New York city ever had," has a keen insight into the workings of human nature; he is also something of a philosopher. At the last annual dinner of the Credit Men's Association of the Building Trades in New York City, Mr. Devery was one of the "orators" and in the course of his remarks he said:

[illegible] you money to pay up. Well, if you can't get [illegible]

The Canadian Northern Ry., according to a reported statement of D. B. Hanna, Third Vice President, according to the present plans will be linked up from ocean to ocean by the fall of 1911. The next big stretch to be under[illegible] clay belt; this will be completed in 2½ years.

W. H. Bancroft, Salt Lake City, Utah, Vice President and General Manager of the Oregon Short Line R. R., has been making an inspection tour over the Idaho lines of the company for the purpose of determining what sections of the Idaho division between Granger and Huntington, shall be double-tracked this year, under the double-tracking program outlined [illegible]

RAILWAYS, STEAM AND ELECTRIC

Alabama.

All arrangements are said to have been made for the construction of the new car line from Birmingham to the top of Shades Mountain, and it is understood that work will be started shortly. The line will be four miles long and is to be completed in about four months. It will be built for the High Point Land Co., of which Eugene Fies, Birmington, Ala., is President.

In order to develop its recently purchased property in the Anniston District it is said that the Great Southern Iron & Development Co. may take steps to build a railway, furnishing an outlet to the south by connecting with the Atlanta, Birmingham & Atlantic at Pyriton or Lineville. The company recently purchased the extensive iron ore lands in the Shinbone valley.

As previously noted, the Mary Lee R. R., a 7-mile line operated by the Alabama Consolidated Coal & Iron Co., has been sold to James Shaw of Boston, Mass. A connection is to be built to Brookwood and thence to the Warrior River

The Tidewater Ry. Co. has made its $30,000 deposit with the city of Birmingham for the franchise for its proposed railway, and is said to be planning to have active construction work under way by the last of April. J. M. Dewberry, Birmingham, Ala., is President.

The Edgewood car line is to be extended a distance of about one mile to the top of Shades Mountain, near Birmingham. G. T. Brazelton, Birmingham, is interested.

Alaska.

It is reported that in anticipation of the opening of the Alaska coal fields, A. W. Swanitz, of Alameda, Cal., Chief Engineer of the Alaska Northern Ry., will sail for Seward April 1, with a party of surveyors who will resurvey the proposed main line of the railway from Cook Inlet to Tanana. It is believed that much construction will be done this year if the coal fields are opened. The Alaska Northern is a Morgan-Guggenheim property, and will tap the Matanuska field.

Arizona.

Grant Bros.' Construction Co., 619 Security Bldg., Los Angeles, Cal., as noted in our March 15 issue, has the contract for the change of line of the Arizona Eastern Ry., from Hayden Junction to Winkelman, Ariz. The contract includes 15,000 cu. yds. of earth excavation, 30,000 cu. yds. of rock excavation and 60,000 cu. yds. of embankment. Work is well underway.

Arkansas.

⊙T. H. Sater has been awarded a grading contract for the first two miles of the eastern extension of the Memphis, Dallas & Gulf R. R. G. H. Cravens, Chief Engineer, Nashville, Ark., from Murfeesboro. It is stated that other contracts are to be let shortly.

Construction work is to be started soon on the projected interurban line of the Coal & Gas Belt Electric Co., of Huntington, which is to connect Huntington, Midland, Mansfield and Hartford. A bonus of $25,000 is reported to be assured and the company is also said to have placed all of its $50,000 of capital stock. L. E. Lake, Huntington, Ark., is interested. George Otis, Mansfield, Ark., is Chief Engineer.

California.

The Turlock Traction Co., the incorporation of which was mentioned in our Feb. 15 issue, is said to be planning to have grading work started at once on its proposed electric interurban from Denair on the Santa Fe, to Newman, through Turlock. The line will run from Denair, through Turlock, a distance of 17 miles. A street railway system will also be installed in Turlock. S. N. Griffith, Fresno, Cal., is the promoter.

The Southern Pacific Co. has placed engineers in the field for a proposed line from Danville to Hayward, which will connect at that point with the company's road to Oakland.

The Southern Pacific Co. is reported to have purchased the Sierra Ry. of California, operating 76 miles of line between Angels, Jamestown, Sonora and Stockton. It is said that immediate steps will be taken to rebuild the 20 miles of track between Angels and Jamestown and that within five or six months the entire system will be rebuilt.

Work is to be started at once on the Mountain Quarries R. R., a short line, which is to extend from Cook to Auburn. The work will be in charge of Engineer George Herrington of the Southern Pacific, with headquarters at Auburn.

The Pacific Electric Ry. Co., Los Angeles, has entered into an agreement with the city of Long Beach to at once build a municipal railway from the docks owned by the city on the inner harbor to connect with its line on Riverside drive. The line will cost about $12,000. Under the terms of the agreement the line is to be built at actual cost. It will extend from the Pacific Electric terminus on Riverside drive and Mitchell St. 1,000 ft. on Clark St., which will in the future be known as Third St., and a further distance of 1,200 ft. on Water St., running to the docks in a southwesterly direction. As the grading has been partly completed, the work will be rushed to an early completion.

Colorado.

Advices from Greeley state that George Peck, a bond broker, who has been in Greeley and vicinity for the past six weeks investigating the proposed interurban railway of the Denver, Greeley & Northwestern Ry. Co., has submitted his final report to the French bond buyers. It is stated that $10,000,000 bond issue of the road can be placed in France if actual construction work is begun by the local people and the first unit of the road constructed. The proposed line will start at Denver and pass through Westminster, Millikin, Greeley, Ault, Fort Collins, Boulder and Longmont, with a branch to Estes Park, the total distance to be 250 miles. For the purpose of raising money for the preliminary construction work the company has authorized an issue of $100,000 worth of debenture certificates at 8 per cent to mature in three years. George J. Spear, Denver, Colo., is President.

The Uintah Ry., M. W. Cooley, General Manager, Mack, Colo., is reported to be tentatively considering a plan for tunneling Baxter Pass to reduce the grade of its line. The tunnel would be several thousand feet long and some reports have it that the money for its construction has already been appropriated.

All the grade work across the mountains between Colorado and Wyoming, on the line of the Denver, Laramie & Northwestern R. R. has been completed and the grading camps have been moved to Dale Creek, 123 miles northwest of Denver. Former Governor J. B. Orman, who has the contract for grading, has had his grading outfits constantly at work building across the mountains during the last eleven months. This completes all the heavier grade work to be done between Denver and the Elk Mountain coal fields. The canon leading up to the summit is about eight miles long and the grade at no point exceeds more than 2 per cent. There is only one tunnel—Butte Royal—which is 400 ft. long. But two bridges of any consequence will be necessary through the mountains—one over Dale Creek at Virginia Dale and the other at Aldrich's gorge on Dead Man's Creek. These will be of steel. W. D. Hodge, Railway Exchange Bldg., Denver, Colo., is Chief Engineer.

Florida.

⊙L. and G. B. Baker have been awarded the contract for grading the Florida Ry., from Live Oak to White Springs, a distance of 18 miles. Frank Drew, Live Oak, Fla., is President.

The Atlantic, Okeechobee & Gulf Ry. Co., mentioned in our Feb. 8 issue, will take steps shortly to decide on the definite route for its proposed line, after which a contract will be let for necessary surveys, incident to the actual construction. It is stated that there is ample capital behind the venture to carry it through to a successful conclusion. The principal offices of the railroad will be in Tampa, and the main line will begin from a point near the city of Tampa, extending easterly through the counties of Hillsborough, Polk, DeSoto, Lee, Palm Beach and Dade to a point near Miami and a branch, beginning at Melbourne, in Brevard County, extending southwesterly through the counties of Brevard, St. Lucie, Osceola, DeSoto, and Lee to a point near Ft. Myers; a branch from that point extending northerly through the counties of Lee, DeSoto, Manatee and Hillsborough to Tampa; a branch line beginning at Bassinger in Osceola County, and extending northerly to St. Cloud. The offices of the company are Henry Clay Ferriot, President, New Orleans, La.; Robert H. Riley, First Vice-President, New Orleans; Walter Graham, Second Vice-President; A. H. West, Third Vice-President, Jacksonville; Daniel A. Simmons, Secretary, Jacksonville; W. H. Milton, Treasurer, Marianna; Francis Belding McGarry, General Counsel.

Georgia.

⊙The Augusta Railway & Electric Co. and the Augusta-Aiken Railway Co. of Augusta, Ga., have arranged for the following extensions and improvements to their power houses and systems: Estimated cost, approximately $500,000. The power house extension is planned for two 2,500 K. W. steam turbines, one of which, with the necessary boilers and auxiliaries, will be installed this year. A 7½-mile transmission line will be built from the power house in Augusta to the power house of the Augusta-Aiken Railway Co., near Clearwater, S. C., and a 500 K. W. motor generator set will be installed at this point, and a 300 K. W. set in the present sub-station near Aiken. Under an arrangement with the city, the wires in the City of Augusta will be placed underground on three of the principal streets, involving the laying of about three miles of conduits. In connection with this underground work, the company will also install ornamental poles on Broad St., Augusta, for carrying its trolley wires and feeders and also clusters of tungsten lamps for street lighting. An extension of about one mile of single track will be made and the reconstruction of a large amount of the present tracks is planned. Contract for the above work has been awarded to J. G. White & Co., Engineers and Contractors, 43 Exchange Place, New York.

The Tennessee, Alabama & Georgia R. R. has applied to the State Railroad Commission of Georgia for authority to issue $2,250,000 of common stock and $750,000 of prefrred stock and also $5,000,000 of first mortgage bonds. The Tennessee, Alabama & Georgia is composed of the Chattanooga Southern R. R. and several other short lines, and proposes a considerable amount of construction work. C. H. Fisk, Chattanooga, Tenn., is Chief Engineer.

The Georgia, Southwestern & Gulf R. R., D. B. Dunn, Chief Engineer, Albany, is reported to have applied to the City Council of Cordele, Ga., for a special ordinance granting the privilege of using certain streets of Cordele for the extension of the line from Cordele to Hawkinsville via old Tippettville, in Dooly County. This extension has been in contemplation for some time, and it is said that this work will be commenced as soon as the balance of the right-of-way can be secured.

The Macon, Dublin & Savannah R. R., J. T. Wright, General Manager, Macon, Ga., is reported to be planning to have work started next month on a $100,000 drawbridge near the Ocmulgee River at Macon. This bridge is to connect the railroad with a tract of land which it is understood has been secured by the Seaboard Air Line Ry. for terminal purposes. The latter road is believed to be planning for an extension from Atlanta to Savannah, by a direct line from Atlanta to Macon, where the Macon, Dublin & Savannah will connect the new line with the Savannah-Montgomery division of the Seaboard at Vidalia.

Idaho.

Engineers of the Lewiston-Clarkston Improvement Co., Lewiston, Idaho, have engineers in the field making surveys for an interurban electric road between Lewiston and Asotin, Wash. As proposed, the line will tap Clarkston, Clarkston Heights, Asotin, thence making a crossing of the Snake River at Asolin to tap the Lewiston Orchards irrigated district and thence tying to the Lewiston Terminal Co. lines in Lewiston, making a complete "loop" of the district.

Work on the extension of the Idaho Northern Ry., E. H. Dewey, President, Nampa, Idaho, from Emmett into the Long Valley country, will probably be started early next month.

It is reported in Wallace that the Chicago, Milwaukee & Puget Sound Ry. and the Northern Pacific are considering a joint project for the construction of a 3-mile tunnel above Haugan's Spur, in order to provide an entry to the Coeur d'Alenes free from the stiff grade encountered in the existing route o Larson, and obviating the circuitous approach to the pass. Such a tunnel probably would take two years to construct and would cost $3,500,000. The project is said to have been proposed by the Milwaukee surveyors in connection with the protected cutoff from Saltese to Spokane, via Wallace, the Fourth of July canyon and Coeur d'Alene city.

Illinois.

The Milwaukee, Peoria & St. Louis Ry. Co., which proposes to build a line of railroad from Peoria to Rockford, passing through Bureau County, has filed articles of incorporation in the recorder's office at Princeton. Similar documents were filed with the secretary of State at Springfield and with the recorders of Winnebago, Ogle, Lee, Putnam, Marshall, Woodford and Peoria counties. According to the plans of the incorporators, the line will pass along the east side of the Illinois River, through Lacon and Hennepin to Howe, where it is the intention to cross the river on the Chicago, Indiana & Southern bridge. Thence it will run in a northerly direction, striking the property of the Princeton Coal Mining Company, east of this city, and continue on a straight line for Rockford, passing through Malden, LaMoille, Sublette, Lee Center, Ashton and Stillman Valley. It is said that an eastern syndicate has been formed to finance the building of the line and that engineering corps are now being organied to make a complete survey of the route. The incorporators and first board of directors are Eugene S. Morton, Frank P. Read, of Princeton, Ill.; Frederick C. Vehmeyer, John H. O'Neill and Frank H. Gardiner, all of Chicago.

The Tri-City Ry. Co., Davenport, Ia., has plans underway for the construction of its Long View line on 25th St. and 13th Ave., at Rock Island. The construction of the line to connect up the Long View loop will require a great deal of grading on 25th St. and on 13th Ave. the grading of a portion of the street will be required and the filling of the ravine spanned by the bridge at 29th St.

The Rockford Traction Co., of Rockford, Ill., has been incorporated. The objects of the corporation are stated to be the separation of the Rockford street railway system from its interurban and other properties. The incorporators of the Rockford system are A. A. Anderson, General Manager of the Springfield Utilities Co., and Warren Partridge, Superintendent of the Springfield Consolidated Railway Co.

Steps are being taken to build an electric railway to connect with the Hawley System at Keokuk at the McKinley system at Carlinville. At a recent mass meeting at Exeter it is said that $30,000 of stock subscriptions were secured. The proposed line would cross the river at Meredosia, necessitating the construction of a bridge at that place. The Concord Oil & Gas Syndicate of Concord, Ill., is pushing the project.

Indiana.

It is expected that the Evansville & Chrisney Traction Co., incorporated recently with a capital stock of $50,000, will announce its plans shortly for its proposed line. The company proposes to build a line from Evansville to Chrisney. J. P. Chrisney, Chrisney, Ind., is the promoter.

The St. Joseph Valley Traction Co., L. T. Owen, Chief Engineer, LaGrange, Ind., is to resume construction work shortly on its Bristol-Middlebury interurban line.

The Vincennes Interstate Traction Co., of Vincennes, Ind., has been incorporated with a capital stock of $10,000, the incorporators being John L. Kleymeyer, Charles W. Benhane and J. D. Lacroix.

The Indianapolis & Seymour Traction Co. has applied for franchise rights through Greenwood and Southport. Surveys have not been made as yet. Grafton Peck, W. H. Todd and A. O. Kelly, of Greenwood, are interested.

The residents of Wolf Lake have petitioned the Vandalia R. R. to build a spur to the village; about 1,000 cars of onions are shipped from that place every year.

The Evansville & Southern Indiana Traction Co., Evansville, Ind., will probably start work this year on its extension from Patoka, Ind., to Vincennes, Ind. The extension will require the construction of a bridge over White River either at Hazleton or Decker.

A company to be known as the Eastern Indiana Traction Co. is now being organized with the idea of building an interurban road from Richmond to Cincinnati by way of Liberty, Brookville and Harrison, Ohio. Attorneys A. M. Gardner and Paul Comstock, of Richmond; Dr. E. R. Beard, of Liberty; Judge R. L. Head, of Brookville, and F. J. Brinkman, of Harrison, Ohio, compose the committee in charge of organization. The proposed capitalization is $1,000,000.

A project is under consideration for the construction of an electric railway from Converse to Somerset. Engineers who have been over the route have pronounced the project feasible. It is planned to promote the enterprise locally. L. O. Arnold, Converse, Ind., is interested.

The Vincennes Interstate Traction Co., recently organized with a capital stock of $10,000, has applied to the City Council of Vincennes for a franchise in that city and for rights on the bridge over the Wabash River for a line to Bridgeport, Ill. The company will repair and strengthen the bridge if the franchise is granted. The incorporators of the company are Albert and Arthur Funkhouser, C. H. Battin and H. M. Lukens, of Evansville, and James L. LaCroix, of Vincennes.

The temporary directors chosen a few weeks ago for the Fort Wayne & Northern Indiana Traction Co. organized to take over the Ft. Wayne & Wabash Valley traction syndicate have resigned, and in their places have been elected J. Levering Jones, Randall Morgan and John J. Collier, Philadelphia; Hugh J. Pritchard and William A. Tucker, New York; Hugh J. McGowan, Indianapolis, and Henry C. Paul and James M. Barrett, Ft. Wayne. Pritchard and Tucker represent new financial interests in the company. Mr. Jones remains president of the traction company; Henry C. Paul is vice-president and treasurer, succeeding Charles Murdoch, of Lafayette. Henry Rainey, Philadelphia, was chosen secretary. The authorized capital stock of the reorganized company is $8,000,000, equally divided into common and preferred.

Iowa.

The Forest City, Fertile & Mason City Ry. Co. has completed surveys and has secured the capital for the construction of its projected 30-mile line from Forest City to Mason City. Construction contracts are to be let May 1. A. L. Sherrin, Watertown, S. Dak., is President and F. R. Lyford, Northwood, Ia., is Chief Engineer.

An order has been filed in the Federal Court granting the Fort Dodge, Des Moines & Southern R. R., P. Sheldon, Receiver, Ames, Ia., the right to expend $500,000 for improvement work. The largest expenditures are $77,500 for new equipment; $48,000 for a new power plant at Fraser; $10,000 for automatic safety signals; $12,000 for new freight terminals in Des Moines; $40,000 for extensions at Ogden, and $18,000 for additional trackage at Fort Dodge. Of the appropriation indicated by the court $230,000 have been already expended. The remaining $270,000 is for immediate use. J. L. Blake, Boone, Ia., is General Manager.

Kansas.

Construction is to be started next month on an extension of the "Hocker" electric railway from its present terminus at Zarah, Kan., to Bonner Springs, a distance of six miles. The most important engineering features in the proposed extension will be a long bridge over Mill Creek, west of Zarah, and a crossing over the Santa Fe Ry., at Zarah. R. W. Hocker, 408 Gumbel Bldg., Kansas City., Kan., is General Manager.

The Manhattan City & Interurban Ry. Co., W. R. West, President, Manhattan, Kan., is considering building a 1¼ mile extension at Manhattan. The route of the proposed line runs north along the west side of the college grounds, ½ mile, and thence west ¾ mile, terminating at the college serum plant.

The Board of Railroad Commissioners of Kansas has granted permission to the St. Louis & San Francisco R. R. Co. to issue $16,000,000 worth of refunding bonds. The bonds are to be issued to take up short-time notes and bonds issued while the company was building some of its lines in Texas. A part of the new issue is to be spent for improvements.

Kentucky.

⊙Langhorne & Langhorne, Lynchburg, Va., who have the contract for building the 28 mile line of the Sandy Valley & Elkhorn R. R. for the Consolidation Coal Co., as noted in our last issue, have let sub-contracts to the following contractors: Pitts Co., Scottsville, Va., for Section 2; Ryan Co., South Portsmouth, Ohio, Section 4; Waugh & Waugh, Cincinnati, Ohio, Section 5; Bollard & Herring, Cincinnati, Ohio, Section 6. Langhorne & Langhorne will handle Sections 1 and 7.

It is now said that the proposed new extension of the Lexington & Eastern Ry. from Potters Fork will pass through the headwaters of Elkhorn and Boone's Fork, through the Cumberland Mountain at Pound Gap, by tunnel, and enter Virginia via Pound and run on through Wise County to a connection at Norton with both the Louisville & Nashville and the Norfolk & Western. It is believed that construction contracts will be let shortly. J. E. Willoughby, Lexington, Ky., is Chief Engineer of Construction.

A citizens' committee has been appointed at Madisonville to co-operate with the Kentucky Midland R. R., M. M. Wheeler, Chief Engineer, Central City, Ky., in securing an extension of the railroad from its present terminus at Earles to the city of Madisonville.

The Brooksville & Wellsburg R. R., Younger Alexander, President, Lexington, Ky., is reported to be considering plans for further extension into the coal and timber sections of Eastern Kentucky.

M. Casey, Yerkes, Ky., has some good team work to sublet and would like to get in touch with parties having team outfits. Mr. Casey also can use a few tunnel foremen at $4 for

[illegible]

Louisiana.

Regarding the report that the St. Louis & [illegible] road has done nothing since. It is possible [illegible] New Iberia & Northern R. R. into the sugar district north of Port Barre, but so far as I know nothing has been decided in that matter by the St. Louis syndicate which owns the New Iberia and Northern property."

The New Iberia, St. Mary & Eastern Ry., which projects a 52-mile steam line, is planning to have grading work started at an early date. The construction contract has not yet been let. H. A. Genung, New Iberia, La., is Chief Engineer.

Maryland.

The Baltimore & Ohio R. R., F. L. Stuart, Chief Engineer, Baltimore, Md., is reported to be about to ask for bids for the construction of a double track tunnel, 30 miles west of Cumberland, Md., or an open cut with three tracks to take the place of the present single-track tunnel at the crossing of Allegheny on the Pittsburg division.

The Washington, Baltimore & Annapolis Electric Ry. has been sold under a decree of foreclosure issued by the U. S. court, to satisfy the first mortgage for $3,000,000 and the second mortgage for $1,000,000. The property was bid in by the reorganization committee for $2,501,000. Application will be made for the removal of the receivership, which has continued for about a year. J. N. Shanahan, Baltimore, Md., is General Manager.

Plans are under consideration for securing railway facilities in the lower sections of Anne Arundel county and also in Calvert county. At a recent mass meeting at Annapolis, a committee of which Robert Moss and John de P. Douw, of Annapolis, are members, was appointed to consider the matter. This committee is to report at a general meeting to be held April 18 at the Court House in Annapolis, Md.

Michigan.

⦿The contract for the construction of the double track on the Pere Marquette R. R., between Detroit, Mich., and Toledo, O., some 40 miles, has been awarded to W. E. Tench & Co., 3090 West Grand Boulevard, Detroit, Mich. A large force of men and teams will be put on this work at once, between Romulus and Alexis. Tench & Co. have just completed 30 miles of railroad for the Michigan United Rys., between Lansing and Owosso, Mich., and will transfer their outfits from Owosso to Monroe, Mich., where headquarters have been established for this work. Mr. J. F. Deimling, of Detroit, is Chief Engineer of the Pere Marquette

Business men of Mt. Pleasant have asked the Board of Trade of Grand Rapids to cooperate with them to secure a concession from the Pere Marquette R. R. Co. for a 29-mile extension of the lines of that company from Edmore through the village of Wynn to Mt. Pleasant

The State Railroad Commission has granted the Minneapolis, St. Paul & Sault Ste. Marie Ry. Co., Thos. Green, Chief Engineer, permission to issue stock to the extent of $6,562,000 for the purpose of extending and improving the property

The Saginaw & Flint Traction Co., Saginaw, Mich., has engineers in the field for a proposed extension from Frankenmuth to Vassar. Right of way is being secured, but it has not been definitely decided as to whether or [illegible] will be built this summer

The State Railroad Commission has authorized the Grand Trunk R. R., H. G. Kelley, Chief Engineer, Montreal, Que., to issue mortgage bonds of $30,000,000 for the purpose of [illegible] improving its service and to permit the western division to purchase the Pontiac, Oxford and Northern branch. The company will have jurisdiction over the expenditure of $23,000,000, and the remaining $7,000,000 will not be used without the consent [illegible] commission.

Minnesota.

The Duluth-Superior Traction Co., 2631 W. Superior St., Duluth, Minn., is to replace about three miles of track on its South Superior car line with heavier steel.

The company, which is projecting an interurban electric line on the range, as noted several times in these columns, has filed its articles of incorporation. The capital stock is $200,000 and the name of the company is the Virginia, Eveleth & Gilbert Traction Co. The officers of the company are W. M Prindle, Duluth, president; C. T. Eagling, vice-president; E. V. Mitchell, secretary and treasurer. The company's headquarters are at Duluth.

The St. Paul Union Depot Co., A. W. Trenholm, President, St. Paul, Minn., has been considering preliminary plans for the proposed new union depot, and is reported to be about ready to appoint a special engineer to work out foundation plans. This committee of Terminal Directors includes J. B. Berry, Chicago, Chief Engineer of the Rock Island; A. G. Hogeland, Chief Engineer of the Great Northern; C. W. Johnson, Chief Engineer of the Omaha and Mr. Trenholm, as ex-officio member.

It is reported that the Chicago, Milwaukee & St. Paul Ry., C. F. Loweth, Chief Engineer, Chicago, Ill., is considering beginning construction work this spring on its line from Hutchinson, Minn., through Fargo, N. Dak., and then on to Winnipeg. It is said that in general the survey of the road, as made last fall, would be followed up to Fargo, where it joins the St. Paul road, but that a new survey would be made from Fargo north to Winnipeg, the objective point of the road. The survey as made last fall extended in a straight line from Hutchinson through Fergus Falls, through Moorhead and Fargo, directly to the St. Paul depot at Fargo.

The St. Paul Railway Promotion Co. has secured about one-half the right of way for the projected line to be built under the name of the St. Paul Southern Electric Ry. Franchises have also been secured at Lake City, St. Paul Park and at Hastings. Surveys for this line were started Dec. 8, 1910, and were completed in February. The line is to extend from St. Paul to Lake City via St. Paul Park, Hastings, Red Wing, Frontenac, etc., to Lake City, and will be 57 miles long. The St. Paul Railway Promotion Co. has also completed surveys and secured considerable right of way on the "Mankato Line" from St. Paul to Mankato via Farmington, Northfield, Faribault, Waterville, Madison Lake, etc. Surveys for this line were completed Dec. 1, 1910. The St. Paul Southern line will be built first. W. L. Sonntag is General Manager of the St. Paul Railway Promotion Co., and Kay Alexander, 709 Metropolitan Opera Bldg., St Paul, Minn., is Chief Engineer.

The Minneapolis, St. Paul & Sault Ste. Marie Ry., Thos. Green, Chief Engineer, Minneapolis, Minn., is reported to be contracting for material, delivery to be made in five months for use in the construction of its proposed connecting line in Minnesota. It is believed from this that construction work will be started this spring. The line will start from somewhere near Foxboro on the Brooten branch and connect with Frederic, Wis.

The Canadian Northern Ry. has had mining engineers going over to Vermillion Range to secure data as to the tonnage of ore originating in the District. The company is understood to be planning to extend a line to Cook and making use of the extension from Virginia to Duluth for an invasion of the Vermillion iron range.

E. J. Hogan of the P. T. Walsh Construction Co., of Davenport, Ia., has gone to Duluth to superintend the building of 85 miles of track, including the bridging, ballasting and other features for the Canadian-Northern Ry., from Duluth to Virginia City, grading work of which has been under way for some time

Duluth and the Ranges.

BY PETER F. MEAGHER.

Mr. G. A. Nordeen, team contractor, was a caller at this office recently. He is in the market for some work.

Mr. C. E. Jamieson, contractor, who has some work on the Canadian Northern R. R., near Duluth, was a caller and stated he was just about through, and was in the market for some work.

Mr. P. C. Pastoret of the Pastoret-Lawrence Co., General Contractors, was a visitor a few days ago, and stated that they expected to start operations on two of their sewer contracts about April 1.

The writer when in Minneapolis last week had the pleasure of renewing acquaintance with an old friend, John A. Buchanan, better known as "Buck." Buck is now President and General Manager of the Standard Steel Whiffletree Co. of Pittsburg, and was on his way to the Coast to see his jobbers. This company which is a new one, has started out very well, and they are more than pleased with the success that they are meeting with so far. They have got a very good line of goods, and they should be very successful.

H. C. McLean, contractor, was a caller recently, and stated that he had a little concrete work left from last year, and would start on the same about April 15 and that he was in the market for some new work.

Mr. A. B. Nelson, team contractor, came in to see us last week. He is in the market for some work.

C. J. A. Morris of Morris & Shepard, contractors, was here a few days ago, and when asked regarding their work for the coming season, stated that at this time, he could not give out anything definite.

⦿The Soo Railway Co. have announced that they will build the Frederick Extension, a distance of 76 miles the coming season. This will give the Soo a short line from Duluth to St. Paul and Minneapolis. I understand that some of the contractors have already shipped their outfits to start on this work Foley, Welch & Stewart, of St. Paul, Minn., are the general contractors on this work.

E. Kimball, of Kimball Brothers, Railroad Contractors, was a caller last week, and stated that he was in the market for some work. They have two traction engines, grading machines, and a general team outfit.

C. H. Overlien, traveling representative of the J. I. Case Company, spent a couple of days with us here recently. He stated that the Good Roads movement is getting started in good shape up here, and the outlook for road making machinery looks pretty fair.

The Great Northern Railway Co. up this way started to put out its extra gangs at the present time, which is a sure sign of spring.

Men are very plentiful here and work for them not in sufficient quantities to take care of all takers. In about two weeks some more of the railroads will start to put on some more extra gangs, and that will use up the surplus of laborers that we have here at present.

Andrew Perrin of Carl Hall & Co., was a caller and stated that they have got through with their work, have laid up their outfit, and are in the market for new work.

Thomas Walsh of the Johnson-Carey Co was here the other day going over their work on the Canadian Northern.

All of the stripping contractors in this vicinity are very busily engaged at present in getting their outfits into shape, and most of them contemplate starting work about April 15 to 20. If they do, that will give work to a large number of men, and will start at least 50 steam shovels.

Contractors and others are invited to make the Labor and Equipment Offices of Peter F. Meagher, No. 409 West Michigan St., Duluth, Minn., their headquarters when in this vicinity.

Missouri.

⊙The Oklahoma & Golden City R. R. Co. is reported to have awarded the contract for the construction and equipment of the first section of its projected line to William Love, of Indianapolis, Ind. The total projected length of line planned by this railroad is 400 miles, including main lines and branches in Missouri and Oklahoma. The main line runs from Fairview, Okla., northeast through Oklahoma and enters the state of Missouri just south of the southwest corner of Kansas, thence northeast through Missouri to Jefferson City. An important part of this road is the line from Springfield north to connect with the main line at Climax Springs. C. E. Hagarty, Golden City, Mo., is President.

The Kansas City, Clay County & St. Joseph Ry. Co. has been incorporated with a capital stock of $720,000 and proposes to build 72 miles of road connecting Kansas City with St. Joseph and extending a branch to Excelsior Springs. Either steam or electric motive power may be used. The incorporators are: George Townsend, George D. Beardsley, William A. Medill and Grant P. [illegible] of Kansas City, and Ward S. Arnold of Chicago.

Kansas City and Vicinity.

(REGULAR CORRESPONDENCE.)

⊙The Kansas City Southern work was let on Monday, March 20. This is the contract we mentioned in our last letter as involving about 1,500,000 cu. yds. of material. It will, no doubt, be of great interest to our readers to learn that Porter Brothers of Spokane, Wash., were the successful bidders. This is especially noteworthy as it marks the entrance of a great contracting firm into an entirely new section of the country.

⊙Hannon & Hickey of St. Louis, Mo., have secured a nice piece of steam-shovel work on the Kansas City Southern under Porter Bros. They expect to start work as soon as their outfit can be assembled.

⊙List & Gifford will do a large section of the Kansas City Southern work. Their contract is strictly a shovel proposition. Standard gage plant will be used. The home office of List & Gifford is Davenport, Iowa, but they expect to open up a nice office in Kansas City in the very near future.

⊙The Lund Contracting Co. will do the lower end of the Kansas City Southern work. This lies directly out of Joplin, Mo. Mr. Lund has just purchased a new steam-shovel plant. This, however, is a 4-yard car proposition and the work will be done accordingly.

The Kansas City, Lawrence & Topeka Electric Ry., better known in this vicinity as the "Hocker Line" will build an extension this summer. The present announcement is for six miles of new track from Zarah to Bonner Springs, Kansas. It is the intention to extend to Lawrence as soon as practical and the ultimate destination is Topeka. D. R. Hocker, Kansas City, Mo., is the General Manager. Funds for construction will be raised by the present stockholders

Mr. T. L. Campbell of Topeka has been quite successful in letting sub-contracts on his Rock Island work He still has room, however, for two or three more small wheeler outfits. Mr. Campbell can be addressed care of Citizens State Bank Bldg., North Topeka, Kansas

Mr. Sten Lund, President of the Lund Contracting Co. of Chicago, is registered at the Baltimore Hotel at the present writing. We regret, however, to report that he is suffering from a severe attack of tonsilitis and is now under the doctor's care.

Mr. L. J. Smith and Mr. Scott Mitchell, both of the L. J. Smith Construction Co., were Chicago visitors Thursday and Friday. They were attending the convention of Railway Maintenance of Way Engineers held in that city last week

R. H. and G. A. McWilliams, the well known Chicago drainage contractors, are making splendid progress on their drainage contract along the Blackwater river in Johnson County, Mo. The actual work is straightening several bends in the stream in order to prevent overflows.

St. Louis Items.

[illegible]

⊙The contract for reducing the grade on the Kansas City Southern Ry. between Grand View and Neosho, Mo., was awarded to Porter Bros. of Seattle, Wash

⊙Hannon & Hickey of St. Louis, Mo., secured a nice piece of steam shovel work from the Porter Bros. on the Kansas City Southern Ry.

Work has begun and will be completed in a few days of laying switches at Venice, Ill., to connect the Southern Railway's belt line from the Illinois coal fields with the tracks of the McKinley system. These tracks are being laid to carry coal from Illinois to St. Louis over the McKinley road. The Southern Railway is one of the proprietary lines of the Terminal Railroad Association, but its belt line is independent of the Terminal. The laying of the switches at Venice, coincident with the opening of the Salisbury street freight yards last week, indicates the McKinley system is preparing to engage in the transportation of coal into St. Louis, hitherto exclusively done by the Terminal and the Wiggins Ferry Co. It is possible for the McKinley system tracks to be used by steam railroad as they are standard gage, and the system at present has a working agreement with the Chicago and Eastern Illinois and the Rock Island. Officials of the McKinley system the other day verified the reported purpose of the Venice switches, but refused to give out details of the agreement with the Southern Railway until later The McKinley system recently arranged to make track connections with the Terminal Association tracks at Granite City.

Construction of an extension from Memphis to New Orleans will be undertaken by the St Louis & San Francisco to form a gradeless short line from St. Louis, Chicago and Kansas City to New Orleans and the shortest route from St. Louis and Chicago to points in Mexico. Reconnoisances have been made under the direction of B. F. Yoakum, chairman of the executive committee, and Albert T. Perkins, railroad expert of the St. Louis Union Trust Co. In the financial district it is thought that G. W. Walker & Co. will participate in the underwriting. The St. Louis & San Francisco enters New Orleans from Baton Rouge over the tracks of the Louisiana Railway & Navigation Company, and it will only be necessary to build an extension from Memphis to Baton Rouge. In partnership with the Southern Railway, which enters the city from the East, the St. Louis & San Francisco has large terminals in New Orleans. The extension from Memphis to Baton Rouge will be about 315 miles long, and the distance from Baton Rouge to New Orleans is 80 miles. As there will be no heavy construction work except in bridging, the work will not be expensive. The distance from St. Louis to New Orleans will be about 700 miles; from Chicago 990 miles and from Kansas City 880 miles. The distance from St. Louis to Brownsville, at the Mexican boundary will be about 1189 miles, and from Chicago 1480 miles. The St. Louis & San Francisco will have a line paralleling the Mississippi river a distance of 700 miles from St. Louis to New Orleans and paralleling the coast of the Gulf of Mexico 488 miles from New Orleans to Brownsville on the Rio Grande. The extension will practically complete the plans of the system with regard to the transportation facilities from St Louis, Chicago and Memphis to New Orleans, Galveston and Houston. The new route will be about 135 miles shorter from St. Louis to Houston and Galveston than the main Southwestern line via Fort Worth. Future extensions of the Southwestern lines will be directed toward San Antonio and El Paso. The extension probably will parallel the St Louis, Iron Mountain & Southern, opening up a new trade territory Reports have been submitted to Mr. Yoakum as to the traffic opportunities, both in through and local transportation, and the estimates of the cost of construction have been prepared.

Newt Wilcoxson was one of the busiest men in Kansas City last week.

After a four-hour session last Tuesday behind closed doors, at which a number of prominent St. Louisans were heard in favor of the Southern Traction Co. franchise bill, the Council Committee decided to report the bill favorably, with a number of amendments. The bill grants the use of the upper roadway of the municipal bridge for an electric street railway, and authorizes the laying of tracks on a number of city streets, among them Third street, between Gratiot street and Lucas avenue. The prominent citizens who were heard by the committee were: Samuel M. Kennard, Albert L. Shapleigh, John F. Shepley and Dan C. Nugent. They pleaded in favor of the passage of the bill and opposed the substitution of Fourth street in the route for Third street. Jeptha D. Howe, attorney for the traction company, was present during the entire hearing except when he left for a few moments to telephone. H. D. Mepham, promoter of the bill, sat in the secretary's office outside during the meeting. The entire Railroad Committee, including Espenschied, Schutz and Hauschulte was present, and after the meeting they stated the committee would make a favorable report on the measure, with a number of amendments. They declined to state the nature of the amendments or whether or not the route named in the bill would be changed. They expressed a doubt that the bill would be ready to report today. The grant of the franchise has been bitterly opposed by a number of St. Louis organizations, led by the Merchants' Exchange and the Real Estate Exchange. It was pleaded at the public hearing that no franchise for the use of the bridge should be granted until the details for its operation had been perfected and definite rules and regulations for the conduct of traffic upon it had been formulated. Opponents of the measure, with the Real Estate Exchange in the lead, have expressed a determination to attack the validity of the grant in the courts if the Assembly enacts it. Two allegations are to be put forward as basis for the attack, one that the Southern Traction Co. is not a Missouri coproration, as required by the statutes; the other that the mandatory majority of the signatures of property owners on the streets, which it is proposed to use, has not been obtained Those who favor the bill base their support on the fact that the present application disproves the argument advanced during the fight for the free bridge that no corporation would be found to use the bridge after its completion. The privileges they seek, it is claimed, are not exclusive, and are subject to control and regulation by the city. In addition to crossing the bridge and using Third street, the line proposes an extensive loop around the business district, with a single line of track on Third street, Lucas avenue, Tenth street, Franklin avenue, Twelfth street, Morgan street, Tenth street south to Walnut, Walnut to Eighth, to Clark avenue, to Seventh street, to Gratiot street where connection will again be made with the bridge approach. A 5 cent fare between St Louis and East St. Louis, "as at present constituted," is provided in the bill The line is to haul passengers, mail and express The franchise is to run for fifty years The Company has a franchise in East St. Louis and Belleville and has a considerable amount of track laid on the East Side it is claimed, but has never been operated The bill contains a provision that the franchise can not be sold without the consent of the city.

Dave Griffith is in Kansas City looking over a piece of Porter Bros.' work on the Kansas City Southern. Would not be surprised if Dave hooked up on a piece of this

The Secretary of State incorporated on March 22 the Kansas City, Clay County & St. Joseph Ry Co., which is capitalized at $720,000. The company was organized to build 72 miles of road connecting Kansas City with St Joseph and extending a branch to Excelsior Springs. Either steam or electric motive power may be used. The incorporators are Geo. Townsend, Geo. D. Beardsley, Wm. A. Medill and Grant Peabody of Kansas City and Ward S. Arnold of Chicago.

Jack Fitzgerald is in Kansas City and expects to get in on some of the team work on the Kansas City Southern R. R.

⦿Wood, Bancroft & Doty got a good slice of steam-shovel work on the Kansas City Southern Ry. from Porter Bros. Mr. Vile, their superintendent, is in Kansas City now, making arrangements to start the work.

⦿The Lund Contracting Co. of Chicago have taken quite a lot of the Kansas City Southern work from Porter Bros. They are going to do the steam-shovel work with their own outfit and sub-let about 150,000 yds. of team and rock work. Their work is about 40 miles north of Joplin. Address them care of Koenig's Labor Agency, 507 Bluff St., Kansas City, Mo.

⦿List & Gifford secured a good piece of the steam-shovel work on the Kansas City Southern. Will start on it at once.

W. C. Williams of St. Paul, Kansas, has finished his work on the M. K. & T. R. R. at Joplin, Mo., and expects to finish his north St. Louis contract on the same road in about 10 days. Williams left here the other day for Kansas City, Mo., to see if he could not get some team work on the Kansas City Southern R. R.

Another new contractor arrived in town last week. A 14-lb. boy at Jack Hichey's house. Congratulations, Jack. Come around some day and we will open a bottle on the boy.

Chas. F. Nagel will not get started on his riprap contract north of the city for at least a couple of weeks. His work on the Electric line at Godfrey, Ill., has delayed him.

Daniel Hannefin writes us from Marble City, Okla., that he has finished his work there and wants some more team work.

J. E. Lyman is in town idle at present.

Wm. O'Connor is skirmishing around looking for some rock work.

Bob Russell spent several days in Kansas City last week.

Pat Walsh took a run down from Davenport to Kansas City to look over the Kansas City Southern work.

W. J. Oliver was another one of the good fellows we had with us in Missouri last week. Oliver has not changed much in the past 10 years.

Cary Bros. are increasing forces on their levee work near Cora City, Ill.

Montana.

The Virginia City-Southern Electric R. R. Co., Virginia City, Mont., is arranging all preliminaries so that the construction of the road between Virginia City and Alder may be commenced just as soon as the arrangements for financing the road, now progressing in the east under the direction of Luther H. Leber, are completed.

New Mexico.

The Farmington, Albuquerque & Gulf R. R., which projects a 190 mile line, the first section being from Farmington to Albuquerque, has partially completed its surveys, and the capital for construction is assured. H. B. Fergerson, Albuquerque, N. Mex., is President; A. M. Edwards, Farmington, N. Mex., is Secretary; Frank P. Hall, Farmington, N. Mex., is Chief Engineer, and W. M. Danburg, Farmington, N. Mex., is General Manager.

New York.

Winston-Dear Co., Hibbing, Minn., have started work on the construction of the new Duluth, Missabe & Northern Ry. passenger and freight line into Hibbing. There is about a mile of right-of-way to be graded, a trestle over half a mile long to be built and a tunnel to be dug under Third Ave.

The Chicago, Milwaukee & St. Paul Ry. will shortly resume work on the uncompleted double tracking work in the vicinity of Winona, stopped by the cold weather last fall. There are stretches from Homer to Richmond and from Minnesota City to Kellogg, where the double track was not completed last year. It is expected to finish this work this year.

The Village Trustees of Ballston Spa have granted to the Schenectady Ry. Co., Schenectady, N. Y., franchises to connect its lines with those of the Hudson Valley Co., at the Lincoln corner in Ballston Spa and to double track Front St. from Bath to Fort St. The railway company will abandon its tracks in Washington St., using the new route and a section of the Hudson Valley tracks through Front St., the two lines connecting at Milton and Malta Aves.

The United Traction Co., Albany, N. Y., has been granted a franchise for laying a double track in Hudson Ave. at Albany, from the end of the present track at Grand St. to South Pearl St. The company will lay a double track in Hamilton St. to connect with the new extension. The work will begin as soon as the frost is out of the ground.

North Carolina.

A $75,000 bond issue has been voted in Rowan and Cabarrus counties for the proposed line of the Salisbury R. R. from Salisbury to Monroe, N. C. As noted in our March 8 issue, this road is being promoted by W. H. Ragland, W. H. Miller and N. B. McCandless, all of Salisbury.

The Southern Ry., D. W. Lum, Chief Engineer, Washington, D. C., is to build 8 or 10 passing tracks between Asheville and Morristown, N. C., and between Knoxville and Cleveland, Tenn.

North Dakota.

The Commercial Club of Minot, N. Dak., has appointed a committee, of which President F. L. Sherman is a member, to confer with officials of the Grand Trunk R. R., in an effort to have that company build a line from Portal, N. Dak., to Minot. It is claimed that the Grand Trunk already has a charter into Portal, and it is with a view to securing the extension from that city to Minot that the local parties have become interested.

Ohio.

The Tri-State Traction Co., Steubenville, Ohio, has placed orders for four cars of trolley poles to be used on its proposed 12-mile interurban line between Weirton and Steubenville, construction work on which is to be started shortly. The Tri-State Co.'s line from Steubenville to Wellsburg, W. Va., is also to be double tracked.

The Cincinnati, Hamilton & Dayton R. R. is reported to be planning to improve its property at Findley. The plan is said to contemplate the joining of its two lines in that place, so that they will use one depot.

Oklahoma.

A movement has been started at Ardmore for the construction of an interurban from Ardmore to Sulphur. As proposed the line will pass through parts of Carter, Johnston and Murray counties and will be about 35½ miles in length.

Engineers have been making a preliminary survey for the proposed change of line of the Missouri, Kansas & Texas to reach Pawhuska. The proposition is said to be feasible, and the cost of the change will probably not exceed $250,000 for the sixteen miles of new road.

The Missouri, Oklahoma & Gulf Ry., J. J. Harrison, Chief Engineer, Muskogee, Okla., which is building a branch from Wapanncha to Bromide, Okla., is understood to be planning to extend the line from the latter place to Pontotoc, Okla.

The greater part of the grading for the Tulsa-Sapulpa interurban line of the Oklahoma Union Traction Co., A. A. Small, President, Tulsa, has been completed, and it is hoped to begin track laying by May 1. The heavy grading from West Tulsa to Red Fork has been finished. This stretch is the most difficult part of the entire line. The grade from Red Fork to Sapulpa will be comparatively easy, with the exception of a 10-ft. cut at one point. Part of the old "battle ax" grade near Sapulpa will be utilized.

The National Construction Co., of McAlester, Okla., has been incorporated with a capital stock of $20,000, and will engage in railroad and electric railway construction. The directors are J. M. Bennett, J. W. Rooks, H. M. Ammons and J. A. Morgan, all of McAlester.

Good progress has been made with the promotion work for the proposed railroad from Lawton, Okla., westward through Duncan and Ardmore to Sherman, Tex. The latter city has raised a $100,000 bonus and the three other cities have also raised the necessary bonuses. Engineers are now in the field between Lawton and Duncan working eastward. The project is being promoted as previously noted, by E. R. Sutton of Philadelphia, Pa., and Jake L. Hamon, of Lawton. It is understood that the construction work will be done by the Development Corporation of Philadelphia.

Oregon.

The Oregon Electric Ry. Co., John F. Stevens, President, Portland, Ore., is planning to have work started soon on its extension from Salem to Eugene. Rights of way through the country south of Salem and in the City of Eugene already have been obtained. Four or five routes have been surveyed, and as soon as a route is decided on detailed arrangements for beginning construction work will be made.

Twohy Bros., Spokane, Wash., are reported to be planning to start construction work about June 1 on the Coyote-Stanfield cutoff of the Oregon-Washington R. R. & Navigation Co. The Coyote cutoff calls for the construction of an additional track from Coyote, on the Columbia River, cross country to Stanfield. The cutoff will eliminate eight miles of the present distance between those two points. However, the present main line track will be continued in use so as to provide a double track for the road. The cutoff will cost about $1,000,000.

Pennsylvania..

⦿Frank Bomgardner, Harrisburg, Pa., has started work on his contract for renewing the tracks of the Central Pennsylvania Traction Co. on Market St., Harrisburg. This work will cost about $25,000, and is said to mark the beginning of other important improvements on the Central Pennsylvania Traction Co.'s lines.

The Johnstown Passenger Ry. Co. (electric), Johnstown, Pa., is reported to have secured practically all right of way for a line to Geistown.

The Delaware & Hudson, A. P. Appler, Mechanical Engineer, Green Island, N. Y., is reported to have let most of the $300,000 contracts for shop improvements at Carbondale to a Pittsburg firm.

The Baltimore & Ohio R. R. is reported to be planning to standardize its narrow gauge division extending from Foxburg, Pa., through Kane, Pa., with its terminus at Mt. Jewett, Pa. This division is the last relic of the old Pittsburg & Western system, taken over by the Baltimore & Ohio, and is approximately 90 miles long, and reaches Clarion, Forest Elk and McKean counties.

The Buffalo, Rochester & Pittsburg Ry. Co., E. F. Robinson, Chief Engineer, Rochester, N. Y., has awarded the contract for straightening the line of road a distance of about two miles, beginning about a half mile south of Hutchins and extending toward Midmont. The work will require the services of two steam shovels and a large force of men during the coming summer. Operations will be commenced at once, it is said, the contractors maintaining headquarters at Mt. Jewett.

The Pennsylvania R. R. is reported to have secured options on right of way for a 30-mile extension of the Conemaugh division from Butler through Queen's Junction, West Sunbury, Anandale, and Clintonville to Kennerdell, Venango county, to connect with the Allegheny Valley road. The route extends through rich coal, fire clay and limestone districts.

The Lehigh Valley R. R., E. B. Ashby, Chief Engineer, New York, is said to have decided that the new Hayes Creek branch of that road, extending from Hazle Creek Junction to Hayes Creek Junction, about two miles from White Haven, be double-tracked at once.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

South Carolina.

⊙William J. Oliver, Knoxville, Tenn., has been awarded the contract for the construction of the roadbed of the Piedmont & Northern Ry. Co.'s electric interurban from Greenwood to Spartanburg, a distance of 90 miles. The contract is said to amount to about $900,000. The contract calls for the completion of the roadbed from Greenwood to Belton within six months from the time work was started; for the completion of the line on to Greenville within eight months and for the completion of the entire Greenwood-Spartanburg link within 15 months. The contract for the line from Charlotte to King's Mountain was let a short time ago to Stewart & Jones, as noted in our issue of March 15. W. S. Lee, Charlotte, N. C., is Chief Engineer.

Tennessee.

⊙Charles and Robert Southern, Bulls Gap, Tenn., have been awarded the contract for grading 10½ miles of railroad to Doak's Cabin for the Heilman Co.

Proposition has been made to the city of Jackson, Tenn., to subscribe $100,000 to be used in extending the New Orleans, Mobile & Chicago R. R. from Middleton, Tenn., its present northern terminal, to Jackson. The proposition was presented by John T. Schley, a member of the firm of McCartney & Schley, bankers and brokers, of Mobile, Ala., representing a syndicate of capitalists who propose to construct the line. Mobile, Ala., is stated to have subscribed $250,000 for the extension. It is estimated that the extension will cost about $700,000. If the money is raised, the company pledges itself to start construction at once and have through trains in operation between Jackson and Mobile by Jan. 1, 1912. W. F. Owens, Mobile, Ala., is General Manager of the New Orleans, Mobile & Chicago R. R.

The Nashville, Chattanooga & St. Louis Ry., H. McDonald, Chief Engineer, Nashville, Tenn., is reported to have plans for a considerable amount of betterment work on its Memphis Division. This will include the construction of long switches between Memphis and Hollow Rock Junction, which, it is said, will be eventually connected into a double track.

City Engineer J. H. Weatherford, of Memphis, has approved the plans for the subway to be constructed at Rayburn boulevard and Railroad Ave. The plans were prepared by the engineers of the N. C. & St. L., the Southern, the Frisco, and the Union R. R. and the Memphis Union Station Co.

A mass meeting is to be held at Henderson, Tenn., on April 17 to take steps towards the building of an electric railway through Chester county, starting at Henderson and running east to some point on the Tennessee River. At a meeting at Henderson on March 21 committees were appointed to enlist the co-operation of all towns along the route. These committees are to report at the April 17 meeting. William Lea, Henderson, Tenn., is interested.

Texas.

It is expected that the Northern Texas Traction Co., Fort Worth, Tex., will shortly place engineers in the field for the proposed interurban line between Fort Worth and Cleburne. Right of way contracts and concessions asked by the traction company are said to have been approved. The new line will be about 28 miles long, and no difficult grading work will be required. The Stone & Webster Engineering Corporation, 147 Milk St., Boston, Mass., control the Northern Texas Traction Co.

Residents of Brownsville are considering forming a company to build an electric street railway at that city. It is proposed to build a line to give service from all points of the city to the business districts and to connect West Brownsville and the Country Club grounds, which are adjoining the city.

The International & Great Northern R. R., A. G. Whittington, Superintendent, Mart, Tex., is planning to improve its yards at Bryan.

Construction work is to be started shortly on a 4½ mile electric railway to extend from the present Liberty Ave. car line, at Houston, to Port Houston. The road will be built for a company organized a short time ago by W. S. Kirkham. McCarthy & Sons, Houston, Tex., are the engineers.

The Sugarland Ry., W. T. Eldredge, President, Sugarland, Tex., now being extended south from Arcola to the port of Velasco at the mouth of the Brazos River, is making arrangements for the early construction of a northern extension to run from Sugarland to Hempstead, about 55 miles. The proposed new mileage will aggregate more than 100 miles. W. T. Eldridge and a syndicate of St. Louis men own the road. When finished these extensions will form a new north and south line through the rich valley of the Brazos River.

Virginia.

It is now believed that the Norfolk Terminal Ry. Co., L. E. Johnson, President, Roanoke, Va., will be ready to open bids about April 15 for the construction of the new $750,000 union depot on East Main St., Norfolk, Va. As noted in our March 15 issue this depot is to be occupied jointly by the Norfolk & Western Ry., the Virginian Ry. and the Norfolk Southern Ry., and will be erected by the Norfolk Terminal Railway Co., as a holding corporation.

Washington.

The Idaho & Washington Northern R. R., F. A. Blackwell, President, Spirit Lake, Idaho, is planning to build about 20 miles of logging road in the Newport country this year to take off the timber damaged by the fires of last August.

Surveys have been completed for the proposed line of the Methow Valley & Washington Northern Ry. from Winthrop to a point below Carlton, a distance of 45 miles, and it is stated that grading contracts for this section will be let at once. The construction of two bridges over the Methow River, one at Carlton and the other near the town of Methow, will be required. Fred D. Culver, Paulsen Bldg., Spokane, Wash., is interested. W. A. Bollinger is President.

The Twin City Light & Traction Co. is planning to extend its street car service to the residential district of Centralia, Wash.

The Stone & Webster Engineering Corporation, White Bldg., Seattle, Wash., has placed 200 men at work on the construction of the Bellingham-Skagit interurban and the force will be increased as fast as material and machinery arrives for the work, which must be completed in 15 months. There are 60 miles of electric railway to be built connecting Bellingham with the Skagit county towns of Sedro-Woolley, Burlington, La Conner and Mount Vernon.

West Virginia.

The Morgantown & Kingwood R. R. Co., J. K. Monroe, Chief Engineer, Kingwood, W. Va., has awarded a contract for shops to be built at Morgantown to replace those destroyed by fire a month ago. The shops will be modern in every respect and very much larger than those burned.

An election is to be held on April 19 in the Magnolia District of Wetzel county to vote on a $100,000 bond issue to aid the proposed Clarksburg Northern R. R. An election will also be held in Tyler county to vote on a $125,000 bond issue for this project. As proposed, the road will extend from Middlebourne, W. Va., to New Martinsville. T. Moore Jackson, Clarksburg, W. Va., is the promoter.

Wisconsin.

The Engineering Department of the Chicago, Milwaukee & St. Paul Ry., C. F. Loweth, Chief Engineer, Chicago, is working on plans for a subway at Park St., Madison, Wis.

Canada.

✣Bids are asked until noon, April 10, by Frank Lee, Division Engineer Canadian Pacific Ry., Winnipeg, Man., for the construction of a boiler shop, Winnipeg, and transfer table, Winnipeg Shops. Plans, specifications and forms of proposal can be seen at the office of the Division Engineer, Winnipeg.

✣Bids are asked until noon, April 5, by the City Commissioners of Regina, Sask., for the construction of approximately 7 miles of street railway track laying, consisting of ordinary construction and track laying in pavements. Full particulars may be had upon application to City Engineer L. A. Thornton.

⊙The Cowan Construction Co., Winnipeg, and the Northern Construction Co., Winnipeg, have been awarded contracts for the construction of about $3,000,000 worth of new lines for the Canadian Northern Ry. These contracts include the construction of a line from a point near Red Deer, Alberta, to Calgary, and 200 miles of main line west of Edmonton.

The Railway Committee of Parliament has approved the bill incorporating the Imperial Traction Co., which proposes to build from Hamilton to Guelph, Berlin, Stratford, London, Woodstock and Brantford and back to Hamilton, with extensions to Niagara Falls and Sarnia. The bill incorporating the People's Ry. Co. was also approved. This company proposes to build a line from Arthur village to Flesherton and Collingwood; from Owen Sound to Collingwood and Midland, from Woodstock to Sarnia via London, from Waterford to Hagersville, from Otterville to Tillsonburg, from Stratford to Goderich, from St. Thomas to a point in Grey county, and with several other short lines.

The Railway Committee of the Ontario Legislature has approved the bill granting the Toronto Suburban Ry. Co., Toronto Junction, Ont., an extension of time for building its present line from Lambton and Weston to reach Hamilton, Niagara Falls, Woodbridge, Brampton, Thorold, Port Colborne, Guelph, Cooksville, Milton, Berlin, Preston, Hespeler and Galt. The bill before the committee sought power particularly to extend from Guelph to Galt and to Hamilton.

The Windsor, Essex & Lake Shore Ry. Co., Windsor, Ont., is reported to be considering extending its interurban line to London in the near future. The company controls the charter of the Windsor Chatham & London Ry., which gives power to build to London, Ont. The Windsor, Essex & Lake Shore Ry. now has 40 miles of line in operation.

The Chatham, Wallaceburg & Lake Erie Ry., Chatham, Ont., is reported to be considering extending its interurban line from a point near Cedar Springs to Blenheim and also on to Rondeau. At present the lake terminus of the line is at Erie Beach. Another development in view by this line is to build a bridge over the river at Wallaceburg with a possibility of still further tapping the country to the north.

The Montreal & Southern Counties Ry. Co., F. B. Powell, General Manager, Montreal, Que., now operating 12 miles of line, has replied to the Board of Control of Montreal for the right to use certain streets to secure an entrance to the city. The company asks permission to extend its line on the following streets: Across McGill St., from Youville St. up east side of McGill St. to St. Paul St., down St. Paul St., westward to Inspector St., up Inspector to Lagauchetiere St., along Lagauchetiere St. to Cathedral St., up Cathedral St. and Metcalfe St. to Burnside Pl., west along Burnside Pl. to Stanley St., down Stanley St. to Osborne St., along Osborne St. to Cathedral St., also west on Ontario St. to Mountain St. to Albert St., along Albert St. and across Chaboillez Sq. to Inspector St.

The Quebec legislature has granted authority to the Montreal & Southwestern Railway & Power Co. to construct an underground railway terminus in Montreal. The underground route as projected will tunnel the St. Lawrence River from Adirondack Junction, and enter Montreal by underground, establishing a terminus in the central part of the city. The itinerary of the road is through the Counties of Beauharnois, Laprairie, Huntingdon and Chateauguay, starting from Adirondack Junction, on the C. P. R. line, and running southwest along the St. Lawrence to the United States boundary.

The Montreal & Northern Colonization Ry. Co. has been incorporated with a capital stock of $5,000,000, the directors being Achille Ber-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

gevin, Olivier Fauher, Robert Bickerdike, W. [illegible] in or near Montreal, northwest to a point on [illegible] for the development of territory.

Thomas Malcolm, the contractor, who recently completed the International R. R. from Campbellton, N. B., to Edmundston, has made a proposition to the New Brunswick Government on behalf of the Quebec & New Brunswick Ry. Co. to construct the St. John Valley road, from Grand Falls to St. John, the line when completed to be leased to the Canadian Government and operated as part of the Intercolonial system.

Officials of the Canadian Pacific Ry. have been at Stratford, Ont., perfecting plans for an early entrance of the railroad to that city. The city, it is said, will be allowed the choice whether the northern line to Wellesley or the southern line to Embro would be constructed first. The officials favored coming into the city on the south side of Victoria Lake.

The Canadian Pacific Ry. proposes to expend [illegible] Barwell, Ont. [illegible] the company's property in the shape of roundhouse, elevator, etc., provided the town agrees to certain transfers of property.

The British Columbia Electric Ry Co., Vancouver, B. C., is to expend $50,000 for improving its freight yards on its Fraser Valley Branch at Chilliwack, B. C. The work will include a considerable amount of filling, as it is intended to raise the level of the yards about 4 ft.

The Grand Trunk Pacific Ry., B. B. Kellihe, Chief Engineer, Winnipeg, Man., proposes to construct large grain elevators at West Fort William on Lake Superior. The scheme includes three big piers devoted to the grain traffic, on which will be placed six elevators of 10,000,000 bu. capacity each. The plans provide for the handling of 2,400 cars a day in these elevators.

The Canadian Pacific Ry. has completed plans for a $70,000 concrete roundhouse to be erected at the Union Depot yards at Ottawa. A number of changes in the yard trackage are also planned.

The Grand Trunk Pacific Ry. is to make surveys for a 25-mile extension of its branch now under construction south from the main line to the Embarrez River. This 25-mile extension will carry the line into the Brazeau coal fields. Phelan & Shirley have the contract for the extension to the Embarrez River and work will be completed in September.

Two local railway projects have been organized in St. John, N. B. One of these proposes to construct a road from Hartland on the St. John River to Sparkle, a point on the Grand Trunk Pacific and on the Miramichi River, a distance of 40 miles through a fine agricultural country. It is also proposed to build a branch railway from the Canadian Pacific to Southampton in York county, a distance of 13 miles.

Mexico.

The Governor of Chihuahua has notified the officials of the Kansas City, Mexico & Orient Ry. that work might be resumed on the construction of the Orient line in that state. This line is being built through the mountains west of Chihuahua. Work was partly discontinued on account of disturbances incident to the insurrection.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣Bids will be received until 7:30 p. m., April 3, by City of Troy, Ala., G. J. Hubbard, Acting Clerk, for the construction of concrete pavement on the sidewalks on both sides of North Three Notch St., from Walnut to Knox St., and on both sides of West College St., approximately 2,000 sq. yds. Each bid to be accompanied by a certified check, payable to the City of Troy, Ala., for the sum of $500, to be held as security.

✣Bids will be received until 11 a. m., April 4, by Commissioners of Elmore County, Ala., for grading and surfacing about 30 miles of sand clay roads to be built between Elmore, Wetumpka, and Tallassee, together with necessary drain pipe and concrete culverts. Bids are requested on a yardage basis, and also on a mileage basis. Plans, profiles and quantities are on file at the Court House in Wetumpka, Ala., and in the office of the Solomon-Norcross Company, 1622 Candler Building, Atlanta, Ga. This is the first contract of an improved system of roads extending throughout the county. About 200 miles of additional work will also be let at a later date.

✣Bids will be received until noon, April 3, by G. R. Thomas, County Engineer, Selma, Ala., for grading and graveling 11¼ miles of road in Dallas County, Ala.

⊙R. B. Cook & Co. have secured a contract from the county board of revenue, Selma, Ala., to build six and three-quarters miles of good road on the south side for the sum of $12,000. The company is now engaged in building a road from Selma to Burnsville, which will be completed within the next 50 days.

The city of Huntsville, Ala., has presented the Madison county commissioners, Huntsville, with a bill for $12,200, the amount claimed to be due the city as its one-half share of the special road fund for four years. Similar action will be taken, it is said, by all of the incorporated towns of Alabama in counties where special road taxes are collected.

Arizona.

✣Bids will be received until 7 p. m., April 3, by Frank Thomas, City Recorder, Phoenix, Ariz., for paving 12 or more city blocks.

Arkansas.

A movement is on foot in Van Buren, Ark., to build a macadamized road from the outskirts of the city to Mulberry, a distance of 20 miles, through Kibler, Alma and Dryer. It is believed the road can be built for $2,500 per mile, or a total of $50,000. The district will embrace 128,000 acres. F. D. Scott is

California.

⊙The board of trustees of Fairfield, Cal., has let the contract to W. B. Connelly to macadamize the street from Union Ave. westward to the city limits. The cost of the improvement will be about $10,000.

⊙The contract for improving the Lafayette road a distance of nine miles from the Eight Mile House to Acampo has been let by the supervisors, Stockton, Cal., to Cyrus Moreing & Sons for $45,198. The supervisors also awarded a contract for the improving of the road from Ripon to the Stanislaus county line for $4,000 to Cotton Bros. Both contracts are part of the highway bond system.

A bill has been passed by the California state senate, Sacramento, providing that automobiles shall pay a graduated annual license fee into the state treasury to be used in the maintenance and improvement of the state roads. The state will receive an additional revenue of approximately $400,000 per year under the law. The machines are to be taxed according to their motive power.

The California state senate, Sacramento, has passed a bill appropriating $10,000 for the construction of a state highway from Folsom, Sacramento county, to Placerville, El Dorado county.

The surveyors in the employ of the county highway commission, San Diego, Cal., practically have completed the survey work for the construction of the county highway between the coast and Vista, connecting with the coast road at South Oceanside and with the inland route between Los Angeles and San Diego at Vista.

Delaware.

The House of Representatives, Dover, Del., has passed a bill authorizing the County Commissioners of New Castle County, Wilmington, Del., to issue bonds for $200,000 for permanent road improvements. The measure specifies the roads to be constructed. New Castle County will have available $800,000 for good roads during the year.

District of Columbia.

✣Bids will be received until noon, April 7, by Capt. H. L. Pettus, Constructing Quartermaster Walter Reed, General Hospital, Washington, D. C., for constructing macadam roads, concrete walks, curbing, etc., at the Walter Reed General Hospital, D. C.

✣Bids are asked by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until 11 a. m., April 22, for vitrified brick pavement and railroad tracks at U. S. Navy Yard, Boston, Mass.

Georgia.

✣Bids will be received until noon, April 18, by City Council of Dublin, Ga., for furnishing necessary labor and material for the construction of 6,000 sq. yds. of vitrified brick pavement. M. J. Guyton is City Engineer and A. P. Hilton is Clerk.

The City Council of Macon, Ga., has adopted a resolution providing for the paving of 4th St., beginning at Pine, with granite cubes.

The Lee county commissioners, Leesburg, Ga., have decided to put the county convicts at work on the road between Leesburg and Smithville.

Illinois.

✣Bids will be received until 11 a. m., April 6, by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Sec'y, 2nd floor City Hall, for paving as follows: Alley bounded by E. Pearson St., E. Chicago Ave., Cass St. and N. State St., with repressed vitrified paving brick; alleys between Chestnut St., W. Chicago Ave., La Salle Ave, N. Clark St., with repressed vitrified paving brick; alley E. Wells St. between W. Oak St., Whiting St., with repressed vitrified paving brick; alleys between Hill St., Wendell St., Wells St., repressed vitrified paving brick; alley, La Salle Ave., from Hill St. to W. Elm St., with repressed paving brick; alleys bounded by North Ave., Meyer Ave., Eugenie St., Mohawk St., with repressed paving brick; alleys bounded by Indiana St., Illinois St., Dearborn ave., N. Clark St., with granite blocks; alleys bounded by W. Superior St., W. Huron St., La Salle Ave., Wells St., with creosoted wooden blocks; alleys between Locust St., W. Chestnut St., La Salle Ave., Wells St., with repressed vitrified paving brick; alleys between Elm St., W. Division St., La Salle Ave., Wells St., repressed vitrified paving brick; alley, W. Goethe St. to 448 ft. S. Wells St., La Salle Ave., with repressed vitrified paving brick; alleys bounded by Wisconsin St., Menominee St., N. Park Ave. and Hammond St., with repressed vitrified paving brick; alley bounded by North Ave., Willow St., N. Halsted St., Dayton St., with repressed paving brick; alleys bounded by Webster Ave., Belden Ave., N. Halsted St., Dayton St., with repressed paving brick; alleys between Sedgwick St., N. Clark St., Garfield Ave., 1041 ft. S. of Webster Ave with repressed paving brick; alleys bounded by Center St., Garfield Ave., Sedgwick St., Lane Court, with repressed vitrified paving brick; alleys bounded by Garfield Ave., Webster Ave., Pearl St., Burling St., with repressed vitrified paving brick; alleys bounded by Center St., Garfield Ave., Clifton Ave., Racine Ave., with repressed vitrified paving brick;

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

alleys bounded by [illegible] Ave., Cleveland Ave., Webster Ave., with repressed vitrified paving brick; alleys between Fullerton Ave. Blvd., Arlington Pl., N. Clark St., Hamilton Court, with creosoted wooden blocks; alley bounded by Wrightwood [illegible], Dewey Place, Orchard St., Burling St., with repressed vitrified paving brick; alley from Menominee St. to S. line Wisconsin St., between Hudson Ave., Cleveland Ave., with repressed vitrified paving brick; alleys bounded by Center St., Lincoln Ave., Cleveland Ave., with exceptions, repressed vitrified paving brick; alleys bounded by Webster Ave., Grant Pl., Sedgwick St., Cleveland Ave., with creosoted wooden blocks. All to be laid on a 6 in. Portland cement concrete foundation with sand [illegible]. Work includes sewer adjustment, curbing, etc.

◉The following contracts have been awarded by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Sec'y: Paving with asphalt Balmoral Ave, East Ravenswood Park to N. Ashland Ave., R. F. Conway Co., 720 Chamber of Commerce Bldg.; Butler St., 25th St. to 26th St., American Asphalt Paving Co., 404 Chamber of Commerce Bldg.; N. Campbell Ave., Fullerton Ave. to Elston Ave., American Asphalt Paving Co., Coblentz St., Robey St. to Western Ave., W. Erie St., Western Ave. to Campbell Ave., Standard Paving Co., 145 La Salle St., Forrestville Ave., 45th St. to 46th St., American Asphalt Paving Co., Marianna St., Florence Ave. to Sheffield Ave., Parker-Washington Co., 920 Chamber of Commerce Bldg.; Maud Ave., Sheffield Ave. to Racine Ave., American Asphalt Paving Co.; Oakdale Ave., Halsted St. to Herndon St., Parker, Washington Co.; Parnell Ave., 43d St. to 44th St., Barber Asphalt Paving Co., 145 Dearborn St.; S. Sawyer Ave., W. 27th St. to W. 30th St., Standard Paving Co.; Wentworth Ave., 21st St. to 26th St., American Asphalt Paving Co.; Belden Ave., North Park Ave. to N. Clark St., R. F. Conway Co.; N. Clifton Ave., Montana Ave. to Wilson Ave., R. F. Conway Co.; Crystal St., Rockwell St. to California Ave., American Asphalt Paving Co.; E. 45th St., Drexel Blvd. to Vincennes Ave., R. F. Conway Co.; E. 48th St., Vincennes Ave. to Drexel Ave., R. F. Conway Co.; Gladys Ave., 40th Ave. to 44th Ave., R. F. Conway Co.; N. Hamilton Ave., Wilson Ave. to Lawrence Ave., R. F. Conway Co.; N. Homan Ave., North Ave. to Grand Ave., American Asphalt Paving Co.; McHenry St., Blanche St. to North Ave., R. F. Conway Co.; W. 19th St., Johnson St., 347 ft. west, R. F. Conway Co., Rossano St., E. 66th St. to E. 67th St., American Asphalt Paving Co.; E. 62d St., Madison Ave. to I. C. R. R., American Asphalt Paving Co.; E. 78th St., Bond Ave. to Lake Ave., R. F. Conway Co.; Starr Ave., North Park Ave. to Sedgwick St., R. F. Conway Co.; S. Troy St., W. 22d St. to W. 26th St.; N. 46th Ave., Montrose Ave. to Wilson Ave., R. F. Conway Co.; N. 46th Ct., Montrose Av. to Wilson Ave., R. F. Conway Co.; N. 47th Ave., Montrose Ave. to Wilson Ave., R. F. Conway Co. Paving with macadam, S. Robey St., W. 52d to W. Garfield Blvd., Jno. A. McGarry Co., 1001 Security Bldg.; 97th St., Ave. H to Ave. N, Illinois Improvement & Ballast Co., 115 Adams St.; Ave. O, 106th St. to 108th St., Calumet Coal & Teaming Co., 2926 E. 95th St.; Greenwood Ave., E. 75th St. to a point 225 N. of 79th St., Calumet Coal & Teaming Co.; Dobson Ave., E. 75th St. to E. 79th St., Calumet Coal & Teaming Co.; Ellis Ave., E. 75th St. to E. 76th St., E. 78th St. to E. 79th St, Calumet Coal & Teaming Co.; Ingleside Ave., E. 75th St. to E. 79th St., Drexel Ave., E. 75th St. to E. 79th St., Jackson Ave., E. 75th St. to E. 79th St., E. 75th Pl., E. 76th St., E. 77th St., Cottage Grove Ave. to Cary Ave., Greenwood Ave. and I. C. R. R., as shown on profiles, [illegible] Paving with repressed vitrified paving brick, W. North Ave., California Ave. to Kedzie Ave., Parker, Washington Co.; Carroll Ave., Carpenter St. to Elizabeth St., American Asphalt Paving Co.; Centennial Pl., Ashland Ave. to Paulina St., Central Paving Co., 172 Washington St.; W. 63d St., Ashland Ave., to P. C. C. & St. L Ry., Ready & Callahan Co., 47th and Halsted Sts.; 75th St., I. C. R. R. to Bond Ave., Calumet Coal & Teaming Co.; 79th St., Halsted St. to Center Ave., Ready & Callahan Coal Co.; Fleetwood St., W. North Ave. to Elston Ave., Central Paving Co.; Foster Ave., Lincoln Ave. to Central Park Ave., Citizens' Construction Co. Paving with creosoted wood blocks, Monroe St., Clark St. to La Salle St., Citizens' Construction Co.; E. 42d St., Lake Ave. to I. C. R. R., Citizens' Construction Co. Paving with granite blocks, Kingsbury St., Erie St. to Chicago Ave., Standard Paving Co., 145 LaSalle St.

Following are the low bids submitted to the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Sec'y, Room 200 City Hall, for constructing cinder sidewalks: Archer Ave., 40th Ave. to 51st St., 630 lin. ft. of walk to be built, average cut 3 ft., average fill 1.3 ft., H. P. Larsen, 1542 N. Rockwell St., 47 3/10c per lin. ft.; Belden Ave., 51st Ave. to 53d Ave., 2250 lin. ft. of walk to be built, average cut 1.25 ft., average fill 1.25 ft., 1804 lin. ft. cut., Siewert-Carlsen Co., 3865 Milwaukee Ave., 32 8/10c per lin. ft.; 45th Ave., Milwaukee Ave. to Addison St., 860 lin. ft. of walk to be built, average fill 1.25 ft., 745 lin. ft. of cut, average cut 7 ft., Siewert-Carlsen Co., at 30 3/10c per lin. ft.; 59th St., Albany Ave. to Kedzie Ave., 620 lin. ft. of walk to be built, average fill 1½ ft., Chas. Chambers & Sons, 5256 S. Wood St., 36c per lin. ft.; Homan Ave., 37th to 39th St., 740 lin. ft. of walk to be built, average fill 1 ft, 496 lin. ft. of cut, average depth 75 ft., H. P. Larsen, 1542 N. Rockwell St., 37 1/10c. per lin. ft.; Hermitage Ave., 90th St. to Beverly Ave., 420 lin. ft. of walk to be built, average fill 1.25 ft., 417 lin. ft. of cut, average depth .75 ft., Chas. Chambers & Son, 50c per lin. ft.; Kingston Ave., 79th St. to 711 ft. s., 560 lin. ft. of walk to be built, average fill 2.25 ft., James Porter, 1557 E. 94th St., 40c per lin. ft.; 102d St., Indianapolis Ave. to Ewing Ave., 700 lin. ft. of walk to be built, average fill 4.25 ft., Jas. Porter, Hanson-Undine Co., 2858 E. 83d St., 95c per lin. ft.; 106th St., Ave. L to Calumet River, 370 lin. ft. of walk to be built, average fill 2.75 ft., H. P. Larsen, 1542 N. Rockwell St., 87c per lin. ft.; St Louis Ave., 38th St to 39th St., 990 lin. ft. of walk to be built, average fill 1 ft., 248 lin. ft. cut, 5 ft average depth, H. P. Larsen, 37 3/10c per lin. ft.; 38th St., Kedzie Ave. to Homan Ave., 515 lin. ft. of walk to be built, average fill 1⅓ ft., 60 lin. ft. cut, average depth .5 ft., 32¾c; 92d St., Vincennes Ave. to 210 ft. w., 650 lin. ft. of walk to be built, 1⅔ ft. average fill, Fred J. Nerger, 32¾c per lin. ft.; Cornelia St., 45th Ave. to 46th Ave., 3000 lin. ft. of walk to be built, average fill 1.25 ft., 2550 lin. ft. cut, average depth ⅔ ft., Siewert-Carlsen Co., 3865 Milwaukee Ave., 31 8/10c per lin. ft.; 37th Pl., Spalding Ave. to 299 ft. w., 1430 lin. ft. of walk to be built, average fill 1 ft., 1171 lin. ft. cut, average depth 1 ft., H. P. Larsen, 37 1/10c per lin. ft.; 112th St., Stewart Ave. to C. & W. I. R. R., 2730 lin. ft. of walk to be built, average fill 1⅓ ft., 1763 lin. ft. cut, average depth .75 ft., A. P. Larsen, 13322 Indiana Ave., 34c per lin. ft.; 76th St., 124 ft. e. of Vincennes Ave. to South Park Ave., 1300 lin. ft. of walk to be built, 1½ ft. average fill, 484 [illegible]

Indiana.

✣B[illegible] 15, by Commissioners of Rush County at Rushville, Ind., [illegible] road in Ripley and Center townships. G. M. [illegible]

✣Bids [illegible] ville, Ind., for the construction of a gravel road in Posey Township and a macadam road in Anderson Township. J. M. Stone is County Auditor.

✣Bids will be received until 1:30 p. m., April 6, by Board of County Commissioners, Rockville, Ind., for the construction of a gravel road in Reserve Township. James E. Elder is Auditor.

✣Bids will be received until 10 a. m., April [illegible] gravel roads in Tippecanoe County.

✣Bids will be received until noon, April 4, by board of County Commissioners, Sullivan, Ind., for the construction of two stone roads in Cass Township, and one stone, sand, clay and oil road in Hamilton Township. Ben C. Crowder is Auditor of Sullivan County.

✣Bids will be received until 10 a. m., April 3, by Board of County Commissioners, Decatur, Ind., for the construction of a macadamized road in Wabash Township. H. S. Michaud is County Auditor.

✣Bids will be received until 10 a. m., April 3, by Board of County Commissioners, Decatur, Ind., for the construction of a macadamized road in St. Maries Township. H. S. Michaud is Auditor of Adams County.

The county commissioners at Winchester, Ind., have been petitioned for two roads on the Wayne and Randolph county lines. One of the roads starts at the Ohio-Indiana state line and runs west four and a half miles to what is known as the old boundary. The other starts at the Bloomingsport pike and runs west about three miles.

The board of public works of Seymour, Ind., has decided in favor of some extensive street improvements, the total cost of which is estimated at $65,000. The streets to be improved are Ewing, Chestnut and Walnut, and the material will be either concrete, asphalt, brick or macadam. The city's part of the expense for the intersections will be about $15,000.

Iowa.

The city council of Clinton, Ia., has been petitioned for the re-paving of Fifth Ave., between Second and Fifth Sts., with creosoted wood blocks and curbing with concrete.

The following bids were submitted to the board of public works of Davenport, Ia., for paving the alley between Front and Second, and Gaines and Warren Sts.: C. H. Hubbell, excavating, $0.44; paving, $1.96; Hydraulic Concrete Construction Co., excavating, $0.45; paving, $1.78; Northwestern Construction Co., excavating, $0.40; paving, $1.60. The bids for the alley between Sixth and Seventh, Perry to Brady: C. H. Hubbell, excavating, $0.44; paving, $1.95; Hydraulic Concrete Construction Co., excavating, $0.47; paving, $1.83; Northwestern Construction Co., excavating, $0.40; paving, $1.62. For Brown St., between Fifth and Sixth: C. H. Hubbell, excavating, $0.44; paving, $1.98; curbing, $0.35; Hydraulic Concrete Construction Co., excavating, $0.45; paving, $1.90; curbing, $0.35; Northwestern Construction Co., excavating, $0.40; paving, $1.78; curbing, $0.33. For Scott St., between Fifth and Sixth: C. H. Hubbell, excavating, $0.45; paving, $1.98; curbing, $0.36; Hydraulic Concrete Construction Co., excavating, $0.45; paving, $1.78; curbing, $0.35; Northwestern Construction Co., excavating, $0.40; paving, $1.65; curbing, $0.33.

The city council of Clinton, Ia., has been petitioned for the re-paving of Fifth Ave., between Second and Fifth Sts., with wood block. R. C. Hart is city engineer.

Kansas.

✣Bids will be received until April 1, by Thomas McKay, Dresden, Kan., Route No. 2, for grading the road 16 miles or more according to the plans and specifications herein set out. The road to begin at the southeast corner of Section 1, in Township 3, south of Range 29 west, running thence due south 12 miles on range line between Ranges 28 and 29, thence west 2 miles, thence south 5 miles to county line, thence south 1½ miles in Sheridan County [illegible] Selden.

◉J. R. Ramsey of Topeka, Kan., has been awarded the contract by the City Commissioners of that city for constructing 17 blocks of brick paving in Topeka for $60,806. The contract calls for 27,906 yds. of paving and 13,296 yds. of curb and gutter.

The Sedgwick county commissioners, Wichita, Kan., are advertising for bids for the construction of a new sand clay road on West Maple and West Central Sts., at a cost of [illegible]

[illegible] stretch of good, hard road.

Kentucky.

County Judge Buir Weissinger, Louisville, Ky., has completed arrangements for the purchase of three new 13-ton steam rollers for the country roads.

The Ryle & South Fork Turnpike Co., of Ryle, Ky., has been incorporated with a capital stock of $4,000. The incorporators are William Williford, Sam Rust, J. E. McCormack, Everett Williford, Curtis Jackson of Ryle; Elmer Waters and E. J. Baker of Berksher.

Louisiana.

⊙Advices from Franklinton, La., state that the contract for grading the town streets has been let to J. S. Moody of Poplarville, Miss.

Michigan.

✣All bids received for the construction of the Bay Shore road have been rejected by the County Commissioners, Menominee, Mich., and the work readvertised for April 10.

At the regular election in April the voters of Bark River township, Delta county, Mich., will be asked to vote on the proposition to issue the bonds of the township in the amount of $6,300 to allow the construction of three miles of macadam road in that township. Escanaba is the county seat of Delta county.

Minnesota.

✣Bids will be received until 10 a. m., April 3 by Board of County Commissioners, Ramsey County, St. Paul, Minn., for the improvement of the following named roads in Ramsey County. All as per plans and specifications on file in the office of Geo. J. Ries, County Auditor of said county. Grade, clay and gravel the Barlow road from the Manomin road north 2 miles; grade, clay and gravel the Lexington Ave. extension from Turtle Lake road north and west 1½ miles to a connection with the Elwood road at the Anoka County line; grade, clay and gravel Rice St. from the Turtle Lake road north 1 mile to the Anoka County line. Grade and macadamize the Bald Eagle and Hugo road north from Bald Eagle junction north 1½ miles to the Washington County line. Also the improvement of Fourth St., Village of White Bear.

The board of public works of St. Paul, Minn., has ordered the paving of Jackson St., University Ave. to Valley St. The estimated cost of the work is $7,500. The sum of $5,000 has been set aside from the general fund.

The board of public works of Minneapolis, Minn., has rejected all bids for the paving of Rosabel St., between Ninth and 10th Sts., because of objection of property owners to the improvement.

The city council of Mankato, Minn., has been petitioned for the paving of Hickory St., from the C., M. & St. Paul railway track to Broad St., with creosoted block, and for the paving of a portion of Front St., to be paved with creosoted block.

Missouri.

At a recent meeting of the Pettis county farmers and business men for the purpose of discussing good roads, decided to petition the Pettis county court to call a special election for the purpose of voting an issue of $400,000 in bonds to build 10 rock roads, radiating from Sedalia.

Montana.

A movement has been started by citizens of Kalispell, Mont., to have the country road from Columbia Falls to Belton, the gateway to the Glacier National Park, improved for the rapid passage of automobiles, and the aid of the commissioners of the National Forest Service will be asked.

Nebraska.

✣Bids will be received until April 10, it is said, by the City Council of Hastings, Neb., for paving Hastings Ave. between 4th and 12th Sts., and Burlington Ave. between 2d and 3d Sts. Brick will be used in both districts.

✣Bids will be received until noon, March 30, by Roscoe C. Ozman, City Clerk, Lincoln, Neb., for the work of paving in District No. 24, being the alley between Q and R Sts., from 10th to 11th Sts.

Bids will be received until noon, March 30, by Roscoe C. Ozman, Clerk, Lincoln, Neb., for paving in District 196, being 25th St. from Vine to X St., or M. P. Ry. right of way. City Engineer's estimate is as follows: Vitrified brick paving, class B, 1 year guarantee, $2.15 per sq. yd.; artificial stone, curbing, class 1, 55c per lin. ft.; artificial stone curb and gutter, 18 in. gutter, 1 year guarantee, 80c per lin. ft.; extra grading, 50c per cu. yd.; extra concrete, $7 per cu. yd.; extra broken stone, $2.25 per cu. yd.; extra sand in place, $1.15 per cu. yd.; resetting old curb, 15c per lin. ft.; cement grouting for brick paving, 13c per sq. yd.; asphalt filler for brick paving, 25c per sq. yd.; paving pitch for brick paving, 22c per sq. yd.; relaying cement sidewalks, 6c per sq. yd.; relaying brick sidewalks, 5c per sq. yd.

⊙The paving committee of the city council of Lincoln, Neb., has re-awarded the contract for the paving of district No. 183 to Michael Ford for $39,694. The work will be done with either Bermudez or Trinidad asphalt. District No. 183 runs on C St., from 19th to 27th; B St., from 19th to 20th, and 19th from A to D Sts.

Property owners along H. St. have petitioned the city council, Fremont, Neb., for the paving of H St., from 10th to 14th Sts.

A movement is on foot to pave North 9th, North 10th and North 11th Sts., in Norfolk, Neb., as far as Prospect Ave., and Norfolk Ave. west to 13th St. Petitions are now being circulated.

New Jersey.

The Hudson County Boulevard Commission, Jersey City, N. J., received the following bids March 16 for the improvement of the Boulevard in the Bayonne, Bergen and Greenville sections. The bids were received on a percentage of estimated cost: Bergen section, Van Keuren & Son, 71 per cent; Thos. Harrington Sons Co., 92 per cent; Joseph Murphy & Son, Inc., 69⅓ per cent; Edward P. O'Neill, 85 per cent; J. F. Shanley Co., 99 per cent, and Wm. Baker, 59 per cent. Greenville section, W. J. Curley, 85 per cent; Jos. Murphy & Son, 69⅓ per cent, and Wm. Baker, 59 per cent. Bayonne section, M. J. Curley, 85 per cent; Jos. Murphy & Son, 73¼ per cent, and Wm. Baker, 59 per cent. The figures prepared by Frederick Dunham gave the cost of the work on the Bergen section as $86,375, the Bayonne section as $24,339, and the Greenville section as $31,187.

New Mexico.

A petition is being circulated in the vicinity of Barelas bridge asking that the county commissioners, Albuquerque, N. Mex., condemn several hundred ft. of land between Cromwell Ave. and Bridge St., on South Fourth St., in an effort to have the road through Barelas cleared and a straight street made to the bridge.

The county of Bernalillo, Albuquerque, N. Mex., county seat, has made financial arrangements to construct this year a road along the Rio Grange from one extremity of the county to the other. The sum of $10,000 is available for the road from the Sandoval county line to Albuquerque, nine miles, and the Territorial Good Roads Commission will construct the road.

New York.

✣Bids will be received until 2 p. m., April 3, by George McAneny, President Borough of Manhattan, New York City, 8 street improvement contracts, the largest being as follows: No. 7, for regulating and repaving with sheet asphalt pavement with close binder on a concrete foundation the roadway of Ave. C from the north side of Houston St. to the south side of 12th St. Engineer's estimate of amount of work to be done: 6,640 sq. yds. of asphalt pavement (including binder course), except the railroad area; 1,280 sq. yds. of asphalt pavement, including binder course, in the railroad area (no guarantee); 1,570 cu. yds. of Portland cement concrete; 4,800 lin. ft. of new bluestone curbstone, furnished and set; 100 lin. ft. of old bluestone curbstone, redressed, rejointed and reset; 2 noiseless heads and covers, complete, for sewer manholes, furnished and set. The time allowed for doing and completing the above work will be 40 working days. The amount of security required will be $6,000.

✣Bids are ordered until 7:30 p. m., April 17, by Grover E. Yerdon, City Clerk, Jamestown, N. Y., for constructing 8535 sq. yds. bituminous macadam on East State St., 3280 sq. yds. bituminous macadam on West State St., and 4885 sq. yds. cobble gutter.

⊙The Board of Contract of Rochester, N. Y., has awarded the contract for constructing about a half mile of roadway and walks in Exposition Park to A. Freiderich Sons & Co., for $14,618.

⊙Following contracts have been awarded by the State Commission of Highways, Albany, N. Y., for the improvement of public highways by state aid; bids received March 20: Road No. 879, Shakers-Watervliet, Albany County, 6.40 miles, with trinidad, John E. Consalus, Albany, N. Y., $76,600; Road No. 5074, Schlodack Centre-Valatie, part 4, Columbia County, 4.30 miles, with residuum, Thomas Shaughnessy & Co., Albany, $48,900; Road No. 884, Malone-Fort Covington, part 1, Franklin County, 3.58 miles, with residuum, St. Regis Construction Co., Albany, $42,222; Road No. 885, Moire-South Bombay, Franklin County, 8.58 miles, with residuum, James Anderson, Albany, $84,429; Road No. 5076, Malone-Moira, Franklin County, 5.22 miles, with residuum, James Anderson, Albany, $59,579; Road No. 659, Brunswick-Lansingburg, Rensselaer County, 5.07 miles, with residuum, John W. Flinn, Waterford, $55,488; Road No. 858, Whitney's Point-Upper Lisle, Broome County, 4.27 miles, T. H. Gill & Co., Boston, Mass., $46,316; Road No. 687, Fair Haven-Sterling-Martville, Cayuga County, 5.30 miles, with residuum, Mosier & Summers, Buffalo, N. Y., $62,000; Road No. 873, Brockton-Stockton, Chautauqua County, 2.93 miles, Miller & Knickenburg, Buffalo, N. Y., $30,525; Road No. 666, Plymouth-Kirk, Chenango County, 4.90 miles, with residuum, E. D. Baker, Binghamton, N. Y., $53,548; Road No. 777, Plattsburg-Cadyville, Clinton County, 4.33 miles, with residuum, Spellman-Oliver Co., Chateaugay, $39,970; Road No. 5072, Livingston-Hudson, part 1, Columbia County, 3.62 miles, Catskill Supply Co., Catskill, N. Y., $41,990; Road No. 5073, Livingston-Hudson, part 2, Columbia County, 5.10 miles, De Graff & Hogeboom, Kingston, N. Y., $66,700; Road No. 712, Armenia-Sharon Station, Dutchess County, 2.29 miles, Lane Construction Co., Meriden, Conn., $20,649; Road No. 625, Theresa-Antwerp, part 2, Jefferson County, 5.37 miles, with residuum, Dale Engineering Co., Utica, N. Y., $54,420; Road No. 626, Burrs Mills-S. Champion, Jefferson County, 4.56 miles, with residuum, Semper Bros., Watertown, $49,917. Contracts on the following roads have not as yet been awarded: Road No. 790, Cohoes City Line-Boghts Corner, Albany County, 2.11 miles; Road No. 695, Otto-Cattaraugus, Cattaraugus County, 1.21 miles, bids exceeded appropriation; Road No. 697, Otto-E. Otto, Section 2, Cattaraugus County, 2.27 miles, bids exceeded appropriation; Road No. 763, Hollowville-Craryville, Columbia County, 7.14 miles; Road No. 679, W. Stephentown-Stephentown Center, Rensselaer County, 4.14 miles; Road No. 680, Stephenson Center-Massachusetts, Rensselaer County, 3.92 miles; Road No. 5084, Schodack Center-Valatie, part 3, Rensselaer County, 2.90 miles; Road No. 4074, Extension Schodack Hudson, parts 1 and 2, Columbia County, 8.70 miles; Road No. 4074, Extension Schodack Center-Valatie, parts 3 and 4, Columbia, Rensselaer Counties, 7.20 miles.

The board of supervisors of Wayne county, Lyons, N. Y., has approved the plans for the building of about eight miles of county highway by state aid this summer. The total aggregate estimated cost of these proposed roads is $73,700, divided as follows: Clyde-Resort road, part 1, 3.87 miles, estimate, $30,500; Lyons-Sodius Point road, part 1, 3 miles, estimate, $31,100; Macedon-Carter Four Corners road, 1:16 miles, estimated cost, $12,100. Beal M. Smith is clerk of the board of supervisors.

North Carolina.

✤Bids will be received until April 3, by Fayetteville, N. C., for the construction of $35,000 worth of light traffic pavement. H. J. McBuie is City Clerk.

Contracts will be let some time during the summer in Bat Cave, N. C., for the construction of about 10 miles of rock pavement. W. L. Spoon, Chappel Hill, N. C., is the engineer. G. W. Conner, Bat Cave, has charge of the work.

Ohio.

✤Bids will be received until 10 a. m., March 31, by Charles J. Sanzenbacher, County Auditor, Toledo, O., for furnishing and delivering macadam materials required in the repair of Stone Road No. 33, known as the Weckerley Road in Waterville Township, from Swan Creek to White House corporation line.

✤Bids will be received until 11 a. m., April 15, by Board of County Commissioners, Cleveland, O., for the grading, draining and improving of Wooster Pike Road, No. 3, from end of the present brick road to the Medina County line in Strongsville Township in accordance with the form of contract and specifications to be furnished by Frank R. Lander, Connty Surveyor.

⊙James C. Wonders, State Highway Commissioner, at the office of County Commissioners, Hamilton, O., has awarded the contract for grading and macadamizing 2.10 miles of road in St. Clair Township, to Garver Contracting & Transfer Co., of Hamilton, for $15,086. Bids were opened March 24.

The good roads commissioners, Dollar Bank Bldg., Youngstown, O., have received the following bids for the improvement of the Powers road, 4,900 ft. long, and extending from the Lansingville school house to the Youngstown and Poland road, at Simon's corners: W. E. Gartland, $13,824; Martin Connelly & Son, $14,668; Oakley & Ensign of Cortland, $13,323; Turner & Olson, $13,023; Kennedy Bros., $14,306; Charles Harris, $13,941, and L. K. H. Young, $17,270. For the Division St. work, which is a connection 18 ft. in length, between Division St. and the Salt Springs road, G. A. Galdini & Co., $1,800; L. H. Young, $1,817; Cleveland Trinidad Co., $2,236; Oakley & Ensign, $1,510; Gray & Shook, $1,889; Ross O'Rourke, $1,912. The proposed improvement on the Shady Run road, extending from Poland Ave. to Kyles' Corners: James Colucci, $11,173; D. J. Shennak, $9,872; F. L. Geiger of Warren, $11,630; G. A. Galdini & Co., $10,477; Oakley & Ensign, $10,691; Ed. Kane, $11,027, and McKee & Co., $10,064. The low bidders on each of the above jobs will secure the contract. Bonds in the sum of $125,000 have been voted for this purpose

The good roads committee of Clark county, Springfield, O., has passed a resolution in favor of the paving of Yellow Springs pike so as to make it a good stone road. The county commissioners will be asked to make the improvement.

An election is to be held in Beaver township, Beaver, O., to see whether the two miles of road from North Lima to East Lewistown are to be paved. The strip of road joins the Youngstown-Columbiana paved road at North Lima and runs directly west.

The city council of Cincinnati, O., has adopted ordinances calling for the resurfacing of 13th St., between Greenup and Garrard Sts., and 20th St., from Eastern to Glen way Ave., with brick paving. Ordinances ordering the paving of sidewalks on Holman St., between 15th and 16th Sts., with cement were also adopted.

The county commissioners, Cincinnati, O., have approved an estimate of $10,515 as the cost of improving the Groesbeck road from the city corporation line to the east line of College Hill, and plans and specifications have been ordered. The commisisoners have also been petitioned for the improvement of the road leading from Miamitown to Cleves and Valley Junction.

Property owners along the Lexington road, which is to be improved during the coming summer by the Stark county commissioners, Canton, O., for a distance of one mile north from the Alliance corporation line, by the construction of a combination dirt and brick paved highway, have asked the commissioners to have the paving placed in the middle of the roadway. It is planned to have the roadway to a width of 16 ft.

Oklahoma.

⊙The city of Oklahoma City, Okla., has awarded contracts for paving to the Cleveland Trinidad and the Western Paving companies. The former concern secured $147,186 of the work and the latter $351,818. The following list shows all the contracts and bids submitted: Linwood: Cleveland, $76,755; Western, $75,911; Levy, $71,681. Lindsay: Cleveland, $9,628; Western, $9,773; Levy, $8,933. Wheeler: Cleveland, $9,530; Western, $9,765; Levy, $8,969; Shelby-Downard, $8,900. Walker: Cleveland, $14,881. Bath: Western, $707. Olie: Cleveland, $33,874; Western, $34,048; Levy, $31,157; Shelby-Downard, $30,840. Seventh: Western, $30,395. Thirty-first St.: Cleveland, $4,252; Western, $4,268; Levy, $3,830. Forty-first St.: Cleveland, $23,160. Seventeenth St.: Cleveland, $36,509; Western, $59,029; Levy, $21,411. Thirty-seventh St.: Western, $52,815; Levy, $52,180. Poplar: Western, $44,846; Levy, $18,426. Robinson: Western, $142,873.

The city council of Oklahoma City, Okla., has passed resolutions providing for the paving, curbing, etc., of the following streets and avenues: Pottawatomie Ave. from the west line of Broadway to the east line of Western Ave.; Pine St. from the west line of Walker Ave. to the east line of Shartel Ave.; Noble Ave. from the west line of Walker Ave. to the east line of Western Ave.; Shartel Ave. from the south line of Chickasaw Ave. to the north line of the St. Louis & San Francisco Railway Right of Way; Lee Ave. from the south line of Chickasaw Ave. to the north line of the St. Louis & San Francisco Railway Right of Way; Dewey Ave. from the south line of Chickasaw Ave. to the north line of the St. Louis & San Francisco Railway Right of Way; Western Ave. from the north line of Twenty-third St. to the north line of Thirty-third St., going west; Twenty-second St. from the west line of McKinley Ave. to the east line of Florida Ave.; Hudson Ave from the south line of Reno Ave. to the north line of the St. Louis & San Francisco Railway Right of Way; Dewey Ave. from the north line of Seventh St. to the south line of Eleventh St.; Francis Ave. from the north line of Fourth St. to the south line of Ninth St.; Francis Ave. from the north line of Sixteenth St. to the south line of Twenty-fifth St.; Reno Ave. from the west line of Western Ave. to the east line of Douglas Ave.; California Ave. from the west line of Western Ave. to the east line of Douglas Ave.; Grand Ave. from the west line of Western Ave. to the east line of Douglas Ave.; Phillips Ave. from the north line of Second St. to the south line of Fourth St.; Durland Ave. from the north line of Second St. to the south line of Fourth St.; Fourth St. from the west line of Western Ave. to the east line of Douglas Ave.; Third St. from the west line of Klein Ave. to the east line of Pennsylvania Ave.; Fifth St. from the west line of Western Ave. to the east line of Ames Ave.; Seventh, Eigth and Ninth Sts. from the east line of Indiana Ave. to the east line of Linwood Blvd., and Kentucky Ave. from the north line of Linwood Blvd. to the south line of Tenth St.; McKinley Ave. from the north line of Tenth St. to the south line of Fourteenth St.; McKinley Ave. from the north line of Fifth St. to the south line of Tenth St.; McKinley Ave. from the north line of Sixteenth St. to the south line of Thirty-fourth St.; Ames Ave. from the north line of the Rock Island Right of Way to the south line of Tenth St.; Ames Ave. from the north line of Sixteenth St. to the south line of Twenty-third St.; Ames Ave. from the south line of Thirteenth St., going east, to the south line of Sixteenth St.; Ames Ave. from the north line of Twenty-fifth St. to the south line of Thirty-sixth St.; Douglas Ave. from the south line of Reno Ave. to the south line of Tenth St.; Brauer Ave. from the north line of Fifth St. to the south line of Tenth St.; Eighth St. from the west line of Klein Ave. to the east line of Indiana Ave.; Ninth St. from the west line of Klein Ave. to the east line of Indiana Ave.; Ellison Ave. from the north line of Sixth St. to the south line of Tenth St.; Douglas Ave. from the north line of Sixteenth St. to the south line of Seventeenth St.; Kentucky Ave. from the north line of Tenth St. to the south line of Sixteenth St.; Florida Ave. from the north line of Sixteenth St. to the south line of Twenty-third St.; Seventeenth St. from the west line of Classen Blvd. to the east line of Ames Ave.; Military Ave. from the north line of Twenty-fourth St. to the south line of Thirty-fourth St.; Geary Ave. from the south line of Third St. to the south line of Eighth St.; Thirty-first St. from the east line of Western Ave. to the west line of Shartel Ave.; Florida Ave. from the north line of Thirtieth St. to the south line of Thirty-fourth St.; Thirty-second St. from the east line of Florida Ave. to the west line of Western Ave.; Twenty-ninth St. from the east line of Classen Blvd. to the west line of Western Ave.; Thirtieth St. from the east line of Classen Blvd. to the west line of Western Ave.; Twenty-seventh St. from the east line of Classen Blvd. to the west line of Military Ave.; Twenty-eighth St. from the east line of Classen Blvd. to the west line of Military Ave.; Olie Ave. from the north line of Thirtieth St. to the south line of Hill St.; Twenty-fourth St. from the west line of Classen Blvd. to the east line of Ames Ave.; Twenty-first St. from the west line of Classen Blvd. to the east line of Florida Ave.; Everest Ave. from the north line of Sixth St. to the south line of Tenth St.; Kelley Ave. from the north line of Sixth St. to the south line of Tenth St.; Sixth St. from the east line of Stonewall Ave. to the west line of East Ave.; Idaho Ave. from the north line of Fourth St. to the south line of Sixth St.; Stonewall Ave. from the north line of Fourth St. to the south line of Tenth St.; Fourteenth St. from the east line of Broadway to the west line of the A., T. & S. F. Ry. Right of Way; Thirteenth St. from the east line of Dale Ave. to the west line of the A., T. & S. F. Ry. Right of Way; Oklahoma Ave. from the north line of Eighth St to the south line of Park Pl.; Euclid Ave. from the east line of Lottie Ave. to the west line of Bath Ave.; Eleventh St. from the east line of Lottie Ave. to the west line of Bath Ave.; Lee Ave. from the north line of Main St. to the north line of the Rock Island Ry. Right of Way, and from the north line of Second St. to the south line of Eleventh St

The city council of Hugo, Okla., has passed resolutions ordering nearly two miles of streets paved, and bids will be advertised for at once. The paving to be done calls for road asphalt on macadam base Work will begin by the middle of April.

Oregon.

The Douglas county commissioners, Roseburg, Ore., have just purchased road machinery, comprising two carloads. One car will be unloaded at Drain and the other at Roseburg and the tools, etc., distributed from those two points to the various road districts. The new equipment includes: Two complete rock crushing plants; 16 two and four horse graders; 31 Fresno scrapers; 23 Slip scrapers; 12 road plows; 4 road rooters; 141 shovels; 60 picks; 48 mattocks, and 17 axes The [illegible]

The City Council of Portland, Ore., has advanced the proceedings for the improvement of Main St., estimated to cost $12,000 Crushed rock will be used

Pennsylvania.

[illegible] New [illegible], Pa., [illegible] for the paving of Atlantic Ave., at an estimated cost [illegible].

Tennessee.

⊙The following contracts have been awarded [illegible] Memphis, Tenn., for street paving aggregating a cost of $170,516: McNeil St., Jefferson to Union Ave., tar macadam, R. C. Houston, $6,690; Walker Ave., College St. to Mississippi Blvd., tar macadam, R. C. Houston, $13,780; College St., Parkway to Kerr Ave., tar macadam, R. C. Houston, $2,086; Dunlap St., Poplar to Jackson Ave., tar macadam, H. P. Streicher & Co., $22,148; Oliver Ave., Rembert to Cooper St., tar macadam, S. W. Johnson, $6,812; Barksdale St., Union Ave. to Nashville, Chattanooga & St. Louis R. R., bituminous macadam, F. D. Harvey & Co., $18,662; Bellevue Blvd., Autumn to Jackson Ave., tar macadam, F. D. Harvey & Co., $10,887; Cox St., Central to Madison Ave., tar macadam, F. D. Harvey & Co., $18,222; South Cooper St., Central Ave. to Parkway, tar macadam, S. W. Johnson, $30,477; Jefferson Ave., Main to Lauderdale St., creosoted wood blocks, E. J. Wetterstrom, $20,227; Mississippi Blvd., Trigg to Kerr Ave., brick, Roach & Mannigan, $11,537; Florida St., Trigg Ave. to Parkway, brick, Roach & Mannigan, $8,873.

Texas.

✣Bids will be received until noon, April 11, by John Ashe, County Auditor, Houston, Tex., for furnishing one road roller.

✣Bids will be received until noon, April 11, by John B. Ashe, County Auditor, Houston, Tex., for paving 4½ miles on Cedar Bayou, Crosby and Houston Road, with shell. Howe & Wise are County Engineers.

✣Bids will be received until 2 p. m., April 18, by Capt. P. W. Whitworth, Constructing Quartermaster, Fort Crockett, Galveston, Tex., for the construction of mud shell roads and walks at the post.

✣Bids will be received until noon, April 11, by John B. Ashe, Connty Auditor, Houston, Tex., for paving Battleground Road from Deer Park to Lynchburg Ferry with (1) shell and (2) gravel and shell. Howe & Wise, County Engineers.

✣Bids will be received until noon, April 11, by John B. Ashe, County Auditor, Houston, Tex., for paving Washington St. with brick, from Old City Limits to west side of Houston Heights. Howe & Wise are County Engineers.

⊙The county commissioners at Beaumont, Tex., have awarded the contract for grading the county road leading from El Vista to West Port Arthur, a distance of three and a half miles, to Elliott Andrews. The road will be 20 ft. wide and is a part of the series of roads which the Gulf Refining Co. is under contract with the county commissioners to shell as a consideration of the court having permitted the refining company to remove the steel drawbridge over Taylors bayou further up the stream.

⊙The board of municipal commissioners of Dallas, Tex., has awarded the contract for furnishing a 10-ton road roller to the J. I. Case Threshing Machine Co., for a consideration of $1,650 and the old machine of the city.

⊙The board of municipal commissioners of Dallas, Tex., has awarded the contract for the paving of Jefferson St., Oak Cliff, from 10th to Tyler Sts., to the Standard Engineering & Construction Co. for $74,825. Rock asphalt will be used for the surfacing.

The board of municipal commissioners of Dallas, Tex., has adopted resolutions approving specifications and calling for bids on paving Second Ave. from Santa Fe to Grand; Third Ave. from Texas & New Orleans Railway to Parry; 10th St. from Lancaster to Polk; Oak Lane from Fourth to Exposition.

Virginia.

⊙W. R. Caxton, Newport News, Va., has been awarded the contract by the Committee on Highways and Sewers of that city for excavating and constructing concrete curb and gutter on both sides of 23d St., between Roanoke and Chestnut Aves.; also for furnishing 300 cu. yds. ¾ trap rock for $.45 per lin. ft. Bids were opened March 20.

Wisconsin.

⊙T. W. Quinn of Madison, Wis., has been awarded the contract by the Committee on Streets and Sidewalks, Monroe, Wis., for furnishing the materials and constructing approximately 5057 sq. yds. of paving on North Jefferson St., running north from Russell St. to George St. Bids were opened March 7.

Bids will be received soon for 9,000 sq. yds. of paving on a concrete foundation for the city of Platteville, Wis. Plans have been completed. W. G. Kirchoffer, 31-32 Vroman Bldg., Madison, Wis., is consulting engineer.

The following bids were received by the board of public works of Fond du Lac, Wis., recently, for the paving of South Main St. They were submitted to the common council March 28: J. Rasmussen & Son, Barr block, $1.94½, total, $20,260.35; Purlington block, $2.02, total, $20,951.10; Metropolitan block, $2.10, total, $21,687.90; curb and gutter, $0.47; G. H. Stanchfield, Barr block, $2.07,total, $21,339.90; Purlington block, $2.15, total, $22,076.70; Metropolitan block, $2.23, total, $22,813.52; curb and gutter, $0.46; Chris Johnson, Metropolitan block, $2.16, total, $22,191.40; Purlington, $2.10, total, $21,638.80; curb and gutter, $0.44; John Brogan, Danville block, $2.02, total, $21,069.20; Indiana paver, $2.02, total, $21,069.20; curb and gutter, $0.50. Cement pavement—J. Rasmussen & Son, Cement, $1.75; curb and gutter, $0.47; lump sum for track work, $1,650; total, $15,701.40; G. H. Stanchfield, cement, $1.43; curb and gutter, $0.47; track work, $1,800; total, $15,487.20; Christ Johnson, cement, $1.64; curb and getter, $0.44; track work, $2,000; total, $17,372.20; John Brogan, cement, $1.39; curb and gutter, $0.50; track work, $1,216; toal, $15,266.90. Bids on Creosote Block—J. Rasmussen & Son, block, $2.49; curb and gutter, $0.47; track work, $1,650; total, $25,279.80; G. H. Stanchfield, block, $2.53; curb and gutter, $0.47, track work, $1,800; total, $25,612.20; Chris Johnson, block, $2.54; curb and gutter, $0.44; track work, $2,000; total, $25,661.20; John Brogan, block, $2.44; curb and gutter, $0.50; track work, $1,216; total, $24,937.40. J. Rasmussen & Son of Oshkosh are the lowest bidders on brick with Barr block, and John Brogan is the lowest bidder on cement.

A bill has been introduced in the Wisconsin legislature, Madison, by Assemblyman John O'Day requiring the state to build a public macadamized highway from the Illinois border to Ashland, Wis., on Lake Superior, the northern border of Wisconsin. Fifty miles of this road will be built each year beginning with 1911, the work to begin in the middle of the route and to proceed in each direction at the rate of 25 miles each year. The cost is to be paid by the state, and the work will be supervised by a commission of experts.

The board of county commissioners, Superior, Wis., has authorized the roads and bridges committee to purchase a motor road roller for use in the construction of macadam and clay roads throughout Douglas county. The roller is to weigh not less than eight nor more than ten tons, and to cost from $2,400 to $2,800.

The city council of Milwaukee, Wis., has adopted a resolution authorizing the expenditure of $46,500 for machinery to enable the city to do its own paving work. C. J. Poetsch is city engineer.

BRIDGES—STEEL AND CONCRETE

Alabama.

✣Bids will be received until noon, March 31, by J. W. Gwin, County Engineer, 103 Court House, Birmingham, Ala., for constructing the following: 100-ft. clear span steel bridge over Cahaba River near Trussville; one 67-ft. clear span steel bridge over double branch near Jasper Ford; one 80-ft. clear span steel bridge with 85 ft. of approach over Turkey Creek, at Hirsch's mill; one 55-ft. clear span steel bridge over Sweat Branch on Jaybird Road, near Rudledge's Springs; one 54-ft. clear span reinforced concrete bridge at Trussville, Ala.; one 54-ft. clear span reinforced concrete bridge at McCalla, Ala.; one 54-ft. clear span reinforced concrete bridge at Rutledge's Springs, Ala.; one 36-ft. clear span reinforced concrete bridge at Alton, Ala.; two 20-ft. clear span reinforced concrete bridges at Huffman; one 22-ft. clear span reinforced concrete bridge near Bessemer; two 20-ft. clear span reinforced concrete bridges near Ensley; one 10-ft. clear span reinforced concrete bridge near Ensley. A $200 certified check must accompany each bid.

California.

✣Bids will be received until 10 a. m., April 4, by County Supervisors, M. Z. Lowell, Clerk, Auburn, Cal., for construction of a steel bridge over North Fork of American River on the Auburn and Forest Hill Road.

⊙It is reported that the board of supervisors, Los Angeles, Cal., has awarded T. J. Shea the contract at $146,700 for the construction of the Arroyo Seco bridge. This bid does not include the pilings and handrails. Other bids were: Mercereau Bridge & Construction Co., $169,600; J. F. Hall-Martin Co., $157,500; Charles Stansbury, $153,964; F. O. Engstrum Co., $248,239, and J. D. Keen Contracting Co., $149,000. The Cement Products & Construction Co., bid $5,171 for constructing the railings and placing tilings.

Citizens of Hughson, Cal., have petitioned the board of supervisors, Modesto, Cal., for the construction of a bridge across the Tuolumne river at Empire. The new bridge would be made of steel and consist of three 200-ft. spans and one 100-ft. span. It is estimated that it would cost about $60,000.

The county supervisors, Modesto, Cal., are making plans to replace or repair several of the county bridges that were either washed away or damaged by the recent flood.

Georgia.

Advices from Macon, Ga., are to the effect that the Macon, Dublin & Savannah railroad, James T. Wright, vice-president and general manager, Macon, Ga., has announced that within the next 20 days work will be commenced on a new bridge across the Ocmulgee river at Macon, which will cost in and around Macon about $100,000. The bridge will be a steel structure with a draw span to allow the passage of boats on the river.

Illinois.

✣City council, Aurora, Ill., will, it is said, receive bids until 2 p. m., April 20, for the construction of a new bridge at that place.

✣Bids are asked until 2 p. m., April 20, by W. H. Reaney, City Clerk, Batavia, Ill., for building a reinforced concrete bridge over the Fox River on Wilson St. The bridge is to consist of three spans and is to have a total length of 270 ft. and a width of 60 ft. Official advertisement will be found elsewhere in this issue.

⊙The bridge committee of the board of supervisors, Pekin, Ill., has awarded two contracts for the construction of bridges in Hittle township. The first is a 112-ft. span on the Logan county line, and the other is four and a half miles north of Armington. The first contract was awarded to the Decatur Bridge Co., and the second to Benjamin Poe of Minier, for $2,000. A contract will be let next month for the construction of a bridge in Elm Grove township.

The Illinois Central Railroad will construct a new steel bridge across the Sangamon river south of Decatur, Ill., at an estimated cost of $40,000 during the coming summer. A. S. Baldwin, Chicago, Ill., chief engineer.

Indiana.

✣Bids will be received until 10 a. m., April 5, by County Commissioners, Rockport, Ind., for the construction of 25 bridges. J. T. White is Auditor of Spencer County.

✣Bids will be received until 10 a. m., April 4, by Board of County Commissioners, Decatur, Ind., for the labor and material for the construction of steel and concrete bridges. H. S. Michaud is Auditor of Adams County.

⦿The board of county commissioners, Indianapolis, Ind., has awarded the contract for timbers to be used in bridge repairs to James C. Dixon at $3,963. The contract calls for about 113,000 ft. of timber.

Iowa.

The following bids were received at 10 a. m., March 15, by the City of Cedar Rapids, Ia., for the construction of the reinforced concrete bridge to be erected at Third avenue in that city. (1) standing for B. J. Sweatt, Boone, Ia.; (2) Bates & Rogers Construction Co., Chicago, Ill.; (3) Lorimer & Gallagher, Chicago, Ill.; (4) Midland Bridge Co., Kansas City, Mo.; (5) Cleary-White Construction Co., Chicago, Ill.; (6) Cullen-Friestedt Co., Chicago, Ill.; (7) W. V. Hoy Construction Co., St. Paul, Minn.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Concrete in piers and abutments below springing lines of arches	$8.87	$8.30	$9.65	$13.00	$1[illegible]	$7.[illegible]	$8.[illegible]
Concrete in retaining walls or abutment wings	8.60	9.50	[illegible].30	16.00	[illegible]	[illegible]	8.2[illegible]
All concrete in above springing line of arches excepting handrails and lamp posts, per cu. yd.	7.20	10.00	8.30	11.[illegible]	[illegible]	10	[illegible]
Reinforcement and all other metal in place, per lb.	0.35	.033	.032	[illegible]	[illegible]	[illegible]	[illegible]
Filling between spandrell walls and back of face of abutments, not including backfilling, per cu. yd.	.85	1.00	.60	.50	[illegible]	.60	[illegible]
Handrails or parapets complete, per lin. ft. of single rail or parapet	3.00	2.50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lamp post complete, ready for fixtures, per post	75.00	35.00	45.00	12.00	12.[illegible]	[illegible]	[illegible]
Piling in place below concrete base, per lin. ft.	.60	.52	.40	.60	.50	[illegible]	.40
Electric lighting system complete, including fixtures	1,900	1,600	1,760	1,900	2,000	1,900	1,780
Removing and storing old spans, piers and abutments and cleaning metal work and painting the same with one coat of paint	1,860	3,41[illegible]	3,401	[illegible]	[illegible]	[illegible]	1,000
Pertaining to the 8th Ave. Bridge —							
Erecting five old spans without floor or joists and painting the metal work with one coat of paint	2,2[illegible]	5,567	3,582	1,[illegible]	[illegible]	[illegible]	[illegible]
Concrete in six cylinder piers, per cu. yd.	7.00	10.35	14.50	7.00	7.60	10.00	10.00
Steel in cylinder piers in place and painted, per lb.	.04	.0585	.0275	.06	.045	.0674	.033
Piling in cylinder piers in place, per lin. ft.	.75	.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lump sum bid for both structures complete in every detail in accordance with plans and specifications	$15[illegible],988	$202,01[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Louisiana.

The Dock board of New Orleans, La., has decided to build a trestle at Valence St., to connect with the wharf. The Belt Railroad will connect with the trestle.

Michigan.

The city council of Grand Rapids, Mich., contemplates submitting the question to the people this spring of a bond issue for $125,000 for the construction of a bridge over Grand river at Leonard St.

Mississippi.

✣Bids will be received until 1 p. m., April 3, by Board of Supervisors, Monticello, Miss., for the construction of a steel bridge across Silver Creek on Columbia River road, 6 miles southeast of Monticello.

Surveys are now being taken for the viaduct to the south [illegible] Meridian, Miss. The surveying corps, under the supervision of City Engineer Wetmore, began work recently. Plans and specifications will be accepted in April.

Misouri.

⦿The Midland Bridge Co. has been awarded the contract by the board of supervisors, Warrensburg, Mo., for the construction of three bridges over the Blackwater drainage canal for $3,174. The largest bridge will go in on the Lexington road north of Warrensburg where the main canal crosses the road about a quarter of a mile north of the present Blackwater bridge. The will be a 75-ft. span, with 14-ft. approaches. Another of the bridges will be across the south fork just south of the Brownlee bridge, near the Rowland Repp farm. This will be a 60-ft. span, and the third, 50 ft., is to be north of the old Perry farm and north of the present bridge in Centerview township.

The Dildine Iron & Bridge Co. will construct a bridge plant at Hannibal, Mo. It will be erected in the western part of the city near Elzea's addition, and will be a large brick building, 124 ft. by 200 ft. E. L. Dildine is president of the company.

Nebraska.

⦿The board of county commissioners, Grand Island, Neb., has awarded the Indenendent Bridge Co. the contract for the construction of county bridges during the year.

New Jersey.

✣Bids will be received until noon, April 4, by the County Board of Freeholders, Cape May C. H., N. J., for the erection of a steel truss pivot swing bridge with trestle apparatus 271 ft. long. The steel draw will be 137 ft. long. L. M. R[illegible], W[illegible] [illegible] Engineer.

⦿ The Gloucester county freeholders, Woodbury, N. J., have awarded the contract for rebuilding the bridge at Mt. Royal to the Owego Bridge Co., of Owego, N. Y., for $2,500.

Hudson, Essex and Bergen, N. J., freeholders composing the joint bridge committee of the three counties, authorized the civil engineers of their respective counties to prepare plans for a modern new steel bridge to be constructed across the Passaic river at Belleville. The new bridge will replace the structure swung across the river 35 years ago. Jersey City is the county seat of Hudson county.

New York.

Commissioner Francis G. Ward of Buffalo, N. Y., has been notified by Chief Engineer W. H. Bish[illegible] [illegible] that plans for the Ferry St. bridge have been determined upon and the estimates are fixed. A 20-ft. bridge with two 5-ft. walks, costing $77,140, is favored.

North Carolina.

A delegation of business men of Mount Holly, N. C., have petitioned the county board of commissioners, Dallas, N. C., for the erection of a bridge over the Catawba at that point.

North Dakota.

The Fargo Bridge & Iron Co., Fargo, N. Dak., has been awarded the contract by the board of county commissioners, Hillsboro, N. Dak., for the construction of county bridges during the coming year; the bid being as follows: Steel span on steel piles, 36 to 45 ft. long, $38.50 per lin. ft.; steel span on steel piles, 50 to 64 ft. long, $37.50 per lin. ft.; steel span on steel piles, 65 to 75 ft. long, $35.50 per lin. ft.; steel span on steel tubes, 80 to 95 ft. long, $40.00 per lin. ft.; steel span on steel tubes, 100 to 130 ft. long, $42.00 per lin. ft.; tubes 36 in. diameter $14.00 per ft. additional when tubes exceed 10 ft.; tubes 42 in. diameter $16.00 per ft. additional when tubes exceed 10 ft.; extra concrete $29.00 per ft. raise over 10 ft.; wooden bridges, 10 to 16 ft. long, $11.00 per lin. ft.; wooden bridges, 20 to 22 ft. long, $11.00 per lin. ft.; wooden bridges, 30 to 32 ft. long, $11.50 per lin. ft.; cedar piling in place, $0.67 per ft.; all concrete bridge, 12 to 22 ft. long, $30.00 per lin. ft.; steel I-beam bridges with wood floor, 12 to 32 ft. long, $26.25 per lin. ft.; steel I-beam bridges with concrete floor, 12 to 32 ft. long, $32.00 per lin. ft.; extra concrete per vard, $12.75. Repair work: 3x12 and 3x16x16 base, complete in bridge per M, $45.00; 4x24x40 base, complete in bridge per M, $57.50; cedar piling in place, $0.67 per ft.

Ohio.

✣Bids will be received until noon, April 5, by County Commissioners, Columbus, O., for necessary labor and material for the following bridge and culvert work: Engineer's Estimate No. 218: Grading roadway and constructing approach to bridge over Hayden Run on the Hilliard and Dublin Pike, Norwich and Washington Townships. Engineer's Estimate No. 220: Constructing approaches to the Eberly bridge over Alum Creek, on the line between Marion, Madison and Truro Townships. Engineer's Estimate No. 221: Constructing a reinforced concrete culvert on the Eberly Road, east of Eberly bridge, on the line between Marion, Madison and Truro Townships. Engineer's Estimate No. 223: Constructing the superstructure of the Wilson bridge over the Olentangy River, in Sharon Township. Engineer's Estimate No. 224: Constructing the roadway on the superstructure of the Wilson bridge over the Olentangy River, in Sharon Township.

✣Bids are asked until 10 a. m., April 6, by J. O. Donovan, Clerk County Commissioners, Dayton, O., for constructing concrete steel arch bridge near Germantown.

The county commissioners, Cincinnati, O., have decided to begin improvements on the Clough Creek turnpike, recently purchased, by replacing and strengthening all the bridges. The county surveyor was instructed to prepare an estimate of the cost of this work.

The county commissioners, Frank Munger, chairman, Dayton, O., have rejected all bids for constructing a steel bridge over Wolf Creek in Brookville. The work will be readvertised. Bids were opened March 24.

The county commissioners at Cleveland, O., received the following low bids for the construction of bridge work per report No. 2769, concrete bridge, Anderson road, Euclid township; report No. 2771, concrete arch, station road, over Chippewa Creek, Brecksville township; report No. 2772, concrete arch, Irish road, over Plum Creek, Olmsted township; report No. 2774, culvert extension, Broadview road, Brecksville-Royalton township: T. B. Husband, No. 2769 and No. 2770; J. N. Buhl, No. 2771; Colbrum Bros., No. 2772, and J.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible]

A. J. Brady has been awarded the con- [illegible] Marion-Kenton pike, and for replacing same after the dredge has completed the river improvements by the county commissioners, Ma- [illegible]

The county commissioners at Marion, will build a bridge over the middle fork of the Whetstone river at the east line of Tully township. Engineer T. E. Buck will have charge of the work. The bridge will cost $2,000

County Surveyor Edward S. Ault, Marion, O., has completed the plans and specifications for the abutments of five bridges to be built by the county over the Little Scioto river.

Oregon.

The Salem, Falls City & Western Railroad, which has just been given a franchise by the city council of Salem, Ore., has made application to the war department at Washington for permit to span the Willamette river at Main St., in Salem. S. B. Taylor, Dallas, Ore., is chief engineer.

Pennsylvania.

✣Bids will be received until 10 a. m., April 4, by A. S. Rhoads, County Controller, Reading, Pa., for erection of three bridges as follows: Bordner's No. 1 bridge is to be erected over the Tulpehocken Creek at a point about seven miles from Robesonia, Pa., where the public road leading from Robesonia to Bernville crosses said creek. Bordner's No. 2 bridge is to be erected over the Swatara Creek, at a point about six miles from Myerstown, where the public road leading from Millersburg to Stouchsburg crosses said creek. Mohnton No. 1 is to be erected over the Wyomissing Creek at a point about five miles from the City of Reading. Plans and specifications can be had at the County Commissioner's office at Reading, Pa.

✣Bids are asked until 11 a. m., April 14, by the County Commissioners, E. K. Raff, Clerk, Chambersburg Pa., for the erection of a reinforced concrete bridge, 30-ft. span, 14-ft. roadway, over Muddy Run at Rankin's Mill.

The commissioners of Lycoming County, Williamsport, Pa., received the following low bids for constructing foot walks on two bridges at Williamsport, and for furnishing and placing steel stringers on one bridge; bids opened March 23: M. K. Dawes, Williamsport, foot walk, Maynard St. bridge, $3,838; United States Construction Co., Albany, N. Y., foot walk on Erie Ave. bridge, $875; Rogers Bros., Albion, Pa., foot walk on Montoursville bridge, $2,122; M. K. Dawes, steel stringers and repair work on Muncy River bridge, [illegible]

The Northampton county engineers have recommended to the Northampton county commissioners the erection of a concrete bridge across the Lehigh river at Easton. The plans call for a bridge the width of the street and will be modern in every respect. It is expected that the cost will be about $150,000

Borough Engineer Edward O'Brien of Blairsville, Pa., is preparing plans and specifications for the construction of a bridge over the Pennsylvania Railroad, the Indiana Street Railway's lines and the creek. It consists of two spans of 61 ft. each in length, made of steel and concrete and the floor of the bridge will be slab concrete. The middle of the spans will rest on a reinforced concrete pier and the bridge will be capable of supporting 20 tons. The approaches will be 150 ft. long.

South Carolina.

The citizens of Columbia township, Columbia, S. C., recently voted the issuance of bonds for the purchase of the present toll bridges over the Congaree and Broad rivers, or to build others paralleling the ones now in use.

Tennessee.

The Knoxville, Tenn., board of trade recommends to the mayor and aldermen of Knoxville, that they go before the state legislature and ask for an appropriation sufficient to extend the Gay St. viaduct, over the Southern railway tracks, from Depot Ave. to Vine Ave.

The McMinn county court, Athens, Tenn., will probably order the construction of the inter-county bridge over the Hiwassee river; from Charleston to Calhoun. The bridge would be of steel and would cost about $35,000

Utah.

The engineering and sewerage committee of the city council, Salt Lake City, Utah, has recommended that the city engineer and officials of the Utah Light & Power Co. meet for the purpose of preparing plans and specifications for the construction of steel bridges over the Jordan river at Second and Seventh South Sts. The new bridges will cost about $9,000 each

The state senate, Salt Lake City, Utah, has passed a bill making an appropriation for the building of a bridge over Grand river, near Moab. The bill calls for an appropriation of $35,000.

Vermont.

⦿The Cole-Mortland Co. with offices at Bennington, Vt., and White Creek, N. Y., have been awarded contract for the construction of an 85-ft. span reinforced concrete arch bridge across the Little Hoosick River at Petersburgh, N. Y., the contract price being $2,700.

Wisconsin.

⦿Bids were opened March 7 by the city of Janesville, Wis., C. V. Kerch, City Engineer, for constructing a plate girder bridge, 348 ft. long, over Rock River at 4th Ave. and a plate girder bridge 264 ft. long, over Rock River at Racine St. The contract for the bridge at 4th Ave. was let on March 20 to the Central States Bridge Co., Indianapolis, Ind.; the contract for the other bridge was not awarded on March 20. The bids received were as follows:

	For Steel According to Plan	
	Fourth Ave.	Racine St.
Central States Bridge Co., Indianapolis, Ind	$21,800.00	$14,[illegible]
The Heil Co., Milwaukee, Wis.	[illegible]	[illegible]
Korden Allen Co., Milwaukee, Wis	[illegible]	[illegible]
T. McGrath Construction Co., Green Bay, Wis.....	25,590.30	16,931.29
Hayes Bros., Janesville, Wis	25,810.00	18,860.00
Milwaukee Bridge Co., Milwaukee, Wis.	26,950.00	16,750.00
Massillon Bridge and Struct Co., Massillon, Ohio.....	29,130.00	19,930.00
Pan American Bridge Co., New Castle, Ind	29,292.00	19,923.00
Joliet Bridge and Iron Co., Wausau, Wis............	31,420.00	18,890.00
King Bridge Co., Cleveland, Ohio	32,100.00	21,850.00
Toledo Bridge and Crane Co., Chicago, Ill.........	32,298.00	20,545.00
Midland Bridge Co., Kansas City, Mo.	32,497.00	19,197.00
Strobel Steel Construction Co., Chicago, Ill.........	34,175.00	21,500.00

For a concrete bridge at Racine St. according to plans submitted by bidders the following bids were received: Illinois Bridge Co., $15,988 and $14,392; Chas. C. Stomell & Co., Rockford, Ill., $21,000 and $18,500.

⦿The Czaropata Construction Co., has been awarded a contract at Milwaukee, Wis., for the erection of a concrete bridge at Chicago Ave., over the Kinnickinnic river, for $5,750.

The city council of Marinette, Wis., has passed a resolution providing for the submission of the bonding proposition for the construction of the new bridge at the Stanton St site, and $75,000 for its construction, to the voters at the spring election.

Canada.

✣Bids will be received until 4 p. m., April 3, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of a Plaza between Dufferin and Sapper's bridges, alterations to Dufferin bridge and demolition and reconstruction of Sapper's bridge. Plans, specifications and form of contract can be seen and forms of tender obtained at that Department.

✣Bids will be received until April 15, by Joseph Armstrong, Secy.-treas., Swan River, Man., for one 94-ft. center to center of end bearings, steel riveted Pratt truss bridge, and two concrete piers with (steel) stringers, and 3-in. tamarac plank floor. To be erected over the Woody River, east side of Section 36, Township 37, Range 27, west of the principal meridian in Manitoba, in accordance with specifications which can be obtained from the Provincial Department of Public Works, Parliament Buildings, Winnipeg, Manitoba. The bridge site is within one mile of Bowsman Station on the Canadian Northern Ry.

✣Bids will be received until April 15 by E. Widmeyer, Secy.-treas., Municipal Council, Minnetonas P. O., Man., for the supply and erection of a steel Warren truss bridge and two concrete piers. Bridge to be 60 ft. center to center of end bearings with steel stringers and 3-in. plank floor in accordance with plan (No. F10) and specifications on file at the office of the chief engineer, Department of Public Works, Parliament Building, Winnipeg, Manitoba.

⦿The contract for building the concrete piers for the bridge which is to be erected over the Macleod River, Winnipeg, Man., for the Grand Trunk Pacific, Edson-Breazeu branch railway, has been awarded to Collins Bros. & Hamilton of Heatherwood, Alta. The company has already purchased 50,000 ft. of lumber and will commence work at once.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

⦿E. C. Royse, Pine Bluff, Ark., has been awarded a contract for constructing a $20,000 levee for the Crawford County Levee District, Van Buren, Ark.

California.

✣Bids will be received until noon, March 30, by H. W. Furlong, General Manager West Sacramento Co., at offices of Haviland & Tibbetts, engineers, 1108 Alaska Commercial Bldg., San Francisco, Cal., for furnishing necessary labor and materials for construction of an earth levee in Yolo County, California. Certified check for $5,000 required with bid.

The Solano County Engineers, Fairfield, Cal., have appointed E. N. Eager, F. J. Kalber and John Frederickson as Commissioners of Reclamation District No. 501 for the purpose of levying an assessment on the land of the district for the purpose of making improvements in the levees. The district is on the Sacramento River near Rio Vista.

County Supervisors at Yuba City, at their regular April meeting, will consider the formation of a new drainage district to comprise about 1,500 acres of land southwest of Tudor. The object of the district is to build a drainage ditch starting on the southeast corner of the Gottwals ranch and running 1½ miles directly south to the tule levee of levee district No. 1.

The Butte-Suter Canal Co. has filed its articles of incorporation in Sutter County. The company has a capital stock of $1,250,000 and proposes to purchase orchards, farms, etc., and operate them, to erect houses and operate irrigation ditches in the above named counties. The directors are M. Rowlands and G. H. Kellog of Berkeley, Gordon Hall and Kent of San Francisco, and T. H. Breeze of Fair Oaks.

Land owners of San Joaquin and Contra Costa Counties at a meeting recently at Stockton, decided that a canal should be constructed from the San Joaquin River at some point near Kasons lake, about Paradise dam, along the edge of the upland on the west side, which would empty into the river again in the vicinity of Antioch. Such a canal, which would [illegible] about 35 miles [illegible], would be [illegible] enough to carry [illegible] the surplus water of the river in time of overflow, and would prevent extremely high water in the vicinity of this city and in the Delta districts. The landowners present agreed to sign up for an assessment of 10 cts. an acre on land in the delta region, with the understanding that San Joaquin County, Stockton city and the railroad corporations interested would also be asked to contribute a fund to make a survey to determine the feasibility and cost of such canal.

Illinois.

✣The commissioners of Big Slough Special Drainage District, Prophetstown, Ill., will receive bids until April 1 for constructing Branch No. 1 in Loraine township, Henry County. The ditch is to be 2 miles long 6 ft. wide at bottom, 5 ft. deep, requiring about 38,000 cu. yds. of excavation, consisting of muck and sand. F. W. Sears of Prophetstown, Ill., is engineer.

✣The commissioners of Union Drainage District of Tampico, Prophetstown and Hume, Ill., will receive bids until April 10 for cleaning out Coon Creek. The creek is 10 miles long, 10 ft. wide at bottom, 3 ft. deep. About 85,000 cu. yds. of excavation is required. A branch of the creek, two miles long, is also to be cleaned, requiring about 20,000 cu. yds. of excavation. This branch is 4 ft. deep. F. W. Sears, Prophetstown, Ill., is the engineer. Bids will be received at Tampico.

✣Bids will be received until 11 a. m., April 15, by the Drainage Commissioners of Union Drainage District No. 1 of the towns of Raymond and Rountree, Montgomery County, Ill., L. L. Potts, Clerk, Raymond, Ill., for constructing an open ditch requiring 5,910 cu. yds of excavation and tile drains requiring 83,925 ft. of 6-in. to 30-in. tile. J. W Dappert, Engineer, Taylorville, Ill.

⊙Coleman & Sons, Paragould, Ark., have been awarded the contract for constructing 38 miles of ditch for the North Fork Special Drainage District of Broughton, Ill. The contract price was 6¾ cts. per cu. yd. and the work requires the moving of about 1,900,000 cu. yds. of material. Bids were opened March [illegible]

Indiana.

✣Bids will be received until 2 p. m., April 1, by Supt of Construction, Boone County, at the office of Surveyor, Lebanon, Ind., for the construction of a ditch.

⊙The Krick-Tyndall Co., Decatur, Ind., has been awarded the contract at $1,866 for constructing the Chapman ditch in Harrison township. The length of the main ditch is 4,960 ft. and the lateral is 3,728 ft. in length.

⊙A. E. Chappell, Ingalls, Ind., has been awarded the contract for construction of a drain in Hancock county, the contract price being $750.

Louisiana.

A movement has been started in Terrebonne Parish, Houma, La., to dredge a sea level canal connecting Bayou Terrebonne with Bayou Lafourche. It is proposed to so construct the two streams that the connecting links will be made navigable to the larger crafts plying the streams and thus assure a short water route to New Orleans. The plan is to use the St. Louis Cypress Co.'s canal, which will require less dredging as the canal is already possessed of some depth

Michigan.

✣Bids will be received by A. H. Reid and John Boutwell, county drain commissioners, Genesee and Shiawassee counties, Michigan, at Gaines, Mich., on April 4, for the construction of the Corrigal drain in Gaines township, about 1,360 rods in length. A certified check of $400 is required with each bid

Minnesota.

⊙Bids were opened March 15 by J. L. Johnson, County Auditor, Olivia, Minn., for constructing Judicial Ditch No. 9, the contract being let to Jerry Sherwood. This is a dredge ditch involving about 166,275 cu. yds. of excavation

Missouri.

Bids will be opened about May 15 for drainage work in Drainage District No. 3, Carroll County, Mo. The main ditch will be about 21 miles long, having a 40 and 50-ft. base with 1 to 1 slopes and a yardage of 1,569,485 cu. yds. of earth excavation and 143,250 cu. yds. of channel cleaning. The six laterals will aggregate about 12 miles, will have 10, 12 and 18 ft. bases and will require 286,520 cu. yds. of earth excavation and 8,900 cu. yds. of channel cleaning. The work will also include a levee of some 20,500 cu. yds. about 1½ miles of 21-in. sewer and highway bridges to the amount of about $12,000. Brooks & Jacoby, 515 Shukert Bldg., Kansas City, Mo., are the engineers.

Ohio.

⊙The County Commissioners at Urbana have awarded the contract for dredging in Mud River to D. E. Weage & Son, Coldwater, Mich., at $37,500. The contractors will use the dredge that they employed on their other contracts on the Mud River. The contract just let will require the removal and replacing of six bridges at a cost of $200 each

Advices from Canton state that the Tuscarawas Improvement Co. is planning to sell $5,000 of stock and to employ an engineer to make [illegible] nel of the Tuscarawas River

Oregon.

⊙The Port Commission of the Port of Toledo, Toledo, Ore., has awarded a contract to Christopher & Swearingen at $8,400 for constructing 2,200 ft. of jetty.

⊙James W. Jory, Midland, Ore., has been awarded the contract at $7,600 by the U. S. Reclamation service for the excavation of about 35,000 cu. yds. of material near Klamath Falls, Ore. Bids were opened March 10.

Surveys are underway for the Weston & Pine Creek irrigation project near Weston, Ore. It is planned to erect a 150 to 200-ft dam in Pine Creek, three miles above Weston for the storage of water. About 6,000 to 10,000 acres are to be watered. F. C. Henke, Lewiston, Idaho, is the engineer.

South Dakota.

⊙The following contracts have been awarded by the U. S. Reclamation service for earth work, North Canal, Belle Fourche Project, bids for which were opened Feb. 24 at Belle Fourche, S. Dak. The itemized bids were given in our March 8 issue:

[illegible] Bros. & Co. [illegible]	
Schedules 1, 6, 7, 8.	
Class 1, [illegible]	[illegible]
Class 2, [illegible]	[illegible]
Class 3, [illegible]	[illegible]
Overhaul 125,000 c.y. @ 2 cts.	2,500
Total	[illegible]
Cornelius Cole, Nisland, S. D. Schedule 2:	
Class 1, [illegible]	[illegible]
Class 2, 8,000 @ 18 cts.	1,440
Class 3, [illegible]	[illegible]
Schedule 3:	
Class 1, 90,000 @ 17 cts.	$15,300
Class 2, [illegible]	[illegible]
Class 3, [illegible]	[illegible]
[illegible]	
[illegible]	[illegible]
Total	[illegible]
Seitz & Shevling, Nisland, S. Dak. Schedule 4:	
Class 1, 75,000 c.y. @ 19 cts.	$14,250
Class 2, 10,000 c.y. @ 19 cts.	1,900
Class 3, 1,000 c.y. @ 19 cts.	190
Overhaul 20,000 c.y. @ 2 cts.	400
Total	[illegible]
[illegible], North Platte, Neb. Schedule [illegible]	
Class 1, 90,000 c.y. @ 19 cts.	$17,100
Class 2, 12,000 c.y. @ 19 cts.	2,280
Class 3, 1,000 c.y. @ 19 cts.	190
[illegible]	[illegible]
Total	[illegible]

Texas.

An election is to be held on April 10 in Drainage District No. 2 of Wharton County to vote on the issuance of $45,000 of bonds John Morris, Wharton, Tex., is County Surveyor.

The State Attorney General has approved a bond issue of $204,500 voted by Drainage District No. 1 of Cameron County, and the County Judge is now in the east selling the bonds. Surveys and estimates of cost have been made and as soon as the bond issue is disposed of the work will be advertised. A. W. Amthor, Box 233, Brownsville, Tex., is Engineer of the District.

Utah.

The Davis and Weber Counties Canal Co., W. H. Bostaph, Chief Engineer, Ogden, Utah will probably have work started about April 15 in its dam in Weber canyon. The company will raise the present dam to a height of 190 ft. in order to conserve a sufficient water supply for the reservoir, which will be enlarged to double its present size, which is now 14,000 acre-ft. The dam will be 300 ft. thick at the bottom and will taper to a 25-ft. thickness at the top. The material to be used in the dam will be concrete with a solid steel core as a foundation. Large boulders from the mountain side will be used in reinforcing the masonry work of the structure. The entire cost [illegible]

WATER-WORKS

Alabama.

[illegible] will [illegible] April 24 for the purpose of voting on the proposition of issuing bonds in the sum of $50,000 for the improvement and completion of the water works.

The city council of Dothan, Ala., it is reported, has ordered the erection of the [illegible] water plant for the city.

Arizona.

✣Bids are asked until 1 p. m., April 12, by L. O. Cowan, City Clerk, Tucson, Ariz., for the erection of a 90-ft. high concrete standpipe to have a capacity of 1,000,000 gals. Plans [illegible] ders.

Arkansas.

The city of Fort Smith, Ark., has sold bonds to the amount of $750,000 for the purchase of the water plant.

California.

Advices from Walnut Creek, Cal., are to the effect that large tracts of land are being purchased near that town for the purpose of installing a water supply system for the towns of Lafayette, Alamo and Walnut Creek

W. F. O'Connor of Red Bluff, Cal., has commenced work on the 20,000-gal. water tank in Gerber, Cal., for the Gerber Light [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible]

Colorado.

[illegible]

Georgia.

✣Bids will be received at once by the City Council of Sparta, Ga., for the construction of a water works and sewerage system. W. H. Stansell is City Clerk.

The citizens of Colquitt, Ga., have voted the issuance of bonds to the amount of [illegible] for municipal improvements. The money will be used to extend the water system, erect and operate a light plant, and erect a modern school building.

Illinois.

✣Bids will be received until 11 a. m., April 1, 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering gate valves as follows: one 36-in. to Chicago Ave. & Larrabee St., one 36-in. to Division St. & Halsted St., one 36-in. to Hawthorn Ave. & North Ave., one 30-in. to Clybourn Pl. & Southport Ave, one 30-in. to Clybourn Av. & Fullerton Av., one 30-in. to Diversey Blvd., east side of river, one 30-in. to Diversey Blvd., west side of river, one 30-in. to Diversey Blvd. & Western Ave., one 24-in. to Crosby St. & Oak St. The valves are to be parallel seat valves with loose discs, and the mechanism shall be such that in closing, the travel of the discs shall cease before they begin to seat and they are fully released from the seats before travel commences in opening seat, disc rings and spindles of valves shall be of solid bronze. All valves before being accepted by the city shall be tested and must prove tight under a hydrostatic pressure of 300 lbs. per square inch; in testing for smooth operation tallow, grease or similar substances will not be used. Bidders must submit separate prices for each size valve and enclose cash or certified check for $150.

✣Bids will be received at the office of W. M. Fike, Chairman of the Water Committee of the City of Lewistown, Ill., up to 7:30 p. m. of Monday, the 10th day of April, 1911, for furnishing material and labor and constructing improvements and extensions to the Municipal Water Works system, in accordance with plans and specifications now on file in the office of the said W. M. Fike, chairman as aforesaid; also at the office of the engineers, Fuller-Coult Co., Chemical Bldg., St. Louis, Mo. Estimated cost of improvements about $7,000. Complete sets of plans and specifications may be obtained from the engineers on the payment of a fee of $3.00.

The citizens of Anna, Ill., have voted the issuance of bonds for the installation of a water works system.

Indiana.

Plans for the extension of the Gary, Ind., water system into the Gary Land Co.'s second subdivision just west of the first subdivision and also for the extension of the system to Tolleston, have been completed by the Gary Heat, Light & Water Co., and as soon as preliminary arrangements can be completed the extension work will be started.

The board of public works of Fort Wayne, Ind., is preparing specifications for water meters, preparatory to asking for new bids on a wholesale supply to carry out the ordinance requiring that all services be metered as quickly as possible.

Iowa.

⊙The contract for a combined waterworks and electric light plant at Adair, Ia., has been let to the Des Moines Bridge & Iron Co., of Des Moines, Ia., for [illegible]

⊙Hagarty & Scrog of Keokuk, Ia., have been awarded the contract at Fort Madison for the digging of four deep city wells, from which water will be pumped for use in the city instead of from the Mississippi river.

Kentucky.

The city council of Dawson Springs, Ky., has decided to build a waterworks system that will cost approximately $15,000. Plans are being prepared by W. E. King, Harry O. Moss and Clyde Bell of the Paducah, Ky., engineering department. J. W. Holmes, superintendent of the Paducah water plant, is consulting engineer. The system will have about 10,000 ft. of mains. The water works will be operated from a gravity reservoir located at the top of the hill southeast of Dawson.

Louisiana.

Mayor Maurice D. Shannon of Morgan City, La., in a communication to the city council, recommends that the city issue bonds in the sum of $100,000 for public improvements and that immediate steps be taken to install waterworks and give fire protection.

Maine.

The new draft reported of the legislative act to incorporate the Hartland Water Co. of Hartland, Me., allows the company to furnish water only and gives the company right to furnish water to any place adjoining the three towns of Hartland, Palmyra, and St. Albans. It also gives it a chance to extend its operations to Athens, Harmony, Cambridge, Dexter, Corinna, Newport, Plymouth, Detroit, Pittsfield, Canaan and Cornville.

Maryland.

The board of estimates of Baltimore, Md., has approved the specifications for the improvements to the Mount Royal Pumping Station, subject to the approval of the city solicitor, when advertisements for bids will be issued. The plans call for the expenditure of about $180,000. Alfred M. Quick is water engineer of the city.

Massachusetts.

⊙The water and sewer commissioners of Medford, Mass., have awarded the contracts for furnishing the city of Medford with about 130 tons of cast iron water pipe and about 13,000 ft. of vitrified salt glazed sewer pipe, as follows: Chas. Miller & Son Co., Utica, N. Y., water pipe; Berry & Ferguson, Boston, Mass., sewer pipe. Bids were opened March 20.

The town of Athol, Mass., has voted to take 1,000 acres in Athol and Phillipston for a future water supply and to construct a pipe line to the Buckman brook. It was voted to borrow $30,000 for this purpose.

Michigan.

At the regular spring election in Benton Harbor, Mich., on April 3, the voters of the city will be asked to vote on the proposition of issuing bonds in the sum of $100,000 for the development of a well supply in connection with the water works.

Missouri.

Mayor Kreismann and Water Commissioner E. E. Wall of St. Louis, Mo., have announced a plan to connect Koch hospital, set apart for the treatment of tuberculosis, with the city water works.

The substitution of two turbine engines connected with centrifugal pumps for two of the pumping engines of the waterworks system at the Chain of Rocks, is proposed in a bill which has been reported favorably by the council public improvements committee, St. Louis, Mo. The two engines to be superseded cost $325,000 and have a capacity of 30,000,000 gals. a day. The new engines, occupying about half the space, cost $46,000, and have a capacity of 60,000,000 gals. a day.

Montana.

A special election will be called in Shelby, Mont., at the regular city election, April 3, to vote upon the proposition of bonding the town in the sum of $50,000 for the purpose of supplying the town with an adequate water supply.

Nebraska.

✣Bids will be received until 9 a. m., April 3, by the City Clerk of Lodgepole, Neb., for constructing waterworks to cost about $10,000. Geo. [illegible] Sethman, Equitable Bldg., Denver, Colo., is the Engineer.

New York.

✣Bids are asked until 8 p. m., April 4, by Mayor Thos. H. O'Neill, Auburn, N. Y., for the construction of subways, with necessary appurtenances and appliances, in East Genesee St., from Owasco St. to Hunter Ave. The approximate quantities of the work are: 67,200 duct ft. of 16 duct tile, 25,800 duct ft. of 12 duct tile, 19,700 lin. ft. of straight iron pipe laterals, 190 iron pipe bends, and 23 double manholes, including sewer connections. E. C. Aldrich, City Engineer.

The water board of Cortland, N. Y., will soon advertise for bids for the construction of the proposed new water tank. The tank will have a capacity of 1,000,000 gals.

North Carolina.

✣Bids will be received until 8 p. m. April 20, by W. J. Hales, City Clerk, Morehead City, N. C., for the installation of a water works system.

The water board of the city of Charlotte, N. C., has purchased the Dilworth water system for $15,000 from the Southern Power Co.

Ohio.

✣Bids will be received until noon, April 10, by Director of Public Service, Cincinnati, O., for the construction, delivery and erection of two turbine water wheels in the head house of the filtration plant of the Water Department of the City of Cincinnati, Ohio, at California, O. Plans, specifications and blank proposals can be obtained at the office of the General Superintendent of Water Works.

⊙It is reported that the J. B. Clow Co., of Chicago, Ill., has been awarded the contract by the board of control of Zanesville, O., for furnishing over $5,000 worth of water pipe and special castings to the water department.

The Lowellville Water Co., of Lowellville, O., has been incorporated with a capital of from $50,000 to $60,000 for the purpose of supplying the city with water.

The city council of Chadron, O., has instructed the city clerk to have ready at the April meeting of the council a resolution calling for a vote on the question of a water works for the city.

Oklahoma.

✣Bids are asked until 8 p. m., April 10, by W. B. Jones, City Clerk, Ada, Okla., for furnishing pipe and machinery for the extension and improvement of the city water works. Official advertisement will be found elsewhere in this issue.

The city council of Oklahoma City, Okla., has arranged for the sale of $400,000 of public improvement bonds to A. J. McMahan of that city. The issue was voted at a special election in February for water main extensions, sewer and city hospital.

Pennsylvania.

The Clear Spring Water Co., of Allentown, Pa., has planned an aggressive extension of its water mains which will involve an expenditure of $20,000.

The Ohio Valley Water Co., of Bellevue, Pa., has employed the firm of Chester & Fleming, Engineers, Pittsburg, Pa., to install additional drilled wells for the water supply on Neville Island.

South Dakota.

The citizens of Kadoka, S. Dak., have voted the issuance of bonds to the amount of $6,700 to install a system of waterworks. As soon as the bonds are sold work on the construction of the system will be commenced.

Tennessee.

An election is to be held in Newport, Tenn., on April 29 for the purpose of voting on the issuance of bonds for the installation of a system of waterworks. The water supply will be secured from springs three miles from the city.

The board of mayor and aldermen of Lexington, Tenn., is considering favorably the granting of a franchise to capitalists of Paris,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Tenn., to install a waterworks and electric light plant in the town.

Texas.

✣Bids will be received until April 3 by Capt Fred H. Gallup, Quartermaster, Fort Sam Houston, Tex., for furnishing 2140 ft. galvanized iron water pipe, 650 ft. cast iron sewer pipe, 520 ft. 4-in. sewer pipe.

⊙The city commissioners of Dallas, Tex., have awarded the contract for the standpipe for the White Rock line in the water main from the new pumping station to the Memphis Steel Construction Co., for $5,727.

The Calvert Water Co., Calvert, Tex., is preparing to extend its pipe line far out into the suburbs.

Virginia.

⊙The water committee of the city council of Richmond, Va., has awarded the contract for furnishing the water department with approximately 600 tons of alum to Harris Bros. & Co., of Philadelphia, Pa. Other contracts were awarded as follows: Smith-Courtney Co., Richmond, for supplying 140 water meters and cast iron pipe; Virginia-Carolina Supply Co., for furnishing brass; Fletcher & Kellum, for relaying granite and cobblestone paving; Hunter B. Frischkorn, for gate valves; John Tyler, hauling for water department; Glamorgan Pipe & Foundry Co., Lynchburg, Va., fire hydrants; Boyd Iron Works, Richmond, for valves and meters.

⊙The contract for furnishing material and labor for laying water mains and installing valves and connections, on Westover Ave., west of Langley road, in Norfolk, Va., has been awarded to R. P. Denby for $1,924.

Washington.

✣Bids are asked until noon, April 1, by Nicholas Lawson, Commissioner Light and Water, Tacoma, Wash., for constructing a concrete lined reservoir and for laying a 27-mile pipe line.

The water board of Bellington, Wash., has decided upon the extension of a 6-in. water main from Larson by way of Electric Ave., to Spruce St., down Spruce St. one block to the Geneva road and on the Geneva road from Spruce Ct. to a point near Forest Landing.

West Virginia.

Improvements will be made to the city water works of Wheeling, W. Va., shortly at an estimated cost of $300,000. C. B. Cooke, Wheeling, Engineer. Board of Control will have charge of the work.

Wisconsin.

✣Bids will be received until 10:30 a. m., March 31, by Department of Public Works, Milwaukee, Wis., for furnishing all the materials and doing all the work necessary and required to lay water mains in such streets in the city of Milwaukee as may be directed by the Department of Public Works during the year 1911, according to specifications on file in this office. Bidders will state separate prices for laying 6-in., 8-in., 12-in. and 16-in. pipe, and contracts will be awarded to the lowest bidders respectively. Bonds to accompany bids required in the penal sum of $7,500, or in lieu thereof the bidder may deposit with the department of public works the sum of $3,750 in money or certified bank check.

✣Bids will be received until 10:30 a. m., March 31, by Board of Public Works, Milwaukee, Wis., for furnishing to the city for the use of its water department, 500 tons of 16-in., 800 tons of 12-in., 850 tons of 8-in. and 50 tons of 4-in., class "C" water pipe and 50 tons of special castings, consisting of 3 ways, 4 ways, curves, etc., from 3 to 16 ins. diameter, both pipe and specials being for class "C" water pipe, according to the American Water Works association's standard specifications for cast iron water pipe and special casting.

✣Bids will be received until 10:30 a. m., March 31, by Department of Public Works, Milwaukee, Wis., for furnishing 1,000 tons of 6-in. class "C" cast iron water pipe to the water department of the city of Milwaukee, according to the American Water Works Association Standard Specifications for Cast Iron Water Pipe and Special Castings.

✣Bids will be received until 10:30 a. m., March 31, by Department of Public Works, Milwaukee, Wis., for hauling and delivering water pipe, hydrants and special castings as may be required by the water department of the city of Milwaukee during the year 1911, according to specifications on file in that office. Bonds to accompany bids in the penal sum of $1,800, or in lieu thereof the bidder may deposit with the department of public works the sum of $900 in money or certified bank check.

⊙The Board of Water Commissioners of Watertown, Wis., has awarded the contract for drilling a deep well to F. L. McCarthy, 407 6th Ave., Minneapolis, Minn. Bids were opened March 18

Canada.

✣Bids will be received until noon, April 8, by T. J. Brown, Resident Engineer, Canadian Pacific Ry., Calgary, Ont., for digging, laying and backfilling pipe line for water supply at Wetaskuvin.

✣Bids will be received until noon, April 4, by W. H. Stewart, Secy.-treas., Ronleau, Sask. "Contract E." Electrical machinery, pole, line, etc.

"Contract F." Pumping machinery, compressed air system.

"Contract G." Producer gas plant. Cast iron or steel water mains, as follows:

12,000 ft. 6-in. C. I. water main, tested to 300 pounds hydrostatic pressure.

1,000 ft. 4-in. C. I. water main, tested to 300 pounds hydrostatic pressure.

1,400 ft. 2-in. C. I. water main, tested to 300 pounds hydrostatic pressure.

Special castings, tees, etc., at per pound, hydrants, valves, etc., as follows:

22 6-in. hydrants, one steamer nozzle and 2 2¼-in. nozzles; 8 ft. 0-in. ———.

47 6-in. left-handed gate valves.

47 6-in. valve boxes extending 7 to 9 ft. J. Darlington Whitmore, Consulting Engineer, 104 Willoughby and Duncan block, Regina, Sask.

The Private Bills Committee of the Ontario Legislature has passed the bill of St. Catherines, Ont., authorizing an expenditure of $180,000 for the extension of the waterworks system

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

The city of New Decatur, Ala., has passed an ordinance for the building of sewers in East New Decatur and another ordinance for the building of concrete sidewalks on Moulton St., Sixth Ave., and Grant St.

Arizona.

The city of Phoenix, Ariz., has purchased the plant of the Phoenix Sewer & Drainage Co., for $60,000. Bonds to the amount of $325,000 will be sold at once for the purpose of building a sewer system in those portions of the city not tapped by the old privately owned corporation. L. S. Olmstead, of the firm of Olmstead & Gillelen, 604 Wright & Callender Bldg., Los Angeles, Cal., is engineer.

Arkansas.

The City Council of Pulaski Heights, Ark., has promised to consider the question of extending that municipality's sewerage system and giving the place a drainage into the Arkansas river below the pumping station. Engineers have been employed to estimate the cost of this work.

California.

⊙The city trustees of Calexico, Cal., have let the contract for the building of the Calexico sewer system to Watson & Spicer of Colorado Springs, Colo., for approximately $26,650. Work will begin about April 1.

City Engineer Dewey of Long Beach, Cal., has completed plans and estimates of the cost of constructing a complete sewer system for the city of Long Beach, and the report will be passed upon by the council at an early date. The project is one of the most extensive in the southwest, involving the laying of more than 150 miles of pipe, at a cost of $400,000. The work contemplates the extension of the municipal sewer system to all parts of the city, with the exception of the recently acquired Belmont Heights section. The location of the outfall sewer will be changed and enlarged so that it will empty far into the ocean.

Residents and members of the chamber of commerce of Centerville, Cal., recently held a meeting to discuss plans for constructing a sewer from the Newark Bay. This sewer has been petitioned for by the Hunt Bros.' Canning Co., which proposes the construction of a canning house.

Colorado.

⊙The National Construction Co., of Denver, Colo., has been awarded the contract by the quartermaster's department at Fort Logan, Colo., for the construction of a sewage disposal system. The contract price is $29,030.

The taxpayers of Colorado Springs, Colo., have been asked to vote $22,000 worth of bonds at the election April 4 for the extension of the sanitary sewer system of the city.

Florida.

Plans are being prepared for a system of storm water drainage for a large portion of the sub-divided land adjoining Tampa, Fla., on the west. Benjamin Thompson, 224 Am. Nat. Bank Bldg., Tampa, Fla., is the engineer.

The Board of Trustees of Pensacola, Fla., has approved the plans submitted for the construction of additional sewers in the city at a cost of approximately $100,000. It is intended to run one large outlet, in addition to the present two, to drain the eastern and middle sections of the city, and to extend the sewerage system to a large portion of the city. The trustees have been authorized to call for bids for this work, as well as for bids for almost half a million dollars' worth of paving, which is to be done at an early date on plans previously approved by the council.

Georgia.

The city council of Camilla, Ga., has passed an ordinance calling for an election in the near future to authorize the issuance of $20,000 in bonds to improve the sewerage system and build a city hall.

The city council of Atlanta, Ga., has submitted a proposition to the county commissioners whereby their aid is solicited in the extension of the trunk sewers provided for in the bond issue to points beyond the city limits. The four most important trunk sewers are the Loyd St. sewer, the Butler St. sewer, the Orme St. sewer and the Proctor St. sewer. It is estimated that the cost of converting the intercepting sewers into trunk sewers will approximate about $600,000. R. M. Clayton is chief engineer of construction.

Idaho.

⊙The following bids were received March 9 by the City of Pocatello, Idaho, W. A.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] Standing for City Engineer's estimate, total, [illegible] for Moran Contracting Co., Ogden, Utah, $75,089; (4) for Gillis Construction Co., Salt [illegible] Whittier, Twin Falls, Idaho, $80,599; (6) for Bannock Engineering Co., Pocatello, Idaho, [illegible] Butte, Mont., $88,000; (8) Peter O'Brien Construction Co., Denver, Colo., $89,181; (9) Montague & O'Reilly, Portland, Ore., $90,397; (10) W. W. Cook & Son, Junction City, Kan., $94,204; (11) Strange & Maguire, Salt Lake City, Utah, $94,275; (12) George Irving, Salt Lake City, Utah, $94,345; (13) E. M. Eby, Wichita, Kan., $95,444; (14) James Kennedy Construction Co., Salt Lake City, Utah, $97,434.

A petition asking the city council of Kellogg, Ida., to submit the question of bonding the city for a sewerage system has been circulated among the business men and property owners.

Illinois.

⊙Arthur Birt has been awarded a contract at Bement, Ill., for the construction of a storm sewer for $22,146. It will require 6,666 cu. yds. of open work, 748 ft. of 48-in. concrete sewer, 1,312 ft. of 36-in. vitrified sewer tile, 1,295 ft. of 27-in., 1,511 ft. of 22-in., 740 ft. of 20-in. tile in the main sewer. Branch No. 1 will require 2,822 ft. of 30-in., 1,720 ft. of 24-in., and 928 ft. of 20-in. tile, and there will be a spur requiring 685 ft. of 12-in. tile. Branch No. 2 will require 951 ft. of 20-in. tile. There will be 85 catchbasins and 16 manholes.

Commissioner of Public Works B. J. Mullaney of Chicago, Ill., has submitted a report to the city council, in which it is asked that measures be taken at once for the construction of a comprehensive system of sewers in the downtown business district. The present system of sewers, it is thought, is inadequate. The sewers will cost between $1,000,000 and $2,000,000.

The board of local improvements of East St. Louis, Ill., has set April 3 for a public hearing on the building of the Winstandley sewer, which will cost $280,000. This sewer will cover all of the territory in the old village of Windstandley and much more, and will serve fully one-fourth of the population of the city. The territory includes the Terminal Belt on the west, to 51st St., and the eastern city limits, and from the Louisville & Nashville Railroad tracks on the north to the Southern Railroad tracks on the south. W. J. Crocken is city engineer.

An ordinance has been presented in the City Council of Canton, Ill., authorizing a further bond issue to the amount of $10,000 for sewer improvements for the submitting of the question to the voters of the city at the election on April 18.

The Board of Local Improvements of Elgin, Ill., has adopted resolutions for constructing the Seventh Ward sewer this year.

Indiana.

✤Bids are asked until 7:30 p. m., April 5 by Board of Local Improvements of Chicago Heights, Ill., W. E. Leinmertz, Secretary, for the construction of storm sewer No. 3, consisting of 5,514 ft. of reinforced concrete sewer pipe from 24 to 42 in., and 6,798 ft. 15-in. to 18-in. tile pipe.

✤Bids will be received until 10 a. m., March 29, by Board of Public Works, Indianapolis, Ind., for the construction of a local sewer in and along alley north of 32d St. from Clifton St. to Barnes Ave.

✤Bids will be received until 10 a. m., March 29, by Board of Public Works, Indianapolis, Ind., for the construction of a local sewer in and along Montcalm St., from 18th to 21st St.

[illegible] Front St., Wheaton, Ill., is the probable contractor for an extension of the sewer system of Wheaton from a point in the center of Col- [illegible]

BIDS RECEIVED MARCH 9 BY THE CITY OF POCATELLO, IDAHO, FOR CONSTRUCTING THE FIRST LINE OF SEWERS FOR THE CITY

Item	Quantity	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
12-in. vit. pipe, 12 ft. to 14 ft. cut, per ft.	1,800	$ 2.16	$ 1.76	$ 1.667	$ 2.43	$ 2.31	$ 1.80	$ 2.55	$ 3.75	$ 3.20	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]
15-in. vit. pipe, 12 ft. to 14 ft. cut, per ft.	334	2.96	2.15	1.973	2.61	2.59	2.30	2.85	4.20	3.50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20-in. vit. pipe, 12 ft. to 16 ft. cut, per ft.	220	4.23	3.33	2.968	3.34	3.64	3.50	4.69	5.30	6.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20-in. vit. pipe, 16 ft. to 18 ft. cut, per ft.	600	4.99	3.63	3.468	1.48	6.74	3.74	6.50	6.50	7.00	6.00	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 5 ft. to 8 ft. fill, per ft.	90	12.16	4.71	7.385	3.70	11.84	4.90	7.08	6.25	10.00	6.40	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 0 ft. to 5 ft. fill, per ft.	180	7.83	3.70	4.695	2.48	5.14	4.00	3.75	5.00	7.00	5.00	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 0 ft. to 5 ft. cut, per ft.	990	4.83	2.81	2.61	2.42	3.47	3.07	3.50	3.75	3.07	4.10	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 5 ft. to 8 ft. cut, per ft.	60	5.44	3.11	3.02	2.90	4.10	3.20	2.75	4.40	3.40	4.40	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 8 ft. to 10 ft. cut, per ft.	510	5.70	3.51	3.35	2.90	4.27	3.65	3.25	5.00	4.07	5.20	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 10 ft. to 12 ft. cut, per ft.	420	6.30	3.86	3.499	2.45	4.65	4.10	3.60	5.65	4.73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 12 ft. to 15 ft. cut, per ft.	1,250	7.14	4.31	4.99	5.53	4.85	4.50	4.25	6.25	5.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 15 ft. to 18 ft. cut, per ft.	540	7.90	6.16	5.68	7.53	6.16	6.25	6.75	7.50	5.06	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 18 ft. to 20 ft. cut, per ft.	270	8.37	6.75	10.73	6.10	6.85	7.05	7.75	8.75	6.57	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 20 ft. to 22 ft. cut, per ft.	300	9.71	7.50	11.61	7.32	7.30	7.72	9.25	10.00	7.07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24-in. vit. pipe, 22 ft. to 25 ft. cut, per ft.	150	10.67	9.00	12.29	[illegible]	7.96	9.00	11.75	13.75	8.08	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30-in. vit. pipe, 0 ft. to 5 ft. fill, per ft.	720	7.77	5.85	4.244	4.88	11.66	5.87	8.10	8.10	8.50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24-in. x 6-in. Y [illegible], each	40	11.57	3.25	8.09	6.59	8.00	3.50	6.00	7.50	7.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6-in. one-eighth bends, each	43	1.15	0.75	0.75	0.30	0.50	0.83	0.75	1.25	1.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6-in. vit. pipe risers, per ver. ft.	149	0.411	0.25	0.75	0.35	1.00	0.27	2.00	1.25	1.00	1.00	[illegible]	[illegible]	[illegible]	[illegible]
6-in. vit. pipe, house con., 0 ft. to 16 ft. cut, per lin. ft.	509	0.87	1.00	1.17	0.86	1.00	1.50	2.00	1.90	1.00	1.06	[illegible]	[illegible]	[illegible]	[illegible]
1 flushing manhole and connections	1	480.00	275.00	120.00	307.00	197.00	300.00	300.00	500.00	250.00	550.00	[illegible]	[illegible]	[illegible]	[illegible]
Manholes and appurt., per ft. depth	370	12.00	6.00	7.29	5.37	6.00	6.15	10.00	8.75	6.50	8.90	5.48	[illegible]	[illegible]	[illegible]
C. I. pipe, per ton	60.7	63.50	90.00	52.00	91.50	35.00	100.00	45.00	63.00	45.00	55.00	33.60	42.00	[illegible]	[illegible]
1 grit chamber and appurtenances	1	385.00	225.00	350.00	183.00	203.00	300.00	500.00	185.00	300.00	155.00	[illegible]	420.00	[illegible]	[illegible]
1 screen chamber and appurtenances	1	2,162.50	3,000.00	350.00	2,037.40	1,828.25	3,600.00	4,500.00	3,125.00	2,500.00	3,100.00	3,000.00	1,650.00	[illegible]	[illegible]
Rock excavation, per cu. yd.	2,200	4.00	2.75	3.00	5.00	4.25	5.00	1.50	2.25	6.00	3.50	2.00	5.00	[illegible]	[illegible]
Excavation in soil, clay and loose gravel, per cu. yd.	474	0.83	2.06	0.90	2.44	1.00	2.50	2.00	1.25	2.50	1.00	1.50	1.50	[illegible]	0.90
Extra earth filling, per cu. yd.	634	1.50	1.00	0.90	0.61	1.00	1.10	1.00	1.25	1.00	1.00	1.75	1.25	0.80	[illegible]
Broken stone or gravel filling, per cu. yd.		1.50	2.00	1.50	10.00	1.00	2.25	3.50	2.50	3.00	1.25	2.00	1.25	1.00	1.10
Concrete, with forms furnished by contractor, per cu. yd.	200	12.00	12.00	10.00	10.00	10.00	14.00	12.00	16.25	15.00	15.00	4.00	[illegible]	14.00	14.50
Lumber for sheeting, per 1,000 ft. B. M.	26,000	31.00	27.00	38.00	25.00	27.00	30.00	30.00	50.00	40.00	36.00	25.00	[illegible]	[illegible]	37.00
Lumber left in place, per 1,000 ft. B. M.	9,000	31.00	35.00	28.00	25.00	44.00	40.00	30.00	50.00	45.00	45.00	25.00	20.00	[illegible]	47.00
Gravel street resurfaced, per sq. yd.	1,725	0.50	0.35	0.90	0.70	0.75	0.50	2.50	0.60	0.50	0.85	[illegible]	[illegible]	0.75	0.77
C. I. pipe discharge apparatus and appurtenances	1	3,517.50	3,500.00	8,189.20	3,000.00	3,580.00	4,200.00	3,500.00	2,500.00	3,500.00	4,500.00	2,400.00	[illegible]	[illegible]	[illegible]
4-in. tile drain		0.16	0.50	0.10	0.50	0.10	0.56	1.00	0.50	0.50	1.00	0.16	[illegible]	0.30	0.35

[illegible] manholes, [illegible] and 1 flush tank. Bids were opened March [illegible]

The town board of [illegible], Ind., has approved the bond of John O. Kain, county surveyor, of $5,000 for the work of putting in the proposed new sewer in Danville, and has employed Charles C. Brown of Indianapolis, Ind., as consulting engineer for the board. It is proposed to build the sewer by general taxation.

E. M. Sheflow of Gary, Ind., is the probable contractor for the construction of a sanitary sewer in West Dundee. The work includes sewer with manholes, flush tank lampholes, outlet and appurtenances. The bid was $11,035. Bids were opened March 16.

The Water Front Commission of Fort Wayne, Ind., is corresponding with sewer experts throughout the country and will make a selection at an early date of some expert on sewage, who will come here to inspect Fort Wayne's sewerage system.

The Board of Public Works of South Bend, Ind., has adopted the declaratory resolution on the new Bowman St. sewer. The estimated cost of the sewer is $170,000. William S. More is City Engineer.

A petition has been presented to the Board of Public Works of Gary, Ind., by residents of the Ridge Road district, for the building of a sewerage system on the extreme south side of the city.

Iowa.

✣Bids will be received until 10 a. m., March 29, by City Council, Cedar Rapids, Ia., for furnishing material and labor for the construction of sanitary sewers, all according to the plans and specifications for said work on file in the office of the city clerk for the city of Cedar Rapids, Linn county, Iowa, which are by reference made a part hereof, on the following described streets of said city: An 8-in. sanitary sewer in 13th St., W., from alley north of A Ave., and a 12-in. sanitary sewer in B Ave., W., from 13th St. to 18th St. A 6-in. sanitary sewer in 2d St., W., from G Ave. to I Ave. A 6-in. sanitary sewer in 4th St., W., from 8th Ave. to 9th Ave., and in 9th Ave., W., from 4th to 6th St., W. A 6-in. sanitary sewer in alley between 8th and 9th Sts., W., from n. line of 10th Ave., W., to C., M. & St. P. Ry. right of way. That the kind of material to be used and the method of construction of said improvement shall be as follows: Vitrified sewer pipe from 6 to 12 ins. in diameter, from 24 to 30 ins. in length, to be laid in trench at the required depth, joined with Portland cement mortar, and Y's to be placed so as to best accommodate abutting property.

✣Bids will be received until 8 p. m., April 4, W. E. Hayes, city clerk, Clinton, Ia., for the necessary labor and material for the reconstruction of certain sewers in District No. 4. The extent of the work is as shown in the following list of approximate quantities: Division "A"—1,343 ft. 30 in. 1½ ring brick sewer, 355 ft. 36 in. pipe sewer, 360 ft. 30 in. pipe sewer, 1,585 ft. 24 in. pipe sewer, 709 ft. 20 in. pipe sewer, 1,636 ft. 18 in. pipe sewer, 1,715 ft. 15 in. pipe sewer, 4,576 ft. 12 in. pipe sewer, 3,605 ft. 10 in. pipe sewer, 3,075 ft. 10 in. catch basin pipe, 4,200 cu. yds. rock excavation, 34 manholes, 41 catch basins, 63 inlet basins. Division "B"—300 ft. 48 in. 2 ring brick sewer, 500 ft. 48 in. 1½ ring brick sewer, 400 ft. 42 in. 1½ ring brick sewer, 410 ft. 36 in. pipe sewer, 810 ft. 30 in. pipe sewer, 867 ft. 24 in. pipe sewer, 831 ft. 18 in. pipe sewer, 840 ft. 15 in. pipe sewer, 4,148 ft. 12 in. pipe sewer, 740 ft. 10 in pipe sewer, 1,620 ft. 10 in. catch basin pipe, 7,200 cu. yds. rock excavation, 26 manholes, 10 catch basins, 41 inlet basins. Division "C"—1,220 ft. 12 in. sewer pipe, 580 cu. yds. rock excavation, 2 manholes. Division "D"—818 ft. 30 in. pipe sewer, 835 ft. 20 in. pipe sewer, 1,093 ft. 18 in. pipe sewer, 438 ft. 15 in. pipe sewer, 1,571 ft. 12 in. pipe sewer, 2,820 ft. 10 in. pipe sewer, 818 ft. 10 in. catch basin pipe, 2,900 cu. yds. rock excavation, 14 manholes, 11 catch basins, 18 inlet basins. All Y's, traps, slants and fittings are included in the above quantities.

It is planned to erect a municipal pumping station and lay [illegible] Ia. The Commercial club is interested.

The city council of Cedar Rapids, Ia., has ordered the city solicitor to draft an ordinance providing for the issuance of $30,000 worth of sewer bonds for the purpose of constructing storm sewers in the 11th precinct and in various other parts of town.

The city council of Valley Junction, Ia., has decided to have a modern purification plant, and has secured the services of Charles P. Chase of Clinton to draw plans for a complete and sanitary sewer system.

City Engineer Keyes C. Gaynor of Sioux City, Ia., is preparing plans for the installation of the proposed sanitary sewer system for Leeds (P. O. Sioux City). The main branch will be laid along Floyd Ave. in Leeds, with laterals to it running north and west. The outlet of the system will be made at the Floyd river.

A resolution has been introduced in the City Council of Cedar Rapids, Ia., for a storm sewer on 15th and 16th Sts., from Fourth Ave. to Fifth Ave.

Engineer Sam Steigerwald, 327 Sixth St., Boone, Ia., has submitted his revised plans for the installation of a sewer system in Nevada, Ia., to the City Council of that city. Bids for the construction of the system will be advertised for shortly.

The City Council of Valley Junction, Ia., has engaged Charles P. Chase of the Iowa Engineering Co., Clinton, Ia., to make the proper surveys and draw up plans for the installation of a complete sewer system and a purifying plant for Valley Junction.

A movement is on foot among the members of the Commercial Club of Logan, Ia., for the construction of a sewerage system for that city. A committee of W. L. Stern, J. C. McCabe and J. A. Heterick has been named to confer with the Board of Supervisors in regard to the joint construction of a sewerage system for the city.

Plans are being made to build another storm sewer similar to the Dry Run sewer in Waterloo, Ia. The present plans provide for the reclamation of a large territory along Virden Creek, in East Waterloo. The sewer will have to be 10 ft. in diameter and a mile or more in length. The cost of construction will be more than $100,000.

Kansas.

The city council of Humboldt, Kan., has passed an ordinance creating a sewer district and calling for the construction of such improvements costing about $20,000. The sewer will cover the business district of the town.

Kentucky.

The citizens of Eastover, a suburb of Louisville, Ky., are discussing possible improvements in the sewerage system. It is planned to construct a comprehensive sewer system

Louisiana.

The Board of Aldermen of Opelousas, La., has adopted an ordinance creating a sewerage district which practically embraces all the property within the lines of the old town, but excluding the new additions and the outlying portions of the city which are not thickly populated. The ordinance authorizes the mayor to call an election for March 28 for the purpose of electing a sewerage board of five commissioners, who, under the law, will provide for holding an election to take the sense of the property taxpayers residing within the district.

Maryland.

✣Bids will be received until 11 a. m., April [illegible] furnishing, building and installing sewage screens for sewage disposal works, as shown on plans on file in the office of Calvin W. Hendrick, chief engineer of the sewage commission.

[illegible] of Awards of Baltimore, Md., on March 15 for the construction of storm water contract No. 12; Calvin W. Hendrick, chief engineer, sewerage commission: C. B. Clark & Co., Huntingdon Ave. and 31st St., Baltimore, $83,246; McCauley-Manton Co., Ave. M and Ocean Parkway, Brooklyn, N. Y., $88,438; The David M. Andrew Co., Baltimore, Md., $98,859; The Whiting-Middleton Constr. Co., Sexton Bldg. Baltimore, Md., $99,981; Ryan & Reilly, Coleman Bldg., Philadelphia, Pa., $99,704; B. F. Sweeten & Son, Baltimore, Md., $100,646; David Peoples, 60 Knickerbocker Bldg., Baltimore, $100,414; W. H. & C. F. Thompson, 627 Law Bldg., Baltimore, $112,227; Wm. McCarthy & Co., Baltimore, Md., $113,038; James Ferry & Sons, Inc., Grafton Sta., Pittsburg Pa., $143,322.

Massachusetts.

The city council of Boston, Mass., has directed L. K. Rourke, Commissioner of Public Works, to advertise for proposals to dispose of garbage, refuse and combustible waste by reduction, incineration or otherwise.

Michigan.

The village of Birmingham, Mich., has voted to bond for $25,000 for sewer construction. George E. Daines is president of the village, and George E. Kemp, village clerk.

Sanitary Engineer W. W. Williams for the city of Detroit, Mich., has recommended that the city build a new sewer in the alley between Jefferson Ave. and Woodbridge St.

The Village Council of Jonesville, Mich., has passed a resolution to construct a sewer along the principal business portion of Chicago St., the total cost not to exceed $1,540.

The City Council of Allegan, Mich., has decided to lay a sewer on Depot Hill on the north side.

Minnesota.

✣Bids will be received until 5 p. m., April 7, by city of Albert Lea, Minn., for 3,475 lin. ft. 8-in. pipe sewer, 13 manholes, 86 house Y's Wm. Barneck is city engineer.

✣Bids will be received until 8 p. m., April 17, by V. M. Roderick, city clerk, Brainerd, Minn., for the construction of a new sewer in Sewer District No. 5.

⦿The following bids were received by the city council of Melrose, Minn., for the installation of a sewer system, for which S. S Chute of St. Cloud, Minn., is engineer: F. E. Kanninske, Watertown, Wis., $13,339; P. M. Donnell, Duluth, Minn., $13,146; Fraxer & Danforth, Rochester, Minn., $14,920; Illstrup & Olson, Minneapolis, Minn., $17,136; C. H Porritt, Fargo, N. Dak., $16,811; C. S. Redman, Pipestone, Minn., $17,852; Pastoret Lawrence Co., Duluth, Minn., $14,951; Cook Construction Co., Des Moines, Ia., $15,550; Thomas Worley, La Crosse, Wis., $15,794; L. Schruth, Fargo, N. Dak., $15,205; W. Bostwith, Ada, Minn., $14,684; M. Deuber, St Cloud, Minn., $11,419. The contract has been awarded to the lowest bidder.

The board of charities and corrections of Minneapolis, Minn., recently held a meeting to discuss the plans for the proposed trunk sewer on Lyndale Ave., to benefit the workhouse and Hopewell property.

The city council of Ely, Minn., has instructed the city attorney to take the necessary steps toward bonding the city for $30,000 for constructing sanitary and storm sewers. The money is to be used in constructing the main sewer to the lake and storm sewers and curbs in readiness for the laying of cement walks. The plans and specifications for the system were prepared by the Duluth Engineering Co., Palladio Bldg., Duluth, Minn. The estimated cost is $21,000

The following bids were submitted to the City Council of St. Cloud, Minn., March 7, for the construction of six miles of sewer during the coming summer; S. S. Chute, City Engineer: East Side Sewers.—The bids on the East Side work were, M. Johnson, Minneapolis, $10,872.15; P. D. McNamara, Dubuque, $10,092.07; Ilstrup & Olson, Minneapolis, $8,825.87; F. E. Kaminski, Watertown, Wis., $11,493.98; Frazier & Danforth, Rochester, Minn., $11,088.85; Carl Kropp, St. Cloud, $10,281.47; P. McDonnell, Duluth, $12,191.22; Bosworth Brothers, Ada, Minn., $11,662.70; McAdam Preston A., Duluth, $11,786.43; Pastoret Lawrence Co., Duluth, $11,079.65; G. S. Redmon, Pipestone, $11,588.40; Cook Construction Co.,

$10,291.78; Thos. E. Wooley, La Crosse, $9,- [illegible] Bosworth Brothers, $27,393.62; McAdam Pres- [illegible] Construction Co., $32,970.12; Thos. E. Wooley, $28,433.14; Gilbert W. Haggert, $27,960.00.

Mississippi.

The city of Meridian, Miss., proposes to construct several miles of concrete sidewalks, small sanitary sewer extensions, etc. W. G. Wetmore is city engineer.

Missouri.

The board of public works of St. Joseph, Mo., has instructed City Engineer Lawlor to prepare plans and specifications for an extension of Lower Whitehead Creek sewer from 16th and Bell Sts., to 11th and Atchison. The estimated cost is $40,000. The sewer will be circular 16 ft. in internal diameter, and will be of materials similar to the Upper Whitehead sewer, with which it will connect.

Property owners of Washington Heights and West Cabanne, St. Louis, Mo., recently held a meeting to discuss the proposed $2,500,000 bond issue to convert River Des Peres into a sewer by tunnel through Art Hill, in Forest Park.

Nebraska.

Citizens of Stanton, Neb., are agitating the installation of a sewer system in their city.

New Jersey.

✣Bids will be received until 8 p. m., April 11, by township committee, South Orange, N. J., for the construction of sanitary sewers for the Hilton District. The work includes the construction of 5,106 ft. of 12-in. pipe, 8,930 ft. of 10-in. pipe, 4,532 ft. of 8-in. pipe, 59 manholes, 4 flush tanks. The attention of all bidders is especially directed to the fact that the capacity of the township of South Orange in the joint trunk sewer is exceedingly limited and that every precaution and restriction that can be taken to secure water-tight work will be insisted upon from the contractor. Plans can be seen and specifications secured at the office of the engineer, Alexander Potter, 114 Liberty street, New York city, and at the office of the township clerk, Maplewood, N. J. A certified check for $5,000 shall accompany each bid.

It is reported that the special sewage disposal committee of the city council of East Orange, N. J., working with representatives of Orange, Glen Ridge, Montclair and Bloomfield, has decided upon a method of sewage disposal which will solve the problem without involving any of them in the Passaic Valley trunk sewer scheme.

In his report to the board of works of Paterson, N. J., Sanitary Engineer William F. Morse, of New York City, recommends the construction of a main destructor plant of 100 tons daily capacity, at a cost of about $100,000, and a yearly maintenance cost of $21,800, together with the erection of another small plant in the over-the-river section with a capacity of about 40 tons. The estimated cost of this is $60,000, and the yearly maintenance cost $10,000.

New York.

✣Bids will be received until 2 p. m., April 3, by George McAneny, president, borough of Manhattan, New York city, for furnishing all labor and material for reconstructing outlet sewer and appurtenances at the foot of 79th St., East River. Engineer's estimate of the quantity and quality of the material and the nature and extent, as near as possible, of the work required is as follows: 100 lin. ft. of brick sewer 5 ft. interior diameter, all complete as per section on plan of the work—Class I; 85 lin. ft. of brick sewer 5 ft. interior diameter, all complete as per section on plan of the work—Class II; 50 cu. yds. of rock to be excavated and removed; 5,000 ft. B. M. of timber and plank for bracing, etc. The time allowance to complete the whole work is 60 working days. The amount of security required will be $2,000.

⦿The department of public works of Buffalo, N. Y., Francis G. Ward, commissioner, has awarded the following contracts for sewer construction; bids opened March 1: A 36, 33, 30, 27 and 24-in. brick; 20, 18, 15 and 12-in. tile sewer in Connelly St., Olympic, Warwick and Northumberland Aves., between Bailey and Kensington Aves., W. C. Culliton, $16,793; a 5½-ft. x 9 ft. brick and stone sewer in Lang Ave. and Texas St., between Bailey and Delavan Aves., Benj. F. Spire, $33,600; a 27, 24-in. brick and 20-in. tile sewer in west side of Elmwood Ave., between Amherst St., and 810 ft. south, John Miller, $4,448; a 15 and 10-in. tile sewer in Wende St., between Ferry and Genesee Sts., W. G. Smith, $96; a 10-in. tile sewer in Prairie Ave., between Tonawanda St. and southwesterly end of same, Frontier Contracting Co., $700.

⦿It is reported that the board of contract of Rochester, N. Y., has awarded the contract for the construction of the intercepting sewer to Ripton & Murphy for $133,350.

The Decarle Incinerator Co., of Hopkins, Minn., submitted the only bid for the new incinerator plant for the city of Rochester, N. Y., to the board of contract of that city, their bid being $82,950.

The village of North Plainfield, N. Y., will soon have plans prepared for the installation of a sewer system.

The board of public works of Rochester, N. Y., has authorized the commissioner of public works to negotiate for assessments for the construction of the intercepting sewer.

Resolutions have been passed by the Queens Local Boards, in Long Island City, for the building o two sewer mains in the Ingleside district of Flushing. One was for a main in Cypress Ave., from 17th Ave. to 23rd St., and in 20th St., from Franconia Ave. to Cypress Ave., estimated to cost $22,100. The other is for 19th St., from Cypress Ave. to Franconia Ave., estimated to cost $1,750. It was also resolved to initiate proceedings to build a sewer in Mills St., Astoria, from the East River to Orchard St., and in Orchard St., from the East River to Mills St., two blocks.

The following bids were recently received by the Board of Public Works of Watertown, N. Y., for constructing the Indiana Ave. trunk sewer system in the old First Ward: Charlebois Bros., Watertown, $24,608; Lou B. Cleveland, Watertown, $23,001; W. J. Semper, Watertown, $21,618; C. D. Hodge & Co., Watertown, $21,275; Philip Thomas, Syracuse, $20,966; Samuel Bonn, Syracuse, $20,209, and Burns Bros. & Haley, Watertown, $19,343.

The Sewer Department of Brooklyn, N. Y., will let a contract early in the spring for the construction of a sewer on Foster Ave., between Coney Island Ave. and the Ocean Blvd.

The State Department of Health, Albany, N. Y., has accepted the plans prepared for an intercepting sewer system and sewage disposal plant by City Engineer John A. Giles and Sanitary Engineer George L. Robinson for the city of Binghampton, N. Y. The system includes the Fifth and Sixth Ward systems which are yet to be developed.

The City Engineering Department has been running lines and taking levels for the construction of a sewer system at East End, Binghampton, N. Y. This part of the city is only partly sewered, and it is planned to have the unsewered section fully mapped out and plotted with sewers so that when the improvements are desired they can be referred to and passed by the council quickly. The East End system is included in the general sewer plans of the city now before the State Department of Health. John A. Giles is City Engineer.

Ohio.

The city council of Marysville, O., has awarded the contract for furnishing the plans for a sanitary sewerage system for the city to E. A. Kimmler of Columbus, for $2,160. The system is to be completed by November.

Plans have been prepared for the construction of sewers in Cincinnati, O., as follows: Kirby road and rights of way from existing sewer at Frederick Ave., northwestwardly to corporation line; Louis Ave., between Eden Ave. and Vine St.; Shields Ave., from existing trunk sewer west of Vine St. to alley east of Vine St.; alley and right of way between Vine St. and Euclid Ave., from Shields St. to Louis Ave. Edwin Henderson is clerk of the city.

Plans prepared by Arnold-Chapin Co., Canton, O., and Pittsburg, Pa., for the construction of a sewer system in New Philadelphia, O., have been approved by the state board of health. The estimated cost of the system, including the disposal plant and the trunk line sewers is $95,000. A bond election will be held shortly to vote on the proposition of issuing bonds in the sum of $95,000 for the work.

Auditor Geo. W. Bish of Dayton, O., will sell bonds April 11 to the amount of $51,000 for the purpose of constructing storm water sewers in certain streets and avenues in the city.

The city clerk of Chardon, O., has been instructed to have ready at the April meeting of the city council a resolution calling for a vote on the question of sewer system, sewerage disposal and waterworks system for the city. An election will be held in May.

The board of control of Elyria, O., has decided to advertise for bids for the construction of the Broad St. and West Ave. sanitary sewer. This sewer will start at the bridge on Lodi St., and extend along Lodi to Mill St., from Mill to Broad, from Broad to West Ave., and out West to the city limits. The job will be in two separate contracts.

Mayor George S. Marshall of Columbus, O., in his annual report to the City Council, urges the construction of relief and main sewers to accommodate territory where street improvements are being demanded, entailing a cost of about $500,000.

City Auditor Geo. W. Bish of Dayton, O., will sell bonds April 11 in the sum of $51,000 and $11,000 for the purpose of constructing storm water sewers and sewer intersections in the city of Dayton, respectively.

The Board of Control of Elyria, O., is advertising for bids for the construction of the Broad St. and West Ave. sanitary sewer. This sewer will start at the bridge on Lodi St. and extend along Lodi to Mill St., from Mill to Broad, from Broad to West, and out West to the city limits. The job will be let in two separate contracts.

Oklahoma.

⦿The Terry Construction Co., of Poteau, Okla., has secured the contract for the completion of the ditching for the sewer and water systems in the city of Altus, Okla. About four miles of ditching remains to be done.

Work will start April 1 in the city of Duncan, Okla., on a system of sanitary, main and lateral sewers, also a storm sewer. Vitrified pipe will be used and the following are the quantities: 11,650 ft. of 8-in., 20,300 ft. of 10-in., 3,350 ft. of 12-in., 1,700 ft. of 15-in., 925 ft. of 18-in., and 460 ft. of 21-in. Cuts will vary from 3 ft. to 15 ft. Two Municipal excavators will be used to cut trench, and work is expected to be finished in 60 working days. A sewage disposal plant will be installed. The water works system will also be extended. The estimated cost of the improvements is $50,000. W. L. Benham is Supervising and Contracting Engineer, 714-16 Campbell Bldg., Oklahoma City, Okla.

Oregon.

⦿The city council of Silverton, Ore., has awarded the contract for the construction of the water and sewer systems to the Mars Construction Co., of Seattle, Wash., for $63,940. Work will begin about the first of April. Other bidders were: G. Jaeger, Rich Hill, Mo., $65,965; Jeffrey & Bluffton, Portland, Ore., $66,320; American Light & Power Co., Chicago, Ill., $67,965; K. Lalset, Corvallis, $68,745; T. B. Sheppard, Denver, Col., $70,-

260; Jacobson, Bade & Co., Portland, Ore., $71,180.

The sewer system of Pendleton, Ore., is to be extended to afford connections in the west end of the city and to change the outlet so that it will empty into the river one mile further west and below the [illegible] of the branch asylum.

D. M. Roberts, recorder of the town of Gresham, Ore., will sell bonds April 4 to the amount of $20,000 for the installation and construction of a sewer and drainage system and a water works and water system.

Pennsylvania.

✣Bids will be received until 7:30 p. m., March 31, by Borough Council, Wyoming, Pa., V. Breese, secretary, for the construction of terra cotta pipe sewers and appurtenances on the various streets and avenues of the Borough of Wyoming, according to the plans and specifications which may be seen at the office of William T. Hutchins, borough engineer, 9th St., Wyoming, Pa. The work consists of approximately the following: 5,151 ft. 20-in. sewer, 1,840 ft. 15-in. sewer, 1,340 ft. 12-in. sewer, 4,415 ft. 10-in. sewer, 31,760 ft. 8-in. sewer, 29,750 ft. 6-in. house connections, 70 manholes, 40 lamp shafts. All bids must be accompanied by a certified check made payable to the order of John J. Shulde, borough treasurer, for the sum of $2,000.

According to advices from Washington, Pa., a special election is to be held in the new Borough of Marianna on April 10 for the purpose of voting on the question of increasing the indebtedness of that borough in the sum of $70,000. The improvements proposed to be made include the grading and paving of some of the streets of the borough, erecting a municipal building and the purchase of a property on which is erected the present school building.

City Engineer M. B. Cowden of Harrisburg, Pa., recommends that work on the river front intercepting sewer should begin simultaneously in four or five places at intervals of several thousand ft. An ordinance is now before the common council authorizing the work, for passage. As soon as the measure has been passed the Board of Public Works and the City Engineer will discuss the plans, specifications, etc.

South Carolina.

A sewerage system and extension to the water works of Rock Hill, S. C., at a cost of $150,000 is planned. Thos. W. Cathran, Rock Hill, is the engineer. E. L. Barnes is city clerk.

Tennessee.

Citizens of Athens, Tenn., have asked the city council to offer for sale bonds to the amount of $10,000 for [illegible] streets, sidewalks and sewers.

Texas.

⊙The Hamilton Bros. Construction Co., of Chicago, Ill., has been awarded the contract for the construction of about five and one-half miles of sanitary sewers in Cameron, Tex. Bids were opened March 15 by D. L. Wilson, city secretary.

⊙C. W. Olcott has been given the contract by the city commissioners of Dallas, Tex., for the construction of a sewer on Katy, Travis, Cole and Knox Aves., for $5,448.

The Round Rock Sewerage Co., of Round Rock, Tex., has been incorporated with a capital stock of $1,000. The incorporators are: C. A. Nelson, J. F. Nelson and A. K. Anderson.

The city council and the board of trade of Seymour, Tex., recently held a joint meeting for the purpose of discussing the sewerage question. G. T. Dougherty of the South Texas Engineering & Construction Co., of Houston, presented a proposition whereby it is proposed to organize a company at Seymour for putting in sewerage.

The city of Temple, Tex., plans the construction of a crematory. A special committee of the City Council will visit various cities of the State gathering information of the subject.

Washington.

The citizens of Kennewick, Wash., recently voted the issuance of bonds to the amount of $30,000 for the construction of the main trunk sewer with two outlets into the Columbia river.

Property owners of Kellogg, Wash., have petitioned the City Council for a sewerage system. If the proposition is received favorably the city will be bonded to cover the expense.

Wisconsin.

⊙N. Richart of Racine, Wis., has been awarded the contract by the common council of Beloit, Wis., for sewer work on 10 streets during the spring, for $4,595. The sewers will be built on the following streets: St. Paul Ave., from State to Shore and laterals; Prospect St., from East Grand Ave. to Bushnell St., and laterals; Vernon Ave., from Eighth St. to Adams St.; Vine St., from Portland Ave. to Merrill St.; Oak St., from Portland Ave. to Merrill St.; Portland Ave., from Fourth to Milwaukee St.; Milwaukee St., from end of said sewer to Water St.; Brooks St., from Eighth St. to Hackett St.; Hackett St., from intersection of St. Lawrence and Brooks to Roosevelt; Liberty St., from Fifth to Fourth Sts.

⊙The city council of Evansville, Wis., has awarded the contract for installing a sewer system to Robert Nelson of Racine, Wis. Work on the system will begin at once.

The department of public works of Milwaukee, Wis., plans to build a relief sewer in the 13th ward this spring, to give relief to the Third St. sewer. The estimated cost is $50,000. C. J. Poetsch is city engineer.

Proposals for the construction of an intercepting sewer and sewage disposal plant for the city of Antigo, Wis., will be received some time in May. W. G. Kirchoffer, 31-32 Vroman Bldg., Madison, Wis., is consulting engineer.

The common council of Madison, Wis., has adopted plans and specifications for a new sewage plant, and a resolution to submit to the people the question of how the money shall be raised for constructing the same. The structure, according to present plans, will cost about $180,000. John F. Icke is city engineer.

Plans are being made for the construction of another storm sewer similar to the Dry sewer for the city of Waterloo, Wis. It is planned to reclaim the territory along Virden creek, in East Waterloo.

Bids will be received until April 15 by city of Kenosha, Wis., for the construction of a new trunk sewer in that city. Two sizes of sewers are advertised for. The bids will cover 5,000 ft. of circular brick or concrete sewer of either 8 ft. 3 ins. or 10 ft. in diameter, 1,200 ft. of 78-in. sewer and 1,200 ft. of 66-in. sewer. There are to be 20 manholes and bids will cover the expense of connecting all present sewers in the city to the same sewer.

The Common Council of Kenosha, Wis., has passed an ordinance providing for the issuance of the $50,000 bonds necessary to begin the work on the trunk line sewer.

The citizens of Antigo, Wis., have voted bonds to the amount of $50,000 for the construction of a sewerage disposal purification and destruction works system.

Canada.

The electors of North Toronto, Ont., have voted the issuance of debentures to the amount of $265,500 for the construction of a sewerage system.

Engineer Gardner has submitted his report on the plans for the proposed trunk sewer along the course of Muddy Run through the city, to the Board of Works of Niagara Falls, Ont.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until noon, April 10, by J. E. Camp, Judge of Probate, in Talladega, Alabama, for the necessary material and labor for the erection and completion of alterations and additions to Talladega County Courthouse, in accordance with plans and specifications prepared and furnished by Chas. W. Carlton, architect, Anniston, Ala. All bids must be accompanied with a certified check made payable to J. E. Camp, Judge of Probate, for $500.

The Alabama Power Development Co., R. A. Mitchell, President, Gadsden, Ala., is reported to be considering constructing a canal so as to assure more power for the hydroelectric development which is to be built at Jackson Shoals.

California.

Plans and specifications are being prepared for an irrigation water works system in Perris Valley, which will cost from $70,000 to $100,000, and will consist of one and possibly two pumping plant units, having a capacity of three second feet, and a total lift of about 300 ft., and a system of mains and distributing pipes of about 15 miles. F. E. Trask, 421 Homer Laughlin Bldg., Los Angeles, Cal., is the Engineer.

The Finance Committee of the State Senate has decided upon a bill appropriating $150,000 for river improvements in the state.

The State Senate has passed a bill for the appropriation of $5,000 for investigations looking to the improvement of inland waterways of the State.

Colorado.

The Central Colorado Power Co.'s plant at Boulder will be ready to be placed in service by April 1, and it is said that the company will shortly expend $400,000 for the construction of new transmission lines. The general offices of the company are at 1210 17th St., Denver, Colo.

Engineers of the Northern Colorado Power Co. have presented a proposition to the Commercial Club of Fort Lupton, Colo., to irrigate 1,200 acres near that place for truck farming.

A. L. Fellows, Consulting Engineer, Denver, Colo., has recorded a filing for 600 cu. second feet of water in the Grand River. The filing called for diversion of the water at the point of intake for the present Grand Valley canal. This is a step toward the construction of the High Line canal by private parties, if the government will withdraw from the field. The plans of the engineers are to take the water filed upon through the Grand Valley canal, one mile east of Grand Junction, where a power house will be erected and the water lifted about 100 ft. to the level of the government High Line survey. To carry this volume of water the Grand Valley ditch will have to be greatly enlarged. The water lifted at the power house would cover all land now covered by the High Line survey and the plans include installation of an additional pumping plant on the canal line to put another 10,000 acres under water, which is now not included in the government survey.

District of Columbia.

✣Bids will be received until noon April 17, by Lieut.-Col. W. C. Langfitt, U. S. Engineer, 920 17th St., N. W., Washington,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible]
Washington, D. C.

✣Bids will be received until April 3 by Capt. F. C. Boggs, General Purchasing officer, Isthmian Canal Commission, Washington, D. C., for furnishing under circular 626 B., steel castings, rock washers, ferrels, bridging reams, tacks, locks, tacking, chamois and plate glass.

✣[illegible] F. C. Boggs, General Purchasing officer, Isthmian Canal Commission, Washington, D. C., for furnishing under circular 626 A., guy cables, spud timbers, etc.

Florida.

✣Bids will be received until noon, April 3, by Commissioners of Osceola County, Kissimmee City, Fla., for the construction of a new county jail.

Georgia.

✣Bids will be received until noon, March 30, by J. W. Calloway, Commissioner of Roads and Revenues of Wilkes County, Washington, Ga., for furnishing all labor and material required for the erection and completion of a county jail, including all cell work, plumbing and steam-heating equipment, for Wilkes County, Georgia, to be erected at Washington, Georgia.

⊙B. H. Hardaway, Columbus, Ga., has been awarded the contract for the construction of a 110 ft. high concrete dam across the Tallulah River at Tallulah Falls for the North Georgia Power Co. C. Elmer Smith, President, York, Pa. A development of 90,000 H. P. is proposed. The powerhouse will be one mile from the dam, and the water will be conveyed there by means of a tunnel.

Hawaii.

✣Bids will be received until 11 a. m., April 29, by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for turbo alternators and electrical equipment for the U. S. Naval Station, Pearl Harbor, Hawaii.

Idaho.

The Panhandle Electric Ry. & Power Co., Sandpoint, Idaho, is said to be planning to expend $2,000,000 on the construction of a power plant on Priest River in northern Idaho, capable of developing 30,000 H. P.

Illinois.

✣Bids will be received until 11 a. m., April 6, by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering 215 dozen shovels to the Bureau of Streets.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering lubricating oils to the various water pumping stations. Certified checks to the amount of $500 must accompany each proposal.

✣Bids will be received until 11 a. m., April 5, by Chas. F. Seyferlich, Fire Marshal, Chicago, Ill., for furnishing and delivering plumbing supplies as are required for period ending Dec. 31, 1911.

✣Bids will be received until 11 a. m., April 5, by Chas. F. Seyferlich, Fire Marshal, Chicago, Ill., for furnishing and delivering such building material as is required for period ending Dec. 31, 1911. Full specifications may be had upon application at the above office.

✣Bids will be received until 11 a. m., April 6, by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing four 6-ft. sluice gates for use at the Southwest Land Tunnel. Proposals must be accompanied by a certified check or in the amount of $250.

Indiana.

✣Bids are asked until 10 a. m., April 15, by Lieut.-Col. George A. Zinn, U. S. Engineer, Chicago, Ill., for dredging in Indiana Harbor, Ind. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 1 p. m., April 4, by the Board of Directors of Garland Brook Cemetery at the office of William Brockman, Treasurer, Columbus, Ind., for a stone gateway and lodge house for Garland Brook Cemetery.

✣Bids will be received on April 20 by J. W. Weidner, Secretary Masonic Temple Building Association, Delphi, Ind., for a new temple, estimated to cost $27,500. Rubush & Hunter, Architects, Indianapolis, Ind.

✣Bids will be received until 10 a. m., April 3, by the Depot Quartermaster, Jeffersonville, Ind., for furnishing 40,000 ft. B. M. cottonwood No. 1 common lumber and 60,000 ft. B. M. sap gum, No. 1 common lumber.

✣Bids will be received until 10 a. m., April 10, by J. T. Overstreet, Township Trustee, at the office of the County Auditor, Franklin, Ind., for the construction of a school house in that township.

✣Bids will be received until 10 a. m., April 8, by Trustee of Root Township, Adams County, at office of Architect Oscar Hoffman, Decatur, for erection of school building; also bids for old buildings; also bids for heating and ventilating plant. Chas. E. Magley, Trustee.

✣Bids will be received until 10 a. m., April 12, by Trustee of Gregg Township, Morgan County, Ind., for the construction of a 3-room school house.

✣Bids will be received until 1 p. m., April 3, by Board of County Commissioners, Jasper, Ind., for the construction of concrete sidewalks around the court house. M. A. Sweeney is Auditor of Duboise County.

Kansas.

✣Bids will be received until 10 a. m., April 5, by R. V. Ladow, Supt. of Prisons, Washington, D. C., for furnishing and delivering steel bars, bolts, angles, etc., the material to be furnished from stock for 100 cell gratings and doors for the main east cell wing at the U. S. Penitentiary, Leavenworth, Kan.

Louisiana.

⊙United Kansas Portland Cement Co., 511 Commerce Bldg., Kansas City, Mo., at $1.42 per bbl., has been awarded the contract for furnishing 4,300 bbls. American Portland cement delivered near Monroe, La., for the U. S. Government. Bids were opened March 21 by the U. S. Engineer at Vicksburg, Miss.

About 3,500 acres of cut-over pine lands have been sold by the Edgewood Land & Logging Co. to a syndicate of foreign capitalists. This land lies west of the Kansas City Southern Ry., between Turner and Edgewood. It is to be developed and colonized immediately, the development operations being in charge of E. E. McCrossett, consulting and mining engineer of Birmingham, Ala.

Bids as follows were received March 17 by the U. S. Engineer, New Orleans, La., for extending the jetties at Southwest Pass, Mississippi River: Christie & Lowe, New Orleans, La., 215,556 sq. yds. mattress, at $1.30, $280,222.80; 97,490 tons riprap and other stone, at $4, $389,960; total, $670,182.80. Doullut & Williams, New Orleans, La., 215,556 sq. yds. mattress, at $1.50, $323,334; 97,490 tons stone, at $4.25, $414,332.50; total, $737,666.50. No bid was received on caisson form of jetty.

Maine.

Bids as follows were received March 23 by Lt. Col. W. E. Craighill, U. S. Engineer, Portland, Me., for dredging in Camden Harbor, Me., (1), standing for bid per cu. yd. for dredging and (2) bid per ton for removing boulders: Charles M. Cole, Fall River, Mass., (1) 39 cts., (2) $10; John H. Gerrish, Boston, Mass., (1) 33.3 cts., (2) $8; J. S. Packard Dredging Co., Providence, R. I., (1) 39.9 cts., (2) $10.

The Newhall Chain Forge & Iron Co., 90 West St., New York City, is the probable contractor for furnishing mooring stones for use in the first lighthouse district for the fiscal year ending June 30, 1912, Portland, Me., at $831. Bids were opened March 15.

Maryland.

⊙The Noel Construction Co., Baltimore, Md., has been awarded the contract for erecting the new 12-story addition to the Baltimore Bargain House at the northwest corner of Liberty and Baltimore Sts., Baltimore.

P. J. Phipps, Washington, D. C., at $126,000, was the low bidder March 22 for constructing new Public School No. 70 for the city of Baltimore, Md.

Bids will be received until noon April 24, by Col. Thos. L. Casey, U. S. Engineer, Room 309, Custom House, Baltimore, Md., for jetty construction at Clayborne Harbor, Md.

Board of Awards of City of Baltimore, Md., has awarded the contract for the city's dredging for the coming year to the Maryland Dredging & Contracting Co., Baltimore, Md. The contract calls for the removal of 203,000 cu. yds. of earth at 15 cts. per cubic yard. It is divided as follows: 65,000 cu. yds. in the main harbor channel; 17,000 cu. yds. in the back basin; 60,000 cu. yds. near the docks; 40,000 cu. yds. in Jones' falls; 21,000 cu. yds. in the main harbor and docks. The only other bidder was the Sanford-Brooks Co., whose bid was 15½ cts. per cu. yd.

The Electrical Commission of the City of Baltimore, Md., has submitted specifications to the Board of Awards for 1,000,000 ft. of duct vitrified tile conduit pipe and 200,000 ft. of special duct pipe.

Massachusetts.

✣Bids will be received until noon, April 20, by Col. Frederick V. Abbot, U. S. Engineer, Boston, Mass., for the construction of superstructure of breakwater at Sandy Bay, Mass.

Michigan.

✣Bids are asked until April 24 by Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for dredging the Saginaw River, Michigan, the area to be improved being divided into two sections. A separate contract may be made for each section. Section 1 extends from the 18-ft. curve in Saginaw Bay to the 23rd St. bridge at Bay City, a distance of about 11½ miles, 6 miles being in the river and 5½ miles in the bay. This section is crossed by four draw span bridges. Section 2 extends from the 23rd St. bridge at Bay City to junction of the Tittabawassee and Shiawassee rivers, a distance of about 15¾ miles. This section is crossed by twelve draw span bridges and one lift bridge. The work to be done consists in furnishing all necessary plant, labor and supplies for dredging a channel 18 ft. in depth from the 18 ft. curve in Saginaw Bay to the mouth of the river, thence 16 ft. in depth to the junction of the Tittabawassee and Shiawassee rivers, with a bottom width of 200 ft. throughout its entire length. The quantity of materials is as follows: For Section 1 from the bay, 464,000 cu. yds. scow measure; from the river, 328,000 cu. yds., scow measure; for Section 2, 2,233,000 cu. yds., place measure. The material to be removed is believed to be sand, clay and hardpan, with occasional logs all in unknown quantities.

✣Bids will be opened at 3 p. m., April 10, by Col. Mc.D. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for dredging on the bar in front of the harbor at Rogers City. The work consists in furnishing all necessary plant, labor and supplies and removing about 10,000 cu. yds. of sand, clay and boulders from a channel across the bar at Rogers City, Michigan. The proposed channel will be about 500 ft. long, 200 ft. wide and 16 ft. deep.

✣Bids are asked until 3 p. m., April 10, by Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for dredging at Ballards Reef, Detroit River. The area to be improved is in the Ballards Reef Channel, Detroit River, from 6,200 ft. to 6,300 ft. north of Texas Dock near the Canadian shore. This area has a length of 3,100 ft., and a uniform

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

width of 600 ft. except [illegible] the north 150 ft. in length which has a width of 300 ft. The work to be done consists in removing material from the designated area to a clear depth of 22 ft. and in furnishing all necessary plant labor, and supplies for the work; for which payment will be made at the contract rate for material above 22 ft. depth and at one-half of the contract rate for material removed from between 22 and 24 ft. depths. The entire work will be let in one contract. The total estimated quantity of materials to be removed to complete the work to be done is 48,000 cu. yds. full rate (above 22 ft. depth).

✣Bids will be received until 3 p. m., April 10, by Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for the construction of sluice gates for St. Mary's Falls Canal.

Minnesota.

✣Bids will be received until noon, April 15, by Lieut.-Col. Graham D. Fitch, U. S. Engineer, Duluth, Minn., for dredging in Ashland Harbor. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, April 30, by Lieut.-Col. Graham D. Fitch, U. S. Engineer, Duluth, Minn., for dredging at Superior Entry, Duluth—Superior Harbor.

The Zenith Dredge & Dock Co., of Duluth, has contracted for a 20-in. hydraulic pump. It will be used in dredging for the new ore dock at Marquette, Mich., and for the dock of the Carnegie Coal Co., at West Duluth.

Mississippi.

✣Bids will be received until noon, April 14, by Capt. Clarke S. Smith, U. S. Engineer, Vicksburg, Miss., for furinshing about 307,000 lbs. of structural metal for use at Locks and Dams No. 4 and 8, Ouachita River, Ark. and La.

Missouri.

✣Bids will be asked until noon, March 31, by Leo M. Gilday, Clerk of the County Court of Jackson County, County Court House, Kansas City, Mo., for the manufacture and furnishing and erecting at the County Court House, Kansas City, the following machinery: One automatic cut-off steam engine, for direct connection to 200 KW. direct current, 220 volt generator. One generator of 200 KW., 220 volts, direct current, direct connected engine. The necessary foundations will be furnished by the County of Jackson.

⦿The contract for the erection of the Jefferson Memorial, to be built at the De Baliviere entrance to Forest Park, St. Louis, on the site of the main entrance to the Louisiana Purchase Exposition, with the surplus from the exposition, has been awarded to James Stewart & Co., New National Bank of Commerce Bldg., St. Louis, at a contract price of $360,000. Bedford limestone will be used.

⦿The Board of Fire and Water Commissioners, Kansas City, Mo., has awarded the Flanagan Bros. Mfg. Co. the contract for the building of two fire stations, one to be located at 15th and [illegible] 2[illegible] and Prospect, for $5,469 and $5,984 respectively. Bids were opened March 6.

Tentative plans have been filed with the Board of Public Works of Kansas City, Mo., for the construction of a wharf landing, along the river front. The dock is to cost approximately $50,000, will be 50 ft. in width and 560 ft. long, running from Delaware St. to within 360 ft. of Walnut St. The dock will require 16,000 ft. of creosoted piles, 164,000 ft. of board measure yellow pine timber, also creosoted; 50,000 ft. of untreated yellow pine and 86,000 ft. of oak planking. The plans were prepared by C. R. Mandigo, Assistant City Engineer. Bids for the work will be asked later.

The Water and Light Committee of Columbia, Mo., has been authorized to advertise for bids for the erection of a new power plant and equipment, including chimney, boiler plant, stokers and breeching; coal and ash handling equipment; steam turbine generator, exciter and switch board; condeser and cooling tower; two motor-driven centrifugal service pumps, two [illegible] feed water heater; pipe work and wiring. Estimated cost is $69,600. The date for bids will be set as soon as specifications are printed. John S. Bicknell is City Clerk of Columbia, Mo.

Nebraska.

✣Bids will be received until 11 a. m., April 10, by Capt. W. L. Clarke, Constructing Quartermaster, Fort Omaha, Neb., for the construction of an extension to the electric lighting system at Fort Omaha.

Nevada.

About 200 men are now working near Verdi on a power plant canal. A steam shovel is on the ground and the work is progressing rapidly and favorably. Compressed air drills are being used and the ground is shot ahead of the steam shovel. Three donkey engines with six cars each, are used to haul away the excavated earth. The work is preliminary to the construction of a large power plant on the Truckee River to furnish electric light and power to this section of the country. The Stone & Webster Engineering Corporation, 147 Milk St., Boston, Mass., are the contractors.

New Hampshire.

✣Bids are asked until 11 a. m., April 1, by the Bureau of Yards and Docks, Washington, D. C., for hot water heating system and power plant extension, the work including furnishing a flue, heaters, meter, valves, piping, etc., installing this with other material and equipment furnished by Government and rearranging piping and equipment now in place at Navy Yard, Portsmouth, N. H.

New Jersey.

✣Bids will be received until [illegible] p. m., April 3, by Board of Education, East Orange, N. J., for necessary labor and material for the construction of a primary and grammar school building. Warren A. Clapp is Secretary.

✣Bids will be received until [illegible] p. m., April 3, by Board of Education, East Orange, N. J., for furnishing labor and materials to erect and complete a primary and grammar school building to be completed not later than December 30, 1911. Warren A. Clapp is Secretary of the Board.

New York.

✣Bids [illegible] 2[illegible] by the Secretary of the Trustees of Public Buildings, in the Executive Chamber, Capitol, Albany, N. Y., for the equipment of the Capitol power house [illegible] on the corner of Sheridan Ave. and North Hawk St., in the City of Albany, N. Y. Separate proposal is required for each of the following items of work: 1. For steam power equipment [illegible] equipment. Plans and specifications are on file and may be inspected at the office of Nygren, Tenney & Ohmes, 87 Nassau St., New York City, or at the office of C. E. Knox, 76 William St., New York City. [illegible] the State Architect, Capitol, Albany, N. Y.

⦿The Fuller Construction Co., New York City, has been awarded the contract for the $2,500,000 New York City postoffice. The postoffice will be situated west of the new Pennsylvania R. R. terminal and will be built of granite similar to that used in the station.

The U. S. War Department has granted a license to the International Mercantile Marine Co., of New York city, to extend two of its pierheads at New York 100 ft. into the North River. Under the terms of the license, the company is permitted to extend two of its three central piers into the river. The license will run until June 30, 1913, unless terminated previous to that date by the Secretary of War. It is required that the extension shall be temporary unroofed structures on wooden piling, arranged so as to permit the free passage of water in the river.

Bids as follow were received March 14 by Lt. Col. J. G. Warren, U. S. Engineer, Buffalo, N. Y., for channel excavation, Black Rock Harbor, N. Y.: (1) standing for Breymann Bros., Toledo, O.; (2) for Great Lakes Dredge & Dock Co., Chicago, Ill.; (3) for Empire Dredging Corporation, New York; (4) for Buffalo Dredging Co., Buffalo, N. Y., and (5) for Great Lakes Construction Co., Buffalo, N. Y.

	(1)	(2)	(3)	(4)	(5)
North Section:					
Excavating material over [illegible] bed rock, pl. meas., 770,000 cu. yds.	$0.25	$0.1[illegible]	$0.21½	$0.17	$0.19½
Excavating bed rock, pl. meas., [illegible] cu. yds.	2.25	2.30	2.09	2.00	2.40
Handling and placing stone, [illegible] tons	1.06	1.00	1.2[illegible]	.90	1.20
Removing wall, 5,200 lin. ft.	9.00	3.50	12.00	6.50	7.00
Removing bridge pier, all	5,000	3,000	3,800	2,000	1,200
Removing old lock, all		10,000	4,000	5,000	5,500
Totals, North Section		$306,200	$384,100	$310,700	$361,250
Bird Island Section:					
Excavating material over[illegible] bed rock, pl. meas., 9,000 cu. yds.		.90	.28	.30	
Excavating bed rock, pl. meas., 18,000 cu. yds.		2.90	2.09	2.10	
Handling and placing capping stone, 2,500 tons		1.25	1.25	1.05	
Totals, Bird Island Section		$63,425	$43,265	$43,125	
Grand totals		$369,625	$427,365	$353,825	

North Carolina.

The Yadkin River Power Co., a $4,000,000 concern, has been chartered under the laws of North Carolina for the specific purpose of taking over the Blewitt Falls Electrical Power plant in Richmond county, with the idea of completing the plant and setting on foot electric transmission and power enterprises in the operation of public utilities, sale of power and interurban car lines. Work on this plant was interrupted by the financial stringency of 1907.

The Virginia Power Co. has been organized at Salisbury, N. C., with a capital stock of $1,000,000, and proposes at an early date to develop electric power on Virginia rivers. The company is said to have power sites capable of developing 100,000 HP. Most of these sites are said to be on the New River. Dr J. J. Mott, Statesville, N. C., is interested.

Ohio.

✣Bids will be received until noon, April 3, by Director of Public Service, Cincinnati, O., for lighting by electricity streets, avenues, lanes, squares and public places in the city. John G. Wenier is Clerk.

✣Bids will be received until 2 p. m., April 20, by Major John V. Oakes, U. S. Engineer, Room 415 Custom House, Cincinnati, Ohio, for the construction in concrete the top of Dam No. 5, Muskingum River at Lake Chute, O.

✣Bids will be received until 2 p. m., April 13, by Maj. H. Jervey, U. S. Engineer, Cincinnati, O., for the hire of four dredging plants, each consisting of one dredge, one tow boat and two dump scows.

⦿James E. Southard & Co., Michigan City, Ind., has been awarded a contract by the Northern Ohio Power Co., at Akron, O. The contract call[illegible] concrete work, including foundations, walls, floors, engine beds, roofs and a dam across the Cuyahoga River. This dam will be 2,000 ft. long, 53 ft. high [illegible] and 20 ft. wide on top.

S. Hannaford & Sons, Architects, Hulbert Bldg., Cincinnati, O., have submitted specifications to the Board of Hospital Commissioners of Cincinnati, for the construction of the 18 new buildings to be erected as a part of the new city hospital in Avondale.

The Cuyahoga County Building Commissioners, 425 Garfield Bldg., Cleveland, O., on March 8 received the following bids for all [illegible] 900; The Mitchell-Vance Co., New York, [illegible]

Oklahoma.

✣[illegible] April [illegible] North addition of the city of Lawton, Okla.

✣Bids will be received until 2 p. m., April 17, by the Secretary of Interior, Washington, D. C., for the construction of a [illegible] school building and sidewalks around same in the north addition of the city of Lawton, Okla.

Wuster & Co., Wichita, Kan., at $127,710, [illegible] March [illegible] for constructing a new high school building for Enid, Okla.

Oregon.

✣Bids will be received until 3 p. m., April 13, by City Auditor, Portland, Ore., for furnishing the fire department of the city of Portland with twenty-five positive non-interfering successive fire alarm telegraph boxes according to the plans and specifications on file in the office of the Superintendent of the Fire Alarm and Police Telegraph, City Hall.

✣Bids will be received until 3 p. m., April 13, by City Auditor, Portland, Ore., for furnishing the fire department with 2 auto runabouts not to exceed $2,000 each; 2 auto runabouts not to exceed $1,400 each; three 3-way and four 2-way deluge sets.

✣Bids will be received until 10 a. m., April 7, by Park Board, Portland, Ore., at the office of A. L. Barber, City Auditor, for furnishing Park Department with approximately 1,565 lin. ft. iron fence and 2 grates for Peninsula Park and approximately 920 lin. ft. of iron fence for Columbia Park.

⊙The Mount Hood Railway & Power Co., of Portland, C. B. Smith, Chief Engineer, has awarded a contract to A. J. McCabe, for the construction of a tunnel from the Big Sandy River to the Little Sandy to carry water for the hydraulic power plants that the company is now building. The tunnel will go straight through the mountain, will be 4,700 ft. in length, and 14 ft. wide by 11 ft. high. The cost is placed at approximately $125,000.

Pennsylvania.

✣Bids will be received until 3 p. m., April 24, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing and gas piping, heating apparatus and electric conduits and wiring of the United States Postoffice at Braddock, Pa.

✣Bids will be received until April 14 by Sylvester Engle, Chairman Property Committee, Hazleton, Pa., for constructing a high school building. E. E. Joraleman, Architect, Peekskill, N. Y.

⊙The Ochs Construction Co., Allentown, Pa., at $84,793, has been awarded the contract for a new grand stand to be erected in Allentown fair grounds for the Allentown Fair Association.

⊙City Council of Chester, Pa., has awarded the contract for the installation of a fire-alarm system to the Gamewell Co. at its bid of $14,860.

⊙C. Hildebrand Dry Dock Co., Kingston, N. Y., at $2,745, has been awarded the contract for furnishing one deck scow for the Department of Wharves, Docks and Ferries, Philadelphia. The contract for furnishing one stiff legged derrick was let to the Kensington Shipyard Co., Philadelphia, at $580. Bids were opened March 6.

⊙The Hope Engineering & Supply Co., W. H. Harmon, President, Pittsburg, Pa., has been awarded the contract by the Tri-County Natural Gas Co., for the construction of about 40 miles of pipe line in Clarion, Forest and Elk Counties.

WATERWORKS.

Helena, Mont.

Sealed proposals will be received at the City Hall, Helena, Mont., until 8 p. m., Thursday, April 20, 1911, for furnishing of all material and the construction of a waterworks system, reservoir pipe line and distribution system for the City of Helena, Mont., all according to plans and specifications.

The work involves headworks with concrete core wall, and approximately 14 miles of 18-in. wooden conduit, 7.4 miles 24-in. wood conduit, 0.8 miles 24-in. steel conduit, 43.4 miles of cast-iron mains, 260 hydrants, 283 gate valves, specials, etc., and a storage reservoir, lined with concrete, to hold approximately five million gallons, together with all appurtenances, using about 2,800 cu. yds. of concrete, and requiring about 79,000 cu. yds. class (A) excavation, 12,000 cu. yds. class (B) excavation, 222,000 lineal feet class (A) trenching, and 16,000 lineal feet class (B) trenching.

Plans and specifications, also forms of contract and proposals, may be seen at the office of the City Clerk, J. A. Mattson; also at the office of the City Engineer, Charles W. Helmick, and copies thereof obtained upon payment of $5.00.

Each bid must be accompanied by a certified check for $20,000.00, payable to the Mayor of Helena, Mont., as a guarantee that bidders will, if successful, promptly execute a satisfactory contract and bond, as specified and required, with satisfactory surety in the sum of one hundred and fifty thousand dollars, for the faithful performance of the contract.

The right is reserved to reject any or all bids, and also to waive any technical defects.

Bidders are invited to be present. Proposals must be marked "Proposals for Construction of Water Works System for Helena, Mont.," and must be made out in the form within, and be accompanied by the printed specifications.

By order of the City Council.

J. A. MATTSON,
City Clerk.

Dated, 1911.
First publication, 1911.

WATERWORKS IMPROVEMENTS.

Ada, Okla

Sealed proposals will be received by the City Clerk of Ada, Okla., at his office in the City Hall, until 8 o'clock p. m., April 10, 1911, for the furnishing of pipe and machinery to be used in the extension and improvement of the waterworks system of Ada

Bids will be opened before the City Council the same evening and bidders are invited to be present and to submit bids on the following items:

For the pipe required for the construction of approximately 63,000 linear feet of 12-inch pipe line, either of steel or cast iron.

If cast iron pipe is used the amount required will be about as follows: Class "B" pipe, 246 tons; Class "C" pipe, 2,062 tons; Class "D" pipe, 750 tons; total, 3,058 tons.

If steel pipe is used 66,000 linear feet of 12-inch O. D. Converse joint pipe will be required

Bids will also be received on 3,000 linear feet of steel pipe, 3/16 inch thick and 30 inches in diameter.

Also on cast iron pipe for extensions to the city mains, all class "B" approximately as follows: 12-inch pipe, 135 tons; 10-inch pipe, 124 tons; 8-inch pipe, 63 tons; 6-inch pipe, 142 tons; total, 464 tons.

For special castings, about 15,000 pounds.

For furnishing and erecting on foundations to be prepared by the city two pumping units, each unit to consist of one horizontal turbine water wheel, direct connected to a multi-stage centrifugal pump, each unit to have a capacity of 600 gallons per minute against a total head of 185 feet.

Plans, specifications, form of contract and proposal and full information may be obtained from the Consulting Engineers, Goodwin & Harper, 920 Scarritt Bldg., Kansas City, Mo.

Each proposal must be accompanied by a certified check of not less than 5 per cent of the amount bid, made payable to the City Treasurer of Ada, Okla., as a guarantee that the bidder receiving the award will enter into contract with the city and furnish satisfactory bond within ten days after the contract is awarded.

The city reserves the right to reject any or all bids, to waive any informality, and to award the contracts as may be deemed to the best interests of the city.

W. B. JONES, City Clerk.

Dated March, 1911.

EARTHWORK.

MAPLE GROVE DRAINAGE DISTRICT.

Sealed proposals will be received by the Commissioners of the Maple Grove Drainage District, of Lee County, Illinois, at the office of J. M. Egan, Jr., Amboy, Ill., Engineer of said District, until 2 o'clock p. m., on the eleventh day of April, A. D. 1911, at which time and place said proposals will be publicly opened.

The work for which the proposals are desired consists of the construction of 34,000 lineal feet of open ditch, 30 feet wide, with a total estimated excavation of 260,000 cubic yards of earth.

Each bidder must deposit with F. N. Vaughan, Secretary of the Commissioners of said District, cash or a certified check on some national bank or state bank of Illinois, equal to not less than 5 per cent of the amount of his bid. The successful bidder will be required to file a personal or surety company bond for the sum of ten thousand ($10,000.00) dollars, which bond shall be subject to the approval of the Commissioners.

Work shall be begun within twenty days after the awarding of the contract and be completed by March 1, A. D. 1912. Payments will be made in cash, monthly, upon the estimate of the Engineer.

Plans and specifications may be seen at the office of the County Clerk, Dixon, Ill.; at the First National Bank, Amboy, Ill., or at the office of J. M. Egan, Jr., Civil Engineer, Amboy, Ill. Specifications may be had upon request to J. M. Egan, Jr., Amboy, Ill.

The Commissioners reserve the right to reject any or all bids.

Dated this 17th day of March, A. D. 1911.

Commissioners:
C. F. WELTY, President,
Amboy, Ill.
WILLIAM ANDERSON,
Ohio, Ill.
F. N. VAUGHAN, Sec'y,
Amboy, Ill.
Attorney, C. H. WOOSTER, Amboy, Ill.
Engineer, J. M. EGAN, JR., Amboy, Ill.

Washington, D. C., Feb. 25, 1911.

Sealed proposals will be received at the office of the U. S. Reclamation Service, North Yakima, Wash., until 10 o'clock a. m., April 15, 1911, for the building of Kachess dam and accessory structures near Easton, Wash. The work involves the excavation of approximately 345,000 cubic yards of material, the placing of about 240,000 cubic yards of embankment, 15,000 cubic yards of riprap and paving, 8,000 cubic yards of concrete, and 300,000 pounds of reinforcing steel, and other items necessary to complete the work. For particulars address the United States Reclamation Service, Washington, D. C., or North Yakima, Wash. R. A. BALLINGER, Secretary.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

DAM, INTAKE, RESERVOIR AND STANDPIPE FOR BIRCH RUN WATER SUPPLY.

Chambersburg, Franklin Co., Pa.

The Borough Council of Chambersburg, Franklin County, Pa., will receive sealed proposals up to 8 o'clock p. m. of April 7, 1911, for the construction of a diversion dam and intake chamber, a reservoir of 2,200,000 gallons capacity, a stand-pipe ten (10) feet diameter and forty-five (45) feet high, all in accordance with plans and specifications.

Bids for the stand-pipe to be in a lump sum, covering the construction and erection complete upon foundations.

Bids for the dam and intake, for the reservoir and foundations for the stand-pipe may be in lump sums covering the entire construction, or bids may be at unit prices per cubic yard of material excavated and placed in embankment, or otherwise disposed of, for borrowed clay, for puddle lining in place, for rubble masonry, or for concrete in place. Also for brick per thousand (1000) laid in sand and laid in cement, for rip-rap per square yard, for fence per lineal foot, and for placing in position, jointing and securing the necessary influent, effluent, drain and overflow pipes, with appurtenances connected therewith.

Each bidder must accompany his proposal or proposals with a certified check, drawn to the order of the Treasurer of the Borough of Chambersburg, in the sum of $300.00.

A date for the completion of the work bid for to be stated in each proposal.

The borough reserves the right to reject any or all bids.

Plans and specifications are available at the City Hall, Chambersburg, and at the office of John Birkenbine, Consulting Engineer, Parkway Building (Broad and Cherry Sts.), Philadelphia.

By order of the Borough Council.

C. O. WOOD,
Chairman Water Committee.

STORAGE DAM.

Salt Lake City, Utah.

Sealed proposals will be received by the Pacific Reclamation Company, at the office of their Consulting Engineer, George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah, until noon of Saturday, April 15, 1911, for the construction of a Storage Dam about fifteen miles north of Wells, Nevada.

The dam will be of earth and rock fill with a reinforned concrete facing on the up-stream side. The principal quantities are:

20,000 cu. yds. earth excavation.
3,000 cu. yds. rock excavation.
71,000 cu. yds. earth embankment.
6,000 cu. yds. dry rubble wall.
1,250 cu. yds. Portland cement concrete.
85,000 lbs. steel reinforcing.

A certified check for $2,500.00 must accompany the bid, and a bond of $15,000.00 will be required for the faithful performance of the contract.

Form of proposal, contract and specifications may be had by applying to George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah.

PACIFIC RECLAMATION COMPANY,
Joseph Gutman, President.

George M. Bacon,
Consulting Engineer.

U. S. Engineer Office, Duluth, Minn., March 20, 1911. Sealed proposals for dredging at Superior Entry, Duluth-Superior Harbor, will be received at this office until noon, April 20, 1911, and then publicly opened. Information on application. Graham D. Fitch, Lt. Col. Engrs.

ILLINOIS HIGHWAY COMMISSION.

City of Batavia, Kane County, Illinois.

Wilson Street East Bridge.

NOTICE OF PUBLIC LETTING.

Notice is hereby given that sealed proposals for the work hereinafter described in this notice and more particularly described in the specifications, will be received at the City Hall, by the Mayor and City Council of Batavia, Kane County, Illinois, until 2 o'clock p. m., April 20, 1911, at which time and place the bids will be publicly opened and read. Briefly described, the work is as follows:

Building a temporary bridge across Fox River on line of the alley immediately south of the present Wilson Street East Bridge and maintaining said temporary bridge until the proposed Wilson Street East Bridge is completed and thrown open to traffic. Removal of the present structure on the site of the Wilson Street East Bridge, which consists of a series of stone arches, the piers to be removed to the bed of the stream, the abutments and retaining walls to the ground line, building a new reinforced concrete bridge across the Fox River on Wilson street on the site known as the Wilson Street East Bridge. Said bridge to consist of three reinforced concrete arch spans, totaling in length about 170 feet and having a width over all about 60 feet.

More detailed information may be obtained by an examination of the plans on file at the office of the City Clerk of Batavia, Illinois, or which may be obtained upon application to the Illinois Highway Commission, Springfield, Illinois.

A charge of two dollars ($2.00) will be made for each set of plans and specifications to cover the cost of preparing and mailing the same.

The work to be completed on or before November 1, 1911.

Springfield, Illinois, March 20, 1911.

By order of the City Council of the City of Batavia, Kane County, Illinois.

W. H. REANEY, City Clerk.

DRAINAGE WORK.

The Commissioners of the Shepard Drainage District will, until April 15, 1911, at noon of said day, receive, at the Bank of Marshall, Marshall, Wis., sealed bids for doing the work of the said district, to be done in accordance with its plans and specifications now on file in the office of the Clerk of the Circuit Court for Dane County, Madison, Wis., and also on file at the Bank of Marshall, in the Village of Marshall, Dane County, Wis.

A copy of said specifications will be sent by mail upon request made to W. H. Tasker, Marshal, Wis., upon payment of $1.00.

Dated March 15, 1911.

MATHIAS LINDAS,
F. G. SCHERNECKER,
W. H. TASKER,
Commissioners.

MISSISSIPPI RIVER COMMISSION, 1st and 2d Districts, U. S. Engineer Office, Custom House, Memphis, Tenn., March 7, 1911.—Sealed proposals for constructing and delivering seven (7) steel barges will be received at this office until noon of April 5, 1911, and then publicly opened. Information on application. CLARKE S. SMITH, Capt., Engrs.

PROPOSALS FOR METAL.—U. S. Engineer Office, Vicksburg, Miss., March 15, 1911. Sealed proposals for furnishing about 307,000 pounds of structural metal, for use at locks and dams Nos. 4 and 8, Ouachita River, Ark. and La., will be received at this office until noon, April 14, 1911, and then publicly opened. Information on application. CLARKE S. SMITH, Capt., Engrs.

SEWERAGE AND SEWAGE DISPOSAL.

Borough of Chambersburg.

Proposals for constructing a system of sanitary sewers, a main out-fall sewer, and a sewage disposal plant, will be received by the Borough Council until 8 o'clock, Monday evening, April 10, 1911, at Council Hall.

Bids will be opened the same evening.

The sanitary sewer system comprises approximately:

69,000 feet 8-inch terra cotta pipe.
4,000 feet 10-inch terra cotta pipe.
1,500 feet 12-inch terra cotta pipe.
2,500 feet 15-inch terra cotta pipe.
3,600 feet 18-inch terra cotta pipe.
4,100 feet 24-inch terra cotta pipe.
Manholes, Y branches, and other accessories.

The main out-fall sewer comprises approximately:

460 cu. yds. concrete of stone retaining walls.
1,400 feet 20x30-in. concrete sewer.
72 feet 24-inch cast iron pipe.

The disposal plant comprises:

900 feet 16-inch force main.
960 feet 12-inch cast iron siphon line.
1 pump house and collecting well, equipped with three electrically driven centrifugal pumps, capacity 1,000 gallons per minute.
5 concrete settling tanks.
1 sprinkling filter bed, 160 ft. x 125 ft.
1 sand filter for sludge, grading, and other work.

Plans and specifications may be seen at the Borough Engineer's office, and at the office of Albright & Mebus, 908 Land Title building, Philadelphia, or may be secured from the Borough's Engineer, R. M. Huber, upon payment of $25.00, which sum will be refunded when the plans and specifications are returned in good order.

Bids must be made out on blanks furnished by the Borough's Engineer.

Each bid must be accompanied by a certified check for at least 5 per cent of the total amount of the bid.

Borough Council reserves the right to reject any or all bids, and award the contract as may be deemed to the best interest of the Borough.

By order of Borough Council.

S. K. SHRYOCK,
Chairman Sewer Committee.

U. S. ENGINEER OFFICE, Chicago, Ill., March 25, 1911.—Sealed proposals for dredging in Indiana Harbor, Ind., will be received here until 10 a. m., April 15, 1911. Information on application. GEO. A. ZINN, Lt. Col., Engrs.

U. S. ENGINEER OFFICE, Duluth, Minn., March 15, 1911.—Sealed proposals for dredging in Ashland Harbor will be received at this office until noon, April 15, 1911, and then publicly opened. Information on application. GRAHAM D. FITCH, Lt. Col. Engrs.

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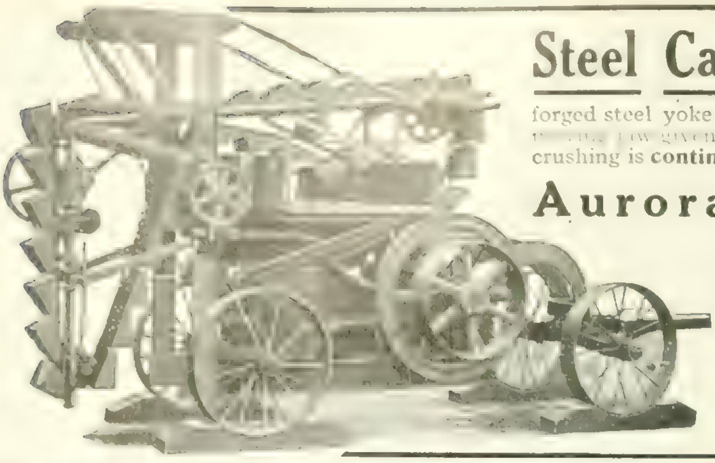

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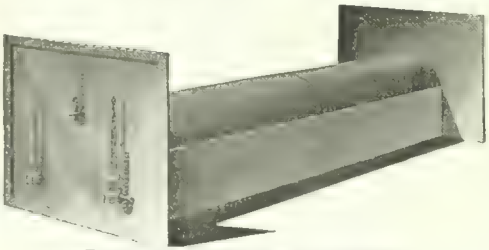

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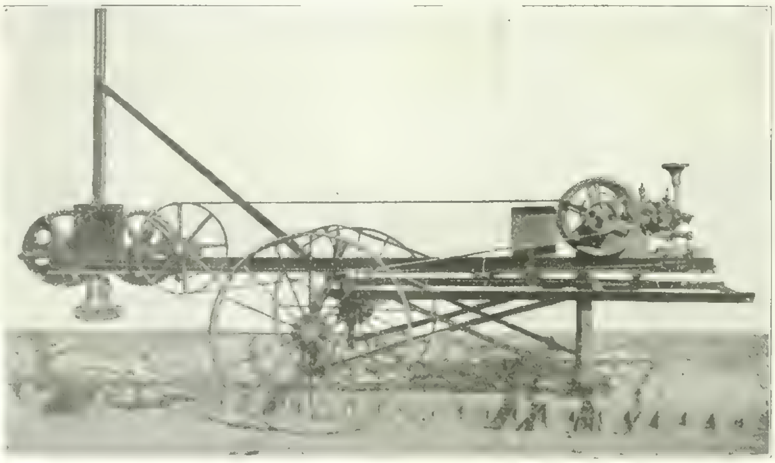

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"Scientific Management."

Faddism enters practically every profession. It is prevalent in medicine and pedagogy; theology and even journalism has its examples Naturally engineering has not escaped infection. The *Engineering News* finds a particularly vicious case in "scientific management." Mr. Brandeis has "capped the climax," and our contemporary evolves a four-column critique. Incidentally it enlivens its arguments with a thorough going castigation of "modernizers," "systematizers," "propagandists" and "charlatans." We are not interested in protecting professional pretensions of scientific management from a blind [illegible], but one is compelled to take exception to the *Engineering News'* estimate of the nature and meaning of scientific management.

The *Engineering News* declares itself skeptical as to "the alleged 'science' of management. It has "no knowledge of the existence of such a science" and it does not "clearly perceive its possibility." "Is it credible," the *News* asks, "that it should have been even fragmentarily in existence for five or ten years and no manual, text or treatise setting it forth should be before the reading public?" "Brilliant work," it admits, "has been done by Taylor and Gantt," but the explanation is to be found in their personalities rather than in their methods. True the managerial successes of these men have been "made to outlast their personal presence," but this comes from their work "in creating conditions favorable to efficient work on the part of employes" and in "setting up a managerial routine." Drawing upon history, our contemporary asserts: "In every case the explanation of Napoleon is found in Napoleon rather than in his procedures." It sums up its argument as follows:

> A point never to be lost sight of in considering such a subject as management is that the managing ability, i. e., the ability to secure efficient work from others, is a personal, individual attribute. It is like success, founded on a gift and not on acquirements by virtue of which some may rise and others may not. Just as the general who leads his armies to victory is born, not made in the academy, so the manager of men and industries is born to the work. The Napoleonic characteristics are inherent, they do not come by instruction; and Napoleon himself was not able to transmit the gift to his colleagues.

In answer to so much of the *Engineering News* argument as denies the present existence or even the future possibility of a science of management we shall let our remarks in a succeeding column stand. These remarks had been put in type when the *News* editorial being considered came to our attention.

The *Engineering News* contention that the man and not his procedures accounts for his success in generalship or management agrees with the most ancient traditions. Does it meet the "considerations of common sense" to which our contemporary urges us to submit the claims of scientific management. Only a supreme ignorance of the procedures of Taylor and his successors in the development of scientific management could attribute to these procedures nothing more than a creation of "conditions favorable to efficient work" or than the setting up of a "managerial routine." No such universality of application of the procedures of these and other management engineers as can be found would have come about had they been thus limited in character. It cannot be denied that this universality of application exists in a remarkably large measure. We mention examples in a succeeding column and they can be largely added to. It may be reasserted by the *News* that these illustrations do not prove that the procedures will be "*perpetuated*," for only the long test of time could justify this word, our [illegible] until time tells its story [illegible] until they are disproved.

The explanation that we would offer is that the "brilliant work," which the *Engineering News* concedes to the managers named, is due to the combination of their personality—their inborn talent plus accumulated experience—and their procedures. In the application of scientific laws to any problem there is and always will be the greatest reward of success to the man with the greatest natural ability plus personal experience. The laws of science are far more efficient tools for the benefit of mankind in the hands of a Kelvin than in the hands of the ordinary mechanic. It may not be overlooked, however, that the mediocre man of today, equipped with science, is superior in productive capacity to the unscientific genius of a few generations ago. The managerial geniuses to whom the *News* alludes so frequently cannot as the *News* says transmit their genius, but they are developing certain principles and codifying certain rules of management which can be transmitted. The ordinary man who receives these principles and rules may not become a managerial genius, but he is more than likely to become a better manager than would have been possible were they entirely wanting.

Only a part of the explanation of Napoleon is found in Napoleon himself, another part is found in the conditions under which he worked and still another part in his procedures. The improved tactics employed by Napoleon lived after him and made a more efficient fighter of every commander who followed.

The Railways and Scientific Management.

Engineers and the public in general have become reasonably familiar through the daily papers with the novel line of reasoning offered by Mr. Louis D. Brandeis against the proposed increase in railway freight rates, permission for which was recently refused by the Interstate Commerce Commission. Mr. Brandeis contended that by applying the principles of scientific management it would be possible for American railways to save a million dollars a day in operating expense, and he produced expert witnesses to show the possibility of such a saving. While the Interstate Commerce Commission has decided adversely to the railways, the commission was not influenced by the testimony and arguments offered by Mr. Brandeis, nor is this to be wondered at. We quote from the text of the commission's ruling:

> It was however, earnestly insisted by the shippers that the railroad might and should find other kinds of economies with which to make good this increase in wages Several prominent manufacturers testified that in their business in recent years wages had been advanced, but they had not been able to make corresponding advances in the price of their product, and were therefore forced to look about for other ways in which to take up the increase in the cost of production.
>
> It was claimed that by the introduction of what was termed "scientific management." the purpose of which was in various ways to make labor more efficient, at the same time increasing the wage and paid the laborer himself, much more than the amount of these advances could be saved.
>
> One gentleman who described these methods testified that they had been introduced to some extent into the operations of railways with remarkable results, and that from a careful analysis and computation he was satisfied that not less than $300,000,000 annually could be saved by the proper application of these methods to the business of railroading in the United States.
>
> It is difficult to see exactly what application the commission can make in this case of this testimony. The witness who apparently had most to do with the originating and applying of these methods testified that they were in actual operation in not over one-tenth of 1 per cent of all the manufacturing establishments of this country. The system is everywhere in an experimental stage. To some extent it has been tried, and is now being tried by our railways. The representative of railway labor who appeared before us stated that these methods could not and should not be introduced into railway work.
>
> Upon this record we can hardly find that these methods could be introduced into railroad operations to any considerable extent, much less can we determine the definite amount of saving which could be made. We can not, therefore, find that these defendants could make good any part of these actual advances in wages by the introduction of scientific management.

The weakness of the testimony given by the experts whom Mr. Brandeis had summoned is found mainly in the fact that few of them had ever done any railway work at all, and the one or two who had been engaged on efficiency engineering by railways seemed to be unable to cite many "repeat orders." But our

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[illegible] viously certain of these engineers would not appear as witnesses against the railways in a rate case if they could, and some of them couldn't if they would. The latter would lose their positions if they did. The former feel that, while it is a fact that railway operating costs can be greatly reduced by scientific management, it is not logical nor fair to offer that as an argument against the advance of railway rates now. It would be equally reasonable to demand a lowering of the price of every manufactured product in the world on the ground that it is possible to reduce the unit costs of every product.

[illegible] often astounding, economies that have been effected by scientific management also have knowledge of the extreme slowness with which it can be introduced. Even on a small railway it is a matter of years to effect changes in methods, so firmly fixed are the prejudices in favor of "the good old way." It may almost be said to be a law of human na[illegible] and popularize an entirely novel machine or method for economizing labor.

First, there is the resistance of owners and managers to be overcome. They are quite certain that they can not be taught more economic ways of production. Second, there is the resistance of foremen. They are absolutely certain that the innovation will be fruitless. Finally there is the rock-founded resistance of the workmen to any device or method that seems likely to effect a saving of labor. We have seen all three of these elements at work in this particular case before the Interstate Commerce Commission. From railway presidents down the line to superintendents have issued derisive statements as to the possibility of any radical reduction in operating costs by application of scientific management. And even the labor unions sent their representatives to testify that "these methods could not and should not be introduced into railway work."

As to the latter, we may reply that "these [illegible] and should be introduced into railway work. Moreover, the workmen have been the greatest gainers where "these methods" have been introduced.

While we do not believe that the railways should be denied increased rates because of economies in operation that may be effected in the future, we do contend that it is a false position for railway managers to take when they scout the possibility of greatly reducing operating costs. Most of them know that decided reductions in cost are not only possible but are actually being effected. If they will study the laws of scientific management, they will find that the principles they have been deriding are the very ones they have been applying, at least in part. They will see that true scientific management is not a few special methods of timing and scheduling work, but that it embraces a system of laws that are founded on experience, and many of which are as old as industrialism itself. They will also learn that there is fundamental difference between following a law unconsciously, by intuition, and following it consciously; for in the latter case management becomes truly scientific, while in the former case it is merely an art. Science can be taught. Art is mainly acquired by practice, and then only by those naturally gifted.

[illegible] also uphold the contention that Mr. Brandeis is ludicrously wrong in asserting that scientific management can be applied in railroading. The *News* holds that the management of a railway is quite unlike the management of a factory, and resembles closely the management of a household. It asks the exponents of scientific management to apply their theories to their own house servants, and then report results. It avers that the number of railway station agents and the like is fixed by conditions, and can not be reduced, and that the same holds true of trainmen and most other employes.

Our contemporary may be interested in knowing that the writer is now writing in a hotel that has reduced its expenses and increased its net income remarkably within a year by applying the principles of scientific management. In fact the hotel under its previous management had gone into the hands of a receiver. Whereas now it is highly profitable. So even a large household such as a hotel is can be reorganized and made profitable by scientific management.

With regard to railways, however, there is vastly more of the factory than there is of the household; and this is best seen by studying the percentages of the different operating cost items. Wellington has well said that a railway is a factory for manufacturing transportation. The maintenance items alone total more than 40 per cent of all the operating expense; and maintenance is nearly all analogous to factory production in so far as the principles of scientific management are concerned.

Fuel for locomotives is another big expense that may be called a factory item. So, too, are train-crew expenses. While the number of men on each train may not be decreased by scientific management, the number of daily train miles per crew can certainly be increased by improved management.

Train loads have been increased remarkably by reducing grades. Yet the man who is father of the principles that engineers apply in determining the justifiable expenditures for grade reduction, the late A. M. Wellington, may well be called an exponent of scientific management in certain phases of its application. Let it not be supposed that scientific management is a thing entirely new, or that it relates wholly to factory work, or that it involves nothing but handling men, or that any single engineer originated all its principles. As we conceive it, scientific management consists in the conscious application of the laws inherent in the practice of successful managers and the laws of science in general. It has been called management engineering, which seems more fully to cover its general scope of the science.

The most important law of scientific management is this: For the most economic production, payment for services must be proportionate to perforamnce.

Who discovered this law? The answer can never be given. It has been discovered and rediscovered independently, times without record. The early railway contractors, who sublet their grading to "station men" recognized this law. The early mine managers who paid the miners by the ton of ore or coal, recognized this law. It antedates the factory system, for, by the very nature of things, individuals then received their pay in proportion to their production. It goes back to the stone age, when daily wages were the daily "product" of the crude stone implements and weapons. We call attention to this rather obvious fact because it seems desirable to dispel the popular illusion that the science of management is founded on laws that are necessarily new. Most of them are necessarily old, but, having not been generally recognized and applied. In other words, the science of management is new, while most of its principles are not new.

So far as we know, the first attempt to formulate a group of important laws of scientific management was made about two years ago. Ten laws were formulated and published in the first chapters of "Cost Keeping and Management Engineering," by Gillette and Dana. These ten laws are by no means all-inclusive, but form a substantial nucleus for the growing science of management. Among them will be found several comparatively new laws of management, such as systematic timing of operations with a view to standardizing performance, as developed by Mr. Frederick W. Taylor.

Certain of these new laws have come recently to be regarded by the public as being the whole of scientific management, although [illegible] but a part of it, important though that part is.

It is self-evident that no business man has ever honestly built up a large enterprise without applying some of the laws of scientific management. Such success is not a matter of chance, although chance may have furnished the opportunities that led to it. If it is not a matter of chance it must be a matter of scientific law, even though the man who has succeeded may not himself have seen a formulated statement of the particular laws that he intuitively applied. Generally, however, successful business men have had pretty clear conceptions of some of the laws of management.

The science of management has now developed sufficiently to have reached the stage when ridicule is heaped upon it. In this it repeats the history of all sciences. Fifteen years ago American farmers were laughing at professors of agriculture. It was a great joke to them to hear it gravely asserted that they did not understand the most important principles of scientific farming. Indeed it was laughable enough in itself, this new linking of the words science and farming. The laughter has ceased.

The Interstate Commerce Commission may wisely refuse to consider scientific management as a factor in rate making. Railway presidents may unwisely ridicule the claims made for the new science. The facts are that some civil engineers are applying the principles of scientific management in railway operation and construction with the same measure of success that has been secured in factories and in contract work. A knowledge of the success of these management engineers will spread slowly at first, but it will spread, and the result will be the inevitable recognition of management engineering as a scientific profession of great importance.

The day is approaching when civil engineers will manage railways as well as design and locate them, and railway management will be regarded as the natural function of an engineer, quite as much as designing bridges. To the young civil engineer now engaged in railway construction or maintenance we commend a thorough study of all that bears upon the principles of scientific management.

The Work of the Merriam Commission—A Study Into the Business Management of a City's Public Works.

City public works cost excessively. Graft is not the principal reason. Waste due to inefficient business management counts into a far greater sum in the long run than do theft and misappropriation. This statement will not appeal to the professional reformer, but its truth is incontestable. The investigations of the Boston Finance Commission gave proof and the studies of the Chicago Commission on City Expenditures, better known as the Merriam Commission, confirm this proof. The disclosures of waste and inefficiency made by the Boston Finance Commission have already been laid before our readers, and a similar presentation of the labors of the Merriam Commission is well worth while.

The Chicago Commission on City Expenditures was authorized by an ordinance passed by the City Council of Chicago on June 21, 1909. It was appointed by Mayor Frederick Busse. Its duties were to inquire into the expenditures of the city of Chicago and to report to the Mayor and to the City Council. The method of work adopted by the Commission was substantially as follows: Experts—engineers, accountants or others—were employed to make an investigation of the city department or bureau or item of work under consideration and to report their findings to the commission. The city officials having charge of this item were then given hearing, were examined on the findings of the experts and their testimony taken. From this combined evidence the commission drew its conclusions and reported them with such portions of the experts' reports and of the other testimony as seemed essential. The Commis-

[illegible] presented [illegible] reports on as many different subjects; the first was made on Dec 18, 1909, [illegible] Dec 12 1910. In the aggregate these reports make a volume of several hundred pages.

The preceding remarks are necessary to coordinate the general reader with the object and the labors of the Chicago Commission on City Expenditures, but it is the findings of the Commission that are of principal interest. They furnish a commentary on the business management of city public works which not merely every engineer but every citizen should study. It is obviously impossible within the space at our command to give these findings in full, nor, fortunately, is it necessary. A very brief digest of the sixteen reports will furnish all the texts needed for a longer commentary on city business management than can be written here. In presenting this digest we shall follow the chronological order in which the reports appeared

Purchase of Lumber.—The Department of Public Works of Chicago uses each year amounts of lumber ranging in cost from $50,000 to $100,000, all of which is furnished by contract on specification. The specifications were found to have been copied from year to year; to call for certain kinds of lumber in quantities which no responsible dealer could contract to deliver; to contain a grading of lumber no longer in existence among lumbermen; and not to indicate at all accurately the amounts of lumber of various kinds actually employed. It was found that the city employers who received the lumber were ignorant of the specified requirements, ordered the kind of lumber they knew to be reliable for their purposes without regard to the specifications, and accepted this lumber on delivery of it as it seemed suitable to them for their work without knowing whether it was of the quality specified. It was found that no competent inspection existed, that no attempt was made to gain advantageous prices by combining the orders of different bureaus into one contract, that a year's contract was made instead of a short time contract with an extension clause which would allow advantage to be taken of fluctuation of prices during the year, that the accounting system was largely a matter of form and furnished no check on the use of lumber; in brief, it was found that the heads of departments using lumber exercised no proper supervision over the making and enforcing of contracts for the purchase of lumber.

Lawrence Avenue Sewer. A contract for constructing some 8,000 ft. of large sewer in tunnels was awarded in July, 1905, at a price of $79.50 per lin. ft. of tunnel and in addition $2 per cu. ft. for all rock excavated. The preliminary borings made by the city did not show the existence of any rock along the line of the tunnel. The time limit of the contract was twice extended and certain matters were omitted. Twice also the contractor was allowed to draw on the 15 per cent reserve held by the city as a guarantee of the proper completion of the work. Upon completion of the work the contractor presented a claim for payment for 26,304 cu. yds. of rock excavation amounting at $2 per cu. yd. to $52,608. This claim was approved by the [illegible]nsulting engineer of intercepting sewers [illegible]d by the city engineer and voucher for its payment to the amount of 22,992 cu. yds. or $45,984 were ordered prepared by the deputy commissioner of public works. The Commission found the facts to be as stated above. It found that all the engineers connected with the work except one had no personal knowledge that rock was actually encountered and furthermore denied knowledge of any claim made by the contractor during construction [illegible]r rock excavation. Th[illegible] one exception was [illegible] engineer from whose notes the contractors claims for rock quantities were computed. This engineer could not furnish his notes claiming that the book containing them had disappeared. His testimony showed that some of the estimates were wholly guesses and that the others had been carelessly made and carelessly preserved. The Commission expressed itself unable to place any confidence in this engineer's testimony. The Commission sought further evidence by employing Benjamin F. Welton a civil engineer to conduct a physical examination. This engineer sunk a test pit down alongside the tunnel where the contractor's bill indicated the greatest amount of rock to have been encountered. This test pit disclosed no rock. An examination of the spoil bank was made and several borings sunk with the same result. The conclusion of engineer Welton was that under no circumstances would any of the material encountered be classified as rock under the specifications. The conclusion of the Commission was that the evidence as to the quantity of "rock" excavated, upon which the claim of the contractor was allowed was untrustworthy while the new evidence secured by the Commission practically demonstrates that no such quantity was or could have been excavated

Bureau of Sewers.—The work of this bureau is the maintenance of the sewer system of the city and its principal item of expenditure, 50 per cent of the total, is for cleaning sewers and catchbasins. Its work is done by day labor and the object of the Commission's investigation was to determine the efficiency of this labor. Inspectors were employed to watch the work of the various gangs of men at first secretly for a period of time and then with the knowledge of the men for another period of time. As a result of the secret observation it was found that the time wasted per gang ranged from 18.9 per cent to 89.6 per cent of the total time observed, the average being 46 per cent. Including time unaccounted for would increase this average to 50 per cent. Under open observation the time wasted was found to average 14 per cent. The greatest percentages of waste time were found to exist on the classes of work aggregating the greatest expenditures and the Commission's experts figured that a fair estimate of the payrool waste was 65 per cent. As the expenditures of the bureau in 1909 amounted to $350,000 the waste would amount to $227,500. The Commission considered that a part of this waste was due to the bad system in vogue and the remainder to long-established habits of inactivity.

Pro[illegible] the city's various water and sewage pumping stations is purchased in specifications. The Commission employed Gulick & Henderson, inspecting engineers, to make an expert analysis of the city's specifications. The procedure of the experts was detailed and technical and only the general conclusions will be given. They are: The specifications are not well drawn to secure lowest prices in relation not only to quantity and delivery service but also to quality; the specifications are not drawn adequately to protect the city's interests after the contracts embodying them are let.

Purchase of Castings.—The hydrant and stop valve, valve cover and lid castings purchased amount yearly in cost to $40,000 to $60,000. The ordinances require that castings shall above certain small amounts be purchased by contract under competitive bids. In 1908 some $57,000 worth and in 1909 some $40,000 worth of castings were purchased largely without competitive bids and without specifications by the city's Business Agent. The reason given to the Commission for this action was that better castings could be secured through the open market than by contract. The Commission had analyses made which showed that somewhat better material—a material worth from $2 to $3 per ton more—was used for the castings purchased in 1909 than for the castings purchased by contract in 1907 but that these contract castings did not fulfill the specifications under which they were purchased. The claim made that the castings purchased without bids in 1908 and 1909 were preferable because they cost less to make was investigated by examining the shop records. This examination showed that no adequate cost records were kept, but that such records as existed discredited the claim of any economy in making. It was not possible to figure from the records the exact cost per ton of the castings purchased without bids in 1908 and 1909, but a very close estimate enabled the following comparison

Year	[illegible]	[illegible]
1906	22.25	37.25
1907	[illegible]	[illegible]
1908	[illegible]	[illegible]
1909	[illegible]	[illegible]
1910	[illegible]	[illegible]

Except in 1907 when pig iron cost $26.80 per ton the cost of pig iron ranged from $17.15 to $18.60 per ton. The Commission estimated that the prices paid in 1908 and 1909 in excess of a fair price were per ton as follows:

Item.	[illegible]	[illegible]
Hydrants and [illegible]	[illegible]	[illegible]
Valve basin covers	[illegible]	[illegible]

The Commission found that in purchasing castings without bids in 1908 and 1909 decided favoritism had been shown to one company, that inspection had been lax, and that the castings furnished were under weight. Referring to the specifications under which the 1910 contracts for castings were made the Commission finds them lacking several requirements necessary to insure the quality and character of castings desired

Maintenance and Oper[illegible] division of bridges and harbors has charge of the designing and construction of new bridges and of the repairs, maintenance and operation of existing bridges besides other work. The total expenditures of the division for 1909 was $896,803. Most of the repair and maintenance work is done by day labor. The Commission found the accounting and cost keeping methods of this division unsatisfactory. They did not permit of separation and classification of costs or of checking materials or labor. This was found true of both designing and new construction work and of maintenance and repair work. Inspection of the gangs engaged in repair work in the field showed waste of time ranging from 14 to 50 per cent, lack of energy at work and poor supervision. These charges are stated to apply to carpenters, painters, machinists, electricians and to practically all labor. The report of W. W. Curtis, M. Am. Soc. C. E., expert bridge engineer, employed to investigate the operations of the bridge department, records generally excessive costs for all work due to lack of efficiency and poor management generally and in some cases to absolutely unfit management. He also found the cost recording methods to be misleading in some cases and of little value generally for determining unit costs and efficiency of work. He reported that: To secure good work at fair cost there are necessary good workmen, an efficient foreman, strict supervision and accurate accounting. He found all these requirements generally lacking.

[illegible] the Building Department at the time of the investigation comprised 71 persons. The Commission found lack of accounting control over financial stationary lack of administrative control over inspections; inadequate force and lack of specifications; loss of revenue on building permits and water privileges; meth[illegible] fire escapes; improper use of courts, and general disorganization of the department. The Commission declared the Commissioner of Buildings incompetent to longer hold office

Street Repair Contracts.—The contract provided for the materials, tools and labor required for repairing the asphalt streets of the city during the year ending Dec. 31, 1908. The Commission employed Mr. Samuel Whinny, M. Am. Soc. C. E., to make the investigation. It was found that after the contract had been awarded the time for its completion had been extended six months; that the specifications were indefinite, inadequate and ambiguous; that a grossly unbalanced bid had been accepted; that a method of making repairs much less expensive than the method called for in the specifications had been permitted; that the amount of work called for in asking for bids ($50,000) had been increased about eight times ($413,247); that the classification of the [illegible] was that due to the various reasons named [illegible] $150,000 to $200,000.

[illegible] and fire alarm systems. The Commission [illegible] this department, but little ambition to obtain more than fair results. It found lax inspection and up-keep of lamps, less rigid and systematic supervision than should be and lack of firmness in the policy of dealing with concerns supplying lights. It also found that [illegible]

[illegible] rock. The Commission appointed A. J. Hammond, civil engineer, to conduct the investigation. [illegible] received of which the higher by $105,000 was [illegible] two extensions of time for the completion of the work had been granted and that the contractor had been allowed to draw about half of the 15 per cent reserve [illegible] changes in materials, methods of work, alinement and grades had been permitted on request of the contractor and involving an additional cost to the city. It was found that various defects existed in the work, such as insufficient thickness of lining, poor concrete, bad alinement and interior surface, etc. It was found that generally the inspection had been lax and that the contractor had been permitted to act in an arbitrary manner in many respects.

[illegible] the investigation of public works the Commission also investigated certain operations of the Police Department, the City Clerk's office, the Business Agent's office and the House of Correction. As the work of these branches are of indirect interest only to our readers we pass them with the mere statement that in each inefficiency [illegible] less degree.

[illegible] the findings have been given and these very briefly the Merriam Commission in each case made such criticism, recommendations and plans for improvement as were called for. The creative work of the Commission was, therefore, an important result of its activities. Those familiar with local conditions know that the effect has been in several instances a decided improvement in management. It has not been our purpose to develop the features but to emphasize the main fact that inefficient business management prevails generally in city public works. We emphasize also the fact that this condition is not peculiar to any particular administration of Chicago affairs or to the city of Chicago alone. It exists in greater or less measure in every large American city. It comes not wholly from roguery and graft, but from the fundamental inability of the great number of citizens to conceive that a city's public works is as purely and completely a business proposition as is the running of a street railway or a gas works. The great fact that stands out beyond all other facts indicated in the reports which we have reviewed is the fact of business inefficiency, not criminal misuse of funds. Yet it is a matter of common memory to residents of Chicago that the one report of all the reports made which aroused general interest in the press and among the people of the city was that one indicating the wrongful payment of $16,000 for work not done on the Lawrence Ave. sewer tunnel. The Commission's report showing waste of time, laziness and [illegible] of the workmen maintaining sewers was only incidentally spoken of at the time and is now scarcely recalled though it [illegible] annual loss of a quarter of a million dollars to the city.

We shall not point out where among these reports, which we review, graft may be surmised. One thing is plain that it is not indicated in all of them, while all without exception do indicate inefficient business management. No manager of a private business can fail to see where the methods reported are [illegible] and inefficient. No manager of a business organization would tolerate for a moment the slipshod methods and the incompetency evidenced time and again by the practices and testimony reported by the Merriam Commission. The conclusion is obvious.

In closing we think it not out of place to direct the attention of engineers to the fact that it has been the work of engineers which has supplied the facts and analyses of facts on which the conclusions of the Merriam Commission have been founded. It may even be mentioned that it is a record of the private history of the Commission's work that results were not got until trained engineers were employed to conduct the work. This is a repetition of the experience of the Boston Finance Commission. This journal has no politics in the matter of managing the public works of cities. Charles E. Merriam, the chairman of the Merriam Commission, will have been either elected or defeated for the office of mayor of Chicago when this issue appears. If he be elected it is gratifying to engineers to know that his experience and practice as an investigator of the city's business will lead him to realize and to appreciate fully the necessity of engineering skill and services in planning the various public works of subway construction, electrification of railways, harbor improvement, etc., which are imminent in the city's development.

CONCRETE AND REINFORCED CONCRETE SECTION

The "Lewens" System of Reinforced Concrete Construction.

Patents covering the "Lewen" system of reinforced concrete construction have been recently granted in the United States. This system takes its name from Mr. Henry L. Lewen, the inventor of the system, who has used this form of construction extensively in South America.

The system was first used in cylindrical forms for poles, chimneys, sewer pipes, and columns. Figure 1 shows the method of reinforcing a concrete telegraph and electric light pole. In this case the corrugated steel plate is the reinforcing element in the pole, and also serves as a form for the concrete placed inside of it. The outside of the curved corrugated plate is plastered with cement mortar to form any desired finish. Figure 2 shows the method of stiffening the corrugated plate by means of passing interlaced wires through perforations in the ribs of the corrugated sheet metal. By means of these wires the corrugated plate is sprung and held in any desired position preparatory to placing the concrete.

The system has been extensively used in building construction in South America, and seems to have given satisfaction to date. It has been used in dwelling houses, office buildings, and large auditoriums. In building construction the corrugated plate is used as the reinforcing element in walls, columns and [illegible] the omitted.

The inventor claims that hollow walls, constructed according to his system of reinforcing, are especially effective in resisting earthquake shocks, on account of their elasticity. The claim is also made for such walls that they are especially efficient in carrying ordinary loads on much smaller gross sec- [illegible] of reinforcing. For hollow walls and floor slabs, special plates with the corrugations all on one side are used, the flat sides of the plates forming the inner surface of the walls, and the corrugations extending into the concrete.

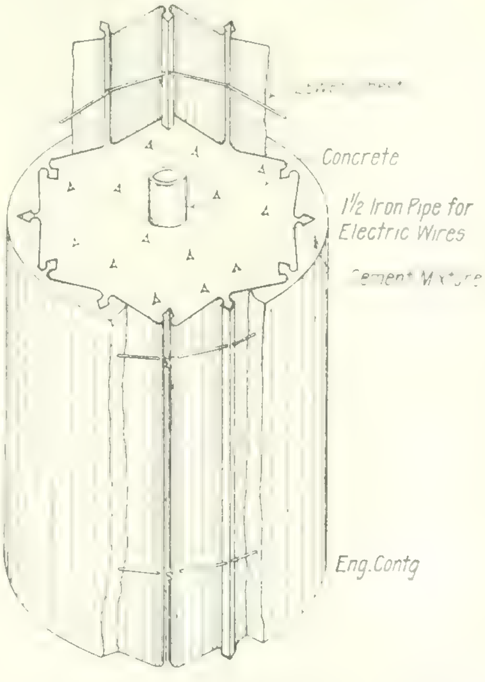

Fig. 1—Method of Reinforcing Concrete Poles.

Floor slabs reinforced according to this system are supported by steel or reinforced concrete floor beams. These slabs, and the sections of the hollow wall as well, may be built in place, or in sections on the ground near by or in a distant factory and then shipped to the building.

The literature descriptive of this system of concrete reinforcing lays great emphasis on the saving affected by the lighter concrete sections, by discarding the ordinary wood forms and staging, and by dispensing with the services of carpenters and other skilled laborers. The claim is made that a saving of 50 per cent of the cost of construction by any other known system of concrete reinforcing is obtained by the use of the "Lewen" system. The general method of procedure in the application of this system to building construction in South America is as follows: Walls, partitions, and roofs are shipped to the building in sections, and are there assembled by common laborers directed by one man competent to read the erection plans.

The system is being tried in the United States and it will be interesting to note the saving effected here where evidently freight rates are higher, and form lumber and building are cheaper than in South America. The system is being handled in the United States by Mr. Henry L. Lewen, 200 Fifth Ave., New York city.

An extensive drainage and levee system along the Patoka and Wabash Rivers in Indiana is proposed, and surveys for the system have been completed. The survey was made from a point near Dongola, several miles northeast of Princeton down both sides of the Patoka to its mouth, opposite Mt. Carmel; thence south along the Wabash to New Harmony, a distance of about 80 miles. The cost of the system of drains and levee is estimated at over $250,000, and it is said that more than 100,000 acres of land would be affected.

Reinforced Concrete Arch Viaduct 4,778 Ft. Long; The Dallas-Oak Cliff Viaduct.

BY VICTOR [illegible]*

The Dallas-Oak [illegible] now building in Dallas, Texas, will be a structure of unusual magnitude. It will be 4,778 ft. long between the end abutments, and from end to end of approaches it will be more than a mile long. It will have a roadway 44 ft. wide between curbs and two sidewalks each 4 ft. 6 ins. wide in the clear, and will be of reinforced concrete construction throughout.

The City of Dallas, including the residence district known as Oak Cliff, has a population of 93,000. Oak Cliff has a population of about 20,000, and is separated from the main portion of the city by the Trinity River valley. Oak Cliff is built [illegible] of residences. The Trinity River is a small stream ordinarily confined between steep banks not more than 200 ft. apart, but at flood stages it rises as much as 50 ft. and spreads out all over the valley, which is from 1 to 1½ miles wide. At such times the traffic between Dallas and Oak Cliff is suspended for days at a time, causing great loss and inconvenience. It was accordingly decided to build a viaduct to do away with such interruption of traffic, and the County of Dallas voted a bond issue of $600,000 with which to build the structure. Neither the city of Dallas nor the city of Oak Cliff furnished any money. It was expected that the railroads whose tracks are to be crossed overhead at the Dallas end of the viaduct would contribute towards the cost, but up to this time they have not done so. After the bonds were sold a sufficient amount was reserved to cover the cost of the right-of-way and the Oak Cliff approach, thus leaving a fund of $563,000 available for the construction of the viaduct.

On Nov. 19, 1909, Mr. J. F. Witt, County Engineer, advertised for competitive plans to be submitted on or before Jan. 1, 1910, the chief requirements to be observed by designers being given as follows:

(1) The structure must be of reinforced concrete, of either arch or trestle construction, and must provide a roadway for vehicular traffic, and two sidewalks. Provision must be made for a double track electric railway to be added at some future time.

(2) The clear width between hand rails must be not less than [illegible] wider structure can be built at a cost not to exceed the amount available.

(3) Conduit spaces easy of access must be provided, having a cross-sectional area of not less than 20 sq. ft.

(4) The live loads to be provided for are as follows: On each electric railway track, two 100,000-lb. cars. On the roadway, 100 lbs. per sq. ft., or a 15-ton road roller having a maximum axle concentration of 10 tons. On the sidewalks, 80 lbs. per sq. ft.

(5) The design should be more than a mere picture or side elevation; sufficient details should be given to enable the relative merits of the design to be determined. Each designer shall furnish a complete analysis of the principal span or spans, and a complete list of working stresses; also sample specifications, an itemized estimate of cost, and a summary of his professional experience.

Designs were submitted by fifteen different engineers and engineering firms. The County Court appointed an advisory board of engineers to pass on the plans, consisting of Prof. T. U. Taylor, M. Am. Soc. C. E., Prof. of Civil Engineering, University of Texas; Mr. Otto H. Lang, M. Am. Soc. C. E., and Mr. N. Werenskiold. The board recommended the adoption of the arch design submitted by Mr Ira G. Hedrick, M. Am. Soc. C. E., consulting engineer, Kansas City, Mo., and Mr. L. R Ash, M. Am. Soc. C. E., associate engineer

Mr. Hedrick's preliminary design was substantially the same as the [illegible]

[illegible] the river were carried on reinforced concrete footings designed for a soil pressure of 2 tons per sq. ft. The borings showed the soil to be compact jointed clay, and since the river bottom is not subject to scour it was thought that it would be unnecessary to use piling. The Advisory Board, however, recommended [illegible]

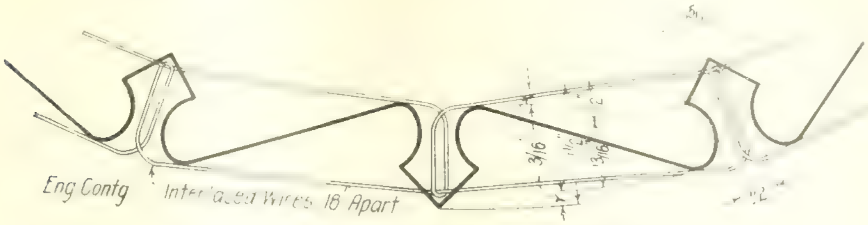

Fig. 2—Method of Stiffening Corrugated Plate.

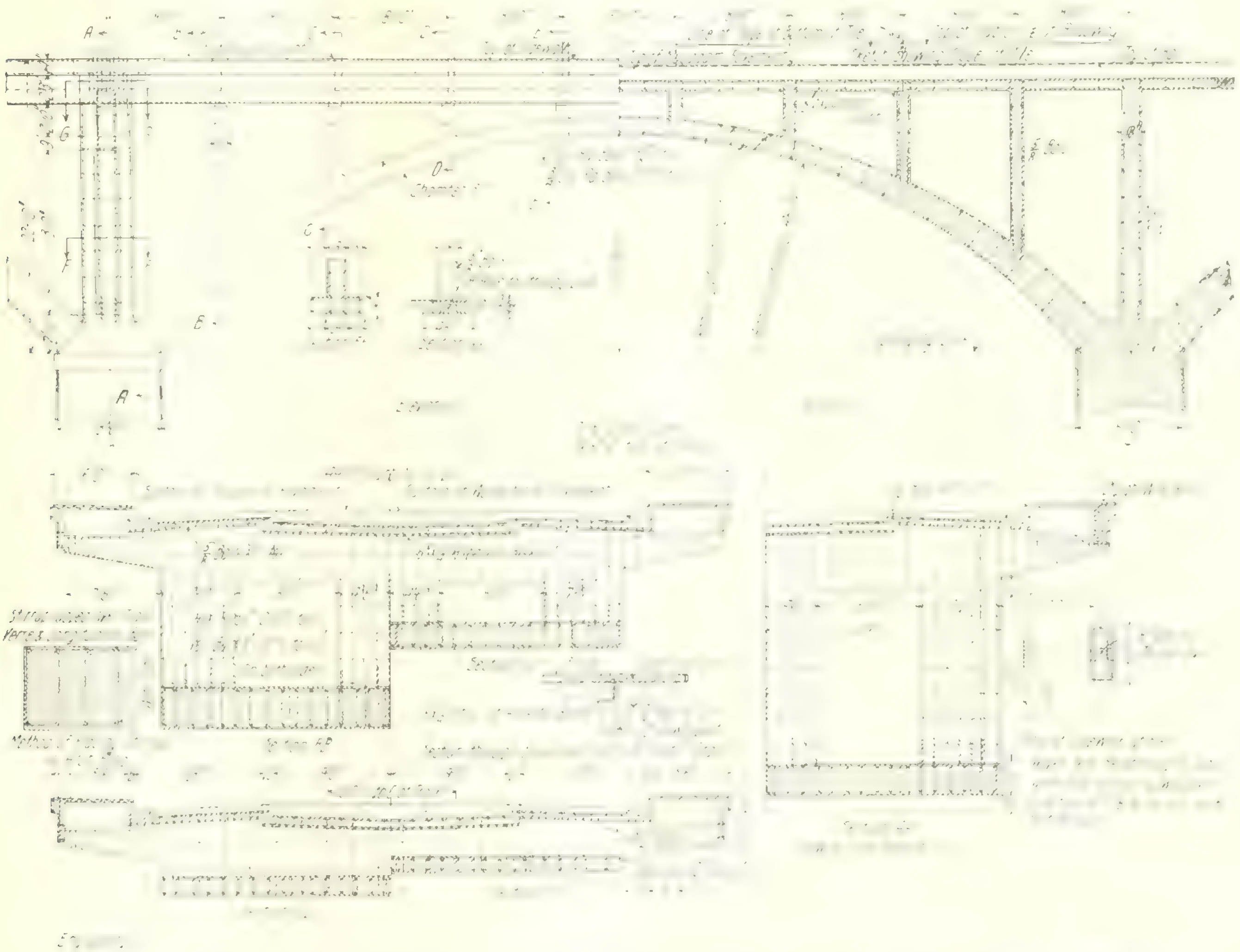

Fig. 1—Details of Arch Ring, Floor Slabs and Cross Walls, Dallas-Oak Cliff Viaduct.

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*Hedrick & [illegible], Kansas City, Mo.

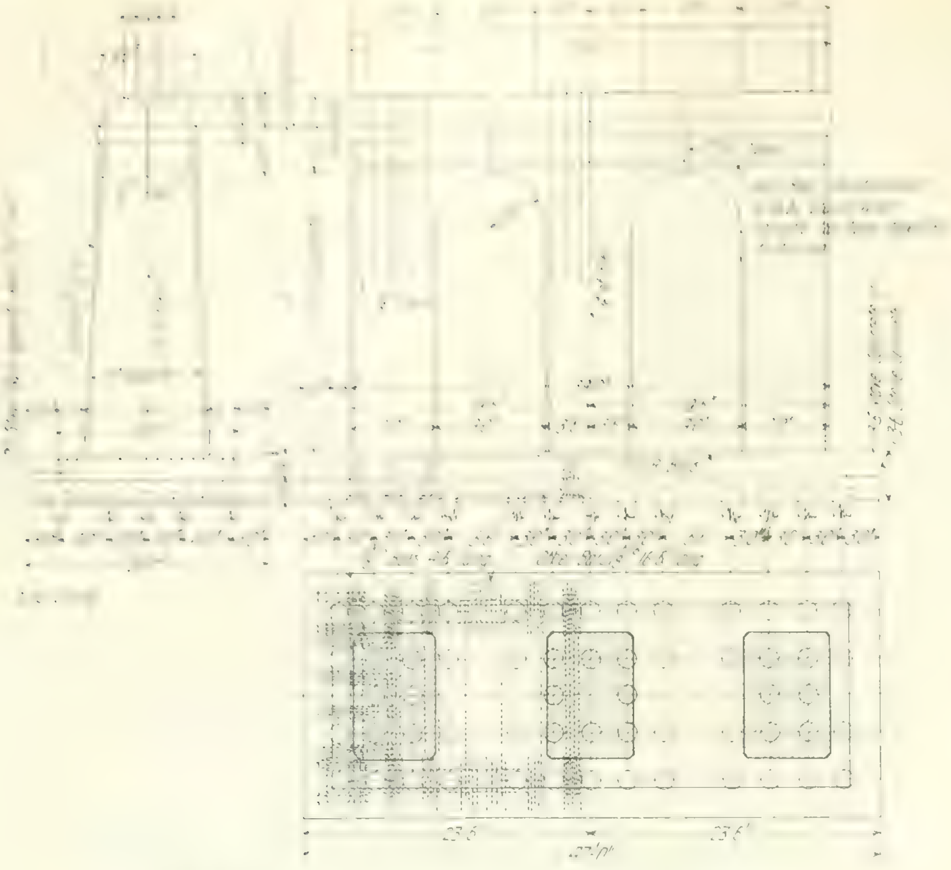

Fig. 2—Details of Ordinary Piers, Dallas-Oak Cliff Viaduct.

The preliminary design provided for two 5 ft. sidewalks and a 40-ft. roadway paved with creosoted wood blocks. In order to compensate for the extra cost due to the use of piling throughout, it was decided to pave the structure temporaily with macadam instead of creosoted blocks. The contract price, however, was enough less than the estimated cost to enable the viaduct to be widened 3 ft., thus making the clear width between balustrades 53 ft. The roadway will be 44 ft. wide between curbs, and the sidewalks each 4 ft. 6 ins. wide in the clear.

The structure beginning in Dallas proceeds on an ascending grade of 2.8 per cent to a point near the tracks of the Missouri, Kansas & Texas Ry., the Dallas Terminal Ry., the Gulf, Colorado & Santa Fe, and the Chicago, Rock Island & Gulf Ry., a distance of 567.7 ft. From this point the viaduct swings to the right through an agle of 47° 44', crosses the railway tracks overhead, and runs on a level grade in a southwesterly direction to the south bank of the Trinity River, a distance of 2,529 ft. Thence it proceeds in the same direction on a descending grade of 0.74 per cent to the west side of Lancaster Ave., a distance of 2,009.4 ft.

The approaches will consist of U-abutments having wing walls of the ordinary buttress type retaining earth fill. Next to the north abutment there will be 439 ft. of trestle construction consisting of longitudinal girders resting on bents. Next to the south abutment there will be 181 ft. of similar construction. The main portion of the viaduct will consist of 51 arches having a span of 71 ft. 6 ins. between springing lines or 79 ft. 6 ins. center to center of piers, and a rise of 17 ft.

The Trinity River is being improved by the Government so as to make it navigable, and it was required that the river span should provide a transverse clearance of 90 ft. between piers, and a vertical clearance above low water of 60 ft. throughout the width of 90 ft. Accordingly, in order to keep the grade of the viaduct as low as possible, the span over the river is to be of steel plate girder construction. All the metal work is to be incased in concrete so that the span will conform in [illegible] adjacent arch spans will be transmitted through this span, and the adjacent arch ribs will have to distort sufficiently to take care of the expansion and contraction of the steel span.

Live Loads.—The live loads for the final design were the same as required in the case of the competitive plans. The electric railway loads were increased to allow for impact, 50 per cent for floor slabs and about 13 per cent for arch ribs. No impact allowance was made for the road roller concentrations or the uniformly distributed loads on roadways and sidewalks. The piers were designed for two conditions of loading: First, four 100,000-lb. cars, 80 lbs. per sq. ft. on a width of 22 ft. of roadway outside of the car tracks, and 60 lbs. per sq. ft. on sidewalks, all symmetrically disposed on the two adjacent spans so as to produce balanced horizontal thrusts; second, four 100,000-lb. cars, 40 lbs. per sq. ft. on a width of 22 ft. of roadway, and 30 lbs. per sq. ft. on sidewalks, all on one of the two adjacent spans and producing an unbalanced horizontal thrust of 700 lbs. per lin. ft. of width of arch ring. For the latter condition, which is considered quite unlikely to occur, it was computed that 2,000 lbs. could, if necessary, be carried through the adjacent arch rib to the next pier, thus leaving an unbalanced live load thrust of 5,000 lbs. per lineal foot of width of arch rib to be taken care of by the pier, or 195,000 lbs. altogether.

Working Stresses.—The working stresses adopted were as follows:

	Lbs. per sq. in
Maximum compression on concrete in arches, excluding temperature stresses..........	500
Maximum compression concrete in girders...	600
Maximum compression on concrete, including stresses due to 80 degrees variation in temperature	750
No tension in concrete will be allowed.	
Maximum shear on concrete, plain..........	30
Maximum shear on concrete, reinforced for shear	100

When temperature stresses are included, the steel reinforcement shall take the entire bending moment without being stressed in tension above its elastic limit.

Foundations.—The specifications provided that the concrete piles might be put in place by any method which would meet with the approval of the engineer. The requirements in regard to the supporting power of the piles were as follows:

> Each of the test piles shall first be loaded with 30 tons for 48 hours and must show no settlement. Each pile shall then be loaded with 60 tons and shall show not more than ¼ in. settlement after the load has been applied for 48 hours. Should the test piles fail to sustain the load specified the contractor must increase the size and length of piling or increase their number, without extra charge, so that in the opinion of the engineer the piling used will carry safely a load equivalent to 30 tons for each pile shown on the plans.

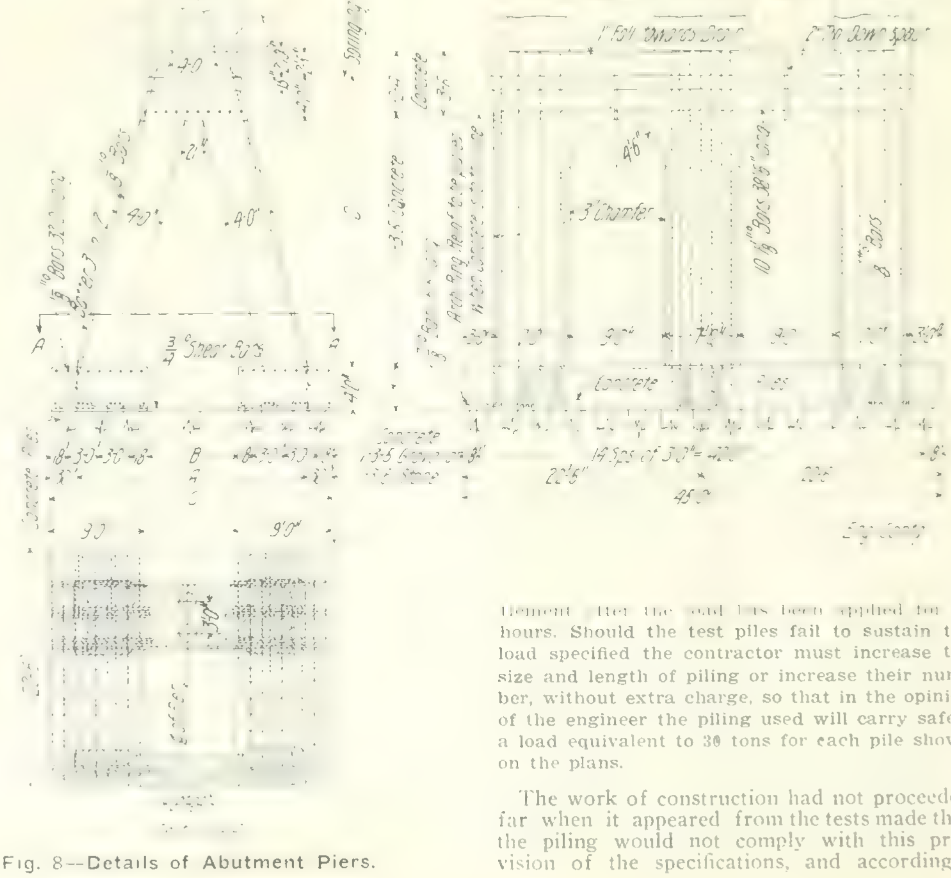

Fig. 8—Details of Abutment Piers.

The work of construction had not proceeded far when it appeared from the tests made that the piling would not comply with this provision of the specifications, and accordingly at a conference of the County Court, the County Engineer, the Advisory Board of Consulting Engineers and the contractor, it was decided that the working load on the piles be

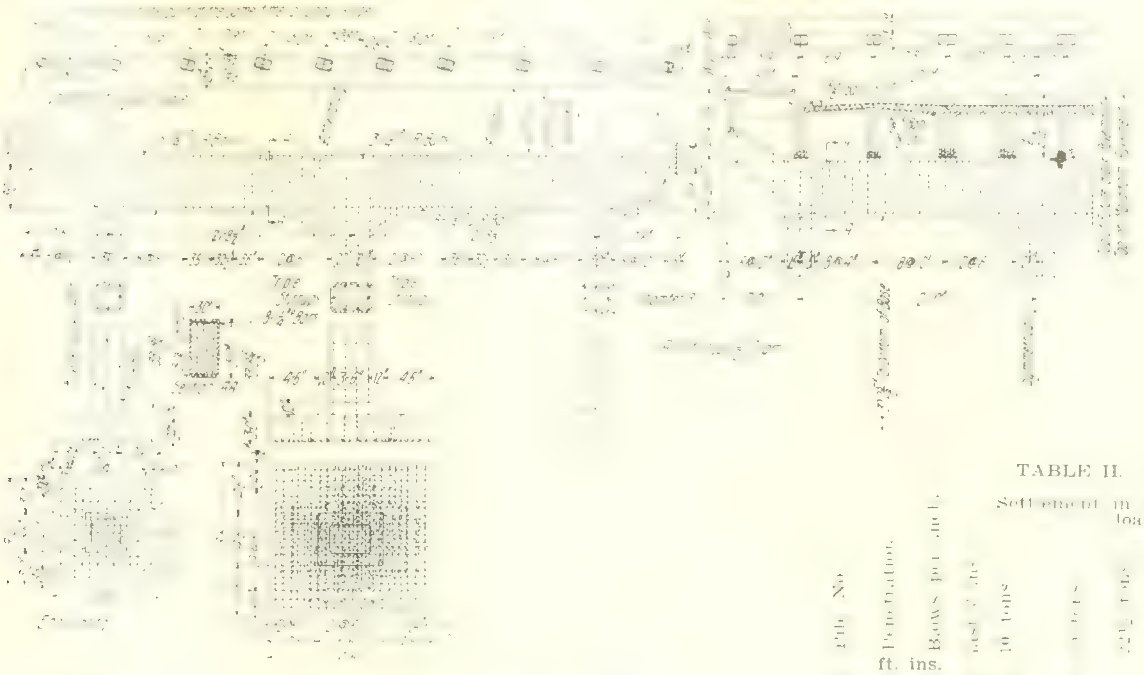

Fig. 4—Details of Bents in Trestle Approach, Dallas-Oak Cliff Viaduct.

reduced from 30 tons to 20 tons, and that the bases be correspondingly increased in size. The contractors agreed to stand the extra expense involved. The piers were then redesigned for the following working loads

Extreme load per pile, tons ....† 20 ‡ 20
Extreme soil pressure, tons per sq. ft. . [illegible] ‡1.6
†Balanced live load condition.
‡Unbalanced live load condition.

The soil, as shown by the borings and ex-

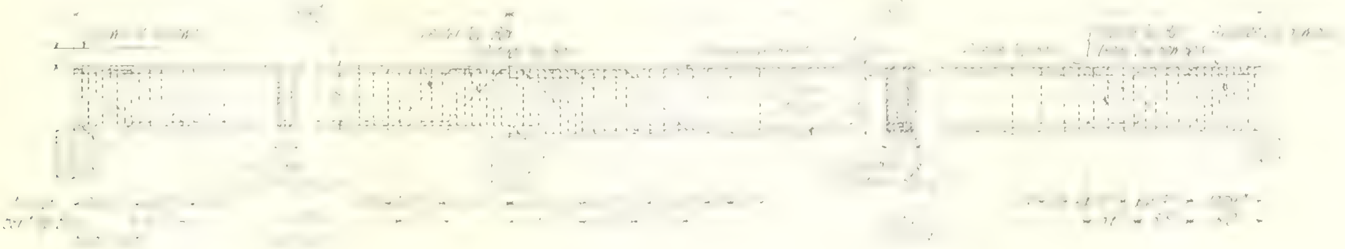

Fig. 5—Details of Girders in Trestle Approach, Dallas-Oak Cliff Viaduct.

cavations, is hard compact black or yellow clay underlaid in places by sand or sand and gravel. At the present time the clay is comparatively dry owing to the long drought which has prevailed in the vicinity of Dallas. Accordingly in testing the bearing capacity of the soil, water was poured into the pits in some cases and allowed to stand. Several tests were made, giving fairly uniform results. The results of a typical test are shown in the accompanying diagram, Fig. [illegible]. It will be noted that the settlement under a load of 6 tons was only about 1/16 in., while under a load of 10 tons it was about ¼ in. It appears that under a constant load the settlement continues for a few hours and then practically ceases. When the load was increased to 10 tons water was added to the pit and was kept standing 3 ft. deep. On the whole the settlement was proportional to the load. The maximum load applied was 20 tons per sq. ft., and after this load was removed it appeared that the permanent settlement of the soil was ⅜ in. This test was made with a 3½x3½-in. timber bearing on the soil. Other tests made with a 12x12-in. [illegible] practically the same results.

The piles were made in place by pouring 1:2:4 concrete into holes prepared by driving a core or former into the ground and then withdrawing it. The average penetration was about 14 ft. The pile spacing is shown in Fig. 2. The aggregate used for some of the test piles was gravel and for others it was Jacksboro stone. All concrete was mixed wet and tamped as it was poured into the holes. Table II gives the results of two groups of typical tests.

Some of the piles were exposed after being tested and it was found that several were cracked in one or more places. It appeared that these cracks were caused by the vibration of the ground while adjacent piles were driving, and that they were made while the concrete was green. In a few cases the cracks had opened a ½ in. or more, showing that the soil had risen and had lifted the upper portion of the pile. In some instances the cross-sectional area of the pile had been reduced,

TABLE II.

Pile No.	Penetration	Blows per [illegible]	[illegible]	Settlement in inches under a load of 10 tons	[illegible]	[illegible]	[illegible] tons	[illegible] tons
	ft.	ins.						
[illegible]	13	0	40	0	0			[illegible]
55	11	6	54	0	0			[illegible]
82	13	6	40	0	0			[illegible]
85	14	0	28	0	0			[illegible]
39	14	10	42	0	9-16	11-16	1 1-16	1 [illegible]
42	14	0	48	0	9-16	11-16	1⅛	1 11-16
60	14	0	60	0	[illegible]	[illegible]	[illegible]	1 7-16

Weight of hammer, 7,000 lbs.; stroke, 36 ins.; weight of ram, 3,000 lbs.; weight of former, 4,700 lbs., diameter at top 14 ins., at bottom, [illegible]

owing to the pressure of the surrounding soil caused by driving adjacent piles. Evidently the soil was so compact that it would not compress to any great extent. The sides of the piles were very smooth. It was found to be impossible to tamp the concrete into the soil [illegible] the diameter [illegible] piles

Fig. 6—Details of End Bearing of Trestle Girders

The subcontractors who were driving the piles were not willing to undertake to remedy [illegible] safe to assume that the piles would carry an [illegible] of 20 tons each, so the sub-contractors agreed to increase the size of the bases at their own expense so as to make good the deficiency in carrying capacity of the piles. The amount of load carried by the piles and the soil respectively depends upon their relative rigidity. The diagram, Fig. 9, shows the variation in the soil pressure under the unbalanced live load condition as the assumed extreme pile load varies from 0 to 20 tons.

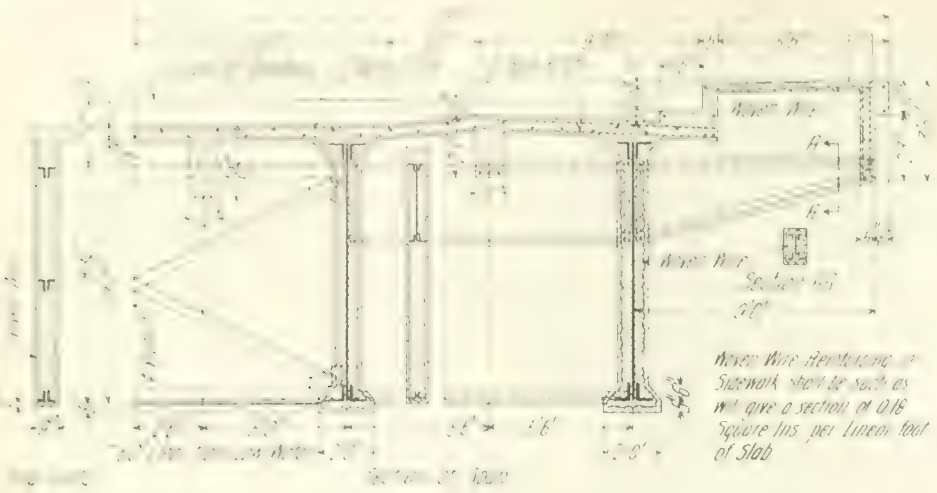
Woven Wire Reinforcing in Sidewalk shall be such as will give a section of 0.16 Square Ins. per Lineal foot of Slab

Fig. 7—Half Cross-Section of Plate Girder Channel Span, Dallas-Oak Cliff Viaduct.

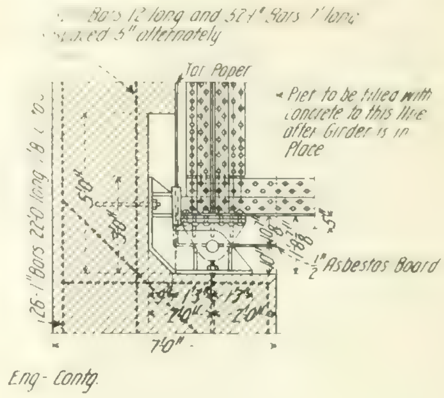
Bars 12' long and 5/8" Bars 7' long spaced 5" alternately
Tar Paper
Pier to be filled with concrete to this line after Girder is in Place
1/2" Asbestos Board
7'0"
2'0"
Eng-Contg.

Fig. 8—Details of End Bearing of Plate Girder Span, Dallas-Oak Cliff Viaduct.

Every fifth pier is large enough to resist the dead load thrust of one adjacent span in case the arch on the other side of the pier should fail. Thus in case of the accidental failure of any portion of the structure not more than five spans would fall.

Both the ordinary piers and the so-called abutment piers are pierced by two openings 9 ft. wide, at the top of which are semi-cylindrical surfaces. The distance from the springing line to the top of these openings is 4 ft., and reinforcing bars are placed just above the openings. The three pier shafts are each 7 ft. wide. The pier bases are reinforced as shown in Fig. 2. The batter of the ordinary pier is ½ in. to 1 ft. and that of the abutment pier is 3 ins. to 1 ft.

The abutment pier at the Dallas end of the arch spans was carried down to bed rock, the lower portion being of cellular construction. The abutment pier at the Oak Cliff end of the arch spans is to be founded on piles, and one-half of these will be driven on a slope of 4½ ins. to 1 ft. in order to take care of the horizontal thrust.

The two piers on either side of the river are of especial interest because they must carry the horizontal thrust of the arch spans in bending. The tension side of each pier is reinforced with 104 corrugated bars 1⅛ ins. in diameter. These piers, unlike all the others, will be founded on timber piles. There will be 168 piles in each base.

Superstructure Construction.—The roadway will be carried by reinforced slabs integral with the longitudinal girders, which are spaced about 5 ft. apart. Thus the girders act as T-beams. The span lengths vary from about 24 to 50 ft. The ends of the girders rest on cross girders 2 ft. 6 ins. in width. On one side of the cross girder the longitudinal girders are rigidly connected to it by means of a reinforced corner bracket. On the other side each of the longitudinal girders rests in a socket formed by means of two bent copper plates of the full width of the girder, the lower resting on the cross girder and the upper being fastened to the longitudinal girder. The longitudinal girders on either side are connected by means of reinforcing bars just above the socket but a cleavage plane is left between them, extend- [illegible] which rests in the socket is more or less free to rotate. The girders are thus discontinuous and are designed as simple beams. At suitable intervals expansion joints are introduced. At these joints the lower copper plate is replaced by two cast iron plates, the lower being embedded in the cross girder and the upper sliding on it. This detail is shown in Fig. 4.

In general, the cross girders are carried on three columns, and are designed as beams continuous over three supports. They are heavily reinforced for shear. The columns rest on reinforced spread footings of the ordinary type.

Arch Spans.—A cross-section through the arch span is shown by Fig. 1. The floor slab is carried on eight crosswalls 8 ft. 10 ins. apart c. to c. These crosswalls rest on the arch ribs, which are of the barrel type and are [illegible] wide. The crosswalls have two openings thus making them virtually a bent having the cross-girder resting on three wide columns and cantilevered outward on either side to support the sidewalks and a small portion of the roadway slab. Over each pier [illegible] heavier wall having a T-shaped section at either end of the pier, the head of the T being 4 ft. wide and 1 ft. 6 ins. thick.

The floor slab is 10 ins. thick under the electric railway tracks and 7 ins. thick between the tracks and the curbs. The sidewalk slab is 3½ ins. thick and spans from the curb to the fascia girder under the hand rail. There is a conduit space provided under each sidewalk slab. The roadway slab has a longitudinal recess or depression deep enough to permit of the laying of the tracks at some future time. This depression is drained by means of a 3 in. tile drain, and the slab is

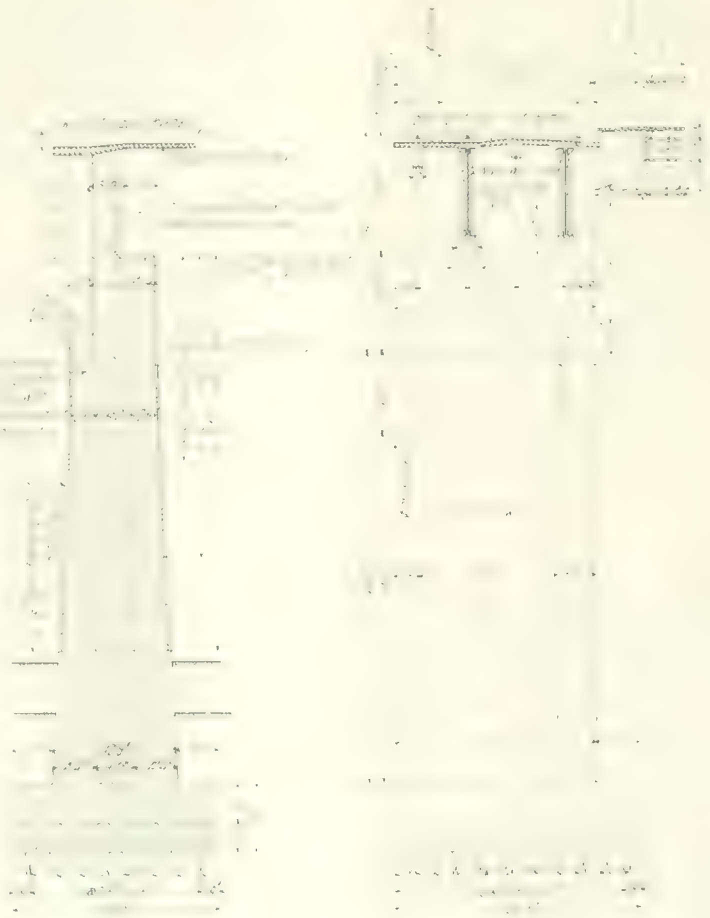

Fig. 9—Details of Pier for Plate Girder Span.

TABLE I.

Cement.	Seventh day.	Fourteenth day.	Average unit load, twenty-eighth day.
1:2:4 Jacksboro Stone, 1.5 ins.			
Trinity A....	1347	1972	[illegible]
Lone Star G..	1278	1589	1813
1:2:4 Gravel, 1.5 ins.			
Trinity D....	1788	1908	[illegible]
Lone Star J..	1520	1949	[illegible]
1:3:5 Jacksboro Stone, 1.5 ins.			
Trinity B....	1253	1319	[illegible]
Lone Star H.	695	938	[illegible]
1:3:5 Gravel, 1.5 ins.			
Trinity E....	794	1061	[illegible]
Lone Star....	826	1083	[illegible]
1:3:6 Jacksboro Stone, 2.5 ins.			
Trinity C.....	939	1119	1293
Lone Star I..	[illegible]	1431	[illegible]
1:3:6 Gravel, 2.5 ins.			
Trinity F	500	[illegible]	797
Lone Star L	555	620	[illegible]

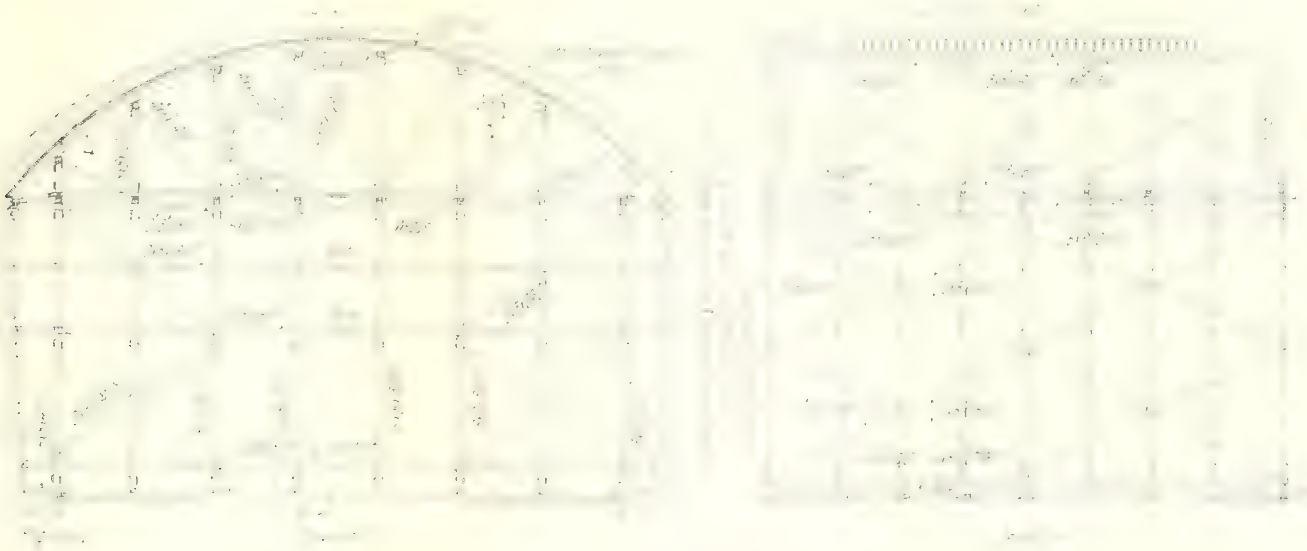

Fig. 10—Circle Centers, Dallas-Oak Cliff Viaduct.

waterproofed. The roadway slab, the curb, and the sidewalk slabs are integral. At the second transverse wall from the pier an expansion joint is provided in the floor slab [illegible] asbestos board.

The arch ribs are [illegible] at the crown and 3 ft. thick at the springing lines. The nominal span and rise are 71 ft. 6 ins. and 17 ft. respectively. The radius of the intrados is 46.09 ft. and that of the extrados is 52.75 ft. The arch rib is reinforced with 35 lines of 1⅛-in. round corrugated rods in both intrados and extrados. The splices are arranged to stagger, and the rods extend 4 ft. into the tops of the piers. The two arch spans next to the Trinity River span are of course subject to greater temperature stresses than in the ordinary case, but these stresses will not be excessive. The details of the arch centering are shown by Fig. 8.

Concrete.—Gravel is to be used throughout for the aggregate. It is found in the vicinity of Dallas in natural beds mixed with sand. In some places there is an admixture of clay, so that considerable care must be exercised to secure gravel [illegible]

The only satisfactory broken stone obtainable in the vicinity of Dallas is that produced at Jacksboro, Tex. It is known as Jacksboro stone. It costs considerably more than the gravel. An elaborate series of tests was made by Prof. T. U. Taylor, to determine the relative merits of Jacksbora stone and Dallas gravel. Table I gives the average results of over 100 compression tests made with two different brands of cement, Trinity and Lone Star.

In view of these results it was decided that the gravel concrete is as strong as the broken stone concrete for the 1:2:4 mixture, but that the broken stone concrete is the stronger for the leaner mixtures.

It is specified that the proportions of sand and gravel as found in the deposits will have to be modified, if required by the engineer, in order to produce the different grades of concrete specified.

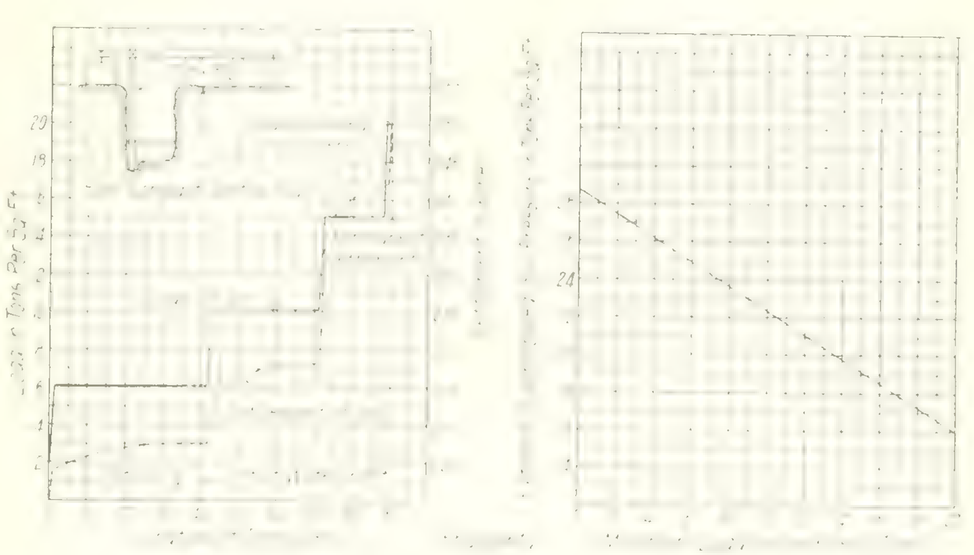

Fig. 11—Diagram Showing Method of Testing Supporting Power of Piles.

Trinity cement, manufactured by the Southwestern States Portland Cement Co., is being used. The cement is furnished to the con- [illegible] mended by the American Society for Testing Materials. The specifications for the grades of concrete are as follows:

For the [illegible] girders [illegible] spandrel walls (above a plane through bottom of cantilevers), and for girders, bents, floor slabs, and arch piers (above a plane 3 ft. 6 ins. below the springing line of arches), and for encasing the metal work for the steel span over the Trinity River, the concrete shall be composed of 1 part Portland cement, 2 parts sand, and 4 parts stone or gravel to pass in any direction through a 1½-in. ring.

Concrete in all [illegible] below the plane of bottoms of cantilevers), in the arch piers (below a plane 3 ft. 6 ins. below springing line of arches), and in the two end abutments and retaining walls shall be composed of 1 part Portland cement, 3 parts sand and 5 parts stone or gravel to pass in any direction through a 1½-in. ring.

Concrete for curbs, wheel guards, sidewalks and parapets or copings shall be composed of 1 part Portland cement to 3 parts of a mixture of clean sand and gravel to pass a ½-in. screen.

The bases of all piers, columns and abutments shall be composed of concrete mixed in the proportions of 1 part Portland cement [illegible] through a 2½-in. ring, or if broken stone be used the proportions [illegible] 1 part Portland [illegible] stone to pass a 2½-in. ring.

Steel Reinforcement.—The specifications require the use of round corrugated rods or [illegible] per sq. in.; an elastic limit not less than one-half the ultimate strength; elongation of 22 [illegible] tested without fracture on the outside of the bend.

[illegible] steel girders connected by steel cross girders. All metal work is to be encased in concrete. The steel girders carry in direct compression the horizontal thrust of the adjacent arch spans. This thrust is carried into the bottom flanges of the girders by means of special cast [illegible] as shown in Fig. 7. The upright portion of the shoe bears against the concrete [illegible] on one side and against the cast steel wedge on the other, the wedge being driven between the cast steel shoe and the end of the bottom flange angles. The girders are otherwise of the ordinary type of construction and the material specified is medium [illegible] except for rivets, which are to be of soft steel.

[illegible] System.—At each pier on either [illegible] there will be a cement lamp standard on [illegible] to be placed three [illegible] c. p., 50-watt series Tungsten lamps. Each lamp will be encased in a heavy 10-in. R. I. glass globe. The wiring system is to be so arranged that the center light on each post will be on one circuit and the two side lights on another circuit, so that either one, two, or three lights in each lamp can be used, as desired. At the Houston St. stairways the lamp standards will have a single lamp only.

The total cost of the structure, including engineering and all incidentals, will be about $570,000. The cost per square foot of floor is about $2.10, which is a remarkably low figure for a structure of this height. The contract was awarded to Corrigan, Lee & Halpin, of Kansas City, Mo. The concrete piles are being put in place by the Gulf Concrete Construction Co. of Houston, Texas. The field work is being carried out under the supervision of Hedrick & Cochrane, consulting engineers, Kansas City, Mo., and J. F. Witt, county engineer. E. N. Noyes is resident engineer, representing the consulting engineers. The work was begun in October, 1910, and is to be completed by Dec. 1, 1911.

EARTH AND ROCK SECTION

Methods and Some Costs of the Construction of the St. Paul Pass Tunnel.

[illegible]

The St. Paul Pass tunnel is on the line of the Chicago, Milwaukee & Puget Sound Ry. where the latter crosses the Bitter Root range of mountains on the Montana-Idaho state line. It is 8,750 ft. long; 3,412 ft. being in Montana and 5,338 ft. in Idaho. The summit grade in tunnel is elevation 4,169 ft. at a distance of 3,520 ft. west of the east portal and this point is 1,020.7 ft. below the surface. The gradient is 0.2 per cent in both directions from the summit. The location lies in a zone of extremely great snow fall, possibly the greatest in the United States; the actual fall during the winter of 1907-08 being 33 ft. 4 ins. Fortunately there is little wind.

Construction was begun Jan. 18, 1907, and [illegible] March 1, 1908 [illegible] assumed charge for the company on Dec. 6, 1907, or about one year after the work was started.

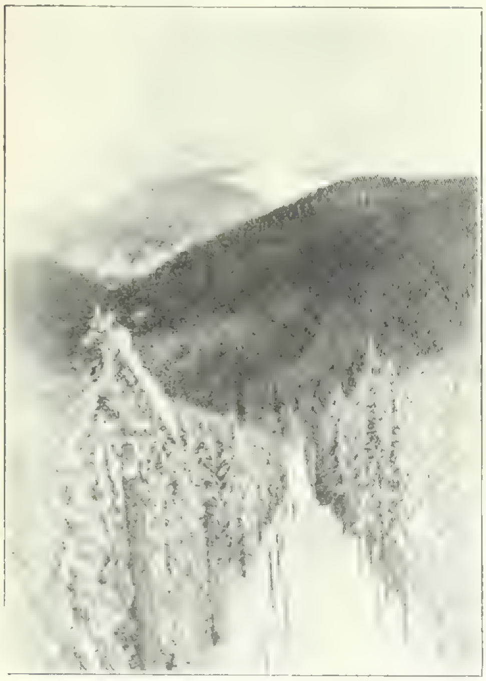

Fig. 1—Looking East from Summit along Tangent, St. Paul Pass Tunnel.

The C., M. & P. S. Ry. practically parallels and lies near the Northern Pacific from Missoula to Taft, Mont.; there they diverge, the former bearing to the southwest and crossing the range into the valley of the North Fork, a tributary of the St. Joe River.

Taft being the nearest point to the tunnel on an operated railroad, 2.5 miles distant, it was decided to locate the power house there, generate the electricity and transmit it to substations, one at each end of the tunnel. There were two alternate propositions, both having the main power station located near the east portal. One provided for the construction of a railroad, which would necessarily be on a steep grade, from Taft to the east portal. This would be difficult and expensive to operate on account of both grade and snow. The other was to team all machinery, fuel and supplies from Taft to the power house. The cost of either would have been greater and the probability of uninterrupted service less than that of the one adopted.

A wagon road was constructed from Taft across the range at great expense, over which all supplies, machinery, timber, etc., were transported both for the west end of the tunnel and for the grading and bridge work on the west slope.

This road required a great deal of attention. The average traffic over it was about 100 four-horse teams per day and the maximum about 160 four horse teams. About 60 men were required in summer to keep the road open, and about twice that number were required in winter and spring. These men were stationed in three camps along the road, one at each portal and one at the summit. The road was about 4½ miles long and the summit was about 1,000 ft. above the portals. Fresh snow was attacked with a steel logging plow pulled by 24 horses, then a 30-horse wooden wedge plow was used and the work was finally finished with shovels. In spite of this work the road bed was steadily elevated during the winter until it was well up to the roofs of the camp houses.

During the winter of 1907-08 a cableway one mile long was built from the east portal to the summit. This cableway was driven by a 30-hp. motor. Supplies, fuel, timber, etc., were teamed from Taft to the lower terminal near east portal, carried on the cableway to the summit, there transferred to wagons and hauled down the west slope. This method obviated the long, heavy team haul up the mountain and greatly lessened the time.

The [illegible] power station equipment consisted of the following items:

6 [illegible] Atlas [illegible] pressure tubular boilers set up in batteries of two.
2 Blake 8x5x10-in. boiler feed pumps.
2 Fairbanks Morse 5½x3½x5-in. boiler feed pump.
1 Blake 14x7½x12-in. underwriters fire pump, normal capacity 500 gals. per minute.
1 Blake 14x[illegible]x24-in. air pump and jet condenser.
2 20x48-in. Corliss engines.
1 14x28x20-in. tandem compound McEwen engine direct connected to a 200-kw. 3-phase 60-cycle, 2,200-volt generator.
1 17x22-in. Atlas engine.
1 [illegible]-in. Atlas engine, driving exciters.
2 [illegible]00-kw. 3-phase, 2,200-volt, 60-cycle, G. E. generators belted to the Corliss engines.
1 200-kw. 3-phase, 2,200-volt, 60-cycle, engine type, Westinghouse generator, direct connected to McEwen engine. A 17½-kw. 125-volt Westinghouse exciter was belted to this generator.
1 35-kw. 125-volt G. E. direct connected generator, used for exciter.
3 250-kw. 2,200 to 6,600-volt, 60-cycle transformers—oil cooled.
3 Sets of 6,600-volt multigap lightning arresters with choke coils and all necessary switch board panels, connections, volt meters, circuit breakers, etc.

The machine shop equipment was as follows:

1 24-in. x 11-ft. New Haven heavy duty engine lathe.
1 Four-jaw chuck, 16-in. diameter.
1 20-in. Hoefer back geared drill press fitted for No. 3 drill socket.
1 30-in. Wallcott & Wood geared shaper, extended base and counter shaft.
1 No. 96 Forbes belt and hand driven pipe machine with dies from 1 in. to 6 ins. with cutting off attachment.
1 Blacksmith outfit complete.

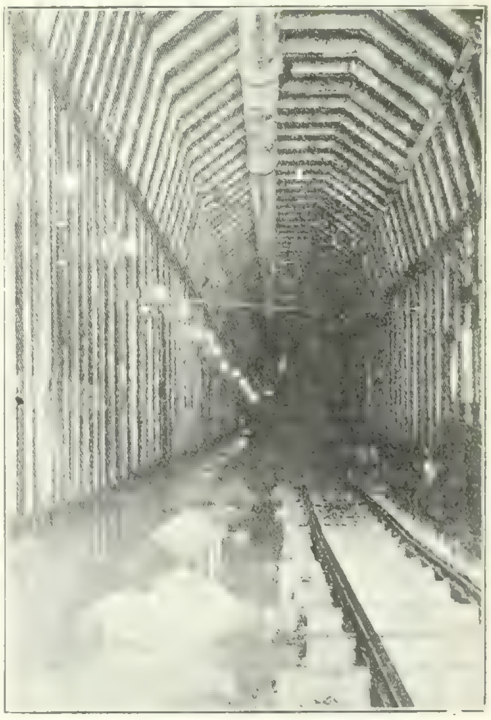

Fig. 2—View Showing Completed Timber Lining of St. Paul Pass Tunnel.

(Large Pipe in Roof is Ventilating Pipe. Small Pipe is High Pressure Line.)

The power station was protected by a good gravity water system in addition to that afforded by fire pump. The capacity of plant was 750 kw. and the alternating current was carried to the sub-station at each end of the tunnel—2½ miles to the east end and 4½ to the west end—over a transmission line of

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[illegible]

three No. 4 copper [illegible] on cross arms bolted to tree trunks about 35 ft. high. The cross arms [illegible] by 1x12-in. [illegible]

- 1 20- [illegible] type J-2.
- 1 Size K E [illegible] vanized [illegible]

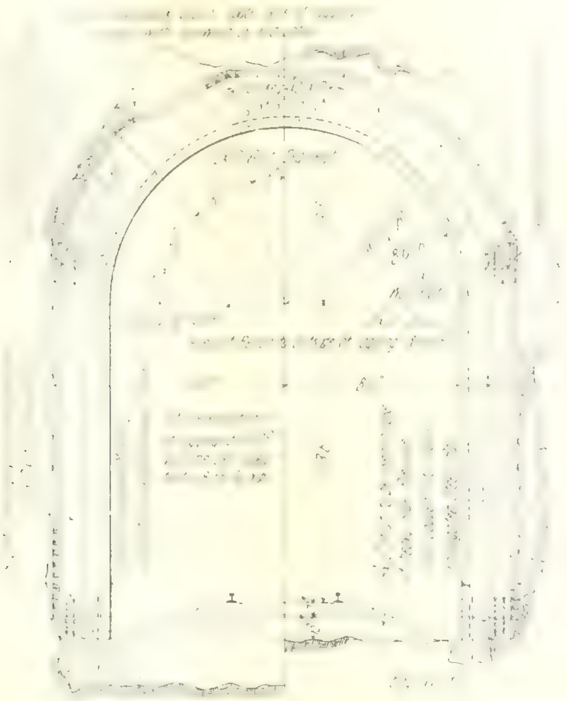

Fig. 3—Cross Section of St. Paul Pass Tunnel.

[illegible] protect the wires [illegible] and prevent short circuiting. They are shown by Fig 1.

At each sub-station the current is stepped down from 6,600 volts to 440 volts through three 100 kw., oil cooled transformers.

The east end sub-station equipment comprised the following items:

- 2 220-hp. 60-cycle, 3-phase, 440-volt, G. E. induction motors, driving compressors.
- 1 100-hp. 60-cycle, [illegible] G. E. induction motor.
- 1 100-kw. 575-volt, G. E., D. C. generator.
- 1 50-hp. 2-pole Thompson Houston 500-volt D. C. generator.
- 1 50-hp. 500-volt Westinghouse D. C. motor.
- 1 30-hp. 4-pole, 500-volt Westinghouse motor.
- 2 Westinghouse-Baldwin electric locomotives fitted with 2 No. 64, 500-volt, D. C. motors, 24-in. gage.
- 2 7½-kw. 500 volt motors.
- 3 100-kw. 6,600 to 440-volt, 60-cycle, G. E., oil cooled transformers.
- 3 7½-kw. 440 to 110/220-volt Westinghouse oil cooled transformers.
- 1 No. 2 Root blower [illegible] galvanized iron air pipe.
- 1 16-in. swing saw.
- 1 Numa drill sharpener.
- 1 No. 1, 20-in. self feed drill press.
- 1 Walcott engine lathe, 18-in. swing, 12-ft. bed.
- 1 Model 20 Marion shovel.
- 25 Ingersoll-Rand $3\frac{1}{2}$-in. air drills.

The equipment at the west end was practically a duplicate of that at the east end except that the air drills used were Wood drills made by the Wood Drill Works, Paterson, N. J.

The compressors at each end furnished power to 13 drills (8 in heading and 5 on bench), the Marion, model 20 shovel, the drill sharpening machine, a welding hammer and two forges. The Marion shovels were constructed especially for this character of work, the booms being short to permit swinging between the lining timbers and were equipped with 1¼ cu. yd. dippers. Drill bits were upset, reshaped and sharpened on a Numa, air driven, drill sharpening machine that proved to be a great factor in making rapid progress.

The ventilation of the tunnel was accomplished by the use of an Exeter fan operated as an exhauster, exhausting through a 24-in galvanized iron pipe made up in 30-ft. lengths with flanged joints and paper gaskets. The end of this pipe was maintained at a distance behind the bench sufficient to prevent the pipe from being dented and perforated by shooting. A No. 2 Root blower was also operated to pump fresh air into the tunnel through an 8-in. galvanized iron pipe. The latter pipe was carried close to the heading face.

The tunnel was driven by the top heading method. The material in general was a laminated quartzite with talc between the strata, but the character changed often, which necessitated changes in the method of conducting the work.

The heading was, when the material permitted, driven with a full face following it as closely as practicable, usually from 50 ft. to 60 ft. with the timber lining, but often it became necessary to drive small side drifts for the wall plates and carry the arch timbers within 2 ft. of the face. Usually 6 drills were operated abreast, driving the full heading face, two on one column about 3 ft. each side of the center line and one on a column in each corner. These were followed by a "trimmer" taking off all points to obtain the correct section. This work was followed by a special timber crew erecting the timber lining.

Fig. 4—View of the West Portal.

The packing back of lagging on side walls from the sills to the height a man could shovel is the natural material excavated from the bench; from this elevation to the wall plates and over the arch the packing is cord wood driven tight and wedged. Wood packing was not particularly objectionable here as the tunnel was very wet. The heading material was shoveled into 1 cu. yd. end dump cars, pushed by hand to a chute back of the bench and dumped into a car on a side track on the bench level. The heading track was [illegible]

TABLE I.—PROGRESS REPORT OF ST. PAUL PASS TUNNEL.

Date	Feet Driven, East End						F[illegible]						Total Feet Driven.	
	Heading.		Bench.		Tunnel.		Heading		Bench.		Tunnel.		Tunnel.	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1				[illegible]									
Feb.	23	38	...		[illegible]	19.0								19.5
Mar.	72	110	...		[illegible]	[illegible]							36.0	55.0
April	68	178	...		34.0	[illegible]							34.0	89.0
May	[illegible]				37.0	[illegible]							37.0	126.0
June	93	345	...		[illegible]	172.5								172.5
July	121	466	...		[illegible]	233.0							60.5	233.0
Aug.	94	560	...		47.0	280.0	[illegible]						60.0	293.0
Sept.	[illegible]				93.5	373.5	38				19.0	32.0	112.5	405.5
Oct.	126	750	172	295	149.0	[illegible]	[illegible]	152				76.0	193.0	598.5
Nov.	[illegible]	[illegible]		134	119.5	[illegible]	91				[illegible]		165.0	763.5
Dec.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				196.5	200.0	963.5
1908.														
Jan.	[illegible]			[illegible]	223.0	[illegible]	159		70					1,291.0
Feb.	[illegible]			[illegible]	[illegible]	1,228.0	285	837	[illegible]	[illegible]	238.5	539.5	176.5	1,767.5
Mar.	218	1,569	205	[illegible]	211.5	1,439.5	[illegible]	1,123	[illegible]	[illegible]	[illegible]	791.5	463.5	2,231.0
April	259	1,828	217	1,527	238.0	1,677.5		[illegible]	[illegible]			1,025.5	472.0	2,703.0
May	[illegible]	[illegible]	[illegible]	1,825	[illegible]	1,947.0	329	1,727	263	[illegible]	296.0	1,321.5	565.5	3,268.5
June	[illegible]			2,150	[illegible]	2,211.0	333	2,060	[illegible]		321.0	1,642.5	[illegible]	3,833.5
July	249	2,521	207	[illegible]	228.0	2,439.0	295			1,544	307.0	1,949.5	535.0	4,288.5
Aug.	[illegible]			2,557	[illegible]	2,698.0	[illegible]			1,959		2,312.0	621.5	5,010.0
Sept.	[illegible]			2,775	262.0	2,960.0	251	2,919	[illegible]	[illegible]		2,605.5	555.5	5,565.5
Oct.	[illegible]			3,047	296.0	3,256.0		3,143	312		[illegible]	2,890.0	580.5	6,146.0
Nov.			[illegible]	3,375	334.0	3,590.0	[illegible]				397.5	3,287.5	731.5	6,877.5
Dec.		[illegible]		[illegible]	320.5	4,211.5			304	3,465	301.0	3,588.5	621.5	7,499.0
1909														
Jan.	[illegible]		[illegible]	3,992	337.0	4,548.5		[illegible]	448		416.5	4,005.0		8,252.5
Feb.	[illegible]		[illegible]	4,312	198.0	4,746.5	104	4,201		4,321		4,261.0	451.0	8,706.5
Mar.			[illegible]	4,389		4,770.0			10	4,361		4,281.0	43.5	8,750.0

[illegible] it was necessary to drill "down" holes and [illegible] a sub bench. In fact, many different tunneling methods were resorted to, as circum- [illegible]

[illegible] and that the effort to maintain this record was splendidly sustained; the [illegible] As will be seen the average monthly progress for 1907 was 80.3 ft. and [illegible] The highest records of daily progress were Nov. 17, 18 and 19, 1908, and were, respectively, 23.5 ft., 32.5 ft., and [illegible]

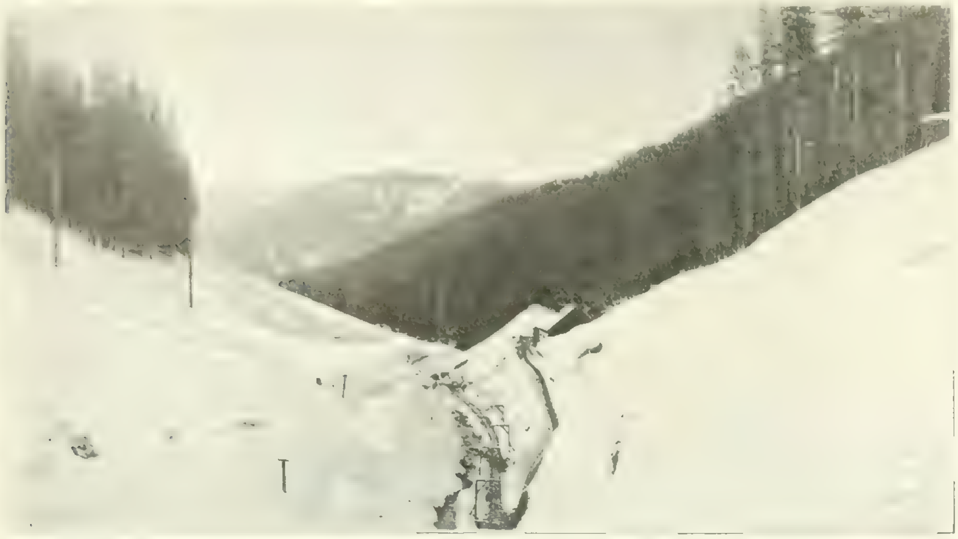

Fig. 5—View from West End of St. Paul Pass Tunnel.

[illegible] was done by the regular bench crew. The completed lining is shown by Fig. 2.

The air shovels loaded all bench material into 1½ cu. yd. Peteler cars which were spotted by horses, but hauled out of and into the tunnel by two 15-hp. electric locomotives at each end—from 8 to 11 cars to the train.

The heading muck cars were run out on a platform over the bench workings a distance of 150 ft. to a muck chute leading to the tunnel trains on a track below. This platform was built ahead as the bench progressed and new chutes were added as required. In front of the bench were two narrow gage tracks on the sides of the tunnel with a crossover beyond the chute for the heading muck.

The electric locomotive hauled the cars to the crossover and the cars were hauled by a horse from here to be loaded and returned to the outgoing track. At the east portal the dump began just outside the approach. Here a 60-ft. fill had to be made for the main line. At the west portal there was a haul of about 2,500 ft. to a 70-ft. fill about 600 ft. long. Snow gave trouble on the dumps and 10 or 12 men were required in winter to keep the track open on the west side and on the east side a temporary snow shed was erected over the dinky track.

The overbreak was carefully measured every 8 ft.—oftener when necessary—and averaged 2.94 cu. yds. per lin. ft. of tunnel. The total quantity removed was 21.5 cu. yds. per lin. ft.

A track incline connecting the heading and bench tracks was utilized for transporting timber and tools to the heading. This incline was so arranged that, as the bench advanced, it could easily be moved forward, and the timbers supporting the heading track could be taken down and used ahead. The incline kept all heading operations away from the bench, and as the work was conducted on the bonus system the bench operations were not interfered with by the carrying of tools, machines and timber into the heading, and consequently the bench operatives could not complain of being discriminated against.

The bonus system consisted in giving $2 to the foreman and $12.50 for distribution among the men for both heading and bench above 3½ ft. per shift based on the monthly average.

The progress record is shown in Table I, a study of which will quickly impress the [illegible]

The view, Fig. 2, and the drawing, Fig. 3, clearly show the type and design of timber lining. The timbers are 12x12-in. Oregon fir; posts 16 ft.; wall plates are 18 ft. long and have a lap joint of 12 ins. fastened together with two ¾-in. bolts. The sills were 4 ft. long, and the arch is made up of five segments with joints slotted for a ½x2½x12-in. key. The usual spacing of the ribs was 4 ft. c. to c., but this was reduced as the pressure became greater. In some places the timbering was placed without spacing between the ribs. The lagging over the arch is 4 ins. thick, but that on the walls, where any at all was used, varied from 4 ins. to 2 ins. in thickness according to the caving propensities of the material. The concrete lining and floor indicated in Fig. 4 was placed at those sections of the tunnel where the pressure was greatest and a year after the driving was completed.

Where the pressure was very great, a built up arch rib was substituted for the solid timber segmental rib. It sustained greater weight without distortion, was more quickly erected and did not collapse when an unusually heavy shot in the bench lowered a wall plate. It also more closely approached the true circular arc.

Both substations were equipped with a complete blacksmithing outfit. The framing sheds were equipped with motor driven swing saws for cutting wedges and lagging.

Two shifts of 10 hours each were worked until about six months prior to the date of completion, when the time was changed to 11 hours per shift. Shifts changed from day to night and vice versa every two weeks. The wage rates were as follows:

	Per 10 hrs.
Shift bosses	$4.75
Machine runners	3.75
Machine helpers	3.25
[illegible] laborers	2.75
Outside laborers	2.25
Carpenters	4.00

No complete records are available of the cost of the work but the following figures are averages taken on the work when it was proceeding at the usual rate. They do not include interest and general office expenses.

Driving	Per lin. ft.
Labor	$ 84.50
Power house labor	7.00
Engineering and superintendence	3.00
Coal 25 tons per 24 hrs. at $2.50	4.16
Freight on coal	3.20
Plant, 50% of cost chgd. against the work	15.00
Power house repairs	8.75
Dynamite heading, 27 lbs. 60% at 16½c	4.45
Dynamite bench, 23 lbs., 40% at 12c	2.76
Caps and fuse	2.10
Rubber clothes	4.62
Drill repairs, small tools, etc	13.65
Water system	.35
Camps	1.16
Total	$154.64

Timbering.	Per M ft. B. M.	Per lin. ft.
Timber delivered at Taft	$18.50	$ 9.25
Timber teaming from Taft, 2½ miles	4.00	2.00
Timber framing	4.50	2.25
Cord wood: cutting $2, teaming $2	4.00	.40
Iron		.40
Erecting on bench		2.00
Erecting in heading		2.35
Total		$ 18.65
Grand total cost of timber lined tunnel		$173.29

The tunnel is on tangent, but there is a curve to the right at the east end and a curve to the left at the west end (stationing increasing toward Seattle) and the spirals extend 20 ft. into the tunnel. The east approach cut is approximately 50 ft. deep and the west cut about 75 ft. deep; these conditions necessitated very short sights for producing the line into the tunnel. Fig. 4 shows the natural conditions.

Owing to the profile of the surface and depth of snow it was necessary to locate all the transit points on towers.

The frame work of these towers was made of round timbers and had a spread at the base of 15 ft. at the top 6 ft. and braced well in both directions. A platform was built on

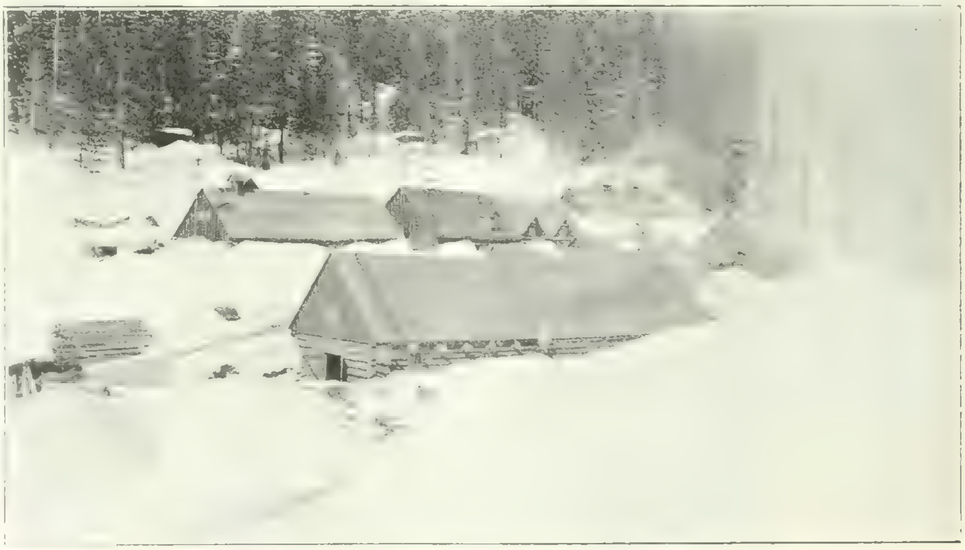

Fig. 6—West End Camp Buildings, St. Paul Pass Tunnel.

the top of the towers, [illegible] access was had by means of ladders. [illegible]mediately after the transit points were established on the towers they were carefully referenced so they could be accurately reset if the towers should shift, which they did. This flimsy method of monumenting the alinement of a tunnel nearly two miles long is justly open to criticism, and it is greatly to the credit of the resident engineer, Mr. A. E. Hammond, and his assistants, that they succeeded in transferring the line into the tunnel with such accuracy and precision that the closure was almost perfect.

The greatest difficulty [illegible] this work was establishing accurately the first points inside the tunnel owing to the refraction occasioned by the meeting of the warm air currents inside the tunnel and the cooler air at the portals. It was necessary to repeat these observations many times, and when the degree of temperature inside and outside was approximately the same. The points inside the tunnel were fine scratches on the heads of tacks driven into a wood block embedded in a concrete monument from which all temporary points were set. Permanent monuments were approximately 500 ft. apart. The levels were run with a 22-in. Gurley instrument, and the alinement with an ordinary Buff & Buff transit. The final result of the instrument work was as follows: Alinement checked to 0.03 ft. Levels checked to 0.01 ft. Measurement checked to 0.13 ft.

The tunnel, shops and camp buildings were lighted by electricity, and a splendid gravity water system with a 150-ft. head provided an ample supply for all purposes including efficient fire protection. Hydrants were conveniently located about shops and camp and 100 ft. of 2-in. hose was attached to each hydrant—all protected from the weather. The camp had lower [illegible] employes.

Substations, power house and headquarters building were connected by telephone. There was a hospital service under efficient management and the railroad division of the Y. M. C. A. had a large and commodious building, under the direction of a regular secretary, devoted to the comfort and amusement of the workmen.

The work was done under Mr. E. J. Pearson, Chief Engineer of the Chicago, Milwaukee & Puget Sound Ry. Co. Winston Bros. Co. were the contractors, while the writer was tunnel engineer for the railway [illegible]

Methods of Constructing and Sinking The Steel Tubes for the Traction Tunnel at La Salle St., Chicago.

The La Salle St. tunnel, the last of the three tunnels under the Chicago River which were required by the U. S. government engineers to be lowered to conform with the regulations of the War Department, was sunk to its place in the bed of the Chicago River on April 2, 1911. The steel tubes lined with concrete are 278 ft. long, 24 ft. in height and 41 ft. wide over all. They are built symmetrically about a center longitudinal axis. The center longitudinal wall is 3 ft. thick, 17 ft. high and forms a heavy reinforced concrete girder the entire length of the tubes. The tubes were erected in a dry dock, floated to the site which had been dredged to receive them, and sunk to a depth giving 27 ft. of water above them.

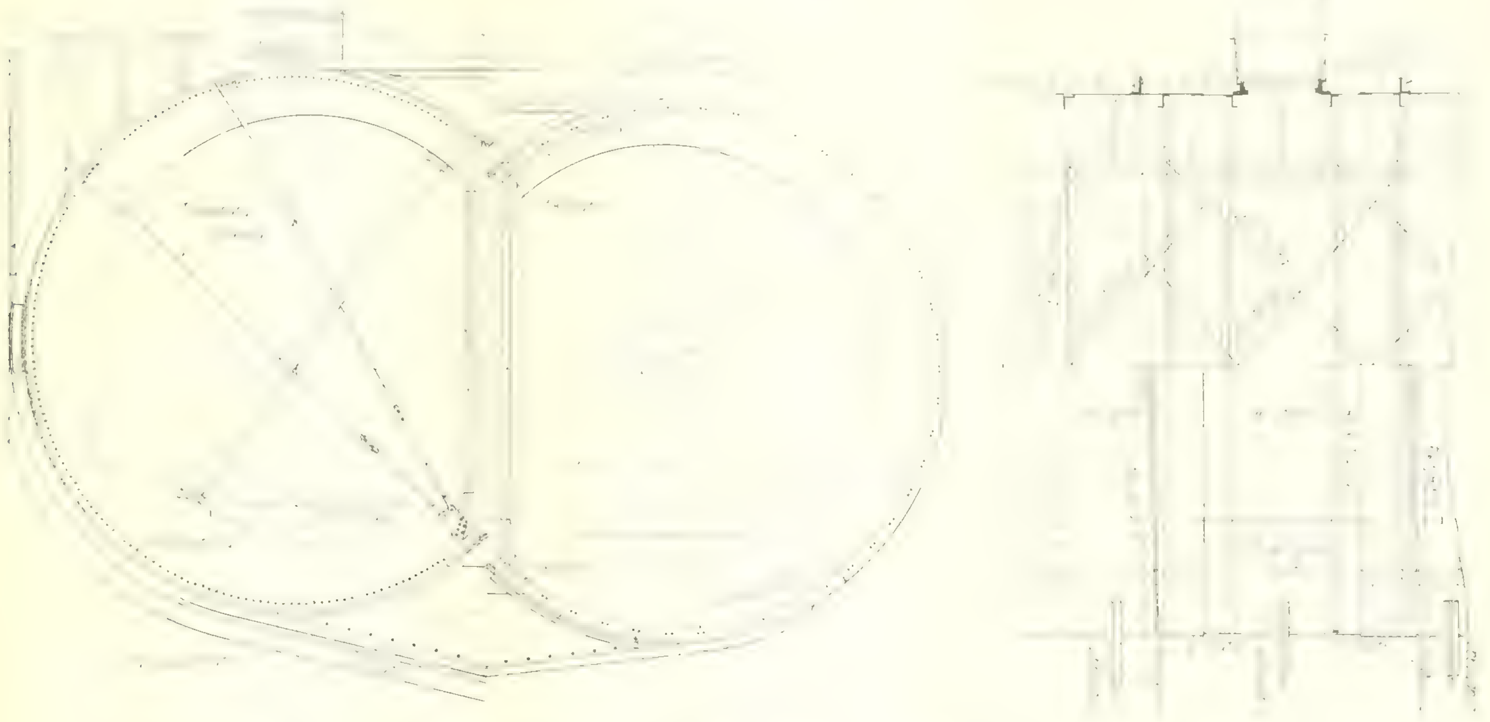

Fig. 1—Showing Details of La Salle St. Tunnel Tubes in Transverse and Longitudinal Sections.

History.—In [illegible] by the Congress of the United States declaring each of the three tunnels under the Chicago River to be an unreasonable obstruction to navigation. The War Department, acting under obedience to the act notified the city of Chicago and the City Council passed an ordinance requiring the tunnels to be lowered so as to clear [illegible]

Work was begun on the Van Buren, the Washington* and the La Salle St. tunnels, but during the work on the latter such serious leaks occurred that the tunnel was filled with water and all work on it was abandoned. In 1908 the Board of Supervising Engineers was organized, which assumed charge of all reconstruction for the Chicago Railways Co. This board immediately set to work upon plans for the reconstruction of the La Salle St. tunnel. Plans were prepared for six types of tunnel, consisting of (1) a single-bore brick of 26-ft. span, (2) a single bore reinforced concrete tunnel of 26 ft. span, (3) a twin-bore brick tunnel (each bore of 14-ft. span), (4) a twin-bore reinforced concrete tunnel (each bore of 14-ft. span), (5) a combined twin and triple bore reinforced concrete tunnel and (6) a triple-bore steel shell for use in the river section in combination with a triple-bore land tunnel.

The general plan for reconstruction of this tunnel provides for a permanent double-bore tunnel extending from Randolph St. on the south to Michigan St. on the north, a distance of 2,000 ft.† Each bore will accommodate a single track with ample room along the outside walls for cables and conduits. The design is such that a connection can be made at either end with a subway without interfering with traffic through the tunnel; and entrances are also provided at either end for the temporary use of the surface cars pending the construction of the Chicago subways. The tunnel will be the main artery connecting territory north of the Chicago River with the subway in the business district.

The plans prepared by the engineers contemplated the execution of the work by the open-cut method, but owing to the fact that the U. S. government engineers objected to obstructing the river with cofferdams the twin-bore steel tunnel was designed. The government engineers permitted the construction of cofferdams for a distance of 60 ft. inside the dock lines, thus leaving 180 ft. free for navigation at all times.

An addenda to the original contract states that the M. H. McGovern Co., contractor for the work, agreed to build the river section of the tunnel by the steel-tube method, "the cost of the same not to exceed the amount originally estimated for doing the work by the open-cut method." Representatives of the contractor presented sketches for the design of a twin-bore steel tube which was similar to that previously developed by the chief engineer of the board, Mr. Bion J. Arnold. These sketches were later developed by the consulting engineers for the contractor, E. C. and R. M. Shankland, and the plans were approved by the board.

Design.—In designing the twin-bore steel shell the scheme of the French engineers for carrying the Metropolitan railway tunnel under the Seine at Paris was considered. A description of this is given in another column in this issue. This method, however, would have involved the use of the open cut method in the river and was therefore out of the question. The method used by the Michigan Central Ry. in sinking its tunnel under the river at Detroit was more closely followed, but the design of the La Salle tubes accomplished a large saving in material over that employed in the Detroit tunnel (Engineering-Contracting, March 2, 1910). The Detroit steel cylinders were separated by about 2 ft. of concrete and were entirely encased in a mass of concrete varying in thickness from 2 ft. at the sides [illegible]

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*See Engineering-Contracting, [illegible]

†See Engineering-Contracting, [illegible] Methods [illegible] Land Sections of the La Salle Street Tunnel.

[illegible] of the [illegible]. The [illegible] ward lined with [illegible].

The La Salle [illegible] two [illegible] to-gether, so that their circumferences overlap. A 3-ft. concrete wall separates the two passages and this contains as reinforcement the [illegible] columns shown in Fig. 1. The tubes are lined with concrete, which varies in thickness from about 2 ft. at the top to about 3½ ft. near the bottom. This lining was designed according to the elastic theory of arches and the concrete was made thicker from arch to invert, closely following the line of pressure. No concrete is placed outside of the steel shell except to level off the depressions above and below the center walls where the tubes join each other.

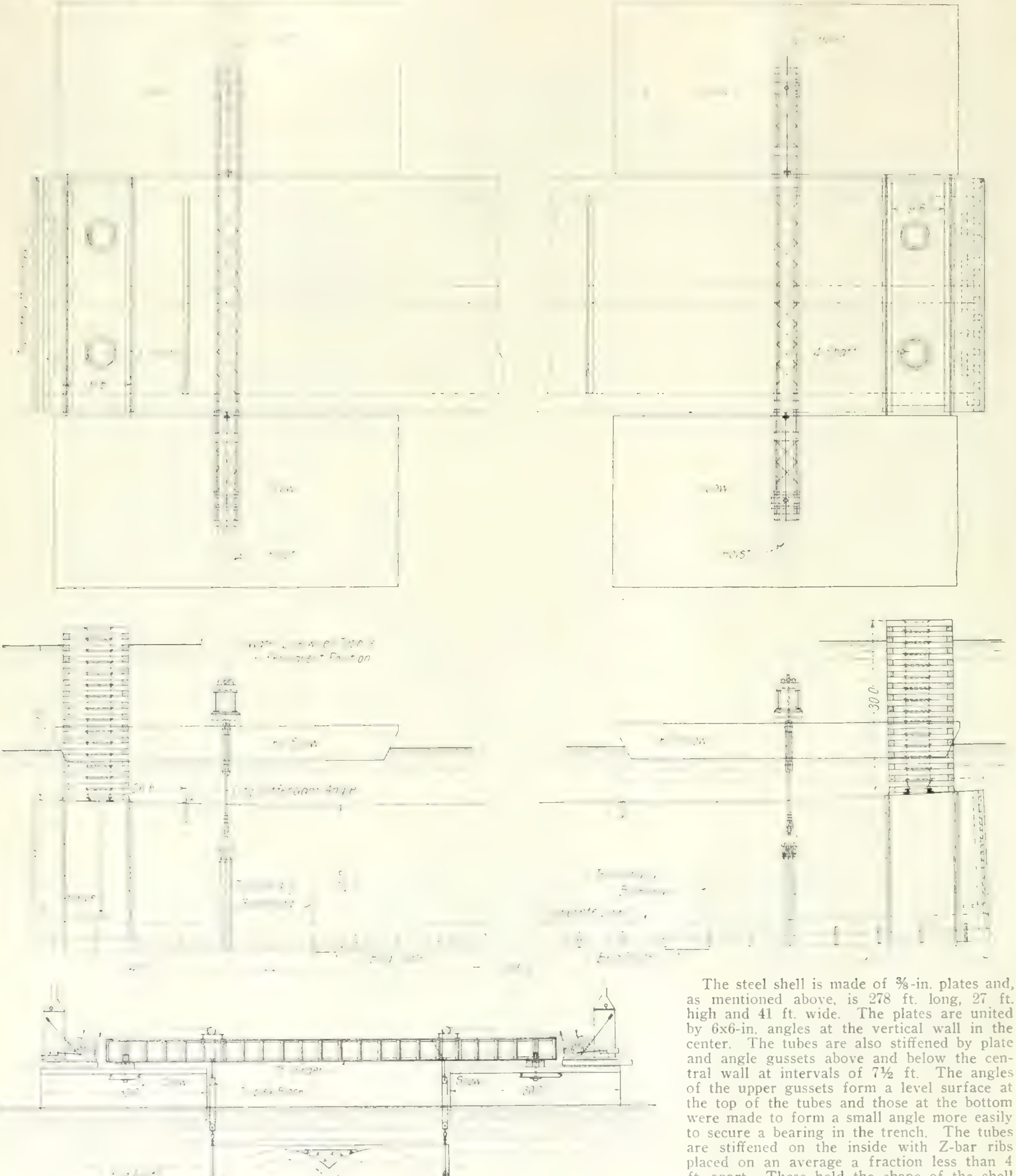

Fig. 2—Showing Method of Sinking the La Salle St. Tunel Tubes, Chicago.

The steel shell is made of ⅜-in. plates and, as mentioned above, is 278 ft. long, 27 ft. high and 41 ft. wide. The plates are united by 6x6-in. angles at the vertical wall in the center. The tubes are also stiffened by plate and angle gussets above and below the central wall at intervals of 7½ ft. The angles of the upper gussets form a level surface at the top of the tubes and those at the bottom were made to form a small angle more easily to secure a bearing in the trench. The tubes are stiffened on the inside with Z-bar ribs placed on an average a fraction less than 4 ft. apart. These hold the shape of the shell during construction and are drilled to receive the ⅝-in. longitudinal reinforcing bars placed in pairs at 11¼-in. centers, as shown by Fig. 3. The Z bars serve also to lock the shell to the concrete lining after the concrete has set. An additional bracing was placed in the tubes to hold their shape during the sinking consisting of 1⅛-in. rods with turnbuckles, as shown by Fig. 3, and a 10x10-in. post to react against the greatest inward pressure, which is near the invert.

Steel Work.—The steel shells were erected in a dry dock on the north branch of the

Chicago River. The [illegible] was handled from the bank to place in the structure by a stiff leg traveling derrick. The accompanying view, Fig. 3 shows the conditions and progress of the work on Aug 10, 1910. The steel work was built and erected by the Henry Pratt Co. of Chicago. The weight of the steel is about 479 tons [illegible] 100,000 ¾ in. rivets were driven for its erection. The seams were caulked inside and outside. The average number of men employed for the erection was between 55 and 60 and the time for erection was about 60 days.

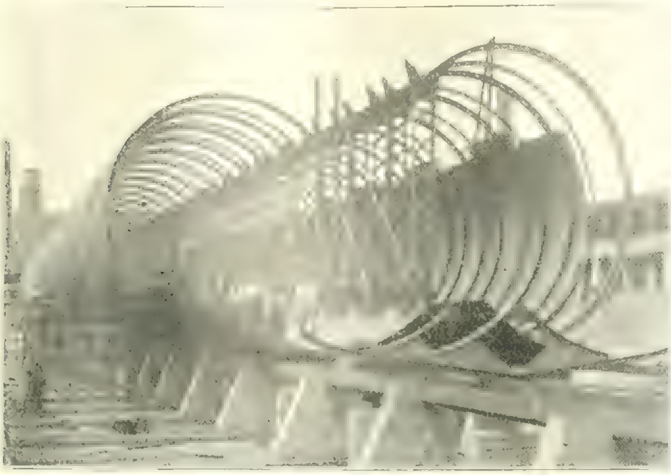
Fig. 3—View of Steel Tubes being assembled at Dry Dock.

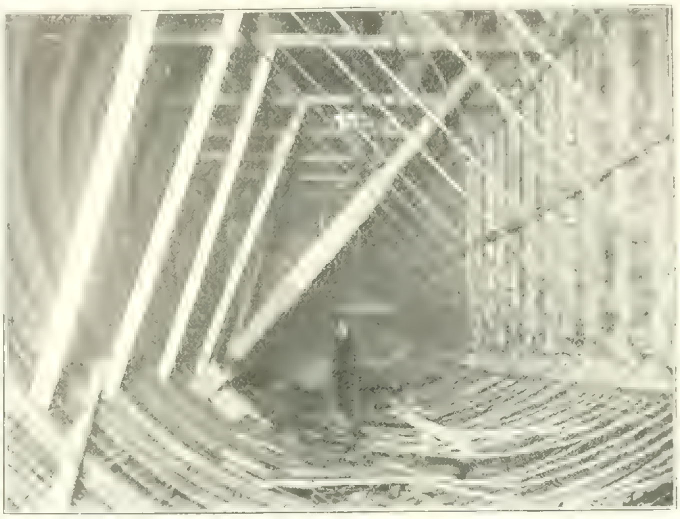
Fig. 4—View of Interior of Tube at Time of Floating.

Concrete Work in Dry Dock.—After the steel construction had proceeded sufficiently a concrete plant was erected near one end of the tubes. A Chicago 1 cu. yd. mixer was supported under a trestle work carrying a platform from one side of the dry dock to the opposite side. The material was brought from storage piles on the bank in wheelbarrows and dumped into the mixer hopper from the platform. At the discharge of the mixer, runways led through the tubes on each side of the center wall.

The first concrete work done was the exterior section beneath the tubes. The tubes were supported on timbering about 3 ft. above the floor of the dry dock and the forms for the exterior section of concrete were supported on short posts under the tubes. The concrete was then [illegible] in the steel shell. The work of concreting the center wall was then begun and the forms were built for it so as to include a very short section of both arch and invert. The forms were carried up [illegible] to permit dumping of concrete from wheelbarrows from the runways. The [illegible] first placed about 5 ft. above the bottom of the tube and later were placed about 5 ft. from the top. A view of the center wall completed with the forms in place is shown by Fig. 4. This also shows the diagonal rods and a few of the 10x10-in. posts which were used as bracing when the tubes were floating. Figure 5 shows the end bulkheads which were put in for floating the tubes. They consist of 3x12-in. plank with 12x12 timbers 1 ft. apart behind them and diagonal braces of 10x10 timbers. The cracks were caulked with oakum. The tubes were floated in this condition on Nov. 21, 1910. The total weight was then about 3,000 tons. It was towed to a wharf near the tunnel where the depth of the water was sufficient to permit the completion of the interior concreting without grounding the tubes.

[illegible] A new concrete arrangement was then devised for carrying on the work of lining the interior. Two 1 cu. yd. Foote mixers were [illegible] the tubes at each end. The mixers were placed on rollers so that they could be used to chute concrete into the manholes of either tube. In this way the long wheelbarrow haul within the tube was limited to one-half the total length of the tube. The shifting of the mixer was a matter of 5 minutes' work for a couple of men. The mixers were worked alternate shifts on the two tubes and concrete was placed at the rate of 200 cu. yds. in 8 hours.

The forms were placed first for a section of the invert about 5 ft. in width. This form consisted merely in a longitudinal bulkhead on the outside and in the forms for the steps which were formed as a base for the cable conduits. Above this point the forms were made of 2x6-in. shiplap, laid over segmental rings formed by two thicknesses of 2x12-in. plank and shaped to the radii indicated on the plans. The arch concrete, only a portion of which has been placed before sinking, was packed in from the end of the forms and grouting pipes were inserted vertically through this section of the lining at short distances apart. After the entire arch is placed a grouting machine will be attached to

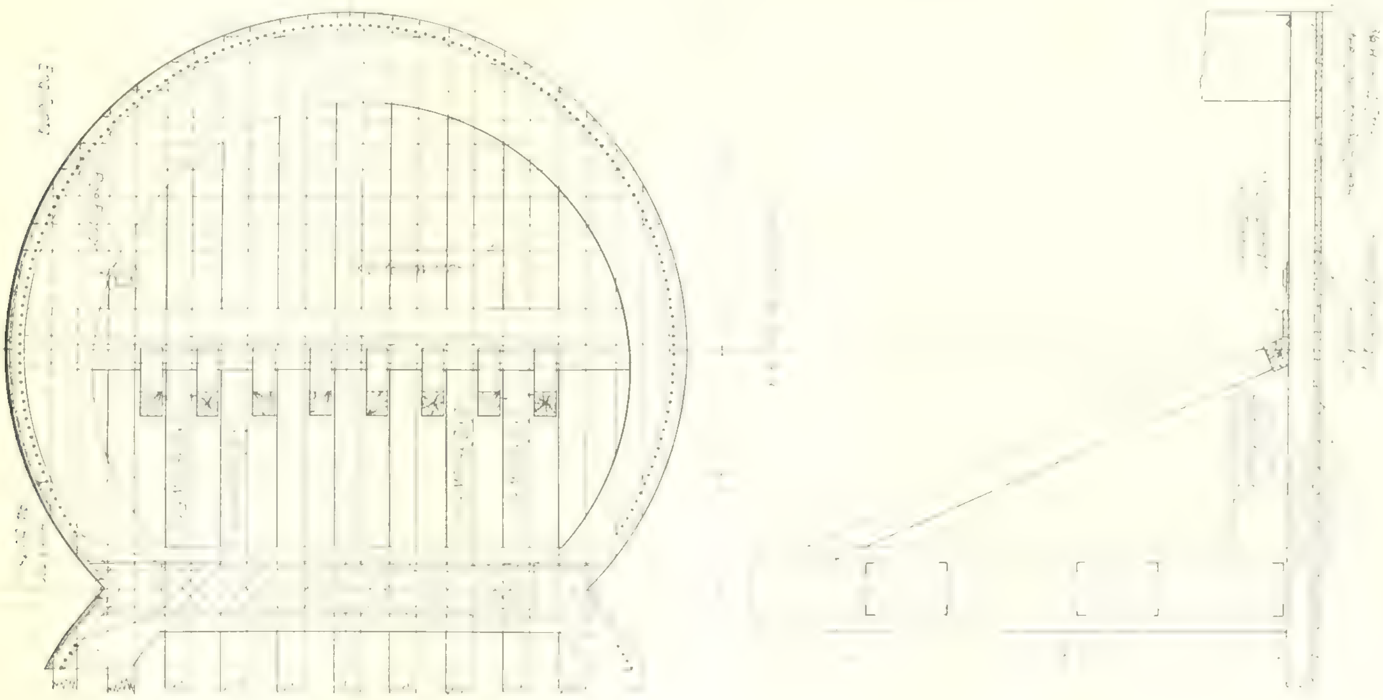
Fig. 5—Plan and Section of End Bulkheads for La Salle Tubes.

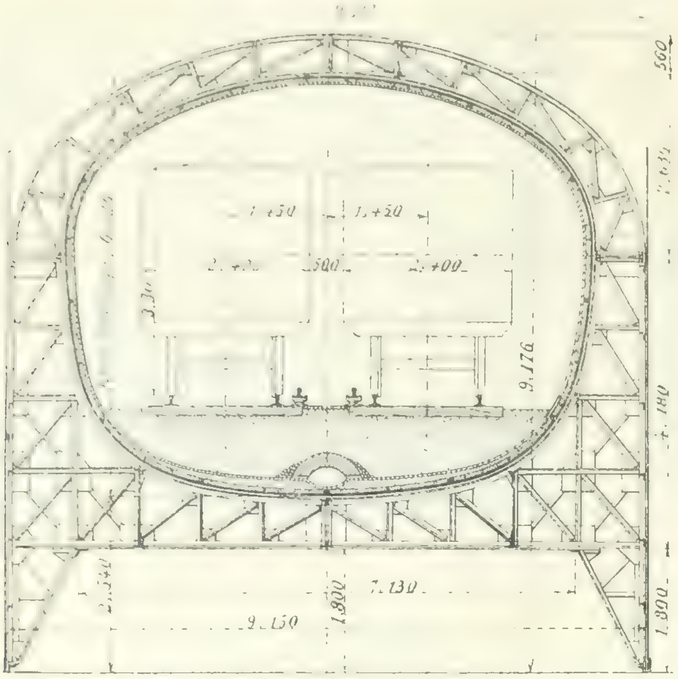

Fig. 1—Section of Tunnel Caisson for the Metropolitan Railway Crossing of the River Seine.

[illegible] fill the voids.

[illegible] ft. below the surface of the water. The ex- [illegible] problem. A dipper dredge was rigged up specially for the work by the Great Lakes Dredge & Dock Co. The dredge was equipped with a 2 cu. yd. dipper bucket on a 72-ft. dipper arm and new spuds of extra length were added. It was at first thought that the dredge could excavate the trench and old invert without blasting, but owing to the length of the dipper arm and spuds, the rivers current, etc., this was found impracticable. A drill boat containing 4 drills was then placed over the invert and in a period of about two weeks the invert was broken up. The material was loaded on scows by the dredge and towed out into Lake Michigan and dumped.

[illegible] the Tubes.—In preparation for the sinking of the tubes, the method for which is illustrated by Fig. 2, crib cofferdams were built on each end of the tubes and the steel shafts for the manholes were built up to the level of the cribbing. This cribbing will be joined at each side by the steel sheet piling forming the balance of the cofferdam connecting the land, and the cofferdam will be completed by filling in between the cribbing and sheet piling with clay. The tubes were estimated to weigh about 7,967 tons when concreted and the displacement is 7,852 tons. For this reason it was necessary to leave a portion of the arch without concreting until after sinking. The tubes when ready for concrete barely projected above water. They were swung across the channel of the river and anchored by guy lines up and down stream to either shore, thus holding the tubes in position on the center line of the tunnel.

The arrangement for letting the water into the tubes consisted of a 4 pipe through the end [illegible] leading to the [illegible] compartments of each tube. The controlling valves were placed at the top of the shafts. The compartments for water were three in number. The center compartment was 80 ft long and on each side of it a 50-ft. compartment was located. The bulkheads dividing [illegible] ins. apart. They were caulked with oakum and the 6-in. space between walls was filled with clay. Water was let into the central compartment first and into each of the other [illegible] accordingly as the weight was needed toward either end.

Another arrangement for controlling the weight of the tubes in sinking consisted in suspending them in cables located near each end. At each point two barges were placed on opposite sides of the tube. These barges supported a box girder 75 ft. long and 42x42 ins. in section, as shown by Fig. 2. At each end of each girder a small hoisting engine and boiler were placed, with cables running from the hoisting drums over the sheaves placed on the girder and down to a belt which was passed under the tube and up to the cable from the engine on the opposite side. This arrangement was calculated to handle 20 tons.

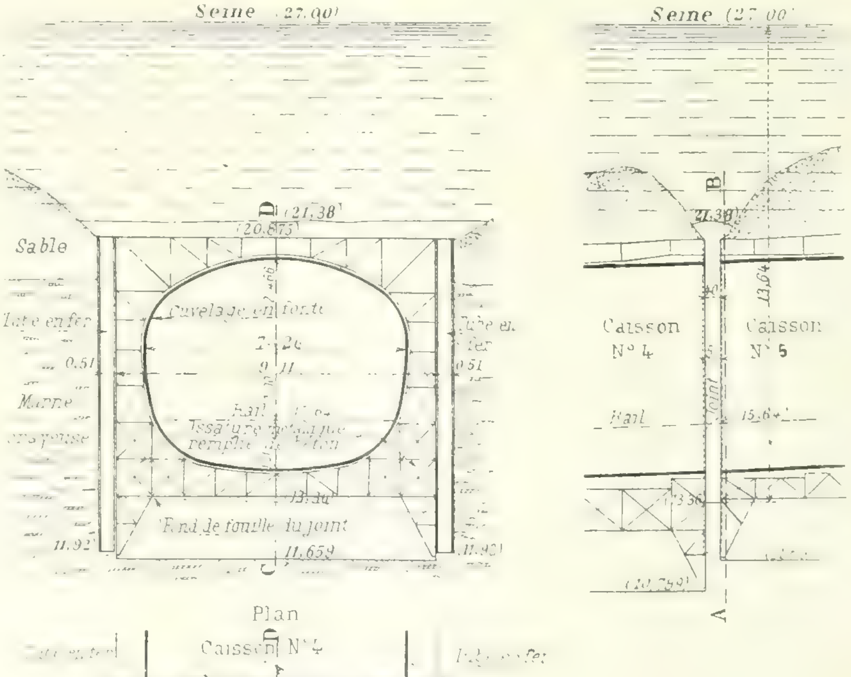

Fig. 2—Sketches Showing Methods Employed for Joining the Ends of Adjacent Caissons.

At each end of the tubes, nailed to the cribbing, were the targets placed for observation by the instrument men. A level rod was placed at each side of the cribbing and a transit target was placed on the center line.

The river current was stopped by closing the gates of the Chicago Drainage Canal at Lockport and little or no interference was had on account of a current in the river. The tubes were landed upon two sets of piles which had been driven to grade in the trench, each set being about 50 ft. from the ends of the tubes. These piles were merely short pieces 6 or 8 ft. long, placed there to take the weight of the tubes until the sand could be pumped in under them, thus forming an even bearing along the entire length. The balance of the filling will consist of sand and clay, leaving a thin layer over the top of the tubes.

The work is being done for the Chicago Railways Co., Mr. John M. Roach president, by the M. H. McGovern Co., which has associated with it Messrs. J. A. Charles and R. H. Green of Chicago. The designs were made for the river section by the E. C. & R. M. Shankland Co., Chicago, consulting engineer for the contractor. The design and work were carried out under the direction and supervision of the Board of Supervising Engineers, Chicago Traction, which has charge of all street railway construction in Chicago. Mr. Bion J. Arnold is chief engineer, Mr. George Weston represents the city and Mr. John Z. Murphy represents the Chicago Railways Co. Mr. Wm. Artingstall is division engineer of the board. Mr. J. Harris is division engineer of the Chicago Railways Co. Mr. Max Landguth is engineer in charge for the contractors and has developed the contractor's method for handling the work.

Method of Constructing a Passenger Railway Tunnel Under the River Seine by Sinking Caissons End to End.

The construction of the river section of the La Salle St. Tunnel, Chicago, by sinking steel tubes across-stream is described in another column. Another method of constructing a somewhat similar tunnel crossing at Paris, France, is illustrated by the accompanying sketches. We are indebted for these sketches and for the following information about the work to *Le Genie Civil* for March 11, 1911:

The tunnel described forms a portion of

[illegible] Metropolitan R[illegible] Paris, an underground rapid transit passenger line. It crosses the River Seine nearly at right angles to its axis at a point near the Pont Mirabeau. Only the river section, which was built by sinking five caissons end to end, is considered here. The total length of caisson tunnel is 196.4 m. (644.2 ft.) and the length of the caissons were as follows:

	M.	Ft.
Two shore caissons [illegible]	35.6	116.77
One center caisson	44.0	144.32
Two intermediate [illegible]	39.8	130.51
Total	194.8	638.94

Adding to the above totals the four 0.4 m. spaces between caissons gives the total caisson tunnel length of 644.2 ft.

A typical [illegible] caisson is shown by Fig. 1. [illegible] frames are spaced 1.4 m. (4.59 in.) apart and carry the tube of cast iron segments like the segments of ordinary cast iron tunnel lining. Inside, the tube was lined with concrete, as indicated. The ends of each caisson were closed with bulkheads of steel plate and the sides of the framework were sheathed with steel plates to the height shown by Fig. 1. The inside of the working chamber was also sheathed and from it there extended upward to above water four steel shafts with air locks. These working shafts are not indicated by Fig. 1, but they were located along the axis of the caisson. Finally the whole framework of the caisson was embedded in concrete.

The caissons were sunk by the ordinary compressed air methods so as to set end to end with a space of 0.4 m. (1.31 ft.) between ends. [illegible] and [illegible] end bulkheads of adjoining caissons could not be removed and the intervening earth be excavated without first closing the joint against water. [illegible] to close the joint at the sides by sinking two iron tubes or cylinders 0.4 m. inside diameter as shown by Fig. 2. The thin slice of earth inclosed by these cylinders and the ends of the caissons was then excavated and the space filled with concrete deposited through a tremie. When this concrete had hardened the steel bulkheads or caisson ends were removed, the wall of concrete was cut through and the segmental cast iron tubing was continued across the space between caissons.

The methods described proved successful in all particulars; not the slightest trouble was had with leaks at the joints.

ROADS AND STREETS SECTION

Average Unit Prices of Pavements Constructed in 1910 in a Number of Representative American Cities.

The accompanying tabulations show the amount and average unit prices for the most common types of pavements laid in 1910 in a number of representative cities. In securing these data no attempt was made to obtain complete statistics for the whole United States. The purpose, rather, was to select cities in various sections of the country on the assumption that their practice and activity would be representative of the section in which they were located. In order to give as much data as possible regarding the local conditions under which the pavement was constructed, information was secured on the prevailing local prices for paving materials and the local cost of labor. These labor and material tables will be found on pages 409 and 413 of this issue. Tables showing the character and average prices of pavements constructed in 1906 werer given in our issue of March 27, 1907; similar information regarding paving work done in 1907 were given in the April 1, 1908, issue of this paper. Data on the paving work done in 1909 were given in our issue of April 6, 1910.

On the blanks sent to the city officials information was asked on only the kinds of pavement most commonly constructed. In many cities, however, various trypes of pavement other than those shown in the accompanying tables were constructed last year, and in the following notes we give a brief description of some of these types.

BITUMINOUS [illegible]

Some 32 cities reported the construction, during the past year, of macadam with a tar or asphalt binder. In most cases this type of pavement was grouped under the general head of bituminous macadam, the kind of binder used and the method of construction not being specified. The following table gives the principal data for the cities thus reporting:

	[illegible]	[illegible]	[illegible]
Boston, Mass.	[illegible]	[illegible]	[illegible]
Hartford, Conn.	[illegible]	[illegible]	
Haverhill, Mass.	[illegible]	[illegible]	6
Lawrence, Mass.	[illegible]		
Lewiston, Me.	[illegible]	[illegible]	
New Bedford, Mass.	[illegible]		
Somerville, Mass.	[illegible]		
Worcester, Mass. [illegible]	[illegible]	[illegible]	
East Orange, N. J.		[illegible]	[illegible]
Corning, N. Y.	[illegible]	[illegible]	[illegible]
Fulton, N. Y.	[illegible]	[illegible]	8
Lancaster, Pa.	5,620	1.00	9
Evanston, Ill.	8,070	1.00	12
Muskegon, Mich.	[illegible]	[illegible]	8
Waukegan, Ill.	2,100[2]	1.85	7½
Minneapolis, Minn.	68,461[1]	1.38	
Little Rock, Ark.	[illegible]	[illegible]	
Berkeley, Cal.	[illegible]	[illegible]	7
Los Angeles, Cal. [illegible]	[illegible]		
Spokane, Wash.	[illegible]	[illegible]	11½

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[1] Laid by city labor. [2] Laid on [illegible] base.

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF BRICK PAVEMENT LAID IN 1910 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES.

	Sq. yds.	[illegible]	Depth of cushion [illegible]	Av. price per [illegible] including grading	[illegible]	Price per [illegible] for grading, if paid separately	Total thickness of pavement [illegible]	[illegible]	[illegible]
New England States:									
Boston, Mass.	37,784	Cement.		$2.60	[illegible]		12		
Bridgeport, Conn.	5,240	Asphalt.	1¼	[illegible]	[illegible]		11¼	5	1-3-6
Cambridge, Mass.	6,222	Cement.	[illegible]	3.25			11		[illegible]
Everett, Mass.	1,216	Cement	[illegible]	3.40[1]			11		1-2-5
Somerville, Mass.	557	[illegible] grout							
Stamford, Conn.	8,458	Cement		2.75[1]					
North Atlantic States:									
Amsterdam, N. Y.	8,130[2]	[illegible] grout	1	2.27	5		11		1-3-6
Annapolis, Md.	2,739[3]	Grout.	[illegible]	[illegible]		$0.42	[illegible]	[illegible]	1-3-6
Bayonne, N. J.	8,874[4]	Cement		2.23*	1	40	11		1-3-6
Binghamton, N. Y.	33,214	Cement	[illegible]	1.96	0		11½		[illegible]
Buffalo, N. Y.	52,119	[illegible] grout	1	2.91	10		11	6	1-10
Corning, N. Y.	[illegible]	Cement	[illegible]	1.73*	1	33	[illegible]		[illegible]
Dunkirk, N. Y.	1,200	Cement	1	1.50*	[illegible]	40	[illegible]		1-3-6
Elizabeth, N. J.	18,996	Grout	1½	2.36	5		[illegible]		1-3-6
Erie, Pa.	38,148		1½	1.51	5		8		1-3-8
Fulton, N. Y.	3,310		[illegible]	2.15					1-3-7
Herkimer, N. Y.	[illegible]	Cement	1½	2.15*	0				1-3-6
Hornell, N. Y.	3,000	Cement	1	[illegible]	1		11		1-4-8
Jamestown, N. Y.	.....	Pitch	1	1.65*[6]		[illegible]	[illegible]		1-2-5
Jersey City, N. J.	6,774	Grout	[illegible]	2.50*	[illegible]	10	[illegible]	[illegible]	1-3-5
Kingston, N. Y.	.....	Cement		2.42			[illegible]		1-2-5
Middletown, N. Y.	[illegible]	Cement		2.50[1]			12	[illegible]	1-3-5
New Brunswick, N. J.	38,000	Cement	1½	2.38			11½		1-3-6
New Castle, Pa.	17,991	Cement	1½	[illegible]	[illegible]	[illegible]	[illegible]		1-3-8
N. Tonawanda, N. Y.		Grout		[illegible]	5		12		[illegible]
Olean, N. Y.	25,000[8]	Cement		1.75*	5	40	11		1-3-7
Oneida, N. Y.	[illegible]	[illegible]	1	[illegible]	[illegible]		11	[illegible]	1-3-6
Oneonta, N. Y.	[illegible]	Cement.		2.03[1]		[illegible]	11	[illegible]	1-4-7
Pittsburg, Pa.	41,398	[illegible]	1	1.81		34	11		1-3-6
Pittsburg, Pa.	2,784[10]	[illegible]	1	1.82	5		11	[illegible]	1-3-6
Port Jervis, N. Y.		[illegible]		1.99*	2	.40	11		1-3-6
Reading, Pa.	[illegible]	[illegible]		2.07	1		[illegible]	[illegible]	1-3-6
Rochester, N. Y.	[illegible]	[illegible]	1	1.80			11	6	1-3-6
Schenectady, N. Y.	10,671	[illegible]	1	2.35*			11		1-3-5
[illegible]	[illegible]	[illegible]		2.19					
Syracuse, N. Y.	[illegible]	Cement.	1	2.01*	10		11		[illegible]
Troy, N. Y.	[illegible]	[illegible]		2.29	5		11		1-3-6
Utica, N. Y.	[illegible]	[illegible]		2.20	5		[illegible]		1-3-7
Wilkesbarre, Pa.	[illegible]	Cement.		2.20		[illegible]	[illegible]		[illegible]
Williamsport, Pa.	[illegible]	Cement.		1.86					
South Atlantic States:									
Charleston, S. C.		[illegible]		1.59	[illegible]				[illegible]
Macon, Ga.	[illegible]	[illegible]		2.08	[illegible]		12		1-3-6
[illegible]	[illegible]	[illegible]	1	1.97					1-3-6
South Central States:									
Gadsden, Ala.	[illegible]	Cement		1.71					
Knoxville, Tenn.	[illegible]	[illegible]	[illegible]						
Louisville, Ky.	[illegible]	Cement							
Vicksburg, Miss.	14,000	[illegible]	1	2.13*			11		
North Central States:									
Anderson, Ind.	25,940	[illegible]		1.35					
Aurora, Ill.	9,400	[illegible]		1.75					
Battle Creek, Mich.		Cement.		1.49[1]			11		
Bloomington, Ill.	[illegible]	[illegible]			[illegible]		10		1-3-5
Bloomington, Ind.	24,000	[illegible]		1.74					1-3-5
Cairo, Ill.		[illegible]		1.58*			11		
Canton, Ill.	8,500	Sand.	1			.35	11		
Cleveland, O.	240,000	Cement.		1.45*			10		
Columbus, O.	154,908	[illegible]			5	10			1-4-8
Dayton, O.		[illegible]	1	1.52					
Evanston, Ill.	20,285	[illegible]				21			
Evansville, Ind.	[illegible]	[illegible]		....			[illegible]		
Flint, Mich.	96,066			1.85*	6		11		
[illegible]	[illegible]			1.59½*			11		
Freeport, Ill.	[illegible]	[illegible]		1.14*		30			
Gary, Ind.	6,509	[illegible]		1.66*	5	26			1-3-5
[illegible], Ill.		Cement.		1.33*					[illegible]
Grand Rapids, Mich.		[illegible]	[illegible]	1.75*					1-3½-7
[illegible], O.		[illegible]		1.89	[illegible]				
Kalamazoo, Mich.	14,894	Asphalt.		1.87	5				
[illegible], Mich.	[illegible]	Pitch.	1	1.95			10		
Lansing, Mich.		Cement.		1.91			11		
Lima, O.	14,000	Cement.		1.40*	[illegible]	[illegible]			1-3-6
Logansport, Ind.	6,000	Cement.		1.71			11		1-3-7
Marion, Ill.	.....	Cement		1.58*	[illegible]		11		1-3-6
Mattoon, Ill.	9,000	Cement.	1½	1.50*		[illegible]	[illegible]		1-2-8

[illegible] average cost of 75.4 cents per sq. yd. Broken [illegible]

[illegible] dam base at an average cost of from 12 cents [illegible] $1.20 per cu. yd. and common labor received $2 for an 8-hour day.

Portland, Me., constructed 16,035 sq. yds. of 6-in bituminous macadam by the penetration method at an average cost of $1.08 per sq. yd.; 7,373 sq. yds. of 7-in. bituminous maca[illegible] Broken stone cost $1.50 per cu. yd., and common labor was $1.75 per 8-hour day.

At Reading, Pa., 3,407 sq. yds. of water bound macadam was resurfaced with bituminous macadam, the work being done by the city labor at a cost of 35¼ cents per sq. yd. Broken stone cost $1.20 per ton, and common labor was paid for at the rate of $1.60 per 8-hour day; $3.60 per day was paid teams with drivers.

[illegible] bituminous macadam was constructed at Watertown, N. Y., by city forces, by the penetration method, 2 gals. of tar being used per sq. yd. The total thickness of the pavement was 6 ins. and the average cost was 85 cents. Broken stone cost [illegible] Common labor was paid at the rate of $1.75 per 8-hour day, and $4.00 per day was paid for teams with drivers.

At Grand Rapids, Mich., 4,767 sq. yds. was constructed by the pouring method at a cost of $1.10 per sq. yd. The macadam was constructed on a 6-in. 1-3½-7 Portland cement concrete base, the total thickness being 11 inches.

Bituminous macadam on a crushed slag foundation was constructed to the extent of 9,500 sq. yds. at Lorain, O. The total thickness of the pavement was 10 in., and the average cost per sq. yd. was 90 cents. Broken stone cost $1.20 per cu. yd. and slag cost 70 cents per cu. yd. Common labor was paid at the rate of $1.75 per [illegible]-hour day, $4.50 per day was paid for teams with drivers.

At Waukegan, Ill., 6,000 sq. yds. of tarvia macadam was constructed at an average cost of $1.20 per sq. yd., with a 2-year guarantee. The total thickness of the pavement was 12 in. Broken stone cost $1.40 per cu. yd. Common labor was paid $2.25 per 8-hour day.

Pasadena, Cal., constructed 49,593 sq. yds. of 6-in. oil macadam, the average cost per sq. yd. being 90 cents. Broken stone cost $1.60 per cu. yd. and common laborers were paid $2.50 per 8-hour day.

At San Francisco, 273,198 sq. yds. of pavement were constructed with a 2-in. or 2½ bituminous rock surface. This surface was placed on a 6-in. 1-2½-7 Portland cement concrete base and the average price, including the base, was $2.43 per sq. yd. Portland cement cost $2.55 per bbl.; broken stone, $1.10 per cu. yd., and sand $1.73 per cu. yd. Common labor was paid $2.50 to $3 per 8-hour day and $6.50 per day was paid for teams with drivers.

[illegible]

A total of 31,019 sq. yds. of bituminous concrete pavement was laid at Grand Rapids, Mich., last year. The average price of the pavement, including a 6-in. 1-3½-7 concrete base was $1.80 per sq. yd., with a 5-year guarantee. The total thickness of the pavement was 8½ ins. Cement cost $1.50 per bbl.; broken stone, $1.50 per cu. yd., and sand $1 [illegible] paid $2 per 10-hour day.

At Lansing, Mich., 7,163 sq. yds. of asphaltic concrete was constructed at an average price of $2.161, this including a 6-in. 1-6 gravel Portland cement concrete base and a 5-year guarantee. The total thickness of the pavement was 8 ins. Cement was $1.50 per bbl. and gravel cost $1.00 per cu. yd. Common labor was paid $2 per 8-hour day.

Asphaltic concrete was also constructed at South Omaha to the extent of 38,174 sq. yds.

[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	..	..	.	..
[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]		11	6	1-3-5
[illegible]	[illegible]	Asphalt.	1½	1.69	[illegible]		10½	5	1-2½-5
[illegible]		[illegible]	[illegible]	[illegible]	1		14	8[illegible]	.....
[illegible]	[illegible]	[illegible]	1			.	11	6	1-3-6
[illegible]	20,921	[illegible]			[illegible]		9½	4	[16]1-7
[illegible]	200,000	Sand.		[illegible]	1	.35[34]	11	5	1-3-6
[illegible]	2,572	Grout.		1[illegible]		.24	12	6	[illegible]1-8
Port Huron, Mich...	2,019[36]	Cement.		[illegible]	[illegible]		12	6	.....
[illegible]	19,812	[illegible]	1[illegible]	..	[illegible]		10	[illegible]	1-3-5
[illegible]	4,700	[illegible]		[illegible]					.....
[illegible]	1,320	[illegible]	1½	1.95			..		
[illegible]	26,240	[illegible]	1	[illegible]	[illegible]	.35	11	6	1-2½-5
[illegible]	[illegible]	[illegible]		1.50[39]	[illegible]	.50	10	6	1-3-6
Springfield, O........	1,200	Cement.	1	1.60	5		11	6	1-3-7
[illegible]	1,800	Asphalt.		1.77*	2	.40	12	.	..
[illegible]	40,600	Sand.		[illegible]	2	.40	12		...
Zanesville, O........	4,190[40]	Sand.		1.05	[illegible]	..	12		
Northwestern States:									
[illegible], Minn.	3,658[41]	Cement.	1½	[illegible]	5	.50	10½	5	[42]1-7
[illegible]	1,262	Pitch.	1	[illegible]	5	....	10	5	[42]1-6
[illegible]	13,522	Sand.		[illegible]*	2	.57	10	4	1-3-5
[illegible], Mont.	2,315	Cement.		3.75	.	....	12	6	1-3-5
[illegible], Ia.	19,000	Sand.	2	2.00	1	....	12	6	1-3½-7
Coffeyville, Kan.....	25,000	Cement.	2[43]	1.45*	2	.25[44]	13		.....
Council Bluffs, Ia...	20,277			2.07½	5	.40	9½	4	1-2-4
Davenport, Ia.	39,381	Sand.		1.65*	2	.40		5	1-3-6
[illegible], Mont.	1,834	Grout.		2.85*	5	.65	11	[illegible]	1-3-6
Independence, Kan..	88,157	[illegible]	1½	1.35*	0[5]	.35	11¾	6[45]	.....
Iowa City, Ia.........	15,300	Sand.		[illegible]½*[46]	1	.45	11	5	1-3-6
Lawrence, Kan	52,000	Grout.[illegible]	1½	1.[illegible]	1	.35	9½	4	1-3½-7
Leavenworth, Kan..	53,606	Grout.	1½	1.47*	5	.35	9½	4	1-3-6
Lincoln, Neb.		[illegible]		2.15[49]	1	.50	11	5	1-3-6
Mankato, Minn.....	[illegible]	Cement.		1.91	5		..	6[illegible]	1-2-6
Minneapolis, Minn..	[illegible]	Asphalt.	1	2.5[illegible]		.	10	5	1-3-6
Ottumwa, Ia.	22,000	Cement.		1.81½	[illegible]	..	12	6	1-3-5
Sioux City, Ia.	7,000	Grout.	1	2.05		..	9		1-3-5
South Omaha, Neb.	[illegible]	Sand.[51]	1½	1.91[52]	1	....	10½	5	1-3-6
Topeka, Kan.	81,1[illegible]0	Sand.[33]		1.26*[53]	0[5]	.32	10		.....
Wichita, Kan.	57,833	Asphalt.[54]	1½	2.00*[55]	5	.45	11½	6	1-3-6
Southwestern States:									
Enid, Okla.	8,577	Cement.	2	2.36*	5	.35	11	5	1-3-5
Little Rock, Ark....	7,000[56]	Asphalt.	[illegible]	1.75*	5	....	..		.....
McAlester, Okla...	26,910		1	2.72*		....	.	5	1-2-4
Muskogee, Okla....	26,97[illegible]	Asphalt.[57]	2	1.98*	5	.35	..	.	1-3-6
OklahomaCity, Okla.	25,000	Cement.		2.10*	5	.35	10	5	1-3-5
St. Louis, Mo....	312,356	Grout.	1	1.80*	5	.	11	6	1-4-7
Waco, Tex.	10,000			2.00	0[5]	..	..		....
Pacific States:									
Everett, Wash.	15,598	Grout.	1½	2.68*		.77	10½	5	1-3-6
Hoquiam, Wash. ..	18,500	Grout.	2	3.00		.65	12	6	1-3-6
Los Angeles, Calif..	.516[58]	......		..		....	.		.....
Seattle, Wash. ..	118,808	Cement.[59]	1½[60]	2.69*	6[61]	.50	9½[62]	4	1-4-7
Spokane, Wash.....	50,217	Grout.	1	2.96*	5	...	10	5	1-3-6
Tacoma, Wash......	58,094	Grout.	1½	2.00*	.	.	10¾	5	1-3-6

*Does not include grading.

[1] Done by city labor. [2] Also 430 sq. yds. at $2.70. [3] Bessemer block. [4] Metropolitan block. [5] No guarantee required. [6] Price for work done by day labor; contract price with 5-year guarantee was $1.85 per sq. yd. [7] Natural cement concrete base. [8] Repressed blocks. [9] 11 or 12 ins.; concrete base 5 or 6 ins. [10] Repaving. [11] Porter block. [12] 50 cts. per cu. yd. over 12 in. deep. [13] 4-in. and 6-in. base. [14] Laid on viaduct. [15] Gravel base. [16] Gravel. [17] Asphalt; also concrete. [18] 10-in. and 12-in. [19] 4-in. and 6-in. base. [20] Washed river gravel. [21] Two courses of brick. [22] 30 cts. to 60 cts. [23] Asphalt and cement grout also used. [24] Sand or cement. [25] 6-in. thick beneath car track ties. [26] 6-in. stone foundation. [27] 25 cts. to 40 cts. [28] Bank gravel. [29] No guarantee, pavement built under Indiana 3-mile road law. [30] Some brick pavement laid on gravel base, using sand filler cost $1.05 per sq. yd. [31] 8-in. gravel base. [32] Some of brickpavement was laid on 12-in. macadam base, sand filler being used and a 5-year guarantee required; this pavement cost $2.19 per sq. yd. [33] Cement and pitch fillers were also used. [34] 35 cts to 50 cts. [35] 11-in. to 12-in., the concrete base being 5-in. or 6-in. [36] Laid on old 6-in. concrete base. [37] 1-in. and 2-in. sand cushions. [38] Sand also used as filler. [39] Cost with crushed stone base. [40] Laid on gravel base. [41] Laid in alleys. [42] Pit run gravel. [43] 1-in. sand, 1-in. chats. [44] 25 cts. to 35 cts. [45] 6-in. macadam base. [46] $1.64½ to $1.69½. [47] Sand also used in fillers. [48] Asphalt; cement grout also used. [49] $2.15 to $2.40. [50] 6-in. natural cement concrete base. [51] Sand, also cement. [52] $1.91 minimum price, $1.93 maximum. [53] $1.26 to $1.39. [54] Cement also used. [55] $2.00 and $1.35. [56] Resurfacing old pavement. [57] Asphalt and grout. [58] .516 per mile. [59] 1-1 mixture Portland cement. [60] 1½-in. and 2-in. [61] Maintenance 0 to 6 years. [62] 9⅛-in. to 11⅛-in. in concrete base being 4-in. or 6-in.

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF STONE BLOCK PAVEMENT LAID IN 1910 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES.

	Sq. yd.	Kind of filler	Av. price per sq. yd., including base and grading	Guarantee, years.	Total thickness pavement, ins.	Portland cement concrete base.	
						Thickness, ins.	Proportions.
New England States:							
Boston, Mass.	27,115	Pitch.[1]	$3.25				
Bridgeport, Conn.	.	Cement.	..	.	13	6	1-3-6
Brookline, Mass.	8,900	Cement.[2]	3.24		10	4	
Cambridge, Mass.	12,095	Cement.	3.00		1[illegible]	6	1-2½-5
Everett, Mass.	6,201[3]	Cement.	3.40[4]		11	5	1-2-5
Fitchburg, Mass.	4,397[5]	Cement.	[illegible][4]			6	1-3-7
Haverhill, Mass.	5,968	Cement.	2.84		9		
Lawrence, Mass.	71,529[6]	Cement.	2.91		12	6	1-3-8
Lowell, Mass.	16,236	Cement.	3.09			6	Hassam
Lowell, Mass.	5,700[7]	Sand.	1.43				
New Bedford, Mass.	1[illegible]	Sand.	4.00				
Portland, Me.	4,830	Cement.	1.94				
Providence, R. I.......................	8,[illegible]	Sand.	2.[illegible]0[4]				
Somerville, Mass.	[illegible]	Cement.	3.15		9½	.	1-3-6
Somerville, Mass.	8	Pitch.	3.08[4]		10	6[9]	
Woonsocket, R. I.	1,152[10]		.....				.
Worcester, Mass......................	[illegible]	Cement.	3.08				
North Atlantic States:							
Buffalo, N. Y.	[illegible]	Cement.[12]	[illegible]	10	15	6	1-10
Camden, N. J.	531	Sand.	1.73	1	[illegible]		
Elizabeth, N. J........................	24,260[13]	Sand.	2.00		12		
Hoboken, N. J.........................	3,015	Asphalt.[14]	[illegible]		1[illegible]	6	1-3-7
Jersey City, N. J......................	..	Tar.[16]	[illegible]*	.	[illegible]	[illegible]	1-3-5
Jersey City, N. J.	25,1[illegible]	Cement.	[illegible]*	[illegible]	16	6	1-3-5
Jersey City, N. J.	[illegible]	Sand.	1.[illegible]0*	[illegible]	1[illegible]		.....
Little Falls, N. Y.	100[19]	Asphalt.	[illegible]	.	11	.	1-3-6
Niagara Falls, N. Y.	1,1[illegible]	Cement.	3.38				.
Pittsburg, Pa.........................	18,[illegible]	Gravel.	2.01	1			
Pittsburg, Pa.........................	21,116[21]	Gravel.	1.97	[illegible]	15		
Reading, Pa.	1,200	Cement.	2.23	1	10½		
Rochester, N. Y.......................	5,600[22]	Cement.	2.90	.	14	6	1-3-6
Scranton, Pa.	[illegible],054	Sand.	2.16	.	10		
Troy, N. Y.	1[illegible],369	Cement.	3.00	[illegible]	12½	[illegible]	1-3-6
Utica, N. Y..........................	[illegible]	Cement.	3.20		1[illegible]	.	1-3-7
[illegible], N. Y.	7,[illegible]	Cement.				6	.
[illegible], Pa.	[illegible]	Cement.	2.95		1[illegible]	6	1-2-5

The minimum price [illegible] was $1.84 and the maximum price was $1.90; a 5-year guarantee was required. The total thickness of the pavement was 7½ ins., which includes a 5-in. 1-3-6 Portland cement concrete base. Cement cost $2.28 per bbl., broken stone cost $2.20 per cu. yd. [illegible] was paid at the rate of $2 per [illegible] and $5 per day was paid for teams with drivers.

At Muskogee, Okla., 3,500 sq. yds. of bituminous concrete was constructed, at a cost of $1.84 per sq. yd., including base. The total thickness of the pavement was 7½ ins., including the 1-3-6 Portland cement concrete base. A 5-year guarantee was required. Common labor cost $1.75 per 8-hour day, and teams with drivers cost $4. Cement cost $1.70 per bbl., broken stone cost $1.35 per cu. yd., and sand cost 80 cents.

Fresno, Cal., constructed 31,000 sq. yds. of 5-in. asphaltic concrete, the average cost per sq. yd. being $1.40. Cement cost $3 per bbl. and broken stone and sand cost $1.00 per cu. yd. Common labor cost $2 per 8-hour day.

ASPHALT BLOCK PAVEMENT.

At Burlington, Ia., 1,255 sq. yds. of concrete pavement was constructed at an average price of $1.45 per sq. yd., including a 2-year guarantee. The pavement consisted of a 2-in. concrete wearing surface and a 6-in. 1-3-5 Portland cement concrete base. Portland cement cost $1.65 per bbl., broken stone cost $2.00 per cu. yd. delivered, and sand cost $1.25 per cu. yd. Common labor was paid $2 per 8-hour day; teams with drivers were paid $4.50.

A total of 15,116 sq. yds. of concrete pavement was constructed at Davenport, Ia., at an average price of $1.38 per sq. yd. The pavement consisted of a 2-in. 1-1 top and 5-in. 1-3-6 base. The guarantee was two years. Common labor received $2.00 per 10-hour day, and $5.00 per day was paid to teams with drivers. Portland cement cost $1.15 per bbl., broken stone cost $1.25 per cu. yd., and sand cost 40 cents per cu. yd.

At Boise, Idaho, 45,325 of 6-in monolithic concrete was constructed at an average price of $1.10 per sq. yd. A 1-3-7 Portland cement concrete was used. Portland cement cost $3.20 per bbl. Common labor was paid $2.50 per 9-hour day, and $5 per day was paid for teams with driver.

At Spokane, Wash., 50,245 sq. yds. of granitoid concrete was constructed at an average price of $2.50 per sq. yd. A 5-year guarantee was required. The total thickness of the pavement was 6¾-ins. A 5-in 1-3-5 Portland cement concrete base was used. Cement cost $2.80 per bbl., broken stone $1.50 per cu. yd. and sand $1.25 per cu. yd. Common labor cost $2.00 per 9-hour day, and $6.00 per day was paid for teams with drivers.

Tacoma, Wash., laid 3,032 sq. yds. of concrete at a cost of $1.20 per sq. yd., the pavement consisted of a 2-in. wearing course in the proportions of 1 cement, 2½ sand and pea gravel and a 4-in. 1-3-6 base. Cement cost $2.25 per bbl., broken stone $3.25 per cu. yd., and sand $1.50 per cu. yd. Common laborers were paid at the rate of $2.50 per 8-hour day and $6 per day was paid for teams with drivers.

[illegible]

The following cities reported the construction of asphalt block pavement last year:

East Orange, N. J.	22,611	$2.00	[illegible]	5
Flint, Mich.	[illegible]	2.01	[illegible]	[illegible]
Grand Rapids, Mich.	[illegible]	[illegible]	[illegible]	5
Jamestown, N. Y.	6,843	2.40	[illegible]	5
Niagara Falls, N. Y.	[illegible]	[illegible]		5
Norfolk, Va.		2.65		[illegible]
Springfield, Mass.	712	[illegible]	[illegible]	
Springfield, O.	7,500	[illegible]	[illegible]	[illegible]

In the case of the first four cities the average price per sq. yd. does not include grading; for the last four cities the price includes

South Atlantic States:							
Norfolk, Va.	16,000	Sand.	.50		11		
Louisville, Ky.	10,435	....	3.27	[illegible]	[illegible]	6	1-3-7
North Central States:							
Cleveland, O.	16,426[22]	Cement.	[illegible]*	[illegible]	[illegible]	[illegible]	[illegible]
Milwaukee, Wis.	[illegible][6]	Cement.	3.14				
Milwaukee, Wis.	10,913[27]	....	3.15				
Northwestern States:							
Butte, Mont.	1,190[27]	Sand.	4.25		14	[illegible]	1-3-5
Minneapolis, Minn.	71,327	Sand.	[illegible]		[illegible]		
Southwestern States:							
St. Louis, Mo.	30,564[27]	Sand.	[illegible]*	[illegible]	[illegible]	[illegible]	1-4-7
Pacific States:							
San Francisco, Cal.	[illegible]	Sand[29]	[illegible]				.....
Seattle, Wash.	19,747[27]	Cement.	3.70*	[illegible]	[illegible]	1	1-4-7
Seattle, Wash.	32,751[32]	Cement.	3.50*				
Tacoma, Wash.	[illegible]	Cement.	3.10*				1-3-6

*Does not include grading. [illegible] per sq. yd. [6]Includes as yardage of old granite blocks furnished by city and laid at a price of [illegible] street railway company, the city furnishing old blocks. [11]Miles. [12]Asphalt cement also used. [13]Laid on 6-in. sand foundation. [14]Asphalt and tar. [15]12-in. and 14-in. [16]Gravel and tar. [17]Granite block. [18]Laid on 6-in. sand base. [19]Medina sandstone. [20]Ligonier block repaving. [21]Ligonier stone. [22]Medina block stone. [23]Sandstone. [24]Granite blocks; work under way now. [25]Second hand stone laid on sand base by city. [26]Kettle River standstone. [27]Granite. [28]Basalt block. [29]Sand, gravel and asphalt filler. [30]Maintaining term 0 to 6 years. [31]11¼ in. to 13¼ in. depending on whether 4-in. or 6-in. concrete base is used. [32]Sandstone.

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF WOOD BLOCK PAVEMENT LAID IN 1910 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES.

						Portland Cement Concrete Base	
		Kind of filler	Average price per sq. yd., including grading	Guarantee, years	Total thickness of pavement, ins.	Thickness, ins.	Proportions
New England States:	Sq. yds.						
Boston, Mass.	[illegible]	Cement	$3.50		10½	6	[illegible]
Bridgeport, Conn.	27,305	Asphalt.	.....	5	10¾	6	1-3-6
Lawrence, Mass.	2,187	Pitch.	.....	.	..	6	1-3-5
Springfield, Mass.	[illegible]	Grout	3.00		[illegible]	4½	[illegible]
North Atlantic States:							
Hoboken, N. J.	5,683	Sand.	3.34	5	9	5½	1-3-6
Jersey City, N. J.	8,687	Grout.	3.15*	5	9	5	1-3-5
Pittsburg, Pa.	1,080	Grout.	4.20	5	10	6	1-3-6
Rochester, N. Y.	3,000	Sand	[illegible]		11	6	1-3-6
Watertown, N. Y.	6,100	Sand.	2.50[1]	5	9½	5	1-5[2]
South Atlantic States:							
Norfolk, Va.	[illegible]	Sand	[illegible]*		[illegible]	[illegible]	[illegible]
Pensacola, Fla.	80,000	Sand	[illegible]		[illegible]	[illegible]	1-3-6
North Central States:							
Milwaukee, Wis.	[illegible]	Tar	[illegible]			6	1-3-6
Peoria, Ill.	[illegible]	[illegible]	[illegible]*	1	11	[illegible]	[illegible]
Northwestern States:							
Albert Lea, Minn.	[illegible]	Tar	2.28				1-7
Ames, Ia.	[illegible]		2.01			4	1-7
Davenport, Ia.	[illegible]	Pitch.	[illegible]	5	9		1-3-6
Minneapolis, Minn.	[illegible]	Pitch	[illegible]		10		1-3-6
Ottumwa, Ia.	[illegible]	Pitch	[illegible]		10½	5	[illegible]
South Omaha, Neb.	14,742[11]	Pitch.	2.60	5	9	5	1-3-6
Wichita, Kan.	[illegible]	Sand	[illegible]*	10	10	6	1-3-6
Southwestern States:							
Little Rock, Ark.	[illegible]	Sand	[illegible]*		[illegible]	5	1-3-6
St. Louis, Mo.	34,152	Sand.	2.60*	5	10½	6	1-4-7

*Does not include grading. [1]$3 per sq. yd. [illegible] Laid by city, cost $2.65 to $3. [4]9½ to 11 ins., base 5 in. to 6 in. [5]Blocks 3½ in. thick. [6]Also 16,439 sq. yds. at $2.13 per sq. yd. [7]Pit run gravel [illegible] [9]Laid by city forces. [10]Southern long leaf yellow pine, 3½ in. deep. [illegible]

TABLE SHOWING MILEAGE OF PAVEMENT LAID IN 1910 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES AND THE MILEAGE OF PAVEMENT PROPOSED FOR 1911.

City.	City Engineer.	Pavement laid in 1910.		Proposed for 1911.	
		Miles.	Total cost.	Miles.	Total cost.
New England States:					
Barre, Vt.	Geo. A. Reed	9	[illegible]		
Boston, Mass.	[illegible]				
Bridgeport, Conn.	M. F. McKeon	11	[illegible]		400,000
Brookline, Mass.	A. H. French				
Cambridge, Mass.	L. W. [illegible]	[illegible]			
Derby, Conn.	D. S. Brinsmade				
Everett, Mass.	Christopher Harrison	[illegible]	25,271		
Fitchburg, Mass.	[illegible]	1.85	17,196	1	14,500
Hartford, Conn.	F. L. Ford	2.35	63,000	[illegible]	[illegible]
Haverhill, Mass.	[illegible]	8.14	155,000		60,000
Lawrence, Mass.	[illegible]	1.52			
Lewiston, Me.	[illegible]	....	11,700	[illegible]	18,000
Lowell, Mass.	George Bowers	1.09[5]	60,147	.91	50,000
Malden, Mass.	[illegible]				
Medford, Mass.	[illegible]				
Meriden, Conn.	[illegible]				
Middletown, Conn.	[illegible]				
New Bedford, Mass.	[illegible]		[illegible]	[illegible]	[illegible]
New Britain, Conn.	[illegible]		65,333		19,830
Newton, Mass.	[illegible]		10,039	1	10,000
Portland, Me.	Bion Bradbury, Jr.		38,884		
Providence, R. I.	[illegible]	3.26		3.26	
Somerville, Mass.	[illegible]	2.56	50,311	.....	
South Norwalk, Conn.	[illegible]			.....	
Springfield, Mass.	[illegible]				
Stamford, Conn.	[illegible]		30,000		45,000
Taunton, Mass.	[illegible]				
Worcester, Mass.	[illegible]				
Woburn, Mass.	Wm. B. Jones				
Woonsocket, R. I.	Frank H. Mills				
North Atlantic States:					
Albany, N. Y.	Frans Engstrom			8[9]	300,000
Amsterdam, N. Y.	F. E. Crane	[illegible]	21,939	1	20,000
[illegible]	J. C. Little				

[illegible]

Ins

Grand Rapids, Mich....... 6

1-3-6
1-3-7

Bituminous Macadam, Gravel and Earth Object Lesson Roads Constructed by the U. S. Office of Public Roads.

During the fiscal year ending June 30, 1910, the U. S. Office of Public Roads, Logan Waller Page, Director, constructed 1,007,569 sq. yds. of object lesson roads. Of this total 45,832 sq. yds. was bituminous macadam, three roads of this type being constructed.

BITUMINOUS MACADAM ROADS.

Bituminous macadam roads were constructed at Atlanta, Ga., El Paso, Tex., and Phoenix, Ariz. The work at Atlanta, Ga., consisted of grading and surfacing with bituminous macadam a section of the Peachtree road. Work was begun Oct. 18, 1909, and completed June 25, 1910. Prior to Oct. 18, 1909, the local authorities had partially graded 9,700 lin. ft. of the road. This was completed and 6,144 cu. yds. of earth were moved between stations 97+00 and 114+50 at a cost of $1,280.24; 11,529 cu. yds. of stone were quarried at a cost of $4,863.85, or 42.2 cts. per cu. yd., and crushed at a cost of $820.37, or 7.1 cts. per cu. yds.; 8,080 cu. yds. of stone were hauled with hauling engines an average distance of 9,500 ft. at a cost of $687.10, or 8.5 cts. per cu. yd. The stone was spread in two courses: The first, 5.5 in. in depth, contained stones from 2 to 3.5 in. in size; and the second course, 5 in. in thickness, contained stones from 0.75 in. to 2 in. in size. After these two courses of stone had been thoroughly rolled, tar was applied at the rate of 2.55 gals. per sq. yd. The cost of applying 41,626 gals. was $718.48 and the cost of the tar was $2,081.30, at 5 cts. per gal. Three hundred and five cubic yards of chips and screenings were used. With labor at from 50 cts to $1.75 per day, convict labor at 50 cts. per day, county teams at 75 cts. per day, and fuel at from $1.80 to $3.50 per ton, the total cost of the work done was $19,336.58. No cost per square yard is available, as the work was begun before this office had anything to do with this road and was continued after participation in the work by this office had ceased.

The work at El Paso, Tex., consisted of supervising and resurfacing of 23,470 sq. yds. of old macadam road, and preparing plans and specifications for 11¾ miles of new construction, including a number of reinforced concrete bridges. The work of resurfacing was begun May 10, 1909, and entirely completed July 22, 1909. The dust was first swept off with wire brooms and the roadway spiked up with a road roller. The road was then shaped and given a crown of ½ in. to the foot, wet and rolled. A course of clean limestone, broken in sizes of from ¾ in. to 1½ in. was then spread upon the road to a depth of 3 in., measured loose, and lightly rolled. Care was taken that the stone should remain free from dust and moisture. Asphalt, heated to 300° F., was then evenly spread over the surface of the road, with flat nozzle sprinkling cans, at the rate of 15 lbs. per sq. yd. Stone chips, ½ in. in size and free from dust, were then spread upon the road in sufficient quantity to fill the voids of the larger stone and were swept into place. The road was then thoroughly rolled and sufficient screenings were spread upon the road to take up any surplus asphalt. The cost of this work was as follows: Furnishing and rolling into place 2,525 cu. yds. of stone, $4,923.98; furnishing 193.8 tons of asphalt, $3,882.22; cost of labor, $1,528; making a total cost of $10,341.20, which is at the rate of 44.08 cts. per sq. yd.

An oil macadam road 3,250 ft. in length and [illegible] was built at Phoenix, Ariz. In

[illegible], N. J.	S. J. Howe	[illegible]	144,910	[illegible]	[illegible]
[illegible], N. Y.	John A. Giles	[illegible]	65,560	[illegible]	[illegible]
[illegible], N. Y.	George H. Norton		651,352		
[illegible], N. Y.	R. H. Canfield				
[illegible], N. Y.	John M. Hackett	1.2	[illegible]	[illegible]	[illegible]
[illegible], N. J.	Frederick A. Reimer	[illegible]	231,162		
[illegible], N. Y.	W. H. [illegible], Jr.	2.10	98,313		
[illegible], N. Y.	F. A. Brown			[illegible]	10,000
[illegible], Pa.	B. E. Briggs		163,000		72,500
[illegible], N. Y.	Geo. W. Hackett	1.1	30,715		[illegible]
[illegible], N. Y.	Albert Webber				
[illegible], N. J.	Eugene Smith	1.32	[illegible]		
[illegible], N. Y.	A. F. Bannon	.17	9,859		
Hudson, N. Y.	M. J. O'Hara		2,990		32,500
Ithaca, N. Y.	Donald F. McLeod				
Jamestown, N. Y.	C. G. Jones			1	5,000
Jersey City, N. J.	C. A. Van Keuren	[illegible]	231,666	1½	70,000
Kingston, N. Y.	John F. Halligan		10,000		50,000
Lancaster, Pa.	J. Carpenter				
Little Falls, N. Y.	O. J. Dempster	[illegible]	14,400		
Middletown, N. Y.	L. H. Robinson	[illegible]	31,000		
New Brunswick, N. J.	Fred C. Schroeder	[illegible]	80,000		
New Castle, Pa.	C. H. Milholland	[illegible]	26,599	[illegible]	47,000
Niagara Falls, N. Y.		32	119,801	3.5	200,000
North Tonawanda, N. Y.	A. F. Smith		24,500	[illegible]	16,000
Olean, N. Y.	John H. Gavin	1.5	48,000	[illegible]	[illegible]
Oneida, N. Y.	Geo. S. Tabor	1	1,500	.33⅓	17,000
Oneonta, N. Y.	O. A. Miller	1.58			
Pittsburg, Pa.	N. S. Sprague	9.71	428,262		
Port Jervis, N. Y.	[illegible]	[illegible]	26,000	[illegible]	26,000
Reading, Pa.	E. B. [illegible]	[illegible]			
Rochester, N. Y.	C. A. Fisher	10	350,000		
Schenectady, N. Y.	J. L. Fitzgerald				
Scranton, Pa.	Wm. A. Schunk	[illegible]	149,879		150,547
Syracuse, N. Y.	Henry C. Allen	5.69	[illegible]	2	126,530
Troy, N. Y.	E. L. Grimes	.83	62,718		
Utica, N. Y.	William F. Cogley	3.04	118,000	3.5	140,000
Watertown, N. Y.	E. W. Sayles	.33	23,400	1	40,000
Wilkesbarre, Pa.	B. K. Fine	1.16		2	80,000
Williamsport, Pa.	John E. Otto	[illegible]	15,569	.86	30,000
South Atlantic States:					
Charleston, S. C.	J. H. Dingle				
Danville, Va.	J. O. Magnum	[illegible]	60,000		
Macon, Ga.	C. C. Huderson	2.5	67,000	[illegible]	[illegible]
Norfolk, Va.	W. T. Brooks	15	599,390		
Pensacola, Fla.	L. Earle Thornton	[illegible]	150,000	13.5	450,000
South Central States:					
Gadsden, Ala.	Chas. L. Marsh				
Knoxville, Tenn		[illegible]		[illegible]	
Louisville, Ky.	D. R. Lyman	9.92	326,803		
Vicksburg, Miss.	C. R. Twiss	3	125,000	2	90,000
North Central States:					
Anderson, Ind.	Geo. P. Lampman	1.89	18,975	[illegible]	65,000
Aurora, Ill.	M. J. Farble	4.7		[illegible]	
Battle Creek, Mich.	E. A. Hunt	1.25	34,860		
Bloomington, Ill.	Elmer Folsom	3.38	118,745	3	100,000
Bloomington, Ind.	U. S. Hanna	3	90,000	2.5	75,000
Cairo, Ill.	W. B. Thistlewood	2.93	107,777	3.03	178,436
Canton, Ill.	C. R. Beam	.55	16,972	1.5	45,000
Cleveland, O.	Robert Hoffman	17.6	446,218	34.1	1,447,869
Columbus, O.	Henry Maetzel	13.33	451,016		
Dayton, O.	F. J. Cellarius		.....		
Evanston, Ill.	J. H. Moore	1.953	64,153	2	60,000
Evansville, Ind.	Aug. Pfeffer	3.16	123,352		
Flint, Mich.	H. E. Terry	3.76	158,612		
Freeport, Ill.	J. A. R. Daniels	2.8	70,000	1.5	50,000
Gary, Ind.	A. P. Melton	[illegible]	130,707		450,000
Grand Rapids, Mich.	L. D. Cutcheon	11.05	345,837	11	345,000
Hamilton, O.	F. E. Weaver	.33	16,542	[illegible]	150,000
Kalamazoo, Mich.	H. A. Johnston	1.15	101,176		
Lansing, Mich.	H. A. Sparks		..		
Lima, O.	A. L. Metheany	.75	26,000	3	75,000
Logansport, Ind.	H. H. Thompson	1.75	107,000	1.75	105,000
Lorain, O.	C. M. Osborn				25,000
Marion, Ill.	P. B. Wilson	.80	26,672	[illegible]	70,674
Mattoon, Ill.	C. L. James			2	68,000
Middletown, O.	G. B. Hall				
Milwaukee, Wis.	Charles J. Poetsch	20.265	900,633		
Muncie, Ind.	B. F. [illegible]	1.25	48,816	[illegible]	[illegible]
Muskegon, Mich.	D. C. Tabor	.6			
New Albany, Ind.	Chas. W. Appleby				
Newark, O.	C. H. Wells	.85		3	
Oak Park, Ill.	W. T. Sargent	3.85	153,752	3.85	[illegible]
Ottawa, Ill.	W. H. Irwin	1.18	36,348	[illegible]	34,000
Peoria, Ill.	R. J. Canterbury	10	100,000	10	100,000
Port Huron, Mich.	Earle R. Whitmore	[illegible]	8,300	1	12,000
Racine, Wis.	P. H. Connolly				
Richmond, Ind.	Fred R. Charles	.....			
Rockford, Ill.	S. B. Hand	.....	[illegible]	[illegible]	[illegible]
Saginaw, Mich.	R. W. Roberts	2.99	106,335		[illegible]
Springfield, O.	M. J. Bahin	2.46	128,000		80,000
Streator, Ill.	F. W. Herbert	2			
Waukegan, Ill.	B. P. Thacker	2.75	[illegible]	[illegible]	[illegible]
Zanesville, O.	Herbert Harris	.....	5,373		41,672
Northwestern States:					
Albert Lea, Minn.	Wm. Babcock		[illegible]		[illegible]
Ames, Ia.	J. Q. Wickham		53,811	[illegible]	[illegible]
Burlington, Ia.	H. G. Vollmer				
Butte, Mont.	R. R. Vail		14,021		
Clinton, Ia.	F. W. Trost	[illegible]	45,000		
Coffeyville, Kan.	A. C. Gillam	1.5	58,000		
Council Bluffs, Ia.	S. L. Etnyre	1.23	42,952		112,250
Davenport, Ia.	A. M. Compton	[illegible]	199,665		
Helena, Mont.	Charles W. [illegible]		5,688		[illegible]
Independence, Kan.	A. D. [illegible]		140,000	50,000	[illegible]
Iowa City, Ia.	C. T. [illegible]				
Lawrence, Kan.	E. H. Dunmire	3	109,071	2	[illegible]
Leavenworth, Kan.	Joseph O'Neil	2.84	66,100	1	25,000
Lincoln, Neb.	Adna Dobson	2.11	120,150	3.5	150,000
Mankato, Minn.	John Wilson	.6	40,519	[illegible]	12,000
Minneapolis, Minn.	Andrew Rinker	18.96	537,243	15	600,000
Muscatine, Ia.	C. H. Young			1	59,900
Ottumwa, Ia.	John T. Brady	2	50,000		
Sioux City, Ia.	Keyes C. Gaynor				[illegible]
South Omaha, Neb.	Geo. W. Roberts		[illegible]		[illegible]
Topeka, Kan.	A. R. Young	[illegible]	[illegible]	6	165,000
Waterloo, Ia.	C. F. Wilson	3.6	[illegible]	3	95,000
Wichita, Kan.	Bert C. Wells	[illegible]	1,019,000	20.4	1,000,000
Southwestern States:					
Brownsville, Tex.	J. W. Davis				
Enid, Okla.	C. H. Sexton	[illegible]	447,800		
Little Rock, Ark.	E. A. Kingsley				
McAlester, Okla.	W. P. Halliday		[illegible]		[illegible]
Muskogee, Okla.	T. P. Coats				

tween March 11, 1910 [illegible] 7, 1910, during which time 24 d[illegible] because of the failure of the contractor to deliver stone. The land over which the road was built is practically level and all earth was moved with a road grader. The local authorities furnished a 10-ton macadam road roller, two im[illegible] road graders, tw[illegible] wagons, and a road grader. Fourteen hundred and thirty-six cubic yards of stone were delivered by contract on the road at a cost of $1.67 per cu. yd. The stone was spread in four courses. The first course, 5½ in. thick, was of stone between 1½ and 4 in. in size, with the voids filled with gravel. The second course, 2 in. thick, was of stone from ¾ in. to 1½ in. in size. The third course was of stone screenings ¾ in. in size or smaller and was applied in such amount as to fill the voids in the second course. The fourth course, of the same size stone as that of the third, was applied in such amount as was necessary to absorb what surplus oil remained on the surface. The oil was furnished in a tank car of 9,000 gals. capacity and was heated by steam coils to a temperature of 190° F. The road was given two applications of oil, the first at the rate of 1 gal. per sq. yd., and the second at the rate of ½ gal. pr sq. yd. The total cost of the road to the community was $3,875.05, which is at the rate of 67.06 cts. per sq. yd., or $6,295.50 per mile. Labor was $2.25 per day, 4 horse teams, $6 to $6.50 per day, and 6 horse teams, $8.50 per day.

GRAVEL ROADS

A total of 71,376 sq. yds. of gravel road was constructed under the direction of the U. S. Office of Public Roads. Two of these roads were constructed near Kalamazoo, Mich., one at Billings, Mont., and one at Sweetwater, Tex.

The construction of the West street—Portage Center gravel road at Kalamazoo, Mich., was begun on April 13, 1910, and on June 1, 1910, the work was completed. One thousand four hundred cubic yards of earth were excavated and hauled an average distance of 600 ft. at a cost of $292.85, or 20.9 cts. per cu. yd. It was loosened with plows and hauled in drag and wheeled scrapers. One thousand four hundred and forty-five cubic yards of gravel were placed upon the road at the following costs per cu. yd.:

Gravel at the pit	$0.10
Stripping the pit	.05
Loading at the pit	.04.6
Hauling an average distance of [illegible] ft.	.32.1
Spreading on road	.01
Harrowing and rolling	.00.62

The length of the surfaced road is 5,520 ft. and the width 9 ft. The gravel was spread in two courses, the first course 7 ins. thick and the second 4 ins. The maximum size of the gravel in the first course was 2½ ins. in diameter and in the second course 1½ ins. in diameter. The road was built with county convict labor, which was estimated at 40 cts. per day, the cost of furnishing them food. The expense of guarding the convicts was $63.75. The total cost of the road to the community was $1,425.45, or 25.8 cts. per sq. yd., which is at the rate of $1,365 per mile. This cost is based upon convict labor at 40 cts. and teams at $4 per day.

The work of surfacing with gravel a section 3,200 ft. in length of the Gull road, in Kalamazoo Township, for a width of 15 ft., was begun on June 1, 1910, and entirely completed on June 30, 1910. The plan of construction was similar to that of the Kalamazoo West Portage road. One thousand three hundred cubic yards of gravel were hauled an average distance of [illegible] at the following cost per cu. yd.:

Gravel at the pit	[illegible]
Stripping the pit	[illegible]
Loading in wagons	.05.3
Hauling to the road	[illegible]
Spreading on the road	[illegible]
Harrowing and rolling	.00.5

The gravel was spread to a depth of 11 ins. at the center and 6 ins. at the edges, measured loose. The total cost of the road to the community was $954.05, which is at the rate of 9 cts. per sq. yd., or $1,574 per mile.

The improvement at Billings, Mont., consisted in surfacing with gravel a section of

Oklahoma City, Okla.	B[illegible]	[illegible]	6,[illegible]		1,125,000
San Antonio, Tex.	[illegible] Girand	1[illegible]	18,1[illegible]		[illegible]
Shawnee, Okla.	[illegible]	8	300,000		[illegible]
St. Louis, Mo.	[illegible] T[illegible]ll[24]	31.0[illegible]	1,384,587		1,400,000
Waco, Tex.	[illegible]en Turner				
Pacific States:					
Aberdeen, Wash.	[illegible]	[illegible]1	168,307		120,000
Berkeley, Cal.	[illegible]	10	[illegible]		
Boise, Idaho	[illegible]	3.8	[illegible]		[illegible]
Everett, Wash.	[illegible] Hoover	2.31	18[illegible]		304,571
Fresno, Cal.	Chris [illegible]	1[illegible]		1	
Hoquiam, Wash.	[illegible]	1	72,805	1.5	[illegible]
Los Angeles, Cal.	[illegible]	34.16		50	
North Yakima, Wash.	[illegible] Doolittle	2.35	[illegible],000		[illegible]
Ogden, Utah	M. Bostaph	.6	45,672		
Pasadena, Cal.	S. J. [illegible]	4.11	[illegible]	10.32	228,000
Salt Lake City, Utah	G. P. [illegible]	[illegible]	613,050		100,000
San Diego, Cal.	[illegible]	[illegible]	120,075		[illegible]
San Jose, Cal.	[illegible]	4.7	[illegible]		155,526
Seattle, Wash.	[illegible]	30.71	1,565,000	[illegible]	2,125,850
Spokane, Wash.	[illegible]n Macartney	18.[illegible]	1,203,000	26.2	[illegible]
Tacoma, Wash.	W. C. R[illegible]	17	970,802		
Vancouver, Wash.	H. H. [illegible]	1	54,000		250,000
Walla Walla, Wash.	[illegible]	[illegible]	217,583		

[1]Engineer, H[illegible] [illegible]ision Public Works Department. [2]Probably one mile of macadam. [3][illegible] mile of [illegible] [illegible] miles of macadam. [4]20,000 sq. yds. bituminous macadam. [5]Does not include macadam. [6]Appli[illegible] [illegible] permission [illegible]. [7][illegible] to [illegible] approximately [illegible]. [8]Bituminous macadam. [9]Brick on 6-in. concrete base. [10]Asphalt, bitulithic and brick. [11]Include[illegible] [illegible] macadam and 13,000 sq. [illegible]. [12]1,650 sq. yds. [illegible] sand filler. [illegible] to 100,000 sq. yds. of brick and asphalt. [18]191,285 sq. yds. of street paving and 7,117 sq. yds. of alley paving proposed for this [illegible] ¼ mile brick [illegible] this summer, brick, [illegible] and creosoted wood blocks. [19]Resurfacing. [20]Possibly 10,000 sq. yds. brick, 4,000 sq. yds. concrete and 6,000 sq. yds. bituminous macadam. [21]47,000 sq. yds. concrete at $1.20 and 4,400 sq. yds. brick block at $2.25. [22]Contracts let; includes 164,934 sq. yds. of pavement. [23]Voted on [illegible] March 1[illegible]. [24]Street Commissioner [illegible] of asphalt, [illegible] miles of [illegible].

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF ASPHALT PAVEMENT LAID IN [illegible] IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES

	Sq. yds.	[illegible]	[illegible]	Av. price per sq. yd. including base and grading	Guarantee, years	Price per cu. yd. for grading, paid separately	Portland cement concrete base: [illegible]	Portland cement concrete base: Proportions
New England States:								
Boston, Mass.	8,104	[illegible]	1½	$2.75	5		[illegible]	[illegible]
Hartford, Conn.	14,500	[illegible]	[illegible]	2.60*	5	$0.7[illegible]	6	
Middle States:								
Bayonne, N. J.	[illegible]		[illegible]	1.58*	[illegible]			[illegible]
Buffalo, N. Y.	[illegible]	1½		2.86	10		[illegible]	1-10
Camden, N. J.	[illegible]		[illegible]	1.69	[illegible]		[illegible]	[illegible]-4½
Dunkirk, N. Y.	[illegible]	1	1½	1.59*	[illegible]	.40	[illegible]	[illegible]
East Orange, N. J.	[illegible]	[illegible]	[illegible]	1.50*				
Erie, Pa.	56,214		[illegible]	[illegible]				[illegible]
Hoboken, N. J.	[illegible]	1		1.34	[illegible]			
Jersey City, N. J.	[illegible]	[illegible]	[illegible]		[illegible]	.40	5	[illegible]
Pittsburg, Pa.	17,264		[illegible]	[illegible]	[illegible]	.85	[illegible]	[illegible]
Pittsburg, Pa.	16,417	1	[illegible]	2.21	[illegible]		[illegible]	1-3-6
Rochester, N. Y.	[illegible]	1		1.8[illegible]	[illegible]		[illegible]	[illegible]
Schenectady, N. Y.	[illegible]			1.86	[illegible]		[illegible]	1-3-7
Scranton, Pa.	[illegible]			[illegible]*		[illegible]	[illegible]	1-3-5
Syracuse, N. Y.	38,627	1	[illegible]	2.11*	[illegible]		[illegible]	1-3-6
Troy, N. Y.	4,219	[illegible]		[illegible]			[illegible]	1-3-6
Utica, N. Y.	41,822	1		1.7[illegible]				1-3-7
Washington, D. C.	[illegible]		[illegible]	[illegible]½*	[illegible]	[illegible]	[illegible]	[illegible]
Wilkesbarre, Pa.	9,382			[illegible]		[illegible]	6	1-2-5
South Atlantic States:								
Norfolk, Va.	[illegible]	[illegible]	[illegible]	1.90				[illegible]
South Central States:								
Louisville, Ky.	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
Vicksburg, Miss.	[illegible]		[illegible]	[illegible]*	[illegible]	.40	[illegible]	[illegible]
North Central States:								
Aurora, Ill.	[illegible]	1[illegible]	[illegible]	1.70				
Bloomington, Ill.	15,104[19]		[illegible]	1.28				
Cleveland, O.	[illegible]	1		[illegible]	10		[illegible]	1-3-6
Columbus, O.	[illegible]		2	[illegible]*		[illegible]		1-4-8
Dayton, O.	[illegible]		1	1.82				
Evansville, Ind.	32,287	1	[illegible]	1.96	[illegible]			1-3-5
Flint, Mich.	[illegible]	[illegible]		1.73*		[illegible]		1-7[illegible]
Kalamazoo, Mich.	[illegible]	1	[illegible]	1.84	[illegible]			[illegible]
Logansport, Ind.	50,000	1	[illegible]	1.90				1-2-5
Milwaukee, Wis.	[illegible]	1	[illegible]					1-3-6
Oak Park, Ill.	18,123	[illegible]	[illegible]	1.83				1-3-6
Peoria, Ill.	[illegible]	1½	1½	[illegible]*		[illegible]	[illegible]	1-3-6
Racine, Wis.	[illegible]	1	2	1.98				1-3-5
Saginaw, Mich.	[illegible]		1½	1.70*			[illegible]	[illegible]
Springfield, O.	[illegible]			[illegible]				1-3-7
Northwestern States:								
Burlington, Ia.	[illegible]			[illegible]*				
Dubuque, Ia.	[illegible]	[illegible]		1.90*		.40		1-3-6
Lincoln, Neb.	[illegible]	[illegible]	[illegible]	2.15		.50		1-3-6
South Omaha, Neb.	[illegible]	1	[illegible]	1.85				1-3-6
W[illegible]	[illegible]	1		[illegible]				1-3-6
W[illegible]	[illegible]	1	1	[illegible]	[illegible]	1	[illegible]	1-3-6
Southwestern States:								
[illegible]	[illegible]	1	1	[illegible]				1-3-5
Little Rock, Ark.	17,000	[illegible]		[illegible]		[illegible]		1-3-6
M[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		80		1-2-4
M[illegible]	[illegible]	1		1.98*				
Oklahoma City, Okla.	[illegible]	[illegible]		1.95*				1-3-5
Shawnee, Okla.	[illegible]	1		1.95*				1-3-6
St. Louis, Mo.	[illegible]	[illegible]	1	1.75*				1-1-7
Pacific States:								
Aberdeen, Wash.	35,808	1		[illegible].13		[illegible]	6	1-3-6
Berkeley, Cal.	3,206	[illegible]						1-3-7
Everett, Wash.	41,233	1		1.56*			[illegible]	1-3-6
Hoquiam, Wash.	6,074	1	2	2.50				[illegible]
Los Angeles, Cal.	[illegible]							
North Yakima, Wash.	48,000	[illegible]		1.83*				
Ogden, Utah	19,121			2.30			[illegible]	
Pasadena, Cal.	[illegible]	1			[illegible]			
Salt Lake City, Utah	[illegible]	[illegible]						

[illegible] ing country is quite level. A concrete culvert [illegible] built at a cost of $214.50, with cement costing $3.50 per bbl., sand and gravel $2 per cu. yd., steel 4½ cts. per lb., and labor $3 per day of eight hours. The gravel for the road was secured from a pit 2⅛ miles distant from the road. On account of the fact that the pit gravel contained about 20 per cent of rocks, 2½ to 6 ins. in diameter, it was necessary to screen it. This was done and the screened gravel was loaded into wagons at a cost of 38.4 cts. per cu. yd. The screening was done by building a high "trap" with a double driveway and placing a screen composed of bars of steel spaced 2½ ins. apart at an angle of about 35° over one of the driveways, and dumping the gravel, hauled with drag scrap- [illegible] that the gravel less than 2½ ins. in diameter fell into one wagon and that over that size fell into another. One thousand eight hundred and twenty-four cubic yards of gravel were placed on the road at a cost per cu. yd. of 38.4 cts. for screening and loading, 98.1 cts. for hauling, and 2.5 cts. for spreading. The total cost of the road to the community, with labor at $3 and teams at $6 per day of eight hours, was $3,557.32, or 57.7 cts. per sq. yd., which is at the rate of $4,743.08 per mile. Work was begun on April 25, 1910, and the road was completed on June 18, 1910.

The work at Sweetwater, Tex., consisted of surfacing a section of road with a mixture of clay and gravel. The adjacent land is rolling and the soil a fine sandy loam. To secure proper cross section and drainage 394 cu. yds of earth were moved with drag scrapers and slat-bottom wagons an average distance of 200 feet at a cost of $81.95, or 21 cts. per cu yd. Six hundred and eight cu. yds. of clay were loaded at a cost of $102.35, hauled a distance of 1½ miles at a cost of $300.85, and spread upon the road to a depth of 5 ins., with a road grader, at a cost of $19.40. Three hundred and seventy-one cu. yds. of gravel were loaded at a cost of $63.45, hauled 1½ miles at a cost of $197.25, and spread upon the road with a road grader to a depth of 4 ins. at a cost of $11.25. The clay and gravel were mixed at a cost of $17.60, and sprinkled and rolled at a cost of $17.50. With labor at $1.80 per day and teams at $3.50 per day the cost of the road to the community was $989.05, which is at the rate of 27 cts. per sq. yd. The work was begun on March 31, 1910, and the road was entirely completed on April 27, 1910.

EARTH ROADS

Earth roads were constructed at Americus, Ga., in DeSoto Parish, La., Ouachita Parish, La., East Baton Rouge Parish, La., at Lawton, Okla., and at Provo, Utah. Details of these roads follows:

The work of grading 1 mile of road at Americus, Ga., was begun on Aug. 25, 1909, and completed on Sept. 18, 1909. The road was graded to a width of 30 ft., including the entire width of the shoulders, and, to secure proper grades, 6,400 cu. yds. of earth and 100 cu. yds. of stone were moved with wheeled scrapers and in wagons for an average distance of 600 ft. at a cost of $621.80. A cross drain was constructed of corrugated iron, 12 ins. in diameter and 34 ft. long, at a cost of $35. The work was done by the county convict road gang, and the cost of labor and teams was the cost of subsistence, which for labor was 60 cts. and for teams $1 per day. The total cost of the road was $656.80.

The work in De Soto Parish, La., consisted of clearing the right of way and grading the Main Street road at Mansfield, a distance of 2 miles, the Battlefield road at Mansfield a distance of 1¾ miles, and the Mansfield-Shreveport road a distance of 17 miles. The Main Street road at Mansfield was graded to a width of 24 ft. from shoulder to shoulder. The natural soil is a mixture of sand and clay and no surfacing was done. Twenty-two hundred cu. yds. of earth were moved. The Battlefield road for a distance of 1¾ miles from

[illegible]	[illegible]	1		1.51	18	.	5	1-2-4
[illegible]	[illegible]			[illegible]		...	6	1-2½-7
[illegible]	116,383		2	1.79	18		6	1-3-6
[illegible]	[illegible]	1	2	[illegible]	7[illegible]	.50	4[illegible]	1-4-7
[illegible]	211,392	1	2	[illegible]			5	1-3-6
[illegible]	[illegible]	1[illegible]		1.85*		.40	5	1-3-6
[illegible]	12,000	1[illegible]		[illegible]*		.60	[illegible]	1-3-5
Walla Walla, Wash..	[illegible]	1	2			.60	4	1-4-7

*Does not include grading

[illegible] price for repaving was $[illegible] per sq. yd. [illegible] Telford base. [illegible] Belgian block base [illegible] streets and avenues for fiscal year ending June 30, 1910. [illegible] For ordinary excava[illegible] [illegible] for excavating macadam [illegible] cts. per cu. yd. over 9 in. deep. [illegible] Naphtha coat. [illegible] Land [illegible] brick pavement. [illegible] 6 in. thick [illegible] track ties. [illegible] Gravel. [illegible] Resurfacing cost 39 cts. [illegible] Resurfacing. [illegible] and 10 year. [illegible] 30 cts., slab, 50 cts., and rock, $1 to $3 per [illegible] Miles. [illegible] No guarantee. [illegible] 6 in. base.

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF PLAIN MACADAM LAID IN 1910 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES

	Sq. yds.	Av. price per sq. yd., including grading	Guarantee, years	Price per cu. yd. for grading if paid for separately	Thickness of macadam, ins.
New England States:					
Barre, Vt.	13,185	$0.51		..	6-8
Boston, Mass.	81,000	[illegible]		....	[illegible]
Bridgeport, Conn.	50,000	[illegible]		....	[illegible]
Cambridge, Mass.	1,979	1.25		...	[illegible]
Everett, Mass.	16,000	.50¹ ²		.	4
Hartford, Conn.	37,200	.80*	.	$0.35	11-15
Haverhill, Mass.	25,038	.70¹		....	6
Lawrence, Mass.	23,523¹	[illegible]		.....	
Lowell, Mass.	33,412	.78		...	6
Medford, Mass.	28,012¹	.		.....	
Middletown, Conn.	1,709	.50		.07	8
New Bedford, Mass.	38,898	..		....	[illegible]
New Britain, Conn.	42,471	49		....	
Providence, R. I.	2.94³	..	.	.....	
Springfield, Mass.	86,477	48⁴	.	....	
Waltham, Mass.	36,925	.30	.	.....	4-[illegible]
North Atlantic States:					
Buffalo, N. Y.	5,400	2.22	10	..	17
East Orange, N. J.	8,403	1.20*	1	.55	12
Hudson, N. Y.	11,200	.27	.	.....	6
Jersey City, N. J.	6,062	1.10*	5	.40	12½-
Lancaster, Pa.	2,800	.80	.	.....	13
Ogdensburg, N. Y.	4,000	...	.	.....	
Reading, Pa.	17,150¹	.....		.....	
Rochester, N. Y.	11,000	1.50	5	....	16⁶
Troy, N. Y.	4,419	.60	5	.....	8
Watertown, N. Y.	25,000¹	.55		.....	6
North Central States:					
Bloomington, Ind.	28,000	45	5	.25	10
Columbus, O.	.43³	...		.....	.
Evanston, Ill.	7,625	.95*		.40	12
Freeport, Ill.	7,400	.39*	.	.30	10
Gary, Ind.	36,836	.67½*	1	.35	10
Milwaukee, Wis.	114,854	.74	..	.....	
Oak Park, Ill.	14,140	1.28	2	....	15½
Peoria, Ill.	3,000	.85*		.35	8
Richmond, Ind.	12,500	.30		....	6
Rockford, Ill.	43,112	.42	.	.....	
Springfield, O.	8,400	.30	2	...	6
Southwestern States:					
Muskogee, Okla.	3,915	1.10*	[illegible]	.35	9
San Antonio, Tex.	320,320	25¹		. .	8
Pacific States:					
Berkeley, Cal.	170,000	72*	.	.45	[illegible]
San Francisco, Cal.	58,659	.70	..	....	12
Tacoma, Wash.	1,291	1.25*	.	....	
Vancouver, Wash.	40,000	.50*	.	.....	.

*Does not include grading.

¹Laid by city forces. ²Interest base. ³Miles. ⁴48 cts. to 72 cts. ⁵10-year guarantee. ⁶Includes 6-in. Portland cement, concrete base.

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF BITULITHIC PAVEMENT LAID IN 1910 IN A NUMBER OF AMERICAN CITIES.

	Sq. yds.	Av. price per sq. yd., including base and grading.	Guarantee, years	Price for grading if paid separately	Total thickness of pavement including base, ins.	Portland cement concrete base	
						Thickness, ins.	Proportion
Bayonne, N. J.	15,854	$2.10*	[illegible]	$0.40	[illegible]	5	1-3-5
Cambridge, Mass.	10,550	2.40	[illegible]		[illegible]	6	1-2½-5
Danville, Va.	29,000	2.00	[illegible]		7	Bituminous base.	
East Orange, N. J.	23,990	1.99*	[illegible]	.50	[illegible]	[illegible]	1-3-7
Herkimer, N. Y.	11,772	2.15	[illegible]	.50	[illegible]	5	1-3-6
Jamestown, N. Y.	1,766	2.30*	[illegible]	.55	10	5	1-2-5
Little Falls, N. Y.	4,500	2.65	[illegible]		[illegible]	6	1-3-6
Muscatine, Ia.	21,284	1.82	[illegible]	[illegible]	[illegible]½	[illegible]	1-3-5
New Britain, Conn.	27,000	2.42	[illegible]		[illegible]	5	1-3-7
New Bedford, Mass.	13,264	2.96	[illegible]		[illegible]	5¹	
Niagara Falls, N. Y.	12,950	[illegible]	[illegible]			4	1-3-8
Norfolk, Va.	158,125	2.20			6	4	1-3-6
St. Louis, Mo.	60,119	1.95*			[illegible]	5	[illegible]
Springfield, Mass.	3,597	2.75	[illegible]		[illegible]	[illegible]	[illegible]
Vancouver, Wash.	5,000	2.20*			[illegible]		
Waco, Tex.	26,000	2.10*	[illegible]		[illegible]		
Wichita, Kan.	[illegible]	2.15*	[illegible]	1	[illegible]	6	1-3-6

*Does not include grading. ¹Rolled dry and grouted 1-3.

the city limits of Mansfield was improved in the same manner as [illegible] Street road. The Mansfield-Shrevep[illegible] was improved by clearing the right of way of trees, stumps, and brush, grading, surfacing certain sections with a sand-clap mixture, and constructing a number of cross drains. One carload of various sizes of corrugated ingot iron was used, costing $1,530.88. Three hundred and sixty lineal feet of oak timber bridging and one concrete box culvert were constructed. The total cost of the above work was $16,206, which is at the rate of $781 per mile. The work was done by the state convict road gang, and the cost of labor was the cost of guarding and feeding the convicts, which was 24 cts. per day. The teams were owned and furnished by the State, and their cost was the cost of their maintenance, which was 50 cts. per day per mule. Work was begun on June 16, 1909, and was completed on Aug. 1, 1910.

The work in Ouachita Parish, La., consisted of improving 14¾ miles of the Claiborne road leading from West Monroe to Calhoun, and 2½ miles on the Arkansas road from West Monroe, or a total of 17¼ miles, of which 13 miles are earth and 4¼ miles are gravel. Equipment, furnished by the State at a cost of $12,851.69, consisted of [illegible] traction ergine, a steam road roller, 2 heavy road graders, 6 cages or cars for housing the convicts, tents, harness, etc. The gravel was spread for an average width of 15 ft., with a depth of 8 ins. at the center and 6 ins. at the sides. The total cost of the gravel road was $10,002.73, and [illegible] $12,016.29. The work was done by the state convict road gang. Work was begun on July 10, 1909, and completed on Aug. 1, 1910.

The work in East Baton Rouge Parish, La., consisted of clearing, grading, and draining 7.6 miles of the Claygut road and 1.7 miles of the Loop road, and surfacing with gravel 12,083 sq. yds. on North boulevard in the city of Baton Rouge. The work was done by the state convict road gang and was begun on Oct. 11, 1909, and completed on Aug. 1, 1910. The cost of the work done upon the Claygut road was $4,882.82, which includes $1,770.67, the cost of the materials for cross drains. The cost of the work done upon the Loop road was $1,194.63, of which $149.46 was for materials for cross drains. The cost of graveling the North boulevard road was $6,043.94, which is at the rate of 50.2 cts. per sq. yd. Gravel was delivered f. o. b. cars at Baton Rouge at $1.37 per cu. yd.

The work at Lawton, Okla., consisted of grading an earth road 5,206 ft. in length for a width of 30 ft. and building a culvert 20 ft. wide with a clearn span of 16 ft. Work was begun on July 20, 1909, and entirely completed on Sept. 1, 1909, with a loss of 7½ days on account of the very hot weather. Fifty-eight hundred and forty cubic yards of earth were loosened with plows and moved in drag scrapers an average distance of 200 ft. at a cost of $846.40. The culvert consisted of concrete abutments, wood stringers, and floor. With cement at $2 per barrel, lumber at $26 per 1,000 feet, board measure, labor at $1.60, and teams at $3.20 per day of eight hours, the total cost of the improvement to the community was $1,110.85, which is at the rate of $1,126.60 per mile.

An earth road 8,850 ft. in length and 23 ft. in width from shoulder to shoulder was constructed at Provo, Utah, between Aug. 24, 1909, and Nov. 30, 1909. This road is a part of a road which it was proposed to improve from the city of Provo to Olmstead, a distance of 6 miles. The surrounding country is rolling and mountainous. Thirty-one hundred feet of the road were built through and along hills composed of gravel and rocks, and the remainder, 5,750 ft., was built over practically level adobe land. Eighty-five hundred and sixty cu. yds. of earth were moved for an average distance of 1,160 ft. About 4,000 cu. yds. were hauled in wagons and the remainder was moved with a road grader, tongue scrapers, and wheeled scrapers. All the materials were loosened with plows, and the wagons were loaded with tongue scrapers dumping through a "trap." The material in the rock banks was quite difficult to loosen and haul in the scrapers on account of the large rocks, many of which were 12 ins. or more in diameter. In some places the old road was so narrow that two vehicles could not pass each other; these passages were widened to 23 ft. With labor at $2 and teams at $4 per day of eight hours, the total cost of the road to the community was $3,157.75, which is at the rate of $1,947.77 per mile.

WATER-WORKS AND SEWERS SECTION

Electrical Sewage Pumping in Great Britain.

BY JAMES A. SEAGER, ASSOC. M. INS[illegible]

The application of electric power to the disposal of sewage has recently made considerable progress in Great Britain and it is proposed briefly to describe and illustrate some of the work which has been done in this respect. In England the water-carriage system of gravitational sewage removal is generally adopted, but cases arise when, owing to topographical difficulties, it is impossible to suit the size and incline of the sewers in all cases to the volume of sewage to be carried. Until some suitable means of easily transmitting power to convenient points, and of automatically applying it there, was found, the tendency was to concentrate sewage pumping plant at one station under one attendance staff. This, however, involves in a good many cases heavy pumping, owing to the necessarily low level of a pumping plant to deal with the whole of an extensive area, and also deep cuttings to allow of a suitable fall throughout, especially where the ground surface is undulatory. For this reason, even on large systems, distributed pumping stations are preferable when these can be automatically regulated. On small schemes the advantage of reducing labor charges by automatic operation is obvious.

Two main methods have been adopted in this connection, the first of these being to concentrate the pressure-producing plant for the pumping operations transmitting the power by means of compressed air. In this, electricity has been utilized at the pumping or compressing station. The second method is to adopt direct electrical transmission. Both these systems may be discussed, and in order to illustrate the former, no better method can be used than to describe the Shone system, which is largely adopted in Great Britain.

Figure 1 shows a sectional elevation of the Shone pneumatic ejector, the lower portion being preferably hemispherical for sewage, sludge and pail contents. The motive power employed is compressed air, which is conveyed in iron pipes, laid under the streets, to the several ejector stations. The sewage gravitates from the sewers through the inlet pipe *A* into the ejector and gradually rises therein until it reaches the under side of the bell *D*. The air at atmospheric pressure inside this bell is then enclosed, and the sewage, continuing to rise, compresses the enclosed air sufficiently to lift the bell, spindle, etc., which opens the compressed air admission valve *E*. The compressed air thus automatically admitted into the ejector presses on the surface of the sewage, driving the whole of the contents before it through the bell-mouthed opening at the bottom, and through the outlet pipe *B* into the iron sewage rising main or high-level gravitating sewer, as the case may be. The sewage can only escape from the ejector by the outlet pipe, as the instant the air pressure is admitted, the valve on the inlet pipe *A* falls on its seat, and prevents the fluid escaping in that direction. The fluid passes out of the ejector until the weight of the cup *C*, exposed and unsupported, is sufficient to pull down the bell and spindle, thereby reversing the compressed air admission valve, which first cuts off the supply of compressed air to the ejector, causes the outlet valve to fall on its seat, thus retaining the liquid in the sewage rising main, and then allows the air within the ejector to exhaust down to atmospheric pressure. The sewage flows into the ejector through an inlet once more, driving the free air before it, through the air valve, as the sewage rises; and so the action goes on so long as there is sewage to flow. The cup-and-bell floats are adjusted so that the compressed air is not admitted to the ejector until it is full of sewage, and the air is not allowed to exhaust until the ejector is emptied down to the discharge level.

A satisfactory alternating arrangement has recently been designed which insures the ejectors in a station working in rotation. This has been of great advantage in making the ejectors work more smoothly, by keeping up a constant pressure on the rising main, while reducing the air pressure required to eject the sewage. With this arrangement, in times of pressure, the ejectors are able to deal successfully with larger volumes than is possible when working independently, and there is a complete absence of shock both in the inlet and delivery valves, even with the ejectors working at their maximum rate.

The area to be sewered is divided into such a number of sectional or gravitation units as are rendered necessary by particular local exigencies or peculiarities; each unit constitutes a separate and distinct drainage section, having its own gravitation sewers, converging and emptying into their own special outfall, which is situated at the lowest point of the unit. These separate outfalls, or ejectors, discharge their contents by means of compressed air, generated at one conveniently situated compressing station into one common main leading to the ultimate common outfall. Hence disabilities of a topographical character, such as are manifested in districts having flat, low-lying, irregular, or difficult surface configurations are removed. The interception of the sewage at higher levels, and a consequent saving of power, is effected when compared with a single pumping station, where the whole bulk has to flow down to lowest point, in which case the excess of fall necessitates a proportional increase of power. There is an entire severance of each district from the main sewer, and from the rest of the drainage area, this constituting an effective safeguard against the conveyance of zymotic diseases, by the sewers, from one district to the others; which cannot be said to be the case when the whole area has an intercommunicating network of drains, and there is a flexibility in extending the system in proportion as the population and as the occupied area increases, in virtue of which a scheme, at its initiation, can be limited to the absolute requirements of the district and to the financial possibilities thereof. As an instance of an installation where very difficult topographical difficulties have been overcome by this system may be mentioned the arrangements made for the Urban District Council of Swalwell, in the County of Durham, where this system has been applied in a very hilly area. The ejectors are operated from a central compressed air plant consisting of two electrically-driven compressors (one being installed as reserve) operated by means of automatic switchgear from the mains of the County of Durham Electrical Power Distribution Co., Ltd. The starting and stopping of the compressors is perfectly automatic under solenoid control, dependent on the pressure of air in the main reservoir. Under ordinary requirements the compressor starts once every eight or ten minutes; when a rush of surface water occurs it may operate every minute, the speed of op-

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*No. 67 Belmont R[illegible] St. A[illegible] Bristol, England.

[illegible]

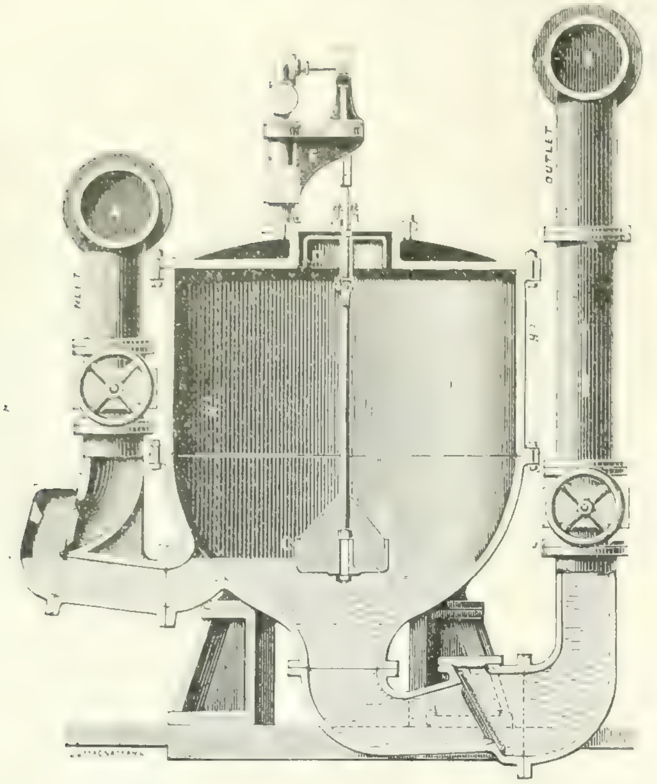

Fig. 1—Cross Section of Shone Pneumatic Sewage Ejector.

[illegible] station, [illegible] where the flow of sewage is of an intermittent character. As regards reliability there is little to choose between the two systems. Electric motors, when made by first-class makers, in these days are so reliable that no apprehension need be entertained as to the success of the electrical part of the work, and nothing could be more simple than a modern centrifugal pump. Automatic control is, of course, necessary, and in order that the centrifugal pumps may be self-starting, the impellers must be drowned. This necessitates a vertical type of motor, but improvements in ball bearings have in recent years greatly simplified the design of such motors, and in many respects they are preferable to the ordinary horizontal type. An interesting example of electric pumping is that of the Eaton sewage pumping station, electrically equipped by Messrs. Laurence Scott & Co., Ltd., of Norwich. The district is an outlying village forming a city suburb, and the distance from the main pumping station and the height of the intervening land precluded the construction of a deep level sewer as a practical possibility. Electrical driving was adopted in preference to the compressed air system used in older installations in other parts of the town. If this method had been available in the past, it would often have saved enormous expense in laying very deep sewers to deal with such places, and in future schemes no doubt this will be taken into consideration. It will be seen from Fig. 2 that the sewage is delivered into a large screening chamber which is provided with a cast-iron screen. The sewage is drawn from this chamber by the two centrifugal pumps through a common suction pipe. Sluice valves are placed in the branch to each pump, so that either of the pumps can be disconnected. The pumps deliver through automatic reflux or retaining valves and sluice valves into the sealed main, where there is a second reflux valve. The electrical installation consists of two 19 B.H.P. motors, each running at 1300 r.p.m. at 440 volts. These motors have vertical shafts and are provided with ball bearings throughout. They drive the pumps [illegible] vertical shafts, which also have all [illegible] designed for running in [illegible] places. The motors are compound [illegible].

There are two floats for operating the automatic [illegible] of the two [illegible]. One float is that which operates under ordinary conditions, and the other is a "flood" float, and only comes in in case of a heavy storm. Each float operates, by means of the usual "tumbler" gear, on to a switch which works the relay circuit of one or other of the starting switches, and a change-over switch is arranged between the starters and the float switches, so that one or other of the motors is operated by the regular float switch and the other by the flood float-switch. The motors and pumps can thus be used evenly, each taking regular duty one day or week, and then flood duty the next day or week. The automatic starters are of the carbon-contact type, by means of which the resistance is cut out on carbon blocks or plungers, thus eliminating sliding friction. The circuit, however, is not broken on these, but on the relay switch, the carbon plungers only unshorting the resistance after the main circuit is broken. The motors, pumps, control gear and screening chamber are all contained in subterranean chambers situated in a low-lying part of the district at the side of the public road. Apart from a very slight hum, nothing can be heard of what is going on below ground. The whole of the installation was carried out according to the instructions of Mr. A. E. Collins, M. Inst. C. E., City Electrical Engineer of Norwich, who has done much to introduce electrical pumping of sewage there and in other towns. Installation of a similar character have for many years been working with perfect success at Weston-Super-Mare, Hull, and in many other places, and there seems every probability of a considerably extended field of this class of work in the near future.

Reference was made above to Mr. A. E. Collins' work at Norwich, and as this is somewhat remarkable, further particulars may be given, condensed from a paper given by him before the Incorporated Association of Municipal and County Engineers. The old sewage outfall pumping station at Trowse, Norwich, was designed and carried out in 1868. The engines, three in number, are jet condensing beam engines, each with a steam cylinder 36 in. by 72 in. and driving a bucket and plunger high-lift pump and a bucket low lift pump. The former pumps sewage a total lift, including suction and delivery, of 132 ft. to the top of the Whitlingham sewage farm through 1⅔ miles of 20-in. cast-iron pipes. The low-lift pump is not used, the valves being removed; the bucket remains attached to the engine as a balance weight only. The low-lift pumps when used delivered direct to the River Yare. These engines are very wasteful of fuel, and are now used as reserves. The sewage is screened through flat bars spaced 1 in. apart, the screen being inclined and fitted with raking gear. The sewage from the low-lying parts of Norwich below the levels commanded by the outfall sewer is raised by Shone ejectors. Ten years' constant use of these ejectors has shown that absolute reliance can be placed upon them. The cost of repairs has been trifling, and the renewals have been of the slightest character. The later pumping machinery at the Trowse outfall consists of four Roturbo pumps constructed by the Rees Roturbo Manufacturing Co., Ltd. (Parker Limited), Wolverhampton, on Rees' patent. One pump is at the bottom

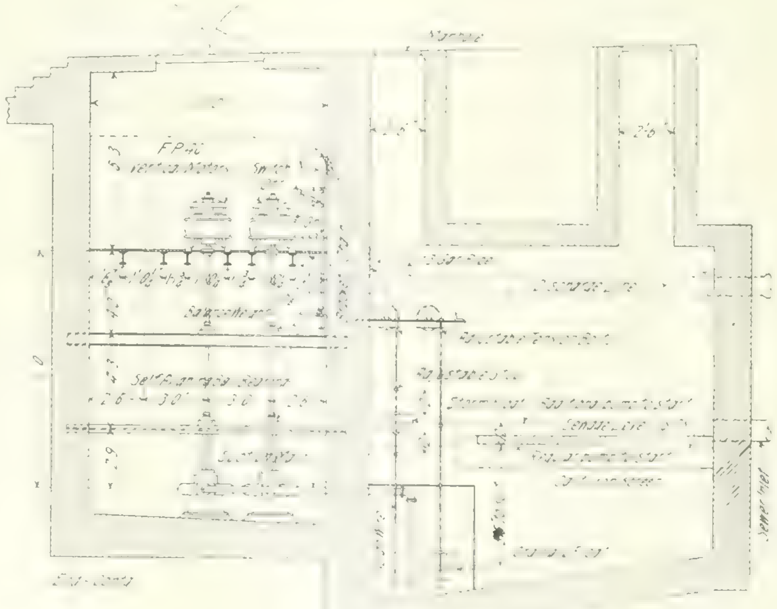

Fig. 2—Cross Section Through Pump and Screening Chambers, Sewage Pumping Plant, Eaton, England.

of a vertical spindle driven by a 150 b.h.p. electric motor at the top. The pump is fixed at such a level as to be self discharging, but it stands in a dry chamber. The suction side is connected with the pump by a 14-in. suction pipe fitted with a sluice valve. The delivery side has a sluice and a retaining valve, both of somewhat special character. The motor circuit is closed and opened by switch gear arranger in five steps and operated by a float rising and falling with the sewage in the sewage sump, from which all the pumps draw. The electrically-driven pump is arranged to start and stop automatically, it being for night work, and when in use an attendant need not be present. In the event of the sewage flow becoming abnormal and beyond the capacity of this unit, the continued rising of the float closes circuits operating alarm bells in the dwellings (close at hand) of the attendants, who start one or more of the other units. The current is continuous at 440 volts and obtained from the Corporation's mains. The other three pumps are similar to that above described, excepting that horizontal spindles are provided; they are fixed 11 ft. 6 in. above suction level, and are not self-charging, as they are driven by gas engines requiring the presence of an attendant for starting and stopping, who can charge the pumps when required by means of an electrically-operated Rotburo air exhauster. The special feature of the Roturbo pump is that the power does not vary appreciably over the whole range of the variation in head. Instead of designing the impeller to impart speed energy to the water equivalent to the head required, the impeller is replaced by what may be described as a revolving pressure drum of very large capacity in comparison with the orifices of the rim. The consequence of this design is that the water enters the pressure drum and becomes practically stationary with reference to the revolving drum, being carried round by vanes or partitions in this drum. Hence a pressure is created at the rim of the pressure drum about 10 per cent greater than the maximum lift that the pump is designed for. A series of directed nozzles or turbine blades are arranged at the rim of the drum, which convert a portion of the pressure in the drum into velocity, and if these nozzles are directed rearward the pressure inside the drum is then available for turbine effect, which increases with increased volumes of water flowing through the drum. The result is that the [illegible] for the power which [illegible] absorbed from the motor [illegible] the impeller. [illegible] power taken [illegible] required for the normal duty of the pump, and as the head [illegible] the motor actually decreases. Curves are given in Fig. 3 of three sample pumps of varying duties, each about 70 ft. to 80 ft. maximum, the normal duties being 60,000 gallons per hour, 30,000 gallons per hour and 12,000 gallons per hour respectively, from which the wide range of head within high efficiency will be noticed. An incidental advantage of the design of the Roturbo is the reduction of wear, and the consequent [illegible] efficiency attained. A [illegible] centrifugal pump requires a velocity of water at the tips of the impeller of approximately 80 ft. a second. In the case of the Roturbo, the rim of the impeller for a similar duty would also revolve at a speed of 80 ft. a second, but having already secured the pressure inside the revolving drum, it becomes possible to throw the water back almost tangentially, at a speed of, say, 40 ft. to 50 ft. a second, consequently, the resultant speed of the water in the fixed casing is only about 35 ft. a second. As a result of this, and also because the pressure drum cannot have any cavitation troubles to reduce the efficiency, the cutwaters or expanding channels may be removed some considerable distance from the rim of the impeller, and the pump will, when dealing with large quantities of water, give high efficiencies with a free vortex. As a result of this there is nothing in the path of the water after leaving the impeller to wear away, and when the water is expanded in a free vortex to the points of the tips of the deflecting vanes in the fixed casing, the speed of the water is so slow that results have demonstrated that there is no tendency to wear at this point. As there are no impediments to the flow of anything that has passed the impeller, there is consequently no possibility of any damage to the Norwich pumps due to pieces of solid matter up to an inch in diameter being carried up with the sewage. The smallest orifice in the rim of the revolving pressure drum in the case of the Norwich pumps is 1⅛ in. diameter, and as the space between the revolving rim and the deflecting vanes in the fixed casing is approximately 2 in., anything which will pass through the pressure chamber has a clear flow through the fixed casing without any possibility of breakage or damage to the pump. The passage through any pump is always, of course, in proportion to the duty, and the larger the

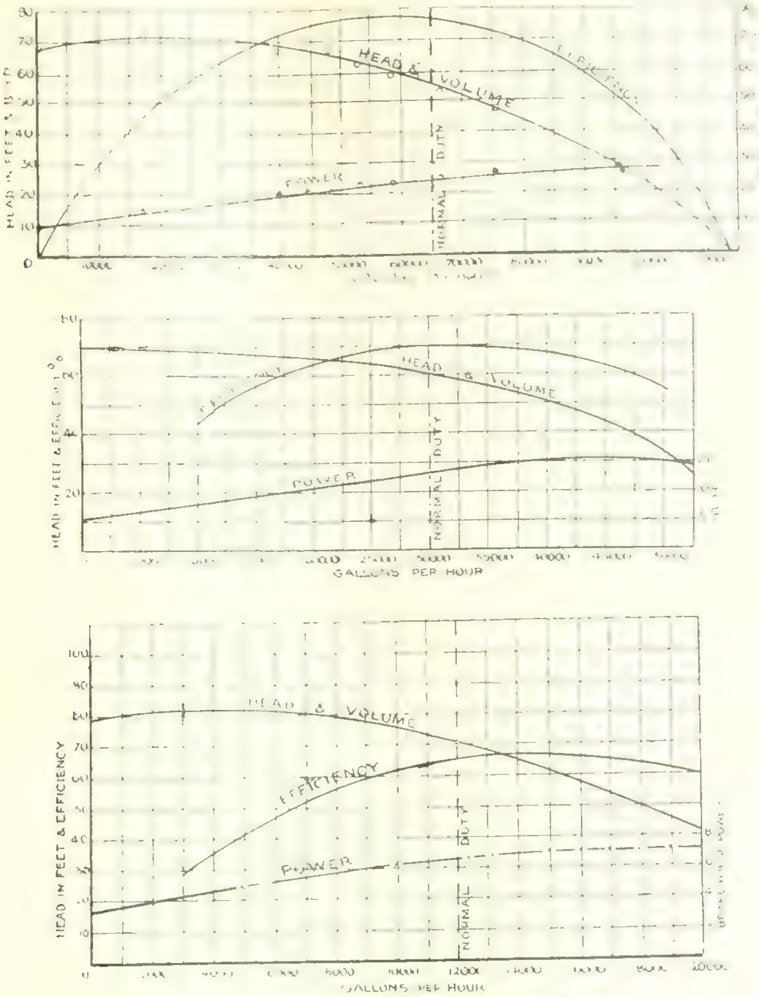

Fig. 3—Efficiency Curves of Three Roturbo Turbine Sewage Pumps.

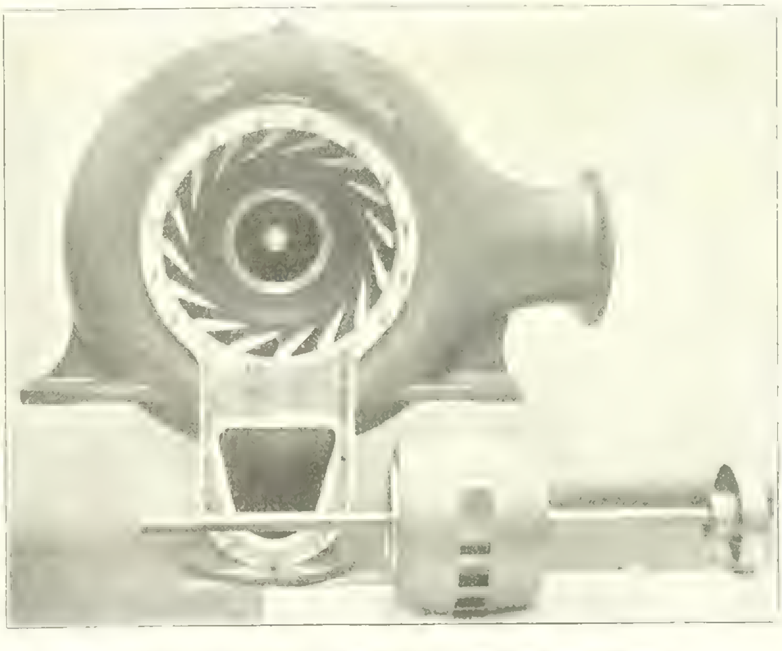

Fig. 4—Horizontal Type of Roturbo Sewage Pump.

[illegible] will pass up the suction pipe

Figure 4 gives the horizontal type of the [illegible] and the deflecting vanes or cutwaters in the [illegible] and tear of the pump journals and their bearings by extrusion of gritty water Mr. Collins designed special lantern brasses to be inserted with the journal gland packings. These lantern brasses form water chambers round the journals, and are supplied with clean water at a higher pressure than that in the pump, with the result that any gland leakage is of clean water into the pump and not gritty water out of it. In sewage pumping the question of screening is one requiring consideration. If the pumping station be at the treatment works, the case is usually simplified, as the detritus tanks can be traversed by the sewage before the pumps are reached, after which screening is generally a simple matter. Where this is not the case, and pumping has to be done from a deep sewer, necessitating the provision of deep underground chambers to contain the screens, great cost in construction is usually incurred. When designing the new pumping installation for sewage at Norwich it was thought necessary to protect the pumps with screens having circular holes of 1 in. diameter, but as the result of experience in running in usual weather conditions the screens are withdrawn, leaving the pumps to deal with unscreened sewage, and this they are doing without any blockage occurring.

The use of alternating current is largely prevalent in Great Britain, and therefore a typical installation employing three-phase motors may be of interest. This is to be found in the village of South Church, in the County of Durham. The increasing use of electric power in the collieries, either obtained from private plant or from the widely extended systems of power supply, renders it possible to apply it to comparatively small and isolated sewage systems with a minimum of expense, and South Church is a case in point. The plant consists of two pumping sets. A vertical three-phase motor is coupled direct to a vertical centrifugal Scott & Mountain pump, this direct coupling being a great advantage of the electrically-driven centrifugal combination. The whole electrical and pumping installation was put in by Messrs. Ernest Scott & Mountain, Ltd., of Gateshead, Durham. The motors are of the squirrel cage type, running at 1,160 r.p.m. on a 440-volt 40-cycle circuit. They are started and stopped by quick-acting make and break switches operated by floats, so that the motor runs when the sewage settling tank is full and switches off when empty. Time limit circuit breakers and fuses are the only other items of the electrical side. The pumps are drowned and [illegible] the delivery end [illegible] release valve to allow of automatic pumping. The mechanical arrangement of the pump is [illegible] the rotor [illegible] withdrawn and cleaned easily without disturbing the casing or pipework. Roller bearings support the [illegible] between motor and pump ends [illegible] is provided. Each pump set deals [illegible] gallons per minute of sewage against [illegible] to 15 ft., with an overall efficiency of 71 per cent.

Probably one of the most interesting electrically-operated sewerage systems in Great Britain is that belonging to the Birmingham Tame and Rea District Drainage Board. An electric power transmission scheme extends from Birmingham down the Tame valley for six miles to pump sewage up to a strip of land near to, but at a higher level than, the main conduit conveying the sewage from the Birmingham outfall works to the sewage farm in the Tame valley. In addition, sewage screening rakes, sludge elevators, sewage distributors, etc., are driven electrically. The generating plant consists of two British Thomson Houston generators coupled to Belliss & Morcom engines, steam being derived from a refuse destructor plant at Saltley (see map, Fig. 5). Current at 2,250 volts is carried by means of a pole line to the Saltley farm, where transformers are tapped onto the line for a local supply at 200 volts for driving sewage screens and farm machinery. Fig. 5 shows the successive pumping stations, each of which is divided into two rooms, one containing the pump, rotor, starting gear and high tension switch gear, and the other the transformers. The pumps used are Gwynnes centrifugals designed to raise from 696 to 1,900 gallons per minute against a head of from 16 to 30 ft. The largest pumping and substation is situated at Tyburn, the station being connected to the high tension lines by underground cable. There are three power circuits. The first controls one B. T. H. motor of 8 h.p. running at 960 revolutions per minute, and one 11 h.p. motor running at 965 revolutions per minute. These motors are used for the operation of general farm machinery and for driving machinery in the mechanics and joiners shops where the mechanical repairs required to the existing plant on the Board's estate are carried out, and any special tools required on the estate are made. The second controls the pumping station proper, which, as in the case of the other stations, is immediately adjacent to the transformer chamber and contained in the same building. This station contains a Gwynne 8-in. centrifugal pump designed to raise 963 gallons per minute against a head of 30 ft. This pump is direct-connected to a B. T. H. 3-phase induction motor of 22 hp. running at 575 revolutions per minute. The third controls one 3½ hp. motor running at 1,420 revolutions per minute and driving a sewage elevator. The cable supplying this motor is partly underground and partly overhead. The high-tension line continues from Tyburn to Plant's Brook, which has the heaviest duty of any of the pumping stations on the estate. This station is a pumping station only, and contains a Gwynn 10-in. centrifugal pump designed to raise 1,900 gallons per minute against a head of 17 ft.; it is direct-connected to a 28 hp. 3-phase B. T. H. induction motor running at 475 revolutions per minute. The transformer chamber contains three 10-kw. single-phase transformers having a ratio of 2,200 to 200 and the usual controlling switchboard. From this station the high-tension line is led to Minworth Greaves, where at present it terminates. The substation at Minworth Greaves is used for supplying power to operate two sewage distributors, which were previously operated mechanically, and are used for distributing sewage over circular bacteria beds. Provision has been made under a new contract to extend the high-tension line from this point one-half mile further towards Curdworth, where the Drainage Board are carrying out very extensive works in the building of bacteria beds, and where it is intended to light the beds with arc lamps and to electrically operate the gravel-washing machinery, consisting of a pump, stone crusher and winch. It is also intended to extend the use of the electric power thus obtained by installing pumps 400 yds. from the Minworth Greaves terminus. These pumps will be supplied with current at a pressure of 200 volts direct from the same substation as the gravel washer. There is no doubt that the undertaking of the Birmingham Tame and Rea Drainage Board, embodying as it now does all the features of a comprehensive high-tension power-distribution scheme, is one of the pioneer undertakings in Great Britain, and it is the first scheme of its kind in the world. It therefore is a matter of interest to all engineers, electrical and otherwise, interested in the problems of the disposal of sewage, and, together with other instances cited above, gives sufficiently clear evidence of the important results which are already attending the application of electric power to this phase of civil and sanitary engineering.

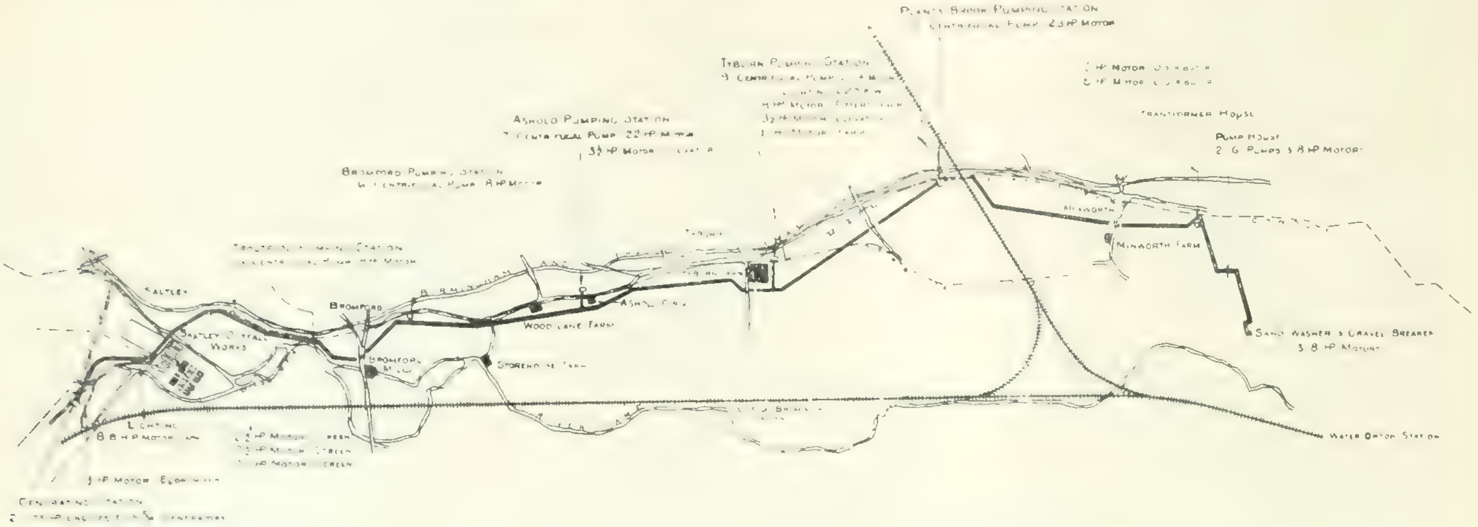

Fig. 5—General Plan of Site of Outfall Works, Birmingham Tame & Rae District Drainage Board, England.

On March 11th, 51 shovels working in the Central Division of the Isthmian Canal excavated 78,293 cu. yds. of material, or an average of 1,535 cu. yds. per shovel for the 8-hour working day. This is the highest average output per shovel ever made in the Central Division for one day. On the same day, 49 Lidgerwood trains and five small Western dump trains, or a total of 54 trains, were unloaded on the Balboa dumps, which is the greatest number of trains unloaded at this place since the commencement of work, the next highest record being on Sept. 14, 1910, when 47 Lidgerwood trains and three Western dump trains were unloaded.

Methods and Cost of Deep Trenching by Machine at Glencoe, Ill.

BY DON [illegible]

The southern [illegible] Village of Glencoe, Ill., has long been awaiting the construction of a sanitary sewerage system. A system was designed some four of five years ago, which used the Skokie for an outlet after passing the sewage through a septic tank.

Because of the constantly increasing objection to the discharge [illegible] Lake Michigan, the sewage from the territory lying east of the ridge was to be carried westward to the septic tank at the edge of the Skokie by a trunk line sewer that for some distance was 30 ft. deep. Because of the high cost of tunneling and the possibility that the Sanitary District of Chicago would provide an outlet such that the costly construction could be avoided, the construction of this system was postponed from year to year, until the territory finally became so thickly settled and the necessity of a sanitary sewer became so imperative that it was determined to proceed with the construction according to the original plans. The contract was awarded to Mr. F. G Mortimer, of Chicago, and actual work was begun about August 1, 1910.

The system spreads over a territory of considerable extent. A small amount of the excavating was [illegible] the most part the excavating was done by two Chicago sewer excavators, manufactured by the Municipal Engineering & Construction Co.

The soil, [illegible] was a hard clay. The top [illegible] brownish clay with slight traces of sand. Below this was a hard blue clay During the fall and winter months this soil becomes extreme- [illegible] soil was [illegible] required.

The length and depth of the various sizes of pipe are tabulated below:

15,500 lin. [illegible] cut.

5,600 lin. ft. of 10-in. pipe from 7 to 13 ft. cut.

250 lin. [illegible]

1,000 lin. ft. of 15-in pipe about 16 ft. cut.

4,700 lin. ft. 18-in. pipe from a very shallow cut up to [illegible]

Reference to the above tabulation will show that a good percentage of the larger size pipe was placed in very deep cuts. This feature, before the construction was actively started, caused the contractor considerable anxiety. The excavator that he had on the job would cut to a depth not exceeding 15 ft., and it was determined to excavate the trench to the full depth of 15 ft. and then from the bottom of this trench sink shafts at about 50 ft. intervals and tunnel between them at the necessary level. Figs. 1 and 2 show the trenching machine in operation.

It was thought by this method, that the amount of hoisting would be reduced and the open trench between shafts could be used for deposit of the excavated material from the shafts and from the tunnel below. But before this plan had actually been put into effect it was determined to ultilize the largest size Municipal Excavator.

The excavator was constructed to dig a trench up to 25 ft. in depth. Where the depth of excavation exceeded this amount, as it was for a considerable distance as deep as 30 ft., the street was graded down 3 or 4 ft. and the remaining foot or two was excavated by hand in the bottom of the trench and the dirt thrown either into the boom or back upon the completed pipe.

The trench dug by this machine was about 33 ins. in width, giving ample room for the proper laying of the 18 ins. sewer pipe and for securing proper joints and also for the reception of junctions. All joints were calked with oakum and then cemented, to exclude seepage as far as possible, making a wide trench quite necessary, for room in which to operate.

The sides of the trench were smooth and vertical. Vertical plank and pack screws were used for bracing. These were placed about 3 ft. apart in the deep trenches and farther apart in shallow cuts.

At only a few points was caving experienced. When ground of a suspicious character was encountered the bracing was kept close behind the machine. In some cases it [illegible] to the excavator. This operation stops the machine for only a few moments, while the workmen use

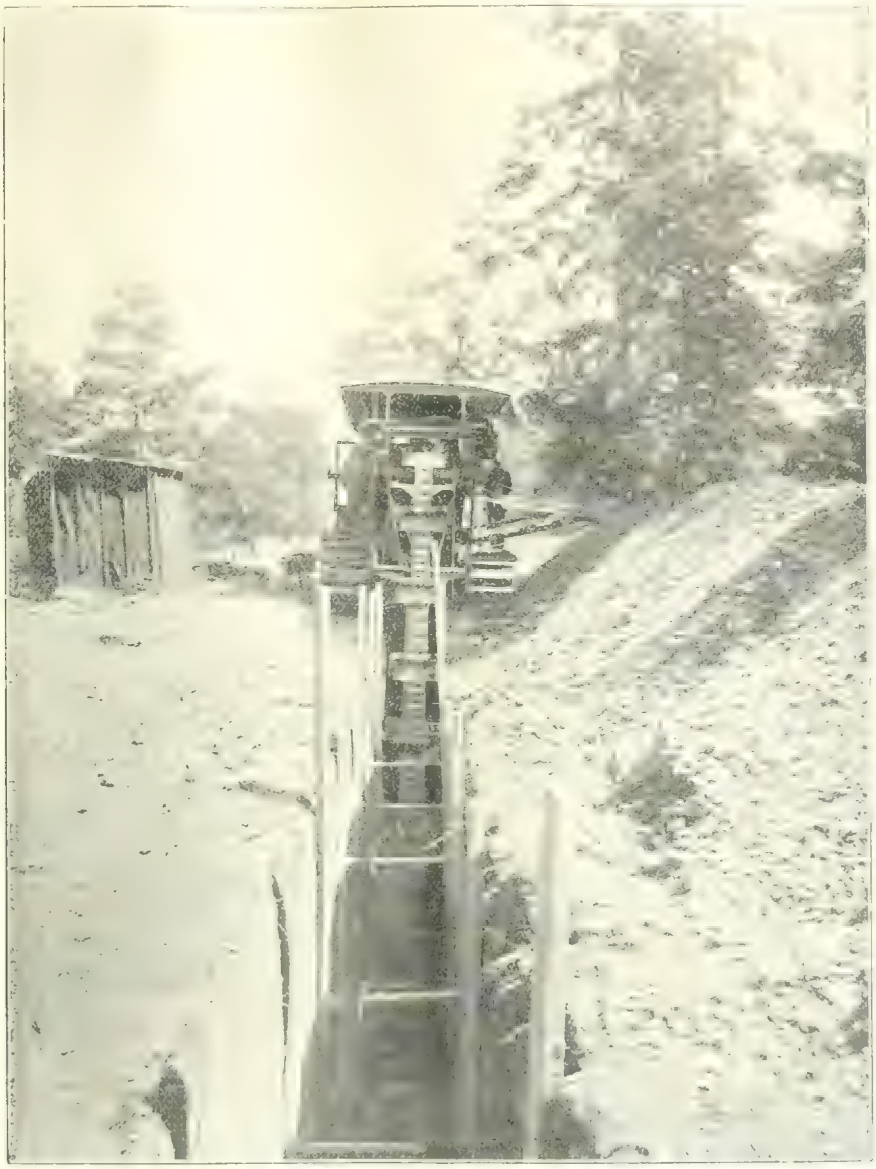

Fig. 2—View of Trench and Bracing, Glencoe Ill., Trunk Sewer

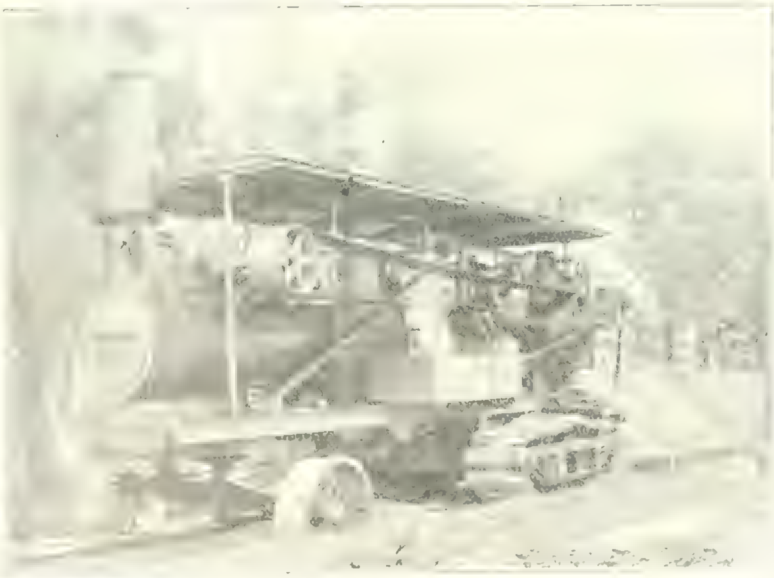

Fig. 1—Chicago Sewer Excavator Digging 15 Ft. Trench, Glencoe, Ill.

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*708 Birch St., W[illegible] Ill.

[illegible] eter when coming entirely in the trench would not stop the machine. When these [illegible] trench, or stones of larger dimension were encountered, sticks of dynamite were placed on top of them and were crushed without making it necessary to raise the boom.

All pipes were vitrified, salt glazed, hub and spiggot pipe. The 18-in. pipe were double strength and were lowered into the open trench by means of a single pulley on a small tripod.

The construction was carried on up to its time of completion, about of the first of January, 1911. For some time there was frost in the ground, finally reaching a depth of 14 to 16 ins.; and although this caused a con[illegible] did [illegible] stop the work.

As regards the cost of this deep excavation it is impossible to get any accurate figures. The deep trenching was being done by one [illegible] at the same time. The workmen were changed from one to the other as [illegible] demanded and to get accurate [illegible] cost would have required constant attention to this one feature. However, by [illegible] the record of a few average days, which does not take into consideration the long or short delays caused by break-downs, storm, or otherwise, the cost of labor alone for excavating at a depth of about 25 ft., laying 18-in. pipe and backfilling appears about as follows:

	Per day
[illegible]	$ [illegible]
Excavating machine, including operator	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible] men at $3.00	[illegible]
[illegible] laborers backfilling at $2.50	[illegible]
[illegible] teams at $6.00	[illegible]
Coal	[illegible]
Repairs and sundry expenses	[illegible]
Total	[illegible]

One hundred and forty seven dollars for 80 ft. or approximately $1.85 per lin. ft. While working in the deep cuts progress of [illegible] to 100 ft. per day was made.

It [illegible] noticed that a large amount of the cost is for backfilling. This item can be reduced where it is possible to use teams with slips. If the backfilling can follow close behind the excavating while the dirt is still fresh, one team with driver and one scraper holder will backfill about as much as ten laborers with shovels.

The clay being hard and dry the excavated material was broken up very fine, ranging from fine dust up to the size of pea coal, and in the damper portions increasing in size up to the dimensions of small egg coal. The material broken so finely is in excellent condition for backfilling.

The contractor purchased an automatic backfiller, but for various reasons its use was abandoned. In order to use the back filler it is necessary to keep the pipe laid up close to the boom, which is not always con venient, especially when the excavating is easy and the pipe layer can not easily lay as fast as the machine is capable of digging.

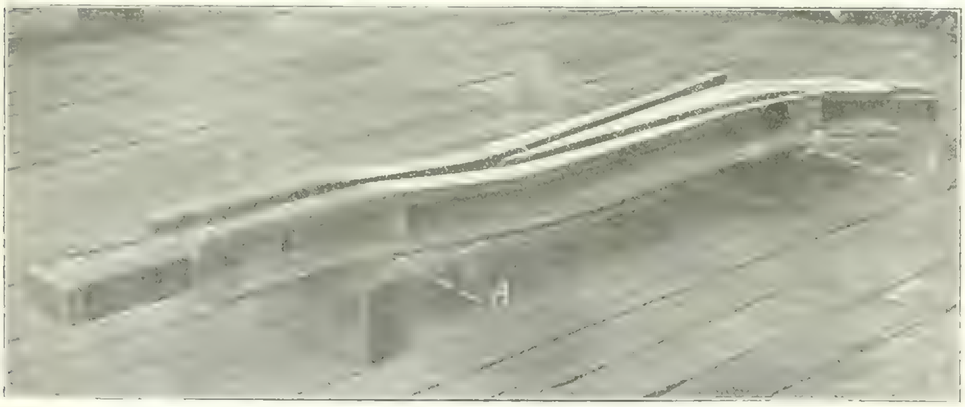
The Engineering and Inspection was done by Windes and Marsh, Civil Engineers and Surveyors, Winnetka, Ill.

STEAM AND ELECTRIC RAILWAY SECTION

Test of a Solid Manganese Steel Frog.

[illegible] exhibition of the American Railway Appliance Association held at the Coliseum, Chicago, in March, manganese track material was an important feature. Among the most interesting of these exhibits were frogs and other castings that had been subjected to severe tests. These tests demonstrated conclusively the high degree of ductility and resistance to fracture possessed by this metal.

In the accompanying illustration is shown a solid manganese frog that was subjected to a series of drop tests. This frog is selected for illustration for the reason that it was fully described in a paper entitled "Manganese-Steel Frogs and Switch Points" that appeared in our issue of March 22, 1911. In this paper the design of solid and built-up manganese frogs was described in detail. This frog is of the solid type, and is therefore [illegible] single manganese steel casting. It was exhibited by the Morden Frog & Crossing Co., of Chicago.



Effect of Drop Test on Solid Manganese-Steel Frog.

In the accompanying illustration points of [illegible] the lines [illegible]. The distance between these points is 4 ft 7 ins. The points at which impact was applied are [illegible] at a point 5 ins. from the actual point of the frog. In making this test the frog rested free on the supports. In tests 2 and 3 impact was applied as near as possible to the ends of the tread. In these tests the opposite end of the frog was, of course, securely fastened to prevent tipping. Two series of tests were made, one with a 1,000-lb. drop, and [illegible] number of blows applied and the distance through which the drops were allowed to fall:

No. of blows	Fall in ft	Weight of drop
	Point No. 1.	
[illegible]	8	1,000
[illegible]	[illegible]	2,800
[illegible]	6	2,800
[illegible]	7	2,800
[illegible]	8	2,800
	Point No. 2	
[illegible]	8	1,000
[illegible]	2	2,800
[illegible]	3	2,800
[illegible]	4	2,800
[illegible]	5	2,800
1	[illegible]	2,800
1	8	2,800
[illegible]	9	2,800
[illegible]	10	2,800
	Point No. 3	
[illegible]	8	2,800
[illegible]	9	2,800
[illegible]	10	2,800

At Point 1 there was applied a total of 454,000 ft. lbs.; at Point 2, 788,400 ft. lbs. and at Point 3, 260,400 ft. lbs. A total of 1,[illegible] ft. lbs. was therefore applied to this frog. The resulting deflections at Point 1 was 1½ ins.; at Point 2, 3 ins.; and at Point 3, 1 in. Careful inspection failed to reveal any evidence of fracture in the casting, while the surface deformations at the point of impact were so small as to be negligible.

Results of Titanium Treatment of Steel Rail.

[illegible] of titanium rail during the past four years in track subject to heavy service has demonstrated high wearing [illegible] of this kind. An interesting comparison of wear on ordinary Bessemer rail and on ferro-titanium Bessemer rail was made at the 56th St. crossover in the New York Central approach to the Grand Central Station in New York City in 1907 and 1908. This crossover is equivalent to a 10° curve, and the service over it is unusually severe. Relative wear is shown by the accompanying figure. The rail is of the 6-ins. 100-lb. Dudley section. Bessemer rail in service for four months lost 3.3 lbs. per yard; while ferro-titanium Bessemer rail in service in the same position for six months lost only 1.01 lbs. per yard.

At the recent exhibit of track appliances at the Coliseum, Chicago, the Lackawanna Steel Co. exhibited ferro-titanium rail, both Bessemer and open hearth, that had been subjected to excessive bending without fracture. In treating the steel from which these rails had been rolled, 0.3 per cent of an alloy containing from 10 to 15 per cent of titanium was added to the steel as it flowed into the ladle from the Bessemer converter or the open hearth furnace. The mixture was then held for from three to six minutes for the completion of chemical reactions and the escape of impurities. On the completion of such a process as this no trace of titanium, when applied in the percentage given above, is found in the steel, the titanium acting as a scavenger in removing injurious oxides and nitrides, and in retarding the segregation of sulphur, phosphorus and carbon. The titanium treatment is said to be extremely simple, but it must be correctly applied in order to secure satisfactory results.

In a paper published in the proceedings of the American Society for Testing Materials, Dr. G. B. Waterhouse comments as follows on the effect of titanium treatment of steel:

> Titanium when rightly applied in the proper [illegible] is found to retard segregation of sulphur, phosphorus and carbon in what is normally [illegible] steel. The noticeable feature is the increased soundness of the Titanium steel due to the concentration of the blow holes in the pipe cavity. The results were checked by taking all the rails from two ingots, one of ordinary steel and one of treated steel, drillings being taken from [illegible] series of rails in exactly similar locations and making careful analyses. Here, also, the treated steel exhibits less segregation than the ordinary steel. Improvement has also been noticed in the working of the steel in the rolling mill and the rails on the different roads have been found to give much better service than ordinary Bessemer steel rails.

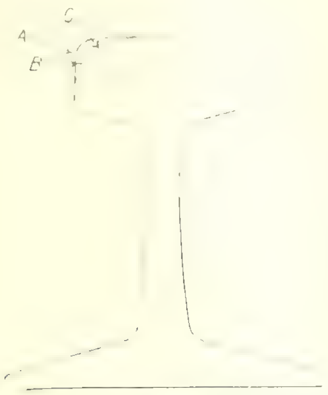
During the past winter many tests have been made by Dr. P. H. Dudley on Bessemer and open hearth rails treated with titanium.

Among these tests [illegible] Bessemer rail of the following average analysis:

Carbon	0.63
Manganese	0.55
Phosphorus	.095

Metallic titanium to the extent of 0.1 per cent was added in the [illegible]

These rails of 100-lb. section were subjected to the standard drop test 2,000-lb. ball at 18 ft. and gave an average deflection of 1.4 ins. In each case 3 to 4 blows were required to fracture the rail. Average elongation, measured on the base of the rail (35 rails) was 13 per cent. Six per cent elongation is considered safe by the majority of engineers and this demonstrates a factor of



Wear on 100-lb. Dudley Section Rail.

(A shows original outline of [illegible] B shows outline of head of ferro-titanium bessemer rail after 6 months of service [illegible] outline of head of ordinary bessemer [illegible] months of service.)

safety of more than 200 per cent in ductility. The increase in carbon necessarily gives a better wearing rail while titanium, through the removal of the occluded gases, makes the metal ductile and without brittleness

[illegible]

with titanium alloy for the Lehigh Valley Ry. the carbon was kept from 8 to 10 points higher than in their plain steel and the use of the alloy enabled the makers to maintain a slightly better ductility than in the plain rails of lower carbon and at the same time to secure a better average [illegible] drop tests [illegible]

Titanium treatment on the basis of 0.03 per cent of metallic titanium costs $1.05 per ton of rail. With 0.1 per cent of metallic titanium, which results in a higher carbon content and [illegible] $1.96 per ton of rail.

Tests of Rolled Manganese-Steel Rail.

Remarkable resistance to fracture has been shown by bending tests made on rolled manganese-steel rails manufactured by the Manganese Steel Rail Co., of New York City. In these tests the rails were bent back and forth until broken by blows from a steam hammer. The bending was done with the rail lying on its side, the rail being turned over after each blow. The distance between supports was 2 ft. 9 ins. The length [illegible] which deflections were measured was 1 ft. 6 ins. The rail tested was of 80-lb. A. S. C. E. section. In the following tabulation the effect of each blow is given:

TEST NO. [illegible]

Blow	Deflection	
1	3½ ins.	
[illegible]	[illegible] ins.	
[illegible]	2¾ ins.	
[illegible]	3⅝ ins.	
5	[illegible] ins.	Began to [illegible]
[illegible]	[illegible] ins.	Began to [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible] ins.	
[illegible]	[illegible] ins.	Began [illegible]
[illegible]	Rail broke	

TEST NO. [illegible]

Blow	Deflection	
1	6 ins.	
[illegible]	[illegible] ins.	
[illegible]	[illegible] ins.	[illegible]
[illegible]	[illegible] ins.	[illegible]
[illegible]	[illegible] ins.	W[illegible]
	Rail broke	

TEST NO. [illegible]

Blow.	Deflection	
1	[illegible]	
[illegible]	3¼ ins	
[illegible]	2½ ins.	
[illegible]	1⅝ ins	
5	1¾ ins	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	1½ ins.	
11	2 ins.	
[illegible]	[illegible]	
15	[illegible]	
[illegible]	[illegible] ins.	
[illegible]	[illegible]	
[illegible]	[illegible] ins.	
[illegible]	[illegible] ins.	
[illegible]	[illegible] ins.	
22	[illegible]	
[illegible]	[illegible] ins.	
[illegible]	[illegible] ins.	
[illegible]	[illegible] ins.	
[illegible]	[illegible] ins.	
[illegible]	[illegible] ins.	
[illegible]	2¾	
[illegible]	[illegible] ins.	

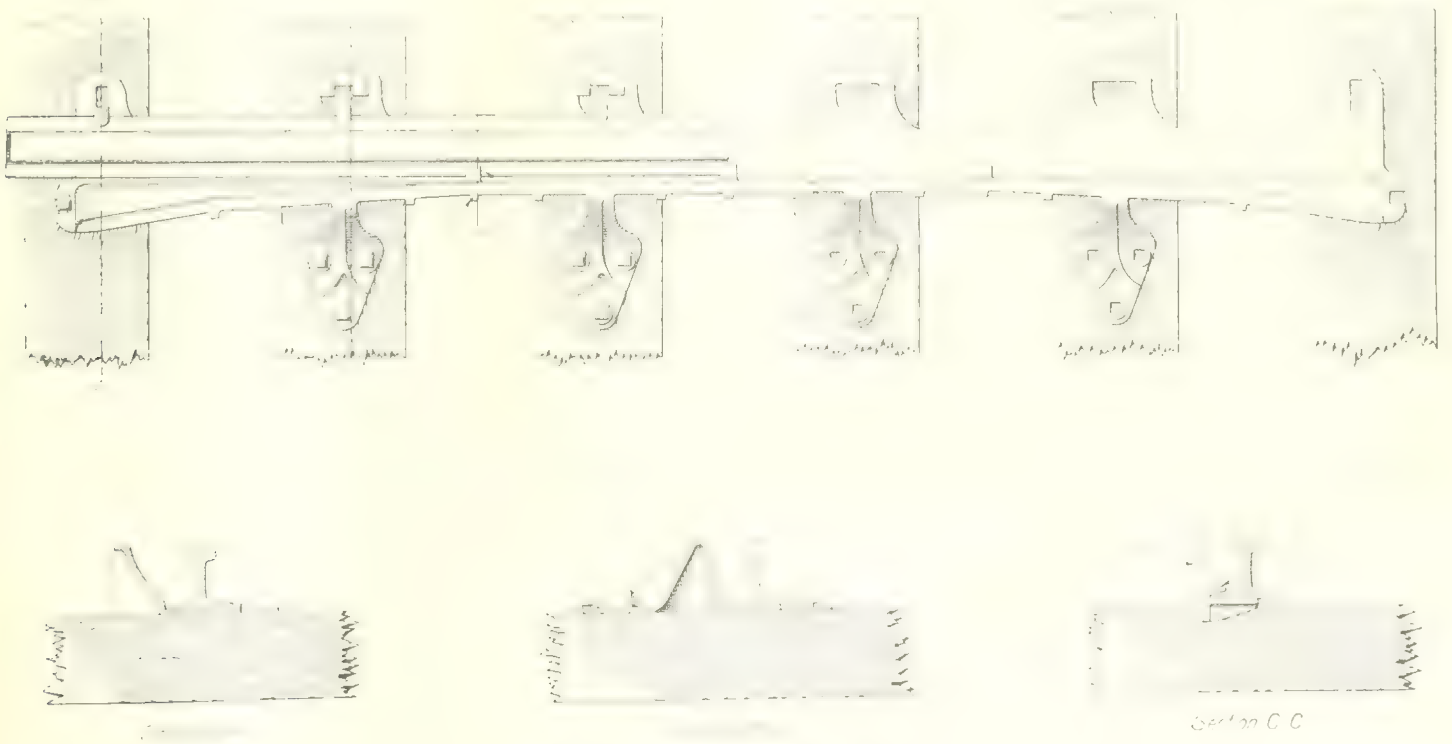
The rails tested are said to have been below the average quality. In comparison it may be stated that fracture occurs in bessemer rail of good quality at the [illegible] with a deflection of 2 ins.

A One-Piece Manganese-Steel Guard Rail.

No one feature of track has been the subject of more experiment and invention during recent years than that of guard rails. The standard rail guard, with its bolts and spacing blocks, is unsatisfactory in several ways, but is still widely used. Its most serious defect is doubtless the lack of rigidity in its connection with the main rail. It is a common thing for the guard rail to tip inward under the impact of wheel flanges. This raises the spacing block slightly, with the result that casting and bolt are often broken by being struck by a wheel flange. Where this does not occur the flangeway may be so widened that the purpose of the guard rail is defeated. Various devices have been proposed for eliminating these defectis in the rail guard.

There was exhibited at the recent exhibition of railway appliances at the Coliseum, in Chicago, a guard rail designed along entirely new lines. This is a cast managanese-steel guard rail, manufactured by the Ajax Forge Co., of Chicago. Details are illustrated by the accompanying figure. It will be observed that this guard rail is so designed as to eliminate entirely the defects of the rail guard mentioned above. The main rail rests [illegible] assured, and the possibility of tipping is prevented.

As small an amount of manganese is used as is consistent with adequate strength. The base and guard portion have a uniform thick- [illegible]



One-Piece Manganese-Steel Guard Rail.

TABLE I.—STATEMENT SHOWING DEPTH

Depth of Ballast Under Tie.

Name of Railroad.	[illegible]	Center of Tie—Kind of Ballast				End of Tie—Kind	
		Rock.	Gravel.	Cinders.	Sand.	Rock.	Gravel.
Baltimore & Ohio	A B C	a12 in. 9 in. 6 in.	b12 in. 9 in. 6 in.	12 in. 9 in. 6 in.	.....	a12 in. 9 in. 6 in.	b12 in. 9 in. 6 in.
Boston & Maine	A C		12 in. 12 in.		....	....	12 in. 15 in.
Central of Georgia	A C	7 in.	7 in. 7 in.	7 in. 7 in.	..	9 in.	9 in. 9¼ in.
Chicago & Alton		e12 in.	12 in.	f12 in.		e13½ in.	13½ in.
Chicago, Burlington & Quincy		8 to 12 in.	8 to 12 in.	8g to o12 in.	.....	8 to 12 in.	8 to 12 in.
Chicago Great Western	A B C	12 in. 9 in. 6 in.	12 in. 9 in. 6 in.	12 in. 9 in. 6 in.	.....	13 in. 10 in. 7 in.	13 in. 10 in. 7 in.
Chicago, Milwaukee & St. Paul	A B C	...	h12 in. h10 in. h8 in.	12 in. 10 in. 8 in.	.....	.....	h12 in. h10 in. h8 in.
Denver & Rio Grande	A B C D	...	12 in. 10 in. 8 in. 6 in.	.....	.....	.....	12 in. 10 in. 8 in. 6 in.
New York, New Haven & Hartford.......		9 in.	7 in.	7 in.	7 in.	k8 & 10 in.	9½ in.
Pennsylvania		6 in.	6 in.	6 in.	.....	7 in.	7 in.
Rock Island Lines	A B C	m6 to 10 in. 6 to 10 in. 6 to 10 in.	6 to 10 in. 6 to 10 in. 6 to 10 in.	6 to 10 in. 6 to 10 in. 6 to 10 in.	n6 to 10 in. 6 to 10 in. 6 to 10 in.	m6 to 10 in. 6 to 10 in. 6 to 10 in.	6 to 10 in. 6 to 10 in. 6 to 10 in.
St. Louis Southwestern	*	12 in.	12 in.	12 in.	12 in.	13 in.	13 in.
St. Louis & San Francisco	A B C	o6 to 10 in. 6 to 10 in. 6 to 10 in.	6 to 10 in. 6 to 10 in. 6 to 10 in.	6 to 10 in. 6 to 10 in. 6 to 10 in.	p6 to 10 in. 6 to 10 in. 6 to 10 in.	o6 to 10 in. 6 to 10 in. 6 to 10 in.	6 to 10 in. 6 to 10 in. 6 to 10 in.
Texas & Pacific..............................	*	8 in.	8 in.	8 in.	.....	9 in.	9 in.
Wabash	A B	r8 in. r12 in.	.....	.....	.....	r12 in r8 in.	.....

with ribs as shown at *D*. These ribs extend under the base of the casting as shown by stiffeners C, and also have a thickness of 7/16 in. The rail is secured on the guard side by means of lugs that fit closely over the base of the rail. Apparently a thoroughly economical disposition of the metal has been secured. The guard rail as shown can be used for a number of different rail sections, variations in width of rail base being provided for by the openings for spiking at the outside of the main rail. No provision is necessary for adjustment for wear, as one of the qualities of manganese steel is its high resistance to abrasion.

The design of this guard rail has evidently been carefully studied. It is stated that it can be sold at a cost about $2 in excess of that of a standard 80-lb. rail guard.

The Proper Thickness of Ballast With Statistics of Practice.*

Some of the reasons for the use of ballast in track construction are as follows:

(a) To provide drainage which will lead any water that may accumulate away from the ties; or to provide a protection for the subgrade from water, as in the case of cementing gravel.

(b) To distribute the load from the ties more uniformly over the subgrade than would be done if the ties rested directly upon the subgrade.

(c) [illegible] which can readily be "worked" or tamped in all kinds of weather and which will not materially lose its carrying power or change its position as a result of the action of the elements.

The proper depth of ballast under the ties will depend among other things upon the following:

(a) The character of the subgrade: (1) Rock. (2) Firm material, as firm gravel. (3) Soft material, as gumbo.

(b) The kind of ballast: (This affects the depth of ballast but slightly compared with other conditions.)

(c) The number and size of ties per rail length: (This determines the bearing surface on the bottom of the tie in a given length of track.)

(d) The stiffness of the rail: (1) 135-lb. used on C. R. R. of N. J. (2) 40-lb. used on branches.

(e) The weight and magnitude of the wheel load and the number of applications in a given period: (1) 100 cars per day. (2) 2,000 to 3,000 cars per day.

(f) The cost of materials used in construction of the track.

Character of Subgrade.—If the subgrade is of rock it will not be deformed by wet weather and it will carry all the load that can be put upon it by a timber tie; therefore, the depth of ballast required in this case is only sufficient to provide an equal bearing under the tie and sufficient material for tamping purposes.

If the subgrade is soft, then it is necessary to provide a depth of ballast which will produce as nearly as possible a uniform pressure on the subgrade.

Between solid rock and soft material, such as gumbo, there exists material used for subgrade of various capacity for supporting the load of the track. The softer the material used in the subgrade, the deeper should be the ballast (within certain limits), to provide as uniform pressure on the subgrade as possible.

Kind of Ballast.—The required depth of ballast under the tie is not materially affected by the kind of ballast, although it is generally the practice to provide a less depth of stone ballast than gravel ballast. (This is probably largely affected by the high cost of stone.)

Number and Size of Ties Per Rail Length.—The number of ties per rail length, where the roadbed is soft, materially affects the depth of ballast, for the fewer the ties the greater the weight on each tie, and a greater depth of ballast will be required to distribute the load more uniformly over the subgrade.

Stiffness of the Rail.—The stiffness of the rail materially affects the depth of ballast, for with the stiffer rail the wheel load is distributed over a greater number of ties and therefore the load on each tie is reduced. The unit weight being less, it is not necessary to distribute same as uniformly on the subgrade.

Weight and Number of Wheel Loads.—The greater the weight and number of wheel loads the greater the necessity for increased depth of ballast, so as to distribute the weight on the subgrade as uniformly as possible.

Cost of Material Used to Construct the Track.—From an economic standpoint the proper depth of ballast frequently depends on the cost of the various materials of which the track is constructed; for example, where ballast is very expensive it may be advisable to increase the weight of rail and cut down the depth of ballast.

Dimensions of Ballast Section.—As information, Table I, is given, being a statement giving the dimensions of the ballast sections on various railroads.

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*Report of Sub-Committee on Ballast, American Railway Engineering and Maintenance of Way Association.

The Railway Storekeepers' Association.—The eighth annual convention of the Railway Storekeepers' Association will be held at the Hotel Pfister, Milwaukee, Wis., on May 22, 23 and 24. Papers and discussions will be given on the following subjects: The Need of a Standard Material Classification and Disbursements in Order to Intelligently Compare the Work of the Various Supply Departments and the Relative Stock of Material Which They Maintain; The Railway as a Manufacturer; The Standardization of Tinware; The Standardization of Storehouses, Oil Houses, Scrap Docks, Supply Cars, etc.; Timber Treating; Stock Upkeep and Stock Reduction; Outline of Methods in Handling Navy Department Stores; Return of Cement Sacks, Carboys, Drums, etc.; Standard Railroad Electric Light Fixtures.

OF BALLAST USED BY VARIOUS RAILROADS.

of Ballast.		Height and Slope of Shoulder.		Width of Roadbed.		
Cinder.	Sand.	Dist. from Top of Tie to Top of Shoulder.	Slope.	Cuts.	Fills.	Tile Drains.
12 in.	...	1½ in.	c1½ to 1	18 ft.	20 ft.	...
9 in.	...	1½ in.	1½ to 1	16 ft.	18 ft.	...
6 in.	...	1½ in.	1½ to 1	[illegible]	16 ft.	...
...	...	1 in.	1½ to 1	19 ft. 5 in.	19 ft. 5 in.	...
...	...	Bottom of tie	Curved	18 ft.	18 ft.	...
9 in.		Top tie rock	Curved	16 ft.	16 ft.	...
9¼ in.		Others 1 in.	Curved	[illegible]	14 ft.	...
f12 in.	...	Top tie rock, bot. gravel	...	18 ft.	18 ft.	...
g8 to 12 in.		1½ in.		18 ft.	18 ft.	6 & 8 in. pipe under ditch.
13 in.		Top of tie, bot for cementing gravel.	...	20 ft.	20 ft.	...
10 in.				18 ft.	18 ft.	...
7 in.	...		...	16 ft.	16 ft.	...
12 in.	...	1½ in.	2 to 1			...
10 in.	...	1½ in.	2 to 1			...
8 in.	...	1½ in.	2 to 1			...
...	...	About 1 in.	Curved	18 ft.	20 ft.	...
...	...	About 1 in.	Curved	18 ft.	20 ft.	...
...	...	About 1 in.	Curved	18 ft.	20 ft.	...
...	...	About 1 in.	Curved	18 ft.	20 ft.	...
9½ in.	9½ in	Top tie rock Others 3 in.	1-1 rock 2-1-others	16 ft.	16 ft.	...
7 in.	...	Top rock and cinder 1 in. above bot. gravel.	1½ to 1	14 ft. 8½ in.	21 ft. 8½ in.	6 in. C. I. pipe cross drain.
6 to 10 in.	n6 to 10 in	1½ in.	2 to 1	20 ft.	20 ft.	Cross drain when needed
6 to 10 in.	6 to 10 in	1½ in.	2 to 1	18 ft.	18 ft.	
6 to 10 in.	6 to 10 in	1½ in.	2 to 1	16 ft.	16 ft.	
13 in.	13 in	Top tie rock, bot. sand	1½ to 1	17 ft.	18 ft.	...
6 to 10 in.	p6 to 10 in	1½ in.	2 to 1	20 ft.	20 ft.	...
6 to 10 in.	6 to 10 in	1½ in.	2 to 1	18 ft.	18 ft.	...
6 to 10 in.	6 to 10 in	1½ in.	2 to 1	16 ft.	16 ft.	...
8 in.		1 in. from bottom, top tie rock.	1½ to 1 1 to 1 rock	18 ft.	15 ft.	...
		Top of tie.	Curved	16 ft.	18 ft.	...
		Top of tie.	Curved	18 ft.	16 ft.	

Remarks.

a Includes hard slag.
b Includes granulated slag.
c Slope is being changed from c'rv'd to 1½ to 1.
d Roadbed has transverse slope ¾ in. to 1 ft. In wet ledge cuts, depth of ballast is sometimes increased to 2 ft.
e Includes furnace slag
f Cinders used in sidetracks only.
g Includes burned clay. Ballast varies from 3 in. in sand to 18 in. in clay.
h Includes burned gumbo. Depth of ballast varies from 6 in. to 12 in. with local conditions and variation in volume of traffic.
k Rock used on double and 4 track. Only 4-track section shown; sub-grade had transverse slope ¼ in. to 1 ft.
m Includes slag and disintegrated granite.
n Includes chats. Depth of ballast varies with nature of soil.
* Shoulder is dressed to bottom of tie in cementing gravel.
o Includes slag and disintegrating granite.
p Includes chats. Depth of ballast varies with nature of soil.
* Variation from standard made account of scant supply of ballast.
r Kind of ballast not stated. Standard not followed in sidetracks.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Current Prices of Material, Supplies and Small Tools Used in Construction Work.

The following information concerning the current prices of materials and supplies has been obtained from various sources. While the list is not as complete as could be wished, yet we think that it contains prices on a greater part of the materials and supplies commonly used in construction work. One feature which should be of interest is the table showing the length of working days and wages paid common labor on paving work in a large number of American cities and the table showing the prevailing prices for Portland cement, broken stone and other paving materials in these cities. These tables were compiled in connection with the tables showing the paving work done last year in representative cities; the tables on this paving work are printed under the Roads and Streets Section in this issue. The prices for the small tools given in this issue are net prices, and in compiling this list we have been greatly indebted to the H. Channon Co.'s Catalog No. 50 for suggestions as to arrangement and selection of articles and also for many of the net prices given.

LABOR.

LENGTH OF WORKING DAY AND PREVAILING RATES OF WAGES IN 1910 FOR LABOR FOR STREET PAVING WORK IN REPRESENTATIVE AMERICAN CITIES.

City.	[illegible]	[illegible]	[illegible]	[illegible]
New England States:				
Barre, Vt.	[illegible]	$1.75		[illegible]
Boston, Mass.	[illegible]	2.00	[illegible]	[illegible]
Bridgeport, Conn.	[illegible]	1.25	[illegible]	6.00
Brookline, Mass.	[illegible]	1.75		...
Cambridge, Mass.	[illegible]	[illegible]		[illegible]
Everett, Mass.	[illegible]	2.00	4.50	[illegible]
Fitchburg, Mass.	[illegible]	2.00		4.00
Hartford, Conn.	9	1.75	5.00	[illegible]
Haverhill, Mass.	[illegible]	[illegible]	4.50	4.50
Lawrence, Mass.		2.00	5.00	5.00
Lewiston, Me.	[illegible]	[illegible]	....	
Lowell, Mass.		2.00	4.00	5.00
Malden, Mass.	8	2.00		3.50
Meriden, Conn.	[illegible]	1.75[4]		[illegible]
Middletown, Conn.		1.85		4.50
New Bedford, Mass.		2.25	2.75	4.50
New Britain, Conn.	9	1.75	1.00	5.00
Newton, Mass.		[illegible]		
Portland, Me.	9	1.75	[illegible]	5.00
Providence, R. I.	9	[illegible]	[illegible]	[illegible]
Springfield, Mass.		[illegible]		5.00
Stamford, Conn.	[illegible]	1.75	2.00	5.00
Waltham, Mass.	8	[illegible]		
Worcester, Mass.		2.00	4.00	6.00
North Atlantic States:				
Amsterdam, N. Y.	[illegible]	1.62		4.50
[illegible], Me.		1.25	[illegible]	2.25
Bayonne, N. J.		1.75		6.00
Binghamton, N. Y.		1.65	2.50	3.50
Buffalo, N. Y.		1.75	4.00	4.80
Camden, N. J.	[illegible]	1.50	3.00	5.00
Corning, N. Y.	[illegible]	1.60		[illegible]
Dunkirk, N. Y.			3.00	4.50
East Orange, N. Y.	10	1.75	3.50	[illegible]
Elizabeth, N. J.		1.75	5.00	[illegible]
Erie, Pa.	10	[illegible]	....	
Fulton, N. Y.	[illegible]	[illegible]	3.00	4.00
Hoboken, N. J.				
Hornell, N. Y.		1.75	3.00	
Hudson, N. Y.		1.50		[illegible]
Jamestown, N. Y.		1.75	2.50	4.25
Jersey City, N. J.		[illegible]	5.00	6.00
Kingston, N. Y.		1.75	4.00	[illegible]
Lancaster, Pa.	10			
Little Falls, N. Y.	8	1.65	[illegible]	[illegible]
Middletown, N. Y.		[illegible]	2.75	[illegible]
New Brunswick, N. J.	10	1.65	5.00	
New Castle, Pa.	[illegible]	[illegible]	3.50	[illegible]
Niagara Falls, N. Y.				5.50
No. Tonawanda, N. Y.		1.75	2.25	5.00
Ogdensburg, N. Y.	8	1.75		3.50
Olean, N. Y.		[illegible]	[illegible]	5.50
Oneida, N. Y.	8	1.75	[illegible]	[illegible]
Oneonta, N. Y.		1.75	4.00	4.00
Port Jervis, N. Y.	8			
Reading, Pa.		[illegible]	2.50	3.60
Rochester, N. Y.	8	[illegible]	3.20	[illegible]
Schenectady, N. Y.	8	1.75		6.00
Scranton, Pa.		1.50	[illegible]	5.00
Syracuse, N. Y.		1.70	4.00	[illegible]
Troy, N. Y.	8	1.75		[illegible]
Utica, N. Y.	8	1.75	[illegible]	[illegible]
Washington, D. C.	8	1.50	3.50	4.00
Watertown, N. Y.	8	1.75	4.00	4.00
White Plains, N. Y.	8	1.65		5.00
Wilkesbarre, Pa.	10	1.60	3.00	4.50
Williamsport, Pa.	10	1.75	2.50	4.00
South Atlantic States:				
Charleston, S. C.	9	1.25	3.00	2.00
Danville, Va.	10	[illegible]	1.75	3.50
Macon, Ga.	10	1.50	4.00	3.50
Norfolk, Va.	9	1.50	3.75	5.00
Pensacola, Fla.	10	[illegible]		[illegible]
South Central States:				
Gadsden, Ala.	10	1.75	3.00	4.00
Louisville, Ky.	9	1.75	3.00	4.00
Vicksburg, Miss.	10	1.50	2.50	[illegible]
North Central States:				
Anderson, Ind.	10	[illegible]		3.50
Aurora, Ill.	9	1.80		[illegible]
Battle Creek, Mich.	10	[illegible]	[illegible]	4.50
Bloomington, Ill.	10	1.75[10]	3.00	3.80
Bloomington, Ind.	10	1.75	2.50	3.50
Cairo, Ill.	10	1.50	4.00	4.00
Canton, Ill.	9	1.75	[illegible]	..
Columbus, O.	8	[illegible]	3.00	4.00
Dayton, O.	[illegible]	2.00	3.50	4.50
Evanston, Ill.	9	2.50	5.00	5.50
Evansville, Ind.	[illegible]	1.60		4.00
Flint, Mich.	10	2.00	3.00	4.00
Freeport, Ill.	10	[illegible]	4.00	5.00
Gary, Ind.	10	2.00	4.50	6.00
Grand Rapids, Mich.	10	2.00	3.00[11]	[12]4.00
Hamilton, O.	[illegible]	[illegible]	3.00	[illegible]
Kalamazoo, Mich.	[illegible]	1.80	3.00	4.05
Lansing, Mich.	[illegible]	2.00		4.50
Lima, O.	[illegible]	2.00	3.50	4.00
[illegible]	[illegible]	[illegible]		4.00
[illegible], O.	[illegible]	1.75		4.50
[illegible], Ill.		1.75	[illegible]	[illegible]
[illegible], Ill.		2.00		4.00
[illegible], Wis.		2.00	5.00	5.00
Muskegon, Mich.	9	2.00		5.00
New Albany, Ind.	10	[illegible]		3.50
Newark, O.		[illegible]	2.50	4.50
Ottawa, Ill.	9	2.00	2.50	4.50
[illegible]		2.00[14]	1.50	[illegible]
Port Huron, Mich.	9		3.00	5.00
Racine, Wis.		2.00		6.00
Richmond, Ind.		1.75	2.50	3.75
Rockford, Ill.	8	2.00	1.00	4.00
Saginaw, Mich.	[illegible]	2.00	2.50	4.00
Springfield, O.	10	2.00	5.00	8.00

[illegible]		2.25	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	
Zanesville, O.	[illegible]	[illegible]	3.00	4.00

[illegible] States:

[illegible]	[illegible]	[illegible]	1.00	1.50
[illegible]	9	2.25	3.00	4.00
[illegible]	10	2.00	3.00	4.50
[illegible]	[illegible]	3.50	[illegible]	7.00
[illegible]	[illegible]	2.00	3.00	4.00
[illegible]	[illegible]	1.50		3.50
[illegible]	10	1.75	3.00	3.50
[illegible]	10	2.00	[illegible]	5.00
[illegible]	8	3.00	7.00	5.50
Independence, Kan.	8	1.60[16]	3.00	3.20
[illegible]	9	1.75	2.25	[illegible]
[illegible]				4.00
[illegible], Kan.	8	1.75	2.50	3.50
Leavenworth, Kan.	8	1.75	3.00	3.50
[illegible]	10	2.00	3.00	5.00
[illegible]	[illegible]	2.00		4.00
Minneapolis, Minn.	8	2.25	4.00	4.80
[illegible]	10	2.00		
[illegible]	[illegible]	2.00[18]	[illegible]	[illegible]
[illegible]	8	2.25	5.00	4.00
South Omaha, Neb.	10	2.00	4.50	5.00
Topeka, Kan.	8	1.75	3.00	4.00
[illegible]	10	2.00	2.50	4.50
[illegible], Kan.	8	1.75		3.50

Southwestern States:

[illegible], Okla.	8	[illegible]	4.00	3.50
Little Rock, Ark.	10	1.50	2.50	4.50
McAlester, Okla.	8	2.00		3.50
Muskogee, Okla.	8	1.75	[illegible]	4.00
Oklahoma City, Okla.	8	2.00	2.50	4.00
San Antonio, Tex.	8	1.50	1.75	3.00
[illegible], Okla.	8	1.60	2.00	3.50
St. Louis, Mo.	10	2.00	3.50	5.00
Waco, Tex.	8	1.50		3.00

Pacific States:

Aberdeen, Wash.	8	[illegible]		6.00
Berkeley, Cal.	9	2.50		5.00
Boise, Idaho	9	2.50		5.00
Everett, Wash.	8	2.25	6.00	6.00
Fresno, Cal.	8	2.00	4.00	4.50
Hoquiam, Wash.	8	2.50	5.00	7.50
Los Angeles, Cal.	8	2.00		4.00
North Yakima, Wash.	8	2.50		5.00
Ogden, Utah	9	2.25		4.00
Pasadena, Cal.	8	2.50		5.00
Salt Lake City, Utah.	10	2.00		4.50
San Diego, Cal.	10	2.25	3.50	5.00
San Francisco, Cal.	8	[illegible]	6.00	6.50
San Jose, Cal.	9	2.00		5.00
Seattle, Wash.	8	2.25	4.50	6.50
Spokane, Wash.	8	[illegible]	3.50	6.00
Tacoma, Wash.	8	2.50		6.00
Vancouver, Wash.	8	2.25	3.00	6.50
Walla Walla, Wash.	8	2.25		5.00

[1]$4.50 for double team, $3.25 for single team. [illegible] per sq. yd. laid [illegible] 9 to 10 hours. [4]$1.75 to $2.25. [5]Per hour. [6]$5.25 for double team, $3.50 for single. [7]$2.25 to $2.50. [8]Single team $4, double team $6. [9]$1.50 to $1.75. [10]$1.75-$2.25. [11]$3.00 to $4.00. [12]$4.00 to $5.00. [13]$1.50 to $1.70. [14]$2 to $2.25. [15]$4 to $4.50. [16]$1.60 to $1.75. [17]$1.75 to $2.00. [18]$2 to $2.25. [19]3 cts. [illegible] to $[illegible]

UNION WAGES IN NEW YORK CITY.

The following table shows the prevailing rates of wages for various classes of union labor in New York City. When not otherwise stated the rate given is per day:

Asbestos workers	[illegible]
Asbestos workers helpers	[illegible]
Architectural iron workers	[illegible]
Bluestone cutters	4.50
Bluestone cutters helpers	3.00
Blasting foremen	4.00
Bricklayers and masons, per hour	.70
Blacksmiths, average	4.00
Building material handlers, per 1,000	.40
Caisson and foundation workers	3.50
Carpenters and joiners, Brooklyn	[illegible]
Carpenters and joiners, Queens	4.00
Carpenters and joiners, Manhattan	5.00
Carpenters and joiners, Bronx	4.50
Carpenters and joiners, Richmond	4.00
Cement masons, all boroughs	5.00
Cement and asphalt laborers	3.00
Cement workers	2.80
Derrickmen and riggers	3.75
Double drum hoister runners	4.00
Drop forgers	3.50
Dock builders, average	[illegible]
Decorative glass art workers	5.00
Electric linemen, Brooklyn	4.00
Electric linemen, Manhattan	4.00
Electric linemen, Richmond	4.00
Electric inside wiremen	4.50
Electrical fixture workers	4.50
Electric helpers	2.20
Elevator constructors	5.00
Elevator Constructors helpers	3.20
Excavators, hour	.22
Engineers, portable	5.50
Engineers, stationary	4.50
Engineers (marine)	3.27
[illegible]	[illegible]
Firemen, Queens	2.60
Firemen, Bronx, average per trip	4.25
Firemen, Richmond	2.04
Granite cutters $4.50 and	5.00
Housesmiths	4.80
Housesmiths and bridgemen	5.00
[illegible]	[illegible]
House shorers and movers	3.50
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Lathers, Brooklyn, per bunch	[illegible]
Lathers, Queens, per 1,000	[illegible]
Lathers, Manhattan	[illegible]
Lathers, Bronx	[illegible]
Lathers, Richmond	[illegible]
Laborers, Brooklyn, hour	[illegible]
Laborers, Queens, hour	[illegible]
Laborers, Manhattan, hour	[illegible]
Laborers, Richmond, hour	[illegible]
Machine stone workers	4.00
Marble cutters and setters	[illegible]
Marble carvers	[illegible]
Marble bed rubbers	[illegible]
Marble sawyers	[illegible]
Marble cutters helpers	3.00
Marble polishers	[illegible]
Machinists, Brooklyn	[illegible]
Machinists, Manhattan	[illegible]
Machinists apprentices, aver., week	7.00
Metallic lathers	[illegible]
Mosaic workers	[illegible]
Mosaic workers helpers	3.00
Paper handlers, average, week	[illegible]
Painters and decorators, Brooklyn	4.50
Painters, Queens	3.28
Painters and decorators, Manhattan	4.50
Painters, Bronx	4.00
Painters, Richmond	[illegible]
Paper hangers	Price list
Pavers, Brooklyn	5.00
Pavers, Manhattan	5.00
Pipe calkers and tappers	4.00
Plasterers, Brooklyn	[illegible]
Plasterers, Queens	[illegible]
Plasterers, Manhattan	[illegible]
Plasterers, Bronx	[illegible]
Plasterers laborers	[illegible]
Plate and sheet glass glaziers	3.50
Plumbers, Brooklyn	5.50
Plumbers, Manhattan	5.50
Plumbers, Bronx	5.00
Plumbers, Richmond	5.50
Plumbers laborers	3.00
Rock drillers	3.50
Roofers, Brooklyn	4.00
Roofers, Queens	4.50
Roofers, Manhattan	5.00
Roofers, Richmond	4.00
Rockmen, hour	.30
Riggers	4.00
Stone cleaners and pointers	3.06
Stone cutters, Brooklyn, hour	.62½
Stone cutters, Manhattan	4.00
Steam shovel and cranemen, month	124.00
Stair builders	5.00
Steam fitters	5.00
Steam fitters helpers	3.00
Stone masons, Brooklyn, hour	[illegible]
Stone masons, Manhattan, hour	.55
Stone setters	[illegible]
Stationary firemen	[illegible]
Tar, felt and waterproof workers	3.75
Tile layers	[illegible]
Tile layers helpers	3.00
Terra cotta workers, average	2.95

BRIDGES AND BUILDINGS.

MATERIALS AND SUPPLIES

Structural Shapes.—The following are the current prices for structural shapes f. o. b. Pittsburg:

I-beams and channels, 3 to 15 in., [illegible] cts. net

I-beams over 15 in., 1.50 to 1.55 cts. net.

H-beams over 8 in., 1.55 to 1.60 cts. net.

Angles, 3 to 6 in., 1.40 to 1.45 cts. net.

Angles, over 6 in., 1.50 to 1.55 cts. net.

Tees, 3 in. and up, 1.45 cts. net.

Zees, 3 in. and up, 1.40 to 1.45 cts. net.

Angles, channels and tees under 3 in., 1.45 cts., base, plus full extras.

Deck beams and bulb angles, 1.70 to 1.75 cts. net.

Hand rail tees, 2.50 cts. net.

Checkered and corrugated plates, 2.50 cts. net.

Store prices at Chicago are as follows:

Angles, 3 to 6 in., 1.40 to 1.90 cts.

Angles over 6 in., 1.90 to 2.00 cts.

Beams and channels, 1.80 cts.

The New York quotations on [illegible] shapes are as follows:

Beams, 3 to 15 in., 1.56 to 1.61 cts.

Angles, 3 to 6 in., 1.56 to 1.61 cts.

Tees, 3x¼ in. and heavier, 1.56 to 1.61 cts.

Plates.—The current prices for plates f. o. b. Pittsburg on the basis of net cash in 30 days are as follows:

Tank plates, ¼ in. thick, 6¼ in. up to 100 in. wide, 1.40 to 1.45 cts. base.

Gages under ¼ in. to and including 3/16 in.	$0.10
Gages under 3/16 in. to and including No. 8.	.15
Gages under No. 8 to and including No. 9.	.25
Gages under No. 9 to and including No. 10.	.30
Gages under No. 10 to and including No. 12.	.40
Sketches, 3 ft. and over in length	.10
Complete circles, 3 ft. diameter and over	.20
Boiler and flange steel	.10
A. B. M. A. and ordinary fire box steel	.20
Still bottom steel	.30
Marine steel	[illegible]
Locomotive fire box steel	.50
Plates in widths over 100 in. to 110 in.	.05
Plates in widths over 110 in. to 115 in.	.10
Plates in widths over 115 in. to 120 in.	.15
Plates in widths over 120 in. to 125 in.	.25
Plates in widths over 125 in. to 130 in.	.50
In widths over 130 in.	1.00

Store prices at Chicago are 1.80 to 1.90 cts.

The following are the New York quotations on plates, the prices being based on carload lots, with 5 cts. extra for less than carload lots. Terms, net cash in 30 days.

Tank plates, ¾ in. thick, 6½ to 100	
Flang and boiler steel	1.85 to 1.90
in. wide	1.60 to 1.75
Marine	1.95 to 2.00
Locomotive fire box	[illegible]
Still bottom	1.95 to 2.05

Plates more than 100 in. in width, 5 cts. extra per 100 lbs.; plates 3/16 in. in thickness, 10 cts. extra; gage Nos. 7 and 8, 15 cts. extra; No. 9, 25 cts. extra.

Sheets.—Makers' prices for mill shipments from Pittsburg on sheets in car load and larger lots are as follows:

Galvanized roofing sheets, No. 28, 2½ in. corrugations. [illegible] per square

Painted roofing sheets, No. 28... 1.55 per square

Galvanized Sheets:

Nos. 13 and 14	2.30 cts.
Nos. 15, 16 and 17	2.45 cts.
Nos. 18 to 22	2.60 cts.
Nos. 23 and 24	2.70 cts.
Nos. 25 and 26	2.90 cts.
No. 27	[illegible] cts.
No. 28	[illegible] cts.
No. 29	3.30 cts.
No. 30	3.70 cts.

Blue Annealed Sheets:

Nos. 3 to 8	1.55 cts.
Nos. 9 and 10	1.65 cts.
Nos. 11 and 12	1.70 cts.
Nos. 13 and 14	1.75 cts.
Nos. 15 and 16	1.95 cts.

Box Annealed Sheets:

Nos. 17 to 21	2.00 cts.
Nos. 22 to 24	2.05 cts.
Nos. 25 and 26	2.10 cts.
No. 27	2.15 cts.
No. 28	2.20 cts.
No. 29	2.25 cts.
No. 30	2.35 cts.

Chicago prices for sheets, car load lots, from mill are as follows:

No. 28 black sheets	2.38 cts
No. 28 galvanized	3.38 cts
No. 10 blue annealed	1.83 cts

Store prices at Chicago are:

No. 10	2.10 to 2.20 cts
No. 12	2.15 to 2.25 cts
No. 28 black	2.75 to 2.85 cts.
No. 28 galvanized	3.65 to 3.75 cts.

Freight Rates.—The freight rates from Pittsburg on finished iron and steel in car loads, per 100 lbs., is as follows: Birmingham, Ala., [illegible] cts.; Boston, 18 cts.; Buffalo, 11 cts.; Chicago, 18 cts.; Cincinnati, 15 cts.; Cleveland, 10 cts.; Indianapolis, 17 cts.; New York, 16 cts., New Orleans, 30 cts.; Philadelphia, 15 cts.; St. Louis, 22½ cts.; St. Paul, 32 cts. For the Pacific Coast the rates are 80 cts. on plates, structural shapes and sheets, No. 11 and heavier; 85 cts. on sheets Nos. 12 to 16; 95 cts. on sheets No. 16 and lighter, and 65 cts. on wrought boiler tubes.

Steel Rivets.—The following current prices for steel rivets are f. o. b. mill at Pittsburg: Structural rivets, ¾ in. and larger, 1.90 cts. base; cone head boiler rivets, ¾ in. and larger, 2 cts. base, ⅝ in. and 11/16 in. take an advance of 15 cts., and ½ in. and 9/16 in. take an advance of 50 cts.; lengths shorter than 1 in. also take an advance of 50 cts.

Corrugated Roofing.—The following New York quotations are for small lots of 2½ in. corrugated roofing:

	Painted.	Galvanized.
No. 24, per 100 sq. ft.	$[illegible]	$4.80
No. 26, per 100 sq. ft.	2.95	4.00
No. 28, per 100 sq. ft.	2.60	3.75

SMALL TOOLS USED IN BRIDGE AND BUILDING WORK

Nail and Riveting Hammers, Etc.—The following are net prices in Chicago for quantities of nail hammers and riveting hammers:

Nail Hammers.

No.	Weight, each	Price each	Price per doz
0	1 lb. 12 oz.	$0.62	$6.2[illegible]
1	1 lb. 1 oz.	[illegible]	4.50
1½	1 lb.	[illegible]	[illegible]
2	13 oz.	40	4.00
3	7 oz.	38	[illegible]

The hammers are made of solid steel, polished with adze eye and plain or bell face, as desired.

Riveting Hammers (Plain Eye).

No.	Weight, each.	Price, each.	Price per doz
0	4 oz.	$0.28	$2.75
1	[illegible] oz.	[illegible]	2.88
2	[illegible] oz.	[illegible]	3.00
[illegible]	12 oz.	30	[illegible]
4	15 oz.	33	[illegible]
[illegible]	1 lb. [illegible] oz.	[illegible]	3.50
6	1 lb. 6 oz.	38	[illegible]
[illegible]	1 lb. 10 oz.	40	4.00

Bridge Builders' and Structural Steel Erectors' Special Tools.—The following prices are net prices in Chicago for quantities, for special tools to bridge builders and structural steel erectors:

	[illegible]	[illegible]	[illegible]	[illegible]
Riveting hammers	[illegible]	1½ and [illegible]	[illegible]	[illegible]
Flogging hammers	[illegible]	[illegible]	[illegible]	1.50
Napping hammers	[illegible]	[illegible]		[illegible]
Rivet "buster"	[illegible]	1½ sq. in.		[illegible]
Straight blade cold cutter		1½ in.	[illegible]	[illegible]
Cross blade cold cutter		1½ in. sq.	[illegible]	[illegible]

[illegible] cutter [illegible]	[illegible] 6½	[illegible]
Handle gouge [illegible]	[illegible] 6½	[illegible]

The net prices of [illegible] used by bridge [illegible] and structural [illegible] are as follows:

	Price, each
Straight dolly	$2.[illegible]
Club dolly	[illegible]
Spring dolly	[illegible]
Heel dolly	1.[illegible]
Half round seamers	.6[illegible]
Hand gouges	[illegible]
Hand chisels	[illegible]
Rivet tongs, pickup or heating, per pair....	.70
Riveting lamp	[illegible]

Rivet snaps or sets for [illegible] head rivets cost as follows:

⅜-in. to ⅝-in., each	$1.20
¾-in., each	1.25
⅞-in., each	1.40
1-in., each	1.50

The net cost of barrel [illegible] are as follows:

[illegible]/16-in., each	$0.10
9/16-in., each	.1[illegible]
11/16-in., each	.1[illegible]
13/16-in., each	.16
15/16-in., each	.17
1 1/16-in., each	.1[illegible]

The net cost figures for backing out punches are as follows:

⅜-in. to ¾-in. inclusive, each	$0.80
⅞-in. to 1-in. inclusive, each	.85

Mortar and Brick Hods. [illegible] prices for wooden mortar and brick hods in quantities at Chicago are as follows: Mortar hods, carrying 150 lbs., [illegible] wooden brick hods, carrying [illegible] per doz. The hods have tin lined shoulder blocks and rough hickory handles. Steel mortar and brick hods can be bought [illegible] following net prices at Chicago: Brick hods, 23x7x10 ins., weighing, with handle, about 8 lbs., $1.00 each, or $10 per doz.; mortar hods, 24x11¾x12 ins., weighing with handle [illegible] $1[illegible] per doz.

CONCRETE.

Cement. The present [illegible] Portland cement for Chicago and vicinity is as follows: $1.30 net delivery by wagon, or $1.12 net on cars.

Reinforcing Bars. [illegible] concrete reinforcing bars for mill shipments f. o. b. [illegible] Chicago [illegible] as follows:

	Base per 100 lbs.
Plain open hearth [illegible]	[illegible]
Plain open hearth steel less than car loads	1.61
Cold twisted open hearth steel, car loads..	1.58
Cold twisted open hearth steel, less than car loads	1.6[illegible]
Plain rail carbon steel, car loads	1.3[illegible]
Plain rail carbon steel, less than car loads	1.48
Hot twisted rail carbon steel, car loads...	1.35
Hot twisted rail carbon steel, less than car loads	[illegible]

For shipment from stock current prices for reinforcing [illegible] length 35 ft.:

¾ in. and larger	$1.90
[illegible]	1.97½
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

EARTH AND ROCK EXCAVATION SUPPLIES.

Blasting Materials. [illegible] general net prices for Illinois for blasting material [illegible]

	2,000-lb. lots, per 100 lbs.	[illegible] 2,000 lbs. per 100 lbs.
[illegible]	[illegible]	$1[illegible]
30% nitroglycerine	[illegible]	[illegible]
35% nitroglycerine	[illegible]	[illegible]
40% nitroglycerine	[illegible]	[illegible]
45% nitroglycerine	[illegible]	[illegible]
50% nitroglycerine	[illegible]	[illegible]
[illegible] nitroglycerine	[illegible]	[illegible]
[illegible] powder	[illegible]	[illegible]

Blasting Batteries.

[illegible]	10.[illegible]
20 holes	1[illegible]
1 to 50 holes	30.00
1 to 100 holes	45.00

Electric Fuses.

	Single strength. Per 100.	Double strength. Per 100.
4' [illegible]	[illegible]	[illegible]
6' [illegible]	[illegible]	[illegible]

Fuse.

Single tape, per 1,000 feet	[illegible]
Double tape, per 1,000 feet	4.85
[illegible], per 1,000 feet	[illegible]

TOOLS AND EQUIPMENT.

Dump Carts.—Net prices for certain types of contractors' dump carts, f. o. b. factory in Ohio, [illegible]

Light cart, capacity 21 cu. ft. or 2,500 lbs., weighing 700 lbs., at $42; heavy cart, capacity 24 cu. ft. or 3,500 lbs., weighing 900 lbs., $45. For carts with hoppers 10 ins. deep add $9.50 to the above figures, and for carts with automatic end gates add $8.50.

Hand Shovels.—Net prices for standard railroad, contractors' and mining shovels, at Chicago, in quantities, are as follows: We give prices for four grades: (1) Extra grade made of best crucible steel, finely finished with best white ash handles; (2) first grade shovels, also made of crucible steel, and grades (3) and (4) made of open hearth steel. The net price in Chicago on these four grades are as follows:

Size No.	Size blade [illegible]	Size [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	9½	11¼	$[illegible]	$[illegible]	$[illegible]	$[illegible]
3	9¾	12¼	10.[illegible]	[illegible]		
4	10½	1[illegible]½	[illegible]	[illegible]		

The above prices are for black finish; for polished add 50 cts. per doz. [illegible] or round points, "D" or long handles are all the same price. The size No. 2 is the one commonly used. For sewer or brick shovels made in No. 2 size, but having a shorter and heavier blade for clay and other heavier material, net prices are as follows:

	Per doz.
Extra grade	$11.10
Second grade	7.20

The net prices at Chicago for spades, plain strap, polished, "D" handle or long handle, are as follows: For size No. 2: Extra grade, $10.20 per doz.; fourth grade, $5.40 per doz. Extra grade shovels made the same as "D" handle molders' shovel, but with straighter, stiffer and heavier blades, for finishing concrete in sidewalks [illegible]

Telegraph Shovels and Spoons.

Telegraph shovels made of fine crucible steel with white grained ash handles, and extra length [illegible] can be bought in quantities at the following net prices, f. o. b. Chicago.

Length of handle	Extra Grade. Per doz.	First Grade. Per doz.
6	$1[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]

The net prices in quantities for telegraph spoons with regular 9-in. straps and black finish are as follows:

Length of handle	[illegible] Per doz.	[illegible] Per doz.
[illegible]	1[illegible]	1[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
10	21.00	19.20

The [illegible] spoons sold are those with 8-ft. handles.

Ditching and Drain Spades.

The [illegible] drain spades are as follows.

Length of blade	Extra Grade. Per doz.	Third Grade. Per doz.
14-in	[illegible]	[illegible]
16-in	[illegible]	[illegible]
18-in	13.20	9.00
20-in	[illegible]	[illegible]

Skeleton ditching and drain spades made of solid cast steel with solid sockets, especially adapted for mucky and sticky soil can be bought at the following net prices in Chicago: Ditching spades, square point, 6½x18-in., $22.80 per doz.; drain spades, round point, 1½x18-in., $21.60 per doz. Drain cleaners' with 6½-ft. handles for finishing tile ditches can be bought at the following net prices.

Size Length. Ins.	Width Ins.	Per dozen.
[illegible]	[illegible]	[illegible]
15	5	11.10

Hand Tools for Rock Drilling. Net prices at Chicago for sledges, striking and drilling hammers, etc., in quantities, are as follows:

Double face and cross pein oil finish sledges and hammers, 5-lb. to 24-lb. weight, 7½ cts. per lb.; striking and drilling hammers, long pattern, 3 to 4½ lbs., 10 cts. per lb.; 5 to 14 lbs., 7½ cts. per lb.; stone sledges, 10 to 24 lbs., 7½ cts. per lb.

The net prices at Chicago for hand drills for stone, marble and granite are as follows: Ball drills, 7 ft. long, 8 lbs. weight, $2.85 each. Rose and Star drills.

	Each.	Per doz.
¼-in. x 8-in.	$0.30	$3.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Net price for drills is as follows: Stone drills, 1 and 1⅛-in. octagon steel, 2 to 6 ft. lengths, 12 cts. per lb.

Hoes. [illegible] or field hoes, forged from best hoe steel, with [illegible] blade [illegible] $4.[illegible] per [illegible] socket and $3.90 per doz. for hoes with solid shank. Grub hoes, adze [illegible] the following net prices:

No.	Weight, lbs.	Size [illegible]	Price, per doz.
1	3½	[illegible]x10¼	$[illegible]
2	4	4x11¼	1[illegible]
3	4½	4¼x11½	[illegible]

Contractors' special caisson grub hoes, heavy pattern, 5 lbs. weight, 4¼x11½-in., can be bought at the net price of 60 cts. each, or $6 per doz.; an extra heavy pattern for hard pan, 8 lbs. in weight and 3x12 ins. in size can be bought at the net price of $1.50 each, or $15 per doz.

Picks and Mattocks. Net prices at Chicago for picks and mattocks, in quantities, are as follows:

Railroad or Clay Picks.

Weight, lbs.	Price, each.	Price per doz.
7½	$0.[illegible]	$[illegible]
8½	[illegible]	[illegible]

The above have adze eye, pick and chisel points, and are made of high grade solid steel. The points are made of crucible tool steel.

Weight, lbs.	Price, each.	Price per doz.
5 to 6	$0.32	$3.15
6 to 7	.34	3.37
7 to 8	.36	3.60
9 to 10	[illegible]	[illegible]

Drifting Picks.

Weight, lbs.	Price, each.	Price per doz.
4½	$0.38	$3.[illegible]
6	[illegible]	4.50

These drifting picks have adze eye and the points and are of the best grade of crucible tool steel.

Mattocks (Adze Eye).

	Weight, lbs.	Size blade. ins.	Size cutter. ins.	Price, each.	Price, doz.
Short cutter	[illegible]	[illegible]	[illegible]	$[illegible]	$3.60
Long cutter	[illegible]	3½x7½	[illegible]	[illegible]	3.60

Pick mattocks, weighing 5½ lbs., with a blade 4⅛x8½ ins. and a cutter 8½ ins. can be bought at a net price of $4.25 per doz.

Post Hole Diggers and Augers.—Net prices at Chicago for post hole diggers and augers are as follows:

Post Hole Diggers.

	Lgth. blade. ins.	Wt. to doz. lbs.	Price per doz.
[illegible] standard pattern	9	11[illegible]	$[illegible]
[illegible] pattern	[illegible]	[illegible]	[illegible]
Hexagon	[illegible]	1[illegible]	[illegible]
Champion	6	11[illegible]	[illegible]

Post hole augers with blades 6-in., 7-in., 8-in. or 9-in. can be bought for $1.00 each.

Grading and Road Plows.—For grading and road plows net prices at Chicago are about as follows:

Railroad or Grading Plows.

No. of horses	Weight, lbs.	Cut. ins.	Price, each.	Extra points, each
[illegible]	1[illegible]	1[illegible]	$1[illegible]	$[illegible]
[illegible]	[illegible]	1[illegible]	[illegible]	[illegible]
6 to 8	230	12	26.00	5.15
1[illegible]	[illegible]	1[illegible]	[illegible]	[illegible]

Contractors' or township plows, right or left hand, cutting a furrow 10 ins. wide and from 6 ins. to 12 ins. deep, and weighing 145 lbs., can be bought for $16.50 each. A heavier plow, weighing 205 lbs., costs $20 each. Extra points are not included in above price, but can be bought for $2.25 each extra. Road plows, all steel, with cast iron, cutting 12 ins., and weighing 170 lbs., can be bought for $21. Rooter or hard pan plows weighing 305 lbs. cost $30 each.

Scrapers.—Net prices at Chicago on the several kinds of scrapers named below are as follows:

Ox Shovels.

[illegible]	[illegible]	Size of Bowl [illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
000	17	16	42	16	210	21

These shovels are made of pressed steel and are used for ditching along railroad tracks. They are usually drawn by locomotives. The above prices are for steel bail for No. 0 and chain bails for Nos. 00 and 000. The shovels have wooden handles 3x48 ins.

Buck Scrapers.

[illegible]

[illegible] follows:

[illegible]

[illegible] follows: 7 cu. ft. capacity, 94 lbs. weight, with [illegible] without runners deduct 30 cts. from above [illegible] add 50 cts.

Shovel Handles.—Net prices at Chicago for [illegible]

[illegible]	[illegible]
Spade, bent and riveted	2.40
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The net prices for long shovel, spade and scoop handles are as follows:

	Per doz.
4½-ft., shovel, bent	$2.40
[illegible]	2.10
[illegible]	2.10
4½-ft., shovel, straight, Maynard pattern	2.10

M[illegible] $1.[illegible] per doz. [illegible] M[illegible] cost $1.25 net doz.

Tool Handles.—Net prices at Chicago for tool handles in full crate quantities are as follows:

	Per doz.
[illegible]	$0.4[illegible]
[illegible]	.40
[illegible]	.40
[illegible]	[illegible]
[illegible]	.6[illegible]
[illegible]	.50
[illegible]	[illegible]

These are [illegible] second growth hickory with wax finish, clear and white, and free from all imperfections. They are packed 5 doz. to the case. The net prices for hickory axe handles, both single bitted and double bitted, 36 ins. [illegible] per doz. for extra grade and [illegible] for No. 1 grade. Railroad pick handles, [illegible] bought at $2.88 per doz. for extra grade second growth hickory, at $2 for second growth, [illegible] at $1.[illegible] for second growth hickory, plain finish. The net prices for [illegible] handles are as follows:

Length.	Price per dozen.	
	Extra grade	No. 1 grade
[illegible]	$1.00	$0.70
[illegible]	1.25	.80
[illegible]	1.40	.95
36	1.70	1.15

Grub hoe handles, 36 ins. long, of second growth hickory, with wax finish, can be bought [illegible] per dozen. [illegible] size handles can be bought for $2.52 per doz.

Tampers.—The net prices for tampers with handles are as follows, No. 1 having steel plate base, No. 2 a cast plate base and No. 3 a round cast plate base:

No.	Size base, ins.	Wght. finished.	Price each.	Price per doz.
[illegible]	[illegible]	[illegible]	$1.[illegible]	$1[illegible]
[illegible]	[illegible]	[illegible]	1.6[illegible]	1[illegible]
1	[illegible]	[illegible]	1.80	18.00
[illegible]	[illegible]	[illegible]	.78	7.80
[illegible]	[illegible]	[illegible]	.9[illegible]	9.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	1.[illegible]	1[illegible]
[illegible]	[illegible]	[illegible]	1.2[illegible]	1[illegible]
[illegible]	[illegible]	[illegible]	1.[illegible]	1[illegible]
3	7	20	1.50	15.00
[illegible]	[illegible]	[illegible]	.6[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	.[illegible]	7.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Comb. curb	1x 3½	8½	1.50	14.04

The above prices are for tampers with wooden handles.

Wooden Wheelbarrows.—Net prices at Chicago [illegible] follows: Full bolted wooden railroad wheelbarrows, with heavy steel wheel, 16½ ins. in [illegible] per doz. [illegible] and 13 ins. at wheel, sells at $2.75 each, or $27.50 per doz. Bent handled wooden stone barrows can be bought at $3.25 each, or $35 per dozen. Folding wooden barrows, with removable sideboards and double frames, 4 cu. ft. capacity, sells at $3 each, or $32.50 per doz.

Tents.—The following are the net prices at Chicago for stable tents and wall tents of the [illegible] engineers.

Stable Tents.

Size.	Wall.	Pole.	10-oz. double filling or 8-oz. army duck.	12-oz. double filling or 10-oz. army duck.
[illegible]	[illegible]	[illegible]	[illegible]	$[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]
[illegible]	[illegible]	[illegible]	1[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	1[illegible]	[illegible]

The above prices are for stable tents complete with poles and pins; tents are roped on ridges, eaves, gables every 9 ft. on top.

Wall Tents.

[illegible]	Height of [illegible]	Height [illegible]	10-oz. duck, single [illegible]	10-oz. duck, double and twisted filling or [illegible]
[illegible]	[illegible]	[illegible]	$ 9.00	$1[illegible]
[illegible]	[illegible]	[illegible]	1[illegible].00	1[illegible]
[illegible]	[illegible]	[illegible]	1[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18x30	11	5	36.00	40.65

The above prices are for wall tents complete with poles and pins, but without flies.

ROADS AND STREETS.

MATERIALS

Asphalt.—The prevailing current prices for asphalt are about as follows:

The California paving asphalt made to conform to the requirements of the standard specifications, standardized by the Organization of City Officials for Standardizing Specifications, is selling on the Coast from $12.00 to $13.00 per ton; freight rate to Chicago is $11.00 per ton, making delivered price of from $23.00 to $24.00.

Vitrified Brick.—The current prices for vitrified paving brick f. o. b. Chicago are about $20 to $2[illegible] per M.

Granite Blocks.—New York prices for granite paving blocks are about as follows: Ordinary granite paving blocks is from $1.65 to $1.75 per square yard delivered alongside dock at New York, which is equivalent to $77 per thousand. For the improved granite paving block the price ranges from $2.00 to $2.25 per square yard, or $80 to $85 per thousand. At Chicago the prevailing price of granite paving blocks at the present time is $2.00 per yard for special dressed granite blocks and $1.60 per yard for No. 2 granite blocks.

Crushed Stone.—The current prices at Chicago for crushed stone are as follows: Crushed granite, macadam size, $.... per cu. yd.; crushed granite, all sizes, $4.50 to $5.00 per cu. yd. delivered. Granite screenings $[illegible] per cu. yd. Crushed stone for concrete [illegible] by team $1.65 per cu. yd.

Sand and Gravel.—The present price of torpedo sand at Chicago is from $1.00 to $1.15 per cu. yd. No. 8 gravel is selling at $1.00 per cu. yd. f. o. b. Chicago on any initial railroad. The price on the same material delivered by team for any ordinary haul in Chicago is $1.65 and $1.50 per cu. yd.

Macadam Binder.—For estimating purposes basing prices f. o. b. Chicago the average quotation for roadway asphalt is 8½ cts. per gallon.

Wood Blocks, Creosoted.—In a general way the price of a 4-in. 16-lb. block in Chicago is quoted to contractors at from $1.75 to $1.[illegible] per sq. yd.

NET PRICES OF TOOLS USED IN PAVING AND ROAD CONSTRUCTION.

Asphalt or Tar Rakes.—Asphalt or tar rakes made of solid steel, with drop shank, strap ferrules, 5-ft. selected white ash handles and 18-in. square iron shank, sells at a net price for quantities, at Chicago, of $12.85 per dozen.

Asphalt Mattocks.—The net prices for asphalt mattocks in quantities, at Chicago, are as follows. For a mattock with crucible steel cutter and chisel ends, weighing 9 lbs., the cost is 90 cts. each, or $9 per doz. A mattock with double cutter, weighing 8 lbs., can be bought for 60 cts. each, or $6 per doz.

Bricklayers Hammers.—The following are net prices for bricklayers hammers, in quantities, at Chicago:

Weight without handle.	Price per dozen.	
	Plain eye.	Adze eye.
1 lb. 2 oz.	$4.95	$5.85
1 lb. 8 oz.	5.40	6.30
2 lbs.	[illegible]	[illegible]
2 lbs. 8 oz.	6.30	7.20

Cement Workers Tools.—The following are net prices at Chicago for tools used in constructing and finishing cement sidewalks. The prices [illegible] for iron nickel plated tools.

Jointer.

2¾ in. wide, 6 in. long, each $0.54

Narrow Jointer.

1¾ in. wide, 8 in. long, ½ in. blade, each .. $0.60
1¾ in. wide, 8 in. long, ¼ in. blade, each .. .60

Straight End Jointer.

3 in. wide, 6 in. long, ½ in. deep, each $0.60

Narrow Straight End Jointer.

1¾ in. wide, 8 in. long, ½ in. blade, each .. $0.60
1¾ in. wide, 8 in. long, ¼ in. blade, each .. .60

Driveway Groover.

The following are net prices for driveway groovers, 3 in. wide and 9 in. long:

Groover, ¾ in. deep, each $1.10
Groover, half round, each 1.10

A 6-in. V-groover, ⅝ in. wide, ½ in. deep, costs 52 cts. each.

Straight End Groover.

[illegible] V-groover, [illegible] wide, ½ in. deep, each [illegible]

Edgers.

The net prices of edgers, ⅜ in., 2¾ in. and 6 in. long, are as follows:

¾ in. turned edger, each $0.52
¾ in. turned edger, 10 in. long, each 1.35

Narrow Edger.

8 in. long, 1¾ in. wide, each $0.60
6 in. long, 1½ in. wide, with guide .... .52

A reversible handle edger, right or left, 1 in. turned edge, ¾ in. radius, 3 in. wide and 6 in. long, costs 60 cts.

Circle Edgers.

[illegible], each .... $0.[illegible]
[illegible], each .... [illegible]

A square edger 3 in. wide, 6 in. long, both edges rounded, with 1½-in. cutting edge, costs 75 cts. Bevel edgers, 2¾ in. wide, 6 in. long, with either ⅜-in. bevel or ⅝-in. bevel, can be bought at 53 cts. each. Corner tools, one end straight, the other curving back, 6 in. long, 1½ in. wide, also cost 53 cts. each. Curbing edgers with 2-in. turned back with radius of 1½ in., 3½ in. wide, 6½ in. long, cost $1.09 each. Raised (tuck) pointers, 3/16, ¼, 5/16, ⅜ or ½ in. size, cost 45 cts. each.

Paving Rammers.—Net prices at Chicago for paving rammers are as follows:

Kind.	Weight lbs.	Price each.
Granite rammer	56	$10.00
Cobblestone rammer	30	7.[illegible]

Rollers.—Hand rollers and horse rollers can be bought at the following net prices, f. o. b. Chicago.

Hand Rollers.

No.	Diameter. Ins.	L'gth. Ins.	No. sections.	Face. Ins.	Weight. Lbs.	Price each.
1	15	15	2	7½	150	$ 7.[illegible]
2	15	22	3	7½	200	9.[illegible]
3	20	16	2	8	225	10.[illegible]
4	20	20	2	10	250	11.65
6	20	24	3	8	300	14.90
8	20	30	3	10	350	16.15
9	24	20	2	10	400	17.40
10	24	24	2	12	450	[illegible]
12	24	30	3	10	500	22.[illegible]
11	28	24	3	8	500	22.[illegible]

The outer edges of these rollers are beveled. They are turned smooth and silver finished.

Horse Rollers.

No.	Diameter. Ins.	L'gth. Ft.	No. sections.	Face. Ins.	Weight. Lbs.	Price each.
80	36	4	4	12	3,000	$141
81	36	5	5	12	3,500	161
82	36	6	6	12	4,000	180
83	48	3¾	3	15	4,000	186
84	48	5	4	15	5,000	228
85	48	6¼	5	15	6,000	270
86	54	3¾	3	15	6,000	27[illegible]
87	54	5	4	15	8,000	363
88	54	6¼	5	15	10,000	450

Stone or Ballast Forks.—Net prices for extra grades stone or ballast forks in quantities, at Chicago, are as follows:

No. tines.	Length tines. Ins.	Width fork. Ins.	Weight per doz. Lbs.	Price per doz.
8	13½	11¼	76	$12.00
10	13½	14½	88	15.00
12	14½	13¾	96	17.4[illegible]

The above prices are for forks with natural finish, wide strap ferrules and heavy caps, with wood "D" ash handles.

Stone Hooks.—Hop or stone hooks in quantities can be bought at Chicago at the following net prices: 4-tined, diamond backed, extra heavy hook, 5 ft. handle, at $9 per dozen; 4-tined diamond backed, light hooks, 4½ ft. handles, at $6.80 per dozen.

Two-Man Rakes.—Two-man rakes, used in leveling broken stone, sell at the following net prices, for quantities, at Chicago:

	Per doz.
10-tooth	$21.[illegible]
12-tooth	23.75
14-tooth	26.25

Asphalt or Tar Rakes.—Asphalt or tar rakes, made of solid steel, 18 in. square iron shank and 5 ft. white ash handle can be bought at Chicago at the net price of $12.85 per dozen.

Tar Pails.—Net prices at Chicago for tar pails are as follows:

	Each.
Pay-off pail	$1.[illegible]
Pay-off pail spouts for wood or stone	.90
3-way spouts for brick or stone	4.50
Carrying pail	2.70

MISCELLANEOUS SUPPLIES AND TOOLS.

Axes.—Net prices at Chicago for axes in quantities are as follows:

	Weight Lbs.	Price each.	Price per doz.
Single bitted	3½ to 4½	$0.50	$5.35
Single bitted	[illegible] to [illegible]	[illegible]	[illegible]
Single bitted	[illegible] to 6	[illegible]	6.[illegible]
Double bitted	4 to 5	.85	8.50

Handled axes bring the following net prices:

	Each.	Doz.
Single bitted, Michigan pattern, 4 to [illegible] lbs.	$0.80	$ 8.25
Single bitted, Michigan pattern, 5 to 6 lbs.	.90	[illegible]
Double bitted, Michigan pattern, 4 to [illegible] lbs.	1.1[illegible]	[illegible]

Mortar Hoes.—The following are net prices at Chicago for mortar hoes forged from best hoe steel, with 6 ft. selected white ash handles and solid shanks. Mortar hoes, weighing 45 lbs. per dozen, 55 cts. each, or $5.75 per dozen; mortar mixing hoes with two holes, 60 cts. each, or $6.25 per dozen.

PREVAILING PRICES IN [illegible] FOR MATERIALS USED IN PAVEMENT [illegible] CONSTRUCTION IN A NUMBER OF REPRESENTATIVE AMERICAN CI[illegible]

City	[illegible]	Broken stone [illegible]	Sand [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
New England States:							
Boston, Mass.	$1.[illegible]	$1.25*	$0.90	$1.[illegible]	[illegible]	$2.75	$1.[illegible]
Bridgeport, Conn.	[illegible]	.90	1.25	1.37		[illegible]	2.00
Cambridge, Mass.	[illegible]	1.50	1.00	28.00†			58.00†
Everett, Mass.	[illegible]	1.30	1.27	1.16			[illegible]
Fitchburg, Mass.	[illegible]	1.00[1]	.60				1.37[1]
Hartford, Conn.	[illegible]	1.35*	[illegible]		[illegible]		
Haverhill, Mass.	[illegible]	1.10[2]	.30				....
Lawrence, Mass.	[illegible]	1.10*	[illegible]			[illegible]	1.30
Lowell, Mass.	[illegible]	[illegible]	1.20				1.25
Malden, Mass.	1.70	1.75	1.00				
Meriden, Conn.	[illegible]	.55*	1.20				
Middletown, Conn.		1.05					
New Bedford, Mass.	[illegible]	[illegible]	1.10				[illegible]
Newton, Mass.	[illegible]	[illegible]	.40				
Portland, Me.	[illegible]	1.50	1.10	....			1.20
Providence, R. I.	[illegible]	1.69	.60	1.25			[illegible]
Springfield, Mass.	[illegible]	[illegible]	1.00			[illegible]	
Stamford, Conn.	1.21	1.00	1.75	[illegible]			
Worcester, Mass.		[illegible]	1.25				1.50[9]
North Atlantic States:							
Amsterdam, N. Y.		1.25	[illegible]				
Annapolis, Md.	[illegible]	1.30[10]	.80	1.00[10]			
Bayonne, N. J.	[illegible]	[illegible]	.50		[illegible]		
Binghamton, N. Y.	[illegible]		1.00	20.00			
Buffalo, N. Y.	[illegible]	.90	.90				
Camden, N. J.	[illegible]	1.35*	.50				[illegible]
Corning, N. Y.	[illegible]	1.50	1.50	.60			
Dunkirk, N. Y.	[illegible]	1.50	.75	.90			
East Orange, N. J.	[illegible]	1.49*	1.70				
Elizabeth, N. J.	1.15	1.75	.90	1.03			[illegible]
Fulton, N. Y.		[illegible]	.85	24.50†			
Hornell, N. Y.	1.25	1.15	1.00	.76			
Hudson, N. Y.	....	[illegible]	....				
Jamestown, N. Y.	1.23	1.50	1.75	.78[14]	13.50		
Jersey City, N. J.	[illegible]	1.50	1.25	2.50		[illegible]	
Kingston, N. Y.	1.20	1.33	.50	.90			
Little Falls, N. Y.	1.22	1.50[15]	1.00[15]				
Middletown, N. Y.	[illegible]	1.00	.70	.94			
New Brunswick, N. J.		1.50	1.00	[illegible]			
New Castle, Pa.	1.15		.75[17]	15.25†			
Niagara Falls, N. Y.	[illegible]	1.10	1.25				
North Tonawanda, N. Y.	[illegible]	1.25	1.00	.80			
Ogdensburg, N. Y.	[illegible]	1.07	1.07				
Olean, N. Y.		1.50	1.40	1.45			
Oneida, N. Y.	1.40	1.40	.80	[illegible]			
Oneonta, N. Y.	[illegible]	1.50	1.50	1.02			
Reading, Pa.	1.20	1.20*	1.20*	[illegible]	[illegible]		[illegible]
Rochester, N. Y.	[illegible]	1.50	1.25	[illegible]			
Schenectady, N. Y.	[illegible]	1.70	1.25				
Scranton, Pa.	[illegible]	1.25	1.25	[illegible]			[illegible]
Syracuse, N. Y.	1.35[20]	[illegible]	1.00[22]				
Troy, N. Y.	1.60	1.50	[illegible]				
Utica, N. Y.	1.50	1.60	1.00				[illegible]
Washington, D. C.	.99	1.50	.39	[illegible]			
Watertown, N. Y.	[illegible]	1.25	1.00	[illegible]		[illegible]	
Wilkesbarre, Pa.	1.35	1.50	1.25	1.00			
Williamsport, Pa.	[illegible]	1.20	[illegible]	18.00			
South Atlantic States:							
Charleston, S. C.	....	1.68*	1.10	[illegible]			
Danville, Va.	[illegible]	2.00	[illegible]	[illegible]			[illegible]
Macon, Ga.	[illegible]	1.25	[illegible]	1.00			
Norfolk, Va.		1.60	1.00			[illegible]	[illegible]
Pensacola, Fla.	1.35	1.90[24]	1.10				
South Central States:							
Gadsden, Ala.	1.35	.90	[illegible]	[illegible]			
Louisville, Ky.	1.80	1.00	[illegible]	15.00	10		
Vicksburg, Miss.	1.80	[illegible]	[illegible]				
North Central States:							
Anderson, Ind.	1.35	1.00	.80	[illegible]	[illegible]		
Battle Creek, Mich.	1.09		[illegible]	.78			
Bloomington, Ill.	1.20	1.50	1.10	.74	[illegible]		
Bloomington, Ind.	1.40	[illegible]	1.50	[illegible]			
Canton, Ill.			1.40	.70			
Columbus, O.	[illegible]	[illegible]	1.30	.65			[illegible]
Dayton, O.	1.60		1.00				
Evansville, Ind.	1.30	[illegible]	1.00	20.00†			
Flint, Mich.	1.40		1.00	.70			
Freeport, Ill.	1.35	.50	1.00[28]	[illegible]			
Gary, Ind.	1.10		1.15	[illegible]			
Grand Rapids, Mich.	1.50	1.50	1.00	1.20			
Hamilton, O.	1.25	1.25	1.00	.90			
Kalamazoo, Mich.	[illegible]		.60				
Lansing, Mich.	[illegible]	[illegible]	1.00	[illegible]			
Lima, O.	1.30	1.00	1.20	.70			
Logansport, Ind.	[illegible]	1.00	.80				
Lorain, O.	....	1.20	1.20				
Marion, Ill.	1.35	1.35	1.00				
Mattoon, Ill.	1.10	1.35	1.00	.70	19.00		
Milwaukee, Wis.	1.30	1.30		.90	[illegible]		[illegible]
Muskegon, Mich.		1.25					
New Albany, Ind.	1.15	[illegible]	[illegible]	.74			
Newark, O.	1.20	[illegible]	[illegible]	.60			
Ottawa, Ill.	[illegible]	1.35	[illegible]	.78			
Peoria, Ill.	1.28	1.27[24]	1.00				
Port Huron, Mich.	1.10	1.10	.90	.85			
Richmond, Ind.	[illegible]	[illegible]	1.00	.78			
Rockford, Ill.	[illegible]		1.00	1.85			
Saginaw, Mich.		1.15	1.00	.76			
Springfield, O.	1.30	1.00	1.00	[illegible]	28.00		
Streator, Ill.	2.00	[illegible]	1.00	.80			
Waukegan, Ill.	1.50	1.10	1.25				
Zanesville, O.	[illegible]	[illegible]	[illegible]	.60			
Northwestern States:							
Albert Lea, Minn.	1.60		.70				
Ames, Ia.	2.00	2.00	1.00				
Burlington, Ia.	1.65	2.00	1.25				
Butte, Mont.	3.10	1.80	1.25	1.10			
Chariton, Ia.	[illegible]	2.00	1.75				
Coffeyville, Kan.	1.30		1.20				
Council Bluffs, Ia.	[illegible]	2.50	1.25				

Pails.—Net [illegible] of pails are as follows:

[illegible]

Capacity Quarts	Weight per dozen Lbs.	[illegible]
10	24	$1.40
12	[illegible]	[illegible]
14	[illegible]	[illegible]
16	—	2.75

Galvanized [illegible]

Capacity Quarts	Weight per dozen Lbs.	[illegible]
12	39	$3.75
[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]

Galvanized cement pails with double braced bottom, extra heavy, [illegible] can be bought at $8 per dozen. [illegible] pails with iron bails, 14-quart capacity, bring a net price of [illegible] per dozen. Common pine pails, 2-hoop, cost $2.50 per dozen; with three hoops they cost $[illegible] per dozen.

Sewer Builders' Mauls.—Net prices [illegible] mauls for sewer builders, etc., with selected [illegible] handles and iron bound head range from $1.40 each for 6x8 and 6x9-in. sizes to $1.[illegible] each for 7x9, $1.60 for 7x10 and $1.70 for 8x10-in.

Manila and Sisal Rope.—The net prices at Chicago for various kinds of [illegible] are as follows:

Manila Rope.

	Per lb. Cts.
All sizes above [illegible]-in. diameter	[illegible]
12-thread or 3/8-in. diameter	9½
6 and 9 thread or ¼-in. and 5/16-in. diameter	10
Fine 6-thread, or 3/16-in. diameter	10½
3-thread laid or 3/16-in. diameter	10
Tallow laid	[illegible]½
Hawser laid	[illegible]

Sisal Rope.

All sizes above [illegible]-in. diameter	[illegible]½
12-thread or 3/8-in. diameter	[illegible]
6 and 9 thread or ¼ and 5/16-in diameter	8½
Fine 6-thread or 3/16-in. diameter	9

Wire Rope.—The discounts from the following standard lists to the larger consumer are as follows: Standard construction crucible cast steel hoisting rope, [illegible] per cent and [illegible] per cent; special flexible dredge rope, 40 per cent and 5 per cent; galvanized iron, 42½ per cent and 2½ per cent.

Standard Construction Crucible Cast Steel Hoisting Rope.

Six strands 19 wires to the strand.

Diameter, ins.	List price per foot.	Approx. circum., ins.	Weight per foot, lbs.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
2	1.16	6¼	6.30
[illegible]	[illegible]	[illegible]	[illegible]
1 5/8	.77	5[illegible]	4.15
[illegible]	[illegible]	[illegible]	[illegible]
1 3/8	.56	4¼	3.00
[illegible]	[illegible]	[illegible]	[illegible]
1 1/8	.38	3½	2.00
[illegible]	[illegible]	[illegible]	[illegible]
9/16	.12	1¾	0.70
[illegible]	[illegible]	[illegible]	[illegible]

[illegible] Flexible Dredge Rope.

Six strands of [illegible] wires [illegible]

[illegible] ins.	List price per 100 ft.	[illegible] foot, lbs.
3/8	$17.50	.22
[illegible]	[illegible]	[illegible]
5/8	27.00	.62
[illegible]	[illegible]	[illegible]
1 1/8	75.00	2.00
[illegible]	[illegible]	[illegible]
1 1/2	125.22	3.55

[illegible]

With 7 wires to the strand.

Davenport, Ia.	1.15			[illegible]			
[illegible]			1.00	[illegible]			
[illegible]	1.30		1.65	.60	22.50		
Keokuk, Ia.	1.40		1.50	1.75			
[illegible]		1.50		10.00[7]			
[illegible]	[illegible]	1.75[8]					
[illegible]	1.60		.70	.95			
[illegible]			.30				
[illegible]		1.75	.75	[illegible]		1.33	[illegible]
[illegible]		1.75	1.00	[illegible]		1.50	
[illegible]	1.60	2.00	1.15	.65			
[illegible]		2.20	2.20	1.02	22.00		
[illegible]		1.85		12.00[3]			
[illegible]			1.00	1.00	30.00		
[illegible]	1.50	1.30	.10	.90		1.50	
[illegible]	1.50			.84	32.00		
[illegible]	1.85	1.75		.95	33.00	[illegible]	
[illegible]	1.72			2.00			
[illegible]	1.70[28]				[illegible]		
[illegible]	1.60	2.00	1.00	1.00	[illegible]		
[illegible]					21.00		
[illegible]			1.00	.65	28.00		
[illegible]		1.20	1.35	[illegible]	25.00	[illegible]	
[illegible]			1.75				
[illegible]	[illegible]		.50				
[illegible]				1.59	19.00	1.35	
[illegible]		1.00	1.00		15.00		
[illegible]		1.00	1.00	1.50			
[illegible]			[illegible]	2.90			
[illegible]			1.25		22.00		2.25
Pasadena, Cal.	2.40	1.60	.50		22.00		
[illegible]		1.90	1.00		36.00		
[illegible]			1.25		20.00		
San Francisco, Cal.	2.55	1.00	1.73		[illegible]		[illegible]
San Jose, Cal.	2.60	1.60	1.50		16.00		
[illegible]	[illegible]	[illegible]		[illegible]	18.00		
Spokane, Wash.	2.80	1.50	1.25	[illegible]	25.00		
[illegible]		[illegible]	1.50	1.40			
[illegible]	[illegible]	[illegible]	1.00				
[illegible]	[illegible]						

[illegible] F. o. b. cars. [4]On street. [5]85 cts. to $1.20. [6]F. o. b. [illegible] [8]$1.10 to $1.50. [9]$1.50 for 4½-in. block. [10]F. o. b. Annapolis. [11]18 cts. to 20 cts. f. o. b. city. [12]Trap block [illegible] gravel [illegible] cts. to 90 cts. [illegible] Delivered [illegible] sand and gravel. [illegible] car load lots, $1.40. [19]Stone block. [20]$1.35 to $1.65. [21]$1.35 [illegible] Sandstone blocks. [illegible] Gravel. [25]Gravel on job. [26]On job. [27]Seconds. [28]Imported; local sand, 25 cts.; delivered, 80 cts. [29]Creek gravel used for paving work, cost [illegible] Delivered [illegible] Delivered on street [illegible] F. o. b. [illegible] Per M [illegible] At yards or bunker. [illegible] Sandstone blocks.

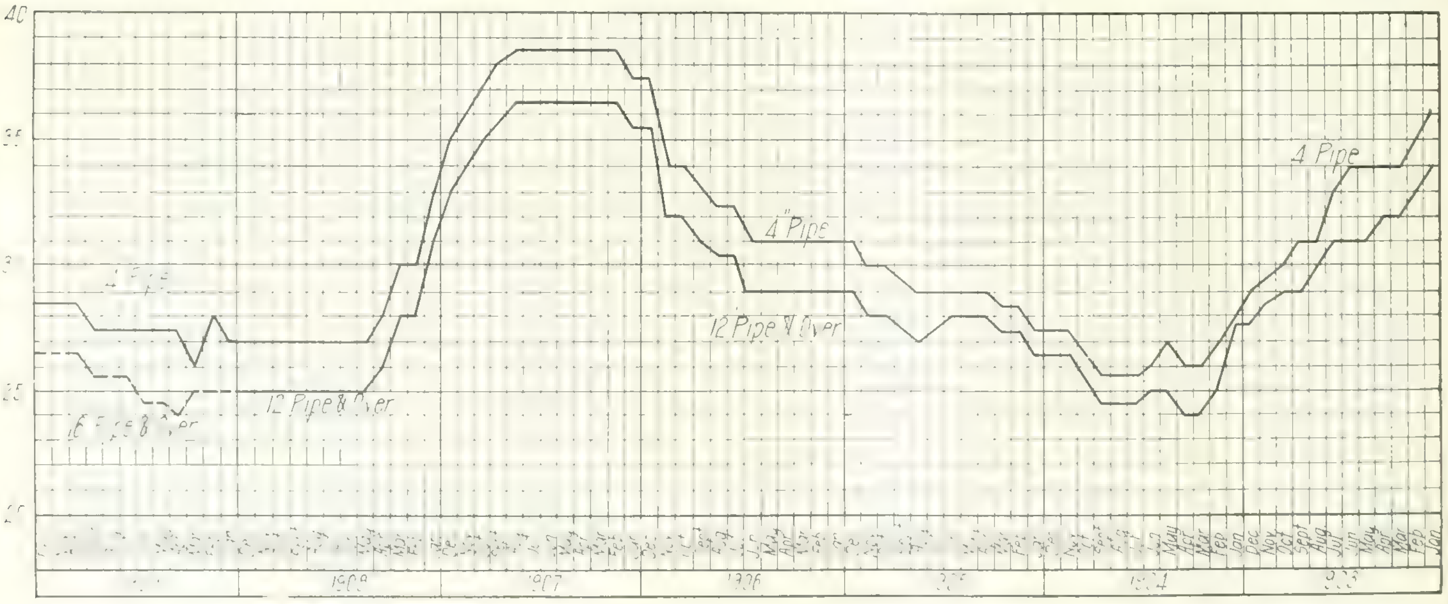

Diagram Showing Market Price of Cast Iron Pipe F. O. B. Chicago.

[illegible]	[illegible]	[illegible]		[illegible]
1	3	1[illegible]	$0.16	1.[illegible]
1 1/16	[illegible]	[illegible]	.18½	1.77
1 [illegible]	[illegible]	.19½	.21	2.00
1 3/16	[illegible]	.22½	.24	2.21
1¼	[illegible]	.25	.26½	2.[illegible]
1[illegible]	4½	.28½	.30½	3.00
1 7/16	4½	.31½	.33½	3.24
1½	[illegible]	[illegible]	.37	3.55
1⅝		[illegible]	.40	4.15
1 11/16	[illegible]	.41	.43	[illegible]
1¾	[illegible]	.44	.46	4.85

Water Pipe.—Birmingham, Ala., quotations on cast iron water pipe, per net ton, f. o. b. cars, are about as follows: 4 to 6-in., $23; 8 to 12-in., $22; over 12-in., average $21, with $1 per ton extra for gas pipe.

Chicago prices, per net ton, are about as follows: 4-in., $25.50; 6 to 12-in., $24.50; 16-in. and up, $24, with $1 per ton extra for gas pipe.

The accompanying diagram shows the market price of cast iron water pipe, f. o. b. Chicago, [illegible] by John P. Alvord, Consulting Engineer, Chicago, Ill., the quotations being taken for the first week in each month's issue of the Iron Age.

White Lead.—The following are the New York quotations for the best brands of white lead: Lots of 500 lbs. and over, in 100, 250 and 500-lb. kegs, 7¼ cts.; in 25-lb and 50-lb. kegs, 7½ cts. In lots less than 500 lbs. the usual advance of ½ ct. is charged.

Linseed Oil.—New York card prices for linseed oil, in 5-bbl. lots or more, are as follows: State, raw, 91 cts.; city, raw, 91 cts.; oil in lots of less than 5 bbls., 1 ct. advance per gal.; boiled oil, 1 ct. advance per gal. over raw.

RAILWAYS.

MATERIALS AND SUPPLIES

Rails and Track Supplies.—The present rates for rails, spikes and track bolts, f. o. b. cars at works in the Chicago district, are as follows:

	Per 100 lbs.
80 to 100-lb. standard rails, Bessemer	$1.[illegible]
50 to 100-lb. standard rails, open hearth	1.34
40 and 45-lb. rails	1.16
30 and 35-lb. rails	1.19½
16 [illegible] rails	1.20½
12-lb. [illegible]	1.25
Standard railroad spikes	1.70
Standard track bolts, base	2.15

Pittsburg quotations on spikes based on $1.60 per keg are as follows:

Railroad Spikes.

[illegible] ½ x 9/16		$1.60
[illegible] and [illegible] x ½	Extra	.10
[illegible] ½ x 7/16	Extra	.20
[illegible] 1½ x [illegible]	Extra	.30
[illegible]	Extra	.40
[illegible] 3½ x [illegible]/16	Extra	.60
2 x 5/16	Extra	.80

Boat Spikes.

¾ in. square, 12 to 24 in. long	Extra	.15
⅝ in. square, 8 to 16 in. long	Extra	.15
½ in. square, 6 to 16 in. long	Extra	.15
7/16 in. square, 6 to 12 in. long	Extra	.20
⅜ in. square, 4 to 12 in. long	Extra	.30
5/16 in. square, 4 to 8 in. long	Extra	.45
[illegible] in. square, [illegible] to 8 in. long	Extra	[illegible]
¼ in. square, 3 to 3½ in. long	Extra	1.00

[illegible] longer than [illegible] in., ¼ cent extra.

Ties.—The following are about the current prices prevailing f. o. b. dock, New York, for Yellow pine railroad cross ties:

	Standard.	Sound and square edge quality.
[illegible]	$0.[illegible]	$[illegible]
[illegible]	69	[illegible]
[illegible]	67	[illegible]

Other quotations on light rails at Chicago are as follows:

	Per lb.
40 to 45-lb.	1.16 to 1.20½ cts.
30 to 35-lb.	1.19½ to 1.24 cts.
16, 20 and 25-lb.	1.20½ to 1.25 cts.
12-lb.	1.25 to 1.30½ cts.

The following quotations are per gross ton delivered at Chicago:

Relaying rails, standard sections	$23.00 to $24.00
Old iron rails	14.50 to 15.00
Old steel rails, less than 3 ft.	12.75 to 13.25

TOOLS.

Bars.—Net prices at Chicago for solid steel crowbars, lining bars, claw bars, and railroad tamping bars, are as follows:

	Per lb.
Crowbars	4 cts.
Lining bars	4 cts.
Claw bars, goose neck	6 cts.
Claw bars, with heel	6 cts.
Railroad tamping bars	4½ cts.

Track Tools.—Net prices at Chicago for track tools are as follows:

	Per lb.
Mauls, 6, 8, 10 and 12-lb.	5½ cts.
Chisels, 4½, 4¾ and 5-lb.	12 cts.
Punches, 4, 4½ and 5 lbs.	12 cts.
Railroad track tongs, 17 lbs., pair	7½ cts.
Rail forks, each 15 lbs.	7 cts.

In hydraulic mines having high banks it is extremely dangerous as well as uneconomical to carry the face, or cut, in the form of a horseshoe. When this is done the giant soon becomes surrounded on both sides and in front by a high bank of gravel, and great falls of earth and landslides are likely to occur at any moment, overwhelming men as well as the giants and pipes leading to them. The bank should be cut on as nearly a straight line as possible, or, even better, so that there is a projection opposite each giant rather than a recess.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week.

The principal feature of the week in railroad construction [illegible] has been the awarding of large contracts by the Grand Trunk Pacific [illegible] were awarded for 620 miles of branch lines and 265 miles of new work on main lines. J. D. McArthur, Winnipeg, Man., secured contracts for most of the branch line work and Foley, Welch & Stewart, St. Paul, Minn., the main line work. These and other contracts which were let recently by the Grand Trunk Pacific Ry. amounted to nearly $17,000,000. Other railroad construction contracts let recently include the following: Tobin & Larson, for building 14 miles of railroad from Beaver Creek to Pincher Creek, Alberta; L. P. McClancy, Memphis, Tenn., for 45,000 cu. yds. grading for the Nashville, Chattanooga & St. Louis Ry.'s belt line south of Hickman, Ky.; Jos. P. Connell, Janesville, Wis., for grading for the new yards of the Chicago & Northwestern Ry., at Boone, Ia.; Raymond M. Booth, Albany, N. Y., for the mason work for the new shops of the Delaware & Hudson Ry., at Watervliet, N. Y.; Dunavent & Co., Knoxville, Tenn., for grading work for new line from Lookout Mountain to Wauhatchie, Tenn., for the Nashville, Chattanooga & St. Louis R. R.; J. H. Orr & Co., for constructing a 4-mile spur for the Cannon & Northern Ry. (Baltimore & Ohio).

A number of large railroad construction jobs look like prospects for the near future. The Chicago, Rock Island & Pacific Ry. is understood to be getting ready to build its new line in Iowa, and it is believed that the Chicago & Northwestern Ry. will also take steps soon for its new line to Peoria. Up in Vermont the Grand Trunk Ry. is rushing location surveys for its new 50-mile line from Windsor, Vt., to Brattleboro, Vt., while down in New York City it is expected that bids will be asked shortly for the first half of the steel for the Hellgate bridge of the connecting railroad to be built across the city by the New York, New Haven & Hartford R. R.

A fair sized levee contract, about the only one of the week, was let at New Orleans on March 30. This contract called for the construction of the Lucca Levee in Desha County, Ark., and involved 350,000 cu. yds. of earthwork. Lowrence Bros. & Co., Memphis, Tenn., secured the contract at 20.82 cts. per cu. yd.

Several of the larger railroads are providing funds for betterment and improvement work. A stockholders' meeting of the Chesapeake & Ohio Ry. Co. is to be held in Richmond on April 29 for the authorization of an issue of $125,000,000 5 per cent [illegible] mortgage bonds. It is said that the bonds will be sold to retire outstanding general funding and improvement bonds, amounting to $11,000,000, and to pay certain outstanding equipment obligations. The amount remaining is to be used for betterment and improvement and the acquisition of additional lines and terminals. Stockholders of the Pennsylvania R. R. at an election on March 28 voted in favor of increasing the capital stock from $500,000,000 to $600,000,000. It was announced that only $40,000,000 of the $100,000,000 increase will be issued for the present. Of this $18,000,000 will be added to an authorized stock balance of $22,000,000 already on hand, making $40,000,000 to be devoted to the purchase of equipment and for the construction, improvement and expansion during the year.

The Bates & Rogers Construction Co., Chicago, Ill., at $631,000, submitted the lowest bid on March 21 for the construction of Lock and Dam No. 29 in the Ohio River near Ashland, Ky. This work had been re-advertised, the previous opening [illegible] Feb. 20.

The First Three Months of 1911.

Even such confirmed pessimists as Mr Dingbat of [illegible] the railroad contractor. Many contracts for the construction of new railroads and for the [illegible] of old railroads have been let, and much betterment work for the older roads has been placed under contract. The following list of some of the larger jobs will give an idea of the new railroads or extensions, the letting of contracts for which were announced during January, February and March of this year:

State.	Railroad.	Miles.
Kentucky	Lexington & Eastern	16
Georgia	Wrightsville, Adrian & Lyons	17
Pennsylvania	Lehigh & New England	32
West Virginia	Middle Island Ry.	14
Pennsylvania	Blacklick & Yellow Creek branch	
Texas	Kansas City, Mexico & Orient	[illegible]
West Virginia	Buckhannon & Northern	18
Washington	North Coast	40½
Kansas	Wichita, McPherson & [illegible]	[illegible]
Nebraska	Union Pacific	50
Kentucky	Sandy Valley & Elkhorn	[illegible]
Florida	Florida East Coast [illegible]	[illegible]
Florida	Florida [illegible] R.	[illegible]
Wisconsin	Minneapolis, St. Paul & Sault Ste. Marie	76

Of the above the Wrightsville, Adrian & Lyons, the Lehigh & New England, the Middle Island Ry. and the Sandy Valley & Elkhorn are new projects. The Lehigh & New England R. R. work and the Sandy Valley & Elkhorn work are especially large contracts. The Buckhannon & Northern extension is also a big piece of work. Perhaps the largest of the above contracts is for the construction of the 40½ miles of line for the North Coast R. R. This line is to be built from Spokane to Ayer Junction and it is reported that it will cost $4,000,000. In the line of betterment and double track work a number of good sized contracts have been let. The Queen & Crescent Route, the Kansas City Southern, the Pere Marquette Ry., and the Chesapeake & Ohio Ry. have all let contracts for a considerable amount of this work. The first three months of the year have also seen the letting of several notably large contracts for the construction of interurban railways. The largest of these contracts is for work on the new line of the Piedmont & Northern Traction Co. in North Carolina and South Carolina. The contract for the first section of this companys' road calls for 35 miles of work and will cost about $400,000. The second section covers 90 miles of line, and the contract is reported to amount to $900,000. The three great railways of Canada, the Canadian Pacific, the Canadian Northern and the Grand Trunk Pacific have been especially active the past months in awarding contracts for new work. Early in the month the first named road awarded contracts covering over 400 miles of grading, culverts and bridges on new branch lines and second tracks on main line. A short time later the Canadian Northern awarded contracts amounting to several millions of dollars for the construction of new lines. The Grand Trunk Pacific contract, which was closed the latter part of March, covers 265 miles of main line, 620 miles of branch lines, the grading of about 200 miles of other branch lines and the erection of 140 stations. These Grand Trunk Pacific contracts are said to amount to $17,000,000. Other Canadian railroads which have awarded contracts are: The Kootenay & Alberta Ry., for a 13-mile line; the Algoma Central & Hudson Bay R. R., for a further extension; the Canadian Northern Pacific, [illegible] line on Vancouver Island; and the Manitoulin & North Shore Ry., for 15 miles of line. The last work will cost about [illegible].

Early Road Building in Maryland.

Road building in Maryland was started at an early date. In a recent report of the Maryland geological survey it is stated that the grant of Bohemia Manor to Augustine Herrmann, in 1662, resulted in the making of a road across the Peninsula. This road was constructed jointly by the New York authorities and the Marylanders. In the Baltimore court proceedings for the year 1694 there is a record that the overseers for clearing the highways were ordered to take with them "Every tythable in their hundred for the making of good highways thirty foote wide, not leaveing Logges, Brushes or Roots, appearing above ground, or young saplings in said Roades. In 1704 an act was passed which with a few amendments was the road law of the province for [illegible] years. This act provided for roads [illegible] ft wide, and for bridges where deemed necessary by the county courts. In accordance with this act masters of servants had to send, upon summons, all their taxable male servants to work under the overseer, the fine for non-compliance being 100 lbs of tobacco for every servant named and not sent. The act provided for the marking of trees as a form of guide post. The trees on roads leading to ferries, court houses of counties, churches or to the post of Annapolis were marked with two notches. At turnings to Annapolis the tree was marked in a smooth place, cut for the purpose, with the letters AA set on with a pair of marking irons and colored. Similarly the trees at turnings to William-stadt were marked with a W, and at turnings to a church the tree was marked with a slip cut down the face near the ground. An extra notch above the two showed that the road led to a county court, a turning to a ferry was marked with three equally spaced notches. Beginning in 1765 special acts were passed establishing single roads to mills, plantations, churches, iron works, forges and many other places of a special or individual character. The persons specially benefited by these roads were usually made responsible for their care. In 1766 a tax of 10 lbs. of tobacco per head was imposed to pay for overseers and hired labor. Some of the roads of the early part of the 18th century were constructed for the particular purpose of rolling tobacco hogsheads to market. These roads were called "rolling roads," and were usually of a round about character to avoid hills. A later development of the idea was to drive pivots into each end of the hogshead, attach shafts, and use horses, mules or oxen to haul it. As to the traveling condition on the early roads the following quotation from a book published in 1800 will show: "'Now, gentlemen, to the right,' upon which the passengers all stretched their bodies half way out of the carriage to balance it on that side. 'Now, gentlemen, to the left,' and so on. This was found absolutely necessary at least half-a-dozen times in half the number of miles."

RAILWAYS, STEAM AND ELECTRIC

Alabama.

[illegible] tion for the draw bridge which will be built over the Mobile River near Mobile. Henry McLaughlin, Pensacola, Fla., is president.

Arkansas.

[illegible] R. R. is reported to have financed a portion of its proposed line and it is believed that construction work will be started this spring. This road, as projected, will when complete, run from Memphis, through southeastern Arkansas, southern Oklahoma and connect with [illegible] near Gainesville, Tex. P. C. Allen, Pine Bluff, Ark., is interested.

Advices from McCrory, Ark., state that a [illegible] work upon the McCrory & Beedeville Southern R. R. and that about 10 miles of grading has been completed and three miles of steel laid. As soon as possible it is planned to connect with the Bonnerville Southern running southeast out of Jonesboro.

California.

A meeting has been held at Willows, Cal., preliminary to the organization of a company for the purpose of building an electric railroad to connect Woodland, Colusa, Willows, Orland, Corning, Red Bluff and Redding. The proposed road is intended to connect at Woodland with the Vallejo Northern R. R. This will give access to Sacramento, San Francisco and all the bay cities. It is estimated that the road from Woodland to Red Bluff will cost $2,200,000. C. L. Donohoe, Willows, Cal., is interested.

The City Council of Oakland has at last passed an ordinance granting to the Southern Pacific Co. a franchise for 35 years, in Seventh Street between Bay and Fallon Sts. The Southern Pacific Co. is now said to be placing orders for materials to be used in electrizing the 7th St. line, besides other branches of the Alameda county suburban system not yet commenced. To electrize the entire system will cost $11,000,000.

The Oakland traction Co. has been granted a franchise in Hopkins St., Fruitvale, from Fruitvale ave. to Redwood road.

The property of the Watsonville Transportation of Watsonville, consisting of rolling stock, power plant, a four-mile track from Watsonville to Monterey Bay and a franchise and realty has been sold by Receiver Edward White to J. W. Forgeus of San Francisco for $22,000. It is the new owners' intention to rehabilitate the line in time to handle this season's apple crop.

Application has been made to the city trustees of Napa, Cal., by Theodore Bell to extend the franchise granted the Napa & Lakeport R. R. for a right of way over certain streets of the city for one year. It is stated that one of the promoters is now in the East financing the line and that work will commence in a few months. The road will extend down the West Side of Napa Valley to San Rafael.

Surveys have been completed for the Fresno, Coalinga & Monterey R. R. through Coalinga and the oil fields and have been started up Warthan Canyon. A. Albrecht, Fresno, Cal., is busy securing the necessary right of way.

Almost all the necessary right of way has been secured by J. D. Armstead, and associates who are promoting the construction of the proposed railroad from San Bernardino to San Diego, Cal., through towns of Hemet and Escondido a distance of 50 miles. Necessary financial backing has also been secured for the work, which it is hoped will be started soon.

It has been announced in Chico, Cal., that the Southern Pacific Ry. has purchased a new right of way through Deer Creek Canyon giving it another route through the mountains into the Sacramento Valley, Cal. It is now believed that the company will run a line down the canyon joining the main line at Gerber, to which point the round house and division point was recently moved.

Colorado.

⦿The Lookout Mountain Park Development Co., Denver, has awarded the contract to the Cuno Construction Co., Denver, Colo., for constructing a 2,600-ft. incline railway from Golden to Lookout Mountain. The average gradient is 45 per cent. Louis W. Vidler, 640 Empire Bldg., Denver, Colo., is Chief Engineer of the Lookout Mountain Park Development Co.

Such good progress has been made with the construction work that it is expected that within five months traffic will be started over the new double track between Pueblo and Walsenburg, being built by the Denver & Rio Grande and Colorado Southern Railways. This is four months sooner than the contracts call for.

Application has been made to the city council of Pueblo for a new franchise for the Kansas-Colorado R. R. through the city. Work on the Kansas-Colorado has been started and stopped several times during the past few years. The road is to extend from Pueblo through the Turkey Creek stone quarries, 25 miles northwest.

It is believed here in Denver that the recent death of David H. Moffat will not affect the plans for completion of the Denver, Northwestern & Pacific R. R., the Moffat line. It will cost $10,000,000 to complete the line, but the capital is said to have been partly provided for and the undertaking will be carried forward the same as during the life of its promoter. The work will now be directed by William G. Evans, former vice president, who was recently elected president.

Plans are under consideration for the construction of a railroad from Austin to Cedar Ridge. The plan proposes that the funds shall be supplied by the ranchers along the route. John R. Charlesworth, Delta, Colo., is interested.

Florida.

⦿Capt. George B. Baker of West Palm Beach, Fla., and Lucien Baker, Fort Pierce, Fla., have received the contract for grading and clearing 15 miles of railroad. The railroad is to extend from Jacksonville to Live Oak, Fla., via White Springs. The contract is said to amount to about $40,000. This is probably the work mentioned in our last issue.

The Ocala Northern R. R., E. P. Rentz, president, Ocala, Fla., has placed an order for the balance of the rails to complete the road from its present terminus near Fort McCoy to Palatka. It is expected to have the road in operation to that city by Sept. 1

The Southern Colonization Co., C. H. Armstrong, Engineer, Graystone Hotel, Kissimee, Fla., is to construct a 34.7-mile standard gage, single track line in Osceola County, Fla. The line will be built over sandy soil, probably by elevating graders, Holt caterpillar gas tractors and surfaced with 5-ft. Fresno scrapers. The work will be done by day labor.

Georgia.

City council of Cordele, Ga., has granted a franchise to the Georgia, Southwestern & Gulf R. R., (steam), D. B. Dunn, chief engineer, Albany, Ga., and it is expected that work will be started shortly on an extension.

The Seaboard Air Line Ry., C. P. Hammond, division engineer, Atlanta, Ga., is to expend $17,000 for the extension of its yard facilities at Cordele, Ga.

The Southern Ry. has begun work on the improvements between Macon and Atlanta, for which an appropriation of $400,000 has been made. Most of the outlay of money will be in the construction of lap sidings at points 5 miles apart, and the installation of block signal offices at each of these sidings. The work will take six months for completion.

J. R. Crandal, of Midville; J. H. Plummer, of New York, and C. O. Hall, of Toomsboro, Ga., have been making a trip of inspection through middle Georgie with a view to locating a route for a railroad to run from Athens via Milledgeville, Toomsboro, Dublin and McRae to some point in southwest Georgia or to the gulf coast.

It is reported in Atlanta that the Nashville, Chattanooga & St. Louis R. R. and its controlling line, the Louisville & Nashville, contemplate the construction of a line to parallel the Western & Atlanta R. R. from Chattanooga to Atlanta. It is stated that as soon as its lease on the state road expires the Nashville, Chattanooga & St. Louis, which is the lessee of the state road, contemplates the construction of the parallel line, so that when its lease expires nine years hence it will be independent of the state of Georga, in so far as the Western and Atlantic is concerned.

Idaho.

Work has been started at Caldwell, Idaho, connecting the main line of the Oregon Short Line Ry. with the grade of the Golden Gate Ry. The latter company and its franchise were purchased by the Short Line nearly two years ago, the property including the depot and 12 miles of completed grade. As originally projected about four years ago the Golden Gate was to run from Caldwell to Winnemucca, connecting there with the Southern Pacific and reducing the distance from Boise and this section to San Francisco by about 400 miles. Afterwards the plans were changed to include a northern connection through Boise and into Montana, and the name was altered to the San Francisco, Idaho & Montana Ry. The company was promoted by E. R. Place of Caldwell. It is thought the present activity means that the road will connect with the Buhl cutoff of the Short Line, which will run along the south bank of the Snake and meet the Golden Gate road at Homedale, about 14 miles from Caldwell.

Illinois.

The Illinois Central Electric Ry. Co. is planning to build a 6½ mile extension to Farmington, Ill. Surveys have not been made as yet but the capital for construction has been secured and it is proposed to let construction contracts in 30 or 40 days. L. W. Morton, Canton, Ill., is president, and G. W. Chandler, Canton, Ill., is chief engineer.

The Chicago & Northwestern Ry. is to lay this season about 100 miles 100-lb. steel rails on the "air line" between Chicago and Fulton. In laying this steel the company will replace much of the 90-lb. steel that was laid several years ago. In addition to laying the steel the company is also planning to complete 45 miles of double track rock ballast this year.

Details are being worked out, it is reported, for making a complete valuation of all of the railroads comprising the Harriman system. The valuation is in charge of E. Holbrook, 135 Adams St., Chicago, Ill., special engineer of the Union Pacific.

Appropriations as follows have been made by the Santa Fe system: $7,000 for bank protection work near Bosworth, Mo.; $4,460 for constructing a 2,500-ft. passing track at Lordsburg, Cal.; $3,400 to cover cost of constructing team tracks at Hoover and Normandy Sts., Los Angeles; $6,000 for constructing a 6-pocket Clifton coal chute, with trestle and storage track at Kenna, N. M.; $25,000 to cover cost of widening the embankment between mile posts Nos. 924 and 926, Valley Division; $32,000 to cover cost of widening banks between mile posts Nos. 188 and 247, Southern

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Division, $25,000 [illegible] cost of necessary fencing along the right of-way on the Eastern Lines; $21,500 to cover cost of constructing right of way [illegible] cattle guards on the Western Lines during 1911. The Santa Fe System also plans on constructing a 120,000,000-gal. capacity reservoir at mile post No. 154, Lampasas [illegible] which, inclusive of pumphouse and machinery, will cost $43,000.

The Chicago, Rock Island & Pacific Ry. Co. has under consideration [illegible] construction of a portion of new track between Chicago and Joliet. Ill. The work will include reballasting.

Indiana.

A company is being organized at Vincennes for the purpose of building a traction line between Vincennes and Jasper, Ind. The company will probably be known as the Vincennes & South Eastern Traction Co. Geo. B. Hazleton, Vincennes, Ind., is said to be interested.

The Gary, Hobart & Eastern Traction Co. is being organized. It proposes to construct a street car line between Hobart and Gary. The company is to have a capital stock of $100,000. Surveys for the line are under way, and it is planned to have construction work started this spring. The line will be about four miles long. T. W. Englehart, Gary, Ind., and J. C. Cavender, Hobart, Ind., are interested.

The Terre Haute, Indianapolis & Eastern Traction Co., T. F. Grover, general manager, Terre Haute, is rebuilding about two miles of its track at Terre Haute. The material has been purchased and the work is being done by company forces.

The Chicago, South Bend & Northern Indiana Ry. Co. (electric) South Bend, has received a franchise from the Board of Public Works to operate its cars in Gary over the Nickel Plate road.

The Vincennes & Southeastern Interurban Ry. Co., of Vincennes, has been chartered with a capital stock of $50,000 and proposes to construct and operate an interurban line from Vincennes to various towns lying to the southeast. The directors are: George B. Hazleton, Ray Eubank and Roger G. M. Lewis.

Plans are underway for the construction of a line of railway between Fort Wayne, Ind., at Toledo, O., paralleling the Wabash. The company that will build the road has not been organized as yet, the promotion work still being in the hands of the promoting company. It is likely that no definite action on this road will be taken before July. The W. H. Schott Co., 39 Jackson Blvd., Chicago, Ill., are the engineers.

The Evansville, Chrisney & Eastern Ry. has completed surveys for its projected 14-mile traction line from Chrisney to Boonville to a connection with E. S. & N. traction line to Evansville. About one-half the capital for construction purposes has been secured. Construction will not be let before June. E. E. Watts, Princeton, Ind., is Chief Engineer, and J. P. Chrisney, Chrisney, Ind., is President.

Iowa.

⦿Jos. P. Connell, 216 Lincoln St., Janesville, Wis., has been awarded the contract for grading for the new yards of the Chicago & Northwestern Ry. at Boone, Ia. About 75 men and 50 teams will be used on the work, which will require several months for completion.

Citizens on Kirkwood avenue in Iowa City, Ia., have raised a fund of $4,000 to secure the extension of the [illegible] railway.

Options on right-of-way are now being secured for the Muscatine Davenport Interurban line. The work of mapping the surveys has been completed by K. C. Weedin, construction engineer of J. G. White & Co., 43 Exchange Pl., New York City. This line is to be built by the Tri-City Ry. Co. J. F. Porter, president, Davenport, Ia.

Construction work may be started about June 1 on the first 35 mile section of the line of the Iowa City-Ottumwa Interurban Ry. Co. Tentative contracts for the construction of this portion of the line are reported to have been let to the Arnold Co., Chicago, Ill.

The Osceola & Southwestern Ry. Co. has filed its articles of incorporation at Osceola. The company proposes to build an interurban line from Osceola to Lacelle and from there to Hopeville, the route favored by the incorporators being alongside the highway to a point a mile south of Lacelle and then straight into Hopeville. The distance is less than 20 miles. Ex-Senator Jamison, John E. Barnard, P. L. Fowler, Henry Stivers and R. M Lewis are the incorporators.

It has been announced that the Chicago & Northwestern Ry. is planning improvements the coming year estimated to cost $1,000,000. The work will include new work at Missouri Valley and Boone, Ia., also double tracking the line between Otis and Beverly. At present that stretch of line, 8 miles in length, is the only piece of track between Chicago and the Missouri River which is not double tracked. That portion of the company's line leads through the city of Cedar Rapids. It is believed that the work of building a new depot, and extensive shops in Clinton, will not be taken up until late in 1911, or in the spring of 1912.

Kansas.

⦿The following are the subcontractors for bank widening work on the Kansas Division of the Chicago, Rock Island & Pacific Ry.: W. G. Hays of St. Joseph, Mo.; F. N. Corser of Willington, Kans.; W. F. Lindbloom of Osage City, Kans.; Wm. Burns of White City, Kans.; W. B. Ogelsby of Caldwell, Kans. The work involves about 200,000 cu. yards of embankment. The general contractor is T. L. Campbell, 801 North Kansas Ave., Topeka, Kans. Two or three more small outfits can be used on the work.

The Santa Fe System is planning the following minor improvements for its lines in Kansas: Replacing the wooden water tank at Douglass with a steel tank and crane; constructing a passing track at Elk City, to cost $4,000; constructing an industrial track at Coffeyville, Kan., costing $2,500; constructing a 300-ton mechanical coaling station at Moline, to cost $11,600; replacing the wooden water tank at Sedgewick, Kan., with a steel tank and crane at an estimated cost of $3,000; constructing a 1,826-ft. extension to the passing track at South Wichita, to cost $4,100; taking up and relaying high pressure water pipe line in the Topeka yard, to cost $16,000.

Kentucky.

⦿L. P. McClavy, Memphis, Tenn., who has been doing some levee work below Hickman, has been awarded a 45,000 cu. yd. grading contract on the Nashville, Chattanooga & St. Louis Ry.'s belt line south of Hickman. The contract covers the work from Troy road south of town to the government levee in West Hickman.

⦿J. H. Orr & Co. has been awarded the contract for the construction of a short spur of the Cannon & Northern, a part of the Baltimore & Ohio system, on the Monongahela River, out of Pittsburg. The road will be four miles long, and its construction will cost in the neighborhood of $70,000. Albert D Stone, Paris, Ky., is engineer for the contractors.

The Ohio & Kentucky Ry., now operating 27 miles of line, is understood to have plans under consideration for building an extension to connect with the Norfolk & Western Ry. near Pike. M. L. Conley, Cannel City, Ky., is general manager.

The Louisville & Nashville Ry. is reported to have negotiations underway for the purchase of the Mountain Central Ry., a 32-mile line in Kentucky.

Louisiana.

Plans are being considered for constructing a railroad from Hammond to Springfield. The line would be about seven miles long, and its cost would be comparatively light as it would traverse a level section of country. Dr. L. D. McGehee, Hammond, la., is interested.

The Southern Ry. & Navigation Co. is said to be operating its railroad between Morville, La., on the [illegible] Vidalia, to Boyle, a distance of ten miles. The line is projected to run from Vidalia to Monterey, and eventually to Alexandria, La. When completed the road will put Natchez in direct communication with Alexandria. Clarence Boyle is general superintendent, with headquarters in Natchez, Miss.

It is expected that an application will shortly be made to the city council of New Orleans, La., for a franchise for a new line of street cars. A number of local people are supposed to be in the transaction, and the line, if secured, will start at Canal Street, near the Terminal Station, and run to Gravier Street, from there to Claiborne and up Claiborne to the purification plant at the extreme upper end of the city and return by Claiborne to the starting point, through just what downtown streets is not made clear, but perhaps back through a street paralleling Gravier, or maybe Gasquet Street to Elk Place. The cars will be operated by gasoline motors.

Maryland.

Steps will probably be taken soon for the electrification of the Chesapeake Beach Ry. and the extension of the route to Drum point, Md. This plan was under consideration by the late David H. Moffatt, owner of the road, and it is expected it will be carried into effect by the managers of the estate. Right of way for this extension was graded several years ago from a locality six miles north of Chesapeake Beach on the line of the railroad. The building of bridges and the laying of tracks is alone necessary to complete the work of connecting Drum point with Washington by rail. To equip the Chesapeake Beach railroad with facilities for electrical operation it is estimated an expenditure of between $300,000 and $400,000 would be involved, and to extend the line to Drum point would cost about $200,000 more. These estimates do not include the cost of constructing a power house. P. W. Waters, 1416 New York Ave., Washington, D. C., is general manager.

Massachusetts.

The New York, New Haven & Hartford R. R. has entered into arrangements with the New York Central looking to an increased traffic by way of Boston & Albany junctions, and will probably in the near future perfect arrangements by which it will run its own trains with its own power over portions of the Boston & Albany lines, notably between South Framingham and Boston, between Ashland and South Framingham, between Ludlow and Springfield in connection with the projected Hampden R. R. extension of the Central Massachusetts division, and between Pittsfield and North Adams.

Michigan.

Saginaw-Bay City Railway & Light Co., Saginaw, Mich., has applied to the city council for permission to double track East Genesee Ave. from the end of the present siding near Burt Street to just north of the Michigan Central railroad crossing at Hartsuff street and also to renew the existing double track on Washington Ave. between Janes Ave. and Johnson Street. About two miles of rail is to be laid; work is to be started shortly.

The Pere Marquette RR. is reported to have decided not to construct its proposed branch from Bay Shore to Walloon Lake this year. Difficulty in securing the right of way is said to be the cause.

At the recent village election at Caledonia the ordinance previously passed by the common council giving a right of way for construction of the Grand Rapids, Hastings & Battle Creek interurban railroad through Lake st. in the village was approved by the voters.

Minnesota.

Surveys have been completed for the projected electric railroad line on the Mesaba Iron Range, to extend from Hibbing, Minn., to Gilbert, Minn., a distance of 32 miles. Construction work on this line will be started within a few weeks under charge of C. F. Thomas, C. E., 304 Alworth Bldg., Duluth, Minn. The Duluth Engineering Co., Duluth, Minn., was in charge of the surveys.

[illegible] miles of line are provided for in this season's work.

[illegible] a surveying party in the field on the Ver-[illegible] sible spurs to various properties undergoing development. W. A. Clarke, Duluth, Minn., [illegible]

Steps are being taken to raise funds for a permanent survey for an interurban line from Mankato to St. Peter. It is stated that the promoters will provide 60 per cent of the money needed to build the line, provided the remainder is raised in Mankato, St. Peter and Kasota. H. E. Hance, Mankato, is the promoter.

Mississippi.

The Chamber of Commerce of Natchez, Miss., is to again open negotiations with the Illinois Central R. R., looking toward building a loop from Natchez to Woodville, Miss., connecting with the Woodville branch, which would shorten the distance from Natchez to New Orleans about 30 miles.

Missouri.

The Chicago, Rock Island & Pacific Ry. has [illegible] for the purpose of reballasting its roadbed between St. Joseph and Topeka.

Directors of the Missouri Pacific Ry., M. L. Byers, chief engineer maintenance of way, St. Louis, Mo., have approved the expenditure of [illegible] for betterment work.

Kansas City, Mo., and Vicinity.

(SPECIAL CORRESPONDENCE.)

Dan Hannefin & Son of Marble City, Okla., were in the city this week. They were successful in securing some nice team work from the Lund Contracting Co. on the Kansas City Southern. This work lies directly out of Joplin, Mo.

W. C. Williams was a Kansas City visitor this week. He came to look over the profiles of the Kansas City Southern work with a view of securing work for his team outfit. At this writing, however, he has not signed for a contract.

Mr. Sten Lund, Pres. of the Lund Contracting Co., is much improved in health since our last report. He is now able to be around and personally conduct the assembling of his large outfit on the Kansas City Southern work. Mr. Lund's many friends join with us in wishing him a successful season's work.

Mr. C. H. Sharp is expected home about the 10th of April. Mr. Sharp has been spending a few weeks in Southern California enjoying a deserved rest.

The Kansas City Rock & Sand Co., 303 Victor bldg., Kansas City, Mo., is just opening up some extensive quarries in the east part of our city. A large Gyratory crusher will be installed shortly and the equipment is to be up to date in every particular.

J. C. Nichols, owner of what is familiarly known here as the Country Club District, is planning extensive work to be started shortly. This work will be let to contract and there will be a 100,000 yds. or more to move.

Mr. James Clarkson of the Porter Bros. Co. has returned from Chicago, where he spent several days last week. Mr. Clarkson is certainly a busy man these days arranging everything preparatory to starting the Kansas City Southern work.

Amos & Dean will do some of the team work on the Kansas City Southern under Porter Bros. Until the right of way on a certain part of the work is definitely settled, we cannot say just where their contract will be.

Dan Morris of Oklahoma City was a caller this week. It is probable the opening of the K. C. Southern work will find Dan's team outfit busy at some point along the line.

There is a well defined rumor around here, [illegible], however, that the Union Pacific railroad will [illegible] There are many facts that point to this, but we are not prepared to state at this time definitely what will be done or when.

St. Louis Items.

[illegible]

Harrington Brothers are doing a little job for the Burlington R. R. at Virden, Ill., which they expect to finish within two or three weeks. They are in the market for more work for their thirty-team outfit.

✣The Board of Local Improvements of East St. Louis announced that bids will be opened April 14 for the improvement of 38th St., from Regent Ave. to the alley between Missouri and Division Aves. and Main St. and Collinsville Ave. The two improvements are estimated to cost $18,008. The 38th St. improvement alone is estimated to cost $16,590. Notices for the public hearing on the proposition to build the Winstanley sewer, which is set for Monday, April 3, were mailed last week. The sewer will cost $280,000. Next to the outlet sewer, which will cost $710,000 when completed, this is the biggest public improvement in the history of the city.

Hannon & Hickey Brothers are making rapid progress with their work at Canal, Ill.

The Chicago, Memphis & Gulf R. R. expect to have their line completed within 60 days.

Dan Hannefin is going to do all of the rock and team work on the Lund Contracting Co.'s job on the Kansas City Southern R. R.

Grant Brothers have decided to quit contracting and are offering their outfit at Bicknell, Ill., for sale.

Montana.

Information from Miles City, Mont., is to the effect that a continuation of the plat of the proposed line of the Great Northern Ry. through Dawson County has been filed at that place. Last year the company filed a plat covering the right of way from Mondak, north of the Missouri River, in Valley County, to Circle, on the Redwater, in Dawson County, the route being briefly, across the Missouri from Mondak south to connect with the Northern Pacific near Ridgelawn and thence the N. P. tracks are used to Newlon, and from Newlon the new route runs variably westward to Circle. The plat just filed takes up the line at Circle, in township 19N., 48E., and parallels the Redwater southwest to Dirty Creek, thence it runs west along Dirty Creek, leaving it at the head and strikes Timber Creek in section 19, township 18N., 44E., and passing near King Gibb's old place, strikes the Big Dry at its junction with the Little Dry. Thence it continues on the north side of the Big Dry, passing through the town of Jordan and thence southwest to the old "79" ranch, which marks the terminus of the present filing. The "79" ranch is close to the 60 miles limit of the N. P. grant and near the east line of range 34 east.

Nevada.

It is reported in Goldfield, Nev., that the Lida Valley RR.Co. has succeeded in financing its proposed 25-mile line and that work will be started shortly from a point near Cuprite to Hornsilver. A. D. Goodenough is the promoter of the enterprise.

New Jersey.

The Morris R. R. Co. has been incorporated and is to locate a route from a steam railroad between Morris St., Morrstown, and Davenport Road, Florham Park, a distance of three miles. This road will be leased to the Morris County Traction Co., Morristown, N. J., which has taken this means of securing right of way for its proposed new trolley line between Morristown and Madison. The incorportors of the Morris R. R. Co., include John L. Desch, chief engineer of the traction company.

New York.

⦿Raymond M. Booth, Albany, N. Y., has been awarded the mason work for the new shops of the Delaware and Hudson Co. at Watervliet. The company will spend between $1,000,000 and $2,000,000 for their shops. Mr. Booth will erect a locomotive repair shop, brick, 386 ft. by 510 ft., two stories and gallery in height; a freight car repair shop, 103 ft. by 266 ft., two stories high; a storehouse, three stories and basement, 6- ft. by 160 ft.; iron foundry, one story, 93 ft. by 180 ft.; hammer house, one story and gallery, 68 ft. by 158 ft.; planing mill, one story, 68 ft. by 180 ft.; truck house, one story, 68 ft. by 92 ft.; power house, one story, 70 ft. by 130 ft.; round house terminal with 30 stalls. As soon as the frost is out of the ground work on this mason and concrete job will be begun and hurried to completion. A. P. Appler, Green Island, N. Y., is mechanical engineer, Delaware & Hudson Ry.

The Black River Traction Co., Watertown, N. Y., has placed an order for $20,000 worth of rails. The company intends to replace the 70-lb. rails now in use in State and Court streets, with 110-lb. rails in order to improve the roadbed in those streets.

North Carolina.

Steps are being taken at Greenville, N. C., to raise $200,000 to secure the extension of the Greenville & Knoxville RR. W. H. Patterson, president, Atlanta, Ga., across the Blue Ridge mountains, giving Greenville a direct connection with Knoxville. By the terms of the proposition the $200,000 will not be required until the road is built to Brevard, N. C.

The Chamber of Commerce of Elizabeth City, N. C., is taking steps to secure the construction of a branch line of railroad from Beckford Junction to Gatesville, the county seat of Gates county. It is understood that a survey has already been made from Beckford Junction to Gatesville and that the route has been found to be a feasible one. The line would go through a village called Merchants' Mills, and would terminate at Gatesville.

North Dakota.

Surveys for the Dakota Midland R. R., a Chicago, Milwaukee & St. Paul proposition, have been completed from Jamestown to Devils' Lake, N. D. From Devils Lake the line will continue north and east to Winnipeg.

The Minneapolis, St. Paul & Sault Ste Marie Ry. has engineers in the field making surveys toward Devils Lake, N. Dak., from Edgeland. It is said to be the plan of the Soo to extend the Brumbaugh branch north into Canada, and south from Edgeland to Devils Lake and possibly to Kensel where connection will be made with the main line of the Soo for the Twin Cities.

Officials of the Commercial Club of Minot, N. D., are reported to have received definite assurances that the Grand Trunk Pacific R. R. will run a line into Minot to connect with the Minot-Fargo cut-off of the Great Northern, which has been practically constructed and will be completed this summer. It is stated that the Grand Trunk will come into Minot via the Berthold-Crosby line of the Great Northern.

The Chicago, Milwaukee & Puget Sound Ry., according to reports from Fargo, N. Dak., has resumed plans for the construction of the proposed line from that city to Hutchinson, which, it is believed will be used as a connecting link with Winnipeg, Man.

The Northern Pacific Ry., according to reports, will extend its branch from Esmond to Towner.

Among the reports in circulation concerning the proposed extensions of the Milwaukee System is that the officials are contemplating the building of a line northward from Brisbane, N. Dak., to Almont and thence to the northwest to Canada.

Ohio.

If the present plans of the Underground Rapid Transit Co. of Cleveland go through work will be commenced in July on a subway in that city which will connect the public square with the Nickel Plate depot at Broadway.

The Lake Erie & Western RR. has closed a contract with the Bluffton Stone Co. at Bluffton, Ind., by which the latter will fur-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

nish stone for the [illegible] of the company's entire trackage from Fremont, O., to Peoria, Ill. It will take about four years to complete the contract. Fifty carloads of crushed stone a day will [illegible]

New York capitalists are reported to have financed the Lorain & Ashland RR., and it is understood that construction work will be resumed this summer. At the present time the track is laid as far as Wellington. Ties are laid, and the roadbed is prepared as far as Lorain. The road will run through Oberlin and Wellington and to Ashland. This road was projected by Joseph Ramsey, Jr., of New York City, [illegible] ago.

The Hills & Dales Ry. Co., of Van Buren Township, Montgomery County, O., has been chartered with a capital stock of $25,000 and proposes to build a street railway. The incorporators are [illegible] P. Matthews, Clayton, O.; Shupert, Albert C. Rice and O. J. Emrick.

It is possible that construction work may be started in August on eliminating the Ludlow Ave. grade crossing at Cincinnati. Practically all the conditions in the form of an agreement submitted to the B. & O. R. R. officials relative to the crossing elimination were accepted by the railroad at a recent conference held in Baltimore.

The city of Cleveland is negotiating for the elimination of all of the West Side grade crossings of the Nickel Plate between W. 96th-st. and Fulton-rd. If the scheme can be broadened to this extent, 26 grade crossings will be abolished instead of two, as originally planned.

The Cleveland, Alliance & Mahoning Valley R. R. Co. of Cleveland, has filed amended articles of incorporation showing an increase of capital stock from $10,000 to $2,500,000.

Oklahoma.

The Muskogee Electric Traction Co., operating the city street car system at Muskogee, has entered into a contract with the recently chartered Peoples' Interurban Electric Ry. Co., for the construction of a line from Muskogee to Gibson, a distance of ten miles. The traction company will operate its cars on the new line which is being promoted by ex-Gov. Charles Haskell, of Muskogee.

Surveys have been started for a proposed electric railway for Tishomingo to the Devils Den. It is proposed to complete the line by Oct. 1, and later to extend it to Denison, Tex. Business men of Tishomingo are financing the project.

William Kenefick of Kansas City, builder and president of the Missouri, Oklahoma & Gulf line, and former Gov. Charles N. Haskell of Muskogee have made a proposition to the stockholders and promoters of the Denver, Kingfisher & Gulf for the latter company's interests, including right of way, bonuses and other property, and charters for building a road northwest from Oklahoma City through Kingfisher, Okeene and Woodward into the Texas Panhandle country. The Denver, Kingfisher and Gulf, which was chartered several years ago, follows practically the same route as was mapped out for the state-built railroad, for the construction of which a bill was introduced in the recent legislature. The bill failed to carry however, and it is understood that the state project has been abandoned.

Oregon.

The city council of Prineville has granted a franchise to the Prineville & Eastern RR. Co. The Prineville & Eastern Company is said to be negotiating with the Hill interests to sell the franchise and rights of way for a branch line from Metolius to Prineville.

A statement reported to have been made by W. H. Bancroft, Vice President and General Manager of the Oregon Short Line Ry., is to the effect that construction work will start at once on that section of the Owinza branch extending from Richfield, Idaho, to Camas Prairie and it is the intention of the company to push it through to completion.

Residents of Lakeview, Ore., and vicinity are of the opinion that work will be started [illegible] on the pr[illegible] line from that city south through Alturas, Cal., to a junction with the proposed road from Fernley, Nev., to Klamath Falls. The work is to be done under the direction of the Nevada-California-Oregon.

Twohy Bros., Marble Bank Bldg., Spokane, Wash., have started work on their contract for double tracking and reconstructing the Oregon-Washington R. R. & Navigation Co. main line between Deschutes and Blalocks, a distance of 29 miles, and it is hoped to have it completed by June 30, the end of the present fiscal year. Considerable grading will be necessary to make room for the second set of rails and in some places the contract calls for the construction, virtually, of an entire new double-tracked road. Plans prepared by George W. Boschke, chief engineer of the O. W. R. & N. Co. construction department, call for the elimination of much curvature and many noticeable grades from one end of this contract to the other. As a whole the new line will not follow the Columbia River as closely as the old, seeking a straight course rather than the banks of the stream. Most of the work for the next few weeks will be done on the west end of the project. Camps will be established later at points farther east. Construction work along part of this route will be somewhat slow, as the lava rocks and sand hills combine to form many miles of difficult track building. With the completion of this project and those now under way the O. W. R. & N., main line will be double-tracked all the way to Stanfield, with the exception of a stretch of 47 miles between Bonneville and The Dalles and a piece 36 miles in length between Blalocks, Ore., and Coyote.

A crew of surveyors under direction of G. H. Cumberland, Assistant Engineer of the Oregon Short Line with headquarters at Salt Lake City, Utah, and D. H. Ashton, Constructing Engineer, is retracing a line for the Buhl-Nyssa extension from Nyssa to Homedale and will cross section this line in a short time. Maney & Wells Bros., contractors, are in Nyssa, Ore., to take up the work of construction as soon as contracts for grading are let. The new line will join the O. S. L. track at Nyssa about three blocks south of the depot. This line will open up a large irrigated territory.

Pennsylvania.

Stockholders of the Pennsylvania R. R. at an election on March 28 voted in favor of increasing the capital stock from $500,000,000 to $600,000,000. It was announced that only $40,000,000 of the $100,000,000 increase will be issued for the present. Of this $18,000,000 will be added to an authorized stock balance of $22,000,000 already on hand, making $40,000,000 to be devoted to the purchase of equipment and for the construction, improvement and expansion during the year.

The Tarentum, Brackenridge & Butler Street Ry. Co. has been chartered with a capital stock of $100,000 and proposes to build two miles of line. The officers of the company are: President, McKinstry Griffith; directors, Otto Sontam, J. M. Griffith, C. H. Battey and F. Flaggenmeier, Tarentum; C. N. Schad, Saxonburg, and J. C. Smith, Brackenridge.

South Dakota.

Advices from Pierre, S. Dak., state that the Chicago, Sioux Falls and Pacific Ry. Co., a corporation backed by Sioux Falls, S. Dak., men to build a railroad from that city to Rapid City by way of Wheeler, crossing the Missouri River, has increased its capital stock from $6,000,000 to $60,000,000.

Grading work for the extension of the Chicago & Northwestern R. R. from Colome to Winner, has been resumed after having been suspended all winter, and will be completed so that track laying can be started this month.

The South Dakota Central Ry., now operating 103 miles of line between Sioux Falls and Watertown, is reported to be planning to build an extension this summer. The road has outstanding bonds of $7,500 per mile, and it is understood that it is planned to replace these bonds with new ones of $15,000 per mile, and use the surplus derived therefrom in extending the new road to new and unoccupied territory. G. W. McArthur, Sioux Falls, S. Dak., is general manager.

Tennessee.

⊙Dunavant & Co., Knoxville, Tenn., have been awarded a contract for the grading work for a new line from Lookout Mountain to Wauhatchie for the Nashville, Chattanooga & St. Louis RR. The contract is said to amount to about $250,000.

⊙H. C. McCrary, Knoxville, Tenn., has started work on his contract with the Southern Ry. for opening up the large cut at Summit. This cut caved in last December and the McCrary contract calls for not only clearing the cut but also for making it considerably wider.

It is now reported that the Louisville & Nashville RR. instead of double-tracking the present line from a point just north of Nashville on down to Decatur, Ala., is considering building a line somewhat to the east of the present line south of Nashville. It is said that no change will be made in the proposed "cut-off" to relieve congestion of going through the Nashville terminal yards with through freight business. The cut-off will start at Edgefield Junction or Madison and will cross the river east of Nashville and go straight on to Brentwood. Here it will cross the L. & N. and then re-cross it and go off to the south, and then southwest a bit. The new line, it is reported, will pass seven miles east of Franklin, 15 miles east of Ewell Station, 18 miles east of Columbia and will enter Lewisburg. It will go from Lewisburg to Athens, Ala. Among other points it will enter besides Lewisburg are stated to be: Carpenter's College Grove, Brick Church, etc., Nolensville, Clovercroft, Rock Hill, Arrington, Triune, Chapel Hill and Verona are in or near the proposed route into Lewisburg. South and southwest of Lewisburg between that point and Athens, Ala., are a large number of towns and villages that have no railroad now, being at present between the main line of the Louisville & Nashville and the branch of the Nashville & Chattanooga that runs from Columbia to Decherd. From the junction to Athens, Ala., the survey makes a line of 95 miles, and it is said the cost per mile will be about $35,000. The prospect of double tracking is said to have been abandoned on account of the expense, and again because the new route opens up new and valuable territory.

Regarding the proposed extension of the Tennessee Central R. R. from Hopkinsville to Paducah, a distance of 40 miles, we are advised that this extension is not contemplated at the present time; in fact it is not thought that any Tennessee Central extension to Paducah will be made in the near future.

Texas.

The Stone & Webster Engineering Corporation 147 Milk St., Boston, Mass., is reported to be planning to build an interurban line from Douglas to Waxahachie to be in active operation by the fall of 1911. The line is to be approximately 30 miles long and will cost about $1,000,000. The line will be built to a connection with the lines of the Northern Texas Traction Co. at Oak Cliff. The Stone & Webster Corporation controls the Dallas Consolidated Electric Street Ry. Co. of Dallas, but it is understood that the new line will be entirely independent of the Dallas lines. E. T. Moore, Dallas, Tex., is representative of Stone & Webster.

The Aransas Terminal RR. Co. has grading work underway at Aransas Pass, for its line from that place to the deep water harbor five miles distant. The Aransas Terminal RR. has secured two thousand feet of the harbor frontage while the Aransas Pass Channel and Dock company has secured 2400 ft. of frontage, extending back into the island for a distance of 4000 ft.

Alexander Brown & Sons of Baltimore, Md., have secured [illegible] the harbor [illegible] Aransas [illegible] [illegible] miles from the mainland towards the harbor, and permission was recently granted to [illegible] & [illegible] canal.

Engineers of the Houston & Texas Central R. R. have been surveying a line from Stone City [illegible] to Giddings. The purpose is thought to be an extension of the Hearne & Brazos Valley from Stone City to Giddings. At Giddings it is proposed to use the tracks of the San Antonio & Aransas Pass to Flatonia, where the San Antonio line of the Southern Pacific is intersected. This would give the Houston & Texas Central a much shorter line from the north and west.

The Sunset-Central lines, T. Fay, general manager, Houston, Tex., have placed an order for 185 miles of new 90-lb. rails, delivery to commence shortly after July 1. Eighty miles of this is intended for the Sunset-Central lines, 105 miles for the Houston & Texas Central and the Houston East & West Texas in replacing the rails now in the track. The 90-lb. rails for the Houston & Texas Central will be laid in the track of the main line, and the rails thus supplanted, which are good 75-lb. rails, will be used on the Waco branch. When this work is finished and the work now in progress on the line between Hempstead and Austin is completed, the Houston & Texas Central will have heavy rails on all its lines, excepting that branch between Austin and Llano. The rails there are only 60-lb. in weight, but they are in good condition and the track is well ballasted so that no change is needed there for the present.

Roach & Stansell of Memphis, Tenn., have been awarded a contract for grading 20 miles of the 56-mile gap on the Kansas City, Mexico & Orient R. R.'s right-of-way between San Angelo and Fort Stockton, 160 miles southwest.

The Nacogdoches & Southeastern R. R., H. W. Whiter, manager, Nacogdoches, Tex., is considering building a 4-mile extension to Chireno.

The American Central Rys. Co., with executive offices at 60 New St., New York City, is planning the construction of a north and south railway through certain portions of Western Texas and Western Oklahoma, with an ultimate terminus at the Gulf of Mexico. It will probably be several months before any work is started. Surveys for the first 200 miles have been completed and it is hoped to start construction work sometime during the coming summer. Geo. W. Angle, 60 New St., New York City, first vice president and chief engineer.

The Southwestern Traction Co. of Temple has been chartered with a capital stock of $165,000 and proposes to operate an interurban between Temple and Belton and also to operate lines within each city. The incorporators are A. F. Bentley, P. L. Downs, W. S. McGregor, W. G. Haag, W. G. Bentley.

The following minor improvement work is planned by the Texas lines of the Santa Fe System: Extending the passing track at Rogers at an estimated cost of $8,700; constructing a team track at Rosenberg, at an estimated cost of $2,700; extending the passing track at [illegible], at an estimated cost of $3,700; extending the passing track at Caldwell, at an estimated cost of $7,360; extending the passing track at Rogers, Tex., at an estimated cost of $8,700; track changes at Dallas, to cost 2$4,400; replacing the wooden water tank at Justin, Tex., with a steel tank, at an estimated cost of $6-000; track changes at Waco, to cost $1000, constructing two Otto water cranes and pipe lines at McGregor, Tex., to cost $7,300; expending $15,000 for tie plates to be used between Blum and Cleburne, on the Southern Division, and $50,000 for tie plates between Cameron and McGregor, Tex.; constructing an undercrossing at 9th St., Fort Worth, to cost $15,000; constructing a steel tank, water cranes and pipe lines at Kopperl, to cost $1,000; constructing a frame autogenous welding plant and the necessary track at Cleburne, to cost $2,400; widening the embankment and cuts to receive ballast between mile posts Nos. 29 to 92, Galveston Division, to cost $60,000; reducing the grade between mile posts Nos. 20.95 and 22.32 E. of Silsbee, and replacing bridge No. 33 and filling bridge No. 31, to cost $9,000.

The Atchison, Topeka & Santa Fe R. R., it is reported, will expend about $1,000,000 in improvements at Port Bolivar, Texas.

It is understood that the Santa Fe System is planning to build a cutoff from Dodge City across the southwestern Kansas and the Panhandle to Colmer, N. Mex., connecting there with the main line. The proposed cutoff would pass through Gray, Haskell, Grant, Stanton and Morton Counties and through the towns of Santa Fe, Ulysses and Richfield.

The town of Georgetown, Texas, has accepted the proposition of L. E. Walker, President and promoter of the Dublin, Seymour, Quanah & Rockport Ry. and paid $1,500 for the survey of the projected line from Garrell to that place.

Work has been completed on the line of the Crosbyton-South Plains R. R. extending from Lubbock to Crosbyton, Texas, and it is the general opinion that an extension from the latter city to Spur to connect with the Stamford & Northwestern giving Lubbock, Texas, an eastern connection.

Utah.

A charter has been granted the Eastern Utah R. R. to build a 60-mile line connecting Wellington, Carbon County and Emery County, Utah, tapping one of the richest sections in Utah. It is understood that the route to be followed is partly surveyed, the work having been done many years ago by the Rio Grande Western for the Saline cutoff.

Grading work has been commenced between Lund and Iron Springs for the proposed line of the Utah & Grand Canyon R. R.

Vermont.

The Grand Trunk Ry., H. G. Kelley, chief engineer, Montreal, Que., has opened an office at Bellows Falls, Vt., for the engineering work for its new line from Windsor, Vt., to Brattleboro, Vt. Location surveys are now underway and the offices will be maintained at Bellows Falls until the construction contract is let. This new line will be 40 or 50 miles long, and will require several bridges.

Virginia.

Surveys have been practically completed from Ashland to Washington for the extension of the electric railway of the Richmond & Chesapeake Bay Ry. Co., Wm. Northrop, General Manager, Richmond, Va.

A meeting of the stockholders of the Chesapeake & Ohio Ry. Co. is to be held in Richmond on April 29 for the authorization of an issue of $125,000,000 5 per cent, 20-year mortgage bonds. It is said that the bonds will be sold to retire outstanding general funding and improvement bonds, amounting to $11,000,000, and to pay certain outstanding equipment obligations. The amount remaining is to be used for betterment and improvement and the acquisition of additional lines and terminals.

Washington.

At a mass meeting held at Selah it was voted to ask the Yakima Valley Transportation Co. (electric), North Yakima, Wash., to extend its lines into the valley in the vicinity of Selah.

The Chehalis & Cowlitz R. R. Co. has secured about 13 miles of right of way for its proposed railroad tapping the timber belt east and south of Chehalis. Over $75,000 of subscriptions for the road were secured in Chehalis in one day. The road will be operated by steam but later electric power will be used. H. C. Coffman and George A. Robinson, Chehalis, are the promoters.

The Springdale & Long Lake R. R. Co. has been incorporated by officials of the Washington Water Power Co. and will build a steam road 21 miles long between Springdale and Long Lake, where the power company is constructing a large power house. The company plans to have the road in operation by Sept. 1. It will be used to convey materials and machinery to the new power plant. D L. Huntington, Spokane, Wash., is president of both companies.

Dr. P. H. Carlyon of Olympia has applied to the city council of that city for a franchise for a belt line railroad over the Olympia waterfront. Carlyon is at the head of the company which now has a dredger at work filling in the entire waterfront, and it is believed that the asking for the franchise in reality means that a new railroad is about to enter Olympia. If the franchise is granted every factory on the waterfront, located on the new fill, will in addition to being able to ship by water have direct rail connections.

Information received from Spokane, Wash., is to the effect that active construction work will be started soon by Bates & Rogers, Old Colony Bldg., Chicago, Ill., on the Milwaukee R. R. in that city. A. G. Holt, Division Engineer, has announced that the first work will be that of tunneling from Division to Sherman street and the subsequent building of an abutment along the bank of the Spokane River near the gas works. By taking this route along the shore of the river the Milwaukee will have no bridges to build and will stay on dry land until they reach the Oregon-Washington R. R. & Navigation Co.'s main line west of Napa St. From Napa St. east to Dishman's the Milwaukee will run over the Harriman line tracks, and then branch off to Coeur d'Alene and Plummer.

The Oregon R. R. & Navigation Co. has formally opened the recently completed branch between North Yakima and Walla Walla, Wash. The new road which forms a link in the Harriman System will assist in the development of the Great Yakima Valley.

Officials of the Northern Pacific Ry. have announced that the company will, during this spring and the coming summer, entirely rebuild the South Bend branch from Chehalis, Wash., to South Bend. The work it is believed, will necessitate an expenditure of thousands of dollars.

Wisconsin.

The Milwaukee Western Electric R. R., J. W. Barber, secrtary, Milwaukee, is to build a 1½ mile spur from the proposed main line of the road to the stone quarries at Lannon, Wis. Citizens of the town have offered to stand the initial expense of grading and laying the branch line.

The Wausau Street Ry Co., Wausau, Wis., has authorized the construction of several extensions in that city.

The Interstate Transfer Ry. Co., according to reports from Superior, Wis., is planning to complete that section of the belt line between Pokegama Junction and Omaha tracks, south of Itasca this season. In addition to grading about eight miles of right of way and laying the necessary steel, there will be a $750,000 bridge constructed across the Nemadj river. There are also several other streams of considerable size to be crossed.

Negotiations are underway for the sale of $200,000 bonds for the completion of the railroad from Prairie Farm to Emerald. The projected length of the road is about 20 miles and nine miles have already been completed. George E. Scott, Prairie Farm, Wis., is president.

Canada.

✣Bids are asked by Frank L [illegible], Division Congress Canadian Pacific Ry., Winnipeg, Man., for the following pieces of work: Freight shed extension, upholstering shop, boiler shop, and transfer table, Winnipeg, and for freight office, Fort William. Plans, specifications, and forms of proposal can be seen at the office of the division engineer, Winnipeg, and those for freight office, also at superintendent's office, Fort William. Bids must be delivered at the office of the Division Engineer at Winnipeg, by noon on following dates: Transfer table and boiler shop, 10th

April, freight shed [illegible] and upholstering shop, 8th April; [illegible] freight office, Fort William, 5th April.

⊙The Grand Trunk Pacific Ry., B. B. Kelliher, chief engineer, Winnipeg, Man., has awarded extensive [illegible] to J. D. McArthur, Winnipeg, Man., and Foley, Welch & Stewart, St. Paul, Minn. The McArthur contract calls for the construction of branch lines; Foley, Welch & Stewart will be engaged in work between Prince Rupert and Edmonton, doing grading at both ends. The following branch lines are to be constructed:

	Miles.
Calgary branch	14[illegible]
Battleford branch	[illegible]
Melville-Regina branch	68
Alberta coal branch	68
Regina-Boundary branch	110
Moose Jaw branch	[illegible]
Prince Albert branch	72
Biggar to Calgary	50

In addition to this work on the branch lines, it is expected that [illegible] miles of new work will be done on the main line. On the line west from Edmonton there will be built 165 miles, and on the line east from Prince Rupert 100 miles will be built. On the branch lines the road into Calgary will be completed. At the present time there has been built of this branch 80 miles. The balance comprises 143 miles. Connection with Battleford will be made through the construction of a line from Ohan north. The line into Regina from Melville on which work has been done for the past two years will be completed. In the far west a line will be built into the coal fields from Bickerdike and will be known as the Alberta coal branch. In southern Saskatchewan two lines will be built, one from Regina to Moose Jaw, and one from Regina to the international boundary. On the latter grading was done last year, but the former projcet is one on which nothing has yet been done. Farther north in Saskatchewan work will be done on two lines, on the road from Biggar to Calgary and on the road from Young to Prince Albert. On the former 50 miles will be built, and on the latter 72. In connection with the construction of these lines it will be necessary to do important bridging. Among the rivers which are to be crossed are the Skeena, the Athabasca, the Red Deer, and the Prairie Creek. The total cost of the construction of these lines is stated to be in the neighborhood of $17,000,000.

⊙Tobin & Larson have been awarded the contract for building 14 miles of railroad from Beaver Creek to Pincher Creek, Alberta. This is the first railroad into the district, but it is said that three other lines are to be built later.

⊙The Canadian Northern Ry. is planning for a busy season, and already has engineering parties in the field running lines and laying out work ready for the graders; the contractors are also busy organizing their forces to commence work as soon as the weather permits. Among the firms which have already secured large contracts are the Northern Construction Co., Union Construction Co., McMillan Bros. and Kenny, and M. McCrimmon. It is understood that further contracts will be awarded in the course of a few days. It is expected that between 300 and 400 miles of new grade will be completed this year on the main line, and between 400 and 500 miles on various branch lines, in addition to which a large amount of work will be done on existing lines, ballasting [illegible] relaying with heavier steel.

City council of Brandon, Man., has adopted a resolution to hold a special election to authorize an issue of city of Brandon debentures in the sum of $300,000, for the purpose of the construction of an electric railway system in the city of B[illegible].

It is stated that the government engineers have reported against the proposed railroad into the Gowganda mining division, and that this projected branch of the Temiskaming & Northern Ontario Railway will not be built.

The Railway Committee of the House of Commons has favorably reported the bill extending the time for the construction of the Quebec & New Brunswick R. R. Co., which proposes to build a line of railway from Levis to St. John. It was agreed that the capitalization of the company be increased from $900,000 to $2,000,000.

Engineers of the Canadian Pacific R. R. are now preparing a route which will give that road an entrance into the downtown section of London, Ont. At present the company's station and freight sheds are in the north end. To secure a downtown station the company plans to build from Pottersburg to the city, and connect with the Pere Marquette, which has running rights into the Grand Trunk station. All the big factories are at the south end of the city in the district in which the Canadian Pacific Railway spur is proposed.

The Grand Trunk Ry. has ordered 40,000 tons of steel rails from the Sydney, Cape Breton mills, to replace 260 miles of its tracks in Western Ontario. The company will ship 209 miles of the displaced track to the West for yards and sidings on the Grand Trunk Pacific. Some of these rails have been in use since 1869, having been imported from England.

From now on it will be [illegible] between the Grand Trunk Pacific and the Canadian Northern R. R. to make the first connection with tidewater on the Pacific. Two years ago the Grand Trunk Pacific and the Canadian Northern were battling for primary location of route through Yellowhead Pass in the Rockies. The Grand Trunk Pacific won out, but the year following the Canadian Northern beat the Grand Trunk to [illegible] location [illegible] North Thompson river into Vancouver. With the Canadian Northern building its line to Vancouver via the North Thompson, and the Grand Trunk Pacific heading for its terminals at Prince Rupert via Fort George, both railways are plunged into a keen race for the first completed grade through to the Pacific. West of Edmonton, which is the base of this race, the Grand Trunk Pacific has 200 miles of grade completed, while the Canadian Northern has only 40. From the Pacific end, the Grand Trunk Pacific has 150 miles of grade completed to the Canadian Northern's 70. For the past two years the Canadian Northern has not been doing much grading on its main line west of Edmonton. With the Grand Trunk Pacific rails laid within [illegible] miles of its proposed route, almost parallel for the whole distance west to the mountains, and with the advantage of being able to ship in supplies and outfits by [illegible] construction camps, the Canadian Northern will concentrate its greatest construction efforts of the undertaking of rushing its main line through. The Canadian Northern will also undertake to complete, ready for the steel, exclusive of the bridges, 400 miles of main line grade every year until its line is completed to the Pacific coast. The Grand Trunk Pacific is building its lines in 100 mile stretches, while the Canadian Northern is building its in 200 mile stretches, building 200 miles from each end of the line. With the completion of the 200 miles contract west of Edmonton, the line will reach the Athabasca river in the mountains, while the 200 mile contract out of Vancouver will carry the line to Kamloops. With the completion of the 400 miles next year, this will bring the two ends of the line within about 300 miles of each other, and in the next year, which will be 1914, the whole line should be finished whereby the east should be connected with the west by the Canadian Northern Ry.

The Lake Erie & Northern Ry. Co. has been incorporated in Canada to build a line from Port Dove on Lake Erie, to Paris, with a branch from Paris to Glenmorris and Ayr. The company is authorized to issue securities to the extent of $30,000 a mile and is also authorized to build and operate telephone and telegraph lines in its territory and to operate steamships on Lake Erie and to develop water powers.

It is reported in Montreal, Can., that a second railway will be constructed between Levis and Moncton. Thomas Malcolm has, it is understood, acquired the charter of the Quebec and New Brunswick Ry., and contemplates building from Levis to St. Leonard's, a distance of 174 miles. From St. Leonard's the road will run to Grand Falls, a distance of 12 miles, and thence to Woodstock, 74 miles. From Woodstock it is 62 miles to Fredericton, and another 20 miles will take the road into St. John. It is rumored that the road would be constructed in the interests of the Canadian Northern.

Mexico.

The National Railways of Mexico, Jas. M. Reid, chief engineer, City of Mexico, is assembling large quantities of material at Tamos, a station on the Tampico-San Luis Potosi division, 25 miles from Tampico, preparatory to resuming the work of constructing the Tampico-City of Mexico Short Line of the government merger system. This road was started by the Mexican Central about five years ago, about 25 miles of grade and track being finished. When the Mexican Central was acquired by the government and was merged into the National Railways of Mexico construction was suspended. As surveyed, the proposed new line will start at Tamos and follow an almost direct southerly direction through Ozu-Juama down to within about 24 miles of the port of Tuxpan, thence running east to that place. From this point where the turn to Tuxpan is made the main line will continue south through the State of Vera Cruz to Anita, where it will connect with the present branch line of the National Railways of Mexico that runs to the City of Mexico. From Tuxpan a branch line will be built down the gulf coast to a connection with the Mexican Southern R. R. at Salmoral. This branch will pass through the gulf port of Nautla, which is at present isolated and undeveloped.

ROADS, STREETS AND PAVEMENTS

Arkansas.

The Johnson county commissioners, Clarkeville, Ark., have engaged Civil Engineer W. A. Reams, of Fort Smith, Ark., to make a survey for the good roads improvement in the county. The survey has been started at the west line of Spadra township through Hartman and Coal Hill to the west line of the county. [illegible] the [illegible] east line [illegible] will be laid out.

California.

✣Bids will be received until April 11 by the County Board of Supervisors, Eureka, Cal., for the construction of road 8,240 ft. long from Ferndale side of the new county bridge on Eel River to Clausen's corner.

The California state senate, Sacramento, Cal., has passed two measures making appropriations for roads in Nevada and Placer counties, aggregating $20,000, to be expended during the next two years. The first is for the maintenance of the state highway from Emigrant Gap, Placer county, over the summit in Nevada county, to Donner Lake, Nevada county. The appropriation amounts to [illegible] improvement of the Lake [illegible] road, a state highway. The improvement is in the nature of repair to bridges and restoration of washed out places.

Petitions are being circulated in Los Angeles, Cal., asking that the city council attend to the repairing of that part of Anaheim road between Long Beach and Wilmington, which lies inside the corporate limits of Los Angeles.

The Assembly, Sacramento, Cal., has amended a bill calling for an appropriation with which to purchase the Big Oak Flat and Yosemite turnpike road, a toll road leading from Big Oak Flat in Tuolumne county to the Yosemite Valley. The bill, as amended and placed on file, calls for an appropriation of $10,000 by the state. The road would shorten the distance into the Valley and benefit tourists.

San Joaquim county, Stockton, Cal., county seat, is making very good headway on road work under the $1,890,000 bond issue of that county. Of the 238 miles of road planned, 100 miles are completed, or under construction. The bonds are being sold as the work progresses, so far $700,000 worth have been disposed of, and the supervisors will dispose of $500,000 more during April.

Colorado.

The Rainbow Route association, Pueblo, Colo., has decided to ask the legislature, Denver, Colo., for an appropiation of $50,000 to be used to complete the Rainbow highway from Pueblo to the Utah state line.

District of Columbia.

✣Bids will be received until 11 a. m., April 18, by H. L. Pettus, Quartermaster, Washington, D. C., for work of resurfacing the road way at the Salisbury, N. C., National Cemetery.

Georgia.

The city of Macon, Ga., will soon sell bonds to the amount of $900,000 for the construction of good roads.

Illinois.

✣Bids will be received by the Board of Local Improvements, C. A. V. Standish, Secretary, Chicago, until 11 a. m., April 10, for constructing Portland cement concrete sidewalks as follows: 6 ft. sidewalk on both sides Albany Ave., Addison St. to Elston Road, 150 sq. ft. to be built, average fill 1.0 ft., assm't price 15½ cts.; Carroll Ave., N. Ann St. to N. Ada St., 6,000 sq. ft. (6 ft. wide) to be built, average fill 1.0 ft., 1,000 lin. ft. of cut average 1.0 ft., assm't price 15½ cts.; W. side Drew St., W. 106th St. to W. 107th St., 3,200 sq. ft., 6 ft. wide, average fill 1½ ft., assm't price 17 cts.; both sides W. 15th St., S. Canal St. to S. Union St., 4,700 sq. ft. 4 ft. wide, average fill 2.0 ft., assm't price 53 cts.; E. side N. 43rd Ave., Wrightwood Ave to Greenwood Terrace, 540 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 17½ cts.; W. 59th St., S. Ashland Ave to P. C. C. & St. L. Ry., 5,700 sq. ft., 6 ft. wide average fill 1.0 ft., assm't price 17½ cts.; N. Francisco Ave., both sides, Grace St. to Waveland Ave., 300 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; both sides N. Francisco Ave., Irving Park Blvd. to Byron St., 150 sq. ft. to be built, 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; Grace St., both sides, N. Mozart St. to N. Francisco Ave., 750 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; both sides Houston Ave., E. 96th St. to E. 98th St., 11,000 sq. ft., 6 ft. wide, average fill 1.0 ft., 400 lin. ft. of cut, average .9 ft., assm't price 15½ cts.; So. Leavitt St., W. side 35th St. to 37th St., 3,000 sq. ft., average fill 1.0 ft., assm't price 15½ cts.; Lowe Ave., both sides, W. 35th St. to W. 36th St., 300 sq. ft., 6 ft. wide, average fill 1½ ft., assm't price 15½ cts. per sq. ft.; N. Mozart St., both sides, Grace St. to Waveland Ave., 2,000 sq. ft., average fill 1.0 (cinders), assm't price 17 cts.; N. Mozart St., Irving Park Blvd. to Byron St., W. side, 150 sq. ft. 6 ft. wide, average fill 1.0 ft. (cinders), assm't price 17 cts.; W. 103rd St., N. side, Union Ave. to S. Sangamon St., 1,200 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 17½ cts.; W. [illegible] St., both sides, Halsted St. to S. [illegible] St., 500 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; South Park Ave., both sides, 500 sq. ft., 6 ft. wide, E. 67th St. to Anthony Ave., 700 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; S. State St., E. side, 770 ft. N. of 107th St. to E. 110th St., 3,300 sq. ft., 6 ft. wide, average fill 1.0 ft. assm't price 15½cts.; W. 34th St., S. side S. Robey St. to S. Leavitt St., 4,000 sq. ft., 6 ft. wide, average fill 2.0 ft. (cinders), assm't price 19 cts.; Throop St. both sides, W. 99th St. to W. 100th Pl., 3,500 sq. ft., 6 ft. wide, average fill 1.0 ft. (cinders), assm't price 17 cts.; W. Van Buren St., S. Center Ave. to S. Throop St., 600 sq. ft., 12 ft. wide, average fill 1.0 ft., 50 lin. ft. cut, average 1.0 ft., assm't price 15 cts.; Vincennes Road, W. side, W. 95th St. to a line 434 ft. S. W. of W. 97th St., 11,000 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; N. Western Ave., both sides, Byron St. to Roscoe St., 12,000 sq. ft., 6 ft. wide, average fill 2.0 ft., assm't price 19 cts.; N. Whipple St., both sides, Addison St. to Elston Ave., 360 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; Belle Plaine Ave., S. side, Kedzie Ave. 71 ft. W., N. Kedzie Ave., Belle Plaine Ave. to 1st alley N., 120 sq. ft., 6 ft. wide, average fill 1½ ft., assm't price 17½ cts.; Berwyn Ave. S. side, N. Sawyer Ave. to Phinney Ave., Foster Ave., N. Kedzie Ave. to N. Sawyer Ave., N. Sawyer Ave., Balmoral Ave. to Foster Ave., N. Spaulding Ave., Berwyn Ave. to Foster Ave., Phinney Ave. to Catalpa Ave., 2,400 sq. ft., 6 ft. wide, average fill 3.0 ft., assm't price 9½ cts.; Grand Ave., Bloomingdale Ave., N. 48th Ave., N. 51st Ave. and N. 52nd Ave., 6,000 sq. ft. 6 ft. wide, average fill 1.0 ft., assm't price 19½ cts.; W. 114th St., W. 115th St., Yale Ave., Princeton Ave, Howard Ave., Steward Ave., etc., 11,000 sq. ft., 6 ft. wide, average fill 1½ ft., assm't price 17 cts.; W. 59th St., W. 60th St., W. 61st St., Honore St., Lincoln St., Winchester Ave., Robey St., etc., 24,000 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; Lawrence Ave., Roberts Ave., Leland Ave., Windsor Ave., Milwaukee Ave., N. 54th Ave., N. 55th Ave., etc., 6,700 sq. ft., 6 ft. wide, average fill 1.0 ft., assm't price 15½ cts.; W. 20th St., Jefferson St., to Blair St., Blair St. Canalport Ave. to 20th St., both sides, 7,400 sq. ft., 4 ft. wide, average fill 1.0 ft., assm't price 15½ cts.

✣Bids will be received until 2 p. m., April 5, by Board of Local Improcements, Aurora, Ill., for the construction of a roadway in Oak Ave., between Galena Blvd. and a point south of Plum St.

✣Bids will be received until 11 a. m., April 13, by Board of Local Improvements, Chicago, Ill., Charles A. V. Standish, Secy., for paving a number of streets and alleys.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, until 11 a. m., April 14, for the construction of the following proposed sidewalks: N. side of W. Chicago Ave, 1800 sq. ft., average fill 7.0 ft., assessment price 26 cts; both sides Dayton St., 500 sq. ft., average fill 5 ft., assessment price, 33 cts; both sides Eddy St., 750 sq. ft., average fill 1.0 ft., assessment price 15½ cts.; W. side N. 44th Ave., 4400 sq. ft., average fill 1.0 ft., 125 lin. ft. cut, average depth 1 ft., assessment price 15½ cts.; W. side N. 52d Ave., 1900 sq. ft., average fill 1 ft., cinder filled, assessment price 15½ cts.; S. side W. 59th St., 1500 sq. ft., average fill 1½ ft., assessment price 17 cts.; both sides Fry St., 288 sq. ft., average fill 1.0 ft., assessment price 27 cts.; both sides Fay St., 840 sq. ft., average fill 6 ft., assessment price 29 cts.; both sides Fox Pl., 1200 sq. ft., average fill 4 ft., assessment price 25 cts.; both sides W. Huron St., 1900 sq. ft., average fill 1½ ft., assessment price 20 cts.; N. side W. Kinzie St., 4800 sq. ft., average fill 1 ft., lin. ft. cut 500, average depth 1½ ft., assessment price 15½ cts.; N. side W. Kinzie St., 3600 sq. ft., average fill 1 ft., lin. ft. cut 300, average depth 1 1/6 ft., assessment price 15½ cts.; S. side Lawrence Ave., 4600 sq. ft., 6 ft. wide, average fill 4 ft., assessment price 27½ cts.; both sides Mather St., 4800 sq. ft., average fill 5 ft., assessment price 33 cts.; both sides E. 99th St., 1100 sq. ft., average fill 1 ft., assessment price 15½ cts.; N. side W. 16th St., 3600 sq. ft., average fill, 1 ft., cinder filled, assessment price 17 cts.; S. side E. 72d St., 700 sq. ft., average fill, 1 ft., assessment price 19 cts.; S. and S. E. sides E. 72d St., 9500 sq. ft., 6 ft. wide, average fill 2½ ft., assessment price, 21 cts.; both sides W. 35th St., 1400 sq. ft., average fill 1 ft., assessment price 17½ cts.; N. side Waveland Ave, 750 sq. ft., average fill 1 ft., cinder filled assessment price 15½ cts.; N. side W. 56th Pl., 1400 sq. ft., average fill 1 ft., assessment price 17½ cts.; N. side W. 59th St., 1900 sq. ft., average fill 1 ft., assessment price 15½ cts.; both sides W. 24th Pl., 1500 sq. ft., average fill 1.0 ft., assessment price 15½ cts.; S. side W. 100th St., 11,000 sq. ft., 1 ft. cinder filled, assessment price 17 cts.; S. side E. 119th St., 6900 sq. ft., average fill 1½ ft., assessment price 17½ cts.; both sides Warner Ave., 4500 sq. ft., average fill 1 ft., assessment price 15½ cts.; N. side W. 19th St., 600 sq. ft., average fill 4 ft., assessment price 27½ cts.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., until 11 a. m., April 7, for constructing sewers in the following streets:

Street.	Length, lin. ft.	Tile, ft.	Cut, ft.	Manholes, No.	Assessment available
N. 40th Ct.	670	1¼	9	5	1,143
W. Madison St.	640	1	10	5	977
South St.	300	1	8	5	460
Coles Ave.	630	1	8½	5	1,752
System.					
W. 66th Pl.	660	1⅔	13		
	670	1½	12		. . .
	670	1¼	11	.	. . .
	610	1	10	20	6,000
System.					
S. Leavitt St.	2,010	2*	19		
S. Leavitt St.	650	1	10		
W. 106th St.	1,000	1¼	13½	.	
S. Hamilton Ave.	1,320	1	8½	.	. . .
S. Irving Ave.	1,320	1	8½	.	. . .
S. Oakley Ave.	1,160	1	7½	.	.
Alley	640	¾	6½	63	[illegible]
System.					
W. End Ave.	570	2*	14	.	. . .
W. End Ave.	380	1½	12	.	. . .
Howard Ave.	510	1	9½	.	
Howard Ave.	460	1¼	9½		
Howard Ave.	440	1	8½	10	.
W. 50th Ave.	330	2½*	12	.	. . .
Sunnyside Ave.	770	1	8½	8	2,500
System.					
W. 51st St.	1,320	3½*	14.7	.	
W. 51st St.	1,340	3*	11.2		
S. California	670	2½*	14		
S. Francisco Ave.	1,000	2	[illegible]		
W. 51st	1,010	2½	13.8		
S. Artesian Ave.	665	1¼	11½	.	
S. Artesian Ave.	535	1	9½	.	. . .
S. Artesian Ave.	665	1½	10.9	.	. . .
S. Artesian Ave.	665	1¼	9.7	.	
S. Artesian Ave.	830	1	8½	.	. . .
S. Campbell Ave.	605	1¼	11½	.	. . .
S. Campbell Ave.	535	1	11½	.	. . .
S. Campbell Ave.	665	1¼	11½		
S. Campbell Ave.	665	1¼	10.4	.	
S. Campbell Ave.	830	1	9	.	. . .
S. Maplewood Ave.	665	1¼	11.7	.	. . .
S. Maplewood Ave.	535	1	9½	.	
S. Maplewood Ave.	665	1½	11.7	.	
S. Maplewood Ave.	665	1¼	10½	.	. . .
S. Maplewood Ave.	830	1	9	.	. . .
S. Rockwell St.	665	1¼	11.8		
S. Rockwell St.	535	1	9.7		
S. Rockwell St.	665	1½	11.9	.	. . .
S. Rockwell St.	665	1¼	10.9	.	. . .
S. Rockwell St.	830	1	9		
W. 54th St.	810	1	10		
W. 50th St.	670	1	9½		
S. Campbell Ave.	670	1	9½	.	. . .
W. 57th St.	250	1½	12.7	156	49,500

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*Brick.

This letting is in accordance with the new specifications, copies of which may be obtained at the office of the Engineers of the Board of Local Improvements, 2nd floor City Hall.

✣Bids will be received by the Board of Local Improvements, Cicero, Ill., until 8 p. m., April 11, 1911, for paving the following streets: 23d pl., 52d Ave. to 48th Ave., 24 ft. roadway; 24th St., 52d Ave. to 48th Ave., 24 ft. roadway; 24th pl., 52d Ave. to 48th Ave., 24 ft. roadway; 52d Ave., 23d St. to 25th St., 12 ft. roadway, e. ½ of street; 51st Ave., 23d St. to 25th St., 24 ft. roadway, and 50th Ave., 23d St. to 25th St., 25 ft. roadway, 2,590 (approximately [illegible] sq. yds. [illegible] paving brick on macadam foundation [illegible] cu. yds. excavating and 500 cu. yds. filling, 22,176 lin. ft. concrete combined curb and gutter, 51 manholes to be brought to grade, 66 catch basins to be brought to grade and connected to curb with 9-in. tile pipe. Payments shall be by voucher and bond, 5-year plan, the town's portion to be paid in cash before Feb. 12, 1812. Cash or certified check on [illegible] Bank for 10 per cent of bid must accompany proposal. Plans and specifications on file at office of Chas. Stoeffel, Town Clerk, Cicero, Ill. Geo. Comerford is President and Jno. Forrest Secretary of the Board.

⦿The board of local improvements of Springfield, Ill., has been awarded the contract for the paving of 14th St., from Cook to South Grand Ave., to Richard Egan for $1.55 per sq. yd., $0.53 for tool finished curbing, and $0.41 for machine finished stone.

⦿The city council of Murphysboro, Ill., has awarded the contract for another $21,000 worth of paving to the Meyer-Thomas Co., of East St. Louis, Ill

⦿The following sidewalk contracts have been awarded by the Board of Local Improvements of Chicago: Archer Ave., 40th Ave. to 51st St., H. P. Larsen, 1542 N. Rockwell St.; Belden Ave., 51st Ave. to 53d Ave. Siewert Callsen Co., 3865 Milwaukee Ave.; 45th Ave., Milwaukee Ave. to Addison St., Siewert Callsen Co.; 59th St., Albany Ave. to Kedzie Ave., Chas. Chambers & Son, 5256 S. Wood St.; Homan Ave., 37th Pl. to 39th St., H. P. Larsen; Hermitage Ave., 90th St. to Beverly Ave., Chas. Chambers & Son; Kingston Ave., 79th St. to 711 ft. south, Jas. Porter, 1557 E. 94th St.; 102d St., Indianapolis Ave. to Ewing Ave., Hanson-Undine Co., 2858 E. 83d St.; 106th St., Avenue "L" to Calumet River, H. P. Larsen; St. Louis Ave., 38th St. to 39th St., H. P. Larsen; 28th St., Kedzie Ave. to Homan Ave., Fred J. Nerger; 92d St., Vincennes Ave. to 210 ft. W., Fred J. Nerger; Cornelia Ave., 45th Ave. to 46th Ave., Siewert Callsen Co.; 37th Pl., Spalding Ave. to 299.95 ft. W., H. P. Larsen; 112th St., Stewart Ave. to C. & W. I. R. R., A. P. Larsen, 13322 Indiana Ave.; 76th St., 121 ft. E. of Vincennes Ave. to S. Park Ave., A. L. Strachan, 5737 S. May St.

Indiana.

✣Bids will be received until 10 a. m., April 12, by Board of Public Improvements, Indianapolis, Ind., for the following street improvement contracts: For the improvement of Washington Boulevard, from S. property line of 32nd St., to S. property line of 34th St., by grading and paving the roadway; the improvement of DeFrees St., from E. property line Temple Ave., to W. property line of first alley E. of Temple Ave., by curbing the outer edge of the roadway; improvement of Tremont Ave., E. side from N. curb line Morris St., to S. property line Wilkins St., by grading and paving the sidewalks; improvement of Raymond St., from E. curb line of Madison Ave., N. side, and from E. property line of Madison Ave., S. side, to W. curb line of East St., N. side, and to the J. M. & I. R. R. tracks, by grading and paving the sidewalks.

✣Bids will be received until 10 a. m., April 6, by Board of Cass County Commissioners, Logansport, Ind., for the construction of a macadamized road in Noble township. J. E. Elder is County Auditor

✣Bids will be received until 10 a. m., April 6, by Board of Laporte County Commissioners at LaPorte, Ind., for the construction of a macadamized road in Center and Springfield townships. Fred A. Hausheer is Auditor of the County.

⦿The board of county commissioners, Anderson, Ind., on March 20 received the following bids for building seven additional gravel roads under the provisions of the three mile law; it is reported the contracts have been awarded to the lowest bidder in each case: The Alfred Rector Road—Butcher & McCord, $14,924; J. D. Reason & Co., $14,121; John B. Mason, $14,124; Thurston & Steele, $13,990; Burke Bros., $12,839; M. H. Downey, $16,134; Madison Construction Co., $13,987; Ayers Construction Co., $12,986; Sullivan, Mason & Sullivan, $11,650. The Alfred Zellar Road—John B. Mason, $4,425; John D. Reason & Co., $4,787; Beutcher & McCord, $4,934; Ryan & Son, $4,244; Burke Construction Co., $4,387; J. E. Thurston, $4,489; Ayers Construction Co., $5,280; Sullivan, Mason & Sullivan $4,900. The William Dillinger Road—Joe E. Thurston, $1,788; Madison Construction Co., $1,450; Sullivan, Mason & Sullivan, $1,760. The Kirkman Road—John O. Potter, $9,191; Green & Hardie, $6,899; M. H. Downey, $7,495; Madison Construction Co., $6,990. The A. B. Summers Road—M. H. Downey, $9,750; Madison Construction Co., $8,350; Sullivan, Mason & Sullivan, $7,800; J. O. Potter, $7,871. The A. J. Harding Road—Madison Construction Co., $2,636. The F. F. Harbit Road—Madison Construction Co., $1,975.

⦿The Board of County Commissioners, Noblesville, Ind., received bids March 3 for the construction of six gravel roads; the contract for five roads being let as follows: H. L. Findley, Noblesville, one road, $8,171; Albert Fox, Noblesville, two roads at $4,291 and $4,893; Haverstick & Holleran, Noblesville, $6,385 and $8,686. Bids were rejected for the sixth road.

⦿The county commissioners at Lafayette, Ind., awarded the contract for the building of the Carl Higley road in Wabash township to Snyder & Barnett of Frankfort for $6,995.

⦿The county commissioners, Brazil, Ind., have awarded the contracts for two gravel roads as follows: Schauwecker & Co., Harris road in Van Buren township for $9,394; A. M. Shattuck, Goddard road in Dick Johnson township for $18,220

A petition has been circulated by the farmers of Oil township, Perry county, Cannelton, Ind., for the purpose of getting better roads.

Iowa.

⦿Hamilton & Schwartz of Shenandoah have been awarded the contract by the city of Red Oak, Ia., for the construction of 33 blocks of brick pavement, amount to 25,411 sq. yds., for $1.83 per sq. yd., cement work, $0.51 to $0.53 per lin. ft.

⦿Flinn & Hanlon, 212 American Block, Sioux City, Ia., have been awarded the contract by the city of Sioux City for the construction of brick pavement on Virginia St., from 1st to 3d Sts., for $3.35 per sq. yd. They also have the following contracts: Concrete paving on 8th St., from Jackson to Jennings St., at 1.24½ per sq. yd., and concrete paving on Jennings from 5th St. to alley north of 13th at $1.28 per sq. yd. Bids were opened March 25.

A resolution has been introduced in the city council of Council Bluffs, Ia., providing for the repavement of Main St., south from First Ave. to its intersection with Pearl, and of Broadway from First to Second Sts., and from Sixth to Eights Sts.

The Commercial club of Denison, Ia., is canvassing the proposition to pave the leading streets of the city.

The city council of Harlan, Ia., has adopted a resolution of necessity providing for the paving of a number of blocks with concrete paving. It calls for a 4-in. concrete foundation with a 2-in. cement surface.

Kansas.

The K[illegible] son, Kan., plan to build an oiled highway through the sand hills running from Kearney south to Ulysses. State Highway Engineer W. S. Gearhart, Topeka, has inspected the route of the proposed road.

The city commissioners of Wichita, Kan., have decided to call for bids for the paving of Main St., between English St., and Murdock Ave. City Engineer Bert C. Wells has estimated the cost at $79,011

Louisiana.

At a recent mass meeting held in Baton Rouge, La., it was decided to ask the police jury to call a special election to submit the question of a levy of a tax of 2½ mills to yield $375,000, half for good roads and half for a new courthouse.

The mayor of Baton Rouge, La., has been notified by P. M. Kerr, chief of the state board of engineers, that maps are being drawn and profiles made of North St., preparatory to estimating the cost of making a model road out of North St., and graveling the thoroughfare.

An election will probably be held in Baton Rouge, La., soon to vote on the issuance of bonds to build a court house and jail; also for good county roads, drainage, etc. Joseph Gihelin, Pres. of Police Jury, Baton Rouge, has charge of the work.

Maryland.

✣Bids will be received until noon, April 6, by Highways Commissioner, Towson, Md., for the following improvements: No. 1. Vitrified Brick Paving, Highland Ave. and Gough St., Highlandtown, Md. No. 2. Sewer, from Baltimore and Third Sts. to Fayette St., as per plans, Highlandtown, Md. Plans and specifications can be seen in the office of the Highways Commission, Towson, Md., and blank proposals can be secured. Henry G. Shirley is Baltimore County Roads Engineer.

A delegation of Baltimore citizens, headed by Senator John Walter Smith, appeared before the state roads commission, Baltimore, W. W. Crosby, chief engineer, to ask permission to go ahead with the construction of the road between Pocomoke City and Snow Hill under the supervision of the county commissioners. The commissioners have authorized the county commissioners to begin work. The commissioners have also authorized the advertisement of bids on the road from Monrovia to Newmarket in Frederick county.

City Engineer B. T. Fendall, of Baltimore, Md., has submitted specifications for approximately $200,000 worth of city paving to the board of estimates. As soon as the specifications are approved bids will be advertised for.

Michigan.

✣Bids will be received until 8 p. m., April 6, by Board of Public Works, Grand Rapids, Mich., for two street flushing machines for the city of Grand Rapids. Henry J. Klevorn is President of the Board.

County Engineer Sawyer, of Menominee County, Menominee, Mich., is making investigation as to the relative merits of the different road machinery that is proposed to be purchased by the county.

Minnesota.

⦿John Page of Mankato, Minn., has been awarded the contract by the City Council of that city for furnishing two sprinklers for street work for $300. Bids were opened March 20 by Geo. R. Rodman, Deputy City Clerk.

The Minesota state highway commission, St Paul, Minn., and G. W. Cooley, state engineer, have formulated a plan for work under the $150,000 yearly appropriation law. The idea includes the appointment of several assistant engineers to have control over the road and bridge work. The new appropriation will not be available until August.

Missouri.

The road overseers of Greene County, Springfield, Mo., have decided to take up the matter of improving the public highways under a county-wide plan.

Nebraska.

The city council of Omaha, Neb., has passed ordinances providing for the repaving or paving of the following streets: 29th, Fowler to Meredith; Davenport, 11th to 13th and 30th to 38th; 31st from Poppleton to Wordsworth; 35th, Leavenworth to Howard; Castellar, from the Boulevard to 32nd.

New Jersey.

✣Bids will be received until 10:30 p. m., April 15, by City Council, Swedesboro, N. J., for the construction of an improved road or street on Railroad Ave. in the Borough of Swedesboro, beginning at the edge of the stone pavement on Main St. and extending over Railroad Ave. to the right-of-way line of the West Jersey and Seashore Railroad, a distance of 859 ft. Said road to be constructed [illegible] of Public Roads, Trenton, N. J.

The [illegible] mittee, Woodbury, N. J., has apportioned $10, [illegible] county, with the expectation that the county would receive a liberal portion of the state automobile money.

Nevada.

The Nevada legislature, Carson, Nev., has [illegible] credited to the men who elect to enter the [illegible]

New York.

✣Bids will be received until 1 p. m., April [illegible] by State Road Commission of Highways, Albany, N. Y., for the improvement of the following highways: Broome County, Road No. [illegible] miles; Cattaraugus County, Road No. [illegible] miles; Cayuga County, Road No. 5101, 1.83 miles; Chemung County, Road No. [illegible], 3.72 miles; Clinton County, Road No. 5102, 7.00 miles; Dutchess County, Road No. 895, 1.06 miles; Fulton County, Road No. 544, 6.28 miles; Herkimer County, Road No. 5105, 1.88 miles; Monroe County, Road No. 5097, [illegible] miles; Oneida County, Road No. 5091, 1.06 miles; Schenectady County, Road No. 5110, 5.42 miles; Seneca County, Road No. 5087, 5.95 miles; Seneca County, Road No. 5100, 2.50 miles; Steuben County, Road No. 906, 5.98 miles; Steuben County, Road No. 907, 4.13 miles; Steuben County, Road No. 5094, 2.50 miles; Suffolk County, Road No. 5111, 5.02 miles; Suffolk County, Road No. 5112, 4.99 miles; Sullivan County Road No. 890, 4.87 miles; Ulster County, Road No. 5114, 3.82 miles; Washington County, Road No. 5113, 3.75 miles; Wayne county Road No. 920, 3.00 miles; Westchester County, Road No. 901, 1.89 miles; Wyoming County, Road No. 894, 3.56 miles. An alternative proposal to be endorsed at "5111-12 combined" will also be received for the following roads combined in one contract, viz.: Suffolk County, Roads Nos. 5111 and 5112, 10.01 miles. Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the offices of Division Engineer Spencer J. Stewart, Columbus Hall, Poughkeepsie, N. Y., for highways in the counties of Dutchess, Nassau, Orange, Putnam, Suffolk, Sullivan, Ulster and Westchester; at the office of Division Engineer Harry P. Willis, Humane Building, Albany, N. Y., for highways in the counties of Clinton, Columbia, Essex, Fulton, Montgomery, Rensselaer, Schenectady, Warren and Washington; also at the office of Division Engineer Guy H. Miller, Cleveland Building, Watertown, N. Y., for highways in the counties of Herkimer, Oneida and St. Lawrence; also at the office of Division Engineer Fred W. Sarr, South Clinton and West Jefferson Sts., Syracuse, N. Y., for highways in the counties of Cayuga, Madison, Onondaga, Seneca and Wayne; also at the office of Division Engineer M. W. Wilbur, 423 Cutler Building, Rochester, N. Y., for highways in the counties of Cattaraugus, Erie, Genesee, Livingston, Monroe and Wyoming; and also at the office of Division Engineer Paul McLoud, Press Building, Binghamton, N. Y., for highways in the counties of Broome, Chemung and Steuben.

✣Bids will be received until 7:30 p. m., April 17, by Grover E. Yerdon, City Clerk, Johnstown, N. Y., for bituminous macadam paving and stone curbing on East and West State Sts. The work will include the following approximate quantities, 8,535 sq. yds. of bituminous macadam on East State St.; 3,280 sq. yds. of bituminous macadam on West State St.; 3,000 ft. of stone curbing on East State St.; 900 sq. yds. of cobble gutter on East State St.; [illegible] sq. yds. of cobble gutter on West State St. Bidders are required to submit a certified check of $500 with bid. Plans, profiles and specifications may be seen, and blank forms, and all necessary information obtained at the office of the City Engineer.

✣Bids will be received until 10 a. m., April 18, by Edward F. Hennessey, Town Clerk, of Mount Pleasant, at his office on Cortlandt St., North Tarrytown, N. Y., for improvement of the following roads: Hardscrabble Road, from the Pleasantville-Ossining Road northerly to the Town Line, a distance of 2.07 miles; Bare Ridge Road, from the easterly line of the Village of Pleasantville to King St., a distance of 1.60 miles.

✣Bids will be received until 1 p. m., April 26, by State Road Commission of Highways, Albany, N. Y., for the improvement of the following highways: Essex County, Road No. 891, 5.99 miles; Dutchess County, Road No. 709, 4.80 miles; Dutchess County, Road No. 748, 5.46 miles; Erie County, Road No. 914, 3.52 miles; Erie County, Road No. 915, 1.46 miles; Erie County, Road No. 916, 2.30 miles; Erie County, Road No. 917, 4.11 miles; Herkimer County Road No. 466, 5.56 miles; Livingston County, Road No. 717, 5.87 miles; Madison County, Road No. 908, 2.07 miles; Montgomery County, Road No. 889, 0.64 miles; Nassau County, Road No. 5106, 2.50 miles; Onondaga County, Road No. 897, 4.24 miles; Orange County, Road No. 416, 6.10 miles; Rensselaer County, Road No. 5108, 0.20 miles; Essex County, Road No. 5117, 6.00 miles; Steuben County, Road No. 904, 1.64 miles; Steuben County, Road No. 905, 3.90 miles; Suffolk County, Road No. 912, 6.69 miles; Sullivan County, Road No. 824, 3.38 miles; Ulster County, Road No. 921, 2.13 miles; Wayne County, Road No. 919, 3.81 miles; Westchester County, Road No. 900, 4.26 miles; Wyoming County, Road No. 893, 3.61 miles; St. Lawrence, County, Road No. 5115, 4.74 miles; St. Lawrence County, Road No. 5116, 5.43 miles. An alternative proposal to be endorsed as "5115-16 combined" will also be received for the following roads combined in one contract, viz.: St. Lawrence County, Roads Nos. 5115 and 5116, 10.17 miles.

✣Bids will be received until 1 p. m., April 24, by State Commission of Highways, Albany, N. Y., for the improvement of the following highways: Columbia County, Road No. 5103, 5.00 miles; Columbia County, Road No. 5104, 4.50 miles; Dutchess County, Road No. 5092, 4.15 miles; Dutchess County, Road No. 5095, 1.33 miles; Erie County, Road No. 913, 1.77 miles; Fulton and Montgomery Counties, Road No. 5096, 3.03 miles; Herkimer County, Road No. 465, 5.43 miles; Livingston County, Road No. 716, 2:23 miles; Madison County, Road No. 883, 2.14 miles; Montgomery County, Road No. 5109, 4.79 miles; Nassau County Road No. 898, 2.88 miles; Onondaga County, Road No. 896, 2.43 miles; Orange County, Road No. 415, 3.18 miles; Putnam County, Road No. 909, 4.56 miles; Putnam County, Road No. 5098, 1.14 miles; Rensselaer County Road No. 5107, 0.40 miles; Steuben County, Road No. 903, 2.07 miles; Ulster County, Road No. 310, 4.25 miles; Wayne County, Road No. 918, 1.16 miles; Westchester County, Road No. 899, 5.68 miles; Wyoming County, Road No. 892, 1.43 miles; Genesee County, Road No. 922, 1.85 miles; Genesee County, Road No. 923, 4.70 miles. An alternative Proposal to be endorsed "5103-4 combined" will be received for the following roads combined in one contract, viz.: Columbia County, Roads Nos. 5103 and 5104, 9.50 miles.

⊙On March 21, George McAneny, President Borough of Manhattan, New York City, awarded the contract for the widening and repaving of 23d St., between 2d and 10th Aves., to the Republic Construction Co., 18 Broadway, New York, at $118,448.

⊙The State Highway Commission, Albany, N. Y., has awarded the following contracts for state road work, for which bids were opened March 22 and 24: Road No. 886, Lexington-Prattsville, Green County, 4.19 miles, De Graff & Hogeboom, Kingston, N. Y., $55,847, on residuum; Road No. 887, South Cairo-Cairo, Greene County, 3.15 miles, De Graff & Hogeboom, Kingston, N. Y., on residuum, $36,118; Road No. 5,090, E. Pembroke-Pembroke, part 2, Greene County, 4.77 miles, Hucknell Construction Co., Albion, N. Y., on residuum, $50,000; Road No. 874, Nobleboro-Morehouseville, Hamilton County, 5 miles, Creeden & Piton, 27 William St., New York City, $49,670; Road No. 5,077, Martinsburg-Turin, Lewis County, 3.08 miles, Thomas Shaughnessy Co., Albany, on residuum, $35,600; Road No. 5,078, Wampville-Oneida Castle, Madison County, 2.56 miles, Newport Construction Co., Newport, on bermudez, $33,220; Road No. 409, Fort Plain-Starkville, Montgomery County, 6.22 miles, Joseph Walker, New Paltz, on bermudez, $80,554; Road No. 837, Waterville-Deansboro, Oneida County, 4.77 miles, Joseph Walker, New Paltz, $49,950; Road No. 838, Saquoit, Oneida County, .56 miles, Fred. W. Berger, Newport, N. Y., on residuum, $7,788; Road No. 839, Augusta-Knoxboro, Oneida County, 1.21 miles, A. C. Brower, Oriskany Falls, N. Y., $12,947; Road No. 840, Brookfield-Waterville, Oneida County, 4.37 miles, Kennedy Roofing & Paving Co., Utica, N. Y., on bermudez, $55,270; Road No. 877, Clinton Village, Oneida County, .97 miles, John Hyde, Rome, N. Y., on trinidad, $11,920; Road No. 5,079, Clayville Village, Oneida County, 1.44 miles, Kennedy Construction Co., Albany, N. Y., on bermudez, $18,497; Road No. 556, Manlius-Chittenango, Onondaga County, 3.22 miles, Central City Paving Co., Syracuse, N. Y., on residuum, $32,470; Road No. 557, Vesper-South Onondaga, Onondaga County, 6.19 miles, Thomas Meehan & Sons, Philadelphia, Pa., on residuum, $65,458; Road No. 655, Jordan-Cross Lake, Onondaga County, 1.78 miles, Central City Paving Co., Syracuse, N. Y., on residuum, $12,675; Road No. 5,080, Elbridge Village-Camillus, part 1, Onondaga County, 3.02 miles, Paddock & Williams, Memphis, N. Y., on residuum, $33,975; Road No. 772, Fulton-Hannibal, part 1, Oswego County, 3.67 miles, Joseph H. Conners, Fulton, N. Y., $43,990; Road No. 825, Fulton-Oswego, Oswego County, 3.33 miles, Monroe Roads Co., Pittsfield, N. Y., on residuum, $34,212; Road No. 826, Pulaski-Orwell, Oswego County, 5.93 miles, Folk & Menzies, Buffalo, N. Y., on residuum, $56,999; Road No. 5,082, Mexico-Union Square, part 2, Oswego County, 2.92 miles, Charles O. McComb, Syracuse, N. Y., on residuum, $37,990; Road No. 5,083, Union Square-Pulaski, part 1, Oswego County, 2.61 miles, Charles O. McComb, Syracuse, N. Y., on residuum, $30,420. The following contracts were awarded for work for which bids were opened March 24: Road No. 639, Cheshire-McJennett Hill, Ontario County, 7.04 miles, James Stewart & Co., 30 Church St., New York City, on residuum, $88,900; Road No. 5,081, Lima-East Bloomfield, part 2, Ontario County, 5.26 miles, John E. Johnson, Buffalo, N. Y., on residuum, $69,889; Road No. 833, West Exeter-West Winfield, Otsego County, 5.44 miles, Thomas Meehan & Sons, Philadelphia, Pa., $45,593; Road No. 875, Elmdale-Gouverneur, St. Lawrence County, 5.83 miles, James Stewart & Co., New York City, $57,950; Road No. 876, Brasies Corners-Elmdale, St. Lawrence County, 3.82 miles, James Stewart & Co., New York City, $34,350; Road No. 878, Ogdensburg-Morristown, part 1, St. Lawrence County, 6.74 miles, A. J. Rockwood, Rochester, N. Y., on residuum, $69,800; Road No. 741, Saratoga-Corinth, Saratoga County, 4.06 miles, Herlihy Contracting Co., Glens Falls, N. Y., on residuum, $38,892; Road No. 815, Corinth-Hadley, Saratoga County, 6.22 miles, Herlihy Contracting Co., Glens Falls, on bermudez, $65,894; Road No. 793, Schenectady-Dunanesburg, Schenectady County, 2.79 2.34 miles, Thomas F. Shaughnessy Co., Albany, N. Y., $22,300; Road No. 880, Schenectady-Dunanesburg Schenectady County, 2.79 miles, Thomas F. Shaughnessy, Albany, on residuum, $24,400; Road No. 5,086, Gallupville Vrooman, Schoharie County, 5.02 miles, Catskill Construction Co., Catskill, on bermudez, $60,000; Road No. 324, Center Road-Fayette, part 1, Seneca County, 3.19 miles, Schroeder-Hicks Contracting Co., Rochester, N. Y., on residuum, $33,700; Road No. 5,087, Geneva-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Watertown, part [illegible], W[illegible] County, 5.95 miles, no bids received; R[illegible] 5,088, Riverside-Wevertown, part [illegible], W[illegible] County, 1.53 miles, Santononi Construction Co., Newcomb, N. Y., on residuum, $22,1[illegible]; [illegible] No. 802, Smiths Basin-Hartford, W[illegible] County, 5.25 miles, Theodore A. Hailes, Jr., Albany, N. Y., $50,480; Road No. [illegible] Clyde-Savannah part 1, Wayne County, 1.55 miles, Thomas Grady & Co., Rochester, N. Y., at $63,300, on residuum; Road No. 881, 1.79 miles, was not let, as bid exceeded [illegible]; Road No. 882, Scotland County, [illegible] miles, John H. Weidman, Syracuse, at $24,740; Road No. 5,075, Cortland County, ½ mile, S. P. Hull, Cortland, N. Y., at $7,303, on bermudez.

The New York state senate, Albany, N. Y., has passed a bill providing for a highway from New York City to Montreal.

The town board of Dewitt, N. Y., has set aside appropriations for highway improvements to be made during the summer by Town Superintendent of Highways, Thomas Baker. The total appropriated was $7,600, of which the state will pay $2,093.

The board of supervisors, Bath, N. Y., adopted resolutions calling for the construction by the county of 17.72 miles of roads in Steuben county this year. Five roads will be improved as follows: Campbell-Thurston, 2.07 miles; Big Creek road, sections 1 and 2, of Fremont and Hornellsville, 5.98 miles; Big Creek road, section 4, town of Avoca, 4.13 miles; Troupsburg to Pennsylvania state line, 3.9 miles; total 17.72 miles.

Plans and specifications have been presented to the Wayne county board of supervisors, Lyons, N. Y., and the same have been presented to the good roads committee, for three proposed county roads to be built with state aid this coming summer. The three roads are of about eight miles and will cost approximately $73,700. The following roads are proposed: Clyde-Resort, 3.87 miles, to cost $30,500; Lyons-Sodus Point road, 3 miles, $31,100, and the Macedon-Cater Four Corners road, 1.16 miles, $12,100.

A special election will probably be held in North Tonawanda, N. Y., in the near future, for the purpose of voting on the repaving of Webster St.

The Assembly Ways and Means Committee, Albany, N. Y., has reported to the House for passage the bill of Senator Murtaugh, appropriating $1,000,000, to become available immediately, to be expended for the improvement of portions of state routes Nos. 4 and 12. The improvement will commence at a point on route No. 4, on the dividing line between the counties of Broome and Tioga; running thence westerly through the southern portions of Tioga and Chemung counties to Elmira, running thence northerly from the city of Elmira to a point at or near Horseheads, being the intersection of route No. 12 with Route No. 4, running thence northerly on route No. 12 through the counties of Schuyler and Yates, by the way of Watkins, to a point on route No. 6, being the intersection of routes No. 12 and No. 6.

North Dakota.

Property owners on First Ave., north between Roberts St. and Broadway, Fargo, N. Dak., have petitioned the city council for the paving of that thoroughfare.

Ohio.

✣Bids will be received until noon, April 12, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and material for the improvement of Benton Alley from Vine St. to Bremen St. by grading, setting granite curbs and paving the roadway with brick. Plans and specifications may be obtained of the Chief Engineer of the Department of Public Service.

✣Bids will be received until noon, April 12, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for the improvement of Benton Alley from McMicken Ave. to Hamer St. by grading, setting granite curbs and paving the roadway with brick. Plans and specifications can be obtained of the Chief Engineer of Department of Public W[illegible] J. J. Wenner is Clerk.

✣Bids will be received until noon, April 12, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and material for the improvement of Bardes Alley from Vine St. to Goose Alley, by grading, setting granite curbs and paving roadway with brick. John J. Wenner is Clerk. Plans and specifications may be obtained of the Chief Engineer of the Department of Public Service.

✣Bids will be received until noon, April 12, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for the improvement of Ahler Alley, from Vine St. to Bremen St., by grading, setting granite curbs and paving the roadway with brick. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer of the Department of Public Service.

✣Bids will be received until noon, May 1, by Commissioners of Portage County, Ravenna, O., for grading and paving with brick 2.12 miles of road in Ravenna and Shalersville Township. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, April 28, by Board of County Commissioners, Cincinnati, O., for the improvement under Specifications No. 181 of the Eight Mile road at Kremer's place in Anderson Township. All bids must be accompanied by a bond for $500.

⦿The county commissioners at Hamilton, O., on March 24 received bids for the improvement of the Venice River road for a stretch of two miles, under the good roads laws of the state. The work consists of grading and macadamizing a section of the road in St. Clair township from the west approach of the Columbia bridge and running southwardly to the north end of the bridge at the Cora Welsh farm, a distance of 2.1 miles. The contract was awarded to the Garver Transfer Co., at $15,086, with macadam and tarvia. The estimate of cost for the work follows: 9,390 cu. yds. excavation at 30c, $2,817; 11,961 sq. yds. two-course macadam at 91c, $19,884; 4,694 sq. yds. one-course macadam at 50c, $2,347; 30 cu. yds. loose limestone for highway approaches at $2.70, $81; spiking, harrowing and grading old roadbed, $200. Estimated cost of construction, $16,329.

⦿The County Commissioners at Bowling Green, O., have awarded the following contracts for grading, draining and macadamizing three roads, [illegible] March 28 by F. W. Toan, County Auditor: The Goetching Stone Co., Lima, O., three roads, and W. M. Gray of North Baltimore, O., two roads.

⦿The Board of County Commissioners, Cincinnati, O., has awarded the contract for the improvement of the Broadwell road, from Round Bottom road to a point ½ mile east of the N. & W. R. R., in Anderson Township, to H. F. Nagel, Cherry Grove, O., for $3,772. Bids were opened March 24.

The city council of Dayton, O., has made appropriations for the paving of the following streets; F. J. Cellarius, city engineer.

STREET PAVING.

Street	From	To	Total No. yds.
Bayard	[illegible]	Perry	1,[illegible]
Broadway	[illegible]	Bolander	[illegible]
Broadway	Bolander	Miami Chapel	[illegible]
Burns Ave	Warren	Main	[illegible]
Burkhardt Ave	[illegible]	Overlook	[illegible]
Carrie	Perry	Mead	[illegible]
Clover	Wayne	Fillmore	6,[illegible]
Concord	Cincinnati	Hopeland	[illegible]
Creighton Ave	Wayne	Wyoming	[illegible]
DeKalb	Liberty	Hussong Lane	710
Huffman Ave	Third	Maitz	[illegible]
Huffman Ave	Maitz	Overlook	[illegible]
Herman Ave	Herman Av. Br	Keowee	[illegible]
Keowee	C. H. & D. R. R.	Old Corp. Line	[illegible]
Lexington Ave	Broadway	Deal	[illegible]
Liberty	Monument Ave	G. M. Ry	[illegible]
Main	[illegible]	Corp. Line	[illegible]
Perry	Fifth	Railroad	[illegible]
Perry	Bayard	Old Levee	[illegible]
Phillips Ave	Wayne	Wyoming	[illegible]
Pine	Fifth	M. & E. Canal	[illegible]
River	Ferguson	Iowa	[illegible]
Summit	Third	Germantown	[illegible]
Troy	Leo	Valley	[illegible]
Valley	Brandt	Findlay	[illegible]
Valley	M. & E. Canal	Brandt	[illegible]
Webster	Monument	M. & E. Canal	1,110
Webb	Troy	Second	1,650

ALLEY PAVING

Alley	From	To	Total No. yds.
2nd W. Broadway	[illegible]	Gordon	350
1st S. Fifth	High	Alley W. High	180
1st N. Grand	Ferguson	Broadway	[illegible]
1st W. Grames	[illegible]	[illegible]	[illegible]
1st N. Gordon	2nd Alley E. Summit	2nd Alley W. Broadway	715
1st E. Logan	Sixth	[illegible]	1,25[illegible]
1st E. Main	[illegible]	Lawn	[illegible]
1st W. Wayne	Stout	Canal Feeder	[illegible]
1st W. Wayne	Fifth	Stout	[illegible]

An election is to be held in Brighton, O., on April 11 for the purpose of voting on the proposition of road improvements.

Plans were developed at a recent mass meeting held in Lisbon, O., for the improvement of the Columbiana county roads, estimated at $500,000. James C. Wonders, Columbus, is state highway commissioner.

The county commissioners at Dayton, O., will on May 4 be petitioned for the establishment of a county road beginning on the road known as the Social Row road, at a lane or byway between the lands of Pine and Sidney Coon, running south to the county line.

The county commissioners, Cincinnati, O., have agreed to macadamize the Cincinnati pike between West Carrollton and Miamisburg. The cost of the improvement is expected to be about $6,000 per mile.

The city council of Lorain, O., has adopted a resolution declaring it necessary to improve East Erie Ave. by paving from Colorado Ave. to the east line of the Gregg addition.

A bill has been introduced in the Ohio Legislature, Columbus, O., providing for an appropriation of $75,000 with which to make surveys and perfect plans for a proposed intercounty highway system for Ohio. Present plans call for the construction of a state system of highways with the counties as units, all county seats and trade centers to be touched. The greater part of the money is to be contributed by the state.

The commissioners of Franklin county, Columbus, O., have been petitioned for the improvement of 27 roads, aggregating 90 miles, under the new road law, which went into effect last year. The commissioners are at present asking for bids for the following roads: Avery road, extending north and south and two miles long; the Wilcox road, paralleling the Avery road for the same distance; the Dublin and Union county road, from the Scioto River to the county line, of five and one-third miles, and the [illegible]

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible] line.

Petitions have been filed with the county commissioners at Columbus, O., calling for nearly 13 miles of highways. The first peti- [illegible] Corners, Black Lick and Gahanna, in Plain, Jefferson and Trure townships. The second covered the territory south to the Fairfield county line from Reynoldsburg.

A petition has been presented to the city council of Lorain, O., calling for the paving of Hamilton Ave.

It is reported that the board of county commissioners, Marion, O., has ordered the construction of the Wild Cat pike road. This road will be six miles in length and will extend from what is known as Bumford's corners, in the western part of the county on the Marion-Kenton pike, west to the Marseilles and LaRue pike.

All bids for the paving of Ludlow Ave., from Clifton to Brookline Ave., with wood block have been rejected by Service Director Sundmaker, Cincinnati, O., and the work has been ordered readvertised under the new [illegible] bids were received last September.

The park commission of Cincinnati, O., has decided to widen the entrance to Burnet Woods park from Ludlow Ave., and the plans for the improvement will be revised and bids asked for under the new paving specifications for wood block. The engineer's estimate on the work is $21,178.

Oregon.

The city commissioners of Baker, Ore., plan to macadamize the principal highways leading into the city.

The Sacramento-street district improvement in Albina, Portland, Ore., will cost about $64,000. It embraces Sacramento, Tillamook, Eugene, San Rafael, Hancock and Rodney Ave., between Union and Williams Ave. Bitulithic is specified. The Williams-avenue district, which embraces a considerable part of Piedmont, will cost about $103,266. The Dekum-avenue district at Woodlawn, for grading and sidewalks, will cost about $17,427. East 17th St. district, located south from Division, is estimated to cost $85,476. East Flanders district includes East Flanders, East Seventh and East Everett Sts., estimated to cost $23,435. Prescott St. will be paved at an estimated cost of $18,000 from Kerby to Patton Ave., with Hassam pavement. The Kenton district, including 15 new streets, will cost approximately $300,000. Westrumite is specified. J. W. Morris, city engineer.

At a special election held in M'Minnville, Ore., March 20, bonds were voted to the amount of $70,000, to provide for improvements in the water system and in the proposed street-paving district. Fifty blocks will be paved during the year.

The Skidmore hard-surface paving district has been formed in Portland, Ore., at an estimated cost of $321,770. It embraces the following streets: Skidmore, from Union Ave. to East 14th St.; Mason, Union Ave. to East 14th; Beech, from Union Ave. and East 14th; Grand Ave., from Fremont to Failing; East Sixth, from Beech to Going; East Seventh, from Fremont to Going; East Eighth, from Fremont to Going; East Ninth, from Fremont to Going; East Tenth, from Fremont to Failing; East 11th, from Failing to Going; East 12th, from Fremont to Going; East 13th, from Fremont to Going; East 14th, from Failing to Going. Bitulithic is specified as the improvement. J. W. Morris, city engineer.

South Carolina.

✣Bids will be received until noon, April 11, by City Council, Columbia, S. C., for paving six city blocks or more, not exceeding 25 city blocks. Each city block will average about 3,150 sq. yds. of paving and 884 lin. ft. of steel-bound concrete curbing, together with the extension of concrete sidewalks and vitrified pipe drains as may be found necessary. Bids will be received for paving with creosoted wood paving block, bitulithic pavement, bituminous concrete pavement and vitrified paving block on a 5 in. concrete foundation, but the kind and amount of each paving to be used is to be decided among the City Council after the proposals are submitted. Samples of vitrified block and wood block properly labeled must be submitted before April 10, 1911. Each tender must be accompanied by a certified check drawn to the order of the Treasurer of the City of Columbia, S. C., or New York draft to the amount of $500. John McNeal, City Engineer; R. C. Keenan, Council Supt. of Streets, Columbia, S. C.

◉Bowe, Page Dray & Construction Co., of Charleston, S. C., has been awarded the contract for constructing 2,740 sq. yds. of brick pavement on a 5-in. concrete base, 1-in. sand cushion filler grout, and 1,160 lin. ft. 5 in. by 13 in. granite curb by the Commissioner of Streets, Wilmington, N. C. Bids were opened March 31.

The sanitary and drainage commission, Charleston, S. C., has been petitioned by M. A. C. Kaufman for the improvement of the Dorchester road, from the point where it diverges from the old state road, six and a quarter miles from the city of Charleston.

Tennessee.

✣Bids will be received until April 10, by J. N. Cox, Secy. Putnam County Good Road Commission, at the office of the Engineer, Cookeville, Tenn., for the construction of $100,000 of pike construction.

Texas.

✣Bids wlli be received until 3 p. m., April 11, by W. A. Frazer, City Clerk, Greenville, Texas, for the construction of 148,600 sq. yds. of paving and 84,000 lin. ft. of concrete curb. The different kinds of paving to be selected after bids are opened at least 25,000 sq. yds. will be let in each contract. Bids will be received on bitulithic, vitrified brick, creosoted wood blocks, Hassam concrete, vibrolithic, sheet asphalt and asphaltic concrete. Each bid must submit a certified check for $1,000. Specifications can be seen at the office of J. H. Rush, City Engineer, or E. L. Dalton, Dallas, Texas, Consulting Engineer.

◉The County Commissioners at Galveston, Tex., have awarded the contract for grading, regrading, paving with gravel and building of culverts, etc., on road from La Marque to Texas City, a distance of about 4½ miles, to Suderman & Dolson of Galveston at $17,410. The excavation work will be done for $.15 per cu. yd., the embankment work for $.15 per cu. yd., and creosoted lumber at $60 per M., pine lumber at $30 and shelling at $1.61 per yd. Bids were opened March 27.

The county engineers of Harris County, Houston, Tex., have submitted estimates of the cost of repairing the county's shelled highways leading into Houston, as well as the cost of oiling and repairing the Harrisburg road from the city limits to the town of Harrisburg. The county court intends to resurface the Harrisburg road with crushed rock and shell and then cover it with a coating of oil.

The city engineer of Houston, Tex., has been directed to stake out grades on Chartres St., between Texas and Hadley Aves., preparatory to shelling the street.

Virginia.

Pulaski County, Pulaski, Va., has sold bonds to the amount of $70,000 for improving the main highways. P. St. Julian Wilson is state highway commissioner.

Washington.

City Engineer Strong of Mount Vernon, Wash., has completed plans and estimates for the paving of First St. with brick. The estimated cost of the improvement is $25,665. Other street work is contemplated including cement sidewalks on Fulton St.

City Engineer Morton Macartney of Spokane, Wash., has completed plans and specifications for the paving of 25th and 26th Aves., from Arthur to Division Sts. The estimated cost is $19,400.

The chairmen of the various boards of township supervisors and the county commissioners, Whatcom County, Bellingham, Wash., will meet April 23 to discuss plans for road work in the county this year. The object of the meeting is to arrive at some arrangement whereby the Bellingham road work, which really lies within the province of the supervisors, can be done by the commissioners who have the road funds available.

The county board of commissioners, Seattle, Wash., has purchased a standard 20th Century asphalt mixing machine for $6,000. The machine will be operated by the county and will be placed in use immediately upon its arrival on the surfacing of the macadam road south from the city to The Meadows, and on state aid road No. 1.

Wisconsin.

✣Bids will be received until 8 p. m., April 13, by J. E. Kennedy, City Clerk, Platteville, Wis., for brick, reinforced concrete, tar or asphalt macadam and sarcolithic paving. Plans and specifications on file in the office of the city clerk, Platteville, Western Builder Pub. Co., 405 Montgomery Bldg., Milwaukee, and W. G. Kirchoffer, 31 Vroman Bldg., Madison, Wis., Engineer.

Advices from Fond Du Lac, Wis., state that definite plans for the improvement of all county roads will be outlined at a meeting of automobile owners, farmers and county officials at Fond Du Lac on May 1.

Plans for the dragging and improving of every road leading to the city of Fond Du Lac, Wis., have been completed by the good roads division of the Business Men's association of Fond Du Lac.

Canada.

✣Bids will be received until April 11 at noon, by G. R. Geary, Chairman Board of Control, Toronto, Ont., for the following work in connection with East Toronto Fire Hall: Concrete paving, etc.; hardware, stable fittings. Plans and specifications may be obtained of the City Architect.

◉The Board of Control of Winnipeg, Man., has let the contract for the supply of from 1,000 to 1,500 tons of asphalt as required during 1911 at $25 per ton, to the Canadian Mineral Rubber Co., of which Dunn Bros. are the local agents.

BRIDGES—STEEL AND CONCRETE

Alabama.

The County Board of Revenue, Birmingham, Ala., is now going over estimates submitted as to the number of bridges to be repaired and rebuilt in Jefferson County. The entire cost is estimated at $8,500, the concrete work alone being estimated at $3,100.

Arkansas.

✣Bids will be received until 1 p. m. April 18, by Commissioners of Ouachita County, Camden, Ark., for the construction of a steel bridge over the Ouachita River near Camden.

◉The contract for the construction of a steel bridge, according to advices from De-Witt, Ark., has been awarded the Memphis Bridge Co., Memphis, Tenn., $2,500. Six other companies [illegible] for the work.

City of Pine Bluff, Ark., has refused the proposition of the St. Louis & San Francisco Ry. and the St. Louis-Southwestern Ry. companies to build a foot bridge over the tracks in the shop district and demands a wagon and foot structure.

California.

⦿The contract for the construction of the Aroyo Seco bridge extending Pasadena Ave. near the Ostrich Farm was let by the Board of County Supervisors, Los Angeles, Cal., to T. J. Shea at $146,700. The contract for the erection of hand railing and pylons was awarded the Cement Products and Construction Co., at $5,171.

Board of County Supervisors, Los Angeles, Cal., has decided to replace the approach to the Hobart bridge across the Los Angeles River by a pile trestle.

Florida.

A bill is to be introduced into the city council of Jacksonville, Fla., for an ordinance giving the promoters of the new bridge over the St. John's River connecting the city with South Jacksonville, the necessary rights over certain streets and lands abutting the river on the Jacksonville side.

Georgia.

The Central of Georgia Ry. has finally agreed to install a 90-ft. span bridge at Singers Hill on the Atlanta Road. This matter has been under consideration by the County Commissioners at Macon, Ga., for some time. J. B. Maddock, Savannah, Ga., is Engineer of Bridges and Buildings of the Central of Georgia Ry.

The Bridge Committee of the Council, according to information received from Atlanta, Ga., is securing the necessary right of way for the Bellwood viaduct, for which purpose $10,000 has been provided. The cost of the structure is estimated at $60,000.

Illinois.

✣It is reported that bids will be asked by Highway Commissioners, Joliet, Ill., about April 8 for the construction of a new bridge over Spring Creek at Landau Ave. The plans call for a span 42 ft. 6 ins. long with 5-ft. walks for pedestrians.

✣Bids will be received at the office of G. W. Lacey, Lawrenceville, Illinois, up to 2:00 o'clock p. m., April 18, 1911, for the construction of five steel bridges in Bond Township, Lawrence County. Thos. J. Phillippe, Town Clerk, Pinkstaff, Illinois. Dollahan Bridge—Span, 60 ft.; removable concrete floor on plain concrete foundations. Estimated amount of concrete in substructure, 113.7 cu. yds. Nearest railroad station, Pinkstaff, 2½ miles. Waters Bridge—Span, 30 ft.; roadway, 16 ft.; removable concrete floor. Substructure, plain concrete. Estimated amount of concrete in substructure, 66.7 cu. yds. Nearest railroad station, Birds, 1¾ miles. Birds Bridge—Span, 30 ft.; roadway, 16 ft., removable concrete floor. Substructure, plain concrete. Estimated amount of concrete in substructure, about 49 cu. yds. Nearest railroad station, Birds, 1¾ miles. Wampler Bridge—Span, 28 ft. Contract for this bridge to include building a new substructure, cleaning and painting old Miller bridge, that is now laying on bank, 1½ miles from Wamplersite, transporting Miller bridge, erecting same on the Wampler abutments and placing removable concrete floor. Miller bridge an I-beam structure with lattice rail. Estimated amount of concrete in substructure, 36.5 cu. yds. Nearest railroad station, Birds, 1¼ miles. Miller Bridge: Span, 60 ft.; roadway, 16 ft., removable concrete floor. Substructure plain concrete. Estimated amount of concrete, 104.4 cu. yds. Nearest railroad station, Birds, 1¼ miles. All material for the above bridges will have to be shipped in. The roads are usually fair, one team hauls 1½ to 2 tons. Excavation for the above bridges will average about full depth of abutments in a sandy loam and clay. The above bridges are to be placed over a new drainage ditch, so the concrete floor will be made in sections and the field connections on the superstructure will be made with machined bolts that the structure may be easily removed for future cleaning of ditch. Work to be completed on or before September 1, 1911.

✣Bids will be received by M. J. Mullaney, Commissioner of Public Works, Chicago, Ill., until 11 a. m., April 8th, for the construction and erection of a pontoon bridge over the North Branch of the Chicago River at Belmont Ave. The work consists of removing and disposing of present superstructure the center pier and center pier protection of the present bridge, in dredging river channel at bride site in constructing new superstructure, and erecting same including an entirely new scow or pontoon, a center pier, an abutment pier pile clumps, land and water approaches, transferring of movable span from North Ave., repairing same and putting it in place. After present substructure and superstructure has been removed, the river channel 70 ft. wide shall be dredged to a depth of 13 ft. below city datum for a distance of 100 ft. north and 200 ft. south of center line of proposed new bridge. Approximate quantity to be dredged is 15,000 cu. yds. scow measurement. The scow is to be built of dressed yellow pine and oak timber, dressed sides and bottoms of 3-in. planks, surfaced and nailed in 40D nails; all joints to be caulked tight. Machinery for scow to be placed by the city. Pivot pier abutment and approaches to be constructed according to plans furnished contractor. All piles used shall be: Norway pine or cypress, sound and straight, 14 ins. in diameter at butt and not less than 6 ins. at small end of uniform taper and are to be driven with a steam hammer. Payment shall be for piles ordered and delivered by the commissioner and for lineal feet driven below cut off line. Roadway and sidewalk stringers shall be of yellow pine; the roadway floor of movable span shall be of 4-in. oak planks, 8 ins. to 12 ins. wide. All timber used shall be of best quality and free from defects. All steel shall be of uniform quality made by open hearth process. All new and old metal work is to be painted according to specifications. Approximate quantity of timber furnished and built in place: Oak 48,000 ft. B. M., yellow pine 11,000 ft. B. M., white pine 42,000 ft. B. M., piles 10,000 lin. ft., 9,500 lin. ft. pile driving, 15,000 cu. yds. dredging, 6,000 lbs. structural steel. Detailed plans and specifications on file at office of Commissioner. Cash or certified check for $1,000 must accompany proposal.

⦿The Illinois Traction Co., in connection with the extension of its line from Morris to Joliet, has awarded the contract for a large trolley bridge over the Des Plaines River at McDonough St., Joliet, Ill., to the American Bridge Co., Chicago, Ill.

⦿Commissioners of Elm Grove Township and Board of Supervisors, Pekin, Ill., have awarded the contracts for the construction of two small bridges over Creek in Elm Grove Township to Walter Porter, Mackinaw, Ill., at $1,189.

The Santa Fe System plans on renewing or replacing the following bridges: Nos. C 244, [illegible] 2110, 2120, 2134, 2155, Beaumont Division; [illegible] veston Division; Nos. 3031, 3151, 3226, 3233, [illegible] Middle Division; No. 11, Girard District, So. Kansas Division; No. C 26, Howard District, So. Kansas Division; Nos. 21, 31, 40, 65, Bartlesville District, So. Kansas Division; Nos. 108-B, 112 A, Oklahoma Division; No. 39-A, So. Kansas Division, Nos. B 1144, C-1144, D 1144, Valley Division; Nos. 75 and 295, N. Mexico Division.

Officials of the Illinois Central R. R. have plans under way for the construction of a new 1 arch concrete bridge across Salt Creek 2 miles south of Clinton. The cost of the new structure is estimated at $20,000. F. L. Thompson, Chicago, Ill., is Engineer Bridges and Buildings.

An ordinance has been introduced into the City Council of Aurora, Ill., providing for the construction of a highway bridge at Illinois Ave. at the cost of $30,000.

Indiana.

✣Bids will be received until 10 a. m., by Board of County Commissioners, Fort Wayne, Ind., for the construction of a steel bridge of two spans 171 ft. each with 18 ft. roadway and concrete block floor over the Maumee River in Adams Township, known as the New Haven bridge. Calvin H. Brown is Auditor of Allen County.

✣Bids will be received until 10 a. m., April 8, by Board of County Commissioners, Vincennes, Ind., for the construction of a bridge in Palmyra Township and two in Vincennes Township. John T. Scott is Auditor of Knox County.

⦿The Board of County Commissioners at Indianapolis, Ind., has awarded the contract for steel culvert pipe and new culverts needed for repairs to the American Boiler & Sheet Iron Works at $3,400.

Advices from Waverly, Ind., state that fire destroyed the 400-ft. wooden bridge spanning the White River at that place causing a loss of about $8,000. It is probable that a modern steel structure will be installed to replace the old affair.

Board of County Commissioners, Anderson, Ind., have announced that a new bridge will be constructed at 8th St. in Park Pl. some time during the coming Summer. The new structure wil, it is believed, be of concrete.

The following bids were recently received by the Board of County Commissioners, Anderson, Ind., for the construction of two bridges over the White River, one between Madison and Delaware Counties and the other on the Anderson and Union Township line: County line bridge—Rochester Bridge Co., superstructure, $4,381; Attica Bridge Co., $4,040; Elkhart Bridge Co., $6,209; Indiana Bridge Co., $6,625; National Construction Co., $7,999; Pan-American Bridge Co., $6,490 Township line bridge—Rochester Bridge Co., superstructure, $4,000; Attica Bridge Co., superstructure, $4,000; Elkhart Bridge Co., $6,079; Indiana Bridge Co., $6,500; National Construction Co., $7,799; Pan-American Bridge Co., $6,490; Penn Bridge Co., superstructure, $5,350.

Iowa.

The Improvement Association, Greenville, Ia., has voted to ask the city council to take action which would result in the Milwaukee R. R. widening its overhead crossing to the width of the street on Fairmount Ave., between 1st and 2nd Sts. A new bridge over Bacon Creek on Helen Ave. was also recommended.

Committee of citizens of Bettendorf, Ia., has been appointed to petition the County Board of Supervisors for the construction of a bridge over Duck Creek 1½ miles east of Bettendorf on the River road.

Bridge Committee of the Waterloo, Ia., City Council is busy making preparations for the preliminary work in regard to the construction of the proposed bridge at San Souci Park over the river.

Kansas.

✣Bids will be received until noon, April 10, by Board of County Commissioners, Kansas City, Kan., for furnishing all material and labor to lergthen and repair the Fifth St. bridge over the Kansas River. Each bid must be accompanied by a certified check for $1,000. Frank M. Holcomb is County Clerk.

Kentucky.

✣[illegible] 17, by Board of Public Works, Paducah, Ky., for the construction of a reinforced concrete bridge 43 ft. wide and 295 ft. long. Approximate quantities as follows: Excavation, 170 cu. yds. Linear feet concrete piling, 3,720 ft. Concrete in piers, abutments and retaining walls, 514 cu. yds. Concrete in arches, gird-

[illegible] sq. yds. All the above material and work to [illegible] plans and specifications on file at the office of the [illegible] payable to E. J. Paxton, Treasurer, to be forwarded [illegible] Washington is City Engineer.

Maryland.

The Maryland State Road Commission has applied to the Secretary of War for permission to build a bridge across Nanticoke River [illegible] Md. [illegible] will be held before Col. T. L. Casey, U. S. Engineer, Custom House, Baltimore, Md., April 11, on the [illegible]

Massachusetts.

[illegible] South Boston and officials of the New York, New Haven & Hartford Ry. [illegible] the proposed changes in the railroad terminus and facilities: Frederic Fay, Division Engineer, estimated that the change would cost about $[illegible], which with the changes on the South Boston side and the damages already awarded [illegible] company would require an expenditure of $[illegible] to complete the work.

Michigan.

City Council of Kalamazoo, Mich., is preparing for the entire reconstruction of the brick bridge over Portage Creek at Alcott St.

Among the bridge questions under consideration by the city of Grand Rapids, Mich., is the proposition to construct a new concrete bridge at Pearl St. to replace the old structure which is being repaired.

At a recent meeting of the Board of Trade Committee on Public Improvements, Saginaw, Mich., it was determined to support the proposed [illegible] for a new Johnson St. bridge at a cost of $85,000.

Minnesota.

⦿The contract for the construction of the new steel bridge across the river at Dundas, has been awarded by the Board of County Commissioners, Faribault, Minn., to A. Y. Bayne & Co., Minneapolis, at $5,900.

It is reported that, providing the Government Engineers approve the proposed plans, the Chicago Great Western Ry. will construct a new bridge across the Mississippi River at St. Paul, Minn. L. C. Fitch is Chief Engineer of the company at Chicago, Ill.

Nebraska.

⦿The Empire Bridge Co., of Falls City, Neb., has been awarded the contract by the commissioners of Dund County, at Benkelman, Neb., for the construction of a wooden wagon bridge across the Republican River, where public road No. 106 crosses said stream in township 1, range 38, west 6th p. m. Bids were opened March 20.

New Mexico.

✣Bids will be received until April 17, by Lorenzo Deladgo, Probate Clerk, Las Vegas, N. Mex., for the construction of bridges over the Rio Pecos, Rio Gallinas and Arroyo Pecos Rivers.

New York.

⦿[illegible] New York City, has been awarded the contract by Commissioner of Charities, M. J. Drummond, foot of 22d St., New York City, for furnishing all the labor and material required for the erection and completion of bridge, connecting main hospital building with the annex (west of main building); also complete heating, ventilating and plumbing systems in the annex, Kings County Hospital, borough of Brooklyn, the city of New York. The contract price is $[illegible]. Bids were opened on [illegible] and the contract awarded March [illegible]

⦿Board of Supervisors has awarded the contract for the construction of a 2-arch bridge over the Bronx at Bronxville to the O'Rourke Construction Co., Yonkers, N. Y., at $9,227 and another at Tuckahoe to E. J. Doyle & Co., Yonkers, N. Y., at $7,742.

⦿Advices from Falconer, N. Y., state that the contract for the construction of two bridges on South Work St. over the Chadakoin River, has been let to S. T. Benson & Co., of Falconer, at $7,886.48 and the contract for the East Main St. extension bridge was awarded to G. C. Holcomb of Kennedy at $6,500.

An agreement has been reached by the City Council of Buffalo, N. Y., and the officials of the Lake Shore R. R. amending the plans for the new lift bridge across the Buffalo River. The plan originally called for a bridge with a lift span giving an 80-ft. opening for the passage of boats. It was tabled by the Councilmen last October and referred to a joint committee. The new plan provides for a lift span giving an opening of 100 ft. for the passage of vessels, this opening to be out in the channel of the river instead of at one end of the bridge; that the supporting piers shall be out in the river far enough to protect boats lying at the docks near them, and that the railroad shall deed to the city an additional strip of land on the south side of the river. The entire bridge will consist of an approach or tower span of 35 ft., the lift span of 100 ft. and another fixed span of 90 ft. reaching to the south shore.

A resolution appropriating $26,000 for the construction of the proposed new bridge across the barge canal at the foot of Ferry St. in conjunction with the United States Government was referred to the Laws and Legislation Committee of the Aldermen of Buffalo, N. Y. The additional fund is to provide for a structure 30 ft. wide and 8-ft. walks instead of 20 ft. wide and 5-ft. walks as stated in our last issue.

Grade Crossing Commission, Niagara Falls, N. Y., has passed a resolution instructing the Secretary, Frederick Chormann, to take the necessary steps to induce the New York Central R. R. to assist in building a subway or overhead crossing at Whirlpool Ave.

The lowest bid received by the State Superintendent of Public Works, Albany, N. Y., for the construction of the bridge over the canal at a point near Rocky Rift Dam, was that of E. J. Doyle & Co., Albany, $10,364.

North Carolina.

⦿Thos. Sheahan of Weldon, N. C., is the probable contractor for the construction of a 1,000 ft. long, 20 ft. roadway, reinforced concrete arch bridge over Dan River on Union St., in Danville, Va., at 38,810. Bids were opened March 28 by J. O. Magruder, city engineer.

Ohio.

✣Bids will be received until April 12, by Board of County Commissioners, Newark, O., for the construction of substructure of the Cortier bridge over the South fork of Licking River in Lima Township; the superstructure for the same bridge; reinforced concrete arch over Dutch fork in Licking Township; reinforced concrete arch over Quarry run in Licking Township; reconstructing the substructure of the Alfred Wells bridge in Union Township; reconstructing the substructure and erecting the superstructure over a branch of Lake fork in Washington Township; constructing the substructure for the McFadden bridge over a branch of Clear Fork in McKean Township.

⦿F. J. P. Brackett of Glendale, O., has been awarded the contract by the county commissioners, Cincinnati, O., for the construction under Specification No. 165 for concrete bridge on the Sheed Road near the Hanxley Road in Colerain township. The contract price is $1,384. Bids were opened March 24.

⦿George Leonard of Glendale, O., has been awarded the contract by the county commissioners, Cincinnati, O., at $902, for the following county work: Under Specifications No. 164—for new superstructure of bridge on the Springfield pike, near the Allen Hoffman farm, ¼ mile north of Springdale, in Springfield township. Bids were opened March 24.

⦿The Board of County Commissioners, Cincinnati, O., on March 24, awarded the contract No. 165 for the construction of the concrete bridge on Sheed Road near Hauley Road to F. J. P. Brackett, Glendale, O., at $1,383. Fred Dreihs is Clerk.

⦿The Commercial Water Co., Youngstown, O., has awarded the contract for the construction of a bridge over its reservoir at Jackson's Gulch to the Hunter Construction Co., Youngstown, O. The structure will be 400 ft. long and will require 200 tons of structural steel.

Plans are about complete for the construction of the proposed Gilbert Ave viaduct in Cincinnati, O., and bids for the work asked shortly. The contract will be let in two sections, one for the foundation and the other for the superstructure. The entire structure will be built of reinforced concrete. Most of the property purchased by the city for the right of way has been vacated and the buildings will be razed as soon as the contracts have been let.

City of Cleveland, O., has decided upon the reconstruction of the Central Viaduct which has been for some time in danger of condemnation by the U. S. Government. The central pier, on which the draw rests, will be entirely removed. This will give a channel 178 ft. wide instead of the two 67-ft. wide channels now on either side of the draw. In place of the draw a 95-ft. span will be provided. This will enable the largest vessels to pass under the viaduct without the necessity of a draw. Robert Hoffmann is City Engineer.

Oklahoma.

Board of County Commissioners, Muskogee, Okla., are planning to soon let contracts for the construction of 54 county bridges. Estimates are now under preparation by County Surveyor.

The Lexington Auto Bridge Co. has been incorporated, according to advices from Oklahoma City, Okla., with a capital stock of $25,000 and proposes the construction of bridges across the South Canadian River for autos to cross. J. A. Brownell, J. J. Brownell, A. Brownell, all of Lexington, Okla., are incorporators.

Oregon.

✣Bids will be received until 2 p. m., April 24, by F. S. Fields, County Clerk, Multnomah County, Portland, Ore., for the construction of the West Portland bridge.

Citizens of Marion County, Ore., are advocating the construction of a bridge over the north fork of Santiam River between the towns of North Santiam and Shelburn. County Court is to be urged to appropriate the necessary funds.

Pennsylvania.

✣Bids will be received until April 7, by Department of Public Works, Pittsburg, Pa., for the construction of a reinforced concrete bridge on Larimer Ave., crossing Washington Blvd. The cost of the work is estimated about $175,000. Joseph G. Armstrong is Director of the Department. N. S. Sprague is Superintendent of Bureau of Construction.

✣Bids will be received until 1 p. m., April 18, by Commissioners of Northampton County, Pa., for the construction of a reinforced concrete bridge and other work incidental thereto, at Easton, Pa. The structure consists of two 92-ft. spans and one 100 ft. span with an approximate width of 65 ft. Young & Reese, 1 Pomfret Bldg., Easton, Pa., are County Engineers.

Officials of the New York Central Ry. Co. have finally decided to permit the officials of the borough of Avis, Pa., to construct a bridge over its tracks connecting Avis proper with the shops on the opposite side of the company's 39 tracks. The cost of the proposed structure is roughly estimated at $3,500.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

The Philadelphia [illegible] Ry. Co. has suggested a few [illegible] the plans of the proposed new 13th St. bridge, Harrisburg, Pa., which will probably [illegible] two weeks' work on the part of the City Engineer. These changes, however, will not cause any delay in the work.

Directors of the Board of Trade of 21st Ward, Philadelphia, Pa., are advocating the introduction of an ordinance to appropriate $300,000 for the [illegible] bridge over the Wissahickon Ravine on the line of Henry St. to open up the residential section of Roxborough.

Board of County Commissioners, Washington, Pa., recently viewed the proposed site for the bridge across Pigeon Creek at the Catholic church in Bentleyville.

Tennessee.

In compliance with a resolution recently passed by the city council of Knoxville, Tenn., an act will be presented to the Legislature for passage allowing the city of Knoxville to issue $50,000 in bonds for the construction of a new Gay St. viaduct across the Southern Ry. tracks. The structure, if built, will be of reinforced concrete.

Texas.

The Missouri, Kansas & Texas Ry., according to information from Denison., Tex., has offered to pay $10,000, one-third the estimated cost of a viaduct over the shops connecting the South Side with the business part of the city.

An order was recently passed by the Commissioner's Court, Dallas, Texas, authorizing the issuance of bonds in the sum of $5,000 to be used for repairing bridges over the Trinity River in Dallas County.

Virginia.

Advices from Richmond, Va., state that the subcommittee on the James River bridge recently met to discuss the plans for the proposed new structure and formulate a report for the full committee.

According to information received from the Consolidation Coal [illegible] recently awarded the contract to Langhorne & Langhorne, Lynchburg, Va., for the construction of 30 miles of standard gage railroad, they will shortly contract for 38 through girder bridges, varying in span from 10 to 100 ft. The structures to be located along the line from Shelby Creek to the headwaters of Elkhorn Creek in Pike and Letcher Counties, Ky. Frank Haas, Fairmont, W. Va., is Consulting Engineer.

Washington.

⊙Information received from Seattle, Wash., is to the effect that Marks, Russell & Gallagher have awarded the contract for the construction of their bridge over 5th Ave. at Yesler Way to the American Bridge Co. The new structure will be of steel and will be 66 ft. square and similar in construction to the bridge over 4th Ave. a block west.

Scott Calhoun, Corporation Counsel of Seattle, is preparing a resolution providing for the [illegible] West Seattle viaduct, an improvement estimated to cost between $1,500,000 and $2,000,000. The resolution provides for the construction of a wood viaduct on 4th Ave. South [illegible] Holgate St. and Railroad Ave. West to Alki Ave., with a steel bridge over each of the waterways. At Railroad Ave. west and Alki Ave. the proposed bridge will cross Alki Ave. at a height of 60 ft. above that thoroughfare, in order to provide laterals in two directions on easy grades.

Wisconsin.

City Council of Janesville, Wis., now has under consideration the construction of another bridge across Rock River. This structure according to plans will be situated at Racine St. and steps are being taken toward securing the property for approaches. C. V. Kerch is City Engineer.

Town of Metomen, Wis., has petitioned the County Board for an appropriation [illegible] toward defraying the expense of building a new bridge to replace the old Fairwater bridge. The cost of the work is estimated at $1,200.

Canada.

The Welland County Board of Trade, according to information received from Welland, Ont., has passed a resolution endorsing the proposal to erect a bridge across the Niagara River at Fort Erie to Buffalo as a peace memorial.

Preliminary plans prepared for the construction of the proposed viaduct between John and Cherry Sts., Toronto, Ont., by the Grand Trunk and Canadian Pacific Rys. Engineers, have been submitted to the Railway Commission at Montreal. G. A. Mitchell, Toronto, Ont., is Master of Bridges and Buildings for Grand Trunk System.

The Minister of Public Works, according to recent information from Ottawa, Ont., has approved the plans of the Grand Trunk Ry. Co. for its proposed new bridge over Humber River. The company must agree to leave a sufficient opening for the flow of water, and the Department of Public Works will determine the requirements in this respect. At the time of construction the company must, if ordered by the department's district engineer at Toronto, excavate a sufficient amount from the bed of the river at the bridge to insure no diminution in the present area of flow, and if at any time navigation interests demand that this area be increased, the company must bear all the expense of carrying out the department's order for further deepening or widening of the channel. Finally, the company must assume all liability for damages to lands above the bridge through flooding because of ice jams or other causes which might be due to the bridge.

It has been announced by officials of the Canadian Northern Ry. that the company will soon build a new steel bridge over the river at Swan River, Man. The cost of the structure as proposed is estimated at $20,000.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

⊙Lowrance Bros. Co., Memphis, Tenn., have been awarded the contract by the Tensas Basin Levee District for constructing the Lucca Levee located in Desha County, Ark., about six miles above Arkansas City. The work includes about 350,000 cu. yds. of earth work and the contract price was 20.82 cts. per cu. yd. Bids were opened March 30 at the office of the Board of State Engineers, G. W. Lawes, Secretary, New Orleans, La.

Colorado.

The Las Animas Consolidated Drainage District of Las Animas, Colo., is to construct a drainage system for about 2,000 acres of land. Hard burnt clay tile is to be used for the main line, 21 in. being used for the first two miles, 18 in. for the next mile and 15 in. for the balance. This will be the first attempt at drainage on more than a quarter section of land in Bent county.

Illinois.

✣Bids will be received until noon, April 19, by Board of Trustees, East Side Levee and Sanitary District, Sexton Bldg., East St. Louis, Ill., for the construction of an earth levee having a crown 8 ft. wide and a length of 3 miles, being Construction Project No. 2, Section 1 of Front Levee. The work will include the following approximate quantities: 200,000 cu. yds. of earth embankment, 130 lin. ft. of 30-in. cast iron pipe, 10 cu. yds. of concrete and 1 automatic flood gate, 1 hand gate and 1 acre of grubbing. R. D. Silkking is clerk of board.

✣Bids will be received until 2 p. m., April 11, by Commissioners of Maple Grove Drainage District of Lee County, at the office of J. M. Egan, Jr., [illegible] including [illegible] wide [illegible] 000.

⊙J. D. Hietle & Co., of Champaign, Ill., have been awarded the contract by the town of Cerro Gordo, Ill., H. C. Phillips, Town Clerk, for furnishing the following drain tile and [illegible] in., 2,100 ft. [illegible] 13 in., [illegible] tile. Larger sizes to be vitrified. Work to be done under Union Drainage District No. 6. The contract price is $5,700. Bids were opened March 18.

⊙Wm. McNeill, Prophetstown, Ill., has been awarded the contract by the Commissioners of Big Slough Special Drainage District, Prophetstown, Ill., for constructing branch No. 1 in Loraine township, Henry County. The ditch is to be 2 miles long, 6 ft. wide at bottom, 5 ft. deep, requiring about 38,000 cu. yds. of excavation, consisting of muck and sand. The [illegible] Bids were opened April 1. F. W. Sears, Prophetstown, Ill., is engineer.

⊙H. L. DeNeen, Chesterton, Ind., has been awarded the contract at 14 cts. per cu. yd. for excavating the ditches in Mint Creek Drainage District, the work requiring about 50,000 cu. yds. of excavation.

The first hearing on the petition for the establishment of the Hickory Drainage District in Jasper County, Ill., was held on April 4. S. A. Connor & Son, Newton, Ill., are the engineers.

Indiana.

✣Bids will be received until 2 p. m., April [illegible] Ind., for [illegible] J. C. Vanta et al. ditch. The main ditch is 69,660 ft. long, 10 to 25 ft. at bottom, 30 to 50 ft. at top, 6 to 11 ft. deep, requiring excavation of 189,072 cu. yds. Also three open laterals, total length 60,640 ft., bottom width 4 to 6 ft., depth 6 to 11 ft., top width 20 to 30 ft., requiring excavation of 159,000 cu. yds. There will also be about 10 miles of tile work, requiring tile from 8 to 24 ins. Paul Ward, Reynolds, Ind., is engineer.

Surveys have been completed for the proposed drainage ditches and levees along the Patoka and Wabash Rivers. The survey was made from a point near Dongola, several miles northeast of Princeton down both sides of the Patoka to its mouth, opposite Mt. Carmel; thence south along the Wabash to New Harmony, a distance of about 80 miles. The cost of the system of drains and levee is estimated at over $250,000, and it is said that more than 100,000 acres of land would be affected. J. S. Spiker, Vincennes, Ind., is the engineer.

Iowa.

⊙C. J. McElhaney, Coin, Ia., has been awarded the contract at $9,000 for constructing a ditch for Drainage District No. 11 bids for the work being opened March 28 at Sibley, Ia. The controct for the tile work was let to the Sibley Cement Co., Sibley, Ia., at [illegible]

Kansas.

A. G. Taubert, Kansas City, Mo., has a contract from Callahan Bros., eneral contractors, for the construction of a concrete wall about 2,000 ft. long and 16 to 24 ft. high, to be built in connection with the Kaw Valley drainage

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] crete into place.

Louisiana.

[illegible] sidering constructing a levee on the northern side of the town across Bayou Plaquemine.

Washington.

⊙Advices from Seattle, Wash., state that [illegible] were on March 23 awarded the contract for the excavation of nearly one mile of canal between Fremont and Salmon Bay. The excavation will be over part of the construction of the Lake Washington Canal, and the contractors will obtain their pay from an appropriation of $186,000 made by the last legislature. Work is to be started May 1. The contract amounts to about $80,000 and bids for the work were opened some three months ago.

Mexico.

Surveys have been started for the projected canal and irrigation system proposed by the Mariposa Plantation & Irrigation Co. for its [illegible] acres of land near Reynosa, Mexico, opposite Brownsville. J. G. Cunningham, Minneapolis, Minn., is president.

WATER-WORKS

Colorado.

The city council of Colorado Springs, Colo., has authorized the water department to purchase water mains, fire hydrants and other supplies necessary to put the system in first-class shape in the paving district. The material and labor will cost approximately $6,000.

District of Columbia.

Plans for including the cost of a high-pressure fire service in Washington, D. C., in the appropriation estimates for 1912 are being prepared by the District Commissioners and will be forwarded to Congress. The cost of the service will amount to about $750,000.

Georgia.

⊙The water board at Atlanta, Ga., has awarded the contract for furnishing the city with water meters to Thompson Co., for $7.20 per meter, and the Gaman Meter Co., for $7 per meter. The former company will furnish 75 per cent of the meters and the latter 25 per cent. Between 2,500 and 3,000 meters will be purchased during the year.

The citizens of Pelham, Ga., have voted the issuance of bonds to the amount of $25,000 for the extension and enlargement of the water and light plant. It is proposed to use $11,000 of the $25,000 to put in another power unit; $6,000 to extend water mains; $6,000 for a jail and fire department house, and $2,000 for electric lights.

An election is to be held in Swainsboro, Ga., on April 17 for the purpose of voting on the issuance of bonds to the amount of $40,000 for the construction of a water works system and electric light plant.

The mayor and council of Barnesville, Ga., have called an election for April 18 for the purpose of submitting to the citizens of Barnesville the question whether bonds to the amount of $50,000 shall be issued.

Idaho.

An election was held in Weston, Ida., on March 27 for the purpose of voting on the proposition of bonding the city for a water system. The water is to be piped two and one-half miles frcm a spring near the Hans Nelson place, west of the city.

Illinois.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, secretary, until 11 a. m., April 7, 1911, for furnishing and laying water supply pipes as follows: Bishop St. W. 95th St. to 1,030 ft. So. 1,065 lin. ft. 6 in. cast iron pipe, $1,428.18, ass'm't. available; N. Central Park Ave. Division St. to 400 ft. north 430 lin. ft. 8-in. cast iron pipe, $717 75, ass'm't. available; W. 105th St. Vincennes Road to Prospect Ave. 1,240 lin. ft. 8-in. cast iron pipe, ass'm't. available $1,980.80; W. 66th Pl. 300 ft. E. of Central Park Ave. to Spalding Ave. 1,642 lin. ft. 6-in. cast iron pipe ass'm't. available $2,400.20; Vincennes Road, 200 ft. So. of 74th St. to W. 79th St., 3,300 lin. ft. 8-in. cast iron pipe ass'm't. available $4,883; So. Side West End Ave. 49th Ave. to 50th Ave. 750 lin. ft. 8-in. cast iron pipe, ass'm't. available $1,102.90; N. 52nd Ct. Grand Ave. to Belden Ave. 1,841 lin. ft. 8-in. cast iron pipe, ass'm't. available $3,108.90.

✣[illegible] April 11, 1911, by the Board of Local Improvements, Geo Comerford, President, John Forest, Secretary, Cicero, Ill., for furnishing and laying cast iron water pipe connections, etc., in the following streets: 12th St., 60th Ave. to 61st Ave., 16th St., 60th Ave. to 61st Ave., 61st Ave., 12th St. to 16th St. The work consists of laying 3,992 lin. ft. of 6-in. cast iron water supply pipe, 30 lin. ft. of 4-in. cast iron water supply pipe for hydrant connections, 5 6-in. gate valves including valve boxes, 5½-in. fire hydrants with 2½-in. hose couplings, 2 8-in. to 6-in. reducers, 1 6-in.x6-in.x6-in. tee, 1 4-in.x6-in.x6-in. tee, 2 6-in. crosses and 5 6-in. plugs, payment voucher and bond 5 year plan. Plans and specifications on file at office of Town Clerk Chas. Stoeffel. Cash or certified check for 10 per cent of bid must accompany proposal.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., until 11 a. m., April 10, for constructing a 9-ft. tunnel in rock, a shaft, and placing 4 sluice gates to complete the Southwest Land Tunnel extensions. The work consists of pumping all water interfering with the work in Sections 1 and 2, removing a 4-ft. concrete bulkhead in State St. south of 73rd St., constructing one 11-ft. shaft in Oglesby Ave. near 73rd St. complete, lining same with 14 ins. of concrete, in earth and 10 ins. in rock, constructing a 9-ft. tunnel in rock, of horseshoe form, with 10-in. concrete lining from the 12-ft. tunnel in 73rd St., 250 ft. northward under Oglesby Ave. with a 5½-ft. bulkhead, cutting out concrete lining in existing 12-ft. tunnel where Venture shaped are to be formed, reconstructing with reduced cross sections the three 9-ft. tunnels at the 11-ft. shaft and the upper ends of the shafts with extensions, new platforms and covers, one in Yates Ave., about 350 ft. south of 73rd St., one in 73rd St., about 60 ft. west of State St., and one in State St.; installing four 6-in. sluice gates in the above shafts with hoisting mechanisms tunnels and floor thimbles, all of which will be furnished by another contractor, furnishing and installing all iron and steel necessary for hoisting stem guide's platforms, extension of ladder and roofs in the four shafts and a ladder in the Oglesby Ave. shaft. In comparing bids, the tunnel will be assumed as being 250 ft. long, the shaft as 50 ft. in earth and 50 ft. in rock and the amount of iron and steel as 35,000 lbs. The pumping equipment to be installed must be capable of delivering at the street level 700 gals. per minute at each of 3 shafts. The concrete lining is to be composed of 1 1/3 parts Portland cement, 3 parts of torpedo sand and 5 parts of crushed limestone, the whole to be plastered smooth with a mortar of neat cement. Contractors proposing to bid on this work must submit separate bids on the following items (a) pumping and Sections 1 and 2, (b) removing bulkhead in State St., (c) constructing shaft in earth, (d) constructing shaft in rock, (e) constructing tunnel in rock, (f) reducing cross section of tunnel and concrete work at 3 existing shafts, (g) setting four sluice gates with hoisting mechanism complete, including oak tunnel covers, (h) all iron work furnished and set. Full plans and specifications on file at office of the Commissioner of Public Works, 4th floor, City Hall. Cash or certified check for $3,500 must accompany proposal.

⊙The city of Wheaton, Ill., has awarded the contract for the water extension, consisting of 235 ft. of 6-in. pipe, one hydrant, etc., to John Hayes Son's Co., of Naperville, Ill. A. L. Webster is city engineer.

Plans have been prepared by C. A. Redinger, care Southern Railway Co., St. Louis, Mo., for the construction of a new water works system for New Athens, Ill., estimated to cost $28,000. The water supply will be secured from the Kaskaskia river. Contracts will probably be let next month. A. J. Loos is city clerk.

The question of installing a municipal water works system in East Alton, Ill., will be submitted to the voters of the city at the spring election.

The citizens of Morton, Ill., have voted the issuance of bonds to the amount of $4,000 to improve the water plant.

Advices from Carmi, Ill., state that improvements costing more than $3,000 have been planned for the city water works. A new suction pipe will be installed, leading from the river to the pumping house.

Iowa.

⊙Cook Construction Co., of Des Moines, Ia., has been awarded the contract for the construction of a water system in the city of Gettysburg, S. Dak., for $14,000. Bids were opened March 28 by F. M. Wright, city auditor.

⊙Fred Jones has been awarded the contract by the board of water trustees of Ottumwa, Ia., for the building of the clear water basin for approximately $6,000. The basin will be 300 ft. long, 130 ft. wide and nine ft. deep, and will be located by the side of the race below the old filter house. It will hold 3,000,000 gals. of water. The embankment will be 15 ft. high of dirt, and the basin will be of stone.

Louisiana.

⊙The contract for the construction work on the proposed water works plant for Patterson, La., has been awarded to the firm of Kelley & Jones of Opelousas.

Merchants of Kinder, La., have organized the Merchants' Water Works Co., to secure fire protection and street sprinkling. W. C. McNabb is president; John T. Jordan, vice president; J. J. Cole, treasurer, and C. C. Lafleur, secretary. A well will be sunk, and an elevated tank erected and mains laid.

Maryland.

Advices from Frederick, Md., state that a representative of Walter Boardman of Philadelphia, Pa., has begun the preliminary surveys for the contemplated improvements to the water supply of Frederick. The work contemplated will cost about $50,000. It includes the construction of a storage reservoir in the mountain and the repairing of the present reservoir.

Michigan.

⊙The water works and electric light commissioners of Lansing, Mich., have awarded the contract for furnishing a centrifugal pump to the Allis-Chalmers Co., of Milwaukee, Wis. The pump is guaranteed to have a capacity of 3,000,000 gals. A 200 H. P. motor is also included in the contract.

The board of public works of Big Rapids, Mich., has voted to ask the council to submit the question of bonding the city for $30,000 to improve the water works system. The board has recommended that the plan of

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Prof Gardner S W [illegible] Ann Arbor be adopted.

The [illegible] Mountain, Mich., contemplates purchasing the plant of the water works company of that city. The estimated value [illegible] is $175,000 to $[illegible]

Minnesota.

The citizens of Mankato, Minn., at a recent election, voted the issuance of bonds to the amount of $20,000 for the installation of a complete water works system.

The Duluth Engineering Co., 613-14-15 Palladio Bldg., Duluth, Minn., has plans under preparation for the construction of a water works system for Forest Hill cemetery in Duluth, which will probably employ an electric pump and air compressor, using an air pressure storage system. The estimated cost of the work is $5,000

The Duluth Engineering Co., 613-14-15 Palladio Bldg., Duluth, Minn., has prepared plans for the installation of a water works system for Taconite, Minn., to cost about $15,000.

The city council of Stillwater, Minn., has passed an ordinance which provides for creating a board of water commissioners and giving it full authority to manage the plant in the city independent of the council, except that in the issuing of certificates of indebtedness the consent of the council must first be obtained.

Montana.

✣Bids will be received until 8 p. m., April 20, by J. A. Mattson, City Clerk, Helena, Mont., for furnishing all material and labor for the construction of a water works system, reservoir pipe line and distribution system. The work involves headworks with concrete core wall, and approximately 11 miles of 18-in. wooden conduit, 7.4 miles 24-in. wood conduit, 0.8 miles 24-in. steel conduit; 43.4 miles of cast iron mains, 260 hydrants, 283 gate valves, specials, etc., and a storage reservoir, lined with concrete, to hold approximately five million gallons, together with all appurtenances; using about 2,800 cu. yds. of concrete, and requiring about 79,000 cu. yds. class A excavation, 12,000 cu. yds. class B excavation, 222,000 lin. ft. class A trenching and 16,000 lin. ft. class B trenching. Plans and specifications, also forms of contract and proposals may be seen at the office of the City Clerk, J. A. Mattson; also at the office of the City Engineer, Charles W. Helmick, and copies of all thereof obtained upon payment of $5.00. Each bid must be accompanied by a certified check for $20,000, payable to the Mayor of Helena, Montana, as a guarantee.

⊙The U. S. Cast Iron Pipe & Foundry Co., has been awarded the contract by the city council of Lewistown, Mont., for furnishing cast iron water pipe for $48,070; approximately 50,000 ft. of pipe, and the J. B. Clow & Son Co. of Chicago was awarded the contract for furnishing valves for $5,559. Bids were opened March 24.

⊙The city council of Lewiston, Mont., has awarded the contract for iron pipe for the new water works system to the United States Cast Iron Pipe Co., of Chicago, for approximately $50,000. The J. P. Clow Co., of Minneapolis, Minn., was awarded the contract for hydrants and valves to amount of about $4,0000, and the Montana Hardware Co., of Butte, Mont., for jute and lead, amounting to about $3,000.

New Jersey.

⊙The Borough of South River, N. J., has awarded a contract to the Buffalo Steam Pump Co., of Buffalo, N. Y., for furnishing pumps for its water works plant. The pumping equipment consists of two 5-in. two-stage centrifugal pumps each having a capacity of 800,000 gals. of water per day against a total head of 135 lbs. The pumps will be driven by 75 H. P. 1,700 R. P. M. [illegible]

New York.

✣Bids will be received until 8 p. m., April 17, by Board of Public Works, Fulton, N. Y., J. A. Foster, President, for the following: 300 tons 18-in. cast iron pipe, 70 tons 14-in. cast iron pipe; 1,200 lbs. 14-in. standard castings, 5,000 lbs. 18-in. standard castings.

The citizens of Tarrytown, N. Y., have voted in favor of a new storage reservoir, new water mains and a new steam fire engine.

At an election held in Lyndonville, N. Y., March 21, the proposition to install a municipal water works system was defeated.

The citizens of Wolcott, N. Y., have voted in favor of the installation of a water works system.

The citizens of Victor, N. Y., have voted to raise $500 for the purpose of extending and installing water mains on Cedar street.

The board of public works of Geneva, N. Y., has requested that the question of appropriating $4,000 for the installation of a filtration plant be submitted to the taxpayers.

The citizens of Newport, N. Y., have voted the issuance of bonds to the amount of $15,000 for the improvement to the water works system. It is planned to replace the present 4-in. main to the springs, with a 6-in. main.

The citizens of Newark, N. Y., at a recent election voted the issuance of bonds to the amount of $5,900 for water works equipment, and to the amount of $2,500 for extending water mains.

North Carolina.

The citzens of Andrews, N. C., will issue bonds to the amount of $20,000 for the construction of a water works and improving the electric light system.

White & Piatt of Durham, N. C., have been employed by the city of Red Springs, N. C., as consulting engineers in charge of construction work in connection with a water and a sewer system. The estimated cost is $25,000

An election will be held in Tarboro, N. C., on May 1 for the purpose of voting on the proposition of issuing bonds for the installation of a water works system. Jno. A. Waddell is city clerk.

Ohio.

⊙The city council of Lexington, O., has awarded the contract for the installation of a water works system to the National Co., of South Bend., Ind., for $62,165.

Seven distinct types of construction have been considered by the city of Cleveland, O., in connection with the new tunnel that is to be extended from the present lake end of the West Side tunnel, far out to a new intake. The improvement will cost upwards of $1,000,000. It is probable that when bids are called for, specifications for masonry and one other type of construction will be used, so that a comparison of prices can be made. It is reported that the water department will be ready to let the contract in three or four weeks. Robert Hoffmann is city engineer.

The city water works department, Dayton, O., has been granted permission to lay water mains in Wisconsin Blvd., by the city park board.

Oklahoma.

The citizens of Boswell, Okla., voted March 28 on the proposition to issue bonds to the amount of $35,000 for the purpose of installing an electric light plant and water system.

[illegible] voted to draw up a call for a bond election to pass on building an additional dam and to construct a pipe line to Gaines Creek for the purpose of pumping water a distance of about eight miles to the present water works reservoir. The people will be asked to vote to the amount of $150,000

The citizens of Waynoka, Okla., have voted the issuance of bonds to the amount of $27,000 for a new water works system.

An election will be held shortly in Kenefick, Okla., for the purpose of voting on the issuance of bonds for the construction of a water works system.

Oregon.

Advices from Roseburg, Ore., state that J. L. Kendall, owner of the water and light systems of that city, will soon let contracts for the construction of more than eight miles of water mains and laterals. H. J. Frear is manager of the company.

South Dakota.

⊙The city council of Gettysburg, S. Dak., has let the contract for the construction of the new water works system to the Cook Construction Co., of Des Moines, Ia., for $14,000

The city commission board of Vermillion, S. Dak., is considering a proposition to purchase the present water works plant for a consideration of $20,000.

Tennessee.

The Keith, Simmons & Co. have been awarded the contract by the board of public works of Nashville, Tenn., for furnishing 200 6-in., 8-in., and 25 12-in. valves to the water works department for $3,337.

The city council of Newport, Tenn., has called an election for April 29 to vote on the issuance of bonds in the sum of $50,000 for a gravity water supply.

Texas.

✣Bids will be received until April 6 by J. A. Gray, Caldwell, Tex., for the construction of one steel stand pipe 16x100. The cost of the work is estimated at $4,500.

Plans have been prepared by the O'Neil Engineering Co. of Dallas, Tex., for the construction of a new water works for Winters, Tex., estimated to cost $20,000. The water supply will be secured from a creek. Contracts will be let in about 30 or 60 days. W. J. McFarland of Winters has charge of the work.

The city council of Alvin, Tex., has granted a franchise for an up-to-date standard water works system to T. P. Majors and W. C. Hunt of Alvin, and associates. The construction work is to start as soon as the material can be delivered on the ground. The system will cost between $20,000 and $30,000.

Bonds have been voted by the citizens of Archer City, Tex., to the amount of $12,000 for the construction of a water works system.

Utah.

The city council of Ogden, Utah, has approved the mayor's communication suggesting the appropriation of $100,000 to aid in the construction of a reservoir in South Fork canyon.

Louis C. Kelsey, civil and hydraulic engineer, 402 Dooly Bldg., Salt Lake City, Utah, has submitted a report and recommendations to the mayor and city council of Burley, Ida., for the construction of a water works system. It is proposed to obtain the water supply from wells and pump into a steel tower tank. The estimated cost is $45,810.

The commercial club of Midvale, Utah, is agitating the installation of a municipal water works system.

Virginia.

An election has been called in Farmville, Va., for April 18, for the purpose of voting the issuance of bonds to the amount of $65,000 for the improvement and purchase of the present water system.

Washington.

The contract for the construction of the pipe line for the Eastern Oregon State Hospital has been awarded to the G. H. Sutherland Co., of Walla Walla, Wash., for $1.49 per ft., for 52 lb. pipe

West Virginia.

City Engineer C. B. Cook, of Wheeling, W. Va., has finished the platting, laying out and staking the locations for the mains to supply the hilltop residents with water. Wm. J. Scroggins is superintendent of the water works.

Wisconsin.

⊙The board of water commissioners of Watertown, Wis., has awarded the contract for the drilling of the new 800 ft. well on the West Side to J. F. McCarthy, of Minneapolis, Minn., for $1,193. Otto Biefeld & Co. was awarded the contract for laying the pipe

[illegible]

Canada.

✣Bids will be received until 11 a. m., April [illegible]

✣[illegible] until 8 p. m., April [illegible] W. Binkley, Secretary-Treasurer, [illegible] for machinery for pumping station, including two gasoline or oil engines, two pumps, duplex, triplex or turbine; two compression tanks; one air compress together with [illegible] piping, shafting and belting. [illegible] Williams is town engineer.

⊙The following contracts in connection with the new water works system have been awarded by the town council of Souris, Man.: Kitchen Bros., of Souris, at $3,200, for building the power house; M. S. Holmes, of Portage La Prairie, for about $39,000, for all the work in connection with the laying of the water and sewer pipes.

SEWERAGE AND GARBAGE DISPOSAL

Florida.

✣Bids will be received until noon, May 2, by John A. Merritt, Chairman of Board of Bond Trustees, Pensacola, Fla., for the construction of storm water drains and sanitary sewers. The work includes approximately 15,060 lin. ft. of storm water drains from 10 to 66 ins. in diameter; 23,880 lin. ft. of sanitary sewers from 6 to 24 ins. in diameter. A certified check [illegible] must be filed with each bid. George Rommel, Jr., is engineer.

✣Reports from Pensacola, Fla., are to the effect that bids will be opened May 2 in that city for the construction of $100,000 worth of sewers to be laid in that city in the near future.

Georgia.

⊙The city of Dublin, Ga., has let the contract for furnishing three miles of sewer pipe to H. Stevens' Sons of Macon, Ga.

Illinois.

✣Bids will be received until 7:30 p. m., April 5, by Board of Local Improvements, Chicago Heights, Ill., for Storm Sewer No. 3: 5,514 ft. of reinforced concrete sewer pipe from 24 to 42 ins. in diameter; 6,798 ft. of tile pipe, from 15 to 18 ins.; 101 catch basins; 39 manholes; 15 cu. yds. of concrete. W. B. Lennertz is secretary.

✣Bids will be received by the Board of Local Improvements, Cicero, Ill., until 8 p. m., April 11, for constructing sewers as follows: 15th St., 60th Ave. to 61st Ave., and 61st Ave., 15th St. to 333 ft. N. of 13th St., 642 lin. ft. 20-in. tile pipe, including 5 6-in. junctions, average cut 8½ ft., 673 lin. ft. 15-in. tile pipe including 54 6-in. junctions, average cut 8.0 ft., 999 lin. ft. 12-in. tile pipe, 82 6-in. junctions, average cut 9½ ft., 10 manholes including iron covers and lids and 20 catch basins including connections to sewer, catch basin covers and iron lids. Manholes and catch basins to be constructed of concrete. Detailed specifications and plans may be seen at the office of Chas. Stoeffel, Town Clerk. Geo. Comerford is President and Jno. Forest Secretary of the board. Cash or certified check for 10 per cent of bid must accompany proposal.

⊙The Board of Local Improvement of West Dundee, Ill., has let the contract for the construction of the sanitary sewer system to E. M. Scheflow of Gary, Ind., for $11,036.

⊙The contract for furnishing different kinds and sizes of packing to the various pumping stations of the water department of Chicago has been awarded to the Anchor Packing Co., 193 Michigan Ave., Chicago, Ill., at a lump sum of $[illegible]

Indiana.

✣Bids will be received until 7:30 p. m., April 6, by Board of Public Works, Fort Wayne, Ind., for the construction of the following improvements: Construction of a sewer in and along alley east of Franklin Ave. from the brick sewer on High St. to Polk St.: for the construction of a sewer in and along and through the south part of lot No. 3, Haswell's Subdivision, in the alley south of Kinnaird Ave., and in the alley east of Beaver Ave. from Indiana Ave. to Kinnaird Ave. H. W. Becker is Clerk of the Board.

⊙Childs & Sawyer of Kendallville, Ind., have been awarded the contract by that city for the construction of the new sewer to be built in the north part of the city for $6,100.

⊙The Reliable Construction Co., of Indianapolis, Ind., has been awarded the contract by the board of public works of that city for the construction of a local sewer in and along alley north of 32nd St., from Clifton St. to Barnes Ave. Bids were opened March 29.

Iowa.

⊙W. A. Edgar of Cedar Rapids, Ia., at $3,319, has been awarded the contract in Cedar Rapids for the construction of sanitary sewers as follows: 2,005 lin. ft. of 12-in. pipe; 205 lin. ft. of 8-in. pipe; 1,856 lin. ft. of 6-in. pipe, 17 manholes, 3 flush tanks, 20 cu. yds. concrete. Bids were opened March 29.

⊙R. C. De La Hunt of Cedar Rapids, Ia., has been awarded the contract by the City Council of Charles City, Ia., for the digging of a sewer on 5th Ave.

Michigan.

✣Bids will be received until noon, April 12, by Board of Public Works, Dowagiac, Mich., for the construction of sewers within the city as follows: 350 lin. ft. of 12-in. sewer; 432 lin. ft. of 8-in. sewer; 3 manholes; 2 lampholes; 395 ft. of 12-in. sewer; 1 manhole. Official advertisement will be found elsewhere in this issue.

Missouri.

✣Bids will be received until noon, April 14, by Board of Public Improvements, St. Louis, Mo., for letting No. 10162 for the construction of sewers in Glaise Creek Sewer District, Number Four, under authority of Ordinance No. 25361, embracing junction chamber of reinforced concrete and sewers of brick and Portland cement mortar, and of vitrified clay pipe, of the following lengths and sizes, to-wit: 17 ft. of reinforced concrete junction chamber, 5.17 ft. to 8.56 ft. in mean diameters. 170 ft. of brick sewer, 58 ins. in diameter. 354 ft. of brick sewer, 54 ins. in diameter. 441 ft. of brick sewer, 40 ins. in mean diameter. 1,726 ft. of brick sewer, 35 ins. in mean diameter. 1,880 ft. of brick sewer, 32½ ins. in mean diameter. 1,454 ft. of brick sewer, 30 ins. in mean diameter. 1,854 ft. of pipe sewer, 24 ins. in diameter. 1,221 ft. of pipe sewer, 21 ins. in diameter. 3,575 ft. of pipe sewer, 18 ins. in diameter. 3,480 ft. of pipe sewer, 15 ins. in diameter. 9,280 ft. of pipe sewer, 12 ins. in diameter. With sewer inlets, catch basins, manholes and appurtenances. Deposit required $1,600.00.

New Jersey.

⊙The following bids were received by the City Council of Bridgeton, N. J., on March 7, Jacob B. Jones, City Clerk, for the completion of the sewage disposal plants, Clyde Potts, 30 Church St., New York City, Engineer: T. J. McGovern, Trenton, N. J., $20,770; Hard & Worm, $22,364; Bond & McNalley, $22,826; Barber & Perrin, $23,443; J. W. Heller, $23,489, and B. F. Sweeten & Son, $25,682. The contract was awarded to the lowest bidder.

New York.

✣Bids will be received until 8 p. m., April 18, by Board of Trustees, East Aurora, N. Y., for furnishing material and labor for the construction of a sewer system including a sewage disposal plant. The work includes approximately 80,000 ft. of 8 to 24-in. tile, also iron pipe and other appurtenances. Frederick K. Wing, 910 White Bldg., Buffalo, N. Y., is engineer.

⊙The contract for constructing the north section of the Harbor brook intercepting sewer and for improving the corresponding section of the brook, Syracuse, N. Y., has been let to John Young and George C. Dounce, under the name of the Young Contracting Co., for $88,121.

Ohio.

✣Bids will be received until noon, April 11, by Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains with their appurtenances in Price Ave. from Mt. Hope road to Matson Pl. and Matson Pl. from Price Ave. to a point 100 ft. south. Plans and specifications can be obtained of Chief Engineer of Department of Public Service. J. J. Wenner is Clerk of the Department.

✣Bids will be received until noon, April 13 by L. Hall, Clerk, Village of Carthage, O., for the necessary labor and material for the construction of the pump well as a part of the sanitary sewer system. Plans and specifications are on file at the office of the Clerk.

✣Bids will be received until April 14, by Board of Control, Niles, O., for the construction of sewers in District No. 6 including all of the streets in the South Side

✣Bids will be received until 11:30 a. m., May 1, by Board of County Commissioners, Green County, at Xenia, O., for the labor and the necessary material for the construction of a sanitary sewer on the Greene County, Ohio, Infirmary grounds and premises and for the preparatory sewages treatment devices in accordance with the plans, specifications and profiles therefor, now on file in the office of the Auditor of Greene County, and also in the office of A. Elliott Kimberly, Sanitary Engineer, No. 827 Columbus Savings & Trust Building Co., Columbus, Ohio. Walter Dean is County Auditor.

Oregon.

✣Bids will be received until 5 p. m., April 20, by J. W. Jacobs, Recorder, Central Point, Ore., for the construction of a sewerage system for the city. The work will consist of excavating and back filling trenches, hauling and laying water pipe, constructing manholes and inlets. All labor and material to be furnished by the contractor. Plans may be seen and specifications obtained at the office of the city recorder of Central Point, Oregon, or at the office of Osgood & Cummings, civil engineers, Medford, Oregon.

Pennsylvania.

⊙George W. Rockwell of Sunbury has been awarded the contract by the highway committee of the city council of Williamsport, Pa., for the construction of the East End sewer down the Penn St. route, for $20,631. The sewer will be constructed of concrete.

⊙The contract for constructing the sewage disposal plant for Valley Camp, Westmoreland County, Pa., has been awarded to the Pitt Construction Co. of Pittsburg, Pa., and work will be started within 10 days. Chester & Fleming, Engineers, Union Bank Bldg., Pittsburg, have charge of the work.

South Carolina.

✣Bids will be received until April 25, for the construction of about 16 miles of sewers; 35 flush tanks; 220 manholes, etc., in Rockhill, S. C. Thomas W. Cothran, Greenwood, S. C., and Rockhill, S. C., is Engineer in charge.

⊙ indicates a contract let recently. ✣ indicates work now open for bids.

Washington.

✣Bids will be r[illegible] 11 a. m., April 19, by Constructing Quartermaster, Vancouver, Wash., for the [illegible] of an extension [illegible] Vancouver Barracks, Wash.

Wyoming.

✣Bids will [illegible] p. m., May [illegible] Casper, [illegible] [illegible] Lud

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

District of Columbia.

✣Bids will be received [illegible] p. m., April 12, by Treasury Department, Washington, D. C., C. D. Hilles, Assistant Secretary, for building two revenue cutters, to be known while in course of construction or until launched as Nos. 22 and 23, which vessels must, in accordance with the provisions of the act of Congress authorizing the same, be constructed under the eight-hour law.

Illinois.

✣All bids received March 14 by Major C. Keller, U. S. Engineer, Rock Island, Ill., for construction and delivery of 40 steel dredging pontons, complete, were rejected, and the work is now being re-advertised by circular letter, inviting new bids for the construction and delivery of the pontons, to be opened by Major Keller at Rock Island, Ill., April 8, 1911, at 2 p. m. The bids received March 14 were as follows: Des Moines Bridge & Iron Co., Pittsburg, Pa., $59,500; Milwaukee Bridge Co., Milwaukee, Wis., $36,850; Springfield Boiler & Mfg. Co., Springfield, Ill., $47,800; Stupp Bros. Bridge & Iron Co., St. Louis, Mo., $44,975; American Bridge Co. of New York, Pittsburg, Pa., $44,000.

Massachusetts.

✣Bids will be received until April 20, by Capt. J. L. Long, Quartermaster, Fort Strong, Boston, Mass., for furnishing and installing screen doors, screen windows and screen transoms on the following public buildings at that post: New four-set officers' quarters No. 38, new double non-commissioned officers' quarters No. 40, new double artillery barracks No. 42 and new double officers' quarters No. 43. Screens are to be made of wood frames and in accordance with specifications Q. M. G. O., September, 1910.

✣Bids will be received until noon, April 28, by Frederic V. Abbot, U. S. Eingineer, Boston, Mass., for removing the wreck of schooner Davis Palmer in Broad Sound, Boston Harbor, Mass.

✣Bids will be received until noon, April 29, by Col. Frederic V. Abbot, U. S. Engineer, Boston, Mass., for dredging in Weymouth, Fore River, Mass.

Michigan.

✣Bids will be received until 8 p. m., April 6, by board of public works, Grand Rapids, Mich., for furnishing and erecting one traveling crane for the city. S. A. [illegible] secretary and general manager [illegible].

Minnesota.

✣Bids will be received until 11 a. m., April 15, by D. W. Arnold, Quartermaster, St. Paul, Minn., for labor and material for excavation, fill, concrete work and sheds at the target range, Fort Snelling, Minn.

✣Bids will be received until Auril 11, by fire board, St. Paul, Minn., for a motor driven auxiliary wagon equipped with an extension ladder several lengths of hose and manned by 12 men.

Montana.

✣Bids will be received until 11 a. m., April 8, by Lieut. Roy W. Winton, Assistant Quartermaster, Fort Missoula, Mont., for the construction of a hospital of reinforced concrete, including plumbing, electric wiring and fixtures and steam heating.

North Carolina.

✣Bids will be received until April 15 by Drainage Commissioners, Statesville, N. C., for dredging Third Creek Drainage District. Ditch 14.7 miles long, requiring approximately 137,240 cu. yds. of earth. P. P. Dulin is commissioner.

ILLINOIS HIGHWAY COMMISSION.

City of Batavia, Kane County, Illinois.
Wilson Street East Bridge.
NOTICE OF PUBLIC LETTING.

Notice is hereby given that sealed proposals for the work [illegible] described in this notice and more particularly described in the specifications, will be received at the City Hall, by the Mayor and City Council of Batavia, Kane County, Illinois, until [illegible] o'clock [illegible] April [illegible] 1911, at which time and place the bids will be publicly opened and read. Briefly described, the work is as follows:

Building a temporary [illegible] Fox River on line of the alley immediately south of the present Wilson Street East Bridge and maintaining said temporary bridge until the proposed Wilson Street East Bridge is completed and thrown open to traffic. Removal of the present structure on the site of the Wilson Street East Bridge, which consists of a series of stone arches, the piers to be removed to the bed of the stream, the abutments and retaining walls to the ground line, building a new reinforced [illegible] bridge across the Fox River on Wilson street on the site known as the Wilson Street East Bridge. Said bridge to consist of three reinforced concrete arch spans, totaling in length about [illegible] width over all about 60 feet.

More detailed information may be obtained by an examination of the plans on file at the office of the City Clerk of Batavia, Illinois, or which may be obtained upon application to the Illinois Highway Commission, Springfield, Illinois.

A charge of two dollars ($2.00) will be made for each set of plans and specifications to cover the cost of preparing and mailing the same.

The work to be completed on or before November 1, 1911.

Springfield, Illinois, March 20, 1911.

By order of the City Council of the City of Batavia, Kane County, Illinois.

W. H. REANEY, City Clerk.

STORAGE DAM.

Salt Lake City, Utah.

Sealed proposals will be received by the Pacific Reclamation Company, at the office of their Consulting Engineer, George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah, until noon of Saturday, April 15, 1911, for the construction of a Storage Dam about fifteen miles north of Wells, Nevada.

The dam will be of earth and rock fill with a reinforned concrete facing on the up-stream side. The principal quantities are:

20,000 cu. yds.	earth excavation.
3,000 cu. yds.	rock excavation.
71,000 cu. yds.	earth embankment.
6,000 cu. yds.	dry rubble wall.
1,250 cu. yds.	Portland cement concrete.
85,000 lbs.	steel reinforcing.

A certified check for $2,500.00 must accompany the bid, and a bond of $15,000.00 will be required for the faithful performance of the contract.

Form of proposal, contract and specifications may be had by applying to George M. Bacon, 159 Pierpont Ave., Salt Lake City, Utah.

PACIFIC RECLAMATION COMPANY,
Joseph Gutman, President.
George M. Bacon,
Consulting Engineer.

THE TRENTON IRON CO.
WIRE AND WIRE ROPE
TI
CO
AERIAL TRAMWAYS
TRENTON, N.J.
WRITE FOR OUR
RED BOOK

Washington, D. C., Feb. 25, 1911.

Sealed proposals will be received at the office of the U. S. Reclamation Service, North Yakima, Wash., until 10 o'clock a. m., April 15, 1911, for the building of Kachess dam and accessory structures near Easton, Wash. The work involves the excavation of approximately 345,000 cubic yards of material, the placing of about 240,000 cubic yards of embankment, 15,000 cubic yards of riprap and paving, 8,000 cubic yards of concrete, and 300,000 pounds of reinforcing steel, and other items necessary to complete the work. For particulars address the United States Reclamation Service, Washington, D. C., or North Yakima, Wash. R. A. BALLINGER, Secretary.

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REINFORCED CONCRETE BRIDGE.

[illegible]

[illegible]

Cast steel hinges, 11,090 lbs.
Lamp posts, 8.
Waterproofing, 720 sq. yds.
[illegible]

[illegible] City of Paducah upon monthly estimates, [illegible] ceptance of the work.

[illegible] furnished and done in accordance with plans and specifications on file at the office of the City Engineer. Each bid [illegible] check for $1,000.00, payable to E. J. Paxton, Treasurer, to be forfeited to the [illegible] shall fail to enter into contract in accordance with his proposal, should his proposal be accepted by the Board of Public Works. Any one desiring copies of plans and specifications can obtain same from the City Engineer upon the receipt of an accepted check for $5.00 payable to E. J. Paxton, City Treasurer.

Proposals must be made on blanks attached to the specifications.

The Board reserves the right to reject any and all bids; to waive any informalities, and accept any bid considered advantageous to the City of Paducah.

By order of the Board.

L. A. WASHINGTON
City Engineer.

SEWERS.

East Aurora, N. Y.

Sealed proposals will be received by the Board of Trustees of the Village of East Aurora, N. Y., at their office in the East Aurora Club in said Village until eight o'clock p. m. on April 18, 1911, for the [illegible] of labor for the construction of a sewer [illegible] Village of East Aurora, according to plans and specifications on file in the office of the Clerk of said Village.

[illegible] feet of sewers ranging from eight-inch tile to twenty-four-inch tile, also iron pipe and other appurtenances, together with [illegible] plant. The Board of Trustees reserves the right to let the contract for the sewers and the disposal plant separately or [illegible] the Village.

[illegible] of East Aurora, N. Y., drawn on an incorporated Bank or Trust Company, satisfactory to said Treasurer, in a sum not [illegible] of said bid.

[illegible] Clerk's office and at the office of the Engineer, Frederick K. Wing, 910 White Building, Buffalo, N. Y. Bids must be made on blanks provided by the Board of Trustees of the Village. Intending bidders may obtain copies of the specifications, bidding sheet, form of contract and bond, upon application to the Village Clerk and on payment of $1.00.

In the preparation of the bid, the rates, extensions and footings may be expressed in figures alone, as called for in the form, but the amount of the bid, which must equal the sum of the extensions must be expressed in words as well as figures as called for. Inaccuracy in extensions of footings will be deemed a sufficient cause for rejection of the bid.

ALFRED BROTHERHOOD,
President.
ALBERT O. ZINK,
ELBERT HUBBARD II.,
Trustees.
D. N. RUMSEY,
Village Clerk.
FREDERICK K. WING,
Engineer.
910 White Building,
Buffalo, N. Y.

WATERWORKS IMPROVEMENTS.

Ada, Okla.

Sealed proposals will be received by the City Clerk of Ada, Okla., at his office in the City Hall, until 8 o'clock p. m., April 10, 1911, for the furnishing of pipe and machinery to be used in the extension and improvement of the waterworks system of Ada.

Bids will be opened before the City Council the same evening and bidders are invited to be present and to submit bids on the following items:

For the pipe required for the construction of approximately 63,000 linear feet of 12-inch pipe line, either of steel or cast iron.

If cast iron pipe is used the amount required will be about as follows: Class "B" pipe, 246 tons; Class "C" pipe, 2,062 tons; Class "D" pipe, 750 tons; total, 3,058 tons.

If steel pipe is used 66,000 linear feet of 12-inch O. D. Converse joint pipe will be required.

Bids will also be received on 3,000 linear feet of steel pipe, 3/16 inch thick and 30 inches in diameter.

Also on cast iron pipe for extensions to the city mains, all class "B" approximately as follows: 12-inch pipe, 135 tons; 10-inch pipe, 124 tons; 8-inch pipe, 63 tons; 6-inch pipe, 142 tons; total, 464 tons.

For special castings, about 15,000 pounds.

For furnishing and erecting on foundations to be prepared by the city two pumping units, each unit to consist of one horizontal turbine water wheel, direct connected to a multi-stage centrifugal pump, each unit to have a capacity of 600 gallons per minute against a total head of 185 feet.

Plans, specifications, form of contract and proposal and full information may be obtained from the Consulting Engineers, Goodwin & Harper, 920 Scarritt Bldg., Kansas City, Mo.

Each proposal must be accompanied by a certified check of not less than 5 per cent of the amount bid, made payable to the City Treasurer of Ada, Okla., as a guarantee that the bidder receiving the award will enter into contract with the city and furnish satisfactory bond within ten days after the contract is awarded.

The city reserves the right to reject any or all bids, to waive any informality, and to award the contracts as may be deemed to the best interests of the city.

W. B. JONES, City Clerk.

Dated March, 1911.

BRICK PAVING.

OFFICE OF THE COMMISSIONERS,
Portage County, Ravenna, Ohio,
March 28, 1911.

Sealed proposals will be received at the Office of the Commissioners of Portage County, Ohio, until 12 o'clock, noon, May 1, 1911, for the grading and paving with brick 2.12 miles of road in Ravenna and Shalersville Township, said County, under the provisions of "The Dodge Act" so-called.

Specifications, plans and profiles are on file in the Office of the County Surveyor in Ravenna, Ohio.

Certified check, $1,000.00.

The Commissioners reserve the right to reject any and all bids.

W. J. DODGE,
County Auditor.

WATERWORKS.

Helena, Mont.

Sealed proposals will be received at the City Hall, Helena, Mont., until 8 p. m., Thursday, April 20, 1911, for furnishing of all material and the construction of a waterworks system, reservoir pipe line, and distribution system for the City of Helena, Mont., all according to plans and specifications.

The work involves headworks with concrete core wall, and approximately 14 miles of 18-in. wooden conduit, 7.4 miles 24-in. wood conduit, 0.8 miles 24-in. steel conduit, 43.4 miles of cast-iron mains, 260 hydrants, 283 gate valves, specials, etc., and a storage reservoir, lined with concrete, to hold approximately five million gallons, together with all appurtenances, using about 2,800 cu. yds. of concrete, and requiring about 79,000 cu. yds. class (A) excavation, 12,000 cu. yds. class (B) excavation, 222,000 lineal feet class (A) trenching, and 16,000 lineal feet class (B) trenching.

Plans and specifications, also forms of contract and proposals, may be seen at the office of the City Clerk, J. A. Mattson; also at the office of the City Engineer, Charles W. Helmick, and copies thereof obtained upon payment of $5.00.

Each bid must be accompanied by a certified check for $20,000.00, payable to the Mayor of Helena, Mont., as a guarantee that bidders will, if successful, promptly execute a satisfactory contract and bond, as specified and required, with satisfactory surety in the sum of one hundred and fifty thousand dollars, for the faithful performance of the contract.

The right is reserved to reject any or all bids, and also to waive any technical defects.

Bidders are invited to be present. Proposals must be marked "Proposals for Construction of Water Works System for Helena, Mont.," and must be made out in the form within, and be accompanied by the printed specifications.

By order of the City Council.

J. A. MATTSON,
City Clerk.

Dated, 1911.
First publication, 1911.

PROPOSALS FOR METAL.—U. S. Engineer Office, Vicksburg, Miss., March 15, 1911. Sealed proposals for furnishing about 307,000 pounds of structural metal, for use at locks and dams Nos. 4 and 8, Ouachita River, Ark. and La., will be received at this office until noon, April 14, 1911, and then publicly opened. Information on application. CLARKE S. SMITH, Capt., Engrs.

CONSTRUCTION OF RAILROAD BRIDGES.

OVER CAHOKIA CREEK DIVERSION CHANNEL, MADISON COUNTY, ILL.

Office of [illegible] Trustees
The East Side Levee and Sanitary District, [illegible] Building
East St. Louis, Ill., [illegible] 11, 1911

Sealed proposals [illegible] duplicate for the construction of Five (5) Railroad Bridges over Cahokia Creek Diversion Channel, in Madison County, Illinois, in accordance with Ordinances [illegible] and 15 of The East Side Levee and Sanitary District and the plans and specifications for the same, now on file in the office of said District, will be received at this office until twelve o'clock noon, standard time, April 25, 1911, and then publicly opened. Copies of plans and specifications may be had on application by mail or in person. All proposals must be made on the printed forms prepared by The East Side Levee and Sanitary District.

DESCRIPTION

The work included in the contract covers the construction of three (3) single track, deck plate girder bridges, each having five (5) spans, [illegible] feet in length, one (1) single track deck plate girder bridge, five (5) spans, fifty-eight (58) feet in length, and one (1) double track deck plate girder bridge, five (5) spans, sixty-four (64) feet in length.

Each bridge will have two (2) abutments and four (4) piers, about twenty-five (25) feet high, on pile foundations. Two of the bridges, in addition to the double track bridge, will be constructed with piers and abutments [illegible] for a future second track. Two of the single track bridges will have reinforced concrete decks.

All five bridges are located along Cahokia Creek Diversion Channel in Chouteau Township, Madison County, Illinois, and are about three (3) miles North of Mitchell, Illinois.

Proposals should be based on the following estimates:

Structural steel, [illegible]
Concrete, 5,[illegible]
Piling, 30,000 lin. ft.
Steel reinforcement, [illegible]
Guard rail, 12,800 lbs.
Creosoted timber, 13,500 ft. B. M.
Wet excavation, 2,000 cu. yds.
Dry excavation, [illegible]

Proposals [illegible] accompanied [illegible] form of [illegible] factory banking institution in the City of East St. Louis, [illegible] St. Louis, Missouri, and payable at sight to the President of The [illegible] for [illegible] per cent) of the amount of the proposal. [illegible] tract with The East Side Levee and Sanitary District [illegible]

[illegible]

blank forms which can be inspected at this office and will be furnished, if desired, [illegible]

Parties making bids are to be understood [illegible] such form of contract.

Upon completion of the work according to the contract, plans, specifications and agreements as determined thereunder by the engineer, including extra work when [illegible] accordance with the terms and conditions of the contract, the said engineer shall make to the contractor, a statement setting forth [illegible] and contractor, together with the amount due the said contractor therefor, and shall certify the same in writing under his hand. The obtaining of the certificate of the engineer as to the work done, and the price thereof, shall be a condition precedent to the right of the contractor to be paid the sum due him under the terms of this contract.

The Board [illegible] right to reject any and all bids.

[illegible]NTON,
President Board of Trustees, The East Side Levee and Sanitary District.

EARTHWORK.

MAPLE GROVE DRAINAGE DISTRICT.

Sealed proposals will be received by the Commissioners of the Maple Grove Drainage District, of Lee County, Illinois, at the office of J. M. Egan, Jr., Amboy, Ill., Engineer of said District, until 2 o'clock p. m., on the eleventh day of April, A. D. 1911, at which time and place said proposals will be publicly opened.

The work for which the proposals are desired consists of the construction of 34,000 lineal feet of open ditch, 30 feet wide, with a total estimated excavation of 260,000 cubic yards of earth.

Each bidder must deposit with F. N. Vaughan, Secretary of the Commissioners of said District, cash or a certified check on some national bank or state bank of Illinois, equal to not less than 5 per cent of the amount of his bid. The successful bidder will be required to file a personal or surety company bond for the sum of ten thousand ($10,000.00) dollars, which bond shall be subject to the approval of the Commissioners.

Work shall be begun within twenty days after the awarding of the contract and be completed by March 1, A. D. 1912. Payments will be made in cash, monthly, upon the estimate of the Engineer.

Plans and specifications may be seen at the office of the County Clerk, Dixon, Ill.; at the First National Bank, Amboy, Ill., or at the office of J. M. Egan, Jr., Civil Engineer, Amboy, Ill. Specifications may be had upon request to J. M. Egan, Jr., Amboy, Ill.

The Commissioners reserve the right to reject any or all bids.

Dated this 17th day of March, A. D. 1911.

Commissioners:
C. F. WELTY, President,
Amboy, Ill.
WILLIAM ANDERSON,
Ohio, Ill.
F. N. VAUGHAN, Sec'y,
Amboy, Ill.
Attorney, C. H. WOOSTER, Amboy, Ill.
Engineer, J. M. EGAN, JR., Amboy, Ill.

PAVING.

[illegible]

Engineer.

Contracts will be let for each street separate.

[illegible] tified check for at least 10 per cent of the amount of the bid, and the right is [illegible]

[illegible]

SEWERS.

The Board of Public Works of the City of Dowagiac hereby gives notice that proposals will be received until twelve o'clock noon on the 12th day of April, 1911, for the construction of sewers within the City of Dowagiac as follows:

(1) 350 linear feet of 12-inch sewer.
432 linear feet of 8-inch sewer.
3 manholes.
2 lamp holes.
(2) 395 linear feet of 12-inch sewer.
1 manhole.

Said sewers to be constructed according to plans, specifications and diagrams of the City Engineer now on file in the office of the City Clerk.

Bids to be separable so that award may be made as to (1) and (2) of said sewers separately.

A certified check of at least five per cent of the largest amount bid by each bidder must accompany the bid or proposal, the same to be forfeited if bid is accepted and bidder neglect or refuse to enter into a contract.

The Board of Public Works reserves the right to reject any and all bids.

Bidders shall furnish to the City of Dowagiac surety bonds for the performance of contract, for labor and materials and for proper construction.

Dated March [illegible], 1911.

WILLIAM T. EASTON,
Clerk.

CONSTRUCTION EQUIPMENT.

Separate or bulk tenders on prescribed forms, will be received, by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, April 11, for the delivery of the following:

(1) Two (2) full circle swing traction steam shovels, one and a quarter (1¼) yard dipper.
(2) Six (6) saddle tank locomotives, 36-in. gauge.
(3) Forty (40) [illegible] dump cars or [illegible] three yard (3 yd.) dump cars, 36-in. gauge.
(4) Four (4) double truck flat cars, 36-in. gauge.
(5) (a) Two [illegible] tons [illegible] steel rail.
(b) Twenty [illegible] No. [illegible] leads.
(c) Seventy-five (75) kegs of spikes.
(d) [illegible] plates.
(e) [illegible]

[illegible] plainly marked on the outside as to contents.

Specification and form tender may be obtained upon application from Department of Railways, Bridges and Docks, City Engineer's Office, Toronto.

[illegible] sarily accepted.

[illegible]

Chairman Board of Control, City Hall, Toronto, March 27, 1911.

U. S. ENGINEER OFFICE, Duluth, Minn., March 15, 1911.—Sealed proposals for dredging in Ashland Harbor will be received at this office until noon, April 15, 1911, and then publicly opened. Information on application. GRAHAM D. FITCH, Lt. Col. Engrs.

[illegible] Ill., March 25, 1911. Sealed proposals for dredging in Indiana Harbor, Ind., will be received here until 10 a. m., April 15, 1911. Information on application. GEO. A. [illegible]

U. S. Engineer Office, Duluth, Minn., March 20, 1911. Sealed proposals for dredging at Superior Entry, Duluth-Superior Harbor, will be received at this office until noon, April 20, 1911, and then publicly opened. Information on application. Graham D. Fitch, Lt. Col. Engrs.

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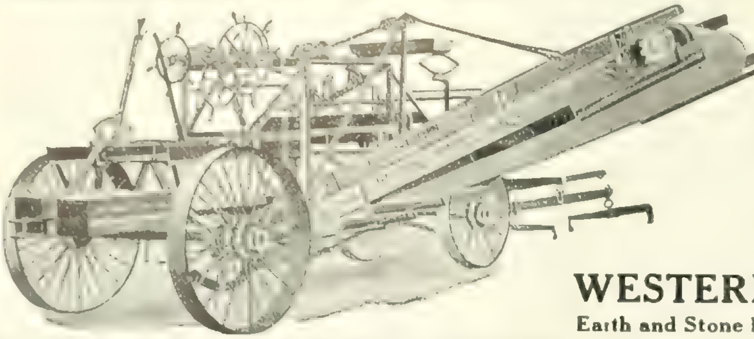

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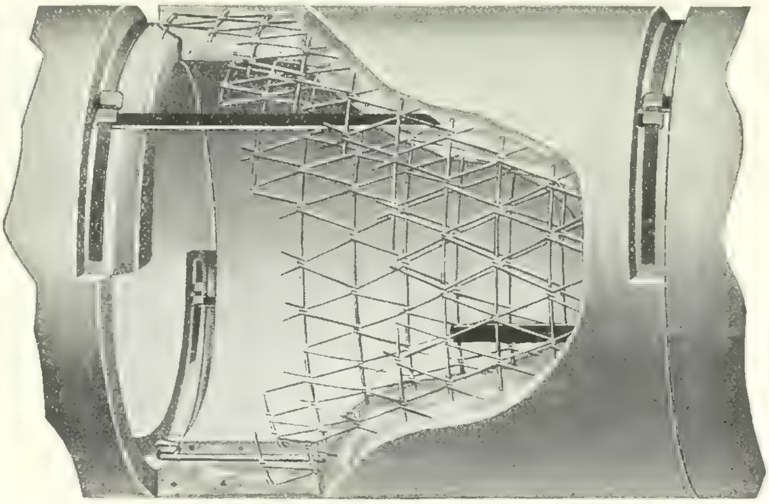

From the above illustration it will be seen that the *lower half* of the joint is joined and cemented from the interior of the pipe; while the arch, or upper portion of the joint is connected from the exterior.

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Entered as second-class matter, April 17, 1907, at the Post Office at Chicago, Illinois, under act of March 3d. 1879.

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Government by Commission for States as Well as for Cities.

What state will be the first to abolish legislatures and adopt the commission form of government? The recent adjournment of farcical legislatures in many states leads us to ask this question. Perhaps the state that will be first to break away from the existing form of legislative government is Washington. Many of its large cities are now ruled by commissioners selected at large and without regard to party politics. The transition to a similar form of government for the state will therefore be an easy step, and a desirable one.

Practically the only branch of the state government in Washington that has "made good" in the eyes of the public is the railroad commission, which has just received enlarged powers and becomes a full fledged public utilities commission having authority over city railways, electric and gas lighting corporations, telephone and telegraph companies, as well as electric interurban and steam railways. Yet the Washington legislature could not keep its hands off the railways and leave their regulation to the only competent body in the state, the railroad commission, but passed a law compelling railways to place a "full crew" on every train. The "full crew" law was urged by railway labor unions, and was passed by the legislature simply because it was expected to win votes. Its merits received no investigation, nor could they receive an investigation worthy of the name at the hands of a legislature unacquainted with railroads or railroading. So the steam railways of Washington are saddled with an unnecessary expense of approximately half a million dollars yearly — provided the "full-crew" law shall be held to be constitutional.

Not only does this law furnish a good object lesson as to the incompetence as well as injustice of state legislatures, but it serves also to indicate why railways have had to take a hand in politics in the past as a matter of self protection. The railways in Washington had retired from politics, but a few more such acts of unfairness by legislatures will doubtless force the railways to enter the political arena again.

We foresee that until log-rolling, wire-pulling, pork-barrel, vote-seeking legislatures are completely abolished there can be no safe retirement of public-service corporations from politics. We foresee that the public that has had a taste of purer politics by virtue of the retirement of railways from that field will not be long in making up its mind about abolishing the present form of state legislatures.

Many state legislatures, as in the state of Washington, met only once in two years, and that is about the only praiseworthy feature of their character—it shortens the mischief-making period. But in the sixty days or so of their session an amazing amount of foolishness is enacted into law. Likewise a very considerable amount of needed legislation is generally left undone, due to the squabbles of men representing different districts of the state. To illustrate again with the Washington legislature, we have the failure to make an appropriation for state roads, in spite of the fact that all were agreed that an appropriation of about two million dollars should be made. Factional fights over the distribution of the appropriation resulted in a deadlock, and the legislature adjourned without providing for the much-needed and much-desired road work.

However, a new state-road law was passed, and incidentally it is about the poorest law of its kind that has been devised in any state up to date. It robbed the state highway commissioner of all real control of state-aid road work. This was done at the instance of county commissioners who were eager to have a hand in the road "pork barrel." All in all, the law is a legal monstrosity such as no man having much knowledge of road work or road management would father.

Aside from the commendable raising of the salary of the state highway commissioner to $5,000 a year, there is nothing to praise about the recent legislative action on roads in Washington state.

It is unfortunate that every voter in a state can not be present during the session of at least one state legislature, for such an experience is a liberal education itself in political economy. The education consists mainly in learning what not to do. First, it is strikingly apparent that a large body of men elected to represent districts of a state can rarely come to any decision that is not the result of dickering. Second, it is equally apparent that so large a body of men must necessarily have few who are well informed on any subject that comes up for consideration. Between [illegible] and the misfortune of ignorance, there is not much likelihood that even honest men will reach logical or fair decisions.

The recent legislature of Washington was composed of as clean and competent a set of men as are ever elected to state legislatures. But the system under which laws are made by men selected to represent districts is wrong. It is just as wrong for a state as for a city. It has evolved the "pork barrel." It has led to the political rules of corporations in the past and will continue to engender the same thing in the future. The commission form of government for states offers the only available solution of the perplexing problems of state government.

Shaft Sinking in Water Bearing Fissured Rock by Grouting the Fissures.

In sinking shafts in America in cases where the work cannot be kept dry by ordinary pumping methods, resort has usually been had to compressed air. Compressed air methods appear not to have been employed much in Europe where, however, there has been a remarkable development of the freezing process and of the Kind-Chaudron "boring" and the "drum" or open caisson processes, which are scarcely known in American practice. The second and third European methods are essentially soft ground methods, but the freezing process has found frequent employment in Europe in water bearing fissured rock shafts. A few years ago there was also developed in Europe the direct cementation method or the method of cement grouting the water carrying fissures, and two noticeable American examples of this method are described in this issue and in our issue of two weeks ago (March 29, 1911). It is interesting to study this newer method in comparison with those of older development.

As stated above the "boring" and the "drum" methods, as employed in Europe, are essentially soft ground methods. This is virtually true of the pneumatic caisson or compressed air method employed in America; the purpose of the caisson has been in most cases to carry the shaft to rock and there stop, after which the sinking continued in rock by ordinary drilling, blasting and lining methods, the air pressure being maintained or not as circumstances advised. Frequently the caisson has been sunk without using air pressure (see ENGINEERING-CONTRACTING, March 2 and May 18, 1910), by open excavation, a method somewhat analogous to the "drum" method employed in Europe. In these cases, however, the caissons have commonly been designed to receive a working chamber roof and compressed air fittings which were not used merely because they were found unnecessary under the conditions. The "drum" method as employed in Europe involves no consideration of compressed air but consists in sinking a "drum" or lining of masonry or metal having a cutting edge by a combination of pressure on top and dredging through .water inside and under the cutting edge. By the "drum" method the shaft is not unwatered until virtually completed.

Freezing and grouting are particularly methods for wet rock shafts. The freezing method is the older of the two having been first successfully employed in Germany in 1883. Perhaps the earliest important use of grouting was in sinking a colliery shaft at Lens, France, in 1904-5, where it was employed in one of two shafts sunk simultaneously, the freezing process being employed at the companion shaft. A description of this work will be found in the Transactions of the Institute of Mining Engineers of Great Britain for 1905. Briefly, at a depth of 166 ft., two fissures were met, one nearly vertical in the shaft bottom and one crossing the shaft horizontally. Pipes reaching down from the surface were inserted in these fissures and in addition eight holes were drilled outside the shaft area and in a row encircling it to a depth of 197 ft. Pumps were operated on the bore holes while grout was fed into the shaft pipes until they were filled, or, as was the

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[illegible] the pipe in the [illegible] the lower end [illegible] blocked [illegible] were then filled. After a [illegible] to allow the grout to harden the water was pumped out and excavation continued without incident until at a depth of 185 ft. the vertical seam which [illegible] grouting [illegible] flow again. [illegible] were again inserted in the seam and grout was run into them until they became closed. After 25 days the shaft was again laid dry and sinking was continued to the bottom.

The next European example of [illegible] which more than a mention is had, was a shaft at the Lievin collieries in France. This work is described by Mr. L. Morin in *Annales des Mines* for 1907. Here a bed of water bearing chalk was encountered at considerable depth and for a depth of 84 m. (275 ft.) grouting was required. The method was as follows: A saucer shaped diaphragm of cast iron segments was fitted into the shaft which was circular and 6 m. (20 ft.) in diameter, the water being kept down by pumping while the diaphragm was being placed. This diaphragm had eight holes around its edge through which drills were worked; pipes were inserted in these drill holes and carried up to the top of the shaft and grout poured into them. When the grout had set hard the diaphragm was removed and excavation continued. A second influx of water lower down made it necessary to insert the diaphragm again at the lower level and to grout a second time. Altogether, as stated, grouting was required for 84 m. (275 ft.) in depth. The cost of the grouting operation is given by Mr. Morin as follows:

	Francs
[illegible]	7,416
[illegible] diaphragm	3,466
[illegible] cement	1,[illegible]80
[illegible] and injecting	3,683
M[illegible]	1,391
Total	20,[illegible]
[illegible] and accessories	18,637
[illegible] and operating pumps	30,117
[illegible] pumping expenses	11,911
[illegible]	10,0[illegible]
[illegible] time lost	1,[illegible]
Total	[illegible]
Grand total	93,0[illegible]

The cost, it will be seen, was 1,107 francs per meter of depth, or say $67 per foot of depth. Mr. Morin states, however, that salvage on the machinery employed reduced the net charge to 900 francs per meter depth, which is roughly $58 per foot depth, or $4.75 per cu. yd. of excavation.

Turning to the two American examples of shaft grouting described in this issue and in our issue of March 30, 1911, it will be seen that the chief variation from the European work described consisted in the use of direct pressure to force the grout into the water bearing material. At the Rondout Siphon shaft, described in this issue, pressures as high as 275 lbs. per sq. in. were employed. The experience at this shaft agrees with that in the European works described, that it is difficult to grout water bearing strata or fissures from the bottom up. The grout collects in the upper portions of the mass or of the rock fissure and then hardens and seals the drill hole before the voids lower down are filled. This makes necessary successive groutings as the shaft is sunk. To overcome this obstacle to grouting deep holes Mr Francis Donaldson suggests* casing the drill holes with flush jointed pipe to the bottom and gradually withdrawing this casing as the grout is pumped in.

Though the grouting method has been comparatively little used its comparison with the freezing process is natural. Altogether several scores of shafts have been sunk by the freezing process. Riemer† lists 64 as completed or in process of sinking in 1907, only one of which is in the United States and two in England. This authority mentions as the principal objections to the process: the bursting of the freezing pipes letting the freezing solution impregnate the surrounding material and render it impossible to freeze further, and the deviation of the bore holes from the vertical in deep working. Various resorts have been tried for overcoming these objections but none has proved entirely satisfactory. Riemer also questions the possibility of effective freezing at great depths.

The grouting process it may be assumed will be as effective, other things being equal, at one depth as another, and it, of course, does not have the other objections named above. If the difficulty of grouting deep holes from the bottom up can be overcome the process would seem to be greater in promise of general success and applicability than any other process which has been extensively used.

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*"Practical Shaft Sinking," McGraw-Hill Book Co., New York, N. Y.

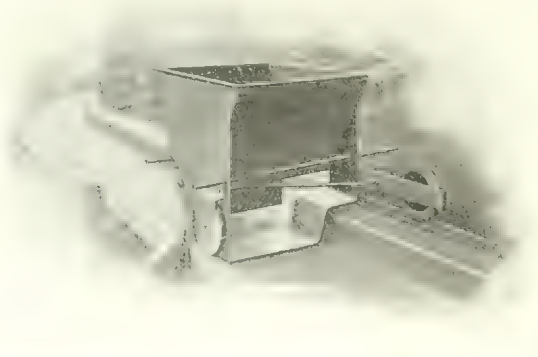
†Shaft Sinking in Difficult Cases by J. Riemer. Translated by J W Brough. J B Lippincott Co Philadelphia

CONCRETE AND REINFORCED CONCRETE SECTION

A Machine for Applying the Finishing Coat on Concrete Curb and Gutter.

The accompanying illustration shows a machine which has been successfully employed in placing and finishing the mortar surface coat of concrete curb and gutter. In operation the body or base of the curb and gutter is placed in the usual manner and using the usual forms. Angle iron rails are then lightly nailed to the edges of the outside forms and the machine is mounted with its grooved wheels on these rails. The hopper being filled with mortar, the machine is pulled ahead and the mortar feeds out at the bottom and is shaped and finished by the template shown.

The machine, as will be seen, consists of few and simple parts. The finishing plates are made of phosphor bronze to the section desired. They weigh 80 lbs., and the [illegible] 75 [illegible] capacity of the machine is enough mortar to apply a 1-in. coat to 30 lin. ft. of gutter and curb of ordinary sections. The machine can be pulled by two men or one man with a snatch block can operate it. It will work around curves of large radius without change and can be arranged to take curves of fairly short radius but it is not designed to finish corners at street intersections. The standard machines are built for the following sections of curb and gutter: 6x6x18 ins.; 6x6x24 ins., and 6x6x30 ins. Special machines are built for any required section desired.



Machine for Finishing Concrete Curb and Gutter.

One of these machines was used by the Meacham Contracting Co., Hopkinsville, Ky., during 1910, in laying curb and gutter at Henderson, Ky. The following information about this work has been furnished by the contractors: The curb and gutters were 6x6x30 ins. and the progress with the regular gang finishing by hand was 350 to 400 ft. per day. With the machine this progress was increased to 900 to 1,000 ft. per day. The following are actual costs for finishing 930 lin. ft. on Fifth St.:

1 foreman, 5 hrs. at 35 cts	$ 1.75
1 engineer, 5 hrs. at 25 cts	1.25
2 finishers, 10 hrs. at 25 cts	5.00
2 laborers, 5 hrs. at 17½ cts	1.75
9 laborers, 5 hrs. at 15 cts	6.75
Total	$16.50

This estimate includes mixing, placing, and finishing the top coat.

These figures give a cost of 1.77 cts. per lineal foot. for labor only.

The machine described is made by Thomas L. Barret, Louisville, Ky.

Suggested Specifications for Reinforced Concrete Water Tanks for Railway Water Supply.*

The tank shall be of reinforcel concrete, as shown on the drawings.

The capacity of the tank shall be within the limits of 50,000 and 106,000 gals., exclusive of the lower 20 ft. of the tank. The height of the tank from bottom to top of shell shall be 40 ft. A diameter of 30 ft. is recommended. On this basis the drawings have been made. The latter shall be made to meet the requirements of the height and diameter selected by the engineer.

The tank is designed to deliver water to locomotives through water columns. The floor of the tank shall not be lower than the tracks served.

In earth, the excavations for the foundation and pipes shall be as deep as the lowest frost line, with a minimum depth of four ft. In rock, only the trenches for the pipes shall be carried below the action of frost. In earth, the bottom of excavations shall be thoroughly tamped to discover and compact any soft places. If the earth will not sustain the total load, including wind pressure, without material or unequal settlement, the foundation shall be supported on piles of the number, size and arrangement as determined by the engineer. Such piles shall conform to the specifications of this Association for piling, as selected by the engineer.

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*Extract from report of Committee on Water Service, American Railway Engineering and Maintenance of Way Association

The foundation shall consist of a disk of concrete, as shown. If the depth of frost is excessive, this disk may be carried on broken rock compacted in the bottom of the excavation, but the minimum vertical thickness of the concrete foundation, exclusive of the tank floor, shall be 42 ins.

The valve box for the piping shall be constructed as a part of the foundation, as shown. The top and bottom of the box shall be reinforced by steel rods laid both ways and doubled around the pipes and the manhole. The manhole frame shall be in one piece of first-class cast-iron with a double seat and a double cover. The latter shall preferably be of wood. When low temperatures require, to prevent freezing within the valve box, an air space shall be constructed in the middle of that portion of the box walls outside of the tank foundation. When the absence of low temperatures permit, the air space and the lower manhole cover may be omitted.

The reinforced concrete floor on the foundation shall be constructed, as shown, giving its surface a sidewalk finish without plastering.

The reinforced concrete shell shall be constructed, as shown, building in the concrete fillet in the angle at the bottom.

The reinforced concrete roof, including manhole and cover shall be constructed, as shown, finishing top of roof as specified for the floor. Where ice will not form to an injurious or troublesome extent and sunlight will not cause vegetable growth in the water, this roof may be omitted at the discretion of the engineer.

The tank shall be equipped with cast-iron piping and standard gate valves, as shown. There shall be a tank supply pipe, a water column supply pipe, an overflow pipe and a washout pipe, the latter two being combined in the valve box beyond the valve closing the washout pipe. There shall be no valve in the overflow pipe. For a gravity supply, the tank supply pipe sh [illegible] to the top of the tank and be capped by a float valve. The washout pipe shall terminate flush with the tank bottom. The water column pipe shall extend several feet above the bottom but not higher than the top of the water column. All piping shall pass through the bottom of the tank, preferably in cast-iron stuffing boxes with lead joints, as shown, but other forms of stuffing box and joint may be used. All pipes and castings, in quality, manufacture and inspection, shall fulfill the requirements of the specifications of the New England Water Works Association for cast-iron pipe. The weights and diameters of the pipes shall be determined by the engineer. No pipe shall have an inside diameter less than 4 ins.

The cast-iron sludge pipe shall be carefully constructed, enclosing in the concrete and doubling the reinforcing rods around it, as shown. When absence of sediment in the water justifies, this pipe may be omitted.

The tank shall be equipped with a gage, indicator and float, according to the design or selection of the engineer.

The steel ladder shall be constructed, as shown and as designed, or selected by the engineer. The ladder shall be carried by connecting straps or angles resting on the roof. It shall not be anchored to the tank shell. The steel shall conform to the specifications of this Association for steel bridges.

The concrete in the tank foundation and the side walls of the valve box shall be a 1-3-5 mix, made and laid in accordance with the specifications of this Association for Portland Cement Concrete.

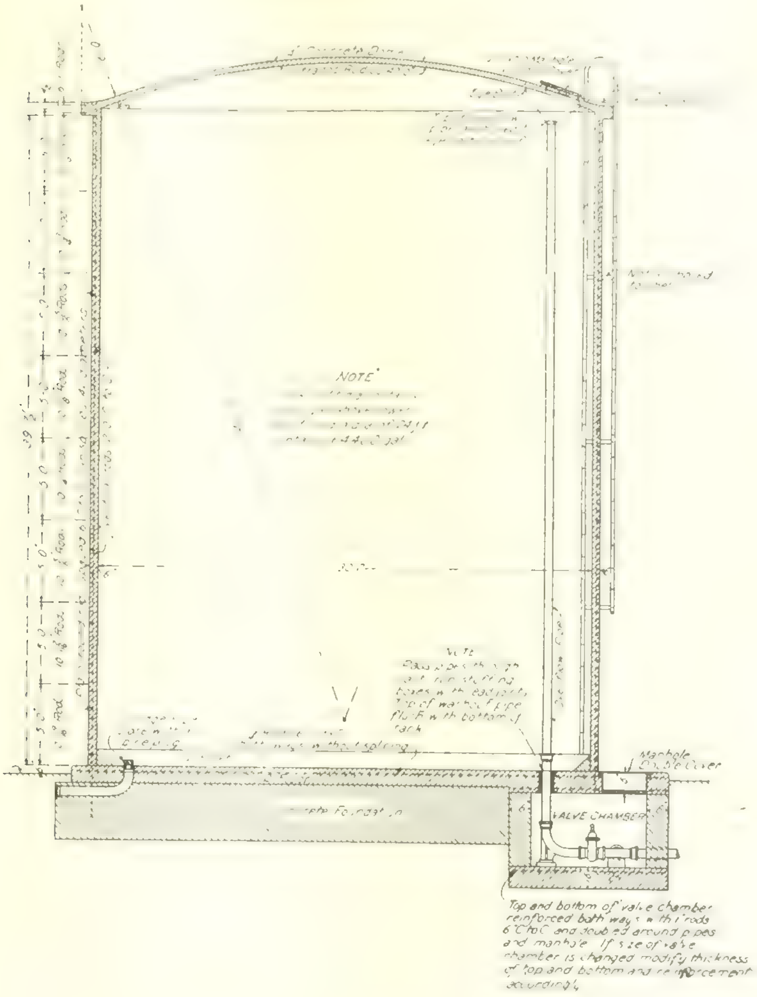

NOTE
Manhole
Double Cover
VALVE CHAMBER
Top and bottom of valve chamber reinforced both ways with rods 6" C to C and doubled around pipes and manhole. If size of valve chamber is changed modify thickness of top and bottom and reinforcement accordingly.

Fig. 1—Standard Reinforced Concrete Tank Construction for Railway Water Supply.

The top and the bottom of the valve box and the tank floor, shell and roof shall be made of reinforced concrete.

Reinforced concrete shall be a thoroughly uniform mixture of cement, sand, stone and water completely enveloping the reinforcing rods.

The volume of the sand shall be 5 per cent in excess of the volume of the voids in the stone. The volume of the cement, considering 100 lbs. of it as 1 cu. ft., shall be 25 per cent in excess of the volume of the voids in the mixed sand and stone. The engineer shall determine the voids and proportions.

The volume of the water shall be sufficient to give the concrete a fluidity that will cause it to flow and mould itself in the forms without tamping.

The concrete shall preferably be mixed by mixing machines. The method used shall yield a complete and even mixture.

All dirt and foreign matter shall be excluded from all materials, concrete and stages of the work.

The concrete, after mixing, shall be poured and worked into final position in the forms before its initial set is complete, and it shall not thereafter be disturbed. As it is thus placed, it shall be thoroughly worked by long, flat, thin-bladed tools in a manner that will eliminate all voids and air pockets and produce unbroken mortar faces against all forms and secure perfect contact with every part of all reinforcing rods.

The surface of concrete shall be clean and wet when concrete is laid thereon. The surface, if hardened, shall also be mopped with cement grout immediately in advance of placing fresh concrete. Smooth or finished mortar surfaces shall be avoided where additional concrete is to be placed. If necessary, as in the joints between the tank floor, shell and fillet, old surfaces shall be tooled, cleaned and grouted before concrete is placed thereon.

A rapid drying out of concrete shall be prevented by regular, frequent and continued wetting until all danger of arrested setting and hardening is past, as the engineer shall direct.

Freezing of concrete before it has finally set shall be prevented.

Any concrete broken or displaced in any manner after having set shall be removed from the work.

The cement shall conform to the specifications of this Association for Portland Cement. It shall retain its original purity and qualities until it is incorporated into the work. Deteriorated or otherwise damaged cement shall not be used.

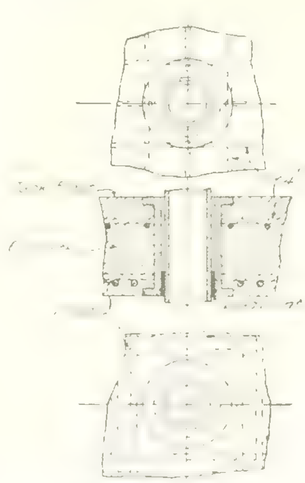


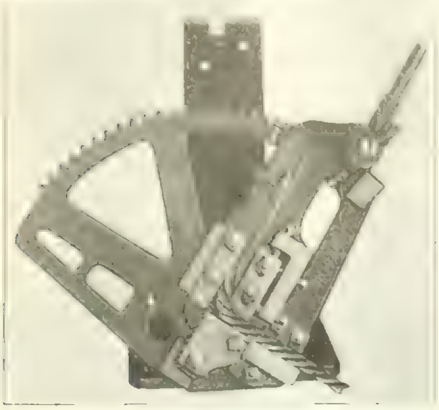
Fig. 2—Detail of Stuffing Box Passing Pipe Through Tank Bottom.

The sand shall be clean, sound and sharp and it shall be of graded sized grains giving a minimum of voids.

The stone shall be clean, sound and durable. The word "stone" includes broken rock and gravel. The stone shall be of graded sizes giving a minimum of voids. All of it

[illegible]

The concrete forms shall be made of metal or of dressed and matched lumber. They [illegible] ity to prevent bending and warping under the load and action of the concrete. They shall be erected in such sections and courses as will permit the concrete to be poured and worked as above specified. No device for holding the forms that would leave a hole through the concrete shall be used. Wires passing through the concrete shall be nipped off beneath the concrete face.



Bar Bending Machine.

Any break in the concrete surfaces not impairing the integrity of the structure shall be pointed with cement mortar, as the engineer shall direct. Any other imperfections in the concrete shall be treated and remedied as the engineer shall direct.

The concrete shall be reinforced by steel rods of the form, size, number and arrangement, as shown. They shall be wired at intersections with each other and be maintained in required position as they are buried in the concrete, at which time they shall be free from dirt and scale. Splices in rods shall be lapped 42 diameters or sides. No splice shall be opposite a splice in an adjacent line of rods. Throughout the splice the ends of the rods making it shall be 1½ diameters or sides apart in the clear. There shall be not more than four splices in the circumference of a tank 30 ft. in diameter. Unnecessary splicing shall be avoided.

The reinforcing rods shall be plain or deformed. Their tensile strength per square inch shall be between 60,000 and 90,000 lbs. Their elastic limit shall be not less than one-half of their tensile strength. They shall not be stressed more than one-third of their elastic limit. Any rod shall be capable of being bent cold on a radius of three diameters or sides through 180° without sign of fracture.

A dense even mixture of concrete as herein specified for reinforced concrete shall be the primary expedient to secure water-tight concrete. This may be supplemented by mixing with the cement some form of waterproofing compound of proved efficiency and now obtainable from manufacturers.

Where the concrete can be worked before it has set, the surface shall be thoroughly troweled until a dense mortar face is secured. Concrete surfaces already set may be plastered by a rich cement mortar, but surfaces so treated shall first be cleaned and roughened by steel brushes or equivalent, and the plastering shall be applied on a fresh coat of cement grout mopped on the surface.

In addition, if necessary, separate and alternate washes of soap and alum in the order named shall be applied to the dried and hardened surface. The number of washes should be not less than two of each, with a 24-hour interval between each. The proportions should be approximately ¾ lb. of soap and ⅛ lb. of alum per gallon of water. These proportions may be varied if better results are thereby secured. The soap wash shall be applied boiling hot, without causing frothing. The alum wash should have a temperature between 60° and 80°.

In lieu of these washes approximately 1 per cent. by weight, of powdered alum may be evenly mixed with the cement, in which case the same proportion of soap shall be dissolved in the water in making the concrete.

Instead of soap and alum, waterproofing paint having an asphalt base to be applied hot or cold, and now obtainable from manufacturers, may be used. In all washing or painting the concrete surface treated shall be dry and clean and the temperature should be above the freezing point.

The weight of water shall be assumed to be 63 lbs. per cu. ft. Wind pressure, acting in any direction, shall be assumed to be, in pounds, thirty times the product of the height by two-thirds of the diameter of the tank, in feet.

A Device for Bending Reinforcing Bars for Concrete.

The accompanying view shows a bar bender capable of bending cold high carbon steel reinforcing bars up to 1¼ ins. in size. The view shows the bender as if looking down from directly above. The bender is set horizontally when in use, being mounted on a special cast iron stand or bolted to any suitable bench or staging. A glance shows the method of operation. The lever, which is 36 ins. long, operates a pinion which meshes into the rack and which gears with the rack in the ratio of about 12 to 1. As will be seen the dies can be adjusted to different sizes of bars by set screws. One man can operate the bender. This bender is made by the Wallace Supply Co., of Chicago, Ill., and is listed at $115, complete, with stand or at $100 without the stand.

The British engineering papers are reporting the following performance in metal cutting: One man employed by the Knowles Oxygen Company, Ltd., cut through 42 girders, 15x5 in. section, in 4¾ hours, with a consumption of less than 200 ft. of oxygen and 300 ft. of hydrogen. Reckoning labor at 1 shilling per hour the cost figured out 6 pence per cut.

An Air Blast Apparatus for Depositing Concrete and Mortar Mixtures.

The accompanying drawings show the details of a machine recently patented which is used for the purpose of depositing concrete by the use of compressed air. The method of forming a concrete wall consists of projecting cement, sand and water simultaneously, with force against a wall or other surface. The material adheres to the surface upon which it is thrown and is gradually built out to the desired thickness.

Figure 1 is an elevation of one form of the apparatus showing the receptacle for dry material, the air drum and the water tank. The sand and cement are mixed in a proportion of about 1:3 and placed in the material drum. It is fed through a hole in the bottom of the drum into the hemispherical pockets of the feed regulating wheel and drops into the conical shaped chamber below, which terminates in the hose carrying the material to the nozzle. The air drum is connected to the conical shaped chamber and an equalizer pipe connects this chamber with the material drum. The water tank is also connected with the air drum so that the water and material is forced to the nozzle under the same pressure. Figure 2 is a section through the feed chamber taken at right angles to the section shown by Fig. 1. Figure 3 shows one form of nozzle used with the apparatus. In this type of nozzle the material is blown through the center pipe and the water enters a chamber surrounding this pipe uniting with the material just at the point of leaving the nozzle. The air pressure used depends upon the density of the mixture desired, from 30 to 40 lbs. per sq. in. being sufficient for all ordinary purposes. The operator stands several feet from the surface to be covered.

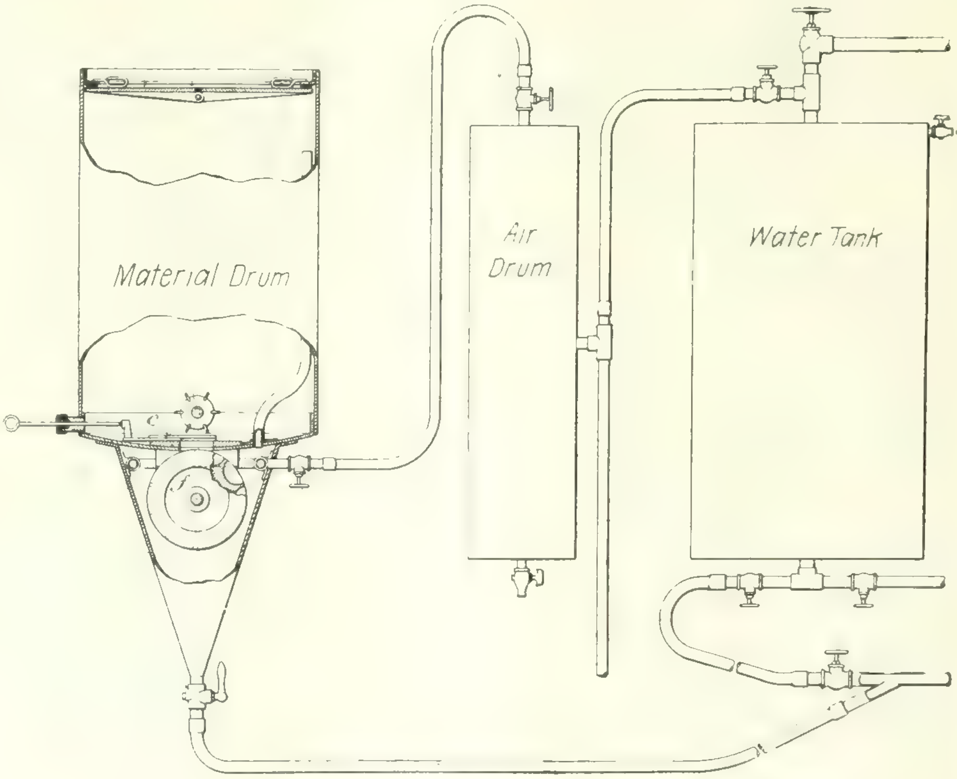


Fig. 1—Side Elevation Air Blast Apparatus for Depositing Concrete.

One of the first pieces of work done with the apparatus was the coating of the Field Museum at Jackson Park, Chicago. This building was one of the old stucco structures of the World's Fair and contains 38,000 sq. yds. of surface which was coated about 1-16 in. thick. The highest point which was covered was about 180 ft. above ground. An ordinary painter's scaffolding was used for the work, some parts being worked from ladders. The work was accomplished in 36 days with a gang of 5 men, consisting of 1 engineer, 2

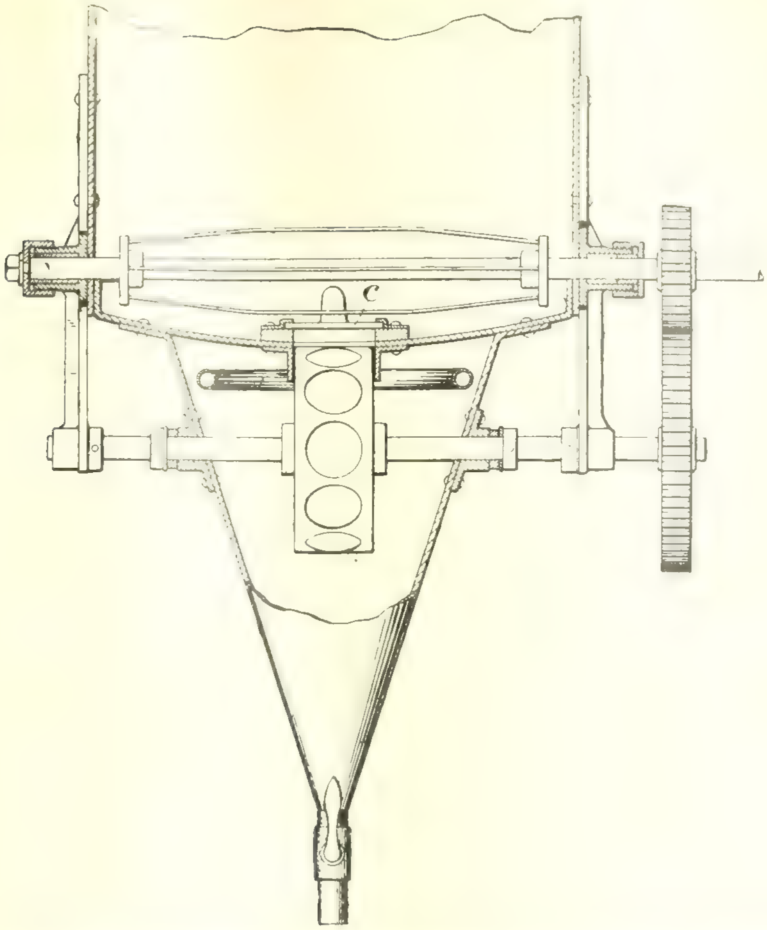


Fig. 2—End Elevation of Air Blast Apparatus for Depositing Concrete.

feeders and 2 nozzlemen. This was at the rate of 1,055 sq. yd. per day for the entire work.

Other examples of the work with this machine have indicated that a wall 1-in. thick and 200 sq. yds. in area can be made in a day.

In practice the cement is shot against a surface made of building paper, covered with a coarse wire netting. The cost of this material, the cement and sand necessary for a 1-in. wall and the labor of putting it on is estimated to be between 15 and 18 cts. per sq. yd. of surface.

The apparatus is the invention of Mr. Carl Akeley, of Chicago. It is known as the "Cement Gun" and is owned by the General Cement Products Co., 30 Church St., New York.

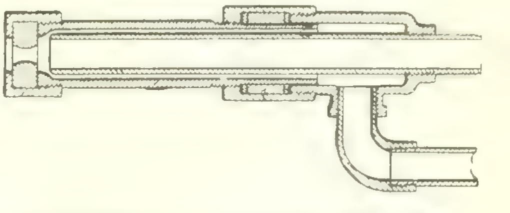


Fig. 3—Nozzle of Air Blast Apparatus.

Assistant Chemical Engineer in Forest Products. The U. S. Civil Service Commission announces an examination on May 24, 1911, at a number of cities in each state, to fill a vacancy in the position of assistant chemical engineer in forest products at a salary of $1,200 to $1,500 per annum. This is in the Forest Service, for duty at Madison, Wis. Applications must be executed and filed with the Commission at Washington by May 13, 1911.

EARTH AND ROCK SECTION

Method of Constructing Short Small-Bore Tunnels Through Clay for Telephone Connections.

The method of making connections from the buildings in the business district of Chicago to the main cables in the tunnel of the Illinois Tunnel Co. is usually by means of a 4-in. iron pipe used as a conduit. This pipe runs vertically from the basement of a building to the level of the Illinois Tunnel and joins a horizontal pipe running to the tunnel.

The former method of placing these pipes consisted in digging a pit for the vertical pipe and then driving a pipe from the tunnel to meet it. The pipe from the tunnel was forced through the clay by means of jacks. The connection between the two pipes was then made in the pit. This method has now been reversed and instead of digging the pit for the vertical pipe, this is driven down with a hand pile driver and for the horizontal pipe a 3-ft. drift, lined with 8-ins. of concrete, is made from the tunnel to the vertical pipe.

The vertical pipe is fitted with a conical point and is plumbed in the position it is to occupy and driven down. The driver consists of a 12x12 in. wood block about 4 ft. long which is suspended in a pair of leads. This is lifted by means of a rope running over a pulley at the top of the leads and down to the four men who hoist and drop the hammer. Two other men are required to hold and guide the pipe. The gang consists of a foreman and five men. Preparing and driving a 30-ft. pipe in Chicago clay takes this gang about one day.

The drift from the main tunnel to the vertical pipe requires a gang consisting of one foreman and five men. The tunnel wall is cut through and the drift is excavated with clay knives to a circular section 4 ft. 4 ins. in diameter for a distance of [illegible] Concrete is then placed in the invert and steel forms are erected. The forms consist of sheet steel with angle iron flanges. They are made in three sections to the circle and are 18 ins. long. The concrete is packed in above the forms from the open end.

After the excavation has proceeded a few feet a narrow gage track is laid and the excavated material is placed on a platform car on this track and pushed back to the main tunnel where it is hauled away in larger cars.

The materials for [illegible] the work [illegible] mixed by hand. The [illegible] averages about [illegible] of these [illegible] Geo. W. Jackson [illegible]

Cost of Operating a Small Steam Shovel in Clay.

A brick plant [illegible] 000 brick per day can easily be supplied with clay by a 25-ton shovel of the revolving type. This is demonstrated by the Macon (Ga.) Brick Co., which has a Vulcan revolving shovel of the above weight. This company manufactures from 50,000 to 60,000 brick per day which requires about 100 cu. yds. of material. The shovel is equipped with a ¾-yd. dipper. The dipper handle is 12 ft. long and will dump 12½ ft. above the rail. It will clear a floor 32 ft. wide and make a cut 40 ft. wide in a six-ft. bank. It swings through a full circle. The Macon Brick Co. informs us that they employ the following men in their work:

1 engineer [illegible]	[illegible]
1 helper [illegible]	[illegible]
2 [illegible]	[illegible]
Oil, waste, [illegible]	[illegible]
Coal [illegible]	[illegible]
Plant [illegible]	[illegible]
Total	$9.55

This total of $9.55 brings the cost of 100 cu. yds. to 9½ cts. a yd. The shovel is in operation only a part of the time and could furnish twice as much clay from the 8-ft. bank if the clay were needed.

Methods of Sinking a Wet Shaft on the Rondout Pressure Tunnel of the Catskill Aqueduct.*

The first pressure tunnel of the Catskill aqueduct for New York City water supply [illegible] under contract [illegible] the Rondout Valley near High Falls, N. Y. There are 8 shafts on the Rondout Syphon, ranging in depth from 371 to [illegible] [illegible] Shaft No. 1 was sunk to [illegible] grade with out any great difficulty.

The total depth of this shaft is [illegible] drift, 226 ft. of Helderberg limestone, 39 ft. of Binnewater standstone, 92 ft. of High Falls shale, and 134 ft. of Shawangunk grit. The Helderberg limestone is a hard, dark gray rock, with layers of flinty material and few seams; the Binnewater sandstone is a soft, greenish, fine-grained rock of a high general porosity, and with numerous open water-bearing seams; the High Falls shale is a soft rock, thin-bedded in horizontal layers, with numerous seams, and varying in color from light green to red; the Shawangunk grit is an exceedingly hard, white, quartz conglomerate. The shale and sandstone grade into [illegible]

The contract was [illegible] June 12, 1908, and

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*Condensed from "Sinking a Wet Shaft," by John P. Hogan, Proceedings American Society of Civil Engineers, Vol. xxxvii, p. 308.

Excavation of Shaft No. 4 [illegible] July 20, 1908, [illegible] rotary plant. Less than [illegible] air was turned on from the large central plant. The shaft, being for construction purposes only, is rectangular, 10x22 ft. over all. It is timbered throughout with 10x10-in. wall plates, 6x8-in. buntons and 2-in. lagging, making its size 8x20 ft. inside the timbers. It is divided into three compartmnets. Four No. 12 tandem Cameron sinking pumps, each having a capacity of 450 gals. per minute, and two No. 10 having a capacity of [illegible] gals. per minute, were arranged for the emergency pumping plant, and, pending delivery, several No. 7 and No. 9 Cameron sinkers were kept in reserve.

The shaft was dry to a depth of [illegible] ft. [illegible] on Sept. 2, the water rushed in from the bottom through the 4-in. bore-hole at an estimated rate of from 600 to 800 gals. per minute, and the shaft was filled to within 40 ft. of the top. As the emergency plant had not then been delivered, a simple air-lift was installed which at first threw 1,600 gals. per minute. As the efficiency decreased, due to lack of back pressure, two more stages were added, and, with the aid of two No. 9 sinking pumps, the water was lowered to within a few feet of the bottom. A 4-in. swedged nipple was then driven into the hole, and casing was attached. It was decided to grout the bore-hole, and a 1-in. pipe was let down inside the hole to the grit and extended to the surface. The shaft was then allowed to fill up, to equalize the pressure and prevent flow, and 1:1 grout was poured down the 1-in pipe, while the latter was raised gradually. When the hole was filled to the top with grout, the 1-in. pipe was withdrawn, the shaft was unwatered, and sinking was resumed.

From this point to the bottom of the limestone the shaft was so dry that occasionally water had to be carried down to mud the drills. It was realized, however, that a large quantity of water under heavy pressure was present in the lower strata, and serious doubt began to be felt as to the possibility of sinking this shaft by ordinary methods. The contract called for grouting behind the lining of the completed tunnel, with a pressure of 300 lbs. per sq. in., and the delivery of this apparatus was hastened.

At a depth of 215 ft. the shaft entered the Binnewater sandstone, and in this formation the water gradually increased until, at a depth of 260 ft. the shaft was making 225 gals. per minute. This was handled by two No. 9 Cameron sinkers. While the sump was being drilled, on Dec. 20, 1908, an additional flow of about 600 gals. came in through one of the drill holes under considerable pressure, quickly drowned out the sinking pumps, and flooded the shaft to within 70 ft. of the top. Preparations had been made to plug any water-bearing hole, but the flow was of unexpected force and volume. It is interesting to note that the water, at this time and later when the shaft was flooded, rose to a lower elevation each time, indicating that the pumping had considerable effect on the general water-table.

A long delay now ensued before sinking was resumed. A single-stage life, having an 8-in. discharge and 2-in. feed, lowered the water to within 60 ft. of the bottom, throwing from 600 to 350 gals. per minute. A second stage of the same size was then installed, discharging into the first 100 ft. from the bottom. This had an initial capacity of 500 gals per minute, and lowered the water to within 30 ft. of the bottom. A third stage was added, and, with the aid of two No. 12 Cameron sinkers, each having a capacity of 450 gals per minute, the bottom was unwatered on Jan. 24, 1909, the No. 9 Cameron pumps were recovered, and the hole was plugged with a 2-in. swedged nipple and gate-valve. A gage on the pipe indicated a pressure of 75 lbs. Drilling was resumed for the purpose of finding the location and extent of the water-bearing seams, the holes being plugged with pipes and valves as water was encountered. On Feb. 3, 1909, while one of the pumps was temporarily out of commission, [illegible] water. The discharge hose broke on the second pump, when speeded up, and the shaft was again flooded and the pumps drowned. This was the beginning of a series of troubles with the pumps which will be described in detail later. Due to their great weight, the high head, and the consequent force of their pulsation, these pumps gave continual trouble with their discharge lines, and discharge and suction hose pipes. These troubles were minimized later by fastening them to the timbers and by improvements in the quality of the equipment, but the sinking pumps could never be relied on for satisfactory service on heads greater than 200 ft.

The pumps were recovered by using the air-lift and an additional No. 12 pump was lowered into the shaft. On Feb. 10, before the holes in the bottom could be plugged, the pumps were put out of commission in rapid succession, the shaft was again flooded, and the pumps were submerged. Again the pumps were recovered by the air-lift and the two No. 9 Camerons; the bottom was uncovered and the holes were plugged on Feb. 16.

Drilling in the bottom was resumed through pipes and gate-valves which could be closed quickly. The leakage from the sides and around the pipes in the bottom had now risen to 450 gals. per minute. With the discharge hose and gaskets on the discharge line blowing out above, and water spurting in from the bottom, difficulty began to be experienced in getting labor. On Feb. 21 the shaft was again flooded, due to pump troubles, and was not recovered by the air-lift until March 12.

A sufficient number of holes had now been drilled to indicate that the rock for at least the next 8 ft. was soft and pourous with several open seams of a maximum width of 8 in. The largest seam was at one point within 18 ins. of the bottom of the shaft. The behaviour of single 2-in. drill-holes made it unpleasant to contemplate the quantity of water which might be encountered if sinking were resumed. Accordingly, it was decided to attempt first to cut off the water by grouting, a matter which had been under advisement for some time. As the rock lay in horizontal layers, it was hoped that the water would not follow the shaft down, but could be completely cut off by grouting the porous layers.

A battery of four Canniff tank grouting machines was set up at the top with a 2½-in. pipe down the shaft and a 2-in. hose connection at the bottom. At first the grout leaked back into the shaft around the pipes and through seams in the bottom. It was thought that a concrete blanket might be necessary, but the difficulty of placing it would have been great. After several experiments, finely-ground horse manure was injected with the grout. Although there was considerable waste of grout, the manure finally clogged all openings, and the bottom was made tight. In three days 2,900 bags of cement were forced in, and the holes were then blocked. The large quantity of cement indicated the size and extent of the seams. After the grout had set, additional holes were drilled, and struck water under a pressure of 65 lbs. at a depth of 14 ft. These holes were then grouted, 60 bags of cement being used.

Experience, up to that time, indicated that the sandstone was very porous and water-bearing, and the High Falls shale lying underneath was believed to be little better. In view of the success of the first grouting, it was decided to put diamond-drill holes down to the top of the Shawangunk grit, and to attempt to grout the intervening strata. The

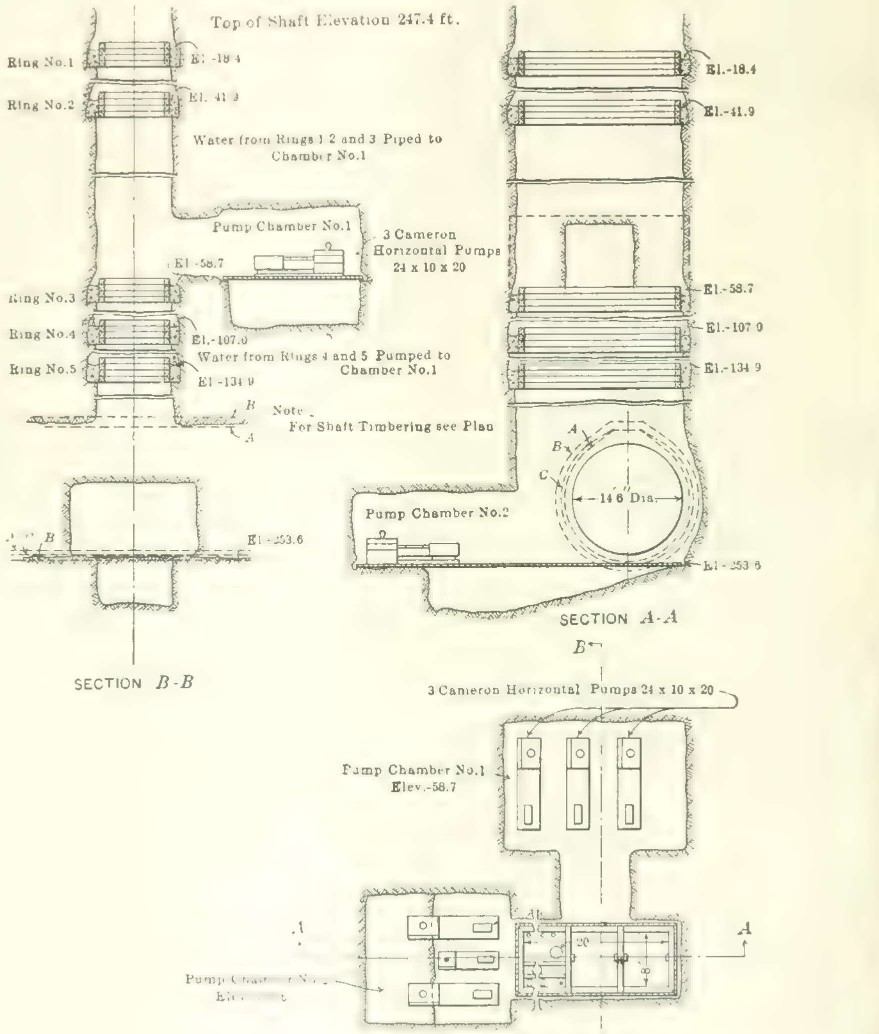
Top of Shaft Elevation 247.4 ft.
Ring No.1
El. -18.4
Ring No.2
El. -41.9
Water from Rings 1 2 and 3 Piped to Chamber No.1
Pump Chamber No.1
3 Cameron Horizontal Pumps 24 x 10 x 20
El. -58.7
Ring No.3
Ring No.4
El. -107.0
Water from Rings 4 and 5 Pumped to Chamber No.1
Ring No.5
El. -134.9
B
A
Note _ For Shaft Timbering see Plan
El. -253.6
SECTION B-B
El.-18.4
El.-41.9
El.-58.7
El.-107.0
El.-134.9
A
B
C
14'6" Dia.
Pump Chamber No.2
El. -253.6
SECTION A-A
B
3 Cameron Horizontal Pumps 24 x 10 x 20
Pump Chamber No.1 Elev.-58.7
A
A
20
8
PLAN
B

Fig. 1—Plan and Sections of Shaft No. 4, Showing Water Rings and Pump Chambers.

distance from th[illegible] the shaft to the grit was 100 ft., [illegible] decided to bore six holes. At [illegible] were drilled to a depth of about [illegible] nipples with gate-valves were driven in tightly, and 2½-in. casing was extended to the top of the shaft where the diamond drills were set up. Three holes were drilled by a Sullivan Badger machine taking a 1[illegible] three with a Sullivan C machine taking a 2-in. core. Water was encountered at a depth of 50 ft. The holes were continued to the grit and 175 bags of cement were forced in under a pressure of 275 lbs. The small quantity of cement required was looked [illegible] an encouraging sign of better conditions; to others it seemed to cast down on the efficiency of the grouting, when considered in connection with the depth and small diamteer of the holes. Both beliefs were shown to have a measure of truth by later developments. The shaft was now making 225 gals. per minute, all coming in from the sides.

Sinking was resumed [illegible] 1909, after a delay of four months, and, in the first 15 ft., numerous seams were passed with a maximum width of 8 ins. All were filled with grout and were tight. Below this point no large seams were encountered, but the seepage from the sides increased until the inflow was 350 gals. per minute at a depth of 280 ft. Trouble with the sinking pumps had become so frequent, due to the high lift, that it was decided to put in a collecting ring and establish a station at a depth of 265 ft. A sketch of a typical ring is shown by Fig. 1. The pumps on the bottom discharged into the ring, and the water was relayed to the top by two No. 12 Cameron sinkers, which were protected from blasts by a bulkhead of timbers. Sinking was resumed, and when the shaft had reached a depth of 300 ft. and was making 450 gals. per minute, a second ring was installed with one No. 12 Cameron sinker pumping to the surface. The second ring intercepted about 100 gals. per minute, the upper ring still being used as a station for the two No. 9 Cameron sinkers on the bottom. As the excavation proceeded, a 2-in. seam was encountered, increasing the inflow to 525 gals. per minute and a third ring was added. The water was strongly charged with sulphur; and the H_2S gas, which had been giving more or less trouble, now increased to 9 parts in 10,000. The water caused cuts and abrasions in the flesh to develop into running sores, and the gas, in addition to a general debilitating effect, irritated the eyes greatly, causing temporary blindness. Great difficulty was experienced in getting men, and it was necessary to raise the pay and shorten the hours of work. The bottom was flooded several times, but the water never rose higher than the first ring.

The shaft was now (July, 1910) about 320 ft. deep, and was so full of pumps and their air and discharge lines that it was almost impossible to do any work. A step which should have been taken earlier, but had been postponed by a hope of improvement in the rock, was now decided on, namely, a station chamber in the side of the shaft.

On July 15 the pumps at the upper ring broke down and the shaft was flooded for the sixth and last time. The shaft was unwatered, the six pumps at the bottom were recovered by the invaluable air-lift, and the excavation of the chamber was started on Aug. 1 at a depth of 309 ft. The chamber was 17x24 ft. and 10 ft. high, and had a sump 16x22 ft. and 5½ ft. high, having a capacity of 14,500 gals. Three 24x10x20-in. Cameron horizontal condensing pumps, with a combined capacity of 1,050 gals. per minute, were installed in the chamber. To relieve the heavy load on the powerhouse, it had been decided to run these pumps by steam, and three 100 hp. boilers [illegible] shaft. A 4-in. steam line from the boilers to the pumps was wrapped successively with asbestos, felt, and tin, to prevent the condensation of the steam and fog in the shaft. A water-bearing seam was encountered in the chamber, increasing the inflow to 725 gals. per minute, and during the excavation the number of pumps in the shaft increased to ten, of all sizes and styles. By this time the gas had become so bad that it was necessary to ventilate the shaft. Three Sturtevant blowers (two No. 35 and one No. 45) were installed at the top, with 10-in. and 14-in. pipe lines. A mixture of 1 part of chloride of lime and 20 parts of ordinary lime was also sprinkled continuously down the sides of the shaft. After steam was turned on, nearly two weeks were consumed in removing superfluous pumps, air-lines, and discharge pipes from the shaft. All water from the rings was either pumped or led by gravity into the sump at the chamber.

Sinking was resumed on Sept. 9, 1909 (a pilot drill-hole being kept well below the bottom) and all seams were grouted in advance, none of them taking more than 50 bags of cement, until the grit was reached. There was still some seepage from the sides, which sprayed in the shaft and increased the bad effects of the sulphur and gas. Several rings with small horizontal pumps were installed to prevent this. At the contact with the grit an additional flow of 125 gals. per minute came in through the old preliminary drill-hole which had been previously grouted, increasing the total flow to 850 gals. per minute. This hole was plugged with a nipple and gate-valve, and registered a pressure of 95 lbs. The flow was cut off by forcing in 318 bags of cement under a pressure of 275 lbs. All water-bearing seams in the grit were grouted, the maximum quantity of cement used at any point being 100 bags. Sinking was continued until Dec. 31, 1909, when the shaft reached [illegible] 497 ft., and the headings were turned. The elapsed time from the start of excavation was 18 months, an average monthly progress of 28 ft. Exclusive of delays due to trouble with pumps, the average monthly progress was 45 ft. The highest monthly progress was 80 ft., which was made in the limestone. The total quantity of water pumped during the sinking was 86,181,000,000 ft-gals. and the total quantity of cement used for grouting was 971 bbl.

The general method of excavation was to sink about 65 ft. below the timbers and then place about 50 ft. of timber, the lower dead-logs being about 15 ft. above the bottom of the sump. After large flows of water were encountered, it was found necessary to keep timbers close to the bottom, for convenience in handling pumps and hanging them and their air discharge lines. Wire guides were carried down to the bottom of the timbers, and a cross-head or "billy" was used with the bucket. Excavation was made with a center cut or sump and two side or bench cuts, by the continuous method, drilling and mucking proceeding simultaneously, as indicated by Fig. 2. Drilling was started on the cut with four 3½-in. Ingersoll drills mounted on two quarry bars, as soon as the bench muck had been cleared away. The sump was then shot, and drilling was started on one bench while the sump was being mucked. This bench was shot as soon as the sump had been cleaned out, and drilling was then started on the other bench. The average number of holes for a complete advance was 32, and the average advance was above 7 ft. The pumps were hoisted into the timbers while blasting. The following data taken together with Fig. 4 shows clearly the methods and progress of handling the material:

[illegible] 80 feet
[illegible] feet
[illegible] 64 feet
[illegible] 240 feet
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

When the inflow became great, the pumps were kept in operation during blasting. The shaft was excavated in separate halves, the pumps being moved to the opposite end of the shaft and protected by a bulkhead. After the station chamber was in operation, the water was kept off the bottom as much as possible by rings, and the former method was resumed. The superintendents and laborers employed at this shaft were mostly trained shaft-sinkers, drawn from the Pennsylvania coal fields.

The methods used in grouting differed somewhat in detail, but in general were as [illegible]

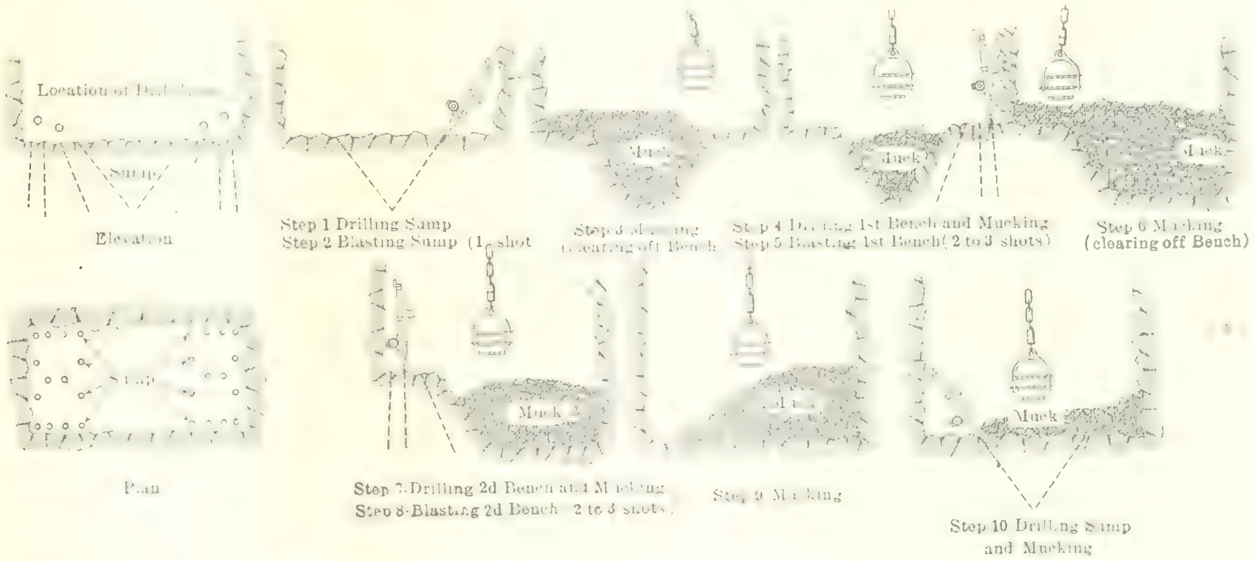
Location of Drill [illegible]
Sump
Elevation
Step 1 Drilling Sump
Step 2 Blasting Sump (1 shot
Step 3 Mucking (clearing off Bench
Muck
Step 4 Drilling 1st Bench and Mucking
Step 5 Blasting 1st Bench (2 to 3 shots)
Muck
Step 6 Mucking (clearing off Bench)
Muck
Sump
Plan
Muck
Step 7-Drilling 2d Bench and Mucking
Step 8-Blasting 2d Bench (2 to 3 shots)
Muck
Step 9 Mucking
Muck
Step 10 Drilling Sump and Mucking

Fig. 2—Method of Continuous Excavation of Shaft Shown in Various Steps.

[illegible] en wedges, flannel, oakum, oil-well packers, [illegible] was necessary to resort to the horse manure. [illegible] the former being obtained from the main air-line and the latter from a small Westinghouse high-pressure compressor. The grout machines were placed at the top of the shaft and connected with the hole by a 2½-in. pipe. The long pipes clogged somewhat and cut down the quantity of sand which could be used, but the difficulty of operating the machines at the bottom would have been too great. A battery of from four to six Canniff air mixing tank machines was used, and connected to one pipe. Owing to the simplicity and rapidity of their operation, these machines are admirable for forcing in large quantities of grout, and kept an almost continuous stream of it passing down the pipe. Between batches a minimum pressure of 100 lbs. was kept on to hold the grout in place, as the back pressure from the water was at times as high as 95 lbs. A very weak mxiture was used at first and the quantity of cement was increased gradually; if this continued to [illegible] was added until the pipe began to clog. All grouting was as nearly continuous as possible and was uniformly successful (except with the deep diamond-drill holes, at one time cutting off a leakage of more than 400 gals. per minute. With the diamond-drill holes, it is believed that, in addition to the length and small diameters of the holes, the partial failure was due to the fact that the chips and dust caused by the drilling clogged the seams. Experience seemed to show that, with the stratified rock (as had been anticipated), the water cut off was not forced into the shaft at a lower level. The grout set very slowly and developed little strength, although the waste grout carried out through the pumps finally set outside.

For any head of more than 200 ft. the sinking pumps gave very poor results, for a number of reasons. The main reliance was placed on two No. 12 19x19x12x16-in. Camerons, with a 10-in. suction and 8-in. discharge. Each pump weighed about 5 tons and they were so large that they could not be passed by each other in the same compartment. Against high heads they never pumped much more than half their rated capacity, because, when speeded up against the heavy back pressure, the pulsation was so great that it soon tore them loose from their connections. The vibration was so great on a flange joint discharge line that bolts and flanges broke continually, and it was necessary to replace it by a screw-joint line. One great trouble was the impossibility of making rigid connections with the discharge line. Wire wound discharge hose, rewound with rope, frequently gave way under pressure, and the connections between the hose and the pumps were continually falling.

Prior to the installation of the horizontal pumps in the chamber the air-lift was the one and only reliable part of the unwatering equipment. It was very wasteful of power, but made unnecessary both a large reserve of pumps and the slow and tedious process of staging them down the shaft when it was flooded. It was efficient until the depth of water in the shaft was less than 60 per cent of the total depth of the shaft. When the water was lowered 40 per cent of the total depth, [illegible] small [illegible] sinking pumps [illegible] out the last 10 or 15 ft of water.

Pumps operated by steam required about half as much boiler-horsepower and half as [illegible]. When it [illegible] central power-[illegible] the cost of installation, maintenance, and hauling coal must be considered as an extra, it is probable [illegible]. The principal cause for its installation was an [illegible] any break-down or overloading of the central power-plant. Steam was never used with [illegible] sive heat and the fogging of the shaft which would result. The steam horizontal pumps used in the chamber were condensing, thus preventing this difficulty. The air gave considerable trouble by freezing up the pumps, although re-heaters and drips were used.

As a source of difficulty and delay in sinking this shaft, the H_2S gas was second only to the water. It is believed to be due to the decomposition and dissolution of pyrites in the rock, under the heavy pressure. The gas arising from the shaft soon oxidized the paint on a building 100 ft. away, and the discharge water would tarnish silver coins in less than a minute. In addition to their debilitating effect on the men, the gas and water attacked pipes, cables, rubber gaskets, and hose with serious effect.

It is believed that an ultimate economy might have been effected by constructing the chamber earlier, and at a higher level, with perhaps a second chamber in a lower position. The completion of the shaft is due to the successful use of the process of cementation, or grouting. The quantity of water which might have been encountered without grouting is largely a matter of speculation, but it is thought that it would have approached the sum of the amounts encountered at different times. One of the things which led to this belief is the fact that, while ungrouted inflows near the top of the shaft showed a very slow and steady decrease due to the general lowering of the water-table, the rate was apparently unaffected when new flows of from 300 to 400 gals. per minute were encountered at the bottom. Another is the fact that an inflow of about 2,000 gals. per minute was encountered in the same strata in the tunnel between Shafts Nos. 3 and 4.

All water pumped from this shaft was paid for under the contract at $0.30 per 1,000,000 ft. gals. and the emergency plant was also paid for under a lump sum, bid price. The water was measured by a 6-in. square orifice, a record of the head being obtained by a Friez automatic water register.

The Rondout Pressure Tunnel is being constructed by contract for the City of New York under direction of the Board of Water Supply, J. Waldo Smith, Chief Engineer; Robt. Ridgway, Dept. Engr., Northern Dept.; Lazarus White, Div. Engr., and Mr. Bertrand H. Wait, Section Engr., in charge of the work. The contractors are the T. A. Gillespie Company, of New York.

It is reported that Vlademar Poulsen, the Danish inventor, has accomplished a wonderful feat after much experimenting in transmitting electric light without wires. The details of the apparatus are not yet known. Poulsen stood at one end of a long room in Copenhagen operating his machinery, while his assistant took up his station at the opposite end holding two incandescent lamps. The lamps in the assistant's hands were lighted and continued to radiate light as if attached by secret wires to some source of power.

Some Principles Governing the Blasting of Rock.*

It is evident that, where rock excavation forms such an important item of expense in mining and in open cut work, it will well repay study to ascertain if science cannot accomplish an improvement in the methods of breaking up rock.

After an explosion of powder in the bore hole *a b*, Fig. 1, the sudden expansion of the resulting gases will exert its force equally in all directions on the bore hole, until either the enclosing rock or tamping yields, and the gases escape. The rock will yield along what is called the line of least resistance, which would be *b c* in the assumed homogeneous rock of Fig. 1. It is evident that the angle between the hole and the rock face can vary from 0 to 90°. At 0 there would be no hole and at 90° the hole would be in the position *b c*, the line of least resistance and would give a blown out shot. The quantity of rock thrown out by the explosion would equal the volume of a cone with a height equal to *b c* and a base with a radius *a c*. For a case with two free rock faces if the powder charge be placed at *e* with the lines of least resistance *e g* and *e m*, of equal length, the explosion will break out two cones *def* and *fek*, or nearly double the volume for one free face so that $v=2h^3$. It is similar for three or more faces so that as a general equation we have, if $v=nh^3$

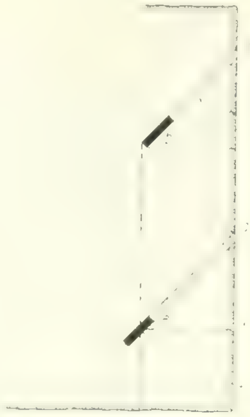

Fig. 1.

From this equation it can be seen that a system of mining should be utilized which utilizes as many free faces as possible in breaking. In work for horizontal, vertical or inclined drives or passages, we start each round of holes, and with the cut holes break out either a cone or a wedge whose surface forms another free face for the benefit of the other holes of the round. In stoping work which must be started from a drive we can always manage to maintain two and often three free faces in homogeneous rock, and in stratified formations sometimes four faces, as a bedding plane is oftentimes nearly equivalent to a free face.

In stratified formations the correct principles of breaking are especially important for economy's sake. The simplest case is that of beds 2 and 4 ft. thick. Here the holes should be in a plane parallel to the beds because it is evident that we can more easily separate two wet coins on a table by sliding one sideways than by trying to lift it off vertically. Also these parallel holes do not weaken the blast by allowing powder gases to escape through the bedding seam. Where the beds are thin, say under 8 ins., we encounter the possibility, with holes parallel to the bedding, of having only the small bed blown out that contains the hole. For this reason it is advisable to make the cut by driving holes across the bedding planes and then break to the cut with the balance of the holes drilled parallel to the bedding plane, but which now exert their maximum force perpendicular instead of parallel to the beds.

The method of firing also affects the pointing and the necessary number of holes to drill for breaking. There is a great advantage in simultaneous or electric firing wherever a weak roof or the greater danger from misfires with unskilled miners do not militate against it. In Fig. 1 it is evident that only the cone *abd* and the double cone *dek* would be broken out by the charges at *b* and *e* fired separately, but if *b* and *e* are not too far apart and are fired together the line of detachment will be along the lines *abek* instead of *abdek* and the extra volume *bde* will be broken with no extra powder or drilling. In any case of breaking, the pressure *p* produced by the explosive multiplied by the area of its section *a* (taken along the axis of the hole) must equal the ultimate tensile or shearing strength *T* of the rock multiplied by the area of its surface of fracture *S* or $pa = TS$.

If *pa* is greater than *T S* it means an excess of explosive over that required for detaching

*Abstracted from [illegible] Mining World by Prof. R. B. [illegible] of the University of West Virginia.

the burden [illegible] "windy" shot, resulting [illegible] blast, a louder report and a long[illegible] than from a normal shot. A normal charge leaves traces of the drill hole, but an insufficient charge leaves "candlesticks" [illegible] rock and loose pieces at the burden [illegible] blasted off.

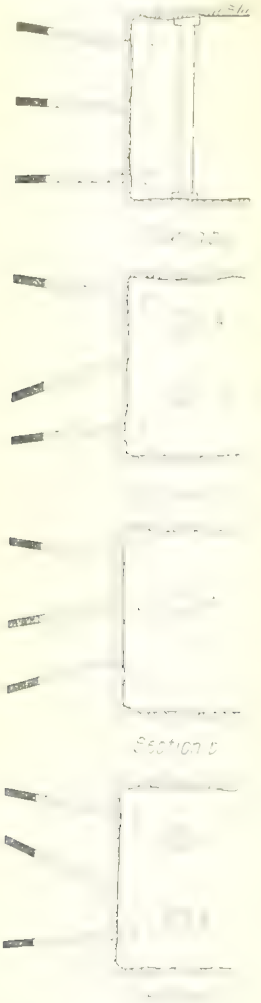

Fig. 2.

In illustrating [illegible] ing horizontal heading[illegible] principles of breaking apply equally well for inclined and vertical shafts and raises. The practical difference in the latter arises from the setting of the drills and the handling of the muck and the water, and the fact that the length of the section in shafts generally makes the central cut advisable. We will also assume, to simplify the illustrations, a heading small and soft enough to allow its breakage by rounds of [illegible] three holes each, although often nine holes are more effective in four rows, one of three and the balance of two holes each. For longer headings with harder rock, the same principles would apply, but more holes must be added for breaking the round. On this basis we will now consider the following six cases of formation.

Case [illegible] *Heading.*—Since this formation breaks equally well in any direction, the holes should be placed for the most convenient drilling and mucking. For setting the bar horizontally, as is usual where it is desired to begin drilling before the muck from the last round is cleaned up, the placing of Fig. 2(*a*) is a favorite. Here the adjustable arm is unnecessary and the first setting of the bar is at *A* to drill the upper and middle rows with the machine above the bar. The second setting of the bar is at *B* and the machine is turned under it for drilling the bottom row 3 of lifters. The horizontal rows of holes are usually fired in the order 1, 2, 3. [illegible]

The side instead of the bottom cut is handiest if we wish to set the bar vertically. We first set up at *A*, Fig 3, and drill row 1, then at *B* with the machine on one side to drill row 2 and on the other to drill row 3. Here the vertical rows of holes are fired in the order 1, 2, 3. Fig. 3 pla[illegible] keep the passage straight, the cut holes of row 1 will be put in for the next round on the opposite side to what is shown, so that the finished sides have a zig-zag appearance, alternately right and left as shown in the plan of Fig. 3. The middle hole of vertical row 1 points downwards, like hole *c*, instead of flat wise, like the balance of horizontal row 1, so as to throw out a bottom cut and avoid a horizontal inclination [illegible] progress in a narrow heading.

For large tunnel heading, 8 ft. square, in hard homogeneous rock, the cone or "Leyner" center-cut system has recently permitted of very fast driving in western metal mines. It is especially adapted to the water Leyner drill on account of the many upper holes used and the fact that this drill is short enough to allow the sharp pointing of the holes with two settings of the bar. For hard steel ore and jasper in a Michigan iron mine, this system was thus applied.

In Fig. 4, [illegible] two machines and from its top the four back holes, Nos. 9, 10, 11 and 12 [illegible] The machines are then tipped forward until the crank can just turn and clear the back or top of the drift for drilling the top center cut holes Nos. 1 and 2, while finally they are turned under the bar for side holes Nos. 5, 6, 7 and 8. [illegible] *B*, the machines are set up on top and side holes Nos. 13 and 14 are drilled. Then, after turning the machines under the bar, they are tipped up in front so the crank just clears the bottom of the drift and holes Nos. 3 and 4 are drilled about to meet Nos. 1 and 2 in the center of the heading. The four lifters, Nos. 15, 16, 17 and 18 [illegible] and better-breaking ground, cut-holes Nos. 5 and 6, one lifter and one back hole can be left out, but the four cut holes, Nos. 1, 2, 3 and 4, are nearly always used and are pitched up and [illegible] center.

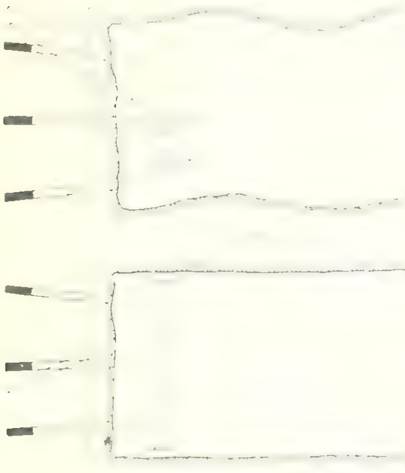

Fig. 3.

The five remaining cases are given for regularly stratified rock, but the joints or cracks of massive rock may, like bedding planes, often be utilized for breaking.

Case [illegible] *Heading* [illegible] from the powder can be got by two settings of the bar vertically and following the drilling and firing directions given above for the method illustrated by Fig 3. In the disseminated lead mines of southeastern Missouri, this method is modified as follows:

For a drift [illegible] 12 to 13 holes are needed, placed in three rows horizontally by four rows vertically. The bar is set up once to drill each vertical row of holes, four set-ups being necessary to complete a round. Each vertical row is fired separately by fuse and dynamite and as only three or four holes are fired at a time, not enough smoke or broken rock is produced to prevent the drillers from setting up again very soon after blasting. This method, with three shifts of two drill men each allows an advance of 5 to 7 ft. in 24 hours with 2¾-in. drills. By the former center-cut system, two drills and four men were able to advance only 10 to 15% faster than by the one drill and the side-cut method just described, all loading and tramming, in each case, having been done by muckers.

(*b*) *Thin Beds:* Here, as already explained, the cut-holes must cross the bedding planes. A bottom cut is advisable. The bar is set horizontally at *A*, Fig. 2(*b*). Often all three rows can be drilled direct although sometimes the use of the adjustable arm on the bar is necessary to get the correct pointing of the holes. The holes of row 1 are fired first and break out the cut to the bedding plane on the floor of the heading. Before loading the row of cut-holes, it is often helpful to stop up their bedding planes, around the powder, with clay but this precaution is unnecessary in the two upper rows where the holes are parallel to the beds.

[illegible] *Heading* [illegible] case requires the bottom cut of Fig. 2(*a*) which has already been described under *Case I*. The placing of holes is shown in Fig. 5 for the 12-hole system, although for most rock nine holes are ample, the center holes of rows 2, 3 and 4 being omitted. For this arrangement the drill bar (with adjustable arm) need only be set up once vertically, as shown. The round of holes is usually loaded and fired at one time and goes off in the order of 1, 2, 3, 4. Some of the miners regulate the explosions by cutting the fuse of different lengths and spitting them simultaneously while held together in the hand, and others by cutting all the fuse of the same length and spitting them separately in the required order.

(*b*) *Thin Beds:* The solution of this case follows Fig. 3 and also resembles *Case II* (*b*) except that here the side instead of the bottom cut is used. With one setting of the bar, the three vertical rows *K*, 2 and 3 may be drilled and shot in the same order, row *K* breaking out the cut, along a side bedding plane, *mn*, and rows 2 and 3 breaking to the cut. Here it is not so necessary for alignment, as in *Case II* (*a*), to alternate the cut on each side of the heading, but it is often an advantage especially where the vertical bedding planes are ill defined.

Case [illegible] *Beds.*—If the cutting angle which the bedding [illegible] 45° or less, the method of Fig. 2(*a*) is usually preferable. If the cutting angle is more than 45°, the choice between the methods of Fig. 2(*a*) and of Fig. 3 will often be merely a question of convenience in setting the bar horizontally or vertically, respectively.

Fig. 4.

[illegible] (a)

[illegible] either medium thick or thin beds the method of Fig. 2(*a*) is the best. Care must be taken, however, in the case of beds dipping over 45° to stop the holes of the horizontal row 1 at the last bedding plane which intersects the face of the heading above the floor.

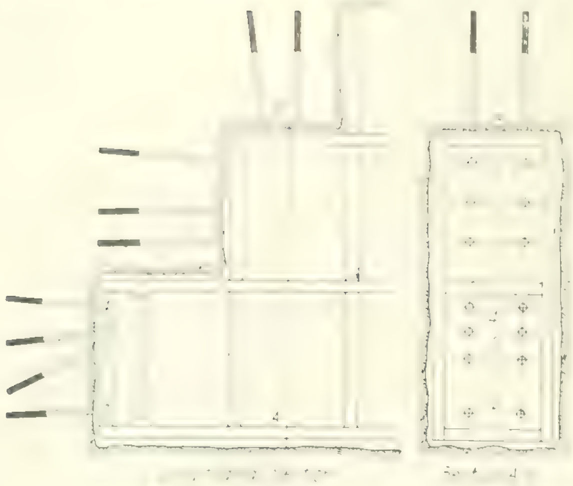

Fig. 5.

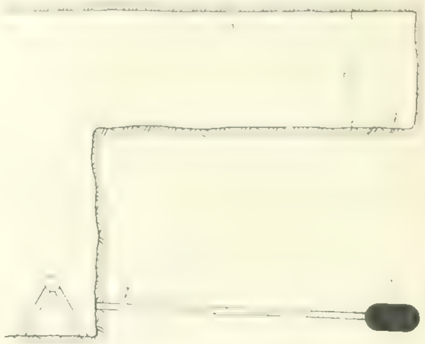

Fig. 8.

Case VI. Rocks in Inclined Beds Dipping Away from the Floor of the Heading.—For either medium thick or thin beds the method of Fig. 2(*c*) should be used. The bar is set up at *A* for row 2 and at *B* for rows 1 and 3. The order of firing the horizontal rows of holes is 1, 2 and finally 3. The end of the holes in row 1 should be stopped beneath the last bedding plane intersecting the face of the tunnel under the roof in order to utilize this plane as a free face in breaking.

Down Holes: Underground.—Down holes are used underground in the underhand benches of tunnels or metal mines. To start this system, a heading *ah*, Fig. 6, is run at the top of the tunnel or stope and the down holes put in its floor for the first bench. The depth of this bench is limited by the length of the bit which can be inserted in the hole and that depends on the height of the heading which is usually around 7 ft. so that the ordinary railroad tunnel, 20 to 25 ft. high, requires two [illegible] and *b*, Fig. 6 to reach the bottom. These bench holes point downwards anyhow but often an advantage may be taken of the structure. Thus with horizontal beds, the holes of the first bench can be terminated at a bedding plane which the gases from the explosion will

[illegible] exert a lifting action on the [illegible] off.

Where there is a choice of plans, a heading can often be driven in a direction that will take the maximum advantage of the bedding and joint planes for breaking, both in driving and stoping. On this principle, the rooms of coal mines are usually laid out perpendicular to the line of the main joint planes of the coal seam or to the "face cleat."

Down Holes; at Surface.—Above ground the only limit to the depth of the hole is the capacity of the drill. In considering breaking from deep holes we have a choice of two methods (*a*) multi-charging, (*b*) chambering.

In the drill hole *ab* of Fig. 7, it is evident that a charge of explosive at any point *b* will only break out a cone like *cbd* where *eb* is the line of least resistance. In order to break the whole length *ab* by multi-charging, other charges of explosives as *f* and *g* would be placed along the hole, with tamping between, and all be set off by simultaneous firing. In this way the whole mass *abd* would be detached.

By chambering, the breaking from a long hole would be achieved differently. Instead of the hole being placed near the face *hd* of the bench as is the hole *ab* (because of its small section for developing explosive pressure), the hole *mn* would be placed back from the face so that *nc*, the line of least resistance in homogeneous rock, would be only a little shorter than the length of the hole above the chamber at *n*. The chambering is effected by shattering the bottom of the hole with high-power dynamite so that the final shape of the chamber approaches a sphere. In France this chambering, in limestone, is performed with hydrochloric acid, each dose of neutralized acid being washed out and a new one poured in until the chamber is of the required size. When the chamber is filled with gunpowder or low-power dynamite and exploded, it will exert nearly as much force upward as horizontally and will break out a mass along the surface of fracture *qnp*.

The choice between multi-charging and chambering depends on the varying conditions of formation, drilling and exploding. In a fissured formation, chambering has often an advantage because the explosive may be localized in a solid portion of the rock, although it often needs the use of two kinds of explosives, one for chambering and the other for breaking. Where it is desired to break off only a thin slice like *hab*, Fig. 2, from the cliff, it is evident that multi-charging should be resorted to. When an even topography will allow the handling of the portable steam or electric drop drill for a 3-in. hole (instead of the reciprocating drill for a 1½-in. hole), the multi-charging method will permit the drilling and breaking of a much longer hole than would be feasible by chambering.

Flat Holes; Underground.—Of the three groups, flat holes are the most difficult to drill, especially those which are pointed above the horizontal for the reason that they neither hold water or discharge their cuttings by gravity. This group is much used in the overhead stoping system with piston drills as the drill tripod can be set on the broken rock. Thus flat water holes which are easier to load than uppers and free from their dust can be drilled at a fair speed. In overhand stoping with a weak back, flat holes have also an advantage over uppers as the timber sets can be carried next to the back and the drilling can proceed under the lagging. Thus in Fig. 5 at *C* rows 1

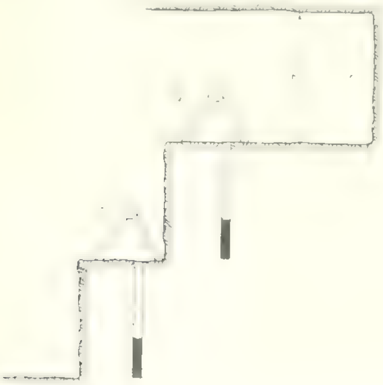

Fig. 6.

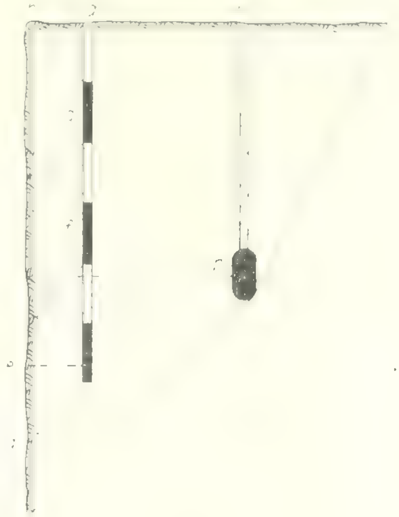

Fig. 7.

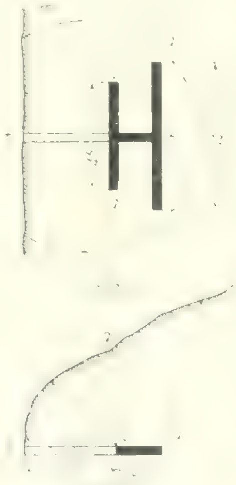

Fig. 9.

and [illegible] need be drilled dry.

In the [illegible] district [illegible] Mo., that holes are used instead of the usual down holes to break the benches below the heading of the underhand stoping system. Stoping is done in "sheet ground" which is partial replacement of flatly bedded limestone by seams of chert and zinc-lead sulphides. The formation is hard but brittle and easily broken. After a heading *ah*, Fig. 8, has advanced about 18 ft. under the roof of the stope *R*, a long water-hole *ab* is put in by a 3¼-in. piston drill on a tripod. The hole is then squibbed three or four times with 40% dynamite and finally the resulting chamber is filled with 50 to 100 sticks of the same explosive and fired by a fuse and cap. Only the most expert drillmen can put in these long holes but they have been found highly advantageous because they can follow [illegible] trary, vertical holes across the bedding planes would be difficult to drill on account of cracks and pockets. For the same reason they would be so porous as to render their exploding inefficient. It only takes three of these long horizontal holes to break off a bench 12 to 14 ft. high across a stope 40 ft. wide.

[illegible] large banks of placer gravel in California before hydraulicking, small adits have been used with crosscuts at their ends to hold the explosive. From a breaking standpoint, these adits correspond to flat drillholes with chambered ends. The same method has also been employed for breaking great masses of rock in quarries or excavations. Often a shaft has been sunk as an entrance to the explosive chamber instead of an adit. Sometimes two crosscuts near the [illegible] chambers, as shown in Fig. 9. There only the crosscuts *cd* and *ab* would be packed with gunpowder or low-power dynamite, while the adit itself would be blocked with timber or masonry bulkheads wherever it met the cross cuts. Elsewhere it would be packed with sand. For firing, electric fuses or caps would be placed in the explosive at intervals of about 10 ft. Finally they would all be connected by wiring in order that they might be fired simultaneously by electricity c^1k being the line of least resistance. The chamber *cd* would break out the cone gc^1f^1, and the chamber *ab* would break the prism ha^1c^1g, the plan of the line of fracture being *mabn*.

The same breaking equation, $pa=TS$, applies as in the case of drill holes, the factor a being the area of the cross section of the explosive taken along the axis of the crosscut

ROADS AND STREETS SECTION

Methods and Costs of Road Preservation and Dust Prevention by Surface Treatment with Tars, Heavy Oils, Etc.

An interesting and valuable discussion of methods relating to road construction and maintenance was held at New York City, Jan. 20 and 21 at a special meeting under the auspices of the American Society of Civil Engineers. A brief account of this meeting was given in our Feb. 1 issue. In the March Proceedings of the American Society of Civil Engineers, Vol. XXXVII, No. 3, pp. 224 to 413, the discussion is given practically in full, and from their Proceedings we have taken the following matter relating to surface treatment with tars, heavy oils, etc.:

GENERAL

One of the main problems which confronts the highway engineer is the treatment of roads already in existence with a view to their preservation as well as the prevention of dust.

There are two general methods by which such roads are treated to remedy the dust nuisance. The first is by sprinkling the surface with any of the emulsions, and the second is by treating the road with a binding material so that only a minimum amount of dust will be formed. The first method of suppressing the dust is of necessity a temporary expedient. Water, salt solutions, light oils, emulsions, etc., come properly in this class. In the second method, it is obvious that the essential properties in a preservative are its binding power and durability. For this reason, and by way of distinction from temporary treatments, materials for this purpose can be properly called permanent binders. Such materials as tar and heavy asphaltic oils are included in this class. It must be pointed out, however, that the word "permanent" is only used in a relative sense, and that binders which on application will last at least one whole season, are included under this head.

In the discussion Mr. Charles W. Ross, Street Commissioner of West Newton, Mass., states that the principal agencies which tend to cause deterioration on tarred and oiled roads are frost, heavy rains, and decaying organic matter on the surface of the road. He gives it as his opinion that this last mentioned cause is more destructive than either of the others, and, for this reason, after a street is treated, it should be swept, by hand sweepers or otherwise, often enough to keep it clean. As far as can be judged from experiments, one kind of road resists the action of these agencies as well as another.

Mr. Ross states that oil, as a rule, penetrates better than tar, but that its value is in the asphalt base, and, before the maximum binding power is reached, the more volatile constituents of the oil must evaporate, which is a slow process. A properly treated road should resemble sheet asphalt pavement, although it is of a more resilient character. The surface material is all bonded together by the binding material, forming a smooth, firm surface which can be cleaned in the same manner as a sheet-asphalt pavement.

Probably as early as 1894 crude oil was used for road treatment in Santa Barbara, Cal. In 1898 six miles of road were treated in Los Angeles County, simply with the idea of laying the dust. The experiment met with astonishing success, and the practice spread rapidly. The oil not only stopped the dust nuisance, but bound together the particles of the road surface, forming a tough layer resembling asphalt pavement. Since California made these first experiments, oil has been used extensively in many parts of the country. It has been found that the quality of the oil used is of the utmost importance.

Mr. Ross points out that too much stress cannot be laid on the fact that the street must be thoroughly clean before any of the material is applied. It is not necessarily advisable to have the road surface absolutely dry, practice having shown that the oil has a tendency to adhere to the dry dust on the road. This can be prevented by sprinkling the surface with water two or three hours before the work is to be done. The oil then penetrates, and prevents the pulling up of the oil and sand.

The idea of applying tar to the surface of broken-stone roads probably originated with an Italian physician, Doctor Guglielminetti, the method being first applied to the streets of Monaco. The first authentic mention of a practical application of coal-tar to the surface of a completed macadam road was in 1880, when a street near Bordeaux was given a surface treatment. The results were unsuccessful, but 6 years later a similar experiment was made at Melbourne, Australia, with so much better results that the practice was continued. More care was taken in this experiment, the road surface being first cleaned, and after the tar was applied the road was given a covering of fine crushed stone. The results showed that tar had considerable value as a dust-layer by cementing the surface of the road together, thereby preventing its deterioration. The wear on the road was diminished, and consequently the cost of maintenance was very materially reduced. Since that time, other experiments have been tried, in France, England, and the United States. The use of tar on road surfaces in the United States has been confined largely to the East and North, except in a few in-

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total cost of [illegible], per square yard, or contract price
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.086
[illegible] Contract [illegible] September, 1910	...	[illegible]	[illegible]	0.504 gal.	11.36 lb.	[illegible]

*Contract price.

[illegible] am roads surfaced with heavy oils. He states that granting that a given road in good condi- [illegible] grade of oil, experience indicates that horse-drawn traffic will damage the surface mat of oil and stone screenings to a greater extent than automobile traffic. In fact, the latter, if not excessive, seems in certain ways to be beneficial to such a surface, by keeping it [illegible] traffic, on the other hand, tends to cut and [illegible] marks are not ironed out promptly by the passage of motor vehicles, the mat is apt to disintegrate and produce an oily, disagreeable mud in wet weather. In general, it may be said that such damage is most pronounced during cold, rainy weather, and that an oil-surfaced road will prove most unsatisfactory at such times. This being true, particular at- [illegible] durning bad weather.

[illegible] under what conditions surface treatment will prove satisfactory Mr. Hubbard states that the following facts are most necessary:

(1) The volume of traffic in bad weather;

(2) The [illegible] of horse-drawn vehicles to motor vehicles during bad weather;

(3) The character of both classes of traffic during bad weather.

The following [illegible] two macadam roads, in good condition, were treated [illegible] with the same [illegible]. One of these roads [illegible] good throughout the year, while the other was far from satisfactory during bad winter weather, at which time an oily mud was formed over the surface to a depth [illegible]. Eventually this mud had to be removed. The oil was a heavy semi-asphaltic residuum, barely fluid enough to apply cold in a satisfactory manner. The following are the specifications for this oil:

[illegible]

(1) The oil shall be a viscous [illegible] product [illegible] water [illegible] showing some degree of [illegible] when rubbed between the fingers.

(2) It shall have a specific gravity of not less [illegible] at 25° cent.

(3) It shall be soluble [illegible] at [illegible] temperature, to at least 99.0 per cent, and shall show not more than [illegible] per cent of mineral matter insoluble.

(4) It shall contain not less than [illegible] per cent [illegible] per cent. of [illegible] Baume paraffin naphtha at [illegible]

(5) [illegible] the first 50 cu. cm. shall flow through the aperture [illegible] min.

(6) When [illegible] grams of the material [illegible] in a cylindrical tin dish [illegible] in. in diameter and 1 in. [illegible] at a constant temperature of 163° cent. for [illegible] the loss in weight by volatilization shall not exceed [illegible] per cent. The residue should be [illegible] sticky.

(7) Its fixed carbon shall be not [illegible] per cent.

A traffic census of the two roads taken on various days during bad weather, showed that it was quite uniform at such times. For both, the traffic consisted mainly of automobiles, light carriages, and delivery wagons, no heavy trucking being allowed. The maximum traffic on the road in good condition amounted to 41 vehicles per hour, while on the road in bad condition there were 127 vehicles per hour, giving a proportion of about 1 to 3. This proportion was practically the same for each hour taken. On the road in good condition, 5 automobiles were counted for every 4 horse-drawn vehicles, while on the bad road the proportion of automobile to horse-drawn vehicles was approximately 1 to 2. In view of the fact that on neither of these roads can the volume of traffic be considered as excessive, it seems probable that the difference in results can be attributed directly to the greater proportion of horse-drawn vehicles to motor vehicles.

Of course, too great reliance should not be placed on a single set of observations, but the following facts would seem to be indicated from these experiments:

(1) With the type of oil used, satisfactory results may be expected when the automobile traffic is in excess of the horse-drawn traffic during bad weather.

(2) With this same oil, unsatisfactory results may be expected when the proportion of horse-drawn vehicles is double that of motor vehicles during bad weather.

Mr. Hubbard gives it as his opinion that the danger line lies much closer to the point where the proportion of horse-drawn vehicles just exceeds that of motor vehicles during bad weather, but this remains to be proved. It would seem reasonable, however, to expect that the number of automobiles must be equal to the number of horse-drawn vehicles in order that the marks on the oil mat made by the latter may be ironed out as fast as formed.

METHODS AND COSTS

West Newton, Mass.—In the discussion Mr. Ross gave the following description of the surface treatment work at West Newton, Mass. He stated that he had tried most of the asphalt preparations in use at the present time for preserving the road and rendering it dustless, and had classified these in three grades, as follows:

Grade A.—This is an asphaltic oil, sufficiently fluid to be applied to the roadway at atmospheric temperature, and is used on the surface of a finished road. It will effectually bind the material in the road, render it waterproof, and protect it from wear of traffic of all kinds. Automobile traffic tends to iron it out and improve it, rather than destroy it. It renders the surface resilient and elastic, and provides an agreeable tread, both for horses and vehicles.

Grade B.—This is a heavier material than Grade A. It is used for the building of new roads, or for resurfacing or reconstructing old ones, and is applied hot to the second course of stone, as set forth in the specifications under what engineers define as the "Penetration Method." It makes a solid bituminous road, extending from 2 to 3 in. below the surface, and will last and remain dustless for several years.

Grade C.—This is a semi-solid bituminous product and is used in building or resurfacing roads by the "Mixing Process." It produces a hard, smooth, dustless roadway, absolutely water-proof, and cemented so solidly that a pickaxe cannot displace or disarrange it without great effort and labor.

At West Newton, Mass., since adopting the new methods of work, large quantities of asphaltic oils, tarvia, tarite, asphalt, and standard macadam binder have been received. The materials come in tank-cars which are heated and unloaded in the following manner: The car is first connected with a small steam boiler, and heated to a temperature of about 100° F., thus rendering the material thin enough to flow through the hose at the bottom of the car, which rests on a trestle about 10 ft. above the surface of the ground.

When adaptable to the work, a Studebaker tank-wagon is used in applying these materials to the roadway. This wagon consists of a steel tank, holding about 550 gal., with 40 perpendicular tubes, 2 in. in diameter, passing through it. Under this tank two large burners are supplied with kerosene oil forced in by pressure. The fire-box, extending the whole length of the tank, gives an even heat. The material is applied through a sprayer or spreader which is perforated so that the oil trickles down on the roadway in very fine streams, covering it thouroughly in one application. This has proved a very satisfactory

TABLE II.—SURFACE TREATMENT WORK IN MARYLAND WITH TARS AND HEAVY OILS.

Section and year macadamized.	Length in miles.	Width in feet.	Material of macadam.	Cost of repairs to macadam, per sq. yd.	Kind of material used for surface treatment and quantity per square yard.	Covering used, and quantity per square yard.	Cost of surface treatment, including covering, per square yard.	Total cost of repairs and treatment per square yard.
Section No. [illegible] [illegible]	[illegible]	[illegible]	Limestone.	$0.0176	Standard No. [illegible] 0.49[illegible] gal.	Pea gravel. 18.49 lb.	$0.0[illegible]	$0.0[illegible]7
Section No. 7...... 1909	1.80	14	Limestone. Trap rock.	0.0526	Standard No. 7 0.442 gal.	Pea gravel. 18.31 lb.	0.036	0.088
Section No. [illegible] 1908	2.30	[illegible]	Trap rock. Gravel.	0.01[illegible]6	Standard No. [illegible] Fairfield Anti-Dust. 0.54 gal.	Pea gravel 13.26 lb.	[illegible]	0.083
Section No. [illegible] [illegible]	[illegible]	[illegible]	Trap rock.	0.016[illegible]	Standard No. [illegible] 0.503 gal.	Sand. 12.05 lb.	0.025	0.19
Section No. [illegible] [illegible]	[illegible]	[illegible]	Trap rock.	0.0145	Standard No. [illegible] 0.6725 gal.	Sand. 12.30 lb.	0.034	[illegible]
Section No. 4A.... [illegible]	0.7[illegible]	[illegible]	Trap rock.	0.0245	Standard No. [illegible] 0.547 gal.	Sand. 13.33 lb.	[illegible]	[illegible]
Section No. [illegible]A [illegible]	[illegible]	[illegible]	Limestone.	[illegible]	Asphaltoilene. 0.564 gal.		0.05	[illegible]
Section No. [illegible] [illegible]	[illegible]	[illegible]	Limestone.	0.0704	Asphaltoilene. 0.564 gal.		[illegible]	[illegible]
Section No. [illegible]E [illegible]	[illegible]	[illegible]	Limestone.	0.0[illegible]	Asphaltoilene. 0.564 gal.		0.05	[illegible]
[illegible] 1908	[illegible]	[illegible]	Limestone.	0.0[illegible]	Asphaltoilene. 0.564 gal.		0.05	0.082*
[illegible]	[illegible]	[illegible]	Limestone.	0.0156	Asphaltoilene. 0.564 gal.		[illegible]	0.065*
[illegible]	[illegible]	[illegible]	Trap rock.	[illegible]	Standard No. [illegible] 0.[illegible] gal.	Sand and gravel. 26.046 lbs.	0.028	[illegible]

AVERAGE TRAFFIC PER DAY [illegible]

[illegible]											
Forestville-Marlboro	No. 0130	[illegible]	[illegible]	[illegible]							[illegible]
[illegible]-Denton	[illegible]	132								[illegible]	[illegible]
Denton-Federalsburg	No. [illegible]	13[illegible]	6	[illegible]		[illegible]		7	10	[illegible]	[illegible]
Hickory-Conowingo	No. [illegible]	12	[illegible]	[illegible]							[illegible]
Easton-Wye Mills	No. 110	117	[illegible]	[illegible]	[illegible]						
Federalsburg-Hurlock	No. [illegible]	[illegible]	10	[illegible]						1	[illegible]
Federalsburg-Hurlock	No. [illegible]	1	10	[illegible]						1	

[illegible] applying [illegible], as the material can be readily [illegible] can be applied in large or small [illegible] flow being controlled by valves [illegible] be regulated so that they will spread as small a quantity as [illegible] gal. per sq. yd. [illegible] these materials it is better [illegible] the roadway at a time, leaving the [illegible] open to traffic.

Asphaltoilene was used in 1907 on two roadways in Newton, [illegible] 16,822 sq. yds. being treated at the manufacturers' contract price, 6 cts. per sq. yd. At present these roads are in very good [illegible].

Several macadam-surfaced streets, having varying grades up to a maximum of 9 per cent, and subjected to heavy horse-drawn and automobile traffic, were selected for the liquid-asphalt treatment. The method used was as follows: A quantity of [illegible] heated to a temperature of about 200° F., dumped in a pile, and leveled. The asphalt was poured over the hot sand in the proportion of 1 gal. to each cubic foot of sand, and then the whole mass was turned with shovels or mixed in a concrete mixer (the latter being preferable on account of cost). This work was done at the pit. The mixture was teamed to the work and spread on the roadway to a depth of less than ¼ in., being raked even with 14-tooth wooden rakes. Rolling was not considered necessary, and the street was kept open for traffic at all times. The cost of this treatment was about 3 cts. per sq. yd. It has the advantage of leveling and building up the surface of the road, [illegible] providing a new wearing surface. This work has remained in perfect condition without further expense since the summer of 1909.

Some cities have had very good results by using the following process for patching. Gravel from an ordinary gravel pit is run through a ½-in. screen, using a little more than ½ gal. of the asphaltoilene, or any of the heavy oils, to a cubic foot of gravel. It is better to heat the oil or the gravel, unless the work is done in the summer, in which case there is no need of heating. A quantity of material can be prepared at the pit and kept ready for use at short notice. The best time to apply this treatment is after a heavy rain, as all the depressions in the roadway show little pools of water, and if these are filled with the mixture and the surface is raked, it saves the expense of resurfacing the entire street.

The state of Massachusetts was among the first to use Tarvia, a number of cities in the vicinity of Boston, as well as the Metropolitan Park Commission, and the State Highway Commission, treating several miles of roadway. At about this time Rhode Island and New York were using Tarvia and other tar preparations on their state roads and streets with good results. Mr. Ross states that the foregoing experiments show conclusively that a specially prepared tar has given better results than any of the crude tars in use up to the present time.

In Newton the first Tarvia was used on a section of the boulevard, in September, 1906. The roadbed was first repaired and shaped up. The area covered was 3,500 sq. yds., and the cost was 11 cts. per sq. yd. This section has not received any repairs up to the present time, and is apparently in first-class condition [illegible].

In 1907 a section of a road, the macadam surface of which had become badly worn, was treated as follows: It was spiked up with the roller and covered with a light grouting of 1 [illegible] spread evenly over the entire surface, and penetrated into the stone in such a way as to bind the whole material together. It was then smoothed off with large street-sweepers' brooms. The road was closed for about four days, giving the cement time to set. After this it was opened to traffic and used for about a year. Then the surface was swept with an ordinary horse-sweeper, and covered with a thin coating of Tarvia A, heated to a temperature of about 170° F., which adhered readily to the cement, giving a smooth and satisfactory surface. This still remains in first-class condition, after a period of about 3½ years. On a small portion of the same street a second coating of cement grout was applied and covered with Tarvia A. This experiment was for the purpose of ascertaining whether the materials would adhere and form a satisfactory surface. It has proved to be all that was expected.

Mr. Ross points out that in recommending the use of the different tar treatments, it is well to bear in mind that they are better adapted to macadam than to gravel surfaces, because the surface is likely to become broken unless the foundation is solid enough to carry the load, and, once broken, deterioration is very rapid. The asphalt oils, however, can be applied to either. They stand the winter weather without breaking, and in the spring are as smooth as when built.

Within the past two or three years, or since the automobile came into general use, many engineers have almost come to the point of deciding against the construction of macadam roads. While this may be true as relates to water-bound macadam, yet, in view of the small cost of building and maintenance, as compared with the more expensive forms of laid pavements, it is questionable if anything better than macadam has yet been discovered for modern traffic in towns and small cities, provided it is bound or surfaced with bituminous preparations. Experience has shown that if a macadam road is properly treated when first built or extensively repaired with any of the foregoing bituminous binders, the results will be satisfactory; and, considering the difference in cost between the old form of water-bound macadam and the new method of using bitumen, the amount is very slight compared with the advantages of a roadway which is water-proof, dustless, easily cleaned and repaired, and will endure both horse-drawn and mechanically propelled vehicles. The automobile is not so much to be dreaded [illegible] treated will stand the traffic of automobiles and horse-drawn vehicles and wear for as [illegible] traction.

[illegible] tion of W. W. Crosby, Chief Engineer State Highway Board, about 50 miles of road in Maryland were treated with various tars and [illegible] finished water-bound macadam. The information concerning this construction is given in [illegible]

For the road between Baltimore and Washington, portions of which had been improved with water-bound macadam in previous years, the information is given concisely in Table II.

The traffic over the roads mentioned in Table I has been counted and is given in Table III.

The traffic over the sections of the Baltimore-Washington road has been counted, and is given in Table IV.

In September, 1908, a 3-year-old stretch of water-bound, traprock macadam, in fair condition, 12 ft. wide and 538 ft. long, was swept thoroughly, and coated with refined water-gas tar to the extent of 1.08 gal. per sq. yd. A coating of stone chips was then applied in sufficient quantity to take up any excess of tar which did not penetrate the road itself in about 5 hours. The chips were then well rolled. The cost was as follows:

	[illegible]
Pitch at [illegible] cts. per gal. delivered [illegible]	[illegible]
Stone chips at [illegible] per ton delivered [illegible]	[illegible]
Labor and incidental expenses	[illegible]
Total	1.[illegible]

This section has been, and is now, in an entirely satisfactory condition; it has not needed any attention or expense since construction. The average traffic on this road per day of 12 hours as counted recently, was:

Single vehicles	[illegible]
Double vehicles	[illegible]
3 (or more) horse vehicles	[illegible]
Motorcycles	3
Runabouts	[illegible]
Touring cars	11

It is impossible to give the ultimate cost of the above work now, as the data when retreatment will be necessary are unknown and at present not even in sight.

In addition to the foregoing, a material, which might perhaps be included as a "Heavy Oil," has been tried.

In November, 1909, a section of Park Heights Ave., about 6 miles from the city limits, was treated by simply spraying "Glutrin" from an ordinary sprinkling cart on the surface. The quantity used was 1,600 gals. on 2,300 sq. yds. of water-bound limestone macadam which was built in 1908, and in November, 1909, was still in very good condition. The limestone was of the white variety, rather soft, though highly cementitious. The "Glutrin" was spread about 1 ft. beyond each edge of the 12-ft. wide macadam, as the shoulder material was ordinarily of poor quality. The traffic over this section of road had been fairly light, and, until the fall of 1910, the "Glutrin" treatment was visible and seemed to have had some good effect. The road surface of the treated section was less friable and less dusty than the untreated macadam of the same road immediately beyond. The cost of this "Glutrin" treatment in 1909 was about 10 cts. per sq. yd. During 1910 a branch road was opened into Park Heights Avenue at about the middle of the "Glutrin"-treated section, and hence the traffic over a part of it greatly increased.

The following is a recent count below the branch road referred to, the figures being the average traffic per day of 12 hours:

[illegible]	[illegible]
Two-horse	1
[illegible]	[illegible]
Six-horse	13
6- or 7-seat cars	1
[illegible]	[illegible]

It was decided to treat the main road below the branch road with bituminous material, which was done. The remainder of this road, to its end (about 10,000 ft.), needed some repairs to the macadam. These were made by water-binding methods, at an average cost of $0.276 per sq. yd., calculated on the basis of the total area of the macadam in the road, as the road was built in 1908 and had received practically no maintenance. Then "Glutrin" was applied to the macadam through an ordinary sprinkling wagon.

[illegible] TABLE [illegible]

[illegible]								4- or 6- [illegible]	[illegible] cars	
[illegible]									11	
2-A		26	[illegible]	1						
1-A	71		[illegible]							
12-B	38		[illegible]							
12-A		[illegible]								
14-A	267		3							

[illegible]

	Per
[illegible]	[illegible]
[illegible]	[illegible]
Total cost	[illegible]

The average traffic on this section per day [illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
7-seat cars	2

[illegible] ing review of the work done by Mercer County in maintaining its system of improved [illegible] County Engineer:

That work has been surface treatment, and has been confined almost entirely to the application [illegible] "No. 4 Road Oil," guaranteed to contain from 40 to 45 per cent of petroleum asphalt, and "No. 5 Road Oil," having an asphaltic content of from 50 to 55 per cent. The primary object in using this oil compound was to allay dust, but it was also found that its application added materially to the condition of the surface of the road, and, for the time being, obviated the necessity of making more costly repairs. It was demonstrated that on macadam roads, where a slight disintegration of the surface had begun, further destruction could be retarded and the road maintained through another season in good condition by a single application of road oil with the addition of a thin coat of stone screenings. Relatively better results were secured when two applications were made.

The oil was purchased by the car load. Without heating, it was distributed on the road with an ordinary sprinkler having an oil-distributing attachment. The cost, including the screenings, was about 8 cts. per sq. yd. This work, while giving good results, was not entirely satisfactory on account of the uneven distribution of the oil caused by variations in the speed of the horse-drawn sprinkler. These speed variations were due to change of grades and the passing from a maximum to a minimum load to be hauled, and also to the uneven oil pressure maintained at the distributing point on account of the constantly changing head. This objectionable feature was entirely eliminated by the use of an auto-sprinkler owned by the oil company. With this prinkler perfectly satisfactory results were obtained, the machine being capable of traveling at uniform speed, regardless of changes in grade or load. The varying pressure due to head of oil was overcome by maintaining uniform air pressure in the tank. This pressure added materially to the final result by forcing a portion of the oil into the body of the road. Almost double the quantity of oil can be used without causing small rivulets to flow to the sides of the road when the distribution is accomplished in this way.

After this first trial, all surface oiling was done with auto sprinklers at a cost of 1.2 cts. per sq. yd. of surface treated; but this did not include the cost of the coat of screenings. The cost of furnishing and spreading the necessary quantity of screenings was 3 cts. per sq. yd., thus giving a total cost of 4.2 cts. as compared with 8 cts. per sq. yd. when the entire work was done by the county.

This method of surface treatment, although of a temporary nature only, gave very good results, and, when considered in connection with its cost, deserves to rank among the foremost methods of maintaining an already constructed water-bounded macadam road. Great care should be taken, however, in selecting an oil for surface application. If the oil is too thick, it will remain on the surface and will not penetrate the body of the road. When of this consistency, it will adhere to the wheels of passing vehicles, causing more or less discomfort to the traveling public as well as injury to the road surface. On the other hand, if the oil is too thin or too light, it has too great a spreading and penetrating power for the base it contains. The result secured with such oils is a stained surface more or less devoid of any cementing bitumen, making frequent applications necessary. An ideal oil is one which will penetrate and yet have sufficient base to assist in holding together the mineral aggregate. Mr. Eppelle gives it as his judgment, that a product containing from 40 to 45 per cent of petroleum asphalt will generally give the best results.

Of course, it is presumed that the surface of the road to which the oil is to be applied is in fair condition, being free from ruts or other pronounced inequalities. If it is not in fair condition, the surface should be renewed before the application is made. In fact, no method of surface renewal should be used for roads in poor condition unless provision is made for spreading a mineral aggregate to a depth of 3 in. or more.

Another method of surface treatment, which gives every indication of producing good results, is the application of a heavy residuum oil, having a specific gravity of about 12° Baumé and a residue of about 90 per cent when reduced to 100 penetration at 77° F., which, when absorbed by the sand coating spread over the oiled surface to a depth of 1 in. or more, depending on the quantity of oil to be taken up, forms a sand asphalt coating which is practically water-proof, dustless, and noiseless, and might be termed an artificial rock asphalt. Unlike the oil product previously referred to, this asphaltic compound, while having no penetrative qualities whatever, possesses distinct binding qualities. It is obtained by the distillation of an asphalt-base petroleum oil.

The method of applying this oil was as follows: The surface of the road was first carefully swept to remove all loose matter, after which water was applied with a sprinkler in sufficient quantity to saturate the road thoroughly, the object being to remove any loose particles remaining on the surface and to deposit them in the existing crevises. Uniform distribution of the oil cannot be accomplished if there is much loose material on the surface. The oil was received in tank cars, and, after heating to about 150° F., was pumped into a road sprinkler and applied to the washed surface with a special spreading device, using ½ gal. per sq. yd. of surface. When the asphaltic product came in contact with the wetted surface of the road, it was chilled, thus preventing it from running off at the sides. While in this chilled state, it was absorbed by the sand coating which had been immediately spread. The sand used was of a sharp, gritty nature, entirely free from loam and moisture. The road was opened to traffic after a reasonable amount of rolling, and the spreading of additional sand at points showing a surplus of oil. The condition of the surface then improved daily. The value of this method of repairing roads depends on the fact that an oil of this consistency, when covered with a layer of sand, will be slowly drawn to the surface by solar heat; consequently, work of this class should be done only on clear, warm days.

The experimental work done by this method, was necessarily crude, owing to improper machinery, etc., but it is understood that heater tank wagons are now being used which apply the oil under pressure, and thus give more uniform results by eliminating the probablity of having a varying thickness of resurfacing material.

It is essential to coat every part of the road with a layer of oil of uniform thickness, as points not coated will have no covering, and those receiving an excess of compound will become wavy by the rolling of the surface under extreme loads. It is also apparent that the surface of a road to be treated by this method should be free from inequalities, thereby removing all possibility of water collecting in pools on the surface. Although no experiments have been made along this line, it is believed that if a light coating of pea-size broken stone is applied first, and then covered with sand, the result will be a great improvement, giving a better and more lasting covering, which will reduce to a minimum the tendency to creep under heavy loads. The asphaltic oil-sand covering which has been in use for one year indicates that fairly good results will be obtained for another season. It is proper to assume, then, that, under normal conditions, the life of roads resurfaced by this particular method is 2 years, after which, with the addition of a lighter coating, it is claimed that the life can be extended to 4 years. The cost of the compound was 5 cts. per gal., delivered, and the total cost for work of this class was about 9 cts. per sq. yd., or an average of 4½ cts. per sq. yd. per year.

By far the greater part of all resurfacing work on roads in New Jersey during 1910 was done, or at least started, under a state specification, which called for the spreading of 4 ins. (loose measurement) of 1½-in. broken stone; the coating of the stone by the application of heated asphaltic binder to the surface; thorough rolling; the addition of ¾-in. stone, or screenings, and sometimes sand, and continued rolling until the road was finished. Although it was thought that excellent results would be produced by this method, it failed to come up to expectation.

A large number of contracts for new construction, as well as reconstruction work, had been entered into throughout the state, when, in the middle of the season, it was decided, with the consent of all interested parties, to change the contract by eliminating the use of the asphaltic binder specified and by providing for the construction of a water-bonded macadam, and the application, when completed, of "No. 4 Road Oil" to the surface. In every case this change carried with it an allowance or rebate, on the part of the contractor, to the state and county, and, at the same time, gave greatly improved results, when compared with those previously obtained.

That part of the original specification relating to the qualities of the asphaltic binder to be used was prepared by an expert chemist, and called for heating the compound, which was shipped in tank cars, to 200° F., after which it was to be applied to the road by a sprinkler.

It is claimed, by the parties who furnished the asphaltic binder, that the cause of failure was due, not to the chemical proportions, but to the physical properties of the compound, and that if a hard binder, without being "cut back" or fluxed with a distillate, had been specified to be applied by hand after heating to 350° F., the final results would have been entirely satisfactory. This claim by the oil company, however, is not in accordance with the results obtained in New Jersey during the past three years. The binder used during 1909 was not a "cut back" product, yet the results were worse than those secured by the "cut back" compound specified in 1910. Both products were of about the same consistency. According to the opinion of the chemist referred to above, one of the causes of failure was the use of an oil having a paraffine base, oils of this type appearing to lose their binding properties much more quickly than those having an asphaltic base.

It is possible, however, with a proper asphaltic binder, to make a satisfactory bituminous macadam road by the foregoing methods, as shown by some of the roads constructed; but, to secure these results, it is essential to have experienced men, a satisfactory distributor, and a reliable contractor. A hard binder, heated to 350° F and applied by hand, should not fail to give good results.

Although the results obtained after changing the method of construction, as related above, were pleasing, it should not be understood that, in the opinion of the State Road Department of New Jersey, or the various county engineers, this is the most desirable method for future construction work. It is Mr. Epnele's opinion that a bituminous binder of some kind should be used, and that a change to the old water-bonded macadam, even if it provided for the application of a light dust-laying oil to the surface, would be a step backward.

The State Road Department, however, was

in a peculiar position, which, in justice to it, should be mentioned. [illegible] understood that, in an opinion given [illegible] Attorney General of the State to the [illegible] Department at the time a change of [illegible] construction was being considered, it was held that the Department would be justified in modifying the specifications where the sole object was to improve the results after construction, provided such change did not involve an addition to the original cost; but that a change at an extra cost would not be legally justifiable without canceling existing contracts and re-advertising for bids. Under these circumstances, there was [illegible] to follow than the one adopted.

The average cost of resurfacing work under the original specifications was 58 cts. per sq. yd., which cost included the necessary work to be done on shoulders. Deducting the average rebate of 6 cents per sq. yd. leaves a net cost of [illegible] cts. per [illegible] work of this class.

Metropolitan Park [illegible] Ways.—Mr. John R. Rablin, Chief Engineer of the Metropolitan Park District, stated that the results obtained on work of surface treatment with tars and oils have been generally very satisfactory, on ordinary macadam and gravel surfaces, and on those constructed with bituminous binders.

The work was begun [illegible] when about 67,000 sq. yds. [illegible] surface was covered with Tarvia. Previous to this work, very little expense had been necessary on these roads, except the cost of watering, as they had been built only from four to five years. The cost of watering alone averaged about 3½ cts. per sq. yd. of surface per year. The cost of this first work of surface treatment with Tarvia averaged 6⅔ cts. per sq. yd. including labor and materials. The details of this cost are as follows:

	Per sq. yd.
Tar	[illegible]
Stone screenings	[illegible]
Labor	[illegible]

The labor item includes preparing the roadway surface and applying the tar and screenings.

When it is taken into consideration that this work acted as a substitute for resurfacing, which would otherwise have been necessary, and also eliminated the sprinkling with water, it is evident that it was an economical method of road preservation, provided it would be effective for at least one year. That this has proven to be a fact will be shown by the costs of maintenance of this and other sections from the time of the first treatment to the present. For the following year, 1907, the total cost of repairs and re-treatments of the Tarvia section averaged 3½ cts. per sq. yd. for the 67,500 sq. yds. During this year about 150,000 sq. yds. additional macadam road surface were treated in the same manner at a cost of from 5¾ to 9 cts. per sq. yd., or at an average cost of 6½ cts., including labor and materials.

Besides this additional Tarvia work, experiments were made with other materials during 1907. About 225,000 sq. yds. of roadway—one-quarter being gravel-surfaced and three-quarters macadam-surfaced — were covered with a mixture of crude water-gas tar and asphaltic oil. These materials were mixed in different proportions of 2, 3, and 4 bbls. of oil to 6 bbls. of tar. The results obtained with this material were more in the nature of dust suppression than surface preservation, as it contained but little actual binding properties. Better results were obtained with it on the gravel surfaces than on the macadam. The average cost was 4 cts. per sq. yd., including materials and labor for one application.

Asphaltoilene, an asphaltic oil, was used on about 35,000 sq. yds. of roadway, one-half macadam and one-half gravel-surfaced. This material was furnished and applied for 6 cts. per sq. yd., the only other expense being the sand covering, which was very small. The results obtained by the use of this material were very satisfactory and economical, as in the case of the gravel-surfaced road it was effective for two years, with practically no expense for repairs during that period, and the macadam roadway was maintained during the second year by patching and some slight re-treatments, at an average cost of 3 cts. per sq. yd.

During the next year, 1908, about one-half of the total area previously surfaced with refined tar, or 120,000 sq. yds., was re-treated with the same material, at an average cost of 4¾ cts. per sq. yd., and the remainder kept in good condition without repairs. About 60,000 sq. yds. additional, of this same class of work, were done, except that a different brand of refined tar was used. The average cost of this additional work was 5 cts per sq. yd. About one-quarter of the area surface-treated during the previous year with asphaltic oil was given a light re-treatment at a cost of about 3 cts. per sq. yd., and 75,000 sq. yds. additional were laid, at a cost of 7 cts. per sq. yd. Of the area previously treated with water-gas tar and asphaltic oil, 53,000 sq. yds. were re-treated with the same material, and 46,000 sq. yds. additional were laid. The cost of both averaged 3½ cts. per sq. yd.

A new combination of materials, which has been used to a considerable extent since, was tried in this year on about 30,000 sq. yds. of macadam surface. It consisted of 90 per cent refined tar and 10 per cent residual asphalt. The cost of this work averaged 5½ cts. per sq. yd. The results obtained with this material appeared to be superior in some respects to those with the tar alone.

During 1909 and 1910, the tar surfaces have been maintained in good condition generally by re-treatments with the tar and asphalt mixture, at the rate of about once in two years, at an average cost of 6 cts. per sq. yd. for each re-treatment, and the asphaltic oil surfaces have required about the same attention and at the same average cost. Where traffic conditions are extremely severe, more frequent repairs are required, and the average cost will vary up to 6 cts. per sq. yd. per year. Where the macadam surfacing is constructed with a bituminous binder, the surface, or painting coat, is also required from time to time, but, as stated previously, not as frequently.

Mr. Rablin states that it appears from these tests of the past five years that surface treatment of macadam and gravel road surfaces with refined tars and asphaltic oils has been, up to the present time, an effective and economical method for the preservation of road surfaces subjected principally to an automobile traffic, which was the class of traffic under which these tests have been made.

Baltimore [illegible] tion given by R. K. Compton, Assistant City Engineer of the method used in Baltimore of applying a surface treatment of oil.

Where the original road bed was in good condition for any material distance, and required no new stone for resurfacing, the surface treatment was tried. The old road-bed was thoroughly cleaned with wire brooms, and all dust, dirt, and foreign material were removed. A coating of Fairfield Anti-Dust, a local material, heated to a temperature of 190 [illegible] gal. per sq. yd. of surface, and was thoroughly broomed in. About two hours was allowed for the bitumen to set and penetrate, after which the surface was covered with a layer of granolithic from ⅝ to ¼ in. in size, and then thoroughly rolled with a 12-ton roller.

The cost of flushing 3,024 sq. yds. of surface was 13.29 cts. per sq. yd., itemized as follows:

	Cts. per [illegible]
Labor	[illegible]
Stone	[illegible]
Rolling	[illegible]
Binder	[illegible]
[illegible]	[illegible]
Hauling	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

The surface treatment was only used where the original section was in fairly good condition, in order to prevent raveling, and at the same time to allay the dust nuisance. A recent inspection of the road, after it had been subjected to a heavy fall of snow, a sudden thaw, and freeze; in succession, showed that the surface treatment has served the purposes for which it was intended. Where the machines had worn a rut through the snow and ice to the surface, the road showed some signs of raveling, but this defect can be corrected at small expense in the spring. Every machine and vehicle followed this same rut for weeks, so that there must have been an enormous wear on the surface for a width of only about 6 in.

Bronx Borough [illegible]—A surface treatment of oil and sand was used in connection with experiments on White Plains Avenue, Borough of the Bronx. The description and detailed cost was given by William H. Connell, Assistant Commissioner of Public Works, Borough of the Bronx, New York.

The Standard Oil Co.'s sand-surface method was used. This part of the road was an old strip of water-bound macadam. It was swept, and then Standard Oil Co.'s Binder A was applied, the quantity being ¾ gal. per sq. yd. Over this was spread a thickness of about 1 in. of sand, which was lightly rolled. The cost per square yard was as follows:

	Per sq. yd.
[illegible]	$[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	$[illegible]

The cost of the sand course was:

		Per sq. yd.
[illegible]	[illegible]	$0.0[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	$[illegible]

[illegible] was as follows:

	No.	Hours.	Rate.	Totals
Foreman	1	[illegible]	$[illegible].00	$7.00
Cleaning macadam	3	24	2.26	6.75
[illegible]	[illegible]	40	[illegible]	11.25
Hauling [illegible]	[illegible]	[illegible]	2.25	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	5.90
[illegible]	[illegible]	[illegible]	2.25	0.56
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				$[illegible]

The actual time of laying the sand course was 2½ days (gang time), or an average of 187 sq. yds. per day, including cleaning and brooming old macadam. The temperature, weather, etc., at the time of the work was as follows:

Date	Time	[illegible]	[illegible]	[illegible]	Weather
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Clear
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Clear
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Cloudy

Experiments are being made by the Chicago, Burlington & Quincy R. R. with an attachment for removing nuts from track bolts. The atachment is applied to common track drills. The drill and bits are removed and a wrench substituted in their place. After the nuts have been loosened with a common track wrench they can be removed and replaced with this attachment much quicker than can be done by hand in the usual way. It is especially convenient in putting on nut locks. While but a few tests have been made, the results obtained so far have been satisfactory.

Topographers of the United States Geological Survey have mapped more than one-third the area of the United States. Detailed topographic maps are prepared as the surveying progresses. The maps represent areas called quadrangles, and show, by a system of contour lines, all topographic features, giving elevations as determined by the Survey's spirit level work. The quadrangles are areas limited by parallels of latitude and meridians of longitude and differ in size with the latitude of the areas and with the scales of the maps. Every year during the open field season the government topographers survey, in very accurate detail, from 25,000 to 30,000 square miles.

WATER-WORKS AND SEWERS SECTION

Method of Using Corrugated Iron Culvert Pipe for a Water Supply Intake.*

[illegible] Station. The building of this plant was started in 1904 with an installed capacity of about 2,500 K. W. and is now being increased to bring the total installed capacity up to about 17,000 K. W. Westinghouse Church Kerr & Co. have been the engineers and constructors of this plant from the beginning.

While the location of the plant at Dutch Point is exceptionally advantageous, the discharge of a large city sewer entering the Connecticut River just above it has always fouled the condensing circulating water and this became more and more objectionable as the business of the company grew and the station load increased.

The river is not more than 10 ft. deep at low water where it flows past the plant and the amount of solid matter which entered the intake or got through the screens and lodged in the condensers was so great and its character so offensive that the operation of cleaning them was not only disagreeable and unhealthy but had to be repeated every few days.

The original intake was provided with a screen chamber fitted with several sets of movable screens in the usual way which strained out so much solid matter that the flow of water through them was seriously obstructed and it was often difficult to get a supply adequate for the condensers, even though the screens were frequently cleaned.

In connection with the recent enlargement of the plant to about 17,000 K. W. capacity it was decided to work out a plan of intake filtration which had proved successful on some of the western rivers though on a somewhat smaller scale. This was to utilize the sand of the river as a filter bed and was effected by sinking a crib, 30 ft. square and 9 ft. high, below the surface of the river bottom. The crib then became a filter box surrounded by stone and covered with sand. Fig. 1 shows the crib before sinking with the outboard section of the pipe in place.

In order to secure a suitable location for this crib it was found necessary to locate it about 500 ft. out in the stream opposite the plant and the engineers were confronted with the problem of connecting this crib in a suitable manner with the condenser intake. After much consideration "Acme" (Nestable) culvert pipe manufactured by the Canton Culvert [illegible] It was selected for the purpose [illegible] many advantages for this class of work. It is manufactured of special rust resisting metal, is heavily galvanized, [illegible] to give it strength and is light and easily handled.

It was necessary to make up the pipe under water [illegible] for this purpose and [illegible] of handling became of great importance. The pipe is 60 ins. in diameter and lies in a trench dredged in the bottom of the river, the bottom of the pipe being 10 ft. below the natural bed of the stream and runs from the center of the crib to the former intake chamber with one right angle bend looking up at the shore end. Figure 2 shows the land end of the pipe with the elbow in place all ready to be sunk into position.

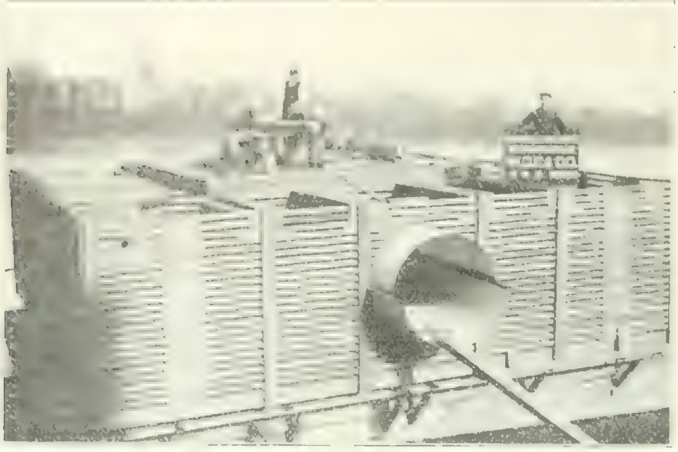

Fig. 1—Filter Crib Before Sinking, Showing Cutboard Section of Pipe in Place.

This 60 inch pipe is made up of No. 12 gage corrugated galvanized plates of "No-Co-Ro" metal and is made up in the factory in semi-cylinders with flanged edges. The plates composing the straight run of pipe are joined up by bolting together the projecting side flanges and by bolting the overlapping girth joints which in the top sheets come half way between those in the bottom sheets, thus breaking joints in every section.

In putting in this pipe the plates were thus joined together above water to make sections of pipe about 50 ft. long which when laid in the trench required only one joint to be made up under water in each length. Figure 3 shows sections of the pipe on the raft ready to lower into place. Before bolting up the sections of pipe, both the longitudinal and girth seams were filled with Slaters cement, [illegible] amount of cement being used to insure a reasonably tight joint.

As the pipe is buried in the river bottom and there is no appreciable pressure it is not necessary to have the joints tighter than is required to prevent the infiltration of sand. After the pipe was laid in the trench the latter was back filled to provide mechanical protection to the pipe and the former intake was converted into a closed chamber to exclude unfiltered river water.

Since this installation was completed about Jan. 1 of this year it has been constantly in use without a moment's interruption and with remarkable results as to volume and quality of water handled and the troubles from condenser maintenace have been entirely overcome.

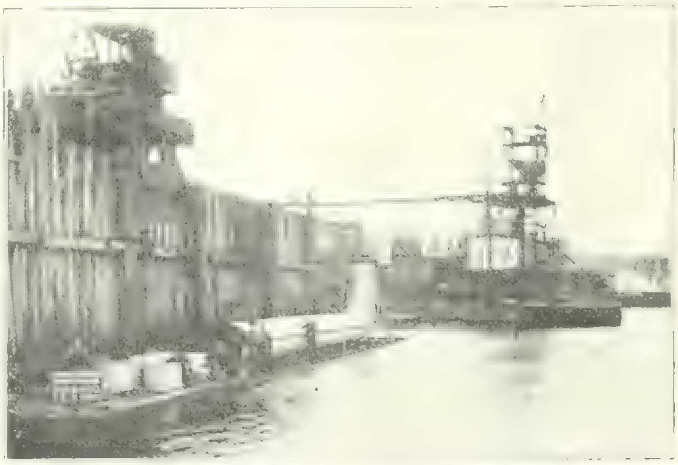

Fig. 2—Shore End of Pipe Intake Ready to Be Sunk into Place.

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*Prepared by [illegible] A. Kerr, Vice-President, [illegible] Kerr & Co., New York, N. Y.

Methods of Keeping Costs by the Engineers of the Pittsburg Filtration Works.

The methods and cost of constructing the filtration works for the new Springfield, Mass., water supply were given in an article by Mr. Charles R. Gary, published in our issues of Jan. 18 and 25 and Feb. 1, 1910. In the discussion of this paper Messrs. Morris Knowles and Frederick E. Field, respectively chief engineer and principal assistant engineer, Bureau of Filtration, Pittsburg, Pa., outline the methods accomplished by them in keeping the construction costs of the $6,000,000 filter plant recently built at Pittsburg under their direction. We give the principal parts of this discussion as follows:

METHODS OF COST KEEPING

The method of cost keeping which the author employed on this work, and which gave such satisfactory results, is practically the same system which was adopted and used by the engineering force of the Bureau of Filtration of Pittsburg, Pa., during the entire period of construction of the Pittsburg Filtration Works, from 1905 to 1910 inclusive, costing about $6,500,000.

On the Pittsburg work there was what was known as the "Central Force Account Division," with a man in charge, under whom were both office and field clerks. Prior to the beginning of work on any contract, a "Distribution of Account" sheet was made out, in which, similar to the method employed by the author, the work on any contract was first noted by its "Item," then subdivided under lettered "Sections" and numbered "Subsections," to indicate the class of work and the detailed cost of all plant materials and labor chargeable to that particular item. With this as a basis, other printed forms were adopted, upon which the daily, monthly and final accounts were made out, either in detail

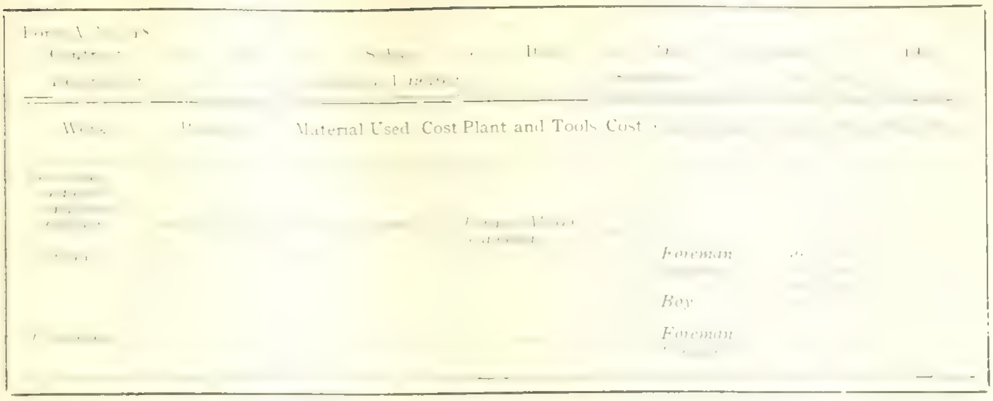

Material Used Cost Plant and Tools Cost
Foreman
Boy
Foreman

Fig. 1.

[illegible] (See sample forms, Figs. [illegible])

The field [illegible] daily, or more frequent, trips about the work, obtained records of the number and wages of men employed on the various subdivisions of the work, [illegible] the materials and supplies received, etc. Furthermore, each inspector on the work was required [illegible] recorded in detail the force, labor and materials used [illegible] responsible, together with the quantity of work done on each subdivision of the work during that day. These diaries were handed in each day to the "Central Force Account Division" [illegible] by its own clerks and the regular inspectors, to record and summarize the costs of the work.

At the end of each month, the quantities of work done, as estimated by the force account clerks and the inspectors, were checked by the engineer's monthly estimate of quantities, thus obviating error and balancing the cost of work [illegible] charges of the administrative force, office expenses, [illegible] shops, interest charges, etc., and these were apportioned at the end of the work.

Figure 1 illustrates the usual 5-in. by 8-in. "Time Card," as filled out by the "field-force-account clerk," with data obtained personally and from the regular inspectors' diaries.

Figure 2 gives a typical "Monthly Summary of Force Accounts" for one item of the work (i. e., concrete in vaulting). This illustrates how the daily record of labor and material costs, obtained from the 5-in. by 8-in. cards noted above was assembled under the important subdivision at the end of each month.

Figure 3 gives the method of computing the [illegible] which are added to the data given on summary [illegible]

Figure 4 shows the grouping of the data obtained from the "Monthly Summary of Force Account" sheet, shown in Fig. 2, for the Semi-Annual Summary of Force Accounts.

Note that the "Unit Cost" of the concrete in vaulting from this sheet agrees with the "Unit Cost" given in table No. 1, after deducting the cost of "Forms," given in a footnote.

Figure 5 shows the assembling of the distributed "Monthly Estimate of the Engineers" with the "Unit Cost," obtained from the "Force Account Records."

The results of this systematic method of cost keeping were of value in several ways.

First. The engineering force was enabled to have daily and monthly records of the cost of the work, in as much or as little detail as desired, the current data not including "General Charges."

Second. A check was secured on such items of "Extra Work" as were executed by the contractor and paid for on the "cost plus a percentage method," claims for which were frequently [illegible] the contractor.

Third. [illegible] the cost of the work was obtained with suitable allowances for "General Expense."

Fourth. [illegible] cost of future work was thus placed at the disposal of all thus interested.

All these cost records were obtained by the engineering force alone, and without any assistance from the contractor, who was adverse to giving any information of this character. Notwithstanding the difficulties of obtaining the desired information under these conditions, a general check on the accuracy and correctness of the work was finally secured. Before the final settlement of the early filtration contracts, aggregating $5,500,000, an audit of the contractor's books was made, and in this way the stated actual cost of the work, indicated by the contractor's own records, was obtained by the engineering force. The differences in accounts were slight and occurred largely upon items other than labor, where the full details were naturally not known to the engineers. The differences are as follows:

On pay-roll: Engineers' account, 6/10 per cent higher than contractor.

On [illegible]: Engineers' account, 8 3/10 per cent lower than contractor.

On total cost of work: Engineers' account, 3 5/10 per cent lower than contractor.

We have been especially interested in the statement that the "General Expense" amounted to 12.9 per cent of the other costs of the work. The early filtration contracts at Pittsburg, valued about $5,500,000, had a total general plant and administrative expense of about 19 per cent, of which 6.5 per cent was for plant charges.

The item for grubbing is very instructive, for it may commonly be said that estimates for such work are usually too low. Much also depends upon the detailed character and extent of the work required. Some work under the observation of one of the writers was originally estimated to cost an average of $67 per acre; while present records, covering 145 acres out of a total of 390 to be done, show the actual cost to run about $120 per acre, including general expenses. This also includes cost of cutting and piling cord wood, about one-fifth of the total cost, which in some few cases has amounted to 200 cords per acre. The work includes all cutting of roots, allowing trees to pull out stumps as they fall over, the blowing out of some old stumps left by previous timber work, and the grubbing out of all underbrush and roots.

TABLE I—COMPARATIVE COSTS—[illegible] AND PITTSBURG CONTRACT [illegible] FILTRATION WORKS.

Class of Work.	[illegible]	[illegible]	Concrete Piers.	Concrete Vaulting.	[illegible]
[illegible]	[illegible]	[illegible]	708	3,673 10,773	[illegible]
Total cost	[illegible]	[illegible]	$9.29	[illegible]	[illegible]
General expense	[illegible]	[illegible]	$0.56	0.78	[illegible]
[illegible]	[illegible]	[illegible]	0.89	0.39	0.24 0.14 0.17
[illegible]	[illegible]	[illegible]	2.87	$2.30	[illegible]
[illegible]	[illegible]	[illegible]	3.77	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	$1.17	[illegible]

[illegible] $1.713 [illegible] yard of concrete at Pittsburg [illegible] based on two-fifths of total quantity of [illegible] on three-fifths of total quantity of gravel to [illegible]

In reviewing that part of the author's paper concerning concrete masonry, the writers have been especially interested in the plant used.

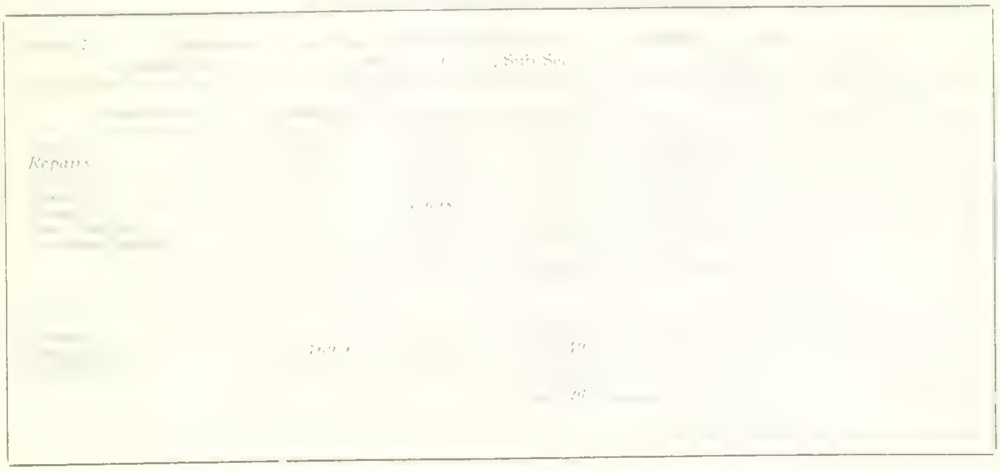
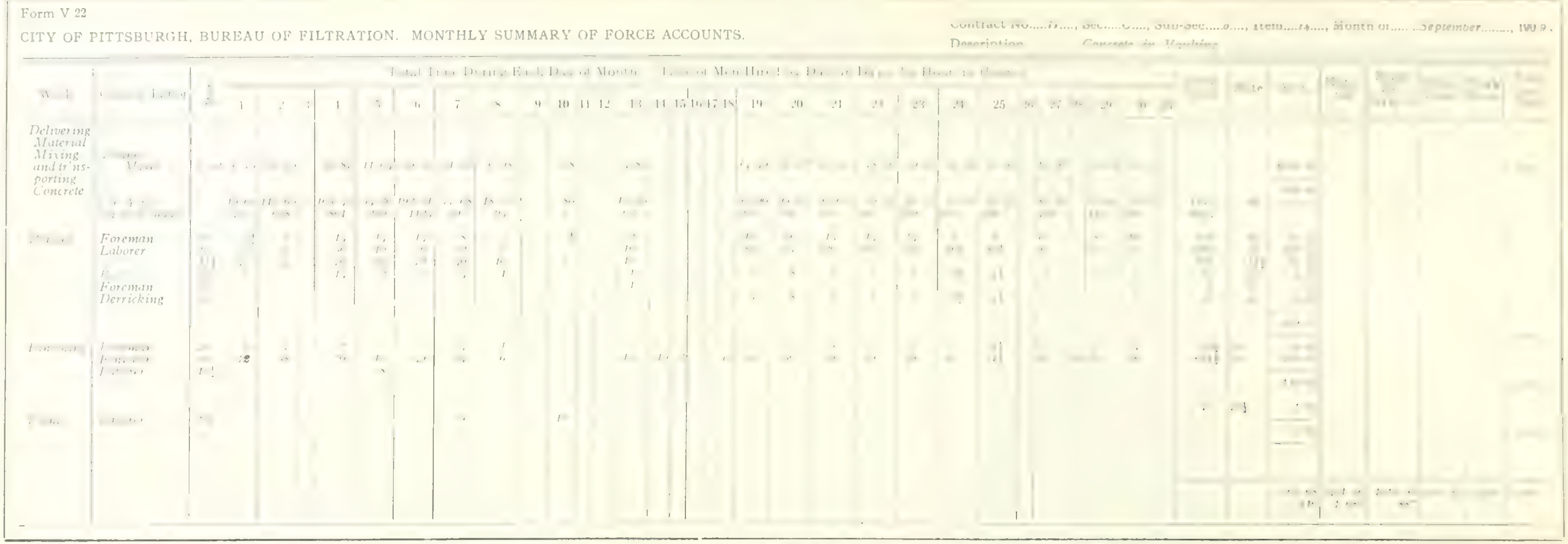

Sub Sec
Repairs

Fig. 2.



Form V 22

CITY OF PITTSBURGH, BUREAU OF FILTRATION. MONTHLY SUMMARY OF FORCE ACCOUNTS.

Contract No....11...., Sec....C...., Sub-Sec....6...., Item....14...., Month of......September......, 1909.

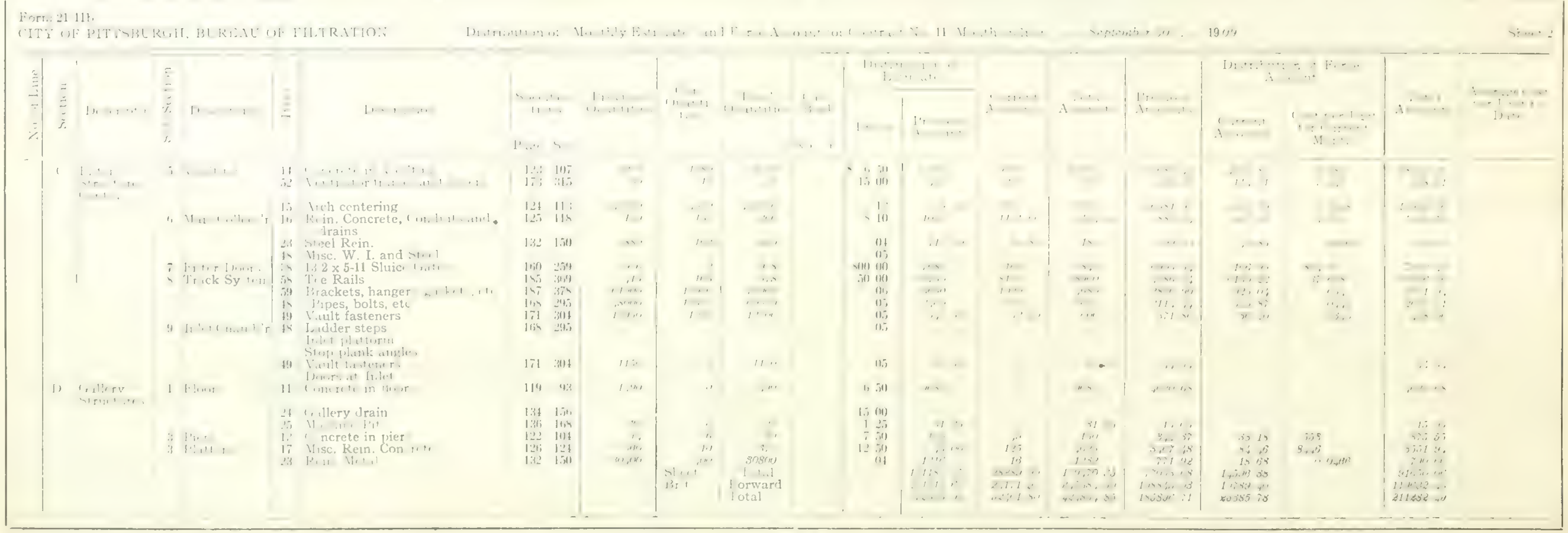
Description Concrete in Vaulting

Delivering Material Mixing and transporting Concrete

Foreman
Laborer

Foreman
Derricking

Fig. 3.



Form 21 11B

CITY OF PITTSBURGH, BUREAU OF FILTRATION

September 30 1909

Sheet 2

Section	Division	Sub-Section	Division	Item	Description	Page	Sec	Price
C		5		14		123	107	6 50
				52		173	315	15 00
				15	Arch centering	124	113	
		6		16	Rein. Concrete, Conduits and drains	125	118	8 10
				23	Steel Rein.	132	150	04
				48	Misc. W. I. and Steel			05
		7	Filter Doors	58	13 2 x 5-11 Sluice Gate	160	259	800 00
		8	Track System	58	Tie Rails	185	369	50 00
				59	Brackets, hangers	187	378	06
				48	Pipes, bolts, etc	168	295	05
				49	Vault fasteners	171	304	05
		9		48	Ladder steps Inlet platform Stop plank angles	168	295	05
				49	Vault fasteners Doors at Inlet	171	304	05
D	Gallery Structures	1	Floor	11	Concrete in floor	119	93	6 50
				24	Gallery drain	134	156	15 00
				25	Manhole Pit	136	168	1 25
		3	Pier	12	Concrete in pier	122	104	7 50
		3	Platform	17	Misc. Rein. Concrete	126	124	12 50
				23	Reinf. Metal	132	150	04

Total
Forward
Total

Fig. 4.

the methods empl[illegible] [illegible]ng the work, and the results and costs.

It may perhaps be granted that, at the Springfield Filtration Plant, the derrick system of handing the work, all other conditions considered, may have been the most economical,—due to the lesser first cost and the possibility of later disposing of the derricks advantageously. But the cableway system has been found advantageous on work of approximately the same size, and especially efficient on larger works of construction, where the first cost of plant is secondary to rapidity of progress, adaptability for many classes of work, non-interference with progress of dissociated items of the work, and simplicity of operation.

We do not agree with the author's statement on page 33, "It would not be practical to utilize the cableway for this purpose," viz., in setting or removing forms or transferring them from one filter to another. Our experience and knowledge of the filtration work at Philadelphia, Washington, D. C., and especially at Pittsburg, indicates that the cableway is most exceptionally adapted for economical handling of forms; in fact, in the Pittsburg work, forms were seldom handled in any other manner. It would be interesting to know whether the erecting of the hoisting engine and the subsequent operation of it upon the "green" or recently placed concrete in the filter roofs was not taking more than a reasonable risk toward developing cracks in the roof, even if not endangering the strength of the vaulting, due to eccentric loading or vibration.

The author states, on page 34, "Two derricks could handle the concrete as fast as a single cable could"; and on page 33 gives "125 to 150 cu. yds. as a large day's work." On the Pittsburg work, one cableway, on Contract No. 2, Filtered Water Reservoir, with a span of about 300 ft. and a distance of about 1,000 ft. from the mixer, placed 289 cu. yds. of concrete in a ten-hour day. On Contract No. 11 Ten Slow Sand Covered Filters, a cableway with 500 ft. span and a distance of over 1,000 ft. from the mixer, placed 432 cu. yds. of concrete in a ten-hour day. On this later contract, the single cableway placed 31,200 cu. yds. of concrete from April to October, 1909, both inclusive; or an average of 180 cu. yds. per day, based on 25 working days per month.

PITTSBURG FILTERS, CONTRACT NO. II.

As we shall refer to this latter contract in comparing cost items, a brief description of this work may be of interest; it is more nearly comparable to the Springfield work in size and quantities than the work under Contract No. 1.

Contract No. 2 comprised 10 one-acre, slow-sand-covered filters, arranged in two rows of 5 filters, between which is a covered operating gallery.

The north wall of the filters is parallel to and about 50 ft. from the center line of the south bank of a large sedimentation basin. The east wall is within 50 ft. of a row of large trees bordering a large private estate. The west wall at one point comes within 25 ft. of a macadam road open to travel. The south wall extends, for a considerable length, at a distance from 25 to 50 ft. from the edge of an important and much traveled road, upon which electric cars pass at intervals.

South of this road, and parallel to it, there are the four tracks of the Western Pennsylvania R. R., and about 500 ft. south of this is the bank of the Allegheny river, from the bed of which all sand and gravel for concrete and filter material were obtained. It is evident that the contractor was considerably cramped in his operations; in fact, it was necessary for him to place one line of cableway tracks considerably within the outside line of the south wall of the filters.

All concrete materials were brought to the receiving bins of a concrete mixer, of the Hains type, located on the river bank; there mixed and transported on flat cars, by dinkey engine haulage, through a subway beneath the Western Pennsylvania tracks, to a point where the buckets of mixed concrete could be lifted from the cars by the cableway. Three and one-half cu. yd. hopper concrete buckets were used, and it was in a large measure due to this type of bucket that such excellent progress was made.

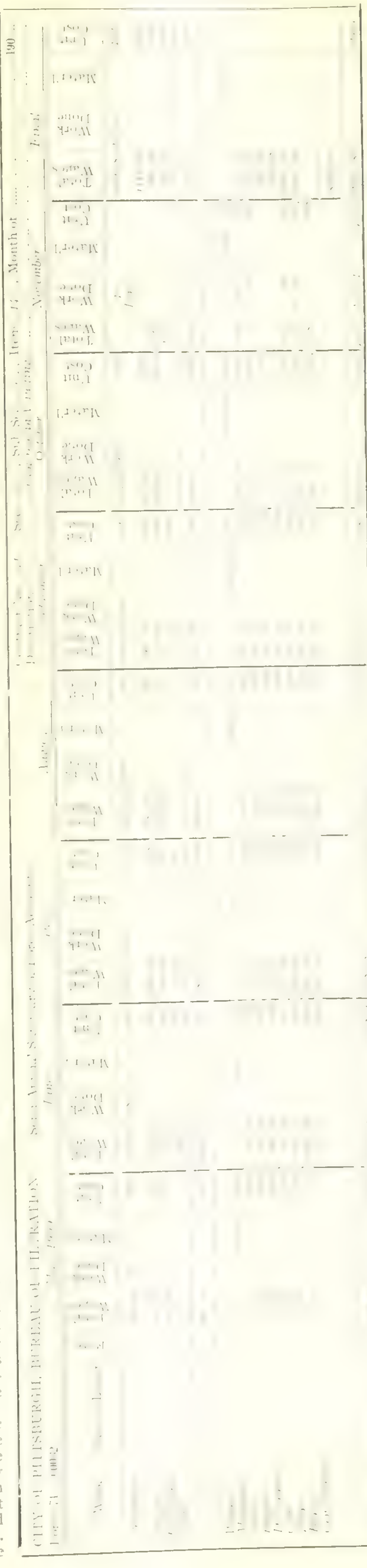


Fig. 5.

FILTER MATERIAL

The author evidently experienced the usual difficulties met with by contractors in furnishing filter material, although in his case the local conditions were apparently especially severe. Similar difficulties of experimental trying-out methods and arrangements and large waste of original product are to be expected and should be planned for. A brief description of the plant and method employed by the contractor for furnishing filter sand and gravel for the Contract No. 11, Pittsburg, is given, to illustrate this one feature of the work at Pittsburg.

The specified requirements for filter sand and gravel for the Pittsburg work did not differ materially from those at Springfield. The mixed sand and gravel, brought up from the bed of the river by the bucket conveyor, of the usual type of Ohio river ladder-sand-digger, was first thrown upon grate bars, spaced 5 ins. apart, which removed all large stones. At this point a 4-in. stream of water, from a pulsometer pump, having a capacity of 420 gals. per minute, was played upon the material, washing it into a cylindrical screening tube, 3½ ft. in diameter. Through the center of this tube, which was evolved at a rate of 14 revolutions per minute, there was a 4-in. perforated pipe, supplied with water under 35 lb. pressure, which furnishes the second and final washing of the gravel on the dredge.

The first section of this screen was 4.50 ft. long and had 3/16-in. mesh, which removed the No. 4 gravel and sand. Outside of this screen there was a screen, with ⅛-in mesh, which separated the No. 4 gravel from the sand. The No. 4 or finest gravel was carried by a belt conveyor to the rear of the boat, where it was dropped into wheelbarrows and thus loaded into a barge.

The sand was carried by a chute to the sand-washing tank, consisting of a box about 6 ft. square and 5 to 6 ft. deep, having a false bottom of perforated plate, supported about 12 in. above the bottom of the tank. Water pumped into this lower compartment passed up through the perforated plate and the sand above and overflowed a waste weir at the top. The upward pressure and velocity of the water not only washed out all dirt and fine material, but also kept the sand in suspension and uniformly varying from coarse sand at the bottom to fine sand at the top. By the opening of gates in the side of the tank, sand of the required size and cleanliness was removed and conveyed by chute and thus loaded into a barge alongside the digger.

The second section of the main screen was 4.50 ft. long and consisted of punched plate with 1.50 in. square holes. This removed the mixed No. 2 and 3 gravel, which was loaded directly into a barge on the right side of the boat. The third and last section of the main screen was 3 ft. long, of punched plate with 3 in. square holes. This removed the No. 1 gravel, which was loaded into a barge by means of a belt conveyor. All material not previously removed passed out the end of the screening tube and was wasted.

The capacity of the dredge as equipped was [illegible] gravel, of a total of 1,000 cu. yds. in 24 hrs., which, however, varied somewhat with the material found in the bed of the stream. The loaded barges were then towed to the dock near Ross Pumping Station and unloaded into the receiving bins, as already described, and previously used for concreting materials.

Here the No. 1 gravel was run through a [illegible], which was revolved at 18 turns per minute, and in this way dirt and fine material were removed. The mixture of No. 2 and 3 gravel was treated in similar manner and then separated by passage through a similar screen with ½-in. mesh, being washed by means of a 1-in. perforated pipe within the screen. After these processes were completed, the different gravels dropped into the distributing bins below. As the No. 1, 2 and 3 gravel was re-

[illegible] the [illegible] The No. 4 gravel and the filter sand were not [illegible] the best.

The screening of material to obtain any par- [illegible]

The character of the raw material.

The dimensions of the screen openings, and particularly whether wire mesh or punched plate with square or round holes is used.

The length of the several screens.

The speed or number of revolutions of the screen tube.

The amount and pressure of water used for washing.

Considerable experimental work along these lines should be expected before satisfactory results are obtained.

The prepared filter material was transported in hopper cars, pulled by an electric locomotive, to the filters, where it was dropped through openings in the roof into special steel cars, running upon the permanent track system in the filters, and was thus distributed where desired.

Five months' records show that 14,460 cu. yds. of gravel and 23,760 cu. yds. of sand, or a total of 38,220 cu. yds. of filter material, was prepared and placed. This, on the basis of 25 actual working days per month, gives an average output of 305 cu. yds. per day. At times the contractor worked an additional night gang and thus we have no figures to compare with the ten hour a day output at the Springfield plant.

COMPARISON OF UNIT COSTS

The table (page 141) is given to show in parallel columns the comparative cost of certain items of work at Pittsburg, Contract No. [illegible], to the cost of similar work at Springfield

DRAINAGE AND IRRIGATION SECTION

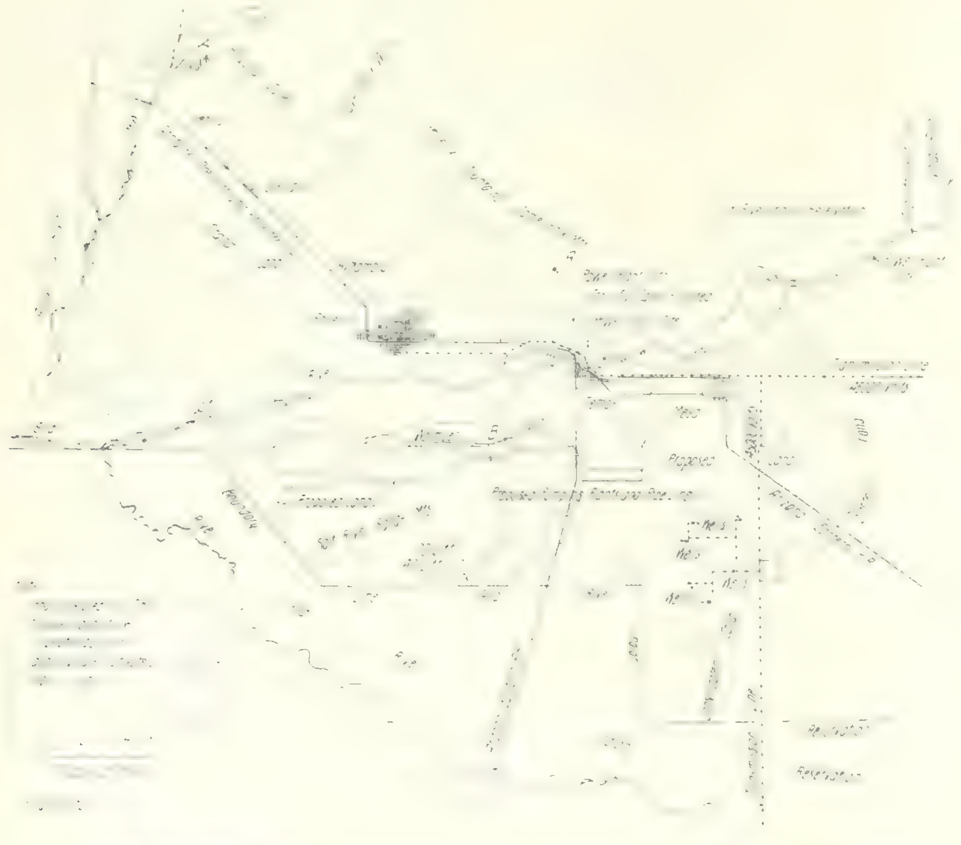
The Existing and Projected Canal System of the Salt River Irrigation Project, Arizona.

In alloting the $20,000,000 appropriation of Congress for irrigation work the sum of $495,000 was provided for the Salt River Project in Arizona. The bulk of this sum is designed for the development of the distributing canal system and in this connection the following account of the present and proposed canal system, which is written by Mr. [illegible] Supervising Engineer [illegible]

When the [illegible] commenced work on the Salt River project, the canals of the valley were all in private ownership. Those of the north side of the river, the Arizona, Grand, Maricopa and Salt River Valley canals were controlled and operated by the principal owner, the Arizona Water Co. The canals of the south side of the river were the Highland, Consolidated, Mesa, Utah, Tempe, San Francisco and Broadway.

With one exception the dams which were used to divert the water to the various canals were of an extremely temporary type of brush and rock construction. They were more or less completely swept away by the floods occurring in winter and in summer. They were always repaired as soon as the flood season had passed and the water in the river had subsided sufficiently to permit the use of teams and wagons in the placing of material.

The Arizona dam was of a more permanent type, being constructed of timber cribs filled with rock and covered with planking. This dam went out in the spring of 1905, and the owners, the Arizona Water Co., refused to make any repairs, and in consequence the repairs were undertaken by the farmers who were dependent upon the water diverted at this point for the irrigation of their crops. They were unsuccessful in making the repairs, but through their efforts the Secretary of the Interior authorized the purchase of the north side canals, which purchase was made early in 1906. In 1909 and 1910 the following canals of the south side were acquired by the Government by purchase: The Consolidated, Mesa, Eastern and a portion of the Utah Canal System.


Map of Present and Proposed Ditch System Salt River Irrigation Project.

In the original construction of these various systems, no thought of a complete symmetrical plan was held, and indeed, it would have been impossible to have worked out any harmonious scheme of construction on account of the diverse and conflicting interests of the various canal owners. The various structures in the main canals and laterals were built of timber that in the majority of cases had been built a number of years and were in a very poor state of repair.

The problems confronting the Reclamation Service engineers were to design a canal system in which the duplication of main canals and laterals should be eliminated, to design permanent concrete structures to replace the decayed and in many instances washed out timber structures then in service, and to carry out construction along these lines without interfering with the established schedules of water service.

In general, the plans as perfected by the Reclamation Service provided for a reduction of the number of both main canals and laterals to the smallest number consistent with good service. By these changes the operating and maintenance charges could be reduced to a minimum.

After the purchase of the north side canals, plans were matured for the construction of a concrete diversion dam at Granite Reef, which is located at a point a little more than two miles below the site of the old Arizona Dam, and about 25 miles from Phoenix. At this point a granite reef extended nearly across the river bed, and forms the foundation of the dam for a little more than two-thirds of its length. In mid-stream the rock was found at such a depth as to make it an impracticable foundation and the dam was founded upon the compact mass of boulders and gravel, into which the curtain walls under the toes of the dam were sunk. The dam is built as an overflow weir, 1,000 ft. in length, and about 26 ft. in height and raises the water about 20 ft. Below that portion of the dam not founded upon solid rock the stream-bed is protected from erosion by a heavy concrete apron, 75 ft. wide, which is made up of heavy slabs of concrete 10 ft. square and 18 ins. thick, separated from each other by a narrow opening that permits the outflow of water collected underneath. The lower edge of this apron is protected by a curtain wall. Two sluiceways at either end of the dam are closed by large gates whose sills are 8 ft. below the crest of the dam and when closed the tops of the gates are 1 ft. above the crest of the dam. Thus the spillway gates add 90 ft. (60 ft. on the north end and 30 ft. on the south end) to the length of the weir. Eighteen intake gates admit water to the Arizona Canal at the north end of the dam, and nine similar gates control the admission of water to the South Canal at the south end of the dam. These gates are located in the walls of the sluicing channels and have their sills 4 ft. above the bottom of the channels, so that the heavier material carried by the river will not enter the canal. The capacity of the north intake is 2,000 sec.-ft. That of the south intake is 1,200 sec.-ft.

Prior to the construction of the Granite Reef Dam, and after the purchase of the north side canals, the Reclamation Service constructed a temporary dam about a mile above the site of the old Arizona Dam, and extended the Arizona Canal to it so that crops might be saved to the farmers, and that the land might be cultivated during the pe-

[illegible] of construct[illegible] Granite Reef Dam.

The accompany[illegible] shows the system of canals, not as [illegible] present, but as planned. The principal point of dviersion is at Granite Reef. On the north side the water is turned into the Arizona Canal and is carried in a general northwesterly direction to New River, which practically forms the western limit of the project. The upper end of this canal will have a capacity of 2,000 sec.-ft. A proposed cross-cut canal taken out of the Arizona Canal (see *A* on map), will deliver water to the Grand Canal through a proposed extension of the latter, and will utilize a fall of about 125 ft. opposite the town of Tempe, which will develop 5,000 to 6,000 hp.

The Arizona Canal is being enlarged throughout its entire length. This work is being accomplished by two steam machines, a Bucyrus dredge and a Lidgerwood excavator.

The Grand Canal divides the valley adjacent to Phoenix into two nearly equal parts. It will furnish the water for the irrigation of the larger part of the lands lying to the south of it while the lands lying north will be irrigated from the Arizona Canal. Since the plans adopted provide for abandoning the larger part of both the Maricopa and the Salt River Valley Canals, it became necessary to give the Grand Canal a greater capacity in order to serve not only the lands that were formerly served by the two mentioned canals, but also to irrigate other lands not then in cultivation. The enlargement of the Grand Canal was done by teams and fresno scrapers. This work was commenced at the lower end and is completed for about two-thirds of its length. The structures along the finished portion of the canal are of concrete. The lateral system of the north side is being enlarged and improved.

On the south side of the river at Granite Reef, the water is diverted into the South Canal, a canal of about 2 miles in length constructed by the Reclamation Service to connect the Granite Reef Dam with the canals already constructed and in service. These are served through the Consolidated Canal which delivers water to the Utah and Mesa Canals and supplies a part of the water of the Tempe Canal System.

The Consolidated Canal was acquired by the Government by purchase in 1909. The Eastern Canal also takes water from the South Canal. It was constructed in 1909 by the water users' association of the valley, and was acquired by the Government by the payment of the claims of the contractor. The Mesa Canal and certain portions of the Utah Canal were acquired by purchase in 1910.

Among the canal systems of the south side there was found the same lack of harmonious plan as was found in the north side systems, and many changes were made necessary in order to carry out the plans for a system that will be most econominal for operation and maintenance. Temporary timber structures are being replaced by concrete structures as upon the north side.

By an agreement made between the Secretary of the Interior and the Salt River Valley Water Users' Association, the latter is to levy an assessment of $2.25 an acre for each of two years. The funds thus made available will be expended in the construction and equipment of three power houses, of a new cross-cut canal between the Arizona and an extension of the Grand Canal, the extension of the Grand Canal and the construction of what is called the Salt Lateral.

Two other canals are proposed. Water will be supplied to them by pumping from a canal. The pumping station is shown at B on the map. A pipe line from the pumping station will deliver water to two canals, one having a lift of 40 ft., the other 70 ft. The work of building the new system and installing the necessary equipment will be done by the people whose lands will be irrigated thereby.

An unsuccessful attempt was made to wreck the new municipal buildings at Springfield, Mass., on April 4. The explosive was placed against the outside of a tower near its base. A hole between three and four feet in diameter was made through the wall.

Proposed Plan [illegible] Drainage for the Fifth Louisiana Levee District With Estimates of Cost.*

The Fifth Louisiana Levee District is shown by Fig. 1 and has an area of about 1,560,000 acres or 2,440 square miles. It has a length of 17[illegible] [illegible] width of 30 miles. The water front along the Mississippi river is 245 miles and along the streams which form the western boundary is 270 miles.

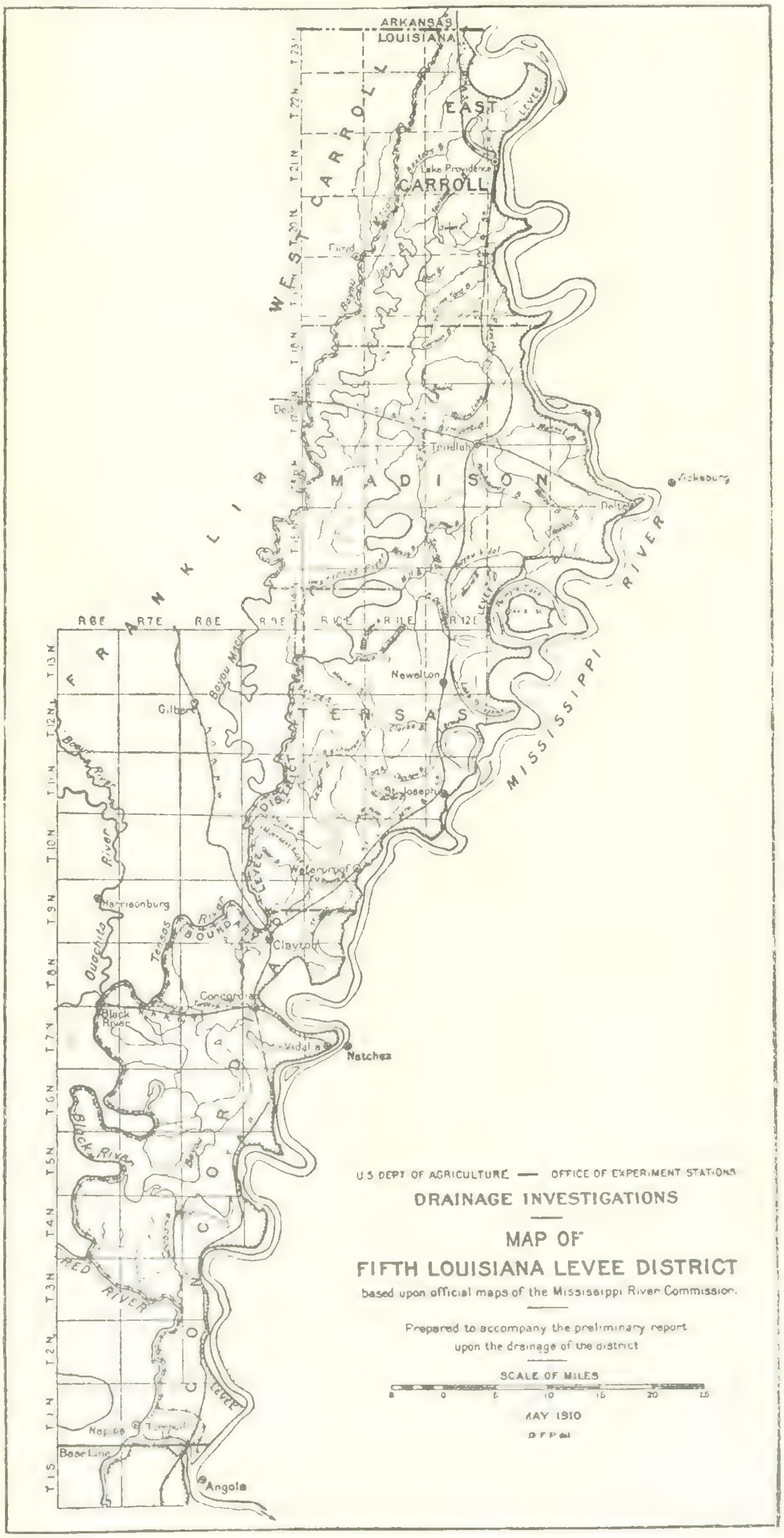


Fig. 1.

Main Drainage System.—The general plan submitted for the improvement of the district is based upon the assumption that the Red river is to be separated from the Mississippi and discharged into the Atchafalaya. The benefit to be received by the separation is not simply a reduction in the cost of reclamation within the district, but a more complete reclamation than otherwise would be possible.

The reclamation of the district must be accomplished by two classes of work: First, the improvement of existing [illegible]

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*Compiled from Circular 104, Office of Experiment Stations, U. S. Department of Agriculture, by A. E. Morgan, S. H. McCrory and L. L. Hidinger, [illegible]

[illegible] tecting works, which will affect the whole or large sections of the entire district and which will be paid for by a uniform tax levied over the entire district; and, second, the detailed or lateral drainage, which will discharge into the main channels and will reclaim the land for agricultural purposes. The main drainage system will consist of the following principal features:

(1) [illegible]

(2) The improvement and relief of Tensas river.

(3) The improvement or construction of main drainage channels in Tensas Parish

(4) Leveeing Concordia Parish, constructing floodgates, and supplementing Cocodrie Bayou with a main drainage channel.

The items which make up these several improvements are incidental in the schedule of cost given further on. In addition, as also indicated in this schedule, there will be needed a complete lateral drainage system.

METHODS AND COST OF CONSTRUCTION.

The fact that a large amount of excavation is included in a single contract usually results in increased competition and lower bids. The very uniform and favorable character of the soil of the flat woodland of the district for dredging operations is also a condition favoring low contract prices.

Considering the project as a whole, water will be abundant for floating dipper dredges. When coal is not easily obtained there is abundant wood upon the right of way for use as fuel. Being in a country where the ground does not freeze, work can continue throughout the year.

On the other hand, much of the work is at a considerable distance from a base of supplies. A large part of the territory is covered with forests, which must be cleared before the excavation can be made. The hot weather of the summer season is a handicap to efficient work, and there is an impression among contractors that the sanitary conditions are not good during a part of the year. The cost of services and the price of supplies are higher than in northern states, and a contractor must take this condition into account. When the excavation is in old channels or bayous the construction becomes much more difficult and can not be estimated upon the same basis as work in flatwoods. In drainage construction in northern states it is customary to demand practical efficiency on the part of the contractor, and little attention is paid to such details as trimming the banks of ditches and removing timber from beneath the waste banks. The custom has prevailed in Louisiana of requiring ditches to be dug with 1½ to 1 slopes and of requiring the contractor to remove all debris from beneath the waste bank. It is probable that as drainage construction increases the custom will prevail here of requiring of the contractors only the essentials of effective work. Otherwise contract prices will be perhaps 20 per cent higher than in the North, the difference in price representing the cost to the contractor of making a better looking, but perhaps no more efficient piece of work.

Excavation.—For digging lateral ditches under conditions found in the wooded parts of the Fifth Louisiana Levee District no machine can compare with the floating steam dipper dredge; and the minimum size of ditch recommended is determined, not by the probable run-off, but by the limitations of this machine. Smaller ditches and smaller dredges are practicable for excavation in prairie countries, but where the dredge must work in woods, taking out stuffs and timber as well as earth, one built for a yard, or a yard and a half dipper, and mounted on an 18-ft. boat, will probably dig a mile of canal as cheaply as any smaller dredge will dig a mile of ditch of any less size. Such a machine will dig a ditch not less than 12 to 18 ft. wide on the bottom, 20 to 22 ft. wide on top, and 5 ft. deep. The minimum ditch recommended is one with a bottom width of 14 ft., a top width of 22 ft., and a depth of 8 ft. The depth is determined by the necessity of good drainage, and not by the requirements of the dredge. A mile of such ditch can be dug in a flat, wooded country at a cost of $1,000 for removing the earth and $500 a mile for clearing the right of way. The contractors' price to cover installation, operation, repairs, exigencies, and profit would ordinarily be about twice this amount, or $3,000 a mile. The latter figure is used as the cost per mile for minimum ditch construction. This amounts to about 10 cts. per yard, with about $200 per mile for clearing right of way. For work in old bayous, where fallen and underground timber is encountered, and where the difficulty of clearing the right of way is greater, a considerably higher price per yard is estimated, depending upon the amount of obstructions which may be encountered. A minimum ditch in fairly good condition and with a fall in the water surface of 6 ins. to the mile will remove about 1 in. of water from 7 square miles of drainage area, or ¾ in. from 10 square miles in 24 hours.

For larger ditches a contract price of 10 cts. per yard should be sufficient with an added amount for clearing right of way on those having a bottom width of less than 20 ft. The largest excavated channels recommended are to have a bottom width of 80 ft. and a depth of 10 ft. It is believed that a contract price of 10 cts. per yard need not be exceeded on work of this size, and that 9 cts. or less per yard can be secured on ditches with bottom widths of 30 to 50 ft. Ten feet is stated as a desirable depth of excavation. A complete survey may indicate the possibility of securing greater depths without danger of caving banks.

Cleared and Improved Natural Bayous and Channels.—The cost of excavating earth in the bottom of old bayous will be perhaps 50 to 100 per cent greater than the cost of excavating on level ground, and for that reason very little excavation is recommended in old channels. The clearing of natural channels of trees and brush will cost $200 to $2,000 per mile, and is estimated at $20 to $50 per acre, depending on the amount of work to be done. For the most part the removal of large trees can best be accomplished by the use of skidding machines, or similar devices used in logging operations. The brush and small trees should be cut by hand and burned.

Levees.—**The levees necessary along the Red** and Black rivers represent ordinary conditions for levee construction. The section adopted has an 8-ft. crown and 3 to 1 slopes on both sides. Where the height is between 5 and 9 ft. the construction is estimated at 20 cts. per cu. yd., and for heights of 9 to 15 ft., 25 cts. per cu. yd.

Floodgates.—An estimate of the probable cost of the floodgate for discharging the water from Concordia Parish was prepared. It is little more than a guess, as no data were avaliable for use as to the conditions of construction. Before an accurate estimate of the probable cost can be made, a survey of the land near the mouth of the Cocodrie Bayou will be necessary. This survey should include an examination of the site by means of borings to determine how deep it will be necessary to carry the foundations of the structure.

Summary of Cost.—The following gives an itemized summary of cost for the various features of the proposed improvement and also an estimate of the additional cost in case the Red and Mississippi rivers are not separated:

MAIN OUTLET DRAINAGE.

Bayou Macon:	
Levee along Bayou Macon from a point noted on the War Department map of the bayou as being about 4 miles below Osborne's Ferry in Franklin Parish to the state line, 106 miles long, 4 ft. high, 6 ft. top, with 2 to 1 slopes, 11,000 cu. yds. per mile, 1,166,000 cu. yds., at 15 cts. per yard	$ 17[illegible],000
Filling old bayous and low places along Bayou Macon, in completing the levee, [illegible] cu. yds., at 15 cts.	11,000
Similar levee along Joes Bayou, 5 miles long, 11,000 cu. yds. per mile, 55,000 cu. yds., at 15 cts. per yard	8,000
Clearing trees and brush from banks of Bayou Macon, 106 miles long, 106 miles, at $1,800 per mile	191,000
Clearing trees and brush from banks of Baxter's Bayou, 13 miles long, 13 miles, at $1,800 per mile	23,000
Total	$ 411,000
Tensas River relief and improvement:	
Clearing banks and bed of Tensas River (mouth of Bull Bayou to mouth of Roaring Bayou), 150 ft. on each side, 36 acres per mile, at 50 cts. per acre, 107 miles, at $1,800 per mile	193,000
Clearing banks of Joes Bayou (entire length), 300 ft. wide, 35 cents per acre, 65 miles, at $1,260 per mile	82,000
Excavating channel through chain of lakes and bayous between Tensas River and Macon Bayou as relief to Tensas River, at $6,000 per mile (no estimate of yardage made, but cost judged sufficient), 10 miles, at $6,000 per mile	60,000
Excavating ditch from Indian Lake south, to carry water from lake through chain of lakes into Bayou Macon, 11 miles long, 165,000 cu. yds. per mile, 1,815,000 cu. yds., at 10 cts. per yard	182,000
Excavating ditch to connect the above-mentioned ditch with Bayou Macon, 2 miles long, 100 ft. base, 340,000 cu. yds. per mile, 680,000 cu. yds., at 10 cts. per yard	68,000
Outlet channel extending 8 miles southwest from Lake One to bayous, 156,500 cu. yds. per mile, 1,252,000 cu. yds., at 10 cts. per yard	125,000
Clearing and improving 20 miles of bayou in southern part of Madison Parish for main outlet, at $5,000 per mile	100,000
Total	$ 810,000
Tensas Parish: Enlarging bayous and constructing channels for outlet drainage	500,000
Concordia Parish:	
Levee along Old and Red rivers, and 15 miles along Black River, 45 miles of levee, 62,000 cu. yds. per mile, 2,790,000 cu. yds., at 25 cts. per yard.	698,000
Enlarging 40 miles of old levee along Black River, estimated at 20,000 cu. yds. per mile, 20 cts. per cu. yd., 800,000 cu. yds., at 20 cts. per yard.	160,000
Main drainage channel to supplement Cocodrie Bayou, 2,310,000 cu. yds., at 10 cts. per yard	231,000
Flood gates and controlling works	500,000
Total	$1,589,000
Grand total	$3,310,000

LATERAL DRAINAGE.

East Carroll Parish, 370 miles of minimum ditches, at $3,000 per mile	$1,110,000
Madison Parish, 620 miles of minimum ditches, at $3,000 per mile	1,860,000
Tensas Parish, 570 miles of minimum ditches, at $3,000 per mile	1,710,000
Concordia Parish, 635 miles of minimum ditches, at $3,000 per mile	1,905,000
Total for lateral drainage	$6,585,000
Total	$9,895,000
8 per cent for cost of administration, engineering, legal expenses, etc.	792,000
Grand total	$10,687,000

Cost of Survey.—Below is given an estimate of the cost of a full and complete survey. The completion of the topographic map of the entire district by the United States Geological Survey would be of material assistance, reducing the cost of the complete survey by about $45,000 or leaving the remaining survey to cost only about two-thirds as much as it otherwise would. That part of Franklin Parish east of Bayou Macon is included in these estimates:

20 gaging stations, at $100 each	$ 2,000
Reading gages, two years, $750 per year	1,500
Hydrographer, two years, at $1,500 per year	3,000
Assistant hydrographer, two years, at $1,000 per year	2,000
Operating expenses for hydrographer and party	5,000
Soil borings for construction purposes and estimate of cost of clearing bayous	3,000
Survey for location of floodgates	5,000
Rainfall data	1,000
2 draftsmen, at $1,200 each per year	2,400
Commissary and property man	900
Stenographer	900
Chief engineer, at $5,000	10,000
Stationery, supplies and equipment	1,000
Topographic surveys and surveys of natural channels:	
East Carroll Parish	10,540
Madison Parish	17,920
Tensas Parish	17,720
Concordia Parish	19,000
Preparing report and estimates	5,000
Consulting engineers	10,000
Incidentals	2,620
Total	$120,500

The piercing of the Alps by the Loetschberg tunnel was accomplished on March 31. Originally, this tunnel was planned to be 8½ miles long. A necessary detour increased the length to 9.04 miles.

A Masonry Faced Earth Dam Having Unusual Features; Bishop's Creek Irrigation System, Nevada.

An earth fill dam [illegible] heavy upstream wall of rubble masonry faced with reinforced concrete is illustrated by the accompanying drawings. This dam has a second novel feature in the gate operating tower of reinforced concrete. Figure 1 is a plan of the dam and a profile on its axis. Fig. 2 is a section through the dam midway of its length, and Figs. 3 and 4 show the general plans and details of the gate tower. The dam will form a part of the Bishop's Creek System of the Pacific Reclamation Co. and will be located on Bishop's Creek about 12 miles north of Wells, Nevada. Mr. George M. Bacon, Salt Lake City, Utah, is consulting engineer for the company and we are indebted to him for the data from which this article has been prepared.

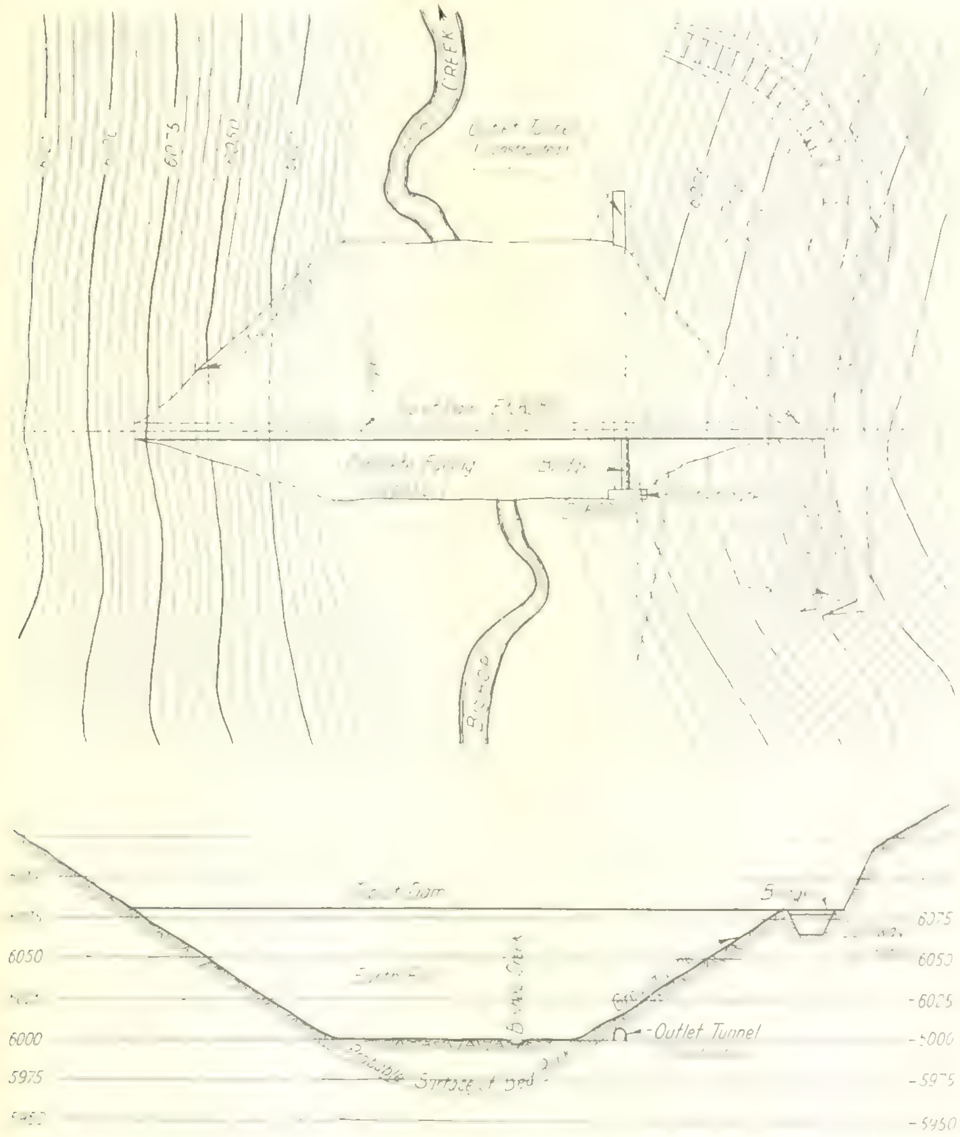

Fig 1—Plan and Profile of Bishop's Creek Dam.

Referring to Fig. 1, it will be seen that the dam crosses a fairly symmetrical gorge with bed rock close to the surface on the sides and only some 30 ft. depth of overlying soil at the deepest points at about mid valley. A spillway channel cut through the rock, passes around one end of the dam and near the foot of the bank on the same side the dam is penetrated by an outlet tunnel. Roughly the length of the dam along the crest will be about 440 ft. including the width of the spillway channel; its greatest height about 110 ft. The approximate quantities called for are:

Excavation, cu. yds.	[illegible]
Embankment, cu. yds.	[illegible]
Rubble masonry, cu. yds.	6,000
Class A concrete, cu. yds.	[illegible]
Class B concrete, cu. yds.	500
Reinforcement, lbs.	85,000

Excavation and [illegible] As will be seen from Figs. 1 and 2, this excavation consists in removing the overburden of unsuitable foundation material over the area covered by the base of the dam, and in cutting a spillway channel and cut off trench partly in earth and partly in rock. All work requiring blasting and all boulders exceeding ½ cu. yd. in volume are classed as rock. Such portions of the excavation as may be suitable may be used in forming the dam embankment and rubble wall. In constructing embankment the material will be deposited in 8-in. layers, wetted if necessary, and rolled with a grooved roller weighing at least 500 lbs. per foot length of roller for each foot of diameter of the roller.

Rubble [illegible] the rubble wall are shown by Fig. 2. The rubble will be laid dry with the outside portions of selected stone. On the face next to the concrete no stone will be permitted to project or recede exceeding 3 ins. from the determined face plane. The rubble wall will be always kept from 1 ft. to 3 ft. higher than the top of the earth embankment behind it.

Concrete [illegible] wall comprises that portion of the concrete lying below the floor of the reservoir as shown by Fig. 2. For this work Class B concrete, a 1:2½:4 mixture of 2-in. stone, will be used and made of the materials and placed by the methods described for Class A concrete. In brief the only difference permitted will be the use of larger stone in the Class B mixture.

Concrete Face Wall.—As will be seen from Fig. 2 the concrete face wall is essentially a continuation upward of the core wall. This facing will be reinforced at mid-thickness by a rectangular network of twisted square steel bars spaced 3 ft. (scaled) apart horizontally and varying distances apart vertically briefly as follows:

Between Elevations	[illegible]
1600-1610	[illegible]
1610-1620	[illegible]
1620-1630	[illegible]
1630-1640	[illegible]
1640-1650	[illegible]
1650-1655	[illegible]
1655-1660	[illegible]
1660-1663	15
1663-1670	[illegible]
1670-1675	[illegible]
1675-1680	20

The vertical bars will all be 20 ft. long; those for the bottom 20 ft. 1-in., those for the middle 40 ft. ¾ in., and those for the top 20 ft., ⅝-in. The horizontal bars will be 12 ft. long and will decrease in size every 20 ft. from the bottom as follows: 1 in., ⅞ in., ¾ in. and ⅝ in. Joining lengths will lap 24 ins. and be secured by at least one turn of No. 12 wire drawn tight.

Portland cement concrete will be used and in proportioning 1 bag of cement is considered 1 cu. ft. The following are the specifications for the concrete facing work:

As no suitable sand is known to be present in the vicinity of the work, stone screenings will be used in its stead. Such screenings shall contain [illegible] larger than will pass a ¼-in. mesh screen, and shall successfully pass the following test as to proportion of finer particles. Samples of screenings shall be prepared for testing by passing them through a sieve with 8 meshes to the inch, made of wire 0.0295 in. in diameter. Of the material passing the sieve with 8 meshes to the inch not more than 15 per cent shall pass a sieve with 100 meshes to the inch, made of wire 0.0045 in. in diameter. Screenings which do not fulfill the above conditions must be screened or washed to produce a sand that will satisfy the above requirements.

Broken stone shall not contain dust, loam, clay, perishable matter, or other improper substances. All broken stone shall be of such sizes that all of it will be retained on a ¼-in. mesh screen. Broken stone for Class A concrete shall be of such sizes that all will pass through a 1-in. ring, and for Class B concrete of such sizes that all can be passed through a 2-in. ring. If suitable for the purpose, material direct from the crusher may be used in Class B concrete, but "run of crusher" shall not be used unless permitted or ordered, and then only in strict accordance with directions.

Concrete shall be mixed by machinery, except that, if permitted, relatively small quantities may be mixed by hand in a satisfactory manner. The machinery shall consist in part of a box or receptacle in which a definite volume of water, cement, sand and broken stone (not exceeding a total of 2 cu. yds. in any one batch) shall be placed and there mixed by stirring or revolving. The mixing shall be thorough and be continued until every particle of broken stone is covered with the mortar of cement and sand. The amount of water used shall be suited to the conditions surrounding the placing of the concrete. [illegible] wet mixture will be required, particularly for Class A concrete.

Concrete shall be deposited in place within 30 minutes after water has been added to the cement. The means of transferring it from mixer [illegible] shall be no loss of grout or mortar in transit. Where concrete is deposited upon or against earth or rock, these latter shall first be well [illegible] or against concrete that has become set, the surface of the latter shall be scrubbed clean, washed and floated with cement grout.

Forms for concrete shall be so constructed as to present a rigid, unyielding surface, and be so braced or tied that the placing and puddling of concrete shall cause no motion or displacement of them. Forms for all concrete above elevation [illegible] as soon as this smoothness becomes impaired the forms shall be discarded. Special care shall be used to make all joints of forms tight, as leakage of grout or mortar through joints or between forms and concrete that has set will be considered sufficient evidence of such poor work-

[illegible]

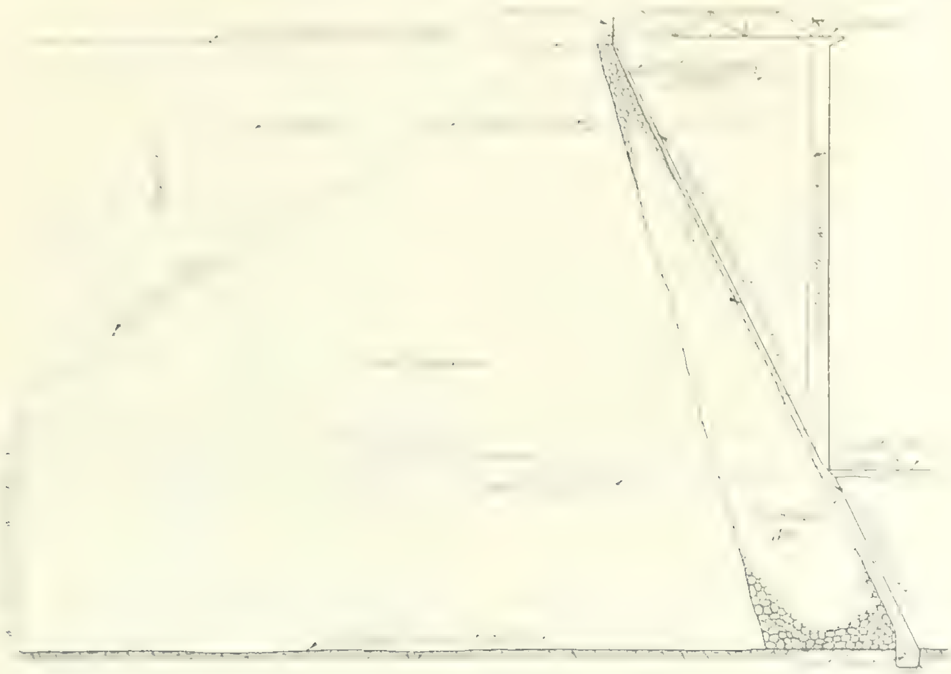

Fig 2—Cross-Section of Bishop's Creek Dam.

[illegible] imbedded in the concrete so as to form if possible a channel through it and shall be cut off flush with the surface of the concrete after the removal of the forms.

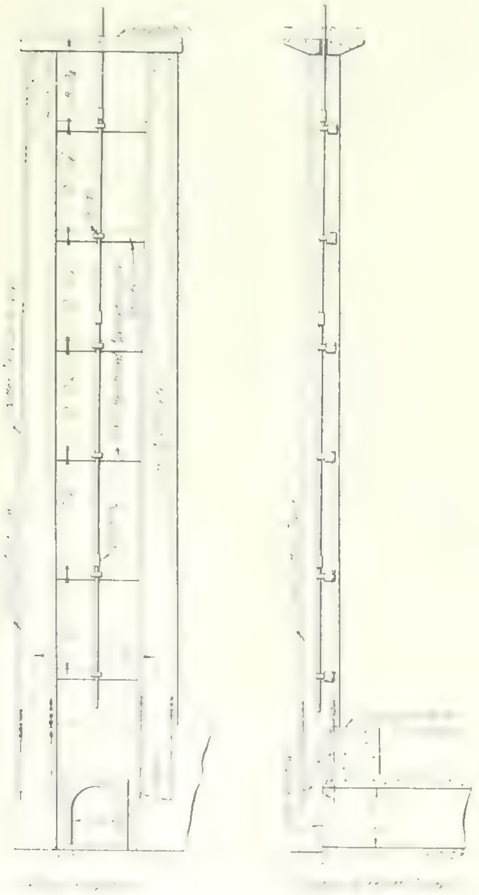

Fig 3—General Elevations of Reinforced Concrete Gate Tower.

[illegible] forms may be removed will be governed by the nature of the cement, the liability of the concrete being damaged when exposed, and the care exercised in [illegible]

[illegible] deposited against them.

[illegible]

along forms. It shall be well paddled to expel air and stones shall be pushed back from contact with the forms by means of spades or suitable tools. Forms shall not be built up around

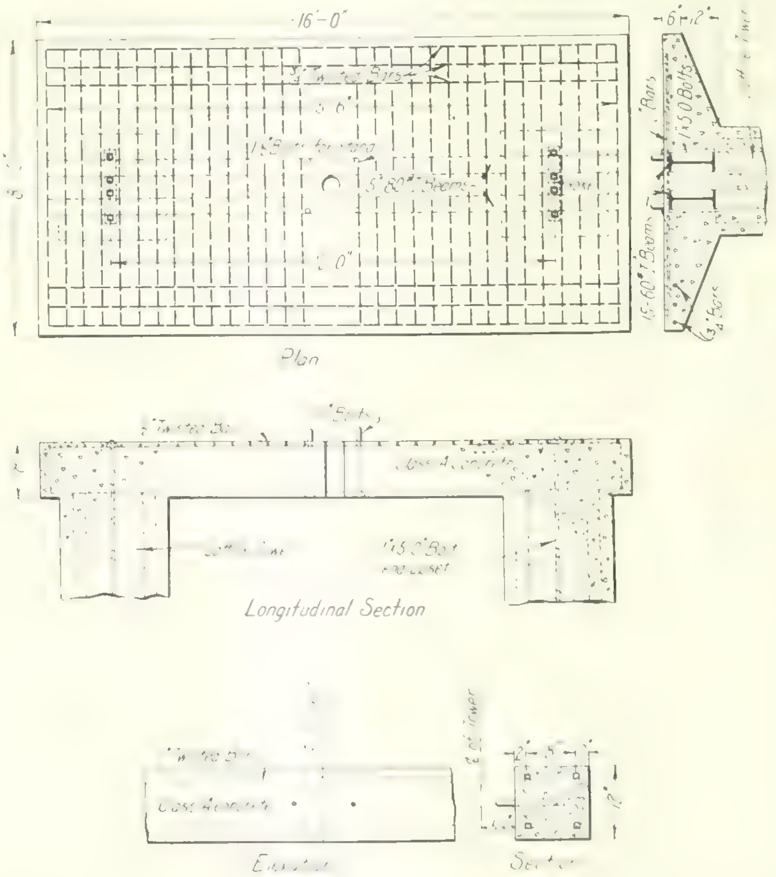

Fig 4—Structural Details of Reinforced Concrete Gate Tower.

of the concrete to such an extent as to hinder the proper paddling and spading.

No concrete shall be made of any ingredients the temperature of which is below 32° F., or deposited in any location where the thermometer registers less than 32° F. Concrete which [illegible] freeze after being deposited shall be covered with hay, straw, or some material that will properly protect it from the action of frost. It shall not, however, be in direct contact with manure or water leaching through it.

All concrete shall be kept wet for a period of six days after being laid, and Class A concrete shall be for the same period shielded from the direct rays of the sun.

Owing to the difficulty of measuring exactly the quantity of Class A concrete actually deposited, it is expressly understood and agreed that the quantity to be paid for will be determined by the engineer's count of the actual number of barrels of cement used in making Class A concrete, and that 1 cu. yd. of Class A concrete in place will be allowed in estimates for each 1.25 bbls. of cement going to make concrete of this class. No allowance will be made for cement used in pointing or repairing or replacing defective concrete, but allowance will be made for cement used in the coat of grout. This allowance will be made on the basis of 1 cu. yd. of Class A concrete estimated for every 3 bbls. of cement used for coat of grout.

No concrete shall be deposited under water without explicit direction and then only in strict accordance with directions; nor shall the contractor, without explicit permission, allow water to rise on any concrete until it shall have set at least twenty-four hours. The contractor shall not permit walking or working over or upon finished concrete surfaces until the concrete, in the opinion of the engineer, shall have set sufficiently. The contractor will not be allowed to commence the erection of centering and forms upon concrete in place, until such time shall have elapsed as may be required, and great care shall be taken at all times to prevent injury to concrete surfaces which will be exposed.

The concrete placed against the dry rubble wall shall not be carried up at a rate of progress that will bring its top surface at any time within 15 ft. in elevation of the top surface of dry rubble wall. To prevent waste of concrete and the draining out of it of grout or mortar, all chinks and joints in the face of the rubble wall shall be carefuly pointed with clay well tamped into place. Where in the opinion of the engineer this means does not sufficiently effect its purpose he may order [illegible] 10-oz. canvas, which shall be laid [illegible] wall in such manner as to lap [illegible] effectually guard against [illegible]

The above [illegible] particularly interesting [illegible] to secure as nearly [illegible] as is practicable.

Gate Leaves.—The [illegible] is shown in [illegible] by Figs. 3 and 4 that it calls for no explanation. The interesting feature is the novelty of the design adopted.

STEAM AND ELECTRIC RAILWAY SECTION

Portable Storage Batteries and Primary Batteries for Operating Automatic Signals.

Portable storage batteries [illegible] operating automatic signals were [illegible] experimental way on certain divisions of the Southern Pacific as early as 1890. Since then their use has been extended, and at the present time a large part of the Harriman Lines is equipped with automatic signals operated in this way.

A detailed account of the operation of these storage batteries is given in a paper read before the Railway Signal Association at the Stated Meeting, on March [illegible] Mr. A. H. McKeen, signal engineer of the Oregon-Washington Railroad & Navigation Co., and of the Southern Pacific Co. lines in Oregon. The following extracts, illustrating methods of handling these batteries with costs of installation [illegible] storage and primary batteries are taken from Mr. McKeen's paper:

The methods of transportation to and from the charging plants vary with local conditions. On portions of the line where local passenger service is available, the batteries are loaded into the baggage car and distributed at each station by the batteryman, who accompanies the batteries. From the stations they are taken to the various battery locations by the maintainer on a velocipede or motor car, the discharge batteries being returned in the same manner to the station, where they are picked up by the batteryman and brought back to the charging plant on the return train in the evening. On other sections of the line the batteries are loaded into a specially arranged battery car and handled on local freight trains, [illegible] where the batteries are changed by the batteryman and the maintainer on that district. The car containing the discharged batteries is sent back to the charging plant on the first freight train. Another arrangement consists of a charging plant built in a box car, which car is moved on the daily way freight and is set out at each alternate station, in one end of the car is located the gasoline engine, generator, switchboard, and cooling tank. A large gasoline tank holding sufficient gasoline for one month's supply is suspended under the body of the car. The center part of the car is used as a battery room and is suitably fitted up with a battery bench, lead-lined sink and a large water tank for battery washing purposes. The other end of the car is ar- [illegible] The car is equipped with heavy draught gear in order to avoid any damage due to rough handling while in transit. During the three years that this portable arrangement has been in service, it has given the best of results, handling on one district 832 cells monthly on a territory of 150 miles of single track signals. An important advantage in this method is that on the 150-mile district referred to, only 80 extra cells are required for changing [illegible] the total number of cells in service on the district.

On the Harriman Lines there are 52 charging plants, each of which (except the portable plants) is located at the headquarters of the assistant supervisor, where a shop building is provided. Since part of this shop building is used to house the charging machinery no special building is necessary. The average territory covered by each plant is 104 miles. Wherever current can be obtained from local power companies, a mercury arc rectifier or motor generator set is installed, and at other locations where electric power is not available a gasoline engine and generator charging outfit is used [illegible] of a special batteryman, whose duties consist of charging, inspecting and cleaning the batteries and assisting the maintainers in changing out the cells on their districts. All cells are returned to the plant monthly and are thoroughly inspected and cleaned before being put on the charging circuit. A record is kept in a book provided for the purpose, [illegible] the voltage, specific gravity and condition of each cell on arrival at the plant and each cell is examined for short circuits and other faults; the hard rubber covers and connectors being cleaned and sediment removed if necessary. Once a year the old electrolyte is replaced with new in order to discard all impurities held in solution.

In the case of stationary batteries it is the usual practice to give an overcharge several times a month, the overcharge having the effect of driving the sulphate out of the plates and keeping them in a healthy condition. Portable cells which are charged once a month only, are subject to considerable sulphating and therefore require a long charge to bring them up to capacity. It is the practice to continue the charge for two or three hours after the voltage and specific gravity has ceased to rise. The uniform gassing of all cells on charge is a good indication of their condition and the failure of any cell to gas is investigated before the charge is continued. During the charge, voltage and specific gravity readings are taken and recorded in the book and any cells not coming up to the proper voltage and gravity are closely watched and given special treatment if necessary. Maintainers are required to make weekly inspection of all cells in service, examining them for loose connections, taking voltage readings and replacing any evaporation of electrolyte that may occur during the time the cells are in service. In replacing the evaporation, only water whose purity has been previously passed on is used. In localities where pure water is not obtainable, distilled water is provided.

In charges subsequent to the initial charge the general rule is that the amount of current put into the cell should be twice the amount delivered by the cell during the 30 or less days elapsing since the previous charge. Under normal conditions and service the amount of current required of a cell will vary from 16 to 75 ampere hours per month.

The batteries are housed in the lower case of the signal, which makes them easily accessible for inspection. The lower signal case also serves to accommodate the track and line relays. At the end of sidings on single track or other locations where two signals are opposite each other, one set of batteries is used to operate both signals. After the batteries have been in service fifteen days, the maintainer interchanges them with the batteries of the distant signal, this having the effect of equalizing the discharge to a considerable extent on all cells in service. It also avoids the necessity of charging cells for different lengths of time on their return to the charging plant and eliminates the possibility of cells being discharged to a point that might result in a signal failure. During the first six months of 1910 there were a total of only 61 signal failures due to weak, dead or defective storage batteries and only 13 failures from poor or broken connections on storage batteries; or a total of 74 failures from all such causes on the entire system. This was less than 5 per cent of the total number of failures from all causes. The total number of signal movements during the same period was 48,758,000, and the number of movements per failure from storage battery causes amounted to 659,000, which is no doubt a more creditable showing than would be possible if primary batteries were used. In addition to the reliability of operation thus secured, the economical advantages of the portable storage battery over the primary battery, both for installation and maintenance is an important consideration.

COST OF STORAGE CELLS

1 cell SS-7 storage battery, complete	[illegible]
2 battery connectors at [illegible] each	[illegible]
Electrolyte	[illegible]
Freight charges	[illegible]
Total cost	[illegible]
Cost of charging [illegible] plants, at [illegible]	[illegible]
Cost of [illegible] storage cells, complete, including freight charges	[illegible]
Cost of [illegible]	[illegible]
Total cost	[illegible]

COST OF PRIMARY CELLS

[illegible] primary cell [illegible]	[illegible]
Freight charges	[illegible]
Total cost	[illegible]
Cost of [illegible] primary [illegible] complete, including freight charges	[illegible]
Cost of [illegible] concrete battery [illegible]	[illegible]
Freight charges on 9,026 concrete battery wells, each weighing 1,600 lbs., [illegible]	[illegible]
Charges for work train and locomotive [illegible] unloading and placing 9,026 battery wells [illegible] estimated)	4,500.00
Cost of labor for digging holes and setting 9,026 battery wells at $10.00 [illegible]	[illegible]
Total [illegible]	[illegible]

COST OF MAINTENANCE OF STORAGE CELLS PER YEAR

[illegible]	[illegible]
[illegible]	[illegible]
[illegible] costing $1.835 each, at 25 per cent....	22,256.71
[illegible] cts. per cell per year..................	4,366.41
[illegible]	[illegible]
Total cost	[illegible]

[illegible]

[illegible]	[illegible]
Total cost	[illegible]

With reasonable care, the average life of SS-7 portable cells and their component parts are found to be as follows:

[illegible]	[illegible]

No charges are made for transporting storage batteries either when handled on passenger or freight trains; and even though a nominal charge should be assessed, the amount would not exceed the freight charges over foreign lines for renewals for primary batteries. This item is therefore not included in the foregoing cost of maintenance of storage or primary batteries; neither is the expense for labor for charging, inspecting and changing out storage cells or making renewals to primary cells taken into consideration, for [illegible] the cost for labor for maintaining primary batteries is practically the same as with port-[illegible] after the charging of the storage batteries on a district averaging 104 miles, the maintainers assisting in distributing the batteries, which requires on an average two days time of each maintainer monthly. Maintainers' districts range from 14 to 20 miles according to the number of signals, local conditions, etc. The average district is approximately 16 miles with 32 signals. Maintainers have no helpers and are required to look after all work in connection with the maintenance of signals on their district including the care of signal lamps.

The prices as shown for both portable storage batteries and primary batteries are the regular list prices less the usual trade discount. The freight charges are figured on an average basis for the entire system and are reasonably accurate.

The cost for current for operating motor-generator or arc-rectifier plants varies from 1½ ct. to 5 cts. per K. W. and the cost for generating current with gasoline engine-generator sets is about 10 cts. per K. W. Taking an average for the entire system the annual cost for charging current is 18 cts. per cell.

(Criticism of the above costs were offered by Mr. E. E. Hudson, of the Edison Manufacturing Co. Mr. Hudson also submitted costs of the installation and maintenance of primary cells which he thought for various reasons were nearer correct than the ones submitted by Mr. McKeen. A summary of Mr. Hudson's discussion is given below.—Editor.)

Under the caption "Cost of Primary Cells," Mr. McKeen gives the price of one 350 ampere-hour cell at $2.00, freight charges $0.20, total cost $2.20. The prevailing price of a 400 ampere-hour primary cell complete, meeting R. S. A. specifications, is $1.95 in less than carload lots, with freight allowed to points east of or on the Mississippi River. In carload lots the difference in freight between CL and LCL, to Chicago, reduces the cost per cell to $1.90.

The most serious objection to the figure shown as representing the cost of primary battery, however, is that the whole cost of the complete cell, including the active elements and the freight thereon is shown as a part of cost of installation; whereas, the storage cells are received in an uncharged condition and the cost of maintenance starts from the time they are set up. In other words, the figures supposed to represent the cost of installation of primary cells include practically all of the cost of maintenance for a year or more and a like charge is not included in cost of installing storage cells. Therefore, only the cost of the inactive or permanent parts of the primary cells is properly chargeable to the cost of installation or first cost.

The price of a 400 ampere-hour renewal complete is 96 cts. and after deducting this from the price of the complete cell we get a cost for permanent parts of 99 cts. per cell in LCL shipments and about 96 cts per cell in carload shipments. The shipping weight of the complete renewal is almost exactly one-half that of the complete cell. Freight on the permanent parts only should be considered as a part of first cost.

It is difficult to see why the number of primary cells given by Mr. McKeen (178,480), should be necessary, as 16 primary cells per battery location are considered sufficient. This would give a total of 144,416. There also seems to be an unnecessary number of wells, provided in the estimate.

In making the following estimate of costs I have not considered the use of wells for two reasons: First, in nearly all the cases that I know of where wells have been installed they are not used solely for the housing and protection of soda or potash batteries; and second, because there are some roads using Edison primary cells in large quantities, which use wooden battery boxes. The cost of these boxes varies slightly, according to conditions, the average being about $10 each installed.

Using corrected figures as a basis of calculation, the cost of primary battery equipment for a signal installation similar to that on the Harriman Lines will be as follows:

COST OF PRIMARY CELLS WITH BATTERY BOXES.

Cost of 144,416 cells, less cost of first renewals	$138,639.36
Cost of freight in carload lots to average point on Harriman Lines after deducting freight on active elements, and manufacturer's allowance 5 cts. per cell	7,220.80
Cost of 9,026 battery boxes installed, $10.00 each	90,260.00
	$236,120.16

I have been furnished with the following figures representing the estimated cost of battery wells for such an installation as that on the Harriman Lines:

3,009 wells for points where extremely cold weather prevails during winter months, at $22 each	66,198
6,016 wells for other locations at $15 each	90,255

The transportation charges estimated by Mr. McKeen on battery wells at $180,520 or $20 per well may be eliminated almost entirely, as figures given above contemplate delivery at some central point on the Harriman Lines.

Revised cost of installation of primary battery using the foregoing corrected figures as a basis for calculation would be as follows for a primary battery equipment for a signal installation similar to that on the Harriman Lines.

COST OF PRIMARY CELLS WITH WELLS.

Cost of 144,416 cells less cost of first renewals	$138,639.36
Cost of freight in carload lots to average point on Harriman Lines after deducting freight on active elements, and manufacturer's allowance, 5 cts. per cell	7,220.80
Cost of 3,009 style "F" Massey wells at $22 each, complete	66,198.00
Cost of 6,017 style "E" Massey wells, at $15 each complete	90,255.00
Charges for work train and locomotive crane or derrick with crew for unloading and placing 9,026 battery wells, 90 days at $50 per day	4,500.00
Cost of labor for digging holes and setting 9,026 battery wells at $5 per well	45,130.00
	$351,943.16

The figures shown as representing the cost of interest on investment will be reduced materially because of the reduction on first cost of permanent equipment. Mr. McKeen assumes one renewal per primary cell per year but the method employed in arriving at this estimate is not given. From the figures given the average number of signal movements per day was 22⅓. Under ordinary conditions a set of primary cells of 400 ampere-hour capacity would last very much longer than a year on one charge with this amount of work.

On the basis of the figures given in Mr. McKeen's paper the efficiency of storage cells under normal conditions is 38 per cent. But if we take into consideration the current used in special treatment of cells, as required by the book of rules, as well as the various other losses due to local action, reduction of output in cold weather and the charging of cells not fully discharged in order to avoid sulphation, we will probably find that the actual efficiency in service does not exceed 30 per cent.

Taking this percentage of efficiency as a basis, it will be seen that from an input of 97,032 K. W. hours for the 48,516 storage cells the effective output is 29,110 K. W. hours.

To find the equivalent ampere-hour capacity in primary cells sufficient to produce this amount of energy it is only necessary to take the total of 144,416 primary cells required to displace the total number of storage cells, multiply by .6 (the mean working voltage per cell under such conditions as prevail on the Harriman Lines) and divide the product (86,650 volts) into 29,110,000 watt-hours (29,110 K.W. hours). This will give us a result of 336, representing the average ampere-hour consumption per year if primary cells were used on this installation. At this rate, cells of 400 ampere-hour capacity would last 14⅓ months on one charge.

At a cost of 96 cts. per renewal, this makes the renewal cost per cell 80 cts. per year, without considering the value of the scrap. But as an allowance of 16 cts. each is made for the exhausted copper oxide and zinc plates when returned to the manufacturer a still further reduction should be made. This allowance will net the railroad company, after deducting freight, about 14 cts. per cell, or 12 cts. per cell per year in this case, making the net cost of the renewal 68 cts. per cell per year instead of $1.00 as shown.

The third item of 7 cts. per cell per year for the replacement of broken jars and covers is entirely too high. Reliable records indicate that the annual percentage is about 0.7 of 1 per cent, or about ⅔ of 1 ct. per cell per year, including freight.

With these figures we are able to arrive at the annual cost of maintenance, which would be as follows:

COST OF MAINTENANCE OF PRIMARY BATTERIES, PER YEAR.

Interest on investment of $236,120.16 at 5 per cent	$ 11,806.00
Cost of renewals for 144,416 cells per year at 68 cts. each	98,202.88
Cost of renewals of broken jars and covers on 144,416 cells at ⅔ cts. per cell per year	962.78
	$110,971.66

GENERAL ARTICLES AND CLASSIFIED ITEMS

Methods and Costs of Laying Five Kinds of Composition and Gravel Roofs.

BY H. [illegible]*

Composition and gravel roofing for flat roof buildings has come into extensive use during past years. During my 25 years of experience I find it the cheapest and most lasting roof as compared to iron, tin, or other material used on flat roofs. The following costs of 5 different kinds of roofing will illustrate that a cheap and good roof may be obtained proportionately with the quality or amount of material and workmanship put into it, and that the life of the roof will be proportionately greater for the larger amount of money expended.

The cheapest composition roof is 3-ply tar and gravel, using 45 lbs. of saturated felt, 70 lbs. of tar and pitch, ⅛ yd. of screened gravel, and lath and nails at a total cost for material of $1.50 per square, (10x10 ft.). The labor cost of the work varies from $0.40 to $1 per square, depending upon the number of squares in each job. It requires 4 men to each gang of roofers, common labor receiving 25 cts. and skilled labor 50 cts. per hour. This would make the total cost of a 3-ply composition roof with tar and gravel from $1.90 to $2.50 per square. This roof, for ordinary uses, will last from 5 to 8 years.

A better roof is a 4-ply composition roof laid in the same manner as a 3-ply, but having one extra ply or 15 lbs. more of saturated felt and 30 lbs. more of composition which will make the total cost from $2.50 to $3.00 per square. This class of roof will easily last 10 years.

The next better roof is the solid mopped roof with a cap sheet over the 4-ply, laid as follows: each of the 4 layers of felt is mopped over the entire surface and laid 8 ins. to the weather. The entire [illegible] then covered with a cap sheet which is coated with the hot pitch compound. In [illegible] every seam of the four layers is covered. Over all, the pitch and tar and screened gravel is laid. I have one of these roofs which has been laid 14 years without recoating. The cost of labor and material on this class of roof is $4 per square. The material used per square is 75 lbs. of saturated felt, 150 lbs. of composition, ⅛ cu. yd. of screened gravel and lath and nails.

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*Roofing Contractor, Hammond, Ind.

Any of the foregoing roofs can be laid with Pioneer asphalt in the same way that the tar and pitch composition is used. This will increase the cost from $0.75 to $1 per square. I put on some of these roofs 10 years ago and they are in good condition today. Asphalt retains its life, but the tar and pitch crumble to dust and require a recoating after about 5 years. The cost of recoating is about $1.50 per square. In recoating, all the loose gravel is swept off and the felt is cleaned of dirt and dust. Then the composition is placed with not less than 60 lbs. to the square.

The best of all these roofs is the Actinolite roof, but it is also the most expensive. If this roofing is laid in according to specifications it will last 50 years. The Actinolite is mixed with hot tar and used as a mortar. The foundation is started with one layer of Flaxfelt and 5-ply solid saturated felt mopped both ways. The entire surface is then mopped with hot pitch and the Actinolite is put on this surface with a trowel. The layer is ¾-in. to 1-in. thick. This material will not run in summer nor crack in winter. The cost of such a roof is from $6 to $8 per square. Several factory and school buildings which I have roofed in Hammond, Ind., and vicinity have borne evidence of my conclusions in regard to this material.

BOOK REVIEWS.

How to Read Plans. [illegible]

The purpose of [illegible] drawings. It is not [illegible] draftsmen [illegible] describe the ordinary conventions used in making [illegible] drawings [illegible] become easy to mechanics.

The first [illegible] pages [illegible] calls the A B C's of drawing. This portion of the book illustrates the difference between perspective and working drawings. Plans, elevations and sections are defined and illustrated. Conventional methods of section lining to represent various materials of construction are shown. Dimension notation, center lines, and projection lines are fully discussed and illustrated. Four pages [illegible] explanation of scales.

Instruction [illegible] pages. This portion of the book is fully illustrated with perspective drawings of several houses, and working drawings of the various floor plans. All the conventions used are pointed out and their meaning explained.

The remaining part of the book contains a complete set of architect's plans for a six-room frame cottage. The object of this section is to afford the reader an opportunity to test his understanding of the principles earlier enumerated and illustrated. Several pages of text follow these specimen plans and the application of the various conventions is pointed out. The book is concluded with a few remarks on the relation of plans and specifications, and a final word of caution relating to common errors in reading plans.

The book is well arranged throughout and is written in a style which will surely appeal to the class of mechanics addressed. The present is the second edition.

The Art of Roadmaking.—By Harwood Frost. The Engineering News Publishing Co., New York, N. Y. Cloth, 5¾x9 ins.; 544 pp.; illustrated, $3.

The aim of the author in preparing this book was to reach and interest the average non-technical general reader. The language used and the material presented are consistent with this aim. The usual tables and formulas, results of tests, [illegible] included in technical [illegible] abbreviated [illegible] author [illegible] drawn conclusions from such information, printed elsewhere [illegible] nical reader.

The book [illegible] chapter on the history of road development. The relation of a country's roads to its civilization is discussed. Egyptian and Roman roads are described and illustrated, and cuts of early American roads still in use are shown.

The body of the book is divided into three parts. Part I deals with fundamental considerations of traction resistance, road and pavement economics, and the principles underlying the selection of pavements for different purposes.

Part II deals with country and suburban roads. The chapter on the location of country roads will no doubt be of special interest to the general reader. The effect of alignment and grades are discussed, and the surveying operations preceding the choice of location are described. There is a good chapter on general construction insofar as it relates to road building and protection. There are other chapters on the materials of road construction, on earth, gravel, sand and clay roads, on broken stone roads, and mountain roads. There are two subjects on road maintenance and allied subjects, and a chapter on state aid laws. The latter chapter should be of special interest to every voter and taxpayer.

Part III relates to city streets and pavements. There is also a chapter on city planning, and chapters on the common classes of pavements. There is a chapter on street cleaning, one on sidewalks, curbs and gutters. Miscellaneous roads are enumerated, defined and briefly discussed, and their advantages and disadvantages pointed out. The final chapter relates to the landscape gardening possibilities of the roadside.

There are five appendixes giving typical specifications and contracts and pavement guarantees [illegible] by automobiles, American road statistics, and a very useful and complete bibliography of roads, streets and pavements.

The book deserves a wide circulation among the classes the author aimed to interest, and young engineers can well read it as a preliminary to a technical study of the general subject of roadmaking.

The Analysis of Paints and Painting Materials. [illegible] tific Section, Educational Bureau, Paint Manufacturers' Association of the United States, and John A. Schaeffer, Instructor in Chemical Practice, Carnegie Technical Schools, Pittsburg, Pa. New York and London: McGraw-Hill Book Co. Cloth, 6x9¼ ins.; 100 pp.; two text illustrations, five tables; two appendixes; $1.50 net.

A publication which is of interest to the engineer and practical chemist alike is the "Corrosion and Preservation of Iron and Steel," by Dr. Allerton S. Cushman and Mr. Henry A. Gardner. Both authors have contributed so much to the current literature of recent years regarding these matters that the book will be welcomed by all who are interested in this field. Dr. Cushman has long been a prominent worker in investigations of the natural influences which produce oxidation of iron and steel, and he has done much toward the conservation of these valuable materials by his excellent studies of the prevention of rust formation. Mr. Gardner, on the other hand, has been very active in the study of paints and pigments, and no one is better [illegible]

Some of the material which makes up the book has previously appeared in bulletins and magazine articles written by one or the other of the authors, and some has been already published in committee reports of various technical societies. Nevertheless there is much that is new, and great pains have been taken to explain the many laws and principles of physical chemistry that underly corrosive action. In the introduction it is stated that one of the objects of the work is to treat these matters in such a manner as to render them clear to manufacturers, engineers, metallurgists, and others who are not familiar with the theories involved. The difficulties arising from an attempt to attain this end are plain to any student of the subject, but in the main very good results have been attained for a work of this size. In a few instances, however, and especially in quotations from other authors, with which the book is replete—material has been brought out which will not be comprehensible to those who have not made an extended study of physical chemistry, and in such cases a little further explanation might profitably have been appended. In most cases, where such added explanation would have proven too bulky to include in this brief work, all mention of the matter involved might probably have been omitted without lessening the value of the book to the majority of readers. For example, in the fifth chapter a quotation from Walker is included, which mentions the silver voltameter and Ostwald's bromide voltameter. It is hardly to be expected that the practical man, aside from a few engaged in electrical work, is familiar with an apparatus of this nature, which finds so little application outside the research laboratory.

In other instances analogies have been drawn between the phenomena involved in corrosion and certain common phenomena familiar to all practical men, for the purpose of making more plain the various theories which are expounded. This practice may be useful at times, but it is likely to produce undesirable results, and false impressions are likely to be brought about in the minds of the uninitiated, which no amount of further explanation will succeed in removing. The unwary beginner in the study of a theory is oftentimes led to extremes in the application of such similes, by his enthusiasm. For example, on page 14 the "driving force" of solution pressure or solution tension is said to be exactly analogous to steam pressure in a boiler, and further on it is stated that as the rising steam pressure tends to resist further evaporation of the water, so the growing number of free particles entering into solution produce a back pressure which tends to resist the entrance of more. The use of this particular example might be excused on the ground that Arrhenious, the father of the electrolytic theory, made use of it also, and that numerous authors have since done likewise. Still, the false impression may be formed in the mind of the beginner that the walls of a vessel of water into which a mass of metal is introduced, are instantly subjected to a bursting pressure due to the solution pressure of the metal. Even though the Helmholtz "double layer" idea be brought out afterward, as is done in this work on page 27, still there remains this unhappy impression, which serves to puzzle the reader in his further study of iron formation.

The first part of the book is given over to a discussion of the problems of corrosion, the various conditions and influences which stimulate and inhibit corrosive action, and the theories which have been advanced to explain the phenomena involved. While the carbonic acid and the peroxide theories receive some attention, greater stress is laid upon the electrolytic theory, and in connection therewith a general exposition of the electrolytic dissociation theory of solution is given. The latter part of the book deals with paints and pigments and preservative measures [illegible] can peruse it without obtaining many valuable [illegible]

[illegible] follows: Chapter I treats of the corrosion [illegible] causes of rust formation. Chapter II gives a very good explanation of the electrolytic dissociation theory of solution, which could hardly be improved upon except perhaps by the introduction of a paragraph on the law of mass action and its application to the explanation of hydrolysis. With this addition the theory of indicators might have been brought out more clearly than has been accomplished, by further applying the law of mass action in this explanation. However, it is hardly to be expected that these matters could be treated in an exhaustive manner in a work of this size. Chapter III deals with the various theories of corrosion, and gives an outline of the evidence which is at hand to prove and disprove each one of them. In connection with these matters the very excellent work of one of the authors with the "ferroxyl [illegible] moved by the fourth chapter. The influence of [illegible] rodibility, and the effects of heat treatment on the corrodibility of the product are also given [illegible] and stimulation of corrosion and the various factors entering into each of these actions. [illegible] tin plate materials.

[illegible] Atlantic City by the same society, in conjunc- [illegible] Chapter X [illegible] given for the composition of inhibitive mixtures. Chapters XI and XII give a very good discussion of the properties of pigments and paint vehicles, [illegible] The processes of manufacture of the more important pigments and vehicles are also described in those closing chapters, including several that are used for the painting of materials other [illegible] consisting of nearly one hundred pages, is taken [illegible] American Institute of Mining Engineers on the [illegible] furnaces, and by the complete bibliography of [illegible]

Taken as a whole the book is altogether the best work on this important and involved subject that has been issued thus far, and may be read with much profit by all those who wish to be well informed along these lines.

Clarification of Sewage. [illegible] The Engineering News Publishing Co., New [illegible] illustrated; $1.50.

Dr. Schmeitzner prepared this volume after visiting several of the larger clarification plants. [illegible] gineering structures. Chemical and bacterial processes are not discussed in the present work.

Since German conditions of population led to researches in this line before America found [illegible] clarification are much more highly developed there than here. A consideration of this condi- [illegible] book into English. He deserves the thanks of every sanitary engineer who does not read German readily. The book as translated is a valuable addition to literature in our language [illegible] tanks, towers, and methods of sludge removal and disposal.

The book is in five chapters. The first chapter treats of the general principles governing the design of clarification plants. The choice of site and details of construction are discussed as factors influencing the cost of plant. The methods of operation which permit continuous service of plant during repairs and sludge re- [illegible] for elasticity of operation to provide for in- [illegible] clarification plant a nuisance is taken up in [illegible] sludge disposal areas, flies, contamination of [illegible]

Chapter II gives physical and chemical analyses of crude sewage.

Chapter III is considerably over half the book. It deals with the component parts of a clarification plant. The general feature of screens is fully discussed. Coarse and fine screens are defined and described and their relative merits and shortcomings enumerated. Their design and operation is outlined and discussed in detail with illustrations. The design and operation of sedimentation devices is handled in a similar manner by the author. Sludge removal methods are named and discussed. The principles underlying the design of settling tanks are enumerated and limiting values for the guidance of the designer are given to enable him to properly proportion works of this character. Sedimentation towers are treated in a similar manner.

Chapters IV and V are very brief; the former dealing with the general problem of sludge removal and by-product recovery, and the latter dealing with the practical arrangement of clarification and purification plants. There are two folding plates showing two typical German installations in detail.

Kinetic Theory of Engineering Structures. By David A. Molitor. McGraw-Hill Book Co., New York. Cloth, 7x9 ins.; 361 pp.; illustrated; $5.00.

The aim of the author in writing this book was to furnish an advanced treatise on stresses and deformations in engineering structures. The book will be of much service to the technical graduate who wishes to continue his studies after taking the usual four-year engineering course. It will also be a great help to designers of what are commonly known as "higher structures" in which the stresses are statically indeterminate. The reader is supposed to be familiar with mathematics up to and including the calculus and algebraic and graphic statics. Both algebraic and graphic methods are used impartially, the method of treatment in any case depending on its fitness to secure the more practical solution. The book deals with the problems of stress determination exclusively. Problems of design of main members and details are not discussed at all.

The book is divided into fifteen chapters. The first three chapters deal with reactions and redundant conditions; with theorems, laws and formulas for framed structures, and for isotropic bodies. Next following there are two chapters on influence lines and areas for statically determinate structures, and special application of influence lines to such structures. There are three chapters on distortions, deflective polygons, and deflection influence lines, for statically determinate structures.

Statically indeterminate structures are next taken up and there are chapters on influence lines for statically indeterminate structures, special applications of influence lines to statically indeterminate structures, and design of statically indeterminate structures. It should be added that the chapter on design is general.

There are two short chapters on stresses in statically determinate structures, and mitering lock gates. A special feature of the book is an excellent chapter on secondary stresses. The last chapter relates to fixed masonry arches. [illegible] treatise on arches. The author deplores the use of fixed masonry arches but offers the chapter as a guide to designers who prefer to follow the old-time practice. The chapter concludes with the investigation of a preliminary design for a concrete arch for 150 ft. span.

Throughout the book is well written and the subject matter is well arranged. The figures are good and the notation is simple, consistent and largely self defining. The author has succeeded [illegible] scholarly.

Personals.

Mr. Richard A. Sanders has been appointed superintendent of construction by the state ar- [illegible] year.

Announcement is made of the removal of the Municipal Engineering & Construction Co. from Chattanooga, Tenn., to 703 Empire building, Atlanta, Ga.

Mr. Abram de Ronde, of Bergen County, N. J., has been elected state director of railroads by the New Jersey legislature, succeeding Mr. Joshua E. Borton, of Burlington, N. J.

Mr. W. H. West, who has been for the past three years superintendent of the Lincoln Park System, of Chicago, has resigned. He will be succeeded by Mr. Arthur S. Lewis, assistant superintendent.

Mr. E. S. Koller, superintendent of the McCook (Neb.) division of the Chicago, Burlington & Quincy R. R., has been appointed general superintendent of the Illinois district of that road, with headquarters at Galesburg, Ill. He succeeds Mr. H. D. Judson, whose death was noted in these columns on March 15. Mr. Koller is succeeded at McCook by Mr. E. Flynn, who is transferred from the Omaha division. Mr. A. G. Smart, train master at McCook, has been promoted to the superintendency at McCook.

Mr. W. S. Ashton, who has been superintendent in charge of tunnel construction on the Los Angeles, Calif., aqueduct at South Portal, is now on his way to Hawaii, where he will take charge of tunnel construction for the Hilo railway. He will take with him four of his assistants on the Los Angeles work: Rodney Carwithen, W. D. Hook, William Gohlson and William Hull. Mr. Ashton has made a remarkable record in tunnel construction and it is said that the position in Hawaii has been kept open for him for several months pending the completion of the Los Angeles work.

Mr. John F. Stevens has resigned as president of the Oregon Trunk Ry. and other railways of the Hill system in the Pacific Northwest. While no announcement has been made, it is stated on apparently good authority that after a brief rest Mr. Stevens will go with the Harriman lines. He is succeeded on the Hill system by Mr. Carl R. Gray, senior vice-president of the St. Louis & San Francisco R. R. Mr. W. C. Nixon, vice-president and general manager of that road, succeeds Mr. Gray. Mr. Chas. M. Levy and Mr. W. H. V. Roring become assistants to the vice-president of the St. Louis & San Francisco, and Mr. W. T. Tyler becomes general manager.

Mr. Charles Wallace Hunt, president of the C. W. Hunt Co. and other industrial concerns, died at his home on Staten Island, N. Y., on March 27. He was born at Candor, N. Y., on Oct. 13, 1841, and was educated at the Cortland Academy, Horner, N. Y. He started in the business of building coal handling machinery in 1872, and the various devices invented and built by him have in many respects revolutionized the methods of handling coal. In late years branch works were established in England and Germany for the manufacture of his devices. He also did an extensive business in the construction of wharves, docks, storage warehouses, power stations and industrial plants. He was a past-president of the American Society of Mechanical Engineers, an associate of the American Institute of Electrical Engineers, and a member of the American Institute of Mining Engineers and the American Association for the Advancement of Science.

Dr. Samuel Franklin Emmons, a noted geologist and author, died of asthma at his home in Washington, D. C., on March 28. He was born in Boston, Mass., on March 29, 1841, and his early education was received in that city. He was graduated from Harvard University in 1861. In 1864 he received the degree of Master of Arts from that institution. From 1862 to 1864 he attended the Ecole Impériale des Mines at Paris, and in 1864-65 the Bergakademie at Freiburg, Saxony. He was Geologist for the United States in the exploration of the 40th parallel from 1867 to 1877. Since 1879 he has served as a geologist with the United States Geological Survey. He has been general secretary of the International Geological Congress for the past 20 years, and was a member of many scientific societies, both in this country and abroad. Dr. Emmons was the author of a number of books and papers on scientific subjects and was an eminent authority on geology and mining.

Catalogs Worth Having.

[illegible] rectly to the advertisers and state that you [illegible] CONTRACTING. If you are in the market for [illegible] will notify promptly the leading manufacturers.

Iron Fences. Paper, 7¾x5½ ins.; 24 pp. Anchor Post Iron Works, 165 Broadway, New York.

An illustrated catalog of ornamental iron fences, special enclosures for factories, reservoirs, etc. Prices are given.

Asphaltum Mastic Floors. [illegible] pp. The American Asphaltum & Rubber Co., 600 [illegible]

Containing illustrations and descriptions of floors laid in various plants. Specifications for laying are given.

Concrete Surfaces. Paper, 6x9 ins.; 32 pp. Universal Portland Cement Co., Chicago, Ill.

This pamphlet describes various methods of [illegible] effects. This booklet takes up the subject very thoroughly and contains considerable useful information.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

Some Election Results.

[illegible] always in[illegible] the [illegible]. The elec[illegible] brought out [illegible] at the latter [illegible] Kansas town a mayor [illegible] was defeated on the ground [illegible] too narrow in his views. He had refused to permit dancing on a newly [illegible] was planned [illegible] Lots of other things [illegible] Kansas where women have [illegible] In Wichita the socialist candidate for mayor was defeated, the result being attributed to the votes of the women. In Hunnewell, Kan., a woman was elected mayor. She and the other candidate each received the same number of votes. At first it was suggested that the two candidates draw lots for the office. But that did not appeal to the male voters. They said if Mrs. Wilson could [illegible] she ought to have the office. Therefore the judges of the election declared her elected. After that the new mayor gave an oyster supper and the whole town jollified over her victory. A small city in Colorado elected a prize fighter mayor. He was unopposed. Tacoma, Wash., tried out the recall with the result that none of the three candidates for mayor received a majority of the votes. Another election will be held on April 18.

The Doings of the Week.

[illegible] few days a noticeable increase in the number of contracts awarded for railroad [illegible]. Among these contracts are the following: Adams & Stern [illegible] Bldg., Columbus, Ohio, for the construction of 208 miles of line for the Atlanta & Carolina Ry. between Atlanta, Ga., and Augusta, Ga.; Marasco & Serriani, Grove City, Pa., general contract for building and equipping the A. & A. Short Line Ry. Co. of Alliance, O.; subcontract for grading on the last mentioned work was let to M. J. McGinty, Minerva, O.; Lorimer & Gallagher, 217 La Salle St., Chicago, Ill., for double track work on the Chicago Division of the Baltimore & Ohio R. R.; J. C. Carland & Co., 831 Spitzer Bldg., Toledo, O., for grading and concrete work for the 19-mile line to be built from Alliance to Ravenna, O., for the Cleveland, Alliance & Mahoning Valley R. R.; James L. Nowell, Steamboat Springs, Colo., and P. S. Rhinehart, Denver, Colo., for the grading work for 42 miles of line from Steamboat Springs, Colo., for the Laramie, Hahns Peak & Pacific R. R.; subcontracts for work on the Piedmont & Northern Traction Co.'s line from Greenwood to Greenville, N. C.: W. L. Marshall & Co., Knoxville, Tenn., grading the first four miles out of Greenwood; McCormick & Co., Evansville, Ind., grading the next five miles; J. L. Hunticutt, Chattanooga, Tenn., grading the first five miles out of Greenville; Kline & Co., Charlotte, N. C., all the wooden trestle work on the 90 miles of line between Greenwood and Greenville; Huett & Co., Marion, N. C., concrete work between Piedmont and Williamston; G. H. Archibold Co., 803 Union Bank Bldg., Winnipeg, Man., for construction of substructure of bridges and culverts on the Manitoba Division of the Canadian Pacific Ry.; C. Wells, Denver, Colo., for the construction of a 6-mile spur from Francisco, Colo., for the Denver & Rio Grande R. R.; M. J. O'Brien, Ottawa, Ont., for constructing the [illegible] Que., 40 miles.

Among the railroad construction jobs which are likely to be let in the near future are the following: Grand Trunk Ry., for constructing the first section of its new line in Vermont. This section will extend from Windsor, Vt., to Bellows Falls, Vt., and will be about 30 miles [illegible] asked. The second section will extend from Bellows Falls to Brattleboro, a distance of 26 miles. Bids were opened April 11 at Jackson, Tenn., for the construction of 48 miles of railroad from Jackson, Tenn., to Dyersburg, Tenn., for the Birmingham & Northwestern Ry. This work will include 400,000 cu. yds. of earth excavation.

One of the largest municipal contracts let recently is the one for the construction of a pipe line and storage reservoir for the city of Tacoma, Wash. The contract for the pipe line was let to George B. Wright, California Bldg., Tacoma, at $736,750. This pipe line is to consist of one mile of riveted steel pipe and 25 miles of wood stave pipe. The contract for the reservoir was let to Maxham & Berne, Tacoma, at $287,770. This contract includes 283,000 cu. [illegible] of concrete.

Difficult Railway Location.

[illegible] ing account, taken from the [illegible] the location [illegible] western & Pacific Ry. through Gore Canyon of the Grand River in Colorado. The canon is a deep, narrow gorge, about six miles long, through which flows the Grand River, from [illegible] ders and a fall of about two feet in 100 ft. For a considerable part of the distance the walls rise directly from the water's edge. The canon was almost inaccessible at all times, although it was possible, when the water was low or the river was frozen, to get through with a great deal of difficulty. During the high water season it was impassable, and it was during this period that the location had to be made. The sides of the canon are in [illegible] height of 3,000 ft. and in other places they are coarse slide rock, standing at about the angle of the sides of a rock dump. Through this slide rock run the small streams, which cut the sides of the canon. It is possible to walk or climb over the slide rock, but the bluff cannot be scaled except by artificial means. It was found possible to work over the bluffs by the use of ropes swung from points above. An active man by holding to these ropes could scramble over an almost perpendicular cliff. An instrument man with his instrument strapped on his back and a rope around his body safely securing him in case he should slip, could go almost anywhere and set up his instrument in seemingly impossible places. By this means, it is stated, a preliminary line was run and ten foot contours ob[illegible] cation projected. This means of getting over the line was slow and unsatisfactory and it became necessary to devise a way of getting to the interior of the canon in a shorter time. The expedient was finally adopted of swinging foot logs along the face of the bluffs over the river, by means of wire rope attached to steel pins fastened in the rock. It was no easy matter to do this with hastily improvised [illegible] foot logs was the most strenuous work of the survey. The method of placing the logs was as follows. Pine logs from 6 to 10 ins. in diameter and about 16 ft. long, which grew on the rock slides of the canon, were cut and taken down to the river bank. Steel rope, ⅝ in. in diameter, was fastened to each end of the log. The pins used for supports were of drill steel, about 16 ins. long, sharpened with a flat point. These were driven into crevices in the rock in most cases, or, when this was not possible, holes were drilled for them. Beginning at the upstream end of the bluff, a pin was located at as near the proper height as possible, a log was floated down the river to its position, and the upper end of the log raised to the proper height and swung by the rope from the pin. A rope was then dropped from the top of the bluff and attached to the lower end of the foot log, allowing men located above to hold the lower end of the log at the same height as the upper end, while a man walked out on the log and put in the steel [illegible] to swing the lower end of the log. Then another log was floated down, its upper end attached to the same pin to which the lower end of the first had been fastened and its lower end raised by the rope from above while a man went out on it and fastened another of the pins in the bluff. After the logs had been placed for a short distance by this method, the whole party handling the logs would be working on these shaky supports, and the swift current made it very difficult to handle the logs in that situation. Sometimes the current was so strong that in floating down the logs one would be lost, rope and all. Sometimes the steel pins, apparently solid, would drop out. This danger was provided against by putting in a large number and by binding the ends of the logs together solidly. The ropes swung from the top of the cliff continually started loose rock, which dropped all around the party, and one or two instruments were smashed by such rocks. There were no serious accidents, however, during the work.

The Causes of Accidents.

[illegible] seen much agitation for the adoption of new sys[illegible] York state passed an employers' liability and compensation act. This act was lately declared unconstitutional by the Court of Appeals of New York state. Employers' liability and employes' compensation bills are now before the state legislature of Illinois. The latter bill provides a fixed scale which employes shall be paid for injuries incurred in the course of employment. The liability bill takes away the "fellow servant," "contributory negligence" and "assumption of risk" defense for personal injury actions in certain dangerous occupations. How large a part these three play in accidents is shown by the following classifications of the causes of 16,000 accidents which were studied by the German government:

	Per cent.
Due to negligence or fault of employer	16.81
Due to joint negligence of employer and [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Due to acts of God	1.31
Due to fault or negligence of employe	28.89
Due to inevitable accidents connected [illegible]	[illegible]

RAILWAYS, STEAM AND ELECTRIC

Alabama

[illegible] is desired by the Louisville & Nashville R. R. for the change in its roadbed. [illegible]

Alaska.

Information received from Cordova, Alaska, is to the effect that the construction work has been completed on the Copper River & Northwestern R. R. from Cordova, on Tidewater and Kennicott.

Arkansas.

Advices from Jonesboro, Ark., state that R. E. Lee Wilson and associates have purchased [illegible] the Jonesboro, Lake City Eastern Ry. Co., of A. J. Kerfoot, E. F. Brown and J. F. Jones. The price paid was $225,000. Steps will be taken immediately toward improving the system.

Arizona.

The business men of Tucson, Ariz., have raised a bonus of $75,000 to secure the extension of the El Paso & Southwestern R. R. to that city. Three routes for the extension have been surveyed—one from Benson to Tucson, one from Fairbanks to Tucson and one from Hereford to Tucson.

The Southern Pacific Ry. has started surveys for a route from Glamis, on the main line, to Blythe, in the heart of the Palo Verde valley.

It is believed that active construction work will be started on the building of the Port Lobos R. R. as soon as the present insurrection in Mexico, particularly along the line of the proposed road, is checked. Frank M. Murphy, 5 Nassau St., New York City, president of the Development Co. of America, who is interested in this new road, was recently in Tucson and Phoenix, looking over maps of the surveys.

California.

It is believed that construction work will be started this month on an extension of the Hanford & Summit Lake R. R. from Hardwick, Kings county, to a point two miles west of Jamison in the western part of Fresno County. The new line will be 38 miles in length and rails and ties are now on the sidetrack at Jamison waiting to be unloaded and distributed along the surveyed route. R. I. Rogers is Chief Engineer, and Charles King, Hanford, Cal., is the promoter.

The Nevada-California-Oregon R. R., according to reports from Los Angeles is rapidly rounding out plans for the construction of a branch line from Moapa down the Muddy River Valley to St. Thomas, a distance of 26 miles. The survey for the road was made more than three years ago and right of way secured for a part of the route. It is understood that the Salt Lake Route has taken over all of the holdings of the old company. Many Salt Lake and Utah people are interested in that section of Nevada. George S. Oliver, Reno, Nev., is Chief Engineer.

Construction work has been started, it is said, on the extension of the Mill Valley & Mount Tamalpais Ry., G. M. Dodge, San Rafael, Cal., Chief Engineer, from West Point on the present line to Willow Camp on Bolinas Beach in northern California. The proposal to extend the road to Bolinas Beach has been before the directors of this road for several months. It is estimated that the improvements will cost close to $200,000. The new road will run from West Point down what is known as the Bolinas road, to Willow Camp, about five miles.

The Oakland & Antioch Ry. Co., which now has an electric railway under construction, has filed new articles of incorporation in which the name is changed to the Oakland, Antioch & Eastern Ry. Co. The operations [illegible] will be largely extended. According to the articles of incorporation the consolidated lines, including the Antioch Stockton section of the road, will include 80 miles of track. The road begins in Oakland, runs thence in a northeasterly direction to Antioch, and thence to Stockton. An authorized capital of $1,000,000 is provided. The chief stockholder is S. L. Naphtaly of San Francisco, the company's treasurer. The other stockholders are A. W. Maltby of Concord, Laurence Armstrong, John R. Selby and A. J. Krutmeyer, of San Francisco, all members of a law firm.

It has been announced in Oroville, Cal., that the Western Pacific, T. J. Wyche, San Francisco, Cal., Chief Engineer, will spend during the coming summer $2,000,000 in improving its roadbed. A goodly portion of this money is to be expended on the north fork of the Feather River. The remainder will be spent along the road where there have been washouts or where the bed has sunk. A big appropriation will be made for the re-ballasting of the roadbed, making it possible for the engines to attain the high speed that they are capable of maintaining upon a good road. At Keddie, where the worst slides were encountered during the past winter, it is planned to erect a large masonry wall to restrain the snow from slipping down onto the tracks and carrying rocks and dirt with it. While trouble has been encountered at a number of other points along the route, it is not expected that the same difficulties will be encountered a second year.

Surveyors in the employ of the Southern Pacific Ry. are laying out the route for the proposed new Y to be constructed at Niles, Cal., to cut down the difficult grade from the Dumbarton cutoff through Niles Canyon. The new line passes directly through the old Vallejo mill, which has been torn down, and passes just back of the Niles school building. If this survey is adopted it will probably mean the removal of the school to another site.

Hard Bros., Orland, Cal., have completed their work at Orland for the Government and are now looking for railroad or any kind of dirt work. They have 80 head of stock and tools.

The Atchison, Topeka & Santa Fe System is reported to be considering the construction of a cut-off on the San Francisco division near Victorville that will save 40 miles. Over this route trains would not go to Barstow, but would cut directly north across the desert from near Victorville, intersecting the San Francisco branch near Hinckly.

Colorado.

⦿It is reported that the Denver & Rio Grande R. R. has awarded a contract to C. Wells, Denver, Colo., for the construction of a spur from Francisco, Colo., to the Indian Creek mines. The line will be 6 miles long and work will be commenced as soon as the contractor finishes up his work on the Apache siding. J. G. Gwyn, Denver, Colo., is Chief Engineer.

⦿Engineers of the Laramie, Hahns Peak & Pacific R. R., R. D. Stewart, chief engineer, Laramie, Wyo., are now at Steamboat Springs, Colo., and it is believed that construction work on that end of the line will be started shortly. It is reported that James L. Norvell of Steamboat Springs and P. S. Rhinehart of Denver have been awarded the contract for construction of 42 miles of road for the work to commence at the Steamboat Springs end.

It is reported in railroad circles that orders have been given by R. S. Lovett, President of the Harriman lines, to double track the main line of the Union Pacific in Nebraska this season, and that work will be started immediately from Julesburg, Colo., to Pine Bluffs, Wyo., a distance of 100 miles. When this is done the Union Pacific will have a double track line from Council Bluffs, Ia., to Wamsutter, Wyo., 731 miles, completed with the exception of two short strips, one from Buford to Hermosa, 11 miles, and another from Pine Bluffs to Archer, 35 miles, which are to be completed next year. R. L. Huntley, Omaha, Neb., is Chief Engineer.

Bids have been received, it is reported, from five companies, by W. M. Cooley, General Manager, Unitah Ry. Co., Mack, Colo., for the construction of a 14-mile extension from Dragon to Temple mine. The extension will be run due north from Dragon down Evacuation creek to the Temple mine. The Temple mine is located in the same vein of coal with the Dragon mines. This coal vein is 50 miles long. The cost of the extension is not known but it is understood that work will begin as soon as the bids are opened and the contract is awarded.

The House of Representatives on April 7 by a vote of 35 to 30 passed the Moffat tunnel bill. The measure now goes to the state senate. The bill authorizes the state to issue bonds to the amount of $4,000,000 to be used in the construction of a tunnel through the Rocky Mountains at James Peak.

Florida.

The Florida Ry. Co. now has work underway on a 120-mile extension from Jacksonville, through Fernandia to Live Oak. The general contractor on the work is the Florida Construction Co. The latest contract to be let was for grading 18 miles of line from Live Oak to White Springs, this contract being let to Lucien Baker, of Fort Pierce, Fla., as noted in our last issue. The balance of the line has been let to various other contractors. Frank Drew, Jacksonville, Fla., is President, and G. W. Bushnell, Jacksonville, is Chief Engineer.

The Louisville & Nashville R. R. has acquired a site at Pensacola, Fla., for its new $250,000 depot.

Georgia.

⦿Adams & Sturm, 810 Columbus Savings & Trust Bldg., Columbus, O., have taken a contract from the Atlanta & Carolina Railway Co., whose general offices are at Atlanta, Ga., for the construction complete of a main line and branches between Atlanta and Augusta, Ga., consisting of approximately 208 miles. The engineer's estimate on the entire line is as follows:

Earth excavation, cu. yds.	2,892,008
Loose rock excavation, cu. yds.	288,674
Solid rock excavation, cu. yds.	200,687
Embankment borrow, cu. yds.	2,755,600
Piling, lin. ft.	39,460
Timber pile bridges, ft. B. M.	437,000
Timber frame bridges, ft. B. M.	6,661,704
Iron, lbs.	622,184
Foundation earth excavation, cu. yds.	10,904
Foundation excavation water, cu. yds.	789
Foundation solid rock excavation, cu. yds.	96
Concrete, class B, cu. yds.	12,547
Culvert masonry, cu. yds.	20,065
Cast iron pipe, 24-in., lin. ft.	288
Cast iron pipe, 36-in., lin. ft.	48
Clearing and grubbing, acres	180
Track laying, miles	208

Adams & Sturm wish to at once sub-let the first 27 miles of this work from Atlanta southeast, the engineer's estimate on this 27 miles being as follows:

Earth excavation, yds.	262,885
Solid rock excavation, yds.	49,941
Total embankment, yds.	430,331
Culvert masonry, yds.	3,166
Bridge masonry, yds.	1,327
Timber bridges, ft. B. M.	979,063

The Elberton & Eastern Ry. Co. is being organized by business men of Wilkes and Elbert Counties and proposes the construction of a railroad about 50 miles in length, running from Elberton by way of Tignall and Washington to Lincolnton. Among the promoters of the new railroad enterprise are M. A. Pharr, of Washington, J. A. Moss, of Tignall, president of the National Bank of Wilkes; W. J. Adams, of Tignall, president of the Bank

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

of Tignall; W. O. [illegible] president of the Bank of Elberton; J. H. Blackwell, a banker of Elberton; Z. B. Rogers, attorney, and R. L. Cauthen, of Elberton.

The Blakely Sou[illegible] C., has completed surveys and has secured the capital for the construction of its projected 22-mile railroad which is to extend south from Blakely, Ga., to Jakin, Ga. The chief engineer has not been secured as yet. The road will be constructed locally. W. E. Snodgrass, Thomasville, Ga., is President.

The Atlantic Coast Line R. R., E. B. Pleasants, chief engineer, Wilmington, N. C., is reported to be planning the expenditure of about $200,000 in the erection of a roundhouse, a turntable and necessary offices at its yards south of Southover Junction, and the building of additional tracks between the intersection of the union station tracks at Savannah and Ogeechee road to a point just east of the yards in question.

All financial arrangements for the construction of the proposed interurban line from Macon to Atlanta, are reported to have been completed and it is said that construction work will be commenced at once. This is a large project involving the expenditure of several millions. W. J. Massee, Macon, Ga., is president of the company.

Idaho.

The Boise R. R. Co. is to start construction work this spring on an extension at Boise from 16th and Main Sts., the present terminus to connect with the Soldiers' Home line, completing a loop.

It is reported that work will be started during this month by the Oregon Short Line on the double track improvement at Pocatello and Montpelier, Idaho. Fifteen miles of the road west from Pocatello and seven miles either side of Montpelier is to be double tracked at a cost of $1,000,000. This added to the $800,000 expenditure between Farmington and Ogden, together with lesser projects, for which estimates are now being prepared, will bring the proposed improvements on the Oregon Short Line in that territory tributary to Salt Lake to a total of more than $2,000,000 for 1911 alone, which is two-fifths of the [illegible] amount [illegible] 000,000 appropriation [illegible]ning. Estimates are being prepared and in some instances bids have been called for for double tracking the busiest sections of the Union Pacific and the Southern Pacific east and west of Ogden. Eventually the entire system through Utah, Idaho, Wyoming and the Pacific coast is to be double tracked, and judging from the activity already manifested, the Harriman officials will be well within their five-year time limit when the undertaking is completed. William Ashton, Salt Lake City, Utah, is Chief Engineer.

The Oregon Short Line will, it is said, construct the first link of the Owinza-Boise cutoff this spring and summer. Eighteen miles of the new road passing through Camas Prairie will be air line. Contracts for the work have been closed.

Advices from Twin Falls state that W. L. Cherry and associates have been purchasing ties and rails for the construction of an interurban line to be built this summer from Twin Falls to the Snake River canyon, both the Shoshone and Twin falls, and return. The project is reported to have been financed in the east principally with Chicago capital. The route of the proposed road is as follows: Starting from the corner of Shoshone and Main, the road will be built down Blue Lakes boulevard to the canyon, where it will turn east skirting the canyon edge to the Shoshone and Twin falls, south nearly to Kimberly and back to this [illegible] Kimberly road, making in all a loop of approximately 15 miles.

Eastern parties headed by John Stewart Clark of Rochester, N. Y., are reported to be planning to purchase the Boise Valley Ry. now operating 20 miles of electric railway. If the deal goes th[illegible] improvements will be made in the line during the year as the plan is to extend it to the Barber dam [illegible] Gooding to connect with the steam line now operating between that town and Jerome.

Illinois.

⊙The Baltimore & Ohio R. R., according to reports, has awarded the contract for double tracking a portion of its Chicago division to Lorimer & Gallagher, 217 La Salle St., Chicago, Ill.

At the recent annual meeting of the stockholders of the Toledo, St. Louis & New Orleans R. R., at Carmi, Ill., the following officers were elected: Nathanial M. Burns, St. Louis, president; Dent Reid, Marion, Ill., vice president; Henry Semple Ames, St. Louis, treasurer; Thomas W. Hall, Carmi, secretary. The company is reported to be backed by St. Louis capitalists, and intends completing the line before the Panama Canal is opened.

The Marengo & Harvard Electric R. R. Co. is reported to have purchased the electric line from Harvard to Fontana, known as the Chicago, Harvard & Geneva Lake R. R. It is said that work on the road between Marengo and Harvard will be pushed as rapidly as possible, and the road west from the end of Lake Geneva to Delavan by way of Delavan will be built.

Surveyors are driving grade stakes for the construction of the new Chicago & Northwestern R. R. line west of Green Valley, Ill.

A temporary oragnization has been formed at a meeting of representatives from Quincy, Carthage, Nauvoo, Hamilton, Niota, Powellson and Warsaw for the purpose of securing an interurban line for Western Illinois, the power to be obtained from Keokuk. Fred Swan, Nauvoo, Ill., is interested.

The Chicago & Northwestern Ry., E. C. Carter, Chief Engineer, Chicago, Ill., is making good progress with the plans for its new branch to the coal fields. It is believed that the line will run from Peoria, past Hollis, across the LaMarsh drainage district, over the Illinois at Pekin, near the site of the American distillery, and from Pekin direct to Girard, touching the western portion of Green Valley. It is stated that there will be a high grade all the way across the LaMarsh drainage district, averaging about 20 ft., and a long trestle will be built at the site of the bridge. The company has been conducting negotiations for property near Pekin for a large transfer yard and may secure a farm near the C., P. & St. L. gravel pit for the purpose.

The Saline Valley Ry. Co. has filed a $3,000,000 mortgage at Marion, Ill., in favor of the Guaranty Trust Co., of New York City to secure funds for construction of a railroad from Harrisburg to Marion.

Indiana.

The Evansville & Eastern Traction Co., Evansville, Ind., is considering extending its lines to Cannelton, Ind., passing through Troy, Ind., and Tell City, Ind. These towns will be asked to vote subsidies for the proposed extension.

Track[illegible] Four branch from Evansville to Mount Carmel, Ill., and by June 1 it is expected trains will be running on the new road. All the grading has been done. All the bridges and culverts have been constructed except the bridge across the Wabash River, above New Harmony, Ind. Piers for the bridge have been completed.

It is [illegible] Traction Co., Gary, Ind., will have work started shortly on the construction of the Gary-Crown Point line. Work will probably be started at the Gary end and continued towards Crown Point. A double track will be laid from the Little Calumet bridge to the Nickel Plate tracks and the same plan will be carried out on the Crown Point end of the line, the double tracking system to be used to the outskirts of the city.

Advices from Bloomington state that it is planned to extend the Bloomington Southern R. R. from its present terminus south through the stone belt of Monroe county into Lawrence county. The extension will be about 15 miles long, and the greater part of the options on right of way for it are said to have been secured. The Bloomington Southern is a spur line from the Indianapolis Southern R. R., A. S. Baldwin, Chief Engineer, Chicago, Ill.

Iowa.

The sum of $100,000 has been raised at Davenport for the proposed Davenport-Iowa City interurban, and work has been started at Iowa City in securing renewals of the $100,000 which was pledged there for the road.

The Iowa Traction Co., George Woodhouse, President, Oskaloosa, Ia., is planning to have construction work started shortly between Tama and Waterloo on its projected line from Oskaloosa to Waterloo. J. C. Lathrup, formerly with the Springfield Railway Co., of Springfield, O., has been selected as Chief Engineer in charge of construction work.

The officials of the Chicago, Rock Island & Pacific have submitted a proposition to the city of Corydon, Ia., offering to construct the short line from Kansas City through that place providing the citizens would give them the use of a street.

According to reports, W. B. Storey, Vice-President of the Santa Fe System, has announced that the construction of the proposed Dodge City-Colmar cutoff is under consideration but no definite time has been decided upon to start work. Several surveys have been run over the contemplated route.

The Iowa Central R. R., it is believed, will soon make an effort to purchase the Newton & Northwestern R. R., which recently went into the hands of a receiver and has been ordered sold by the Federal Court. Recently Chief Engineer R. G. Kenly, Assistant Freight Agent D. M. Denison, and other officials made a trip of inspection over the property for the purpose of reporting on its physical value and the prospects of business from the territory which it taps. These reports have been made and it is very possible that the Iowa Central and Minneapolis & St. Louis will make a bid for the property, or more especially that thirty-four miles of the abandoned line running from Newton to Des Moines junction, a few miles south of Ames.

It is expected that the double-tracking of the main line of the Union Pacific will be practically completed from Council Bluffs, Ia., its eastern terminus, to Kamsutter, Wyo., a distance of 731 miles, this summer. A specific order has been given for the immediate double-tracking of the main line from Julesburg, Colo., to Pine Bluffs, Wyo., a distance of 100 miles. Pine Bluffs is just over the Nebraska line. In connection with the Chicago & Northwestern, this will complete a double track line from Wyoming to Chicago, the first continuous double track of such length in the West. It is intended to take up immediately thereafter the completion of double-tracking across Wyoming and Utah to Ogden. Additional work planned for Wyoming this year is a second track from Laramie to Lookout, a distance of 27 miles. Second track from Buford to Hermosa, 11 miles, and from Pine Bluffs to Archer, 35 miles, will be built next [illegible]

The project for the construction of an interurban line from Sioux City through West Liberty to Muscatine seems to be assuming such tangible shape that definite announcement has been made that before long an effort will be made to float a bond issue of $500,000 for the proposed line. The promoters are Col. William G. Dows, Isaac B. Smith and John A. Reed of Cedar Rapids. The largest portion of the right of way between Iowa City and [illegible] have all been made.

Kansas.

[illegible] Kansas. The new law permits counties to vote not exceeding $100,000; townships not more than $15,000, and third class cities not more than $15,000, providing that the total aid does not exceed $4,000 per mile in any county. Counties having no railroads at all may vote aid to the amount of $4,000 per mile;

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] will control the proposed new union station and elevated tracks at Wichita, has been chartered. This completes all the formalities for the beginning of actual work on track elevation. The necessary ordinance is now before the mayor and commission. The directors of the terminal company are R. R. Vermilion, of [illegible] who represent the Frisco railroad in the terminal company; A. E. Sweet and M. A. Law, both of Topeka, who represent the Rock Island; C. W. Kouns and W. R. Smith, who represent the Santa Fe, and J. M. D. Tromble and W. W. Colpitts of Kansas City, who represent the Orient.

The directors of the recently incorporated Arkansas City & Wellington Northwestern R. R. have made a contract with Fremont [illegible] of the proposed route. The line is to run from Arkansas City northwest to Conway Springs via Wellington. State Senator George H. Hunter of Wellington is President of the company.

According to reports from Atchison, Kan., the [illegible] of the Central Branch of the Missouri Pacific will be ballasted this spring and summer, work to begin almost immediately. With this improvement in view the new ballast plant at Frankfort was put in [illegible] March 24 and a special work train will be put in operation to distribute the ballast over the division. It is estimated that 200,000 yds. of ballast, or about 8,000 carloads will be [illegible]. O. Rickart, Atchison, is Assistant Engineer.

The Arkansas Valley Interurban Ry. Co. has completed surveys and has secured the capital for the construction of its 17-mile line from Sedgwick to Newton and Halstead. The contract has been let to the Interurban Construction Co., Wichita, Kan. O. A Boyle, Wichita, is general manager and Chas. D. Bell, Wichita, is chief engineer of the Arkansas Valley Interurban Ry.

Kentucky.

The Kentucky Midland Ry., M. M. Wheeler, Chief Engineer, Central City, Ky., is expected to start work shortly on the extension from the present terminus at Earles to Madisonville and thence to Central City, Ky. A good stretch of trackage from Earles to Madisonville was laid some time ago.

Surveys are under way for the proposed interurban lines of the Henderson Interurban Ry. Co. As projected these lines will connect Henderson, Ky., with Owensboro, Uniontown, Morganfield, Sebree, Dixon and Providence. H. N. Wallace, 204 Dearborn St., Chicago, Ill., is Engineer.

Surveys [illegible] made for a 7-mile [illegible] Virginia Coal & Iron Co. proposes building from the main line of the Big Sandy & Elkhorn R. R., up Robinson Creek to tap rich coal lands recently [illegible]

Louisiana.

[illegible] proposition to the Police Jury of East Carroll Parish for the building [illegible] parish. The pro[illegible] mill tax for ten years on the assessed valuation of East Carroll parish and a free right of way [illegible] proposed the line will begin at Portland, Ark., on the Valley Division of the St. Louis, Iron Mountain & Southern Railroad, and will run in a southeasterly direction through southeastern Arkansas and West Carroll Parish, passing through the town of Oak Grove, and into Lake Providence; thence from Lake Providence in a southwesterly direction through what is known as the Joe's Bayou country to a point on the Vicksburg, Shreveport and Pacific Railroad, possibly Waverly. H. S. Janes, Buffalo, N. Y., is interested.

Plans are said to be taking definite shape for extending the Louisiana Southern Ry. from its present terminus at Belair to Bohemia. This railroad is operated by the United Railway & Trading Co., Samuel Gibbs, Manager, New Orleans, La.

Press reports quote W. L. Park, vice president of the Illinois Central Ry. as stating in a recent interview at New Orleans that the company was going ahead with new work in the South held up for several years back. He stated that a million dollars will be spent in the vicinity of New Orleans during the coming spring and summer, and that the work will commence at once.

Maine.

The ✣Fore River Shore Line R. R. Co., of Portland, Me., has been incorporated and proposes to build a railroad skirting the South Portland shore and connecting with the Boston & Maine at Pleasantdale, a distance of about two miles. It is expected that work will be started this spring.

Massachusetts.

A bill is to be introduced in the state legislature providing for the purchase of the Springfield Street Railway Co.'s system by the Berkshire Street Railway Co. of Pittsfield, which is owned by the New York, New Haven & Hartford R. R. The bill provides that it shall go into effect when the trolley connection between the Springfield system and Berkshire is completed, and it is further provided that an extension shall be built from Agawam or Westfield to Granville and another from Huntington to Commington, the new company bonding itself to the amount of $1,500 000 to complete them by Jan. 1, 1914. The New Haven railroad owns the Berkshire system, which includes about 148 miles, counting construction contemplated in the act of 1910. The Springfield system, covering about 161 miles of road, embraces the old Springfield system, the Springfield and Eastern and the Western Massachusetts, now merged into one road, and it reaches from Huntington on the west to Brimfield on the east. At Brimfield it connects with the Worcester Consolidated.

Michigan.

The Michigan United Rys Co., Lansing, Mich., will start work shortly on improvements at Lansing which will involve the expenditure of about $45,000.

The Lake Superior Southern Ry. Co. has filed a mortgage for $12,000,000 in the office of the register of deeds at L'Ansc, Mich. This is believed to be a step preliminary to the construction of the line of railroad traversing portions of Michigan and Wisconsin. The mortgage covers 14,000 acres of land in Baraga and Marquette counties, most of which is well timbered, and the right of way of the Iron Range & Huron Bay Railroad. The Lake Superior Southern, as projected, extends from Huron Bay in a southerly direction through portions of Baraga, Marquette and Iron counties to the state line and thence through Wisconsin to the city of Madison.

Officials of the city of Detroit and the Detroit United Rys. Co. have reached an agreement whereby the street car company will build the four extensions granted last year. These extensions are the Hamilton boulevard line, Mack and Chene lines and the [illegible] Beaubien St. loop.

City of Coldwater, Mich., voted on April 3 on granting the Battle Creek, Coldwater & Southern Ry. Co. a franchise over certain streets. The company has opened offices in the White Block, South Monroe St., Coldwater, preparatory to beginning the sale of [illegible] of bonds to people along the proposed line.

Mississippi.

S. A. Tomlinson of Gulfport, Miss., in co-operation with the Gulfport & Mississippi Coast Traction Co., is to build an electric line [illegible] North Gulfport, where he owns [illegible] of land.

Minnesota.

Manufacturing and business interests of Red Wing are advocating the construction of a railway line across the Mississippi from Red Wing to Eau Claire. The idea is to hold out inducements to capital independent of existing lines to finance the road.

The Minneapolis Street Ry. Co. will soon begin paving its right of way on Lake st. from Nicollet to Elliot ave, at Minneapolis, and will replace the 80-lb. steel rails now in use with heavier rails.

The construction of a trolley line from Sauk Rapids to a paper mill near that place is proposed. The cost of the line will be about $25,000. The Commercial club of Sauk Rapids is interested in the proposition.

The Northern Traction Co., of Hibbing, Minn., is planning to complete its line this summer and has applied to the City Council of Hibbing for a 25-year franchise. The company proposes a line connecting Hibbing, Chisholm, Buhl, Mt. Crow, Virginia and Eveleth.

Missouri.

⦿It is stated that work will be started about May 1 on the construction of the Oklahoma & Golden City R. R. mentioned in our March 29 issue. The company projects 400 miles of line in Missouri and Oklahoma. The contract for this work has been let to William Love, Lafayette, Ind., and it is said that much of the work will be sublet. John W. Fervell, Lafayette, Ind., is chief engineer for the contractor.

Engineers of the Springfield & Western R. R. have just completed preliminary survey for the interurban line between Springfield and Joplin, through the counties of Greene, Lawrence, Barry, Newton and Jasper. The principal places touched are Paris Springs, Mount Vernon, Hoberg, Freistatt, Monett, Peirce City, Wentworth and Diamond. The distance is about 90 miles. M. M. Hollenback, Springfield, Mo., is chief engineer.

Plans are under way for an interurban electric line to extend from Kansas City to Harrisonville, Mo., about 30 miles southeast. The promoters of the line plan to start from a connection with the Marlborough line of the Metropolitan at 73rd street and Woodland av, Kansas City, and build southeast. It is reported that the right of way already has been secured from Dodson to Belton. Henri D. Pattee & Co., Kansas City, Mo., are understood to be the promoters.

The Shelby Northwestern R. R. Co. has been chartered with a capital stock of $225,000 and proposes to build and operate a line of standard gage road from the city of Shelbyville to the orth line of Shelby county, a distance of 15 miles. The incorporators of the company are M. M. Houck, G. L. Houck, Giboney Houck, Cape Girardeau, Mo.; John A. Hope, J. H. Byrd and John A. Flapek. The incorporators are interested in the Shelby County Ry., now operating 10 miles of steam road.

George Townsend and Ward S. Arnold, of Kansas City, Promoters of the Kansas City, Clay County & St. Joseph R. R. Co., recently chartered, have submitted a proposition to the committee appointed some time ago to consider ways and means of building a line from Kansas City to Excelsior Springs. The committee is composed of representatives of the Commercial Club, Kansas City, Mo., the Union Depot Bridge & Terminal Railway Company and the Metropolitan Street Railway Company. The Union Depot Bridge & Terminal Company is building the new Armour-Swift-Burlington bridge. Frank A. Faxon is chairman of the committee and E. M. Clendening secretary. The company offers the Union Depot Bridge & Terminal Railway Company $1 for every car that crosses the new bridge, and guarantees $25,000 annually. The bridge company would be compelled to arrange with the Metropolitan for an entrance into Kansas City, to build tracks through its lands on the north side of the river to a connection with the tracks of the Kansas City, Clay County & St. Joseph line. Power would be bought from the Metropolitan. F. W. Pratt, president of the Union Depot Bridge & Terminal Company, will refer the proposition to directors of the company in Chicago. Another meeting of the committee probably will be held within a few

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

days. It is said [illegible] has received propositions [illegible] which also will be referred to [illegible] directors.

Kansas City, Mo., and Vicinity.

[illegible]

✣The [illegible] project, from Kansas City to Overland Park in Johnson County, Kansas, [illegible] the Johnson County Commissioners [illegible] after a session extending over three days. The project provides for a [illegible] from 39th St. and the state line, Kansas City, following the route of the old Santa Fe trail. The Clerk was authorized to advertise for bids for the construction of [illegible] road. Bids for the [illegible] May 9 and for the last section of 6 miles by May 16. It is estimated the work cannot be completed before October 1, 1911.

•It is understood that Phelan & Shirley, Omaha, Neb., will soon start work on their Union Pacific contract between North Port and Gehring, Neb. This is the contract on which bids were received about two months ago at Omaha. There is about 700,000 yds. of team work involved.

O'Hearn Brothers, 108 East 34th St., Kansas City, Mo., have quite a job of stripping to do in one of their quarries. They will do the work with their own forces.

Mr. L. J. Smith, President of the L. J. Smith Construction Co., has been confined to his home this week with a severe attack of tonsilitis. However, at this writing he is improving.

Porter Bros. have decided to do a large section of the Kansas City Southern work with their own forces. The most up-to-date plant [illegible] material on their contract.

O. K. [illegible] County, is preparing specifications for the building of 1½ miles of macadam road in the Kaw Valley east of Edwardsville, Kan. This leaves only one mile more of unmacadamized road between Kansas City, Kan., and Edwardsville.

The Terminal Railroad Co. of Kansas City is receiving bids on about 30,000 yds. of material. The work is so situated that the material will be difficult to move. Probably a small steam shovel plant will be used by the successful bidder.

Contractors desiring work for their outfits should write M. T. Babb, Agent for the Western Wheeled Scraper Co., 1020 Commerce Bldg., Kansas City, Mo. In writing the size and style of outfit should be given. All names will be kept on file and the outfits placed as soon as work in this section permits.

It is stated on excellent authority that plans for double tracking the Harriman system from the Missouri River to the coast have been completed and preparations are under way to begin the work. One section will be from Bonica, Cal., to Sacramento, 60 miles. This will give a doube track from San Francisco to Colfax. Another stretch will be at the end of the Salt Lake cut-off. There will also be some changes of line and reductions of grades. The Union Pacific will be double tracked from Julesburg, Colo., west about a hundred miles and from Ogden to Farmington, Utah. Kansas City contractors are much interested in this announcement.

St. Louis Items.

[illegible]

✣R. W. [illegible] Side Levee and Sanitary District, East St. Louis, Ill., informs us contracts will be let April 19 for the first three miles of the fruit levee protection work, extending from Mitchell north to Cahokia division channel. Contractor Robinson is now at work placing detouring tracks for the use of the five steam railroads for which bridges will be built over the division channel. Contracts for these bridges which will cost nearly $125,000 will be let April 25.

✣The Board [illegible] April [illegible] bids for the improvement of the following streets with material named: Arkansas Ave., from Miami St. to Potomac St., asphalt; Virginia Ave., from Osage St. to Keokuk St., asphalt; Mary Ave., from Carter Ave. to Florissant Ave., asphalt; Michigan Ave., from Bates St. to Eichelberger St., brick; Virginia Ave., from Potomac St. to Cherokee St., brick; Clark Ave., from Prospect Ave. to Spring Ave., brick; Compton avenue, from Keokuk St. to Chippewa St., brick; Greer Ave., from Elliot Ave. to Glasgow Ave., brick; Belmont St., from 11th St. to 16th St., brick; Johnson St. [illegible] brick; Cottage Ave., from Grand Ave. to Spring Ave., bitulithic; 12th St. from Hebert St. to Branch St., wood blocks; Brooklyn St., from 2d St. to Broadway, granite; Mitchell Ave., from McCausland Ave. to city limits, telford.

Cary Brothers [illegible] some nice team work to sublet on their levee job near that point.

Keating Brothers [illegible] Cary Brothers levee work in Southern Illinois.

Jack Carroll has taken two miles of the levee work [illegible]

The Rock Island [illegible] extensive switch [illegible] vette, St. Louis County. Twelve sets of tracks are to be laid near the Olive street road between Woodson and Lin roads. The Rock Island connects with the Terminal Belt Railway at this point. Much of the products of truck gardeners and farmers are also shipped from here. The residents of the section and those living along Olive street road are confidently looking forward to the building of the proposed Olive street road trolley line, promoted by county capital. Persons living along the proposed route have been asked to become interested in the new line. The line as planned will extend [illegible] Maple avenue to Olive street road and west on that thoroughfare to Creve Coeur Lake, the western terminus.

Emil Ebers [illegible] his home in Bellville, Ill., last week at the age of [illegible] years [illegible] the general building contracting business in Bellville for over 20 years. He is survived by a wife and [illegible]

Capt. Jas. K. Golike has started work on his rip-rap and shore protection job north of the city.

Capt. A. A. [illegible] open up [illegible] next week.

Chas. N. [illegible] for Capt. Fetter's Government work in the north part of the State.

Peterson & [illegible] Co. are going to open eight camps for tourists in the Glazier National Park in the northwest part of Montana.

Contractors [illegible] to call at Koenig's Labor Agency, 612 Walnut St., and make this office their headquarters. Koenig will post you on everything that is going [illegible]

Montana.

The [illegible] recent reports, is preparing to ballast the Yellowstone [illegible] miles. [illegible] about 1,000 men and eight work trains. Three [illegible] and Sherry.

It is [illegible] this spring on the proposed electric railway at Billings [illegible] been financed. The promoter, John A. Connolly [illegible]

Nebraska.

•The [illegible]

ton to the Elkhorn river at Elk City. There it will divide into two main lines, one going to Fremont, Maple Creek, Webster, Howells, Clarkson and ending at Madison. From Howells another line runs to Stanton and Norfolk. Starting from the Elk City junction the line to the north runs through Arlington, Craig, Bertha and Lyons, with a branch to Decatur, and from Lyons to Walthill, Winnebago, Homer and Sioux City. From Bertha a spur runs west to West Point. The total projected length is 284 miles and it is proposed to complete 100 miles this year. The Baker Construction Co., 314 Range Bldg., Omaha, Neb., has the contract.

Property owners and business men in the vicinity of Sixteenth and O Sts., at Lincoln, have petitioned the State Railroad Commission to compel the Lincoln Traction Co. to build a line from O St. south on 16th St. to M St. to connect the O St. and South 17th St. lines of the company.

Advices from Broken Bow, Neb., state that an election will be held shortly to vote on the issuance of township bonds to the amount of $50,000 for the proposed Nebraska Central & Western Ry., mentioned in our March 15 issue as calling for bids for 690,000 cu. yds. of earth work out of Broken Bow, west to Arnold, Gandy, and Tyron. Headquarters of the company are at Broken Bow and Arnold, Neb.

Nevada.

The Lida Valley R. R. Co. has been incorporated at Carson City, Nev., and has received a charter to construct the proposed line, grading upon which will begin in about 30 days. The headquarters of the company are at Goldfield, Nev., and the officers are G. F. Blesse, president; A. Lorenz, vice-president; A. D. Goodenaugh, general manager; H. B. Leonard, secretary and general agent.

New Jersey.

The Public Service Corporation, Newark, N. J., is securing franchises for an extension of its line from the Bergen Turnpike north through Ridgefield Park to connect with the Hudson River line at Queen Anne Road [illegible] Ridgefield Park [illegible] Teaneck.

The West Jersey & Seashore R. R. (Pennsylvania Lines), J. B. Hutchinson, Jr., Division Engineer, Camden, N. J., is understood to be planning to lay a double track from Mill[illegible]

New Mexico.

Promoters have under consideration the construction of the Portales, Texas & Torrance R. R. in an easterly and westerly direction through Portales, Roosevelt county, N. [illegible]

The Santa Fe System, according to reports from Santa Fe, N. Mex., is planning the construction of a new spur up Blossburg Canyon, Colfax county, to the new coal mine. The work will require ¾ mile of track and the construction of four bridges.

New York.

[illegible] applied to the State Public Service Commission, 2d District, for a certificate of convenience and necessity for the construction of a steam railroad in the towns of Leicester and York, Livingston County, covering a distance of 3.18 miles. The railroad is proposed to connect the Sterling Salt Co.'s plant with the [illegible] after construction is to be leased to the Genesee & Wyoming R. R. Co., of which H. C. Finch, Retsof, N. Y., is General Manager.

Good progress is being made with the construction work on the New York, Westches[illegible] work at the north end of East Chester cut, [illegible] has been completed. A large force is at work putting in concrete on retaining walls north of the New Haven crossing, the Hutchinson River viaduct, and Lincoln Avenue, Mount [illegible]

✣ indicates work now open for bid. • indicates a contract let recently.

[illegible] over Fifth Ave. are all in, and the work of placing the forms over the street is under [illegible] the Hutchinson River on the White Plains [illegible] has also been started on the foundations for the bridge immediately north of the Hutchinson crossing. Contractors are moving in the steam shovels for the work on the line north [illegible]

North Carolina.

The Charlotte Rapid Transit Co. has begun construction work on its proposed line to Charlotte, N. C. Paul Chatham, Charlotte, is the promoter.

The Raleigh, Charlotte & Southern Ry. Co., chartered early last month, is effecting arrangements to complete its organization. This company projects a line between Raleigh and Charlotte, by way of Pittsboro, Ashboro and Albemarle. W. L. Mann, Albemarle, N. C., is one of the promoters.

The controlling interest in the railroad, electric light and power and gas companies of Salisbury, Concord and Spencer, N. C., has been sold to William J. Oliver, of Knoxville, Tenn. The purchase also includes the electric interurban line of 22 miles connecting Salisbury and Concord, and the line connecting Salisbury with Spencer, where the Southern railway has large shops. It is stated that extensive improvements will be made to the properties.

North Dakota.

Officials of the Northern Pacific are making preparations to reballast and lay new steel on the Red River branch, running from Lake Park, Minn., to Pembina, this state, a distance of almost 200 miles. Several hundred carloads of ties have already been distributed along the tracks, running both north and south of Grand Forks and several hundred more carloads will be scattered in the near future. The ties have been taken to the East Grand Forks yards during the winter months in lots of four and five carloads, and the fine weather of the past few weeks induced the officials to begin work earlier than was first anticipated and work trains have been running north and south this week distributing these ties. Heavier rails will be put on the tracks on the Red River branch. Heretofore the rails have been of the 60 and 65 lb. variety, but the new rails to be laid will weigh either in the 85 or 90 lb. class and also be of a better grade. This improvement has been made necessary by a gradual change in the size of the engines being used on this branch of the Northern Pacific.

Among the reports concerning the construction of new railroad lines is one to the effect that the Northern Pacific will build from Mott, a city south of Bismarck, N. Dak., on the Cannon Ball Division to Miles City, Mont. W. L. Darling, St. Paul, Minn., is Chief Engineer of this company.

It has been announced, according to reports, by officials of the Minneapolis, St. Paul & Saulte Ste. Marie Ry., that although the construction of the extension from Drake to Devil's Lake is planned no plans have been laid for the immediate undertaking of the project. Thomas Green, Minneapolis, Minn., is Chief Engineer.

Ohio.

⦿J. C. Carland & Co., 831 Spitzer Bldg., Toledo, O., have been awarded the contract for grading and concrete work for the new 19-mile line to be built from Alliance to Ravenna for the Cleveland, Alliance & Mahoning Valley R. R.

⦿The general contract for building and equipping the line of the A. & A. Short Line [illegible] and Serriani, of Grove City, Pa. The sub-contract for grading has been let to M. J. Mc- [illegible] liance, O., is President of the A. & A. Short Line Ry. Knox & Elliott, Rockefeller Bldg., [illegible] house and carbarns and L. C. Marble, 312 Lennox Bldg., Cleveland, O., is Chief Engineer of the line.

The Baltimore & Ohio R. R. is said to have decided to double track the Cincinnati, Hamilton & Dayton R. R. between North Baltimore and Tontogany, and from the latter point into Toledo; the construction of new bridges and complete repair of the present tracks at Toledo end of the Toledo-Cincinnati road is also proposed.

Practically all right of way for the extension of the line of the Columbus, Urbana & Western Electric Ry. Co., Colubus, O., from Fishinger's bridge to Dublin has been secured. The new route for this extension has been approved by the city officials of Columbus, so it is probable that construction work may be started this spring.

The 1911 improvement budget of the Chesapeake & Ohio R. R., F. I. Cabell, Chief Engineer Maintenance of Way, Richmond, Va., is said to include an item of $1,500,000 for double-tracking 60 miles of line on the Cincinnati division. About 70 miles on this division has already been double-tracked. The company contemplates the double-tracking of the Indiana division between Cincinnati and Chicago.

Application has been made to the County Commissioners at Warren, O., by Henry Orth, for a franchise to construct an electric railway from Warren north to the county line. The proposed road would be installed on the "Old Turn Pike." The applicant agreed to have the road in the county completed and in working order by April 1, 1912, if the franchise is granted.

Oklahoma.

W. E. Rhodes, of the Sand Springs Construction Co., has been in conference with the City Commissioners of Tulsa, Okla., relative to a franchise for the Sands Springs Interurban Ry. through the city. It is the plan of the company to run a line of tracks through the city from west to east, going almost through to Kendall College.

Definite arrangements have been completed, according to advices from Butler, Okla., for the extension of the Chicago, Oklahoma & Gulf R. R. west of that city. Two miles of trackage will be laid on the original survey and it is not known as to how far the road will be extended at this time.

The People's Ry. Co., G. W. Riser, President, Oklahoma City, is now letting contracts for its line from Muskogee, Okla., to Oklahoma City. The route is by way of Fort Gibson, Wagoner, Claremore, Tulsa, Bartlesville, Sapulpa and Shawnee.

The Kansas City Southern Ry. has started surveys from Stilwell, Okla., down Lees Creek. It is believed that the railway is considering building a line down the creek to Fort Smith.

The Clinton & Oklahoma Western Ry., which recently completed its first line between Clinton and Butler, is reported to have made definite arrangements for the extension of its line from the latter place into the Texas Panhandle country. Col. C. C. Godman, Fort Smith, Ark., is the promoter.

The Oklahoma City Railway Promotion Co. was organized early this month at Oklahoma City to arrange for right of way, terminals and bonus matters for an extension of the Missouri, Oklahoma & Gulf Ry. from either Henrietta or Weleetka westward to Oklahoma City and thence northwest to Woodward. It is stated that the extension of the road is to be constructed by Ex-Gov. Haskell, William Kenefick of Kansas City, builder of the Missouri, Oklahoma & Gulf, and George W. Risser of Oklahoma City. This company now owns and operates 216 miles from Wagner, Okla., south to Denison, Tex., and the new extension adds 350 additional miles. Westward from Henrietta the road will be built via Okemah and Shawnee, and westward from Oklahoma City via Kingfisher. Mr. Kenefick is reported to have arranged with the same Paris syndicate that financed the Missouri, Oklahoma & Gulf to finance the new venture.

Oregon.

The Booth-Kelly Lumber Co., according to advices from Eugene, Ore., has taken bids for the work of building 3½ miles of standard gage logging railway above Wendling as an addition to the ten miles it already operates there.

Pennsylvania.

The approved map of the definite location of the Modoc Northern R. R. has been filed in the U. S. Land Office at Lakeview, Ore. The line is to be built from Fernley, Nev., to Klamath Falls, with a possible branch to Lakeview. After crossing the state line into Oregon at a point east of Tule lake, the line, as platted, skirts the shores of the lake to Merrill, after which it turns north and runs in almost a straight line to Klamath Falls. Rights of way for the railroad have been obtained nearly the entire distance of the road through Modoc county. It is thought that the work of construction will begin this spring, between Alturas and the point where the proposed road will intersect the branch that is surveyed from Klamath Falls to Anderson in the Sacramento Valley. The road will probably intersect the Fernley & Lassen railroad in Long Valley, Lassen county. The road will be built to a point on Pit river and form a junction with the proposed road running north from Klamath Falls near Lookout, in Modoc county.

Plans are under consideration for the construction of an electric railway between Middletown and Elizabethtown, and franchises will probably be asked shortly. Fred Alleman, Summit, N. J., is interested.

Negotiations are under way with the Williamsport Passenger Ry. Co., C. H. Davis. Manager, Williamsport, looking to the building of a ⅓ mile extension from Southern Ave., Williamsport, to a new amusement park which is to be established by Walter E. Ritter of Williamsport.

Citizens of Waynesburg, Pa., have subscribed $50,000 toward the proposed $100,000 bond issue to aid in building an electric line from Waynesburg to Blackville, in Monongalia county, W. Va., where connection will be made with a line being built from Mannington. At the latter place connection is made with existing trolley lines to Fairmont and Clarksburg. In addition another line is being built from Morgantown to Blackville.

The Ephrata & Lebanon Ry. Co. has decided to have construction work strated this month on its proposed trolley road from Ephrata to Lebanon. The line will be 23 miles long, connecting the points named and passing through Clay, Hopeland, Klinefeltersville, Schaefferstown and Reistville. All the rights of way have been secured, most given free. The road and equipment will cost $425,000, all of which has been already subscribed.

A charter will be applied for this month for a company which proposes a network of trolley lines connecting a number of towns with the larger cities in Central Pennsylvania. John G. Johnson, of Philadelphia, and J. Fred Shaffer, of Sunbury, are acting as solicitors for the merger planned, connecting Sunbury and Selinsgrove by trolley throughout the territory embraced by the counties of Northumberland, Union, Snyder, Montour, Columbia, Lycoming, Luzerne and Schuylkill. A line to Philadelphia by the way of Pottsville, through Schuylkill county, is included in the plans.

The Board of Trade of Mt. Pleasant, Pa., and the Retail Merchants' Association of Southwestern Pennsylvania have asked the Pennsylvania R. R. to extend its line from Pecla, Pa., to Mt. Pleasant.

The Pittsburg & Lake Erie R. R. has been making extensive purchases of farm land along the Mahoning River between Mahoningtown and Covert's Station, and is understood to be planning to make extensive improvements between those two points within the next two years.

The Lock Haven & Jersey Shore R. R. has completed surveys for its projected 14 mile line through Lockport, Chathams Run and [illegible] construction has been secured and it is expected to let construction contracts in the next 30 days. L. M. Patterson, Lock Haven, Pa., is President.

The Eastern Pennsylvania Rys. Co., Pottsville, Pa., is planning to have work started shortly on an 18-mile branch to be built from Pottsville to Frackville at Shenandoah.

Rhode Island.

A bill is now before the Rhode Island legislature to amend the charter of the Southern New England Ry. Co. (Grand Trunk), so that the Grand Trunk can secure an entrance to tidewater in Providence by crossing the tracks of the New York, New Haven & Hartford Ry. at both Harbor junction and Allens. [illegible] that it is absolutely impossible to reach tidewater at the desired point without crossing at grade, owing to the proximity of those points to tidewater, thus making it impossible to cross either over or under. As these are the only grade crossings asked for it is inferred that the line will be constructed from Woonsocket to tidewater without grade crossings except those asked for by the amendment. The charter granted contained the somewhat difficult requirements that the road must pass through the city of Pawtucket and could have the right of entrance to the Union station in Providence only on tracks entering from the south. From the requests made by the Grand Trunk of the general assembly for rights in North Providence and also across Woonasquatucket reser[illegible] route is given. It is apparent that the engineers have decided on a location skirting the western confines of the city, possibly on the North Providence side of the line. Evidently the road will cross over the Pascoag branch of the New Haven road at Olneyville. Grade crossings with highways and other railroads have been entirely avoided in locating from the northern state boundary in Woonsocket to the water front in the southern part of Providence.

South Carolina.

•Subcontracts for work on the first section of the Piedmont & Northern Traction Co.'s line from Greenwood to Greenville have been let as follows: W. L. Marshall & Co., Knoxville, Tenn., for grading the first four miles out of Greenwood; McCormick & Co., Evansville, Ind., for grading the next five miles. Other subcontracts on this work are as follows: J. L. Hunticutt, Chattanooga, Tenn., for grading the first five miles out of Greenville; Kline & Co., Charlotte, N. C., for all the wooden trestle work on the 90 miles of line between Greenwood and Greenville; Huett & Co., Marion, N. C., for the concrete work between Piedmont and Williamston.

South Dakota.

[illegible] Bridgewater, Dalton and Marion Junction and this has given rise to a report that the Chi[illegible]gin operating on what is known as the [illegible]arion cutoff," between Marion and Sioux Falls, a distance of 33 miles, and thus connecting with the Running Water branch, making a direct line between the latter place and Sioux Falls.

[illegible] ported to have grading work underway be[illegible] its line to the latter place. It is understood [illegible]t the grading work to Winner will be com[illegible]

Tennessee.

•Dunavant & Co., Knoxville, Tenn., have [illegible] double track work for the Nashville, Chattanooga & St. Louis Ry., as noted in our last issue. The work is located between Chattanooga and Wahatchie. T. J. Dailey & Co., have taken a sub-contract on the work.

The County Court at Memphis granted [illegible] of its Bellevue freight yards, to the southeast of the city. Nothing now remains to impede the progress of completing the erection of the proprosed new freight terminal. Through the contract accepted by the county, the Frisco is to erect a viaduct at Otey Ave. and its crossing. The county agrees to close certain roads and to grant the company the right to lay its tracks.

The Southern Ry., J. B. Akers, Assistant Engineer, Knoxville, is reported to be planning to extend a spur track at Knoxville, 2½ miles to the granite quarries.

Bids were opened April 11 at the offices of the Jackson Construction Co., Jackson, Tenn., for the construction of 48 miles of railroads for the Birmingham & Nothwestern Ry. Co., from Jackson, Tenn., to Dyersburg, Tenn. The work includes 400,000 cu. yds. of earthwork 85 acres of clearing, 2,700 lin. ft. 24-in. pipe and about 3,000 lin. ft. trestle. R. M. Hall, Jackson, Tenn., is President, and Mike Harvey, Jackson, Tenn., is Chief Engineer.

Meeting was recently held at the Board of Trade at Nashville in the interest of the proposed Hermitage interurban project. S. A. Craig, Nashville, is Secretary of the committee.

Officials of the Tennesse & North Carolina R. R. now operating 21 miles of line from Newport, Tenn., will shortly go over the route of the projected 35 mile extension to Canton, N. C. J. B. Hart, Clarksburg, W. Va., is president.

The Elizabethton, Milligan & Johnson City Electric R. R. Co., of Carter county, has been chartered with a capital stock of $25,000 and proposes to build a line from Johnson City to Milligan College in Carter county, and from that point via Oak Grove to Elizabethton.

Texas.

The San Leon Terminal R. R. Co. according to advices from Houston, has taken bids for grading its 3½ miles of standard gage line from the bay front at San Leon, connecting with the Southern Pacific at San Leon station. Sixty-lb. steel is to be used and the roadbed is to be of shell. Gasoline motor cars with a seating capacity of thirty-five and regular compartments for baggage and express will constitute the rolling stock of the new line. Later in the year it is contemplated to extend the San Leon line a distance of 4½ miles to Dickinson, and to connect with the Houston-Galveston interurban. It is also planned to electrify the road during the early part of 1912.

Commercial Club of Belton, Tex., has taken up the matter of building an interurban line between that city and Holland. Steps will be taken immediately to co-operate with Holland interests in having the route surveyed.

Citizens of Hearne, Texas, are very enthusiastic over the reports stating that the Hearne & Brazos Valley R. R. extension to Giddings will soon be built. Surveys, it is said, have been nearly completed for the work.

Steps are being taken toward obtaining permission to issue bonds, by L. I. Featherstone, of the Port Bolivar & Iron Ore R. R. projecting a line from Longview, Texas, into Cass county. Over one-half of the 50 miles of track have been laid and the funds will be used to proceed with the work.

Citizens of Aransas Pass, Texas, at a recent meeting at the Commercial Club subscribed one-half the necessary bonus of $50,000 for the construction of the proposed rail[illegible] point on the Rio Grande River. The contracts were signed, and the promoters agree to start the work of grading within 30 days. Construction is to begin within 60 days and the road is to be completed to a connection with the Brownsville road within six months.

Citizens of San Antonio, Texas, according to reports, have subscribed $500,000 necessary for the construction of the proposed line [illegible] The project was mentioned in our March 15 issue.

The Houston B[illegible] Terminal Ry. Co. has filed with the R[illegible] Commission, Austin, Texas, an appl[illegible] and register $2,697,146 additional bonds upon the new terminal stations, trackage, franchise and improvements in Houston, Texas. The commission has already allowed the road to issue $2,246,000 of bonds. Fred L. Lapierre is Resident Engineer of the company and M. Eckert is Auditor.

L. E. Walker, President and promoter of the Quanah, Dublin, Seymour and Rockport Ry., from Quanah, Texas, to the gulf, with a corps of surveyors and railroad engineers has completed the survey on the road from Jarrell to Georgetown. The survey to Jarrell from Belton was completed about ten days ago. Georgetown has accepted the proposition of Colonel Walker and his associates and if the road is built will be on the line.

The state attorney general has approved an amendment to the charter of the Texas Central Ry. for an extension of about 100 miles from De Leon, in Comanche county, through Callahan, Taylor and Nolan counties to Nolan. The line is now in operation from De Leon to Cross Plains and it is proposed to go through Pioneer, Sipe Springs and other points. C. Hamilton, Waco, Tex., is general manager.

The Morey-Faulhauber Construction Co., St. Louis, Mo., has completed the grading work on the San Saba extension. It is understood that the construction company will pasture its mules near Lometa for a while.

The Oklahoma Central Ry., Dorset Carter, President, Purcell, Okla., is said to be planning to construct an extension to Paris, Tex.

The Southern Traction Co., recently organized with headquarters at Dallas, has awarded the contract for the engineering work for its proposed line to the Fred A. Jones Engineering Co., Dallas, Tex. The company proposes a line to run from Dallas to Waco and a branch from Waxahachie to Corsicana via Ennis. The main line will be a little more than 100 miles long and the branch more than 30 miles long. J. F. Strickland of Dallas is president of the new company. Mr. Strickland is also president of the Texas Traction Co., which owns the interurban electric light running between Dallas and Sherman.

The company owning and operating the interurban electric railway between Temple and Belton, Tex., has been reorganized under the name of the Southwestern Traction Co., and has filed its charter. The new company has a capital stock of $165,000. Its incorporators are A. F. Bentley, P. L. Downs, W. M. McGregor, W. G. Haag, and W. G. Bentley. In addition to its interurban line the company owns local systems of street railway in the two terminal towns.

City council of Matamoros, Mexico, has approved the application of A. B. Cole, Brownsville, Tex., for a concession for a street car line in that city. The concession will give extensive rights as to all of the streets of the city for 30 years and the road will be free from taxes for that period. Electric or gasoline motive power is to be used. R. B. Renfro and R. C. Cowen of Brownsville and Procopio Guerra of Matamoros will be interested with Mr. Cole.

The Trinity Valley Traction Co., organized some ten years ago for the purpose of building an electric railroad from Dallas to Palestine, passing through Waxahachie, Corsicana and Ennis, has made two surveys and is now securing the right of way with a view to starting construction work in the near future. As projected the line will be 118 miles long. J. V. Watkins, Houston, is president.

Utah.

Citizens of Centerville and Bountiful have held a mass meeting at Bountiful, at which initial action was taken in a combined effort to secure the extension of the street car lines of the Utah Light & Railway Co., from Salt Lake to Bountiful and Centerville.

It is reported at Salt Lake City, Utah, that the Oregon Short line is to shortly let contracts for double tracking the road between Farmington and Ogden, Utah. The work will cost over $800,000 and will require the employment of several hundred men during the spring and summer months. This piece of [illegible] the entire system. This is due chiefly to the [illegible] Salt Lake City, Utah, is Chief Engineer.

The [illegible] & [illegible] R. R. [illegible] Salt Lake route to Kanarraville, Iron county, Utah. The survey for the road was com- [illegible] It is expected that the [illegible] will be passed on favorably [illegible] the distance of the [illegible] proposed line, it being the intention of the company to build through to St. George in Washington county and then on to Searchlight, Nev., to connect with the Santa Fe. Another line for which the survey is com- [illegible] from Marysvale, the end of the Sanpete valley branch of the Denver & Rio Grande, to the Grand Canyon, tapping the [illegible] forest in southeastern Utah and northeastern Arizona.

The Board of County Commissioners at Salt Lake City has granted the Utah Light & Ry. Co., Joseph S. Wells, general manager, Salt Lake City, a franchise permitting the construction and operation of what is called the "Halliday extension" of the Sugar House line and the extension of the West Temple St. line from Tenth to Twelfth South.

It is expected that work will be started this spring on a railroad to be built from Sandy up into Little Cottonwood canyon for the purpose of conveying the ore from Alta down to the valley. W. W. Wilson, Sandy, is interested.

The Eastern Utah Ry. Co., Henry Wade, president, Price, Utah, is reported to have closed a contract with eastern contractors for the completion of 90 miles of road bed. The Eastern Utah line will branch off from the main line of the Denver & Rio Grande Ry. at Wellington, in Carbon county, and will run [illegible] in a southwesterly direction. For 50 miles the new road will follow the old survey of the Salina cutoff, which was made 20 years ago, when the Denver & Rio Grande and the Utah Central railroad were competing for southern Utah territory. Twenty miles of the route has already been graded and will require but little work to place it in shape for the installation of steel.

The Milwaukee-Northern Ry. Co. (electric), Milwaukee, Wis., is to lay a second track this year for much of the distance between Milwaukee and Thiensville. It is also stated that the company will begin grading next fall for an extension from Sheboygan to West Bend. The work will not be finished until next year.

Vermont.

The Grand Trunk Ry. has asked bids for the first section of its new line from Windsor, Vt., to Bellows Falls, Vt. This section will be [illegible] miles long and will extend from the Central Vermont tracks at Windsor to the Rutland R. R. yard at Bellows Falls. The second section will extend from Bellows Falls at Brattleboro, a distance of 26 miles. Both sections will be built on the Vermont side of the Connecticut River. Construction headquarters will probably be at Bellows Falls, [illegible]

Virginia.

The [illegible] & Danville R. R. [illegible] The principal [illegible] Danville and the proposed road is to [illegible] the state, starting [illegible] Pittsylvania county and connecting with a line to be built in North Carolina. The officers are Gilbert C. White, C. E., president; [illegible] secretary and treasurer; W. [illegible] G. C. White, W. B. Guthrie, [illegible] and [illegible] Wily, all of Durham, N. C. [illegible] directors [illegible] W. R. Harris, of Danville, Va.

Steps are being taken for the construction of a railroad from Hampton Roads, Va., York[town] to Fredericksburg. The road will probably be known as the Washington & Norfolk Ry. The line has already been surveyed from Newport News to Yorktown and satisfactory grade found. The means have been provided for extending the survey from Gloucester Point to Fredericksburg, a distance of about 70 miles, and work will soon begin. Estimates have been asked for for a bridge across the York river at Yorktown, the distance across being about 2,800 ft. The counties of York and Gloucester will be asked to aid in the construction of this bridge, so as to make it a public highway as well as a railroad bridge. This road was originally projected to run from Newport News to Yorktown and a charter was taken out a year or so ago. W. J. Burlee, Gloucester, Va., is President.

Washington.

The contract for 30,000 ties for use on the new Springdale & Long Lake Railroad Co., the proposed 22 mile railroad to be built by the Washington Water Power Co., as mentioned in our last issue, to haul in material to the new power site, has been awarded to the Phoenix Mill Co. The final survey of the road, which is estimated to cost $175,000, has just been completed. D. L. Huntington, Spokane, Wash., is President.

It is reported in Bellingham, Wash., that the Chicago, Milwaukee & Puget Sound R. R. is planning to enter that city by the Samish Lake Route and that work will be started shortly.

Clearing work has been started for the proposed line of the Chehalis & Cowlitz R. R. A camp has been established two miles north of Chehalis and grading equipment has been received. The construction work is in charge of George A. Robinson of Chehalis, one of the incorporators of the company.

West Virginia.

The Chesapeake & Ohio R. R., H. Frazer, Chief Engineer of Construction, Richmond, Va., will, it is understood, shortly take up the work of extending the Cabin Creek branch to connect with the Coal River branch. This would require the construction of about 11 miles of new line. It is also understood that the Cabin Creek branch will be practically rebuilt.

Wisconsin.

A gang of Wisconsin Northern Ry. Co. engineers are laying out a line from Appleton, Wis., to Shawano and have reached Kaukauna. This line was projected several years ago and surveying done on it at several times although no decision as to the exact route has ever been made, or at least has never been given to the public. The intimation has been given out in the past, however, that it was the intention to go to the west of Green Bay.

The Badger Railway & Light Co., of Milwaukee, organized to build an interurban road connecting Whitewater, Elkhorn and Lake Geneva, has filed an amendment increasing its capital stock from $10,000 to $400,000. H. B. Kemnelaufe is president, and Gustav [illegible]hardt, secretary of the company.

Canada.

⊙Advices from Ottawa, Ont., state that the contract for the construction of the new Quebec & Saguenay Ry. has been let to M. J. O'Brien, Ottawa, Ont., and the work will be rushed through to completion. The road will run from St. Joachim, Que., to Murray Bay, which is about 70 miles below Quebec. The line will be about 40 miles long.

⊙The contract for the construction of substructure of bridges and culverts on the Manitoba Division of the Canadian Pacific Ry. has been awarded to G. H. Archibald Co., 803 Union Bank Bldg., Winnipeg. The contract for constructing the subway at Main St., Kenora, was let to C. G. Anderson Co., 439 Agnes St., Winnipeg. Bids were opened March 27 by Frank Lee, Division Engineer, Winnipeg, Man.

⊙The following contracts were awarded at Calgary for improvements to Alberta Division of the Canadian Pacific: Red Deer roundhouse, Dominion Equipment & Supply Co., Winnipeg; five standard No. 5 stations at Tompkins, Suffield, Burdett, Bow Island and Redcliffe, J. L. Lussier, Medicine Hat; six stall engine house addition at Red Deer, Carter Hall's Aldinger Co., Winnipeg; No. 1 bunkhouse, Red Deer and Calgary, G. M. Eaton, Strathcona; extension to Medicine Hat depot, brick and stone, G. L. Lussier, Medicine Hat.

A. and W. D. Wheaton have moved their outfit from Amherst, N. S., to Smith Falls, Ont., to do some double track work at the latter place.

The New Brunswick government has introduced in the House of Assembly legislation to provide for the extension of the New Brunswick Coal & R. R. line from Minto to Fredericton, a distance of 31 miles. The line now runs from Norton to Minto, tapping the coal fields of Queens county. The legislation will provide a bond guarantee of $15,000 a mile, and stipulate that any company contracting to build the extension must lease the present line, purchase at least 10,000 tons of coal a year and enter into a contract with the Canadian Pacific railroad or other company under which the latter will take over the line on a 98-year lease and equip, maintain and operate it, paying the province 40 per cent of the gross earnings. P. S. Archibald, Moncton, N. B., is commissioner for the government in charge of the New Brunswick Coal & R. R.

The Canadian Pacific Ry. is preparing, it is said, to construct its line from the present terminus at the north end of London, Ont., into the heart of the city.

The following is an outline of the work which the Grand Trunk Pacific Ry. expects to do the present season:

GRADING

	Miles
Main Line.	
Prairie Creek to Tete Jaune Cache	111
Copper River to Aldermere	140
Branches.	
Calgary branch (to complete)	117
Battleford branch (to complete)	28
Regina branch (to complete)	30
Regina Boundary branch (to complete present contract)	40
Regina-Moose Jaw branch (to complete)	35
Prince Albert branch (to complete)	59
Alberta Coal branch (to complete)	48
New branch off same (new contract)	25
Biggar-Calgary branch (new contract)	50
Total	683

TRACKLAYING.

	Miles
Main Line.	
Prairie Creek to Tete Jaune Cache	111
Copper River to Aldermere	140
Calgary branch	117

In addition it is the intention of the company to erect 140 station buildings this season. B. B. Kelliher, Winnipeg, Man., is Chief Engineer. Contracts for most of the above work have been awarded. Noted previously in these columns.

It is stated that the contractors for the recently chartered Niagara, Welland & Lake Erie Ry., are planning to start work between Welland and Niagara Falls. From Welland the work will be pushed on to Port Colborne and thence back to Fort Erie. The division between Port Colborne and Port Dover, the Lake Erie terminal of the line will be taken up when the work [illegible] divisions is well under way.

A bridge gang [illegible] has arrived at Pelly, Sask., to [illegible] operation on the Thunderhill exten[illegible] Canadian Northern Ry. west of [illegible]

The Grand Trunk Ry. has placed two steam shovels at work on its $2,000,000 improvements in the west end of Toronto extending to Mimico. Plans for the proposed subways at Indian road and Howard Avenue have been submitted to the City Engineer and are awaiting the approval of the city before commencing their construction. These are to be of solid concrete and have ornamental parapet fences. The structures are designed to present a handsome appearance. One of the steam shovels is working at the Exhibition grounds and the other resumed operations at Dowling Ave., where it ceased work last autumn. Four tracks will be laid from Bathurst street to Mimico, instead of the two tracks formerly in use. A cut which will be 30 feet deep at Dufferin St. will be made in front of the Exhibition grounds and the tracks depressed. A retaining wall will be constructed between the tracks and Dufferin Park. The city will leave the tracks at the park at the present level. Workmen have started to remove the old buildings along the northern wall of the Fair grounds and will place at this point additional tracks in accordance with the plans approved by the Railway Commission. The Grand Trunk will start the depression of its tracks at the Canadian Pacific Ry. diamond crossing on the eastern limit of the Exhibition grounds, and these will not come up till Sunnyside is reached. At that point the viaduct will be begun. The company will have a grade of four-tenths of one per cent from Bathurst Street to Mimico. The revised plans for the bridge over the Humber River provide for two abutments from a central pier, each 100 feet long. Beneath are no impediments and the structure will be 18 feet above the water. It will have a modern solid ballast floor, so that no water can drop through. The width is to be 55 ft. The cost will [illegible] The bridge over the Mimico River will consist of one span about 100 feet in length. It will be of the same style as the Humber River bridge, except that it will have open flooring. In all subways will be erected over fourteen crossings, and four overhead bridges will be constructed. The bridges are to be at Dufferin Street and Dunn, Jameson and Dowling Aves.

The Canadian Northern Ry. has filed its route map with the Board of Control of Toronto showing how its line will run from Bronte to the eastern limit of Wentworth county. According to the map the line will parallel the Grand Trunk line and run south of it till it reaches a point east of the centre of the city. There it will cross to the north of the Grand Trunk right-of-way and parallel it out of the city.

City Council of Toronto has instructed C. H. Rust, City Engineer, to prepare plans for a subway on Yonge St. from the Union Station to St. Clair Ave.

The Winnipeg Electric Ry. Co., Winnipeg, Man., is planning to extend its line to Sanford, 23 miles southwest of Winnipeg.

An engineering [illegible] been engaged in the surveys for the Hudson Bay R. R. reached Winnipeg last week. This party under the charge of F. P. Moffat left Winnipeg last May for Split Lake via Nelson river and Manitou rapids and commenced work at the portage between Landing lake and Winter Camp lake. About 20 miles from this point the lines part, one going to Churchill, the other going to Port Nelson. The party continued on the line of survey from this point toward Churchill [illegible] miles and spent Christmas at Split lake. On Dec. 26 the party with 15 dog teams commenced the journey south toward civilization again and during their trip to Thicket Portage they encountered the coldest weather ever experienced by any of the old timers of the party, the mercury staying at from 46 to 56 below zero for a period of three weeks. The line was then located south from this point for about 60 miles to Crooked River and the party left this place for Le Pas March 24 and arrived there March 31. From this place they caught the first glimpses of civilization after being away almost one year. The men enjoyed splendid health during the entire trip. About two weeks before Christmas the party came across the survivors of the ship Jeanie, which was wrecked in Hudson bay last fall and whose crew later arrived in Winnipeg. The winter was very mild and open with the exception of a very cold snap about the beginning of the year. One of the inconveniences which was experienced by the party was the incessant rainfall which commenced about the middle of June and continued until September. During the trip they never encountered any person except Hudson's Bay employees and Indians, the country not being settled by anyone excepting traders for this company and missionaries.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣Bids will be received until 8 p. m., April 19, by the city council, New Decatur, Ala., for the construction of certain cement sidewalks, provided for under improvement ordinances Nos. 222 and 223. John Patterson is Mayor and Henry Hartung is clerk.

Work advertised by G. R. Thomas, County Engineer, Selma, Ala., for the grading and [illegible] of 11¼ m[illegible] Dallas County, for which bids were received on April 3, will not be done by contract. It has been [illegible] to the [illegible] county convict force.

California.

The [illegible] senate [illegible] passed [illegible] for the location, survey and construction of a state highway, from the Calaveras big tree grove, located in Calaveras county, to Dorrington, Calaveras county, thence running easterly following what is known as the Big Tree and Carson Valley turnpike through Calaveras and Alpine counties, to Markleville, Alpine county.

Connecticut.

[illegible] of New Haven, Conn., has under consideration an act providing for [illegible] city streets.

District of Columbia.

✣[illegible] April 11, by Commissioners, District of Columbia, [illegible]

✣Bids will be received until 2 p. m., April 22, by Commissioners of District of Columbia, Washington, D. C., for making repairs to asphalt pavements for a period ending June [illegible]

Advices from Washington, D. C., are that 20 miles of the old Leesburg turnpike, forming the direct route between Washington and the Virginia [illegible] the Good Roads association of Fairfax county, Fairfax, Va., county seat.

Florida.

✣Bids will be received until 10 a. m., April 28, by Board of Duval County Commissioners, Jacksonville, Fla., for the resurfacing of St. Johns avenue from the city limits to McGirts Creek bridge with asphalt macadam. The work includes approximately 27,000 sq. yds. Gail L. Barnard, Jacksonville, Fla., is county engineer.

The city council of Jacksonville, Fla., has adopted a resolution providing for the grading and paving of the following streets. The board of public works will soon call for bids and award contracts for the work. Philip Preileau is city engineer: Davis st., from Adams st. to Ashley st.; Fifth st., from Main st. to Walnut st.; Market st., from the north side of Fourth st. to the south side of Eighth st.; Liberty st., from Forsyth st. to Union st.; Washington st. [illegible] st.; Monroe st. from Florida ave. to Georgia st.; Monroe st. from Washington st. to Catherine st.; Catherine st., from Forsyth st. to Duval st.; Davis st., from Bay st. to the Seaboard Air Line railway; Van Buren st., from Church st. to Adams st.; Spearing st., from Duval st. to Ashley st.; Ashley st., from Spearing st. to Florida ave.; Date st., from May st. to Oak st.; Riverside ave., from King st. to city limits; Highway ave., from Palm st. to city limits; State st., from Main st. to [illegible] from Main st. to Davis st.; Davis st. from [illegible] road to Eighth st.; Hubbard st., from Fourth st. [illegible] st. to Talleyrand ave.; Riverside ave., from Roselle st. to Margaret st.; Church st., from Bridge st. to Myrtle ave.; Bay st. from Ridge st. to Market st.; Monroe st., from Palmetto st. to Florida ave.; Market st., from Bay st. to Forsyth st.; North st., from [illegible] to Hogan st.; May st., from Date st. to Forest st.; Ashley st., additional sixteen feet in width from Bridge st. to Davis st.; Enterprise st., from Cleveland st. to Myrtle ave.; Church st., from Newnan st. to Washington st.; St. Johns place east and west from Duval st. to Church st.; Lee st., from Bay st. south to the north tracks of the Seaboard Air Line railway; Palm st., from Forest st. to Highway ave.; Georgia st., from Church st. to Beaver st.; Laura st., from Hogans creek to south side of Fourth st.; Adams st., from Florida ave. to east side of Georgia st.; Beaver st. and Corning st., from Davis st. to Cleveland st.; Union st. from Hogan st. to Cedar st.

Georgia.

The committee on public works of the county commissioners, Atlanta, Ga., has agreed to extend the roadway, which they are now building in the direction of East Point as far as the opposite limits of the town, for a distance of one and one-half miles.

The county commissioners, Macon, Ga., on April 4 decided to have a special bond issue election in the fall, when issues aggregating $525,000 will be submitted to the voters for approval. The money, if authorized, will be spent as follows: Bridges, $200,000; roads, $100,000; courthouse improvements, $100,000; jail, $25,000; boys' high school, $100,000.

The citizens of Americus, Ga., on April 4 voted the issuance of bonds to the amount of $105,000 for the improvements to the business streets, sewer system and water works.

Illinois.

✣Bids will be received until 8 p. m., April [illegible] Ill., for furnishing material and labor for the construction of vitrified brick pavement on concrete foundation. The approximate quantities of the work to be let under this contract are as follows: Brick pavement on 5-inch concrete foundation, complete with filler, 12,560 sq. yds.; excavation, 1,500 cu. yds.; concrete curb, 6 ins. thick and 30 ins. deep., 301 lin. ft.; concrete curb, 6 ins. thick and 2 ins. deep, 580 lin. ft.; old curbing refaced, 2,450 lin. ft. Plans, specifications and ordinance may be seen and examined and blank proposals obtained at the office of the Engineer, Hugh

M. Price, 1507 [illegible] Bldg., Chicago, Ill., or at the office of the President of the Board of Local Improvements in Harvard, Ill.

⦿The board of local improvements of Canton, Ill., has awarded Roller & Saville of that city the contract for the paving of five blocks around South park at $0.30 for excavating, $0.55 for curbing and $1.17 for paving. Bids were also received from Patrick H. Tierman of Macomb; E. R. Harding Co., Racine, Wis.; J. B. McCauley, Galesburg, Ill.; Brereton Cement Walk Co., Galesburg, Ill.; J. M. Heckard & Son, Canton, Ill.

⦿Bids were received April 6 by the board of local improvements, Chicago Ill., for paving work. The work includes the following general items, constructing concrete curbs, concrete sidewalks, granite or gravel concrete combined curb and gutters on a foundation of sand or cinders, furnishing and setting sandstone curbing on limestone blocks, furnishing and setting wooden curbing, spiked to cedar posts, earch excavation and filling, paving with repressed vitrified paving brick on a 6-in. Portland cement concrete foundation with a 2-in. sand cushion, joints filled with a coal tar filler, surface dressed with ½ in. of sand; paving with asphalt on a 6-in Portland cement concrete foundation, surface swept with natural cement; paving with macadam consisting of 8 ins. of blast furnace slag, 3 ins. of limestone and 3 ins. of granite bonded with ½ in. of gravel; constructing a pavement of No. 2 granite blocks on 6-in. Portland cement concrete foundation with a 2-in. sand cushion, the joints to be filled with coal tar and gravel, the surface dressed with ¾ ins. of gravel; adjusting manholes, catch basins and sewer connections; furnishing covers, gratings, etc. Contracts as follows were awarded:

Alley Jackson Blvd., Central Paving Co., 172 Washington St., Contractor:

1,400 lin. ft. wood curb at 18 cts.	$ 252.00
1,200 sq. yds. brick pavement at $2.47	2,964.00
Total	$ 3,216.00

Alley Adams St., Jno. A. McGury, 188 Madison St., Contractor:

1,000 lin. ft. wood curb at 25 cts.	$ 250.00
900 sq. yds. No. 2 granite block at $3.57.	3,213.00
1 new catch basin at $45	45.00
1 old catch basin at $20	20.00
1 old manhole at $5	5.00
2 new covers with iron lids at $10	20.00
10 lin. ft. 9-in. tile pipe at 75 cts.	7.50
1 cast iron grating at $10	10.00
Total	$ 3,570.50

Alley Ashland Ave., Central Paving Co., Contractor:

625 lin. ft. concrete curb at 18 cts.	$ 112.50
350 sq. yds. brick at $2.73	955.50
Total	$ 1,068.00

Alley Congress St.:

1,400 lin. ft. concrete curb at 18 cts.	$ 252.00
1,300 sq. yds. brick pavement at $2.59	3,367.00
Total	$ 3,619.00

Alley 18th St.:

700 lin. ft. concrete curb at 18 cts.	$ 126.00
200 cu. yds. earth cutting at 60 cts.	120.00
600 sq. yds. brick pavement at $2.43	[illegible]
Total	$ 1,704.00

Alley Jackson Blvd., Alexander Todd, 197 N. Hamlin Ave.:

900 lin. ft. concrete curb at 20 cts.	$ 180.00
700 sq. yds. brick pavement at $2.53	1,771.00
Total	[illegible]

Alley Fulton St.:

1,210 lin. ft. sandstone curb (4 in. x 24 in.) at 50 cts.	$ 605.00
[illegible] cu. yds. earth cutting at 25 cts.	[illegible]
1,030 sq. yds. brick pavement at $2.38	2,451.40
Total	[illegible]

Bauwans Ave., American Asphalt Paving Co., 138 Washington St

624 lin. ft. combination curb and gutter at 54 cts.	$ 336.96
1,110 sq. yds. asphalt pavement at $1.87	2,075.70
2 new catch basins at $45	90.00
1 old catch basin at $20	20.00
1 new cover with iron lid at $10	10.00
4 lin. ft. 9-in. tile pipe at 75 cts.	3.00
1 cast iron grating at $10	10.00
Total	[illegible]

California Ave., Citizens' Construction Co., 138 Washington St.:

4,390 lin. ft. sandstone curb (5 in. x 30 in.) at [illegible]	$ [illegible]
820 lin. ft. curbing to be reset at 40 cts.	328.00
60 lin. ft. curb wall repair at 20 cts.	12.00
[illegible]	[illegible]
[illegible] new catch basins at [illegible]	[illegible]
[illegible] old catch basins at [illegible]	[illegible]
[illegible]	10.00
[illegible]	[illegible]
[illegible]	15.00
15 cast iron gratings at $10	[illegible]
Total	[illegible]

Costello Ave., American Asphalt Paving Co.:

3,740 lin. ft. C. C. C. & G. at 61½ cts.	$ 2,300.10
2,500 cu. yds. rock cutting at 75 cts.	1,875.00
100 cu. yds. earth cutting at 25 cts.	25.00
[illegible] sq. ft. sidewalk at 20 cts.	72.00
[illegible] sq. yds. asphalt at $1.6[illegible]	9,606.60
10 new catch basins at $45	450.00
8 old catch basins at $20	160.00
15 old manholes at $5	75.00
2 new covers with iron lids at $10	20.00
10 lin. ft. 9-in. tile pipe at 75 cts.	7.50
[illegible] cast iron gratings at $10	40.00
Total	[illegible]

Congress St., Standard Paving Co., 1101 S. 48th Ave.:

4,000 C. C. C. & G. at 40 cts.	$ 1,600.00
6,000 sq. yds. concrete cutting at $5	3,000.00
200 sq. ft. sidewalk at 20 cts.	40.00
11,400 sq. yds. asphalt resurfacing at 99 cts.	11,286.00
2 new catch basins at $45	90.00
30 old catch basins at $20	600.00
30 old manholes at $5	150.00
10 new covers with iron lids at $10	100.00
50 lin. ft. 9-in. tile pipe at 75 cts.	37.50
10 gratings at $10	100.00
Total	$17,003.50

Cottage Grove Ave., Calumet Coal & Teaming Co., 2926 E. 95th St.:

5,600 lin. ft. C. C. C. & G. at 57 cts.	$ 3,192.00
4,000 cu. yds. earth cutting at 5 cts.	200.00
600 sq. ft. sidewalk at 15 cts.	90.00
9,540 sq. yds. brick pavement at $2.05	19,557.00
1 new catch basin at $45	45.00
26 old catch basins at $20	520.00
24 old manholes at $5	120.00
20 cast iron covers with lids at $10	200.00
400 lin. ft. 9-in. tile pipe at 75 cts.	[illegible]
26 cast iron gratings at $10	260.00
Total	[illegible]

Drexel Ave., R. F. Conway Co., 138 Washington St.:

2,420 lin. ft. C. C. C. & G. at 53 cts	$ 1,282.60
100 sq. ft. sidewalk at 20 cts.	[illegible]
3,090 sq. yds. asphalt at $1.77	5,469.30
4 new catch basins at $45	180.00
10 old catch basins at $20	200.00
10 old manholes at $5	50.00
6 new covers with iron lids at $10.	60.00
100 lin. ft. 9-in. tile pipe at 75 cts.	75.00
10 cast iron gratings at $10	100.00
Total	[illegible]

Ewing Ave., Calumet Coal & Teaming Co.:

1,260 lin. ft. sandstone curb (5 in. x 30 in.) at 70 cts.	$ 882.00
3,000 cu. yds. earth filling at 50 cts.	1,500.00
1,820 sq. yds. macadam at $1.01	1,838.20
1 new catch basin at $45	45.00
6 old catch basins at $20	120.00
1 old manhole at $5	5.00
6 new covers with iron lids at $10	60.00
60 lin. ft. 9-in. tile pipe at 75 cts.	45.00
6 cast iron gratings at $10	60.00
Total	$ 4,555.20

Fullerton Ave., American Asphalt Paving Co.:

2,880 lin. ft. sandstone curb (5 in. x 30 in.) at 70 cts.	$ 2,016.00
580 lin. ft. curb to recut and reset at 20 cts.	116.00
8,630 sq. yds. creosoted block pavement at $2.92	[illegible]
10 new catch basins at $45	450.00
13 old catch basins at $20	[illegible]
1 old manhole at $5	5.00
2 new covers with iron lids at $10	20.00
10 lin. ft. 9-in. tile pipe at 75 cts.	7.50
2 cast iron gratings at $10	20.00
Total	$28,094.10

Greenwood Ave., R. F. Conway Co.

4,980 lin. ft. C. C. C. & G. at 53 cts.	$ 2,639.40
200 sq. ft. sidewalk at 20 cts.	40.00
7,540 sq. yds. asphalt at $1.75	13,195.00
1 new catch basin at $45	[illegible]
18 old catch basins at $20	360.00
21 old manholes at $5	[illegible]
30 new covers with iron lids at $10	300.00
320 lin. ft. 9-in. tile pipe at 75 cts.	[illegible]
14 gratings at $10	140.00
Total	[illegible]

Haddon Ave., R. F. Conway Co.:

2,610 lin. ft. C. C. C. & G. at 60 cts.	$ 1,566.00
60 sq. ft. sidewalk at 20 cts.	12.00
3,970 sq. yds. asphalt at $1.65	[illegible]
4 new catch basins at $45	[illegible]
8 old catch basins at $20	[illegible]
9 old manholes at $5	[illegible]
12 new covers with iron lids at $10	120.00
10 lin. ft. 9-in. tile pipe at 75 cts.	7.50
8 cast iron gratings at $10	[illegible]
Total	[illegible]

Indiana Ave., Farr Bros.:

1,390 lin. ft. sandstone (5 in. x 30 in.) at [illegible] cts.	[illegible]
1,000 cu. yds. earth cutting at 25 cts.	250.00
2,420 sq. yds. macadam at $1	2,420.00
[illegible] new catch basins at $45	[illegible]
8 old catch basins at $20	160.00
5 old manholes at $5	25.00
4 new covers with iron lids at $10	40.00
100 lin. ft. 9-in. tile pipe at 75 cts.	75.00
8 cast iron gratings at $10	80.00
Total	$ 4,01[illegible]

Jackson Ave., R. F. Conway Co.:

2,420 lin. ft. C. C. C. & G. at 60 cts.	$ 1,452.00
100 sq. ft. sidewalk at 20 cts.	20.00
3,630 sq. yds. asphalt at $1.75	6,352.50
1 new catch basin at $45	45.00
16 old catch basins at $20	320.00
10 old manholes at $5	50.00
6 new covers with iron lids at $10	60.00
100 lin. ft. 9-in. tile pipe at 75 cts.	75.00
16 cast iron gratings at $10	160.00
Total	$ 8,534.50

Lake Ave., Parker Washington Co., 138 Washington St.:

16,600 C. C. C. & G. at 53 cts.	$ 8,798.00
150 lin. ft. concrete gutter at 25 cts.	37 50
1,000 sq. ft. concrete sidewalk at 18 cts.	180.00
34,410 sq. yds. creosoted wood block at [illegible]	[illegible]
20 new catch basins at $45	900.00
65 old catch basins at $20	1,300.00
57 old manholes at $5	285.00
20 new covers with iron lids at $10	200.00
600 lin. ft. 9-in. tile pipe at 75 cts.	450.00
20 cast iron gratings at $10	200.00
Total	$101,107.20

Lawndale Ave., American Asphalt Paving Co.:

6,460 lin. ft. C. C. C. & G. at 61.5 cts.	$ 3,972.90
2,950 cu. yds. earth cutting at 40 cts.	1,180.00
500 sq. ft. sidewalk at 20 cts.	100.00
9,980 sq. yds. asphalt at $1.65	16,467.00
16 new catch basins at $45.	720.00
16 old catch basins at $20	220.00
25 old manholes at $5	125.00
2 new covers with iron lids at $10.	20.00
40 lin. ft. 9-in. tile pipe at 75 cts.	30.00
16 cast iron gratings at $10	160.00
Total	$23,094.90

Lincoln St., R. F. Conway Co.:

2,420 lin. ft. C. C. C. & G. at 60 cts.	$ 1,452.00
150 lin. ft. concrete gutter at 40 cts.	60.00
150 lin. ft. curb wall repairs at 20 cts.	30.00
5,155 sq. yds. asphalt pavement at $1.62.	8,351.10
4 new catch basins at $45	180.00
10 old catch basins at $20	200.00
9 old manholes at $5	45.00
6 new covers with iron lids at $10	60.00
8 lin. ft. 9-in. tile pipe at 75 cts.	6.00
10 cast iron gratings at $10	100.00
Total	$10,484.10

Superior St., R. F. Conway Co.:

1,380 lin. ft. C. C. C. & G. at 60 cts.	$ 828.00
100 sq. ft. sidewalk at 20 cts.	20.00
2,250 sq. yds. asphalt at $1.02	2,295.00
4 new catch basins at $45	180.00
3 old catch basins at $20	60.00
5 old manholes at $5	25.00
1 new cover with iron lid at $10	10.00
40 lin. ft. 9-in. tile pipe at 75 cts.	30.00
1 cast iron grating at $10	10.00
Total	$ 3,458.00

33rd Pl., R. F. Conway Co.:

2,540 lin. ft. C. C. C. & G. at 60 cts.	$ 1,524.00
200 sq. ft. sidewalk at 20 cts.	40.00
3,850 sq. yds. asphalt at $1.69	6,506.50
10 old catch basins at $20	200.00
8 old manholes at $5	40.00
18 new covers with iron lids at $10	180.00
200 lin. ft. 9-in. tile pipe at 75 cts.	150.00
10 cast iron gratings at $10	100.00
Total	$ 8,740.50

Wabash Ave., American Asphalt Paving Co.:

9,880 lin. ft. C. C. C. & G. at 59.5 cts.	$ 5,[illegible]
500 sq. ft. sidewalk at 20 cts.	100.00
17,470 sq. yds. asphalt at $1.63	28,476.10
16 new catch basins at $45	720.00
32 old catch basins at $20	640.00
44 old manholes at $5	220.00
10 new covers with iron lids at $10	100.00
600 lin. ft. 9-in. tile pipe at 75 cts.	450.00
32 cast iron gratings at $10	320.00
Total	$3[illegible] 904.70

West End Ave., Standard Paving Co.:

2,825 lin. ft. C. C. C. & G. (gravel) at 50 cts.	$ 1,412.50
3,500 cu. yds. earth cutting at 20 cts.	700.00
60 sq. ft. sidewalk at 20 cts.	12.00
5,700 sq. yds. asphalt at $1.68	9,576.00
8 new catch basins at $45	360.00
10 old catch basins at $20	200.00
1 old manhole at $5	5.00
1 new cover with iron lid at $10	10.00
80 lin. ft. 9-in. tile pipe at 75 cts.	60.00
6 cast iron gratings at $10	60.00
Total	[illegible]

Whipple St., Jas. A. Sackley Co.:

3,850 lin. ft. sandstone curb (5 in. x 30 in.) at 70 cts.	$ 2,695.00
800 cu. yds. earth cutting at 10 cts.	80.00
100 sq. yds. sidewalk at [illegible] cts.	[illegible]
6,780 sq. yds. macadam at $1.21	8,203.80
4 new catch basins at $45	180.00
18 old catch basins at $20	360.00
14 old manholes at $[illegible]	[illegible]
1 new cover with iron lid at $10	10.00
100 lin. ft. 9-in. tile pipe at 75 cts.	75.00
18 cast iron gratings at $1[illegible]	[illegible]
Total	[illegible]

60th St. System, R. F. Conway:

11,680 lin. ft. C. C. C. & G. at 60 cts.	$ [illegible]
4,800 cu. yds. earth filling at 20 cts.	[illegible]
600 sq. ft. sidewalk at 20 cts.	[illegible]
17,350 sq. yds. asphalt at $1.67	28,974.50
[illegible] new catch basins at $45	[illegible]
[illegible] old catch basins at $20	840.00
[illegible] old manholes at $5	195.00

30 new covers with [illegible] at $10	300.00
800 lin. ft. [illegible]-in. tile p[illegible]	600.00
40 cast iron gratings [illegible]	400.00
Total	$39,487.50

System, 108th St., [illegible] St., Michigan Ave. to Wentworth Ave., Farr Bros.

5,120 lin. ft. sandstone [illegible] x 30 in.) at 60 cts	$ 3,072.00
2,500 cu. yds. earth cutting at 20 cts....	500.00
7,600 sq. yds. [illegible]	8,664.00
1 new catch basin at [illegible]	45.00
20 old catch basins at $20	400.00
18 old manholes at $5	90.00
5 new covers with iron [illegible]	60.00
200 lin. ft. 9-in. tile pipe at 75 cts	150.00
20 cast iron gratings at $10	200.00
Total	$13,181.00

Notes. C. C. C. & G., concrete combined [illegible] ned. [illegible] adjustment of same.

The state senate, Sp[illegible] passed a bill introduced by Senator F. A. Landee, [illegible] county of the state, under whose direction all of the [illegible]

An election was held in Saline county, Harrisburg, Ill., on April 4, for the purpose of voting on the proposition [illegible] bonds to the amount of $35,000 for the building of gravel, rock, macadam or other hard roads. R. N. [illegible] Harrisburg [illegible] supervisor.

Indiana.

✣Bids will be received [illegible] May 1, by Board of County Commisisoners, Williamsport, Ind., for the construction of a gravel road in Kent township. David H. M[illegible] is auditor of W[illegible]

✣Bids will be received until 7 p. m., April 17, by common council, Princeton, Ind., for the construction and repair of all sidewalks in the corporate limits between May 1 and November 1, 1911. William R. Lamb is city clerk.

⊙The Board of County Commissioners at Bloomfield, Ind., on April 4 received bids for the construction of two macadam roads in Stockton township and awarded the contract to Gageby & Couningham of Linton, Ind.

⊙W. F. Smith & Co., Rensselaer, Ind., at $5,753, and L. T. Kent, Brookston, Ind., at $6,309, received the contracts for the construction of the Hewitt and Jacks roads for which bids were opened by the Board of County Commissioners, Monticello, Ind., on April 4. A. G. Fisher is County Auditor.

⊙Samuel B. Smallwood, Ewing, Ind., has been awarded the contract by the county commissioners at Brownstown, Ind., for the construction of gravel road in Owen township for $3,099. Bids were opened April 4.

⊙John F. Gubbin, Muncie, Ind., at $31,862, has been awarded the contract by the board of county commissioners, Muncie, for the construction of a highway in Center township. The highway will be paved with India brick. Bids were opened April 5 by Francis M. Williams, County Auditor.

⊙Kilty & Heck, North Main St., Chester, Ind., received the contract for the construction of a gravel road in Chester township, Wabash County, Ind. J. P. N[illegible]ftzger, Wabash, is County Auditor.

⊙The board of county commissioners at Logansport, Ind., received bids April 4 for the construction of three roads in Eel township and awarded the contracts to the following: Beal & Bell, Logansport, $1,666; Frank Justice, Logansport, $2,11[illegible] and Fred Grover, Lo[illegible]

⊙Eli Engle & Son of Monroe, Ind., have been awarded the contract by the county commissioners at Decatur, Ind., for the construction of two macadam roads in Wabash township for $6,198 and $[illegible]. Bids were opened April 4.

⊙D. E. Everhart, Sullivan, Ind., at $9,464, Keegan Bros., Brazil, Ind., at $8,465, and Gageby & Cunningham of Linton, Ind., at $3,425, received the contracts from the county commissioners, Sullivan, Ind., for constructing rock roads in Cass township and Hamilton township. Bids were opened April 4.

No bids were received on April 4 by Alvin B. Ham, County Auditor, Paoli, Ind., for the construction of a gravel road in French Lick Township.

All bids were rejected by the commissioners of Lawrence County, Bedford, Ind., on April 4, for the construction of two gravel roads. Ezra W. Edwards, County Auditor.

The county commissioners, Huntington, Ind., have been petitioned for the improvement of a road extending five miles on the county line. The proposed road would run along the eastern three miles of the line between Clear Creek township in Huntington county and Jefferson township in Whitley county. The remaining two miles are to be on the western end of the line between Jackson township in Huntington county and Washington township in Whitley county.

The board of public works of Evansville, Ind., has ordered the paving of Blackford ave., between Garvin and Kentucky aves. The paving will extend for a distance of four blocks and will cost approximately $15,000.

Iowa.

The city council of Harlan, Ia., has ordered the construction of 14 blocks of paving in the business and residence districts of the city. [illegible]

Kansas.

⊙The city commission of Wichita, Kan., has let a contract for the resurfacing of North Main st., from English st. to Murdock ave., to the Warner-Quinlan Paving Co., for the asphalt paving at $1.64 per sq. yd. H. L. Miles was awarded the contract for constructing curbing at $0.30 per yd., and gutter at $0.37 per yd.

Kentucky.

The city council of Mt. Sterling, Ky., has passed an ordinance directing the building of 11,250 yds. of brick streets in the business section of the city.

Louisiana.

The city council of New Orleans, La., has been petitioned for the construction of a roadway from City Park ave. to Taylor ave. The residents have asked that Canal blvd. be made a highway.

The board of trustees of Melville, La., has adopted the specifications for eight blocks of concrete pavement and curbing.

Maryland.

The first branch council of Baltimore, Md., has voted to submit the $5,000,000 paving ordinance to a vote of the people. Calvin W. Hendricks is city engineer.

Michigan.

✣Bids will be received until noon, April 22, by Board of County Road Commissioners, Bessemer, Mich., for grading 11½ miles of road between Wakefield and Dunham. H. A. Harper is Engineer. Official advertisement will be found elsewhere in this issue.

⊙William F. Bower, Adrian, Mich., at $21,462, has been awarded the contract by the city of Adrian, John Mawdsley, City Clerk, for the paving of East Maumee St., including curbing and gutters combined, concrete foundation, fronting, catch basins and intakes. [illegible] the highway improvement fund and $15,000 [illegible]

Mississippi.

✣[illegible] J. m[illegible] construction of about 150,000 ft. granolithic sidewalks.

Missouri

✣[illegible] 17, by A. J. M[illegible]e, city engineer, Webb City, Mo., for the construction of 4,718 lin. ft. of combined concrete curb and gutter and [illegible]. Each bid must be accompanied by a certified check for $100.

Nebraska.

⊙The city council of Lincoln, Neb., has awarded the contract for the paving district 196 and alley paving district 24 to Abel & Roberts for $2.07, brick. The total cost will be about $1,335.

The city council of Omaha, Neb., has ordered the following streets paved: Douglas, from 16th to 20th; 36th, from Woolworth to Lincoln; 35th, from Martha to Arbor. The petition for paving 9th, from Howard to Douglas, was declared insufficient. Petitions were received for paving 24th, from Fort to Florence blvd.; 22nd, from Poppleton to Pierce; 25th, from Burt to Cuming, and a short stretch of 25th ave. from Ames north.

New Jersey.

✣Bids will be received until April 18, by William H. Kemp, chairman of the township committee of South Orange, at the committee room, Maplewood, N. J., for oiling about 8 miles of streets. Edward R. Arcularius is clerk.

⊙The Telford Construction Co., of Newark, N. J., has been awarded the contract for the improvement of the Clearfield & Roosevelt Aves., in Bloomfield, N. J., for approximately $9,000. The contract was awarded April 3. Raymond F. Davis is Town Clerk.

⊙Shire & Woods of Lyndhurst, N. J., have been awarded the contract for constructing concrete curbs, gutters and sidewalks on Roosevelt Ave. and Crown St., Bloomfield, N. J., for $5,400. Bids were received March 20 by Raymond F. Davis, Town Clerk, and the contract was awarded April 3.

The house of representatives, Trenton, N. J., has passed two bills, providing for the repaving and regrading of Bloomfield ave., Montclair. About a mile and a half of road will be constructed at an estimated cost of $20,000.

New York.

⊙The board of contract and supply of Rochester, N. Y., has awarded the contract for the paving of St. Paul st. to Whitmore, Rauber & Vicinus for $83,398. Other bidders were: The Rochester Vulcanite Co., $83,995; Julius Friederich Co., $84,350, and H. N. Cowles, $84,765.

Village Attorney B. D. Jackson, Lancaster, N. Y., has received a complete set of maps, plans and details from County Engineer Diehl for the county highway through this village, from the city line at Broadway. The sum of $17,000 is being raised by local taxpayers to pay for the village share of the paving. The contract will be let shortly.

The state highway commission, Albany, N. Y., has submitted plans to the city of Auburn for the construction of connecting links of state roads in Grant ave., to the Sennett line and in South st. to the Fleming town [illegible] roads.

An election will be held in the town of Corinth, Saratoga county, N. Y., soon for the purpose of voting on the issuance of bonds to the amount of $2,500 to alter the position of part of the road through the town and extend Main st., in Corinth village, an eighth of a mile beyong the village limits. This is the first action taken toward making a state road through the town from the Greenfield line on the south to the Hadley line on the north, a distance of about 10 miles.

The taxpayers of the town of Oyster Bay, N. Y., have circulated a petition to have improved the highway known as Jerusalem ave., from Fleischbein's cottage at Hicksville south to the line of division between the town of Oyster Bay and Hempstead, to be macadamized at an estimated cost of $19,000.

Commissioner of Public Works Charles S. Darling, Binghamton, N. Y., plans to do a considerable amount of street improvements in the 11th ward during this year. Among the improvements contemplated are: Shear st., Pearne st., to be resurfaced from Robert to Chenango st.; a new walk on the south side

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] the walk [illegible] the west side of Liberty st., between the Erie and D. & H. tracks; a walk on the east side of Liberty st., between the D. & H. tracks and Eldridge st.

Ohio.

✣Bids will be received until 11 a. m., April 15, by board of county commisisoners, Cleve[illegible] and improving Wooster Pike Road No. 3 from end of the present brick road to the Medina county line in Strongsville township. Frank R. Lander is county surveyor.

✣Bids will be received until April 12, by Service Director, Canton, O., for furnishing a 7 or 10-ton steam road roller either standard or tandem style.

✣Bids will be received until noon, May 5, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under specification No. 129 of Carthage ave. between corporation line of Norwood and Reading road in Columbia township. Fred Dreihs is clerk.

✣Bids will be received until noon, April 12, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under specification No. 181, of the Eight mile road at Kremer's place in Anderson township. Fred Dreihs is clerk.

⦿The Kircher Construction Co. has been awarded the contract by Service Director Sundmaker of Cincinnati, O., for the improvement of Young st. from Crawling to Dorchester st., with macadam for $3,549.

⦿Taylor & Briggs of Findlay, O., have been awarded the contract for the construction of 9.6 miles of pike road in Huron county. The contract will amount to approximately $42,000.

⦿C. A. Rozelle, of Solon, O., has been awarded the contract by the county commissioners at Cleveland, John F. Goldenbogen, Clerk, for road improvement on Ledge Hill, for $775. Bids were opened April 1.

⦿It is reported that J. W. Paule of Mansfield, O., at $6,053 has been awarded the contract at Bucyrus, O., for the paving of South Walnut st., from the intersection with Oakwood ave. to the intersection with Southern ave. Other bids received were: H. N. Oberlander, Bucyrus, $6,266; A. P. Caldwell, Galion, $6,652; P. Drake & Sons, Marion, $6,467; J. W. Scott, Marion, $6,654; George J. Bock, Coshocton, $6,491; L. R. McMichael, Bucyrus, $6,071.

⦿Service Director C. F. Brotherton, Ashtabula, O., has awarded Thomas Fitzgerald of Ashtabula the contract for the paving of West Prospect st., for $32,324, Bessemer block and sand filler to be used. Other bidders were: Walter Clifford, Ashtabula, $33,647; W. J. Kunkle Co., Ashtabula, $35,085; Downs & Campbell, Canton, $36,362; R. P. Burnett, Cleveland, $36,534; Harvey & Hukari, Ashtabula, $37,167; George M. Harris, Meadville, Pa., $37,036; Gould & Maybaugh, Cleveland, [illegible]

The city council of Marietta, O., has decided to grade Riley ave., from Ambrose to Bradshaw ave.; grade and pave Sugar st., from Pennsylvania ave. to Thompson ave.; grade Wall st., from St. Clair ave. to Lincoln ave.; grade and pave Fairview alley from Lisbon st. to Division st.; and grade and pave Elm st., from Pennsylvania to Thompson ave.

The county commissioners of Stark county, Canton, O., plan to expend approximately $250,000 for the permanent improvement of the county roads during 1911. Fred Gilcrest is county engineer. James C. Wonders, Columbus, O., state highway commissioner.

Oklahoma.

⦿The Healy Construction Co. of McAlister, Okla., has been awarded a contract by the Good Roads Commission, Meridian, Miss., to construct 20 miles of paved highways. The material to be used to be novaculite.

Oregon.

A movement has been started in Hood River, Ore., to make improvements on the wagon road leading from Hood River to Mosier. It is planned to make not to exceed an 8 per cent grade. The matter is being financed by popular subscription.

The city council of The Dalles, Ore., plans to do a considerable amount of paving during this year, estimated between $175,000 and $200,000.

The city council of St. Johns, Ore., has adopted the specifications for the paving of Jersey st., at a cost of $25,000. The council also ordered a portion of Chicago st., between Jersey st. and Portland blvd., improved at an estimated cost of $2,230.

At a recent meeting of the east side property owners, Portland, Ore., at the East Side Business Men's club, Grand ave. and East Alder sts., it was decided to initiate a measure to establish a municipal paving plant. The measure will carry with its authority a bond issue to the amount of $1,000,000 to be used in the erection of the plant. J. W. Morris is city engineer.

The street committee of the executive board, Portland, Ore., has awarded contracts for street improvements on the following streets: Market st., from 17th to 19th, grading and concrete curbs and walks, Kern & Field, $5,258; Myrtle st., from 16th to 17th, Hassam pavement, Oregon Hassam Paving Co., $2,191; East 32nd st., from East Morrison to Belmont, Hassam pavement, Oregon Hassam Paving Co., $1,463; Vista ave., grading and laying Hassam pavement, Oregon Hassam Paving Co., $23,685; Cornell Road, bitulithic pavement, Warren Construction Co., $35,616; East 41st st. district, Hassam pavement, Oregon Hassam Paving Co., $10,441; Gladstone ave., between East 26th st. and the S. P. shops, grading and concrete curbs and walks, Hilliard & Maginnis, $2,459; Buxton st., from Lawrence to East 28th, grading and concrete curbs and walks, Bechill Brothers, $753· Halsey st., from East 15th to Holladay addition, bitulithic pavement, Warren Construction Co., $4,407; East 42nd ave., from East 42nd to East 52nd sts., grading and concrete curbs and walks, Bechill Brothers, $10,199.

Pennsylvania.

✣Bids will be received until noon, April 17, by W. W. Caldwell, commissioner of highways, Harrisburg, Pa., for the construction of sewers in the following highways: Berryhill st., 18 ft. east of 18th to Bolton st.; Kelker st., Green to Mifflin st.; Nectarine st., Hunter to 80 ft. south of Swatara st.

⦿United Fire Brick Co., of Uniontown, Pa., at $21.50 per M, secured the contract from the Board of Awards of Baltimore, Md., for furnishing the following approximate quantities of vitrified block: 100,000 to Druid Hill Park, 200,000 to Patterson Park, and 15,000 to Harlem Park. Bids were opened March 22 by Wm. S. Manning, General Superintendent of Parks.

The committee on public works of the city council of Pittsburg, Pa., has recommended a schedule apportioning the appropriation of $146,200 for street repaving among portions of 30 streets. The schedule is as follows; N. S. Sprague, city engineer: Gibbon st. from Harper eastwardly, $2,400; Locust, from Miltenburger to Van Braam, $3,200; Tustin, from Miltenberger to Van Braam, $2,500; Mulberry alley, 186 ft. east of Twenty-sixth st., $1,600; Twenty-sixth st., from Penn ave. to Spring alley, $850; Penn ave., Eleventh st. eastwardly, $15,000; Adelaide st., Camp st. northwardly, $5,000; Thirty-ninth st., from end of present pavement to Allegheny Valley road, $4,000; Forty-seventh st., Butler to Plummer, $3,500; Pleasant alley, Forty-third to Forty-fourth, $1,400; Larkins, from South Twenty-second eastwardly, $6,600; Fox alley, South Seventeenth to South Nineteenth, $4,200; Muriel st., South Twelfth to South Fifteenth, $5,000; South Nineteenth, from Merriman alley 300 ft. northwardly, $3,600; Davidson st., Main st. to Forty-fourth, $4,200; Colwell st., Stevenson st. eastward, $6,000; Fifth ave., College st. eastwardly, $900; Fifth ave., Craft ave. westwardly, $12,000; Forty-second st., Foster to Allegheny Valley Railroad, $2,400; Lincoln ave., $8,000; Ohio st., from East st. eastwardly, $10,000; Spring Garden ave., from Chestnut st. eastwardly, $10,500; Greenfield ave., Haldane st. to bridge, $7,000; Cotton alley, from present pavement to Allegheny Valley railroad, $2,400; Lotus alley, Fifty-second st. to McCandless, $2,300; Holmes st., McCandless st. westwardly, $8,350; Millbridge st., Warrington to Excelsior, $3,200; Grandview ave., from Bertha westwardly, $3,000; total, $146,200.

Two highway appropriation bills have been presented in the house of representatives, Harrisburg, Pa., one making an appropriation of $700,000 for reimbursement of townships which abolish work tax in the fiscal years 1909 and 1910. The other bill appropriates to the state highway department $310,000 paid into the state treasury of boroughs and townships as state aid for construction of roads.

Tennessee.

✣Bids will be received until May 16, by city of Memphis, Tenn., for the construction of gravel, tar macadam, vitrified brick, asphalt, wood block or bitulithic pavement on streets as follows: Linden, from South Fourth to South Lauderdale, foundation only; Ayres st., from Vollentine to Chelsea, gravel; Kney st., from Vollentine to Chelsea, gravel; Breedlove, from Vollentine to Chelsea, gravel; Decatur, from Vollentine to Chelsea, gravel; East Leon place, Ayres to Decatur, gravel; East Muller place, Decatur to Barrett place, gravel; Olympic st., from Jackson to Vollentine, gravel; Vollentine ave., from Ayres st. to Bellevue blvd., gravel; Pearce st., from Jackson ave. to Chelsea ave., gravel; Jefferson ave., from East End park to North Cooper, gravel; Court ave., from East End park to Cooper st., gravel; Monroe ave., from Cooper st., to Cox, gravel; Diana st., from Madison st. to Cooper st., gravel; East Trimble place, from Diana st. to Cooper st., gravel; Tunis ave., from Cox st. to Edgewood st., gravel; W. Colorado ave., from Kansas st. to Delaware st., gravel; College st., from Trigg to Parkway, tar macadam; Greenwood st., from Ryder ave. to Trigg ave., gravel; Butler ave., from Main st. to Fourth st., old stone on gravel; Decatur st., from Poplar ave. to Jackson ave., vitrified brick; Auction ave., from Main st. to Jackson ave., vitrified brick; Union ave., from Dunlap st. to McLean blvd., asphalt, wood blocks or bitulithic; Vance st., from Front st. to Fourth st., asphalt, wood blocks or bitulithic; Union ave., from Main to Wellington, asphalt, wood blocks or bitulithic; S. Lauderdale st., from McLemore to Parkway, tar macadam; S. Bellevue blvd., from Frisco railroad to S. Parkway, tar macadam; S. Wellington st., from Mississippi to Walker, tar macadam; Cummings st., from McLemore ave. to Parkway, tar macadam; LeMaster st., from Union ave. to Peabody ave., gravel; N. Idlewild st., from Madison ave. to asylum property, gravel; Lumpkin st., from Union ave. to Poplar ave., tar macadam; Higbee ave., from Barksdale st. to Cooper st., gravel.

Texas.

⦿The city council of Sweetwater, Tex., has let the contract for the construction of 11 blocks of macadam-asphalt pavement to A. J. Ray. Bonds to the amount of $100,000 have been sold for this purpose.

The county commissioners court of Liberty county, Libertv. Tex., has granted a petition for a bond issue to the amount of $250,000 for road improvements, the election to be held May 16.

The city council of Austin, Tex., is calling for bids for nearly a mile of paving, which will cost in the neighborhood of $100,000. About 50,000 sq. yds. of material will be required. The streets to be paved are Fourth, from Colorado to Trinidad; Fifth, from Colorado to Trinity; Sixth, from San Antonio to West ave.; Seventh, from Colorado to Brazos; Eighth, from Congress to Brazos; Tenth, from Colorado to Brazos; and the

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

alley east and the [illegible] of Congress, from Fifth to Sev[illegible]

Utah.

Residents of the [illegible] Salt Lake City, Utah, have petitioned for the paving of B st., from the north line of Third ave. to the south line of Eleventh ave.; Ninth ave., from the west line of B st. to the east line of A st. The material specified is asphalt with cement curb and gutter.

Washington.

⊙The city council of Bellingham, Wash., has awarded the following contracts, aggregating $18,000 in amount, for paving: Asphalt paving, concrete sidewalks, sewer, curbs and gutters on Forest st., to C. G. Burnett for $11,726; concrete sidewalks, concrete curbs and gutters, High st., from Myrtle to Oak st., to J. H. Lich for $2,353; concrete sidewalks on the east side of James st., from Iowa st. to Carolina st., to J. H. Lich for $1,173, and for concrete sidewalks and grading of parking strip, Irving st., from Broadway to Young st., for $3,909

The county commissioners, North Yakima, Washington, have decided to construct better roads throughout the county, and will purchase machinery at an estimated cost of $16,250 for the purpose. An extra rock crusher and two complete hauling outfits will be added to the present equipment.

The county commissioners, Montesano, Wash., have decided to extend the Westport road from Johns river to Westport at a cost of $50,000. This will include a draw bridge. The commisisoners will also finish the road to the North river country and build a bridge across the North river.

The state highway commission, Olympia, Wash., has decided to call for bids for the completion of the state aid road from Spokane westward. The original contract for 17½ miles was awarded to Ilse & Elliott as the first section for a road from Spokane to Lincoln county. This contract, it is reported, has since been cancelled. W. R. White is state highway commissioner.

Advices from North Yakima, Wash., state that the suburban of Nob Hill will organize as a village. It is desired to pave two of the main roads running out from the city and a number of the cross streets with bitulithic.

The East Sprague Improvement club, Spokane, Wash., D. I. Donovan, treasurer, will pave East Sprague ave., from Lee st. to the city limits, with a rough pavement.

Wisconsin.

The Automobile club of La Crosse, Wis., has raised $5,000 to improve the principal highway from La Cross to La Cresent, Minn., part of which is a long bridge across the Mississippi river.

A bill has been introduced in the state senate, Madison, Wis., providing for the construction of a state road from the extreme southern boundary [illegible] northern part of the state. The proposed road would be three rods in width and extend from a point on the Illinois border to the northern line, and thence northwestwardly to Ashland.

Wisconsin.

⊙Bids were opened March 24 by the city of Burlington, Wis., P. J. Hurtgen, city engineer, for brick paving, cement paving, etc., the contract being awarded to Fred Eul, Menasha, Wis., at $21,922. In this work the sand, gravel and crushed stone cost 75 cents per cu. yd. delivered in the street; common labor is paid $2 per day, and teams $4.50 per day. About 5,460 cu. yds. of excavation are included in the price given below for the paving. The unit bids received on the work were as follows: (1) standing for 12,645 sq. yds. cement paving on 5-in. concrete base, (2) for 2,240 sq. yds. brick paving on 6-in. concrete base, (3) for 5,875 lin. ft. combined curb and gutter, the latter being 2 ft. wide, (4) 5,970 lin. ft. cement curb.

	(1)	(2)	(3)	(4)
R. R. Birdsall, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jno. Brogan, Green Bay, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
J. Rasmussen & Sons, [illegible]	[illegible]	[illegible]	[illegible]	.37
Western Improvement Co., [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N. F. Reichert, Racine, Wis.	1.17	1.66	.53	.40
Fred Eul, Menasha, W[illegible]	[illegible]	[illegible]	[illegible]	.27
Jas. Cape & Sons, Racine, Wis.	1.22	1.69	.60	.40
Chris Petersen, Kenosha, Wis.	1.09	1.78	.53	.34
Fred Nelson, Racine, Wis.	1.32	1.80	.58	.58
Thos. Wooley, LaCrosse, Wis.	1.19	1.71	.49	.29
McGrath Constn. Co., Green Bay, Wis.	1.26	1.83	.49	.29

Canada.

✣Bids will be received until noon, April 15, by A. J. McPherson, city commissioner, Regina, Sask., for one Squeegee street washing machine for the city.

✣Bids will be received until noon, April 13, by city clerk, Brandon, Man., for the paving of the following streets: Rosser ave., Twelfth st. to Sixth st.; Pacific ave., Eleventh st. to Eighth st.; Princess ave., Tenth st. to Eighth st.; Eleventh st., Rosser ave. to Pacific ave.; Tenth st., Pacific ave. to Pacific, Ninth st., Princess ave. to Pacific ave.; Eighth st., Princess ave. to Pacific ave.; Tenders are invited for wood block, asphalt block, sheet asphalt, granitoid, bitulithic and vitrified brick on 5-in and 6-in concrete foundation, or other kinds of pavements. Further particulars can be obtained from city engineer's office. R. E. Speakwall is city engineer.

The Power City Stone Co., St. Catharines, Ont., has been awarded the contract by John H. Jackson, Supt. of Queen Victoria Park, Niagara Falls, Ont., for the construction of (a) steel concrete bridges, and (b) a macadam roadway, with the necessary drainage, being Section 4b, 5,182 ft., commencing at Miller's Creek and extending to the southerly limit of the shipyard. The contract price is $13,500. Bids were reopened March 31.

The city council of Kingston, Ont., has adopted a recommendation of the board of public works, providing that plans and specifications be prepared by the city engineer and bids asked for the construction of asphaltic macadam in the following streets: Wellington st., Brock to West; Clarence st., King to Bagot; Johnson st., King to Bagot; William st., King to Bagot; Earl st., King to Bagot; Gore st., King to Bagot; Union st., King to Bagot. That plans and specifications be prepared by the city engineer and tenders asked for the construction of sheet or block pavements of a permanent type on a concrete base on King st. from Clarence st. to Brock st.; on Clarence st., from Ontario to King st.; on Brock st., from King to Wellington st., and on Wellington from Brock to Princess st.

BRIDGES—STEEL AND CONCRETE

California.

[illegible] Young Construction Co., Los Angeles, Cal., [illegible] ing to construct the proposed bridge over the [illegible] Colorado St. for $200,000

Delaware.

⊙The Levy Court, Dover, Del., has awarded the contract for the construction of the new bridge over Brown's branch to Pierce Bros. Milford, Del., at $960.

Georgia.

The County Commissioners at Macon, Ga., have decided to hold a special election in the fall to vote on a proposition to issue bonds amounting to $200,000 for the construction of bridges.

Idaho.

Commissioners of Idaho County, Idaho, Grangeville, Ida., have selected a site on the Salmon River for the proposed wagon bridge for the construction of which the legislature recently appropriated $15,000 and have instructed Walter Hovey Hill to prepare plans and specifications to be submitted at the April Session. The structure will be 300 ft. above the Goff Ferry and to get the material on the ground it will be necessary to blast out a road through the solid rock which will necessitate an expenditure of $600. The bridge will be [illegible]

Illinois.

✣B[illegible] Bank Building, Edwardsville, Ill., up to 10 [illegible] tion of four reinforced concrete culverts in Fort Russell Township, Madison County. Henry Heepke, town clerk, Edwardsville, Ill.

Preuitt ..3 20 17 1170 Bethalto, 1½ miles.

All material will have to be shipped in. Roads fair. One team will haul about 2 tons. Excavation will be in clay. Schaake bridge to be located on new site, excavation full depth. Work to be completed on or before June 1, 1911.

✣Bids will be received until 1 p. m., April 26, by Stephen White, town clerk, Port Byron, Ill., for the construction of the Quick Bridge. The structure will be of reinforced concrete with 28 ft. span, 16-ft. roadway, finished roadway to bottom of footings, 10 ft., 10 and 16 ft. wings, plain concrete substructure. It is estimated that the structure will require 87.3 cu. yds. of concrete and 6,575 lbs. reinforcing steel. Nearest railroad station is 5 miles, Hillsdale, on the C., B. & Q. Ry.

Following are the low bids received by B. J. Mullaney, commissioner of public works, Chicago, for the reinforcement of the Western Ave. bridge over south branch of the Chicago River: Furnishing necessary labor, materials, tools, machinery, etc., as shown on plans, including steel, timber, iron, etc., $72.30; additional structural steel not shown on plans and not included in lump sum bid, 8 cts. per lb.; additional cast steel, 10 cts. per lb.; additional yellow pine timber, $60 per 1,000 B. M.; additional white pine timber, $60 per 1,000 B. M.; additional oak timber, $70 per 1,000 B. M. (timber bids to include cost of bolts, washers, nails, etc.). Total tabulated bid, $7,600. Kelter-Elliott Erection Co., 112 Clark St., Chicago. The commissioner has recommended the award of the contract.

The report of Hedrick & Cochrane, Bridge Engineers, Kansas City, Mo., on the proposed viaduct across the railroad tracks at the end of South Adams St., Peoria, Ill., has been submitted to the Commissioner of Public Works, George F. Simmons, and referred to the [illegible] The viaduct [illegible] concrete. [illegible] than $70,000. Ross Canterbury is City Engineer.

City Council of Peoria, Ill., has appropriated $3,300 for the repair of the upper free bridge and $5,000 for repair work on the east [illegible]

[illegible] voted to issue [illegible] the proposed new bridges, the construction of the proposed new bridges, the [illegible] being as follows: Chicago [illegible] St., $25,000, Belmont Ave., $[illegible]; $400,000; Fuller St., $175,000; Blackhawk St., $2[illegible]

Citizens of [illegible] petition the city council to remove the present [illegible] Donough St. to a site at [illegible] in our last issue a contract has been let by the Illinois Traction Co. for the construction of a new trolley bridge at McDonough St.

Indiana.

✣Bids will be received until 1 p. m., April 17, by Commissioners of Benton County, Fowler, Ind., for the construction of three cement and I beam bridges with gaspipe hand rails. Lemuel Shipman is County Auditor.

⊙Information from LaGrange, Ind., is to the effect that the contract for the construction of 5 concrete and iron bridges has been let to the Elkhart Bridge & Iron Co., Elkhart. Ind., at $1,798. The contract for a wooden bridge 30 ft. long and 12 ft. wide has been let to J. E. Doty, Milford, Ind., at $281. Bids were opened at 2 p. m., April 4.

⊙The contracts for the construction of 25 bridges in Spencer County, Ind., have been awarded to the Vincennes Bridge Co., Vincennes, Ind., Greensburg Iron Co., Greensburg, Ind.; and Haines & Kinman, Evansville, Ind. J. T. White, Rockport, Ind., is County Auditor.

⊙The contract for the construction of the new bridge across the Wabash River, in Adams County has been awarded by the County Commissioners to T. J. and H. F. Burke, New Castle, Ind., at $4,148. H. S. Michaud is County Auditor.

⊙The Commissioners of Clay County, Brazil, Ind., have awarded the contract for the construction of the James Burnham Bridge, Clay City, Ind., to L. W. [illegible] & Son, Saline City, Ind., at $8.30 per cu. yd. The structure will be of reinforced concrete and will be 30 ft. long. E. A. Staggs is Auditor.

Iowa.

✣Bids will be received until 2 p. m., April 25, by Board of Supervisors, Cerro Gordo County, Mason City, Ia., for the construction of the following: Item 1, two concrete slab bridges; Item 2, one concrete arch 50-ft. span; Item 3, one 32 ft. girder; Item 4, two steel bridges, alternate designs for concrete bridges. A. S. Clark is county auditor. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, April 26, by Board of County Supervisors, Estherville, Ia., for the erection of several reinforced concrete or steel bridges according to specifications for bridges on file at the office of C. A. Root, county auditor. Official advertisement will be found elsewhere in this issue.

⊙The Iowa Bridge Co., Des Moines, Ia., has been awarded the contract for the construction of all new bridges and the repairing of old bridges in Beadle County during the [illegible] T. C. Young, county auditor.

[illegible] Council, Des Moines, Ia., for the construction [illegible]

Kansas.

Blue prints have been completed for the construction of the proposed McKinley bridge across the Missouri River at Atchison, Kan. According to the plans the structure will cost about $400,000. H. E. Chubbuck, Peoria, Ill., is general manager of the system.

According to the estimates prepared by Josepeh O'Neil, City Engineer, Leavenworth, Kan., the cost of building a concrete bridge over Three-Mile Creek on 3rd St. will be about [illegible]

Kentucky.

Advices from Elizabethtown, Ky., state that a conference will be held at Louisville, Ky., by W. P. Montgomery, Special Commissioner, Hardin County, with Commissioner Charles Taylor, of that city in regard to the construction of the proposed new bridge across the Salt River at West Point.

Louisiana.

Plans for the construction of the proposed bridge at Shreveport, La., have been submitted to the United States War Department and future work is now under consideration by the City Commissioners and authorities of Bossier Parish. The site for the bridge, which has been approved is 1,000 ft. below the V. S. & P. tracks, and 200 ft. above the foot of Jones St., being selected on account of the height of the banks making it possible to build a high bridge without the necessity of large piers.

Maryland.

Advices from Denton, Md., state that the commissioners of Caroline and Dorchester are preparing to hasten the construction of a bridge across Upper Hunting Creek, now known as the Linchester River at Back Landing a short distance from Preston.

Massachusetts.

According to estimates recently made by the Department of Public Works, Boston, Mass., of the cost of changing the grade of the approaches to the Cove St. bridge from 5 ft. to [illegible] and 3½ ft. an expenditure of $1,000,000 would be required. This work would be done in connection with the improvement of the New York, New Haven & Hartford R. R. terminals mentioned in our last issue.

Michigan.

The Common Council of Grand Rapids, Mich., has authorized the submission to the voters of the proposition to issue bonds for a new and modern bridge at Leonard St. crossing of the river.

Minnesota.

Advices from Grand Rapids, Minn., state that designs are being prepared by order of the county commissioners for the construction of two steel bridges to be erected in Itasca County. The cost of the work will be about $1,200 for each structure.

Missouri.

✣Bids will be received until 2 p. m., April 18, by F. M. Latimer, County Highway Engineer, Marshall, Saline County, Mo., for furnishing steel for 12 girder bridges, also for steel joist and handrail to repair old spans.

New York.

✣Bids will be received until April 18, by City of Niagara Falls, N. Y., for painting the Pine, Pierce and Walnut Ave. bridges.

⊙Holleran Bros., 608 Walnut St., Elmira, N. Y., on April 1, were awarded the contract by Henry Peterson, Fredonia, Superintendent of Pomfret, N. Y., for the construction of concrete arch bridge over Candaway Creek at Hunt's. The contract price was $2,752.

At a recent meeting of the tax payers of the town of West Seneca, N. Y., it was decided to construct a bridge across Cazenovia Creek at Lein's Park.

Ohio.

✣Bids will be received until April 17 [illegible]

✣Bids will be received until 11 a. m., April 29, by Board of County Commissioners, Cleveland, O., for furnishing the necessary labor and material for furnishing of the material necessary for the elimination of the grade crossing of the Penna. and W. & L. E. Railroads, Dunham Road, in Bedford Township, by the construction of an overhead bridge across the said railroads on Dunham Road between Granger Road and Bedford Road, in accordance with the forms of contract, plans, descriptions, bills of material specifications of work and estimates on file in the office of the County Engineer at the New Court House, West 3rd St. and at the office of the County Auditor in the old Court House, in Cleveland, Ohio. John F. Goldenbogen is [illegible]

✣Bids will be received until 1 p. m., April 17, by Board of County Commissioners, Trumbull County, Warren, O., for furnishing labor and material for the construction of a concrete bridge over Little Squaw Creek, Liberty Township. Fred T. Stone is County Auditor.

⊙The contract for the construction of the new bridge over the river at Port Clinton, O., has been awarded to the Home Engineering & Construction Co., Canton, O., at $7,000. The substructure went to the Modern Construction Co., of Fremont, O., for $6,000. Work will be started immediately.

The Cincinnati, Hamilton Dayton R. R., according to advices from Dayton, O., has decided it necessary to construct another bridge across the Great Miami River at the northern extremity of North Dayton to handle the double tracks being laid into the city. Right of way for the approaches has already been purchased. M. V. Hynes, Dayton, O., is Division Engineer.

According to preliminary plans and estimates of City Engineer, Toledo, O., the removing of the old Cherry St. bridge and reestablishing it at Ash and Consaul Sts., will necessitate an expenditure of $325,000. The proposition to build a concrete approach on the Consaul St. side would cost $30,000 additional. The plans will be submitted to the Council at once and if approved will be forwarded to Washington for Government approval.

The East Side Improvement Club has passed a resolution demanding that the city council and board of county commissioners eliminate the Oak St. grade crossing in Youngstown, O., by erecting a bridge from Oak St. to either Summit or Raven Aves., and the executive committee has been authorized to present the resolution to the commissioners.

The Ohio Electric Ry. Co. and the County Commissioners have reached an agreement to build a new concrete bridge over Sycamore Creek at Miamisburg, O. The structure will replace the old iron span.

Oklahoma.

Field Engineers of the Topeka Bridge & Iron Co., which has the contract for the construction of the Cleveland Ave. viaduct, Guthrie, Okla., are engaged in work preliminary to the building of the structure.

Oregon.

A bill was recently passed by the legislatures of Oregon and Idaho providing for the construction of a joint bridge over the Snake River at or near Brownlee Ferry. By the terms of the bill each state will appropriate $10,000 toward the cost.

Pennsylvania.

If the proposed bridge over South St. at Wilkesbarre, Pa., is built according to plans prepared by the engineers and approved by the Bridge Committee of the City Council, the cost will range about $180,000, which amount will be divided between the city and various railroad companies.

It is reported that the Philadelphia & Reading Ry. will construct a concrete arch bridge over the Delaware River at Yardley, Pa., to replace the present wrought iron structure. The cost of the new improvement is estimated at approximately $400,000. The bridge, which

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

will be double track, will be 1,256 ft. long consisting of 14 arches, 12 of which will be 90 ft., 9 ins. in length and two 83 ft., 6 ins. The height from the water level to the crown of the arches will be 65 ft. The site selected is directly parallel with the present bridge a distance of 35 ft. south. William Hunter, Philadelphia, Pa., is Chief Engineer.

N. R. Rambo, County Surveyor, West Chester, Pa., has about completed the plans for the construction of an iron and concrete county bridge over Doe Run at Springdale and bids will be asked for the work by the County Commissioners in the near future.

The County Commissioners, Pittsburg, Pa., have under consideration the construction of the following bridges in Allegheny County. Over Reardon Run at Hookstown, over Turtle Creek at McClures, over Sewickley Creek, over Tillbrook Run in Sutton township, over Dirty Camp Run in Sutton, over Plum Creek in Plum, over the Allegheny River at Natrona, Chartiers Creek at Duffs Station, Upper Plum Creek in Plum, Dry Run in Jefferson, Ripling Run in Franklin, Oakwood Run in Charters. These bridges have been approved by grand jury, judges and viewers, and the total estimated cost is $281,150.

An ordinance has been signed by the Mayor of Scranton, Pa., providing a bond issue of $150,000 to pay the city's share of the cost of the long-expected Mulberry St. viaduct.

The County Commissioners, York, Pa., recently viewed the proposed site of the new bridge across Fox Run near Brookside Park in Dover township to replace the frame structure washed out by high water. Commissioners signed $30,000 of bridge bonds.

City of Brownsville, Pa., is taking steps toward securing the construction of a new bridge over the Monongahela River and Senator W. E. Crow has introduced a bill in the upper House of the Legislature appropriating $100,000 to defray half the expense of this bridge, Fayette and Washington counties to bear the other half of the expense.

Minnesota.

It is rumored in Minneapolis, Minn., that the Minneapolis & St. Louis R. R. is contemplating the construction of a new bridge across the Missouri River at Le Beau, S Dak. J. W. Reid, Chicago, Ill., is Bridge Engineer.

Tennessee.

The Southern Ry. Co. will, it is reported, construct a steel bridge over the Tennessee River about 4 miles from Rogersville, Tenn., replacing the old stone and wooden structure. W. H. Wells, Washington, D. C., is Chief Engineer of Construction.

Texas.

Advices from Fort Worth, Texas, state that a conference will soon be held between representatives of the Northern Texas Traction Co. and the County and City Commissioners with a view of entering into a joint contract for the construction of a new bridge across the Trinity River at the foot of E. 4th St. to connect with Riverside.

Virginia.

⦿The Road Board of Spottsylvania County, Spottsylvania, Va., has awarded I. D. Ireland, Richmond, Va., the contract for the construction of a concrete girder bridge over Hazel Run on the improved Spottsylvania road at $1,843.

⦿Advices from Danville, Va., state that it is believed that the contract for the construction of the proposed reinforced concrete bridge over the Dan River to replace the present wooden structure at Union St. Crossing, will be let to Thomas Sheehan. J. O. Magrudger is City Engineer.

Washington.

At a recent session of the City Council, Seattle, Wash., an ordinance was introduced providing $50,000 for the construction of a bridge over the Government Canal at Westlake Ave.

The North Division St. Improvement Club, Spokane, Wash., has appointed a committee to urge the city commissioners to take action toward the construction of the proposed viaduct over the Oregon R. R. & Navigation Co. and Spokane International R. R. tracks at Division St.

Committee of Citizens have urged the City Commissioners, Spokane, Wash., to take action toward having work started on the proposed $415,000 bridge over Hangman Creek.

Canada.

⦿Information received from Niagara Falls, Ont., states that the contract for the construction of five steel concrete bridges has been awarded Rutherford & Patten, St. Catherines, Ont., at about $24,000. The structures will have spans from 30 to 70 ft. John H. Jackson is Superintendent.

The estimated cost of the superstructure of the Quebec Bridge contract for which, as noted in our March 29 issue, was awarded the St. Lawrence Bridge Co., Montreal, Que., is $8,650,000.

It has been decided by the city of Toronto, Ont., that the Grand Trunk and Canadian Pacific Rys. must build the proposed viaduct over the Esplanade at that city.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

✣Bids will be received until noon, June 1, by Board of Drainage Commissioners, W. Barnes, Chairman, for digging drainage canal and laterals in Ashley County. The work, according to plans and specifications on file with Secy. W. B. De Yampert, Wilmot, Ark., will include 700,000 cu. yds. of excavation.

California.

The levees for the control of the Colorado river in Lower California have been completed and the grading stock and equipment taken into Mexico from the United States has been withdrawn. The levees are in all 21 miles long.

Indiana.

✣Bids will be received until 2 p. m., April 17, by Albert R. Keaton, Drainage Commissioner of Shelby County, at Shelbyviile, Ind., for the construction of a drain. Bids will be received at the office of Hord & Adams, Shelbyville, Ind.

Iowa.

✣Bids will be received until noon, April 20, by Frank McSpaden, Auditor of Franklin County, Hampton, Ia., for the construction of Drainage District No. 16 consisting of the following sizes of tile and approximate average cuts: Station No. 1, 4,892 ft. 14-in. tile, average cut about 5.93 ft. Station No. 2, 928 ft. 6-in. tile, average cut about 6 ft. Bulkhead 6 yds. concrete composed of 1 part Portland cement and 4 parts clean sharp sand. Catch basin 12-in.., with sewer pipe, and top with cast iron grate. Tile to be used will be No. 1 salt glazed vitrified, except the 6-in., which shall be hard burned, acceptable by the engineer of construction. Average haul about 4 miles. Time of commencement May 15, 1911, time of completion, January 1, 1912. Bids will be received separately for the tile f. o. b. nearest station, and for labor including hauling from station, and bulkhead and catch basin complete, or for work complete according to plans and specifications.

✣Bids will be received until noon, April 20, by Frank McSpaden, Auditor of Franklin County, Hampton, Ia., for the construction of Drainage District No. 2 in District No. 6, including the following sizes of tile and approximate average cuts: Section No. 1, 1,473 ft. 14-in. tile, av. cut. about 6.99 ft. Section No. 2, 4,600 ft. 16-in. tile, av. cut about 6.94 ft. Section No. 3, 1,000 ft. 18-in. tile, av. cut about 6.35 ft. Section No. 4, 4,000 ft. 24-in. tile, av. cut. about 6.03 ft. Section No. 5, 7,400 ft. 12-in. tile, av. cut about 4.51 ft. Section No. 6, 2,750 ft. 14-in. tile, av. cut about 6.75 ft. Section No. 7, 2,050 ft. 18-in. tile, av. cut about 5.60 ft. Section No. 8, 829 ft. 12-in. tile, av. cut. about 4.53 ft. Section No. 9, 500 ft. 14-in. tile, av. cut about 5.58 ft. Section No. 10, 500 ft. 10-inch tile, av. cut about 4.50 ft. Section No. 11, 400 ft. 12-in. tile, av. cut about 4.30 ft. Section No. 12, 630 ft. 10-inch tile, av. cut. about 5.20 ft. Section No. 13, 2,136 ft. 12-in. tile, av. cut about 5.56 ft. Section No. 14, 2,100 ft. 14-in. tile, av. cut about 6.22 ft. Section No. 15, 2,000 ft. 18-in. tile, av. cut about 4.75 ft.; Section No. 16, 1,500 ft. 20-in. tile, av. cut about 5.31 ft. Section No. 17, 249 ft. 12-in. tile, av. cut about 5.00 ft. Section No. 18, 2,200 ft. 10-in. tile, av. cut about 6.28 ft. Three 12-in. catch basins with sewer pipe and cover of cast iron grating. Four 8-inch catch basins with sewer pipe and cover of cast iron grating. Tile to be No. 1 salt glazed vitrified farm drain tile except 10 and 12-in. which shall be hard burned, quality acceptable to construction engineer. [illegible] commencement May 15, 1911, time of completion January 1, 1912. Time of letting will be at 1 o'clock p. m., April 20, 1911. Bids will be received separately for the tile f. o. b. nearest station and for labor including hauling from station, and catch basins complete or for work complete according to the plans and specifications. For further information write Geo. L. Mechem, Clarion, Iowa, Engineer of Construction.

✣[illegible] 20, by Frank McSpaden, Auditor of Franklin County, Hampton, Ia., for the construction of Drainage District No. 1 in District No. 6, consisting of the following sizes of tile and approximate average cuts: Sec. 1, 965 ft. 10-in. tile, av. cut. 7.79 ft.; Section 2, 3,100 ft. 16-in. tile, av. cut 7.56 ft.; Section 3, 1,100 ft. 20-in. tile, av. cut. 6.20 ft Sec. 4, 300 ft. of 20-in. tile, av. cut. 4.78 ft.; Sec. 5, 900 ft. of 22-in. tile, av. cut. about 4.71 ft.; Sec. 6, 3.200 ft. of 24-in. tile, av. cut 6.64 ft.; Sec. 7, 800 ft. 20-in. tile, av. cut. 8.95 ft.; Sec. 8, 1,200 ft. 24-in. tile, av. cut about 5.90 ft.; Sec. 9, 1,000 ft. 18-in. tile, av. cut about 5.34 ft.; Sec. 10, 1,376 ft. 14-in. tile, av. cut 4.73 ft.; Sec. 11, 600 ft. 12-in. tile, av. cut 4.23 ft.; Sec. 12, 665 ft. 12-in. tile, av. cut 7.41. Tile to be No. 1 salt glazed vitrified farm drain tile except the 10 and 12-in. which shall be No. 1, hard burned tile of quality accepted by construction engineer. Bulkhead of 6 cu. yds. concrete composed of one part Portland cement to four parts of clean sharp sand. Catch basins to be constructed with sewer pipe and covered with cast iron gratings as designated by engineer comprising four 12-in. and two 8-in. basins. Sections 1, 2, 3, 4 and 5 about 8 miles haul; Sections 6, 7, 8, 9, 10, 11 and 12 about 7 miles haul. Time of commencement May 15 and completion Jan. 1, 1912. For further information write George L. Mechame, Clarion, Ia., Engineer.

✣Bids will be received until 2 p. m., April 26, by Joint Board of Supervisors, Webster and Calhoun Counties, Ia., at the office of J. 1. Hanrahan, County Auditor, Webster County, Fort Dodge, Ia., for the construction of a ditch and drain in Webster County known as Drainage District No. 70 and in Calhoun County as Drainage District No. 95. The work will be divided in six sections including tile as follows: Sec. 3, 15,850 ft. of 12 to 24-in. tile, average cut. 5.1 to 10.4 ft.; Sec. 4, 4,900 ft. of 14 to 18-in. tile, average cut 6.7 to 5.7 ft.; Sec. 5, 8,700 ft. of 12 to 24 in. tile, average cut. 6.4 to 8.1 ft.; Sec. 6, 1,700 ft. of 14 to 16-in. tile, average cut 5.5

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible] P. Smith, Fort Dodge, Ia., is Engineer.

Louisiana.

⦿[illegible], La., has been awarded a contract to dig a canal for the Isle Maronne Drainage District Commission of [illegible], La.

⦿[illegible] & W[illegible] have been awarded a contract at 21½ cts. per cu. yd., for building a levee in Plaquemine parish on the Cusilich canal side levee. The levee will contain about [illegible]

Minnesota.

⦿Bids were opened April 3 by Edgar Weaver, County Auditor, Mankato, Minn., for constructing Ditch No. 25 in Dicona and McPherson, the contract being awarded to Christopher S. Erickson. The work includes 65,500 cu. yds. of earth excavation and 3,700 ft. of 10-in. tile.

South Dakota.

⦿Bids were opened April 5 at DeSmet, S. Dak., for the construction of approximately 26,000 lin. ft. of tile drainage. Work consists of furnishing all materials and labor and constructing the work complete, 10 in. to 20 in. tile. Contract awarded to F. Desormoux Const. Co., Cottonwood, Minn., at $17,797.74. The other bidders were: Brookings Const. Co., Brookings, S. Dak (Clay tile), $17,904.34; Sherbourn Cement Drain Tile Co., Sherbourn, Minn. (cement tile), $17,889.66; Worthington Concrete Tile Co., Worthington, Minn. (cement tile), $16,008.57; Argillo Works, Rock Island, Ill. (vitrified clay tile), $18,330.65. The Missouri Valley Engineering Co., Mitchell, S. Dak., is the Engineer.

Memphis and Vicinity.

(REGULAR CORRESPONDENCE.)

⦿Lowrance Brothers & Co., of Memphis, were awarded a contract by the Louisiana State Board of Engineers for the building of the Lucca Levee at Lucca Landing, Ark., which contract involves 350,000 cu. yds. George Lowrance has his outfit at Arkansas City, about eight miles from the new work and will move at once on the contract just secured. It is understood that the contract price is 20.85 cts.

⦿Sam Bush has closed a contract for about 20,000 yds. of levee work with Bob Leonard, [illegible] Texas, on the banks of the Brazos River. It is good work and Sam says he will [illegible]

⦿Roach & Stansell were awarded another contract last week by the Kansas City, Mexico & Orient R. R. for the construction of 25 miles of roadway from Mertzon, Texas, south. This contract testifies to the security of American finances in Mexico, for it puts at an end the talk that this road would have to discontinue operations on account of the revolution now going on in that country. The K. C., M. & O. are building a line into Mexico from Kansas City.

The Frisco Railroad has asked bids on the building of a connecting track with the Illinois Central Railroad at Bellevue, Tenn. It is understood that several of the larger local firms will submit propositions. J. M. Sills, Springfield, Mo., is to be in charge of the work and will award contracts.

Heiskell Weatherford, the popular City Engineer, has gone to Hot Springs, Ark., for ten days' rest. Heiskell has been so busy looking after the new work let that he feels the necessity of a short rest to be in trim for the coming season.

George Weathers has moved his outfit off the Government work at Wilson, Ark. It is presumed that he will send his full equipment to Kentucky, where he has a contract with the L. & N. R. R. It was thought by all that George was doing pretty well at Wilson, especially so after such a season of good weather.

William Beach has resigned his position with J. T. Walsh & Bro., to accept one with Roach & Stansell on the big Huntington Loop contract, where the latter firm proposes to revolutionize levee work by the use of 90-ton steam shovels and dump cars. And speaking of this contract, the number of cars of rail and ties that have been shipped to the base of operations are enough to pay the revenue of a small sized railroad for ten years. According to Mike Roach, the hustling head of the firm, things will be doing in a short time on the big new loop.

Ed Manigan came home sick from Ft. Worth and has been confined to his bed for the past two weeks. Ed was in charge of the street paving in the latter city and reported good progress along all lines.

Charlie Hudson, the little fellow who for so many years was in charge of a labor agency in Memphis, has bought a farm in Arkansas and is raising cotton, corn and peas. Charlie's going has been greatly regretted by all the contractors, who liked him very much on account of his willingness to go out of his way to help them when hard up for labor.

L. F. Slaughter is now busy at work on the U. S. levee at Mound City, Ark. Slaughter has a fine outfit and understands the movement of dirt and it looks as if he is going to make a lot of money on his present contract.

Bickford & Price have their large grader outfit at work on the Frisco yard contract at Bellevue, Tenn., and are rolling up a great deal of dirt on this work. Billy Bryan has also an outfit on the same work, a spick and span new team outfit.

Utah.

A company is to be incorporated with a capital stock of $750,000 for the purpose of constructing a large reservoir in South Fork Canyon for the city of Ogden and irrigation companies operating in the vicinity. Mayor William Glasman, of Ogden, is a member of the committee having charge of the preliminaries.

Canada.

⦿Kimball Bros., Bassano, Alberta, have taken a two years' contract on the Canadian Pacific Ry.'s irrigation ditch at Bassano, and will use two engines, two grading machines and 150 teams. The permanent headquarters of Kimball Bros., is at 401 Globe Bldg., Minneapolis, Minn.

Advices from Lethbridge, Alberta, state that the Cozier Construction Co. has established camps for building a reservoir in Chin Coulee and canals there for the Alberta Railway & Irrigation Co. P. L. Naismith, General Manager, Lethbridge, Alberta. This extension of the system will water a large amount of land.

Mexico.

⦿Advices from Calexico, Mexico, state that Depositaro A. F. Andrade, who has control of the affairs of the Alamo River canal in Mexico, has ordered the improvement of the canal between the Alamo Mucho and Sharps Heading. The contract has been let to W. K. Bowker and the work has been started with 50 teams on the job. The work at present consists merely of building up the south banks of the canal. Silt has deposited in the bed until the water slops over the edge and the capacity of the canal is seriously lessened. The improvements now are of a temporary nature and permanent work will be undertaken as soon as sufficient money is available.

WATER-WORKS

Alabama.

The citizens of Greenville, Ala., at a recent election, voted the issuance of bonds in the sum of $15,000 for the purchase of duplicate parts for the pumping station of the city water works system.

California.

⦿The Board of Trustees of Suisun, Cal., has let a contract to W. B. Connelly of Suisun, to raise the dam of the municipal water system reservoir a distance of 12 ft., whereby it is planned to increase the storage capacity of the lake to 25,000,000-gals. of water.

The Board of Trustees of Marin County, San Rafael, Cal., has passed a resolution recommending the purchase by the municipality of the water plant of the Marin Power and Water Co.

Colorado.

The citizens of Norwood, Colo., on April 4 voted the issuance of bonds to the amount of $12,000 for the erection of a water works. Charles H. Morgan is Mayor.

The citizens of Fort Lupton, Colo., on April 4 voted the issuance of bonds to the amount of $25,000 for the installation of a water works. Charles H. Sells is Mayor.

The citizens of Olathe, Colo., on April 4 voted the issuance of bonds to the amount of $56,000 for the installation of a municipal water works.

District of Columbia.

Chief Engineer W. A. McFarland of the District of Columbia Water Department, Washington, plans to connect every outlying suburban subdivision in the District with water mains by Oct. 1. Congress has appropriated $101,000 for the laying of water mains for the fiscal year.

Florida.

✣Bids will be received until April 29, by Constructing Quartermaster, Fort Dade, Fla., for constructing an addition to the water supply system.

Georgia.

An election is to be held in Thomaston, Ga., on May 1, for the purpose of voting on the issuance of bonds to the amount of $45,000 for the construction of a water and a sewer system.

The citizens of Fairburn, Ga., have voted the issuance of bonds in the sum of $20,000 for the construction of a water works.

Illinois.

✣Bids will be received by B. J. Mullaney, Commissioner of Public Works, until 11 a. m., April 19, 1911, at his office, 4th floor City Hall, for furnishing all material, machinery and labor necessary to construct and erect the wet well of the Roseland pumping station as follows: Furnishing and delivering the structural steel and iron work complete with the fish screens and guides, erecting in place the above work, including cutting of concrete for setting I beams and anchors, erecting two cast iron sections and glands furnished by others and delivered on premises; erecting two 42 in. hydraulic valves furnished by others and drilling necessary bolt holes in valves and glands. The drilling consists of 36 11/16 in. holes in one flange of each of two hydraulic valves and 32 1¼ in. holes in each of two glands to match holes in stuffing boxes now in place; also placing and tamping the lead wool furnished by city. Proposal must be accompanied by cash or certified check to the amount of $150. Detailed plans and specifications on file at above office.

✣Bids will be received until 11 a. m., March 14, 1911, by B. J. Mullaney, Commissioner of Public Works, 4th floor City Hall, for furnishing and delivering rubber gaskets and valves to the water works shops, 2304 S. Ashland Ave. The contract consists of furnishing 4,000 rubber gaskets 8 15/16 ins. outside diameter, 6 11/16 ins. inside diameter, not less than ⅛ in. thick and weighing not more than 3 ozs.; 1,000 rubber gas[illegible] 15/16 ins. outside diameter, 8 7/16 ins. inside diameter, not less than ⅛ in. thick and weighing not more than 5¾ ozs.; 2,000 rubber hydrant valves, 5½ in. outside diameter, 2 in. inside diameter, not less than 1 in. thick; 500 hydrant valves 6 9/16 in. outside diameter, 2 15/16 in. inside diameter, and not less than 15/16 ins. thick; 1,000 hydrant valves, 4⅞ in. outside diameter, ⅞ in. holes in center, and not less than 9/16 in. thick valves, to weigh 19, 22 and 10½ ozs. each. All samples accompanying proposal are to be of a grade equal [illegible] than those on file at office of Commissioner. Detailed drawings and specifications on file at above office. One hundred and fifty dollars in cash or certified check must accompany proposal.

⊙The contract for setting two batteries, each of 300 H. P. boilers, at [illegible] pumping station, 104th St. and Stewart Ave., has been awarded by B. J. Mullaney, Commissioner of Public Works, Chicago, to Jos. T. Dorgan, 109 Randolph St., for the sum of $4,195.

⊙The contract for furnishing an open feed water heater and purifier to the Roseland pumping station, 104th St. and C. & W. I. R. R., has been awarded to the Platt Iron Works Co., Chicago, Ill., by B. J. Mullaney, Commissioner of Public Works; contract price $888.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing hydraulic packing for the pumping stations to the Quaker City Rubber Co., 186 Lake St., for the lump sum of $1,500, and other packing to the Anchor Packing Co. at $5,810. Detailed specifications published in Engineering Contracting.

⊙The contract for furnishing, delivering and erecting in place two electrically driven centrifugal pumps, including bed plates, transformers, switchboards, piping, etc., necessary to deliver 4,000,000 gallons of water against a head of 130 ft. has been awarded by B. J. Mullaney, Commissioner of Public Works, Chicago, to the Platt Iron Works Co., 311 Dearborn St., Chicago, for a total of $53,900. The plant is to be erected at the pumping station located at 22d St. and Ashland Ave. Detailed specifications published in Engineering Contracting.

Following are the low bids received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing, delivering and erecting in place at pumping station, located at 22d and Ashland Ave., two 30 in. Venture meters with registering mechanism capable of measuring 6,000,000 gals. per 24 hours' minimum flow and 32 gallons per 24 hours' maximum flow against 85 ft. head. Simplex Valve & Meter Co., Philadelphia, Pa., $1,944.

Following are the low bids received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the water works shops corporation ferrules as follows: (a) 7,500 ¾ in., (b) 300 1 in., (c) 200 1¼ in., (d) 200 1½ in., (e) 2 in., J. J. Ryan & Co., 104 S. Jefferson St., Chicago, (a) 57 3/10 cts., (b) 81 cts. [illegible] (d) $2.39, (e) $3.76; Mueller Mfg. Co., (a) 61 cts., (b) 78 cts., (c) $1.42, (d) $2.43, (e) $3.89; Glauber Brass Co., (a) 60¾ cts., (b) 77 cts., (c) $1.53, (d) $2.55, (e) $[illegible]

Following are the low bids received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the water works shops, 23d St. and Ashland Ave., 10 2½ in. double hydrants complete, 4 4 in. double hydrants complete, 4 6in. valves, 4 8 in. valves, 1 12 in. valve, 1 16 in. valve, 1 24 in. valve, approximating 20 tons. T. A. Cummings, 1338 Clybourn Pl., $44.10 per ton.

Following are the low bids received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering special castings to the water department, specifications of which were published in Engineering Contracting: Jas. A. Brady Foundry Co., 35th St. and Ashland Ave., $47.80 per ton; U. S. Cast Iron Pipe Foundry Co., The Rookery, $49 per ton.

Bids for cleaning hydrant basins for year 1911 were received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill. The bid of Thos. L. [illegible], was lowest at 59 cts. per basin.

Following are the low bids submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering cast iron valve basin and fire cistern covers to the water pipe yards located at various points throughout the city, approximately 200 tons will be required: T. A. Cummings Foundry Co., 1338 Clybourne Pl., Chicago, $25.40 per ton. The contract has not been awarded.

Following are the bids of the Fehr Construction Co., 102 Desplaines St., Chicago, Ill., for constructing the reinforced concrete floor in the Roseland pumping station, 104th St. and C. & W. I. R. R.: Steel rods in place, 2 9/10 cts. per lb.; steel rails, 2[illegible] cast iron in place, 2½ cts. per lb.; all other work as shown on plans, $1,800.

Indiana.

⊙John W. Weigel, at $6,400, has been awarded the contract by J. W. Sanderson, Treasurer, Marion Branch, N. H. D. V. S., National Military Home, Indiana, for machinery and materials for [illegible] water supply at the Soldiers' Home. Bids were opened March 25.

A. T. Maltby, Consulting Engineer, Great Northern Bldg., Chicago, has been selected to provide a new and increased water supply and rebuild the water works plant for the city of Peru, Ind.

Iowa.

⊙The city of Corydon, Ia., has awarded Bosch & Gray of Joplin, Mo., the contract for the construction of a water works system for $26,872.

The town of Anita, Ia., has secured the services of the W. K. Palmer Co., Engineers, 717 Dwight Bldg., Kansas City, Mo., in connection with the remodeling of the water works plant at that town, and the installation of a new municipal electric lighting plant and system. The total appropriation will be approximately $30,000. Further particulars and information can be obtained from the office of the engineers.

Louisiana.

The City Commissioners of Shreveport, La., are considering a plan whereby the city can be furnished with a better water supply. It is said that the plan contemplates the expenditure of about $150,000 by the water company and the pumping of water directly from the river to the waterworks plant.

Maryland.

✣Bids will be received until 11 a. m., April 26, by Board of Awards, Baltimore, Md., for furnishing and delivering and erecting complete to the Water Board of Baltimore, one 30,000,000 gallon Vertical Triple Expansion Pumping Engine, two batteries of two boilers each, the necessary steam piping between engines and boilers, and economizers for heating the feed water, for the Mount Royal Pumping Station, Baltimore, Md., according to specifications which may be obtained at the office of the Water Engineer, City Hall, Baltimore, Md.

All proposals must be accompanied by a certified check of the bidder drawn to the order of the Mayor and City Council of Baltimore, on a clearing-house bank for $2,000. Alfred M. Quick, [illegible]

The Cumberland, Md., city council on April 4 passed an ordinance fixing May 16 as the date for the election to vote on the $500,000 bond proposition for a new water supply. Should the proposition carry, Evitts creek would be the source of supply.

Mississippi.

It is reported that the citizens of Seminary, Miss., have voted the issuance of bonds in the sum of $10,000 for the installation of a water works.

The citizens of Bassfield, Miss., on April 3 voted the issuance of bonds for the purpose of installing a water works system.

Missouri.

✣Bids [illegible] April 20, by Board of Public Works, Moberly, Mo., for the improvement of the water works. The work is divided in sections as follows: Section 1. Two four-valve high speed automatic engines. Certified check $200. Section 2. Two 75-KW. A. C. Generators, 2,300 v. for direct connection to above engines. Complete with exciters, etc. Certified check $200. Section 3. One 2,000,000-gal. crank and flywheel pumping engine. Certified check $200. Section 4. Three horizontal high pressure return tubular boilers, 125 HP. each. Certified check $275. Section 5. One 400-HP. feed water heater and boiler feed pumps. Certified check $50. Section 6. Heads for two wells already sunk. All motor driven. Certified check $100. Section 7. One switchboard. Certified check $100. Section 8. One brick stack 85 ft. high. Certified check $100. Section 9. Construction of power house, construction of street lighting system and setting and connecting up of machinery and equipment. Certified check $500. Rollins & Westover are Consulting Engineers, Beals Bldg., Kansas City, Mo.

Nebraska.

The citizens of Bridgeport, Neb., have voted the issuance of bonds to the amount of $17,000 for the purpose of putting in water works.

New York.

⊙The Board of Public Works of Geneva, N. Y., has awarded the contract for furnishing the water department with a pump to the Snow Pump Works of Buffalo, N. Y., for approximately $14,000.

The Board of Trustees of the Village of Honeoye Falls, N. Y., called an election on April 6 for the purpose of voting on an appropriation of $1,000 for a preliminary investigation to obtain a water supply.

The citizens of Lancaster, N. Y., have voted in favor of the proposition to raise by taxation the sum of $2,000 to extend the water mains, and to take from the sewer fund the sum of $12,000 and place to the credit of the street fund for paving purposes.

The following bids were received March 31 by the Board of Contract and Supply, Troy, N. Y., for the construction of the Martin-Dunham reservoir: Reservoir Construction-McDonough Construction Co., $155,278; Corliss Construction Co., $158,851; Philip Casey, $174,703; Brown & Lowe, $186,284; Powers & Mansfield Co., $199,219; Haggerty & Drummond Co., $214,410, and Winston Construction Co., $219,529. Cast iron pipe, John Fox & Co., $2,163; Donaldson Iron Co., $2,153; Charles Miller & Sons Co., $2,138, and R. D. Wood & Co., $1,997. Valves, etc., Ludlow Valve Co., $978; Eddy Valve Co., $1,033, and Rensselaer Valve Co., $1,038. John Flynn Jr., Electrical and Civil Engineer, 83 Third St., Troy, N. Y., is Engineer in charge.

North Dakota.

Plans for the proposed filtration plant for the city of Fargo, N. Dak., have been completed and submitted to the city council for its approval. The plant, inclusive of the head house, filter beds and sedimentation basins, will be 210 ft. in length and the greatest width of the building will be 170 ft.

Ohio.

✣Bids will be received by Director of Public Service, Canton, O., until April 12 for the erection of an auxiliary water works pumping station in Navarre St.

⊙W. E. Wynne, Village Clerk, Feinbank, O., received bids March 20 for furnishing and laying 14,125 ft. of 4-in., 6-in. and 12-in. water pipe, placing 34 fire hydrants, 504 6-in. and 12-in. valves and boxes, and 16,500 lbs. of special castings. The U. S. Cast Iron Pipe & Foundry Co. received the contract for furnishing the pipe; the Bourbon Copper & Brass Works Co., for furnishing valves and boxes, and J. H. L. Barr for construction work. The total cost is $14,238.

A bond issue amount of $106,000 has been introduced in the City Council of Cincinnati, O., to provide funds for the construction of a tunnel under the bed of the Little Miami River in connection with the proposed water pipe extension to the village of Mt. Washington, and also to extend a 12-in. main to Madisonville.

Plans are being laid by Superintendent George Cotter of the water works department, Springfield, O., to advertise for bids for material for the supply of pipe for the proposed force main, which is to be laid from the pumping plant.

The citizens of East Liverpool, O., it is reported, have voted the issuance of bonds to the amount of $175,000 for water works improvements. A mechanical filtration or well system is planned.

Oklahoma.

The citizens of Ada, Okla., have voted in favor of the proposition of installing a water works system.

Pennsylvania.

⦿O. E. Christ, Ephrata, Pa., at $11,903, secured the contract from the city council of Akron, Pa., P. D. Getz, Clerk, for the erection of a water plant, except engine and pumping machinery. Bids were opened Feb. 27. The contract was awarded April 4.

The State Water Commission, Harrisburg, Pa., has received applications for charters for the Florin Water Co., Mt. Joy township, Lancaster County; Towanda Water Power Co., Towanda and Red Hill Water Co., Red Hill, Montgomery County.

The State Water Supply Commission, Harrisburg, Pa., has approved a charter for the Dickerson Run Water Co., of Dunbar and Franklin townships, Fayette County.

Advices from Johnstown, Pa., state that the Johnstown Water Co. will expend between $4,000 and $5,000 in the remodeling of the recently purchased Robert Sagerson property, located at the corner of Locust St. and Potts Pl.

A great deal of opposition has developed to the Fahey bill now before the House Municipal Corporation Committee of the state legislature, Harrisburg, Pa. The bill prohibits the use of alum in filtration plants and it is claimed that if it is passed it would put many plants out of commission and cause heavy expenditures with doubtful benefits. Out of the 66 plants now in operation in the state all but five are said to be compelled to use alum.

Plans and specifications are being prepared by Chester & Fleming, Consulting Engineers, Union Bank Bldg., Pittsburg, Pa., for a concrete lining for a large circular masonry reservoir belonging to the Ohio Valley Water Co., at Bellevue, Pa. This work will be complete at an early date.

South Dakota.

The W. K. Palmer Co., Engineers, 717 Dwight Bldg., Kansas City, Mo., have been engaged as engneers for the city of Vermillion, S. Dak., in connection with the remodeling of the water works system which is soon to be taken over by the city, and also in connection with the design and construction of a modern electric lighting plant and system. Particulars can be had from the office of the engineers.

Tennessee.

A bill has been introduced in the legislature authorizing the city of Dayton, Tenn., to issue bonds in the sum of not exceeding $25,000 for the installation of waterworks, but provides that the question shall first be submitted to the voters of the city.

The Sparta Water Works Co., Sparta, Tenn., has been sold to J. A. Wilson. The new owner plans to make various extensions and improvements.

Texas.

The city of Eagle Lake, Tex., contemplates municipal ownership of the present water works system owned by George Herder of Eagle Lake. A bond issue will probably be voted upon for water and sewer systems.

Bids for the construction of a duplicate water main across Galveston bay to supply the city of Galveston, Tex., with water from the wells at Alta Loma were opened April 3 by the city secretary. The main will be located on the causeway and will be 10,766 ft. in length. The following bids were received: Isaac Hefferon, Galveston, $66,389; A. M. Blodgett Construction Co., $70,652; Kelso & Vautran, $72,025, and A. L. Patterson, New Orleans, La., $85,051.

W. C. Teter of New York City, president and owner of the Beaumont Water Works Co., Beaumont, Tex., has employed J. E. Gibson, water works engineer of Philadelphia, Pa., to investigate the feasibility of providing a better source of supply for the mains and pipes of the Beaumont water works.

Washington.

✣Bids will be received until May 1, by F. E. Tily, Municipal Clerk, Penticton, B. C., for the pipes, hydrants, valves, meters, and also for the construction of infiltration chambers, reservoir, works, and excavation for and laying of pipes for water works system in the municipality. Tenders requested for material (1) pipe, cast iron and special; (2) pipe, wrought iron, galv.; (3) hydrants, valves and other fittings; (4) meters; (5) steel pipe, lapwelded; (6) and for excavation and laying of pipes and fittings and general construction.

⦿Bids were received April 1 by Nicholas Lawson, Commissioner Light and Water, Tacoma, Wash., for constructing a concrete lined reservoir and for laying a 27-mile pipe line. George P. Wright, California Bldg., Tacoma, at $736,750, was awarded the contract for constructing the pipe line which will include two miles of riveted steel pipe, 25 miles of wood stave pipe and 27 miles of telephone line. Maxham & Berne, 221 North I St., Tacoma, at $287,770, secured the contract for constructing a 110,000,000-gal. reservoir, requiring 283,000 yds. of excavation and 25,000 yds. of concrete. E. R. Preble, Tacoma, is chief engineer of the Green River Gravity System.

The Centralia, Wash., Water Supply Co. has been sold to the Oregon-Washington corporation. It is the intention of the new owners to install a gravity system for Centralia and Chehalis, four miles apart. The water will be taken from the Newaukum River. The estimated cost of the system is $175,000.

The Washington-Oregon corporation recently ordered more than $60,000 worth of pumps, pipe and supplies for improvements to the Vancouver Water Works. A 16-in. pump, connected with an electric motor, with a capacity of pumping 2,000,000 gals. of water in 24 hours, was ordered for the upper reservoir, which holds 1,250,000 gals. of water. A 12-in. pump of the same kind with a capacity of 1,500,000 gals. a day, was ordered for the lower reservoir. Eight miles of 6, 8, 10 and 12-in. pipe for new mains, and for mains for the fire hydrant system to be installed, were also ordered.

Wisconsin.

⦿A contract has been let to E. W. Van Atkin of Richberg, Wis., by the town of Buhl, Minn., for drilling a new village well which will be located close to the water plant.

SEWERAGE AND GARBAGE DISPOSAL

Alabama

✣Bids will be received until 8 p. m., April 19, by City Council, New Decatur, Ala., for furnishing labor and material for the construction of sewers provided for under Improvement Ordinances Nos. 216 and 217. John Patterson is Mayor and Henry Hartung is Clerk.

✣Bids will be received until 8 p. m., April 19, by City Council, New Decatur, Ala., for furnishing labor and material for the construction of certain sanitary sewer laterals provided for under improvement ordinance No. 221. John Patterson is Mayor and Henry Hartung is Clerk.

Arizona.

City Recorder Frank Thomas of Phoenix, [illegible]

Arkansas.

Arrangements have been completed for the installation of a sewer system in Berryville, Ark. The first section will be laid along Huntsville St.

A petition has been presented to the city council of Little Rock, Ark., by residents of the 7th Ward, providing for the creation of a new sewer district in a portion of the East End.

California.

The city council of Oakland, Cal., has called a special election for April 14 for the purpose of voting on propositions in four of the sanitary districts created under a new act of the legislature which provides for the establishing of sanitary districts within the limits of cities. Fred C. Turner is city engineer.

The Santa Fe System will shortly begin the construction of a private sewer to extend from the railroad yards to Lytle Creek in the city of San Bernardino, Cal. The pipe line is to be built at the request of the city council to make it possible for the Santa Fe to deposit its waste water in some place other than the city sewer. The line will be 2,900 ft. in length, and will cost about $15,000. M. C. Bryan, San Bernardino, division engineer.

Plans have been prepared for the installation of a sewer system in the town of Terra Bella, Cal., including a disposal plant.

The board of trustees of Dixon, Cal., has decided to call an election on or about May 2 to vote bonds for the construction of a sewer system. The plans and specifications have been prepared. The system will have a septic tank and disposal plant. The estimated cost is $40,000.

The Town Trustees of Sisson, Cal., will proceed immediately to call an election for the purpose of bonding to the amount of $40,000 for the installation of a sewer system, and for the purchase of the present water system for $20,000.

Colorado.

The citizens of Leadville, Colo., have voted in favor of the proposition to install a municipal sewer system. H. C. Rose is mayor.

Georgia.

The mayor and city council of Barnesville, Ga., have called an election for April 18 for the purpose of submitting to the citizens of Barnesville the question whether bonds to the amount of $50,000 shall be issued for enlarging the water, light and sewerage systems and for erecting new and additional buildings for Gordon institute.

Illinois.

✣Bids will be received until 8 p. m., April 17, by Board of Local Improvements, Dolton, Ill., for the construction of sewers. W. B. Ewing, 1742 Monadnock Bldg., Chicago, Ill., is engineer.

The City Council of Canton, Ill., has passed an ordinance providing that the proposition of issuing $10,000 additional sewer bonds be submitted to the voters at the April election.

The city council of Bloomington, Ill., has been petitioned for a vitrified pipe sewer on the following streets: Clay, between Willard Ave., and Woodland Ave.; Woodland Ave.,

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

between Clay and Jackson St.; Jackson St., between Woodland Ave. and Davis St. Elmer Folsom is city engineer.

Bids for furnishing and delivering 250 tons (approximate) of cast iron valve basin and fire hydrant covers to the various yards of the water pipe extension department were opened March 18 by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill. Five bids were submitted, the lowest being that of the Thos. A. Cummings Foundry Co., 1338 Clybourne Pl., at $25.40.

Following bids were received March 23 by the city of Wheaton, Ill., A. L. Webster, City Engineer, for a sewer extension: (1) Radcliffe Plumbing & Heating Co., Wheaton, Ill.; (2) The Swanson Co., 834 N. Clark St., Chicago. Ill.; (3) Chas. M. Porter Co., 702, 84 LaSalle St., Chicago, Ill.; (4) G. Maffioli & Son, Rockford, Ill.; (5) John Hayes Son's Co., Naperville, Ill.; (6) H. G. Goelitz, Oak Park, Ill.; (7) Illinois Engineering & Construction Co., 2047 Ogden Ave., Chicago, Ill.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Furnishing Pipe:							
1,764 ft. vitrified pipe, per ft	$0.11	$0.14	$0.13	[illegible]	$0.15		$0.12
50 "Y" connections	.50	.30	.50	.30	.40	...	[illegible]
Trenching, laying pipe and backfilling, per ft	.....	...	...	....		.74	.
221 ft. of 5-6 ft. cut	.25	.35	.35	.40	.40		.48
1,255 ft. of 6-7 ft. cut	.30	.45	.47	.50	.50	.	.56
400 ft. average 8-ft. cut	.35	.55	.58	.60	.65		.92
4 manholes, each	17.00	25.00	25.00	25.00	25.00	30.00	20.00
2 lampholes, each	5.00	3.50	4.50	5.00	5.00	6.00	7.00
1 flush tank	46.10	60.00	60.00	60.00	50.00	60.00	55.00
Hauling and breakage	98.00	.....	.	....	....	....	....
Extra for cutting and replacing 33 ft. of macadam paving	20.00	10.00	10.00	10.00	10.00	6.60	10.00
Totals	$1,033	$1,301	$1,333	$1,380	$1,430	$1,504	$1,571

Iowa.

Plans and specifications have just been completed for the construction of 10,340 ft. of 8-in. sewer in Essex, Ia. The contract will be let some time in May. Delbert Wheeler of Shenandoah, Ia., is engineer.

No contracts were awarded by the city of Clinton, Ia., W. E. Hayes city clerk, for the necessary labor and material for the reconstruction of certain sewers in District No. 4. Bids will again be received in about six weeks. The extent of the work is shown in the following list of approximate quantities, bids being opened April 4: Division "A"—1,343 ft. 30 in. 1½ ring brick sewer, 355 ft. 36 in. pipe sewer, 360 ft. 30 in. pipe sewer, 1,585 ft. 24 in. pipe sewer, 709 ft. 20 in. pipe sewer, 1,636 ft. 18 in. pipe sewer, 1,715 ft. 15 in. pipe sewer, 4,576 ft. 12 in. pipe sewer, 3,605 ft. 10 in. pipe sewer, 3,075 ft. 10 in. catch basin pipe, 4,200 cu. yds. rock excavation, 34 manholes, 41 catch basins, 63 inlet basis. Division "B"—300 ft. 48 in. 2 ring brick sewer, 500 ft. 48 in. 1½ ring brick sewer, 400 ft. 42 in. 1½ in. ring brick sewer, 410 ft. 36 in. pipe sewer, 810 ft. 30 in. pipe sewer, [illegible] 18 in. pipe sewer, 840 ft. 15 in. pipe sewer, 4,148 ft. 12 in. pipe sewer, 740 ft. 10 in. pipe sewer, 1,620 ft. 10 in. catch basin pipe, 7,200 cu. yds. rock excavation, 26 manholes, 10 catch basins, 41 inlet basins. Division "C"—1,220 ft. 12 in. sewer pipe, 580 cu. yds. rock excavation, 2 manholes. Division "D"—818 ft. 30 in. pipe sewer, 835 ft. 20 in. pipe sewer, 1,093 ft. 18 in. pipe sewer, 438 ft. 15 in. pipe sewer, 1,571 ft. 12 in. pipe sewer, 2,820 ft. 10 in. pipe sewer, 818 ft. 10 in. catch basin pipe, 2,900 cu. yds. rock excavation, 14 manholes, 11 catch basins, 18 inlet basins. All Y's, traps, slants and fittings [illegible]

Indiana.

The Board of Public Works of South Bend, Ind., has adopted preliminary resolutions for the following improvements: Sewer on Howard St.; grading on first alley west of Catalpa Ave.; pipe sewer on Clover St.; grade, curb and walks on Prairie Ave.; pipe sewer on Pipe St.; sidewalk on west side of South Michigan St., between Ewing and Chippewa Aves.; grade on Allen St., and Ewing Ave., betw[illegible]

Iowa.

✣Bids will be received until 8 p. m., April 8, by R. L. Taylor, City Clerk, Spencer, Ia., for the construction of a sewer commencing at the present Water St. sewer and running west along the center line of 4th St. to a point where the center line of said 4th St. intersects the center line of Hough St., a distance of 1,262 ft. Said sewer to be 8 ft. 7¼ ins. deep at Water St. and 8 ft. 6 ins. deep at Hough St. and to be constructed of 10-in. salt glazed first quality vitrified sewer pipe solidly cemented at the joints and provided with 50 6-in. Y connections, six catch basins and three man holes.

⦿The city of Corydon, Ia., has awarded the contract for the construction of water works and sewerage to Bosch & Gray of Joplin, Mo., for $26,872 and $16,119 respectively. Work is to commence at once and it is expected to have everything completed by October 1.

⦿The city council of Indianola, Ia., has let the contract for the construction of 4½ miles of sewer in the north part of town, and for a septic tank to the Little Construction Co., of Sioux City, Ia., for $24,950.

The city council of Des Moines, Ia., has been petitioned for a sanitary sewer on East 14th St., between Washington and Thompson Aves. The approximate length of the sewer is 2,000 ft.

The city council of Sioux City, Ia., has rejected all bids received for the construction of a storm sewer for the west side in West Fifth St., owing to a misunderstanding as to the time of entering the bids. The council has authorized Councilman E. O. Wesley to readvertise for bids.

The city of Manning, Ia., again contemplates the installation of a sewer system. Plans have been drawn and estimates submitted to the town council who voted for the sewer system.

The city council of Cedar Rapids, Ia., plans the issuance of bonds in the sum of $20,000 or $25,000 for the building of storm sewers in the south end of the west side. P. P. Smith is city engineer.

The city council of Clinton, Ia., intends to repeal all former resolutions and notices in regard to the construction of the completion of sewers in Sewer District No. 4 of Clinton, and will not take bids on April 4 as contemplated. Bids will be taken about the 2nd day of May. This is in consequence of providing another plan of time of payment. R. C. Hart is city engineer.

Kentucky.

⦿The Louisville Sewer Commission, Louisville, Ky., has awarded the C. T. McCracken Co., of Columbus, O., the contract for the construction of three sewerage systems in various parts of the city. The three systems have been designated as the Fourth Ave. sewer, extending from Hill St. to A St.; the Twenty-eighth St. sewer, extending from Walnut St. to an alley north of Jefferson St., and the Cedar St. sewer, extending from Nineteenth St. to Twentieth St. The most important contract was that providing for the [illegible] will be of concrete material, 5 ft. in diameter. The lowest bid was $10,559. The Fourth Ave. sewer will be a small pipe system. The lowest bid was $2,307. The Twenty eighth St. sewer also will be a pipe system, a little [illegible] was $3,510. Other bidders were: James Ferry & Son, Pittsburg; James Duff Construction Company, Cleveland, and R. D. Smith & Co., [illegible] Henry Bickel Company and Lynch & Eady, all of Louisville.

Residents of Eastover, a suburb of Louisville, Ky., are working on plans for a comprehensive sewer system.

Louisiana.

The board of sewerage commissioners, Opelousas, La., was formally organized in that city on April 3. Steps have been taken to submit the question of a bond issue and a special tax in support thereof to the property taxpayers of the district, so that the election will be held at an early day. E. B. Dubuisson is president; William J. Sandoz, secretary, and H. E. Estorge, treasurer.

Massachusetts.

✣Bids will be received until 3 p. m., April 17, by Committee on Sewerage, Charles S. Holden, M. D., chairman, Attleborough, Mass., for furnishing cast iron pipe and special castings, including the following approximate quantities; 30-in., 396 ft.; 24-in., 4,860 ft.; 20-in., 11.388 ft.; 18-in., 1,500 ft.; 16-in., 552 ft.; 12-in., 1,368 ft.; 10-in., 648 ft.; 8-in., 1,956 ft.; 186 pieces of special castings ranging in size from a 6-in. on 8-in. Y branch to a 24-in. on 24-in. tee branch—in all about 59.06 tons.

Michigan.

The city of Kalamazoo, Mich., has issued bonds to the amount of $103,000 for the sanitary sewer and the water service extensions and the Gull St. bridge.

The Board of Public Works of Pontiac, Mich., has been petitioned for sewers on South Paddock St., from Foote St., as far as needed, and on Henderson St., from Cooley St., to Huron St.

The Board of Health of Kalamazoo, Mich., will probably take steps to have the bond issue, which amounts to $25,000 for the ensuing year, increased to $100,000. The increase is necessary on account of the number of petitions received for sanitary sewers.

Minnesota.

✣Bids will be received until 8 p. m., April 17, by V. N. Roderick, City Clerk, Brainerd, Minn., for the construction of a new sewer in District No. 5 in that place.

✣Bids will be received until 8 p. m., April 17, by V. N. Roderick, City Clerk, Brainerd, Minn., for the construction of a new sewer in Sewer District No. 4 in that city.

City Engineer T. F. McGilvray of Duluth, Minn., has submitted his report on the proposed Woodland sewer to the city council.

The Duluth Engineering Co., 613-14-15 Palladio Bldg., Duluth, Minn., has prepared plans for an intercepting sewer, with purification plant, and a storm water system for the city of Ely, Minn., to cost about $20,000.

Missouri.

The city council of Cameron, Mo., has passed an ordinance authorizing the purchase of 10 acres of land in southeast Cameron upon which it is proposed to erect a purification plant for a system of sewers.

Arrangements have been completed for the installation of a sewer system in Madison, Mo., and, it is said, within a short time work will begin on the construction of the same. The estimated cost of the system is $200,000. The sewer will also care for the sewage from Venice. B. H. Colby, civil engineer, St. Louis, Mo., will have charge of the work.

The citizens of Holden, Mo., at the regular spring election on April 4, defeated the proposition to establish sewer districts.

The officials of Kansas City, Mo., contem[illegible] proposed that the city collect waste and garbage direct instead of letting the work by contract.

The City Council of Kansas City, Mo., has approved a resolution calling upon the board of public works to proceed immediately with the construction of a joint sewer in the Brush Creek valley district. William Buck[illegible] Works.

The Des Peres Improvement and Protective Association, St. Louis, Mo., which was or-

[illegible] struction of a storm water sewer for the [illegible] by the association includes the territory from [illegible] the city limits between Maple Ave. and Forest Park. This district includes Washington Heights, First and Second Additions, Parkview, West Cabanne and Hamilton place. A. H. Frederick is president of the association.

The City Council of Chillicothe, Mo., has instructed City Engineer Broaddus to make an estimate of the cost of a sewer from the intersection of Polk and Cherry Sts., north on Cherry for three blocks.

Montana.

The State Board of Health of Montana, at Helena ,has approved the endorsement of Secretary Tuttle for sewer plants at Roundup and Whitefish, and for water works plants at Townsend and Harlowton. The proposed Billings sewer plant was rejected. Dr. William Treacy of Helena is president, and Dr. T. D. Tuttle, Helena, is secretary.

The Town Council of Terry, Mont., has passed a resolution providing for the submission of the question of constructing a sewer line along Logan Ave. to the vote of the people at the general election to be held April 3.

New Jersey.

The town of Nutley, N. J., has decided to enter into a contract with the Passaic Sewerage Commission for participation in the cost and benefits of the proposed trunk sewer. The estimated cost of the sewer in $12,250,000.

The borough of North Plainfield, N. J., has decided to complete its plans for the installation of sewers in Bound Brook.

MacArthur Bros. Co., contractors of New York City and Chicago, are reported to have made an offer to the Passaic Valley Sewerage Commission, Newark, N. J., whereby they propose to build the Passaic Valley sewer for $12,235,000.

The Township Committee of Millburn, N. J., has passed a resolution favoring the sale of a portion of the joint trunk sewer, of which Millburn is a part owner, to the borough of Roselle Park. The owners of the sewer, besides Millburn, are the city of Newark, Summit, South Orange, West Orange and Irvington. Roselle Park wishes to purchase $15,000 worth of capacity in the sewer.

New Mexico.

The City of Roswell, N. Mex., will lay 3,400 ft. of 8-in. sewer down the alleys in the Lea subdivision, between 2nd and 3rd and between 3rd and 4th Sts.

New York.

⦿The contract for the construction of the 52-in. sewer in Lafayette Ave., and other streets in the north end of Niagara Falls, N. Y., has been awarded to the Reed-Coddington Engineering Co.

⦿E. A. Matthews, 21 Park Row, New York City, has been awarded the contract by George McAneny, president of the borough of Manhattan, New York City, for reconstructing outlet sewer and appurtenances at the foot of 79th St., East River, for $4,255. Bids were opened April 3.

The citizens of Franklinville, N. Y., have voted, at an election held March 21, an appropriation of $600 for plans and specifications for a village sewerage system.

At a special election held in Hamburg, N. Y., on March 21, the citizens voted against the proposition of building a drainage sewer.

The Committee of Sewers of the City Council of Huntington, L. I., has decided to call a public meeting for April 17 for the purpose of getting public opinion on the proposed plans for the formation of a sewer district. It is, at present, planned to construct a disposal plant and a system of mains covering the highways of the district. The district included extends from Prime Ave. and Spring St., on the east, with a spur to the high and primary school building, and top of Cold Spring Hill on the west. The proposed plant will cost approximately $77,500. Herring & Fuller, 170 Broadway, New York City, Engineers.

The citizens of East Aurora, N. Y., on March 21 voted in favor of the proposition of issuing bonds to the amount of $100,000 for the installation of a disposal plant and sewage system. Alfred Brotherhood is town trustee.

An election is contemplated in Kenmore, N. Y., for the purpose of voting on the proposition of building a sewer system at an estimated cost of $55,000.

Advices from Syracuse, N. Y., state that the governor has signed the intercepting sewer bonding bill which permits the city $350,000 additional on its sewer and creek improvements, and also provides for certain changes in the method of selling the bonds.

North Dakota.

⦿The City Commission of Minot, N. Dak., has awarded the contract for the construction of the North Side sewer system to G. W. Kemper of Minot for $29,926. Other bidders were: Illstrup & Olson of Minneapolis, Minn., $31,854; G. W. Haggert of St. Paul, Minn., $31,327; C. H. Porritt, Fargo, N. Dak., $31,550, and Magee Johnson of Minneapolis, Minn., $31,400.

Ohio.

✣Bids will be received until noon, April 17, by Board of Public Service, Dayton. O., for the construction of the following sanitary sewers: District No. 9 territory lying north of Victor St., District No. 6, Lakeview Ave., from Germantown St. to new corporation line. W. A. Budroe is Clerk of the Board.

✣Bids will be received until noon, April 14, by Director of Public Service, Columbus, O., for the grading and paving of a number of streets and the construction of several sewers throughout the city. H. S. Holton is Director and D. A. Jones is Clerk.

✣Bids will be received until 3 p. m., April 17, by Committee on Sewerage, C. S. Holden, M. D., chairman, Attleborough, Mass., for furnishing manhole collars and covers. J. J. Valkenburgh is engineer.

⦿Service Director Sundmaker of Cincinnati, O., has awarded Charles L. Wright the contract for the construction of a sewer in Potomac Ave., and adjacent streets for $8,544, and the Connelly Construction Co., the contract for the construction of a sewer in West 8th St., for $7,353.

⦿The Board of Control of Hamilton, O., has awarded the contract for a sanitary sewer on South C St., to W. H. Louthan for $2,049.

The City Council of Girard, O., has passed an ordinance providing for the construction of storm sewers in District No. 3.

T. B. Husband was the lowest bidder for the construction of bridge work, per report No. — storm sewer, Elmyra Road, Warrensville township, for which bids were received April 5 by John F. Goldenbogen, clerk, county commissioners, Cleveland, O.

The City Council of Marysville, O., has selected Consulting Engineer E. A. Kemmler of Columbus, O., to prepare plans and specifications for the proposed sanitary sewerage.

Oklahoma.

⦿The following contracts have been awarded by the city of Duncan, Okla., in connection with the proposed sewerage system to be installed in that city: W. S. Dickey Clay Mfg. Co., St. Louis, Mo., pipe, $10,401; Chas. M. Keer, Oklahoma City, Okla., ditching machine, $3,450; Union Iron Works, El Reno, Okla., castings for manholes and lamp holes, $808; Malone Brick Co., Duncan, 135,000 brick, $1,012; W. S. Dickey Clay Mfg. Co., four flush tanks at $21 each, and four regulators at $4 each. All bids for building manholes were rejected and will be readvertised.

The City Council of Tulsa, Okla., has passed an ordinance creating a new sewer district to be known as District No. 27, which includes 27 blocks. District No. 27½ was also created, which comprises block 82 of the original town.

Advices from Stillwater, Okla., state that an election was held in Yale on April 3 for the purpose of voting on the issuance of bonds to the amount of $25,000 for the installation of a water works.

Oregon.

An election will be held in Hillsboro, Ore., on April 17 for the purpose of voting on a new charter to permit the installation of a sewer system.

City Engineer Bush Davis of Newport, Ore., has submitted plans of the proposed sewer system to the city council. An election will soon be hold to vote on the proposition of installing the system.

Advices from Portland, Ore., are to the effect that the contract will soon be let for the construction of the Brooklyn sewer branch, Rhine St. sewer. This branch of the Brooklyn sewer system between Holgate and Powell Sts. connects with the south Brooklyn branch on East 16th and Rhine Sts. It runs northeast along the Powell Valley road for some distance, supplying a large district.

Pennsylvania.

✣Bids will be received until April 19 by West New York Improvement Co., 112 North Broad St., Philadelphia, Pa., for furnishing all of the material and constructing a system of sewers, grading streets and sidewalks and completing the same. Oro J. Darling, 17th St. and Bergenline Ave., West New York, N. J., is engineer.

A committee of the city council of West Middlesex, Pa., has been named to go to New Wilmington and make inquiries as to the cost and the maintenance of the new sewage disposal plant that has been installed there within the past year, with a view to installing a similar one in West Middlesex.

It is reported that the City Engineer of McKeesport, Pa., will have the plans completed by May 15, for the construction of the Eighth ward sewers. H. S. Arthur is Mayor.

Mayor Meals of Harrisburg, Pa., has signed the ordinance passed by the city councils authorizing the building of the river front intercepter and the Paxton creek improvements. The ordinance provides that a consulting engineer shall be secured to help the plans for the sewer, and that his compensation shall not be more than $3,000. M. B. Cowden is city engineer.

The Chairman of the Highway Committee of York. Pa., on March 21, was authorized to advertise for bids for the laying of a sewer on Richland Ave., from Market St. to Princess St., and to ask for bids for the repair of such asphal-paved streets where guarantees have expired.

Albert F. Damon of Darby, Pa., special engineer employed by the Borough of West Chester, Pa., is engaged in preparing specifications for the new sewer plant for the borough. The revised plans have been endorsed by State Health Commissioner Dr. Samuel G. Dixon. The work will probably be started on the borough's property, in West Goshen and East Bradford, on what was formerly the Benjamin Place farm, where the disposal plant and septic beds are to be located. The main sewer to the plant will pass through the hill north of the Corcoran's stone quarries, and on the Strasburg road to West Chester. There will be a tunnel bored through the hill, a considerable distance. Sewage, it is said, can be run to the beds by gravity from about one-half of West Chester, north of Gay St. The other half will be drained to a proposed plant at "Point of Rocks," near Eachus' mill, south of West Chester, where it is intended, it is said, to erect another disposal plant later.

Rhode Island.

⦿F. H. Gammino of Providence, R. I., has been awarded the contract by the highway committee, Putnam, Conn., for Sewer Contract No. 5, the work including 600 ft. of 24-in. vitrified sewer, 300 ft. of 20-in. vitrified sewer, 1,080 ft. of 15-in. vitrified sewer, 600

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

ft. of 12-in. vitrifi[illegible] 700 ft. of 10-in vitrified sewer, 7,900 ft. [illegible] in. vitrified sewer, and 31 manholes. [illegible] opened March 24. The contract pr[illegible]

South Dakota.

The City Commissioners of Huron, S. Dak., have rejected all bids received for the extension of the 9th and 3rd St. sewers. The work will be re-advertised.

An election will be held in Madison, S. Dak., on April 18 for the purpose of voting on the proposition of issuing bonds in the sum of $65,000 for the installation of a sewerage system. Plans and specifications for this work are now practically complete, and should the proposition be voted upon favorably at the election, bids will be asked and the work pushed as rapidly as possible. The Missouri Valley Engineering Co., Mitchell, S. Dak., is consulting engineer.

Tennessee.

An enabling act will be presented to the legislature by the city of Knoxville, Tenn., for passage which provides for an issue of bonds for $125,000 to be used for the purpose of constructing a sewer along the banks of Third Creek, from the Southern railway to the river.

Texas.

⊙Truehart & Jackson of San Antonio, Tex., have been awarded the contract for the installation of the city of Beeville's, Tex., sewer system for which bonds in the sum of $30,000 have been sold.

The Committee of Citizens of Longview, Tex., appointed to confer with the owners of the sewerage system with reference to purchase by the city, have decided that the figures of J. M. Walker, president and general manager of the sewerage company, of $27,500, are reasonable and advised the council to purchase the system.

West Virginia.

The City Council of Moundsville, W. Va., has awarded the contract for constructing a complete system of sanitary and surface sewerage for the city to B. F. Sweeten & Son of Camden, N. J., for $121,180. Other bids received were: Henning Vineyard Co., Evansville, Ind., $222,912; Thorney Pietro, of Morgantown, W. Va., $145,943; Whiting Middleton Construction Co., Baltimore, Md., $268,217; P. J. Kerns, of Knoxville, Tenn., $162,965; J. B. McCleans, Newport, Ky., $174,087; Van Meter Construction Co., Steubenville, Ohio, $132,215; Althous Construction Co., St. Louis, Mo., $201,609; Trainer & Scanlon, Huntington, West Va., $169,562; James Ferry & Sons, Pittsburg, $157,500; Rosser & Maloney, Bellaire, Ohio, $147,511; Cantrel Construction Co., Pittsburg, $165,000; M. O'Heron Co., Pittsburg, $196,608; John W. Stringer, Rayland, Ohio, $148,726; Thomas W. Savage, Parkersburg, W. Va., $149,932; W. H. & C. F. Thompson, Baltimore, Md., $174,692

Wisconsin.

✣Bids will be received until April 15, by City Council of Kenosha, Wis., for the construction of a trunk sewer estimated to cost $105,000. John W. Alvord, Hartford Bldg., Chicago, Ill., is Consulting Engineer.

⊙The Board of Public Works of Appleton, Wis., has awarded Julius W[illegible] the contract for the construction of the sewer on Bruecke St., which is to be about 18 ft. deep and run 940 ft. with 15-in. vitrified clay and 221 ft. of 14-in. cast iron pipe. The contract price is $2,886.

⊙The contract for the construction of a sewer system in Evansville, Wis., has been awarded to Robert Nelson of Racine, Wis., for $16,459. The work is to be completed by Nov. 1.

⊙The City Council of Burlington, Wis., P. J. Hurtgen, City Engineer, has awarded the contract for the construction of sewers in the city to C. E. Reed of Burlington at the following bid: bids being opened March 24: 1,250 ft. 15-in. vitrified pipe, $.45 per ft.; 938 ft. 12 in. vitrified pipe, $.34 per ft.; 518 ft. 10-in. vitrified pipe, $.28 per ft.; 290 ft. 8-in. vitrified pipe, $.25 per ft.; seven manholes, $23 each; 18 10-in. ¼ bend, $3 each; total amount of bid, $1,110.

Canada.

✣Bids will be received until noon, April 21, by City Commissioners, Saskatoon, Sask., for the following material: Contract No. 89, furnishing cast iron pipe and specials; contract No. 90, furnishing fire hydrants, gate valves and valve boxes; contract No. 91, furnishing sewer pipe and junctions; contract No. 92, furnishing manhole frames and covers. Specifications, instructions to bidders, general conditions, forms of tender, and forms of agreement may be seen at the office of the City Engineer, Saskatoon.

Advices from Toronto, Ont., are that bids are to be called for at once for the construction of a sewage plant at North Toronto. T. Aird Murray, Toronto, is Engineer.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until 2 p. m., April 28, Room 25, Potter Bldg., Birmingham, Ala., for the erection of a mine rescue station building on a lot situated in the West End Birmingham.

Alaska.

✣Bids will be received until 11 a. m., May 27, by Commanding Officer, U. S. Marine Barracks, Sitka, Alaska, for a wharf, trestle, etc., at the U. S. Naval coal depot, Japonski Island, Sitka, Alaska.

Arizona.

✣Bids will be received until 3 p. m., May 19, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office and Court House at Phœnix, Ariz.

California.

✣Bids will be r[illegible] p. m., April 27, by Department of Interior, Office of Indian Affairs, R. G. Valentine, Commissioner, Washington, D. C., for employes' quarters, Greenville School, Cal.

⊙J. C. Franks Dredging Co., San Francisco, Cal., has been awarded the contract for dredging about 100,000 cu. yds. of material from Redwood Creek for the U. S. Government.

The Tunnel Committee of the City of Alameda has applied to County Supervisors at Oakland for a $3,500 appropriation for the securing of preliminary data regarding the building of the tunnel.

Board of Harbor Commissioners of Los Angeles has approved plans of Homer Hamlin, City Engineer, for filling Main and Canal Sts. and Broadway and the private property between these streets from Sixth to Front St., at Wilmington. The plan is to use the material dredged from in front of city waterfront land and place it on the low spots in the business portion of Wilmington. It is estimated that the damage to private property will be about $25,000 and that it will cost about $60,000 to do the dredging.

L. A. Thompson has applied to the U. S. War Department for permission to construct a pleasure pier in the city of Santa Monica extending from the southerly line of Raymond avenue to the southerly line of Kinney street, and extending 404 ft. into the ocean from the high water line.

Colorado.

The trustees of the Myron Stratton Home for the Poor, Tyson S. Dines of St. Louis, Mo., and Dr. D. H. Rice and William Lennox of Colorado Springs, have signed a contract with George Edward Barton, Colorado Springs, to prepare the plans for the home. The home will be erected at an initial cost of $1,000,000. This will include various buildings and improvements on the site of the old Broadmoor dairy. The trustees a year ago bought 3,500 acres, including Broadmoor townsite, hotel, casino and water system.

District of Columbia.

✣Bids will be [illegible] 11 [illegible] 3, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for two electrically operated floating cranes [illegible] Navy yard, Boston, Mass., [illegible] the U. S. Naval [illegible] Pearl Harbor, Hawaii.

✣Bids will be received until noon, April 25, by Lieut. Col. W. C. Langfitt, U. S. Engineer, 920 17th St., N. W., Washington, D. C., for furnishing and delivering 260 tons, more or less, special iron castings and bolts.

✣Bids will be received until April 25, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under circular 627 chain, milling cutters, spiral end mills, machine bits, reamers and slitting and band saws.

✣Bids will be received until 2 p. m., May 4, by Commissioners District of Columbia, Washington, D. C., for furnishing during the fiscal year beginning July 1, 1911 and ending June 30, 1912, as follows: Stationery, printing, furniture and housefurnishings, hardware and tinware, miscellaneous (photographic supplies, rubber stamps, flags and athletic goods); plumbing supplies; groceries and provisions; boots and shoes; drugs and chemicals; glass, paints and oils; lumber; meats, fish and poultry; dry goods, electrical supplies; ice; fuel; saddlery and wheelwright supplies; kindergarten supplies; laundry work; automobile supplies, and for the purchase of waste paper during the period named.

✣Bids will be received until 10:30 a. m., May 27, by Capt. F. C. Boggs, General Purchasing officer, Isthmian Canal Commission, Washington, D. C., for miter gate moving machines, miter forcing machines, and electric motors for same lock gates.

✣Bids will be received until 2:30 p. m., April 27, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing equipment necessary to completely equip the mechanical filters at Gatun.

✣Bids will be received until 2 p. m., April 25, by Treasury Department, Office of General Supply Committee, Washington, D. C., for furnishing supplies for the fiscal year of 1912.

Bids were opened March 30 by the General Purchasing Officers, Isthmian Canal Commission, Washington, D. C., for furnishing three pairs of emergency dams at the upper locks of Gatun, Pedro Miguel and Mira Flores. The bids received were as follows: U. S. Steel Products Co., 30 Church St., New York, dams at Gatun Locks, $811,419; dams at Pedro Miguel Lock, $811,419; dams at Mira Flores Locks, $749,391. Pennsylvania Steel Co., Steelton, Pa., dams at Gatun Locks, $823,251; dams at Pedro Miguel Lock, $823,251; dams at Mira Flores Locks, $756,118. McClintick Marshall Construction Co., Pittsburg, Pa., dams at Gatun Locks, $781,875; dams at Pedro Miguel Lock, $781,875; dams at Mira Flores Locks, $715,922.

Georgia.

✣Bids will be received until May 1, by Capt. Charles D. Winn, Constructing Quartermaster, Fort Screven, Ga., for furnishing and delivering at the fort door and window screens for quartermaster's store house and for civilian employes' quarters.

⊙ indicates a contract let recently. ✣ indicates work now open for bids.

Hawaii.

✣Bids will be received until 11 a. m., April 29, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for [illegible] water tube boilers, equipped with all [illegible] superheaters, a flue and stack, furnished and [illegible] in the central power plant at the United States naval station, Pearl Harbor, Hawaii.

✣Bids will be received until 11 a. m., April 29, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing one [illegible] cu. ft air compressor with intercooler, aftercooler and air receiver for the central power plant, U. S. naval station, Pearl Harbor, Hawaii.

Idaho.

✣Bids will be received until 10 a. m., June 1, by U. S. Reclamation Service, 605 Federal Bldg., Los Angeles, Cal., for the enlargement of the Main South Side Canal, between stations 789 and 799, near Boise, Idaho, involving the excavation of about 13,000 cu. yds. of material. For particulars address the U. S. Reclamation Service, Washington, D. C., or Boise, Idaho.

Illinois.

✣Bids will be received until 3 p. m., May 17, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office at Pana, Ill.

⊙Proposals for furnishing and delivering lumber to the Fire Department, Chicago, Ill., Chas. Seyferlich, Marshall, were opened and the bid of the Edward Hines Lumber Co. was accepted as low, offering to fulfill specifications as to sizes and quantities enumerated in specifications for $14,200.

B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing tug service to the various cribs from March 15 to Dec. 15, 1911, to Jno. Rolson, at $543 per month.

Bids will be received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., until 11 a. m., April 8th, for erecting a dock on the north side of the main channel of the Chicago River across the foot of Orleans. The work consists of the removal of 91 ft. of old dock and the construction of 91 ft. of new dock to consist of white oak piles, capped, sheathed with oak sheet piling and pine battens and anchored back by wrought iron rods to anchor-piles and back logs with fender wales attached to channel face of dock. The dock piles are to be straight, sound white oak piles, 40 ft. long, tapering from 9 ins. in diameter at small end to not less than 18 ins. in diameter at butt end, and are to be spaced not less than 5 ft. from center to center and aligned. Anchor piles to be 3 ft. long, 18 ins. in diameter at butt end and are to be spaced 7 ft. center to center, and in parallel line, at a distance sufficient to permit of 40 ft. tie rods to be used, with front iron. The caps are to be of white oak, 12 ins. x 12 ins. and not less than 22 ft. long. The back log is to be 10x12 Norway pine or 12x12 hemlock, not less than 16 ft. long and 3.5 ft. above water level, sheet piling to be 4 ins. x 12 ins. and 30 ft. long; the tie rods are to be 40 ft. long of wrought iron 1¼ ins. in diameter, not exceeding 5 ft. apart passing through each front pile and through back log. All wrought iron shall be of the best double refined American bar iron, tensile strength not less than 48,000 lbs. per sq. in. Detailed spans and specifications on file at office of the Commissioner of Public Works. Cash or certified check for $500 must accompany proposal.

Bids for furnishing lumber to the Bureau of Streets, Department of Public Works, Chicago, Ill., were opened March 18th. The Heitler Lumber Co., Chicago, Ill., was the low bidder. The following prices were submitted: [illegible] ft. B. M. 2"x4", $[illegible] per M.; 5,000 ft. B. M. 2"x6", $19.50 per M.; 25,000 ft. B. M. 2"x8", $[illegible] per M.; 2"x10", 25,000 ft. B. M. $23.00 per M.; 25,000 ft. B. M., 2"x12", $26.00 per M.; 5,000 ft. B. M., 3"x6", $23.00 per M.; 30,000 ft. B. M., 2"x12", $26.00 per M.; 5,000 ft. B. M., 5,000 ft. B. M., 4"x4", $22.00 per M.; 5,000 ft. B. M., 4"x6", $22.00 per M.; 25,000 ft. B. M., 1"x4", 6 ft., 8 ft., 10 ft., or 12 ft long, $25.00 per M. All lumber to be No. 1 common Norway Pine, and to be delivered in commercial lengths up to 18 ft. long, as desired.

Proposals for furnishing and delivering ten storage tanks were received and opened March 23 by B. J. Mullaney, commissioner of Public Works, Chicago, Ill. The lowest bid received was $225.00 each, and was submitted by the Wm. Graver Tank Co., 217 La Salle St., Chicago, Ill.

Indiana.

✣Bids will be received until 10 a. m., April 21, by Trustee of Linlawn, Wabash, Ind., for the construction of an addition to Linlawn school. B. F. Hubbard is Trustee.

⊙The W. H. Schott Co., 39 Jackson Blvd., Chicago, Ill., has been awarded contracts for building central station heating plants at Kokomo, Ind., and Terre Haute, Ind. Orders for the Kokomo work are now being placed, but orders for the Terre Haute work will probably not be ready until May.

The Evansville & Terre Haute R. R., J. C. Muir, general superintendent, Evansville, Ind., is reported to be planning to have work started this year on the construction of large shipping docks on the Ohio River at Evansville.

Kansas.

✣Bids will be received until 10 a. m., April 17, by Constructing Quartermaster, Fort Riley, Kan., for furnishing and installing door and window screens in the following quarters. Officers, teamsters and packers. Capt. R. W. Briggs, is Constructing Quartermaster.

✣Bids will be received until 3 p. m., May 18, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office at Coffeyville, Kan.

Kentucky.

Engineers are now in the field surveying on 100,000 acres of coal land, owned by the Consolidation Coal Co., Fairmont, W. Va., in Pike and Letcher counties, Kentucky, for the purpose of making definite plans for the installation of sufficient mines to produce 3,000,000 tons per year. All of this output will be tributary to the C. & O. and the L. & N. R. R. The installation of these plants includes all necessary mines, tipples, houses, machine shops, etc. It is also proposed to erect a central power station of 5,000 alternating K. W., together with the necessary transforming stations. The water supply will probably be obtained by an impounding dam 40 to 50 feet high near the headwaters of Little Elkhorn Creek. Frank Haas, Fairmont, W. Va., is Consulting Engineer.

The following bids were received March 21 (readvertisement) by Maj. H. Jervey, U. S. Engineer, Cincinnati, O., for constructing Lock and Dam No. 29 in the Ohio River, near Ashland, Ky.: (1) Sheridan-Kirk Contract Co., Cincinnati, O.; (2) Bates & Rogers Construction Co., Chicago, Ill.:

Items.			(1)	(2)
Cofferdam, 16-ft	lin. ft.	4,200	$20.00	$26.40
Cofferdam, 10-ft	lin. ft.	1,600	5.00	16.05
Common excavation	cu. yds.	93,681	.65	.65
Rock excavation	cu. yds.	4,155	5.00	3.60
Fill	cu. yds.	19,935	.60	.45
Riprap	cu. yds.	2,500	5.00	3.60
Oak timber	ft. B. M.	69,317	100.00M	85.00M
Reinforced concrete	cu. yds.	130	15.00	13.00
Concrete	cu. yds.	36,868	8.00	6.85
Concrete paving	cu. yds.	1,200	10.00	7.20
Structural steel	pounds.	1,024,884	.065	.064
Reinforcing rods	pounds.	[illegible]	.055	[illegible]
Forgings (including W. I.)	pounds.	[illegible]	.07	.11
Bolts, etc.	pounds.	73,808	.055	.069
Iron castings	pounds.	277,357	.05	.06
Steel castings	pounds.	183,506	.10	.14
Bronze	pounds.	1,170	1.00	.75
Pipe, 5 in.	lin. ft.	370	2.00	1.85
Pipe, 4 in.	lin. ft.	2,400	1.50	1.35
[illegible]	[illegible]	770	1.00	1.35
[illegible]	[illegible]	[illegible]	.80	[illegible]
Pipe, 2 in.	lin. ft.	800	.60	[illegible]
Tile drain	lin. ft.	850	.80	.65
Drilling bolt holes	lin. ft.	[illegible]	.75	.75
			$633,526	$631,441

Louisiana.

⊙The Texas Building Co., Fort Worth, Tex., has been awarded the contract at $180,132 for constructing a parish court house at Lake Charles, La.

Maine.

✣Bids will be received until 11 a. m., May 2, by Capt. G. O. Hubbard, Constructing Quartermaster, Portland, Me., for the construction of a landing stage for boats at Fort Lyon, Me.

Massachusetts.

✣Bids are asked until noon, April 29, as noted in our last issue, by Col. Frederic V. Abbott, U. S. Engineer, 25 Pemberton Sq., Boston, Mass., for dredging in Weymouth Fore River, Mass. The work is located in Weymouth Fore River below Quincy Point Bridge and extends for a distance of about 7,500 ft. down stream from a point about 500 ft. below that bridge. The estimated quantity of material to be removed to complete the work is 267,000 cu. yds. The material is believed to be mud, sand and gravel.

Plans are under way for the development of a tract of land at Nantucket called Kimberma. The construction work includes the building of a concrete sea-wall, streets and granolithic walks and a bathing pool or lagoon. E. B. & C. L. Hayward, 62 School St., Brockton, Mass., are the engineers.

Michigan.

✣Bids are asked until 3 p. m., April 24, by Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for dredging Saginaw River, Michigan. The work to be done consists in furnishing all necessary plant, labor and supplies for dredging a channel 18 ft. in depth from the 18-ft. curve in Saginaw Bay to the mouth of the river, thence 16 ft. in depth to the junction of the Tittabawassee and Shiawassee rivers, with a bottom width of 200 ft. throughout its entire length. The total estimated quantity of material to be removed is: For Section 1—From the bay, 464,000 cu. yds., scow measure; from the river, 328,000 cu. yds. scow measure. Total, 792,000 cu. yds., scow measure. For Section 2—2,233,000 cu. yds., place measure. The material is believed to be sand, clay and hardpan.

✣Bids will be received until 3 p. m., April 27, by Lt. Col. C. S. Riche, U. S. Engineer, 57 Park St., Grand Rapids, Mich., for the following work: (1) Repairs to piers at South Haven Harbor, Mich., the estimate of work and material including the following: Cutting down and removing old work, 415 lin. ft.; oak timbers, 16,000 lin. ft.; pine or douglas fir timber, 81,107 ft. B. M.; pine or douglas fir planks for sheet piles, 253,115 ft. B. M.; drift bolts, 6,951 lbs.; screw bolts, 17,398 lbs.; angle irons, 6,914 lbs.; etc. (2) Pier repairs at Grand Haven Harbor, the work including cutting down and removing old work 666 lin. ft.; driving 2,248 lin. ft. piles furnished by U. S. Government; furnishing 8,294 lin. ft. oak piles; 95,800 ft. B. M. pine or douglas fir timbers; 16,673 lbs. drift bolts; 11,123 lbs. screw bolts, etc. (3) Stone filling at Grand Haven Harbor, Mich., the work including the placing

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

of 8,000 tons of stone. (4) Work at Muskegon Harbor, Mich., the work calling for the extension of the north revetment 1,100 ft. to Muskegon Lake, by 1,050 ft. of sheet pile revetment ending with 50 ft. of crib work at the east end, and repairing the present damaged east end of the revetment adjacent to station 32+00. (5) Work at Frankfort Harbor. This work calls for the extension of the north pier at Frankfort Harbor by one crib 100 ft. by 30 ft. by 20½ ft. deep, on a foundation of 84 piles, and with a superstructure 6 ft. high. (6) Work at Petoskey Harbor, Mich. The work to be done is repairing the top of the outer 220 lin. ft. of the stone breakwater with large stones and removing the present stone filling from between the third and fourth (counting from the outer end) small, detached cribs, and placing it in the 200-ft. section first described.

⊙Capt. Larson of Marinette, Mich., has been awarded the contract for building a $5,000 dock at Menominee, for C. I. Cook.

Minnesota.

✣Bids will be received until 3 p. m., May 9, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office at Faribault, Minn.

Missouri.

✣Bids will be received until April 17, by Board of Public Works, Kansas City, Mo., for sand to be delivered on sidetrack at the Municipal asphalt plant. A certified check for $500 must be filed with each bid.

✣Bids will be received until noon, May 1, by Maj. E. H. Schulz, U. S. Engineer, Kansas City, Mo., for the construction and delivering of steel barges.

✣Bids will be received until 3 p. m., May 22, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office at Warrensburg, Mo.

Nebraska.

✣Bids will be received until 3 p. m., May 2, by James Knox Taylor, Supervising Architect, Treasury Departmnt, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States postoffice at North Platte, Nebr.

New Jersey.

✣Bids will be received until April 18 by the Electric Launch Co., Bayonne, N. J., for dredging yacht basin located at Avenue A and North St., Bayonne, N. J.

✣Bids will be received until 3 p. m., April 26, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for a hydraulic freight lift and pumping plant in U. S. Post Office at Elizabeth, N. J.

✣Bids will be received until 3 p. m., May 11, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus and electric conduits and wiring of the United States Post Office at Hope, Ark.

New York.

✣Bids will be received until 1:30 p. m., April 29, by M. Gray Zalinski, Depot Quartermaster, Army Bldg., New York City, for remodeling plumbing in Army Bldg.

✣Bids will be received until noon, May 4, by Col. W. M. Black, U. S. Engineer, 39 Whitehall St., New York City, for the following dredging work: Wappinger Creek, N. Y., 16,300 cu. yds.; Tarrytown Harbor, 88,600 cu. yds. dredging, and removing 25 cu. yds. broken rock and bowlders; Peekskill Harbor, N. Y., 6,000 cu. yds. dredging.

✣Bids will be received until 10 a. m., April 24, by Capt. W. L. Guthrie, U. S. Engineer, Oswego, N. Y., for dredging machinery for dipper dredge.

⊙The D'Olier Engineering Co., 114 Liberty St., New York City, has been awarded the contract at $46,685 by the Board of Water Supply of that city for furnishing, installing and operating during tests at drainage chamber shaft 5, Rondout Siphon, a complete drainage equipment for unwatering the shafts and tunnel of Rondout Siphon of Catskill Aqueduct. Bids were opened March 21.

⊙U. S. Government engineers have awarded two contracts on the Black Rock Harbor improvement work. One went to the Great Lakes Dredging & Dock Co., of Chicago, for excavating at the north section of Black Rock harbor. The other goes to the Buffalo Dredging Co., Buffalo, N. Y., and amounts to $43,250, for the excavation of Bird Island Pier and widening the harbor to 200 ft.

Nevada.

✣Bids will be received until 2 p. m., April 13, by F. H. Newell, Director, Department of Interior, U. S. Reclamation Service, Washington, D. C., for furnishing electrical apparatus for Truckee Carson project, Nev. Address U. S. Reclamation Service, 605 Federal Bldg., Los Angeles, Cal., for particulars.

✣Bids will be received until 2 p. m., April 17, by U. S. Reclamation Service, 605 Federal Bldg., Los Angeles, Cal., for furnishing a 72-in. penstock for the Truckee-Carson project, Nev.

✣Bids will be received until 2 p. m., April 12, by Department of Interior, U. S. Reclamation Service, 605 Federal Bldg., Los Angeles, Cal., for furnishing hydraulic turbines for Truckee-Carson project, Nev.

Ohio.

✣Bids will be received until noon, April 24, by Board of Education, Cincinnati, O., for furnishing labor and material for alterations and additions to school buildings as follows: (1) At Walnut Hills High School, two inside toilet systems complete. (2) At Wm. H. Morgan Public School, shower bath and electric light systems complete. (3) At Horace Mann Public School, inside toilets, drinking fountains and electric light and clock systems complete. (4) At Harrison Public School, heating and ventilating, vacuum cleaning and temperature regulation systems complete and the remodeling of the building. (5) At Garfield Public School, heating and ventilating, temperature regulation, vacuum cleaning and air washer complete. (6) At Bond Hill Public School, electric lighting system complete. (7) At Webster Public School, vacuum cleaning system complete. (8) At Sixteenth District Public School, electric lighting and telephone systems complete. (9) At Fourteenth District Public School, complete system of electric light and power wiring, electric light fixtures, time clocks, program bells, house telephones and conduits for long-distance telephone purposes.

✣Bids will be received until noon, May 10, by Board of Hospital Commissioners, Cincinnati, O., for furnishing labor and material for the erection of 18 buildings composing the main group of the New General Hospital. The work will embrace the following departments: Excavation and foundations, brick work, fireproof partitions and furring, cut-stone work, ornamental terra cotta work, re-enforced concrete work, concrete piling, cement work, roofing and sheet metal work, structural iron and steel work, ornamental iron work, plastering, terrazzo floors and "marbleithic" work, tile work, marble work, carpenter work, weather strips, hardware, painting and glazing, plumbing, gas piping, electric wiring and signal system. Bids must be made in accordance with the drawings and specifications for said work as prepared by Samuel Hannaford & Sons, Architects, which drawings and specifications are now on file at the office of the Board of Hospital Commissioners in the City Hall, and at the office of said architects, Hulbert Block, Cincinnati, O.

The following bids were received March 7 by Maj. H. Jervey, U. S. Engineer, Cincinnati, O., for reconstruction in concrete of three ice piers in Ohio River at Middleport, O.: (1) standing for Fassig & Campbell, Wheeling, W. Va., (2) for Curtis & Shumway, Portsmouth, O., (3) for Pfaff & Smith Co., Charleston, W. Va., (4) for Thos. J. McKim, Cincinnati, O., (5) for Frank A. Bone, Cincinnati, O., and (6) for the Advance Sand & Construction Co., Pittsburg, Pa.:

		(1)	(2)	(3)	(4)	(5)	(6)
Removing 3 old timber cribs, including approximately— 160,000 ft. B. M. timber 3,900 cu. yds. stone 1,600 cu. yds. earth, etc.	.....	$ 2,400	$ 3,300	$ 4,500	$ 3,850	$ 4,500	$ 7,500
Timber protection, M. ft. B. M.	44,350	65.00	60.00	90.00	100.00	100.00	100.00
Pumping (days of 24 hours) days	45	25.00	15.00	15.00	15.00	15.00	50.00
Wrought iron or steel in protection and forms, etc., lbs.	8,400	.07	.06	.06	.10	.06	.10
Wrought iron or steel nosings, anchors, etc., lbs.	18,500	.09	.06	.08	.10	.05	.10
Concrete masonry, cu. yds.	3,750	7.50	6.45	6.25	7.50	5.90	9.75
		$36,786	$32,437	$34,588	$39,775	$33,164	$53,437

Pennsylvania.

✣Bids will be received until 1 p. m., May 5, by Frankford Arsenal, Philadelphia, Pa., for furnishing during the fiscal year ending June 30, 1912, smokeless powder, olive drab drilling and webbing, forage, steel and iron, sheet tin and zinc, pig lead and tin, iron castings, cartridge metals, etc.

✣Bids will be received until April 21, by Depot Quartermaster, U. S. Army, Pittsburg Storage and Supply Depot, Pittsburg, Pa., for repairing roofs, etc., of the following public buildings: 2, 5, 7, 10, 13, 14, 14 annex, 17 and 21.

The State Senate has passed finally the Reynolds-Breitinger resolution for a constitutional amendment that would allow Philadelphia unlimited moneys for the construction of subways, wharves and docks and to reclaim waste lands. The amendment would further permit that city to float a bond issue for general municipal improvements, provided that the city's income from the improvements exceeded the interest on the loans. The approval of the governor, now, is not necessary. The bill will be submitted to the voters at the coming November election, and if then accepted the money can be obtained by floating a bond issue in 1912. This, too, would necessitate the consent of the voters.

South Dakota.

✣Bids will be received until 3 p. m., May 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, etc., except elevator, including plumbing, gas piping, heating apparatus and electric conduits and wiring system of the U. S. Post Office and Court House at Sioux Falls, S. Dak.

✣Bids will be received until April 10 by J. T. Trezona, Clerk School District No. 20, Winner, S. Dak., for moving school house from Lamro, Tripp County, S. Dak., to Winner, Tripp County, S. Dak.

The Fairview Milling Co. of Fairview, S. Dak., is to install a hydro-electric plant on the Big Sioux River to cost about $50,000. The Missouri Valley Engineering Co., Mitchell, S. Dak., are the engineers.

Tennessee.

✣Bids will be received until April 12, by Hanker Cairns, 528 Scimitar Bldg., Memphis, Tenn., for the following items in connection with the construction of the asylum, Poplar Ave.: Excavating and grading, concrete and cement work, brick work, stone work, tile and metal work, iron work, plastering, dimension lumber, mill work, painting, hardware.

[illegible] as may be found necessary to purchase a plant or build one. It is provided in this bill that a special election be called in Memphis to vote on the proposition of issuing the bonds and proceeding with the plans. If a majority of the votes cast are favorable a special board is to be named to take up the details of the work.

Texas.

⊙Officials of the William M. Rice Institute of Houston have awarded contracts for the electric and plumbing installation in the administration building and the mechanical laboratory and power plant of the institute to the W. G. Cornell Co., of New York, for the plumbing at a [illegible] $16,945, and to the Newbery Electric Co of St. Louis for the electrical equipment at $18,960.

⊙Fred Tarry & Son, Leavenworth, Kans., have been awarded the contract at $53,980 for constructing the U. S. Post Office building at Waxahachie, Tex.

⊙The Bowers Southern Dredging Co., Galveston, Tex., has been awarded the contract by the U. S. War Department for the excavation of 22 miles of intercoastal canal from Matagorda to the mouth of the Brazos river near Velasco. Work is to begin at once.

I. A. Walker of Dallas, representing the Dallas Gas Appliance Co., has applied to the City Council of Temple, Tex., for a franchise for a gas plant. This is the second application for a gas franchise made within the past week. One franchise is already in existence and the owners state that they are preparing to utilize the same by constructing a gas plant to cost $100,000. The proposition as made by Mr. Walker requires that he post a cash forfeit to commence actual work within 90 days after the franchise is granted, and to give bond in the sum of $10,000 to finish the plant and have it in operation within twelve months thereafter.

The City of Corpus Christi on March 21 voted to issue $50,000 of bonds for construction of a wharf to be 200 ft. wide and 1,000 ft. long, connecting with the new 12-ft. channel to the city to be dredged by the government.

Application has been made by residents of Port Arthur for a charter for a company to control the new pleasure pier to be erected in that city. About $150,000 will be available for the pier, this sum having being raised by subscriptions. Contractors have already been looking over the plans.

The W. K. Palmer Co., 717-720 Dwight Bldg., Kansas City, Mo., has been engaged as engineer for the design and installation of a municipal hydro-electric plant for the city of New Braunfels, Tex.

Vermont.

⊙The H. P. Cummings Construction Co., 95 Milk St., Boston, Mass., has been awarded the contract for additions to a paper mill and a concrete dam to be built for the Adams Paper Co., at Wells River, Vt.

Virginia.

✤Bids will be received until 1:30 p. m., April 18, by John T. Hume, Treasurer, Southern Branch, N. H. D. V. S., National Soldiers' Home, Va., for labor and material for furnishing and installing gas water heaters and gas ranges and quarters and for gas supply piping.

A plan has been laid before the Public Improvement Committee of the City Council of Norfolk, Va., by J. E. Cole, an attorney of that city, for a tunnel under the Elizabeth River, from Pinners Point to Norfolk. Permission of the city to use Smith's creek as an extension of the tunnel is desired.

Washington.

The Puyallup Veneer & Mill Co., of Puyallup, Wash., has petitioned the city council for the right to construct a loading dock over Eastern Ave., from the plant to the company's property on the opposite side of Cascade Ave

West Virginia.

✤Bids are asked until 11 a. m., April 13, by Capt. F. W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for dredging at Dam No. 11, Ohio River, about four miles below Wellsburg, W. Va. The work calls for the removal of about 38,000 cu. yds. of sand and gravel.

✤Bids will be received until 11 a. m. (eastern time), April 13, by Capt. F. W. Alstaetter, U. S. Engineer, Wheeling, W. Va., for dredging at dam No. 11, Ohio River.

Wisconsin.

✤Bids will be received until 7:30 p. m., April 18, 1911, by Reuben Sutton, City Clerk of Richland Center, Wis., on a 110-ft. or 125-ft. brick or concrete chimney. Certified check for 5 per cent; bond, $2,000. Plans and specifications are on file at office of City Clerk, Richland Center, W. G. Kirchoffer, 31 Vroman Bldg., Madison, Wis., American Contractor, 40 Dearborn St., and Engineering-Contracting, 355 Dearborn St., Chicago. W. G. Kirchoffer, consulting engineer.

⊙Fred Eul, Menasha, Wis., has been awarded the contract at $1,710, for constructing a retaining wall for the city of Burlington, Wis. Contract includes 285 cu. yds. of reinforced concrete.

It is expected that work will be started this spring on the construction of the new power plant at Gardner Dam. John I. Beggs, Milwaukee, Wis., is President of the company.

Preparations are being made for the construction of a dam at Cornell for power development. V. D. Simons, Grand Rapids, Wis., is interested.

The city of LaCrosse, Wis., has secured the necessary land for a levee park and construction work will be started soon. The river will be filled in for several hundred feet into the channel. The work will cost $100,000.

John Minix of Barneveld, Wis., is interested in the purchase of fire apparatus for a small village such as hose carts, fire engines, hose, chemical engines, etc.

Canada.

✤Bids will be received until 4 p. m., April 15, by L. K. Jones, Secy., Department of Railways and Canals, Ottawa, Ont., for improving upper entrance to Lock No. 28. Plans, specification and form of contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Resident Engineer of the Ontario-St. Lawrence Canals, Cornwall, at which places form of tender may be obtained.

✤Bids will be received until 4 p. m., April 15, by L. K. Jones, Secy., Department of Railways and Canals, Ottawa, Ont., for the improvement of the Upper Entrance to Lock No. 19. Plans, specification, and form of contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Resident Engineer of the Ontario-St. Lawrence Canals, Cornwall, at which place form of tender may be obtained.

✤Bids will be received until 9 a. m., April 13, by J. S. Dennis, Mgr., Irrigation, A. & B. C. Lands, Canadian Pacific Ry., Calgary, Alta, for the construction of reinforced concrete building at the city of Calgary.

✤Bids will be received until 4 p. m., April 15, by L. K. Jones, Secy. Department of Railways and Canals, Ottawa, Ont., for improving upper entrance to Lock No. 28. Plans, specification and form of contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Resident Engineer of the Ontario-St. Lawrence Canals, Cornwall, at which places form of tender may be obtained

✤Bids will be received until 4 p. m., April 15, by L. K. Jones, Secy. Department of Railways and Canals, Ottawa, Ont., for the improvement of the upper entrance of Lock No. 19, Cornwall Canal. Plans, specification and form of contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Resident Engineer of the Ontario-St. Lawrence Canals, Cornwall, at which place form of tender may be obtained.

✤Bids will be received until 4 p. m., April 15, by L. K. Jones, Secy., Department of Railways and Canals, Ottawa, Ont., for improving the Upper Entrance to Lock No. 28, Galops Canal. Plans and specifications and form of contract to be entered into can be seen at the office of the Chief Engineer of the department of Railways and Canals, Ottawa, and at the office of the Resident Engineer of the Ontario-St. Lawrence Canals, Cornwall, at which places form of tender may be obtained. An accepted bank check for the sum of $6,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender.

⊙David Dick & Sons of Welland, Ont., have been awarded the contract for the construction of the new Page-Hersey Iron Tube & Lead Co.'s plant at Welland. The value of the contract is $150,000. Dick & Sons also obtained the contract for the Canadian Automatic Transportation Co.'s plant at Welland, the value of which is $25,000.

⊙The following contracts have been let by the Department of Public Works of Canada: 15-in. suction dredge for maritime provinces. Contractors, La Compagnie Pontbriand. of Sorrel, at $59,865. Michipicoten River, Ont., wharf.—Contractor, D. G. Stewart, of Ottawa, at $18,430.

The Canadian Government has approved the plan of the Hydro-Electric Commission, Adam Beck, chairman, Toronto, for the extension of the St. Thomas Power line to Windsor at a cost of about $2,000,000.

A. J. Stevens, Engineer Public Works Department, Winnipeg, Man., has been at Kenovia, Ont., taking the measurements and soundings required for the building of a government dock at the north end of the bay, between Short's mill and the town.

The Committee on Works of the City Council of Toronto, Ont., has provided an appropriation of $50,000 for the construction of 1,000 ft. of sea wall to the east of the sea wall already constructed, to give the street cleaning department a place to deposit garbage. C. H. Rust is City Engineer of Toronto.

The New Ontario Dock Co., Sault Ste. Marie, will add 200 ft. of new dockage and a 600-ft. slip this spring to its property in Sault Ste. Marie, Ont. The improvements will cost about $100,000.

TRADE NOTES.

The King-Lawson Car Co. has removed to its new quarters in the Singer Bldg., 140 Broadway, New York City.

The American Locomotive Co. has moved its Chicago office from Railway Exchange building to Suite 907-912 McCormick building, Michigan boulevard and Van Buren street.

The Chicago office of the Atlantic Equipment Co. has been moved from Railway Exchange building to Suite 907-912 McCormick building, Michigan boulevard and Van Buren street.

The Foote Concrete Machinery Co., 184 La Salle St., Chicago, Ill., has taken the agency for the district east of the Rocky Mountains for the Wallace concrete hoist and gravity system.

The Orton & Steinbrenner Co., Chicago, Ill., announce the appointment of W. Van R. Whitall, Inc., 30 Church street, New York City, as its New York and New England representatives for its locomotive cranes and grab buckets.

Prof. W. F. Schaphorst of the mechanical engineering department of the New Mexico College of Mechanic Arts has resigned his position there to become a technical writer on the staff of A. Eugene Michel, advertising engineer, New York City.

The Sullivan Machinery Co., Chicago, Ill., has established a branch office at 35 Federal street, Boston, Mass., to permit of a more adequate service for its patrons in New England, Eastern Canada and the Maritime Provinces. Mr. George E. Wolcott, for several years manager of New England sales at the company's Claremont, N. H., office, is in charge of the Boston headquarters.

The Merchants' Steel & Supply Co., Marquette Bldg., Chicago, Ill., has added to its business an equipment and machinery department which will be in charge of Mr. Loren Bugbee, M. E. The company will buy, sell and repair a general line of contractors' equipment and machinery, consisting of steam shovels, locomotive cranes, dinkies, dump cars, standard gage cars, locomotives, boilers, engines, pumps, generators and miscellaneous machinery, new and relaying rails and industrial track.

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

REINFORCED CONCRETE BRIDGE.

Paducah, Ky., March 27, 1911.

Sealed propo[illegible] received at the office of the Board of Public Works until April 17, 1911, at 10 a. m., for the construction of a reinforced concrete bridge 43 ft. wide and 295 ft. long.

Approximate quantities as follows:

Excavation, 170 cu. yds.

Linear feet concrete piling, 3,720 ft.

Concrete in piers, abutments and retaining walls, 514 cu. yds.

Concrete in arches, girders, columns, beams, floor and railing, 767 cu. yds.

Reinforcing steel in piles, 77,600 lbs.

Reinforcing steel in superstructure, 115,366 lbs.

Cast steel hinges, 11,090 lbs.

Lamp posts, 8.

Waterproofing [illegible]

Cement sidewalks, 4,380 sq. ft.

Creosote wood paving blocks, 920 sq. yds.

Eighty per cent (80%) to be paid by the City of Paducah upon monthly estimates, and balance paid upon completion and acceptance of the work.

All the above material and work to be furnished and done in accordance with plans and specifications on file at the office of the City Engineer. Each bid must be accompanied with a certified check for $1,000.00, payable to E. J. Paxton, Treasurer, to be forfeited to the City of Paducah in case he shall fail to enter into contract in accordance with his proposal, should his proposal be accepted by the Board of Public Works. Any one desiring copies of plans and specifications can obtain same from the City Engineer upon the receipt of an accepted check for $5.00 payable to E. J. Paxton, City Treasurer.

Proposals must be made on blanks attached to the specifications.

The Board reserves the right to reject any and all bids; to waive any informalities, and accept any bid considered advantageous to the City of Paducah.

By order of the Board.

L. A. WASHINGTON,
City Engineer.

ILLINOIS HIGHWAY COMMISSION.

City of Batavia, Kane County, Illinois.
Wilson Street East Bridge.
NOTICE OF PUBLIC LETTING.

Notice is hereby given that sealed proposals for the work hereinafter described in this notice and more particularly described in the specifications, will be received at the City Hall, by the Mayor and City Council of Batavia, Kane County, Illinois, until 2 o'clock p. m., April 20, 1911, at which time and place the bids will be publicly opened and read. Briefly described, the work is as follows:

Building a temporary bridge across Fox River on line of the alley immediately south of the present Wilson Street East Bridge and maintaining said temporary bridge until the proposed Wilson Street East Bridge is completed and thrown open to traffic. Removal of the present structure on the site of the Wilson Street East Bridge, which consists of a series of stone arches, the piers to be removed to the bed of the stream, the abutments and retaining walls to the ground line, building a new reinforced concrete bridge across the Fox River on Wilson street on the site known as the Wilson Street East Bridge. Said bridge to consist of three reinforced concrete arch spans, totaling in length about 270 feet and having a width over all about 60 feet.

More detailed information may be obtained by an examination of the plans on file at the office of the City Clerk of Batavia, Illinois, or which may be obtained upon application to the Illinois Highway Commission, Springfield, Illinois.

A charge of two dollars ($2.00) will be made for each set of plans and specifications to cover the cost of preparing and mailing the same.

The work to be completed on or before November 1, 1911.

Springfield, Illinois, March 20, 1911.

By order of the City Council of the City of Batavia, Kane County, Illinois.

W. H. REANEY, City Clerk.

CONCRETE BRIDGES.

Mason City, [illegible]

Sealed propos[illegible] Board of Sup[illegible] of [illegible] Gordo County, at the office of the County Auditor, Mason City, Iowa, until 2 p. m., April [illegible] 1911 [illegible] shall be opened [illegible] materials and labor [illegible] following items:

Item 1—Two concrete [illegible]

Item 2—One concrete [illegible]

Item 3—One 32-ft. girder.

Item 4—Two steel [illegible] designs for concrete bridges.

Plans and specifications prepared by the Iowa Highway Commission.

A certified check for five per cent (5%) shall accompany [illegible] Plans and specifications and blank proposal forms may be obtained [illegible] The board reserves the right to waive defects and to reject any or all bids.

A. S. [illegible], County Auditor.

CONCRETE BRIDGES.

Estherville, Iowa, April [illegible]

Sealed proposals will [illegible] Board of Supervisors of Emmet County, Iowa, up to 12 o'clock noon, April 26, 1911, for the erection of several reinforced concrete or steel bridges, according to specifications for concrete bridges on file at the Auditor's office at Estherville, Iowa. Bidders for steel bridges shall furnish their own plans and specifications. 2 10-ft, [illegible] bridges.

These specifications contemplate bidders [illegible] file in the County Auditor's office.

A certified check for five per cent of the bid shall accompany each bid.

The board reserves the right to reject [illegible]

[illegible]
Chairman [illegible]
CHAS. A. ROOT,
County Auditor.

SEWERS.

East Aurora, N. Y.

Sealed proposals will be received by the Board of Trustees of the Village of East Aurora, N. Y., at their office in the East Aurora Club in said Village until eight o'clock p. m. on April 18, 1911, for the furnishing of material and performance of labor for the construction of a sewer system including a sewage disposal plant in said Village of East Aurora, according to plans and specifications on file in the office of the Clerk of said Village.

The work includes the construction of approximately eighty thousand (80,000) feet of sewers ranging from eight-inch tile to twenty-four-inch tile, also iron pipe and other appurtenances, together with the construction of a sewage disposal plant. The Board of Trustees reserves the right to let the contract for the sewers and the disposal plant separately or together or to reject any or all bids as they may deem best for the interests of the Village.

No proposal will be considered unless it is accompanied by a certified check payable to the Treasurer of the Village of East Aurora, N. Y., drawn on an incorporated Bank or Trust Company, satisfactory to said Treasurer, in a sum not less than two per cent (2%) of the amount of said bid.

Plans, profiles and specifications may be seen and examined at said Village Clerk's office and at the office of the Engineer, Frederick K. Wing, 910 White Building, Buffalo, N. Y. Bids must be made on blanks provided by the Board of Trustees of the Village. Intending bidders may obtain copies of the specifications, bidding sheet, form of contract and bond, upon application to the Village Clerk and on payment of $1.00.

In the preparation of the bid, the rates, extensions and footings may be expressed in figures alone, as called for in the form, but the amount of the bid, which must equal the sum of the extensions must be expressed in words as well as figures as called for. Inaccuracy in extensions of footings will be deemed a sufficient cause for rejection of the bid.

ALFRED BROTHERHOOD,
President.
ALBERT O. ZINK,
ELBERT HUBBARD, II.,
Trustees.
D. N. RUMSEY,
Village Clerk.

FREDERICK K. WING,
Engineer.
910 White Building,
Buffalo, N. Y.

SEWERS.

The Board of Public Works of the City of Dowagiac hereby gives notice that proposals will be received until twelve o'clock noon on the 12th day of April, 1911, for the construction of sewers within the City of Dowagiac as follows:

(1) 350 linear feet of 12-inch sewer.
432 linear feet of 8-inch sewer.
3 manholes.
Lamp holes.
(2) 395 linear feet of 12-inch sewer.
1 manhole.

Said sewers to be constructed according to plans, specifications and diagrams of the City Engineer now on file in the office of the City Clerk.

Bids to be separable so that award may be made as to (1) and (2) of said sewers separately.

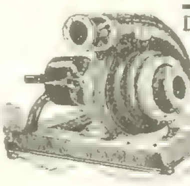
A certified check of at least five per cent of the largest amount bid by each bidder must accompany the bid or proposal, the same to be forfeited if bid is accepted and bidder neglect or refuse to enter into a contract.

The Board of Public Works reserves the right to reject any and all bids.

Bidders shall furnish to the City of Dowagiac surety bonds for the performance of contract, for labor and materials and for proper construction.

Dated March 28, 1911.

WILLIAM T. EASTON,
Clerk



DREDGING—IRRIGATION
Write for information about the BUSH IMPROVED CENTRIFUGAL PUMPS used by some of the biggest contractors and dredging companies.
Greaves Specialty Mfg Co.
154 Nassau St., N. Y. City

BRICK PAVING.

[illegible]
[illegible]
March 28, 1911.

[illegible] County, Ohio, until 12 o'clock, noon, May [illegible] 1911, for [illegible] brick 2.12 miles of road in Ravenna and Shalersville Township, said County, under the provisions of "The Dodge Act" so-called.

Specifications, plans and profiles are on file in the Office of the County Surveyor in Ravenna, Ohio.

Certified check, $1,000.00.

The Commissioners reserve the right to reject any and all bids.

W. J. DODGE,
County Auditor.

GRADING.

Bessemer, Mich., April 4, 1911.

Sealed proposals will be received by the Board of County Road Commissioners of Gogebic County, at their office at Bessemer, Mich., until noon of Saturday, April 22, 1911, for the grading of about 11½ miles of road between Wakefield and Dunham. Specifications, plans and profiles are on file at the engineer's office in the county building.

Each bid must be accompanied by a certified check for one hundred dollars ($100.00), which check will be forfeited to said Board of County Road Commissioners in case the successful bidder shall fail to furnish satisfactory bond and enter the proposed contract within five (5) days from the date of notification of the award.

The Board of County Commissioners reserves the right to reject any or all bids.

G. S. BARBER, Chairman.
H. A. HARPER, Engineer.

PROPOSALS FOR METAL.—U. S. Engineer Office, Vicksburg, Miss., March 15, 1911. Sealed proposals for furnishing about 307,000 pounds of structural metal, for use at locks and dams Nos. 4 and 8, Ouachita River, Ark. and La., will be received at this office until noon, April 14, 1911, and then publicly opened. Information on application. CLARKE S. SMITH, Capt., Engrs.

Washington, D. C., Feb. 25, 1911.

Sealed proposals will be received at the office of the U. S. Reclamation Service, North Yakima, Wash., until 10 o'clock a. m., April 15, 1911, for the building of Kachess dam and accessory structures near Easton, Wash. The work involves the excavation of approximately 345,000 cubic yards of material, the placing of about 240,000 cubic yards of embankment, 15 000 cubic yards of riprap and paving, 8,000 cubic yards of concrete, and 300,000 pounds of reinforcing steel, and other items necessary to complete the work. For particulars address the United States Reclamation Service, Washington, D. C., or North Yakima, Wash. R. A. BALLINGER, Secretary.

U. S. Engineer Office, Duluth, Minn., March 20, 1911. Sealed proposals for dredging at Superior Entry, Duluth-Superior Harbor, will be received at this office until noon, April 20, 1911, and then publicly opened. Information on application. Graham D. Fitch, Lt. Col. Engrs.

U. S. ENGINEER OFFICE, Chicago, Ill., March 25, 1911.—Sealed proposals for dredging in Indiana Harbor, Ind., will be received here until 10 a. m., April 15, 1911. Information on application. GEO. A. ZINN, Lt. Col., Engrs.

U. S. ENGINEER OFFICE, Duluth, Minn., March 15, 1911.—Sealed proposals for dredging in Ashland Harbor will be received at this office until noon, April 15, 1911, and then publicly opened. Information on application. GRAHAM D. FITCH, Lt. Col. Engrs.

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The Philadelphia Sewage Purification Tests.

[illegible] Philadelphia [illegible] by the Bureau of Surveys. The attention of our readers is directed to the brief review of this report which appears elsewhere in this issue. The present report deals with the purification and disposal features.

The [illegible] record were performed at Spring Garden, Philadelphia, between March [illegible] and May 15, [illegible] the period of investigation extended over a year the effect of the change of seasons on the various processes of purification investigated was noted.

The processes investigated are the ones now in favor in Europe and America. Before the experiment station was equipped or the processes to be tested were selected some of the principal purification works of England, Belgium, Holland, Germany and France were visited by George R. Stearns, director of the Department of Public Works, and George S. Webster, chief engineer of the Bureau of Surveys, of Philadelphia, to secure first hand information concerning the recent advances made in sanitary science in those countries. Various types of sanitary works in use in the eastern part of the United States were also visited. The processes finally selected for investigation at Philadelphia were therefore truly representative of present day practice.

While in some cases the efficiency of the various processes, as determined in these experiments, are relative rather than absolute, the great value of unbiased tests made by a trained corps of scientific investigators must be apparent to all sanitary engineers. It is well known that widely different results may apparently be secured from a given purification plant, depending on the method of collecting samples and conducting the subsequent chemical and bacteriological tests. The attention of our readers especially is directed to this feature of the investigations.

We believe that the review of this excellent report, as we have arranged it, will be useful to sanitarians in checking up on current methods of sewage purification and relative efficiencies. It should prove of special interest and value to engineers just taking up this line of work.

The Centering for the Spokane Arch.

In another column we publish a report of the collapse of the timber arch centering for the 281-ft. span arch of the Monroe St. bridge at Spokane, together with the plans and illustrations of the new centering which has been designed and is now being erected. No very satisfactory reason has ever been given for the failure of the first center designed for this circle. It was blown down by a 40-mile gale—that's all. It fell like a pile of blocks. The centering was itself a timber arch put together in framed sections which were suspended from the old steel bridge overhead. This type of centering, while economical in itself, does not seem practicable for arches of such great size. The manner in which the centering collapsed would indicate that it could never have been successfully loaded with concrete. To load it successfully it would have been necessary to load it uniformly, or nearly so, over the entire arch at one time, in order to prevent its collapse due to eccentric loading. A series of small concrete voussoirs might have been poured but so many of these would have been required that the task would have been impracticable.

The new centering consists of four steel trusses of 192-ft. span, supporting a timber falsework. It is a much more substantial type of construction. A look at the plans on another page will suffice for a description. There are, however, a few minor criticisms which we would offer, which have been called to the writer's attention through experience on similar construction. According to the plans of the falsework, the rib timbers will be cut to fit the curve of the intrados. It is assumed that the wedges placed on the caps of the bents beneath will be used to adjust the height of these timbers after they are put in place. This method will be found more difficult and expensive, and less accurate than the method of placing furring strips on top of the rib timbers. It is very difficult to move wedges under loads of this kind, and especially difficult when the wedges are located where they can not easily be reached, as these are. It is assumed that these wedges are to be adjusted under the load of the timber above them only. If the load of concrete were placed on them it would be practically impossible to move them.

According to the plan there is no arrangement for adjusting the tangential compressive stresses due to the loading with concrete. Wedges should be located between the butt ends of the rib timbers, at the quarter points at least, to prevent the buckling of these timbers.

The bents supporting the rib timbers are crossbraced with 6x12-in. timbers bolted to the posts. This construction will no doubt be sufficient where the load is nearly vertical, but it would seem desirable not to bolt these braces where lateral strains are introduced, but that they should be framed diagonally between the bents. These are perhaps minor items but it is the miner items often that cause the most worry in actual construction.

The two concrete arches of next largest span in the United States are at Cleveland (281-ft. span) and at Philadelphia (233-ft. span). Descriptions of these may be found in ENGINEERING CONTRACTING for Sept. 14, 1910, and Jan. 6, 1909.

In the Walnut Lane bridge at Philadelphia the centering for the 233-ft. arch consisted of a steel trestle carried on concrete piers and supporting a timber staging or falsework. The means for adjusting the height of the centering were jacks and wedges. One set of jacks was placed in the 4-ft. space left between the top of the steel trestle and the timber staging and the other set was placed between the top end of timber staging and the bottom of the bents of the upper trestle. The lower set of jacks were placed for emergency use only, but fortunately it was not necessary to use them. The jacks were adjusted to their greatest height so that any movement would be a downward movement in adjusting the height of the falsework and in lowering for moving to the second rib. In the Spokane arch center there is opportunity for a similar arrangement of jacks between the upper chord of the lower staging and the bottom of the upper trestle work.

The Rocky River arch at Cleveland is but 1 ft. less in span than the Spokane arch, and like the Spokane arch, the conditions made it necessary to erect the arch without placing piers for the centering in midstream. A 3-hinged steel arch was used and through its use the concrete rib was built nearly exactly to the lines called for on the plans. The arch rib was formed with timber, supported on the steel arch. The manner of supporting the lagging was by a series of joists laid parallel to the span of the arch. These joists presented the opportunity of utilizing them as continuous compressive members, which following the lines of the intrados of the arch from end to end would assist the centering to that extent, and while this assistance was more or less indeterminate, yet it was made use of. These timbers were 12x12 ins. at the spring line, but were decreased in size toward the crown where 3x12 plank were used. To bring the lagging to the theoretical curve of the arch the engineer took levels and measurements on the ends of these timbers which formed short chords of the curve. From these figures the thickness of furring strips was calculated thus saving the cutting of the heavy timbers. The timbers when placed were an inch or so low, as designed for placing the strips. The arch when concreted was exactly correct for level at the [illegible]

Wedges were placed between the butt ends of the timbers at 4 points, the points being taken in the 4-ft. keyways, so as not to be interfered with by the concreting [illegible] that the wedges were easily accessible from above.

One mistake made in handling the steel arch center at the Rocky River bridge was in not having a continuous track built in the concrete pier from one side to the other. A temporary timber cribbing was made to span the gap from one position of the arch center to the other and in crossing this the 3-hinged arch spread longitudinally about 2 ins. and it required 3 days with several heavy jacks to get it back into position.

The steel center for the arches of large span is much more to be desired than a timber centering as shown by the experience at Cleveland. This arch was built exactly to its proper elevation at the crown and only ½ in. low at the quarter points. The Walnut Lane centering was placed 2½ ins. high at the crown to allow for settlement and the settlement was 3½ ins. The posts crushed into the timbers, in places nearly 3 ins., causing no little worry to the men in charge.

The cost of the Rocky River steel centering figured a couple hundred dollars more than the wood centering, but it is believed that the difference was made up in the moving from one rib to another.

Progress in the Investigation of Rail Failures.

Since the advent of heavy wheel loads the failure of steel rails has become a most serious problem for the railroads. Prior to about three years ago Bessemer rail was used almost universally for the reason that it cost less than open hearth rail. When the question of rail failures began to assume a serious aspect many of the leading railroads adopted the policy of buying only open hearth rail. This was thought to be a satisfactory if not final solution of the problem, and this action received commendation from both the technical and popular press.

A brief experience, however, has demonstrated the fact that while failures are less frequent with open hearth rail, the problem is still a serious one, and that some satisfactory solution is urgently needed.

Many investigations have been conducted for the purpose of discovering the specific causes and the cures for rail failures. By far the most important of these have been prosecuted during the past nine months by the American Railway Engineering Association, acting through its rail committee and its engineer of tests. Certain definite results have been secured pointing to immediate improvements in the situation, and probably an ultimate solution of the problem.

In another column of this issue we present an address delivered by Mr. M. H. Wickhorst, engineer of tests, before the association during the recent convention. This address, while designed primarily to indicate the methods and progress of the rail committee in the matter of rail investigations, is in our opinion of especial value in supplying to the maintenance engineer just such information as he needs in regard to processes of making steel, methods of testing steel rail, and the results and indications derived from tests that have been made. The address supplies, in concise form, matter that could only be secured otherwise by the reading of exhaustive treatises and numerous reports.

The most important indication secured from the investigation of the rail committee is that in the majority of cases rail failures are due to excessive segregation of carbon, sulphur and phosphorous. Excessive segregation produces a brittle zone in the steel. This is exceedingly dangerous for the reason that it can only be discovered by analysis or when a break occurs. A "pipe" is due to a cavity in the ingot and appears either as a cavity or as a split in the finished rail. "Pipes" are carefully watched for and are usually discovered during the process of drilling the rail, and few failures are attributed to this cause. The problem of making a safe rail is therefore mainly one of making an ingot free from excessive segregation or in controlling the segregation so that the segregated area can be cropped off.

In this connection recent experiments made on ferro-titanium steel rail are interesting. In our issue of April 5 we gave an account of comparative wear on ordinary Bessemer rail and ferro-titanium Bessemer rail. This test indicated superior wearing qualities in steel subjected to the ferro-titanium treatment. It is also claimed for this treatment that it acts to retard the segregation of sulphur, carbon and phosphorous, and thus to eliminate the failures due to this cause. The question as to whether this is the only treatment, or even the best, for bringing about such a result remains to be determined.

With the most prolific source of rail failures definitely fixed, and considering the investigations now in progress, it would seem that a satisfactory solution of the problem should be a matter of a short time.

CONCRETE AND REINFORCED CONCRETE SECTION

The Centering for the 281-Ft. Concrete Arch, Monroe St. Bridge, Spokane, Wash.

The city of Spokane has under construction a concrete arch which will be one of the largest in the world. Its main arch, which has a span of 281 ft., is the largest concrete arch in the United States, there being one at Cleveland, however, which is of 280 ft. span. This Spokane bridge, known as the Monroe St. Bridge, was designed under the direction of Mr. J. C. Ralston, formerly city engineer. The under the direction of the present city engineer, Mr. Morton Macartney, and the work is being done by the day labor system.

The most interesting construction problem so far has been the centering for the main arch over the river, which has a span of 281 ft. and a rise of intrados of 114 ft. This arch is of the twin rib type, the ribs being placed 36 ft. c. to c. The ribs are 16 ft. wide by 6 ft. 9 ins. deep at the crown, and flare toward the haunches to a width of 19 ft. 9 ins and a depth of 18.5 ft. The first center designed and built for this arch collapsed during a wind

Some notes on this first centering and a description of the conditions leading to its collapse have been furnished us by Mr. Macartney, from which we quote as follows:

Monroe St. runs north and south and the Spokane River is crossed by it at the foot of the last of a series of falls, the total drop in which approximates 135 ft. In the course of the ages a basin has been formed on the line of Monroe St., in which the water varies in depth from 50 ft. on the east property line to 30 ft. on the west property line. The low water flow of the river is 2,000 cu. ft., the high

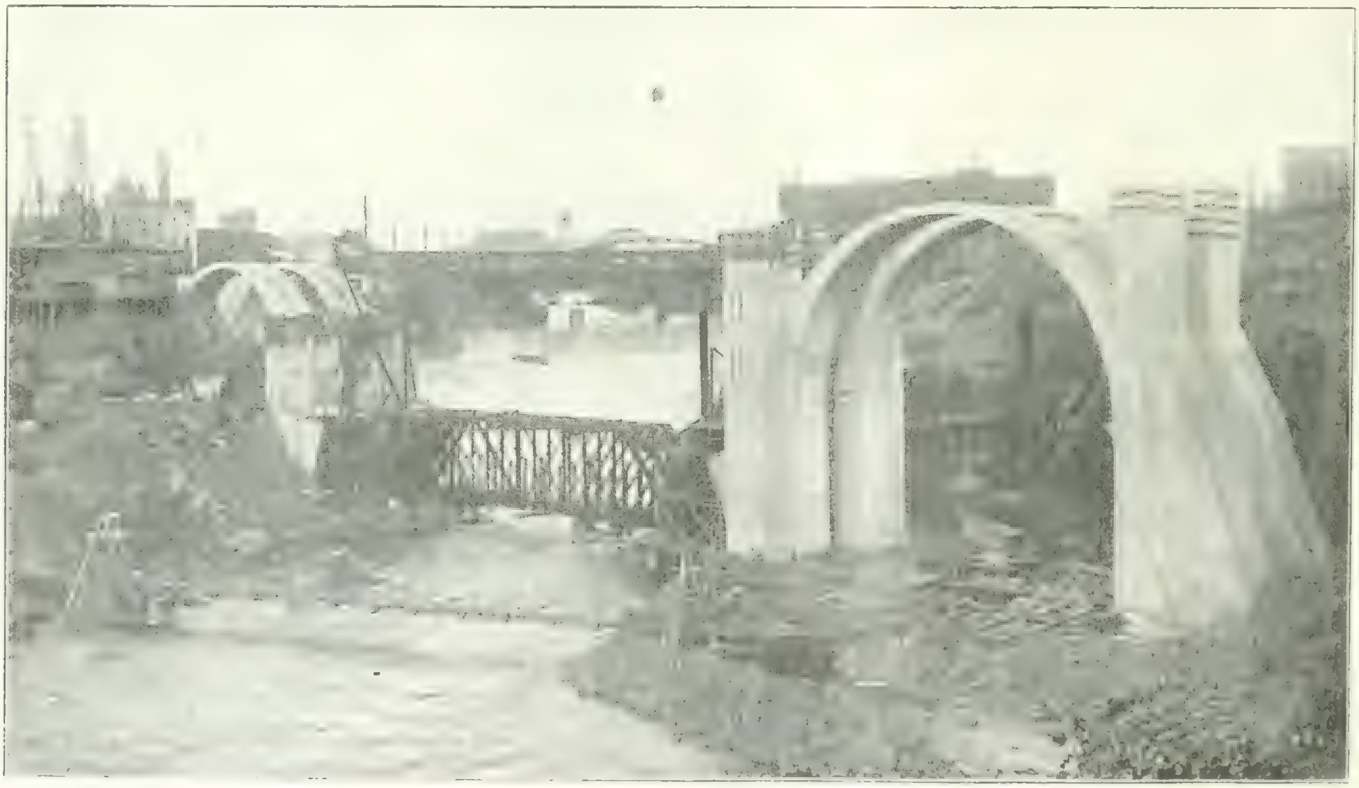


Fig. 1—View Showing Spokane Arch With Steel Trusses in Place to Receive 281 Ft. Timber Center.

the period of high water the stream is very swift and turbulent. Just above the falls there are situated several lumber mills and the breaking of a log boom would precipitate an immense number of logs over the falls.

The power plant building of the Washington Water Power Co. abuts on the east property line of Monroe St. and extends north from the south pier of the river span to the south border of the deep basin that has been described. The tail-races of the power plant traverse the line of the bridge. These several circumstances eliminated from consideration not only the use of falsework supported on bents in the river, but also the use of falsework which would require many temporary river bents for its erection.

Fig. 2—Sketch of Original Timber Arch Center.

On the other hand, the existence of a steel bridge on the line of Monroe St. offered a means of erecting falsework by suspension therefrom. This steel bridge was of the cantilever type; the anchor spans 189 ft. long and the cantilever and suspended span crossing the river 277 ft. long. By placing one pier upon a rock shelf rising between two of the power plant tail-races, and another pier upon a similar shelf on the north edge of the deep water basin, it was possible to obtain a span of 192 ft. for falsework symmetrically located with respect to the 281 ft. concrete arch. In the 44.5 ft. between such falsework piers and the piers of the concrete arch, a simple system of vertical post falsework could readily be constructed. The span of 192 ft. was therefore chosen for the center falsework.

After comparison of arch and truss spans for falsework, an arch was determined upon. The large steel bottom chords required in a truss by the heavy load of the concrete arch made a combination arch, in which the heavily stressed members were all in compression much cheaper. A combination arch of the type shown by Fig. 1 was designed, consisting of seven timber ribs, spaced 3 ft. apart on centers. A wider base was not given to the structure because of the location of the power plant upon the east property line of the street. Wind pressure was to be taken care of by guy cables in addition to the bracing.

Construction on the falsework arch was begun late in June, 1910. Cables suspended from the steel bridge supplied the means of erection. It was possible to erect the four westerly and the two easterly ribs without any interference with the steel structure. The third rib from the east, however, came directly in line with the easterly chord of the steel bridge and interfered in its upper four panels. Consequently, after six ribs were completed and the seventh brought up to the point of interference, really active operations were suspended until the steel could be removed. Due to the fact that the uncompleted rib was kept blocked up in order to insure its ready adjustment when meeting at the crown, it was not feasible to put on the final bracing. The ribs were all tied together with temporary braces and there were 22 guys, up and down stream upon the structure.

The timber arch was cut free from the steel July 13 and the work of removing steel was begun. On July 20 the last piece of interfering steel was removed. The following day, July 21, a squall of unusual nature occurred, during which the timber arch collapsed. With the resumption of work after the noon-hour, the clear weather of the morning continued, with the wind blowing 10 to 20 miles per hour, from the southeast. About 1:40 p. m. there were evidences [illegible] gathering in the west. According to the local weather reports, the first thunder clap came at 1:45 p. m. and at 1:46 p. m. the wind changed from 20 miles per hour S. E. to 42 miles per hour S. W. There followed a brief wind squall accompanied by rain.

The weather bureau is located about one-third of a mile southeast of the river basin. The river gorge at the bridge site runs from southwest to northeast and in all likelihood the storm following the ravine caused a higher wind than on top of the building wherein the weather bureau is located.

From the testimony of eye witnesses the structure raised and collapsed, all members holding well together. Due to the excitement incident to such events and the brief space of time offered in which to make observations, the condition of the debris after the collapse offers perhaps a more noteworthy indication of what actually happened than the evidence of excited witnesses. The debris was piled high on the north shore and, of that portion which fell in the water, the most distant piece was scarcely over 50 ft. from the original line of the arch. There was no debris on the south pier and some timber which had been lying there was left undisturbed. Although positive conclusions are impossible, it seems reasonable to infer from the above circumstances that the sudden wind from the southwest, striking the structure at an angle of about 45°, lifted it clear of the south support and did not merely cause it to topple sideways as would have occurred had the arch not been guyed. An examination showed all the guy cable anchorages intact and none of the guys themselves broken.

The collapse of this timber arch presented anew the problem of centering. To re-erect the arch would necessitate the replacing of that portion of the old steel bridge already removed. Such a procedure was not only a step backward and therefore undesirable, but it was also deemed unwise because those portions of the removed steel members which were inaccessible in the erected structure showed that the 20 years of over-stressing service had made their future use unsafe and the structure had in consequence already been condemned for re-erection [illegible] highway bridge, without car service, farther downstream, as was originally intended. It was then decided to adopt a system of centering composed of timber bents supported on four steel trusses of 192 ft. span, the four trusses to be used later in pairs to form part of the proposed bridge down-stream. The work of dismantling the old steel bridge was continued after the accident and provision was made in building the piers of the main spans for anchorages and toggles to allow of the erection of the steel trusses as cantilevers.

The steel for the trusses began to arrive in Spokane in the middle of February, 1911. Erection was started March 2 and was completed in eleven working days of 8 hours each, at a cost of $10 per ton.

The adopted construction of the new centering is shown by the accompanying plans and photograph. The steel support for the timber falsework consists of four 12-panel Baltimore trusses. The trusses are 35 ft. high and the panels 16 ft. long, all pin connected. The timber falsework is erected on the steel trusses, except beyond the ends of the trusses where it is carried to the ground. The falsework is built of 12x12-in. timbers with 6x12-in. braces. The load is carried to the panel points on the steel trusses, as shown by the drawing, by means of radial posts. This system of radial posts divides the falsework into two parts which may be called, for convenience of description, the upper and lower centering. The top chords of the lower centering forms the foundation for the bents of various heights, which are carried up to within a short distance of the ribs. Sets of wedges are placed on the caps of the bents and on the wedges rest the 12x16-in. transverse timbers which support the 6x12-in. rib timbers. The bents are braced with 6x12-in. timbers bolted to them diagonally with ¾-in. bolt.

The falsework is erected in position for concreting on arch rib and is to be adjusted by cast iron wedges beneath the steel truss. After concreting, the falsework will be moved west 36 ft. on rollers for concreting the second rib. The accompanying photograph showing the steel trusses erected was taken March 20.

All work is being done by day labor under the direct supervision of Messrs. P. F. Ken-

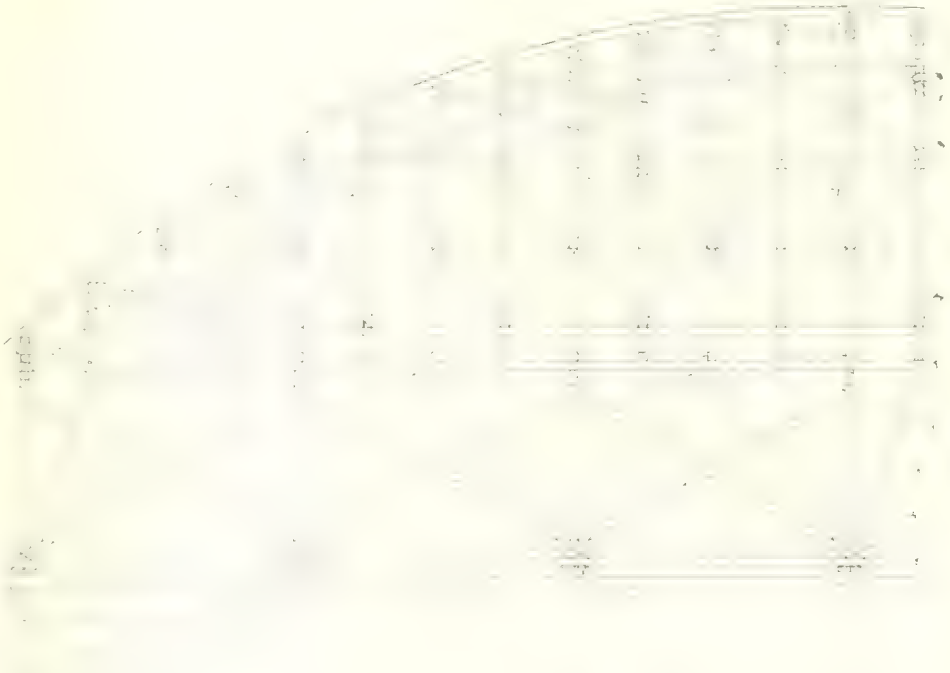


Fig. 3—Details of Timber Center for 281 Ft. Concrete Arch, Spokane, Wash.

[illegible] the direction of the City Engineer, Mr. [illegible] Macartney.

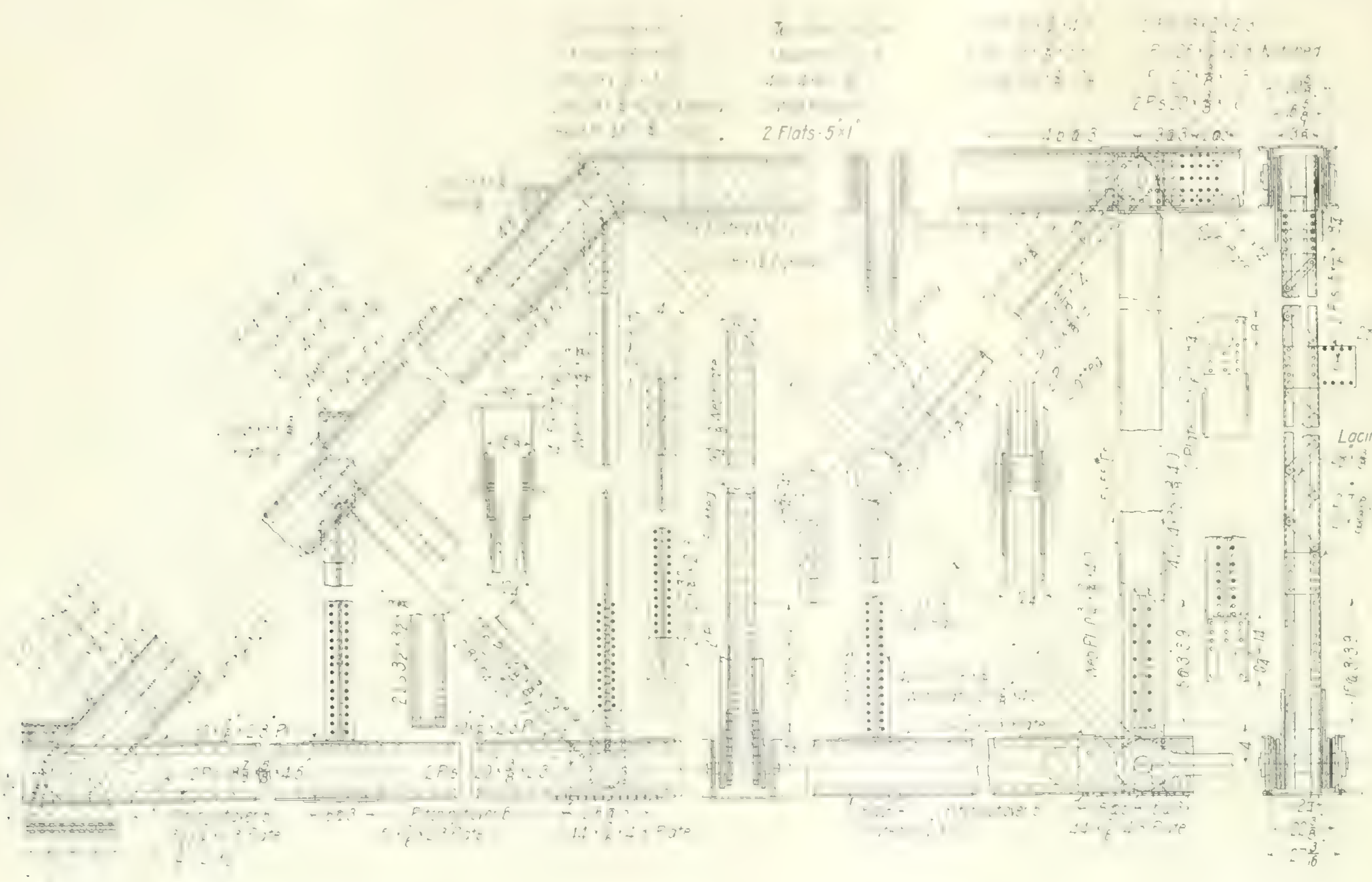


Fig. 4—Details of End Panels of Trusses Supporting Wooden Centering.

The Use of Corrugated Iron Floor Forms.

One of the recent departures in concrete [illegible] erable future development is the use of corrugated iron sheets for the centering of concrete flooring. In discussing this feature of concrete work at the recent annual meeting of the National Association of Cement Users, Mr. Leonard C. Wason of the Aberthaw Construction Co. gave some interesting details.

Corrugated iron has been used extensively for this purpose in Minneapolis and more recently in the vicinity of Boston, notably in the construction of the new concrete warehouse of the Massachusetts Cotton Mills at Lowell, Mass. No. 20 gage black corrugated iron is the material employed. For flat floor construction particularly, where the design calls for the mushroom type of construction, corrugated iron has proven most satisfactory, especially in the matter of cost.

In the erection of the Massachusetts Cotton Mills warehouse the Aberthaw Construction Co. adopted the following method: The junction of column heads with floor were arranged with a square metal plate fastened to column head. The inside was the outline of the column, sometimes octagonal and sometimes circular, but the outer edge was a square. The corrugated plates lapped onto the square [illegible] longitudinally the right amount of lap and close the area of floor was obtained. Then by lapping over one or more corrugations crosswise you get the correct fit the other way, so there is practically no cutting to do. They were supported on plank on edge 24 ins. apart and did not sag when loaded.

Of course, if the appearance of the ceiling is objectionable this type of form could not be used; but in a storage warehouse, the looks were of no particular consequence. Although there were some laps, which made a rather blunt edge, its appearance was no worse than [illegible] from bad parts with [illegible]

As [illegible] economy goes, the cost is about one-half that of wooden floor forms; and it therefore, from that standpoint, was a great success. When drawing the false work nearly all the props were taken out, leaving just barely enough to keep the forms up, ropes were then put around these, the men keeping at a distance where there was no danger of getting hurt, and the remaining posts were then jerked all out at once, dropping the forms of a large room at a single operation. The corrugated iron came down pretty straight and did not get bent up much, but what little damage there was was taken care of by two men with a hand straightener.

Method and Cost of Encasing and Widening with Concrete the Boardwalk Structure at Atlantic City, N. J.

Work has been in progress improving and enlarging the boardwalk at Atlantic City, N. J., for two years or more. This structure in its main part consists of a platform of plank and joists carried on bents of iron piles capped with plate girders. The improvement consists in encasing the original metal structure in concrete and of widening the bents from two piles to three piles by sinking additional reinforced concrete piles and building reinforced concrete extensions to the girders. The accompanying drawings of work done during 1910 indicate the character of the work clearly. This improvement has been made in sections from season to season. The portion of the work considered particularly here was done by the Nelson-Merydith Co., of Chambersburg, Pa., and we are indebted to these gentlemen for the data which follow.

The method of work was in general as follows: The new pile was cast and sunk and the two old piles encased, completing the work to the tops of the pile caps. Forms for the girders were then erected on the pile caps, the reinforcement placed as shown and the concreting done. In sinking the new piles only the bottom portion reaching to the surface of the ground was molded separately. When this section or length had been sunk forms were erected on it and the top portion of the pile was molded in place. The cast portions of the piles were sunk by jetting.

The costs of this work which follow cover [illegible] each consisting of two old columns encased, of one new concrete column and of one girder. As will be seen, the work proved to be quite expensive. Two items which contributed to this were (1) the fact that the labor proved to be rather unreliable and it was found very difficult to keep up an efficient organization, owing to the fact that the labor was continually changing; (2) the fact that the work was done during the summer, when large crowds were to be found on the boardwalk. In making out the final costs, the cost of looking after the work was prorated on the labor items. All other general items were divided according to the yardage in the different parts of the work.

The cost of superintendence for the whole work, which, as stated, was prorated on the labor, was as follows:

Superintendent	$ 775.35
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

The other general items prorated according to the yardage were as follows:

[illegible]	$ [illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible] tools	[illegible]
[illegible] tools	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

In addition there were the following general items not prorated:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

The following were the costs of the materials used:

Concrete per barrel	$ 1.40
Lumber per M. ft. (average)	25.00
Bank sand per ton delivered	[illegible]
Run of bank sand per ton delivered	1.45
River gravel per ton delivered	2.10
Trap rock per ton delivered	2.65

The bulk of the aggregate was run of beach sand, gravel being added to make the required proportions. The total cost of the materials bought was as follows:

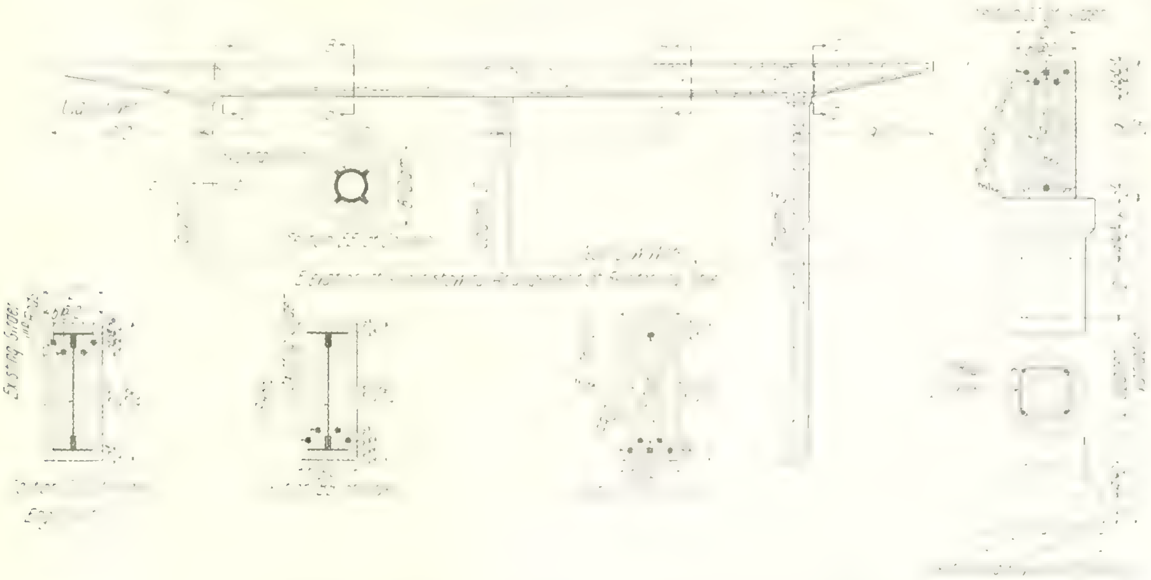
Cement	[illegible]
Sand and gravel	1,649.50
Lumber	[illegible]
Total	[illegible]

The cost of casing the old piling, which required 93 cu. yds. of concrete, was as follows:

Item.	Total.	Per cu. yd.
Cement	[illegible]	[illegible]
Sand and gravel	[illegible]	[illegible]
Total material	[illegible]	[illegible]
Lumber	[illegible]	[illegible]
Labor	[illegible]	[illegible]
Total forms	[illegible]	[illegible]
Excavating	[illegible]	[illegible]
Mixing and placing	[illegible]	[illegible]
Total concrete	$ 669.13	$ 7.20
Superintendence	241.51	2.60
General	146.23	1.57
Total general	$ 387.74	$ 4.17
Grand total	$2,079.63	$22.36

The cost of molding and sinking the new reinforced concrete piles, containing 112 cu. yds. of concrete, was as follows:

Item.	Total.	Per cu. yd.
Cement	[illegible]	[illegible]
Sand and gravel	292.31	2.61
Total materials	$ 521.75	$ 4.66
Lumber	[illegible]	[illegible]
Labor	[illegible]	[illegible]
Total forms	[illegible]	[illegible]
Excavating	49.73	0.44
Mixing and placing	412.10	3.68
Jetting	[illegible]	[illegible]
Total concrete	[illegible]	[illegible]
27.160 lbs. reinforcement at $2.42	656.70	5.86
Superintendence	[illegible]	[illegible]
General	176.10	1.57
Total general	$ 457.85	$ 4.09
Grand total	$3,108.05	$27.75



Details of Concrete Structure for Atlantic City Boardwalk.

The encasing and extension of the girders required 427 cu. yds. of concrete and cost as follows:

Item.	Total.	Per cu. yd.
Cement	$ 874.73	$ 2.05
Sand and gravel	1,114.46	2.61
Total material	$1,989.19	$ 4.66
Lumber	[illegible]	[illegible]
Labor	[illegible]	[illegible]
Total forms	$1,837.86	$ 4.3[illegible]
[illegible] lbs. reinforcement [illegible]	[illegible]	[illegible]
Placing reinforcement [illegible]	[illegible]	[illegible]
Total reinforcement	$2,764.97	$ 6.48
Mixing and placing concrete	1,138.07	2.67
Superintendence	613.80	1.44
General	671.39	1.57
Total general	$1,285.19	$ 3.01
Grand total	$9,015.28	$21.12

Including the items of bond, travel and cutting braces as given above the total cost of the work was $14,841.95.

The price of common labor was $1.75 to $2 per day of 10 hours. The contractors paid for different grades of skilled labor from 25 cts. to 37½ cts. an hour; for engineer, 60 cts. The higher priced labor, that is, 30 cts. and 37½ cts. an hour, was classed as carpenters.

In connection with the above data the reader may consult articles on other portions of the boardwalk improvement which were published in our issues of Feb. 17, 1909, and Sept. 14, 1910.

Repairing Concrete Floors.—There is a popular and widespread fallacy to the effect that a concrete floor once chipped or cracked is practically at the end of its usefulness. This is undoubtedly due to the results of unskilled workmen attempting to repair a damaged floor. Unless proper care is taken and the workmen engaged on the job has sufficient knowledge of concrete, a repair job is most unsatisfactory. In this connection, the practice of the Aberthaw Construction Co., the Boston concrete contractors, is worth noting. In certain of the concrete buildings erected by this firm, floors have been chipped in particular places because of some phase of the industry which gave rise to dropping heavy materials in one place, as, for example, the winding rolls in a paper mill. When a floor has become chipped out in some such manner as this, the proper method of repairing is to chip out with mallet and chisel a recess usually square, of sufficient depth to reach to the bottom of the deepest break in the concrete surface. The rough surface resulting from this process is then treated with acid to bring out the solid aggregate, or else a stiff brush is used to remove all the loose dust, and the recess washed out by sluicing out with a hose. When all the dust particles have been removed the recess is grouted with cement and before this has set the granolithic finish applied, [illegible] floor. Repairs made in this manner are stated to be just as permanent as the remainder of the floor, as the bond between the new and old concrete will be perfect if all the loose [illegible]

Meters and Water Waste.

[illegible] say about the efficacy of meters in curtailing water waste: "The only way to prevent waste is to make all takers pay for the water they actually use. In other words, to sell water by meter instead of by flat rate. If a man knows that every gallon of water he allows to run is being charged up against him by the meter, he will see to it that the water is shut off when he is through using it, that leaky fixtures are promptly repaired, and if he lets the hose work while he sleeps he will at any rate pay for it. The experience of other places in Massachusetts in the comparative amounts of water used under the flat rate and the meter system is shown in the following table:

[illegible]	[illegible]	[illegible]
Boston	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Worcester	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Holyoke	[illegible]	[illegible]
Lawrence	[illegible]	[illegible]
Lowell	[illegible]	[illegible]
New Bedford	[illegible]	[illegible]
Springfield	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Adams	[illegible]	[illegible]
Attleboro	100	37
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

A New Gasoline Mine Hoist.—The Seager Engine Works of Lansing, Mich., have perfected a new gasoline mine hoist. The manufacturers of this hoist have aimed to produce an economical unit for intermittent service. Between loads the engine is shut down entirely and is brought to speed at any time within ten seconds. By means [illegible] used on automobile engines, loads of various weights may be raised at the most advantageous speeds. This gives the hoist the economy of gasoline and the flexibility of steam. The engine consists of a multi-cylinder gas engine of the four cycle type. The ignition system is the "jump-spark" with [illegible] avoided. The [illegible] 30 ft. per min.; [illegible]

[illegible] miles of th[illegible] 1,500 miles from [illegible] and 2,500 m[illegible] ard.

EARTH AND ROCK SECTION

Methods of Determining the Slope and Direction of Deep Drill Holes.

In determining the exact location and direction of any part of an inclined diamond-drill boring no exact method has yet been devised, but there are three methods used by which such a boring may be located closely enough for all practical purposes.

The simplest method is the hydrofluoric acid test for inclination which is based on the power of hydrofluoric acid, to etch glass, and the principal whereby the surface of a liquid at rest assumes a level position. This method was used on the Catskill aqueduct.

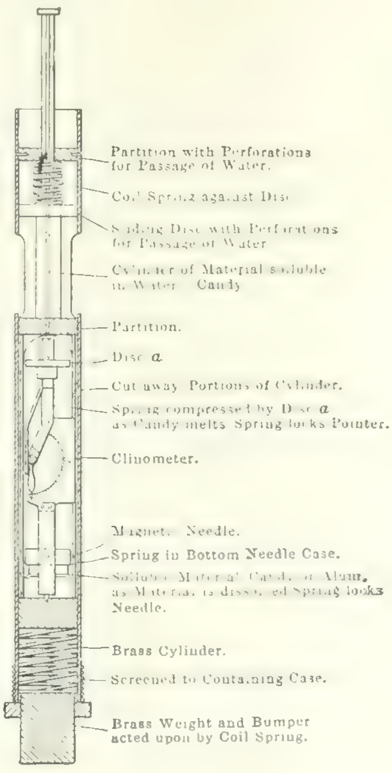
The acid solution is placed in a small bottle about the size of a pill vial. The solution is diluted to about 1 part of acid to 9 parts of water so that the bottle is required to lie in a stationary position for some time to show a definite line of etching. The bottle is placed in a cylindrical water-tight steel shell about 1 ft. long and bored to fit the bottle. This is lowered into the hole to the point desired and allowed to remain ½ hour or more. The angle of the etched line with the line of the side of the bottle showed the inclination of the hole. The angle was read by attaching the bottle to a pivot which operated a needle over the graduated scale of a protractor. The bottle was clamped to the revolving pivot in such a manner that the side of the bottle and the etched line could be sighted parallel to a straight edge which marked the diameter of the semicircular protractor. A correction was necessary, however, on account of the capillary attractions on the acid solution on the inside of the tube or bottle. A minus correction varying between 4° for a reading of 26° 24′ to 8° for a reading of 52° .05′ was applied to obtain the true slope. The final accepted angle was an average of 24 readings by two independent observers. This method, though simple, had a serious drawback—one incorrect reading changed the location of all points read below it.

Another method used on the Catskill Aqueduct at the Hudson River crossing was the pressure gage test. The pressure gage was an instrument designed to record the water pressure, thus assuming that the static head of water in the hole could be calculated, giving the vertical depth at which the pressure was recorded. Then with the measurement of the length of the hole, the position of the point could be indicated. The pressure gage consisted of an arrangement of two steel cylinders, one within the other, the inner one being filled with mercury and having a calibrated glass tube leading from it to the airtight chamber of the other cylinder. The hydrostatic pressure on the outer casing forced the mercury into the inner tube from which it could not return, thus recording the highest pressure. This scheme was excellent in principal, but under the conditions obtained at the Hudson River crossing, it did not work well. Only the highest pressure could be recorded and higher pressures than that of static head might be obtained.

A third method is that used in the Mineville district of New York, which was recently described by Guy C. Stoltz in the *Engineering and Mining Journal*. The instrument used is called the azi-clinometer which, as the name implies, is for determining the azimuth and inclination of the hole. The azimuth can be read from a magnetic needle and the inclination on a clinometer. The instruments are mounted in a brass cylinder (see Fig. 1), 1 ft. long and 1⅜ in. inside diameter, on a vertical axis which at both ends rests in jeweled bearings in the cylinder partitions. A portion of each side of the cylinder is cut away to enable reading of the instruments. At the base of the cylinder is a brass bumper and lowering weight which is free to slide in the cylinder and which is pressed upon by a coil spring. As the instrument is lowered in the drill hole, the instrument is protected from shock that might result in the instrument striking the bottom severely.

Preparatory to taking readings with the aziclinometer, a piece of stick candy or alum, or any substance readily soluble in water, is inserted in a spring framework mechanism operating on the clinometer pointer and above the graduated arc, while another piece of the soluble substance is placed in a similar housing under the magnetic needle. The candy upon melting in these housings disengages the springs and levers, one system of which locks on the clinometer pointer, while the other acts upon the magnetic needle of the compass box.

The instrument is then screwed into the base of a brass containing case, 5 ft. long and 1⅜ in. internal diameter, which has previously been filled with water. Attached to the top of the containing case is an eye to which the end of a line of wire coiled on a winch is fastened. This wire is marked at 25-ft. intervals by means of white paint. The instrument in the case is then lowered by uncranking the winch to a point decided upon for taking the reading.



Partition with Perforations for Passage of Water.
Coil Spring against Disc
Sliding Disc with Perforations for Passage of Water
Cylinder of Material soluble in Water Candy
Partition.
Disc *a*
Cut away Portions of Cylinder.
Spring compressed by Disc *a* as Candy melts Spring locks Pointer.
Clinometer.
Magnet. Needle.
Spring in Bottom Needle Case.
Soluble Material Candy or Alum, as Material is dissolved Spring locks Needle.
Brass Cylinder.
Screwed to Containing Case.
Brass Weight and Bumper acted upon by Coil Spring.

Aziclinometer.

The clinometer disk and pointer are then free to assume the position due to gravity and the magnetic needle seeks the position of magnetic north since its case is free to assume a horizontal position on any inclination. In the course of perhaps half an hour the candy has dissolved and the framework which has housed the candy is free to contract due to the springs which are attached. As it does so, the levers act upon the clinometer and needle, locking both in their proper positions.

The containing case with the instrument is then hoisted and the readings are recorded. These readings are taken at intervals of from 25 to 100 ft. throughout the course of the hole. The readings are then plotted on the map by protractor, and the course of the drilling determined.

The magnetic needle is of course useless in detecting the azimuth of a drill hole in the magnetic formation, but away from influencing metals the readings should be of great value.

The instrument was invented by M. Garvey, a drill contractor in Mineville, N. Y.

Cost of Removing the Overburden of a Clay Pit by Hydraulic Sluicing.*

The shale pit is about 1,800 ft. from the Raccoon River in Des Moines, Ia. The nearest building of the plant itself to the shale pit is the pan room, 150 ft. away. The pan room floor is 9 ft. above the floor of the pit. There is no place near the pit to which the overburden might be moved, and it became necessary to devise a scheme for carrying the effluent some 1,100 or 1,200 ft. to a tract of low ground owned by the company. After working out the differences in elevation (given below) between the pump house and low water in the river, also between the pump house and the top of the shale, and in the intake and outlet of the sluiceway, a plan was evolved for the operation of an hydraulic plant.

The hydraulic plant consists of a 14 and 20, 10¼x15, Worthington compound duplex outside packed plunger pump, steam for which is furnished by a 75-hp. horizontal fire tubular boiler. The pump has 8-in. suction, 7-in. discharge, 2½-in. exhaust steam, and 5-in. exhaust. At the entrance to the pump the suction line carries a vacuum chamber 12 ft. high, 8 ins. in diameter, with a vacuum gage. The pump is operated at 40 revolutions per minute (80 lbs. steam). That portion of the 8-in. line which runs between the river and river bank is carried on two floats and is connected to the line at the river bank by a rubber sleeve securely clamped. The 7-in. discharge line carries a gate valve at the pump and a pressure gage.

Two leads of hose are carried from 5-in. line by a siamese connection. Each lead is operated by one man. This is possible by reason of a standard to which the play pipe is rigidly attached, and which is susceptible of both a vertical and horizontal motion. Each lead of hose terminates in a ⅞-in. nozzle.

The 6-in. spiral pipe is connected to a 6 to 12-in. spiral increaser, flat on the bottom. Above this increaser are three 10-ft. lengths of 12-in. spiral pipe, which afford a reservoir to the 6-in. spiral pipe. The spiral pipe is susceptible of easy bends. There are two 45° ells in the spiral pipe line, one at station 375 and one at station 025. The spiral pipe is carried through a 12-in. cast iron pipe under the C. G. W. tracks. The cast iron pipe terminates in three lengths of 12-in. sewer pipe.

The pump-house was located about 655 ft. from the river bank, and so planned that the lift from the river would amount to less than 18 ft. at extreme low water. It was decided to install a pump sufficiently large to handle the requisite amount of water without injury to the pump, at the same time insuring fuel economy. The difficult problem, of course, was the determination of the character of sluiceway which would carry away the effluent from the pit and place it. For only a short distance could the sluiceway be carried above ground, it being necessary for the major portion of the distance to carry it underground.

An experimental line of 12-in. sewer pipe was tried with much misgiving. True to prophecy, it was impracticable, requiring long periods of flushing, and thus reducing the efficiency of the plant in that only a small amount of stripping could be done in a day. This line was one already in place, it being used as a drainage sewer to carry off storm water, drips, etc., from the pit and from the plant. The sewer line could dispose of clay or earth in solution or gravel, but it was absolutely impracticable in the disposition of sand. The sand would settle to the bottom of the pipe, requiring hours to remove it.

Because of the large proportion of sand in the overburden, much more than is apparent from a casual observation, it became necessary to devise a sluiceway which would insure greater velocity to the effluent and at the same time agitate it and during its flow. A 6-in. spiral pipe line was decided upon and installed. It works splendidly. This line has become clogged only twice: First, the original screen at the intake was of light material and the openings were extended by a laborer, thus admitting stones too large for the pipe; second, a flat stone 5¾ ins. long, 2 ins. wide, ½-in. thick, passed through the present screen, ran along for a distance of 600 ft., then in some manner tipped up and a quantity of roots gathered behind this stone and clogged the pipe. It required about a half day to find this obstruction and clean the pipe. The plant has been in operation since May 1, and since that time to Nov. 1 there has been moved about 50,000 yds. of overburden.

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*Abstracted from a paper by Paul Beer, read before the National Brick Manufacturers' Association on Feb. 6-11, 1911.

The following are the principal data relating to the pipe lines:

8-in. Suction Line:

Elevation extreme low water	80.0
Elevation bottom 8-in. pipe at intersection with pump house	93.60
Elevation top of pump foundation	97.1
Elevation entrance to pump	97.6
Extreme total lift of suction	17.6
Length of suction line from pump to river bank (feet)	655
Total length of line (feet)	690
Grade from pump house to river bank (per cent)	1.6

7-in. Discharge Line (Water Line):

Total present length (feet)	1,080
Elevation at pump	100.75
Elevation at discharge	161.0
Total lift of discharge	60.25

6-in. Spiral Pipe (Hydraulic Sewer):

Total present length (feet)	1,030
Elevation of intake (station 1030)	110
Elevation of station 729	109.67
Elevation of station 375 (45-degree bend)	103.6
Elevation of station 025 (45-degree bend)	101.45
Elevation of station 000 (outlet)	101.25

The work accomplished and its cost were as follows: Total volume of water per minute at 20 complete revolutions of each piston rod equals 428.8 gals. Total volume per day of 9 hours equals 231,552 gals., equals 1,146.6 yds. Total effluent per day equals 1,432.5 cu. yds. Of this, conservatively, 20 per cent is solid material, thus giving 286.5 cu. yds. overburden disposed of per day of 9 hours. Samples of effluent are taken every hour and percentage measured.

Cost of Operation:		Per day.
Boiler fireman		$2.25
Man at intake		1.50
One man at nozzle		2.00
One man at nozzle		1.80
Total labor		$7.55
Fuel, 1½ tons, at $1.50	$2.25	
Oil	.15	
Maintenance and supplies, including hose, new pipe, etc.	.85	
Total cost		$10.80

At 286.5 cu. yds. per day, it follows that the cost of stripping and placing is about 3¾ cts. per cu. yd.

Magnetized Drill Rods as the Cause of Borehole Deflections.*

While the deflection of long boreholes may be attributed to various causes, such as the quality of the rock and the weight of the rods in a long hole slightly larger than the diameter of the rods back of the core barrel, the deflection is also attributed in a considerable extent to the effect of magnetism. Mr. J. S. Curtis has made numerous experiments in South Africa on the effect of magnetism in long drill rods and has observed that the drill rods after they have been rotated for a time in boring become highly magnetic. In fact after they have been used for a while they become practically saturated with magnetism; that is, they become as magnetic as their composition will allow. Being made of a high quality of mild steel, they are susceptible of being magnetized to a very considerable degree, though naturally they cannot retain the same amount of magnetism which hardened rods of high grade steel would retain. Moreover the drill rods remain magnetic for a very long time, though there is a slight loss of magnetism when they are not in use. The loss, however, is not much greater than would be the case with a permanent magnet left without an armature. The magnetism communicated to the drill rods in drilling is due to the fact that they revolve constantly in a terrestrial magnetic field. Further observations also elicit the fact that the top of the rods, when connected, shows north magnetism, and the bottom of the rods, carrying the core barrel and bit, corresponds to the south end of the needle. This is the case whether the rods are 500 ft. or 1,000 ft. or of much greater length.

When uncoupled in lengths of 10, 20 or more feet, they exhibit the usual phenomena of a bar magnet when divided into several portions—namely: each section becomes an independent magnet showing the same polarity as the joined drill rods. The top of the rod is north pole and the bottom of the rod is south pole. It has already been mentioned that the great majority of boreholes are deflected to the north, but usually the deflection is slight until the drill has reached a depth of 300 ft. or more, when the deviation of the bore becomes more pronounced. This can be accounted for by the fact that a few hundred feet of the drill remain practically rigid, and therefore do not deflect much from the perpendicular. With every 10 ft. of drill rod added the flexibility of the drill becomes greater, until at a depth of 1,000 ft. or so the hole can be and usually is deflected very considerably from the vertical. What is the cause of this deflection? It is, in my opinion, due to the magnetization of the drill rods brought about by their revolution in the terrestial magnetic field.

The quantity of magnetism communicated to the steel by the earth depends upon the time the drill is in use and the character of the formation it is working in. The probability is that it will take up all the magnetism which any formation is capable of communicating after operating in the rock for a month. Dolomite magnetizes the rod less than quartzite, while diorite or diabase induces more magnetism in the drill than either of the two rocks.

As before stated, the bottom of the drill exhibits south magnetism corresponding to the south end of the compass needle. In a comparatively short bar magnet the lines of force are practically confined to the ends, but the magnetized drill rod, as boring is done on the Rand, can be any length up to 6,000 ft. In a drill rod 1,000 ft. long the effects of magnetism must make themselves felt a couple of hundred feet from the ends. A certain distance above the core barrel the drill hugs the wall of the hole and in so doing causes the top of the core barrel to also touch the wall, thus bringing the crown or bit, carrying the diamonds in contact with the opposite wall of the bore. This deviation, though but slight, owing to the fact that there is only about 1/32 of an inch clearance between the bit at the end of the core barrel and the walls of the hole, is nevertheless sufficient to alter the boring plane of the crown, causing it to dip to the south, in that way inclining the boring axis to the north. It is the magnetic field of the earth which causes the south pole of the rod to go to the south side of the hole, thereby deflecting the crown to the north. This can be demonstrated by the following experiment. A rod of mild steel with a pin passing through its centre to which threads are attached, is hung vertically in a solenoid carrying an electric current. When the current passes in a sense which will make the bottom of the rod south pole, this end moves to the south side of the solenoid. When the current passes in a reverse direction, so that the bottom of the rod becomes north pole, the rod moves to the north side.

Although the couplings by which the rods are joined are carefully turned there is more or less flexibility in the drill. I have seen a 50 feet length of "P" rod, when hanging at the end of the cable after being hoisted out of the hole, vibrate like a harp string.

It is not contended that the total deflection of any particular bore-hole is due to magnetic causes alone. It is not. The deflection of the rods from the perpendicular is due, in the first place, to magnetic influence, but when the drill has once been put in a few degrees out of the vertical, mechanical laws govern its course. The drill begins to deflect when it has penetrated a few hundred feet of the earth's crust. The region of perceptible deflection varies from three to seven hundred feet ordinarily, and this deflection is almost always slight at the beginning. In some cases the drill has been known to go down as much as a thousand feet without much deviation, but these instances are very rare, even in limestone. In general, then, the long bore hole will be a curve trenching toward the north. The weight of the drill rods themselves on the pressure from above tends to increase the curvature as the sag in the rods to the south pulls the top of the core-barrel also to the south, driving the crown up against the northern side of the hole. In fact, the deflection is produced by gravity playing the part which magnetism played when the bore was begun, not but what magnetism still attracts the rod to the south, but that attraction is feeble in comparison with the force of gravity. This is the reason that it is useless, when the bore is much deflected, to apply methods of keeping the rods vertical by reversing their polarity by hoisting or lowering them through a solenoid carrying an electric current which will magnetize them in an opposite sense. The process I have advocated is only intended to keep the rods vertical by regulating their polarity and must be put in effect from the start.

The fact must not be lost sight of that the pressure put upon the rods when drilling will have a curving influence either to the east or west in a similar manner to that which caused the curvature to the north. It must be remembered that the bore begins with a curve in a vertical plane, and now through its tendency to twist to the east or to the west the curve takes on the shape of a portion of a corkscrew. The direction of a bore-hole is often changed by a difference in the character of the country rock, by a change from hard to soft strata, and vice-versa, or by the presence of slips, faults, and caves, which last occur mostly in dolomite. Occasionally a hole keeps a direction due magnetic north, in which case it must be cutting the formation normal to its strike, and also the formation must be very regular.

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*Abstract from Borehole Deflections, a paper by Mr. J. S. Curtis in the Journal of the South African Institute of Engineers.

Method of Taking Soundings.—The following method of taking soundings in a rapid current above a waterfall was employed: A wire was stretched across the stream and drawn taut and a heavy weight was suspended from it by another wire. The wire to which the weight was attached was pulled gradually across the river. At stated distances the vertical angle was read from a transit to the point of suspension of the weight on the horizontal wire. From this the elevation was calculated. The horizontal angle was then read between the point of suspension and the point where the wire entered the water. From this the angle of the wire with the water surface was calculated. The length of the submerged wire and its angle with the water surface being known, it was easy to calculate, approximately, the depths of the stream.

Water Works Statistics.—The Battle Creek, Mich., Water Works Report for 1910 contains some interesting facts and figures. The population of the city is 26,000. The average daily per capita consumption throughout the year was 80 gals. The pump counters registered a total of 762,000,000 gals. for the year. Of this amount only 58½ per cent was paid for: 57 per cent by meter rate, and 1½ per cent at flat rate. The remaining 41½ per cent of the total was distributed as follows: Parks, public buildings, etc., except schools 4 per cent; schools, including lawns, 3 per cent; drinking fountains for horses and people, 4 per cent; flushing sewers, 1½ per cent; blowing-off hydrants, 1 per cent; wetting down trenches, sewer, water, etc., 1 per cent; fires, 3 per cent; slip of pumps, 3 per cent; under-registration of meters, 2 per cent; leaks, loss and waste, 16 per cent.

ROADS AND STREETS SECTION

Nine Years' Experience with Creosoted Wood Block Pavement in Minneapolis.

[illegible]*

The first creosoted wood blocks in the streets of Minneapolis, were laid early in the season of [illegible]. This was after much discussion and a strenuous amount of argument for and against. It was an experiment, and as such, was much criticised. The interested property owners on the street on which the trial of the new pavement was made, as is usual in such cases, were about evenly divided on the question. The objectors, to the then new kind of wood blocks, based their arguments on the familiar objection to the old cedar block streets, with which Minneapolis had had a large experience.

At that time, to the average person with no knowledge of the process of treating woods, a wood pavement was a wood pavement and nothing more, and it was decidedly unpopular here, there being miles of streets paved with cedar blocks going to pieces and needing to be replaced. The property owners objected to paying for the pavement a second time, and if they were obliged to do so, a large part of them objected to any further experiments with wood.

The use of creosoted blocks in this city for paving purposes, for the above reasons had a stormy inauguration. Also, immediately after the pavement was completed and the street thrown open to travel, there was a storm of criticism on account of the large amount of pitch used as a filler and placed and left on the surface. Just why such an amount of pitch was used, I don't now recall, but there certainly was a lot of it put on the street. The people of the whole neighborhood tracked it into their houses, and then came to the City Hall to kick about it. Bicyclists got their tires smeared with it, and many of them got falls on, or into the street. However, the pitch finally wore off, although it took a long time and the street began to lose its bad odor, and it even began to take on some popularity. About the close of the second year, people had begun to find out what the pavement really was and drivers of vehicles in that locality sought it out and commented favorably on it. The paving covers between a half and three-quarters of a mile of street, and the first few years carried a very heavy traffic owing to its being, at that time, the only well paved road leading to the then best residence street in the city.

The first creosoted blocks were long leaf yellow pine from Alabama, furnished and treated by the Republic Creosoting Co. They were treated in Indianapolis and were laid by the city by force account. The blocks are 4 ins. thick today, just as they were when put down and there has been no repair at all on the street from the fault of the paving. It has been opened a number of times by plumbers in making connections for new buildings. For actual repairs, not one dollar has been spent in nine years. No particular effort has been made to keep this street extremely clean. It has been swept constantly with horse sweepers and has been kept thoroughly sprinkled, which latter is one of the things we find here to be absolutely necessary with wood pavements, whether creosoted or otherwise.

This street, 10th St., between 1st Ave. South and Park Ave., in the city of Minneapolis, the writer considers one of the best, if not possibly the best example of modern wood pavement in America today. It has been driven over, walked over and examined thoroughly by engineers and city officials from all over the United States, and I personally have answered scores of letters of inquiry in regard to it.

It was laid on 6 ins. of natural cement concrete which is in good shape today. We have since stopped entirely the use of natural cement in base, for pavements. The crown is 5 ins., with center 1 in. below the curb and a 40 ft. roadway. Figure 1 shows a section and plan of this first creosoted block pavement. The quarter or half way between center and gutter is sprung about 1¼ in. from a plane between center and gutter. The blocks are laid on 1 in. of sand cushion and were rolled with a horse roller weighing approximately five tons. The roller was pulled by men. The filler is a pitch distilled from coal tar by the Barrett Manufacturing Co., which company has a branch establishment here. The pitch comes on the street in tank wagons, heated by fire under the tank, and can be kept at any desired temperature.

The grade of the roadway is light, being at most, less than 2 per cent and averaging much less than 1 per cent. The oil was what the contractors call creodone, being a double distillation of coal tar, and having a specific gravity of from 1.06 to 1.08. The amount of oil used was 12 lbs. to the cubic foot. The blocks were laid at an angle of 22° 30′ approximately, from a line perpendicular to the street. This is the manner in which all creosoted blocks have been laid in this city, and thereby all expansion joints at right angles to the street are done away with. We consider this very essential, not only on account of the expansion but from the fact that it is belived here that the blocks wear better at that angle than when laid at right angles to the street. An expansion joint was provided along each side by placing an inch board along the curb and paving against it. Afterward the board was removed and about half the space filled with dry sand, and the balance with paving pitch filler. The blocks were furnished at a price of $1.95 per square yard, street measurement, f. o. b. Minneapolis. All work in connection with the paving was done by the city by day labor, paid at the rate of $2.00 for a day of eight hours. The pavement cost complete, $2.79 per square yard, and the total yardage is 13,305.

PRESENT METHODS OF CONSTRUCTION AND COST DATA.

Since that paving was laid, creosoted wood blocks have been laid in Minneapolis every year in increasingly large amounts, until the last year in round figures, nearly 160,000 sq. yds. were placed in the streets, and the total yardage in use has risen to about 800,000. Nearly all the blocks used since the first job described above, have been manufactured from Minnesota woods. Largely norway pine and tamarac, but hemlock and white pine have been used to a limited extent. Hemlock is not satisfactory for paving purposes, at least that is the experience here.

In recent years the method of proceedure in paving matters has been as follows: In the fall the city council designates certain streets desired to be improved with a permanent pavement requiring a concrete base. These streets are ordered paved the following year and the city engineer proceeds to have all house connections made ahead of the improvement. By ordering this in the fall, the work can be done by the plumbers late in the fall or early in the spring and enough street completed with house connections so that the actual paving operations can begin in the spring without the work being delayed. After this preliminary work is out of the way, the street is graded to a base slightly above a point which is the actual thickness of the pavement below the finished surface. The base is rolled with a 10-ton roller and the street is ready for concrete. Two inch planks are then laid down the center of the roadway over about 12 ft. of the width for the heavy loads of concrete stone to come in on, and the stone is dumped on this plank was making a suitable bed from which the stone can be easily shoveled into barrows. The sand is dumped from wagons on the unplanked portion of the street in piles sufficiently close together and not too close, so that none of it will have to be wheeled further than necessary to place it in the work. Considerable care has to be taken in this matter of placing stone, sand and cement along the street, as it is easy to get the material wrongly placed, or too much or too little in place, so as to add 25 per cent almost to the cost of the labor in the street. Another thing which any experienced contractor knows, is that the grading previous to the concrete has to be well and closely done, otherwise either too much concrete has to be put in the street, or a lot of unnecessary and very expensive grading work must be done by the concrete men before they can put the base in place. All these things practically have to be done by skilled and experienced men. Such men are absolutely necessary and are worth in certain parts of the work, at least twice what an inexperienced man is.

The method used by us here for several years, in mixing concrete, and putting the mixture in place in the street, is a little out of the ordinary and worth a few words of explanation: Two flat pans 12 ft. by 16 ft. by ¼ in., are used to mix on, one placed on each side of the roadway. A horse is hitched to each pan to move it ahead, after each batch is mixed and placed. The sand and cement are put on the pan mixed with necessary water, and then the stone is run on with barrows. Then 8 to 10 men to each pan with hoes, start at the end of the pan away from the finished concrete, and hoe the mixture back turning it over and over until the rear end of the pan is reached and the mixture is in place in the street. The pan in the meantime has been moved slightly ahead once or twice, by the horse. This method, while not ordinarily used, has been very successful here, and we have made a 5 in. Portland cement concrete for from $0.50 to $0.60 per square yard. In fact the figure has never yet reached 60 cts. per yard at a mixture of 1 part cement, 3 parts sand, and 6 to 7 parts stone. Salesmen for concrete mixers have not claimed, heretofore, that they could beat those figures, at the price paid here for labor. These low prices in concrete are brought about, not alone by the method used, but by using experienced men in some parts of the work, and rather exceptionally good men in handling the hoes. However, makers of concrete mixers at the present time, claim to be able to mix and place concrete in the streets considerably cheaper than our cost for that same item. If they can show here, that that can be done, concrete mixers will very likely be used from now on.

After the concrete has set for about two weeks, the sand for the cushion is hauled on the street. One inch strips are nailed to the concrete at right angles to the roadway 10 or 15 ft. apart and a straight edge long enough to reach over three of these strips, and heavy enough to bear the weight of one or two men, is pulled by two other men across the street to level the sand. At intersections and very largely on streets with street railway tracks on them, the bed is drawn by a man with a sort of wooden hoe. This he uses entirely by his eye and skill, there being one man on our work for a number of years who can draw a bed for paving, better than it can be done with a templet. Some care must be used in obtaining cushion sand as fine sand should be used, and it is necessary that no gravel or dirt be allowed to go in. Before the sand cushion is spread, the blocks are hauled in on the concrete and piled on the outer edge of the walk and the space between the curb and walk, if on a residential street. Care, of course, must be taken to have these correctly placed as to quantity in each block and on each side of the street. After the sand cushion has been hauled in, the block laying gang [illegible]. This consists of from 32 to 35 men, as follows:

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*Street Engineer, Minneapolis, Minn.

6 men spreading and [illegible] the bed.
7 men wheeling blocks.
3 men setting up blocks for the pavers.
5 block layers on the line.
1 block layer, patcher.
1 block layer cutting [illegible] and at tracks.
1 man sweeping in [illegible].
1 man pulling cull-blocks.
[illegible] men putting in filler.
1 team.
1 roller-man.
1 water boy.
1 foreman.

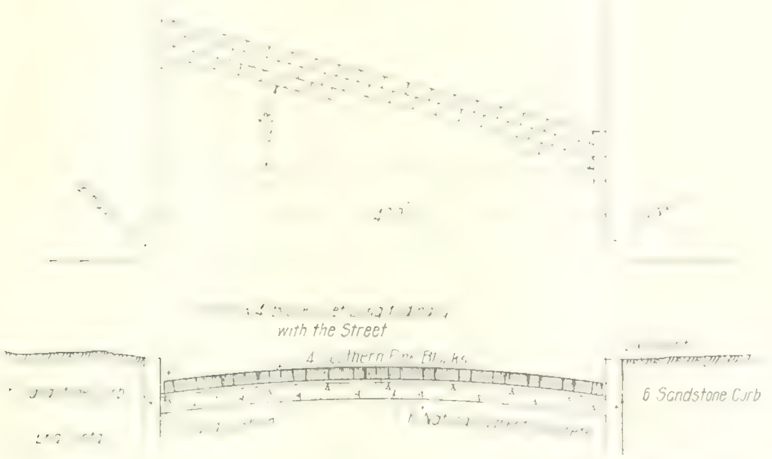

Fig. 1—Section and Plan of First Creosoted Wood Block Pavement Laid in Minneapolis.

This force is sometimes increased by one or two pavers and by the further help made necessary by the increase of the pavers. The above force has laid as high as 1,800 sq. yds. in nine hours. This force averages about 1,100 sq. yds. per day for the season, taking one day with another, and including moving from one job to the next. Moving takes up a considerable per cent of the time, especially as for various reasons it is very seldom possible to move from one place to the next nearest one, or even to one in the same neighborhood. It takes constant scheming and planning to get everything out of the way ahead of the pavement.

There are always plumbers who are slow with house connections, or the gas company comes in at the last moment and wants to put in a new or larger gas main, or some public utility company wants to put in a conduit, or a new man-hole, or some of them have neglected to put their man-hole covers to the correct grade. In fact, there are enough of such things to keep an engineer in charge of paving work in hot water a good part of the time. An engineer on railway construction for some large railway company or in charge of construction work for any other large corporation whose word is usually law out on the work, has a lot to learn from force account work on the streets of a city. If he hasn't learned it before, one of the first things he will have to learn, will be to control his temper.

The contract cost of creosoted blocks in this city, the past year 1910, was lower than for some years, and consequently pavement was laid cheaper. I submit herewith the average cost price per square yard for all the different items in the whole season's work, excepting two or three streets where unusual conditions prevailed, making their cost peculiar to themselves alone. A few words of explanation are necessary for one or two items of the work. The first refers to street railway concrete. The Street Railway Co. takes care of the space between their tracks and between the rails and the tracks, being 15 ft. over all. The ends of the ties project into the portion of the street taken care of by the city. It is more convenient and satisfactory for the company to place the concrete base about the 1.5 ft. partly occupied by their ties on each side of the tracks when they concrete the balance, than for the city to do it later. Then the city pays them for this 1.5 ft. of concrete at the same price [illegible] the work averages elsewhere on the streets. This constitutes the item of street railway concrete. Another item is that of headers. On the returns on the cross streets and at alleys where there is no paving, a 4 in. x 10 in. plank is set on edge to pave against and to protect the edge of the new paving. This explains the item of headers.

The itemized cost per square yard of creosoted wood block pavement laid in 1910 was as follows:

	Per sq. yd.
Street railway concrete	[illegible]
Concrete stone	.2386
Concrete sand	[illegible]
Mixing and placing concrete in street	.1392
Hauling concrete, plank and cement	[illegible]
Cement	[illegible]
Total cost concrete per sq. yd.	[illegible]
Grading	[illegible]
Hauling blocks	[illegible]
Laying blocks	[illegible]
Labor on filler	[illegible]
Cleaning up after [illegible]	[illegible]
Miscellaneous labor	[illegible]
Cushion and filler sand	.0255
Pitch in filler	.0490
Tools	[illegible]
Headers	[illegible]
Miscellaneous [illegible]	[illegible]
Creosoted Norway and T[illegible]	[illegible]
Total average cost per sq. yd.	$2.3795

The above figures represent the average cost of about 150,000 yds. of work in nearly all parts of Minneapolis, and under about all the conditions possible. The year was favorable in weather conditions for street work, as there was very little rain, the men losing hardly a day during the whole season. Prices for labor were $2.25 per 8 hour day for common labor, and 59 cts. per hour for teams. Some special men were paid wages ranging from $2.50 to $3.00 for 8 hours. Pavers received $2.75 to $3.50 per day, rollermen $3.50, and foremen from $3.50 to $4.50.

The blocks are paid for at square yard prices measured in the street, and they are bought f. o. b. Minneapolis. The concrete stone is bought from quarrymen in the city at a price based on $1.00 per cubic yard at their quarries, and they haul it to the street. It cost us in 1910, on an average, about $1.70 per cubic yard on the street. The cement cost $1.12 per barrel f. o. b. cars here and we hauled it to the work. The sand comes from cellars largely, as the city, or a considerable portion of it is underlaid with a very good quality of mason sand. Often it comes from points very close to the work. Sand averaged in cost on the work, where it is hauled by the contractors, about 60 cts. per cubic yard.

The men on the work are paid twice per month, and the material men are paid once per month, the blocks being paid for on monthly estimates by the city engineer.

The paving in Minneapolis is strictly on a cash basis, no certificates of indebtedness being used. The money is all in hand or in sight before the work is started. This explains for one thing why we can do street work here for so reasonable a price. The property owners pay for their abutting frontage on the street, and the city pays from a general fund, for the street and alley intersections. The assessed portion is paid for in 5 annual installments, with 5 per cent interest on the deferred payments. The money as collected goes into a revolving fund, which was started in 1885 by an act of the Legislature authorizing a bond issue for that purpose. This method of paying for paving, sewers and curbing seems to be very satisfactory to the people and works well if the fund is kept intact, and no portion of it diverted to other uses.

COMPARATIVE TEST OF DIFFERENT WOODS

On Jan. 1, 1905, Minneapolis had about 150,000 sq. yds. of creosoted wood paving, some of which had been in use for three years. This was by far the largest amount in any American city, and as there was a wood treating plant here at this time, the attention of the United States Government Forestry Bureau was called to this city in its endeavor to find, what, if any, cheaper woods might be available for paving purposes. To the end that a test might be made here through cooperation of the Forestry Bureau and the city, correspondence was begun and finally arrangements were made with the two companies operating in this market to treat certain woods free of cost, the same to be placed in the street by the city, and a record kept of the travel. The place selected for the test was a block at the lower end of Nicollet Ave., the principal shopping street and the main artery leading from the east side of the Mississippi River to the west and most populous side. This block carried then, as now, about as heavy a traffic, although not quite, as any block in the city. The street was already paved with granite blocks on a sand base, and had been for years. The blocks had become rounded and the whole pavement was in rather bad shape for a main thoroughfare. It was also very noisy and had been the cause of many complaints and much discussion as to the best disposition to be made of it. It was finally decided to remove the granite blocks, use them elsewhere, and repave under the conditions as above set forth. The work [illegible] by the middle of July the concrete was in place in the street and ready for the cushion. The Forest Service furnished the white birch, larch, jack pine, fir and hemlock lumber. The Republic Creosoting Co. furnished the southern pine, norway pine and tamarac on the regular contract for blocks with the city.

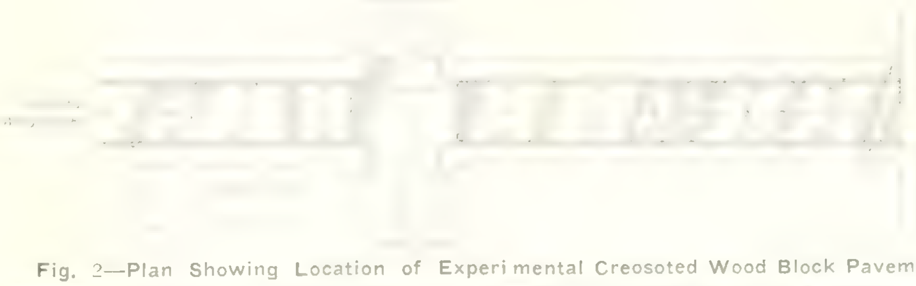

Fig. 2—Plan Showing Location of Experimental Creosoted Wood Block Pavement.

Kettle River Quarry Co. manufactured and treated the white birch, larch and jack pine, and the Republic Co. treated the fir and hemlock and also, the southern pine, norway and tamarac. The concrete was mixed, placed in the street and the work handled about as described in the work generally, above. The conditions for sub-grade, and in fact, the general conditions were about the average for the business district in Minneapolis. That is to say, there is no clay or heavy soil liable to heave with frost, or to settle after through rolling, which was done with a ten-ton, three-wheel roller. The finished surface was rolled with a 7 or 8-ton tandem roller.

In this test pavement a 5-in. Portland cement concrete foundation mixed in the proportions of 1 cement, 3 sand and 7 crushed limestone was laid. The cushion was 1 in. of sand, and the blocks were 4 in. deep, 4 in. wide and from 5 to 10 in. in length. Paving pitch of medium hardness, was used as the filler. The top dressing was a thin coat of sand. A 1 in. expansion joint next to and parallel with the curb was provided; but no cross expansion joints were provided. In laying the blocks the row of header blocks were placed next to and parallel to the expansion joint. The rest of the blocks were laid mostly at an angle of 22° 30′. The blocks were laid in contact and slightly driven.

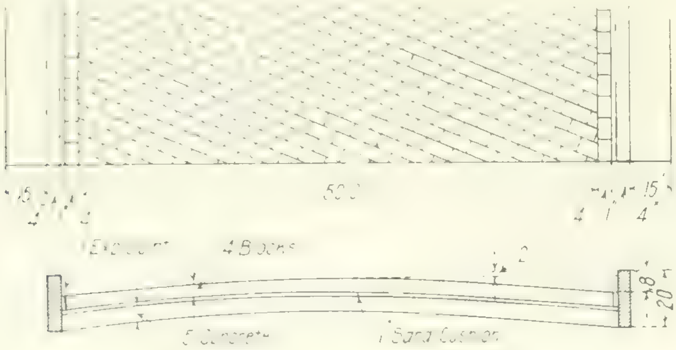

Fig. 3—Section of Experimental Creosote Block Pavement at Minneapolis.

Figure 2 is a plan giving the location of the street, with reference to intersecting streets. The numbers 1 to 15 show the location of the different kinds of block. In Fig. 3 a section of this street is also shown.

The Travel Record—The statistics for travel were taken between the hours of 6 a. m., and 6 p. m. and were always taken about the first of each month, and a portion of the time in the middle of the month, one day at a time only, and in every case week days. I am giving herewith a condensation of these travel records showing an average of 62 days' observations, taken between August 1, 1906, shortly after the completion of the paving, and January 1 of the present year.

Kind of vehicle	Average number per day	Average number tons weight
1 horse, rubber tire (loaded)	43	[illegible]
1 horse, steel tire (loaded)...	425	638.0
2 horse, rubber tire (loaded)	[illegible]	[illegible]
2 horse, steel tire (loaded)...	599	2,680.0
4 horse, steel tire (loaded)	28	219.7
1 horse, rubber tire (light)	221	221.0
1 horse, steel tire (light)	[illegible]	[illegible]
2 horse, rubber tire (light)..	105	261.7
2 horse, steel tire (light)	[illegible]	[illegible]
4 horse, steel tire (light)....	18	78.3
Horses	6	[illegible]
Bicycles	776	77.9
Autos	[illegible]	[illegible]
Total tons in the 12-hour day		[illegible]
Average tons to the per ft. of roadway		[illegible]
Estimating 90 per cent of travel on middle [illegible] ft. of roadway, average tons to the per ft.		[illegible]

It will be seen by these figures that the traffic on Nicollet Ave. in the limits where the record was kept, while not heavy as compared with a few streets in Chicago, Philadelphia or Boston and many in New York City, is still what might be called heavy traffic for American cities. One peculiarity of the traffic and wear, as clearly shown in the condition of the roadway at present, is that the heavy loads as a rule come on the northerly side of the roadway, or the right hand side going from 2nd St. toward Washington Ave.

Present Condition of Paving Included in Test.—The writer recently examined the Nicollet Ave. paving closely one Sunday morning, when the conditions of traffic were such that it could be done carefully. Before making the inspection, however, the measurements were made locating the stretches of different woods. The lines between the varieties show plainly on the street, especially after the relocation has been made. It is very possible that all engineers would not agree as to the best and poorest woods there now; in fact, it is barely possible that no two might agree in a classification of the whole list as to best, second best, third best, etc. I am going to give the opinion I arrived at after examining the street closely for an hour and a half. And I will state that they were agreed to very closely by the man who was with me when I looked over the work. My examination was made only between Washington Ave. and Second St. I am giving my impressions of the condition of the woods starting with the one considered best at present and going in order of conditions, to the poorest:

White Birch: A strip measured along the street about 65 ft., covering 358 sq. yds. It is in fairly good shape, has never been touched for repairs, shows some wear, but almost entirely in individual blocks, and no large depressions or worn places. A good many of the worn blocks are where they had been laid on the side originally. It is more difficult apparently to tell the fibre side of birch blocks than of softer woods after treatment. This strip dries out quicker than the others after wetting. The morning the inspection was made there had been a trace of rain late in the night and the birch was noticeably nearer dry than any of the others. Fully nine-tenths of the blocks show no wear, and those showing wear, in my opinion, were either originally poor quality or were laid on the side.

Southern Pine: Shows considerable wear, but in a different manner than the birch. There are worn places of rather large area, shown by depressions in the surface of the pavement. The depressions are not of any great depth however, and the strip of southern pine blocks, about 72 ft. long in the street, is in very fair shape, and will stand the same traffic for some time yet.

Hemlock: This strip, 51 ft. along one side of curb line and 70 ft. on the other, shows wear plainly. The worn places are more numerous than in the southern pine, but are of smaller extent and worn deeper.

Tamarac: The small strip of tamarac only about 15 ft. along curb, shows extensive wear on the northerly side, or the heavy traffic side of the street. It is too small an area of paving to give a very fair test of the wood. On the whole, the condition is much the same as the hemlock.

Norway Pine: Very small strip and unfortunately located in this test, as the most of it is located on the heavy traffic side of the street. It is 17 ft. on the northerly side and runs out to nothing on the southerly side, or the light traffic side. Too small to give any fair test of the wood for paving, as the small number of blocks in this section might happen to be nearly all of comparatively inferior quality. It is bady worn on the northerly side into large depressions showing deep wear. None of the blocks have been taken up, but they are worn in places at least a half inch.

Larch: Very badly worn into wide depressions. This strip is 60 ft. along the curb giving area enough to make what should be a fair test. If this wood was a fair sample of Western larch, then Western larch is of no use for paving purposes. The worn places are on both sides of the street, and must cover at least half the surface. All the wear is deep. It has had no repair, however.

Fir: This strip of 50 ft. along curb is practically gone on the northerly side and has been repaired recently. Should have been repaired more than a year ago. It is worn into holes so deep as to make it extremely rough riding over. It is only fair to say that this was said by the workmen at the time it was laid to be a very poor quality of wood, and probably not a fair sample. If it was anywhere near a fair sample, then that kind of wood is of no use at all for paving purposes.

In conclusion as to the comparative test of different woods, I will state that none of these woods have buckled or lifted up from the concrete. The block has been sprinkled about six times per day, in fact, has been well sprinkled. There have been no years of very heavy or long extended snowfall so that the paving has not been covered in the winter more than it would be in Chicago or any other northern city.

CONCLUSION.

Generally speaking, creosoted wood block pavement is very popular in Minneapolis at the present time. On at least three-fourths of the streets to be paved, the property owners want it. We have had very little, if any trouble with the swelling and consequent bulging of the blocks, which seems to be a common complaint in many cities. Also another thing that I have often had given to me as an objection to the modern wood paving, that is slipperiness, has given but little trouble here. In fact the slipperiness is no more than in the case of asphalt or brick, and we have laid the blocks on a 6 to 7½ per cent grade. I have often seen 2 cu. yds. of sand hauled by two horses up that steep a grade here on a creosoted street. The only thing in the nature of bulging that has happened here is in the early spring when the snow is going off and melts in the day time and freezes at night; bulging occurs then along the street car tracks in a few places every year. The water seems to follow along the rail, gets down under the blocks, and then freezes and raises them. This has happened in a few cases, until the blocks have lifted enough so the street car step has struck them, and we have had to open up the street and drop the blocks back into place. It has been inexpensive and amounts to practically nothing. By the way, this always happens on paving laid the previous season, and has been almost entirely done away with by using an asphalt filler along the track, pouring it in between the blocks and rail.

There is but one other street here that at the present time shows marked wear. That is a street on the east bank of the river leading to the west side. This is the main artery to the west side in fact, and carries in a westerly direction at any rate, the heaviest traffic by tonnage, of any street in the city. On the northerly, or heavy traffic side, the blocks are worn badly, in much the same way as the same kind of blocks in the government comparative test. The blocks on this street are norway pine, tamarac and hemlock. They were put down in 1905, one year before the comparative test was started. They show even more wear in places, but have never had any repairs. I will state here that the city council has decided to use southern pine blocks the present season entirely, which probably means that no more Minnesota and Wisconsin soft woods will be used for paving purposes here. While I am at the [illegible] that this is probably a wise move on the whole, I think that Minnesota norway pine and tamarac will answer every purpose on streets of moderate traffic.

Our experience here has led to the following general conclusions in regard to wood pavement:

1st: That it is of no use to treat inferior woods or an inferior quality of wood. A rotten, sappy or shaky block can't be helped by infusion of oil.

2nd: That the blocks must be laid at an angle of about 22° 30′, from a right angle to the street.

3rd: That the blocks must not be paved too closely together. By that, is not meant that they should be very loosely placed, but that they should not be driven tightly together.

4th: That the street must be kept well sprinkled in any weather when sprinkling is possible or necessary.

5th: That while treated woods used for paving purposes undoubtedly will wear out, there is only one material that we have found to outwear them, and that is granite blocks.

As a last concluding statement, the writer is willing to go in on record as saying that creosoted wood blocks have proven thus far a success in the city of Minneapolis.

Methods and Costs of Road Construction with Bituminous Materials by the Penetration Method.

In the last few years four methods have come into common use in connection with the treatment of roads with a view to their preservation as well as the prevention of dust. These four methods are the use of palliatives, the surface treatment, the penetration method and the mixing method. The first two methods are generally used in connection with the treatment of roads already in existence; the last two methods are used in the construction of new roads. These four methods were discussed by road engineers at a special meeting held last January under the auspices of the American Society of Civil Engineers, and in the March number of the Proceedings of that society, Vol. XXXVII, No. 3, pp. 224 to 413, much of the discussion is reprinted. In our last issue we abstracted a portion of the discussion relating to surface treatment and in this issue we take up that part of the discussion relating to the penetration method of road construction with bituminous materials.

Maryland.—Up to the present time local conditions have seemed to require the use of the penetration method in the treatment of the state roads of Maryland with bituminous materials. The following refers only to the work directly under the supervision of the state authorities.

In 1909 Park Heights avenue was treated with 15 different bituminous materials in 29 sections. The details of the treatments were reported to the second International Road Congress, and this report has been reprinted in some American publications,* so that repetition will be avoided here. Heretofore circumstances have prevented giving the costs of the 1909 work, therefore tables of cost data are submitted herewith.

The method generally used was to put down the macadam in the ordinary way up to the point of beginning the binding, as usually practiced, with water and stone chips or screenings. Slight variations from this method have been made. For example, in a few instances the courses of the macadam have been reversed and the "number ones" placed on top and the "number twos," as ordinarily called, placed in the bottom. In some cases, before the pitch was applied to the stone (which had been thoroughly rolled), a layer of sand, to fill partly the voids between the stones, was put on and rolled in. In other cases the pitch was applied to the clean rolled second course.

The quantity of pitch used has varied from ¾ gal. to as much (in one particular instance) as 5 gals. per sq. yd. The use of 5 gals. was an accident, which has brought about a very curious result which is now being watched. It is too early to report at the present time, however, on the success or non-success of this particular road.

TABLE II—MAINTENANCE COST DATA ON EIGHT SECTIONS OF MARYLAND ROADS

Section No.	Area, sq. yds.	Material used	Time when used	Cost per sq. yd. [illegible] macadam	Cost of [illegible] per sq. yd.	Total cost [illegible] per sq. yd.
10	[illegible]	U. G. I.	May and June, 1910	$0.381	$0.292	$0.673
11	5,981	Texas	June, 1910	0.374	0.251	0.625
11-A	1,261	Mixed T[illegible]	June, 1910	0.355	0.272	0.627
12	4,6[illegible]8	[illegible]	June and July, 1910	0.384	0.174	0.558
13	4,203	B. A. P.	July and August, 1910	0.373	0.400	0.773
14	3,184	Fairfield	August and September, 1910	0.387	0.269	0.656
15	[illegible]	Fairfield Anti-Dust	October, 1910	0.385	0.069	0.454
16	1,100	U. G. Anti-Dust	October and September, 1910	0.407	0.279	0.686

The maintenance cost data shown in Tables I and II include taking care of the bleeding by putting on chips, taking care of the slipperiness, which was objectionable on some sections, and in one case it covers the removal of a very disagreeable mud which developed on the surface in the early spring following its construction.

The average traffic on this road per day of 12 hours has been counted as follows:

Section No. 1. City End.

One-horse vehicles	[illegible]
Two-horse vehicles	104
Three-horse vehicles	19
Four-horse vehicles	14
Five-horse vehicles	..
Six- (or more) horse vehicles	1
Motorcycles	8
Motor runabouts	26
Motor touring cars (4 or 5 seats)	111
Motor touring cars (6 or 7 seats)	66
Motor wagons	4

At times these figures are greatly exceeded, such as in periods when there is racing at the course, the entrance of which is at the end of Section 3.

Sections Nos. 1 to 3, inclusive.

One-horse vehicles	195
Two-horse vehicles	101
Three-horse vehicles	3
Four-horse vehicles	19
Six- (or more) horse vehicles	1
Motorcycles	[illegible]
Motor runabouts	[illegible]
Motor touring cars (4 or 5 seats)	141
Motor touring cars (6 or 7 seats)	55
Motor wagons	7

Sections Nos. 14 and 15.

One-horse vehicles	52
Two-horse vehicles	23
Three-horse vehicles	3
Four-horse vehicles	1
Six-horse vehicles	1
Motorcycles	7
Motor runabouts	11
Motor touring cars (4 or 5 seats)	[illegible]
Motor touring cars (6 or 7 seats)	1
Motor wagons	3

Sections Nos. 16 and 17.

One-horse vehicles	31
Two-horse vehicles	19
Three-horse vehicles	3
Four-horse vehicles	1
Six-horse vehicles	1
Motorcycles	3
Motor runabouts	6
Motor touring cars (4 or 5 seats)	[illegible]
Motor touring cars (6 or 7 seats)	40
Motor wagons	4

Some other penetration work has been done and some, such as on road surfaces of gravel and of oyster shells, is especially interesting.

West Newton, Mass.—In addition to a large amount of work by surface treatment,* the penetration method has been used in Newton to some extent.

Several roadways were treated with preparations of 90 per cent heavy standard oil and with tarite-asphalt by the penetration method. The materials were heated sufficiently to make them flow freely through the sprinkler of the oil distributor. The macadam surface of the roadway was first spiked up and then covered with a 2-in. layer of screened stone. This stone came from an ordinary gravel pit, and varied in size from ½ to 2 ins., the smaller stones filling in between the larger ones. The surface was rolled smooth and hard, after which the oil was applied hot. Used at the rate of about 1 gal per sq. yd., the oil readily penetrated the entire mass. A coating of gravel which had passed through a ½-in. screen was then applied and thoroughly rolled with a steam roller. The road was opened to traffic within 12 hours after completion. The cost of work of this class varied from 21 to 23 cts. per sq. yd., including all labor and materials.

Early in the spring of 1908 one of the principal streets was so badly out of shape that it required a new surface of about 3 ins. of stone. It was decided to bind the new material with Tarvia A by the penetration process, and an area of 6,290 sq. yds. was surfaced at a cost of 46 cts. per sq. yd. At about this time another street, having an area of 9,821 sq. yds., was treated in like manner with Tarvia A, except that a much thinner coating of stone was applied. The cost of this latter construction was 28½ cts. per sq. yd.

Baltimore, Md.—The following are the methods of constructing bituminous macadam roads by the penetration method in Baltimore, Md. This experience extends over a period of 2½ years, but the following description pertains particularly to a stretch of road 1.55 miles in length, from 18 to 32 ft. in width, and having a total area of 17,788 sq. yds. The original roadbed was of ordinary macadam 6 ins. thick. It had been in use about four years, and was badly worn in places. The en-

TABLE I—MAINTENANCE COST DATA ON [illegible] SECTIONS OF MARYLAND ROADS

Section No.	Area, sq. yds.	Material used	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Remarks
1	11,226	Tex[illegible]	[illegible] 09	[illegible]	$0.290	$0.040	$0.330	$0.666	
2	1,936	Gulf	[illegible]	[illegible]	0.432	0.130	0.561	0.900	
3	1,243	Tex[illegible]	[illegible]	0.336	0.759	[illegible]	[illegible]	1.256	
4	1,173	Fairfield	9/09	[illegible]	0.449	0.161	0.610	0.947	
5	1,712	U. G. I.	9/09	0.339	[illegible]	[illegible]	0.477	[illegible]	
6	1,908	Warren	[illegible] 10/09	[illegible]	[illegible]	0.140	0.750	1.083	
7	1,909	Tarvia	10/09	0.337	0.618	0.107	0.725	1.062	
8	1,816	Tarite	10/09	0.336	0.541	0.060	0.601	[illegible]	
9	1,264	U. G. I.	11/09	[illegible]	[illegible]	0.092	0.543	0.883	
19	128	S. O.	11/09	0.241	[illegible]	0.085	0.247	0.488	Mat. gratis
20	1,[illegible]	U. G. I.	10/09	0.230	0.408	0.158	0.566	0.795	
21	694	Texas	10/09	0.228	0.552	0.184	0.736	0.964	
22	977	Gulf	10/09	[illegible]	[illegible]	[illegible]	0.682	[illegible]	
23	845	Warren	10/09	0.224	0.691	0.031	0.722	0.946	
24	2,246	U. G. I.	9/09	0.229	0.256	0.042	0.298	0.528	
25	1,532	Fairfield	9/09	0.228	[illegible]	0.015	0.370	0.598	
26 and 27	5,207	Local and U. G. I.	8/09	[illegible]	[illegible]	0.016	[illegible]	0.494	

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*Engineering-Contracting, Sept. 7, 1910.

*See Engineering-Contracting, April 12, 1911.

the street [illegible] traffic, and the section near the Stony Run Bridge, [illegible] drive, is subjected to heavy team traffic from an adjacent sand and gravel plant. The team traffic, though slow moving, is poorly controlled, owing to the poor judgment exercised by drivers.

When the original roadbed was in such condition as to require resurfacing with new stone, the following method was used: The surface was first swept clean with the ordinary street sweeping machine, then "spiked" with the roller, picked and raked by hand, and all dirt and foreign material removed. It was then rolled to a firm bed, and sufficient new stone was added to bring the surface to the proper cross section. In no case was the thickness of new stone less than 3 ins. after rolling, nor more than 6 ins., so that the average thickness was about 4½ ins. Where sufficient depth was available, a layer of stone in sizes from 2 to 1 in., known as No. 2, was first spread, then covered with stone dust in sufficient quantities to fill all interstices. Great care was used in this operation, as it was realized that if the bitumen penetrated the No. 2 course a slack roadbed would result. In order to secure the filling of all interstices, the dust was swept in, and water was used where necessary. Where water was used, however, this course was allowed to dry before placing the next or No. 3 course.

After the No. 2 layer was completed a 3-in. layer of No. 3 stone, ranging in size from 1 to ¼ in., was laid. Where only the minimum depth of 3 ins. was available, this size was used alone. The method of rolling was the same for all courses as with ordinary macadam, except that the last or No. 3 course was rolled firmly but not tightly, the idea being to allow the bitumen to penetrate not less than 1½ ins.

After the macadam had been rolled, the binder was applied at the rate of not less than 1½ nor more than 2 gals. per sq. yd. of surface. Two materials were used, namely: "Fairfield Anti-Dust," a local material, which was applied at a temperature of not less than 150° F., and "Standard Asphalt Binder," "B," which was applied at a temperature between 300° and 400° F. An ordinary asphalt thermometer was used, and the binder was at all times applied at the temperature recommended by the manufacturer.

In heating the binder two kettles were used, one having a capacity of 200 gals. and the other a capacity of 100 gals. Both kettles were mounted on wheels and were easily moved. The smaller kettle worked more satisfactorily with the "Fairfield Anti-Dust," which material runs freely from the barrel and is easily heated, while the larger kettle worked more satisfactorily with the "Standard," which does not run freely from the barrel and requires more heat, thereby requiring more storage capacity, if the work is to be handled economically. A 1½-in. hose, with a spreader on the extreme end, was attached to the rear of the kettle, the length of the hose being from 10 to 15 ft., depending on the width of the road. The binder was applied with this hose, and the flow was regulated by a valve on the rear of the kettle. A rubber hose was first tried, but it was found that it burned out too frequently under the extreme heat of the bitumen. It was then found that the ordinary linen hose, worth about 15 cts. per foot, answered the purpose and was, of course, much more economical. A more uniform distribution of the bitumen was obtained by using the hose than by hand pouring. The former method is also more economical than hand pouring, as the labor of heating and spreading bitumen, spreading granolithic, and rolling it was 4 cts. per sq. yd., as compared with 8 cts. for the same items by hand pouring. In all cases the bitumen was spread by beginning at the lower elevation of the roadbed and working up grade.

After the bitumen had been applied the entire surface was covered with granolithic stone ranging in size from ⅝ to ¼ in., and free from dust. The roadbed was then thoroughly rolled. If the bitumen appeared on the surface, more granolithic was added, and the rolling was continued until the material ceased to appear and became a solid mass, showing an [illegible], dense, and granular surface. The rolling was generally begun at the gutter lines and carried toward the crown, the shoulders being rolled to prevent spreading. For several weeks after the road was open to traffic it was noticed that the bitumen appeared on the surface in places. Granolithic was placed in convenient piles at the sides of the road and was spread on these places when required. In some cases it was found necessary or advantageous to do more rolling.

Two rollers were used on the work, one weighing 12 and the other 6 tons. The 12-ton roller was used for "spiking," for rolling the No. 2 course, and at times for rolling the No. 3 course.

It was found, however, that the 6-ton roller worked very satisfactorily for the No. 3 course, and also for the final rolling on the granolithic.

The cost of constructing 14,764 sq. yds. of roadway by this method was 72.95 cts. per sq. yd., itemized as follows:

	Per sq. yd. Cents.
Labor	24.82
Stone	27.40
Rolling	4.84
Binder	13.74
Coal	0.95
Hauling binder	0.41
Incidentals, including supplies and repairs to plant	0.79
Total	72.95

The cost of rolling represents the hire of the 6-ton roller at $10 per day and the use of the department's 12-ton roller at $5 per day, which covers the salary of the engineer and watchman. The quantity of bituminous binder used was 1.9 gals. per sq. yd., which included a sealing coat on about 25 per cent of the bituminous work. The bituminous binder flushed up very evenly on the greater part of the surface, so that the sealing coat was used only where it was deemed necessary.

The following rates of wages prevailed per day of 8 hours:

Foreman	$3.50
Roller engineer	3.00
Labor	2.00
Carts	2.50
Double team	3.60
Watchman	2.00

The following prices were paid for materials:

Crushed stone, No. 2, per cu. yd.	$1.90
Crushed stone, No. 3, per cu. yd.	2.15
Crushed stone dust, per cu. yd.	1.75
Crushed stone granolithic, per cu. yd.	2.25
Binder "Fairfield," per ton of 2,000 lbs.	18.50
Binder "Standard," per ton of 2,000 lbs.	18.00
Coal, per ton	4.25
Hauling binder, per ton	0.75

"Gabbro" crushed stone was used throughout the entire work.

Except in a few places, the surface is in excellent shape at this time. The exceptions are in that portion of the work which was done during the latter part of September and the first part of October, when the nights and parts of the day were cool, thus preventing the bitumen from flushing to the surface in a satisfactory manner. This defect, it is believed, will correct itself in the spring when the warm weather comes. The portion done during warmer weather has flushed up in a very satisfactory manner, and at present presents a bitulithic appearance. There are also at this time four or five weak places, each about 2 sq. ft. in area, due without doubt to the bitumen being too hot, which condition will occur at times at the bottom of the kettles.

Bronx Borough, New York City.—As a part of the experiments on White Plains Ave.,* borough of the Bronx, several sections were built by the penetration method, using both asphaltic and tar binders. The description and detailed costs of the sections follow:

SECTION 12—ASPHALT BINDER.

On Section 12, stations 29 + 00 to 31 + 00, a bituminous pavement was constructed by the penetration method. The foundation course consisted of 1½ ins. crushed trap rock and sufficient screenings to fill the voids. It was spread and rolled to a finished depth of 3½ ins., the cost per sq. yd. being as follows:

	Total.	Per sq. yd.
65.7 cu. yds. 1½-in. trap rock at $1.65	$108.40	$0.229
13.1 cu. yds. screenings at $1.65	21.68	.046
Labor		.054
Total (472 sq. yds.)		$0.329

The surface course or paving mixture was made as follows: Crushed trap rock (1½ ins.) was spread and lightly rolled to a depth of [illegible] ins. From 29 + 00 to 30 + 50 about 1½ gals. per sq. yd. of Sanford and Strain's asphalt binder was applied and a layer of ¾-in. stone was spread and rolled. From 30 + 50 to 31 + 00, the Standard Oil Co.'s special binder was used.

The detailed labor cost of the surface course was as follows:

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	28	$4.00	$14.00	$0.0296
2 men wheeling stone	21	2.25	5.90	.0125
[illegible] men spreading 1½-in. stone	92	2.25	25.87	.0548
3 men heating ¾-in. stone	32	2.25	9.00	.0191
1 man spreading ¾-in. stone	20	2.25	5.62	.0119
2 men heating binder	38	2.25	10.68	.0226
[illegible] men carrying binder	34	2.25	9.56	.0202
1 man pouring binder	16	2.25	4.50	.0095
1 rollerman	15	4.50	8.43	.0178
Total (472 sq. yds.)			$93.56	$0.1980

The cost of the materials for the surface course was as follows:

	Total.	Per sq. yd.
1½-in. stone, 45.9 cu. yds. at $1.65	$75.73	$0.161
¾-in. stone, 3.5 cu. yds. at $1.80	6.30	.013
Binder, 719* gals. at $0.085	61.11	.129
Total (472 sq. yds.)	$143.14	$0.303

*1.52 gal. per sq. yd.

This makes the total cost of labor and material for the surface course $0.501 per sq. yd.

The quantity of binder applied per sq. yd. for the seal coat was ¾ gal. Over this coarse sand and chips were spread and rolled. An 18-ton roller was used.

The labor cost of this seal coat was as follows:

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	5	$4.00	$2.50	$0.0052
2 men heating binder	13	2.25	3.65	.0077
3 men carrying binder	12	2.25	3.37	.0071
1 man pouring binder	5	2.25	1.40	.0029
2 men heating chips	11	2.25	3.09	.0065
2 men wheeling chips	9	2.25	2.53	.0054
1 man spreading chips	7	2.25	1.96	.0042
1 rollerman	5	4.50	2.81	.0059
Total (472 sq. yds.)			$21.31	$0.0449

The cost of materials for the seal coat was as follows:

	Total.	Per sq. yd.
Chips, 3.5 cu. yds. at $1.90	$6.65	$0.0140
Binder, 353 gals. at $0.085	30.01	.0640
Total (472 sq. yds.)	$36.66	$0.0780

The total cost of labor and materials for the seal coat was therefore $0.123 per sq. yd.

Summarizing the cost of the bituminous pavement in Section 12 was as follows:

	Per sq. yd.
Base course	$0.329
Surface course	0.501
Seal coat	0.123
Hauling binder	0.006
Tar and stone heaters	0.003
Fuel	0.021
Total (472 sq. yds.)	$0.983

The actual time required for laying the surface course (including the top course) was 3½ days, or an average of 135 sq. yds. per day. The ¾-in. stone required heating. Work was postponed three times on account of delayed shipments of binder, thereby increasing the cost. The actual time for laying the seal coat was 5 hours, or an average of 755 sq. yds. per day. The chips required heating.

SECTION 11—BARRETT MFG. CO.'S "MODERN PAVEMENT."

The experimental pavement on Section 11, stations 27 + 97 to 29 + 00 of White Plains Ave., was the Barrett Manufacturing Co.'s "Modern Pavement." The foundation consists of 1½-in. crushed trap rock, spread and rolled to a finished depth of 3 ins. The cost of this 3-in. foundation was as follows:

	Total.	Per sq. yd.
[illegible] cu. yds. trap rock at $1.65	[illegible]	[illegible]
[illegible] cu. yds. screenings at $1.65	[illegible]	.022
Labor		[illegible]
Total ([illegible] sq. yds.)		[illegible]

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*Engineering-Contracting, Dec. 7, 1910.

The surface course was constructed as follows. A sufficient quantity of sand was spread to fill the voids. It was about ½ in. in thickness on top of the foundation course, over which about 1 gal. of Tarvia X per sq. yd. was applied. Then 1½-in. crushed trap rock was spread and lightly rolled to a depth of 3 ins. About 2 gals. of Tarvia X per sq. yd. was then applied by the penetration method. A layer of ¾-in. stone was spread and rolled. An 18-ton roller was used.

The detailed labor cost of this surface course was as follows:

First Coat.

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	6	$4.00	$3.00	$0.0123
10 men spreading sand	[illegible]	[illegible]	5.62	.0231
2 men heating binder	13	[illegible]	3.65	.0150
3 men pouring	12	[illegible]	3.37	.0138
1 rollerman	2	4.50	1.12	.0046
Total (243 sq. yds.)			$16.76	$0.0688

Second Coat.

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	16	$4.00	$8.00	$0.0329
10 men spreading stone	20	[illegible]	5.62	.0231
10 men spreading stone	30	[illegible]	8.43	.0347
2 men heating binder	16	[illegible]	4.50	.0185
3 men heating binder	9	2.25	2.53	.0104
2 men pouring binder	16	2.25	4.50	.0185
3 men pouring binder	9	2.25	2.53	.0104
1 rollerman	11	4.50	6.19	.0254
Total (243 sq. yds.)			$42.30	$0.1738
Grand total, 1st and 2d coat				$0.2426

The cost for the materials for the surface course was as follows:

	Total.	Per sq. yd.
1½-in. stone, 19.6 cu. yds. at $1.65	$32.34	$0.133
Sand, 6.5 cu. yds. at $1.21	7.86	0.032
Binder, 1st coat, 262 gals.* at $0.095	24.89	0.102
Binder, 2d coat, 480 gals.† at $0.095	45.60	0.188
Total (243 sq. yds.)	$110.69	$0.455

*$1.08 gal. per sq. yd.
†$1.97 gal. per sq. yd.

The total cost of labor and material for the surface course was $0.698 per sq. yd.

For the seal coat about 1 gal. per sq. yd. was applied, over which coarse sand was spread and rolled. The detailed labor cost of this seal coat was as follows:

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	6	$4.00	$3.00	$0.0123
1 man heating binder	6	[illegible]	1.68	.0069
2 men pouring binder	[illegible]	[illegible]	2.81	.0115
2 men spreading sand	10	2.25	2.81	.0015
2 men spreading ¾-in. stone	[illegible]	[illegible]	[illegible]	.0185
3 men spreading screenings	[illegible]	2.25	[illegible]	.0073
1 rollerman	[illegible]	4.50	1.68	0.069
Total (243 sq. yds.)			[illegible]	$0.0710

The detailed cost of materials for the seal coat was as follows:

	Total.	Per sq. yd.
¾-in. stone, 5.0 cu. yds. at $1.80	$9.00	$0.037
Sand, 2.0 cu. yds. at $1.21	2.42	0.010
Screenings, 10 cu. yds. at $1.65	1.65	0.007
Binder, 240 gals.* at $0.095	22.80	0.094
Total (243 sq. yds.)	$35.87	$0.148

*$0.99 gal. per sq. yd.

The total cost of labor and material for the seal coat was $0.219 per sq. yd.

Summarizing the detailed cost of the "Modern Pavement" on Section 11 was as follows:

	Per sq. yd.
Base course	$0.305
Surface course	0.698
Seal coat	0.219
Hauling binder	0.010
Tar heaters	0.003
Fuel	0.021
Total (243 sq. yds.)	$1.256

The actual time for laying the surface course was: First coat, 6 hours, or an average of 324 sq. yds. per day; second coat, 8 hours, or an average of 243 sq. yds. per day. The actual time for laying the seal coat was 6 hours, or an average of 324 sq. yds. per day.

SECTION 15 [illegible]

The pavement on Section 15 extended from Stations 34 + 50 to 36 + 25. The foundation course consisted of 1½-in. crushed trap rock and screenings, spread and rolled to a finished depth of 3½ ins. The detailed cost of this 3½-in. foundation was as follows:

	Total.	Per sq. yd.
57.4 cu. yds. trap rock at $1.65	$94.71	$0.229
5.7 cu. yds. screenings at $1.65	9.47	.022
Labor		.054
Total (413 sq. yds.)		$0.305

The surface course was constructed as follows: Crushed trap rock (1½-in.) was spread and lightly rolled to a depth of 2½ ins. Tarvia—2.3 gals. per sq. yd.—was then applied, after which a layer of chips was spread and rolled. For a seal coat about ¾ gal. of Tarvia per sq. yd. was applied, over which chips were spread and rolled with an 18-ton roller. The detailed labor cost of this surface course and the seal coat was as follows:

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	[illegible]	$4.00	[illegible]	$0.0[illegible]
15 men spreading 1½-in. stone	[illegible]		16.88	.040
2 men heating tar	[illegible]	[illegible]	[illegible]	[illegible]
1 man heating tar	11	2.25	3.08	.0074
3 men pouring and carrying tar	106	[illegible]	29.81	.072
1 man spreading chips	16	2.25	4.50	.0109
1 rollerman	16	[illegible]	[illegible]	.0218
Total (413 sq. yds.)			$100.77	$0.2440

The cost of materials for the surface course and seal coat was as follows:

	Total.	Per sq. yd.
1½-in. stone, 40.2 cu. yds. at $1.65	$66.33	$0.161
Chips, 80 cu. yds. at $1.65	13.20	.032
Binder, 1,296 gals.* at $0.095	123.12	.298
Total (413 sq. yds.)	$202.65	$0.491

*3.14 gals. per sq. yd.

The total cost of the pavement on Section 15 was as follows:

	Per sq. yd.
Base course	$0.305
Surface course and seal coat	.735
Fuel	[illegible]
Hauling binder	.008
Tar heater	[illegible]
Total	$1.071

The costs of the first coat of binder and the seal coat were not separated. About ¾ gal. of binder per sq. yd. was used for a flush coat. The actual time of laying was 5 days (4 full days and 2 part days), or an average of 80 sq. yds. per day. The length of time was due to poor supervision.

SECTION 16—BERMUDEZ ROAD ASPHALT.

Section 16 extended from stations 36 + 25 to 37 + 75. The foundation course consists of 1½-in. crushed trap rock and screenings, spread and rolled to a finished depth of 3½ ins. The detailed cost of this 3½-in. foundation course was as follows:

	Total.	Per sq. yd.
49.[illegible] cu. yds. trap rock at $1.65	[illegible]	$0.2[illegible]
4.9 cu. yds. screenings at $1.65	8.12	.022
Labor		[illegible]
Total (243 sq. yds.)		[illegible]

The surface course was laid as follows: Crushed trap rock (1½-in.) was spread and slightly rolled to a depth of 3 ins., then 1½ gals. of Bermudez road asphalt per sq. yd. were applied, after which a layer of chips was spread and rolled.

The detailed labor cost of this surface course was as follows:

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	11	$4.00	$5.50	$0.0155
7 men spreading 1½-in. stone	6	[illegible]	10.12	[illegible]
2 men spreading chips	18	2.25	5.06	.0143
2 men heating asphalt	19	2.25	5.34	.0151
2 men carrying asphalt	18	2.25	5.06	.0143
2 men pouring asphalt	18	2.25	5.06	.0143
1 rollerman	16	4.50	9.00	.0254
Total (354 sq. yds.)			$45.14	$0.1276

The detailed cost of the materials for the surface course was as follows:

	Total.	Per sq. yd.
1½-in. stone, 34.5 cu. yds. at $1.65	$56.92	$0.161
Chips [illegible] cu. yds. at [illegible]	[illegible]	[illegible]
Binder, 530 gals.* at $0.131	[illegible]	[illegible]
Total	[illegible]	[illegible]

*1.5 gals. per sq. yd.

The total cost of labor and material for the surface course was $0.519 per sq. yd.

For the seal coat Bermudez (½ gal. per sq. yd.) was applied, over which chips were spread and rolled, an 18-ton roller being used. The detailed labor cost of this seal coat was as follows:

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	1	$4.00	$.50	$0.0014
1 man heating asphalt	3	2.25	.84	.0023
2 men carrying asphalt	6	2.25	1.68	.0047
2 men pouring asphalt	6	2.25	1.68	.0047
1 man on squeegee	3	2.25	.84	.0023
2 men spreading chips	6	2.25	1.68	.0047
4 men spreading chips	4	2.25	1.12	.0031
1 rollerman	3	4.50	1.69	.0047
Total (359 sq. yds.)			$11.53	$0.0321

The total cost of the seal coat including labor and material was as follows:

	Total.	Per sq. yd.
Labor	$11.53	$0.032
Chips, 5 cu. yds. at $1.90	9.50	.027
Binder, 173 gals.* at $0.131	22.66	.064
Total	$43.69	$0.123

*0.48 gals. per sq. yd.

A summary of the various items shows the cost of the pavement in Section 16 to have been:

	Per sq. yd.
Base course	$0.30[illegible]
Surface course	0.519
Seal coat	0.123
Hauling binder	0.00[illegible]
Tar heaters	0.002
Fuel	0.021
Total	$0.9[illegible]

In the work on Section 16 nothing except the binder was heated on the ground. The chips were delivered hot from the plant and remained warm until the end of the job. The actual time of laying the surface course was 1 day and 3 hours, or an average of 257 sq. yds. per day. The actual time of laying the seal coat was 4 hours, or an average of 708 sq. yds. per day.

SECTION 17—STANDARD OIL CO.'S BINDER.

This section extended from Station 37 and 75 to 39 and 22. The surface and base course were spread in one course. This consisted of 1½ in. crushed trap rock spread and rolled to a depth of 6 ins. Standard Oil Co.'s binder

TABLE III.

Pavement.	Date.		Temperature. 9 a.m.	12 noon.	3 p.m.	Weather.
Standard Oil Penetration	Oct. 18, '10.	Begun.	[illegible]	[illegible]	66	Clear.
	Oct. 19, '10.		[illegible]	65	68	[illegible]
	Oct. 21, '10.		[illegible]	[illegible]	[illegible]	[illegible]
	Oct. 24, '10.		[illegible]	[illegible]	[illegible]	Clear.
	Oct. 25, '10.	Finished.	[illegible]	[illegible]	60	Cloudy.
Tarvia Penetration	Oct. [illegible] '10.	Begun.	48	[illegible]	[illegible]	Clear
	Oct. 11, '10.		[illegible]	[illegible]	[illegible]	[illegible]
	Oct. [illegible] '10.		[illegible]	[illegible]	[illegible]	[illegible]
	Oct. 17, '10.		60	[illegible]	66	Cloudy.
	Oct. 18, '10.		[illegible]	[illegible]	[illegible]	[illegible]
	Oct. 19, '10.	Finished	59	[illegible]	68	Clear.
Barber Penetration	[illegible]	Begun.	[illegible]	[illegible]	[illegible]	Clear
	Oct. 27, '10.		[illegible]	65	67	Cloudy.
	Oct. 28, '10.	Finished.	[illegible]	[illegible]	56	Clear.
'Modern Pavement'	[illegible] '10.	Begun.	59	65	68	Clear.
	Oct. 21, '10.		[illegible]	[illegible]	59	Cloudy.
	Oct. [illegible] '10.		[illegible]	[illegible]	[illegible]	Rain.
	Oct. [illegible] '10.		[illegible]	[illegible]	[illegible]	Clear
	Oct. 25, '10.	Finished	55	[illegible]	60	Cloudy.
Sanford and Strains (Penetration)	Nov. [illegible] '10.	Begun.	[illegible]	[illegible]	43	Cloudy.
	Nov. [illegible] '10.		[illegible]	[illegible]	[illegible]	Cloudy.
	Nov. 17, '10.		[illegible]	40	42	Clear.
	Nov. 18, '10.		[illegible]	44	[illegible]	Clear.
	Nov. 22, '10.	Finished.	[illegible]	42	[illegible]	Overcast.

[illegible] gal. per sq. yd.) was then applied, over which a layer of ¾ in. stone was spread and rolled. The detailed labor cost of this surface and base course was as follows:

	Hours	Rate	Total	Per sq. yd.
1 foreman	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] spreading oil [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] men heating	[illegible]	[illegible]	[illegible]	.02
[illegible] men carrying and pouring oil	18	[illegible]	[illegible]	[illegible]
[illegible] men spreading stone	[illegible]	[illegible]	[illegible]	[illegible]
1 rollerman	[illegible]	[illegible]	[illegible]	[illegible]
Total ([illegible] sq. yds.)			$41.[illegible]	$0.1206

The total cost of this surface and base course, including labor and materials, was as follows:

	Total	Per sq. yd.
Labor	$41.[illegible]	$0.121
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Binder, 480 gals.* at $0.08	38.40	0.111
Total (347 sq. yds.)	$224.60	$0.648

*1.38 gal. per sq. yd.

For the seal coat binder "B" (1.1 gal. per sq. yd.) was applied, after which chips were spread and rolled, an 18-ton roller being used. The detailed cost of the labor for this seal coat was as follows:

	Hours	Rate	Total	Per sq. yd.
1 foreman	12	$4.00	$6.00	$0.0173
1 man heating oil......	13	2.25	3.65	.0105
2 men carrying and pouring oil	24	2.25	6.75	.0194
3 men spreading chips	23	2.25	6.47	.0186
1 rollerman	4	4.50	2.25	.0064
Total (347 sq. yds.)			$25.12	$0.0722

The total cost of labor and materials for this seal coat was as follows:

	Total	Per sq. yd.
Labor	$25.12	$0.072
Chips, 3 cu. yds. at $1.90	5.70	.016
Binder, 384 gals.* at $0.08	30.72	.088
Total (347 sq. yds.)	$61.54	$0.177

*1.11 gal. per sq. yd.

A summary of the various items shows the cost of the work on Section 17 to have been:

	Per sq. yd.
Surface and base course	$0.648
Seal coat	0.177
Fuel	0.021
Hauling binder	0.006
Tar heater	0.001
Total	$0.853

The actual time of laying the surface course, excluding the base course, was 2¼ days, or an average of 154 sq. yds. per day. The actual time of laying the seal coat was 1½ days, or an average of 231 sq. yds. per day. Nothing but the binder was heated. The 1½-in. trap rock was spread in one course, without screenings.

Table III shows the temperature, weather conditions, etc., during the time the above work was being done.

WATER-WORKS AND SEWERS SECTION

Methods and Results of Sewage Purification Experiments, Philadelphia, Pa.

In July, 1907, the director of the Department of Public Works of Philadelphia was authorized and directed to make investigations and to report upon a comprehensive plan for the purification and disposal of the sewage of the city. During the year of 1910 extensive experiments were conducted along these lines at the sewage experiment station at Spring Garden, Philadelphia. The report of the Bureau of Surveys comprising the work at Spring Garden has been issued and it is a very valuable addition to the literature relating to sewage purification. The methods of conducting the experiments and the results obtained are here briefly reviewed.

Before undertaking the Philadelphia experiments Mr. George R. Stearns, director of the Department of Public Works, and Mr. George S. Webster, chief engineer of the Bureau of Surveys, visited some of the principal cities of England, Belgium, Holland, Germany, and France in order to secure at first hand valuable information concerning the recent advances made in sanitary science in those countries. Various types of sewage purification plants in use in this country were also visited.

The processes of sewage clarification and purification finally selected for investigation at Philadelphia are shown in Fig. 1. This division of methods into groups shows the relation of the processes studied. The numbers on the diagram, Fig. 1, are the sampling stations numbers. Crude sewage was collected at stations numbered between 1 and 9. Table I shows the other sampling station numbers and the corresponding purposes for which samples were taken.

TABLE I.

Process and Purpose	Sampling Station Numbers
Preparatory: Primary removal of suspended solids	10 to 19
Oxidizing: Removal of putrescibility....	20 to 29
Finishing: Secondary removal of suspended solids	30 to 39
Disinfection: Removal of pathogenic organisms	40 to 49
Dilution: Utilization of the natural purifying powers of bodies of water	50 to 59

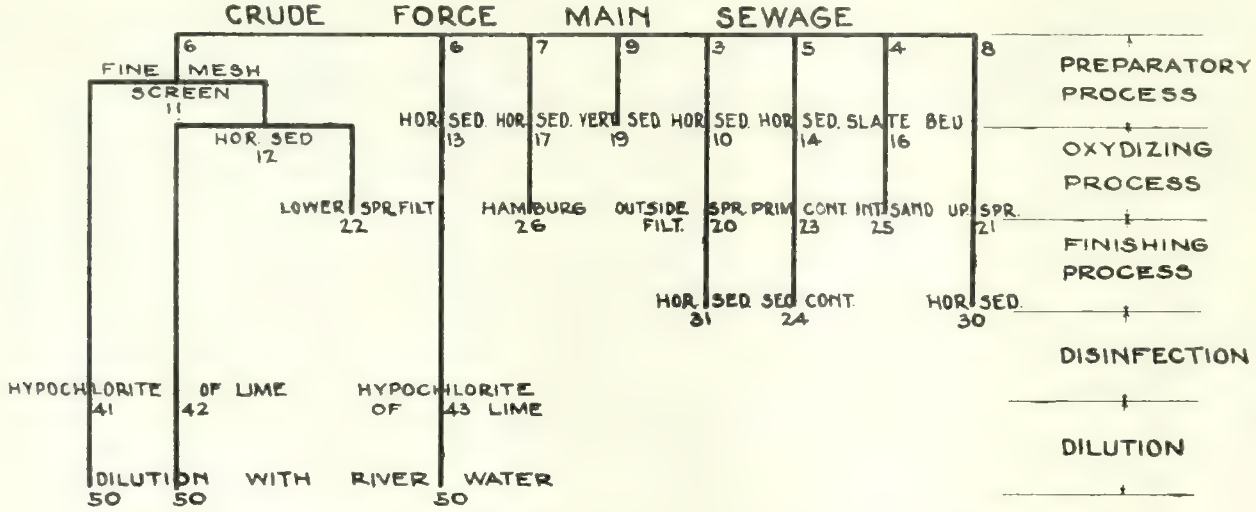

Fig. 1—Relation of Processes Studied and Sampling Station Numbers.

COLLECTION OF SEWAGE SAMPLES FOR TESTING

The sewage used for experimental purposes at the Spring Garden station was drawn from a large sanitary intercepting sewer. This sewer now drains at least 1,500 acres of built up property. Many mills and industrial plants are located in this area, but some of the territory is almost entirely residential. Since the sewage carried by this sewer is concentrated and large amounts of trade wastes are present, it was thought that mechanical or biological processes found successful in treating this sewage would be satisfactory for any portion of the city.

An 8-in. vitrified pipe connection was made at right angles to the intercepting sewer and 15 ins. above the invert. The main sewer is 4 ft. 7 ins. in diameter and the depth of flow is usually 32 ins. The 8-in. branch was therefore completely submerged. This 8-in. line discharged into a pump well 3 ft. 6 ins. in diameter and 13 ft. deep. The sewage was lifted from this well by means of a 12x8x12-in. Barr pump through a 6-in. suction main. The end of the suction pipe was 1 ft. above the bottom of the well, so very little sediment accumulated in the well. The sewage was pumped through a 4-in. cast iron force main about 413 ft. long and raised about 90 ft. to the testing station at Spring Garden. At the station a 6-in. cast iron main connected with the 4-in. line and also connected with the various tanks and fixtures of the testing station. The experimental work was begun on March 23, 1909, and discontinued May 15, 1910.

For the chemical laboratory composite samples were collected over weekly periods. Every half hour 75 c. c. were taken from the force main and put in a 4-liter bottle containing 20 c. c. of chloroform. This was tested daily for suspended solids and a quantity proportional to the number of hours the pump was in operation was taken to form the weekly composite sample.

From processes utilizing continuous flow, such as sedimentation and filters, samples were collected in 75 c. c. portions each 3 hours to form weekly chloroformed samples.

From processes utilizing intermittent flow, such as slate bed, contact beds, sand filter, etc., four samples of the influent were evenly spaced and four of the effluent each time the bed was filled or emptied, to form the weekly composite sample.

The Emscher tank was studied carefully. Influent and effluent were sampled each half hour, as in the method used in collecting composite samples of crude sewage.

The influent and effluent of the dilution tank were ordinarily collected twice a week, 500 c.

c portions at 3-hour intervals being taken to form a daily composite sample. As soon as the day's collection was finished the analysis was begun on iced samples. Two liters of the composite effluent sample were placed in an uncorked, wide-mouth glass bottle and suspended in the dilution tank for 2 weeks to determine its condition at the end of that period.

Bacteriological samples were placed in sterilized bottles and plated at once, every sixth day being omitted except in taking crude sewage samples, which were plated daily.

METHODS OF ANALYSIS.

The chemical and bacteriological methods of analysis used were in all cases the newest and most approved. These methods are not described here since engineers usually turn this phase of the investigation over to specialists in the sciences involved. The collection of samples was described at some length, since engineers in small cities frequently assist in this work or take charge of it. The extreme care used in taking truly representative samples should be especially noted by any one contemplating efficiency tests of existing purification plants.

METHODS OF CLARIFICATION AND PURIFICATION TESTED.

Fine Mesh Screening.—Crude sewage was discharged through 24—¼-in nozzles at right angles to the conical surface of a fine mesh screen at station No. 11. The screen was composed of red metal cloth of 32 meshes per inch, leaving clear openings of 5/10 mm by 5/10 mm. That portion of the applied sewage which did not pass through the screen splashed over the surface, thereby washing the screenings down into a gutter and thence to a drain. The screened sewage passed to sedimentation basin 12 and to disinfection tank 41.

The percentage removal of suspended solids by the fine screen is not comparable with a disposal works screen, since the applied sewage was withdrawn from beneath the surface of the sewage in the intercepting sewer; also it had passed through a coarse screen and a plunger pump before reaching the fine screen. In an actual installation at Reading, Pa., 41.8 per cent of the suspended solids were removed, while at the experimental plant under consideration only 33.5 per cent were removed.

The effect upon subsequent treatment produced by fine screening is important. Since solids larger than ½ mm square were held back by the screen, the load of suspended solids upon a sewage disposal plant by irregular contribution of trade wastes would be eliminated by fine screening. A marked effect upon the sludge collected in subsequent sedimentation was produced. The quality of sludge produced was lessened, its percentage of moisture was increased, and the sludge solids were so finely divided that it was easily pumped. Where sprinkling filters were used after fine mesh screening the clogging of nozzles was reduced to a minimum. The nozzles of the lower sprinkling filter, the influent of which was settled screened sewage, were never clogged during its nine months' operation.

Horizontal Flow Sedimentation.—Sedimentation by horizontal flow was studied in three tanks, Nos. 12, 13 and 17. Tanks 12 and 13 were formed by building concrete walls across a large tank, dividing it into three portions. At first they had level bottoms, no baffles or screen boards, and crudely constructed effluent collectors. The ratio of depth to length was as 1 is to 1½ in tank 12 and 1 to 2½ in tank 13. The capacity of tank 12 was 9,943 gals. and of tank 13 7,767 gals. In August, 1909, a steeply sloping bottom (16° to the horizontal) toward the inlet end was built in tank 12, and in October, 1908, a transverse brick baffle and screen board at mid length and inclined screen boards placed about the effluent collecting pipe. Also in October, 1909, a similar sloping bottom, sludge baffle and scum board were placed in tank 13. The collection of the effluent was improved by adding a wier the entire width of the tank, protected by an inclined scum board. After these changes the capacity of tank 12 was 8,738 gals. and of tank 13 was 5,475 gals. Sedimentation tank 17 was of better proportion, the ratio of depth to length being as 1 to 4. The bottom was practically level and until late in September, 1909, was unbaffled. At that time two transverse baffle walls with scum boards were built and a collecting wier protected by an inclined scum board was added.

While tank 12 was rectangular and run at a nominal storage period of 6 hours, the average percentage removal of suspended solids was 65.3. For a storage of 4½ hours the removal was 77.5 per cent. After the steep bottom was built to allow deposition of sludge at the inlet end without increasing velocity of flow above that in a flat bottom tank, the removal was again 77.5 per cent. After the transverse baffle wall was built at mid length with a scum board and a discharge wier protected by inclined scum boards was added and the storage time reduced to 3½ hours the removal was 64.1 per cent. For a storage period of 1½ hours the removal was 67.1 per cent. The investigators concluded that long storage periods were not essential. The percentage removal of suspended solids for a storage period of 3½ hours was the same in a baffled tank at Philadelphia as in an unbaffled tank at Columbus, O., for a storage period of 6 to 8 hours. In baffled tanks it was shown, by floating trade wastes, that the velocity of flow was uniform throughout the cross section of the tank. The baffles also served to hold sludge back at the inlet end, where in case septic action should develop the rising masses had much less chance to reach the outlet and pass out upon the filters. A scum never formed on tank 12.

It will be remembered that tank 12 treated screened sewage. Tank 13 treated crude sewage. While 13 was rectangular and unbaffled for a storage period of 6 hours, the removal was 59 per cent. For a storage period of 1½ hours the removal was 69.3 per cent. When the inclined bottom, scum board, and protected effluent wier were added the removal was 61 per cent for a storage period of 3½ hours. Scum always formed on this tank and after the introduction of baffles it became very thick and leathery in the inlet half of the tank. A thinner scum formed on the outlet half. In the inlet half considerable gas was held by the leathery cover. This scum when penetrated or removed was very offensive and contained much volatile and fatty matter.

A comparison of the results accomplished by tanks 12 and 13 is given in Table II.

TABLE II.

Conditions	Hours Storage		Suspended Solids. Parts per Million Effluent		Per cent Removal	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
First unbaffled..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
First baffled	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sloping bottom, [illegible] and scum	3½	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sloping bottom, baffle and scum	[illegible]	[illegible]	[illegible]	75	[illegible]	[illegible]

While unbaffled, for a storage period of 10 hours, for crude sewage, an effluent issue from tank 17 containing 65 parts per million of solids in suspension, the removal being 50.4 per cent. This with a weaker influent than with tanks 12 and 13. For 6 hours' storage and a much stronger influent the effluent was the same and the removal 67.5 per cent. For 4 hours' storage the effluent contained 41 parts per million and the removal was 81.2 per cent of suspended solids. After the tank was baffled for a storage period of 10 hours the effluent contained 46 parts per million and the removal of suspended solids was 74 per cent, again demonstrating the value of baffles. In the horizontal sedimentation tests for periods of 3½ to 6 hours' flow the influent was not deoxidized nor rendered offensive when sprayed upon sprinkling filters. To prevent septic action the tanks required sludging and washing out every six weeks.

Sedimentation in an Emscher Tank.—Sedimentation during vertical flow was studied in an Emscher or Imhoff tank, originally 5 ft. in diameter and 6 ft deep. Later the depth was increased to 10 ft. A concrete bottom forming an inverted cone, whose sides made 30° with the horizontal, was placed in the wooden tank. At 4 ft. above the bottom a galvanized iron baffle was fastened to the sides and upon this rested the inverted funnel with its ventilating stem, concentric with which was a circular baffle extending above the surface of the water. Crude sewage was added from a circular wier concentric with the funnel, passed down between the ventilating stem and the baffle, turned under it and flowed upward to the collecting wier around the sides of the tank. Scum boards protected this wier.

The theory of the Imhoff tank is that it exercises a dual function—sedimentation of sewage and digestion of sludge. The two functions are carried on in separate compartments, the lower or digestion compartment being so arranged as to exclude the flow of fresh sewage. In the sludge in this chamber the successful biological action depends upon the generation and growth of bacteria peculiar to its needs. The effect of this condition and of the concentration of the mass of sludge in the conical chamber is to produce a sludge of very low moisture, of uniform constituency, and lacking hydrogen sulphide either in the gas given off or in the sludge itself. This gas is one of the chief sources of nuisance in a sewage disposal works. Another advantage of this form of tank is that sludge can be removed by the excess head of sewage from the tank without placing it out of service. This results in great economy.

It should be noted that the tank here used allowed vertical sedimentation through 4 ft. 6 ins. only, while in an actual installation the distance would be much greater. The experimental tank served to illustrate the principles involved. The efficiency would be increased in tanks of working size.

Three experiments were performed. In the first the tank was 5 ft. deep and for 6 weeks ran at 1 hour storage. The influent contained 233 and the effluent 87 parts per million of suspended solids, giving a removal of 63 per cent. The effluent was very irregular in solids and was not at all suitable for subsequent bacterial action. The quality of sludge was excellent. It was low in moisture, reduced in organic matter, and of inoffensive odor.

The second experiment was more or less of a failure due to mechanical difficulties. An attempt was made to improve the character of the erratic effluent, remarked in the first experiment, by passing it through another tank for an hour's storage. The attempt to operate the tanks in series was unsatisfactory, as stated, the removal being 57 per cent.

The third experiment was conducted in the tank of 10-ft. depth. This tank during three months operated at 2 hours' storage, effected a removal of 53 per cent of the solids in the crude sewage, producing an effluent containing 92 parts per million.

All the gas formed by decomposing sludge in this form of tank is conveyed through the ventilator or stem of the inverted funnel, and the settling sewage is thereby kept fresh. There is no appreciable loss of dissolved oxygen nor reduction of nitrites or nitrates during the short time of passage through the tank. The emitted gas is said to be 75 per cent marsh gas and 25 per cent carbon monoxide.

Dibdin Slate Bed, No. 16.—This bed was .0021 acre in area and 5 ft. deep. Nineteen horizontal layers of 12x24-in. slates were separated by brickbats, leaving a clear space of about 3 ins. between them. This bed is another attempt to accomplish both the sedimentation of sewage and the digestion and concentration of the sludge in the same apparatus. In the Imhoff tank the latter function is accomplished by anaerobic bacteria, but in the Dibdin bed it is accomplished by aerobic bacteria, and the bacterial action is no doubt supplemented by worms and other low forms of animal life.

As the results accomplished by this bed are more than mere sedimentation, including an oxidation of the nitrogen of the applied sewage, it has been considered in two ways: first, as a sedimentation tank in which the resulting [illegible] as a contact bed producing a partially stable effluent. If looked upon as a sedimentation process it would consist of 19 superimposed quiescent basins, each about 3 ins. deep. The bed should be filled at such a rate that the velocity of influx is too low to disturb the deposit on the slates. The bed must then remain quiescent for an hour at least. During the filling and contact periods the settling solids are deposited upon the upper surface of the slates, where they form a deposit called by Dibdin "living earth" on account of the enormous number of animals, especially worms, developed therein. The sludge freshly deposited in sedimentation basins is usually about 90 per cent water and has a specific gravity of 1.02; using these figures and assuming the crude sewage to contain 200 parts per million of suspended solids and the effluent 50 parts it will be seen that a deposit of wet sludge only 0.118 mm. thick is deposited on the "living earth" each time the bed is filled. Before the bed is filled again the worms and other animals and the bacteria have attacked the organic matter of this deposit and are ready for the next thin layer of food, when the bed is subsequently filled.

If considered as a contact bed, its large void space as compared with a contact bed filled with ordinary media is of great aerating value, also due to the construction in horizontal layers, one slate resting upon another; on the under side of many slates a large flat bubble of air must be entrained, which tends to oxidize the sewage while in the bed.

The best results were accomplished when this bed was filled twice a day, or at a rate of two million gallons per acre per day. Crude sewage applied, deposited 75 per cent of the suspended solids; the effluent was slightly nitrified and rendered partially stable. For one test the average relative stability was 0.46, which was a higher value than the effluent of two of the outside sprinkling filters described later. The deposit on the slates was inodorous, resembling earth, and could be removed by flushing in the small size bed experimented with. The slates were flushed with water under pressure applied by an iron pipe held at each layer in a small vertical hole left between the slates during the construction of the bed. It should be borne in mind that the method and quantity of water satisfactory on such a small installation might not prove practical or economical on a large unit. The water capacity of the bed after flushing was 98½ per cent of the original capacity. It is pointed out in the report that where slates are not a waste product the construction of the bed would be costly.

Contact System.—The contact system consisted of a sedimentation tank, a primary and a secondary contact bed. The wooden tank held 2,060 gals. and was rectangular in cross section and unbaffled. The primary contact bed was 0.0066 acre in area, 3 ft. deep, with brick underdrains and ½ to 2-in. slag media. Its effluent was discharged onto a secondary bed of 0.00585 acre area, 3 ft. deep, with brick underdrains, and filled with hard furnace clinker rejected by a ½-in. screen to remove the dust and fine pieces.

The contact system was in operation for about 5 months. The effluent produced was almost free from suspended solids, but considering the low rate at which the beds were operated, of insufficient stability to warrant an extended study of this method of purification.

The preliminary sedimentation and adhesion to the new, rough, porous media of the two beds effected an almost complete removal of suspended matter. The effluent contained considerable matter in a colloidal state. Nitrogen as free ammonia was efficiently removed, but the effluent was never nitrified to an extent that would indicate that the beds were mature, nor did the daily stability tests show satisfactory results. The report gives its opinion of the contact system without prejudice to its use in combination with a septic tank or other preliminary treatment. The policy of operation of the testing station was to get rid of the sewage in its fresh state and not to allow it to become septic. The maximum rate at which sewage was applied to the beds was 1,350,000 gals. per acre per day. With sewage containing less trade waste better results might have been obtained.

Sprinkling Filters.—So much of the report is devoted to the description of methods of constructing and operation of the 16 sprinkling filters that only the conclusions drawn can be given in this review.

The best results were obtained with fixed sprinkler nozzles when the flow of sewage was made to constantly travel back and forth over the media, without a resting period; this caused a uniform rate of flow from the underdrains.

A uniform rate of operation produced better results than the same net area obtained when operated irregularly. With filters exposed to the weather and receiving sewage partially settled, the maximum rate obtained was 2,500,000 gals. per acre per day, but in the winter the stability of the effluent deteriorated.

With a filter protected from the weather, having fine screened and settled sewage uniformly distributed over its surface and having a ventilating system, the maximum rate used was 3,100,000 gals. per acre per day. The effluent was practically always stable. How far this would have been affected by exposure to the weather was not determined.

The trap rock and gravel used as filter media retained their original size. Limestone and slag disintegrated to a slight extent. The smooth surface of gravel stones was not as well adapted to the formation of a bacterial jelly as rougher media, and the extreme roughness of slag caused it to retain the deposited solids. Rough, irregular cinders removed all the suspended matter from coarsely screened sewage, so that clogging soon ruined the bed.

The size of the media used in filters is partially controlled by the completeness of the preliminary treatment. In filters exposed to the weather and treating sewage partially settled, operated at the rate of 2,500,000 gals. per acre per day, the best results were obtained from trap media 1 in. to 3 ins. in size. Under the more favorable conditions of fine screened and settled sewage as an influent uniformly distributed, at a rate of 3,100,000 gals. per acre per day, media ¾ in. to 1½ ins. produced an excellent effluent.

Filters of less depth than 6 ft. were not satisfactory, but from filters 6 ft. or more in depth effluents could be obtained at rates between 2½ and 3 million gals. per acre per day of satisfactory quality. The additional depth over 6½ ft. did not seem to be economical.

Filters exposed to the weather, receiving sewage partially settled, and put in operation in March, yielded a satisfactory effluent in three weeks and after three months the effluent was perfectly stable. A filter protected from the weather, having fine screened and settled sewage uniformly distributed over its surface, and put in operation in July, yielded a perfectly stable effluent after one week of service.

In filters operated at rates between 2½ and 3 million gals. per acre per day, media composed of stones approximately uniform in size completely unloaded the solids stored up in the interstices, whereas media composed of stones of great diversity in size became badly clogged, but did not unload.

No trouble was experienced from the formation of ice upon the surface of the filters; biological activity was decreased by the low temperature to such an extent, however, that at a rate of 2½ million gals. per acre per day the fine grain and graded mixture beds pooled and the effluents of all the exposed filters were of lower stability than in summer.

Fungus growths on the surface were completely removed by an application of calcium hypochlorite dissolved in water. The continual disinfection with calcium hypochlorite of the influent to a filter maintained its surface in perfect condition and did not interfere with the biological action of the bed.

The average number of bacteria in the effluent of a mature sprinkling filter operated at rates between 2½ and 3 million gals. per acre per day was 400,000 per cubic centimeter, which represented a removal of 86 per cent from the crude sewage. Bacterial efficiency within a limited range of small size stone was proportional to depth of bed.

The effluent from the filters was rendered uniform and a large part of the suspended solids was removed by storing for a nominal period of two hours.

Some tests were made on a filter of the Hamburg type, in which distribution is effected by a layer of fine coke; also a shallow, coarse sand filter was tested. The rate at which these filters could be efficiently operated was too low for conditions in Philadelphia.

Disinfection.—Some studies were made for the purpose of determining the practicability of disinfecting sewage from which the large suspended solids had been removed. Studies were made upon screened sewage from tank 11, screened and settled sewage from tank 12, and settled sewage from tank 13. Bleaching powder or calcium hypochlorite was the disinfectant employed, and the economical amount of disinfectant required was determined. No experiments were made on crude force main sewage, since other experimenters have shown that it is not practicable to disinfect sewage containing particles larger than 1 mm.

The experiments showed that the screened sewage required the largest quantity of disinfectant and screened and settled sewage the least. Owing to the varying strength of sewage from hour to hour, the amount of disinfectant added must be that needed to meet the maximum requirements.

Two degrees of disinfection were studied. First, enough disinfectant was added so that during an epidemic considerable assurance would be felt that other cities down stream were adequately protected. Second, such an amount was added that over 95 per cent of the B. Coli. were destroyed. With the after effect of dilution and oxidation this would clearly indicate efficient disinfection, practically speaking.

For the first case 300 lbs. of dry bleaching powder per million gallons of sewage effected almost complete disinfection. Under the second or ordinary condition adequate disinfection was accomplished with less than one-half that amount. Sewage which had been passed through the fine mesh screen only and treated with about 150 lbs. of dry bleach per million gallons, or when screened and settled and treated with 105 lbs. of bleach, was economically disinfected. Economy of design and operation can be attained by short storage and mechanical agitation to insure contact of the disinfectant and the sewage.

Dilution.—Owing to lack of funds the experiments on dilution were not completed. Later experiments will be conducted to determine the amount of dilution necessary for the treatment without disinfection of raw, screened, and settled sewage.

The experiments made were on crude sewage from which all solids larger than 1-25 in. had been removed by a fine screen or by satisfactory settling, and disinfected with 150 lbs. of bleaching powder per million gallons of sewage. This disinfected sewage was added in proportions up to 1 to 10 to river water, and the water was purified without offense to sight or smell, and without the depletion of the dissolved oxygen of the river water below 50 per cent saturation, which is sufficient for major fish life.

In the examination for Resident Engineer, Department of State Engineer, New York, the time for receiving applications has been extended to April 20, 1911. While candidates will not be assembled for a written examination, they may be summoned for an interview with the examiners. Two theses will be required, including a report upon some work of importance carried out under the charge of the candidate, and a discussion of some assigned topic relating to the problems to be handled in the construction of the barge canal. The theses are to be written and submitted by the candidate in accordance with instructions to be issued by the Commission.

The Relation of the Intake to Pure Water From the Great Lakes—The Relative Cost of Long Intakes Compared With Purified Supplies From Short Intakes.*

There is no better municipal water supply in the world than that furnished by the Great Lakes, if drawn at such location that it is free from shore pollution. The water in its natural state is clear, tasteless and odorless, and in mineralization it is the lowest of our western water supplies.

It is commonly supposed that cities upon the lake shores are blessed with a pure and abundant water supply cheaply obtained. This is not entirely true. Experience has demonstrated that, not considering pollution, intake pipes of considerable length are required in order to maintain a continuity of draught, owing to the action of ice and the movement of sand. This is particularly objectionable in the shallow waters. Referring particularly to Lake Michigan, the depths of water from Waukegan around the south shore, and north on the east shore up to Manistee, at various distances from shore, are approximately as follows:

At 1,000 feet, 10 to 15 feet.
At 2,000 feet, [illegible] to 30 feet.
At 3,000 feet, 20 to 40 feet.
At 5,000 feet, 30 to 45 feet.
At 10,000 feet, 30 to 60 feet.
At 15,000 feet, 30 to 72 feet.
At 20,000 feet, 36 to 120 feet.

The shallowest water is generally found upon the west shore of the lake in the vicinity of Chicago; the depth ranging from 24 ft. one mile off shore to about 40 ft. four miles out. At most of the other cities between Waukegan and Manistee depths of 25 to 40 ft. are available 3,000 ft. from the shore; 35 to 45 ft. one mile out, 40 to 60 ft. two miles out, and 60 to 120 ft. four miles from shore.

In the supply of the smaller cities fed by pipe intakes, the first difficulty arises in the maintenance of a constant supply due to the action of sand and ice. The off-shore storms in the shallow waters erode the sand bottom rapidly, tending to clog the intakes or embarrass the pumping operations through wear upon the pumps. In winter time the ice, driven by on-shore winds, piles in huge windrows, often 10 to 20 ft. above the lake level, and, in shallow water, filling the lake solidly to the bottom to such extent as to shut off entirely a water supply drawn close to the shore.

It has been the result of experience that an intake location from 2,000 to 3,000 ft. offshore in from 20 to 30 ft. of water is required to furnish a draught reasonably constant. At times intakes even in such positions give trouble, both from ice and sand, and although these troubles can be minimized by proper intake structures, the trouble cannot be entirely obviated at a reasonable expense. In the larger supplies, particularly at Chicago, much trouble is experienced by anchor ice as far out as four miles in 40 ft. of water. The trouble from this cause is largely a matter of the total draught in one locality and the velocity of the water as it enters the intake. These conditions make it impracticable for even small cities to draw water at a less distance from shore than from 2,000 to 3,000 ft. The construction of submerged intake pipes is expensive, requiring considerable dredging in depths of less than 20 ft., and therefore in the villages and smaller cities it is often less expensive to secure well water than to draw the supply from the lake.

Turbidity.—Throughout the majority of the year the water is clear, even when drawn close to the shore. In rough weather it is quite turbid near the shore, and under certain conditions this turbidity may extend for several miles into the lake. The lake bed, at least as far out as the water-works inlet, is clay. Adjoining the shores the clay is overlaid with more or less sand, ranging in depth from about 20 ft. at the shore line at Chicago to 40 ft. at Gary. In certain places it extends into the lake from one to two miles. A thin layer is sometimes found even further out. At certain other places, particularly along the west shore, the sand is almost entirely lacking, being found generally in large quantities only in the vicinity of such obstructions as piers, harbors and points. The action of the lake storms tends to erode the clay bottom and to pick up the sediment discharged at the river mouths. This results in a decidedly turbid water at many of the Chicago suburban towns, and is quite noticeable in the water supplied to Chicago in time of severe storm.

The frequency of this trouble is somewhat dependent upon the location of the intake as regards distance from shore. It is apparently most frequent in the small towns with intake pipes of from 1,500 to 3,000 ft. in length, and it is of least significance at Chicago, where water is drawn two to four miles from shore, even although the lake bottom at this place is doubtless quite dirty from the dredge dumpings and sediment discharged by the sewers prior to the opening of the drainage canal.

It is generally believed that in depths exceeding 40 ft. the influence of wave action is insufficient to [illegible] serious washing and consequent turbidity. However, the distance of the intake from the shore has also a bearing upon this matter. In the off-shore storms, which cause the most serious cutting, the travel of the surface water is shoreward, with an undertow outward. The turbidity caused by sediment and clay is extremely fine, and waters containing these substances require many days to regain their clearness. Under these circumstances the turbidity developed in the shallow water is transmitted to the deeper waters in the same manner that the shore pollution reaches off-shore intakes. The Chicago cribs are located in water ranging in depth from 27 to 40 ft., the shore distance varying from two to four miles. The trouble is not entirely lacking at Gary with the intake in 45 ft. of water one and a half miles off shore.

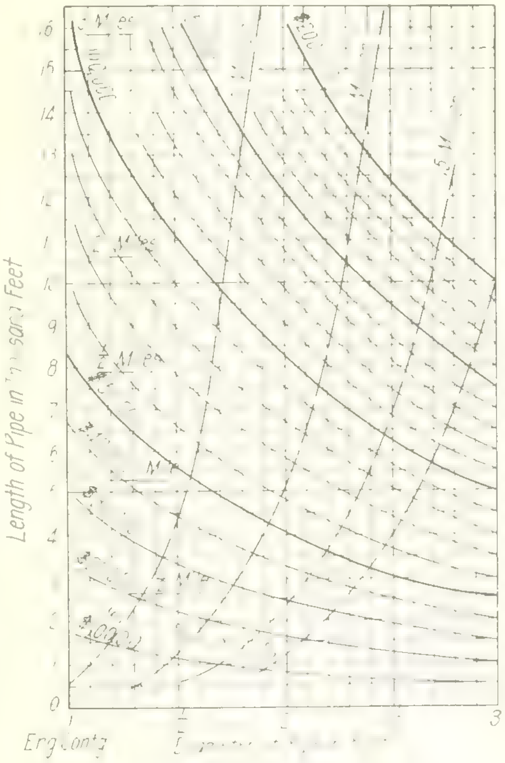

Diagram Showing Relation of Diameter, Length, Delivery and Cost of Cast Iron Intake Pipes (20 ft. friction loss).

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	$0.36	[illegible]	[illegible]
16	1.62	[illegible]	[illegible]	5.90	8.06
18	1.94	[illegible]	[illegible]	6.50	9.05
20	2.25	69	[illegible]	[illegible]	10.07
24	[illegible]	92	[illegible]	[illegible]	12.21
30	4.38	[illegible]	[illegible]	[illegible]	[illegible]
36	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note—Pipe [illegible] ton. [illegible] joint [illegible] 96 ft.

Location from Sanitary Standpoint.—It is, of course, not sufficient that a water be clear, tasteless and odorless. Although these qualities are all necessary to a good water, the foremost consideration is the freedom from sewage contamination. Unfortunately, the matter of expense makes necessary the drawing of a municipal water supply close to the town, and the problem of pure water is therefore complicated by the common practice of discharging municipal sewage into the lake.

Several investigations have shown that the effects of a relatively small sewage pollution may be traced several miles from the point of its entrance to the lake under certain conditions.

Major Judson, in his paper before the Commission, states that surface velocities of 1.6 miles per hour have been actually measured, and it is probable that currents as rapid as three miles per hour occur during storms.

Experiments have shown that the typhoid bacillus may exist in comparatively pure water from 3 days to 40 days, dependent upon the local circumstances, the character of the water, and the temperature. Under these circumstances it is quite surprising that the results from using lake water drawn in proximity to the sewer outlets have not been fraught with greater harm in many of our water supplies. The answer is probably to be found in a missing link in the chain of typhoid pollution—rate of travel, direction of current, and possibly some uncertainty as to the virulence of the typhoid bacillus after immersion for a certain time in the lake water. It may lose its virulence before life is extinct. As is the case with turbidity, except when the lake is grossly polluted, a good water may be obtained throughout the majority of the year at comparatively small distances from the pollution source. The extent of the pollution decreases very rapidly under most circumstances with distance from the sewer outlet. It is not sufficient, however, that a municipal water supply be pure most of the time. The occasional combination of circumstances brings consequences of such seriousness as to warrant its governing the plans for the water supply.

There has been some study of the currents in Lake Michigan with a view to determining their effect on intake location, and, as has been elsewhere pointed out, there seems to be a notion that the lake inlet is in least danger to the northward of sewer outlets upon the west shore, and to the southward upon the east shore. As has been elsewhere stated, however, the ordinary current, at least within several miles of shore, is extremely sluggish, and it is undoubtedly the occasional wind-induced currents that do most harm. They are most dangerous when most rapid. This will depend upon the velocity of the wind, and bad consequences are doubtless augmented by the turbulence of the waves in stirring up lake bottom deposits.

It is true that upon the west shore the storms of most consequence in this matter come from the north and northeast, and it is probably also true that upon the east shore the north and northwest storms produce the most serious consequences. Upon the south shore of the lake it has been noted that the storms from the north quarter of the compass have the most detrimental effect upon the water supplies, and that the strong southern winds have the opposite effect. This is doubtless due to the use of submerged cribs for the smaller municipalities on the south shore. The north wind is ordinarily accompanied by considerable wave action and an undertow which reaches the intakes. At Gary the lowest bacterial counts are obtained during the prevalence of a strong south wind. Under this condition the shore water is apparently blown out into the lake on the surface, accompanied by a shoreward current along the lake bottom. These facts suggest the desirability, where surface cribs are used (as is the case at Chicago), of so locating port openings that water may be drawn near the surface or near the bottom, depending upon the direction of the currents. It seems probable that in most storms this practice would permit a considerable improvement in the character of the water drawn, both in purity and clearness.

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*Paper read before the Illinois Water Supply Association, Feb. 21, 1911, by Charles B. Burdick, Hydraulic and Sanitary Engineer, Chicago.

Relation of Intake Shore Distance, Cost and Capacity.—The cost of an intake to supply a given draught of water increases rapidly with its length. Assuming that in any particular situation there is a certain distance from shore or pollution source where pure water may always be obtained, it becomes a question as to whether, from a financial standpoint, it is best to construct an intake of sufficient length to secure pure water, or draw a supply closer to shore and subject the water to purification. To illustrate this point, the writer has prepared a diagram showing approximately the cost and capacity of intake pipes of various sizes and lengths. It is, of course, impracticable to make any cost estimates that are applicable to individual cases of varying conditions. It is believed, however, that they are sufficient to cover first-class practice in the ordinary circumstances on the Lake Michigan shore, where it is necessary to dredge a bed for the pipe in clay and sand practically throughout its length. The estimates provide for cast iron pipes, with flexible joints at intervals of 8-pipe lengths, and include the cost of pipe, trenching and laying, but do not include intake crib or shore well.

To illustrate the importance of more definite knowledge of the distance of pollution travel, the writer would make two comparisons, as follows: of the relative costs of long intakes, compared with purified supplies drawn from short intakes.

Case 1.—We will assume that water is demanded at a constant rate of 5,000,000 gal. per day; that pure water can be obtained three miles off shore, and that a constant supply can be secured one-half mile from shore.

To provide the required quantity of water from an intake three miles off shore, a 24-in. pipe will be required, with an expenditure of about $200,000. The cost of securing water from this intake will practically amount to the fixed charges, which we will assume at 5 per cent to cover interest plus 2 per cent for depreciation, making a total annual charge of 7 per cent, or $14,000 per year. For the intake one-half mile off shore, a 16-in. pipe is required, at a cost of $21,000, and a filter plant can probably be constructed for $75,000, making a total expenditure of $96,000. Placing the fixed charges on filtration plant and intake at 8 per cent, assuming that the water can be coagulated with alum at not to exceed one grain per gallon, and including the cost of secondary pumping and chemical supervision, 5,000,000 gals. per day could be purified for about $8.35 per million gallons, making the total annual cost $15,200, as compared with $14,000 per year, the estimated cost of a three-mile intake.

It will thus be seen that the investment in the short intake and purification works is less than that of the long intake, but that the annual cost, including all charges, is approximately the same in the two cases.

If the situation is such that turbidity is not an important factor, the supply from the short intake may be purified by the "hypo process," including chemical supervision and fixed charges on the intake, at a total cost of about $3,500 per year, which sum will pay a fixed charge of 7 per cent on an investment of $50,000; this would cover the cost of an 18-in. pipe one mile in length, capable of furnishing 5,000,000 gals. per day. To summarize, we can filter a supply drawn one-half mile off shore for approximately the same cost as an unfiltered supply three miles off shore, and if the hypo treatment is applicable, a half-mile intake purified is comparable with a one-mile intake unpurified, the quality of the resulting waters being equal.

Case 2.—In the case of larger quantities of water the relative merits of the pure water proposition are different, owing to the fact that large supplies require relatively small expenditure in intakes. Take, for instance, a case where 100,000,000 gals. per day is required, and again assume that pure water may be secured three miles off shore. Compare this proposition with a purified supply secured one-half mile off shore. A supply of this size is beyond the capacity of our largest pipes, and a multiplication of pipes is not economical. The best investment, if underground conditions are at all favorable, lies in a tunnel. A 7-ft. tunnel, three miles in length, in clay, under favorable circumstances, can be constructed for about $25 per foot, including shafts, but exclusive of intake crib. A three-mile tunnel at this price would require an investment of $400,000, which, at 6 per cent (the depreciation is small on this type of construction), would involve an annual expenditure for fixed charges of $24,000.

A filtration plant could probably be built to purify this water for about $1,200,000, and a 6-ft. tunnel one-half mile in length, which is about the smallest that it is practicable to build, would cost about $100,000, making a total expenditure of $1,300,000, which, at 8 per cent, produces a fixed charge of $105,000 per year. Such a plant could be operated, including coagulant, secondary pumping, labor, supervision and ordinary maintenance for an additional $105,000 per year, making a total cost of $210,000 per year, as compared with $24,000 per year, the annual cost of a three-mile intake.

The sum required for the filtration of the water will pay 6 per cent interest on an expenditure of about $3,000,000. It will thus be seen that if filtration is required, very long intakes for large supplies are warranted.

Assuming that the turbidity of the water is such that the hypo process will give a satisfactory supply from a short intake, the conclusions are somewhat different. Including the fixed charges on the intake, and the nominal investment required for the application of the process, the water from the half-mile intake could be purified for about $22,000 per year, which sum will pay 6 per cent on an expenditure of only $370,000, a sum sufficient only to build a tunnel about three miles long.

Now these estimates are not given in the hope that they will solve the problem for any particular locality. Conditions and costs vary so widely that the conclusion applicable in one city may be reversed in another. Furthermore, in the consideration of any expenditure for these purposes allowances must be made for deterioration in the supplying capacity of the pipes, and provision must be made against the reasonable variations in the rate at which water is demanded. This is particularly important in the smaller supplies. The object of these estimates is to emphasize the fact that there is a relation, a balance, in the financial value of the pure and purified waters, and that to solve the problem for any locality requires a better knowledge of the sanitary conditions in the lake than is possessed at the present time. Individual and fragmentary analyses are not sufficient. They must cover daily analyses in any locality over a sufficient period to include all conditions of wind and weather, and, while the conclusions at any particular place do not necessarily solve the problem for all the lake cities, yet they very materially assist in the formation of correct opinions subject to general application.

If the generally accepted sanitary standards for surface waters are applicable to Lake Michigan, then a very large majority of the Great Lake supplies are deficient in quality. It may be that these standards are too severe, and it is important that more knowledge shall be gained on which to judge this matter. This cannot be done from a canvass of sanitary literature. It needs a study of the lake supplies, and their effect upon health. It may require a standardization of the vital statistics of the lake-supplied cities, and a study of the water supplies of these cities, before a satisfactory standard can be approximated.

Mast machines for drilling are now coming into wide use. Where a well does not require frequent cleaning, and permanent rig is unnecessary, there is economy in lumber in using the mast rather than the derrick.

Comparative Costs of Lead and Leadite Joints in Water Pipe.

BY W. C. HAWLEY.*

The Pennsylvania Water Co. has been using leadite for sealing joints in cast iron water pipe for about five years. In that time we have used it on all of the extensions to our distribution system, totaling about 15 miles of mains, ranging in size from 4 ins. to 16 ins. in diameter and in small amounts for repairs on sizes up to 42 ins. in diameter.

We have found leadite a very satisfactory material for making joints. So much so that we have abandoned the use of lead entirely except in the case of a large pipe where we sometimes find in using a sleeve that the joint room is excessive and for some reason, probably due to the shrinkage in cooling, together with the too rapid pouring of the joint, we have had trouble two or three times with leaky joints. Our pressures range up to a maximum of 210 lbs. per sq. in. in our distribution system with a large part of the system under pressures ranging from 100 to 175 lbs. per sq. in., so that under our conditions we have given the material a pretty thorough test.

Compared with lead it is very easy to manipulate, requiring no special skill. It has its own peculiarities, however, the same as lead has and to be used properly, a man must be familiar with it. I know of a number of people who have tried to use leadite and have not gotten satisfactory results, but in such cases as I have been able to investigate, the failure was due to the methods used.

Leadite when cast in the joint is hard and vitreous in nature. It is therefore more elastic than lead and does not squeeze out of the joint as does lead in the case of settlement or repeated jars to the pipe. It is especially adapted in the case of pipe being laid on a curve, as it will not blow out of such a joint on a part of the joint on the outside of the curve and is not driven in as happens so often with lead on that part of the joint on the inside of the curve.

During the past fall we laid a line of 12-in., 10-in. and 8-in. pipe nearly five miles long. The joints were run by an experienced man and the pipe was tested before the trench was backfilled and there was not a single leaky joint on the whole line and there has not been a leak on that line to date. We have had two cases where sidehill slips carried small lines of pipe with them. In both cases the leadite merely crushed in the joint, causing a slight leak, whereas our experience is that lead in such cases would have been partly or entirely blown out.

In making joints with leadite, we use a little more than is given by the table published by the Leadite Company. This is because of the pressure in our system. Probably with lower pressures smaller amounts could be safely used. Table I shows the average weight per joint of lead and leadite which we use and the cost per joint, the lead being computed at 5 cts. per pound, the leadite at 10 cts. per pound. The last column of the table gives the saving per joint in material only. In addition to this saving there is the saving in excavation of large manholes for calking in sizes from 12 ins. up, the saving of the cost of calking and the added saving in the cost of maintaining the bell hole during the time that the joints are being calked. There is also a saving in the cost of inspecting the calking and a further item of saving in the cost of repairing an occasional lead joint even after it has been inspected. There is an additional saving due to the fact that the man who tends the leadite kettle can look after his leadite and carry it to the man in the trench who makes the joint, as the leadite melts more readily and is much lighter. In fact the difference in weight is very much in the leadite's favor when it comes to deep trench and large joints. We can give no figures on these, but we estimate that the saving in the use of leadite over lead amounts to from one-half to two-thirds of the cost of lead joints.

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*Chief Engineer and General Superintendent Pennsylvania Water Co., Wilkinsburg, Pa.

TABLE I.—COMPARATIVE COSTS OF LEAD AND LEADITE FOR MAKING JOINTS IN CAST IRON WATER PIPE.

Size of Pipe Int. Diameter	Weight required per joint lbs. Lead	Weight required per joint lbs. L'dite.	Cost. Lead at 5c per lb.	Cost. Leadite at 10c per lb.	Saving on material leadite over lead per joint.
4-in.	7	[illegible]	$0.3[illegible]	$0.20	$0.15
6-in.	10	3	.50	.30	.20
8-in.	13	4	.65	.40	.25
10-in.	16.5	5	.825	.50	.325
12-in.	20.5	6	[illegible]	.60	.425
16-in.	29	8	[illegible]	.80	.65
20-in.	38	10	1.90	1.00	.90

Results of the Electrolytic Process of Sewage Purification at Santa Monica, California.

In the summer of 1908 sanitary engineers throughout the country were greatly interested in the novel form of sewage treatment adopted by the City of Santa Monica, Calif. The process was widely advertised at the time and the claims made for it attracted much attention and were discussed generally by the technical press. Engineers who realized the limitations of chemical and biological sewage treatment, as then practiced, were especially interested in the electrolytic process introduced at Santa Monica. The plant has been in operation over two and one-half years and the results obtained are pronounced satisfactory by City Engineer Thos. H. James. For this reason a review of the conditions which led to the adoption of this process, and of the chief features of the construction of the plant, becomes of interest.

Santa Monica is a coast town and the obvious method of disposing of the city's sewage was to discharge it into the ocean. However, it was imperative that the beach and the water close to shore be kept free from offensive pollution. The first method of purification considered was the biological process and plans for a septic tank were considered. The estimated cost of the tank was $23,000, and this sum did not cover the cost of works necessary for the subsequent filtration of the septic tank affluent. While considering the adoption of the tank the attention of the city was attracted to an experimental electrolytic plant at Ocean Park, Cal., where good results had been secured. This experimental plant was installed by the California Water Purification & Sanitation Co. of Los Angeles, Cal., and this company agreed to install a similar plant at Santa Monica, of a size sufficient for that city, on 60 days trial. At the end of the test, which was made during the hottest days of the year, Sept. 1, 1908, the city accepted the plant and paid $10,000 for it. It has given general satisfaction in the city and it is especially interesting to note that there has been no complaint of nuisance lodged by citizens living near the outlet from the plant. The first point of discharge was 150 ft. from shore, but the outlet pipe was finally carried 1,600 ft. from shore through a reinforced concrete pier built by the municipality.

The purification plant is 22 ft. above mean tide elevation, beneath a city street. Steps lead from the sidewalk to the treatment chamber. The trunk sewer of the city discharges into a receiving basin of 30,000 gals. capacity at the shore end of the pier previously mentioned, and the sewage is pumped from this basin up into the forebay of the electrolytic plant by a centrifugal pump. Organic solids in the sewage are broken into small pieces by the churning they receive while passing through the pump and this greatly facilitates electrolytic purification. Many of the solids in the sewage which do not require purification are screened out before the plant is reached.

The forebay, or conduit used as an equalizing chamber, has a capacity of 7,000 gals. The sewage never comes to absolute rest. The forebay has a gradient of 0.44 per cent, and is constructed in a sealed manner, excepting at the gates. After leaving the forebay the sewage may be discharged into two redwood flumes, each 30 ft. long, by 22 ins. wide by 18 ins. deep. If desired the flumes can be operated one at a time. They are set to a grade of 1 in. in 30 ft. They are placed side by side with room enough between them to allow ready access by the operators. Adjustable wiers are placed in the downstream ends of the flumes and by means of these the depth of water in the flume is regulated. This depth of flow is ordinarily about 15 ins. This is 2 ins. above the top of the electrodes. The discharge from the wiers falls into the open end of the outfall pipe.

Each flume has ten sets of electrodes spaced 32 ins. c. to c., and operated in parallel. Each electrode set consist of 29 plates, each 9x24 ins., spaced ⅝ ins. c. to c. Since this plant at Santa Monica was the first to be operated on a commercial basis it is not surprising that certain novel features of the original design were changed after the plant had been in operation for a time. In this connection Mr. H. Hawgood, M. E. C. E., has stated as follows.

> The experience gained in the operation of the plant has resulted in some interesting changes from the original design, among the most important being the metal of the electrodes and manner of cleaning them. The electrodes as first installed consisted of alternate plates of iron and aluminum, these plates were decomposed very rapidly, having a useful life of only three weeks. The cost of replacement at such brief intervals would have proved prohibitory to the use of the plant. All iron plates of No. 8 gage were then substituted, with very substantial gain in durability. The plates, however, still showed undue tendency to decomposition along the upper edges. Experiments were then made to protect the upper edges by copper clips or bindings of No. 20 gage, [illegible] in. deep, extending the entire length of each plate, tightly pressed or squeezed on to give good contact. This experiment was very successful, good protection was given to the edges of the plates, and at the same time a more uniform wear was observable over their entire surface. All the plates are now fitted in this manner. Incidentally, the copper strips, in their decomposition, yield copper sulphate and aid in the treatment.
>
> With the aluminum and iron plates there was a heavy deposition of solids upon the plates, with the all-iron plates, the deposit has not been so heavy. The cleaning of the plates was at first attended with considerable trouble. The original installation provided for this being done by steam, and perforated pipes for this purpose were laid under each electrode set. It was expensive, unsatisfactory, and the piping obstructive to the flow through the troughs. The cleaning is now effected in a simple and natural manner by reversing the current every 24 hours, the anodes becoming the cathodes, and vice versa. As the solids are attracted and adhere to the poles electrically opposite in character to themselves, it follows that they are repelled and fall off on reversal of polarity. With the addition of an occasional washing of the plates, using for that purpose an ordinary ¾-in. garden hose, the reversal of the current every 24 hours is found in practice to accomplish the desired dislodgement of deposit, and the plates are kept in good order. The arresting of all decomposition of the plates is, of course, not sought. The condition sought to be attained is a uniform and gradual dissipation of an inexpensive metal, and this appears to have been accomplished. The present indications are that the consumption of iron will be at the rate of about 20 lbs., and of copper in the binding strips, at the rate of ⅓ lb. per 1,000,000 gals. of sewage treated.

The operation of the plant is considered economical. It is kept in constant operation except for a period of about 1 hour of each twenty-four. This hour is used to wash out the flumes and to wash off the plates by a stream of water from a common hose as mentioned above. The down stream end board of each flume is fitted with a light wooden flap gate extending the full width of the flume. This is for washing out purposes.

The actual time required to attend to the plant is from 3 to 5 hours per day. Two operators are employed, each at the rate of $85 per month. In addition to looking after the plant they do considerable other work such as police duty.

The plant is now treating about 550,000 gals. per 24 hours on the average. The city pays a flat rate of 3 cts. per kilowatt hour, which is about 40 per cent above the average price paid in most cities in that part of the country. The electric plant consists of an A. C. motor driving a D. C. generator. The operation of the plant is very largely automatic. Ordinarily the sewage is lifted from the receiving basin by means of a No. 4 centrifugal pump. A No. 6 Byron Jackson Slime and Sewage Pump is put in operation at intervals to lift all the sludge and silt from the bottom of the receiving basin. The monthly expense of operating the magneto electric plant, including the pumping of sewage, is about $400. Mr. James advises that 1,000,000 gals. could be pumped and treated for $600 per month. The total original cost of installing the plant, including the pumps, buildings and forebay was about $18,000.

City Engineer James further advises that the estimated cost of treating sewage by the magneto electric process, exclusive of pumping sewage, is $5,000 per annum for a city of 75,000 population. This includes renewal of plates, etc. It has been the experience of Mr. James, at Santa Monica, that the best results are obtained in the treatment for deodorization of sewage by thoroughly churning up the sewage before it enters the flumes. This may be accomplished by allowing the sewage to flow a mile beyond the last house connection before reaching the plant, or by placing a rotary agitator within the receiving basin. As now operated the only vents necessary at the plant are in close proximity to the weir for discharging the effluent from the flumes. At this point hydrogen gas is released and a vertical 6-in. galvanized pipe takes care of it, and it is carried to a height of about 60 ft. above the surface of the street.

The precipitation of the organic matter by the feric hydrate formed at the electrodes, as an inodorous coagulum is immediate and complete. The precipitate is floculent, easily carried along by the effluent, and very different from the slimy nature of the sludge associated with bacterial purification. At the experimental plant at Ocean Park, previously mentioned, the effluent, continuing the precipitate, was discharged on the ground and remained there exposed to a hot sun without fermentation of putrefaction, and without any discernable odor even on close examination.

The purification of the sewage is not caused by the direct action of the electric current, but proceeds from the electrolyte and the decomposition of the electrodes. The chemical and aseptic actions of the process are described by Prof. Frederick Solathie, Ph. D., who made a report to the California company as follows:

> The chemical action takes place in a nascent state, and therefore acts upon the sewage in the most powerful manner. In a "nascent state" gases such as oxygen, ozone, chlorine, or hydrogen, act upon organic, and also upon inorganic salts in an intensified manner, being readily combined with the above mentioned products. By such treatment with nascent gases formed in this process, the sewage will, under all circumstances, be rendered neutral, which condition can not be obtained and controlled by either chemical or biological treatment.
>
> By "neutral state" it is understood that neither free alkalies nor free acids should be contained in the sewage in excess; they should be held chemically combined.
>
> An analysis of raw sewage compared with the electrolytically treated sewage, shows the following results:

	Raw Sewage.	Treated Sewage
Organic matter	2.09	1.26
Nitrates	[illegible]	[illegible]
Nitrites	[illegible]	[illegible]
Phosphates	[illegible]	[illegible]
Lime	[illegible]	[illegible]
Magnesia	[illegible]	[illegible]
Oxide of Iron	2.72	[illegible]
Sulph. Acid	14.3	16.2
Chlorine	27.7	11.03

The above analysis, which was made the latter part of July, 1908, clearly shows the sewage while it passes through the electrolytic troughs.

The organic matter contained in the raw sewage is composed of albuminates, starch, sugar, uric acid, urea, nitrogenous compounds of organic constitution, fatty acids and bacteria. By the electrolytic chemical action, these organic products are reduced to a very small amount, leaving no traces of albuminates and nitrogenous bodies, which in the septic tank treatment are chiefly the cause of a secondary fermentation of the effluent, a state most dangerous for future infection when used on irrigation fields.

The microscopial examination of a diluted sample [illegible] 500 magnifying power showed a decrease from 700 live bacteria to 6, and those remaining showed no sign of multiplying, therefore were completely destroyed by the nascent oxygen or ozone and free chlorine gas generated by the electro-chemical process.

Nitrates are reduced from 7.4 parts to 4.4 parts in 100,000 parts of water, and are partially converted into nitrites and ammonia. The reduction of nitrates to nitrites as intermediate nitrogen compounds, which finally are converted by the electrolytic process into ammonia salts, is shown by the decrease of nitrates in the comparative analysis of raw electrolytically-treated sewage.

By the formation of ammonia from nitrates the proportion of nitrogen is increased and changed into an immediately available form, readily assimilated by plant life.

Phosphates are not decomposed to any extent by the electrolytic action, but they are held in a condition for ready assimilation by plant life.

Lime is reduced from 7.35 parts to 4.78 parts in 100,000 parts of water, which reduction is due to the formation of insoluble organic compounds of uric acid, etc.

Magnesia and iron in connection with nascent chlorine, are reduced in the following manner: First, the electric current decomposes the common salt contained in the sewage. The sodium which forms on the cathode is converted into hydrate of sodium, which saponifies fatty acids contained in the sewage by forming soluble soaps. The free chlorine on the anode acts in two ways. The analysis shows that the raw sewage contains 27.7 parts of chlorides in 100,000 parts of water, while the electrolytically-treated sewage contains but 11.03 parts. The chlorides are decomposed and the chlorine gas is set free in a nascent state and spontaneously acts chemically on the sewage; one part deodorizes the water, while the other part forms ferrous chloride, oxychloride of magnesia, and chloride of lime. The ferrous chloride is decomposed, setting free nascent chlorine and producing ferrous hydrate, this readily oxidizes to ferric hydrate, which is the main active element in the precipitation of the albuminates.

The resultant coagulum greatly assists in clearing the water by precipitating any suspended matter contained therein. All substances liable to undergo putrefaction are thus converted into an insoluble state and are therefore made immune to secondary fermentation and putrefaction.

The oxychloride of magnesia and lime acts chiefly as a deodorizer and disinfectant, and destroys bacteria, such as bacillus coli communis, bacillus subtilis, bacillus cavi cida, bacillus urae.

Dangerous bacteria, such as bacillus typhus, etc., are also destroyed. It is not only the chlorine, but to a large extent, the nascent oxygen or ozone, which causes the destruction of bacterial life. There is also free sulphuric acid formed, by oxidation of hydrogen sulphide during the electrolytic action, as indicated in the foregoing analysis, which in a quantity of .02 per cent is known to destroy even cholera bacteria.

A part of the iron salts liberated from the electrodes is precipitated by the sulphuretted hydrogen as insoluble sulphide of iron. The water is decomposed as follows: The free oxygen forms as an electro-negative element on the anode, the hydrogen as an electro-positive element on the cathode; free oxygen and hydrogen in a nascent state, in the presence of organic matter, produce peroxide of hydrogen, which spontaneously oxidizes organic substances or bacteria present, under a decomposition into water and ozone, to carbon dioxide. Also, nitrogenous organic substances are decomposed and oxidized by the free or nascent oxygen, and can therefore produce no further fermentation or putrefaction in the effluent.

The following different analyses plainly show a large decrease of organic matter and chlorine obtained under the electrolytic process, as conducted at Santa Monica:

August 1st.

	Raw Sewage.	Treated Sewage.	Treated Sewage.
Total residue	103.32	93.2	75.9
Lime	27.74	11.52	13.96
Magnesia	21.63	3.92	2.92
Chlorine	17.6	14.6	11.4
Organic matter	1.78	0.88	0.92

August 29th.

	Raw Sewage.	Treated Sewage.	Treated Sewage.
Organic matter	2.03	1.47	1.71

September 2d.

	Raw Sewage.	Treated Sewage.
Organic matter	2.99	1.57

September 13th.

	Raw Sewage.	Treated Sewage.
Organic matter	2.02	1.25
Lime	1.0	1.0
Magnesia	9.0	trace
Chlorine	37.8	27.1

September 20th.

	Raw Sewage.	Treated Sewage.
Organic matter	2.38	1.21

September 24th.

	Raw Sewage.	Treated Sewage.
Chlorine	45.3	29.7

It seems that a union of the magneto electric process with subsequent land irrigation will eventually become a method widely used in regions where the rainfall is light or unfavorably distributed.

Plans are now under way for the installation of a similar plant at Oklahoma City.

Results of Water Waste Survey at Yonkers, N. Y.

The report of the recent United States Census brought out the fact that Yonkers, New York, was one of the few cities in this country in which the revenue from a municipal water works was less than the cash operating expenses of the plant. Although all services were metered there was considerable discrepancy between the amount pumped and the total amount delivered as shown by meter readings, so the city undertook a water waste survey for the purpose of locating the trouble.

The Pitometer Co. of New York city was engaged to conduct the investigation. The amount of water flowing in any pipe under consideration was determined by the pitometer method. Pitometers were placed on all discharge mains immediately outside of the various pumping stations, the measured flow being thus the total amount pumped. By counting the pump strokes, in any case, and multiplying this by the displacement per stroke the apparent pump discharge was obtained. By comparing the apparent discharge so obtained with the corresponding actual discharge obtained by the pitometer test, the slip of the pump was determined. In this manner all the pumps were calibrated for slip and thereafter actual discharges were easily obtained by applying a correction for slip to the apparent pump displacement. The slip of one pump was 1.75 per cent. The slip of a new pump was 3.25 per cent when first tested, but after adjustment this was reduced to 2 per cent. The slip on the pump which had done the heavy work for several years reached the high mark of 18.2 per cent.

In addition to the measurement of flow near the pumping stations, the distributing system was divided into twenty districts, and the flow into each district was continuously observed for several successive days, readings being taken throughout the day and night. Where the flow into a district as measured by the pitometer method considerably exceeded the meter totals for that district further investigations were made to trace the trouble to its source. A measurement of the flow between the pump feeding the distributing reservoir and the reservoir showed a loss of 240,000 gals. per day. The city officials had accounted for much of the loss by attributing it to leakage from this reservoir. Actual measurements evaluated this leakage at 150,000 gals. a day, which in the judgment of the consulting engineers was not excessive. In all, the field investigations covered a period of ten weeks.

During the year of 1909 the average daily consumption as inferred from the pump counters, was 7,650,000 gals. per day. The consulting engineers could account for 6,020,000 gals. of the total amount pumped, which was distributed as follows:

	Gals.
Total meter registration	4,260,000
Estimated under-regulation of meters, 4%	170,000
Estimated public use	250,000
Leakage from mains (normal) at 2,000 gal. per mile	250,000
Force main leakage	250,000
Leakage from distributing reservoir	150,000
Pump slip	690,000
Total	6,020,000

It will be noted that the entire pumped supply was accounted for save approximately 1,500,000 gals. per day, or about 20 per cent of the total amount used.

During the investigation the fact was emphasized that about 50 per cent of the total metered supply was sold at 6 cts. per thousand gallons, while it cost the city 9 cts. per thousand gallons to furnish it. This 50 per cent went to five large manufacturing plants. Investigations on the premises of these industries disclosed the interesting fact that considerable water was being used that did not pass through the meter. The water so used was, of course, a dead loss to the city since all settlements were made on the meter readings as a basis. In one case the meter reading increased enough in a single day to reach the engineer's estimate of the amount used by the plant. This happened when the investigation reached the plant in question. In some cases the amount used was greater than the carrying capacity of all the known service connections. This condition indicated service connections unknown to the water works department.

The consulting engineers recommended the following innovations to improve existing conditions and to promote more efficient operation of the city water works:

That all pipes for supplying fire streams be segregated from pipes supplying water for ordinary purposes in manufacturing plants.

That the number of service connections for any plant be as small as practicable.

That large meters be used, and these to be placed in brick vaults located on city property.

That the meters be owned and maintained by the city.

That meters be large and accurate, and that the city hold duplicate meters in reserve.

That meters be so protected that tampering with them by the water consumer is impossible.

The above information has been furnished by Mr. Ed. S. Cole of the Pitometer Company.

Raising the Assouan Dam.—The Assouan Dam in Egypt, which impounds some 234,000,000,000 gals. Imp. of water, is being thickened and increased in height to give a storage capacity of 2½ times the above quantity. The original dam was 6,450 ft. long, 23 ft. wide on top, 82 ft. wide at the bottom at the deepest point, which is 130 ft., and contained about 1,000,000 cu. yds. of stone masonry. The new work consists in adding a thickness of 16 ft. of masonry on the downstream face and raising the height about 23 ft. A grout joint is employed to connect the old and the new masonry. This joint is 6 ins. thick, about 100 ft. high and about 6,000 ft. long. It is grouted in sections, as the facing progresses. The grout is mixed on the top and fed to the joints through flexible hose.

STEAM AND ELECTRIC RAILWAY SECTION

Processes of Making Steel, and Methods and Results of Testing Steel Rail.*

I expect to give this evening a very brief survey of the matter of making steel, and will then outline the work done by the Rail Committee during the past year, and end with a statement as to the conclusions indicated by the work.

PROCESSES OF MAKING STEEL.

Steel, first of all, is obtained from iron ore, which is essentially oxide of iron; and the first thing that is done is to get the oxygen away from the iron. Iron ore is essentially iron rust. The reduction of the iron from the ore is done in the blast furnace. The essential action is to take the oxygen away from the iron. The ore is mixed with coke. Intense heat is produced in burning the coke, the ore is reduced to the metallic state, and iron is secured in the form of molten pig iron. The iron is poured into a large ladle, and then into a mixer. This is for the purpose, first, of acting as a balance wheel, as it were, for the mill, and second to get a more uniform material for further operation.

There are two processes in general use for making steel. One is the open hearth process, and the other is the Bessemer process. There is still a third process coming into use, the electric process.

The process of steel production in an open hearth furnace consists of charging the furnace with limestone and ore and piling on scrap, the furnace being heated with producer gas. After two or three hours liquid mixer metal is added, and during the process of melting, small quantities of fluor-spar are added at intervals to make the slag more fluid and to assist in the melting. The process results in taking out a large amount of silicon, which has been combined with the iron in the blast furnace, and the carbon is greatly reduced. Generally the carbon is nearly all taken out and is afterwards brought up to the desired amount.

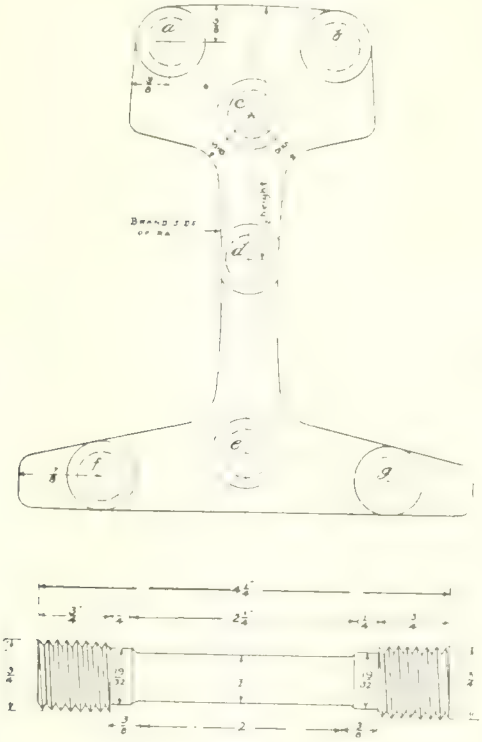

Fig. 2—Location of Samples for Tensile Test.

In the Bessemer process iron from the blast furnace is poured into a mixer, from which it is weighed into a ladle. The metal is then poured into the converter, scrap is added, and the mixture is blown with a pressure of about 20 lbs. In the process of blowing air is forced through the metal, and in going through, it burns out the silicon and carbon.

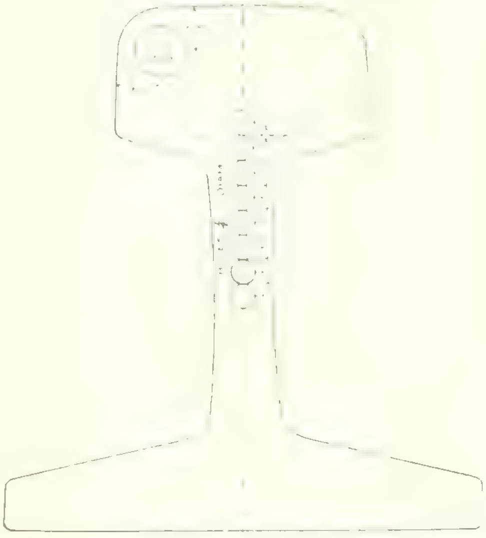

Fig. 1—Location of Samples for Chemical Analysis.

In the electric process no fire is necessary at the furnace. The fire can be kept at the power house. The heat that is generated, due to the passage of the current, is what melts the metal. In the use of the electric furnace, the metal generally comes from the Bessemer converter. The carbon and silicon have been eliminated, but the phosphorus and also the sulphur still remain in about their original amount. The phosphorus, for a high grade of steel, is too high as it exists in the metal as it comes from the Bessemer process ordinarily, which does not burn out the phosphorus. But by means of lime the phosphorus can be eliminated in this furnace. This is also true of the open hearth furnace, and a double process is used, called the duplex process; that is, the metal is first partly reduced in the Bessemer converter and then carried over to the open hearth furnace, and the purification carried on there. In this way the elimination of the phosphorus is carried through. The electric furnace does a good deal the same thing, but it is not necessary to have a fire at the furnace. It may be kept in the power house or somewhere else.

STRUCTURAL AND CHEMICAL PROPERTIES OF STEEL

I have now given a brief survey of the process of steel making, and I want now to dwell on the structure of steel and its chemical composition. First of all, steel with carbon below 0.9 per cent consists of two structural elements, iron itself, called ferrite, and another portion containing the carbon, called pearlite. These two structural constituents make up steel, as we have to deal with it in structural materials, including rail steel. Steel, therefore, can be likened somewhat to concrete. It consists of these structural elements: the ferrite, which is more or less pure iron, and the other portion containing the carbon, or the pearlite. You can consider steel as concrete, with the grains varying from less than 1/10,000 of an inch in diameter, up to several thousandths or even hundredths of an inch in diameter. With soft steel we have a large proportion of ferrite; but as we go up in the scale, the proportion of pearlite or carbon metal increases. When we get to a point where the iron is nine-tenths carbon, the whole thing is of practically a uniform structure consisting of pearlite. I might dwell right here upon phosphorus. The phosphorus does not exist in the material as a special structure, but seems to be contained in the ferrite in what is called solid solution. Now, phosphorus combined with iron makes a very brittle compound. If a certain amount is distributed in a large portion of ferrite its effect is not very marked. Its effect, however, keeps on increasing, as the carbon increases, as it becomes concentrated in a smaller amount of the ferrite, and we get a strong brittleizing effect. It seems to be for this reason that phosphorus has a more marked effect in high carbon steels than in low carbon steels.

In a diagram intended to show the proportion of the various structural constituents, with the increase of carbon, we have about 0.45 per cent of carbon, and the material consists of about half ferrite and the other half pearlite. It is in that class that rail steel comes.

The effect of the carbon on the tenacity of steel is something you are generally familiar with, and I will not dwell upon that. As the carbon increases the tensile strength increases. But as the carbon increases the ductility or the elongation of the material goes down; that is, with increasing carbon, we have an increase in the tensile strength, but a decrease in the ductility of the material.

When the ingot is poured and the steel solidifies, all the material does not stay together. The carbon, phosphorus and sulphur tend to go toward the middle and the upper part of the ingot, as ingots are ordinarily made for rails and for all structural material. Around the sides of the mold where the steel first chills, we have the average carbon in the metal. That represents the steel as it is poured from the ladle, but up toward the top there is a considerable increase in the carbon. That is true also of the phosphorus and sulphur, while in the middle and lower part of the ingot we have a small de-

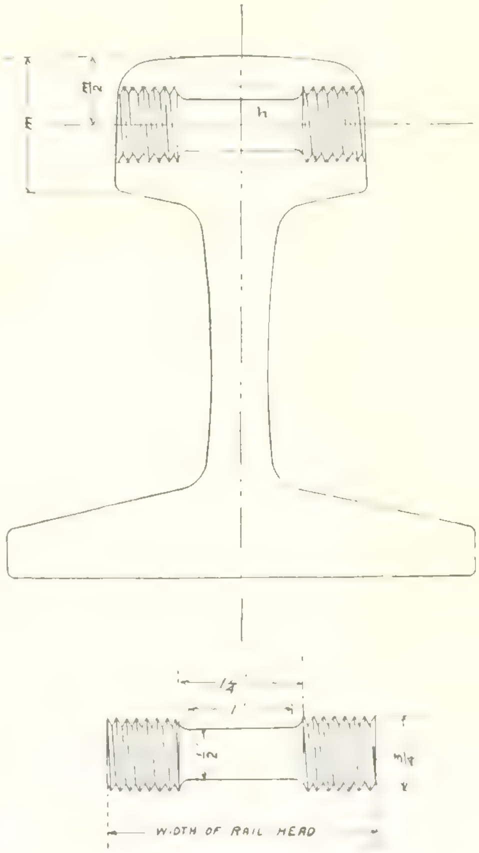

Fig. 3—Location of Samples for Transverse Test.

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*From address by Mr. M. H. Wickhorst, Engineer of Tests, before the American Railway Engineering and Maintenance of Way Association, Chicago, March 21, 1911.

[illegible] We have up at the top of the ingot what is called positive segregation and near the bottom negative segregation. The negative segregation amounts to only a few points of carbon, although it can be distinctly found by analysis; but up toward the top of the ingot in the middle the carbon may at times be 50 per cent or more above the average in the ladle. In a moderate segregation it may go up to 20 per cent.

METHODS AND RESULTS OF TESTS OF STEEL RAIL

Figure 1 shows how we took drillings for analysis from the rails which we have examined during the last year. A sample taken from the upper corner represents somewhere near the average steel, as it is poured from the ladle, and it agrees generally with the ladle analysis. We have also a series of ¼ inch drillings, on the vertical axis of the rail, all put together to make one sample. That gives what would be the segregated material, either positive or negative. We find in taking the whole rail bar that concentration of the carbon, phosphorus and sulphur occurs near the upper end at the center of the section. The manganese and silicon remain fairly evenly distributed, and show not much tendency toward segregation. The lower end of the rail bar shows a little lower carbon, phosphorus and sulphur in the center of the section.

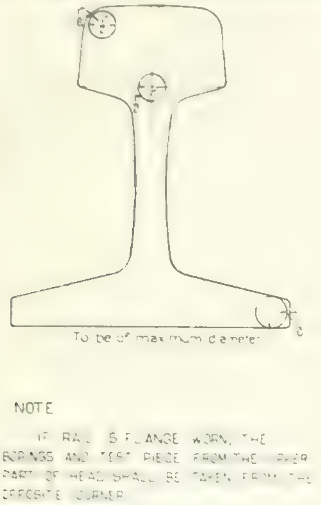
To be of maximum diameter
NOTE
IF RAIL IS FLANGE WORN, THE
BORINGS AND TEST PIECE FROM THE UPPER
PART OF HEAD SHALL BE TAKEN FROM THE
OPPOSITE CORNER

Fig. 4—Recommended Location of Samples for Chemical Analysis.

Figure 2 shows how the test pieces for tensile tests have been taken. Samples taken from the upper corner of the head, from the middle of the head, and also from the web confirm the results of the analysis. Toward the upper end of the rail bar we find that the center of the rail shows a higher tensile strength, and toward the middle of the ingot the results will be about alike in the different locations; but when we get to the lower part of the ingot, or bottom rail of the rail bar, the center of the section shows a lower tensile strength; in other words, at the upper part of the ingot the rail shows a hard center and at the lower part of the ingot shows a soft center.

Figure 3 shows how samples were taken for transverse test.

Figures 4 and 5 show the standard locations for chemical analyses and tensile test piece as recommended by the Rail Committee.

The chemical analysis of rail for special examination should be taken from at least two locations, and, preferably, from three. That is, from the upper part of the head, from the middle of the head down toward the web, and sometimes also from the edge of the base. A sample from the upper corner of the head will usually give the steel as it comes from the ladle, but a sample from the middle of the head will not represent the ladle steel, except along about the middle of the ingot.

Now, I want to dwell on some special tests we made to determine the effect of putting fire clay on top of the ingot after pouring, although the purpose at present is to show the relation of ingot position to ductility of the rail. We took two ingots and rolled them into rails making only sufficient discard from the top to permit of rolling, which was about 4 per cent instead of the usual 10 per cent.

Two rails from the top of the ingot were taken for this examination. Each rail was divided into thirds, and tests made of each third. We took samples for analysis, and tests of two pieces were made with the drop test; with the base, and with the head in tension. Sections were etched with copper potassium chloride solution. It was found that starting near the top of the ingot, about 4 per cent from the top and going down to about 10 per cent, or a little more, the phosphorus increases very rapidly, and goes very high in the center of the section. Then as we get down in the ingot, the phosphorus in the middle decreases again until at about 30 per cent from the top we strike the average ladle phosphorus. This is also true of the carbon and sulphur.

I desire to call particular attention to the diagram shown by Fig. 6, as the others were preliminary to explaining this. This shows the results of the drop test. In making the drop test, gage marks were put on the rail, and after the break we got the amount of stretch of the extreme fibres in tension. At 8 per cent from the top of the ingot the bottom fibres of the piece in the drop test, when broken with base in tension stretched about 6 per cent at the time of breakage. Lower down, at about 15 per cent, there was a very good stretch. When we get to 15 and 20 per cent, it remains constant for the rest of the rail bar.

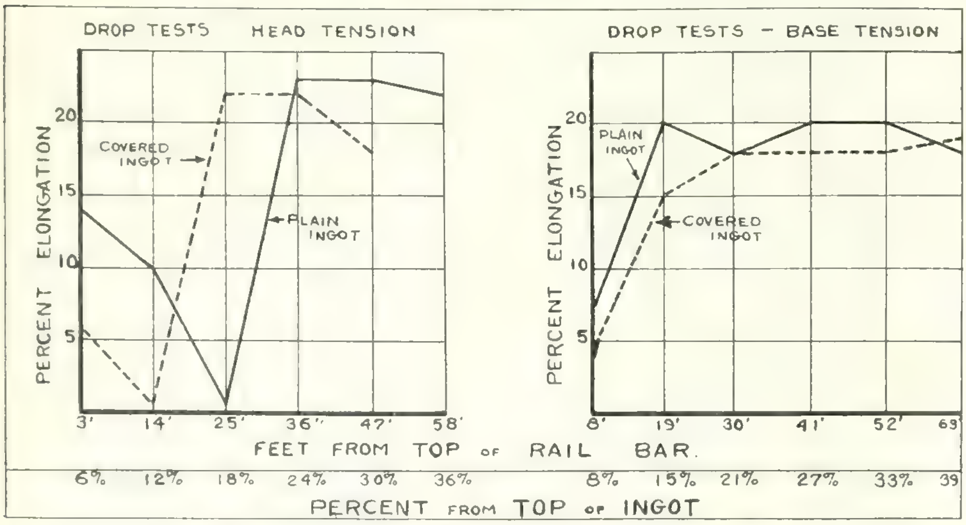

Fig. 6—Elongation Diagrams of Drop Tests.

In tests made with the head in tension it was found that at about 12 or 15 per cent from the top of the ingot, the ductility reaches a minimum—1 or 2 per cent. Then it very rapidly goes up. At 20 per cent we get good ductility. The low point corresponds very closely with the findings of the analysis as regards segregation, and also with the findings of the etching. In other tests it was shown that the break did not start where the stretch was greatest, but where we had the least ductile material.

A special machine for rail testing made by the Maryland Steel Company, called a reciprocating machine, is intended for making endurance tests of rails. It comprises a system of levers by which a loaded wheel can in effect be placed upon a rail, and the conditions of a wheel rolling over a rail simulated. By means of this machine it can be shown what thickness of head will bear up various loads. It is found that with a load of 30,000 lbs., a ⅜ in. head is not sufficient, but a ⅝ in. head will just hold up the rolling of the wheel with the load concentrated at the edge of the head. With a load of 60,000 lbs. the head had to be 1 in. thick to hold it up. With 90,000 lbs. the head would have to be 1⅜ ins. thick.

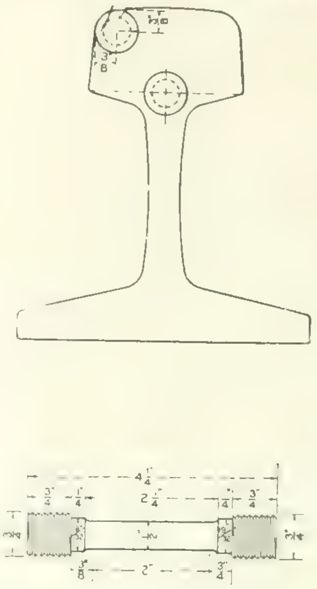

Fig. 5—Recommended Location of Samples for Tensile Test.

Figure 7 shows a split-head rail. A trackman would call it a piped rail. Analysis shows it to be badly segregated metal. The carbon in the "core" is about double what it is near the surface, and the phosphorus is high. We have, in other words, a very brittle "core," which practically has no ductility. When the load comes and spreads the rail, the outer portion is ductile, but the center portion cannot stretch transversely, and develops a crack. The cracks do not exist in the rail as turned out of the mill, but

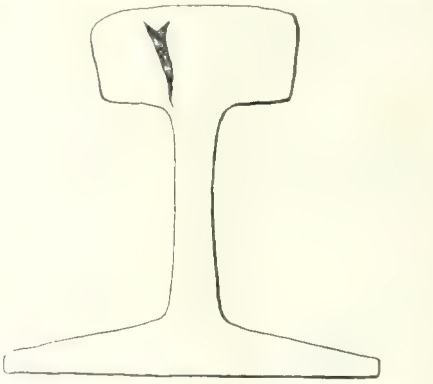

Fig. 7—Typical Split in Rail Head Due to Segregation.

develop in service. In a piped rail, on the contrary, the cavities exist when the rail is rolled.

CONCLUSIONS

In conclusion I want to explain some of the results that are indicated by our work.

The height of drop that a piece of rail will stand depends upon its position in the ingot. Starting from the top of the ingot the height that is just sufficient to break the rail, at first decreases until a "brittle zone" is reached, when the rail may only stand a few feet fall of a weight of 2,000 lbs. Passing this, the allowable height rapidly increases and remains roughly uniform for the rest of the rail bar. The heights called for in various specifications vary from 15 ft. to 20 ft. Close to the top of the ingot the rail may stand such a height, but in the brittle zone, with some makes of material, the rail may stand only 5 ft. or less. In the lower part of the ingot the rail may be able to stand heights of 40 to 80 ft. or even more. Just where the brittle zone is in different materials and with different size ingots has not been determined, but an extensive investigation should be undertaken to work this out.

When molten steel is poured into the mold the different constituents that compose the liquid mass do not stay together when solidifying, but the carbon, phosphorus and sulphur tend to collect or "segregate" toward the interior and upper part of the ingot. The region of maximum segregation seems to correspond in location with the brittle zone developed by the drop test. The tests indicate that a small amount of segregation is not harmful, but the allowable limit has not been determined.

The problem of ingot making apparently consists largely of controlling segregation as to maximum allowable limit, and as to location in the ingot so that a small discard will always remove it.

It has been shown that at least some rail failures, such as are ordinarily classed as split heads, are due to excessive segregation which results in [illegible] metal in the interior of the rail. Segregation is apt to be attended with blow holes and slag and probably all three conditions are factors in causing failures. Pipes and laminations seem to have no particular relationship to the results in the drop tests, and apparently we have not come across many failures due to pipes.

Our work in the last [illegible] months has shown fairly definitely that the matter of making safe rails is almost entirely a matter of making a good ingot, free from excessive segregation, or in being sure to crop off enough from the top of the ingot to remove the segregation. The work indicates that the thing which causes most of the trouble is excessive segregation of the carbon and phosphorus, either in itself or due to conditions which attend segregation. The object of the studies which we are now making will be to determine whether or not we can find some practice that will limit the segregation. Our idea is that we will endeavor to discover and demonstrate good practice in this respect.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Methods of Guying and Anchoring Telephone Poles.*

It is not the purpose in this article to treat the question of the construction of pole lines except in a general way, as the subject has been very ably handled by articles in the telephone journals from time to time. We will therefore treat the question of guying and anchors more thoroughly than any other branch of the work, because of the fact that we consider them to be the most important factors in the construction and maintenance of telephone and telegraph lines. To this end we will attempt to show how necessary it is for the construction foreman to have some simple and, at the same time, correct means of determining what the actual strain or stress is or may eventually be at a given point, be it on a cross corner or on a dead end, in order to safely sustain the lead when the extreme strain comes, either by the stringing of additional circuits, sleet or wind storm.

In the construction of toll or telegraph lines the practice of crossing the road in order to be free from a few trees is practically a thing of the past. The difference in the cost of construction will almost always purchase the right to trim and hang proper insulators through the trees in order to clear the lines, or purchase and remove the objectionable trees, thus obviating a bad bend or break in the line that is hard to hold and expensive to maintain.

When crossings or corners are necessary, great care should be taken in placing the anchors and guy poles and also in the proper setting of the corner poles. The best of construction, the best of wire and other material will avail but little and go to pieces within a very short time unless the lead is properly guyed.

The ordinary construction man has but little knowledge of the actual strain upon a given point, and has no means by which he can determine what is necessary to properly hold the strain at a given point. They have unquestionably gained much valuable information, and acquired considerable knowledge from years of experience, but failure comes frequently because they do not understand the enormous strain that is sometimes placed upon their work, which does not hold because they could not foresee and prepare against unexpected conditions.

In preparing the figures and facts on this subject we will quote liberally from a paper on the subject read by W. J. Stanton at one of the recent telephone conventions:

> In stringing circuits on a pole line it is necessary that the wire be pulled to the proper tension. It should be done in an intelligent manner, [illegible]
>
> Tables have been worked out and published giving the proper sag in inches for the different sizes of wire on spans of various lengths. Table I shows the data clearly which can be found in any of the standard works. To this table has been added the figures showing the strain resulting from the pulling of wires of different size of gage to conform to the table given. This provides a table of ready reference and with such data at hand the construction foreman can, by the use of a demonstrator, pull all of his wires properly and at the same time check the dip or sag by the use of a common foot rule or steel square in the usual manner.
>
> It must be remembered that the guys and anchors when placed either for a corner or a dead end must be sufficiently strong to safely and securely hold the load of the combined breaking strain of all of the wires on the lead; if this is not the case the entire work is endangered. Table II "gives the actual strain or pull to be provided for each gage of wire used. This table shows that on a pull of 5 ft. the span should not exceed 120 ft., and the strain to be provided for in guying should be for a No 6 B. & S. copper, 51.4 lbs.; for No. 8 B. & S. copper, [illegible] lbs.; for No. [illegible] B. & S. iron, 71.6 lbs.; the guys and anchors should be figured to withstand the strain of the total of all of the circuits which it is proposed to carry on the lead when filled."

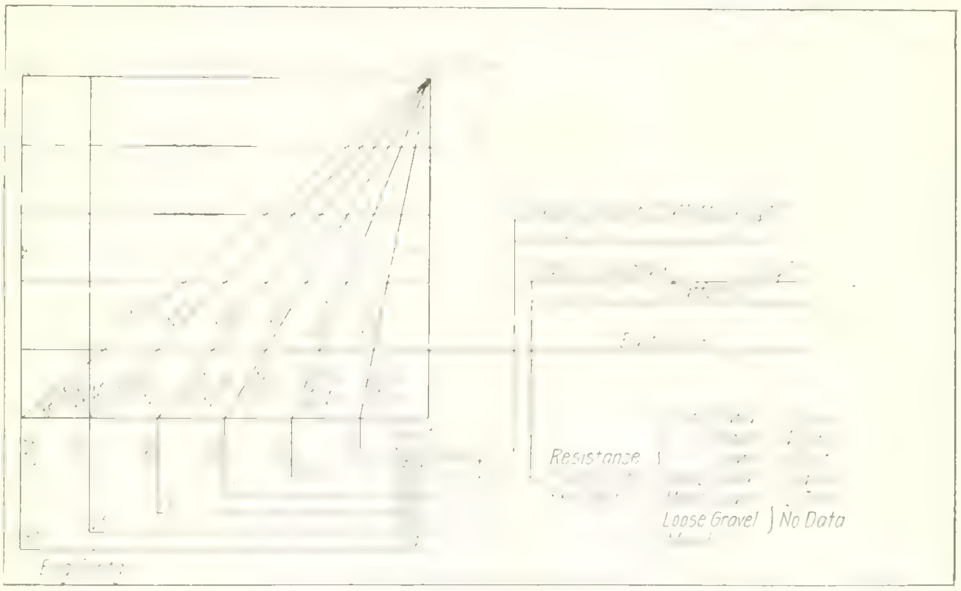

Fig. 1—Diagram for Computing Strain on Guys for Telephone Poles.

The proper placing of the anchor or deadman is of the utmost importance, as upon the anchor depends the strength of the entire structure. We frequently find a guy or anchor placed within five or six feet of the butt of the pole on an ordinary lead of five circuits.

The following results would obtain with one circuit of No. 9 iron, two circuits of No. [illegible] copper, the breaking strain would be:

[illegible]

[illegible] the strain on the guy would be 28,982 lbs. and the downward thrust on the butt of the pole would be 28,240 lbs. With the guy placed at 10 ft. from the base, the strain would be 14,491, and the downward thrust on the pole would be 14,210 lbs.

If the anchor had been placed 30 ft. from the butt of the pole the strain on the guy would have been reduced to nearly one-fourth. The same ratio holds true with the thrust on the pole.

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*From "W. & M. Telephone Wire News." American Steel & Wire Co., Chicago.

TABLE I.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Span.	
					Copper					Iron		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	10	6	9	10	12	14
[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	495	7.8
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	232.5	28.8
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	391.6	[illegible]	209.4	.....
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	180	[illegible]	[illegible]	[illegible]	174.3	.....
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	151.8	....
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	120	108.7	[illegible]	[illegible]	116.2	.....
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	99	320.1	[illegible]	[illegible]	91	.....
[illegible]	[illegible]	[illegible]	11	[illegible]	[illegible]	190.5	[illegible]	77	[illegible]	[illegible]	74.7	.....

Contraction of copper is .0000098 of its length for each degree of Fahrenheit.
Contraction [illegible] of its length for each degree of Fahrenheit
Contraction [illegible] copper on span of [illegible] for each degree [illegible] Fahrenheit
Contraction [illegible] span of [illegible] for each degree [illegible] Fahrenheit
Total [illegible] temp. drop 100 to 30 copper span [illegible] Fahrenheit.
Total [illegible] temp. drop 100 to 30 iron span [illegible] Fahrenheit
Formula for determining tension:

$$\text{Tension} = \frac{(\text{Span}^2)\ \text{weight per ft.}}{(\text{Deflection in inches})^8.}$$

A study of Fig. 1, which is worked out on the basis of a strain or pull of 3,050 lbs. at the crossarm, will show that with the anchor set 5 ft. from the pole the strain on the guy would be 15,532 lbs., and the thrust on the pole 15,250 lbs. With the guy at 30 ft. from the pole the strain is 3,955 lbs. and the thrust 2,541 lbs.

It can readily be seen that the trouble is not always with the anchor and guy, but that the downward thrust on the pole is so enormous at times as to drive it into the earth, loosening the guy and causing the guy pole to go over.

The necessity for support at the butt of the pole to protect against the downward thrust, has almost been overlooked in construction work, so that the majority of the cases of bad guying or slack corners can be attributed to this fact.

Many construction foremen will set a pole on a corner that is not square on the butt or one that has a hollow center, thereby materially reducing the surface. Figure I shows the resistance of the different soils and the necessity of planking or making a base upon which the pole should stand. A concrete base can easily be placed under the butt of a corner pole or guy stub, that will insure its permanency. The hole should be enlarged at the bottom to the desired size and a floor or base of concrete made of one part Portland cement, two parts clean sharp sand, five parts crushed rock—crusher run. The concrete should not be wet, just enough to show moisture when being tamped lightly. When it is possible the concrete should be allowed to set several days before placing the pole. A concrete base when properly placed is better than planking as it is indestructible. The use of the patent anchors for heavy guying purposes has not met wtih the best of results and the old fashioned "dead man" with a 3 or 4-in. iron washer under the two nuts will give the best results. The timber used should be sound when buried.

Care should be used in the selection of hardware and only standard and high-class materials used. Many tons of good bolts have been discarded because the threads were not standard and the nuts would not fit.

The Belle Fourche irrigation dam in South Dakota is one of the most interesting projects which the government has yet undertaken. This earthern dam will be 6,200 ft. long, 20 ft. wide on top and 115 ft. high at the highest point, and will contain 42,700,000 cu. ft. of material. The reservoir created will cover 9,000 acres.

TABLE II

[illegible]	Copper.			Iron.					
	No. 6	No. 8	No. 10.	No. 6	No. 9.	No. 10.	No. 12.	No. 14	Span
5 ft	[illegible]	[illegible]	20.3	[illegible]	38.1	31.	19.7	12.	120
10 ft	[illegible]	70.7	[illegible]	156.2	183.1	[illegible]	43.1	[illegible]	110
15 ft	[illegible]	116.7	73.3	257.8	137.2	112.5	71.2	[illegible]	100
20 ft.	274.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	64	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	96	75
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	288	...

Profitable Ethics.*

Business is war and money-making is and always has been the chief motive of all our efforts at progress. In the present organization of society it is inevitable that money-getting shall be primarily our inspiration, and indeed, it is doubtful if any other motive will ever be practicable. On the other hand, unrestricted money-making, like any other dissipation overdone, is not good for the health of the body politic.

Present management of "big business" is probably not much more efficient or freer from evils than government management, but the possibilities of individual control are far greater than those of community control and must be realized if we are to escape the latter.

Competition forbids employers doing more for their employes than their competitors; rather inclines them to do less, so that if reforms are to be accomplished, they must be accompanied by greater profits. The chief interest the employer should have in the welfare of his employes is to enable them to earn more than his competitors' employes are able to earn. All other interests are incidental and will be largely taken care of by the employes themselves if they have the money with which to do it. It is the instinctive desire of every employer to promote the welfare of his employes to the fullest possible extent as long as it does not interfere with his profits. His philanthropy and good will do not extend much beyond this.

Maximum output, lowest cost of production and highest wages can be accomplished through the accurate knowledge of what every detail of the business actually is, the determination of what it should be and the bringing of the actual to the standard and keeping it there. Every man is capable of a reasonable maximum output, every dollar spent is capable of a maximum return and when the maximum results are reached, the efficiency is one hundred per cent. The higher the efficiency, the lower the unit cost and the higher wages the employer can afford to pay as compared with competitors.

A small concern managed by a man of ability is likely to be fairly efficient because most of the details can be kept under his personal observation. As the business grows it becomes necessary for him to leave it more or less to his subordinates. In proportion as the magnitude of the business increases, the importance of the personality of the leader decreases and that of the system and organization through which he exercises his personality increases. It is through a systematic control of employes of the rank and file that he reduces waste of time and material, rather than through his personal influence over his immediate subordinates. The measure of the efficiency of an organization is the extent to which the enthusiasm of the individuals in it is maintained through the organization and not through the personality of the man at the head of it.

Few men in positions of great executive responsibility realize how little influence they exert on the business under them. It is not a serious exaggeration to say that the difference between the results obtained by an average manager and one who is known as an exceptionally able man is not material, and whether the result is good or bad is largely accidental in so far as the man in charge is concerned, and chiefly due to conditions surrounding the business.

The conventional manager depends upon cut and dried expedients rather than scientific standards or ideals. His methods are based more on superficial observation and haphazard opinion than on the fundamental laws governing his business. Failure to accomplish the results he hopes for is not, in his opinion, a criticism of his methods but rather calls forth his regret at the passing of the good old times when men were less independent and indifferent or conditions otherwise more favorable.

Under detail-control management as little as possible is left to individual judgment, but the movements of every man, every piece of material and the expenditure of every dollar are guided according to a prearranged schedule.

If the objection is made that guiding every move men make, makes machines of them, destroys their initiative, the answer is that there is not much initiative to destroy and that the best results are obtained for both employer and employes when men are worked like machines and treated like men. In large organizations they are more likely to be treated like machines and allowed to work as their own individual fancy dictates.

Most men are actuated by the fear of losing the job they have and by the hope for a better job or better pay. It is a much more comfortable feeling to a man to know that when he has accomplished definitely prescribed results his work is entirely satisfactory, rather than that, no matter what he accomplishes, his employer, in his ignorance, may feel that he ought to have done more.

It is also a satisfaction to him to know that his employer knows beyond question he is as good or better than his fellow workman. Moreover his employer has a feeling of security in that he is able to deal justly with each individual through his records rather than through the more or less prejudiced opinions of subordinate officials.

Not the least asset created by the management which has accurate record of the individual, is the impression made upon the employe that the highest officials know of him personally; that he is less subject to the whims and prejudices of his immediate superior and that he is recognized as an essential part of the organization, which arouses an enthusiasm that cannot be too highly valued.

The treatment of men like machines by dealing with them as a class and treating good and bad more or less alike, creates indifference and antagonism, and is the necessary result with conventional management.

The organization created by this control of details is of vastly greater importance than the facilities or equipment. The good organization will obtain good results with poor equipment, but the poor organization will obtain poor results no matter how good the equipment may be.

Management through control of details takes advantage of the fact that few men know how to work efficiently and few employers know definitely what they should ex-

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*Extracts from a paper by David Van Alstyne, Vice-President Allis-Chalmers Co., Milwaukee, Wis., presented before the Congress of Technology at the Fiftieth Anniversary of the Granting of the Charter of the Massachusetts Institute of Technology.

[illegible] of their empl[illegible] their money otherwise expended.

Some employes take advantage of the ignorance of their employers by doing even less than they know they could do. Time and material are wasted in an infinite number of ways and the efficiency is limited to the personal attention of those who are in charge and able to give to the comparatively few details coming under their notice. Under conventional management the foreman, or man immediately in charge, has a fair technical knowledge but usually little organizing ability. The multitude of details under his jurisdiction receive his attention a few at a time, the others drifting along, according to the fancy of the individuals handling them. The few details receiving the attention of the foreman are brought up to a standard proportionate to his skill and knowledge, and begin to drop again as soon as he returns his attention to some of the other details. The result is to confine attention chiefly to those details which seem of most importance and to let the rest drift along as they will. Hence, average output per dollar expended for labor and material is small and must continue so as long as so much depends upon the efforts of one man.

Under detail management an investigation of the possibilities of each operation and each [illegible] or foot of material [illegible] made and a standard set per unit of output. These investigations are made and the standards set by experts, each in his own line. Records giving a continuous comparison of each detail of labor and material with its standard indicate which are satisfactory and which need attention. The value of establishing a standard or measuring stick for every detail cannot be overestimated. It not only gives the manager a feeling of security in his knowledge as to exactly how his affairs stand and as to what needs his concentrated attention, but also gives his subordinates something definite to work for and arouses their enthusiasm, especially when extra pay is given for reaching the standard.

Men do not object to hard work if they are well paid and contented, and the harder they work within reasonable limits, the more contented they are.

It is not sufficient to know that high speed steel can cut four times as fast as carbon steel or that one make of file is seven times as good as another. It is of much greater importance to know that high speed steel does cut four times as fast as carbon steel and that the good file does all that it is capable of, and that they continue to do so as long as they are used.

It may seem that the expense of such details will not be justified by the results, but this argument is not used very long after the effort is made. The results are usually beyond expectation and the returns frequently as high as 1,000 per cent on the investment necessary to obtain them. It is probable that the profits of the average railroad or manufacturing concern can be increased from 25 to 100 per cent.

The fundamental principles in reaching high efficiency are:

1st. Records.—An accurate record of each detail, or group of details, of labor and material. A record should be looked upon as a working tool and its value measured by its capacity for producing lower cost and greater output.

2nd. Standardized Conditions.—This involves putting the equipment into such condition as will make maximum output and most economical operation possible.

3rd. Standardized Quality.—The determination of a standard of quality of output or efficiency of service below which it is not permissible to go, is necessary because efforts to reduce cost and increase output may result in lowering the quality unless systematically prevented.

4th. To find out what is to be done and how to do it.—This involves stripping the work of all unnecessary refinement, finish, material and operations, bearing in mind that what is worth doing at all is worth doing well enough for its purpose and not a bit better, and then determining the simplest and quickest method of doing it with the facilities at hand and establishing a time or cost limit.

5th. [illegible] standard [illegible] cost.—Such instructions constitute a text-book of the business and are not to be deviated from. Employes should be constantly checked on their knowledge and close observance of instructions; otherwise the instructions are rarely fully understood and are quickly forgotten or ignored.

6th. Constant comparison of actual performance with standard to see that the actual reaches the standard and continues there.—It is not essential that allowances, standards or ideals should be ultimate or represent the highest state of the art; in fact such standards may appear to be so hopelessly impossible of attainment as to be undesirable for present purposes. The standard should be set as far ahead of present practice as is practicable. The ideals of today are the only ones we are immediately interested in reaching though they may be the practice of tomorrow and it then becomes necessary to set up new ideals.

The essential thing is to see that whatever ideals are set are reached, and that, as long as they are not changed, there shall be no falling away from them.

This is the principle which is most neglected by managers and at which usual management fails. It is easy to establish rules and standards, but it is not easy to have them lived up to continuously. Unless the organization provides for comparing in detail what is done with what should be done, with mathematical accuracy, a high efficiency cannot be maintained. It is a common experience for a concern to reach a good efficiency during dull business and to drop to a low efficiency during heavy business because the management has so little control over details.

For those who have the courage to break away from some of the old traditions and conventional methods, there is an unlimited field. The difficulties are great, but the possibilities are greater. The results are conspicuously good.

It is strange but true that it should be difficult to persuade the owners of a property to accept greater profits with small investment. It is equally true that the scientific manager will find it more difficult to educate his superiors than his inferiors. Plain facts connected with the business do not count for much against fixed opinions. A proposition to invest one dollar to save ten is frequently less attractive than a proposition to invest ten dollars to save one, because it is unconventional.

Most men seem to have a genius for seeing things as they want to see them; not as they are; and for fixing their attention on non-essentials.

To make real progress, such characteristics must be overcome; and the one and only way it can be done is to show how much more profitable is a policy based on scientifically accurate knowledge.

The science of management is in a very undeveloped state, but progress is being made and another generation or two will look back upon the methods of today as exceedingly crude.

Assuming that detail-control will produce and maintain maximum output, better quality, lowest cost, higher wages and contented employes and that, as a consequence, it meets with the approval and support of employers, what results may be justified in looking for an amelioration of some of the social evils which exist today, chief of which are the extremes of wealth and poverty?

It is true that when all concerns in the same business are equally well managed, no one of them will have any advantage and the same competitive conditions will exist as before; but the next step forward will be from a higher plane.

The greater number of factories in Germany now use acetylene for welding in preference to hydrogen. This is due to the fact that it requires from three to five times as much hydrogen as acetylene to do a given piece of work.

Some Mistakes and Mishaps in Designing and Constructing Foundations for Bridge Piers.*

In presenting this subject it is not the writer's intention to deal exhaustively with the matter in hand, but rather to pick out enough important constructions to clearly illustrate the more important of the writer's experiences and mistakes, and how they were met and dealt with in their solution.

The Ohio River Bridge.—The first construction considered will be the Ohio River Bridge, a highway bridge across the Ohio River, 24 miles from Pittsburg, Pa., connecting the Boroughs of Rochester and Monaca. This bridge was built in 1895-7. The structure is of the suspension type and consists of one 22-ft. roadway, one 6-ft. sidewalk in the clear, and two street car tracks; the total length is 2,240 ft. made up of a channel span, 800 ft., two suspended arms 400 and 416 ft. each, and 824 ft. of viaduct.

The Rochester abutment and pedestals are of ordinary construction, artificial anchorages had to be provided, and two channel piers built in the Ohio River. The anchorage on the Rochester side was 40 ft. long, 36 ft. wide and 28 ft. deep, the excavation being carried down to firm gravel, 21 ft. below the ground line. The anchorage, built of the same dimensions, on the opposite, or Monaca side, was on top of the gravel bank. On account of the unequal bank pressure a triangular nose, 15 ft. on the base, extending across the face was added to the rectangular anchorage, which rested on compact gravel foundation. The two channel piers are composed of Beaver Valley sandstone shell and concrete centers, supported on pile foundations.

The usual method of river pier construction up until this time was to dredge out the river at the proposed pier location from 6 to 12 ft. below the bed of the river to hard gravel, construct a timber grillage of 12x12 in. lumber, laid on courses at right angles, of desired width and length, and built up in thicknesses varying from 4 to 8 ft. of solid timber. On top of the last course of timber 3-in. plank were firmly spiked, and calked, and upon this deck an open caisson or box was built and made water tight, in which the masonry for the pier was placed. Usually a timber grillage complete and ready for the masonry floated at the level of the top courses, or if built of hemlock, from 1 to 2 ft. out of the water, and, as Beaver sandstone weighs about 140 lbs. cu. ft., and fresh river water 62½ lbs. per cu. ft., an even course of 2-ft. stone would sink the grillage nearly 4 ft. if the caisson were filled solid with masonry, which is never done with masonry construction, as it would not permit of pointing the masonry afterwards. As it was impossible to dredge out the foundation footing perfectly level, the writer never succeeded in landing a grillage foundation level, and if a list developed before the top of the masonry was above Pool Full, or low water, as the case might be, it was built out under water, and if otherwise it was built out gradually above water level, but the list at the water level was there, unavoidable, unmechanical and an eye-sore.

These and many other similar conditions, coupled with the fact that an uneven settlement in a suspension bridge must not be allowed, led the author to adopt piles instead of a gravel foundation, and a substantial concrete center instead of the common practice of cut stone ashlar for the face and stone and spalls for backing in the center of masonry pier construction. As it had been my previous practice in the erection of bridges to load selected piles to 50 tons, or over, without detecting weakness, it was then considered good practice in construction of bridge foundations to load selected piles practically one-half that amount, so do not be surprised when you learn that the load per mile for the 119 piles in the channel pier of the Ohio River Bridge is [illegible] load

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*A[illegible] E. K. Morse, M. [illegible] C. E., Consulting Engineer, Pittsburg, Pa., before the Engineering Society of Western Pennsylvania.

load above, and 65,000 lbs. per pile for the combined moving and static load.

The piles were selected white oak and pig nut, 15 to 18 ins. in diameter at the top, not less than 9 ins. at the bottom, straight and sound; the driving was in compact gravel and the distance driven to cut-off averaged about 12 ft. No unusual difficulties were encountered in constructing these two piers.

The contract for the substructure was let in the autumn of 1895. The materials specified were as follows: Stone: Beaver Valley standstone; cement: Hoffman brand of New York Rosendale; mortar: 1:2; concrete: 1:2:4 (broken stone).

Work was not started on the Rochester anchorage until fall, and owing to bad winter weather prevailing when the contractor was ready to begin concreting for the anchorage an American Portland cement was suggested, and, after considerable misgivings, the Vulcanite Portland cement was selected, a new American cement of unknown and untried qualities; the first car shipped into this section was delivered at Rochester and put into the Rochester anchorage, mixed 1:3:6, and the upper half finished with Vulcanite cement. About the same time the Monaca anchorage was started and the lower half constructed of concrete using Vulcanite cement, but about the first of March the weather was considered warm enough to change back to the specifications and consequently the upper half was finished with Hoffman cement. April, May and most of June were cold, wet months. The cement in the anchorage on the Monaca side, after taking its initial set, refused to harden during the month of April. The Board of Directors ordered it removed, and the author refused to do so, claiming the concrete was well mixed, put in according to specifications and would harden in process of time. The contractor for the superstructure would not need this anchorage before July or August and the removal of the concrete involved considerable money. The author's resignation was demanded and all kinds of trouble developed, but after about six weeks of the most miserable experience of his life there were a few warm days and nights the latter part of June, and before any of us knew it, the concrete in the Monaca anchorage had hardened up and all hard feelings were history.

In February, 1897, the bridge was turned over to travel, and on the 21st there was a 29-ft. flood in the Ohio River, which scoured under the upper half of the channel pier on the Rochester side to the extent of 9 ft. below the cut-off, or 9 ft. below the bottom of the timber grillage, and deposited the gravel scoured out just below the lower end of the pier. This alarming condition of affairs was not known until after the flood had gone down and the bar thus formed below the pier showed above the water. The author was called to inspect the pier and a half hour spent in making soundings revealed the fact that above the upper half of this pier the river had scoured to the depth of 9 ft. below the cut-off, and at a point where the piles were only driven, on the average, 12 ft. below the cut-off. Fortunately several scows loaded with gravel were tied up at the Rochester wharf, which were immediately dumped in front of and around the upper half of the pier where the scour had taken place, other scows of gravel were brought from Pittsburg, and, after the hole had been filled up, level with the bottom of the river, small boulders were placed as evenly as possible around the nose, and upper sides of the pier. No further trouble has been experienced, neither has there been any settlement detected or the slightest crack developed in the joints of the masonry. The company had been urged to place rip-rap around the piers the fall before, but felt it was a waste of money. It may be noted that the low water line is 18 ins. below the top of the timber grillage on the pier on the Monaca side of the channel. This was done simply to save money, and with the full knowledge that the underflow from the river and bank were sufficient at all times to keep the timber grillage under water. In the fall of 1896 the extreme low water up to that date was established and at a time when the low water was 18 ins. below the top of the timber grillage, a test trench 3 ft. deep was dug out to the then extreme low water a distance of 150 ft. The water flowed freely out of the ditch from the excavations around the grillage, but did not expose the top of the timber.

Denny Bridge.—During the month of May 1896, Mr. F. E. House, chief engineer of the Bessemer & Lake Erie R. R. turned over to the author the complete charge of designing and constructing the substructure of the railroad bridge across the Allegheny River, near Denny Station, 14 miles from Pittsburg. This crossing is for a single track railroad, extending from bluff to bluff of the river banks, a distance of 3,552 ft. and as the extreme height of 167 ft. from the top of rail to the bottom of the river bed in the center of the channel span demanded the best of foundations, test holes were made by drilling near the location of each river pier, and the results carefully tabulated.

If ever time was the essence of a contract, it was on this work, and nothing was spared to save time. It was, therefore, thought best to rush to completion the two piers in the river, and follow up with the two shore piers, and the one on Fourteen Mile Island. The piers were located as follows: Pier No. 1 in a corn field; Pier No. 2 in the back channel; Pier No. 3 on Fourteen Mile Island; Pier No. 4 in the river near Fourteen Mile Island shore; Pier No. 5 on the left shore;

The drill holes showed the following formations: Pier No. 1: Rock at a depth of 18 ft.; Pier No. 2: Gravel and sand; Pier No. 3: Gravel and sand, Rock at 22 ft.; Pier No. 4: Gravel and sand; Pier No. 5: Shale at 9 ft. and rock at 16 ft.

The crib style of construction was decided upon around piers No. 2 and No. 4, the deepest water being at No. 2, where there was only 4 ft. at low water. It was also decided, where possible, to drive piles, cut and capped with 12x12-in. oak timbers, concreted around and up to the top of the cap. At piers Nos. 1, 3, and 5, where rock was expected, excavation was to be carried down to the rock.

Pier No. 2 was started first and completed during the spring of 1897 and while preparations for No. 4 were being made, excavations for No. 3 were started, and, to everyone's surprise, cemented or hardpan, gravel was met with under 21 ft. of soft loamy sand and gravel. A jumper drill hole showed the formation to be over 8 ft. thick, and No. 3 pier, 87 ft. high, was built on this foundation, without a sign of settlement. Pier No. 4 followed No. 3, and was built during the same winter, 1897. At one time during the latter part of January some 20 ft. of No. 4 was laid in weather from 1° to 7° below zero, with the outside of the pier frozen solid, the concrete core apparently not taking its initial set. The author saw an inch pipe, 16 ft. long, pushed by hand its full length into the mushy concrete in the center of this pier. Something had to be done, and no one knew what was proper. Vulcanite cement was specified, and the tests made at the site were entirely satisfactory. It was finally decided that the contractor should cover the masonry with two large tarpaulins, and turn steam under them during the night, and see if thawing out the masonry shell would help matters. By morning the masonry was warm, and the concrete in the center had started to harden so nicely that the steam sweating was kept up 24 hours longer, when work was started again. No further trouble of this nature was experienced and when it came to pointing the masonry the following summer, it was found that the mortar in this pier could not be removed and cleaned out as easily as in the other piers, so hard had been the set.

Excavation for pier No. 1, located in the corn field was considered as simply a question of digging down 25 ft. to rock, which showed in three drill holes to be nearly the same elevation on each shore, and was verified in exposed rock formation on the east, or left bank of the river. Instead of finding rock a semi quicksand formation was met with that gave all kinds of trouble. Finally 280 piles were driven in the hole at an additional cost of piles and extra concrete and masonry amounting to a large sum of money. If test holes had not been drilled, piles would have been designed for every foundation, except that of Pier No. 5, and the exception would have been No. 3 on hardpan. This is the only case known to the author where a hardpan gravel formation has been met with underlying an island in the middle of a river.

The error was in not having test holes drilled at distances not to exceed 200 ft. apart from shore to shore. At drill hole No. 1 and 4 the rock drilled into was, no doubt, one of the many granite nigger heads so frequently met with in excavations for No. 2 and No. 4 piers, deposited there during the glacial period.

Port Perry Bridge.—On the last day of June 1897, the organization at Denny was moved to Port Perry on the Monongahela River, 14 miles above Pittsburg, to take full charge of the construction of the foundations for Carnegie's Hot Metal Bridge, connecting the furnaces at Bessemer with the Homestead and Duquesne mills. Mr. F. E. House, chief engineer of the Bessemer & Lake Erie R. R., and consulting engineer for W. H. Smith, chief engineer of the Union R. R., decided that test holes drilled the same as at Denny were quite the proper thing, and the author's instructions were to proceed and put down four holes all in the river, which, as anticipated, showed gravel and sand formations. The plans approved by the War Department called for seven piers. The first, pier No. 1, was located on the right bank of the river, or the Bessemer side, on the shore line 46 ft. from the south bound track of the P. Mc. & Y. R. R., and pier No. 7 on a sand beach on the left bank. The plans and specifications called for a pile foundation, cribbing, and back fill sufficient to set the masonry below the Pool Full line, which was to be kept dry at least 24 hours before allowing the water to cover it. The object to be attained was to cut the piles by hand at the desired elevations, capping them and concreting around and up to the top of the cap, upon which pier masonry would be laid.

Pier No. 1 was excavated and the hole kept pumped out. Excavation was started in pier No. 7 at the same time, as it was planned to get the foundation in and up to the top of the ground while dredging, pile driving, and cribbing were progressing on the river piers.

Pier No. 6 was gotten ready first, and an attempt made to pump it out without results. On account of the double Wakefield sheeting leaking, gravel and sand were dredged and deposited up and around the outside of the sheeting, first to a depth of 9 ft. and later to Pool Full, a depth of 18 ft., and with pumps of a capacity of 16,000 gals. per min., running for hours, the water in the inside of the crib could be lowerer only 2 ft. below Pool Full. Beautifully filtered water boiled up through the gravel formation of the bottom. An attempt was then made to seal the bottom by depositing a few feet of concrete (deposited through a pipe lowered down to the bottom of the hole and moved about by a driver), expecting to place about 2 ft. of concrete evenly over the whole bottom. It was discovered at once the concrete lowered through a pipe washed sufficiently to allow the cement, sand and gravel to segregate, and the results were so poor that the attempt to seal the bottom was abandoned. Pier No. 6 was abandoned and piles for No. 5 driven, cut off under water by power, concrete lowered and placed around the piles by marine bucket, and the concreting pushed night and day. All unevenness of the concrete above the tops of the piles was leveled off by dragging a heavy I-beam across the concrete while green, and as soon as it had hardened, a timber grillage was sunk upon this foundation, and the masonry brought up to Pool Full, by means of open caisson with such good results that it was decided to construct all the piers, wholly within the river by this method. The sheeting and filling on the lower half of No. 6 was removed, and piles driven, cut and concreted the same as No. 5, and afterward a caisson was floated into position and sunk as in the case of No. 5, No. 4 and No. 2.

It had been the practice in constructing a grillage to first use 12x12-in. white pine timbers, later hemlock throughout. The great weight of the masonry, steel work and moving load concentrated on tops of the piles frequently caused an uneven crushing of the bottom timbers of a grillage with the result that this uneven settlement either developed cracks in the body of the masonry or a list in the whole pier, which had to be built out. It occurred to me that the crushing of the soft timbers of the grillage over the top of a hardwood pile could be overcome by adopting the plan of using 12x12-in. oak timbers for the first or bottom course of the grillage, which completely corrected the trouble.

It had been customary up until this time to mix concrete so dry that it required hard tamping to bring water to the surface, but on No. 4 the mix was made sufficiently wet to flow, and disturbed the cement manufacturer to such an extent that threats were made that shipments would be stopped if such abuse was not immediately corrected. The discussion grew so warm that it was decided that it would be tried out in the following manner. For a distance of about 10 ft. above Pool Full in pier No. 5, the concrete in the center of the pier was mixed just wet enough to show water on the surface after ramming, and in No. 4 the concrete for an equal distance above Pool Full was mixed so wet it flowed and would not support the weight of a man. These two piers were then allowed to season for about two weeks, and the agent for the Portland cement invited to come from Philadelphia to Pittsburg and decide for himself. His decision was "Well, this is astounding." He had seen the cement go into pier No. 4, had marked the work and knew there had been no deception.

The condition of the concrete in No. 4 was by far superior to that in No. 5. Apart from the fact that there could be no voids in concrete mixed so wet it had required no labor for tamping, usually two men to each pier under construction, and it was just that much cheaper to the contractor, an item that no engineer must allow himself to neglect, which is always due the contractor, and which if willfully refused reflects cowardice and dishonesty on the part of the engineer. All concrete thereafter was mixed wet.

One morning after No. 4 had been carried up to an elevation about 15 ft. above Pool Full, great fissures and cracks extended diagonally across the top of the pier, and down each side to water's edge, opening a few joints, but in most cases breaking the stone, plainly showing the pier had broken its back. There was nothing to do but to remove the stone and concrete, float the caisson and send a diver under the grillage to discover the cause of the trouble. When it came to removing the concrete that had been put into position wet, though comparatively green, it had to be dynamited. As soon as the caisson floated the grillage about 2 ft. a diver was sent down, and reported that a pile had found its way under the grillage just before landing same on the piles, and that it was located near the center of the foundation. The grillage was strong enough to support the masonry until the full weight of the masonry in the air crushed the timbers over the pile. The contractor had his diver examine the condition of the hole and piles for No. 4 just before the caisson was floated into position, and the laying of masonry in same started, but the mistake was made in not sending the diver down again just before drawing the plugs of the six or more 3-in. holes in the sides of the caisson through which the water is allowed to flow freely, and in a few minutes sink the caisson into position on the piles.

The current in any of our rivers is sufficient to roll submerged timbers into the holes dredged out for such foundations. In this case it was one of the contractor's own piles that had gotten away, sunk and was probably washed under by his tow boat, which was constantly delivering materials.

The design for pier No. 7 called for 20 ft. of excavation. After about 12 ft. was excavated a semi-quicksand was met with that proved too interesting for the contractor. The hole inside the cribbing was 20 ft. wide by 84 ft. long. Repeated efforts were made to pump out the crip sufficiently to enable the excavation to proceed. Quite often the bottom would be exposed for a few minutes, only to have the water boil up all over the bottom, and then suddenly stop, only to break out in a few minutes at some other point. The problem was finally solved by driving all the piles for this pier (176) from the top, sheet off the pier into four equal compartments, pump out one at a time sufficiently to complete the excavation, cut off the piles, clean up the rubbish, cap the piles and concrete up to the top of the caps, and in this way possession of the pier was gained, and the balance of the pier completed according to the original specifications.

The question may be quite properly asked, did the author ever have any river masonry built in exact accordance with his plans and specifications, the answer must be emphatically, No! The contractor could have been forced to build all seven piers for the Port Perry bridge in exact accordance with the plans and specifications. The result would have been that a fortune would have been sunk in the foundations. The commercial value to the railroad company would not have been any greater, a year longer would have been required to complete the bridge, and as it turned out money was actually saved by changing the plans and specifications to suit the conditions met with in actual construction, for it was not until then that it was clearly shown that the old channel was close up along the left bank of the river, and not over on the right side where the Government locks are located. Shallow water is now met with where once there was a channel from [illegible] to 30 ft. wide. This soft fill on the left side is what caused most of the trouble. There is no denying that the author's plans were also at fault in specifying such foundations so long before the days of steel sheet piling.

The originally desired results would easily be obtained today by dredging out to the required elevation, driving piles, sawing them off under water, and then driving modern steel sheet piling around the piles as driven and cut off, and depositing material from the bottom of the river around the outside of the steel sheeting up to Pool Full, and finally placing from 4 to 6 ft. of concrete around the piles with marine bucket, thereby forming the base, or first footing course of the pier, pumping out the water in the inside after the concrete had set and completing the masonry with ease and precision.

Mosgrove Bridge.—There is a hard sheet of gravel about 3 ft. thick in the bed of the Monongahela River for a distance of 55 miles from Pittsburg, under which the formations are alternately soft and hard down to rock. In the Allegheny River, however, the condition of the river bed is compact gravel with boulders from the Ohio River to Oil City, 133 miles. There is a decided ground flow, below the bed of the river, of hard water, due to the many beds of limestone throughout the length of the river, together with frequent indications of more or less extensive deposits of soluble silica, which may be the explanation of the tendency towards hard pan gravel so frequently met with.

Although there were no such beds of hardpan met with in the construction of the substructure of the B. R. & P. R. R. bridge across the Allegheny River at Mosgrove, 55 miles from Pittsburg, as at the Denny Bridge, it is, nevertheless, interesting to review the experiences on that work, especially the river pier masonry.

Excavation for pier No. 2 was started in July 1898, and carried down 11 ft. below the bed of the river. Sheeting was started, but the contractor discovered that the gravel was literally glued together, stopped the sheeting about 5 ft. below the surface, and never drove it any further.

Although the excavation was carried 4 ft. below the bed of the river in the channel, there was scarcely any water in the hole. During the driving of 288 piles for this foundation the constant jarring never sluffed down any of the 6 ft. of exposed gravel on the sides and ends. This cheese-like condition and action of a gravely loam foundation, out of 72 piers built within a radius of 60 miles, from Pittsburg, stood up under rough treatment as no other had. You will also note the ground flow was not in evidence. At pier No. 3 in shallow water the conditions and results were the same.

Pier No. 4 was located at the front of a rapid riffle in two feet of water at low water stage. A rough log crib was built around the proposed pier, outside of which piles were driven supporting a timber frame and sheeting, all back filled with gravel about 6 ft. above the bed of the river. No trouble was experienced in keeping the water pumped out and excavating to the specified depth of 11 ft. below the bed of the river, and notwithstanding the gravel removed was so compact and the excavation so difficult, the chief engineer ignored good advice and decided to have piles driven and his instructions were followed. The piles in the first row were driven only 5 or 6 ft., the driving was hard, the piles when released from the leads of the pile driver would not stand alone, and were actually nailed together, and braced to the cribbing until cut, capped and concreted level with the top of the caps. The hard pounding necessary to drive the first row of piles so shook up the compact gravel that the balance of the piles drove easier, the heaving up of the gravel became greater, and a splendid foundation was converted into one no better, if as good. Considerable money was expended for piling and the additional concrete base that should have been saved. There are times in one's life when one is the sledge and gives the blows, there are also times when one is the anvil and must gracefully receive the blows.

Thirtieth Street Wall.—After completing a wall along the right of way of the P. McK. & Y. R. R. and by the Jones & Laughlin Steel Co. double storage mill at 30th St., south side, and while foundations were being completed for expensive machinery, it was decided to make a direct connection under the retaining wall, the main line tracks of the P. McK. & Y. R. R. and their Thirtieth St. yard to the Monongahela River for sewage and water.

There was nothing out of the ordinary in laying the sewer and water pipes until the excavation reached the inside, or mill side, of the above mentioned masonry wall, when a bed of black sand of a semi-quicksand tendency was met with that was too soft to excavate and finally flowed so freely that a centrifugal pump handled it like so much muddy water. The contractor was warned against removing this soft sand, but remarked that he was responsible for the integrity of the wall, foundations, etc., and if they were damaged he would make them good. Additional centrifugal pumps were connected up, and, after pumping out sand and water for about 48 hours, the wall and foundations for a radius of about 50 ft. all slowly settled about 3 ft. An expense of not over $100 in driving 3-in. plank sheeting would have saved the contractor several thousand dollars. This case is especially interesting in pointing out to the younger engineers the impossibility of specifying with absolute certainty what material will be met with in construction of substructures. Here was a case where the author had been several years personally designing and looking after all kinds of foundations, some of them massive, all around this site, and, yet, at the least expected place a bed of semi-quicksand was met with, that with the addition of water was actually made soft enough to remove by centrifugal pumps.

Vesta Coal Company Works.—The rapidly increasing demand for blast furnace coke necessitated the Jones & Laughlin Steel Co. opening up Vesta Mine No. 4 on such lines of permanent construction and capacity of output as had never before been attempted in this country. Everything was built to last forever and then some. The main entrance was two miles from the river front. Apart from one slight curve it was an air line of tunnels, bridges and viaducts. The experiences with small foundations, slips, creeping hills, broken roofs in old workings, etc., met with in these two miles, was sufficient in itself for a paper, but as your attention has been confined principally to river pier construction, it will be confined in this case to the river pier at the tipple for crushing and loading the coal into barges ready for towing to the works in Pittsburg. This pier is situated on the left bank of the Monongahela River at California, Pa., 50 miles from Pittsburg.

This pier designed large enough on top to accommodate engines, crushers, motors, etc., besides supporting an elaborate steel tipple, which required a pier 20 ft. wide by 60 ft. long on top, with the river face smooth and vertical, and the first offset 10 ft. below Pool Full in order to always provide ample clearance for floating craft fully loaded. In order to accommodate the maximum number of empty and loaded barges, the pier was located on dry ground wholly within the shore line, necessitating cutting into the slope. The center of the pier was located 100 ft. from the center line of the north and southbound tracks of the P. V. & C. R. R., and the cut-off of the pile foundation for the pier 54.8 ft. below the top of the rail. The railroad tracks were 34 ft. above Pool Full on natural ground, composed of sand for the first 12 or 15 ft., and stratifications of clay and sand to the water line, a bad omen. Every contractor bidding on this work was well aware of the fact that trouble could safely be predicted, as it was a shore pier, on account of the geological formation and because the Pennsylvania R. R. tracks were laid on the very edge of the bank, with a sharp curve towards the river, and a bad grade at this particular point.

The company had even invited each bidder to estimate on a V-shaped permanent pile fender to be driven on the slope of the river bank. Everything went smoothly until the dredging was nearly completed, when the resident engineer saw the material dredged out, black sand and gravel, did not materially reduce the depth of the hole; the material was flowing in as fast as it was being dredged out.

The V-shaped fender of piles had been put in the specifications by the advice of the author with the full belief this device would effectually prevent any caving away of the bank while putting in the pier. The contractor was to assume all responsibility in sinking the foundation and incorporate in his bid any additional protection he saw fit, which was written in both the specifications and contract, and written notice given at the time proposals were asked, which is quite the exception.

It was perfectly plain the dredge had reached a dangerous bed of semi-quicksand. The contractor's attention was promptly called to the danger, but with no effect and the dredging proceeded. About midnight the second day following, without a moment's warning, the dredge boat was shot half way across the Monongahela River. The whole bank slid into the river, four gondolas loaded with stone on a siding back of the pier site were buried in the hole, the northbound, main line, track was gone, the southbound track was undermined, sand, stone, gravel, cement, timbers and tools all were dumped with the gondolas into the river.

After weeks of wrecking and dredging out the tangle, together with great loss to the contractor in time, material and three gondolas never recovered, double sheeting was driven on the bank side, and a strong framework of piles, timber and sheeting was placed on the two ends and river side. The site was then excavated down to the proper depth, and the pier completed according to plans fully six months after it would have been had the contractor driven sheeting around the hole and acted promptly on the friendly advice given him when the flow of semi-quicksand was first discovered. Simply because he had never had any experience of his own he would not listen to what had been the experience of others under like circumstances. Fortunately this is the exception, rather than the common practice of contractors.

The Newell Bridge.—The habit of traveling, or rather the cultivation of the habit, was never better illustrated than in dividends from the construction and turning over to travel on July 4, 1905, the Newell bridge across the Ohio River, connecting the Borough of East Liverpool with the bluff on the opposite side of the river.

In excavating for the artificial anchorage in Liverpool, hardpan gravel was found about 5 ft. above the elevation intended for the bottom of the foundation. A careful examination showed this formation was about 3 ft. thick, extending over a considerable area. Concreting was started from the top of the hardpan with excellent results and considerable saving of money. The channel span was 750 ft. c. to c. of the two channel piers. The pier on the Ohio side was on a bar uncovered at low water. The foundation consisted of piles driven and cut off 2 feet below the gravel bar, and well concreted around and up to 2 ft. above the cut-off, upon which a masonry shell and concrete center pier was built. The rock was exposed all along the shore on the West Virginia side and soundings showed level rock bottom at the site for the channel pier on this side of the river. The plans were drawn for rock bottom construction.

Double cribbing, 3-in. plank sheeting, and suitable fill between and outside same were made, preparatory to pumping out the crib and starting the foundation courses. When the water was pumped out, and the bed of rock exposed, it was discovered that the bed of the river was as nicely paved with large flat stones as any of the stone paving in the streets in older New Orleans, or of the old Roman pavements. The stone averaged about 16 ins. square by 12 ins. thick, closely laid, smooth and even on top, just the same as if the Romans some day had paved and used the bed of the Ohio River for a great highway, a second Appian Way. There was nothing to be done, but to remove this paving, under which was an irregular formation of smaller stones, sand gravel and mud. Solid rock was obtained on the upper end 5 ft. below the paved bed of the river, and 3 ft. on the lower end, the stratification of the solid rock dipping about 10° down stream.

The only explanation for this unexpected, and certainly unlooked for formation the author can make is that he personally sounded rock with a 1-in. rod, not only at the site of the pier but all around it. The ring of the steel sounding rod unmistakably indicated rock, yet, later developments showed a pocket in the real rock which had been filled up with stone, sand and gravel irregularly placed in ages past. Blocks of stone had slid along the rock bottom above the pier site until finally one after the other the heaviest blocks had become wedged together, which formed as nice a piece of paving as if done by skilled mechanics.

Jones & Laughlin Steel Company's Hot Metal Bridge.—In 1887 the Eliza Furnaces were connected with the mills on the Southside by the construction of a single track railroad bridge across the Monongahela River, in the city of Pittsburg.

During the winter of 1900, it was decided to extend the piers down stream sufficiently to allow the old bridge to be double tracked, and also accommodate a single track hot metal bridge; the former connecting the two yards at grade, and the latter elevated in the Southside mill yard. The bottom of the foundations of the old piers had been originally about nine feet below the bed of the river, but owing to constant encroaching on both sides of the river, the bed of the river in the channel had scoured until the bottom of the river was two feet below the bottom of the timber grillages of the channel piers. The plans for the extension called for river pier masonry on pile foundation.

The rip-rap protecting the old piers was removed from the lower half of the piers down to the bottom of the grillage, piles driven and cut off at proper elevations and open caissons floated into position and landed close against the grillage of the old piers. As soon as the new masonry was brought up to Pool Full it was arched over to the top of the last footing course of the old masonry, and the new masonry built against but not joined to, the old piers, and completed according to plans. Of the six new piers, four were entirely within the river. No trouble was experienced though there was one item worth your attention, and shows why no two foundations in the same bridge are exactly alike. Several piers had been completed without more than ordinary care being used, and with no more than the usual amount of trouble always met with. The piles were driving hard clear across the river. The pile driver had finished the upstream half of No. 4 pier using large, straight, carefully selected white oak and pignut piles, today specifications read, "Any hardwood piles that will stand driving" when without the slightest warning a spot was encountered, so soft that the 40 ft. piles literally sank out of sight.

Longer white oak piles could not be gotten in the market and after doubts and misgivings, the contractor was allowed to substitute long leaf yellow pine sticks 18 in. diameter by 60 ft. long, almost without taper, driven home, first passing through about 12 ft. of soft material and then averaging 12 ft. more in compact gravel.

Summation.—Only enough foundations have been described to clearly demonstrate some of the more common mistakes, experiences and methods of construction, trusting that the younger engineer may be spared from duplicating them. We often hear and read of the successes, but no one enjoys explaining his errors, and perhaps the author would not do so now were it not that he feels it a duty to the Society, which has so honored him. Be this as it may, condiitons are so constantly changing that the greatest of our experiences are all too soon classed as history. Twenty years ago all piers within the 60-mile limit, especially in our navigable rivers were placed in position by dredging out the bed of the river, constructing a timber grillage and landing same by the open caisson process. On account of the unsatisfactory results due to uneven settlement causing unsightly listing of the body of the pier and opening of joints, this method gave way to the method of dredging out the hole as formerly, but driving and cutting off piles and landing the timber grillage by the open caisson process, which was universally adopted in deep water and navigable streams, from about 1896 until 1905. The rapid rise in the cost of hemlock timber and the desire of the engineer to be foremost in reforestration, led to the substitution of a concrete base for the timber grillage.

The introduction of steel sheet piling enables the contractor to drive it around wooden piles, that have previously been driven and cut off, or driven by follower to a close approximation of the cut-off elevations, forming the desired rectangle for the concrete base. The day has come when the concrete pile in this style of pile foundation will take the place of the wooden pile, and it can be easily accomplished with perhaps the necessity of using one wooden test pile to determine the exact condition of the formation of the river substratification. Steel sheet piling has been a great step forward in that it will stand driving where wooden sheeting would fail, that it is comparatively easy to drive it to a true line in closing the rectangle for the base, that its strength results in a consequent saving of bracing and comparatively easy manipulation of the buckets of concrete placed in the bottom, and that the danger of collapse from added pressure of high water, and loss by being flooded out are almost eliminated. It must be admitted, however, that the first cost is considerable and the damage to sheeting great in driving through the hard gravel generally met with in local and river pier foundations, and the scrap value is correspondingly small.

Steel piling will often pass through an obstruction that would arrest wooden sheeting. On the other hand the author has seen steel sheet piling for a shore pier on the Donora-Webster bridge, across the Monongahela River, 35 miles from Pittsburg on the Webster side, the sheeting opened and lapped past in three places in blue clay, 20 ft. below the surface. In another pier of the same bridge the same weight sheeting drove through compact gravel to a true and even line without a single section opening. There should be an explanation, but the author has not had experience enough to make it, though it may be due to lack of care in driving.

Some of the best and most lasting monuments in masonry construction were constructed of natural cement in the days when Portland cement was an imported luxury. The efficient and high class of work then done was not due to a better grade of materials but was due in great part to the pride mechanics took in their work. The foreman who had charge of the construction of the concrete anchorages at Rochester and Monaca was so particular with the sand and broken stone for the mix that it was a common occurrence for him to condemn materials furnished by the contractor who employed him, he was just as particular about the men directly under him who mixed and placed concrete, as he was with the class of materials that went into the work. This condition of affairs continued in this vicinity until the use of American made Portland cement crowded out imported Portland cement and supplanted the American made natural and Rosendale cements. In the use of natural cements, time had to be given for them to set and harden, it took just so long to get possession of the work, and there was nothing else expected, but when American made Portland cement at $2.08 and $2.14 per barrel took the place of Dickerhoff at $3.50 per barrel, equally as good for all practical purposes, and gave immediate possession of the work, there was a complete change brought about in the construction of substructure work. The word was passed along the line to mix Portland cement mortar and concrete any old way as it was quickly discovered that it not only hardened in 24 hours, but got harder than the natural cement mixes. This led to a certain class of contractors cutting their prices and finally there was a general cut in all classes of masonry, and by all contractors.

It is interesting to cite two examples:

(a) The specifications for the river piers at Rochester-Monaca highway bridge called for Beaver sandstone, and the costing $1.25 per barrel, and two parts by measure of river sand. The following mixes were employed for concrete, one part by measure of Rosendale cement, two parts by measure of river sand and four parts by measure of broken stone.

These were contracted for in 1895, during hard times, at $9.50 per cu. yd., the timber grillage, stone shell and concrete center all figured in as yardage under one classification at $9.50.

(b) The river piers of the Port Perry bridge were built for the Union R. R. under railroad specifications, which were especially strict regarding the ashlar or stone facing for the shell of the piers, and called for the following mix:

Mortar.—Mix 1 part by measure of Vulcanite or Giant cement at $2.08 per barrel and 3 parts by measure of Allegheny River sand.

Concrete.—Mixed 1 part by measure of cement as above specified, 3 parts by measure of Allegheny River sand, 6 parts by measure of broken stone and two parts by measure of very fine gravel.

The piers including excavation and removal of same were contracted for at $6.85 per cu. yd., measured as in the Rochester-Monaca bridge.

The great discrepancy in the cost price per cubic yard cannot be explained by the difference of geographical location, for while the former was built 25 miles west of Pittsburg with the channel pier on the Rochester side in only 4 ft. of water, the pier on the Monaca side on dry land at extreme low water, and the freight on cement slightly higher, it must be remembered that the stone for the ashlar and concrete was quarried almost within sight of the bridge; while on the other hand six of the seven piers of the Port Perry bridge had the advantage of navigable water in their construction. Neither can the change of mixtures account for the difference.

The average price quoted for river masonry showed a reduction from 25 to 40 per cent, in many cases ending in a loss to the contractor. It resulted in a complete overhauling of the methods of construction and unfortunately introduced one requirement from the foreman and the time-keeper that has caused more annoyance and been directly accountable for more violations of specifications than all the other causes combined. It is not the necessity of reporting daily upon the amount of work done, but the pernicious habit of rating a foreman according to the daily yardage he can show. If a foreman knows that his rating and pay with the contractor who employs him depend upon the yardage, it can be depended upon that the yardage is somehow kept high, which means either slighting the work or abusing the contractor's plant, and generally both. The inspection of river pier masonry construction today is more rigid than it was in the days of natural cement, yet, notwithstanding this additional care, the workmanship is with few exceptions inferior, and were it not for the fact that the quality of American Portland cement had reached such a high standard, the finished work would be retrograding rather than reflecting the care and thought given upon design, inspection and vastly superior foundations.

Although the author has designed foundations within the 60-mile limit aggregating several hundred thousand cubic yards of concrete construction, no river pier has been constructed of solid concrete above low water or Pool Full line. This style of construction has not been cheaper than piers with stone shell and concrete core, and so long as the Beaver Valley and Mahoning sandstone give such excellent results a change to solid concrete construction is not called for, and should not be specified. The Beaver Valley sandstone does not crack, spall, or weather in place, in a river pier, while on the other hand the author has not seen an all concrete pier that is free from cracks that time only can determine the amount of resultant damage. If the concrete pier was the cheaper the engineer might be justified in substituting concrete for stone.

The argument has been made by certain advocates of reinforced concrete that a large quantity of yardage could be saved. In answer to that argument it is interesting to refer to a certain bridge across the Monongahela River with a channel span of 517 ft. 6 ins. of channel piers. The piers were built so light that the expansion and contraction in the channel span rocks the pier on the expansion end, rocks two shore piers and has broken the third shore pier at the ground line; and, as a matter of fact, the expansion and contraction of the channel span takes place at this third pier, 559 ft. 6 ins. away. This condition developed before the structure was completed, and was predicted by the author. It could have been prevented by adding two more rows of piles and six feet of width to the [illegible] the channel piers as suggested by the author. The piers, designed for a vertical load only, are so light and so weak sideways that the friction of a nest of six 4-in. rollers 2 ft. 3 in. long was actually sufficient to rock the channel pier and the two frail shore piers. A slight increase in yardage would have added needed weight and stability. There may be places where it is quite proper to save yardage; it was very unfortunate in this case.

The introduction of steel reinforcing has unfortunately been coupled with more or less [illegible] concrete. There are places such as floors of buildings, and members not exposed to the elements where such designing is good engineering. We all know that steel in inside construction acts vastly different in resisting the tendency to rusting from that exposed to the weather. My observation is absolutely the same with reinforced concrete construction, and for that reason the author has continued to reinforce plain concrete work with steel where more strength is desired and to prevent cracking, but not with the studied intention of saving money at the expense of stability.

The tendency to figure the section down to the last fraction of an inch in thickness and lay stress of argument on steel that has an elastic limit of 65,000 lbs. per sq. in., is meeting with its just reward in principle as bad or worse than frenzied financing.

Like everything else that meets with success the best results reflect painstaking, and eternal vigilance is the price of good masonry and concrete work. Some of the best masonry work done has been that laid in zero weather for no other reason than that the engineer in charge, the inspectors and contractor knew that the greatest care must be exercised, the water, sand, gravel, or stone kept warm, and the finished work protected, which resulted in uniform, harmonious action all along the line, and a uniformly excellent quality of finished work. It is wise to add about one quart of common salt per cubic yard of concrete in weather below 20° F. and after 15 years of close observation no bad results have been detected in any stone masonry, concrete foundations, or concrete pedestals and walls where it has been used. Concrete work can freeze solid after it has taken its initial set and before hardening, thaw out in the spring and harden up without suffering any loss in strength, provided it has met with no shock, such as blasting, etc., during the hardening process. A stinging blow of an 8 to 10-lb. sledge on a block of concrete 4x4x4 ft., while hardening, has been known to ruin the work. Carelessness in erection on green concrete often does more damage than poor mixing, and instead of the efficiency being 85 to 90 per cent, it is often reduced to 50 to 60 per cent, where a little care exercised, or timely supervision, would pay many times over the cost of an experienced supervising engineer. There is far more damage done to concrete work from careless tramping over green work than freezing or even zero weather, and far more damage than both of these combined is done by permitting the green work to literally starve for water.

It is a rare exception that green concrete and mortar work get even a small fraction of the amount of water in actual construction, hardening and final seasoning, that is absolutely necessary for ordinarily good and much less for high-class results. This starving for water is one of the greatest abuses in general use that is universally permited.

During the process of setting of cement, sharp crystals are formed which in good work are so sharp they prick the palm of the hand like so many pins, thereby giving away the simplest secret in the detection of a poor mix. As all one has to do is to press the palm of the hand against the freshly hardened work; if the angles of crystalization prick the hand so it is painful, the work is good; if it is soft, the work is bad, a simple but severe test. These sharp crystals that prick the hand like the points of so many pins can only be formed by an abundance of pure water, hence the fatal mistake of starving the work for want of water. This is just as necessary in laying ashlar with a ½-in. joint of mortar, as in concrete work. The Author had so much trouble in getting contractors to wet the stone thoroughly that of late years specifications call for the contractor to submerge in the river each stone just before setting, in weather other than freezing. By doing this all dust is washed off the stone, and it is thoroughly wet. If this were not done, especially in the summer time, the warm dry stone would absorb all the moisture from the mortar, retarding, if not completely arresting the chemical action and reducing the efficiency of the work anywhere from 20 to 30 points in this one item; one that the engineers have been unpardonably [illegible] interfering and attention that great [illegible] has been clearly manifest. It is easy to blame everything on the designing contractor, but, in my experience, but one contractor [illegible] tried to take good when placed on his honor who deliberately set out to systematically slight the work. This remark must not be taken to mean that resident engineers and inspectors should not be placed on important work, and kept there day and night, the time will never come when both the company and the contractor will not demand their inspection and assistance. The word assistance is used advisedly with full knowledge that the contractor, and all the men employed by him are quick to detect the willingness of the engineer and his assistants to assist the contractor in the many little ways that can always be done in carrying on important work. It is within the power of the engineer to interpret the specifications on any work in such a way that the contractor may make or lose a good profit, and with no benefit to the construction. A contractor is made of flesh and blood just as is an engineer, is just as human, and is just as susceptible to decent treatment. Show me a successful engineer who doesn't resent harsh treatment, and unfair decisions from those who may be over him. The engineer in charge of construction who fails to appreciate his position as arbitrator on all questions of disputes between the contractor and company, and who feels called upon to interpret the plans and specifications always in favor of the company who pays him, is dishonest, a coward and unworthy the title of engineer.

With one exception the better the author has treated the contractor the better the finished work. Futhermore, when one contractor gets stung others soon find it out. The author has in mind several cases where the arbitrary ruling of an engineer has resulted in the contractors, by common consent, adding to their unit price to both sub and superstructures to such an extent that it amounted to an extra of over 10 per cent in excess of what should, and would have, been bid for the same work constructed under fair treatment. All of which the company paid in blissful ignorance.

You may feel from these remarks that the author favors the contractor. That is exactly the case within certain limitations. The author spent 15 years of his life as a contractor, and has consequently, been on both sides of the fence, and has paid for many of his own mistakes out of his own pocket, which helps to keep the memory fresh; and he still smarts when he recalls many of the rank decisions that have caused him needless loss of money, and to this day keen humiliation. Furthermore the contractor assumes all contingencies and should be liberally treated; he should be given the benefit of doubt. Do not expect more from a contractor than you should from yourself, do not expect or ask him to shoulder your omissions and mistakes, unless you expect to secretly take care of him through dishonest estimates. Do not treat him as a rascal until he proves himself such. After he has proven himself a rascal, there is plenty of time to take him into camp. The contractor is rare who doesn't respond to and reciprocate good treatment. First prove conclusively the trouble is with the contractor and not his masons, it may be you are both deceived. The relations of the engineer and the contractor have been treated rather plainly for the reason that a large percentage of bad results should be charged direct to the engineer and poor materials. A poor contractor and a competent engineer generally result in fairly good construction, but good materials, a good contractor and an incompetent engineer insures indifferent construction.

It would appear from what has been said that there wasn't much left for the helpless company after the contractor and the engineer get through with it, but to pay the bills and be thankful they were not greater. This is by no means the case, the company is responsible for the appointment of the engineer in charge, for the loyal, or otherwise support given him, and too often the choice of the contractor, who has only the [illegible] held for his recommendation.

In days long gone by the author assumed to know everything by intuition, certainly not from experience, and it was his habit to dictate to the contractor how the work should be done. It is the province of the engineer to see that the quality of materials and finished work comply with the plans and specifications, and in doing this the terms of the agreement have not been violated. It is unfair and contemptible in the engineer to insert any clause in an agreement compelling the contractor to assume and stand good for unforseen conditions, and contingencies, without just compensation that both the company and the engineer did not and could not anticipate in the plans and specifications. Such a clause and such cowardly rulings will almost justify an honest contractor slighting his work, it is only human for him to do so, and one should ask no more from the contractor than should be expected from himself under similar circumstances and like treatment. It is so easy to unload on the contractor with the full knowledge that the contractor is rare who wishes to even dispute the rights of the engineer for fear of bad treatment. In earlier days the author presumed to be sole arbitrator; in other words, attorney, judge and jury, but some sense of the fitness and fairness of things, together with some mighty hard jolts shot that nonsense out of his head long ago.

It is the plain duty of the engineer, if he has any ability, to see to it that the work done complies with the plans and specifications, and to that end decide all questions concerning quality of materials, workmanship and construction, but sacredly keep his hands off the management and direction of the work, and any and all disputes arising between the company and the contractor that do not effect the quality of the work done. For instance, the engineer makes plans for a river pier with pile foundations, concrete base, stone shell and concrete core, constructed according to printed specifications. Does it make any difference to him whether the contractor makes a double crib and back fill, or drives sheet piling, just so long as the finished work is completed according to plans and specifications? Does the engineer presume to dictate to the contractor how he shall manage his work, and then make the contractor responsible for the mistakes of both the first and second parties without just compensation?

The author knows of certain companies and engineers who think it smart to keep from contractors certain information, other than plans and specifications, that if known to contractors when bidding on work would materially change the price of construction, resulting later on in delays and loss of time and money. Any company or engineer who knows from past experience that difficulties will be in the way for the successful contractor and do not acquaint him of same before the tender for the work is made and contract entered into, is dishonest. Sooner or later they are sure to be found out and the word passed from one contractor to another, with that absolute certainty of paying extra in the future for contingencies. The engineer who takes pains to explain to the contractor, not only the meaning of the plans and specifications, but also all the features of the physical conditions reasonably sure to be met with at the site, uniformly obtains for his clients the lowest safe bid that would be paid for the work. Such conditions guarantee good work, the best of feelings and rapid construction, the trade mark of a successful engineer.

Personals.

At the recent city election in Quincy, Ill., Mr. Welson P. Bushnell, engineer of the Sny Island Drainage District, was elected city engineer.

Mr. Richard L. Humphrey, president of the National Association of Cement Users, has been elected an honorary member of the Oesterreichischer Beton Verein, of Vienna, Austria.

Mr. W. G. Evans, president of the Denver City Tramway Co., has been elected president of the Denver, Northwestern & Pacific Ry. He succeeds David H. Moffat, whose death was announced in this column on March 29.

Mr. H. A. Brown, formerly connected with the Wellman-Seaver-Morgan Co., the Nevada Consolidated Mining Co. and the Brown Hoisting Machinery Co., and Mr. R. M. Gates, formerly with the Browning Engineering Co., have joined together under the firm name of Brown, Gates and have opened an office for the practice of mechanical and structural engineering at the Citizens' building, Cleveland, O.

Mr. J. G. Spielman, of the Illinois Steel Co., delivered an illustrated lecture before the Associated Engineering Societies of the Iowa State College, at Ames, Iowa, on March 18, describing the construction and operation of the steel plant at Gary, Ind.

At the next regular meeting of the Albany Society of Civil Engineers, to be held at Albany, N. Y., on April 25, Mr. Theodore Horton, consulting engineer of the New York State Department of Health, will deliver an illustrated lecture on "Water Filtration."

Mr. Herbert E. Hudson, until recently junior engineer of the Board of Local Improvements, Chicago, has been promoted to the position of assistant engineer of the Board of Local Improvements. Mr. Hudson will take charge of sewer construction in the near future.

Mr. T. C. Tarrer, city engineer of Houston, Tex., has tendered his resignation, and the offices of the city engineer and consulting engineer have been consolidated. Mr. F. L. Dormant, consulting engineer, has been appointed city engineer and will take charge of the combined offices.

Messrs. Wm. B. Weldon, Howard Meyers and Tenny Ford, until recently civil engineers in charge of sewer construction for the Board of Local Improvements of Chicago, have been promoted to the positions of junior engineers in the Department of Public Works. They will be in charge of waste water surveys.

Mr. Raymond W. Nutting, resident manager of the mining properties of the Aporoma Goldfields, Ltd., fell from a cliff near Sandia, Peru, on Feb. 21, and was instantly killed. He was an American and a graduate of Cornell University. Before going with the Aporoma Goldfields company he was for several years connected with the Cerro de Pasco Mining Company.

Mr. Charles Widney Wood, one of the leading engineers of the South, died at his home in New Orleans, La., on April 3, after an illness of several years. He was born in Pittsburg, Pa., on Nov. 4, 1863. He was a graduate of the State University of Louisiana. After graduating from that institution he took a post-graduate course at the Polytechnic Institute of Troy, N. Y., receiving the degree of Civil Engineer. In 1887 he settled in New Orleans, and until the time that ill health compelled him to give up business was actively engaged in bridge construction and marine wrecking.

The State Highway Commission of Louisiana, which was created by an act of the legislature last fall, is now completely organized. Mr. Gervais Lombard, assistant state engineer, has been appointed engineer of the commission. He will also continue to discharge the duties of assistant state engineer. Other appointments on the staff of the commission are as follows: Superintendent of construction, George L. Cooley, of the Office of Public Roads, U. S. Department of Agriculture; secretary, C. C. Sandoz; draughtsman, C. M. Kerr. The engineering work in the field will, as long as practicable, be carried on by the corps of the Board of State Engineers.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Simplex Melting Furnace.—Paper, 9x12 ins.; 4 pp. Rockwell Furnace Co., Fisher Building, Chicago.

An illustrated description of a furnace for melting aluminum, bronze, gray iron, semi-steel, etc. Tables of sizes and capacities are given.

Acme Culverts.—Paper, [illegible] ins.; [illegible] pp. The Canton Culvert Co., Canton, O.

This catalog illustrates the numerous uses to which this culvert is applied. Descriptions, tests and methods of handling are given.

Engines.—Paper, $6\frac{3}{4}$x10 ins.; 32 pp. The Bruce-Macbeth Engine Co., Cleveland, O.

Illustrates and describes several types of gas engines in detail. Tables of sizes and of power costs are given.

Grab Buckets.—Paper, 9x7 ins.; 1 p. Andresen-Evans Co., Monadnock Block, Chicago.

A folder illustrating a grab bucket for digging and handling materials.

Shelton Convertible Dump Car.—Paper, 9x12 ins.; 24 pp. Ernst Weiner Co., 30 Church St., New York.

A descriptive circular with illustrations of a new type of dump car for narrow and broad gage railways.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

Railroad construction work still continues on the upward slant, and the past few days have seen the letting of a considerable number of good sized contracts. Reports from various sections of the country indicate that many heavy lettings are being held up for the time being and will probably not be thrown open to bids until June. This seems probable, as that month marks the close of the railroad year, after which time new projects and policies will be put under way.

One of the biggest railroad construction jobs so far this year is shortly to be put under contract by the Chicago, Rock Island & Pacific Ry. This contract calls for constructing a line from Carlyle, Ia., to Allerton, Ia., a distance of 70 miles. The estimated cost is $60,000 per mile, and bids are to be opened April 24 at Chicago. Another good sized contract which it is expected will be let shortly is for the construction of a new line of the Grand Trunk Ry., from Windsor to Bellows Falls in the state of Vermont. Bids for this work are now in the hands of the Grand Trunk officials.

Among the railroad construction contracts let recently are the following: John W. Wright, Jr., Union Springs, Ala., for constructing 50 miles of railroad from Jackson, Tenn., to Dyersburg, Tenn., for the Birmingham & Northwestern Ry., the contract including 500,000 cu. yds. of earth work and about 3,000 lin. ft. of trestle; Robert Grace Contracting Co., Cleveland, O., and R. J. Malone & Co., Washington, D. C., for second track work on the Baltimore & Ohio R. R., from Wellsboro east to La Paz Junction, Ill., a distance of 24.8 miles; Watson, Flagg & Standifer, Portland, Ore., for constructing 18 miles of roadbed from the west city limits of Spokane to Cheney, Wash., through the Marshall canyon for the North Coast R. R.; Jones Bros., Columbus, O., for about 1,000,000 cu. yds. of work on the Pere Marquette R. R.; C. W. Lane & Co., Atlanta, Ga., and M. M. Elkan, Macon, Ga., for constructing lap sidings between Atlanta and Macon, Ga., for the Southern Ry.; Propst Contracting Co., Charlotte, N. C., for the construction of a line from Winston-Salem, N. C., to Floyd, Va., a distance of 102 miles, for the North Carolina Traction Co.; Thrasher & Gunter, Knoxville, Tenn., for constructing a switching yard at Decoursey, near Livonia, O., for the Louisville & Nashville R. R.

Just to show that some of the Canadian cities sometimes do their work by the wholesale, it may be stated that the city of Victoria, B. C., will open bids April 28 for paving with asphalt approximately 40 miles of streets.

Bids for a large government dredging contract were opened March 31 by the U. S. Engineer at Galveston, Tex. This contract called for widening and deepening Galveston channel, the work involving some 4,200,000 cu. yds. of excavation. The lowest bidder was the Atlantic, Gulf & Pacific Co., at 6.7 cts. per cu. yd.

An extensive irrigation and reclamation project is planned for the San Joaquin Valley in California by the San Joaquin Light & Power Co., of Fresno, Cal. The company has authorized a bond issue of $25,000,000 for the work.

The Pennsylvania State Senate has passed **the Sproul highway bill** which provides an appropriation of $6,000,000, of which $4,000,000 is for the use of the highway department and the remaining $2,000,000 for state aid on roads. The bill also provides for the laying out of nearly 30 routes joining county seats.

Hearings are being held by the commission recently appointed under authority of the State Legislature of Massachusetts to report upon the value to the state of a canal from Narragansett Bay to Boston Harbor, to be constructed and maintained without tolls by the government. A canal survey has been made by the United States Army engineers and an estimated cost prepared for a canal 25 ft. deep, 200 ft. bottom width, and a canal 17 ft. deep and 125 ft. bottom width, 52 miles in length, from Taunton River to Hingham Harbor—a feasible route—having four locks, two of which would be at Hingham. The canal would run through southern Massachusetts and develop one of the most important manufacturing sections of New England, embracing the cities of Taunton, Bridgewater, Brockton, Campello, Whitman, Abington, Rockland, South and East Weymouth, Quincy, Hingham and a number of smaller towns.

Moving Monuments.

In the early days of this country the boundary lines between some of the states were not always as clearly defined as could have been wished. In making resurveys of these lines the engineers in charge of the work have sometimes been inclined to think that at certain points their predecessors must have selected monuments almost as permanent as the ones suggested by the famous lawyer, Rufus Choate. In 1847 Mr. Choate was the lawyer for parties whose rights were affected by the boundary lines between Massachusetts and Rhode Island, which was described thus in the agreement: "Beginning," etc., etc., "thence to an angle on the easterly side of Watuppa Pond, thence across said pond to the two rocks on the westerly side of said pond and near thereto, thence westerly to the buttonwood tree in the village of Fall River." In his argument, commenting on the boundary, Mr. Choate referred as follows to the above part of the description: "A boundary line between two sovereign states described by a couple of stones near a pond and a buttonwood sapling in a village! The commissioners might as well have defined it as starting from a blue jay, thence to a swarm of bees in hiving time, and thence to 500 foxes with firebrands tied to their tails."

Grub on the Isthmus.

In these days of high costs it is interesting to note that the negro laborers on the Panama Canal are now paying 9 cts. for each meal secured from the Canal Commission. Reductions in the prices of food stuffs and economies in the methods of preparing and serving meals to negro laborers have made it possible for the Commission to reduce the price per ration of three meals from 30 to 27 cts. In the past the white and the negro laborers have been served at separate places necessitating separate kitchens for the cooking. Except at Gatun and Ancon the food is now prepared in one kitchen and served on opposite sides, so that, although one kitchen organization does the cooking, the food is still served separately to the two classes of laborers. An interesting point in this serving of meals to negro laborers is that the average daily number of rations served to this class of labor has decreased from 5,000 in July, 1908, to 1,116 in February, 1911. This shows that the negro is changing his status from that of a laborer to that of an inhabitant, and instead of getting his meals from the subsistence department he now buys food from the local markets or the Commissary.

Commission Government at Memphis.

The recently issued annual report of the Mayor of Memphis, Tenn., covering the first year under Commission Government is something of a boost for this system of city rule. In brief the report shows that the city saved $12,000 to $15,000 in one year by getting interest of 3½ per cent on its bank deposits, while cutting down the per cent of overdrafts from 5 to 4 per cent; the delinquent tax collections were largely increased; street paving was increased heavily and the character of the work improved; sewer construction was also largely increased; a number of street subways were built, and a new police station and a fire station were erected; both the fire and police services were improved; a site for a new hospital purchased; an increase of 20 per cent made in the gas department; 40 men added to the police force, and large improvements made in the health department. In all $1,116,345 was spent for permanent improvement, and the fact that will interest the average citizen most is that all this and more was accomplished with the tax rate reduced to the lowest point it had reached for 16 years.

An 8-Hour Law Decision.

A decision of much importance to public works contractors in the state of Pennsylvania was rendered last week, according to press dispatches, by the Supreme Court of that state. On the ground that it was special legislation the court declared that the Pennsylvania eight-hour law was unconstitutional. The decision reverses the Allegheny County Court and the State Superior Court and frees from liability John J. Casey, a Columbus, O., contractor, who had contracts for work on the filtration plant of the City of Pittsburg, and who was convicted of violating the terms of the law. The Eight-Hour Law was passed in 1897 and provided that workmen engaged in public works for the state or any municipality could work only eight hours a day. The Supreme Court holds that this is special legislation regulating labor and violates the State Constitution. In rendering its decision the court says: "If this were an attempt by general law to regulate the hours of labor throughout the state argument in support of the act would call for consideration."

A syndicate in which [illegible] D. R. Francis of St. Louis, Mo., and D. B. Chapin of Edinburg, Tex., are interested, is planning the construction of a system of irrigation and the installation of hydro-electric plants on the Devil's and Pecos Rivers in Western Texas. The estimated cost of the proposed works is more than $5,000,000. It is stated that nearly 400,000 acres of the land would be reclaimed by means of irrigation. Two large dams will be constructed, one across the Devil's River and the other across the Pecos River. Several hundred miles of power transmission lines will be built. Most of the land to be placed under irrigation already has been purchased by the syndicate.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

It is expected that work will start shortly on the belt line railroad, to be constructed in the northern part of the city of Mobile by the Mobile Railway & Terminal Co. The work as planned will begin from the north Mobile territory, and track laying will be towards the river front in the vicinity of One Mile Creek where the company has a river frontage property.

Alaska.

The formal opening of the Copper River & Northwestern Ry. was celebrated on April 8 at Cordova, Alaska. An especial cause of rejoicing was the shipment of the first train load of rich copper ore over the railroad from the Bonanza Mines to Cordova, where the ore was loaded on the steamship Northwestern for the Tacoma smelter. This shipment is insured at $250,000 and runs 70 per cent copper.

Arizona.

It is believed here in Tucson that grading work on the new line of the El Paso & Southwestern R. R., Walter Douglas, Vice President, Bisbee, Ariz., between Fairbanks and Tucson, will be started in May or early in June.

Arkansas.

The property of the Eureka Springs Electric Co. of Eureka Springs, Ark., has been purchased by E. F. Ackerman and others of Chicago. The property consists of the opera house, light, power and ice plants, the auditorium and the street railway. The purchase price is said to have been $500,000.

Information received from Rogers, Ark., in regard to the Memphis & Kansas City R. R. from Cave Springs to Tontitown is to the effect that work is progressing nicely. Eleven car loads of steel rails were unloaded recently at Cave Springs for the Tontitown branch road. Two miles of steel rails have been laid on this road. Nearly all of the bridges on the road from Cave Springs to Tontitown have been completed and the steel rail gang will begin work in earnest this week and will rush the road to completion. The road will be completed in time to handle the large strawberry crop in this section. After the road has been completed from Cave Spring to Tontitown, work will be commenced on the extension of that road to Fayetteville. From Fayetteville the road will be extended to Memphis via Bald Knob. When completed this will give Memphis and this section of the country a direct route to Kansas City.

Cities along the proposed route of the Memphis, Dallas & Gulf R. R. are subscribing toward the necessary fund required for preliminary work, locating a suitable route, etc. The line as proposed will pass through Little Rock, Hot Springs and DeQueen, Ark., and these towns will be visited and solicited to add to the preliminary expense fund. It is estimated that the preliminary surveys will begin in about four months.

California.

The city council of Oakland has granted the Oakland Traction Co. franchises for lines from East 16th St. along the Foothill Blvd. to Ygnacio Ave., and for a line along Market St. from San Pablo Ave. to 55th St., with the stipulation that the company shall widen Market St. for five blocks.

A proposition is under consideration for the formation of an intercounties railway company, with a capital of $5,000,000, to run a network of railroads through the San Joaquin valley in connection with a similar system in the Sacramento valley, with connections with San Francisco and the bay cities. The present concern, the Intercounties Ry. Co., purposes to build its initial line from Modesto to Crows Landing and Newman on the west side of the San Joaquin river in Stanislaus County, and from Modesto to Turlock, Merced, Fresno and the southern part of the San Joaquin valley. A. W. Maltby, Concord, Cal., and Joseph F. Peters, Stockton, are interested in the proposition.

Citizens of Turlock, at a recent mass meeting indorsed the plan of the Tidewater & Southern Ry. for an extension of the proposed line southward from Modesto and accepted the proposition to subscribe $75,000 toward the work. It is the plan of the Tidewater and Southern to extend its line already provided for to Modesto, south for 14 miles to Turlock, and still further to Merced. This would open a portion of the country not now tapped by an interurban railroad. Byron Bearce of Stockton, Calif., is President of the road.

The Southern Pacific Ry. has been making surveys at Niles preparatory to the construction of a new line through this section and the enlargement of the local yards.

The Atchison, Topeka & Santa Fe system is reported to be planning the expenditure of $750,000 for the establishment of a division terminal at Calwa, two miles south of Fresno. A roundhouse, machine shops, etc., will be built and 30 miles of switching track constructed. R. J. Arey, Los Angeles, is Engineer, Santa Fe System.

The Mill Valley & Mt. Tamalpais Scenic Ry., George M. Dodge, Chief Engineer, San Rafael, Cal., has filed with the County Clerk at San Rafael an application for a court order condemning for use as a right-of-way a strip of land 100 ft. wide extending from West Point station, the present terminus of the railroad, to Bolinas bay. This is taken as signifying the intention of the company to begin construction of its proposed extension in the near future.

Three miles of the Nevada-California-Oregon R. R. branch from Moapa to Logan, 13 miles down the valley have been completed. Citizens of Logan provided right of way.

Surveying corps of the Oregon Short line, according to information received from Bishop, Cal., has completed the last link in the survey of the through line between Los Angeles to Portland via Owens valley, preparatory to building the greatest scenic road of the Southern Pacific system. It parallels the Sierra Nevada for 200 miles, gives a view of Mount Whitney and constitutes the easiest line of travel, eliminating snowsheds. The construction work requires 16 tunnels.

Right of way is being cleared by the Southern Pacific Ry. for the construction of the new Fernley & Lassen road through the old town of Wadsworth, where a large round house will be constructed. Construction work, it is said, will be pushed through to completion.

Colorado.

Ranchers in Palisades, Colo., are working on a right of way to bring the interurban line from Grand Junction to Palisades. Part of the necessary right of way has already been secured and some of the big orchard companies have offered to donate money to buy additional land as it is required.

The Union Pacific R. R. Co. has placed an order for 72,000 tons of steel rails with the Colorado Fuel & Iron company, and the entire tonnage will be turned out at the Minnequa works of the company in Pueblo. This is said to represent about one-third of the quantity that will be consumed by the Union Pacific in construction work planned for this summer. The remainder will be rolled by the Illinois and Tennessee steel companies.

William G. Evans of Denver, president of the Denver, Laramie & Northwestern R. R., is now in the East to resume negotiations for financing the extension of the road beyond Steamboat Springs, where they were interrupted by the death of Mr. David H. Moffat.

Florida.

The following was the status of work on the Florida East Coast Ry.'s Key West extension on April 1. Work on the extension has now begun to be concentrated on that unfinished part between Bahia Florida and Boca Chica. C. B. Colby, foreman of the bridge work, with a large portion of the steel workers, is now at Bahia Florida getting the steel at that place in condition to start on the bridge spanning Bahia Florida channel. This will be one of the most difficult pieces of bridge work on the whole line. Work at Pine channel and the camps at Bow and Nyles channels is now well under way, and the progress that is being made argues well for a speedy connection with the terminus at Key West. The force at Pigeon Key has been increased to the number of nearly 500 and the work across Knights Key and Moser channel is being rushed to a rapid completion. The steel work on Pacet channel is now under the supervision of Mirian Colby. The force at Boot Key harbor machine shops has also been increased to meet the growing demands of the repair departments. It is at this place that all repairs to marine engines, hulls and machines of all kinds are made. Grassy Key is now the largest camp north of Marathon. It has developed into quite a little city. The spur track branches off from the main line just below the postoffice and extends to the lower end of the key and then extends out into the water for a considerable distance. It is at this place that the marl is procured to bank the grade on the fills between Crawl Keys and Key Vaca. These marl beds are so extensive at this place they will furnish marl enough to bank miles of grade as well as to fill the approaches to the various trestles. These approaches are being constructed entirely of that material.

The Gulf, Florida & Alabama R. R., which projects a line from Pensacola, Fla., to Jasper, Ala., 260 miles, and a branch to Bay Minette, Ala., from Cantonment, Fla., 40 miles, has opened offices in the Brent Bldg., Pensacola, Fla. Orders have been placed for 20 miles of steel rails for July delivery, and it is stated that the company will shortly be in the market for 60,000 crossties. This material is for use in building the stretch from Pensacola to Muscogee, there connecting with the 60 miles of road purchased from the Southern States Lumber Co. While this 20 miles is under construction, the company proposes to commence work at the north end just as soon as the surveys can be made, and build towards the Warrior river. This is the line promoted by Roy C. Megargil, 5 Nassau St., New York. George C. Berry, New York, is Engineer of construction.

Georgia.

⊙The Southern Ry. has awarded contracts for the construction of lap sidings between Atlanta and Macon to C. W. Lane & Co., Atlanta, Ga., and M. M. Elkan, Macon, Ga.

The Ocilla Southern R. R., J. A. J. Henderson, President, Ocilla, Ga., has awarded the contract and construction has been commenced on the extension to Nashville, Ga., from Allapha, a distance of 25 miles. The road will also be extended from Fitzgerald to Rochelle northward. The extension will be pushed southward as far as Valdosta and northwards to Hawkinsville, and probably as far as Macon, as rapidly as the work can be completed.

The Elberton & Eastern Ry. Co. of Elberton, Ga., has been chartered and proposes to construct a line about 50 miles long from Elberton southeast to Lincolnton, Ga., via Washington, Ga., and traversing Elbert, Wilkes and Lincoln counties.

The Atlanta & Northwestern R. R., which projects an electric line to Cummins and Creighton, has applied to the city council of

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Atlanta for a franchise for entrance into that city at Orme St. and North Ave., and the installation of tracks in Orme, West Cain, Bartow and Walton Sts. The company proposes to enter the city at the junction of Orme St. and North Ave., proceed along Orme St. to West Cain St., traversing West Cain St. to Bartow St., thence to Walton St. and along Walton St. over the tracks of the Georgia Railway & Electric Co. to Peachtree St. The new line will tap the towns of Roswell, Alpharetta, Creighton and Cummins. Two-thirds of the right of way between Atlanta and Roswell has been secured and practically all the land condemned north of Roswell to Cummins. The officers of the new line are: John M. Ponder, of Forsyth, Ga., president; John L. Murphy, of Atlanta, vice president, and Robert P. Jones, of Atlanta, secretary and counsel.

Illinois.

A meeting is to be held at Springfield on May 13 to take steps for the organization of the Pana, Girard & Jacksonville Ry. Co. This line is being promoted by W. O. Myers and Charles Russell, both of Chicago, Ill., and it is claimed that the project in the main has already been financed.

The Northern Illinois Industrial Co. has been organized by the cities of Waukegan and North Chicago for the purpose of building a switch track for freight traffic around both cities on the west and connecting with the Northwestern and Elgin, Joliet & Eastern Ry. The company also plans to build factory structures as inducements to new industries.

The Evansville, Mount Carmel & Olney Traction Co. has been granted a franchise at Mount Carmel, and it is expected that actual construction work on the line will be started shortly.

The Southern Traction Co. of Illinois which recently secured a franchise to operate an electric interurban railway into St. Louis, Mo., across the Free Municipal Bridge, has been granted a license to carry on the transportation business in Missouri. The company is capitalized at $1,500,000 and $200,000 of the amount is to be expended in St. Louis. The present status of this road according to H. C. Begole of Belleville, Ill., secretary of the company, is as follows. "We have all necessary franchises for operation in Belleville, East St. Louis and between Belleville and East St. Louis. We have several miles of steel laid in Belleville and several miles in East St. Louis. Sixty per cent of our grade is completed between Belleville and East St. Louis. Our double track runs right up to Tenth and Piggott Ave., in East St. Louis, the point where the approach to the wagon or upper deck of the St Louis free bridge comes to the ground level. The tracks run out Market St. to 17th and thence to the city limits at 29th St. It is the purpose of the company at once to complete and operate the line from Belleville through East St. Louis to the point where our line will go onto the free bridge. It is also the purpose to build and operate the line from Belleville south into the southern Illinois coal fields in Williamson County."

Governor Deneen has signed the bills giving the St. Louis, Peoria & Northwestern Ry. Co. the right to build a drawbridge over the Illinois River at South Bartonville and a right of way 1,000 ft. long and 200 ft. wide over land owned by the state at the Bartonville insane hospital. Under the name of the St. Louis, Peoria & Northwestern Ry. the Chicago & Northwestern Ry., E. C. Carter, Chief Engineer, Chicago, Ill., is to extend its lines from Peoria to coal fields it owns in Macoupin County. When completed the branch will relieve the Northwestern from using the Chicago & Alton lines for hauling its coal from Girard to Peoria. It will give the road a southern branch running from Chicago to within 40 miles of St. Louis.

Indiana.

⦿Robert Grace Contracting Co., Cleveland, O., and R. J. Malone & Co., Washington, have been awarded contracts for second track work on the Baltimore & Ohio R. R. from Wellsboro east to La Paz Junction, Ill., a distance of 21.8 miles.

⦿Lorimer & Gallagher Co., 947 The Rookery, Chicago, Ill., as noted in our last issue, have been awarded a contract for recent track work by the Baltimore & Ohio R. R. The work extends from Hamler to Holgate and from Mark Center to The Bend, O., and includes about 175,000 cu. yds. of earth excavation and about 4,000 cu. yds. of concrete masonry. The work is all covered, a subcontract for the team work having been let to J. J. McCaughey, Chicago, and the shovel and masonry work will be done by Lorimer & Gallagher.

It is expected that business men of Crawfordsville and Danville, Ill., will get together to make plans for preliminary steps looking toward the organization of a company to build an interurban line between the two cities. The line will be about 43 miles long and the route under consideration is through Rileysburg, Gessie, Perrysville, Kinghan, Wallace and Alamo into Crawfordsville. Ransom Myers, Charles W. Gregg and Dr. W. T. Gott, Crawfordsville, Ind., are interested.

The Gary, Hobart & Eastern Traction Co. is planning to let construction contracts about May 20 for the five-mile line from Hobart to Broadway, Gary, Ind. U. P. Hord, Aurora, is President. J. C. Cavender, Hobart, Ind., is interested.

Construction contracts for the Indianapolis & Delphi Traction Co.'s line will probably be let this spring. The proposed line will go northwest via Carmel, Westfield, Sheridan, Burlington and Flora to Delphi, a distance of about 75 miles. Henry L. Smith, Board of Trade Bldg., Indianapolis, is general manager and H. A. Mansfield, Board of Trade Bldg., Indianapolis, is Chief Engineer.

At a recent meeting of the directors of the Commercial Club of Richmond, Ind., Fred R. Charles, City Engineer of Richmond, made a report on the proposed traction line from Richmond to Union City, and from Richmond to Cincinnati. The length of the proposed route would approximate 110 miles. The only excessive construction cost will be between Richmond and Liberty, a distance of 16 miles. From Brookville, the proposed route will be along the Whitewater canal basin. The Commercial club directors believe there will be little difficulty in obtaining the necessary capital to build the line.

The Calumet United Rys. & Traction Co., C. H. Geise, President, Philadelphia, Pa., is reported to have secured practically all of its right of way east of Gary and will probably ask for a franchise from Gary within a few days. An application has been made to the commissioners of Porter county for the privilege of running through that county and the Chesterton town board has granted a franchise for the use of the streets by the company. This brings the road almost to Gary. It is the plan of the company to start the road at Chesterton and run straight west through Porter, Miller, Gary, Indiana Harbor, East Chicago, Whiting and thence to Chicago. A large power station is laid out for East Chicago.

Iowa.

Surveys have been made and the capital has been secured for the construction of the projected 30-mile interurban railway from Davenport to Muscatine. The J. G White Co., New York City, will do the construction work. J. F. Porter, Muscatine, Ia., is President of the railway.

The Iowa Traction Co has completed surveys for its projected 112 mile line, to extend from Oskaloosa to Waterloo by way of Tama. The construction capital has been secured and construction contracts will be let in about 60 days. J. C. Lathrop, Oskaloosa, Ia., is Chief Engineer and Geo. E. Wodehause, Oskaloosa, is President.

[illegible] now asking bids for the construction of its new line from Carlisle, Ia., south to Allerton. The road will be built under the name of the [illegible] estimated cost is $60,000 per mile. There will be a number of short plate girder bridges, also some short but high trestles. Bids will be opened April 24. J. H. Berry, Chicago, Ill., is Chief Engineer of the Chicago, Rock Island & Pacific.

Kansas.

The Chicago, Rock Island & Pacific Ry., J. B. Berry, Chief Engineer, Chicago, Ill., will expend about $1,000,000 this year in the continuation of work started a year ago. About $160,000 will be expended at Armourdale, Mo., to include additions to the yards and shop buildings. The $1,000,000 is in addition to the $750,000 which the company proposes to spend in Kansas City during the summer for a new freight house in the West Bottoms. A large part of the new improvement program includes track betterment. About $400,000 will be spent in ballasting and other improvements. From McFarland to Herington, one of the heaviest traffic stretches of track in Kansas, $100,000 will be spent. Between Topeka and St. Joseph, a line used almost exclusively for fast freight, $150,000 will be expended. Another $100,000 will be required to reballast the line between Herington and Caldwell, and $30,000 for a short stretch from Cuba to Belleville. Nearly $200,000 will be expended for new eating houses. Three will be built, one each at McFarland, Caldwell and Liberal. The McFarland structure will cost $50,000, the other two $65,000 each. These will be operated by the John J. Grier Co. At Topeka drainage improvement will necessitate the expenditure of $85,000 in the construction of dikes and the raising of the bridge over the Kaw. Other improvements will include $30,000 for a coal chute and tie treating plant at Cortland; $10,000 for a treating plant at Dwight; $85,000 for additions to terminals at Wichita; $40,000 for work at Herington; $20,000 for coal chutes at Clyde, and $50,000 for miscellaneous work.

The Interurban Construction Co., O. A. Boyle, President, Wichita, Kan., which has the contract for constructing the Arkansas Valley Interurban Ry., as noted in our last issue, has placed an order for $65,000 worth of steel rails for use on the line between Sedgwick and Newton.

The Union Traction Co., D. H. Siggins, President, Coffeyville, is to build a belt line street car system around the city of Coffeyville, touching every factory in the city. The line will be four miles in length and the city commission has granted the use of the streets necessary for the line.

Surveys are now under way for the projected 97-mile line of the Arkansas City, Wellington & Northwestern Ry. The road is to extend to Hutchinson, Kan., via Wellington and Conway Springs. Construction contracts are to be let as soon as possible after the survey is completed. Fremont Hill, Wellington, Kan., is Chief Engineer, and Geo. H. Hunter, Wellington, Kans., is President.

Kentucky.

The Louisville & Mammoth Cave Traction Co., which proposes to build an interurban road from Louisville through Kentucky, taking in Glasgow, Barren County, Scottsville and Allen County, and as far as the Tennessee state line on the old Louisvile & Nashville Turnpike, is considering building through Sumner County, Tenn., along the line near the bed of the old Louisville & Nashville Turnpike. G. W. Ellis, Glasgow, Ky., is interested.

Engineers of the Chicago, Memphis & Gulf R. R., S. G. Latta, President, Dyersburg, Tenn., are now working on the route from Hickman to Paducah. It is expected that the line will be completed to Hickman by May 1. It is understood that this line, which is a short cut from Paducah to Memphis, is to connect with the Burlington bridge at Metropolis Landing, twelve miles below Paducah.

The Levisa River R. R. Co. of Ashland, Ky., has been incorporated with a capital stock of $50,000 and proposes the immediate construction of a railroad in Pike County, branching [illegible] and running up the Levisa River fork to Grundy, Buchanan County, Va. The incorporators are: G. B. Wall, Decatur Axtell, E. W. Grice and A. Trevvett of Richmond, Va., all of the Chesapeake & Ohio Ry.; J. A. Fox, Ashland, Ky.; E. T. D. Wallace, Louisa, Ky., and LeWright Browning, Maysville.

The last spike in the track completing the Kentucky Highlands R. R., which connects the Louisville & Nashville R. R. at Frankfort with its recently acquired property, the Louisville & Atlantic R. R., extending to Beattyville was driven on April 1. The work of ballasting the new line will be pushed as rapidly as possible and it is planned to establish through passenger service between Louisville and Beattyville, beginning May 1.

D. R. Lyman, City Engineer of Louisville, Ky., is considering plans for the changing of the grade at the intersection of the Southern Railway Co., the Louisville & Nashville R. R. Co. and the Louisville Street Ry. Co.'s lines on Fourth Avenue, at G Street, Louisville. It has not been decided whether the track will be raised and the street pass under it, or whether the street grade will be raised and the various tracks pass under it.

The Louisville & Nashville R. R., is understood to have plans under consideration for the building of a railroad from Scottsville to Glasgow. It is said that their plans are to extend the road on to Horse Cave where it will tap the main line to Louisville, shortening the distance by 25 miles from Scottsville.

The Kentucky Midland R. R. has made preliminary surveys for its projected extension from the present terminus at Earles to Madisonville and Central City. The projected length is 14 miles. G. B. Hengen, Chicago, Ill., is President and M. M. Wheeler, Central City, Ky., is Chief Engineer.

Louisiana.

The New Iberia & Northern R. R., R. J. Lockwood, Chief Engineer, New Iberia, La., has surveys underway between Moreauville and Port Barre. It is proposed to extend the line, now in operation between New Iberia and Port Barre, and connect it with the Louisiana Railway & Navigation Co.'s road at Moreauvile.

The Globe Lumber Co., according to advices from Ringgold, La., has been making a survey from its main line at Ringgold to Lake Bistneau, a distance of nine miles, for the purpose of building a spur to haul timber to the main line.

The Louisiana & Arkansas Ry., W. H. Vance, Engineer Maintenance of Way, Stamps, Ark., is considering a proposition to run a tap line from the main line at Jamestown to Ringgold, a distance of four miles.

Reports from Baton Rouge state that plans are under consideration for the extension of the Baton Rouge, Hammond & Eastern R. R. (Illinois Central) to a connection with the Central of Georgia.

Press reports quote Charles H. Markham, President Illinois Central R. R., as stating that among the improvements planned by the system are the completion of double tracks from New Orleans to Chicago, the construction of interlocking plant at Harahan, and purchasing $2,000,000 worth of steel cars.

Promotion work is under way for the building of the Delhi, Lake Providence & Manghum R. R., and it is stated that parties will be put in the field at once for preliminary work. The Business Men's League, W. S. Buchanan, Secretary, Delhi, La., is understood to be interested.

The East Carroll Police Jury, at Lake Providence, has ordered an election for May 3 on the proposition to levy a tax of five mills for ten years in aid of the proposed railroad from Portland, Ark., in a southeasterly direction through Oak Grove to Lake Providence, in a southwesterly direction through East Carroll Parish and the upper part of Madison Parish to the Vicksburg, Shreveport & Pacific Ry. at or near Waverly. The promoters guarantee a modern band sawmill at Lake Providence. They will also construct docks at the terminus on the Mississippi River here.

The Bastrop & Lake Providence R. R. Co. has been chartered with a capital stock of $100,000 and proposes to build a rail road between Bastrop and Lake Providence, La. J. H. Allen is President and R. Morris is Secretary.

Maryland.

An ordinance for the elimination of the grade crossing at Lafayette Ave., Baltimore, is now before the city council of that city. By the terms of the ordinance the grade crossing at Fafayette Ave. is to be eliminated by sinking the Pennsylvania R. R. tracks about 13 ft. below the present grade and carrying the street crossing overhead. This will necessitate raising the street about 13 ft. above the present grade. It is believed that the work will cost about $400,000. B. T. Fendal is City Engineer.

It is stated that over $110,000 of the authorized $200,000 stock of the Kent Traction Co., which proposes to construct a trolley line from Tolchester to Chestertown, 10 miles, has been subscribed. If the link to Chestertown is a success it is planned to extend the road to Centreville, and thence to Easton, Hurlock, Salisbury and Crisfield. Branch lines will reach Rock Hall, Denton, Cambridge, Ocean City, Snow Hill and Pocomoke City. Alva A. Lamkin, Baltimore, Md., is interested.

The Western Maryland R. R. is understood to have plans under consideration for a terminal on the north side of the harbor at Baltimore. The plans include a new terminal in the block bounded by Hillen, High and Front Sts.; a new passenger station on the present site and extensive improvements to the freight yard now adjoining the passenger station. An office building to accommodate the employes of the company in Baltimore may be constructed over the new passenger station.

In his annual report Oscar Lacky, Harbor Engineer of the city of Baltimore, Md., recommends a municipally constructed belt line connecting the Baltimore & Ohio, Pennsylvania, Western Maryland and Canton R. R. He suggests that this line be extended along the proposed water-front street in South Baltimore, up Light St. to connect with the Baltimore & Ohio at Pratt St., then to the Pennsylvania tracks at Central Ave., and on to the Canton R. R. To build such a line would require the co-operation of the railroads which own the rights of way along the streets. The suggestion was that the city construct the belt line and then turn it over to a company to be formed by the railroads affected, to be operated under a satisfactory rental.

The Hagerstown & Clearspring Ry. Co., projecting a 12 mile electric railway from Hagerstown to Clearspring has secured all of the right of way and is planning to have construction work started shortly. But one bridge of any size will be required. Later on the road is to be extended to Mercersburg, Pa. The company was recently incorporated; it has the following directors: Major Loren N. Downs, of New York; Hugh L. Kirby, of Harpers Ferry; Alexander R. Hagner, James B. Kreps and Oscar D. Bower, of Hagerstown.

Michigan.

Citizens of Benton Harbor have voted to grant a 4-year extension of the present charter or the Benton Harbor-St. Joe Ry. & Light Co., Benton Harbor. The charter still has 26 years to run. It is proposed to bond the road for $200,000 to build an interurban line to Dowagiac.

The Grand Rapids & Indiana Ry., E. H. Barnes, Chief Engineer, Grand Rapids, is to make a number of improvements at Kalamazoo. These will include the laying of a double track through the city and the construction of additional sidings in its yard in the city.

At a recent meeting between the track elevation commission at Kalamazoo and representatives of the Michigan Central, it was stated by the officials of the railroad that it would cost the road $2,000,000 for grade separation in Kalamazoo. The representatives of the road stated that the company would undoubtedly co-operate with the city in the efforts to secure track elevation. Conferences will also be arranged with other lines running through Kalamazoo. The preliminary work will probably take several years. A. K. Edwards, Kalamazoo, is chairman of the track elevation commission.

Minnesota.

Official announcement is stated to have been made that the Chicago, St. Paul, Minneapolis Ry., C. W. Johnson, Chief Engineer, St. Paul, Minn., will spend about $1,000,000 in improving its terminal facilities in Minneapolis.

Duluth and the Ranges.

BY PETER E. MEAGHER.

⦿Pastoret-Lawrence Co., Contractors, were awarded a small sewer job by the city of Duluth amounting to about $3,800, and will start on the same immediately.

⦿H. L. Bartlett Co., Contractors, were awarded a $4,000 sewer job by the city of Virginia, Minn., and will start on the same immediately.

⦿C. R. McLean, Duluth Contractor, was recently awarded a concrete job by the town of Grand Rapids, Minn., amounting to about $7,800, and will start work on the same in about two weeks. Mr. McLean is one of the young ones in this territory, but is coming to the front very fast.

⦿Jones Brothers, railroad contractors, Columbus, O., have written us stating that they had just secured a contract from the Pere Marquette Railroad amounting to about 1,000,000 yds., and that they will start on the same immediately. At the present time they are moving their outfit that they have located at Nashwauk, Minn., forward to this work.

⦿E. Kimball of Kimball Brothers, Contractors, was a caller last week, and reported that his firm had taken a large irrigation contract in Alberta, Canada; had already moved their outfit on to the same and had quite a bit of this work to sublet. The work they want to let is all laterals, and they have enough of it to keep a few team outfits busy for two years. This work is located close to the C. P. R. R., and they state that the material is very good, and the prices that they are offering are attractive. Anyone interested in this work by writing to Kimball Brothers, General Contractors, Bassano, Alberta, will receive full information.

W. F. Carey of the Johnson-Carey Co., large railroad contractors, was a caller at this office last week. They are quite busy at the present time, being engaged on several large contracts, and have figured on some new work for the coming season.

F. D. Beal, erecting superintendent for the Brown Hoisting Machinery Co. of Cleveland, O., was a caller a few days ago. Their contract for a large coal dock at Duluth, which they started last year is not yet completed, and they expect to resume work on the same, about April 20th.

Forrestal & Feyan, General Contractors, St. Paul, Minn., write us that they have 11 miles of railroad work to let, and they would like to sublet the same to some team contractors. Anyone interested, address these people direct.

We are very sorry to report the death of Jacob Zimmerman, one of the old time contractors, which occurred last week. Mr. Zimmerman has been engaged in the general contracting business in this vicinity for the past 35 years.

W. G. Philips, representing the Chicago Pneumatic Tool Co., was a caller this week. He stated that prospects for business in his line were very encouraging.

We are very pleased to announce that F. J. Webb, General Superintendent of the mines for the Republic Iron & Steel Co. in this territory, has removed his office and residence from the Range to Duluth. Mr. Webb is a very popular gentlemen in this vicinity, and will be a welcome addition to the bunch at Duluth.

C. J. Madden, General Superintendent for the Johnson-Carey Co. on their railroad contract on the Canadian Northern near Duluth,

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

came in to see us last week. They are progressing pretty well with their job, and expect to have the same completed on time.

H. A. Lewis, Assistant General Passenger Agent of the Soo Railway Company, was a caller at this office last week.

C. J. A. Morris, contractor, St. Paul, Minn., was in the city this week. He did not have any information to give at this writing.

C. W. Betty, representing Beall Brothers, manufacturers of track tools, was a caller at this office last week, and reported the outlook for business very encouraging.

The writer recently returned from making a week's trip to Chicago and other cities, and had the pleasure of meeting many old friends, and accumulating a crop of new ones, I think. I am especially indebted to one large contractor in Chicago who was the means of making me miss my train; but, never mind, there is a day of reckoning coming for that gentleman. I was very pleased to know that there was a general feeling of optimism among the people that I met. There is a lot of new work in sight for the contracting fraternity, and the manufacturing industries that I came in contact with seemed to be well satisfied with the outlook for the coming season's business.

Contractors and others, when in this vicinity, are invited to make the labor and equipment offices of Peter E. Meagher, No. 409 West Mich. St., Duluth, Minn., their headquarters.

Mississippi.

The Vicksburg Traction Co., Vicksburg, Miss., is considering the construction of a branch line to the National Cemetery, and later to the village of Walters. The line will be a connection of the Washington St. line north.

An application for a charter for the Meridian & Deep Water R. R. Co. has been filed with Governor Noel of Mississippi. It is proposed to build a new line from Meridian, directly east to a point on the Tombigbee River, where it will cross into Choctaw County, Alabama. The distance is about 40 miles, and in Choctaw County, it will connect with another line, chartered under the laws of Alabama, intended to eventually enter Birmingham. Those signing the application are C. F. Scofield and S. A. Neville, Meridian, and W. C. Stowell, Chicago.

Missouri.

⦿The West Missouri Electric Ry. Co., which projects a 34-mile line from Kansas City to Grandview, Belton and Harrisonville, Mo., has completed surveys and has partially secured the construction capital. H. A. Nagle, Kansas City, Mo., is Chief Engineer and Henri D. Patee, Kansas City, Mo., ———. The construction contract has been let to the Spitcaufsky-Wagner Contracting Co., Kansas City, Mo.

The Missouri, Arkansas & Gulf R. R. Co., of Rolla, Mo., has been chartered with a capital stock of $2,000,000 and proposes to build a line from Rolla to Bakersfield, a distance of 125 miles.

Business men of Bismarck, Mo., have been holding mass meetings to aid in construction of the proposed Bismarck, Belleview Valley & Western Ry. This is an interurban line to extend from Bismarck to Sunlight, in Washington County, a distance of 20 miles. The route traverses a densely settled farming district and will afford accommodation to more than 10,000 people now without railway facilities.

Kansas City, Mo., and Vicinity.

[illegible]

⦿Lamoreaux & Peterson of Omaha have secured some extensive work in Canada and will be kept busy in that country for some time to come. The Omaha address of the above firm is Brandeis Theater Bldg.

⦿Phelan & Shirley, Omaha Bank Bldg., Omaha, Nebr., are just starting a branch line of the Union Pacific from Gehring, Nebr., to North Port. This is the work on which bids were received about two months ago. [illegible] work has [illegible] let. J. F. Williams has the largest contract. He will cover about 15 miles of the work. Other contractors on the line are John Owen, Jno. Massey, Grinnell & Oeltjen and W. D. Waldo. There are no heavy cuts and not a single steam shovel will be used. For the most part Fresno scrapers can be put to work to good advantage.

List & Gifford, formerly of Davenport, Iowa, have opened an office in Kansas City, Mo., at 529 N. Y. Life Bldg. While this firm is not as yet ready to announce that Kansas City will be their permanent home, yet we firmly believe they will like it so well down here that they will remain. It will be remembered that List & Gifford have a large contract on the Kansas City Southern under Porter Brothers.

Contractors in Kansas City are very much interested in the Rock Island work to be let in Chicago on April 24. Quite a few are figuring on bidding.

The writer was in Omaha last week and interviewed a number of contractors there. It seems to be the general opinion among those seen that some extensive contracts will soon be awarded for double tracking the Union Pacific R. R. No definite announcement has been made at this writing. It will be our aim to keep in close touch with the situation and we will advise our readers from time to time as to the progress that is being made.

Work on the Kansas City Southern has not as yet started. Some questions involving the right of way are still unsettled but it is expected that everything will be arranged so that the contractors can get busy within a short time.

Now that the Kansas City Southern R. R. has actually let a big piece of work and the Rock Island is about to do the same, contractors in this section feel very much encouraged over the outlook. A man of high standing in the contracting world recently told the writer that in his opinion the heavier lettings would not take place until June, that month marking the close of the railroad year, after which time the new projects and policies will be put under way.

New Hampshire.

The State Legislature has passed a bill granting the Connecticut River R. R., a Boston & Maine line, the right to extend its line on the New Hampshire side of the Connecticut River from Hinsdale to Walpole. Walpole is located 12 miles or more up from a point opposite Brattleboro, and if the Connecticut River line were extended as far north as that on the New Hampshire side it would meet the Cheshire R. R. tracks, also under Boston & Maine control, and this would enable the Connecticut River R. R. trains to reach Bellows Falls without using the Vermont Valley line on the Vermont side from Brattleboro to Bellows Falls.

New Jersey.

The State Assembly has passed the bill authorizing the city of Newark, N. J., to spend $2,000,000 for subways.

New York.

The paper manufacturers of northern New York State are discussing the building of an electric road from Watertown to some nearby port on Lake Ontario, as a means of securing Canada wood pulp at cheaper rates than at present paid the railroads.

The recently organized Little Falls & Johnstown R. R. Co. (electric) will shortly start preliminary work for its proposed 27 mile line to connect Johnstown and Little Falls. The necessary capital for building the road is reported to be in sight and it is understood that the line will be completed by the fall of 1912. The stockholders in the road are Joshue J. Gilbert, Lorenzo O. Bucklin, Frederick G. Teall, Homer P. Snyder, Little Falls; Frederick Englehardt, St. Johnsville; Edward C. Decker, George C. Potter, A. J. Baker, James P. Argersinger, Johnstown; J. Ledlie Hees, Fonda; L. N. Littauer, Gloversville; John Barnes, Amsterdam; Henry C. Harnickell, New York. Directors: Joseph H. Heaney, St. Johnsville; John G. Ferres, Johnstown; Zenas B. Whitney, Frank Burton, Gloversville; William Harris, Northville.

The State Public Service Commission has approved the franchise granted by the Board of Estimate of New York City for the Third Avenue Ry. to build a trolley extension in St. Ann's Ave., Bronx, from 161st St. to Southern Boulevard, and thence south through Southern Boulevard. The cars running over this line will continue across the Harlem River and through 138th St. and 135th St. in Manhattan to 8th Ave.

The State Public Service Commission has approved the franchise authorizing the United Traction Co., Albany, to double track its line on Hamilton St. and to lay a double track on Hudson Ave. from Grand to South Pearl St. in Albany.

The Catskill Traction Co., Catskill, N. Y., is to at once begin the securing of rights of way for the proposed extension from Leeds to Cairo. Work is also to be started making the necessary surveys and securing rights of way for a proposed extension of the railroad southward from Catskill to Alsen and Cementon. The question as to which extension will be built first has not been definitely decided, but one of them will be completed and in operation before the end of the present year.

North Carolina.

⦿The North Carolina Traction Co. has awarded the contract for the construction of its line from Winston-Salem, N. C., to Floyd, Va., a distance of 102 miles, to the Propst Contracting Co., Charlotte, N. C. The contract is said to amount to about $2,000,000.

The recent purchase of 100,000 acres of timber land in Haywood County by the Champion Lumber Co., of Asheville, N. C., is said to be the forerunner of extensive development work in that section. It is stated that the company will extend the Tennessee & North Carolina R. R. to Canton and complete the Pigeon River R. R. from Canton to Sunburst. One big mill will be constructed near Canton. J. B. Hart, Clarksburg, W. Va., is President of the Tennessee & North Carolina R. R.

North Dakota.

It is believed that the announced intention of the Grand Trunk Pacific R. R. to construct an extension of its Regina branch into Ward County, North Dakota, is the first step in plans to reach St. Paul and Minneapolis, and then secure a connection for Chicago.

The Great Western Ry., A. H. Hogeland, Chief Engineer, St. Paul, Minn., is understood to be planning to build its air line from Fargo to Surrey this summer.

Advices from Devils Lake, N. Dak., state that the Chautauqua Ry. Co. is about to start work on the construction of about a mile of new line from a point in the bottom southwest of the city to the 5th St. underground crossing, the site of the new station.

Among the rumors in circulation are those stating that the Minneapolis & St. Louis R. R. is planning the extension of its line from Leola to Mound City and also the construction of a bridge across the Missouri River at LeBeau and the laying of track on the grade between Aberdeen and Pierre.

Preparations are being made for commencing work on the Midland Continental R. R., the projected north and south line from the south line from the Canadian border to the Gulf of Mexico, planned and backed by capitalists and business men of Chicago and vicinity. Trains first will be put in operation between Edgeley and Jamestown, N. D. Grading then will proceed on the next division, to Courteney, which will be completed and turned over to the operating company, and on to the Canadian border. Then work south from Edgeley will be taken up. The plan is to build and turn over the railroad in units of approximately 50 miles. O. B. Chamberlain, Chief Engineer, Chicago, Ill.

Ohio.

• [illegible] & [illegible], Knoxville, [illegible], have been awarded a contract by the Louisville & Nashville R. R. for the construction of a switching yard at [illegible] near [illegible]. The work calls for a double-hump switching yard with a capacity for handling [illegible] cars per diem and with storage facilities for over 1,500 cars.

Surveys are reported now underway on the proposed extension of the Pomeroy Belt line of the Hocking Valley Ry. at Pomeroy, O. It is planned to extend the belt line to open several coal mines in that vicinity.

A resolution is before the City Council of Columbus to submit a $400,000 bond issue to a vote of the people for the elimination of North Side grade crossings at Columbus. It is estimated that the total cost of the work will approximate $1,200,000. The railroads must pay two-thirds of the cost. The plan includes the Big Four and the Columbus, Sandusky & Hocking R. R. crossings at 2nd, 5th and 11th Aves. Henry Maetzel is City Engineer.

The stockholders of the Northern Ohio Traction & Light Co., Akron, O., have approved the proposed issue of $1,000,000 preferred stock. A combined steam and hydraulic power station will be constructed with the proceeds, with which electric power will be furnished to Akron.

The Cleveland Short Line Co., a Lake Shore & Michigan Southern line, is to increase its capital stock from $3,750,000 to $7,375,000. It is understood that the capital increase is purely a financial measure, indicative of the construction progress being made. The Belt line will be in complete operation some time in 1912. It is now in operation from Marcelline Ave. S. E., Cleveland, to Linndale, the distance from Marcelline Ave. to Collinwood being yet unfinished.

The Cincinnati Short Belt R. R. & Traction Co. is reported to have interested foreign capital in its project. This company proposes to operate a line through Duck Creek valley, Madisonville, Oakley, Norwood, Bond Hill and the Mill Creek Valley, from Red Bank to Chester Park. Later on the line may be extended to the Ohio River line and will connect all railroads in the Cincinnati zone and facilitate switching traffic. It is also the intention to operate a passenger route. Capt. Peter Eichels, Cincinnati, O., is interested.

It is now believed that work on the elimination of the grade crossings of the Pennsylvania R. R. at Cleveland will be started early in June. The company has accepted the ordinance authorizing the carrying out of the improvement in accordance with plans approved by engineers of the city and company.

It is now stated that the Cincinnati, Hamilton & Dayton Ry. will be double tracked between North Baltimore, O., and Toledo. New bridges will be built and complete rehabilitation of the road bed accomplished.

The Cleveland, Alliance & Mahoning Valley Ry. Co., which is constructing an interurban line from Alliance to Cleveland, has filed a trust deed or mortgage, for $2,000,000 in the Stark county recorder's office. The mortgage is given to the United Banking & Savings Co. of Cleveland as trustee and is to secure coupon bonds to be issued by the railway company in denominations of $500 to $1,000. It is said the company expects to provide $475,000 for the construction of the railway between Alliance and Ravenna.

Advices from Youngstown, O., state that the Mahoning Valley Ry. has started preliminary work for the construction of double tracks across the Market St. viaduct. It is thought the work will take from six to eight weeks including the extending of the double track out as far as McKinnie St. The track now in use across the bridge will be moved toward the center of the bridge to conform with the double tracks in Market St. between Central Square and Front St.

Oklahoma.

The Commercial Clubs of Beaver, Okla., and Meade have taken up a matter of building an electric line between the two towns and are reported to have negotiations under way with F. Corp of Hutchinson, Kan., in connection with the contract for building the proposed line.

The Oklahoma Ry Co., John W. Shartel, vice-president, Oklahoma City, is stated to have succeeded in arranging for its $12,000,000 bond issue, and it is said that extensions of the lines probably will be made to Guthrie, El Reno and Norman before the close of the year.

Oregon.

The Oregon Electric Ry. Co., Portland, Ore., placed an engineering party in the field early this month for work preliminary to the construction of the proposed line from Albany to Salem.

Work has been completed on the construction of the line of railroad from Medford, Ore., to Butte Falls and operations will be commenced at once.

The condemnation of right of way by the Oregon Eastern Ry. through Malheur Canyon to Central Oregon gives rise to the report that the construction work will be under way shortly. Surveys on the south side of the Snake River from the Oregon Short Line tracks to Homedale show that the new track will strike the Short Line near Arcadia, about 7 miles south of Ontario. It is believed that a double track will be laid to the present line used by the branch road running to Brogan, thus making a double track from its connection with the Short Line to Ontario, which will undoubtedly become the division point. A coal chute is being built at Ontario large enough to hold several cars of coal. It will be operated by hydraulic machinery.

Headquarters buildings have been erected at Nyssa, Ore., for the engineering corps for the Oregon Short Line R. R., and it is believed that construction work on the Nyssa-Homedale extension will be started at once. Construction contracts, it is understood, will be let this month. Wm. Ashton, Salt Lake City, Utah, is Chief Engineer.

Pennsylvania.

The Lehigh Coal & Navigation Co., Mauch Chunk, Pa., has surveys underway for a trolley line between Nesquehoning and Lansford. The Lehigh Coal & Navigation Co. owns the trolley line throughout the Panther Creek Valley, which is being operated by the Eastern Pennsylvania Street Railways Co., and the object of this new line is to put Summit Hill, a town of 4,500 inhabitants, on the main line of that road.

Surveys are being made for an electric railway to connect Wellsboro and Mansfield. The line will be 15 miles long. James F. Fisher, Williamsport, Pa., is the Engineer.

The Tarentum, Brackenridge & Freeport Street Ry. Co., recently chartered, as mentioned in our last issue, has completed surveys for the first 4 miles of its line to Birdville, and this portion will shortly be placed under construction. McKinstry Griffith, Tarentum, Pa., is President.

Constructive operations have been resumed in the building of the Lancaster & Northern R. R., which will connect the newly opened cement district near Browntown, where mills are being erected, with the Philadelphia & Reading Ry. at Millway, and the Pennsylvania R. R. near the New Holland turnpike crossing.

Citizens of Harrisville, Pa., have succeeded in raising nearly the entire $15,000 loan asked by the officials of the Pittsburg & Great Lakes Connecting Railroad Co., promoting a line between Ellwood City and Franklin by way of Wurtemburg, Portersville, Barber's Station, Slippery Rock and Harrisville

It is reported at Connellville, Pa., that work has been started upon the construction of the standard gage railroad to be constructed from Humbert to Barronvale, Somerset County, a distance of 10 miles. The line is planned to develop the immense timber tract owned by the United Lumber Co., Uniontown, Pa.

Plans are under consideration for the construction of a steam railroad for a connection with the Philadelphia & Reading Ry. at Biglerville through Arendtsville to Cashtown. H. W. Hamblin, of Harrisburg, representing a Harrisburg and New York syndicate, has the proposition in charge. The road is planned to be entirely independent of the Reading and will simply connect with it.

South Carolina.

• Additional sub contracts for work on the Piedmont & Northern Traction Co.'s line from Greenwood to Greenville have been let as follows: J. R. Ervin, Lenoir, N. C., a section of the work in South Carolina; A. V. Miller and T. L. Nelson, work near Gastonia, N. C., and Irwin, Hart & Co., Knoxville, Tenn., four miles of grading near Pelzer, S. C.

South Dakota.

The Sioux Falls Traction System, Jas. Brooks, Superintendent, Sioux Falls, S. Dak., has two extensions under consideration at that city—one to the cemetery on the east end and the other to a new park on the west.

Tennessee.

⊙J. W. Wright, Jr., Union Springs, Ala., has been awarded the contract for 56 miles of construction for the Birmingham & Northwestern Ry. from Jackson to Dyersburg, Tenn. Contract calls for completion of road within six months from date of signing contract. Construction will commence at Jackson end. The work includes approximately 500,000 cu. yds. earthwork, no rock, 100 acres clearing, 3,300 lin. ft. trestles, 2,500 ft. pipe, one 70-ft. steel span across Forked Deer River. The line passes through Madison, Crockett and Dyer counties and touches the following towns: White's Store, Humphries, Bells, Alamo (county seat of Crockett County), Crockett Mills, Friendship and Bessento. It passes through some of the best timber and farming lands in West Tennessee. The road will connect with the Nashville, Chattanooga & St. Louis Ry., Illinois Central and the Mobile & Ohio at Jackson, the Louisville & Nashville at Bells, Tenn., and the Illinois Central and the Memphis, Chicago & Gulf Ry. at Dyersburg, Tenn. The Jackson Construction Co., R. M. Hall, President, and Mike Harvey, Chief Engineer, Jackson, Tenn., which has the general contract for the construction and equipment for the above road, wishes prices on the following: Materials for construction of 50 miles of railroad for Birmingham & Northwestern Ry.: 60-lb. rail, with spikes, angle-bars, etc.; 70-lb. rail, with spikes, angle-bars, etc.; 1,600 lin. ft. 24-in. and 18-in. pipe, all classes; 270,000 ft. B. M. bridge timber; one 70-ft. steel span, two railway crossings, cattle guards, switches, switch-stands, etc. Quote prices f. o. b. at Jackson, Bells and Dyersburg, Tenn.

The County Commissioners at Memphis have granted a franchise to the Memphis & Rugby Electric Ry. Co. to lay tracks extending northward from Chelsea and Paine Aves. along the Hindman Ferry road across Wolf River to property owned by the Rugby Land Co. of Memphis, which is interested in the proposed line. The construction of the railway will begin at once, it is stated. It is planned by the promoters of the line to have it connect with a line of the Memphis Street Railway Co. and through an agreement with that company to arrange for a transfer system.

The incorporators of the Elizabethtown, Milligan & Johnson City Electric R. R. Co., mentioned in our last issue, are W. G. Payne, A. B. Bowman, J. H. Smith, J. G. Burchfield, W. C Burchfield and J. N. Edens of Johnson City, Tenn. The company proposes connecting Johnson City with Milligan College and Elizabethtown by an electric railway system. This line is to make connection with that of the Johnson City Traction Co.

Texas.

Surveys have been started from Waxahachie to Waco for the proposed interurban line of the Southern Traction Co., J. F. Strickland,

✢ indicates work now open for bids. ⊙ indicates a contract let recently.

President, Dallas. This company proposes to build a line from Dallas to Corsicana and Waco. As noted in our last issue the Fred A. Jones Engineering Co., Dallas, Tex., has the contract for the engineering work.

Promoters from Greenville have been in conference with the Board of Trade of Palestine, looking to the securing of a franchise for building a street car line in that city.

It is expected that construction work will be started shortly for the new railroad line from the Panhandle to the Gulf. This is the line of which L. E. Walker, Austin, Tex., is President, and which is projected from Quanah to Rockport. The first section to be built will be from Belton to Georgetown. The grade work will be for the most part light being largely a scraper proposition. Thomas Moore, Austin, has the construction contract.

The Rock Island, Texas & Gulf R. R. of Amarillo, Tex., has applied for a charter to build a line 290 miles in Western Texas. The road will run from Dalhart to Bronco, in Yoakum County. The capital stock is $175,000.

Utah.

Preliminary surveys for the Salt Lake City & Utah Electric Railway Co., the interurban road from Salt Lake City to the south boundary of Utah County, have been completed through this county, and the permanent survey has been commenced. Rights of way have been secured through Utah County and cities of the county and the only remaining rights to be secured are those at the north end of the proposed line.

Plans and estimates are now being made for double tracking the Salt Lake Division of the Southern Pacific between Ogden and Little Mountain, a distance of 14 miles and it is expected to start the actual construction work shortly.

It is reported that officials of the Harriman lines at New York have authorized the construction of the long-planned Raft River cut-off, destined eventually to connect the Lucin cut-off with the main line of the Oregon Short Line at Burley, Ida., thereby saving several hours between Salt Lake and Portland, and providing transportation facilities for a territory that has long been clamoring for an outlet to its vast resources. Provision for the construction of the first leg of the project will be included among the 1911 expenditures of the $75,000,000 improvement appropriation. A call for bids for the construction of the road from Burley to Kelton, on the old line of the Southern Pacific, has been issued from the Salt Lake City, Utah, offices of the Oregon Short Line, and contracts will be let within a few days, it is said. Acual construction work out of Burley will be started some time in April. This part of the cut-off will be finished in 1911 and will cost several million. For years the Raft River project has been contemplated by the Harriman system as a possible shorter route to the northwest from Salt Lake and, though the present plans to build from Burley to Kelton do not provide for actual connection with Salt Lake, it is admitted that such a cut-off is the ultimate purpose of the road. Wm. Ashton, Salt Lake City, Utah, is Chief Engineer.

Vermont.

As noted in our last issue the Grand Trunk Ry. has taken bids for the construction of that portion of its new line from Windsor to Bellows Falls, in the state of Vermont. Our latest adv[illegible] were that these bids were then being considered by E. H. Fitzhugh, 1st Vice President, Montreal, Que.

Virginia.

The Chamber of Commerce, Richmond, Va., is making every effort to raise the required $150,000 for the construction of the proposed railroad fom Doswell, in Hanover County to Great Wicomico River in North Umberland County. The Northern Neck and South Side sections of Virginia have been at work on the plan to have this road built since last August. The Northern Neck, composed of the counties of Richmond, Lancaster, Westmoreland, King George and Northumberland, lying between the Rappahannock and Potomac rivers, is one of the most fertile and prosperous sections in the eastern part of Virginia, the lack of railroad facilities being the only barrier in the way of its progress.

Washington.

⊙The North Coast R. R., according to information received from Spokane, Wash., has awarded to the Watson, Flagg & Standifer Co., Portland, Ore., the contract for the construction of 18. miles of roadbed from the west city limits of Spokane to Cheney, Wash., through the Marshall canyon. The contract including those awarded several weeks ago for work west of Cheney, covers the entire roadbed of 103 miles to be constructed by the North Coast from Spokane to Ayer Junction on the Snake River, where a connection will be made with the present line of the O. W. R. & N. The company will establish an office at Spokane at once and the entire work will be handled from there. The contractors will have five steam shovels at work besides many dinky trains and other equipment. The company will establish a shop somewhere along the line of construction, where all tools will be sharpened, cars built and general repairs made.

The Chehalis & Cowlitz R. R. Co. has completed surveys and has secured the capital for the construction of its projected 20-mile railroad to run southwest from Chehalis. The construction contract has been let. H. C. Coffman, Chehalis, Wash., is President, and R. F. Southwick, Chehalis, is Chief Engineer.

Wisconsin.

⊙M. D. Keith, Crandon, Wis., is reported to have been awarded the contract for clearing and grading ten miles of line from Crandon for the extension of the Wisconsin & Northern R. R. from Crandon to Shawano. It is said that the work will be sublet.

The Wisconsin Traction, Light, Heat & Power Co., Appleton, Wis., is securing options on land with a view to straightening a curve in its line at the upper end of Wisconsin Ave. in Kaukauna.

Canada.

✣Bids will be received until noon, April 25, by P. E. Ryan, Secretary Commissioners of Transcontinental Ry., Ottawa, Ont., for the construction of the coaling station, ash-pits and cinder-hoists required at Transcona (Man.), Redditt (Ont.), and Graham (Ont.). Plans and specifications may be seen, and full information obtained at the office of Gordon Grant, Chief Engineer, Ottawa, Ont., and of S. R. Poulin, District Engineer, St. Boniface, Man.

⊙Canadian Pacific Ry. has awarded the contract for 1,000 miles of wire fencing. This fencing will be done in the three provinces, Manitoba, Saskatchewan and Alberta. In the first two, work will be done for a distance of 730 miles and in Alberta for a distance of 270 miles. None of this work will be done on lines which are under construction, all being on lines which were completed prior to the close of last season. The fences will be seven strands high, so that 7,000 miles of wire will be used. The contract for the work in Manitoba and Saskatchewan was let to the Banwell Hoxie Wire Fence Co., and that in Alberta to the Ideal Fence Co.

Application has been made to the Canadian government to incorporate the Newport & Northern Alberta Ry., which purposes to build a line from Newport, at the head of Howesound, B. C., to Peace River Landing.

The Canadian Pacific Ry. has served notice on all its tenants in the district bounded by Cherry, Water, Overend, Tate and Front Sts. at Toronto to vacate their premises by the end of this month. Construction will then begin on the new freight yards and freight sheds which the company will erect in that section. The yards and freight shed will occupy an area of upwards of two or three acres.

Bids were opened April 18 by Frank Lee, Division Engineer, Canadian Pacific Ry., at Winnipeg, for the extension of the passenger car shops at that city.

Mexico.

The National Rys. Co. of Mexico, Jas. M. Reid, Chief Engineer, City of Mexico, has completed the preliminary survey on the Durango Canitas Road, which will connect the Sombrerete mines with the main line, and the location is complete for a distance of 90 miles out from Canitas, about half way to Sombrerete. The construction gangs have been at work for 8 weeks out of Durango and if not interfered with, the entire line of 275 kilometers should be completed in from 16 to 18 months.

The following item has been received from Guadalajara, Mexico, regarding the construction of the Southern Pacific Ry. in that country: The construction force on the Southern Pacific R. R. of Mexico is being increased and more than 4,000 men are now employed in the different camps. It is planned to have not less than 6,000 men at work by the early part of May. The grade is now finished to Aguacate, about 15 miles from Tepic. Every effort will be made to finish the tracklaying to Aguacate before the next rainy season. The main construction camp has just been moved from Nanche to a point near Tepic. At present no construction work is in progress on the mountain division between Tepic and Magdalena, but it is stated that as soon as the disturbed political conditions are settled the contract for the tunnel work and grade on this latter stretch of road will be let and pushed to completion as rapidly as possible. It is estimated that it will take three or four years to construct the road through the mountains. For many miles it will be an almost unbroken alternation of tunnels and bridges. The Southern Pacific is making arrangements to begin the construction of its Guadalajara-City of Mexico lines within the next few months, and it is planned to have this line finished by the time Guadalajara is connected with Tepic, thus forming a through line from Nogales on the Arizona-Mexico border to the capital of Mexico. The construction of the line between Guadalajara and the City of Mexico involves no difficult problems, it is stated, and nothing is to hinder it from being finished very rapidly when once the work is started.

ROADS, STREETS AND PAVEMENTS

California.

P. S. Venable, W. S. Sprinkle and A. B. Steel, to whom the contract for the macadam for the boulevard to be laid between Redondo Beach and Wilmington, Cal., has been let by the county commissioners, Los Angeles, will construct a steel frame crusher about three miles southeast of Redondo Beach. The crusher will have a capacity of 225 tons of rock a day and will cost about $5,000.

The highway commission in Orange county, Santa Ana, Cal., has made its report favoring a bond issue for county highways and recommends the following road to Riverside county: Length 15.51 miles, consisting of two sections: Section 1, beginning at Main St., and the northerly city limits of Santa Ana, running thence by Main St. and Chapman St., to the westerly limits of Orange. Section 2, beginning at Glassel St., and the northerly city limits of Orange and running thence by

Olive and the Santa Ana canyon to the boundary line between the counties of Riverside and Orange.

Connecticut.

✣Bids will be received until 11 a. m., May 2, by Capt. F. J. Arnold, constructing quartermaster, New London, Conn., for the construction of macadam roads, including approximately 5,700 sq. yds. and about 13,000 sq. ft. of cement sidewalks at Fort H. G. Wright, N. Y.

District of Columbia.

Among the bills that are to be introduced at this session of Congress, appropriating money for the improvements in the District of Columbia, will be a number providing for the widening and extending of several streets in the northwestern part of the city. One bill provides for the widening of Colorado Ave., between 16th St. and Georgia Ave., to 160 ft. Congress will be asked to provide for the extension of Kenyon St., from 17th St. to Mount Pleasant, and of 17th St., from Kenyon St. to Irving St. It is also planned to widen Buchanan St., between Piney Branch road and 16th St., to 90 ft.

C. B. Hunt, engineer of highways for the District of Columbia, Washington, has finished the plans for laying of asphalt and asphalt block on unpaved streets. The commissioners appropriated $79,500 for this work.

Florida.

✣Bids will be received until 10 a. m., May 3, by Board of Duval County Commissioners, Jacksonville, Fla., for the construction of approximately 13,000 sq. yds. of asphalt macadam resurfacing from the city limits of South Jacksonville on the Atlantic Boulevard for a distance of 1⅛ miles. Carl Barnard is County Engineer.

Georgia.

⦿The board of local improvements of Aurora, Ill., has awarded the contract for the paving of Oak Ave., from Galena St. to Plum St., with asphalt, to the McCarthy Improvement Co., of Davenport, Ia., for $17,113.

The city council of Augusta, Ga., has notified the property owners on both sides of Jackson St., from Fenwick to Twiggs Sts., that it intends to construct cement sidewalks thereon.

Illinois.

✣Bids will be received by the Board of Local Improvements, Cicero, Ill., Frank Comerford, President, Jno. Forest, Secretary, until April 25, 1911, 8 p. m., for the paving of 23rd Pl., 24th St. and 24th Pl. from 52nd Ave. to 48th Ave. and 50th Ave., 51st Ave. and E. ½ of 52nd Ave. from 23rd St. to 25th St. Following is the engineer's estimate: 23,176 lin. ft. concrete combination curb and gutter, 7 ins. in thickness, gutter flag 18 ins. by 6 ins. laid on cinders; total $10,644.48; 25,590 sq. yds. vitrified brick pavement on an 8-in. macadam foundation with 2-in. sand cushion, $46,062.00; 51 manholes to be brought to grade, $102.00; 66 catch basins to be brought to grade, $330.00. Total, $57,138.48. Plans and specifications may be had upon application to Chas. Sheffield, Town Clerk, Cicero, Ill.

The Board of Local Improvements of Taylorville, Ill., has ordered the paving of Webster St. for a distance of 2,585, and Second st. The estimated cost of improving Second St. is as follows: Earth excavation, 2,410 cu. yds., at 25 cts., $602; earth fill, 21 cu. yds., at 25 cts., $5; total combined curb and gutter, 5,292 lin. ft., at 50 cts., $2,640; total curb, without gutter, 282 lin. ft., at 30 cts., $82; concrete end curbing, 198 lin. ft., at 15 cts., $30; 6,725 sq. yds. of vitrified block paving on concrete base, including sand cushion and asphaltic filler, laid complete at $1.66, $11,164; adjusting manhole covers, valve boxes, water cut-offs, catch basins, etc., $185; assessment expenses, etc., $881; total estimated cost, $15,595. James W. Dappert, Taylorville, Engineer. The board also ordered the improvement of West Main Cross St., for which the engineer has estimated the work to cost as follows: Earth excavation, 1,150 cu. yds. at 25 cts., $288; combined concrete curb and gutter, 1,805 lin. ft., at 50 cts., $903; concrete end curbing, 153 lin. ft., at 15 cts., $23; adjusting inlets, valve boxes, water cut-off, etc., $45; 2,947 sq. yds. vitrified block paving on concrete base, including sand cushion, vitrified block and asphaltic filler, complete, at $1.66 per sq. yd., $4,892; assessment expenses, etc., $368; total estimated cost, $6,519.

Farmers residing along the Peoria road north of Springfield, Ill., and representatives of the zinc works and the Devereaux mine, recently met with the state highway commission to discuss the construction of a macadam road from Sangamon Ave. to the state biological laboratory. The proposed road will cost approximately $10,000, of which $8,000 will have to be contributed by those interested in the road. It is proposed to build an asphalt macadamized highway, beginning at Sangamon Ave. and Eighth St., and following Peoria road two miles. A. M. Johnson is state highway engineer.

Indiana.

✣Bids will be received until 1 p. m., May 1, by the board of county commissioners, Williamsport, Ind., for the construction of a gravel road in Kent township. David H. Moffit is auditor of Warren county.

✣Bids will be received until 2 p. m., May 1, by Board of Crawford County Commissioners at English, Ind., for the construction of a pike road in Liberty township. J. Evan is county auditor.

✣Bids will be received until 1 p. m., May 1, by Board of Benton County Commissioners at Fowler, Ind., for the construction of a free stone road on Boliver and Oak Grove township line. Lemuel Shipman is auditor of Benton county.

✣Bids will be received until 11 a. m., May 1, by Board of Jennings County Commissioners at Vernon, Ind., for the construction of three miles of pike road in Vernon township. M. W. Brogan is auditor.

✣Bids will be received until 1 p. m., May 1, by Board of Benton County Commissioners at Fowler, Ind., for the construction of a free stone road in Oak Grove township. Lemuel Shipman is county auditor.

✣Bids will be received until 1:30 p. m., May 1, by the Board of Washington County Commissioners, Salem, Ind., for the construction of a road in Gibson township. Frank S. Munket is county auditor.

✣Bids will be received until 10 a. m., May 2, by Board of Spencer County Commissioners, Rockport, Ind., for the construction of two public highways in Ohio township. J. T. White is auditor of the county.

✣Bids will be received until 1 p. m., May 2, by Board of Cass County Commissioners at Logan, Ind., for the construction of a gravel road in Jefferson township. J. E. Wallace is auditor.

✣Bids will be received until 1 p. m., May 2, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of two gravel roads in Chester township. J. P Noftzger is county auditor.

✣Bids will be received until 1:30 p. m., May 2, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of two roads in Noble township. J. P. Noftzger is auditor of county.

✣Bids will be received until 1 p. m., May 2, by Board of Lawrence County Commissioners, Bedford, Ind., for the construction of two gravel roads. Ezra W. Edwards is county auditor.

✣Bids will be received until 11:30 a. m., May 5, by Board of Clay County Commissioners, Brazil, Ind., for the construction of gravel roads in Van Buren, Dick, Johnson and Posey townships. E. A. Staggs is county auditor.

✣Bids will be received until 1 p. m., May 9, by Board of Franklin County Commissioners, Brookville, Ind., for the construction of a highway in Bath and Springfield townships; also one in Springfield township. Charles A. Miller is auditor.

✣Bids will be received until 1 p. m., May 13, by Board of Rush County Commissioners, Rushville, Ind., for the construction of a gravel road on line of Rush, Shelby and Hancock counties. J. M. Stone is county auditor.

✣Bids will be received until 10 a. m., April 21, by Board of Public Works, Indianapolis, Ind., for the improvement of Trenton Ave. from the west curb line of New Jersey St. to the west curb line of Princeton Ave., by grading, graveling and rolling the road way; also Princeton Ave., from south curb line of Trenton Ave. to the south curb line of Thirtieth St., by grading, graveling and rolling the roadway.

✣Bids will be received until 10 a. m., April 21, by Board of Public Works, Indianapolis, Ind., for the improvement of Trenton Ave., from the west curb line of Princeton Ave., and Princeton Ave., from the south curb line of Trenton Ave. to the south curb line of Thirtieth St., by grading and paving the sidewalks.

✣Bids will be received until 10 a. m., April 24, by Board of Public Works, Indianapolis, Ind., for the improvement of the following streets: Kentucky Ave., northwest side from the west curb line of Drover St. to a point 214 ft. southwest of Morris St., by grading and paving the sidewalks; Meridian St., west side, from the north curb line of Fortieth St. to a point 1,028 ft. north of the north property line of Fortieth St., by grading and paving the sidewalks; Washington St., north side, from the east curb line of Tacoma Ave. to the west curb line of Temple Ave., by grading and paving the sidewalks; Michigan St., north side, from the east curb line of Belmont Ave. to the west cement walk line of Elder Ave., by grading and paving the sidewalks; Henry St., from the east property line of Delaware St. to the west cement walk line of Alabama St., by grading and paving the sidewalks; Arlington Ave., west side, from the south property line of University Ave. to the north property line of Beechwood Ave., by grading and paving the sidewalks; Meridian St., from the south property line of Thirty-eighth St. to the south property line of Forty-second St.

✣Bids will be received until 10 a. m., May 1, by Board of Adams County Commissioners, Decatur, Ind., for the crushed stone and other supplies for repair of turnpikes. H. S. Michaud is auditor.

⦿Ryan & Carroll of Jonesboro, have been awarded a contract by the county commissioners, Marion, Ind., for the reconstruction of the Thomas Baird road in Jonesboro, the bid being $7,435.

⦿The county commissioners, Lafayette, Ind., have awarded contracts as follows for the construction of three gravel roads: Mahoney & Allen of Greencastle, Thomas road No. 1 in Tippecanoe township for $4,846; and the Thomas road No. 2 in the same township for $1,937; G. H. Fatout of Indianapolis, for the Gaylord road in Wabash township for $3,227.

⦿The county commissioners at Marion, Ind., have awarded the contract for the improvement of the Earl Plough road to Harvey B. Sick of Bluffton, Ind., for $3,100.

⦿L. F. Kent of Brookston, Ind., has been awarded the contract by the county commissioners at Monticello, Ind., for the construction of the Wm. Hewitt gravel road between West Point and Round Grove townships for $6,309. Bids were opened April 4.

The Board of Public Works of Vincennes, Ind., has confirmed the resolution calling for the improvement of Jefferson Ave. from Second St. northwesterly to the Terre Haute road. The street is to be improved by grading and graveling the road bed and building concrete sidewalks and curbing. The engineer's estimated cost of the improvement is as follows: Excavation, $138; embankment, $1,302; gravel, $2,892; walks, $3,055; curbing, $2,599; sewers, $40.

No bids were received by the county commissioners of Laporte County, Ind., on April 6, as advertised for the construction of a macadamized road in Center and Springfield townships on account of the low estimate of cost. Fred A. Hausheer is Auditor.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Iowa.

The board of public works of Davenport, Ia., on April 5 received the following bids for the paving of several of the down town streets, reported that the contracts were awarded to the lowest bidder in each case: Brady St., between Second and Fifth, asphalt and brick, excavation, $0.44; paving, $1.89½; curbing, $0.12; McCarthy Improvement Co. Harrison St., between Second and Fifth Sts., asphalt and brick paving, same as Brady St. in price and company. Main St., between Front and Fourth Sts., asphalt and brick, same as Brady and Harrison Sts. in price and company. Eighth St., Farnam St. east 310 ft., brick paving, Northwestern Construction Co., excavation, $0.40; paving $1.88; curbing, $0.32. Lincoln Ave., between Telegraph road and Newberry St., brick paving, Northwestern Construction Co., excavation, $0.40; paving, $1.85; curbing, $0.33. Sylvan Ave., between Sixth and Tenth Sts., brick paving, Northwestern Construction Co., excavation, $0.35; paving $1.78; curbing, $0.33; Ripley St., between Lombard and Norwood Aves., concrete paving, C. H. Hubbell, excavation, $0.34; paving, $1.29; curbing, $0.33½; Brown St., between Fifth and Sixth Sts., brick paving, Northwestern Construction Co., excavation, $0.35; paving, $1.78; curbing, $0.33; Alley between Front and Second Sts. and Gaines and Warren Sts., brick paving, Northwestern Construction Co., excavation, $0.40; paving, $1.63; bids for the paving of Vine St. between Fifth and Sixth Sts. were rejected owing to a change in the materials to be used in the paving of the street.

The city council of Denison, Ia., has passed a resolution looking to the paving of 40 blocks of streets this season. Engineers will start at once to make the needed drawings and calculations as to grades.

The city council of Des Moines, Ia., has been petitioned by property owners on Ninth St. for the paving of that thoroughfare from Euclid Ave. to Seneca St.

The town council of Greenfield, Ia., has taken the necessary steps to pave the public square in Greenfield and the streets and alleys leading therefrom to a point one-half block from the square.

Kansas.

The county commissioners of Johnson county, Olathe, Kan., have decided that within 30 days they will ask bids for the construction of an 18 ft. rock road running into Johnson county from 39th St. and State line, 10 miles in the direction of Olathe. The estimated cost of the road is $100,000. Joseph Hibner is chairman of the commissioners.

The Wyandotte county commissioners, Kansas City, Kan., have ordered County Surveyor O. K. Williamson, to prepare the grade for a mile and a half of rock highway to be built on the Kaw Valley road extending from Edwardsville, Kan., toward Kansas City, Kan.

Kentucky.

✣Bids will be received until May 15 by Board of Council, Catlettsburg, Ky., for the construction of approximately 25,000 sq. yds. of street paving and 15,00 lin. ft. of concrete curb and gutter. J. J. Montague is Mayor and John McDyer is City Engineer.

The Hardin county surveyor, Elizabethtown, Ky., has completed the survey for the construction of a model highway through Hardin county as part of the Louisville-Mammoth Cave Blvd.

Louisiana.

⦿The Washington Parish police jury, Franklinton, La., has decided to enter into a contract with J. S. Moody to build a mile of improved road on the route known as the $5,000 road.

The police jury of Winn Parish, Winnfield, La., has been authorized to borrow $25,000 to begin work on the construction of roads by July 1. The sum of $50,000 is available for the work.

The citizens of Shreveport, La., on April 4 voted the issuance of bonds to the amount of $250,000 for paving purposes. The commissioner of finance has issued notices that he will receive bids until April 25 for the purchase of the bonds.

The city council of Estherwood, La., has ordered sidewalks built in South Estherwood to correspond with those in the northern part of town.

The police jury, Natchitoches, La., has adopted a resolution making application to the state highway department for state aid provided under act 49 of 1910, for the construction of 18 miles of good road from Natchitoches to Robeline, to join with the De Soto good road work. This work will be let out by contract, bids for which will be asked under the supervision and plans of the highway department.

Maine.

✣Bids will be received until 11 a. m., May 8, by Capt. G. O. Hubbard, Constructing Quartermaster, Portland, Me., for the construction of a cinder road to cemetery at Fort McKinley, Me.

Michigan.

✣Bids will be received until 1 p. m., April 22, by Board of County Road Commissioners, Iron Mountain, Mich., for the construction of a dirt road near Waucedah. Plans and specifications are on file at the office of G. V. Carpenter, County Road Engineer.

⦿The Sanitary St. Flushing Machine Co., of St. Louis, Mo., at $940, and the Studebaker Corporation of South Bend., Ind., at $1,100, have been awarded the contract by the board of public works of Grand Rapids, Mich., for furnishing two street flushing machines. Bids were opened April 6.

Spaulding township, Saginaw county, Mich., has voted the issuance of bonds in the sum of $5,000 to build new roads. The money will be expended on the East St. road, south of Saginaw, under direction of John Ederer.

Holly township, Holly, Mich., has voted the issuance of bonds in the sum of $1,500 for the construction of a mile of state reward road

Minnesota.

⦿The city council of Crookston, Minn., has awarded the contract for paving the principal streets of the city to P. McDonnell of Duluth for approximately $60,000. The paving will be laid at $1.85 per sq. yd. Work will start at once.

⦿The city council of Winona, Minn., has awarded the contract for the paving of Mankato Ave., with brick between the stone arch bridge and Lake Ave., to John Abel, R. No. 1, Evansville, Minn., for $1.39 per sq. yd. for brick, $0.32 per lin. ft. for curbing, $0.20 per lin. ft. for headers, and $1 each for water drain through curb.

The county commissioners of Swift county, Benson, Minn., have appropriated $2,000 to be spent upon the state highway extending east and west through this county, along the Great Northern railway, through the villages of Kerkhoven, Murdock and De Gran to the city of Benson, and running through Danvers and Holloway to Appleton.

Mississippi.

✣Bids will be received until June 1 for the construction of 58 miles of gravel roads at Hazlehurst, Miss., in Copiah County. Plans and specification will be ready after May 1 at the office of The George Co., Randolph Bldg., Memphis, Tenn. W. O. Harter is Secy. and Treas. of the company.

Missouri.

✣Bids are asked [illegible] Council of Fulton, Mo., P. D. Thurmond, City Engineer, [illegible] an asphalt filler, 12,000 yds. of macadam with a binder and 10,000 ft. of concrete curb. Official advertisement will be found [illegible] this issue.

An election is to be held in Pettis county, Sedalia, Mo., on May 16 for the purpose of voting on the issuance of bonds in the sum of $350,000 for the construction of 125 miles of rock roads.

The city council of Fulton, Mo., has passed an ordinance calling for the improvement of 14 blocks of street at an estimated cost of $30,000. Seven blocks are to be paved with vitrified block and seven are to be macadamized. Improvements are also contemplated on streets in outlying districts.

The first election held under the new law was held in Lexington, Mo., special road district on April 10, and $125,000 bonds voted to be used in macadamizing the roads. The formation of six other similar districts in Lafayette county will be submitted May 20

Nebraska.

✣Bids will be received until noon, April 20, by Roscoe C. Ozman, City Clerk, Lincoln, Neb., for the curbing, grading and paving in Paving District No. 198, being 17th St. from South to Sewel Sts.

⦿E. R. Bing of Hastings, Neb., has been awarded the contract by the city of Hastings, Neb., for the paving of Hastings Ave. with brick blocks on a concrete base, having concrete curbing. The contract price is $1.88 per sq. yd. Bids were opened April 10.

New York.

✣Bids will be received until 10 a. m., April 24, by Capt. W. D. Davis, Constructing Quartermaster, Plattsburg Barracks, N. Y., for the construction of approximately 154 sq. yds. of concrete walk for building No. 60 and for installing window and door screens in buildings Nos. 59 and 60 at Plattsburg Barracks, N. Y.

✣Bids will be received until 1 p. m., May 1, by State Highway Commission, Albany, N. Y., for the improvement of the following highways: Monroe county, Road No. 495, Parma Corners - Spencerport, Spencerport - North Chili, approximate length 6.15 miles; Monroe county, Road No. 497, Pittsford-North Henrietta, approximate length 2.67 miles; Monroe county, Road No. 502, Honeoye Falls-Pittsford Town Line, approximate length 5.19 miles; Monroe county, Road No. 538, Ridge-Rochester-Sea Breeze, approximate length 5.67 miles; Monroe county, Road No. 573, Sea Breeze-Nine Mile Point, approximate length 6.38 miles; Orleans county, Road No. 394, Oak Orchard, Sec. 3, approximate length 3.24 miles; Orleans county, Road No. 395, Medina-Alabama, approximate length 5.40 miles; Orleans country, Road No. 5118, Holley-Albion, Part 2, approximate length 2.24 miles; Niagara county, Road No. 749, Lockport-Tonawanda Creek, approximate length 10.30 miles; Jefferson county, Road No. 5119, [illegible] Watertown, Part 3, approximate length, 3.20 miles; Madison county, Road No. 5120, [illegible]etteville-Shittenango, Part 2, approximate length, 3.31 miles; Chenango county, Road No. 5121, North Norwich-Sherburne, approximate length, 6.88 miles; Oneida county, Road No. 840, North Brookfield-Waterville, approximate length, 4.37 miles; Tompkins county, Road No. 5122, Ithaca-Danby, Part 2, approximate length, 3.24 miles; Montgomery county, Road No. 5123, Nelliston-Palatine Bridge, approximate length, 4.06 miles; Montgomery county, Road No. 5124, Palatine Bridge Fonda, Part 1, approximate length, 4.26 miles; Montgomery county, Road No. 5125, Palatine Bridge-Fonda, Part *2, approximate length, 4.01 miles; Montgomery county, Road No. 5126, Hoffman - Cranesville, approximate length, 2.24 miles; Wayne county, Road No 5127, Union Hill-Ontario Center, aprpoximate length, 3.48 miles; Cattaraugus county, Road No. 695, Otto-Cattaraugus (reconstruction), approximate length, 1.21 miles; Cattaraugus county, Road No. 697, Otto-East Otto, Sec. 2 (reconstruction), approximate length, 2.27 miles. An alternative proposal to be endorsed as "5124-25 combined" will also be received for the following roads combined in one contract: Montgomery county, Road No. 5124, Palatine Bridge-Fonda, Part 1, approximate length, 4.26 miles; Montgomery county, Road No. 5125, Palatine Bridge-Fonda, Part 2, approximate length, 4.01 miles. Maps, plans specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the [illegible]

Mumm[illegible] Bldg., Albany, N. Y.; [illegible] [illegible] roads; at the office of Division Engineer Guy H. Miller, Cleveland Bldg., Watertown, N. Y., for Jefferson and Oneida county roads; also at the office of Division Engineer Fred W. Sarr, South Clinton and West Jefferson Sts., Syracuse, N. Y., for Crenango, Madison and Wayne county roads; also at the office of Division Engineer M. W. Wilbur, Cutler Bldg., Rochester, N. Y., for Cattaraugus, Monroe, Niagara and Orleans county roads, and at the office of Division Engineer Paul McLoud, Press Bldg., Binghamton, N. Y., for Tompkins county roads.

✣Bids will be received until 10 a. m., April 24, by Capt. W. D. Davis, Constructing Quartermaster Plattsburg Barracks, N. Y., for the construction of approximately 154 sq. yds. of concrete walk for building No. 60 and for installing window and door screens in buildings Nos. [illegible] and 60, all at Plattsburg Barracks, N. Y.

✣Bids will be received until 11 a. m., April 24, by Lawrence Gressler, President, Borough of Queens, third floor, Borough Hall, New York City, for nine street improvement contracts, the largest being No. 2, as follows: For regulating, grading, curbing, recurbing, reflagging and paving with asphalt blocks on a concrete foundation in Second Ave., from Jackson Ave. to Flushing Ave., First Ward. The time allowed for doing and completing the above work will be 175 working days. The amount of security required will be $35,000. The engineer's estimate of the quantities is as follows: 2,000 cu. yds. of earth excavation; 2,600 lin. ft. of old concrete curb reset; 300 lin. ft. of cement curb; 4,000 sq. ft. of old flagstone sidewalk, retrimmed and relaid; 6,650 cu. yds. of concrete; 39,800 sq. yds. of asphalt block pavement, outside of railroad area; 8,920 sq. yds. of asphalt block pavement, within railroad area; 1,500 cu. yds. of concrete within railroad area.

✣Bids will be received until 11 a. m., April 26, by Alfred E. Steers, President of Borough of Brooklyn, N. Y., for 32 street improvement contracts, the largest being No. 1, as follows: For regulating and repaving with grade 1 granite on a concrete foundation the roadway of Bay Ridge Ave. from Shore Road to 3rd Ave., together with all work incidental thereto. The engineer's estimate of the quantities is as follows: 11,400 sq. yds. grade 1 granite pavement, with cement joints (1 year maintenance); 1,900 cu. yds. concrete for pavement foundation; 2,230 lin. ft. new curbstone set in concrete; 3,350 lin. ft. old curbstone reset in concrete. The time allowed for the completion of the work and the full performance of the contract is 60 working days. The amount of security required is $15,000. Blank forms and further information may be obtained at the office of the Bureau of Highways, Room 14, Municipal Bldg., the Borough of Brooklyn.

✣Bids will be received until 2 p. m., May 4, by J. M. Guion, Clerk Board of Trustees, Seneca Falls, N. Y., for paving State and Bayard Sts. The work for which proposals are invited consists of the following approximate quantities: 12,500 cu. yds. of excavation, 17,000 lin. ft. of curbing, 15,000 lin. ft. of 3-in. drain tile, 5,000 lin. ft. of vitrified pipe, 42 catch basins, 25,000 sq. yds. of brick or macadam pavement. Specifications and blank forms of proposals can be obtained upon application to John M. Guin, Village Clerk, or to J. W. Brennan, Village Engineer. Plans may be seen at the Engineer's Office, Room 8, Schnirel Bldg., Geneva, N. Y.

✣Bids will be received until 8 p. m., April 25, by Common Council, City of Dunkirk, N. Y., for paving and grading or macadamizing East and West Sixth Sts., Lion St. and King St. The approximate amount of work to be done is as follows: Lion St., 6,425 sq. yds. of pavement; Sixth St., 9,285 sq. yds.; King St., [illegible] sq. yds. R. H. [illegible], City Clerk.

✣Bids will be received until 10:30 a. m., May [illegible], by Commissioner of Public Works, Hudson, N. Y., for furnishing material and labor necessary to relay approximately 5,400 lin. ft., [illegible] and to pave about 13,500 sq. yds. of street with vitrified brick. William Wortman is City Clerk. M. J. O'Hara is City Engineer.

✣Bids will be received until 7:30 p. m., April 25, by Board of Public Works, Plattsburgh, N. Y., for construction of about 1,400 sq. yds. of asphalt block pavement on Margaret St.; also for about 1,400 sq. yds. of vitrified brick paving on Dock St. and 1,500 sq. yds. of concrete pavement on such streets as board may designate.

⦿The Borough of Queens, New York City, has awarded contracts for paving amounting to $164,328, as follows: The Barber Asphalt Paving Co., at $152,451, for the repaving with asphalt block of that portion of Jackson Ave. from the Queens-borough Bridge plaza, in Long Island City, to the Woodside car barns; Clancey & Van Alst, at $9,262, for the repaving with the second hand granite blocks of Jackson Ave., from Woodside to the Trains Meadow road.

North Carolina.

The Appalachian Highway Co., has been organized at Asheville, N. C., with State Geologist Dr. Joseph H. Pratt, president; Dr. C. P. Amblen, vice president, and George L. McKay, secretary and treasurer. The company has a capital stock of $300,000 and its principal object is to build the crest of the Blue Ridge highway.

North Dakota.

Jolliete township, Pembina county, North Dakota, is in the market for quotations on 24 wheel scrapers, also $500.00 worth of corrugated culverts. Frank Emerson of Jolliette, No. Dak., is clerk of said township.

Ohio.

✣Bids will be received until 1:30 p. m., April 24, by Commissioners of Road District No. 1, Mahoning County, O., for the improvement by slag and limestone macadam of the following roads, viz., the Snyder Road in Austintown Township, a distance of 133 ft.; the Town Line Road in Youngstown and Austintown Townships, a distance of 5,440 ft.; and Glenwood Ave. Extension Sec. 2 in Youngstown Township, a distance of 3,820 ft. Each separate proposal must be accompanied by a certified check for $500.00 by a bank located in Mahoning County and made payable to the order of Frank Agnew, Secretary of said Road Commissioners, and mailed or delivered at their office, Room No. 420, Dollar Bank Bldg., on or before 1:30 p. m., April 24, 1911, at which time all bids will be opened. Plans and specifications will be on file at the office of the County Auditor and will be furnished to bidders on application to E. S. Smith, Engineer, No. 419 Dollar Bank Bldg., Youngstown, Ohio.

✣Bids will be received until noon, April 28, by Board of County Commissioners, Cincinnati, O., for the improvement under specifications No. 182, for the improvement of 8 mile road at the schoolhouse in Anderson township.

✣Bids will be received until noon, April 28, by Board of County Commissioners, Cincinnati, for the improvement under specifications No. 72, of the Loveland and Madeira pike in Symmes township. Fred Dreihs is clerk.

✣Bids will be received until noon, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for the improvement of Ratterman Ave., from Harrison Ave. to McKinley Ave., by grading, setting cement combined curb and gutters, paving the roadway with brick and constructing the necessary drains and inlets. J. J. Wenner is clerk.

✣Bids will be received until noon, April 21, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for improving Wellington Pl. from Auburn Ave. to its western terminus by grading, setting cement curb, paving the roadway with brick where grade is 6 per cent less and by macadamizing the roadway and paving the gutters with brick where the grade exceeds 6 per cent and constructing the necessary drains and inlets.

✣Bids will be received until noon, April 21, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for the improvement of Dirheim Ave., from Lischer Ave. to right of way of Cincinnati & Westwood Railroad, by grading, setting cement combined curb and gutters, paving the roadway with brick and constructing the necessary drains and inlets. Plans, specifications and blank proposals can be obtained at the office of the chief engineer of the Department of Public Service.

✣Bids will be received until noon, April 20, by Director of Public Service, Springfield, O., for the construction of a sewer in Sheridan Ave. from Belmont Ave. to a point 150 ft. west, and in Belmont Ave. from Sheridan Ave. to Burnett Ave., and in Burnett Ave. from Belmont Ave. to the first alley east of Douglas Ave., and in the first alley east of Douglas Ave. from Burnett Ave. to Harrison St., and in Harrison St. from Belmont Ave. to Oakland Ave., and in Clairmont Ave. from Harrison St. to High St., and in Belmont Ave. from Harrison St. to High St., and in Douglas Ave. from Harrison St. to High St., and in Arlington Ave. from Harrison St. to High St., and in Kenilworth Ave. from Arlington Ave. to Oakland Ave., and in Elmwood Ave. from Belmont Ave. to Oakland Ave., and in Charles St. from Belmont Ave. to Oakland Ave. in accordance with the plans, profiles, specifications and estimates therefor now on file in the office of the Department of Public Service. Wm. H. Mahoney is clerk.

✣Bids will be received until noon, April 21, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for the improvement of Ratterman Ave., from Harrison Ave. to McKinley Ave., by grading, setting cement combined curb and gutters, paving the roadway with brick and constructing drains and inlets. J. J. Wenner is clerk.

✣Bids will be received until noon, April 21, by Department of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for the improvement of Dirheim Ave., from Lischer Ave. to right of way of C. & W. R. R., by grading, setting cement combined curb and gutters, paving the roadway with brick and constructing the necessary drains and inlets. Plans and specifications are on file at the office of the chief engineer of the department. J. J. Wenner is clerk.

✣Bids will be received until noon, April 28, by Director of Public Service, Cincinnati, O., for the necessary labor and material for the improvement of Ludlow Ave., from the east line of Brookline Ave. to east line of Clifton Ave., by grading, setting cement curbs, paving the roadway with wood blocks and constructing the necessary drains and inlets. Plans and specifications can be obtained of the chief engineer of the department. J. J. Wenner is clerk.

⦿Taylor & Biggs of Findlay, O., have been awarded the contract for the construction of nine miles of pike in Huron county by the commissioners of that county, Norwalk, O. The contract involves about $42,000.

Hayes Ave., Youngstown, O., is being surveyed preparatory to being paved. The council passed the legislation for the improvement three weeks ago.

The city council of Lorain, O., has adopted a resolution providing for the paving of Pearl Ave., from East 28th St. to East 34th St.

The city council of Delaware, O., has passed a resolution providing for the improvement of Campbell St., and of Elizabeth St., and Central Ave., from Elizabeth to Euclid.

Advices from Youngstown, O., state that Poland township has voted in favor of a bond issue not to exceed $100,000 for the making of good roads.

The county commissioners at Marion, O., have granted a petition calling for the construction of a pike eight miles in length, known as the Gracely pike and located in Richland and Waldo townships.

The county commissioners at Marion, O., have granted a petition calling for a pike four miles in length, in Montgomery township and running from Agosta and Scott town pike to the state road. The new road will be known as the Clements road.

The Henry county commissioners, Napoleon, O., are advertising for bids for the construction of about 30 miles of new stone roads, varying in length from three to eight miles. The commissioners have also been petitioned for a joint pike between the counties of Hancock, Henry and Putnam. The average cost of the stone roads per mile in Henry county, is said to be about $5,000.

Service Director Sundmaker of Cincinnati, O., has approved the revised plans and specifications for the improvement of Ludlow Ave., between Brookline and Clifton Ave., and ordered the work re-advertised.

Oklahoma.

⊙The city council of Hugo, Okla., has awarded the contract for paving nearly two miles of the residence streets, with road asphalt to F. R. Stone of Lima, O.

A resolution is being prepared by the city council of Hugo, Okla., for paving the business section with either creosoted pine blocks or brick.

The city council of Oklahoma City, Okla., has adopted two resolutions from residents of certain streets and alleys in the outlying districts requesting that the paving contracts be let. Paving will be done to the extent of approximately $1,000,000. The streets to be paved under the petition are: Twenty-second St., Dewey Ave., Francis Ave., Fourth St., Third St., Fifth St., Seventh St., McKinley Ave., Ames Ave., Douglas Ave., Brauer Ave., Eighth St., Ninth St., Ellison Ave., Douglas Ave. (east), Kentucky Ave., Seventeenth St., Thirty-first St., Thirty-second St., Twenty-ninth St., Thirtieth St., Twenty-eighth St., Twenty-first St., and Fourteenth St.

Oregon.

Advices from Portland, Ore., state that Mayor Simon has declared himself in favor of the proposed establishment of a municipal paving plant.

Pennsylvania.

✣Bids will be received until noon, April 21, by W. W. Caldwell, Commissioner, Highway Department, Harrisburg, Pa., for grading the following highways: Nectarine from Berryhill to Swatara; Hunter from Nectarine to 13th; Summit from Derry to Thompson.

✣Bids will be received until noon, April 27, by J. H. Mount, County Controller, Washington, Pa., for furnishing of vitrified paving brick or block to be used in the constructon of the Charleroi-Bentleyville road and the McDonald-Venice road. There are 17,600 sq. yds. of paving on the Charleroi-Bentleyville road, more or less, and 5,900 sq. yds. of paving on the McDonald-Venice road, more or less. Prices quoted to be by the thousand f. o. b. Bentleyville and f. o. b. McDonald, Pennsylvania R. R. A certified check for $200.00 must accompany each bid and samples of brick and block must be furnished to Chaney & Armstrong, County Engineeers.

⊙The commissoners and controller of Allegheny county, Pittsburg, Pa., have awarded the contract for materials and improvements on roads throughout the county to the Pittsburg Amiesite Co., and the Standard Bithulithic Co. Amiesite will be used. The Pittsburg Bituminous Engineering Co. was awarded the contract for 15,000 tons of gravel and screening at $1.75 per ton, delivered by the Pennsylvania railroad, and at $1.50 per ton, delivered by the Pittsburg & Lake Erie railroal. The C. P. Mayor Brick Co. received the contract for 496,000 bricks to be delivered over the Mt. Lebanon road at $14.45 per M, and 592,000 to be delivered over the Brownsville road at the same price.

A movement has been started in Bellefonte, Pa., for the paving with brick of that section of High St. between the Springs Creek bridge and Dunlap St.

⊙The borough council of Youngwood, Pa., has awarded the contract for the paving of the borough streets to James Nixon of Clairton, Pa., for approximately $63,000. The streets to be paved are Third, Fourth, Fifth and several cross streets, totaling almost three miles. Paving block will be used.

The state senate, Harrisburg, Pa., has passed the Sproul highway bill which provides an appropriation of $6,000,000, of which $4,000,000 is for the use of the highway department and the remaining $2,000,000 for state aid for roads. The bill also provides for the laying out of nearly 300 routes joining county seats.

Tennessee.

✣Bids will be received until noon, April 21, by Ennis M. Douglass, City Clerk, Memphis, Tenn., for furnishing the necessary labor and material for work on the following streets: West Court Ave., from North Main St. to North Front St., 815 sq. yds. old brick pavement removed, 815 sq. yds. concrete foundation bushed, 815 sq. yds. asphalt pavement; South Lyceum lane, from Union Ave. to Monroe Ave., 320 cu. yds. excavation, 631 sq. yds. concrete foundation, 631 sq. yds. old brick relaid. Old brick used on Lyceum lane will be furnished by the city of Memphis.

A bond issue of $300,000 has been voted by Blount county, Maryville, Tenn., for the construction of additional roads. It is understood that bids will be sought shortly for this work.

Texas.

✣Bids will be received until 3:30 p. m., June 1, by commissioner's court, for the construction of graveled and macadamized roads in Road District No. 2 (Granger-Bartlett) in Williamson county. W. W. Jenkins, Georgetown, Texas, is auditor.

⊙The board of municipal commissioners of Dallas, Tex., has awarded the following contracts for paving of streets aggregating $200,000: The Texas Bitulithic Co., at $2.30 per sq. yd., for paving Forest Ave. from Central to Arza, the total cost is estimated at $65,018; The Creosoted Wood Block Paving Co., at $2.59 per sq. yd., for the paving of Grand Ave. from Ervay to Fair Park, the total cost is estimated at $70,961; The Texas Bitulithic Co., at $2.30 per sq. yd. for the paving of Worth St. from Pacific Ave., the total cost is estimated at $55,088; The Texas Co. also received the contract for the paving of Arza St. from Grand Ave. to Forest, at $2.30 per sq. yd., total cost, $10,000, and for paving Boulevard from Central to Oakland, from Jeffries to Arza, and from Jeffries to Oakland, $7,429.

The Gulf Coast Good Roads association of Galveston, Tex., has been incorporated by George Sanders, Sam Harris, Frank Smith and others. There is no capital stock.

Two elections were held in Caldwell county, Tex., on April 6 to vote bonds in each road district for $2,500 each. The towns effected are Luling and Joliet in road district No. 2, and Prairie and Fentress in district No. 3. The money will be used for the construction of good roads.

The city council of Beaumont, Tex., on April 4 rejected all bids received for the paving of Pearl and other designated streets with brick and wooden blocks and instructed the city engineer and mayor have the work done by day labor.

The citizens of Dayton, Tex., have organized the Dayton Good Roads association with Mayor W. M. Babcock and W. C. Crawley as president and secretary respectively. The citizens have signed a petition for bonds to the amount of $275,000 for shell roads.

A movement as been started by the farmers of Elm Mott, Gholson and Ross, towns in Justice precinct No. 3, and in which precinct West is located, for the purpose of starting the movement to issue bonds for road improvement in West [illegible]

Utah.

[illegible] City, Utah, has been petitioned for the paving of Fifth East St., from Third South to Liberty park; Virginia St., from South Temple St. to Third Ave., and Second Ave., from Virginia St. to [illegible]

Virginia.

The Southeastern Virginia Good Roads association has been organized, according to advices from Richmond, Va., with O. C. Roland, president, Garrett, Va., and H. Crim, secy.-treas., Peck, Va. It is reported that the association will construct 87 miles of road between Richmond and Carolina line via Petersburg.

Washington.

✣Bids will be received, it is reported, until May 1, by the Board of County Commissioners, Hoquiam, Wash., for the construction of a plank roadway 20 miles long at an estimated cost of $60,000.

⊙The Spokane Bitu-Mass Paving Co. of Spokane, Wash., has been awarded the contract by the city council of Ellensburg, Wash., for the paving of the upper Pearl St. improvement district and for one block of paving on Fourth St.

⊙The Warren Construction Co. has been awarded the contract by the city of North Yakima, Wash., for paving contracts in the West Yakima Ave. and Pleasant Ave. districts amounting to $148,731. The material to be used is bitulithic. The Pleasant Ave. work will cost $16,681 and the West Yakima work will cost $131,799.

The city council of Olympia, Wash., has passed an ordinance providing for the paving of Main St., from Seventh to Eighteenth St. The council will also probably pass a resolution providing for the paving of the street from 18th to 21st at its next meeting.

Citizens of Toppenish, Wash., are agitating the paving of Toppenish Ave., and other parts of the Toppenish business district, with brick and of the residence streets with asphalt.

The Dayton Commercial club, Dayton, Wash., plans to pave Main St., from Front St. to Fourth St., and to hard surface two blocks on Front St., Second, Third and Fourth Sts. The cost will probably exceed $50,000. The city council is in favor of paving.

A resolution has been introduced in the city council of Cofax, Wash., calling for the paving of a large part of the streets in the southern part of the city. It calls for paving on South Main St., on Wawawwai, James, Fairview, Mill and other streets.

West Virginia.

According to the figures compiled by the department of public roads, Charleston, W. Va., approximately $900,000 will be expended on the state highways during the present year. Following is a list showing the approximate amount each county will have to spend this year, with the exception of the counties of Cabell, Fayette, Mercer and Putnam, where the amount of the county's levy has not as yet been learned: Barbour county, Philippi, $6,630; Berkeley county, Martinsburg, $10,374; Boone county, Madison, $13,561; Braxton county, Sutton, $4,306; Brooke county, Wellsburg, $6,920; Cabell county, Hintington, $6,521; Clay county, Clay, $7,141; Calhoun county, Grantsville, $5,740; Doddridge county, West Union, $25,788; Fayette, Fayetteville, $9,263; Gilmer county, Glenville, $4,306; Grant county, Petersburg, $8,094; Greenbrier county, Lewisburg, $11,321; Hampshire county, Romney, $18,557; Hancock county, New Cumberland, $1,395; Hardy county, Moorefield, $8,906; Harrison county, Clarksburg, $48,021; Jackson county, Ripley, $9,509; Jefferson county, Charlestown, $22,432; Kanawha county, Charleston, $28,151; Lewis county, Weston, $16,118; Lincoln county, Hamlin, $6,749; Logan county, Logan, $8,715; Marion county, Fairmont, $24,950; Marshall county, Moundsville, $32,008; Mason county, Point Pleasant, $1,057; Mercer county, Princeton, $5,833; Mineral county, Keyser, $13,695; Mingo county, Williamson, $11,964; Monongalia county, Morgantown, $8,371; Monroe county, Union, $9,240; McDowell county, Welch, $42,189; Nicholas county, Summersville, $14,473; Morgan county, Berkeley Springs, $6,670; Ohio county, Wheeling, $22,124; Pendleton county, Franklin, $4,761; Pleasants county, Saint Marys, $5,606; Poca-

[illegible] county, Madison, $19,3[illegible]; Preston county, Kingwood, $19,[illegible]; Putnam county, Winfield, $1,459; Raleigh county, Beckley, $11,943; Randolph county, Elkins, $15,159; Ritchie county, Harrisville, $23,422; Roane county, Spencer, $15,971; Summers county, Hinton, $2,919; Taylor county, Grafton, $9,-[illegible]; Tucker county, Parsons, $[illegible]; Tyler county, Middlebourne, $11,074; Upshur county, Buckhannon, $[illegible]; Wayne county, Wayne, $8,336; Webster county, Webster Springs, $4,613; Wetzel county, New Martinsville, $78,411; Wood county, Parkersburg, $[illegible], and Wyoming county, Pineville, $11,425.

Wisconsin.

✣Bids will be received until 10 a. m., April 29, by Board of Public Works, Racine, Wis., for the necessary labor and material for paving N. Erie St. from St. Patrick St. to north city limits, approximating the following quantities: Asphalt or asphaltic concrete: 8,100 sq. yds. of paving, 5,175 lin. ft. concrete combined curb and gutter. Brick paving: 8,850 sq. yds. of paving, 5,175 lin. ft. concrete curbing. Said work to be completed on or before the 1st day of October, 1911. All in accordance with the plans and specifications of the work on file in the office of said city clerk.

✣Bids will be received until 10 a. m., April 29, by Board of Public Works at the office of City Clerk, Racine, Wis., for furnishing necessary labor and material for paving N. Erie St. from Dodge St. to the north line of St. Patrick St., approximating the following quantities: Asphalt or asphaltic concrete: 7,500 sq. yds. of paving, 4,160 lin. ft. combined curb and gutter. Brick paving: 8,300 sq. yds. of paving, 4,610 lin. ft. concrete curbing. Said work to be completed on or before the 1st day of October, 1911.

The city council of Platteville, Wis., on April 13 received the following low bids on brick, reinforced concrete, asphalt macadam and sarcolithic paving: W. G. Kirchoffer, 31 Vroman Bldg., Madison, Wis., Engineer: T. W. Quinn, Madison, on brick, $1.82 per sq. yd.; Thos. E. Woolley, LaCrosse, Wis., on reinforced concrete, $1.39 per sq. yd., on asphalt macadam, $1.82 per sq. yd., and on sarcolithic, $1.82 per sq. yd. The contract will be awarded on April 25.

Citizens of Beloit, Wis., are agitating the paving of Highland and Vernon Aves., from Bluff St. to Hackett.

The streets and alleys committee of the common council of Milwaukee, Wis., has recommended improvements as follows: Greenfield Ave., from 11th Ave. to Clinton St., asphalt; North Ave., from Seventh to 25th St., asphalt; and Lincoln Ave., from Howell Ave. to the Kinnickinnic river, asphalt and sandstone. The committee also recommended resolutions calling for the purchase of $100,000 worth of crushed stone screenings and gravel; an asphalt repair plant, $3,500; two melting kettles, $1,200, and an automobile, $3,500.

Canada.

✣Bids will be received until noon, April 28, by City Clerk, Brandon, Man., for paving the following streets: Rosser Ave., Twelfth St. to Sixth St.; Pacific Ave., Eleventh St. to Eighth St.; Princess Ave., Tenth St. to Eighth St.; Eleventh St., Rosser Ave. to Pacific Ave.; Tenth St., Princess Ave. to Pacific Ave.; Ninth St., Princess Ave. to Pacific Ave.; Eighth St., Princess Ave. to Pacific Ave. Tenders are invited for wood block, asphalt block, sheet asphalt, granitoid, bithulithic and vitrified brick, on 5-in. and 6-in. concrete foundations, or other kinds of pavements. R. E. Speakman is City Engineer.

✣Bids will be received until 4 p. m., April 28, by William Northcott, Purchasing Agent, Victoria, B. C., for paving with asphalt approximately 40 miles of streets. Plans and specifications are on file at the office of Angus Smith, City Engineer.

⦿The city commissioners of Saskatoon, Sask., on April 11 awarded the contract for the construction of cement sidewalks, aggregating 500,000 sq. ft., exclusive of curbing, which amounts to 12 miles, to the Western Pavers Ltd., of Winnipeg, Man., for approximately $90,000. The work of the Western Pavers is in charge of Charles Curtis of Winnipeg.

BRIDGES—STEEL AND CONCRETE

Alabama.

⦿Commissioners of Morgan County, according to advices from Hartselle, Ala., have awarded the contracts for the construction of five new steel and concrete bridges. One steel bridge one mile southeast of Hartselle, one 18 miles east of Hartselle, and another 1 mile east of Somerville, were awarded to Austin Bros., of Atlanta, Ga. The contracts for two steel bridges near Decatur were given Goodrich & Crinkley, who are now engaged in constructing a pike road from Hartselle to Danville. The total cost of the five bridges will be about $6,000.

The House on April 7, according to advices from Montgomery, Ala., passed the Morrow bill providing that every city of 100,000 population or more in the state may construct viaducts or bridges and subways across railroads and contiguous lands within the city limits.

Arkansas.

At a meeting of the Quorum Court at Fort Smith, Ark., April 10, action was taken toward purchasing the Poteau bridge. It was decided that providing the structure can be purchased of the present owners at a reasonable price it will be made a county free bridge. A report of the acting committee will be made April 24.

California.

✣Bids will be received [illegible] p. m., April 26, by Board of Public Works, San Francisco, Cal., for the construction of northerly section of Mission St., viaduct. Marsden Manson, Hewes Bldg., 995 Market St., is City Engineer.

⦿The Board of Placer County Supervisors, Auburn, Cal., has awarded the contract for the construction of steel bridge 171 ft. long resting on concrete piers over the River to Ross Construction Co., Sacramento, Cal., at $[illegible].

A resolution has been introduced into the Yuba County Supervisors at Marysville, Cal., providing for the construction of a bridge across Little Dry Creek in Brown's Valley, consisting of a 70-ft. steel span to cost $2,000.

City Engineer of Wilmington, Cal., has recommended the construction of a pile trestle bridge similar to the one now being [illegible] cost of the structure would be, according to the estimate, $12,000.

Colorado.

The Board of Public Works, Denver, Colo., has decided upon the construction of two bridges on Alameda Ave., one crossing the ditch of the Denver Union Water Co. and the other over the Platte River. The estimated cost of these structures is $30,000.

Georgia.

Arrangements have been made with the property owners by the Bridge Committee for securing the necessary right of way for the construction of the viaduct on Bellwood Ave., Atlanta, Ga., over the Seaboard; Atlanta, Birmingham & Atlantic; Western & Atlantic, Louisville & Nashville and Southern Rys.

Illinois.

✣Bids will be received at the Town Hall, Sheridan, Ill., at 11 a. m., April 25, 1911, for the construction of six reinforced concrete bridges as follows in Mission Township, La Salle County. Robert Knapp, Town Clerk, Sheridan, Ill.

Name	Span	Height of Abut.	Total Con. Yds.	Total Steel	Average [illegible] Ft.	Nearest R. R. Town [illegible]
Johnson	[illegible]	[illegible]	21	1,151	[illegible]	S[illegible]
[illegible]	8	[illegible]	[illegible]	1,795	7½	Millington
V[illegible]	16	8	18	[illegible]	[illegible]	Sheridan
Peterson	8	[illegible]	18	2,414	[illegible]	Sheridan
[illegible]	1[illegible]	12½	[illegible]	3,021	[illegible]	Sheridan
[illegible]	1[illegible]	11	19	3,304	8½	Millington

All the above bridges have 20 ft. roadways and wings varying in length from 7 to [illegible] ft. Present structures to be removed, 1, 2 and 6, large tiles. Number 3 has a 11-ft wood, A truss; number 4, wood on stone abutments; number 5, remove wood superstructure only, new abutments inside of old stone walls. Excavation will be in black sandy loam except at 4 and 5 which will be in gravel. Gravel for concrete will be furnished by commissioners, within 50 ft. of each bridge site. Work to be completed on or before Sept. 1, 1911.

✣Bids will be received at the Town Clerk's office, Cissna Park, Illinois, up to 12 o'clock, noon, April 21, 1911, for the construction of a reinforced concrete bridge in Pigeon Grove Township, Iroquois County. J. H. Rothery, Town Clerk, Cissna Park, Illinois. Hodel bridge: Span, 50 ft.; roadway, 16 ft.; finished roadway to bottom of footing, 13½ ft.; wings, 12 ft. Estimated amount of concrete in structure, 150 cu. yds.; reinforcing steel, 21,649 lbs. Present structure, a 48-ft. steel bridge on tubes, to be removed. Excavation will average about 9 ft. in black loam to clay. Average flow of stream 6 ins. deep, 15 ft. wide. Material will have to be shipped in. Nearest railroad station, Cissna Park on the C. & E. I., 3½ miles. Work to be completed on or before August 1 to 8, 1911.

⦿The Chicago, Terre Haute & Southeastern, according to reports, has contracted with the American Bridge Co., Chicago, Ill., for the construction of a 207-ft. viaduct to be erected at Donovan, Ill. E. H. Pfafflin, Chicago, Ill., is Chief Engineer.

⦿Information received from Oregon, Ill., states that the contract for the construction of seven bridges in Mount Morris township was let the M. M. Billmire Co. of Ashton at $[illegible].

⦿The contract for the construction of two new reinforced concrete bridges known as the Pickens and Reid Bridges in the town of Guilford was awarded to J. H. Sabin, Rockford, Ill., at $1,050.

A bill has been passed by the State Senate, Springfield, Ill., authorizing the St. Louis, Peoria & Northwestern Ry. Co. to build a draw bridge over the Illinois River at South Bartonville. Marvin Hughitt is an officer of the railway company which is subsidary to the Chicago & Northwestern.

Bids were submitted to the Highway Commission ranging from $3,589 to $5,998 for the construction of the new bridge over the creek at Landau Ave., Joliet, Ill., by the following: The Waterproof Building Block Co., Newkirk & Powers, W. B. Curtis, Joliet Steel Construction Co., Joliet Bridge and Iron Co., Charles T. Erickson, Sauber & Paulson, and Pitts & Dougherty.

Following are the bids received April 8 by B. J. Mullaney, Commissioner of Public Works, Chicago, for the removal of present bridge at Belmont Ave., dredging channel and construction and erection of a pontoon

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

bridge: (A) for removing the present draw span, center pier and pier protection, including all piles, pile clumps and obstructions located in the proposed new river channel and in the way of the proposed pontoon bridge and approaches; (B) for building and furnishing a scow complete for transferring a movable span from the turning basin near North Ave. to the bridge site for placing it on the new supports, for furnishing and placing in position all metal work necessary for reinforcement of span, for furnishing and setting in place the track plates on the pivot pier, setting screw jacks and sea valves, for cleaning and painting old metal work, etc.; (C) for oak planks and timbers furnished and built in place including all necessary bolts, washers, drift bolts, etc., quantities, assumed at 48,000 ft. B. M., per 1,000 ft. B. M. (D) for furnishing and building in place yellow pine timber including nails, spikes, etc., quantity assumed at 110,000 ft. B. M., per 1,000 ft. B. M.; (E) for white pine timber furnished and built in place, including washers, bolts, etc., quantity assumed 42,000 ft. B. M., per 1,000 ft. B. M.; (F) for Norway pine or cypress piles delivered at site of work, quantity assumed at 10,000 lin. ft. per lin. ft.; (G) for driving 9,500 lin. ft. of piles below cut-off line, per lin. ft.; (H) for dredging approximately 15,000 cu. yds. of material, per cu. yd.; (I) for additional structural steel and iron, if needed, also for the proof chains to be used for pile clumps, built in place, quantity assumed 6,000 lbs., per pound: National Construction Co., 115 Adams St., (A), $2,000; (B), $3,725; (C), $55.00; (D), $50.00; (E), $50.00; (F), 20 cts.; (G), 8 cts.; (H), 35 cts.; (I), 6 cts. Great Lakes Dock & Dredge Co., [illegible] Bldg., Chicago, (A), $900.00; (B), $2,000; (C), $69.00; (D), $60.00; (E), $50.00; (F), 18 cts.; (G), 11 cts.; (H), 35 cts.; (I), 5 cts. The Simons Counell Co., 131 La Salle St., low, (A), $500.00; (B), $1,000.00; (C), $65.00; (D), $60.00; (E), $50.00; (F), 20 cts.; (G), 10 cts.; (H), 33 cts.; (I), 6 cts. The contract has not been awarded.

Indiana.

✣Bids will be received until 2 p. m., May 1, by Board of Greene County Commissioners, Bloomfield, Ind., for the construction of three bridges 70 ft., 60 ft. and 40 ft. spans respectively. C. H. Jennings is Auditor of Greene County.

✣Bids will be received until 10 a. m., May 2, by Board of Shelby County Commissioners, Shelbyville, Ind., for the construction of four concrete steel culverts. G. B. Huntington is Auditor of the County.

✣Bids will be received until 1 p. m., May 2, by Board of Boone County Commissioners, at Lebanon, Ind., for the construction and repair of 32 bridges numbered [illegible] 32 to 64 inclusive. B. F. Hedrich is Auditor.

✣Bids will be received until 10 a. m., May 2, by Board of Adams County Commissioners at Decatur, Ind., for the material and labor for the construction of a number of bridges, arches and abutments. Also repairs to other bridges. H. S. Michaud is County Auditor.

✣Bids will be received until 11 a. m., May 2, by Board of Orange County Commissioners at Paoli, Ind., for the construction of a new floor system in Valcene bridge in South East township. A. B. Ham is Auditor.

✣Bids will be received until 10 a. m., Apr. 22, by Board of Marion County Commissioners, Indianapolis, Ind., for the construction of a culvert in Decatur township. Albert Sahm is County Auditor.

✣Bids will be received until 10 a. m., April 24, by Board of Public Works, Indianapolis, Ind., for the construction of a concrete slab bridge over Pogue's Run at Highland Ave. and North St.

⦿The Attica Bridge Co., of Attica, Ind., has been awarded the contract by the Board of County Commissioners at Fort Wayne, Ind., for erecting in place with creosote block floor of a steel bridge having two spans of 171 ft. each and the [illegible] plans [illegible] $9,000. Bids were opened [illegible]

⦿The following bridge and culvert contracts were recently awarded by the Jay County Commissioners, at Portland, Ind.: Walter Swhier was awarded two contracts, that for the Carey culvert, at $317, and the Shaneyfelt culvert, at $428; Isaac J. Walker will repair the Walters bridge for $369 and the Via bridge for $319. All the remaining contracts were sold to Plummer Swhier, Portland, [illegible] Pingrey culvert, $242; Hilton culvert, $210; Baldauf culvert, $250; Freemyer culvert, $210; Moorehouse culvert, $156; Harter culvert No. 1, $280; Harter culvert No. 2, $282; Jaqua culvert, $224; Mitchell culvert, $150; Ickes culvert, $235; Neal culvert, $142; Rupel culvert, $392; A. Black culvert, $157; Cupp culvert, $354; Sheffer culvert, $165; I. Miller, culvert, $185; Warnock culvert, $192; Kochersperger culvert, $395; Swarner culvert, $150; Current culvert, $292; Tieben culvert, $174; Newton culvert, $156; A. Miller, culvert, $185; Milligan culvert, $394; Journay culvert, $500; Alexander culvert, $144; Jackson bridge repair, $517; Rain [illegible] $96.

⦿The contract for the construction of three bridges in Knox County, known as the Joe Dutton Bridge No. 1 in Palmyra township; the 72-ft. iron bridge No. 2 in Vincennes township along the Evansville & Terre Haute R. R. and the Paris, O., Riddle bridge No. 3 [illegible] awarded by the commissioners to the Vincennes Bridge Co., Vincennes, Ind., at $3,398.

City Council of Hammond, Ind., has been asked for an appropriation of $500 to provide funds for the drawing of plans and specifications for the new bridges to be built over the Indiana Harbor Canal at East Chicago, Ind.

Board of Ohio County Supervisors, Rising Sun, Ind., has adopted plans for the construction of a bridge across the Island branch.

Iowa.

⦿The following contracts were awarded April 6, by the County Commissioners at Eureka, Kan.: Elmer James, Madison, Kan., the construction of a concrete arch bridge on the Verdigris River near Virgil, Missouri Valley Bridge Co., Leavenworth, Kan., for the construction of a 20-ft. steel bridge across Fall River about 10 miles southeast of Eureka, contract price, $2,521; substructure of the latter bridge was awarded Davis & Huntington, Eureka, Kan.

⦿The Saline County [illegible] Salina, Kan., have awarded the contract for the construction of the steel bridge across Dry Creek 1½ miles northwest of Smolan to the Missouri Valley Construction Co., at $880. The substructure [illegible]

The Sioux City Service Co., Sioux City, Ia., operating a railway in that city, will, according to a statement, reported to have been made by E. L. Kirk, General Manager, construct two steel girder bridges on the river side line where it crosses the Perry Creek at 5th St. and one on the Leeds line where it crosses a big run near the Lawrence Farm, replacing the old wooden structures.

At a recent meeting of the Clinton County Board of Supervisors, Clinton, Ia., a resolution was adopted to locate a number of steel and concrete bridges to be erected this year in accordance with plans and specifications of the Iowa Highway Commission placed on file.

A conference was held at El Dorado, Kan., April 5, by the Commissioners of Harvey and Butler Counties in regard to the construction of the joint steel and concrete bridge over the Whitewater River between the two counties. W. Buskirk is County Surveyor.

The Knox County Fiscal Court, Barbourville, Ky., has ordered the construction of six modern steel bridges in different sections of the county. The construction of a modern steel bridge over the Cumberland River in Tye Bend Section is also under consideration.

Maine.

At a special town meeting at Foxcroft, Me., it was voted to build a new concrete bridge across the Piscataquis River and $25,000 was appropriated for the purpose. The structure, it is estimated, will cost $19,000 and the remainder of the appropriation provides for land damages.

At a special meeting the town of Mechanic Falls, Me., decided the old bridge over the Little Androscoggin River was unsafe and voted to replace it with a 15-ton bridge, having a 20-ft. roadway and two 6-ft. walks. Bids for the work will be advertised at once.

Maryland.

⦿The Commissioners of Talbot and Caroline Counties, according to advices from Denton, Md., have awarded the contract for the construction of the draw and a 70-ft. span of the Dover bridge, across the Choptank River together with .83 of a mile of causeway on the Caroline Side to the York Bridge Co., York, [illegible]

Michigan.

At the recent election held in Saginaw, Mich., the proposition to spread a tax of $85,000 running over four years to build a new modern bridge at Johnson St. was carried by a large majority. R. W. Roberts is City Engineer.

At a recent election the citizens of Battle Creek, Mich., voted favorably on a $15,000 bridge bond issue.

A resolution has been passed by the city council of Saginaw, Mich., providing for an expenditure of $1,000 for replanking the Court St. bridge.

At a recent special election in Benton Harbor, Mich., the proposition to bond the city for $20,000 to provide funds for the construction [illegible]

Minnesota.

✣Bids will be received until 2 p. m., May [illegible] by Board of County Commissioners, Bemidji, Minn., at the office of J. L. George, County Auditor, for the construction of a steel and concrete bridge over the Mississippi River 4½ miles south of Solway in Section 16 of the town of Jones, 146-35, Beltrami County, Minn.

⦿At a recent meeting of the County Commissioners, Ada, Minn., the contract for the construction of six bridges was let to the Security Bridge Co., Minneapolis, Minn.

New Jersey.

✣Bids will be received until [illegible] p. m., April 28, by Joint Committee, Board of Chosen Freeholders, Bergen County and Passaic County, N. J., for the construction of a steel and concrete bridge across the Passaic River at the foot of Rutherford Ave., Rutherford, N. J.

Advices from Cape May Court House, N. J., state that the contract for the construction of the proposed steel truss pivot swing bridge with trestle apparatus 271 ft. long and a draw 137 ft. in length was awarded April 4 to J. Har[illegible] Bennett, Cape May [illegible] N. J., at $19,800. Leaming M. Rice, Wildwood, N. J., is County Engineer.

Advices from Trenton, N. J., state that the Donnelly bill authorizing two boards of Freeholders to construct bridges between their [illegible] the House.

The Board of Freeholders of Cape May at Cape May, C. H., N. J., has awarded the contract for the construction of the steel draw bridge at Sea Isle City to Harry Hoffman.

New York.

Advices from Lestershire, N. Y., state that the construction of a bridge at a point near Willow Point on the river is being agitated. A petition will soon be circulated among the property owners on the Vestal side of the river and also among the Westover residents, both of which will be presented to the members of the Town Board.

Ohio.

✣Bids will be received until noon, April 27, by Director of Public Service, Cleveland, O., for the [illegible] necessary for repairing city bridges. [illegible] is Director and [illegible]

✣Bids will be received until 11 a. m., April [illegible], by Board of County Commissioners, Cleveland, O., for the necessary labor and material for the elimination of the grade crossing of the Penna. and W. & L. E. Railroads, Dunham Road, in Bedford Township, by the construction of an overhead bridge across the said Railroads on Dunham Road between Granger Road and Bedford Road, in accordance with the forms of contract, plans, descriptions, bills of material, specifications of work and estimates on file in the office of the County Engineer at the New Court House, West 3rd St., and at the office of the County Auditor in the old Court House, in Cleveland, Ohio.

Pennsylvania.

⊙The Board of Public Works, Pittsburg, Pa., on April 13, awarded the contract for the construction of a reinforced concrete bridge on Larimer Ave., crossing Washington Blvd. to Booth & Flinn, Ltd., Forbes and Jumonville Sts., Pittsburg, Pa., at $140,948. Bids for the work were opened April 7.

⊙Board of Greene County Supervisors, Waynesburg, Pa., has awarded the contract for the erection of a reinforced concrete bridge in Wayne Township known as Phillips bridge, to Travis & Kimbell at $1,192. The span of the bridge in the clear will be 28 ft.

⊙The following bids were received by the Board of County Commissioners, Allentown, Pa., for the reconstruction of the bridges at Geiger's, Egypt, Bogert's and Schlichers and the Furnace bridge in Allentown: Butz & Clader—Geiger's, $2,880; Egypt, $2,782; Schlicher's, $3,900; Bogert's, $3,700; Furnace, $2,900. Weaver Contracting Co.—Egypt, $2,979; Furnace, $3,278; Geiger's, $3,218; Bogert's, $3,918; Schlicher's, $4,061. The award was made in but one case, that of the Egypt, to Butz & Clader. That was the only one under the estimate. The other bids were rejected because they were above the estimates and new bids will be asked.

Taxpayers are preparing to take action to induce the Road Supervisors of Waterford, Pa., township to construct a bridge over Leboeuff Creek near the Lattimore mills about a mile from the borough to replace the old structure washed out some time ago by high water.

C. M. Schwab, Bethlehem, Pa., is advocating the construction of a new bridge across the Lehigh River and has tendered the officers of the bridge company the necessary right of way. The estimated cost of the structure, which will be known as the Minsi Trail Bridge, is $150,000.

Plans have been received by J. B. Hogg, Borough Engineer, Connellsville, Pa., for the construction of the arch bridge over Possum Run to be built by the Pittsburg & Lake Erie R. R. The drawings provide for a 20-ft. concrete arch 16 ft. high from the bed of the creek. There will be a parapet wall of 4 ft. and the driveway is to be 26 ft. wide.

Tennessee.

⊙The Bridge Commission, Chattanooga, Tenn., has awarded the contract for the construction of the bridge at Wash Hixon's Mill on the North Chickamauga Creek, Hamilton County, to the Converse Bridge Co., Chattanooga, at $3,155. Other bidders for the work were Nashville Bridge Co., $3,185 and Austin Bros., Atlanta, $3,283.

Texas.

At the election held April 4, at Angleton, Texas, it was voted to authorize the commissioners court to issue $100,000 for the construction of two bridges across the Brazos River. There are to be two of the structures, one at Brazoria and the other at Columbia.

Virginia.

⊙Supervisors of Southampton County, Suffolk, Va., have awarded the Virginia Bridge Co., Roanoke, Va., the contracts for the construction of 12 new bridges at $19,705. The principal bridges in the lot will be: One across the Blackwater River at Franklin; one across the Meherrin River, between Southampton and Greenesville counties; Gillette's bridge across "Three creeks" and others across the runs of the Nottoway at Cypress.

⊙It is believed in Richmond, Va., that the contract for the construction of the proposed new bridge over the James River was awarded to I. J. Smith & Co., whose bid of $232,051 was submitted on plans drawn by the Concrete Steel Engineering Co., New York, N. Y. This design provides for the Melan System of concrete reinforcement.

Washington.

✣Bids will be received until 10:30 a. m., April 22, by Department of Public Works, Milwaukee, Wis., for doing the work of constructing a fender and cluster piling for State House bridge in the city of Milwaukee, Wis. H. E. Briggs is Commissioner of Public Works.

✣Bids will be received until 10:30 a. m., April 22, by Department of Public Works, Milwaukee, Wis., for the work of constructing a fender and cluster piling for the Chestnut St. bridge in the city of Milwaukee, Wis. H. E. Briggs is Commissioner of Public Works.

The Board of County Commissioners, Tacoma, Wash., has rejected all bids submitted for the construction of a steel bridge over the Carbon River near Crocker. No announcement has as yet been made on the time when another call for bids will be made.

The United States Government has awarded the contract for the construction of the new cement and steel bridge at Lake Bluff Naval Station to James Corse, Racine, Wis., at $10,000.

Panama.

Government Engineers have approved the plans for the construction of the railroad bridge across the Panama Canal at Empire. The structure is to be 175 ft. above the water level and will carry a railroad covering a width of about 16 ft. roadway of about the same width and one or more foot walks 6 ft. wide. It will be of the high plate girder arch type.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

California.

The San Joaquin Light & Power Co., Fresno, Cal., has authorized a bond issue of $25,000,000, the proceeds from which will be used to establish an extensive irrigation and reclamation project in the San Joaquin Valley of California.

Colorado.

Dr. B. L. Jefferson, register of the state land board, Denver, has ordered the segregation of 136,000 acres of state land in La Plata county at the request of the Interstate Irrigation Co. This company intends to begin the construction of a $1,000,000 irrigation project that will reclaim this large tract of land. It is planned to put water from the Animas River on this land. The company is said to be backed by Eastern capital and to have ample means to complete the big undertaking.

Residents of the Loveland section have presented a petition to the County Commissioners at Fort Collins for the formation of the Fort Collins and Loveland Irrigation District. It is proposed to take water from Nunn creek, on the other side of the range, carry it across into the Poudre, and, taking, the water out from the above headgate of the high line ditch, carry it down over 13,000 acres between Fort Collins and Loveland. An election will be held June 3 to vote on the formation of the district.

Idaho.

✣Bids will be received until 2 p. m., May 4, by Department of Interior, Reclamation Service, Washington, D. C., for furnishing about [illegible] Boise project, Idaho. For particulars address U. S. Reclamation Service, 777 Federal Bldg., Chicago, Ill., or Washington, D. C.

✣Bids will be received until 2 p. m., April 26, by Department of the Interior, U. S. Reclamation Service, Washington, D. C., for furnishing hydraulic turbines for Boise project. Particulars can be obtained by addressing 605 Federal Bldg., Los Angeles, Cal., or Washington, D. C.

✣Bids will be received until 2 p. m., April 27, by Department of the Interior, U. S. Reclamation Service, Washington, D. C., for furnishing electrical apparatus for Boise project Idaho. For particulars address U. S. Reclamation Service, 605 Federal Bldg., Los Angeles, Cal., or Washington, D. C.

Illinois.

✣Bids will be received until 10 a. m., [illegible] 2, by the Drainage Commissioners of District No. 5, of the town of Honey Point, Macoupin County, Ill., for constructing and open ditch requiring 2,400 cu. yds. of excavation and tile drains requiring 25,353 ft. of 6-in. to 24-in. tile. The Morse-Warren Engineering Co., Engineers, Carlinville, Ill. Official advertisement will be found elsewhere in this issue.

Indiana.

✣Bids will be received until 2 p. m., April 22, by Superintendent of Construction, Laporte County, Laporte, Ind., for the construction of a drain. Bids at the office of Osborn McVey, 810 Main St. W. I. Robinson is Supt.

✣Bids will be received until 10 a. m., April 22, by Board of Adams County Commissioners, Decatur, Ind., for the construction of Schindler Ditch in Monroe and Wabash Counties. C. C. Ernst is County Surveyor.

✣Bids will be received until 10 a. m., April 22, by W. Canfield, Supt. of Construction, Laporte County, Laporte, Ind., for the construction of a drain. Bids at the office of Osborn, McVey & Osborn, 810 Main St., Laporte, Ind.

✣Bids will be received until 2 p. m., May 2, by Board of Construction Commissioners, Shelby County, Shelbyville, Ind., for the construction of a drain in Brandywine township. Bids received at the office of Isley & Israel, Morrison Bldg., Shelbyville, Ind.

⊙Bids were opened April 8 by Paul Ward, Drainage Commissioner, Monticello, Ind., for constructing the John C. Vannatti ditch and branches. The contract for the dredge work for the main ditch and two branches involving 610,000 cu. yds of excavation of which 14,771 cu. yds. is stone, was let to James L. Taylor, Monticello, Ind., at $52,000. The contract for the tile and open work was let to Casey & Lee, Colfax, Ind., at $11,605.

Iowa.

✣Bids will be received until 1:30 p. m., April 29, by County Auditor, Newton, Ia., for the construction of Drainage Ditch No. 4, having a 4 ft. bottom, slopes 1 to 1. H. S. Rayburn is County Auditor.

✣Bids will be received until noon, May 3, by E. L. Marriage, Eldora, Ia., for the construction of Drainage District No. 16, Hardin County, in sections as follows: Sec. 1—2,000 ft. of 30 in. tile, average cut 5.78, max. 7.20; 2,300 ft. of 28 in. tile. Bulkhead 6 cu. yds. concrete at outlet. Bulkhead 10 cu. yds. concrete at R. R. bridge No. [illegible] Sec. No. [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ft. of 26 in. tile; 2,300 ft. of 20 in. tile, average cut 6.52; max. 8.50. Sec. No. 3—1,500 ft. of 18 in. tile, 2,200 ft. of 16 in. tile, 1,000 ft. of 15 in. tile, average cut 6.62, max. 8.90 Sec. No. 4—1,200 ft. of 14 in. tile, 600 feet of 12 in. tile, 400 ft. of 10 in. tile, average cut 7.63, max. 9.60. Sec. No. 5—1,000 ft. of 12 in. tile, 800 ft. of 10 in. tile, average cut 5.07, max. 7.60. Time of commencement June 1, 1911. Time of completion on or before January 1, 1912.

✣Bids will be received until April 26 by A. J. Peterson, County Auditor, Webster City, Ia., for furnishing, trenching, laying, etc., of the following tile: 3,102 ft. 24-in, 7,788 ft. 2-in., 4,494 ft. of 20-in., 3,102 ft. of 18-in., 990 ft. of 16-in., 3,386 ft. of 14-in., 1,122 ft. 12-in. salt glazed, vitrified tile.

✣Bids will be received until April 26 by A. J. Peterson, County Auditor, Webster City, Ia., for furnishing salt glazed, vitrified clay tile and the construction of drain No. 115 in Hamilton county as follows: 2,000 ft. 36-in., 1,200 ft. of 24-in., 1,200 ft. of 22-in., 6,300 ft. of 20-in., 2,550 ft. of 18-in., 2,750 ft. of 16-in., 1,400 ft. of 15-in., 3,622 ft. of 15-in., 3,972 ft. of 12-in., 2,485 ft. of 10-in., 508 ft. of 8-in., 700 ft. of 7-in.

⊙Bids were opened April 6 by B. E. Norton, County Auditor, Algona, Ia., for the construction of Ditch No. 51, comprising 59,700 ft. of 6-in. to 16-in. tile. The contract was awarded to the Northwestern Drainage & Construction Co., Bancroft, Ia., at $14,400.

Louisiana.

✣Bids will be received by the Board of Commissioners of the Atchafalaya Basin Levee District, at the office of the Board of State Engineers, Rooms 213-215 New Orleans Court Bldg., New Orleans, La., until noon, April 26, for the construction of the following levee work on the Mississippi River, Right Bank, Ascension Parish, Louisiana. [illegible] Ascension—New Hope Levee; River side enlargement, length of line about 8,200 ft.; approximate contents, 90,000 cu. yds.; deposit required, $300; bond required, $4,500.

Minesota.

⊙The Valley Dredging Co., Stephen, Minn., has been awarded the contract for constructing Judicial Ditch No. 14 in Pennington and Marshall Counties, Minn. The ditch with laterals is about 31 miles long and has a 1 to 1 side slope. The work includes 298,157 cu. yds. earth excavation and several 16 to 40 ft. span iron and wood bridges. The nearest railroad station is Viking on the Soo line.

⊙Bids were opened April 7 by J. L. George, County Auditor, Bemidji, Minn., for constructing Judicial Ditch No. 5, the contract being awarded to Brown & McGraw, Litchfield, Minn., at $17,696. The work includes a ditch approximately 15 miles long, 4 and 5 ft. wide at bottom, average depth 4 ft., slopes 1 to 1, requiring excavation of 72,496 cu. yds. There will also be 14.71 miles of highway to be constructed and 20 corrugated iron culverts.

Missouri.

✣The contract for the construction of main canal and laterals of Drainage District No. 3, Carroll County, Mo., will be let at public outcry by the engineer in Carrollton, Mo., on May 15. Work includes cutting bends and straightening water course. Bottom width main canal, 40-50 and 60 ft.; laterals, 12 to 20 ft.; side slopes, 1-1; cutting, 12 to 18 ft. deep; 1,710,000 cu. yds. in main canal and 286,000 cu. yds. in laterals. Information can be obtained from Brooks & Jacoby, Civil Engineers, 515 Shukert Bldg., Kansas City, Mo. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, April 29, by Board of Supervisors Adair Drainage No. 1, at the office of [illegible], Sec., Kirksville, Mo. The work is divided into two sections: Sec. 1 of the main ditch, 98,420 cu. yds.; Sec. 2 of the main ditch, 139,231 cu. yds.; Blackbird Lateral, 30,700 cu. yds. P. S. Holbrook, Onawa, Ia., is Engineer.

Petitions have been filed at the County Court, St. Charles, Mo., by Missouri point farmers for the formation of a levee district of 3,300 acres. All but three land owners in the district have signified their consent.

New Mexico.

The State Territorial Engineer has approved the following water right applications: Ex-Gov. George Curry of Tularosa, Otero County, for 17 second feet of the Rio Rinconada to store 10,000 acre ft. to reclaim 15,000 acres, at a cost of $300,000; W. Goff Black and Arthur Ponsford of Aztec, 50 second ft. from the San Juan River to reclaim 10,000 acres and for power purposes, the project to cost $80,000, and John Du Beau of Fruitland waters of arroyos and the Meadows storage system

North Carolina.

✣Bids will be received until noon, May 4, by Board of Drainage Commissioners, Mattamuskeet, Drainage District No. 1, Swanquarter, Hyde County, N. C., for the excavation of 83 miles of drainage canals and tne erection of a pumping plant. The work will require approximately 2,700,000 cu. yds. of excavation and the installation of the pumping plant requires the furnishing and putting in place of suitable pumps, engines and boilers to discharge 1,800 cu. ft. of water per second against a head of 8 ft.

Texas.

The Cline Wharf & Dock Co. of Port Aransas has been chartered with a capital stock of $75,000, the incorporators being Ed Cline, Charles Rogan and Shelley Grover.

WATER-WORKS

California.

The Sierra Blue Lakes Water & Power Co., San Francisco, Cal., has submitted to the Mayor of that city for the consideration of the purchase of the Spring Valley Water Co., two new propositions relative to the holdings of the Blue Lakes Co. One proposition contemplates the duplication of the Spring Valley plant, with double capacity, taking city bonds in payment therefor. The second offers to sell to the city the property of the company at the price on file with the Board of Supervisors, or to leave the price to the judgment of a committee or board selected by the Supervisors, its decision to be final.

The Mutual Water Co., of Escondido, Cal., has taken steps to replace the sections of wooden flume line between the impounding reservoir and the source of the water supply at the San Luis Rey river, with rock-cement ditch, the amount which needs attention being about 4,500 ft.

Connecticut.

✣Bids will be received until 11 a. m., April 25, by Capt. P. T. Arnold, Constructing Quartermaster, New London, Conn., for the construction of additions to the water system at Fort H. G. Wright, N. Y., including two reinforced concrete pump houses, two electrically driven centrifugal pumps, water mains and reinforced concrete storage reservoir.

District of Columbia.

Gen. W. L. Bixby, Chief Engineer, has approved the application of the District Commissioners, Washington, for permission to construct a water supply pipe across and under the Conduit road at Rock Springs, east of Glen Echo, Md.

Georgia.

⊙The Water Board and the City Bond Commission of Atlanta, Ga., has awarded a contract to the Columbian Iron Works of Chattanooga, Tenn., for fire hydrants for 1911, at approximately $8,000. George A. Clayton was awarded a contract for the erection of a filter house at the city filtration plant for $5,810.

The city of Jackson, Ga., is preparing to make extensive improvements on the waterworks system. New mains will be laid on Indian Springs St., on West Third St. and on West Ave.

Idaho.

It is reported that the citizens of Preston, Ida., have voted the issuance of bonds for the installation of a municipal waterworks.

Illinois.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded to the Jas. A. Brady Foundry Co., 35th St. and Ashland Ave., the contract for furnishing and delivering to the various pipe yards 200 tons of special castings from 4 ins. to 12 ins. in diameter and others (not to exceed 48 ins.) for the sum of $9,560. Bids were opened March 25th, 1911.

⊙B. J. Mullaney has awarded the contract for finishing and delivering packing for various pumping stations to the H. W. Johns Manville Co., 27 Michigan Ave., for a total of $2,900. Bids were opened March 2nd, 1911.

⊙B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing the water department 250 tons of valves from 4 inches to 24 inches and 2½ and 4-inch double flue hydrants.

⊙The contract for furnishing and delivering valve basins and five cistern covers to the various pipe yards of the water department, Chicago, Ill., has been awarded to the T. A. Cummings [illegible]

Following are the low bids submitted to the Board of Local Improvements, Chicago, Ill., for furnishing and laying cast iron water supply in the following streets: Bishop St.—Walther & Luhr and M. Murphy, 5315 Wabash Ave. (tie bid), 1,065 lin. ft. of 6-in. at 97 cents; 1 valve basin at $30. Central Park Ave.—Simon Ryan, 2927 W. Congress St., 430 lin. ft. 8-in. at $1.23; 1 valve basin at $30. W. 105th St.—Walther & Luhr., 1,240 lin. ft. at $1.22; 2 valves basins at $30. W. 66th Pl.—M. Murphy, 1,642 lin. ft. 6-in at 95 cents; 1 valve basin at $30. Vincennes road—M. Murphy, 3,330 lin. ft 8-in. at $1.15½; 4 valve basins at $30. West End Ave.—Simon Ryan, 750 lin. ft. 8-in. at $1.16; 1 valve basin at $30. W. 52nd Ct.—M. Murphy, 1,841 lin. ft. 8-in. at $1.19; 2 valve basins at $30.

Following are the bids submitted April 10 to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for constructing a 9-ft. tunnel and shaft to complete the Southwest Land Tunnel Extension. (A) Lump sum bid for pumping sections 1 and 2 of tunnel to permit of setting gates and removing bulkheads; (B) lump sum for removing bulkhead in 9-ft. tunnel and lining space with concrete; (C) price per lin. ft. of completed shaft in earth including iron work, cover, street pavement, etc.; (D) price per lin. ft. for completed shaft in rock, including concrete backing for gate, etc.; (E) price per lin. ft. of tunnel in rock, this includes the bulkhead at north end with pipe and valves; (F) lump sum for reducing cross sections in tunnels and concrete work for extension of shafts, platforms, and covers at 3 existing shafts; (G) lump sum for setting four sluice gates, with thimbles and hoisting mechanism complete; (H) price per lb. for all steel and iron work, including setting: Gindele Bros. Co., A, $11,300.00; B, $400.00; C, $80.00; D, $76.00; E, $60.00; F, $9,500.00; G, $1,630; H, 6 cents. National Construction Co., 115 Adams St., A, $5,500.00; B, $340.00; C, $104.00; D, $88.00; E, $42.00;

[illegible] G, $[illegible]; H, 5½ cents. Jas. J. Gallery, 154 Whiting St., A, $11,000.00; B, $[illegible]; C, $200.00; D, $250.00; E, $45.00; F, $3,500.00; G, $6,500.00; H, 7 cents. Parker Washington Co., Chamber of Commerce, A, $20,500.00; B, $400.00; C, $110.00; D, $135.00; E, $69.00; F, $8,000.00; G, $5,400.00; H, 6 cents.

The Sterling Water Co., of Sterling, Ill., has agreed upon the terms of the ordinance passed by the City Council of that city which provides for the extension of the system over the city. The proposed improvement will cost about $75,000.

Following are the bids received by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to shafts of Southwest Land & Lake Tunnel the following work: 46 ft. cylindrical thimbles, 2′ 6″ long, to be set in the concrete at opening at tunnel's gate bearings and guides; 1 gate complete with by-passes, hoisting stems with splices and supporting nuts, stem guide boxes with bolts, etc.; supports for stems and gates, floor thimbles, hoisting pedestals complete with hoisting nuts, rings, etc., bolts, nuts, fillers, keys, etc.; one complete set to be delivered to each of the following shafts: Oglesby Ave. and 73rd St., Yates Ave. and 73rd St., State St. and 73rd St. and State St. and 79th St. Vulcan Iron Works, 327 N. Irving Ave., $6,727, Swedish iron, $6,327; cold rolled iron, Jas. A. Brady Founndry Co., 35th St. and Ashland Ave., $6,140; cold rolled iron. Coffin Valve Co., Boston, Mass., $7,000; Swedish iron or cold rolled iron.

Following are the bids received April 16th by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., 4th floor City Hall, for furnishing and delivering lubricating oils to the various pumping stations: Magie Bros., 155 N. Canal St. (a) Cylinder oil, 17¼ cts. per gal.; (b) engine oil, 14½ cts; (c) dynamo oil, 15½ cts. per gal. Melrose Oil Co., (a) 18½ cts, (b) 15 cts, (c) 15 cts. Western Engineers Supply Co., (a) 19 cts., (b) 14 cts., (c) 14 cts. The contract has not been awarded.

Iowa.

It is estimated by the City Council of Bedford, Ia., in consideration of the data furnished by City Engineer C. L. McClanahan, that a dam 400 ft. long and 20 ft. high on property owned by Alex. John, will furnish a water supply ample for all the needs of the city at present.

Kansas.

⦿The Union Light & Power Co., of Junction City, Kan., has let contracts for the installation of a water plant of its own, with a pumpage capacity of about 1,000,000 gals. a day. Four wells, 50 ft. apart, will be put down at the power plant on East Eighth St. The contract for a cement pump pit, with connecting tunnels to the various wells, was let to C. C. Stevenson. It will be of reinforced concrete.

The citizens of Waterville, Kan., on April 3 voted the issuance of bonds to the amount of $30,000 for the installation of an electric light system and a waterworks system.

Kentucky.

The City Council of Bowling Green, Ky., has adopted a resolution requesting State Engineer Paul Hansen to submit a proposed plan for the improvement of the filtration plant of the waterworks.

Louisiana.

The Washington Parish Police Jury, Franklinton, La., has a proposition under consideration, presented by A. J. Johnson, J. S. Brock, Jr., Vol Brock and P. G. String, that if the Police Jury will join in maintaining the pumping expense, citizens of Franklinton will erect a tank of [illegible] capacity and a pumping station to utilize water from the artesian well in the court house square.

The Mayor and City Council of White Castle, La., has decided to extend the waterworks on lower Bowie St.

Maine.

The committee appointed by the Town Council of Brunswick, Me., to investigate the advisability of the town's purchasing the property of the Freeport Water Co., has recommended the purchase of the plant for a sum not to exceed $25,000. The company values the plant at $50,000.

Maryland.

✣Bids will be rectived until 1 p. m., April 26, by Board of Awards, Baltimore, Md., for furnishing, delivering and erecting complete to the Water Board one 30,000,000 gal. vertical triple expansion pumping engine, two batteries of boilers each, the necessary steam piping between engines and boilers and economizers for heating the feed water for the Mount Royal Pumping Station, Baltimore. Alfred M. Quock is Water Engineer.

Michigan.

The citizens of Big Rapids, Mich., have voted against the issuance of bonds in the sum of $20,000 for repairs to the waterworks.

Minnesota.

✣Bids will be received by A. H. Scherer, City Clerk, Mankato, Minn., until 10 a. m., May 1, for removing old boiler and furnishing and installing a new boiler at the pumping station, 125 hp., 150 lb. pressure. Bids will be received on both internally fired and horizontal tubular. Official advertisement will be found elsewhere in this issue.

✣Bids will be received at office of Village Clerk, Chokio, Minn., at 11 a. m., April 26, for the following work: 33,000-gal. reinforced reservoir, 1,000 ft. 6-in. and 4,600 ft. 4-in. cast iron water main, hydrants, valves, specials, etc. Pumping plant consisting of air lift, air compressor, triplex power pump, gasoline engine and accessories. Concrete or brick pump house. Or the following: 40,000-gal, steel tower and tank, cast iron water main as above, deep well pumping plant, concrete or brick pump house. Bids will be called for on each proposition. Plans may be had at the office of the Village Clerk or at the office of the Oscar Claussen Engineering Co., 514 Nat. Ger. Am. Bk. Bldg., St. Paul, Minn. A. A. DeLong, President of Council; Louis L. Larson, Village Clerk.

✣Bids will be received until 6 p. m., May 1, by F. B. Knoff, Village Clerk, Madison Lake, Minn., for the installation of a water works system approximately as follows: 1,740 ft. of 6-in. pipe, 516 ft. of 8-in. pipe, 8 hydrants, 3 8-in. gates, 3 6-in. gates and a 60,000-gal. elevated tank and tower. Specifications may be seen at the office of Village Clerk, Madison Lake, Minn., or at the office of John Wilson, Engineer, Mankato.

✣Bids will be received until 8 p. m., May 1, by J. A. E. Grenier, City Clerk, Cloquet, Minn., for the construction of sewers and water mains, including approximately 13,600 cu. yds. excavation, 10,300 lin. ft. 6 in. and 10 in. pipe sewers, 12,000 lin. ft. 6 in. and 4 in. water mains. Plans and specifications on file at the office of the City Engineer, Cloquet, Minn.

✣Bids will be received until 10 a. m., May 1, by A. H. Scherer, City Clerk, Mankato, Minn., for furnishing and installing a steam boiler at the Pumping Station, 125 h. p., 150 lb. pressure.

Mississippi.

The Board of Aldermen of Bassfield, Miss., has issued bonds for the purpose of providing funds with which to install a waterworks plant for the municipality.

The citizens of Seminary, Miss., have voted the issuance of $10,000 in bonds for the erection and completion of a school building and a waterworks system.

It is reported that the Board of Aldermen of Tylertown, Miss., has granted a franchise to Q. D. Sauls for light and water plants.

Missouri.

At the election held in Monroe City, Mo., April 4, the voters cast a straw vote on the proposition to issuing bonds to the amount of $75,000 for waterworks and sewerage.

New Jersey.

✣Bids will be received until 8 p. m., May 3, by Board of Water Commissioners, Rahway, N. J., for furnishing and installing one 5,000,000 gal. horizontal high duty, cross compound, crank and flywheel pumping engine. A. A. Kirstein is Supt. of the Board. Charles A. Hague is Consulting Engineer.

✣Bids will be received until 10:15 a. m., May 1, by David F. Weeks, M. D., Supt., New Jersey State Village for Epileptics at Skillman, N. J., for furnishing all labor and material necessary for the construction of an extension to the water system, including necessary fire hydrants, gates, valves, fittings, etc.

Former Senator E. C. Hutchinson of the Hutchinson Milling Co. has organized the E. C. Hutchinson Water Co., filing articles of incorporation with the Secretary of State of New Jersey. The purpose of the company is to supply water to Hamilton township residents. The company is capitalized at $125,000 and the incorporators are: Senator Hutchinson, Ella Hutchinson and Samuel T. Atchley.

New York.

The Common Council of Geneva, N. Y., has passed a resolution authorizing the finance committee to formulate a resolution submitting the proposed installation of a filtration plant to the taxpayers of the city.

The Water Board of Niagara Falls, N. Y., has taken steps to lay before the taxpayers a proposition to parallel the mains of the Western New York Water Co. An election will be held shortly to vote on the issuance of bonds in the sum of $345,000, which is the estimated cost of the laying of the new mains.

North Dakota.

✣Bids will be received until 6 p. m., May 1, by J. H. Johnson, City Auditor, Grafton, N. Dak., for sinking a 6-in. artesian well on the premises in the vicinity of the Electric Light Plant.

Plans and specifications for the installation of the proposed filtration plant have been adopted by the City Council of Fargo, N. Dak. Bids for the work are now being received.

Ohio.

✣Bids will be received until noon, April 29, by Director of Public Service, Cleveland, O., for furnishing and delivering lubricants for Water Department of the city. I. O. Hoffman is Secy.

✣Bids will be received until noon, May 12, by Board of Trustees of Public Affairs, Rockport Village, Rockport, O., for constructing water mains on Settlement road and Linndale road. Plans and specifications are on file at the office of F. Feuchter, Clerk, or W. H. Evers Engineering Co., 332-334 The Arcade, Cleveland, O.

The citizens of Kenton, O., on April 10 voted the issuance of bonds in the sum of $40,000 for the rebuilding of the waterworks plant and improvement of the system.

The city of Urbana, O., has purchased the waterworks system of that city for a consideration of $100,000.

George Cotter, Supt. of the Water Department of Springfield, O., will soon advertise for bids for the furnishing of material for the waterworks force main and supply of pipe for the season's work.

Oklahoma.

⦿The contract for furnishing materials for waterworks extension April 10 were awarded by the city of Ada, Okla., W. B. Jones, City Clerk, as follows: A. Wyckoff & Son, Alexandria, La., at $248.87 per 100 ft., for 4,000 ft. of 30-in. wood pipe; A. Wyckoff & Son, at $0.84 per ft., for 33,000 ft. of 12-in. wood pipe; National Tube Co., St. Louis, Mo., at $0.99½ per ft., for 33,000 ft. of steel pipe; Builders' Material & Supply Co., Kansas City, Mo., at $1,548, for pumping machinery.

Winters & Dove, 810 First Nat. Bank Bldg., Fort Smith, Ark., have finished the necessary surveys and are now preparing plans for a water works extension for Coweta, Okla. The work will include two miles of pipe line and auxiliary pumping plant and other improvements.

Winters & Dove, 510 Nat. Bank Bldg., Fort Smith, Ark., are preparing plans for a water works system for the city of Braggs, Okla. An election to vote on the issuance of bonds for the improvement will be held at an early date.

The citizens of Inola, Rogers County, Okla., it is reported, have voted the issuance of bonds for the installation of a waterworks.

The citizens of Soper, Okla., have voted bonds for the purpose of installing a waterworks system.

The City Council of Stillwater, Okla., has entered into an agreement with the Citizens' Water Co., whereby the company engages to furnish the city 100,000 gals. of water a day at $0.10 per 1,000 gals. The city will, as soon as possible, hold a bond election for the purpose of voting bonds to buy the water plant for $10,000.

Oregon.

The City Council of Pendleton, Ore., has called a special election for May 9 for the purpose of approving of the $200,000 bond issue for the construction of a gravity water system, the approval of the $20,000 bond issue for the extension of the sewer system, etc.

It is reported that the Executive Board of Portland, Ore., is receiving bids for furnishing $50,000 worth of water pipe and specials.

The following bids were received by the City Council of Falls City, Ore., on April 5 for the construction of a waterworks: Parker, Oregon City, $24,299; K. Saulchet, Corvallis, $24,200; H. Benake, Portland, $23,524; Jahn Contracting Co., Portland, $21,206.

Pennsylvania.

✣Bids will be received until 3 p. m., April 24, by J. A. Affleck, President of the Water and Lighting Department, Harrisburg, Pa., for furnishing cast iron water pipe and special castings, [illegible] hydrants, corporation cocks, iron and brass castings and sulphate of alumina.

South Dakota.

The City Council of Highmore, S. Dak., has completed negotiations for the purchase of a private water system in that city for $9,500.

Texas.

◉The contract for the installation of a filter plant to cost $10,000 at the Brownsville, Tex., waterworks, has been let to J. C. Debruin of Brownsville. The plant will have a daily capacity of 1,000,000 gals.

The Grandbury Water, Light, Ice & Power Co., of Grandbury, Tex., has been incorporated with a capital stock of $30,000. R. Vickery, W. T. Pittman, James W. Hockaday and others are the incorporators.

The citizens of Hearne, Tex., on April 18 voted on the proposition to issue bonds for the installation of a waterworks system.

The Atchison, Topeka & Santa Fe Railway Co., John Roach, Division Engineer, Amarillo, Tex., is having surveys made preliminary to the construction of a large lake near Killeen. The lake will cover 75 acres of ground, and the location for same has practically been selected. This is one of a number of reservoirs that the company is to build along the route of the new Texas-California line.

We are informed by the City Secretary of Fort Worth, Texas, that the Board of Engineers for the Water Supply will soon have plans and specifications ready for a dam for an impounding reservoir across the Trinity River, a conduit pipe line of some six miles in length, and a filter plant of from five to six million gallons daily capacity, the total cost of which, including lands, will be approximately $1,000,000. E. C. Woodward, City Engineer; W. J. Estes, City Secretary.

Utah.

The Douglass Percolating Pipe Line Co. has filed articles of incorporation with the County Clerk at Provo, Utah. The capital stock is $6,000 and the company will take over the business and property of the Douglass waterworks at Payson. The officers are: S. B. Wilson, President; William Ferre, Vice-President; [illegible], Secretary and Treasurer.

Washington.

The City Council of Medical Lake, Wash., is receiving bids for the furnishing of 50 water meters.

The City Council of Pasco, Wash., has passed a resolution calling for the incurring of a general indebtedness of $30,000 to purchase the waterworks system which is owned by the Pacific Power & Light Co., with headquarters at Portland, Ore. If the plant is purchased, $20,000 in bonds will be sold for repairing and bettering the system.

Wisconsin.

•F. R. Harding of Racine, Wis., has been awarded the contract by the Board of Local Improvements of East Moline, Ill., for the construction of seven and one-half miles of water mains for approximately $75,000.

Canada.

✣Bids will be received until noon, April 26, by City Comissioners, Regina, Sask., for supply of approximately 900 tons 18-in. c. i. pipe, 150 tons 6-in. c. i. pipe. A marked check for $2,000 must accompany each tender. L. A. Thornton is City Engineer.

✣Bids will be received until noon, April 25, by Board of Control, G. R. Geary, Chairman, Toronto, Ont., for the supply of a priming [illegible] for centrifugal pumps [illegible] Toronto filtration plant.

The citizens of Melville, Sask., on April 24 will vote on the issuance of bonds to the amount of $63,000 for the installation of a waterworks and a storm water sewer.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

◉Wilburn Hill, formerly City Engineer of Gadsden, Ala., has been engaged by the city of Attalla to superintend the laying of a sewer system, estimated to cost $30,000. J. L. O'Conner, Knoxville, Tenn., has been awarded the contract.

Arizona.

Frank Thomas, City Recorder, Phoenix, Ariz., on April 25 will again receive bids for the $325,000 issue of sewer bonds.

Arkansas.

The City Council of Pulaski Heights, Ark., contemplates the installation of a sewer system, draining into the Arkansas River.

California.

◉The City Council of Oakland, Cal., has awarded the contract to the Piedmont Construction Co., for the construction of the High St. sewer for $28,167. The specifications call for 18,000 ft. of sewer, which will serve as an outlet for the Allendale and Wettall districts. Other bids received were: H. Gould, $28,550; Chambers & Heafy, $29,485; Michael Murphy, $31,503; William Heafy, $33,801, and John Geary, $37,295.

The citizens of Concord, Cal., have voted the issuance of bonds to the amount of $29,000 for the construction of a sewerage system. The contract for this improvement will soon be let. Sloan & Robson of San Francisco, Cal., are Engineers.

Colorado.

The citizens of Colorado Springs, Colo., on April 5 voted the issuance of bonds to the amount of $22,000 for the extension of the sanitary sewer system planned in connection with paving the streets in the business section of the city.

Connecticut.

Advices from Manchester, Conn., say the South Manchester Sanitary District contemplates the extension of its sewer system.

District of Columbia.

Gen. W. L. Bixby, Chief Engineer, has approved the application of the District Commissioners, Washington, for permission to extend the water and sewer services at points in the Conduit road between the New Cut road and the District line. Permission has also been granted for the construction of a water supply pipe across and under the Conduit road at Rock Springs east of Glen Echo, Md.

Georgia.

An election will probably be held in Cartersville, Ga., soon for the purpose of voting on the issuance of bonds in the sum of $100,000 for a more efficient waterworks, a better gas plant, a sewerage system, better and larger school buildings and grounds, better streets, etc.

An election will be held in Blakely, Ga., on April 22 for the purpose of voting on the issuance of bonds to the amount of $60,000 for improvements to the sewer system and the erection of a school building.

Illinois.

The Board of Local Improvements of Plainfield, Ill., has approved the plans prepared by Consulting Engineer H. D. Hallet of Aurora, Ill., for the construction of a sewerage system, estimated to cost $10,000. It is probable that bids for the work will be asked soon. Coll McNaughton of Joliet, Ill., is City Attorney for Plainfield.

The Board of Local Improvements of East St. Louis, Ill., has adopted the specifications and plans prepared by City Engineer J. Crocken for the construction of a lateral to the outlet sewer, to be known as the Winstandley sewer. This lateral, it is estimated, will cost $288,000, while the outlet sewer will cost about $710,000. The Winstandley sewer will join the outlet sewer at 16th St. and Cleveland Ave. The main sewer will be of concrete and 6½ ft. in diameter. More than 120 smaller sewers, or pipes, will be from 20 to 30-in. in diameter and of vitrified clay brick. The district is bounded on the north by Ridge Ave. and the Illinois Transfer Co. tracks; on the east by the city limits; on the west by the Terminal Belt, and on the south by the Southern Railway tracks.

The Board of Local Improvements of East St. Louis, Ill., has introduced a bill in the City Council to authorize the beginning of work on District Sewer, No. 2, in the Winstandley section of the city. Silas Cook is Mayor.

The City Council of Elgin, Ill., has passed an ordinance providing for the construction of the West Chicago St. sewer system. The Board of Local Improvements has decided to defer the advertising for bids until the commission takes office.

The Board of Local Improvements of Cicero, Ill., will soon call for bids for constructing a brick sewer improvement to be connected with said South 52nd Ave. (also known as Robinson Ave.) from the West Fork of the South Branch of the Chicago River (also known as Ogden Ditch) to West 22nd St. The estimated cost of this work is as follows:

7,330 ft. of $7\frac{1}{2}$-ft. brick sewer at $15.70, $115,-

[illegible]

✣ indicates work now open for bids. • indicates a contract let recently.

[illegible] John J. [illegible], Chairman, Board of Local Improvements, Chas. [illegible] is Town Clerk.

Following are the low bids received April 7 to the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Secretary, for constructing sewers:

N. [illegible]	[illegible]	1¼	[illegible]	[illegible]	$[illegible]
M. [illegible], [illegible] W. [illegible], Chicago					
W. Madison st.	[illegible]	1	1	1.40	[illegible]
[illegible] Roberts, [illegible] Taylor st., and Michael Pontorelli, 4817 W. Dakin st., Chicago					
S[illegible] st.	[illegible]	1	8	1.40	[illegible]
Jos. Saraiano, [illegible] Ewing st.					
[illegible] ave.	[illegible]	1	8	[illegible]	1,[illegible]
Rock [illegible]					[illegible]
John W. [illegible], [illegible]					
Chicago					$2,[illegible]
W. [illegible]	[illegible]	1½	13.0	[illegible]	
W. [illegible] pl.	670	1¼	12.0	[illegible]	
W. [illegible] pl.	[illegible]	1¼	11.0	1.[illegible]	
W. [illegible] pl.	610	1	10.[illegible]	1.40	
[illegible], 29[illegible] W. Congress st., Chicago					1,[illegible]
S. Leavitt st.	2,0[illegible]	2	19.0	[illegible]	
S. Leavitt st.	[illegible]	1	10.0	1.50	
[illegible] st.	1,000	1½	13[illegible]	1.60	
S. Hamilton ave.	1,3[illegible]	1	8[illegible]	[illegible]	
S. Irving ave.	1,[illegible]	1	[illegible]	1.2[illegible]	
S. Oakley ave....	1,160	1	7.5	1.10	
Alley N. of W. [illegible] st.	640	1	[illegible]	1.00	
Christino Fosco, 814 Desplaines st., Chicago					$16,[illegible]
West End ave.	770	2	14.0	4.00	
West End ave.	780	1½	12.[illegible]	1.50	
Howard ave......	510	1¼	9.5	1.50	
Howard ave......	560	1¼	9.5	1.50	
Howard ave.	440	1	8.5	1.50	
Jos. Saraiano					$5,115.00
N. [illegible] ave.	330	2½	12.0	3.50	
Sunnyside ave....	770	1	8.5	1.25	
Christino Fosco, 814 Desplaines st., Chicago					$2,117.50
W. 51st st........	1,320	3½	14.7	5.00	
W. 51st st.	1,340	3	14.2	4.00	
W. 51st st.	[illegible]	2½	14.0	4.00	
W. 51st st........	1,000	2	13.2	2.75	
W. 51st st.	1,[illegible]	2½	13.8	4.00	
S. Artesian ave..	665	1¼	11.5	1.45	
S. Artesian ave.	[illegible]	1	9.5	1.33	
S. Artesian ave..	665	1½	10.9	2.25	
S. Artesian ave..	665	1¼	9.7	1.40	
S. Artesian ave..	831	1.0	8.5	1.33	
S. Campbell ave..	665	1¼	11.5	1.40	
S. Campbell ave..	535	1.0	10.0	1.33	
S. Campbell ave..	665	1½	11.5	2.25	
S. Campbell ave..	665	1¼	10.4	1.40	
S. Campbell ave..	830	1	9.0	1.33	
S. Maplewood ave	665	1¼	11.7	1.40	
S. Maplewood ave	535	1.0	9.5	1.33	
S. Maplewood ave	665	1½	11.7	2.25	
S. Maplewood ave	665	1¼	10.7	1.40	
S. Maplewood ave	830	1.0	9.0	1.33	
S. Rockwell st....	665	1¼	11.8	1.40	
S. Rockwell st....	535	1.0	9.7	1.33	
S. Rockwell st....	665	1½	11.9	2.25	
S. Rockwell st....	665	1¼	10.9	1.40	
S. Rockwell st....	830	1.0	9.0	1.33	
W. 51st st.	810	1.0	10.0	1.33	
W. 51st st.	670	1	9.5	1.33	
W. 51st st.......	250	1½	12.7	2.25	
Michael Pontorelli, 4817 W. Dakin st., Chicago					$14,[illegible]

Note—All work in this letting to be in accordance with new specifications; all sewers less than 2 ft. internal diameter to be vitrified tile pipe, over 2 ft. brick.

Indiana.

✣Bids will be received until 10 a. m., April 24, by Board of Public Works, Indianapolis, Ind., for the construction of local sewers with appurtenances in and along Dearborn St. from Michigan St. to a point 1,645 ft. north.

⊙A contract has been awarded by the Board of Public Works of Indianapolis, Ind., for a sewer in the district between 21st and 25th Sts., from Columbia to Ralston Aves., known as Jackson Park, to the American Construction Co., for $72,152.

⊙Fred H. Fuelling, Eliza St., Fort Wayne, Ind., at $.86½, and Anton Rieg, Putnam St., Fort Wayne, Ind., at $.59, have been awarded the contract by the Board of Public Works of Fort Wayne for the construction of sewers as follows: Construction of a sewer in and along alley east of Franklin Ave. from the brick sewer on High St. to Polk St.; for the construction of a sewer in and along and through the south part of lot No. 3, Haswell's Subdivision, in the alley south of Kinnard Ave., and in the alley east of Beaver Ave. from Indiana Ave to Kinnard Ave. H. W. [illegible] is Clerk of the Board. Bids were opened April 8.

The City Council of Newcastle, Ind., is advertising, it is reported, for bids for the converting into a large arched sewer of the open stream running through the center of the city, known as the Bowery Brook. It is expected the work will cost not less than $[illegible].

The Committee on Sewers of the City Council of Brazil, Ind., has reported favorably for the construction of a sanitary sewer from the east end of the Pogue Run sewer to the plant of the Food Product Co. The distance is about 3,000 ft., and the work will cost approximately $4,000.

Iowa.

The City Council of Avoca, Ia., has employed Surveyor John P. Crick of Omaha, Neb., to prepare plans for a sewerage system.

Kentucky.

The City Council of Bowling Green, Ky., has adopted a resolution requesting State Engineer Paul Hansen to submit a proposed plan for inaugurating a system of sewerage for the city, and also for a plan for the improvement of the filtration plant of the waterworks.

Plans and specifications are being prepared by Engineers Alvord & Burdick, Hartford Bldg., Chicago, Ill.; for the construction of a disposal plant and about eight miles of sanitary sewers for the city of Madisonville, Ky.

Maryland.

The citizens of Ridgely, Md., will vote April 24 on the proposition to issue bonds for sewer construction.

Michigan.

⊙John A. Ellison of Munger, Mich., has been awarded the contact by the county drain commissioners of Genesee and Shiawassee counties, at Gaines, Mich., for the construction of the Corrigal drain in Gaines Township, about 1,360 rods in length. The contract price is $3,450. Bids were opened April 4.

The Board of Public Works of Eaton Rapids, Mich., has decided to construct a sewer on State and River Sts., in the First ward.

The City Council of Hamtramck, Mich., has awarded William Blanck the contract for the construction of two lateral sewers.

An official canvass showed that the city of Battle Creek, Mich., voted favorably on charter revision on a $15,000 bridge bonding proposition and on a $30,000 sewer bond issue.

Minnesota.

✣Bids will be received until 10 a. m., April 24, by A. H. Scherer, City Clerk, Mankato, Minn., for the construction of a storm sewer on Van Brunt St. from Carrol St. to Byron St., and on Second St. from Byron St. to Warren Creek, approximately the following quantities: 1,080 ft. of 20-in. pipe, 725 ft. of 10-in. pipe, 160 ft. of 12-in. pipe, and five manholes. Plans and specifications are now on file in the office of the City Clerk.

⊙J. J. Connolly of St. Paul, Minn., has been awarded the contract by the city of Albert Lea, Minn., William Barneck, City Engineer, for the construction of an 8-in. pipe sewer for $3,144. Bids were opened April 7.

The village of Wadena, Minn., is agitating the question of public sewers.

The City Council of Gilbert, Minn., has borrowed $20,000 from the state, which with the $12,000 already on hand, will be sufficient to complete the proposed sewer system. Plans prepared by Engineer Frank Bowman have been approved.

Missouri.

A straw vote was cast at the election held in Monroe City, Mo., on April 4, to see if the people were in favor of issuing bonds to the amount of $75,000 for waterworks and sewerage.

At the regular election to be held in Aurora, Mo., the voters will be asked to cast a straw ballot on the proposition to bond the city for $[illegible] to put in a general sewer system. If the voters favor the proposition a special election will be called.

Montana

City Engineer John M. Duthie is drawing up plans and making an estimate of the cost of a complete sewer system for the town of Libby, Mont. It is proposed to install the sewers by issuing bonds, a special election to be held for that purpose.

Nebraska.

At the coming town election in Stanton, Neb., the citizens will be asked to vote on the proposition of issuing $10,000 in bonds for a sewerage system.

Plans and specifications for the construction of a sewerage system in Falls City, Neb., have been completed.

New Jersey.

⊙Bids were opened April 11 by South Orange Township, N. J., Alexander Potter, Consulting Engineer, 114 Liberty St., New York, for constructing sanitary sewers in the Hilton District, the contract being awarded to J. J. Fusco, Mountclair, N. J., at the following bid:

1,060 ft. 12-in. vit. pipe sewer, 6 to 8 ft. deep	$ 0.67
3,300 ft. 12-in. vit. pipe sewer, 8 to 10 ft. deep	0.75
656 ft. 12-in. vit. pipe sewer, 10 to 12 ft. deep	0.82
90 ft. 12-in. vit. pipe sewer, 12 to 14 ft. deep	1.00
823 ft. 10-in. vit. pipe sewer, 0 to 6 ft. deep	0.52
2,540 ft. 10-in. vit. pipe sewer, 6 to 8 ft. deep	0.57
3,592 ft. 10-in. vit. pipe sewer, 8 to 10 ft. deep	0.67
805 ft. 10-in. vit. pipe sewer, 10 to 12 ft. deep	0.75
[illegible] ft. 10-in. vit. pipe sewer, 12 to 14 ft. deep	0.87
635 ft. 10-in. vit. pipe sewer, 14 to 16 ft. deep	1.00
300 ft. 8-in. vit. pipe sewer, 0 to 6 ft. deep	0.47
967 ft. 8-in. vit. pipe sewer, 6 to 8 ft. deep	0.52
3,115 ft. 8-in. vit. pipe sewer, 8 to 10 ft. deep	0.57
100 ft. 8-in. vit. pipe sewer, 10 to 12 ft. deep	0.65
[illegible]0 ft. 8-in. vit. pipe sewer, 12 to 14 ft. deep	0.77
59 manholes less than 10 ft. deep........	52.00
25 ft. of manholes over 10 ft. deep........	7.50
8 ft. of drop manholes....................	8.50
4 flush tanks	125.00
100 branches on 12-in. pipe...............	1.25
100 branches on 10-in. pipe...............	1.00
200 branches on 8-in. pipe................	0.87
20,000 ft. B. M. sheeting at..............	25.00
400 cu. yds. quicksand at	1.50
300 cu. yds. rock at......................	2.00
Total	$18,246

The City Council of Ocean City, N. J., has agreed to submit to popular vote the question of a bond issue of $75,000 for surface water drainage and improved gutters. The election will be held May 9.

Advices from Chatham, N. J., state that the Chatham-Madison Joint Sewer Commission has decided to place a siphon to carry the sewerage from Madison to the disposal works Chatham.

New York.

✣Bids will be received until 11 a. m., April 26, by Alfred E. Steers, President of the Borough of Brooklyn, N. Y., for furnishing all the labor and materials required for foundation for sewers in Malta St. between Wortman Ave. and Fairfield Ave.; in Fairfield Ave., between Malta St. and Van Sicklen Ave., and in Van Sicklen Ave., between Fairfield Ave. and the 26th Ward Disposal Works, situated between Fairfield Ave. and Vandalia Ave. The Engineer's estimate of the quantity is as follows: Foundation consisting of piles and pile capping complete in 2,000 lin. ft. of trench. The time allowed for the full completion of the work and full performance of the contract is 200 working days. The amount of security required is $4,000. Each bidder will state in the estimate a price for foundation per linear foot of trench, by which price the bids will be tested. Further information may be obtained at the office of the Bureau of Sewers, 215 Montague St., Borough of Brooklyn.

✣Bids are asked until 10 a. m., May 15, by the Sewerage Commission of Batavia, N. Y., K. B. Mathes, Chairman, for furnishing materials and labor for the construction of preliminary settling tanks of the Imhoff type, sprinkling filterers and sludge drying beds, including necessary fittings and appurtenances. Plans and specifications may be seen at the office of Hering & Fuller, Consulting Engineers, 170 Broadway, New York City. The plans may be seen and specifications and forms of proposal obtained from Charles Hoopes, Resident Engineer, at the office of the Sewer Comission in aBtavia, N. Y. Official advertisement will be found elsewhere in this issue.

The citizens of Dodgeville, N. Y., have voted the issuance of bonds in the sum of $12,000 for the extension of the sewer system. Chas. E. Collins, Drexel Bldg., Philadelphia, Pa., Engineer.

The Board of Trustees of Port Chester, N. Y., has approved the plans prepared by Frederick S. Odell of Port Chester for the construction of a sewage disposal plant on Fox Island, estimated to cost $100,000.

Francis Ward, Commissioner of Public Works, Buffalo, N. Y., will soon advertise for the construction of 10-in. tile sewers in the west side of South Ogden St., south of Clinton St., and in the west side of Morgan St., between Tracy and Tupper St.

Ohio.

✣Bids will be received until noon, April 27, by A. B. Lea, Director of Public Service, Cleveland, O., for the construction of sewers in Botany Ave. S. W., between West 15th St. and West 16th St.; West 15th St., between Denison Ave. S. W. and Botany Ave. S. W. Ira O. Hofman is Secy.

✣Bids will be received until noon, April 21, by Department of Public Service, Dayton, O., for the construction of storm water sewers in Huffman Ave. from Third St. to Martz Ave., and Lexington Ave. from Broadway to Yuncker Ave. William A. Budroe is Secy. of the Department.

✣Bids will be received until noon, April 28, by Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains with their appurtenances in Atkinson St. between Clifton Ave. and Moerlein Ave. Plans and specifications can be obtained of the Chief Engineer of the Department.

Bonds in the sum of $6,000 have been sold to provide for the construction of the sanitary sewer planned for the South End of Springfield, O. M. J. Bahin is City Engineer.

Oregon.

The citizens of Eugene, Ore., voted April 4 on the proposition to issue bonds in the sum of $28,000 for the purpose of constructing two main sewers, one through Fairmont down to Ninth St., thence to Ferry St., on Ferry St north to river, and the other on Tyler St. and its extensions.

Pennsylvania.

Chas. E. Collins, Drexel Bldg., Philadelphia, Pa., is preparing plans for the installation of a sewage disposal plant, consisting of settling tanks and sprinkling filters for the town of Winchester, Ky.

Chester & Fleming, Consulting Engineers, Union Bank Bldg., Pittsburg, Pa., are preparing plans for a sewage disposal plant for the borough of Masontown, Pa., in connection with Mr. E. C. Baker, City Engineer.

The citizens of Everson, Pa., on April 4 voted the issuance of bonds to the amount of $15,000 for the sewering of the borough. A system of sewers will be laid on the principal streets.

The citizens of Lehighton, Pa., are agitating for the construction of sewers. It is probable that the Town Council will order the same.

The property owners of that portion of Scott township adjoining Mount Lebanon, Pa., recently held a meeting with the Township Commissioners at Mount Lebanon to induce the authorities to pay for a sewerage disposal plant provided property owners pay for putting in the sewers.

Borough Surveyor N. R. Rambo of West Chester, Pa., and assistants are engaged in staking out the lines of the route of the proposed sewer system of West Chester to the site of the septic beds and disposal plant in West Goshen township. Bids for the work will be asked for shortly.

South Carolina.

✣Bids will be received until 4 p. m., April 24, by City Treasurer, Spartanburg, S. C., for the construction of four lines of sewers 300, 1,600, 100 and 50 ft. long, respectively, pipes to be 8 ins. in diameter.

South Dakota.

✣Bids will be received until 8 p. m., May 15, by F. W. Raymond, City Auditor, Aberdeen, S. Dak., for the construction of all the sewers ordered by the city council, including approximately 1,430 ft. of 8-in. and 430 ft. of 12-in. and 5 manholes. Plans and specifications are on file at the office of the City Engineer.

Washington.

A petition is being circulated in Ritzville, Wash., requesting the City Council to have surveyed and constructed a sub sewer to serve the residents of South College hill.

West Virginia.

✣Bids will be received until 1 p. m., May 8, by Board of Commissioners, Huntington, W. Va., for the construction of 12-in. lateral sewers in various alleys. A. B. Maupin is City Engineer.

Wisconsin.

✣Bids will be received until 10:30 a. m., April 25, by Department of Public Works, Milwaukee, Wis., for the construction of a concrete relief sewer in that part of the West Sewerage District connecting with the Hubbard St. sewer. H. E. Briggs is Commissioner of Public Works.

✣Bids will be received until 10 a. m., April 29, by Board of Public Works, Racine, Wis., for furnishing the necessary labor and material for the construction of a public sewer in Forest St. from [illegible] St. to [illegible] Road, approximating the following quantities: 440 lin. ft. 24-in. pipe sewer, 660 lin. ft. 20-in. pipe sewer, 375 lin. ft. 18-in. pipe sewer, 510 lin. ft. 15-in. pipe sewer, 4 man holes, 12 catch basins. Said work to be completed on or before the 1st day of September, 1911. All in accordance with the plans and specifications of the work on file in the office of said City Clerk.

⊙The city council of South Milwaukee, Wis., has awarded R. J. Hickey, 255 14th St., Milwaukee, Wis., the contract for the construction of a complete sewage [illegible] plant composed of a settling tank, dosing chamber, sand filter beds and appurtenances. Alvord & Burdick, 1212 Hartford Bldg., Chicago, Ill., Engineers. The contract price is $6,789. The work will require 2,270 cu. yds. of sand. Bids were opened April 6.

⊙R. J. Hickey, 255 14th St., Milwaukee, Wis., has been awarded the contract by the city council of South Milwaukee, Wis., for the construction of 7,299 ft. of 8 to 24-in. tile pipe sewers and appurtenances in the Second Sewerage District of the city. Alvord & Burdick, 1212 Hartford Bldg., Chicago, Ill., Engineers. The contract was awarded on the following bids: 1,291 ft. of 8-in. pipe, av. cut, 7.5 ft., $.92 per ft., total, $1,265; 6,008 ft. of 24-in. sewer, av. cut, 14 ft., $1.97½ per ft., total, $11,866; 32 manholes, $33.75 each. Bids were opened April 6.

Wyoming.

✣Bids will be received until 9:30 a. m., May 8, by Capt. F. S. Armstrong, Fort D. A. Russell, Wyo., for the construction of approximately the following estimated quantities of drain: 3,125 lin. ft. of 8-in. S. G. vitrified pipe and specials, 2,900 lin. ft. of 6-in. S. G. vitrified pipe and specials and 9 manholes. Plans, specifications and general instructions to bidders are on file in this office and also in the office of the Chief Quartermaster, Department of the Missouri, Omaha, Neb.; Chief Quartermaster, Department of Colorado, Denver, Colo., and in the office of the Secretary of Builders' Exchange, St. Paul, Minn.

Canada.

✣Bids will be received until noon, May 9, by G. R. Geary, Chairman Board of Control, Toronto, Ont., for laying reinforced concrete pipe sewer complete including the following approximate quantities of pipe: Sec. No. 5, 3,350 lin. ft. of 60-in.; Sec. No. 6, 2,830 lin. ft. of 66-in.; Sec. No. 7, 3,778 lin. ft. of 66-in.; Sec. No. 8, 3,238 lin. ft. of 66-in. Plans may be seen and specifications and further information obtained from the Main Drainage Works, City Engineer's Office, Toronto.

✣Bids will be received until noon, April 30, by City Commissioners, Regina, Sask., for the supply of one 1,000,000 gal. per 24 hrs. capacity pump and motor, switchboard and apparatus. J. Marshall is Chief Engineer Trunk Sewer Works.

Messrs. Stuart Howard and D. W. Cowie have submitted plans to the Board of Control of Montreal, Que., for the new Elgin basin sewer. It will be a 10-ft. stone conduit branching on McGill St., by way of Youville Square.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

✣Bids will be received until 11 a. m., May 3, by Col. G. McK. Williamson, Constructing Quartermaster, Fort Mason, Cal., for constructing reinforced concrete barracks for four troops of cavalry at Presidio of San Francisco, Cal.

✣Bids will be received until 2 p. m., May 18, by Department of Interior, Indian Office, Washington, D. C., for furnishing the necessary labor and material for the construction at the Round Valley School, California, a girls' frame dormitory.

✣Bids will be received until 2 p. m., May 16, by Department of the Interior, Office of Indian Affairs, Washington, D. C., for furnishing labor and material for the construction of one employes' quarters and one school building for the Campo Day School, Cal.

Fred C. Turner, City Engineer, Oakland, Cal., is preparing plans and specifications for a wharf to be constructed in the Key Route basin. Freight sheds and a temporary approach to the shore from the wharf, to be used pending the completion of the filling-in work, will also be provided. The cost is estimated at $30,000.

Colorado.

✣Bids will be received until 3 p. m., May 23, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Fort Collins, Colo.

District of Columbia.

✣Bids will be received until 10:30 a. m., May 10, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing steel rails, frogs, switches, switch stands, tie plates, angle bars, track bolts and spikes, nut locks, steel, iron, galvanized roofing, nuts, pipe, wire rope, wire, babbitt metal, pig tin, slab zinc, pig lead, ingot copper, pig iron, etc.

✣Bids will be received until 2 p. m., April 25, by Commissioners of the District of Columbia, Washington, D. C., for furnishing two steam engines and two generators for use in the McKinley Manual Training School in that city.

Florida.

✣Bids will be received until noon, May 1, by Capt. G. R. Spalding, U. S. Engineer, Jacksonville, Fla., for dredging in St. John's River below Jacksonville, Fla.

Illinois.

✣Bids will be received until noon, May 4, by L. J. Bryan, Clerk of Trustees Sanitary District of Chicago, 1500 American Trust Bldg., Chicago, Ill., for the excavation of certain premises adjacent to the Chicago River between Jackson St. and 14th St. Official advertisement will be found elsewhere in this issue.

Following are the low bids received April 8 by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for constructing a dock at the foot of Orleans St. Great Lakes Dock & Dredge Co., Tacoma Bldg., Chicago, $23.90 per lin. ft. Fitz Simons & Connell Co., 131 LaSalle St., Chicago, $24.50 per lin ft.

Following are the bids submitted to B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering lumber to the Bureau of Engineering, bids opened March 18th, 1911. Following prices are based upon quantities required for use: (A) White pine; (B) Norway pine; (C) kiln dried mouldings; (D) hemlock; (E) whitewood; (F) maple; (G) white or burr oak; (H) yellow pine No. 1 common; (I) Oregon fir; (J) miscellaneous; (K) white pine D. & M. flooring, siding, etc.; (L) white pine (special) see specifications; (M) yellow pine, D. & M.; (N) maple, D. & M.: Edward Hines Lumber Co., Blue Island Ave. and Lincoln St., (A), $672.50; (B), $1,546.50; (C), $42.11; (D), $1,134.50; (E), $113.00; (F), $110.00; (G), $3,894.00; (H), $2,447.00; (I), $320.00; (J), $603.50; (K), $2,901.00; (L), $683.00; (M), $970.00; (N), $1,357.00; Thornton-Claney Lumber Co., 2315 Elston Ave., (A), $714.50; (B), $1,630.38; (C), $52.25; (D), $1,170.50; (E), $150.00; (F), $105.00; (G), $1,101.25; (H), $2,494.00; (I), $290.00; (J), $617.00; (K), $3,000.00; (L), $725.00; (M), $969.50; (N), $1,361.00; Herman H. Hettler Lumber Co., 2601 Elston Ave., (A), $717.25; (B), $1,596.25; (C), $48.73; (D), $1,101.50; (E), $120.00; (F), $110.00; (H), $2,518.25; (I), $360.00; (J), $693.75; (K), $3,691.00; (L), $731.00; (M), $1,062.00; (N), $1,355.00. Marsh Bingham Co., 1405 W. 37th St., (G), $3,864.77; (H), $2,505.50. The contracts have not been awarded.

Indiana.

✣Bids will be received until May 6, by Maj. J. T. Davidson, Depot Quartermaster, Jeffersonville, Ind., for furnishing under Schedule [illegible] 300 army ranges No. 3 and 300 army ranges No. 5.

Kansas.

The Commercial Club of Topeka, Kan., has appointed to consider the matter of constructing a hydro-electric development on the Kaw River. It is probable that the committee will [illegible] report on the project.

Maine.

The following bids were received April 11 by Lt. Col. W. E. Craighill, U. S. Engineer, Portland, Me., for rock excavation in Kennebec River, Maine: John J. Fitzpatrick & Sons, Plattsburg, N. Y., $23.85 per cu. yd.; Johnston & Virden, Lewes, Del., $26.50 per cu. yd.; Frank W. Carlton, Bath, Me., $24.00 per cu. yd.; Mastern Dredging Co., Boston, Mass., $26.80 per cu. yd.

Maryland.

✣Bids will be received until 1 p. m., May 15, by Col. T. L. Casey, U. S. Engineer, Room 309 Custom House, Baltimore, Md., for dredging in Patapsco River, Md.

The Harbor Board of Baltimore, Md., has adopted the recommendation of Harbor Engineer Oscar Lackey that the board create a special department under a competent engineer to study and report upon the cost of constructing canals in the bed of Gwynn's falls and the Patapsco River.

Massachusetts.

✣Bids will be received until noon, May 12, by Col. F. V. Abbot, U. S. Engineer, Boston, Mass., for repairing breakwater at Gloucester, Mass.

The commission recently appointed under authority of the State Legislature to report upon the value to the state of a canal from Narragansett Bay to Boston Harbor, to be constructed and maintained without tolls by the government, has begun holding hearings at the State House at Boston. A canal survey has been made by the United States Army engineers and an estimated cost prepared for a canal 25 ft. deep, 200 ft. bottom width, and a canal 17 ft. deep and 125 ft. bottom width, 52 miles in length, from Taunton River to Hingham Harbor a feasible route having four locks, two of which would be at Hingham. The canal would run through southern Massachusetts and develop one of the most important manufacturing sections of New England, embracing the cities of Taunton, Bridgewater, Brockton, Campello, Whitman, Abington, Rockland, South and East Weymouth, Quincy, Hingham and a number of smaller towns.

Michigan.

⊙The board of public works of Grand Rapids, Mich., has awarded the Shaw Electric Crane Co., of Muskegon, Mich., the contract for furnishing and erecting one traveling crane for the city of Grand Rapids. The contract price is $2,452. Bids were opened April 6.

The following bids, per cu. yd. place measurement, were received April 10, by Col. C. McD Townsend, U. S. Engineer, Detroit, Mich., for dredging about 18,000 cu. yd. of material at Ballards Reef, Detroit River: Edward Bros. Dredge Co., Sault Ste. Marie, Mich., $3.49; Byermann Bros., Toledo, O., $4.85; The Brindley Co., New York, N. Y., $3.08; Great Lakes Dredge & Dock Co., Chicago, Ill., $4.25; The Buffalo Dredging Co., Buffalo, N. Y., $2.65; M. Sullivan, Detroit, Mich., $2.61.

Bids as follows per cu. yd. scow measurement, were received April 10, by Col. C. McD Townsend, U. S. Engineer, Detroit, Mich., for the improvement of harbor at Rogers City, Mich.: Greiling Bros. Co., Green Bay, Wis., $0.85; Great Lakes Dredge & Dock Co., Chicago, Ill., $0.80; Edward Bros. Dredge Co., Sault Ste. Marie, Mich., $0.99; James Davidson, Bay City, Mich., $0.75.

Bids as follows were received April 10, by Col. C. McD. Townsend, U. S. Engineer, Detroit, Mich., for construction of sluice gates from St. Mary's Falls Canal, Mich.: (1) structural steel, 300,000 lbs. per lb.; (2) operating machinery, 60,000 lbs. per lb.; (3) cast iron, 111,000 lbs. per lb.; (4) wire rope, 480 ft., per ft.; (5) timber 8,000 ft., B. M. per M.; (6) equipment, lump sum; (7) [illegible]

	(1)	[illegible]	[illegible]	(4)	(5)	(6)	(7)
Milwaukee Bridge Co., Milwaukee, Wis.	[illegible]			$0.06	$48.00	$100.00	[illegible]
Lawrence D. Wenning, Cleveland, O.	[illegible]		.018	13	65.00	600.00	[illegible]
J. & J. B. Milholland Co., Pittsburg, Pa.	[illegible]		[illegible]	10	100.00	[illegible]	[illegible]
Penn Bridge Co., Beaver Falls, Pa.	[illegible]			18	65.00	390.00	[illegible]
Detroit Bridge & Steel Works, River Rouge, Mich.	[illegible]			14	[illegible]	440.06	[illegible]
Russel Wheel & Foundry Co., Detroit, Mich.	[illegible]			[illegible]	100.00	750.00	[illegible]
Steacy-Schmidt Mfg. Co., York, Pa.	[illegible]			[illegible]	80.00	755.00	[illegible]
Modern Steel Structural Co., Waukesha, Wis.	[illegible]	[illegible]		10	47.20	361.00	1,448
Whitehead Kales Co., Detroit, Mich.	[illegible]		.035		94.00	600.00	[illegible]
Minneapolis Steel & Machy. Co., Minneapolis, Minn.	[illegible]	[illegible]	.03		[illegible]	[illegible]	[illegible]
[illegible] Steel Construction Co., Chicago, Ill.	[illegible]	[illegible]	.042		[illegible]	600.00	[illegible]

Mississippi.

✣Bids will received until 3 p. m., May 24, by James Knox Taylor, Supervising Architect Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office at Greenwood, Miss.

Missouri.

✣Bids will be received until 10 a. m., April [illegible], by Edward Kahlbaum, Secy. Executive Committee, Rolla, Mo., for the completion of the ore dressing building of the school of mines at Rolla. Plans and specifications can be seen at the office of H. F. Hoit, Architect, Kansas City, and Buxton & Skinner, Sta. Co., St. Louis.

Bids were opened April 10 by the Board of Public Works of Kansas City for the construction of a municipal wharf along the river front between Delaware and Walnut Sts. The A. M. Blodgett Construction Co., Kansas City, at $22,760, was the lowest bidder.

New Jersey.

✣Bids will be received until 11 a. m., May 3, by Commanding Officer, Fort Hancock, N. J., for the erection of wood jetties, aggregating about 1,900 ft. in length protecting the east shore line.

The State Assembly has passed the bill appropriating $150,000 for an inland waterway between Barnegat Bay and Manasquan Inlet, paving the way for another link in the proposed State canal.

New York.

✣Bids will be received until 11 a. m., April 26, by Alfred E. Steers, President, Borough Brooklyn, New York City, for furnishing the necessary labor and material for the dredging and filling at the Eighth Ward Market property between 36th and 38th Sts. The estimated cost of the work is $21,000. Further information can be obtained at the office of Bureau of Public Buildings and Offices, Room 29, Municipal Bldg., Borough of Brooklyn.

✣Bids will received until 2 p. m., May 3, by Constructing Quartermaster, Fort Totten, N. Y., for dredging channel to wharves at Fort Totten, N. Y.

✣Bids will be received until 2 p. m., May 3, by Constructing Quartermaster, Fort Totten, N. Y., for installing heating plant in barracks Nos. 107, 108 and 110 at Fort Totten, N. Y.

Following bids were received April 10 by Lt. Col. J. G. Warren, U. S. Engineer, Buffalo, N. Y., for the excavation of 9,000 cu. yds. scow measure of blasted rock in Niagara River, N. Y.: Empire Engineering Corporation, New York, N. Y., 83 cts. per cu. yd.; Buffalo Dredging Co., Buffalo, N. Y., 76 cts. per cu. yd.; Arthur H. Vogel, Milwaukee, Wis., 79 cts. per cu. yd.

Ohio.

✣Bids will received until noon by Director of Public Service, Clev for dredging the Cuyahoga River. S tions are on file at the office of the Ch gineer of the Department.

Plans for a reinforced concrete buildi be erected for The Union Thread Co. at Car thage, O., are in course of completion. Th building will be two stories high, 40 ft. x 12 ft. of skeleton reinforced concrete type, using

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

cold twisted steel reinforcement, solid steel window sash and brick spandrels. The work will include heating, electric work, power and lighting, elevators and sprinkler system. Bids will be called for in about a week. Henry N. Hooper, 517 Provident Bank Bldg., Cincinnati, is the Architect and Consulting Engineer.

Bids as follows were received April 13 by Maj. H. Jervey, U. S. Engineers, Cincinnati, O., for hire of four dredging plants, each consisting of one dredge, one towboat, and two dump scows (Ohio River improvement): Monongahela & Western Dredging Co., Pittsburg, Pa., $150.00 per day; Ohio River Contract Co., Evansville, Ind., $150.00 per day; Fieger Austin Dredging Co., Pittsburg, Pa., $125.00 per day.

Pennsylvania.

✣Bids will be received until 7 [illegible], April 21, by Newport School Board for the erection and completion of a Public School Building, the drawings and specifications for which can be seen at the offices of the Architects, Hauer & Mowere, 3110 Columbia Avenue, Philadelphia, and Eighth and Cumberland Streets, Lebanon, Pa., or at the office of the President, Dr. C. E. DeLancey, Newport, Pa.

Tennessee.

The following bids were received March 22 by Capt. Clarke S. Smith, U. S. Engineer, Memphis, Tenn., for furnishing riprap stone: W. B. Arnold, Cape Girardeau, Mo., 75 cts. per cu. yd., for 25,000 cu. yds. on government boats, loaded at a point 1½ mile above Neelys, Mo.; Oscar F. Barrett, Cincinnati, O., $2.10 per cu. yd. for 15,000 cu. yds. on contractor's barges at Memphis; Miles & Straub, Helena, Ark., $2.03 per cu. yd. for 25,000 cu. yds. on government barges, loaded at Helena, Ark. Informal bids were reserved as follows: Miles & Straub, Helena, Ark., 15,000 cu. yds., $1.35, f. o. b. on tracks of Rock Island R. R. at Wheatley, Ark.; Wm. Parkin, Little Rock, Ark.; 15,000 cu. yds. at 73½ cts. f. o. b. cars on land grant portion of St. L., I. M. & S. Ry.; Ward & Carmack, Little Rock, Ark., 40,000 cu. yds. at 65 cts. f. o. b. cars at Quarry on land grant roads upon arrival of stone at Hopefield, Ark., will unload same on bank for 25 cts. per cu. yd. additional; Katterjohn Construction Co., Paducah, Ky., 40,000 cu. yds. at $1.25 f. o. b. at Memphis, Tenn., or $1.35 delivered on ground at Telher plant, about 5 miles below Memphis; Edward Hely, Cape Girardeau, Mo., 15,000 cu. yds. at $1.80 delivered on bank at Hopefield or West Memphis, Ark.

Texas.

✣Bids will be received until Noon, May 15, by L. W. Tittle, Prison Commissioner, Huntsville, Texas, for 1 cane crusher, 26x60, to be erected at Harlem State Farm in Fort Bend County, Texas, and 1 pair of independent cane engine drivers.

✣Bids will be received until 11 a. m., May 10, by P. W. Guiney, Constructing Quartermaster, Fort Sam Houston, Texas, for the construction, etc., of an isolation hospital at Fort Sam Houston, Texas.

✣Bids will be received until 8 p. m., April 24, by Board of Education, East Orange, Texas, for necessary labor and material for the construction of alterations to the present High School Building. Warren A. Clapp is Secy.

✣Bids will be received until 10 a. m., April 21, by Ralph Donnell, Trustee of Fugit township, Decatur County, at [illegible], Ind., for the construction of [illegible] house.

✣Bids will be received until 11 a. m., May 3, by P. W. Guiney, Constructing Quartermaster, Fort Sam Houston, Texas, for furnishing and installing wire screens in nine buildings at Fort Sam Houston, Tex.

✣Bids will be received until noon, April 21, by Edgar Odell Lovett, Pres., 1110-1112 Scanlan Bldg., Houston, Texas, for heating the administration building and mechanical laboratory and power house of the W. M. Rice institute.

✣Bids will be received until noon, April 21, by Edgar Odell, Lovett, President, 1110-1112 Scanlan Bldg., Houston, Tex., for a complete installation of a generating and distributing system in the power house of the W. M. Rice Institute.

✣Bids will be received until 8 p. m., May 1, Superintendent of the Water Works, Sherman, Texas, for the following items: Two deep wells, internal-combustion engine, gas producer, air compressor, electric generator, motors, switchboards and power-driven pump. Specifications are on file in the office of the City Secretary. The right is reserved to reject any or all bids or parts of same. Barney C. Kreager is City Secretary.

✣Bids will be received until 3 p. m., April 21, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Postoffice at McKinney, Texas.

✣Bids will be received until 3 p. m., April 25, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Postoffice at Terrell, Texas.

✣Bids will be received until 3 p. m., May 6, by James Knox Taylor, Supervising Architect, Washington, D. C., for the construction of the Quarantine Station at Galveston, Tex.

The following bids were received March 31 by Maj. George P. Howell, U. S. Engineer, Galveston, Tex., for widening and deepening Galveston channel: L. T. Gaylord (Atlantic, Gulf & Pacific Co.) Houston, 6.7 cts. per cu. yd.; Bowers Southern Construction Co., Galveston, 7.4 cts. per cu. yd.; R. A. Perry, San Francisco, 8.24 cts. per cu. yd.; Southern Dredging Co., Mobile, 9 cts. per cu. yd.; Home Dredging Co., Moline, 9.84 cts. per cu. yd. Mr. Gaylord agrees to commence work within ninety days from date of notification of contract and complete within two years. The plant to be used will be the 20-in. hydraulic dredge now engaged upon the Texas channel. The estimated yardage is 4,200,000.

The Busch-Everett syndicate of St. Louis, Mo., has had representatives in Houston looking over industrial conditions with a view to determining whether it would be a good investment to build a line from the Caddoo Gas fields in Louisiana to Houston and lateral lines to Beaumont and Port Arthur. It is estimated that the trunk line to Houston would cost $4,000,000.

Virginia.

✣Bids will be received until 3 p. m., May 27, by James Knox Taylor, Supervising Architect Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office and Customs House at Richmond, Va.

✣Bids will be received until noon, May 15, by M. M. Patrick, U. S Engineer, Room 2, Custom House, Norfolk, Va., for dredging the channel to Newport News, Va.

✣Bids will be received until 3 p. m., May 10, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the installation of a steam heating and ventilating apparatus, etc., for the reconstruction of the United States Post Office, Court House and Custom House at Richmond, Va.

✣Bids will be received until 3 p. m., May 9, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for [illegible] Post Office, Court House and Custom House at Richmond, Va.

✣Bids will be received until 3 p. m., May 8, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the installation of conduit and wiring and lighting system in the reconstruction of the U. S. Post Office, Court House and Custom House Building at Richmond, Va.

✣Bids will be received until 11 a. m., May 6, by R. C. Hollyday, Chief, Bureau of Yards & Docks, Navy Department, Washington, D. C., for repairs to slips for torpedo vessels at the U. S. Navy yard, Norfolk, Va.

Bids as follows were received March 30 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Cat River and Bogue Bay, Va.: Miner Engineering Co., Washington, D. C., 15½ per cu. yd., place measurement; River & Harbor Improvement Co., Philadelphia, Pa., 16.8 cts.; McLean Contracting Co., Baltimore, Md., [illegible] French, Norfolk, Va., 35 cts.; Rickards Dredging Co., Philadelphia, Pa., [illegible]

Washington.

✣Bids will be received until 11 a. m., May 6, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for a dry kiln at the U. S. navy yard, Puget Sound, Wash.

West Virginia.

✣Bids will be received until 11 a. m., May 11, by Maj. F. W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for erecting one lock house and two outbuildings on Little Kanawha River, W. Va.

✣Bids will be received until 11 a. m., May 10, by Maj. F. W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for constructing lock and dam No. 14, Ohio River, at Woodland, W. Va.

✣Bids will be received until 3 p. m., May 16, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, electric conduits and wiring of the U. S. Post Office and Court House at Charleston, W. Va.

✣Bids will be received until 11 a. m., April 20, by Board of Hardy County Commissioners, Moorefield, W. Va., for the erection and completion of a new court house. Plans and specifications prepared by Milburn, Heister & Co., Washington, D. C. Each bid must be accompanied by a certified check for $1,000. C. B. Welton is Clerk of the County Court.

◉Bids were opened April 13 by Maj. F. W. Alstatter, U. S. Engineer, Wheeling, W. Va., for 38,000 cu. yds. of dredging at Dam No. 11, Ohio River, the contract being awarded to the Monongahela & Western Dredging Co., Pittsburg, [illegible]

Wisconsin.

The city of Spooner, Wis., has purchased a 40-acre tract and made surveys for the establishment of a power dam on the Namekagon River. The dam will be 30 ft. high and 100 ft. wide and will develop 1,500 h.p. [illegible] purposes.

Canada.

✣Bids will be received until 4 p. m., April 25, by R. C. Des Rochers, Secy., Department of Public Works, Ottawa, Ont., for dredging in the province of Ontario at the following places: Big Creek, Big Island, Echo Bay, Kincardine, Port Elgin, Kingsville, Penetan- [illegible] (Presqu'Ile) and Wiarton.

✣Bids will be received until noon, May 1, by John Bowes, Secy.-Treas., Box 48, Kamsack, Sask., for the erection of an addition to the school building.

✣[illegible] 1, by M. Peterson, Secy., Board of Control, Winnipeg, Man., for furnishing f. o. b. cars to Winnipeg ornamental lighting standards.

◉McGillivray & O'Toole, Ottawa, Ont., have been awarded the contract for the construction of the Plaza Laurier at Ottawa by the Canadian Government. The work embraces the filling in of the space between Sappers and [illegible] tial rebuilding of the bridges. The contract amounts to about $235,000.

The Canadian Government and the Harbor Commissioners of Montreal, Que., have entered into a contract with Vickers' Sons & Maxim of England for a floating drydock to [illegible] for the construction and operation of a floating drydock with a lifting capacity of 27,000 tons, the establishment of a ship-repairing plant and a mill for the production of steel railway ties. The contract stipulates that the dock is to be placed in a basin at the mouth of Molson's Creek, at the east end of the harbor, and the site of the proposed works will be a piece of land 36 acres in extent to be reclaimed from the river shore by the Harbor Commissioners of Montreal. The floating dock is to be completed and installed by May, 1912, by which time the basin will be ready for its reception.

A charter has been granted a company with a capital of $10,000,000 for a shipbuilding plant on Sydney Harbor. Sir Henry Pellatt of Toronto, Lieut.-Governor J. M. Gibson, Chas. Ellis of Clyde Bank, Scotland; Alex. Gracie of the Fairfield Shipbuilding Co. and A. Cross of Sydney are the incorporators. The company will carry on business under the name of the British-Canadian Shipbuilding & Dock Co.

The following appropriations have been made by the Canadian Government for maintenance and improvement of harbors, canals and inland waterways and for other purposes in connection with the facilitating of commercial traffic on the great lakes and connecting waters. River and harbor improvements, including additional dredging at Port Arthur and Fort William, $267,422.27. For continuing improvements at Victoria harbor, $111,300. For additional dredging in Ontario and Quebec provinces, $55,492.87. To compensate M. Barret, harbor master at Amherstburg, for lifting buoys during the season of 1910-1911, $400. Extending north mooring pier at upper entrance to canal, Sault Ste. Marie, $32,000. Welland canal improvements at Port Colborne, $189,000. To widen Welland canal near Welland, $5,000. For rebuilding north entrance pier upper entrance of the canal at Sault Ste. Marie, $28,000. For a tug and improvement of canal at Sault Ste. Marie, $24,000. Heavy repairs, Welland canal, $20,000; bridge at Jane St., Welland, $2,500. Stone protection to Welland canal banks, $10,000. Harbor and river improvements, Port Arthur and Fort William, $108,333.33. Improvements at Byng Inlet, $3,500. To repair and reconstruct superstructure on east pier at north end, Cobourg, $1,000. Extension of wharf at Colchester, $2,666.66. Protection of east bank of Detroit River in Malden township, $666.67. Harbor improvements, Goderich, $29,166.66. Renewing wharves at Kingston, $2,500. Harbor improvements, Hamilton, $8,333.34. Wharf on Michipicoten River, Lake Superior, $3,166.66. Harbor improvements, including repairing of sheet piling on west side of harbor, Owen Sound, $1,000. Improvement to harbor works, Port Burwell, $8,333.34. Repairs to piers at Port Hope, $833.33. Harbor improvements at Port Stanley, $10,000. Harbor improvements at Rondeau, $15,833.34. Extension of wharf, Sault Ste. Marie, $1,666.66. Toronto harbor improvements, $25,833.33. Extension of breakwater pier, at Wiarton, $2,398.34. To provide for breaking ice in Thunder Bay and Lake Superior and other points, deemed advisable for the good of navigation, $33,333.33. Charter of steamers for Lime Kiln crossing, Detroit River, to be employed keeping the channel open, $8,333.33.

TRADE NOTES.

The officers of the Wisconsin State Automobile Association have accepted the offer of the J. I. Case Threshing Machine Co., of Racine, Wis., and will use a Case touring car during the annual state reliability run next July for the technical committee.

Charles T. Topping, representing the Chicago Concrete Machinery Co. in Pittsburg territory, has opened an office in the Bessemer Bldg., Pittsburg. He will handle Chicago mixers, Smith hand mixers, Sterling wheelbarrows, concrete cars, elevators, contractors' equipment and supplies.

The Blaw Collapsible Steel Centering Co., Westinghouse Bldg., Pittsburg, Pa., announces the removal of its eastern sales office from the present location in the Park Row Bldg., New York, to more commodious quarters in the City Investing Bldg., 165 Broadway, New York. This change is in effect May 1st. The western sales office of the company will be located at 1008 Ashland Blk., Chicago, Ill.

Among the contracts awarded to the MacArthur Concrete Pile Foundation Co., of 11 Pine St., New York, are the pedestal pile foundations for the reinforced concrete viaduct on Seattle boulevard, between Fourth and Fifth Aves., Seattle, Wash., forming a part of the work being done on the new terminal of the Oregon & Washington R. R. Co., Grant Smith & Co. being the general contractors.

The Sullivan Machinery Co., Chicago, Ill., has established an office at Salisbury House, London, E. C., England, which will in future have general charge of its business in England and on the Continent of Europe. Mr. Howard T. Walsh, for several years Pacific Coast manager at San Francisco, is in charge of this new office, and he has associated with him Mr. Arthur F. Belding, who has been with the Joplin office for some time past.

The Buffalo Forge Co., Buffalo, N. Y., has recently closed a contract with the Anheuser-Busch Brewing Association, St. Louis, for an equipment of Buffalo down draft forges with the necessary fans and motors. Among other recent orders for similar equipment are the Weyher Wagon Works, Wausau, Wis.; Bradley Polytechnic Institute, Peoria, Ill.; Shaw University, Raleigh, N. C.; N. C. Palmer & Singer Mfg. Co., New York City, and Fait Automobile Co., Poughkeepsie, N. Y.

Owing to the remarkable growth in its all steel furniture and herringbone metal lath business, the General Fireproofing Co. at Youngstown, O., announce the sale of its entire bar and fabricated beam reinforcement business to the General Reinforcement Co. of Youngstown, O. This move has been made to gain necessary additional manufacturing facilities which will permit of their specializing along the metal lath and furniture lines.

The Erie & Western Transportation Co., Buffalo, N. Y., placed a contract for the installation of a ventilating system in the Anchor Line steamer "Tionesta" previous to the 1910 season. This system was for the ventilation of the inside staterooms and proved very satisfactory. Orders have recently been placed with the same contractors, the Buffalo Forge Co., Buffalo, N. Y., for similar installations in the Anchor line boats "Juniata" and "Octarara" to be completed by the opening of navigation.

The Cyclone Drill Co., of Orrville, O., reports a splendid supply of orders on hand at the close of March, which is unusual at that season of the year. Orders for more than 25 complete outfits have been booked, among the largest being seven electric traction blast hole drills for the Dolese & Shepard Co., of Chicago. Other outfits are being furnished for the following concerns: Cornwall Ore Bank Co., Cornwall, Pa.; Hydraulic-Press Brick Co., Cleveland, O.; Knickerbocker Portland Cement Co., Hudson, N. Y.; Prentiss Tool & Supply Co., New York City. The company report a large number of inquiries, especially from limestone producers and railroad contractors.

Six years ago the J. I. Case Threshing Machine Co. put on the market their power steered 10-ton steam road roller. This year the company decided to put forth a line almost complete for road building. In addition to the road roller and road sprinkling wagon, they have been selling, they have added recently the Perfection graders and drags, rock crushers, rotary stone screens, rooters, road scrapers, railroad and township plows and the Troy line of bottom dump wagons and boxes, also the Troy reversible bottom dump wagons and Case municipal tractors, especially constructed for use on any kind of paved streets, and Case contractors' hauling engines, which complete the line.

The Buffalo Forge Co., Buffalo, N. Y., reports receipt of a contract from the Hazel-Atlas Co., of Wheeling, W. Va., for the installation of one of its natural gas heating systems. This system consists of a motor driven fan with air distributing ducts and a natural gas heater with specially designed and mining chamber in which the products of combustion are consumed. A moderate temperature is maintained in the heating chamber, with a resulting increase in durability. This system, which uses the gas fuel direct without an intermediary boiler, has proven very efficient and a number of installations have been made in the natural gas section of Pennsylvania and West Virginia, including some repeat orders.

Among the prominent lines represented by Harold L. Bond Co. as agents in New England and New York through their stores in Boston and New York City is the Marsh-Capron line of concrete mixers. This line of machinery has taken a prominent place in the concrete mixer field owing to its improved design, careful construction and economy in operation. Included in the line are the rail-track (non-tilting) mixer and the tilting mixer, which is simplicity itself, owing to the few parts of which it is composed. These mixers will be carried in stock in Boston and New York in various sizes of regular equipment and the manufacturers are prepared to fill orders for special equipment with promptness and facility.

Following the announcement made recently that extensive improvements would be made at the industrial city of Koppel, Pa., where is located, the American plant of the Orenstein-Arthur Koppel Co., the trade has been advised that the contract for the work has been let to the Nieola Building Co., of Pittsburg. Preparations are already being made for the work, which will begin as soon as the weather permits. The plans include new buildings, a number of additions and various improvements which will make the plant the largest owned by these well known manufacturers of portable and industrial railways. Although the plant at Keppel, Pa., is already of large proportions and turns out a big tonnage of railway material, viz., contractor, quarry, brick and mine cars, switches, turntables, rails, etc., it was found necessary to double the capacity to take care of all the orders.

The John W. Rapp Co. and the J. F. Blanchard Co., both manufacturers of hollow metal and metal covered doors, windows and trim, have combined under the name of the United States Metal Products Co., and have established general offices and show rooms at 203-205 West Fortieth street, New York. The officers are: John W. Rapp, president; H. C. Randall, C. J. Hale and A. J. Connell, vice-presidents; E. B. Wire, treasurer, and C. A. Leonard, secretary. The factory of the John W. Rapp Co., College Point, L. I., covering seven acres, will be continued under the combined management and the main offices on West Fortieth street, New York, will be devoted to sales offices and show room. The company has plans under way for the erection of an addition to the Rapp plant at College Point, L. I. The plans include the erection of a shop, 250x600 feet, with saw tooth roof, a dock 75x600 feet, and an employes' bath house 50x60 feet.

In order to make prompt delivery of concrete mixers, the Standard Scale & Supply Co., of Chicago, recently used a new method of handling one of its Eclipse mixers. A customer at Gary, Ind., had a breakdown on a tilting mixer and it was necessary to have another machine on the job the next morning. The subject was taken up with the railroad company and the latter could not guarantee delivery by freight. The mixer, which was mounted on trucks and equipped with gasoline engine, was too large to conveniently load in express cars, so an automobile moving van was secured and the complete mounted outfit loaded on this van at 6 o'clock in the evening and the next morning at 8 o'clock it was delivered at Gary, Ind., about thirty miles from Chicago, complete and ready for operation. The mixer referred to has a capacity of about 100 yards per day and because of its simple construction it was possible to load the complete outfit without taking it apart, and the machine being of moderate weight, enabled the automobile to handle it without any difficulty even on the country roads.

Details of the organization of the Saurer Motor Co., which is headed by a number of New York capitalists who have acquired the American rights on the Saurer motor truck, from Adolph Saurer, Arbon, Switzerland, were perfected recently at a meeting held in the new company's headquarters, 30 Church St., New York. The new company is incorporated under the laws of New Jersey and capitalized at $1,600,000, of which $600,000 is preferred and the balance common stock. The entire amount is paid up, and the company will immediately begin to manufacture three, five and seven-ton Saurer trucks at its plant at Plainfield, N. J. C. Philip Coleman, formerly vice-president, secretary and treasurer of the Singer Sewing Machine Co., is president; Frank S. Richardson, treasurer, and Vernon Munroe, secretary. The board of directors is headed by William D. Sargent, president of the Reading Steel Casting Co., and includes a number of prominent New Yorkers, among whom are Frederick H. Eaton, president of the American Car & Foundry Co.; Charles H. Sabin, vice-president the Guaranty Trust Co.; Otis H. Cutler, president the American Brake Shoe & Foundry Co.; W. G. Pearce, vice-president of the same company; Benjamin Strong, Jr., vice-president the Bankers Trust Co.; Arthur H. Lockett, of Pomroy Brothers, bankers; Hunter Marston, of Blair & Co., bankers, and George B. Case, of White & Case, attorneys.

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PAVING.

The Council of the City of Fulton, Mo., will receive bids until 8 o'clock, Thursday, May 4, 1911, for 9,000 yards of brick paving with an asphalt filler, 12,000 yards of macadam with a binder and 10,000 feet of concrete curb. Plans and specifications may be seen at the office of the City Engineer. Copies of specifications will be sent on request.

P. D. THURMOND,
City Engineer.

SEWAGE DISPOSAL WORKS.

Batavia, N. Y.

Sealed proposals will be received at the office of the Batavia Sewer Commission until 10 o'clock a. m. on the 15th day of May, 1911, for furnishing materials and doing all work as specified for the construction of preliminary settling tanks of the Imhoff type, sprinkling filterers and sludge drying beds, including necessary fittings and appurtenances.

Plans and specifications may be seen at the office of Hering & Fuller, Consulting Engineers, 170 Broadway, New York City. The plans may be seen and specifications and forms of proposal obtained from Charles Hoopes, Resident Engineer, at the office of the Sewer Commission in Batavia, N. Y.

A full set of blue prints and specifications, including bidding sheets, will be forwarded to any applicant, express prepaid, upon receipt of a deposit of $5.00, which will be returned upon the return of the blue prints in good condition. Each bid must be accompanied by a certified check on a solvent bank for 5 per cent of the amount of bid.

The Board of Sewer Commissioners of the Village of Batavia reserves the right to reject any and all bids, to waive any informality in the bids received and to accept any of which it deems to be most favorable to the Village of Batavia. Unbalanced bids will be rejected without consideration.

K. B. MATHES,
Chairman Board of Sewer Commission.
Attest: JOHN H. WOOD,
Clerk, Board of Sewer Commission.

DRAINAGE.

Bids will be received until 10 a. m., May 2, by the Drainage Commissioners of District No. 5, of the town of Honey Point, Macoupin County, Ill., for constructing an open ditch requiring 2,400 cu. yds. of excavation and tile drains requiring 25,353 ft. of 6-in. to 24-in. tile. The Morse-Warren Engineering Co., Engineers, Carlinville, Ill.

STEAM BOILER.

Mankato, Minn.

Sealed proposals will be received by the Council in and for the corporation of the City of Mankato, Minn., until 10 a. m., May 1, 1911, for removing old boiler and furnishing and installing a new boiler at the pumping station, 125 hp., 150-lb. pressure.

Bids will be received on both internally fired and horizontal tubular, according to specifications of the Travelers' Indemnity Co. of Hartford, Conn., which specifications are now on file in the office of the City Clerk.

A certified check for 10 per cent required. The city reserves the right to reject any or all bids. Address all bids to

A. H. SCHERER,
City Clerk.

IRRIGATION, DRAINAGE, LEVEES AND CANALS.

The contract for the construction of the main coal and laterals of Drainage District No. 3, Carroll County, Mo., will be let at public outcry, by the Engineer, in the City of Carrollton, Mo., on the 15th day of May, 1911. Nature of work, cutting bends and straightening water course. Bottom width main canal, 40-50 and 60 ft.; laterals, 12 to 20 ft.; side slopes, 1-1; cutting, 12 to 18 ft. deep; 1,710,000 cu. yds. in main canal and 286,000 cu. yds. in laterals. For full information address Brooks & Jacoby, Civil Engineers, 515 Shukert Bldg., Kansas City, Mo.

THE SANITARY DISTRICT OF CHICAGO.

DREDGING CHICAGO RIVER.

Sealed proposals for the excavation of certain premises adjacent to the Chicago River between Jackson street and Fourteenth street will be received by the Clerk of the Sanitary District of Chicago, Room 1500, American Trust building, Chicago, Ill., until 12 m., standard time, on Thursday, May 4, 1911, and will be publicly opened by the Board of Trustees of said District on that day.

Plans and specifications and forms for bids may be obtained at the office of the Sanitary District.

The said Board of Trustees reserves the right to reject any or all bids.

THE SANITARY DISTRICT OF CHICAGO,
By Thomas A. Smyth.
President of its Board of Trustees.
Attest: L. J. BRYAN,
Clerk.
Attest: I. J. BRYAN.

SEWERS.

Reedsburg, Wis., April 14, 1911.

Sealed proposals for the construction of trunk sewers along the Franklyn Street Sewer District, City of Reedsburg, Wis., will be received at the City Clerk's office, Reedsburg, Wis., until 5 p. m., May 17, 1911.

The work consists of 1,650 lin. ft. 30-in. pipe, 1,200 lin. ft. 27-in. pipe, 1,410 lin. ft. 18-in. pipe, the trenches varying from 8 to 20 ft. in depth, with 10 manholes and 22 catch basins.

Plans, specifications and proposal forms are on file at the City Clerk's office. A certified check of 5 per cent of the amount of the bid must accompany the bid and the right is reserved to reject any and all bids.

By order of the City Council.

A. H. HUEBING,
City Clerk.

BRICK PAVING.

OFFICE OF THE COMMISSIONERS,
Portage County, Ravenna, Ohio,
March 28, 1911.

Sealed proposals will be received at the Office of the Commissioners of Portage County, Ohio, until 12 o'clock, noon, May 1, 1911, for the grading and paving with brick 2.12 miles of road in Ravenna and Shalersville Township, said County, under the provisions of "The Dodge Act" so-called.

Specifications, plans and profiles are on file in the Office of the County Surveyor in Ravenna, Ohio.

Certified check, $1,000.00.

The Commissioners reserve the right to reject any and all bids.

W. J. DODGE,
County Auditor.

GRADING.

Bessemer, Mich., April 4, 1911.

Sealed proposals will be received by the Board of County Road Commissioners of Gogebic County, at their office at Bessemer, Mich., until noon of Saturday, April 22, 1911, for the grading of about 11½ miles of road between Wakefield and Dunham. Specifications, plans and profiles are on file at the engineer's office in the county building.

Each bid must be accompanied by a certified check for one hundred dollars ($100.00), which check will be forfeited to said Board of County Road Commissioners in case the successful bidder shall fail to furnish satisfactory bond and enter the proposed contract within five (5) days from the date of notification of the award.

The Board of County Commissioners reserves the right to reject any or all bids.

G. S. BARBER, Chairman.
H. A. HARPER, Engineer.

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Wave Action on Earth Dams.

One familiar with the power of the waves along our ocean coasts and on the shores of our great lakes may reasonably be expected to regard with some derision the troubles reported from wave action on the artificial reservoirs of our irrigated west. These troubles, however, are not to be derided, as a study of an article published in our Drainage and Irrigation Section this week will indicate. The engineer who builds earthen dams in the irrigated west has to keep wave action firmly in mind—not merely the gradual disintegration of loose earth slopes by lapping water but the crushing, tearing destruction of heavy seas. The magnitude of the surf to be dealt with at times is impressively illustrated in the article which we publish, and in a letter to the editors the author of this article comments further on the matter as follows:

> In over ten years' experience at Atlantic City I did miles of sheet piling, jetting of piles for the boardwalk and bath houses and piers, all by means of the water jet, and naturally during those years [illegible] I saw some heavy seas [illegible] along the beach-front, but I have a very wholesome respect for the wave action that, at times, occurs at many of the reservoirs in this section of the country, upon which I have had occasion to report. Many of these reservoirs are so situated as to receive the effects of winds that sweep over many miles of flat country, presenting practically no obstruction to its force.

The dweller in the hilly and wooded sections of the east has no clear conception of the power of the wind sweeping across miles of open prairie to make heavy seas on even small bodies of water. Reports of the U. S. Office of Experiment Stations show that with very frequent heavy winds waves having a height of 3 ft. are created when the reach of water is only one-fourth to one-half mile.

It will be clear from what has been said why the design of earth dams for irrigation reservoirs calls for provision against wave action far more elaborate in character than the simple slope paving that meets the requirements for ordinary storage and reservoir work in the east. All the countless small private irrigation reservoirs to be seen in Wyoming, Montana and South Dakota have their provision of stone pitching, banks of willows or wave fences against wave action and scarcely one of these dams does not require periodic attention to keep these protections in safe repair. When the reservoirs are of magnitude the protective structures must naturally be more elaborate, as illustrated by the work described in this issue and by the Bishop's Creek dam described in our issue of April 12, 1911.

Development in Land Reclamation by Drainage.

Careful readers of our Contract News Section during the last two months can hardly fail to have been impressed with the large amount of land reclamation and drainage work being undertaken. A considerable portion of this work it may also be noted is composed of reclamation projects of size as exemplified by the two described in our Drainage and Irrigation Section this week. All down the Mississippi valley from Minnesota to the gulf there is scarcely a state tributary to the great river that has not one or more similar works of comparable size. It needs no argument to convince any one that these works in the aggregate embrace many thousands of acres and require the expenditure of many hundreds of thousands of dollars in ditches, levees and pumping plants. It is not so well understood, however, how great a size as individual structures some of these channels, etc., attain.

While in drainage parlance the term ditch is applied to any dug channel of any size, it is in popular usage restricted to somewhat small dug channels. When, therefore, the drainage engineer speaks of his main ditch the average person pictures a cut of perhaps a dozen feet in width, while actually there is a channel comparable in size with the famous transportation canals of two generations ago. Specific examples will best illustrate the point being made.

The main ditch of the Mud River project described in another column is 11½ miles long, 40 ft. wide on the bottom and involves some 1,500,000 cu. yds. of excavation.

The main ditch of the North Fork project described in another column is upward of 6 miles long, from 60 ft. to 80 ft. wide on the bottom and involves 1,141,000 cu. yds. of excavation.

The Carrol County, Missouri, project has a main ditch 21 miles long, with a width of from 40 to 50 ft. on the bottom and involves 1,569,000 cu. yds. of excavation.

The J. C. Vannatta ditch near Monticello, Ind., is over 13 miles long, ranges from 10 to 25 ft. wide on the bottom and involves 490,000 cu. yds. of excavation.

All of the works named are under construction, but they by no means comprise all the large drainage ditches that are under construction, nor does any of them comprise all, nor always the major portion, of the ditch work of the project of which it is a part. For example, the Mud River project involves 497 miles of ditches, requiring 5,500,000 cu. yds. of excavation; the North Fork project involves 37½ miles of ditches, requiring 2,271,000 cu. yds. of excavation; the lateral ditch and levee work of the Carrol County project adds 459,000 cu. yds. of excavation to the volume given above, and the total excavation of the Vannatta project is 610,000 cu. yds. The Matamuskeet project in North Carolina calls for 83 miles of ditches, requiring 2,700,000 cu. yds. of excavation. As a matter of curiosity it may be noted that the five drainage projects named involve over 13,000,000 cu. yds. of excavation.

These aggregate yardages of ditch and levee indicate plainly the importance of drainage work in the contracting business, but they do not by themselves indicate its importance fully. To secure the benefit of these ditches the adjoining land must in many cases be tile drained. The open ditch work also often involves bridges and culverts. Frequently too the project involves pumping plants of magnitude. Another collateral task is highway construction. In connection with the Mud River drainage there will be some 325 miles of highway constructed from the spoil banks.

In conclusion it is perhaps worth while noting that here is actual practical conservation work being done by the people without government aid or acclaim. That we hear so little of it is due doubtless to the fact that it is prosecuted as a commonplace business proposition and not as a moral propaganda.

A Discussion of Contract and Day Labor Methods of Doing Bituminous Road Work.

The methods and costs of bituminous road construction and maintenance, which we have summarized in this and our two immediately preceding issues from the discussion held Jan. 20 and 21, 1911, before the American Society of Civil Engineers, are among the most valuable that have ever been published. In a future issue we shall consider some of the reforms which these records seem to argue in our methods and practice of studying and experimenting with bituminous materials and ways of using them. Here we propose to remark briefly in another line of thought which came in for rather incidental consideration in the course of the discussion. This is the relative value of contract and day labor methods for performing bituminous road work.

In calling for opinions on this point at the meeting the question was put as follows: What is the relative value of the following three methods of carrying on work: (1) that in which both labor and material are furnished by the contractor; (2) that in which the material is supplied by the party of the first part, and the labor by the contractor, and (3) that in which both the labor and the material are supplied by the party of the first part? The principal discussion on this question was submitted by Mr. Harold Parker of the Massachusetts Highway Commission and Mr. H. B. Drowne, Assistant Engineer, Rhode Island State Board of Public Roads.

It is plain that the comparison called for is between the day labor method of construction and maintenance and either of two well known forms of contracting. Method three, though rather confusingly worded as quoted above, is obviously nothing but the plain day labor or force account method familiar to everyone. Method one, it is equally clear, is the straightforward lump sum contract method. Method two differs from method one only in the fact that certain construction materials are not furnished by the contractor nor is he responsible for their quality or suitability. Obviously the comparison called for is two-fold, first a comparison of the merits of [illegible]

[illegible] were [illegible] a comparison of the results of two forms of contract work. We shall give as briefly as may be the remarks of Messrs. Parker and Drowne and then comment on them.

Mr. Parker's opinion is fairly summarized, we think, in the following quotation:

From the speaker's experience in Massachusetts and elsewhere, he believes that work under contract should be done under either method one or method two. If method three is contemplated at all, it should be when the conditions are such that reasonable bids cannot be obtained, on account of the inexperience of contractors, or for other reasons. Therefore, method three only contemplates a comparison between contract and day labor. In order to get economical work by day labor, it is necessary that the party of the first part shall have a constant force of laborers and foremen trained in the particular kind of work he has in mind, and constantly employed on work of the same type or class. It may be, and, in fact, is found, that in the maintenance of certain roads, where the conditions under which a contract could be made are uncertain and involve unknown costs which will not permit the contractor to make a reasonable bid, method three is preferable. In general, the speaker maintains that, wherever possible, method one (the contractor furnishing all labor and material) is preferable for all construction, except where reinforced concrete constitutes a large proportion of the work. Method two, in which the contractor supplies the labor and the party of the first part the material, or a certain proportion of it, is preferable where the largest portion of the work is of reinforced concrete, or is of an experimental nature, or where a bituminous material of a specified kind is used. Method three, in which the party of the first part furnishes both the labor and material, is preferable in cases where the amount and kind of work are difficult to determine, and where it is of such a nature that the contractors cannot make intelligent estimates of the cost.

Referring to method one Mr. Drowne pointed out that the majority of road contractors are not familiar with bituminous road construction and therefore generally bid out of proportion to the actual cost of the work. He said:

When all road contractors have become familiar with bituminous road construction, and the engineers are so well informed that they can specify a certain bituminous material and method of construction and know that the resulting road should be good for a definite number of years, then the work could be let out by contract, and fair prices would probably be obtained.

Because this method allows the correction of any uncertainties that exist in definitely specifying bituminous material and also permits changing the material used and the methods of construction as desired, Mr Drowne preferred method two modified as follows:

The contracts were advertised as ordinary macadam, and bids were received for stone in place and grading. If it was decided after signing the contract that the work was to be of bituminous construction, the contractor was informed, and a separate agreement was drawn up and signed by both parties. This agreement covered the prices for labor furnished, all allowances for equipment, etc., necessary for the bituminous construction, and any deductions that were to be made from the contract price for work to be done on labor account and already included in the contract.

Referring to method three or the day labor method, Mr. Drowne said:

The advisability of using the third method, the party of the first part furnishing all material and labor, depends to a great extent on conditions. Excellent results ought to be obtained by having the work done by a gang of men trained specially for the purpose. As the party of the first part has also an unhampered choice of materials there is no reason why those best suited to the road could not be obtained. There is no doubt that maintenance work and the application of a bituminous surface to roads already constructed could be accomplished economically by this method, as these particular branches of the work do not require either large gangs or much equipment, and the rapidity with which the work can be done allows a few gangs of trained men to cover a large territory. Any large amount of new construction in one season could not be carried out by the smaller municipalities and towns, on account of the large equipment required to do the work. In places where an efficient public works department is maintained and in other places where sufficient work is contemplated to warrant an outlay for the necessary equipment, this method might be used to advantage.

The success of the third method, if conditions warrant its use, depends to a large extent on the efficiency of the corps of laborers and foremen employed by the party of the first part. Politics creep in on most public work, so that oftentimes many incompetent men are employed, and, although civil service remedies this evil, it is almost impossible to eliminate it entirely. Many instances might be cited where the labor cost in doing the work by this method is as cheap or cheaper than if the work was done by contract, and still, as a general rule, the opposite is true.

Summarizing, the conclusions apparently are that while the day labor method may profitably be employed for minor maintenance work it is preferable to do construction and heavy repairs by contract. As between the two methods of contract work, the first or straightforward contracting is preferable when the contractor is experienced and where the engineer can definitely specify materials and methods, but the second method works better in the present experimental stage of bituminous road work where the contractor is unacquainted with costs and the engineer is uncertain of the exact behavior of the new materials and processes.

CONCRETE AND REINFORCED CONCRETE SECTION

Adaptation of Concrete to Long Span Bridges.*

For the longer concrete arches, especially those in which the span exceeds 150 ft., a type has been developed which differs considerably from the more common arch of short span. But before proceeding to point out some of the characteristics of long span arches it might be interesting to notice how the concrete arch of the present day compares in length with the steel arch and truss bridge.

There are about fifteen steel arch bridges of spans over 500 ft., the longest of these being the Upper Niagara, span 840 ft., and the Viaur, France, 720 ft. in span. Also about fifteen simple truss bridges have been built over 500 ft. in span, of which the longest is the Municipal Bridge, St. Louis, span 668 ft.

Many lists of concrete arches have been published, the list of 500 concrete and stone bridges of all lengths, by Prof. Malverd A. Howe, in "Symmetrical Masonry Arches," being specially worthy of mention. None of these, however, that are known to me are up-to-date. I shall read a list of concrete arches, plain and reinforced, over 175-ft. span which I believe is correct to date. It is remarkable that most of them have been completed within six years.

The following figures are given as approximately correct. There are at least 34 masonry arches all over 150-ft. span, 15 of which exceed 200 ft., and some 19 concrete arches over 150-ft. span, and 11 of these are [illegible]

It will be understood that in the present discussion by the length of the bridge is meant its clear span, or the span of its longest arch. There are bridges very much longer than those in the list just read, which, however, are supported by many piers resting on the bed of the stream, one of these joining the mainland of Florida with one of the Florida Keys, now nearing completion, is about 2½ miles of continuous concrete bridge. Mere length in a bridge when it is made up of short spans is not a claim for merit; and though it may be a distinguishing mark which carries interest, it forms no part of our present discussion.

The first great masonry span was built in the 14th century, when some bold engineer flung across the River Adda in Italy, a span of 251 ft. This was soon after destroyed, but the span was not exceeded for over 500 years. The beginning of the more recent activity in long arch construction was in 1833, when two arches of 200 ft. were built, one, the Grosvenor Arch at Chester, in England, and the other at Turin in Italy. These held the record for length until 1864, when the Cabin John Arch of 220 ft., was completed at Washington, D. C. This span was not exceeded until 1902, when the Luxemburg Bridge in Germany was built, of span 227 ft. The palm then passed to the present holder for the longest stone arch, the Plauen Bridge, Saxony, 295 ft., finished in 1905 by the Engineer Leibold.

It is only within the last decade that concrete has challenged stone for record spans. The longest arch existing is of concrete, the Grafton Bridge, New Zealand, span 320 ft., and this span will soon be exceeded by one over the Tiber at Rome of 328 ft. The two longest and finest concrete arches in America are the Walnut Lane, Philadelphia, 233 ft. span, and the Rocky River, Cleveland, of 280-ft. The Sitter Bridge, in Switzerland, designed by Prof. Morsch, is in the class of those just mentioned, all of which have been completed since 1908.

The longest concrete arch bridge so far projected, is the great Henry Hudson Memorial Arch, span 703 ft., which may, however, never be built. Only two steel arches exceed this in span. For longer spans than these recourse has been had to cantilever or suspension bridges.

We have not yet built any very long span concrete bridges in Canada. I shall mention the first four to show our present developments. The longest is the Wadsworth Arch, Weston, span 118-ft. 6-in., designed by our firm, Barber & Young. Next to this is the span of 116 ft. over Kettle Creek, St. Thomas, designed by Jas. Bell. The third in length was built last year at Coaticook, Que., span 100 ft., and after this is the arch at Massey, of nearly the same span, designed by W. A. McLean, of the Public Works Department.

It will be noticed that the long arches are generally designed to have open spandrels, whereas the common short arches have solid masonry or concrete spandrel walls, and the roadway is supported by solid earth filling resting upon the arch ring. The reason for the open spandrels is partly that the calculations for design cannot be exact with earth filling over the arch ring. The exact amount of horizontal thrust on the arch ring due to earth filling is not known, and moreover, the weight of earth varies with the season and the amount of moisture contained. But earth filling is prohibited in long arches of concrete chiefly on account of its great weight for this would make a long arch unnecessarily massive and expensive.

Another point of design which may be mentioned in this connection, is the possibility of using hollow abutments. In this case the main wall and wing walls of the abutments are in the shape of the letter "U." In the ordinary abutment, wing walls are designed to resist the earth pressure from the inside, but in the

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*A paper by F. Barber, read before the Canadian Cement and Concrete Association.

TABLE 1.—CONCRETE ARCH BRIDGES OVER 175-FT. SPAN

Year	Name or Location	Engineer	[illegible]	Rise.	Floor width ft.	ins.
1910.	Grafton St., Auckland, New Zealand	B. F. Moore	320		36	
191[illegible]	Rocky River, Cle[illegible]	A. M. Felg[illegible]	[illegible]	[illegible]	60	[illegible]
1908.	Sitter, Switzerland	Prof. E. Horsch	259	[illegible]	[illegible]	
1908.	Walnut Lane, Philadelphia	Harry H. Quimby	233	[illegible]	[illegible]	
[illegible]04.	Grunwald, Germ[illegible]	Prof. E. M[illegible]	[illegible]	[illegible]	[illegible]	
1905.	Ulm, Germany		215	[illegible]	[illegible]	
1907.	Kempten, Bavaria	[illegible]	[illegible]	[illegible]	[illegible]	
1908.	Fogaras-Kronstadt Railway, Hungary	Prof. K. Zielinsky.	*197	70		
	Almendares, Cuba		190			
190[illegible].	Lautrach, Bavaria	[illegible]	[illegible]	[illegible]	13	9
1904	[illegible], France	[illegible]	[illegible]	[illegible]		
1907.	Pyranout, France	M. S. DeMollins	*177			
	Under Construction.					
	Rome, over R. Tiber		328		..	
	Monroe St., Spokane, Wash	J. C. Ralston	281		68	
	Projected.					
	Henry Hudson, New York	Moisseiff	703		80	
	Larrimer Ave., Pittsburg		300		..	
	Medland, N. Y., for Barge Canal	Wm. R. Davis	285		129	

Arch reinforced with steel. †Three-hinged. *Center to center.

hollow abutment design the wing walls have merely to support the floor system, and are consequently very much thinner and cheaper. There are at least two cases where hollow abutments have been used.

A further and later development of the type we are considering is the use of several arch ribs instead of a continuous ring. One advantage of the ribbed arch which can be immediately seen, is the possibility of simpler construction on the upper part of the bridge. In this design, one row of columns resting upon each rib is used to support the floor system, whereas with the continuous ring many more columns, or even continuous spandrel walls are necessary in order to distribute the weight of the floor system as evenly as possible over the arch ring. Another feature of the ribbed arch is that the floor is cantilevered over the outside ribs, so that the out-to-out width of the arch ribs is always considerably less than the total width of floor. The virtue of this lies in the narrow abutment required in a bridge with continuous ring, in which the abutments must be as wide as the floor.

In order to discuss another point regarding the ribbed arch, we must get a clear idea of the structural function of the arch. An arch rib or ring is first of all a column under compression throughout its length from skewback to skewback. Further than this it is a beam, and must resist the bending moment induced by shifting live loads and by temperature changes. Now we know that a beam of rectangular section will resist bending better when set on its edge than when it is laid flat on its side between its supports. For the same reason a concrete arch when made into two or more deep ribs, will resist bending due to live loads much better than if the same amount of concrete should be spread out in a comparatively thin continuous ring.

On the other hand, temperature stresses can be resisted better by a thin arch ring than by the comparatively thick ribs, but time does not permit me to enter into the mathematical reasons for this. Thus for a given quantity of concrete, the deeper and narrower the rib, the better for resisting live load movements, but the worse for resisting temperature stresses. Between these two opposing tendencies for any given set of conditions as regards span, rise and loading, it is possible with the ribbed arch to work out the economical section for the rib, and this should always be computed for each case. But with a continuous ring its width is fixed by the width of roadway, and the most economical section is not possible. This must not be considered as typical of present practice, for I know of but one case, that of the Wadsworth Ave., where the economical section has been computed, but we may look for a future advance in this line.

A feature of some long arches which is adopted more especially by European designers, is the use of pivots or hinges in arch ribs. Ribs may have one, two or three hinges. If a single hinge is used it is placed at the crown, and if two hinges, at the skewbacks. But the best design for hinged arch ribs is to use three hinges, one at the crown and one at or near each skewback. These hinges may be cast-steel or iron, working upon pins, or they may consist simply of thin sheets of lead, which on account of their malleability will permit all the motion that is expected to take place. With three hinges temperature stresses are entirely eliminated, but the stresses resulting from live loads cannot be so well resisted as in the arch with no hinges. A discussion as to the relative merits of hinged and hingeless arches would be too mathematical for our present purpose. American practice, even for the longest arches, is to use no hinges.

I sometimes hear an opinion thoughtlessly expressed by some lay brother that the longer the arch the more need of reinforcement. This is contrary to the truth. In order to get a clear idea of the reason for this we shall consider the effect of three sets of forces on the arch ring; those due first, to live loads; secondly, to changes of temperature, and lastly to the dead weight of the bridge itself.

Let us consider for a moment the nature of these different kinds of stresses. When a live load is placed over the haunch of an arch, the latter acts as a beam, so that the intrados of the arch under the load is in tension, and the whole arch at that point deflects downward. But downward deflection at this point must be accompanied by an upward deflection of the arch on the other side of the center, and consequently the extrados of that part of the arch under the load is in tension, and rise of temperature has an effect on the arch exactly similar to squeezing the two skewbacks together and slightly bending the whole ring. This causes tension of the extrados at the crown, and tension of the intrados at the skewbacks. A fall of temperature has the opposite effect and those parts of the arch which were before in tension will then be in compression. Thirdly, as to deadload stresses, when the arch is economically designed the deadload line of pressures will lie along the neutral axis, which means that the whole arch is in compression, and that this compression at any radial section is equal on all parts of that section. In order to express this in less technical language, let us disregard for a moment the effect of live loads and temperature changes, and let us suppose the arch ring made up of a number of voussoirs or building blocks separated by a number of imaginary radial joints. When the curvature of the arch is correct, all these blocks will bind together under the weight of the bridge, so that the whole rib is in compression throughout its length.

Thus we see that live loads and temperature changes have a tendency to cause tension, but when the bridge is properly designed the dead load can cause nothing but compression. It will be noticed that the tensile stresses due to live load and temperature changes are of a temporary nature but the dead load compression is constant. As these three influences may all act together, the tensile stresses may at times in certain parts of the arch exceed the dead load compression. The net result of this will be tension in some part or parts of the ring. Wherever this occurs, or is likely to occur, steel reinforcement must be used, for, as we know, concrete cannot of itself economically resist tension.

We have just seen the nature of the stresses caused by the three sets of forces, whether tensile or compressive, temporary or permanent. We shall now consider for a moment their magnitude, and how the magnitude of each set of forces increases or remains stationary as the span of the arch increases.

In a small arch the stresses due to a live load consisting of, say, a twenty-ton roller, may be greater than those resulting from the weight of the bridge itself, but, as the span becomes greater, the effect of this roller becomes comparatively slight compared to the greater dead weight of the bridge. For instance a twenty-ton roller could have only a trifling effect on the great Walnut Lane arch (except on the floor system, which we are not now considering). Thus as the span increases, the effect of a live load does not increase in the same proportion.

As to the temperature changes, we may lay down this principle. Temperature stresses vary inversely as the rise of the arch, and directly as the thickness of the rib, other things being equal. This is not the exact law, but it is near enough for our present purpose. Thus in flat arches temperature stresses will be greater than in high arches, other things being equal. Now as the span of an arch increases, in general so will the rise become greater, and also the depth of the rib. It is quite possible for the span, rise and rib thickness to be all increased in such a way as to leave the temperature stresses unchanged. It is difficult to lay down a general law, though we are safe in drawing this conclusion, that as the span of an arch increases temperature stresses do not increase in the same proportion.

On the other hand, the weight of the floor system, other things being equal, will increase in about the same proportion as the span increases, and the weight of the arch ribs in a still higher ratio, this rate being more nearly according to the square of the span. Thus as the span of an arch increases, the weight of the whole bridge, and consequently the dead load stresses increase in an accelerating ratio. From the previous discussion it will be seen that as the arch increases in length the dead load compression also increases still more, but the tensile stresses due to live loads and temperature do not increase in proportion to the length. Thus as the span increases, a certain span will be reached where the tensile stresses can never exceed the constant dead load compression. For arches of this and all greater spans no tension can exist in any part of the rib, and if steel is used at all it will not be to resist tension, but to aid the concrete in resisting compression and to bind the whole together. As an example of this we may take the 259-foot Sitter arch in Switzerland, in which, according to the calculations of Prof. Morsch, no tensile stresses ever occur. This is one of the most important features which distinguish long from short arches.

In the longer arches we have seen that the principal stresses are due to the weight of the concrete itself, and if engineers are to keep on designing arches of ever-increasing spans it will become necessary to use a concrete capable of resisting high unit stresses. In this connection it is interesting to notice the experiments of the president of this association, Prof. Peter Gillespie, with concretes rich in cement. He has shown that the amount of the large aggregates so long as the voids are filled has little effect on the strength of the concrete, which seems to depend altogether on the strength of the mortar. Further, the strength of the mortar seems to vary approximately with the amount of cement, a mixture of one cement to two of sand being stronger than when one of cement is used to three of sand, and so forth, until the sand is entirely eliminated, when the strongest mortar is the result consisting of neat cement. The strongest concrete is, therefore, made with large aggregate and cement enough to fill the voids without any sand. Gillespie's concrete, by which we may denote the sandless variety on account of its greatly increased strength, was found under certain circumstances to be cheaper than leaner concrete. It would be well worth while to conduct experiments to discover a method of so grading coarse aggregate as to produce a minimum of voids could be filled with less cement and the strength of the concrete could be prepared. I think that Gillespie's concrete will be largely used in days to come for very long span arches.

The method of concreting the arch ring is very different in long span arches from that used on shorter ones. The concrete is first placed in large voussoirs with small spaces between them, and after this concrete has set, the small key-spaces are concreted, completing the arch ring. By this method, before the small key spaces are filled in the shrinkage from setting has taken place, and, since the main weight of the ribs has been taken by the false work, all the settlement that is possible will have occurred. Thus no danger of cracking is to be expected from either shrinkage of concrete or slight settlement of forms.

The architects have made us painfully aware of the fact that a style of architecture suitable to concrete buildings has not yet been evolved. This, in my opinion, does not apply to the type which has been developed for long arches. Let us take the Walnut Lane bridge as an example of this type. The design is not only beautiful and simple, but it is inevitable, and results from the distinctive characteristics of concrete. This masterpiece in concrete presages a time when only the things shall be considered best whose makers have dedicated their work to Time.

EARTH AND ROCK SECTION

Method and Cost of Operating the Weeks Two-Line Shovel for Drag Line Excavators.

BY GLENVILLE A. COLLINS *

The Weeks shovel was designed to meet the demand for an excavator of small first cost to cope with conditions for which the steam shovel is not adapted and yet approach its cost of operation. For this purpose many shovels of various makes have been brought out with much success but lacking that all important feature of being able to actually dig, and release and dig again as desired and being entirely under the control of the operator.

The shovel designed by Mr. Weeks actually accomplishes its purpose and with much better success than anticipated. It has now been in operation for several years and applied to a wide scope of work very successfully. It has been used principally in excavating gravel and boulders under water of varying depths, from 10 ft. to 75 ft., with a haul often as much as 400 ft. The shovel has also been used to convey coal from stock piles to bunkers, gravel from barges to bunkers, to dig trenches and sewers and for extensive railroad embankments and excavations

The principles involved in the operating design are better described by the accompanying line drawings, Fig. 2. The great feature is the ability to dig and release as desired, which is possible through the use of a steel mast carrying the sheaves. This shovel, like others, is actuated by means of a haul line to draw forward and a return line to draw back. The shovel consists of a heavy pan, Fig. 1, open at the top and front, having lugs attached to the sides for use in dumping the load forward, and a sloping back to facilitate the return of the shovel for its load. To the forward portion of the sides of the pan is attached a rigid yoke, carrying two sheaves over which pass the chains, which when properly actuated, cause the shovel to dig and to release. To the forward part of the bail, by which the shovel is drawn, is fixed a sheave, around which also passes the digging chain, the end of which is fastened to the casing of this same sheave. The other end of the chain is attached to a lug at the back of the shovel, and the rebail fastens to the digging chain at a suitable point near the rigid yoke.

The bail by which the shovel is drawn forward may be either flexible or rigid, the latter type being preferable in soft material, as by its leverage action, it assists in forcing the shovel out of engagement with the material being excavated. The cutting edge may be straight, but is preferably curved upward to assist in releasing the shovel from its cut.

To make the shovel dig, the haul line being taut, the return line is tightened slightly which action, by the aid of the sheaves shown in Fig. 2, draws the mast and haul line together which tips the shovel forward on its cutting edge and in this position it is drawn forward until filled. Then the return line is slackened, causing the mast to part from the haul line, after which the drawing in of the haul line releases the shovel (now filled) from engagement and owing to the slightly upturned lip or cutting edge the shovel immediately rises out of the material engaged. This action is so positive that the shovel will dig in cemented gravel, rough boulders, soft rock and shale. In this loaded condition the shovel is drawn forward to the point where it is to be dumped. Dumping is accomplished in a number of ways, according to local circumstances. When working under a boom or A frame, the slacking of the tail line causes the shovel to take a vertical position allowing its contents to fall out the back. In under water operations, this principle is still used but the back of the shovel is in the form of a trap-door, similar to that of a steam-shovel dipper, the top of the shovel being covered to hold the material in while being drawn up out of the water. The material is also dumped by drawing the shovel up a skid-way in which case it is guided by the lugs on the sides. To dump, the haul line is slackened allowing the shovel to tip forward by the action of gravity, thus throwing its contents out the front into bunkers or cars, as the case may be. It is also possible to rig the shovel from a long swinging boom, plying the return line from the boom end and the haul line at its base. In this rig the back of the shovel is a little differently constructed to facilitate dumping automatically, the mast and the positive digging action still being maintained in such a way that the weight of the shovel is still used to assist in digging and is not held up by the return line. In this rig the boom with the loaded shovel below can be swung to any position at the side for dumping, such as in canal work.

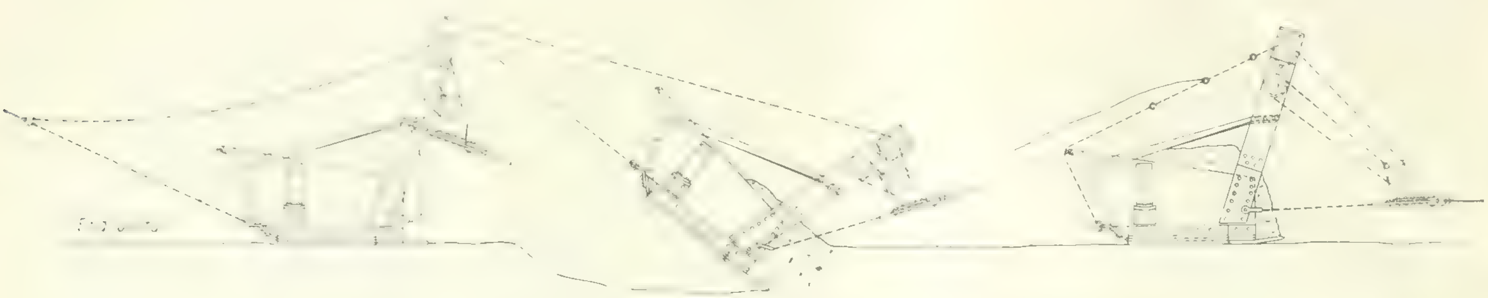

Fig. 1—Sketches Showing Successive Positions of Weeks Drag Bucket.

The construction of the shovel is very simple and rigid and made of heavy steel plate. The wearing parts are renewable requiring no labor not found within the capacity of the ordinary blacksmith shop. The bottom plate is of 15/16-in. steel and will wear many years. The shovel is balanced carefully and cannot be overturned by striking boulders or snags owing to the steel nose and the position of the [illegible]

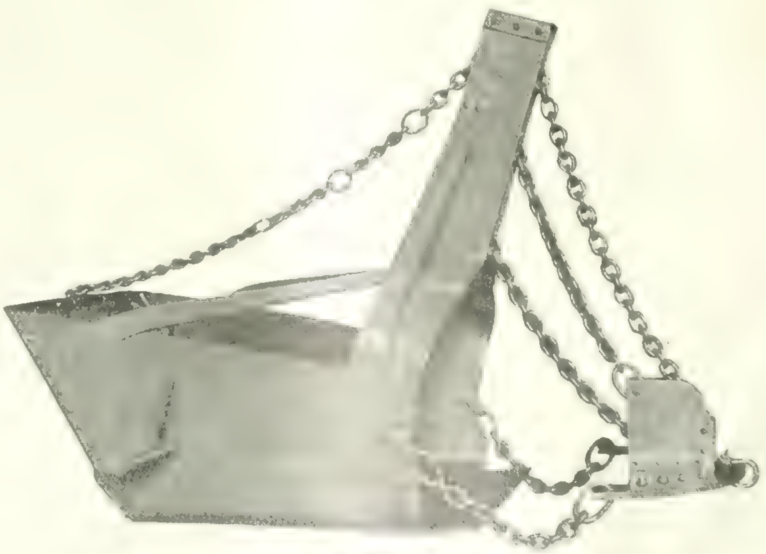

Fig. 2—View of Weeks Bucket for Drag Line Excavators.

These shovels are constructed in sizes ranging from 1½ cu. yd. to 3 cu. yds. The 1½ cu.

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*Consulting Engineer, Seattle, Wash.

yd. size being the most commonly used. This size is, under ordinary conditions, operated by means of an 8¼x10-in. double drum hoisting rig requiring from 35 to 60 h. p., depending upon the kind of material in which it is operated.

With the 34 cu. ft. shovel using the 8¼x10-in. steam hoisting engine and operating over a 250 ft. to 300 ft. haul and under 45 ft. of salt water, in gravel bottom containing some boulders, this shovel has averaged, per 9 hour run, between 400 and 450 cu. yds. of material requiring 3 men in the crew, 1 to operate the hoist and shovel, 1 to fire the boiler, and 1 to be generally useful about the plant. From this it is easily seen that under the particular condition described the operating cost is within the following:

Operating engineer	[illegible]
Fireman	[illegible]
Laborer	[illegible]
Oil and waste	[illegible]
1½ tons coal at [illegible]	[illegible]
Depreciation [illegible] equipment	[illegible]
[illegible]	[illegible]
Miscellaneous expenses	[illegible]
Total	[illegible]

400 [illegible] per day [illegible]

This [illegible] 1 7/10 minutes per round trip. In practice the distance [illegible] circumstances but by timing operations with a stop watch on many occasions a round trip of 300 ft. is frequently made in 1 4/10 minutes.

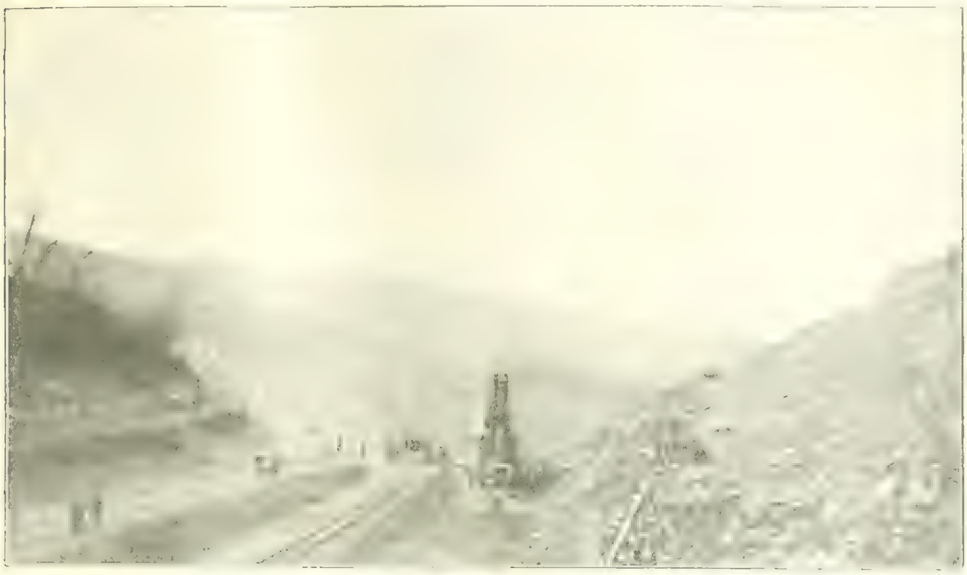


Fig. 1.

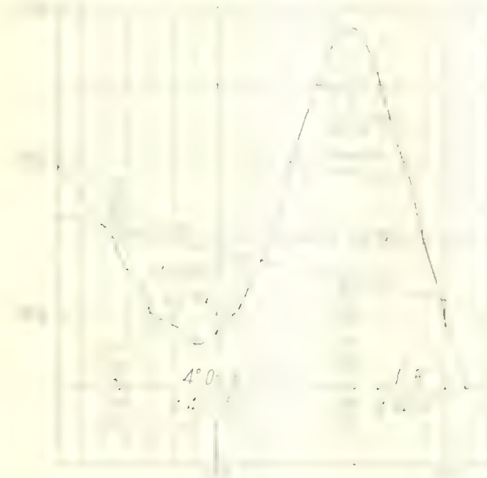


Fig. 2.

The above case was that of a gravel plant near Vancouver, B. C., the haul line of the shovel being operated over a 40-ft. boom.

A large [illegible] conditions of excavation is that of placer mining in such districts as Alaska where rich gold-bearing gravels are not worked for lack of water for hydraulicking but where there is [illegible] the shovel being to dig and convey from the dry banks and dumping into the sluice boxes. This has been successfully done in many instances and the economical operation of which can be easily calculated and compared with the values shown in the gold bearing gravels. A shovel is also filling a field in the excavation of building foundations, being swung on a boom and dumping directly into wagons on the street.

This shovel is being manufactured and sold by The Moran Co., of Seattle, Wash.

A Steam Shovel Record on the Cumberland-Connellsville Extension of the Western Maryland Railway for the Month of March, 1911.

On the first division of the Cumberland-Connellsville Extension of the Western Maryland Ry. there are 13 steam shovels in use by the J. B. Carter Co., Contractors. The one under consideration is a 70-ton Bucyrus used in excavating a 134,000 cu. yd. cut at camp No. [illegible] W. M. [illegible] tendent.

The plan of taking out the cut required a switch-back in order to get the material to the fill. The distance from the center of gravity of the cut to the center of gravity of the fill was 1,600 ft. by dinky track measurement, and a 3.5 per cent grade was used from the mouth of the cut, to point of switch-back, a distance of 950 ft. A passing siding open at both ends, of sufficient length to hold a dinkey and 12 dump cars, was placed about mid-way of the switchback and as soon as the loaded train cleared the up-hill switch the empty train had a clear right of way to the shovel.

The record output of 37,100 cu. yds., single [illegible] during the month of March, 1911. Figures 1 [illegible]

The grade left by the shovel in making each cut was always in a uniform condition for moving the shovel back for a new cut and when the dinkey track was thrown, it required very little surfacing to put it in order. A gang of 1 foreman and 4 men maintained the track and kept it in such good condition [illegible]

A dump gang [illegible] able to take care of the material as it came to the fill and at the same time keep the dump in good shape. In beginning the fill—that is when the material was dumped from the trestle, planks were extended from each side in order to hold a foot walk for the men, so the entire train could be dumped from the trestle. In doing this there was always enough material deposited on the bottom sills of the trestle bents to prevent the main fill from pushing the trestle down. The method of raising the fill from the trestle (which is below grade) to a height to allow for shrinkage, is novel. As the trestle on side hill work is always placed on the up-hill side of the center line, by elevating the down-hill rail, it prevents the cars from being overturned in dumping (requiring very little chaining, only when the cars are loaded with heavy boulders) and at the same time the dump is being raised to the proper height, *C* to *B*, at the required width of roadbed on the lower side, as shown by Fig. 3; the fill is then made from *B* to *A*.

For the first 15 days the shovel was working in a hard sandstone ledge about 12 ft. thick, and in shooting the material broke in large boulders which required considerable chaining. A total of 16,000 cu. yds. were moved during this time. During the latter 15 days the shovel was working in black shale and moved 21,100 cu. yds.

There were five moves during the month, a distance of 500 ft. each time. There was an average loss of 1 hour per day during the month in shifting track on the dump. The total number of cars for the 30 days were 12,443. The largest day's run was 836 cars, the average number of cars per day was 415, and the average yardage per car was 2.98 cu. yds.

The cost of the work, 37,100 cu. yds. for the month, was as follows:

Total expense of the [illegible] including Supt., walking [illegible] shovel and dinkey [illegible] all other labor	[illegible]	[illegible]
Cost of explosives	[illegible]	[illegible]
Cost of teeth	[illegible]	[illegible]
Cost of coal	235.00	0.00¾
Cost of oil and waste	[illegible]	[illegible]
Cost of water	11 [illegible]	[illegible]
Cost of interest on plant	[illegible]	[illegible]
Cost of depreciation	460.00	0.01¼
Total	$5,103.00	[illegible]

The equipment comprised one 70-ton Bucyrus shovel, two 16-ton Vulcan dinkey engines, 24 4-cu. yd. Western dump cars, 54 tons 60-lb. rail and one Cyclone well drill.

The excellent showing made for the month was due to a number of reasons. The superintendent, a man of exceptional ability, with a mind capable of planning his work so as to obtain the best results at a minimum cost, is not only a practical railroad man, but one who respects labor as he wishes to be respected. The old method of driving labor with a club is unknown at this camp and it is only necessary to visit the work in order to see how thorough is the organization. Steam shovels and dinkeys are kept in first class order and the dinkey tracks would be a credit to some standard gage steam railroads. Mr. Douglas' rule is the maintenance of a well regulated boarding house for his men and good dinkey tracks, regardless of cost of either, the result of which is one of the main reasons of his success.

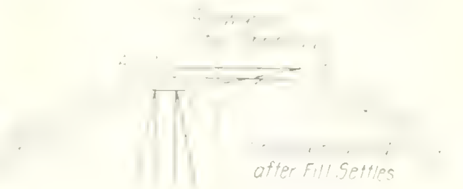


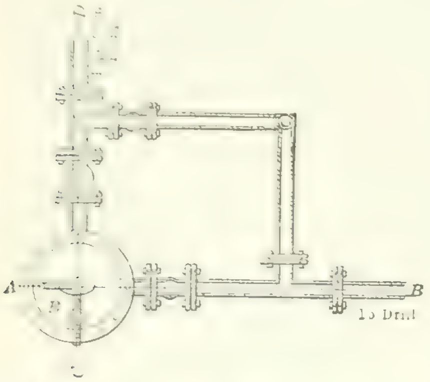
Fig. 3.

Sidewalks at Panama will hereafter be made of concrete because the board walks rot out quickly and their maintenance is costly. Some walks made of rock screenings have

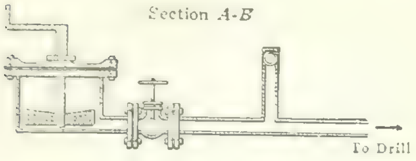
A Novel Method of Diamond Drilling Using Cement Grout Instead of Steel Casing.*

The Brejcha system of diamond drilling, as [illegible] beds in the Saint Etienne basin, differs from others in three particulars: (1) in the setting of the diamonds, (2) in the use of cement grouting instead of casing pipes where it is necessary to support the walls of the hole, and (3), in directing the current of the wash water down around the outside of the drill rods and up through them, instead of the usual, opposite direction.

By avoiding the use of casing pipes a saving is effected through the possibility of starting a hole but little larger than it is required to be at depth. The object of inverted flow of wash water is to minimize the wear that ordinarily occurs between fragments of the core which break apart in the core barrel—particularly in soft rock or coal. The upward flow of water through the barrel is thought to diminish the pressure and friction between one fragment and the next one below it, and thus yield a larger percentage of core.



Section *A-B*



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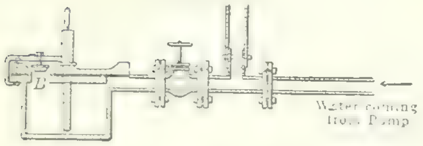

Fig. 1—Cement Mixer for Grouting Shafts.

Equipment.—The equipment employed consists of a derrick 52.5 ft. high; a shed 54.4 ft. x 21.0 ft., covering a portable boiler of 15 to 20 h.p.; a hoisting drum; pump for injecting water or cement grouting; cement mixer; and the drilling apparatus. The mixer shown by Fig. 1 consisted of a strong iron drum with a covered opening at *B* for the introduction of cement and a shaft, turned by hand, carrying a pair of perforated paddles. By means of the pipe connections shown the water from the pump could pass into the drill rods either through the mixing drum or through the by-pass, the latter being the usual route during drilling.

The boring machine comprised a swivel head, a driving sleeve, a rotating device, drill rods, core barrel and diamond bit. The swivel head, shown by Fig. 2, was designed to support most of the weight on the steel balls, *N*. The dish shaped receptacle catches the overflowing water and sand, discharging them through a pipe at one side. The stuffing box, as shown at the top of the cut, was screwed into place only when it was desired to reverse the flow of the wash water through the rods.

The driving sleeve, shown by Figs. 2 and 3, is 90 mm. (3½ ins.) outside diameter, 7 mm. (¼ in.) and 4.7 mm. (15.42 ft.) long, having two projecting feathers or splines diametrically opposite and extending throughout its length. The upper end carried the shoulder *P*, turning on the steel balls, its lower end passing through the rotating device, being driven by the latter through the medium of two splines.

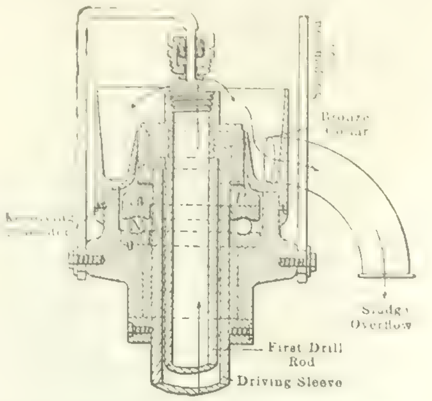

Fig. 2—Swivel Head for Drilling Machine.

The rotating device is shown by Fig. 3. The outer shell is cast iron. The bottom part is embedded in concrete, forming a closure for the top of the drill hole as well as a standard for the machine. The method of transmitting rotation by means of splines up and down through a revolving collar is the same as is commonly adopted by the best known diamond drills in America.

The drill rods, Fig. 4, were of two sizes, heavy ones being used to start the hole and lighter ones to finish it. The first had an exterior diameter of 70 mm. (2¾ ins.) a thickness of 6 mm. (¼ in.) and lengths of 5 m. (16.4 ft.) weighing 17 kg. per m. (11.4 lbs. per ft.).

The smaller rods were 51 mm. (2 ins.) outside diameter 5 mm. (1/5 in.) thick and 16.3 ft. long, and weighed 10 kg. per meter (6.72 lbs. per ft.). At each end was a slightly conical screw of square threads, for connecting two rods together. Rods of lighter size were sometimes coupled by an outside sleeve. Near the top of each rod were cut two opposite flat spaces, 50 mm. (2 in.) high for the purpose of applying wrenches for coupling and uncoupling. The uppermost section of the rod was enclosed by the driving sleeve, and received its rotation from the latter through two lugs projecting into corresponding notches on the upper edge of the collar which formed the top of the sleeve.

The core barrel and lifter employed by the Brejcha system are practically identical with corresponding parts in the ordinary American method but the diamond bit is wholly different in design and in the method of inserting the stones. The cylindrical bit is made of soft steel, as illustrated by Fig. 5, the outside diameter is 73 mm. (2⅞ ins.), the inside diameter is 53 mm. (2 1/16 ins.), leaving 11/16 in. of metal in the walls. Four rounded grooves are cut vertically on both outside and inside surfaces to allow free circulation of water. Bored upward in the lower edge of the bit are 14 holes, of 6.7 mm. (2⅝ ins.) diameter, tapering at their inner ends, and so inclined as to break through the outer or inner wall of the cylinder, in a small aperture. Four other similar holes are bored inward from the outer wall surface and two more, outward from the inside surface, making provisions for 20 diamonds so placed with respect to one another as to cover the grinding surface completely as they rotate.

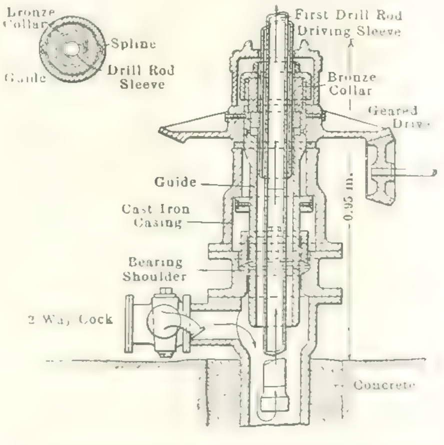

Fig. 3—Rotating Mechanism for Drilling Machine.

The diamonds are not bedded directly in the steel of the bit but are fixed in little conical shaped pieces of steel which are fitted as chucks into the holes in the bit; this method is thought to permit a more rapid exchange of stones and to reduce the wear on both stones and bit. The little steel plugs carrying the worn diamonds are simply forced out of their sockets by driving a steel pin through the small apertures for that purpose, and other plugs previously fitted with fresh diamonds, are inserted in their places.

The stones are fitted into the little steel plugs in the following manner: Starting with a short piece of soft steel bar, 1 cm. (1/6 in.) square, a shallow hole, slightly larger in diameter than the stone to be inserted, is drilled in one side, near one end. Turning then to the special tool illustrated by Fig. 6, the diamond *A* is placed in the spring socket *P*, and the square steel bar, hole uppermost, is laid on the anvil *M*; by means of the thumbscrews *S S*, the guiding arms *G G*, are so adjusted as to hold the hole in the square bar exactly under the diamond, when the lever *L* is depressed. The hole in the bar is then filled with solder, which is heated until it melts; the bar is then replaced in position on the anvil and the diamond forced into the melted solder by a quick stroke of the lever. The spring *R* absorbs superfluous force, so that the stone may not be crushed. The bar is then immediately cooled in water. When carbonados are used, extra precautions must be observed to chill the stone at the instant that it is inserted into the melted solder; this is accomplished by connecting the tube *T* by a rubber pipe, to a source of cold water, a jet of which is produced just as the stone enters the cavity. When the diamond has been successfully seated in the square bar, the end of the latter is turned in a lathe into the form of a cone, 20 mm. (¾ in.) long and cut off from the rest of the bar, Fig. 7.

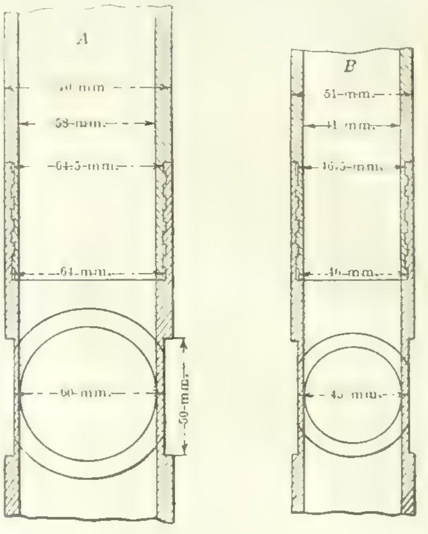

Fig. 4—Sections of Drill Rods.

Three forms of diamonds were tried, carbonados, borts and balas stones. Carbonados, being angular, were found unsuitable for this particular work, although they might serve for boring in fine grained, uniform rocks; they cost about $19.30 per carat. Borts are

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[illegible]

rounded, but as [illegible] of an aggregate of minute crystals, cleavage soon developed and the stones broke while boring in rocks of irregular texture; as they cost only $3.47 to $3.86 per carat, they were quite commonly used. Balas stones, being round and homogeneous, gave the best satisfaction; they cost

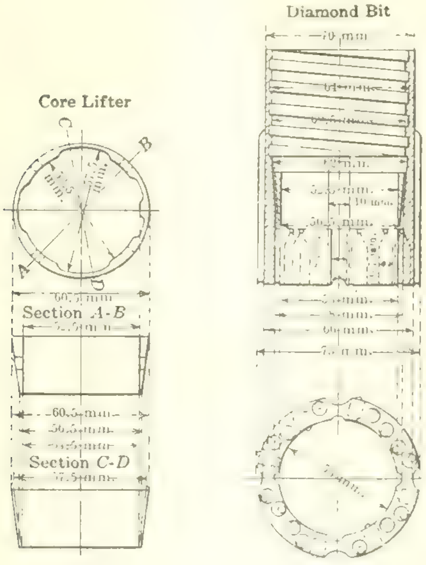

Fig. 5—Core Lifter and Diamond Bit.

about $5[illegible] per carat. The [illegible] diamonds was exceedingly variable: For the first 600 m. it averaged only $5.40 per meter, then rose for a short distance, while traversing a fissured zone, to $96 per meter; the average for the whole 1,152 m. was about $11.58 per meter.

Registering Device.—To avoid the possibility of passing through a coal seam without noticing the fact by failure to observe the color of the sludge, an automatic device was constructed for recording the progress of the rods. As shown by Fig. 8, it consisted of a drum *A*, on which was wound a light cord which passed over a pulley and was fastened to the swivel head of the drill. The shaft of this drum was threaded, and passed through the traveling nut *C*, from which projected an arm *D*, bearing a pencil in contact with the graduated paper on the drum, *F*. As the drill rods descended, it is obvious that the pencil would trace a rising line on the ruled paper. The scales adopted for the ruling of this paper were 5 cm. per meter for the depth, and 3 cm. per hour for the time; the registering cylinder rotates once in 12 hours, and could record an advance of 6 m. in that period.

The average speed in sandstones and similar rocks was 50 cm. (1.97 ft.) per hour, corresponding to a rising slope of about 45° on the recording diagram; while passing through a coal seam, the speed would rise to 420 cm. (16.53 ft.) per hour, recording a line which would be almost vertical. During stoppages for hoisting and lowering drill rods, the depth indicator was held stationary, making a horizontal mark on the recording sheet until operations were resumed. A sample record is shown by Fig. 9, and these being kept on file, an indisputable record of the coal seams was procured.

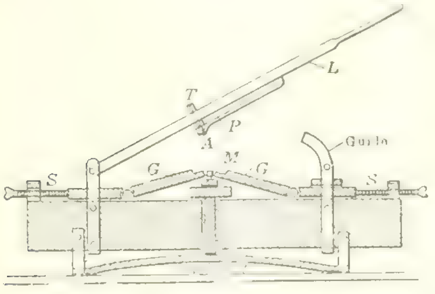

Fig. 6—Device for Setting Diamonds.

The [illegible] were conducted [illegible] America and elsewhere with other types of diamond drill. A pit 1 m. square was dug to bed rock, a piece of cast-iron pipe of 250 mm, (9.85 ins.) diameter was put in and surrounded with concrete, the hole was started with a diameter of 156 mm. (6.14 ins.) to a depth of 20 m. and was cased with pipe to act as a guide. As the hole then had to pass through an abandoned coal seam with caved roof and hydraulic filling, it was further cased to a depth of 111 m., with 108- and 95-mm. (4¼ and 4 in.) pipes. Below 111 mm. no casing was used. The hole had a diameter of 78 mm. (3.07 ins.) to a depth of 285 m., 76 mm. (3 ins.) to 320 m., 74 mm. (2.93 ins.), to the 500 m. point, and 73.5 mm. (2.88 ins.) for the remainder of the 1152 meters.

The rods rotated at 60 r.p.m. The longest solid core obtained measured 16.5 m. (54 ft.), but the average over the whole depth was only 2.3 m. (7.54 ft.) The volume of water needed was 176½ cu. ft. per hour, corresponding to a velocity upward through the drill rods of 3 ft. per second. Friction and the falling tendency of the solid grains reduced the velocity of the latter to such an extent that it required about 25 minutes for sand to reach the surface from 700-m. depth. The normal pump pressure was 57 lbs per sq. in., increasing sometimes to 230 or 280 lbs., when obstructions were met.

Drill rods were hoisted and lowered, and the feed of the rods through the driving sleeve was arranged in precisely the same way as with ordinary drills. Before breaking off the core, the water current was stopped for a moment so as to allow the suspended sand to settle down around the core, assisting the action of the core lifter, and protecting the core somewhat from breakage during its journey to the top. On lowering the rods, they

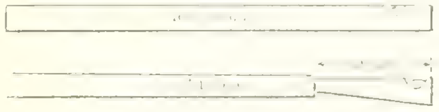

Fig. 7—Method of Mounting Diamonds.

[illegible] bottom, wash water was circulated for at least half an hour, and the rods were rotated while gradually being lowered into position to continue cutting. Hoisting, washing and lowering to the bottom of the hole, 1,150 m. (3,772 ft.); occupied nine hours.

Cementing [illegible] of the Brejcha method is the use of cement grouting to take the place of casing pipes through fissured or watery zones. The treatment of strongly fissured, porous rock differs from that required for passing through more compact rock in which the fissures, with or without water, are more isolated.

In the first case, injection of cement can go on without stopping the boring, by simply switching the flow of wash water into and through the cement mixer, as indicated by Fig. 1. Two sacks of screened cement are poured into the mixer, with some water, and the crank is turned until the grout is thoroughly mixed. The valve leading to the drill is then slowly opened, allowing the grout to mingle with the wash water; as the fluid cement passes down along the wall of the hole, under increasing pressure, it naturally penetrates into any open fissures and solidifies there. If the fissures are so large and numerous as to require a continuous flow of grout, two mixers may be installed in parallel pipe lines, so that the mixtures can be made alternately and fed into the hole without interruption.

In dealing with more compact rocks, but with larger cavities or fissures, several cases may arise. If it is only a cavity, without a [illegible] made up into a conical, sausage shaped plug, [illegible] spot, it should be made slightly larger than the hole; on pushing it down with the drill [illegible] poured on top of the plug, and time is allowed for it to set. Then enough grout is poured in through the drill rods to solidify the cavity, the rods being slowly withdrawn as the cavity fills. After 36 hours it will usually be safe to resume drilling in the ordinary way. A speed of 80 ft. per hour can readily be maintained through the cement plug. While drilling through cement, it is a good plan to force the wash water down inside the rods instead of up, with the object of disintegrating the core as much as possible, and thus avoid the necessity of hoisting the rods with the usual frequency, to no useful purpose. It is an obvious advantage to use the quickest setting cement available.

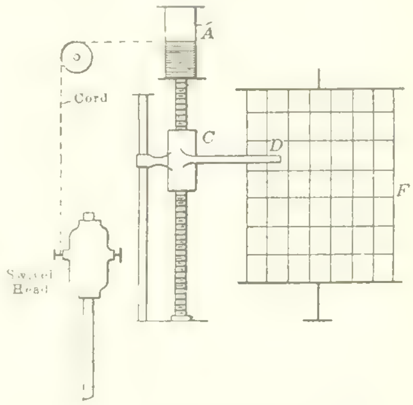

Fig. 8—Registering Device.

In case an inrush of material is met at or below a cavity, boring is continued past the fissure, and cement is then forced by the pump down through the rods and up between them and the sides of the hole into the running material; on drawing the rods up slowly, while continuing to feed cement, the hole can be solidly filled up to a point above the cavity. If a fissure should be met which drains water out of the hole, cement may be forced down the rods under heavy pump pressure, so as to cause it to penetrate as far as possible into the fissure before setting. In these two last mentioned cases, three or four days should be allowed for the cement to set before resuming boring.

Tunnel Ventilation.—The Saccardo system of tunnel ventilation consists of the use of a blower fan connected with a conduit outside of one of the entrances. The conduit feeds an air chamber that completely encircles the tunnel just inside the entrance. This chamber opens into the tunnel through a ring of 17 nozzles. The chamber and conduits are of reinforced concrete; the nozzles are of wrought iron. This system produces a current of air at the tunnel entrance and to take advantage of this blow [illegible]

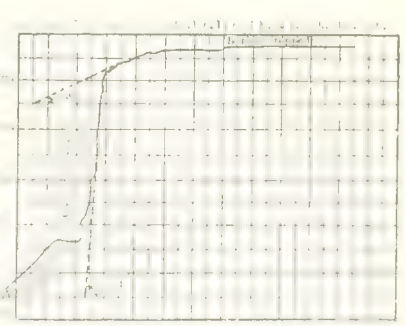

Fig. 9—Example of Record Sheet.

10 ins. to 19 ft. 8 ins. per second were installed in the St. Gothard and Tavern tun-[illegible] in supplying pure air to trainmen, but also in reducing the deterioration of track caused [illegible]

ROADS AND STREETS SECTION

Methods and Costs of Road Construction With Bituminous Material by Mixing Methods.

[illegible] extensively in highway work. In the construction of new roads, where these materials are used, two methods have been employed—the penetration method and the mixing method. Both of these methods were fully discussed at a special meeting of road engineers, held last January under the auspices of the American Society of Civil Engineers, and in the March number of the Proceedings of that society, Vol. XXXVII, No. 3, pp. 224 to 413, much of this discussion is reprinted. That portion of the discussion relating to the use of bituminous material by the penetration method was abstracted in our last issue, and in this issue we take up that part of the discussion relating to the use of bituminous materials by mixing methods.

RHODE ISLAND.

The following general observations on the use of bituminous materials by mixing methods and the description of the road construction by the method in Rhode Island were given by Prof. Arthur H. Blanchard, consulting highway engineer, Providence, R. I.

Bituminous pavements constructed by mixing methods may be considered under two types. Type A has as its characteristic a carefully graded aggregate, and may be classified with sheet asphalt and wood block pavements, from the standpoint of adaptability under certain traffic conditions, while Type B, consisting of a pavement with an upper course containing a larger percentage of voids than Type A, is suitable for residential streets in cities, roads on state trunk lines, etc., which are subjected to excessive motor car traffic and heavy commercial traffic, considered from the standpoint of the present traffic on trunk highways.

In the construction of bituminous pavements of Type A, the materials for the aggregate are broken stone and sand of graded sizes mixed so as to form a dense mixture, while the usual bituminous materials are natural asphalts, oil asphalts, and refined tars, either alone or in combination with asphaltic materials. In connection with the construction, machines are used to heat and in some cases to clean the aggregate and thoroughly mix it with the bituminous binders. These plants are of two kinds, stationary and portable. The results secured by the use of pavements of this character have been very satisfactory, from the standpoint of durability, but in some instances the surfaces have been slippery and in other cases dusty. Particular attention should be given in the future to the nature of the material used as a flush coat, as it is possible to construct a pavement of this type so that the surface will not be either slippery or dusty.

Pavements of Type B are usually constructed by using as an aggregate either the run of the crusher or a mixture of certain sizes of broken stone, with or without sand, and a bituminous cement of natural asphalt, oil asphalt, heavy asphaltic oil, tar, or a combination of tar and asphaltic materials. The two methods which have been adopted in constructing pavements of this type are, first, the hand-mixing method, in connection with which unheated stone is generally used, and, second, by mixing the aggregate and the bituminous material with mechanical mixers. The results to date by these methods in some cases have proved satisfactory and in others but insufficient and uneconomical. The results have generally proved satisfactory when the method and the materials were adaptable to local conditions, when the roads were well constructed with a bituminous cement of good quality, and the work was in charge of a competent inspector. Here, again, the function of the flush coat and the course of mixed aggregate should be carefully considered. In the future much attention should be devoted to the design of a mixer, including a dryer as an essential adjunct under certain conditions. One type of plant of this character should be designed so as to be economically adaptable to road work on which portable crushers are used, the output of which is necessarily limited. Distributors for the application of a flush coat also receive attention.

In Rhode Island bituminous pavements have been constructed by the mixing method since 1906. Judging from the results obtained to date the most economical and efficient pavements for heavy combination trunk line traffic under normal conditions in Rhode Island have been those constructed with tar in the mix and an oil asphalt flush coat, the oil asphalt which has proved most satisfactory during all seasons of the year being a Texaco asphalt having a melting point of from 90° to 95° C., as determined by the test proposed by the Special Committee of American Society of Civil Engineers. The first pavement of this type was built in 1908 in East Providence. When inspected, in January, state of preservation and practically dustless, the flush coat of asphalt being in such condition as to take the prints of the calks of horses' hoofs, although the air temperature was 0° C. The average traffic for 12 hours on this road during the summer of 1909 was 355 horse-drawn vehicles and 810 motor vehicles. Under normal conditions, when constructed under competent supervision, and in the months of June to September, inclusive, a pavement of the class referred to will cost from 25 to 35 cts. per sq. yd. more than the cost of ordinary macadam.

For roads subjected to traffic consisting of 90 per cent motor cars and a light horse-drawn vehicle traffic, the results in Rhode Island indicate that a flush coat on a bituminous pavement constructed by the mixing method is not necessary. The excellent condition, when examined in October, 1910, of the 1906 section in Charlestown built of Providence tar, and the 1908 section in Narragansett built of Tarvia, are evidence that a road of this type is economical and efficacious. The summer traffic during 1909 on the Narragansett road averaged 42 horse-drawn vehicles and 410 motor vehicles for a period of 12 hours. A road of this character can be constructed, under normal conditions, during the months from June to September, inclusive, with refined tar or an oil-asphalt for from 15 to 25 cts. per sq. yd. in excess of the cost of ordinary macadam, provided the construction work is supervised by a competent inspector. The estimates given are based on 1910 labor and material cost data.

The 1909 experimental sections built in Barrington, while Prof. Blanchard was in charge of bituminous work in Rhode Island, have been open to traffic for more than a year. The sections were all built by the mixing method, each section having a paint coat of the same kind of bituminous material as was used in the mix. The materials were Malden Tarite, Springfield Tarite, Tarite-Asphalt E (20 per cent asphalt), Tarite-Asphalt J (10 per cent asphalt), Texaco Macadam Binder and the U. G. I. Road Compound No. 4. When examined in January, 1911, the various sections exhibted the following characteristics: The Malden Tarite and Springfield Tarite sections presented an excellent, close-grained, mosaic surface, the surface coat on the top of the stones having entirely disappeared. The surface afforded an excellent foothold for horses. There has been a slight abrasion of the road metal composing the upper surface. Very little difference was noted between the Tarite-Asphalt E and Tarite-Asphalt J sections, except that the mosaic surface of the stones was more apparent in the latter than in the former. The surface presented a fairly good foothold for horses, and was practically dustless. On the section constructed with Texaco Macadam Binder the stones composing the upper layer were not visible. The flush coat was remarkably dustless, and, at a temperature of 0° C., was slightly impressed by the calks of horses' hoofs. On the surface constructed with the U. G. I. Road Compound No. 4 the stones were not visible. The surface was extremely hard and smooth, and hence slippery, but was dustless.

The road on which these various sections were constructed is between West Barrington and Nyatt Point, in the Town of Barrington. Eact sections was built on a tangent, and the grades varied from 0.50 to 1.14 per cent. The sub-grade encountered was composed of a very hard layer of clay and sand over a foundation bed of bricks, which had been placed there several years before by the town highway authorities. Almost the entire length of the road was through a wooded district, the shade being very dense. Previous to reconstruction, the road had been surfaced with gravel. In June and July, 1909, the average traffic for 8 hours was as follows:

Horse-drawn vehicle traffic—	
One-horse vehicles	71
Two-horse vehicles	3
Motor vehicle traffic	
Motorcycles	1
Motor runabouts	9
Motor touring cars (4 or 5 seats)	43
Motor touring cars (6 or 7 seats) including limousines and landaulets	17

The contract was let originally for ordinary macadam construction, and later a secondary agreement was drawn up by which the extra labor required on the bituminous work was paid for as per agreement covering prices for different grades of labor plus a commission of 15 per cent. The prices paid to laborers on bituminous work were $2.00 per day of 10 hours for experienced men, and $1.75 per day for ordinary laborers. One-horse teams and drivers were paid $3.50, and two-horse teams and drivers $5.00 per day.

The following plant equipment was used: A Kelly-Springfield 15-ton roller; a tar-coating machine manufactured by the American Tar Co., the rent of which was $2.00 per day. The contractor supplied three tar kettles, mixing platforms, square-pointed shovels, pails, dippers, and rakes, at a rent of $0.25 per kettle and accessories per day. Brooms, potato-hooks, and steel-bodied wheel-barrows were supplied by the State.

The macadam was built in two courses: The foundation course consisted of broken stone varying from 1½ to 2¾ in. longest dimensions, which was 6 in. deep when loose, and was rolled to 4 in. The top course consisted of stone of the same quality, varying in size from ¾ to 1½ ins., which was 3 ins. deep when loose, and was rolled to 2 ins. The rock used was a chlorite gneiss, having the following characteristics:

Determinations.	Results.
Specific gravity	2.80
Weight per cu. ft., lb.	[illegible]
Water absorbed per cu. ft., lb.	0.16
Per cent of wear	1.6
French coefficient of wear	[illegible]
Hardness	[illegible]
Toughness	[illegible]
Cementing value	[illegible]

The width of macadam was 14 ft. and the crown throughout was ¾ in. per ft. The top-course stone was mixed by hand with bituminous material until all stones were thoroughly coated. Most of the mixing was done by hand, with long-handled, square-pointed shovels, on plank platforms composed of three sections, each 8 ft. square. The tar-coating machine was used on the sections built with Springfield-Tarite and the U. G. I. No. 4 Road Compound. This machine and the method using it was described by Prof. Blanchard in a paper on "Use of Binding Materials in the Construction of Metalled Roads," which was presented before the Second International Road Congress at Brussels, in August, 1910. The mixing gang consisted of three experienced and five common laborers. The flush-coat gang consisted of one experienced and

TABLE I.—GENERAL INFORMATION ON EXPERIMENTAL ROADS CONSTRUCTED IN [illegible] IN RHODE ISLAND.

Material.	Length [illegible]	[illegible]	Air Temperature in Degrees Fahrenheit. Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Malden Tarite	350	0.50	80	60	Sept. 20.	Sept. 22.	240	1⅝	[illegible]	232	550
Texaco Macadam Binder	[illegible]	2.12	80	[illegible]	Sept. 22.	Sept. 29.	255	[illegible]	[illegible]	217	400
Tarite-Asphalt (20%)	168	0.28	70	[illegible]	[illegible]	Sept. 30.	255	[illegible]	[illegible]	216	400
Tarite-Asphalt (10%)	169	0.83	[illegible]	50	Sept. 30.	Oct. 2.	250	[illegible]	[illegible]	200	[illegible]
Springfield Tarite............	291	1.14	75	50	Oct. 2.	Oct. 6.	240	[illegible]	[illegible]	150	[illegible]
U. G. I. Road Compound No. 4	275	1.14	[illegible]	[illegible]	Oct. 6.	Oct. 9.	290	[illegible]	[illegible]	155	450

two common laborers. In applying the flush-coat house brooms were used, the material being supplied to the spreader in steel-bodied wheel-barrows.

Table I contains general information and Table II cost data relative to the various experimental sections; Table II gives analysis of the bituminous materials used. The analyses were made in accordance with the methods proposed by the Special Committee of American Society of Civil Engineers appointed "To Report on Bituminous Materials for Road Construction, and on Standards for their Test and Use."

The following notes, relative to details of construction were taken from the records of the Resident Engineer, Irving W. Patterson, Jun. Am. Soc. C. E.

Malden Tarite.—At the prevailing temperature, the material refused to run from the bungs of the barrels with sufficient rapidity to keep the work constantly progressing. For this reason the heads of the barrels were knocked out and the contents emptied into the kettles in a very short time. On this section rolling was done each day until a thorough compacting had been effected and the material had set up so that there was no appreciable movement under the wheels of the roller. Rolling was never done until the material had been down over night. The first day rolling was done about 9 a. m., before the material had softened excessively. Later, as the material began to set up, rolling was delayed until the middle of the day because in the earlier hours the stiffness of the surface did not allow of compacting. The surface had set up in such a manner that painting might have been done at the end of about 6 days.

Texaco Macadam Binder.—The weather conditions during the construction of this section were the most unfavorable during the entire period of construction. Owing to frequent rains and almost constant mists, it was impossible to keep the stone dry. Work was carried on, however, except when rain was actually falling, because of the lateness of the season and the desire to finish to a certain point before weather conditions prevented further bituminous construction. The stone was mixed with no great difficulty when dry but when damp, as was generally the case, it was very difficult to get it coated. The material was exceedingly slow in setting up. It was impossible to apply the flush coat until 3 weeks after laying the stone. Even at that time the surface felt very elastic under foot pressure.

Tarite-Asphalt (10 per cent).—The heads of the barrels had to be removed in order to allow the material to flow into the kettles. Mixing was difficult because of the low temperature and the consequent stiffness of the bituminous materials. Owing to the rapidity with which the material hardened on contact with the cold stones, it was necessary to mix very small patches at one time. Rolling on this section was done in the middle of the day. Rolling was also done on the day the material was laid because if the surface was left unrolled over night permanent compacting was very difficult. At the end of 2 days the surface had set up sufficiently to allow painting.

[illegible] and the length of time necessary for setting up varied very slightly from the experience with Tarite-Asphalt (10 per cent), but there was somewhat more difficulty in removing the material from the barrels.

Springfield Tarite.—Rolling was done on this section in the warm part of the day, because the season was rather late, and the mornings and evenings being cold the material was stiffened so much that rolling did not compact the surface well. The flush-coat might have been applied on the third day.

U. G. I. No. 4 Road Compound.—The first section laid with this material was allowed to remain over night before rolling, but this section was never compacted as well as where the rolling followed close after the laying of the surface. Rolling in the early morning appeared to affect the surface in no way except to break up the stones of the No. 2 course. Rolling in the middle of the day, except on the day on which the material was laid, appeared to be but slightly more effective than rolling in the early morning. Hence it was found absolutely necessary to roll very soon after laying the No. 2 course. The great change produced by relatively slight changes of temperature can be judged from the fact that in the early morning at this season of the year the material in the barrels might be split to pieces with an axe, while earlier in the season it would flow slowly from the bungs.

Based on experience acquired while in charge of bituminous work in Rhode Island, and investigations conducted in the United States and Europe, Prof. Blanchard considers [illegible] ments constructed by mixing methods have been due to one or more of the following factors: Poor bituminous binder; bituminous material not adapted to the method used; the [illegible] material; poor mix; an aggregate unastisfac-

TABLE III.—ANALYSES OF BITUMINOUS MATERIALS USED IN EXPERIMENTAL ROADS CONSTRUCTED IN [illegible] IN RHODE ISLAND.

	Malden [illegible]	Texaco Macadam Binder	Tarite-Asphalt [illegible]	[illegible]	Springfield Tarite	U. G. I. Road Compound No. 4
Specific gravity	[illegible]	[illegible]	1.176	1.211	[illegible]	1.167
[illegible]	[illegible]	0.3	0.5	0.6	0.2	[illegible]
Water soluble [illegible]	[illegible]	0.0	0.1	0.0	0.4	0.1
Free carbon [illegible]	[illegible]	0.3	18.6	22.5	[illegible]	[illegible]
[illegible]	[illegible]	0.0	0.0	0.1	0.0	0.1
Solubility in cold C Cl₄..........................	...	99.6	74.0	69.5		
Fixed carbon	[illegible]	[illegible]	27.4	26.2	30.7	22.1
[illegible]		0.2				
[illegible]						
Evaporation in 5 hours at 170° cent..........	15.0	16.6	10.5	13.5	[illegible]	[illegible]
[illegible]		65	70	67	63	[illegible]
[illegible]		[illegible]		1		0.5
[illegible]		105	12	[illegible]	15	
Evaporation in 5 hours at 205° cent............	...	19.1	17.5	[illegible]		
Melting point residue..........................	..	[illegible]	80	[illegible]		
[illegible]		[illegible]	1	1		
[illegible]		58				
Solubility 88° Baume naphtha..............	...	77				
[illegible]		sticky.				
[illegible]	[illegible]			18.7	20.7	[illegible]
[illegible]	[illegible]			0.3	[illegible]	0.0
[illegible]	[illegible]			1.0	0.3	[illegible]
170° to 225° cent...............................	7.8				4.8	0.0
[illegible]				[illegible]	10.9	10.4
[illegible]				4.7		[illegible]

TABLE II.—COST [illegible] EXPERIMENTAL ROADS CONSTRUCTED [illegible] ISLAND.

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Material per gal., f. o. b.............	$0.080	$0.110*	$0.098	$0.092	[illegible]	$0.070
Freight, per gal.......................	.010	....	.009	.009	[illegible]	.025
Loading and hauling, per gal........	.007	.005	.004	[illegible]	[illegible]	[illegible]
Material on road, per gal............	.097	.115	.111	.106	.093	.099
Heating material, per gal............	.008	.008	.008	.008	[illegible]	.007
Mixing material, per gal.............	.029	.030	.026	.028		[illegible]
Painting, per gal......................	.021	.021	.033	.036	.032	.037
Total cost of material [illegible] per sq. yd.†	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$0.391

*Price per gal. includes freight.

†The total cost per sq. yd. given above [illegible] macadam. The cost of 2-in. course of ordinary macadam was 16 cts. per [illegible]

[illegible] of road metal in the aggregate; aggregate covered with dust or dirt; damp broken stone or sand; overheated broken stone, sand, or bituminous material; the use of excessively heavy three-wheel rollers; the coating of the bituminous [illegible] with [illegible] dust, either before rolling or preceding the application of the flush-coat; insufficient bond between the foundation course of macadam and the bituminous course, due in certain cases to over-compacting the lower course; and, finally, incompetent supervision of the handling of materials and of the details of construction.

MASSACHUSETTS.

The general discussion that follows was given by Mr. F. C. Pillsbury, Division Engineer, Massachusetts Highway Commission:

Road surfaces should be designed, as nearly as possible, for the traffic to be sustained, and at the present time, it seems that it is possible to draw the line closely between the necessity for a mixed bituminous macadam and for a less expensive type on the one hand, and a superior pavement on the other.

There is no doubt that it is possible to construct on a suitable base a mixed bituminous macadam which will sustain extremely heavy horse-drawn vehicle traffic, and it is even possible that in the future a pavement may be found which will sustain the very heaviest horse-drawn vehicle traffic. On the other hand, there is no doubt that even the most successful bituminous macadam constructed by penetration or layer methods will not sustain a traffic equal in weight to that which may be borne by the mixed composition.

This seems to prove the superiority of a mixed aggregate over other kinds of bituminous macadam when heavy loads drawn by horses must be sustained. For medium traffic, partly or even almost altogether automobile, it seems that the penetration and layer methods of construction will answer. They are less expensive, of course, but if the mixing method is superior in one case, why should it not be in the other? It is probable that its superiority will give much greater permanence, and that this may prove it to be more economical. On the other hand, a large volume of swiftly-moving automobile traffic may disturb the actual surface, causing abrasion to such an extent that either mixed, penetration, or layer treatment will be badly disturbed on the surface after two or three years, so that it would be economy in any case to restore the surface continually before destruction by surface applications of some form of bitumen.

Mr. Pillsbury stated that he believed that there are many cases where an asphaltic bituminous macadam could be laid which would answer all the purposes now served by brick or wood block, except that wood block is quieter. Bituminous macadam, however, is quieter than brick or granite-block pavements. The cost of such pavement should not exceed one-half that of the brick or other more expensive forms mentioned above. Asphaltic bituminous macadam must be constructed only of selected materials placed with the greatest care.

The actual operation of mixing and placing the aggregate may be accomplished at a low cost by careless methods, but the results will be uncertain, and, without doubt, will result in failures in many cases. So much depends on the personal factor, that skilled and experienced labor should be employed. This leads to a question of machinery *versus* hand labor. Mr. Pillsbury states that from experience he had no doubt that machine work is more satisfactory, as machinery may be used which will mix uniformly and thoroughly. It is almost impossible to obtain a uniform product by hand mixing.

One of the most interesting roads, on which both hand and machine mixing were used, was constructed in the summer of 1910 on the State highway between the City of Lynn and the Town of Revere, in Massachusetts. This road carries all the business traffic between Boston and Lynn and other cities and towns [illegible] automobile travel [illegible] heavy horse-drawn vehicle traffic, a mixed bituminous macadam would not have been constructed. The traffic was so heavy that the Massachusetts Highway Commission thought it advisable to use a bituminous material which was, as far as known, least likely to oxidize and lose its plastic and adhesive qualities until after the greatest period of wear had been obtained. It was finally decided to use a composition of natural oil and refined natural asphalt, and to mix this in a thorough manner with an excellent quality of trap rock.

The work was complicated and made difficult and expensive by the necessity of keeping the road open to travel. The entire width of the roadway was only 22 ft., hence only 11 ft. were available at one time.

At first the mixing was done by hand, but the cool nights and mornings made it difficult to combine the stiff bituminous material with the cold stone satisfactorily, and it was found that the work was progressing too slowly. Hence, it was decided to mix by machinery. Two Smith concrete mixers were used. The stone was heated and the mixing accomplished with entire satisfaction. The two Smith mixers turned out daily sufficient material to cover about 800 sq. yds. of surface. This amount kept three steam rollers busy, and was all that could possibly be handled.

Mr. Pillsbury states that this practical type of surface and the method of operation is to be strongly recommended for roads which are somewhat remote from a central mixing plant and are subjected to heavy traffic.

WHITE PLAINS ROAD, BRONX BOROUGH, NEW YORK CITY.

Last fall an experimental pavement was laid on the White Plains Road in the Borough of the Bronx, New York City, in order that a comparison might be made as to the cost and durability of bituminous pavements laid by the mixing and by penetration methods, with water-bound macadam and other types of pavements. A general description of the methods employed in constructing the experimental sections was given in ENGINEERING-CONTRACTING of Dec. 7, 1910. The experimental pavements consist of 18 sections, ranging in length from 100 to 350 ft., with a width of 21 ft. Fourteen of these sections comprise the bituminous pavement group, two of which consist of a wearing surface of broken stone and sand with an asphaltic binder, built by the mixing method and laid on a concrete foundation. The wearing surfaces of twelve sections were laid on a broken stone foundation, five built by the penetration and seven by the mixing method. In all but one section built by the mixing method the stone was heated. The remaining four are made up as follows: Hassam Portland cement concrete pavement, water-bound macadam, Sicilian Asphalt Co.'s Asphalto, which in appearance resembles ground Kentucky Rock Asphalt, and a surface application of asphalt binder and sand on an old macadam strip. In all but one section, where paving gravel was used in the wearing surface, the stone, both for foundation and wearing surface, was Clinton Point crushed trap rock. Data on the section built with the surface application and those built by the penetration methods were given in ENGINEERING-CONTRACTING April 12, 1910, and April 19, 1910, respectively.

The water-bound macadam section was laid as a basis of comparison, both with regard to wear and cost of construction. The cost of experimental work of this character, where the sections are short and all differ in methods of construction, is necessarily high, as the organization can hardly be perfected in making satisfactory progress before the section is completed. Therefore it may be safe to assume that the excess cost of the water-bound macadam may be used to determine the percentage to be deducted from the actual cost of any other section, in order to ascertain its normal cost. The total cost per square yard of the ordinary macadam, 6 in. deep, as laid on this road, was $0.771, which is about 25 per cent in excess of the average cost.

Work on the experimental road was begun on Sept. 29th, and was completed on Nov. 22d, 1910. The number of sections under construction at the same time ranged from two to nine. It will be observed, from the lateness of the season and daily record of the temperature taken during the period of construction, that the work was not done under the most favorable conditions. The temperature when the work was in progress varied from 40 to 79° F., the average being 57° F. However, it was thought better to make a start and finish this season than wait about 9 months for more perfect conditions.

It is to be observed that the labor item is somewhat high. This is partly due to the rate of pay, namely, $2.25 for an 8-hour day, and partly to the fact that the style of work was entirely new to the foreman as well as to the men. There are several points which stand out in connection with the work, which it may be worth while noting, namely: the comparatively low cost of Section 5, where the binder was mixed with cold stone in a concrete mixer; the high cost per square yard for fuel where the stone was heated; the additional cost per square yard for mixing tar and asphalt; the excess of binder used in the seal coat of several sections; the high cost of handling the Amiesite pavement, due entirely to the paving mixture being stiff, owing to cold weather; the difference in the cost of the concrete foundations laid by the mixing method and that by the process of spreading cement and screenings mixed, sprinkling and rolling, as in water-bound macadam; and the high cost of labor, namely, $0.054 per sq. yd., for spreading and rolling the broken stone foundation course, due to re-handling the material.

The methods of construction used on the White Plains Road, both for penetration work and the mixing method, were rather crude, and unless a suitable pressure machine is used for penetration work which will insure an equal distribution of bituminous binder, and unless an economical mixer is used for heating and mixing the stone and bituminous binder, thereby decreasing the labor cost, the cost of work of this character will be unnecessarily high in comparison with water-bound macadam. The method of construction, therefore, should be taken into consideration in comparing the relative cost of the various sections with the water-bound macadam.

The experimental work on the White Plains Road was in charge of Mr. William H. Connell, Assistant Commissioner of Public Works, Borough of the Bronx. The accompanying data are taken from his discussion before the American Society of Civil Engineers.

Section 1—Barber Asphalt Co.—This section extended from Station 0 + 00 to 3 + 25. The pavement was laid by the Barber Asphalt Co. The foundation course consists of 1-3-6 concrete laid to a finished depth of 4½ ins. The detailed cost of this 4½-in. concrete base was as follows:

		Per sq. yd.
Labor	$168.00	$0.219
1½-in. stone, 86 cu. yds. at $1.65	141.90	0.185
Sand, 43 cu. yds. at $1.21	52.03	0.068
Cement, 95 bbls. at $1.35	128.25	0.167
Total, 767 sq. yds. at $0.639	$490.18	$0.639

The labor cost was distributed as follows:

	Hours.	Rate.	Totals.
1 foreman	24	$5.00	$15.00
22 laborers	528	1.75	115.50
2 watchmen	48	1.75	10.50
1 timekeeper	24	3.00	9.00
1 team	24	6.00	18.00
Total			$168.00

The paving mixture consists of the following mineral aggregate by weight, 73 per cent paving gravel, 19½ per cent sand, 1½ per cent dust, and 5.4 per cent Bermudez Asphalt, 55° penetration. The mixing was done at the Barber Asphalt Plant, then laid at a temperature of 220° and rolled to a finished depth of 1¾ ins. with a 10-ton roller. The cost of this surface course was about 71½ cts. per sq. yd., estimated from the cost of Bronx 55° penetration, deducting $27 for the difference in the cost of gravel and trap rock. The cost of field labor for the surface course was as follows:

	Hours.	Rate.	Totals.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

TABLE OF TEMPERATURES DURING THE CONSTRUCTION [illegible] WHITE PLAINS [illegible] EXPERIMENTAL ROAD.

Pavement	Date.	[illegible]	[illegible]	[illegible]	Weather.
Barber Asphalt...	Sept. 29, '10. {Begun / Finished}				Clear.
Bronx Asphalt [illegible]	Sept. 30, '10. Begun....	[illegible]	[illegible]	67	Hazy.
	Oct. 1, '10. Finished....	[illegible]			Clear.
Bronx Asphalt....	Oct. 11, '10. Begun	[illegible]	[illegible]		Fair.
	Oct. 15, '10. Finished...				Cloudy.
S. O. Mixture.....	Nov. [illegible], '10. Begun		45	46	[illegible]
	Nov. [illegible], '10.				[illegible]
	Nov. 11, '10.............				Cloudy
	Nov. 12, '10............		37		[illegible]
	Nov. 14, '10............		44		[illegible]
	Nov. 15, '10. Finished.		39		Cloudy.
Texas Oil Mix.	Oct. [illegible], '10. Begun	71		76	[illegible]
	Oct. 6, '10...............	[illegible]		79	[illegible]
	Oct. 8, '10...............	[illegible]			[illegible]
	Oct. 10, '10	[illegible]	59		Clear.
	Oct. 11, '10...............	[illegible]		69	Clear
	Oct. 13, '10...............	[illegible]	[illegible]		[illegible]
	Oct. 14, '10	[illegible]	68	69	[illegible]
	Oct. 15, '10. Finished...	[illegible]			[illegible]
Amiesite	Nov. [illegible], '10 Begun	[illegible]	40	43	[illegible]
	Nov. 9, '10...............	[illegible]	[illegible]	46	Cloudy.
	Nov. 10, '10	[illegible]	[illegible]		[illegible]
	Nov. 11, '10. Finished...	[illegible]	48		Cloudy.
Sicilian Asphalt	Oct. [illegible], '10 Begun	[illegible]		68	Clear.
	Oct. 21, '10. Finished...	55	57	59	Cloudy.
Tarvia Mixture..........	Oct. 26, '10 Begun	49			Clear
	Oct. 27, '10.............	[illegible]	65	67	Cloudy.
	Oct. 28, '10	[illegible]		56	Clear.
	Oct. 29, '10.............	44	48		[illegible]
	Oct. 31, '10	[illegible]	49		Clear.
	Nov. 1, '10. Finished..	44		56	Clear.
(Flush Coat)	Nov. 10, '10.............	[illegible]	51		Clear
	Nov. 11, '10	[illegible]	48	43	Cloudy
Tar and Asphalt Mixture	Oct. 26, '10 Begun	49	54	56	Clear
	Oct. 27, '10.............		[illegible]	67	Cloudy
	Oct. [illegible], '10	40	[illegible]		Clear.
	Nov. [illegible], '10	[illegible]		[illegible]	Clear
	Nov. [illegible], '10			[illegible]	Cloudy.
	Nov. [illegible], '10	[illegible]	[illegible]	43	[illegible]
	Nov. [illegible], '10	[illegible]	45	[illegible]	[illegible]
	Nov. 10, '10.............	[illegible]	54	[illegible]	Clear
U. S. Tar	Oct. [illegible], '10 Begun		57	59	Cloudy.
	Oct. 22, '10.............	[illegible]			Rain.
	Oct. 24, '10.............		54	56	Clear
	Oct. 25, '10.............	55	60	[illegible]	[illegible]
	Oct. 26, '10.............	49	[illegible]	[illegible]	[illegible]
	Oct. 27, '10.............		[illegible]	67	Cloudy
	Oct. 28, '10.............	[illegible]		[illegible]	Clear.
	Oct. [illegible], '10	[illegible]	[illegible]		Clear.
	Oct. 31, '10. Finished..	[illegible]	[illegible]		[illegible]

[illegible] tampers	[illegible]	[illegible]	[illegible]
3 rakers	[illegible]	[illegible]	[illegible]
2 smoothers	16	2.00	4 00
1 rollerman	8	[illegible]	[illegible]
1 timekeeper	[illegible]	[illegible]	[illegible]
Total, 767 sq. yds. at [illegible]			[illegible]

For a seal coat [illegible] gal. of asphaltic cement per sq. yd. was applied from Station 0 + 00 to 1 + 52, over which sand was spread. The cost of this seal coat was as follows:

		Per sq. yd.
Labor	[illegible]	[illegible]
Chips, 5 cu. yds. at $1.90........	9.50	0.027
Binder, 89 gals.* at $0.131......	11.66	0.032
Total, 359 sq. yds. at [illegible]	$30.38	[illegible]

*0.248 gal. per sq. yd.

The detailed labor costs for the seal coat were as follows:

	Hours.	Rate.	Totals.	Per sq. yd.
1 foreman	[illegible]	[illegible]	[illegible]	[illegible]
2 men pouring asphalt	[illegible]	[illegible]	1.68	.0047
1 man on squeegee	[illegible]	[illegible]	0.84	[illegible]
1 man heating asphalt	[illegible]	[illegible]	0.84	[illegible]
2 men carrying asphalt.	6	2.25	1.68	.0047
2 men spreading chips..	6	2.25	1.68	.0047
Total (359 sq. yds.)...........			$9.22	$0.0256

The total cost of the Barber Asphalt Co.'s pavement was as follows:

	Per sq. yd.
Concrete base	[illegible]
Surface course	[illegible]
Seal coat	.085
Total	[illegible]

The actual time of laying the surface course was 8 hours, or an average of 767 sq. yds. per day. The actual time of laying the seal coat was 3 hours, or an average of 957 sq. yds. per day.

Section [illegible] Bermudez Asphalt. This section extended from Station 1 + 52 to 6 + 50 and the pavement was constructed in accordance with Borough of The Bronx Specifications

The foundation course consists of 1½-in. crushed trap rock, thoroughly rolled with an 18-ton roller to a finished depth of about 3¾ ins. The detailed cost per [illegible] of the foundation course was as follows:

		Per sq. yd.
[illegible] cu. yds. trap [illegible]	[illegible]	[illegible]
Labor		[illegible]
Totals		[illegible]

The surface course or paving mixture is composed of two parts of crushed trap rock passing through a 1¼-in. ring and not containing more than 5 per cent of dust, one part of sand and 7.4 per cent by weight of Bermudez Asphalt, 55° penetration. The mixing was done at an asphalt plant, and the paving mixture was laid at a temperature of 220° and rolled to a finished depth of 2½ ins. with a 10-ton roller. The details cost of this surface course was as follows:

		Per sq. yd.
Mixing at plant	[illegible]	[illegible]
Labor	[illegible]	[illegible]
Hauling	[illegible]	[illegible]
Asphalt cement, 1,600 gals. at $0.131	209.60	0.273
¾-in. stone, 54 cu. yds. at $1.25..	67.50	0.088
Sand, [illegible] cu. yds. at [illegible]	[illegible]	[illegible]
Dust, 2,760 lbs. at $3.50..........	4.83	0.006
Grit, 3 cu. yds. at $1.25..........	3.75	0.005
Coal, 8,030 lbs. at $3.00..........	12.05	0.016
Total, 767 sq. yds. at $0.751..	$576.17	$0.751

[illegible]

The detailed [illegible] of the surface course was as follows:

	Hours.	Rate.	Total.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
1 tamper	[illegible]	[illegible]	[illegible]
3 rakers	24	2.50	7.50
1 smoother	8	2.00	2.00
1 rollerman	8	4.50	4.50
1 timekeeper	[illegible]	[illegible]	[illegible]
Total, 767 sq. yds. at $0.067................			$51.25

For a seal coat [illegible] gal. of asphaltic cement, not [illegible], was applied from [illegible] to [illegible] over which chips were spread and rolled. The detailed cost of this seal coat was as follows:

		Per sq. yd.
Labor	[illegible]	[illegible]
Chips, 3 cu. yds. at $1.90..........	5.70	0.016
Asphalt cement, 95 gals.* at $0.13.	12.35	0.035
Wood, ¼ cord at $6.50............	1.52	0.004
Total, 361 sq. yds. at $0.081.....$29.19		$0.081

*0.26 gal. per sq. yd.

The details of the labor costs on the seal coat were

	Hours.	Rate.	Total.	Per sq. yd.
1 man heating asphalt	11	[illegible]	[illegible]	[illegible]
1 man pouring asphalt	11	[illegible]	[illegible]	[illegible]
1 man spreading chips	[illegible]	[illegible]	[illegible]	[illegible]
Total (361 sq. yds.)................			$9.52	$0.026

The total unit cost of Section 2 was as follows:

	Per sq. yd.
Concrete base	[illegible]
Surface course	[illegible]
Seal coat	[illegible]
Total	[illegible]

The actual time of laying the surface course was 8 hours, or an average of 767 sq. yds. per day.

Section 3, Bermudez Asphalt. This section extended from Station 6 + 50 to 8 + 00. For the foundation course a concrete base was laid to a finished depth of 4¾ ins.; 1½-in. stone was spread to a depth of 6 in., then screenings and cement mixed dry in proportions of 3 : 1 were spread, rolled, and sprinkled with water. The operation was repeated until the voids were filled An 18-ton roller was used. The detailed cost of the concrete base (4¾ ins. to 5 ins. thick) was as follows:

		Per sq. yd.
Labor	[illegible]	[illegible]
1½-in. stone, 59 cu. yds., at $1.65.	97.35	0.275
Screenings, 9.0 cu. yds., at $1.65.	14.85	0.042
Cement, 20¼ bbl., at $1.35.......	27.34	0.077
Total, 354 sq. yds. at $0.45.....$159 50		$0 45
Spreading 1½-in. stone		[illegible]
Total		[illegible]

The details of the labor cost for the concrete base were

	Hours.	Rate.	Totals
1 foreman	[illegible]	[illegible]	[illegible]
[illegible] laborers	[illegible]	[illegible]	[illegible]
1 rollerman	6	4.50	3.37
Total			[illegible]

The paving mixture or surface course is composed of 2 parts of crushed trap rock passing through a 1¼-in. ring and not containing more than 5 per cent of dust, 1 part of [illegible] penetration. The mixing was done at an asphalt plant, and the paving mixture was laid at a temperature of 220° and rolled to a fin-

TRAFFIC CENSUS, WHITE PLAINS ROAD. [illegible] AND 9 P. M.

	Friday, Jan. 6, 1911.	Jan. [illegible] 1911.	[illegible] 1911	[illegible]
Horse [illegible]	[illegible]		[illegible]	
Horse [illegible]	[illegible]	36		
Horse vehicle [illegible]			[illegible]	
2-horse vehicle, light.....		59		[illegible]
2-horse vehicle, heavy....	1		..	
3-horse vehicle		2		
4-horse vehicle				[illegible]
[illegible]				
[illegible]			34	9
6- or 7-passenger car........				
[illegible]	17			
Traction engine	..			
2-traction engine	..			
[illegible]				

ished depth of 2 ins. with a 10-ton roller. The detailed cost of this surface course follows:

		Per sq. yd.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Hauling	40.80	0.115
[illegible]	[illegible]	[illegible]
Trap rock, 22.5 cu. yd., at $1.25	28.12	0.079
Sand, 9.0 cu. yds., at $0.75	6.75	0.020
[illegible]	[illegible]	[illegible]
Coal, soft, 5,300 lbs., at $3.00	7.95	0.022
Coal, hard, 400 lbs., at $6.00	1.20	0.003
Total, 354 sq. yds., at $0.907	$321.06	$0.907

*[illegible] per sq. yd.

The details of the labor cost for the surface course were:

	Hours.	Rate.	Totals.
[illegible]	[illegible]	[illegible]	[illegible]
8 laborers	48	1.75	10.50
1 watchman	6	1.75	1.31
2 tampers	12	2.50	3.75
3 rakers	18	2.50	5.62
1 smoother	6	2.00	1.50
[illegible]	[illegible]	[illegible]	[illegible]
1 timekeeper	6	3.00	2.25
Total, 354 sq. yds. at $0.090			$32.06

For a seal coat the surface course was painted with about ¼ gal. of asphaltic cement per sq. yd. over which chips were spread and rolled. The detailed cost of the seal coat was as follows:

		Per sq. yd.
Labor	[illegible]	[illegible]
Chips, 3 cu. yds. at $1.90	5.70	0.016
Asphalt cement, 82.5 gals.* at $0.13	10.72	0.030
Wood, ½ cord at $6.50	3.25	0.010
Total, 354 sq. yds. at $0.080	$28.47	$0.081

*0.23 gal. per sq. yd.

The labor cost in detail for the seal coat was:

	Hours.	Rate.	Totals.	Per sq. yd.
1 man heating asphalt	6	$1.75	$1.31	$.0037
2 men pouring asphalt	12	1.75	2.62	.0074
2 men spreading chips	12	1.75	2.62	.0074
1 timekeeper	6	3.00	2.25	[illegible]
Totals			$8.80	$0.0248

The detailed cost of Section 3 was as follows:

	Per sq. yd.
Concrete foundation	[illegible]
Surface course	.900
Seal coat	.080
Total	[illegible]

The actual time of laying the surface course was 5 hours, or an average of 454 sq. yds. per day

Section 4—Standard Oil Co.'s Asphalt Binder.—Section 4 extended from Station 8 + 00 to 11 + 25. The experimental pavement on the section was laid under the supervision of the Standard Oil Co.

The foundation course consists of 1½-in. crushed trap rock, thoroughly rolled with an 18-ton roller to a finished depth of about 3¾ ins. The detailed cost of the 3¾-in. base course was as follows:

	Per sq. yd.
[illegible] cu. yds. traprock at $1.65	[illegible]
Labor	[illegible]
Total	[illegible]

The surface course or paving mixture consists of the following mineral aggregate by weight: 58 per cent of ¾-in. crushed trap rock, 20 per cent of ⅜-in. chips, 15 per cent of sand, and 7 per cent of Standard Oil Co.'s special asphalt binder. The binder, stone, and sand were heated on the ground and mixed by hand on mixing boards; the mixture was spread and rolled to a finished depth of 2¾ ins. with an 18-ton roller. The detailed cost of this surface course was: :

		Per sq. yd.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible]

The detail of the field labor for the sur[illegible]

	Hours.	Rate.	Totals.	Per sq. yd.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2 men spreading	48	2.25	13.50	.0176
8 men mixing	192	2.25	54.00	.0704
[illegible]	108	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 men heating and carrying oil	[illegible]	[illegible]	[illegible]	[illegible]
5 men heating and carrying oil	120	2.25	33.75	.0440
5 men heating stone	235	2.25	66.09	.0881
3 rollermen	39	4.50	21.93	.0289
Total, 767 sq. yds. at $0.480			$368.14	$0.482

[illegible] seal coat from 9 + 95 to 10 + 66 [illegible] gal. per sq. yd. was applied over which chips were spread and rolled. The detailed cost of the pavement in Section 4 was as follows:

	Per sq. yd.
Base course	$0.283
Surface course	.964
Hauling binder	.009
Fuel	[illegible]
Asphalt and stone heaters	.004
Total	$1.323

On this section during the first three days one gang worked; during the last three days two gangs worked. The total quantity laid was 767 sq. yds., or an average of 85 sq. yds. per day per gang.

Section 5—Texas Macadam Binder.—Section 5 extended from Station 11 + 25 to 14 + 50. The pavement was laid under the supervision of the Texas Co.

The foundation course consists of 1½ in. crushed trap rock thoroughly rolled with an 18-ton roller to a finished depth of about 3¾ ins. The detailed cost of this 3¾-in. base was as follows:

	Per sq. yd.
106.6 cu. yds. trap rock at $1.65	[illegible]
Labor	[illegible]
Total	[illegible]

The surface course of paving mixture consists of ¾-in. trap rock and 6.7 per cent by weight of Texas Macadam Binder. The binder was heated and mixed with the cold stone in a standard concrete mixer on the ground. The paving mixture was spread and rolled with an 18-ton roller to a finished depth of 2¾ ins. The detailed cost of the surface course was:

		Per sq. yd.
Labor	[illegible]	[illegible]
¾-in. stone, 81 cu. yds. at $1.80	145.80	0.186
Binder, 1,728 gals.* at $0.12	207.36	0.265
Concrete mixer (rent), 7 days at $4.00	[illegible]	[illegible]
Total, 782 sq. yds. at $0.721	[illegible]	[illegible]

*2.2 gals. per sq. yd.

The details of the labor cost are as follows:

	Hours.	Rate.	Totals.	Per sq. yd.
1 foreman	44	$4.00	$22.00	$0.0281
2 men spreading	90	2.25	25.31	.0323
4 men feeding mixer	171	2.25	48.09	.0615
3 men wheeling	132	2.25	37.12	.047[illegible]
3 men wheeling	25	2.25	7.03	.0091
1 man heating binder	48	2.25	13.50	.0172
1 rollerman	9	4.50	5.06	.0064
1 mixer engineer	44	4.50	24.75	.0316
Total, 782 sq. yds. at $0.234			$182.86	$0.2337

From 12 + 36 to 13 + 03 a seal coat of Texas 55 special (about 1¼ gal. per sq. yd.) was applied, over which chips were spread and rolled. The total unit cost of Section 5 was as follows:

	Per sq. yd.
Base course	[illegible]
Surface course	0.721
Tar heater	0.001
Fuel	[illegible]
Hauling binder	[illegible]
Total	[illegible]

The actual time of laying the surface course on Section 5 was five days and four hours, or an average of 142 sq. yds. per day.

Section 6—Amiesite.—This section extended from Station 14 + 50 to 17 + 75. The Amiesite was laid under the supervision of the Amiesite Co.

The foundation course consists of 1½-in. crushed trap rock and sufficient screenings to fill the voids. This was spread and then rolled with an 18-ton roller to a finished depth of 3½ in. The detailed cost of the 3½-in. foundation course was:

	Per sq. yd.
106.4 cu. yds. trap rock at $1.65	$0.229
21.3 cu. yds. screenings at $1.65	0.046
Labor	0.054
Total	$0.329

The paving mixture was shipped from the Amiesite plant and laid in two courses: the first course was composed of 1½-in. stone with binder, etc.; laid and rolled to a finished depth of 2 ins. The second or wearing course was composed of ⅝-in. stone, binder, etc., laid and rolled to a finished depth of 1 in. The paving mixture, therefore, had a finished depth of 3 ins. An 18-ton roller was used. The detailed cost of the field labor for spreading the surface course was as follows:

	Hours.	Rate.	Totals.	Per sq. yd.
1 foreman	21	$4.00	$10.50	$0.0137
[illegible] laborers	356	[illegible]	[illegible]	1307
1 rollerman	15	[illegible]	[illegible]	0110
Total (766 sq. yds.)			$119.05	$0.1554

Screenings, 1½ cu. yds. at $1.65 equals $0.003 per sq. yd.

The detailed labor cost of unloading 72 cu. yds. Amiesite from railroad cars was:

	Hours.	Rate.	Total.	Per sq. yd.
1 foreman	24	$4.00	$17.00	$0.0222
9 laborers	297	[illegible]	[illegible]	1095
Total (766 sq. yds.)			$100.90	$0.1317

Or about $1.40 per cu. yd.

The cost of hauling the Amiesite by teams from the station was 17.9 cts. per sq. yd. of pavement.

The unit cost of the pavement in Section 6 was as follows:

	Per sq. yd.
Base course	$0.329
Surface Course	
Labor, spreading	0.155
Labor, unloading	0.132
Hauling	0.179
Total	[illegible]*

*Does not include cost of Amiesite.

The actual time of laying the surface course was 2 days and 4 hours, or an average of 306 sq. yds. per day. The material was very hard, due to the length of time it remained in the cars, making the work of unloading from the cars and laying the surface very difficult. Under favorable conditions the labor should be reduced by 70 per cent.

Section 7—Sicilian Asphalt.—Section 7 extended from Station 17 + 75 to 20 + 67. The Sicilian Asphalt was laid by the Sicilian Asphalt Co.

The foundation course consists of 1½-in. crushed trap rock, rolled with an 18-ton roller to a finished depth of 4½ ins. The detailed cost of this 4½-in. base was:

	Per sq. yd.
129.9 cu. yds. trap rock at $1.65	$0.299
13.0 cu. yds. screenings at $1.65	0.029
Labor	0.054
Total	$0.382

The paving mixture is called "Asphalto," and was mixed at the Sicilian Asphalt Co.'s plant, hauled to White Plains Avenue and spread. The paving mixture was not rolled until comparatively cool, and then a Sicilian Asphalt 10-ton grooved roller was used. The finished depth was 1½ ins. A light layer of cement was then sprinkled over the surface. The detailed cost of field labor was as follows:

	Hours.	Rate.	Totals.
[illegible]	[illegible]	[illegible]	$3.12
[illegible] spreading	[illegible]	[illegible]	10.93
2 rakers	10	2.50	3.12
[illegible] cement	[illegible]	[illegible]	1.31
1 rollerman	6	4.50	3.37
Total, 718 sq. yds. at $0.030			$21.85

Cement, 2½ bags at $1.35 per bbl., $0.840, $0.001 per sq. yd.

The cost of hauling 19 loads at $3.25 per load amounted to $61.75 or 8.7 cts. per sq. yd.

The unit cost of the work on Section 7 was as follows:

	Per sq. yd.
[illegible]	$0.382
[illegible]	
Field labor	0.030

Cement	[illegible]
Hauling	0.008
Total	$0.[illegible]

[illegible] asphalt.

The actual time of laying the surface course on Section 7 was 5 hours or an average of 1,148 sq. yds. per day.

Section 8—Tarvia X.—The pavement on this section, extending from Station 20 + 67 to 22 + 75, was laid under the supervision of the Barrett Mfg. Co.

The foundation course consists of 1½-in. crushed trap rock and screenings, rolled with an 18-ton roller to a finished depth of 3¾ ins. The detailed cost of this 3¾-in. base was:

	Per sq. yd.
[illegible] trap rock [illegible]	$0.229
[illegible] screenings [illegible]	0.022
Labor	[illegible]
Total	[illegible]

The paving mixture consists of 3 parts of ¾-in. crushed trap rock, 1 part of chips and 6½ per cent by weight of Tarvia X. The stone and Tarvia X were heated on the ground and mixed by hand on mixing boards, spread, and rolled with an 18-ton roller to a finished depth of 2¾ ins. The detailed cost of this surface course follows:

		Per sq. yd.
Labor	[illegible]	[illegible]
1½-in. stone, [illegible]	[illegible]	
¾-in. stone, 43 cu. yds. at $1.80....	77.40	0.177
Chips, 14 cu. yds. at $1.90........	26.60	0.054
Binder, [illegible]	[illegible]	[illegible]
Total, 491 sq. yds. [illegible]	[illegible]	[illegible]

*[illegible] gals. per sq. yd.

The details of the field labor in the construction of the surface course were as follows:

	Hours.	Rate.	Totals.
1 foreman	[illegible]	[illegible]	[illegible]
1 man spreading	[illegible]	[illegible]	11.81
4 men mixing	[illegible]	[illegible]	[illegible]
[illegible] men wheeling	[illegible]	[illegible]	[illegible]
[illegible] heating binder	[illegible]	[illegible]	[illegible]
3 men heating stone.....	150	2.25	42.19
4 men heating stone......	29	2.25	8.15
1 rollerman	17	4.50	9.56
Total, 491 sq. yds. at $0.421..............			$206.60

For the seal coat about .6 gal. per sq. yd. of Tarvia X was applied, over which chips were spread and rolled. The detailed cost of this seal coat was:

		Per sq. yd.
Labor	[illegible]	[illegible]
Chips, [illegible]	[illegible]	[illegible]
Binder, 288 gals.* at $0.095........	27.36	0.055
Total, 491 sq. yds. at $0.137....	$67.25	$0.137

*0.58 gals. per sq. yd.

The details of the [illegible] the seal were as follows:

	Hours.	Rate.	Totals.
1 foreman	[illegible]	[illegible]	[illegible]
1 man pouring binder	[illegible]	[illegible]	[illegible]
1 man on squeegee..........	8	2.25	2.25
3 men heating and carrying binder	[illegible]	[illegible]	[illegible]
2 men spreading chips	[illegible]	[illegible]	[illegible]
4 men wheeling and heating chips	[illegible]	[illegible]	[illegible]
1 rollerman	[illegible]	[illegible]	[illegible]
Total			[illegible]

The detailed cost of the pavement on Section 8 was as follows:

	Per sq. yd.
Base course	$0.305
Surface course	0.913
Seal coat	0.137
Hauling binder	[illegible]
Tar and stone heaters	[illegible]
Fuel	[illegible]
Total	$1.429

The actual time of laying the surface course was 6 days and 2 hours, or an average of 78½ sq. yds. per day. The actual time of laying the seal coat was 1 day, or an average of 491 sq. yds. per day. The chips required heating, as they were wet and cold.

Section 9—Bermudez Asphalt.—This section extends from Station 22 + 75 to 24 + 50.

The foundation course consists of 1½-in. crushed trap rock and screenings, spread and rolled to a finished depth of 3¾ ins. The detailed cost of this 3¾-in. base was:

	Per sq. yd.
57.3 cu. yds. trap rock at $1.65..............	$0.229
5.7 cu. yds. screenings at $1.65.............	0.022
Labor	0.051
Total	[illegible]

From [illegible] to 23 + 02, the binder consists of a mixture of tar and 10 per cent of refined Bermudez asphalt. From 23 + 02 to 24 + 00, the binder consists of a mixture of tar and 15 per cent of Bermudez asphalt of 60° penetration. From 24 + 00 to 24 + 40, the binder consists of a mixture of tar and 15 per cent of Bermudez asphalt of 110° penetration. From 24 + 40 to 24 + 50, Bermudez asphalt of 110° penetration was used for a binder. The paving mixture consists of 3 parts of ¾-in. stone, 1 part of chips, and 7 per cent by weight of bitumen. The stone and binder were heated on the ground, mixed by hand on mixing boards, spread, and rolled with an 18-ton roller to a finished depth of 2¾ ins. The detailed cost of the surface course was:

		Per sq. yd.
Labor	$197.84	$0.479
1½-in. stone, 5 cu. yds. at $1.65...	8.25	0.181
¾-in. stone, 37 cu. yds. at $1.80....	66.60	0.181
Chips, 12 cu. yds. at $1.90..........	22.80	0.055
Binder, 1,115 gals.* at $0.118.......	131.57	0.319
Total, 413 sq. yds. at $1.034......	$427.06	$1.034

*2.7 gals. per sq. yd.

The details of the field labor employed on the surface [illegible]:

	Hours.	Rate.	Total.
1 foreman	[illegible]	[illegible]	[illegible]
1 man spreading	[illegible]	[illegible]	[illegible]
4 men mixing	[illegible]	[illegible]	[illegible]
3 men wheeling	146	2.25	41.06
4 men heating binder.........	192	2.25	53.98
3 men heating binder.........	18	2.25	5.06
1 rollerman	[illegible]	[illegible]	[illegible]
Total, 413 sq. yds. at $0.479..............			$197.84

[illegible] ground was as follows:

Foreman, [illegible]	[illegible]
Laborers, 2 men, [illegible]	[illegible]
Laborers, 3 men, 24 hours..................	6.75
Total, 288 gals. at $0.037..................	$10.78

This labor included part of two days, requiring heating up twice and emptying from kettles to barrels for future use. The material should be mixed as used, requiring only an extra kettle kept hot, with asphalt in it ready to mix.

For a seal coat about .6 gal. of asphalt was applied, over which chips were spread and rolled. The detailed cost of the seal coat was:

		Per sq. yd.
Labor	[illegible]	[illegible]
Chips, 3 cu. yds. at $1.90..........	5.70	0.014
Binder, 264 gals.* at $0.118........	31.15	0.076
Total, 413 sq. yds. [illegible]	[illegible]	[illegible]

*[illegible] gals. per sq. yd.

The details of the labor cost on the seal coat were as follows:

	Hours.	Rate.	Totals.
1 foreman	[illegible]	[illegible]	[illegible]
1 man pouring	[illegible]	[illegible]	[illegible]
1 man on squeegee.........	6	2.25	1.68
3 men heating and carrying binders	19	2.25	5.34
2 men spreading chips	[illegible]	[illegible]	[illegible]
4 men wheeling and heating chips	[illegible]	[illegible]	[illegible]
1 rollerman	5	4.50	2.81
Total			[illegible]

Mixing binder at plant, $31.56 = $0.076 per sq. yd.

The detailed cost of the pavement on Section 9 was:

	Per sq. yd.
Base course	[illegible]
Surface course	1.034
Seal coat	[illegible]
Fuel	[illegible]
Hauling binder	[illegible]
Tar and stone heaters	[illegible]
Mixing binder	[illegible]
Total	[illegible]

The cost of this section is high because the work was not continuous, due to waiting for binder and also due to cold weather, which made the stone harder to heat. The chips were wet and cold, and required heating.

The actual time of laying the surface course was 6 days, or an average of 69 sq. yds. per day. The actual time of laying the seal coat was 6 hours, or an average of 551 sq. yds. per day.

Section 10—Refined Tar.—This section extends from 24 + 50 to 27 + 97. The foundation course consists of 1½-in. crushed trap rock and screenings, spread and rolled to a finished depth of 3¾ in. The detailed cost of this 3¾ in. base was:

		Per sq. yd.
113.6 cu. yds. trap rock, at $1.65..	$187.41	$0.229
[illegible]	[illegible]	[illegible]
Labor	.....	0.054
Total		[illegible]

The paving mixture consists of 3 parts of ¾-in. trap rock, 1 part of ⅜-in. trap rock chips, and 6 per cent by weight of refined tar. The binder and stone were heated on the ground, and mixed by hand on mixing boards, spread, and rolled with an 18-ton roller to a finished depth of 2¾ ins. The binder used was refined tar made up in accordance with specifications drawn up by the Office of Public Roads, of the U. S. Department of Agriculture. The detailed cost of this surface course was as follows:

		Per sq. yd.
Labor	$308.91	$0.377
¾-in. stone, 82.5 cu. yds. at $1.80..	148.50	0.181
Chips, 27.5 cu. yds. at $1.90......	52.25	0.064
Binder, 2,016 gals.* at $0.10......	201.60	0.246
Total, [illegible]	$711.26	$0.868

*2.46 gals. per sq. yd.

The details of the field labor for the surface course are as follows

	Hours.	Rate.	Totals.
1 foreman	52	$4.00	$26.00
2 men spreading	20	[illegible]	5.62
2 men [illegible]	63	2.25	17.71
[illegible] men mixing	201	2.25	56.53
4 men wheeling stone.	99	2.25	27.84
5 men wheeling stone.	140	2.25	39.37
3 men heating stone..	36	2.25	10.12
5 men heating stone..	200	2.25	56.25
5 men heating tar....	176	2.25	49.50
3 men heating tar....	23	2.25	6.47
[illegible]	24	4.50	13.50
Total, 819 sq. yds. at $0.868............			$308.91

For the seal coat about .6 gal. per sq. yd. was applied, over which chips were spread and rolled. The detailed cost of this seal coat was as follows:

		Per sq. yd.
Labor	[illegible]	[illegible]
Chips, 6.0 cu. yds. at $1.90.......	11.40	0.014
Binder, 480 gals.* at $0.10........	48.00	0.059
Total, 819 sq. yds. at $0.135.	$110.29	$0.135

*0.59 gals. per sq. yds.

The labor force engaged in constructing the seal coat was as follows:

	Hours.	Rate.	Totals.
1 foreman	9	$4.00	$4.50
1 man boring	10	2.25	2.81
1 man on squeegee	[illegible]	[illegible]	[illegible]
6 men heating tar..........	54	2.25	15.18
4 men carrying tar........	35	2.25	9.84
1 man spreading chips.....	9	2.25	2.53
1 [illegible]	[illegible]		8.72
[illegible]	[illegible]	4.50	4.50
Total, 819 sq. yds. at $0.062............			$50.89

The detailed cost of the pavement on Section 10 was as follows:

	Per sq. yd.
Base course	$0.305
Surface course	[illegible]
Seal coat	0.135
Fuel	[illegible]
Hauling binder	0.008
Tar and stone heaters......................	0.003
Total	$1.382

The actual time of laying the surface course was 6 days and 4 hours, or an average of 126 sq. yds. per day. The actual time of laying the seal coat was 1 day and 2 hours, or an average of 655 sq. yds. per day. The chips were not heated.

[illegible] of the macadam bases for the experimental roads may be summarized as follows:

	Per sq. yd.
[illegible] Macadam Base	
[illegible]	[illegible]
37.9 cu. yds. screenings at $1.65............	0.02[illegible]
Labor	[illegible]
Total [illegible]	[illegible]
[illegible]	
221.3 cu. yds. 1½-in. trap rock at $1.65....	$0.229
[illegible]	[illegible]
Labor	[illegible]
Total [illegible]	[illegible]
[illegible]	
[illegible]	[illegible]
Labor	[illegible]
Total, [illegible] sq. yds.	[illegible]
1½-in. Macadam Base	
129.9 cu. yds. 1½-in. trap rock at $1.65....	$0.299

[illegible]

[illegible] for the above macadam base was as follows:

Foreman, 98 hrs., at 50 cts......................$ 49.00

[illegible]

Fuel.—A summary of the data on the fuel used in the experimental work is as follows:

[illegible]

The heating surface required to heat the stone was twice the area of that required to heat the tar and asphalt, therefore the [illegible] jobs when the stone was heated, required three times the quantity of wood used on pen[illegible] stone sections, when the binder only was heated.

Hauling Water.—The cost of hauling 12,000 gals. was $93.70 = $0.0078 per gal., the cost for the same haul should be: 5 loads = 500 gals. × 5 = 2,500 gals. per day, at $6.50 = $0.0026 per gal.

Tar Kettles and Stone Heaters.—Tar kettles cost about $100; their life is 10 years. Interest at 4 per cent for 10 years, plus sinking fund = $8.006 per year for 10 years = $120.06 The total cost is $120.06 for 10 years = $12.006 per year; 120 working days = 10 cents per day.

Stone heaters or flat plates cost about $15.00; their life is 10 years; interest at 4 per cent for ten years, plus sinking fund = $1.20 per year for 10 years = $18.00. Total cost $1.80 per year, 120 working days = 1½ cents per day.

WATER-WORKS AND SEWERS SECTION

Methods and Results of Sewage Sludge Studies, Philadelphia, Pa.

In our issue of April 19, 1911, we reviewed the methods and results of sewage purification experiments performed at the Spring Garden testing station in Philadelphia, except insofar as those experiments related to the study made of sludge disposal. In this issue the methods employed and the results secured in the sludge disposal experiments will be briefly reviewed.

IMPORTANCE OF STUDIES.

In the operation of a disposal plant the liquid portion of the sewage can be handled in an economical and inoffensive manner. One of the chief reasons for installing purification works is to keep the solid portion of the sewage from reaching the natural water course into which the purified liquid effluent is ultimately discharged. This solid portion is usually screened or settled away from the liquid portion and the residue is called sludge. Sludge is watery in composition, consequently bulky, and generally foul and offensive to the senses. The big problem in sewage purification is the economic and sanitary disposal of sludge.

There are two conditions of sludge which are of the greatest importance: first, the percentage of moisture, and second, the offensive odor.

The moisture content of sludge determines its bulk. A cu. yd. of sludge (sp. gr. 1.02) would weigh 1,720 lbs. if the moisture content amounted to 90 per cent; then 10 per cent of the weight of the mass, or 172 lbs., would be dry residue; if the moisture amounted to 95 per cent, then only 5 per cent of the weight of the wet mass, or 86 lbs., would be dry residue. Consequently when a certain amount of dry residue is settled from sewage the bulk of the resulting sludge is determined by the percentage of moisture thereof, and as the volume of the wet mass increases very rapidly with slight increase of percentage moisture above 90 per cent, any design of tank or process which will yield a sludge low in moisture is a step in the right direction.

The offensive odor of sludge is produced by the putrefaction of the organic matter in the sewage by the action of anaerobic bacteria. Freshly deposited or thoroughly digested sludge is not offensive, but when discharged into sludge beds to dry a large area is exposed to the air and the emanation may become offensive. Hence the determination of a purification process which will produce an inodorous sludge is just as important as the development of a method which yields a sludge of low moisture content.

Table No. I gives the results of some of the average analyses of sludge.

[illegible] tanks [illegible] 13 and 17 and the Emscher tank were described in our issue of April 19. The outside sprinkling filters, six in number, were outside the testing station building. The influent to these filters was roughly settled sewage from a wooden settling tank 10 ft. in diameter and 9 ft. 3 ins. deep, containing 5,600 gals. Crude sewage was pumped into this tank and the effluent passed into a small dos[illegible]. A [illegible] nozzle, under falling head from the dosing tank, distributed the sewage over the filters.

TABLE I.—AVERAGE ANALYSES OF SLUDGE.

Source of Sludge.	Wet Sludge. Specific Gravity.	Wet Sludge. Per cent moisture.	Per Cent of Dry Residue. Volatile.	Per Cent of Dry Residue. Fixed.	Per Cent of Dry Residue. Nitrogen.	Per Cent of Dry Residue. Fat.
Sedimentation of screened sewage in Tank No. 12 Horizontal flow.	1.036	90	49	51	1.3	8.1
Sedimentation of crude sewage in Tank No. 13 Horizontal flow.	1.053	86.1	48	52	1.4	7.4
Sedimentation of crude sewage in Tank No. 17 Horizontal flow.	1.043	87.7	50	50	1.3	7.2
Sedimentation of crude sewage in the Emscher Tank Vertical sedimentation.	1.085	82.6	38	62	[illegible]	[illegible]
Sedimentation of the effluent of the outside sprinkling filters Horizontal flow.	1.024	91.5	46.5	53.5	1.8	6.4

AMOUNT OF SLUDGE PRODUCED.

It is interesting to note that the amount of sludge in the tanks, at the conclusion of a test run, did not follow any definite law. Consequently it was impossible to calculate the amount of wet sludge to be expected, knowing the suspended solids in the influent and the percentage removal. Perhaps this was due to the large amounts of trade wastes in the sewage used.

Tank 12, when operated at from 3½ to 6 hrs. storage and treating fine-screened sewage, collected 4.65 cu. yds. of sludge, per million gals. of sewage, with a moisture content of 90 per cent. This was while the tank had a sloping bottom and after the baffle and scum boards were installed.

Tank 13, when operated at from 3½ to 6 hrs. storage and treating crude sewage, collected 4.07 cu. yds. of sludge per million gals. of sewage, with a moisture content of 86.1 per cent. This was with tank bottom sloping toward inlet end, and with baffle and scum board at mid-length.

Tank 17, when operated at from 4 to 10 hrs. storage and treating crude sewage, collected 6.31 cu. yds. of sludge, per million gals. of sewage, with a moisture content of 87.7 per cent. This was with a level bottom in tank, and with baffle and scum boards at the one-third points of the length.

In the Emscher tank, when operated at 2 hrs. storage and treating crude sewage, produced 0.9 cu. yds. of sludge, per million gals. of sewage, with a moisture content of 82.6 per cent. This was with a tank 10 ft. deep and 5 ft. in diameter. It should be borne in mind that the sludge formed in the sedimentation chamber of this tank fell into a sludge chamber, when digestion and condensation materially reduced its bulk.

The Dibdin slate bed, operated at from one to three fillings per day and treating crude sewage, collected 1.17 cu. yds. of sludge, per million gals. of sewage, with a moisture content of 54 per cent.

It should be borne in mind that during a time when the filters are storing the amount of sludge deposited in the settling basins from a million gals. would be small and when the filters unload large. Under the first condition the effluent from the outside sprinkling filters in passage through a plain settling basin deposited sludge, 90.2 per cent moisture, at the rate of 2.2 cu. yds. per million gals., settled, and under the second condition, when the filters were unloading, 5.3 cu. yds., of 91.5 per cent moisture.

CONDITION OF THE SLUDGE.

The sludges deposited in sedimentation tanks 13 (sloping bottom) and 17 (level bottom), from crude sewage, were similar in appearance. Not having been allowed to septicize, the final suspended matters were found in their original state, and in pumping out the wet mass trouble was caused by wool fibers clogging the diaphragm pump. The sludge from tank 12, treating screened sewage, was a uniform, homogeneous mass, containing no particle larger than 1 mm. It flowed freely, whereas that from tanks 13 and 17, which contained wool, hops, and other substances, was more sluggish. The sludge from these three tanks produced an offensive odor.

The condition of the sludge as withdrawn from the Emscher tank was different from any other. Although crude sewage was settled in this tank, the fermentation in the sludge chamber had broken down even resistant bodies and the resultant sludge was fine, granular, and homogeneous. Considering the dryness of this sludge it flowed freely. The odor is described as "tarry," and after dried was inodorous. This confirms the claims for this process advanced by German engineers.

A peculiarity of this sludge is that it contains a gas which is 75 per cent methane or marsh gas. When the sludge was withdrawn from the tank this gas expanded and the consistency of the mass became like that of "rising" bread dough. This is a great advantage as it facilitates the drying of the mass. A microscopical examination of this sludge when fresh showed it to be composed of granular structureless masses, indicating the complete digestion of the solids.

The deposit upon the slates of the Dibdin slate bed was an inodorous mud, even gritty when rubbed between the fingers, and microscopic examination revealed large amounts of sandy matter. The dry residue was full of [illegible]

FORMATION OF SCUM.

When crude sewage was settled in horizontal flow tanks, Nos. 13 and 17, without scum boards, the formation of scum was irregular. At times it would form in patches and after floating around the tank a while finally disappeared. After baffle and scum boards were put in these tanks the formation of scum at the inlet end of the tank always commenced soon after the tank was put in service, and by the end of the test run attained serious thickness, being tough and tenacious, and cov-

TABLE II. ANALYSES OF SCUM.

Date	Source Influent Crude Sewage	Wet Sludge Specific gravity (Gas bubbles expelled before determination)	Wet Sludge Per cent moisture	Dry Residue, Percentage Volatile	Dry Residue, Percentage Fixed	Dry Residue, Percentage Nitrogen	Dry Residue, Percentage Fats
Dec. 24, 1909.	Sedimentation Basin No. 13.	1.07	[illegible]	55.6	44.4		14.3
March 10, 1910...........		1.0[illegible]	[illegible]	[illegible]	34.1	1.4	[illegible]
May 3, 1910..............		...	[illegible]	[illegible]	40.3	1.6	7.7
Jan. 6, 1910..............	Sedimentation Basin No. 17. 1st Compartment.	1.05	85.2	56.4	43.6	1.7	8.0
March 11, 1910...........		1.04	[illegible]	[illegible]	34.6	1.9	21.7
May 2, 1910..............		...	78.8	57.4	42.6	1.5	10.0
March 21, 1910..........	Emscher Tank No. 19.	1.05	87.2	[illegible]	[illegible]	1.9	14.3
Average		1.05	[illegible]	60.5	39.5	1.7	13.5

ered with a leathery, impervious skin, upon which, in several cases, small plants began to grow.

Table II gives analyses of typical scum on crude sewage tanks 13 and 17. The high specific gravity is consistent, although the scum floats, because entrained gas bubbles buoy it up. The scum contained much more organic matter than the sludge. When the scum was removed and the entrained gas liberated, the odor emitted was very foul. The solids forming the scum remained in their original structural condition, the entire mass being bonded together by the wool fibers.

On tank 12, which treated screened sewage, a scum such as is described above never formed. A frothy material was generally present on the inlet end of the tank. This was probably due to the agitation of the sewage in passing through the screen. It never formed a layer of more than 2 ins. thick and ought not to exist on an actual installation.

During the early operation of the Emscher tank no scum appeared on its surface, but later, as on all the crude sewage tanks, a thick scum formed on the area inside the baffle, and later a thin, fatty scum formed between the baffle and the outlet weir. The ventilating opening always contained a scum which was continually broken up, however, by the gas bubbles. For an actual installation a larger ventilation should be used than the 6-in. pipe of the experimental tank. This would prevent clogging and would carry away the gases of fermentation.

EFFECT OF DESIGN OF TANKS ON SLUDGE PRODUCED.

When sedimentation tanks Nos. 12, 13 and 17 had level bottoms and were unbaffled, the majority of the sludge was deposited at the inlet end of the tank, and the sludge at the inlet end contained more dry residue of a fixed or inorganic nature than that found at the outlet end. The construction of baffles and scum boards, in addition to improving the efficiency of sedimentation, also restrained the sludge at the inlet end, thereby keeping the outlet compartment freer from sludge or scum likely to be carried away with the effluent. When baffles were placed at the one-third points of the length of tank 17, two-thirds of the sludge was deposited in the first part, one-fourth in the second, and one-twelfth in the third parts. When the sloping bottoms were built in tanks 12 and 13 it was expected that as sludge formed upon the bottom of the tank it would continually slip along the inclined (16° to the horizontal) bottom into the deepest part at the inlet end. During the operation of the tanks this did not occur to as great an extent as hoped for, but when the liquid above the sludge was removed the sludge assumed a level surface.

The device for removing sludge from the Emscher tank by utilizing the hydrostatic head of water proved successful, even when the sludge was very compact. In case the sludge at the bottom of the tank should become so dry as not to flow through the sludge pipe, or to prevent, during the maturing of the tank, the liberation of excessively large volumes of entrained gas in the sludge, whereby it might be carried up into the settling chamber, it is the practice in Germany to run a perforated lead pipe down the side of the tank, circling it near the bottom with a branch to the apex of the bottom, so that water under pressure can be forced into the sludge to thin it.

SLUDGE DIGESTION.

Three experiments were made to study sludge digestion in open water tight tanks. In each case the sludge from sedimentation tank 17 was tested.

In the first test, after the water in tank 17 had been withdrawn, the remaining sludge was flushed out by a stream of water from a fire nozzle into a concrete basin. The sludge and the water carrying it filled the concrete basin to a depth of about 15 ins. It was expected that the sludge would settle and the water used to drive it could be drawn off the top. However, in 24 hrs. the reverse occurred; the thin watery mass separated into three layers, sludge at the bottom, scum at the top and water between. Gas bubbles arose continually and, when breaking through the scum, became offensive. No diminution of sludge was noted.

In the second test the sludge was pumped to a concrete tank 50 ft. square and 5 ft. deep. A small amount of settled sewage was allowed to run over this sludge from time to time. A thick, leathery scum formed on the surface, beneath which the mass continued to grow thinner and watery, at least partly due to the settled sewage passing over it. After two weeks the entrie content was thoroughly stirred and pumped to a lagoon.

The result of the third test was similar to the first. Sludge was again placed in the digestion tank without the addition of sewage. In two days stratification commenced and in eight days it was pronounced, the surface appearing like the thick leathery scum of a septic tank, being 78 per cent moisture, while the sludge at the bottom was 88.3 per cent moisture.

As an actual example of a similar condition on a large scale, sludge lagoons may be seen in England, 5 to 6 ft. deep, on which a thick scum formed, beneath which the sludge remains in its original condition with no apparent loss in amount, and continually giving off a foul odor, irrespective of age or density.

The experimenters at Philadelphia concluded that the placing of sludge in open water tight tanks is not an advantageous means of disposal.

AIR DRYING OF [illegible]

Four lagoons were excavated to a depth of 3 ft., each 8x12 ft. in plan. One lagoon had a drainage base consisting of a 3-in. layer of 1 in. to 3 ins. slag, covered by ⅜-in. slag screenings to level off the surface, and over that a thin layer of slag screenings from ⅛-in. to dust. A 3-in. drain led from the lowest corner. The other three lagoons had earth bottoms.

Three and one-half cu. yds. of sludge were put in the lagoon with the slag drainage floor. The drain pipe had to be plugged at once. In three weeks the sludge had dried to a consistency fit to remove, but was allowed to remain in the lagoon to watch its action. This sludge was from tank 12 (treating screened sewage). The screened influent to this tank contained almost no wool fibers nor other sludge bonding material. The mealy nature of the sludge became evident as soon as the surface was dry enough to crack; the cracks gradually developed into fissures extending to the bottom of the layer of sludge. This facilitated drying by increasing the exposed area. When removed the lumps piled on the side of the lagoon were not offensive, although the fresh sludge was.

Sludge from tank 13 (influent crude sewage) was pumped to a lagoon and filled to a depth of 12 ins. In 4 days the surface cracked but the cracks never reached the bottom. When finally removed the sludge was much more difficult to handle, than in the preceding case, due to the bonding action of wool fibers.

When sludge from the Emscher tank was placed in a lagoon, the entrained gas expanded so that the surface became convex. This arch collapsed as the mass dried. When dry it was very pourous and spongy, and was an odorless and unobjectionable substance.

The sludge removed from the digestion tank previously described was placed in a lagoon. In 3 weeks the surface cracked and was firm; when removed from the lagoon it was an inodorous, felt-like mass.

It was found in the Philadelphia experiments that fine sand or sawdust over a coarse stone drainage floor was more efficient for reducing moisture in sludge than a plain earth lagoon.

Wet sludge from a sedimentation tank, applied 6-ins. deep in winter weather, under cover, dried to a consistency fit to remove in 6 days, and under the same conditions but not under cover, in 12 days.

Based upon small size tests in winter weather, Emscher sludge 12 ins. deep upon a sand bed, dried to a consistency fit to remove in 12 days, during freezing weather. In Germany the time is given as from 4 to 5 days, but sludge is not withdrawn in freezing weather which accounts for the difference.

When equal weights of rice coal and wet sludge were mixed and placed on sludge beds, the mixture was fit to remove in one day and was successfully burned.

Investigations of Flow in Brick-Lined Conduits.

In a paper read before the Western Society of Engineers, April 19, 1911, by John Ericson, city engineer of Chicago, the conclusion was drawn that for brick-lined conduits a value of *n* in Kutter's formula of 0.0130 is readily attainable. This is a coefficient due to roughness and is applicable to tunnels or sewers of ordinary sizes and velocities of flow, lined with sewer brick laid in cement mortar, if the brick is properly selected and not too warped or uneven, laid in a workmanlike manner and true to line, not disturbed by blasting and the mortar joints scraped off flush with the brick.

Under certain circumstances, especially if there has been any disturbance whatever of the brick work on account of blasting, it will be found advisable and profitable to have in addition the entire interior surface of brick conduits washed with neat cement, the strokes of the brush applying the wash to be always along the geometrical axis of the conduit. By this method a coefficient of roughness, *n*, considerably smaller than 0.0130 should be obtained in well constructed tunnels of the sewer brick lined class.

In relation to blasting in the excavation of trenches for brick-lined conduits Mr. Ericson pointed out that if the lining is thereby at all disturbed, whether such disturbance is especially noticeable or not, will have the effect of increasing the resistances to flow and consequently decreases the capacity of such a tunnel. The jarring of the brick work undoubtedly disturbs the mortar joints more or [illegible] that the bond with the brick will be [illegible]. Slight projections and irregularities [illegible] caused by this shaking of the brick work, and irrespective of any visible disturbance or distortion of the same, resistances to the flow of water are created.

A brick tunnel in rock should not be lined until after the completion of the entire excavation, or at least the brick lining should be kept far enough back of the face and be so protected as to be unaffected by the blasting.

In an earth tunnel, blasting should preferably not be permitted at all, and if anywhere found to be necessary care should be taken to protect the brick work from the effect of such blasting and to remedy any defects in the brick work that upon close inspection may be discovered.

DRAINAGE AND IRRIGATION SECTION

The 320,000-Acre Mud River Drainage Project in Minnesota.

[illegible]*

The first effort at drainage made in Minnesota, outside of small farm drains and the ordinary highway ditch which was but an incidental feature of road construction, was made by President James J. Hill, of the Great Northern R. R., between 1878 and 1880, and while one of its purposes was to improve the roadbed of the Great Northern Railway in the Red River Valley it was intended by Mr. Hill as an object lesson to the Red River farmer showing the benefits attending the proper drainage of these naturally wet lands.

The next work of a public character to advance the cause of drainage in Northern Minnesota was that so splendidly prosecuted by the Red River Valley Drainage Commission, under the able leadership of the late Ezra G. Valentine of Breckenridge. This resulted in about 125 miles of main ditches, with highways alongside, and cost about $140,000, of which Mr. Hill contributed $25,000. These ditches were scattered throughout the Red River Valley, from Kittson County on the north to Wilkin County on the south and by the immediate and permanent benefits they brought to bordering and near-by farm lands they demonstrated to the people of Northern Minnesota that though nature had been a little over particular in applying the finishing coat and had used the smoothing trowel too much for ordinary farming purposes, yet she had deposited the soil with a generous measure and the problem of removing that part of the rain-fall not needed for crops was but a question for the law makers to formulate a plan to finance and the drainage engineer to design and construct the system.

Northern Minnesota has fully realized this for some years and has been actively engaged in constructing many miles of public ditches for the most part independent of any state aid and, it might be added, in spite of laws not adapted in all respects to the treatment of large areas which the topography of Northern Minnesota imposes upon an efficient drainage system.

The earlier effort for public drainage in Northern Minnesota, as in the Red River Valley, consisted simply of a single large ditch from 3 to 8 miles in length, starting at the foot of the slope down which the water coming from the east on its western course to the Red River was able, by reason of its natural erosive action due to its velocity down the slope, to maintain an open river channel and running thence across a practically level stretch, across which nature unaided was unable to maintain a river channel, and here discharging either into a coulee connected directly with the Red River or into a connection with the river itself.

Each ditch was a system by itself or, more accurately, an artificial link in a natural chain-system; and though two such connecting links were constructed on parallel road lines—and practically all the main ditch-lines in the Red River Valley are along east and west section lines but three or four miles apart—their design would have little or no relation to each other. An engineer under one legal proceeding could design and construct the one without reference to the other which might be financed by another county quite independent of the first. But the problem presented by the natural conditions of the Mud River watershed, the subject of this sketch, with which the engineer must deal, is of a radically different type.

The area, extending east from Thief River, about 40 miles and extending south about 12 miles from the Moose River watershed, comprising about 500 square miles, contains but one stream and even this is not continuous but is "lost" for about a mile near the "half way" place. The fact that the storm water from 500 square miles in reachnig an ultimate outlet has been able to create and maintain but two disconnected pieces of river channel of about 15 miles each is sufficient proof of unusual topographic conditions.

The whole area is essentially *one* system, not an assembly of several sub-systems, capable of being treated as such. Not even one whole township within the area could be adequately drained independent of adjoining territory.

Efficiently to promote projects of this size, our laws were cumbersome and inadequate. At the last session of the Legislature, however, the State Drainage Commission through its special attorney, Mr. W. J. Brown, of Warren, was instrumental in amending the drainage laws so that large systems could be efficiently and expeditiously promoted both in their legal and in their engineering phases. Under the former law the legal formalities were unnecessarily exacting and expensive, especially as to the serving of personal notice to each land owner, and provided for no exercise of engineering discretion in the relocation of any part of the system.

The Middle River watershed forms a part of what was known as the Red Lake Indian Reservation and to bring these Indian lands on a basis permitting their assessment the same as other benefited lands, required an act of congress. This was accomplished by what is known as The Volstead Act.

Yet another fundamental work was needed before such a comprehensive system of ditches could be safely and economically designed. As noted above, this watershed is one of small slope. A system of ditches is essentially a system of levels. With a fall of 6 to 8 ft. to the mile; 1 ft. of error may ordi-

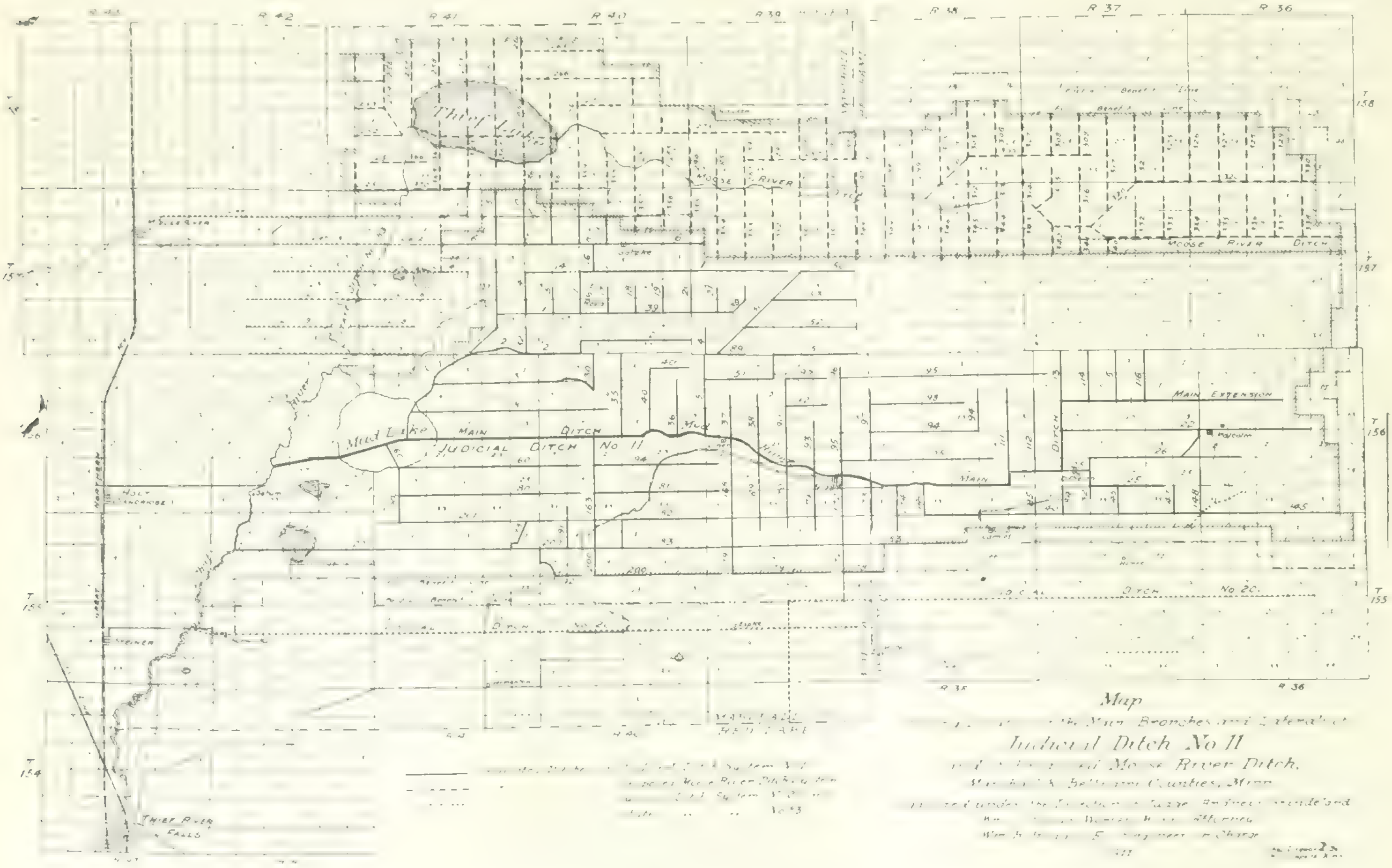

Fig. 1—Map of Ditch System for the Mud River Drainage Project, Minnesota.

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*[illegible] Engineer [illegible] Judicial Ditch No. 11, [illegible] Minn.

narily be of small [illegible], but here it would mean the available head to transport the water of the main ditch half way across a township and thus of the utmost importance, an error of even one-tenth this size in the level control could not be allowed with safety.

The ordinary leveling, employing the common instruments and methods is not adequate for this class of work. A system of precise level-control must be made and a system of permanent bench marks at selected points must be established throughout the area. To provide this Mr. Halvor Steenerson, Congressman for this district, secured the passage of a bill authorizing the U. S. Geological Survey to cover this area together with several hundred miles of adjoining territory with a topographic survey. This was done during 1907 and 1908, followed by a published report and contour map having a 10 contour-interval.

With all these legal and engineering fundamentals cared for, the counties, part of whose territory would be included in the proposed system, were ready to proceed with its organization. Mr. Wm. J. Brown of Warren, representing the petitioners cared for this work and by September, 1909, field parties were at work running out preliminary lines for the system under the supervision of the writer, who was appointed by Judge Andrew Grindeland as engineer, in charge.

General Layout of the System.—The accompanying map shows the location of the ditches according to the preliminary design. As this design was based, to a considerable extent, upon the 10 foot contour map of the Geological Survey, the more detailed information obtained by levels along the proposed lines of the ditches called for by the preliminary design leads occasionally to the need for relocations which are being effected as the work proceeds.

The system provides [illegible] miles of ditches and about 325 miles of highway alongside. These ditches are to be so located that each of the 2,000 quarter sections of land has a ditch and a road along at least one of its half-mile sides. No such complete system of drainage has been attempted in this state to cover any considerable area.

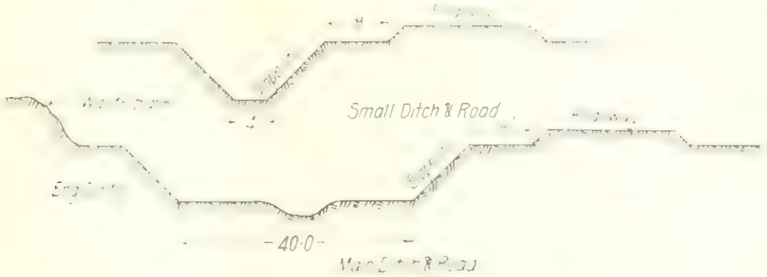


Fig. 2—Typical Ditch Sections, Mud River Drainage Project.

Considering the rate at which the contractor must dig to complete the work in three years, calling 6 months a working year and 8 hours, a day, he will be required to move fourteen cu. yds a minute or about 6 cu. ft. a second. [illegible] dirt as rapidly as dug would require [illegible] teams abreast carrying 1 cu. yd each, moving at the ordinary rate of a loaded team.

The contract for the earthwork involving 5,500,000 cu. yds. was let to one firm of contractors, The Northwestern Drainage Co., of Grand Rapids, Wis.

Fig. 4—View of Corrugated Iron Culvert Carrying Ditch Under Road.

Thief River Improvement.—Thief River, which is receiving the waters from the Mud Lake area, is to be enlarged from its source, in Thief Lake, to a point a few miles above Thief River Falls, where it enters the Red Lake River. [illegible] will be divided among three sub-drainage districts in the ratio of their use of the river as an outlet for each sub-system. The first of these sub-systems is known as state system No. 83, comprising about one-eighth of the area, and situated mostly on the west side of the river near its head waters. The second sub-system of this area is known as county ditch No. 20. It comprises about one-quarter of the watershed and is located on the east side of the river, along the southern boundary of the Mud River area. The remaining five-eighths, or about 500 square miles, comprises the central, and eastern portions of the Thief River watershed and is known as judicial ditch No. 11.

Thief River, with its tributaries, Mud and Moose Rivers, provides the only nautral drainage for about 1,000 square miles situated in the eastern part of Marshall County and the western part of Beltrami County. It is a tract about 25 miles wide and 40 miles long. Grygla is situated near the center and Thief River Falls in its southwest corner. This area, about 650,000 acres, which is smaller by only two townships than the state of Rhode Island, has an average slope from northeast to southwest of nearly 2 ft. to the mile. A fall entirely sufficient to provide ample drainage for it had nature been but reasonably judicious in its distribution.

Small streams must have from 3 to 8 ft. fall a mile to overcome the obstructive effects of sedimentation and vegetation. The Thief River watershed has ample fall in the general direction of slope to maintain good-sized rivers, capable of removing all excess storm water in the usual time—that insuring safe cultivation on adjacent lands—but it has no cross valley lines of sufficient slope to collect the storm water into small streams and conduct it quickly to a central channel or river. Accumulated water from these many small valleys coming in at the same time would maintain a river channel capable of carrying efficiently such waters even though its fall per mile is but a fraction of that needed to bring the water to it along the lines of the small streams.

But this area has no such cross drainage lines, and hence cannot have the larger streams, even though there is present the necessary fall for maintaining the latter. As proof of this, there is a tract within that covered by the drainage system being described which contains about 300 square miles yet within this area there are less than 10 miles of continuous open river channel, and this single stretch of river is where the storm water from about 200 square miles has been compelled, by reason of some small ridges, to "get together" and make a river, resulting in a river channel of a size increasing from 20 ft. wide and 4 ft. deep, at the upper end, to 40 ft. wide and 8 ft. deep at the lower end. Here, however, it meets a broad marsh about 3 miles across with practically no fall. Coming to this level area the waters part and spread out over whole townships, but are collected again 10 miles to the west in Mud Lake. The general route between these points is scattered over with pieces of rivers, sometimes connected, although crooked and poorly put together, while at other places they are wholly disconnected.

To remove the excess storm water from this area in time to insure the ordinary planting season and properly to guard against harmful overflow [illegible] lands during

Fig. 3—View of Typical Lateral Ditch.

[illegible] about 60 ft. wide, capable of passing 1,600 cu. ft. of water a second. [illegible] here provided only a crooked stream about 30 ft. wide and 5 ft. deep, and has given it such a small slope that it can deliver only about 400 cu. ft. a second. Thus, the usual time for the safe delivery of storm water, commonly placed at from two to three weeks, is here lengthened into two or three months, while at the same time the ordinary season furnishes enough rainfall during even the drier summer months to keep fully replenished this small amount of run-off.

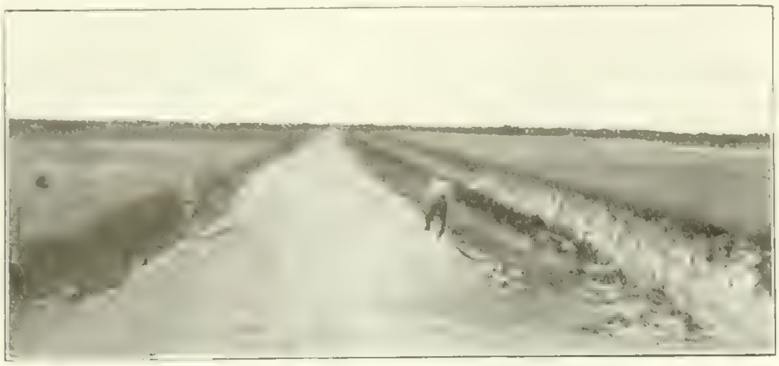


Fig. 5—View Showing Waste Bank Leveled to Form Highway.

A large part of the Thief River watershed is thus kept wet by reason of its peculiar topography; that is, having its slope all in one direction, rendering impossible the usual and natural processes of river-making. Considerable relief from too much surface water is frequently furnished by a pervious subsoil, consisting of sand and gravel, which permits much of the ground water to get away to remote localities, later appearing as springs and entering river channels and lake beds. But all such relief is denied this area, as the whole tract is underlain with a stratum of impervious clay, extending from 2 to 4 ft. below the surface to an unknown depth. Test pits made during the last season to the depth of 10 ft. along the line of all the ditches show this clay sub-soil to be always present.

So in order to correct this two-fold unfavorable condition imposed by nature, the drainage engineer is called in counsel. He must provide a complete system for the whole area, since the Thief River, which is to receive the water from the several main ditches, is as inadequate in its present size and capacity to provide adequate drainage to the bordering lands as are any of the present small streams entering it.

The working out of the most economic system properly to drain each quarter section has resulted in making the map of this area look more like a cross between a checkerboard and a crazy-quilt than a drainage system . But an efficient drainage system of this extent must have each mile of each main and branch of a carrying capacity to meet the demands made upon it by the territory whose storm water must pass through it. This carrying capacity in every ditch is the result of the combined effect of five distinct factors, some of which the engineer has under complete control, while others he can safely control only within small limits.

The side slopes of the ditch he will design to suit the soil conditions to be met in the ditch and the agency to be employed in making the excavations. Greatest economy will be secured with the steeper side-slopes. These can be employed where clay or gravelly-clay predominate, but with sand or gravel the steeper side-slope will result in caving banks and a speedy and serious filling up of the ditch will follow.

If the ditch is to be dug with teams, that is with horses and small scrapers, the flatter side-slopes will be employed. Floating dipper-dredge machines can work only on the steeper side-slopes, while the dry land excavators can work on any slope fixed by the engineer, but can afford to dig the steeper slopes at least cost.

In fixing upon the proper side slopes the designing engineer will also give some weight to the fact that the steeper slopes permit, at the same cost, a deeper ditch which insures better opportunity for sub-drainage to bordering lands and enables a wider territory to be properly drained through intercepting lateral ditches.

The second factor with which the drainage engineer has much to do in designing a system which shall have each section just large enough efficiently to do its work is what is called the coefficient of roughness. Over this he has no control whatever. He must determine what it is, however, in order to fix upon the necessary size and grade of the channel, all other features of the design having been determined upon. Hydraulic tables show this coefficient to have a range of values differing by 400 per cent, depending largely upon the nature of the ditch surfaces in contact with the water and slightly affected by the grade of the ditch.

The remaining three factors of the five which together largely determine the discharge capacity of the ditch and which govern in its economic design, are the bottom width, the allowable depth of water in the ditch at flood stage, and the slope or fall per mile of the bottom of the ditch. Since a proper discussion of the part these factors play in finally reaching the most economic design for an involved ditch system would lead to technicalities outside the general purpose of this paper the part they play in engineering design will be no further considered.

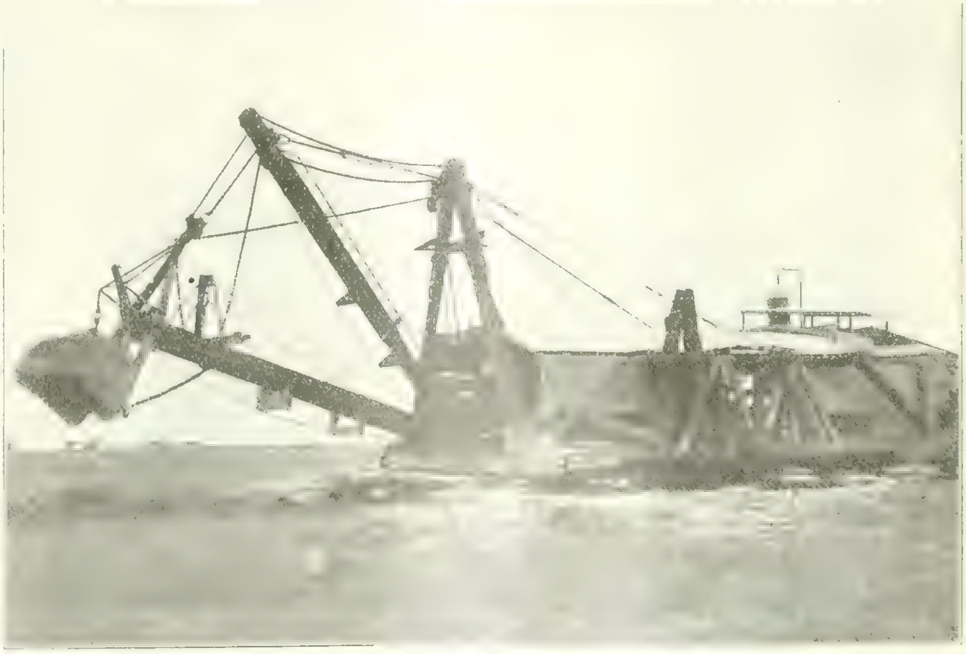


Fig. 6—View of Wa[illegible] Dredge for Dry Ditching.

Ditch Design.—In the design of an adequate system of ditches for a particular locality the ultimate purpose of the system must first be determined.

If the object is to provide a lower level for ground-water as in the case of a system for tile-drainage the depth of the ditch becomes the ruling factor governing the design—the nature and depth of the soil would, of course, be important factors but the carrying capacity of the ditch would be secondary since, to provide the necessary depth, the ditch would be ample as an open ditch, and usually excessive as furnishing an escape for the ordinary run-off surplus.

In the dsign, however, of a system, whose only or chief function is to provide an economical means of quick escape to excess surface water, the character and amount of local precipitation becomes the chief consideration, the general topographic features and soil conditions being considered only as these would influence the per cent of rainfall which would reach and must be cared for by the ditch.

The slopes and character of vegetation as determining the time of such delivery and the character of the soil in its ability to absorb and retain precipitation would be important though not ruling factors.

The nature of the top and sub-soil influences the design only as it affects the cost of digging and maintaining the ditch, loose top soils with very hard or gravely-clay subsoils tending to wide and shallow ditches for considerations of economy of construction alone; while sandy loams and homogenous clays would point to a narrower and deeper ditch approaching more nearly to the economic cross-section.

The probable means to be employed in constructing the ditch may influence the design somewhat, though this can seldom be taken advantage of since the design as a rule is completed in advance of definite knowledge in this regard.

The availability of his material equipment and the habit of work of the contractor may influence the particular plan of excavation quite as much as inherent economic considerations determined by locality of work and different styles of machines best suited to do the work.

Passing by all these minor factors and others which might be mentioned which will receive their due share of weight in a well balanced ditch design, we return to the factor controlling the main features of the design of the system known as Judicial Ditch No. 11, which is typical of most drainage work now in progress in Northern Minnesota.

[illegible] Consequent Run-[illegible].—According to Government records of the Crookston Station (that nearest the Mud Lake district and likely to differ but little from it) the

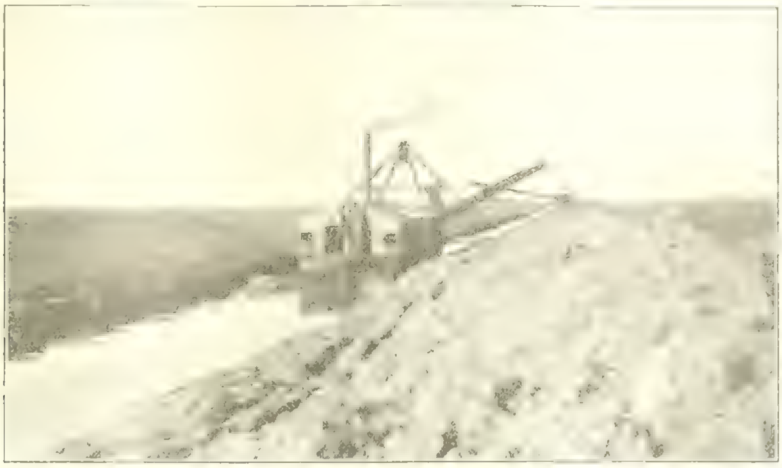


Fig. 7—Dredge Making Second Cutting for Main Ditch.

period from 1895 to 1906 shows a mean monthly rainfall of 4.0 ins. for the wettest month (August) and 5.4 ins. as the average of the wettest of each year. Allowing that any 15 day period of the wettest month for any year would be [illegible] per cent greater than the average for the wettest month gives 8.1 ins. as the maximum rainfall which need be considered. Even this is likely to come but once in three or four years.

It must be here observed that flood stages resulting from spring freshets or single heavy rains (cloud-bursts) establish no basis for ditch design. The former frequently result in serious inconvenience but comparatively little property loss, and guarantee of loss against the latter can no more be justified on economic grounds than to secure the same from damage from cyclones. If for business or temperamental considerations we must have personal and property security from these unusual and destructive agencies, we must look to flat-boats, cyclone cellars or tornado insurance for relief since the engineer cannot furnish it and justify it on economic grounds.

We assume, then, that the area is to be visited frequently enough from season to season with a 15 day period of 8.1 in. rainfall to warrant the design of a system whose discharge capacity will care for the probable run-off following this amount of precipitation, without causing damage from overflow. Though but one-third of the year's precipitation reaches the stream or ditch, we assume that one-half of the rainfall during this 15 day wet period will need to be cared for by the ditch system. This calls for removing 4.0 ins. of water from the area in 15 days or about ¼-in. per 24 hours. This is assumed to apply to an area (20 to 25 square miles) large enough to escape the effect of small downpours covering its whole area and too small to get any considerable relief, from the fact of not being fully covered in a somewhat general rain.

These assumptions lead to the following table showing the number of cubic feet per second run-off to be cared for by the ditches of Judicial System No. 11:

No. of sq. miles	Cu. ft. per sec.	No. of [illegible]	Cu. ft. [illegible]
1	13	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
8	79	90	472
[illegible]	[illegible]	[illegible]	[illegible]
10	90	100	520
11	[illegible]	[illegible]	[illegible]
12	100	140	690
13	105	160	775
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
17	125	300	1.315
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
20	140	450	1.860
25	160	500	2,040
[illegible]	[illegible]	600	[illegible]
35	206	700	2,797

[illegible]

Mud Lake watershed [illegible] 30 per cent less than might be required for other Minnesota drainage districts.

[illegible] depth of water in [illegible] for this discharge with [illegible] within 1 ft. of bank full [illegible] joining lands will have [illegible] fall for its surface water into the ditch even at flood stage. For other stages it will be more as the water recedes and for the last running water never less than 4 ft., the minimum depth of any ditch or lateral.

On account of the depth of patches of peaty soils scattered over the territory and the small differences in cost between a ditch 4 ft. wide on the bottom and 4 ft. deep and one of less cross-sectional area it was decided to start at the upper end of all ditches and laterals with this size—though usually much in excess of the rigid demands—and continue it down to the point where an increase of carrying capacity was needed to meet local requirements. This has resulted in making about one-half the mileage of ditches of this size involving about 6,000 cubic yards to the mile.

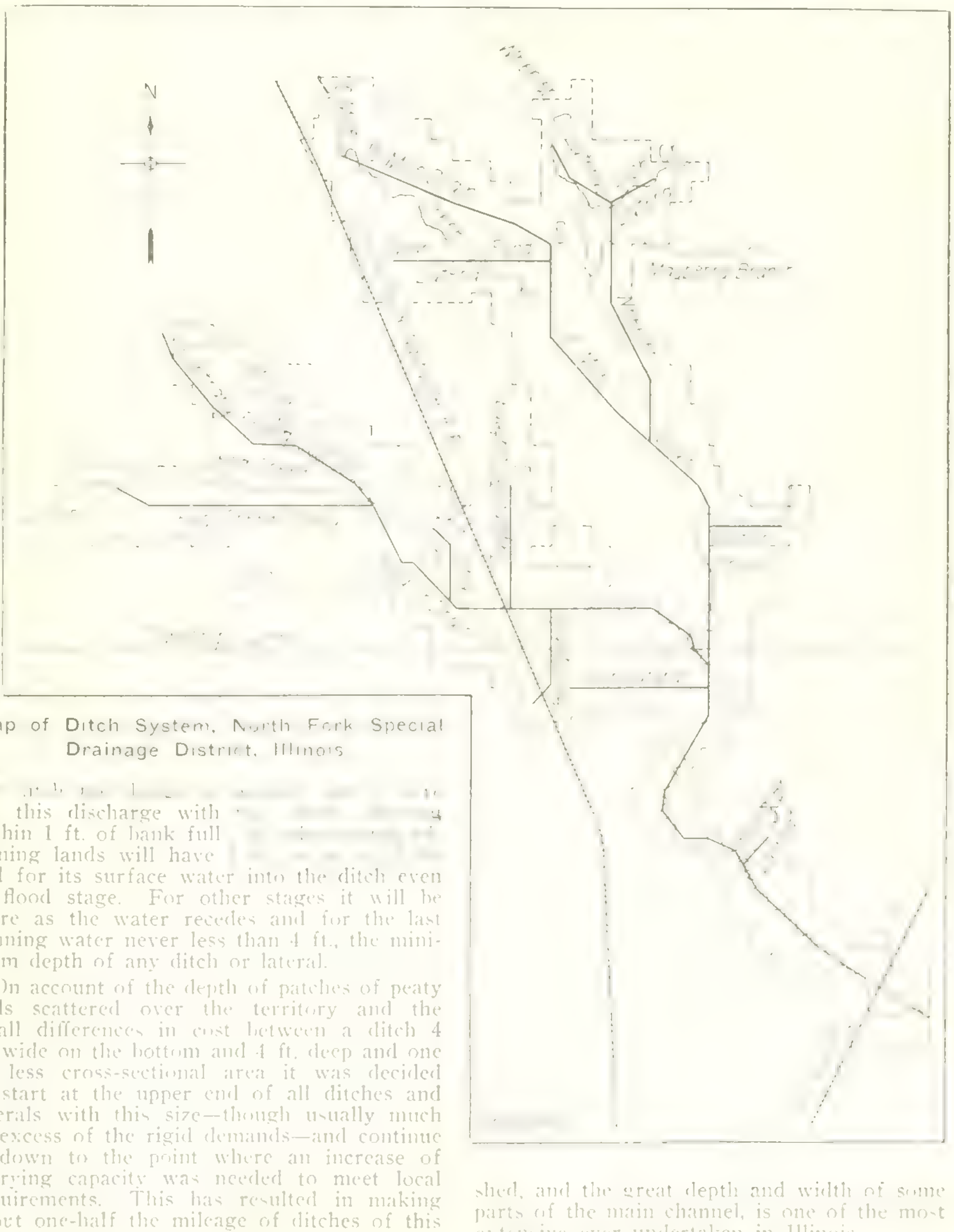
The Main Ditch is 11.5 miles long and discharges the run-off from 347 square miles; is 40 ft. wide at the bottom and about 60 ft. wide at the top on the lower five miles, where its carrying capacity is 1,500 sec. ft. It involves 1,500,000 cu. yds. of earthwork.

The greater economy resulting from bringing branches into the main ditch at all points where nature has not been actually obstructive to such union has resulted in many short laterals a considerable number of branches not more than 10 miles in length and but two over 20 miles long. Of these, branch No. 50 is 24 miles long, drains 97 square miles, and will discharge at flood stage 550 sec. ft. Branch No. 200, discharges directly into Thief River, is 23 miles in length and drains 67 square miles. The sketches below show typical cross-sections of ditches and finished highway, and the accompanying views present other features of this work.

The Ditch System for a 23,000-Acre Drainage Project in Illinois.

By W. W. [illegible]

Drainage work which will reclaim or greatly benefit 23,000 acres of wet land and will handle the run-off from a watershed of 175,000 acres is now under way in Hamilton and Saline counties. This project is known as the North Fork Special Drainage District and was originated in the County Court of Hamilton county, February 19, 1910. The work on account of the size of the district, the mileage of ditches to be constructed, the extensive watershed, and the great depth and width of some parts of the main channel, is one of the most extensive ever undertaken in Illinois.



Map of Ditch System, North Fork Special Drainage District, Illinois [illegible] the organization of this scheme into a drainage [illegible] crop losses occasioned by an extraordinary rain in July, 1909, when about 4 ins. of rain fell in about 36 hours, inundating much of the improved land to a depth of from 1½ to 4½ ft. in depth—the old shallow tortuous channel being, of course, unable to carry such a downpour in time to save the crops. Had the ditches been cut, as now planned, as shown on the map herewith, probably 80 per cent of these losses would not have occurred and it is safe to say that such losses, from this one rain would have constructed the whole system of drains as now planned.

The main ditch of this system begins near the northwest quarter of Sec. 3 T. 7, S, R 7 E, and empties into the bed of the North Fork of Saline river, at the east line of Sec. 25 T 7 R 7, Saline county, Ill., and is, as will be seen from the map, a straightening and deepening of the North Fork of the Saline river, the cuts ranging from 7 to 21 feet. The bottom width of the lower 1½ miles is to be 80 ft., with the usual side slopes of 1 on 1, making the top width at and immediately eastward of the C. C. C. & St. L. R. R., 122 ft. The next section northward for a distance of about 2 miles is on a base of 70 ft. and the remainder on a base of 60 ft., making the top width at the upper end of the main 80 ft.

This ditch is on a comparatively small grade, being 0.03 ft. to each 100 ft. A concrete and steel bridge will be built by the C. C. C. & St. L. R. R. at the point crossed. with 150 ft. opening. This bridge is estimated to cost about $25,000. The railroad company already has a magnificent concrete and steel bridge with an opening of 177 ft. where the old channel now crosses. This bridge will still be maintained, and immediately below it a pool will probably be constructed by the railroad which will afford an abundant supply of water for railroad purposes.

The Ten Mile and Pond Creek drains enter the main ditch at its upper end. The Ten Mile drain is on a base of 26 ft. from its lower end northward about 3 miles, then has bases of 20, 18, 16 and 14 ft. This ditch averages about 9¾ ft. in depth and has a grade of 2½ to 3½ ft. per mile. The lower 3¼ miles of the Pond Creek drain is on a base of 22 ft., then reduces to 20 and 16 ft. bases; cuts average about 9½ ft., grade 2½ to 3½ ft. per mile.

The short laterals have bases of 6 ft., an average depth of 6 ft. and a top width of 18 ft.

The total length of all the ditches, 37½ miles. The estimated number of cubic yards to be excavated is 2,270,725. The estimated price per cubic yard by the engineer was 7 cts.

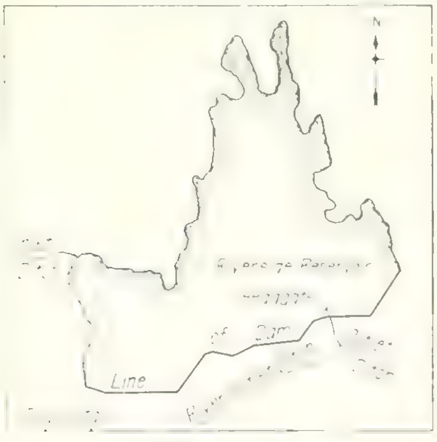


Fig. 1—Map of Riverside Reservoir and Dam, Colorado.

The successful bidder for the work on March 16, 1911, was Coleman & Sons, Paragould, Ark., who took the entire work at 6¾ cts. per cu. yd. There were 21 bids ranging as high as 9½ cts. per cu. yd. The total cost of this work, including payments for right of way and all incidental expense will be about [illegible]

Method of Repairing and Refacing Concrete Slope Paving on an Irrigation Reservoir Dam, Riverside, Colo.

BY ROBERT E. PRINCE*

The Riverside Reservoir, the subject of this article, is located in Weld County, Colorado, about 1½ miles north of Masters, which is a station on the line of the Union Pacific R. R. The contract for the construction of this reservoir was executed on May 31, 1907, between The Riverside Reservoir & Land Co., Contractor, and The Riverside Irrigation District. The actual work of construction was sub-let to DeRemer & Olsen, of Denver, which firm completed the work in November, 1908.

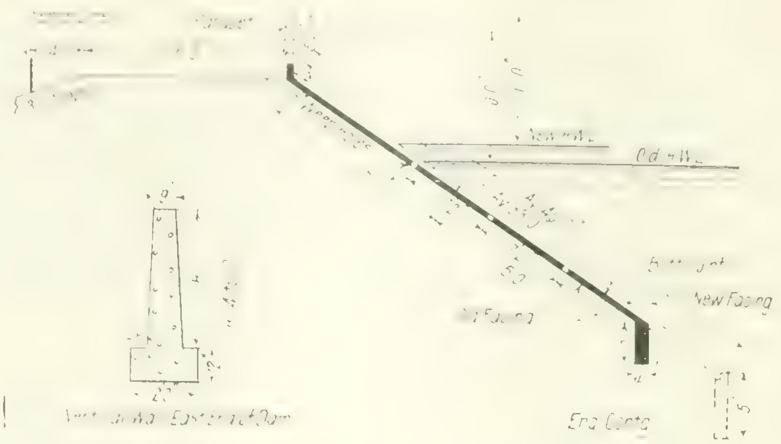


Fig. 2—Sketch Showing Original and New Concrete Facing, Riverside Dam.

As will be noted by inspection of the accompanying map, Fig. 1, the dam impounding the water of this reservoir extends along the southern portion of the storage basin for a distance of 4½ miles. At the eastern end of the main dam and separated from it by about 450 ft., is an auxiliary dam, about 1,000 ft. long and having a height approximating 5 ft. The acreage covered by the impounded water ranges from 40 acres, at low water, to 3,811 acres at high water. The elevation of high water is 32 ft. above the bottom of the outlet. The reservoir has a storage capacity, when full, of 57,525 acre feet.

Water is conducted to the reservoir from the South Platte River, through a ditch 12 miles long and is discharged from the reservoir through a ditch 104 miles long and applied upon lands lying to the east of the reservoir, in Weld and Morgan counties.

Original Construction of Dam.—The material of which the dam is composed is a light sandy soil, easily moved under wind action. The result is that the contour of the top and lower slope of the embankment is continually changing, dependent upon the force and direction of the wind currents.

The height of the dam, above the natural surface, varies from 5 to 30 ft. The bottom of the outlet is about 10 ft. below the natural surface. The embankment has a top width ranging from 14 to 16 ft., with an average of about 15 ft. The outer or lower slope varies from 2 horizontal to 1 vertical to 4 horizontal to 1 vertical, with a general average of about 3 horizontal to 1 vertical. The inner slope is 1½ horizontal to 1 vertical and was originally paved with a reinforced concrete facing, varying in thickness from 3 to 4 ins.

The concrete facing, shown solid black in Fig. 2, was laid in strips up and down the inner slope of the bank, each strip having an average width of 10 ft. Butt joints separated the strips of facing. There were no horizontal joints, that is, in line of the dam, each strip extended for the full length of the slope, from the parapet wall to toe-wall. The steel reinforcement (so called) used in the concrete facing was made from wire of about No. 10 gage, woven into a netting of about 3½-in. mesh. It was intended to be placed well into the concrete of the facing; as a matter of fact, most of it was not firmly imbedded in the concrete and very much of it was entirely below and outside of the concrete section. A parapet or coping wall extends along the top of the concrete facing, having a thickness of 6 ins. and a height of 14 ins., above the top edge of the facing.

Three outlet conduits, built side by side, conduct water through the embankment to the outlet ditch. Each of these conduits has an inside width of 3 ft., side walls 4 ft. high, with semi-circular arch of 18 ins. radius. Each conduit is supplied with a sluice gate. placed in a concrete chamber, which is located near the top of the lower slope. This chamber is 12½ ft. long inside, in line of the dam, 4 ft. wide and 44 ft. deep.

A concrete toe-wall, averaging 6 ins. in thickness, was constructed along an irregular line, determined by the intersection of the inner slope with the natural surface. The depth of this toe-wall varied from a few inches to a maximum of 3½ ft.

[illegible] Failure of the Dam.—Water was first stored in the reservoir during the winter and spring of 1908 and 1909, with the result that the concrete facing failed in a number of places under the high wave action and sediously menaced the stability of the dam. These failures in the concrete facing were repaired during the summer of 1909. During the winter and spring of 1909 and 1910, the concrete facing was again broken in numbers of places and it was only by the most heroic efforts that the complete destruction of the embankment, at critical points, was averted.

Fig. 3—Break in Concrete Facing of Riverside Dam.

For over 10 years the writer was in charge of the water company at Atlantic City, N. J., and in that capacity had much experience in fighting old ocean, but never did he see higher surf than that which he encountered on his first visit to this reservoir, April 14, 1910. The force of the wind was terrific and it was well nigh impossible to stand on the dam. Water was being thrown clear over the embankment and to a distance of 100 ft. below. More than 100 head of cattle had been blown into the reservoir along the north shore, and their carcasses were washed against the dam.

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*Consulting Engineer, [illegible] Champa St., Denver, Colo.

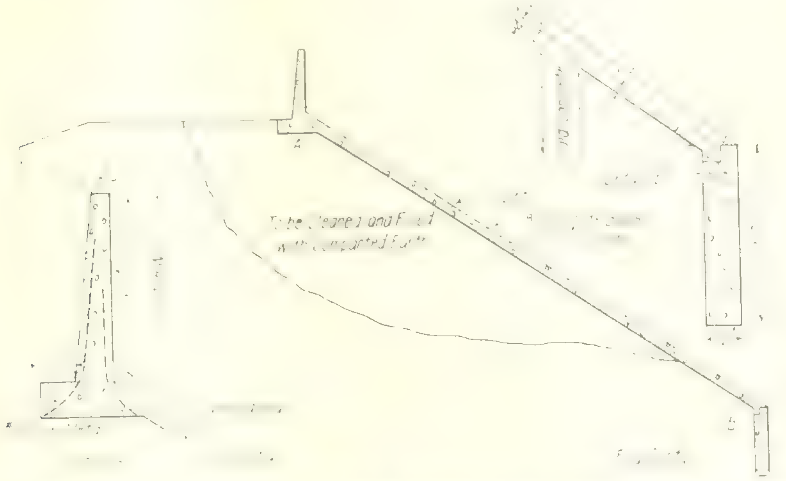

Fig. [illegible]—Sketches Showing Special Facing at Breaks and Toe and Parapet Details, Riverside Dam.

As a result of these alarming conditions, it was determined by the officers of The Riverside Reservoir & Land Co. and The Riverside Irrigation District, to have a careful examination made by a commission of engineers, of the cause of these failures and to suggest remedies and improvements that should be instituted to guard against further damage. Mr. J. W. Johnson, Deputy State Engineer of Colorado, Mr. John E. Field, and the writer were appointed to make these examinations and report conclusions. These engineers made careful examination of the existing and governing conditions and reported their conclusions under date of July 27, 1910. Because of the decision of interested parties, in the reservoir, to increase its storage capacity, a second and supplementary report was made by engineers under date of Aug. 11, 1910.

In these reports the examining engineers recommended methods to be adopted in reconstructing the facing of the dam, together with other safeguards to be employed, and submitted the following estimated costs for making the repairs and improvements as recommended:

Trenching at foot of [illegible]	[illegible]
[illegible]	
Concrete facing, 9,200 [illegible]	69,[illegible]
Standard [illegible]	[illegible]
Standard [illegible]	[illegible]
Concrete [illegible]	[illegible]
Footing, [illegible]	[illegible]
New [illegible]	[illegible]
Total [illegible]	75,700
Steel reinforcement	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
	[illegible]
[illegible] and [illegible]	[illegible]
Total	[illegible]

[illegible] The provisions outlined in the supplementary report, with slight exceptions, were embodied in a contract executed between The Riverside Reservoir & Land Co. and The Riverside Construction & Securities Co., Contractor, whereby the latter named company agreed, for a stipulated lump sum, to complete the work outlined in the report of the examining engineers. The lump sum named in the contract was in excess of the total given in the above estimate, because a portion of the payments were to be in bonds of The Riverside Irrigation District, which district controls one-half of the stock of The Riverside Reservoir & Land Co. The cash value to be paid, however, was substantially the amount of the estimate submitted by the engineers, having regard to the expense involved in handling said bonds.

The actual work of construction was sublet to DeRemer & Olsen, of Denver, and that firm has completed the toe-wall and facing during the past summer and autumn, under the direction of the writer; Mr. J. M. Dille, superintendent of The Riverside Irrigation District, acting as superintendent in personal charge of the work.

Fifg. 6—View Showing Forms for Blocks of Slope Paving.

The examination of the engineers had indicated that the primary cause of failure of the concrete facing was due to the suction effect of the wave action along the butt-joints, which separated the strips of concrete. [illegible] the joints and also in enlarging the joints. The enlarging of the joints was followed by a breaking down of the surrounding concrete and this in turn extended to greater or less degree up and down the slope, in some instances the whole length of the slope was involved, as shown by Fig. 3.

The eastern end of the main dam was assumed as Station O. From that point westward 100-ft. stations were measured and plainly numbered upon the parapet wall, in red-lead paint, for the entire extent of the reconstructed work.

It was decided to cover the original facing between Stations 10 and 182, with a second course of plain concrete 5 ins. thick, composed of Portland cement, sand and gravel, mixed in the proportions of 1 sack of cement, weighing approximately 95 lbs., 2 7/10 cu. ft. of clean, sharp sand, graded from fine to coarse, particles not to exceed ⅜-in. in any dimension, and 4 5/10 cu. ft. of screened gravel, the gravel to be obtained from the bed of the South Platte River, near Masters, and to be clean and free from all organic matter and particles to range in size from ⅜-in to 1½-ins. in diameter. Both gravel and sand were screened at the river, mixed in the proportions above specified and hauled to the work,

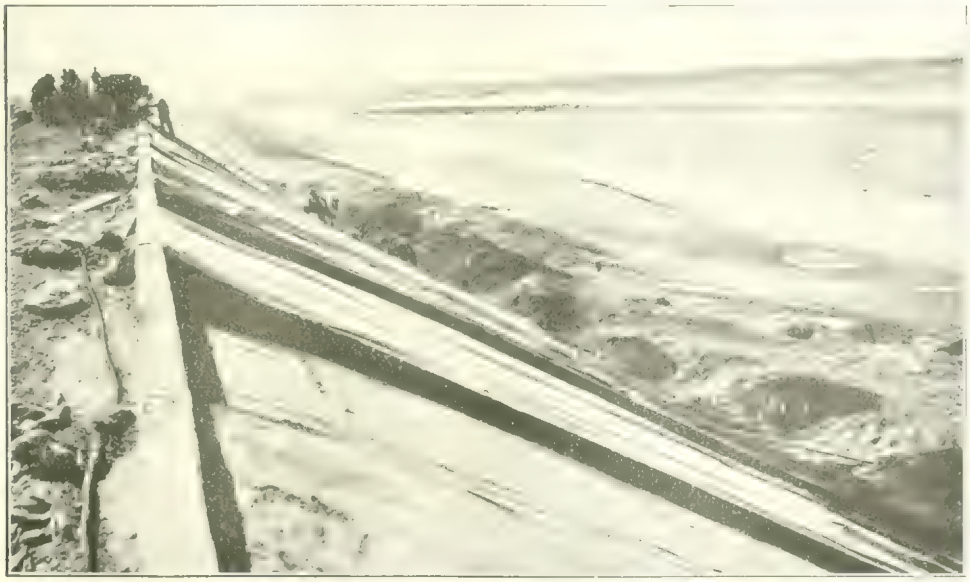

Fig. 5—View Showing Method of Protecting Concrete from Sun by Canvas.

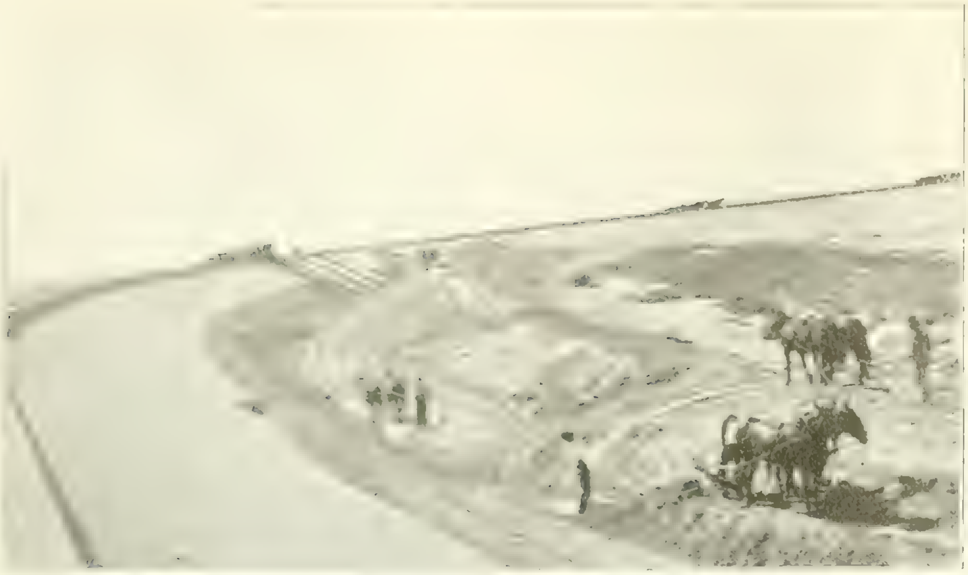

Fig. 7—View Showing Extension of Original Paving at Knalls.

an average distance of about 2 miles. Three-horse teams were employed in handling the aggregate, the loads varying from 1 to 1½ cu. yds.

Because of the scarcity of suitable river gravel, within reasonable distance of the work and the desire to expedite the work, so as to complete the facing and toe-wall before winter, possibly one-third of the concrete used was made from a good quality of bank gravel, obtained near the work. The proportion of mixture, when bank gravel was used, varied from 4½ to 5½ parts of gravel to 1 of cement.

Ideal Portland cement was used exclusively. It was tested by the George Pierce Testing Laboratories. The quality and character of the cement was required to conform to the standard specification for Portland cement, adopted by the American Society for Testing Materials, of date Aug. 15, 1908.

All concrete was machine mixed and was placed in as wet condition as the steepness of the slope would allow, that in the toe-wall was of a very wet consistency.

The additional course of facing was laid in block form, 10 ft. in length, measured in line of the dam, and 15 ft. in length measured on the slope. The blocks of the facing were laid with butt-joints; the slope-joints being placed approximately midway between the slope-joints of the original facing. Contiguous blocks were separated by two thicknesses of tar felt.

Before laying the second course of facing, three lines of "weep-holes," 3 ins. in diameter, were cut through the original facing, as shown on Fig. 1. These weep-holes were filled with large gravel and during the process of laying the second course of facing were kept open and free from being clogged with concrete by being covered with tar felt. The reason for providing these weep-holes was to guard against the possibility of hydrostatic pressure being produced between the two courses of the facing, due to the possible passage of water through the upper course, which might tend to lift and break that course. If water does find a lodgment between the courses of the facing, it is believed that these weep-holes will provide a means for its passage and escape into the sand below the original facing and thereby guard against possible rupture of the upper course.

At those places where the original concrete facing had been destroyed under wave action, the sand of the embankment that had been washed out was replaced by new gravel filling, which was well tamped in place to the correct slope. Upon this new, compact filling, a concrete facing, Fig. 4, was laid, having a thickness of 8 ins. This facing was also laid in block form, of dimensions shown, provided with lap-joints containing two thicknesses of tar felt. The surface of the old facing was thoroughly washed and cleansed from all dirt and organic matter before the placing of the new facing. The concrete in the new work was well tamped and the upper surface worked to a smooth, even finish. The specifications required that all projecting tar felt at joints should be neatly trimmed to the surface of the facing and then be carefully calked into the joints, with suitable tools, after which the space made by the calking should be filled with neat cement grout. As the blocks of the facing were completed they were covered with canvas, Fig. 5, which was kept wet for at least 36 hours, after which the facing received a thick coating of sand.

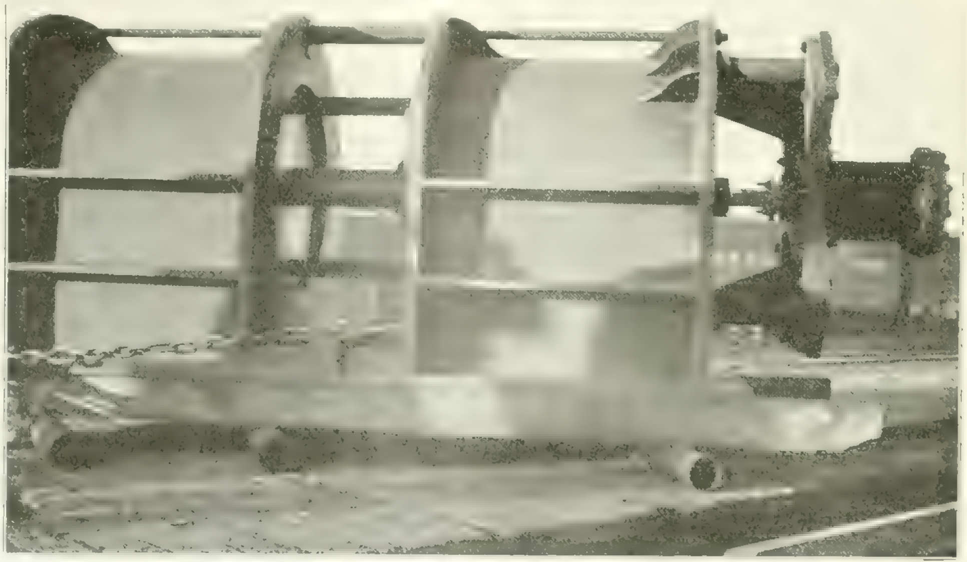

Fig. 9—View of Balanced Valve for Outlet Culvert.

Water for construction purposes was secured from pools located at several points along the line of the work, on the floor of the reservoir or from pipe wells, which were sunk for the purpose to depths varying from 20 to 50 ft. and of 4 or 6 ins. in diameter. Gasoline pumping plants were installed at these places.

A concrete toe-wall, Fig. 4, has been constructed along the toe of the inner slope, between Stations 9 and 182, having a thickness of 1 ft. and sunk to a depth of 5 ft. below the lower edge of the concrete facing.

It was deemed advisable to cut down all knolls and this was done, so that the profile along the line of this toe-wall is practically a level line. In excavating these knolls, much of the original concrete facing had to be extended, Fig. 7, to conform with the lengthened slope. This extended facing was at least 8 ins. thick.

A horizontal joint occurred within a few feet of the toe-wall and that portion of the facing between that joint and toe-wall was laid at the same time as the toe-wall, thus effecting a good bond between the two. Examination of the original facing had dis-

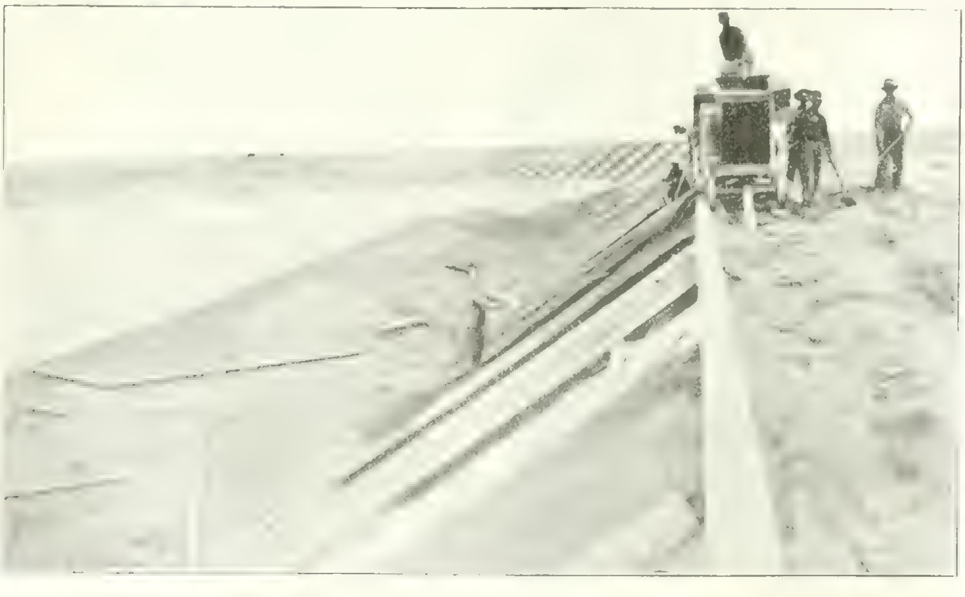

Fig. 8—View Showing Method of Mixing and Depositing Concrete, Using Coltrin Mixer.

closed the existence of horizontal cracks at the junction of the old toe-wall and facing. As a preventive against the possible occurrence of like cracks in the new work, ⅝-in. iron rods, 36 ins. long, having the ends bent at about 90° were embedded equally (18 ins.) in both facing and toe-wall. These rods were generally spaced about 3 ft. apart and were used in the eastern half of the dam, a distance of about 2 miles, as that portion of the work will have to sustain the heaviest wave action.

It is intended to construct a new parapet wall in accordance with the dimensions shown by Fig. 4. It has been deemed best to delay the construction of this wall until the weather is settled and free from frost.

The examining engineers advised that auxiliary valves be placed at the reservoir end of the outlet conduits, as a precautionary measure. The type of valve employed is shown by Fig. 9. It will be noted that the valves are "balanced." Two valves have been installed, with provision for a third, should it be required. Each valve has two cylinders, 40 ins. long over all and a hydraulic cylinder, 20 ins. over all, which is bronze lined and fitted with a water-packed piston, 8 ins. in diameter and 4 ins. thick. Three-quarter inch pressure pipes were connected with the hydraulic cylinders and laid under the concrete facing, at a depth of about 5 ft., to a concrete camber constructed at the top of the embankment, in which are placed 4-way bronze valves and a force pump. Either oil or water may be used to operate the gates, which have a maximum throw of about 12 ins.

These valves have been securely founded upon a concrete chamber, connecting with the outlet conduits. Especial care was exercised in placing and anchoring the valves in such manner as to prevent the passage of water when the valves are closed.

The valves are protected by an iron grating, consisting of bars 3 ins. deep and ½ in. thick, spaced 1½ in. apart. The grating is securely anchored to the concrete walls surrounding the gates.

Increase of Storage Capacity.—As before stated, the reservoir has a storage capacity of 57,525 acre-feet, when filled to high water mark or to elevation 96. The elevation of the top of the parapet wall or coping is 104.17, thus providing for a "free-board" of 8.17 ft. Under the new plan as adopted, the elevation of the new coping will be 108.17. It has, however, been decided to provide for a free-board of 10 ft., thus making the elevation of the new high-water mark 98.17 or 2.17 ft. higher than the original high-water mark. It is believed that the raising of the high-water mark will allow of an increased storage of at least 8,000 acre-feet, which will make a total storage capacity of 65,525 acre-feet, when the new coping is in service.

Fence.—One other suggestion recommended by the engineers above referred to, was the construction of a fence to be built along the top of the lower slope of the embankment.

The object of this fence is to create eddies in the wind currents, which at times sweep across the reservoir and embankment with great force. It is believed that a fence of wire mesh would not only effectually prevent possible erosion of the embankment under wind action, but would tend to deposit sand, in considerable quantities, upon the top and lower slope of the bank.

A portion of this fence, consisting of wooden posts 8 ft. long, set into the bank 36 ins., spaced 16 ft. apart and supporting a strip of "chicken-wire" 36 ins. wide, has been constructed along the embankment for a distance of 2½ miles and this will be extended to such length as will protect the bank at all places where wind currents may cause erosion.

Cost Data.—As above stated, the contract price for which The Riverside Construction & Securities Co. agreed to complete the specified work was a lump sum, based upon the examining engineer's estimate, modified because of the work being paid for in part by District bonds and for other reasons not of general interest. No cost data was kept, but the writer believes, from his personal observation that the *actual cost* (not the amount paid) of the concrete facing and toe-wall closely approximated $5.25 per cu. yd., including materials and labor.

The estimate of the engineers did not include the cost of the emergency valves at the outlet. The cost of these valves in place approximated $3,500, including all concrete foundation and side walls, steel reinforcement and over-head grating bars, which will protect the valves from possible injury because of floating debris.

STEAM AND ELECTRIC RAILWAY SECTION

Recent Developments in Bridge Construction.

Never before in the history of bridge engineering has the influence of public opinion been so noticeable as at the present time and the interest shown by the public in this important branch of construction is very gratifying, especially to those engineers who have labored unceasingly to have bridges regarded from the artistic as well as from the utilitarian standpoint. Public opinion is now demanding not only that bridges shall be made better but that they shall be more suited to and expressive of their purposes and environments. Although great advances have been made in the status of bridge engineering there is still room for improvement, for it is often impossible to make communities realize that a bridge is something more than merely a means of crossing an opening. They are not willing to make the additional appropriations necessary to secure artistic bridges, even though the structures may occupy such conspicuous positions as to require more impressive and finer treatment than some public buildings upon which vast sums are expended to secure pleasing architectural effect. How common it is to see post office buildings, for example, beautifully designed and well constructed, but placed in such surroundings as to lose the intended effect, while nearby may be a bridge in a location of magnificent possibilities, but upon which no attempt has been made to display grace or beauty. Let the public fully realize that when a bridge is built without making it architecturally beautiful a splendid opportunity for civic improvement is lost. In the past the one great difficulty in securing pleasing structures has been that appropriations for bridges have generally been so small as to exclude all but the more utilitarian requirements, but fortunately more recent awakenings of civic pride are resulting in great improvements.

A beautiful arch bridge is a wonderful structure. There is something inspiring about it. And engineers must do all in their power to have the public realize this and to appreciate the beauties that can be created by proper and simple combinations of common materials of construction. Symmetry, grace, simplicity and truthfulness are essential elements in a bridge possessing architectural merit. Truth is a basic element, and when one material is disguised to represent another, or when a part is made to appear as if performing a certain function when in reality it is performing quite a different one, the result is a dismal failure.

The most remarkable development in bridge construction during the past quarter of a century has been the progress made in the use of concrete, either alone or reinforced with steel. When it is considered that only 22 years ago the first reinforced concrete arch bridge was built in Golden Gate Park at San Francisco, and that from this small span of only 35 ft. to the recently constructed arch span of 320 ft. in New Zealand (Eng.-Contg., Aug. 24, 1910) is a tremendous step, it is evident that progress has been truly wonderful. Concrete, like stone, is best suited to resist compressive stresses, and it can be readily molded into any desired form or size, and it is therefore not surprising that when concrete came into use as a bridge material it should have been used in the arch form. It was a comparatively easy change from the stone arch that had been the standard arch form for many centuries to the concrete monolithic or voussoir arch of similar outline. But it was soon realized that concrete in combination with steel has a distinct individuality of its own and hence important changes were made in the form of construction, resulting in the use of lighter structures of more pleasing design and appearance. The constant tendency has been towards the elimination [illegible] arch ribs, with the variation in size and shape thereof to conform to different classes of loads, or the use of solid arch rings upon which rest columns or cross walls to support the roadway above, approaches the design so commonly adopted for arches with steel ribs and in this respect represents a decided departure from and improvement upon the solid arch ring with its superimposed earth fill, which was until recently the standard form of masonry arch construction.

The most recent type in reinforced concrete highway bridge construction consists of a flat deck on which the roadway is placed, the deck in turn being supported by columns or cross walls resting on a solid arch ring or upon ribs. These ribs are usually rectangular in cross section, although those of circular form would give a more pleasing appearance, but would be more costly and more difficult to build. Unless the ribs are very wide they should be braced to prevent lateral displacement under stress. Much can be said in favor of this open spandrel construction except for very short spans or for spans of small rise where the old method of placing the roadway on earth filling retained between longitudinal side walls is better. In the absence of such limitations, however, the open spandrel construction results in a great saving of weight of superstructure, with consequent diminution in size of foundations and often also in a more pleasing design. For railroad bridges the column and rib type has not been adopted, but open spandrels with cross walls on solid arch rings are of frequent occurrence.

Arch analysis—that is, the determination of forces and stresses acting upon and within the arch—is an interesting and beautiful application of mathematics and mechanics, and it is doubtful if in the whole category of engineering design a more enticing field for study can be found. The insertion of three hinges in the arch makes the solution more nearly determinate, and in case of slight settlement of foundations the stresses within the arch ring remain unchanged. In addition to this advantage, hinges relieve the ring from temperature stresses, since as temperature of the arch changes the crown rises or falls with almost perfect freedom. For arches of small rise the advantages of hinges are so notable that their use will undoubtedly become more common, especially if some form be devised which can be economically constructed. For analysis of hingeless arches the elastic form theory should [illegible] which are usually large and which can be computed only by this method.

Little progress can be reported in short span steel bridges, in fact concrete beams or arches are so admirably adapted to short span construction that steel is hardly its own in

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A paper by Frank P. McKibben, Professor of Civil Engineering, Lehigh University, South Bethlehem, Pa., presented before the Congress of Technology at the Fiftieth Anniversary of the Granting of the Charter to the Massachusetts Institute of Technology.

this year. But for long spans steel only [illegible]. Great progress is now being made in the manufacture of alloy steels, and the time is not far distant when record breaking spans of steel will be built.

As a result of the increased strength of nickel steel, the new municipal bridge spanning the Mississippi River at St. Louis has a span of 668 ft. (Engineering-Contracting, March 8, 1911), which far surpasses any simple truss length previously attempted. The manufacture of vanadium steel, nickel steel and other alloy steels for structural purposes is only in its infancy and seems to be a most promising field of investigation and progress for the immediate future.

No notable advances have been made recently in the type employed for long steel spans, but many wonderful structures similar to those tried and not found wanting are now being erected. The cantilever and the suspension forms are the two kinds commonly used, although there is also an increasing tendency to employ steel arches of considerable length. The Quebec bridge failure has had the effect of temporarily throwing the cantilever type of truss into some disrepute, but engineers must not let the pendulum swing too far, because the cantilever has certain well defined advantages which should not be completely ignored simply on account of one failure of its truss members. Lamentable as was this failure, it has been the cause of inaugurating a searching investigation into methods of design that are founded upon empirical knowledge, and much good is being derived therefrom. Resulting from the influence which the Quebec bridge failure had upon the engineering world there is a tremendous desire on the part of experimenters to discover new laws underlying the action of structural materials and to verify experimentally methods of design which until recently were accepted as being sufficient for all cases that might arise in practice.

One hesitates to predict what developments science may bring forth in bridge engineering, but it is probable that for the next decade progress will be made along three lines, the perfection and increased use of alloy steels, the production of structural shapes which are free from objectionable details of fabrication, and finally the combination of steel and concrete into a composite structure in which the steel will afford great strength and the concrete will be a protection against corrosion and against other destructive elements.

Plan for Elimination of West Side Surface Tracks in New York City.

The operation of the New York Central's tracks in the streets of the west side in New York city has been the subject of numerous investigations. These tracks enter Manhattan Island at the Harlem River and extend southward along or near the shore of the Hudson River to a distributing station at St. John's Park, in the vicinity of Beach St. Two important terminal yards, the 60th St. yard and the 30th St. yard, as well as numerous industries, are served by these tracks. Only a small percentage of the business originating and terminating in Manhattan Island is handled in this way, the greater part of it being transferred by lighters and car floats from railroad terminals located along the west shore of the Hudson. In spite of this fact, however, the operation of railroad tracks in the congested districts of the west side has long been recognized as a nuisance, and in late years a number of plans have been proposed for getting rid of these tracks.

Each of these plans has been fully described in the technical journals, as proposed, and detailed description at the present time is unnecessary. The following is a brief summary of these plans:

A plan proposed in early days was for a suspension bridge across the Hudson, with an elevated railroad extending south through the shipping district and connecting with all piers. Connection was to be made with all railroad terminals in Jersey City, and both freight and passenger traffic was to be handled. Following this a number of schemes for elevated railroads were proposed, some with and some without the feature of a bridge across the Hudson.

In 1908 Mr. W. J. Wilgus, formerly chief engineer of the New York Central & Hudson River R. R., proposed a belt subway, with lateral distributing subways, extending from the 60th St. yard south to the battery and thence north along the shore of East River to the Harlem River. This was designed to be a complete freight distributing system for Manhattan Island. The subways were to be 8½x8½ ft. and located directly beneath the surface of the street. This plan included a tunnel under the Hudson to connect with a transfer yard on the Hackensack meadows. In this transfer yard and in the 60th St. yard the transfer between standard gage steam road cars and the small subway cars was to be made.

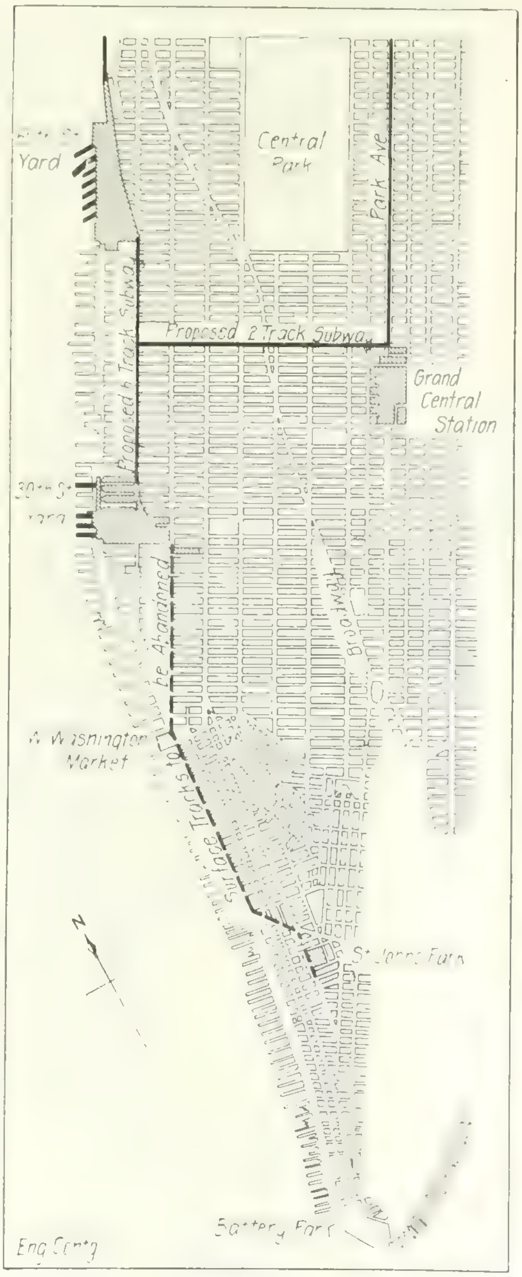

Fig. 1—Principal Freight Distributing Centers and Proposed Subways, Hudson River Water Front, New York City.

The Saxe law, which was enacted in 1906, required the New York Central to construct a subway and to remove its tracks from the streets. Following the annulling of this law by the courts, the New York Central volunteered to construct a subway in 11th Ave. from 59th St. to 30th St., provided the city would grant a perpetual franchise for four additional tracks along the Hudson River from 60th St. to the Harlem River. This offer was rejected by the city.

After an exhaustive study of the terminal problem Mr. Calvin Tomkins, commissioner of docks and ferries, proposed in 1910 a combined elevated and car ferry system that was designed to give the roads entering Jersey City the same advantages as are possessed by the New York Central. A series of car float terminals for transfer to and from Jersey City were to be located near 30th St. An extensive group of terminal warehouses was also to be located at this point. From the piers tracks were to connect with a classification and storage yard near 30th St., and with an elevated railroad extending south and connecting with industries and steamship piers. This plan contemplated the removal of all surface tracks south of 30th St.

Last June the Board of Estimate and Apportionment appointed a committee consisting of three of its members to study the west side terminal problem and to devise a means for ending the operation of steam railroad tracks on the city streets. The study was delegated by the committee to three engineers—Messrs. H. P. Nichols, E. P. Goodrich and E. C. Moore. This engineering committee has recently submitted its report, which contains a definite recommendation for the solution of the terminal problem. This report is prepared by Messrs. Nichols and Goodrich. It contains an entirely new feature, called the "unit terminal." Mr. Moore did not concur in the report, but favored the Tomkins plan, outlined above. The plan submitted by Messrs. Nichols and Goodrich has been adopted by the committee of the Board of Estimate and Apportionment. It is comprehensive in scope, covering the entire west side terminal problem.

SCOPE OF THE PLAN

Under this plan it is proposed, first, to abolish all grade crossings in the district between 60th St. and the Harlem River. This is to be accomplished by carrying the streets over the tracks, except in the vicinity of 130th St., where the railway is to be elevated. It is also suggested that the drawbridge over the Spuyten Duyvil ship canal is a sufficient obstruction to navigation to warrant its replacement by a tunnel.

The 60th St. and 30th St. yards are to be retained. To connect these yards it is proposed to construct a six-track subway in 11th Ave. A section of this subway is shown by Fig. 2. The two outside tracks will be used as loading tracks, and the adjacent tracks as running tracks. Since the Park Ave. approach to the Grand Central station has about reached the limit of its capacity, it will soon be necessary to provide additional facilities for reaching this station. With this in view it is planned ultimately to use the two middle tracks in the subway for passenger service in connection with a two-track subway to be located in 50th St. and extending from 11th Ave. to the Grand Central station.

The surface tracks south of the 30th St. yard are to be removed and all traffic to this part of the city handled by means of lighters and car floats operating in connection with the "unit terminals," proposed by the committee. It is estimated by the committee that eight or ten of these terminals located at intervals along the 4-mile stretch south of 30th St., with the proposed extensive terminals at 60th St. and 30th St., will provide all the facilities that are needed.

THE "UNIT TERMINAL" PLAN

The type of terminal proposed by the committee is the unique part of this scheme. The following abstract from the report of the committee will illustrate its essential features:

The plan for freight handling on the water front devised by the committee, consists of a number of what may be termed "combination freight terminals" or "unit terminals." Such a terminal will consist of a new type of double decked pier containing two float bridges, and a terminal building on the easterly side of the water front street, the pier and building to be connected at the second story level by a bridge or trestle across the water front street.

Upon the pier will be hauling tracks, a "switch back," and a ramp to elevate the cars to the second story, in order that they may not cross the intervening street at grade; also sidings for direct truck delivery at street and second story levels and storage tracks for cars on the second floor.

The terminal building will provide on the first story for truck delivery, on the second for car delivery, and upon the upper stories for storage—all connected by elevators, and the first and second stories by gravity chutes. A plan and elevation of the terminal is shown by Fig. 3.

Such terminals, it is believed, will form a practicable substitute plan of operation for the New York Central, as well as provide additional facilities with less use of water frontage for all other companies, either in separate stations or in joint terminals operated by two or more companies. In the latter case the water front occupancy by railroads would be reduced still further.

The delivery of freight to trucks can be more expeditiously and economically handled from a station located away from the water front, which can be approached from four sides and provided with interior gangways, and at which delivery can be made either from cars direct or from cars on the upper floors to trucks on the ground floor, principally by gravity, it being a fact that the major portion of the freight on Manhattan Island is inbound. Such methods of truck delivery are to be found at the Eastern District and Jay St. terminals in Brooklyn, and have been carefully worked out by the engineers of the New York Central for the terminals which they have considered in connection with a possible elevated railroad. At such stations a much larger tonnage can be handled per day than is possible with any of the piers now occupied by the railroads along the west side of Manhattan Island.

In order to transfer freight cars from the water to such a terminal, float bridges and ferry racks, with the necessary hauling tracks, are essential. It is evident from an examination of the better managed float bridges in New York harbor that the capacity of one such bridge has many times the daily capacity of any but a pier of extraordinary size when the latter is operated according to present day methods. The records of such bridge capacity in one case amount to as much as 1,000 cars transferred over it in twenty-four hours, or practically one float unloaded and loaded over the bridge each hour. The two old style bridges of the New York Central at the 30th St. yard which were erected about 1888, now handle approximately that number of cars, working only a few hours each day, while a single bridge belonging to one of the private terminal companies in the harbor handled nearly a million cars with ease during 1910.

Assuming a capacity of only half this figure, or 500 cars, and assuming further that each car has an average load of 8 tons, there would be given a bridge capacity of 4,000 tons per day, or about a million and a half tons per annum. This is easily accomplished, and many bridges in the harbor are operated on this basis 365 days each year.

The plan of the committee contemplates the longitudinal use of the pier for a ramp as opposed to the location of such incline along the marginal way. The obstruction to traffic to and from and along the water front is entirely eliminated by the committee's design. The grade of the ramp has been so fixed as to provide proper clearance for vehicular traffic along the marginal way and at the same time secure enough lead at the foot of the ramp to hold a locomotive and all the cars which can be contained on a single track of the longest float now used in the harbor. It so happens that this length is practically the average length of trains now operated by the New York Central on West St. and is furthermore rather greater than a large number of the trains which daily leave the Manhattan terminals of the railroads on schedule to catch the fast freights. Some criticism has been made of the gradient of the ramp (5 per cent) shown on the design submitted, which obviously will depend entirely upon local conditions for a determination of the actual figure. The only objections to a steep grade are the alleged danger of accident should the train get beyond control, and the necessity of using very heavy locomotives, large enough to secure sufficient tractive force to start cars on such an incline. Accidents can be practically eliminated by operating on the ramp with a locomotive supplied with the best safety devices like the latest improved magnetic-pneumatic brakes, the locomotive always placed on the lower end of the train. The operation of such roads as the Northern Pacific and Colorado Southern for years with grades even heavier than the one shown on the committee's designs indicates the entire practicability of the latter.

The alternative in place of the sharp curve proposed by the dock department design is the use of a "switch-back" upon the pier. The only difference between the design prepared by the committee, which makes use of such a switch-back, and that of the dock commissioner, employing a sharp curve, shows that by the former a train movement with two throws of a switch is required, while with the sharp curve a continuous movement may be obtained if but half the float is pulled and taken direct to its destination. The slight advantage, it is believed, is more than overcome by the disadvantages above mentioned.

With regard to the car platforms, the design can be worked out in accordance with the ideas of the railroad which will operate the terminal. For example, platforms may be placed adjacent to each pair of tracks, or several tracks may be interposed between two platforms, and cars "spotted" on these tracks for both loading and unloading purposes. This method is used at a large majority of freight terminals. At others, certain platforms are used for unloading purposes and other platforms for loading purposes, cars being switched from one set of platforms to the other during noon hour intermissions and other periods when the labor force can be efficiently employed on other work than loading and unloading. Obviously the plan of the committee is available for either type of development. Similarly the platforms for truck loading and unloading purposes can be arranged either as inbound and outbound platforms or certain platforms can be used as inbound platforms during the morning hours and the same platforms as outbound platforms during the afternoon hours. Certain railroads have developed stations in which the truck [illegible] car platforms on the floor above. Other roads, however, believe that the two sets of platforms should lie at right angles to each other. Obviously the typical design of the committee can be developed to meet the particular taste of any road.

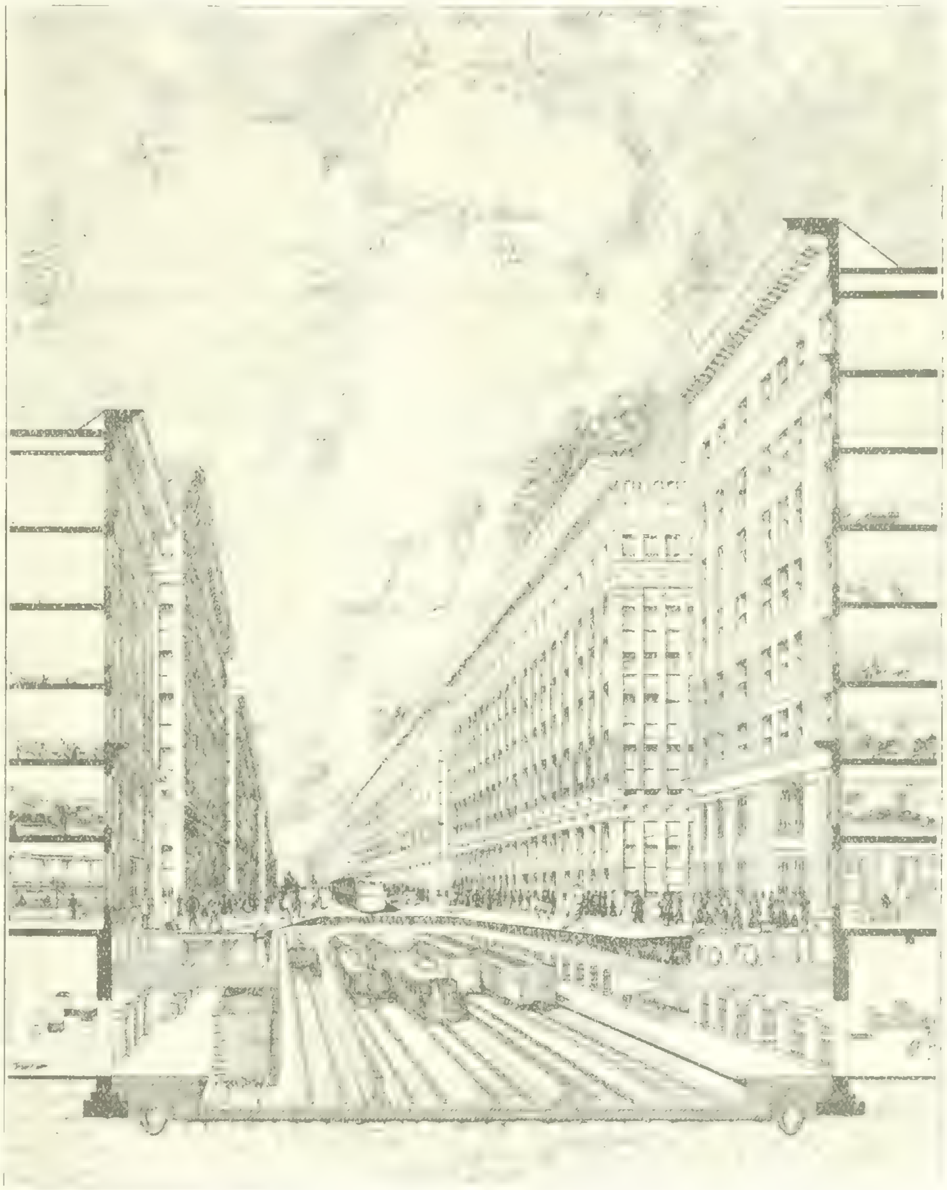

Fig. 2—Proposed Six-Track Subway in Eleventh Ave., New York City.

An important point which should be considered in connection with any terminal is the provision for facilities to allow of direct transfer of freight between cars and trucks. The suggested plan of the committee provides two locations at which this can be done. From two to four tracks may be available upon the pier, according to whether or no three or two [illegible] pier tracks, provision has been made for truck elevators capable of transferring loaded trucks [illegible] direct loading tracks have been provided.

The plan of the committee has been laid out so as to be capable of enlargement as the growth of business dictates. A single bridge could be employed at first, and while such limitation has its disadvantages, it is to be noted that the majority of the private terminals in the harbor have operated over single bridges for a large number of years with annual tonnages aggregating close to a million each.

In combination with this single bridge, one-half of the switching and standing tracks could be provided along either half of the scheme as devised.

Additional standing room and platform space could be secured, as necessary, by the acquisition of property extending further and further inshore. Such property extending toward the center of the island is more satisfactory from a traffic point of view than terminal stations parallel with the water front, because in the first instance the merchants' average haul is slightly shortened and the terminal can be approached along a greater number of thoroughfares. With increase of traffic, the additional bridge shown could be installed, and additional switching and standing tracks constructed.

With the location of the terminal at right angles to the water front, connection can be obtained between three sides of the terminal building and factories or warehouses by means of connecting bridges, so that shipment can be made practically direct from factory to car.

Such a combination terminal may be operated either by a single road or jointly by two or three, or it may be operated by a private terminal company in a manner identical with the existing private terminals in the harbor.

A further advantage is due to the fact that such terminals when once constructed can easily be connected by an elevated railroad if it should ever become evident that the commercial necessities of the port demand such extreme measures for the benefit of intercommunication.

One other feature is essential in dealing with water front traffic, and that is that a certain amount of wharf length should be provided for tying up car floats which are waiting to be loaded or unloaded. The plan as submitted gives ample wharfage room, more than now afforded by present day piers or by the design of the dock commissioner.

The furnishing of storage facilities in connection with the terminal station we believe will prove most popular when thoroughly understood. According to its annual reports, the storage business of the New York Central is so profitable that it seems fair to assume that the storage element of the terminal development will pay all carrying charges on the land and buildings required for inshore stations.

An examination was made of the water front with a view to the location of one or more unit terminals. Several locations were found which, in the opinion of the committee, can be easily adapted to such use as is here proposed, and which are most advantageously situated to carry the plan into practical effect for the benefit of existing traffic centers.

Plan for Immediate Elimination of Surface Tracks.—The commercial centers on the existing tracks of the New York Central comprise zones, in the vicinity of the 60th St. yard, in that of the 30th St. yard, of West Washington Market, and of St. John's Park. The present equipment of the railroad, including as it does float bridges at both the 30th and 60th St. yards, and a large fleet of tow boats and car floats, makes it entirely feasible to discontinue surface track operation between 30th and 60th Sts. Similar operation could be discontinued south of 30th St. within a very few months without interfering with the freight traffic involved in the commercial centers near West Washington Market and St. John's Park, by the construction of two additional float bridges and hauling tracks. These could be built inside of six months and the main line surface railway traffic discontinued immediately after they are put into operation. One bridge could be located on the water front adjoining the West Washington Market. In connection with this bridge, short lengths of the existing tracks could remain and be operated temporarily, so as to supply the storage and manufacturing enterprises now served by the New York Central in that vicinity. A similar bridge could be located on a convenient pier close to the westerly end of Canal St. This latter arrangement would thus serve the territory in the vicinity of St. John's Park.

Such operation would prove fully as expeditious as the surface operation now in use, because better running time is now maintained by the New York Central between the 60th St. yard and its pier terminals on Franklin, Desbrosses and Barclay Sts. than is made on the average to St. John's Park, and prboably at no greater expense. Only one shipper upon the entire line would be inconvenienced by the elimination of the surface tracks, as all others could be reached in the manner above described.

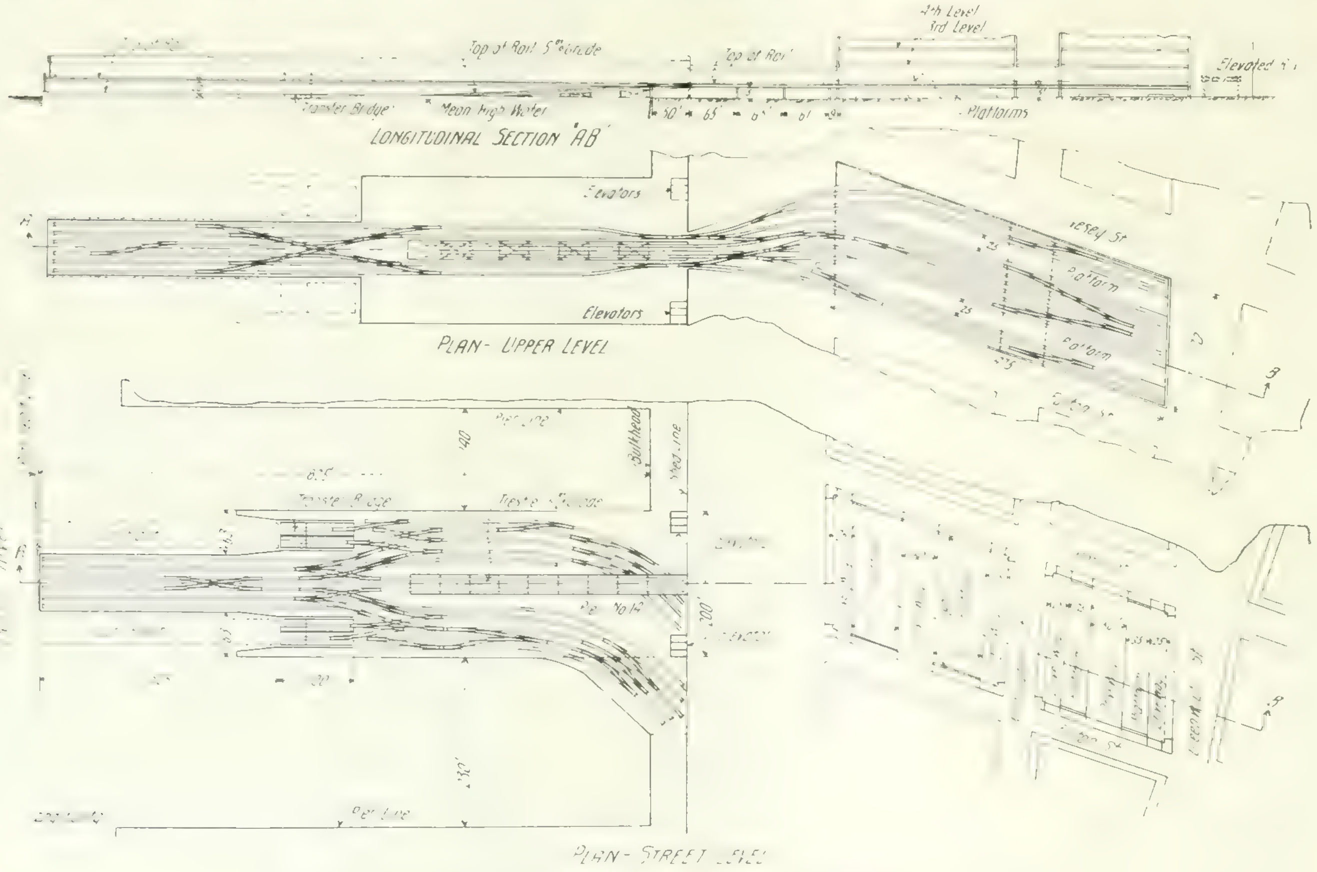

Fig. 3—Plan and Elevation of Proposed "Unit Terminal," New York City.

First Cost and Annual Operating Cost of Five Small Producer Gas Power Plants.*

The following are actual records of operation of small producer gas power plants:

Plant No. 1:
35 h.p. anthracite producer,
28 h.p. two cylinder engine,
18 kw. electric generator (belted),

Cost installed	$ 3,000
Interest and depreciation at 10 per cent..	300
Supplies and repairs	150
Labor per year	500
Total	$ 950
Fuel charge per kilowatt with coal at $4..	.30 ct.
Operating charges per kilowatt	.61 ct.
Total cost per kilowatt hour	.91 ct.

Plant No. 2 (24 hour a day service):
150 h.p. lignite producer,
150 h.p. gas engine,
100 kw. electric generator (direct current),

Cost installed	$ 960
Interest and depreciation	960
Supplies and repairs	480
Labor per year	1,700
	$ 3,140
Cost of fuel per kilowatt hour	.17 ct.
Cost of operation per kilowatt hour	.43 ct.
Total cost per kilowatt hour	.60 ct.

Plant No. 3 (24 hour a day service):
300 h.p. anthracite producer,
Two [illegible] h.p. gas engines,
Two 100 kw. alternating current generators operating in parallel,

Cost installed	$22,000

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*Extract from a paper by Godfrey M. S. Tait, before the National Association of Cotton Manufacturers, April 12-13, 1911.

Interest and depre[illegible]	$ 2,2[illegible]
Supplies and repairs	1,100
Labor per year	[illegible]
	$ [illegible]
Cost of fuel per k[illegible]	[illegible]
Cost of operation per kilowatt hour	.40 ct.
Total cost per kilowatt hour	.70 ct.

Plant No. 4:
400 h.p. bituminous producer (suction type, 24 hour day),
400 h.p. tandem double-acting engine,
200 ton ammonia compressor (direct connected),

Cost installed (without compressor)	$ 4,400
Interest and depreciation	4,400
Supplies and repairs	2,200
Labor (three shifts)	6,353
Fuel at 1¼ lbs. per horsepower	2,916
	$15,869

Total cost .459 ct. per horsepower hour.

This last plant was operating on Illinois Slack of 10,300 B. T. U. per pound, and containing 4 per cent sulphur and 38 per cent volatile matter.

Methods and Cost of Drilling for Oil in the Caddo Oil Fields of Louisiana.*

Location and Erection. [illegible] it is the common practice to place the derrick on one of the so-called gas mounds, or as near as possible to a producing well. The average hire of a surveyor to locate a well is from $10 to $25. The rotary derrick used can be easily framed and erected by any competent carpenter, although there are rig-builders here, as in every field. The building of a rig is by no means easy work; and every man who works up in the rig as it is erected generally receives $5 per day. The derrick is usually 84 ft. high to the top of the crown-block, with a 22-ft. base. The cost of a rig or derrick, including lumber and labor, is about $250.

Machinery Equipment.—Rigging up, one of the most expensive items to the operator or contractor, includes the purchasing and transporting of the rotary, engine, hoisting-machine, pumps, boiler, casing and pipe. The cost of transportation of machinery and pipe from the railroad to the well varies from $150 to $200, according to distance.

There are several good rotaries now in use in the various oil-fields, each one possessing advantages for a particular field. I might mention the Parker rotary and the Oil-Well Supply rotary as two types used in the Caddo field. These rotaries vary in weight from 900 to 4,000 lbs. and in size of pipe handled from 1.5 to 20 ins. The price varies from $225 to $1,600. Several makes of engines of 20, 23, 25 and 28-h. p. are in use. The price of one of these engines complete varies from $320 to $365. The hoisting-machines vary in weight from 1,990 to 2,800 lbs., and in price from $180 to $250. Pumps of several styles are used in connection with the hydraulic rotary system. These are the Smith-Vaile, Knowles, Special Duplex, Gardner and Parker rotary drilling-pumps. The price varies from $220 [illegible]

The boiler, placed from 100 to 200 ft. away from the well, to insure against danger from an unexpected flow of gas or oil, is run by gas, generally supplied by a pipe-line from some gas-well in the field. The oil-country boilers, of locomotive type, are generally used. These are made of open-hearth flange steel, having a tensile strength of 60,000 lbs. per sq. in., and an elastic limit of 30,000 lbs. They are tested at 160 lbs. hydrostatic pressure and 125 lbs. steam pressure per sq. in.

The total cost for a complete rotary outfit, including tools and materials, f. o. b., is estimated at $2,825, not including freight-charges. The weight of this outfit is about 30,000 lbs.

[illegible] method of drilling [illegible] in the Caddo field, is a modification of the Fauvell system, invented in 1845, and used for some time in several of the European oil-fields. It is rapid and economical, when used in unconsolidated [illegible] quicksand.

Several styles of rotaries are used, [illegible] work on the same principle. The principal features of the rotary outfit are the derrick, the rotary machine, the hoisting-gear, the engine, the boiler, and the pump. In addition are the numerous accessories and appliances for connecting the machinery; for attaching the pump to the boring-tube or casing; for hoisting and handling the tubes or casing; the bits or cutting-shoes; the pipe and casing.

The rotary method consists in rapidly turning a column of pipe, the lower end of which is armed with a steel shoe having a serrated edge or a bit for cutting. The drill-pipe is held by a chuck, and the descent of the pipe is controlled by the driller by means of a feeding-device. Water is kept under constant high pressure in the pipe and the cuttings are thus forced to the surface, passing up on the outside of the pipe with the water. This ascending current of water keeps the hole clean and allows the drill to turn freely. It is essential that the flow of water should be continuous, and a drilling-outfit is always supplied with two force-pumps in order to prevent any stoppage of the flow. If the drill has passed through a pervious stratum, such as a bed of loose sand, the ascending water is liable to pass into that stratum, instead of returning to the surface. This quickly results in the clogging of the hole; and in order to prevent it the water which is pumped in is mixed with a large amount of fine clay. By this means the outlets through porous beds are sealed up, the unconsolidated material forming the walls of the hole is prevented from caving, and the water returns unimpeded to the surface. When drilling through quicksand or similar formations, a back-pressure valve is inserted in the coupling above the first joint of pipe, to prevent water and sand from rushing back into the pipe when the service is disconnected. This also assists materially in sustaining the wall of the well and permitting the pipe to turn. When the pipe has reached the desired depth, the valve, which is constructed of brittle material, is punched out, and the pieces either removed or forced down outside of the pipe.

When the formation is not of sufficient hardness to form a core, but washes out as the pipe advances, the rotary steel shoe with a serrated edge is used. In cases where the formation is composed of clay of sufficient density to retain the wall of the well in place, a smaller pipe is used, armed with a perforated bit, through which the water is forced from above, and when the depth is reached where it may be desirable to insert the casing, the drill-pipe is removed and the casing is inserted in the hole thus prepared for it.

Two forms of bit are generally used, the fish-tail and the core-barrel. The fish-tail bit requires considerable care both in making and in dressing. It cuts through comparatively hard formations, and must be so shaped that, as the points advance and outline the hole, the center portion crumbles the core which tends to form, and the small holes must direct the jets of water in such a way that the bit as well as the hole is kept clean. The core-barrel bit is used when a stratum is encountered which is too hard to yield readily to the fish-tail bit. This core-barrel consists of a piece of steel pipe, about 8 ft. long, swaged at the upper end to connect to the drill-pipe. The lower end is left smooth, and two or three holes are drilled a short distance above, to permit the water to pass out and return to the surface. Chilled iron or steel particles averaging about the size of bird shot are fed down the inside of the pipe in small quantities and find their way to the bottom of the hole, where they are rolled between the bottom of the core and the rock, rapidly crushing the latter. As the cuttings rise above the [illegible] current of water and carried to the surface. The core is removed by means of an extractor consisting of a piece of pipe of the same size as the core-barrel and provided with short inwardly-projecting steel springs which engage the core and carry it up when the pipe is removed. It is necessary to exercise care, in pumping water, to admit only enough to remove the cuttings and not wash out the shot.

In starting a well arrangements are generally made first for a 12-in. casing; and in boring for this size the drill-pipe is generally made of 6-in. casing with a 13.5 in. bit. This size of bit is used to allow the collars at the joints of the 12-in. casing to slide past without damaging the wall of the well. The length of 12-in. casing used varies from 500 to 800 ft., depending largely upon the nature of the ground and the skill of the driller. The hole is generally left open until the whole depth calculated for one string of casing has been drilled. This generally extends until a hard stratum is met, upon which the casing to this depth may stand.

Following the 12-in. casing, the hole is next drilled for an 8-in. or 9-in. casing. In either case a 10.5-in. bit is used. After the 9-in., a 6-in. casing is used; then a 4-in., and then finally a 2-in. casing.

The drilling depends largely upon the driller, who controls the engine and the drilling-pipe. It is necessary to keep the hole clean, and the pumps are generally kept going even though not drilling. Very often the well becomes clogged and it is necessary to pull out the whole string of pipe in the hole. The bits also require dressing, which necessitates the withdrawal of the pipe. The pipe is generally drawn out in sections of three lengths, or about 60 ft. It is stood up on the derrick-floor until put in the hole again. The cuttings as they are washed out by the water under the rotary are examined every 20 to 50 ft., and a log or record of the well is kept by the driller.

When the oil-bearing formation is reached, the oil will be noticeable on the water as it passes into the slush-pit. When, in the driller's judgment, the drill has penetrated the oil-bearing formation to a sufficient depth to assure a good flow, the pipe is removed and the well is bailed. A strainer is generally set at the bottom of the hole before bailing. The 10 or 20-ft. bailer generally used, is lowered to the bottom of the well, the dart-valve opened, and the water allowed to fill the bailer. It is then pulled up and the water dumped into the slush pit. Before the well is entirely bailed a gate-valve is fitted to the casing [illegible] oil rises and the well flows. The well is allowed to clean itself of all loose pieces of [illegible] the well shut in. The well is then connected [illegible] or the loading rack. In drilling for gas great [illegible] ent is now used.

[illegible] well: the driller, derrick-man, boiler-man, and two helpers. The driller is in complete charge of the drilling of the well. The daily wage of the driller varies from $5 to $6. Night-drillers sometimes receive more than this. The derrick-man receives from $3 to $5 per day [illegible]

The average length of time required to drill [illegible] 90 days. The length of time required to drill [illegible]

Besides the hydraulic rotary system of drilling, the standard or cable-tools method has been used in the Caddo field, but without satisfactory success. J. C. McCue, superintendent of the Producers' Oil Co., writes: "You will please note that I answer by saying 'Impossible to drill with cable tools.' We find that the formation is such that cable tools cannot be used."

The drilling of a well by this cable tools method is done with a steel drill, measuring with its fittings 30 ft. in length, and weighing from 1 to 1.5 tons. This drill is continually lifted and dropped in the hole, the force of its impact breaking the rock. At intervals the debris is removed by a sand pump—a tube with a valve at the bottom, which is lowered

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*Extracts from a paper by Walter E. H[illegible] in the Bulletin of the [illegible] Engineers, April, 1911.

[illegible]

Four men are required on a standard rig—the driller, boiler-man and tow helpers. The [illegible] build a standard rig is about $750, while the estimated cost of tools, not including machinery, is about $2,000.

[illegible] for the well to flow, in which case a pump is put on the well. In the Caddo field few gushers are brought in; hence a large majority of the wells are pumped. A standard rig, built for the pumping, costs about $600. Recently two air-compressors have been installed. Wells producing large quantities of water with the oil are best blown by compressed air; indeed, it is the only way to handle them.

Frequently, when the oil-bearing formation is reached, the oil either does not flow at all or flows only in small quantities. Instead of putting the well on the pump, it is sometimes "shot." By exploding a charge of nitro-glycerine at the bottom of the hole, the surrounding rock is broken up and the flow of oil stimulated. The shooter lowers the glycerine into the well in cylindrical tin shells. The well is then filled for a couple of hundred feet with water to "tamp" the charge. The shooter lights the fuse of a "jack squib," a long [illegible] with [illegible] small charge of [illegible] and a slow burning fuse, and starts the squib down the well. I have record of only one well having been [illegible] with no success. The explosive in this case cost $275.

Cost.—The general impression is that it costs from $10,000 to $12,000 to drill a deep well in Caddo field. C. W. Brown, of Brown Brothers, well contractors, has stated the cost of drilling an oil well to the depth of 2,200 ft. at [illegible] $10,000, and that of a gas well 1,000 ft. deep at about $4,000. The following data show the average cost of drilling a deep well:

[illegible]	$ 300
[illegible]	250
Cost of machinery, tools and material......	2,824
Cost of transportation of above to well....	100
[illegible] per day....	750
Cost of four helpers for 150 days at $3 per day	1,800
[illegible] of pipe and casing	3,265
Total	$9,289

With oil worth $0.44 a barrel, it would be necessary to have a production of 21,111 bbls. in order to pay expenses. When one considers that a good well in the Caddo field means 200 bbls. per day, some idea of the returns an operator receives can be obtained.

The review of the Caddo field for 1909 shows 69 oil wells completed, with an initial output of 8,750, and an average of 127 bbls.; 19 "gassers" completed; 33 dry holes drilled; and 10 wells abandoned.

The 69 oil wells represent a total expenditure of about $690,000. The 19 gas wells represent about $76,000. Assuming 25 of the dry holes to have been deep holes, we have $250,000 spent on these holes; and assuming 8 to have been "gassers," we have $32,000 for these. The total expenditures for oil wells would thus be $940,000 and for gas wells $108,000. No doubt the same machinery was used to drill several wells; but still the foregoing figures furnish an idea of the amount of money spent in the field during the year 1909. Besides the drilling, there are the pipe lines, storage tanks, pumps, loading racks and cooking tanks for oil; also the pipe lines for the [illegible]

The cost of lap-welded pipe is, at the lowest average, about 3 cts. per lb., including the joint. The cost of hauling, laying, and painting, per foot, as given by the *Oil Investors' Journal*, is:

Size.	Cost.	Hauling.	Laying.	Painting.	Total.
2-in.	$0.24	$0.01	$0.03	$0.01	$0.29
4-in.	0.41	0.02	0.03	0.01	0.47
6-in.	0.65	0.02	0.04	0.02	0.73
8-in.	1.05	0.02	0.04	0.03	1.13
10-in.	1.30	0.03	0.05	0.03	1.41
12-in.	1.70	0.04	0.05	0.03	1.82
16-in.	2.80	0.05	0.06	0.04	2.95
18-in.	4.00	0.06	0.07	0.04	4.17
24-in.	5.10	0.08	0.08	0.05	5.31
30-in.	7.50	0.09	0.09	0.06	7.74

These prices, however, are sometimes far from the actual cost.

Let us consider the proposed gas lines to New Orleans and St. Louis, the length of each being about 400 miles. The former, a great undertaking, will necessitate the laying of 18-in. pipe for 400 miles through swamps and bayous, and the crossing of the Atchafalaya and the Mississippi rivers. Assuming $4.15 as an average total cost per foot, the cost will amount to $8,764,800. Very few appreciate the enormous expenditures represented by these pipe lines.

Another considerable cost to a company operating on a larger scale are the large steel storage and cooking tanks. The Producers' Oil Co. has a 50,000-bbl. tank in the Caddo field, which cost about $14,000. The Caddo Gas & Oil Co. owns a 35,000-bbl. steel tank, which cost about $9,800.

LETTERS TO THE EDITOR.

A Problem in Drainage Ditch Maintenance in Drifting Sand.

Sirs: I am interested as engineer in a drainage proposition for a basin in a river valley, the only practicable manner of drainage being the construction of an open ditch about 10 ft. wide on the bottom and 6 ft. in depth. The rate of fall is 0.2 per cent, but at the outlet for several hundred feet the ditch will be as much as 11 ft. in depth, and will pass through a low sand ridge which is composed of drifting sand.

The course of the ditch is nearly due north and south having the direction of the prevailing winds. The objection is offered to this location that the sand will continually fill the ditch and it will be costly to maintain.

Across the line of the ditch at one point and in this sand is a stone fence, standing for about 30 years and embedded in the blow sand about 18 ins. It runs at right angles with the prevailing winds and is besides on the lee side of a cultivated field nearly a mile across, the soil of which is light and easily drifted.

The ditch is to take care of the run off from about 2,500 acres of very hilly land, which is discharged upon this basin in such a deluge that the ditch will be taxed to carry it, but for months no water will run in the ditch at all. What is your own or your readers' opinion about the upkeep of this ditch?

I should add that the ridge is timbered and the ground along this portion of the ditch line is not cultivated land, but overgrown with weeds and other natural growth.

It seems to me that in the face of the condition of the stone fence—which has only gathered 18 ins. of sand in thirty years, though lying in a most exposed condition, that the contention that the ditch will fill up with sand through acting as a channel for the winds through the timber is not well taken.

However, this is a new condition in my experience.

Awaiting any suggestions or recital of experience by your readers along this line, I remain,

Yours truly,
O. T. REECE.

Wellington, Kan., April 1, 1911.

Suggestions Wanted for Concrete Fences for Stock Pens.

Sirs: During the coming summer our company is contemplating the construction of several blocks of stock pens in their yards. As all the previous construction has been of wood and the cost of maintenance is very heavy, we have serious thoughts of constructing fences of concrete. As there are very few fences constructed in this manner throughout the various stockyards of the country, we will have to work out something on this order as an experiment to determine whether it is practicable. It would be a very simple matter to construct a tight fence of concrete if it were not for the intense heat. The fences have to be 6 ft. high to prevent the stock from interfering from one pen to another. If fences were constructed of solid material 6 ft. high there would be practically no breeze entering the pen; it would be bad on the men as well as on the stock.

We would be glad if you could offer any suggestions in this line, or if any engineers contributing to your paper would offer any. I have seen fences built of concrete paneling, but this does not seem to me very practicable, owing to the cost of handling same. In the Chicago stockyards they have been experimenting along this line, but according to my view I think there should be a more practicable and much less expensive method of construction.

Yours respectfully,
ST. PAUL UNION STOCKYARDS CO.,
E. L. Dorsett.
Chief Engineer.

St. Paul, Minn., March 30, 1911.

The Hydraulic Ram.

Sirs: I write to call attention to what seems to me a dangerous suggestion in an article under the above heading in your journal of March 22, 1911. The author does not state whether the type of ram shown in Fig. 2, p. 337, has ever been used or not. I hope it will never be used with a polluted supply coming in at A under the expectation that nothing but pure water from I will be delivered through valve C. How many strokes could take place before there would be an intermingling of polluted and pure water in the passage between B and C? According to the author's own statements there would be a reversal of flow in this passage for every complete stroke or pulsation. What would be the position and form of his surface of separation between the polluted and pure waters at different stages of the operation?

If the polluted water were known to contain typhoid bacilli would the author have the nerve to recommend anyone to drink the water delivered from chamber D?

Yours respectfully,
H. P. BOARDMAN.
Professor of Civil Engineering.
University of Nevada.

Reno, Nev., March 26, 1911.

Efficiency of Hydraulic Rams.

Sirs: I should like to secure information regarding the efficiency of hydraulic rams for a capacity of say 10,000 gals. per 12 hours with a fall of 5 to 10 ft. "SUBSCRIBER."

Personals.

Mr. E. C. Crum, of the firm of Crum & Davidson, engineers, Frederick, Md., has been appointed city engineer of that city. Mr. Crum is engineer for the county. He will also continue his interest in the firm.

Mr. Willard D. Lockwood has resigned as chief engineer of the M. C. Madsen Construction Co. to organize the Lockwood Engineering Co. This company will do a general engineering and contracting business, with office at 50 Church St., New York City.

Mr. H. Eckhardt, who has been for the past four years, chief engineer for C. Leonardt, contractor, has resigned and has opened an office at 256 Wilcox Bldg., Los Angeles, Cal. He will engage in practice as a bridge and structural engineer and contractor.

Jas. A. Green & Co., Inc., with offices at 226 South LaSalle St., Chicago, and 509 Overland Building, Boise, Idaho, announce that they have taken over the business formerly conducted by Mr. Jas. A. Green. This company will continue in a general engineering and construction line, paying particular attention to irrigation and hydraulic work.

Mr. Wm. B. Ewing, consulting municipal engineer, died at his home in Chicago on April 8, at the age of 52 years. He was a graduate of Cornell University, and a member of the American Society of Civil Engineers and the Western Society of Engineers. In recent years he has been prominently connected with the development of sewerage and water works systems in the middle west.

Messrs. Milo D. Burke and William M. Venable have formed a partnership under the name of Burke & Venable, and will be located at Room 706, Second National Bank Building, Cincinnati, Ohio. They will engage in practice as consulting engineers in a general line of municipal work and of work connected with the development of property and public works, and will give special attention to sewage and refuse disposal, hydraulics and reinforced concrete construction.

Mr. Horace G. Burt, formerly president of the Union Pacific R. R., and at one time chief engineer of the Chicago & Northwestern Ry., has been selected as chief engineer for the investigation of the question of electrification of steam railroad terminals in Chicago. For the past ten years Mr. Burt has engaged in a general engineering practice in Chicago, and has headed a number of extensive engineering undertakings. He will enter on his duties as chief engineer on May 1.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week.

[illegible] tracts, and other large pieces of work are now being advertised, or will be advertised in the near future.

In the line of railroad construction work the number of contracts let were not up to the average of the two previous weeks. Several large railroad construction jobs, however, are to be let shortly, and this week shoud be a good one for the railroad contractor.

The principal railroad contract let recently appears to be the one secured by H. S. Kerbaugh, Inc., The Arcade, Philadelphia, Pa. This contract calls for the construction of the double track tunnel at the summit of the Alleghany Mountains near Sand Patch for the Baltimore & Ohio R. R. The tunnel will be about 4,000 ft. long and will cost about $1,250,000. Among the other railroad construction contracts let recently are the following: W. Z. Williams Co., Macon, Ga., for improvement work for the Atlantic Coast Line at Savannah, Ga.; Boynton, Church & McCoy, Spokane, Wash., for constructing a 21-mile standard gage steam line from Springdale, Wash., for the Washington Water Power Co., and R. S. Talmadge, Alapaha, Ga., for extending the Ocilla Southern Ry. from Alapaha to Nashville. Two large contracts for bridge construction work for railroads were also let. One of these contracts calls for constructing a 1,400-ft. long concrete arch bridge over the Delaware River at Yardley, Pa., for the Philadelphia & Reading Ry. F. M. Talbot Co., 1 Madison Ave., New York City, secured the contract. The other contract calls for the construction of viaducts in Louisville, Ky., Grainger & Co., Louisville, being awarded the contract for the steel superstructure, and B. C. Milner & Sons, the contract for the concrete substructions.

Several large dredging contracts are now being advertised by the U. S. government. The largest of these calls for dredging in St. John's River below Jacksonville, Fla., the estimated quantity of excavation under this contract being 5,486,200 cu. yds. Another large contract calls for dredging in the Patapsco River, Maryland. The total yardage under this contract is 2,260,000 cu. yds.

It looks now as though something would be doing shortly on the proposed water supply tunnel under New York City, as the Board of Water Supply has again called for bids for portions of the work. These contracts are being advertised, and the bids will be opened May 16. The tunnel will be constructed in rock.

Bids are now being asked by the U. S. Government for the construction of Lock and Dam No. 20, Ohio River, near Belleville, W. Va. The work includes constructing lock, guide walls, river wall power house, the dam (including the navigable pass and the beartrap and Chanoine weirs and the abutment; and grading and paving the esplanade and the bank back of the abutment. The estimate of quantities includes: Cofferdam, 16-ft., 4,240 lin. ft.; cofferdam, 10-ft., 1,500 lin. ft.; common excavation, 117,300 cu. yds.; concrete (solid construction), 57,800 cu. yds.; concrete (arched-void construction) (alternative bid), 54,300 cu. yds.

The construction work on two large irrigation projects in California will shortly be open [illegible] for for about $1,000,000 worth of work on the [illegible] Irrigation District, near Stockton, Calif. It is probable that the Oakdale Irrigation District adjoining will call for bids on about the same amount of construction work at about the same time.

One of the largest government contracts let in Cuba for some years has been awarded to Champion & Pascual, P. O. Box 84, Havana, Cuba. This contract calls for building the Roque canal in Matanzas province. The amount of the contract, according to the engineer's estimate, will be about $1,500,000. Work on the project will commence at once and will require about 2½ years to complete. The proposed canal is to be 52 kilometers in length, and from 95 to 210 ft. in width. Its purpose is to relieve the thousands of acres of sugar and fruit lands from being flooded each year during the rainy season which causes the streams to overflow the lowlands inflicting heavy losses to the planters.

The Situation in New England.

The New York, New Haven & [illegible] and the Grand Trunk Ry., as everybody [illegible] New England [illegible] [illegible] friendly [illegible]. As a result [illegible] this [illegible] situation has arisen which [illegible] tory to contractors. The ill feeling between the two roads became acute when the Grand Trunk decided to invade the New York, New Haven & Hartford's territory by the construction of a line from Palmer, Mass., to Providence, R. I. To reach Palmer the Grand Trunk, through its leased line, the Central Vermont, runs over the tracks of the Boston & Maine R. R., a subsidiary company of the New York, New Haven & Hartford, from Windsor, Vt., to Brattleboro, Vt., a distance of some 50 miles. From the latter place to South Vernon, Vt., some 12 miles, the Central Vermont has its own tracks, which extend through to Palmer and New London. Now the main line of the New York, New Haven & Hartford from New York to the White Mountains runs over the Central Vermont tracks from South Vernon to Brattleboro and from Windsor to White River Junction, 10 or 12 miles. Following the disagreement the New York, New Haven & Hartford refused to any longer grant the Grand Trunk running rights over its tracks between the above mentioned points. The Grand Trunk retaliated in kind, and as a consequence some $5,000,000 or $6,000,000 will be spent in the construction of new short lines in southern New Hampshire and Vermont. The Grand Trunk will construct a new line from Windsor to Brattleboro and has already taken bids on the first section, extending from Windsor to Bellows Falls, Vt., some 26 miles. The New York, New Haven & Hartford in order to avoid using the Grand Trunk tracks will build a line from Hinsdale, N. H., to Brattleboro, and continuing on the New Hampshire side of the Connecticut River to some point in either the towns of Walpole or Westmoreland, N. H. It is estimated that the first section, Hinsdale to Brattleboro, 10 miles, will cost $1,700,000. It is understood that work on this section may be started this month. The New York, New Haven & Hartford will also build a new line from Windsor, Vt., to West Lebanon, N. H., thus getting away from using the Grand Trunk tracks from the former place to White River Junction, Vt. Surveys for the line are being [illegible] began [illegible] ble.

Road Work in 1910.

Some idea of the magnitude of the highway work accomplished last year is given in a compilation from state highway reports made at Albany, N. Y. According to the compilation a total of $35,725,000 was spent in 1910 by 25 states for road improvement work. The state of New York spent about $8,000,000 and plans to expend $9 000,000 this year. New Jersey built roads at a cost of more than $825,000 and had work amounting to about $620,000 under contract at the end of the year. Pennsylvania spent considerably more than $1,000,000 on roads, with contracts amounting to $700,000 not completed. California besides completing three out of seven state roads voted a bond issue of $18,000,000 for a state highway system. Ohio had construction and repair bills of nearly $500,000, with work aggregating $620,000 still to be finished. The total expenditures of other states were as follows:

Arizona	[illegible]
Colorado	1,396,000
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Massachusetts	[illegible]
Minnesota	80,000
Missouri	100,000
New Hampshire	800,000
North Carolina	[illegible]
Rhode Island	400,000
Texas	7,000,000
Utah	125,000
Vermont	[illegible]
Virginia	850,000
Washington	300,000
West Virginia	1,150,000
Wisconsin	2,000,000
Total	$24,002,000

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7 Miles of Road in 1 Day.

Wynne, Ark., has had a road working day, and as a result seven miles of road were constructed between sunrise and sunset. Over 1,000 men were engaged in the work. The road was divided into 10 sections, each section having its foreman and the necessary men, tools, teams, etc., assigned to it. The road, seven miles in length, began at the outskirts of Wynne, and the first four miles extended through hilly country, requiring a considerable amount of cuts and fills. On this section most of the work was done with plows, scrapers and graders. The last three miles of the road was through bottom lands, where trees had to be cut, ditches filled and bushes removed. In connection with the road a 65 ft. timber bridge was constructed, and work on this was practically completed in the one day. Possibly this road work was more spectacular than permanent, but anyway it shows what can be accomplished by united effort and concerted action.

Transportation of Explosives.

The enforcement of a policy of regulation and inspection in connection with the transportation of explosives has brought marked results. According to the recently issued report of the U. S bureau for the transportation of explosives and other dangerous articles only one person was killed in 1910 by explosives in transit. In 1907, the year the bureau was established to enforce the rules of the interstate commerce commission and the American Rail- [illegible]

[illegible] express companies. The total number of inspections made during [illegible] inspections of stations, 315 of factories, 1,528 [illegible] of steamship piers and 617 of cars in transit. The most significant item in the statistical table, that showing the total number of boxes of high explosives condemned as unsafe for transportation, remains large 10,902 in 1910, as compared with 10,029 in the previous year. Also 1,291 kegs of black powder were condemned; 1,468 in 1909.

RAILWAYS, STEAM AND ELECTRIC

Arizona.

Surveying crew running lines in the vicinity of Pantano, Ariz., for the El Paso & Southwestern Ry. has completed its work and is about to start work locating a line east from Tucson to Mescal.

Arkansas.

The Missouri Pacific Ry., E. F. Mitchell, Engineer of Construction, St. Louis, Mo., is reported to be planning to have work started on a line from Womble to Greenwood, thus making a direct route by the way of Camden to Alexandria and to New Orleans.

J. A. Perdue & Co., Pine Bluff, Ark., has been awarded a contract by the Tombigbee Valley R. R., for 10 miles. This work is in addition to the 20 miles already awarded Perdue & Co. There is about 5 miles of fine station work in the new contract. Butler, Ala., is Perdue & Co.'s camp address.

It is rumored in Fort Smith, Ark., that the Kansas City Southern is soon to make changes in its system in Benton county. Reports say that the Kansas City Southern plans a north and south road through Benton county, with Joplin as the northern terminal. It is also believed by some that it intends using the Kansas City & Memphis road to reach some of the towns in that county.

California.

The Central California Traction Co., San Francisco, is to extend its road from Lodi to Woodbridge, a distance of 1½ miles. The extension is to be completed in time to handle the grape crop.

The Southern Pacific Co. has made formal application to the city council of Oakland for permission to electricize its steam lines stretching east and north from the terminus at the Oakland pier to the city boundary lines.

A hearing was held April 24 by the city council of Oakland on the application of the Oakland, Antioch & Eastern Ry. Co. for a franchise along Shafter Ave. from Rockridge to 40th St. The franchise will connect the Oakland and Antioch line with the Key Route at 40th St. and Shafter Ave.

Officials of the Mill Valley & Mt. Tamalpais Scenic Ry., mentioned in our last issue, have approved plans for the immediate construction of two important extensions, a direct line from Mill Valley to Dipsea and Bolinas on the Pacific Ocean at an ultimate cost of about $1,000,000. George M. Dodge, San Rafael, Cal., is Chief Engineer.

The Santa Fe System plans on the following minor improvements in California for the near future: Constructing an extension to siding at Riverside, estimated cost $4,500; additional track construction at Oakland; additional trackage at Reedley, estimated cost $13,000, and an extension to house tracks at Daggett costing $6,800. The Santa Fe System plans on constructing an addition to its shops at San Bernardino, Cal., to cost $11,000. R. J. Arey, Los Angeles, is Engineer Santa Fe Coast Lines.

The Nevada-California-Oregon Ry., the present terminus of which is at Alturas, Modoc County, Cal., is, according to advices from Lakeview, Ore., to be extended on the east side of Goose Lake to that city this summer. The line is graded two miles north of Alturas and to within a few miles of Davis Creek, where a station and townsite will be located. G. S. Oliver, Reno, Nev., is chief engineer.

It is reported in Escondido, Cal., that the Armstead Ry. proposing the construction of a line between San Bernardino and San Diego, via Escondido, Cal., is being backed by the Nevada-California-Oregon. G. D. Armstead, the promoter, is devoting most of his time to the investigation of provisional routes, having had surveyors in the Moosa canyon section within the past few weeks. It is reported that a feasible way into Escondido from the San Luis Rey River has been found by the way of Gopher canyon and Twin Oaks.

The Southern Pacific Ry., according to advices from Santa Barbara, Cal., is planning the improvement of its roadbed at the base of Ortega Hill this summer. The project includes the widening of the road bed.

Information received from Folsom, in Sacramento County, Cal., states that the presence of surveyors on the Levi Darrington ranch near Negro Hill gives rise to the report that preparations are being made for the construction of a railroad in that vicinity.

At a recent meeting of the city council of Watsonville, Cal., the Southern Pacific Ry. was granted the right to lay three tracks on Walker St., for a period of 50 years.

Colorado.

The Santa Fe System has plans for sinking a deep well at Sedalia, Colo., at a cost of $5,000.

The Santa Fe System has appropriated $5,700 to cover cost of constructing an additional well, pump house and derrick at Lamar, Colo., and $5,500 to cover cost of sinking a deep well at Rocky Ford, Colo. D. E. Helverson, Pueblo, Colo., is Division Engineer.

Steps are being taken for the formation of a co-operative concern to build a railroad from Austjn to Cedaredge, Colo., directly north via Eckert, the route following along Surface Creek Mesa. The projected length is 12 miles. One preliminary survey has been made and about $11,000 has been raised for construction purposes. The project is still in an indeterminate state and the president and chief engineer have not be selected. John R. Charlesworth, Delta, Colo., is interested.

It is reported that the Denver & Rio Grande R. R. has plans under consideration for the shortening of the road between Denver and Salt Lake, a distance of 160 miles. It is to be accomplished by the construction of a link between Dotsero station on the Rio Grande and some point on the Moffat line, which will send Rio Grande traffic from the west into Denver over the Moffat line from Dotsero. The link will also shorten the distance between Salt Lake and Denver via the Rio Grande and the Moffat roads about the distance that Rio Grande interests are claiming

A meeting of the stockholders of the Denver, Laramie & Northwestern Ry. Co., the original concern and the Denver, Laramie & Northwestern R. R. will be held May 10 at Laramie, Wyo. The road is now operated from Denver to Greeley and is being graded to Fish Creek canyon, on its way to the Laramie valley. It is the intention of the company to extend the road to the coal fields at Elk mountain and ultimately to Seattle and the Pacific coast.

The Laramie, Hahn's Peak & Pacific R. R will complete its line to Coalmont, Jackson County, Colo., by November 1, according to advices from Laramie, Wyo.

Engineers are in the field looking over the proposed route of the freight belt line around Pueblo, Colo., to reduce the haulage of freight trains across Union Ave. and through the business section of the city.

One section of the grade of the Cheyenne-Wellington branch of the Colorado & Southern Ry., according to advices from Cheyenne, Wyo., has been completed and contractors are rushing work on the remainder of the work. Right-of-way agent announces the line will undoubtedly be completed by July 1st, the time limit granted by Cheyenne when it gave the right to cross the streets of the city with the Wellington and Cheyenne & Northern lines. The most difficult piece of construction on the entire line is entering Cheyenne. Just west of the city where the road crosses the Union Pacific a fill 60 feet high is being thrown up, and a cement and steel bridge will span Crow creek.

It has been intimated in Salt Lake City, Utah, that the Colorado Midland Ry. is considering the construction of its line from the present western terminus at Grand Junction, Colo., on to Salt Lake. Nothing definite, however, has been obtained in regard to the proposition. F. F. Mallon, Colorado City, Colo., is chief engineer of the C. M. Ry.

Florida.

The Jacksonville Traction Co., Jacksonville, Fla., has acquired the railroad constructed by the Ortega Co. and extended from the terminus of the tracks of the Jacksonville Electric Co., Jacksonville, on St. Johns Ave., to Ortega, a distance of 3¾ miles.

Georgia.

⊙The W. Z. Williams Co., Macon, Ga., has been awarded the contract for the concrete substructure for the new bridge to be built over the Okmulgee River at Macon for the Macon, Dublin & Savannah R. R.

⊙The Atlantic Coast Line has awarded contracts for the greater part of its proposed improvements at Savannah to the W. Z. Williams Co., Macon, Ga. It is stated that these improvements will cost about $200,000 and will include a round house, turntable and offices.

⊙The contract for extending the Ocilla Southern Ry. from Alapaha to Nashville, mentioned in our last issue, was let to R. S. Talmadge, Alapaha, Ga., and he has a large force at work along the right-of-way. Rail sufficient to connect Alapaha and Nashville has been ordered and will arrive in time to insure the early completion of the extension.

Stockholders of the Atlantic, Waycross & Northern R. R. Co. have voted an issue of bonds in the sum of $4,800,000 and stock to the amount of $1,500,000 to build and equip the line projected from St. Marys, on the Atlantic, through Nichols, Broxton and Abbeville, to either Perry or Fort Valley, thence to Atlanta. Surveys for this line were reported under way in February. Offices have been opened in Waycross. D. G. Zeigler, Rocky Ford, Ga., is Engineer.

The Byrd-Matthews Investment Co., recently incorporated with a capital stock of $2,000,000, will open up 36,000 acres of white oak, yellow poplar and white pine in White, Union, Townes and Lumpkin counties, Ga., and will build a railroad from Gainesville, Ga., 40 miles long to this timber. A. R. Byrd, Jr., St. Louis, Mo., is secretary of the Byrd-Matthews Investment Co.

Surveys have been started for the permanent route of the proposed extension of the Valdosta, Moultrie & Western R. R. from Moultrie to Fort Gaines. The road from Moultrie to the Chattahoochee River will be about 100 miles long. Gordon Tillman, Valdosta, Ga., is Chief Engineer.

Illinois.

The Chicago, Milwaukee & St. Paul Ry. is reported to have contracted with the Illinois

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Steel Co. for 100,000 tons of heavy rails for 1911 delivery.

Citizens' committee from Lewistown has been in conference with the directors of the Illinois Central Electric Ry. Co., Canton, Ill., in an effort to secure an extension from St. David to Lewistown, a distance of 10 miles.

The Rock Island Southern Ry., J. W. Walsh, Seoretary, Davenport, Ia., is to have work started as soon as weather conditions will permit on the construction of a stub line from its main line to Alexis.

It is reported in Lewiston, Ill., that the Chicago, Burlington & Quincy Ry. is seriously considering the construction of a branch line from Sepo through Isagel and Kerton townships to connect with its St. Louis line at Browning, Schuyler county. Crossing Spoon river near Sepo the proposed track would be for a considerable distance on the embankments already erected in the Isabel drainage districts, thence south and westerly, the entire line being practically on a level to Browning. The proposed branch road would traverse a [illegible] farming section in Illinois and coal fields.

The street railway company at Springfield has had work started on the double tracking of Spring St. from Monroe to Cedar Sts. This work when completed will cost the railway company about $60,000, and will be completed within the next three months. The contract for the grading and paving of the street, which is being done at the same time by the city, is in charge of John E. Bretz, who in addition to his contract with the city for the paving, has been employed by the railway company to do its grading. All material necessary for the work is on hand.

Indiana.

The Evansville Rys. Co., Evansville, is to have work started shortly on a ½-mile extension at Evansville to the Locust Hill cemetery.

The Lake Shore & Michigan Southern Ry. has submitted to the city officials of Ligonier blue prints of the proposed subway under company's tracks at Market St., and also for moving the station further west and providing better and larger accommodations and grounds.

The Vincennes North & South Traction Co., of Vincennes, Ind., has been chartered with a capital stock of $100,000, and proposes to construct and operate interurban lines. The directors are E. D. Logsdon, B. M. Willoughby and J. M. House.

The Board of Public Works of Indianapolis has continued the formal hearing on the proposed track elevation in that city until Aug. 2.

Surveys are under way for a railway from a new town on the Kentucky side of the Ohio River opposite Evansville, Ind., to Henderson, Ky. It is the purpose of the promoters to eventually extend the line down through Central Kentucky, probably as far south as Hopkinsville, Ky. J. A. Brown, Evansville, Ind., is interested.

Iowa.

The Commercial Club of Fort Dodge is advocating the construction of an interurban line from that city to Gilmore City.

The Albia Interurban Ry. Co., Albia, Ia., has secured the right of way for an extension to Buxton and it is believed that construction work will be started as soon as weather conditions permit.

It is believed in some quarters that the Chicago, Rock Island & Pacific R. R. will start work this spring on building a second track from Iowa City to Des Moines. The promise of abundant crops, now indicated, makes it rather necessary for the company to enlarge its facilities for handling a largely increased volume of both freight and passenger business during the fall and winter months. Construction of a second track will not be a difficult feat, as the company, years ago, anticipating the future, in reconstructing the single track from Iowa City westward, extended all its culverts and bridges to a width to accommodate two tracks. During the last three or four years the company also has put in many siding tracks in expectation of utilizing them ultimately as parts of a second track.

Work of grading the Quincy branch of the Chicago, Burlington & Quincy Ry. has been resumed, according to reports from Burlington, Ia., and [illegible] road is being obtained at [illegible]

Consulting engineers and representatives of an eastern bonding company in company with the president of the Iowa & Omaha Short Line Ry. are going over the road in view of extending the line to Des Moines, Ia. The line, now about completed to Treynor, has been gone over and the probable cost of the line to Des Moines via Oakland, Atlantic and Guthrie Center has been estimated.

Kansas.

The Metropolitan Street Ry. Co., E. Butts, Engineer, 1500 Grand Ave., Kansas City, Mo., is to have work started shortly on extensions at Kansas City, Kan. Material has been ordered for these extensions.

The Santa Fe System plans on the following improvements in Kansas for the near future: Extension of passing track at Belpre; erecting a water tank and crane at Moline, estimated cost $4,000; constructing additional water facilities at Florence, estimated cost $3,700; purchasing a 120-ton wrecking derrick to be stationed at Newton, estimated cost $15,000; constructing a new passing track at Larned, estimated cost $2,400, and constructing a new reservoir at Attica for which $6,100 has been appropriated. J. M. Meade, Topeka, Kan., is Engineer Eastern Lines Santa Fe System.

The Santa Fe System has appropriated $45,000 to cover the cost of widening embankments preparatory to ballasting track between mile posts 888 and 924 on the Valley Division.

Kentucky.

The Levisa River R. R. Co., recently incorporated, as noted in our last issue, will probably let contracts in the near future for its proposed railroad in Pike County. The line will be built from a connection with the Chesapeake & Ohio Ry., and will run up the Levisa River fork to Grundy in Buchanan County, Va. This is understood to be a Chesapeake & Ohio Ry. project. H. Pierce, Richmond, Va., is Chief Engineer of Construction of the Chesapeake & Ohio.

The Chicago, Memphis & Gulf R. R., S. G. Latta, President, Dyersburg, Tenn., has filed amended articles of incorporation providing for an extension from Hickman, through Fulton, Hickman, Carlisle, Ballard and McCracken counties, to Paducah, Ky. The new railroad will open that section of Kentucky along the Mississippi River that has been long in need of a railroad line, and will give Paducah direct connection with Memphis by a shorter route than is provided by any of the other railroads running out of that city. It will be a connecting link between Chicago, St. Louis and Memphis, and will develop an entirely new territory. As noted in our last issue, surveyors are now engaged in locating the route. The extension from the state line to Hickman will be completed in a short time and trains will be running into Hickman over this new road in May.

It is reported that the Illinois Central R. R. will build its contemplated cut off from Mayfield to Gilbertsville this year.

Maryland.

The Hagerstown & [illegible] completed surveys and has secured the capital for the construction of its projected 12-mile electric railway along the old National Pike from Hagerstown to Clearspring, Md. Construction contracts are to be awarded this month, the Burton Construction Co., Richmond, Va., being the probable contractor. L. N. Downs, Hagerstown, Md., is President, and J. B. Ferguson Co., Hagerstown, Md., are the Engineers.

Massachusetts.

The Committee on Rules of the State Legislature has voted to admit the bill to authorize the Berkshire Street Ry. Co., Pittsfield, to purchase the rights and franchises of the Springfield Street Ry. Co., which involves the building of several trolley extensions by the New York, New Haven & Hartford R. R., the owners of the Berkshire Co.

Michigan.

Official announcement has been made of the taking over of the Manistique & Northern R. R. by the Ann Arbor R. R. The Manistique & Northern R. R. operates about 45 miles of line in the upper peninsula of Michigan. It is believed that the Manistique & Northern will be connected at once with the Cleveland Cliffs Iron Company's railroad system. This can be done by the construction of a two-mile extension.

According to a recent announcement reported to have been made by officials of the Pere Marquette, an expenditure of $30,000 is planned for the new round house at Port Huron, Mich.

As a result of a recent trip of the Pere Marquette Ry. officials over the system it has been decided, according to reports from Flint, Mich., to double track the line which passes through that city. The double tracks will extend from the Fenton road, south of the city, to a point a mile and a half north of Hamilton St. The entire distance is about four and a half miles. Because of the extensive freight business which is being carried on in Flint at the present time it is stated that the double tracks were considered absolutely necessary. Work on a roundhouse at the north end yards is to be started in a short time. A water tank and a large coal dock are also to be built. V. E. Duncan, Detroit, Mich., is assistant chief engineer of the system.

Minnesota.

The Granite City Ry. Co., (electric) St. Cloud, Minn., is to construct a 7 mile extension to its Waite Park car line at St. Cloud. The franchise for the extension has been secured and work will be started shortly.

It is believed in Fergus Falls, Minn., that the Northern Pacific Ry. will soon complete the construction of the Fergus Falls division to Miles City, Mont. The Fergus Falls division leaves the main line at Wadena, and runs due west to Oakes, N. D., passing through Henning, Fergus Falls, Breckenridge, Wahpeton and several other villages. From Oakes, the line curves a little to the northward, and eventually reaches Edgerly, N. D. The annual reports issued by the company have shown that the line was projected to Miles City, where it will again connect with the main line, and the company has been gradually working toward this end for some time. There is a gap between Edgerly, N. D., and Cannon Ball, N. D., but from Cannon Ball the company has completed its line to Mott, N. D., and recently opened that line to service. It has laid heavy steel on this line. There is another gap from Mott to Miles City, but some work has been done toward filling in both these gaps, some grading being completed both west of Edgerly and west of Mott.

According to a statement reported to have been made at Missoula, Mont., by John R. Toole, president of the Big Blackfoot Ry. Co., work will be started shortly on the construction of a 12-mile connecting line to the logging road which now ends at McNamara's Landing. The completion of the entire line would cost about $1,000,000 and probably more. The entire road, when completed, will be about 50 miles in length, and will extend to about six miles on the other side of Ovando. After reaching McNamara's siding there will be about 25 more miles of road to build. Probably one-third of the grading on this 25-mile stretch has been completed.

Missouri.

•The Missouri, Arkansas & Gulf R. R. Co., recently incorporated as noted in our last issue, has elected the following officers: Gilbert Lay, St. Clair, Mo., President and Treasurer; E. C. Comstock, Lecoma, Vice President, and Wm. E. Fink, Springfield, Secretary. The company proposes to construct a steam railroad from Rolla to the Arkansas state line, a distance of 125 miles, where it will [illegible] with a [illegible] through Arkansas and Texas by members of the syndicate which is backing this enterprise. It is stated that the company has purchased all the rights of way, donations, construction equipment, real estate and other assets of the Missouri, Inland & Southern Ry. Co. Contracts have been let to E. E. Young for construction and equipment for the first 80 miles from Rolla to connect with the Memphis branch of the Frisco.

An issue of $7,000,000 St. Louis & San Francisco R. R. Co. general lien 15-20-year 5 per cent gold bonds, due 1927, has been sold in France. The $7,000,000 general lien bonds are issuable under the mortgage for the following purposes: For refunding notes maturing February 1, 1912, $4,000,000; for refunding equipment notes, $1,443,000; for additions and betterments, $1,557,000.

The Kansas City Terminal Ry. Co., W. S. Kinnear, President, Kansas City, Mo., has notified the city that the company is ready to proceed with the construction of subways at 15th St., 9th st., Hardesty Ave. and Indiana Ave., and the construction of a viaduct at Campbell St.

Kansas City and Vicinity.

[illegible]

Mr. L. J. Smith is in Southern California at the present writing. He expects, however, to make his trip a short one and no doubt within a very few days he will be at his office once more.

Mr. C. W. Marshall of the Ohio Construction Co. was a Chicago visitor on the 24th. The letting of the Rock Island work and a chance to meet many of his contractor friends were the attractions.

Mr. R. J. Buck of Portland, Ore., has arrived in Kansas City to assume the superintendency of the Porter contract on the Kansas City Southern Ry. work. Mr. Buck has been with Porter Bros. for several years on the west coast.

Mr. Scott Mitchell of the L. J. Smith Construction Co. has returned from Arizona. On his way home he was in quite a railway accident. He escaped uninjured, however, save for a severe shaking up.

Wood, Bancroft & Doty have moved their team outfit on their Kansas City Southern work. They have quite an extensive piece of work to do about 60 miles south of Kansas City.

The writer spent a pleasant day last week in the camp of the Lund Contracting Co., near Joplin, Mo. Mr. Sten Lund, the President of that concern, is in active charge of the work at hand. Mr. Lund states double shifts will be worked as soon as the shovel starts digging and that it is his plan to push the work with as great speed as is possible. On account of the fact that actual work has not been started, we had ample time in which to inspect the camp. Mr. Lund certainly has one of the finest and best equipped camps we have ever seen. His organization throughout is highly commendable.

It is reported in Kansas City that the Fred C. Jones Co. of Dallas, Tex., is about to build an electric suburban road out of Dallas. Just the extent of the road we do not know, but it is said to be quite a large project.

Mr. G. H. Sharp has returned from California, where he has been for several weeks past.

Several contractors from this city are in Chicago at the present time, bidding on the C. R. I. & P. work. Probably by the time this is read the contract will have been awarded, but we will venture to say if any one takes the contract away from the K. C. contractors they will have to have a sharp point on their pencil when they make their bids.

Porter Bros. have opened an office in the Dwight Bldg., Kansas City. This will be their address during the life of the Kansas City Southern contract and we trust the firm of Porter Bros. will find their work in this [illegible] the country so pleasant and profitable that Kansas City will be one of their permanent addresses.

Mr. James Clarkson, R. J. Buck and T. Kreiter of the Porter Bros. Co., together with Mr. Sten Lund of the Lund Contracting Co., covered the entire Kansas City Southern contract in Mr. Lund's automobile last week. This involved a trip from Joplin to Kansas City, a distance of 150 miles.

Callahan Bros. are now making splendid progress on their work of levee building along the Kaw River. Obstacles in the way of Court injunctions having now been removed, the Callahans are able to show just what they can accomplish. In riprap work alone as high as 125 running feet have been built in a single day. Other portions of the contract are progressing in the same rapid manner as is the riprap work. The office address of Callahan Bros. is Daniels Bldg., Kansas City, Kansas.

The South Side Stone Co., Wm. Cribo, President, with office in the Orear-Leslie Bldg., has secured quite a large contract from the Kansas City Terminal Co. The earth moving portion of the work has been let to J. J. McInerney.

Montana.

A committee of business men of Columbus, Mont., are gathering data looking to the construction of an electric line between the Musselshell River and Cooke City. The statistics will be submitted to eastern capitalists who are considering financing the project.

Nebraska.

Officials of the Chicago, St. Paul, Minneapolis & Omaha Ry., C. W. Johnson, Chief Engineer, St. Paul, Minn., were recently in Omaha, Neb., looking over the local terminals with a view to making a number of improvements and enlargements. It is understood that improvements are under consideration for the Itasca terminal and that the yards east of the Globe elevator system are to be enlarged.

New Hampshire.

It is believed that the Boston & Maine R. R. will shortly put under construction the first section of the Connecticut River R. R. of New Hampshire, recently chartered as mentioned in our last issue. Contractors are understood to have already been over the route. The first section will cost about $1,700,000 and will be built from Hinsdale, N. H., to Brattleboro, Vt. It will be continued up the New Hampshire side of the Connecticut River to some point, either Walpole or Westmoreland, N. H. The contract will call for the construction of a roadbed for a double track for a distance of 10 miles, and will necessitate the handling of about 1,000,000 cu. yds. of material. The contract will also include the building of a double track steel bridge across the Connecticut River to a point near Brattleboro to connect the new line with the Vermont Valley road and one across the Ashuelot branch of the Boston & Maine in the town of Hinsdale, N. H. The larger bridge will be more than 600 ft. long and will rest upon granite piers. The smaller bridge will be about 225 ft. long. George M. Thompson, Brattleboro, Vt., is Engineer in charge of construction.

The Boston & Maine R. R. has ordered that surveys be completed as soon as possible for its new line from Windsor, Vt., to West Lebanon, N. H., a distance of some 20 miles. This line will be built so as to avoid the necessity of using the Central Vermont R. R. tracks between Windsor, Vt., and White River Junction. West Lebanon, N. H., is located just across the river from White River Junction.

New Jersey.

A bill is before the State Senate to enable any railroad company to acquire land by condemnation where necessary, not exceeding 50 ft. in addition to the 100 ft. right of way previously allowed, in order to widen roads to six tracks where congestion of traffic requires. This will enable the Pennsylvania R. R. to carry out at some future time its plan to lay two additional tracks across the State and make a six-track system from New York to Philadelphia. The Pennsylvania has already acquired land for two additional tracks, but this right of way has offered so many obstacles that it was decided to make an effort to secure a right of way directly parallel with the present line.

The Morris County Traction Co., Morristown, N. J., has secured practically all the necessary property owners' consent for its proposed trolley line on Main St. at Chatham, N. J.

Directors of the Millville, Tuckahoe & Ocean City Transportation Co. of Millville, N. J., have been over the proposed route of the branch trolley line between Millville and Port Norris, and expect to begin work in the near future.

A commission has been appointed to condemn land wanted by the Central Railroad of New Jersey, J. O. Osgood, Chief Engineer, New York City, to provide an embankment for its tracks over the Kearney meadows, near Newark. The railroad company proposes to elevate its tracks where they approach the bridges, and the extra land is needed in order to give a better support for the tracks. It is also proposed to raise the bridges, which would permit of many small craft passing up and down the river without the necessity of opening the draws. The strip of land desired is 20 ft. wide by 600 and is along the plant of the Crucible Steel Co. in West Bergen and the Gantz estate.

The Public Service Ry. Co., Newark, N. J., has been petitioned by citizens of Belleville to extend the Mt. Prospect Ave. trolley line through Belleville by the "most direct" route.

New Mexico.

The Santa Fe System has appropriated $20,000 to cover the cost of constructing a second track from Pavo, N. M., to bridge No. C 34 on the Albuquerque Division.

New York.

The Little Falls & Johnstown R. R. Co., mentioned in our last issue, has an engineer making estimates of the cost of its proposed trolley road from Little Falls to Johnstown. J. Ledlie Hees, Gloversville, N. Y., is President.

The State Public Service Commission has authorized the New York & Stamford Ry. Co., Port Chester, N. Y., to exercise a franchise granted by the village of Port Chester, permitting it to construct a single track street railroad in and through North Regent St., South Regent St. and Putnam Ave.

Excavation work for the foundation of the bridge and viaduct for the New York Connecting R. R. at New York City has been started, and the work of building three miles of bridgework and the three miles of railroad on land that is to connect the Port Morris yards of the New York, New Haven & Hartford R. R. with the Long Island and Pennsylvania systems in the Sunnyside yards will begin as soon as the foundations are completed. The New York Connecting R. R. is owned jointly by the New York, New Haven & Hartford R. R. and the Pennsylvania R. R., and was formed to connect the two systems at New York. This will be done by a line beginning in the yard of the New Haven road, near 142d St., The Bronx, and proceeding by viaduct to the shores of the Bronx Kill. The kill is crossed by a bridge of the lift type, 300 ft. long, to a viaduct that runs southward along the eastern shore of Randall's Island to Little Hell Gate. This viaduct is about 2,600 ft. long. A second bridge 1,000 ft. long crosses to Ward's Island. A viaduct traverses Ward's Island 2,600 ft. to the shores of Hell Gate. Hell Gate itself is spanned by a bridge 1,000 ft. long. When the Long Island shore is reached the four tracks which have crossed from the New Haven road's yard run southward to the Sunnyside yards on a viaduct. Here connection may be made to the Pennsylvania Station in 7th Ave., Manhattan, or with the lines running out into Long Island. The towers of the Hell Gate bridge will be 200 ft. high and the span will be 140 ft. above high-water mark.

The arches will have a length of 3,000 ft. The four railroad tracks will be embedded in stone ballast to prevent oscillation and noise.

The Hornell & Dansville R. R. Co. is obtaining options for the purchase of a right of way along the east side of Lincoln St., in Dansville, to be used for the construction of its road. It is understood that this line will be an extension of the Dansville & Mt. Morris R. R., A. S. Murray, Jr., Receiver, 22 William St., New York, to Hornell.

North Carolina.

The Raleigh, Charlotte & Southern R. R., recently chartered as mentioned in our April 12 issue, is now carrying on the preliminaries of the organization and it is expected that the organization plans will be completed within the next 30 days. W. L. Mann, Albemarle, N. C., is interested.

Business men of Washington, N. C., have been in conference with Governor Kitchen, at Raleigh, relative to the work of grading the Belle Haven-Washington end of Mattamuskeet R. R. from Fairfield to Belle Haven and Washington with convict labor.

⊙The contract awarded the Probst Contracting Co., Charlotte, N. C., noted in our last issue, for the construction of the North Carolina Traction Co.'s line from Winston-Salem, N. C., to Floyd, Va., a distance of 102 miles, calls for the grading, building bridges and trestles, track laying and purchasing all the equipment for the complete operation of the road. The work is not ready to start at this time. Most of the work will be sublet when it is ready.

North Dakota.

It is reported at Minot, N. Dak., that the Grand Trunk Pacific Ry. has let the contract for the completion of the Regina-Boundary branch to a point 12 miles east of Portal. It is now believed that the Great Northern will construct a branch to connect with the Grand Trunk. B. B. Kelliher, Winnipeg, Man., is chief engineer of the Grand Trunk Pacific Ry.

Ohio.

The proposed increase of capital stock of the Cleveland & Pittsburg R. R. (Pennsylvania Lines) from $22,000,000 to $40,000,000, is to be used for the following purposes: $4,500,000 for the completion of work heretofore authorized and already undertaken at different points along the line; $3,000,000 for track elevation in connection with grade-crossing elimination at Cleveland; $2,000,000 for new docks and dock machinery at the same point; $2,500,000 for the road's one-fourth share of the estimated cost of the proposed new union passenger station in Cleveland; $2,000,000 for the completion of the second track between Pittsburg and Cleveland, now under construction of third and fourth tracks, and $2,000,000 for additional equipment.

The Cleveland Railway Co. of Cleveland has filed with the county recorder its mortgage for $35,000,000 to the Citizens' Savings & Trust Co. and the Bankers' Trust Co. of New York, to secure an authorized bond issue of that amount. Under the terms of the mortgage the bonds are issued to take up the floating debt, for extensions, equipments, improvements and betterments as the funds are needed. The first $10,000,000 will bear 5 per cent interest, but interest on the remainder will be determined when they are needed.

Deeds have been filed for the purchase of 62 acres of land in South Columbus for the new freight terminals of the Hocking Valley R. R. The new yards will represent an expenditure of about $1,000,000, but the contemplated improvements are held in abeyance until the litigation now in the courts is settled. The road is understood to be making the immediate improvements out of earnings.

The Baltimore & Ohio R. R. is understood to be planning to have construction work started shortly on new yards at Canal Dover, O. Land for these yards was purchased several months ago.

The Guthrie Fairview Construction Co., Guthrie, Okla., was recently incorporated with a capital stock of $10,000 and proposes to construct the projected line of the Guthrie, Fairview & Western Ry. chartered about five years ago to build a railway from Guthrie to Fairview, connecting with the Kansas City, Mexico & Orient. The directors of the new construction company are as follows: W. S. McCaull, H. G. Hermlink and Nora E. McCaull of Kansas City, R. L. Dryer of Joliet, Ill., and W. C. McKee of Oklahoma City.

Oklahoma.

The Peoples Electric Ry. Co., organized for the purpose of building an electric line from Muskogee to Oklahoma City, has commenced grading and has ordered rails and expects to complete 50 miles of road within the next six months. G. W. Risser, Muskogee, Okla., is President.

The Sallisaw, McAlester & Southern Ry. Co., chartered about a year ago, has been rechartered with $100,000 capital, and with McAlester as headquarters. The company contemplates building a line from Sallisaw in a southwesterly direction through the counties of Sequoyah, Haskell, Latimer and Pittsburg to McAlester, and thence south to Honey Grove, Tex., passing through the Oklahoma counties of Atoka, Pushmataha, Choctaw and Bryan. It is estimated the 190 miles will cost $3,000,000. Work on this road was commenced some time ago, a contract having been let for the grading to James Wilkinson, of McAlester, who is now at work between Craig and Savanna.

The Grand River Power Co. is reported to have completed arrangements for the immediate construction of its Grand River dam at Muskogee. C. N. Haskell, Muskogee, is interested in this project.

Oregon.

Joseph H. Wilson, Corvallis, Ore., representing S. P. Mackey of Portland, Ore., has applied to the city council of Newport, Ore., for a franchise for a proposed road to run from the waterfront to a point six miles north of the city.

The Great Southern R. R., J. G. Heimrich, General Manager, The Dalles, Ore., has asked bids and will probably award contracts this month for the construction of an extension from Dufur, its present terminus, to the west end of Juniper Flats, 40 miles south of Dufur. It is estimated that the extension will cost about $25,000 per mile. The Great Southern R. R. is now operating 30 miles of standard gage line.

Pennsylvania.

The Ephrata & Lebanon Street Ry. Co., which proposes to build a railway from Lebanon to the upper end of Lancas County this spring and summer, has put a force of engineers at work making estimates of cost of the proposed railway. The line is to be 23 miles in length and is to be operated with Edison storage battery cars.

Advices from Connellsville state that the Somerset Street Ry. Co., a company chartered for the purpose of constructing a trolley line between Somerset and Rockwood, will start work immediately and will have the line completed as soon as possible. Last year considerable preliminary grading was done on the company's right of way. G. C. Winslow is Chief Engineer.

⊙H. S. Kirbaugh, Inc., Arcade Bldg., Philadelphia, Pa., has been awarded the contract for the construction of the double track tunnel at the summit of the Alleghany Mountains near Sand Patch for the Baltimore & Ohio R. R. It will cost about $1,250,000. The new tunnel will be of standard Baltimore & Ohio design, with a bore of about 4,000 ft., 30 ft. in height, double-tracked throughout and lined with brick. The new line will join the present one in the vicinity of Manila on the east and Sand Patch on the west.

The Sheffield & Tionesta Valley Road is being extended from Nebraska, Pa., to Tionesta, a distance of 7 miles, and it is expected that trains will be in operation this fall.

Preliminary surveys are being made by the Pennsylvania R. R. and the Lake Shore R. R. for a new line to tap the lumber section of Forest County, Pennsylvania, and the limestone belt of Clarion County. The line will be 18 miles long and will extend through a section that is now without railroad facilities.

The Baltimore & Ohio R. R. is reported to be considering the standardization of the narrow-gage branch from Foxburg to Kane, Pa., a distance of 82 miles. Some preliminary work has already been done

The Philadelphia Rapid Transit Co., Philadelphia, Pa., is considering building a branch line extending from its present Short Line, at its new bridge spanning Ridley River, to Fourth St. and Highland Ave., in the extreme western section of Chester. It is understood that the company will bear the expense of a modern bridge over Chester River, which is the dividing line between the eastern and western sections of the city, providing City Councils extends it the necessary franchises on 4th St.

The Reading Transit Co., Reading, Pa., has filed notice of an intended $20,000,000 bond issue for the purpose of retiring underlying bonds and obligations, mortgages and options on stock. It is stated that no bonds will be sold except for extensions and the building of lines in new territory. It is understood that much of the track on the Norristown and other systems will be renewed during the year, and if conditions are favorable a line between Hamburg and Reading will be built.

South Carolina.

A plan is under consideration for the construction of an electric railway from Camden to Sumter, a distance of 30 miles. R. E. Sharpe, Rembert, S. C., is interested.

Tennessee.

An agreement has been reached by the city of Memphis whereby railroads interested in the subways project will begin work immediately, bearing all costs until the work is completed. When that is done, the city will settle for its share. Under the terms of the ordinance, the city is to stand one-eighth of the physical cost of construction, one-half of the damage done to abutting property, and all of the paving. There are eleven subways to be built, two of them this year and the balance within five years. The approximate cost exceeds $1,000,000. All the railroads entering the city are interested. Work will be started first on Railroad Ave. crossings at Rayburn and Mississippi Boulevards.

Texas.

Board of Trade of Haskell, Tex., has accepted a proposition for the construction of an electric railway from Haskell to Rule, 11 miles west. The road would be constructed across level country, and the grading would be light. M. R. Hemphill, Haskell, Tex., is the promoter.

The Texas Traction Co., of Dallas, has taken over the Denison-Sherman interurban line. The price paid was $670,000, of which $217,500 was cash and $452,500 was securities. This also gives the Texas Traction Co. control of the street car system of both Sherman and Denison.

The Gulf & Rio Grande Construction Co. has been chartered and proposes constructing a line of railroad through Southwest Texas, to run from some point on the Gulf Coast to Eagle Pass, a distance of about 200 miles. The company has a capital stock of $100,000. The incorporators are: R. K. Valentine, of Brooklyn, N. Y.; A. W. Lilliendahl, Saltillo, Mexico; Robert P. Coon and Albert Tolle, San Antonio, and Lee Frisby, Beeville, Tex. Mr Lilliendahl built the old Coahuila & Pacific R. R., that runs between Saltillo and Torreon, about 250 miles and is now a part of the National Railways of Mexico. It is announced that the proposed road has been financed and that construction work will soon be started.

Official announcement is reported to have been made that the proposed railroad from Stone City to Giddings will be built by the Harriman lines. This road will pass through Caldwell, coming through the rich black land belt to Caldwell and passing through the [illegible] of the [illegible]

[illegible] Tex., General Manager of the Houston & Texas Central R. R., was recently over the route.

The Crosbyton & South Plain Ry. is to ask the State Railroad Commission for permission to issue bonds upon the completed portion of its line from Lubbock to Floydade. It is understood that the line will be extended to Spur to connect with the Stamford & Northwestern.

A party of capitalists from Dayton, O., have been in Palestine, Tex., looking over the city with a view to installing a street car system.

The Texas Short Line Ry. T. B. Meeks, President, Grand Saline, Tex., has plans under consideration for an extension south from Grand Saline.

The Santa Fe System plans on the following improvements in Texas for the near future: Extension of passing track at Canyon, estimated cost $4,700; extension of passing track at Harvey, estimated cost $1,500; extension of passing track at Black at a cost of $1,600; additional trackage at East Dallas at a cost of $6,800, and extension of passing tracks at White Deer, Tampa and Higgins. H. W. Wagner, Amarillo, Tex., is Principal Assistant Engineer.

The Denton Street Ry. Co., R. J. Wilson, Manager, Denton, is to build a 1-mile extension into the north part of the city and to the College of Industrial Arts. A bonus of $3,000 was raised by the citizens to secure the extension.

President L. E. Walker, of the Quanah, Seymour, Dublin & Rockport Ry., according to advices from Georgetown, Tex., is at that city closing up the survey of the road from Georgetown to Jarrell. A satisfactory survey of the company has been completed.

Advices from Timson, Tex., state that work is progressing nicely on the construction of 13 miles of railroad from Waterman toward San Augustine, Tex. When completed this line will be within eight miles of the Santa Fe main line and it is believed that the latter company will then construct that section.

It is believed that at a future meeting of the Board of Directors of the Santa Fe System that the matter of extending the line into Waco, Tex., will be considered. The Santa Fe made two surveys into Waco more than 25 years ago; one was started at Buckholts and the other at Rogers, both lines passing through Mooreville, McLennan county, and entering Waco on the south side of the city just west of Oakwood cemetery. It was the plan at that time to pass through Waco and build up the Bosque, tapping the main line of the Santa Fe at Meridian or Valley Mills. The notes of these old surveys are at the general offices in Galveston.

Information received from Snyder, Tex., in regard to the construction of the new Santa Fe cutoff, states that work has been about completed between Snyder and Post City and that the line will be ready for train service shortly.

Utah.

The Uintah Ry. Co., M. W. Cooley, General Manager, Mack, Colo., is extending its railroad from Dragon to Rainbow. The contractors for the work are the Wasatch Construction Co., Salt Lake City, Utah.

Committee of the Commercial Club of Bountiful has presented to the Utah Light & Ry. Co., Salt Lake City a petition asking for an extension of the lines into Bountiful and Woods Cross.

The Oregon Short Line R. R. has sent engineers into Cache County for the purpose of investigating the feasibility of a short cutoff from Cache Junction to Logan. Two routes are under consideration, one through Benson and the other to leave the main line from Ballard and then across the bottoms. It is believed that the latter route will be selected should the company decide to build the cutoff.

The Utah & Grand Canyon R. R. Co., mentioned in our April 12 issue, is reported to have placed mortgage bonds to the amount [illegible] a line from Marsvale, Prute county, Utah, to the north rim of the Grand Canyon in Arizona. The company, which has already taken over the Utah & Southern R. R. Co., is believed to be subsidary to the Denver & Rio Grande.

Excellent progress is reported on the line of the Bingham & Garfield R. R. from the mills at Garfield to the mine at Bingham. The winter months were taken advantage of for doing the tunnel work, and three tunnels are completed and only about 70 feet remains to be driven in tunnel No. 4. It is stated that the road is now completed and ready for trains from Garfield, Utah, to Dry Fork, the scene of the old Copperton concentrator, which places the management at this date in possession of about 15 miles of finished road. The work of extending the long and extremely high bridges across Carr fork and Markham gulch is receiving considerable attention and good results are being gained.

According to announcement made at Vale, Ore., by Right-of-way Agent C. Stradley, Salt Lake City, Utah, of the Oregon & Eastern Ry., work will be started on that project in a short time.

Work has been started on the proposed line of the Dixie R. R. which will leave the Salt Lake Route at Lund, Utah, and run as far as Dixie. It is believed that work will reach St. George, 86 miles, by January 1, 1912, and Dixie a year later.

Virginia.

The Southern Ry. has had an engineering corps working in the vicinity of Chatham, Va., and it is believed in that city that construction work may be started soon on the change of line at Chatham.

The Bristol Traction Co., a new organization, has purchased the properties of the Bristol Belt Line Ry. Co. at Bristol, including all the electric railway lines now in operation. The company will spend about $100,000 in improvements and extensions, beginning at an early date. These improvements will include an extension to the King Spring settlement, in South Bristol; an extension to Virginia Park, in the northwestern suburbs; a loop thence connecting with the State Street Line; a loop in West Bristol, and the electrifying of the Holston Valley Railway, which has been acquired by the company, and which extends to Big Creek Park, on the Holston River, a distance of ten miles. It is the purpose of the company to have a part of these extensions completed for early summer use. Fred Dulaney, Bristol, Va., is Manager.

Engineers are now working on the Washington & Norfolk Ry. in Gloucester county for the line from Norfolk to Washington by way of Gloucester Point and Fredericksburg. W. J. Burlee, Gloucester, Va., is president of the company mentioned in our April 12 issue.

Washington.

⦿Boynton, Church & McCoy, Spokane, Wash., have been awarded the contract for grading and laying the steel for the 21-mile standard gage steam road of the Springdale & Long Lake R. R. Co., mentioned in our issue of April 5. This road is to be built for the Washington Water Power Co., D. L. Huntington, President, Spokane, to enable it to carry in the materials to the new power site at Long Lake. The rails are to be furnished by the Power Co. The contract amounts to about $175,000 and it is said that about 300 teams and 500 men will be engaged in the work, which is to be completed by Sept. 1.

Surveys have been completed for the construction of the Methow Valley & Washington Ry. Co.'s proposed line from Winthrop to Pateros, at the mouth of the Methow River, 50 miles. At a recent meeting of the directors of the company at Twisp, Wash., steps were taken to finance the building of two 50 mile sections. J. C. Barton, Twisp, is the Engineer.

West Virginia.

The Tyler Traction Co. has been chartered with an authorized capital stock of $500,000 and proposes to build a line from Sistersville, Tyler County, through Middlebourne to the village of Shirley, in Tyler County. The incorporators are J. T. Ingram, of Pursley, W. Va.; W. J. Neuenschwander, E. A. Durham, A. J. Jackson, Joseph McKay, Henry W. McCoy and John Kincaid, all of Sistersville, W. Va.

It is probable that a company may be formed at Wheeling to finance a trolley line between that city and Waynesburg, Pa., which will connect with the Waynesburg, Blacksville, Pittsburg line, thus forming a loop from Wheeling to Pittsburg. President Cecil Robinson of the Board of Trade and B. Walker Peterson, head of the Dollar Savings and Trust Co., both of Wheeling, are interested in the project.

Officials of the Fairmont & Clarksburg Traction Co. have been inspecting the proposed route for an extension from Clarksburg to the new Fair Grounds, and it is expected that announcement will be made shortly as to the construction of the line. S. B. Miller, Fairmont, W. Va., is Chief Engineer.

Wisconsin.

⦿Marve Case and L. Brillion have secured the contract for the clearing of five miles of right-of-way for the Wisconsin & Northern R. R. extension south from Crandon.

The Milwaukee Northern Ry. Co. (electric), Cedarburg, Wis., has issued a $4,000,000 mortgage and it is understood that part of the proceeds will be used for the construction of an extension to West Bend this summer.

The Chicago & Wisconsin Valley Street Ry. Co. is planning to have construction work started shortly. Some tracklaying has already been done at Madison. This company proposes a line from Madison to Portage, a distance of 40 miles. J. S. Jones, Madison, Wis., is Secretary.

The Minneapolis, St. Paul & Sault Ste. Marie Ry., according to recent reports from Neenah, Wis., is contemplating the extension of the line from Manitowoc to Two Rivers and Kewaunee and possibly Sturgeon Bay. Surveyors of the Wisconsin & Northern are now working in the Fox River valley laying out a right of way to connect with the Soo line here.

Canada.

⦿The following contracts have been let for improvements to buildings, etc., on the Manitoba Division of the Canadian Pacific Ry.: Extension of freight shed at Winnipeg, A. J. Barker, 59 Pearl St., Winnipeg.; construction of upholstering shop at Winnipeg, Carter, Halls, Aldinger Co., Union Bank Bldg., Winnipeg; boiler shop, Winnipeg, J. McDiarmid Co., Cottage Ave., East Winnipeg; transfer table at Winnipeg, Jackson-Goldie, Box 237, St. Boniface, Man.; freight offices at Fort William, J. McDiarmid Co.

⦿Charles Schultz and R. A. Grams, of Bowbells, N. Dak., have taken a sub-contract for grading work on the Canadian Pacific R. R. out of Swift Current, Sask., and have shipped an outfit to that place.

According to advices from Vancouver, B. C., Mackenzie, Mann & Co. will receive bids until May 12 for the construction of 163 miles of Canadian Northern Ry. from Hope to Kamloops on the North Thompson river. The work which will be let in four sections must be completed within two years of the date of signing of contracts. The tenders include clearing, grubbing, grading, bridges, trestles, culverts, masonry and fencing. The construction is in four sections as follows: Hope to Boston Bar, 40 miles; Boston Bar to Lytton, 28 miles; Lytton to Ashcroft, 44 miles; Ashcroft to Kamloops, 51 miles. The estimated cost of construction of the 163 miles is about $15,000,000, as some of the work is heavy. Between Hope and Kamloops numerous tunnels, aggregating a total of two and three-quarter miles, will have to be driven. The longest tunnel, 2,400 ft., will be on the north side of Kamloops Lake at Battle Bluff. The next longest, 2,000 ft., will pierce a mountain near Yale. A great deal of construction along the Fraser River, especially in the canyon, will cost $300,000 a mile. W. H. MacLeod, Winnipeg, Man., is general manager.

The Temiskaming & Northern Ontario Ry. Commission, J. L. Englehart, Chairman, Toronto, Ont., has arranged to purchase for $250,000 the Nipissing Central Ry., an electrical road. One advantage of this transaction will be that the Kerr Lake branch, the Haileybury spur, and the New Liskeard spur of the T. & N. O. can all be electrified. This is regarded as in reality but a step towards the ultimate electrification of the entire T. & N. O. system, a scheme which was advanced by the Commission some years ago. It is understood that the purchase carries with it the control [illegible] the water [illegible] The charter of the N[illegible] line connecting Cobalt, Haileybury and New Liskeard, and runs [illegible] Lake Nipissing [illegible] the road runs from Cobalt to Haileybury, and it has been quite a competitor with the T. & N. O. line. The acquisition of the line by the Government road will put the latter in a position to dis[illegible] eight trains a day.

Mexico.

Now that the N[illegible] has completed [illegible] steel bridge across the Rio Grande to connect with [illegible] Tex., it [illegible] started soon on the branch line to run from Allende to Las Vacas, opposite Del Rio, Tex. Plans for the proposed line were adopted some time ago, but revolutionary disturbances prevented the necessary material from being shipped and greatly hindered the work. With the starting of construction on the branch line the work of erecting another international bridge across the Rio Grande will also begin, the latter structure to connect Las Vacas and Del Rio. The bridge will be erected jointly by the National Railways of Mexico and the Kansas City, Mexico & Orient. The latter is now constructing a branch line from San Angelo, Tex., to Del Rio.

ROADS, STREETS AND PAVEMENTS

Arizona.

The city council of Phoenix, Ariz., on April 3 rejected the bids made by the Arizona Bitulithic Co., for 12 blocks of paving in that city, their bid being $2.25 per sq. yd. for paving and $.11 for excavating.

Arkansas.

A bill is before the legislature of Arkansas, Little Rock, to create the Little Rock and Fort Smith road district. The bill provides for the building of a macadam highway on the north side of the river, commencing at Argente and ending at Fort Smith. The counties traversed are Pulaski, Conway, Pope, Johnson, Franklin, Crawford and that part of Sebastian lying between Fort Smith and the Arkansas river at Van Buren. Bonds are to be issued to construct the road.

California.

⊙The Barber Asphalt Paving Co., 906-916 Addison Head Bldg., San Francisco, Cal., has been awarded the contract by the city council of Sacramento, Cal., for furnishing a street road roller of modern and approved type weighing not less than 12 tons and propelled either by steam or gas. The contract price is $3,250. Bids were opened April 3.

⊙Raston Poole & Keistner, Ferndale, Cal., have been awarded the contract by the County Board of Supervisors, Eureka, Cal., for the construction of road, 8,240 ft. long, from Ferndale side of the new county bridge on Eel River to Clausen's corner for $556. Bids were opened April 11.

⊙The board of supervisors of San Joaquin County, Stockton, Cal., has let the contract for repairing the Linden road from East St., to the Diverting Canal, to McDonald & Jenkins on their bid of $17,365.

Plans for the improvement of the Linda Vista district of Oakland, Cal., have been laid out by the members of the Linda Vista Improvement Club, who have asked that the district be lighted, the streets macadamized and oiled, and more sidewalks constructed.

Advices from Santa Ana, Cal., county seat of Orange county, state that a $1,500,000 bond issue is strongly advocated for the construction of good roads in that county.

The board of supervisors of Butte County, Oroville, Cal., has decided to co-operate with the supervisors of Plumas County, Quincy, Cal., in the construction of a road from Oroville through the North Fork canyon to Shoo Fly and on to the Nevada state line. The two counties will ask for an appropriation of $500,000 from the $18,000,000 bond issue recently voted by the state.

The Planada Development Co., Los Angeles, Cal., J. Harvey McCarthy, president, has awarded the contract for improvement work on the Merced project of Planada to Paonessa & Taylor of Los Angeles for $80,000.

Delaware.

The city council of Wilmington, Del., has decided to borrow $100,000 for street work, $50,000 for sewer work and $100,000 for the purchase and establishment of public playgrounds in the city.

District of Columbia.

✣Bids will be received until 2 p. m., May 6, by District Commissioners, Washington, D. C., for paving various streets and avenues with sheet asphalt.

Florida.

✣Bids will be [illegible] 2:30 p. m. by Board of Public Works, Jacksonville, Fla., for furnishing necessary labor and material for grading, curbing and paving with vitrified blocks Davis, 5th, Market, Liberty, Washington [illegible] other streets. P. A. Dignan is Chairman of the Board.

Georgia.

The street committee of the city council of Atlanta, Ga., has rejected all bids received on April 14 for the paving of North Blvd., from Ponce de Leon Ave. to the Southern railroad with wood block. New bids will be called for.

Illinois.

✣Bids will be received until 2 p. m., April 29, by Board of Local Improvements, R. P. Van Deusen, Secretary, Pekin, Ill., for the improvement of Park Ave., from 4th St. to Court St. It is estimated that the materials and labor will be about as follows: 24,000 sq. yds. of vitrified brick pavement; 10,000 lin. ft. of combined Portland cement concrete curb and gutter; 10,000 lin. ft. Portland cement concrete curb; 700 lin. ft. of marginal protection stone curb; 10,000 cu. yds. of excavation, earth work and filling.

✣Bids will be received until 11 a. m., May 2nd, by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, secretary for paving the following and other streets: Chestnut Pl., 460 lin. ft. concrete curb, 470 sq. yds. brick pavement; 42nd Pl., 3,170 lin. ft. granite concrete combined curb and gutter, 2,000 sq. ft. concrete sidewalks, 5,120 sq. yds. asphalt pavement; 53rd St., 2,180 lin. ft. granite concrete combined curb and gutter, 3,750 sq. yds. asphalt paving; Greenwood Terrace, 1,260 lin. ft. granite concrete combined curb and gutter, 1,900 sq. yds. asphalt pavement; N. Hamlin Av., 700 lin. ft. gravel concrete combined curb and gutter, 1,140 sq. yds. asphalt paving; Maplewood Ave., 1,830 lin. ft. gravel concrete combined curb and gutter, 150 sq. ft. sidewalk, 310 cu. yds. earth cutting, 2,410 sq. yds. asphalt pavement; S. Sacramento Ave., 1,880 lin. ft. granite concrete combined curb and gutter, 200 sq. ft. sidewalk, 300 cu. yds. earth filling, 3,120 sq. yds. asphalt; Seminary Ave., 1,150 lin. ft. granite concrete combined curb and gutter, 120 lin. ft. concrete gutters, 80 sq. ft. concrete sidewalks, 2,000 sq. yds. asphalt pavement; 76th Pl., 1,410 lin. ft. granite concrete combined curb and gutter, 200 sq. ft. concrete sidewalk, 1,000 cu. yds. earth cutting, 1,340 sq. yds. asphalt; 77th St., 550 lin. ft. granite concrete combined curb and gutter, 100 sq. ft. concrete sidewalk, 850 sq. yds. macadam pavement; W. 23rd Pl., 2,080 lin. ft. granite concrete [illegible] crete gutters, 100 lin. ft. curb wall to be repaired and replastered, 100 sq. ft. concrete sidewalk, 6,570 sq. yds. asphalt; W. 33rd Pl., 3,730 lin. ft. granite concrete combined curb and gutter, 5,600 sq. yds. asphalt pavement; 37th St., 2,470 lin. ft. granite concrete combined curb and gutter, 200 sq. ft. concrete sidewalk, 3,900 sq. yds. asphalt; Wilson Ave., 1,460 lin. ft. granite concrete combined curb and gutter, 100 sq. ft. concrete sidewalk, 200 cu. yds. earth filling, 2,330 sq. yds. asphalt pavement. In the above work all combination curb and gutters is to be set upon a sand or cinder base, all asphalt pavement is to have a 6-in. Portland cement concrete foundation, the surface of pavement to be swept with natural hydraulic cement. All brick pavement is to have a 6-in. Portland cement concrete foundation with 2-in. sand cushion, joints to be filled with coal tar or asphaltic filler as specified and surface dressed with sand. Work includes 28 streets and alleys. Proposal must be accompanied by cash or certified check on a responsible Chicago bank, made payable to the President of the Board of Local Improvements for 10 per cent of aggregate of each proposal.

The Cass County Commissioners, Virginia, Ill., have pledged an additional $3,000 to Chandlerville for the construction of a hard road leading out south from that town.

⊙The Board of Local Improvements, Chicago, Chas. A. V. Standish, secretary, has awarded the contracts for paving the following alleys: Alley, Hill St. to W. Elm St., Central Paving Co., 172 Washington St.; alleys, W. Superior St. to W. Huron St., John A. McGarry & Co., 188 Madison st.; alleys, Locust and W. Chestnut Sts., Central Paving Co.; alley, E. Chicago Ave. and N. State St., Central Paving Co.; alleys, between LaSalle Ave. and N. Clark St., Central Paving Co.; alley, between W. Oak St. and Whiting St., Central Paving Co.; alleys, between Hill St and 200 ft. E. Wells St., Central Paving Co.: alleys, Eugenie St. and Mohawk St., John A. McGarry & Co., 188 Madison St.; alleys, Elm St. and Division St., Central Paving Co.; alleys, Wisconsin and Menominee Sts., John A. McGarry & Co.; alleys, Goethe St. and LaSalle Ave., John A. McGarry & Co.; alley, North Ave. and Willow St., Jas. A. Sackley & Co., 307 Chamber of Commerce; alleys, Webster Ave. and Belden Ave., Jas. A. Sackley & Co.; alleys, Sedgwick St. and Webster Ave., John A. McGarry & Co.; alleys, Garfield and Webster Aves., John A. McGarry & Co.; alleys, Center St. and Garfield Ave., John A. McGarry & Co.; alleys, Center St. and Racine Ave., John A. McGarry & Co.; alleys, Lincoln and Cleveland Aves., Jas. A. Sackley & Co.; alleys, Fullerton Ave. and Arlington Pl., Jas. A. Sackley & Co.; alley, Wrightwood Ave., and Dewey Pl., Jas. A. Sackley & Co.; alley, Menominee St. and Wisconsin St., Jas. A. Sackley & Co.; alley, Wisconsin St. to Center St., Jas. A. Sackley & Co.; alleys, bounded by Center St., Lincoln and Cleveland Aves., John A. McGarry & Co.; alleys, Webster Ave., Grant Pl. and Sedgwick St., Central Paving Co.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

✣[illegible] by L. E. McGann, Commissioner Public Works, 4th floor, City Hall, Chicago, Ill., for [illegible] twelve to fifteen ton road rollers, according to specifications on file in the office of the Department of Public Works. Proposals must be accompanied with $1,000.00 in cash or certified check for the same amount on some Chicago bank and made payable to the order of Commissioner of Public Works.

✣Bids will be received until 11 a. m., May 4, by L. E. McGann, Commissioner Public Works, 4th floor, City Hall, Chicago, Ill., for furnishing and delivering approximately 25,000 cubic yards of crushed limestone f. o. b. certain switch tracks in the 25th, 26th and 27th wards in said city, according to specifications on file with the office of the Department of Public Works of said city. Proposal must be accompanied with $2,000 in cash or certified check made payable to the Commissioner of Public Works.

✣Bids will be received until 11 a. m., May 3, 1911, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., 4th floor City Hall, for furnishing and delivering approximately 600,000 gallons of road oil to various ward yards, switch tracks and loading stations located throughout the city. Proposal must be accompanied by cash or certified check to the amount of One Thousand Dollars, check to be made payable to the Commissioner of Public Works.

Indiana.

✣Bids will be received until 10 a. m., May 1, by Hancock County Commissioners, Greenfield, Ind., for the construction of a retaining wall on Steele road No. 2. Charles H. Troy is County Auditor.

✣Bids will be received until 10 a. m., April 28, by Board of Park Commissioners, Indianapolis, Ind., for the imrovement of 38th St., latterly named Maple road from Capitol Ave. to Northwestern Ave. Leroy E. Snyder is Secretary.

✣Bids will be received until May 5, by Board of Lake County Commissioners at Crown Point, Ind., for the construction of eight gravel roads. Charles A. Johnson is County Auditor.

✣Bids will be received until 1 p. m., May 4, by Board of Wells County Commissioners, Bluffton, Ind., for the construction of two stone roads in Jefferson township. O. D. Garrett is County Auditor.

✣Bids will be received until 1:30 p. m., May 3, by Commissioners of Parke County, Rockville, Ind., for the construction of a gravel road in Howard township. J. E. Elder is County Auditor.

✣Bids will be received until noon, May 2, by Board of Pulaski County Commissioners, Winamac, Ind., for the construction of a gravel road in Salem and Beaver townships. W. E. Munchenburg is Auditor of the county.

✣Bids will be received until 2 p. m., May 2, by Board of Green County Commissioners, at Bloomfield, Ind., for the construction of a macadamized road in Taylor township. C. H Jennings is Auditor of the county.

✣Bids will be received until 1 p. m., May 1, by Board of Benton County Commissioners, Fowler, Ind., for the construction of the Thomas P. Carroll free stone road on the township line between Bolivar and Oak Grove townships. L. Shipman is County Auditor.

✣Bids will be received until 11 a. m., April 29, by Board of Vigo County Commissioners, Terre Haute, Ind., for the construction of four gravel roads. Nathan G. Wallace is Auditor of the county.

◉Kilty & Heck of Urbana have been awarded the contract by the County Commissioners, Wabash, Ind., for building the Smith road, located between Servia and Bippus, for $11,175.

◉W. W. Hatch Sons Co., Goshen, Ind., has been awarded the contract by the city of Goshen for the improvement of N. Main St. with Metropolitan brick with Pioneer asphalt filler. Bids were opened April 3.

◉The Commissioners of Rush County at Rushville, Ind., awarded the contract for the construction of the J. A. Brown stone road in Anderson township to Coulter Bros. of Rushville for $6,890. Bids were opened April 15.

◉John Berry, St. Hart St., Princeton, Ind., has been awarded the contract by the common council of Princton, Ind., for the construction and repair of all sidewalks in the corporate limits between May 1 and Nov. 1, 1911, for $.94½ per sq. yd. Bids were opened April 17.

Iowa.

✣Bids will be received until 8 p. m., May 15, by O. F. Graves, City Clerk, Harlan, Ia., for the construction of about 7,000 lin. ft. of concrete curb and gutter and 15,000 sq. yds. of concrete pavement, more or less. Official advertisement will be found elsewhere in this issue.

◉The city council of Hampton, Ia., has awarded the contract for the paving of several blocks of streets and three alleys to John A. Beebe of Omaha, Neb., at the following bid: Brick, $1.92½; cement concrete, $1.49; cement curb, $.38; extra grade, $.46; gutter plate, $.05 per lb.; false curb, $.20. The district comprises the two blocks on the south and east side of the city park, one block on Main St., from Chadima's corner meat market to J. Sikkema's blacksmith shop, and the block on 3d St., from the blacksmith shop to the Hampton Mercantile Co.'s store.

City Engineer R. C. Hart of Clinton, Ia., has prepared preliminary reports and estimates for the paving of 5th Ave., between 2d and 5th Sts. The estimated cost of the improvement, provided creosoted wood block is used, is $41,932.

The city council of Villisca, Ia.. has ordered specifications prepared for the paving of the business streets of the city. Bids for the work will be asked for shortly.

Plans and specifications are being prepared for the laying of 30 blocks of paving in the city of Denison, Ia., in the near future.

Mayor J. F. Starr of Fairfield, Ia., recommended to the city council the construction of about three more miles of paving, an improvement to the city lighting system, and the installation of electrollers in the business district, installation of a filtration system at the water works and the adoption of a comprehensive plan for a better sewer system.

Kansas.

◉Contracts for the construction of sand-clay roads to cost $11,088 were awarded by the County Commissioners, Wichita, Kan., on April 10, as follows: C. K. Whitney, for the building of the roads, which start at the first section line west of Meridian St., at the end of the paving on Douglas Ave., running then north and south a half mile each way and then running five miles west on Maple St. and Central Ave. Two bridges will be built along the improved road and 46,781 cu. yds. of grading will be necessary before the road is built. The roads will be about 11¼ miles in length.

The Leavenworth and Wyandotte County Commissioners, Leavenworth and Kansas City, Kan., county seats respectively, plan the construction of the Kansas City-Leavenworth rock road. A meeting was recently held to apportion the cost of culverts that must be built on the part of the road which follows the county line.

Kentucky.

The city council of Mt. Sterling, Ky., has passed an ordinance authorizing the construction of brick streets in the business section of the city. About 12,000 sq. yds, will be laid this year. Bids for the work will be received at once.

Louisiana.

◉The Bunkie and Bayou Dulac Canal committee, according to advices from Bunkie, La., on April 15 opened bids on the proposed road and canal from Bunkie to Bayou Delac. The contract was let to S. J. Burlin of Cottonport for $2,700.

◉The Board of Aldermen of Houma, La., has awarded the contract for the paving of Church, Lafayette and Roussel Sts., with cement sidewalks to Comerford, Garber & Co.

Maryland.

The construction of a new road from Dodge Park, Md., into the District of Columbia is being planned by an association recently organized and known as the Kent Citizens' Association. Arrangements have been completed to build the road from the Marlboro pike at Dodge Park to Huntsville, a distance of 11½ miles. The officers of the association are: O. C. Strawn, president; J. J. Crawley, secretary, and Lloyd Prather, treasurer.

Massachusetts.

Approximately $1,000,000 will be spent on the roads of Massachusetts this season under the direction of the Massachusetts Highway Commission. Of this amount about $500,000 will go into the construction of new state roads, and the other $500,000 will be devoted to improvements of other main highways and to the maintenance of the roads which already have been built by the commission. There are in Massachusetts about 837 miles of state highway. By the end of this season it is intended to have constructed approximately 45 miles additional. Besides this the commission proposes to improve many miles of existing town roads.

Michigan.

✣Bids will be received until May 2, by Common Council, Charlevoix, Mich., for the paving of Michigan Ave. in said city 42 ft. wide between gutters, covering about 600 lin. ft., and for paving Dixon Ave. from Michigan Ave. to the P. M. right-of-way, 32 ft. between gutters, and a lineal distance in length of about 4,600 ft. The curb and gutter on all streets to be 6 in. curb and 18 in. gutter, concrete construction. Bids are desired on the curb and gutter, separate from the paving. E. J. Miller is City Clerk.

The County Commissioners at Menominee, Mich., have rejected all the bids received April 12 for the construction of 7½ miles of gravel road. The lowest bid received amounted to $13,728. The work will now be done by the county force.

Supervisor John Rauchholz of Richland Township, Saginaw County, Saginaw, Mich., states that an election will be held in that township on May 20 to vote on the proposition of issuing bonds to the sum of $20,000.

The Board of Estimates of Detroit, Mich., has authorized approximately $250,000 of brick and asphalt resurfacing.

Marengo Township, Marengo, Mich., has voted $1,500 to be used for the building of a mile of gravel road under the state award plan, directly east from Marshall.

Minnesota.

✣Bids will be received until 7:30 p. m., April 28, by City Council, Minneapolis, Minn., for furnishing the city with 5,000 sq. yds. of granite blocks according to specifications on file with the City Engineer. Henry N. Knott is City Clerk.

The County Commissioners of Saint Louis County, Duluth, iMnn., have called for bids on several jobs of county road and bridge work. The contracts will be let at the May meeting of the commissioners. There is $225,000 to be spent on St. Louis County roads during the coming year.

Mississippi.

✣Bids will be received until noon, May 2, by Mayor E. S. Donnell, Columbus, Miss., for constructing approximately 6,000 lin. ft. of concrete curb and gutter or granite curb and concrete gutter.

The Board of Supervisors, Clarksdale, Miss., has ordered that a new road be laid out in the Big Creek territory, northwest of Lyon, connecting with the road from Lyon to the Quitman county line.

Advices from Gulfport, Miss., state that the Beat Road Commissioners, who have charge of the expenditure of the $50,000 provided for the building of roads in Beat two of Harrison County, have rejected the bid they received for the building of about four miles of road north of Gulfport. The estimated cost of the road is $10,000. It is probable that the specifications will be [illegible] and the work re-advertised.

Missouri.

✣Bids will be received until noon, May 5, by Board of Public Improvements, W. T. Findly, Secy., St. Louis, Mo., for reconstructing 25th St., from Cass Ave. to St. Louis Ave. Plans and specifications can be obtained of the board.

✣Bids will be received until noon, May 5, by Board of Public Improvements, W. T. Findly, Secy., St. Louis, Mo., for the reconstructing of 21st St., from Washington Ave. to Cass Ave. Plans and specifications can be obtained at the office of the board.

✣Bids will be received until noon, May 5, by Board of Public Improvements, W. T. Findly, Secy., St. Louis, Mo., for reconstructing Benton St., from Broadway to 20th St.

⊙The Board of Public Works of Kansas City, Mo., has awarded the contract for the paving of the alley between Gillman road and Holmes St., 31st St., to Linwood Blvd., to A. R. Mense for $1.23 per sq. yd.

The Board of Public Works of St. Joseph, Mo., has been petitioned for the paving of Albemarle St., 3d to 4th, with concrete or asphalt.

The city council of Kansas City, Mo., has decided to widen 18th St., between Baltimore and Woodland Aves. It is intended to appropriate 25 ft., on the south side of the street, from Baltimore Ave. to the Paseo, and 15 ft. on the north side from the Paseo to Woodland Ave. The estimated cost of the improvement is $600,000, which will have to be borne by a benefit district extending a half block on each side of 18th St., from Baltimore to Cleveland Aves.

The citizens of De Soto, Mo., on April 18 voted the issuance of bonds to the amount of $30,000 for road purposes in De Soto Road District.

Pettis County, Sedalia, Mo., has called a special election for May 16 to vote on a proposed bond issue of $350,000 for the construction of 125 miles of rock road radiating from Sedalia to all parts of the county.

Montana.

⊙The city council of Great Falls, Mont., has awarded the contract for boulevarding work in special improvement district 107 and four on 108 to Nelson & Smith for $2,209, and $1,817.

The county commissioners, Libby, Mont., are considering the matter of bonding Lincoln County for the purpose of building a trunk line wagon road through the county, following the Kootenai river. The proposed work calls for the building of somewhere in the neighborhood of 50 miles of highway.

New Jersey.

⊙The Buffalo Steam Roller Co., of Buffalo, N. Y., has been awarded a contract by the Hudson County Boulevard Commission, Jersey City, N. J., for a 15 ton standard steam roller for $3,500, less an allowance of $600 for two condemned rollers.

⊙The Filbert Paving Co., of Philadelphia, Pa., has been awarded the contract by the city council of Swedesboro, N. J., for the construction of an improved road or street on Railroad Ave., in the Borough of Swedesboro, beginning at the edge of the stone pavement on Main St. and extending over Railroad Ave. to the right-of-way line of the West Jersey & Seashore R. R., a distance of 859 ft. The contract price is $4,390. Bids were opened April 15.

Fiebleman & Co., of Newark, N. J., have commenced work upon the development of land in Passaic Ave., in Chatham, N. J. Over 500,000 cu. yds. of dirt will be used to fill and nearly seven miles of concrete walks are to be laid.

New York.

✣Bids will be received until [illegible] p. m., [illegible] 15, by Common Council, Lackawanna, N. Y., for necessary labor and material for paving Ridge Road from the east curb line of S. Park Ave. to the east curb line of the Hamburg Turnpike with vitrified brick, the pavement to be 42 ft. in width from curb to curb. J. J. M[illegible]

The Assembly, Albany, N. Y., on April 20 passed the bills of Senator Murtaugh, appropriating $1,000,000 for improved highways in the southern tier of the state; Assemblyman Merritt, appropriating $600,000 for good roads in St. Lawrence County, and Assemblyman Washburn, appropriating $60,000 for an improved road [illegible]

North Carolina.

✣Bids will be received until 3 p. m., May 12, by R. O. Edwards, Lieut., Constructing Quartermaster, Fort Caswell, N. C., for the construction of 500 sq. yds. macadam concrete or gravel road and about 2,000 sq. ft. concrete walk at Fort Caswell, N. C.

North Dakota.

The city council of Grand Forks, N. Dak., on April 11 received the following bids for paving of the three districts, Nos. 15, 16 and 18. District 15 takes in Cottonwood, Chestnut and Walnut Sts., and such parts of First, Second and Third Aves. that intersect. The estimated cost is $75,000. District 16 takes in Third St., from the end of the present paving to Skidmore Ave., taking in Ion Ave., in Skidmore Ave., Hill Ave., Third St., to the alley between Third St. and Second St. The estimated cost is $26,600. District 18 takes in Lewis Blvd., running in front of St. Michael's hospital, alley between Third St. and Second St., to a point 150 ft. south of Park St. The estimated cost is $18,700. The Bithulithic Co., on bithulithic, $2.52 per sq. yd., in district 15 and $2.57 per sq. yd. in districts 16 and 18; combination pavement of 15 ft. paved roadway with a 7½ ft. strip of cement concrete on each side, for district 15, $1.90 and $2.45 for concrete strips and roadway respectively, and for Nos. 16 and 18, $2 and $2.55 for the two kinds; The R. S. Blome Co., granitoid pavement for all districts, $2.40 per sq. yd. P. McDonnell, uniform for all districts, as follows: Cement concrete, $1.70; donnellite, $2; asphalt macadam, $1.80; asphalt concrete, $2; creosoted block, 20 lb. treatment, 3½-in., $2.70, 3-in., $2.50; vitrified brick, $2.55; combination, cement section, $1.70; paved roadway, $2.10, and $2.20; The Grand Forks Concrete Co., cement concrete, $1.83; asphalt macadam, with Tarvia V treatment, $1.80, with Westurmite, $2.20; creosoted block, 3½x20, $3.35; combination cement work, $1.85; paved roadway, $1.85 with Tarvia and $2.25 with Westurmite; The Northern Construction Co., on cement concrete, $1.85; asphalt macadam, Tarvia finish, $1.85; combination, $1.95 for concrete work, and $1.85 for paved roadway with Tarvia finish. Westurmite Co., on asphalt concrete, $2.10; combination concrete work, $1.98, and paved roadway, $2.20.

Ohio.

✣Bids will be received until noon, May 19, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under Specifications No. 187, of extension of Stuble road by macadamizing from Pippin Road to Hamilton Pike in Colerain and Springfield township. Fred Dreihs is clerk.

✣Bids will be received until noon, May 19, by Board of County Commissioners, Cincinnati, O., for the improvement, under specifications No. 192, of Compton Road from Colerain township line 1,600 ft. east in Springfield township. Fred Dreihs is clerk.

✣Bids will be received until 10 a. m., April 28, by Board of County Commissioners at the office of C. C. Meekison, County Auditor, Napoleon, O., for the improvement of seven roads.

✣Bids will be received until noon, April 27, by Director of Public Service, Youngstown, O., for furnishing necessary labor and material for sewering and grading Flemming St., between Federal St. and North End. A certified check for $300 must be filed with each bid. W. H. McMillin is Clerk.

✣Bids will be received until 11 a. m., May 3, by Board of County Commissioners, Cleveland, O., for grading and improving Harvard Road between Stations 11 and 16. Plans and specifications may be obtained of Frank Lander, County Surveyor.

⊙The board of control of Youngstown, O., on April 10 awarded six contracts for paving and grading, as follows: Bettie Ave., grading, to J. M. McGraw, at $943; Duquesne St., paving, to Youngstown Construction Co., at $5,411; Breaden St., paving, to Mullin & Quinn, at $10,523; Superior St., paving, to A. Collucci, at $12,558; Oak St., paving, to A. O'Hara, at $27,441, and Logan Ave., paving, to S. H. DeGroodt, at $35,766.

⊙Baldwin Bros., Rose Bldg., Cleveland, O., have been awarded the contract by the Board of County Commissioners, Cleveland, for grading, drainage and improving Wooster Pike road No. 3 from end of the present brick road to the Medina county line in Strongville township. The contract price is $30,105. Bids were opened April 15.

⊙The Trustees of Salem Township, Wyandot County, Upper Sandusky, O., have rejected the bids received for piking the Moody road a quarter of a mile, and the Johnson road a mile and three-quarters and entered into a private contract with Joseph Eckert of Salem township for $2.10 per cu. yd., on the Moody road, and $1.55 per cu. yd., on the Johnson road.

Citizens of Oakley, O., have asked the assistance of the County Commissioners at Cincinnati, O., in paving Madison road with granite.

State Highway Commissioner James C. Wonders, Columbus, O., has notified the County Commissioners at Portsmouth, O., that the Chillicothe pike which was started last year must be completed this year. It is estimated that it will cost $2,000 to complete the work.

The county surveyor of Athens County, Athens, O., has been instructed to go ahead with his survey of the route of the state aid road through the town of Nelsonville. This highway will be built this year from the corporation line of Nelsonville east toward Athens to Myers' Crossing. James C. Wonders, Columbus, is state highway commissioner.

The Columbiana County Commissioners, Lisbon, O., have announced their intention of constructing this summer 10 miles of the brick roads contemplated, which are to cross the county from east to west and from north to south. The roads will be constructed in sections, two miles to be built this summer at each of the following points: East Liverpool, Wellsville, Salem, Lisbon and East Palestine. It is estimated that the work to be done this year will cost in the neighborhood of $150,000. The entire improvement will cost $500,000. James C. Wonders, Columbus, is state highway commissioner.

The County Commissioners, Port Clinton, O., have granted the building of two stone roads in Allen township, which are estimated to cost about $40,000. One road, the Curtice road, is about two and a half miles in length, will be 16 ft. wide and have a water cement top dressing. The other, the Williston road, will be about three miles long and 14 ft. wide and have a covering of a tar preparation.

Plans and specifications for improvement of the Country Club road, from Reading Pike to Ohio pike, Silverton, at an estimated cost of $5,011, have been ordered by the County Commissioners, Cincinnati, O.

[illegible] for improvement on Bond road, from Montgomery road to Camargo pike, at an estimated cost of $17,510, have been approved by the county commissioners, Cincinnati, O. The plans and specifications for macadamizing of the extension of Struble road, from Pippin road to Hamilton pike, at an estimated cost of $1,588 were received by the commissioners.

The county commissioners, Bowling Green, O., have ordered the building of two stone roads to the Geolschin Stone Co. The roads extend five miles between Weston and Milton [illegible]

Oklahoma.

A petition has been circulated by L. D. Lindsey, Keystone, Okla., to have the county commissioners of Tulsa County, Tulsa., Okla., established a road which passes [illegible] on the Missouri Kansas & Texas Railroad.

⊙The city council of Lawton, Okla., has awarded the contract for the paving of [illegible] blocks to C. H. Shaw of that city for approximately [illegible].

Oregon.

⊙The City Executive Board of Portland, Ore., has awarded the following contracts for street improvements: Joplin & Meeks, $1,902, for grading and concrete curbs and walks on Hood St.; O'Neill & Co., $2,955, for grading and concrete curbs and walks on Grand Ave., from Broadway to Schuyler; Oregon Independent Paving Co., $7,596, for asphalt pavement on East Washington St., from East 16th to East 20th St.; Barber Asphalt Paving Co., $149,195, asphalt paving on East Everett St. district; Bechill Bros., $10,137, grading and concrete curbs and walks on 42d Ave., from East [illegible] to East 52d Sts.; [illegible] Wiles, $157,413, bithulithic pavement on Beaumont district.

⊙The Hassam Paving Co. has been awarded the contract by the city of Portland, Ore., for the paving of Myrtle St., from 16th to 17th Sts., with Hassam for $2.25 per sq. yd.

The Ladd Estate Co., of Portland Ore., will soon let the contract for improvement of Eastmoreland and Westmoreland in Portland. The total sum will approach $900,000. Plans for this work are now being developed by City Engineer J. W. Morris. They will call for hard surfacing every street in the two additions, laying of sidewalks and curbs and the installation of complete sewer, water and gas systems, serving every lot in the property.

Following bids were received by the Executive Board of Portland, Ore., for public improvements: Arlington Heights District, grading and concrete curbs and walks, Porter Bros., $109,217. East 24th St. District, asphalt pavement, Oregon Independent Paving Co., $40,000. Abernathy St. from Kelly to Corbett, grading and concrete curbs and walks, A. D. Kern, $1,500; C. A. Finley, $1,702; Nat Costanza, $1,497. Belmont St. District, Hassam pavement, Oregon Hassam Improvement Co., $25,718. East 11th St. from Prescott to Going, grading and concrete curbs and walks, Oregon Independent Paving Co., $1,977; Baker Bros. & Hayden, $1,466; Bechill Bros., $1,962. Killingsworth Ave., from Union to the city limits, grading and concrete curbs and walks, K. G. Lundstrom, $30,863; Oregon Independent Paving Co., $31,916; Baker Bros. & Hayden, $31,087; R. J. Debuhr, $31,912; Giebisch & Joplin, $30,224; Joplin & Meeks, $30,327; Beehill Bros., $31,309. Linn St. from Gladstone to Cook, grading and concrete curbs and walks, Oregon Independent Paving Co., $13,438; Beehill Bros., $12,993; Baker Bros. & Hayden, $12,681; Joplin & Meeks, $12,862; C. A. Akerson, $12,823; Giebisch & Joplin, $12,178; Coast Construction Co., $12,226. Newark St. District, grading and concrete walks and curbs, E. Sandeberg, $5,966; Oregon Independent Paving Co., $6,160; R. J. Debuhr, $6,205; Baker Bros. & Hayden, $6,115; C. A. Akerson, $6,003; Kelkenny Bros., $6,649; St. Johns Sand & Gravel Co., $4,995; Hilliard & McGinnis, $5,493; Coast Construction Co., $6,267; J. Hahn, $6,150.

The citizens of Baker, Ore., on April 12 voted the issuance of bonds in the sum of $45,000 for paving street intersections, balance of paving to be paid by property benefited directly. [illegible] A. Bale is city engineer.

Pennsylvania.

✣Bids will be received until 3 p. m., April 28, by C. A. Stewart, Borough Engineer, Municipal Bldg., Jones Ave., North Braddock, Pa., for the improvement of Bridge Ave., from alley south of Bowers St. to South St.; for the improvement of Orchard alley, from Anderson St. to Apple alley; for the improvement of 2nd St., from Hawkins Ave. to Lobinger Ave.; for the improvement of Earl St., from Stokes Ave. to Seddon Ave.; for the improvement of 13th St., from south side of Rebecca St. to south side Packer Ave.; for the improvement of Price Ave., from 4th St. to present end of paving; for the improvement of School alley, from Lobinger Ave. to Price Ave.; for the construction of about 1,070 ft. of pipe sewer on Ash alley; for the construction of about 520 ft. of pipe sewer on Zuerner alley, and for the construction of about 620 ft. of pipe sewer on Jones Ave. Plans, specifications and bidding blanks at engineer's office.

⊙The Barber Asphalt Co. has been awarded the contract at Philadelphia, Pa., for the resurfacing with asphalt of Spring Garden St., between Broad and 25th, for $0.93 per sq. yd. The work comprises about 14,000 sq. yds. of asphalt and 1,700 sq. yds. of Belgian block. The Barber Co. was also awarded the contract for furnishing the city with asphalt and other paving material for use by the city's repair gangs in making minor street repairs. For such material there is $50,000 appropriated.

The Hecht bill to levy a special tax of one mill on the dollar of actual value of all property in Pennsylvania, subject to state taxation for improvement of public roads, has been passed by the House. The bill will raise about $300,000.

The Filbert Paving & Construction Co. has submitted the lowest bid to the Bureau of Highways of Philadelphia, Pa., for the paving of 11 streets with asphalt, the bid being $1.65 per sq. yd. The Filbert Co. also submitted the lowest bid for the repairing of streets other than those paved with asphalt, the bid being $0.22 per sq. yd.

Tennessee.

✣Bids will be received until June 1 by the George Co., Randolph Bldg., Memphis, Tenn., for 58 miles of gravel roads at Hazlehurst, Miss., in Copiah County.

Texas.

✣Bids will be received until 3:30 p. m., June 1, by Commissioners' Court of Williamson County at Georgetown, Texas, for the construction of graveled and macadamized roads in Road District No. 2. W. W. Jenkins is County Auditor.

✣Bids will be received at once for clearing, grubbing and grading about 3 miles of streets in Houston Harbor addition. Plans and specifications are on file with Tolman Engineering Co., 403 First National Bank, Houston, Texas.

⊙The city commission of Dallas, Tex., has awarded the Standard Engineering & Construction Co. the contract for the paving of certain streets in Exposition Park addition for approximately $25,000. Asphalt macadam will be used.

⊙The city of Greenville, Tex., on April 11 received bids for the construction of 148,600 sq. yds. of paving and 84,000 lin. ft. of concrete curb. The contracts for the work were awarded as follows: Texas Bitulithic Co., Dallas, Tex., 89,876 sq. yds., bitulithic and 10,000 lin. ft. of curb and gutter; [illegible] Wood Block Paving Co., Gulfport, Miss., 33,230 sq. yds. of wood block paving with 20,000 lin. ft. of curb and gutter; General Paving Co., Hot Springs, Ark., 22,354 sq. yds. of vitrified brick and asphaltic concrete paving with 15,000 lin. ft. of curb and gutter; R. C. Stubbs, Dallas, Tex., 3,700 sq. yds. of concrete paving.

Virginia.

The city council of Bristol, Va., has joined the people of the Goodson District of Washington county in an agreement to spend $50,000 for the construction of pike roads, leading in four directions out of Bristol. Work will be commenced this spring.

⊙The contract for laying concrete roadways on Martin's lane and on Hall St., east of Yarmouth St., in Norfolk, Va., has been awarded to T. J. McGuire by the board of control for $1.35 per sq. yd.

The board of supervisors of Fairfax County, Fairfax, Va., has authorized the Juniata Paving Co., of Philadelphia, Pa., to begin construction on May 1 of a highway from Fairfax Court House to the District of Columbia line. More than $92,000 will be expended in grading and surfacing the pike.

Washington.

⊙J. Kalberg, it is reported, has been awarded the contract by the Board of Public Works of Seattle, Wash., for grading and curbing of North Eighty-Second St. and others for $15,416. The board also awarded Hansen & Co. the contract for planking of Western Ave., for $9,250.

The county commissioners, Cathlamet, Wash., have made arrangements for the issuance of the $50,000 of bonds for road purposes, which proposition carried at the last general election. As soon as the preliminaries can be arranged the bonds will be placed on the market and road building at once begun.

West Virgina.

City Engineer Charles B. Cooke of Wheeling, W. Va., has completed the survey of Wheeling hill, and is preparing specifications, which provide for restoring the road to its original width, the leveling up of the thoroughfare and placing it in good condition.

Wisconsin.

✣Bids will be received until May 15 by Waukesha, Wis., for macadam on three streets The Engineer's estimate is as follows: 4,894 cu. yds. excavation, 4,796 ft. concrete curb and gutter, 4,620 sq . yds. asphalt macadam, 270 sq. yds. brick gutters, 170 ft. storm sewer. M. R. Butler is City Engineer.

The town of Dunkirk, Wis., has voted the sum of $1,000 towards defraying the expense, which with equal amount supplied by Dane County, will enable the town to start work of improving the highways this season.

An appropriation of $5,000 has been made by the village of Rio, Wis., and neighboring townships to build roads in and around Rio.

Wyoming.

The city council of Cheyenne, Wyo., will probably be petitioned for the paving of 16th St., between Central Ave. and Eddy St.

Canada.

The city council of Galt, Ont., has been petitioned for a macadam roadway, cement curb and gutter on MacKenzie St. and for a Tarvia roadway with cement curb and gutter on [illegible] St. Edw. O. Fuce is Town Engineer.

BRIDGES—STEEL AND CONCRETE

Alabama.

⊙The Board of County Commissioners, Decatur, Ala., have awarded the contracts for the construction of four steel bridges to Austin Bros. Bridge Co., Atlanta, Ga., at $4,027. The bridges are to be built at the following places: One mile east of Hartselle over Shoal creek on the Hartselle and Cedar Grove road; Stringer bridge on the county road between Nunn's Mill and Center Grove; two bridges over Town creek east of Somerville on the Somerville and Tell Stringer road.

Advices from Decatur, Ala., state that the Board of County Commissioners will soon let contracts for the building of steel bridges over Dinsmore creek four miles south of Decatur on the Decatur and Flint road, and a bridge across Betty Wright creek on the Courtland and Decatur road near Decatur.

Arkansas.

It has been announced by Kahmann & McMurry, contractors, who are building the 8 piers and 2 abutments of the free bridges at Vanburen, Ark., that work will be completed by May 1. It is believed that the American Bridge Co. which is to furnish the steel and complete the bridge will begin erecting the false work between the piers about May 1 and have everything in readiness for the steel when it arrives during June and July.

California.

⦿The Board of County Supervisors, Modesto, Cal., has awarded the contract for making repairs on the Bailey Ferry Bridge, approaches to which were recently washed out by high water, to the Pacific Construction Co. at $3,230. The work will include the construction of 180 ft. pile trestle approach.

⦿Board of County Supervisors, Ventura, Cal., has awarded the contracts for the construction of the proposed new bridges at Piru and Saticoy, Cal. The first to the Missouri Valley Bridge & Iron Co., Denver, Colo., at $19,210; the latter to Merry-Elwell Co., Oakland, Cal., at $53,800. Both structures will be built of steel with a solid timber floor and a 2-in. asphalt surface. The piers will be of concrete.

Board of County Supervisors, Sacramento, Cal., has authorized the County Surveyor to prepare plans and specifications for the construction of a new bridge across the American River at a point northeast of that city. The cost of the structure is estimated at $30,000.

Illinois.

⦿The contract for the construction of 5 bridges in Bond Township, Lawrence County, Ill., was awarded by G. W. Lacey, Lawrenceville, Ill., April 18, to the Vincennes Bridge Co., Vincennes, Ind., at $7,300. The structures will be of steel with concrete abutments and movable concrete floors.

⦿The contract for the construction of a reinforced concrete bridge at Cissna Park, Ill., has been let to C. A. Never & Son, Clayton, Ill., at $2,175.

State Highway Engineers of Illinois have recommended the construction of a reinforced concrete bridge to replace the old structure at Woodland at an estimated cost of $9,000 The structure as planned will consist of four spans. Rufus Kendall, Watseka, Ill., is Clerk of Belmont Township.

The contract for the construction of the reinforced concrete bridge over the Fox River on Wilson St., Batavia, Ill., consisting of three spans 60 ft. wide and totaling 270 ft. in length, has been let by City Council to Carl J. Ekman & John MacKimmie at $30,500. Other bidders for the work were: Cornelius Collins, Batavia, Ill., $41,000; Sauber & Paulson Const. Co., Lockport, Ill., $37,200; Cullen & Friedstedt Co., Chicago, Ill., $45,000; Pitts & Dougherty, Lockport, Ill., $41,700; Joliet Bridge & Iron Co., Joliet, Ill., $37,800; J. J. O'Heron & Co., $38,100; the Gould Const. Co., Davenport, Ia., $36,750; Wolcott-Jones Const. Co., Batavia, Ill., $33,150. Bids were opened April 20 by W. H. Reaney, City Clerk.

The Santa Fe System has prepared plans for the reconstruction or renewal of the following bridges: Bridge No. 56, Colorado Division, to be replaced, estimated cost $6,500; No. 183, Colorado Division, to be replaced, estimated cost, $3,000; No 127, Colorado Division, estimated cost, $1,700; No. 109, to be replaced, estimated cost, $3,300; No. 52, Western Division, to be replaced; No. 31, Illinois Division, to be renewed, estimated cost $11,000; No. 46, Illinois Division, estimated cost $2,500; No. 3076, Southern Division, to be replaced, estimated cost, $3,200; No. 3032, Southern Division, to be replaced, estimated cost $3,000; No. 3136, Southern Division, to be replaced, estimated cost $2,100; No. 7, Rio Grande Division, to be renewed, estimated cost $8,700; No. 47, Southern Kansas Division, to be replaced, estimated cost $12,000; and No. 361, Missouri Division, to be renewed and track raised to grade at an estimated cost of $11,400.

Indiana.

✣Bids will be received until 10 a. m., May 8, by Board of Shelby County Commissioners, Shelbyville, Ind., for the following supplies: 8,000 ft. b. m. bridge flooring, either red beech, white oak or burr oak 2½ in. thick and 16 ft. lengths of the best grade and quality, delivered at the bridge over Flat Rock River about 1 mile west of the town of Flat Rock, Ind. Also for 900 ft. of 18-in. common drain tile; three 18-in. ¼ curved sewer, one 18x18x12-in. branch tile; one 18x18x10-in. branch tile; one 18x18x8-in. branch tile. Said tile to be delivered f. o. b. Waldron, Ind. G. B. Huntington, Auditor.

✣Bids will be received until 1 p. m., May 15, by Commissioners of Vermillion County at Newport, Ind., for the repair of west abutment of Perryville bridge and reflooring. H. T. Payne is County Auditor.

✣Bids will be received until 10 a. m., May 8 by Commissioners of Shelby County, Shelbyville, Ind., for the construction of concrete abutment and repair work on St. Paul bridge; also for bridge in Sugar Creek township. G. B. Huntington is County Auditor.

✣Bids will be received until May 4 by Board of Wells County Commissioners, Bluffton, Ind., for the construction and repair of 15 bridges and arches. O. D. Garrett is Auditor of Wells County.

✣Bids will be received until 11 a. m., May 3, by Board of Gibson County Commissioners, Princeton, Ind., for the construction of 12 steel bridges and one repair job. W. T. Roberts is County Auditor.

✣Bids will be received until 2 p. m., May 3, by Daviess County Commissioners, Washington, Ind., for the construction of seven bridges. Thomas Nugent is County Auditor.

✣Bids will be received until May 2 by Board of Marshall and Fulton County Commissioners, at Plymouth, Ind., for the construction of two bridges between Tippecanoe and Newcastle townships on the county line road. Charles M. Walker is Auditor of Marshall County.

✣Bids will be received until 11:30 a. m., May 2, by Board of Clay County Commissioners at Brazil, Ind., for the construction of a bridge across Connely ditch. E. A. Staggs is County Auditor.

✣Bids will be received until 2 p. m., May 2, by Commissioners of Greene County, Bloomfield, Ind., for filling approaches to Headricksville bridge. C. H. Jennings is County Auditor.

Commissioners of Elkhart County, Fort Wayne, Ind., have decided upon the construction of a new bridge over Rock Run at an estimated cost of $7,000.

The Board of County Commissioners, Bluffton, Ind., has adopted the profiles for the construction of 14 new bridges in Wells County at a total cost of $10,000. The two largest structures will be at Poneto and Domestic, costing $3,000 and $2,500, respectively. The bridges will be of concrete.

The County Commissioners have under consideration the construction of two bridges in Indianapolis, Ind., for which $105,000 was appropriated at a meeting last September. One structure will be located at Capitol Ave. over Fall Creek, estimated cost $85,000; the other in West Washington St. over Little Eagle Creek, estimated cost $20,000.

Iowa.

Bids were opened at Clinton, Ia., and contracts awarded for the construction of a number of culverts, etc.: Three tubular culverts in Manufacturers' Addition, one at Eleventh Ave., near Fourteenth St., one at Sunnyside Ave., between Fifteenth and Sixteenth Sts., and one at Fifteenth St., near Stockholm, contract to Godber Hansen, whose bids was $50 less than engineer's estimate, the bids being as follows: Godber Hansen, $605; P. C. Donahue, $669; Thomas Carey & Son, $705; Cooley Construction Co., $845; Bridge wall, Main and Franklin Sts., Lyons, contract to P. V. Clarke, whose bid was $20 less than estimate, the bids being as follows: P. C. Donahue, $371.69; Thomas Carey & Son, $370.70; Godber Hansen, $359.45; P. V. Clarke, $346.45; Concrete steel bridge at Fourth and Lumber Sts., Lyons, contract to P. V. Clarke, the bids being as follows: Godber Hansen, $2,136.10; Thomas Carey & Son, $2,136.80; P. V. Clarke, $2,073.30; P. C. Donahue, $2,029.60, but the latter failed to bid on excavation and earth fill which would increase bid $165 or to $2,194.60.

It has been announced, according to reports from Boone, Ia., by officials of the Fort Dodge, Des Moines & Southern Interurban Co., that work will soon be started on the erection of a big steel viaduct over the Des Moines River near that city to shorten the route between Boone and Fraser 1½ miles. J. L. Blake, Boone, Ia., is General Manager.

Kentucky.

⦿Advices from Cincinnati, O., state that the Baltimore & Ohio and the Chesapeake & Ohio Railroads have awarded the contracts for the construction of steel viaducts in Louisville to Grainger & Co., Louisville, Ky. The reinforced concrete supports have been let to B. C. Milner & Sons. The work, it is said, will involve an expenditure of $800,000.

⦿Bids were opened April 17 by the city of Paducah, Ky., L. A. Washington, City Engineer, for constructing a reinforced concrete bridge 43 ft. wide and 295 ft. long, the approximate quantities being as follows: Excavation, 170 cu. yds. Linear feet concrete piling, 3,720 ft. Concrete in piers, abutments and retaining walls, 514 cu. yds. Concrete in arches, girders, columns, beams, floor and railing, 767 cu. yds. Reinforcing steel in piles, 77,600 lbs. Reinforcing steel in superstructure, 115,336 lbs. Cast steel hinges, 1,090 lbs. Lamp posts, 8. Waterproofing, 720 sq. yds. Cement sidewalks, 4,380 sq. ft. Creosote wood paving blocks, 920 sq. yds. The bids received were as follows: Foy-Proctor Co., Nashville, Tenn., $39,062; J. A. Omberg, Jr., Memphis, Tenn., $30,600 (awarded contract); L. W. Hancock & Co., Louisville, Ky., $35,770; Standard Concrete Co., Chicago, Ill., $32,700; Nashville Bridge Co., Nashville, Tenn., $34,800; Davis-Hoys Constr. Co., Paducah, Ky., $33,329.

Residents of Ashbysburg have petitioned the County Court, Madisonville, Ky., for the construction of a bridge over Pond River near that place. The structure would cost, it is estimated, $3,000.

Louisiana.

Government engineers have approved the proposed plans to locate the proposed bridge 1,000 ft. below the present railroad bridge in Shreveport, La. Ira G. Hedrick, Kansas City, Mo., prepared plans for the structure which will be for vehicular traffic across the Red River, connecting Shreveport and Bossier City. Bids will be asked for the work within a month, it is said.

Minnesota.

⦿Commissioners at St. Louis County at Duluth, Minn., recently let two bridge contracts. One bridge will be built over the St. Louis River at Brookston by the Continental Bridge Co. It will be of steel and with the approaches and foundationh will cost $8,585. Another steel bridge over the Cloquet River at Burnett. It will be 171 ft. long and will cost the county $5,779. Both the bids for the bridges were cut down several hundred dollars before the contracts were let

City of Melrose, Minn., has engaged S. S. Chute, City Engineer of St. Cloud, Minn., to prepare plans and submit estimates for the construction of a steel foot bridge and a steel wagon bridge to cross the Mill pond in that city. The structure, it is believed, will be over 400 ft. long.

Missouri.

✣Bids will be received until May 3 by the County Court, Maryville, Mo., for the following bridges and improving roads No 1 16 ft. steel I beam bridge on concrete abutments and concrete floor on road through [illegible] township. No 2 24 ft steel I beam on steel [illegible] floor, on west line section 11, T 65, R 38, [illegible] eter, with 4 ft. retaining walls reinforced in [illegible]

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible] 21, T. 63, R. 35, White Cloud township, 60 ft. [illegible] retaining walls, reinforced. No. 5—Repairs on Platte river bridge on township line between Jefferson and Jackson townships. No. 6 [illegible] bridge over 102 river in section 34, township 65, range 35, Polk township. Plans and specifications on file in highway engineer's office. J. E. Reese, Highway Engineer.

⦿The contract for furnishing steel for 12 girder bridges and for steel joist and handrail to repair old span has been let by F. M. Latimer, County Highway Engineer, Marshall, Mo., to the Kansas City Bridge Co., Kansas [illegible]

⦿The contract for the reconstruction of the Fifth St. bridge at Kansas City, Mo., over the Kaw River to conform to the 734-ft. harbor lines as outlined by the War Department has been let to the Western Bridge Co., of Harrisonville, Mo., at $9,400. The work will include raising the bridge and constructing two new spans and new approaches.

The Upper House of the Council, Kansas City, Mo., has passed the ordinance, as amended, providing that the Metropolitan St. Ry. Co. is to contribute $320,000 towards the construction of the viaduct for the West Twenty-seventh St. trafficway. The amendment stipulates that if any other street car company wants to use the viaduct between Liberty and Broadway pier to June, 1925, when the franchise of the company expires, the Metropolitan is to be reimbursed by such company.

⦿Advices from Rolla, Mo., state that the County Court of Phelps County has awarded the contract for the construction of the proposed iron bridge over the Little Piney River at Newburg to the Missouri Bridge Co., St. Louis, Mo.

Montana.

The County, according to advices from Troy, Mont., has bonded to the amount of $150,000 for the construction of a bridge across the Kootenai River at Troy and for constructing a truck line.

Nebraska.

✣Bids will be received until noon, May 12, by Board of County Commissioners, Madison, Nebr., for furnishing the necessary labor and material for erection and completion of the following bridges or as many thereof as may be ordered during the year beginning May 16 and ending May 16, 1912, in Madison County of which S. R. McFarland is Clerk: One 32-ft. span, 16-ft. roadway steel I-beam bridge with 12-ft. approach, across Union Creek near Madison. And such other bridges of like class as above as necessity or emergency may require to be ordered by said board of county commissioners during the time specified. One 16-ft. roadway, 16-ft. span, steel I-beam bridge near Madison, and such other bridges of like class as above, ranging in span from 16 to 80 ft., as necessity or emergency may require to be ordered by said board of county commissioners during the time herein specified.

Business men of Omaha, Nebr., recently held a conference with Commercial Club at Yankton, S. Dak., in regard to the construction of a bridge across the Missouri River at that place, hoping thereby to secure direct connections between those cities.

New Jersey.

✣Bids will be received until 2:45 p. m., April 28, by Board of Chosen Freeholders, Bergen County, N. J., Hackensack, N. J., for constructing concrete sidewalks on the Garfield Bridge, Garfield, N. J. Plans and specifications can be examined and all necessary information obtained at the office of the Clerk of the Board of Freeholders of Bergen County, at the Court House, Hackensack, N. J., and at office of the Passaic County Engineer, Court House, Paterson, N. J., any day except Saturday, between the hours of 10 a. m. [illegible]

✣Bids will be received until 3 p. m., May 4, by Board of Chosen Freeholders, Hudson County, Jersey City, N. J., for the construction of a new highway bridge over Morris Canal at Communipaw Ave., Jersey City, N. J. Walter O'Mara is Clerk of the Board.

⦿The Hudson County Boulevard Commission, Jersey City, N. J., on April 19 awarded the contract for a new concrete and steel bridge over the Central R. R. of New Jersey tracks to Joseph Murphy & Son, Inc., at $69,999. The Boulevard Commission also awarded the contract for repairing a bridge over the Pennsylvania R. R. tracks to the Vulcan Rail & Construction Co., Brooklyn, N. J., at $16,642. The work includes new railing and other improvements.

Information from Trenton, N. J., is to the effect that a bill has been passed by Senate providing for the continuance of the commission to investigate and report on a proposition to erect a bridge across the Hudson.

Board of Freeholders, Trenton, N. J., have received the following bids for the construction of the South Stockton St. bridge and repairing the arch bridge at Titusville. South Stockton St. bridge: Ginder Construction Co., $4,765; Newton A. K. Bugbee Co., $3,779; McGovern Contracting Co., $2,960. Titusville Bridge: McGovern Contracting Co., $1,833; Gibbs & Morgan, $2,590; Russell Klockner, $1,950.

At a regular meeting of the city council, Rahway, N. J., the question of constructing a new swing bridge over the Rahway River between East and South Rahway was taken up for consideration.

New York.

Among the improvements planned by the New York Central in the vicinity of Albany, N. Y., will be the construction of a 3-arch concrete bridge to replace the present pile trestle over the Poestenkill River at Madison St. in Tray, N. Y. The sum of $50,000 will be expended upon the work, which will be begun as soon as the high water in the river subsides.

Common Council of Tonawanda, N. Y., has passed a resolution approving the present plans of movable bridges across Tonawanda Creek from Niagara River to Pendleton.

At a recent meeting of the Grade Crossing Commission, Niagara Falls, N. Y., Frederick Chormann, Secy., and J. L. Harper, Engineer, were appointed on a committee to go to New York to confer with the New York Central Ry. officials in regard to constructing some sort of a crossing at Whirlpool Ave.

North Dakota.

✣Bids will be received until 2 p. m., May 16, by Pembina County, N. Dak., at Pembina, N. Dak., for the construction for an all steel and concrete bridge that may be built by county during the year of 1911. Plans and specifications on file in the office of W. W. Felson, County Auditor, Pembina, N. Dak.

Ohio.

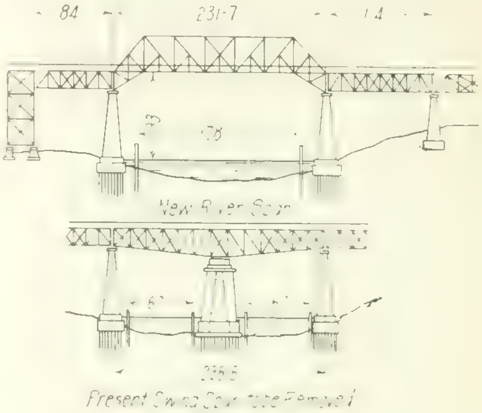
✣Bids will be received until 11 a. m., May 17, by the Board of County Commissioners, Cleveland, O., for the construction of bridge work as follows: Report No. 2782, painting bridge Harvard Road, in Newburg township; Report No. 2783, painting bridge Harvard Road in Brooklyn township; Report No. 2784, painting bridge Lorain Road in Rockport township. Plans and specifications are on file at the office of the County Engineer, New Court House, Cleveland, O. John F. Goldenbogen is Clerk.

✣Bids will be received until 1 p. m., April 27, by Commissioners of Morrow and Marion Counties, Mt. Gilead, O., for furnishing all materials and performing all work or such parts thereof as bidders may see proper for the construction of the superstructure and substructure for a steel bridge known as the Whetstone Bridge over the middle fork of Whetstone Creek on the county line between Tully township, Marion county, and Washington township, Morrow county, Ohio. Said bridge to be 60 ft. in length from center to center, and roadway 14 ft. Plans and specifications for this work are on file in the office of the Auditor of either of said counties. Proposals will also be received for making grade north of said bridge, the specifications for which are on file in the office of the Auditor of either of said counties. Clifton Sipe is Auditor of Morrow Council.

⦿The contract for the construction of the new Germantown Traction Bridge, according to advices from Dayton, O., has been awarded to Charles Bird, Springfield, O., at $6,295. The structure, which will be of concrete and steel, will replace the one now standing at the edge of Germantown.

According to reports received from Portsmouth, O., it has been definitely decided by the Chesapeake & Ohio Ry. to build a bridge across the Ohio River at Portsmouth, O., to replace the ferry now being used between that city and South Portsmouth.

Application has been made to the U. S. Government by the city of Cleveland, O., for authority to replace the draw span of Central viaduct at Cuyahoga River with a fixed span, providing for a clearance of 95 ft. above the average stage of water in the river. It is the intention of the city, should permission be given by the government, to replace the draw span as above indicated, and also to replace the existing plank flooring, with a creosoted block pavement, also to strengthen the floor system underneath the street railway tracks, to rebuild four piers at the south end of the bridge which have cracked, due to unequal settlement or sliding. It is estimated that the contemplated improvements will cost something less than $300,000. The accompanying cut shows the changes contemplated. Robert Hoffmann is Chief Engineer, Department Public Service, of Cleveland.



Oklahoma.

Steps are being taken to secure authority to construct and operate a new bridge across the Arkansas River between Muskogee and Fort Gibson to be used for the tracks of the interurban electric line promoted by Ex-Governor Haskell of Oklahoma.

Oregon.

⦿The contract for the construction of the steel superstructure of the new Oregon-Washington Railroad & Navigation Co., over the Willamette River eastward from the foot of Flanders St. has been awarded Robert Wakefield of Portland, Ore., at $232,000. The bridge, including the substructure, which is now being completed by the Union Bridge & Construction Co., will entail an expenditure of $1,000,000.

The following bids were recently received by the city council of Pendleton, Ore., for the construction of the new Main St. bridge and same referred to the Street Committee: O. H. Stratton, Spokane, $12.50 per cu. yd. for the concrete work, 5½ cents per lb. for the steel superstructure and $4,500 for the walks and flooring; C. E. Lum, North Yakima, $13.90 per cu. yd. for concrete work, 6 11/100 cents per lb. for steel and 55 cents a square foot for flooring, the bridge to be completed by Sept. 15; Minnesota Steel Co., by W. W. Roberts, $10 per cu. yd. for concrete, 5 6/100 cents per lb. for steel, $4,000 for walks, a total of $31,588.62, the bridge to be completed by Sept. 15; A. Valk, $12 per cu. yd. for concrete, $17,475 for the superstructure, $2,745 for concrete walks and flooring or

$1,280 for wood walks and flooring, work to be finished by Aug. 15 and traffic guaranteed not to be stopped over 30 days; Central State Bridge Co., $11.51 per cu. yd. for concrete, 5 24/100 cents per lb. for steel, and $3,200 for walks, work to be finished by Aug. 15; Coast Bridge Co., Portland, $10 per cu. yd. for concrete, 6 55/100 cents per lb. for steel and $3,800 for walks.

Commissioners of Jackson County, Jacksonville, Ore., have decided to construct in connection with their good roads movement two new bridges, one over Rogue River connecting Sams Valley with Eagle Point and the other at Derby.

Pennsylvania.

⊙The Philadelphia & Reading Ry., has awarded the contract for the construction of 1,400 ft. concrete arch bridge over the Delaware River at Yardley, Bucks County, to F. M. Talbot Co., 1 Madison Ave., New York City.

⊙Quigley Hafer of Chambersburg, Pa., has been awarded the contract by the County Commissioners, Chambersburg, for the erection of a reinforced concrete bridge, 30 ft. span, 14 ft. roadway, over Muddy Run at Rankin's Mill. The contract price is $850. Bids were opened April 14.

Pittsburg & Lake Erie R. R. officials are awaiting the decision of the U. S. War Department in regard to the proposed plans for the construction of a bridge across the Monongahela River at Brownsville, Pa. A. R. Raymer, Pittsburg, Pa., is Assistant Chief Engineer.

At a special meeting of the city council, Harrisburg, Pa., plans for the construction of the proposed Thirteenth St. bridge over the Reading Ry. were altered providing for the construction of a concrete instead of a stone pier under the middle of the structure.

The following bids were received by the Board of County Commissioners, York, Pa., April 13 for the construction of the concrete bridge over Muddy Run at Rankins Mill in Antrim township; Ferro Concrete Co., $1,200, and for their own plans, $1,100; W. H. Murphy & Son, $987.50; Quigley Hafer, $850; Nelson-Merydith Co., $1,047; A. Buchanan, $1,272. The award will be made later.

South Dakota.

✣Bids will be received until 2 p. m., May 12, by Board of County Commissioners, at the office of County Auditor, Sioux Falls, S. D., for planking and paving the 6th St. bridge and the 10th St. bridge in the city of Sioux Falls with 3 in. creosoted fir planks covered with two layers of heavy tar felt paper, and paved with creosoted wood blocks, 3½ in. deep, 3 to 4 in. wide and 4 to 9 in. long. Planks and blocks to be treated with 16-pound treatment, and asphalt filler between blocks. Bidder to name kind of wood used in blocks.

⊙Advices from Mitchell, S. Dak., state that the contract for the construction of the bridge between Dakota and Hanson Counties has been let to Fred Bjodstrup, Mitchell, S. Dak., at $7,563. The structure will have cement piers and floor of the bridge will be of reinforced concrete. The length will be 130 ft. and width 18 ft.

A meeting was recently held at the Commercial Club of Sioux Falls, S. Dak., to discuss plans for the construction of the proposed concrete bridge over the Sioux River at Eighth St. The estimated cost of the structure as roughly figured by representatives of the Missouri Valley Engineering Co., Sioux Falls, S. Dak., is $40,000.

Texas.

Advices from Georgetown, Texas, state that Williamson County will soon erect a concrete causeway 4 ft. high and 24 ft. wide over the San Gabriel River at Mabins' Crossing connecting the macadam road from Jonah to Georgetown.

Virginia.

⊙Advices from Luray, Va., state that the contract for the construction of the bridge across the Shenandoah River at Alma in Page County has been let to the Virginia Bridge & Iron Co., Roanoke, Va., at $11,030.

Washington.

Sinking Fund Committee has instructed the Corporation Counsel to amend the old council's ordinance authorizing the issuance of $415,000 of bonds for the construction of two bridges over Latah Creek. After the amendment the council of Spokane, Wash., will advertise for bids. Commissioner of Public Works will have charge of the construction.

⊙The Columbia Bridge Co., Walla Walla, Wash., according to advices from Pendleton, Ore., has been awarded the contract for the construction of seven small steel bridges in Umatilla County, Ore., at $4,980.

Plans have been prepared by H. W. Pettijon, Engineer of Adams County, Ritzville, Wash., for the construction of a bridge over the Palouse River at Palouse Falls, a short distance above the falls. The structure will be of steel consisting of two spans, one 40 and one 45 ft. long. The cost is estimated at $6,000.

Wisconsin.

⊙The contract for the construction of the proposed new bridge at the Lake Bluff, Ill., Naval School has been awarded to James Corse, Racine, Wis., at $10,000.

Canada.

✣Bids will be received until noon, May 9, by M. E. Boughton, Secy.-Treas., Lansdowne, Arden, Man., for the erection of a steel truss bridge, sections 17 and 18, township 17, range 14, near Birnie. Municipality provides the stone and sand for the abutments and wing walls. The bridge is to be of 30 ft. span with clear width of 18 ft.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

✣Bids will be received until noon, June 1, by Board of Commissioners, Drainage District No. 1, Ashley County, Wilmot, Ark., for digging a canal and laterals. The work will include about 700,000 cu. yds. The estimated cost is $90,000. R. B. Eggleston, England, Ark., is Engineer; W. B. De Yampert is Sec'y of the Board.

California.

⊙The West Sacramento Lands Co., which is to reclaim 10,000 acres of land across the river from Sacramento into Yolo County, has awarded a $100,000 contract to the Vulcan Dredging Co. for the construction of seven miles of levees. The levees will stand 39 ft. above the sea level. At the extreme high water mark they will be 70 ft. thick. They will have a base of 210 ft. with a top 15 ft. wide. The plans for the construction of these levees call for a "key pit." This pit will be 6 ft. deep by 50 ft. wide and will be at the base of the levee in the center. Soil tests have shown that there is a peat surface 6 ft. in depth, and as water would easily seep through such a layer the peat will be removed down to a layer of clay, and the pit filled in with more clay from a borrow pit, thus giving the levee a binding that will furnish a firm foundation.

Citizens of Napa are raising funds to buy a right of way and dredge a cut through Carr Bend in the Napa River below this city. The land necessary will cost $700 and the dredging will cost $5,000.

Early in May bids will be asked for about $1,000,000 worth of work on the irrigation system of the South San Joaquin Irrigation District, near Stockton, Calif. It is probable that the Oakdale Irrigation District adjoining will call for bids on about the same amount of construction work at about the same time. The South San Joaquin Irrigation District's bid will be advertised in this paper. Edwin Duryea, Jr., 1315 Humboldt Bank Bldg., San Francisco, is Chief Engineer of the South San Joaquin Irrigation District. Geo. L. Dillman, Union Trust Bldg., San Francisco, is Chief Engineer of the Oakdale Irrigation District.

Cuba.

•Champion & Pascual, P[illegible] [illegible], Havana, Cuba, have been awarded a contract by the Cuban Government for building the Roque canal in Matanzas province. The amount of the contract, according to the engineers' estimate, will be about $1,500,000. Work on the project will commence at once and will require about 2½ years to complete. The proposed canal is to be 52 kilometers in length and from 95 to 210 ft. in width. Its purpose is to relieve the thousands of acres of sugar and fruit lands from being flooded each year during the rainy season which causes the streams to overflow the lowlands inflicting heavy losses to the planters. T. T. Allard, Chief Engineer in the employ of Champion & Pascual, will have full supervision of the work which calls for the most improved canal digging machinery. A large number of men will be given employment

Idaho.

✣Bids will be received until 2 p. m., May 1, by U. S. Reclamation Service, Boise, Idaho, for constructing roadbed for a branch railway from Barberton to the site of the Arrowrock Dam, between Stations 0+00 and 457+00. The work involves the excavation of about 65,000 cu. yds. of earth and about 4,500 cu. yds. of rock. Further particulars may be obtained from the office of the United States Reclamation Service, Boise, Idaho. F. E. Weymouth, [illegible]

✣Bids will be received until 10 a. m., June 1, by U. S. Reclamation Service, Boise, Idaho, for the enlargement of the main South Side Canal, between stations 789 and 799, near Boise, Idaho, involving the excavation of about 13,000 cu. yds. of material. For particulars address the U. S. Reclamation Service, Washington, D. C., or Boise, Idaho. Frank Pierce, Acting Secretary.

Illinois.

✣Bids will be received until 2 p. m., May 5, by U. S. Reclamation Service, 777 Federal Bldg., Chicago, Ill., for furnishing explosives and blasting supplies for a period of two years from May 15, 1911. F. H. Newell is Director.

⊙Bids were opened April 12, in the office of F. W. Sears, County Surveyor, in Prophetstown, for the draining out of Line No. 2 of the Union Special Drainage District of Tampico, Prophetstown and Hume, and of branch H of the same district. There are 8 miles of the first named ditch which must be left with a 10 ft. bottom and must be made on a slope of 1 to 1, requiring 65,000 yds. of dirt to be removed. Branch H must be left 6 ft. on the bottom, the same slope. In this ditch the estimated amount of dirt to be removed is 13,000 yds. There were ten bidders ranging in price from 16 cts per cu. yd. to 10.49 cts., which was the bid of M. T. O'Mera, of Cullom, Ill., the successful bidder.

✣bids will be received, it is reported, during the month of May, by the Panhandle Drainage District, Jersey County, Jerseyville, Ill., for the construction of a main ditch 17,540 ft. long, 14 ft. wide at bottom, 7 to 11 ft. deep, average cut 8 ft., slopes 1 to 1, containing approximately 123,150 cu. yds. of material. J. W. Dappert, Taylorville, Ill., is Engineer.

✣[illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] Trust Bldg., Chicago, Ill., for excavation and collateral work on the Contract Section 3 of the Calumet-Sag channel. The work will include 325,000 cu. yds. of glacial drift excavation, 197,000 cu. yds. rock excavation, 83,500 sq. ft. channeling, 7,500 cu. yds. of concrete retaining wall, [illegible]. Official advertisement will be found elsewhere in this issue.

The following bids were received April 19 by Board of Trustees, East Side Levee and Sanitary District, East St. Louis, Ill., for the construction of an earth levee having a crown 8 ft. wide and a length of 3 miles, being Con[illegible] Levee. The work includes the following approximate quantities: 200,000 cu. yds. of earth embankment, 130 lin. ft. of 30 in. cast iron pipe, 10 cu. yds. of concrete and 1 automatic flood gate, hand gate and 1 acre of grubbing. The bids received were as follows: (1) embankment per cu. yd., (2) total: J. A. Ware Construction Co., St. Louis, Mo., (1) 13 3/10 cts., (2) $27,705; McCann Bros. Construction Co., Murphysboro, Ill., (1) 13⅞ cts., (2) $28,040; R. H. & G. A. McWilliams, Chicago, Ill., (1) 14½ cts., (2) $29,850; S. R. H. Robinson & Son Contracting Co., St. Louis, Mo., (1) 14 cts., (2) $29,605; Cameron, McMannis & Joyce, Keokuk, Ia., (1) 13 39/100 cts., (2) $27,940; John Scott & Sons, St. Louis, Mo., (1) 13 68/100 cts., (2) $28,870; Mulvill Brothers, Alton, Ill., (1) 15¾ cts., (2) $33,400.

Indiana.

⊙Noah Yoder has been awarded the contract, by the Adams County Commissioners, Decatur, Ind., for the construction of the Schindler ditch in Monroe and Wabash counties for $471. Bids were opened April 22 by C. C. Ernst, County Surveyor.

Iowa.

⊙Bids were opened April 20 by Frank McSpaden, County Auditor, Hampton, Ia., for the construction of tile drains in Drainage District No. 2, the contract being let to W. H. O'Brien, Ledyard, Ia., at $15,055. The contracts for the construction of tile drains in Drainage District No. 1 were let as follows: Tile, Plymouth Clay Products Co., Fort Dodge, Ia.; labor to T. D. Stephens.

The city of Des Moines will shortly call for bids for excavating a new channel for the Coon River and for the removal of certain obstructions in the bed of the Des Moines River. J. W. Budd is City Engineer.

✣Bids will be received until noon, May 9, by County Auditor, Sibley, Ia., for the construction of Drainage District No. 12 in Osceola County. The work will consist of 2,800 ft. of 22 in. tile at av. depth of 5.2 ft., 8,100 ft. of 15 in. tile, av. depth 4.8 ft., 4,100 ft. of 12 in. tile, av. depth 4.8 ft. Maximum cut on entire tile work 6 ft. In addition to tile there will be 240 rods of open ditch, 4 ft. bottom, average 3.8, maximum 6.25. This may be dug with a capstan machine and trimmed to grade. Average haul for tile about 2½ miles. Either cement or clay tile may be used. Estimated cost $7,500. L. A. Wilson, Engineer.

Louisiana.

At a special election at Franklin, La., on April 17 property owners in the Franklin Drainage District voted to issue $40,000 of bonds. The first work the Drainage Commission intends to start is the continuance of the canal from the basin, about one mile from Franklin, to the Southern Pacific tracks.

Minnesota.

✣Bids will be received until May 10, by [illegible] Stocking, County Auditor, Glencoe, Minn., for the construction of County Ditch No. 18 and furnishing the following tile: 5,700 ft. 6 in., av. depth 4.57; 4,000 ft. 7 in., av. depth 4.5 ft.; 6,100 ft. 8 in., av. depth 4.50 ft.; 4,850 ft. 10 in., av. depth 6.30 ft.; 2,600 ft. 12 in., av. depth 6.10 ft.; 2,800 ft. 14 in., av. depth 5.40 ft.; 2,400 ft. 15 in., av. depth 12.33 ft.; 814 ft. 18 in., av. depth 13.50 ft. Estimated cost of the work is $7,032.86. I. C. Christlieb, Hutchinson, Minn., is the Engineer.

Mississippi.

✣Bids will be received until 11 a. m., April 28, by Capt. J. A. Woodruff, U. S. Engineer, Vicksburg, Miss., for constructing about 65,000 cu. yds. of earth work in the Lower Yazoo Levee district.

Missouri.

Field work has been completed for the Big Creek Drainage District No. 1, of Johnson County, Missouri. The main ditch is to be 6.4 miles in length, requiring about 304,000 cu. yds. excavation and in addition there will be 85,000 cu. yds. excavation in proposed laterals. About 4,400 acres of land are included in the District. The main ditch will have a 12 ft. base, and side slopes of ¾ to one. The average depth will be 12 ft. The soil is gumbo and silty clay. The District is organized under Article IV, Chapter 41, R. S. of Missouri. The final court hearing is set for May 2 and it is expected that bids will be ordered some time in June. Brooks & Jacoby, 515 Shukert Bldg., Kansas City, Mo., are the engineers.

The final court hearing on the Big Creek Drainage District No. 1 of Henry County, Missouri, has been set for May 2, and it is believed that the construction work will be advertised sometime in June. Field work for this District has been completed by the engineers, Brooks & Jacoby, Kansas City, Mo. The main ditch will be 6.4 miles in length and will require about 316,000 cu. yds. excavation; about 52,000 cu. yds. excavation will be required in proposed laterals. Some 4,600 acres of land are included in the district. The main ditch will have a 15 ft. base, and side slopes 1 to 1; average depth will be 15 ft. The soil is gumbo and silty clay.

Brooks & Jacoby, Civil Engineers, 515 Shukert Bldg., Kansas City, Mo., have completed the field work for the Pioneer Drainage District of Henry County, Missouri. The main ditch is to be 9.1 miles in length, requiring approximately 528,000 cu. yds. excavation and 48,500 cu. yds. excavation in proposed laterals. About 7,000 acres of land are in the district. The main ditch will have a 15 ft. base and side slopes ¾ to 1. The average depth is 13 ft. and the soil is gumbo and silty clay. The district is organized under Article 1, Chapter 41, R. S. of Missouri. The final court hearing is set for the May term of the Circuit Court. It is expected to let the work in June or July.

Surveys are being made for the location of a 10 mile levee along the Missouri River north and east of Kansas City. This levee will be constructed on the north bank of the river and in accordance with plans and specifications which will be determined later. The work is being planned in connection with the Government revetment work at this point. The approximate height of the levee will be 15 ft., with a top width of about 15 or 20 ft. and side slopes of 2 to 1. The number of acres protected will be about 6,000, the ground to be used as building sites for manufacturing plants and elevators. Brooks & Jacoby, 515 Shukert Bldg., Kansas City, Mo., are the Engineers.

Montana.

The Yellowstone Irrigation District is planning to install a system to cost about $250,000 for irrigating 14,000 acres of land. The District has sold the necessary bonds for construction purposes. The Henry Gerharz Engineering Co., Babcock Block, Billings, Mont., are the engineers.

Surveys and plans have been made for the Hulling Drain, and it is expected that the work will be placed under contract as soon as the necessary right of way is received. This drain will be about 2½ miles long and will cost about $20,000. It is located about four miles from Billings. The Henry Gerharz Engineering Co., Billings, Mont., are the Engineers.

North Carolina.

✣Bids will be received until noon, May 1, by Board of Drainage Commissioners of Mattamuskeet Drainage District No. 1, J. P. Kerr, Secy., Swanquarter, N. C., for the excavation of 83 miles of drainage canals and the erection of a pumping plant. The excavation of the drainage canals requires the removal of approximately 2,700,000 cu. yds. of earth excavation. The installation of the pumping plant requires the furnishing and putting in place of suitable pumps, engines and boilers to discharge 1800 cu. ft. of water per second against a head of 8 ft. J. O. Wright, Tallahassee, Fla., is Consulting Engineer.

Ohio.

⊙The American Dredging Co., Cleveland, O., has been awarded a $15,000 contract for work at Cedar Point for a reclamation project that will ultimately make available hundreds of acres of what are now submerged lands.

A bill to appropriate $3,000 for construction of a levee at Grand Rapids, Wood County, to protect the village from possible flood, is before the State Legislature. The work will be in charge of the State Board of Public Works, Columbus.

Texas.

The Byrd-Matthews Investment Co., A. R. Byrd, Jr., Secretary, St. Louis, Mo., is now arranging to finance in New York an irrigation project which calls for the building of a dam and canals, to cost $620,000, on the headwaters of the Nueces River in Texas. The company has filed on water rights for this development and will take over 50,000 acres of land in Vallalla County, Tex.

WATER-WORKS

Alabama.

The state senate of Alabama has passed a bill to empower the city of Birmingham to acquire and operate its own waterworks and electric light plants.

Civil engineers have been looking over the city of Fayette, Ala., and surrounding territory for the purpose of submitting plans and estimates for the construction of a waterworks.

Arkansas.

[illegible] the amount of $65,000 for the pur[illegible] establishing a system of waterworks.

California.

⊙Advices from Los Angeles, Cal., state that the Patton & Longley Co., has just closed a contract with the Western Gas Engine Co. for the installation of a complete and up-to-date pumping plant on their Lankershim property. The engine is to be a 50 h. p. of the latest model.

The Escondido Mutual Water Co., of Escondido, [illegible] plans to replace the [illegible] of wooden flume line between the impounding reservoir and the source of the water supply at the San Luis Rey River, with rock-cement ditch, the amount which needs attention being [illegible].

Haviland & Tibbets, Civil Engineers, Alaska Commercial Bldg., San Francisco, Cal., have been retained by the Board of Trustees of Lindsay, Cal., in connection with proposed municipal ownership of the waterworks.

Florida.

[illegible] received until May [illegible] by the city of Pensacola, Fla., for the construction of sewers as planned by George Rommel, Jr., engineer. The following are the approximate quantities: Storm Water Sewers—650 lin. ft. sewer 66 in., 2,560 lin. ft. sewer 63 in., 2,200 lin. ft. sewer 60 in., 1,650 lin. ft. sewer 48 in., 2,400 lin. ft. sewer 36 in., 1,450 lin. ft. sewer 24 in., 950 lin. ft. sewer 15 in., 2,450 lin. ft. sewer 12 in., 750 lin. ft. sewer 10 in., 50 slants in drains, 43 manholes, 65 corner inlets, 15 side inlets, and 20 grate inlets. Sanitary Sewers—1,500 lin. ft. 12 in., 1,500 lin. ft. 10 in., 20,380 lin ft. 8 in., 500 lin. ft. 6 in., 50 Y branches in 12 in. terra cotta pipe, 50 Y branches in 10 in. terra cotta pipe, 500 Y branches in 8 in. terra cotta pipe, 10 Y branches in 6 in. terra cotta pipe, 35 manholes, 10 lampholes, and 10 flush tanks. L. G. Aymard is clerk.

A waterworks system is to be constructed in Sarasota, Fla., bonds have been voted for the purpose.

An election is to be held in Arcadia, Fla., on May 16 for the purpose of voting the issuance of bonds in the sum of $20,000 for waterworks construction.

Georgia.

At a recent election the citizens of Fairburn, Ga., voted the issuance of bonds to the amount of $20,000 for the construction of a waterworks system.

The citizens of Swainsboro, Ga., on April 17, voted the issuance of bonds in the sum of $40,000 for the construction of a waterworks and electric light system.

The citizens of Clayton, Ga., have voted the issuance of bonds for the installation of a waterworks and sewerage system. By midsummer it is expected to have a complete waterworks system from the springs of Black Rock mountain.

The city council of Colquitt, Ga., will make extensions to the waterworks system. A reinforced concrete reservoir will be constructed having a capacity of from 110,000 to 200,000 gals. The improvement will cost about $22,000

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., 4th floor City Hall, until 11 a. m., May 3rd, 1911, for furnishing and delivering boiler tubes as follows for period ending Dec. 31st, 1911: Springfield Ave. station, 25 standard charcoal iron tubes 3 ins. in diameter, gauge B. W. G. 10, 11 ft. 8½ ins. long, 100 furnace steel tubes, 2 ins. in diameter, 5 ft. 1¾ ins. long. Central Park Av. station, 112 standard charcoal iron tubes, 3 ins. in diameter, 11 ft. 8½ ins. long; 28 stay charcoal iron tubes, 3 ins. in diameter, 11 ft. 8 ins. long; 102 furnace steel tubes, 2 ins. in diameter, 5 ft. 1¾ ins. long. Chicago Av. station, 112 standard charcoal iron tubes, 3½ ins. in diameter, 12 ft. 7½ ins. long; 84 stay charcoal iron tubes, 3½ ins. in diameter, 12 ft. 7 ins. long; 90 furnace steel tubes, 2 ins. in diameter, 5 ft. 1¾ ins. long. 14th St. station, 250 standard charcoal iron tubes, 3½ ins. in diameter, 12 ft. 6 ins. long; 125 furnace steel tubes, 2 ins. in diameter, 5 ft. 1¾ ins. long. 22nd St. station, 25 expanded furnace steel tubes, 2 ins. in diameter, 5 ft. 1¾ ins. long; 25 screwed furnace steel tubes, 2 ins. in diameter, 4 ft. 9½ ins long. 68th St. station, 25 standard charcoal iron tubes, 4 ins. in diameter, 18 ft. long. Harrison St. station, 20 standard charcoal iron tubes, 4 ins. in diameter, 18 ft. long. Rogers Park station, 4 standard charcoal iron tubes, 16 ft. long; 12 furnace steel tubes, 2 ins. in diameter, 5 ft. 1¾ ins. long. Fullerton Av. station, 10 standard charcoal iron tubes, 4 ins. in diameter, 16 ft. long. Washington Heights, 10 standard charcoal iron tubes, 4 ins. in diameter, 16 ft. long. Norwood Park station, 10 standard charcoal iron tubes, 4 ins. in diameter, 16 ft. long. All tubes to be made of lap welded special charcoal iron and to have a smooth surface free from blisters, cracks, pits, etc.

◉The following bids were opened April 11 by the Board of Local Improvements of the Town of Cicero for furnishing and laying water pipe as follows: 12th St., 60th Av. to 61st Av.; 16th St., 60th Av. to 61st Av.; 61st Av., 12th St. to 16th St. The work consists of laying 3,992 lin. ft. of 6 in. cast iron water supply pipe, 30 lin. ft. of hydrant connections, 5 6-in. gate valves, 5 5½-in. fire hydrants with 2½ in. hose couplings, 2 reducers, 2 tees, 2 crosses, 5 plugs. Malachy Murphy, 5315 Wabash Av., Chicago, $3,129.68; Tutille & Scully, 518 W. Taylor St., Chicago, $3,443.10; Jas. Healy, 7738 Normal Av., Chicago, $3,848.58; The Swanson Co., 834 N. Clark St., Chicago, $3,968.72; T. H. Iglehart, Morgan Park, Ill., $3,255.00; W. T. Ryan, Lyons, Ill., $3,281.92; Simon Ryan, 2927 W. Congress St., Chicago, $3,465.48. The contract has been awarded to T. H. Iglehart, Morgan Park, Ill. Geo. Comerford is President and John Forrest, Secretary of the Board.

◉B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., has awarded to J. J. Ryan & Co., S. Jefferson St. and Monroe St., Chicago, the contract for furnishing the Department of Water Pipe Extension with 8,500 corporation ferrules of various sizes. Contract price, $6,130. Detailed specifications published in Engineering-Contracting.

◉The following contracts have been awarded by the Board of Local Improvements, Chicago, for furnishing and laying water service pipes in the following streets: Bids opened April 7. Jas. J. Renn, 367 W. Chicago Ave.—155 lin. ft. at 78 cts.; Kimball Av., 1,298 lin. ft. at 72 cts.; Eberly Av., 588 lin. ft. at 69 cts.; S. 48th Av., 1,863 lin. ft. at 79 cts.; Daniel Hardin, 3139 Indiana Av.—W. Erie St., 180 lin. ft. at 75 cts.; N. 51st Av., 130 lin. ft. at 84½ cts.; Hamilton Av., 156 lin. ft. at 84½ cts.; Indiana Av., 119th St. to 120th St., 88 lin. ft., contract price 90 cts. per ft.; David Walsh, 6628 South Chicago Av.—Morse Av., Ridge Blvd. to C. M. & St. P. Ry., 608 lin. ft., contract price 68 cts. per ft.; Jas. J. Renn, W. Park Av., N. 46th Av. to N. 48th Av., 403 lin. ft., contract price 78 cts. per ft.; Jas. J. Renn, E. 63rd St., So. Park Av. to Cottage Grove Av., 1,054 lin. ft., contract price 69½ cts.; Daniel Hardin, E. 78th St., Sherman Av. to Bond Av. No award. W. 26th St., S. 40th Av. to S. 46th Av., 3,249 lin. ft., contract price 57½ cts. per ft.; Daniel Hardin, W. 26th St., California Av. to S. 40th Av., 1,702 lin. ft., contract price 73 cts. per ft.; Jas. J. Renn, Winona St., Sheridan Road to 574 ft. E., 105 lin. ft., contract price 80 cts. per ft.; Jas. J. Renn, Evans Av., E. 93rd St. to Lyons Av., 171 lin. ft.; Lyon Av., E. 93rd St. to Cottage Grove Av.; E. 90th Pl., St. Laurence Av. to Dauphin Av., 1,200 lin. ft.; E. 91st St., St. Laurence Av. to Dauphin Av., 56 lin. ft.; E. 91st Pl., St. Laurence Av. to Cottage Grove Av., 1,083 lin. ft.; E. 92nd St., St. Laurence Av. to I. C. R. R., 1,050 lin. ft.; E. 92nd Pl., St. Laurence Av. to Cottage Grove Ax., 408 lin. ft., contract price 54 cts. per ft. David Walsh.

◉Thos. L. Dooley has been awarded the contract for cleaning water basins by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., contract price, $13,375.00.

◉The Board of Local Improvements, Chicago, has awarded the following contracts for furnishing and laying cast iron water supply pipes: N. Central Park Av., from W. Division St. to a point 400 ft. N. of N. line W. Division St., Simon Ryan, 2927 W. Congress St.; W. 66th Pl., from 300 ft. E. S. Central Park Av. to S. Spalding Av., Malachy Murphy, 5315 Wabash Av.; Vincennes Road, from 200 ft. S. of S. Line of W. 74th St. to W. 79th St., M. Murphy; W. End Av., from N. 49th Av. to 350 ft. W. of W. line N. 50th Av., Simon Ryan; N. 52nd Court from Grand Av. to Belden Av., M. Murphy. (Prices and specifications published in Engineering-Contracting April 19th, 1911.)

Following are the low bids received April 20th by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and erecting at the Roseland Pumping Station, 104th St. and Stewart Av., coal and ash handling [illegible] for [illegible] pivoted bucket carrier with rails, rail chairs and casing, drive and sprocket wheels for carrier with take up, two dumpers, one motor not less than 5 horse power to operate the feeder, one motor not less than 13 horse power, to operate the crusher, one motor not less than 10 horse power to operate conveyor, all to be fully enclosed and of an approved make, compound wound for 110 volts D. C., runway with railing and all supports, connections and accessories necessary to install the conveying system complete. Phillips, Long & Co., 98 Jackson Blvd, $12,000.00; Link Belt Co., 39th St. and Stewart Av., $8,300.00; Standard Conveyor Co., $8,800.00.

Following are the low bids received April 14th, 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering rubber gaskets as follows: 1,000 (A) 8 15/16 ins. outside diameter, 6 11/16 ins. inside diameter to weigh not more than 3 ounces, 1,000 (B) 10 15/16 ins. outside diameter, 8 7/16 ins. inside diameter, to weigh not more than 5¾ ounces, rubber hydrant valves as follows: 2,000 (C) 5½ ins. outside diameter, 2 ins. inside diameter, weighing not more than 19 ounces; 500 (D) 6 9/16 ins. outside diameter, 2 15/16 ins. inside diameter, weighing not more than 22 ounces; 1,000 (E) 4⅞ ins. outside diameter, ⅞ in. hole in center weighing not more than 10½ ounces. Morgan & Wright Co., 81 Michigan Av., per lb. (A) 35 cts, (B) 45 cts, (C) 35 cts, (D) 45 cts, (E) 45 cts. The contract has not been awarded.

Following are the low bids received April 7, 1911, by B. J. Mullaney, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering 9 double gate vlaves to the water works shops. Kennedy Valve Mfg. Co., 138 Jackson Blvd., 3 36-in. at $423.00 each, 5 30-in. at $248.00 each, 1 24-in. at $158.00. Total $2,890.00. The contract has not been awarded.

The city of Joliet, Ill., on April 18 voted the issuance of bonds to the amount of $35,000 for the sinking of two artesian wells and equipping them. This improvement is to be done in connection with the betterment of the water system of the city. John R. Cronin is mayor. Matt. Berscheid is city clerk.

✣Bids will be received until 11 a. m., May 4th, by L. E. McGann, Commissioner Public Works, 4th floor, City Hall, Chicago, Ill., for furnishing and delivering at the Thirteenth Ward yard, located at Fillmore St. and Central Park Av., three (3) open-bottom portable boilers, locomotive type, mounted on wheels, according to specifications on file in the office of the Department of Public Works. Proposals must be accompanied with $100.00 in cash or certified check for the same amount on some Chicago bank and made payable to the order of Commissioner of Public Works.

✣Bids will be received until 11 a. m., May 4, by L. E. McGann, Commissioner Public Works, 4th floor, City Hall, Chicago, Ill., for furnishing and delivering at the Meter Mechanical Shops, located at 1330 Indiana Ave., hemlock and pine lumber during the term ending Oct. 1st, 1911, according to specifications on works of said City. Proposals must be accompanied with $100.00 in cash or certified check for same amount on some Chicago bank and made payable to the order of Commissioner of Public Works.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, City Hall, until 11 a. m., May 4th, 1911, for furnishing and delivering three vertical boiler tubes, one to be delivered at 7th ward yard, 6109 Cottage Grove Ave.; one at 13th ward yard, Fillmore St. and Central Park Av., and one at 35th ward yard, Kinzie St. and 48th Av., according to specifications on file at office of the Commissioner. Proposal must be accompanied by cash to the amount of one hundred dollars or certified check made payable to Commissioner of Public Works.

The readopting of the resolution for the [illegible]

Civil Engineer McCallman, at present engaged on the Pana, Ill., waterworks proposition, [illegible] field, Ill., to erect a similar dam to that pro-

[illegible] grounds at Litchfield. The estimated cost is [illegible]

The village board of New Athens, Ill., has passed an ordinance providing for the con[illegible] for steel tank power system, capacity of 70,000 gals., to be erected on a four-post steel tower, 100 ft. in height, on the southeast corner of the public square. The supply will be from the Kaskaskia River.

Indiana.

⊙John E. Neigle, Washington St., Marion, Ind., has been awarded the contract by the Marion Branch, N. H. D. V. S., National Military Home, Grant County, Ind., for the installation of machinery and materials for the improvement of the water supply. The contract price is $6,110. Bids were opened March 25 by J. W. Sanderson, Treas.

Consulting Engineer A. T. Maltby, 77 Jackson Blvd., Chicago, Ill., has been retained by the city of Peru, Ind., to investigate the feasibility of obtaining a new and increased water supply and rebuild the waterworks plant.

Kansas.

⊙The city commissioners of Topeka, Kan., have let the contract for the construction of a well and a well roof at the city water plant to Hoar & Flynn at Topeka for $4,168. The well will be 60 ft. in diameter.

Rollins & Westover, Consulting Engineers, Kansas City, Mo., are engineers for the proposed waterworks system for the town of Luray, Kan. The estimated cost is $20,000.

The firm of Rollins & Westover, Consulting Engineers, Kansas City, Mo., is preparing plans and specifications for a water works system for the town of Burden, Kan., estimated to cost $15,000.

The city of Emporia, Kan., is contemplating changing their pumping from steam to electricity. They will want about 3 and one-half miles of transmission line, two 3,000,000-gal. pumps and Booster pump. Bids will probably be advertised for early in May. Fred H. Smith is city clerk. Matthew Brown is city engineer.

The city water department of Topeka, Kan., has ordered 195 tons of iron water pipe to make extensions to the city water mains this summer. About two and a half miles of extensions will be made.

Kentucky.

Members of the state board of control of charitable institutions recently visited Louisville, Ky., for the purpose of taking the final steps in connection with the securing of rights of way for a pipe from the reservoir of the Louisville Water Co. to the asylum at Lakeland. The rights of way have been secured and bids for supplying the water will soon be asked. The legislature has appropriated $50,000 for the purpose of securing the right of way and laying the pipes, and an additional $15,000 with which to erect a reservoir and station on the grounds at Lakeland.

Louisiana.

Plans have been submitted to the city council of Morgan City, La., by three engineers for the installation of a water system. It is proposed to put in a plant costing $60,000. The city anticipates a bond issue of $100,000.

Minnesota.

✣Bids will be received until 7:30 p. m., May 12, by Henry N. Knott, City Clerk, Minneapolis, Minn., for furnishing the city with water meters for the season 1911-1912 as follows: 4,000 more or less, ⅝-in. meters; 400 more or less, ¾-in. meters; 100 more or less, 1-in. meters; 75 more or less, 1½-in. meters; 50 more or less, 2-in. meters. All according to specifications on file in the office of the Supervisor of Water Works. A certified check in the sum of $500, payable to the order of C. A. Bloomquist, City Treasurer, must accompany each proposal as a guaranty for the execution of the contract, if awarded.

Mississippi.

Bonds have been voted by the city of Seminary, Miss., in the sum of $10,000 for the installation of a waterworks system.

The city of Biloxi, Miss., plans improvements to the city water plant. The present plans provide for two pumps, one with a capacity of 1,500 gals. for fire pressure, and the other to have a capacity of 500 gals. for the daily uniform pressure.

Missouri.

Plans and specifications are being prepared by Rollins & Westover, Consulting Engineers, Kansas City, Mo., for the construction of a water works system in Kennett, Mo., estimated to cost $40,000.

New Jersey.

✣Bids will be received until 10:15 a. m., May 1, by D. F. Weeks, M. D., Supt., New Jersey State Village for Epileptics, Skillman, N. J., for the labor and material necessary for the extension of the water system, with necessary fire hydrants, gates, valves, fittings, etc. J. A. Fuld is Secy.

The Irvington Improvement association of Irvington, N. J., is agitating the purchase of the Clinton Water Co.'s plant.

The borough officials of Glen Ridge, N. J., have been notified by the Orange Water Co. that it will sell its plant to the city for a consideration of $42,000. The city recently offered the company $38,000 for the plant.

New Hampshire.

The town of Weare, N. H., plans to construct a reservoir at an estimated cost of $19,000. J. B. Warren is town clerk.

New York.

✣Bids will be received until 11 a. m., May 16, by Board of Water Supply, J. P. Morrissey, Secy., 165 Broadway, New York City, for the Contract 63 for the construction of a portion of the City tunnel of the Catskill aqueduct, a circular tunnel in rock, 15 ft. inside diameter, and about 21,260 ft. long. From the northerly end of the work in Yonkers, about 200 ft. north of the New York City line, between Jerome and Mt. Vernon avenues, the tunnel line extends in a general southerly direction through the Borough of The Bronx, under Van Cortlandt Park and Jerome Park reservoir, and thence beneath the Old Croton aqueduct and Aqueduct avenue to Burnside avenue, near University Heights. Tunnel construction will be carried on through five shafts, spaced from 3,500 to 5,000 ft. apart, and varying in depth from 215 to 240 ft.

✣Bids will be received until 11 a. m., May 16, by Board of Water Supply, 165 Broadway, N. Y. for Contract 65, for the construction of a portion of the City tunnel of the Catskill aqueduct, a circuit tunnel in rock, 15 ft. and 14 ft. inside diameter. From the northerly end of the work at Aqueduct and Burnside avenues near University Heights, the tunnel line extends in a general southerly direction under Aqueduct and Lind Avenues, in the Borough of The Bronx, to the crossing under the Harlem river at 167th Street, near Highbridge, thence beneath Highbridge, St. Nicholas and Morningside parks and connecting streets, in the Borough of Manhattan, to Central park near Eighth Avenue and West 99th Street. The work will be carried on through 7 shafts, spaced from 2,500 to 5,100 feet apart, and varying in depth from 260 to 175 feet.

✣Bids will be received until 11 a. m., May 4, by Board of Water Supply, 165 Broadway, New York, for Contract 77, for the construction of the Wakefield Ave. blow off, a concrete and cast iron pipe conduit in Wakefield Ave. about ½ mile north of the New York City line in the City of Yonkers, N. Y. Charles Strauss is President of the Commission of Board of Water Supply.

✣Bids will be received until 11 a. m., May 16, by Board of Water Supply, 165 Broadway, N. Y., J. P. Morrissey, Secy., for the construction of a portion of the City tunnel of the Catskill Aqueduct, Contract 66, a circular tunnel in rock, varying from 14 ft. to 12 ft. inside diameter. From the northerly end of the work in Central park, near Eighth Ave. and West 99th St., the tunnel line extends in a general southerly direction under Central park, Sixth Ave. and Broadway to 14th St., in Union Square. The work will be carried on through 6 shafts, spaced from 2,300 to 4550 ft. apart, and varying in depth from 200 to 250 ft.

⊙The R. T. Ford Co., of Rochester, N. Y., has been awarded the contract by the public building trustees, Albany, N. Y., for establishing standpipes throughout the capitol for $15,900.

The city of Riverhead, L. I., plans to spend $50,000 for the construction of a new up-to-date water plant.

Ohio.

✣Bids will be received until noon, May 2, by Board of Trustees of Public Affairs, City of Lakewod, O., for furnishing labor and material necessary for the erection of an elevated steel water tower on a concrete base in accordance with the form of contract, plans and specifications on file at the city hall, city of Lakewood, O., and at the office of The Wm. H. Evers Engineering Co., 332-334 The Arcade, Cleveland, O. A certified check for $1,000 is required with each bid. E. R. Lieblein is clerk.

The citizens of Kenton, O., have decided to issue bonds in the sum of $40,000 for the rebuilding of the waterworks plant and improvement of the system.

Oklahoma.

Advices from Bartlesville, Okla., state that the city will probably install a waterworks system at an estimated cost of $200,000.

The town of Tulsa, Okla., plans to improve its waterworks system at a cost of $40,000.

The city council of McAlester, Okla., has again decided that it will be necessary to readvertise for boilers, pumps, pipe and other material for a pipe line from the city waterworks reservoir to Gaines Creek.

The city council of McAlester, Okla., has adopted a suggestion by Commissioner of Public Works Schreiner, whereby the city will build an additional dam north of the dam at the city water shed at a cost of about $50,000. A pipe line from Gaines Creek, which will require about 40,000 ft. of pipe, will also be constructed at an approximate cost of $30,000. Six-in. steel pipe will be used.

Ohio.

⊙The Director of Public Service of Canton, O., has awarded Keeler E. Huff of that city the contract for erecting an auxiliary waterworks pumping station in Navarre St., for $2,903. Bids were opened April 12.

Oregon.

✣Bids will be received until 4 p. m., May 9, by Water Board, Frank T. Dodge, Portland, Ore., Supt., for the following quantities of cast iron pipe and special castings: 500 lengths of 12-in cast iron pipe, estimated weight 245 tons; 3,500 lengths of 8-in. cast iron pipe, estimated weight 1,005 tons; 1,320 lengths of 6-in. cast iron pipe, estimated weight 250 tons; special castings for cast iron pipe, 100 tons. Specifications and form of proposal can be obtained at the office of D. D. Clarke, Engineer of the Water Board, City Hall, Portland, Ore.

The citizens of Baker, Ore., on April 12 voted bonds to the amount of $90,000 for 43,000 lin. ft., of wood stave or concrete pipe to replace present wood flume for gravity water system. The pipe is to be 13 in. in diameter. J. W. Bailey is city engineer.

The citizens of Baker, Ore., on April 12 voted bonds to the amount of $25,000 for the construction of a 3,000,000-gal. reservoir.

Bonds to the amount of $20,000 have been sold by the city council of Gresham, Ore., to E. H. Rollins & Sons of New York City. Of this amount $15,000 will be expended on the installation of new water mains.

Bonds to the amount of $15,000 have been voted by the citizens of Drain, Ore., for a waterworks and to the amount of $5,000 for sewers.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Pennsylvania.

✣Bids will be received until 8 p. m., May 1, by Council of the Borough of Springdale, Pa., for grading certain streets, construction of a system of sewers, a system of water lines and the building of a reservoir. Approximate quantities are 30,000 cu. yds. of grading, 36,660 lin. ft. of sewers, 35,660 lin. ft. of cast iron water lines, and one 350,000 gal. capacity reservoir. A certified check for $1,000, payable to the Treasurer of the Borough of Springdale, must accompany each proposal. All proposals must be sealed and addressed to H. J. Barnes, Clerk of Council, Springdale, Pa.

⦿The Borough Council of Chambersburg, Pa., has awarded the contract for the construction of a diversion dam and intake chamber, a reservoir of 2,200,000-gals. capacity, a standpipe 10 ft. in diameter and 45 ft. high for the Birch Run water supply, for which John Birkenbine, Parkway Bldg., Broad & Cherry Sts., Philadelphia, Pa., is Engineer, to B. H. Brooke & Co., 50 Church St., New York City, at [illegible], $7,917 and [illegible], respectively. Bids were opened April 7.

The town council of Catasauqua, Pa., contemplates the installation of a municipal waterworks system.

Director Armstrong of the Department of Public Works, Pittsburg, Pa., has decided to purchase the Cabbage hill site for the new Northside reservoir. Plans have been made for a reservoir to hold 145,000,000 gals.

South Carolina.

⦿The city council of Columbia, S. C., has awarded the contract for furnishing water pipe and other supplies to the Lynchburg Foundry Co., of Lynchburg, Va., for $3,780. The council also awarded the contract for laying water mains to Weston & Brooker for [illegible]

The Public Service Commission of Aiken, S. C., has closed a contract with Dr. T. C. Croft for Shiloh branch for a source for the water supply. The spring is about five miles from the city. The water will be run by gravity to within three and a half miles of the city, where a pumping station will be located.

South Dakota.

⦿[illegible] recently voted bonds for a new waterworks system. The contract has been awarded to Tanzer Bros. [illegible], for $5,000.

Tennessee.

The citizens of [illegible], Tenn., at a recent election voted the issuance of bonds to the amount of $25,000 for the installation of a waterworks and electric light system.

Texas.

✣Bids will be received until 8 p. m., May 1, by Supt. Water Works, Sherman, Texas, for the following items. Two deep wells, internal-combustion engine, gas producer, air compressor, electric generator, motors, switchboards, and power-driven pump. Specifications are on file in the office of the City Secretary. Barney C. Kreager, City Secretary.

The city council of Eastland, Tex., contemplates the installation of a waterworks system at an estimated cost of $13,000.

The Princeton Waterworks Co., of Princeton, Tex., has been incorporated with a capital stock of $5,000. The incorporators are: J. H. Godwin, J. H. Stinson and C. A. Wilson.

The citizens of Lott, Tex., have voted the issuance of bonds in the sum of $14,000 for improvements to the waterworks.

Plans and specifications are practically completed by the board of engineers of Fort Worth, Tex., for an impounding reservoir across the Trinity River and for a six mile conduit line and filter plant of 5,000,000 to 6,000,000 gals. daily capacity, etc. About $1,000,000 will [illegible]

Utah.

The people of Three Mile, known as Perry, are considering the installation of a waterworks system. A corporation will be formed to finance the proposition.

The following bids were received by the city of Salt Lake City, Utah, G. F. McGonagle, City Engineer, for the construction of water mains for 1911; (1) bid of P. J. Moran, Salt Lake City, (2) bid of J. W. Percival, (3) bid of P. J. Moran for the 1910 contract:

	(1)	(2)	(3)
Excavating and Backfilling, per cu. yd.	[illegible]	[illegible]	[illegible]
Furnishing and Laying C. I. Pipe:			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
16-in., per lin. ft.	[illegible]	[illegible]	
18-in., per lin. ft.	[illegible]	[illegible]	
24-in., per lin. ft.	6.57	7.90	....
Laying C. I. Pipe furnished by City:			
6-in., per lin. ft.	[illegible]	[illegible]	....
10-in., per lin. ft.	[illegible]	[illegible]	....
12-in., per lin. ft.	.23	.74	....
16-in., per lin. ft.	[illegible]	[illegible]	
18-in., per lin. ft.	[illegible]	[illegible]	
24-in., per lin. ft.	[illegible]	[illegible]	
Furnishing and setting special castings, per lb.	[illegible]	[illegible]	[illegible]
Furnishing and setting gate valves:			
6-in., each	[illegible]	[illegible]	[illegible]
8-in., each	25.00	25.00	25.20
10-in., each	[illegible]	[illegible]	[illegible]
12-in., each	[illegible]	[illegible]	[illegible]
Setting valves furnished by city:			
6-in., each	[illegible]	[illegible]	
10-in., each	[illegible]	[illegible]	
Furnishing and setting hydrants, each	[illegible]	[illegible]	[illegible]
Setting hydrants furnished by city, each	[illegible]	[illegible]	....
Furnishing and setting C. I. valve boxes, each	[illegible]	[illegible]	[illegible]
Setting C. I. valve boxes furnished by city, each...	.50	1.50	....
Const. brick valve boxes, C. I. covers, each	[illegible]	[illegible]	[illegible]
Const. brick valve boxes, asph. filled covers, each...	35.00	39.50	35.40
[illegible]	[illegible]	[illegible]	[illegible]

Virginia.

Advices from South Hill, Va., state that the city is contemplating the installation of a waterworks.

An election was held in Christiansburg, Va., on April 24 for the purpose of voting on the proposition to issue bonds to the amount of $10,000 for the construction of a waterworks system.

Wisconsin.

The city council of Superior, Wis., now has on hand a proposition looking toward the construction of a waterworks plant.

W. G. Kirchoffer, Consulting Engineer, Madison, Wis., has been employed by the City of Monticello, Wis., to prepare plans for a waterworks system, consisting of 8,000 ft. of 6-in. and 8-in. cast iron pipe, a concrete reservoir or elevated tank, one deep well and a power pump. The plant will be operated by engine and boilers now located in the electric light plant.

Canada.

Edw. O. Fuce, Consulting Engineer, Galt, Ont., is preparing plans for the installation of a waterworks for Wingham, Ont.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

The mayor and aldermen of Fayette, Ala., have had civil engineers looking over the city and surrounding territory for the purpose of submitting plans and estimates for the installation of a water works and sewerage system.

Arizona.

Engineers Olmsted & Gilleln, 601 Wright & Callender Bldg., Los Angeles, Cal., have completed plans for the municipal sewer system to be built at Phenix, Ariz. The estimated cost is $200,000. Bids are to be received on this work at once.

California.

The city trustees of Oakdale, Cal., have employed Engineer Dillman of that town to do all preparatory work and superintend the construction of the proposed sewer system. The estimated cost of the system is $10,000. Bonds will be voted to that amount.

Plans and specifications for the sewering of the Allendale sanitary district have been adopted by the city council of Oakland, Cal. The plans call for the construction of more than 20 miles of sewers. Fred C. Turner is city engineer.

It is reported that the voters of sanitary districts Nos. 1, 2, 3 and 4, situated in the annexed district of Oakland, Cal., on April 14 voted in favor of the four bond propositions for the construction of 69 miles of modern sewers, the total cost being $406,000. Fred C. Turner is city engineer.

The Board of Trustees of Lindsay, Cal., has retained Haviland & Tibbetts, civil engineers, Alaska Commercial Bldg., San Francisco, Cal., as engineers in connection with proposed municipal ownership of the water works and sewer system of the city.

Georgia.

The citizens of Camilla, Ga., on April 13 voted to authorize the issuance of $15,000 in bonds for the installation of sewers and $5,000 for improvements in the city hall.

Florida.

✣Bids [illegible] by Board of Bond Trustees, City Hall, Pensacola, Fla., for constructing storm water drains and sanitary sewers. The work to be done consists of approximately 15,060 lin. ft. of storm water drains from 66 ins. to 10 ins. in diameter, and 23,880 lin. ft. of sanitary sewers from 24 ins. to 6 ins. in diameter, with all the necessary appurtenances. Proposals must be accompanied by a certified check in the sum of $2,000. George Rommel, Jr., is Engineer.

Illinois.

⦿The board of local improvements of Freeport, Ill., has awarded J. W. Turner of Des Moines, Ia., the contract for the construction of the West Freeport sewer for $29,979 and Frank Kaminski of Watertown, Wis., the contract for the construction of the East Freeport sewer for $14,967. Other bids received on the West Freeport sewer are: James Grogan, Green Bay, Wis., $31,558; A. C. Scheister, Manitowoc, Wis., $31,655; Kenny & Lee, Dubuque, Ia., $31,528; Gund, Graham & Co., Freeport, $31,594; Keys & McNamara, Dubuque, Ia., $32,298, and W. A. Kammarer, Harlan, Ia., $34,228. J. W. Turner, at $16,198, submitted the only other bid on the East Freeport work.

⦿Following are the bids received April 11, 1911, by the Board of Local Improvements of the Town of Cicero for constructing sewers as [illegible] to 333 ft. N. of 13th St., 642 lin. ft. 20 in. tile pipe, 673 lin. ft. 15 in. tile pipe, average cut 8.0 ft., 999 lin. ft. 12 in. tile pipe, including 10 concrete manholes and 20 concrete catch basins; T. H. Igelhart, Morgan Park, Ill., $3,406.20; N. Mancini, 900 W. Taylor St., $3,525.70; Tirtelle & Scully, 518 W. Taylor St., $3,515.57; Jas. Healy, 7738 Normal Ave., $3,847.08; Simon Ryan, 2927 W. Congress St.; the Swanson Co., 834 N. Clark St., $3,666.20; Edward Connor, $3,629.76; W. T. Ryan, Lyons, Ill., $3,225.55. The contract has been awarded to W. T. Ryan. George

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Comerford is President and Jno. Forrest, Secretary of the Board.

The Board of Local Improvements of Waukegan, Ill., has passed a resolution for a new sewer system on the North side which will cost $32,600, including the court costs. The new system takes the place of the system that was dropped by the board because of the great pressure that was being brought to bear by property owners.

City Engineer William J. Crocken of East St. Louis, Ill., has begun work on the plans for the second arm of the outlet sewer now building, which will serve all of the Lansdowne district and of one-sixth of the population of the city. It will serve the district between the Louisville & Nashville and the Baltimore & Ohio railroad tracks, about two miles in area, while the eastern boundary of the district will be the city limits and the western boundary the Terminal Belt tracks. The estimated cost is $250,000. The outlet sewer, the Winstanley sewer and the Lansdowne arm will cost approximately $1,240,000.

The Des Peres Improvement association of St. Louis, Ill., instructed its attorney, E. F. Stone, to draft an ordinance for the enclosing of River des Peres. The ordinance to be submitted to the Municipal Assembly will provide a bond issue to meet the expense of the undertaking.

Specifications and estimates have been drawn up by the Board of Local Improvements of Monmouth, Ill., for the construction of a public sewer in the southeast part of the city. The city council has been asked to draw up an ordinance ordering the construction of the improvement. The sewer would be three-quarters of a mile long and would cost about $7,000.

⊙The Board of Local Improvements, Chicago, Chas. A. V. Standish, Sec'y, City Hall, has awarded the following contracts for constructing sewers: N. 40th Ct., Lawrence Ave. to Ainslee St., Michael Pontorelli, 4817 W. Dakin St., $1,018.40; W. Madison St., S. 47th Ave. to S. 48th Ave., Carmine Roberts, 7565 Taylor St., $934.40; Soult St., King Pl. to Wellington St., Joe Savaiano, 732 Ewing St., $420; W. 66th Pl., S. Kedzie Ave. to S. Central Pk. Ave., Simon Ryan, 2927 W. Congress St., $4,902.60; S. Leavitt St., W. 103d to W. 107th; W. 106th from S. Hamilton Ave. to S. Oakley; S. Hamilton Ave., from W. 105th to W. 107th St.; S. Irving Ave., from W. 105th to W. 107th; S. Oakley Ave., W. 105th to alley N. W. 107th St. and alley N. W. 107th, from S. Leavitt St. to S. Oakley Ave., Christino Fosco, 814 Desplaines St., $16,836; W. End Ave., Prairie Ave. to Howard Ave. in Howard Ave., from alley N. Washington Blvd. to 85 ft. S. of S. Boulevard, with house drains from alley N. Washington Blvd. to 85 ft. S. South Blvd., Joe Savaiano, 732 Ewing St., $5,115. System: W. 51st St. from S. Western Ave. to S. Kedzie Ave.; W. 54th St. from S. Western Ave. to alley first W. S. Campbell Ave.; W. 50th St., from S. Campbell St. to S. Rockwell St., S. Artesian Ave., S. Campbell Ave., S. Maplewood Ave., S. Rockwell St. from right of way of C. & G. T. Ry. to W. 54th St., Michael Pontorelli, $44,698.20. (Detailed specifications published in Engineering Contracting.

Indiana.

✤Bids will be received until 10 a. m., April 28, by Board of Public Works, Indianapolis, Ind., for the construction of local sewers, as follows: In and along Churchman Ave., from Pleasant Run to first alley south of Prospect St.; in and along Newton Ave., from Rural St. to Tuxedo St.; in and along Belmont Ave., from alley south of Michigan St. to New York St.

✤Bids will be received until 7:30 p. m., May 15, by City Clerk, Auburn, Ind., for approximately 10,000 ft. of 20-in. vitrified to 42-in. concrete storm sewer. L. O. Little is clerk. Phil Holman is city engineer. Official advertisement will be found elsewhere in this issue.

✤Bids will be received until noon, May 1, by Board of Public Works, Kokomo, Ind., for the construction of an intercepting sewer, siphons overflows, and connections from 10 in. to 48 in. in diameter, about 12,935 ft. long. Ben Havens is City Clerk.

The Board of Public Works of Gary, Ind., has decided to go ahead immediately with the construction of the Tolleston sewer. This will entail an expense of about $150,000. The sewer will drain practically all of the old town of Tolleston.

The city council of Terre Haute, Ind., has decided to commence the work of extending the Pogue run sanitary sewer east to the piano factory and to the site on which the Food Product Co. will locate its plant. The cost of the entire extension, which will be about $4,000, will be paid out of the sewer fund.

Iowa.

✤Bids will be received until 8 p. m., April 26, by Otto P. Geiger, City Recorder, Dubuque, Ia., for the construction of an 8-in. tile pipe sanitary sewer in the alley between Lemon St. and Couler Ave., from Millville road to 32d St., thence in 32d St. to the alley between Couler Ave. and Jackson St. According to the engineer's estimate the work will include 1,268 lin. ft. of 8-in. tile pipe, 20 ft. of 8-in. iron pipe, and 5 manholes.

Kansas.

⊙The contract for constructing a lateral sewer in district 38, which comprises Cleveland St., between E and F Aves., has been awarded by the city commissioners of Hutchinson, Kan., to O. F. Davis.

⊙According to information received from Fort Leavenworth, Kan., the A. J. Taussig Construction Co., of Kansas City, has been awarded the contract for the construction of the sewer system at the Fort for $48,928. The sewer will start near the crematory and run south to Two-Mile Creek and then southeast to the river and then south to the grain elevator. The length of the system will be about two miles. Other bids received were: McGuire & Stanton, Leavenworth, $52,522; E. W. Geiger, Leavenworth, $53,045; Boyd Construction Co., Kansas City, $52,000, and John Barnes, Leavenworth, $56,987.

H. I. Roetzel, Commissioner of Public Improvements, and Bert C. Wells, City Engineer of Wichita, Kan., are working out plans for the construction of the main central sanitary sewer, extending through the city, costing about $200,000. The plans call for a sewer about ten miles long.

The city council of Kinsley, Kan., has been petitioned for the installation of a sewer system to take care of the sewage from hotels and the business part of town, and also to investigate the soft water possibilities with a view to giving the city better water.

Louisiana.

The Board of Sewerage Commissioners of New Orleans, La., has closed a contract privately for the sale of $125,000 bonds of the sewerage district and expect to advertise for bids for the construction of the city's sewerage system within a short time.

The City Council of New Iberia, La., on April 24, conferred with a citizens' mass meeting to devise ways and means of looking to a survey for sanitary sewerage, and to revise a project inaugurated two years ago by the New Iberia board of trade of cutting Bayou Bouttee canal, connecting the Teche with the Atchafalaya.

Maryland.

⊙Hines & Hayman, of Baltimore, Md., have been awarded the contract by the city of Easton, Md., on the proposed sewerage work to be done in Easton for $37,002.

Minnesota.

⊙The City Council of Albert Lea, Minn., has awarded J. J. Connolly of St. Paul, Minn., the contract for the construction of lateral sewer No. 6. William Barneck is city engineer.

⊙The Pastoret-Lawrence Co. of Duluth, Minn., has been awarded the contract by the city of Brainerd, Minn., for the construction of sewers in Districts 4 and 5. The contract price is $9,587. Bids were opened April 17.

City Engineer S. S. Chute of St. Cloud, Minn., has been called upon by the village of Cold Springs, Minn., to assist in preparing for the installation of a sewerage system in that village.

Missouri.

The firm of Rollins & Westover, Consulting Engineers, Kansas City, Mo., has been retained by the city of Paris, Mo., as engineers for the proposed sewerage system for that city, the estimated cost of which is $15,000.

Rollins & Westover, Consulting Engineers, Kansas City, Mo., are the engineers for the proposed water works improvements and sewer system for the city of Princeton, Mo., estimated to cost $25,000.

The Althaus Construction Co., 609 Burlington Bldg., St. Louis, Mo., has been awarded the contract by the Board of Public Improvements of St. Louis for letting No. 10162 for the construction of sewers in Glaise Creek Sewer District No. 4, embracing junction chamber of reinforced concrete and sewers of brick and Portland cement mortar, and of vitrified clay pipe, of the following lengths and sizes, to-wit: 17 ft. of reinforced concrete junction chamber, 5.17 ft. to 8.56 ft. in mean diameters; 170 ft. of brick sewer, 58 ins. in diameter; 354 ft. of brick sewer, 54 ins. in diameter; 441 ft. of brick sewer, 40 ins. in mean diameter; 1,726 ft. of brick sewer, 35 ins. in mean diameter; 1,880 ft. of brick sewer, 32½ ins in mean diameter; 1,454 ft. of brick sewer, 30 ins. in mean diameter; 1,854 ft. of pipe sewer, 24 ins. in diameter; 1,221 ft. of pipe sewer, 21 ins. in diameter; 3,575 ft. of pipe sewer, 18 ins. in diameter; 3,480 ft. of pipe sewer, 15 ins. in diameter; 9,280 ft. of pipe sewer, 12 ins. in diameter; with sewer inlets, catch basins, manholes and appurtenances. The contract price is $51,819. Bids were opened April 14.

A sewerage system is to be installed in Huntsville, Mo., at an estimated cost of $30,000. Rollins & Westover, Consulting Engineers, Kansas City, Mo.

The City Council of Unionville, Mo., has called a special election for May 8 for the purpose of submitting the sewer proposition to the voters. The plan is to issue $24,000 in bonds to cover the expense of installing a complete, sanitary and modern system.

South Joseph property owners have urged the board of public works of St. Joseph, Mo., to construct a system of district sewers in that part of the city that will permit of the drainage of the lowlands embraced in the district which the board has planned to relieve by a drainage canal.

Montana.

The city council of Billings, Mont., has created improvement district No. 71, for the construction of an 8-in. sewer between 31st and 32nd Sts., on the north side addition, between 9th and 12th Aves. The cost will approximate $3,989.

The village trustees of Mullan, Mont., have approved plans for the installation of the proposed sewerage system, and will receive bids for the construction of the same immediately.

Nebraska.

Plans for the southwest branch of the South Omaha sewer and the extension of the Burt St. sewer, which have been adopted by the city council of Omaha, Neb., will have to be revised so that portions of the improvements will be eliminated. It is proposed to cut off five blocks from the Burt St. sewer extension and about a block off the southwest branch of the South Omaha sewer. Bonds in the sum of $100,000 have been sold for these improvements.

New York.

✤Bids will be received until 10 a. m., May 15, by Sewer Commission, John H. Wood, Clerk, Batavia, N. Y., for furnishing materials and doing all work as specified for the construction of preliminary settling tanks of the Imhoff type, sprinkling filterers and sludge Drying Beds, including necessary fittings and appurtenances. Plans and specifications may

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

be seen at the [illegible] & Fuller, Consulting Engineers, 170 Broadway, New York City. The plans [illegible], and specifications and forms of proposal obtained from Charles Hoopes, Resident Engineer, at the office of the Sewer Commission in Batavia, N. Y.

The State Legislature of New York has been asked to pass an act legalizing the sewer bond issue of $40,000 in South Glen Falls, N. Y. It is thought that this system of sewers will be constructed this summer.

Engineer A. M. Scripture of New Hartford, N. Y., has submitted his report to the committee appointed to circulate a petition with reference to the establishment of a sewer district in New Hartford. The proposed district lies in two basins, Nail Creek, which passes through West Utica, and the Sauquoit Creek, to the west of it. The system will require 41,475 ft. of pipe and will cost $43,932.

Ohio.

✣Bids [illegible], May 5, by Director of Public Service, Cleveland, O., A. B. Lea, for the construction of sewers in the following named streets, avenues and thoroughfares: Bessemer Ave. S. E., between East 88th St. and East 93rd St.; East 88th St., between Laisy Ave. S E. and Harris Ave. S. E.; Harris Ave. S E., between East 88th St. and East 93rd st.; Marshall Ave. S. E., between East 88th St. and East 93rd St.; Pensacola Ave. S. W., between West 39th St. and 200 ft. west of West 42nd St.; East Branch of Dugway Brook Interceptor, between Main Interceptor and Sellars Ave. N. E.; that part of Lorain Ave. between West Boulevard and West 117th St which lies between West Boulevard and West 110th St. Each bid must be made in accordance with the plans and specifications which may be seen at the office of the City Engineer, Room 305, City Hall

✣Bids will be received until noon, April 27, by Director of Public Service, Youngstown, O., for furnishing necessary labor and materials for sewering Edwards St. from Mercer to Mt Pleasant St. W. H. McMillin is clerk of the director.

✣Bids will be received until noon, April 27, by Director of Public Service, Youngstown, O., for furnishing the necessary labor and materials for sewering Hawthorne St., between Glenwood Ave and east line City Lot No. 15964 W H. McMillan is clerk of the director.

✣Bids will be received by Director of Public Service, Youngstown, O., until noon, April 27, for furnishing the necessary labor and material for sewering Florist Ave., between Logan and City Lot No. 16989. A certified check for $300 must be filed with each bid. W. H. McMillan is clerk

✣Bids will be received until 11:30 a. m., May 15, by Board of Greene County Commissioners at the office of W. L. Dean, County Auditor, Xenia, O., for performing labor and furnishing the necessary material for the construction of a sanitary sewage system on the new Greene County Children's Home grounds and premises and for the preparatory sewage treatment devices. A. Elliott Kimberly, 827 Columbus Savings & Trust Bldg., Columbus, O., is Sanitary Engineer.

⦿Frank Manilla, Chancer No. 6941, Pittsburg, Pa., has been awarded the contract by the Board of Control, Niles, O., for the construction of sewers in District No. 6, including all of the streets in the South Side. The contract price is $15,497. Bids were opened April 14

⦿Evan Evans, 1226 Ida St., Cincinnati, O., has been awarded the contract by the Board of Public Service, Cincinnati, for constructing sewers in Prince Ave. and Matson Pl. for $974. Bids were opened April 11.

⦿Charles L. Wright has been awarded the contract for the construction of a sewer in McMillan St., from Reading road to May St., and for sewers in Essex place, Irwin St., and Morgan St., by Service Director Sundmaker of Cincinnati, O. The cost will be $9,840

[illegible], Dayton, O., has rejected all bids received April 17 for the construction of sanitary sewers Nos. 6 and 9. W. A. Budroe is clerk of the board.

The board of control of Dayton, O., has rejected bids on the 11 storm water sewer jobs which were above the estimates made by City Engineer F. J. Cellarius. The city will ask for new bids on each job

The city council of Canton, O., has adopted the report of plans and an estimate of City Engineer Phil H. Weber for the construction of a sanitary sewer system covering about eight miles in the southwestern part of the city. The estimated cost of the system is $39,000.

E. A. Kemmler, sanitary engineer of Columbus, O., has been retained by the city of Marysville, O., to prepare plans and specifications for the installation of a sanitary sewer system to cost about $100,000. The state board of health has ordered the city to install a system by Nov. 1 of this year.

Oklahoma.

City Engineer E. D. Hocker of Guthrie, Okla., is preparing plans and profiles for the construction of a new sanitary sewer to be constructed in West Capital Heights, between Logan and Mansur Aves., from 14th St. to 20th St., thence south on 20th St. to Oklahoma Ave., and into Shartell addition.

Oregon.

At a recent election held in Central Point, Ore., the citizens voted in favor of the expenditure of $125,000 this summer for civic improvements. A modern sewer system is to be installed, the water system extended, and over a mile of street paved.

The city council of Gresham, Ore., has sold bonds in the sum of $20,000 for water mains and a sewerage system to E. H. Rolling & Sons of New York City. The sewer system will cost $5,000.

Plans prepared by Deputy City Engineer Johnson of Portland, Ore., for the Columbia trunk sewer to drain the Vernon and Woodlawn districts have been adopted by the city council. J. W. Morris is city engineer.

Following bids were received by the Executive Board of Portland, Ore., for the construction of the Belmont district sewer: Paquet, Giebisch & Joplin, $10,840; Jeffery & Bufton, $10,165; E. Sandeberg, $11,953; Wil[illegible]son, $11,414.

Pennsylvania.

✣Bids will be received until noon, May 24, by J. J. Galbraith, City Clerk, Williamsport, Pa., for the construction of storm water sewer in Hepburn St., from Park Ave. to 6th St., and in 6th St., from Hepburn to Laurel St. Robert J. White is chairman of the Joint Highway and Sewer Committee

⦿Joseph Murphy & Son, Inc., West Hoboken, N. J., have been awarded the contract by the West New York Improvement Co., 112 N. Broad St., Philadelphia, Pa., for furnishing all the material and constructing a system of sewers, grading streets and sidewalks for $65,000. Bids were opened April 19.

⦿The Borough Council of Chambersburg, Pa., has awarded the following contracts for the construction of a system of sanitary sewers, a main out-fall sewer, and a sewage disposal plant, for which Albright & Mebus, 908 Land Title Bldg., Philadelphia, Pa., are Engineers: Pitt Construction Co of Pittsburg, Pa., $38,471, for the disposal plant; Cantrell Construction Co., Philadelphia, Pa., $6,943, for the main outfall sewer; Jas. Ferry & Son, Pittsburg, Pa., $114,471, for the main sewers. Bids were opened April 10. The sanitary sewer system comprises approximately 69,000 ft of 8 in. terra cotta pipe, 4,000 ft. of 10 in. terra cotta pipe, 1,500 ft. of 12 in. terra cotta pipe, 2,500 ft. of 15 in. terra cotta pipe, 3,600 ft. of 18 in. terra cotta pipe, and 4,100 ft. of 24 in. terra cotta pipe. The main out-fall sewer comprises approximately 460 cu. yds. concrete or stone retaining walls, 1,400 ft. of 20x30 in. concrete sewer, 72 ft. of 24 in. cast iron pipe. The disposal plant comprises 900 ft. of 16 in. [illegible] iron siphon line, one pump house and collecting well, equipped with three electrically driven centrifugal pumps, capacity 1,000 gals. per minute, five concrete settling tanks, one sprinkling filter bed 160 ft. x 125 ft., one sand filter for sludge, grading and other work.

The city council of Harrisburg, Pa., has passed an ordinance authorizing the construction of sewers for a draining system in Reservoir Park. These sewers are to be constructed to do away with the unsanitary cesspools in the park.

The State Board of Health of Pennsylvania has notified Mayor C. W. Wick of Parker, Pa., that a sewer system must be installed and that the Parker Water Co. must provide an approved filtering plant.

On April 10 the Borough Council of Chambersburg, Pa., received bids for the construction of a system of sanitary sewers, a main out-fall sewer and a sewage disposal plant, for which Albright & Mebus, 908 Land Title Bldg., Philadelphia, are engineers. The sanitary sewer system comprises approximately 69,000 ft. of 8-in. terra cotta pipe, 4,000 ft. of 10-in. terra cotta pipe, 1,500 ft. of 12-in. terra cotta pipe, 2,500 ft. of 15-in. terra cotta pipe, 3,600 ft. of 18-in. terra cotta pipe and 4,100 ft. of 24-in. terra cotta pipe. The main out-fall sewer comprises approximately 460 cu. yds. concrete of stone retaining walls, 1,400 ft. of 20x30-in. concrete sewer, 72 ft. of 24-in. cast iron pipe. The disposal plant comprises 900 ft. of 16-in. force main, 960 ft. of 12-in. cast iron siphon line, one pump house and collecting well, equipped with three electrically driven centrifugal pumps, capacity 1,000 gals. per minute, five concrete settling tanks, one sprinkling filter bed, 160 ft. by 125 ft., one sand filter for sludge, grading and other work. The Cantrell Construction Co. of Philadelphia, submitted the lowest bid for the sewer, its bid approximating $100,000. The Pitt Construction Co. of Pittsburg submitted the lowest bid for the disposal plant, its bid approximating $40,000. S. K. Shryrock is chairman of the sewerage committee.

South Carolina.

⦿R. F. & E. N. Beaty of Georgetown have been awarded the contract for the construction of sewers and connections down Gervais St. from Main to Pulaski, for $10,193, city of Columbia, S. C.

South Dakota.

✣Bids will be received until 8 p. m., May 15, by F. W. Raymond, City Auditor, Aberdeen, S. D., for the construction of all sewers ordered by the Council. The following are the approximate quantities: 1,430 ft. of 8 in., 430 ft. of 12 in. and 5 manholes.

The citizens of Madison, S. D., have voted the issuance of bonds in the sum of $65,000 for the construction of a sewer system.

The citizens of Aberdeen, S. D., on April 18 voted the issuance of bonds to the amount of $200,000 for sewerage extension purposes.

Tennessee.

The town of St. Elmo, Tenn., contemplates employing a sewer engineer to make estimates for the proposed sewerage system.

Texas.

The city of Cameron, Tex., has employed a surveyor to make the surveys for the construction of the sewerage system and work has already begun. As soon as surveys are completed bids will be called for the construction of the system.

Washington.

⦿It is reported that A. Peterson has been awarded the contract by the Board of Public Works of Seattle, Wash., for the construction of a trunk sewer on Virginia St., between Eighth and Boren Aves., for $14,250. The board also awarded the contract for the construction of sewers on North and East 58th St. [illegible]

Wisconsin.

✣Bids will be received until 4 p. m., April 29, by E. L. Williams, City Clerk, Appleton,

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Wis., for furnishing the necessary labor and material for the construction of a sewer on Outagamie and Lenox Sts. in the third ward, Appleton. A certified check for $200 must accompany each bid.

✣Bids will be received until 2 p. m., May 17, by G. O. Palmiter, City Clerk, Antigo, Wis., for laying 11,537 ft. of 10, 18, 20 and 24-in. vitrified pipe intercepting sewer from 2 ft. to 19 ft. deep and 31 concrete manholes; one sewage disposal plant consisting of 3 reinforced concrete sedimentation tanks, screen and grit chamber, sludge beds, automatic syphons and syphon chambers and 2½ acres of sand filter beds. W. G. Kirchoffer, 31 Vrooman Bldg., Madison, Wis., is engineer.

[illegible] advertisement will be found elsewhere in this issue.

⦿C. M. Nelson of Neenah, Wis., has been awarded the contract by the Board of Public Works of Appleton, Wis., for furnishing all labor and material for the construction of sewers in the following streets: Brucke St., from the center of Owaissa St. to east end of Pacific St. bridge, and from the east end of Pacific St. bridge southwesterly to connect with large sewer manhole in Bellaire Park, also on Pacific St., from Meade St., west 145 ft.; and on Pacific St., from Center St. west 145 ft., and on Pacific St., from Bateman St. east 190 ft. The contract price is $3,417. Bids were opened March 30.

⦿E. R. Harding of Racine, Wis., has been awarded the contract by the common council of Stoughton, Wis., for the construction of a [illegible] system for $69,999.

⦿The N. F. Reichert Co. of Racine, Wis., will probably be awarded the contract for the construction of the trunk sewer for the city of Kenosha, Wis., for which bids were opened by the city engineer on April 15. This sewer will cost approximately $95,000.

Canada.

The city of Fort William, Ont., plans the installation of a crematory. Dr. W. H. Hamilton is chairman of the board of public works.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until 3 p. m., May 27, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the enlargement and completion, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office at Gadsden, Ala.

California.

✣Bids will be received until 3 p. m., May 25, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction, including plumbing and ventilation, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office and Custom House at San Diego, Cal.

✣Bids will be received until noon, May 29, by Col. John Biddle, U. S. engineer, 401 Custom House, San Francisco, Cal., for furnishing and delivering stone for Humboldt Harbor jetties.

The County Supervisors have directed Perry A. Haviland, County Surveyor, Oakland, Cal., to make surveys and estimates for the construction of the proposed tunnel beneath the estuary waters between Oakland and Alameda. This work is preliminary to the calling of an election to vote on issuing bonds for the construction of the tunnel. It is estimated that the tunnel will cost $4,000,000.

City Council Finance Committee of Los Angeles has recommended that the Board of Public Works be authorized to have plans drawn and advertise for bids for harbor improvements in the Wilmington district without waiting for the Supreme Court to pass upon the legality of the harbor improvement bonds. This recommendation was made, however, with the understanding that no bids were to be opened nor contracts let until the Supreme Court has declared the bonds legal. It is expected that a decision regarding the bond issue will be made early in May. Homer Hamlin is City Engineer of Los Angeles.

Delaware.

✣Bids are asked until 11 a. m., May 11, by Maj. R. R. Raymond, U. S. Engineer, 6th and King Sts., Wilmington, Del., for dredging Murderkill River, Del. It is proposed to dredge, as far as available funds will permit, a channel 7 ft. deep and 60 ft. wide, widening at sharp turns, between the head of navigation at Frederica and the 7-ft. contour of Delaware Bay, a distance of about 9 miles. The amount available is $13,500.

✣Bids will be received until 11 a. m., May 15, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, for dredging Appoquinimink River, Del. It is proposed to dredge, as far as available funds will permit, a channel 7 ft. deep and 60 ft. wide, widening at sharp turns, between the head of navigation at Odessa and the mouth of the river, a distance of about 7 miles. The amount available is $5,100.

✣Bids are asked until 11 a. m., May 15, by Major R. R. Raymond, U. S. Engineers, Wilmington, Del., for dredging Appoquinimink River. It is proposed to dredge, as far as [illegible] 7 ft. deep and 60 ft. wide, widening at sharp turns, between the head of navigation at Odessa and the mouth of the river, a distance of about 7 miles. The depth of cutting will be from 0 to 5 ft. The estimated quantity is 36,400 cu. yds. place measurement; the amount available is $5,100.

Plans are now in preparation for an electrochemical plant to be constructed at the Delaware Mills of the Jessup & Moore Paper Co., Wilmington, Del., the work to be constructed at once. Sawyer & Moulton, 120 Exchange St., Portland, Me., are the Engineers.

District of Columbia.

✣Bids will be received until noon, June 20, by the Navy Department, Beekaman Winthrop, Acting Secy., Washington, D. C., for construction by contract of four fleet colliers, Nos. 9, 10, 11 and 12, and two sea going tugs.

✣Bids will be received until 10:30 a. m., May 8, by Capt. F. C. Boggs, general purchasing agent, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 629 equipment for steel foundry, including converter, blower, sand crusher and mixer, ladles, ladle heaters and materials for making steel castings, cast iron wheels for cross conveyor, manganese steel castings, steel castings, clutch fibres for rock crusher, ball governor, ejectors, rheostats, white oak lumber, etc.

✣Bids will be received until 2 p. m., May 1, by District Commissioners, Washington, D. C., for furnishing and delivering 830, more or less, cast iron lamp posts and accessories of special design.

✣Bids will be received until 2 p. m., April 28, by Board of District Commissioners, Washington, D. C., for extension of the cement warehouse at 14th and D Sts., southwest, D. C.

Florida.

✣Bids are asked until noon, May 12, as noted in our last issue, by Capt. Geo. R. Spalding, U. S. Engineer, Jacksonville, Fla., for dredging in the St. John's River below Jacksonville, Fla. The area to be dredged extends from a point opposite Fulton, about five miles above the mouth of the river, to the lower end of Trout Creek Shoal, a distance of about 10 1-3 miles. The work to be done is to dredge a channel having a bottom width of 300 ft. in the straight reaches and varying widths at the turns. The depth to be obtained is 30 ft. at mean low water. The channel at the turn opposite Browns Creek will be made 400 ft. wide. The increased width will extend about 3,000 ft. in Browns Creek Cut and about 1,000 ft. in St. Charles Creek Cut. The channel opposite Dames Point will be made 600 ft. wide for a distance of about 4,000 ft. It may be required to increase the width for a distance of about 1,000 ft. at the intersections of New Berlin Cut with St. Charles Creek Cut, and with Dames Point Cut. The total estimated quantity of material to be removed under the project is 5,486,200 cu. yds. place measurement. The amount of money at present available for contractors' estimates is about $100,000, with $200,000 additional from the amount authorized by Congress, and a possible further additional amount of $60,000.

Georgia.

✣Bids will be received until noon, May 12, by Eugene C. Wachendorff, architect, 826 Empire Bldg., Atlanta, Ga., for changes and additions to buildings on Marietta St. between Tabernacle Pl. and Ponders Ave. for the city of Atlanta. R. M. Clayton is chief engineer of construction.

✣Bids will be received until May 1 by Capt. C. D. Winn, constructing quartermaster, Fort Screven, Ga., for furnishing screens for quartermaster's storehouse and civilian employes' quarters as well as porch screens.

✣Bids will be received until 2 p. m., May 18, by Commanding Officer, Augusta Arsenal, Augusta, Ga., for furnishing during the fiscal year ending June 30, 1912, steel, brass, building materials, paints, oils, tools, cotton waste, hardware, fuel, photographic paper, etc.

Idaho.

✣Bids will be received until 11 a. m., May 16, by Constructing Quartermaster, Boise Barracks, Idaho, for construction complete, with plumbing, hot air heating and wiring of quarters for four non-commissioned officers at Boise Barracks, Idaho.

The Boise King Placers Co., Arthur H. Stevens, Engineer, Boise, Idaho, is planning to build a 7-mile flume to cost about $40,000.

Illinois.

✣Bids will be received until noon, May 10, by Fred W. Simpson, Secy., Hydro Electric Power Plant, Yorkville, Ill., for the construction of a dam across the Fox River at Millhurst, Ill., for the construction of a power house with wheel pits and tail races complete for four 210 hp. turbines, four 175 kw. generators with switchboards and instruments complete. Plans and specifications can be seen at the office of Fred W. Simpson, Yorkville, Ill., and at H. D. Hallett's, Engineer, Aurora, Ill.

It is officially announced that the Fox River Electric Power Co. will start construction work on its property by May 15. The company will build a hydro electric power house on the Fox River a few miles from Yorkville and will generate over 1,000 H. P. The building will be constructed of concrete and will be 50 by 125 ft. The dam will be concrete and will be 275 ft. long with 12 ft. head. The equipment will be four 66 in. water turbines direct connected to four 250 K. W., three phase, 60 cycle, alternating current generators, at 2,300 volts. The current will be stepped up through transformers to 12,000 volts. The line equipment will be three No. 4 copper wires mounted on high tension insulators on poles set 100 ft. apart. The high tension line will be 23 miles in length and will serve the following towns: Yorkville, Oswego, Bristol, Plano, Sandwich, Somonauk, Millington and Millbrook, and in addition will supply light and power to the manufacturers and farmers en route. All franchises have been secured and 85 per cent of the contracts for sale of light and power have been signed up. The sys tem will cost about $100,000 and it is expected will be in operation by the first of January. Catalogues and prices on machines, motors, wire, fixtures and supplies are desired. The work will be in charge of Hugh G. Palmer, Chief Engineer, Yorkville, Ill.

Indiana.

✣Bids will be received until 11 a. m., June 6, by Board of Spencer County Commissioners, Rockport, Ind., for the erection of a poor asylum. J. J. White, county auditor.

✣Bids will be received until 10 a. m., May 4, by C. C. Beer, Berne, Ind., R. D. No. 4, trustee of Monroe township, Adams county, for the construction of a school house. A. Boegly, Berne, Ind., is architect.

✣Bids will be received until 2 p. m., May 4, by Charles Gilespie, trustee of Posey township, Clay county, at Staunton, Ind., for the construction of a two-story school house with basement. Material to be brick.

✣Bids will be received until 2 p. m., April 29, by Trustee David Stewart of Winfield township, Lake county, at residence, ½ mile east of Leroy, Ind., for the construction of a school house of brick with stone trimmings, one story and basement.

Iowa.

✣Bids will be received May 17 by L. E. Burris, Chairman Building Committee, the Church of Christ, Elliott, Ia., for the erection and completion, excepting seating, frescoing and lighting of a new brick church in Elliott, Montgomery County, Ia.

Negotiations are underway for securing a water right on the Des Moines River at Fort Dodge, Ia. It is proposed to install a hydro-electric plant. Geis Botsford, Secretary Commercial Club, Des Moines, Ia., is interested.

Kansas.

✣Bids will be received until 10 a. m., May 9, by R. V. LaDow, supt. of prisons, Washington, D. C., for boiler feed, water heater and receiver, etc., at U. S. penitentiary at Leavenworth, Kan.

Louisiana.

⊙Bids were opened April 6 at the office of the U. S. Engineer, New Orleans, La., for the delivery of 60,000 tons of rock on board U. S. barges at Vidalia, La. The bid of Guy Dickinson, 111 Center St., Little Rock, Ark., was recommended for acceptance. The total amount of the bid was $120,000.

Maryland.

✣Bids will be received until 11 a. m., May [illegible], by R. C. Hollyday, chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for ice making and refrigerating machinery at the U. S. Marine Corps rifle range, Winthrop, Md.

✣Bids are asked until 2 p. m., May 15, by Col. Thos. L. Casey, U. S. Engineers, 309 Custom House, Baltimore, Md., as noted in our last issue, for dredging in Patapsco River, Md. The areas to be dredged are at the Cutoff-Brewerton bend, and the Cutoff-Craighill bend of the channels leading to Baltimore, Md. These areas are about 4,200 ft. long by 300 ft. wide, and [illegible] ft. long by a width varying from nothing to 600 ft., and contain approximately 860,000 cu. yds., and 1,400,000 cu. yds. of material (scow measurement) respectively.

Rollins & Westcott, [illegible] Kansas City, Mo., have been retained as engineers by the town of Monett, Mo., for the installation of an electric lighting plant, estimated to cost $35,000.

Massachusetts.

✣Bids are asked until noon, May 12, as noted in our last issue, by Col. Frederic V. Abbot, U. S. Engineer, Boston, Mass., for repairing breakwater at Gloucester, Mass. The work required is to furnish and deposit heavy rubblestone along the seaward face of the breakwater which extends westward from Eastern Point at the entrance to the outer harbor at Gloucester, Mass. The rubblestone apron placed along the face of this breakwater at the time of its construction has been dragged [illegible] the sea, and it is proposed to restore and enlarge this apron where necessary throughout the entire length of the breakwater, by placing rubblestone weighing not less than five tons each on top of the superstructure and against the seaward face of the superstructure in such quantities [illegible] water as the contracting officer shall direct. The rubblestone are to be of dimensions of which the [illegible] fourth of the greatest and shall be laid as compactly as practicable. There is available for this work about $11,[illegible]

Michigan.

✣Bids will be received until 11 a. m., April 28, by U. S. Public Health and Marine Hospital Service, office of R. M. Woodward, Detroit, Mich., for new tin roof, stairs, repairs, etc.

Minnesota.

✣Bids will be received until 7:30 p. m., April 28, by H. N. Knott, City Clerk, Minneapolis, Minn., for extending the steel runway at Gacbage Transfer Station, Plymouth Ave. and 1st St. north, 36 ft. more or less.

✣Bids will be received until 8 p. m., May 1, by Village Council of Nashwauk, Minn., John H. Carlson, Clerk, for the following direct current electric meters: 70 3-ampere, 110-volt, 2-wire; 30 5-ampere, 110-volt, 2-wire; 5 7½-ampere, 110-volt, 2-wire; 17 10-ampere, 110-volt, 2-wire; 7 15-ampere, 110-volt, 2-wire; 1 25-ampere, 110-volt, 2-wire; 1 25-ampere, 220-volt, 2-wire; 3 5-ampere, 220-volt, 3-wire 1 7½-ampere, 220-volt, 3-wire; 3 10-ampere, 220-volt, 3-wire; 1 15-ampere, 220-volt, 3-wire; 1 25-ampere, 220-volt, 3-wire; 1 75-ampere, 220-volt, 3-wire

Mississippi.

✣Bids will be received until noon, June 6, by Capt. J. A. Woodruff, U. S. Engineer, Vicksburg, Miss., for furnishing and delivering one steel hull towboat. Official advertisement will be found elsewhere in this issue.

⊙The following bids were received April 14 by Capt. J. A. Woodruff, U. S. Engineer, Vicksburg, Miss., for furnishing and delivering about 307,000 lbs., of structural metal for Ouachita River Locks and Dams Nos. 4 and 8, La. and Ark., and for erecting about 232,000 lbs. of structural metal at Ouachita River, Lock No. 8, Ark.: (1) Penn Bridge Co., Beaver Falls, Pa., (accepted); (2) Whitehead & Kales Iron Works, Beecher Ave. and M. C. R. R., Detroit, Mich., (3) Chas. Hegewald & Co., New Albany, Ind.; (4) [illegible] Bridge Co., Beaver Ave. and Rebecca St., North Side, Pittsburg, Pa.:

	Per lb.	Per lb.	Per lb.	Per lb.
Monroe, La.:				
24,300 lbs. structural steel......	6	7.9	6.619	5.75
16,500 lbs. wrought iron	7.5	13	7.149	5.75
460 lbs. steel castings	12	5.5	12.4	19
30 lbs. iron castings	15	4.5	3	8.5
For 4 valves, com[illegible] each)	$118	$65	$142.50	$170
Calion or Stark, Ark.:				
255,600 lbs. structural steel	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] lbs. wrought iron	[illegible]	[illegible]	[illegible]	[illegible]
4,340 lbs. steel castings	10.6	11.25	11.49	19
200 lbs. iron castings	15	5	3	8.5
For erecting 232,[illegible] No. 8	[illegible]			

Missouri.

✣Bids will be received until 9 a. m., May 8, by Ira T. Graham, City Auditor, Chillicothe, Mo., for furnishing material, tools, labor, etc., for the construction of a complete municipal electric lighting and power plant in accordance with plans and specifications on file at the office of the city clerk and Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., Engineers. The work will be divided into sections as follows: Sec. 1, concrete work, floors, machinery and building foundations; Sec. 2, brick power house building complete, less foundation and floor; Sec. 3, radial brick or concrete chimney; Sec. 4, steam boilers and equipment erected; Sec. 5, boiler feed pumps, heater, separators, traps and all pipe work erected complete; Sec. 6, two steam engines erected, 125-250 K. V. A.; Sec. 7, two generators and exciters, switchboard and regulators erected complete; Sec. 8, pole line transformers and street lighting system; Sec. 9, 1,000 ft. deep well for water supply; Sec. 10, steel tower and tank, 5,000 gal. capacity.

New Hampshire.

✣Bids will be received until 11 a. m., June 3, by R. C. Hollyday, chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for a locomotive for yard service at the navy yard, Portsmouth, N. H.

New Jersey.

✣Bids are asked until 11 a. m., May 18, by Maj. R. R. Raymond, U. S. Engineer, Old Federal Bldg., 6th and King Sts., Wilmington, Del., for dredging Cohansey River, N. J. It is proposed to dredge a new entrance to the river, through the marsh to the northwest of Cohansey Light, 100 ft. in width on the bottom and 7 ft. in depth, from that depth in the river to the same in Delaware Bay, a distance of about 2,000 ft.; and to redredge the channel from Stony Point to Broad St. bridge, about 1 mile, to a bottom width of 100 ft.; thence to Commerce St., a distance of about 700 ft., to a bottom width of 75 ft.; and thence to the Nailworks Bridge, a distance of about 850 ft., to a bottom width of 60 ft.; all to a depth of 7 ft. The total estimated quantity of material to be removed is 180,000 cu. yds., place measurement. The amount of money available is about $33,000.

New York.

✣Bids will be received until 2 p. m., May 3, by Constructing Quartermaster, Fort Totten, N. Y., for dredging channel to wharves at Fort Totten, N. Y.

✣Bids will be received until 10 a. m., May 15, by Capt. W. L. Guthrie, U. S. Engineer, Oswego, N. Y., for dredging at Ogdensburg Harbor, N. Y.

✣Bids will be received until 2 p. m., May 8, by Constructing Quartermaster, Fort Totten, N. Y., for construction of an addition to post hospital, including plumbing, heating, electric wiring and fixtures at the fort.

✣Bids will be received until noon, May 18, by Col. S. W. Roesseler, U. S. Engineer, New York, N. Y., for dredging in Flushing Bay, Hempstead Harbor and Huntington Harbor, N. Y.

✣Bids will be received until 10 a. m., May 8, by Commanding Officer, Torpedo Depot, Fort Totten, N. Y., for furnishing 1,840 compound plugs with brass fuse cans, 280 extra fuse cans, 2,000 extra split pins, 70 gross set screws, 100 lbs. friction bushings, 125 lbs., gland washers, 200 gland nuts, 2,000 ft. steel glands and 280 connecting nuts.

✣Bids will be received until 1 p. m., May 15, by Lieut. Col. W. W. Gibson, Watervliet Arsenal, Watervliet, N. Y., for furnishing steel hardware, forage fuel, oils, etc.

⊙Frost & Sheldon, of Albany, have been awarded the contract for installing an electrical generating plant, with feeders and transformers and general equipment, for the power house at the Hudson River State hospital at Poughkeepsie. The contract price was $37,[illegible]

North Carolina.

✣Bids will be received until 2 p. m., April 27, by Lieut. R. O. Edwards, Constructing Quartermaster, Fort Caswell, N. C., for furnishing and delivering (not installing) in the pump house at Fort Caswell two 53-h.p. simple automatic high speed single valve engines, complete, with all steam and exhaust connections, with subbase and extended shaft and outboard bearing for generators in accordance with item 6 on pages 56 to 67, respective-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] plant machinery and electric lighting system at Fort Caswell, N. C

Ohio.

✣Bids will be received until noon, May 10, by Board of Hospital Commissioners, Cincinnati, O., for the necessary labor and material for the construction of 18 buildings, compos- [illegible] pital of the city. Said buildings to be sit- [illegible] Ave., Bethesda Ave., Eden Ave. and Goodman St. The work will embrace the following departments: 1, excavation and foundations; 2, brick work; 3, fireproof partitions and furring; 4, cut-stone work; 5, ornamental terra cotta work; 6, re-enforced concrete work; 7, concrete piling; 8, cement work; 9, roofing and sheet metal work; 10, structural iron and steel work; 11, ornamental iron work; 12, plastering; 13, terrazzo floors and "marbleithic" work; 14, tile work; 15, marble work; 16, carpenter work; 17, weather strips; 18, hardware; 19, painting and glazing; 20, plumbing; 21, gas piping; 22, electric wiring and signal system. Bids must be made in accordance with the drawings and specifications for said work as prepared by Samuel Hannaford & Sons, Architects, which drawings and specifications are on file at the office of the Board of Hospital Commissioners in the City Hall, and at the office of said architects, Hulbert Block, Cincinnati, O.

Rhode Island.

✣Bids will be received until 10 a. m., May 11, by Lieut. J. J. Thomas, Constructing Quartermaster, Fort Adams, R. I., for construction of a sea wall, excavation, filling, etc., at that post.

✣Bids will be received until 2 p. m., May 15, by Lieut. Col. J. C. Sanford, U. S. Engineer, Newport, R. I., for dredging in Providence Harbor, R. I.

South Carolina.

✣Bids will be received until noon, May 10, by Col. Dan. C. Kingman, U. S. Engineer, Charleston, S. C., for dredging in Winyah Bay, S. C.

✣Bids will be received until noon, May 10, by Col. Dan. C. Kingman, U. S. Engineer, Charleston, S. C., for dredging in Winyah Bay, S. C.

Tennessee.

✣Bids will be received until 3 p. m., May 29, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office at Dyersburg, Tenn.

Texas.

✣Bids will be received until 3:30 p. m., May 9, by Commissioners' Court, Williamson county, Georgetown, Texas, for the furnishing of the new court house. W. W. Jenkins is county auditor.

✣Bids will be received until 3:30 p. m., May 9, by W. W. Jenkins, county auditor, Georgetown, Tex., for furnishing the new court house. Plans and specifications can be obtained at the office of C. H. Page & Bro., architects, Austin, Texas.

Virginia.

✣Bids will be received until noon, May 15, by Lieut. Col. W. C. Langfitt, U. S. Engineer, 920 17th St., N. W., Washington, D. C., for dredging in the Potomac River at Alexandria, Va.

✣Bids will be received until 11 a. m., May 20, by R. C. Hollyday, chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for roof coverings for a number of buildings at the navy yard, Norfolk, Va.

✣Bids will be received until 11 a. m., May 27, by R. C. Hollyday, chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for dry dock pumping equipment at the navy yard, Norfolk, Va.

✣Bids will be received until noon, May 20, by Lieut.-Col. W. C. Langbitt, U. S. Engineers, 920 17th St., Washington, D. C., for constructing and revetting jetties and driving piles in James River, Virginia. The jetty work to be done comprises the construction of about 4,700 lin. ft. of jetty, as follows: In Kingsland Reach, about 10 miles below Richmond, constructing 6 new jetties, aggregating about 1,000 lin. ft.; in Varina Reach, about 15 miles below Richmond, constructing 3 new jetties and extending 3 of the existing jetties, an aggregate of about 1,200 lin. ft.; in Deep Bottom Reach, about 19 miles below Richmond, constructing 10 new jetties and extending 1 of the existing jetties, an aggregate of about 2,500 lin. ft. About 40 per cent of the total length of jetty will be placed in deep water from about 4 to 22 ft. deep. The remainder comprises shore ends and parts to be placed in the mud flats that are, for the greater part, bare at low tide. The total estimated quantities of material to be used is as follows: Round white oak piles, 1,350 lin ft.; round pine piles, 9,400 lin ft.; 3-in. merchantable pine sheet piling, 165,000 ft., B. M.; 4-in. merchantable pine sheet piling, 7,000 ft., B. M.; white oak wales, 30,000 ft., B. M.; white oak string pieces, 7,000 ft., B. M.; stone riprap, 1,500 tons.

✣Bids will be asked until noon May 15, by Lieut.-Col. W. C. Langbitt, U. S. Engineers, Washington, D. C., for dredging in Potomac River at Alexandria, Va. The dredging is to be done in the harbor of Alexandria, Va., on that portion of the bar outside of a line parallel to and 20 ft. in front of the established pier head line and between the prolongation of the center line of Pendleton St. and the northern city limits. This area is about 2,400 ft. in length and will average about 200 ft. wide, and contains about 300,000 cu. yds of excavation.

West Virginia.

✣Bids will be received until 11 a. m., May 17, by Maj. F .W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for constructing Lock and Dam No. 20, Ohio River, near Belleville, W. Va. The site for the work is in the Ohio River, near Belleville, about 17 miles below Parkersburg, W. Va. The Ohio River Division of the B. & O. R. R. passes the site on the West Virginia side at a distance of about ⅓ mile from the river, and Belleville Station on that road is about one mile below the site. The work includes constructing lock, guide walls, river-wall power-house, the dam (including the navigable pass and the beartrap and Chanoine weirs) and the abutment; and grading and paving the esplanade and the bank back of the abutment. The following is the estimate of quantities: Cofferdam, 16-ft., 4,240 lin. ft.; Cofferdam, 10-ft., 1,500 lin. ft.; common excavation, 117,300 cu. yds.; rock excavation, 1,000 cu. yds.; fill, 37,200 cu. yds.; Riprap, 2,670 cu. yds.; fill, 37,200 cu. sq. yds.; round piles, 9,050 lin. ft.; sheet piles, 129,000 ft. B. M.; Oak timber, 68,500 ft. B. M.; reinforced concrete, 190 cu. yds.; concrete (solid construction), 57,800 cu. yds.; concrete (arched-void construction) (alternative bid), 54,300 cu. yds.; concrete paving, 1,800 cu. yds.; structural steel, 917,900 lbs.; reinforcing rods, 22,400 lbs.; forgings (including wrought iron), 52,450 lbs.; bolts, etc., 74,700 lbs.; iron castings, 247,500 lbs.; steel castings, 180,200 lbs.; bronze, 1,170 lbs.; pipe, 5-in., 400 lin. ft.; pipe, 4-in., 2,550 lin. ft.; pipe, 3-in., 1,020 lin. ft.; pipe 2½-in., 190 lin. ft.; pipe, 2-in. 580 lin. ft.; tile drain, 860 lin. ft.

Wyoming.

✣Bids will be received until 9:30 a. m., May 15, by Constructing Quartermaster, Fort D. A. Russell, Wyo., for constructing one hospital corps barrack plan No. 276.

Canada.

✣Bids will be received until noon, May 23, by G. R. Geary, Chairman, Board of Control, Toronto, Ont., for the construction of dock in Ashbridges Bay. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until May 11 by Angus Martyn, Secy. Treas., Ripley, Ont., for the construction of a telephone system in the town of Huron, part of Kinloss, in province of Ontario.

THE SANITARY DISTRICT OF CHICAGO.

Calumet-Sag Channel Excavation.

Sealed proposals indorsed "Proposals for excavation and collateral work on contract section three of the Calumet-Sag Channel" will be received by the Clerk of the Sanitary District at the offices of the district on the 15th floor of the American Trust Building, Chicago, Illinois, until 12 m., Standard time, on May 18, 1911, and will be publicly opened by the Board of Trustees at a meeting to be held on that day, or the first meeting thereafter.

The work for which tenders are invited consists of the excavation and collateral work on contract section three of the Calumet-Sag Channel of the Sanitary District of Chicago, in the Township of Palos, County of Cook, State of Illinois.

The approximate quantities for the comparison of bids are:

(a) 325,000 cubic yards of Glacial drift excavation.

(b) 197,000 cubic yards of rock excavation.

(c) 83,500 square feet of channeling.

(d) 7,500 cubic yards of concrete retaining wall.

(e) 114,000 square yards of rip-rap slopes.

Plans and specifications may be obtained upon application at the office of the said district.

All bids must be upon blank forms of proposals furnished by the Sanitary District, and shall be made in accordance with and to conform with all the terms and conditions stated therein.

The Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF
CHICAGO,
By THOMAS A. SMYTH.
President of Its Board of Trustees.
Attest: I. J. BRYAN,
Clerk.

Chicago, April 21, 1911.

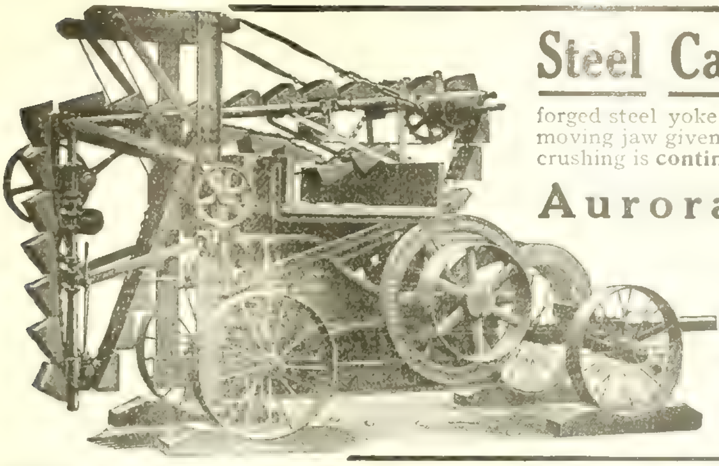
INTERCEPTING SEWER AND SEWAGE DISPOSAL PLANT, ANTIGO, WISCONSIN.

Sealed proposals will be received by G. O. Palmiter, City Clerk, Antigo, Wisconsin, until 2:00 p. m., May 17, 1911, for the laying of 11,537 ft. of 10-in., 18-in., 20-in. and 24-in. vitrified pipe intercepting sewer from 2 ft. to 19 ft. deep, and 31 concrete manholes; also on sewage disposal plant consisting of 3 reinforced concrete sedimentation tanks, screen and grit chamber, sludge beds, automatic syphons and syphon chambers and 2½ acres of sand filter beds. Bids on the intercepting sewer will be received separate from bids on the disposal plant. Each bid is to be accompanied by a certified check for 5% of the bid with a minimum of $1,000. The successful bidder will be required to furnish a bond in the sum of 25% of the contract price, or a minimum of $5.000. The right is reserved to reject any or all bids.

Plans may be seen at the office of the city clerk, Antigo, Wisconsin; Western Building Publishing Co., 405 Montgomery Bldg., Milwaukee; Engineering-Contracting, 527 South Dearborn Street, Chicago; The Improvement Bulletin, 910 Lumber Exchange, Minneapolis, and W. G. Kirchoffer, Engineer, 31 Vroman Bldg., Madison, Wis.

G. O. PALMITER,
City Clerk.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.



Steel Castings and No Lost Motion

forged steel yoke, cross bars on yoke remove all strains from main frame, moving jaw given a compound oscillating and reciprocating motion so that crushing is **continuous,** are features of the

Aurora Steel Rock Crusher

Its compact form combines great strength with light weight, making it very portable and **specially adapted for contractors' use.** Strongest and most durable crusher on the market combining maximum product with minimum power. Adjustable to various sized stone. *Get our Special Crusher Catalog.*

Western Wheeled Scraper Co.

Earth and Stone Handling Machinery **Aurora, Ill.**

BRICK PAVING.

OFFICE OF THE COMMISSIONERS,
Portage County, Ravenna, Ohio,
March 28, 1911.

Sealed proposals will be received at the Office of the Commissioners of Portage County, Ohio, until 12 o'clock, noon, May 1, 1911, for the grading and paving with brick 2.12 miles of road in Ravenna and Shalersville Township, said County, under the provisions of "The Dodge Act" so-called.

Specifications, plans and profiles are on file in the Office of the County Surveyor in Ravenna, Ohio.

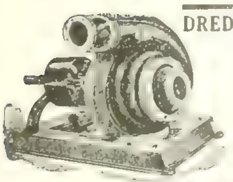
Certified check, $1,000.00.

The Commissioners reserve the right to reject any and all bids.

W. J. DODGE,
County Auditor.

THE TRENTON IRON CO.
WIRE AND WIRE ROPE
TI
CO
AERIAL TRAMWAYS
TRENTON, N.J.

WRITE FOR OUR
RED BOOK



DREDGING—IRRIGATION

Write for Information about the BUSH IMPROVED CENTRIFUGAL PUMPS used by some of the biggest contracting and dredging companies.

Greaves Specialty Mfg. Co.
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PAVING.

Harlan, Iowa, April 22, 1911.

Sealed proposals will be received by the City Clerk of the City of Harlan, Iowa, at his office in Harlan, Iowa, until 8 o'clock p. m., May 15, 1911, for the construction of about 7,000 linear feet of concrete curb and gutter, and 15,000 square yards of concrete pavement more or less, as per plans and specifications on file in the office of said City Clerk; the Council reserves the right to reject any or all bids.

O. F. GRAVES,
City Clerk.

SEWER.

The City of Auburn, Ind., will receive bids for approximately 10,000 feet of from 20-inch vitrified to 42-inch concrete storm sewer on the 15th day of May, 1911, at the hour of 7:30 p. m., at the office of the city clerk, E. O. Little.

For further information, write Phil Holman, City Engineer, Auburn, Ind.

SEWAGE DISPOSAL WORKS.

Batavia, N. Y.

Sealed proposals will be received at the office of the Batavia Sewer Commission until 10 o'clock a. m. on the 15th day of May, 1911, for furnishing materials and doing all work as specified for the construction of preliminary settling tanks of the Imhoff type, sprinkling filterers and sludge drying beds, including necessary fittings and appurtenances.

Plans and specifications may be seen at the office of Hering & Fuller, Consulting Engineers, 170 Broadway, New York City. The plans may be seen and specifications and forms of proposal obtained from Charles Hoopes, Resident Engineer, at the office of the Sewer Commission in Batavia, N. Y.

A full set of blue prints and specifications, including bidding sheets, will be forwarded to any applicant, express prepaid, upon receipt of a deposit of $5.00, which will be returned upon the return of the blue prints in good condition. Each bid must be accompanied by a certified check on a solvent bank for 5 per cent of the amount of bid.

The Board of Sewer Commissioners of the Village of Batavia reserves the right to reject any and all bids, to waive any informality in the bids received and to accept any of which it deems to be most favorable to the Village of Batavia. Unbalanced bids will be rejected without consideration.

K. B. MATHES,
Chairman Board of Sewer Commission.
Attest: JOHN H. WOOD,
Clerk, Board of Sewer Commission.

CITY OF TORONTO.

Tenders for Construction of Ashbridges Bay Docks.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Canada, up to noon on Tuesday, 23d May, 1911, for the construction of dock in Ashbridges Bay.

Envelopes containing tender must be plainly marked on the outside as to contents.

Specifications and forms of tender may be obtained upon application to the Department of Railways, Bridges & Docks, City Engineer's Office, Toronto.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman Board of Control.
City Hall, Toronto, April 12, 1911.

SEWERS.

Reedsburg, Wis., April 14, 1911.

Sealed proposals for the construction of trunk sewers along the Franklyn Street Sewer District, City of Reedsburg, Wis., will be received at the City Clerk's office, Reedsburg, Wis., until 5 p. m., May 17, 1911.

The work consists of 1,650 lin. ft. 30-in. pipe, 1,200 lin. ft. 27-in. pipe, 1,410 lin. ft. 18-in. pipe, the trenches varying from 8 to 20 ft. in depth, with 10 manholes and 22 catch basins.

Plans, specifications and proposal forms are on file at the City Clerk's office. A certified check of 5 per cent of the amount of the bid must accompany the bid and the right is reserved to reject any and all bids.

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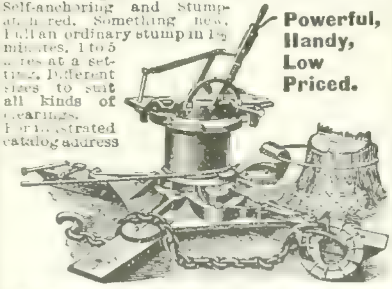

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Two Notable Articles on Reinforced Concrete.

In our issue of March 22, 1911, we printed an article under the caption "Simplified Reinforced Concrete Mathematics," by Melvin D. Casley, and this week we are printing another article by the same author, entitled "Applications of the Slide Rule Principles to Reinforced Concrete Design." The present article follows closely the former one in subject matter and method of treatment and presentation. These articles will prove of special interest to engineers actively engaged in reinforced concrete design. Anyone familiar with the necessary and sufficient conditions for equilibrium of non-concurrent coplaner forces, and the elements of the common theory of flexure as applied to elastic ribs, can readily follow the various steps in the derivation of the formulas in the first article. The methods developed in that article will produce a great saving in time, and will also lead to greater accuracy and reliability of results than the ordinary curves and tables now in use. Moreover, the formulas are perfectly general in their application and any designer familiar with them need have no further annoyance from the necessity of exhuming the particular curves applicable to unusual problems.

The present article is based on the formulas derived in the first article, and the methods of evaluating the desired quantities for any problem by means of specially constructed slide rules is explained. The use of any of these rules makes the design of reinforced concrete beams as simple a problem as the design of wooden beams with the common slide rule.

We commend these articles to the careful attention of our readers who are engaged in this line of work.

Two Recent Achievements in Bridge Reinforcement.

On account of the necessity for economical operation the tendency of the railroads has long been toward the employment of heavier power. Great advances have been made in recent years, but it is doubtful if the limit, from an economical point of view, has yet been reached. On many lines bridges exist that are in good condition physically, but which were designed for lighter loads than those now in use, and operation over such lines presents an embarrassing problem to the operating departments. In such a case either reconstruction or reinforcement is ultimately necessary

Within the past year two interesting undertakings in reinforcement have been completed. The conditions governing in the two cases were widely different, and with the data at hand, they do not admit of direct comparison in the matter of cost. The examples referred to are the Pecos river viaduct of the Southern Pacific Ry., and the steel trestle approaches in the Wabash R. R. bridge over the Missouri river at St. Charles, Mo.

The Pecos river viaduct is a typical example of steel reinforcement. It consisted originally of thirty-four 35-ft. deck plate girders, one 45-ft deck plate girder, eight 65-ft. lattice girders, two 62½-ft. cantilever arms, two 85-ft. anchor arms and an 80-ft. suspended span, making a total length of 2,180 ft. The trusses and girders were placed 10 ft. apart, center to center throughout the structure and were carried on 4-column towers 35 ft. long measured longtitudinally of the track. All the columns except the two supporting the cantilever trusses consisted of four 6-in. Z-bars. The columns in the two towers supporting the cantilever trusses consisted of channel sections laced together. The bracing of the towers consisted of diagonal rods and horizontal struts composed of 4 angles laced in an I-shaped section. The structure was built by the Phoenix Bridge Co., and was designed for a live load of 5,000 lbs. per ft. with a concentrated load of 30,000 lbs. The deck of the viaduct is 321 ft. above the river

In late years the operation of the line has been seriously limited by this structure, it being necessary to use lighter locomotives over this portion of the line than elsewhere. It became necessary to provide a structure capable of sustaining the standard loading of the Harriman Lines, which is about equivalent to Cooper's specification E 55.

It was unavoidable that the work should be done under traffic, and after several plans had been considered the reinforcement was carried out in the following manner: New center girders were provided for all girders and trusses. These girders were carried by means of cross girders riveted to the tops of the columns. The new center girders were made the same depth as the outside girders. In the case of the 65-ft. lattice span the center girder was made the same depth as the span, but was reduced to a depth of 4 ft. at the ends for attachment to the towers. The new cantilever and suspended trusses corresponded in outline to the old trusses, but were riveted instead of pin-connected.

Of particular interest is the method of reinforcing the towers. The Z-bar columns were reinforced mainly by the addition of 3½x3½ in. angles. Where this did not give sufficient section, 7-in. plates were added. Batten plates were used to connect the angles. In six of the bents, the ones supporting the cantilevers and anchor arms, it was found that reinforcement of the existing columns would require an excessive amount of metal, and it was therefore decided to provide new center columns to carry the additional load on these bents. The new center columns were made of plates and angles or of channel sections, and rested on new concrete piers similar to the old piers.

At the time the work of reinforcement was done the structure was shortened 665 ft. by the removal of 19 spans at the west end.

In our issue of February 22, 1911, we presented a detailed account of the method of reinforcing the steel trestle approaches of the Wabash R. R. bridge over the Missouri river at St. Charles, Mo. This work was of an unusual nature, and practically established a new precedent in bridge reinforcement. In the two approaches to this bridge there are 75 towers, each consisting of four Phoenix columns, the track being supported on wooden stringers. It was necessary to reinforce or to rebuild the trestle supports and to replace the wooden stringers with steel stringers. It was found after exhaustive investigation that the columns could be reinforced by an envelope of reinforced concrete at a cost of about one-third that of a new trestle. Elaborate tests demonstrated that columns thus reinforced were of ample strength for carrying any locomotives now in use.

Each column was poured as a monolith, a mixture of 1:3 being used, with No. 6 spiral hooping reinforcement. Although very effective, the spiral reinforcement proved to be a difficult and expensive thing to place. The forms were made of ⅞x5½ in. fencing, with cleats every 2 ft. The concrete was mixed in a mixer mounted on a car, and was poured direct into the forms.

The reinforcement of this trestle cost $7.30 per lin. ft., while the steel stringers cost, in place, $10.50 per lin, ft., making a total of $17.80 per lin. ft. The approximate cost of the Pecos river viaduct was $130,000, or $85.45 per lin. ft. Considering the wide difference in conditions, especially in the matter of height, and with the scant data at hand, accurate comparison of costs is impossible. It seems probable, however, that reinforcement of the larger structure by means of reinforced concrete was worth considering, and might have proved more economical than the method adopted.

The Commercial Engineers' Club is the name of a new society recently organized in Chicago. This society is organized for the mutual benefit of commercial engineers, manufacturers and representatives of manufacturing firms. It is proposed to make a national organization with the principal headquarters at Chicago. The officers are Mr. C. W. Aveling, President; Mr. A. J. Reed, Vice-President, and Mr. N. A. Engleman, Secretary and Treasurer, all of Chicago. The club meets Friday noons at the Kaiserhof Hotel, Chicago.

In the excavation of the new capital Power House at Albany, N. Y., the R. T. Ford Company, contractors, are using three Packard auto-trucks equipped with rear-end dumping bodies. [illegible] Thew shovel which supplies the trucks and also several dump wagons which are hauled by teams. The contractor estimates that one of the trucks is doing the work of eight teams.

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CONCRETE AND REINFORCED CONCRETE SECTION

Applications of the Slide-Rule Principle to Reinforced Concrete Design.*

BY MELVIN D. CASLER.†

As demonstrated in the standard works on reinforced concrete design, the four fundamental formulas‡ for designing reinforced concrete beams may be stated as follows:

$(1-x)/x = RC/S$ ......(a)
$(1-x)(2+x)/6 = M/Cbh^2$ ......(b)
$(1-x)^2(2+x)/6x = RM/Sbh^2$ ......(c)
$(1-x)^2/2x = Rp$ ......(d)

NOMENCLATURE

These four fundamental equations result from a rigid mathematical analysis of Fig. 1, employing the nomenclature indicated there and the following:

C = maximum unit stress in concrete at section AB in lbs. per sq. in.

S = unit stress in steel at section AB in lbs. per sq. in.

M = transverse bending moment at AB in in inch lbs.

Ec = coefficient of elasticity of concrete.

Es = coefficient of elasticity of steel.

$R = Es/Ec$.

b = width of beam in inches.

h = depth of beam to steel in inches as indicated in Fig. 1.

d = total depth of beam in inches as indicated in Fig. 1.

p = percentage of steel reinforcement, = area of steel in section AB in square inches ÷ bh.

A = cross-sectional area of steel, = pbh.

x is a decimal coefficient as indicated in Fig. 1.

The unit concrete stress is assumed to decrease uniformly from the maximum value, C, at the compression side of member to 0 at the neutral axis.

Concrete tensile resistance below neutral axis not considered.

Plane cross sections before deflection remain planes after deflection.

The four functions of x involved in equations (a), (b), (c) and (d) may be expressed in terms of the following three functions: $(1-x)/x$, $(1-x)(2+x)/6$ and $(1-x)/2$. For simplicity, let us represent these three functions of x as follows:

$(1-x)/x = D$.
$(1-x)(2+x)/6 = Y$.
$(1-x)/2 = Z$.

Then from (a) we have $D = RC/S$.....(1)
From (b) we have $Y = M/Cbh^2$.....(2)
From (c) we have $DY = RM/Sbh^2$....(3)
From (d) we have $DZ = Rp$..........(4)

From these four equations we derive the following:

(5) $C = DS/R = M/Ybh^2$
(6) $S = RC/D = RM/DYbh^2$
(7) $bh^2 = M/YC = RM/DYS$
(8) $M = YCbh^2 = DY\ Sbh^2/R$
(9) $p = DZ/R$
(10) $A = pbh$.

The above equations are seen to involve operations of multiplication and division only, thereby enabling all the work to be rapidly performed on the slide rule.

PERTAINING TO FIGURE 2

Figure 2 represents the application of an idea, recently conceived by the writer, of a reinforced concrete slide rule which facilitates the mathematical operations to such a degree that the design of reinforced concrete beams becomes as simple a matter as that of timber beams. This rule is perfectly general in its application and by its aid reinforced concrete members may be designed for any desired stresses in the concrete and steel and for any coefficients of elasticity, without performing any mathematical operations other than those which may be rapidly read from the rule. It affords not only a rapid, simple means of design but with it any existing reinforced concrete member subjected to a known loading may be quickly investigated with reference to the stresses developed, and the amount of reinforcement required in a concrete beam of known dimensions can be told in a moment. The device can be applied not only to beams but also to any member subjected to bending moment or to direct stress in conjunction with bending moment. The writer has constructed a model for his own use and finds that it reduces reinforced concrete design to an extremely simple proposition.

There are no arbitrary assumptions made in the construction of the rule, which consists of the familiar logarithmic slide rule with the addition of two simple auxiliary scales, the graduations of which are located by means of the exact mathematical formulas stated above, and so placed that they may be readily worked in conjunction with the usual slide rule scales. It is thus seen that the reinforced concrete slide rule, as I call it, is not an instrument for the sole purpose of reinforced concrete computations, but is an ordinary slide rule which may be used for miscellaneous slide rule work as well, the reinforced concrete device consisting merely of the two added scales, Y and Z, or Y' and Z', as lettered in Fig. 2. The usual slide rule scales are lettered A, B, C, D, F, and G. Scale F is scale B reversed and scale G is scale C reversed. Thus every graduation of scales F and G is opposite its reciprocal on scales B and C respectively. The scales Y' and Z' are Y and Z reversed and are shown in the cut merely to suggest a different possible arrangement of the latter as explained in the following pages. The ease and rapidity with which reinforced concrete computations may be performed with this rule are apparent from the specimen problems solved below. Fig. 2 (a) represents the face of the rule and Fig. 2 (b) the reverse side, the rule there illustrated being of the duplex type. The quantities D, Y and Z as used in equations (1) to (10) are found on the scales D, Y and Z respectively, as lettered in Fig. 2. By letting the scale D represent the function $\frac{1-x}{x}$ as explained above, the correct graduation of the scales Y and Z is easily accomplished by means of a tabulation as suggested by Table I, following, which also gives the values of the other functions that are applied to the various scales hereinafter described. The scales Y and Z are so constructed that the corresponding values of D, Y and Z are opposite each other thereon. In all cases the slide is of course to be so inserted that the lettered ends of the scales are all at the same end of the rule, and scales B and C are to be in contact with scales A and D respectively. The graduation of the scales shown in Figures 2 to 6 inclusive may be only approximately correct, the purpose of the cuts being merely to illustrate the idea rather than to serve as accurate instruments. The graduation spaces of the various scales can of course be further subdivided so as to give more accurate readings.

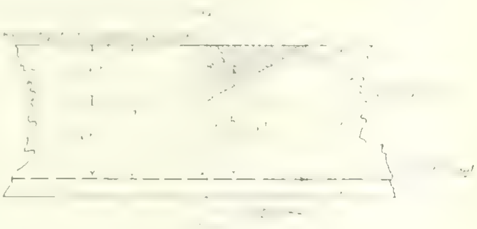

Fig. 1.—Dimension Diagram.

In the following discussion, whenever the "rider index" is referred to it is represented in the illustrations by the line (i); the word "index" refers to the graduation, 1, of scales A, B, C, D, F, G and G'; rule closed means all scale indices in line. It is thus seen that the rider index (i), in any position, covers corresponding values of D, Y and Z on scales D, Y and Z respectively.

If we wish to design a beam completely for a given amount, we of course first adopt the values of C, S and R upon which the design is to be based. Compute D by means of equation (1). Then the corresponding values of Y and Z are found on scales Y and Z of Fig. 2 opposite this value of D as given by scale D. From (7) compute bh^2. From (9) compute p by the usual slide rule methods. Area of steel = pbh. The beam is designed.

Let us solve the following examples of reinforced concrete beams subjected to transverse bending moment only:

Example 1:—M = 60,000 in. lbs.
S = 16,000 lbs. per sq. in.
C = 500 lbs. per sq. in
R = 12.
Required: b, h and pbh.

Example 2:—M = 100,000 in. lbs.
b = 8 ins.
h = 12 ins.
R = 12.
S is not to exceed 16,000 lbs. per sq. in.
C is not to exceed 650 lbs. per sq. in.
Required: the amount of steel reinforcement necessary = pbh.

Example 3:—M = 80,000 in. lbs.
b = 10 ins.
h = 12 ins.
Area of steel reinforcement = 1 sq. in.
R = 15.
Required: the stresses developed in the concrete and steel.

Example 4:—Same assumptions as for Example 3 except as to the value of M.

Required: the transverse bending moment which will stress the concrete to 500 lbs. per sq. in.; also the transverse bending moment which will stress the steel to 16,000 lbs. per sq. in.

Solutions:

Example 1. From (1), $D = \frac{12 \times 500}{16{,}000} = .375$.

Hence Y = .124 and Z = .1365 (see Fig. 2). From (9) p = .00425. From (7) $bh^2 = 968$. Knowing bh^2 = 968, we find possible values of b and h to satisfy this condition as follows: Place the middle index of scale B opposite 968 on either portion of scale A. With the slide so placed, the corresponding values of h and b will be found opposite each other on scales G and A respectively as shown by the rider index. This follows from the principle of reciprocal scales as explained in any slide rule instruction book. We will get the greatest number of combinations of corresponding values of h and b without reshifting the slide if we place the middle index of scale B opposite that value of 968 on scale A which is nearest the middle index of same. Doing this we find that if h = 8, b = 15.1±; if h = 10, b = 9.68; if h = 12, b = 6.7±; if b = 6, h = 12.7±; if b = 8, h = 11; if b = 9, h = 10.4±, etc., etc.

Let us adopt b = 9 ins. and h = 10½ ins. Then area of steel = pbh = .00425 × 9 ins. × 10.5 ins. = 0.4 sq. in. cross section.

Example 2. From (3) $DY = \frac{100{,}000 \times 12}{16{,}000 \times 8 \times 144} = .065$. Knowing DY, it is an easy matter to

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‡In our issue of March 22, 1911, Mr. Casler contributed an article entitled "Simplified Reinforced Concrete Mathematics," in which the equations (a), (b), (c) and (d) of the present article were derived.—Editors.

†Assistant Engineer, Designer, Board of Water Supply, 107 N. High St., Mount Vernon, N. Y.

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obtain D, Y and Z from the rule as follows: Place the right index of scale C opposite .065 on scale D. Turn rule over and find a position for the rider index such that it will cover the same values on scales G and Y. This occurs when $Y = .142$, as is seen from Fig. 2, in which the slide and rider index are shown as set for this example. The correct values of D and Z will then be found opposite this value of Y. Hence $Y = .142$, $Z = .157$, $D = .46$.

The principle governing this operation is that of reciprocal scales applied as follows:

Suppose, as above, $DY = .065$. Then $\frac{.065}{Y} = D$. To divide .065 by Y by means of the reciprocal scale G, we place the right index of scale C opposite .065 on scale D and place the rider index over the value of Y as given by scale G. The rider index will then cover the quotient, D on scale D. But we know from the construction of the scales that the corresponding values of D and Y are opposite each other on the scales D and Y respectively. Hence, to satisfy both these conditions, with the slide set as stated, the value of Y must be given by both the scales G and Y, and must therefore be that value at which scales G and Y register the same—viz: .142. From (5) let us see what stress the above results put into the concrete: $C = \frac{.46\times16,000}{12} = 613$ lbs. per sq. in.

From (9) $p = DZ \div 12 = .46 \times .157 \div 12 = .00602$.

From (10) $A = .00602 \times 8 \times 12 = 0.578$ sq. in.

Example 3: $p = \frac{1}{10 \times 12} = .00833$. From (4) $DZ = .00833 \times 15 = .125$.

From this value of DZ we get the corresponding values of D, Y and Z by the same method as used above for obtaining these functions from DY—place opposite .125 on scale D that index of scale C which will bring the same values on scales G and Z opposite each other. In this case, by placing the *left* index of scale C opposite .125 on scale D we fine .195 on scale G opposite .195 on scale Z.

Hence, from Fig. 2, $Z = .195$, $Y = .169$, $D = .64$.

From (6) $S = \frac{80,000 \times 15}{.64 \times .169 \times 10 \times 144} = 7,700$ lbs. per sq. in.

From (7) $C = \frac{80,000}{.169 \times 10 \times 144} = 330$ lbs. per sq. in. This is checked by the first expression of (5), from which $C = \frac{.64\times7700}{15} = 330$.

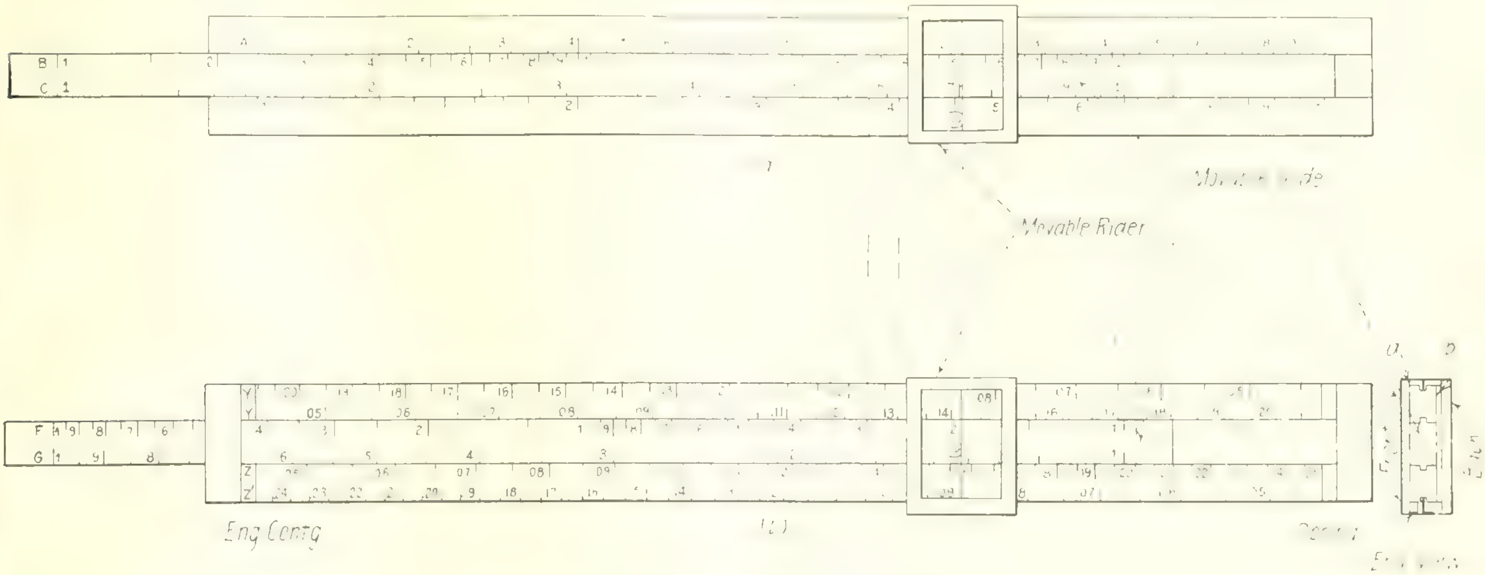


Fig 2.—Rectilinear Form of Slide-Rule.

Example 4: As before, $DZ = .125$, from which $Z = .195$, $Y = .169$, $D = .64$.

From (8), if $C = 500$, $M = .169 \times 500 \times 10 \times 144 = 121,700$ in. lbs.

From (8), if $S = 16,000$, $M = .64 \times .169 \times \frac{16,000 \times 10 \times 144}{15} = 166,000$ in. lbs.

If $M = 121,700$, $S = \frac{15 \times 500}{.64} = 11,720$ lbs. per sq. in.—from (6).

If $M = 166,000$, $C = \frac{.64 \times 16,000}{15} = 680$ lbs. per sq. in.—from (5).

As previously staed, the scales Y and Z in Fig. (2) are graduated on the supposition that $D = \frac{1-x}{x}$, $Y = \frac{(1-x)(2+x)}{6}$ and $Z = \frac{1+x}{2}$. The scales Y' and Z' are graduated on the supposition that $D = \frac{x}{1-x}$, $Y' = \frac{(1-x)(2+x)}{6}$ and $Z' = \frac{1+x}{2}$ scales D, Y' and Z' representing the quantities D, Y' and Z' respectively, as before, with the corresponding values opposite each other. It is noticed that, by virtue of the reciprocal principle of the slide rule, if we construct the scales Y and Z for $D = \frac{1-x}{x}$, the only change necessary to construct these scales for $D = \frac{x}{1-x}$, providing the functions represented by Y and Z remain unchanged, is to turn scales Y and Z end for end. These new assumptions necessitate slight changes in some of the formulas (1) to (10) and in the method of operating the rule, as will be apparent from the foregoing demonstration. These changes involve no new principles, however, and are introduced merely to illustrate the fact that the main features of the device may be applied in different ways without adding anything to the principles governing the arrangement already demonstrated.

PERTAINING TO FIGS. 3 AND 4.

Still different arrangements of the added Y and Z scales are suggested in Figures 3 and 4 under the same and different assumptions as to the functions represented by the scales D, Y, Z, Y' and Z'. Figure 3 represents another rule having the back of the slide flush with the back of the rule, while Fig. 4 represents the more common form of Mannheim rule. In both cases (a) represents the face of the rule. In Fig. 3 scales Y and Z are constructed

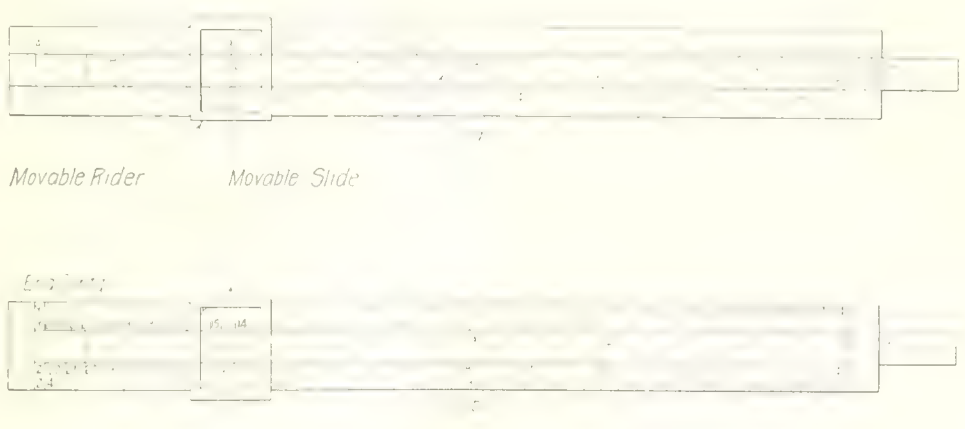


Fig. 3.—Alternate Form of Slide-Rule.

from the assumption that [illegible]

[illegible], $Z = $ [illegible], while scale G' is [illegible] merely a repetition of scales [illegible] Y' in Fig. 3 [illegible] assumption that D [illegible]

$\frac{2}{1-x}$

The slides of Figures 2 and 3 are interchangeable.

In Figures 4 (a) and 4 (b) scales Y and Z and Y' and Z' are constructed under the same assumptions as the similarly lettered scales in Fig. 2. The repetition of the scales Y, Z, Y' and Z' in Figs. 4 (a) and 4 (b) are merely suggestions as to different possible arrangements of same. Referring to the scales Y and Z on the back of the slide in Fig. 4 (b) it is seen that when *either* index of the slide is opposite the value of D as given by Scale D, the corresponding values of Y and Z are found on scales Y and Z respectively, opposite the *other* index of scale D. In all other cases the corresponding values of D, Y and Z, or D, Y' and Z' are found opposite each other. The changes to be made in the statement of formulas (1) to (10) and in the manipulation of the rules will be readily apparent from the above assumptions. For instance, referring to Fig. 3 and using scales Y and Z, our new assumptions produce the following fundamental formulas:

$$(1a)\quad D = \frac{RC}{S}$$

$$(2a)\quad Y = \frac{Cbh^2}{M}$$

$$(3a)\quad \frac{D}{Y} = R\frac{M}{Sbh^2}$$

$$(4a)\quad \frac{D}{Z} = Rp.$$

Suppose in Fig. 3, $\frac{D}{Z} = .125$. To solve for D, Y and Z, place left index of slide opposite .125 on scale D. Then run the rider over the scales G' and Z until the index of same covers identical values on each—viz: 13.6. Then Z = 13.6, Y = 14.1, D = .17. The slide and rider of Fig. 3 are set for the above operation. It might be pointed out here that we can use the scales Y' and Z' under the same assumptions as cited above for scales Y and Z. Suppose, as before, $\frac{D}{Z} = .125$. Place .125 of scale C opposite either index of scale D. With the slide in this position place rider index over index of slide. Then draw the slide under the rider until the rider index covers identical values on scales G' and Z'—viz: 13.6 as before. This optional use of scales Y' and Z' or Y and Z can be similarly demonstrated as applying to Figures 2, 4 (a) and 4 (b) and to Figures 2 and 3 with slides of same interchanged.

PERTAINING TO FIG. 4.

Referring to Figs. 4 (a) and 4 (b) and using scales Y and Z, the equations to be used are the same as equations (1) to (10). Suppose DY = .065. To obtain the values of D, Y and Z place the rider index on .065 of scale D. Then draw the slide under the rider until the index of the letter registers the same value on scale C as the right or left index of the slide registers on scale Y. Whence Y = .142, Z = .157, D = .46. The slide and rider in Fig. 4 are set for this example. The above refers to all the scales Y and Z of Figs. 4 (a) and 4 (b) except those on the back of the slide. The method of operating scales Y' and Z' is apparent from the assumptions made in the graduation of same. With reference to the scales Y and Z on the back of the slide as shown in Fig. 4 (b), it is only necessary to point out that for any position of the slide the end of the back of the rule registers the same values on these scales as is found on the other scales Y and Z opposite the index of the slide.

It is apparent that various different methods can be employed in constructing the scales. Different functions may be plotted than the ones I have represented and different devices may be employed than the ones I have used in applying the ideas involved, but no new principles would be thereby introduced. For instance, it would be possible to plot and apply separate scales for each of the functions D, Y, DY and DZ as used in equations (1) to (10), thereby avoiding the necessity of solving for D, Y and Z when DY or DZ is known; but this construction would necessitate the addition of three extra scales to the ordinary slide rule instead of two, and in view of the ease with which D, Y and Z may be obtained from values of DY or DZ, this additional scale may seem unwarranted. Also we could leave scale Y unchanged and, instead of plotting the values of Z on scale Z and multiplying these values by D, plot the values of DZ at once in place of the scale Z, since Z is never used alone; but this results in a rather cumbersome scale with a much wider range of values, as is seen from Fig. 6.

By letting the regular slide rule scale D represent the function D, the range of the values of D represented runs from 0.1 to 1.0 or from 1.0 to 10.0 according as to whether D [illegible] respectively. As seen from Table I, this range of D gives a range of x of from 0.5 to 0.91, which is sufficient for all but the very unusual problems. If a greater range of values for D is desired, however, the standard slide rule scale can be extended at either end or both ends to take care of such increase in range of D. As is seen from the following explanation of Fig. 5, this extension becomes unnecessary in the case of a cylindrical arrangement of the scales.

It is noticed from the scales Y and Z of Figs. 4 (a) and 4 (b) that the corresponding values of these two functions do not differ very greatly from each other. For instance, when Y = .0483, Z = .05; when Y = .2083, Z = .25. If the error involved in assuming that Y = Z for all values of the same is considered allowable, we can substitute one scale in place of the scales Y and Z, using for the graduations of this scale the graduations of the present scale Y or those of the present scale Z or an average of the corresponding values of Y and Z. Or, taking notice that when Y = .0483, Z = 1.035 Y, and when Y = .2083, Z = 1.2 Y, we can plot the present scale Y only, and assume that Z = an average value of, say 1.1 Y; or plot the present scale Z only, and assume that Y equals an average value of, say 0.9 Z.

These approximations would call for only one scale on the rule in addition to the usual slide-rule scales, as is seen from Fig. 4 (c), which shows the scales Y and Z or Y' and Z' of Figs. 4 (a) and 4 (b) as being replaced by a single scale, called Z, located on the side or edge of the slide rule. Each graduation of scale Z of Fig. 4 (c) represents the average of the values registered at that point by the scales Y and Z of Figs. 4 (a) and 4 (b). Scale D, as before, represents values of the function (1—x)/x.

Our equivalents and formulas now become as follows:

$D = (1-x)/x.$
$Z = (1-x)\ (2+x)/6 = (1-x)/2.$
$(1')\ D = RC/S.$
$(2')\ Z = M/Cbh^2.$
$(3')\ DZ = RM/Sbh^2 = Rp.$
$(4')\ C = DS/R = M/Zbh^2.$
$(5')\ S = RC/D = RM/DZbh^2.$
$(6')\ bh^2 = M/ZC = RM/D\ ZS.$
$(7')\ M = ZCbh^2 = DZ\ Sbh^2/R.$
$(8')\ p = DZ/R = M/Sbh^2$ [from (3')].
$(9')\ A = pbh = M/Sh$ [from (8')].

Let us solve examples 1, 2, 3 and 4 by means of Fig. 4 (c) to ascertain the degree of approximation introduced by this method of graduating scale Z.

Example 1:

From (1') D = .375 as before.

From Fig. 4 (c) Z = .131 (opposite D = .375).

From (6') $bh^2 = M/ZC = 60{,}000/.131 \times$ [illegible] as before.

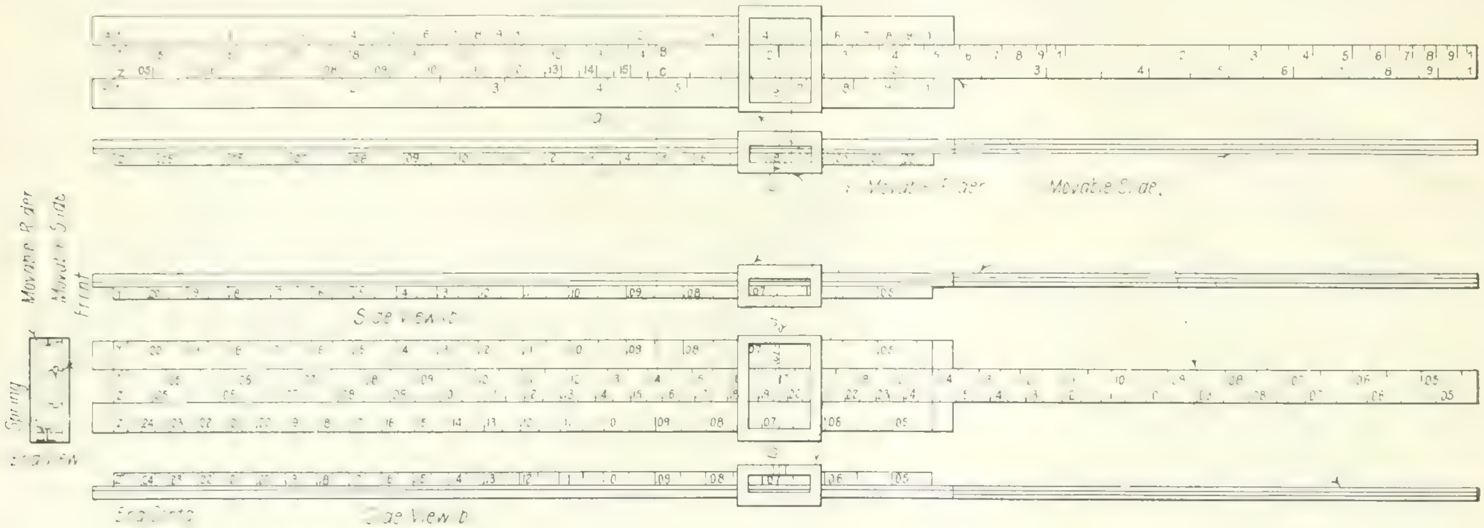


Fig. 4.—Alternate Form of Slide-Rule.

If $b = 9$ ins., $h = 10.1$ ins. instead of 10.4, as before.

From (9') $A = M/Sh = 60{,}000/16{,}000 \times 10.1 = 0.37$ sq. in. instead of 0.4, as before.

Example 2:

From (9') $A = M/Sh = 100{,}000/16{,}000 \times 12 = .521$ sq. in. instead of .578, as before.

Example 3:

As before, $p = .00833$.

From (3') $DZ = Rp = 15 \times .00833 = .125$.

From this value of DZ we get the corresponding values of D and Z in the same manner as before. Place the rider index on .125 of scale D; then draw the slide under the rider until the index of the latter registers the same value on scale C as the index of the slide registers on scale Z. Opposite this value of Z on scale Z will be found the correct value of D on scale D. Whence $D = .67$ and $Z = .187$, as indicated by the dotted lines in Figs. 4 (c) and 4 (a).

From (4') $C = M/Zbh^2 = 80{,}000/.187 \times 10 \times 144 = 297$ lbs. per sq. in. instead of 330, as before.

From (5') $S = kC/D = 15 \times 297/.67 = 6{,}650$ lbs. per sq. in. instead of 7,700, as before.

Example 4:

As before, $DZ = .125$ from which $Z = .187$.

From (7'), if $C = 500$, $M = .187 \times 500 \times 10 \times 144 = 134{,}640$ in. lbs. instead of 121,700 as before.

From (7'), if $S = 16{,}000$, $M = .125 \times 16{,}000 \times 10 \times 144/15 = 192{,}000$ in. lbs. instead of 166,000, as before.

It will be noted that all of the above comparisons indicate that Fig. 4 (c) results uniformly in a slight reduction of the factor of safety in both the concrete and steel, the logic of which is apparent from a study of the formulas. Hence this method of approximation is capable of being adjusted by reducing the allowable working stresses somewhat.

[illegible] FIG. 5

The writer has recently constructed a cylindrical device illustrated by Fig. 5, which has several advantages over the rectilinear slide rule. The scales indicated in Fig. 5 are identical with the similarly lettered scales of Fig. 2, but are wrapped around a cylindrical drum so that the right and left indices of same coincide. The two arms, a, a, carrying the index (i), are secured to a cylindrical ring (b) which turns inside the hollow cylinder (c) with sufficient friction to hold the arms (a) in any position desired. The scales Y, A, D and Z are rigidly secured to the cylinder (c), while scales B, F, G and C are mounted on the endless band (d), which slips around the cylinder (c) with sufficient friction to hold it in any desired position on same. It is thus seen that the band (d) and the index (i) can be moved independently of each other and of the cylinder (c).

ADVANTAGES OF CYLINDRICAL RULE

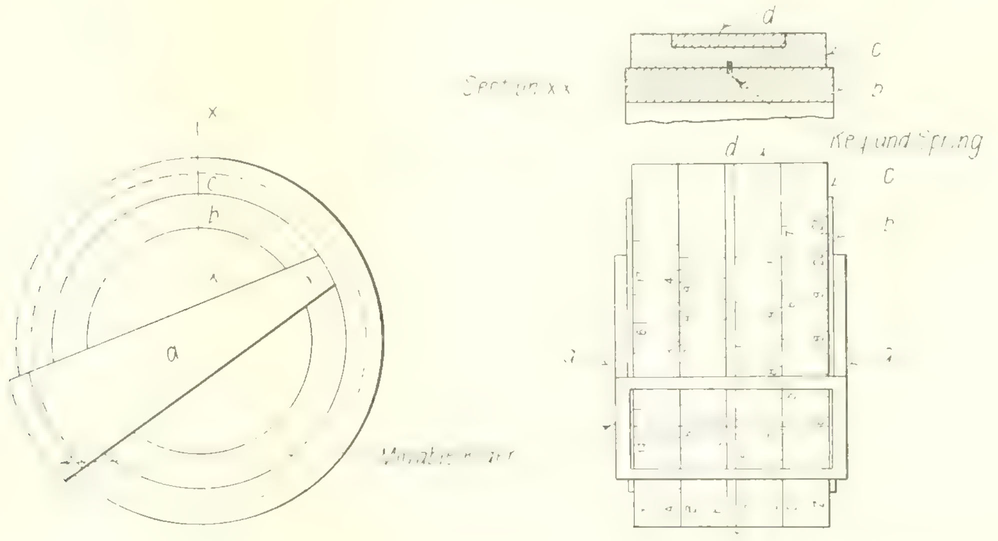
One of the advantages of this arrangement, coming directly from the cylindrical construction, is the fact that the broken scales of the flat slide rule are replaced by continuous scales progressing without interruption from 1 to 10, thence to 100, 1,000, etc., thus avoiding the necessity of resetting the slide, as must be done in the case of the flat rule when the factor sought on the slide is on that portion of the same projecting beyond the end of the rule. Another advantage of the cylindrical construction, as illustrated in Fig. 5, consists in the location of all the scales on the face of the drum, while the rectilinear rule must be turned over to read the scales on the back of the same or on back of slide. Also, if it is desired to construct the scales Y and Z to correspond to a greater range of values of D than from 0.1 to 1.0 when $D = \frac{1}{[illegible]}$ or from 1.0 to 10.0 when [illegible], it is only necessary to add two or more cylindrical scales to represent these extended values of Y and Z.

The same assumptions and methods of construction apply to the similarly lettered scales in Figures 2 and 5; and the cylinders and rider index of the latter are operated in exactly the same way as the slide rule illustrated in the former, using the formulas (1) to (10). In Fig. 5 those graduations near the edges of the cylinder have not been shown because of the excessive distortion of same. For instance, suppose again that $DY = .065$. Place the index of scale C opposite .065 on scale D. With the band (d) so set, find a position for the index (i) such that it will cover the same values on scales G and Y. This occurs as before when $Y = .142$, as is seen from Fig. 5, where the scales and indices are set for this example.

Hence $D = .46$ and $Z = .157$, as per Fig. 5.

The arrangement of the logarithmic scales A, B, C, D, and the reciprocal scales F and G, as illustrated in Fig. 5, allows us to perform extended operations of multiplication and division with a minimum of labor. Suppose we have the equation $x = \frac{a\sqrt{bc}}{de}$. Set ($b$) on scale F opposite (a) on scale D. Then place index (i) over (c) on scale B. (i) will then cover the product of $a\sqrt{bc}$ on scale D. Now place (d) on scale C under the index (i) and then place [illegible] as given by Scale G. The result, $\frac{a\sqrt{bc}}{de}$, will then be found under index (i) on scale D, the whole operation requiring only two settings of the band (d). The style of construction illustrated by Fig. 5 can of course be applied to other problems than those of reinforced concrete design by simply substituting other special scales in place of the scales Y and Z of Fig. 5, or by omitting these scales entirely.

The set of formulas (1) to (10) may be considerably abridged without seriously interfering with the efficiency of same by expressing [illegible]



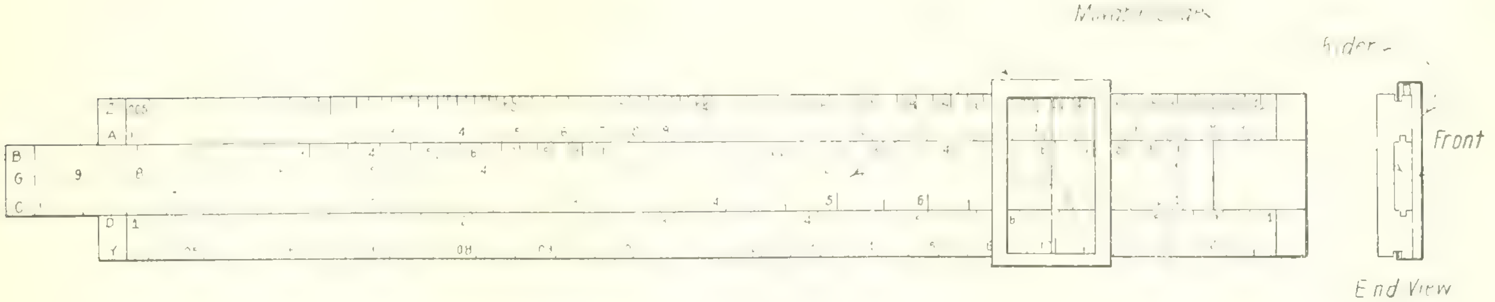


Fig. 5.—Cylindrical Form of Slide-Rule.
Fig. 6.—Alternate Form of Rectilinear Slide-Rule.

TABLE 1. VALUES OF SCALE FUNCTIONS

$\frac{x}{1-x}$															$\frac{(1-x)^2}{2x}$			
1	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	10/4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	96	4.8	[illegible]	[illegible]	20	.2083
	2	2			4			4			16x6		20		8		96	
1.5	3	2	.6667	[illegible]	[illegible]	[illegible]	13/5	1	.2	5	26	.1733	150	5.77	[illegible]	.1333	52	.1155
	2	3		3				5			[illegible]		26		15		450	
2	4	2	.5	6	4	[illegible]	[illegible]	1	.1667	6	32	.1481	216		2		64	
	2	4		4	6			6			36x6		32	6.75	24	.0833	864	.0741
2.5	5	2	.4	7	5	2/7	14/7	1		[illegible]	38		294		2		76	
	2	5		5	7			7	.1429		49x6	.1292	38	7.74	35	.0571	1,470	.0517
3	6	2	[illegible]	8	6	[illegible]	[illegible]	1	.125	8	44	.1145	384	8.73	2	.0417	88	.0382
	2	6		6	8			8			48x6		44		48		2,304	
3.5	7	2	[illegible]	9	7	[illegible]	[illegible]	1	.1111	9	50	.1028	486	9.73	2	.0317	100	.0294
	2	7		7	9			9			81x6		50		63		3,402	
4	8	2	[illegible]	10	8	[illegible]	[illegible]	1	.1	10	56		600	10.7	2	.025	112	.0233
	2	8		8	10			10			100x6	.0933	56		80		4,800	
4.5	9	2	.2222	11	9	2/11	31/11	1	.0909	11	62	.0855	726	11.7	2	.0202	124	.0190
	2	9		9	11			11			121x6		62		99		6,534	
5	10	2	.2	12	10	2/12	34/12	1	.0833	12	68	.0787	864	12.7	2	.0167	136	.01575
	2	10		10	12			12			144x6		68		120		8,640	
6	12	2	.1667	14	12	2/14	40/14	1	.0714	14	80	.0680	1176	14.7	2	.0119	160	.0113
	2	12		12	14			14			196x6		80		168		14,112	
7	14	2	.1429	16	14	2/16	46/16	1	.0625	16	92	.0599	1536	16.7	2	.0089	184	.00855
	2	14		14	16			16			256x6		92		224		21,504	
8	16	2	.125	18	16	2/18	52/18	1	.0556	18	104	.0535	1944	18.7	2	.0069	208	.0067
	2	16		16	18			18			324x6		104		288		31,104	
9	18	2	.1111	20	18	2/20	58/20	1	.05	20	116	.0483	2400	20.7	2	.0056	232	.00537
	2	18		18	20			20			400x6		116		360		43,200	
10	20	2	.1	22	20	2/22	64/22	1	.0455	22	128	.0441	2904	22.7	2	.0045	256	.0044
	2	20		20	22			22			484x6		128		440		58,080	

entirely on equation (6), repeated below as (6"), to give us the corresponding values of *S*. Also let *Z* represent the function formerly expressed by *DZ*, i. e., $Z = \frac{(1-x)^2}{2x}$.

Then we have the following equations:

$$(1'')\ D = \frac{RC}{S}.$$

$$(2'')\ Y = \frac{M}{Cbh^2}.$$

$$(4'')\ Z = Rp$$

$$(5'')\ C = \frac{DS}{R} = \frac{M}{Ybh^2}$$

$$(6'')\ S = \frac{RC}{D}$$

$$(7'')\ bh^2 = \frac{M}{YC}$$

$$(8'')\ M = YCbh^2$$

$$(9'')\ p = \frac{Z}{R}$$

$$(10'')\ A = pbh.$$

The values of *Z* for these assumptions are given by Table 1, from which scale *Z* of Fig. 6 is constructed. The remaining scales of Fig 6 are identical with the similarly lettered scales of Fig. 2, the corresponding values of *D*, *Y* and *Z* being opposite each other. It is seen from formulas (1") to (10") that in no case are we obliged to compute *Y* and *Z* from values of *DY* and *DZ* as formerly. Fig. 6 represents a flat slide rule with the scales all placed on one side to avoid the necessity of turning the rule over.

To illustrate the operation of the rule shown in Fig. 6 let us apply it to Example 3:

$p = \frac{1}{10\times12} = .00833$. From (4"), using the regular slide rule scales, $Z = .00833 \times 15 = .125$. Opposite this value of *Z* as taken from scale *Z* we find $Y = .169$ and $D = .64$, as before, as seen from the position of index (*i*) in Fig. 6. From (5") $C = \frac{80,000}{.169\times10\times144} = 330$ lbs. per sq. in.

Then from (6") $S = \frac{15\times330}{.64} = 7,700$, as before.

It will be seen that the reinforced concrete feature of all the computing devices described in this paper consists of a plurality of parallel scales representing values of various related functions of a dependent variable, "*x*," involved in the design of concrete-steel beams, said dependent variable "*x*" representing values of the ratio $\frac{xh}{h}$, "*xh*" and "*h*" being the distances designated thereby in Fig. 1. Said scales are so graduated that the corresponding values of these related functions are either opposite each other on the said scales or in a known relation to each other. If one of the scales of a logarithmic slide rule be utilized as one of the above mentioned parallel scales we have a device for the simultaneous evaluation of the said related functions, whereby upon evaluating one of the said functions by means of the relatively movable logarithmic scales, the corresponding values of the related functions are registered by the proper scales therefor.

Wherever the letters *D*, *Y*, *Z*, *Y'* and *Z'* are used in the foregoing exposition, they may of course be replaced by any other letters if for any reason such change is considered desirable.

EARTH AND ROCK SECTION

Shaft Sinking Against Water in Fissured Ground By Cement Injection.*

This process is now replacing to some extent the Poetsch freezing process for the sinking of shafts in water-bearing ground. It was developed in the chalky formation of the Pas-de-Calais coal field, but is equally suited for any fissured water-bearing rocks, although not for soft-running ground such as quicksand.

The principle is as follows: A number of boreholes of suitable dimensions are sunk at equal intervals in the form of a ring surrounding the proposed site of a shaft. Cement and water, injected through these boreholes by means of a force pump, find their way into all the cavities and crevices of the ground surrounding each hole, in which the cement sets. As the cement from one hole penetrates the rocks surrounding it, that coming from the adjoining hole is encountered and a cemented water-tight wall is formed round the proposed site of the shaft, and it is in this way that one is able to get rid of the water troubles that occur in the process of sinking. The equipment for this process is small and inexpensive as compared with that required for making an ice wall by the Poetsch process, besides which, when once the cement has set, the work of the plant is finished, while with the Poetsch method the machinery has to be kept at work until the shaft has been sunk and lined, a considerable extra expense being thus incurred. As a result of these savings the cost of sinking by the cement injection is only about one-third that of the Poetsch process.

Its practical advantage is that water is almost completely shut out, and the erection of a masonry lining, if necessary, is made more secure; indeed, the solid wall of concrete makes the lining almost superfluous. The danger to shaft sinkers is greatly lessened by the employment of this method, as they have not to cope with continual water troubles when sinking, and in the event of repairs to shaft lining being necessary later, the existence of the permanent cement wall practically shuts out all water from the shaft, whereas with the Poetsch freezing process the water is only held back by the tubbing.

The particular shaft to which reference is now made was sunk at a coal field in the concession of Lens, in the Pas-de-Calais basin, where the process has proved so successful that all the most modern shafts have been sunk by this method. The section of the ground was as follows, in descending order:

	ft.	ins.
Earth	16	3
Chalk	67	0
Chalk and flint	118	1
Sandstone	131	0
Gray marl	213	0
Blue marl	262	0

Deeper than this the strata were strong and practically impervious to water; thus the process only required to be taken down to 213 ft.

A preliminary pit was first dug to facilitate operations and to afford a fairly solid stratum for inserting injection pipes. This pit was lined with masonry 2 ft. 3 ins. thick to an inside diameter of 24 ft. 4 ins., and six boreholes, evenly spaced around a circle having a radius of 14 ft. 3 ins. were then bored and injected with cement in successive stages. Each hole was bored with a churn drill when encountering hard measures, but for soft, argillaceous strata rotary auger drills were used. The lining case at the head of each borehole was packed round with concrete in order to prevent leakage around the upper ends of the hole and to insure the application of the full pressure of the pumps. The lining case was made of steel 2 ins. in thickness, with an inside diameter of 1⅛ ins., and is shown in detail in Fig. 1. Its upper end had a cast-iron head or plug to which the necessary pipe connections were made. An iron pipe fitted with a pressure gage and stop cock entered the side of the casing just below the iron plug or head. During the washing of the hole which followed each drilling operation this pipe carried off the muddy water, but as soon as the water came clear the pipe was connected to the cement mixer, in order that any excess of cement injected might be returned to the mixer and utilized.

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*Extract of a paper by Mr. A. L. S[illegible] [illegible] before the Institution of Mining and Metallurgy of Great Britain.

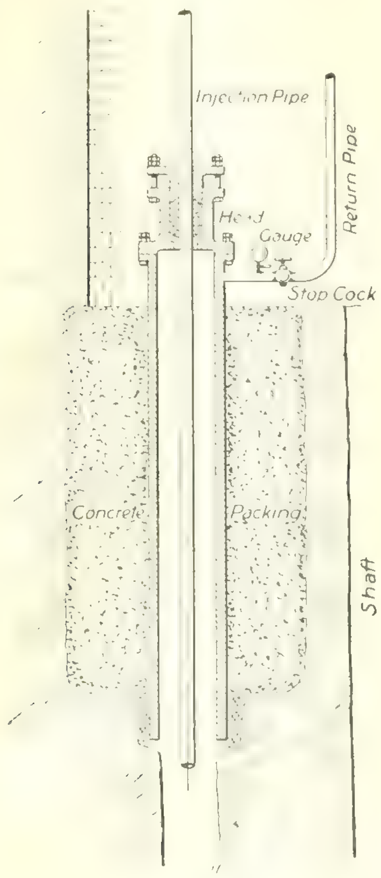

Fig. 1.

For boring through the limestone, a heavy free-falling system of drilling was used, which permitted of more rapid boring and a quicker injection of cement than were obtainable by means of the lighter drills which were originally tried, but without good results

Special augurs were employed for boring in the argill[illegible] materials containing over 18 per cent clay, as these were found by experience to resist all attempts at cementation on account of the chips of clayey material produced by the ordinary boring augurs, which would lodge in the fissures and crevices and effectually block them, even against pressures of as much as 142 lbs. per sq. in. The adhesion of the material cut by these augurs was sufficient to bring it to the surface attached to the augurs. Each application of these augers deepened the hole about 3¼ ft. and the walls of the hole were then scraped by means of reamers, which removed any clay covering or other material that had been forced into the cavities and fissures, and which would otherwise prevent the cement from penetrating into the cracks and fissures. The drill stem, which was formed of hollow steel tubes of 2½ ins. internal diameter, was used for injecting the cement. By this method between 10 and 13 ft. were bored and cemented per day of 13 hours.

In order to ensure a perfect mixing of the cement and water, as well as to save in labor, mechanical mixers are now installed. These each consist of a tub in which a shaft with paddles makes about one revolution per second. The cement and water are thrown in at the top and the mixture run off to the pumps through suction pipes placed near the bottom of the tub, but above the suction valves of the pump. The general arrangement is shown in Fig. 2. The pumps are of the Weise and Monski compound type, with flywheel and two plungers run at 75 rev. per min., and delivering a flow of 335 cu. ft. per hour. In order to avoid the corrosive action of the cement the valves were replaced by steel balls 3½ ins. in diameter, weighing 10 lbs. apiece. With this precaution it was possible to pass 2,000 to 2,500 sacks of cement without any difficulty, whereas otherwise the valves had to be changed after every 60 to 80 sacks of cement; one sack of cement weighs 100 lbs.

From the bottom of the casing pipe, embedded in concrete, the strata were either injected with cement in successive stages of 16 ft. 5 ins. at pressures varying according to the ground, or in some cases a borehole was driven to its full depth so as to cement round the entire length of the hole in one process. If the injection was being done by stages, after the required depth had been bored and the hole thoroughly washed in each case before injection, a cup-shaped plug was lowered to the bottom of the hole for the purpose of preventing any cement from sinking downwards that would naturally solidify and hinder the boring of the next stage. This plug was raised after each injection, and not lowered until the next injection was required.

The injection pipe should be of comparatively small section, so as to compel a rapid circulation of the liquid cement in the pipe and round the bottom of the hole, whereby any tendency of the mortar to separtate is overcome. If at the surface the end of the pipe is connected to the pump by means of a strong rubber hose, permitting a certain amount of vibratory and sliding motion of the pipe, this [illegible] prevents [illegible] accumulation of the cement in the pipe, that would tend to choke it.

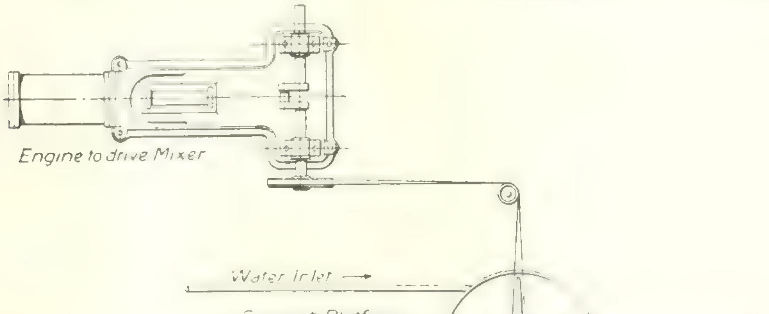

Fig. 2.

After the injection pipe has been lowered almost to the bottom of the hole the head-gear or "plug" is bolted to it. Clear water is then put through the pump, the cock on the return pipe at the top of the casing under the plug being left open.

After a thorough washing of the hole, and when the return water is clear, the cock is shut and the pump drawn at full capacity, in order to drive any remaining debris as far back as possible into the fissures and cavities which are to be cemented. This lasts about a half-hour, and then, without changing any conditions, cement is injected gradually to form about 5 per cent of the weight of mixture. After about one hour the quantity of cement is raised to 10 per cent if no increase of pressure has been noticed in the hole. As the cement deposits in the fissures of the rock the pressure recorded by the gage increases. Finally, as the fissures become more thoroughly plugged with cement, in order to avoid too great a pressure and the stopping of the pump, the cock on the return is gradually opened and any excess of cement carried back to the mixer. The operation is finished when it becomes necessary to keep the return pipe entirely open to maintain the working of the pumps. The pump and pipes are then cleaned by running through them a current of water, after which the pipe in the hole is withdrawn and the hole left from 8 to 10 hours to allow the cement to set and solidify. No cement is left in the hole after the washing, as all the cement that has been consumed has found its way into the surrounding ground. When it is noticed that the pressure in the pipe has suddenly dropped, this being due to the dislodgment of a plug in a partially solidified cemented fissure or to the opening of a channel connecting with the surface, mortar containing 30 to 33 per cent of cement is injected under low pressure. Another way of meeting this trouble is to line the hole down to some solid stratum with a casing pipe smaller than the upper one.

All six boreholes were injected in the same manner, and, after they had been taken to a depth of from 10 to 15 m. (32 to 49 ft.), sinking operations were started. To give some idea of the amount of cement injected and the pressure required in different cases. I have taken No. 2 borehole for an example:

Depth		Rock	[illegible]	[illegible]	[illegible]	
ft.	in.		Sacks	Sacks	Lbs.	
16	0	Earth			....	
[illegible]	0	Crumbly chalk	[illegible]	7	71	
49	0	Crumbly chalk	[illegible]	20	14	14
[illegible]	0	Crumbly chalk	[illegible]	[illegible]	[illegible]	[illegible]
81	0	Chalk and flints	[illegible]	[illegible]	[illegible]	[illegible]
97	[illegible]	Chalk and flints	[illegible]	11	[illegible]	[illegible]
114	0	Chalk and flints	[illegible]	40	[illegible]	[illegible]
130	[illegible]	Chalk and flints	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0	Chalk and flints	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				
Total for [illegible] ft			[illegible]	[illegible]		

Sacks

The number of sacks used in [illegible] [illegible]

The number brought to the surface [illegible] [illegible]

The number [illegible] [illegible] utilized [illegible]

During the actual operation of injection the percentage of the total consumption of cement used effectively in the six different holes was 84 per cent, but, of course, the remaining 16 per cent were subsequently utilized by being pumped back, and subsequently injected into other holes as they came to be bored.

Costs.—The work was done by contract at $4.83 per meter for the first 10 m. and the balance at $5.77 per m. A charge of 150 fr. ($28.95) was made for the plug in the top of each bore hole; that is to say, for placing the accessories in position, which prevented the cement sludge from overflowing at the top of the hole. A charge of 9 frs. ($1.74) per m. of [illegible] was made [illegible] steam [illegible] the machinery.

The total cost for the six bore holes required for cementing the ground around the shaft, which was sunk with a diameter of 15½ ft., was as follows:

[illegible] M at [illegible] per M	$1,1[illegible]
120 M at [illegible] per M	[illegible]
6 plugs and accessories at [illegible] ft. each	173.[illegible]
Cost of [illegible] per M, [illegible] M	[illegible]
Cement [illegible]	[illegible]
Cement	[illegible]
Labor employed by company	[illegible]
Explosives	[illegible]
Two teams	[illegible]
Repairs	11[illegible]
Sundries of rubber, tubes, etc.	[illegible]
Materials for head of each borehole....	96.50
Labor to move machinery...............	33.78
Total cost of 6 holes (60 M each)	[illegible]

From the above figures we may deduce the following units:

Total depth bored (meters)................	360 m.
Average depth bored	60 m.
Cement used, per hole (sacks).............	1,182
Average cost per hole.....................	$1,098.83
Average cost per meter....................	18.31
Average cost per ft.......................	5.58

Method of Constructing the Land Section of the La Salle Street Tunnel at Chicago.

The method of constructing the La Salle St. Tunnel "open cut" section was described in our issue of Jan. 11, 1911, and that of constructing the "river" section in our issue of April 5, 1911. In this article we describe that part of the work which is now in progress between the open cut section and the river. This section is being constructed by a method proposed by the Board of Supervising Engineers. The contractor had proposed carrying on the work with the aid of a steel shield but, on account of the many obstructions underground and the existence of the old tunnel, the present method was adopted. In brief, this method consists in sinking two shafts, one on each side of the river and prosecuting the main drift at the elevation of the invert of the new tunnel. The work will proceed from both shafts in a direction away from the river and toward the open cut work which is now approaching completion. It was proposed to cut side drifts, at points 30 ft. apart, leading off the main drift and excavated to the full height and about 10 ft. in width. The side [illegible] ample space for constructing 10 ft. of tunnel as called for on the plans. After this it was proposed to construct the adjoining 10 ft. of tunnel in the same way and by this method a third series of 10 ft. sections would complete the tunnel. This method has been followed out in substantially the same manner as was proposed at first but the manner of attack has been different. The details may be followed by reference to the sketch, Fig. 1.

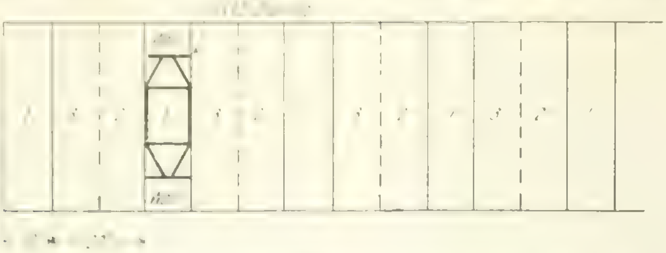

Fig. 2—Plan of La Salle Tunnel, With Sections Numbered to Show Sequence of Construction.

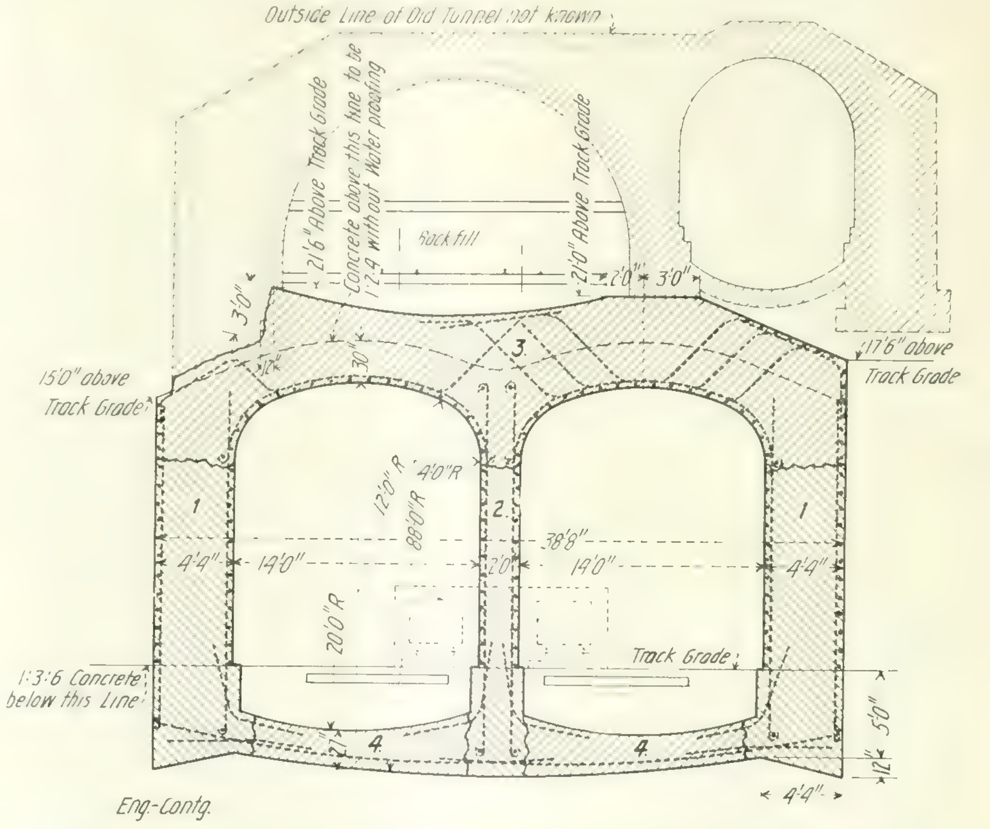

Fig. 1—Section of La Salle Tunnel, Showing Sequence of Operation for Construction.

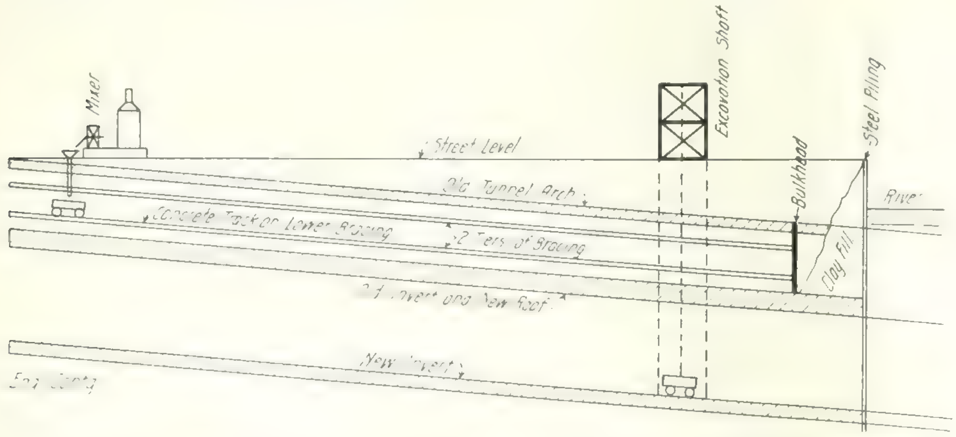

Fig. 3—Profile of La Salle Tunnel, Showing Arrangement of Plant for Building the Section Lying Beneath the Old Tunnel.

It will be seen by reference to the sketch that the invert of the old tunnel was somewhat below or coincident with the roof of the new tunnel. The first step was to enter the old tunnel and dig out a 10 ft section of the invert 30 ft. apart. The walls of the old tunnel were braced with heavy timbers placed in two tiers which, in plan are as shown by Fig. 2. After excavating the invert of the old tunnel the excavation for the side walls followed. These were excavated a little wider than the actual width of the wall to provide for the step in the wall at track grade. In the meantime the center drift had been excavated from the main shaft and was made just wide enough for two tracks, one on each side of the center wall of the tunnel. A small shaft was made from this drift up through the section where the side walls were being excavated and all the material excavated from the side walls was dumped down through the temporary chute or shaft into the cars in the center of the monkey drift. Concrete was placed in the side walls up to track grade at which point the wall was stepped off as shown. On this step the inside forms for the wall were erected, vertical timbers being placed on the step for studding, and held in position by blocks between the studding and the clay. Then D. & M. plank sheeting was laid against the studding, the reinforcing rods were set in and the concrete poured. It may be mentioned here, in passing, that short reinforcing bars were placed in the bottom of the wall to form a tie with the invert when it should be placed. These bars were driven into the clay sides of the excavated pit so that after the concrete was poured and the clay excavated for the invert the rods will be in place.

After the sidewalks were completed the center wall was built in the same manner, leaving the tracks in the monkey drift, one on each side of the center wall. The third operation as shown by Fig. 1 was placing the roof of the section. Wooden centers were used, the ribs being semi-circular and covered loosely with 1⅞-in. shiplap boards. After the roof was poured the excavation of the core was carried on from the monkey drift and carried down to the invert of the new tunnel which was put in as soon as the excavation was completed, thus completing the first 10 ft. section of the tunnel.

Excavation.—The material, excavated as described above, was taken in cars of 31 cu. ft. capacity to the river, where it was dumped into bottom dump scows and towed out into

Lake Michigan. The narrow gage cars for transporting the clay were hoisted up the shaft and pushed out over a temporary trestlework on the bank of the stream. The cars are mere narrow gage trucks with wooden boxes on them. The boxes are 5 ft. long, 2½ ft. high and 2½ ft. wide. The sides are loose so they can be lifted off, and when loaded, an iron bar with the ends bent down, is straddled over the top of the car to sold the sides in place. The cars of excavation are dumped at the top of an iron chute leading to the barge. This chute is kept wet to prevent the clay from sticking to it.

From 90 to 160 cars of material are taken out in 8 hours, depending upon where the material is being dug. When excavating the core, after the roof has been placed, the work required about 3 shifts with 4 muckers and 2 car pushers on each side of the center wall. At the bottom of the shaft one man takes care of the loading and unloading of cars onto the elevator and at the top, one man performs the same service; two men are required to push the cars to dump them in the scow and one hoisting engineer handles the elevator.

The concrete is mixed in a Marsh-Capron mixer at the upper end of the tunnel. The material for concrete is stored on the platform covering the open cut section of the tunnel and as near to the mixer as possible. The storage facilities are poor. The concrete is dumped from the mixer, as shown by Fig. 2, into V-shaped narrow gage steel cars. The tracks for these cars are laid on the bracing in the old tunnel and, as the old tunnel is on a 3 per cent grade, the incline is sufficient to carry a car rapidly down to the point of depositing concrete and from there on to the end where the car is switched to the return track and pushed back to the upper end by two men. The concrete gang consists of about 35 men and about 200 cu. yds. of concrete is placed in a shift of 8 hours. The concrete work is carried on about every third day on an average depending upon the space ready to receive it. During one week, a 10-ft section of arch was run every day.

The reinforcing bars, shown in the drawing, Fig. 1, are stored in a yard several blocks from the work and are bent to conform with the plans at the yard. They are delivered to the work as needed.

The work is being done for the Chicago Railways Co., Mr. John M. Roach, President, by the M. H. McGovern Co., which has associated with it Messrs. J. A. Green and R. H. Green, of Chicago. The design and work is being carried out under the direction and supervision of the Board of Supervising Engineers, Chicago Traction, which has charge of all street railway construction in Chicago. Mr. Bion J. Arnold is Chief Engineer, Mr. Geo. Weston represents the city and Mr. John Z. Murphy represents the Chicago Railways Co. Mr. Wm. Artingstall is Division Engineer of the board, Mr. J. Harris is Division Engineer of the Chicago Railways Co. Mr. Max Languth is engineer and superintendent for the contractors and has developed the contractor's methods for handling the work.

Methods and Cost of Stripping with Steam Shovels in Utah.*

The Utah Copper Co. owns 580 acres of ground which was first exploited for the ore by underground methods but when the extent of the deposits were satisfactorily proved the underground method was abandoned and the tract is being stripped by steam shovels. A section through the ore, shown by Fig. 1, illustrates the lay of the land and at once shows the adaptability of the bench method of working steam shovels.

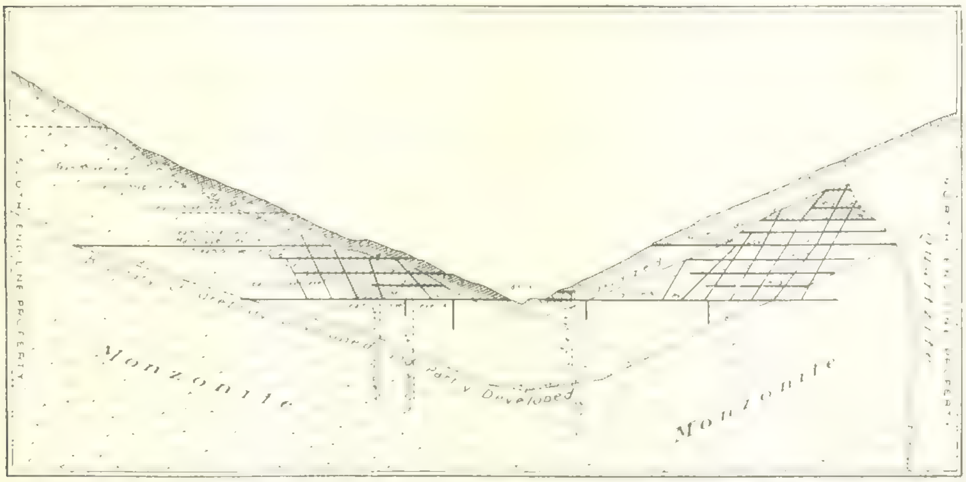

Fig. 1—Section Showing Ore Body, and Bench Method of Stripping.

The average thickness of the cap is 70 ft., representing about 115,000 cu. yds per acre to be removed. Assuming that the cap weighs 2 tons per cu. yd., as has been ascertained in other similar deposits, the cost of stripping during the year 1909 was 35.2 cts. per cu. yd. or, allowing for all expense such as railway construction and dumping rights, 53.1 cts. per cu. yd. The great elevation of the upper portion of the deposit has made necessary the construction of narrow gage tracks for handling the material, this being the item represented as railway construction.

The vertical distance from the lowest point in the canyon to the highest point of the work is 1,850 ft. This is divided into 22 benches on most of which the work is in progress. The lowest bench, which is above the portion called the pit, is 240 ft. high. The remaining benches are each 75 ft. high, except some at the top, which were started by another company, and which are 60 ft. high. The 240 ft. bench is all in ore, which is of a uniform grade so that it can be worked to a greater height than is customary.

The shovels used on the work are 2 Marion (model 95), 2 American, 2 Marion (model 60 with 2½-yd. dippers), the remainder being Marion Model 91, with 3½-yd. dippers. There are 24 shovels on the work and allowing for those laid up for repairs there is an average of 20 in continual operation. The narrow gage cars used on the upper levels are 4 cu. yds. capacity, but the standard gage cars used below are the standard type of steel cars, with two way dump, and a capacity of 12 cu. yds.

Churn drills are used for both prospecting and mining. Four of these are Star machines and the rest Keystone, six being used for each class of work. The rock is comparatively soft and the shattered condition makes it difficult to get a good core and therefore core drills are not satisfactory. The bits used vary from 4 to 12 ins., 6 in. bits being used for the blast holes. The Star machines, which are the heavier of the two used, have 16 h.p. engines with 8x8-in. cylinders and are adjustable crank, usually run with an 18-in. stroke. The weight of the tool on Star drills is about 2,000 lbs. and on the Keystones about half as much. Two men are employed to a drill, an engineer and a driller, and one of the heavier machines will drill 15 to 25 ft. in a 10-hour shift.

For blasting the holes are put down 8 ft. lower than the bank with a burden varied to suit the height of the bank and the nature of the ground, 30 to 35 ft. at the bottom being a fair average. A 6-in. bit is used. Each hole is cased to a depth of 20 ft. in starting and if the sides show a tendency to crumble the casing is extended to full depth. When a hole is complete it is sprung with 35 per cent dynamite. The seamy and uneven nature of the ground gives the drill a tendency to drift and this causes the hole to break with a wide toe.

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*Abstracted from [illegible] article by L. A. Palmer in the "Mining [illegible]

Methods of Making a Large Blast at Corona, California.

A large blast was recently made at Corona, Cal., for the purpose of securing rock for street work. About 250,000 cu. yds. of rock were broken up, and so successfully that a very small amount of rock will have to be blasted before going to the crusher. The site of the blast was about 150 ft. from the Santa Fe railway tracks and near the railway water tanks. The hill formed a precipitous nose of rock about 80 ft. in height and consisted of a tough, blocky trachyte.

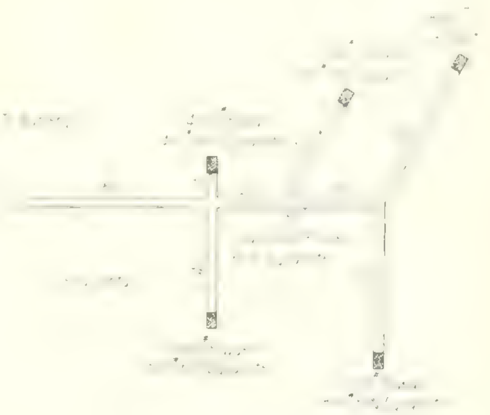


Fig. 1—Sketch Showing Layout of Tunnels for Blasting.

The main tunnel was excavated on a line at right angles to the face of the cliff, for a distance of 110 ft. At 60 ft. from the face of the cliff a side drift was run 15 ft. to the left and another to the right 40 ft. in length. At 80 ft. from the face a drift 40 ft. long was run diagonally to the left. At the end of the main tunnel two drifts were run, each 50 ft. in length. The first was run diagonally ahead to the left and the other at right angles to the right. These drifts were each loaded at the ends with Judson R. R. P. powder and 60 per cent dynamite, the dynamite being proportioned 10 per cent by weight to the Judson powder. The Judson R. R. P. powder is quicker in action than ordinary blasting powder and is slower than dynamite. The dynamite was used to detonate the powder. The location and quantity of explosive were carefully estimated in each case, considering the weight of the material to be lifted and shattered, the rock formation and the contour of the hill. The height of the overburden was about 80 ft. The total explosive used was 30,000 lbs. of powder and 3,000 lbs. of 60 per cent dynamite. Figure 1 shows the distribution.

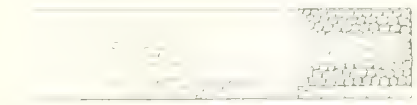


Fig. 2—Sketch Showing Manner of Loading Tunnel for Blast.

In placing the explosive the greatest precautions were taken. Men wore rubber shoes or tied gunny sacks on their feet to prevent any possibility of striking a spark on the [illegible] rock. They were also searched for matches or other dangerous things which might cause trouble. Electric torches were used in place of candles.

The charge was fired by an electric battery. The wires were connected in series with the five charges. Two detonators, prepared especially for this blast, were placed in each charge. The wire circuit was tested with a galvanometer to see whether the wires had become short circuited or broken. The galvanometer shows the resistance of the circuit. The resistance of the entire circuit should equal the sum of the resistances measured separately for each set of fuse. In this way the connections were tested before backfilling the tunnels.

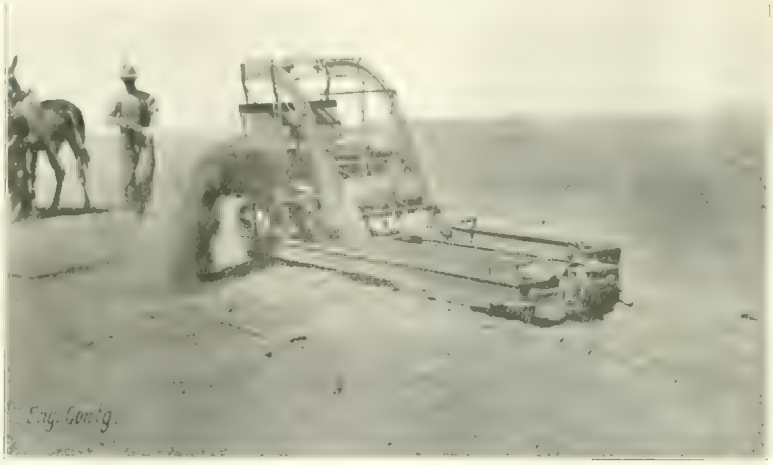
When the blast was fired the hill rose a few feet and fell forward in a shattered mass. The tracks, mentioned above, were buried for a distance of about 150 ft. under about 2 ft. of rock, but the water tanks were unhurt, being just a few feet beyond the danger line.

A New Combined Excavator and Loader.

The accompanying illustration shows a machine which is designed for loading dump wagons. It is operated by a cable attached to a drum on a 35 H. P. traction engine. There are 7 plows near the front of the machine which loosen the ground. The dirt is picked up behind the plows by a scoop and carried up and dumped on the belt, which carries it to the dump wagon. The machine will handle any material that can be plowed, and will load from either side, going forward or backward.

It is claimed that the full sized machine (the cut shows a model 1/3 size) will load between 1,500 and 2,000 cu. yds. in 10 hours, but this is no doubt an optimistic estimate. The cost of operation per day is as follows:

1 engineer	$ [illegible]
1 [illegible]	[illegible]
1 [illegible]	[illegible]
Coal and repairs	10.00
Hauling water	[illegible]
Total	$[illegible]



Machine for Loading Dump Wagons.

The machine is the invention of its owner Mr. L. C. Wood of Arlington, Colo.

La Salle St. Tunnel Tubes.—After sinking the La Salle St. tunnel tubes at Chicago, as described in our issue of April 5, the tubes listed to the west somewhat. This was due to the settlement of foundation piles, and probably to the current in the river. It may, also, have been due to allowing too much weight, in water, into the tubes after they had settled to position. The sand filling should have been placed under the tubes as soon as possible. This was probably done, but evidently not soon enough. The contractor will attempt to right the tubes and hopes to secure them in the exact position. The list is about 4 ins. to the west.

ROADS AND STREETS SECTION

The Plants and Methods of Operation of the Asphalt Paving Companies Operating in New York City.*

The area of sheet asphalt pavements maintained by the Borough of Manhattan in 1910 was 2,460,089 sq. yds., the entire amount of asphalt pavement in the city, both under and out of guarantee, being 5,230,484 sq. yds. This area is maintained by four principal companies, which operate in the city under contracts with it to the number of about 800. The companies referred to are the Barber Asphalt Paving Co., the Sicilian Asphalt Paving Co., Uvalde Asphalt Paving Co. and the Asphalt Construction Co. The Barber Co. has three plants, the Sicilian Co. one, Uvalde Asphalt Co. three plants (one of which is not operated) and the Asphalt Construction Co. one plant. Seven of these plants laid, during the year 1910, about 1,250,000 sq. yds. of pavement in new and repair work. The Barber Asphalt Co. has under guarantee about 1,500,000 sq. yds. of pavement, considerably more than the other companies, and the bulk of work is, in consequence, done by it, most of the material coming from its plant in Jersey City. This company has plants on the Harlem River, in the Borough of the Bronx, at the foot of 151st St., at Varick and Stagg Sts., Brooklyn, and in Jersey City at the foot of Henderson St. The plant in Jersey City is located on the water front, about 1¼ miles from the ferry, and the asphalt, broken stone, sand and other materials are supplied by lighter. The asphalt is refined at Maurer, N. J., about 17 miles from Jersey City, and is sent there in barrels by lighter to the plants. The sand is obtained from Perth Amboy and other places, and the broken stone from Nyack, N. Y. The plant contains the following machinery:

1 120 HP. boiler,
1 100 HP. engine,
1 revolving sand screen,
1 revolving stone screen,
2 sand drums,
2 stone drums,
4 asphalt melting tanks, 16,000 lbs. capacity each,
4 dipping tanks,
oil tanks of 27,000 gals. capacity,
1 binder mixer, 16 cu. ft. capacity,
1 asphalt mixer, 16 cu. ft. capacity.

About 1,200 cu. yds. each of sand and stone may be stored in bins, and the yard has ample area for additional storage for coal, wood, stone dust and street equipment and contains machine shop for plant repairs—an important adjunct. The force engaged in running the plant is as follows:

1 day engineer,
1 day foreman,
1 night foreman,
1 machinist and general mechanic,
1 office clerk, recording materials used,
1 hoisting engineer (for material brought in by boat).
3 machinists,
1 night watchman,
1 yard foreman,
3 coal passers,
1 tally clerk,
1 day watchman,
42 laborers.

The maximum capacity of this plant per day of eight hours is 500 boxes of top, each of 9 cu. ft.; or 900 boxes of binder, each of 9 cu. ft., or between 7 and 8 loads per hour of five boxes of 16 cu. ft. The plant is in operation nearly the whole year and often to its full capacity. The work starts at 5 a. m., and stops at 4 p. m. The cost of operating its full capacity, exclusive of fixed charges and cost of material, is said to be about $800 per week. This plant delivers asphalt pavement material to that part of the borough between the Battery and 59th St., the duration of the longest haul being about three hours; this, of course, included the ferry trip. The material is delivered in bottom dumping trucks, horse drawn, and supplied by sub-contractor.

The street equipment of this company for laying the pavement, consists of gangs of 23 men, made up as follows:

2 rakers,
2 smoothers,
1 roller engineer,
1 night watchman,
1 foreman,
2 tampers,
1 roller attendant,
1 day watchman,
11 laborers,
1 timekeeper.

The work of the gang is divided into two parts: that of cutting out, or preparatory work, and of laying. By this system the work of laying the material quickly follows that of cutting out, and, if bad weather occurs, the work may be stopped, leaving no holes unfilled. The company maintains a storage yard at No. 640 West 39th St., for its street equipment, and a machine shop in Long Island City, foot of 6th St., where the extensive repairs to street equipment are made. The plants located in the Bronx and Brooklyn Boroughs are somewhat better arranged and more modern than the Jersey City plant, and are of about the same capacity, and supply, when all the plants are working, that part of the borough north of 59th St. (Bronx plant), and south of 59th St., east of Broadway (Brooklyn plant). These three plants have supplied material for laying 7,100 sq. yds. of pavement in repairs in one day.

The Bronx plant refines its own asphalt and supplies paving material to the Bronx, Mt. Vernon and adjacent districts, as far north as New Rochelle. It differs from the Jersey City plant in these particulars: Refines its own asphalt (four refining tanks) and uses both Trinidad and Bermudez asphalt. It has one binder mixer of 9 cu. ft. capacity, and one top mixer of 16 cu. ft. capacity. Its maximum output is about 500 boxes of top per day of eight hours, each box being 9 cu. ft., or about 8 loads per hour of 81 cu. ft. are delivered. The yard has area for the storage, in bins, of 700 cu. yds. of stone, 1,400 cu. yds. of sand, and 350 tons of coal. There are two oil storage tanks, which contain 16,000 gals. each. The force employed is as follows:

[illegible] engineers at $5.00 per day
[illegible] foremen at $5.00 per day.
[illegible] blacksmith at $4.00 per day
[illegible] blacksmith's helper at $3.00 per day.
[illegible] carpenter at $3.50 per day.
1 yard clerk at $3.00 per day
1 hoisting engineer at $3.50 per day.
1 day watchman at $1.75 per day
1 night watchman at $1.75 per day
[illegible] laborers at $1.75 per day
2 yard foremen at $5.00 per day.

The plant is not often run to its full capacity. It is the headquarters for the company's asphalt block paving work, and materials and tools connected with this work are stored here.

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*From a paper by Daniel B. Goodsell, Assistant Engineer, Highways Bureau, Borough of Manhattan, presented before the Brooklyn Engineers' Club on Feb. 9, 1911.

The Williamsburg plant is situated at Varick and Stagg Sts., at the head of Newtown Creek, Borough of Queens. It has the usual outfit of Corlis engine, 80 h. p., 4 sand drums, 16 ft. by 30 ins., revolving stone and sand screens, 6 melting tanks, 15,000 lbs. capacity, oil tanks 35,000 gals. capacity. The top mixer is of 15 cu. ft. capacity and the binder mixer of 9 cu. ft. capacity and the maximum output of paving material is about 320 boxes of top or 640 boxes of binder, working 8 hours, or 10 loads of binder of 9 boxes, each 9 cu. ft., or 9 loads of top each of 5 boxes of 15 cu. ft. There is storage for about 1,700 cu. yds. of stone and 1,200 of sand and the yard contains the usual sheds for cement and stone dust and the machine shop. The refined asphalt is sent here from Maurer, N. J., and no refining is done. The force is as follows:

2 engineers, night and day, at $[illegible] per day
2 firemen, night and day, at $3.50 per day.
2 watchmen at $2.00 per day.
1 fireman for tanks at $[illegible] per day.
2 oilers at $2.25 per day.
1 coal passer at $2.50 per day.
1 hoisting engineer at $5.00 per day.
2 yard foremen at $5.00 per day.
2 clerks at $3.00 per day.
42 laborers at $1.75 per day

The Jersey City plant and Bronx plant have drums for heating old asphalt removed from the street. It is fed to a crusher and elevated to the top of the drum, which stands on end and is steam jacketed. The material is removed from the bottom and placed in a mixer, where asphalt cement is added, and the material used, where permitted, as a binder course. The repair work of this company is in charge of a superintendent who directs the locations of the gangs daily, after consultation with the city's engineer, and he obtains his material from the three plants, as indicated, and as the necessity of the work requires. The foremen of the gangs report daily to him the material used and square yards of pavement laid; the latter being classified into pay work and the company's maintenance work on its streets under guarantee. The Barber Asphalt Paving Co. has available for immediate use, 22 rollers of 5 tons weight, 4 rollers of 3 tons weight and 1 roller of 8 tons weight.

The plants of the Uvalde Asphalt Paving Co. are situated at the foot of Greene St., Jersey City; at Grand and Varick St., Brooklyn, and at 157th St. and Harlem River, Manhattan. The latter plant has not been operated in some time, but is in good repair and could be put in operation at short notice. These plants are nearly uniform in design and are all kept in excellent repair. They turn out about 200 boxes of material in 8 hours, each box being 16 cu. ft. It is delivered almost exclusively in end dumping carts, which have been especially designed for the work; each plant refines the crude asphalt used by it. The roller outfit consists of ten of 5 tons and one of 10 tons. The street equipment and manner of working it is the same as that described for the Sicilian Asphalt Paving Co.

The Jersey City plant is housed in a building which has a steel frame work covered with galvanized iron, and the entire plant is under cover with the exception of the storage area for the sand, stone and asphalt. There are four sand and two stone drums, 95 H. P. Corliss engine, 150 H. P. boiler, top mixer 16 cu. ft. capacity, and binder mixer same capacity; oil tanks 30,000 gals. The company has at its disposal about 45 trucks; 1 fireman, 1 engineer, 1 machinist, 1 foreman, 1 clerk and 30 laborers employed to make up a force of 35 men. Asphalt is refined and is agitated by air and dipped by hand. The dust collecting apparatus is complete and effective. The company claims to have laid 3,750 yds. of pavement, including binder, in one day. Eight loads of top and ten loads of binder, is maximum output, or 80 to 100 loads per day.

The plants of the Barber Asphalt Paving Co. and the Uvalde Asphalt Co., which are located in Williamsburg, on Newtown Creek, are accessible by the Williamsburg Bridge, which places them within easy reach of the lower district in Manhattan.

The plant of the Sicilian Asphalt Paving Co. is located on the north side of 54th St., near 12th Ave., at the water front. It is about 15 years old, is built of steel and is carefully and systematically arranged to occupy a small ground space. An upright engine drives two sand drums, two stone drums, elevator and machinery for making roofing material. Refining is done here and crude asphalt is brought in carts up an incline to the level of the stills. There are two mixers of 16 cu. ft. capacity each; 65 loads per day of 4 boxes, 16 cu. ft. each, is about the maximum capacity. This output, however, is obtained when end dumping wagons are used. If bottom dumping wagons are used, the output is increased as these take 5 boxes of 16 cu. ft. The company claims that it can lay 2,500 yds. of finished asphalt pavement in a day, using its maximum output. It confines its operations that part of the city below 100th St., and is not troubled by long hauls, that to Maiden Lane being its longest and the duration of that about two hours. The carts used are of the end dumping variety largely, only about one-third being of the bottom dumping style and these are used on new work. The composition of the street force is about the same as that described as being used by the Barber Asphalt Co., but the cutting out of the pavement is followed by the laying and they do not proceed simultaneously as with the before mentioned company. Its roller outfit, available for immediate use, is two 2½ ton rollers, five 5 ton rollers, one 13 ton roller. The rollers are of the tandem "Pioneer" type. Blacksmithing and light repairs are done at this plant.

The plant of the Asphalt Construction Co. is located at 137th St. and Harlem River and is a modern plant in every particular. It has two large sand drums, sizes 21 ft. by 48 in., 4 melting tanks, oil tanks of 27,000 gals. capacity, and its mixers are two in number, the top mixer having 16 ft. capacity and the binder mixer 13 cu. ft. capacity. There is storage in the yard for 700 cu. yds. of stone and 700 cu. yds. of sand. Owing to this small storage capacity, in the busy time it is necessary that boats should always be at the dock in the course of unloading. The company uses Bermudez and California asphalt. The plant is run by a 125 H. P. Corliss engine, steam for which is supplied by a 150 h. p. boiler. The dust collecting apparatus is a feature of this plant and makes it cleanly and convenient and agreeable to work in. The roller outfit, available for immediate use, is one 3 ton roller, one 7 ton roller, one 11 ton roller. The maximum output of pavement material is about 88 loads of 5 boxes, each of 16 cu. ft., per day, or 144 boxes of top, each of 14 cu. ft. and 244 boxes of binder, each of 13 cu. ft. The estimated cost of running the plant, exclusive of pavement material used, is stated to be $85 per day.

The Borough organization for the recording of pavement defects consists of a division of the city into six districts, each in charge of a Chief Inspector under whom are four to six division inspectors who patrol the streets and record all holes, openings or other defects in the asphalt pavement. Asphalt contractors are sent copies of these records and are directed to do the work indicated. Should they fail, special reports are made to the Assistant Engineer in charge, who initiates steps to carry out the work as provided by the contracts.

Difficulties in carrying out the work in accordance with the contract provisions, which require a continuous maintenance of the pavement in good repair, are the large number of street openings and the consequent confusion as to ownership and responsibility for pavement damage, interference with the repair work due to congested traffic conditions making it slow and requiring it to be done over, and the sudden accumulation of work due to unfavorable weather conditions. During the winter, when snow and ice and low temperature prevail, rollers are difficult to move and slide easily on the slippery pavements, nor can they be stored, except temporarily, on the streets, because of frequent objections of property owners. Materials are difficult to move from plant to street; ferries are delayed, and sand and stone at plant are wet or frozen. Less work is gotten from the men and tools are apt to be too hot. The holes are likely to be filled with snow and mud, even though the adjacent pavement be dry, and in addition there is the uncertainty of the weather conditions. During the suspension of repairs the traffic continues and is highly destructive in the wet and cold periods, and results in pavement conditions of which loud complaint is made by the public.

Some English Data on Resurfacing Macadam.—The following data for the resurfacing of main roads through an urban district in the Lake District of England were given in a recent issue of The Surveyor by M. C. Watson, Surveyor to the Amblerside Urban District Council. The roads are located about 5 miles from a railway station and have to bear a very heavy through carting traffic all the year round, and in the summer months have to withstand probably a heavier coach and motor traffic than those of any other part of the county, besides a service of heavy motor buses to and from the station. The stone used is from the council's quarries, and is known as a blue limestone. It is of a very varying nature and difficult to break, the price paid for quarrying being 36 cts. per cu. yd. of broken stone, and for breaking 60 cts. per cu. yd. The following refers to work done in January. The weather was wet with spells of frost. The length of road rolled was 930 lin. yds.; the superficial area, 4,500 yds. The cost was as follows:

	Per Sq. Yd., Cts.
Stone, 300 cu. yds. at 96 cts.	6.40
Binding	.26
Scarifying, [illegible] hours at [illegible]	.12
Roller drivers' wages, 21 days at $1.20, including getting up steam but not scarifying. The actual time rolling being about 7 hours per day	.56
Manual labor	.68
Team labor, including hauling rough stone from quarry to depots to be broken, greatest distance 2 miles, also watering	2.40
Fuel, [illegible] cwts. smokeless coal, including carting, at 45 cts. per cwt.	.60
Total	11.[illegible]

This gives a cost of 53 cts. per lin. yd., or $943 per mils for a road approximately 5 yds. wide; the average width of roadway being 7 yds., one cubic yard of stone covering about 15 sq. yds. Number of yards rolled per day was 44 lin. and 214 super. The following relates to work done in February. The weather was wet and there were spells of frost. The length of roadway rolled was 648 lin. yds.; the superficial area was 4,500 sq. yds.

	Per Sq. Yd., Cts.
Stone, [illegible]	[illegible]
Binding	.28
Scarifying, 36 hours at 14 cts.	.12
Roller drivers' wages, 16 days at [illegible]	[illegible]
Manual labor	[illegible]
Team labor, also watering [illegible] to depots	[illegible]
Fuel	[illegible]
Total	[illegible]

This gives a cost of 78 cts. per lin. yd., or $1,390 per mile for a road average 7 yds. wide. The actual width of the roadway in this case was 13 yds. One cubic yard of stone covered about 12 super. yds.; number of yards rolled per day, 40 lin. and 280 super.; the slight increase in cost over the first figures due to extra metal put on some parts of the road. Nothing has been allowed in the above figures for depreciation of roller, or for the driver's wages when not able to roll on account of frost—which amounted to 28 days out of 65—wear and tear of tools and carts, or for horse keep, and so forth. A cause of considerable trouble in winter time is the way in which horses are shod in this district. On the first signs of frost the horses are fitted with block shoes, capable of holding four sharps in each shoe, and this class of shoe is used throughout the winter—frost or no frost. The result is that great damage is done to the roads through the loosening of the metal.

[illegible] OF [illegible] SPECIFICATIONS FOR OIL MACADAM PAVEMENT

City	Foundation	Roller	Total Thickness of Pvt	First Course		Second Course	
				Size Stone	Thickness	Size Stone	Thickness
Long Beach	[illegible]	[illegible]	[illegible]	[illegible]	2½"	¾" to 2"	[illegible]
Los Angeles	Rolled Earth	[illegible]	According to amount of traffic	[illegible]		¾" to 1½"	
Santa Monica	[illegible]	250 lbs. per in.	[illegible] to 4" of gravel	[illegible]		Dust to 1"	[illegible]
Berkerley	Rolled Earth	[illegible] lbs. per in.	[illegible]	[illegible] then [illegible] layer of [illegible] gravel			
Santa Barbara	Rolled Earth	[illegible]	[illegible] at gutter [illegible] at crown	[illegible]	2" (gutter) 3" (crown)		
Bakersfield	Rolled Earth	[illegible]	2" at gutter [illegible] at crown	Earth pulverized for 6" below gravel		½" to [illegible]	2" (gutter) [illegible] (crown)
Sacramento	Rolled Earth	[illegible] lbs. per in.	[illegible]	[illegible] to [illegible] with screenings and water	4"	¾" to 1½" with screenings and water	[illegible]
New Jersey (State)	Rolled Earth	[illegible] ton		[illegible] to [illegible] with screenings		1" to 2" with sand to fill 50 [illegible] of voids	[illegible]
Boise	Rolled Earth	[illegible] ton	[illegible]	1½" to [illegible] with screenings and water	4"	¾" to 1½" with screenings and water	1½"

City	Top Course		Oil				Am't Rolling	Remarks
	Size Stone	Thickness	Temperature	Character	Total Amt	How Applied		
Long Beach	¼" to [illegible]	[illegible]	[illegible]	90% asphalt S. G. 10° 11° 13	1½ gal. per sq. yd.	[illegible] gal. on 2nd course [illegible] " top "	Unyielding sprinkle each course	Lay undisturbed 48 hours before top course is added
Los Angeles	¼" to [illegible]		[illegible] to [illegible]	80% asphalt	1½ gal. per	1 gal. on 2nd course [illegible] top "	Sprinkle and roll till loaded wagon does not disturb	Stone dry for 1" deep before any oil applied. Lay undisturbed for 12 hrs. before top course is added
Santa Monica	Dust to [illegible]	[illegible]	[illegible]	[illegible] asphalt S. G. 10° 12 11	[illegible] to [illegible] gal.	[illegible] gal. [illegible] earth 1½ gal. on 2nd course	Sprinkle as oil is mixed with earth. Roll top solid	
Berkerley	[illegible]	[illegible]	[illegible]	[illegible] asphalt	[illegible] gal.	[illegible] gal. on gravel let stand [illegible] days	Sprinkle top course and roll solid	
Santa Barbara	[illegible] to [illegible] and screenings	[illegible] (gutter) 3" (crown)	[illegible]	[illegible] asphalt	1½ gal.	[illegible] gal. on 1st course [illegible] top "	Sprinkle and roll solid	Lay undisturbed 24 hours before top course is added
Bakersfield	[illegible] pea gravel		[illegible]	[illegible] asphalt	2 gal.	1 gal. in earth [illegible] " on 2nd course [illegible] " top "	Rolling tamper on 1st course till unyielding Smooth roller " top " " "	
Sacramento	Screenings and sand to fill voids		[illegible]	75% asphalt S. G. 10° 12 1[illegible]	[illegible] gal.	1[illegible] gal. on 2nd course [illegible] " top "	1st course 3 rollings 2nd [illegible] Top [illegible]	Stone dry 1½" deep before oil is applied. Undisturbed two days
New Jersey (State)	[illegible] Dust	[illegible]	1[illegible] to 200°	99½% bitumen S. G. 13[illegible] 15		On 2nd course and top in two applications	Unyielding	Stone perfectly dry when oils applied—Not even dew
Boise	¾" to [illegible] with screenings and water	[illegible]	20[illegible] to 2[illegible]	[illegible] asphalt S. G. 10° 11 1[illegible]	[illegible] gal.	[illegible] gal. on 1st course [illegible] " 2nd [illegible] " top	Unyielding	

A Comparison of Certain Specifications for a Macadam Pavement.

Oil macadam has been used quite extensively by California cities for a number of years. In our issue of March 8, 1911, we described the methods employed by several of these cities in constructing this type of pavement and in this issue we print a tabulation showing the main features of the oil macadam specifications of several additional cities. The tabulation was prepared by Mr. J. B. Marcellus, C. E., of Boise, Idaho. It will be noted that about the only uniform points in the specifications are the ones regarding the kind of foundation and the weight of the roller. On all the other details there seems to be some little differences of opinion.

Some Details of Sand-Clay Object Lesson Roads Constructed in 1909-10 by the U. S. Office of Public Roads.

During the fiscal year ending June 30, 1910, the U. S. Office of Public Roads constructed 177,960 sq. yds. of sand-clay object lesson roads. Some details of these roads are given in the last annual report of Logan Waller Page, director of the U. S. Office of Public Roads, and from this report we have taken the matter that follows:

Dothan, Ala.—The work at Dothan, Ala., consisted of grading a section 4,000 ft. in length of the Columbia road and surfacing with a sand-clay mixture a section of the graded road 1,600 ft. in length and 14 ft. wide. The work was begun on May 4, 1910, and completed on May 26, 1910. The adjacent country is hilly and the soil sandy. To secure proper grades and drainage 2,000 cu. yds. of earth were moved an average distance of 100 ft. with a road grader and wheeled scrapers at a cost of $120.85. Eight hundred and twenty-nine yards of surfacing material were hauled an average distance of 300 ft., spread upon the road, and mixed at a cost of $99.77. One cross drain of corrugated iron, 24 ins. in diameter and 24 ft. long, was constructed at a cost of $24. Two wooden culverts were built, one 4 ft. high, 10 ft. wide, and 20 ft. long, at a cost of $38.70, and one 9 ft. high, 16 ft. wide, and 20 ft. long at a cost of $65.47. Part of the road was relocated, and grubbing was done that cost $60.78. With labor at $1 per day and teams at the cost of subsistence—that is, 70 cts. per day—the total cost of the road to the community was $479.02, which is at the rate of $632.30 per mile.

Tyler, Ala.—Work on the construction of a sand-clay road at Tyler, Ala., through a level country over deep sand was begun on May 3, 1909, and completed on July 29, 1909. The work consisted of surfacing, with a sand-clay mixture, a road 4,300 ft. in length and 20 ft. wide. Clay to the amount of 2,785 cu. yds. was hauled a distance of 1¼ miles, spread upon the road about 12 ins. thick and mixed with sand by means of plows, harrows, and a road grader. A vitrified clay tile cross drain 12 ins. in diameter and 30 ft. in length was put in. The work was done with the county convict road force. The cost of labor was based upon the cost of feeding and guarding the convicts, which was 75 cts. per day, and the cost of feeding the teams, which was $1 per day. The total cost of the road to the community was $1,628.40, which is at the rate of 17 cts. per sq. yd., or $1,969.32 per mile.

Palatka, Fla.—The work at Palatka, Fla., consisted of grading and surfacing a section 5,000 ft. in length of the Bostwick road. The adjacent country is low and level and the soil sandy. Since the road was a new one which had been laid through a forest, it was necessary to grub more than 400 trees and stumps, and this was done at a cost of $233.11. To secure proper drainage, 580 cu. yds. of earth were moved at a cost of $116.75, or 20.1 cts. per cu. yd. Fifteen hundred cubic yards of clay were hauled an average distance of 1 mile, and for a width of 14 ft. were spread upon the road to a depth of 8 ins. at the center and 6 ins. at the sides, at a cost of $1,167.48. With labor at $1.25 per day and teams at $4 per day the total cost of the road to the community was $1,646.35, which is at the rate of $1,738.53 per mile.

Albany, Ga.—The work at Albany, Ga., consisted of surfacing a road 5,775 ft. in length with a natural sand-clay mixture for a width of 20 ft. The surrounding country is level and the soil in the road is quite sandy. Earth to the amount of 3,722 cu. yds. was excavated at a cost of $345.20, or 9.27 cts. per cu. yd. The natural sand-clay mixture was hauled an average distance of 1,200 ft. and spread 8 ins. thick. The cost of loading was 6.5 cts., of hauling 7.3 cts., and of spreading 1.4 cts. per cu. yd. The labor used was convict, which is estimated at 50 cts. per day, with county teams at $1 per day. The total cost of the road to the community was $838.30, which is at the rate of $766.45 per mile. Work was begun on March 26, 1910, and the road was entirely completed on May 3, 1910.

Americus, Ga.—The work at Americus, Ga., consisted in demonstrating the proper method of building a sand-clay road. A section of clay road 528 ft. in length was graded ready for the demonstration. One hundred and ninety-five cubic yards of sand were hauled a distance of 3 miles and spread upon the road with shovels. The sand and clay were mixed with plows and harrows, and the road was shaped with a road drag. The work was done by the county convict road gang. With labor at 60 cts. and teams at the cost of subsistence —that is, $1 per day—the total cost of the improvement was $92, which is at the rate of $920 per mile. Work was begun on Aug. 26, 1909, and completed on Sept. 1, 1909.

Blakely, Ga.—The construction of a sand-clay road at Blakely, Ga., was begun on Jan. 25, 1910, and completed on March 5, 1910. A section of the Gordon road, 5,300 ft. in length, was graded for a width of 30 ft. The surface of the old road was gray sand underlaid, at a depth of a foot or two, with clay, and in grading the road about half of the material excavated was used for surfacing. Seventeen hundred and thirty-two cubic yards of earth were excavated at a cost of $145.11, and 1,005 cu. yds. of clay were loaded and hauled in wagons an average distance of ½ mile at a cost of $162.35. Cross drains, 20 ft. in length, with concrete end walls, were constructed at a cost of $120.37, as follows: One 12-in. and one 15-in. vitrified clay tile and two concrete boxes with waterways 1 by 2 ft. The total cost of the road to the community was $731.77, or $611 not including the cost of the culverts. The work was done by the county convict road gang, and the cost of labor and teams was the cost of guarding and feeding the convicts and feeding the teams, which was 45 cts. per day for labor and $1.60 per day for teams.

Brunswick, Ga.—A very sandy road, 1,200 ft. in length, at Brunswick, Ga., was surfaced, for a width of 12 ft. with a sand-clay mixture. Work was begun on April 7, 1910, and completed on April 26, 1910. The grade and shape of the road were satisfactory and the work consisted only of surfacing. Clay could be secured only from a marsh, which was covered with water at high tide. It was wheeled out of the pit in wheelbarrows and dumped on a platform, from which it was loaded into one-horse carts of about ⅓ cu. yd. capacity, hauled an average distance of ½ mile, spread upon the road to a depth of 10 ins., and mixed with the sand with a plow and disk harrow. Labor cost 85 cts. per day and one-horse carts $3 per day. The cost of the road to the community was $470.14, which is at the rate of $2,068.62 per mile.

Colquitt, Ga.—The work at Colquitt, Ga., consisted of grading ½ mile of earth road and surfacing with a sand-clay mixture a section of very sandy road, 800 ft. in length. The clay, of which 110 cu. yds. were needed for the sand-clay mixture, was obtained by trenching along the roadside and was mixed with the sand with a plow and road grader. The cost of moving $800 cu. yds. of earth with a road grader was $24.45, or 3 cts. per cu. yd. All work was done by the county convict road gang, at a cost of 50 cts. per day for labor and $1.20 per day for teams. The total cost of the road to the community was $66.73, which is at the rate of $133.46 per mile. Work was begun on March 10, 1910, and entirely completed on March 16, 1910.

Stump Neck, Md.—The work at Stump Neck, Md., begun on June 15, 1910, and completed on June 25, 1910, consisted of grading and surfacing with a sand-clay mixture a section of road 580 ft. long and 14 ft. wide, and a section 400 ft. long and 8 ft. wide. The cost of grading was $40.80. Two hundred and ten cubic yards of surfacing material were loaded, hauled an average distance of 1,500 ft. and spread upon the road at a cost of $77.65. The total cost of the road to the community was $150, which is at the rate of $985.60 per mile for a 14-ft. roadway.

Brandon, Miss.—Work at Brandon, Miss., was begun on Sept. 6, 1909, and was completed on Nov. 11, 1909. It consisted of grading and surfacing, with a sand-clay mixture, a section of road 5,344 ft. in length and 18 ft. wide, and constructing a number of cross drains. The adjacent country is hilly and the soil, which is quite variable, has the following nature along the road: Station 0 to station 10, stiff clay; station 10 to station 13+50, sand-clay mixture; station 13+50 to station 17, deep sand with a clay subsoil; station 17 to station 24, sand and clay with sand predominant; station 24 to station 28, deep sand; station 28 to station 31, sand-clay mixture; station 31 to station 35+50, sandy clay; station 35+50 to station 40, clay; station 40 to station 46, sand and clay; station 46 to station 50, sandy soil; station 50 to station 53+44, clay. To secure proper grades and drainage, 6,097.4 cu. yds. of earth were moved an average distance of 350 ft. at a cost of $1,743.85, or 28.6 cts. per cu. yd. A long drought had caused some portions of the road to become so hard that they could not be plowed and it was necessary to loosen the earth by blasting and with picks, which increased the cost of excavation quite materially. By properly distributing the earth that was excavated a great portion of the road was practically surfaced with a sand-clay mixture when the excavation was completed. Nine hundred cubic yards of surfacing material were hauled an average distance of 3,300 ft. at a cost of $211.80. Cross drains with concrete end walls were constructed as follows: One concrete box culvert, 27 ft. long, with a waterway 24 ins. by 21 ins.; one concrete box culvert, 27 ft. long, with a waterway 24 ins. by 15 ins.; one vitrified clay tile drain, 25 ft. long, 15 ins. in diameter; two vitrified clay tile drains, 27.5 ft. long, 18 ins. in diameter; one vitrified clay tile drain, 27.5 ft. long, 15 ins. in diameter; one vitrified tile drain, 27.5 ft. long, 12 ins. in diameter; one vitrified clay tile drain, 57½ ft. long, 18 ins. in diameter. With labor at from $1 to $1.25 per day and teams at $3 per day, the total cost of the road to the community was $2,980.40, which is at the rate of $2,815.54 per mile.

Charleston, Mo.—Funds for the improvement of a very sandy road leading north from Charleston, Mo., were raised by subscription by the business men of Charleston, excepting $250, which was paid from the county funds. Work was begun on Aug. 6, 1909, and this road was entirely completed on Aug. 26, 1909. The road was graded 30 ft. in width between ditches for a length of 5,050 ft., and a strip 15 ft. in width in the center was surfaced with a sand-clay mixture. For the surfacing, 1,300 cu. yds. of clay were hauled an average distance of 5,000 ft. in slat-bottom farm wagons of 1 cu. yd. capacity, at a cost of $569.10. The cost of loading the clay was 23.8 cts. and of spreading upon the road 4.25 cts per cu. yd. Nine hundred and thirty-one cubic yards of earth were excavated and hauled an average distance of 400 ft. at a cost of 19.4 cts. per cu. yd. The total cost of the road to the community was $1,302.77, which is at the rate of $1,360.48 per mile. Labor cost $1.50 and teams $3 per day.

Magnolia, Miss.—Work was begun at Magnolia, Miss., on May 18, 1910, and was completed on June 10, 1910. It consisted of building a sand-clay road 1,200 ft. in length and 15 ft. in width, putting in an 18-in. vitrified tile drain 30 ft. in length and building a wooden culvert 23 ft. in length with an opening of 3 by 5 ft. The road was built through a rolling country on a heavy clay soil. Four hundred and seventy-four cubic yards of earth were moved an average distance of 200 ft. at a cost of 25.4 cts. per cu. yd. Sand to the amount of 222.2 cu. yds. was loaded in wagons with shovels at a cost of 17.9 cts., hauled an average distance of 1 mile at a cost of 20.7 cts. per cu. yd., and spread upon the road with shovels at a cost of 14.07 cts. per cu. yd. This work was done with convict labor, and the total cost to the community, with guards at $1, convict at 80 cts., mules at 50 cts., and hired teams at $4 per day, was $338.40, which is at the rate of $1,488.96 per mile, or 10.1 cts. per sq. yd.

Benton, Mo.—Two sand-clay roads were constructed at Benton, Mo., one on a sandy soil and the other on a gumbo soil, to illustrate the methods of construction on a sand base and on a clay base. Work was begun on Sept. 13, 1909, and completed on Oct. 6, 1909. The first road, 850 ft. in length, was constructed on a sandy soil. To secure proper grades and drainage, 250 cu. yds. of earth were moved with drag scrapers and a road grader at a cost of $15. Gumbo was hauled an average distance of 6,000 ft. and spread 15 ft. in width and 10 ins. deep, and mixed with the sand with plows and a road grader. The total cost of the road was $184.01, which is at the rate of $1,143 per mile. The second road,

AVERAGE COST PER MILE OF SAND-CLAY OBJECT LESSON ROADS CONSTRUCTED IN 1909-10.

Place	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dothan, Ala	[illegible]	14	2,000	[illegible]		[illegible]	[illegible]	$0.72
Tyler, Ala.	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Palatka, Fla	[illegible]	14	[illegible]	[illegible]	[illegible]	1,739	1.25	[illegible]
Albany, Ga	[illegible]	20	3,722		[illegible]	[illegible]	[illegible]	[illegible]
Blakely, Ga	[illegible]		1,752	1,005		730	.45[8]	1.60[8]
Brunswick, Ga. .	[illegible]	[illegible]		.....	[illegible]	2,069	[illegible]	3.[illegible]
Colquitt, Ga	[illegible]		[illegible]	110		[illegible]	.50[6]	[illegible]
Stump Neck, Md	[illegible]	[illegible]		[illegible]		980		
Brandon, Miss. ..	[illegible]	[illegible]	[illegible]	[illegible]		2,816	[illegible]	[illegible]
Charleston, Mo. ..	[illegible]	[illegible]	931	[illegible]		[illegible]	1.50	3.00
Magnolia, Miss. .	[illegible]	15	474	[illegible]		1,489	[illegible]	[illegible]
Benton, Mo.	850	15	250		[illegible]	[illegible]		
Benton, Mo.	1,125	[illegible]	[illegible]		[illegible]	[illegible]		
Fremont, Neb. ..		[illegible]				2,088	2.25	4.00
Ravenna, Neb. ...	[illegible]	[illegible]		.....		673		[illegible]
Stuart, Neb	[illegible]	[illegible]	[illegible]			1,022		
Edenton, N. C	[illegible]	[illegible]	.....		9	[illegible]		
Edenton, N. C	[illegible]	[illegible]	500	[illegible]		[illegible]	[illegible]	2.50[illegible]
Laurinburg, N. C.	[illegible]	[illegible]	[illegible]		1	718	[illegible]	3.00
Nashville, N. C...	[illegible]	[illegible]	495	[illegible]	[illegible]	[illegible]	1.00	[illegible]
Hartsville, S. C...	[illegible]			.....	1	[illegible]	[illegible]	1.50[illegible]
Marion, S. C	[illegible]	16	[illegible]	1,055		[illegible]		1.06[2]
Newberry,. S. C...	[illegible]	20			[illegible]	508		1.30[2]
Winnsboro, S. C..	[illegible]		[illegible]	[illegible]		808	[illegible]	1.50
Paris, Tex	[illegible]	20	[illegible]		[illegible]	900	1.50	3.00

Sand-clay [illegible] 1,600 ft. Cost of subsistence [illegible] feeding and g[illegible] Cost of feeding teams. [illegible] labor. County [illegible] Convict labor, cost of guarding and feeding each [illegible] teams. 800 ft. surfaced with sand-clay. 580 ft. [illegible] wide [illegible] —guards at $1, convicts at 80 cts. [12]Mules at 50 cents and hired teams at $4. [13]4-in. to 5-in [illegible] [14]$2.50 to $5. [15]10-in. in center, 6-in. at sides. [16]Convicts, 50 cts. for feeding and guarding each man. [17]County teams driven by convicts. [18]Convicts, cost of feeding and guarding. [19]600 ft. surfaced with sand-clay mixture. [20]7-in. in center, 4-in. at edges.

1,125 ft. in length, was built on a gumbo soil. To secure proper drainage [illegible] cu. yds. of earth were moved with drag scrapers and a road machine at a cost of $53.38. Sand was hauled an average distance of 600 ft. and spread over the road for a width of 15 ft. and a depth of 11 ins. The sand and clay were mixed with plows and a road grader. The cost of this section was $127.70, which is at the rate of $599.30 per mile.

Fremont, Neb.—The work at Fremont, Neb., consisted of building a sand-clay road 5,221 ft. in length and 16 ft. wide through a level country on gumbo soil. The road was satisfactorily graded and the work consisted in surfacing it. Sand shipped 4½ miles by rail and hauled ¾ mile in wagons was spread from 5 to 6 ins. deep and 16 ft. wide over the gumbo, which had previously been plowed and pulverized for a depth of from 4 to 5 ins. Considerable difficulty was experienced in getting the sand and gumbo thoroughly mixed, but by wetting the road quite thoroughly fair results were obtained. Water was obtained by pumping with a gasoline engine, from driven wells along the roadside. The sand was delivered at the railroad siding for 42.5 cts. per cu. yd. With labor at $2.25 per day and teams at $4 per day, the cost of the road to the community was $2,064.24, which is at the rate of 22.24 cts. per sq. yd. or $2,087.59 per mile.

Ravenna, Neb.—At Ravenna, Neb., the work consisted of building a sand-clay road 4,935 ft. in length and 12 ft. in width over a sandy soil. At a cost of 6.2 cts. per cu. yd., clay to the amount of 2,120 cu. yds. was loaded into wagons with an elevating grader, hauled an average distance of 1,525 ft. at a cost of 12.2 cts. per cu. yd., and spread with a road grader at a cost of 3.1 cts. per cu. yd. The total cost of the road to the community was $628.88, which is at the rate of 4.4 cts. per sq. yd. or $672.84 per mile. The cost of labor was $2.25 and teams $4 per day. The work was begun on Oct. 4, 1909, and completed on Oct. 20, 1909.

Stuart, Neb.—The work at Stuart, Neb., consisted in surfacing with sand-clay 4,520 ft. of road 18 ft. wide over gumbo and black prairie soil. Work was begun on June 29, 1909, and completed on July 27, 1909. Eighteen hundred and sixty-eight cubic yards of earth, removed from a cut, were found suitable for surfacing and were hauled an average distance of 1,750 ft. in wheeled scrapers and wagons, and spread upon the road with shovels and a road grader, at a cost of $781.66. The wagons were loaded with an elevating grader drawn by a traction engine. One hundred and thirty cubic yards of sand were required and were hauled an average distance of 600 ft. The total cost of the road to the community was $875.32, which is at the rate of $1,022.47 per mile.

Edenton, N. C.—Two roads were built at Edenton, N. C., between May 26 and June 27, 1910. The first, 500 ft. in length, was built as an experiment to determine the value of a clay which consisted of a fine slate-colored silt. A very sandy road was surfaced with this clay 16 ft. wide and 9 ins. deep. The sand and clay were mixed with plows, harrows, and a road grader. The indications were that the material would make a fairly satisfactory road. The total cost of this experimental road was $137.05, which is at the rate of $1,440 per mile. The second road, 1,600 ft. in length, over very sandy soil, was surfaced with a sand-clay mixture for a width of 12 ft. To secure proper grades and drainage 500 cu. yds. of earth were moved an average distance of 200 ft., at a cost of $79.65. Five hundred and seventy cubic yards of surfacing material were used, and provided a wearing surface about 8 ins. in thickness. The total cost of this road to the community was $206.20, which is at the rate of $680 per mile. The cost of labor was $1 and of teams from $2.50 to $5 per day.

Laurinburg, N. Co.—On Aug. 30, 1909, the work of grading and surfacing with a sand-clay mixture 5,200 ft. of the Maxton road at Laurinburg, N. C., was begun and on Sept. 25, 1909, it was entirely completed. Fourteen hundred and ninety-eight cubic yards of earth were excavated and hauled with wheeled scrapers and wagons an average distance of 250 ft., at a cost of $269.50. Thirty feet of 16-in., 96 ft. of 18-in., and 48 ft. of 24-in. vitrified pipe were furnished, at a cost of $85.80, and laid for cross drains. The first 4,000 ft. of the road were sand and the remainder, 1,200 ft., was clay. Clay was hauled from the clay section to the sand section, and sand from the sand section to the clay section in such quantities as to give a compacted wearing surface of a sand-clay mixture 12 ft. wide and 4 ins. thick. The total cost of the road to the community was $705.62, which is at the rate of $718 per mile. Labor cost $1 and teams $3 per day.

Nashville, N. C.—The work of building a sand-clay road at Nashville, N. C., 2,300 ft. long and 12 ft. wide, was begun on Aug. 9, 1909, and completed on Aug. 17, 1909. The adjacent land is rolling and the soil sandy. To secure proper drainage 495 cu. yds. of earth were moved with drag scrapers and a road grader an average distance of 75 ft., at a cost of $59.40, or 12 cts. per cu. yd. Six hundred and eighty-two cubic yards of surfacing material were hauled in one-horse carts an average distance of 800 ft. and spread upon the road to a depth of 10 ins. in the center and 6 ins. at the sides, at a cost of $81.70. The total cost of the road to the community was $180.94, which is at the rate of $341.19 per mile. Labor cost $1 per day, one-horse carts $1.50 per day, and teams $3 per day.

Salisbury, N. C.—The local authorities at Salisbury, N. C., had graded 1 mile of clay road for a width of 25 ft. between shoulders and had covered a strip 10 ft. in width with sand about 6 ins. deep. The work therefore consisted in mixing the sand and clay and adding additional sand where needed. Two hundred and seventy-eight cubic yards of sand were hauled ¾ mile and spread upon the road at a cost of $157.30. The sand and clay were then mixed with plows and harrows at a cost of $9.60. The work was done by the county convict road gang. With labor at 40 cts. and teams at the cost of subsistence—that is, 80 cts. per day—the total cost of the work was $198.75. Work was begun on Sept. 21, 1909, and completed on Sept. 27, 1909.

Darlington, S. C.—The work of constructing a sand-clay road at Darlington, S. C., was begun on June 27, 1910. The proposed road will be 3,780 ft. in length and surfaced with a sand-clay mixture 20 ft. in width. Since the work was not completed in this fiscal year, a detailed statement of it will be deferred until the next annual report.

Florence, S. C.—The work at Florence, S. C., consisted of improving a section of the Dargan road, 1,000 ft. in length, with gravel and a sand-clay mixture. One hundred and seventy feet were surfaced with gravel which had been shipped in by rail previous to the arrival of the representative from this office. The remainder of the section, 830 ft., was surfaced with a sand-clay mixture. The clay and sand which were used were obtained practically from the roadside, at a cost of about one-fifth that of the gravel. Fifty-eight cubic yards of gravel were purchased at 83 cts. per cu. yd., hauled a distance of 1 mile, and spread upon the road at a total cost of $85.90. The cost of the sand-clay section was $77.90. The work was done by the county convict road gang and labor was estimated at 40 cts. per day, horse and cart at $2 per day, and teams at $3 per day.

Hartsville, S. C.—A sand-clay road, 5,280 ft. in length, was built at Hartsville, S. C., through a practically level country on a sandy soil. Under the sandy soil, which was about 1 ft. in thickness, was found a good quality of clay. A wide trench was dug along both sides of the road, the sandy soil was thrown to the outside of the road, and the clay, sufficient for a 10-in. sand-clay surface, was dragged to the middle of the road. The sand and clay were then spread and mixed with a road grader. All surplus sand was drifted back into the trench. Cross drains of vitrified pipe were constructed as follows: Two 24-in., 50 ft. long; one 30-in., 40 ft. long; one 15-in., 24 ft. long; and one 12-in., 24 ft. long. All labor was performed by jail convicts, which cost the county for feeding and guarding 50 cents per day for each man. The total cost of the road to the community was $338, including the cross drains, and $134.75 exclusive of the cross drains. Teams were furnished by the county and as a rule driven by the convicts, and were considered as costing the county $1.50 per day. Work was begun on June 2, 1910, and the road was completed on June 21, 1910.

Marion, S. C.—The work at Marion, S. C., consisted of grading to a width of 30 to 40 ft. 4,750 lin. ft. of road and surfacing it for a width of 16 ft. with a sand-clay mixture. The country adjacent to the road was level and the soil quite sandy. Work was begun on May 31, 1910, and completed on July 21, 1910. In grading the road 1,456 cu. yds. of earth were loosened with plows and picks and hauled in wagons and wheelbarrows an average distance of 500 ft. at a cost of 23.5 cts. per cu. yd. One thousand and fifty-five cubic yards of clay were used on the road for the sand-clay mixture, of which 656 cu. yds. were hauled an average distance of 1,500 ft., while the remainder, 399 cu. yds., was obtained from trenches dug along the roadside. The work was done by the county convict road gang, and the cost of labor was the cost of feeding and guarding the convicts, which was 35 cts. per day. Teams were owned and furnished by the county, and the cost of team labor was estimated at the cost of subsistence, which was $1 per day. The total cost of the road to the community was $609.06, which is at the rate of 3 cts. per sq. yd., or $677.02 per mile.

Newberry, S. C.—Work was begun at Newberry, S. C., on the construction of 5,360 ft. of sand-clay road, on May 26, 1909, and the road was completed on July 15, 1909. Since the natural grades were satisfactory, no grading was required. The clay was secured from the bottom of the side ditches, loosened with picks, and thrown on the road with shovels. The roadway was 20 ft. wide between the ditches and was covered with clay to a depth of 8 ins. at the center, gradually diminishing in thickness to nothing at the edges. Sand was hauled an average distance of 2,000 ft. and spread 6 ins. deep at the center, gradually diminishing to nothing at the edges. The sand and clay were mixed with plows, harrows, and a road grader. Three cross drains of vitrified clay tile were constructed, together with one of corrugated iron 18 ins. in diameter and 20 ft. long with rubble masonry head walls. The work was done with the county convicts and teams. Labor was estimated at 30 cts. per day and teams at $1.30 per day, which is the cost of feeding. The cost of guarding the convicts with guards at $1 per day was $48. The total cost of the road to the community was $515.49, which is at the rate of 4.33 cts. per sq. yd., or $508.04 per mile.

Winnsboro, S. C.—The work at Winnsboro, S. C., consisted of grading a section of the Rockton road 1,700 ft. in length and 40 ft. in width, except a section 400 ft. in length, which was graded to a width of 20 ft., and surfacing a section 600 ft. in length with a sand-clay mixture. The country is quite hilly and the soil a red clay. To secure proper grades and cross section it was necessary to excavate 1,658 cu. yds. of earth, which was done with picks and shovels. This earth was then hauled in slat-bottom wagons an average distance of 400 ft., at a cost of $163.10. Two hundred and sixty-six cubic yards of sand were hauled, spread upon the road 8 ins. deep, and mixed with the clay by means of plows and harrows. To protect the abutment of a bridge in the line of the work 33 cu. yds. of riprap were placed about it at a cost of $7.20. The work was done by the county convict road gang. With labor at 30 cts. per day and teams at $1.50 per day, the cost of the improvement was $203, which is at the rate of $807.73 for the completed road. Work was begun on Aug. 2, 1909, and completed on Aug. 14, 1909.

Paris, Tex.—Work was begun at Paris,

Tex., on Aug. 9, 1909, and the road was entirely completed on Aug. 27, 1909. Two days time was lost in waiting for a concrete culvert, which had been constructed in the line of work, to harden sufficiently to remove the forms. The road, 5,280 ft. in length, was graded to a finished width of from 32 to 35 ft., including the entire width of the shoulders. Twenty-six hundred cubic yards of earth were loosened by plows, and moved an average distance of 150 ft. with drag and wheeled scrapers, at a cost of 11 cts. per cu. yd. The adjacent land is rolling and at station 2+85 and station 43+87 concrete culverts, with spans of 10 ft., were constructed at a cost of $323.09. Clay was hauled an average distance of 600 ft. with wheeled scrapers and spread over the road for a width of 20 ft., and a thickness of 7 ins. in the center and 4 ins. at the edges. Sand was spread over the clay from the sides of the road with a road grader, and the sand and clay were mixed with plows and harrows. The road was then completed by rolling with a 10-ton steam roller. The total cost of the road to the community, exclusive of bridges, was $900, with labor at $1.50 and teams at $3 per day of ten hours.

The accompanying tabulation gives detail as to the construction of some of these roads, together with the average cost per mile.

WATER-WORKS AND SEWERS SECTION

Methods and Costs of Deep Well Drilling.*

Modern well drilling methods may be grouped into three general classes—percussion, hydraulic, and abrasion methods. Since the hydraulic methods are readily understood from the short descriptions given in standard text books, and the abrasion methods are but little used in sinking wells, especially for water, the major portion of this abstract will deal with the percussion method and its various subdivisions.

DEFINITION OF METHODS

Percussion outfits use a heavy drill bar or other tool, with suitable apparatus for lifting it and allowing it to drop, to pound the rock into fragments small enough readily to be removed from the hole. The percussion principle is utilized in the standard, portable, pole-tool, self-cleaning, and California methods, whose outfits are recognized as distinct but differ in their arrangements for handling the tools rather than in the operation of drilling. The California method belongs in this class, for though its successful use depends on a plentiful supply of water, it involves drilling by percussion.

Hydraulic outfits use water under pressure to loosen the material and bring it to the surface. The chief method in which water plays an active part in drilling—the hydraulic rotary method—has been developed mainly within the last ten years as a result of the discovery of oil in Texas in unconsolidated materials, for penetrating which the hydraulic rotary drill is especially adapted. In the jetting method used for sinking water wells in unconsolidated deposits water under pressure plays an even more important part than it does in the hydraulic rotary method, for the water jet receives little aid from the drill in loosening the material to be removed.

In methods involving abrasion the rock is worn and chipped off by rotating upon it a shoe or bit armed with some harder material. The abrasion principle is employed by three types of drills, which differ chiefly in the abrasive with which the bit is armed and are known as the diamond, calyx, and the chilled shot drills.

Several methods, including boring, punching, and driving, as well as digging, which do not come within the above classification, are employed to obtain shallow water supplies.

In many wells a single method is not employed throughout the entire work, and in some wells modifications of several methods are successively used. Though percussion tools are usually employed in drilling by any of the percussion methods, the shape of the bit used and the means of removing the drillings may be changed at different stages of progress. In the hydraulic rotary outfit a percussion drill may be substituted for the cutting shoe in penetrating hard strata, and for this purpose chilled shot, or adamantine, is also occasionally used with a suitable revolving shoe. Combinations of the hydraulic rotary and the jetting methods are also employed when penetrating alternate beds of clay and gravel. In the abrasion methods it is often found advantageous in passing through hard or tough material to replace the usual bit by one operated by percussion.

Abrasive or core drills are seldom exclusively employed for well sinking, their particular field of usefulness being in boring prospect holes for ore deposits or for other exploration work.

The terminology employed by well drillers throughout the country is fairly uniform. One of the major terms that may be mentioned is "rig." Among standard drillers this is usually applied only to the derrick, wheels, and reels, the word "outfit" being used to include the rig, power machinery, tools, and accessories. Those using portable drilling machines, however, apply the term "rig" to the complete machine.

CHOICE OF METHOD

The choice of method to be employed for drilling any given well requires the consideration of many factors, chief among which are the location and purpose of the well and the geological structure of the rocks to be penetrated. In many localities, for example, small tubular wells, from 2 to 4 ins. in diameter, and from 50 to 200 ft. in depth, will provide satisfactory water supplies. In other localities such wells are not satisfactory and wells of larger diameter are required. The advantage of knowing the kind of outfit to select can readily be understood. It must be borne in mind that no one method of drilling is best under all conditions. No one method can even be said to be the best under most conditions. Different methods are adapted to different localities; each style of outfit has advantages and disadvantages which must be considered before drilling is begun.

STANDARD METHOD

Rig.—The most noticeable part of a standard outfit is the derrick, a pyramidal framework, 30 to 90 ft. high, erected over the well. The derrick consists of four legs, steadied by girts and braces and surmounted by a crown block. In this block is set the crown pulley over which the drilling cable passes. A ladder extending up one side of the derrick provides access to the crown block. The weight of the derrick rests on foundation posts, which are set deep in the ground to render the structure firm.

At one side of the derrick are the bull wheels. This part of the rig consists of a reel, on which the drilling cable is wound, at each end of which is a wheel, usually built up of wooden arms and segments, fastened together with wooden pins. These parts are known to the trade as arms, cants, and handles. The whole is set firmly into the bull-wheel posts and strengthened by the bull-wheel post brace. The wheel at the farther end of the reel is grooved to receive the bull rope, which acts as a belt to operate the reel. The brake by which the reel is controlled passes over the near wheel of the illustration, Fig. 3, and is controlled by a lever. In the early rigs this brake consisted of rope or a piece of old rubber belting. When the tools were lowered the rope would burn and smoke, and the rubber would emit a very disagreeable odor. In present rigs an iron brake band is used.

In the California style of standard rig a second reel, known as the calf wheel, is placed on the side of the derrick opposite the bull wheels. It carries a cable that is used in lowering and in pulling casing. It is claimed that in deep drilling it saves much time as it obviates the necessity of disconnecting the tools from the drilling cable for these operations.

Opposite the bull wheels is the samson post, usually about 14 ft. long. This post is strongly braced and supports the walking beam. The derrick end of this beam is directly over the well and carries the temper screw to which the tools are fastened and by which they are fed downward. The other end of the beam carries a pitman, which is connected with the crank of the jack or band wheel by a wrist pin. This band wheel is supported on jack posts and transmits power to the several parts of the rig—to the walking beam by means of crank and pitman, and to the bull wheels through the tug wheel and bull rope. In the California rig the calf wheel is also operated by the band wheel through a second tug wheel and rope belt. The operation of the calf wheel is usually controlled by a lever and clutch, and the bull wheels are usually thrown in or out of gear by putting on or removing the bull rope.

The sand reel is just behind the band wheel and is operated by the latter through a friction pulley. This reel is mounted on a knuckle post and is controlled from within the derrick by means of the sand-line pulley, and, as its name indicates, it is used in handling the sand bucket or bailer.

The part of the rig that extends beyond the derrick rests on mud sills, which are usually sunk in trenches and have gains cut in them to receive the subsills and main sill, and the whole foundation is carefully leveled up and firmly keyed together.

The size of the parts of a rig depend on the amount and difficulty of the work to be done. In one case for a well 2,000 ft. deep the derrick was 72 ft. high. Again, for wells from 2,000 to 3,000 ft. deep the derrick was 82 ft. high. An increase in the length and weight of tools used is always accompanied by an increase in the size and strength of the derrick. The stems alone of the drills used with the 82 ft. derrick were 39 to 42 ft. long, and the sand buckets used with some outfits are 60 ft. long. The walking beams used were 16 and 24 ft. long for the 72 and 82 ft. derricks, respectively. Derricks are usually made of wood, though structural steel has been used in some cases. A bolted wood or steel derrick may be set up in two or three days. Three or four skilled workmen can set up an ordinary nailed derrick in from 3 to 5 days, the time depending on the size of the rig and the quality and accessibility of the lumber. Wood used in a nailed derrick can be used in two or three derricks before becoming badly split and worn out.

Power.—Steam power is almost universally used and is supplied by a boiler placed a short distance from the engine. The power is transmitted from the engine to the band wheel of the rig by means of a belt. Ordinarily the throttle is moved by wires from the derrick and the reverse lever is similarly operated by a man at the well by means of a rod from the derrick to the engine. The engine is commonly of from 12 to 30 h.p., and the boiler ranges from 15 to 40 h.p.

Tools.—The string of tools used in deep drilling consists of several parts, all of which have certain definite functions and are the outgrowth of years of experience. A full string (Fig. 1, *A*) comprises rope socket, sinker bar, jars, auger stem, and bit. Whether or not the complete string is used depends on the conditions under which drilling is done.

The socket may be fastened to the drilling rope in several ways. It may have a tapered hole in which the rope is secured by knotting; the rope and socket may be riveted together, or the rope may be threaded back and forth through several holes in the socket and secured by wedging.

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*Condensed from Water Supply Paper No. 257, U. S. Geological Survey, Washington, D. C.

The sinker bar is a long, heavy bar, which is used to add weight and length and thus aids in keeping the hole straight. It was formerly thought to be an essential part of the string, but it is now seldom used unless a wet hole (one partly filled with water) is being drilled. It then assists in sinking the cable rapidly. If it is placed between the jars and the bit, it adds force to the blows of the latter.

The jars consist of a pair of linked steel bars. When drilling in rocks in which the bit is apt to stick they are necessary to "jar" the drill loose. The drill responds to the powerful upward blow of the jars as they are jerked violently together by the stroke of the walking beam when it will not yield to the steady pull of the rope. Jars are now generally discarded in drilling through brittle rock. In fishing for lost tools jars are very useful and are sometimes made longer for that purpose than for use in drilling.

The only weight which is effective in adding to the blow struck by the drill is the combined weight of the lower jar, the auger stem, and the drill. This weight is from ¾ to ⅞ of the total weight of the string of tools, and is all the drill can bear. Besides adding to the effective weight the auger stem increases the length of the drill and so helps to maintain a straight hole.

Various patterns of drilling bits are used according to the character of the rock that is being penetrated. The shape illustrated at the bottom of the string of tools in Fig. 1, *A*, is used in moderately hard rock; Fig. 2 (1) is a similar, but thicker, drill used in hard, fissured rock; the California pattern, Fig. 2 (2) which is concave on the bottom, is used in shales; Fig. 2 (3) is a shorter and lighter bit used in "spudding" preliminary to drilling. Star bits Fig. 2 (4) are sometimes used in creviced rock that dips abruptly. Still more complex shapes are used in reaming and in other special operations.

Temper Screw.—The cable supporting the string of tools is connected to the walking beam by a temper screw (Fig. 1, *B*), which allows the drill to be fed downward as the drill hole is deepened. The temper screw consists of a frame or reins, at whose lower end is a split nut held together by a yoke clamp. Through this nut the main screw passes, and to its lower end is fastened a handle, by which it is turned. Below the handle is attached a ball-bearing swivel, from which depend the clamp links and rope clamps. The cable is gripped tightly between the rope clamps by a C clamp and is prevented from slipping by means of a "cat," made of strands of raveled rope or strips of coarse cloth, loosely plaited or twisted so as to form a cord about as thick as a man's finger in the middle, and tapering toward each end. The "cat" is wound about the cable at the point where the clamps are attached, and the set screw is then turned so as to bring the rope clamps firmly against it. Slightly different forms of clamp, Fig. 2, are sometimes used with wire rope.

When the screw has been run out its full length, and it is desired to bring it up again, the slack of the drilling rope is taken up on the bull-wheel shaft, the pitman of the walking beam is disconnected, and the C-clamp is loosened. The yoke clamp is then loosened, the main screw is drawn up through the split nut, the yoke clamp is again tightened, and the temper screw clamped to the cable. Small ropes are fastened to the short crossbar, or elevator, at the upper end of the main screw, and by pulleys on the under side of the walking beam a counterweight is hung beside the samson post. This weight balances the temper screw and renders its raising easy.

Cable.—Both hemp and steel wire ropes are now used for drilling cables. The approved hemp rope consists of three ropes of three strands each, twisted together into a single rope. Steel-wire cable consisting of six strands of seven wires each is a section commonly used. Both hemp and wire have their limitations. Hemp is lacking in durability, while wire cable is lacking in elasticity. Elasticity is desirable since the contraction of the cable after a blow is struck often is sufficient to prevent the bit from getting stuck fast in the hole.

Spudding.—The term "spudding" is applied to drilling without the aid of the walking beam. Since the string of tools is too long to be used in starting the well, spudding is usually resorted to for sinking the first 75 or 100 ft. of a well. This depth is also sufficient to give enough rope in which to provide enough elasticity to prevent the dead weight of the string of tools from breaking the rope.

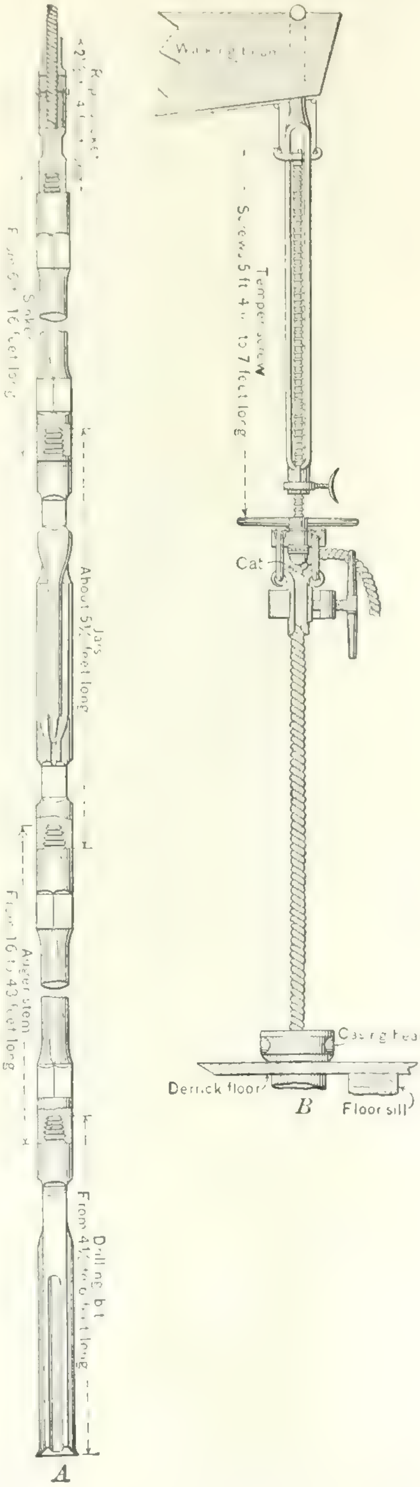

Fig. 1—A, String of Tools Used with Standard Drilling Outfit; B, Temper Screw.

Figure 3 shows the standard rig arranged for spudding. The cable is wound firmly about the bull-wheel shaft and passed through the crown pulley and from its other end the tools, usually only auger stem and spudding drill, are suspended in the drill hole. A rope called the jerk line is attached to the wrist pin of the band-wheel crank, brought inside the derrick and attached to the part of the drilling cable which extends from the crown pulley to the bull-wheel shaft by a curved metal slide called a spudding shoe. By carefully adjusting the length of this rope each revolution of the band wheel results in a pull on the line and its subsequent release, and a corresponding rise and fall of the tools. As the hole is deepened the cable is let out by giving the bull-wheel shaft a partial revolution, and the spudding shoe is slipped farther and farther down, for this downward sliding of the spudding shoe increases the length of the pull on the drilling cable and hence the distance through which the drill drops. The sliding motion is imparted by the driller's assistant, between jerks of the line, by means of a crooked stick long enough to reach the spudding shoe from the floor of the derrick.

Spudding is much harder on the derrick than is ordinary drilling, as the strain is brought on the top of the derrick where there is the greatest leverage. In drilling with the walking beam the weight comes on the samson post, which is not directly connected with the derrick, and the strain comes on the derrick only when raising or lowering tools or casing and when using the sand bucket or the bailer.

Drilling With Walking Beam.—After the hole has been sunk to the depth required for the string of tools a heavier drilling bit is attached, the drill rope is suspended from the walking beam by the temper screw, and regular drilling by means of the walking beam is begun. To allow freedom of motion to the walking beam, 20 or 30 ft. of the drill rope are unwound from the bull-wheel shaft and loosely coiled on the floor. The pitman of the walking beam is then fastened to the wrist of the band-wheel crank. The crank is provided with a number of holes, so that the length of stroke can be adjusted to the depth of the well, a short stroke being used near the surface, as the strain would otherwise be too great for the rope to bear. The engine is then started and the walking beam begins rocking up and down, raising and dropping the tools at the rate of about 25 strokes a minute.

Formerly it was the custom to revolve the drill by inserting a stick in the rings below the temper screw and slowly turning the rope, first in one direction and then in the other. It is now considered that after the hole is 200 or 300 ft. deep it is needless to turn the rope while drilling to secure a round hole. The torsion of the cable under the lifting strain has the effect of rotating the tools in one direction on the upstroke and in the other direction on the downstroke.

As the drill cuts deeper it is necessary to let out the drill rope gradually, so that the drill will strike bottom at each stroke. This is done by loosening the yoke clamp a little, and running out the temper screw a turn or two. At the end of from half an hour to several hours the temper screw has been run out its length of several feet and the drill has advanced an equal or greater distance. The tools are then withdrawn, the waste that has accumulated since the last bailing is removed with the sand bucket, and if necessary a sharpened bit is substituted.

The withdrawal of the tools is accomplished by first taking up the slack cable on the bull-wheel shaft, thus transferring the weight of the tools to it through the crown pulley. The rope clamp is then loosened, the temper screw is disconnected, and the pitman is thrown off from the band-wheel crank pin. By rotating the bull-wheel shaft with the engine connection, the tools may then be raised or lowered at will. This part of the work demands skill, for if the bull-wheel brake should not be applied as the tools reach the surface, the crown block and pulley would be torn loose and the tools would fall on the workmen beneath. After the tools are clear of the hole, they are swung to one side and caught in the loop of a quarter-inch rope fastened to a leg of the derrick.

The operator is now ready to bucket the drillings from the well. The sand bucket, or bailer, consists of a section of tubing 15 to 60 ft. long and somewhat smaller than the well. It has an iron valve at the bottom, either of the flat pattern, or the ball and tongue pattern. See Fig. 2 (^{8}-^{9}). In some materials in which the drillings are thick and heavy and do not readily enter the bailer, a sand pump Fig. 2 (^{10}) is used. In addition to the bottom valve this has a plunger which is worked like that of a water pump, and thus sucks the drillings into the tubing. The bucket or pump is suspended from a wire cable that is wound on the sand-line reel and carried through the sand-line pulley. The reel is operated from the derrick by a lever, which brings its friction pulley into contact with the band wheel. The sand-bucket line is thus wound up and the sand bucket is swung over the hole. The friction bearing on the band wheel is then released and the bucket is lowered into the well at any desired speed. As the drillings form a thin mud, owing to the addition of water from time to time by the driller, they rise into the sand bucket, are retained by the valve in its bottom, and are then removed. The bucket is emptied by lowering it upon an upright stake or pin beside the well, thus opening the valve.

The liquid condition of the drillings often makes it possible to drill 5 or 6 ft. without bucketing; otherwise the drill would become ineffective at the end of a very short time, by striking into its own cuttings, and the necessity for frequent bailings would greatly increase the work and cost of drilling. Water is usually added to the drillings by the bucketful at the well head. Sometimes it comes into the well from water-bearing strata that have been penetrated by the drill in a quantity sufficient to soften up the drillings, and yet not great enough to interfere with the work. It is then unnecessary to pour in water from the surface.

Dressing the Bit.—As the bit gradually becomes worn on the edges, its diameter is constantly reduced. When the tools are withdrawn if the bit is noticeably worn it is removed and heated in a forge. The edges of the drill are then hammered out to fit the circular gage, which has a diameter of ⅛ in. greater than the nominal size of the bit when properly dressed. The hammering is done with sledges, working from the center toward the edges of the bit. Proper temper is secured in cooling the bit. When the bit is again added to the string of tools all the joints are tightened up.

Wet and Dry Drilling.—A "wet" hole is one in which water in excess of that required for the operations is present while drilling; a "dry" hole is one in which excess water is cased off during the sinking of the well. In a dry hole the drilling can be done faster, as the tools are not buoyed up by the water, the rope lasts longer because it is not always saturated, and if tools are lost in the hole they are more easily recovered, as fishing tools are used to better advantage in a dry than in a wet hole. Wet drilling is usually cheaper (there being no outlay for additional casing), no time is lost in putting in casing and replacing the tools by a smaller set, and when the well is down the charge of nitroglycerine used in shooting the well has much greater effect, as it is tamped by the heavy column of water. The greatest disadvantage of wet drilling is that the sides of the hole are kept so wet that some of the shales are reduced to a semifluid mud, which frequently caves. Another disadvantage is that when tools are lost there is danger of sand and mud settling around them, even if the sides of the well do not cave.

Casing the Well.—In many places the surface material consists of loose, sandy clay, sand and gravel, varying in thickness from a few feet to several hundred feet. To restrain this material, which would otherwise impede the work of drilling, a conductor box is sometimes sunk to bed rock. This box is made of plank and is circular, square or octagonal in section, 8 ins. to 20 ins. across. If the rock lies only a few feet below the surface the necessary excavating is done by hand; if the soil is deep, a large drilling bit is used to spud down a hole, into which the conductor box or a section of large iron pipe may be sunk as fast as drilling proceeds.

After passing through the surface material the drill enters the "live" rock. As a rule this rock is made up of alternating layers of hard and soft, of very porous and slightly porous, of water-bearing and nonwater-bearing rock. Unless the water in the rock is under notable head and is considerable in amount, it is welcomed by the driller, as it saves the trouble and expense of pouring into the hole sufficient water to keep the drillings liquid. If, however, the water coming into the hole is too great for rapid drilling, it is necessary for the driller to insert a string of casing extending from the surface into the first hard, nonwater-bearing rock that is encountered after passing through the water-bearing layer. This casing is set very firmly into the hard layer and shuts out the water. In order to continue drilling, it is necessary to use a smaller bit which will pass, with clearance, inside the casing. If other heavy flows of water are encountered at greater depths, each flow must be cased off by a string of casing extending from the surface to the bottom of the water-bearing layer. As each string must slip inside the preceding one, a smaller drill must consequently be used after each casing operation.

Several kinds of casing are used. The common kind, called steam pipe, is made in sizes up to 12 ins. and of three grades—standard, extra strong and double extra strength. Still another kind of lining is the regular drive pipe, which is made very heavy in order that it may be driven to great depths. The ends of the pipe are cut off smoothly and meet squarely in the middle of the sleeve coupling. In this way the whole strain in driving comes not on the threads, but on the pipe; otherwise the joints would be disabled before reaching any considerable depth.

If a cheap well is desired, heavy wrought-iron pipe is driven to rock, and the well is finished by drilling to the required depth. A casing made of sheet iron 1/16 in. thick and ½ in. smaller than the drilled hole is then used. If it is necessary to shut off sand the bottom of this pipe may be flanged outward a little. After the sheet iron pipe has been placed in the well the heavy pipe may be pulled out and used again. If the depth to rock is not more than 50 or 75 ft. and the material is all clay or earth which will not cave, the heavy pipe may not be used at all, the sheet iron pipe serving in its stead, though its use in this way is attended by considerable risk.

In deep drilling, where caving material may be encountered, it is customary to sink casing or drive pipe as fast as drilling proceeds. For this purpose pipe heavier than the usual casing is employed, and stronger joints are made generally by heavy sleeve couplings. On the bottom of the lower joint there is screwed or shrunk a shoe of tempered steel, which will stand heavy driving without injury, and which gives clearance for the pipe and couplings. The ordinary pipe would be greatly damaged in driving long distances if it were not protected by this shoe. To prevent the top of the pipe from being battered, a drive head is screwed or placed on it. In some places the material is so loose that the tubing will follow the drill for some distance without requiring to be driven; but when driving becomes necessary drive clamps are bolted to the pin square of the upper end of the auger stem. The machinery is then coupled as for spudding, and 50 or 60 blows a minute are delivered by this driving clamp to the drive cap on the top of the pipe. The pipe may also be driven by a heavy wooden maul attached to the drill rope. In this case a solid drive head is used, and proper direction and effectiveness are insured to the blows by means of temporary guides set within the derrick.

Sometimes in drilling through a compact formation, such as clay, the pipe becomes lodged, owing to the projection of the couplings. When this happens a cap is screwed to the drive pipe, and water is forced down it so as to come up outside of the pipe and loosen the material about the coupling.

When the pipe has been driven as far as practicable drilling is resumed. The driller endeavors to keep the hole sunk a few feet ahead of the casing, for in this way the casing is let down straight, whereas if the pipe is driven ahead of the drill, it may be deflected from its course by changes in the hardness of the material or by encountering a bowlder or a layer of coarse gravel.

This method, however, can only be used where the material will stand up for some distance without the support of the pipe. Quicksand will flow around the bit and even rise in the pipe, and in this material the pipe must be driven down to the bottom of the hole and kept ahead of the drill. If the bed of quicksand is not thick, the difficulty of drilling through it will be slight, but where beds 50 or 60 ft. in thickness are encountered, some of the greatest difficulties known to well engineers have to be met and overcome.

When long and difficult strings of casing or drive pipe are to be withdrawn or "pulled" from a well, as on completing or abandoning it, a pipe ring is placed over the upper end of the pipe; this ring grips the casing firmly by means of its corrugated iron wedges and is then subjected to upward pressure by specially designed hydraulic lifting jacks. When short or easily pulled lengths are to be removed, wrought iron elevators are clamped to the upper end of the last length of pipe, are caught by a hook suspended from the derrick and are tugged upward by means of pulley sheaves.

Several machines for pulling casing are on the market. For pulling casing from abandoned wells they have the great advantage of portability, and they are cheaper and more efficient than a derrick erected over the well.

Cost.—The regular standard outfit, including rig, power, and tools, in the Pennsylvania oil fields costs from $1,700 to $3,000 or more. A 72-ft. derrick with reels and ironwork costs $600 to $750. The boiler employed varies from 15 to 40 h. p. and the engine from 12 to 30 h. p., the size depending on the depth to be drilled; the two cost between $600 and $900. The necessary tools usually cost about $500, though fishing tools and other extras may involve an aggregate expenditure for the outfit of as much as $4,000.

The average cost of oil well casing ranges from 40 to 50 cts. a foot for 4-in. to about $2 a foot for 12-in., though the price varies with the iron market and with the freight charges.

In the Gaines oil field of northern Pennsylvania, where drilling sometimes proceeds at the rate of 70 ft. in 24 hours, through shakes and shaly sandstones and limestones, drilling is done by contract at about 65 cts. a foot, the cost of casing being additional.

In the Coalinga oil district in California, where water has to be purchased and forms an extra item of expense, the average cost of a 4,000-ft. well has been estimated at $7,500, divided as follows: Land and water, $1,500; casing, $2,500; outfit, $3,500. Many of the deep wells in this district, which start with a casing 11⅝ ins. in diameter, greatly exceed this average cost, however.

In the Summerland oil district of California wells 6 or 8 ins. in diameter at the top and about 250 ft. deep are put down at a cost of about 85 cts. a foot for drilling only.

[illegible] METHOD

Rig.—Several modified forms of the standard outfit, called portable rigs, are on the market. These rigs are built in compact form, on heavy frames, and are usually mounted on wheels. Horses are usually employed to move these rigs, but in favorable localities traction engines are used to move the rig and to run it while in operation. The total weight of a portable rig is usually about 15,000 lbs., though the weight of these rigs varies from 5,000 to 20,000 lbs. or more.

In mode of operation and in the kind of tools used these portable rigs are like the standard outfit, but most of them are lighter. To make these rigs more compact the walking beam is made 2 to 6 ft. shorter than on the standard rig. This gives a shortened stroke and becomes a disadvantage when the hole reaches considerable depth. These rigs may be used with good results for depths not exceeding 1,500 ft. Beyond that depth they are less efficient than the standard outfit. Portable rigs are so fully covered by patents that all the good features of this class of drilling outfit cannot be included in one machine.

Advantages and Disadvantages.—Most portable rigs are not intended for deep, heavy work and do not come into competition with the standard outfit, though of late years heavy semi-portable rigs with a capacity of 2,000 ft. or more have been built for oil drilling. The chief advantage of a portable rig is that it can be easily and cheaply moved after the well is completed, whereas a standard outfit must be torn down and rebuilt for use in a new location. In some localities where muddy roads make transportation difficult, drillers with standard outfits are usually able to tear down and rebuild the derrick in a shorter time than would be required to haul a portable rig to a new location and set it up.

Much of the difficulty that has attended the use of portable machines may be attributed to the fact that the men engaged to operate them have been accustomed to standard outfits and are prejudiced in their favor. Drillers have been severely criticised by manufacturers and well owners because of this prejudice, asserting that every improvement devised was condemned by the drillers because it was novel and at first somewhat difficult to manipulate. However, a man who begins his drilling experience with a portable rig is always enthusiastic over the machine and its possibilities. This is especially true of drillers of water wells ranging in depth from 400 to 500 ft.

Once in position the standard rig is preferable to the portable on account of its greater rigidity, the larger space it affords for handling tools, oiling bearings, and repairing broken parts, and the better protection is given during stormy weather. The compactness of some portable rigs makes it difficult to oil or adjust the machinery while in operation without danger, or at least without great discomfort, to the workmen. The extra work of lifting large wrenches and drill bits to the drilling platform when adjustments are necessary is also very considerable. Breakdowns with a portable rig are annoying and expensive, as the driller must often send to the factory for the broken part; whereas most breaks in a standard outfit can be repaired by a local blacksmith or carpenter, or by the workmen themselves.

Percussion Core Drill.—A manufacturer of portable drilling machines recently put a percussion core drill on the market. This drill is substituted for the ordinary drill after the hole has been sunk nearly to the material of which a sample is desired.

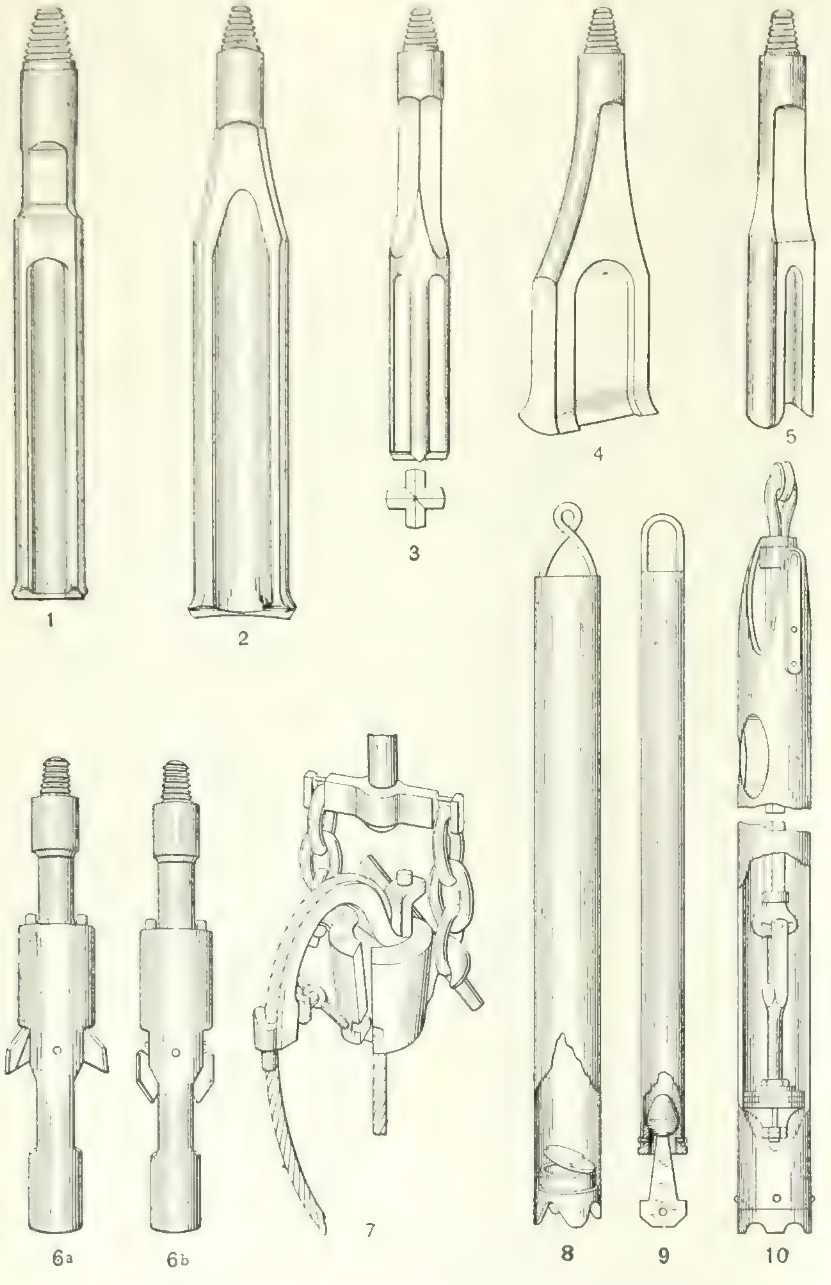

Fig. 2—Drilling Tools Usedvith Standard Drilling Outfit.

(1-5, bits; 6a, 6b, reamers; 7, rope clamp; 8, 9, sand boilers; 10, sand pump.)

The drill consists essentially of a hollow tube or bit stem armed with a toothed cutting bit, a core barrel, and a weighting bar. The teeth of the bit are set alternately in and out, like those of a hand saw, so as to give clearance to the drill on the outside and to the core within. The core barrel is a tube about 4 ft. long that slides with the bit stem. It has a split ring near the bottom, which grips the core when the tools are withdrawn. As sinking progresses a weighting bar forces the core barrel down over the core and protects it from abrasion.

The chief advantages claimed for the attachment are its adaptability to the ordinary portable drilling outfit; the large core yielded, as the device is made chiefly for 5⅝ or 6 in. tools; the ease and rapidity of withdrawing tools, as they are on a cable, not on jointed rods; and special adaptation to taking samples of very soft material. It is not intended for work in very hard rock nor in localities difficult of access.

Cost.—Portable rigs are much used for drilling water wells 4 or 6 ins. in diameter. A machine capable of drilling to a depth of 1,000 ft. costs about $1,100 with nontraction power, and about $1,400 with traction power. The tools for such a machine, exclusive of cables, cost $400 to $500 additional. Lighter machines, with a capacity of about 300 ft., cost about $700 with power, this amount being about equally divided between the machine and the engine and boiler. Tools and cable for such a machine cost $200 to $250 more.

The rate of drilling with portable outfits varies. In shale, soft sandstone, and similar materials, 30 to 50 ft. a day is a common record; in hard substances, 15 to 25 ft. a day, and in clay and other unconsolidated material, 75 to 100 ft. a day is a fair average.

The cost of drilling wells varies from 10 or 15 cts. a foot in the softer materials to $1 or more a foot in hard rock. In the northern Mississippi Valley 4-in. and 6-in. wells in shale and limestone cost 50 cts. to $1 a foot for drilling only; in quartzite the cost runs up to $3 and $4 a foot.

In the hard, tough lava of eastern Washington, where in some wells only 2 or 3 ft. a day can be drilled, the drillers charge $2.25 to $3 per foot, fuel and board being furnished them.

The portable rig has been used in drilling shallow holes of small diameter for blasting or exploration purposes at a cost as low as 8 cts. per foot.

POLE-TOOL METHOD.

General Features.—The pole-tool or wood-rod method is old and in some respects rather primitive. It differs from the standard method chiefly in using wooden rods instead of a cable for operating the tools. This method is still used in parts of this country in drilling "wet" holes where the friction of 1,200 or 1,500 ft. of hemp rope in as many feet of water greatly reduces the force of the blow. In drilling wells for water "dry" drilling is often undesirable, since all flow may be required to supply the completed well. Experience has shown that under ordinary conditions the expense of the casing and of the increased labor required in drawing or perforating it, when using the standard outfit, exceeds the cost of drilling with the pole-tool outfit, in spite of the extra labor involved in the actual drilling with the latter.

The diameter of the well must not be reduced below the size which gives ample clearance between the rods and the walls of the well, consequently a smaller well can be drilled with a cable than with a wood rod. In the pole-tool method the drill falls on the rock as a dead weight, and a springing blow can not be struck as with a cable. This operates to reduce the speed of drilling considerably.

Outfit.—A derrick resembling the standard derrick is used with this method. Usually it is about 60 ft. high and 16 ft. square at the base. It takes about 10 days to set up and from 2 to 4 days to take down this derrick. The same string of tools is used as with the standard method, and the jars should never be omitted. The rods are 2 to 3 ins. in diameter, and are made of two 18-ft. pieces spliced together and reinforced with irons at the joints, thus forming 36-ft. lengths. A walking beam is used and the length of stroke is regulated by the length of the crank. A ratchet on the walking beam, operated by hand, acts as a temper screw. A chain runs from the drum of the ratchet over the end of the walking beam and is connected with the rods by means of a swivel.

Operation.—The tools must be constantly rotated while drilling to keep the hole round. When the drill is removed from the well the rods are unscrewed section by section as they are raised above the well top. Expert drillers can raise and lower the rods at the rate of 100 ft. per minute, and ordinary workmen at the rate of 60 to 75 ft. per minute. In bailing the cuttings a steel cable should be used. Sometimes the buckling and breaking of the rods in the hole prevents their withdrawal and the hole must be abandoned. Where a pole-tool outfit encounters quicksands it is almost worthless because of the great amount of time required in withdrawing the tools and the rapid inflow of the sand, and it must therefore be supplemented by rotary appliances.

Cost.—The figures of cost given for drilling with a portable outfit apply approximately to walls drilled with pole-tool outfits, since the chief advantage of this outfit is its adaptability to drilling wet holes.

SELF-CLEANING OR HOLLOW ROD METHOD

Outfit.—The self-cleaning or hollow-rod method of well sinking includes the essential features of the percussion methods, but differs in combining in one operation the breaking up and removal of the material.

The tools consist of a string of pipe with screwed couplings, usually of special manufacture to insure strength and durability, with a water swivel at the upper end and a drill bit at the lower end. Because of this use of joints of pipe instead of a drilling cable the machine is often called the hollow-rod outfit.

The water swivel is essentially a swiveled gooseneck that allows the water and drillings to be discharged from the pipe in a constant direction and still permits the drill pipe to be rotated. In the usual outfits of this class the pipe is 1½ or 2 ins. in diameter and the drill is 2½ to 4 ins. across, though the hole may be enlarged by using an expansion bit.

The drill bit has one or more holes at its upper end and a flap valve that allows water and drillings to enter the pipe and be lifted automatically to the surface. Blind valves are also usually placed at intervals within the pipe to relieve the lower valve of the weight of the entire column of water and drillings.

The outfit usually includes a mast that is held upright by guy lines and supports a sheave pulley over which passes the cable used in operating the tools. In many of the outfits the device for lifting and dropping the tools consists simply of a pulley and reel. The cable is fastened to the upper end of the string of hollow rods, passed over the sheave pulley, and one or two turns are taken around a hoisting reel. As the reel is continuously revolved by engine or other power, the drill is raised and dropped by alternately tightening or loosening the rope on the reel. Self-cleaning tools are also commonly used with portable rigs, being operated by the spudding attachment.

Operation.—The hole must be kept wet. The drilling is continuous, for as the drill is raised and let fall the pumping action forces water and drillings into the drill rods and upward to the surface. The efficiency of the pumping action of the drill depends on the shape of the drill shoulder, which should have a circular cross section a little smaller in diameter than the width of the flat cutting edge from which it should flare outward sharply so as to obtain the greatest effects of compression in opening the valves and forcing the drillings upward. Many holes 100 to 150 ft. in depth have been drilled with one bit without removing it from the hole.

Uses.—The self-cleaning outfit is admirably adapted to sinking water wells of small diameter in sand, clay, shale, soft limestone and other easily penetrated materials. It is often used in prospecting for coal and is especially good for that purpose since the thickness of bed is readily determined.

Cost.—Hollow-rod tools are often used with a portable machine built for cable tools, the rods and other extras costing $150 to $250 for a capacity of 250 ft. Additional rods cost 25 cts. to $1 a foot, depending on their quality. The common sizes are 1 to 2½ ins. in diameter.

Machines built especially for hollow-rod tools, complete with horse power attachment, tools, and 100 ft. of rods, cost from $225 for 2-in. outfits to $325 for 5-in. outfits. The price of a machine with a 5 or 6 horsepower engine and boiler ranges from $65 to $800.

The cost of drilling with hollow-rod tools does not differ greatly from that with small portable cable rigs under similar conditions, but no specific figures are at hand. It is, however, usually 20 to 30 cts. per foot, without casing.

CALIFORNIA OR STOVEPIPE METHOD.

For sinking water wells in the unconsolidated alluvial deposits of portions of California a method is used which, on account of its distinctive character, is called the California or stovepipe method. This method is sometimes called the mud-scow method, because of the instrument by which drilling and bailing are accomplished. The following description is adapted from two articles by C. S. Slichter and I. N. Knapp:

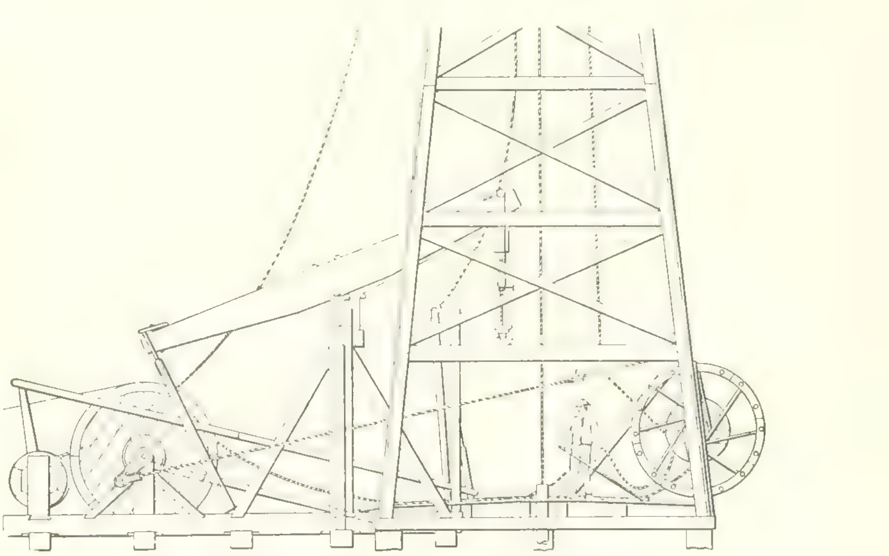

Fig. 3—Standard Rig Arranged for Spudding.

Rig.—The rig consists of a horizontal rectangular frame to which is hinged a derrick about 34 ft. high, held vertical by two diagonal braces from the frame to the derrick. The walking beam, a marked feature of this rig, is carried at the top of the derrick. The bottom of the derrick is hinged to a saddle piece resting on two coiled car springs, which in turn rest on a heavy crosspiece bolted between the sides of the frame.

The hoisting reel and other machinery are placed on the framework just back of the derrick, and at the farther end are the engine and hydraulic pumps. When the machine is to be moved, the mast is swung back on its hinges, with its top resting on an upright at the rear end of the rig. Jackscrews are then placed under the sills and the whole machine is raised sufficiently to allow wheels to be slipped onto axles bolted to the sills.

In drilling, the walking beam is given a reciprocating motion by a wooden rod attached to its rear end and to the driving machinery. The tools are suspended from its forward end by a cable, usually a half-inch wire rope. The string of tools below the socket by which it is attached to the cable consists of a box and tongue sub, to which is screwed a pair of jars of the usual type, and below the jars is another sub to which is fastened the sand bucket or mud scow. The sand bucket is similar in shape to that used with the standard outfit and has a flap valve at the bottom, like that of the standard sand bucket, but it differs in being connected to the tools above by a knuckle joint that permits easy dumping, instead of by a bail, and at the bottom it carries a cutting shoe similar to that used on the bottom of a string of casing. For drilling in clay this shoe may be modified by a straight chisel-like bit extending as a diameter across it.

Casing.—The casing used in this method of drilling is made of lap-riveted cylinders of sheet iron or steel, usually of No. 10 to No. 14 gage, 24 ins. long and 6 to 14 or 16 ins. diameter. These short joints are known as stovepipe casing. The pieces of sheet metal may be taken to the field flat and riveted there, but usually the riveting is done at the shops and the ends are also turned square and true. Two sizes are used for the string of casing, one of which just slips within the other, so that the joints of one may be adjusted to fall midway between the joints of the other. The sections are added one at a time as sinking proceeds, each 2-ft. joint adding only 1 ft. to the length of the string, and the outer and inner sections are united simply by denting with a pick. This casing is water tight, but for water wells it is not necessary that it should be.

Stovepipe casing may be started from a properly recessed drive shoe, but it is easier to begin a well straight and keep it plumb by using a starter, as with other casing. This starter is 15 or 20 ft. long and may be made of sections of stovepipe casing, often of three thicknesses, riveted together, or of a joint of heavy lap-weld casing. At the lower end is an annular steel drive shoe.

The casing is usually sunk by two or more hydraulic jacks which are buried in the ground and anchored to two timbers, about 14 ins. square and 16 ft. long, planked over and buried 8 or 10 ft. deep. In the smaller sizes of shallower wells the casing is sometimes forced down by two steel I beams or railroad rails arranged as powerful levers.

Operation.—The sand bucket or mud scow, as it is worked up and down by the walking beam, acts both as a drill and a bailer. In ordinary material it is rotated to loosen the sand and gravel from inside of the casing, and when it is drawn up to be emptied the bucket is manipulated in such a way that the weight of the jars and connections assists in the dumping.

The hole must be kept wet. Bowlders that lie in the way are forced to one side by the bucket or are broken to pieces by a drill substituted for the sand bucket. In quicksand or caving ground it is necessary to keep the water level about the same inside the casing as on the outside, and to keep the casing even with or ahead of the excavation made by the bucket. The average rate of sinking by this method is 40 to 50 ft. in a 10-hour day.

A record of the material encountered in

TABLE I—COST PER FOOT OF DRILLING WELLS BY THE CALIFORNIA METHOD.

	4-in.	5-in.	6-in.	7-in.	8-in.	9½-in.	10-in.
First 100 ft.	$0.30	$0.30	$0.35-0.40	$0.40	$0.40-0.50	$0.60-0.65	$0.65
Additional for each 50 ft. increase in depth	0.25	0.25	0.20-0.30	0.20-0.35	0.20-0.35	0.20-0.35	0.35

sinking the well is kept, and after the well has been sunk to the required depth a cutting knife is lowered into it and vertical slits are cut in the casing at such water-bearing strata as may be most advantageously drawn upon.

Advantages.—The advantages of the California method of well construction for use in unconsolidated deposits have been summarized by Slichter as follows:

1. The absence of screw joints liable to break and give out.
2. The flush outer surface of the casing, without couplings to catch on bowlders or hang in clay.
3. The elastic character of the casing, permitting it to adjust itself in direction and otherwise to dangerous stresses, to obstacles, etc.
4. The absence of screen or perforation in any part of the casing when first put down, permitting the easy use of sand pump and the penetration of quicksand, etc., without loss of well.
5. The cheapness of large size casings because made of riveted sheet steel.
6. The advantage of short sections, permitting use of hydraulic jacks in forcing into the ground.
7. The ability to perforate the casing at any level at pleasure is a decided advantage over other construction. Deep wells with much screen may thus be heavily drawn upon with little loss of suction head.
8. The character of the perforations made by the cutting knife are the best possible for the delivery of water and avoidance of clogging. The large side of the perforation is inward, so that the casing is not likely to clog with silt and debris.
9. The large size of casing possible in this system permits a well to be put down in bowlder wash where a common well could not possibly be driven.
10. The uniform pressure exerted by the hydraulic jacks is a great advantage in safety and in convenience and speed over any system that relies on the driving of the casing by a weight or ram.
11. The cost of construction is kept at a minimum by the limited amount of labor required to man the rig as well as by the good rate of progress possible in what would be considered in many places impossible material to drive in, and by the cheap form of casing.

Cost.—The machinery and power cost $1,500 to $1,800, and the tools and accessories $500 or more in addition. A pair of hydraulic jacks cost $250. Tables I and II give approximate cost data of sinking wells by this method and the cost of stovepipe casing. The latter cost, of course, varies with the price of steel:

TABLE II—COST OF RIVETED STEEL WELL CASING IN 2-FOOT JOINTS.

Diameter, ins.	Gage.	Price per foot.
4	16	$0.32
4	14	.38
5	16	.35
5	14	.43
6	16	.42
6	14	.50
7	16	.48
7	14	.55
8	16	.55
8	14	.64
8	12	.78
9½	16	.65
9½	14	.75
9½	12	.94
10	16	.68
10	14	.78
10	12	.98

GENERAL ARTICLES AND CLASSIFIED ITEMS

Appraisal of the Seattle Telephone Companies by the Railroad Commission of Washington.

I

COMPILED BY HENRY S. GRAY, ASSO. M. AM. SOC. C. E.*

FOREWORD.

It is the policy of the Railroad Commission of Washintgon to precede all rate hearings with an appraisal of the property under investigation, in order that a basis may exist for fixing both the values and rates. The steam railroads within the state were appraised several years ago, so that the work at the present time is confined largely to electric railways, telephone and telegraph companies. The 1909 legislature, although instructing the commission to proceed with the appraisal of the telephone companies, appropriated only $5,000 to carry the work over the ensuing two years. As this sum was manifestly inadequate, the commission did not formulate any well defined plan of appraisal, but decided to first investigate the plants in cities where complaints were filed against the rates. The first appraisal made was that of the independent company of Seattle, followed by the appraisal of the plants of the Pacific Telephone and Telegraph Company in Seattle, Spokane and Tacoma. The first appraisal, affected by a time limit, is necessarily lacking in many desirable details, the second affords a much better idea of the nature and scope of the work, while the third appraisal, that of the Spokane company, was made in great detail, and the article descriptive of this work will present a careful analysis of all unit costs.

INDEPENDENT CO. OF SEATTLE APPRAISAL.

The appraisals of the telephone companies of Seattle, made independently by the Railroad Commission of Washington, the Public Utilities Commission of Seattle and the telephone companies themselves, gave rise to so many peculiar circumstances and were marked by such an unusual chain of events that a description of such work might prove of interest. The causes which led to the appraisal were odd, the low cost of the work was unexpected, while a comparison of the results obtained was highly gratifying to all concerned.

Two companies operate in Seattle—the Independent Telephone Co., listing 18,234 subscribers, and the Pacific Telephone & Telegraph Co., a subsidiary corporation of the American Telephone & Telegraph Co., which serves 29,126 subscribers. The Independent company, the more recent of the two, permitted its maximum rates to be fixed by the ordinance granting its franchise, and numerous applications to the city council for permission to raise such rates have proved unavailing. The Pacific company has been in the field for a number of years, and its franchise contains no such limiting clause.

The amended railroad commission act as passed by legislative session of 1909 provided that all telegraph and telephone companies within the state should fall under the jurisdiction of the Railroad Commission, which was endowed with full power to investigate and regulate both rates and service. This amended bill became a law on Jan. 30, 1909. Immediately thereafter the president of the Seattle Hardware Co., one of the directors of the Independent company of Seattle, filed a formal complaint with the Railroad Commission, alleging that the rates charged by the Independent company were too low, and that the company should be permitted to raise them. The petition also contended that the rates charged by the Pacific company were excessive and that they should be reduced. This latter contention was made simply for the purpose of presenting a comparison of the value of the respective plants, and of the rates charged by the different companies, as the main line rate charged by the Pacific company was almost double that charged by the Independent company. Under the complaint the Railroad Commission was bound to investigate both companies; hence, as soon as the matter could be taken up, the engineer of the Railroad Commission began an investigation of the Independent company in order to ascertain the actual cost of the plant, its reproduction cost, and its present or depreciated value.

Upon investigation it was found that the system of accounting in use by the company was not in accordance with modern methods, and did not properly reflect the amount of money invested in the plant. A readjustment of the accounts had been made a year previous, at the suggestion of Mr. Edwin W. Webster, the general manager, who became convinced that such a readjustment was necessary, as a large number of expenditures properly chargeable to operating expenses had found their way into the plant account, and no reserve had been established to take care of depreciation. No demand existed for the securities of the company.

The company was extremely anxious to market its securities and, at the same time, realized that it was face to face with the problem of a depreciated plant and no funds to rehabilitate same. As the authorized issue of securities was well under the probable actual plant cost, it was determined to meet the issue squarely and eliminate from the plant account such operating expenses as had been erroneously included, and to estimate the total depreciation and charge it directly off the plant account, leaving a sum which would represent the actual cost of the plant, less the estimated depreciation. This readjustment was made on Aug. 31, 1909, at which date the plant account showed a total expenditure of $2,118,071.53. There was credited to this account the sum of $622,983.64, of which approximately $328,000 was estimated depreciation; $28,000 actual depreciation, and $267,000 of operating expense, so that on Sept. 1, 1909, immediately after the readjustment, the plant account was represented by only $1,499,555.89. Depreciation accounts were then set up and the accounting system revised and modernized.

Obviously the sum shown by the readjusted plant account did not in any way represent the actual cost and a further readjustment was made by the commission's engineers on which only the operating expenses and the discount on bonds was eliminated, so that on June 1, 1910, the date of the approval, the net cost of the plant was found to be $1,950,863.73, of which sum $835,950 had been obtained from stock subscriptions; $400,000 from the sale of bonds; $310,500 being covered by outstanding notes, while $414,463.73 had been applied from earnings. As dividends had been few and far between, the use of net earnings for construction purposes might be considered in the nature of dividends.

In appraisals of this nature, it is reasonable to expect that considerable information concerning the physical characteristics of the plant may be had from the office records, but in this case, the Independent Company, not having had sufficient revenue in the past to maintain a proper organization, had suffered its records to become obsolete. With the exception of the underground system, practically no data of value existed; nor was there anyone in the employ of the company who had accurate knowledge of what their work was costing; and as no material had been purchased for several years, accurate costs of material or apparatus were not available from the Supply Department. Hence it was necessary to compile a statement of the greater portion of the property owned from notes taken in the field, and to obtain all cost data from outside sources. Fortunately, maps of the overhead and underground systems were available and these maps were followed up and notes taken of the height of poles, number of arms, number and size of cables, etc. Automobiles and livery rigs were extensively used and more than paid for their hire by the saving in time. Two men in an automobile could take notes covering a large district in one day. No attempt was made to measure distances in the field, as such were easily scaled from the city maps. After the compilation of the notes on the overhead system, certain districts were selected and accurately and carefully checked. This check brought to light certain errors, such as differences in the size of aerial cable and wire, but in the main the notes were found to be substantially correct. The underground records were checked in the field by men on foot and found to be accurate in the main, any differences being in favor of the company. The work was greatly facilitated by the fact that the material and apparatus in use were fairly well standardized.

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*Engineer, The Railroad Commission of Washington.

The number and type of instruments was obtained from cards in the keeping of the wire chief, who also possessed a record of private branch exchanges and intercommunicating systems. A sufficient number of such records were selected and checked in the field to demonstrate the correctness of the wire chief's records, from which the statements of this class of apparatus were then compiled. No effort was made to detail the central office apparatus, as the original bills were in the possession of the accounting department showing the exact cost of each installation. All of the property of the company was subjected to a thorough investigation and check until it was certain that nothing had been overlooked and that the statements compiled were correct.

Obtaining representative costs of labor and material presented the major problem in connection with the appraisal.

As previously stated, the company possessed little or no information of this character; and it is fair to assume that no man or body of men, however familiar he or they may be with appraisals of this nature, will be able to provide reliable cost data to fit each specific case without considerable investigation.

The commissioners consider their engineer in the light of an expert witness, and his work had no more weight than that of any other such witness. Such appraisals generally culminate in legal proceedings, thus rendering it absolutely imperative that the appraisor be able to substantiate his costs with facts concerning work in progress at the time of the appraisal. It is a very easy matter to say that work should cost so much; but it is not always so easy to get the courts to see it that way. The writer has observed the discomfiture of several eminent high-brows who relied altogether on their generally limited personal knowledge, and has profited by their example.

The writer had just completed an appraisal of a large electric railway system, and was able to use a great deal of the data compiled in this connection. The electric supply houses generously responded to all requests for prices, as did the Pacific Telephone and Telegraph Company, and the Lighting Department of the city of Seattle. But by far the greater portion of the labor costs were deduced by the writer and his assistants from their experience in telephone work, and checked with the cost of similar work under way at the time. All attempts to obtain reliable costs from the department heads resulted in utter failure.

Every written description of similar appraisals that could be obtained was carefully studied, and it is a matter of much regret that such reports were so taken up with glittering generalities and rambling answers to hypothetical questions that it was different to connect them with the telephone appraisal. The writer is not a novice at this class of work and has been connected with the appraisal of many different properties in the last five years. During that time several facts have been clearly demonstrated. Almost every case is distinctly different from any preceding case: The same methods and prices will not apply. Almost no information of value is to be had from the reports of similar work; and no great amount of information is to be had from the company without a great deal of digging, even though the officials may be extremely friendly, as they were in this case. The general rule applies here; it is necessary to search persistently in order to obtain the information desired. Anyone who believes for an instant that a large public service corporation actually knows what it owns, or what its work is costing, is due to be disillusioned.

In preparing such appraisals, it has frequently been the custom to use the average of prices prevailing during several years previous, this method being based upon the assumption that the number of years selected would cover the construction period. The wisdom of so selecting prices has not been clearly demonstrated. If the plant is new, and actually was constructed during the years selected, then the advantage is obvious, but if the date of appraisal is remote from the date of construction, why average a number of prices that bear no relation to the actual cost, or the prevailing prices? It is equally fair, and much more convenient to assume that the date of the appraisal represents the beginning of the construction period, rather than the end. It may be well said that the past years exhibit the prevailing cost of work, while those of the future do not. Nevertheless, it should be borne in mind that practically all the material will be contracted for at the beginning of the work, and that labor costs are not apt to vary materially in three or four years. After all, the probable construction period is an assumption, either way it is taken, and the folly of splitting hairs over assumptions, and entailing a great deal of additional work, should be evident, particularly when it is remembered that the cost of reproduction is only one element of the value.

After all of the physical property had been listed and priced, there came the problem of intangible values, to be covered by the "loading" or "overhead" charges. Arriving at such loading charges presented a comparatively easy task, as they may be based altogether on personal opinion. As the different authorities have never succeeded in agreeing, again the appraiser must disregard precedent and depend upon his own judgment. There was included in the estimate an allowance for Engineering, Supervision and Organization expense, amounting to 10 per cent of the cost of all labor and material; for Interest During Construction, 5 per cent of the cost of all labor and material, including engineering, supervision, etc., based upon the assumption that two years would be required to reconstruct the plant and that the sum required would be invested an average of one-half of the time, the interest rate being 5 per cent per annum. Contingencies were provided for by an allowance of 5 per cent of all preceding items. No item for discount was included, but an allowance of 5 per cent of 75 per cent of the total estimated cost of reproduction was made to cover brokers' fees, based upon the theory that if 25 per cent of the capital stock was paid up, the bonds would sell at par, the brokers' commissions amounting to 5 per cent. The total net loading charge, composed of the percentage allowances for engineering, supervision and organization expense, interest, contingencies and brokers' fees, amounted to 23.82 per cent.

There was also included in the estimate an allowance for exchange right of way, or in plainer terms, the cost of obtaining permission to set poles. It was found that the Pacific company, which was at that time engaged in a large amount of construction work, was expending monthly in this connection approximately 0.4 per cent of the total monthly construction charge. Hence it was considered that the total expenditure during the reconstruction period would be approximately 0.4 per cent of the estimated cost of reproducing the plant, exclusive of loading charges. There is no doubt but that this percentage is too high, and that much more logical results can be obtained by considering that the cost of this class of work would be approximately represented by 1 per cent of the unloaded cost of Pole Lines.

The inventory value of the stores and supplies on hand at the date of the appraisal was $53,570. To this was added the sum of $46,430, to cover working capital, the whole being shown as $100,000, under the head of "Stores and Working Capital necessary to the proper maintenance and operation of the plant." The sum shown as Working Capital is wholly arbitrary and bore no relation whatever to the actual bank balances, which were in fact somewhat less, and clearly insufficient.

The estimate does not include an item covering the cost of obtaining stations. Authorities differ in this regard, but all admit that such expenditures are a part of what might properly be called "Cost of Reproducing a Going Concern." There is no doubt but that the construction accounts of a telephone company should include such an item, as solicitors are constantly at work during the construction period, while the extent of the plant depends somewhat upon their activity. A number of such solicitors will continue in the employ of a company, but there certainly is a point at which the cost of soliciting should cease to be a part of cost of the plant and should become a part of the operating expense.

The different headings were adopted altogether as a matter of convenience and do not conform to the general accounts of the company. Such a conformation is generally highly desirable, but in this case it would have been of no advantage, as the revision of the accounting system destroyed all chances of a comparison of the actual cost and the estimated cost of reproduction by accounts.

The depreciated value of a plant may either be arrived at by inspecting its elements and passing personal judgment on their condition, which might be termed the "Michigan Box Car Method," or by ascertaining from the accounting records the sums expended each year for the different parts of the plant, calculating the average age of the dollar invested assuming an annual rate of depreciation for each class of property and deriving the total depreciation from these factors. This is known as the "Gillette Mortality Table Method" and is the only rational scheme for arriving at the depreciated value of a plant. By the Michigan method everything is assumed; by the Gillette method the age is absolutely known and only the rate of annual depreciation is assumed. This latter assumption has been made so repeatedly by so many different authorities that rather definite conclusions have been reached, so that with careful investigation an assumption of the rate of annual depreciation can be made to approach a certainty. As the revision of the accounting records rendered it impossible to arrive at the yearly expenditures for the different parts of the plant, it was decided to compute the age of the plant as a whole and consider all of its parts of the same average age. The net sum invested in the plant to June 1, 1910, amounted to $1,774,609, exclusive of real estate and several other items not considered as subject to depreciation. The maximum age of the plant was taken as eight and one-half years and the sum of money expended each year was ascertained. Table I shows the method used to arrive at the average age of the dollar invested:

Dividing the total sum years by the total sum invested gives a result of 4.4 years. On account of certain known facts concerning the readjustment, it was considered fair to modify the result and to assume the average age of the plant as 5 years.

Table II shows the method of arriving at the percentage of annual depreciation. The life and salvage value of the different [illegible] were thoroughly investigated and it is believed that this table is quite representative for the North Pacific Coast district:

The annual depreciation in dollars was derived by applying the percentage of annual depreciation to the amounts estimated as necessary to reproduce the different elements of the plant. It should be noted that all indirect or loading charges, with the exception of contingenies, were considered as non-depreciating. It is admitted that such items as engineering, interest and brokers' fees are as properly a part of the cost of the plant as is the cost of poles, wire and cable, but the expense of the former items is practically all incurred during the construction period. If the plant should be permitted to become entirely worn out, then it would probably be necessary to again expend money to satisfy these indirect charges, but as the plant is maintained, and is earning money, it is fair to assume that the sums invested in engineering, supervision and organization expense, exchange right of way, interest during construction and brokers' fees remain intact as long as the plant is a going concern, and do not depreciate. In other words, depreciation affects only property which wears out, which becomes obsolete or inadequate, and requires eventual replacement. As indirect items do not require replacement, they do not depreciate. It is not contended for an instant that it is unnecessary to expend money for such items after the plant becomes a going concern. The items under discussion are only those strictly chargeable to construction and not in any way connected with maintenance. Hence in the calculation of the annual depreciation in dollars these indirect charges were omitted, and they were also considered as having a value of 100 per cent new in arriving at the depreciated value.

Table III shows the annual depreciation in dollars, amounting to 6.87 per cent of the unloaded cost of plant, exclusive of real estate, which appreciates rather than depreciates; but such appreciation cannot be used in any way to offset an equal amount of depreciation:

Table IV shows the condensed estimate of the cost of reproduction as submitted, while in Table V the loading charges were distributed among the various items:

Anticipating the investigation, the Independent company also prepared an estimate of the cost of reproducing its plant, which, as it stands, does not afford a fair comparison with the Railroad Commission estimate, for in the former the loading charges were included in the unit prices. Table VI shows the actual comparison of the two estimates, while Table VII shows a rational comparison, the loading charges being distributed in each case and all items eliminated which did not appear in both estimates:

Table VIII shows the depreciated value of the plant. As above stated, it was assumed that the average age of all parts of the plant was the same, namely 5 years. Multiplying the average age by the percentage of annual depreciation and subtracting the result from 100 gives the depreciated value in percentage of the new value. By multiplying the estimated cost of reproduction by such percentage, the depreciated value in dollars is obtained. In this case, the plant possessed a value of 74.59 per cent of its cost of reproduction. This result was to be expected as it is well known that any properly maintained telephone plant will have a value between 70 and 80 per cent of its new value.

TABLE II

Item.	Life.	Salvage	Annual deprec.	Av. age.	Total deprec.
Pole lines	12	00	8.5	5	42.5
Aerial cable	12	30	6.0	5	30.0
Underground cable	20	40	3.0	5	15.0
Submarine cable	10	00	10.0	5	50 0
Aerial wire, copper	15	40	4.0	5	20.0
Aerial wire, iron	8	00	12.5	5	62.5
Conduit, clay	50	00	2.0	5	10.0
Conduit, fibre	30	00	3.5	5	17.5
Central office equipment	10	10	9.0	5	45.0
Substation apparatus	10	5	9.5	5	47.5
Installation, single	10	5	9.5	5	47.5
Installation, group	20	10	4.5	5	22.5
Drops and block wires	8	10	11.5	5	57.5
Private exchanges	8	15	10.5	5	52.5
Booths, etc.	10	10	9.0	5	45.0
Buildings	20	30	3.5	5	17.5
Tools and vehicles	4	20	20.0	5	100.0
Furniture and fixtures	10	20	8.0	5	40.0

TABLE IV.

Pole lines	$ 142,533.00
Aerial cable	292,326.00
Underground cable	126,299.00
Submarine cable	5,464.00
Aerial wire	67,951.00
Underground conduits	114,818.00
Central office equipment	244,610.00
Subscribers' station apparatus	154,399.00
Substation apparatus installation Single	41,027.00
Substation apparatus installation Group	46,123.00
Drops and block wires	57,200.00
Private branch exchanges	45,822.00
Booths and special fittings	600.00
Exchange right of way	5,357.00
Real estate and buildings	214,898.00
Tools and vehicles	4,700.00
Furniture and fixtures	12,582.00
Engineering and superintendence	147,351.00
Interest during construction	86,203.00
Contingencies	90,513.00
Stores and working capital	100,000.00
Brokers' fees	75,291.00
	$2,076,067.00

TABLE VII.

	Railroad Commission.	Telephone Company.
Pole lines	$ 179,335.00	$ 224,042.00
Aerial cable	367,805.00	369,398.00
Underground cable	158,909.00	178,161.00
Submarine cable	6,875.00	6,607.00
Aerial wire	85,496.00	100,003.00
Underground conduit	144,464.00	170,829.00
Central office equipment	307,768.00	356,318.00
Substation apparatus	194,265.00	192,329.00
Substation apparatus installation—Single	51,620.00	22,999.00
Substation apparatus installation—Group	58,032.00	29,152.00
Drops and block wires	71,969.00	87,821.00
Private branch exchanges	57,653.00	57,293.00
Booths and special fittings	755.00	644.00
Real estate and buildings	258,886.00	236,928.00
Tools and vehicles	5,914.00	7,056.00
Furniture and fixtures	15,831.00	13,209.00
Stores and working capital	103,750.00	56,238.00
	$2,069,327.00	$2,109,027.00

TABLE III.

Item.	Amount.	Per cent annual deprec.	Annual deprec.
Pole lines	$ 142,533	8.5	$ 12,117
Aerial cable	292,326	6.0	17,540
Underground cable	126,299	3.0	3,789
Submarine cable	5,464	10.0	546
Aerial wire, copper	65,333	4.0	2,613
Aerial wire, iron	2,618	12.5	327
Conduit fibre	114,818	3.5	4,024
Central office equipment	244,610	9.0	22,015
Substation apparatus	154,399	9.5	14,668
Installation, single	41,027	9.5	3,898
Installation, group	46,123	4.5	2,076
Drops and block wires	57,200	11.5	6,578
Private branch exchange	45,822	10.5	4,811
Booths and fittings	600	9.0	54
Buildings	111,698	3.5	3,909
Tools and vehicles	4,700	20.0	940
Furniture and fixtures	12,582	8.0	1,007
Contingncies 5% of above	73,409		5,046
	$1,541,581		$105,958
Annual depreciation, 6.87%			

TABLE VI.

	Railroad Commission.	Telephone Company.
Pole lines	$142,533.00	$ 213,114.00
Aerial cable	292,326.00	351,875.00
Underground cable	126,299.00	169,709.00
Submarine cable	5,464.00	6,294.00
Aerial wire	67,951.00	95,259.00
Underground conduit	114,818.00	162,725.00
Central office equipment	244,610.00	339,464.00
Subscribers' station apparatus	154,399.00	183,205.00
Substation apparatus installation—Single	41,027.00	21,908.00
Substation apparatus installation Group	46,123.00	27,769.00
Drops and block wires	57,200.00	83,655.00
Private branch exchanges	45,822.00	54,575.00
Booths and special fittings	600.00	613.00
Exchange right of way	5,357.00	....
Real estate and buildings	214,898.00	225,689.00
Tools and vehicles	4,700.00	6,721.00
Furniture and fixtures	12,582.00	12,582.00
Engineering and superintendence	147,351.00	
Interest during construction	86,203.00	
Contingencies	90,513.00	..
Stores and working capital	100,000.00	53,570.00
Brokers' fees (or discount)	75,291.00	100,000.00
Stocks and bonds	......	38,374.00
Cost of obtaining stations	......	90,399.00
	$2,076,067.00	$2,237,733.00

TABLE VIII.

	New value.	Per cent of new value.	Value.
Pole lines	$ 142,553	57.5	$ 81,968
Aerial cable	292,326	70.0	204,628
Underground cable	126,299	85.0	107,354
Submarine cable	5,464	50.0	2,732
Aerial wire, copper	65,333	80.0	52,266
Aerial wire, iron	2,618	37.5	982
Underground conduit	114,818	83.5	95,873
Central office equipment	244,610	55.0	134,536
Substation apparatus	154,399	52.5	81,059
Installation, single	41,027	52.5	21,539
Installation, group	46,123	77.5	35,745
Drops and block wires	57,200	42.5	24,310
Private branch exchanges	45,822	47.5	21,765
Booths and special fittings	600	35.0	330
Buildings	111,698	83.5	93,268
Tools and vehicles	4,700	00.0	00,000
Furniture and fixtures	12,582	60.0	7,549
Contingencies, 5% on above	73,409	00.0	48,295

TABLE I.

To January 1, 1903	$ 99,606 x 8.50	$ 846,651
January 1, 1903, to January 1, 1904	142,300 x 7.00	996,100
January 1, 1904, to January 1, 1905	238,958 x 6.00	1,409,748
January 1, 1905, to January 1, 1906	384,445 x 5.00	1,922,225
January 1, 1906, to January 1, 1907	324,984 x 4.00	1,299,936
January 1, 1907, to January 1, 1908	302,573 x 3.00	907,719
January 1, 1908, to January 1, 1909	110,857 x 2.00	221,714
January 1, 1909, to January 1, 1910	141,244 x 1.00	141,244
January 1, 1910, to June 1, 1910	29,639 x .25	7,410
	$1,774,609	$7,776,747

TABLE V.

	[illegible]	Pct. loaded.	Total.
Pole lines	[illegible]	1.2582	$ 179,335
Aerial cable	[illegible]		367,805
Underground cable	[illegible]		158,909
Submarine cable	5,464		6,875
Aerial wire	[illegible]		85,496
Underground conduit	[illegible]		144,464
Central office equipment	[illegible]		307,768
Subscribers' station apparatus	[illegible]		194,265
Substation apparatus installation—Single	11,027		51,620
Substation apparatus installation—Group	[illegible]		58,032
Drops and block wires	[illegible]		71,969
Private branch exchange	[illegible]		57,653
Booths and special fittings	600		755
Exchange right of way	5,357		6,740
Real estate and buildings	[illegible]		258,886
Tools and vehicles	4,700		5,914
Furniture and fixtures	12,582		15,831
Stores and working capital	100,000	1.0375	103,750
	$1,676,709		$2,076,067

Net loading, 23.82%.

Contingencies, not depreciating	17,104	00.0	17,104
Exchange right of way	5,357	00.0	5,357
Real estate	103,200	00.0	103,200
Engineering, etc.	147,351	00.0	147,351
Interest during construction	86,203	00.0	86,203
Stores and working capital	100,000	00.0	100,000
Brokers' fees	75,291	00.0	75,291
	$2,076,067		$1,548,705

Depreciated value in relation to new value equals 74.59%.

Table IX is the detailed estimate of the cost of reproducing the Independent plant on June 1, 1910, as made by the engineers of the Railroad Commission:

TABLE IX

POLE LINES

(Labor and Material.)

8,856 40-ft. cedar poles in place at $11.00	$97,416
1,639 45-ft. cedar poles in place, ½ interest, at $7.00	11,473
17,464 3¼x4¾ 10-pin cross arms in place, without glass, at $1.17	20,438
1,118 terminal arms, same as above, additional cost, at $1.33	1,487
1,040 pole guys, complete, at $10.00	10,400
331 guy stubs in place, at $4.00	1,324
	$142,533

AERIAL CABLE.

(Labor and Material.)

Lineal feet of No. 20 B. & S. hard drawn double spiral wrapped 2% 0.1 capacity lead covered cable in place

171,553 lin. ft. 200 pr. cable at $0.74	$126,949
22,817 lin. ft. 150 pr. cable at $0.59	13,462
101,872 lin. ft. 150 pr. cable at $0.47	47,880
159,295 lin. ft. 50 pr. cable at $0.32	50,974
110,031 lin. ft. 25 pr. cable at $0.24	36,408
22 cable terminals, box type, 100 pr., in place, at $80.00	1,760
41 cable terminals, box type, 50 pr., in place, at $45.00	1,845
43 cable terminals, box type, 25 pr., in place, at $30.00	1,290
18 cable terminals, box type, 15 pr., in place, at $20.00	360
11 cable terminals, box type, 10 pr., in place, at $15.00	165
6 cable terminals, S. & W. type, 100 pr., at $75.00	450
174 cable terminals, S. & W. type, 50 pr., at $35.00	6,090
82 cable terminals, S. & W. type, 25 pr., at $20.00	1,640
10 cable terminals, S. & W. type, 15 pr., at $12.00	120
20 cable terminals, S. & W. type, 10 pr., at $10.00	200
278 terminal cans, 25 pr., Am. Elec. Fuse Co., at $23.00	6,394
85 terminal cans, 15 pr., Am. Elec. Fuse Co., at $17.00	1,445
29 terminal cans, 10 pr., Am. Elec. Fuse Co., at $15.00	435
758 pole seats, at $[illegible]	1,674
59 distributing rings, old style, at $25.00	1,475
31 distributing rings, new style, at $10	310
200 aerial cable bonds, at $5.00	1,000
	$292,326

UNDERGROUND CABLE.

(Labor and Material.)

Lineal feet of No. 20 B. & S. hard drawn double spiral wrapped 2% 0.1 capacity, lead covered cable in place.

35,918 lin. ft. 400 pr. at $ 1.30	$ 46,693
83,346 lin. ft. 200 pr. at $ 0.72	60,009
4,484 lin. ft. 150 pr. at $ 0.57	2,556
17,309 lin. ft. 100 pr. at $ 0.45	7,789
19,850 lin. ft. 50 pr. at $ 0.30	5,955
3,350 lin. ft. 25 pr. at $ 0.22	737
43 200 pr. pot heads, old style, at $20.00	860
4 200 pr. pot heads, new style (4-50), at $20.00	80
43 200 pr. pot heads, new style (2-100), at $20.00	860
190 underground cable bonds at $4.00	760
	$126,299

SUBMARINE CABLE.

(Labor and Material.)

3,000 lin. ft. 25 pr. No. 19 lead covered steel armored cable in place, at $1.00	$ 3,000
61,600 lin. ft. 1 pr. No. 14 hard drawn rubber covered braided duplex cable in place, at $0.04	2,464
	$ 5,464

AERIAL WIRE

(Labor and Material.)

1,457 loop miles No. 14 hard drawn B. & S. G. bare copper wire in place, at $35.00	$ 50,995
40 loop miles No. 12, same as above, at $48.15	1,926
89 loop miles No. 10, same as above, at $68.30	6,079
2 loop miles No. 8, same as above, at $100.00	200
15 single miles No. 16 duplex copper, at $98.00	1,470
60 loop miles No. 12 B. B. bare iron wire, at $26.75	1,605
25 loop miles No. 10 B. B. bare iron wire, at $32.50	813
10,890 deep groove double petticoat insulators, at $0.045	490
174,930 pony insulators, at $0.025	4,373
	$ 67,951

UNDERGROUND CONDUITS.

(Labor and Material.)

204,865 duct ft. fibre conduit, at $0.30	$ 61,460
141,870 duct ft. creosoted wooden conduit, at $0.25	35,468
625 sq. yds. brick pvmt. torn up and relaid, at $4.00	2,500
171 brick manholes, at $90.00	15,390
	$114,818

CENTRAL OFFICE EQUIPMENT

(Labor and Material.)

Main exchange	$141,158
Queen Anne exchange	23,942
East exchange	33,856
Green Lake exchange	16,283
West Seattle exchange	[illegible]
South Park exchange	1,670
Cutting in 10,622 lines at $0.20	2,124
	$241,610

SUBSCRIBERS' STATION APPARATUS

(Material Only.)

9,026 wall sets, at $7.80	$ 67,695
5,160 desk sets, at $8.50	43,860
125 adjustaphones, at $11.00	1,375
1,141 high frequency wall sets, at $7.75	8,843
820 low frequency wall sets, at $8.00	6,560
300 high frequency desk sets, at $9.00	2,700
147 low frequency desk sets, at $8.75	1,286
333 extension desk sets, without bells, at $5.00	1,665
377 adjustaphone extensions, without bell, at $8.50	3,105
283 extension bells, at $3.50	991
55 gongs, at $7.50	413
264 pay station coin boxes, at $12.00	3,168
101 intercommunicating wall sets, at $8.50	[illegible]
479 intercommunicating desk sets, at $8.50	4,072
225 intercommunicating adjustaphones, at $11.00	2,475
805 Intercommunicating boxes, at $6.00	4,830
590 cross connecting strips, at $0.85	502
	$154,399

SUB-STATION APPARATUS INSTALLATION SINGLE.

(Labor and Material.)

18,234 sub-station installations, exclusive of drops and telephones, at $[illegible]	$ 11,027

SUB-STATION APPARATUS INSTALLATION —GROUP.

(Labor and Material.)

21,779 lin. ft. moulding, at $0.015	$ 327
428 lin. ft. 200 pr. lead covered silk and cotton cable, at $1.25	535
45 lin. ft. 150 pr. same as above, at $1.00	45
4,402 lin. ft. 100 pr. same as above, at $0.75	3,302
3,271 lin. ft. 50 pr. same as above, at $0.55	1,799
1,950 lin. ft. 25 pr. same as above, at $0.25	488
13,963 lin. ft. 15 pr. same as above, at $0.16	2,234
30,512 lin. ft. 10 pr. same as above, at $0.12	3,661
1,180 lin. ft. 100 pr. cotton covered switchboard cable, at $0.40	472
1,317 lin. ft. 50 pr. same as above, at $0.25	329
13 lin. ft. 25 pr. same as above, at $0.18	2
1,199 lin. ft. 20 pr. same as above, at $0.12	144
11,594 lin. ft. 10 pr. same as above, at $0.08	928
3,125 lin. ft. 28 pr. conduit cable, at $0.23	719
3,391 lin. ft. 13 pr. conduit cable, at $0.10	339
894 lin. ft. 25 pr. okonite cable, at $0.30	268
3,515 lin. ft. 10 pr. okonite cable, at $0.15	527
4,070 lin. ft. No. 14 rubber covered duplex, at $0.025	102
60,467 lin. ft. No. 16 rubber covered duplex, at $0.0175	1,058
117,005 lin. ft. No. 18 rubber covered duplex, at $0.015	1,755
791,851 lin. ft. No. 19 rubber covered duplex, at $0.009	7,127
11,230 lin. ft. No. 20 rubber covered duplex, at $0.0075	84
46,557 lin. ft. No. 20 lamp cord, at $0.0065	303
361 lin. ft. 2-in. soft iron conduit, at $0.20	72
961 lin. ft. 1½-in. soft iron conduit, at $0.15	144
522 lin. ft. 1-in. soft iron conduit, at $0.10	52
1,642 lin. ft. ¾-in. soft iron conduit, at $0.075	123
615 lin. ft. ½-in. soft iron conduit, at $0.05	31
190 lin. ft. ⅜-in. soft iron conduit, at $0.045	9
24 lin. ft. 100 pr. lead covered silk and wool cable, at $1.00	24
700 lin. ft. No. 14 rubber covered iron wire, labor, wiring office buildings and installing intercommunicating systems	19,116
	$ 46,123

DROPS AND BLOCK WIRES

(Labor and Material.)

14,300 No. 16 duplex drops, average length 175 ft., at $4.00	$ 57,200

PRIVATE BRANCH EXCHANGES.

(Labor and Material.)

22 Stromberg cabinets No. 2176 wired, at $140.00	$ 3,080
6 Stromberg cabinets No. 886 wired, at $135.00	810
24 Stromberg cabinets No. 4656 wired, at $133.00	3,192
16 Stromberg cabinets No. 2766 wired, at $100.00	1,600
10 Stromberg cabinets No. 5550 wired, at $86.00	860
3 No. 1 fir cabinets wired, at $55.00	165
10 No. 2 fir cabinets wired, at $40.00	400
25 Dean cabinets No. 2 wired, at $110.	2,750
4,437 line circuits, at $2.40	10,649
535 trunk circuits, at $10.30	5,511
821 cord circuits, at $8.60	7,061
129 operators' circuits, at $18.00	2,322
860 chloride accumulator cells, at $2.50.	2,150
Labor of installation (13%)	5,272
	$ 45,822

BOOTHS AND SPECIAL FITTINGS.

(Labor and Material.)

10 oak double wall booths, installed, at $60.00	$ 600

EXCHANGE RIGHT OF WAY

Estimated cost of reproduction	$ [illegible]

REAL ESTATE AND BUILDINGS.

Real estate values fixed by The Gilham-Lyons Realty Company.

Main Exchange.

Lot—Lot 3, Block 15, Boren's plat of ... addition to the town of Seattle	$90,000
Bldg.—Three story and basement, brick and stone 100x120	28,400
	$118,400

East Exchange.

Lot—South 20 ft. of Lot 8 and north 20 ft. of Lot 9, Block 2.

[illegible] W[illegible]'s addition to the city of Seattle	[illegible]	
Bldg.—One story and basement, [illegible] 40x60	[illegible]	
		[illegible]

Queen Anne Exchange.

Lot—West [illegible] of Lot [illegible], Block 12, Mercer's Add. to North Seattle	4,700	
Bldg.—Two story brick, [illegible]	[illegible]	
		9,009

Green Lake Exchange.

Lot—Lots [illegible] and [illegible], Block [illegible], Potterfield's addition to the city of Seattle	2,500	
Bldg.—Two story and basement, [illegible] 30x60	[illegible]	
		14,952

West Seattle Exchange.

Lot—Lots 1 and 2, Block 13, first plat of West Seattle	3,000	
Bldg.—Two story and basement brick, 40x50	10,551	
		13,551
		$211,898

TOOLS AND VEHICLES

1 [illegible]	$ 700	
1 [illegible]	250	
1 single express wagon	60	
1 double express wagon	100	
1 pole wagon	100	
2 [illegible] at $[illegible]	[illegible]	
1 set double harness	70	
1 set single harness	20	
1 International Harvester auto wagon and fittings	900	
1 Excelsior auto cycle and fittings	280	
Miscellaneous hand tools	2,170	
		4,700

FURNITURE AND FIXTURES.

Inventory value	$ 12,582

ENGINEERING, SUPERVISION AND ORGANIZATION EXPENSE.

10% of all above items	$147,351

INTEREST DURING CONSTRUCTION.

5% on all above items	$ 86,203

CONTINGENCIES.

5% of all preceding items	$90,513

STORES AND WORKING CAPITAL.

Inventory value of stores and supplies on hand	$53,570	
Working capital necessary to operation of the plant	46,430	
		$100,000

BROKERS' FEES.

5% of 75% of all preceding items	$ 75,291
Grand Total	$2,076,067

This appraisal was begun on June 28, 1910, and was completed in about 30 days. The work was handled by the writer, with one assistant engineer and a stenographer, with the additional assistance of an engineer in the employ of the telephone company. The actual cost to the state was about $1,000, or approximately 5½ cts. per subscriber's station. It was absolutely necessary that the appraisal should be completed by a certain date, and the appropriation for such work was extremely small. It is hoped that these facts will be taken into consideration by those who may be inclined to criticize. As to whether or not the work was well done, the reader will have an opportunity of judging; for later, at the formal hearing held in Seattle in the latter part of July, the Department of Public Utilities of that city, evidently resenting the interference of the Railroad Commission in the city affairs, denied the jurisdiction of the Commission, and at the same time denied the accuracy of the estimate made by the Commission's engineers. Upon the recommendation of the head of the Department, the City Council authorized a municipal appraisal, appropriating $5,000 for such work. Mr. A. H. Judson, of Seattle, a former chief engineer of the Independent Company, and Mr. Frank N. Hall, of Wheeling, West Virginia, two recognized authorities, were retained to make the appraisal for the city and to report on Nov. 1, by which time it was expected that the engineers of the Railroad Commission would have completed their report covering the Pacific Telephone & Telegraph Co. This work, as well as that done by the city, will be described in the following installment.

Some Observations on Recent Steel Bridge Construction in America.*

I have been requested to write an article relating to some observations made in the United States and Canada during my Sabbatic leave of absence. The limitations of such an article necessarily exclude references to the great mass of details which received more or less study, and hence only the more general results and tendencies of recent construction will be given so far as they were noticed.

It is surprising to notice how few railroad bridge trusses with pin connections are being built at present. This tendency is not merely due to the decreased cost of foundations and piers or abutments due to the extensive use of concrete which makes the economic span shorter than formerly, but wherever an old pin span can be divided by an intermediate pier without excessive cost, two riveted truss spans or two plate-girder spans will replace it. The length of riveted trusses has been steadily increasing as the shops have changed their equipment and methods, so that the maximum span has passed 400 ft., and spans between 200 and 300 ft. are numerous. Accordingly, pin spans are mainly confined on railroads to crossings of the larger rivers where the interests of navigation require long spans.

The longest riveted truss spans in the United States are those of the new terminal bridge over the Missouri River at Kansas City, the span being 425 ft. and 6½ ins. The special reason for making this a riveted truss bridge is that one of the spans has a suspended lifting deck in which the stiff suspenders telescope into the hollow posts of the truss. The upper deck accommodates the highway and electric railway traffic and the lower deck the railroad traffic. The bridge has such an elevation that deck trusses are used over the river in all spans except that of the lift bridge. Since structural reasons required the through trusses of the lift span to be made with riveted connections the same details were used for the fixed spans to secure uniformity.

In the United States the riveted trusses that are next in length to those mentioned in the preceding paragraph are located in the channel spans of the Sixth St. viaduct over the Kaw River at Kansas City. The trusses are also of the Baltimore type, with a span of 300 ft., 10 ins. Next in order come the riveted truss spans of the Idaho & Washington Northern R. R. over the Pend Oreille River at Box Canyon, Idaho, completed in 1910. The channel span is 280 ft. and was erected from one end by the cantilever method without the use of falseworks. The adjacent shorter span was used for this purpose as an anchor span.

In Canada the largest riveted truss bridge for railroad traffic has an effective span of 412 ft. 8 ins. It is on the Canadian Pacific Ry. where it crosses the French River, 43 miles south of Romford, Ontario. Special conditions also led to the adoption of this unusually long span for riveted trusses. The Cisco bridge over the Fraser River in British Columbia, erected in 1910 on the same railroad, has riveted trusses with a span of 315 ft., which are designed for E50 loading.

It is worthy of note that the longest span of a pin truss railroad bridge remains the same today as in 1893, or 546.5 ft. Only one light highway bridge exceeds this in effective span, with a length of 586 ft. At present, however, the sub-structure is well advanced for the new municipal bridge at St. Louis, popularly known as the "free bridge," in which the effective spans are 668 ft., due to the demands of navigation as decided by the United States government. This bridge is to accommodate the highway on an upper deck and a double track railroad on the lower deck. It is to be built of nickel steel and it is proposed to begin the erection this spring.

Plans are under consideration which make it probable that in a few years the largest span for simple truss bridges will exceed 700 ft.

The larger live loads now adopted by some railroads tend to increase still further the magnitude of plate-girder construction. The construction of bridges now in progress on the Boston & Albany R. R. for E60 loading includes a plate girder for a skew span with solid floor which has an effective span of 115 ft. and a gross flange section of 249.5 sq. ins. exclusive of the equivalent flange area of the web.

There are at least two other railroads, both of recent construction, in which all the bridges are designed for E60 loading, the Virginian and the Carolina, Clinchfield & Ohio. They were built primarily for the economic transportation of coal, requiring very costly construction in order to secure the low grades adopted.

A number of prominent bridges are being replaced or reconstructed. The Lachine bridge over the St. Lawrence River near Montreal is to be changed from a single track to a double track bridge, using only simple trusses, thus causing the only statically indeterminate continuous truss bridge in the country to disappear. During the past season work was begun in lengthening the piers and in building some additional piers. After completing a new single track bridge alongside of the present trusses on the longer piers, the old structure will be removed, many of the spans being used elsewhere on branch lines, and a new single track structure built to replace it.

The Fraser River cantilever bridge on the Canadian Pacific Ry. near Cisco in British Columbia, completed in 1884, was removed last year and will be re-erected on Vancouver Island on the Esquimalt & Nanaimo R. R., one of the operated lines of the Canadian Pacific. The Cisco bridge was replaced by three simple truss spans. The middle one with a span of 315 ft. was erected by the cantilever method, using the side spans as temporary anchor spans. All of the trusses have riveted connections.

The superstructure of the Coteau bridge over the St. Lawrence River was also reconstructed last year by the Grand Trunk Ry. by substituting heavier riveted trusses designed for modern loading. The trusses were built on skids on an island, and between trains one of the old spans was removed by floating it out on a barge and a new span put in its place by the same method. One of the most interesting features of the design consists in the complete elimination of all lacing in the web members of the trusses, exclusive of the end posts. The difference in appearance due to this feature is apparent to an observer at a considerable distance. The web members are composed of two pairs of bulb angles connected by a solid web plate. This gives an H section with a bulb at each corner of the post, thus securing greater resistance to injury in the shops during transportation and in erection. In some cases the section is increased by adding two plates on the outside. The value of the bulb angle in ship building has long been recognized, but it appears that the value of this detail of bridge construction in Canada has not been recognized in the United States. It is claimed that it has been used in Canada for a number of years with entire satisfaction.

Wheelbarrow Hand Guard.—A hand guard attachment for use on the handles of wheelbarrows has been put on the market. The guards are simple in form and are inexpensive and may be attached to any barrow. They are fastened on the outside of the handles at a section near the rounded part of the handle. They are properly bent to give hand room and then become parallel to the handle. The guard was introduced to prevent the numerous cases of blood poisoning caused by slight injuries to the hands of persons operating wheelbarrows. It is made by the Lansing Wheelbarrow Co., of Lansing, Mich.

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*Extracts from a paper by Henry S. Jacoby, Professor of Bridge Engineering at Cornell University.

Efficiency and Cost of Modern Pumping Engines.*

The commercial pumping engine for water works purposes has been brought to a high level, and has been divided into four distinct types, each to suit conditions imposed, including pressure, quantity, location, first cost, fuel, maintenance, etc. These types and rather close approximations of cost of engines complete, with foundations, piping and appurtenances, per million gallons per 24 hours' capacity, under average conditions, are as follows:

(1) Compound condensing, low-duty engines, horizontal	$2,300
(2) Low-duty triple, condensing, horizontal	2,800
(3) Cross-compound, condensing, horizontal	3,300
(4) High-duty triple, condensing, vertical	4,800

The first and second are non-rotative or "direct acting" machinery and the third and fourth are of the crank and fly wheel type. The figures do not include anything for buildings, land, chimneys, wells, boilers, etc.

The cost of boilers with mechanical stokers, feed pumps and appurtenances, steam piping and minor details—everything ready for service under average conditions—would be covered by $20 per boiler horse power. It is impossible to include all plants, therefore these averages are based on:

Total water load against the plungers, 90 lbs. per sq. in., or a head of 207 ft., including suction and friction.

Actual evaporation in the boilers under working conditions, 8 lbs. of water per pound of coal, with feed at 150° and with coal at $3 per net ton of 2,000 lbs.

Steam pressure at throttle valve of engine, 75 lbs. gage, for low-duty compound; 125 lbs. gage for low-duty triple and cross compound; 150 lbs. gage for high-duty triple; an allowance of 5 lbs. above the pressures given for boiler pressures.

The desire is often expressed for a schedule, rate of cost, or price of pumping engines, but it is a very difficult matter to make a price list at any certain time which will be reliable beyond an approximate guide for estimate. Although the water works pumping engine has been brought largely to a commercial basis in manufacture and sale, the conditions under which it must operate are special for the location where wanted, and all prices pertaining to specially defined contracts are more or less changeable.

The best attempt at making a price list can only result in a fair average, according to the labor and material markets, and also depending on the amount of work on hand in the competing shops.

EFFECT OF HIGHER STEAM PRESSURE.

The higher steam pressures, which closely accompany greater steam economy, also changed ideas on boilers, brought greater horse power per boiler by enlarging the units and led to restricting the dimensions of the boiler plant. In the long run and among the many plants built the boiler for high pressure, made up of small diameters of parts, on the unit principle, economizes space, buildings, initial cost in large powers and other important items to a very satisfactory degree. Under present circumstances of unit capacity, cost of construction, convenience and economy of operation, together with considerations as to buildings and space required, the water-tube boiler, fitted with automatic stokers and damper regulators, takes the lead as a general steam generator for water works pumping plants. The practical relation between the economic duties of pumping engines and the amount of boiler power required, may be illustrated by Table I, the measurable amount of boiler power being indicated by taking 10 sq. ft. of heating surface for each boiler horse power:

Table I is based on the fact, repeatedly demonstrated, that in good ordinary practice, 1 sq. ft. of heating surface will evaporate 3 lbs. of water per hour, from 150° (temperature of feed), into steam at 150 lbs. gage pressure. Therefore 10 sq. ft. will evaporate 30 lbs. of water as above, and this amount of evaporation is taken as 1 boiler horse power.

TABLE I.—BOILER-HORSE-POWER REQUIRED FOR EACH PUMP-HORSE-POWER, COUNTING 10 SQ. FT. OF HEATING SURAFCE PER BOILER-HORSE-POWER.

Duty in foot-pounds per 1,000 lbs. of dry steam.	Boiler-horse-power per pump-horse-power.
40,000,000	1.63
50,000,000	1.32
60,000,000	1.10
70,000,000	0.94
80,000,000	0.82
90,000,000	0.74
100,000,000	0.66
110,000,000	0.60
115,000,000	0.57
120,000,000	0.55
125,000,000	0.52
130,000,000	0.51
135,000,000	0.49
140,000,000	0.47
145,000,000	0.46
150,000,000	0.44
155,000,000	0.43
160,000,000	0.41
165,000,000	0.40
170,000,000	0.39
175,000,000	0.38
180,000,000	0.37
185,000,000	0.36
190,000,000	0.35
195,000,000	0.34
200,000,000	0.33

This is a good basis and safe in most cases, but if at any time caution or any special reason should suggest an increase in heating surface, any desired percentage of increase may be readily added without disturbing the relations of the different rates of economy. For example, if it should be decided that 2½ lbs. of water per square foot of heating surface per hour is all that it would be safe to reckon on, then 20 per cent added to the boiler horse power of Table I would provide for such a case, or, to go to extremes, if it was thought that 2 lbs. of water per square foot of heating surface per hour was the limit, 50 per cent added to the figures in Table I would meet the demands for boiler capacity. With boilers properly constructed and arranged, however, Table I will answer all reasonable purposes.

The limits of steam economy in the pumping engine are about reached, both theoretically and practically. The modern duty record is shown by Table II:

TABLE II.—DUTY RECORD PER 1,000 LBS. OF DRY SATURATED STEAM.

Year.	Duty, in foot-pounds.
[illegible]	[illegible]
[illegible]	[illegible]
1898	167,800,000
1900	[illegible]
1900	178,497,000
1900	179,419,600
1906	181,068,605

The leading type is a vertical, triple-expansion, condensing engine, with outside-packed plungers, mostly of the crank and fly wheel type.

In the early days of the pumping engine the tendency toward increase in size was not realized nor what tremendous capacities the pumping units would reach; but the view is clearer now, and there is no good reason for straying too far afield in search of the appropriate line to follow. It is not easy to forecast what developments may take place; but, with the analysis of coal, a full knowledge of the heat possibilities demanded by the steam at the working pressure, the efficiency of the boilers, a clear idea of the laws of steam expansion, and with the types of the most efficient pumping engines practically fixed, it is evident that some radical departure must be made to defeat what is known at the present time.

Table III gives an example of how methodically the cost of plants built on the unit basis may be determined. In some cases these figures may be too high and in others too low; they are closely approximate, and enough of the data are based on records fairly to insure the figures in the table as safe for practical use in making estimates. However, the table is so close that it would be taking chances for an engineer or a contractor to guarantee the production of results for the figures named, without investigating each case by itself. The work contemplated is for the best type of modern, triple-expansion pumping engines, and high-pressure boilers. The buildings are assumed to be of good design and quality; of brick, or of stone where stone is cheap; the roofs steel-trussed and slate-covered; the chimneys adequate; and the intakes properly proportioned and thoroughly screened. The cost given includes everything except the land.

TABLE III.—COST OF COMPLETE PUMPING STATIONS.

Pressure of water load pumped against, in pounds per square inch.	Cost of plant, per million gallons capacity, including [illegible]
30	6,750
40	7,000
50	7,250
60	7,500
70	7,750
80	8,000
90	8,250
100	8,500
110	8,750
120	9,000
130	10,000

There are cheaper classes of pumping engines, but they are necessarily of lower economic efficiency, and therefore require more boiler capacity, more coal storage, and other incidentals which, when balanced up, will tend to keep the figures about the same. A cheaper and less durable building may be used, but in the long run this will need more repairs, which when capitalized will bring the account fully up to the figures given and most likely exceed them.

It is scarcely possible that the cost of equipping pumping stations for water-works will be increased much on account of a higher type of steam machinery, because it is evident that the top limit has just about been reached, with the record a little more than 181,000,000 ft.-lbs. per 1,000 lbs. of steam. Ten years ago it nearly touched the 180,000,000 mark; and a gain of 0.8 of 1 per cent in ten years, with every nerve strained, is eloquent evidence of the top limit. The Mariotte curve is about the nearest approach to perfection possible for the steam engine to accomplish, in expressing the relation between the work done and the amount of steam used. If the terminal pressure is taken as expressing the steam used, and all the steam is accounted for by the diagram, then somewhere in the immediate neighborhood of 180,000,000 duty, with 96 per cent mechanical efficiency of the machine, will be the resulting figures, with a reasonable amount of steam used in the jackets and re-heaters charged against the account.

If there were no necessity for the use of steam-jackets, or jacket steam, the figures would approach 200,000,000 rather closely, and if superheating can save jacket steam, and vitalize the working steam in the cylinders, the latter figure may be reached in the near future, as far as the official test is concerned. This pleasing result may have to be obtained, however, by the use of a surface condenser with a comparatively small air-pump, and this type of condenser may require more maintenance account than the jet form; and the superheat may have to be obtained at the cost of coal.

Plants equally constructed and with equally low repair and maintenance accounts can have no advantage over each other excepting in the matter of fuel economy; and the lessened quantity of coal to be bought is the real foundation on which to base an increased investment in the plant. There are only two important items which grow less by higher duty, and these are the coal account and the fixed charges on the boiler plant. Everything else increases with higher duty, excepting the wages account for equal capacities, and this remains at least as much with high as with low duty, excepting with the large high-duty triple engines, and with these the wages are somewhat less in the fire-room on account of the lessened quantity of coal to be shoveled in proportion to the pumping.

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*Condensed from "The Present-Day Pumping Engine for Water-Works," by Chas. A. Hague, Proc. Am. Soc. C. E., Vol. XXXVII, p. 288.

The items for and against the high-duty pumping plant are

- Against High Duty—
  - Maintenance account for machinery
  - Interest on machinery
  - Oil, waste, packing, etc.
  - Sinking fund for machinery
- In Favor of High Duty—
  - Maintenance account for boilers
  - Interest on boilers
  - Sinking fund for boilers
  - The coal account.

To ascertain which type and class it will pay best to buy requires comparisons and calculations which call for thought and care, but which may be readily enough made when the conditions of the contemplated plant are clearly laid down. The fixed charges against pumping machinery and boilers are as follows:

Vertical Triple-Expansion Pumping Engines.	
Maintenance account	2%
Interest account	4%
Sinking fund account	3%
Oil, waste, packing and small repairs	1%
Total fixed charges	10%

All Other Types of Pumping Engines.	
Maintenance account	3%
Interest account	4%
Sinking fund account	5%
Oil, waste, packing and small repairs	1%
Total fixed charges	13%

The reason for the difference of 2 per cent in the sinking fund account, between vertical triple machinery and all other forms, is that it has become evident that the vertical triple type of pumping engine will probably not be replaced as obsolete by any of the other types, but the other types will eventually give way to the vertical triple. Under these circumstances, when the vertical triple is properly built, its life is taken at 33⅓ years, and that of all the other types at 20 years; representing, respectively, 3 per cent and 5 per cent, to make up the sinking fund to 100 per cent in the time specified. The fixed charges against the boiler plant are as follows:

Maintenance account	5%
Interest account	4%
Sinking fund account	5%
Total fixed charges	14%

Even when the cost of coal is $1,350 per year for each 1,000,000 gals. of water pumped per day, the total coal bills do not amount to very much for 2,000,000 or 3,000,000 gals. per day; but when the quantity gets toward 10,000,000 gals. the figures are more important. The larger triple-expansion pumping engines of the reciprocating, displacement type, pump 1,000,000 gals. per day with $625 worth of coal per year for the best records, and $900 is an ordinary good record; while $1,350 is about the best steam-turbine pumping record, as far as the writer can learn. It looks as though the great struggle to keep down the capital account in the turbine outfit must be partly abandoned, as far as water works service is concerned.

Within its limitations, the certifugal pump is an ideal machine for lifting water; which means that it must be designed and constructed for known positive conditions, if the best results are looked for. At constant speed, for a considerable range of capacity, as is often found in water works, or for a varying head—very frequently found in the Middle West, where domestic and fire service are combined in the same apparatus—it is inefficient and unreliable. Even on standpipe work, as at Schenectady, N. Y., the centrifugal pump proved to be a total failure, and that city is now seriously contemplating the construction of a reservoir for the relief of these pumps; and there are others.

The centrifugal pump sends the water by centrifugal force, from the center toward the outside, and the main principles to be followed in designing are the prevention of: *(a)* Sudden changes in water velocity, *(b)* Sharp changes in direction of flow, *(c)* Unnecessary friction losses.

With a steep vane there is required a less number of revolutions per minute; with a flat vane there is required a higher number of revolutions per minute, to do the same work. The above-mentioned formula ($V = \sqrt{2gh}$) gives an average result in feet per second of the peripheral speed of the runner; the actual results depend on the angle of the vanes and the width of the impeller.

A case in practice, which has just come to hand—the figures being taken from the annual report of the operation of a water-works plant—will be to the point, in comparisons between displacement and centrifugal pumps in practical water-works service. The data are as follows:

Pumpage per day, U. S. gals	9,000,000
Head against displacement pumps, ft	207
Head against centrifugal pumps, ft.	[illegible]
Cost of centrifugal pumps	$10,000.00
Cost of displacement pumps	50,000.00
Cost of fuel used for both plants, per net ton	1.25

Cost of Fuel to Pump 1,000,000 Gals. 207 Ft. High.	
With displacement pumps	$3.27
With centrifugal pumps	6.48
Difference in favor of displacement pumps	$3.21

The difference in cost of fuel per annum at 9,000,000 gals. daily pumpage, against 207 ft. head, in favor of displacement pumps, amounts to $10,544, which means that the economic duty of the displacement machinery is 1.96 times that of the centrifugal, or the ratio between a cost per million gallons 207 ft. high, of $6.48 and $3.27, as shown by the coal account given. It may be noted in passing that the mechanical efficiency of the displacement machinery is 93 per cent, and that of the centrifugal machinery is 65 per cent, which corresponds with the results found in general practice along these lines.

The mere recording of various statements of economy in coal per power unit does not tell the entire story, as will be shown by the analysis of data. For example: confining the comparison for the moment to steam pumping plants, consider these two records; one of 1.02 lbs. of coal per indicated-horse-power-hour, and the other 1.98 lbs. Both records were obtained as nearly as could be under similar conditions in actual water-works pumping. The fuel calling for 1.98 lbs. is slack coal at $1.50 per net ton; and the fuel calling for 1.02 lbs. is anthracite coal at $4.50 per net ton. The analysis of the two fuels for heat units on complete combustion is as follows:

	Per lb.
Heat units developed by the slack	11,000
Heat units developed by the coal	14,000

In the case of the slack coal, the buyer obtained 146,000 heat units for 1 ct. In the case of the anthracite coal the buyer obtained 62,000 heat units for 1 ct. The plant consuming the slack coal used 363 heat units per horse-power-minute, while the plant with the anthracite coal consumed 238 heat units per horse-power-minute. The efficiency of the boilers was 70 per cent with the slack and 80 per cent with the anthracite. This, reduced to work demonstrated by indicated horse power, gives 13,200,000 ft.-lbs. for 1 ct. for the anthracite and 9,805,680 ft.-lbs. for 1 ct. with the slack, with the efficiencies of the boilers equalized; and this shows that a difference of 3,394,320 ft.-lbs. for 1 ct. existed in the difference in steam economy of the two engines. The engine with the slack fuel gave 130,000,000 ft.-lbs. per 1,000,000 B.t.u., and that with the coal gave 163,000,000 ft.-lbs. per 1,000,000 B.t.u., further demonstrating the difference in steam economy in the two machines. The gain in foot-pounds for 1 ct. with the engine using anthracite coal over the other is 34 per cent, and the gain on the heat-unit basis in favor of the anthracite coal engine is 26 per cent, which indicates good judgment in putting enough investment into the engine, boilers and fuel to obtain good results. The engine with the coal fuel cost $4.166 per 1,000,000 gals. capacity per 24 hours; and the engine with the slack fuel cost $4.083 per 1,000,000 gals. capacity per 24 hours. This price per 1,000,000 gals. does not include foundations and appurtenances, so that the $4.800 per 1,000,000 gals. for the vertical triple pumping engine of large size given earlier in this paper is fairly well checked, as the latter figure includes everything in the engine-house belonging to the machinery. It may be of some interest to know that the two pumping engines which have just been compared were by different builders.

The present high type of water-works pumping engine apparently cannot be improved to any material extent in principle, so that the very best that can be expected is an extremely small increase in economy secured by improved construction. It is very probable that an increase in fuel economy from 6 per cent to 12 per cent can be gained in many steam plants by the use of superheated steam. Some think this too low a figure for the gain by superheat, but it must not be forgotten that many of the good records for superheat have been made where engines and boilers of only fairly good economy are in use, whereas, when the best type of pumping engine is supplied with superheated steam, the application is then made to steam machinery of the very highest class, where all the steam refinements can be operated to the best advantage, and where multiple expansion, steam-jackets, re-heating, etc., are used under the very best conditions to reduce internal losses and condensation to an extremely low point. A pumping engine at the Boston high-service station at Chestnut Hill Reservoir has a capacity of 30,000,000 U. S. gals. per 24 hours, and has the following data to its credit:

Duty per 1,000 lbs. of dry saturated steam (no superheat), ft.-lb.	178,497,000
Duty per 1,000,000 b.t.u., ft.-lb.	163,925,000
Duty per 100 lbs. of coal, ft.-lb.	173,869,000
Dry saturated steam per indicated horse-power per hour, lb.	10.34
Coal per indicated horse-power per hour, ib.	1.06
British thermal units per indicted power per minute	188

If the duty for this engine, with dry saturated steam, should be increased 12 per cent by superheating, it will read 199,916,640 ft.-lbs. which is about 2,000,000 above the highest record with the use of superheated steam. The highest known duty per 1,000 lbs. of dry saturated steam—in round numbers 181,000,000 ft.-lbs.—would go up to 202,720,000 ft.-lbs. with 12 per cent increase, which is considerably above the superheat results thus far obtained.

Some, who are not familiar with pumping engines at work, rebel at the idea of triple-expansion engines with aims at economy; but there are other items, aside from the particular method of handling the steam, and among them the fact that the distribution of water into a force main from three plungers has never been surpassed, and probably has never been equalled. In addition to that fact, the triple-expansion pumping engine holds a record for economy of steam far ahead of compound machinery. In nearly all cases a compound would have to be fitted with two double-acting plungers on account of pulsations in the mains; horizontal engines would be rather limited in capacity, and a cross-compound, vertical machine would be objectionable to a very serious extent.

The growth and drift of the public pumping engine seems to be toward larger and larger units, and the introduction of the higher duty idea into smaller and smaller units, with the vertical, triple-expansion engine rapidly taking the lead, and the cross-compound crank engine gradually forcing the direct-acting machine out of the field in the moderate and small sizes. The direct-acting, non-rotative, triple, with six steam cylinders and two double-acting plungers, stubbornly holds on, and probably will for a while longer. Just what the next ten years will bring out is not known. It looks doubtful for the dominance of the turbine type in that time if at all, and the gas engine has not yet really made a good start for the front line. Superheated steam and generally higher steam pressures up to about 175 lbs. gauge pressure will take place gradually, and that will be the last firing line of the reciprocating, triple-expansion, displacement, pumping engine. It will hold this line stubbornly, and it will require a great deal more progress than is evident in any direction at present to dislodge it or even to shake it materially. Its capital and fuel accounts, even with coal at a moderate price, make a satisfactory showing, and its maintenance in the presence of good design and workmanship will not exceed 2 per cent in large or moderate plants where it is properly cared for.

The perfect present-day pumping plant involves the following items:

Vertical, triple-expansion, crank-and-flywheel pumping engine
Long stroke, with rotative speed not to exceed 20 rev. per min.;
Maximum piston travel 2[illegible] ft. per min.;
Modified steam-jacketing and re-heating;
Steam pressure at throttle, 1[illegible] lbs. per gage;
Moderately superheated steam by independent apparatus;
Smoke-flue re-heating;
Water-tube boilers;
Mechanical stokers;
Natural draft at least 0.8 ins. of water;
Feed-water economizers;
Automatic damper regulators;
Coal bought on the basis of 14,000 heat units per lb.;
Boiler efficiency of 75%;
Coal per indicated horse-power, 1 lb. for large plants;
Coal per indicated horse-power, 1.75 lb. for small plants;
Maintenance of engines, 1.5% for large plants;
Maintenance of engines, 3% for small plants.

These and other items of a similar nature are about what a look ahead discerns as the coming events in the planning, construction, and operation of present-day pumping plants for public water supply.

Method of Unloading Cars to Bins in a Small Space.

In our issue of Oct. 12, 1910, we described a mixing and handling plant which was built and operated by the Falkenau Construction Co. for the construction of a 7-story concrete building at Peoria and Adams streets, Chicago. This plant has been transferred to the Union Stock Yards, Chicago, for the erection of another 7-story concrete building, and changes made in the arrangement for loading the bins which are interesting.

The accompanying sketch illustrates a hoisting tower located over the material track adjacent to the bins. A clamshell bucket is operated in the hoisting tower to raise the material from the gondola cars, as shown, to a point in the tower above a swinging chute. The chute is automatically swung under the bucket so that the discharged load falls from the bucket to the swinging chute and from there is guided to its proper compartment in the bins.

The former method for loading the bins was by means of a bucket conveyor which carried the material from a pit below street level. The material was dumped into the pit through a grating from wagons. This method would have been possible at the present location of the plant if bottom dump cars could have been secured, but as this could not be guaranteed the new device was gotten up.

From 8 to 10 cars are unloaded per 8-hour day, allowing for time lost for switching and moving the cars for the clamshell. Three men are used in the car to locate the bucket and an engineer and fireman are required to operate the double drum engine and boiler. The cost of the labor is estimated as follows:

3 laborers at 37½ cts. per hour	$ 9.00
1 engineer at 75 cts. per hour	6.00
1 fireman at 37½ cts. per hour	3.00
Total	$18.00
300 yds. average per day, per yd.	$0.06

The plant and methods were worked out by Mr. J. K. Thompson, who is superintendent for the contractors.

Dynamite at Panama.—The Isthmian Canal Commission has contracted for 10,000,000 lbs. of dynamite to be used during the fiscal year ending June 30, 1912. Saltpeter dynamite is specified and an analysis of the materials will be made. If there is a variation of 3 per cent from the contract strength the dynamite will be rejected, and for a variation of more than 1 per cent and less than 3 per cent it will be accepted at a reduction of 15 cts. per 100 lbs. for each 1 per cent reduction from the contract strength required.

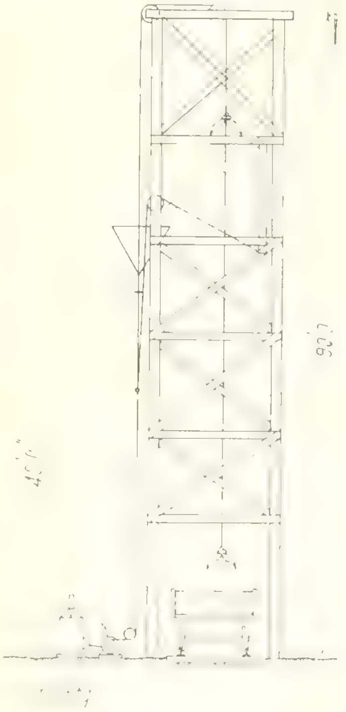
LETTERS TO THE EDITOR.

The Under Pressure of Water on Dams.

Sirs: Kindly permit me to correct some erroneous statements by Mr. R. C. Beardsley on the subject of my reversed dam and my retaining wall, in your issue of March 2[illegible], 1911.

Mr. Beardsley would make me say that because his book is not on dams his warning against under pressure has no weight or priority. The statement of mine which he contradicted in "Concrete Engineering" was merely that no book on dams mentions this. (He is mistaken in saying that there are only two books on dams. I find four others at least, namely, Gould, Krantz, Merriman and Morrison & Brodie.) As to priority, I mentioned this upward pressure in Engineering Record, Dec. 3, 1904. This antedates Mr. Beardsley's book by some two or three years. I have never claimed to be the first to mention it, but have done my share to emphasize it publicly.

In regard to originality in my retaining wall, the one described by Mr. Beardsley is the antithesis of mine in the essential feature of my patent. He says his rods are hooked around others for anchorage. I do not consider a hook an efficient anchor any more in reinforced concrete than in structural steel design. He can continue to build such walls. His wall was built in 1908. Mine was described in "Engineering News" in 1906 and patented later. His priority here is not evident.



Sketch of Arrangement for Unloading Concrete Materials from Cars into Bins.

Mr. Beardsley says of my retaining wall that no drainage is provided for. I quote from my paper in Engineering-Contracting, Dec. 21, 1910: "A retaining wall built on this or any other plan should have the backing well drained. This plan admits of ample provision for drainage by means of weep holes through the slabs. In order that these do not fill with mud some loose stone should be [illegible]."

This is not a matter of sparring for points. It is a serious matter, a matter on which millions of dollars worth of property and scores of lives hang. In Mr. Beardsley's four-page article on his reversed dam in Engineering-Contracting, Feb. 1, 1911, there is not the scintilla of a hint that he would underdrain his dam. An unwary designer following all his directions and using his drawings could build a structure that would float away with great force. Mr. Beardsley wrongly condemns me for not mentioning drainage of my retaining wall, when the fact is that I emphasized this very thing, as quoted above. His idea of the drainage of the reversed dam has only come out publicly in his letter in the last issue of Engineering-Contracting.

It would be a crime to build a dam that may lose its entire stability by the mere silting up of an inaccessible drainage trench or the freezing up of its outlet. Dams are built to retain water. Some of them are made with the express idea of conserving every gallon of water possible. In a stream of small flow it would be quite possible for the outlet of the drainage to freeze up. Leaks in dams are common. It is next to impossible to stop up completely all leaks. The only way possible in many cases (of a dam in use) would be to seal up the outlet on the downstream side. This would only serve to intensify the pressure of the confined water. The best way to make a dam entirely safe is to make it with mass enough to resist any possible horizontal or vertical pressure that the water may exert against it. It is absurd to say, as Mr. Beardsley has said, that "No dam ever built would be a safe dam if the water did react in such a way" (that is, against the base of the dam). It is entirely possible to build a gravity dam with stability enough to resist such pressure.

Mr. Beardsley would depend upon a concrete-filled trench at the up-stream edge of his dam. The Dansville, N. Y., dam had this kind of trench (See Engineering News, Jan. 13, 1910.) It failed by water getting under it. The Austin, Pa., dam had this kind of trench. (See Engineering News, March 17, 1910.) It failed. Here is what is said of it: "The most important cause, however, was due to the water getting under the dam. This condition was not anticipated when building the dam, and all precautions which seemed to be necessary at the time were taken to guard against it."

What is to prevent an underdrainage system from silting up in time, with an unlimited flow of water and mud to draw from?

On a soft soil Mr. Beardsley would depend on sheet piles. How could a perfectly water tight joint be made between sheet piles and a concrete slab?

Why could not water enter by a fissure, as in the case of the Austin, Tex., dam, and get under his dam?

These are vital questions on the design and safety of a dam. The public, as well as engineers, are interested in this subject. An engineer may be a man who can make a dollar do the work of two dollars in other hands; this is sometimes overworked. Early highway bridge builders had that idea; the public is now spending the two dollars.

It is easy to make models and to seal them against a few inches of water head with a rubber sheet. It is quite a different proposition to seal up the entire bed of a stream and the surrounding soil against admission of water working 24 hours a day 365 days in the year to penetrate the obstruction.

Yours very truly,
EDWARD GODFREY.

Monongahela Bank Bldg., Pittsburg, Pa.
March 23, 1911.

The Relative Merits of Wet and Dry Concrete for Curbs.

Sirs: The question of using wet or dry mix for curbs, combined curb and gutter, and sidewalk work often comes up. It would seem that any one with a practical knowledge of how the work is done and a theoretical knowledge of what constitutes good concrete can favor but one method, the wet mix. The reason for this is that the strength of concrete depends upon its density, other things being equal. In practice it is impossible to ram the concrete in or curb form sufficiently hard to make a dry mixture dense. If there is some doubt in the reader's mind as to the truth of that statement, let him stand for a half hour close to where a gang is putting in curb and observe the texture of the concrete which the 1:2 dry facing is going to cover up. As he looks let him remember that wherever he sees voids he sees condemned concrete.

He will very soon become an advocate of wet concrete.

Anyone who has used the wet mix knows that [illegible] work is concerned the matter of water tight forms is of no consequence. Forms for curb do not have to be any more water tight for a wet mix than for a dry mix. Also, forms may often be removed in an hour's time after the wet mix was deposited and soon after the surface can be finished with a wooden float in the usual manner. If desired the forms may be left until the following day and the surface then finished with a float. The concrete should be spaded.

Such work looks just as well as the dry mix with rich facing and will outlast the latter several times over.

When engineers understand thoroughly the relative merits of the two classes of work, sidewalks, curb and combined curb and gutter will be made of wet concrete. Authorities agree that a dry mix properly tamped is stronger than a concrete made of the same ingredients mixed wet, but in practice, where the dry mix is used, in 99 out of 100 cases it is far inferior to the wet mix, and for that reason engineers who specify the former lack experience.

Yours truly,

EDWARD O. KEATOR

Cincinnati, Ohio, April 29, 1911.

Personals.

Mr. W. S. Keller, formerly good roads engineer for Madison County, Tenn., has been elected state highway engineer of Alabama.

Mr. Hiram A. Miller, consulting engineer, announces that, having completed the Charles River dam and basin, he has removed his office to No. 8 Beacon St., Boston, Mass.

Mr. Con M. Buck, an engineer formerly of Manhattan, Kan., has been placed in charge of the work of line and grade revision of the Kansas City Southern Ry., at Jaudon, Mo.

Mr. Ernest G. Eagleson, who succeeds Mr. J. L. Baldwin as City Engineer of Boise, Idaho, took charge of the office on April 15. Mr. J. B. [illegible] has been appointed Assistant City Engineer.

The American Bureau of Inspection & Tests announces the appointment of Mr. George W. Greene as inspecting engineer, vice Mr. Morgan T. Jones, retired; and the appointment of Mr. E. C. McMillan, mechanical engineer, to succeed Mr. Greene.

Mr. Henry R. Cobleigh has resigned as mechanical editor of The Iron Age, which position he has held for the last seven years, to take charge of the advertising and publicity of the International Steam Pump Company, No. 115 Broadway, New York City. He entered upon his new duties May 1.

Mr. Squire Sampson, a retired railroad builder, died suddenly at his home in Baltimore, Md., on April 25. He was born in Wyoming County, Pa., in 1841. At the age of 18 he went to Brazil. He engaged in railroad building, and remained in that country until his retirement from business 40 years later.

Mr. James L. Tighe, who has been for the past 19 years, city engineer and engineer of water works of Holyoke, Mass., has opened offices in the Caledonian Bldg., in that city, and will engage in practice as a consulting engineer. He will give particular attention to problems relating to hydraulic and municipal engineering.

The Board of Railroad Commissioners of Kansas has taken up actively the question of the valuation of all railroad and public utility properties and will within a few days call a conference of representatives of all railroads operating in the state. Mr. Carl C. Witt, who conducted the South Dakota railroad appraisal, has been appointed engineer of the board at an annual salary of $4,500.

Mr. Jewett N. Darling, an engineer well known in the middle west, died in Colton, Cal., on April 21. For a long period of years he was connected with the Illinois Central R. R., and had charge of the construction of that line through the Yazoo delta in Mississippi. Later he had charge of the reconstruction of the South Side Elevated R. R. in Chicago. He was a member of the Western Society of Engineers, and contributed a number of valuable and interesting papers to the literature of that society.

The civil and consulting engineering practice of Wm. B. Ewing, whose death was announced in our last issue, is to be continued by the firm of Ewing & Stone, at 1742 Monadnock Block, Chicago. The new firm consists of Mrs. Wm. B. Ewing, who has been intimately connected with her husband's work in recent years, and Mr. Frank L. Stone, an engineer of wide experience in railroad and municipal work. For the past five years Mr. Stone has been engineer of track elevation of the Chicago, Burlington & Quincy R. R., and under his supervision the design and construction of the track elevation of that road in the city of Chicago has been carried out. Associated with the firm is Mr. Edwin Hancock, who has served as Mr. Ewing's assistant for the past eight years. The new firm will make a specialty of hydraulic, sanitary and municipal work.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Cement Manufacture.—Paper, 6x9 ins.; 68 pp. Chicago Portland Cement Co., Chicago.

This pamphlet entitled "From the Raw to the Finished Product," tells how Portland cement is made and describes and illustrates the various parts of this company's plant.

Porch Molds.—Paper, 9¼x12¼ ins.; 4 pp. United Concrete Mach. Co., Basic City, Va.

Gives illustrations of 25 or more patterns of porch columns for which this company made the molds.

Keystonia Paint.—Paper, 3½x6¼ ins.; 14 pp. Keystone Varnish Co., 71-79 Otsego St., Brooklyn, N. Y.

Describes and contains sample colors of Keystonia Paint.

Jordan Spreader.—Paper, 5¾x8¾ ins.; 16 pp. The O. F. Jordan Co., 332 S. Mich. Ave., Chicago.

An illustrated catalog with descriptions of spreaders of late designs for the moving and spreading clay, sand, rock or other materials.

Concrete Bridge.—Paper, 4¾x9 ins.; 20 pp. Marquette Portland Cement Co., Marquette Bldg., Chicago.

A pictorial description of the construction of the Grand Ave. Viaduct, Milwaukee.

Conveyors and Transmission Machinery.—Paper, 6x9 ins.; 24 pp. Stephens-Adamson Mfg Co., Aurora, Ill.

Catalog No. 34 entitled the Labor Saver contains an illustrated description of the Tompkins Cove Stone Crushing plant and other articles descriptive of .other plants where conveying machinery is employed.

Watson Dump Wagons.—Paper, 9x12 ins., 8 pp. Watson Wagon Co., Canastota, N. Y.

Contains illustrations and descriptions of performances with Watson Wagons.

Cement Machinery.—Paper, 6¼x10½ ins.; 4 pp. The United Cement Machinery Co., Columbus, Ohio.

Several of these pamphlets contain illustrations and descriptions of machines for making concrete blocks, roofing tile and various cement products. Prices are given.

Wheel Barrows and Trucks.—Paper, 6x9 ins.; 20 pp. J. W. Paxson Co., Philadelphia, Pa.

Bulletin No. 21 contains price lists, illustrations and descriptions of wheelbarrows and hand trucks. Discounts are indicated on an enclosed sheet.

Motor Drive.—Paper, 8x10½ ins.; 26 pp. General Electric Co., Schenectady, N. Y.

In Bulletin No. 4815, recently issued by the General Electric Co., are illustrated and described continuous and alternating current motors and apparatus for controlling them when applied to machine tool operation. The publication contains also illustrations of the motors installed on drills, saws, shapers, milling machines, slotters, planers, lathes, etc., etc.

G. E. 214 Railway Motor.—Paper, 8x10½ ins.; 20 pp. General Electric Co., Schenectady, N. Y.

This bulletin describes the above company's 75 h.p. direct current commutating pole railway motor which represents the latest construction in this class of apparatus.

Buffalo Forges.—Paper, 3½x6¼ ins.; 4 pp. Buffalo Forge Co., Buffalo, N. Y.

A folder which illustrates the Hardy attachment for anvils.

Mulconroy Air Hose.—Paper, 3½x9 ins.; 8 pp. Mulconroy Co., Inc., 722 Arch St., Philadelphia, Pa.

Shows some abuses to which the hose has been subjected without effect.

Hayward Handling Machinery.—Paper, 7⅜x9⅛ ins.; 4 pp. The Hayward Co., 50 Church St., New York.

Pamphlets Nos. 568 and 570 illustrate and describe orange peel buckets and coal handling machinery.

White Cement.—Paper, 6⅞x9 ins.; 32 pp. Sandusky Portland Cement Co., Sandusky, O.

Describing tests of this cement, its stainless properties and giving illustrations of buildings constructed with it.

Electricity on the Farm.—Paper, 8x10½ ins.; 36 pp. General Electric Co., Schenectady, N. Y.

This bulletin is divided into brief chapters, each covering the specific use for electricity on the farm, the various descriptions of motor applications being accompanied by illustrations of electrically operated farm machinery in actual service. Other chapters deal with electrically operated refrigerating plants, the application of motor drive and auxiliary electrical devices in the farm work-shop and the possibilities of electric haulage.

Avery Tractors.—Paper, 8x9 ins.; 48 pp. Avery Co., Peoria, Ill.

Illustrates and describes an automobile tractor, designed for hauling and belt driving.

Twentieth Century Grader.—Paper, 6x9 ins.; 32 pp. Baker Mfg. Co., 256 Madison, Chicago.

Illustrating and describing this grader with letters of recommendation showing costs of operation.

Lidgerwood-Crawford Scraper Bucket Excavator.—Paper, 9x12 ins.; 76 pp. Lidgerwood Mfg. Co., Chicago, Ill.

This is Bulletin 103, illustrating and describing swinging boom machine as employed on various ditch excavation, handling a drag line bucket.

Cast Iron Pipe, Lamp Posts, Fountains, Etc.—Cloth, 9½x12¼ ins., 256 pp. J. B. Clow & Sons, Chicago.

This is one of the most complete general catalogs of cast iron products ever published. It is illustrated with views of the separate pieces in stock, and each view is accompanied by a description and a table of dimensions, weights and prices. The book contains cast iron pipe and specials, valves, hydrants, manholes, sewer inlets, gratings, lamp posts, lawn and drinking fountains.

Portable Pumping Machinery.—Folder, 6x10½ ins. The Water Works Equipment Co., 50 Church St., New York.

A circular, illustrating and describing a portable gasoline engine pumping outfit for excavation and sewage work.

The Machinery List.—Paper, 4x6 ins., 36 pp. A. H. Hitchcock, 1220-1235 Caxton Bldg., Chicago.

A reference list of machinery published monthly for buyers.

Chicago A.-A. Cement.—Paper, 6x9 ins., 48 pp. Chicago Portland Cement Co., 30 N. LaSalle St., Chicago.

A catalog of illustrations and descriptions of structures built with Chicago A.-A. cement.

Reinforced Concrete Poles.—Paper, 6x9 ins., 60 pp. Chicago Portland Cement Co., 30 N. LaSalle St., Chicago.

Containing interesting and useful reprints (illustrated) from Bulletin No. 25, published by the Association of American Portland Cement Manufacturers. The articles deal with the history and development of concrete poles and contain tests and methods of construction of various types.

Universal Cement.—Paper, 6x9 ins., 20 pp. Universal Portland Cement Co., 72 W. Adams St., Chicago.

This is the regular monthly bulletin for April, 1911, containing illustrations and descriptions of structures which have been made with Universal Cement.

Chesterman Tapes and Engineers' Tools.—Paper, 5½x8⅝ ins., 64 pp. Jas. Chesterman & Co., Ltd., Sheffield, England, and Weibusch & Hilger, Ltd., agents for United States, 108 La Fayette St., New York.

This catalog contains a complete list of measuring tools for engineers. Tables of sizes and prices are given.

Surveying Instruments.—Paper, 5¾x8¾ ins., 4 pp. Keuffel & Esser Co., 127 Fulton St., New York.

Giving illustrations, descriptions and prices of four selected types of field instruments, the entire line of which is shown in the 550-page catalog.

Aggregate.—Paper, 6x9 ins., 16 pp. Edison Portland Cement Co., St. James Bldg., New York.

The monthly bulletin describing work on the Fourth Avenue Subway, Brooklyn, and in various structures using Edison cement.

Sullivan Air Compressors.—Paper, 6x9 ins., 20 pp. Sullivan Machinery Co., 122 S. Michigan Ave., Chicago.

Giving descriptions of Sullivan straight-line air compressors, with simple steam and two-stage air cylinders. Half-tone illustrations and line drawings are given, also tables of general dimensions and weights. This is bulletin 58-J.

Steam Turbines and Generators.—Paper, 7⅛x10½ ins., 32 pp. Allis-Chalmers Co., Milwaukee, Wis.

This catalog contains complete and detailed descriptions of steam turbines and generators, amply illustrated. This is bulletin No. 1079.

Centrifugal Pumps.—Paper, 7⅞x10½ ins., 20 pp. Allis-Chalmers Company, Milwaukee, Wis.

This is bulletin No. 1624, a catalog of standard single stage centrifugal pumps. Illustrations and line drawings showing parts are given.

Foundry Equipment.—Paper, 8½x11 ins., 4 pp. Hanna Engineering Works, 2057 Elston Ave., Chicago.

Illustrating shakers, sand blasts, molding machines and other equipment.

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week.

As far as the letting of large railroad construction contracts is concerned, the past week has been on the punk. Very few contracts of any size seem to have been let. The Chicago, Rock Island & Pacific, which opened bids April 24 for a new 70-mile line in Iowa, has not as yet awarded the contract and will probably not do so before Wednesday. The officials of the Grand Trunk Ry. at last reports were also still considering the bids received for the first section of its new line in Vermont.

Among the railroad construction jobs let recently are the following: Costello Bros., Indianapolis, Ind., 200,000 cu. yds. of steam shovel work for the Big Four R. R. in Ohio; Alex McGavock, Minnesota City, Minn., for about 300,000 cu. yds. team and steam shovel work for second track for the Erie R. R. in Ohio; C. J. McKinney, Knoxville, Tenn., subcontract for two tunnels—one 1,800 ft. and one 500 ft.—on the Lexington & Eastern extension in Breathitt county, Ky.; Johnson Construction Co., Amarillo, Tex., for grading work for an extension of the Atchison, Topeka & Santa Fe's D., E. & G. line from Belvidere into Dodge City, Kan.; E. T. Johnson, Portland, Ore., for three miles of logging railway in Oregon for the Booth-Kelly Lumber Co.; Keystone State Construction Co., for the grading and masonry work for the double track extension of the Philadelphia & Western Ry. (electric) between Villanova, Pa., and the Schuylkill River; Bates & Rogers Construction Co., Chicago, Ill., for constructing a subway at Washington St., Spokane, Wash., on the Chicago, Milwaukee & Puget Sound Ry.

Bids were opened April 24 by the U. S. Engineer at Detroit, Mich., for one of the largest government dredging contracts of the year. The work was divided into two sections—dredging 792,000 cu. yds. from Sec. 1, Saginaw River, and 2,233,000 cu. yds. from Sec. 2, Saginaw River. Breymann Bros., Toledo, O., at 12⅞ cts. and 17 cts. respectively, were low bidders on both sections. Another large government dredging contract, now being advertised, calls for 1,910,000 cu. yds. of dredging for the channel at Newport News, Va. Bids for this work are to be opened May 15.

Convi
Costs

The state senate of Colorado has passed the bill providing for a bond issue of $4,000,000 for the construction by the state of a tunnel through the Rocky Mountains, to be leased to the Moffatt road. The bill was amended so that the question of issuing the bonds will be voted on by the citizens of the state.

Extensive harbor improvements are planned by the government of Chile for the cities of Valparaiso and San Antonio. About $15,000,000 is to be expended on this work. Bids are to be opened July 22.

In the line of government irrigation work, the largest contract for a number of months appears to be the one for the construction of the Kachess dam for the Yakima project in Washington. Bids for this work were opened April 15, the Far West Construction Co., Tacoma, Wash., being the low bidder at $394,100.

It is "rumored" that the Board of Rapid Transit Commissioners of New York city is about ready to take definite action regarding the construction of the new subway systems, bids for which were opened many moons ago. Should there be anything in this rumor it will mean busy days for the successful contractors. Anyway if nothing happens bids are to be opened by the city on May 16 for about the most extensive piece of rock tunnel work for municipal purposes that has ever been undertaken.

At a recent meeting of the Mississippi River Commission, Col. Sidney F. Lewis of the Orleans Levee Board, New Orleans, stated that $1,000,000 more is to be spent to complete plans already mapped out for the completion of improvements on the levee system in the New Orleans harbor.

A good sized highway contract is now being advertised by the Maryland State Road Commission, Baltimore, Md. The work calls for the construction of 57 miles of roadway and concrete bridges.

The Missouri, Kansas & Texas R. R. has asked the Board of Railway Commissioners of Kansas for authority to issue $107,000,000 bonds, of which $82,000,000 will be for refunding and $25,000,000 will be sold to pay for improvements.

Advertising for a Mayor.

An ex-congressman in a recent speech before the members of the Chamber of Commerce of Pittsburg, Pa., prophesied that the day will come when the cities of this country will advertise for a mayor, just as a merchant advertises for a good clerk, salesman or book keeper. He asserted that the time will come when men will be trained to manage municipal affairs just as at present they are trained to manage business affairs. The idea put forward was that the municipally trained man would start in as mayor of some small city, and if he made good there he would advance to a similar position in a larger city and so on up the line. This plan is not so revolutionary as it may seem. In fact, the mayors of many German cities are selected in this manner. In that country when a vacancy occurs in the position of mayor, the city council sends out notices that applications for the position will be received up to a certain date. Then the candidates are put through an examination and the one making the best showing as regards experience and results obtained in his former positions is selected. Although the plan has worked well in Germany, it will doubtless be many years before the cities of this country will be willing to change from the professional politician to the professional office holder.

Scientific Management.

When Mr. Brandeis in the rate case hearing before the Interstate Commerce Commission stated that scientific management would save $1,000,000 a day to the railroads, the general public pricked up its ears, kicked itself in the shins and said here is something decidedly new. Later on when the magazine articles began to blossom out it was shown that the principles of scientific management had been applied to many classes of work for a number of years. In fact some of these principles were understood over half a century ago, as the following extracts from one of the first books on road construction published in this country show: "Labor by the day is always less profitable than that done by the piece, in which each man's skill and industry receive proportionate rewards. . . . The laborers hired by the deputy in each town should be employed by piece work as far as possible. This can be carried out to a great extent when the superintendent is competent to measure accurately the various descriptions of work, and to estimate their comparative difficulty. When the work cannot be properly executed by portions allotted to one man, it may be taken by gangs of four or five, who should form their own associations, make a common bargain, and divide the pay." This was written some 60 or 70 years ago, just about the time of the invention of the steam shovel, to which the author refers as follows: "Steam has been applied to excavation and a machine constructed which can dig and load 1,000 cu. yds. per day, in favorable soil, at an annual cost, including interest, wear and tear, labor, etc., of $7,500, making the cost per cubic yard $\frac{\$7{,}500}{300\times1{,}000}=2\frac{1}{2}$ cents."

When's Rock.

Quite often in construction work there arises a difference of opinion between the man who is paying for the work and the man who is doing the work as to the definition of rock. In many cases this difference of opinion furnishes a job for the lawyers and in the resulting law suit both parties usually learn that the term rock is susceptible of as many definitions as there are expert witnesses. The city of Chicago, some months ago, had a little misunderstanding as regards shale rock. Possibly with a view to the prevention of future misunderstandings of this sort, the Board of Local improvements of that city in its specifications "for the materials and construction of sewers" has incorporated the following:

> Wherever the word "rock" occurs in these specifications it shall be interpreted to mean any material geologically in place and of a hardness when first exposed of three or greater in the scale of mineral hardness which corresponds to the hardness of the transparent variety of calcite. Other materials shall not be classed as rock, although it may be more economical to remove the same by blasting.

Levee Work.

New methods of constructing levees are so rare that when anything of the kind occurs it is worthy of notice. Just at present a contractor for a large levee in the south is employing methods somewhat out of the ordinary. The work required the draining of two large lakes. Instead of digging a ditch and cutting through the existing levee for an outlet, the contractor used specially designed siphons of large size for removing the water from the lakes. The other innovation consists of the use of a steam shovel outfit in building the levee. The dirt is excavated by the shovel some five or six miles from the site of the levee, loaded in cars and hauled by locomotives over track laid for the purpose to the levee, where it is dumped in place.

A Bouquet for the Mule.

Many contractors swear by (and at) the mule for all kinds of earth moving operations. Such contractors may be interested in the following [illegible] which appeared in the Line-o'-Type column of the Chicago Tribune:

> Overland Limited, April [illegible] grading outfit. They were hauling gravel in [illegible] Some wagons were [illegible] others by two mules. [illegible] conduct is exemplary and his ability warrants it, he is promoted [illegible] mule. MIKE

RAILWAYS, STEAM AND ELECTRIC

Alabama.

Advices from Bay Minette, Ala., state that Milton Smith, President Louisville & Nassville, Louisville, Ky., H. Walters, Chairman, Board of Directors, and B. M. Starks, Louisville, Ky., General Manager, recently made a careful examination of the survey for the proposed extension of the Fort Morgan R. R. from Foley to the Fort in the extreme southwestern point of Baldwin County.

The National Lands & Orchards Co. has been incorporated with a capital stock of $100,000. The incorporators are G. B. Hengen of Chicago and J. M. Rodger and R. E. Gwinn of Des Moines, Iowa. The company will do a general land business, and the incorporation papers also give it the right to construct street railways and operate steamship lines if the business should demand it. The Mobile, Ala., representative of the concern is E. X. Bixler, Jr.

Arizona.

Board of Directors of the El Paso & Southwestern Ry. Co., has passed resolution agreeing to purchase the property acquired for terminal site and right of way for the extension to Tucson, in event the extension is decided upon. Walter Douglas, Bisbee, Ariz., is Vice President.

Arkansas.

Permission has been granted the directors of the Wilson Northern Ry. Co., to amend their charter to extend the road both on the north and south. The northern extension, according to the amended articles, will extend from the northern terminus at Keiser and extend in a northeasterly direction until connection is established with the Jonesboro, Lake City and Eastern Railroad at, or near, the town of Ross, a distance of 8½ miles. The cost of this extension was estimated to be about $100,000, and the capital stock was accordingly increased from $100,000 to $200,000. The southern extension will start with the southern terminus, which is the town of Wilson, and will extend 36 miles through Mississippi and Crittenden counties to Bridge Junction in Crittenden county. The estimated cost of this extension is $800,000, and the capital stock is increased from $200,000 to $1,000,000. It is stated that 5 per cent of the increase is paid up. H. H. Brown, Bardstown, Ark., is Chief Engineer.

The Kansas City & Memphis Ry. Co. has absorbed the Arkansas, Oklahoma & Western R. R. and the Monte Ne Ry., and has assumed entire control and management of both these properties. Geo. D. Locke, Rogers, Ark., is President.

We are advised that the report the Missouri Pacific Ry. would extend its line from Womble to Greenwood, is incorrect. The work is not contemplated by the company.

Special meeting of the stockholders of the Fort Smith Light & Traction Co. was held on May 1 to take action on issuing $6,000,000 of bonds. Extensive betterment work is planned by the company. J. Walter Gillette, Fort Smith, Ark., is general manager.

Citizens of Marianna, Moro, Brinkley and Oak Forest are taking steps to secure the construction of a railroad from Marianna to Brinkley via Oak Forest and Moro.

Little Rock Items.

BY A. B. KOENIG.

⦿Contracts have been let for the construction of two big drainage ditches, one petitioned for by J. R. Wulff and others and the other by C. F. Prange and others. The Wulff ditch will drain 18,823 acres of land lying within the bounds of Morris township and many thousand acres in other townships. J. W. Wright, T. W. Keaton, J. B. Capps, M. Rollison and L. P. Bracy are the contractors. The price is $27,33[illegible]. The C. F. Prange ditch is not nearly as large and the contract was let to A. A. Trindall and C. F. Prange. The ditch will drain only 5,049 acres and cost $7,873.96.

⦿The Little Rock school board let to Contractor George W. Fair the contract for the erection of the annex to the Little Rock high school, which is to cost in the neighborhood of $27,000. The plans for this addition were drawn by Frank W. Gibb, and do not involve the new high school building which is to be erected on the same block, plans for which are now being drawn by George R. Mann.

It is reported that the Kansas City Southern R. R. plans a north and south road through Benton county, Ark., with Joplin as the northern terminal. It is also believed that it intends to use the Kansas City and Memphis road to reach some of the towns in that county. Rogers, Bentonville and several other cities are supposed to be placed on the proposed line.

The Missouri & North Arkansas R. R. is in a fair way to get the property of the Newman Coal and Ice Co. of Helena and will erect a $25,000 depot; additional trackage will also be laid.

The Missouri, Arkansas & Gulf, a new railroad, obtained a charter from the secretary of state of Missouri. The proposed road will extend from Rolla, Mo., to Bakersfield and is to be capitalized at $2,000,000. The distance is 125 miles.

Judge Light of Paragould disposed of the final hearing of reports on the proposed Greene and Lawrence county drainage ditch, which is designed to drain about 100,000 acres of land in two counties. The contracts for the construction will be let some time in May.

A bill carrying an appropriation of $672,000 for the completion of the Arkansas state capitol building has been introduced. Will publish proceedings as to this bill as soon as passed.

A bill creating Jefferson county into an improvement district for the purpose of authorizing and providing for the construction of a bridge over the Arkansas river, near Pine Bluff, was passed by the House. The new enterprise is even a larger construction project than that authorized by the legislature two years ago, when it authorized the construction of a bridge between Fort Smith and Van Buren. It is understood that the bridge will be not only a free bridge for ordinary traffic by wagons and on foot across the river at that point, but will be sufficiently substantial as an engineering proposition to accommodate railroad traffic in addition. Combining the two propositions the bridge would probably cost $500,000 to $750,000.

L. A. Busby has 10 first class teams to put on a grading, levee or other kind of proposition. Address care of Koenig's Labor Agency, Little Rock, Ark.

Ed. McKenna, in charge of M. J. Coles' work on the Van Buren levee, reports very favorable progress, having moved the record amount of dirt for like amount of teams for any one month.

W. R. Stewart, one of Little Rock's best known contractors, died here last week. He was president of the Stewart-McGehee Construction Co.

Articles of incorporation were filed with the secretary of state by the Spring River Power Co. of Jonesboro, a corporation that intends to harness Spring River and build a series of dams for developing power for domestic use and manufacturing. The capital stock is placed at $100,000, of which $70,000 has been subscribed. The directors are W. H. Vaughn, J. D. Browne, W. W. Fisher, James E. Parr and F. R. Lang.

The directors of the Wilson Northern Ry. Co. announce that they have been given permission by the state board of railroad incorporations to amend their charter to extend the road both on the north and south. The northern extension, according to the amended articles, will extend from their northern terminus at Keiser and will extend in a northeasterly direction until connection is established with the Jonesboro, Lake City & Eastern Ry. at Ross, a distance of 8½ miles. The cost of this extension is estimated at about $100,000 and the capital stock was accordingly increased from $100,000 to $200,000. The southern extension will start with the southern terminus, which is the town of Wilson, and will extend 36 miles through Mississippi county, through Crittenden county to Bridge Junction. The estimated cost of this extension is $800,000 and the capital stock is increased from $200 000 to $1,000,000. It is stated that 5 per cent of the increase is piled up.

Among the important bills approved by the governor of Arkansas is that authorizing the Argenta street railway to build a bridge over the Arkansas River at this point, connecting Little Rock and Argenta. The bridge is to be used as a street car bridge, but if suitable arrangements can be made with the county authorities it may also be used as a free bridge for ordinary traffic between two cities. It will be necessary to have the consent of the government engineer as to the exact location of this bridge, as the Arkansas River is navigable and navigation must not be obstructed.

One hundred thousand dollars has been appropriated by a bill passed in the house for an annex to the asylum for the insane.

Contractors, when in Little Rock call at Koenig's Labor Agency, 107 N. Main St., and get acquainted with "Do It Now" Jack Gordner, the manager here.

California.

It is rumored in San Francisco, Cal., that the Western Pacific may build a branch line from Keddie into Indian Valley, Plumas County, tapping the big mineral and timber resources of that district.

The Southern Pacific Ry. has applied to the City Council of Los Angeles, Cal., for a franchise for its third track on Alhambra Ave. from the river to East Lake Ave.

The Southern Pacific has applied to the City Trustees of Redwood City, Cal., for a 51-year franchise for a double track through the city and for extensions to the Woodside District. It is believed in that city that it is part of the new work planned by the company to cover all parts of the peninsula.

It has been announced that construction work will be commenced as soon as right of way can be obtained for the Southern Pacific line from Arbuckle up to Hamilton City, Cal. It is thought that the river route will be made the main line. Wm. Hood, San Francisco, Cal., is Chief Engineer.

Plans are being made, according to advices from Anderson, Cal., for the construction of a railroad from Ingot, Cal., to connect with the Bella Vista & Anderson Railroad. Work will be started this summer.

A meeting of the promoters of the Inter-Counties R. R. Co. has been held at Modesto to complete plans for the organization of a $5,000,000 company to build electric lines throughout the San Joaquin valley. Several electric railroad companies are interested in the scheme and if the plans carry, the entire San Joaquin valley will be connected with the Sacramento valley by a network of electric lines. Among the railroad companies interested are the Oakland & Antioch, now building from Oakland to Stockton, and the Tidewater & Southern, building from Stockton to Modesto. The plan of the company is to build from Modesto to Bakersfield, on the east side of the valley, and also to build down the west side. If this can be done the San Joaquin and Sacramento valleys will be linked together by electric lines, as the new company will be able to connect with the Tidewater & Southern to Stockton and with the Northern Electric into

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

the Sacramento valley. A. W. Maltby, Concord, Cal., and Joseph F. Peters, Stockton, Cal., are interested in the proposition.

The Hanford & Summit Lake Ry. Co. of Hanford has filed amended articles of incorporation, extending the length of the proposed road 50 miles. The road will connect Hanford with a point on the Southern Pacific Ry. about three miles west of Jamison in Fresno county.

The Pacific Electric Ry. Co., Los Angeles, Cal., has taken bids for the construction of an extension from 4th St., Glendale, to Burbank, a distance of 4½ miles. The improvement will approximate $200,000.

The Inglewood Board of Trade has appointed a committee to confer with the officials of the Pacific Electric Ry. Co., Los Angeles, in an effort to secure the building of a line through Inglewood.

Colorado.

The Colorado Midland Ry. has plans under consideration, providing the proposed tunnel under Gray's Peak is built and all roads permitted to use it for the construction of extension from the present terminus at Grand Junction, Colo., to Salt Lake City, Utah. F. F. Mallon, Colorado City, Colo., is Chief Engineer of the railway.

Engineers are now at work in the Juan Jose Lobato grant, Rio Arriba county, recently purchased by E. B. Skinner and J. W. Mullen of Colorado Springs, running a permanent line for a railroad from Chamita, on the Rio Grande, up the Chama and Rio del Oso to Gallina and the continental divide. This line would open a large tract of timber and be the most difficult link in a railroad from Durango, Colo., and Farmington, San Juan county, to Santa Fe.

The Colorado-Kansas Ry. Co. of Pueblo has been incorporated with a capital stock of $500,000. The directors for the first year are J. F. Springfield, C. E. Sutton, F. G. Kelley, A. Henley, A. McClelland, R. K. Potter, E. W. Wilson, Scott Hopkins, Asbury White.

It is expected that the Colorado & Southern Ry., H. W. Cowan, chief engineer, Denver, Colo., will begin laying track on the main line of the extension from Wellington to Cheyenne about June 1 and will have the work completed early in July. Contractors for the grading are making rapid progress.

The State Senate has passed the bill providing for the issuance of $4,000,000 of bonds for the construction by the state of a tunnel through the Rocky Mountains, to be leased to the Denver, Northwestern & Pacific Ry. (Moffat road). The bill was amended so as to submit the question of issuing the bonds to a vote of the citizens of the state.

Cuba.

The directors of the United Railways of Havana and Regla Warehouses, Ltd., have sanctioned an increase in the capital of $10,000,000 to be devoted to the purchase of $2,500,000 of Havana Central Railroad Co.'s notes, due July 1; the development of the terminal at Matanzas and the purchase of rolling stock and equipment.

Florida.

⊙The King Lumber Co., Charlottesville, Va., has been awarded the contract for the erection of the union station at Tampa for the Tampa Union Station Co., C. H. Hix, president, Portsmouth, Va. The building will cost about $280,000.

The Tampa & Jacksonville Ry., A. L. Glass, General Manager, Gainesville, Fla., proposes to build a 21-mile extension from Fairfield to Ocala.

The Ocala Northern R. R., E. P. Rentz, president, Ocala, Fla., has received 60-lb. rails and will shortly begin laying them from Fort McCoy to Palatka. The grade for the section has been completed for some time.

The Jacksonville Traction Co., Jacksonville, Fla., has taken over all property of the Jacksonville Electric Co. The first named company was formed to finance the extensive improvements that are now under course of construction and requiring immediate attention and others which will require attention at a later date.

Georgia.

Citizens of Sandersville, Ga., are taking much interest in the projected route of the proposed Brinson Railroad. The line will probably run from Louisville to Sandersville, connecting with the Athens & Waycross R. R., thence through Waynesboro to Milledgeville.

The first spike in the construction of the Hawkinsville & Western R. R. was driven at Hawkinsville on April 21. This road is being built to Fort Valley via Perry, Ga. It connects at Fort Valley with the Southern's Atlanta and Florida branch.

Illinois.

The Chicago & Eastern Illinois R. R. is reported to be planning to build an extension from Ridenour to Metropolis, Ill.

The Chicago, Burlington & Quincy R. R. is said to be planning to build a second track between Lewistown and Arenzville.

The Waukegan, Rockford & Elgin Electric Ry. Co., which has completed its line from Palatine to Wauconda, Ill., intends to push the line east to Waukegan and north into Wisconsin in the near future. Justin K. Orvis, Waukegan, Ill., is the promoter.

The Rockford & Interurban Ry., operating the interurban line between Rockford, Ill., and Janesville, Wis., has increased its capital stock by nearly $3,000,000. It is thought that part of this increase will be used to build an interurban line from Janesville to Madison.

A project is under consideration at Galesburg for the construction of an interurban line from that city to Galva. It is proposed to organize a local company to build and operate the line. J. D. McKnight, Galesburg, is interested.

The Chicago, Rock Island & Pacific Ry. is reported to have approved plans for improvements at Rock Island to cost about $250,000. These plans are said to call for a complete reconstruction of the freight yards between the government bridge and the 40th St. viaduct. Under the present system all of the freight trains come in and out of the yards on the main tracks, which pass immediately in front of the 31st St. passenger station. This is to be changed and the yards are to be reconstructed and the freight trains run in and out over main tracks to be laid past the Rock Island roundhouse and over the ground where the present coal chutes are located.

Indiana.

The Vincennes North & South Traction Co. of Vincennes, the incorporation of which was mentioned in our last issue, proposes to build an interurban between Decker and Sullivan, thus almost closing up the gap between Evansville and Terre Haute of the interurban system in southwestern Indiana. Edward T. Lagsdon, Indianapolis, is primarily interested in this line.

The commissioners of Knox county have decided that an election shall be held in Vincennes township on May 19, to decide whether a 1 per cent subsidy shall be granted the Vincennes, Washington & Eastern Traction Co., a 1 per cent subsidy be granted the Vincennes North & South Traction Co., and a three-fourths of 1 per cent subsidy to the Vincennes Interstate Traction Co. An election is also called for May 19 in Palmyra and Steen township to vote on the proposition of granting a 1 per cent subsidy to the Vincennes, Washington & Eastern Traction Co.

Proposition is under consideration for the construction of a railroad from Converse to Somerset, a small town near Wabash, and points to the northwest, as an opening for the market of stone and gravel through that section of the country. As projected the road would probably follow very closely the Grant-Miami county line. A crossing of the Mississinewa River would have to be made. L. O. Arnold, Converse, Ind., is interested.

The Circuit Terminal Ry. Co. of Indianapolis is to increase its capital stock from $100,000 to $3,000,000. This company proposes a line which is to circle Indianapolis, touching at the county seats of the seven counties next around Marion county. It is said the first link will be put in between Indianapolis and Lebanon. Work is expected to be begun in May. Surveys are now under way by John Schaefer. U. Z. Wiley, Indianapolis, Ind., is attorney for the company.

A company is being organized at Richmond under the auspices of the Commercial Club for the purpose of making a preliminary survey and securing rights for a proposed electric railway from that city to Cincinnati. It is said that the capital stock will be $50,000 and that this will be used for the preliminary work. This project was mentioned in our last issue.

The property of the Indianapolis, Newcastle & Toledo Electric Ry. Co. has been purchased at a sheriff's sale by William E. Stevenson and David M. Parry, who held $2,438,000 worth of the first mortgage bonds of the company. This is understood to be the first step in the organization of a company which will extend the line into Muncie from Newcastle. The tentative plans are to rush the work of obtaining the right of way between Newcastle and Muncie that has not been obtained already. Entrance to Muncie will be made through the south part of the city, connecting with the city tracks of the Indiana Union Traction Co. and entering the terminal station. As soon as the Muncie extension is built it is the intention of those backing the new company to build to Richmond from Newcastle.

Iowa.

Orders have been received at Mason City, Ia., according to reports, for the reconstruction of the Iowa & Dakota division of the Chicago, Milwaukee & St. Paul R. R. between Mason City and Mitchell, S. Dak., with 85-lb. rails and the strengthening of bridges. The road between those points is now equipped with 65-lb. rails. R. E. Pauley, Mason City, Ia., is Assistant Engineer.

It is reported in Atlanta, Ia., that Col. G. W. Adams, Council Bluffs, Ia., is taking steps to interest the necessary capital for taking over the line of the Atlantic Northern & Southern Ry. and make it a part of the proposed Omaha & Iowa Short Line Ry., mentioned in our last issue. It is proposed to extend the line from Council Bluffs by way of Tracer, Red Oak, Pela, Adel to Des Moines.

Surveys have been made for an extension of the street railway system at Des Moines to Waveland Park.

Kansas.

⊙The Atchison, Topeka & San Fe Ry. is reported to have awarded a contract to the Johnson Construction Co., Amarillo, Tex., for the grading work for an extension of its D. E. & G. line from Belvider into Dodge City.

The Missouri, Kansas & Texas R. R. Co. has applied to the board of railroad commissioners for authority to issue $107,000,000 in bonds, $82,000,000 of which will be to take up outstanding debts and $25,000,000 for improvements. The line from Kansas City to Parsons will be straightened until it will be almost an air line, and several new bridges and much new steel will be laid. From Parsons through Oklahoma a double track will be laid. Nearly all the $25,000,000 in improvements will be spent in Kansas and Oklahoma. S. B. Fisher, St. Louis, Mo., is chief engineer.

Kentucky.

⊙C. J. McKinney, Knoxville, Tenn., has taken a sub contract for the construction of two tunnels on the Lexington & Eastern Ry. extension in Breathitt county. The contract includes a 1,800-ft. tunnel and a 500-ft. tunnel.

Surveys are under way for a new route for the Kentucky Central R. R., which will extend from the new town being built on the Kentucky side of the Ohio river opposite Evansville to Henderson, Ky., a distance of about ten miles. It is understood that the extension will not end at the new town, but will proceed down the river to a point opposite the

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Louisville & Nashville terminals on the Indiana side. James Saunders, Evansville, Ind., is the engineer.

Promoters of the Chicago, Memphis & Gulf R. R., S. G. Latta, president, Dyersburg, Tenn., have completed surveys to Paducah for the proposed extension from Hickman. As noted in our last issue the railroad company has filed amended articles of incorporation providing for this extension.

The Mountain Central Ry., J. C. M. Day, general manager, Winchester, Ky., is stated to be planning to have work started this month on an extension from Campton to Hazel Green, a distance of 10 miles.

The Ryan Co., Portsmouth, O., which has five miles of railroad work on Shelby Creek, Ky., as noted in our March 29 issue, has one short tunnel to sublet; also considerable car and cart work to sublet. The post office address of the Ryan Co. for this work is Virgil, Ky.

The Barcus Construction Co., Watertown, Ky., has a 15-team and machine outfit at that place and is looking for a contract.

Louisiana.

The streets and landings committee of the city council of New Orleans, La., has taken up an ordinance providing for the sale of the franchise to build a double electric street car line on Claiborne St. from Napoleon Ave. to the upper portion of the parish of Orleans.

Regarding the double track work of the Illinois Central R. R., we are advised that the company now has double track in operation to Ponchatula, La., and also from Orleans Junction, which is 12 miles north of New Orleans, to the latter city, leaving a gap of 37 miles from Ponchatula to Orleans Junction, which it is proposed to complete this season. From Ponchatula to Frenier, a distance of 24 miles, the grading is completed and the track laid with a light rail, which has been used more or less for freight service. It is proposed to relay this 24 miles with new 90-lb. rail and ballast it with gravel from Brookhaven, Miss., so as to put it in first class shape for both passenger and freight service, which work is now under way. Some work has already been done on five miles of the remaining 13, which work will be completed, as well as the 8 miles on which no work has been done. The new work is through the swamp, where it is impossible to do grading in the usual manner, for which reason the work will not be contracted, but the filling will be hauled in by train and the work done by company forces. A. S. Baldwin, Chicago, Ill., is chief engineer of the Illinois Central R. R.

We are advised that the Louisana & Arkansas Ry. Co. has made no surveys for any extension from Jamestown to Ringgold, La.

F. W. Crosby, New Orleans, La., president of the Southwestern Traction Co., has applied to the city council of New Iberia, La., for a franchise over several streets for the use of a trolley line, and the imposition of a 2-mill tax for ten years in aid of the project. Under the city charter the application will be referred to the electorate. The idea of the promoters is to build a trolley system, with New Iberia as the hub, and radiating to the four points of the compass. The building of a summer and winter resort at Spanish Lake is also contemplated.

Advices from New Orleans state that the St. Louis & San Francisco R. R. has obtained a 99 year lease on the Louisiana Southern Ry. running about 30 miles south from New Orleans along the Mississippi river to Relaire.

Committees have been in conference with the management of the Liberty-White R. R. in an effort to get that company to extend its road from Liberty to Gloster, a distance of 14 miles. W. M. White, McComb, Miss., is president Liberty-White R. R.

Maine.

Considerable railroad construction work in northern Maine is planned for the present season. It is understood that A. R. Gould, Presque Isle, Me., president of the Aroostook Valley R. R. (electric), has announced that that road will build 100 miles of new line this summer unless something occurs to interfere with the present program. Mr. Gould and his associates have charter rights covering a continuous line from the tide water at St. John diagonally across the province of New Brunswick to Andover parish on the St. John river, thence to Presque Isle and Washburn, the last named section being already built and running; thence due west across the state of Maine and Montmagny, Bellechasse and Levis counties in the province of Quebec to the Quebec bridge across the St. Lawrence river. The Aroostook Valley route from Quebec to St. John is only 375 miles in length, as compared with 578 miles via the Intercolonial line, which swings up around the Maine border, but stays entirely on Canadian soil. Another piece of construction work which it is understood will be undertaken this year is the building of the Allagash extension of the Bangor & Aroostook R. R., M. Burpee, chief engineer, Houlton, Me. This extension calls for an estimated expenditure of over $7,750,000 and for about 157 miles of new track.

The Maine Central R. R. has sold $1,500,000 one year 4 per cent notes, dated April 1, 1911. The proceeds will be held to pay off in cash the $500,000 of 5 per cent four year notes maturing June 1.

Maryland.

The Western Maryland Ry., H. R. Pratt, Chief Engineer, Baltimore, Md., will shortly begin the erection of an additional open pier at Port Covington, Baltimore. The construction of another closed pier will also be started shortly.

Preliminary surveys for the proposed trolley line from Nanticoke have been finished to Sharpstown, Md. The survey was begun several months ago, but has been delayed by bad weather. The proposed route passes through Quantico, Hebron, Spring Hill and Columbia. The business men of Laurel, Del., have offered the promoters of the road $10,000 to tap the road at Sharpstown and run a branch into Laurel. An old charter has been brought to light, by the use of which the road can be run through Sussex county, Delaware. The right of way has been given in Delaware as well as in Maryand.

The Highways Commission of Baltimore county has granted a franchise to the Towson & Cockeysville Electric Ry. Co. for the construction of a line from Towson to Cockeysville.

Massachusetts.

The House has refused to admit for consideration by the present legislature the bill authorizing the Berkshire Street Ry. Co., owned by the New York, New Haven & Hartford R. R., to purchase the franchises and property of the Springfield street railway.

The Shelburne Falls & Colerain Street Ry. Co., Frank L. Read, general manager, Shelburne Falls, Mass., now operating 7 miles of line, proposes to build an extension from Colerain, Mass., to Wilmington, Vt.

The Connecticut Valley Street Ry. Co., Greenfield, Mass., is considering building a line from Millers Falls to Orange, 12 miles.

Michigan.

The Michigan United Rys. Co. (electric), Jackson, Mich., has purchased the Kalamazoo, Lake Shore & Chicago Ry., a steam road 60 miles in length, which connects South Haven, Mich., and Kalamazoo. It is stated that this road will be electrified and by means of a new electric line connection will be made with Benton Harbor, Mich.

Surveys have been completed into Saginaw for the proposed electric railway from Owosso to that city. Construction work on the line into Owosso is now under way and as soon as this is completed work will be started north to Saginaw. The Michigan United Rys., Jackson, Mich., is backing the project.

Minnesota.

Forrestal & Feyen, 308 Scandinavian-American Bank Bldg., St. Paul, Minn., have about 160 miles of road leveling to sublet. These roads are to be built along side of drainage ditches that Forrestal & Feyen are digging with their dredges in Marshall and Roseau counties, close to Thief River Falls, in the northwestern part of the state of Minnesota. They would like to let out this work to subcontractors who have teams and road graders, etc. It is believed that this would be good work for contractors who have been doing sub-contracts for railroads.

Good progress is reported by the Walsh Construction Co., Davenport, Ia., on their contract for ballasting the Canadian Northern from Duluth, Minn., to Virginia, work having been completed to a point near Eveleth, Minn. It is expected to have the road completed by September.

It is reported that Winston-Dear Co., Hibbing, Minn., is making good progress on its contract for constructing the Missabe line into Hibbing. The cut, which varies from 5 to 12 ft. was made in a very short time and preparations are now being made on the site for the new depot.

Duluth and the Ranges.

BY PETER E. MEAGHER

⊙P. McConnell, Duluth contractor, returned from a western trip recently and on his way back he stopped off at Crookston, Minn., and picked up a $60,000 paving contract. I understand he will start this work immediately.

⊙P. G. Pastoret of the Pastoret-Lawrence Co. was a caller at this office and reported that his firm had just been awarded a sewer contract at Brainerd, Minn., amounting to $10,000 and that they would start on this work immediately.

⊙The Zenith Dredge Co. of Duluth, Minn., was awarded a $16,000 dredge contract at Ashland, Wis., by the United States government; work to be started immediately.

Herbert Whelan, traveling representative for the Macomber & Whyte Rope Co., spent a few days with us here recently. He reported business satisfactory.

J. B. Mishler, railroad contractor, was a caller at this office last week. He said that he was not doing anything and that he was in the market for a contract suitable for a one-yard car outfit.

With the exception of the railroad work being done on the Canadian Northern Ry. into Duluth, there is no other construction work going on here at the present time. Stripping contractors on the iron range are getting their outfits in shape and will be working along full blast about May 10. At the present time there is no new work in sight in this territory and quite a few of the contractors are idle.

Any one having work to sublet, if they will write to Peter E. Meagher, 409 West Michigan street, Duluth, Minn., he will be glad to put subcontractors in touch with them.

W. F. Lawrence returned from a trip to West Montana, where he was bidding on some sewer and water-works contracts. Bill reported "nothing doing."

Mississippi.

The charter of the West Point & Houston Railroad Co. has been amended, changing the name of this corporation to the Scoona Valley & Southeastern R. R. Co. This company was chartered some time ago, and was granted a franchise to build through Calhoun, Chickasaw, Clay and Lowndes counties, the road to be completed in May, 1913. The eastern terminus of the road will be on the west bank of the Tombigbee River, where it will connect with another road to be built in Alabama and the western end of the road will be in Calhoun county, thus passing through three counties—Lowndes, Clay and Chickasaw—and part of Calhoun, in Mississippi. It was originally intended to build this line from the Tombigbee River to a point in the northeast corner of Nexubee county, but the scope of the plans has been changed to some extent with the name of the corporation.

Missouri.

It is rumored in Moberly, Mo., that the Chicago, Burlington & Quincy Ry. is taking steps toward the construction of the proposed line from St. Louis to Kansas City, Mo. Surveys for such a line were made last October. R. W. Willis, St. Louis, Mo., is District Engineer.

J. B. Davis has started work on his subcontract at Jaudon, Mo., for change of line and grade for the Kansas City Southern Ry. He is using slips, wheelers and machines.

Plans have been completed for the new union station to be erected at Kansas City by the Kansas City Terminal Co., W. S. Kinnear, president, and contractors are now reported to be figuring on the work. It is understood that the contract, which will amount to about $5,500,000, will be let as a whole and that work will be started by July 1.

The Springfield Lighting Co., of Springfield, Mo., has been sold to a New York syndicate represented by Harrison Williams of that city. It is understood that the companies, as far as Springfield is concerned, will undergo little change, as the new owners are reported as favoring the plan of building an interurban from Springfield west to Carthage.

The Commercial Club of Columbia, Mo., has pledged $10,000, completing the $70,000 bonus asked by the North Missouri Central electric line, projected from Columbia to Jefferson City.

Kansas City and Vicinity.

(REGULAR CORRESPONDENCE.)

⦿Daniel Hannefin of Marble Rock, Okla., has taken some team work on the Kansas City Southern near Joplin, Mo.

⦿The Acme Paving & Crusher Co., 716 Commerce Bldg., Kansas City, Mo., has secured a nice contract in the Country Club district of Kansas City. There is a considerable quantity of Rubel rock to be moved.

Practically all the railroad contractors in this city were in Chicago the past week attending the letting of the Rock Island work there. Some went to bid, others to see what they could do in the way of a sub-contract from the successful bidder. At this writing it is stated the successful contractor will not be announced before Tuesday, May 2. This statement, however, is unofficial.

The writer was in Chicago for a day during the past week. Conditions in the contract world there seem to be similar to Kansas City—slow in starting. The general feeling, however, seems to be that conditions will soon improve. In talking with our old friends, H. A. Clapp and H. F. Riley, the well known labor and machinery agents, we found that the movement of labor was extremely slow this spring, and the contract and railroad labor business is the most accurate barometer in the world by which to size up conditions generally. Nevertheless a slow but steady improvement is reported.

Mr. W. C. Williams, the well known team man of St. Paul, Kans., has moved his outfit on the Kansas City Southern work. He has about 60,000 yards to move. It is a grader proposition and Mr. Williams has purchased a new grader for the work at hand.

Mr. Joyce of the firm of Joyce Bros. & Bagwell met with a painful accident last week; a loaded wagon ran over his ankle. A severe sprain was the result; so severe that crutches will be popular with Mr. Joyce for some little time to come.

Mr. Brown of the firm of McGuire & Brown was a caller at our office today. Mr. Brown has just completed his work in the south part of the city at a handsome profit to his company.

St. Louis Items.

BY A. B. KOENIG.

⦿On the report made April 25 by the engineering department of the East Side Levee and Sanitary District, the trustees awarded the contract for the first three-mile section of the flood protection levee to J. A. Ware & Co. of St. Louis, the total of the contract to be $27,705. This is the first letting on the 20-mile flood protection levee which the trustees will construct along the river in front of East St. Louis. The section to be built under the contract just let is the three miles between Mitchell, Ill., and the new Cahokia Creek diversion channel. The trustees which the first contract completed by Sept. 1 and have planned to have six miles of the first levee completed by January, 1912. In a few days bids will be opened on the contract to construct five bridges for the five steam railroads that cross the Cahokia diversion channel. The contract will call for the expenditure of nearly $250,000 and the bridges are to be completed this year.

⦿The following contracts for street improvements were let Friday by the Board of Public Improvements: Arkansas Ave., between Miami St. and Potomac St., asphalt, Parker-Washington Co., $5,174.49; Virginia Ave., between Osage St. and Keokuk St., asphalt, Parker-Washington Co., $5,188.32; Mary Ave., between Carter Ave. and Florissant Ave., asphalt, Parker-Washington Co., $5,391.86; Michigan Ave., between Bates St. and Eichelberger St., brick, Ruecking Construction Co, $7,866.20; Virginia Ave., between Potomac St. and Cherokee St., brick, William R. Bush Construction Co., $5,663.59; Clark Ave., between Prospect Ave. and Spring Ave., brick, Skrainka Construction Co., $5,230.17; Compton Ave., between Keokuk St. and Chippewa St., brick, Ruecking Construction Co., $5,328.07; Greer Ave., between Elliott Ave. and Glasgow Ave., brick, William H. Redemeyer, $2,492.06; Cottage Ave., between Grand Ave. and Spring Ave., bitulithic, Granite Bituminous Paving Co., $4,479.64; Twelfth St., between Hebert St. and Branch St., wood block, Gustavus A. Heman, $5,102.90; Brooklyn St., between Second St. and Broadway, granite, Heman Construction Co., $2,830.10; Mitchell Ave., between McCausland Ave. and city limits, Telford, John B. Turner, $2,660.45.

⦿Costello Bros. of Indianapolis, Ind., have been awarded 200,000 yds. of steam shovel work by the Big Four R. R. Co. in Ohio.

Wm. O'Connor is with us very nearly every day. He is looking for some rock work.

Young Mr. Walsh of the Walsh Construction Co. of Davenport, Ia., was with us a day last week. The company has secured several nice jobs in Illinois and Ohio since last issue.

Dan Hannefin bought another car load of horses in Kansas City last week, which he shipped on to his Kansas City Southern work at Gulfton, Mo.

Friday, May 19, has been selected as the date of the dinner which the Business Men's League will give to welcome to St. Louis Benjamin Bush, the new president of the Missouri Pacific railroad. The function will be held at the Southern Hotel, and Rolla Wells, president of the league, will be toastmaster. The league is planning for an attendance of 500 men, representing the mercantile, manufacturing and railroad interests of St. Louis, and several prominent financiers and railroad executives from out of town have been invited. Mr. Bush is expected in St. Louis Sunday and will take charge Monday.

Pat Hannon of Hannon & Hickey was in Kansas City last week getting out labor and supplies for their new Kansas City Southern work at Richards, Mo.

The Edwardsville (Ill.) Commercial Club was provided with plans of the Springfield & Central Illinois Traction Co., a proposed interurban from Springfield to southern Illinois, with a branch from Greenville to Edwardsville to connect with other lines for St. Louis. The plans were drafted by Isaac A. Smith of St. Louis, consulting engineer for the work. He pointed out the benefits he said would be derived from the operation of the road, as it will have no competitor, but work in conjunction with other steam and electric lines. Industries along the route are mentioned from which coal, freight and express may be handled. The line as proposed will be 320 miles long and come in with other systems, totaling 1,376 miles. Surveys over half the distance afford an estimate of $16,000 a mile for the construction of the new road. According to the last census 475,520 people live along the proposed line. The company is capitalized at $5,000,000.

L. J. Smith of the L. J. Smith Construction Co. is in Chicago on business.

A. E. Gilford has 25 teams idle. Address him care of Koenig's Labor Agency, 507 Bluff St., Kansas City, Mo.

L. W. Winter of Joplin, Mo., is getting out the timber for the false trestle work for the Lund Contracting Co., also for List & Gifford on the Kansas City Southern R. R.

Contractors, when in want of labor or a new contract, write Koenig's Labor agencies, 612 Walnut St., St. Louis, Mo.; 507 Bluff St., Kansas City, Mo., 107 N. Main St., Little Rock, Ark.; 65 Poplar Ave., Memphis, Tenn., 326 Victoria Ave., Pueblo, Colo.

Jim Cary of Cary Brothers was in town last Friday. He is one of the few levee contractors whom the high water has not affected so far and from the present outlook he doesn't think it will. Cary Brothers are fortunate enough to have work north of the Ohio River this year, as all contractors south of Cairo have been forced to lay up on account of high water. Cary Brothers can still use a few small outfits on their work. Address them Fordyce, Ill.

Costello Brothers have part of their outfit at work at Bicknell, Ind., on the new double track of the Pennsylvania R. R. They are also stripping a gravel pit for the Big Four R. R. at Cincinnati. They have finished their steam shovel work at Evansville, Ind.

The flood protection work of the Kaw Valley Drainage Board may be again tied up by a legal action instituted by property owners affected by the board's plans. This time the supreme court of the United States has been drawn into the controversy and the board will have to await a decision by that body in mandamus proceedings brought against Judge Smith McPherson of Red Oak, Ia., before it can proceed further. An order issued by the supreme court was served upon Judge McPherson last week by Willard P. Hall and Frank Hutchings, attorneys for the property owners, ordering him to show cause why he should not have called in two other judges before making his recent decision as to the constitutionality of an act of the Kansas legislature which gave the drainage board the power to condemn property and proceed with its work and fix the price to be paid for the property later. Judge McPherson made his answer in writing immediately and mailed it to the supreme court. It will probably be several weeks before the court renders a decision. The decision upon which the action was based was in favor of the drainage board, and made it practically impossible for the property owners to further tie up the work by appealing to the lower courts. It gave the board the power to proceed with its work, which had been held up months by suit after suit and injunction after injunction. The act of the legislature, which the decision declared unconstitutional, was for this purpose, as it gave the board the right to condemn the necessary property and proceed with the work and to award damages later, but as soon as it was passed the protesting property owners got an injunction from Judge Polloyk, restraining the state from enforcing it until the United States courts could decide upon its constitutionality. The property owners asked that this decision be rendered by two United States district judges and a judge of the United States court of appeals, sitting en banc. Instead of handling the matter in that way, however, Judge McPherson, then sitting in Kansas City, rendered the decision himself. It was upon this technicality that the mandamus proceedings are based. The attorneys for the property owners immediately asked the United State supreme court for permission to file a petition for a writ of mandamus, compelling Judge McPherson to show cause why this decision should be allowed to stand, as he had not called in two other judges as requested. The permission was granted, the petition filed and the order served on Judge McPherson last week was issued. If the supreme court should decide that Judge McPherson should have called in two other judges, the work of the drainage board may be tied up for several months, as another hearing upon the constitutionality of the act of the Kansas legislature probably will have to be held.

Big Jack McCaughey stopped off here a day on his way to Chicago. McCaughey Brothers are doing some work for the Baltimore & Ohio R. R. near Sherwood, O.

The Missouri, Kansas & Texas R. R. Co. applied to the board of railroad commissioners of Kansas on April 24 for authority to issue $107,000,000 in bonds, $82,000,000 of which will be to take up outstanding debts and $25,000,000 for improvements. The line from Kansas City to Parsons will be straightened until it will be almost an air line, and several new bridges and much new steel will be laid. From Parsons through Oklahoma a double track will be laid. Nearly all the $25,000,000 in improvements will be spent in Kansas and Oklahoma.

J. J. McInerney writes us from Horatio, Ark., that his 15-team outfit is idle at that point.

Interest in the improvement of highways is being promoted here by Charles P. Light, former state commissioner of public roads of West Virginia, and at present special representative of the American Association for Highway Improvement. Mr. Light conferred with Sam D. Capen, president of the Automobile Club of St. Louis, and representatives of the Missouri Pacific, Cotton Belt and Wabash railroads to arrange a systematic campaign for road improvement throughout the state. He departed for Washington, but will return in three weeks to meet the Business Men's League. Mr. Light proposed that the railroads furnish a special train, each road sharing the expense of operating, according to the mileage traveled over its line. The United States Office of Public Roads is to furnish a series of exhibits, including pictures and lantern slides, and to furnish lectures and demonstrators to accompany the train. The publicity work is to be carried on by the American Association for Highway Improvement, as well as the business details of the campaign. It is proposed that the State Highway Department as well as all good roads associations and organizations interested in the improvement of the highways, co-operate in their respective states by assisting in the publicity work, as well as the educational work, by the assignment of lecturers. Models of all forms of road materials and implements used in road construction are to be shown during the lectures, should the plan be adopted.

The Big Four R. R. Co. started track laying on April 17 on its new extension between Mt. Carmel, Ill., and Evansville, Ind. It is expected trains will be running on this line not later than July 15.

A resolution requesting the Public Service Commission to inform the House of Delegates regarding the "terms on which it is fair and equitable to grant a license or franchise to allow the Mississippi River Belt Railway & Transportation Co., a railroad corporation of Illinois, to use the lower deck or railroad portion of the municipal free bridge," was adopted by the House of Delegates Tuesday night, following its introduction by Delegate Eilers. The resolution mentioned specifically that the railroad corporation wished to observe all the rules and regulations which the Public Service Commission believed should govern the bridge and that its grant or franchise was in no way to be exclusive. The railroad corporation mentioned is known popularly as the Scherer road, being the corporation planned by Leo Scherer, an East St. Louis man, who at one time offered to give the city of St. Louis the right of way for an approach of the east side. The law department of St. Louis has been opposing the effort of this road to condemn a right of way on the east side, which the city contends would interfere with the construction of the bridge approaches as planned. The case is still pending in the courts, the city having applied for an injunction to restrain the proposed condemnation. At the same meeting of the House of Delegates, Delegate Laihy introduced a bill to repeal the franchise granted to the Southern Traction Co. to use the upper [illegible] of the municipal bridge for an electric interurban railroad. It had previously been announced that the Southern Traction Co. proposed to introduce at the present session of the assembly a bill granting a franchise for the use of the lower deck of the bridge for a steam railroad.

Bids for the reconstruction of Benton St. from Broadway to 20th St., also for the reconstruction of 21st St. from Washington Ave. to Cass Ave. and for the reconstruction of 25th St. from Cass Ave. to St. Louis Ave. will be received by the city of St. Louis, Room 300, New City Hall, until 12 m., May 5, 1911. Plans, specifications, form of bid and other information can be had at the office of the Board of Public Improvements.

T. J. Galley, general manager of the Daily Construction Co., left here for Chattanooga, Tenn., to begin work on the Chattanooga, Nashville & St. Louis R. R.

Frank McCaughey is on a small piece of work on the Burlington R. R. at Stoddart, Wis.

C. F. Nagel came to town the other day. Reports his rip-rap work fine and dandy.

Montana.

It is reported in Great Falls, Mont., that the Great Northern R. R. will soon start construction work on the branch line connecting that city with Augusta, passing through the territory of the Sun River Irrigation project. P. S. Hervin, Great Falls, Mont., is Resident Engineer.

The Silver Lake Gold Mining and Milling Co. has been organized at Butte, Mont, with a capital stock of $1,500,000 divided into 150,000 shares. The articles of incorporation, filed for record, provide for the company to carry on the business of mining, milling, etc., and permits it to purchase, construct, maintain, operate, own and develop railroads for public service, and for the conveyance of persons and property, worked by steam, electricity or any other motive power. The principal place of business for the corporation will be in Butte. The directors are Patrick Wall, Charles P. Nevin and C. S. Jackman of Butte; Frank Clinton and Thomas McGrath of Anaconda. Mr. Nevin is president of the company and Mr. Jackman secretary. Mr. Wall will be the managing director and Arthur V. Cory is the consulting engineer.

It is believed in Lewiston, Mont., that the Chicago, Milwaukee & Puget Sound is preparing to start steel laying during May on the lines from Lewiston to Kendall Junction and Grass Range.

The proposed cutoff of the Oregon Short Line from Dillon toward Twin Bridges, Mont., and around to strike the main line again near Melrose, cutting out the Apex hill, is again under discussion.

Board of directors of the Helena Light & Ry. Co., J. H. White, manager, Helena, Mont., has authorized the issuance of a bond issue of $100,000, or so much thereof as may be necessary, to build a double track line to the state fair grounds. The extension will be completed in time for the fair this fall. New equipment has also been ordered.

Nebraska.

The Chicago, Burlington & Quincy R. R., according to reports, has under consideration improvement of its lines in Nebraska. About 100 miles of the new 90-lb. rails will be laid during the spring, of which 60 miles east and west of Seneca will be the big portion. Between ten and twelve miles will be laid near Rulo in this state, and seven and one-half miles between Seward and Tamora and other small pieces of track are to be raised to the ninety pound basis. This heavier rail will release about 75 miles of 75-lb. steel to be used on the branch lines, and the use of the lighter rail on the branch lines will release a large amount of still lighter steel to be used on sidetracks, yard tracks, etc. About 25 miles of 85-lb. steel will be laid on the Ashland-Sioux City line during the season.

Citizens of Sargent and Brewster, Neb., and the country lying between the towns have taken steps to induce the Attorney General to instruct the Chicago, Burlington & Quincy Ry. to lay a track on the right of way which has been graded for 20 years.

Construction work is to be started some time this month on the projected 284-mile line of the Nebraska Transportation Co. W. E. King, Omaha, Neb., is chief engineer, and C. W. Baker, Omaha, Neb., is president. The construction contract has been let to the Baker Construction Co., Omaha, Neb.

Nevada.

It has been announced in Reno, Nev., that Eureka & Palisade R. R., which was damaged by spring freshets, will be rebuilt this summer by the United States Copper Co. The line extending from Eureka, Calif., to Palisade, is 100 miles long, 60 miles of which were damaged.

New Hampshire.

Additional steps have been taken by the Boston & Maine R. R. in its effort to secure a line of track in the Connecticut River valley along the Vermont-New Hampshire border, entirely independent of the Central Vermont Ry. This last step was the filing with the supreme court of a petition by counsel for John H. Albin, president of the Sullivan County R. R., one of the leased lines of the Boston & Maine, for leave to construct an extension of the Sullivan County road from some convenient point in the town of Cornish to a connection with the Concord division of the Boston & Maine near the present station in Lebanon. The petition states that the proposed extension would be a double track line with bridges and culverts of steel, concrete or granite. It would be 14.65 miles long, running through parts of the towns of Cornish, Plainfield and Lebanon. The estimated cost of its construction is $2,500,000. An order was issued for a hearing on the first Tuesday in June, following which the matter will be referred to referees or to the public service commission.

Attorneys for the Connecticut River R. R., a subsidiary of the Boston & Maine, have filed with the secretary of state the location for the extension of that road, authority for which was granted by the last legislature, from the present Ashuelot branch to connect with the Sullivan county road in the town of Walpole. This will form another link in the Connecticut Valley project of the Boston & Maine. This is the work mentioned in our last issue. George M. Thompson, Brattleboro, Vt., is engineer, Boston & Maine R. R.

New Jersey.

The House has passed the bill to permit half-mile trolley extensions. The bill applies to first class cities and is a modification of the Lee bill of last year. The extensions or detours are limited to half a mile in length.

The Elizabeth, New Brunswick & Trenton R. R. Co. has been incorporated with a capital stock of $500,000. This is a step in the long pending plans of the Public Service Corporation of Newark, N. J., to run a through line between Newark and Trenton by way of New Brunswick. The incorporators of the new company are Thomas N. McCarter, president of the Public Service Corporation; Uzal H. McCarter, president of the Fidelity Trust Co. and a Public Service director; and Frank Bergen, general counsel for the utility corporation. For some time the operating officers of the Public Service Corporation have been in charge of the Elizabeth & Trenton line, which, if the present plans are carried through, will be eventually turned over to the Public Service Railway Co. and made a link in the Newark-Trenton system.

Ohio.

⊙Alex McGavock, Minnesota City, Minn., has taken a contract for second track work on the Erie R. R. from Mansfield, O., to Burbank. The contract includes some good team work and steam shovel work and involves about 300,000 cu. yds. of earth excavation. Part of the work will be sublet as soon as possible. Mr. McGavock's headquarters for the work are at Mansfield, O.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The Cincinnati, Hamilton & Dayton Ry. Co. will receive bids on about 17,000 cu. yds. of team grading and incidental work on changes of public highways, made necessary by the revision of grade and line near Sidney, O. Particulars can be obtained from the general superintendent, F. H. Alfred, Cincinnati, O., or the Resident Engineer, A. B. Ziegweid, Sidney, O.

The issuance of $15,000,000 of bonds and the increase of the capital stock of the Lake Erie & Pittsburg, Ry. of Lorain, O., is, according to an announcement, reported to have been made by the attorneys of the company, to defray expenses which have already been incurred in construction work between Cleveland and Pittsburg as well as to finance improvements and extensions. Among the projects to be taken up is the completion of the Cleveland-Pittsburg double track line.

The Hills & Dales Electric Ry. Co., incorporated recently, as noted in our April 5 issue, has acquired complete right of way for 12 miles of railway. This line is to extend from Dayton through the suburb of Hills and Dales on the southern border of the city. The incorporators of the company are William Stroop, Edwin P. Mathews, Clayton, O.; Shupert, Albert C. Rice and O. J. Emrick.

The Ohio Electric Ry. Co., Cincinnati, proposes to extend its street car line at Lima to the newly built Gramm motor works and the Ohio steel casting plant.

Plans are under consideration for the construction of an electric railway from Fremont to Port Clinton, a distance of 18 miles. F. D. Carpenter, Lima, O., who recently completed the Fostoria-Fremont line, is backing the new project.

The Chesapeake & Ohio Ry. of Indiana has formally accepted the terms of the Hamilton county commissioners for the elimination of the grade crossings at the Crookshank and Bridgetown roads. The railroad is to pay the entire cost of the improvement, as the viaduct to be built and connecting roads are made necessary by the railroad yards which are being constructed between the two roads, where the grade crossings are to be eliminated.

The Pennsylvania R. R. is reported to be negotiating with the Hocking Valley Ry. for the purchase of a big slice of dock property owned by the latter on the Maumee river in Toledo. It is said that the Pennsylvania will spend several hundred thousand dollars improving the dock property and in building a double track steel bridge across the Maumee.

A company is being organized at Cleveland to construct a traction line from the city limits south seven miles to the Randall race track. Cleveland horsemen interested in having the line built are understood to have asked the Cleveland Railway Co. to furnish power for the road and the railway company has signified its willingness to comply.

Oklahoma.

The Railway Committee of the Grandfield, Okla., Commercial Club has signed a tentative agreement according to reports with the Oklahoma & El Paso Construction Co., by which the proposed north and south road is to be built from Oklahoma City to El Paso. The city is to arise a cash bonus of $30,000, provide 10 miles right of way and terminal grounds while the construction company is to have work started within 90 days.

At a special election in Oklahoma on April 25 it was voted to amend the state constitution so as to permit interstate lines to purchase railroads built within the state. A considerable amount of new railroad work will doubtless now be undertaken.

Oregon.

⊙E. T. Johnson of Portland has been awarded the contract by the Booth-Kelly Lumber Co. to build three miles of logging railway in the vicinity of the saw mill at Wendling. The road will extend from the company's main line, which runs several miles up the Mohawk to Wendling, up Deer creek, tapping a heavily timbered tract of land.

The Clackamas Southern R. R. has been organized at Oregon City, Ore., to construct a railroad from Oregon City through Clackamas County. Promoters are now at work securing subscriptions to provide funds and right of way for the project.

Directors of the Deschutes Railroad Co. recently passed resolutions providing for the construction of the branch to Ashwood in Cook County, Ore.

The Oregon Trunk Line Ry. has under consideration the construction of a line between Prineville, Ore., and Metolius to serve as a feeder to the main line. Ralph Budd, Portland, Ore., is Chief Engineer of the company.

The Albany & Interurban Railway Co. of Albany has made a survey and has secured rights of way for a line as far up the South Santiam Valley as Sweet Home. This company is formed of Albany men and it is reported that it has enlisted the support of sufficient eastern capital to build this Santiam Valley line as a part of a loop line from Albany via Lebanon to Sweet Home and return down the Calapooia Valley via Holley, Crawfordsville and Brownsville.

Pennsylvania.

⊙The Warren Silica Co., Torpedo, Pa., has awarded the contract for the construction of its works and 1½ miles of railroad to the Erie Contracting Co., Downing Bldg., Erie, Pa., for $35,000.

⊙The Philadelphia & Western Ry. Co. (electric), Upper Darby, Pa., has awarded the contract for the grading and masonry work for its double track extension between Villanova and the Schuylkill River to the Keystone State Construction Co. The bridge over the river, which with its viaduct approaches on each side, will be 3,800 ft. long and about 40 ft. high, will be built by the Pennsylvania Steel Co.

The stockholders of the Philadelphia & Reading Ry. Co., at a special meeting on April 20 authorized an increase in the capital of the $20,000,000 to $45,000,000. The new stock will be issued to the Reading company, the holding corporation, to reimburse it for the payment of prior lien and consolidated mortgage bonds of the Philadelphia & Reading R. R. Co.

It is reported that the Pennsylvania R. R. will double track its Youghiogheny branch, which extends from Irwin to County Home Junction. It is said that the tracks at Irwin will be raised to a level with the main line and the two lines will be connected there, instead of at Shafton, as at present.

The Ephrata & Lebanon Street Ry. Co. has completed surveys and has practically secured the construction capital for its projected 22.8 mile line from Ephrata through Lincoln, Clay, Hopeland, Kleinfetterville, Schaefferstown, Reisterville to Lebanon. Construction contracts will probably be let within a month. H. H. Singer, Ephrata, Pa., is President and M. H. Shirk, Lincoln, Pa., is Secretary and Treasurer.

The Somerset Street Ry. Co. is now making surveys for the projected 10 mile line from Somerset to Rockwood. The capital for construction has been secured and construction contracts will be let about June 15. J. A. Berkey, Somerset, Pa., is President and G. C. Winslow, Somerset, is Chief Engineer and General Manager.

Contracts are to be awarded this month, it is said, for the first section of the proposed line of the Pittsburg & Fairmont Traction Co. The work is to begin at Blacksville, on the state line between Pennsylvania and West Virginia, and extend north to Waynesburg, a distance of 13 miles. From Blacksville the company, under different charters, has built and is operating a line to Fairmont, and easterly to Morgantown on the Monongahela river. These lines form feeders for the main line to Pittsburg. From Waynesburg the rights of way have been secured to Bridgeville in Allegheny county, where a connection is to be made with the Wabash-Pittsburg railroad and an entrance into the city will be over the tracks of that line. To accomplish this the Wabash-Pittsburg is to be electrified into the Liberty Ave. terminal. The line to Waynesburg from Blacksville is to be a double track road, following a natural water course most of the way, and with a small tunnel at one point at the backbone of the mountain divide. The double track line will be built all the way to Pittsburg. Wm. M. Laws, Fairmont, W. Va., is interested.

South Carolina.

A preliminary survey has been completed for a proposed electric railway from Abbeville to Antreville, a distance of 12 miles. The report is now in the hands of a committee of citizen of Abbeville, which is handling the project. W. H. H. Newell, Anderson, S. C., is the engineer.

Definite steps are reported to have been taken at a recent meeting at Anderson, S. C., for the extension of the Blue Ridge Ry. over the mountains into Tennessee. A. B. Andrews, Raleigh, N. C., is president of the Blue Ridge Ry.

Tennessee.

The Nashville-Gallatin Interurban Ry. Co. has filed its articles of incorporation and has decided upon a route for its projected interurban line from Nashville to Gallatin. The company has a capital stock of $750,000. Surveys have been made and it is understood that construction work will be started shortly. H. H. Mayberry, Franklin, Tenn., is the promoter.

The Middle Tennessee R. R., John White, chief engineer, Franklin, Tenn., is contemplating extending the line from Leatherwood to Mt. Pleasant and the phosphate fields.

Texas.

The Eureka Construction Co., Tulsa, Okla., has been granted a permit to transact business in the State of Texas. The headquarters of the company will be at Houston and the capital stock is $50,000.

At a recent meeting of the stockholders of the Pecos Valley Southern Ry. the matter of extending the line was taken up. W. L. Carwile, Dallas, Tex., is president.

Construction contracts are to be let shortly for the first 30 miles of the Palacios, San Antonio & Pecos Valley. The work of construction will start at the Palacios end of the line and proceed westward to Francitar, in Jackson county, thence to Edna. H. W. Dean is general manager.

The Chicago, Rock Island & Gulf Ry. has applied to the State Railroad Commission for permission to issue and register bonds on its division from Amarillo to the state line on the Albuquerque, N. Mex., extension.

The State Railroad Commission has approved a valuation of $519,000 on the Kansas City, Mexico & Orient Ry. from San Angelo to Mertzon, a distance of 30 miles. The road intends to take out $419,000 of this amount in bonds and $28,000 in stock. With this additional valuation there is authorized upon the 269 miles of the road in Texas $4,666,000 in bonds and $1,000,000 in stock.

Utah.

According to an announcement reported to have been made by the Engineering Department of the Oregon Short Line, Salt Lake City, Utah, plans have been prepared for the double tracking of the road from Farmington to Ogden, giving a through double track line from Salt Lake to the Junction City. The preliminary work, including the surveying and the assembling of materials and equipment, is now well under way, various contractors are busy figuring on the bids and the expectation is that all the details will be arranged and contracts let within the next three weeks

The Utah Light & Ry. Co., Joseph S. Wells, general manager, Salt Lake City, is perfecting arrangements for a number of extensions and other improvements to its lines at Salt Lake City.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Virgina.

Frank J. Gould of New York city is reported to have secured control of the Norfolk & Portsmouth Traction Co., which also operates electric trains to Ocean View, Pine Beach and Willoughby Beach, summer resorts. The traction company also controls a line of ferry steamers between Pine Beach and Newport News and Willoughby Beach and Old Point Comfort. It is stated that the properties will be combined with the Virginia Railway & Power Co. of Richmond, which has been controlled by Gould for several years. The combined interests will have a capital of $15,000,000 common stock and $20,000,000 in bonds. One result of the deal, it is said, will be the establishing of an electric line from Norfolk to Richmond. It is understood that William Northrup of Richmond, Va., will be president of the new system.

Washington.

⊙The Bates & Rogers Construction Co., 84 Van Buren St., Chicago, Ill., has been awarded the contract for constructing a subway at Washington St., Spokane, for the Chicago, Milwaukee & Puget Sound Ry. The contract includes 4,000 cu. yds. of concrete masonry.

A crew of surveyors, according to advices from Husum, Wash., is running a line over the old route surveyed during the fall of 1909 from Underwood to Trout Lake.

Work of laying rails on the North River extension of the Oregon-Washington Railroad & Navigation Co. will, it is reported in Hoquiam, Wash., be started May 1. More than 90 per cent of the grade has been completed. Work on the branch, which is 12 miles in length was discontinued last winter and resumed early in April. G. W. Boschke, Portland, Ore., is Assistant General Manager.

The Spokane Traction Co., Clyde M. Graves, general manager, Spokane, is to at once start construction work amounting to $60,000 on extensions on North Madison and North Howard Sts. at Spokane. One extension is to connect with the present line at Heroy Ave. and Madison St., going north on Madison to Francis Ave., the present city limits, a distance of 14 blocks. The other extension is on the North Howard St. line for a distance of 18 blocks.

O. A. Hoag, Chelan, Wash., has applied to the county commissioners for a franchise for the construction of an electric line from Chelan to Wenatchee. Mr. Hoag recently filed on the water power in the Chelan river, which had previously been held by the Great Northern by virtue of appropriations made two years ago.

Louis W. Pratt, president of the National Realty Co., Tacoma, Wash., has applied to the city council of Wenatchee for a franchise for an electric railway in that city. It is proposed to run the line from Leavenworth to Wenatchee, and when traffic demands it to extend the line down the Columbia River to connect with the North Coast road or the Milwaukee.

Preliminary survey has been completed for the proposed electric railway from the North Bank to White Salmon. The survey calls for a line about 2.16 miles long with an average grade of 4½ per cent. It is estimated that the cost of the line will be about $50,000 and that the equipment will cost another $10,000. It is stated that if residents of White Salmon will take $20,000 of stock, the Mount Adams Electric Ry., a local corporation, will at once build the line.

Surveys have been made and practically all right of way secured for the Lynden branch of the Nooksack Valley R. R. J. A. Welch of Vancouver, one of the promoters, has returned to that city from the east, where he has been conducting negotiations with representatives of the English capitalists who are contemplating the purchase of the $2,000,000 bond issue of the company.

West Virginia.

The Baltimore & Ohio R. R. is understood to have surveys under way for the prospective double tracking of the Baltimore & Ohio Southwestern from Midland City to Parkersburg, W. Va.

Wisconsin.

E. Pennington. President, Minneapolis, St. Paul & Sault Ste. Marie Ry., (Soo Line) Minneapolis, Minn., is reported to have stated that among the new work to be undertaken by the company this year is the construction of the proposed Mellen-Reserve Line. Reserve is a town east of Hayward in Sawyer County, Wis., and the Soo has a line extending from the main line at Cameron to Reserve. Between the latter city and Mellen there is a distance of only about 50 miles and when this cut-off is completed the Soo will have a direct line from the Twin Cities to Ironwood, Hurley and Bessemer and by making a connection there with the South Shore railway it would be a direct line clear through to Marquette, Ishpeming and the copper country.

Brogan Co., Green Bay, Wis., is working about 30 teams on its contract for grading for a branch of the logging railroad to be built for the government on the reservation near Antigo, Wis. The work is to be completed by June 10.

Canada.

D. McNicholl, Montreal, Que., Vice President Canadian Pacific Ry., has directed the engineering department to begin work at once on the new lake shore line to Toronto. A single track will be laid first, and a double track will be added as soon as business warrants it. At least that is the proposal at present, though there is a possibility that a double track may be built at the outset. In order to expedite the work one party of engineers will work east from Toronto and another west from Glentay.

It is understood that governmental legislation authorizing the construction of the Hudson Bay Ry. and a supplementary estimate, covering the preliminary cost will be introduced before the end of the present session of Parliament.

The Canadian Pacific Ry. is to start work shortly on the location of the line from Glentay, 16 miles west of Smith's Falls, to Toronto. The location will extend from Glentay southwest to Belleville, thence along the lake shore to a point east of Leaside Junction. It will then work up to Leaside. The company will have a grade of about four-tenths of 1 per cent per mile. The line between Guelph Junction and Hamilton has been located, and the bulk of the right of way bought. Grading is now progressing on the Victoria Harbor route from a point six or seven miles from Orillia to Bethany. Steel will be laid on the new railway from Victoria Harbor to Bethany, near Peterborough, this year, and before the snow flies it is expected that wheat will be hauled from that harbor.

ROADS, STREETS AND PAVEMENTS

Alabama.

⊙The city council of New Decatur, Ala., has awarded contracts for streets and sidewalk work as follows: Cement sidewalks in East New Decatur, $8,319, to Halliburton & Brooks of Birmingham, Ala.; storm sewers in south New Decatur, $7,308, Adamant Stone & Roofing Co., of Nashville, Tenn.; storm and lateral sewers in west New Decatur, $2,918, W. M. Leftwich Co., of Nashville, Tenn.

Arkansas.

An improvement district is being former on 11th St., from Martin to Oak Sts., and on Oak St. from 9th to 12th Sts., in Little Rock, Ark., for the purpose of grading, curbing, guttering and draining the streets within the district. E. A. Kingsley is City Engineer.

California.

⊙It is reported that the city council of San Diego, Cal., has awarded contracts as follows for paving work; Edwin M. Capps, City Engineer: Front St., B. to H., Fairbanks-Gilmore-Wilton Co., paving, $0.189 per sq. ft.; curbing, $0.36 per lin. ft.; grading, $0.35 per lin. ft. State, from B. to H., Barber Asphalt Co., paving, $0.21 per sq. ft.; curbing, $0.35 per lin. ft.; grading, $0.395 per lin. ft. Union, from B. to H., Barber Asphalt Paving Co., paving, $0.21 per sq. ft.; curbing, $0.35 per lin. ft.; grading, $0.395 per lin. ft. Columbia, from B. to H., Barber Asphalt Co., paving, $0.19 per sq. ft.; curbing, $0.35 per lin. ft.; grading, $0.36 per lin. ft.

The Tulare County Good Roads association has voted to co-operate with the association in Kings County in the matter of securing the location of the $18,000,000 highway through Kings and Tulare counties. Vasalia is the county seat of Tulare county.

City Engineer Edwin M. Capps of San Diego, Cal., has computed the cost of paving Ninth St. from the city park to L. St., at $5.94 per lin. ft. for property owners on each side of the street. The estimates include the cost of concrete culverts.

District of Columbia.

✣Bids will be received until 2 p. m., May 6, by Commissioners of District of Columbia, Washington, D. C., for laying asphalt block pavement.

Idaho.

Property owners along the American Falls-Tilden road in Bannock County, Ida., recently appeared before the county commissioners, Pocatello, and asked for the establishment of a county road on the American Falls-Tilden road along the O. S. L. railroad track west of Pocatello, branching at a point on the section line between sections 16 and 17, township 6, range 34, and running due north along the section line to the reservation border.

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 4, for furnishing and delivering three open bottom portable 25 H. P. boilers, locomotive type, mounted on wheels, to the Bureau of Streets, 13th ward yard, Fillmore St. and Central Park Av.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 4, for furnishing and delivering vertical tube boilers as follows: 6109 Cottage Grove Av., Fillmore St. and Central Park Av., Kinzie St., and 48th Av. Each boiler shall be required to develop 25 H. P. normally.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., fourth floor, City Hall, until 11 a. m., Saturday, May 6, for furnishing labor, material, apparatus, etc., and for repairing asphalt pavements in the City of Chicago, according to plans and specifications on file in the office of the Department of Public Works of said city. Cash or certified check to the amount of $7,500 must accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 4, for furnishing and delivering two three-wheel road rollers ranging in weight from 12 to 15 tons, to be used for building and repairing roadways paved with macadam or other material of a similar nature. Bidders must submit with their proposals cuts, photographs or drawings giving

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

the following information: Total weight, horse power of engine, single or double engine, speed at which machine can be operated in finishing road surface, size and face of wheels, character of materials used in different parts, size of steam dome, method of power transmission, steaming arrangement, size of water tanks and other information of similar nature. Rollers must be guaranteed for one year from date of delivery and any parts proving defective shall be replaced free of charge to the city. Cash or certified check for $1,000 must accompany proposal

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 6, for furnishing and delivering 2,500 cu. yds. of paving gravel as follows: 1st Ward, Randolph St. and Beaubien Ct.; 17th Ward, 1004 Austin Av.; 18th Ward, Adams St. and Center Av.; 19th Ward, 806 S. May St.; 21st Ward, 125 W. Huron St.; 22d Ward, 942 Orleans St. All gravel must be dry, entirely free from loam, sand and dirt, and not to exceed ½ in. in size. Cash or certified check for $250 must accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., fourth floor City Hall, until 11 a. m., May 11, for furnishing, delivering and unloading 1,000 cu. yds. of sand for mason work. All sand to be free from pebble sand particles larger than 1/20 of an inch, clean and free from vegetable or other injurious foreign matter. All sand shall be delivered within the following limits: North Lawrence Av., west 48th Av., east Lake Michigan and south 75th St. Cash or certified check for $100 must accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 4, for furnishing and delivering 25,000 cu. yds. of limestone to the Bureau of Streets, f. o. b. cars at most convenient switch track in 25th Ward, 26th Ward and 27th Ward. All stone shall be of the best, dry, clean and as near to a cube in form as possible, and graded as follows: Coarse, 4 in. to 2 in.; medium, 2½ in. to 1 in.; screenings, ¾ in. to powder. Cash or certified check for $2,000 must accompany each proposal.

⊙A. E. Rutledge of Rockford, Ill., has been awarded the contract by the Board of Local Improvements, Harvard, Ill., for the construction of vitrified brick pavement on a concrete foundation of 5 in., for $1.69 per sq. yd. The work includes 12,560 sq. yds. of pavement with bituminous filler, 2,450 ft. of re-surfaced curb, 304 ft. of 6 in. x 30 in. concrete curb, and 580 ft. of 6 in. x 22 in. concrete curb. Hugh M. Price, 1207 Hartford Bldg., Chicago, Ill., is Engineer. Bids were opened April 22.

Indiana.

✣Bids will be received until 2 p. m., May 11, by Town Board, Carmel, Ind., for the improvement of College Ave., both sides, with cement sidewalks and curbs, from south corporation line to Gray St.; also Main St., with curbs, from south corporation line north to Hawkins St.; and also Main Cross St. with brick pavement, from Main St. to Monon Railroad right of way, and curbs from tracks of Indiana Union Traction Company to right of way of Monon Railroad.

✣Bids will be received until noon, June 7, by Board of White and Carroll Counties at the office of the County Auditor, Monticello, Ind., for the construction of a stone road on the county line.

✣Bids will be received until 10 a. m., May 8, by Board of Public Works, Indianapolis, Ind., for the following street work: The improvement of the first alley north of Vermont St., from the east property line of Meridian St. to the west property line of Scioto St., by grading and paving the roadway; the improvement of Alvord St., east side, from the north curb line of 16th St. to the south curb line of 19th St., by grading and paving the sidewalks; the improvement of Locke St., from the south property line of Indiana Ave. to the north property line of Walnut St., by grading and paving the roadway; the improvement of Delaware St., from the north property line of 28th St. to the south property line of 30th St., by grading and paving the roadway; the improvement of Adams St., from the south property line of 21st St. to the south property line of Massachusetts Ave., by grading and paving the sidewalks.

⊙The board of public works of Indianapolis, Ind., has awarded the Union Asphalt & Construction Co., the contract for the paving of Audubon road, from Washington to C. C. C. & St. L. Railway Co.'s tracks for $3.68 per lin. ft. Asphalt will be used.

⊙The Rush County Commissioners, Rushville, Ind., have awarded contract for three township roads, the cost of building to be $31,803. Two of the contracts were awarded to O'Connor Bros., of Crawfordsville. The other was awarded Colter Bros. of Rush County.

⊙George T. Miller has been awarded the contract for paving with brick the 8 ft. space between the tracks of the Terre Haute, Indianapolis & Eastern Traction Co., on Main St., in Zionsville, Ind., and the stretch of 1,000 ft. on North Lebanon St., in the city of Lebanon. The contract price is $7,505.

⊙The board of public works of Indianapolis, Ind., has let the following contracts for road and sidewalk work: A. D. Bowen, $0.17¼ per lin. ft., Trenton Ave., from New Jersey to Trenton with cement walks; Wm. H. Lackey, $1.23½ per lin. ft., Trenton Ave., from New Jersey to Princeton, gravel roadway and curb; Marion County Construction Co., $5.50 per lin. ft., Washington Blvd., from 32d to 34th, asphalt roadway; A. D. Bowen, $0.15¼ per lin. ft., Princeton Ave., from Trenton to 30th, cement walks.

⊙The Board of Public Works of Indianapolis, Ind., on April 26 awarded the following contracts: Michigan St., from Belmont to Elder, cement sidewalks, to M. Sapirie for $0.13½ per sq. ft.; Kentucky Ave., from Dover St. to a point 214 ft. southwest of Morris on northwest side, cement sidewalks, to Wm. H. Holl, for $0.15 per sq. ft.; Henry St., from Delaware to Alabama, cement walks, to Henry Maag for $0.15½ per sq. ft.

According to advices from Elkhart, Ind., a plan to construct an entire road between Goshen and Elkhart at a cost of $20,000 is being advocated.

A petition has been filed with County Auditor Albert Sahm, Indianapolis, Ind., asking for the improvement of the road which connects the Indianapolis-Pendleton pike and the gravel road on the line between Marion and Hancock counties. The road is about two miles long.

Reports of viewers for proposed rock road extensions in Center, Columbia and White River townships have been filed with the county auditor, Princeton, Ind. The reports include the Edgar Mauck extension in Center township, those of the James Bruner and William Cassidy petition in White River township, and the George Tichenour and Robert Erwin extensions of Patoka township. The estimated cost of the five proposed extensions is $24,272, which includes bridges and retaining wall.

Iowa.

⊙The contract for laying seven blocks of concrete paving in Cresco, Ia., has been let by the city council of that city to the Concrete Construction Co. of Cedar Rapids, Ia., for $1.34 4-5 per sq. yd. The contract for curbing was awarded to Fred Carlson of Decorah, Ia., for $0.23 per ft.

⊙The Bryant, McLaughlin Asphalt Paving Co. of Des Moines, Ia., has been awarded the contract for approximately $25,000 worth of pavement by the city council of Des Moines. The bid was $1.75 per sq. yd.

The city council of Mt. Pleasant, Ia., has instructed the City Solicitor to draw up a proposed resolution of necessity providing for the following street paving: Broadway, from the railroad to the north line of Orange St.; East Monroe from the east line of Adams St., to the east line of Jay St.; West Monroe, from the west line of Van Buren St., to a point 462 ft. west of the west line to Marion St. The paving will be about 12 blocks long.

The city council of Carroll, Ia., has reconsidered the resolutions recently adopted calling for a considerable amount of paving in the city, and has added 10 more blocks so that the business district will be taken in.

Kansas.

The city council of Chanute, Kan., has been petitioned for the paving of Elm St., with brick, between Lincoln and Highland Aves.

Kentucky.

Plans for the extension of the Bardstown road as the new proposed Lincoln roadway are being considered by the Buechel Commercial club. It is planned to extend the road through Mount Washington, New Haven and Buffalo, Ky., and eventually to Nashville, Tenn., using the old roadway employed for transportation between Louisville and Nashville before the completion of the Louisville & Nashville railway.

Maryland.

✣Bids will be received until noon, May 10, by John M. Tucker, Chairman State Roads Commission, Union Trust Bldg., Baltimore, Md., for the construction of 57 miles of roadway ard concrete bridges. The work will be in the following counties: Anne Arundel County, Baltimore County, Calvert County, Dorchester County, Garrett County, Prince George County, Queen Anne's County.

✣Bids will be received until May 10, by Board of Awards, Baltimore, Md., for furnishing Belgian Blocks for general purposes in the City Engineer's Department during the year of 1911. B. T. Fendall is City Engineer.

✣Bids will be received until noon, May 6, by Board of Road Directors, Alleghany County, Cumberland, Md., Clinton Uhl, Chairman, for improving the public highway between Bedford Road and Baltimore Pike and known as the Cross Road; also between Mount Savage and Frostburg, for a distance of 7,000 ft. The work to be done includes the grading and macadamizing of about 4,000 ft. on the Cross Road and 7,000 ft. on the Legislative Road, according to the plans and specifications that will be on file at the office of the Road Directors in Cumberland, Md.

The board of public works of Louisville, Ky., will reconstruct Broadway, on the north side of the car tracks, from Fourth St., to Campbell. The work will cost about $30,000.

Michigan.

⊙Waldstrom Bros. of Iron Mountain, Mich., have been awarded the contract by the Board of County Road Commissioners, Iron Mountain, for the construction of a dirt road near Waucedah, 2.2864 miles long, for $2,682. The work includes 8,093 cu. yds. of excavation, 6.097 acres of clearing and grubbing, 1,000 lin. ft. of guard rail. Bids were opened April 22.

⊙John Brogan of Chicago, Ill., has been awarded the contract by the Board of County Road Commissioners, Bessemer, Mich., for the grading of about 11½ miles of road between Wakefield and Dunham for $19,495. H. A. Harper is Engineer. Bids were opened April 22.

Kinderhook and Ovid Townships, Branch County, Coldwater, Mich., in about three weeks will let six miles of gravel road, to be constructed under the Michigan State Reward Road Plan. Plans and specifications are now on file with the township clerks of both townships and at the office of John J. & Wm. W. Cox, Civil Engineers, Coldwater.

Supt. Madison D. Irland and Township Clerk Wenz Yaklin of Maple Grove, Mich., are making arrangements to submit a bond issue to the electors of their township to bond for $10,000 for the construction of five miles of stone roads this summer. The election will be held May 22.

The county board of supervisors, Marquette, Mich., has been petitioned for a new road betwen Little Lake south to McFarland, near the Delta County line.

The Superior Land & Gravel Co., has been recently incorporated in Michigan with a capital stock of $75,000. The principal stockholders are: Benjamin Douglas and Elbert H. Bingham. The company will operate sand and gravel pits at Utica, Mich.

Minnesota.

✣Bids will be received until 2 p. m., May 20, by Oscar Roos, Town Clerk, Pelan, Minn., for grading three-quarters of a mile on the section line between Sections 19 and 30; also one mile on the line between Sections 6 and 7 in the town of Pelan. The work will include about 3,080 cu. yds.

The county commissioners of McLeod County, Glencoe, Minn., have decided to expend $6,500 for the improvement of the county roads this season. F. D. Stocking is county auditor.

The city council of Duluth, Minn., has authorized the board of public works to spend $2,000 on the improvement of the Sundby and Farrel roads at the upper end of the Second ward.

Mississippi.

The citizens of Tupelo, Miss., on April 22 voted the issuance of bonds to the amount of $50,000 with which to improve the electric light plant, build a city hall and pave certain streets.

Missouri.

✣Bids will be received until noon, May 5, by Board of Public Improvements, St. Louis, Mo., for 19 street improvement contracts, the largest being letting No. 10,197, for reconstructing Benton St. from Broadway to Twentieth St., by taking up and removing the old curb and gutter, crosswalks and such portions of the roadway pavement as are above the proper grade of the foundation, furnishing granite, curbing and setting the same in concrete, preparing the roadbed, laying a concrete base, placing on the same a layer of sand and a roadway pavement of Southern long-leaf yellow pine blocks, treated with creosote oil, making all proper connections and intersections with other streets and alleys, and to guarantee and keep in repair all of the aforesaid work and the materials used in connection therewith for a term of five years, commencing on the date of acceptance of the work of reconstruction. Deposit required, $1,450.

The board of public works of Kansas City, Mo., has decided to pave Lynn Ave., between Woodland and Vine with concrete.

Montana.

The Hamilton, Mont., Chamber of Commerce has about completed arrangements for the launching of a campaign which, if successful, will result in the establishment of a park to park highway under federal, state and county control and connecting the Yellowstone National Park with the Glacier National Park. The road would be about 450 miles in length and would cross six or seven counties. J. F. Florence of Hamilton is interested.

Property owners in Kalispell, Mont., have protested against the proposed use of bitulithic for paving this year. As a result the city council will probably order the streets paved with macadam.

Nevada.

The commissioners of Washoe County, Reno, Nev., are considering the matter of building a road from Reno along the banks of the Truckee River to the Nevada state line, to join California's proposed road from the state line to Truckee.

New Jersey.

✣Bids will be received until 2 p. m., May 8, by Board of Street and Water Commissioners, George T. Bouton, Clerk, Jersey City, N. J., for the improvement of Whyte St. from Fairmount Ave. to the northerly line of Dupont St. Blank forms of bid and agreement of sureties must be obtained at the office of the Chief Engineer, City Hall, Jersey City, N. J. Estimate of quantities: About 860 cu. yds. of earth excavation, 115 cu. yds. of earth filling, 375 cu. yds. of sand filling, 1,625 sq. yds. of paving (Belgian), 925 lin. ft. of curbstone, 5x16, set in concrete, 500 sq. ft. of bridgestone, 3,800 sq. ft. of flagging, 15 sq. yds. of repaving, 100 sq. ft. of relaid and dressed bridgestone, 175 sq. ft. of relaid and dressed flagging, 90 lin. ft. of cribbing, 5x16, set in concrete, 1 reset receiving basin head, 5 reset manhole heads, 3 new receiving basins and connections, 1 receiving basin and connections complete, 2 resetting water gate boxes. Time allowed for the completion of the work, 50 working days.

⊙The Warren County Commissioners, Belvidere, N. J., have awarded Salmon Bros., of Netcong, N. J., the contract for the construction of the macadam road between Washington and Asbury, for $50,305.

Recommendations for the expenditure of more than $100,000 of county money in Montclair were decided upon by the Committee on Roads and Assessments of the Board of Freeholders, Newark, N. J. Most of it will be devoted to paving of Bloomfield Ave., with granite block.

New York.

✣Bids will be received until May 5, by M. Gray Zalinski, Depot Quartermaster, 39 Whitehall St., New York City, for furnishing one 10-ton tandem pipe steam road roller; alternative proposals are also desired for an 8-ton roller.

✣Bids will be received until 1 p. m., May 20, by E. Cady White, Town Superintendent of Highways, East Chatham, N. Y., for the construction of a section of town highway in Chatham known as Rowe Hill. Plans and specifications for said work, prepared by the State Commission of Highways, may be obtained at the office of the Town Clerk and Lester J. Bashford, County Superintendent, Hollowville, N. Y.

⊙The Common Council of Dunkirk, N. Y., on April 25 received bids for the paving and grading of East and West 6th Sts., Linn St. and King St., and awarded the contract to McCormich & Son of Erie, Pa., and the Dunkirk Construction Co. of Dunkirk on asphalt and brick respectively. The approximate amount of work to be done is as follows: Lion St., 6,425 sq. yds. of pavement; 6th St., 9,285 sq. yds.; King St., 11,620 sq. yds.

Flood & Van Wert of Hudson Falls, N. Y., have been awarded the contract by the city of Johnstown, N. Y., for bituminous macadam paving and stone curbing on East and West State Sts. The work will include the following approximate quantities: 8,535 sq. yds. of bituminous macadam on East State St.; 3,280 sq. yds. of bituminous macadam on West State St.; 3,000 ft. of stone curbing on East State St.; 900 sq. yds, of cobble gutter on East State St.; 985 sq. yds. of cobble gutter on West State St. Bids were opened April 17.

Ohio.

✣Board of Stark County Commissioners, Canton, O., will receive bids, it is reported, until May 24, for the construction of one mile of paved highway on the Alliance-Harrisburg Road and one mile on the Lexington Road.

✣Bids will be received until 2 p. m., May 13, by Fort Meigs Commissioners, Fort Meigs, O., for furnishing all material and labor for the construction of a macadam driveway from the public highway to and around the Fort Meigs monument. C. W. Shoemaker is Secretary of the Commission.

✣Bids will be received until noon, May 22, by Clerk of the Board of Education, third floor, City Hall, Cincinnati, O., for furnishing all materials and doing all the work necessary to complete the grading, cementing and parking of the lot surrounding the building known as the Twenty-third District Public School, located on the southwest corner of Vine St. and University Ave., in the City of Cincinnati, O., in accordance with drawings and specifications on file in the office of C. W. Handman, Business Manager, No. 511 West Court St., in said city of Cincinnati.

✣Bids will be received until noon, May 9, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and materials for the improvement of Probasco Ave., from Deckebach Ave. to Marshall Ave., by grading, setting limestone curbs and crossings, paving gutters with brick, roadway with macadam, with special binder, and constructing concrete retaining walls and necessary basins and drains. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer of the Department of Public Service. Each proposal must be accompanied by a bond in the sum of $1,800, or a certified check on a solvent bank, as a guarantee that if the proposal be accepted a contract will be entered into. John J. Wenner is City Clerk.

⊙The Commissioners of Road District No. 1, Mahoning County, Youngstown, O., have awarded the following contracts for the improvement by limestone macadam with furnace slag base of the following roads: The Snyder road in Austintown Township, to Ross O'Rourke of West Austintown for $10,603; the Town Line Road in Youngstown and Austintown Townships, a distance of 5,540 ft., to McKee & Co. of Youngstown for $9,265, and the Glenwood Ave. Extension Sec. 2 in Youngstown Township, a distance of 3,820 ft., to E. J. Kane, R. F. D. No. 2, Youngstown, for $5,670. Bids were opened April 24.

Petitions for road improvements, aggregating more than seven miles of highway, have been filed with the county commissioners, Columbus, O. One of the roads starts at the intersection of Garnes free pike with Geyer free pike and continues west through Prairie and Brown townships. The other extends from Lane Ave. and the Litchford road to Fairview pike and ends at the Columbus and Dublin pike.

The county commissioners, Lisbon, O., have agreed to expend $2,500 toward extending the improvement of the state road at the Unity school house to the blacksmith shop, East Palestine. The improvement will cost about $5,500, and the trustees have begun to take subscriptions to raise the additional $3,000.

The Carroll County Commissioners, Carrollton, O., have appointed R. H. Lee, Resident Engineer, for the two miles of state aid road to be built in Center township.

The county commissioners at Columbus, O., have been petitioned for the construction of a road running by the infirmary at the intersection of the Kilmore road and the Groveport pike, in Hamilton township. The road will be 10½ miles long.

The county commissioners, Cleveland, O., are planning to rebuild the state road that runs south through the county, from the Pearl road in Brooklyn. It is estimated the job will cost $70,000.

Petitions have been filed before the board of county commissioners, Columbus, O., for the construction of four miles of new road in Prairie and Brown townships, connecting the Geyer free pike with the Amity free pike.

The County Commissioners, Cincinnati, O., have approved plans and specifications for the improvement of the Bond road, from Montgomery road to the Camargo pike, which will cost $17,513. The commissioners also approved an estimate of $5,011 as the cost of improving the County Club road, from Reading pike to the Ohio pike.

The city council of Wooster, O., has been petitioned for the paving of High St., from Beall St., east, and for the paving of

Nold Ave., from Spink St., to 60 ft. east of Gasche St.

The Columbian County Commissioners, Lisbon, O., and the Perry Township Trustees, Salem, O., have decided to extend the McKinley Ave. pavement 2,000 ft. east this summer. The extension will be a 16 ft. brick road with stone curb and will be built as soon as bids can be advertised for and the contract let.

The county commissioners at Marion, O., have been petitioned for the construction of the Tron pike. A hearing will be held by the commissioners on May 24.

Oklahoma.

The city council of Oklahoma City, Okla., has rejected all bids received April 18 for the paving of streets in Capitol Hill. The contractors had failed to submit samples and source of supply of all materials used to the city chemist. It is understood that the paving committee will ask for a readvertisement. W. C. Burke is City Engineer.

Oregon.

Plans, specifications, etc., have been prepared by Louis C. Kelsey, Civil Engineer, 404-5 Selling bldg., Portland, Ore., for street pavements for the city of Hillboro, Ore., estimated to cost $59,356.

The Linn County Court, Albany, Ore., plans to prosecute the improvement of county roads, according to plans which have been already formulated. Many new sections will be added to the system already established, new bridges will be built and many miles of roadway will be surfaced with crushed rock. It is estimated that the sum of approximately $90,000 will be expended during the season.

Pennsylvania.

⊙The United Ice & Coal Co. of Harrisburg, Pa., has been awarded the contract by W. W. Caldwell, Highway Commissioners, Harrisburg, for the grading of Nectarine St. for $326, of Hunter St. for $248, and of Summit St. for $374. Bids were opened April 24.

Texas.

✣Bids will be received until 3:30 p. m., June 1, by W. W. Jenkins, County Auditor Georgetown, Texas, for the construction of graveled and macadamized roads in road district No. 2 (Granger-Bartlett).

Surveyor E. R. Overstreet, Georgetown, Tex., has completed the survey of a nine-mile stretch of road on the Taylor-Thrall road. The road is to be macadamized the entire distance from Taylor to two miles beyond Thrall.

The city council of Paris, Tex., has decided to pave the streets surrounding the square to a width of 48 ft., instead of 42 ft., as first intended. The engineer has been instructed to revise the plans and estimates.

Utah.

⊙P. J. Moran of Salt Lake City, Utah, has been awarded the contract in that city for the paving of College St. and Temple Ave., with asphalt for a total sum of between $6,000 and $7,000. The pavement will be asphalt 20 ft. wide with a lawn and curb on each side between the pavement and the sidewalk.

The city of Murray, Utah, proposes to pave Vine and 17th South Sts., at an estimated cost of $14,136.

Virginia.

⊙E. Parke Lindsay of Portsmouth, Va., at $0.74½ per sq. yd., has been awarded the contract by the Norfolk county supervisors for the construction of the county's portion of the proposed new macadam road through Lafayette Residence Park, Tanner's Creek district, from the limits of the city of Norfolk to the thoroughfare formerly known as the Cottage Toll Bridge road. The road will be three-quarters of a mile long.

Washington.

⊙The city council of Ellensburg, Wash., has voted to accept the bid of the Independent Asphalt Paving Co., for paving the Pearl and Fourth St. districts. The contract price is $57,337.

⊙The city council of North Yakima, Wash., has let contracts for grading and sidewalk construction in the Modern addition as follows: Root & Biegel, Spokane, Wash., for sidewalks in the McKinley Ave. division, $23,432; Kibler & Erricson, sidewalk in Garfield Ave. division, $22,590; D. P. Daniels of North Yakima, grading in the Garfield Ave. division, $13,060. The bids for grading in the McKinley division were rejected and will be readvertised for.

Residents of Morton St., in North Colfax, Colfax, Wash., have circulated a petition to have the street paved and the sewer system extended.

The Whatcom County Commissioners, Bellingham, Wash., has petitioned the state highway commission for aid in the improvement of six of the county roads. Will E. White, Olympia, Wash., is state highway commissioner.

The city commission of Spokane, Wash., has approved the plans for the paving of Rockwood Blvd., Hatch St., to Arthur St., and south to 29th Ave. The estimated cost of the improvement is $57,000. Morton Macartney is City Engineer.

City Engineer Morton Macartney of Spokane, Wash., has completed plans for the grading of Jefferson St. from Wellesley to Garland Ave., at an estimated cost of $10,500, and for the grading of Euclid Ave. from Hemlock to Lindeker St., at a cost estimated at $5,300.

Wisconsin.

⊙The contract for the building of the new road near Evansville, Wis., has been awarded by the county commissioners at Janesville, Wis., to Dan Drew, of Footville, for $0.32½ per cu. ft.

Members of the Appleton Auto Club have opened negotiations with Menasha business men which is expected to result in the construction of a concrete road between Menasha and Appleton. The road is five miles long and work may be started within a month.

The supervisors of Milwaukee County, Milwaukee, Wis., have appropriated for this year $10,000 for improving the road between Hales Corners and Post.

As a result of a mass meeting held in the court house at New Cumberland, all roads in Grant district, Hancock County, are to be improved. A board of commissioners has been appointed to view each road and name the character of material that is to be used in improvement. All roads are to be surveyed, probable cost of improvement obtained, and this will be followed by the ordering of a bond election to complete the improvement. Brick or paving blocks are to be used.

Wyoming.

The city clerk of Sheridan, Wyo., is advertising for bids for grading Gould St., from Fourth to Ninth, Adair St., from Clyde to Lewis, and from Lewis to Adam, and College Ave., from Main to Gladstone, according to specifications prepared by the city engineer.

Canada.

The John Galt Engineering Co., P. O. Box 1119, Calgary, Alta, has prepared plans for the construction of cement sidewalks for the town of Stettler, Alta.

BRIDGES—STEEL AND CONCRETE

California.

⊙The contract for the construction of the northerly section of Mission St. viaduct was awarded by the Board of Public Works, San Francisco, Cal., to Healy-Tibbetts Co., San Francisco, Cal., at $105,000. Bids for the work were opened April 26. Marsden Manson, Hewes Bldg., 995 Market St., is City Engineer.

Delaware.

The Governor of Delaware, according to advices from Dover, Del., has signed an act authorizing the Levy Court of New Castle County to build a bridge over the Christiana Creek in the place of the Third St. bridge and to issue bonds and borrow $150,000 therefor if necessary. Wilmnigton, Del., is county seat.

Georgia.

Citizens of Atlanta, Ga., are advocating the construction of a viaduct over the Pryor St. railroad crossing. R. M. Clayton, Chief Engineer of Construction, has announced the project feasible.

Illinois.

⊙Board of the Village of East Peoria awarded the contract for the construction of the proposed new bridge over Farm Creek to the Illinois Concrete Steel Co., Peoria, Ill., at $1,170.

⊙The contract for the construction of 4 reinforced concrete culverts in Fort Russell township, Madison County, mentioned in our April 12 issue, was awarded to G. R. Hyten, Edwardsville, Ill., at $1,190. Bids were opened April 22. Henry Heepke is Town Clerk, Edwardville.

⊙The contract for the construction of two concrete bridges and removing old structures in Mission Township, La Salle County, Ill., was awarded April 25 to Eph Swenson, Sheridan, Ill., at $800. Robert Knapp is Town Clerk, Sheridan, Ill.

⊙Joseph Klein of Freeburg, Ill., has been awarded the contract by the town of Port Byron, Ill., for the construction of the Quick bridge for $1,056. The structure will be of reinforced concrete with 28-ft. span, 16-ft. roadway, finished roadway to bottom of footings, 10 ft., 10 and 16 ft. wings, plain concrete substructure, requiring about 87.3 cu. yds. of concrete and 6,575 lbs of reinforcing steel. Bids were opened April 26 by Stephen White, Town Clerk.

Board of Supervisors, Peoria, Ill., have decided to take up the matter of construction of three new bridges, one over Prairie Creek on the road between Tremont and Allentown, one over Mud Creek between Tremont and Mackinaw, and the other over Prairie Creek between Tremont and Morton. A committee was appointed to take charge of the proposition.

Iowa.

⊙The County Board of Supervisors, Burlington, Ia., awarded the contract to the Nebraska Bridge & Supply Co., Omaha, Neb., for supplying material for a large number of bridges. Other bidders for the work were Stadtlander Hardware Co., Burlington; Springfield Supply Co., Robt. Donahue Co., Nebraska Bridge Co., Murray Iron Works, Clinton Bridge Co., Ottumwa Supply Co., Shorthill Co., Des Moines Bridge Co., Hawkeye Hardware & Jobbing Co.

⊙The Waterloo, Cedar Falls & Northern R. R., T. E. Rust, Waterloo, Ia., Chief Engineer, has awarded the contract for the construction of the concrete bridge which is to be erected at the cut-off to replace the present embankment to the Miller-Hey Construction

Co., Waterloo, Ia. The contract calls for a two-span, reinforced concrete arch bridge, designed for double track and capable of carrying the heaviest rolling stock now in use. Each arch is to have a 42-ft. span and a rise of 18 ft. above the bed of the stream.

⊙ N. M. Stark & Co., of Des Moints, Ia., have been awarded the contract by the Board of County Supervisors, Estherville, Ia., for the erection of eight bridges for $6,080. Bids were opened April 26.

It has been decided by the Commercial Clubs of Council Bluffs, Ia., and Omaha, Nebr., that bridge facilities between the two cities are inadequate and steps are to be taken by the municipalities toward the construction of new structures.

The Sioux City Service Co., Sioux City, Ia., has under consideration the raising of its bridge over Perry Creek 1½ ft. on the east end and 2 ft. on the west end. A conference was recently held by the General Manager E. L. Kirk and G. Y. Skeels, City Engineer, in regard to plans.

The Board of Marshall County Supervisors, Marshalltown, Ia., has appointed a committee to act on the matter of erecting a new bridge over Spoon River at Canton.

The Cole's Addition Improvement Association has adopted a resolution waiving all objections to the postponement for one year of the construction of the proposed Great Northern Ry. bridge over the Floyd River at Charles St., Sioux City, Ia.

Illinois.

✣Bids will be received at the Town Clerk's office, Libertyville, Ill., until 1 p. m., May 9, 1911, for the construction of one reinforced concrete bridge in Libertyville Township, Lake County. E. D. Hubbard, Town Clerk, Libertyville. Bridge No. 1—Span, 25 ft.; roadway, 20 ft.; finished roadway to bottom of footings, 13 ft.; wings, 10 ft. Estimated amount of concrete in structure, 80.5 cu. yds.; reinforcing steel, 8,203 lbs. Nearest railroad station, Leighton on the E. J. & E., 1½ miles. Libertyville, 3½ miles. Commissioners advise that good gravel may be secured at pit 3½ miles from bridge site. Cost of gravel and condition of old bridge and foundation not known. Work to be completed on or before June 10, 1911.

⊙The Board of County Commissioners, Petersburg, Ill., has awarded the contract for the construction of a 45-ft. steel bridge over the slough near Johnson Valley Coal Company's mine in Menard County to Burnham & Ives at $1,090. The structure will be set on tubes and will have 12-ft. roadway floored with 2½ in. flooring.

At the recent election held at Aurora, Ill., the proposition to issue $30,000 of bonds for the construction of a new bridge over the Fox Rixer at Illinois Ave. was carried by a large majority.

Indiana.

✣Bids will be received until 2 p. m., May 13, by County Commissioners, Rushville, Ind., for 4,800 ft. of oak lumber, 3 in. thick, delivered at Bartlett Bridge, for 4,400 ft. of sugar tree lumber, 3 in. by 8 in. by 16 ft., delivered at Overleese Bridge, for 4,400 ft. sugar tree lumber 3 in. by 8 in. by 16 ft., delivered at Lock Ferree Bridge, all in Anderson Township, Rush County, Indiana. Also for curbing on north side of court house. Also for one No. 9 Burroughs Electric Adding Machine and stand. Jesse M. Stone, Auditor.

⊙The County Commissioners at Marion, Ind., have awarded Henry Tielking, 827 S. State Ave., Indianapolis, Ind., the contract for the construction of a culvert in Decatur township for $500. Bids were opened April 22.

⊙The Germania Park Co., Fort Wayne, Ind., has awarded the contract for the erection of a suspension foot bridge across the St. Joe River at the recreation park north of the city to the La Fayete Bridge Co. The work is to be finished by June 1.

A meeting of the County Council, Fort Wayne, Ind., has been held to take final action upon the appropriation of money for the new bridge over the St. Joseph River. The bridge is to be at Tennessee Ave., where it was finally decided upon by the County Commissioners several months ago. The council at a former extra session held up the appropriation until the commissioners could further investigate the question of location, some of the councilmen believing that the Tenessee Ave. site had been prematurely selected.

Kansas.

C. W. Lovelace, City Purchasing Agent, Kansas City, Kan., has received specifications for the new viaduct over Reynolds Ave. at Sixth St. of Otto Anderson, Commissioner of Streets, and will purchase the necessary materials at once. The viaduct will complete the last gap in Sixth St. between Central Ave. and Minnesota Ave., and when completed Sixth St. will be the easiest grade from Central to Minnesota Ave. of any other cross town street. The Metropolitan St. Ry. Company has been asked to straighten its viaduct over Reynolds Ave., so that its tracks will run directly south from that point to Central Ave., parallel to Sixth St., instead of cutting "corners" as they do at Riverview.

City Engineer, Hutchinson, Kans., has been instructed to prepare plans for the construction of a bridge over Cow Creek at Walnut St., the full width of the thoroughfare.

Maryland.

✣Bids will be received until 11 a. m., May 18, by Highways Commission of Baltimore County, Towson, Md., for furnishing and erecting over the Back River at Easton Ave., a Strauss Trunion Bascule Bridge. Henry G. Shirley is Roads Engineer of the county. Official advertisement will be found elsewhere in this issue.

The Board of Estimates, Baltimore, Md., has submitted to the Second Branch of the City Council a new ordinance to take the place of that agreed upon by the Railways Committee with reference to the proposed crossing at Lafayette Ave. over the tracks of the P. B. and W. R. R. This reduces the amount to be contributed by the city from $123,000 to $100,000 and makes it obligatory for the railroad company to assume all claims for damages. Under the terms of the ordinance the company is to lower its tracks eleven feet and construct an overhead bridge. This arrangement will enable the city to open other streets across the railroad and to carry them across by overhead bridge at less expense and render more feasible the future abolition of grade crossings between Edmondson Ave. and Payson St.

Minnesota.

Following the authorization by the legislature of $850,000 of new city bridge bonds the Minneapolis, Minn., aldermen are planning quick action toward the construction of new bridges. The Camden bridge is considered most needed and a special committee will view the three locations proposed, on 42d, 43d and 44th Aves. N. City Bridge Engineer Christ Ousted will be instructed to submit sketches of various types of bridges and the civic commission will be consulted in the selection of a general type to be adopted in all bridges to be built.

New Jersey.

⊙The Board of County Freeholders, Trenton, N. J., has awarded the contrasts for the rebuilding of the South Stockton St. bridge and repairing of the Titusville bridge to the McGovern Contracting Co. The cost of the Stockton St. bridge will be $2,960 and the Titusville structure will cost $1,835.

Efforts are being made by the County Freeholders, Hackensack, N. J., to have a bridge constructed over Susquehanna Railroad cut. The cost of such an improvement would be about $7,000.

Board of Freeholders recently held a special meeting at the court house, Elizabeth, N. J., on the advisability of rebuilding the old draw bridge over the Elizabeth River at Bridge st. The cost of the work is estimated at $8,000.

New York.

✣Bids will be received until 2 p. m., June 1, by Kingsley Martin, Bridge Commissioner, New York City, for strengthening the end spans of the Williamsburg Bridge over the East River between the boroughs of Manhattan and Brooklyn.

At a special town meeting held April 20, at Richmondville, N. Y., it was voted to construct a new bridge at the paper mill dam, at a cost of approximately $5,000. The old bridge was recently damaged by a runaway team and condemned.

Advices from Herkimer, N. Y., state that an ordinance has been passed authorizing the issuance of $20,000 of bonds for the construction of a bridge across the Moose River at the town of Webb.

Ohio.

✣Bids will be received until noon, May 9, by Director of Public Service, J. J. Wenner, Clerk, Cincinnati, O., for painting and cleaning superstructure work of the Eighth St. viaduct. A bond for $500 must be filed with each bid.

⊙Board of County Commissioners, Marion, O., has awarded the contract for building the abutments for the Kenton Pike bridge, which is to be rebuilt over the Little Scioto River, to T. J. Hoyles, $1,264. The other bidders and bids were A. J. Brady, $1,391; P. Drake & Sons, $1,310; Deyer & Son, of Caledonia, $1,346; T. J. Hurley, $1,271.40; and J. D. Gillisspie, $1,300. County Surveyor Ault's estimate on the work was $1,391.

The proposed Gilbert Ave. viaduct at Cincinnati, the plans for which are almost completed, will give a new and direct outlet to Walnut Hills, a portion of the city of Cincinnati, O., with a population of about 50,000. Gilbert Ave. is 100 ft. wide and at its western terminus joins East Court St., which is 66 ft. wide. The new viaduct will extend from the intersection of East Court St. and Gilbert Ave. in line with the present Gilbert Ave. to Egglestone Ave. and East Eighth St., a distance of about 693 ft. From thence, making an angle of 47 degrees with first described portion, the viaduct will extend parallel to and south of East Eighth St. to Broadway, a distance of about 487 ft., making a total length of about 1,180 ft. The viaduct will have a total width of 80 ft. with roadway 58 ft. wide and two sidewalks each 11 ft. wide. There will be short earth-work approaches contained between reinforced concrete retaining walls at each end. The viaduct proper with the exception of the span over Eggleston Ave., will be constructed of reinforced concrete of beam and girder construction supported by four rows of columns, resting on reinforced concrete piers. The spans in general will be 30 ft. The span over Eggleston Ave. will consist of 6 plate girders incased in concrete and resting on reinforced concrete abutments. The span over Egleston Ave. will be 100 ft. The location of the viaduct is for the greater part on an old fill. The entire structure will be constructed on concrete It is planned to use piles 30 ft. long but the length will depend upon the penetration. Bids will be received on any system of concrete piling, which the contractor may choose to figure on but the piles must meet tests required in specifications. Accompanying the bid there must be a complete specification of the system bid on. The kind to be used will be determined after the bids are opened. There will be approximately 34,000 lin. ft. of piling necessary. The contract for the superstructure will be let as a whole. The slabs, beams and girders will be reinforced with cold square twisted bars, the columns with round bars, and stirrups and hoops will be square bars. There will be two street railway tracks on the structure with pole supporting feed wires in the center of the roadway. The roadway will be paved with wood block. The structure will be illuminated by the boulevard system of lighting. The lamp posts will be of concrete mounted on the railing posts and will be 60 ft. apart. There will be a cluster of five lights on each post consisting

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

of one one hundred watt and four fifty watt tungsten electric lights. The approximate quantities of the principal materials of construction for the whole viaduct are as follows: Concrete piling, 34,000 lin. ft.; reinforced concrete, 8,000 cu. yds.; reinforcing steel, 500 tons; structural steel, 200 tons. It is estimated that the structure will cost from $325,000 to $350,000. H. F. Shipley is Chief Engineer, Department of Public Service, of Cincinnati; Frank L. Roschig is Assistant Engineer.

Oklahoma.

The Santa Fe System will, it is reported, call for bids for the construction of the proposed viaduct over its tracks at Guthrie, Okla., as soon as plans are approved. The structure according to plans will be 1,000 ft. long, 40 ft. wide, and built of reinforced concrete. Arches over Cottonwood and Railway tracks. Soundings were recently made for the foundations. C. F. W. Felt, Topeka, Kan., is Chief Engineer.

It was recently voted by the city of Hugo, Okla., to issue bonds amounting to $125,000 for court house and jail and $120,000 for the construction of bridges.

Pennsylvania.

⊙The Commissioners of Northhampton County, Pa., on April 18, awarded the contract for the construction of a reinforced concrete bridge and work incidental thereto, at Easton, Pa., to the Ferro Concrete Co., Harrisburg, Pa., at $109,950. The structure will consist of two 92-ft. spans and one 100 ft. span with an approximate width of 65 ft. Young & Reese, 1 Pomfret Bldg., Easton, Pa., are County Engineers. There were three other bids, as follows: Smith & McCormick Company, Easton, $125,000; Whiting-Middleton Construction Company, Baltimore, Md., $116,250; Nelson-Meredith Company, Baltimore, $124,000.

Bids were opened at Wilkesbarre, Pa., by the County Commissioners on April 18 for the construction of 60 bridges in Luzerne County, Pa. The lowest bidders were as follows: John Aubend for two bridges in Ashley Borough, $976; Zieser Bros., two bridges in Bear Creek Township, $420, a bridge in Dallas Borough, $183, one bridge in Huntington Township, $470, bridge in Nescopeck Township, $396, two bridges in Wright Township, $558; Edward W. Conley, two bridges in Bear Creek Township, $400; N. O. Clark, bridge in Black Creek Township, $804, 2 bridges in Exeter Township, $847, 2 bridges in Franklin Township, $786, 2 bridges in Hollenback Township, $1,062; George Dinkelacher, 3 bridges in Butler Township, $988, one bridge in Fairview Township, $780, 5 bridges in Sugar Loaf Township, $1,879; T. A. Williams, 2 bridges in Butler Township, $816; Thomas W. Haines, bridge in Dallas Township, $150, bridge in Lake Township, $175; C. S. Norris, 2 bridges in Dorrance Township, $545, 2 bridges in Slocum Township, $494; D. J. Edwards, 1 bridge in Edwardsville Borough, $2,000; Forty Fort Bros., 1 bridge in Forty Fort Borough, $1,400; Andrew Croop, 3 bridges in Hunlock Township, $3,434, 1 bridge in Pittston Township, $364, 1 bridge in Union Township, use gravel, $274; W. S. Hoover, 2 bridges in Lehman Township, $1,015; A. J. Harter, 1 bridge in Nescopeck Township, $421; R. A. VanHorn, 1 bridge in Pittston Township, $324, 2 bridges in Union Township with gravel, $449; J. L. Lavin, 1 bridge in Sweyersville, $412.

Two ordinances for widening Smithfield St. bridge, Pittsburg, Pa., have been recommended. The bridge is to be extended 4 or 5 ft., the street cars are to be confined to the east side and the west side is to be for wagon traffic exclusively. The Pittsburg & Lake Erie Railroad gives up a strip of ground on the eastern side of the south approach and acquires the right to erect a shelter over the street at its station and to build a tunnel under the bridge, so that persons desiring to take passage on trains or arriving need not cross Smithfield street. The Baltimore & Ohio Railroad Company is to give up its lease of a small strip on the eastern side of the north approach to make room for the widening.

Oregon.

⊙According to advices from Portland, Ore., the County Court has awarded the contract for the construction of the county bridge in the West Portland district outside the city limits to P. W. White, 928 East Couch St., at $2,650.

⊙The contract for the construction of the Main St. bridge, Pendleton, Ore., mentioned in our last issue, was awarded by the City Council to the Coast Bridge Co., Portland, Ore. The total cost of the work is approximately $35,000.

⊙The Commissioners of Jackson County, according to advices from Jacksonville, Ore., have awarded the contracts for the construction of the Big Butte bridge near Derby and the Upper Sams Valley bridge across the Rogue River to the Columbus Bridge Co., at $8,000 and $12,000, respectively. The Sams Valley bridge will have concrete piers and have a 220-ft. span with long approaches. The Big Butte bridge will also have concrete piers and will be of the steel highway type. The span will be 200 ft. in length.

The Linn County Court, according to advices from Albany, Ore., has been petitioned to construct two steel bridge, one at Shelburn and another at Harrisburg crossing the Williamette River between Linn and Marion Counties. The estimated cost of the structures is $60,000.

The Bross Construction Co. has filed articles of incorporation, Portland, Ore., and will construct bridges, sewers and similar public works. The incorporators are Albert Bross, Joseph Bross and John A. Bross.

At the election to be held at Portland, Ore., June 5, one proposition voted upon will be that providing for the issuance of $1,400,000 of bonds for the construction of a high street bridge across the river from Meade St. on the east side to Woodward Ave. on the west side.

Advices from Elgin, Ore., state that County Superintendent J. Campbell has been awarded the contract for building two steel bridges over Wallowa River and Bear Creek north of Wallowa.

Tennessee.

⊙The County Court from Memphis, Tenn., has ordered the construction of a bridge over the Hatchie River at Fite Ave. to cost $13,945, the contract being awarded to the Memphis Bridge Co. The same company was awarded contracts for bridges at Bell's Switch, $3,698; at Walnut Ave., near White Station, $2,285, and at Hurricane Creek, near Bartlett, $2,995. W. F. Allen got the contract for a bridge over Big Creek for $3,497.

City Engineer of Chattanooga, Tenn., has approved the proposed plans for the construction of the Southern Railway bridge on McCallie Ave. and it is believed that work will be started within a short time. The estimated cost of the structure is $11,000. D. W. Lum, Washington, D. C., is Chief Engineer of the Southern Ry.

The steel bridge over the Tennessee River at Austin Mills, Tenn., on the Rogersville branch of the Southern Ry. Co., mentioned in our April 12 issue, has been practically completed by the contractors of the work, Curtis & Shumway of Lynchburg, Va. The work was under the immediate direction of their superintendent on the job, Mr. A. N. Campbell. All of the iron is now in place, only the painting remains to be finished. The bridge, erected to replace the old Howe truss wooden structure, is of the deck truss type and will rest on the old stone piers and abutments, which were re-pointed and re-capped with concrete copings. The iron having been exposed for some time to the weather, was thoroughly scraped and given a good coat of red lead and linseed oil before erection and will be given two coats of the Southern Railway Co.'s standard bridge paint—Metallastic No. 2—after erection. The first span was swung during August and the last span was in place April 15, traffic having been kept open at all times during construction. The total length of the bridge is 1,315 ft. and it is 78 ft. above water.

Texas.

Bridge bonds amounting to $500,000 have been disposed of by the city of Houston. The main bridge will begin at the north line of Commerce St. on Main, thus giving three openings on the south side, and will extend to the south line of Wood St. on Montgomery Ave., with an opening into Wood St. Then there will be a bridge from Wood St. back across White Oak, underneath the elevated portion of the main bridge and with an opening into Girard St. This will make the property in the vicinity of the Katy passenger station easily accessible from either north or south side. To reach such property from the south side the way will be across the main viaduct to the Wood street opening, then a turn into the parallel bridge back across White Oak and into Girard. The main viaduct will be elevated high above the ground on the north side, clearing the tracks and leaving ample room for the traffic on the railways. The bridge will rest on a series of four columns wide enough apart to admit of roadways lengthwise underneath the bridge.

The Commissioners Court at Cameron, Texas, has ordered the construction of a steel bridge over the Elm Creek at the Belton-Yarrellton crossing near Yarrellton. The estimated cost of the work is $1,350.

Washington.

The North Coast Division of the Oregon-Washington Railroad & Navigation Co., according to advices from Spokane, Wash., has announced the closing of contracts for steel for two bridges amounting to $900,000. One of the bridges, to be erected over the Snake River, near the mouth of the Palouse River, will be the largest in the northwest, crossing the river 275 ft. above the water and being 4,070 ft. long. The other is to be erected across the Spokane River at Spokane, near the mouth of Hangman Creek, and will be 3,400 ft. long and 165 ft. high. Both are to be completed within fifteen months. Chief Engineer F. L. Pitman, Spokane, Wash.

Advices from Spokane, Wash., state that the Boone Ave. Improvement Club bridge committee recently held a meeting to take into consideration the matter of building a $500,000 concrete bridge over the river from the western end of Boone Ave.

Wisconsin.

Bids were opened at Kenosha, Wis., for the rebuilding of Middle St. bridge. The tenders received were as follows: Marsh Engineering Co., Des Moines, Ia., $9,875; John Brogan, Green Bay, Wis., $17,800; Cleary-White Construction Co., Milwaukee, Wis., $9,270.

Canada.

✣Bids will be received until noon, May 16, by J. W. Johnston, Secy. Treas. Town of Dauphin, Man., for the supply, delivery and erection complete of two 70-ft. steel bridges with 18-ft. roadway over the Vermillion River in the Town of Dauphin. Copies of the specification and form of tender may be obtained at the office of the Chief Engineer, Department of Public Works, Parliament buildings, Winnipeg, Man.

✣Bids will be received until May 29, by the City Commissioners, Edmonton, Alta., for the construction of steel bridge over the Saskatchewan River at Edmonton, Alta. A. J. Latornell is City Engineer.

The Dominion Board of Railway Commissioners has instructed the Canadian Pacific and the Grand Trunk Railways to build the viaduct along the water front at Toronto, Ont., within two years. The board also heard the application of the Grand Trunk Ry. for permission to construct a bridge across the Humber River with a pier in the center of the stream. No action was taken but ruling was delayed about 10 days.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

•The County Court at Dewitt, Ark., has awarded contracts for two ditches. Contracts for the building of the [illegible] ditch were let as follows: J. W. Wright and [illegible] W. Keaton, 1 section; L. B. Capps and M. [illegible], 1 sections; L. P. Bracy, 1 section. This ditch will cost about $8,000. The contract for the Prange ditch was let to A. A. [illegible] and C. F. Prange. It is wholly in Crockett township, near White River. It will drain 5,049 acres of land, and will cost $7,873.

California.

✣Bids will be received until 2 p. m., May 15, by F. H. Newell, Director U. S. Reclamation Service, Los Angeles, Cal., for furnishing a steam power plant for Rio Grande project, New Mexico-Texas. For particulars address United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., or Washington, D. C.

Advices from Yuba City, Cal., state that the new owners of the Sutter-Butte canal system are maturing plans for commencing work on the extension of the lateral system of the canal and of making permanent weirs all along the line of the main ditch. The present wooden weirs will be replaced by cement structures. The weak places in the embankments will be strengthened and many miles of new laterals will soon be under construction.

Colorado.

The Fountain-Chico irrigation system, which is being financed by the Pueblo-Northeastern Co., has filed descriptive plats at Colorado Springs. The plans as set forth in the seven plats call for an expenditure of nearly $5,000,000. A large part of the land to be irrigated is in the southern part of El Paso county and the rest is in Pueblo county. The heaviest expense will be incurred in the construction of the main reservoir in El Paso county, which will have a capacity of 155,682,619,800 cubic feet and will cost $2,000,000. The dam will be 125 feet high. The reservoir will be filled from Squirrel creek. The second reservoir, known as the Lake May reservoir, is to cost $1,897,500 and to have a capacity of 6,864,294,000 cubic feet. It will receive its water from Fountain, Chico and Squirrel creeks. The plats provide for the construction of a canal and three ditches. Canal No. 1 will cost $85,520 and will be 10.73 miles long, with a capacity of 900 cu. ft. per second. The Squirrel creek ditch is to be 37,100 feet in length, with a carrying capacity of 1,450 cu. ft. a second. It will cost $170,000. The Chico feeder ditch will carry 2,500 cu. ft. a second and will be 2.18 miles long. Its cost is estimated at $56,000. The Fountain feeder ditch, 10 miles long, with a carrying capacity of 2,500 cu. ft. a second, is to cost $236,260.

Idaho.

Premliminary report has been completed by R. A. Hart, Drainage Engineer, 1027 Boston Bldg., Salt Lake City, Utah, of a proposed drainage system for Drainage District No. 1, Canyon County, Idaho, in which 12,000 acres are involved, with 409,000 cubic yards of excavation.

Illinois.

Bids will be received until 11 a. m., May 12, by Commissioners of Union Drainage District No. 2, Edward J. Zimmerman, Harvel, Ill., Clerk for the construction of drains as planned by J. W. Dappert, Taylorville, Ill. Engineer. The work consists of vitrified salt, glazed drain tile upon all sizes greater than 10 in., and good red clay tiles upon the smaller sizes, together with the unloading from cars at Harvel, hauling out to the lines of work, trenching, laying the drains and refilling same after acceptance by the engineer, as follows: 4,450 ft. 27-in. drain, av. depth 5.2 ft.; 4,950 ft. 18-in. drain, av. depth 3.6 ft.; 3,040 ft. 16-in. drain, av. depth 4.5 ft.; 2,240 ft. 15-in. drain, av. depth 4.7 ft.; 2,000 ft. 14-in. drain, av. depth 3.6 ft.; 2,300 ft. 12-in. drain, av. depth 4.2 ft.; 5,950 ft. 10-in. drain, av. depth 3.9 ft.; 2,050 ft. 8-in. drain, av. depth 4.3 ft. Three concrete retaining walls at outlets of said tile drains comprising 17 cu. yds.

Indiana.

✣Bids will be received between 10 a. m. and 11 a. m., May 13, by William I. Robison, Supt of Construction at the offices of Osborn, McVey & Osborn, LaPorte, Ind., for the construction of a drain 11,358 ft. in length requiring 20,210 cu. yds. of excavation, with teams or with dry land excavator. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until May 2, by Drainage Commissioners of Rush County at Rushville, Ind., for the construction of Deputy Drain. J. A. Cowan is Drainage Commissioner at the office of Sparks and Gary, Rushville, Ind.

⦿Ananias Ipe of Elkhart, Ind., has been awarded the contract by W. Canfield, Supt. of Construction, Laporte County, Laporte, Ind., for the construction of a drain for $5,028. Osborn, McVey & Osborn, 810 Main St., Laporte, Engineers. Bids were opened April 22.

Iowa.

✣Bids will be received until 1 p. m., May 3, by W. L. Fitkin, County Auditor, Garner, Ia., for the removal of 6,000 cu. yds. of earth and the construction of four concrete control dams in connection with drainage district No. 10.

⦿Jens Jensen, Williams, Ia., has been awarded the contract by the Hamilton County Commissioners, Webster City, A. J. Peterson, County Auditor, for furnishing salt glazed, vitrified clay tile and the construction of drain No. 115 in Hamilton county as follows: 2,000 ft. 36-in., 1,200 ft. of 24-in., 1,200 ft. of 22-in., 6,300 ft. of 20-in., 2,550 ft. of 18-in., 2,750 ft. of 16-in., 1,400 ft. of 15-in., 3,622 ft. of 15-in., 3,972 ft. of 12-in., 2,485 ft. of 10-in., 508 ft. of 8-in., 700 ft. of 7-in. The contract price is $20,000. Bids were opened April 26.

⦿Bids were opened April 26 by A. J. Peterson, County Auditor, Webster City, Ia., for furnishing, trenching, laying, etc., of the following tile: 3,102 ft. 24-in., 7,788 ft. of 2-in., 4,194 ft. of 20-in., 3,102 ft. of 18-in., 990 ft. of 16-in., 3,386 ft. of 14-in., 1,122 ft. 12-in salt glazed, vitrified tile. The contract was awarded to Henry Swift, Webster City, Ia., at $17,200.

⦿Bide were opened April 26 by J. L. Horrabin, County Auditor, Fort Dodge, Ia., for labor and material for ditch work, Drainage District No. 75-95. J. H. Larison, Lanesboro, Ia., at $11,577, was awarded the contract for ditching and the Lehigh Clay Products Co., Lehigh, Ia., at $15,479 was awarded the contract for the tile.

Louisiana.

⦿Hearin & Ryan, Baton Rouge, La., have been awarded the contract at 13.45 cts. per cu. yd. for constructing the Ascension-New Hope Levee for the Atchafalaya Basin Levee District. The contract includes about 90,000 cu. yds. of river side enlargements. Bids were opened April 26 at the office of the Board of State Engineers, G. W. Lawes, Secretary, New Orleans, La.

At a meeting of the Mississippi River Commission, Col. Sidney F. Lewis, of the Orleans Levee Board, New Orleans, stated that $1,000,000 more is to be spent to complete plans already mapped out for the completion of improvements on the levee system in the New Orleans harbor. It was also stated that it is necessary before any extensive improvement of existing levee lines in the lower stretch of the Third District be undertaken by the Orleans Levee Board, that the United States government continue and complete levee work from Caffin's st., New Orleans, to the lower end of the parish.

Minnesota.

✣Bids will be received until 4 p. m., May 12, by P. D. McKellar, County Auditor, Jackson, Minn., for the construction of Judicial Ditch No. 12.

✣Bids will be received until 2 p. m., May 16, by W. A. Seeman, County Auditor, Slayton, Minn., for the construction of Ditch No. 19, including approximately 18,600 ft. of 6 to 14-in. tile. The estimated cost of the work is $5,939.

Missouri.

✣Contract will be let at Public Outcry on May 15 for the construction of main canal and laterals in Drainage District No. 3, Carroll County, Carrollton, Mo., the main canal being 21 miles in length and including 1,170,000 cu. yds. of excavation. Brooks & Jacoby, 515 Shubert Bldg., Kansas City, Mo., Engineers.

✣Bids will be received until noon, May 22, by Maj. E. H. Schulz, U. S. Engineer, Kansas City, Mo., for the construction of standard revetment on Missouri River 4 miles below St. Charles, Mo.

Nevada.

⦿P. J. Moran, Salt Lake City, Utah, has been awarded the contract for building an 80-ft. dam in the Bishop creek district, northwest of Wells, Nev., his bid being $100,010.

New Mexico.

Parties interested in the Everlasting Ranch, Aztec, N. Mex., are arranging to put in a pumping plant for the purpose of raising water for irrigation. The Fields-Fellows & Hinderlider Engineering Co., Century Bldg., Denver, Colo., is the engineer.

Ohio.

✣Contract will be let May 16 at Public Outcry for constructing ditch in Coitsville township. George M. Montgomery is County Surveyor, Youngstown, O.

Porto Rico.

All bids received Feb. 7 by the Porto Rico Irrigation Service for the construction of the Cavite Dam, Guayabal Dam, and Patillas Canal were rejected and laws have been enacted recently directing that the work shall be carried on administratively rather than by contract. The work for which bids were opened Feb. 7 was as follows: (1) Carite Dam and appurtenant structures, containing about 150,000 cu. meters of earth and loose rock, the estimated cost of which is about $190,000. (2) Guayabal Dam and appurtenant structures, containing about 73,500 cu. meters of concrete masonry and 82,000 cu. meters of excavation, the estimated cost of which is about $550,000. (3) Patillas Canal and appurtenant structures, including about 32,000 cu. meters of open-cut excavation, 2,000 lin. ft. of tunnels, 2,500 lin. ft. of flumes, 600 lin. ft. of siphons, and 100 bridges, the estimated cost of which is about $70,000. J. W. Beardsley, Guayama, P. R., is Chief Engineer Porto Rico Irrigation Service.

South Dakota.

Surveys are to be made shortly for a $10,000 drainage district. The Dakota Engineering Co., Mitchell, S. Dak., is the engineer.

At a recent meeting at Caputa, owners of nearly 40,000 acres of land in the Rapid valley formed a co-operative irrigation company with the object of putting the lands of the valley under irrigation.

Texas.

✣Bids will be received by McSweeney Bros., Italy, Texas, at once for 75,000 yds. of levee work 5 to 7-ft. filling, 6 to 8 ft. berm borrow on both sides. No shrinkage. Mostly through fields.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

⊙Dr. A. C. Wilkins, Jennings, La., has been awarded contract by Orange County for building a 5-ft. levee and a canal through the Sabine River marsh from the river to the east end of Green ave. at Orange, connecting with the Trans-Calcasieu road.

The American Rio Grande Land and Irrigation Co. is planning to extend its canal system over 30,000 acres more of land at Mercedes. It is stated that the work will begin in the new canals at once.

Utah.

A considerable amount of drainage work is projected in the vicinity of Salt Lake City. Among the projects at Benjamin, Utah, for which plans and estimates have been made are the following: Benjamin Drainage District No. 1, 1,000 acres; 14,000 cu. yds. excavation; 4,550 ft. tile drains. Benjamin Drainage District No. 2, 1,000 acres; 54,000 cu. yds. excavation. Benjamin Drainage District No. 3, 800 acres; 17,000 cu. yds. excavation; 8,830 ft. tile drains. Surveys have also been made and plans are about completed for the drainage of the Lake Shore Drainage District, Lake Shore, Utah. In this project 5,200 acres are involved, with 210,000 cu. yds. of excavation, 30,000 cu. yds. of which is already done. The project involves a pumping plant and the leveeing of a part of the drainage water into Utah Lake, which is at a higher elevation than the adjacent lands. Plans have also been submitted for the drainage of the Hinckley-Deseret-Oasis tract of Millard County, Utah, which involves 6,500 acres, and will require 233,000 cu. yds. of excavation. C. F. Brown, of Salt Lake City, who is interested in this project, was at last reports in Chicago for the purpose of purchasing a machine for the rapid handling of this latter work. R. A. Hart, 1027 Boston Bldg., Salt Lake City, Utah, prepared the plans and estimates for all of the above work.

Virginia.

✣Bids will be received until 11 a. m., May 27, by R. C. Hollyday, Chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for water closets and lavatories at the navy yard, Norfolk, Va.

✣Bids will be received until noon, May 20, by Lieut. Col. W. C. Langfitt, U. S. Engineer, 920 17th St. N. W., Washington, D. C., for constructing and revetting jetties and driving marking piles in James River, Va.

✣Bids will be received until noon, June 1, by Lieut. Col. Mason M. Patrick, U. S. Engineer, Custom House, Norfolk, Va., for dredging in harbor at Norfolk, Va.

Washington.

Bids were opened April 15 at the office of the U. S. Reclamation Service, North Yakima, Wash., for the construction of the Kachess Dam for the Yakima project, of which Chas. H. Swigart, North Yakima, is Supervising Engineer. The bids were received on two schedules, schedule 1 being for the embankment and outlet works and schedule 2 for the spillway. The bids received on schedule 1, embankment and outlet works, were as follows: (1) Far West Construction Co., Tacoma, Wash.; (2) Nelson Bennett, Tacoma, Wash.; (3) Maney Bros. & Co., Oklahoma City, Okla.; (4) C. L. Morris Construction Co. & Traphagen, Seattle, Wash.

		(1)	(2)	(3)	(4)
1.	Clearing, [illegible] acres	$150.00	$100.00	$100.00	$[illegible]
2.	Grubbing, 20 acres	130.00	[illegible]	100.00	150.00
3.	Stripping, 15,000 cu. yds.	.40	.60	.40	[illegible]
	Dredging:				
4.	Class 1, 95,000 cu. yd.	.30	1.00	.50	.80
5.	Class 2, 500 cu. yds.	15.00	2.00	1.00	[illegible]
	Outlet channel excavation:				
6.	Class 1, 90,000 cu. yds.	.45	.60	1.00	1.00
7.	Class 2, 5,000 cu. yds.	.80	.70	1.50	2.00
	Trench excavation:				
8.	Class 1, 5,500 cu. yds.	.45	2.50	5.00	5.00
9.	Class 2, 500 cu. yds.	[illegible]	3.00	6.00	6.50
	Wet excavation:				
10.	Class 1, 4,500 cu. yds.	2.25	2.00	5.00	1.91
11.	Class 2, 500 cu. yds.	3.00	2.50	6.00	6.34
	Dry excavation:				
12.	Class 1, 50,000 cu. yds.	.27	.40	1.00	.87
13.	Class 2, 40,000 cu. yds.	.50	.45	1.50	1.01
14.	Class 3, 5,000 cu. yds.	.80	.75	2.00	3.00
15.	Backfilling around conduits, 20,000 cu. yds.	.70	.40	.50	.45
16.	Embankment, hydraulic method, 240,000 cu. yds.	.36	.33	.60	.70
17.	Embankment, alternate method, 240,000 cu. yds.	.45	.34	.85	.75
18.	Rock fill in drain at toe, 7,000 cu. yds.	1.50	1.50	1.40	3.00
19.	Riprap, 10,000 cu. yds.	1.75	2.50	2.00	4.25
20.	Grouted paving, 2,600 cu. yds.	6.00	3.50	6.00	5.00
21.	Dry paving, 520 cu. yds.	2.00	2.50	3.00	4.81
22.	Gravel under dry paving, [illegible] cu. yds.	1.00	.50	2.00	4.00
	Concrete:				
23.	Class A, 2,500 cu. yds.	6.30	6.25	10.00	9.00
24.	Class B, 3,500 cu. yds.	10.00	6.50	15.00	11.00
25.	Class C, 370 cu. yds.	15.00	10.00	20.00	12.00
26.	Placing reinforcing steel, 300,000 lbs.	.01½	.02	.00½	.03
27.	Placing wrought iron and structural steel, 37,000 lbs.	.02	.07	.01	.03
28.	Placing gates and operating gear, 4 sets	100.00	150.00	500.00	200.00
29.	12-inch glazed drain pipe in place, 1,000 lin. ft.	1.25	.60	1.00	2.00
	Total by hydraulic method	$351,730	$418,965	$628,730	$683,291
	Total by alternate method	$375,730	$421,365	$688,730	$695,291

The bids received on schedule 2—spillway—were as follows: (1) C. L. Morris Construction Co. & Traphagen, Seattle, Wash.; (2) Midland Engineering Co., North Yakima, Wash.; (3) Far West Construction Co., Tacoma, Wash.; (4) Nelson Bennett, Tacoma, Wash.; (5) Maney Bros. & Co., Oklahoma City, Okla.

		(1)	(2)	(3)	(4)	(5)
30.	Clearing, 6 acres	$150.00	$[illegible]	$170.00	$110.00	$100.00
31.	Grubbing, 5 acres	150.00	170.00	130.00	130.00	100.00
	Dry excavation:					
32.	Class 1, 35,000 cu. yds.	.55	.21½	.35	.60	.50
33.	Class 2, 10,000 cu. yds.	1.00	.30	.50	.60	1.00
34.	Class 3, 2,000 cu. yds.	2.00	2.00	1.00	.75	1.50
35.	Backfilling, 2,000 cu. yds.	.45	.60	.70	.60	.50
36.	Grouted paving, 250 cu. yds.	5.00	5.50	8.00	2.50	6.00
37.	Dry paving, 1,700 cu. yds.	4.81	2.50	2.00	2.50	3.00
38.	Gravel under dry paving, 850 cu. yds.	4.00	2.00	1.00	.60	2.00
	Concrete:					
39.	Class A, 1,700 cu. yds.	9.00	7.50	8.00	6.50	10.00
40.	Lumber, 5 M. ft. B. M.	35.00	50.00	40.00	40.00	50.00
		$64,102	$37,400	$42,370	$47,645	$59,650
	Total for Schedule 1, by hydraulic method (for [illegible])	$683,291		$351,730	$418,965	$628,730
	Total for both schedules by hydraulic method	$747,393	....	$394,100	$466,610	$688,380
	Total for both schedules by alternate method	$759,393		$418,100	$469,010	$748,380

Wisconsin.

✣Bids will be received until 1:30 p. m., May 20, by W. C. Staples, Osceola, Wis., for the construction of Drain Nos. 1, 2 and 3 and fencing the same as follows: All open ditch, running from 2 to 15 ft. in depth. Total estimated dirt to be removed, 33,397 cu. yds. Total length of ditches, about 3⅝ miles; three concrete arch culverts; 7½ miles five-wire fence, galvanized barbed wire, consisting of two No. 12-gauge wires twisted with barbes not over six inches. Work to be commenced on or before June 10, 1911, and prosecuted with reasonable dispatch and completed November 1, 1911

WATER-WORKS

Alabama.

The citizens of Gadsden, Ala., have voted bonds to the amount of $50,000 for the completion of the waterworks now in process of construction. The entire system will cost $150,000.

California.

✣Bids will be received until 11 a. m., May 17, by Col. George McK. Williamson, Deputy Quartermaster General, Fort Mason, Cal., for constructing a 6,000,000 gal. reinforced concrete reservoir and reconstructing water system at Presidio of San Francisco, Cal.

Water Supt. Fay of San Diego, Cal., has made requisitions for pipe for the water main to be laid along University Ave., and for pipe for La Jolla.

Colorado.

An election was held in Grand Junction, Colo., on April 29 to determine between mountain and artesian water for a municipal supply. If the water is secured from Kannah Creek the system will cost $500,000, while the artesian well proposition will cost $125,000.

Florida.

The citizens of South Jacksonville, Fla., have voted the issuance of bonds to the amount of $60,000 for the installation of a waterworks system and an electric light plant.

Georgia.

⊙Walton & Wagner of Atlanta, Ga., have been awarded the contract by the city council of Sparta, Ga., for the construction of three and one-half miles of from 4-in. to 8-in. water mains, two 750,000-gal. pumps, air compressor, boiler, power house, 100,000-gal. brick reservoir, 80,000-gal. tank on a steel tower, and for the construction of three miles of sewers and a purification plant.

Bonds to the amount of $15,000 have been voted by the citizens of Barnesville, Ga., for extensions to the water, sewer and light systems.

An election will soon be held in Ashburn, Ga., to vote on the proposition of issuing bonds to the amount of $20,000 for the construction of a waterworks and a sewerage system.

An election was held in Fort Valley, Ga., on April 29 for the purpose of voting on the proposition of issuing bonds to the amount of $35,000 for the erection of a school building, complete the waterworks system and the laying of sewerage.

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until May 4 for furnishing and delivering to the Meter Mechanical Shops, [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Ave., hemlock and pine lumber as follows. For term ending Oct. 1, 1911, hemlock, 1,000 pcs. 2 in.x10 in.x4 ft. 4 in., 1,000 pcs. 2 in.x10 in.x4 ft., 1,200 pcs. 2 in.x10 in.x4 ft. 10 in., 1,200 pcs. 2 in.x10 in.x4 ft. 10 in., 800 pcs. 4 in.x4 in.x3 ft. 4 in., 400 pcs. 4 in.x4 in.x1 ft. 6 in., 400 pcs. 4 inx4 inx2 ft. 4 in., 1,200 pcs. 2 in.x10 in.x1 ft. 6 in., 200 pcs. 1 in.x12 in.x3 ft. 8 in., 200 pcs. 1 in.x12 in.x3 ft. 8 in., 200 pcs. 1 in.x12 in.x4 ft. 6 in.; 1,560 pcs. No. 1 pine as follows: 20 pcs. 1 in.x6 in.x12 ft. D. & M., 16 pcs. 1 in.x6 in.x16 ft. D. & M., 16 pcs. 2 in. x12 in.x14 ft. rough, 16 pcs. 3 in.x12 in.x14 ft. rough, 20 pcs. 2 in.x6 in.x12 ft. matched lumber. All lumber furnished hereunder shall be grade No. 1 hemlock and No. 1 pine, sound and free from dry rot, culled or split pieces. Cash or certified check for $100 must accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., fourth floor City Hall, until 11 a. m., Thursday, May 11, for materials, labor, etc., on concrete foundations for two electrically driven centrifugal pumps in the Twenty-second St. Pumping Station and make necessary changes in the building. Cash or certified check to the amount of $500 must accompany proposal.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to Gindele Bros., Chicago Opera House Block, Chicago, the contract for materials, labor, etc., necessary for pumping out Sections 1 and 2 Southwest Land Tunnel, constructing one 11 ft. shaft in earth and rock and constructing 250 lin. ft. of 9 ft. tunnel in rock and other work for the lump sum of $47,700. Bids were opened April 10, 1911. (Details specifications published in ENGINEERING-CONTRACTING April 5.)

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing lubricating oils to the various pumping stations to the Magie Oil Co., 155 N. Canal St. Bids opened April 6.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to F. W. Myrick, 218 LaSalle St., the contract for constructing a reinforced concrete floor and ash-pits in the boiler room of the Roseland Pumping Station, 104th St. and Stewart Ave., for the lump sum of $3,100. Bids opened March 27.

The East St. Louis, Ill., city council has passed an ordinance empowering the City Water Co. to lay an 8-in. water main in Regent Ave., and Monroe St., in Lansdowne.

Iowa.

✣Bids will be received until 7:30 p. m., May 15, by City Council, Tipton, Ia., for the work of drilling an artesian well and furnishing all necessary labor and material. C. H. Foy is City Clerk.

The citizens of Roland, Ia., on April 18 voted the issuance of bonds to the amount of $8,000 for the erection of an electric light plant and to the amount of $10,000 for a waterworks plant.

The city council of Des Moines, Ia., has instructed Mayor Hanna to continue negotiations with the officials of the Des Moines Water Co., to purchase the plant. An election will be held shortly to vote bonds for that purpose.

Kentucky.

Chas. E. Collins, Civil Engineer, Drexel Bldg., Philadelphia, Pa., is preparing plans for a concrete dam for the Shelbyville Water & Light Co., of Shelbyville, Ky.

Louisiana.

The Waterworks Co., of Shreveport, La., has placed an order for the machinery for a new intake. The entire cost of the new intake is estimated at $50,000, and it is to take its supply of water from the Red River instead of Cross Bayou.

Michigan.

✣Bids will be received until May 10, by the Well Committee, Akron, Mich., for the construction of 6 wells in the village to be curbed with cement blocks and arched over with concrete. Further particulars can be obtained of E. A. Hess,, A. Brandt or C. W. Stacy.

The city council of Flint, Mich., has been petitioned for the extension of the water main on Harrison St., from Eighth to 10th Sts.

The city council of Benton Harbor, Mich., has voted to resubmit the water bonding proposition to the voters on May 4.

Minnesota.

✣Bids will be received until 7:30 p. m., May 22, by D. Donohue, Village Clerk, North Mankato, Minn., for the construction of water works system, including the following approximate quantities: 1 8-in. artesian well from 300 to 400 ft. deep; one concrete storage reservoir and settling basin, capacity 96,000 gallons; one reinforced concrete reservoir, capacity 60,000 gallons. Also about 900 ft. of 10-in. water main, 15,000 ft. of 6-in. water main, 20 fire hydrants, one 10-in. gate valve, 15 6-in. gate valves, 900 ft. of sewer drain pipe. Bids will be received on electric pumping equipment, consisting of two 3-phase, 60-cycle, 220-volt motors, direct connected to single stage centrifugal pumps. Alternate bids will also be received on gasoline equipment, consisting of engine and triplex pump. Separate bids will be received on reservoirs and pump house, pumping equipment, water mains and well.

⊙The water works committee of the city of Minneapolis, Minn., has awarded the contract for furnishing special castings for the filtration plant to James B. Clow & Sons of 350 Franklin St., Chicago, Ill., for $117 per ton, total amount $3,805. The Rensselaer Valve Co., at $1,822 was awarded the contract for furnishing valves, and the Venturi Meter Co. secured the contract for one 60-in., and one 6-in. meter for $1,910.

Bids were opened on April 26th for a Water Works System for Chokio, Minn., for which Oscar Claussen Engineering Co., Nat. Ger.-Am. Bank Bldg., St. Paul, Minn., is Engineer. Alternative bids were called for on (A) Air compressor system, consisting of 3,300 gallon reinforced concrete reservoir, about 5,600 ft. of 6 in. and 4 in. cast iron pipe; pumping plant and accessories, including 15 h.p. gasoline engine; 8 ft.x36 ft. compression tank, air compressor and air lift; 25 ft.x40 ft. power house. (B) Gravity system, consisting of 40,000 gallon steel tower and tank, about 5,600 ft. of 6 in. and 4 in. cast iron pipe; 5 h.p. gasoline engine, a deep well, pumping head and 14 ft.x16 ft. pump house. The following bids were received: Cook Construction Co., Des Moines, Ia., (A) $9,460, (B) $9,993; C. W. Roland Co., Des Moines, Ia., (A) $9,560, (B) $9,560; Gilbert W. Haggart, Fargo, N. D., (A) $10,500, (B) $10,600; J. G. Robertson, St. Paul, Minn., (contract awarded) (A) $8,776, (B) $9,159; Des Moines Bridge & Iron Co., Des Moines, Ia., (A) $9,690, (B) $8,895; Blackhawk Const. Co., Waterloo, Ia., pipe line, pipe line $4,541, steel tower and tank $4,896; Minneapolis Steel & Machinery Co., Minneapolis, Minn., steel tower and tank $3,500; Magnee Johnston, Minneapolis, Minn., pipe line $5,611; Chicago Bridge & Iron Co., Chicago, Ill., steel tower and tank $4,025.

Mississippi.

✣Bids will be received until 1 p. m., May 5, by J. P. Dear, Village Clerk, Bassfield, Miss., for the construction of a complete water works system. Xavier A. Kramer, Magnolia, Miss., is Village Engineer.

The citizens of Amory, Miss., have voted bonds in the sum of $65,000 for the installation of a waterworks and a sewerage system.

At a recent mass meeting of the citizens of Tylertown, Miss, to consider the question of private or municipal ownership of water and electric light plants, it was voted unanimously in favor of private ownership. The franchise will be let to the best bidder.

Missouri.

C. R. Anderson, City Clerk of Purcell, Mo., will sell bonds May 9 to the amount of $[illegible] for waterworks.

Mayor John N. Olson of St. Charles, Mo., is agitating improvements to the waterworks system.

Montana.

Charles E. Bockus, receiver for the Helena Water Works Co., has offered the plant of that company to the city of Helena, Mont., for the consideration of $400,000.

Nebraska.

An election was held in Anselmo, Neb., on April 25 for the purpose of voting on the installation of an electric light and waterworks for the village. It is reported that the proposition carried.

The water board of Omaha, Neb., will submit a bond proposition to the people some time during this month in the amount approximately of $8,250,000, to make payments in full for the purchase of the water plant of the Omaha Water Co., and to build the new mains needed.

The city council of Beatrice, Neb., has voted not to construct the concrete reservoir proposed in connection with the new waterworks system. The estimated cost of the reservoir was $21,520. The W. K. Palmer Co., 717-720 Dwight Bldg., Kansas City, Mo., is Engineer.

The purchase of the Plattsmouth, Neb., water plant by the city is being considered by a committee from the Commercial club and the city council.

The city council of Fairbury, Neb., plans to improve the city water plant to the extent of $30,000. A new standpipe will be erected and new mains laid. Plans and specifications for the work were prepared by Burns & McDonnel, Scarritt Bldg., Kansas City, Mo.

New Jersey.

The city council of Brighton, N. J., has authorized the issuance of bonds in the sum of $75,000 for a water system.

The Somerset Water Co., of Somerset County, Somerville, N. J., owing to objections by the State Water Supply Commission, Trenton, N. J., has agreed to make a number of changes in its plans to furnish water to Bedminster, Peapack and Gladstone.

New York.

✣Bids will be received until 7:30 p. m., May 11, by Board of Public Works, Geneva, N. Y., for laying about 13,000 ft. of 20 in. cast iron water main, including valves and specials. C. T. Church is Superintendent.

The aldermen of Geneva, N. Y., at a recent meeting voted to put before the taxpayers at a special election to be held May 23, the proposition to install a sand filtration plant to cost $40,000.

It is planned to install a waterworks system in the city of Sodus, N. Y., at an estimated cost of $25,000. The water supply would be secured from springs located in the village.

Chas. E. Collins, Civil Engineer, Drexel Bldg., Philadelphia, Pa., is preparing plans for improvements to the waterworks for the village of Granville, N. Y. The improvements will consist of a new concrete reservoir, filtration plant, a pumping station of about 2,000 gals per minute capacity and about two miles of 12 in. cast iron mains.

North Carolina.

Bonds in the sum of $15,000 have been voted by the citizens of Black Mountain, N. C., for the installation of a waterworks and a sewer system.

It is planned to construct a waterworks system in Concord, N. C., at an estimated cost of $[illegible].

The Oxford Water Co. has been incorporated at Oxford, N. C., with a capital stock of $15,000. The incorporators are: A. H. Powell of Oxford; Richard C. M. Calvert of College Park, Md., and Charles F. Nesbit of Washington, D. C.

Ohio.

✣Bids will be received until Noon, May 9, by Director of Public Service, J. J. Wenner, Clerk, Cincinnati, O., for laying cast iron pipe, special castings and valves, and other miscellaneous work in connection therewith, for the

Water Distribution System of the City of Cincinnati, Ohio, in Lick Run road, Boudinot Ave., Mozart Ave., Walnut St. and Harrison pike. Plans, specifications and blank proposals can be obtained at the office of the General Superintendent of Waterworks.

Citizens of New Berlin, O., voted April 22 the issuance of bonds, it is reported, to the amount of $35,000 for the installation of a water works plant and a sewerage system. The bond issue proposed for the water system will total $15,000 and the issue for the sewerage system $20,000.

The city council of Cincinnati, O., has decided to issue bonds to the amount of $100,000 for the purpose of providing funds for extending and improving the existing waterworks.

Oklahoma.

Bonds have been voted by the citizens of Kingfisher, Okla., to the amount of $28,000 for the extension of the waterworks system and electric light system.

A waterworks system is to be constructed in Soper, Okla., estimated to cost $12,000. J. E. Davis of Caddo, Okla., is Engineer.

Oregon.

✣Bids will be received until about May 29, City of Gresham, Ore., for the construction of water works distributing system and sanitary sewerage system for that place. Louis C. Kelsey, Selling Bldg., Portland, Ore., is Engineer.

It is reported that the citizens of Haines, Ore., on April 20 voted the issuance of bonds to the amount of $20,000 for the installation of a water pumping system.

Pennsylvania.

At a recent meeting of the citizens of Wyomissing, Pa., it was unanimously decided to adopt the recommendations of a special committee appointed to establish a municipal light and power plant.

South Dakota.

✣Bids will be received until 8 p. m., May 8, by L. L. Ness, City Auditor, Mitchell, S. Dak., for the construction of approximately 6,900 ft. of 4 in. water mains and separate bids will be received for laying same, including fire hydrants, valves, crosses, etc., connected with present system.

The Dakota Engineering Co., 309-313 Western Nat. Bank Blk., Mitchell, S. Dak., is preparing designs for a water works system for the town of Ipswich, S. Dak., which will cost about [illegible]

Tennessee.

Steps are being taken to issue bonds for a water plant in Arlington, Tenn. The city proposes to erect and maintain a water plant to cost approximately $6,000.

Texas.

An election has been called for May 23 in Caldwell, Tex., for the purpose of voting again on a question of issuing bonds for the erection of a standpipe.

The Gulf Coast Drilling Co., has been incorporated at San Antonio, Tex., with a capital stock of $10,000, for the purpose of constructing and operating dams, reservoirs, canals, laterals for irrigation, etc. The incorporators are: I. N. Bettison, M. J. Bass, H. G. Egli.

The Granbury Water, Ice, Light & Power Co., has been incorporated at Granbury, Tex., with a capital stock of $30,000. The company will begin at once the construction of water, ice, light and power plant. Jas. W. Hockaday, Granbury, is interested.

The Mission Land & Improvement Co., of Mission, Tex., has floated bond issue of about $500,000 and plans to install waterworks system, electric light system and an ice plant.

Utah.

It is reported that the city of Ogden, Utah, has sold bonds to the amount of $100,000 to H. T. Holtz & Co., of St. Louis, Mo., for waterworks improvements.

Virginia.

✣Bids will be received until 12:30 p. m., May 16, by Board of Control, T. E. Purdie, chairman, Norfolk, Va., for furnishing, delivering and installing three electrically driven centrifugal sewer pumps, including electrical apparatus, switchboard, etc. The pumps will be of following capacity: Two of 1,000 gals. per minute and one 1,500 gals. per minute. W. T. Brooks is City Engineer.

The citizens of Christiansburg, Va., on April 25 voted the issuance of bonds to the amount of $40,000 for the purpose of installing a waterworks.

An election will be held in Blacksburg, Va., on May 16 to vote on the proposition of issuing bonds in the sum of $12,000 for the installation of a waterworks system and a sewerage system.

The Norfolk Water Commission, Norfolk, Va., has made its report to the city council, recommending a source for a larger municipal water supply, and the additional source or sources will, it is said, yield 30,000 or 40,000 gals. of water per day, at an estimated cost of $1,000,000 to purchase the property necessary for the purpose and make that new supply available.

Washington.

· Louis C. Kelsey, Civil Engineer, 404-5 Selling Bldg., Portland, Ore., has been employed by the city of Elma, Wash., to prepare plans, specifications and estimates for increasing the water supply by means of pumping and for the installation of a sewerage system

Wisconsin.

The city council of Wausau, Wis., has granted petitions for the extension of the water mains from Garfield Ave. to Porter St., on Werle Ave., from Prospect Ave. to Genrich St., on Dunbar St., and from Fifth Ave. south to Bopf St.

⊙The Allis-Chalmers Co., of Milwaukee, Wis., has been awarded the contract by the Board of Awards of Baltimore, Md., for furnishing a new pump to be placed in the Mount Royal pumping station for $166,336. The new pump will be a triple expansion one of 30,000,000-gals. capacity per day. It will be used to pump water to the high and low service section of the water system. Bids were opened April 26.

Wyoming.

✣Bids will be received until Noon, May 31, by Constructing Quartermaster, Fort Yellowstone, Wyo., for furnishing labor and material for constructing pipe line from Panther Creek to point near Rustic Falls for Fort Yellowstone water system.

Canada.

⊙The town of Gleichen, Alta., voted on April 26, for the second time, on a by-law to spend $30,000 on water works and sewers, on account of a technical error in the original by-law, and passed the new by-law. The following contracts for materials have been awarded: Contract A—drilling deep well—The Alberta Well Drilling Co., Calgary. Contract B—supply of lapwelded steel pipe—General Supplies, Ltd., Calgary, for Stewards & Lloyds. Contract C—gate valves—Canadian Fairbanks Co., for Alley & McLellan's valves. Contract D—hydrants—Calgary Iron Works Co., Calgary. Contract E—elevated steel tank—Des Moines Bridge & Iron Co., Des Moines, Ia. Contract F—sewer pipe—Red Wing Sewer Pipe Co., Red Wing, Minn. Contract G—manhole covers, etc.—London Foundry Co., London, Ont. The work will be constructed by the John Galt Engineering Co., P. O. Box 1119, Calgary, Alta.

The town of Ridgetown, Ont., has practically decided to invest a sum not exceeding $35,000 in a water works system. The system as outlined will produce 1,250,000-gals. of water per day from artesian wells. A bond election will be held.

The citizens of Welland, Ont., on April 26 voted the issuance of $75,000 in bonds for additions and extensions to the waterworks plant.

The town of Red Dear, Alta., will put in a considerable amount of water and sewer extensions and a large extent of cement walks this year under the supervision of The John Galt Engineering Co., P. O. Box 1119, Calgary, Alta.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

⊙The city council of New Decatur, Ala., on April 19 received bids for the construction of sewers and awarded the contracts as follows: Adamant Stone & Roofing Co., Nashville, Tenn., storm sewer, $7,308; W. M. Leftwich Co., Nashville, Tenn., storm sewer, $1,628, and a sewer lateral, $1,370.

Arkansas.

A sewer district is contemplated in Little Rock, Ark., that will extend from 18th St. on the north to the city limits on the south and from Park Ave. to the city limits on the west. Another district is contemplated which will include all the unsewered portion of the old city surrounding Mount Holly cemetery.

California.

⊙The city council of Fresno, Cal., has awarded August Spooner the contract for the laying of a 12-in. sewer in Kern St. for $5,995.

An election [illegible] held [illegible] May 2 for the purpose of voting on the issuance of bonds in the sum of $50,000 for water works and sewers.

Colorado.

The election [illegible] bonding the [illegible] postponed on account of the desire of the city attorney to make a change in the ordinance calling for election. Another election will be held [illegible]

District of Columbia.

✣Bids will be received until 2 p. m., May 9, by commissioners of the District of Columbia, Washington, D. C., for constructing sewers in the district.

Georgia.

The board of aldermen of Americus, Ga., has received plans from a number of consulting engineers for a survey of the city to prepare for the extension of the water and sewerage systems.

Idaho.

✣Bids will be received until 10 a. m., May 10, by J. W. Hutchins, chairman, sewer committee, Local Sewerage Improvement District No. 1, Mullan, Idaho, for the construction of a sewer system in Local Sewerage Improvement District No. 1 in the village of Mullan.

Illinois.

The board of public works of Monmouth, Ill., plans the construction of a new public sewer in the southeast part of the city. Specifications and estimates have been drawn up by the board and will be presented to the city council. It is proposed to start the sewer on East 11th Ave. at the intersection with South Fourth Ave. and run it so as to connect with the main city sewer on East Second Ave., between South Seventh and Eighth Sts. The estimated cost of the improvement is $7,000.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The town of Hamilton, Ill., contemplates the installation of a sewer system and a water works system.

Indiana.

⊙The American Construction Co. has been awarded the contract by the Board of Public Works of Indianapolis, Ind., for the construction of a sewer in Dearborn St., from Michigan to a point 1,645 ft. north. Contract awarded on April 26.

City Engineer William S. Moore of South Bend, Ind., has submitted specifications to the board of public works for the construction of the Bowman creek sewer, which will cost approximately $125,000. The sewer will be 9,000 ft. in length and will have an average inside area of 100 sq. ft. It will be of concrete.

Iowa.

✣Bids will be received until 5 p. m., May 8, by Charles J. Duff, city clerk, Council Bluffs, Ia., for the construction of a sewer. The following approximate quantities are included: 425 lin. ft. of 8-in. sewer, 685 lin. ft. of 10-in. sewer, 470 lin. ft. of 6-in. laterals sewer. And the said improvement and sewers, if any, is to be made, constructed and reconstructed upon and in the following streets, avenues and alleys of said city, and in case of sewers of the sizes designated, to-wit: 8 ins. in diameter on Charles St. from Kappel Ave. to Stahl Ave; 10 ins. in diameter on Twelfth Ave. from center of Third St. to a point 116 ft. each of east line of High St.

⊙The city council of Iowa Falls, Ia., has closed a contract with Guy E. Smith of Indianola, Ia., to construct a sanitary sewer on the south side. The improvement will cost about $4,000.

The city council of Logan, Ia., will receive bids until May 5 from engineers as to cost of making a survey and plat and profile of a sanitary sewerage system for the city of Logan.

A resolution will be before the city council of Valley Junction, Ia., on May 25 calling for the construction of the sewer system and the erection of a modern sewage disposal plant, estimated to cost $41,000. Charles P. Chase of Clinton, Ia., has prepared the preliminary plans for the system.

It is proposed to construct a sanitary sewer in the city of Essex, Ia., on Omaha, Nebraska, Illinois, Iowa and Burlington Aves.

Kansas.

✣Bids will be received until 3 p. m., May 9, by Board of Commissioners at the office of Ed Metz, city clerk, Hutchinson, Kan., for the construction of approximately 3,675 ft. of 8-in. and 170 ft. of 6-in. sewer in Jefferson St. sub-district, laterals No. 13, 14 and 15, in accordance with plans and specifications of the city engineer on file in the clerk's office. A check certified by a local bank for $100 must accompany each bid.

Kentucky.

The Board of Sewerage Commissioners of Louisville, Ky., is discussing plans for a proposed sewer to begin at a point in Alta Ave. and extend through Cherokee Park to the so called Beargrass sewer. The proposed sewer is to be about one mile in length and will cost about $60,000.

Maryland.

The $10,000,000 sewerage loan will be submitted to the voters of Baltimore, Md., at the May election. This money will be used to complete the sewer system and disposal plant and for machinery.

Massachusetts.

The following bids were received April 23 by the Commissioner of Public Works, L. J. Rourke, for the disposal of garbage and refuse in the city of Boston, with the exception of West Roxbury and East Boston. In all cases the city will do the collecting and dumping in stations, the contractor to remove the garbage and refuse for the stations and dispose of it in a sanitary manner: Joseph P. O'Riordan, $197,000 for the first year, with an increase of 2 1/0 per cent each succeeding year; the Boston Disposal Co., $234,940, with 2 1/10 per cent increase each year; Frank P. Neelon & Co., $189,000 per year, with the city to erect and maintain the stations; Daniel P. Sullivan, $24,995 per year, and ashes and other waste at 24.1 cts. per ton; the Vulcan Incinerating Co., New York, 66 2/3 cts. per ton, city to construct a plant at Brighton or to dispose of the garbage and waste in districts 1, 6, 7, 8 and 10, or about 316,000 tons annually, at the rate of 66 2/3 cts. per ton, and in addition to construct a station at Cow Pasture or on Deer Island at a cost to the city of $276,000; Joseph Marrone, 52 cts. per ton or on a 10 year contract for $200,000 the first year and an increase of 2 per cent each succeeding year; the Boston Development & Sanitary Co., first to build receiving stations and to dispose of the matter at a cost of $221,000 the first year and an increase of 3 per cent each following year; second, city to erect and maintain the stations, company to pay an annual rental of $1,500 and then charge $184,000 for the first year, with a 3 per cent increase each year following; third, for the erection of stations by the city, some to be on city land and others on land owned by the company, with a cost to the city of $210,000 for the first year and an annual increase of 3 per cent; fourth, to erect buildings owned by the company, $200,000 for the first year and a 3 per cent increase in succeeding years.

Michigan.

Mayor M. W. Brown of Reed City, Mich., contemplates the installation of a sewerage system in Reed City. Several changes in the water works system are also contemplated.

The common council of Detroit, Mich., in the budget for 1911 has allowed $64,790 for maintenance and about $1,100,000 for new public sewers and improvements, besides about $20,000 of supplemental estimates.

Minnesota.

⊙The board of public works of St. Paul, Minn., has awarded P. J. Ryan the contract for an extension of the Blair St. sewer for $1,116.

The board of public works of Duluth, Minn., has been directed to construct storm sewers in Grand Ave., between 54th Ave. east between 4th and 8th Sts.

Missouri.

City Engineer H. G. Horton of Springfield, Mo., has been instructed to prepare plans and specifications and estimates of cost for the construction of sewer district No. 25 of section No. 2.

The citizens of Paris, Mo., have voted the issuance of $15,000 in bonds for the installation of a sewerage system.

New Jersey.

The plans for the new sewage disposal plant for Ocean City, N. J., have been approved by the state board of health. The new system will cost $35,000.

New York.

⊙The Board of Trustees of East Aurora, N. Y., has awarded the contract for furnishing material and labor for the construction of a sewer system to the Republic Engineering & Construction Co., of Buffalo, N. Y., for $75,139, and the contract for the construction of the disposal plant to A. C. Bame of Lancaster, N. Y., for $21,719. The work includes approximately 80,000 ft., of 8 to 24-in. tile, also iron pipe and other appurtenances. Frederick K. Wing, 910 White Bldg., Buffalo, N. Y., is Engineer. Bids were opened April 18.

The city of Albany, N. Y., has asked Consulting Engineer Rudolph Herring, 170 Broadway, New York city, to investigate the matter of the proposed intercepting sewer for Albany.

Alderman Isaac C. Davis of Syracuse, N. Y., is preparing to order the construction of several sewers in the extreme western part of the Ninth ward. The first to be constructed are in Hayden Ave., from Morton St. to Essex, in Essex St. from Avery Ave. to Myrtle St., and in Myrtle St. from Essex St. south for several hundred feet. It is also intended to build a sewer in Driscoll Ave.

North Dakota.

✣Bids will be received until 5 p. m., May 9, by E. R. Orchard, city auditor, Fargo, N. Dak., for furnishing all materials for and the construction of a 12-in. lateral sewer on Tenth St. south, from Tenth Ave. south to Twelfth Ave. south in Sewer District No. 3 of said city, according to the plans and specifications thereof on file in the office of the city auditor.

Ohio.

✣Bids will be received until noon, May 9, by Director of Public Service, Lorain, O., for furnishing labor and material for the construction of sewers and delinquent curb connections as follows: East Erie Ave. storm water sewer in East Erie Ave. between Georgia and Kansas Aves., Pearl Ave. sanitary sewer extension from the present end of sanitary sewer at alley south of E. 32d St. to approximately 760 ft. southerly; sanitary sewer in Wickens Pl. from W. Erie Ave. to 4th St.; sanitary sewer in E. 33d St., from Clifton to Elyria Ave; delinquent curb connections; approximately 40 ft. on Pearl Ave. between E. 28th St. and alley south of E. 32d St. L. B. Johnson is clerk.

✣Bids will be received until noon, May 22, by village council, East Youngstown, O., at the office of the mayor, for furnishing the necessary labor, material and tools to construct a sewer on Wilson Ave. from the easterly limits of said village to the southeast corner of village lot No. 680. Plans and specifications for the same may be seen at the office of the village clerk. Proposals must be addressed to J. P. Carney, clerk of the village of East Youngstown, Ohio. A certified check for $500 must be filed with each bid.

⊙A. J. Meyers, at $2,252, has been awarded the contract by the director of public service, Lima, O., for the construction of the Woodlawn Ave. sewer, which is to be built jointly by the city and the James L. Heath Realty Co.

⊙The Department of Public Works of Dayton, O., has awarded the contract for the construction of a storm water sewer in Huffman Ave., from Third to Martz Ave., to Shafer & Dill of Dayton, and the contract for the construction of a storm water sewer in Lexington Ave. from Broadway to Yuncker Ave., to Heelser & Kirchner of Dayton. Bids were opened April 21.

Representatives from the Niles, Newark and Centerville chambers of commerce met in the rooms of the Newark Chamber of Commerce recently and passed resolutions recommending that their respective chambers take the necessary steps for the calling of an election for the creation of a sanitary district to include the three towns. The estimated cost of the system of sewers is $75,000.

The city council of Amherst, O., has rejected all the bids received for the construction of the sewer system because they were found to be about $4,600 above the estimate of Engineer L. E. Chapin of Canton, O., and Pittsburg, Pa. The engineer has been instructed to revise the plans to come within the funds and the work will be readvertised.

Engineer Riley has prepared a plan for a new storm sewer to relieve that portion of water adjoining Fourth, Pearl, Buckeye and Sugar Sts., Miamisburg, O. The proposed sewer will run up the alley just east of Fourth St. to Sycamore Creek.

An ordinance has been introduced in the city council of Cleveland, O., calling for the construction of a sewer in Benham Ave.

The council of Canton, O., has approved the plans of City Engineer Phil H. Weber for a sanitary sewer in district No. 4.

Sanitary Engineer A. Elliott Kimberly, 827 Columbus Savings & Trust Bldg., Columbus, O., has practically completed the plans for sewage disposal for the town of New Bremen, involving sedimentation and hypochlorite of lime treatment with disposal by dilution. The work will be advertised shortly.

The Greene County Commissioners, Xenia, O., will soon construct a sewage disposal

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

plant for the new Children's Home near Xenia, now under construction. A. Elliott Kimberly, 827 Columbus Savings & Trust Bldg., Columbus, O., is Engineer.

Oregon.

⊙Jacobson-Bade Co., at $64,496, has been awarded the contract by the city council of Central Point, Ore., for the construction of a sewer system. The work includes 16,263 ft. of 8-in. pipe, 3,415 ft. of 10-in. pipe, 1,985 ft. of 12-in. pipe, 3,372 ft. of 16 in. pipe, 1,670 ft. of 20-in. pipe, 1,576 ft. of 22-in. pipe, 2,978 ft. of 24in. pipe, 1,388 ft. of 30in. pipe, 101 manholes, eight inlets and 25,725 cu. yds. of excavation. Bids were opened April 20. J. W. Jacobs is city recorder.

The estimated cost of the sanitary sewerage system for the city of Newport, Ore., according to plans and specifications prepared by Louis C. Kelsey, 404-5 Selling Bldg., Portland, Ore., is $64,024. F. B. Davis is City Engineer. Bids for construction will be invited during the coming summer.

Plans, specifications, etc., have been prepared by Louis C. Kelsey, Civil Engineer, 404-5 Selling Bldg., Portland, Ore., for sanitary and storm sewerage systems and street pavements for the city of Hillsboro, Ore. The sewerage systems are estimated to cost $83,248, and the pavements $59,356.

Pennsylvania.

The town council of West Middlesex, Pa., has appointed a committee to visit New Wilmington and inspect the disposal plant being erected there, with a view to installing a sewer system in West Middlesex.

Chas. E. Collins, Civil Engineer, Drexel Bldg., Philadelphia, Pa., is preparing plans for a sewage disposal plant for the Borough of Danville, Pa., which will include a sewage pumping station of 2,500 gals. per minute capacity, Imhof clarification tanks, percolating filter beds and sludge beds.

South Carolina.

Bids were received April 25 by the city council of Rock Hill, S. C., for the construction of 16 miles of sewers, including 220 manholes, 35 flush tanks, etc., to cost approximately $55,000, for which Thos. W. Cothran of Greenewood, S. C., is Engineer. The following firms submitted bids on the work: J. J. Cain of Columbia, S. C.; P. J. Curran of Knoxville, Tenn.; I. C. Mishler, Chattanooga, Tenn.; The Robertson Construction Co., of Charlotte, N. C., and Sullivan, Long & Hagerty of Bessemer, Ala.

South Dakota.

The citizens of Aberdeen, S. Dak., have voted the issuance of bonds to the amount of $200,000 to construct a plant for the disposal of the city's sewage.

The Dakota Engineering Co., 309-313 Western Nat. Bank Blk., Mitchell, S. Dak., have two sewer systems that will probably be advertised for construction in the near future The estimated costs of these systems are $5,000 and $15,000.

Virginia.

The streets committee of the city council of Richmond, Va., has recommended an appropriation of $200,000 for the sewer system of Washington ward.

Washington.

⊙Cline & McKim have been awarded the contract by the city council of Puyallup, Wash., for the construction of the sewer line from the foot of Harrison St. to the main channel in the river for $2,366.

City Engineer Morton Macartney of Spokane, Wash., has completed plans for the construction of the Manito Park sewer. The sewer, known as First ward sub-trunk sewer No. 9, is to cost $83,306, according to estimate. It provides for a sewer in Browne and Bernard Sts., from 21st to 29th Aves., 28th and 27th Aves., from Bernard to Tekoa St., Division St. from 25th to 29th Ave., 29th Ave., from Washington to Tekoa St., Park Drive and other streets in the vicinity.

The city council of Oakesdale, Wash., has appointed a committee to confer with the committee appointed by the Commercial club regarding the installation of a septic tank and sewer system for the business district of the town. The committee has also been instructed to make arrangements for cement sidewalks in the business part of town.

West Virginia.

Citizens of Glenova, W. Va., contemplate forming a stock company for the purpose of constructing sewers in every street of the town.

Wisconsin.

⊙The N. F. Reichert Co. of Racine, Wis., has been awarded the contract by the city council of Kenosha, Wis., for the construction of a system of sewers. A trunk system will be constructed of brick for $82,100 and a branch system of brick for $73,900. Other bids received are: Trunk sewer—Cleary, White. & Newman of Chicago, Ill., $151,305; Interstate Construction Co. of Hammond, Ind., $134,200; John Brogan, Green Bay, Wis., $158,157; E. R. Harding Co., Racine, Wis., $181,950; General Construction Co., Milwaukee, Wis., $186,155. Other bids received on the branch system are: Cleary, White & Newman, $139,848; Interstate Construction Co., $122,200; John Brogan, $150,100; Rauff Construction Co., Milwaukee, Wis., $144,400; E. R. Harding Co., $172,950, and the General Construction Co., $176,955.

⊙P. B. Johnson has been awarded the contract by the board of public works of Racine, Wis., for the construction of a sewer on Spring St., at $1.49 for 15-in. pipe, $39 for manholes and $39 for catch basins.

⊙R. J. Hickey of Milwaukee, Wis., has been awarded the contract by Deputy Commissioner of Public Works John J. M. Tucker, Milwaukee, Wis., for the construction of a relief sewer of concrete in that part of the West Sewerage District connecting with the Hubbard St. sewer. The contract price is $45,802. Bids were opened April 25.

Canada.

✣Bids will be received until [illegible] p. m., May 15 by Frank Howe, Chairman of Works Committee Englinton Town Hall, North Toronto, Ont., for the furnishing and laying of main sanitary pipe sewers, construction of manholes, etc. Contract No. 1 includes approximately sewers to streets and trunk sewers south of and including Englinton Ave. Contract No. 2 includes approximately Sewers to streets and trunk sewers north of Eglinton Ave., and south of and including Glenview Ave. to the west of Yonge St. and south of and including Victoria Ave., to the east of Yonge St. Contract No. 3 includes approximately sewers to streets and trunk sewers north of Glenview Ave. to the west of Yonge St. and Victoria Ave. to the East of Yonge St. to the Town Limits North. Plans may be seen and information obtained at the office of T. Aird Murray, 303 Lumsden Bldg., and office of Canadian Engineer, B32 Board of Trade, Montreal, Que.

✣Bids will be received until 4 p. m., May 12, by J. King Kelley, County Secretary, 108 Prince William St., St. John, N. B., for furnishing and delivering vitrified salt glazed sewer pipe for the village of Fairville. Gilbert G. Murdock, 74 Carmarthen St., St. John, N. B., is Engineer.

✣Bids will be received until noon, June 6, by G. R. Geary, Chairman, Board of Control, Toronto, Ont., for furnishing the following equipment for the Main Drainage Works: Vertical electrically driven pumps; motors and other electrical equipment; screens and cleaning apparatus; Venturi meters.

✣Bids will be received until noon, May 9, by G. R. Geary, Chairman Board of Control, Toronto, Ont., for the construction of Low Level Interceptor in Sections as follows: Sec. No. 5—3,350 lin. ft.; Sec. No. 6—2,830 lin. ft.; Sec. No. 7—3,778 lin. ft.; Sec. No. 8—3,238 lin. ft. The concrete pipe to be laid will be supplied by the city. The diameters are as follows: For Sec. No. 5, 60 ins.; for Sec. Nos. 6, 7 and 8, 66 ins. Plans may be seen, and specifications and further information may be obtained from the Main Drainage Works, City Engineer's Office, Toronto.

✣Bids will be received until 3 p. m., May 15, by City Commissioners, Edmonton, Alta., for furnishing necessary labor and material for the construction in tunnel of a concrete sewer 10 ft. 6 in. in internal diameter and approximately 3,290 ft. long. Plans and specifications can be seen at the office of A. J. Latornell, City Engineer.

⊙The city of Saskatoon, Sask., on April 14 received bids for the construction of an intercepting sewer. The contracts were awarded as follows: A. McGougan, Port Arthur, Ont., Contract No. 78, for pipe laying; the Lock Joint Pipe Co. of New York, N. Y., Contract No. 79, for furnishing reinforced concrete pipe; Contract No. 80, the Gartshore-Thompson Pipe & Foundry Co., Hamilton, Ont., for furnishing cast iron sewer pipe and specials. W. B. Neil is city commissioner.

The John Galt Engineering Co., P. O. Box 1119 Calgary, Alta., will construct a sewage disposal plant at Wetaskiwin, Alta., this summer.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until 11 a. m., May 22, by Maj. W. W. Harts, U. S. Engineer, Nashville, Tenn., for rock excavation at Tuscumbia Bar near Sheffield, Ala.

✣Bids will be received until 1 p. m., May 31, by Lt. Col. G. D. Fitch, U. S. Engineer, Montgomery, Ala., for furnishing 35,000 barrels American Portland cement. Officials advertisement will be found elsewhere in this issue.

California.

✣Bids will be received until 11 a. m., May 22, by Board of Public Works, Oakland, Cal., [illegible] following items of work entering into the [illegible]ruction and completion of the New Oakland C[illegible] 1, [illegible] work; 2, structural steel and erection; 3, concrete work; 4, granite work and setting; 5, Indiana lime stone work and setting; 6, manti stone work and setting; 7, architectural terra cotta; 8, dampproof paint and painting; 9, paving; 9, paving and sidewalks; 10, sheet metal, [illegible] lights; 11, metal doors; 12, [illegible] ornamental iron and bronze; 13, metal furri[illegible] 14, [illegible] and imitation stone work; 15, interior marble and tile; 16, rough carpentry; 17, cork floors; 18, [illegible] 19, [illegible] glazing; 20, painting and finishing; 21, finished hardware; 22, vaults and vault doors; 23, elevators; 24, heating and ventilating; 25, vacuum cleaning and mopping system; 26, electric wiring; 27, plumbing.

The Pacific Gas & Electric Co., 925 Franklin St., San Francisco, Cal., is reported to be planning to abandon the present flume and ditch system carrying water for eight miles [illegible] Colgate plant east of Marysville. The plans are said to involve the boring of a tunnel [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Connecticut.

✣Bids will be received until 3 p. m., May 26, by Lieut. Col. Harry Taylor, U. S. Engineer, New London, Conn., for dredging in Pawcatuck River, R. I. and Conn.

Delaware.

✣Bids will be received until 11 a. m., May 22, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Leipsic River, Del.

✣Bids will be received until 3 p. m., June 7, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring system and lighting fixtures of the U. S. Post Office and court house at Wilmington, Del.

District of Columbia.

✣Bids will be received until 10:30 a. m., May 26, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 630: Hand cars, push cars, wheelbarrows, shovels, picks, wrenches, Nails, cotters, hacksaw blades, hose clamps, sledge handles, stable brooms, scrubbing brushes, lanterns, garbage cans, brass unions, manila rope, canvas, leather, toilet paper, fire clay, rosin, caustic soda and crude carbolic acid.

✣Bids will be received until 2 p. m., May 31, by Department of the Interior, Office of Indian Affairs, Washington, D. C., for furnishing labor and material for the construction of two cottages and one barn at the Coeur D'Alene Agency, Idaho.

✣Bids will be received until 2 p. m., May 15, by Commissioners of the District of Columbia, for making and installing boiler, painting and repairing one fire engine.

✣Bids will be received until noon, May 10, by E. E. Capehart, acting Chief of Bureau of Ordnance, Washington D. C., for furnishing 5,000 6-in. 1,000 7-in. and 200 14-in. target projectiles for the Navy Department.

Florida.

✣Bids will be received until noon, May 22, by George R. Spalding, Capt. U. S. Engineers, Jacksonville, Fla., for dredging in Caloosahatchie River and entrance, Florida.

✣Bids will be received until 3 p. m., May 19, by Lieut. Col. Harry Taylor, U. S. Engineer, New London, Conn., for dredging in Shaw's Cove, New London Harbor, Conn.

✣Bids will be received until noon, May 25, by Capt. G. R. Spalding, U. S. Engineer, Jacksonville, Fla., for dredging and constructing short revetment in St. John's River, Florida.

Georgia.

✣Bids will be received until 3 p. m., June 5, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office at Dublin, Ga.

Illinois.

✣Bids will be received by Wm. Carroll, City Electrician, Chicago, Ill., until 11 a. m., May 5, for furnishing the Department of Electricity 25,000 ft., more or less of No. 6 B. & S. G. rubber covered lead incased electric light cable.

Indiana.

✣Bids will be received until May 12, by Maj. J. T. Davidson, Depot Quartermaster, Jeffersonville, Ind., for furnishing under Schedule No. 638, 30,000 ft. cottonwood lumber No. 1, 20,000 ft. gum sap lumber No. 1, and 2,000 ft. white pine B select.

Bids as follows were received April 15 by Lt. Col. George A. Zinn, U. S. Engineer, Chicago, Ill., for dredging in Indiana Harbor, Ind.: (1) dredging 54,000 cu. yds. between piers, place measurement; (2) dredging 181,000 cu. yds. in lake, scow measurement: Arthur H. Vogel, Milwaukee, Wis., (2) 30 cts. The Fitz Simons & Connell Co., Chicago, Ill., (1) 22 cts., (2) 27 cts. Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 19¾ cts., (2) 25 cts.

Iowa.

Surveys and estimates have been made by the Northern Roller Milling Co. and the Humboldt Electric Light & Power Co., of Humboldt, Ia., both operated under the same management, for a concrete dam to be built across the Des Moines River at Humboldt. About $80,000 will be spent, and the new plant will develop 1,200 hp.

The Stone & Webster Engineering Co., 147 Milk St., Boston, Mass., which is financing the $25,000,000 dam now under construction in Keokuk, has asked the City Commission of Keokuk for an extension of the present franchise for the operation of public utilities to a period of 25 years. The company has an option on the gas, electric light and street car system, and will take over the property if the franchise is extended. The proposition will be submitted to a vote of the people.

Kentucky.

✣Bids will be received until May 17, by Kash C. Williams, County Superintendent of Schools, Jackson, Ky., for the construction of 21 schoolhouses in Breathitt County, Ky. Houses must be completed before Oct. 1.

✣Bids will be received until noon, May 26, by Maj. J. C. Oakes, U. S. Engineer, Custom House, Cincinnati, O., for constructing lock and dam No. 14, Kentucky River, at Heidelberg P. O., Ky.

Maryland.

✣Bids will be received until 11 a. m., May 13, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for a 12-kw. gasoline engine belted generating set, 200-ampere-hour storage battery, accessories, wiring material, etc., at the U. S. Marine Corps Rifle Range, Winthrop, Md.

Massachusetts.

✣Bids will be received until 1 p. m., May 15, by Capt. A. M. Miller, Constructing Quartermaster, 268 Summer St., Boston, Mass., for the construction, plumbing, heating, wiring and fixtures of an addition to post hospital at Fort Strong, Boston Harbor, Mass.

The Furst-Clark Construction Co., Sandwich, Mass., has 1,000,000 cu. yds. of dry excavation, suitable for light steam shovel plants, etc., to let on the Cape Cod canal work.

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Michigan.

Bids as follows were received April 24 by Col. McD. Townsend, U. S. Engineer, Detroit, Mich., for (1) dredging 792,000 cu. yds. from section 1, Saginaw River, and (2) for dredging 2, 233,000 cu. yds. from section 2, Saginaw River: Breymann Bros., Toledo, O., (1) 12⅞ cts., (2) 17 cts.; Greiling Bros., Green Bay, Wis., (1) 13 7-10 cts., (2) 22 cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 14 cts., (2) 17 9/10 cts.; Adolph Bros., Milwaukee, Wis., (1) 15¼ cts., (2) 22 cts.; Michael Sullivan, Detroit, Mich., (1) 17¼ cts.; Edward Bros. Dredge Co. Sault Ste. Marie, Mich., (1) 17½ cts.; Zenith Dredge Co., Duluth, Minn., (1) 25 cts.; Duluth Superior Dredging Co., Duluth, Minn., (2) 24½ cts.; Northern Dredge & Dock Co., Duluth, Minn., (1) 18 cts.; Duluth Marine Contracting Co., (1) 16½ cts.

The Escanaba Traction Co., Escanaba, Mich., is reported to have opened bids for the construction of a dam across the Escanaba River at Groos and for the erection of a large pulp mill at that point. The dam is for the purpose of furnishing power for the operation of the mill and in adding to the supply of electrical energy used by the Traction Company. It is expected that the dam will develop 2,500 hp. and that the mill will be able under favorable conditions to turn out daily at least 100 tons of pulp ready for the paper mills. The dam is to be constructed across the east side of the river about half a mile above Groos and the mill will be located near by.

Minnesota.

Following bids were received April 20 by Maj. Francis R. Shunk, U. S. Engineer, Duluth, Minn., for dredging at Superior Entry, Duluth-Superior Harbor: (1) bid per cu. yd. scow measurement on Sec. A., 18,000 cu. yds in Stilling Basin, (2) Sec. B, 213,000 cu. yds. entrance channel, (3) Sec. C, 258,000 cu. yds. inner channel, (4) for removing boulders over 1 cu. yd. in size, 1,500 cu. yds., per cu. yd., (5) totals. Duluth-Superior Dredging Co., Duluth, Minn., (1) 20 cts., (2) 17 cts., (3) 8¾ cts., (4) $1.00, (5) $63,885. Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 12 cts., (2) 12 cts., (3) 8 cts., (4) $2.50, (5) $52,110, (Recommended for acceptance). Duluth Marine Contracting Co., Duluth, Minn., (1) 15 cts., (2) 15 cts., (3) 9¾ cts., (4) $1.25, (5) $61,680. Northern Dredge & Dock Co., Duluth, Minn., (1) 16 cts., (2) 18 cts., (3) 9½ cts., (4) $1.50, (5) $67,980. Edward Bros. Dredge Co., Sault Ste. Marie, Mich., (1) 18 cts., (2) 20 cts., (3) 11 cts., (4) $1.50, (5) $76,470. Zenith Dredge Co., Duluth, Minn., (1) 12 cts., (2) 12 cts., (3) 9.9 cts., (4) $0.95, (5) $54,687.

Missouri.

✣Bids will be received until 4 p. m., May 16, by Board of Managers of State Hospital No. 1, Fulton, Mo., for the general work of repairing and replacing hot and cold water pipes in and about the buildings of the institution. Plans and specifications can be obtained of the Chief Engineer, Charles Strong, Fulton, Mo.

✣Bids will be received until 7:30, May 16, by J. S. Bicknell, City Clerk, Columbia, Mo., for furnishing the entire work or any section of work covered by specifications for the power plant at Columbia. The work includes furnishing three 400-hp. water tube boilers, settings, breeching and furnaces; one 500-kw. turbo-generator, exciters, and switchboard panels; jet centrifugal condenser and cooling tower; 2,000-hp. feed water heater: boiler feed pumps; motor driven turbine service pumps; reenforced concrete chimney; coal and ash handling machinery and bins; conduits, cabinets and electric wiring; pipe work and covering; and fireproof building to house the same.

✣Bids will be received until noon, May 22, by E. H. Schulz, Maj., U. S. Engineer, Kansas City, Mo., for constructing standard revetment on Missouri River about four miles below St. Charles, Mo.

New Jersey.

✣Bids will be received until 10 a. m., May 15, by Col. R. Birnie, Commanding Officer, Sandy Hook Proving Ground, P. O. Fort Hancock, N. J., for furnishing lumber, forage, fuel, oils, etc.

New York.

✣Bids will be received until 11 a. m., May 16, by Capt. F. T. Arnold, Constructing Quartermaster, New London, Conn., for repairs to inner wharf at Fort H. G. Wright, N. Y.

✣Bids will be received until 10 a. m., May 15, by Capt. W. L. Guthrie, Oswego, N. Y., for dredging at Charlotte Harbor, N. Y.

✣The Central States Dredging Co., Schuylerville, N. Y., has been asking for bids for 16,000 cu. yds. of wheel scraper work at Stillwater, N. Y.

✣The R. H. Howes Construction Co., 105 W. 40th St., New York, contractors for the construction of the U. S. Post office at Keene, N. H., has been asking bids for setting of approximately 7,000 cu. ft. of exterior gran-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ite. Labor brick work will also be sublet. Work to be started June 1.

⊙The Buffalo Dredging Co., Buffalo, N. Y., has been awarded the contract for channel excavation in Niagara River, N. Y., under bids opened April 10th by the United States Engineer at Buffalo, N. Y. The work calls for the excavation of 9,000 cu. yds. of blasted rock, scow measure. The contract price was 76 cts. per cu. yd.

The New York Dock Co., New York City, will have work started early next month razing an entire block of 4-story brick warehouses fronting on what is known as Commercial Wharf in Erie Basin, Brooklyn. Upon the site of the razed buildings the company has planned to build a large railroad terminal, with a concrete bulkhead, having a frontage of 600 ft. on Erie Basin. In conjunction with this work the Dock Co. also contemplates erecting a building for manufacturing purposes on the vacant plot bounded by Imlay, Van Brunt, Commerce and Bowne Sts. According to the plans $1,000,000 will be expended on the latter project alone.

The Kerbaugh Empire Co., of Valhalla, N. Y., has been incorporated with a capital stock of $4,000,000 and will engage in a general contracting business. This company took over the contract from the Rogers Company of Valhalla to enlarge the Kensico reservoir and dam of the city of New York. The work includes the raising of the dam 100 ft. higher than it now exists and enlarging the reservoir. The Directors of the new company are Edward B. Adams, 71 Broadway, New York City; William Barclay Parsons, 80 Wall St., New York City; M. S. Kerbaugh, Philadelphia; William H. Cooke, 60 Wall St., New York City; Robert K. Cassatt, Philadelphia, Pa.; Eugene Klapp, 60 Wall St., New York City; Lamar Hardy, 71 Broadway, New York City, and G. Dallas Dixon, Jr., Philadelphia. Edward B. Adams holds 10,900 shares of the stock, William Barclay Parsons 1,000 shares, and William H. Cooke 100 shares.

Bids were opened April 20 by the State Architect, Albany, N. Y., for steam power equipment for the new capitol power house at Albany. The lowest bidders were Gillis & Geoghegan of New York, at $212,558 for plan No. 1 and [illegible] for plan No. [illegible] The lowest bid for electrical equipment was that of the Lord Electric Company of New York, as follows: No. 1, [illegible] No. [illegible]

Bids were opened April 24 by Capt. W. L. Guthrie, U. S. Engineer, Oswego, N. Y., for dredge machinery. For machinery for 4½ to 5-yd. dipper with spud hoisting engines bids were received as follows: American Locomotive Co., New York City, $36,875, delivery in 4 months; Bucyrus Co., South Milwaukee, Wis., $24,730, delivery in 3½ to 4 months; Marion Steam Shovel Co., Marion, Ohio, $18,820, delivery in 65 days; Norbom Engineering Co., Philadelphia, Pa.; Osgood Dredge Co., Albany, N. Y., $26,750, delivery 3½ months; Vulcan Steam Shovel Co., Toledo, Ohio, $23,550, delivery in 120 days. The Bucyrus Co., offered independent capstan engines for $210 additional. They also asked $1,350 additional for spare parts named in paragraph 28. The following bids were received on machinery with both spud hoisting and crowding engines for 4½ to 5lyd. dipper: American Locomotive Co., New York City, $37,475, delivery in 4 months; Marion Steam Shovel Co., Marion, Ohio, $19,820, delivery in 65 days; Norbom Engineering Co., Philadelphia, Pa.; The Bucyrus Co., South Milwaukee, Wis.; Osgood Dredge Co., Albany, N. Y., $27,950, delivery in 3½ months; Vulcan Steam Shovel Co., Toledo, Ohio, $24,350, delivery in 120 days. For machinery for 4½ to 5-yd. dipper, without crowding engine and without spud hoisting engine bids were received as follows: American Locomotive Co., New York City, $35,975, delivery in 4 months; The Bucyrus Co., South Milwaukee, Wis., $23,800, delivery in 4½ months; Marion Steam Shovel Co., Marion, Ohio, $17,820, delivery in about 65 days; Norbom Engineering Co., Philadelphia, Pa., $31,500, delivery in 16 weeks; Osgood Dredge Co., Albany, N. Y., $25,900, delivery in 3½ months; Vulcan Steam Shovel Co., Toledo, Ohio, $21,750, delivery in 120 days. The American Locomotive Co. bid includes independent capstan engines. The bids on fore and aft steel trusses were as follows: American Locomotive Co., New York City, $3.95 per cwt., delivery in 30 to 60 days; The Bucyrus Co., South Milwaukee, Wis., $1,350, delivery in about 2½ months; Marion Steam Shovel Co., Marion, Ohio, $1,425, delivery in about 65 days; Norbom Engineering Co., Philadelphia, Pa., $850, delivery in 16 weeks; Osgood Dredge Co., Albany, N. Y., 5c per lb., delivery in 3 months; Vulcan Steam Shovel Co., Toledo, Ohio, $1,400, delivery in 120 days. The Bucyrus Co. bid on metal parts only of truss combination, wood and iron. Posts and chords to be of wood to be furnished by the government. The above price offered by the Vulcan Steam Shovel Co., is for trusses for 85 ft. hull. The price for 105 ft. hull is $1,700. Bids on smaller machinery, without spud hoisting or crowding engines, about 3½-yd. dipper for soft material, and 2½-yd. dipper for hard material, were as follows: American Locomotive Co., New York City, $30,050, delivery in 4 months; The Bucyrus Co.; The Marion Steam Shovel Co.; Norbom Engineering Co.; Osgood Dredging Co., $20,100, delivery in 3½ months; The Vulcan Steam Shovel Co., Toledo. The American Locomotive Co., offered a crowding engine for this machinery for $500 extra.

Ohio.

✣Bids will be received until May 15 by the Board of Education, Toledo, O., for an electric light and power system, interior telephone system and electric time clock and program bell system for the Scott and Waite high schools, two fire proof buildings, which will cost approximately $400,000 each. Plans and specifications may be obtained of G. L. McKesson, director of schools.

⊙The Union Gas & Electric Co., Cincinnati, O., has been awarded the contract by the Director of Public Service, Cincinnati, O., for lighting by electricity streets, avenues, lanes, squares and public places in the city. The work includes luminous magnetite or metallic flame arc lamp in underground district, $55 per year per lamp; overhead district, $50 per year per lamp; boulevard system, $56 per year per cluster; 80 Watt tungsten, Mazda or other satisfactory met. fil. inc. lamp in overhead district, $13 per year per lamp. Bids were opened April 3.

Bids as follow were received April 20 by Maj. John C. Oakes, U. S. Engineer, Cincinnati, O., for reconstructing in concrete the top of Dam No. 5, Muskingum River: (1) S. George Campbell, Parkersburg, W. Va., (2) Clifton Bros., Zanesville, O., (3) J. A. Swingle & Co., Zanesville, O., (4) Bates & Rogers Construction Co., Chicago, Ill.:

	(1)	(2)	(3)	(4)
Excavation, 4,000 cu. yds...	$1.50	$0.90	$0.60	$3.25
Concrete, 1,591 cu. yd.	[illegible]	[illegible]	[illegible]	[illegible]
Cement, 1,800 bbl.	[illegible]	[illegible]	[illegible]	[illegible]

The Aetna Foundry & Machine Co., of Warren O., was low bidder on furnishing the gate winches and valve jacks for Dam No. 26, Ohio River slackwater work. The job amounts to about $10,000.

Oklahoma.

⊙The Secretary of the Interior has awarded the contract for the contruction of a 10 room schoolhouse, an addition, at Lawton, [illegible] at [illegible]

Oregon.

The city of Baker, Ore., on April 12, voted to issue $25,000 of bonds for a hydro-electric lighting plant. J. W. Bailey is City Engineer.

Pennsylvania.

Edwin H. Vare, Philadelphia, Pa., was the only bidder, April 19, for the installation of 190 2000-C. P. arc lights in pairs on standards similar to those in the center of Philadelphia on either side of the Southern Boulevard, between Moyamensing Ave. and League Island, and also 426 single Tungsten incandescent electric lights on the service driveways flanking that boulevard and in other parts of League Island park. Mr. Vare offered to do the entire work for $69,900. The bid was held under advisement by the city.

South Carolina.

✣Bids will be received until noon, May 9, by County Court, Dillon, S. C., for the construction of a court house and jail building. Each bid for the construction of the court house must be accompanied with a certified check for $5,000 and for the jail building with a certified check of $1,000, and for the heating of the court house building with a certified check of $200, made payable to T. A. Dillon, chairman, as a guarantee that if awarded the contract, the successful bidder will promptly enter into contract and furnish his bond, as required, by specifications. Drawing and specifications may be seen at the office of William A. Edwards, Architect, 632 Candler Bldg., Atlanta, Ga.

Tennessee.

The State Senate, by unanimous vote, passed the bill authorizing Memphis to issue bonds up to $1,000,000 to purchase or build a municipal lighting plant. Before the bonds are issued the matter will have to be voted on by the citizens of Memphis. Heiskell Weatherford is City Engineer.

Texas.

✣Bids will be received until 3:30 p. m., May 10, by Capt. P. Whitworth, Constructing Quartermaster, Fort Crockett, Galveston, Texas, for screening eighteen buildings at that post.

✣Bids will be received until 3 p. m., May 31, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office at Sulphur Springs, Texas.

✣Bids will be received until 3 p. m., June 6, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office at Wichita Falls, Tex.

The City Commissioners of Dallas, Tex., have authorized the purchase of 40 acres of land out of the Babbitt survey on Elm Fork and have instructed the City Engineer to make the necessary surveys and prepare plans and specifications for a concrete dam at this point on Elm Fork of the Trinity. The dam will be at California Crossing, near Letot Station.

The required 50 per cent of the capital stock of the Port Arthur Pleasure Pier of Port Arthur has been fully paid in and it is expected that the contract for the $150,000 pleasure pier will be let and active work inaugurated in the course of a very short time.

James Stewart & Co., National Bank of Commerce Bldg., St. Louis, Mo., has been awarded the contract for erecting a wharf shed at Galveston for the Galveston Wharf Co. The shed, to be constructed of reinforced concrete, with roofing, vitrified brick paving and all modern protection against possible spread of fire.

Virginia.

✣Bids are asked until noon, May 15, by Lt. Col. Mason M. Patrick, U. S. Engineer, Norfolk, Va., as noted in our April 19 issue, for dredging the channel to Newport News, Va. The work calls for the dredging within the limits of a new channel across Newport News Middle Ground Bar, north of the Middle Ground light, and will require the removal of approximately 1,960,00 cu. yds. of material, scow measurement. The area to be dredged is 3 miles long, 300 ft. wide for a distance of 1¾ miles, and 200 feet wide for a distance of 1¼ miles. The least depth now existing is 22 feet below mean low water, and the ultimate depth to be secured is 35 ft. at mean low water.

Washington.

Bids as follows were received April 7 by Maj. C. W. Kurtz, U. S. Engineer, Seattle, Wash., for 375,000 tons of stone: Northwest

Connecticut.

Bids will be received until 3 p. m., May 20, Lieut. Col. Harry Taylor, U. S. Engineer, London, Conn., for dredging in Paw- ck River, R. I. and Conn.

Delaware.

Bids will be received until 11 a. m., May by Maj. R. R. Raymond, U. S. Engineer, nington, Del., for dredging Leipsic River,

Bids will be received until 3 p. m., June James Knox Taylor, Supervising Archi- Treasury Department, Washington, D. for the extension, remodeling, etc., includ- plumbing, gas piping, heating apparatus, ric conduits and wiring system and light- fixtures of the U. S. Post Office and court e at Wilmington, Del.

District of Columbia.

Bids will be received until 10:30 a. m., 26, by Capt. F. C. Boggs, General Pur- ng Officer, Isthmian Canal Commission, hington, D. C., for furnishing under l Circular 630: Hand cars, push cars, lbarrows, shovels, picks, wrenches, Nails, rs, hacksaw blades, hose clamps, sledge les, stable brooms, scrubbing brushes, rns, garbage cans, brass unions, manila canvas, leather, toilet paper, fire clay, , caustic soda and crude carbolic acid.

Bids will be received until 2 p. m., May y Department of the Interior, Office of n Affairs, Washington, D. C., for fur- ng labor and material for the construc- of two cottages and one barn at the r D'Alene Agency, Idaho.

Bids will be received until 2 p. m., May Commissioners of the District of Colum- for making and installing boiler, painting repairing one fire engine.

Bids will be received until noon, May 10, E. Capehart, acting Chief of Bureau of ance, Washington D. C., for furnishing 6-in. 1,000 7-in. and 200 14-in. target ctiles for the Navy Department.

Florida.

Bids will be received until noon, May 22, eorge R. Spalding, Capt. U. S. Engineers, onville, Fla., for dredging in Caloosa- ie River and entrance, Florida.

Bids will be received until 3 p. m., May Lieut. Col. Harry Taylor, U. S. Engi- New London, Conn., for dredging in 's Cove, New London Harbor, Conn.

ids will be received until noon, May 25, pt. G. R. Spalding, U. S. Engineer, Jack- le, Fla., for dredging and constructing revetment in St. John's River, Florida.

Georgia.

ids will be received until 3 p. m., June James Knox Taylor, Supervising Archi- Treasury Department, Washington, D. C., the construction, complete, including ing, gas piping, heating apparatus, elec- onduits and wiring and lighting fixtures e U. S. Post Office at Dublin, Ga.

Illinois.

ids will be received by Wm. Carroll, Electrician, Chicago, Ill., until 11 a. m., 5, for furnishing the Department of icity 25,000 ft., more or less of No. 6 S. G. rubber covered lead incased electric cable.

Indiana.

ids will be received until May 12, by J. T. Davidson, Depot Quartermaster, sonville, Ind., for furnishing under ule No. 638, 30,000 ft. cottonwood lum- o 1, 20,000 ft gum sap lumber No 1 000 ft. white pine B select.

s as follows were received April 15 by l. George A. Zinn, U. S. Engineer, Chi- Ill., for dredging in Indiana Harbor, (1) dredging [illegible] cu. yd. between place measurement, (2) dredging [illegible] . yds. in lake, scow measurement: Ar- [illegible] Milwaukee, Wis., (2) [illegible] Fitz Simons & Connell Co., Chicago, Ill., [illegible] Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 19¾ cts., (2) 25 cts.

Iowa.

Surveys and estimates have been made by the Northern Roller Milling Co. and the Humboldt Electric Light & Power Co., of Humboldt, Ia., both operated under the same management, for a concrete dam to be built across the Des Moines River at Humboldt. About $80,000 will be spent, and the new plant will develop 1,200 hp.

The Stone & Webster Engineering Co., 147 Milk St., Boston, Mass., which is financing the $25,000,000 dam now under construction in Keokuk, has asked the City Commission of Keokuk for an extension of the present franchise for the operation of public utilities to a period of 25 years. The company has an option on the gas, electric light and street car system, and will take over the property if the franchise is extended. The proposition will be submitted to a vote of the people.

Kentucky.

✣Bids will be received until May 17, by Kash C. Williams, County Superintendent of Schools, Jackson, Ky., for the construction of 21 schoolhouses in Breathitt County, Ky. Houses must be completed before Oct. 1.

✣Bids will be received until noon, May 26, by Maj. J. C. Oakes, U. S. Engineer, Custom House, Cincinnati, O., for constructing lock and dam No. 14, Kentucky River, at Heidelberg P. O., Ky.

Maryland.

✣Bids will be received until 11 a. m., May 13, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for a 12-kw. gasoline engine belted generating set, 200-ampere-hour storage battery, accessories, wiring material, etc., at the U. S. Marine Corps Rifle Range, Winthrop, Md.

Massachusetts.

✣Bids will be received until 1 p. m., May 15, by Capt. A. M. Miller, Constructing Quartermaster, 268 Summer St., Boston, Mass., for the construction, plumbing, heating, wiring and fixtures of an addition to post hospital at Fort Strong, Boston Harbor, Mass.

The Furst-Clark Construction Co., Sandwich, Mass., has 1,000,000 cu. yds. of dry excavation, suitable for light steam shovel plants, etc., to let on the Cape Cod canal work

Bids as follows were received April 20 by Col. Frederic V. Abbot, U. S. Engineer, Boston, Mass., for construction of superstructure of breakwater at Sandy Bay, Cape Ann, Mass (1) Bid per ton of 2,000 lbs., for capstones including iron pins, (2) per ton for all other wall stone, (3) per ton for rubblestone of Class in the interior of superstructure and substructure, (4) per ton for rubblestone of Class B in substructure and in apron: Holbrook, Cabot & Rollins Corp., Boston, Mass., (1) $9.60, (2) $7.60; (3) $3.10; (4) $3.70. The Breakwater Co., Philadelphia, Pa., (1) $7.23; (2) $5.7[illegible]; (3) $1.90; (4) $2.18. Rockport Granite Co. [illegible] Pigeon Hill Granite Co., Rockport, Mass., (1) $8.63; (2) $5.80; (3) $1.93; (4) $2.37

Michigan.

Bids as follows were received April [illegible] by Col. McD. Townsend, U. S. Engineer, Detroit Mich., for (1) [illegible] section 1, Saginaw River, and (2) for dredging [illegible] 12⅞ cts., (2) 17 cts. [illegible] Michael Sullivan, Detroit, Mich., (1) 17¼ cts. [illegible] Minn., (1) 18 cts.; Duluth Marine [illegible] the construction of a dam across the Escanaba [illegible] tion of the mill [illegible] electrical energy [illegible] the Traction Com- [illegible] he mill will be able [illegible] turn out daily at least [illegible] tructed across [illegible] near by.

Minnesota.

Following bids were received April 20 by [illegible] Du- [illegible]

[illegible]

✣ [illegible]

✣ [illegible] May 22 [illegible]

stock, William Bar

[illegible] buildings, which will [illegible] $100,000 each. Plans and

[illegible] Square, Cincinnati, O., for

Oklahoma.

[illegible] has award [illegible] construction of a 10 [illegible] station, at Lawton, [illegible] of East Liverpool, O.

Oregon.

[illegible] of Baker, Ore., on A [illegible] $25,000 [illegible] for a [illegible] plant [illegible] is

win H [illegible] bidde [illegible] 000-C [illegible] ar t [illegible] the [illegible]

South Carolina

Tennessee

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Texas

C., for the construction complete, including plumbing, gas piping, heating apparatus, elec

Treasury Department, Washington, D. C., for

[illegible] The work to be constructed [illegible] concrete, with roofing, vitrified brick [illegible] and all modern protection against [illegible] spread of fire.

Virginia.

✣Bids are asked until [illegible] Col. Mason M. Patrick, [illegible] folk, Va., as noted in our April [illegible] dredging channel to N [illegible] The [illegible] for the dr [illegible] channel ac [illegible] Bar, [illegible] will [illegible] 1,960 [illegible]

[illegible] Bldg., Seattle, Wash., $2.15 per ton, f. o. b. scows or barges on jetty wharf; Hercules Sandstone Co., Tenino, Wash., $1.78 per ton, f. o. b. scows or barges on jetty wharf; $1.62 per ton, f. o. b. barges at South Aberdeen.

Wisconsin.

✣[illegible] Col. Geo. A. Zinn, U. S. Engineer, Milwaukee, Wis., [illegible] Wis. The area to be dredged is located at the mouth of the Oconto River, Wis., and extends [illegible] shore line to the 18-ft. contour in Green Bay, a total distance of about 4,100 ft., with a width varying from 100 to 500 feet. This area is divided into two sections, to be known as Section A and Section B. Section A is that portion lying between the shore line and the 18-ft. contour. The approximate yardage of this section is 227,000 cu. yds. Section B is that portion lying inside the shore line, and its approximate yardage is 153,000 cu. yds.

The La Crosse Water Power Co., W. J. Ferris, President, La Crosse, Wis., which now has two dams and storage reservoirs, one located at Hatfield and the other seven miles north of that point across the main channel of Black River, is considering building a third dam, to be located on the east fork of Black River, eight miles from Hatfield. Plans are completed, together with all topographical surveys and other needed data, and contracting firms have been over the ground with a view of bidding on the work.

Following bids, per cu. yd., scow measurement, were received April 15 by Maj. Francis R. Shunk, U. S. Engineers, Duluth, Minn., for dredging in Ashland Harbor, Wis.: Edward Bros. Dredge Co., Sault Ste. Marie, Mich., 18 cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., 12 cts.; Zenith Dredge Co., Duluth, Minn., 11½ cts., (recommended for acceptance), Northern Dredge & Dock Co., Duluth, Minn., 12½ cts.; Duluth Marine Contracting Co., Duluth, Minn., 14 cts. About $16,000 is to be expended.

Canada.

✣Bids will be received until 11 a. m., May 15, by M. Peterson, Secy., Board of Control, Winnipeg, Man., for the manufacture, delivery and installation of 6 500-kw. step-down transformers for substation No. 1. Smith, Kerry & Chace, Carnegie Library Bldg., Winnipeg, Man., are Power Engineers.

✣Bids will be received until 6 p. m., May 12, by E. D. Tuttle, Architect, 701 McArthur Bldg., Winnipeg, Man., for the erection and completion of a brick school building at Gretna, Man. Charles Wahn is Secretary and Treasurer of Gretna School District No. 336.

✣Bids will be received until 4 p. m., May 29, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of a dam and sluiceway across the head of Gordon Creek at Kippewa Village, in the county of Pontiac, Que. Plans, specification and form of contract can be seen and forms of tender obtained at the office of J. E. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the postmaster at Haileybury, Ont.

✣Bids will be received until 4 p. m., May 5, by L. K. Jones, Secy., Department of Railways and Canals, Ottawa, Ont., for dredging Rapide Plat Canal, Ontario, St. Lawrence Canals. Plans and specification and form of contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Resident Engineer of the Ontario—St. Lawrence Canals, Cornwall, at which places form of tender may be obtained.

✣Bids will be received until 4 p. m., May 5, by L. K. Jones, Secy., Department of Railways and Canals, Ottawa, Ont., for improving the Lower Extreme to Lock No. 24. Plans, specification and form of contract to be en[illegible] can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and the office of the Resident Engineer of the Ontario—St. Lawrence Canals, Cornwall, at which places form of tender may be obtained.

✣Bids will be received until May 6, by D. W. McCuaig, Chairman Manitoba Elevator Commission, Winnipeg, Man., for the re[illegible] of the government elevators at the following points: Canadian at Minitonas, Canadian at Dauphin, Dominion at Dauphin, Northern at Grandview, Northern at Miami, Winnipeg at Oakville, Western at St. Claude, Northern at Swan Lake, Canadian at Valley River, Imperial at Miniota. Particulars and form of tender my be obtained at the offices of the Commission, 279 Garry street, Winnipeg.

✣Bids will be received until 4 p. m., May 29, by R. C. Desrochers, Secy., Department Public Works, Ottawa, Ont., for the construction of a dam and sluiceway across the head of Gordon Creek at Kippewa Village in the County of Pontiac, Que. Plans, specification and form of contract can be seen and forms of tender obtained at the office of J. E. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the postmaster at Haileybury, Ont.

✣Bids will be received until 4 p. m., May 22, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the erection of a public building at Uxbridge. Plans, specification and form of contract may be seen and forms of tender obtained on application to Mr. Thos. A. Hastings, Clerk of Works, postal station F, Yonge street, Toronto, Ont., and at the postoffice at Uxbridge.

✣Bids will be received until 11 a. m., June 3, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for extension of dikes at the Navy Yard, Mare Island, Cal.

The Ridgetown Fuel Supply Co., recently organized with a capital stock of $800,000, proposes to construct a pipe line for natural gas between the cities of Ridgetown, Ontario, and Honden, Canada. The capital stock is $800,000. The line will be 80 miles in length and twelve-inch pipe will be used. Bond Jasperson, Ridgetown, Ont., is Secretary and Treasurer of the Company. The project is being backed by Lima, O., men, among whom are M. P. Colt, W. L. Parmenter, John B. Kerr, E. R Curtain and J. R. Sinclair.

Chile.

✣Bids will be received until 3 p. m., July 22, in the Ministerio De Hacienda, Santiago, Chile, for the construction of Valparaiso and San Antonio Harbors. The work will cost about $15,000,000. Plans and information can be seen at the office of Consulate General of Chile, 2 Rector St., New York, N. Y., Room 431 from 12 to 3 p. m.

TRADE NOTES.

The New Jersey Zinc Co. has placed an order with the Buffalo Forge Co., Buffalo, N. Y., for 54 large special fans.

The Western Wheeled Scraper Co. has removed its office at Kansas City, Mo., to 410 Orear-Leslie Bldg. Mr. M. T. Babb continues in charge of the office at that point.

Peter E. Meagher, Duluth, Minn., has taken the sales agency for the boilers, hoisting engines and derricks manufactured by the Clyde Iron Works. These articles are carried in stock at Duluth.

Andresen-Evans Co., manufacturers of grab buckets, for handling ore, coal, crushed stone, [illegible] from 1501 Monadnock Bldg. to 635 Railway Exchange Bldg., Chicago, Ill.

In order to take adequate care of its increasing business on the Pacific Coast, the Raymond Concrete Pile Co. of New York and Chicago has recently opened offices at 689 Pacific Electric Bldg., Los Angeles, and at 503 Market St., San Francisco, in charge of Mr. Thomas D. Campbell.

The Terry & Tench Co., Inc., has moved its offices to the Grand Central Terminal, New York City, where the company has several large [illegible] practically all the structural steel in the Suburban Station, the Main Station Building and Power House, the Merchants' and Manufacturers' Building and concluded that it could find no more fitting place for an office than right on that job.

The contract for the piling foundations of the Pilgrim Laundry Building, Eleventh Ave. and Seventeenth St., Brooklyn, N. Y., has been awarded to the MacArthur Concrete Pile & Foundation Company of New York. The piles will be of the Pedestal type. Kirby & Pettit are the architects.

The International Steam Pump Co., 115 Broadway, New York City, has established a Publicity Department which hereafter will handle its advertising and news matter. This department will be in charge of Mr. Henry R. Cobleigh, who recently resigned as Mechanical Editor of the Iron Age to accept this new position.

The Harold L. Bond Co. of New York announces that Mr. Burr R. Brown, well known to the contracting trade in New York City, is now associated with the company. The Harold L. Bond Co. has recently removed to 78-80 Beach St., near West St., where a large and varied line of contractors' equipment and supplies is kept in stock.

The Superior Sand & Gravel Co. has placed a contract with James H. Phinney & Co., Detroit, Mich., local representatives of the Jeffrey Mfg. Co., for a Shoemaker & Casparis elevating and loading machine. The machine will be placed in the company's pit near Utica, Mich., and it is claimed, will dig, elevate, screen and wash from 15 to 20 40-ton cars of sand and gravel per day.

To handle more efficiently its increasing business in the middle west, the Iroquois Iron Works, of Buffalo, N. Y., have established a warehouse in Chicago, where a complete line of macadam and tandem rollers, asphalt tools, kettles, etc., is carried for immediate shipment. The new shipping depot is in charge of Mr. T. H. Morris, the Chicago representative of the Iroquois Iron Works, with offices in the Tribune Bldg.

Due to the increase in business west of the Mississippi River, the McCormick Waterproof Portland Cement Co. of St. Louis, Mo., have opened another office in Kansas City, Mo., Reserve Bank Bldg., Room 332. Wm. H. K. Bennewitz has been appointed Special Representative of the Company in that territory. The McCormick Waterproof Portland Cement Co. has now seven offices located in the following cities, viz.: St. Louis, Mo.; Chicago, Ill.; New York City; Boston, Mass.; Pittsburg, Pa.; Toledo, Ohio, and Kansas City, Mo.

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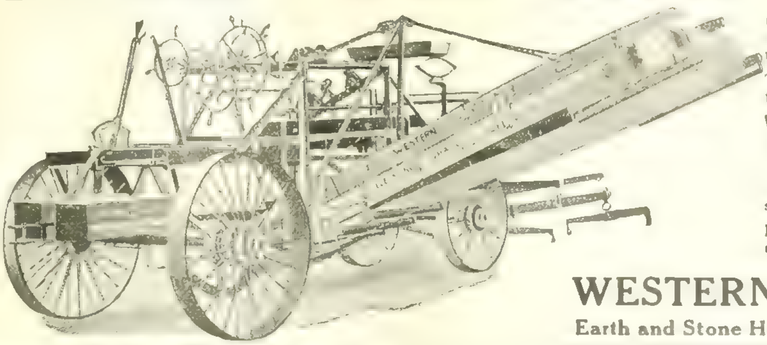

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OFFICE OF THE ROADS' ENGINEER OF BALTIMORE COUNTY

Towson, Md., May 6, 1911.

Sealed proposals addressed to the Highway Commission of Baltimore County and endorsed proposals for furnishing and erecting a Strauss Trunnion Bascule Bridge, on Eastern Avenue over Back River, will be received by the Highways Commission of Baltimore County at their office in the Court House, Towson, Maryland, until 11 a. m. of the clock, Thursday, May 18, 1911, when they will be publicly opened and read. Each bid shall be accompanied by a certified check for Five Hundred Dollars ($500.00) as a guarantee that the successful bidder will sign contract. Plans and specifications can be seen and obtained in the office of the Highways Commission, Towson, Md., and at the offices of the Strauss Bascule Bridge Co., 901 Fort Dearborn Building, Chicago, Illinois.

The Contractor shall state in his bid the date he will complete the bridge ready for use.

The Highways Commission reserves the right to reject any or all bids.

HENRY G. SHIRLEY
Baltimore County Roads Engineer.

DRAINAGE EXCAVATION.

Notice is hereby given that the undersigned will open bids for the construction of an open ditch, between the hours of 10 a. m. and 11 a. m. on Saturday, May 13, 1911, at the offices of Osborn, McVey & Osborn, at La Porte, Ind., pursuant to an order of the La Porte Circuit Court in the matter of the petition of Willard W. Place et als for Drainage. Said ditch will be 11,358 feet in length and will require the excavation of 20,210 cubic yards, with teams or with a dry land excavator.

Bids may be sent to the undersigned in the care of Osborn, McVey & Osborn, La Porte, Ind., and must be accompanied by a certified check for ten per cent of such bid.

The right is reserved to reject any and all bids.

[illegible] ROBINSON
Superintendent of Construction.

CITY OF TORONTO.

Tenders for Construction of Ashbridges Bay Docks.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Canada, up to noon on Tuesday, 23d May, 1911, for the construction of dock in Ashbridges Bay.

Envelopes containing tender must be plainly marked on the outside as to contents.

Specifications and forms of tender may be obtained upon application to the Department of Railways, Bridges & Docks, City Engineer's Office, Toronto.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman Board of Control.
City Hall, Toronto, April 12, 1911.

Fort Yellowstone, Wyo., April 27, 1911. Sealed proposals, in triplicate, will be received here until 12 noon, May 31, 1911, and then publicly opened, for furnishing labor and material for constructing pipe line from Panther Creek to point near Rustic Falls for Fort Yellowstone water system. Information furnished on application. Envelopes containing proposals to be indorsed "Proposals for pipe line" and addressed to Constructing Quartermaster.

U. S. Engineer's Office, Kansas City, Mo., April 20, 1911. Sealed proposals for constructing standard revetment on Missouri River about four miles below St. Charles, Mo., will be received here until 12 noon, May 22, 1911, and then publicly opened. Information furnished on application. Edward H. Schulz, Major, Engrs.

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One No. 6 McCully [illegible] (Chicago)
One No. 5 " " (N. Y.)
One No. 5 Gates style "D" (N. Y.)
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SEWER.

[illegible] bids for approximately 10,000 feet of from [illegible] May, 1911 [illegible] city clerk, E. O. Little.

For further information, write Phil Holman, City Engineer, Auburn, Ind.

[illegible] Office, Montgomery, Ala., May 1, 1911. [illegible] will be received at this office until one o'clock p. m., May 31, 1911. Information on application. G. D. Fitch, Lt. Col., Engineers.

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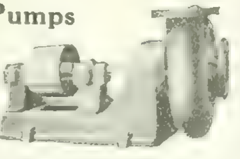

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Including Diagrams for [illegible] and Strengths of Steel Beams, by G. F. Dodge, M. West. Soc. Engrs. 13 × 15½ inches; 104 pages. Postpaid, $1.00.

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(Both Conduit and Pole Lines.)
The title of this book, by Clarence Mayer, is "Telephone Construction Methods and Cost," which is somewhat a misnomer in that it does not indicate its wide scope. It is 6 × 9 ins.; 300 pages. Postpaid, $4.00.

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A Notable Achievement in Tunnel Construction.

American tunnel builders will be prompt in expressing admiration of the remarkable progress of excavation secured by the builders of the Loetschberg tunnel in the Swiss Alps. This tunnel is briefly described elsewhere in this issue and progress figures are given in some detail. These figures, as will be observed, establish records both of average progress and of maximum monthly progress for hard rock tunneling. Indeed they mark a pace which tunnel builders, we imagine, will find some difficulty in equaling in years to come.

It [illegible] published accounts of the [illegible] difficulties [illegible] tunnel [illegible] untoward [illegible] these, the Goppenstein avalanche at the south portal, was [illegible] completed [illegible] proceeded [illegible] full speed [illegible] break; excavation was then stopped to be begun again on a new line, after which it proceeded at speed [illegible] troubles [illegible] pressures [illegible] Austrian tunnels [illegible] railway to Triest," described in our issue of Jan. 4, 1911. Finally the rock temperatures seem not to have been so high as seriously to delay progress when the usual precautions were taken in ventilation works and water spraying.

Returning [illegible] Kander, two questions arise: (1) Why was the probability of this accident not determined beforehand? (2) Why was it decided to make a detour around the break instead of driving through it on the original line? The data are not available for precise answers. At the time of the break [illegible] full speed and apparently [illegible] of safety [illegible] concerned. The inrush of mud and water was so sudden that the men were compelled to run for their lives and [illegible] enough to escape. The [illegible] engineers in their safety from the river above appears to have [illegible] reports of the geologists employed who asserted that a safe thickness [illegible] the river bottom and the tunnel [illegible] It is always captuous to fling criticism when looking back at an occurrence of this sort [illegible] point ahead, but this accident proves anew that it is a mighty [illegible] security of tunnel work on geologists' reports alone. It [illegible] may have been [illegible] the place, but had it been done and a hole or two bored [illegible] it would have been a profitable precaution.

It was decided by the engineers to be impracticable to [illegible] heading across the break. Beyond this statement there is little information at hand [illegible] conditions [illegible] the abandoning [illegible] heading already driven and the construction of some [illegible] tunnel than was called for by the original line. The aggregate is a considerable item of work and only rather insuperable obstacles to procedure on the original line would appear to warrant its being undertaken. Lacking information of the nature of the [illegible] provisionally accepted as having been impracticable to overcome.

The method of [illegible] tunnel, it will be [illegible] It may be defined more precisely, perhaps, as typically Austrian. The claims which are made for this method of tunneling were stated in our issue of Jan. 4, 1911. The more interesting matter is the speed of driving attained which, it will be noted, far exceeded that on any previous long European tunnel with which the Loetschberg work is compared in a succeeding column. Fetching into this comparison the Austrian tunnel work described in our issue of Jan 4, 1911, we find the Loetschberg record equally superior and these Austrian tunnels were driven by exactly the same method of bottom heading and section enlargement. The exceptional speed of driving secured at Loetschberg would seem, therefore, to result from other reasons than merely the tunneling method followed. It would appear from the accounts which have been published that there were several reasons, principally, [illegible] the drills [illegible] individually [illegible] electric power [illegible]

The Choice of Subjects for Thesis Work in Engineering Schools.

It is the custom of engineering schools to require each year the students of its graduating class to submit a written thesis as a test of ability The object of this task is not the same as that of the preceding studies undertaken by the students. These latter have been initiated by the teachers and carried out under the immediate and close direction of these teachers—their object has been specifically the instruction of the students. The purpose of thesis work is different; it is not specifically to enable the students to secure instruction from the teacher. It differs in nature by being initiated by the student and conducted on his own responsibility. Thesis work is, therefore, a test of the students' ability to conduct independent work and to present the results in permanent form for the service of others. The last feature of its purpose is no less compelling than the first and inferentially it obligates the student so to select and conduct his task that the results shall be an addition to engineering knowledge. Does the ordinary run of college thesis work meet these requirements and if not why does it fail?

The subjects usually chosen for theses may somewhat roughly be divided into the following classes: (1) The design of a specific engineering structure or tool. (2) A critical investigation of some existing engineering structure or of the designs for such a structure. (3) An experimental investigation of some engineering problem and (4) Tests of the working results or efficiency of some engineering machine or work. To which of these classes of subjects does the choice of students mostly lean? No precise answer may perhaps be given without collating a considerable number of records, but we have recently received from one of the larger and more representative engineering schools a list of the subjects chosen for theses by its graduating class of the present year, which is indicative of the answer. There are 55 graduating students in the class, divided somewhat equally between the civil, mechanical and electrical engineering courses. The subjects chosen for theses by 30 of these students fall without doubt into classes one and two as given above and nearly all of the 30 subjects fall in class one. The subjects chosen by the remaining 25 students are divided between classes three and four, but the most of them fall in class three. While this record may not quantitatively represent the distribution of thesis subjects in engineering schools generally it is in a measure qualitatively representative, that is, the bulk of the thesis subjects chosen call for designs, plans, specifications, etc., of structures or apparatus to meet a given set of conditions What are the chances of such a choice of subjects meeting the full purpose of thesis work?

Few senior students in an engineering school are capable of designing, planning and specifying engineering works The thesis designs of engineering students are seldom creditable engineering designs It is not to be expected that they can be. Planning and designing are a high grade of engineering work

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They [illegible] be long experienced to be capably [illegible]. Some engineers never become highly capable designers. The graduating engineer has little or no experience; his accumulated information has not even been classified into working shape by the necessities of actual work. He is not an engineer. Coupled with this fact and because he has been taught to hitch his wagon to a star he frequently chooses for his thesis work some problem in design whose magnitude would cause the grizzled veterans of the profession to lead their attack with caution. The result is obvious—a design that is at best only mediocre and is usually faulty and one which the student will later, when he gets to be really a designer, be the first to regret. If one of the purposes of thesis work is to add something to engineering knowledge it is evident that the chances of its doing so are small if the class of subjects under consideration is chosen.

When the student steps aside from original design to review and criticise the design of existing works his work is likely to be only one degree less fruitful in information. For exactly the same reason that he can seldom design capably he is incapable of adjudging the design of another who has had experience. His lack of experience and his scholastic training prevent him from realizing and allowing for the conditions which may have limited the practical designer's work and lead him to see inexcusable errors where the design falls short of theoretical perfection as it has been taught him.

We have thus far spoken of those matters in which the student is lacking as compared with the engineer having experience. There are other ways in which he has a decided advantage over the practicing engineer in developing useful knowledge. The practicing engineer has neither the means generally nor the time to conduct tests and experimental investigations to determine many questions which arise in his work. The student has the time and the means for any such work as he is capable of doing and completing. Here again, however, his ambition to attempt some monumental work is his danger. Few students have the training of judgment necessary to conduct worthily the major investigations in applied science and still fewer have the time. There are, however, numerous minor investigations which can be brought within all these student limitations and their conduct is an opportunity for thesis work of lasting value.

Our purpose here is not to suggest subjects for thesis work but to urge an efficient choice of subjects. In this work as in all other work the task which counts most is the one that can be capably handled and completed. There are hundreds of these minor tasks that need to be performed—tasks of experimental investigation and tasks of collecting and collating existing data.

CONCRETE AND REINFORCED CONCRETE SECTION

A Study of Economic Design of Retaining Wall for a Special Condition.

BY J. H. PRIOR*

The Chicago, Milwaukee & St. Paul Ry. Co. engineering department has just completed the construction of a long retaining wall at Elgin, Ill. This retaining wall, which was designed and constructed under the direction of C. F. Loweth, chief engineer of the company, is of somewhat unusual design. The circumstances which led to the selection of this particular type are described in this article.

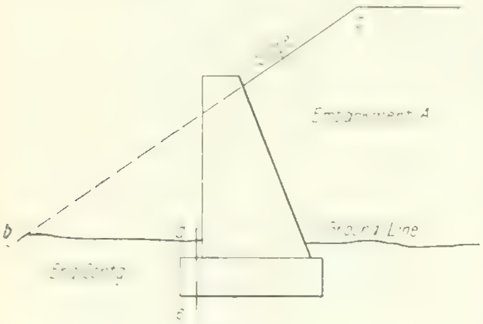

Fig. 1.

A retaining wall can be usually described as a structure such as is shown in Fig. 1 and Fig. 2, which prevents the embankment *A* from spilling forward to whatever point *b* at which the natural slope of its material *b-c* intersects the ground line. Where it is necessary to build a retaining wall to keep the embankment from encroaching on the ground to the left of the line *d-e*, it will also be often necessary to keep the footings from encroaching on the land to the left of the same line, especially in centers of population or industry, where land values are high.

Where the embankment which the retaining wall restrains is surcharged, as shown by Fig. 1, the location of the toe of the footing of the retaining wall can be moved from the point *f* to the point *g*, Fig. 3. The toe of the footing, having been thus moved so as to be entirely on the land of its owner, the designer has the choice of building the wall the height *h-l*, and losing the use of the land of the width *i*, or of building the wall to the height *h-2* and obtaining the use of the land *i*, the value of the land represented by the dimension *i* being compared with the additional cost of the retaining wall *h-2* over the retaining wall *h-1* in making a decision.

If, however, the top of the embankment is flat, as shown by Fig. 2 and Fig. 4, and it is required the footings should not project beyond the line *d-e*, the full use of the right of way can only be obtained by removing in the design the front projection of the footing *j-k* in Fig. 4 and by extending the footing beyond the rear of the wall whatever distance *m* is required to give a stable retaining wall of plain concrete or else by using some special design in reinforced concrete.

The situation represented by Figs. 2 and 4 recurs often enough in railway work to give the matter considerable general importance, especially where the allowable bearing of the toe of the footing upon the foundation is low. The same circumstances which make it necessary to build a retaining wall to keep the railway company's embankment within the right of way, tend to make it also necessary to keep the footings of the retaining wall itself within the railway company's right of way. Such a situation occurs at Elgin, Ill.

As shown by Fig. 4, the right of way of the railway company at this point occupies a narrow strip on the west bank of the Fox River. The ground to the left of the line *d-e* is occupied by a row of mills and factories which abut on the right of way line, and so the footing could not project to the left of that line. The wall could not be moved to the right, as shown by Fig. 2, in order to keep the footings from projecting beyond the right of way line, as it was necessary to maintain the present distance *w* of the side track *p* from the right of way line *d-e*, the distance *w* being determined by the use made of the side track *p*. Test pits showed the allowable bearing on the foundation to be about 2 tons. Piles could not be driven, as their driving would interrupt the use of the side track and disturb the foundations of the adjoining buildings.

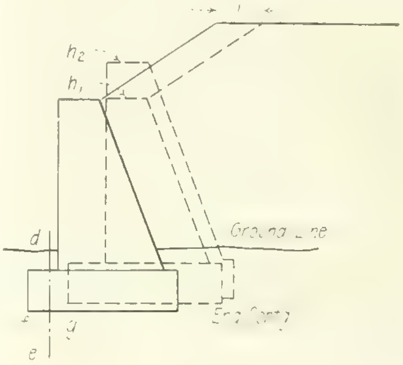

Fig. 3.

To meet the above conditions all the following types shown in Figs. 5 to 9 inclusive were designed. The five different types are roughly as follows: Type A, Fig. 5, plain gravity wall with footing projecting on the rear of the wall. Type B, Fig. 6, reinforced retaining wall, cantilever type. Type C, Fig. 7, reinforced wall, buttress type. Type D, Fig. 8, cellular retaining wall filed with earth. Type E, Fig. 9, a longitudinal wall *t* supported on the outside by buttresses *u* with a slab *v* on top, the whole forming a retaining wall practically hollow.

Each of the above walls was investigated for three conditions of loading, namely: Case

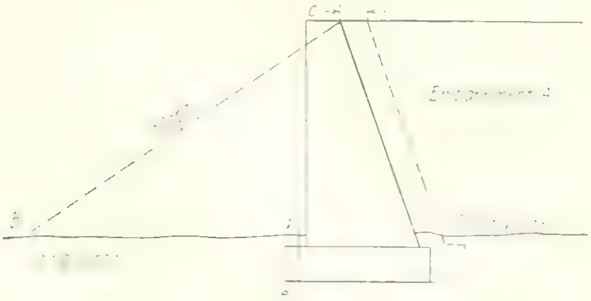

Fig. 2.

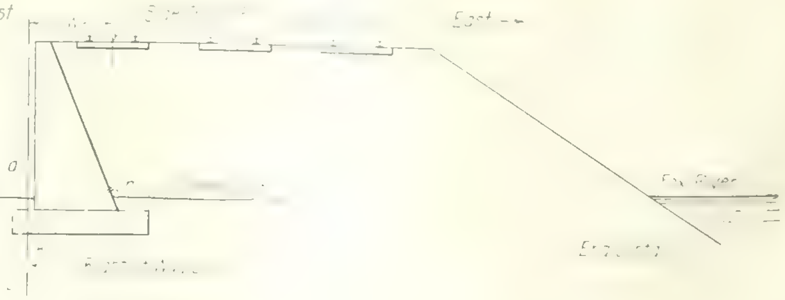

Fig. 4.

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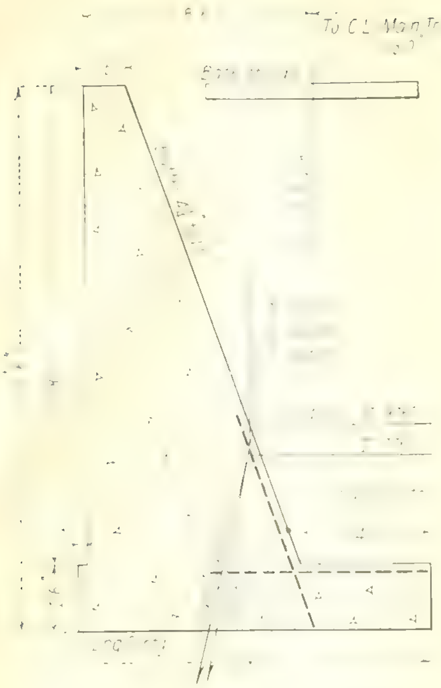

Fig. 5—Plain Gravity Wall With Footing Projecting at Rear.

TABLE OF BEARINGS IN LBS. PER SQ. FT.

	Toe.	Heel.
Case I	5320	590
Case II	[illegible]	630
Case III	5700	570
Concrete, 4.33 cu. yds. at $6.00		$25.98
Steel, 40.8 lbs. at $0.025		1.02
Forms, 4.12 sq. yds. at $1.20		4.94
Total cost per lineal ft.		$31.94
Cost of steel per cu. yd.		$0.24
Cost of labor and material per cu. yd.		7.11

I, live load on side track *p* only. Case II, live load on main track *o* only. Case III, live load on both tracks.

Type A, Plain Concrete Retaining Wall.—This type is shown by Fig. 5. Its design is fully shown in this figure and requires no explanation. This figure shows that the differences which are developed between the loadings of Case I and Case III are so small for this design that they could have been neglected. The different cases of loading are retained, however, both to show the slight difference which exists between them and to show the same information throughout all designs, instead of omitting information which proved unimportant as the design was worked up. This design has a maximum bearing on the toe or footing of 5,700 lbs. per sq. ft. and its cost per lineal foot of wall is $31.94. Notice that this cost covers only the items tabulated, and does not include such special items as excavation, falsework, etc., since they are subject to such wide variations that it was thought best to omit them in this comparison, as their insertion would introduce a large amount of guess work. The items shown are those which must be taken account of in every situation, and the reader is left to add whatever special items are required to cover conditions in other places.

The unit prices of concrete per cubic yard, steel per pound in place, forms per square yard, which were selected, were given values which would make them as general as possible. The quantities being given, other unit prices can be substituted by the reader, if he desires. The maximum bearing of 5,700 lbs. on the toe of footing was greater than the foundation would carry, causing the rejection of design A.

Type B, Cantilever Retaining Wall Reinforced Concrete.—Type B retaining wall is shown by Fig. 6. All the essentials of this design are shown in this figure. This wall has a bearing at toe of footing of 5,470 lbs. and cost $29 per lin. ft., but was found unsuited for the situation outlined, for the same reason as Type A—excessive bearing on toe of footing.

Type C, Buttressed Retaining Wall, Reinforced Concrete.—Type C is shown by Fig. 7. This is the ordinary buttress retaining wall. The bearing on the toe of the footing is 5,970 lbs. per square foot and the cost per lineal foot is $29.26. It was rejected for the same reason as types before—excessive pressure on toe of footing.

Type D, Cellular Retaining Wall Filled with Earth.—This wall, Fig. 8, is formed of two longitudinal curtain walls, *q* and *r*, connected by two transverse diaphragms, *s*. The vertical space between the parallel longitudinal walls *q* and r and the transverse diaphragms *s* is filled with earth. The maximum pressure on the toe of the footing for this type is 4,250 lbs. Its cost per lineal foot is $42.15. This design was also rejected on account of high pressure on the toe of the footing.

Type E, Lacher Design.—Type E, Fig. 9, is a design of W. S. Lacher and is a new type in reinforced concrete, as far as the knowledge of the writer goes. It is an old type in stone masonry, having been illustrated in Benjamin Baker's "Actual Lateral Pressure of Earthwork"* 30 years ago. The wall called type E consists of a footing, *y*, which supports a longitudinal wall, *t*, and the cross walls, *u*. The cross walls, *u*, which are spaced about 12 ft. centers, connect at one end to the longitudinal wall *t* and at the other end support the girder which spans from one cross wall to another. Above the girder, the slabs *v* are supported at one end by the girder and at the other end by the longitudinal wall *t*. The drawings show the design in sufficient detail. It will be noticed in this design the maximum pressure on the toe of the footing is only 2,580 lbs., which is only 61 per cent of the next lowest bearing, Type D, or 43 per cent of the highest bearing, Type C. The cost per lineal foot of this wall is $42.75. As this cost is greater than any other types, this design is only suitable to the situations described in the opening paragraphs, namely: where the retaining wall must give full use of the right of way and low bearings on the toe of the footing. As this was the situation at Elgin the design Type E was adopted and built.

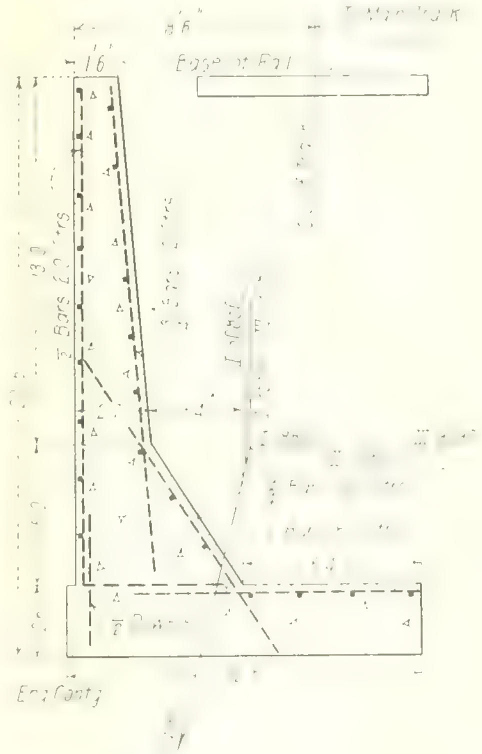

Fig. 6—Reinforced Concrete Retaining Wall, Cantilever Type.

TABLE OF BEARINGS IN LBS. PER SQ. FT.

	Toe.	Heel.
Case I	[illegible]	[illegible]
Case II	4400	550
Case III	[illegible]	[illegible]
Concrete footing, [illegible] at $6.00		[illegible]
Concrete neatwork, 1.8 cu. yds. at $7.50		13.50
Steel, 148 lbs. [illegible]		[illegible]
Forms, 4.12 sq. yds. at $1.20		4.95
Total cost per lineal foot		[illegible]
Cost of steel [illegible]		[illegible]
Cost of labor and material, per cu. yd.		8.59

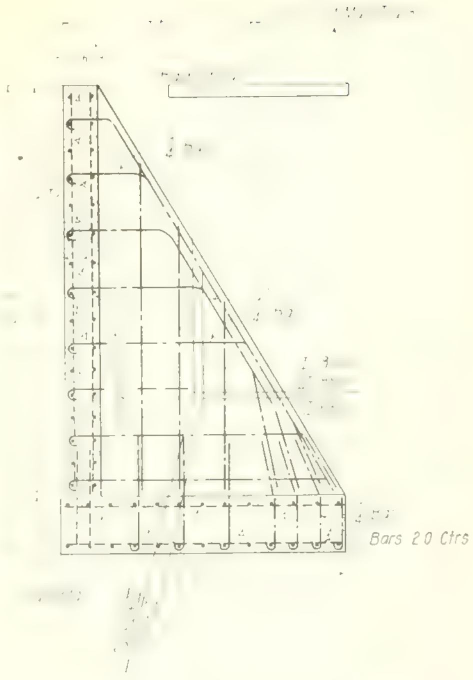

Fig. 7—Reinforced Concrete Retaining Wall, Buttress Type.

TABLE OF BEARINGS IN LBS. PER SQ. FT.

	Toe.	Heel.
Case I	5610	0
Case II	4030	830
Case III	5970	0
Concrete footing, 1.15 cu. yds. at $6.00		$ 6.90
Concrete neatwork, 1.44 cu. yds. at $7.50		10.80
Steel, 1.51 lbs. at $0.025		3.78
Forms, 6.4 sq. yds. at $1.20		7.78
Total cost per lineal foot		$29.26
Cost of steel, per cu. yd.		$1.46
Cost of labor and material, per cu. yd.		9.85

In the retaining wall, Type E, the greatest reduction in toe pressure is brought about by eliminating the weight of the earth directly above the footings, the space between the side walls *u* being an open and empty space in this design. As the vertical loads on the footing are thus diminished and as the horizontal loads are not much altered, the inclination of the resultant of the vertical and horizontal loads is increased. In the resultant, marked Case II, Fig. 9, the ratio of the horizontal to the vertical components is 0.41, and as this ratio of 0.41 might exceed the coefficient of friction of the wall on a slippery foundation, this wall is somewhat unstable if built on such a foundation and its tendency to slide is the principal weakness in the design. This weakness, of course, is partly remedied by the depth and compactness of the back filling in front of the wall.

In making these comparisons, it was not thought practical to find the cost of the wall of different types having exactly the same toe pressure, but instead each type was proportioned in the manner which it was thought would show it in the most favorable way as a whole.

Drainage Engineer.—A civil service examination will be held May 24, 1911, for the positions of drainage engineer and assistant drainage engineer in the U. S. Department of Agriculture. The examination will be held to fill four vacancies at salaries ranging from $1,200 to $2,000 per year. Applicants should write the United States Civil Service Commission, Washington, D. C., for application and examination forms and particulars.

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*See [illegible] Pressure of Earthwork," Benj. Baker-D. Van Nostrand, New York, [illegible]

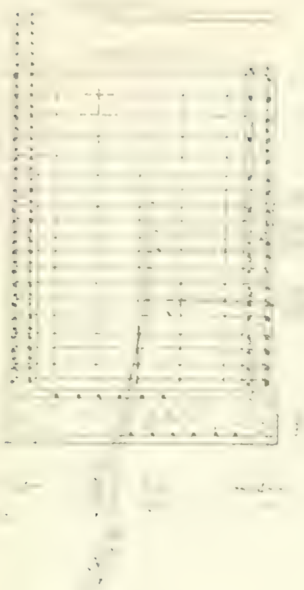

Fig. 8—Cellular Retaining Wall Filled With Earth.

TABLE OF BEARINGS IN LBS. PER SQ. FT.

	Toe.	Heel.
Case I	1250	1860
Case II	[illegible]	[illegible]
Case III	[illegible]	2170

Concrete footing, 1.20 cu. yds. at $6.00	$ 7.20
Concrete neatwork, 2.12 cu. yds. at $7.50..	15.90
Steel, 270 lbs. at $0.025	6.75
Forms, 10.25 sq. yds. at $1.20	12.30
Total cost, per lin. ft.	$42.15
Cost of steel, per cu. yd.	$2.03
Cost of labor and material, per cu. yd.	10.65

The Design for the Steel Centers for the Rocky River Bridge at Cleveland, Ohio.

The Rocky River Bridge at Cleveland, Ohio, is a concrete structure with a main span of 280 ft. and a rise of 80 ft. The length of the bridge over all is 708 ft. Its design was the subject of an article which appeared in Engineering-Contracting for March 10, 1909, and the construction was fully described the succeeding issue of Sept. 14, 1910. The present article is taken from a paper* by Mr. Wilbur J. Watson, M. Am. Soc. C. E., who as consulting engineer for the contractors designed the centering for the main arch. The use of steel centers for the construction of such long span masonry arches had never been tried before. The steel centers for the 150-ft. arches of the Delaware River Bridge of the D., L. & W. Ry. were designed some months later when the centers for the Rocky River arch were well under way in the shop.

Preliminary plans for both timber and steel centers were made, including several types of the latter, and the three-hinged arch was finally decided upon as being the most economical and practicable. Among the advantages which the steel center possessed were, (1) Economy—These centers were estimated to be at least $15,000 cheaper than timber centering of the usual type. (2) Freedom from danger of being carried away by ice. It was evident that these centers would have to be in the river at least one winter and there was great danger of losing them if timber centering of the ordinary type were used. (3) The three-hinged arch is a statically determined structure and it was a simple matter to compute the exact stresses and deflections for each position of the load. (4) The deflection of the hinged arch under load was found to be far less than that of the truss or beam type.

In computing the stresses it was assumed that only the radial component of the vertical weight was to be carried by the steel centers, and that the tangential component would be [illegible] by the timber bows, or by the reinforced concrete struts placed across the keyways. In carrying out the work, both of these provisions were made, the timber bows being of sufficient strength to carry the entire tangential components of the loads, and the reinforced concrete struts were also provided. See Fig. 1. This assumption has been criticized and the best proof of its accuracy is the fact that the observed and computed deflections corresponded precisely, and they would not have done so had not the assumption been correct. The design was computed on the assumption that the arch ring would be concreted in 15-ft. transverse sections, or voussoirs, and it was assumed that a section on one side of the arch might be completed in advance of the corresponding section on the other side. It was also assumed that the placing of the voussoirs might take place in any order, symmetrically about the center. Before checking, however, the order of loading had been determined and the computations were based on the assumption of such order of loading. The centers were designed to be erected in an approximately vertical position, and then lowered into position from the banks. The contractors, however, preferred to erect them on light timber falsework, which was to be removed as soon as the centers were in place. The weight of the steel in the centers was approximately 400 tons, of which about 160 tons were steel I-beams which were afterward used as floor beams in the structure, being placed across the opening between the two arch ribs, transversely to the axis of the bridge, and encased in concrete.

Bolts were used in making all field connections, instead of rivets. This was done in order to facilitate the removal of the centering after the completion of the work. These bolts were turned to a diameter of 29/32 in. and placed in 15/16 in. reamed holes. All holes for field connections were reamed in the field, using pneumatic reamers.

The remarkable economy of the steel centers was in a large part due to the use of such a large portion (40 per cent. in weight) of the steel centering in the permanent structure. The cost was approximately as follows:

Material and fabrication	$2[illegible],000
Freight and erection	[illegible]
Dismantling	1,200
Total	[illegible]
Value of steel I-beams used in permanent structure	[illegible]
Value of remainder of structure as scrap material	2,500
	[illegible]
Net cost of centers	$17,2[illegible]

The above figures, exclusive of wedges, take no account of overhead or engineering charges, nor the cost of timber lagging and moving the centers, the latter being a very small item.

[illegible] for Expansion and Contraction.—The two most troublesome problems to be solved were the provision for expansion or motion due to temperature changes, and the design of the lowering jacks.

It was the original intention of the engineer to wet the steel centers during the pouring and setting of the last key at the crown of the arch in order to prevent the expansion and contraction of the steel centering. As city water, at practically a constant temperature, would be used it seemed that by this means and by using a canvas to protect the steel from the direct rays of the sun, the position of the crown hinge might be kept at a constant elevation for the length of time necessary for the concrete in the key to harden. It was decided, however, that this was not necessary, as the arch was not reinforced and any rise of the center hinge would only serve to open up the voussoir joint at the crown. The last key was, therefore, concreted on a cool day and the surfaces of the two arch sections adjacent to the key were oiled in order to prevent an immediate bond, so that there would be no danger of the key concrete being prematurely loaded; and the joint at the crown was allowed to open and close with the temperature changes. At one time the opening was as great as 5/16 in. The rise and fall of the center hinge was so sensitive to changes of temperature that the Resident Engineer, Mr. A. L. Stevens, stated that he could determine the temperature of the air by measuring the opening. The concrete used in the keys was composed of 1 part Portland cement, 1 part sand and 2 parts broken stone, as it was found by experiment that this mixture would attain as great a strength in 7 days as the concrete used in the arch would attain in 30 days. The rich mix was therefore used in order that the centers might be sooner removed. The first concrete in the main arch rib was placed on Aug. 6, 1909, and the voussoirs were completed on August 30, 1909. The keys were run on Sept. 3 to 9 and the centers were struck on Sept. 28.

The computed deflection of each truss, or half of the steel arch, under full load was 2 ins. and the trusses were cambered this amount. The observed deflection corresponded with this precisely. It is evident that, in the case of a reinforced arch, it would have been necessary to carry out the original intention of wetting down the centers, but it is difficult

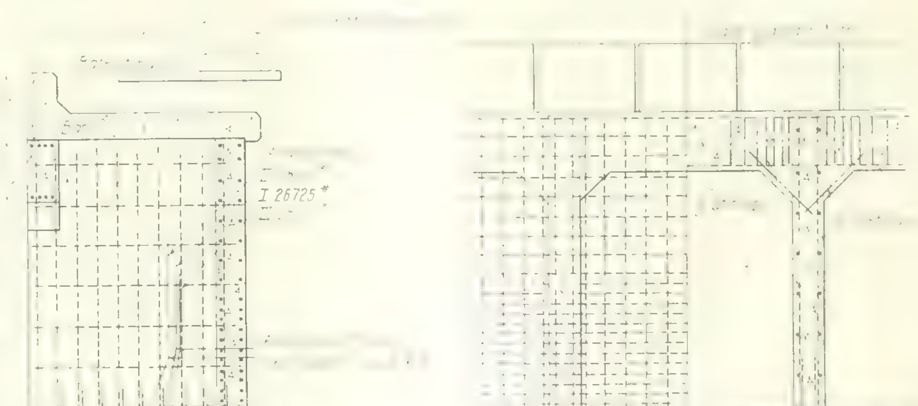

Fig. 9—Special Wall, Designed by W. S. Lacher.

TABLE OF BEARINGS IN LBS. PER SQ. FT.

	Toe.	Heel.
Case I	2[illegible]80	[illegible]
Case II	[illegible]	[illegible]
Case III	2160	2630

Concrete footings, 1.09 cu. yds. at $6.00	$ 6.54
Slabs, .62 cu. yds. at $9.00	5.58
Concrete neatwork, [illegible] cu. yds. at $7.50	[illegible]
Steel, [illegible] lbs. at $0.025	[illegible]
Forms (including slabs), 9.9 sq. yds. at $1.20	11.88
Total cost per lineal ft.	$4[illegible]
Cost of steel per cu. yd.	$1.85
Cost of labor and material, cu. yd.	10.80

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*Abstracted from "Steel Centering Used in the Construction of the Rocky River Bridge, [illegible] Watson, Proc. Am. Soc. C. E., Vol. xxxvii, p. 507.

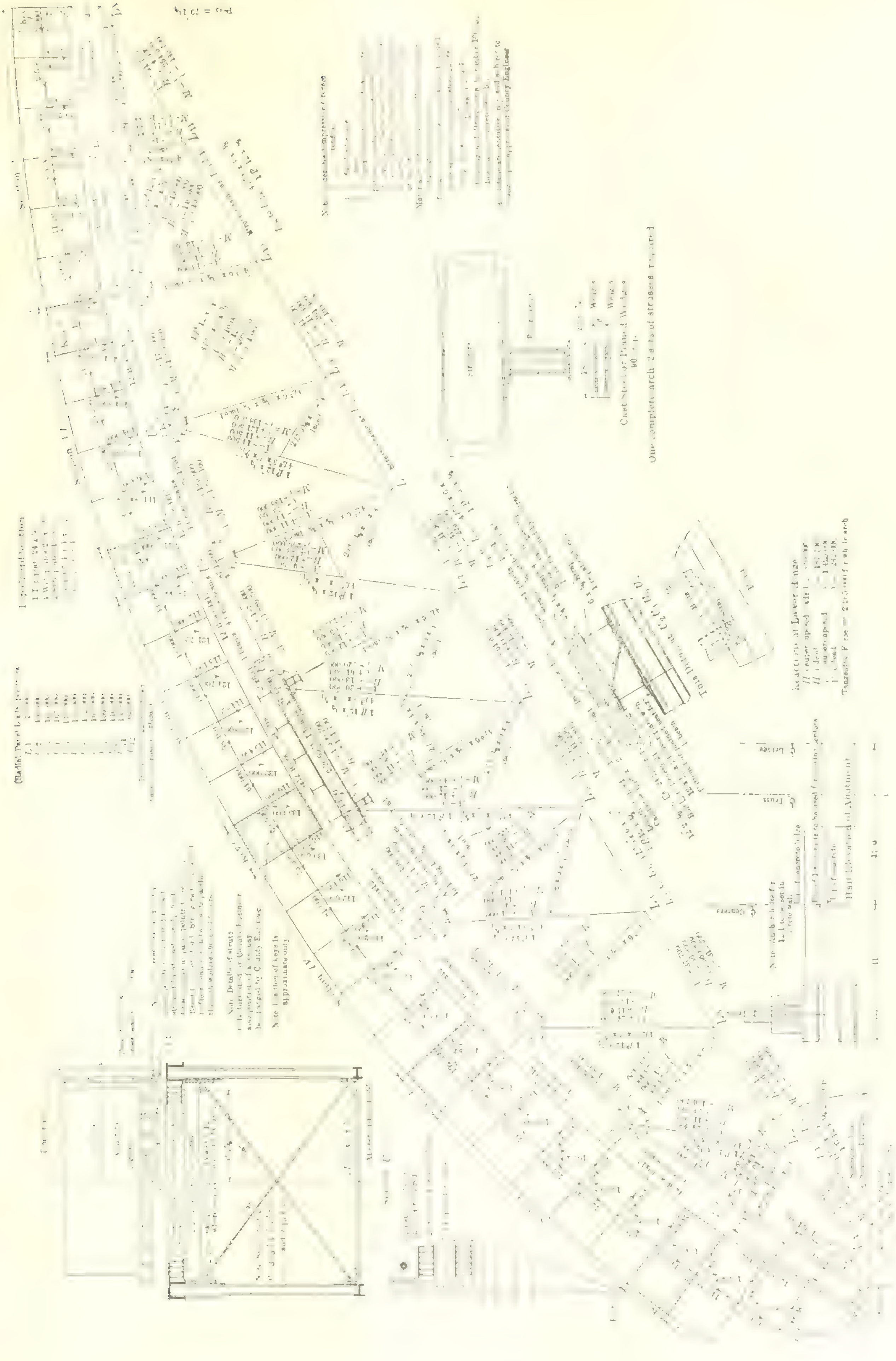
Radial Panel Lengths
This Distance
Half Elevation of Abutment
Cast Steel for Pinned Washers
Note: Details of struts to be furnished by County Engineer
Note: Location of keys is approximate only

Fig. 1—Strain Diagram for Steel Centers for Rocky River Arch.

[illegible] how the principle of center [illegible] of this kind can be defended, because the live load is practically negligible in comparison with the dead load, and the curve of the arch can be adopted [illegible] polygon, thus practically eliminating all bending and [illegible]

The unit stress in the arch rib, due to its [illegible] settlement of the crown when the centers [illegible] curve of the intrados, as constructed, varies from the computed curve less than ½ in. at the point of maximum variation.

Lowering Devices.—It was at first intended to use hydraulic jacks for lowering the centers, and the engineer in connection with the Duff Manufacturing Co. of Pittsburg, worked out a plan for lowering, using 32 jacks in nests of four, each jack having a lowering capacity of 105 tons. Nests of eight were to be operated by a single pump and reservoir. As it would be necessary to lock these jacks, owing to the length of time that they would be called upon to sustain their load in one position, the Duff Manufacturing Co. designed a special locking device which could be released without lifting the ram.

In addition to the hydraulic jacks, the use of sand boxes, screw wedges, and screw jacks was investigated. It was found that the sand boxes were a little cheaper than any of the other devices, but, owing to the fact that these boxes would be immersed in water (as their position was below mean water level), it was thought that it would be practically impossible to keep the sand dry. The sand-boxes, as contemplated, were to be of cast steel, and the cost was but little less than that of double acting screw wedges, which were finally adopted.

The design of these double acting screw wedges, Fig. 3, was suggested by A. M. Felgate, County Bridge Engineer, while looking at the engineer's design for a similar single-acting screw-wedge, and appeared to be exactly what was needed. They were made of carefully annealed cast steel, in four sections, planed on all sliding and bearing surfaces, and very carefully adjusted to uniform height when set in position. The motion allowed was for a vertical drop of 6½ ins. and the slopes calculated so that locking would not be required to hold them under full load. They were lowered by four men on each screw. Each wedge weighed about 1,350 lbs.

Next in cost to the steel wedges were the screw jacks each of which was designed to lower 105 tons and lift 22 tons. The hydraulic jacks were found to be the most expensive, as follows:

Estimated cost of sand boxes	$1,300
Estimated cost of screw wedges	1,650
Estimated cost of screw jacks	2,000
Estimated cost of hydraulic jacks	2,400

Particular attention is called to the high class of shop workmanship required on the centers. The reaming was done with unusual care. The planed joints were required to be perfect. In fact, the workmanship was better than that required for standard railroad bridge work. In view of this, and also of the fact that the structure was free from impact, the engineer is of the opinion that the unit stresses assumed were not unreasonable.

The bridge was built by Cuyahoga County, under the direction of A. B. Lea, former County Engineer, and F. R. Lander, present County Engineer. The structure was designed by A. M. Felgate, County Bridge Engineer. The Contractor was the Schillinger Brothers Company. The Resident Engineer was A. L. Stevens. The centers were built by the Interstate Engineering Co., and the wedges were cast by the Variety Iron Works Co. of Cleveland.

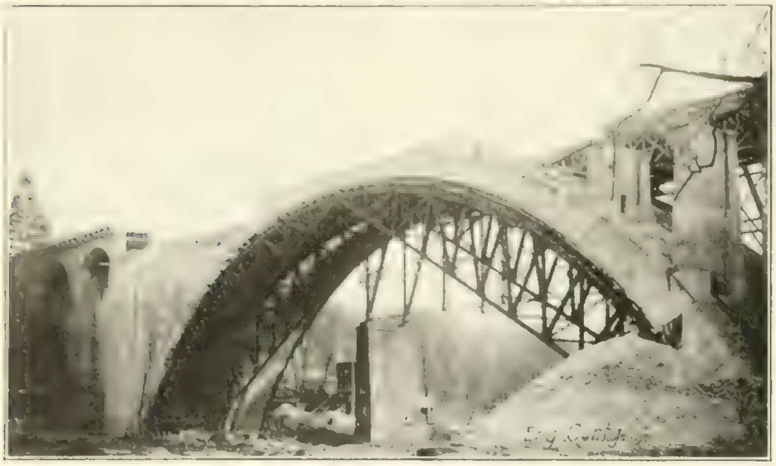

Fig. 2—View of Steel Center and Completed Arches, Rocky River Bridge.

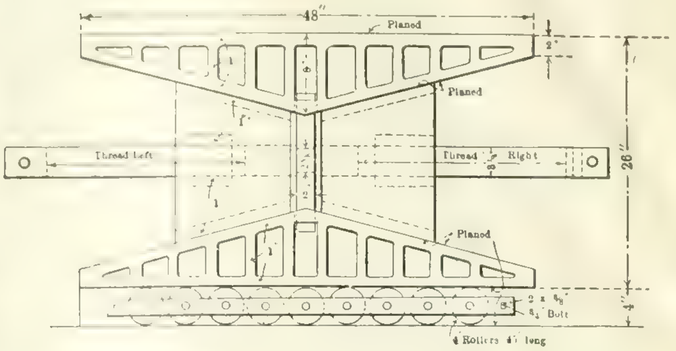

Fig. 3—Lowering Wedge for Centering of Rocky River Bridge.

EARTH AND ROCK SECTION

Progress Records in Driving the Loetschberg Tunnel and a General Description of the Methods of Work.

The headings of the Loetschberg tunnel met some 4½ miles from the two portals on March 31, 1911. This tunnel is 14,535.44 m. (47,676 ft.) or about 9 miles long through rock, and the elapsed time until the meeting of the headings was 1,611 days, from Nov. 1, 1906, to March 31, 1911, giving an average advance of 10 x 6½ ft. heading of 9.2 m. (30 ft.) per day. This progress has never previously been equaled in rock tunnel of comparable length driven from the ends alone. We, therefore, give the progress in detail with some comparisons and a description of the work and of the contractors' methods. The records of progress have been converted into English measure from *Le Genie Civil* for April 15, 1911, and the other data are collated from this and other articles published during the last few years.

Location and Alinement.—The Loetschberg tunnel is located on the new direct route between Milan, Italy, and Berne, Switzerland, of which the Simplon tunnel is a part. It is wholly within Switzerland. As planned the tunnel line was to be tangent throughout as shown by Fig. 1, and 13.735 m. (44,051 ft.) long. When, however, the work from the north portal had advanced to meter 2,675 on July 24, 1908, which was a point directly below the bed of the River Kander, an inbreak of water and earth stopped work and partly filled the heading. A study of the conditions led to the conclusion that it would be impracticable to continue along the original line and a change in alinement was made as indicated by Fig. 1. By this new alinement the tunnel was swung to the east around the danger zone and three curves were introduced and the length between ends was increased to 14,535.44 m., or, including portal extensions, to 14,605.44 m.

The changes in alinement and length involved, of course, corrections in levels, etc., in the original surveys, but the meeting of the headings was, notwithstanding these, remarkably close. The deviation laterally in alinement was 257 mm. (10¼ ins.) and vertically 102 mm. (4.1 ins.), and the difference in computed and measured lengths was 410 mm. (16.4 ins.).

Method of Driving.—The excavated section was 26¼x20 ft. for two tracks and of the general form shown by Fig. 2. The rock penetrated was granite and gneiss. The method of work was to drive first a bottom center heading 10 ft. wide and 6½ ft. high. From this bottom heading an uprise shaft was driven every 600 ft. and from each uprise the top heading was driven. This top heading was widened to full tunnel width and the remainder of the rock removed in successive cuts as indicate by the numerals in Fig. 2. The only timbering required was square sets lagged on top in that portion of the bottom heading from which the roof rock was being removed in enlarging the section. All hauling was done on a single track, with turnouts every 600 ft., on the floor of the bottom heading, which received the spoil from the upper workings by means of chutes as indicated in Fig. 2.

Driving was done by hand until March, 1907, when power was installed at both portals. Compressed air percussion drills mounted on carriages were employed. The carriage or truck carried two horizontal, across-heading shafts on which the drills were mounted by means of collar bearings so that they could be given any inclination desired. The drills used were Ingersoll Rand "F 94" and corresponding sizes of foreign make. Air was furnished at 90 to 100 lbs. by electrically driven compressors. The holes were 2 ins. in diameter and 4 ft. deep and were arranged in four vertical rows. Ordinarily 12 to 15

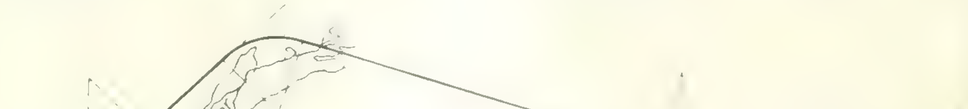

Fig. 1—Diagram Showing Original and Relocated Line of the Loetschberg Tunnel

holes were used but in certain rock the number was increased to 19. The explosive used was 93 per cent dynamite and the blasts were fired by caps and fuse.

In driving heading three 8-hour shifts were worked and each shift was expected to drill and fire two rounds. The mode of procedure was in general as follows: After a round was drilled and loaded a steel plate was laid on the heading floor and the drill carriage hauled back. As soon as the blast was fired mucking was begun removing a center channel through this pile down to the steel plate and wide enough for the drill carriage. The drill carriage was run ahead into this cut on the steel plate as a track and drilling begun while the **remainder of the** muck was being removed. The operations for a single round were about as follows:

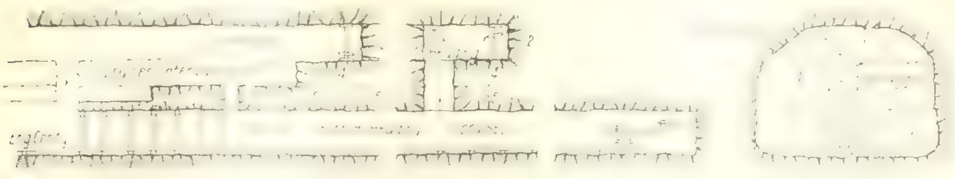

Fig. 2—Sketch Illustrating Method of Excavating Loetschberg Tunnel.

	Mins.
Setting up drill carriage	20
Drilling round of holes	60
Removing drill carriage	20
Loading and firing	30
Clearing out smoke	20
Cut through center of [illegible]	90
Total, 4 hr.	[illegible]

The men worked under a bonus system of payment. All hauling was done by compressed air locomotives.

Progress of Heading. The heading was driven from the two ends and its total length was 14,535.44 m. The progress by approximately monthly periods was as shown by Tables I and II. These figures are represented diagrammatically by the progress curve of Fig. 3. The smoothness of this curve indicating the even rate of advance is notable.

The driving of heading virtually began Nov. 1, 1906, and terminated March 31, 1911, so that the elapsed time from start to finish was 1,611 days. The length of useful heading driven, that is the length of tunnel, was 47,676 ft., so that the average daily advance elapsed time was 29.6 ft. Actually considerably more than 14,535.44 m. (47,676 ft.) of heading was excavated in the time named since a portion of the original heading to the rear of the inbreak from the River Kander was abandoned when the new line was adopted. Counting in this abandoned heading, a total of 15,940 m. (52,283 ft.) of heading was excavated in the elapsed time of 1,611 days, or an average of 32½ ft. per day.

TABLE I.—PROGRESS DRIVING FROM NORTH PORTAL.

Date 1906.	Feet.	Date 1909.	Feet.
Oct. 19	65.6	Jan.	
Nov. [illegible]	36.1	Feb.	
Dec. [illegible]	[illegible]	Mar.	
1907.		April 1[illegible]	758.3
Jan. 19	[illegible]	May [illegible]	[illegible]
Feb. 16	121.4	June [illegible]	825.6
Mar. 16	[illegible]	[illegible]	[illegible]
Apr. 1[illegible]	[illegible]	[illegible]	908.2
May 11	307.0	Aug. [illegible]	808.8
June 15	318.2	Sept.	855.4
July [illegible]	[illegible]	Oct. 23	599.9
Aug. [illegible]	[illegible]	Nov. [illegible]	334.6
Aug. 31	502.5	Dec. 1[illegible]	313.9
Sept. 28	544.8	1910.	
Oct. 26	484.5	Jan. 1[illegible]	[illegible]
Nov. 23	[illegible]	Feb. 12	717.9
Dec. 21	461.5	Mar. 12	754.4
1908.		April 9	772.4
Jan. 18	462.8	May [illegible]	[illegible]
Feb. 15	510.4	June 4	[illegible]
Mar. 1[illegible]	703.9	July 2	762.9
Apr. 11	374.3	July 30	769.8
May [illegible]	[illegible]	Aug. 2[illegible]	761.3
June [illegible]	[illegible]	Sept. 2[illegible]	[illegible]
July [illegible]	[illegible]	Oct. 2[illegible]	[illegible]
Aug.		Nov. 19	792.8
Sept.		Dec. 17	[illegible]
Oct.		1911.	
Nov.		Jan. 14	[illegible]
Dec.		Feb. 11	727.2
		Mar. 11	[illegible]
		Mar. 31	[illegible]

TABLE II.—PROGRESS DRIVING FROM SOUTH PORTAL.

Date. 1906.	Feet.	Date. 1909.	Feet.
Nov. 24	[illegible]	Jan. [illegible]	[illegible]
Oct. [illegible]		Feb. 28	492.0
Dec. 22	112.1	Mar. 13	416.2
1907.		April 10	328.7
Jan. 19	[illegible]	May [illegible]	[illegible]
Feb. 16	[illegible]	June 5	412.6
Mar. 16	[illegible]	July 3	509.7
April 13	[illegible]	July 31	465.8
May 10	322.4	Aug. [illegible]	[illegible]
June [illegible]	337.5	Sept.	[illegible]
July [illegible]	448.4	Oct. 23	453.6
Aug. [illegible]	[illegible]	Nov. [illegible]	[illegible]
Aug. 30	479.2	Dec. [illegible]	[illegible]
Sept. 28	349.7	1910.	
Oct. 26	396.9	Jan. [illegible]	[illegible]
Nov. 23	398.7	Feb. [illegible]	[illegible]
Dec. 21	351.5	Mar. [illegible]	485.1
1908.		April [illegible]	412.9
Jan. 18	434.9	April	523.0
Feb. 17	[illegible]	May	436.7
Mar.		June	432.3
April 11	339.2	July 29	432.9
May [illegible]	498.2	Aug. 27	457.9
June [illegible]	520.9	Sept. 24	[illegible]
July [illegible]	[illegible]	Oct. 22	471.2
Aug. 1	[illegible]	Nov. 19	481.7
Aug. 29	533.9	Dec. 17	[illegible]
Sept. 26	583.8	1911.	
Oct. 24	464.3	Jan. 14	511.8
Nov. 21	444.1	Feb. 28	[illegible]
Dec. 19	490.8	Mch. 11	528.9
		Mar. 31	[illegible]

The actual working time was considerably less than the elapsed time. A total of 48 days is to be deducted for holidays of one sort or another; also work was stopped at the south end for 31 days due to the avalanche at Goppenstein and at the north end for 207 days due to the inbreak of the River Kander. As the two accidents stopped work in one heading only the actual loss of time was one-half the two periods of time given and we have therefore the total of 48+15½+103½=167 days lost time and 1,611—167—1,444 days actual working time. The average advance of useful heading per working day was, therefore, 47,676÷1,444=33+ft. and the lineal feet per day of heading actually excavated was 52,283÷1,444=36.2+ft. These figures include the slow progress made by hand drilling until the power machinery was installed. There were 140 days of hand drilling, during which an aggregate advance of heading of 353 m. (1,158 ft.), or 8.27 ft. per day, was made. Deducting the period of hand work, we get 46,518 ft. of heading driven in 1,304 days, or an advance of 35.67 ft. of useful heading per day of actual working time driving by power. The advance per day of heading actually excavated was 40 ft.

The average advance given is the greatest, counted both by time elapsed and by time actually worked, of any long tunnel ever built. The following is a comparison of advance per day elapsed time converted into English measure from a tabulation in *Le Genie Civil*:

Name of Tunnel.	Length in feet.	Date of holing through.	Duration of work.	Average per day, ft.
Mont Cenis	[illegible]	Dec. 26, 1870	13 yrs. 1 mo.	8.53
St. Gothard	49,148.1	Feb. 29, 1880	7 yrs. 5 mos.	18.40
Arlberg	33,719.6	Nov. 13, 1883	[illegible]	28.04
Simplon	[illegible]	Feb. 24, 1905	6 yrs. 6 mos.	27.81
Tauern	27,081.3	July 21, 1907	6 yrs. 1 mo.	12.79
Loetschberg	47,905.8	Mar. 31, 1911	4 yrs. 5 mos.	29.58

These are all Alpine tunnels and all were driven from the ends only.

The figures of progress given above for the Loetschberg Tunnel are for the bottom heading, 10×6½ ft. alone. At the time this heading was holed through the full section excavation had been completed for 10,083 m. (33,072 ft.) and the concrete lining had been constructed for a length of 9,070 m. (29,750 ft.). The end of 1911 is expected to see the tunnel fully completed.

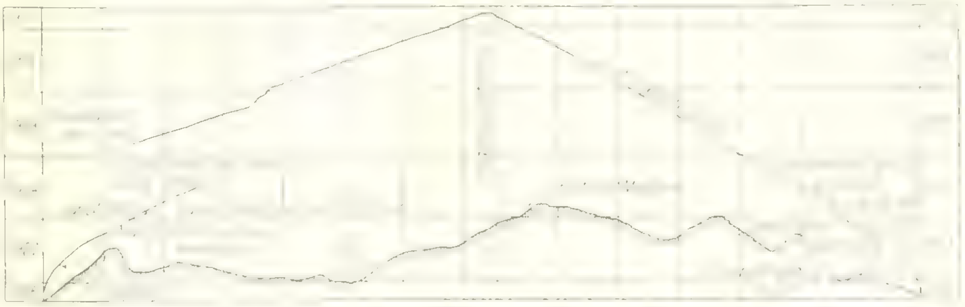

Fig. 3—Curve Showing Progress of Driving Heading, Loetschberg Tunnel.

A Hollow Drill Bit with Side Channel for Ejecting Sludge.

The accompanying sketch illustrates a drill with a hollow chamber running longitudinally through the center to the shank, where it meets the curve to the side. This is described by Mr. Geo. Weston in the *Engineering and Mining Journal*, as having been devised by an Australian by the name of Tippet and it is said that it may result in making it possible to use a one man drill in the mines of the Rand. He conceived the idea of withdrawing the sludge through, instead of forcing water down hollow steel. He intended to bring the sludge right through the machine by means of a suction device which was to be worked by exhaust air.

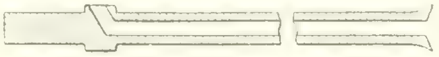

Fig. 1—Hollow Steel Bit With Side Opening.

One day, while using a rose bit, he noted that when the suction was not operating, the drillings were being vigorously ejected. The sludge evidently entered the hollow steel with considerable velocity on the down stroke, the inertia of which was not entirely overcome during the period of the return stroke.

All that is necessary to take advantage of this effect is to employ hollow steel and forge a collar or thickened mass of metal near the shank, then to drill a transverse hole to connect with the central channel at a point just below the chuck.

The steel used with piston drills is 1¼ ins. in diameter, through which passes a ¾-in. channel. The central channel becomes filled with sludge but does not choke with pieces of [illegible] piece.

It has been found in using steel of this construction, that it loses gage less rapidly. A total of 37 ins. of hole was bored by a New Century air-hammer drill in 12 minutes, operating at 55-lbs. pressure, as follows; with 1⅝-in. steel 15¼ ins. of hole; with 1⅜-in. steel 16¾ ins., and with 1⅛-in. steel 5 ins.

The accompanying illustration shows the enlarged part of the drill below the chuck, the transverse and longitudinal passages.

Methods and Some Costs of Constructing a 19,000 Ft. Rock Tunnel for the Strawberry Valley Irrigation Project in Utah.*

The Strawberry Valley Tunnel is part of the Strawberry Valley Irrigation Project undertaken by the United States Reclamation Service. This project when completed will [illegible] land, lying about 60 miles south of Salt Lake City on the east and south shores of Utah Lake, in Utah and Wasatch counties.

The project consists of a large storage reservoir, 30 miles of concrete lined canals for distributing the water to the various irrigation ditches, and a tunnel for the purpose of conducting the water from the reservoir through the rim of the great basin, to the main canal.

The capacity of the reservoir will be 110,000 acre feet of water. It covers an area of 6,000 acres in the great basin and stores the flood waters of Indian Creek, Strawberry River and their various tributaries. The watershed furnishing this water is 200 square miles in extent. The dam across the Strawberry River, necessary to form the above reservoir, will be 45 ft. in height, 325 ft. in length, and 25 ft. wide across the top. The construction work on this dam and reservoir will be started this year, as soon as weather permits.

The water is taken from the reservoir through the rim by means of a tunnel. From the west portal of this tunnel the water will be lowered about 1,500 ft. through the canyon of Sixth Water Creek, thence through Diamond Fork River, and so into the main canal in the valley and from there into the various diversion canals and finally to the irrigation ditches.

The drop of 1,500 ft. through the canyon of Sixth Water Creek may be utilized at a later date for power purposes.

The construction work on these canals has been in progress since 1907.

Preliminary Work.—On account of the great amount of cement to be handled, together with the other necessary supplies, it was found necessary to establish and maintain a railroad station for the exclusive use of the government. This was located about one mile west of Thistle on the main line of the D. & R. G. R. R. in Utah and was named Diamond Switch. A freight house, barn, boarding-house, office, and the necessary living houses for the men employed at this plant are maintained at this station.

On account of the bad road from this station a new road had to be built. This new government road is about 22 miles long and a uniform grade is maintained throughout, the entire rise from the railroad station to the tunnel portal being 1,500 ft. A load of five tons may easily be hauled over this road by 6 horses in one day, without any undue strain on the teams. It is necessary to haul the entire annual supplies during the good weather from June 1 to Oct. 1, as the road, on account of the snow and deep mud, is absolutely impassable with freight wagons during the late fall, winter and early spring. All freight wagons are equipped with tires at least 3½ ins. in width.

A snow fall of 200 ins. was reported at the government station at the west portal of the tunnel between Sept. 1, 1909, and June 1, 1910. The greatest fall was in February, when 42 ins. of snow fell in 48 hours. At this time of the year the construction camp at the west portal is practically snowbound.

The Tunnel.—The east portal of the Strawberry Tunnel is located at an altitude of about 7,500 ft. above sea level and about 1,500 ft. below the crest of the rim of the great basin, which it pierces. This portal is about 32 miles by road from Diamond Switch. The total length of the tunnel is 19,000 ft. A uniform fall of 2 ft. per 1,000 is maintained from the east to the west portal. The general dimensions of the tunnel cross section are 9 ft. 6 ins. in width at the grade line by about 10 ft. in height. The walls from the grade line to the spring line of the arch or invert are vertical and 7½ ft. in height. This tunnel is designed so that inside of the concrete lining it will have a carrying capacity of 500 cu. ft. of water per second at a velocity of about 12 ft. per second. The water will stand 6 ft. 6 ins. in depth to secure this rating.

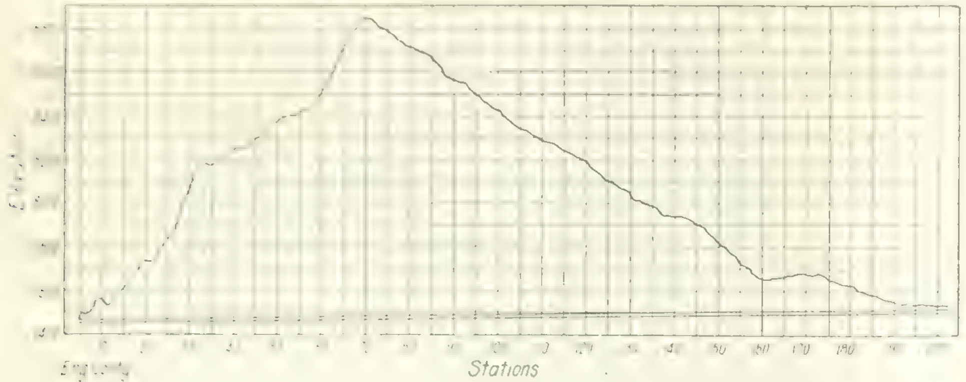

Fig. 1—Profile of the Strawberry Valley Tunnel, United States Reclamation Project, Utah.

At first the tunnel driving proceeded slowly. One shift, only, was worked, and later on two shifts were put at work, in 1907, and finally, in July, 1907, the work was stopped on account of various difficulties, chief of which was the need of power. In order to supply this necessary power, at this point, it was found necessary to install a hydro-electric power plant in the valley. This plant was located near the town of Spanish Fork, Utah, and now furnishes all the power for the construction work and also furnishes the light and power for one or two of the neighboring towns. The cost of this plant is entirely charged out in the footage cost of the tunnel, so that when the tunnel is finished, the plant will be paid for.

The power is generated at 11,000 volts, then stepped up to 22,000 volts, and transmitted over a line about 30 miles in length to the tunnel, where it is stepped down to 2,200 volts.

In 1908, work was resumed with electric rock drills, but owing to difficulties connected with the machinery, work advanced at a slow pace until the early spring of 1909, when these machines were replaced by Sullivan 3¼-in. differential valve air drills.

Up to the present time, the tunnel has only been driven from one heading or from the west portal as originally started. The east end of the tunnel is overlain with wet ground and a portion of it is in very soft rock and mud. This wet ground would all be drained by the tunnel, so that if it should be attempted to drive from the east end, it would necessitate the installation of a heavy pumping plant at this portal. The rise from both portals to the rim of the great basin is so rapid that the vertical distance from the tunnel to the surface is too great to make an intermediate shaft practicable, so that it was impossible to drive headings from an intermediate point.

However, due to the better organization of the tunnel force as the work progresses, driving from only one heading has not involved such a loss in time or expense as at first appeared probable, and the installation of a second plant has not seemed necessary.

Previous to the beginning of the actual construction work, a system of prospect holes was drilled along the tunnel line with Sullivan diamond drills, and an accurate record of the cores kept, so that practically all the difficulties of construction were foreseen and arranged for before the work was begun.

Drilling.—For advancing the tunnel, the heading and bench method is used. The two Sullivan drills are mounted in the heading on two double screw columns with adjustable arms. After each machine runner has finished his half of the drilling in the heading round, he turns his machine up on the arm and drills half of the holes necessary for blasting the bench, thus the entire round of holes necessary for blasting the entire cross section of the tunnel are drilled in one shift and by the same machines.

Fig. 2—View Showing Inflow of 7 Sec. Ft. of Water Into Heading.

Mr. J. L. Lytel describes the method of drilling the holes as follows:

> [illegible] holes are drilled in the face and two in the bench. (See Fig. 5.) The cut holes are drilled 7 ft. deep and the remaining holes, including the holes in the bench, average about [illegible] deep. The heading is driven with a bench [illegible], which is being carried from 10 [illegible] of the face. The strata in the [illegible] and broken to such an extent [illegible] not possible to adopt any definite [illegible] drilling.

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*[illegible] Sullivan Machinery Co., Chicago.

The columns that support the air drills are set vertically and generally from 2½ to 4 ft. apart, and about 4½ ft. back from the face. This gives room for the arms, which support the drills, to be used anywhere on the column. The explosive used is 40 per cent gelatine powder and from 120 to 150 lbs. are required to break a round. The holes are exploded with fuse in the order that they are numbered in Fig. 5. The powder is thawed in the thawing house located outside near the tunnel portal. The heat for thawing the powder is furnished by an electric heater, which gives very satisfactory service. No powder is kept in the tunnel, that required for shooting being brought in by the motorman just before the shift is ready to load the holes.

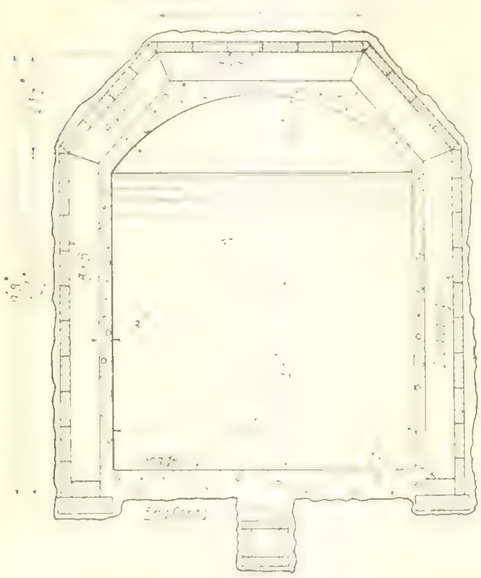


Fig. 3—Section of Tunnel Showing Timbering.

Two machines and one complete column are held in reserve to replace either machine or column in the heading which may at any time need overhauling, so that the entire drill equipment necessary for one heading in this tunnel consists of four drills and three columns.

Table I shows the footage made in the tunnel, operating three shifts per day, in the 20 months from April, 1909, to November, 1910, inclusive. It also shows the number of shifts lost in that time and the reason for their loss.

Beginning in October, 1910, a bonus system was instituted. For each foot over 400 ft. driven during the month the shift boss receives 28 cts., the drillmen and helpers each 23 cts., and the muckers, 16 cts. Besides this a bonus of 1 per cent of the wages of each is paid for each full per cent under 12 per cent **over** breakage. The rates of wages are, for shift boss $4.75 for 8 hours, drillmen $3.50, helpers $2.75 and muckers $2.75.

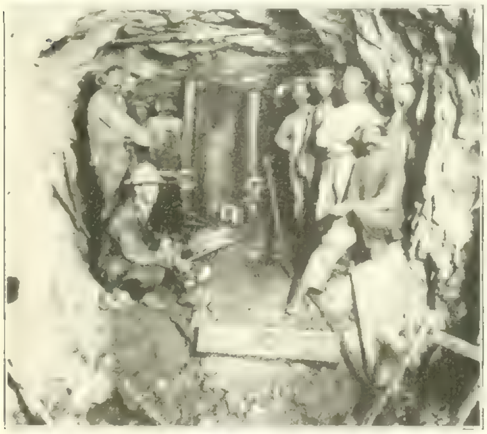


Fig. 4—View of Heading Showing Drilling Outfit.

The rock encountered during the time covered by Table I was practically the same in character, viz, alternate strata of very hard sandstone with very hard blue limestone. The limestone predominating by quite a large percentage. The air pressure used on this work is about 85 lbs. in the heading or as near to that as it can be kept. An air receiver is installed in the pipe line about every 5,000 ft., so that this pressure may be very easily maintained without showing much drop between the compressor house and the heading.

Drill Repairs.—The average cost of drill repairs per foot of tunnel for the completed cross section of the tunnel for 19 months was 17.2 cts. During the month of October, 1910, when the drills had been in use for nearly two years, a government record was kept of the number of times it was necessary to bring a drill out of the heading for repairs. During the 497 ft. of tunnel advance, which was made during this month, machines were brought out of the heading only ten times and most of these instances were for replacing packing.

The cost of drill repairs quoted above consists of the actual cost of drill parts, cost of hose, cost of hose connections, cost of all labor connected with the repairing of the machines, and the freight on the parts, which includes a cost of 50 cts. per 100 lbs. wagon haul from Diamond Switch to Camp Quinton.

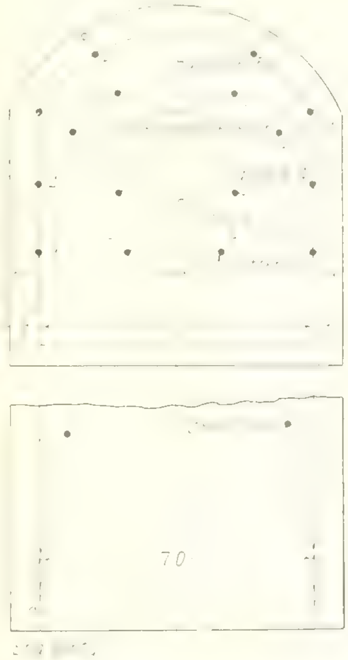


Fig. 5—Arrangement of Holes in Heading and Bench.

It will also be noted that the greatest amount of tunnel advance was accomplished in a month after the machines had been in almost continuous use for a period of nearly two years. Further, an average of over 436 ft. of tunnel advance per month has been maintained during the second year of the life of these machines.

The total force required for the 3 shifts, including the executive force, office force, store, barn, cook house, power house, and underground men, is from [illegible] to 100.

Mucking.—The muck is handled in the heading in the ordinary way and taken out in cars holding 1.7 cu. ft., made up in trains, hauled by a 50-hp. electric locomotive, which weighs about 6,000 lbs.

When these cars reach the dump, they are all dumped by the train crew which hauls them out. This crew consists of two men. The work is accomplished in the following manner: The car bodies are built solid, with two trunions, one on each end of the car, and so placed that when the car is loaded the trunnions are beneath the center of gravity, but when it is empty, the weight of the running gear shifts the center of gravity to a point beneath the line of the trunnion. This permits the cars to be automatically handled and dumped by an ordinary electrically operated stiff legged derrick. The derrick used in this case has a capacity of 10 tons and is shown by Fig. 7 in the operation of lifting a loaded car.

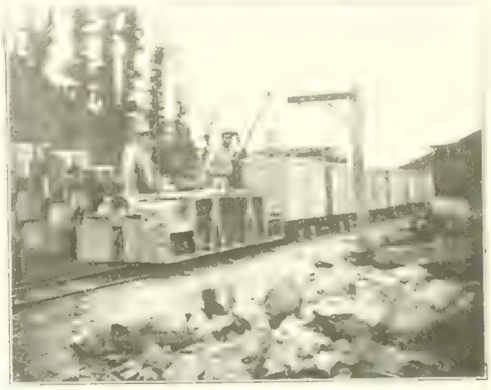


Fig. 6—View Showing Electric Locomotive and Train of Muck Cars.

One leg of the bail which is used for lifting the car is swiveled so that it is free to swing. This facilitates the ease with which it is attached to the car. This leg is also provided with a spring operated pin, which fits a recess in the car above the trunnion. This pin is pulled out of the recess in the car by a short lever. A rope is connected with this lever of sufficient length to reach to the top of the dump when the car is overhanging the point where it is destined to deposit the broken rock, in any particular case. Thus, a loaded car may be lifted from the track by the **derrick** and prevented by the pin from tipping until it is brought to position over the desired point on the dump and then the rope connected with the lever operating this pin may be pulled by the brakeman. Then the car automatically turns over, due to the fact that the center of gravity is above the line of the trunnions. As soon as the car is empty, it automatically rights itself, due to the fact that the line of the center of gravity is then beneath the line of the trunnions.

By this means, the work of at least two men is saved on the dump, without considering the additional safety it gives the men and also the absence of expense due to cars going over the dump.

The derrick is mounted on wheels so that it may be run on a track, when it is necessary to extend the dump from time to time, the derrick [illegible] simply extending the derrick track. It has been found necessary to move this derrick [illegible]

[illegible]

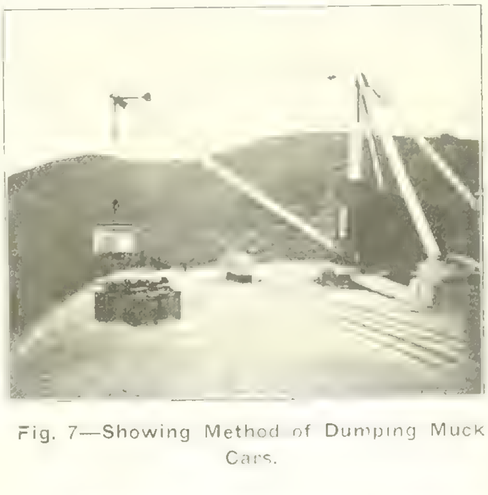


Fig. 7—Showing Method of Dumping Muck Cars.

TABLE I.

[illegible]	Month.	Footage No.	No. shifts lost.	Remarks.
[illegible]	[illegible]	[illegible]		[illegible] to March 15.
[illegible]	[illegible]	[illegible]		3 shifts after March 15.
[illegible]	M[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		[illegible] ground, together with water, [illegible] timbering to be carried on the entire [illegible]
[illegible]	May	[illegible]		
[illegible]	June	[illegible]		Account of installing electric haulage, and celebrating 4th of July.
[illegible]	July	[illegible]	[illegible]	[illegible] and water.
[illegible]	[illegible]	331	[illegible]	
[illegible]	S[illegible]	[illegible]		
1909	October	[illegible]		
[illegible]	November	387		
1909	D[illegible]	[illegible]	[illegible]	Christmas holidays.
[illegible]	January	[illegible]		
1910	February	[illegible]		
[illegible]	M[illegible]	[illegible]		
[illegible]	April	389	[illegible]	[illegible] water.
1910	M[illegible]	[illegible]	[illegible]	Account of building station for blower
1910	J[illegible]	[illegible]	[illegible]	[illegible]
1910	July	377	1[illegible]	Account of holiday on July 4.
1910	August	[illegible]	[illegible]	Account of water.
1910	September	[illegible]		
1910	October	497		
1910	November	[illegible]		
1910	D[illegible]	[illegible]		[illegible] shifts worked. Dec. 27 a flow of 6 sec. ft. of water was encountered.
1911	January	150	..	Water.
1911	February	214	..	7 to 8 sec. ft. of water flowing.

T[illegible] per cent completed March 1, 1911. Total for 26 months, 9,292 ft. Average per month, [illegible]. Average per month for 20 months, working 3 shifts and preceding water trouble 392.2. Average advance per shift for this period, [illegible].28 ft.

the present time is a 40-h.p. Root blower capable of handling 3,000 ft. of air per minute under a pressure of 2 lbs. per sq. in. This blower is placed at the present time in a station 5,000 ft. in from the portal, so that it draws on one side and pushes on the other, through a 14-in. ventilation pipe.

This blower at the present time is run full speed for 26 minutes after each blast and at half speed the balance of the time. Under these conditions, air tests show about 6 to 10 parts of carbon dioxide gas in 10,000 parts of air, which is about what a well ventilated school room will show.

The ventilation pipe is put together, tarred and riveted in 16-ft. lengths, in a separate plaint, maintained for that purpose at the tunnel. The manufacturer simply rolls and properly punches this pipe, then it is nested in 4-ft. lengths and shipped in that manner. This greatly facilitates the handling of the pipe, both on the railroad and also by the freighters on the long haul from Diamond Switch to the tunnel. In addition the ventilation plant maintains itself on the reduction in the actual cost of the pipe.

Outside Equipment.—A complete stone crushing and concrete mixing plant has been constructed and installed at the west portal of the tunnel. The plant is used in the process of constructing the concrete lining of the tunnel. Concreting began in September. During November, 563 lin. ft. of tunnel were lined, and over 2,000 lin. ft. have been completed up to the present writing.

The power plant at the west portal consists of the necessary transformers for stepping down the voltage of the transmission line; a motor generator set for converting the current from alternating to direct current, which is used in the locomotives, derrick, and machine shop; a 15x9x12-in. power driven air compressor, driven by belt from an induction motor.

The carpenter shop maintained at the west portal is equipped with an electric planer, band and crosscut saws.

The machine shop is equipped with a drill press, lathe, pipe cutter and emery wheel.

Where it is necessary to use timbers, a uniform timber section is maintained. The timbers used are 8x8 ins. and placed on 4-ft. centers. The trolley line into the tunnel, instead of being suspended from the roof or the timbers as in ordinary cases, is hung from separate poles, so that as soon as concreting is begun, this work may be continued without interfering with the trolley wire. A 25-lb. rail is used in the track.

The cost of excavation for the month of November, 1910, is given by Mr. J. L. Lytel as follows:

[illegible] FROM WEST PORTAL (ADVANCE DURING MONTH [illegible] FT.)

Classification.	Cost per lin. ft.
L[illegible]—	
[illegible]	[illegible]
[illegible]	[illegible]
Shift bosses	1.[illegible]
Timekeepers	[illegible]100
Drillmen	2.[illegible]
Miners	[illegible]
Muckers	[illegible]
Track and dumpmen	[illegible]
Skinners	[illegible]
Timbermen	[illegible]
Miscellaneous	[illegible]
Materials—	
Powder, fuse and caps	[illegible]
Lumber	[illegible]
Oils, candles	[illegible]
Vent pipe	[illegible]
Track and ties	.523
Air pipe	.219
Drill repairs	[illegible]
Miscellaneous	[illegible]
Machine shop expense	[illegible]
Blacksmith shop expense	[illegible]
Corral expense	[illegible]
Power	[illegible]
Depreciation, tramway plant	.200
Labor—	
Motorman and brakeman	1.080
Electrician and blowerman	[illegible]
Disabled employes	
Equipment depreciation	[illegible]
Camp expense	[illegible]
General expense	[illegible]
Total per lin. ft.	$26.[illegible]

A hospital is maintained and a doctor is constantly available at the camp. A government store for general supplies and groceries is maintained for the convenience of the workmen and their families. For the use of the men during recreation hours, a reading room and also a hall provided with billiard and pool tables are maintained by the government.

Instead of arranging the sleeping quarters for the single men in one large bunkhouse, it has been found much more satisfactory and also much more sanitary to build a number of small houses, some of which only accommodate three or four men, while others provide quarters for ten to sixteen. For families, separate houses are built.

The entire project was 5.5 per cent completed at the close of February, 1911.

The work is under supervision of Mr. J. L. Lytel, Project Engineer. Mr. W. H. Davis is Superintendent in charge of the tunnel work.

In drilling through soft rock, or rock composed of alternate layers of hard and soft material, the cores made by diamond and shot drills are apt to break into short lengths in the core barrel. In the drilling process, these short pieces of core revolve on one another, resulting in the grinding of the ends, so in such cases the core obtained is shorter than the distance drilled through.

Steel Pipes for Water Mains.—At the monthly meeting of the Birmingham (England) Association of Mechanical Engineers, held on March 4, a paper was read on welded steel pipes for water mains. The following synopsis of this paper was furnished by Consul Albert Halstead of Birmingham: "The most important requirement of a pipe was reliability, by which was meant not merely that the pipe must be strong, but that the engineer should have a reasonably good idea of just how strong it was. Mild steel pipes were at once the strongest and most reliable, and were gradually but surely taking the place of cast iron, not only for water but for sewage and gas mains. Another advantage which the lapwelded steel pipe claimed over cast iron was its increased carrying capacity, the smoothness of the bore reducing the friction, known as 'skin friction,' between the fluid and the surface of the pipe. This was an important point frequently overlooked or often underrated, but seeing that the capacity of a pipe of a given bore may be more than doubled by substituting a smooth for a rough interior surface, it would be understood that it was a matter worth careful consideration. The smoother rolled surface of the lapwelded pipe took an excellent coating or protective solution having a hard glossy surface. Added to this the pipe was a smooth cylinder from end to end, as there was a complete absence of anything in the nature of rivets, butt straps or lapped plates. In consequence, the frictional resistance was less, and the velocity and carrying capacity greater with lapwelded than with any other form of pipe. The question of the life of steel pipes had long been the subject of much conjecture, owing to the fact that there was no data on which to base a rule. All that could be said was that the oldest and best known steel pipe lines were, as far as could be ascertained, in as good condition and as free from corrosion now as when they were laid."

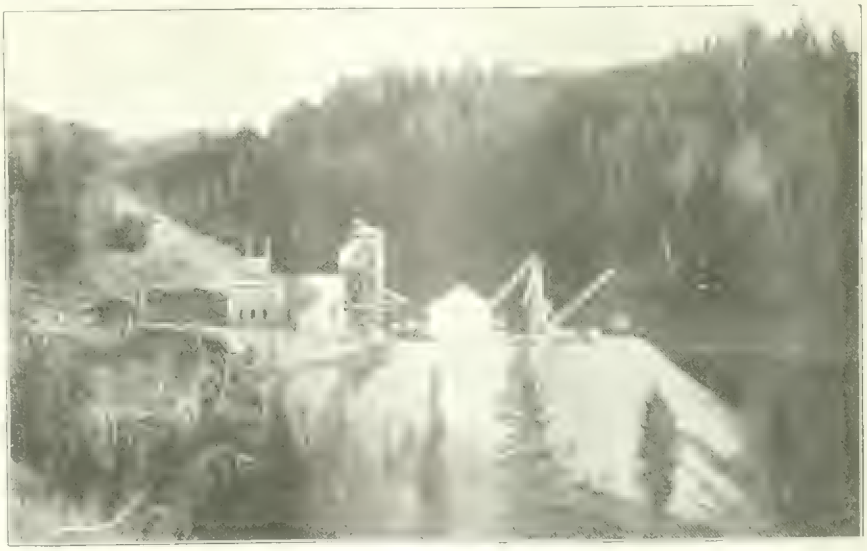


Fig. 8—General View of the Dump and Concrete Plant.

ROADS AND STREETS SECTION

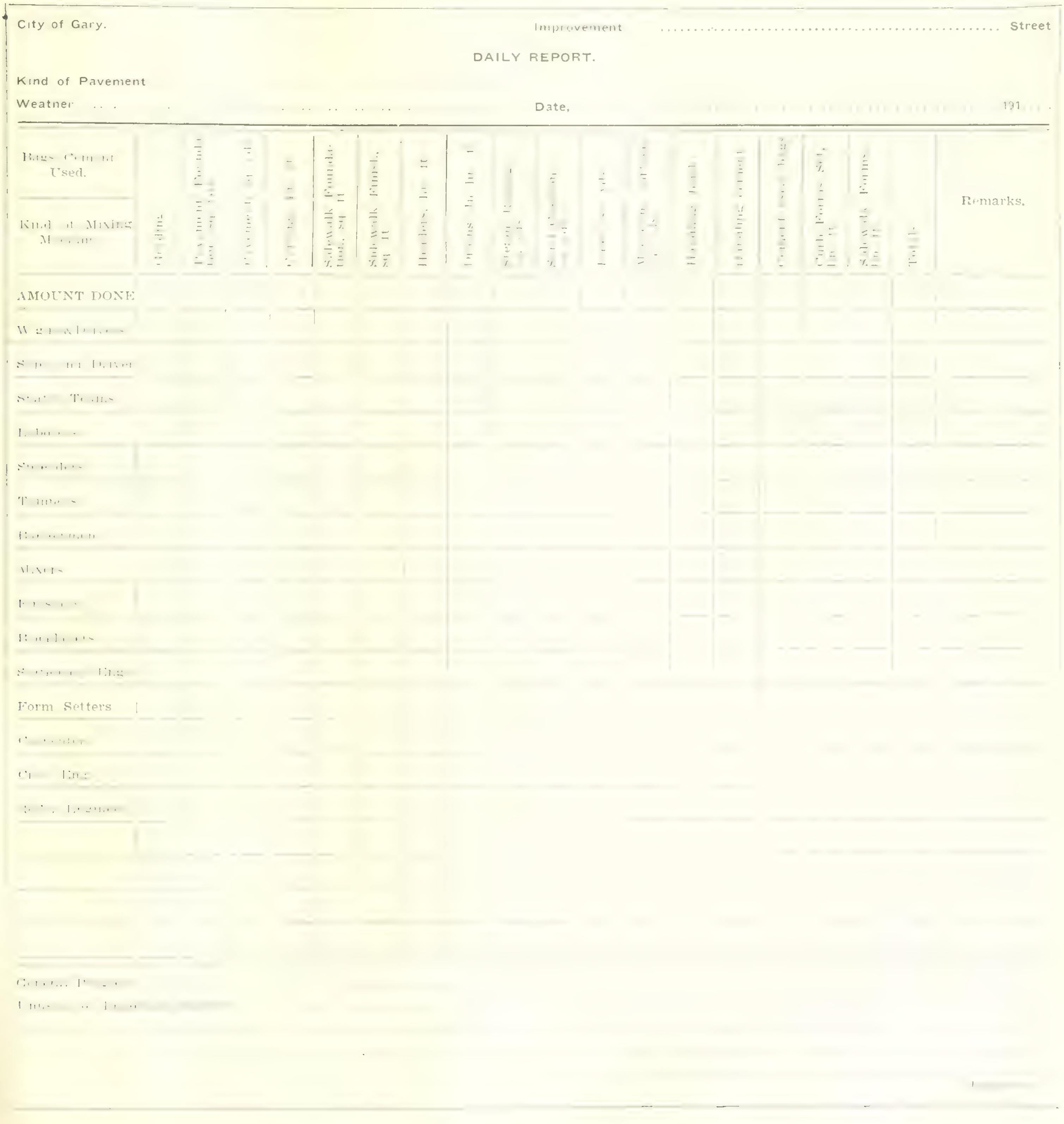
Methods and Cost of Grading, Concrete Curb and Sidewalk Work, and of Macadam and Brick Paving at Gary, Ind., 1908-10.

The general reading public is familiar with the remarkable growth and development of Gary, Indiana. In the spring of 1906 the present site of the city was ordinary uncultivated and unoccupied land, of the sand hill variety. Today Gary has a population of 18,000 people.

This rapid growth in population has been accompanied by prompt attention to street improvements. The entire city was, in a sense, built to order and consequently when street grading started in any given section of the city, sidewalk and pavement construction followed at once. In the majority of cases discussed in this article contracts were let covering a section of street for all operations from grading to paving, including sidewalks, concrete curb, catch basins, and connections.

City inspectors made daily reports on the progress of the work to the City Engineer, Mr. A. P. Melton. The form used in making these reports is here given as Fig. 1. This form of daily report blank was adopted in 1907 and had been in use long enough before the collection of the data given in this article so that the staff of inspectors were thoroughly familiar with it, and all reports were made in a faithful and competent manner. We are indebted to Mr. A. P. Melton, who has been City Engineer of Gary since building first started there, for the data given in this article.

The soil at Gary is wind blown sand from Lake Michigan. Hungarian, Slavish and other south European laborers were employed on all the common labor. The work was all



City of Gary. Improvement .... Street

DAILY REPORT.

Kind of Pavement

Weather .... Date, ... 191 ..

Bags Cement Used.

Kind of Mixing Machine

Grading

Sidewalk Foundation, Sq. ft.

Sidewalk Finish, Sq. ft.

Total

Remarks.

AMOUNT DONE

Form Setters

Fig. 1—Daily Report Form, Gary, Indiana, Street Improvements.

[illegible] man.

Monroe Street.—In the season of 1908 the grading on Monroe St. amounted to 2,637 cu. [illegible] cu. yd. of 24.15 cts., distributed as follows:

		Cost per [illegible] Cts.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Totals	$637.00	24.15

16th Ave., Madison to Monroe.—In the season of 1908 the grading on 16th Ave., from Madison to Monroe, amounted to 417 cu. yds. and cost $274.50. This was a cost of 65.84 cts. per cu. yd. and was distributed as follows:

		Cost per cu. yd. Cts.
Wagons and drivers, 21 days at $5.50	$115.50	27.70
Slips and drivers, 3 days at $5.50	16.50	3.96
Laborers, 66 days at $1.75	115.50	27.70
Foreman, 9 days at $3.00	27.00	6.48
Totals	$274.50	65.84

Alley No. 1 W.—During 1909 the grading on Alley No. 1 West amounted to 3,992 cu. yds. and cost $1,613.25. This was a cost of 40.42 cts. per cu. yd. The dirt was hauled one mile in wagons and placed on the track elevation at the new Union Passenger Station. The cost was distributed as follows:

		Cost per cu.yd. Cts.
Wagons and drivers, 207 days at $5.50	$1,138.50	28.53
Slips and drivers, 4½ days at $5.50	24.75	.62
Laborers, 225 days at $2.00	450.00	11.27
Totals	$1,613.25	40.42

Massachusetts Street.—During 1910 the grading on Massachusetts St. amounted to 2,187.7 cu. yds. and cost $520. This was a cost of 23.75 cts. per cu. yd. and was distributed as follows:

		Cost per cu. yd. Cts.
Wheelers and drivers, 15 days at $6.00	$90.00	4.11
Snatch team and driver, 3 days at $6.00	18.00	.82
Slips and drivers, 16 days at $6.00	96.00	4.38
Wagons and drivers, 21.7 days at $6.00	130.20	5.95
Laborers, 86.9 days at $2.00	173.80	7.94
Foreman, 3 days at $4.00	12.00	.55
Totals	$520.00	23.75

Alley No. 1 West.—During 1910 the grading on Alley No. 1 W. amounted to 250 cu. yds. and cost $88.75. This was a cost of 35½ cts. per cu. yd. Considerable rubbish which had been placed in a low place had to be removed. The cost was distributed as follows:

		Per cu. yd. Cts.
Teams and drivers, 4½ days at $6.00	$27.00	10.8
Laborers, 27½ days at $2.25	61.75	24.7
Totals	$88.75	[illegible]

Adams Street.—During 1910 the grading on Adams Street amounted to 3,751.2 cu. yds. and cost $1,298.80. This was a cost of 34.62 cts. per cu. yd. The grading was light and the average haul was ¼ mile, all through sand. The cost was distributed as follows:

		Per cu. yd. Cts.
Wagons and drivers, 124.2 days at [illegible]	[illegible]	[illegible]
Slips and drivers, 8.5 days at $6.00	51.00	1.36
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Foreman, 22.6 days at $3.00	67.80	1.80
[illegible]	[illegible]	[illegible]
Totals	[illegible]	[illegible]

16th Avenue.—During 1910 the grading on 16th Ave. amounted to 5,857.8 cu. yds. and cost $1,691.50. This was a cost of 28.9 cts. per cu. yd. and was distributed as follows:

		Cost per cu. yd. Cts.
Slips and drivers, 155.5 days at $6.00	$933.00	15.94
Wagons and drivers, 36.5 days at $6.00	219.00	3.74
Laborers, 190.5 days at $2.00	381.00	6.51
Foreman, 49.5 days at $3.00	148.50	2.54
Slip holder, 4 days at $2.50	10.00	.17
Totals	$1,691.50	28.90

10th Avenue.—During 1910 the grading on 10th Ave. amounted to 1,431.6 cu. yds. and cost $355.80. This was a unit cost of 24.85 cts. per cu. yd. and was distributed as follows:

		Cost per cu. yd. Cts.
Wagons and drivers, 16.5 days at $6.00	$99.00	6.91
Teams and slips, 26 days at $6.00	156.00	10.90
Laborers, 48.9 days at $2.00	97.80	6.83
Foreman, 1 day at $3.00	3.00	.21
Totals	$355.80	24.85

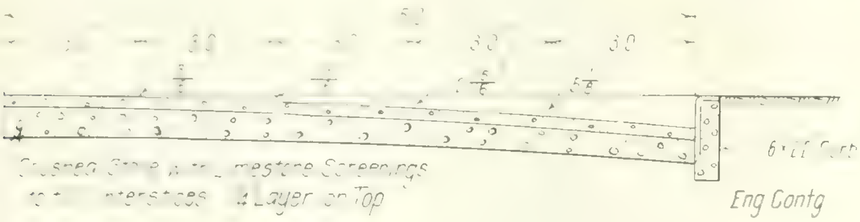

5'0"
3'0"
3'0"
3'0"
3'0"
6"x22" Curb
Crushed Stone with Limestone Screenings to fill Interstices & Layer on Top
Eng Contg

Fig. 2—Section of Standard Macadam Pavement, Gary, Indiana.

CONCRETE CURBING.

Monroe Street.—In 1908, 2,160 lin. ft. of 6x20 in. concrete curb was placed at a cost for labor only of $268.10, all the concrete being mixed by hand. This was a cost of 12.40 cts. per lin. ft. of curb, for labor, distributed as follows:

		Cost, labor, per lin. ft. Cts.
Laborers, 13.5 days at $2.00	$27.00	1.24
Spreaders, 7 days at $2.80	19.60	0.91
Tampers, 9 days at $2.80	25.20	1.17
Mixers, 30 days at $2.80	84.00	3.89
Finishers, 9 days at $5.20	46.80	2.17
Form setters, 10 days at $5.20	52.00	2.41
Foreman, 4.5 days at $3.00	13.00	0.62
Totals	$268.10	12.40

16th Ave., Madison to Monroe.—In 1908, 515 lin. ft. of 6x20 in. concrete curb was placed at a cost for labor only of $86.25, all the concrete being mixed by hand. This was a cost of 16¾ cts. per lin. ft. of curb, for labor, distributed as follows:

Labor.		Cost per lin. ft. Cts.
Laborers, 3 days at $1.75	$5.25	1.02
Spreaders, 3 days at $2.80	8.40	1.63
Tampers, 2 days at $2.80	5.60	1.08
Mixers, 14 days at $2.80	39.20	7.63
Finishers, 3 days at $5.20	15.60	3.03
Formsetter, 1 day at $5.20	5.20	1.01
Form laborers, 4 days at $1.75	7.00	1.35
Total for labor	$86.25	16.75

Alley No. 1 West.—In 1909, 5,573 lin. ft. of 6x16 in. concrete curb was placed at a cost for labor and material of $966.27, all the concrete being mixed by hand. This was a cost of 17.333 cts. per lin. ft. of curb for labor and material, distributed as follows:

Labor.		Cost per lin. ft. Cts.
Laborers, 38 days at $2.00	$76.00	1.365
Spreaders, [illegible] days at $2.80	[illegible]	[illegible]
Tampers, 14.5 days at $2.80	40.60	0.728
Mixers, 63 days at $2.80	176.40	3.168
Finishers, 17 days at $5.20	88.40	1.587
Formsetters, 30 days at $5.20	156.00	2.790
Total	$578.00	10.366
Materials.		
664.9 bags cement at 25c	$166.22	2.983
64.03 cu. yds. sand at $1.50	96.05	1.724
84 cu. yds. stone at $1.50	126.00	2.260
Total	$388.27	6.967

Massachusetts Street.—In 1910, 2,423.7 lin. ft. of 6x22 in. concrete curb was placed at a cost for labor and material of $803.44, all the concrete being mixed by machine. This was a cost of 33.144 cts. per lin. ft. of curb for labor and material distributed as follows:

Labor.		Cost per lin. ft. Cts.
Formsetter, 12 days at $5.85	$70.20	2.896
Helper, 12 days at $3.60	43.20	1.784
Labor, 63.4 days at $3.60	228.24	9.420
Mixer, 21 days at $3.60	75.60	3.120
Finisher, 13 days at $5.85	76.05	3.135
Foreman, 9 days at $5.85	52.65	2.173
Total	$545.94	22.522
Material.		
7.56 cu. yds. granite screenings at $3.50	$26.46	1.092
83 cu. yds. stone screenings at $1.13	93.79	3.870
549 bags cement at 25c	137.25	5.660
Total	$257.50	10.622

Alley No. 1 West.—In 1910, 853 lin. ft. of 6x16 in. concrete curb was placed at a cost for labor only of $103.20, all the concrete being mixed by hand. This was a cost of 12.10 cts. per lin. ft. of curb for labor, distributed as follows:

		Cost per lin. ft. Cts.
Labor, 16 days at $3.15	$50.40	5.915
Finisher, 6 days at $5.20	31.20	3.655
Helper, 6 days at $3.60	21.60	2.530
Total	$103.20	12.100

Adams Street.—In 1910, 5,090.4 lin. ft. of 6x16 in. concrete curb was placed at a cost for labor and material of $1,010.22, all the concrete being mixed by hand. This was a cost of 19.841 cts. per lin. ft. of curb for labor and material distributed as follows:

Labor.		Cost per lin. ft. Cts.
Laborers, 10.6 days at $3.00	$31.80	0.624
Finisher, 22.5 days at $5.20	117.00	2.295
Helper, 18.7 days at $3.20	59.84	1.176
Mixer, 33.2 days at $3.00	99.60	1.956
Labor on forms, 35.5 days at $2.00	71.00	1.395
Formsetter, 12.1 days at $5.20	62.92	1.237
Helper, 9.8 days at $3.20	31.36	0.616
Barrowmen, 18 days at $3.00	54.00	1.061
Foreman, 9.5 days at $5.60	53.20	1.045
Total	$580.72	11.405
Material.		
657 bags cement at 25 cts	$164.25	3.225
185 cu. yds. stone and sand at $1.25	212.75	4.180
15 cu. yds. granite screenings at $3.50	52.50	1.031
Total	$429.50	8.436

16th Avenue.—In 1910, 4,743 lin. ft. of 6x22 in. concrete curb was placed at a cost for labor and material of $2,015.15, all the concrete being mixed by machine. Length of haul 3,500 ft. This was a cost of 42.447 cts. per lin. ft. of curb for labor and material distributed as follows:

Hauling.		Cost per lin. ft. Cts.
Wagons and drivers, 26.5 days at $6.00	$159.00	3.352
Laborers, 17 days at $2.00	34.00	0.720
Foreman, 8 days at $3.00	24.00	0.510
Total	$217.00	4.582
Labor.		
Wagons and drivers, 8 days at $6.00	$48.00	1.020
Laborers, 238.3 days at $3.00	714.90	15.065
Foreman, 26 days at $5.60	145.60	3.075
Mixer, 1 day at $3.00	3.00	0.070
Helper, 18.7 days at $3.20	59.84	1.270
Finisher, 24.5 days at $5.20	127.40	2.690
Formsetter, 20.2 days at $5.20	105.04	2.215
Helper, 20.2 days at $3.20	64.64	1.365
Total	$1,268.42	26.770
Material.		
15 cu. yds. granite screenings at $3.50	$52.50	1.110
225.8 cu. yds. stone and screenings at $1.23	277.73	5.865
798 bags cement at 25c	199.50	4.120
Total	$529.73	11.095

10th Avenue.—In 1910, 2,066 lin. ft. of 6x16 in. concrete curb was placed at a cost of $603.29 for labor and material, all concrete being machine mixed. This was a cost of

29.20 cts. per lin. ft. [illegible] for labor and material, distributed [illegible]:

Labor.		Cost per lin. ft. Cts.
Formsetter, [illegible]	[illegible]	[illegible]
Tampers, [illegible]	[illegible]	[illegible]
Wagons and [illegible] at $5.00	76.80	3.719
Laborers, [illegible]	34.00	[illegible]
Mixers, [illegible]	[illegible]	[illegible]
Finisher, 11.1 days at $5.20	57.72	2.794
Foreman, [illegible]	[illegible]	[illegible]
Total	$425.04	20.579
Material.		
[illegible] granite [illegible]	[illegible]	[illegible]
64 cu. yds. stone and screenings at $1.15	73.60	3.565
[illegible] bags cement at [illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]

Broadway, Sec. 2.—In 1910, 2,828.5 lin. ft. of 6x24 in. [illegible] was placed at a cost of $822.41 for labor and material, concrete mixed by [illegible] part, balance by hand. This was [illegible] cts. per lin. ft. of curb for labor and material, distributed as follows:

Labor. [illegible]		Cost per lin. ft. Cts.
Spreader, 4 days at $3.20	$ 12.80	0.451
Tamper, 7.3 days at $3.00	21.90	0.774
Mixer, 27 days at $3.00	81.00	2.865
Finisher, 19.3 days at $5.20	100.36	3.535
Foreman, 9 days at $5.60	50.40	1.782
Laborers, 6 days at $3.00	18.00	0.636
Barrowmen, 15 days at $3.00	45.00	1.593
Helper, 7 days at $3.20	22.40	0.792
Total	$351.86	12.428
Labor Form Setting.		
Formsetter, 17 days at $5.20	$ 88.40	3.127
Helper, [illegible]	[illegible]	[illegible]
Laborers, 23.5 days at $3.00	70.50	2.493
Total	$171.50	6.071
Materials.		
396 bags cement at 25 cts.	$ 99.00	3.500
154 cu. yds. stone and sand at $1.15	177.10	6.255
65 cu. yds. granite at $3.50	22.75	0.804
Total	$298.85	10.559

The wearing surface, or exposed portions of the curb, was composed of 2 parts Portland cement and 3 parts torpedo sand and was 1 in. thick. All concrete work described in this article was mixed in the proportions of 1 part Portland cement, 3 parts sand, and 5 parts broken stone.

SIDEWALKS.

Monroe Street.—In 1908, 10,602 sq. ft. of concrete sidewalk was placed at a cost for labor only of $281.30, concrete hand mixed. This is a cost of 2.651 cts. per sq. ft. of walk, for labor, distributed as follows: (Walk 5 ft. wide, 4¼ in. base, ¾ in. wearing coat.)

Labor.		Cost per sq. ft. Cts.
Laborers, 9 days at $2.00	$ 18.00	0.169
Spreaders, 8½ days at $2.80	23.80	0.225
Tampers, 9½ days at $2.80	26.60	0.251
Mixers, 35 days at $2.80	98.00	0.925
Finishers, 8½ days at $5.20	44.20	0.417
Formsetters, 11 [illegible]	[illegible]	[illegible]
Foreman, 4½ days at $3.00	13.50	0.127
Total	$281.30	2.651

16th Ave. [illegible]—In 1908, 2,421 sq. ft. of concrete walk was placed at a cost for labor only of $71.70, concrete hand mixed. Walk 5 ft. wide, 4¼ in. base, ¾ in. top. This is a cost of 3.087 cts. per sq. ft. of walk for labor only, distributed as follows:

Labor.		Cost per sq. ft. Cts.
Laborers, [illegible]	[illegible]	[illegible]
Spreaders, 3 days at $2.80	8.40	0.347
Tampers, 3 days at $2.80	8.40	0.347
Mixers, 12 days at $2.80	33.60	1.388
Finishers, 3 days at $5.20	15.60	0.645
Foreman, [illegible]	[illegible]	[illegible]
Total	$ 74.70	3.087

[illegible] concrete walk was placed at a cost for labor and material of $1,283.70, concrete hand mixed. Walk 2½ ft. wide, 4¼ in. base, ¾ in. top. This is a cost of 9.22 cts. per sq. ft. of walk for labor and material, distributed as follows:

Labor.		Cost per sq. ft. Cts.
Laborers, [illegible]	[illegible]	[illegible]
Spreaders, 18 days at $2.80	50.40	0.362
Tampers, 7 days at $2.80	19.60	0.147
Mixers, 71 days at $2.80	198.80	1.427
Finishers, 18½ days at $5.20	96.20	0.690
Formsetters, 5 days at $5.20	26.00	0.187
Laborers, 10 days at $2.00	[illegible]	[illegible]
Total	$417.00	2.999
Material.		
1,167 bags cement at 25 cts.	$291.75	2.095
143.3 cu. yds. sand at $1.50	214.95	1.543
240 cu. yds. stone at $1.50	360.00	2.583
Total	[illegible]	[illegible]

On this work the contractor acted as his own foreman.

Massachusetts Street.—In 1910, 22,699.8 sq. ft. of concrete walk was placed at a cost for labor and material of $1,906.28; concrete machine mixed. Walk 9 ft. 6 in. wide, 4½ in. base, 1 in. top. This is a cost of 8.40 cts. per sq. ft. distributed as follows:

Labor.		Cost per sq. ft. Cts.
Formsetter, 11.4 days at $5.8	$ 66.69	0.294
Helper, 9.5 days at $3.60	34.20	0.150
[illegible]	317.88	[illegible]
Mixers, 25.8 days at $3.60	92.88	0.409
Finisher, 13.7 days at $5.8	80.14	0.353
Foreman, 11.5 days at $5.85	67 [illegible]	0.297
Total	$659.06	2.901
Material.		
52.5 cu. yds. sand at $1.13	$ 59.32	0.261
537.3 cu. yds. stone and screenings at $1.13	607.15	2.675
2,323 bags cement at 25 cts.	580.75	2.563
Total	[illegible]	[illegible]

Washington Street.—In 1910, 9,724.5 sq. ft. of concrete walk was placed at a cost for labor and material of $975.84; concrete hand mixed. Walk 9 ft. 6 in. wide, 5 in. base, 1 in. top. This is a cost of 10.035 cts. per sq. ft., distributed as follows:

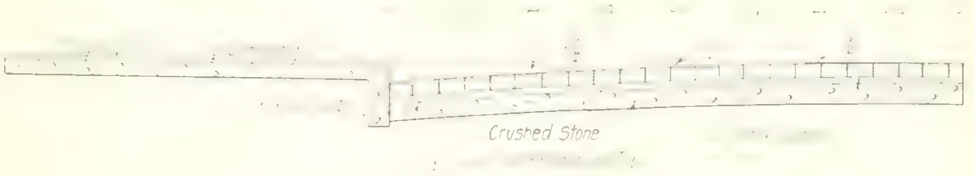


Fig. 3—Section of Standard Brick Pavement on Concrete Foundation, Gary, Indiana.

Labor.		Cost per sq. ft. Cts.
Laborers, 81.5 days at $3.20	$260.80	2.683
Finisher, 13.2 days at $5.85	77.20	0.793
Helper, 20.9 days at $3.60	75.24	[illegible]
Foreman, 15 days at $5.85	87.75	0.903
Total	[illegible]	[illegible]
Material.		
[illegible] bags cement [illegible]	[illegible]	[illegible]
209 cu. yds. sand and stone at $1.15	240.35	2.472
Total	$474.85	4.881

8th Avenue.—In 1910, [illegible] sq. ft. of concrete walk was built at a cost for labor and material of $675.18, concrete machine mixed. Walk 5 ft. wide, 4¼ in base, ¾ in. top. This is a cost of 8.21 cts. per sq. ft and is distributed as follows:

Labor.		Cost per sq. ft. Cts.
Laborers, 45 days at $3.20	$144.00	1.751
Finisher, 8.7 days at $5.85	50.89	0.619
Helper, 9.2 days at $3.60	33.12	0.403
Foreman, 5.2 days at $5.85	30.42	0.370
Total	$258.43	3.143
Material.		
650 bags cement at 25 cts.	$162.50	1.977
225 cu. yds. stone and sand at $1.13	[illegible]	[illegible]
Total	$416.75	5.067

St. John and Sibley Streets.—In 1910, 3,375 sq. ft. of concrete walk was built at a cost for labor and material of $233.86, concrete machine mixed. Walk 5 ft. wide, 4¼ in. base, ¾ in. top. This is a cost of 6.93 cts. per sq. ft., distributed as follows:

Labor.		Cost per sq. ft. Cts.
Laborers, [illegible]	[illegible]	[illegible]
Finisher, [illegible]	[illegible]	[illegible]
Helper, [illegible]	[illegible]	[illegible]
Foreman, 2 days at $5.85	11.70	0.346
Total	[illegible]	3.020
Material.		
248 bags cement at 25 cts.	$ 62.00	1.836
62 cu. yds. stone and screenings at $1.13	70.06	2.074
Total	$132.06	3.910

6th Avenue.—In 1910, 4,934.7 sq. ft. of concrete walk was built, at a cost for labor and material of $475.01, concrete machine mixed. Walk 5 ft. wide, 4¼ in. base, ¾ in. top. This is a cost of 9.63 cts. per sq. ft. distributed as follows:

Labor		Cost per sq. ft. Cts.
Laborers, [illegible]	$142.08	2.878
Finisher, [illegible]	[illegible]	[illegible]
Helper, 7 days at $3.60	25.20	0.514
[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]
Material.		
515 bags cement at 25 cts.	$128.75	2.608
89 cu. yds. stone and sand at $1.15	102.35	2.075
Total	[illegible]	[illegible]

Adams Street.—In 1910, 25,020 sq. ft. of concrete walk was built, at a cost for labor and material of $1,524.86, concrete mixed by hand. Walk 5 ft. wide, 4¼ in. base, ¾ in. top. This is a cost of 6.09 cts. per sq. ft. and is distributed as follows:

Labor.		Cost per sq. ft. Cts
Formsetter, 11.9 days at $5.20	$ 61.88	0.247
Foreman, 12.8 days at $5.60	71.80	0.287
Laborers, 16 days at $3.00	48.00	0.192
Barrowmen, 60.8 days at $3.00	182.40	0.727
Finisher, 16.9 days at $5.20	87.88	0.351
Helper, 20.1 days at $3.20	64.32	0.257
Mixer, 30.2 days at $3.00	90.60	0.362
Tamper, 17.4 days at $3.00	52.20	[illegible]
Total	$658.96	2.630
Material.		
1,987 bags cement at 25 cts.	$496.75	1.985
321 cu. yds. stone and sand at $1.15	369.15	1.475
Total	$865.90	3.460

16th Avenue.—In 1910, 21,826.8 sq. ft. of concrete walk was built, at a cost for labor and material of $2,521.37, concrete machine mixed. This is a cost of 11.56 cts. per sq. ft. and is distributed as follows:

Hauling.		Cost per sq. ft. Cts.
[illegible] and wagons, [illegible] days at $6.00	$333.00	1.526
Laborers, 31 days at $2.00	62.00	0.284
Foreman, 3 days at $3.00	9.00	0.041
Total	$404.00	1.851
Laying.		
Laborers, 196.5 days at $3.00	$589.50	2.703
Finisher, 16.5 days at $5.20	85.80	0.393
Helper, 16.5 days at $3.20	52.80	0.242
Foreman, 13.5 days at $5.20	75.60	0.346
Total	$803.70	3.684
Form Setting.		
Form setter, 14 days at $5.20	$ 72.80	0.334
Helper, 12.5 days at $3.20	42.00	0.192
Total	$114.80	0.526
Material.		
174 cu. yds. sand at $1.23	$214.02	0.983
370 cu. yds. stone at $1.13	418.10	1.917
2,267 bags cement at 25 cts.	566.75	2.599
Total	[illegible]	[illegible]

10th Avenue.—In 1910, 17,035.2 sq. ft. of concrete walk was built at a cost for labor and material of $1,662.51, concrete machine mixed. Walk 9 ft. 6 in. wide, 4½ in. base, 1 in. top. This is a cost of 9.76 cts. per sq. ft. [illegible]

Labor.		Cost per sq. ft. Cts.
[illegible] $6.00	$117.00	0.686
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Finisher, 25.8 days at $5.20	134.16	0.787
Total	$647.76	3.797
Material.		
40 cu. yds. sand at $1.15	$ 46.00	0.271
[illegible] $1.15	188.75	2.873
[illegible]	[illegible]	[illegible]
Total	$1,014.77	[illegible]

[illegible] labor and material of $3,657.80, concrete was mixed by machine, steam power. Walk 16 ft. 6 in. wide, 5 in. base, 1 in. top. This is a cost of 8.25 cts. per sq. ft. distributed as follows:

Labor.		Cost per sq. ft. Cts.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Mixers, [illegible]	[illegible]	[illegible]
Finisher, 59.5 days at $5.20	309.40	0.699
[illegible] $3.00	71.10	0.160
Spreader, 1 day at $3.20	3.20	0.007
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	$[illegible]	[illegible]
Material.		
[illegible]	$[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Total	$[illegible]	[illegible]

MACADAM PAVEMENT

[illegible] standard macadam pavement, which shows the thickness of the two layers. The bottom layer is of broken limestone in no case larger than 3 ins. It was rolled with a 10-ton steam roller. The upper layer is broken limestone from 1 to 3 ins. in greatest dimension. The binder consists of limestone screenings. The screenings were first deposited in a 1 in. layer, sprinkled, and then rolled with a 10-ton roller. This was repeated until a layer of screenings ¼ in. thick was at the wearing surface after further rolling failed to make any impression.

The water used in sprinkling the macadam was furnished free by the city. The cost of steam roller per day includes fuel, oil, and wages of driver. The variation in cost of roller per day from $17.50 to $10 is accounted for by the fact that some contractors rented and others owned the steam rollers used.

Monroe Street.—In 1908 3,400 sq. yds. of macadam pavement was laid at a total cost for labor and material of $1,896.82, average thickness 10 in., average haul 5,000 ft. Unit cost, 55.8 cts. per sq. yd. for labor and material distributed as follows:

		Per sq. yd. Cts.
Wagons and drivers, [illegible] days at $[illegible]	$291.[illegible]	8.[illegible]
Laborers, 94 days at $2.00	188.00	5.[illegible]
Foreman, 12 days at $3.00	36.00	1.07
Steam roller, 14½ days at $15.00	217.50	6.39
Team and sprinkler, 14½ days at $[illegible]	[illegible]	[illegible]
944 cu. yds. stone at $1.13	1,066.82	31.36
Total	$1,896.82	55.80

16th Avenue.—In 1908 931.5 sq. yds. of macadam pavement was laid at a total cost for labor and material of $569.92, average thickness 10 in., average haul 4,500 ft. This is a cost of 61.18 cts. per sq. yd, distributed as follows:

		Cost per sq. yd. Cts.
Wagons and drivers, 21 days at $[illegible]	$11[illegible]	1[illegible]
Laborers, 41 days at $1.[illegible]	71.[illegible]	7.[illegible]
Foreman, 9 days at $3.00	27.00	2.90
Steam roller, [illegible] days at $1[illegible]	45.00	4.8[illegible]
Sprinkler, 3 days at $6.00	18.00	1.93
259 cu. yds. stone at $1.13	292.67	31.41
Total	$569.92	61.18

Massachusetts Street.—In 1910 5,651.3 sq. yds. of macadam pavement was laid at a total cost for labor and material of $3,229, average haul 3,000 lin. ft. This is a cost of 57.15 cts. per sq. yd.

Hauling.		Cost per sq. yd. Cts.
Labor, [illegible]	[illegible]	[illegible]
Teams and drivers, 114.7 days at $[illegible]	[illegible]	[illegible]
Snatch team, 6 days at $6.00	36.00	0.64
Total	$[illegible]	[illegible]
Rolling.		
[illegible]	$[illegible]	[illegible]
Labor, 11.1 days at $2.00	22.20	0.39
[illegible]	[illegible]	[illegible]
Total	$350.80	6.21
Material.		
[illegible]	$[illegible]	[illegible]
Total per sq. yd.		57.15

16th Avenue.—In 1910 9,094.7 sq. yds. of macadam pavement was laid at a total cost for labor and material of $6,359.45. This is a cost of 69.90 cts. per sq. yd. The haul was 3,500 ft. Part of the stone was rejected after it had been placed and the cost of removal is here included. The cost is distributed as follows:

Hauling.		Cost per sq. yd. Cts.
Teams and wagons, [illegible] days at $[illegible]	$1,[illegible]	16.[illegible]
Laborers, 239.9 days at $2.00	479.80	5.27
Foreman, 36 days at $3.00	[illegible]	[illegible]
Total	$2,057.80	22.60
Spreading.		
Laborers, 163.7 days at $2.00	$ 327.40	3.60
Foreman, 8.5 days at $3.00	25.50	0.28
Total	$ [illegible]	[illegible]
Rolling.		
Teams and sprinkler, 14 days at $6.00	$ [illegible]	[illegible]
Engine and roller, 32 days at $10.00	320.00	3.51
16 tons of coal at $4.00	64.00	0.71
Total	$ [illegible]	[illegible]
Material.		
[illegible] cu. yds. broken stone at [illegible] cts.	$2,737.00	30.11
875 cu. yds. screenings at 85 cts.	743.75	8.17
Total	$3,480.7[illegible]	38.28
Total cost per sq. yd.		69.90

BRICK PAVEMENTS ON SAND FOUNDATION

In several cases brick pavements were built on the natural sand base. After the subgrade was prepared it was thoroughly drenched with a fire hose immediately before laying brick. A grout of one part sand to one part cement was used to fill the joints between the bricks. Expansion joints of asphalt filler 1 in. in width were placed next to each curb and about 100 ft. apart across the pavement. In the pavement laid in 1909 on Alley No. 1 West, instead of the 1 in. transverse joint, every 100 ft. of length, five consecutive transverse joints from curb to curb were pitch filled instead of cement grouted.

Alley No. 1 West.—In 1909 7,764 sq. yds. of brick pavement was laid on the natural sand subgrade. The cost for labor and material was $8,463.40, equivalent to $1.09 per sq. yd., distributed as follows:

Subgrade.		Cost per sq. yd. Cts.
Labor, 64 days at $2.00	$ 128.00	1.647
Teams, 3 days at $5.[illegible]	16.[illegible]	[illegible]
Finisher, 10 days at $3.50	35.00	0.450
Total	$ 179.[illegible]	[illegible]
Paving—Labor.		
Labor, 105 days at $2.00	$ 210.[illegible]	[illegible]
Bricklayer, 21 days at $3.50	[illegible]	[illegible]
Total	$ [illegible]	[illegible]
Paving Material.		
7,764 sq. yds. paving brick at 90 cts.	$6,987.60	90.00
Hauling brick per M. at $1.60	524.40	.6.75
454 bags cement at 30 cts.	[illegible]	[illegible]
24 bbls. pitch at $5.00	120.00	1.54
Total	$7,[illegible]	[illegible]
Grouting.		
Labor, 48 days at $2.00	$ 96.[illegible]	1.[illegible]
454 bags of cement at 30 cts.	136.20	1.754
Total	$ [illegible]	[illegible]
Total per sq. yd.		$1.08986

10th Avenue.—In 1910 3,719 sq. yds. of brick pavement was laid on the natural sand subgrade. The cost for labor and material was $3,958.82, equal to $1.06468 per sq. yd., distributed as follows:

Hauling.		Cost per sq. yd. Cts.
Teams and wagons, 21.5 days at $6.00	$ 12[illegible]	[illegible]
Laborers, 86 days at $2.00	172.00	4.624
Total	$ [illegible]	[illegible]
Paving and Grouting Labor.		
Laborers, 70.9 days at $2.00	$ 141.80	3.813
Bricklayer, 28.9 days at $6.00	173.40	4.663
Total	$ [illegible]	[illegible]
Material.		
[illegible] bags cement at 30 cts.	$ [illegible]	[illegible]
3,719 sq. yds. paving brick at 88 cts.	3,272.72	88.000
Total	$3,[illegible]	[illegible]

Adams Street.—In 1910 8,995.3 sq. yds. of brick pavement was laid on the natural sand subgrade. The cost for labor and material was $9,176.86, equal to $1.0204 per sq. yd., distributed as follows:

Hauling.		Cost per sq. yd. Cts.
Wagons and drivers, 32.8 days at $6.00	$ 196.80	2.189
Laborers, 78 days at $2.00	156.00	1.733
Total	$ 352.80	3.920
Laying.		
Laborers, 204.8 days at $2.00	$ 409.60	4.555
Bricklayer, 24.6 days at $6.00	147.60	1.642
Team and rolling, 3.2 days at $6.00	19.20	0.213
Foreman, 17.8 days at $3.00	53.40	0.593
Total	$ 629.80	7.003
Grouting.		
Laborers, 50.2 days at $2.00	$ 100.40	1.117
Bricklayer, 2 days at $6.00	12.00	0.133
Foreman, 5.5 days at $3.00	16.50	0.183
606 bags cement at 25 cts.	151.50	1.685
Total	$ 280.40	3.118
Brick.		
8,995.3 sq. yds. paving brick at 88 cts.	$7,913.86	88.000
Total per sq. yd.		$1.02041

BRICK PAVEMENT ON CONCRETE FOUNDATION

Fig. 3 shows the cross section of brick pavement on concrete foundation used. The average thickness of concrete base is 6 ins.

Broadway, Section 2.—In 1910 6,509.5 sq. yds. of brick paving on concrete base was constructed at a cost for labor and material of $10,261.43, or $1.57595 per sq. yd., distributed as follows:

Hauling.		Cost per sq. yd. Cts.
Wagons and drivers, 80.9 days at $6.00	$ 485.40	7.450
Laborers, 171.3 days at $2.00	342.60	5.255
Foreman, 17.7 days at $3.00	53.10	0.815
Total	$ 881.10	13.520
Concrete Foundation.		
Labor, 442 days at $2.00	$ 884.00	13.580
Tamper, 5 days at $2.00	10.00	0.153
Sta'nry engr., 28.5 days at $3.00	85.50	1.314
Foreman, 23.1 days at $3.00	69.30	1.064
Spreader, 2 days at $2.00	4.00	0.061
Finisher, ½ day at $5.20	2.60	0.040
Total	$1,055.40	16.212
Foundation Material.		
4,083 bags cement at 25 cts.	$ 102.07	1.567
1,085 cu. yds. stone at $1.15	1,247.75	19.150
Total	$1,349.82	20.717
Paving.		
Laborers, 209.3 days at $2.00	$ 418.60	6.430
Bricklayer, 49.9 days at $6.00	299.40	4.595
Foreman, 7.6 days at $3.00	22.80	0.350
Wagons and drivers, 14.9 days at $6.00	89.40	1.373
Total	$ 830.20	12.748
Grouting.		
Laborers, 109.4 days at $2.00	$ 218.80	3.360
Wagons and drivers, 3.7 days at $6.00	22.20	0.341
Foreman, 7.6 days at $3.00	22.80	0.352
611 bags cement at 25 cts.	152.75	2.345
Total	$ 416.55	6.398
Brick.		
6,509.5 sq. yds. paving brick at 88 cts.	$5,728.36	88.000
Total per sq. yd.		157.595

Experience at Baltimore, Md., With Emulsions as Dust Palliatives.*

In Baltimore, Md., after experimenting for several years with both light and heavy oils, it was finally decided that, from the standpoint alone of a dust-layer, an emulsion was efficient and much more economical than any of the heavy oils. Accordingly, during the season of 1910, nothing else was used.

The emulsion was prepared under the specifications of the Street Cleaning Department. The first three carloads of oil ordered in the spring were shipped in iron drums, each containing about 110 gals. These drums were distributed by teams to the various macadam streets. All subsequent quantities of oil were delivered in tank cars, and the drums were used for unloading the cars and for storage purposes. There was quite an appreciable reduction in the freight charges by this method, and it is probable that considerable saving was effected.

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*From the Proceedings of the American Society of Civil Engineers, Vol. xxxvii, p. 343. This is a part of the discussion at the special meeting last January on the subject Road Construction and Maintenance. This description of the use of emulsions at Baltimore was given by Mr. J. L. Wickes, Commissioner of Street Cleaning.

The method of removing the oil from the tank cars and filling the drums was as follows: The yard where the filling was done had a railroad siding which was high enough to allow the oil to flow by gravity through a 4-in. pipe attached to the bottom of the car and empty into the drums. What is known as a tank-car coupling was used on the bottom, and at the coupling the size of the outlet pipe was reduced from 5 to 4 in. Below this there was a short 4-in. nipple, with a 4-in. stop, and a 4-in. bolted flange union. This stop and union were used when the railroad company had to shift the cars, so that the flow of oil could be stopped and the car quickly disconnected. From this union, a 4-in. wrought-iron pipe was laid for a distance of 30 ft., with a 6-in. fall so that the oil could flow freely. At the end of the 4-in. pipe there was a T or cross, and from this there were two 2-in. wrought-iron pipes with stop-cocks, so that two drums could be filled at the same time.

From time to time some difficulty was caused by lumps of asphalt clogging the pipe and impeding the flow of oil; this, however, occurred only in chilly weather. At such times the asphalt base in the oil congealed and formed in large lumps, and it was then found necessary to stir the oil in the car, in order to make it flow freely into the drums. The outlets to these two 2-in. pipes were high enough to permit the drums to be rolled under them, and a large funnel was sometimes used in filling.

There was great difficulty at times in removing the oil from the drums with the siphons, because they became clogged, and there was not sufficient pressure on the plugs to lift the oil from the drums. This was noticed particularly at the low-pressure plugs; at the high-pressure plugs there was no difficulty.

The first application was made with 20 per cent of oil and 80 per cent of water. In the second and subsequent applications the percentages of oil varied from 10 to 5, according to the weather conditions and the amount of traffic on the road. It was found necessary to treat some of the heavy-traffic roads once a week; some of the lighter traveled thoroughfares were treated only once in 2 or 3 weeks, which was found to be sufficient.

The length of [illegible] road treated aggregated about 20 miles, with an area of 441,263 sq. yds., at a total cost of $9,085.63, of which amount $5,583.92 was for oil and $3,501.71 for distribution and application. These two amounts include all the expenditure for this work, with the exception of the water used and supervision. The entire supervision, however, was done by the writer in the course of the discharge of other duties, so that no additional expense was incurred on this account. Hence the cost per square yard was a trifle more than 2 cts. ($0.0206), which is less than one-half the cost of applying any of the oils used in this work.

The fact that not a single complaint was received relative to dust on any of the roads treated as above described is good and sufficient evidence that the work was done well and efficiently.

For the benefit of those who are contemplating the use of an emulsion instead of straight oil for the treatment of roads, a synopsis of the specifications and report of Messrs. Penniman and Browne, the chemists who made the tests of the material, are given:

Specifications for the Compound.—The compound must mix with water to form an emulsion so perfect that it can be applied to roads by an ordinary sprinkling wagon without noticeable separation or clogging of the jets. It must be free from objectionable odor, and must consist of at least 75 per cent of asphaltic oil or base.

This asphaltic base must have the following characteristics:

(1) When 20 grammes of the material are heated for 7 hours in a dish, 2½ in. in diameter, to 205° cent., the weight of the residue shall be at least 65 per cent.

(2) When 20 grammes are heated for 21 hours in a flat-bottomed dish, 2½ in. in diameter, at a temperature of 105° cent., the loss shall not exceed 5 per cent.

(3) The percentage of "free carbon" shall not exceed 3 per cent.

(4) The percentage of paraffin shall not exceed 1½ per cent.

(5) The consistency of the base shall be such that 50 cu. cm. shall flow through an Engler instrument in not less than 185 sec. nor more than 300 sec., at 100° cent.

(6) The consistency shall be such that a Lunge tar tester will sink to the mark, 1.4, in not less than 30 sec., nor more than 45 sec. at 25° cent.

Specifications for the Asphaltic Oil.—These are the same as indicated above, except that the base itself is specified and the following clause is added:

(7) It must form a proper emulsion, using the method of the Street Cleaning Department of Baltimore City.

Method of Making Emulsion Oil.—Dissolve 5 per cent of common resin soap in 30 per cent of water and bring to a temperature of 50° cent. Put this soap solution in a churn and add 65 per cent of oil at the same temperature, churn for 20 min. and run into barrels or tanks through a cooler which reduces its temperature to 21° cent. or less. A portion of the compound prepared in this way must remain unchanged for 48 hours at a temperature of 38° cent. When 20 per cent of the compound is mixed with 80 per cent of water at 32° cent. the emulsion formed must remain without separation for 3 hours.

Theory of the Foregoing Specifications.—The base is specified so that it is sufficiently liquid to be broken up by the paddles of the churn at 50° cent., but, on being cooled to 25° cent., the small particles do not run together, being covered with a film of soapy water. The temperature of 38° cent. is also inserted as an additional practical safeguard to prevent the concentrated emulsion from breaking down before use. The dilution test is introduced for the same reason. The manufacturer of the base is thus compelled to test his product according to the foregoing method of procedure, and shipments are rejected if they are not suitable.

The churning arrangement is not very important, provided the action is that of beating and not merely stirring. A butter churn is efficient, but rather expensive in first cost and power; several paddle wheels attached to the vertical shaft have been found to work efficiently, and are cheaper. A churn having a capacity of from 300 to 500 gals. is a convenient size. The necessary heating tanks are evidently matters of individual requirement, and require no description in detail. The process is most likely to break down through lack of efficient cooling between the churn and the storage tanks. The cooler should be of sufficient capacity to chill the material, and, of course, must be well supplied with water and have proper arrangements for heating and storage. Two men should have no difficulty in making from 8 to 10 batches per day.

WATER-WORKS AND SEWERS SECTION

Cost of Pipe Sewers and Appurtenances in Water Bearing Sand, Gary, Indiana.

During the years 1909-10 three district sewers were laid in Gary, which will be here referred to as Local Sewers Nos. 8, 9 and 10. These sewers were laid, for the most part, in water bearing sand. In some cases water stood in the ground within a foot of the surface. In all cases where water was encountered it was drawn down by pumping. In some cases small hand pumps were sufficient, but in the majority of cases steam power pumps were used.

Suction lines were laid horizontally along the braces and two-way valves were placed in this main every four feet; 1¾-in. well points were driven into the sand with their tops near the water line and their bottoms from 1 ft. to 6 ins. below the grade of the sewer. The points were connected to the suction main at the valves by means of a short piece of flexible hose.

The excavating was done by teams and slip scrapers until the level of the ground water was reached. Below that point, after the water had been pumped out, the excavating was done by hand. The backfilling was done by teams and slip scrapers. The trenches were about 4½ ft. wide and were sheeted in all cases except on about two-thirds of the 12-in. lines in Sewer No. 10 where the cut was small. The cost of backfilling is included in all cases. The labor of sheeting is included unless otherwise stated. The sheeting was all pulled as the backfilling progressed.

This work was all done under competent city inspection. The form of daily report used is here shown as Fig. 1. We are indebted to Mr. A. P. Melton, City Engineer, for the data given in this article.

European laborers were employed on the common labor and all work was done under labor union conditions.

The standard brick manholes, brick catch basins, and concrete gutter inlets, are shown by Figs. 2, 3 and 4, respectively.

LOCAL SEWER NO. [illegible]

747 ft. of 18-in. Sewer.

	Total.	Cost per lin. ft. Cts.
Teams and [illegible] $5.50	[illegible]	[illegible]
Foreman, 19 d[illegible]	57.00	7.63
Laborers, 20[illegible]	[illegible]	[illegible]
Tenders, [illegible]	[illegible]	8.03
Pipe layers, [illegible]	[illegible]	[illegible]
Mixers, 14 d[illegible]	28.00	3.75
Sta. engr., 21 [illegible]	63.00	8.43
Firemen, 21 [illegible]	[illegible]	[illegible]
Pipeline men [illegible]	[illegible]	[illegible]
Water boy, [illegible]	6.00	0.80
747 ft. of 18-in. [illegible]	280.12	37.47
Hauling pipe [illegible]	14.82	6.00
Total	$1,[illegible]	[illegible]

Cost of sheeting trench and coal for boiler are not included in the above. This sewer was laid in water bearing sand. Well points were used for pumping. The average depth of cut was 11.5 ft.; maximum cut 18.0 ft.

	Total.	Cost per lin. ft. Cts.
1,1[illegible] ft. of [illegible]-in. Sewer.		
Teams and drivers, [illegible] days at $5.50	[illegible]	[illegible]
Foreman, 16[illegible] days at $3.00	[illegible]	[illegible]
Laborers, [illegible] days at $2.00	1,1[illegible]	[illegible]
Tenders, 20 days at $2.00	40.00	3.55
Pipe layers, 14 days at $2.75	38.50	3.42
[illegible]	[illegible]	[illegible]
Mixers, [illegible]	[illegible]	[illegible]
Sta. engr., 25 days at $3.00	75.00	6.67
Firemen, [illegible]	[illegible]	[illegible]
Pipeline men, [illegible]	[illegible]	[illegible]
1,1[illegible] ft. of [illegible] pipe [illegible]	[illegible]	[illegible]
Hauling pipe [illegible]	[illegible]	[illegible]
Total	$[illegible]	[illegible]

The cost of sheeting trench and coal for boiler are not included in the above. This sewer was laid in water bearing sand. Well points were used for pumping. The average cut was 11.5 ft. and the maximum cut was 13 ft.

897 ft. of 12-in Sewer, So. of 13th Ave.

	Total.	Cost per lin. ft. Cts.
Teams and drivers, [illegible] $5.50	[illegible]	[illegible]
Foreman, [illegible]	[illegible]	[illegible]
Laborers, 166½ days at $2.00	333.00	37.13
Tenders, [illegible]	[illegible]	[illegible]

Pipe layers, [illegible]	[illegible]	[illegible]
Mixers, [illegible]	[illegible]	[illegible]
Sta. engr., [illegible]	[illegible]	[illegible]
Firemen, [illegible]	[illegible]	[illegible]
Pipeline men, [illegible]	[illegible]	[illegible]
Helpers, [illegible]	[illegible]	[illegible]
897 ft. of 12-in. pipe at 22 cts.....	197.34	21.98
Hauling pipe at [illegible] per ft	[illegible]	[illegible]
Totals	$[illegible]	[illegible]

The cost of sheeting trench and coal for boiler are not included in the above. This sewer was laid in water bearing sand. Well points were used for pumping. The average cut was 13.8 ft., and the maximum cut was 26 ft.

[illegible] Sewer, [illegible] Ave.

	Total.	Per lin. ft. Cts.
Teams and drivers, [illegible] days at [illegible]	$[illegible]	[illegible]
Foremen, [illegible]	[illegible]	[illegible]
Laborers, [illegible]	[illegible]	[illegible]
Tenders, [illegible]	[illegible]	[illegible]
Pipelayers, [illegible]	[illegible]	[illegible]
Mixers, [illegible]	[illegible]	[illegible]
Sta. engr., [illegible]	[illegible]	[illegible]
Firemen, 13 days at $2.25.........	29.25	2.86
Pipeline men, [illegible]	[illegible]	[illegible]
Helpers, [illegible]	[illegible]	[illegible]
1,023 ft. of 12-in. pipe at 22 cts....	225.06	22.00
Hauling pipe at 2½ cts. per ft....	25.57	2.49
Totals	$[illegible]	[illegible]

The cost of sheeting trench and coal for boiler are not included in the above. Well points were used for pumping. The average cut was 13.8 ft., and the maximum cut was 19.8 ft.

10-in catch basin connections. Total length of connections 710 ft.

	Total.	Cost per lin. ft. Cts.
Teams and drivers, 2 days at $5.50	$ 11.00	1.54
Foremen, 1½ days at $3.00........	4.50	0.63
Laborers, 48 days at $2.00........	96.00	13.52
Pipe layers, 6¼ days at $2.75	17.19	2.42
Tenders, 1 day at $2.00............	2.00	0.28
Mixers, 5½ days at $2.00..........	11.00	1.54
710 ft. of 10-in. tile at 16½ cts....	117.15	16.47
Hauling tile at 2 cts. per ft........	14.20	2.00
Totals	$[illegible]	[illegible]

No sheeting was required and no pumping was necessary. The average cuts were as follows:

	Ft.
Average cut for 110 ft	16
Average cut for 110 ft	[illegible]
Average cut for 140 ft	16.2
Average cut for 220 ft	[illegible]
Average cut for 130 ft	[illegible]

11 Brick Manholes. Average depths 11.7 ft.

	Total	Per man-hole
Bricklayers, 102 hrs. at $1.25......$	127.50	$11.58
Tenders, 37 days at $2.00..........	74.00	6.73
Mixers, 10¾ days at $2.00..........	21.50	1.96
Laborers, 1 day at $2.00...........	2.00	0.18
Sta. engr., 1 day at $3.00..........	3.00	0.27
Pipemen, 1 day at $2.00...........	2.00	0.18
22 M. brick at $7.00...............	154.00	14.00
11 manhole covers at $5.00........	55.00	5.00
Totals	$[illegible]	$[illegible]

10 Standard Brick Catch Basins.

	Total.	Per basin.
Bricklayers, 62 hrs. at $1.25	$[illegible]	[illegible]
Tenders, 18¾ days at $2.00........	37.50	3.75
Mixers, 8 days at $2.00	[illegible]	[illegible]
Laborers, 1 day at $2.00...........	2.00	0.20
10 M. brick at $7.00...............	70.00	7.00
10 C. B. covers at $5.00...........	50.00	5.00
250 ft. 10-in. pipe at $0.16½.......	41.25	4.12
10 double Ls and traps at $1.15....	12.50	1.25
Totals ....$	306.75	$30.67

4 Standard Catch Inlets and Connections.

	Total.	Per inlet.
Laborers, 10 days at $2.00.........$	20.00	$5.00
Concrete	10.00	2.50
4 gratings at $2.00.................	8.00	2.00
100 ft. 8-in. tile at 11 cts..........	11.00	2.75
[illegible]	[illegible]	[illegible]
Total	$[illegible]	$[illegible]

2,136 ft. of 6-in. House Connections.

	Total.	Per ft. Cts.
Pipe layers, [illegible] days at $2.75	$[illegible]	[illegible]
2,136 ft. of 6-in. pipe at $0.07½....	160.20	7.50
Hauling pipe at $0.01..............	21.36	1.00
137 12-in. Y's at $0.46.............	63.02	2.95
78 15-in. Y's at $0.60..............	46.80	2.19
[illegible] Y's at [illegible]	[illegible]	[illegible]
267 6-in. stoppers at $0.01.........	2.67	0.13
Total	$[illegible]	[illegible]

All house connections were tunneled from the connection to the lot line. The sewers are in the center of the 12 ft. alleys.

LOCAL SEWER NO. 9.

[illegible] Sewer, on Alley No. 4 West, South of [illegible] Ave.

	Total.	Per lin. ft. Cts.
Foreman, [illegible] days at $3.00 ....$	45.00	[illegible]
Pipe layer, [illegible] days at $2.75	42.62	5.00
Mixer, 13 days at $2.00............	26.00	3.05
Sta. engr., 28 days at $2.50........	70.00	8.22
Firemen, 28 days at $2.25..........	63.00	[illegible]
Pipeline men, 42 days at $2.25.....	94.50	11.08
Laborers, 139½ days at $2.00	279.00	32.72
Tender, 8 days at $2.00............	16.00	1.87
852 ft. of 12-in. pipe at 22 cts......	187.44	21.95
Hauling pipe at 3 cts. per ft......	25.56	3.00
28 tons coal at $4.00..............	112.00	13.14
Total ....$	961.12	112.70

This sewer was laid in water bearing sand. Well points were used for pumping; 20 hp. steam boiler and No. 4 Nye Pumps were used. The average cut was 10.9 ft. the maximum was 11.2 ft.

747 ft. of 18-in. Sewer, on Alley No. 4, South of 13th Ave.

	Total.	Per lin. ft. Cts.
Foreman, 24 days at $3.00.........$	72.00	[illegible]
Pipe layer, 13½ days at $2.75......	37.12	4.97
Mixer, 13½ days at $2.00..........	27.00	3.61
Sta. engr., 14 days at $2.50........	35.00	4.68
Fireman, 21 days at $2.25.........	47.25	6.32
Teams and drivers, 5 days at $6.00	30.00	4.02
Pipeline men, 41 days at $2.25.....	92.25	12.34
Bricklayer, 1 day at $10.00........	10.00	1.34
Laborers, 143 days at $2.00........	286.00	38.28
Sheeting men, 37 days at $2.00..	[illegible]	[illegible]
Tender, 15½ days at $2.00.........	31.00	4.15
747 ft. 18-in. pipe at 37½ cts......	280.12	37.50
Hauling pipe at 6 cts. per ft....	44.82	6.00
14 tons coal at $4.00...............	[illegible]	[illegible]
Total	$1,1[illegible]	[illegible]

This sewer was laid in water bearing sand. Well points were used for pumping; 20 hp. steam boiler and No. 4 Nye Pumps were used. Average cut, 12.3 ft.; maximum cut 16.1 ft. The labor union rules required the presence of a bricklayer on the job.

750 ft. of 15-in Sewer, on Alley No. 4 West, South of 15th Ave.

	Total.	Per lin. ft Cts
Foreman, 27 days at $3.00.........$	81.00	[illegible]
Pipe layer, 13 days at $2.75........	[illegible]	[illegible]
Mixer, 11½ days at $2.00..........	23.00	3.06
Sta. engr., 16½ days at $2.50......	41.25	[illegible]
Fireman, 19 days at $2.25.........	42.75	5.70
Teams and drivers, 1½ days at $6.00	9.00	[illegible]
Pipeline men, 31 days at $2.25.....	69.75	[illegible]
Laborers, 152 days at $2.00........	304.00	40.50
Tender, 14 days at $2.00...........	28.00	3.73
Steam roller, 1 day at $10.00.......	10.00	1.33
750 ft. of 15-in. pipe at 29.7 cts. per ft	222.75	29.68
Hauling pipe at 5 cts. per ft......	37.50	5.00
Total ....$	904.[illegible]	120.56

This sewer was laid in water bearing sand. Well points were used for pumping. A 20 hp. steam boiler and No. 4 Nye Pumps were used. Average cut, 9.7 ft.; maximum cut 13.2 ft.

693 ft. of 12-in. Sewer, on Alley No. 4 West, South of 17th Ave.

	Total.	Cost per lin. ft. Cts.
Foreman, 8 days at $3.00 ....$	24.00	3.46
Pipe layer, 13½ days at $2.75	37.12	5.36
Mixers, 12½ days at $2.00.........	25.00	3.61
Sta. engr., 15½ days at $2.50......	38.75	5.59
Firemen, 20 days at $2.25..........	45.00	6.49
Teams and drivers, 2 days at $6.00	12.00	1.73
Pipeline men, 33 days at $2.25....	74.25	10.72
Laborers, 219 days at $2.00........	438.00	63.20
Tenders, 14 days at $2.00..........	28.00	4.04
[illegible] tons coal at $4.00	62.00	8.95
693 ft. 12-in. pipe at 22 cts........	152.46	[illegible]
Hauling pipe at 3 cts. per ft.......	20.79	3.00
Total ....$	957.37	138.07

This sewer was laid in water bearing sand. Well points were used for pumping. A 20 hp. steam boiler and No. 4 Nye Pumps were used. Average cut, 10.9 ft; maximum cut, 14.5 ft.

220 ft. of 10-in. Pipe Connections for Catch Basins.

	Total.	Cost per lin. ft. Cts.
Pipe layer, 3 days at $2.75........$	8.25	3.75
Laborers, 16 days at $2.00.........	32.00	14.54
Mixers, 3 days at $2.00........	6.00	[illegible]
220 ft. 10-in. pipe at 16½ cts.	36.30	16.50
Hauling pipe at 2 cts. per ft...	4.40	[illegible]
Total ....$	86.95	39.52

GARY.

DAILY REPORT.

..........Sewer No......

Weather...

Date.......... 190 .

Amount Done.	Excavation, lin. ft.	Excavation, cu. yds.	Brick sewers	Brick sewers	10-in. tile	12-in. pipe	15-in. pipe	18-in. pipe	20-in. pipe	Catch basins	Manholes	Sheeting, driving	Sheeting, pulling	Back filling, lin. ft.	Pumping	Orange peel	Hauling brick		Totals	Remarks
Teams with drivers																				
Foremen																				
Laborers																				
Carpenters																				
Form setters																				
Bricklayers																				
Pipelayers																				
Tenders																				
Mixers																				
Stationary engineer																				
Fireman																				
Pumps																				
Pipeline men																				
Helpers																				
Civil engineers																				
Water carriers																				

General progress........

Personal or important matters

....

Engineer in Charge.

FIG. 1.

These connections were all laid in dry sand and pumping was not required. Average cut, 4 ft.; maximum cut, 6 ft.

1,632 ft. of 6-in. House Connections.

	Total.	Cost per lin. ft. Cts.
Pipe layer, 40 days at $2.25	$ 90.00	5.52
1,632 ft. 6-in. pipe at 7½ cts. per ft	122.40	7.50
Hauling pipe at 1 ct. per ft....	16.32	1.00
204 6-in. stoppers at 7 cts....	14.28	0.87
12 10-in. stoppers at 12 cts...	1.44	[illegible]
1 12-in. stopper at 12 cts.......	.12	0.01
Total ....$	244.56	14.98

All house connection were tunneled to the lot line from the sewer in the center of the 12 ft. alleys.

9 Standard Brick Manholes. Average Depth 12.106 ft.

	Total.	Cost per man-hole.
Bricklayer, 10 days at $10.00..	$ 100.00	$11.11
Laborers, 33 days at $2.00...	66.00	7.33
Mixers, 9 days at $2.00......	18.00	2.00
9 manhole covers at $5.00....	45.00	5.00
18 M. brick at $7.00..........	126.00	14.00
81 manhole steps at 20 cts...	16.20	1.80
Total ....$	371.20	$41.24

7 Standard Catch Basins and Connections.

	Total.	Cost per basin.
Bricklayer, [illegible] days at $10.00	$ [illegible]	$7.13
Laborers, 17 days at $2.00........	34.00	4.88
Mixers, [illegible] days at $2.00	10.00	[illegible]

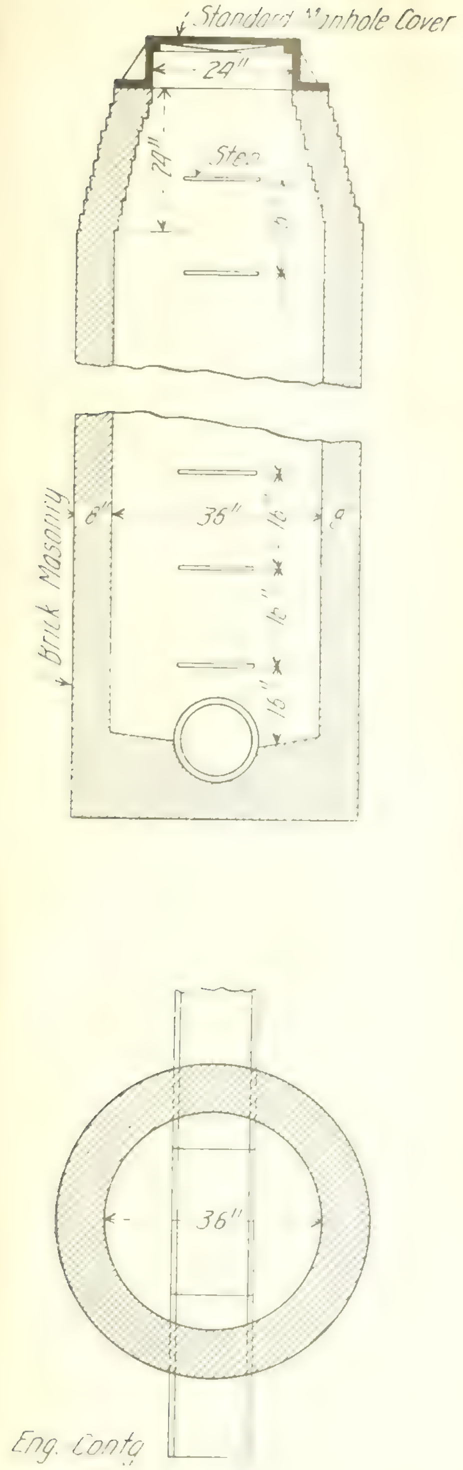

Fig. 2—Standard Brick Manhole for Gary, Indiana, Sewers.

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]

W[illegible]

[illegible]

[illegible]

	Total.	Cost per lin. ft. Cts.
Foreman, [illegible]	12.00	1.14
Laborers, [illegible]	516.00	[illegible]
Pipeline men, 35 days at $2.25	[illegible]	7.53
Bricklayer, 5½ days at $10.00	55.00	[illegible]
Pipe layer, 11 days at $3.00...	33.00	3.15
Tender, [illegible]	[illegible]	[illegible]
Firemen, 27 days at $2.00.....	54.00	[illegible]
Mixers, [illegible]	17.00	[illegible]
Water boy, [illegible]	[illegible]	0.48
1,046 ft. [illegible] per ft.	230.12	22.00
Hauling [illegible] per ft.	26.15	2.49

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]

[illegible] Well points [illegible] maximum cut, 8.4 ft. The labor union rules required the presence of the bricklayer on Sewer [illegible]

[illegible] South of 17th Ave.

	Total.	Cost per lin. ft. Cts.
T[illegible] $6.50	$110.50	14.82
Foreman, [illegible]	[illegible]	[illegible]
Laborers, [illegible]	[illegible]	[illegible]
Pipeline men, [illegible]	[illegible]	[illegible]
Bricklayer, 12 days at $10.00......	120.00	16.07
Pipe layer, 11 days at $3.00.......	33.00	4.42
Tender, 11 days at $3.00..........	33.00	4.42
Firemen, [illegible]	[illegible]	[illegible]
Mixer, 9½ days at $2.00..........	19.00	2.55
Water boy, 12 days at $0.50.......	6.00	0.80
746 ft. of 18-in. pipe at 37½ cts...	279.75	37.47
Hauling pipe at 6 cts. per ft......	44.76	6.00
Rental of boiler and outfit 18 days at $10.00	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]

Water in sand, well points, boiler and pumps as before. Average [illegible] maximum cut, 12.9 ft.

[illegible] ft. of [illegible] Sewer in Alley [illegible] West, South of 17th Ave.

	Total.	Cost per lin. ft. Cts.
T[illegible]	[illegible]	[illegible]
Foreman, 16 days at $3.00.........	48.00	6.40
Laborers, [illegible]	[illegible]	[illegible]
Pipeline men, 36 days at $2.25....	81.00	10.80
Bricklayer, [illegible]	[illegible]	[illegible]
Pipe layer, 14½ days at $3.00....	43.50	5.80
Tender, 13½ days at $3.00........	40.50	5.53
Firemen, 13½ days at $2.00.......	27.00	3.69
Mixer, 11 days at $2.00...........	22.00	2.93
Water boy, 7 days at $0.50........	3.50	0.47
750 ft. of 15-in. pipe at 29.7 cts...	222.75	29.68
Hauling pipe at 5 cts.............	37.50	5.00
Rental of [illegible]	[illegible]	[illegible]
13½ tons of coal at $4.00..........	54.00	7.19
Total	[illegible]	[illegible]

Water removed as before. Average cut, 11.5 ft.; maximum cut, 15.1 ft.

719.5 ft. of 12-in. Sewer in Alley No. 3 West, South of 17th Ave.

	Total.	Cost per lin. ft. Cts.
T[illegible] $6.50	$240.50	33.[illegible]
Foreman, 24½ days at $3.00.......	73.50	10.2[illegible]
Laborers, 207 days at $2.00.......	414.00	57.55
Pipeline men, 27 days at $2.25....	60.75	8.45
Helpers, 20 days at $2.00.........	40.00	5.5[illegible]
Bricklayer, 16½ days at $10.00....	165.00	22.93
Pipe layer, 4 days at $3.00........	12.00	1.67
Tender, 17½ days at $3.00........	52.50	7.29
Fireman, 20 days at $2.00.........	40.00	5.56
M[illegible]	[illegible]	[illegible]
719.5 ft. of 12-in. pipe at 22 cts...	158.29	21.98
H[illegible]	[illegible]	[illegible]
R[illegible]	[illegible]	[illegible]
[illegible] coal	[illegible]	[illegible]
Total	$1,547.53	215.06

W[illegible] 12.8 ft.; mamimum cut, 11.5 ft.

[illegible] 12.106 ft.

		man-hole
[illegible]	[illegible]	[illegible]
Mixers, [illegible]	[illegible]	[illegible]
Laborers, 55 days at $2.00.........	110.00	6.11
36 M. brick at $7.00...............	252.00	14.00
[illegible]	[illegible]	[illegible]
164 manhole steps at 20 cts.......	32.80	1.82
Total	[illegible]	[illegible]

[illegible] tions.

Bricklayer, [illegible]	[illegible]	[illegible]
Foreman, 2 days at $3.00..........	6.00	2.00
Mixers, 2½ days at $2.00.........	5.00	1.67
Laborers, 21 days at $2.00.........	42.00	14.00
[illegible] M. [illegible]	[illegible]	[illegible]
3 cast iron covers at $5.00.........	15.00	5.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]

Well points [illegible]

American Society of Mechanical Engineers.—The [illegible] E. M. Herr, Chairman, Elmer K. Hiles, Secretary, [illegible] in charge [illegible] preparations for the convention of the society, which will be held in Pittsburg, Pa., May 30 to June 2, inclusive, has nearly completed the work of arranging the program for each day during the meeting. It has been settled that the arriving guests will be received and registered at the Hotel Schenley, the society headquarters, on Tuesday morning, May 30. In the evening there will be an informal reception for the members and ladies in the parlors of the hotel. Professional sessions will be held in the lecture hall of the Carnegie Institute, near the headquarters, Wednesday morning and evening, Thursday and Friday morning. In the meantime there will be a number of inspection trips to various industrial plants in the vicinity; a boat excursion for the members and ladies up the Monongahela River, a reception and ball at the Hotel Schenley on Thursday evening and, finally, on Friday evening, a smoker and entertainment given by the Engineers' Society of Western Pennsylvania, in their rooms, in the Oliver Building.

A New Flush Tank Siphon.—An improved automatic siphon has been put on the market by F. Stacy & Sons of Cedar Rapids, Ia. The siphon consists of three plain castings and has no moving parts or joints to be kept tight. The chief feature is that the familiar imbedded deep seal trap is dispensed with. Consequently when a lateral sewer is extended and it becomes necessary to change the old flush tank into a manhole, the flushing apparatus is easily and quickly removed.

Fireproofing a Water Tower.—The tower consisted of four legs 135 ft. long with horizontal struts on all four sides about every 20 ft. The legs and struts were embedded in 3 ins. of concrete at a cost of $4,000 or $3 per lin. ft. of column and struts fireproofed.

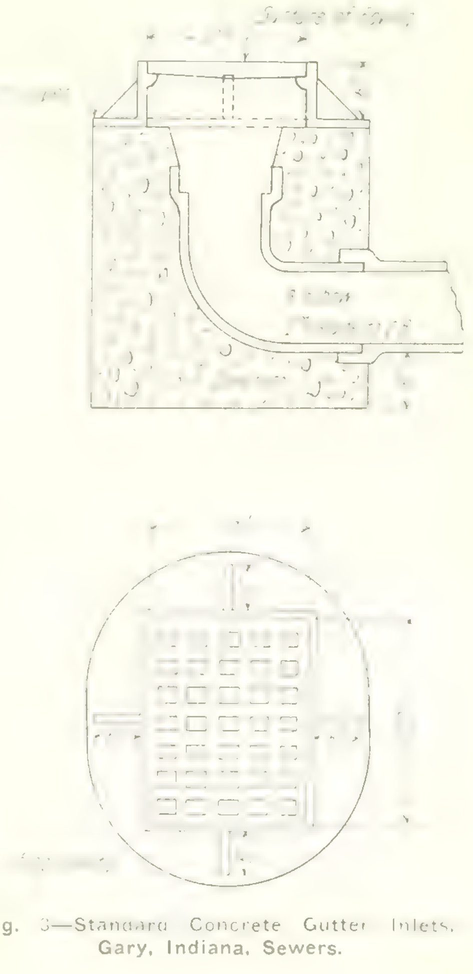

Fig. 3—Standard Concrete Gutter Inlets, Gary, Indiana, Sewers.

DRAINAGE AND IRRIGATION SECTION

A 37-Mile Ditch System for Draining 77,000 Acres of Bottom Lands in Carroll County, Missouri, with Estimates of Cost.

The accompanying map shows one of the largest drainage works that is to be undertaken in the near future in the lower Mississippi valley. Altogether it involves over 2,000,000 cu. yds. of ditch excavation and levee, which, with bridges and collateral works, is estimated to cost some $200,000. The following description of the work is compiled from information furnished by Brooks & Jacoby, Kansas City, Mo., the engineers of the work.

General Description.—Wakenda Creek rises in the eastern part of Ray County, Mo., and flows in a general easterly direction through the southern part of Carroll County, Mo., emptying into the Missouri River near Dewitt. The complete drainage basin of the Wakenda and its tributaries includes about 430 square miles and lies between the Crooked River and Grand River on the west and north and the Missouri River on the south. The upper sections of the valley are narrow, gradually broadening to a width of five to six miles on the lower sections.

The entire area is well settled and may be classed as a rich agricultural territory, at least 60 per cent of which is in a high state of cultivation, wheat, corn, oats and grasses being the staple crops. Many of the low places, lakes and swamps, have been drained by open ditches and in places underdrainage has been begun. The best agricultural lands are worth from $75 to $125 per acre, while other land, which would be just as good if it were protected from overflow, is valued at only $25 to $50 per acre.

The channel of the Wakenda is very crooked, but has a well defined bed, averaging in width from 50 ft. to 75 ft. and from 13 ft. to 18 ft. in depth, and is gradually becoming smaller on account of growing trees sliding down the banks; numerous drifts and bars also cause obstructions which prevent the free flow of the water and tend to increase the height of the floods.

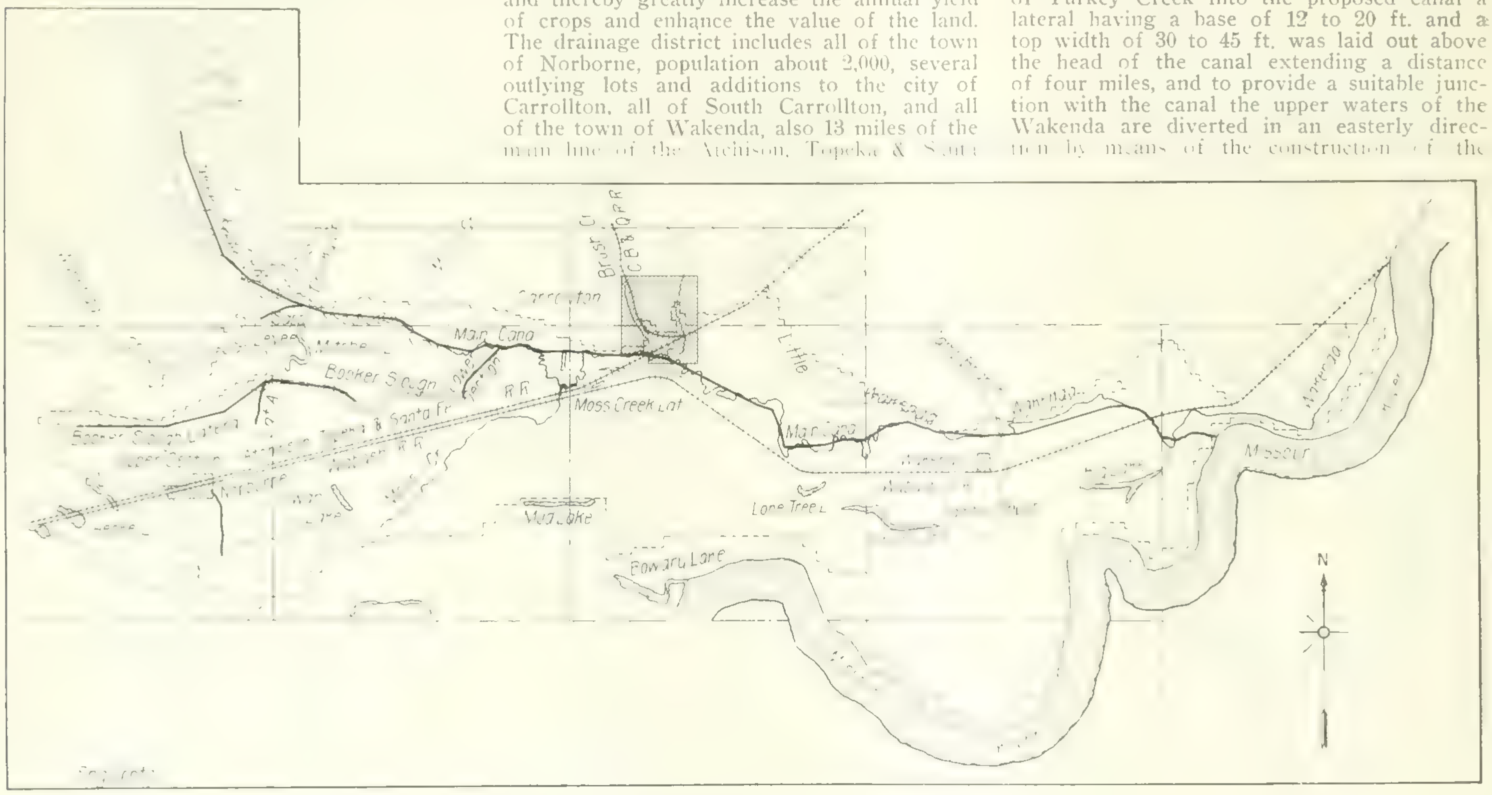

Fig. 1—Map of Ditch System, Drainage District No. 3, Carrol County, Missouri.

[illegible]—The drainage district practically includes all that portion of the bottom lands draining into the Wakenda in Carroll County, comprising in all about 77,000 acres. Perhaps not over 10 per cent of this area is timber land and 20 per cent low, wet and swampy; the remaining portion is in a high state of cultivation, subject to overflows which greatly diminish the average yield. That part of the valley east of Norborne, Mo., is from four to six miles in width, the creek being located well toward the northern part of the valley, and the southern divide between the Missouri River and the creek being near the river and generally not over 3 to 5 ft. in height. The general slope is toward the east and north. That portion of the valley lying south and east of Carrollton, although possessing a very fertile and highly productive soil, is very flat and subject to overflows from the Missouri River and Wakenda Creek. To protect the lands from the high waters of the Missouri several levee districts have been organized and the construction work for the most part has been completed, it now remains to prevent the overflows from the Wakenda and thereby greatly increase the annual yield of crops and enhance the value of the land. The drainage district includes all of the town of Norborne, population about 2,000, several outlying lots and additions to the city of Carrollton, all of South Carrollton, and all of the town of Wakenda, also 13 miles of the main line of the Atchison, Topeka & Santa Fe Ry. and 27 miles of the main line of the Wabash R. R.

Carrollton, the county seat of Carroll County, has a population of over 6,000 and is situated on the hills overlooking the valley about midway between the upper and lower end of the district. Carrollton is known as one of the wealthiest and most substantial towns of its size in the state of Missouri, having three banks with a combined capitalization of $425,000 with over a million and a half in deposits, an $80,000 court house and five miles of brick paving. The lands adjacent to the district possess rich and productive soils. Lands in the Sugar Tree bottoms lying south and west of the district are valued at $200 per acre. The two trunk line railroads above mentioned extending through the district for almost the entire length afford first class accommodations to contractors in the installation of excavating machinery and carrying on the work of construction.

Plan of Drainage.—The plan adopted for the reclamation of the overflow lands consists of straightening and widening the natural watercourse of Wakenda Creek, removing obstructions and cleaning out such portions of the channel as may be utilized; also the construction of several laterals to provide drainage for lands that have sufficient fall but poor outlet. The location of the Wakenda being well toward the foot of the hills makes it is comparatively easy to divert the hill water in this channel and prevent the flood waters from spreading over the low lands. In order to carry out this plan of diverting the hill water and providing an adequate channel for carrying the same, the main canal from its point of beginning to the end was laid out along the entire length of the present creek location instead of cutting an overflow ditch across to the river at some point higher up the valley.

The main canal begins at the junction of Turkey Creek with the Wakenda; these streams meet coming from opposite directions with the result that in time of floods the water piles up and spreads out over the banks, flooding the fertile bottoms lying to the south and east. In order to draw the flood waters of Turkey Creek into the proposed canal a lateral having a base of 12 to 20 ft. and a top width of 30 to 45 ft. was laid out above the head of the canal extending a distance of four miles, and to provide a suitable junction with the canal the upper waters of the Wakenda are diverted in an easterly direction by means of the construction of the "Sapp Levee," which consists of a ditch and levee, the excavated earth being placed on the south side of the ditch so as to form a levee 8 ft. in height having a crown of 6 ft. with side slopes of 1½ to 1. Following along the general course of the creek the main canal finally enters the Missouri River opposite Millers Island, the distance measured along the present channel of Wakenda Creek from its junction with Turkey Creek to its mouth is 40 miles, while the main canal is only 21 miles in length. In the construction of the main canal the excavated earth will be so placed as to make a continuous levee on the south side, sluice ways being provided for branch streams. The levee on the north side of the canal will not be made continuous, openings being left to accommodate numerous creeks and branches from the hills, except on the lower portion, where the levees will be continuous on the north side also, so as to carry the flood water of the Wakenda out over the back water of the Missouri during the June rise.

The work of Booker Slough consists of opening up a natural water course which, through neglect, has [illegible] filled and made inadequate to carry any amount of water in flood times.

Summary of [illegible] of Drainage.—(1) Prevention of the [illegible] from spreading over the low lands. (2) Provision for the carrying through the district water from more than 400 square miles drainage area. (3) The prevention of overflow at the junction of Turkey Creek and Wakenda. (4) Outlet for 14 square miles of land along Booker Slough. (5) Provision for carrying flood water of the Wakenda out over the back water from the Missouri River by means of continuous levees and sluice gates.

[illegible]—On the upper part of the district the soil is black loam and gumbo underlaid with silty clay. Toward the lower portion the soil becomes more sandy and of finer texture.

Quantities and Dimensions of Works.—The construction work comprises a main ditch, 5 laterals and cut-offs and a levee, besides bridges and culverts. The ditches, levee, etc., are as follows: The main ditch is 109,850 ft. (20.8 miles) long and of the following dimensions:

Stations	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

The side slopes are 1 on 1; about 600 acres right of way [illegible] 300 acres are to be cleared. The grades of the ditch will be as follows:

Stations.	Feet per mile.
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The Turkey Creek lateral 21,000 ft. (4 miles) long will be 12 ft. wide and 7 ft. deep to Sta. 110 and 20 ft. wide and 8 ft. deep from Sta. 110 to Sta. 210. About 28 of the total 60 acres of right of way will have to be cleared. The Booker Slough lateral having a total length of over 11 miles will vary from 12 to 14-ft. wide and will be 8 ft. deep. The other laterals aggregate something over a mile of ditch. The levee is 3,830 ft. long, 8 ft. high and 6 ft. wide on top with side slopes of 1 on $1\frac{1}{2}$.

As specifications for drainage ditch work are not readily found in engineering literature we give those prepared for this work as follows:

[illegible] the right of way.

[illegible] of the work.

[illegible] include the clearing of all trees, or other obstructions necessary to be removed in order to [illegible].

The contractor will not be allowed to place any logs, brush or other material taken from [illegible].

The contractor must use due caution not to unnecessarily obstruct any public highway or private crossing or in any way injure private property.

The main canal and laterals to be excavated to a depth as indicated on the profiles, the bottom width and side slopes to be the same as hereinbefore mentioned. All materials excavated [illegible] by the cubic yard.

[illegible] will not be required to be dressed to a smooth surface by hand work.

The earth and other material excavated from the ditches to be deposited on both sides of the ditches so as to form a continuous levee, unless otherwise directed by the engineer in charge of construction.

[illegible] of the ditches and the edge of the waste banks, to be not less than 15 ft. on the main canal, and not less than 10 ft. on the laterals. This berm must be kept clean as nearly as possible as the convenience and the condition of the ground will permit, but it is not expected to be kept clean from slush and the roll in front of the dipper. This roll not to exceed 18 ins. in any event.

The mouth of all ditches, whether open or tile drains, both on the land and on the highways, to be left open and uncovered, unless otherwise ordered or agreed upon. Openings in the waste banks shall also be left at points designated by the engineer, for the purpose of [illegible] tiling.

[illegible] location and width of the ditch and the depth of cutting marked on the stakes. A profile showing [illegible] station, will be furnished the contractor upon request.

Any extra work that may be required by the county court will be paid for upon the estimate of the engineer at the same price as similar work lets for in the general contract.

[illegible] upon his own information as to the character of the material encountered and other physical characteristics.

All materials other than stone will be classified as earth, although stone that may be excavated with a steam dredge without blasting will be classified as loose rock. All stone that requires blasting will be classified as solid rock. Gravel excavated 4 ins. or less in diameter will be classified as earth. Any gravel over 4 ins. in diameter will be classified as loose rock.

Work of constructing the main canal and laterals shall begin within 60 days after the date of letting and to be prosecuted vigorously and continuously so as to be completed within two years from the date of letting.

If any party contracts to do the work in more than one section, or part of this work, his beginning work in any one part of his contract will be considered as beginning all the work; provided [illegible] pleted within the time specified.

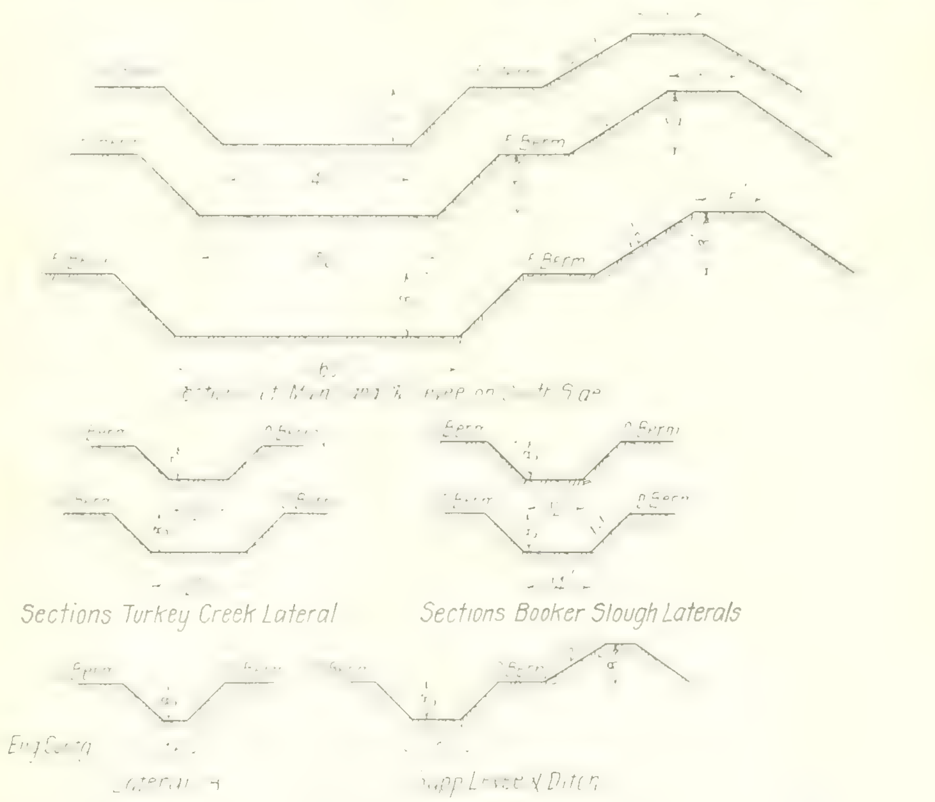
Berm
Berm
Berm
Berm
Berm
Berm
Berm
Berm
Berm
Berm
Sections Turkey Creek Lateral
Sections Booker Slough Laterals
Lateral
Levee & Ditch

Fig. 2—Typical Ditch Sections, Drainage District No. 3, Carrol County, Missouri.

Once each month, or as specified in the contract, the engineer shall examine the work and if found complete according to plans, specifications, contracts and instructions, he shall issue an estimate for the work so completed, showing the amount due, since the last preceding estimate, and shall certify the same to the county court, who shall allow 90 per cent of said [illegible] allowed upon the completion and final acceptance of the whole work, or of each section as may be specified in the contract.

Should the engineer at the time of making [illegible] struction, he shall at once notify the contractor of such deficiencies and the contractor shall proceed to complete the section of the ditch where the deficiency appears and after such compliance by the contractor with the requirements of the engineer, said section shall be [illegible].

[illegible] and restoration of all bridges or culverts and provide for temporary crossings wherever required, on public roads; provided, however, it shall be the duty of the contractor to give such assistance with the dredge, or excavating ma[illegible]

[illegible] work is [illegible] to the grade line as given on the profile, and the contractor shall not be responsible for any defects that may arise in that part of the ditch after that time.

The engineer reserves the right to make alterations in the line, grade or dimensions of the ditches or any part thereof, either before or after the commencement of the work, when such changes are approved by the county court of the county and state above mentioned. If such alterations diminish the quantity of work less than 10 per cent on any individual station, they shall not constitute a claim for damages; if they increase the amount of work, such increase shall be paid for according to the quantity actually done and at prices established for such work under the contract; or in case there is no price established, it shall be paid for at the actual reasonable cost, plus 15 per cent of said cost.

The engineer shall make trips of inspection to all of said work at least once in every two weeks, and at all times he shall keep the center line and right of way staked out. To assist the engineer in staking the center line of said ditches and right of way, and in measuring work the contractor agrees to furnish a competent man.

The contractor shall keep on the work in his absence a competent superintendent or foreman who shall receive orders and instructions from the engineer, and such suprintendent or foreman shall obey said orders or instructions if the same are in regard to the faithful performance of the contract.

Construction and Cost.—The [illegible] canal, Turkey Creek Lateral and Booker Slough Lateral may be constructed with either dredge boats or drag line excavators. In the use [illegible] lem for the contractor will be the maintenance of about a 4-ft. water line in order to successfully operate the boat, and the difficulty for the drag line excavator will be the crossing and recrossing of the present creek channel and the removal of stumps and roots. The smaller laterals and levees may be constructed with dry land machines or teams and scrapers. About 2-3 of the proposed work on the main canal and ½ of the work on Turkey Creek Lateral is in wooded land, only 1-3 of which could be classed as heavy timber. This comprises practically all of the clearing. The cost of clearing has been estimated at $25 per acre. The estimates of the cost of con[illegible]

Main Ditch:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible] per acre	10,000.00

Turkey Creek Lateral:

[illegible]	[illegible]

[illegible]	[illegible]
28 acres of clearing at $25 per acre....	700.00
[illegible] tion:	
[illegible]	[illegible]
[illegible] tion:	
Earth excavation, 25,060 cu. yds. at 8 cts.	2,001.80
[illegible]	[illegible]
[illegible]	[illegible]
One acre clearing........................	25.00
[illegible]	
20,500 cu. yds. exc. in emb. at 10 cts...	2,050.00
[illegible]	
18,000 cu. yds. exc. at 12 cts............	2,160.00
Total	[illegible]

[illegible] bridging for the whole work is estimated at $12,000. Under special agreement the district [illegible] sum of $[illegible] 20-in. tiling to be laid from the east part of the city south about 7,500 ft. to Moss Creek.

Method and Cost of Constructing by Hydraulic Sluicing the Conconully Dam of the Okanogan Irrigation Project, Washington.*

[illegible] Northern Washington, on Salmon Creek, [illegible] of the Okanogan River, which empties into the Columbia River. The dam is part of the Okanogan project of the United States Reclamation Service, intended for the irrigation of 10,000 acres of land along the west bank of the Okanogan River, between the Towns of Okanogan and Riverside. The land lies in benches above the Okanogan River, which has too flat a grade to serve as a source of supply. The water, therefore, is derived from the Salmon Creek, and as the midsummer flow is very small, the storage of flood flow was necessary.

Part of the needed storage (1,800 acre-ft.) is found in utilizing Salmon Lake, situated in a side canyon just above the main reservoir. The main storage was created by the Conconully Dam, the principal features of which are as follows:

Greatest height above bottom of creek, [illegible]	[illegible]
[illegible]	[illegible]
Length of crest of dam, ft..................	1,010
[illegible]	[illegible]
[illegible]	180
[illegible]	[illegible]
[illegible]	1
[illegible]	[illegible]
[illegible] acre-ft.	13,000
Required capacity of outlet works, sec-ft.	100
[illegible]	[illegible]
Drainage area above dam, sq. miles.......	113

Reservoir Site.—The dam is 15 miles above mouth of Salmon Creek and immediately below the junction of the two forks called the North and West Forks, as shown by Fig. 1. The water in the reservoir fills a basin with a high-water area of 460 acres, the water backing up to the limits of the Town of Conconully. The reservoir is surrounded by mountains on all sides except to the east where an extensive gravel bar exists, which is probably a glacial moraine.

The reservoir bottom consisted of meadows, and was covered with thick brush, which has been slashed and burned. The surface soil is a black sandy loam for a depth of 4 or 5 ft., below which the sand gradually becomes cleaner, deeper layers occasionally showing coarser material, the rock being at unknown depth both in the reservoir bottom and at the dam site, where soundings were continued to a depth of 95 ft.

The dam is at the outlet of the valley, where it contracts to a width of about 1,200 ft., the gap being further reduced by a low mountain spur from the west, leaving an opening, about 1,000 ft. long, to be closed by the dam, the spur serving the purpose of a spillway by being cut down for a width of 180 ft. to the proper elevation. The formation of the hillsides is a close, heavy granite, but in the above mentioned spur this granite merges into limestone of a rather soft and seamy character.

Design of Dam.—The total height above the valley bottom to which the water was to be raised is about 50 ft. The foundation could not be made water-tight, and the design simply aimed at a retardation of the percolation by providing a broad base to the dam due to flat slopes, and by driving a row of sheet-piling, running across the valley, joining the rock slopes at both ends.

Materials Available.—The following materials were available for dam construction: (1) Fine sandy loam near the surface, in the valley bottom, principally to be found up stream from the dam; (2) gravel and sand from the gravel bar to the east of the reservoir, at a distance of from 2,000 to 5,000 ft.; (3) talus material on the west mountain side, just below the dam, consisting of sand and silt from the disintegration of the granite rock, mixed with angular rock fragments of sizes from a man's fist to a cubic yard.

The latter material was selected as that most suitable for the dam, in connection with the method of construction to be followed.

The location of the dam is quite remote, the nearest railroad station being Wenatchee, Wash., 105 miles distant, from which material can be shipped by river steamer to Brewster, whence the wagon haul over mountain roads to the work is 45 miles.

The country affords practically no local labor, and for machine repairs it would be necessary to send to Spokane, Seattle, or Portland. Thus it was desirable to depend as little as possible on mechanical equipment, and to utilize the local resources to their maximum extent. The use of the valley bottom material would have implied the installation of pumping machinery, in connection with either hydraulic or mechanical means of transportation, as the ground-water was close to the surface. Gravel and sand, obtainable from the gravel bar on the east side of the reservoir, would have necessitated the importation of a steam shovel, and probably railroad equipment. The material available on the steep mountain side above mentioned could be had at practically any elevation, and could be moved by the hydraulic process. Water was available in the West Fork of Salmon Creek by diversion through a 3-mile flume, the creek flow being 50 sec-ft. and more during April, May, and June, and gradually dropping to 10 sec.-ft. in August and September.

The pit material, as revealed by numerous test-pits, appeared to contain a sufficient proportion of silt for producing a tight core. Consequently, the hydraulicking process was adopted, and the dam was designed in accordance therewith, the plan and sections being shown on Fig. 2 to 4.

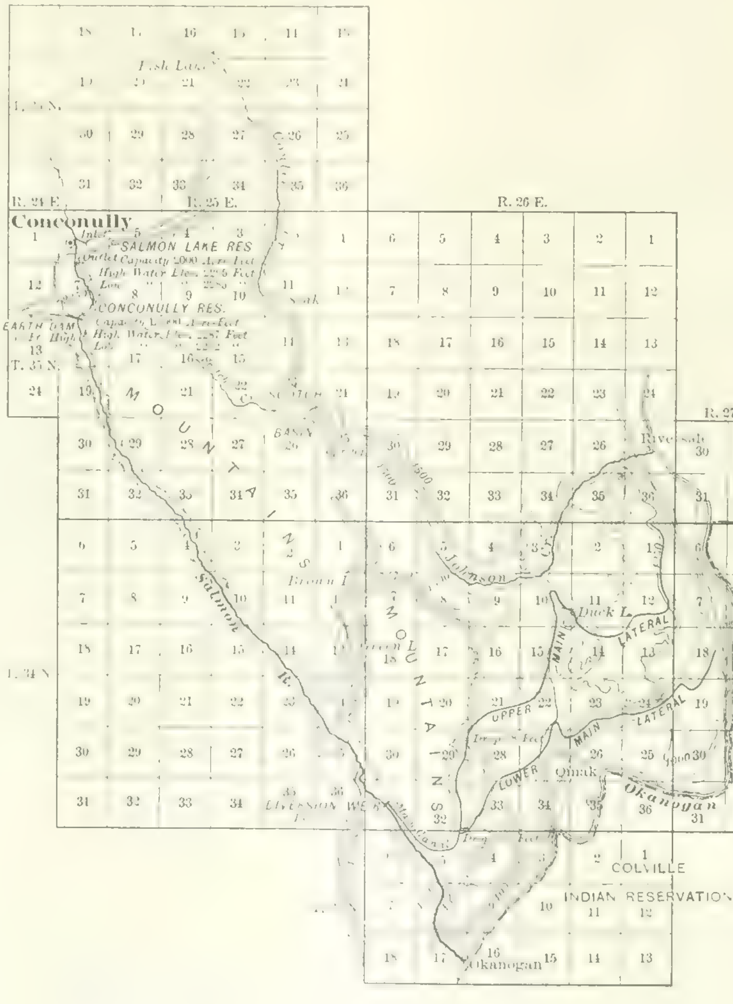

Fig. 1—Map of Okonagon Irrigation Project, Washington, Showing Location of Conconully Dam.

The character of the material hydraulicked in 1908 is best shown by the physical analyses (Table I) after from 10 to 40 per cent of material coarser than would pass a 7 by 13-in. screen had been eliminated. Much of the material hydraulicked in 1909 and 1910 was coarser than that from the 1908 pit No. 2. On the whole, the material was found to be far coarser than had been inferred from test-pit examinations.

It was considered desirable to place the core section as near forward in the dam as practicable so as to have it backed by the maximum quantity of more open material. As a result, the central plane through the core has a downstream inclination. It was expected that no difficulty would result from this position of the core, as it would be possible to keep the down stream dumps at a higher elevation than those up stream and thus maintain the central pond at a point well forward toward the reservoir side.

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*Condensed from "Two Earth Dams of the United States Reclamation Service," by D. C. H[illegible]

The core section connects with the side-hill by cleaning to bedrock and excavating a rock trench in line with the inclined central core plain. A drainage trench was provided at the down-stream toe of the dam, filled with coarse material, hydraulicked in, connecting with the old creek channel below the dam.

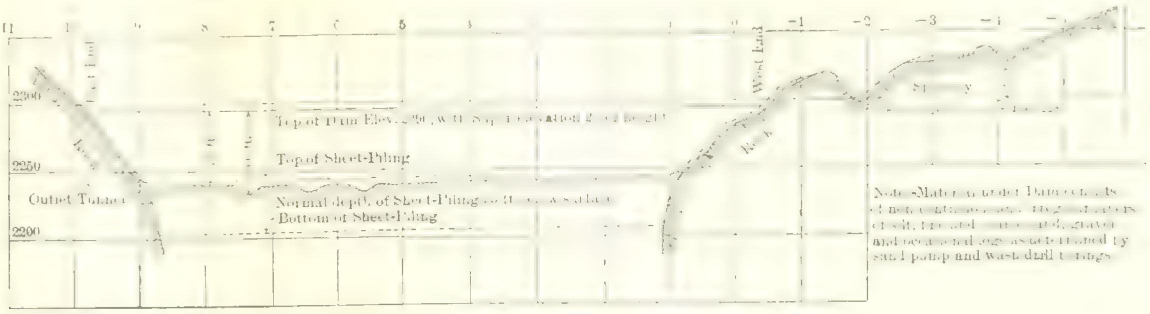

Fig. 2—Longitudinal Section of Conconully Dam.

TABLE I.—PHYSICAL ANALYSIS OF MATERIAL AVAILABLE FOR CONCONULLY DAM.

Pass sieve	Stop on sieve	Percentage by Weight Pit No. 1. Average of [illegible] samples.	Pit No. 2. Average of three samples.
[illegible]	[illegible]	[illegible]	40.65
[illegible]	No. 4	[illegible]	32.69
No. 4	10	12.4	6.21
10	20	11.9	[illegible]
20	30	3.8	1.46
40	60	14.5	[illegible]
60	80	[illegible]	2.07
80	100	[illegible]	0.97
100	200	6.1	4.45
200		2.0	1.98
		100.0	100.0

The spillway has a crest length of 180 ft. and a crest height 9 ft. below the top of the dam, giving an approximate overflow capacity of 4,500 sec-ft., with 5 ft. freeboard on the dam, or about 40 sec-ft. per square mile of drainage area. It was cut into the west ridge and was provided with concrete crest and channel lining, the point of discharge at the foot of the hill being 300 ft. from the downstream toe of the dam.

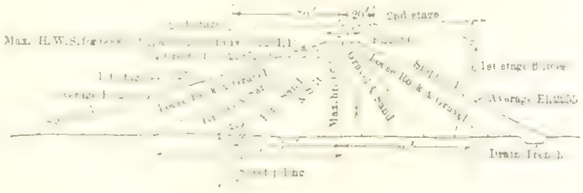

Fig. 3—Cross Section of Conconully Dam.

The discharge from the reservoir is through a tunnel in the hard granite mountain side on the east, partly lined with concrete, in which two 36-in. common water-works gates were installed. These are set side by side, and operated through a vertical shaft connecting with the surface and well up stream from the center line of the dam. The tunnel was left unobstructed, and the water stored during the 1908 season [illegible] controlled by a temporary wooden gate in the shaft, the final gates not being installed until the summer of 1909. The required discharge capacity is 100 sec-ft.

Construction.—Construction was commenced in the summer of 1907, during which year the following work was done: (1) Building 3 miles of feed-water flume, mostly on steep mountain sides; (2) building a dirt flume, partly on mountain side, partly on trestle; (3) driving and jetting 855 ft. of 6 by 12-in. triple lap, tongued and grooved, sheet-piling, 36 ft. long, for a distance of 33 ft. into valley bottom; (4) excavating 395 ft. of 8 by 9-ft. outlet tunnel, partly lined, through the east mountain side, and excavating a vertical shaft; (5) partial excavation of the spillway gap in the ridge at the west end of the dam.

During the season of 1908, 97,000 cu. yds. of material were sluiced from the borrow-pits, and the spillway excavation was completed and lined with concrete. At the end of the season, second-stage flume trestles were erected. During the season of 1909, 188,000 cu. yds. of material were sluiced from the borrow-pits, and the permanent gates were installed in the outlet tunnel. During the season of 1910, the remaining 64,000 cu. yds. of material were sluiced, mostly from the second-stage, and partly from the third-stage flumes. The dam was completed during August, 1910.

The building of auxiliary structures presented no special points of interest, and the following remarks will be confined to the hydraulicking feature.

The original supply flume had a capacity of 17 sec-ft. Its location is shown on Fig. 5. At the end of the 1908 season it was decided to increase this capacity to 26 sec-ft. Small storage reservoirs were built above the flume intakes to permit of concentration of the flow during the dry season for two shifts or one shift each day. The large boulders found in the pit had to be broken by blasting, or wasted, to prevent them from accumulating in the bottom. For this reason two pits were kept in operation alternately.

The feed-water was led down the mountain side through 14-in. No. 16, steel, slip-joint pipes, one line of pipe for each borrow-pit, and was used partly by the giant, which consumed from 1½ to 5½ sec.-ft., through nozzles changed from 2 to 3½ ins. in diameter, as required. The water was supplied under a pressure due to the difference in elevation of the feed-flume and the bottom of the pit, which difference ranged from 129 to 169 ft. for the first stage, and from 114 to 140 ft. for the second and third stages. A flow of from 2 to 3 sec.-ft. was delivered under pressure through a 4-in. pipe at the head of the borrow-pit dirt flume near its bottom, serving as push-water. The remainder of the available water was used as push-water at the point where the pit flume dropped its load into the main dirt flume. A small quantity of water, however, was allowed to enter the pit at its upper end on a level with the supply flume, in order to cause the fine upper material to slide in from above.

A 7x13-in. screen was used at the head of the pit flume during the 1908 season, to exclude large rock, but its use was discontinued after the water supply was increased.

The main dirt flume ran along the lower edge of the pits opposite the point on the dam equidistant from its ends, and then proceeded on a high trestle from the mountain side to the dam. On reaching the dam, the main flume connected on either side with two lateral flumes near the down-stream toe of the dam, and continued to similar flumes close to the up-stream toe. When the dam was built up to the elevation of the first lateral flumes the main trestle was raised 29 ft., and was connected with a new flume laid along the mountain side, while the new lateral flume trestles were built closer to the center line of the dam. In the final finishing of the dam, a single flume was built on trestle near the center line.

The main dirt flume was built with wooden sides slightly inclined outward, and with a curved bottom of No. 10 mild steel with a 12-in. radius. The width at the top was 2 ft. 9 ins. and the total depth 2 ft. 3 ins. The velocity of the water ranged from 14 to 18 ft. per sec.

Fig. 4—Plan of Conconully Dam.

It soon became apparent that the angular rocks sliding on the bottom caused serious wear, and when 11,000 cu. yds. had been delivered, many holes had been worn within a

TABLE II.—SLUICING CONCONULLY DAM

Season.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April 22d-October 15th, 1908	1,935	231	13.2	97,165	50.2	2.85
April 14th-November 13th, 1909...	[illegible]	[illegible]	20.2	[illegible]	65.1	[illegible]
March 31st-June 24th, 1910	1,154	297	22.3	[illegible]	55.4	1.87
	5,981	1,092				

[illegible] the center [illegible] wide, the steel higher [illegible] little wear. The flume was [illegible] given a flat wooden bottom 16 ins. wide, and lined with No. 10 mild steel, which stood the wear far better.

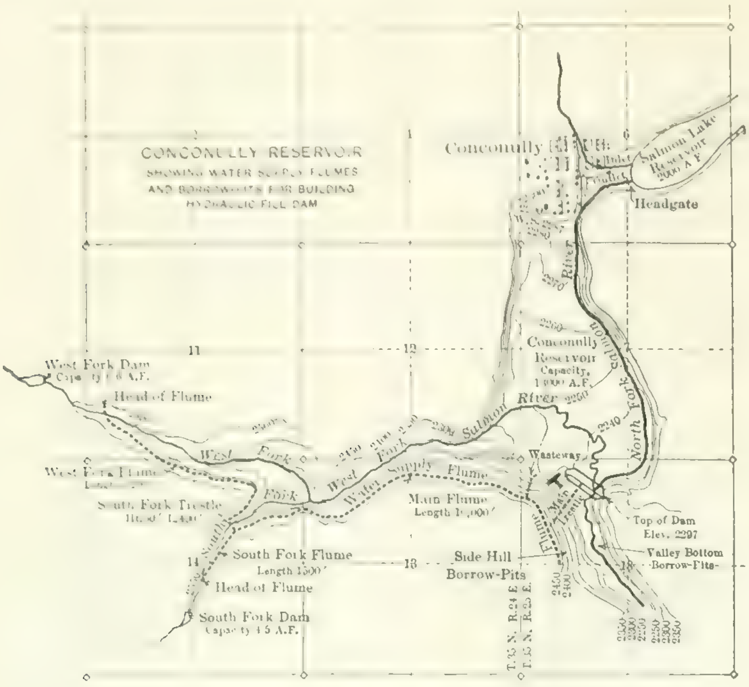
CONCONULLY RESERVOIR
SHOWING WATER SUPPLY FLUMES
AND BORROW-PITS FOR BUILDING
HYDRAULIC FILL DAM
Conconully
Salmon Lake Reservoir 2000 A.F.
Headgate
River
Conconully Reservoir Capacity, 13000 A.F.
Salmon River
North Fork Salmon
West Fork Dam Capacity [illegible] A.F.
Head of Flume
West Fork Flume
South Fork Trestle
South Fork Flume Length 1500'
Head of Flume
South Fork Dam Capacity 45 A.F.
West Fork Water Supply Flume
Main Flume Length 1[illegible],000'
Wasteway
Main Trestle
Flume
Top of Dam Elev. 2297
Valley Bottom Borrow-Pits
Side Hill Borrow-Pits
T. 35 N. R. 24 E.
T. 35 N. R. 25 E.
11
12
13
14
18
1
6

Fig. 5—Conconully Reservoir Water Supply Flumes and Borrow Pits.

At the end of the first season, when it was decided to increase the water supply from 15 to 26 sec.-ft., the dirt flume was rebuilt to rectangular shape, with a bottom 30 ins. wide and lined with ¼-in. high-carbon steel, and 27-in. sides lined for the lower 6 ins. with No. 10 mild steel. The heavier and harder steel answered the purpose satisfactorily, and lasted through the delivery of 252,000 cu. yds. of material, showing serious wear only at the butt joints.

The flumes had 4 per cent grades, except the short borrow-pit flumes, which had 8 per cent grades, and the third-stage flumes for the finishing of the dam, which for part of the distance back had a 3 per cent grade.

The material was discharged from delivery points at the dam in two rows of cones, forming ridges, the principal ridge being along the down-stream slope. By deflecting screens, gratings, spouts, and other means, the coarsest material was discharged, as far as possible, outward, and the finer material inward, toward the pond maintained between the two ridges. The surplus water from the pond was drawn off on the reservoir side through flumes near the ends of the dam, which were alternately raised 6 ins. at a time, the pond being maintained at a depth of from 12 to 18 ins.

The material settling in the pond consisted of very fine sand and silt, the coarser sand and gravel coming to rest on the sloping sides of the pond, and the large rock dropping vertically and sliding down the cone slopes. The pond at first was quite wide, but, as elevation was gained, it narrowed up to such an extent that in spite of skillful handling, the sloping coarse sand layers would at times extend well into the puddle section and sometimes clear across it. Such layers were broken up by systematic stirring with paddles, but when this tendency to stratification became more marked and could not be satisfactorily prevented or counteracted, it was decided to introduce an artificial core with puddling material from other sources. The surface material in the valley below the dam, consisting of black, loamy sand, was well suited to form a core. This material was hauled in by scrapers on an up-hill road, dumped on a platform and washed into the dam through an 8-in. pipe. In order to insure against stratification across this core, two wooden diaphragms were built of 2 by 4-in. studding and 1-in. boards, which were first given a vertical position and made to step back in sections, so as to have their center plane correspond, as nearly as possible, with the center plane of the general core, but which were later built in a sloping position. Thus, while the material from the upper borrow-pits was hydraulicked in on the slopes, the core material was washed in through the 8-in. pipe between diaphragms. The artificial core was started at an elevation 14 ft. above the general base of the dam in the late spring of 1909, and was continued about 39 ft. up to the high-water line. It contains in the aggregate 11,600 cu. yds. and, owing to the long haul of about 1,000 ft. on a 7 per cent upgrade, and also to the necessity of using a large quantity of lumber for diaphragms, its cost was quite high.

The coarse rock, as dumped on the outer slopes, was of sufficient size to serve as riprap, but it did not prove possible to deposit it to final slopes by the use of water alone, and after hydraulicking was completed, it required a large amount of hand-work to obtain reasonably good slopes.

As the quantity of rock found in the borrow-pits was larger than had been estimated, the relative quantity of rock on the water slope became sufficient to justify the steepening of this slope from 3 : 1, as had been originally designed, to 2½ : 1 for the upper 26 ft. of the dam, as shown by the dotted lines in the central section on Fig. 3.

The dam was built with a super-elevation of 1 ft. across the valley, equivalent to nearly 2 per cent of its height. In view of the hard pounding and washing which the material received in being dumped, and the prevalence of sand and gravel, this provision may seem excessive. During the progress of construction, however, it was found that as the load came on the base, considerable settlement occurred in the trestles, due apparently to a compacting of the fine loamy sand in the foundation. The amount of this settlement, extending over the

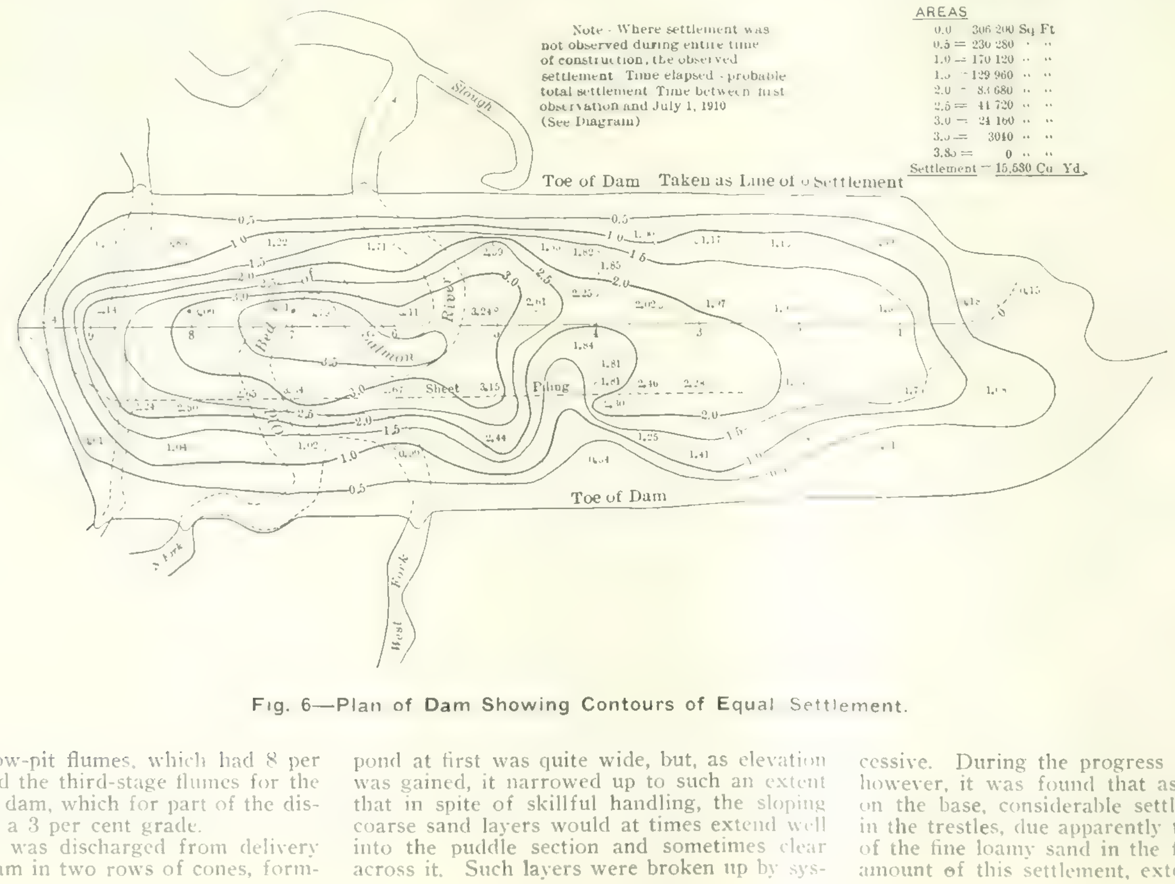

Fig. 6—Plan of Dam Showing Contours of Equal Settlement.

last 560 days of construction, is shown on Fig. 6 by contour lines, the maximum settlement being 3.9 ft., and occurring along the old creek bed. In total volume, this settlement amounted to 15,500 cu. yds. and while it may have ceased on the completion of the dam, it was deemed wise to finish to the super-elevation above mentioned. Careful watch was kept for possible evidence of a swelling up of the ground surface beyond the toes of the dam, but none was observed. The degree of effectiveness of the sluicing for each season is shown in Table II.

The decreasing percentage of material carried by the water, in spite of increasing skill and larger water supply, is due to the increasing proportion of coarse rock in the borrow-pits. It will be observed that, of the total 7,073 hours of sluicing, 1,092 hours, or about 15 per cent, were lost. This was due principally to clogs in the dirt flumes, and in part also to breaks in the feed flume, and to the necessity of replacing the dirt flume bottoms.

The largest output in any one day was 181 cu. yds. per hour, at which time the water carried 5.3 per cent of solids. The largest rocks carried in the flume, with 25 sec-ft. flow, weighed 250 lbs. The waste-water from the pond did not run out perfectly clear, but contained from 0.1 to 0.2 per cent of silt, which sometimes rose to 0.5 per cent. The total loss of silt from this cause during the entire work is estimated at 20,000 cu. yds. The segregating effect of the water caused an increase of dam measurement over borrow-pit measurement, possibly offset in part by a shrinkage where sand, gravel, and rock, with some silt, happened to be well mixed in the dump pile. The swell in volume during the first season was estimated at 12 per cent, but, for the completed work, a lower percentage is computed, as follows:

	Cu. yds.
Sluiced from side-hill borrow-pits	349,455
Loss in waste water	20,000
Remaining in dam, pit measurement	329,455
Volume of dam above original surface	336,000
Volume of dam below original surface	15,500
Total volume of dam	351,500
From valley pits	11,600
From side-hill pits, bank measurement	339,900
Swell [illegible]	[illegible]

Many physical analyses were made of the material in the tight section of the dam, of which those in Table III are representative. Table IV contains the results of a few percolation experiments which were made. The temperature was not noted continuously, but was subsequently reported to have averaged approximately 70° F. A correction has been applied on the basis of Hazen's formula, and the figures in Table IV are on a basis of 50° temperature.

The high rate of percolation in the fine silt, Sample *A*, is surprising, even though the material was not compacted in the tank except in so far as it settled by subsequent admission of water. Sample *D* and *E* showed one-third the rate of percolation when tamped, as compared with being put in loose, and if this ratio be likewise applied to Sample *A*, a rate might have been noted of nearly 190,000 gals. per day.

TABLE V.—COST OF CONCONULLY DAM.

	Hydraulicking.	Main dam.	Total.	Cost per Cubic Yard, Bank Measurement. Side-hill pits, 339,900 cu. yd.	Bottom pits, 11,600 cu. yd.
Clearing reservoir site			[illegible]		
Main dam:					
Creek diversion		$965			
Clearing dam site		936			
Trenches		[illegible]			
Sheet-piling		13,982			
Hydraulicking:					
Plant	[illegible]			[illegible]	
Supplies	[illegible]			[illegible]	
Labor	[illegible]			21.99	
Total		155,637		[illegible]	
Puddle core		[illegible]			$1.97
Sloping		8,465			
Cleaning up		.....			
Miscellaneous		1,382			
			208,219		
Outlet works			23,114		
Spillway			[illegible]		
Telephone			2,827		
Real estate			30,977		
General investigation of dam sites.			19,028		
13,000 acre-ft., at [illegible]			$324,325		

*Cents.

The sandy loam, represented by Samples *E* and F, may be considered water-tight. Sample *E* was taken closer to the point of discharge than Sample *F*, and averaged coarser, which explains the high rate of percolation.

TABLE IV.—PERCOLATION EXPERIMENTS, CONCONULLY DAM.

Sample	Percolation rate, in gals. per acre per day, 3 ft. of material under a 3-ft. head.	Rate observed at end of following period.
MATERIAL DEPOSITED IN DRY, LOOSE CONDITION IN TANK.		
A	561,000	12 hours
D	16,600,000	¾ hour
E	98,000	23 hours
F	13,300	62 hours
MATERIAL PACKED IN TANK IN 8-IN. LAYERS WITH IRON CONCRETE TAMPER.		
E	34,700	39 hours
F	4,500	12 hours

Referring again to core silt, as per Sample *A*, the effect of compacting by superincumbent weight would probably reduce its rate of percolation, there being no apparent reason why this material, when well packed and with surplus water squeezed out, should not be as tight as clay.

The results with Sample *D*, which was taken from a coarse sand layer which had penetrated the silt core, shows the absolute necessity of avoiding stratification, and justified the additional expense involved in the adoption of the artificial core.

The distribution of the material in the dam as built is fairly represented by the cross-section Fig. 7, which also shows the stages of completion at the end of each season, and may with advantage be compared with the central section on Fig. 3, showing the original design.

Cost.—The total cost of the reservoir, arranged by its principal features, is shown in Table V. The items in the table include all charges for administration, engineering, and general expenses. The cost of puddle core includes lumber for diaphragms. The total material in the dam is 351,500 cu. yds. and the combined cost of hydraulicking and puddle core is $178,522, making the average cost, on the basis of bank measurement, 50.8 cents per cu. yd., including lumber for core and all overhead charges, but exclusive of the cost of sloping.

The details of the cost of hydraulicking are shown in Table VI. The prices paid for labor were as follows:

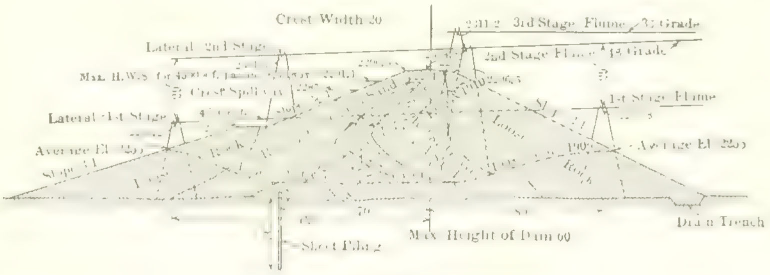

Fig. 7.

Fig. 7—Sections of Material Placed in Dam and Its Distribution.

	For 8 hours.
Common labor	[illegible]
Pitmen	[illegible]
Giant men	[illegible]
Powder men	[illegible]
Carpenters	4.00@4.50
Foremen	[illegible]

It will be noted that the steel lining cost 4.25 cts. for material, and 1.48 cts. for replacing, or a total of 5.73 cts. per cu. yd. of sluiced material in the dam.

TABLE III.—PHYSICAL ANALYSES

Passes sieve No.	Stops on sieve No.	A	B	C	D	E	F
		Percentage, by Weight					
	4	0	0	[illegible]	[illegible]		0
4	10	0.52	0.16	6.70	9.38	[illegible]	[illegible]
10	20	[illegible]	0.37	11.15	16.60	3.31	[illegible]
20	40	[illegible]	2.34	23.59	[illegible]	7.03	0.50
40	60	7.68	10.66	15.52	13.45	[illegible]	[illegible]
60	80	12.21	8.16	9.65	5.75	12.69	[illegible]
80	100	7.70	5.83	2.41	1.73	6.25	0.58
100	200	33.70	36.99	12.60	2.93	29.11	19.00
200		36.48	35.49	9.93	1.50	20.86	78.50
		100.0	100.0	100.0	100.0	100.0	100.0
Taken from dam at Station		[illegible]	Average of 3 samples	Average of 3 samples	[illegible]	[illegible]	[illegible]
Elevation		2,252	2,243	2,251	2,252	2,269	2,269
Source		Side-hill borrow pits.				Valley borrow-pits.	
		Pure silt.			Coarse sand found stratified in core.	Fine, black sandy loam.	

TABLE VI.—COST OF HYDRAULICKING, CONCONULLY DAM.

	Total.	[illegible]
Plant		
Feed supply dams and flumes	$17,140	5.04
Dirt flumes [illegible]	[illegible]	[illegible]
Steel lining	[illegible]	[illegible]
Pipe, giants and [illegible]	[illegible]	[illegible]
Electric light plant	1,250	0.37
Proportion [illegible] building	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]
[illegible] engineering and general expenses	[illegible]	[illegible]
	$71,204	20.95
[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]
[illegible]		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Powder and explosives	4,793	1.41
[illegible]	[illegible]	[illegible]
Superintendence	776	0.23
[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Clearing borrow-pit	547	0.16
[illegible]	[illegible]	[illegible]
Giant men	2,365	0.70
Pit men	13,232	3.89
[illegible]	[illegible]	[illegible]

Building lateral flume in pit	963	0.28
Hauling and laying pipe in pit	2,707	0.79
Feed flume tenders	7,748	2.28
L bar steel lining	4,975	1.46
Spreading material and puddling in dam	1,354	0.40
Carpenters on dam and flume	3,915	1.15
Blacksmith	914	0.27
Operating light plant	767	0.24
Transporting laborers	1,308	0.38
Dismantling plant	936	0.28
Proportionate charge for camp buildings	998	0.29
Superintendence	4,543	1.34
Administration, engineering and general expenses	6,989	2.06
	$74,755	21.99

STEAM AND ELECTRIC RAILWAY SECTION

Impact Tests on Reinforced Concrete Trestle for C., M. & St. P. Ry.

[illegible]

Some tests to determine the amount of the impact on a trestle of reinforced concrete under train loads have recently been completed by the Engineering Department of the Chicago, Milwaukee & St. Paul Railway under the direction of Mr. C. F. Loweth, Chief Engineer of that railway. The tests were made on the reinforced concrete trestle shown in Figs. 2 and 4, by R. L. Stevens, assisted by an instructor from the University of Wisconsin experienced in such work.

An examination of Fig. 4 shows the trestle to consist of two beams *A*, supporting the slab *B*, forming a double T-beam. The total depth of this beam is 3 ft. 6 ins., but if the parapets are considered as part of the beam this depth is increased to 5 ft. 4 ins. As the span is only 16 ft. center to center of piers, the concrete beam has a large ratio of depth to span. Some unexpected difficulties were encountered in this work, due to this ratio of depth to span, and also to the fact that the girders are practically continuous over the supports.

The information mostly sought in these tests was the unit stress in the steel due to the total load on the structure including impact, as this information is of fundamental importance in the design of similar structures. On account of the great depth of span compared with its length, and the partial continuity of the beam over the supports, which had been only partly relied upon in the design, the unit stresses in the steel were low, and the consequent distortions were so small that errors of the smallest magnitude affected the results by large percentages. On account of this, the results as a whole are somewhat unsatisfactory, but are thought worthy of publication in order to mark out a little progress in the subject and save others from traversing the same ground.

Table I gives most of the important results of the tests. Following is a description of the manner in which trese results were obtained. The test train shown in Fig. 1, consisting of the railway company's class A-2 engine, one gondola car, loaded with sand, and a caboose, was used for making the test. The trestle spans were designed for an E-50 loading, but the above train was equivalent only to about E-35 loading. An engine of class A-2 was selected because, in this type, which is a four-cylinder compound, the unbalanced weights on the drivers are rather excessive, and were expected to produce greater impact than other classes of locomotives. A marker was placed on one driver so that the location of the counter-weight might be determined for the various runs.

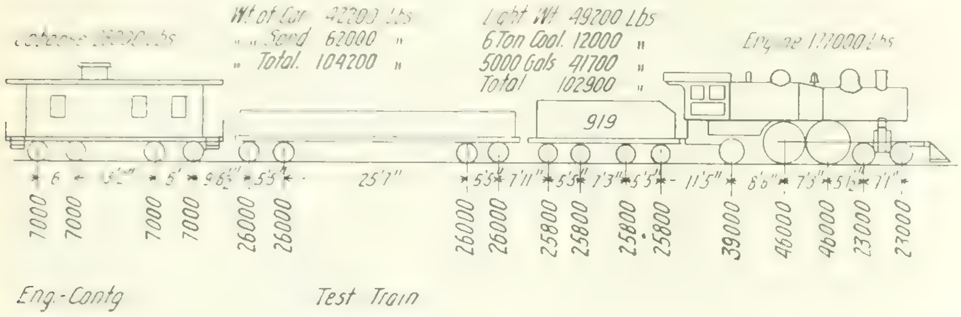

Fig. 1—Diagram of Test Train, C., M. & St. P. R'y.

The four extensometers and the deflectometer used in the tests were loaned by the University of Wisconsin. The tests were conducted in a manner similar to those made by the American Railway Engineering Association.† The four extensometers were attached to the bars which had been built into the girder so as to project a short distance, as shown at *A* in Fig. 2. One extensometer was located on the side of each girder. The projecting bars are located in the same plane as the lowest reinforcing steel in the girders, so that the deformations measured were the actual deformations of the steel reinforcement. The deflectometer was attached near the center of one of the girders. The deflections were so slight, however, that no records of any value were obtained from this instrument, and consequently no results from it are mentioned in this report.

In Fig. 5 are shown some diagrams obtained from the extensometer to a scale enlarged two times. The "measured ordinates," which are shown in column 2 of Table II, were obtained from these diagrams by scaling on the diagram the distance between the curve and a base line drawn to connect the zero stress ends of the curves. An examination of these diagrams shows the presence of some lost motion, due either to the projecting bar, or the imperfection of the extensometer. On account of the small amount of the distortions, this lost motion, if not corrected, would introduce a substantial error. The amount of this lost motion was determined as follows:

A theoretical investigation of the properties of the section of the spans tested, comprising the girders, floor slab and parapet, showed that if all were assumed to act together, the section has a resisting moment in inch pounds of 1,081 times the unit stress in the steel in the lower portion of the beam. For the test train this resisting moment gives a unit stress due to live load only in the reinforcing steel of but 680 lbs. per sq. in. and 103 lbs. per sq. in. tension in the concrete at the top of the parapet wall over the piers. These low stresses throughout cause only small distortions in the steel and give small ordinates in the extensometer diagrams.

For the E-50 loading, including impact and dead load, the stresses at the same points are 2,310 lbs. in the steel and 344 lbs. in the concrete. Since this bridge has never in its lifetime been loaded to quite this amount, it seems justifiable to assume that there are extensive regions to which the concrete on the tension side has never been ruptured, and that in the remaining portions the elongation of the steel is sufficiently restrained by the surrounding concrete to justify the assumption that the entire section acts effectively to resist distortions due to bending.

Using the above assumptions, there is shown in the 4th and 5th columns of Table III the calculated stress in the steel for the test train with its corresponding ordinates. These ordinates were assumed to be correct for static loads.

It is reasonable to assume that the error of lost motion mentioned is a constant, and that it affects all of the "measured ordinates" in column 2, Table II, by the same amount. If these "measured ordinates" contain a constant error, this constant error will be eliminated whenever we are considering the differences between two "measured ordinates." Now it is known that for speeds of 8 miles per hour the impact is practically nothing, and that the difference between "measured ordinate" for 8 miles per hour and the "measured ordinate" for 20 miles per hour gives the increase in ordinate, due to impact at 20 miles per hour. The difference between "measured ordinates" for speed of 8 miles per hour and the "meas-

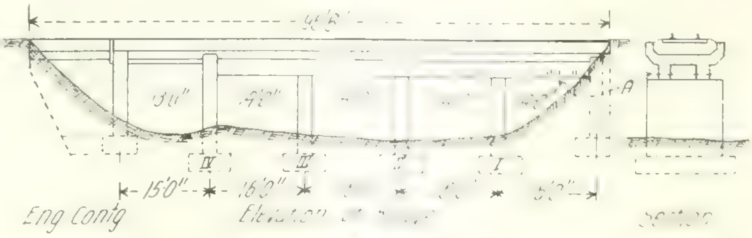

Fig. 2—Reinforced-Concrete Trestle Tested for Impact.

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*Assistant Engineer, Engineering Dept., C., M. & St. P. Ry., Chicago.

†Bulletin 125 (July, 1910), American Railway Engineering Association.

[illegible] ordinate" [illegible] of 20 miles per hour in Table II is 0.012. This difference divided by the total calculated ordinate for instrument No. 9 in column 5, Table III, is 0.2, which [illegible], would show an impact of 20 per cent [illegible] a speed of 20 miles per hour. The value 20 per cent just calculated was obtained from a reading of only one instrument, extensometer No. 9.

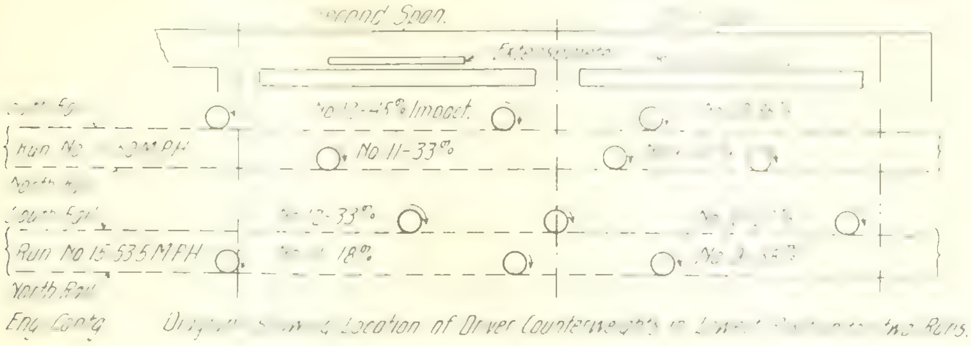

Fig. 3—Location of Counter-Balances on Locomotive, in Lowest Position.

TABLE I.—SUMMARY OF RESULTS OF IMPACT TESTS.

Speed	Extensometer No. 9.		Extensometer No. 10.		Extensometer No. 11.		Extensometer No. 12.	
m. p. h.	Engine	Car	Engine	Car	Engine	Car	Engine	Car
	Percentage							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE II.—ORDINATES AND IMPACT, EXTENSOMETER NO. 9.

(1) Speed m.p.h.	(2) Measured ordinate. Ins.	(3) Corrected ordinate. Ins.	(4) Corrected static. Ins.	(5) Excess [illegible] Ins.	(6) [illegible] impact. [illegible]
[illegible]	0	0.073	0.073	[illegible]	[illegible]
[illegible]	[illegible]	0.085	[illegible]	0.012	[illegible]
[illegible]	[illegible]	0.085	0.073	0.012	16
50	0.036	0.097	[illegible]	0.024	[illegible]
[illegible]	[illegible]	0.103	[illegible]	[illegible]	11
[illegible]	[illegible]	0.083	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.101	[illegible]	[illegible]	38

TABLE III.—RESULTS OF TESTS, EXTENSOMETER NO. 9.

(1) No. extens.	(2) Lever ratio.	(3) Length of [illegible] Ft.	(4) Stress. Lbs.	(5) Calc[illegible] Ordinates. Ins.	(6) Static Ordinates. "Corrected [illegible]" Ins.	(7) Stress Ins.
9	47.0	[illegible]	680	0.059	[illegible]	840
10	[illegible]	4.40	[illegible]	0.059	0.073	840
11	52.5	4.35	680	0.066	0.067	690
12	[illegible]	[illegible]	680	0.061	0.133	[illegible]

The records of two other instruments, not shown, give values of 15 per cent and 18 per cent. The values given by the 4th instrument are divergent, but can be accounted for by the irregular character of the quantity measured. Of these values, an impact of 15 per cent was [illegible] way with the values obtained for a speed of 20 miles per hour in a large number of experiments on steel structures.* When the impact [illegible] determined, it is an easy matter to make an approximation of the lost motion and to correct the "measured ordinate" by the calculated lost motion, so as to obtain the values in the third column of Table II, called "corrected ordinate." This "corrected ordinate" is obtained by the following equation, in which, in the first member of the equation, "a" is the cor[illegible] second member of the equation are the first, second and sixth items in column 2 of Table II.

[illegible]

From the above we get "calculated ordinate" for speed of 8 miles per hour 0.073. The "measured ordinate" for speed of 8 miles per hour is 0.012, in the second column of Table II. Their difference is the constant error, 0.073 — 0.012 = 0.061. If the constant error thus determined is added to the "measured ordinates" in column 2, Table II, we obtain column 3, Table II, marked "corrected ordinate."

The difference between the "corrected ordinates" of column 3, Table II, and the "corrected static," column 4, is the "excess over static," column 5. The values in column 5 divided by the values in column 4 give the percentages of impact, column 6.

Column 6 of Table II is the 2nd column of Table I. The other columns of the "summary of results," Table I, were obtained in the same manner from tables similar to Table II, but not shown in this report. The "corrected static" ordinates for the extensometers 10, 11 and 12 obtained in a similar manner to extensometer No. 9 of Table II, are shown in the 6th column of Table III, where they are compared with the calculated ordinate shown in the 5th column of the same table. Considering the small quantities involved, the agreement is fair and seems to justify the assumptions made.

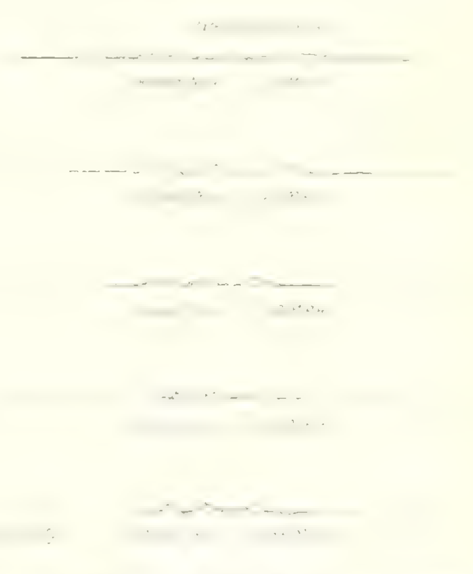

Fig. 5—Curves Drawn by Extensometer

Incidentally, Table III shows that the structure does not receive anything like the stresses for which it was designed. The longitudinal joint *c* of Fig 4, between the slab and the parapet wall, which it was thought inadvisable to count in the design for transmitting longitudinal shear, seems to be entirely effective for that purpose, making the entire span a monolith, and suggests that possibly the design of the parapet walls of similar slabs might be modified so that there might be no doubt as to the ability to carry the stresses, which they unquestionably receive.

Fig. 4—Details of Reinforced-Concrete Bridge Tested for Impact.

The location of the counter-balances on the locomotives in their lowest position with regard to the center of the span is shown by diagram in Fig. 3 for two runs. These runs are typical of the others, and from them it does not seem that the location of the counter-weight in its lowest position with regard to the center of the span had influenced particularly the amount of impact obtained. However, as the structure consists of five spans fully continuous and integral with the piers, it is hardly expected that the effect of the counter-weights would be as clearly defined as in simple spans, although the unbalanced weights may be just as effective in producing impact, especially if the span had been the ordinary shallow slab, not built in place.

As shown on Table I, the maximum impact obtained under the engine was between 50 and 60 per cent, although the number of ob-

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*Bulletin 12[illegible], American Railway Engineering Association (previously quoted).

[illegible]

[illegible] economic value in the design of reinforced concrete structures, the subject seems to be worthy of further study and investigation, and the Chief Engineer of the Chicago, Milwaukee & St. Paul Railway Co., Mr. C. F. Lowth, has at present in mind some further tests to be made on shallower and longer spans, if possible.

GENERAL ARTICLES AND CLASSIFIED ITEMS

The New Standard Rattler for Testing Paving Brick.

Four tests were formerly commonly used to ascertain the quality of paving brick. These tests were the transverse or cross breaking test, the crushing test, absorption test, and the abrasion test commonly called the rattler test. Of these tests but two—the absorption test and the rattler test—were recommended for common use by the Organization of City Officials for Standardizing Paving Specifications. The rattler test has been for many years a matter of more or less concern to brick manufacturers, and [illegible] experiments have been conducted in order to determine a definite and standard method for making this test.

In 1909 the National Paving Brick Manufacturers' Association (an organization distinct from the National Brick Manufacturers' Association) appointed a committee to investigate the subject of paving brick tests and to recommend standard methods for conducting the same. This committee reported at the annual meeting of the Association on Feb. 7, 1911, recommending certain changes in the design of the machine used in the tests. This report was adopted by the Association. The rattler was also accepted by the Organization of City Officials for Standardizing Paving Specifications. It may be stated here that the cost of this standard rattler is estimated at about $150, with $22.50 extra for 500 lbs. of shot.

An abstract of the report of the committee of the National Paving Brick Manufacturers' Association and the specifications which accompanied it, follows:

[illegible] adopted in 1901 by the National Brick Manufacturers' Association developed a great variation in results due to the fact that the specifications were not definite. These indefinite specifications led to a great difference in the construction of the machine, the character of the shot and the manner of conducting the test, so that there were as many results as machines in use. From these results a condition was created that was unsatisfactory to both the users and makers of paving brick.

The National Paving Brick Manufacturers' Association felt it so important both to themselves and the users of paving brick that they authorized a series of experiments and tests to be made for the purpose of specifying a rattler and test that would avoid the uncertainty and lack of uniformity in the National Brick Manufacturers' Association rattler and test formerly used.

The National Paving Brick Manufacturers' Association appointed a committee to investigate the subject of paving brick tests, and to recommend standard methods for conducting the same. Marion W. Blair, of Indianapolis, Ind., was retained by a committee to direct the investigation about to be undertaken. But, prior to any actual testing, arrangements for which had been made at Indianapolis, Prof. Edward Orton, Jr., of Columbus, O., dean of the College of Engineering of the Ohio State University, offered to duplicate, at his own expense, in his private laboratory, any series of tests which might be made, provided that the results of the joint investigation should be available for joint publication before some suitable technical society. This offer was accepted and tests to the number of nearly 1,000 were made in each laboratory, under conditions designed to permit accurate duplication and close comparison. The machines used were made from the same patterns, in the same shops, and as the work progressed the changes of shot, replacement of worn parts, etc., were made simultaneously in the two laboratories. The conclusions reached, therefore, are based upon the results of two independent investigators, each checking the work of the other.

After due consideration of the construction and the results obtained by the experimental use of the rattler, as hereinafter specified, it is the conclusion of this committee that the National Paving Brick Manufacturers' Association [illegible] completed a machine and specification covering its construction and manner of operation, that will produce uniform results, and that the trouble of erratic results as formerly obtained is now practically eliminated. But we are further of the opinion that this perfected machine can never make the No. 1 paving brick of the different manufacturers, or the material in the different localities where the machine will be used, to test the same. Neither do we believe that it is the duty or object of this Association to determine the class of the material that should be used by any city on its several streets, requiring as it were a different grade of material, or to determine for the different localities the class of material that should be used in that locality, but submit this machine to the engineers or city officials that they may determine the quality of the material suitable for their use, and to the manufacturer that he may determine the quality of the material of his manufacture in so far as it may be determined by this method.

SPECIFICATIONS FOR RATTLER AND TESTS.

The machine shall be of good mechanical construction, self-contained, and shall conform to the following details of material and dimensions, and shall consist of barrel, frame and driving mechanism as herein described.

The Barrel.—The barrel of the machine shall be made up of the heads, headliners and staves.

The heads shall be cast with trunions in one piece. The trunion bearings shall not be less than 2½ ins. in diameter or less than 6 ins. in length.

The heads shall not be less than ¾ in. thick nor more than ⅞ in. In outline they shall be a regular 14-sided polygon inscribed in a circle 28⅜ ins. in diameter. The heads shall be provided with flanges not less than ¾ in. thick and extending outward 2½ ins. from the inside face of the head to afford a means of fastening the staves. The flanges shall be slotted on the outer edge, so as to provide for two ¾-in. bolts at each end of each stave, said slots to be 13/16 in. wide and 2¾ ins. center to center. Under each section of the flanges there shall be a brace ⅜ in. thick and extending down the outside of the head not less than 2 ins. Each slot shall be provided with recess for bolt head, which shall act to prevent the turning of the same. There shall be for each head a cast iron head liner 1 in. in thickness and conforming to the outline of the head, but inscribed in a circle 28⅛ ins. in diameter. This liner or wear plate shall be fastened to the head by seven ⅝ in. cap screws, through the head from the outside. These wear plates, whenever they become worn down ½ in. below their initial surface level, at any point of their surface, must be replaced with new. The metal of which these wear plates are to be composed shall be what is known as hard machinery iron, and must contain not less than 1 per cent of combined carbon. The faces of the polygon must be smooth and give uniform bearing for the staves. To secure the desired uniform bearing the faces of the head may be ground or machined.

The Staves.—The staves shall be made of 6-in. medium steel structural channels 27¼ ins. long and weighing 15.5 lbs. per lineal foot.

The channels shall be drilled with holes 13/16 in. in diameter, two in each end, for bolts to fasten same to head, the center line of holes being 1 in. from either end and 1⅜ ins. either way from the longitudinal center line.

The space between the staves will be determined by the accuracy of the heads, but must not exceed 5/16 in. The interior or flat side of each channel must be protected by a lining or wear plate ⅜ in. thick by 5½ ins. wide by 19 ins. long. The wear plate shall consist of medium steel plate, and shall be riveted to the channel by three ½-in. rivets, one of which shall be on the center line both ways and the other two on the longitudinal center line and spaced 7 ins. from the center each way. The rivet holes shall be countersunk on the face of the wear plate and the rivets shall be driven hot and chipped off flush with the surface of the wear plate. These wear plates shall be inspected from time to time, and if found loose shall be at once reriveted, but no wear plate shall be replaced by a new one except as the whole set is changed. No set of wear plates shall be used for more than 150 tests under any circumstances. The record must show the date when each set of wear plates goes into service and the number of tests made upon each set.

The staves when bolted to the heads shall form a barrel 20 ins. long, inside measurement, between wear plates. The wear plates of the staves must be so placed as to drop between the wear plates of the heads. These staves shall be bolted tightly to the heads by four ¾-in. bolts, and each bolt shall be provided with lock nuts, and shall be inspected at not less frequent intervals than every fifth test and all nuts kept tight. A record shall be made after each such inspection, showing in what condition the bolts were found.

The Frame and Driving Mechanism.—The barrel should be mounted on a cast-iron frame of sufficient strength and rigidity to support same without undue vibration. It should rest on a rigid foundation and be fastened to same by bolts at not less than four points.

It should be driven by gearing whose ratio of driver to driven should not be less than one to four. The counter shaft upon which the driving pinion is mounted should not be less than 1 15/16 ins. in diameter, with bearings not less than 6 ins. in length and belt driven, and the pulley should not be less than 18 ins. in diameter and 6½ ins. in face. A belt of 6-in. double-strength leather, properly adjusted, so as to avoid unnecessary slipping, should be used.

The National Paving Brick Manufacturers' Association will furnish without cost to all proper applicants the complete drawings of a machine which will meet the above specifications and requirements.

The Abrasive Charge.—(a) The abrasive charge shall consist of two sizes of cast-iron spheres. The larger size shall be 3.75 ins. in diameter when new and shall weigh when new approximately 7.5 lbs. (3.40 kilos) each. Ten shall be used.

These shall be weighed separately after each ten tests, and if the weight of any large shot falls to 7 lbs. (3.175 kilos), it shall be discarded and a new one substituted; provided, however, that all of the large shot shall not be discarded and substituted by new ones at any single time, and that so far as possible the large shots shall compose a graduated series in various stages of wear.

The smaller size spheres shall be when new 1.875 ins. in diameter and shall weigh not to exceed .95 lb. (0.430 kilos) each. Of these spheres so many shall be used as will bring the collective weight of the large and small spheres most nearly to 300 lbs., provided that no small sphere shall be retained in use after it has been worn down so that it will pass a circular hole 1.75 ins. in diameter, drilled in a cast-iron plate ¼ in. in thickness or weigh less than .75 lbs. (or .34 kilos). Further, the small spheres shall be tested by passing them over [illegible] plate drilled [illegible] or [illegible] weighed after [illegible], and any [illegible] pass through [illegible] weight shall be replaced [illegible], and provided, further, that all of the small spheres [illegible] as [illegible] possible the small spheres shall compose a graduated series in various stages of wear. At any time that any sphere is found to be broken or defective it shall at once be replaced.

(b) The iron composing these spheres shall have a chemical composition within the following limits:

Combined carbon—Not [illegible] per cent.
Graphitic carbon—Not more than 0.10 per cent.
Silicon—Not more [illegible] per cent.
Manganese—Not more than 0.50 per cent.
Phosphorus—Not more than 0.25 per cent.
Sulphur—Not more than 0.08 per cent.

For each new batch of spheres used the chemical analysis [illegible] be obtained by the user, before introduction into the charge, and unless the analysis meets the above specifications, the batch of spheres shall be rejected.

The [illegible] bricks per charge shall be ten for all bricks of the so-called "block size" whose dimensions fall between [illegible] No brick [illegible]

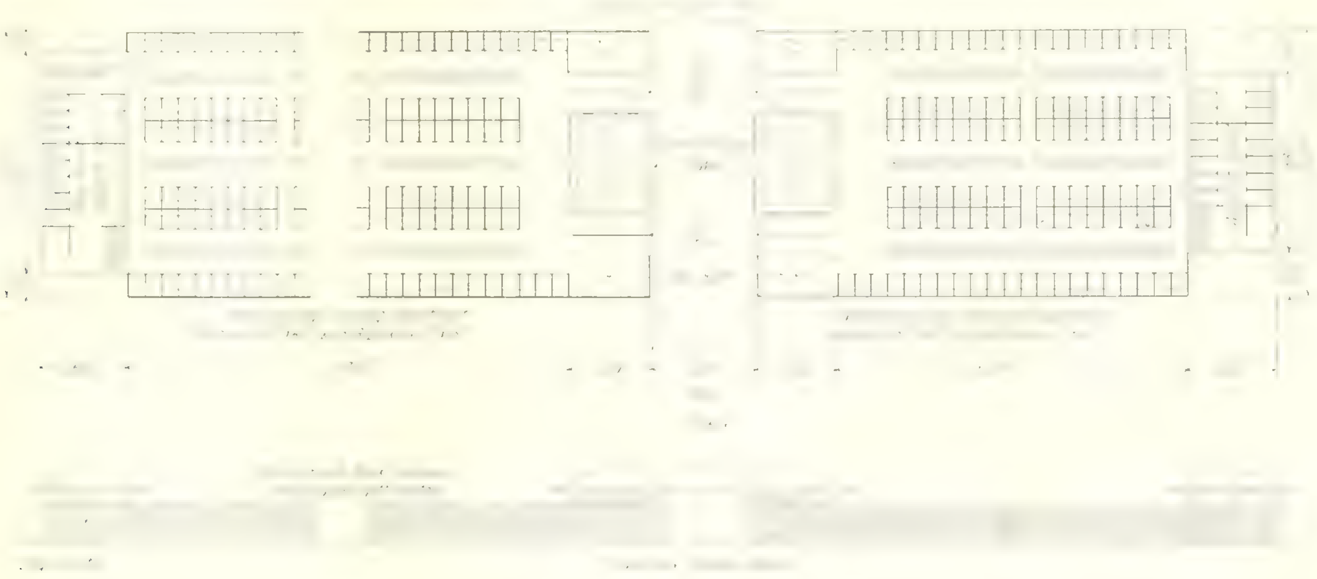
[illegible] Clothing is not [illegible] of the [illegible]

[illegible] gives a pleasing effect. The structures are all frame and are built of rough lumber with concrete floors 6 ins. thick.

The [illegible] and at first difficulty was experienced in excavating to the desired length. The task was accomplished successfully and easily by the use of ordinary barrels which were sunk at each pier. After water was encountered the barrel was placed in position and a small sand pump was used to pump out the sand. The barrel was sunk easily to the desired depth and the bottom was sealed with a layer of concrete 6 or 8 ins. thick. After the concrete had [illegible]

American Mining Congress.—The directors of the American Mining Congress, the permanent headquarters of which are in Denver, Colo., have selected Chicago as the meeting place for the 1911 session, which will be the 14th annual meeting of this body. The exact date has not yet been decided upon, but it will probably be some time in October. The official call for the convention will be issued shortly, authorizing the appointment of delegates to the meeting by the President of the United States, Governors of the various states and territories, the Mayors of cities, and mining organizations, etc. It is pobable that this will be the last annual session of the Mining Congress to which outside delegates will be appointed, as the directors have for some time been working out plans which have in view the abolition of the delegate system, and permitting only members of the American Mining Congress to participate in [illegible]

Conference on Scientific Management.—A conference on scientific management is to be held at Dartmouth College Oct. 12-14, 1911. The following program of papers and discussions has been outlined: "The Principles of Scientific Management" by Frederick W. Taylor, Philadelphia. "The Task and the Proper Day's Work," by Henry L. Gantt, New York. [illegible] of Scientific Management," by Harrington Emerson, New York. "Types of Management: Unsystematized, Systematized and Scientific," by Henry P. Kendall, Norwood, Mass. "The Spirit in Which Scientific Management Should be Approached," by James M. Dodge, Nicetown, Philadelphia. Round Table Confer- [illegible] in Machine Manufacture; (b) Scientific Man- [illegible] tific Management in Shoe Manufacture; (d) Scientific Management in Printing and Publishing; (e) Scientific Management in Pulp and Paper Manufacture; (f) Efficiency in Lumbering and in the Management of Timber Properties; (g) Academic Efficiency. "The Application of the Scientific Method to the Activities of the State," by Frederick A. Cleveland, New York. "The Application of Business Methods to the Government of a Municipality."



Elevation and Plan of Bath House, Lincoln Park Bathing Beach, Chicago.

[illegible] specifications.

The bricks [illegible] three hours in a temperature of 100° F. before testing.

The Test.—The rattler shall be rotated at a uniform rate of not less than 29½ nor more than 30½ revolutions per minte, and 1,800 revolutions shall constitute the standard test.

A [illegible] rattler for counting the revolutions.

A margin of not to exceed ten revolutions will be allowed [illegible]

Stopping and Starting.—Only one start and stop per test is regular and acceptable.

The Results.—The loss shall be calculated in percentage of the original weight of the dried brick composing the charge. In weighing the rattled brick any piece weighing less than 1 lb. shall be rejected.

Design and Cost of a Bath House, Lincoln Park Bathing Beach, Chicago.

An attractive and economical building for the accommodation of the bathers at Lincoln Park, Chicago, is shown by the accompanying drawings. The Park furnishes bathing suits and accommodations free to the public. The idea of supplying several lockers for each dressing room or booth is unusual and in this way less booths are required to serve

The [illegible] sioners by day labor and the costs are given below. These costs include everything except electric wiring and lights.

Labor:	
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Material:	
[illegible]	[illegible]
[illegible]	[illegible]
Hardware	1,262.22
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The above labor was paid at various rates of wages. The carpenters and helpers rates varied from $2.50 to $5 per 8 hour day. The teamsters were paid about $60 per month. The [illegible] hour. Plumbers received from $2.25 to $2.75 per day. The foremens' time is distributed between this work and other work upon which they were engaged at the same time.

The *Electrical World* records the novel use of a large electromagnet to replace a steam shovel. At the Moose mountain iron mine, in Ontario, Canada, steam shovels were formerly used for loading the ore on to cars to be transported to the crushers. The density and hardness of the magnetite rapidly de- [illegible]

[illegible] slope to the base of the hill. Here, the electro-[illegible] the blocks of iron ore loading them into the cars. The magnet is capable of lifting 1,200 lbs. of pig-iron at a load, but the less magnetic character of the iron ore permits the [illegible] lbs. The magnet at the same time effects a rough sorting, since the rock and other non-magnetic matter are left behind.

Method of Canal Excavation Using a Locomotive Crane with a Dragline Bucket.

[illegible] tive crane has been put is as a revolving dragline excavator. The work upon which the machine is engaged is that of the T. A. Gillespie Co., on the New York Barge Canal at Palmyra, New York. The crane was bought for handling concrete but while waiting for the concrete work to begin it was put to digging a channel, 60 ft. wide on top and [illegible] 2,600 ft.

[illegible] April 14 and in the 12 working days of the month, excavated about 6,000 cu. yds. according to the state engineers' estimate. There were two crews em-[illegible]

1 engineer at $100 per month.
[illegible]
[illegible] per day.

[illegible]

[illegible] a 48 ft. radius, with 12,000 lbs. of ballast in the buck frame. It has a moving gear at-[illegible] gear, reversible link motion engine and spur [illegible] hand brake, and hand friction and the dragline drum is equipped with a foot brake to control the bucket while slacking out on the dragline while hoisting. The dragline drum [illegible] the engine and gears. The boom is equipped with two heavy special sheaves for the dragline, the sheaves being set in the lower left [illegible]

The bucket used is a standard Page bucket of 1 cu. yd. capacity. The material in which it works is a yellow clay for about 5 ft. in depth and below is gravel and blue clay. The bucket works well in the clay and the only objection found is in disposing of the soft mushy muck which remains after the heavier and more solid material has been removed. Water seeping into the pit continually keeps the lower portion of the cut quite soft.

[illegible] in charge of the excavation work.

PERSONAL.

[illegible]

[illegible] parish of Natchitoches, has resigned.

[illegible] Co., of Cambridge, Mass., manufacturers of [illegible]

[illegible] Summer St., Boston, Mass., has recently added [illegible]

It is announced that Mr. Alton S. Willer will [illegible] president of the Union Electric Light & Power Co., of St. Louis, Mo., on July 1, and, with Mr. A. C. Humphreys, of New York City, [illegible] Humphreys & [illegible] consulting [illegible] all matters pertaining to gas and electricity.

Mr. W. M. White, formerly of the I. P. Morris Co., of Philadelphia, has become manager and [illegible] engineer of the hydraulic [illegible] ment of the Allis-Chalmers Co. Mr. White is a member of the American Society of Mechanical Engineers, and is well known to the engineering profession as the designer of some of the largest hydraulic installations in the country.

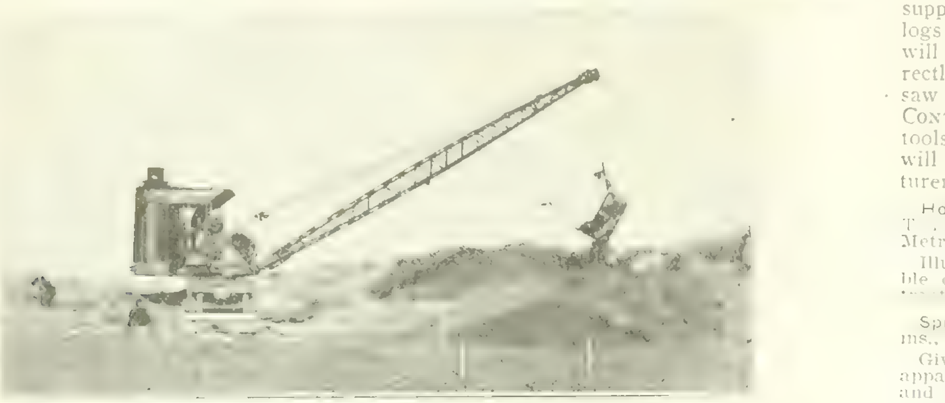
Mr. Hardy S. Ferguson, for [illegible] engineer of the Great Northern Paper Co., has established an office at 200 Fifth [illegible] New York, and will engage in practice as [illegible] ing engineer. He will devote his attention particularly to engineering work in connection with paper, pulp and fibre mills, including buildings and complete mechanical equipment, water power development, steam power plants, examinations, estimates of cost, designs, specifications and valuations.

Mr. Hilon A. Parker, formerly vice-president and general manager of the Rock Island [illegible] in Chicago on May 3. He was born in Plessis, N. Y., in 1842. He served through the civil war [illegible] lieutenant. During the same year he entered railroad work as vice-president and chief engineer of the Chicago, Kansas & Nebraska R. R. He remained with that road until 1885, when he became vice-president and general manager of the Rock Island system.

Mr. Niels Poulson, an engineer and iron manufacturer of New York City, [illegible] in Brooklyn, N. Y., on May 3. His death removed from Brooklyn a figure long identified with the business life of the borough. Mr. Poulson was born in Denmark [illegible] to this country in 1864. After working as a draftsman and designer for various companies he formed, in 1876, the firm of Poulson & Eger. [illegible] Iron Works. He took an active part in public [illegible] educational movements.

Mr. W. F. Kelly, general manager of the Oakland Traction Co., the San Francisco, Oakland & San Jose Connecting Ry., and the California Ry., severed his connection with this group of interurban railways on May 1. His resignation has brought about several changes in the administration of these roads. The offices of general manager and assistant general manager are abolished, and Mr. W. R. Alburger, vice-president, will have general supervision over all departments. Mr. J. O. Brown is appointed chief engineer of mechanical and electrical departments and purchasing agent. Mr. Edward M. Boggs is appointed chief engineer of construction and maintenance of way department. Mr. [illegible] Potter is appointed ge[illegible] superintendent of the rail and marine transportation department.

Mr. Alexander E. Brown, president of the Brown Hoisting Machinery Co., died at his home in Cleveland, Ohio, on April 26, as the result of a stroke of apoplexy from which he had suffered several weeks before. He was born in Cleveland in 1852, and received his preliminary education in the schools of that city. He took a course in civil engineering at the Boston Polytechnic Institute, graduating in 1872. Following his graduation he served for several years with the United States Geological Survey. He was later associated with various iron manufacturing companies. In 1879 he began working out the problem of unloading and handling of iron ore from boats. This resulted in his taking out, in 1880, patents on the Brown hoisting and conveying machines. Immediately following this, the Brown Hoisting Conveying & Machine Co. was organized and Mr. Brown devoted the remainder of his life to this company. During his later life he took an active interest in the development of trade schools in Cleveland. He was a member of the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the Engineers' Club of New York, and other engineering nad social organizations.



Brownhoist Locomotive Crane Operating as a Drag Line Excavator.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Hoisting Machine.—Paper, [illegible] ins., [illegible] pp. [illegible] Hoisting Machinery & Mfg. Co., [illegible] Metropolitan Life Bldg., Minneapolis, Minn.

Illustrating and describing a single and double elevator hoist, pulled by a horse, for con-[illegible] construction work.

Spray Nozzles and Strainers.—Paper, [illegible] ins., 16 pp. Buffalo Forge Co., Buffalo, N. Y.

Giving illustrations, descriptions of spraying apparatus and strainers. Tables of discharge and of prices are given.

Eclipse Mixers.—Paper, 6x9 ins., 32 pp. The Standard Scale & Supply Co., 111 Broadway, N. Y.

This is Bulletin Y-40, which illustrates and describes a low feed mixer as mounted for various purposes. The catalog embraces gasoline and steam engine driving equipment and contains tables of sizes, capacities, weights, etc. Bulletin Y-39 contains testimonials.

Second-Hand Machines and Equipment.—[illegible] ins., 4 pp. [illegible] Supply Co., Spokane, Wash.

A circular list of second-hand equipment for sale and wanted for sale.

Pumps and Engines.—Paper, 3½x6 ins., 32 pp. [illegible] Pump and Engine Works, Erie, Pa.

Illustrating a few of the combinations of the various styles and types of centrifugal pumps and engines which the company offers.

Symons Disc Crusher.—Paper, 7⅞x9⅛ ins., 20 pp. Symons Brothers Co., Milwaukee, Wis.

Illustrating and describing a new type of crusher for crushing rock embodying several new and unusual features. Tables of sizes, dimensions and capacities are given.

Building Progress.—Paper, 6¾x9¾ ins., 28 pp. National Fireproofing Co., Pittsburg, Pa.

A monthly magazine published by the above company describing structures built with hollow [illegible]

Catalogue Cabinet Service.—Paper, 6x9 ins., 16 pp. The Globe-Wernicke Co., Cincinnati, O.

Some suggestions on economy in preparing, filing and finding catalogs. Illustrated.

Rapid Loader.—Folder, 6x3½ ins., 8 pp. Thos. [illegible] Youngstown, O.

Illustrates and describes a chute which is attached to the side of a gondola car and filled, ready to discharge into a wagon, thus preventing loss of time. Prices given.

Waterproofing.—Paper, 3¼x6¼ ins., 24 pp. The Neuchatel Asphalte Co., Ltd., 265 Broadway, [illegible]

Illustrating and describing a special camera for commercial purposes. Prices given.

Rock Drills.—Paper, 6x9 ins., 16 pp. Ingersoll-Rand Co., 11 Broadway, New York.

Two rock drill catalogs recently published by this company are Form No. 4003, which deals with Little Giant drills, and Form No. 4016, which deals with the Imperial valveless telescope feed hammer drill, type "MC22." Both include complete descriptions of the drill, with notes on their construction. Illustrations are given. Each contains tables of sizes and di-[illegible]

CONTRACT NEWS SECTION

of

ENGINEERING-CONTRACTING

The Doings of the Week

[illegible] for its new line from Carlisle, Ia., to [illegible] miles. The contract was secured by MacArthur Bros. Co., Fisher Bldg., Chicago. Some 23 miles of the work have already been let to J. P. [illegible], Neb., and 20 miles to E. H. Wickham & Co., Council Bluffs, Ia.

The Erie R. R. has placed under contract a considerable amount of grading work in Ohio for second track. Contracts for this work have been awarded to the following: Bates & Rogers Construction Co., Chicago, Ill., for constructing grade for second track on the Cincinnati Division on the Erie R. R. from Milton to Summit, 6½ miles, and from Creston to Q. M. Tower, 9.2 miles. Ferguson & Edmondson, Brookville, Pa., for constructing grade from West Salem to Polk, 5.4 miles; Robert Grace Co., Cleveland, O., for construction of grade for second track from Barberton to Q. M. Tower, 9.2 miles, and from Ferguson to Hills, 3 miles. Among the other railroad construction contracts let recently are the following: H. C. McCrary & Co., Knoxville, Tenn., for the construction of additional sidings for the Southern R. at Roe Junction, east of Morristown, also at eight of the stations between Knoxville and Chattanooga; H. H. Leach & Co. for constructing the street railway system in Welland, Ont., for the Niagara Falls, Welland & Lake Erie Ry. Co.; Dunn & Lallande Bros., Birmingham, Ala., for constructing about [illegible] from Brookwood to Tuscaloosa, Ala., for the Tuscaloosa Mineral R. R., and Gus Olander for constructing 12 miles of standard gage railroad in Kalkasha County, Mich., for the Stearns Salt & Lumber Co.

Among the good prospects in the way of railroad construction work are the following: Nevada-California-Oregon Ry., which is planning to let contracts in about 30 days for the balance of its line to Lakeview, Ore.; the Pecos Valley Southern Ry., which may build [illegible] Jan. 1 next, and the Aroostook Valley R. R. Co. (electric), which contemplates building about 20 miles of line in Maine and 50 miles in Canada this season.

The U. S. Reclamation Service has rejected all bids received April 15 for building the Kachess Dam and accessory structures near Easton, Wash., and the work will be done by force account. The unit bids received on this work were given in our last issue.

Something in the way of a granolithic sidewalk contract has just been let by the city of Grenada, Miss. The contract calls for 75,000 to 150,000 sq. ft. of walk. The contract was let to P. C. Powers & Son., Memphis Tenn., at 13.2 cts.

Extensive river straightening work in Oklahoma County, Oklahoma, is proposed, and plans are now being prepared. It is proposed to straighten and deepen the river bed of the Canadian River on its whole course in Oklahoma County, similar to work now being done in Canadian County. In all about 23 miles of the river bed will be improved and it is estimated that the total cost of the work will be nearly $800,000.

A bill has been introduced in the New York Legislature to consolidate the forest, fish and game and water supply departments, forming a new branch of the state government to be known as the Department of Conservation. The executive head is to be the conservation commissioner and he is to act in co-operation with an advisory board composed of other state officials. The conservation commissioner, according to a statement accompanying the bill, is to appoint 10 deputies and each is to have charge of a bureau. The procedure for construction of storage reservoirs, recommended by the state water supply commission, has been embodied in the bill, together with existing statutes, after necessary modification, for river improvement and control over potable water supply. A companion bill authorizes submission to the people this year of a proposition to borrow not to exceed $20,000,000 by 50 year bonds for the construction by the state of storage reservoirs and hydraulic works. The income from such developments is to be paid into the sinking fund.

The Board of Water Supply of New York City is calling for bids for the completion of the Hudson siphon, a deep pressure tunnel in rock, 14 ft. inside diameter, extending under the Hudson River about 1,100 ft. below the water surface, with two shafts 3,022 ft. apart on the opposite shores, between Storm King and Breakneck mountains, in the towns of Cornwall, Orange County, and Fishkill, Dutchess County, New York.

Wouldn't This Get Your Goat.

[illegible] Winsted, Conn., snake stories is dead, but judging from the [illegible] spirit goes marching on:

[illegible] Puget Sound Electric Co. in clearing its right of [illegible]

State Aid for Dirt Roads.

[illegible] aid for dirt roads. The [illegible] shall aid the townships in [illegible] per mile. This bill covers every dirt road in the state, and as there are something like 90,000 miles of this kind of road in Pennsylvania, it will mean the expenditure of about $1,800,000 by the state if all of these roads are improved. At first glance it would seem that $20 per mile was a mighty small allotment for the improvement of even a dirt road. But experience has shown that the judicious expenditure of even such a small sum will work wonders in improving the average light traffic country dirt road. A concrete example of what can be done by the skillful use of the road grader and road drag is given below: The road is located in Waupaca County, Wisconsin, and was one of the worst stretches in the country round about. It was low and almost always wet and soft. The following description of how the road was put in shape is given by Mr. Arthur R. Hirst, Highway Engineer of Wisconsin: The road was a single wagon track with brush growing right to the ruts to begin with. The brush was cut out and the road plowed. When the sods had dried they were shaken out and thrown to one side. Three teams and four men then took a grader and turnpiked the ¾ mile that was to be fixed. It took them 1½ days to do all this. After each rain, the road supervisor took three horses and a split-log drag and went over it several times. He estimated that he had spent a total of about three days' time dragging. From this record (at Wisconsin wages) it is evident that the total cost of making ¾ mile of the best dirt road to be seen in the state was only about $25. After this the dragging alone will keep it in good shape and will cost not to exceed $6 per mile per year.

Bonus System at Los Angeles.

The bonus system of paying the laborers engaged in the construction of the tunnels on the [illegible] Los Angeles aqueduct worked so well that the Board of Public Works of that city has adopted bonus schedules for the work on the concrete conduit portion of the aqueduct. It is stated that four schedules have been adopted: In level ground a gang of 80 men will be required to complete 2,700 ft. of covered aqueduct each month, and for every foot over this required amount each man will receive a bonus; for open ditch level ground a gang of 72 men will be required to line 2,400 ft. each month; in side hill work the required amount per month is 1,700 ft. for a gang of 65 men; and where the conduit winds through boulders the required amount is 1,700 ft. per month for a crew of 72 men. In driving the tunnels for the aqueduct the bonus system was found to work advantageously in three ways: The time required for doing the work was greatly shortened, the Elizabeth Lake tunnel having been completed a year in advance; the men received $10 or $15 a month and sometimes much more over what would be their regular monthly wages; and the city actually saved money, as the bonus was actually less than the work would cost per foot if the men received only a stipulated wage and took their time about it. A further advantage of the bonus system was that only the most competent men worked in the crews [illegible] amount of the bonus depends on the willing work of the crews as a unit, the other members of the crew will not tolerate a shirk or an incompetent. To permit one of their men to loaf on the job means that the bonus will not be as large as if all work as fast as they can and the crew soon makes it so hot for a lazy man that he is glad to quit and look for another job.

Some pessimists are inclined to think that labor saving devices are invented by persons endowed with a large and active hookworm. In one case at least laziness was at the back of an important invention. It was a lazy switchman who hit on the idea that made the distance signal possible. In 1846 a switchman who had to attend to two station signals some distance apart, decided to save himself the [illegible] by fastening the two levers together by a long piece of wire. A broken iron chair served as a counterweight. The wire ran on into his hut, and there he sat nightly and worked the two signals without setting foot outside. This went on until he was found out, and reprimanded, and promoted.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

⊙The [illegible] Mineral R. R. Co., [illegible] has awarded the contracts for the construction of about 18 miles of railroad line from [illegible] to [illegible], necessitating an expenditure of more than $1,000,000, to [illegible] & [illegible] Bros., Birmingham, Ala. It has been announced that work will be started at once. F. G. Blair, Tuscaloosa, Ala., is President of the company.

Construction work on the Tidewater R. R. from East Lake to Bessemer is reported to have been started. MacArthur Bros. Co., New York and Chicago, are said to have the contract for the section from East Lake to Bessemer.

The Union Springs & Northern Ry., W. M. Blount, President, Union Springs, Ala., is reported to have completed arrangements for the extension of the new road which is being constructed between Fort Davis and Milsted. The steel rails have been purchased and will be delivered in about 30 days. Fourteen miles of grading have been completed. One-fourth of the bridges have also been completed and one-third of the ties delivered.

California.

The Southern Pacific Co. is reported to be planning to build a loop electric line of 15 miles, connecting Alum Rock Park, Berryessa, and San Jose, Cal. The line is to be double track, standard gage, and the cost is estimated at about $500,000. Paul Shoup, 431 South Hill St., Los Angeles, is Vice President, in charge of the electrical railways of the Southern Pacific Co.

Citizens of Bolinas are raising funds to build a drawbridge over the narrow channel of Bolinas Bay in order to secure the extension of the Mill Valley and Mt. Tamalpais Scenic Ry., George M. Dodge, Chief Engineer, San Rafael, Cal., to Bolinas. This railroad is now making preliminary surveys for its extension.

The Vallejo & Northern R. R. Co. has filed amended articles of incorporation increasing its capital stock from $2,500,000 to $10,000,000. Melville Dozier, Chico, Cal., is a director of the company.

The Coalinga, Monterey & Fresno R. R. has secured practically all its necessary right of way from Fresno to Coalinga. It is stated that immediately upon the securing of complete rights of way, grading for the first part of the railroad, from Fresno to Coalinga, will be started.

The Watsonville Railway & Navigation Co has filed its articles of incorporation with principal place of business at San Francisco and a capital stock at $200,000, with $5,000 subscribed. The directors named are as follows: F. E. Snowden of Oakland, C. P. Fisher and E. M. Heaney of San Francisco, Golden W. Bell of Berkeley and C. A. Shuey of Oakland. This is the company which has taken over the old Watsonville Transportation Co. as noted some time ago in these columns. The road is five miles long, running from Watsonville to Port Rodgers.

The Los Angeles Ry. Co., Los Angeles, is reported to have decided to build a line on Vernon Ave. from Sante Ave. to Vermont Ave., also on Jefferson St. from Central Ave. to Hoover St., on Hoover St. to Alvarado St., on Alvarado St. to 7th St.; also on Temple St. from Araminta St. to Hoover St. and on Virgil St. from Temple St. to 1st St., at Los Angeles.

Advices from Glendale, Cal., state that E. D. Goode, builder and owner of the Glendale & Eagle Rock R. R., has disposed of his interests in the line to the Western Empire Suburban Farms Association, who will start work on the extension of the line within 30 days from the date that the transfer papers are signed.

The Southern Pacific Ry. has made a proposition to the city officials of Sacramento, Cal., to construct wharves and warehouses on the river in the lower part of the city and turn same over to the city, payments being made by the municipality in installments. By this agreement the Western Pacific will have ample accommodations at the foot of Q street with room to spread and the city will have more wharfage to relieve the congested conditions at present existing.

Tracklaying has been resumed on the San Diego & Arizona R. R. Thirty-five miles of track has already been laid and the stretch now being built is 5 miles long to Valle Redondo, near Rock Springs. The contractors now are working on a 9-mile contract from Rock Springs eastward towards the Tecate Valley, and about 400 men are being employed. This number of men has been kept steadily at work in spite of the insurrectionary troubles in Lower California, and at no time has the revolt impeded or stopped the construction of this railroad.

Information received from Suisun, Cal., states that the Southern Pacific Ry. Co. has started double tracking the Sacramento-Benicia line which it is hoped will be completed within 6 months. The grading and the concrete culverts and bridges through the tule section between Suisun and Benicia, a distance of 18 miles, were completed last year, and there will be little work on that stretch except to lay rails and ballast. A few additional sidings and passing tracks will be constructed. The Suisun yards are to be enlarged so as to handle the transfer business of the California Northwestern when the line to Eureka is completed.

Georgia.

The Barnesville R. R. Co. of Barnesville has been chartered and proposes to build a 6 mile line from Barnesville to a point south of Piedmont. The incorporators include T. W. Cochran, R. A. Stafford and W. H. Mitchell.

The Cary North & South R. R. Co. of Cary, Ga., recently chartered, proposes to construct a line from Jeffersonville or Danville to Cary. H. R. Brown, Macon, Ga., is President.

Idaho.

Engineers of the Idaho & Washington Northern are making surveys for the construction of a new logging railroad west from Dalkena to Davis Lake. A right of way has been cleared along Davis Creek nearly to the lake and work of grading will be commenced soon, it is believed. W. C. Smith, Spirit Lake, Idaho, is chief engineer.

Illinois.

A proposition is under consideration for the construction of an interurban line between Pekin and Delavan. It is estimated that the preliminary survey can be made for about $400, and it is probable that a subscription for this amount will be taken at the two places named. John Fitzgerald, Pekin, and J. W. Crabb, Delavan, are interested.

A mass meeting has been held at Galesburg to take steps to aid in the construction of an interurban line from that city to Galva. Present plans provide that the project be financed by local capital. Mayor J. J. Lord of Galva, is a member of the committee that is pushing the matter.

The Waukegan, Rockford & Elgin Traction Co. is projecting a 150 mile line, the route being Waukegan to Marengo and Elgin and to Lake Geneva in Wisconsin. The contract for the first 15 miles has been let; contracts for the balance of the line will not be let until 1912. P. Ryan, Janesville, Wis., is the contrator for the first section. C. H. Patten, Palatine, Ill., is President; H. J. Farmer, Lake Zurich, Ill., is Chief Engineer, and J. K. Orvis, Waukegan, Ill., is Secretary.

Iowa.

⊙MacArthus Bros. Co., Fisher Bldg., Chicago, Ill., has been awarded the contract for constructing the St. Paul & Kansas City Short Line R. R. This road is to extend from Carlisle, Ia., to Allerton, Ia., a distance of 68 miles, and is to be built for the Chicago, Rock Island & Pacific Ry. The contract includes 5,000,000 cu. yds. earth excavation, 6,000 cu. yds. concrete masonry, and 153,000 lin. ft. of piling. MacArthur Bros Co. have let 23 miles of this work to J. P. Atkinson & Son, Omaha, Neb., and 20 miles to E. H. Wickham & Co., Council Bluffs, Ia. The remainder of the work is also to be sublet.

A special election is to be held at Keokuk, Ia., on May 25 to vote on extending the present franchise for the operation of public utilities in the city for 25 years. If the proposition carries, Stone & Webster, Engineering Corporation, 147 Milk St., Boston, Mass., financiers of the Keokuk water power project, will take over the properties, on which an option is now held. The new company proposes to spend $500,000 on reconstruction work.

The Chicago, Burlington & Quincy R. R. has completed plans for the erection of a two blocks long freight terminal between Sixth and Eighth and Market and Elm Sts., to be completed probably in time for the fall business. It is to be 500 ft. long, excluding loading and unloading platforms, and is to be equipped with every modern freight depot device for the rapid handling of freight of all descriptions. Brick will be the construction material used. The depot itself will cost $100,000, it is estimated, but the whole investment, including additional trackage and the newly acquired real estate, will reach $200,000 or $250,000, it is understood.

Judge W. R. Green of the District Court at Council Bluffs has ordered the sale of the Atlantic Northern & Southern Ry. at receivers' sale July 24 next. The road, about 75 miles in length, was promoted by farmers in the territory through which it runs. The headquarters of the road are at Atlantic.

Officials of the Rock Island Southern Ry., W. W. McCullough, General Manager, Monmouth, Ill., are to go over the route of a proposed extension from Aledo to Muscatine.

Kansas.

The Missouri & Kansas Interurban Ry. Co., W. B. Strang, President, 1121 Market St., Kansas City, Mo., has applied to the Kansas state board of railroad commissioners for permission to issue $300,000 of stock to double track from 39th St., Kansas City, to Overland Park, and reballast and retie the entire line, and for the acquisition of additional power equipment.

The Kansas state board of railroad commissioners will, on May 11, hold a conference with the Kansas railroads regarding a physical valuation of the railroad lines of the state Carl C. Witt was recently appointed Engineer of the Board.

Stockholders of the Gulf & Northwestern R. R. Co. at the annual meeting elected the following officers: William Walker, President; G. L. Calvert, Vice President; John Keeran, Secretary. J. F. Kimmel is Treasurer. Headquarters of the company are at Goodland, Kan.

Kentucky.

Advices from Richmond, Va., state that according to announcements made on May 3, plans for the extension of the lines of the Chesapeake & Ohio Ry. through a number of the counties along the Big Sandy division in eastern Kentucky, as well as double tracking the system from Cincinnati to Pikeville, have practically been completed. Among other improvements will be the building of the Shelby Creek branch of the road and a branch 12 miles long up Miller's Creek, for which surveys have been made. H. Pierce, Richmond, Va., is Chief Engineer of Construction, Chesapeake & Ohio Ry.

Louisiana.

The Town Council [illegible] Donaldsonville has granted the right of w[illegible] [illegible]ver the town levee to the Mississippi & [illegible] Ry., better known as the "Motor Car Line," to be constructed from Leesville to Donaldsonville on the west bank of Bayou La[illegible]

The Police Jury of Calcasieu Parish has granted a one year extension for the Lake Arthur, Jennings & Northern R. R. to complete its line. This road is being constructed by E. P. Fox, of Jennings, La.

The lease of the Louisiana Southern Ry. to the St. Louis & San Francisco R. R., mentioned in our last issue, will mean the expenditure of a considerable sum of money by the latter road for the improvement of the terminal facilities acquired by the lease. The price paid for the lease is said to have been $2,000,000 for the 40 miles of track owned by the Louisiana Southern, and it is also said that the Frisco will spend about twice this amount in improving the terminals and docks in St. Bernard Parish, about 20 miles below the Chalmette slips.

Maine.

Grading work has been started at Deering Junction for the new Portland, Gray & Lewiston R. R. The road is being built by Libby & Dingley of Lewiston, and C. H. Barron of the same place is Chief Engineer with his brother, G. H. Barron, as assistant. L. S. Ferguson is Superintendent of Construction. The bridge work is being done by the Fred T. Ley Co., of Springfield, Mass., with Walter M. Denman of the same city as Consulting Engineer.

The Aroostook Valley R. R. Co., mentioned in our last issue, has secured charter rights to build about 200 miles of railroad. The company, however, contemplates building only about 20 miles in Maine and 50 miles in Canada this season. A. R. Gould, Presque Isle, Me., is President.

Maryland.

Work of clearing the right of way for the Towson & Cockeysville Electric Ry. has been started at a point between Towson and Lutherville, and it is expected that the line will be completed to the Temonium fair grounds by Sept. 1. The J. H. Harlow Contracting Co. has the clearing contract.

Massachusetts.

The mayor and the members of the City Council of North Adams, Mass., have signed a petition to the Berkshire Street Ry. Co., Pittsfield, asking the company to extend its tracks from North Adams to Wilmington, Vt.

Michigan.

⊙Advices from Kalkaska, Mich., state that Gus Olander has been awarded the contract for the construction of 12 miles of standard gage railroad in Kalkaska County for the Stearns Salt & Lumber Co. It is expected to have the work finished about the middle of the summer.

Minnesota.

The Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Co., M. W. Savage, President, International Bldg., Minneapolis, now operating 40 miles of line, has construction gangs now working between Northfield and Owatona, Minn., and it is expected the latter point will be reached by July 1. Construction capital is reported to have been secured to carry the line through to Rochester, which point it is expected will be reached by Nov. 1. The objective of the road is Dubuque. When it will have been put through to Rochester, 133 miles from Minneapolis, it will be nearly half finished, the distance to Dubuque from Rochester being about 167 miles.

Thoreen & Sandeen of Stillwater, Minn., have gone to Sandstone, Minn., which will be their headquarters while they are fulfilling a contract for the Soo road on the Duluth-Frederic extension. The contract will not be completed until fall.

Mississippi.

At a special meeting at the Chamber of Commerce of N[illegible] W. [illegible] Thos. Reber, John F. Jenkins and C. R. Byrnes were appointed to confer with the Port Adams committee in an effort to secure an extension of the Louisiana Railway & Navigation C[illegible] from Baton Rouge to Natchez.

Missouri.

Surveys have been started by the Bismarck-Bellevue Valley & Western Ry. Co., to locate the line from Bismarck to Caledonia, Belgrade and west to the proposed terminus. The road will be an interurban standard gage, and no grade is to be over 1½ per cent. The road will be of first-class construction throughout. The organization has been completed, and articles of incorporation will be filed at once. It is understood that the road for the present will be 22 miles long.

The Kansas City, Ozark & Southern Ry (electric), J. B. Quigley, Chief Engineer, Ava, Mo., is to start surveys shortly with a view to extending the road southwest to Forsythe in Tamey County.

It is expected that construction work on the Shelbyville & Northwestern R. R., recently incorporated, as noted in these columns, will be started this month. This line, which is to be an extension of the Shelby County R. R., will be 15 miles long, and will cost about $180,000. The road will run from Shelbyville to the north line of Shelby County. Louis B. Houck, Shelbina, Mo., is President.

Surveys are to be started shortly, it is understood, for the proposed electric railway between Warsaw and Springfield. As projected, the route follows the Pomme de Terre river south from Warsaw through Hickory and Polk counties, touching at the principal towns in line between Warsaw and Springfield. B. Orlando Taylor, Cross Timbers, Mo., is the promoter.

Ordinance is before the City Council of Kansas City, Mo., requiring the Metropolitan Street Ry. Co. to build its own viaduct and electrify the 12th St. line west of Broadway to the stock yards. The ordinance provides for the reconstruction of the company's present viaduct. It is to be finished in six months' time, and it is to have a side-walk 5 ft. wide for the accommodation of pedestrians.

The Jefferson City Bridge & Transit Co., Jefferson City, Mo., is extending its street car line for a distance of one mile. A further extension to the Ruwalt ball park is also planned.

Montana.

It has been announced that the Northern Pacific will at once begin work ballasting 200 miles of track on the Yellowstone division, namely the portions from Yates to Glendive, Mont., and from Shirley to Billings, Mont. The cost of the improvement, according to estimates will be about $300,000. E. M. Grime, Glendive, Mont., is Division Engineer.

Nebraska.

It is reported in Benkelman, Neb., that the Garden City & Northern is making good progress on its proposed line and has nearly completed grading from Russell Springs to Winona and efforts are being made to complete the work as far as Goodland, Kan., this summer.

It has been announced in Kearney, Neb., that the Union Pacific R. R. will extend its line beyond Callaway and construction work will commence as soon as right of way can be secured. A. L. Mohler, Omaha, Neb., is Vice President and General Manager of the company.

New Jersey.

⊙F. D. Hyde, Newark, N. J., has been awarded a contract by the Public Service Ry. Co., Newark, for building the proposed new carhouse on the north side of Springfield Ave., near 43rd St. It is understood that the contract price is about $150,000. The new building which is to be built of brick, steel and concrete will be 200 by 362 ft. in size. It will include in addition to the carhouse, which will have storage facilities for 120 cars, an office building and repair shops. It is expected that it will be completed by Dec. 1 next.

Maher & Ackerman, electrical overhead contractors, Syracuse, have undertaken the construction of the trolley system from Mahwah, N. J., to Suffern, N. Y., under contract with the North Jersey Construction Co. Maher & Ackerman will go to Paterson, N. J., and commence work at once.

The Morris County Traction Co., Morristown, N. J., has applied to the Common Council of Summit for appropriate legal action by council for the acquirement of 15 ft. of land on the southerly side of Park Ave. from Overlook road to the easterly line of Maple St. This strip, about 1,500 ft. in length, is required by the traction company for the widening of Park Ave. in the center of which a double track extension of the trolley line is to be constructed from the present terminal of the line to Maple St.

The Pennsylvania R. R. has tentative plans under consideration for improvements at Trenton, which will involve the expenditure of about $500,000. The changes include the abolishment of the Perry St. grade crossing, the abandonment of the canal lock at East State St., the depression of the canal from East State St. to a point between Perry St. and the Belvidere division trestle, the lowering of the grade at Perry and State Sts. at the point where they cross the canal and railroad, the elevation of the viaduct over the main line near the Greenwood Ave. bridge and an extension of the freight station.

New Mexico.

It is thought that construction will soon be resumed on the Albuquerque Eastern R. R., now that the court decision segregating its receivership from the New Mexico Central has been handed down. Former Governor M. A. Otero of Santa Fe has been appointed as receiver of the properties of the Albuquerque Eastern R. R.

Surveyors are running lines for the construction of a railroad from Chamita, N. Mex., on the Denver & Rio Grande R. R. up the Chama River and then along the Rio Del Oso to the Sierra de la Gallina near the summit of the continental divide. J. W. Mullens, Colorado Springs, Colo., is interested.

New York.

The International Traction Co., Buffalo, N. Y., has applied to the City Council of that city for a franchise to operate a double track overhead trolley line in the Abbott Road, between Cazenovia St. and the south city line. The line would be about 1¼ miles long.

The Syracuse, Watertown & St. Lawrence River R. R. Co. has been incorporated with a capital stock of $1,250,000, the directors for the first year being Harold C. Beatty of Skaneateles, Nathan Abelson, William W. Foster, Martin H. Knapp, J. Stanley Moore, Edwin Nottingham, Henry D. Brewster and W. C. Gray of Syracuse, and F. K. Hiscock of North Yakima, Wash. The company was incorporated to build the extension of the Syracuse & South Bay R. R., C. D. Beebe, President, Syracuse, to Brewerton. The new road will use the tracks of the Syracuse & South Bay R. R. from Syracuse to Stop No 9, at which point it will branch off on its own tracks to Cicero and Brewerton. The distance from Stop No. 9 to Brewerton is 6⅓ miles. Surveys having been completed and plans for construction being well under way, it is probable that actual operations on the roadbed will be begun at the Stop 9 end as soon as the necessary permission for the building and operation of such a road is secured from the Public Service Commission of the Second district.

Charles H. Petitt of Welland, Ont., and William C. Perkins of Niagara Falls, N. Y., have applied to the Stamford Township Council for a franchise for the Niagara Frontier Electric Railway Co., which purposes to build [illegible]

North Carolina.

Surveys have been started for a railroad to [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] The length of the line is to be about 35 miles, and it will penetrate deposits of iron ore, [illegible] ern syndicate is at the head of this movement. R. L. Dyer, Johnson City, Tenn., is engineer.

The North Carolina Public Service Co., Greensboro, N. C., is to start work at once [illegible] Greensboro. Orders for the material have been placed.

Ohio.

⊙The Erie R. R. has recently let the following contracts for work in Ohio: Bates & Rogers Contracting Co., of Chicago, Ill., for constructing grade for second track on the Cincinnati Division on the Erie R. R. from Milton to Summit, 6.5 miles, and from Cres[illegible] to Ferguson & Edmondson of Brookville, Pa., for constructing grade from West Salem to Polk, 5.4 miles; also contract to the Robert Grace Co. of Cleveland, O., for construction of grade for second track from Barberton to Sherman, [illegible] miles, and Tallmadge to Hills, 3 miles.

A proposition has been laid before the business men of New London looking to the building of an electric railway from New London to North Fairfield to intersect the Sandusky, Norfolk & Mansfield Electric Ry. at that place. The road would be 11½ miles in length and the proposition submitted for consideration was as follows. The construction of the road would cost $160,000. Those interested outside the territory covered by the road would assume $60,000, leaving $100,000 to be assumed by citizens or anyone interested in the purchase of five per cent bonds. Right of way to be purchased in addition to the $100,000. Sherman Culp, Norwalk, O., President of the Sandusky, Norfolk & Mansfield Electric Ry., is interested.

Cleveland & Pittsburg R. R. Co., is reported to be now purchasing right of way for the construction of a low-grade cutoff from Smith's Ferry, Pa., which is at the Ohio-Pennsylvania State line and the Ohio River, through Columbiana County to Kinsington, a small station south of Alliance, O. Funds for the proposed improvement will be derived from the increase in the capital stock from $22,000,000 to $40,000,000, now under consideration.

It has been announced, according to reports, by officials of the Lake Erie & Pittsburg, that work will be resumed soon on the construction of the main line from a point 40 miles east of Pittsburg where work was stopped three years ago. Funds for the project will be derived from any issuance of $16,000,000 of bonds and $5,900,000 of stock. Samuel Rockwell, Cleveland, O., is Chief Engineer of the company.

Work has been started by the Cleveland, Cincinnati, Chicago & St. Louis Ry. laying new rails between Marion, O., and Ridgeway and the line will be rushed through to completion.

Work is reported progressing nicely on the double track which is being installed on the low grade of the Lake Shore & Michigan Southern between Latimer and Dorset, O., and it is believed that work will be completed in September.

The Cleveland, Akron & Columbus Ry., R. C. Harris, Engineer Maintenance of Way, Akron, O., is reported to be planning to extend its second track work south from East Union.

It is probable that the city of Dayton, O., will vote this fall on issuing $350,000 of bonds for grade crossing elimination work. The cost of the work is estimated at $1,000,000.

[illegible] being made with the plans for the elimination of grade crossings at Youngstown, O., and it is expected that the [illegible] submission to the City Council and railroads this month. F. M. Lillie is City Engineer of Youngstown.

[illegible] Cincinnati, Chicago & St. Louis Ry., Geo. P. Smith, Chief Engineer, Cincinnati, O., has applied to the County Commissioners [illegible] right of way over several roads in the eastern part of Butler County. The purpose of the application is the se[illegible] way between [illegible] Sharonville, a distance of about nine miles. This change contemplates the eradication of numerous curves and grades, the erection of at least 20 new bridges and the expenditure in all of about $1,000,000 in these improvements.

The Cincinnati, Hamilton & Dayton Ry. Co. is reported to have changed its plans regarding the proposed double tracking of the Toledo end of the line, in that the improvement will begin at Deshler and extend north from that station instead of North Baltimore. Deshler is a junction point of the C. H. & D. and the Baltimore & Ohio, and is on the main line of both systems. North Baltimore is the terminal point of a short branch of the C. H. & D. and is a junction point with the B. & O. as well. It was the first intention to double track from North Baltimore, which would have made a slightly shorter haul for the coal traffic of the B. & O. which is to be diverted from Sandusky to Toledo. Apparently the other route is considered the most feasible. The distance from Toledo to Deshler is 45 miles.

Berton C. Harding and Albert E. Royce of Bowling Green have been appointed receivers of the Lake Erie, Bowling Green & Napoleon R. R. Co. The company is capitalized at $1,000,000 and has an authorized bond issue of $1,000,000, of which $400,000 has been issued.

Oklahoma.

The Missouri, Kansas & Texas Ry. system is to send agents to Pawhuska to investigate the amount of tonnage, etc., that would go to a branch line to that place. Business men of Pawhuska have asked the M., K. & T. to change the main line to Oklahoma City so that it will go through Pawhuska. The proposed change would necessitate the rebuilding of 17 miles of roadbed in Osage County, at a cost of $312,000, besides the right of way and settlements with interests along the present route. Instead of such a change officials of the railway suggested a spur to Pawhuska or an extension through Pawhuska westward to Enid.

Sanderson & Porter, Engineers, New York City, are reported to have arranged for the purchase of the Comanche Light & Power Co.'s property and the Lawton & Fort Sill Electric Railway Co.'s rights and assets. The purchasers plan to complete the construction of the electric railway and to put both the properties on a first-class operating basis.

The Kansas City, Southern Ry. is considering the construction of an extension of its line from Texarkana, Texas, to Oklahoma City, a distance of 200 miles.

The Clinton & Oklahoma Western, which has completed 22 miles of line from Clinton to Butler at a cost of $300,000 is planning to secure the necessary capital for the extension of the system. C. H. Lamb, Clinton, Okla., is Secretary of the company.

H. A. Noah, Alva, Okla., promoter of the proposed railroad crossing the northern counties of Oklahoma through Bartlesville, Pawhuska, Ponca City, Pond Creek, Cherokee and Alva, has left for Europe, where he hopes to interest capital in the proposition.

Oregon.

The Portland & West Coast R. R. Co. is securing right of way for its projected line from Willamina, the terminus of a Southern Pacific branch line operating out of Sheridan Junction, to Pacific City, on the ocean shore, about 35 miles northwest. J. H. Fitzgerald of Portland is interested.

The Nevada-California-Oregon Ry. is planning to let contracts in about 30 days for the balance of its line to Lakeview, Ore. Geo. S. Oliver, Reno, Nev., is Chief Engineer. The Hall Construction Co., Lakeview, Ore., is working on contracts for a portion of the [illegible] Nevada-California-Oregon Ry. at the present time.

The Willamette Valley & Coast Railroad Co. has, according to reports from Forest Grove, Ore., let the contract for the construction of 2 miles of railroad from Gaston to Cherry Grove, where the Lowegren Lumber Co. is to build a large plant.

The Spokane, Portland & Seattle Ry. has under consideration the improvement of the Lyle-Goldendale branch including the construction of a new depot at Centerville and the laying of new rails from Lyle to Warkick. R. Budd, Portland, Ore., is Chief Engineer.

All grading has been completed on the Oregon-Washington Railroad & Navigation Co. Troutdale Cutoff and it is expected to have the line in operation by June 1.

Pennsylvania.

✣Bids are to be opened at noon, May 10, by W. Hunter, Chief Engineer Philadelphia & Reading Ry., 520 Reading Terminal, Philadelphia, for the following work in connection with the abolishment of grade crossing on the Richmond Branch Elevated at Philadelphia. Contract No. 24—Masonry walls and abutments between Trenton Ave. and Richmond St. Contract No. 25—Bridges ready for ballast over Aramingo Ave., Belgrade and Thompson Sts.

Engineers have been laying out a contemplated low-grade line for the proposed Philadelphia, Bethlehem & New England R. R. The line is to extend from Bethlehem to Quakertown, via Pleasant Valley.

The Select Council of Pittsburg has passed the bill giving the Pittsburg Rys. Co. the right to lay tracks in Diamond St., from Smithfield to Wood St.

The Hellertown & Richlandtown Electric Ry. Co., of Hellertown, has been chartered with a capital stock of $36,000 and proposes to build a 6-mile line extending from the terminus of the Lehigh Valley Transit road at Hellertown, through Leithsville, Passer and Richlandtown. The incorporators are Justice A. R. Trumbauer, Benjamin Huttel, Jacob Apple and Eugene Leith.

The Pottstown & Phoenixville Ry. Co. has been chartered and proposes to construct and operate a street railway in the township of Lower Pottsgrove. The incorporators are Geo. N. Malsberger, president of the Security Trust Co., and Harry F. Sweinhart, of Pottstown, and C. Taylor Leland, of Philadelphia. This is a step in the plans to build the trolley link from Spring City to Sanatoga via Royersford, thus connecting the Pottstown & Reading Street Ry. line with that of the Montgomery & Chester, from Spring City to Phoenixville.

Rhode Island.

The amendment to the charter of the Southern New England R. R. (the new line by which the Grand Trunk Ry. will reach Providence), giving the road a clear path to tidewater, in Providence, was presented in the State Legislature on May 2. The amended act, which is the result of an agreement between the Grand Trunk and the New York, New Haven & Hartford R. R., gives the Canadian road the right to cross the tracks of the New Haven at one point and run under them at another, at which the New Haven will pay the additional cost of tunnel-[illegible]

The New York, New Haven & Hartford R. R. is reported to be planning to have work started in June on improvements at Westerly, R. I., which will involve the expenditure of about $300,000. The work calls for the erection of a new station, the plans including the elimination of the Canal St. grade crossing. The new station will be located about 75 ft. west of the present site and will be some 100 ft. long with an 800-ft. platform extending nearly to the Connecticut line. There will be a greatly enlarged freight yard and a new freight station.

South Carolina.

As noted in our May 3 issue, preliminary surveys have been made for an electric railway to extend from Abbeville to Antreville, 14 miles. The company has not been organized as yet, nor have any definite steps been taken. W. H. H. Newell, Anderson, S. C., is the engineer.

South Dakota.

Surveys have been completed for the construction of the proposed line of the Chamberlain-Huron Ry., as noted some time ago, and steps are now being taken by E. E. Dye, Chamberlain, S. Dak., to secure necessary right of way. City of Huron, S. Dak., is asked to provide 10 miles of the necessary right of way.

Tennessee.

⊙H. C. McCrary & Co., Knoxville, Tenn., have been awarded the contract for the construction of additional sidings for the Southern Ry. at Roe Junction, east of Morristown, also at eight of the stations between Knoxville and Chattanooga. There are eight of the sidings to be put in between Knoxville and Chattanooga. It is said that the work of extending the sidings will be completed within the next 90 days.

Advices from Memphis, Tenn., state that contracts are to be let at once for constructing the Rayburn Blvd. subway. The contract for the Mississippi Blvd. subway is to be let about 30 days later. J. Heishell Weatherford is City Engineer of Memphis.

The City Council of Chattanooga has passed over the Mayor's veto the James franchise for another and competing street railway system for Chattanooga, and it is promised that work on the new system will be started at once or in the near future. Mr. James is now in New York making plans for the building of that road. It is understood that the system contemplated [illegible] lines.

Texas.

Citizens of Palestine, Tex., are considering raising a bonus of $30,000 to secure a street car system for the place. Ralph E. Hoskat, Dayton, O., is the promoter.

The Gulf, Texas & Western Ry., B. B. Cain, General Manager, Dallas, Tex., now operating 75 miles of line between Jacksboro and Seymour, is reported to have its plans well along for several important extensions. These are said to include a line about 100 miles in length, a branch line to Fort Worth, and another line of 150 miles running west from Seymour to Lubbock, in the Panhandle. The road and much of the coal lands that lie along the route belong to a syndicate of Pennsylvania capitalists, headed by J. J. Jermyn, of Scranton, Pa. The proposed construction is being undertaken to secure an outlet for the coal shipments.

The Beaumont Lumber Co., Beaumont, has secured a contract from the Jamaican government for supplying 2,000,000 ft. of timber and lumber, which will be used by the Jamaican government in making an extension of the railroad which it owns.

The Texas Central R. R., C. Hamilton, General Manager, Waco, Tex., has applied to the State Railroad Commission for a revaluation of its entire line for improvements and for permission to issue and register bonds on extensions. No amount is specified, but it is understood that the road desires about $6,000,000 additional. It is expected that certain extensions will be authorized shortly. An extension west from Rotan and either to Abilene or Sweetwater is said to be looked upon with favor. South from Waco a line to the gulf with the Beaumont & Great Northern as a connecting link, may also be built.

Construction work is to be started in June on the procted 12-mile electric railway from Haskell, Tex., to Rule. Surveys for the line have not been made as yet. M. R. Hemphill, Haskell, Tex., is the promoter.

No definite decision has been reached as yet regarding the extension of the Pecos Valley Southern Ry. It is possible, however, that the company will build 60 additional miles of line between June and Jan. 1 next. W. L. Carwile, Dallas, Tex., is President and General Manager.

Citizens of Cleburne, Texas, have decided, providing the proposed railroad is built from Glen Rose to Fort Worth, to build a 10-mile line connecting with that road.

It is believed that the St. Louis Southwestern Ry., W. T. Eaton, Chief Engineer, Tyler, Tex., will shortly award a contract for a line from Stephenville to the Thurber coal fields, about 30 miles.

Arrangements are being made for an extension of the Crystal City & Uvalde R. R., A. R. Ponder, General Manager, Crystal City, Tex., from Guadalupe to Dulls, a distance of about 25 miles. It is thought that work will be started at an early date.

A bonus of $60,000 has been raised by the farmers and land owners of Santa Maria for the construction of a motor car line to connect with the line now being constructed at San Benito. R. H. Kein of St. Louis, Mo., one of the large land owners at Santa Maria, is behind the move.

The citizens of Linden have signed a contract with the Jefferson & Northwestern R. R. for the extension of this road to Linden. Linden gave a bonus of $7,500 and the right of way in the county and ten acres in the town for depot and terminal purposes.

Utah.

S. B. Ulmer of the Oregon Short Line staff of Engineers and citizens of Logan, Utah, interested in the construction of the proposed Benson cutoff between Logan and Cache Junction have been conferring in regard to the route. While no route was officially selected a preference was expressed for the so-called north route, which will run through the south side of Benson. It will leave the main line three miles south of the Junction and run direct from there to Benson and then take a turn toward Logan. The rights of way for the road are now being secured.

Work has been completed on the tunnels of the Bingham & Garfield R. R. and nearly all the track is laid from Markham Gulch to Dry Fork, a distance of more than a mile. The new road which required an expenditure of $3,000,000, will shorten the distance between Utah Copper Mine and the Garfield smelter fully 7 miles. Between Markham gulch and Dry Fork four tunnels have been drilled through solid rock. The bore is 18 ft. wide by 22 ft. in height. Tunnel No. 1 is 1,280 ft. long and extends to Freeman gulch. It has a curve of six degrees. Tunnel No. 2 from Freeman to Smelter gulch, is 2079 ft. long. Tunnel No. 3 is 754 ft. long, and tunnel No. 4 is 680 ft. in length with a curve of three degrees. A steel bridge already spans Carr Fork, carrying the rails of the new road into the yards of the Utah Copper mine.

Virginia.

Supplemental articles of incorporation have been secured from the State Corporation Commission by the North Carolina-Virginia Railway Co. The original charter, secured in December, had a nominal capital stock of $2,000 to $5,000. This has been increased to $100,000 as the minimum and $500,000 as the maximum. The charter gives the right to build a line between the North Carolina border and the town of Ridgeway, in Henry county, a distance of six miles. The principal office was moved from Ridgeway to Roanoke, but no additional powers were asked to extend the road to Roanoke.

The Tuckahoe & James River R. R. is reported to be taking bids for the construction of nine miles of line from Carbon Hill to Laurel, Va. Wm. G. Woolfolk, Lorraine, Va., is President.

The stockholders of the Norfolk Southern R. R. have voted to join with the Norfolk & Western and the Virginia Rys. in guaranteeing an issue of bonds not to exceed $2,000,000 of the Norfolk Terminal Ry. for the erection of the proposed new union depot at Norfolk.

The Washington & Old Dominion R. R. Co. has been chartered with a capital stock of $2,000,000 and proposes to build a line from Winchester to the Potomac River in Alexandria county, [illegible] Alexandria, Fairfax, Loudoun, Clarke and Frederick, with such lateral or branch lines as may be deemed necessary, or expedient. The length of the main line is estimated at about 90 miles. The officers are: Charles M. Henley, president; William B. Emmert, vice-president; George Howard, treasurer; Charles E. Howe, secretary, all of Washington, D. C. The above officers, with Hugh A. Thrift, also of Washington, compose the board of directors of the road. The principal office and headquarters of the road will be located at Roslyn, Alexandria county, Va.

Washington.

⊙Watson, Flagg, Standifer & Co., Spokane Hotel, Spokane, Wash., and 310 Wells-Fargo Bldg., Portland, Ore., as noted in our April 19 issue, have been awarded a contract for work on the North Coast R. R. (Oregon-Washington R. R. & Navigation Co.'s line). This work is on the Spokane-Ayer Junction Line and is located between Spokane and Cheney. The contract includes 634,000 cu. yds. earth excavation, 385,000 cu. yds. rock excavation, 40,000 cu. yds. loose rock excavation, three railroad crossings of concrete abutments and steel girders, and 350 cu. yds. concrete masonry.

Property owners at Seattle interested in the movement to construct a street railway line from Oxbow to the Lake Burien district have organized preparatory to proceeding with steps to build the road as soon as a franchise is secured from the county. William H. Murphy, Seattle, is chairman of the committee.

Surveys are under way for a railroad from Ellensburg to a sawmill which is to be constructed at the mouth of the Nanum canyon. From the latter place the line will continue up the canyon to the summit of the Wenatchee Mountain. The road from the mill to the summit will be a logging railroad but from the mill to Ellensburg the railroad will be a common carrier. Foreign capital, it is said, is interested with the Waltheur Lumber Co., which owns a heavy tract of white pine on the Nanum ridge. Robert E. Cravette, Seattle, Wash., is in charge of the surveys.

A company of Milwaukee capitalists, represented by A. M. Wehe, Pasco, is considering building a system of electric lines radiating from Pasco and connecting that city and Kennewick with Walla Walla and intermediate towns. The plan would necessitate building a bridge across the river connecting the twin cities.

Orrin E. Stanley, C. E., Chamber of Commerce Bldg., Portland, Ore., has completed the location survey for a 3-mile extension of the logging railway for the North Fork Logging Co. of Vancouver, Wash. The maximum gradient is 5½ per cent and the sharpest curve 23°. Construction by company forces has already been begun.

At a recent hearing of the Railroad Commission it was brought out that plans are being made by the Spokane & Inland R. R. for the construction of the line down the Spokane River to the Columbia. Rights of way have already been secured. A. M. Lupfer, Spokane, Wash., is Chief Engineer.

The Milwaukee System has 2,000 men employed on its projected line from North Bend to Snohomish, Wash., endeavoring to complete the stretch of track ready for operation by July.

J. C. Barton, Twisp, Wash., President and General Manager of the Methow Valley & Washington Northern Ry., is quoted as stating that work would be started shortly on the projected line for which surveys have been completed and nearly all right of way secured. It is hoped to complete the road which will run through the Methow Valley from Winthrop to Pateros within the next year.

West Virginia.

The [illegible] Co., of Grafton, W. Va., has been chartered with a capital stock of $500,000, and proposes to construct a railway to connect Grafton with Fairmont and Clarksburg. The incorporators [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

port, W. Va.; Arthur Staley, Austin C. Merrill, H. P. Keenan, Fairmont; Charles F. Sutherland, Morgantown; C. Lee Reynolds, Flemington, W. Va.; J. M. Roberts, Morris W. Head, John G. Leasure, Charles G. Ben[illegible] William Stark, New Kensington, Pa.

Wisconsin.

It is now expected that the Chicago & Northwestern's belt line around Milwaukee will be completed and ready for use by Sept. 1. The grading work under the direct supervision of John Marsch of the John Marsch Co., Chicago, will be completed before June 1. Most of the work at present is centered around Butler and on the bridges and steel work of the new line. It is said that the company would [illegible] the construction work at Butler before Sept. 1. The new town will be the terminal freight station. There will be 23 miles of track in the Butler yards. Work on the 60-stall roundhouse is well under way.

The Von Platen Lumber Co. of Iron Mountain will build a logging railroad into Florence County a distance of about four miles to tap a tract of timber. The logging road will connect with the North-Western road at Pentega.

The Johnson-Carey Co., St. Paul, have moved an outfit onto their contract for grading for the second track of the Omaha between Necedah and Wyeville.

Canada.

⊙The Niagara Falls, Welland & Lake Erie Ry. Co. has awarded the contract for constructing its street railway system in Welland, Ont., to H. H. Leach & Co.

A syndicate has been formed in London for the construction of a railway from the Saguenay River to Cape Charles Bay, on the east coast of Labrador, a point 650 miles from Quebec. Montreal people, including Rodolphe Forget, are interested in the enterprise, which will connect with the Quebec & Saguenay line, which M. J. O'Brien of Ottawa, Ont., will build during the next 18 months to Murray Bay.

The Canadian Pacific Ry. has awarded contracts for tearing down or removing about 60 houses in the section bounded by Cherry, Front, Overend, and Tate Sts., at Toronto, in order to clear the ground for the construction of new freight shed and yards. The space to be cleared has an area of about 1½ acres, and it is intended to close Tate and Water Sts. The freight shed will be 300 ft. long by 30 or 40 ft. wide, and a contract for its construction has been let to George Martin, Smith's Falls, Ont.

The Grand Trunk Ry., H. G. Kelley, Chief Engineer, Montreal, Que., has submitted plans to the Dominion Railway Commissioners and the officials of Montreal for improvements to its terminal facilities in that city, which will involve the expenditure of about $10,000,000. The improvements include the elevation of the tracks between Bonaventure Station and the Turcot yards, and from St. Henri to the Point St. Charles yards; also the building of new freight and passenger terminals at Bonaventure.

Advices from Lethbridge, Alta., quote A. M. Grace, Chief Engineer of the South Alberta Land Co., as stating that the survey is completed and stakes driven for a railway line from Kipp, across the river from Lethbridge, to Suffield, on the Canadian Pacific main line, bringing Lethbridge into direct communication with the irrigated tract of land.

The Cowan Construction Co., Winnipeg, Man., which has the contract for the first 40 miles of the new Canadian Northwest line towards Peace River, is to start work at once. The new line towards Peace River has been located for a distance of 80 miles northwest of Edmonton. The line leaves the main line at Onoway, about 30 miles west of the city, and runs northwest to Pembina and to the Athabasca River, and crosses at Habaska, 30 miles below the mouth of the McLeod River. It is understood to be the intention of the railway company to push this line forward as fast as possible, and to have at least 40 miles completed this year. The survey of the line is to be carried through next year to Dunvegan on the Peace River, and eventually through Pine Pass to the Pacific coast.

ROADS, STREETS AND PAVEMENTS

California.

⊙The County Supervisors at Los Angeles, Cal., have awarded the following contracts for two links in the county system of good roads: Peter Walker, for section 3 of the Foothill Blvd., for $21,642; Rife, Cave and Frensele, for the construction of sections 3, 4 and 5 of the San Fernando road for $80,204.

The Board of Public Works of Los Angeles, Cal., has asked the City Council for authority to purchase three additional street flushing machines, to be used on the paved streets. The machines will cost $3,100 each.

The County Commissioners at Susanville, Cal., plan to employe a road expert to make plans and estimates for the construction of highways, and propose to hold election to vote bonds for the proposed road improvements.

Colorado.

✣Bids will be received until 9 a. m., May 10, by City Clerk, Colorado Springs, Colo., for the grading, curbing, parking and otherwise improving Wood Ave., Improvement District No. 1, in the City of Colorado Springs. The following is the Engineer's approximate estimate: 9,900 sq. yds. gravel surface; 2,150 cu. yds. soil and adobe; 2,050 cu. yds. sub-grading; 9,665 sq. yds. seeding; 4,870 lin. ft. combined concrete curb and gutter; 300 lin. ft. concrete gutter; 4,565 lin. ft. open concrete irrigation ditch; 200 lin. ft. concrete street ditch, with reinforced cover; 68 lin. ft. concrete ditch cover (at sidewalk intersections); 4 manhole changes. Plans and specifications may be obtained at the City Engineer's Office. Certified check in the sum of $1,000 must accompany each proposal.

It is reported that the citizens of Grand Junction, Colo., on April 29 voted the issuance of bonds in the sum of $118,000 for paving purposes.

District of Columbia.

✣Bids will be received until 2 p. m., May 25, by Commissioners of the District of Columbia, Washington, D. C., for furnishing the following materials during the fiscal year beginning July 1, 1911, and ending June 30, 1912: Granite curbing, asphalt paving blocks, repressed vitrified paving blocks, repressed vitrified invert sewer bricks, red sewer bricks, terra cotta sewer pipe, Portland cement, miscellaneous castings, sand and gravel and hauling broken stone.

Florida.

All bids received May 3 by the Duval County Commissioners, Jacksonville, Fla., for the construction of approximately 13,000 sq. yds. of asphalt macadam resurfacing from the city limits of South Jacksonville on the Atlantic Blvd., for a distance of one and one-eighth miles, have been rejected. New specifications will be prepared and the work re-advertised. Gail Barnard is County Engineer. P. D. Cassidey is County Clerk.

Illinois.

✣Bids will be received until 2 p. m., May 20, by Commissioners of Highways, at Town Clerk's Office, Mendota, Ill., for hauling 5,000 tons more or less of material for constructing gravel, rock and macadam hard roads, from cars on the track, or from piles on the ground on right of way of Chicago, Burlington & Quincy Railroad, or Rochelle & Southern Railroad, in the city of Mendota, Illinois, and distributing the same along the following described route in said township of Mendota. Commencing at the north end of the present hard road on section line between Sections 9 and 16, thence East on section line one-half mile; thence North to the County line.

✣Bids are asked by L. E. McGann, Commissioner of Public Works, Chicago, until 11 a. m., May 12th, for furnishing and delivering 50,000 gals. of paving pitch to the Bureau of Streets. The paving pitch is to be the direct result of the distillation of "straight run" coal tar. It shall be waterproof and shall contain not less than 15 per cent nor more than 35 per cent free carbon and shall have a melting point at a temperature of not less than 130° nor more than 140° F. Cash or certified check for $125 must accompany proposal.

✣Bids are asked by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 12th, for furnishing and delivering 1,100,000 paving bricks to the Bureau of Streets. All brick are to be not less than 8 ins. in length, 4 ins. in depth and 2½ ins. in width with edges rounded to a radius of ¼ in. They are to be repressed vitrified paving brick. No salt glazed brick will be received. Proposals must contain price per thousand delivered on streets and to ward yards. [illegible] or certified check for $1,000 must accompany proposal.

✣Bids are asked by L. E. McGann, Commissioner of Public Works, Chicago, until 11 a. m., May 15th for furnishing an delivering 2,500 sq. yds. of cedar block to the various ward yards of the Bureau of Streets, the blocks shall be cut from live cedar posts, free from bark and shall be 5 ins. in length and of any diameter from 4 ins. to 10 ins. Any block containing more than 10 per cent decayed wood will be rejected.

⊙Jansen & Zoellers of Pekin, Ill., have been awarded the contract by the Board of Local Improvement, R. P. Van Deusen, Secy. Pekin, for the improvement of Park Ave., with brick from Fourth St. to Court st., for $39,075. The work includes 24,000 sq. ft. of brick paving, 10,000 lin. ft. of curb and gutter, 10,000 lin. ft. of curb and 700 lin. ft. of protecting curb. Bids were opened April 29.

⊙J. H. Palmer of Danville, Ill., has been awarded the contract by the City Council of that city for the paving of two streets for $1.39 and $1.60 per sq. yd., respectively.

Following is the low bid received May 4, by L. E. McGann, Commissioner of Public Works, Chicago, for furnishing approximately 600,000 gals. of road oil to the Bureau of streets: Standard Oil Co., 115 Adams St., 2.7 cts. per gallon F. O. B. cars, 3.2 cts. per gallon delivered to storage tanks.

Following is the low bid received May 4 by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the various ward yards of the Bureau of Streets 125,000 lbs. of soap for emulsion: Fitzpatrick & Co., 28th St. and Western Ave., 2.1 cts. per lb. Bids opened May 4th, 1911.

Following are the low bids submitted to L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the Bureau of Streets two steam rollers: F. C. Austin Co., Railway Exchange Bldg., 12 ton gasoline, $2,350.00; 15 ton gasoline, $2,650.00; Kelly Springfield Road Roller Co., 138 Wabash Ave., 12 ton gasoline, $2,700; 12 ton steam, $2,400; Iroquois Iron Works, 143 Dearborn St., 13 ton gasoline, $2,542. The contract has not been awarded. Bids opened May 4th, 1911.

Following is the low bid received May 4 by L. E. McGann, Commissioner of Public

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Works, Chicago, Ill., for furnishing and delivering portable boilers to the Bureau of Street: Gindele Bros., Chicago Opera House Bldg., Chicago, $729 each.

The Board of Local Improvements of Freeport, Ill., has under consideration a number of street improvements for the ensuing year. It is proposed to pave parts of Benton and Float Sts., with brick, Maple Ave. and regrade Jefferson St.

The City Council of Alton, Ill., has passed an ordinance providing for the paving of State and Elm Sts., in the North Side.

The town of Chandlerville, Ill., will build one mile of hard road running south of the town on the Beardstown road. The county has given $3,000 toward the improvement.

The City Council of Watseka, Ill., will soon let the contract for the paving of Central St., and will take preliminary steps for the paving of an additional street through the main part of town and for a short cross street in the south part to connect the two pavements that run south. John H. Gleason is mayor.

Indiana.

◉The contract for improving the public square in Greencastle, Ind., has been let to the Madison Construction Co., of Anderson for $21,720.

◉The Clay County Commissioners, Brazil, Ind., have awarded the contracts for the construction of gravel roads in Van Buren, Dick, Johnson and Posey Townships to Hawkins Bros., 316 Coal St., Brazil, and Austin M. Shattuck, 1018 N. Meridian St., Brazil. Bids were opened May 5.

◉The Board of Adams County Commissioners, Decatur, Ind., has awarded the contract for furnishing the crushed stone and other supplies for repair of turnpikes as follows: A. & C. Stone Co., Ridgeville, Ind.; Erie Stone Co., Huntington, Ind.; Erie Stone Co., at Willshire, O., and the Berne Supply Co., Berne, Ind. Contract applies to all who are nearest the place of work. Bids were opened May 1.

◉Chas. Ireland, Montezuma, Ind., has been awarded the contract by the Parke County Commissioners, Rockville, Ind., for the construction of the Turkey Run Road in Howard Township for $3,121. Bids were opened May 3.

◉The Greenfield Bridge Co., of Greenfield, Ind., has been awarded the contract by the Hancock County Commissioners, Greenfield, for the construction of a retaining wall on Steele Road No. 2, for $150. Bids were opened May 1.

◉P. J. Kennedy, Templeton, Ind., has been awarded the contract by the Board of County Commissioners, Fowler, Ind., for the construction of the Carroll Road in Oak Grove Township, for $2,379. Bids were opened May 1.

◉The Board of County Commissioners at Williamsport, Ind., has awarded the contract for the construction of the Hoover gravel road in Kent Township to Otho Allison, State Line, Ind., for $2,317. Bids were opened May 1.

◉The Board of County Commissioners, Bluffton, Ind., has awarded the following contracts for the construction of four gravel roads: J. N. Neff, $9,767; Charles Nash, $5,669; Geo. W. Tabor, $3,759, and Crosbie E. Alexander, $2,209. Bids were opened May 4.

◉The Board of County Commissioners, Terre Haute, Ind., has awarded the following contracts for the construction of four gravel roads, for which bids were opened April [illegible]: Jas. T. Dailey, Riley, Ind., at $6,611, Brown Road in Riley Township; Elijah E. Reed, for the construction of the Strole Road, the Philip Long Road and the James S. Whitesell Road, [illegible] $2,337.

◉P. J. Kennedy of Templeton, Ind., has been awarded the contract by the Board of County Commissioners, Fowler, Ind., for the construction of the Anderson Road in Oak Grove Township for $6,900. Bids were opened May 1.

Petitions are being circulated in Fort Wayne, Ind., asking for the building of 30 miles of stone roads in Lafayette township. The approximate cost of the work is $15,000.

Iowa.

✣Bids will be received until 10 a. m., May 13, by City Clerk, Sioux City, Ia., for the construction of 4,000 ft. of cement gutter for Floyd cemetery. Specifications are on file at the office of the City Engineer. G. B. Healy is Supt. of Public Property.

A resolution has been offered in the City Council of Fairfield, Ia., for the improvement of the following streets: Fourth, north to city limits, brick; Court, from Briggs to Hempstead, brick; north to Stone, asphalt; Kirkwood, from Court to D, asphalt; D, from Court to Evergreen cemetery, asphalt; Briggs, from Court to Main, brick; Main, from Briggs to Hempstead, brick; Hempstead, from Main to Court, brick; Main from Madison to city limits, brick; West Burlington; from Second to west line of Rock Island right-of-way, brick; Broadway, from B to D, brick; D, from Broadway to Burlington, brick. The committee on streets has recommended that engineers be secured at once to prepare the necessary plans for the paving.

The City Council of Council Bluffs, Ia., has adopted paving resolutions covering new pavements for vitrified brick with a 4-in. sand base and will cover the following streets: Fifth Ave., from Indian Creek to 21st; 21st St., from Avenue G to Avenue I; Second Ave., from 11th to 13th St., and 10th St., from Eighth Ave., to 10th. Specifications for repaving Broadway between Second and Scott Sts. have been changed in a petition from property owners within that limit. Instead of concrete filler ordered in the original resolution, an asphalt filler will be substituted.

The City Council of Maquoketa, Ia., has passed a resolution deciding that bids should be received for four different kinds of material for the proposed 20 blocks of paving to be laid this year.

Kentucky.

Bids for 15 squares of vitrified brick street work to cost about $40,000 were received by the Board of Public Works of Louisville, Ky., on April 26. The bidders were: L. W. Hancock & Co., L. R. Figg; Jefferson County Construction Co.; G. W. Gosnell, and Henry Bickel Co. The bids range from $1.79 to $1.90 per sq. yd. The specifications call for the reconstruction of 15 squares of streets.

The Hardin Fiscal Court, Elizabethtown, Ky., has appropriated the sum of $250 per mile out of the general road fund of the county to be used in the proposed reconstruction of the Lincoln and Jackson Way, provided a sufficient amount is raised by private subscription to insure the work being done. The way extends through the county a distance of 50 miles, making the appropriation total about $12,500.

Louisiana.

✣Bids will be received until noon, May 15, by Highway Department of Board of State Engineers, 104 New Orleans Court Bldg., New Orleans, La., for the construction of a road from Colfax to Rochelle, Grant Parish, Louisiana, a distance of 32 miles. Frank M. Kerr is Chief State Engineer and President of the Board.

✣Bids will be received until May 15, by the State Highway Commission, New Orleans, La., for the construction of 35 miles of road in Grant Parish. Gervais Lombard, New Orleans, La., is State Highway Engineer.

Maryland.

✣Bids will be received [illegible] 24, by J. E. Schell, Mayor and Board of Aldermen, Frederick, Md., for paving approximately 16,000 sq. yds. and furnishing and setting 8,500 lin. ft. of curbing. Each bids must be accompanied by a certified check for $1,250 payable to the Mayor. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until Noon, May 15, by Commissioners of Carroll County, Westminster, Md., for building a section of State Aid Road 1.12 miles long in Carroll county along the Black Rock road between Hampstead and Baltimore County line. Each bid is to be [illegible] certified check for $200, payable to the County Commissioners of Carroll County, said check to be returned to the bidder unless he fails to execute the contract should it be awarded to him. Plans can be seen and forms of specifications and contract may be obtained at the offices of the State Roads Commission, Baltimore, Md.

Massachusetts.

◉James Doherty submitted the lowest bid to the Department of Public Works, Boston, Mass., on May 1 for the laying of brick paving in Geneva Ave., and for edgestones, gutters and crosswalks in Melville Ave., Dorchester. The bid submitted was $23,804.

Michigan.

✣Bids will be received until 8 p. m., May 11, by Board of Public Works, Grand Rapids, Mich., for furnishing the city one 10,000-lb. steam roller of tandem type, f. o. b. car Grand Rapids. S. A. Freshney is Secy. and General Manager of the Board.

The Richmond Township Supervisors, according to advices from Reed City, Mich., has secured a surveyor to lay out certain roads and report on the same at a special meeting of the board. Several miles of state reward roads will be built.

The city of Alpena, Mich., will purchase a street automatic flusher to clean the paved streets downtown.

A system of macadamized highways will be constructed in Iron County, Mich., during this year. A bond issue of $150,000 has been voted for that purpose. Crystal Falls is the county seat of Iron County.

Commissioners A. S. Putnam, Chas. R. Orr and Frank Cookson of Schoolcraft County, Manistique, Mich., will soon advertise for bids for the construction of from 18 to 20 miles of macadam road. As soon as the bonds are sold the work will be let.

Minnesota.

✣Forrestal & Feyen, St. Paul, Minn., are advertising 150 miles of road leveling along side of ditches in Marshall and Roseau Counties in northwestern Minnesota. Good work for team and road grader outfits.

◉D. H. Clough was recently awarded the contract by the City Council of Duluth, Minn., for the paving of Third alley between 20th and 21st Aves., and 21st and 22nd Aves. The cost of the first block will be $1,281 and of the second, $710.

Under the bill introduced in the last session of the legislature by Senator James T. Elwell of Minneapolis, St. Louis County, Duluth, Minn., has $90,000 available for road work during this year.

About two miles of paving is to be laid on the business and residence streets of Mankato, Minn. Twenty blocks are to be paved with creosoted blocks, one block with brick and five blocks with tar or asphalt macadam.

Mississippi.

✣Bids will be received until May 12 (readvertisement of bids asked May 2) by E. D. Donnell, Mayor, Columbus, Miss., for the construction of approximately 6,000 lin. ft. of concrete curb and gutter or granite curb and concrete gutter.

◉P. C. Powers & Son of Memphis, Tenn., have been awarded the contract by the city of Grenada, Miss., for the construction of from 75 to 150 miles of granolithic sidewalks for $.13½ per sq. ft. The work will include about 150,000 sq. ft. Bids were opened May [illegible]

Missouri.

✣Bids will be [illegible] 15, by A. J. McKenzie, City Engineer, Webb City, Mo., for the following work: 8,865 sq ft. of concrete sidewalks; 1,556 lin. ft. of concrete combined curb and gutter; 2,500 sq. ft. of brick block pavement; 11,744 sq. yds of asphalted macadam pavement.

The Board of Local Improvements of St. Louis, Mo., on April 28, received the following bids for a municipal asphalt plant: Warren Bros. Co., Boston, Mass., $19,800; Heatherington & Berner, Indianapolis, Ind., $22,162, [illegible]

[illegible] where now the Street Department asphalt- [illegible]

The Moberly, Mo., Commercial Club is planning to petition the county court of Randolph County, Hutsville, Mo., to call a special election for issuing $250,000 worth of bonds [illegible]

New Hampshire.

✣Bids will be received until 1 p. m., May 19, by the State Highway Department, Concord, N. H., for the construction of 3½ miles of native stone road in Hinsdale, N. H. H. C. Hill is State Engineer.

✣Bids will be received until 1 p. m., May 22, by State Highway Department, Concord, N. H., for the construction of 4,500 ft. of native stone road in Bethlehem, N. H. Plans and specifications may be seen at the office of H. C. Hill, State Engineer, Concord, N. H.

New Jersey.

✣Bids will be received until 8 p. m., May 15, by M. Stockman, Towns Clerk, Irvington, N. J., for the following improvements: The flagging of Welland avenue, from Normandy place, easterly to Cout St. The grading and flagging of Fern Ave., from Chester Ave. easterly to Rosehill place. The grading and flagging of Silkman place, from Myrtle Ave. westerly to Linden Ave. The grading of Saranac place, from Clinton Ave. southerly to Cottage St. The construction and laying of a telford pavement and the necessary curbing and flagging of Washington Ave., from Clinton Ave. northerly to Springfield Ave. The construction and laying of a telford pavement and the curbing and guttering of Montrose terrace, from Grove St. westerly to East Speedway Ave. The construction of sanitary sewers in North Forty-third St., Frederick terrace, Laurel Ave., Brighton terrace, Highland terrace, Saranac place, Twenty-first St., from Sixteenth Ave. to Roosevelt terrace, and Stephen terrace, in the town of Irvington. Specifications may be seen at the office of I. J. Casey, Jr. & Co., town engineers, Glorieux building, or at the office of the town clerk, Town Hall, Irvington.

Repairs to county highways to the amount of $55,000 have been decided upon by the road committee of the Board of Freeholders at Paterson, N. J.

The City Council of Bridgeton, N. J., will purchase a steam road roller which will be used in the construction and repair of all streets.

New York.

✣Bids will be received until 8 p. m., May 11, by Common Council of Lakawanna, N. Y., for the furnishing of materials and performance of labor for the paving of the Ridge Road from the east curb line of South Park Ave. to the east curb line of the Hamburg Turnpike, with vitrified brick, the pavement to be 42 ft. in width from curb to curb, together with a drainage system, according to the plans and specifications on file in the office of the City Clerk J. J. Monaghan.

⊙The Acme Engineering Co., of Herkimer, has been awarded the contract by the city of Canajoharie, N. Y., for the paving of Church St., from the lift bridge to the Longshore block for $14,800.

⊙The Board of Public Works of Geneva, N. Y., has awarded Edward Higgins the contract for sprinkling and flushing the street for $100 per week and $12.50 for flushing.

⊙The State Highway Commission, Albany, N. Y., has awarded the following contracts for improvements to public highways by state aid, for which bids were opened April 24, Stottsville-Stuyvesant Falls, state highway No. 5,103, and Stuyvesant Falls-Valatie, state highway No. 5,104, a total of 10.85 miles, J. C. Hourigan, Albany, at $118,440, on residuum; Blodget Mills-Cortland, county highway No. 881, Cortland County, 1.79 miles, Joseph McCormick, East Providence, R. I., at $22,780; Stuyvesant Falls-Valatie, state highway No. 5,104, Columbia County, 4.5 miles, contract not awarded; Stottsville-Stuyvesant Falls, state highway No. 5,103, Columbia County, 5 miles, contract not awarded; Red Hook-Rhinebeck, state highway No. 5,092, Dutchess County, 4.15 miles, Suffolk Contracting Co., Huntington, $10,000, on residuum; Red Hook Village-Dutchess County, Road No. 5,095, 1.33 miles, W. J. Cowhig, Poughkeepsie, N. Y., $12,280, on residuum; Ellicott Creek, Erie County, Road No. 913, 1.83 miles, Louis R. Gipp, Buffalo, $38,990; Fonda, Johnstown Road, No. 5,096, Fulton and Montgomery Counties, 3.07 miles, The Hollington Co., Troy, N. Y., $37,970; Salisbury Center, Burrels County, Road No. 465, Herkimer County, 5.43 miles, Brown & Lowe, Schenectady, $52,147; Livonia-Lakeville, County highway No. 716, Livingston County, 2.23 miles, Carlton-Reynell, Long Island City, $17,950; De Ruyter-Lawsons Forks, County Highway No. 883, Madison County, 2.14 miles, Joseph McCormick, East Providence, R. I., $23,973; St. Johnsville-Nelliston, State highway No. 5,109, Montgomery County, 4.79 miles, no contract awarded; E. Norwich Memorial Cemetery, Road No. 898, Nassau County, 2.88 miles, H. J. Mullen, Jamaica, N. Y., $37,000, on bermudez; East Wood Village-East Syracuse Road, No. 896, Onondaga County, 2.43 miles, no contract awarded; Newburg-Cornwall road No. 415, Orange County, 3.37 miles, Harper, Jova & Kehoe Co., Inc., Newburg, N. Y., $30,990; Brewster-Carmel Road No. 909, Putnam County, 4.56 miles, Harvey B. Sproul, Peekskill, $45,800, on residuum; Brewster Village, Putnam County, road No. 5,098, 1.14 miles, Samuel Beskin, Fishkill, N. Y., $15,900, on residuum; Rensselaer City road No. 5,107, Rensselaer County, .40 miles, Wilt-Seyo & Rigney, Rensselaer, N. Y., $7,468, on residuum; Thurston-Campbell road No. 903, Steuben County, 2.07 miles, Fred E. Ellis, Melrose, Mass., $19,902; Post road No. 310, Ulster County, 4.25 miles, Lane Construction Co., Meriden, Conn., $34,380, on residuum; Macedon-Cator Four Corners road No. 918, Wayne County, 1.16 miles, Bellew & Merritt, Tuckahoe, N. Y., $8,999; Cross River-Crafts Corners, road No. 899, Westchester County, 5.68 miles, Frank G. Fowler, Mt. Kisco, N. Y., $24,512, on residuum; Castile-Castile, road No. 892, Wyoming County, 1.43 miles, Frederick J. Mumm, Buffalo, N. Y., $15,800; Indian Falls-Corfu, Part 2, Road No. 922, Genesee County, 1.85 miles, Miller & Knickenberg, Buffalo, N. Y., $15,944; Pavilion-Batavia, Part 1, road No. 923, Miller & Knickenberg, Buffalo, N. Y., $42,500.

⊙The State Highway Commission, Albany, N. Y., has awarded the following contracts for the improvements to state highways, for which bids were opened April 26: Ticonderoga-Crown Point, Part 1, Road No. 891, Essex County, 5.99 miles, Santanoni Contracting Co., Newcomb, $56,989; Millerton-Columbia County Line, Road No. 709, Dutchess County, 4.80 miles, Lane Construction Co., Meriden, Conn., $41,390, on residuum; Pleasant Valley-Washington Hollow, Road No. 748, Dutchess County, 5.46 miles, Samuel Beskin, Fishkill-on-Hudson, $63,325; Broadway-Depew, Road No. 914, Erie County, 3.52 miles, Niagara Construction Co., Corning, N. Y., $79,470; Lancaster Village, Road No. 915, Erie County, 1.46 miles, Niagara Construction Co., Corning, N. Y., $68,800; Depew Village, Road No. 916, Erie County, 2.30 miles, Ed. T. Beck & Co., Warren, Pa., $53,750; Lancaster-Alden, Road No. 917, Erie County, 4.11 miles, no bids received; Burrels-Middleville, Road No. 466, Herkimer County, 5.56 miles, Buckley Construction Co., Plattsburg, $69,342; Livonia-Ontario Co. Line, Road No. 717, Livingston County, 5.87 miles, no contract awarded, above estimate; Canastota Village, Road No. 908, Madison County, 2.07 miles, no contract awarded; Fort Plain Village, Road No. 889, Montgomery County, .64 miles, Joseph Walker, New Paltz, $7,204; Little Neck-Old Westbury, Parts 1 and 4, Nassau County, 2.50 miles, Clancy & Van Alst, Astoria, $25,980; Skaneateles-Camillus, Part 2, Road No. 897, Onondaga County, 4.24 miles, W. H. Burns Co., Syracuse, $48,389; Rockland Co. Line-Tuxedo, Road No. 416, Orange County, 6.10 miles, Sproul & Elsin, Peekskill, $86,230; Brainerd Station Highway, Road No. 5,108, Rensselaer County, .20 miles, Krow & Walsh, Pittsfield, Mass., $4,389; Euba Mills-New Russia, Road No. 5,117, Essex County, 6 miles, J. D. Moynehan Co., Mohawk, $74,989; Atlanta-North Cohocton, Road No. 904, Steuben County, 1.64 miles, T. H. Gill Co., Whitneys Point, $14,420; Troupsburg Center-South Troupsburg, Road No. 905, Steuben County, 3.90 miles, no contract awarded; Port Jefferson-Coram, Road No. 912, Suffolk County, 6.69 miles, no contract awarded; Stone Bridge-Falls Mills, Road No. 824, Sullivan County, 3.38 miles, Bellew & Merritt Co., Tuckahoe, $42,850; Rifton Village, Road No. 921, Ulster County, 2.13 miles, Joseph Walker, New Paltz, $27,594; Clyde-Resort, Part 1, Road No. 919, Wayne County, 3.81 miles, Greece Construction Co., Rochester, $23,850; Woods Bridge-Lewis Corners, Road No. 900, Westchester County, 4.26 miles, Samuel Beskin, Fishkill, $46,500; Bliss-Smith Corners, Road No. 893, Wyoming County, 3.61 miles, Thomas E. Murray, Troy, $44,400; Canton-Potsdam, Part 1, and Canton-De Kalb, Road Nos. 5,115-16, St. Lawrence County, 10.19 miles, Buckley Construction Co., Plattsburg, $99,940;

⊙The State Highway Commission, Albany, N. Y., has awarded the following contracts for the improvement of state highways, for which bids were opened April 28: Glen-Aubrey-Whitney's Point, Road No. 902, Broome County, 5.30 miles, T. H. Gill Co., Whitneys Point, $52,354; Olean City, Road No. 5,099, Cattaraugus County, .36 miles, B. V. Taylor, Olean, $11,869; Auburn City, Road No. 5,101, Cayuga County, 1.83 miles, Brayer Bros., Auburn, $22,667; Horseheads-Catlin, Road No. 888, Chemung County, 3.72 miles, P. H. Murray, Rochester, $42,260; Champlain-Mooers Forks, Part 2, Road No. 5,102, Clinton County, 7 miles, Spellman-Oliver Co., Chateaugay, $63,800; Fishkill Village, Road No. 895, Dutchess County, 1.06 miles, Hallock & Angle, Newburg, $15,489; Johnstown-Broadalbin, Road No. 544, Fulton County, 6.28 miles, S. B. Van Wagenen, Rondout, $55,000; Little Falls City, Road No. 5,105, Herkimer County, 1.88 miles, James E. Martin, Poughkeepsie, $21,994; Garbutt's Crossing, Road No. 5,097, Monroe County, 1.06 miles, Monroe Roads Co., Pittsford, $9,762; Yorkville Village, Road No. 5,091, Oneida County, 1.06 miles, no contract awarded; Wyatt's-Hoffman, Road No. 5,110, Schenectady County, 5.42 miles, Joseph Walker, New Paltz, $48,304; Geneva-Waterloo, Road No. 5,087, Seneca County, 5.95 miles, no contract awarded; Seneca Falls Village, Road No. 5,100, Seneca County, 2.50 miles, Frederick A. Brotsch, Jr., Rochester, $83,000; Big Creek, Parts 1 and 2, Road No. 906, Steuben County, 5.98 miles, Frederick E. Ellis, Melrose, Mass., $67,077; Big Creek, Part 4, Road No. 907, Steuben County, 4.13 miles, Frederick E. Ellis, Melrose, Mass., $45,491; Painted Post-Addison, Part 2, Road No. 5,094, Steuben County, 2:50 miles, T. H. Gill Co., Whitneys Point, $25,240; Jericho Turnpike, Part 2, Road No. 5,111, Suffolk County, 5.02 miles, H. J. Mullen, Jamaica, $34,500; Pericho Turnpike, Part 3, Road No. 5,112, Suffolk County, 4.99 miles, H. J. Mullen, Jamaica, $45,168; Monticello-Mongaup Valley, Road No. 890, Sullivan County, 4.87 miles, DeGraff & Hogeboom, Kingston, $46,744; Milton-Marlboro, Road No. 5,114, Ulster County, 3.82 miles, Samuel Beskin, Fishkill, $39,400; Cambridge-Salem, Part 1, Road No. 5,113, Washington County, 3.75 miles, W. A. Burnham & Co., Glens Falls, $34,000; Lyons-Sodius Point, Port 1, Road No. 920, Wayne County, 3 miles, Greece Construction Co., Rochester, $25,650; Port Chester-Crystal Springs, Part 1, Road No. 901, Westchester County, 1.89 miles, White & Colligan, Purchase, $19,225; Java Village, Road No. 894, Wyoming County, 3.56 miles, Frank Foote, Nunda, $40,828; Luzerne-Lake George, Road No. 805, Warren County, 3.68 miles, S. B. Van Wagenen, Rondout, $34,754.

⊙The State Highway Commission, Albany, N. Y., has awarded the following contracts for road improvements, for which bids were opened on May 1: Parma Corners-Spencerport, Spencerport-North Chili,, County Highways, 495, Monroe County, 6.15 miles, Hucknall Contracting Co., Albion, $51,200; Pittsford-North Henriette, County Highway No. 497, Monroe County, [illegible] miles, Monroe Roads Co., Pittsford, $16,000; Honeoye Falls-Pittsford Town Line, County Highway No. 502, Monroe County, Monroe Roads Co., Pittsford, $52,705; Ridge-Rochester-Sea Breeze County Highway No. 538, Monroe County, 5.67 miles, Julius Freiderich Co., Rochester, $76,100; Sea Breeze-Nine Mile Point, Road No. 573, Monroe County, 6.38 miles, A. J. Rockwood, Rochester, $62,190; Oak Orchard-Section 3, Road No. 391, Orleans County, 3.24 miles, Hucknall Contracting Co., Albion, $24,300; Medina-Alabama, Road No. 395, Orleans County, 5.40 miles, Rhody & Tyler, Albion, $45,000; Holley-Albion, Part 2, State Highway No. 5,118, Hucknall Contracting Co., Albion, $20,646; Lockport Tonawanda Creek Highway No. 749, Niagara County, 10.30 miles, no bids received; Adams, Watertown, Part 3, State Highway No. 5,119, Jefferson County, 3.24 miles, Burns Bros. & Haley, Watertown, $30,978; Fayetteville-Chittenango, Part 2, State Highway No. 5,120, Madison County, 3.31 miles, J. H. Weidman, Syracuse, $35,100; North Norwich-Sherburne, State Highway No. 5,121, Chenango County, 6.88 miles, Thos. F. Shaughnessy & Co., Albany, $65,400; North Brookfield-Waterville, County Highway No. 840, Oneida County, 4.37 miles, Thos. F. Shaughnessy & Co., Albany, $56,400; Ithaca-Danby, Part 2, State Highway No. 5,122, Tompkins County, 3.24 miles, Thos. F. Shaughnessy & Co., Albany, $36,400; Nelliston-Pallatine Bridge, State Highway No. 5,123, Montgomery County, 4.06 miles, Olin T. Benedict, Pittsfield, Mass., $41,000; Palatine Bridge-Fonda, Part 1, State Highway No. 5,124, Montgomery County, 4.25 miles, James E. Martin, Poughkeepsie, $51,825; Palatine Bridge-Fonda, Part 2, State Highway, No. 5,125, Montgomery County, 4 miles, James E. Martin, Poughkeepsie, $46,900; Hoffman-Cranesville, State Highway No. 5,126, Montgomery County, 2.24 miles, Thomas Karr, Troy, $25,470; Union Hill-Ontario Center, State Highway No. 5,127, Wayne County, 3.48 miles, Chambers & Truesdale, Rochester, $27,999; Otto-Cattaraugus, County Highway No. 695, re-construction, 1.21 miles, no contract awarded; Otto-East Otto, County Highway No. 697, Cattaraugus County, re-construction, 2.27 miles, no contract awarded.

The Board of Supervisors, Elmira, N. Y., has approved the plans for the construction of the new West Church St.-Water St., road to Fitch's bridge. The foundation of the road will be native stone, with a crown of trap rock. The State will pay 50 per cent or $12,850 of the expense, the county $8,995, the town of Big Flats about $500 and the town of Elmira, $3,407. The contract for this work will be let immediately. The board has also asked the State Highway Department to build or improve the highway on the north and east side of the drive between Elmira and Lowman, the work to be included in the Murtaugh $1,000,000 highway route.

The Town Board of Guilderland, N. Y., has voted to improve the highway between the Andrew La Grange and Judge Clute places.

Bills appropriating $2,925,000 for the construction by the state of improved highways have been passed by the lower house of the New York legislature.

North Carolina.

Advices from Asheville, N. C., state that the board of trustees of the state central highway has decided to begin at once the preliminary survey of the route for the proposed state highway, which is to traverse the states from the Atlantic coast to Asheville and the Tennessee line. H. E. Varner of Lexington, N. C., is president of the board of trustees.

Ohio.

✣Bids will be received until Noon, May 16, by Oscar Kosche, Clerk, Oakley, O., for furnishing the necessary labor and materials for the improvement of the Madison pike, from B. & O. S.-W. R. R. to east corporation line by grading and macadamizing the roadway, between the present macadam in the center of said street and the curb and gutter on both sides, constructing combined curb and gutters on both sides thereof, furnishing and laying the necessary drains, etc., in accordance with the plans and specifications on file in the office of said clerk and on file in the office of the engineer of said village, Chris. Stichnath, 3519 Shaw Ave., Hyde Park. Each bid must be accompanied by a bond or a certified check in the sum of $250.

✣Bids will be received until Noon, May 16, by Oscar Kosche, Clerk of the Village of Oakley, O., for furnishing labor and material for the improvement of Brotherton Road from the Madison pike to Cresap St., by grading and macadamizing the roadway, constructing combined curb and gutters on both sides; furnishing and laying the necessary drains, etc. Chris. Stichnath, 3519 Shaw Ave., Hyde Park, is Engineer of the village.

✣Bids will be received until 11 a. m., May 27, by Board of Cuyahoga County Commissioners, Cleveland, O., for grading and improving Harvard Road between stations 11 and 16. Frank Lander is County Surveyor. J. F. Goldenbogen is Clerk.

✣Bids will be received until 11 a. m., May 27 (readvertisement of bids asked May 3), by Board of County Commissioners, Cleveland, O., for grading and improving Harvard Road between Stations 11 and 16. Frank Lander is County Surveyor.

✣Bids will be received until noon, June 5, by C. C. Jenkins, Village Clerk, Willoughby, O., for furnishing the necessary labor and material for grading and paving and curbing Euclid St. in the village from the north end of Erie St. southwesterly to the Corporation line. Each bid must be accompanied by a certified check for $2,500 payable to the Village Treasurer.

✣Bids will be received until 11 a. m., May 27, by Board of County Commissioners, Cleveland, O., for the necessary material for the repair of the following roads in Cuyahoga County, O.: West Madison road; Berea road; Pearl St. approach; Independence road. J. F. Goldenbogen is Clerk.

✣Bids will be received until 2 p. m., May 17, by Board of Commissioners of Franklin County, Columbus, O., for furnishing the necessary labor and material for grading, macadamizing and improving roads under Engineer's estimates No. 231, 232, 233 and 234. John Scott is Clerk of the Board.

✣Bids will be received until noon, June 2, by Commissioners of Hamilton County, Cincinnati, O., for repairing under specifications No. 203 Indiana Hill Ave. from Plainville pike to Wooster pike in Columbia township. Fred Dreihs is Clerk.

The Village Council of Middlefield, O., has instructed Village Engineer Harlan Sperry to prepare specifications for paving Elm St., from the east line of the bank to the square, and thence west to the bridge on Main St., and from the bridge on North St., to the old C. & E. track near the sugar house.

⊙Evan Evans has been awarded the contract by the Department of Public Service, Cincinnati, for the grading, granite curbing and brick paving of Benton alley between Vine and Bremen St., for $570. Bids were opened April 12.

⊙Evan Evans has been awarded the contract by the Department of Public Service, Cincinnati, for the improvement of Benton alley between McMicken Ave. and Hamer St., for $527. Bids were opened April 12.

⊙The Department of Public Service of Cincinnati, O., has awarded Evan Evans, 1226 Ida St., Cincinnati, the contract for the improvement of Ahler alley, from Vine to Bremen St., for $521. Bids were opened April 12.

⊙Evan Evans, 1226 Ida St., Cincinnati, O., has been awarded the contract by the Department of Public Service, Cincinnati, for the improvement of Bardes alley, from Vine St. to Grose [illegible] granite curbing and brick paving, for $1,066. Bids were opened April 12.

⊙Peter Praechter, Gerard St., north of Donohue, Cincinnati, O., has been awarded the contract by the Hamilton County Commissioners, Cincinnati, for the improvement under Specifications No. 181 of the Eight Mile Road at Kremer's place in Anderson Township, for $4,668. The contract for the improvement of the Eight Mile road at School House was also awarded Peter Praechter for $2,017. Bids were opened April 12.

⊙Wm. Keller of Madisonville, O., has been awarded the contract by the Board of County Commissioners, Cincinnati, for the improvement under Specifications No. 72, of the Loveland and Madeira pike in Symmes Township, for $14,440. Bids were opened April 28.

⊙J. M. Quill, Temple Court Bldg., Cincinnati, has been awarded the contract by the Department of Public Service, Cincinnati, for the improvement of Batterman Ave., from Harrison to McKinley, for $14,213. The work includes grading, setting cement curb and gutter, paving the roadway with brick, and constructing necessary drains and inlets. Bids were opened April 21.

⊙J. M. Quill, Temple Court Bldg., Cincinnati, O., has been awarded the contract by the Department of Public Service, Cincinnati, for the improvement of Dirheim Ave., from Lischer to C. & W. R. R., for $4,754. The work includes grading, cement curb and gutter, paving the roadway with brick, necessary drains and inlets, etc. Bids were opened April 21.

⊙W. F. Payne has been awarded the contract by the Board of Control of Springfield, O., for the macadamizing of Belmont Ave., for $2,318.

⊙Service Director Holton of Columbus, O., has awarded contracts for nearly $100,000 worth of street improvements as follows: William M. Graham, for paving Barthman Ave. with brick from High St. to Parsons Ave., for $21,684; S. T. Knight, for paving Beech St. with brick from Forest to Schiller Sts., at $9,325, and Columbus St., from Parsons Ave. to Front St., for $25,603; John C. Beasley, for paving Pendleton Ave. with brick from Raynard St. to Livingston Ave., for $6,904; William M. Graham, for paving Reeb Ave. with brick between High and 7th Sts., for $12,404; John C. Beasley, paving Stone Ave., with brick from Nicholas to 18th St., for $7,788; D. E. Sullivan & Sons, for paving Town St., with brick from Hawkes Ave. to Central Ave., for $14,932.

The County Surveyor has reported to the County Commissioners, Cincinnati, O., that the improvement of the Giffin pike, known as Lincoln Ave., 12 ft. of roadway, would cost $18,351, and constructing the road with a 16 ft. roadway would cost $30,000.

The City Council of Cincinnati, O., contemplates the reconstruction of Eastern Ave., from Undercliff west.

The Advisory Board of the County Good Roads Association, Lisbon, O., has approved the plans of the commissioners in regard to the paving of roads in Columbiana County. The plans involve the immediate paving of 15½ miles of road. The following roads will be paved: Two miles out of East Palestine on the Lisbon road towards Lisbon on Lisbon road; two miles out of Wellsville on Lisbon road; two miles out of Wellsville on Salineville road; one and one-half miles out of Lisbon, toward Salem on Salem road; two miles out of Salem on Winona road; two miles on road leading from West township line toward Kensington, and two miles out of Leetonia on the Franklin Square road.

Oregon.

The city of Portland, Ore., proposes to improve the Portland Blvd. between Vancouver Ave., and the Williamette Blvd. about a mile. The cost is estimated at $27,192. The street will be graded and sidewalks laid.

Improvement districts have been formed in the East Side of Portland, Ore., which will be paved during the year at an estimated cost of $334,945. J. W. Morris is city engineer.

Pennsylvania.

✣Bids will be received until 8 p. m., May 12, by Board of Public Works, [illegible], Pa., for resurfacing a portion of highways in the city. Sheet and block asphalt and brick will be the material used. W. M. C. Craine is President of the Board.

✣Bids will be received until noon, May 16, by Highway Department, W. W. Caldwell, Commissioner, Harrisburg, Pa., for paving and curbing the following streets: Berryhill from Cameron to 13th. Hunter from Crescent to [illegible]; Neptune, from Swatara to Berryhill; Shrub, from 12th to 14th; Whitehall, from 18th to Prospect; Forest, from 6th to Jefferson; 15th, from Berryhill to Catherine; 16th, from Berryhill to Catherine; Catherine, from 15th to 17th; Naudain, from 15th to 17th; Linden, from Bailey to State; Balm, from Bailey to State; Summit, from Bailey to King; Summit, from Derry to Thompson; Peffer, from Second to 7th; approximate quantities: paving 28,087 sq. yds.; sheet asphalt or vitrified brick curbing, 24,536 lin. ft.; granite, granolithic or steel-bound granolithic.

The street committee of Conshohocken, Pa., accompanied by Civil Engineer John H. Dager of Norristown, Pa., recently made a trip to Boston, Mass., to inspect the various patent street surfaces, with a view to determining what material will be most desirable for the permanent surfacing of Fayette St., from 1st Ave. to 12th.

The Philadelphia Councils have passed the councilmanic loan bill of $2,300,000, and the bill authorizing a popular loan of $11,500,000 for public improvements, which is to be submitted to a vote of the people at a special election May 23.

The City Council of New Castle, Pa., has been petitioned by property owners on South Jefferson St., between Division St., and Lutton St., asking that the contract be awarded for the paving of the thoroughfare. A petition has also been received by the City Council asking that South Mercer St., between Division and Maitland Sts., be paved.

Tennessee.

⊙The contract to build the new pike connecting Rockford with Maryville has been awarded by the County Commissioners, to R. B. Oliver. The county court, Maryville, Tenn., has voted a bond issue of $300,000 for the improvement of roads in Blount County, and the road between Maryville and Rockford is one of the thoroughfares to be improved.

Texas.

✣Bids will be received until Noon, May 10, by Howe & Wise, County Engineers, 722 National Bank Bldg., Houston, Texas, for the paving of the Washington County Road from the city limits of Houston to the Houston Heights boulevard with vitrified brick or wood block.

✣Bids will be received until 3.30 p. m., June 1 by Commissioners Court, at the office of W. W. Jenkins, County Auditor, Georgetown, Texas, for the construction of graveled and macadamized roads in Road District No. 2. Further information can be obtained of Judge Richard Critz, Georgtown, Texas.

⊙The City Council of Austin, Tex., has awarded the contract for 45,700 sq. yds., of street paving to the Texas Bitulithic Co., of Dallas and Knox T. Johnson of Austin. The Texas Co., secured 37,778 sq. yds. of the work while the other contract calls for 7,922 sq. yds. The aggregate cost will be $105,000.

⊙The Board of County Commissioners, Galveston, Tex., has awarded the contract for the construction of the road from the west end of Broadway to the causeway, Galveston, to J. C. Kelso at $1.69 for shell, $1.44 for surfacing $59.50 for lumber. The total amount of the bid is $37,406.

⊙The County Commissioners at Houston, Tex., have awarded the contract for shelling five and one-half miles of the San Jacinto battleground road, between Deer Park on the Houston and La Porte road and the Lynchburg ferry and two and one-half miles on the Cedar Bayou and Crosby County road, to the Texas Grading Co. The bids received by the county on the San Jacinto battleground road were as follows: Texas Grading Co., $10,595; W. A. Scott, $10,777; L. R. Davis, $10,932; J. M. Parker, $11,020; M. C. Otto, $11,496; Horton & Horton, $12,404; Blackwell & Davis, $13,021; W. D. Haden, $13,294; Suderman & Haden, $13,991; T. E. Tierney, $17,177. Bids for hauling the shell for this road were as follows: W. A. Scott, $3,850; L. R. Davis, $4,025; M. C. Otto, $4,550; J. M. Parker, $4,550; Blackwell & Davis, $5,600. The bids received by the county for the work on the Cedar Bayou and Crosby county road were as follows: Texas Grading Co., $15,194; E. G. Smith, $17,044; Horton & Horton, $22,012.

Property owners of Greenville, Tex., have decided upon what kind of pavement they will use in paving the streets. The following shows the pavement, name of streets and number of sq. yds. which have been decided upon: Bitulithic pavement—West Washington, 2,700; North Sayle, 2,924; Park, 18,357; East Jones, 4,666; North Stonewall, 8,054; South Stonewall, 11,835; Oneal, 1,627; St. John, 4,362; South Wesley, from Lee St., to city limits, 19,570; East Pickett from public square to Bois d'Arce St., 4,466; North Wesley, 6,478, total, 85,039. Wood block pavement—West Washington from public square to Katy track, 7,864; West Lee from depot to city limits, 23,417; King, 1,882, total, 33,163; Brick pavement—East Washington from public Square to oil mill, 3,003; East Lee, 11,339; North Stonewall, 672; South Johnson, from public square to Pickett St., 1,000; total 16,013; asphaltic concrete pavement—West Henry St., 8,013 sq. yds.; grand total, 143,228 sq. yds.

An election was held in Lavaca County, Hallettsville, Tex., to determine whether or not a special tax of $0.10 on the $100 valuation should be levied for the purpose of improving the public roads. It is reported that the proposition carried.

Active preparations are now under way in San Angelo, Tex., for the paving of from 16 to 20 blocks in the business section of the city. Approximately $100,000 will be spent for paving during the year.

Utah.

⊙The City Council of Logan, Utah, has awarded the contract for paving work to be done in District No. 19 to the Madsen Whittier Co., of Boise, Ida., for $19,386. Other bids received on the work are: N. S. Andrews of Logan, $20,639; Joseph E. Wilson, Jr., of Logan, $20,218; L. S. Hills of Logan, $20,082, and Browne & Doremus of Tooele, $23,429.

Virginia.

✣Bids will be received until 11 a. m., May 25, by P. St. J. Wilson, State Highway Commissioner, Richmond, Va., and Board of Wise County Supervisors, at the office of Clerk, Wise, Va., for the permanent improvement of 125 miles of county highway. Official advertisement will be found elsewhere in this issue.

Government experts have completed the survey of the proposed boulevard route from Norfolk to Virginia Beach by way of Lynnhaven Inlet. It is proposed to compromise on sand clay road, which will cost about $500 a mile to lay.

Washington.

✣Bids will be received until 11 a. m., May 11, by the Commissioners of the City of Spokane, Wash., for 23 street improvement contracts as follows: Paving McClellan St., from Pacific to Second Ave.; paving Washington St. with Hassam concrete, from Waverly Place to Spofford Ave.; paving Eighth Ave. with brick, from Cannon to Chestnut St.; paving Howard St., from the south Howard St. bridge to the middle of Howard St. bridge; also Havermale Ave., from Howard to Washington St., and Washington St., from the viaduct to the O. R. & N. tracks with brick; sewer on Garfield St., from Hartson Ave. to Fifth Ave.; sewer in the alley between Mansfield and Montgomery Ave., from Northwest Boulevard to Wall St.; grading, curbing, parking and sidewalking Twenty-fifth Ave., from Wall to Jefferson St.; the same on Twenty-second Ave., from Wall St. to Jefferson St.; sewer on Sheridan St., from a point 276 feet south of Hartson Ave. to Fifth Ave., thence east on Fifth Ave. to a connection 70 ft. east of Hatch St., for grading, parking, curbing and sidewalking Twentieth Ave., from Lincoln to Adams St.; Sixteenth Ave., from Crestline to Pittsburg St.· Sixteenth Ave., from Southeast boulevard to Rockwood Boulevard; Oak St., from Knox to Augusta Ave.; Madison St., from Wellesley Ave. to Garland Ave.· Hatch St., from Seventeenth Ave. to Twenty-ninth Ave.; Lincoln St., from Cliff Ave. to Wall St.; Euclid Ave., from Cedar to Maple St.; Elm St., from Twentieth to Twenty-eighth Ave.; Eighteenth Ave., from Martin to Helena St.; Bryant Ave., from Altamont to Woodfern St.; Lincoln St., from Ninth to Cliff Ave.; Seventh Ave., from Napa St. to Pittsburg; Seventh Ave., from Latah creek bridge to Lindeke St.

Preliminary surveys are being made by County Engineer Lindbery, Bellingham, Wash., for the permanent improvements to be made on the Northeast and the Northwest Diagonal roads. On the Northwest road it is planned to put down three miles of permanent surfacing, and a like amount on the Northeast road.

Wisconsin.

✣Bids will be received until 10:30 a. m., May 15, by Department of Public Works, Milwaukee, Wis., for furnishing f. o. b. cars Milwaukee, 2,500 net tons of bituminous road binder. H. E. Briggs is Commissioner of Public Works.

✣Bids will be received until 10:30 a. m., May 15, by Department of Public Works, Milwaukee, Wis., for furnishing in accordance with plans and specifications on file at that office 2 500-gal. melting kettles. H. E. Briggs is Commissioner of Public Works.

The Common Council of Wausau, Wis., has decided to pave Scott and Washington Sts., between Third and Fourth. Plans and specifications are being prepared by the city engineer for the improvement.

Canada.

Highway Commissioner A. C. McGillivray has presented the profile, plans and an estimate for the construction of the contemplated improved highway between Winnipeg Selkirk and Winnipeg Beach, to the Red River Highway Association at Selkirk, Man.

BRIDGES—STEEL AND CONCRETE

Arkansas.

⊙Advices from Lonoke, Ark., state that the Vincennes Iron & Bridge Works, Vincennes, Ind., has been awarded the contract for the construction of two steel bridges in Lonoke County, Ark. The work is to be [illegible] by July 1.

California.

Citizens of Bolinas, Cal., are [illegible] the construction of a draw bridge over the channel of Bolinas Bay in Marin County and steps will be taken, it is believed, to raise the necessary funds.

Colorado.

The Public Works Committee of the City

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Council of Pueblo, Colo., and the County Commissioners recently held a meeting in that city to take up the matter of repairing the Santa Fe Ave. bridge over the Arkansas River. Norbert Zink is a member of the Public Works Committee.

Georgia.

✣Bids will be received until May 15 by Commissioners of Wilcox County, Abbeville, Ga., for the construction of steel bridge over Alapaha River 4 miles from Rochelle, Ga., on Rochelle and Ashburn road. D. D. Faircloth is Chairman of the Commissioners.

City Engineer of Savannah, Ga., and Engineer of the Atlantic Coast Line Ry. will soon commence work on plans for the extension of the viaduct across Barnard St. to Montgomery, a distance of 1,100 ft., requiring an expenditure of about $250,000.

Advices from Atlanta, Ga., state that work will be started in about three weeks for the construction of the proposed Belwood Ave. viaduct in that city. The viaduct will start at the junction of Means St. and Bellwood Ave., extending across the railroad right of way. The cost of the work is estimated at $60,000, of which the railroads will pay $20,000, the county $15,000 and the city $25,000. Capt. R. M. Clayton is Engineer of Construction, Atlanta, Ga. J. J. Greer is Chairman of the Council Bridge Committee.

Idaho.

Commissioners of Lemhi County, Salmon, Idaho, have decided to construct a bridge over the Salmon River at the Shoup ranch. Private subscriptions amounting to about $2,000 have been raised toward the cost.

Illinois.

✣Bids will be received at the County Clerk's office, Virginia, Ill., up to 2:30 p. m., May 11, for the construction of the following reinforced concrete bridges in the County of Cass. L. O. Skiles, County Clerk, Virginia, Ill.

Name	Span No. ft.	Roadway, No. ft.	Cu. yds. concrete.	Total lbs steel.	Nearest R. R. Station.
[illegible]	[illegible]	[illegible]	[illegible]	2,510	[illegible]
Logan	[illegible]	[illegible]	24.1	2,240	S. E. of Chandlerville, 9 mi.
Red Oak	[illegible]	[illegible]	63.4	[illegible]	N. of Cass, 3 mi.
Schroeder	[illegible]	[illegible]	92.6	13,850	N. of [illegible]
Gilbert	[illegible]	[illegible]	43.5	[illegible]	N. E. of Philadelphia, [illegible]
Sugar Grove	[illegible]	[illegible]	46.9	783	N. W. of Philadelphia, 5 mi.
Nigger Creek	[illegible]	20	41.2	[illegible]	E. of Philadelphia, ½ mi.
Turner	[illegible]	20	39.8	2,722	E. of Palmerton, ¾ mi.
Warner	[illegible]	[illegible]	42.1	524	E. of Palmerton, 2½ mi.
Mattews	[illegible]	[illegible]	57.6	[illegible]	E. of Virginia, 6 mi.
Bell	[illegible]	[illegible]	68.2	[illegible]	N. of Philadelphia, [illegible]

All materials for the above bridges will have to be shipped in. Excavation will be in sandy loam and clay. Numbers 3, 5, 6, 7, 9, 10 and 11 have plain concrete sub-structures. Work to be completed on or before August 15, 1911.

✣Bids will be received up to 11 p. m., May 15, at the board room of the County Commissioners in the Cook County Court House, Chicago, Ill., for the following reinforced concrete bridges to be built in Rich Township, Cook County. Albert Reese, Town Clerk, Matteson, Ill

Name	Span No. ft.	Roadway No. ft.	Cu. yds. concrete.	Total lbs. steel.	Nearest R. R. Station
Aohlerking	10	[illegible]	36.9	1,298	Richton, 3 mi
Meyer	[illegible]	[illegible]	44.8	941	Flossmoor, 2 mi.
Mahler	[illegible]	[illegible]	12.4	2,040	Richton, ¼ mi.
Vollmar	[illegible]	[illegible]	23.5	4,181	Matteson, ½ mi.
McFadden	15	[illegible]	23.1	2,070	[illegible]

Excavation for the Aohlerking and Meyer bridges will average 3 to 4 ft. in clay. Plain concrete in sub-structures. The McFadden bridge will require a little excavation to make extension on up stream wings. Plain concrete for extension. The Mahler, Vollmar and McFadden bridges have old stone abutments: contract to include raking out the joints and repointing. Contract also includes back fill, approach grades and gravel or macadam wearing surface. Commissioners wish stone and sand used for concrete. All material will have to be shipped in. Work to be completed on or before October 1, 1911.

⦿The East Side Levee & Sanitary District, Sexton Bldg., East St. Louis, Ill., has awarded the contract for the necessary steel for the construction of the 5 railroad bridges over the [illegible] awarded to the King Bridge Co., Cleveland, O., at $60,000.

A conference was recently held by Carter Harrison, Mayor of Chicago, Ill., C. A. Knight of the Chicago & Oak Park R. R. and Commissioner of Public Works in regard to the construction of the new bridge over the river at Lake St., Chicago. By terms of the recently passed ordinance, the railway will pay one-third the cost.

It is reported that the Atchison, Topeka & Santa Fe Ry. is preparing to renew the viaducts at 12th and 18th Sts. in Chicago, Ill., at an estimated cost of $20,000 each. A. F. Robinson, Chicago, Ill., is Bridge Engineer of the system.

Indiana.

⦿The following bids were received by the Board of Public Works, Indianapolis, Ind., April 24, for the construction of the proposed concrete slab bridge across Pogues Run at Highland Ave: H. F. Hackedorn (awarded contract), $6,785; Pease-Buzatt Construction Co., $7,500; American Construction Co., $8,200.

⦿The contracts for the construction of 12 bridges were let by the Board of County Commissioners, Princeton, Ind., seven of the structures going to George Soller, Princeton, Ind., at $3,369 and the other five to the Vincennes Bridge Co., Vincennes, Ind., at $5,221.

⦿The contract for the construction of two steel bridges was let May 2 by the Board of County Commissioners, Plymouth, Ind., to the Rochester Bridge Co., Rochester, Ind., at $1,570. The work includes only the superstructure.

⦿Board of County Commissioners, Bluffton, Ind., on May 4 awarded the following bridge contracts: Thomas Turfin, Liberty Center, Ind., 9 bridges at $4,503; George Joy, Fort Wayne, Ind., 1 bridge at $1,099; Crosbie & Johnson, Bluffton, Ind., 4 bridges at $845.50. O. L. Garrett is County Auditor.

⦿The Algoma Steel Bridge Co., Winnipeg, Man., has been awarded the contract by the Municipal Council, Minnetonas P. O., Man., for the erection of a steel Warren truss bridge for $2,180. Bids were opened April 15.

⦿The Daviess County Commissioners, Washington, Ind., have awarded the following contracts for the construction of seven bridges, for which bids were opened May 5: James F. Hopkins, three bridges, $1,159; Kuttev & O'Donnell, three bridges, $2,172, and Virgil Grannan, one bridge, $350.

⦿The Board of Clay County Commissioners on May 2 awarded the contract for the construction of a 50 ft. steel bridge over the Connolly Ditch in Harrison township to the Sullivan Bridge & Supply Co., Sullivan, Ind., at $1,125. Other bidders were George M. Knotter, Worthington, $1,250; LaFayette Engineering Co., LaFayette, Ind., $1,317. E. A. Staggs is County Auditor.

⦿The Vincennes Bridge Co. of Vincennes, Ind., has been awarded the contract by the Board of County Commissioners at Bloomfield, Ind., for filling approaches to Headricksville bridge for $194. Bids were opened May 2.

⦿Ham & Cadle of Paoli, Ind., have been awarded the contract by the Board of County Commissioners, Paoli, for the construction of a new floor system in Valcene bridge in South East Township. Bids were opened May 2.

Iowa.

✣Bids will be received until [illegible], May 11, by Board of Clinton County Supervisors, Clinton, Ia., for the construction of pile bridges for the year ending March, 1912. F. W. Leedham is County Auditor and Charles Mordhorst is Chairman of the Board. Reuben C. Hart, Clinton, Ia., is County Surveyor.

✣Bids will be received until 1:30 p. m., May 15, by Board of Supervisors, Story County, Ames, Ia., at the office of D. C. F. Curtiss, Ames, Ia., for furnishing necessary labor and materials for the construction of a reinforced concrete bridge consisting of 4 32-ft. deck girders complete, reinforced concrete bridge consisting of 3 37-ft. deck girders complete, for the construction of a reinforced concrete bridge with a minimum of 1,200 sq. ft. of waterway in 10 ft. from stream bed. C. A. Batman is County Auditor. Official advertisement will be found elsewhere in this issue.

⦿The Board of Cerro Gordo County Supervisors, according to advices from Mason City, Ia., has awarded the contracts for the construction of six new bridges, four of which are to be concrete to Hinkle & Bruns, Mason City, Ia., and the other two of steel to the Illinois Steel Bridge Co.

The Supervisors of Sioux County at Orange City, Ia., have decided to construct a county bridge of concrete across Six Mile creek, north of Hawarden, Ia., at an estimated cost of $4,500.

The Commercial Club of Eldora, Ia., has appointed a committee to take up the matter of constructing a large steel bridge over the Iowa River at the foot of Marion St. C. F. Stauffer, Eldora, Ia., is Chairman of the committee.

The Board of Butler County Supervisors, Allison, Ia., has decided upon the construction of a new bridge across the Shell Rock in Dayton township. The new structure will be built about 1½ miles up the river from Root's Siding bridge and will require an expenditure of about $5,000.

Kansas.

⦿The County Commissioners, Topeka, Kan., have awarded the contract for the construction of the proposed steel bridge over the Kaw River, consisting of two 134.4 ft. spans resting on concrete abutments to the Leavenworth Bridge Co., Leavenworth, Kan., at $5,850.

A petition is being circulated in Barton County, Kan., asking the County Commissioners for an appropriation of $20,000 for the construction of a bridge at Great Bend, Kan.

The County Commissioners of Shawnee and Jefferson Counties, according to advices from Topeka, Kan., are considering the construction of a new bridge across the river on the Grantville road and of improving the road along the Calhoun Bluffs.

City Commissioners are to be petitioned by the citizens of Wichita, Kan., to call a special election for the voting of bonds to the amount of $60,000 for a new concrete bridge over the Arkansas River at Maple St.

Kentucky.

⦿The Louisville & Jeffersonville Bridge Company has awarded the Raymond Concrete Pile Company of New York and Chicago the contract for placing over 1,000 Raymond concrete piles in the foundations of a viaduct that will be built at Louisville, Ky., connecting the Louisville & Nashville R. R. and the Chesapeake & Ohio R. R., with the Louisville & Jeffersonville Bridge Company's tracks. G. P. Smith, chief engineer C. C. C. & St. L. Railway; B. C. Milner Sons Company, general contractors.

⦿The Oregonia Bridge Co., Lebanon, O., has been awarded the contract for the construction of the Robbin Ave. bridge at Covington, Ky., which was closed to traffic early this year.

The following bids were received by Commissioners W. C. Montgomery and Charles F. Taylor of Hardin and Jefferson Counties, Ky., respectively, for the construction of the proposed bridge over the Salt River at West [illegible] $69,227; J. T. Moorman, Winchester, Ind., $52,300; Attica Bridge Company, Attica, Ind., $51,000 and $56,000; Capital Construction Company, Columbus, O., $56,000, $60,000 and $70,000; Mt. Vernon Bridge Company, Mt. Vernon, O., $85,000; Champion Bridge Company, Wilmington, O., $77,870 and $83,647; Central States Bridge Company, Indianapolis, $37,000 and $38,500. Elizabethtown, Ky., is county seat of Hardin County and Louisville, Ky., is county seat of Jefferson County.

Officials of the Louisville & Nashville Ry. have announced, according to reports, that they will construct a steel bridge with reinforced concrete piers over Bay's Ford creek, near Scottsville, Ky. E. F. Kuersteiner, Louisville, Ky., is Bridge Engineer.

Louisiana.

At a recent meeting of the St. Mary Parish Police Jury at Franklin, La., a committee was appointed to look into the matter of constructing a swing bridge across the Bayou Teche at Charenton in the upper end of the parish.

Long Island.

W. G. Stearns & Co., Jamaica, L. I., who had the contract for making test borings to determine the necessary depth of excavations for the proposed new Penn St. bridge in Reading, Pa., have completed their work, including 23 borings from 5 to 35 ft. in depth. Plans for the structure will now be completed and it is believed that the Commissioners, Berks County at Reading, will probably advertise for bids during the month of June.

Maryland.

A conference was recently held at Wilmington, Del., by Levy Court of New Castle County, James Wilson, County Engineer, J. E. Greiner and Louis Chevalier, Baltimore, Md., Consulting Engineers, in regard to the construction of the proposed bridge over the Christiana River between Third and Fourth Sts., mentioned in our last issue.

At a recent meeting of the Kent District Citizens Association of Prince George's County, Md., at Dodge Park, it was decided to construct the bridge spanning Beaver Dam branch on the new road being built from Marlboro Pike and Sheriff road of steel and concrete. Upper Marlboro, Md., is county seat.

Mississippi.

The United States War Department, Washington, D. C., has approved plans for the construction of a new steel draw span highway bridge by Leflore County over the Yazoo River at Roebuck Ferry, near Siddon, Miss. Greenwood, Miss., is county seat.

New York.

✣Bids will be received until 2 p. m., June 1, by Kingsley L. Martin, Commissioner of Bridges, 12-21 Park Row, New York City, for strengthening the end spans of the Williamsburg bridge over the East River between Manhattan and Brooklyn.

A resolution is to be submitted to the city council of Montour Falls, N. Y., providing for the construction of a new bridge over Catherine Creek at South St. The structure as proposed will have a single cement roadway 18 ft. wide, two 6-ft. walks. The cost is estimated at $1,800.

The following bids were received bv the Grades Crossing Commission, Niagara Falls, N. Y., for the construction of approaches to the proposed 11th St. bridge at the north end of the city: Braas Bros., $35,987; Reade-Coddington Engineering Co., $36,950; Eastern Concrete Steel Co., Buffalo, N. Y., $30,150; J. E. Johnson Co., Buffalo, $25,990.

North Carolina.

⊙The York, Pa., Bridge Co., the Pennsylvania Bridge Co. of Philadelphia, the Pennsylvania Steel Co. of Philadelphia, the American Bridge Co., the Virginia Bridge & Iron Co., the Belmont Iron Works of Philadelphia and McClintoic-Marshall Construction Co. have submitted plans, specifications and bids for the following bridges to be built by the Piedmont Traction Co., W. E. Lee, Charlotte, N. C., Chief Engineer, along its projected interurban line in the vicinity of Charlotte, N. C.: Long Creek viaduct near Mt. Holly; Catawba River crossing at Mt. Holly; Smith Fork of Catawba River crossing five miles west of Mt. Holly; undergrade crossing of Southern Ry. in Gastonia; highway bridge at Gastonia on East Air Line St.; undergrade crossing of the Carolina & Northwestern R. R. in Gastonia; Reedy River cross, Greenville, S. C.; undergrade crossing of Southern R. R. near Brandon Mills, Greenville, S. C.; overhead crossing of Southern Ry. at Piedmont, S. C.; depot branch viaduct at Piedmont; Saluda River crossing near Pelzer, S. C.; undergrade crossing of Southern Ry. at Williamston, S. C.; undergrade crossing of Southern Ry. at Belt, S. C.; undergrade crossing of Southern Ry. at Greenwood, S. C. It is reported that the American Bridge Co. [illegible] awarded the contract for the construction of the following five of the above structures: Bridges over the Catawba River at Mount Holly, the South Fork, between Mount Holly and Gastonia, and over Long Creek and the Saluda and Reedy Rivers in Souah Carolina. The work covers the steel only.

A meeting was recently held by representative committees of the Boards of Commissioners of Mecklenburg and Gaston Counties to discuss the matter of constructing steel bridges, one at Sloan's Ferry and the other at Mount Holly over the Catawba River. John F. Leeper, Belmont, N. C., is Chairman of the Gaston County Board.

North Dakota.

✣Bids will be received until 8 p. m., June 5, by City Auditor, Valley City, N. Dak., for plans, detail drawings, strain sheets, specifications and proposals for the erection and construction of a steel truss foot bridge over the Cheyenne river. The structure is to have one 100 ft. span and two 20 ft. steel approaches. C. A. Myhre is City Engineer.

The Board of U. S. Engineers, War Department, Washington, D. C., has accepted the plans of the Fargo & Moorhead Street Ry. Co. for the construction of a bridge over the Red River near Fargo, N. Dak., and it is expected that work will be started at once. It is believed that the new bridge will cross the river just north of the old structure. C. P. Brown, Fargo, N. Dak., is General Manager of the railway.

Ohio.

✣Bids will be received until noon, May 19, by Department of Public Works, Dayton, O., for the necessary labor and material for constructing the sub-structure, re-erecting the superstructure and ripraping the south approach for a bridge over Wolf Creek at its confluence with the Great Miami River, connecting Sunrise and Edgewater Aves. in the city of Dayton, O., in accordance with the plans and specifications on file in the office of the city civil engineer. William A. Budroe is Secy. Department.

✣Bids will be received until noon, May 29, by Director of Public Service, Cincinnati, O., for the driving of piling, the construction of the sub-structure and miscellaneous work in connection thereof for the Gilbert Ave. viaduct. Plans, specifications and blank proposals can be obtained at the office of the Chief Engineer of the Department of Public Service. Each proposal must contain the full name of the party or parties making the same and all persons interested therein, and must be accompanied by a bond in the sum of $1,000 or a certified check on a solvent bank as a guarantee that if the proposal be accepted a contract will be entered into. This work was mentioned in our last issue. J. J. Wenner is Clerk.

✣Bids will be received until 1 p. m., May 22, by Board of County Commissioners, Elyria, O., for furnishing the necessary labor and material for the construction of the sub and superstructure of Twining Bridge No. 222 in Camden township, Lorain County, O. Plans and specifications can be obtained of C. H. Lawrence, Elyria, County Surveyor.

✣Bids will be received until 1 p. m., May 22, by the Commissioners of Lorain County at Elyria, O., for furnishing the necessary labor and material for the sub-structure and superstructure of bridge No. 196 on Spring St. in Oberlin Village. Plans and specifications can be obtained of C. H. Lawrence, County Surveyor.

✣Bids will be received until 1 p. m., May 22, by Lorain County Commissioners, Elyria, O., for furnishing the material and labor for constructing Bassett bridge, sub-structure and superstructure No. 205, Russia Township. C. H. Lawrence is County Surveyor. Charles Chandler is Clerk of the Board.

⊙The Commissioners of Washington County at Marietta, O., recently awarded the contract for the construction of the bridge over the Wolf Creek, a short distance above Watertown, to Nelson & Merydith at $1,105.

⊙The Commissioners of Richland County at Mansfield, O., have awarded the contract for the construction of the proposed concrete bridge over Rush Creek at the foot of Water St. to Capitol Construction Co., Ruggery Bldg., Columbus, O., at $4,250. Other bids were as follows: E. J. Lander, Canton, O., $5,025; George J. Bock & Son, Coshocton, O., $4,300; Illinois Bridge Co., $5,300. The work is to be completed by August 24.

⊙The Commissioners of Green County at Xenia, O., have awarded the contract for the construction of the sub and superstructure of the Louis Hill bridge over the Little Miami in Sugar Creek township to the Oregonia Bridge Co., Lebanon, Pa., at $9,317. The contract for the excavation was awarded Addison Long at $1,500.

The Commissioners of Marion Countv, Marion, O., have under discussion the construction of a bridge over the Little Scioto River at Holland Pike, and steps will be taken to secure the co-operation of the Morrow County officials.

At a recent meeting of the Council Finance Committee, Toledo, O., it was decided necessary to construct a new bridge on Sumner St., crossing the Lake Shore near the Union Station and plans for a structure not to exceed a cost of $25,000 were ordered. A. H. Smith is Engineer.

The Commissioners of Ross County, Chillicothe, O., have signed a resolution for a new iron bridge across Paint Creek at the foot of Paint St. and a hearing will be held May 22. The estimated cost of the structure, which as planned will be 150 ft. long, consisting of two spans, is $37,000.

The estimates prepared by the County Surveyor, Elyria, O., for the construction of the proposed bridge at South Lorain set the necessary expenditure for the improvement at $66,800.

An ordinance was approved April 25 by the Mayor of Cleveland, O., authorizing the Director of Public Service to expend a sum not to exceed $8,000 for the construction of the superstructure of W. 3d St. extension bridge over the Lake Shore & Michigan Southern and the Pennsylvania R. Rs. R. Y. McCray is City Clerk.

Oregon.

⊙The contract for the construction of the interstate bridge at Nyssa, Ore., has been awarded to the Coast Bridge Co., Portland, Ore., at $34,000. This bridge will be a four-span steel bridge 684 ft. long. It will be built at the east end of Main St. at Nyssa and will connect this town with the LaPoint & Fox of Boise, Idaho, are the engineers in charge.

A special election has been called by the City Council of Salem, Ore., to be held June 19 for the purpose of voting on the proposition to issue $60,000 of bonds for the construction of concrete bridges. It is proposed to build one structure across Mill Creek at 12th St. between Bellevue and Oak.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Pennsylvania.

✤Bids will be received until noon, May 15, by Commissioners of Chester County, West Chester, Pa., for the erection of a reinforced concrete bridge at Springdale Station, West Marlborough township, over Doe Run Creek. A certified check for $500 must be filed with each bid. E. Vinton Philips is Clerk.

⊙Boyer, Patterson & Morris, 1328 Arch St., Philadelphia, Pa., have been awarded the contract for the construction of the reinforced concrete highway bridge over Pine Run, Westover, Clearfield County, Pa.

The Wilkesbarre Ry. Co., T. A. Wright, Gen. Mgr., Wilkesbarre, Pa., providing permission can be obtained of the County Commissioners, plans to enlarge and strengthen the Market St. bridge at a cost of about $70,000. The plan as outlined is to extend the bridge piers down the river from 10 to 15 ft. and putting up a new series of bridge spans and girders so that there would be ample room and sufficient strength to support a double track where the present single track is now located. The present track is suspended on girders out from the main bridge structure, so that it is necessary to add to the width of the bridge before an additional track could be laid

The Wilson-Glassport Bridge Association has been organized by the citizens of Wilson and Glassport, Pa., to induce the county commissioners to erect a free bridge over the Monongahela River between the boroughs. It is believed that McKeesport, Clairton, Coal Valley and Elizabeth boroughs and part of Jefferson Township will join in the movement.

Advices from Bethlehem, Pa., state that the Grand Jury has condemned the old covered wooden bridge spanning the Lehigh River between Bethlehem and South Bethlehem and steps will be taken soon toward the construction of a new bridge to replace the old structure. The cost of the work, it is estimated, will range between $250,000 and $500,000.

South Carolina.

⊙T. W. Boyd, Supervisor of York County at Yorkville, S. C., has let the contract for the construction of the steel bridge at Davis' Mill on Crowder's Creek a few miles north of Clover to the Roanoke Bridge Co. at $1,460. C. K. Creitzberg, Rock Hill, S. C., is representative of the bridge company.

Advices from Florence, S. C., state that business men of that city and county have organized an association to take up the matter of erecting a causeway and bridge across the Great Pee Dee River near the old Mars Bluff Ferry. W. R. Barringer, Florence, S. C., is a member of the investigating committee.

Tennessee.

Information received from Clarksville, Tenn., is to the effect that the Louisville & Nashville Ry. is planning the reconstruction of its trestle over Bud's Creek, 9 miles west of that city, during the coming summer. F. Ingram, Erin, Tenn., is Supervisor of Bridges and Buildings of that section.

West Virginia.

✤Bids will be received until 2 p. m., May 16, by J. E. Dougher, Road Engineer, Greenbrier County, Lewisburg, W. Va., for the construction of a bridge across Meadow River near mouth of Brackens Creek at Russellville. Bids will be received on two types, No. 1, reinforced concrete bridge capacity of 100 lbs per sq. ft. or capable of supporting 20 ton road roller; No. 2, steel superstructure with concrete sub-structure with 14 ft. roadway, capacity of 150 lb. per sq. ft. or 20 ton load, floored with wood or concrete slabs.

✤Bids will be received until May 16 by Greebrier County Court, Lewisburg, W. Va., for the construction of a reinforced concrete or steel bridge over Meadow River. As planned the structure will consist of one 45 ft. span with 14 ft. roadway 9 ft. from the bed of the river. J. E. Dougher, Lewisburg, W. Va., is County Road Engineer.

Reports from Benwood, W. Va., state that five bids were received by the Council April 25 for the construction of the proposed bridge to span the Baltimore & Ohio tracks to connect the traction line on the Kentucky Heights with Center Benwood at 6th St., the lowest bidder being the York Bridge Co., at $2,153.

Wisconsin.

At a recent meeting of the Marathon County Board at Wausau, Wis., appropriations for the construction of bridges were made as follows: A bridge across the Big Eau Pleine River, on the town line near Hull and Holton, estimated cost $2,800; bridge across Black Creek, in the town of Bern, $4,000; bridge over Romeo Creek, in the town of Brighton, $800; bridge across the Little Eau Pleine, in the town of Day, $3,200.

Canada.

It is rumored that officials of the Canadian Northern Ry. are considering the construction of a bridge connecting United States and Canada at International Falls, Minn. M. H. McLeod, Winnipeg, Man., is General Manager of the railway.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

✤Bids will be received until noon, June 1, by Board of Commissioners of Drainage District No. 1, Ashley County, Wilmot, Ark., for the construction of a drainage canal and laterals in Ashley County, Ark., the work including approximately 700,000 yds. W. B. De Yampert, England, Ark., is engineer.

⊙Bids were opened April 24 by the directors of the White River Levee District at Cotton Plant, Ark., for constructing 60,000 cu. yds. of levee embankment across Jackson Bayou in Prairie County, the contract being awarded to R. L. Leonard, Memphis, Tenn., at 29 cts. per cu. yd.

Colorado.

⊙C. G. Shiely, Denver, Colo., has been awarded a $6,000 contract by the Chivington Canal Co. for the construction of a canal and dam

Illinois.

✤Bids will be received until noon, May 20, by L. O. Haville, commissioner, Lawrenceville, Ill., R. F. D. No. 4, at the office of R. J. Benefiel, engineer, Lawrenceville, Ill., for the construction of the following ditches: 15,300 ft. open ditch, 4 ft. bottom, 12,712 cu. yds. excavation; also to furnish and lay 3,500 ft. 10-in. tile and 2,600 ft. 8-in. tile, work to be completed by Oct. 1, 1911.

The Cache River Drainage District of Pulaski County is planning the construction of a main ditch about 7½ miles long and about 20 miles of laterals. John Charp, Cypress, Ill., is engineer for the district.

The Engineering Department of the East Side Levee & Sanitary District, East St. Louis, Ill., will during the present month locate the second and third sections of the flood protection levee, extending from the Merchants' Bridge through East St. Louis to the Pittsburg Dike. The location of the levee below Pittsburg Dike will be made some time during the summer. It will end at the mouth of the Prairie Dupont Creek. The contract for the first section of the levee was let a few days ago, from Cahokia diversion channel to Mitchell, three miles, as noted in our last issue.

Indiana.

✤Bids will be received until 3 p. m., May 13, by James M. Burns, construction commissioner, Rochester, Ind., for the construction of Obert Goss, et al., main and branch ditch, including 1,240 ft. 6-in., 200 ft. 8-in., 500 ft. 10-in., 100 ft. 12-in., 4,700 ft. of 14-in., 1,200 ft. 16-in., 1,260 ft. 18-in. tile and 4,220 cu. yds. of excavation.

✤Bids will be received until 3 p. m., May 13, by James Burns, commissioner of construction, Rochester, Ind., for the construction of the George Barkman ditch. Certified check for $150 must be filed with each bid.

Iowa.

✤Bids will be received until 1:30 p. m., May 13, by C. A. Bateman, county auditor, Nevada, Ia., for furnishing the necessary labor and material for the construction of the ditch in the Franklin-Milford township drainage district. Drain will consist of the "main" and laterals "A" and "B." The main is to consist of 2,000 ft. of 12-in. tile, 1,900 ft. of 10-in. tile. Lateral "B" is to consist of 433 ft. of 7 in. tile, to be completed to Station No. 9 July 1, 1911, and fully completed Dec. 1, 1911. Section 2—Lateral "A" shall consist of 580 ft. of 10-in. tile, 1,090 ft. of 8-in. tile. Lateral "A-1" shall consist of 1,214 ft. of 7-in. tile, to be completed Dec. 1, 1911.

⊙Bids were opened April 27 by the County Auditor, Fort Dodge, Ia., for work in Drainage District No. 137, the contract being let to Phil Rivard, Pocahontas, Ia., at $3,239.

Webster County Drainage District No. 96 has been established and bids on the work will probably be advertised in June or July. This work requires 550,000 cu. yds. of excavation and a system of tile laterals. The estimated cost is $97,000. G. P. Smith, Fort Dodge, Ia., is the engineer.

⊙Bids were opened May 1 by the County Auditor at Newton, Ia., for constructing Drainage Ditch No. 4, requiring about 12,700 cu. yds. of excavation. The contract was let to A. S. White, Grinnell, Ia., at 17¾ cts. per cu. yd.

⊙Koch & Schultz, Milwaukee, Wis., has been awarded a $90,000 contract for constructing a drainage ditch in Wright County.

Kansas.

An experimental irrigation well is to be put down at Garden City, Kan., for the irrigation of a tract of 40 to 80 acres. The well will cost $4,000, of which $2,000 will be furnished by the government and the state of Kansas jointly, and the other $2,000 by the Commercial Club of Garden City and the commissioners of Finney County. The last legislature passed a law and made an appropriation for experiments in irrigation, the government and the state to prosecute the work jointly. The well to be put down at Garden City is the beginning of a series of experiments. It is planned to put down a 24-in. well, with a centrifugal submerged pump run by gasoline power. The well will be located on the experiment station grounds at Garden City, and the land irrigated will be experiment station property. The ground is high and the experiment will show what can be done with thousands of acres of western Kansas land similarly situated. A. H. Webster, Garden City, Kan., is director of the Kansas Experiment Station.

Louisiana.

✤Bids will be received until noon, June 6, by Board of Commissioners, Bayou Sale Drainage District, 920 Hibernia Bldg., New Orleans, La., for the excavation of drainage canals, construction of levees, construction of pumping plant and such other work as is necessary to the complete drainage of subdivisions 1 and 2 of the Bayou Sale Drainage District.

⊙Advices from Houma, La., state that R. R. Barrow has awarded a contract to E. F. Mor-

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

gan to dredge the Barataria Canal, belonging to Mr. Barrow, from Bayou Terrebonne to Bayou Black. The canal will be [illegible] wide, with a depth of 6 ft. medium low tide water.

In a report to the Orleans Levee Board, New Orleans, La., Chief Engineer Lewis stated that steps should be taken immediately towards the repair or rebuilding of the levee below Kentucky St., so as to be prepared for the next high water.

Mississippi.

Bids were opened April 28 at the office of the U. S. Engineer, Vicksburg, Miss., for 65,000 cu. yds. of levee work at Warfield Point. Roach & Stansell, Memphis, Tenn., at 10.98 cts., was the lowest bidder.

Nebraska.

✣Bids are asked until noon, May 22, by Sanitary District No. 1, W. J. Blystone, Chairman, Lincoln, Neb., for excavating a 2-mile channel for Oak Creek, requiring about 160,000 cu. yds. of excavation.

New Mexico.

The Santa Fe Dredging Co., Capital City Bank Bldg., Santa Fe, N. Mex., has been incorporated with a capital stock of $1,000,000. The object of the company is to deal in mines, lands and developing mines, etc. The incor[illegible] A. Ward, J. H. Vaughn and A. B. Renehan.

Oklahoma.

Plans for extensive river straightening work in Oklahoma County are being prepared. It is proposed to straighten and deepen the river [illegible] the Canadian River on its whole course in Oklahoma County, similar to work now being done in Canadian County. In all about 23 miles of the river bed will be improved and it is estimated that the total cost of the work will be nearly $800,000. It is the plan of Oklahoma county to form two districts to do the work. One of them includes the first six miles of the course of the river this side of the Canadian County boundary, and the estimated cost of the work in that district is $65,000. The county commissioners now are advertising for bids on the work, as the district has been formed and the levies made. The other district will include all of the remainder of the county and that part of the river within the limits of Oklahoma City. Within the city the work will be done by the municipality. There are about four miles of this work west of the city, five within the corporation limits and the remaining nine miles between the city and the eastern line of the county. A report on the work in the city has been prepared by W. C. Burke, City Engineer, of Oklahoma City, and it is estimated that this portion will cost $400,000. The county surveyor is in charge of the report for the district outside of the city.

South Dakota.

✣Bids will be received until 4 p. m., May 18, by Department of Interior, U. S. Reclamation Service, at the office at Newell, S. Dak., for the construction of approximately 39,000 lin. ft. of canal known as the "Townsite Lateral," Belle Fourche, S. Dak., project. F. C. Magruder is project engineer.

Texas.

✣Bids will be received until 9:30 a. m., May 30, by Galveston County Drainage District, No. 1, R. H. Bushway, Alga, Texas, chairman, for construction of laterals opening La Fourche Bayou and Willow Bayou. The contract will include the excavation of 100,000 cu. yds. of earth. E. Evans, Galveston, Texas, is engineer.

Washington.

All bids received April 15 by the U. S. Reclamation Service for building the Kachess Dam and accessory structures near Easton, Wash., have been rejected, and the work will be done by force account. The unit bids received on this work were given in our last issue. Chas. H. Swigart, North Yakima, Wash., is Supervising Engineer, U. S. Reclamation Service.

WATER-WORKS

Alabama.

A city election has been called in Columbiana, Ala., for May 15, to determine whether or not bonds to the amount of $7,000 shall be issued for the construction of a waterworks plant for the city.

The City Council of Aliceville, Ala., has granted a franchise to a newly organized company to construct a waterworks plant. The town is to subscribe for seven fire plugs and provision is made for additional plugs as the system is extended. About $6,000 will be spent now in the construction of a system along Broad St. The tank will be located on a hill 75 ft. above the town, and will be mounted on a 55-ft. tower or standpipe.

Arkansas.

The People's Bank of Imboden, Ark., has sold the electric light and waterworks plant of that town to George Dutton of Imboden. The plants will be overhauled, new machinery placed, and the water mains extended.

California.

✣Bids will be received until 11 a. m., May 22, by Department of Finance, Ways and Means, P. E. Woods, Supt., San Diego, Cal., for furnishing the city the following cast iron water pipe: 405 lengths of 36-in. cast iron water pipe, 363 lengths of 36-in. cast iron water pipe, 100 lengths of 30-in. cast iron water pipe, 713 lengths of 30-in. cast iron water pipe, 100 lengths of 30-in. cast iron water pipe, 370 lengths of 24-in. cast iron water pipe, 530 lengths of 16-in. cast iron water pipe, 303 lengths of 16-in. cast iron water pipe, 442 lengths of 12-in. cast iron water pipe, 1,170 lengths of 12-in. cast iron water pipe, 1,170 lengths of 12-in. cast iron water pipe, 920 lengths of 10-in. cast iron water pipe, 1,750 lengths of 10-in. cast iron water pipe, 200 lengths of 8-in. cast iron water pipe. All of said pipe to be in accordance with the plans and specifications on file in the office of the City Clerk of San Diego.

Colorado.

It is reported that the citizens of Grand Junction, Colo., on April 29 voted the issuance of bonds to the amount of $150,000 for the sinking of artesian wells in connection with the proposed new water supply system.

Georgia.

Bonds to the amount of $40,000 have been voted by the citizens of Fort Valley, Ga., for the installation of a waterworks system.

Illinois.

⊙The City Council of Lewiston, Ill., has approved and accepted the $5,000 bond of the Cook Construction Co., of Des Moines, Ia., and according to contract, work will begin on the waterworks improvement and extension which will cost $6,801.

⊙The contract for furnishing and erecting coal and ash handling machinery at the Roseland Pumping Station, 104th St. and Stewart Ave., Chicago, has been awarded to the Link Belt Machinery Co., 39th St. and Stewart Ave., contract price $8,300. L. E. McGann is Commissioner of Public Works. Bids opened April 20, 1911.

⊙L. E. McMcGann, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing and installing sluice gates in the Southwest Land Tunnel to the Coffin Valve Co., Neponsit, Boston, Mass. Contract price, $7,000. Bids opened April 6th. Detailed specifications were given in ENGINEERING-CONTRACTING.

Following are the low bids received May 3 by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering boiler tubes to the various pumping stations. (Detailed quantities and dimensions published in ENGINEERING-CONTRACTING): (A) diameter (B) gage. A 3 ins. B 10, 29½ cts.; A 3½ ins., B 9 36.6 cts., A 3½ ins. B 10 31.2 cts., A 4 ins. B 10 33 cts., A 3 ins. B 8 80 cts, A 3½ ins. B 8 80 cts, A 2 ins. B 6 50 cts., A 2 ins. B 6 55 cts., Jno. Mohr & Sons, 349 Williams St., Chicago, Ill.

Iowa.

✣Bids will be received until 8 p. m., May 16, by J. G. Davenport, Clerk, Clear Lake, Ia., for the improvement of the existing system of water works. Official advertisement will be found elsewhere in this issue.

Residents of Luther, Ia., have petitioned the City Council to call a special election to vote bonds for the establishment of a waterworks plant. The estimated cost is $5,000.

The City Council of Council Bluffs, Ia., has voted unanimously to purchase the water plant at the valuation placed upon it by the first court in condemnation held in the state. Bonds were voted some time ago to the amount of $600,000 for the purchase of the plant and they have been ordered sold. The valuation placed upon the plant is $510,500.

The city of Lamotte, Ia., has sold bonds to the George Bechtel Co., of Davenport, Ia., for the purpose of constructing a new waterworks system.

Kansas.

✣Bids will be received until 7 p. m., May 16, by City Council of Atwood, Kan., for laying water pipes from the tapping point on water mains to the curb line of street and furnishing all material for such work. Rank E. Robinson is City Clerk.

The City Council of Hill City, Kan., has voted in favor of the installation of a waterworks and an electric light plant.

Maryland.

The citizens of La Plata, Md., on April 31 voted the issuance of bonds to the amount of $15,000 for the purpose of establishing a water system.

Massachusetts.

✣Bids will be received until 2 p. m., May 15, by Clerk of the Board of Public Works, Pittsfield, Mass., for laying water pipe. The work will include 10,500 ft. of 18-in. cast iron pipe. A. B. Farnham is Engineer of the Board.

✣Bids will be received until noon, May 15, by Board of Water Commissioners, T. J. Carmody, Chairman for the construction of a concrete dam across the Manhan Brook in Southampton, Mass. A certified check for $2,500 must accompany each bid. T. J. MacCarthy is City Engineer.

Michigan.

An election was held in Marquette, Mich., on May 5, for the purpose of voting on the issuance of bonds in the sum of $75,000 for a pure water supply.

The Water Commissioners of Detroit, Mich., have decided to construct a new $30,000 intake at the Windsor waterworks pumping station. Plans for the work have already been prepared and approved. Bids will be asked for at once.

Minnesota.

✣Bids will be received until 10 a. m., May 22, by Council, Mankato, Minn., for removing old boiler and furnishing and installing a new boiler at pumping station, 125 h. p. 150 lb. pressure. A. H. Scherer is City Clerk.

⊙The Village of Madison Lake, Minn., has awarded the contract for the installation of a water works system as follows: Chicago

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Bridge & Iron Works, Chicago, Ill., constructing the tower and tank, 160,000 gal capacity, at $3,600; John Keogh, St. Peter, Minn., laying mains complete, about $2,350. Bids were opened May 1.

Missouri.

✣Bids will be received until noon, May 19, by Board of Public Improvements, St. Louis, Mo., for furnishing cast iron coated water pipes, cast iron coated special castings, stop valves, post fire plugs and post fire plug top parts, to be delivered at the city pipe yard.

✣Bids will be received until noon, June 2, at the city hall by Board of Public Improvements, St. Louis, Mo., for furnishing general and detailed drawings, constructing and erecting in place, exclusive of foundations, at Low Service Pumping Station, Chain of Rocks, two steam turbine driven centrifugal pumping units complete with condensing apparatus and all appurtenances.

✣Bids will be received until 11 a. m., May 25, by C. W. Dobbins, Pleasant Hill, Mo., for the construction of a water works system, including 1,500 ft. 8-in. pipe, 10,000 ft. 6-in. pipe, 7,500 ft. 4-in. pipe, lake covering 100 acres, two 220-gal. per minute motor driven pumps, 50,000-gal. tank on 50-ft. tower. Bids may be submitted on entire plant or portion thereof.

Montana.

⊙The contract for the extension of the city water mains from town to the Bitter Root creamery and the A. C. M. Co.'s lumber yard has been awarded by the city council of Stevensville, Mont., to Lord & Walbridge of Hamilton. The extension will be for a distance of about 1,000 ft., running from Pine St., on Second St., to the eastern boundary of town, whence it will run north to the creamery and lumber yard.

The city council of Helena, Mont., has voted to adopt an ordinance providing for the submission to the people of the question whether or not the city shall accept the offer of the Helena Water Works Co., to sell its plant for $400,000.

Nebraska.

The town of Anselmo, Neb., has voted the issuance of bonds in the sum of $7,500 for a water plant and $2,500 for electric lights.

New Jersey.

⊙The Harrison Construction Co., 837 Broad St., Newark, N. J., has been awarded the contract by David F. Weeks, M. D., Supt., New Jersey State Village for Epileptics at Skillman, N. J., for furnishing all labor and material necessary for the construction of an extension to the water system, including necessary fire hydrants, gates, valves, fittings, etc., for $9,884. Bids were opened May 1.

New Mexico.

An election was held in Las Cruces, N. M., on May 9, for the purpose of voting on the issuance of bonds to the amount of $35,000 for the installation of a new water system.

New York.

✣Bids will be received until 11 a. m., May 23, by Board of Water Supply, 165 Broadway, New York City, for the completion of the Hudson Siphon, a deep pressure tunnel in rock 14 ft. inside diameter, extending under the Hudson River about 1,100 ft. below the water surface with two shafts 3,022 ft. apart on the opposite shores between Storm King and Breakneck mountains in the towns of Cornwall and Fishkill. The contract is No. 90. J. P. Morrissey is Secy. of the Board.

⊙The Eddy Valve Co., of Waterford, has been awarded the contract for furnishing hydrants and supplies for $2,463 by the Board of Contract and Supply of Albany, N. Y.

⊙The Board of Contract and Supply of Troy, N. Y., has awarded the following contracts for the new storage reservoir at Grafton: Excavation and construction, McDonugh Construction Co., Troy, $155,278; valves, Ludlow Valve Co., Troy, $978; iron work, Camden Iron Co., Philadelphia, $1,997. The total cost is $158,252.

The citizens of Interlaken, N. Y., are agitating the propriety of establishing a water works system for the protection from fire.

It is reported that the city of Fredonia, N. Y., has adopted the plan prepared by Engineer E. A. Wilder for the improvement of the water supply.

The Water Commissioners of Niagara Falls, N. Y., have approved the prospectus for the proposed tax election on the extension of the water mains in the southern portion of the city. The election has been called for May 16.

North Carolina.

⊙The Harris Hardware Co., of Washington, N. C., has been awarded the contract by the City Council of Morehead, N. C., for the construction of a water works, for approximately $20,000. The work will include a standpipe 120 ft. high with a capacity of 12,000 gals.

Ohio.

✣Bids will be received until noon, May 26, by Director of Public Service, Toledo, O., for the construction, delivery and erection complete of one rotary pump 15,000,000 gals. daily capacity, direct connected to a vertical gas engine. J. R. Cowell is Director.

✣Bids will be received until noon, May 23, by Director of Public Service, Kenton, O., at the office of G. S. Binckly, City Clerk, for the construction, delivery and installation of one pumping engine capable of delivering 2,500,000 gals. water per 24 hrs. V. H. May is Supt. of Water Works. W. P. Steffen is Director. Charles Brossmann, Union Trust Bldg., Indianapolis, Ind., is Consulting Engineer. Official advertisement will be found elsewhere in this issue.

City Engineer F. J. Cellarius of Dayton, O., has submitted a description with plans and profiles of the property to be appropriated for the city's new water supply territory and reservoir.

The City Council of East Liverpool, O., has definitely decided to go ahead with the installation of the well system of water filtration for East Liverpool without waiting for another vote on the question. It is estimated that the system will cost $50,000.

Oklahoma.

Bonds have been voted at Weleetka, Okla., in the sum of $45,000 for the installation of a water works system and an electric light plant.

The citizens of M'Alester, Okla., on April 22 voted the issuance of bonds to the amount of $80,000 for extensions to the water works.

The Mayor and City Council of Ada, Okla., have let the contract for the material and labor for the construction of the Byrds Mill water works system at an estimated cost of $150,000, for which bonds were recently voted. The water is to be piped 18 miles.

Oregon.

✣Bids will be received until 7:30 p. m., May 15, by City Council, Toledo, Ore., for the construction of a gravity water supply system in accordance with plans and specifications on file at the office of F. N. Hayden, Recorder, Toledo, Ore., and the office of Stannard & Richardson, 410 Henry Bldg., Portland, Ore., Engineers.

John T. Whistler has been engaged by the City Council of Hermiston, Ore., to make a survey of the city and report on the most feasible plan for a water system. The Council is considering a proposition to secure some private company to install a water system.

Pennsylvania.

The State Board of Health has approved the plans of the city of Camden, Pa., for a new water supply system, subject to such condition of construction, operation and equipment as might be required from time to time.

Chester & Fleming, Consulting Engineers, Union Bank Bldg., Pittsburg, Pa., who have been studying the water supply system of Jamestown, N. Y., by direction of the Water Commission, have sent their report and recommendations. The engineers recommend the erection of a 5,000,000-gal. storage reservoir on English Hill at a cost of $117,859, including the cost of the large inlet and outlet mains. Another plan is for the construction of a 5,000,000-gal. reservoir on Mee Hill north of Falconer.

South Carolina.

An election will soon be held in Dillon, S. C., for the purpose of voting on the issuance of bonds to the amount of $80,000 for the construction of a water works and a sewer system.

South Dakota.

✣Bids will be received by the Regents of Education, Fred W. Ford, Secy., Vermillion, S. D., for the construction of a water works system at the University of South Dakota at Vermillion, S. D.

The citizens of Mandan, S. D., have voted the issuance of bonds to the amount of $80,000 for the construction of a municipal water works. Plans for the work have already been made.

Tennessee.

It is reported that the city of Newport, Tenn., has engaged Civil Engineer W. P. Bullock, of Kansas City, Mo., to prepare plans for the proposed water works. Bonds to the amount of $50,000 have been voted for the purpose.

Texas.

An election is to be held in Bonham, Tex., on May 15, for the purpose of voting on the proposition of issuing bonds to the amount of $30,000 to install a water works.

It is reported that the city of Pecos, Tex., has retained Fountain-Shaw Engineering Co., of Dallas, Tex., in connection with the proposed construction of a soft water system for commercial purposes.

Virginia.

✣Bids will be received until 11 a. m., May 25, by Capt. W. W. Whitside, Constructing Quartermaster, Fort Myer, Va., for the construction of a 10-in. water main from Rosslyn, Va., to Fort Myer, Va., a distance of 2 miles and for remodeling the pump house

Washington.

⊙The City Council of Rockford, Wash., has let the contract for 1,600 ft. of pipe for water mains to D. C. Farnsworth. The mains are to replace wooden pipes laid five years ago.

The following bids were recently submitted to the City Council of Wenatchee, Wash., for furnishing the new pump for the city water system: Columbia Engineering & Construction Co., Wenatchee, three-stage De Laval type, $5,294; two-stage, $5,059; installation time, 112 days. Bliss Electric Co., Eclipse type, $5,625, $4,938; installation time, 120 days. Charles C. Moore Co., Seattle, Platt turbine, $5,100; with Westinghouse electrical equipment substituting General Electric, $100 less. J. D. Hull & Co., Janesville, two-stage turbine, $4,908; 135 days

Wisconsin.

⊙M. T. Peterson of Madison, Wis., has been awarded the contract by the city of Grafton, N. Dak., for sinking a 6-in. artesian well on the premises in the vicinity of the Electric Light Plant, at $4 per ft. Bids were opened May 1.

The City Council of Racine, Wis., has appointed a committee to consider hiring an expert to appraise the water works plant with a view to its purchase.

The Village Board of Monticello, Wis., has employed Consulting Engineer W. G. Kirchoffer of Madison, Wis., as engineer to draw plans and specifications for the water works plant.

Canada.

The bylaw to raise $75,000 for a new water works pumping station on the east side of the canal, has been voted by the citizens of Welland, Ont. Work will begin at once on the new plant. Water power as well as a supply of water will be obtained from the canal.

Civil Engineers Chipman & Power, 204-206 Toronto, Ont., have just been engaged by the Municipality of the Town of Neepawa, Man., to prepare plans and specifications for the proposed water works and sewerage systems, estimated to cost $125,000

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

✣[illegible] plant to be constructed at or near Ensley. The [illegible] and will care for a considerable amount of sewage. L. H. Salter, the sanitary engineer, has the tentative plans for the septic tank and will show same to those proposing to bid on [illegible]

The Board of Revenue of Jefferson County, Birmingham, Ala., has under consideration the [illegible] Ensley, one one of the trunk sewers of the [illegible] 000. Bids will be called for in order to ascertain the cost of construction of the plant. L. H. Salter is County Engineer.

California.

✣[illegible] 11 a. m., May 15, by Department of Finance, Ways and Means, San Diego, Cal., for the furnishing of the following sewer pipe and specials: 111,390 ft. 6-in. sewer pipe, 4500 4-in.x6-in. Ys; 22,338 ft. 8-in. sewer pipe, 700 4-in.x8-in. Ys; 13,035 ft. 10-in. sewer pipe, 100 4-in.x10-in. Ys. 14,082 ft. 12-in. sewer pipe, 120 4-in.x12-in. Ys; 10,670 ft. 14-in. sewer pipe, 100 4-in.x14-in. Ys. P. F. Woods is Supt. of the Department.

⊙The Board of Public Works of San Francisco, Cal, has awarded the contract for the construction of the main intersecting sewer in Lincoln Way between 40th and 49th avenues, to R. C. Storre & Co., for $130,000.

The Alhambra Board of Trustees will take up with South Pasadena the project of operating jointly in the installation of a $75,000 sewerage system and outfall. The plan is to install concrete mains with laterals, taking the sewage to a modern spetic tank in the San Gabriel bottoms south of Alhambra, the affluent being either spread on a sewer farm or taken direct to the sea.

Colorado.

It is reported that the citizens of Grand Junction, Colo., on April 29 voted the issuance of bonds in the sum of $35,000 for the construction of a sewer system.

Georgia.

The citizens of Marietta, Ga., on April 29, voted the issuance of bonds to the amount of $15,000 for the completion of the sewer system recently installed.

Illinois.

⊙Frank Sullivan of Bloomington, Ill., has been awarded the contract by the Town Board of Gibson City, Ill., for sewer work to the extent of $2,500.

⊙The Ottawa Construction Co., of Ottawa, Ill., has been awarded the contract for the construction of the Swinnerton St. sewer in Peoria, Ill., by the City Council.

⊙Arthur Birt of Decatur, Ill., has been awarded the contract by the Board of Local Improvements, Bement, Ill., for the furnishing of the material and the construction of a system of storm sewers and also an out-flow drain for the village, as follows: Outflow drain open ditch, length, 2,645 ft.; excavation, 6,166 cu. yds.; concrete retaining wall, approx., 9 cu. yds. concrete. Sewer proper: 740 ft. of concrete sewer, wall 6 ins. in thickness, dia. 48 ins., av. cut 8.20 ft.; 1,312 ft. of vitrified sewer pipe, average cut 6.10 ft. (size 36 ins.); 1,295 ft. of 27-in. vitrified pipe, average cut, 7.20 ft.; 1,511 ft. of vitrified pipe, average cut, 5.50 ft. (size 22 ins.); 741 ft. of 20-in. vitrified sewer pipe, average cut 5.80 ft.; 2,822 ft. of 30-in. vitrified sewer pipe, average cut, 6.17 ft.; 1,720 ft. of 24-in. vitrified sewer pipe, average cut, 6.59 ft.; 928 ft. of 20-in. vitrified [illegible] average cut 6.40 ft.; 685 ft. of 12-in. vitrified sewer pipe, average cut, 4.90 ft.; 951 ft. of 20-in. vitrified sewer pipe, average cut, 5.26 ft.; 16 manholes; 85 catch basins. Engineer's estimate of the cost of material and construction is 23,088.

City Engineer Elmer Folsom of Bloomington, Ill., has been instructed by the Board of Local Improvements to prepare plans and estimates for a sewer on West Clay St., from Lee to Allin

Indiana.

⊙Frank Meguiar has been awarded the contract by the City Council of Evansville, Ind., for the construction of the Morton Ave. sewer between Division and Illinois ts. The bid is $0.52 per ft., $18 each for manholes, and $26 for inlets.

Plans for a sewer in Sheridan Ave., from East Washington St., to Lowell Ave., have been ordered by the Board of Public Works of Indianapolis, Ind. The plans will be prepared by City Engineer H. W. Klausmann and the sewer will connect with the old Irvington sanitary sewer system in East Washington St.

The City Council of Goshen, Ind., has under consideration the construction of a new sewer system. If constructed the trunk sewer would run along the Rock Run [illegible] empty in the Elkhart river at a point below the city.

Consulting Engineers Herring & Fuller, 170 Broadway, New York city, have submitted the revised plans of the sewer system to the Board of Public Works of Vincennes, Ind.

Iowa.

✣Bids will be received until 9 a. m., May 12, by City Council of Des Moines, Ia., for the construction of a 12-in. vitrified clay pipe sewer in Mondamin Ave., 10-in. vit. clay pipe sewer in 20th St.; 10-in. vit. clay pipe in 21st St. The entire work includes about 1,573 lin. ft. of sewer. Horace Susong is City Clerk.

⊙C. B. McNamara & Co., 206 West Locust St., Dubuque, Ia., have been awarded the contract at Dubuque for the construction of a storm water sewer in the alley between Lemon St. and Couler Ave. from Millville Rd. to 32d St., thence in 32d St. to the alley between Couler Ave. and Jackson St. The work will include 1,268 lin. ft. of 8-in. tile pipe, 20 ft. of 8-in. iron pipe and five manholes. Bids were opened April 26.

The City Council of Waterloo, Ia., has passed a resolution providing for the calling of a special election on May 29 for the purpose of allowing the voters of District No. 1, which is composed of the Third and Fourth wards, to vote on a tax of 2.8 mills each year for a period of 20 years for the construction of a sewer along Virden Creek. It is estimated that this levy will aggregate the sum of $100,000, the approximate cost of the sewer.

The City Council of Sioux City, Ia., has ordered a storm sewer constructed on the West Side. The sewer will start at West 7th and Sioux Sts., run north in Sioux St., one-half block, then a block west to Market St., and then two blocks north to Perry Creek, a distance of about 1,000 ft.

Kansas.

✣Bids will be received until noon, May 31, by Capt. John S. Winn, Acting Quartermaster, Fort Leavenworth, Kan., for the construction of a main storm water drain in the college section of Fort Leavenworth.

It is proposed to install a sewer system in Nickerson, Kan. At a recent mass meeting a committee composed of C. A. Stevens, J. D. Cooke, C. N. Wooddell, George Turbush and L. C. Brown, was selected to confer with city officials in regard to the system.

The City Commissioners of Girard, Kan., will probably ask for estimates on the cost of installing a sewer system soon. The citizens recently petitioned the Commissioners for the construction of the system.

Maryland.

✣Bids will be received until 11 a. m., May 24 by the Board of Awards, Baltimore, Md., for constructing the office and laboratory building, sanitary contract No. 60 and for constructing lateral sewers in District 36 A. Sanitary Contract No. 66 including approximately 10,000 lin. ft. terra cotta pipe sewer 8 to 22 in. in diameter, and 15,000 lin. ft. of 6-in. house connections. H. W. Rodgers is Secy. of the Sewerage Commission.

✣Bids will be received at once by the President and Commissioners of Princess Anne, Md., for the laying of a sewer in that town.

✣Bids will be received until 11 a. m., May 24, by Board of Aldermen and J. E. Schell, mayor, Frederick, Md., for the construction of approximately 4,000 lin. ft. of 6 to 42 in. sewers with the necessary inlets, manholes and lampholes. E. C. Crum is city engineer. Official advertisement will be found elsewhere in this issue.

The Board of Awards of Baltimore, Md., on May 3 rejected all bids received April 19 for screens for the sewerage disposal plant.

The citizens of Baltimore, Md., on May 2 voted the issuance of bonds to the amount of $10,000,000 for the completion of the sewer system, disposal plant and for machinery.

The new Board of Town Commissioners of Ridgely, Md., contemplate the installation of a new sewer system. The system, if constructed, would empty into the Choptank river, four miles from the city.

Michigan.

The City Council of Grand Rapids, Mich., has obtained the entire right of way for the proposed East Side trunk sewer.

The City Council of Flint, Mich., has decided to build sewers on Helen St., from Oren to Donald St., and on Oren St., from Detroit to Francis St. The council has been petitioned for a sewer from Frost to Begole St., and then south on Begole St. to the river.

The Allegan, Mich., City Council has adopted resolutions to build a sewer on the north side of the city.

Minnesota.

⊙The Pastoret-Lawrence Co., Duluth, Minn., has been awarded the contract by the city of Cloquet, Minn., for the construction of sewers and for laying water mains for $23,398. Ed Johnson of Superior, Wis., was awarded the contract for the construction of cement sidewalks. Bids were opened May 1.

Missouri.

The City Council of Kansas City, Mo., has passed an ordinance to open and establish a right of way for a sewer extending along Brush Creek from Wornall Road to Jackson Ave.

Nebraska.

✣Bids will be received until 6 p. m., May 15, by City Clerk, Auburn, Nebr., for furnishing the necessary labor and material for the construction of a sewer lateral in District No. 39, consisting of 1,400 ft. of 8-in. sewer, manholes, flush tank, lamphole and Y connections. Charles Anderson is Sewer and Water Commissioner, South Auburn, Nebr.

New Jersey.

The State Board of Health, Trenton, N. J., has disapproved the plans and proposed site for North Plainfield's sewage beds at Greenbrook.

New Mexico.

✣Bids will be received until 4 p. m., May 17, by Charles Tamme, City Clerk, East Las Vegas, N. M., for furnishing labor and materials for a sanitary sewer in the city of Las Vegas, comprising approximately 19,750 lin.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ft. of 8-in. vitrified pipe sewer, 3,350 lin. ft. of 10-in. vitrified pipe sewer, 100 lin. ft. of 15-in. vitrified pipe sewer; 50 manholes, complete; 12 single flush tanks, complete.

⊙The Board of Village Trustees of Deming, N. Mex., has awarded the contract for the construction of a [illegible] sewer system in Deming to G. Jaeger of Rich Hill, Mo., for $34,940. The contract calls for 38,600 ft. of about seven and one-fifth miles of sewer line, 80 standard manholes, five flush tanks, one double compartment spetic tank, and all material, labor, tools, and equipment necessary for the complete construction of the same.

The citizens of Las Cruces, N. Mex., voted May 9 on bonds for a $40,000 sewerage system and $35,000 for a water system.

New York.

✣Bids will be received until 11 a. m., June 2, by Constructing Quartermaster, Fort Hamilton, N. Y., for the construction of a sewer.

✣Bids will be received until May 24 by the Board of Contract and Supply, Binghamton, N. Y., for the construction of $15,000 worth of sewers in various streets throughout the city.

✣Bids will be received until 8 p. m., May 16, by Board of Street Commissioners, Canandaigua, N. Y., for furnishing materials for and constructing a sanitary sewer on Clark St. from Mason St. to 100 ft. east of South Pearl St. E. P. Warner is President of the Board.

✣Bids will be received until 8 p. m., May 15, by Board of Public Works, Fulton, N. Y., for the following: 8,500 lin. ft. of 8-in. vit. pipe sewer, 4,500 lin. ft. of 6-in. vit. pipe sewer, 900 lin. ft. of 10-in. vit. pipe sewer, 20 manholes, 14 flush tanks, 400 "Y" branches. J. A. Foster is president of the board.

A bill has been introduced in the legislature, Albany, N. Y., authorizing the village of Hempstead to issue bonds not exceeding $250,000 for the construction of a sewer system and sewage disposal plant, in accordance with a proposition adopted at the annual election of the village on March 21.

Advices from Syracuse, N. Y., state that the contract for the construction of the Colvin St. sewer will soon be let. Specifications for the sewer and its tributaries have been prepared.

The City Council of Syracuse, N. Y., adopted an ordinance declaring intention to construct the following sewers in the Ninth ward: 18-in. in Essex St., from Avery Ave. to Myrtle St.; 15-in. in Hayden Ave., from Essex St. to Morton St.; 12-in. in Hayden Ave., from Morton St. to Driscoll Ave.; 15-in. in Myrtle Ave., from Essex St. to Morton St.; 12-in. in Myrtle St., from Morton St., to Driscoll Ave., and 12-in. in Morton St., from Hayden Ave. to Myrtle St.

Ohio.

✣Bids will be received until noon, May 24, by Director of Public Service, Dayton, O., for the construction of storm water sewers on the following streets: Troy St., from Edmund St. to Leo St.; Valley St., from Brandt St. to Findlay St.; Valley St., from Miami and Erie Canal to Brandt St.; Keowee St., from Earl Ave. to Chapel St.; Cincinnati St., from Bolander Ave. to Miami Chapel road; Main St., from Fairview Ave. to corporation line; Perry St., from 1st St. to Wilkinson St.; and for the construction of sanitary sewers as follows: Sanitary sewer in Sewer District No. 6, south of Bolander Ave.; sanitary sewer in Sewer District No. 6, Lakeview Ave.; sanitary sewer in Sewer District No. 9, north of Victor St.

✣Bids will be received until noon, May 12, by Village Council, Fairport, O., for the necessary labor and materials for the construction of a sewer system in District No. 1. Robert Meyers is Clerk of the Village.

✣Bids will be received until noon, June 2, by Director of Public Service, Bellefontaine, O., for furnishing the necessary labor and material for the construction of reduction tanks and primary contract beds, and for building outlet drains and for furnishing and erecting all automatic controlling machinery. The work will include 4,400 ft. of 6 to 24 in. sewer pipe, 2,270 ft. of 12 to 24 in. sewer outlet drain, 2,100 cu. yds. excavation, 1,530 cu. yds. concrete, 7,000 lbs. of steel, 8,500 cu. yds. broken stone, washed gravel or screened coke, 4 manholes, 16 cu. yds. masonry in bulkhead. Official advertisement will be found elsewhere in this issue.

⊙The Department of Public Service, Cincinnati, O., has awarded the contract for the improvement of Atkinson St. by sewering to Thos. P. Strack, Goodall Bldg., Cincinnati, for $1,267. The work includes 560 lin. ft. of 12-in. pipe sewer, Y branches, inlets, manholes, etc. Bids were opened April 28.

⊙The J. Duff Construction Co., has been awarded the contract for finishing the West 25th St. sewer in Cleveland, O., for $38,431, and William Lehman was awarded the contract for the construction of the E. 79th St. sewer for $26,800.

⊙Huonker & Williams have been awarded the contract by the Board of Control, Springfield, O., for the construction of the Elmwood sewer and the Washington St. arch over Mill Run sewer for $13,893 and $1,000 respectively.

The City Council of Struthers, O., has passed ordinances to construct sanitary sewers on the following streets and part of streets: Poland Ave., from State St south to the macadam road; Terrace St., from Poland Ave. to Sport St.; Bridge St., from Poland Ave. to the Yellow Creek bridge; Hawthorne and Stewart their entire length and State from Park Ave. west to the village limits.

The Finance Committee of the City Council of Milo, O., has approved the ordinance providing for a $50,000 bond issue and passed a bond issue calling for $75,000. The approved ordinance provides sewers from Cleveland Ave. to Howard St., the other from Cleveland Ave. to St. Clair Ave. The district for which sewers are not provided probably will be cared for next year. An ordinance has also been approved providing for a storm water sewer on the West Side, carrying a bond issue of $58,000.

Oklahoma.

✣Bids [illegible] 18, by Grant R. Hanford, City Clerk, Guthrie, Okla., for the construction of a sanitary sewer in District No. 59 located in First, Third, Fourth and Fifth Capital Heights additions and Shartel Blvd.

✣Bids [illegible] 23, by City Council, Muskogee, Okla., for the construction of a portion of the Coody Creek sanitary outfall sewer. The work included will be in Sections 1 to 6 inclusive: Sec. 1 embraces 5,200 ft. of 48-in sewer, Sec. 2 embraces 5,000 ft. of 48-in. sewer, Sec 3 embraces 5,600 ft. of 48-in. sewer, Sec 4 embraces 5,400 ft. of 48-in. sewer, Sec 5 embraces 6,500 ft. of 45-in. sewer, Sec. 6 embraces 7,100 ft. of 42-in. sewer. Alternative bids are asked for two-ring brick with vitrified invert and manufactured concrete pipe. Charles Wheeler, Jr., is city clerk, T. P. Clonts is city engineer and Alexander Potter, 114 Liberty St., New York, is consulting engineer. Official advertisement will be found elsewhere in this issue.

An election will be held in Tulsa, Okla., within the next 20 days for the purpose of voting on a bond issue of $300,000. Of this amount $200,000 is to cover sewer extensions and $100,000 is for city parks.

Consulting Engineer Alexander Potter, 114 Liberty St., New York City, who recently completed the plans for the proposed improvements to the sewer and water systems of Muskogee, Okla., has submitted a proposition to the city officials of that city whereby he offers to supervise the construction work on the improvements. Bids for the proposed work will shortly be advertised for

Oregon.

The Sewer Committee of the City Council of Portland, Ore., has voted to have City Engineer J. W. Morris proceed with his investigation of the best plan for a sewer to drain the Peninsula district, including Vernon, Woodlawn and Piedmont.

The Dalles, Ore., City Council has asked an ordinance providing for the establishment of a sewer system in the city.

Pennsylvania.

Preliminary work on the intercepting sewer to be built in Harrisburg, Pa., will begin at once. City Engineer M. B. Cowden will be assisted by Civil Engineer George Roberts of Harrisburg in the preparation of plans

Plans have been drawn for new sewers on Veech St., 7th St., and Meason Ave., West Side, Connellville, Pa., that are to be constructed by the Pittsburg & Lake Erie Railroad Co. The line on Veech St. will be 18-in. in diameter and will intercept sewage from the hill district. A 24-in. line will be laid on Meason Ave., from 8th St to 7th, and on 7th St., from Meason Ave. to the river. Asst. Eng. E. W. Boots, Pittsburg, of the P. & L. E. prepared the plans. J. B. Hogg is city engineer.

The East Washington Council, according to advices from Washington, Pa., has passed the ordinance providing for a special election by the voters of that borough to determine the question of the proposed bond issue for the purpose of connecting the East Washington sewer system with the system of the old borough. The election will be held June 10 and provides for the issuance of $25,000 in bonds.

South Dakota.

✣Bids will be received until 8 p. m., May 22, by Board of Commissioners, Huron, S. Dak., and South Dakota State Fair Board, for the construction of sewers on 3d and 9th Sts. and in the state fair grounds. The work will comprise approximately the following amount of vitrified pipe sewer: 2,110 ft. of 18 and 20 in., 2,200 ft. of 12, 10 and 8 in. The work is to be done in accordance with plans and specifications now on file in the office of the city engineer of Huron, S. D. S. S. Oviatt is city auditor, Huron, S. Dak.

Tennessee.

⊙John Broderick has been awarded the contract at Nashville, Tenn., for the construction of a sewer between Shelby and Sylvan Aves., for $1,177.

An enabling act has been passed by the State Senate, Nashville, Tenn., authorizing the city of Tullahoma to issue $25,000 worth of bonds for the purpose of sewering the town

Texas.

Street Commissioner P. A. Gorman of Waco, Tex., has asked the mayor and board of commissioners to submit to the people the question of voting bonds for the extension of the sanitary sewer system.

Wisconsin.

⊙J. R. Clark and Jos. Titulaer have secured a contract from the City Council of Shawano, Wis., for the construction of a sewer amounting to approximately $20,000.

The city of Beloit, Wis., proposed to put in an up-to-date sewerage system in the new extension district in the east side. Robert Caldwell is city engineer.

Wyoming.

The town of Lusk, Wyo., contemplates the installation of a sewer system, and the extension of the water service upon completion of the new reservoir, which is now over half done.

South Carolina.

Bids were opened April 25 by the City of Rock Hill, S. C., Thos. W. Cothran, Greenwood, S. C., Consulting Engineer, for the construction of 16 miles of sewers. The bidders and time for completion were as follows: (1) Jno. J. Cain, Columbia, S. C., May 1, 1912; (2) J. C. Mishler, Chattanooga, Tenn., 275 days; (3) Sullivan, Long & Haggerty, Bessemer, Ala., May 1, 1912; (4) H. S. Bosler, Chattanooga, Tenn., 260 days; (5) P. J. Cur-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ran, Knoxville, Tenn., Dec. 31, 1911; (6) Greenwood Hardware Co., Greenwood, S. C., May 1, 1911; (7) Guild & Co., Chattanooga, Tenn., 8 months; (8) Johnson & Matthews, [illegible] S. C., March 1, 1912; (9) Meeks Construction Co., Atlanta, Ga., May 1, 1912; (10) McCartin Construction Co., Birmingham, Ala., Dec. 31, 1911; (11) Robertson Construction Co., Charlotte, N. C., 150 days; (12) Stewart & Jones, Rock Hill, S. C., time not stated. The unit bids on the sewers were as follows:

		(2.)	(3.)	(4.)	(5.)	(6.)	(7.)	(8.)	(9.)	(10.)	(11.)	(12.)
[illegible]	$ 15.00	$ 20.00	$ 12.00	$ 15.00	$ 14.00	$ 15.00	$ 18.00	$ 15.50	$ 16.50	$ 18.00	$ 16.50	$ 15.00
[illegible]	7.50	9.00	7.65	7.00	9.00	8.00	9.00	9.00	9.00	7.50	8.00	7.20
[illegible]	2.67	2.00	3.00	2.50	1.35	2.50	2.50	3.00	3.75	2.50	3.50	2.00
[illegible]	.25	.75	.10	.35	.75		.50	.40	.40	.50	:27	.50
[illegible]	14.00	21.00	10.00	18.00	25.00	10.00	16.00	25.00	15.00	15.00	13.50	25.00
[illegible]		.50	.40	.25	1.25		.50	.40	.40	.35	.25	.25
[illegible]	65.00	70.00	60.00	58.00	65.00	65.00	65.00	56.00	47.50	60.00	55.00	40.00
[illegible]	75.00	125.00	75.00	70.00	85.00	75.00	75.00	76.00	60.00	70.00	62.00	45.00
[illegible]	.45	.25	.25	.30	.20	.40	.25	....	.40	.45	.31	.60
[illegible]	.65	.35	.35	.60	.30	.60	.35	....	.70	.60	.40	.90
[illegible]	.90	.45	.55	.65	.50	.80	.50	....	1.00	.90	.63	1.25
100 12-in. Y branches	1.15	.60	[illegible]	.70	.70	[illegible]	.70	...	1.25	1.10	.79	1.90
[illegible]	.65	1.00	1.00	1.00	1.10	.50	1.00	.40	.50	1.00	.45	3.80
[illegible]	.31	.25	.31	.40	.29	.31	.31	.29	.33	.31	.32	.58
[illegible]	.37	.35	.38	.48	.35	.42	.38	.33	.40	.38	.37	.76
6-in. sewer 8 to 10 ft. deep, 100 ft.	.44	.51	.43	.60	.50	.58	.53	.40	.48	.50	.52	.85
[illegible]	.60	.76	.63	[illegible]	.64	[illegible]	.58	.52	.63	.63	.70	1.10
6-in. sewer 12 to 14 ft. deep, 200 ft.	.80	1.01	.82	.90	.78	1.00	.90	.62	.78	.85	.84	1.12
6-in. sewer 14 to 16 ft. deep, 100 ft.	1.10	1.41	.95	1.10	.95	1.20	1.00	.75	1.05	1.05	1.18	1.15
[illegible]	[illegible]	.31	.37	.45	.35	.36	.37	.35	.38	.38	.37	.60
8-in. sewer 6 to 8 ft. deep, 9,500 ft.	.43	.37	.43	.55	.41	.48	.41	.41	.44	.44	.43	.83
8-in. sewer 8 to 10 ft. deep, 4,200 ft.	.50	.42	.49	.65	.57	[illegible]	.57	.50	.52	.55	.57	.92
8-in. sewer 10 to 12 ft. deep, 2,800 ft.	.67	.54	.68	.85	.72	.88	.61	.60	.67	.70	.69	1.17
8-in. sewer 12 to 14 ft. deep, 1,900 ft.	.88	.78	.88	.95	.87	1.15	.96	.73	.85	.95	.77	1.23
8-in. sewer 14 to 16 ft. deep	1.19	. .	.98	1.25	1.05		1.25	.85	1.00	1.00	1.24	....
8-in. sewer 16 to 18 ft. deep	1.45	....	1.13	1.50	1.25	.	1.25	1.00	1.25	1.35	1.64	....
10-in. sewer 6 ft. deep, 15,300 ft.	.46	.39	.46	.50	.42	.45	.43	.45	.46	.50	.46	.80
10-in. sewer 6 to 8 ft. deep, 4,300 ft.	[illegible]	.48	.51	.60	.50	.60	.48	.51	.55	.58	.52	1.00
10-in. sewer 8 to 10 ft. deep, 4,700 ft.	.60	.62	.57	.70	.58	[illegible]	.59	.60	.61	.70	.66	1.15
10-in. sewer 10 to 12 ft. deep, 800 ft.	[illegible]	.72	.77	.85	[illegible]	.97	.73	.72	.76	.85	.78	1.30
10-in. sewer 12 to 14 ft. deep, 1,400 ft.	.95	1.02	.95	[illegible]	.89	1.25	1.00	.84	.95	1.00	.99	1.45
10-in. sewer 14 to 16 ft. deep	1.25	....	1.08	[illegible]	1.15		1.25	1.00	1.10	1.20	1.32	....
10-in. sewer 16 to 18 ft. deep	1.45	...	1.33	1.75	1.40	...	2.00	1.20	1.30	1.45	1.73	....
10-in. sewer 18 to 20 ft. deep	1.65	.	1.47	2.00	1.75		2.00	1.36	1.65	1.70	2.79	....
12-in. sewer [illegible] deep, 1,000 ft.	.51	.47	.57	.65	.51	.53	.55	.55	.55	.55	.54	.96
12-in. sewer 6 to 8 ft. deep, 2,900 ft.	.57	.59	.64	.70	.60	.70	.62	.62	.68	.65	.59	1.12
12-in. sewer 8 to 10 ft. deep, 600 ft.	.65	.72	.77	.85	.67	.80	.75	.68	.80	.77	.73	1.28
12-in. sewer 12 to 12 ft. deep, 600 ft.	.80	.89	.91	.95	.81	1.15	.95	.84	1.03	.92	.85	1.45
12-in. sewer, 12 to 14 ft. deep, 600 ft.	1.00	1.13	1.04	1.10	.94	1.40	1.30	.96	1.14	1.08	1.05	1.60
12-in. sewer 14 to 16 ft. deep, 100 ft.	1.30	2.07	1.22	1.30	1.25	1.60	1.60	1.11	1.33	1.30	1.40	1.76
12-in. sewer 16 to 18 ft. deep	1.50	....	1.48	2.00	1.60	.	2.00	1.30	1.47	1.53	1.80	42.00
12-in. sewer 18 to 20 ft. deep	1.70	.	1.61	2.25	1.90	.	2.00	1.46	1.70	1.85	2.86	54.00
12-in. sewer 20 to 22 ft. deep	2.20	....	1.86	2.50	2.25	.	2.50	1.70	2.00	2.10	4.25	....
118 manholes, 6 ft. deep	30.00	26.00	26.50	30.00	30.00	32.50	32.00	31.00	21.50	26.50	30.50	42.00
45 manholes, 6 to 8 ft. deep	36.00	33.00	30.00	35.00	36.00	37.50	35.00	38.50	27.00	30.00	33.50	54.00
23 manholes 8 to 10 ft. deep	43.00	40.00	35.00	40.00	42.00	45.00	37.00	46.50	30.00	33.05	39.75	60.00
10 manholes, 10 to 12 ft. deep	50.00	50.00	40.00	45.00	48.00	55.00	40.00	55.00	37.00	36.00	46.00	70.00
9 manholes, 12 to 14 ft. deep	55.00	60.00	45.00	55.00	54.00	65.00	45.00	65.00	39.00	38.00	53.00	80.00
1 manhole, 14 to 16 ft. deep	62.00	70.00	50.00	65.00	60.00	75.00	50.00	75.00	41.00	40.00	60.00	95.00
Manholes 16 to 18 ft. deep	75.00	....	55.00	80.00	72.00	....	50.00	85.00	58.00	45.00	70.00	....
Manholes 18 to 20 ft. deep	85.00	...	60.00	90.00	84.00	....	60.00	95.00	61.00	48.00	82.00	....
Manholes 20 to 22 ft. deep	95.00	....	65.00	100.00	96.00	....	70.00	105.00	65.00	50.00	95.00	....
1 drop manhole 1 to 12 ft. deep	55.00	70.00	45.00	55.00	48.00	50.00	45.00	68.00	44.00	40.00	50.00	90.00
4 drop manholes 12 to 14 ft. deep	65.00	80.00	50.00	65.00	54.00	60.00	50.00	72.00	50.00	43.00	58.00	105.00
Drop manholes 14 to 16 ft. deep	75.00	....	55.00	75.00	66.00	....	55.00	82.00	52.00	45.00	68.00	....
Drop manholes 16 to 18 ft. deep	85.00	....	60.00	85.00	80.00	...	60.00	92.00	53.00	50.00	80.00	....
Drop manholes 18 to 20 ft. deep	95.00	..	65.00	95.00	90.00	..	75.00	102.00	56.00	55.00	95.00	....
Drop manholes 20 to 22 ft. deep	110.00	...	70.00	105.00	100.00	..	85.00	115.00	61.00	60.00	105.00	....
Drop manholes 22 to 24 ft. deep	125.00	. .	75.00	115.00	112.00		100.00	140.00	75.00	70.00	125.00	....
1,000 cu. yds. rock excavation	2.25	2.50	2.45	3.00	2.00	2.00	3.00	3.50	3.00	1.50	2.50	3.00
Deductions for 6-in. Pomona	.03½	.	.01½	.01½	.02	.03½	.01½	.02½	.01	.01½	.03½	.04
Pipe per foot 8-in. Pomona	.03⅝	...	.01½	.02	.02	.03¾	.02	.03	.02	.01½	.04	.06
10-in. Pomona	.05¾	....	.02¾	.02½	.02	.05¾	.02¾	.04	.02	.02	.05¾	.07
12-in. Pomona	.06¼	....	.02¾	.02½	.02	.06¼	.02¾	.04	.03	.02	.06¾	.08
6-in. Ys Pomona	.11	....	....	.03	.02	.10	....	.06	.04	.02	.06	.10
8-in. Ys Pomona	.13	....	...	.15	.04	.11	. . .	.15	.10	.10	.15	.30
10-in. Ys Pomona	.14	....	....	.20	.08	.10	....	.20	.10	.10	.17½	.35
12-in. Ys Pomona	.15	....	. . .	.20	.10	.15½	....	.20	.10	.10	.30	.40
Deductions for 6-in. Chattanooga	.04	.01	..	.02	.02	.04	.02	.02	.01	.01½	.04	....
Deductions for 8-in. Chattanooga	.04½	.01	.03	.03	.02	.04⅝	.03	.03	.02	.01½	.05	....
Deductions for 10-in. Chattanooga	.07	.01	.03	.04	.02	.07	.04	.04	.03	.02	.07	....
Deductions for 12-in. Chattanooga	.07½	.02	.04	.04	[illegible]	[illegible]	.04	.04	.03	.02	.07½	....
Deductions for 6-in. Ys Chattanooga	.10	.03	.04	.15	.02	.10	. .	.05	.04	.02	.19	....
Deductions for 8-in. Ys Chattanooga	.11	.03	....	.20	[illegible]	.11	.	.15	.10	.10	.20	....
Deductions for 10-in. Ys Chattanooga	.10	.03	. . .	.03	.10	.10		.20	.10	.10	.20	....
Deductions for 12-in. Ys Chattanooga	.15	.04	. . .	.20	.12	.15½	....	.20	.10	.10	.35	....
Total specifications	$57,646	$55,729	$56,719	$65,722	[illegible]	[illegible]	$59,097	$59,135	$58,675	$59,183	$58,000	$94,016
Total Pomona pipe	53,586	....	54,028	63,551	56,598	58,518	57,211	56,535	56,779	57,542	53,633	88,162
Total Chattanooga pipe	52,646	54,599	53,956	62,586	56,553	57,680	56,334	56,535	56,779	57,542	52,658	.....

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until 11 a. m., May 27, by Maj. C. A. Flagler, U. S. Engineer, Mobile, Ala., for the construction of 1,150 ft. of creosoted timber bulkhead, River, Texas.

California.

✣Bids will be received until 11 a. m., May 25, by Col. G. McK. Williamson, Deputy Quartermaster, Fort Mason, Cal., for the construction of officer's ward, U. S. Army, General Hospital, Presidio, San Francisco, Cal.

✣Bids will be received until 2 p. m., June 14, by Department of the Interior, Office of Indian Affairs, Washington, D. C., for furnishing the necessary labor and material for the construction of two dormitories and one new hospital at the Sherman Institute, Cal.

✣Bids will be received between 10 and 11 a. m., May 17, by Board of Public Works, Oakland, Cal., for furnishing the equipment and apparatus described in the following propositions: (1) For furnishing three combination chemical and hose wagons; (2) for furnishing three third size steam fire engines; (3) for furnishing one motor-driven pumping engine; (4) for furnishing three motor-driven combination chemical and hose wagons; (5) for furnishing one hose wagon, and (6) for furnishing fire hose for the fire department of the city of Oakland, Alameda County, California. James W. Nelson is Secy. Board of Public Works.

The San Joaquin Light & Power Co. expects to complete its conduit and power plant on the Tule River and North Fork San Joaquin River this year and to begin work on the conduit of another plant on the main San Joaquin River. The work includes 6 or 8 miles of tunnels. A. G. Wishon, Fresno, Cal., is General Manager.

Citizens of Huntington Beach, Cal., have started a movement to have the city trustees call a bond election for the purpose of voting municipal bonds to cover the cost of building a $75,000 pleasure pier at the foot of Main St.

Connecticut.

✣Bids will be received until May 22 by Francis L. Field, 165 Broadway, New York, Attorney of the Southfield Point Co. for the necessary labor and material for the construction of a timber bulkhead on the property on the west shore of Stamford, Connecticut Harbor.

✣Bids are asked until 3 p. m., May 19, by Lt. Col. Harry Taylor, U. S. Engineer, New London, Conn., for dredging in Shaws Cove, New London Harbor, Conn. Shaws Cove is a small portion of New London Harbor lying on the west side of the harbor between the main part of the city of New London and Fort Trumbull. Depth of 23 ft. at mean low water may be carried up to the proposed entrance channel to the Cove. It is estimated that it will require the removal of about 68,000 yds. of mud, sand, clay, hardpan and boulders. The amount available is $10,500.

✣Bids are asked until 3 p. m., May 20, as noted in our last issue, by Lt. Col. Harry Taylor, U. S. Engineer, New London, Conn., for dredging in Pawcatuck River, R. I., and Conn. The navigable part of the Pawcatuck River extends five miles from Westerly, R. I., to its outlet in Little Narragansett Bay. The location of the proposed dredging is as follows: Deepening the channel from a point opposite the northerly portion of Stanton's Weir Point upstream for about 2,000 ft., widening several bends in the existing channel between Stanton's Weir Point and Pawcatuck Point, and removing any shoals which may have formed in the dredged portions of the channel in any part of the river or across Little Narragansett Bay. Depth of 10 ft. at mean low water may be carried upstream as far as Stanton's Weir Point. It is estimated that it will require the removal of about 40,000 cu. yds. of material. The amount available is $12,000

District of Columbia.

✣Bids will be received until 2 p. m., May 18, by Department of the Interior, C. A. Thompson, Asst. Secy., Washington, D. C., for the erection and completion of a concrete coal bunker and conveyor machinery for the central heating and lighting plant at the Freedman's hospital and Howard University, Washington, D. C.

✣Bids will be received until 2 p. m., May 15, by Department of Interior, Carmi A. Thompson, Asst. Secy., Washington, D. C., for an addition to the ice making system now installed in the Patent Office Bldg., Washington, D. C.

✣Bids will be received until 2:30 p. m., May 12, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 630-A lumber and steel reinforcing bars.

✣Bids will be received until May 12, by Capt. F. C. Boggs, U. S. Army, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Z. R. 5198, 1,650 attachment plugs, 100 marine attachment plugs, 150 green glass shades, 8,000 ft. No. 2 B. & S. wire, W. P. 135,000 ft. rubber-covered wire Nos. 10, 12 and 14 B. & S. gage and 5,000 ft. trolley wire No. 00 B. & S.

✣Bids will be received until May 11, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing under Z. R. 1631-C, 1,000 lbs. calcium carbide.

✣Bids will be received until 10:30 a. m., May 31, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Circular 631, lumber and creosoted piles.

✣Bids will be received until 2 p. m., May 1, by Commissioners of the District of Columbia, Washington, D. C., for furnishing and delivering four wheels for chemical engine used in the department of fires, Washington.

✣Bids will be received until 2 p. m., June 15, by Commissioners of the District of Columbia, Washington, D. C., for furnishing and delivering one second size double acting, steam fire engine for use in the fire department of that city.

Georgia.

✣Bids will be received until noon (eastern time), May 31, by Col. Dan C. Kingman, U. S. Engineer, Savannah, Ga., for building and repairing dikes in Savannah River near Augusta, Ga.

Hawaii.

✣Bids will be received until 11 a. m., May 15, by Capt. A. B. Putnam, U. S. Engineer, Honolulu, Hawaii, for furnishing 12,000 barrels of Portland cement.

Illinois.

✣Bids will be received until 2 p. m., June 15, by Thomas Cruse, Chief Quartermaster, 556 Federal Bldg., Chicago, Ill., for furnishing and delivering to the constructing quartermaster at Fort Mills, Corregidor, P. I., 61,000,000-gal. pumps, overhead crane and automatic device.

⦿L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing lumber to the Bureau of Engineering to the Edward Hines Lumber Co., Blue Island Ave. and Lincoln St., for $17,000. Bids opened March 18th, 1911; detailed specifications given in ENGINEERING-CONTRACTING.

Indiana.

✣Bids will be received until 10 a. m., May 15, by Depot Quartermaster, Jeffersonville, Ind., for furnishing under Schedule 642, 15,000 lbs. horseshoe nails, 57,500 lbs. light steel horse shoes, 37,500 lbs. light steel mule shoes.

✣Bids will be received until 10 a. m., May 12, by Depot Quartermaster, Jeffersonville, Ind., for furnishing under Schedule No. 643, 39 boilers, range, extra heavy galvanized iron complete with circulating tube and galvanized malleable iron boiler couplings, ess stands.

Iowa.

✣Bids will be received until noon, May 15, by Board of Clinton County Supervisors, Clinton, Ia., for the construction of two horizontal tubular boilers, 16 ft. by 60 ins., according to plans and specifications of the Hartford Steam Boiler Inspection and Insurance Company, now on file. F. W. Leedham is County Auditor and Charles Mordhorst is Chairman of the Board. R. C. Hart is County Surveyor.

The Northern Iowa Power Co., D. M. Sterns, Manager, Humboldt, Ia., has had plans prepared and has sold a $60,000 bond issue for improving the power development in the Des Moines River. The plans include the construction of two concrete dams, 14 ft. high, the enlargement of the mill race and the erection of power plant.

Kansas.

✣Bids will be received until 8 p. m., June 5, by Board of Education, O. T. Cropper, Clerk, Pittsburg, Kan., for the heating and ventilating of two school buildings. Official advertisement will be found elsewhere in this issue.

Louisiana.

✣Bids will be received until May 25, by James McRacken, Secy.-Treas., Firemen's Charitable Benevolent Association, New Orleans, La., at 320 Charles St., New Orleans, La., for the construction of 48 vaults in Greenwood and 48 vaults in Cypress Grove Cemeteries. John Fitzpatrick is President.

✣Bids will be received until noon, July 6, by Police Jury, Evangeline Parish, H. E. Currie, Clerk, for construction of courthouse and jail buildings at Ville Platte, La.; bids to be separate and combined, and all bids must be in accordance with plans and specifications and prepared by Emile Weil, architect, on file at his office, 1312 Whitney-Central Building, New Orleans, La., and in office of Clerk of Evangeline Parish Police Jury, at Ville Platte, La. A set of plans and specifications can be secured from architect upon application by making a deposit of $50 certified check, which will be refunded on return of plans and specifications. Bids must be accompanied by a certified check of $1,000, drawn to the order of Mr. B. S. Dossmann, President Police Jury, guaranteeing bidders entering into written contract within fifteen days after acceptance of bid.

✣Bids will be received until 11 a. m., May 15, by Lieut. Col. Lansing H. Beach, U. S. Engineer, 325 Custom House, New Orleans, La., for furnishing and delivering stone at South Pass and Southwest Pass, Mississippi River.

Massachusetts.

✣Bids will be received until 2 p. m., May 12, by Board of Harbor and Land Commissioners, Boston, Mass., Frank W. Hodgdon, Chief Engineer, for building a section of stone jetty at Scorton Harbor, East Sandwich. The work to be done is furnishing and depositing in place 1,500 tons of granite quarry grout and chips at the inner end of the present stone jetty at Scorton Harbor.

✣Bids will be received until 11 a. m., June 2, by Capt. A. M. Miller, Depot Quartermaster, 263 Summer St., Boston, Mass., for furnishing 20,000 white marble headstones.

The following bids per cu. yd., scow measurement, were received April 29 by Col. Frederic V. Abbott, U. S. Engineer, Boston, Mass., for about 267,000 cu. yds. of dredging in Weymouth Fore River, Mass.: J. P. O'Riorden, Charlestown, Mass., 25⅜ cts.; Eastern Dredging Co., Boston, Mass., 13 8/10 cts.; Daly & Hannan Dredging Co., Ogdensburg, N. Y., 13¾ cts.; G. H. Breymann & Bros., Toledo, Ohio, 14 cts.; Charles M. Cole, Fall River, Mass., 17½ cts.; Bay State Dredging Co., Ltd., Boston, Mass., 18 cts.

Bids as follows were received April 28 by Col. Frederick V. Abbott, U. S. Engineer, Boston, Mass., for removing wreck of schooner "Davis Palmer" from Broad Sound, Boston Harbor, Mass.: Eugene Boehm, Atlantic City, N. J., $6,622; Lewis W. Blix, Harry A. Hanbury, Brooklyn, N. Y., $16,100; Johnston & Virden, Lewes, Del., $15,207; C. T. Johnston & Co., Lewes, Del., $11,223; Betts Bros. & Co., Boston, Mass., $12,875; Merritt & Chapman, Derrick & Wrecking Co., New York, N. Y., $27,742.

Michigan.

✣Bids will be received until 3 p. m., May 15, by Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for dredging Clinton River, Mich.

✣Bids will be received until 3 p. m., June 29, by Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for the construction of lock masonry at Sault Ste. Marie, Mich

✣Bids will be received until 9 a. m., May 20, by Light and Power Commission, J. E. Sherman, President, Marquette, Mich., for the furnishing of all materials and labor and building of two dams on Dead River, one about five miles from the business center of city and the other on the head waters of said stream on the outlet of Silver Lake on Section 17, T. 49, R. 28, about eighteen miles by road from the city of Ishpeming, Mich. The dam near the city to be solid concrete and includes head works to connect with present operating six foot wood penstock. The dam at Silver Lake to be of earth fill, with concrete bulkhead, wing walls, core wall and spillway, and contractor to allow this commission out of the contract price the sum of $3,800 for 40 M feet pine lumber and 1,000 barrels of cement now on the dam site. Bids must be separate for each dam. O'Keefe-Orbison Engineering Co. are Engineers.

⦿Bragen & Rich, Green Bay, Wis., have been awarded the contract by the Escanaba Traction Co., Escanaba, for the construction of a concrete dam and pulp mill on the Escanaba River about ½ mile south of Groos.

The Cleveland Cliffs Iron Co., according to advices from Ishpeming, Mich., has about 35 men employed on the preliminary work of the dam to be constructed on the Carp River, about three miles below Eagle Mills. The dam will be of concrete, about 400 ft. long, 50 ft. high and 50 ft. wide at the base. The power house will be located at Marquette, but work on that will not be started for some time. A 5½-ft. pipe line will be run from the dam to the power house. Seven thousand horsepower will be developed and a transmission line will be constructed from Marquette to the Maas mine at Negaunee, where the power will be distributed to the many mines of the Cleveland-Cliffs Co. in the county.

The Commonwealth Power Co., Jackson, Mich., is reported to have negotiations under way for the purchase of the old power site at Petriville on the Grand River two miles below Eaton Rapids. It is said that the Power Co. plans to construct a new concrete dam at the site.

Bids were opened April 27 by Lt. Col. C. S. Riché, U. S. Engineer, for the repair and construction of piers at a number of harbors. The bids recommended for acceptance were as follows:

[illegible] Love & Son, Muskegon, Mich., at [illegible]:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Pile shoes, 2,700 lbs.	.07
Total	[illegible]

Work at Grand Haven Harbor: Robert Love & Son, Muskegon, Mich., at the following bid:

[illegible] lin. ft.	$ 2.00
[illegible] lin. ft.	.15
Furnish and secure in work:	
[illegible]	[illegible]
Oak timber, 7,631 ft. B. M.	60.00
[illegible] B. M.	[illegible]
Pine or Douglas fir plank for walks, 5,878 ft. B. M.	38.00
Drift bolts, 16,673 lbs.	.04
Screw bolts, 11,123 lbs.	.04
Angle irons, 10,854 lbs.	.04
Tie rods, [illegible] lbs.	.04
Spikes, 298 lbs.	.04
Pile shoes, 540 lbs.	.04
Total	$10,[illegible]

Work at Grand Haven Harbor: Leathem D. Smith, Sturgeon Bay, Wis., at $1.26 per ton for 8,000 tons of stone filling.

Work at Muskegon Harbor, Mich.: Robert Love & Son, Muskegon, Mich., at the following bid:

Dredging for crib foundation, 2,600 cu. yds.	$ 0.30
Furnish and secure in work:	
Foundation piles, 577 lin. ft.	.60
Oak piles, 12,792 lin. ft.	.31
Oak timber, [illegible] ft. B. M.	[illegible]
Hemlock timber, 64,592 ft. B. M.	31.00
Pine or Douglas fir, 146,931 ft. B. M.	39.50
Pine or Douglas fir planks for sheet piles, 262,188 ft. B. M.	42.00
Pine or Douglas fir planks for walk and deck, 12,291 ft. B. M.	37.00
Drift bolts, 24,317 lbs.	.04
Screw bolts, [illegible] lbs.	.04
Angle irons, 19,966 lbs.	.04
Tie rods, 11,213 lbs.	.04
Spikes, [illegible]	.04
Carriage bolts, 7,213 lbs.	.04
Stone, 100-lb., 732 tons	1.15
Stone, 500-lb., 85 tons	2.00
Total	[illegible]

Work at Frankfort Harbor: L. S. Schnorbach & Co., Muskegon, Mich., at the following bid:

Dredging for crib foundation, 100 cu. yds.	
Furnish and secure in work:	
Foundation piles, 1,722 lin. ft.	$ 0.80
Oak timber, [illegible] ft. B. M.	[illegible]
Hemlock timbers, 150,068 ft. B. M.	28.00
Pine or Douglas fir timber, 59,410 ft. B. M.	45.00
Pine or Douglas fir planks for decking, 7,12[illegible] ft. B. M.	[illegible]
Drift bolts, 23,407 lbs.	.04
Screw bolts, 6,228 lbs.	.04
Spikes, [illegible] lbs.	[illegible]
Stone, 100-lb., 2,420 tons	1.60
Stone, 500-lb., 550 tons	1.60
Total	$1[illegible]

Work at Petoskey Harbor. T. L. Durocher, Sault Ste. Marie, Mich., at $1,431.

Minnesota.

✣Bids will be received until 2 p. m., May 29, by State Board of Control, Capital Bldg., St. Paul, Minn., for the erection and completion of an administration building, men's and women's ward buildings, service building and connecting corridors, superintendent's house, power plant, laundry building and connecting tunnels, including general contract work, plumbing work, heating and ventilating and electrical work.

The Oscar Claussen Engineering Co. of St. Paul, Minn., will draw up a preliminary report on the remodeling or new construction of an electric light plant to give the Village of Delano a 24 hours' service. The proposition for bond issue for these improvements will then be put to a vote of the people.

Mississippi.

✣Bids will be received until noon, June 6, by Capt. J. A. Woodruff, U. S. Engineer, Vicksburg, Miss., for the furnishing and delivering of one steel hull towboat. Official advertisement will be found elsewhere in this issue.

New Hampshire.

✣Bids will be received until noon, June 1, by Lieut. Col. W. E. Craighill, U. S. Engineer, [illegible] Congress St., Portland, Me., for the construction of a breakwater at Isles of Shoals, Me. and N. H.

New Jersey.

[illegible] Wilson has named Frederick W. Donnelly, Trenton; Walter Wood, Camden; Charles A. McCormick, James N. Reilly of Newark, and Colonel W. M. Black of Washington, who is to represent the government, as the Jersey Ship Canal Commission created by a resolution adopted by the legislature. The commission will investigate the feasibility of the plan to build a ship canal across the state and report to the next legislature.

New York.

✣Bids will be received until May 15, by Board of Contract and Supply, Isidore Wachsman, Albany, N. Y., for the installation of a complete police signal system. Edward B. Cantine is Commissioner of Public Safety.

The Board of Water Commissioners of Niagara Falls, N. Y., has approved of the project to construct a city dock on the Niagara River at the city water works plant. The estimated cost of the work is $40,000.

The U. S. Treasury Department, James Knox Taylor, Supervising Architect, Washington, D. C., has rejected all bids for the proposed Government Barge Office at New York because none was within the $500,000 limit set by Congress. The Treasury Department will readvertise for new bids on modified plans.

A bill has been introduced in the State Legislature to consolidate the forest, fish and game and water supply departments, forming a new branch of the state government to be known as the Department of Conservation. The executive head is to be the conservation commissioner and he is to act in co-operation with an advisory board composed of other state officials. The conservation commissioner, according to a statement accompanying the bill, is to appoint 10 deputies and each is to have charge of a bureau. There is to be a bureau of administration, of water storage and development, of water supply, of parks, of forestry, of inland fisheries, of marine fisheries, of fish and game protection, of engineering and of law. The creation of other positions and the fixing of salaries, except that of commissioner, is to be subject to the approval of the governor. The present staff of the water supply and forest, fish and game commissions is taken over. The advisory board to be composed of the commissioner of conservation, the lieutenant-governor, the attorney general, the state engineer and surveyor, and the superintendent of public works is created. The procedure for construction of storage reservoirs, recommended by the state water supply commission has been embodied in the bill, together with existing statutes, after necessary modification, for river improvement and control over potable water supply. A companion bill authorizes submission to the people this year of a proposition to borrow not to exceed $20,000,000 by 50 year bonds for the construction by the state of storage reservoirs and hydraulic works. The income from such developments is to be paid into the sinking fund.

North Carolina.

✣Bids will be received until noon, June 1, by H. S. Bunn, Clerk of the Board of County Commissioners, Tarboro, N. C., for the necessary labor and material for the construction and completion of a new county court house at Tarboro, N. C.

✣Bids will be received until 3 p. m., May 15, by Lieut. R. O. Edwards, Constructing Quartermaster, Fort Caswell, N. C., for dredging in a narrow channel with narrow basin to launch wharf at Fort Caswell, N. C., including approximately 40,000 cu. yds. material in cut.

Ohio.

✣Bids will be received until 10 a. m., June 1, by Col. John Millis, U. S. Engineer, Federal Bldg., Cleveland, O., for dredging Toledo Harbor, Ohio.

✣Bids are asked until 10 a. m., June 1, by Col. John Mills, U. S. Engineer, Room 420 Federal Bldg., Cleveland, O., for dredging Toledo Harbor, O. The locality to be dredged is the channel from Lake Erie through Maumee Bay and river to the Fassett Street Bridge in the city of Toledo, or such portion of this channel as it may be practicable to dredge with funds available. This channel is 100 ft. in width and approximately 16 miles in length. As estimated in 1908 the total quantity of material to be removed is about 1,800,974 cu. yds. place measurement. The channel has been dredged for a width of 400 ft. out as far as the outer lighthouse. It is proposed to clear this channel of any fill and to lower the bottom of the original dredged channel about 2 ft., extending it to corresponding depth in Lake Erie in order to provide a channel 21 ft. deep below the low water of 1895 which is practically equivalent to 23 ft. below mean lake level 1860-1875. The material to be removed is believed to be clay overlaid with sand and silt.

The State Senate has passed the Huffman bill, appropriating $30,000 for the chief engineer of the board of public works, Columbus, to make a survey of the canal system and report to the next legislature as to the advisability of a Lake Erie to Ohio River canal.

The County Commissioners, at Dayton, have been petitioned to construct a ditch at Brookville.

Oklahoma.

✣Bids will be received until 1 p. m., May 15, by Capt. L. Hardeman, Quartermaster, Fort Reno, Remount Depot, Okla., for the construction of addition to the Post Hospital.

✣Bids will be received until 10 a. m., May 18, by Capt. David L. Stone, Constructing Quartermaster, Fort Sill, Okla., for the construction of a powder magazine at the fort.

Oregon.

The City Sanitary and Reclamation Board of Astoria, Ore., is planning to build a 2,000 ft. long reinforced concrete bulkhead on a piling foundation. The work will cost about $25,000.

Pennsylvania.

⦿Andrew Regan, Lansford, Pa., according to advices received from Philadelphia, has been awarded the contract for the construction of a tunnel at No. 4 colliery of the Lehigh Coal & Navigation Co., at Summit Hill, which will require several years.

South Dakota.

✣Bids will be received until 3 p. m., May 19, by State Capitol Commission, H. B. Anderson, Secy., for grading, laying water pipes and lighting conduits, building retaining wall contracting cement walks and paving driveways on State capitol grounds at Pierre, S. Dak.

✣Bids will be received until noon, May 27, by H. G. Joy, Secy. Board of Education, Doland, S. Dak., for the erection of a public school building at Doland. A. H. Shoultz, Watertown, S. Dak., is Architect.

The Fairview Milling Co., Fairview, S. Dak., as noted sometime ago in these columns, has had surveys and estimates made for a new dam and power plant at Fairview. The following is the estimate:

Cost of dam	$ 18,000.00
Power house	[illegible]
Generators (600 hp.)	[illegible]
Switch board	1,850.00
Turbines (900 hp.)	[illegible]
Wire conduit	[illegible]
Incidentals	[illegible]
Water rights	[illegible]
Steam auxiliary (500 hp.)	25,000.00
High tension transformer equipment	[illegible]
Transmission line to Canton, 12 miles, transformer station buildings and equipment at Canton	12,100.00
Transmission line to Inwood, 10 miles, transformer buildings, and equipment at Inwood	10,000.00
Engineering, superintendence and contingent expenses, 10 per cent	10,537.50
Total	$115,912.50

The Missouri Valley Engineering Co., Mitchell, S. Dak., is the engineer.

Texas.

✣Bids will be received until May 20, by J. A. Palmer, Secy., Prison Commission, Hunts-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

ville, Texas, for [illegible], lubricating and illuminating [illegible] prison systems.

✣Bids will be received until noon, May 25, by Maj. G. P. Howell, U. S. Engineer, Galveston, Texas, for [illegible] mouth [illegible] Brazos River, Texas.

✣Bids will be received [illegible] May 22 by J. A. Palmer, Secy., Prison Commission, Huntsville, Texas, for supplying textile machinery for the prison system at that place.

✣Bids will be received until 3 p. m., June 9, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office and court house at Victoria, Texas.

Washington.

✣Bids will be received [illegible] June 6, by Department of the Interior, Office of Indian Affairs, Washington, D. C., for furnishing materials and labor for extension of the steam heating system and the installation of a hot water service system at the Cushman School, Washington.

West Virginia.

The Pine Swamp Big Vein Coal Co., of Piedmont, W. Va., has been chartered with a capital stock of $600,000 and will develop coal lands in Mineral County. The capital stock is $600,000. Lewis P. Winston, Joshua L. Craig, Harry F. Geisendaffer, Harry F. Shew and Arthur M. Easter, of Baltimore, are named as incorporators.

Wisconsin.

⊙The contract for the new dam at the Okauchee Lake property of Henry Schoelkopf of Milwaukee has been awarded J. Nelson & Co. of Oconomowoc, who will also build the concrete combined power plant and dwelling house.

Bids, as follows, per cu. yd., scow measurement, were received May 6 by Maj. Francis R. Shunk, U. S. Engineer, Duluth, Minn., for 47,000 cu. yds. dredging at Port Wing Harbor, Wis.: Zenith Dredge Co., Duluth, Minn., 20¼ cts.; Duluth Marine Contracting Co., Duluth, Minn., 14 cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., 16 cts.; Northern Dredge & Dock Co., Duluth, Minn., 13½ cts. (accepted).

Wyoming.

✣Bids will be received until 2 p. m., May 24, by Department of the Interior, at the office of the Acting Superintendent of Yellowstone National Park, Yellowstone Park, Wyo., for the erection of an administration building within the Yellowstone National Park.

Canada.

✣Bids will be received until 4 p. m., May 15, by R. C. DesRochers, Secy., Department of Public Works, Ottawa, Ont., for dredging at the following places: Prince Edward Island, Summerside and Vernon River; Nova Scotia, Cheticamp, Digby, L'Archeveque, Larry's River, Margaree Harbor, St. Mary's River, West Bay; New Brunswick, Buctouche Beach, Cape Tormentine, Loggieville, Maquapit Lake, Ox Island, Raft Channel, Richibucto, Scotchtown, Shediac, Shipigan Gully, St. George, St. Stephen.

✣Bids will be received until 4 p. m., May 15, by R. C. DesRochers, Secy., Department of Public Works, Ottawa, Ont., for hot water boilers, setting, etc., in the Hamilton, Ont. public building.

✣Bids will be received until 4 p. m., May 29, by R. C. DesRochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of a dam and sluiceway across the head of Gordon Creek at Kippewa village in the county of Pontiac, Que. Plans, specification and form of contract can be seen and forms of tender obtained at the office of J. E. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the postmaster at Haileybury, Ont.

⊙The Dominion Department of Railways and Canals, Ottawa, Ont., has awarded the contract for improving the upper entrance to Lock No. 28, Galops Canal, to the Randolph Macdonald Co., Toronto, Ont.

⊙The Dominion Department of Railways and Canals, Ottawan Ont., has awarded the contract for the improvement of the upper entrance of Lock No 19 of the Cornwall Canal to Fallon Bros of Cornwall, Ont.

The Canadian Power Co., Montreal, Que., has submitted a proposal to the Canadian government to dam the St Lawrence River. The proposal will be referred to a board of engineers.

SEWAGE DISPOSAL.

[illegible]

erecting all automatic controlling machinery [illegible]

[illegible]

a guarantee of good faith.

Bid must be made on printed blanks to [illegible] Service.

All [illegible] material of each item and must include [illegible]

The [illegible]

Excavation, 2,100 cu. yds.

Concrete, [illegible]

Steel, 7,000 lbs.

Broken stone, washed gravel or selected [illegible]

[illegible] sewer pipe, [illegible] drains.

[illegible] sewer pipe, [illegible]

4-in. sewer pipe, [illegible]

500 ft. 24-in. sewer outlet drain

120 ft. 20-in. sewer outlet drain.

600 ft. 15-in. sewer outlet drain.

850 ft. 12-in. sewer outlet drain

4 manholes.

1 catch basin.

[illegible]

Complete equipment of controlling machinery, design to be adopted after bids are received from competing manufacturers.

The Director of Public Service reserves the right to reject any or all bids or to waive defects [illegible] the city.

All bids must be in sealed envelopes, endorsed on the outside, "Proposal for Sewage Disposal," and must be addressed to the Director of Public Service.

By order of the Director of Public Service.

PAUL O. BATCH, Clerk.

Bellefontaine, Ohio, April 2, 1911.

CITY OF TORONTO.

Tenders for Construction of Ashbridges Bay Docks.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Canada, up to noon on Tuesday, 23d May, 1911, for the construction of dock in Ashbridges Bay.

Envelopes containing tender must be plainly marked on the outside as to contents.

Specifications and forms of tender may be obtained upon application to the Department of Railways, Bridges & Docks, City Engineer's Office, Toronto.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman Board of Control.

City Hall, Toronto, April 12, 1911.

WATERWORKS

Sealed proposals [illegible] Lake, Iowa, covering the proposed improvements [illegible] time bids will be opened and contracts awarded, however, city reserving the [illegible] cept a bid considered most advantageous [illegible] any informality in bid, or price thereof.

Proposal must be accompanied by a [illegible] of Clear Lake [illegible] the Clerk of the town of Clear Lake, Iowa. [illegible] per cent of contract price as offered in proposal and shall be held and deemed [illegible] in case the successful bidder fails to enter into a contract with said town of Clear Lake, Iowa, in accordance with the terms of proposal, accompanying such check within 24 hours and furnish satisfactory bond within 10 days from the awarding of the contract. Bond to be 50 per cent of the amount of contract price called for in proposal.

[illegible] on waterworks fund.

GENERAL SPECIFICATIONS.

These specifications are to provide for the necessary changes for the improvement [illegible] Clear Lake, Iowa, and, in addition to the plan and specifications on file with the Clerk of the town of Clear Lake, the bidder should make a personal examination of location of work and any point not specifically covered in general specifications and shown on plans, of vice versa, which will be required to make a complete and satisfactory installation of work as generally understood by the committee in charge of the work, same shall be furnished at no additional expense for the town of Clear Lake.

Passed May 2, 1911.

D. H. CAMPBELL, Mayor.
J. C. DAVENPORT, Clerk.

OFFICE OF THE ROADS' ENGINEER
OF BALTIMORE COUNTY.

Towson, Md., May 26, 1911.

Sealed proposals, addressed to the Highway Commission of Baltimore County, and endorsed proposals for furnishing and erecting a Strauss Trunion Bascule Bridge, on Eastern Avenue over Back River, will be received by the Highways Commission of Baltimore County at their office in the Court House, Towson, Maryland, until 11 a. m. of the clock, Thursday, May 18, 1911, when they will be publicly opened and read. Each bid shall be accompanied by a certified check for Five Hundred Dollars ($500.00), as a guarantee that the successful bidder will sign contract. Plans and specifications can be seen and obtained in the office of the Highways Commission, Towson, Md., and at the offices of the Strauss Bascule Bridge Co., 901 Fort Dearborn Building, Chicago, Illinois.

The Contractor shall state in his bid the date he will complete the bridge ready for use.

The Highways Commission reserves the [illegible]

HENRY G. SHIRLEY,
Baltimore County Roads Engineer.

SEWER.

The City of Auburn, Ind., will receive bids for approximately 10,000 feet of from 20-inch vitrified to 42-inch concrete storm sewer on the 15th day of May, 1911, at the hour of 7:30 p. m., at the office of the city clerk, E. O. Little.

For further information, write Phil Holme [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

SPECIAL BOND ISSUE OF 1911.

MUNICIPAL IMPROVEMENTS OF
MUSKOGEE, OKLA.

CONTRACTS A [illegible] Creek Sanitary Outfall Sewer.

Sealed proposals will be received by the City Council of the City of Muskogee, Okla., at the Council [illegible] May [illegible] for the construction of a portion of the Coody Creek Sanitary Outfall Sewer and [illegible]

The work included in the advertisement will be Section 1 to 6, inclusive.

Section 1 embraces [illegible] of 48" sewer.
Section 2 embraces 5,000′ of 48" sewer.
Section 3 embraces [illegible] of 48" sewer.
Section 4 embraces [illegible] of 48" sewer.
Section 5 embraces 6,500′ of 45" sewer.
Section 6 embraces 7,100′ of 42" sewer.

Alternative bids are asked for two ring brick with vitrified invert; manufactured concrete pipe; and monolithic concrete with vitrified invert.

Proposals for these contracts shall be accompanied by certified checks amounting to 10 per cent of the amount of the work bid upon, made payable to the City of Muskogee, Okla., without conditions.

Plans and specifications can be secured at the office of the City Engineer, or at the office of Consulting Engineer, Alexander Potter, 114 Liberty Street, New York, on or after May 10th, by depositing $10.00 for any or for all sections.

The right is reserved to reject any or all bids and to accept those that in the opinion of the City Council is for the best interest of the City.

By order of the City Council.

D. H. MIDDLETON,
Mayor

CHAS. WHEELER, JR.,
City Clerk.

T. P. CLONTS,
City Engineer.

BRIDGE.

Sealed proposals will be received by the Board of Supervisors of Story, County, Iowa, at the office of Dean C. F. Curtiss, in the City of Ames, Iowa, until 1:30 p. m., May 15, 1911, for furnishing materials and labor as follows:

Item 1.

For a reinforced concrete bridge consisting of 4 32-ft. deck girders complete.

Alternate.

Item A.

For a reinforced concrete bridge consisting of 3 37-ft. deck girders complete.

Alternate.

Item B.

For a reinforced concrete bridge with a minimum of 1,200 sq. ft. of waterway in ten feet from stream bed. Profile will be furnished on application to the State Highway Commission at Ames.

Bids will be received for the above work, on plans and specifications as designated by T. H. MacDonald, and also on other designs of the same capacity.

Each bid must be accompanied by cash or certified check in an amount equal to ten per cent of the amount of the bid.

The board reserve the right to reject any or all bids.

C. A. BATMAN,
County Auditor.

War Department, U. S. Engineer's Office, Montgomery, Ala., May 1, 1911. Sealed proposals for furnishing about 35,000 barrels American Portland Cement will be received at this office until one [illegible] May 31, 1911. Information on application. G. D. Fitch, Lt. Col., En-

31 New and Standard Books

Send for Complete Catalog of the Following Books:

Handbook of Cost Data. SECOND EDITION.
By Halbert P. Gillette, M. Am. Soc. C. E., Managing Editor of "Engineering-Contracting." The 1910 edition of this book contains nearly 1,900 pages. Postpaid, $5.00.

Diagrams for Designing Reinforced Concrete Structures.
Including Diagrams for Reactions and Strengths of Steel Beams, by G. F. Dodge, M. West. Soc. Engrs. 13 × 15½ inches; 104 pages. Postpaid, $4.00.

Cost of Electric Transmission Lines.
(Both Conduits and Pole Lines.)
The title of this book, by Clarence Mayer, is "Telephone Construction-Methods and Cost," which is somewhat a misnomer in that it does not indicate its wide scope. It is 6 × 9 ins.; 300 pages. Postpaid, $4.00.

Engineers' Pocketbook of Reinforced Concrete.
By E. Lee Heidenreich. "Mr. Heidenreich's pocketbook is nearer the ideal than any on the same subject heretofore published." —Engineerings News, Jan. 14, 1909. Leather; 4½ × 6¾ ins.; 374 pages. Postpaid, $3.00.

The Reinforced Concrete Pocketbook.
By L. J. Mensch, M. Am. Soc. C. E. A book by an experienced engineer and successful contractor. Leather; 4¼ × 6¼ ins.; 216 pages. Postpaid, $4.00.

Concrete Bridges and Culverts.
(Both Railway and Highway.)
By H. Grattan Tyrrell. Leather; 4½ × 6¾ ins.; 272 pages. Postpaid, $3.00.

Tables for Structural Engineers.
By Edward Godfrey. Leather; 4 × 6½ ins.; 218 pages. Postpaid, $2.50.

Solid Bitumens.
Their Physical and Chemical Properties and Chemical Analysis, by S. F. Peckham. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $5.00.

Graphic Statics.
By Charles W. Malcolm. This book has been adopted as a textbook by a large number of engineering colleges. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $3.00.

Cost Keeping and Management Engineering.
By Halbert P. Gillette and Richard T. Dana. Cloth; 6 × 9 ins.; 360 pages. Postpaid, $3.50.

Theory and Design of Reinforced Concrete Arches.
By Arvid Reuterdahl, Chief of Bridge Dept., City of Spokane. Cloth; 6 × 9 ins.; 132 pages. Postpaid, $2.00.

Railroad Location Surveys and Estimates.
By F. Lavis, M. Am. Soc. C. E. Cloth; 6×9 ins.; 270 pages. Postpaid, $3.00.

The Trackmen's Helper.
By J. Kindelan. Cloth; 5¼ × 7½ ins.; 350 pages. Postpaid, $1.50

Practical Switchwork.
By D. H. Lovell. Cloth; 4¼ × 6¼ ins.; 174 pages. Postpaid, $1.00.

Maintenance of Way Standards.
By F. A. Smith. Cloth; 5½ × 7¾ ins.; 600 pages. Postpaid, $1.50.

Railway Curves.
By F. A. Smith. Cloth; 4 × 6¼ ins.; 50 pages. Postpaid, $1.00.

Standard Turnouts.
By F. A. Smith. Leather; 4½ × 7¾ ins.; 41 pages. Postpaid, $1.00.

Engineering Work in Towns and Cities.
By Ernest McCullough. Cloth; 6 × 9 ins.; 510 pages. Postpaid, $3.00.

Tables of Squares and Logarithms.
By G. D. Inskip. Give five place squares and logs of feet, inches and 32ds of inches from zero to 100 ft. Logs of numbers to 10,000; logs of sines and tangents, log functions of angles and natural functions, etc. Write for sample pages. Leather; 5½ × 7½ ins.; 405 pages. Postpaid, $3.00.

Practical Cement Testing.
By W. Purves Taylor. The most complete book on the subject. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $3.00.

Concrete Construction—Methods and Cost.
By Halbert P. Gillette and Charles S. Hill, Editors of "Engineering-Contracting." Cloth; 6 × 9 ins.; 700 pages. Postpaid, $5.00.

Cements, Mortars and Concretes.
By Myron S. Falk. A summary of tests and conclusions derived therefrom. Cloth; 6 × 9 ins.; 184 pages. Postpaid, $2.50.

Surveyor's Handbook.
By T. U. Taylor, Professor of Civil Engineering, University of Texas. Leather; 4½ × 7 ins.; 328 pages. Postpaid, $2.00.

Concrete and Reinforced Concrete Construction.
By Homer A. Reid, Assoc. M. Am. Soc. C. E. The largest book on concrete. Cloth; 6 × 9 ins.; 906 pages; 715 illustrations. Postpaid, $5.00.

Bricklaying System.
By Frank B. Gilbreth, M. Am. Soc. M. E. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $3.00.

Field System.
By Frank B. Gilbreth. A book of rules and instruction for the guidance of his foremen and superintendents on contract work, by the contractor who made the "Cost-plus-a-fixed-sum contract" famous. Leather; 4½ × 7 ins.; 200 pages. Postpaid, $3.00.

Rock Excavation—Methods and Cost.
By Halbert P. Gillette. Cloth; 5½ × 7 ins.; 384 pages. Postpaid, $3.00.

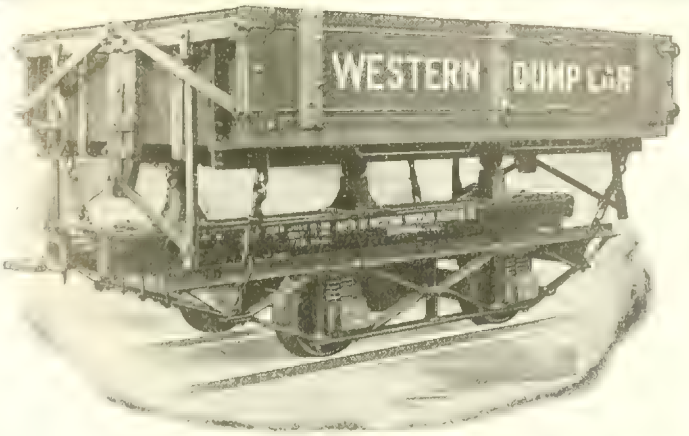
Backbone of Perspective.
By T. U. Taylor, Professor of Civil Engineering, University of Texas. Cloth; 4½ × 7 ins.; 56 pages. Postpaid, $1.00.

Engineering Law—The Law of Contract.
By Alexander Haring, LL.B., M. Am. Soc. C. E., Professor of Bridge and Railway Engineering, New York University. Cloth; 6 × 9 ins.; 510 pages. Postpaid, $4.00.

Concrete Inspection.
By Chas. S. Hill, C.E. Cloth; 3½ × 6 ins. 186 pages; illustrated. Postpaid $1.00.

Reinforced Concrete—A Manual of Practice.
By Ernest McCullough, M. West. Soc. Engrs. Cloth; 5 × 7¾ ins.; 136 pages; illustrated. Postpaid $1.50.

THE MYRON C. CLARK PUBLISHING CO., 355 Dearborn St., CHICAGO
13-21 Park Row, New York



The Proved Quality Dump Car

The [illegible] practical experience back of Western [illegible] Cars combined with their sturdy construction and the fact that they [illegible] led in improvement is the reason [illegible] matchless [illegible] for quality and efficiency—the[illegible] good as greatest skill can make them.

The Western Four Yard Car

is ideal size for 3-ft. gauge. It is unbeatable in design and construction—ample capacity for heavy loads, yet of low, compact form, with bed and truck separable, steep dumping angle and automatic pivoted side boards. It is dependable in **any** service.

Sizes and styles of Dump Cars for every purpose are described in our general catalog of earth and stone-handling machinery.

Western Wheeled Scraper Co.

Aurora, Ill., U. S. A.

PROPOSALS.

OFFICE OF STATE HIGHWAY COMMISSION.

Richmond, Va., May 1, 1911.

Bids will be received by the undersigned and the Board of Supervisors of Wise County, at the clerk's office at Wise Court House, up to 11 a. m., Thursday, May 25, 1911, for the permanent improvement of about one hundred and twenty-five (125) miles of county highway.

Separate bids are ask on the following sections in according with the printed notice to contractors, as follows:

Section 1. Big Stone Gap to West Norton and from West Norton to Dorchester 13.3 miles.

Sec. 2. Lee County Line through Big Stone Gap and East Stone Gap to Mintern, 8¼ miles.

Sec. 3. Appalachia through Norton to the end of present macadam, 13.4 miles.

Sec. 4. Appalachia up Pigeon to Lee County Line, Appalachia up Looney to Inman, Appalachia up Callaghan to Stonega, 13 miles.

Sec. 5. Coeburn through Virginia City and St. Paul to Lick Creek, 15.3 miles.

Sec. 6. Wise through Coeburn to Banner and Slabtown to Riverview, 11½ miles.

Sec. 7. Wise through Glamorgan to Donkey, 11½ miles.

Sec. 8. Wise to Cranes Nest, 10 miles.

Sec. 9. Coeburn to Cranes Nest, 9½ miles.

Sec. 10. From mile 1 to 8 inclusive, Esserville to Flat Gap, 8 miles.

Sec. 11. From mile 9 to mile 17 inclusive, Esserville to Flat Gap, 9 miles.

Plans and specifications and instructions to bidders may be seen at the office of the State Highway Commission, Richmond, Va., and at the office of the County Engineer, Norton, Va., and the Clerk's office, Wise, Va., and at the Monte Hotel, Big Stone Gap, Va., or a complete set of maps, plans and specifications may be had on application to the Highway Commissioner, Richmond, Va., or the County Engineer, Norton, Va., for the sum of $.............. per section. Bids on each separate section must be accompanied with a certified check, payable to the Board of Supervisors of Wise County, in the sum of five hundred (500) dollars; but a certified check in the sum of fifteen hundred (1,500) dollars will entitle the bidder to bid on three (3) or more sections; this as a guaranty of the acceptance and performance of the contract by the party to whom it may be awarded, and his failure to execute said contract will forfeit said check.

The right is reserved to reject any or all bids.

P. ST. J. WILSON,
Commissioner.

PROPOSALS FOR TOWBOAT.—U. S. Engineer Office, Vicksburg, Miss., May 5, 1911. Sealed proposals for furnishing and delivering one steel-hull towboat will be received at this office until noon, June 6, 1911, and then publicly opened. Information on application. J. A. WOODRUFF, Capt., Engrs.

U. S. Engineer's Office, Kansas City, Mo., April 20, 1911. Sealed proposals for constructing standard revetment on Missouri River about four miles below St. Charles, Mo., will be received here until 12 noon, May 22, 1911, and then publicly opened. Information furnished on application. Edward H. Schulz, Major, Engrs.

SEWERS AND PAVING.

Sealed proposals will be received by the Mayor and Board of Aldermen of Frederick, Maryland, until 11 a. m., May 24, 1911, for constructing approximately 4,000 lin. ft. of sewers (6" to 42") together with necessary inlets, manholes and lampholes. Each bid must be accompanied by a certified check for $250.00 drawn payable to J. Ed. Schell, Mayor.

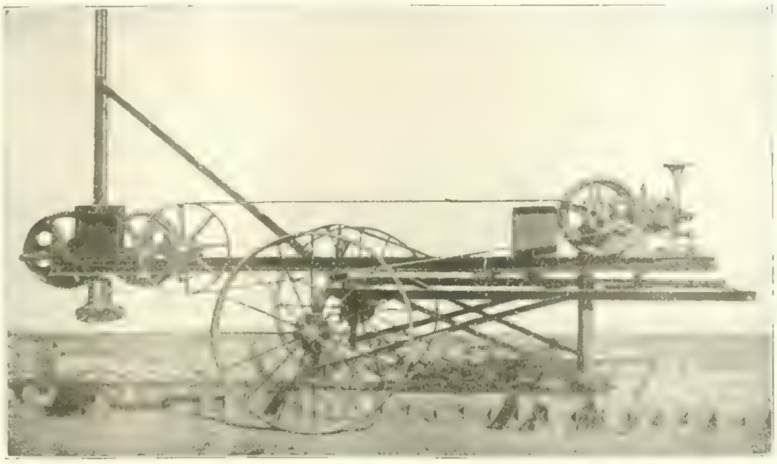
At the same time and place sealed proposals will be received for paving approximately 16,000 sq. yds., and for furnishing and setting 8,500 lin. ft. of curbing. Each bid must be accompanied by a certified check for $1,250.00 drawn payable to J. Ed. Schell, Mayor.

Plans, specifications, instructions to bidders, and forms of proposals may be obtained from the City Engineer, upon payment of $2.00.

The right to reject any or all bids or any portion of any bid, or to accept any portion of any bid, which may be deemed for the best interest of the city, is expressly reserved.

J. ED. SCHELL,
Mayor.
E. C. CRUM,
City Engineer.

Fort Yellowstone, Wyo., April 27, 1911. Sealed proposals, in triplicate, will be received here until 12 noon, May 31, 1911, and then publicly opened, for furnishing labor and material for constructing pipe line from Panther Creek to point near Rustic Falls for Fort Yellowstone water system. Information furnished on application. Envelopes containing proposals to be indorsed "Proposals for pipe line" and addressed to Constructing Quartermaster.



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Box 229 **Springfield, Ill.**

PUMPING ENGINE.

[illegible] Ohio, until 12 o'clock noon, standard time, [illegible] office in said city, for the construction, delivery and installation of one pumping engine capable of delivering two and one- [illegible] ty-four (24) hours. Bids will be considered on both Compound Crank and Fly wheel engines or Triple Expansion direct [illegible] reserved to reject any or all bids. Certified checks for Ten (10) per cent to be furnished payable to Director of Public Service. Instructions to bidders, specifications and blank proposals may be obtained from the Director of Public Service, Kenton, Ohio, or from Charles Brossmann, Consulting Engineer, Union Trust Building, Indianapolis, Ind.

W. P. STEFFEN
Director.
G. S. BINCKLY
City Clerk.

HEATING AND VENTILATION.

Bids will be received by the Board of Education of the City of Pittsburg, Kansas, until 8 p. m., June 5, 1911, for [illegible] two school buildings, according to plans and specifications now on file at the office of the clerk of the board of education in the City of Pittsburg, Kan., or on separate plans and specifications submitted by bidder. Bids must be accompanied by a certified check in the sum of Two Hundred Dollars ($200). The right is hereby reserved to reject any and all bids. Dated at Pittsburg, Kansas, this 5th days of May, 1911.

O. T. CROPPER,
Clerk.

ROCK EXCAVATION, TUNNELING and QUARRYING

These subjects are treated in detail, economic methods being described and detailed costs given in Gillette's "Rock Excavation—Methods and Cost." A contractor writes us that one method described has saved him hundreds of dollars by enabling him to prevent drill bits from sticking in the drill hole. A mining engineer has sent us a table showing the output before certain of the author's suggestions were adopted and after they were put into practice, giving an increase of 70% in the number of tons broken per drill.

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Instructor in Civil Engineering, Columbia University

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Studies for City Betterment at Pittsburg, Pennsylvania.

Pittsburg has been for years—how justly we do not venture to say—the synonym for absolute utilitarian smudginess in city development. We are safe, however, in saying that no city in America has undertaken so thorough and comprehensive a plan of study for city betterment as has the great iron and steel making center of the United States. Entire credit for this work cannot be given to any individual or to any single citizens' body, but a great measure of it is doubtless due to the Pittsburg [illegible]. We are prompted to make [illegible] and to review [illegible] work by the report just received of Mr. Frederick Law Olmsted to the commission's committee on city planning on a plan of improvement of the main thoroughfares [illegible] the buildings and grounds of the city. We urge a study of this document by every one concerned in city planning and beautifying, but our more particular purpose here is to outline briefly the notable work, of which this is only a part, which is being carried out by the Civic Commission.

This commission began its work by a report prepared by Bion J. Arnold, John R. Freeman and Frederick Law Olmsted outlining a plan of procedure of city planning for Pittsburg. This report stated the scope of and methods of investigation on the following subjects: Steam Railroads, Water Transportation, Electric Railroads, Street Systems, Public Lands and Buildings, Water System, Sewerage System, Control Over Developments on Private Property, Smoke Abatement and Building Code. The range of study recommended, it will be observed, was wide enough to cover practically all city activities affecting public service and comfort. The important feature is that these studies were not only recommended but have largely been put under way.

The first of these specific studies reported upon was the transportation problem. The study was made by Mr. Bion J. Arnold, and his report, considering (1) immediate surface railway improvements, (2) future surface railway improvements, (3) future rapid transit developments and (4) legal developments and comprising some 200 pages, was presented late in 1910. This report is a notable analysis of traffic opportunities and transportation conditions in a large city. Incidentally it may be mentioned that the study was conducted directly for the city administration, which secured the release by the Civic Commission of Mr. Arnold's services for this purpose.

In a similar manner the city administration has relieved the Civic Commission of its proposed building regulation, sewerage and water supply studies. A special commission is now at work preparing a new and improved building code. The sewerage problem is being studied by Mr. Allen Hazen, who will report upon a comprehensive sewerage system for the city. The study of the city's water supply problem is planned for.

It is important to note that these several studies have been and are being made with reference not merely to present demands but with the purpose of providing for years ahead and the comprehensive and systematic development of the city's growth along aesthetic and utilitarian lines. As stated above, we are not aware of any similarly comprehensive and systematic plan of study for city betterment being undertaken by any other large American city.

Method of Determining the Stresses In Guy Wires.

The theory of the stresses in guy wires has been, until recently, [illegible] neglected fields in applied mechanics. [illegible] method for determining such [illegible] existed, and engineers and builders have been compelled to resort to rule-of-thumb methods that were often erroneous.

In another column of this issue we present a paper read by Mr. W. M. Wilson at a recent meeting of the Western Society of Engineers, in which the theory of stresses in guy wires is outlined, and a method of determining them is proposed. The mathematical development of this theory is complex and would be of little use to the engineer in applying the method. For this reason we have omitted that portion of the paper.

It may be explained briefly that this analysis is based on the theory of the catenary, the curve in which a flexible cord or cable of uniform weight per unit of length, and carrying only its own weight, will hang when supported at two points. In the case of a guy wire this curve is determined by the points where the wire is attached to the stack and the anchor, and by the sag in the wire. The wire, while determining the form of the catenary, is only a part of it, the vertex of the curve being always at some point beyond the anchor.

This consideration leads to an ingenious use of a function, *c*, which is defined as being the length of a theoretical wire extending to the vertex of the catenary, "whose weight is equal to the horizontal component of the stress in the wire" under consideration. In this way the analysis is greatly simplified, and the complications involved in considering the wire as a flexible tension member are avoided.

This theory is applied further in determining the stress in the wire when the stack is in a deflected position owing to wind or the application of other force. In such a case a new catenary is formed, the anchor and the point of attachment to the stack—in its new position—being two points on the new curve. The form of the theoretical curve is thus determined, as before, by that part of it that coincides with the curve of the actual guy wire. The vital feature of this method is found in the fact that the stress placed on the guy wire by the stack in its deflected position is simply the stress that would be produced by the weight of a similar wire lying in the catenary of which the guy wire is a part, and having rigid supports at the point of attachment to the stack at the vertex of the catenary.

Several points of immediate practical value are brought out in the paper. One of these relates to the initial stress that should be placed in the wire. It is found that in tightening any wire the stress increases gradually until a certain point is reached. This point lies within narrow limits and is determined roughly in the process of tightening. Stress applied beyond this point has little effect on the sag of the wire, and any tightening beyond this point simply produces a stretch in the wire. This fact is clearly demonstrated by the curves shown in the paper. The author concludes that this sudden increase in stress in the point at which to stop tightening, and calls attention to the fact that a breaking strain is often placed in a wire by tightening beyond this point.

Another feature to be considered is the effect of the slack wire when the stack is in a deflected position. It is found that the effect of this wire is not negligible, as is ordinarily assumed. The righting force exerted on the stack under any given condition is the resultant of the forces exerted by the two opposite wires.

It is usually assumed that the flatter the slope of the guy wires the greater the stability of the stack. It is demonstrated in the paper that this is not the case. While no definite limit is set, it appears that when judged by the magnitude of the righting force developed—which, as explained above, is the resultant of two opposite forces—better results are obtained with a slope of 1 to 1 than with a slope of 1, vertical, to 2, horizontal.

In practice there is one indefinite feature in any method of determining the stress in a guy wire. That is the initial stress, mentioned above. It may be added that in any given case there is a certain stress that will insure a maximum of stability in the stack without placing an excessive strain on the wire. Owing to the impracticability of measuring this stress, its exact magnitude, within the limits mentioned above, must depend on the judgment of the operator.

The Chicago Gas Appraisal.

Elsewhere in this issue we publish an abstract of the report of Wm. J. Hagenah on the appraisal of the properties of the Peoples' Gas Light & Coke Co. of Chicago. So far as can be ascertained this is the first instance in which an appraisal of a gas property of this magnitude, accompanied as the appraisal is by detailed explanation and reasoning on every point, has ever been published. For this reason and because of the fact that the report embodies certain principles in the appraisal of

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public utility properties that are constantly receiving wider acceptance among engineers and the public, we believe that it merits the unusual amount of space allotted to it in our columns.

At every point the greatest care is evident in the making of this appraisal. Inventories of the physical property were secured from the gas company. These inventories were used as a basis for the physical appraisal, but not until after they had been carefully checked against the property. In the case of structures plans were inspected for the purpose of discovering details or conditions that might have added to the cost, but that were not discoverable by an inspection of the property. This is merely an example of the thoroughness in investigation and analysis manifested throughout the appraisal.

The existence of non-visible elements of expense is a matter that is often overlooked by appraisers, but experience has shown that this is sometimes a feature of the greatest importance. This is particularly the case with foundations. Ordinarily no amount of inspection of the structure itself will reveal the depth of the foundation or the difficulties encountered in placing the foundation. These matters can only be determined by an inspection of the plans and construction records. If these are not available it is often necessary to secure the evidence of men that knew personally of the conditions encountered during construction.

This consideration of non-visible elements of expense is one detail of a broad principle that applies not only to the physical appraisal but to the appraisal of the so called "intangible values" as well. That principle is briefly this: For the purpose of rate making a public service corporation is entitled to a valuation that includes all money legitimately expended in constructing the plant and in developing the business. It will be seen that this principle is broad in its application. It includes not only the non-visible elements of physical cost, of which the matter of foundations mentioned above is one instance, but it also covers losses incurred in establishing and building up the business during the early years when the enterprise was not a paying proposition. Any public service corporation is entitled to a "fair return" on its investment. These development losses then logically include not only actual losses of capital but all deficits in earnings during the years when earnings were less than a "fair return." In the case of the Chicago gas company this "fair return" has been placed at 7 per cent.

The application of this principle eliminates the necessity for recourse to "going value," "hypothetical plant," franchise value, and other methods of computing "intangible value." These various methods were considered in connection with this appraisal and are discussed in the report. It was considered, however, that a full allowance for "development expense" would include all values of this nature that the corporation was entitled to hold as against the public.

One important item of development expense is found in the fact that prior to 1897 there were seven different gas companies operating in the city of Chicago. This led to much duplication in plant and equipment and to expensive litigation in connection with the final consolidation. These expenditures were assumed ultimately by the Peoples' Gas Light and Coke Co.; they are held to be a legitimate development expense, since they were brought about by the granting of franchises by the public. In this may be found perhaps one of the strongest points in the argument that public utilities, from the point of view of the public good, are natural monopolies.

CONCRETE AND REINFORCED CONCRETE SECTION

A Form of Cost Recording for Building Contractors.

BY MASON F. PRITCHARD*

The accompanying forms, Figs. 1 and 2, illustrate a cost recording system used by a large firm of building contractors in Cincinnati, O. One form, as will be seen, covers practically every item of work, whether the structure is a small residence or a large office building. Referring to the large form, we have, first of all, the number of the contract, No. 120; the amount, $15,000; the name of the party, Jas. E. Anderson; his or their address, in this case Cincinnati, Ohio; date of contract, May 1, 1911; the lot number, No. 15; the subdivision, Emery; the street upon which the lot is located, Maple Ave.; and the city or town in which it is to be located, Cincinnati, Ohio. The first column shows the date on which subcontract is accepted, the next the name of subcontractor and the third the total amount of subcontract's bid, regardless of to what it may possibly refer. This total is then distributed in columns, as indicated, according to the work that this particular subcontractor has bid upon. For instance, Crane & Co. bid (accepted) is $1,350, distributed as follows: Drains, $100; plumbing, $450; heating, $500; tile work, $200; service pipes, $100. These figures are of course not correct, but are used as illustration only. Each and every subcontract is listed as above stated (and there may be several bids accepted for the same class of work, which is then divided). The total amount contained in the first column, called amount, is added after the completion of contract. In this case, No. 120, the aggregate amounts of the entire component parts of this structure must and should correspond with the first columns mentioned previously. These several component totals are then, after proof has been made showing positively that there has been no omission of amounts or incorrect figures, carried forward to the summary at the right of sheet. This summary is only a matter of convenience; it shows at a glance the total cost of the various parts of construction. In the summary the amount of contract is stipulated. The difference which may exist between the cost and the contract price renders at once the gross profit upon this particular contract, No. 120. There is also a miscellaneous column which would take care of any items not mentioned on the form. The names and amounts of subcontracts are taken from a small form, printed in duplicate and numbered consecutively, giving the name of the subcontractor, the amount of contract, and upon which work the material is to be used. This original is forwarded by mail or in person, as the case may require, the duplicate is then entered on the contract form 1, to which it refers. All issues of these

---

*53 Wiggins Block, Cincinnati, O.

CONTRACT NO. 120 NAME: James E. Anderson ADDRESS: Cincinnati, Ohio

AMOUNT OF CONTRACT: $15,000.00 DATE: May 1st, 1911 Phone: M 544

Date 1911	Name	L. F.	Amount	Contract No.	Plans	Permit	Excavation	Foundation	Vault	Drains	Cement Work	Brick Work	Iron Work	Stone	Lumber	Mill Work	Carpenter	Roofing
May 15	Adams & Co.	30	80000	1		1000					35000	45000						
" 20	City of Cincinnati	19	1000	2														
" 21	L. [illegible]	23	2500	3	2500													
" 23	Johnson & Co.	25	12500	4			7500		5000									
" 27	Ohio Cut Stone Co.	28	22800	5				12800						10000				
" 30	Crane & Co.	31	135000	6						10000								
June 1	Hill Electric Co.	32	30000	7														
" 1	Ferris & Co.	27	122500	8											122500			
" 1	Hardwood Door Co.	29	375000	9														
" 2	Pape Bros.	33	425000	10												42500		
" 2	J. W. M[illegible]	34	237600	11													200000	
" 3	J. A. Adams	35	27600	12														
" 4	Pittsburgh Glass Co.	36	67600	13														
" 4	Cincinnati Roof. Co.	37	38500	14														38500
" 4	[illegible]	38	29500	15														
" 4	Evans Bros.	39	28750	16														
" 5	Baer Nursery Co.	41	37600	17														
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				32														
				33														
			[illegible]		2500	1000	7500	12800	5000	10000	35000	[illegible]		10000	122500	42500	200000	38500

subcontracts contain the number of the contract record, No. 120 in this case. The contractor is charged with the full amount of the contract and the construction account is credited with a like amount; the subcontractors are credited at the end of each month with the specified amounts of their subcontract and construction account charged. Every matter pertaining to a contract has a given number, regardless of what it may possibly be, and is filed in a vertical binder, giving the number of the contract and the contractor, where it can be easily located. It can readily be seen by referring to the forms that if this method is carried out there would be very little or no difficulty at all in ascertaining the gross profits of each contract and the amount expended; of course this does not at all include the usual expenses of office, salaries, etc. The only object of this form which is bound in a book is to give very positive and definite information at once. As previously stated, every matter pertaining to a contract is known by contract number only. The old method of keeping track of subcontracts was to throw them in a file and let it go at that. The consequence was that if the owner or architect came in for any information a half day or more was lost hunting up the subcontractor's bid to see how it was distributed. With the present method the whole history of the contract can be seen at a glance. It serves also another purpose, inasmuch as it serves as a guide for the contractor to bid on future similar jobs and thereby give his client something definite in the way of probable costs.

DICKMAN & ORTMAN
ARCHITECTS
and BUILDERS
402 [illegible]
Seventh and Vine Sts.
Phone Canal 72

Contract No. *120* Order No. 495

CRANE & CO. Put our Order No. on Your Invoice

CINCINNATI, O., *5-30-1911.*

Please deliver to [illegible] *Maple Avenue* the following:

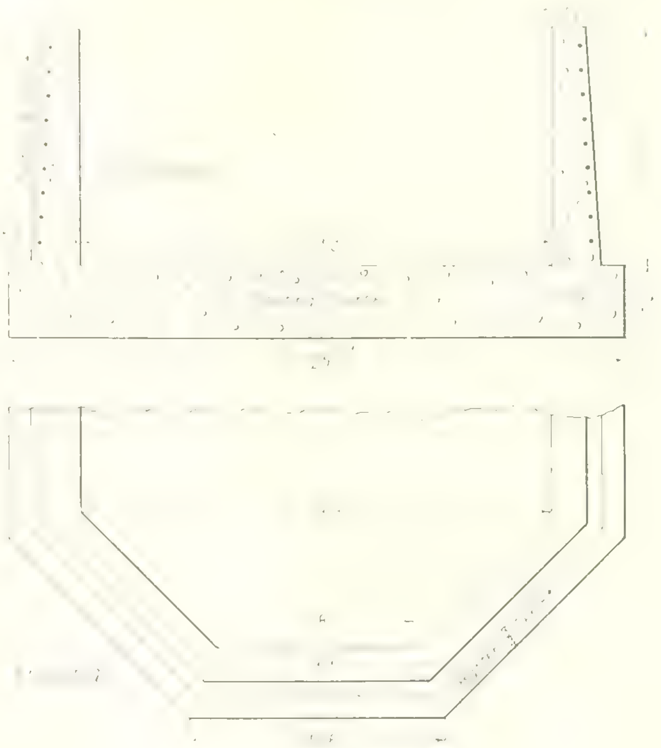
Materials [illegible]	[illegible]
" " [illegible]	*450.00*
" " [illegible]	*500.00*
" " [illegible]	*200 00*
" " [illegible]	*100 00*
	$1350.00

Invoice must be rendered to our office **immediately** upon delivery.

DICKMAN & ORTMAN,
Per *A.*

Cost of a Concrete Hot Water Tank.

The [illegible] sketch shows the plan and [illegible] hot water tank installed during the summer of 1908 at the Aldin Colliery near Wilkesbarre, Pa. The shape of the tank, as described by W. Horton in the *Engineering and Mining Journal,* is octagonal with a diameter of 19 ft. 3 ins., as shown in the sketch.



Reinforced Concrete Hot Water Tank.

One cubic yard of the concrete used in building the tank consists of the following materials: 12 wheelbarrows of sand, 4 wheelbarrows of ashes, 3.64 bags of cement and 16 pails of water. This proportion is based on an actual test made with a box holding exactly 1 cu. ft. The tank walls required 44.7 cu. yds. of concrete, containing 3.64 bags of cement per yard, while the footing course required 50 cu. yds. of leaner mixture, in which only 1.4 bags of cement per yard were used.

The following is the itemized cost of the construction:

Labor	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
	[illegible]

This makes 94.7 cu. yds. of concrete at $3.14 per cu. yd. The capacity of the tank is 23,184

ERECTED ON LOT No. 15 SUBDIVISION: Emery STREET: Maple Ave. CITY: Cincinnati, Ohio

[illegible] No.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Painting	Mantels	Tile Work	Art Glass	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1																
2																
3																
4																
5																
6	45000			50000					20000					10000		
7			10000										20000			
8																
9												[illegible]				
10																
11		37600														
12					27600											
13						17600	20000			30000						
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	45000	37600	10000	50000	27600	17600	20000	29500	20000	30000	28750	[illegible]	20000	10000	37600	

SUMMARY

[illegible] Sundry Expense	Cost	Amount of Contract	
Plans	2500	1500000	1
Permits	1000		2
[illegible]	7500		3
Foundation	12800		4
Vault	5000		5
Drains	10000		6
Cement Work	35050		7
Brick Work	45000		8
Iron Work	00		9
Stone	10000		10
[illegible]	122500		11
Mill Work	42500		12
Carpenter	200000		13
Roofing	38500		14
Plumbing	45000		15
Stairs	37600		16
[illegible]	10000		17
Heating	50000		18
[illegible]	27600		19
[illegible]	17600		20
Painting	20000		21
Mantels	29500		22
Tile Work	20000		23
Art Glass	30000		24
[illegible]	28750		25
[illegible]	[illegible]		26
[illegible]	20000		27
[illegible]	10000		28
[illegible]	27600		29
Miscellaneous			30
Total Cost	953450		31
Balance			32
Gross Profit	546550		33
	1500000	1500000	

gals. [illegible] 17 gals. [illegible] [illegible] [illegible] [illegible] 15 cts. per [illegible] [illegible]

The tank is reinforced with ⅞-in. old wire ropes which are placed about 1 ft. apart as shown in the sketch. After the form was removed, the inside of the tank was faced and plastered so as to fill up all the pores and to prevent leaking. The tank is covered with 3/16-in. steel sheets, which rest on three 56-lb. rails (not shown in sketch). Upon the sheet iron there is a stack 30 ins. in diameter, 12 ft. high.

Concrete Standpipes.*

It is interesting to know that the first standpipe erected in this country was that at Little Falls, N. J., in 1899. To date there have been 53 built in this country and abroad. Of these, thirteen have been erected in New England, which would indicate that engineers and water companies here have more faith in this type of construction than in any other part of the world.

The Aberthaw Construction Co. have built two large standpipes and a tank, the smaller, 40 ft. in diameter and 70 ft. high, at Westerly, R. I., and the larger at Attleboro, Mass., 50 ft. in diameter and 100 ft. high to water level.

The Attleboro standpipe was designed on the basis that the hoops take the entire load with a unit stress in the steel of 13,500 lbs. per sq. in. In order not to have the bars too close together, 1½ in. diameter bars were used in two rows, from the bottom of the standpipe to a height of 61 ft. From 61 ft. to 81 ft., a single row of 1½ in. diameter bars were used. From 81 ft. to 100 ft. the bars were 1⅛ in. diameter. In the upper 15 ft. of the height, the section of steel was kept constant, although the hoop stresses from the water were constantly diminishing to the top. This was done to provide for possible stresses caused by the formation of ice in the standpipe.

The walls of the standpipe started with a thickness of 18 ins. at the bottom and tapered to a thickness of 8 ins. at the top.

In order to space the reinforcing bars an exact distance apart, 4 in. channels with ⅜ in. punched holes through both flanges were used. The channels were set upright at intervals of about 15 ft., c. to. c., a ¼ in. rod was passed through the holes, and the hoops were rested directly on the ends of these ¼ in. rods, which were then bent up to secure the hoop firmly. From the height of 61 ft. to the top, 3 in. channels were used for spacers. The floor of the standpipe was 12 ins. thick and met the wall with a curve whose radius was 5 ft. The top surface of the floor was reinforced with ¼ in. square twisted bars 6 ins. on centers each way. The foundation consisted of a slab about 18 ins. thick but under the walls of the standpipe the depth of this slab was increased to 4 ft. for the width of 5 ft. A concrete curb 3 ft. high and 12 ins. thick was built around the outside at the bottom.

A gate-house enclosing various valves was erected at one side and access to the interior of the standpipe could be obtained through a passage in the same. The roof was Guastavino tile dome, suitably ventilated.

The method used in splicing the ends of the bars together may be of interest. These bars were obtained long enough so that three would reach entirely around the circumference with a lap of 40 diameters at each joint. Two wire loop clips were then used at each splice to insure the bars being held firmly together. By actual test at the Watertown Arsenal these clips alone were found sufficient to secure the full working stress of the bare bars.

From our experience with this standpipe and the one we erected at Westerly later, I believe the addition of considerable vertical reinforcement in the lower 8 or 10 ft. of the standpipe wall would assist very materially and perhaps entirely obviate the formation of a horizontal crack in the lower few feet of a standpipe. The walls under water pressure must increase in circumference. At the bottom of the standpipe, however, this increase in diameter cannot take place owing to the rigid connection of the wall with the floor. It is apparent then, that unless precautions are taken, either by the use of very low stresses in the hoops or by the addition of vertical steel bars, there may be a distinct movement back and forth on some joint in the standpipe. That this movement is present is further indicated by the fact that when a standpipe has been kept full of water for some time the leakage through these joints almost entirely disappears, but on emptying and refilling the standpipe the little dams formed have apparently been broken down as the leakage again occurs as vigorously as at first.

In the Westerly standpipe we endeavored to take care of this by increasing the amount of steel. At the lowest foot the stress is 6,000 lbs. per sq. in. This stress was increased 1,000 lbs. for each foot in height, until we reached a maximum stress of about 12,500 lbs. per sq. in. No vertical steel, however, was used and on filling the standpipe we found that with a maximum head of water that a small line of dampness occurred in a horizontal joint about 3½ ft. above the floor of the tank. This damp place was nearly 30 ft. long.

Quite different methods were used in erecting the Attleboro and Westerly standpipes. In the case of the former, a large tower of pine timbers, properly braced, was erected. On the top of this were placed two bull-wheel derricks. Concrete was handled in a bottom dump bucket swung to the position desired by the derricks, dumped in boxes and shovelled into the wall. Wooden forms were used.

At the Westerly standpipe, the plant consisted of a simple concrete mixer fed by wheelbarrows. The mixed concrete was delivered to an ordinary elevator, hoisted to a hopper erected on the elevator tower where it was dumped, and from which it was fed into wheelbarrows and shovelled into place. Steel forms were used.

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*Abstract of paper read before the Boston Society of Civil Engineers by Leonard C. Wason, President of the Aberthaw Construction Company, of Boston, Mass.

EARTH AND ROCK SECTION

Methods of Constructing a 95-ft. Fill Across Papio Valley on the Union Pacific Ry.; A Comparison of Costs of Excavation by Old and Modern Outfits.*

The construction of a 95-ft. fill for the Union Pacific Ry. over the Papia Valley furnished a valuable lesson in constructing heavy fills on soft ground. Also the investigation of conditions and of handling machinery developed interesting information on plant economics.

The work in question consisted of a large railroad fill 95 ft. from base of rail to the bottom of the valley and three-quarters of a mile long. The material was hauled from a cut a little over 2 miles away, of almost the same depth as the fill, but considerably shorter. The method of constructing this fill consisted of erecting a timber trestle to the full height for the entire length, the bents of which were set upon piles driven about 20 ft. into the soft gumbo to a firm bottom; the trains loaded at the cut were brought over the temporary track and backed out on the trestle and there discharged, filling the trestle to a height of about 30 ft., 500 ft. in advance of a second 30-ft. layer, and again this second layer was kept about 500 ft. in advance of the third layer. This third layer, however, raised the fill only about 20 ft., requiring a final layer to give the remaining 15 ft. The stepping off of the fill in this way was supposed to gradually impose the load upon the soil and permit the weight to squeeze the water out of the soft material and allow it to solidify before applying a greater load. The weight of the trestle structure and the equipment were presumably carried by the piles. The fill had been raised this way until the last layer had been nearly finished, when without warning the valley floor underwent a decided change, much in the nature of an upheaval. While the earth fill settled down in places many feet, the trestle was thrown badly out of line and level and condemned as unsafe for further use. The contractor then changed his equipment to the lightest form of narrow gage and after expending another eight months, succeeded in rebuilding the fill to its required height. Soundings had been taken by the railroad company at the time of location and the contractor accepted the work with full knowledge of the railway company's borings. He considered the subsoil sufficiently strong to support the superimposed load, with the feeling that a slip, should one occur, would be but surface dislodgement, and its effects would be of little consequence. The slip that did occur, however, had a much more far reaching effect, that might have been avoided had the contractor realized the situation and provided for this contingency in the beginning.

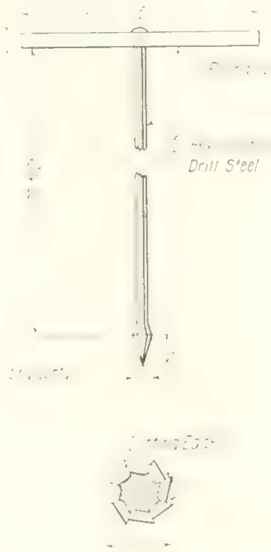

Fig. 1—Sketch of Device for Boring

The geological formation of the Papio Valley consisted of a stratum of gumbo about 15 ft. thick, underlying which was a bed of yellow clay, hard and compact, 12 to 15 ft. thick, in some places 20 ft. thick. Beneath this was a stratum of water-bearing, fine smooth sand, some 10 or 15 ft. thick, overlying a limestone base.

The general appearance of the valley was one of unbroken smoothness except the depression of the creek which drew off the surface water—there was not a rock visible, not even a stone the size of a man's hand; nothing but dry river silt—and upon this was to be placed a fill of the same dried alluvial material 95 ft. high, a narrow belt across the entire valley. When the load of this new fill grew sufficient, the clay supporting strata underneath broke through at the point of maximum weight, which was near the center of the embankment, and settled, displacing the material from underneath the trestle and crowding it out and away, effecting a wave-like action, elevating the once level floor of the valley in several graduated hills, the highest being elevated nearly 30 ft., about 300 ft. from the center of the fill.

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*Abstracted from a paper by Mr. [illegible] W. [illegible] [illegible] American Society of [illegible] [illegible] 1911.

This particular phase has caused the writer to go deeply into this subject, with a view of determining the stabilty of substructures of this nature, and he has tabulated various information, some of which he respectfully submits. Our first operation is to determine the weight superimposed upon the ground from the fill, our premises being that for loosely placed earth the weight is in direct proportion to the height and that the triangular cross section does not distribute the load uniformly, but imposes it upon the foundation beginning with zero at the edge, and increases to the maximum at the center. Therefore at the center of a 95-ft. fill a square foot of base supports all above it; should this material weigh 2 tons per cu. yd., or about 150 lbs. per cu. ft., as it might do if compressed by the continual dumping on top, the weight on this column, 1 ft. square and 95 ft. high, would be approximately 7 tons—really a very large amount for a soft foundation.

These loads for [illegible] of various heights—with cubic contents for both single and double track—estimated timber and quantity of irons for both a temporary and permanent trestle, also estimated weights of steel viaducts of corresponding heights, are submitted in Table I:

For the resistance of soils we will present two tables, one taken many years ago, which the writer has used in his considerations with the best results, as follows:

Ultimate resistance of soils for foundations:
Compact bed-rock, granite or equivalent, 30 tons per sq. ft.
Compact bed-rock, limestone, Northern, sound, 25 tons per sq. ft.
Compact bed-rock, sandstone, Northern, red, 20 tons per sq. ft.
Soft friable rock, [illegible] to 10 tons per sq. ft.
Clays, in thick beds, [illegible] 4 tons per sq. ft.
Clays in thick beds, [illegible] tons per sq. ft.
Soft clays, 1 ton per sq. ft.
Dry coarse gravel [illegible] tons per sq. ft.
Compact dry sand [illegible] 4 tons per sq. ft.
Clean, dry [illegible] 4 tons per sq. ft.
Good [illegible] tons per sq. ft.
or [illegible] Standard Detail Sheet, entitled —— dated Oct. 11, 1905:

	Tons per sq. ft.
Ultimate [illegible]	[illegible]
Silt [illegible]	[illegible]
Sand [illegible]	1.0
Gravel	[illegible]
Clay, moist	1.0
Clay, [illegible]	1.0
Bed-rock	[illegible]
Hard [illegible]	[illegible]

Therefore, with a superimposed load of 7 tons, we should look for resistance sufficient to withstand this weight, which, according to the last table, will be found under rock only.

With well packed gravel and thick beds of clay the loading has reached the ultimate strength of the subsoil at the level of the surface, while at the level of the clay substratum the accumulated weight of fill and surface soil amounted to a trifle over 8 tons per cu. ft.; more than the clay's resistance. Therefore, the real foundation on which the piles should have rested was at bed rock, at which point the weight would be nearly 11 tons per sq. ft.

Boring Device.—If the contractor has any doubts as to the subsoil and foundation, a very simple device, used twenty-odd years ago by the writer, and many times afterward, would furnish him, with a little skill, all this information very cheaply. The instrument referred to is a bar of hexagon or octagon steel, the end of which is swedged and enlarged at the butt and tapered to a point at the ends; the sides of the head are corrugated with a cutting edge. On the opposite end the bar has a T handle riveted firmly to the shank, and this shank or rod may be 20 to 25 ft. long, often more. The method of operating is to raise this rod to a vertical position with the sharp bit on the ground and then by churning the rod drive same into the earth until the bit reaches a resistance. If continued churning does not remove or penetrate the obstacle in its path, several hard churns will dislodge particles from the obstruction, and by twisting the handle around several times the particles will lodge within the cutting edge of the bit, and may be brought to the surface, where they may be examined and their substance determined.

In open-cut mining work, where the writer first employed this method, it was customary to lay off our tract of land to be examined in squares of 10 ft., so that each square contained 100 sq. ft., staking the corners, and at each stake we sounded with the above method and charted the results, and in this way determined the extent of our beds, with the amount of overburden necessary to be removed. We always found this method very satisfactory.

As the cost of making these soundings we found that two men were sufficient, and they were capable of sounding from 10 to 15 holes per hour.

Choosing a Plant.—In the average soft material the steam shovel has the capacity to excavate as many hundreds of yards as the shovel dipper will hold in a given hour; i. e., a 3½-yd. dipper, for instance, on a good effective shovel working in gravel should load upon cars 350 cu. yds. bank measure, which, by the way, is not too much for a good shovel to do; they often run much higher if they have a chance. Now the problem is to take 350 cu. yds. away from the shovel in cars every hour. Should the distance from the shovel to the dump consume a running time of 10 mins. and 10 mins. are consumed in dumping and replacing the cars ready for transit, and 10 mins. in transit to return to the shovel, the total time consumed would be only 30 mins. Therefore two trains handling 175 cu. yds. bank measure will about equalize the product of the shovel and furthermore the length of train is dependent upon the length of haul in most cases, or at least the time the train is away from the gravel pit; for one train should finish loading and start on its way to the dump just as the other train returns and is ready to load.

In choosing the proper car to be used the preliminary consideration is to arrange the larger cars in their respective orders by separating them in their various classes. One variety we term static cars, which differ from those of a rotary variety.

The static cars consist of those cars arranged to withhold their burden in a quiescent state and are unloaded by the opening of a gate or partition in the bottom or side, allowing the load to flow gradually out of these respective openings. Their great effectiveness is obtained in discharging an easily flowing burden usually between the rails or in the center of the track. They discharge readily material containing a certain amount of "life"—that is, a material that does not adhere to itself or the car, such as sand, rock, ballast, gravel, etc.—and cars like the Rogers, Hart Convertible, Goodwin, National Dump, Inglesby, etc., are developed along these lines with great success.

With the rotating car, which is of the oldest principle, the body is overturned or tilted to an angle to discharge the burden on either one side or the other or on both sides of the track. Connected with the motion of overturning of the body, the sides or gates that retain the burden are arranged to open automatically by lifting or lowering, or to loosen and swing outwardly, whereby they effectually dislodge material that would adhere to the floor or sides of static cars, such as clay, earthy soil, cellar dirt, alluvial material, etc.

There are only about five varieties of ro-

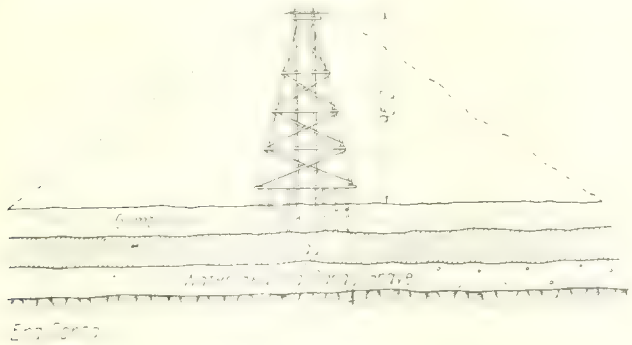
Fig 2—Section Through 95 Ft. Fill Showing Subsoil Strata Before Settlement.

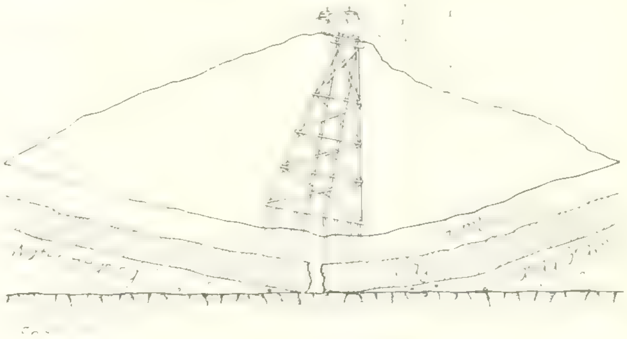
Fig. 3—Section Through 95 Ft. Fill Showing Subsoil Strata After Settlement.

TABLE I.

Height from ground to base of rail	Earth Fills.			Temp. Trestle. Single Track		Permanent Trestle. — Single Track. —			
	[illegible]	Volume [illegible]	Volume in [illegible] double track	Timber [illegible] lin. ft.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50	[illegible]	168	191	520	[illegible]	[illegible]	[illegible]	12	1,200
60	[illegible]	[illegible]	262	580	40	[illegible]	[illegible]	13	1,320
70	[illegible]	314	[illegible]	640	[illegible]	[illegible]	[illegible]	14	1,440
80	[illegible]	[illegible]	440	700	48	[illegible]	[illegible]	15	1,560
90	[illegible]	505	[illegible]	760	[illegible]	[illegible]	[illegible]	17	1,680
100	7.42	615	660	820	[illegible]	1,240	42	18	1,800
110	8.17	738	789	880	60	1,340	43	19	1,920
120	[illegible]	870	[illegible]	940	[illegible]	1,480	[illegible]	[illegible]	2,040
130	9.65	1,010	[illegible]	1,000	[illegible]	[illegible]	48	[illegible]	2,180
140	[illegible]	1,180	1,230	1,060	[illegible]	[illegible]	50	[illegible]	2,300

[illegible] adaptable to his needs the contractor must also consider his track and road bed and arrive at the maximum weight of car and load he may transport. Should he, however, have a suitable road bed with heavy rail and dump over the sides of a single track trestle, then [illegible] the units of this intermittent conveying system be reduced to the fewest possible number, each with the greatest burden, which is to be found with the Lawson car, having 33 cu. yds. displacement and a dead weight of 58,000 lbs., or a load upon the track of about 80 tons per car, distributed over eight wheels. This would require a train of five cars or a car equipment of ten cars in service, to which one more should be added to provide against breakdowns—in all eleven cars. But this equipment is limited to a single track use, as the cars are provided with two longitudinal boxes which must be dumped on both sides of the car.

But should it be necessary to dump this burden all to one side, then such a car as the King auto-pneumatic "Class P," of nearly the same size, would be required. The Lawson car, from actual timing on the trestle, dumped four loaded cars, replaced same and started on return to gravel pit within 5 mins., or at the rate of 1¼ mins. per car, which, for a 5-car train, at this rate would require 6¼ mins. at dump; also allowing 22½ mins. for transit to and from shovel, which might be sufficient for a 3 to 3½ miles' haul.

But should the track not permit of handling this very heavy equipment and wishing to handle the same quantity per hour, then a car of about 15 cu. yds. capacity, which would give a load of about 8 tons per wheel, or nearly 66 tons for the loaded car, can be operated effectively. Assume that a load of 15 cu. yds., bank measure, be carried per car, it would require two trains of 12 cars each, or 25 cars, for the complete equipment. Two men might dump such a train in about 7½ mins., but comparing the dead weights of trains we find the 5-car train having a total capacity of 185 cu. yds. will weigh 147½ tons, while the 12-car train with a total capacity of 180 cu. yds. will weigh from 228 to 328 tons, thus showing the great economy for the heaviest cars.

The question of dead haul in a contractor's plant is a matter of importance, as it constitutes an expenditure of energy with no compensation to the contractor, and is carried both ways, to and from the shovel; coal and water must be consumed, which are often quite difficult to obtain without shutting down the shovel and causing a loss of effectiveness of both shovel and labor during working hours.

Now to the actual practice. This fill, which is shown by Figs. 1 and 2, across the Papio Valley, was started and work had progressed for a considerable length of time with the plant the contractor already had on hand. It had been worked sufficiently long to relieve its operation of all "kinks," so that these comparisons are as near true as it is possible to acquire. The original plant consisted of:

2 70-ton shovels,
[illegible]
2 60-ton road locos., separate tender, switching type, .060,
3 30-ton saddle tank locos.,
1 [illegible]
1 "Mill" or winding engine.

Working double shift, or 20 hours per day, accomplished 5,890 cu. yds., bank measure. Cost of direct operation per cu. yd., bank measure, about 5.56 cts. This does not include plant or overhead expenses, but only the labor connected with the revenue-producing work, necessitating nearly 100 individuals.

When the Lawson cars were put to work the contractors revised their system so as to obtain the best possible results from their use. The new plant consisted of:

1 90-ton shovel,
8 Lawson cars,
[illegible]

Eleven units against 57 of former method, working double shift of 20 hours per day, accomplished 4,800 cu. yds., bank measure, at a comparative cost of 3.45 cts. per cu. yd., using but 40 men instead of 100. This quantity of output was increased considerably afterward, and the cost still further reduced, but as these examinations were both taken within a week, the results are practically under the same existing conditions—costing by this new method on this particular work only 62 per cent of the former, or making a saving in the operation of 38 per cent.

Therefore, in drawing our conclusion from this work where the conditions were the least subject to detrimental or varying influences, we are led to believe that the most economical method of handling excavated material is the most expeditious; that likewise the most expeditious arrangement requires the fewest number of units, each of the greatest possible capacity. By placing reliance upon mechanical ingenuity to accomplish what once was the result of manual labor, the output is steadied, while the adoption of mechanical means, with an equal amount of physical labor or with even less labor, provides for an increased accomplishment. Large and expeditious cars, properly handled, with an equal number of laborers, render possible the execution of an increased amount which shortens the duration of a work of limited extent. The per diem costs would be the same as with the older methods, but of less duration for the execution of the completed work, thereby requiring the expenditure of less money. While the reverse relation also exists, that with a limited amount of money a greater amount of work may be executed with the employment of labor-saving devices than was formerly done with the old and accustomed means.

Methods and Costs of Blasting 10,000 Cubic Yards of Rock.

A blast which loosened 10,000 cu. yds. of rock for the construction of a dam was recently set off in Colorado. A "one man" tunnel was excavated for a distance of 40 ft. into the face and just above the base of the cliff. At the end of the drift a cross cut was excavated to the right and another to the left for a distance of 12 ft. At the ends of these, pits were excavated 4x4x4 ft. below the tunnel floor. These pits received the explosive, which consisted of 7,500 lbs. of F. F. B. powder and 500 lbs. of 40 per cent dynamite. The charges were connected to an electric battery about 300 ft. distant. The tunnel was backfilled with earth well packed in. The cost was as follows:

Labor	[illegible]
Dynamite	[illegible]
Powder	[illegible]
Caps and fuse	[illegible]
Total	[illegible]

Cost per cu. yd., $0.169.

Mr. Wm. M. Strong is engineer in charge of the work for the Phillips Construction Co. and O'Gara of Denver, Colo.

Summer School of Engineering, University of Wisconsin.—The eleventh annual session of the Summer School of Engineering, under direction of the College of Engineering of the University of Wisconsin, opens June 25, continuing for six weeks. Regular and advanced courses are offered in Direct and Alternating Currents, Hydraulics, Machine Design, Descriptive Geometry, Applied Mechanics, Shopwork, Steam and Gas Engineering and Surveying. Elementary courses adapted to the requirement of those not having preparation for the advanced work are offered in Mechanical Drawing, Machine Design and Shopwork, in addition to which opportunity is offered for laboratory work in the Electrical, Steam and Gas Laboratories for those who have had power plant experience or correspondence instruction. The teaching staff is taken from the regular instructional force, and all laboratory equipment of the Engineering College is available for students. For bulletin or further information address F. E. Turneaure, Dean, College of Engineering, Madison, Wisconsin.

Method and Cost of Core Drilling for Mining Explorations in Missouri.*

The workings of a zinc mine in the Joplin district are at a depth of 240 ft., but an old deep drill hole showed ore at a depth of 300 ft. The management conceived the idea of installing a drill underground in order to explore below the present mine and save a depth of 240 ft. of drilling.

The ground drilled was limestone and flint, and seemed to offer no theoretical obstacles to core drilling, other than extremely hard rock and occasional small pockets. These the company was satisfied could be surmounted by the core drill, so it purchased from the Ingersoll-Rand Co. a Davis-Calyx class F-1 shot drill. The drill bores a hole 4¼ ins. in diameter, makes a 3½-in. core and has a depth capacity of 800 ft. A drilling expert was sent to install the drill and train a local crew to operate it.

The drill was lowered into the ground and set up without difficulty, and contrary to all prophecies concerning this drill and the usual delays encountered in installing machinery under new conditions, it started without trouble. The driving engine was first operated by steam, but later by compressed air, and ran perfectly with either.

Five holes have been completed to date, the first to a depth of 90 ft. from the floor of the mine, or 330 ft. from the surface. The others were drilled to an average depth of 300 ft. The drill is now operating on the sixth hole.

The character of the strata penetrated was white, gray, and brown limestone, white, blue, and black flint, varying in hardness in the order named, the limestones being the softest and the black flint the hardest, all of the rock being similar in character to that found on the 240-ft. level of the mine. The black flint in this formation is reputed by all men who have worked in this mine to be as hard or harder to cut with the rock drill than any rock in the entire district. The hardest material encountered by the core drill was balls or nodules of blue and black flint bedded in the limestone.

The cores varied in length up to 30 ins., the average being about 6 or 8 ins. The broken nature of the cores was due to the numerous cracks and fissures in the rock. No difficulty was encountered in picking up the broken pieces of core, as they readily worked into the core barrel, and were held there by the solid core coming immediately under them. One of the principal objections to the shot drill for this district was in drilling through pockets, in which case it was predicted the shot could not be kept under the bit, hence the drill would not cut. A number of pockets were drilled through, some as much as a foot and a half in depth, and no serious difficulty was noted.

Drilling Speed.—The depth drilled per day of eight hours on the first hole varied from 2 to 8 ft., averaging 4 ft.; on the second day the average was 5½ ft., on the third, fourth and fifth holes 6 to 7 ft. The best day's drilling on the first hole was 8 ft., on the second 13 ft. and on the last three holes 17 ft. The character of the rock was about the same in each hole. The increased average on the various holes was doubtless due to the increased experience of the drilling crew, which became better acquainted with the performance of the drill as the work proceeded.

Of course the hard blue and black flint drilled very slow, 2 or 3 ft. per day while drilling in them exclusively being a fair day's work, while drilling in limestone 15 ft. per day was easily made. One condition that prevented faster drilling was the frequency with which the cores had to be taken out. This was mainly due to the broken condition of the core. After the core barrel became partly filled with broken core, the pieces had a tendency to revolve on each other, thus grinding off the ends. The jack, being comparatively soft, was thus most easily ground and lost, so while drilling in ore-bearing ground it was [illegible] the cores very frequently.

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*Abstract from an article by F. W. Sansom in the Engineering and Mining Journal.

Another [illegible] time was the comparatively low derricks used. The derrick on the first, second, fourth and fifth holes was 26 ft. high, allowing a break in the drill rods in drawing the tools of 20 ft. On the third hole the derrick was only 21 ft. high, necessitating a break every 10 ft. The change of rods was 2, 5 and 10 ft.; thus the time required for taking out cores consumed at least one-third of the working time of each shift.

[illegible] drilling is [illegible] third, fourth, and fifth holes, the first hole being drilled by a high [illegible] men to operate the drill. All other holes were drilled by one drill man and one helper. The costs per foot on these last four holes were as follows:

Labor	$0.95
Shot	0.15
Bits	0.10
Power	0.10 to 0.17
Total	[illegible]

This seems a high cost when compared to a churn drill at 80 to 90 cts. per foot, but when [illegible] factory and economical investment.

The [illegible] holding two cores each, side by side, or 10 ft. of core. The pieces of core were tagged with consecutive numbers, and were thus recorded in the written log of the hole, in which the character of the rock, apparent value of the ore contents, depth, etc., were noted. For the purpose of finding the exact value of the ore, [illegible] sample grinder to a ½ or ¾ size, then quartered; one portion was powered and assayed, the other returned to the core boxes for fu- [illegible]

ROADS AND STREETS SECTION

Some Notes on Object Lesson Macadam Roads Constructed in 1909-10 by the U. S. Office of Public Roads.

During the years 1909-10 object lesson macadam roads were constructed at Greenville, S. C., Winchester, Tenn., Mexia, Tex., Provo, Utah, and Rosslyn, Va. The work was done under the supervision of the U. S. Office of Public Roads. The following notes on these roads have been taken from the annual report of Logan Waller Page, director of the Office of Public Roads.

The work at Greenville, S. C., consisted of grading, surfacing with water bonded macadam a section of road 3,300 ft. in length and 12 ft. wide, and surfacing with bituminous macadam a section of road 500 ft. in length and 12 ft. wide. To secure proper grades and drainage, 3,201 cu. yds. of earth were moved an average distance of 700 ft. in slat-bottom farm wagons, at a cost of $412.75, or 12.8 cts. per cu. yd. About 1,100 cu. yds. of stone were shipped a distance of 20 miles and furnished f. o. b. at Greenville at $1 per cu. yd. The stone was loaded with shovels into wagons at the car at a cost of 4 cts. per cu. yd., hauled an average distance of 1,500 ft. at a cost of 21 cts. per cu. yd., and spread upon the road with shovels at a cost of 2 cts. per cu. yd. The rolling was unsatisfactorily done with a hauling engine having smooth tired front and rear wheels at a cost of 2 cts. per sq. yd. On account of frequent rains practically no sprinkling was done. The bituminous section was constructed by the penetration or grouting method. Fifteen hundred gallons of refined coal gas tar were spread with hand-pouring pots at a cost of 2 cts. per sq. yd. The tar cost 6 cts. per gal. and the total cost of the tar treatment was 17.5 cts. per sq. yd. Two cross drains of concrete pipe, molded in place with concrete end walls, were constructed, one 24 ins. in diameter and 40 ft. long and one 36 ins. in diameter and 45 ft. long, at a total cost of $126. The total cost of the road to the community was $2,322, which is at the rate of $2,600 per mile for water bonded macadam and $3,150 per mile for bituminous macadam. The work was begun on Oct. 18, 1909, and was completed on Jan. 1, 1910. The convict labor cost 50 cts. per day and teams $2 per day.

The work of improving the Winchester-Decherd road at Winchester, Tenn., was begun on June 11, 1909, and completed on Dec. 13, 1909. The improvement consisted of opening 9,600 lin. ft. of new road, grading it to the width of 28 ft. from edge to edge of the shoulders, surfacing it 16 ft. in width, and constructing cross drains of corrugated ingot iron as follows: One 28 ft. long and 20 ins. in diameter, one 38 ft. long and 20 ins. in diameter, one 38 ft. long and 18 ins. in diameter, three 26 ft. long and 18 ins. in diameter, and one 46 ft. long and 12 ins. in diameter. The grading required the moving of 9,749 cu. yds. of earth, which was hauled an average distance of 891 ft. in wheeled scrapers and slat-bottom farm wagons. The earth was loosened with picks and plows and the wagons loaded with shovels and drag scrapers. The total cost of excavation was $2,504.65, or 25.7 cts. per cu. yd. Stone for the road was purchased for 85 cts. per cu. yd. It was placed upon the road in three courses. The first course, 8 ins. thick, measured, loose, was of stone between 1½ and 3½ ins. in size; the second course, 2 ins. thick, measured loose, was from ½ to 1½ ins. in size; and the third course, screenings smaller than ½ in., was applied in sufficient quantity to bond the road; that is, to a depth of about 1 in. Water for the roller and sprinkler was hauled a distance of 1 mile. The roller which was used was a 10-ton macadam roller and was hired for $7 per day, while the roller man was paid $3 per day. A total of 5,157 cu. yds. of stone was hauled an average distance of 700 ft. at a cost of 29.1 cts. per cu. yd., spread upon the road with shovels and rock rakes at a cost of 6.1 cts. per cu. yd., and sprinkled and rolled at a cost of 6.1 cts. per cu. yd. The total cost of the road to the community was $11,452.83, which is at the rate of 67.1 cts. per sq. yd., or $6,299.06 per mile. The cost of labor was $1 per day, of teams $3 per day, and of coal $4 per ton.

A macadam road was built at Mexia, Tex., 1,475 ft. in length and 15 ft. in width. Work was begun on July 13, 1909, and the road was completed on Aug. 4, 1909. Six hundred and eight cubic yards of earth were moved with a road grader and with drag scrapers at a cost of $21.26. The stone used was a fossiliferous limestone picked up from the surface of adjoining fields and delivered to the crusher for 25 cts. per cu. yd. A total of 613 cu. yds. of stone was used, of which 329 were crushed at a cost of $106.78 and 284 cu. yds. were purchased at 65 cts. per cu. yd. The stone was hauled from the crusher to the road, an average distance of 13,000 ft., at a cost of $321.75, and spread with shovels and potato rakes for $41.63. Water was hauled 6,000 ft. for sprinkling and for the roller. With coal at $5 per ton, the cost of rolling was $27.10. The total cost of the road to the community was $995.26, which is at the rate of $3,526.60 per mile. Labor cost $1.25 and teams $2.50 per day.

A macadam road 2,850 ft. in length and 15 ft. in width was constructed at Provo, Utah, between Oct. 25, 1909, and Dec. 24, 1909. It was a part of a proposed improved road ex- [illegible] Canyon, a distance of 6 miles. During this time 8½ days were lost on account of rain and snow. The immediate surrounding country is practically level. The soil over which the road was built is adobe, which, when wet, has very little ability to support a load. In winter the road was practically impassable. At the north end of the road it was necessary to make a hillside cut in a hill composed principally of rocks of quartzite varying in size from 2 to 12 ins. in diameter, and on account of a large irrigation ditch running along the foot of the hill it was not practicable to push the material from the cut down the hillside. A plat was leveled off large enough to set up the crushing plant and the rocks were crushed and used as a foundation course 9 ins. in thickness. This was covered 3 ins. deep with limestone of excellent binding and fair wearing quality crushed until it was from ¾ in. to 2 ins. in size, and bonded in the usual way with limestone screenings. The rocks were loosened in the bank with a plow, hauled with tongue scrapers, and dumped through a "trap" into the crusher. The crushed material was elevated, passed through a revolving screen with ¾, 2 and 3 in. perforations, dropped into a bin of 25 cu. yds. capacity, and loaded by gravity into slat bottom farm wagons. It was necessary to break the large rocks with hammers, as the crusher opening was 9 by 18 ins. Power for the crusher was furnished by a 20-h.p. electric motor. The average power consumed was 15 h.p., and this was had at a rate of $6.20 per horsepower month. The total cost of putting the crushed rocks into the bins was 42.9 cts. per cu. yd. A total of 1,230 cu. yds. of earth was excavated with a road grader at a cost of $96, or 7.8 cts. per cu. yd. The average haul from the crusher to the road was 1,940 ft. The crushed material was spread on the road with shovels and rock rakes and rolled with a 14-ton roller. With labor per day of eight hours at $2, teams at $4, and coal at $5.50 per ton, the total cost of the road to the community was $2,180.67, or 45.9 cts. per sq. yd., which is at the rate of $4,039.62 per mile.

The work of building a macadam road at Rosslyn, Va., was begun on Nov. 23, 1909, and completed on July 23, 1910. The road, 3,913 ft. in length and 16 ft. in width, was built through a hilly country over red clay soil. To secure proper grades and drainage 1,325 cu. yds. of earth were moved with drag scrapers and in wagons an average distance of 500 ft. Two hundred and thirteen cubic yards of the first course, a local quartz stone of poor quality for road work, were quarried at a cost of 50 cts. per cu. yd. and crushed at a cost of 67 cts. per cu. yd. For the remainder of the work 1,616 cu. yds. of stone were purchased, shipped 38 miles by rail at a cost of $2,084.75, and hauled a distance of 4 miles to the road. Water for the roller and sprinkler was obtained from a tank by the roadside. The cost of sprinkling and rolling was 4.3 cts. per sq. yd. Labor cost $1.50 per day, teams $1 per day, and coal $1.50 per ton. The actual cost of the road was $5,258.65. All labor and material was furnished by contract for $4,943.88, which is at the rate of $6,370 per mile, and which is the amount actually paid [illegible]

Maintenance of Rural Highways.*

The question of the efficient and reasonably economical maintenance of rural highways is one of much complexity, presenting many difficulties, not the least of which is that of inducing the road authorities and finance committees to adopt the broad and far seeing policy on which the just combination of efficiency and true economy depends.

The lack of proper or adequate foundation structure, which is one of the pronounced [illegible]

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*[illegible] lin, Ireland, April 19-21, 1911.

[illegible] in the kingdom, presents an important initial difficulty, and one which (in view of the far greater strain that practically all roads are now subjected to, by reason of the rapid growth of mechanically propelled traffic) will become from year to year more important, and at the same time less easy of solution.

It has many times been said that one cannot expect to maintain a road unless such road has a good foundation. This is a very attractive and guileless proposition, yet practical road engineers have to get along as best they can in this connection, maintaining in good condition, year after year, roads the chief characteristic of which is the lack of the very foundation said to be indispensable for satisfactory maintenance.

The practical road engineer realizes that it is economically impossible to refound even a small proportion of the badly founded roads which already exist, and that he must take them for what they are and make the best of them. It is here that there has been and still is a large field for the exercise of ingenuity in supplying on the surface of an existing road an element of strength which, in some measure at all events, takes the place or serves the function of the foundation which ought to be there, but isn't.

One of the methods adopted by the author to increase the strength of a weak road foundation is to excavate along each side or shoulder of the road to a depth varying from 10 to 15 ins. and about 15 ins. in width, packing into these excavated side trenches good chalk flints or other suitable hard material of gage varying from 6 ins. downwards to 3 ins., to be afterwards well rolled down. This method not only serves in some measure to underdrain the road, but by strengthening the "shoulders" of the road prevents lateral "spread," and appears to prevent that collapse of the road center or crown which is so characteristic of many weak roads.

The question of steam rolling is not without interest, and the author considers that, generally speaking, steam rollers for country work should not exceed 8 tons in weight, and even at this weight should be carefully used for the purpose for which they are intended; i. e., consolidating the road metal, not rolling it to destruction.

The manner and extent to which some rollers are misused or overused must be a source of joy to steam-roller makers and granite merchants. It will, however, be conceded that the former are, in these latter days, deserving of some measure of sympathy. They must have had a good time in some respects when some "genius" propounded the idea of fixing spikes on the driving wheels of the roller for scarifying purposes. It is now, however, becoming generally recognized that it is not essential or even desirable for the proper repair of an existing road to tear it to pieces by means of a scarifier. Of course, in some cases a moderate amount of shallow scarifying is desirable to improve the cross section of a road where the crust is of ample thickness.

The necessity for a thorough remodeling of the method of road repair and maintenance—which may be said to be the outcome of the revolution in use to which roads are being and will be subjected—has given birth to many ideas and has resuscitated others. Very numerous and diverse are the new binding materials which have been suggested—even sugar and treacle have not escaped attention. The consensus of practical opinion, however, appears to point to bituminous products of various kinds as affording a range of materials readily available applicable as a binder or flux for use with an aggregate ordinary road stone.

There can be little doubt that properly prepared tar macadam forms one of the best, most practical, and ultimately economical preparations for road surfacing work. Considerable difficulty in its use has hitherto been found when the tarred material had to be carried long distances to the point of the user. The author therefore views with satisfaction the probability that this difficulty is being overcome. It is now possible to purchase or hire machines which have been specially designed to perform the operations of screening, drying, and tar coating the road stone at the depot or on the roadside, thus greatly facilitating the use of local materials or of such particular description of road stone as the surveyor prefers to use, and even of such suitable old material as may be scarified from an existing road surface.

Four years ago the author laid down experimental stretches of road in various parts of England on the following lines: Upon a cushion ¾ in. thick of tar mastic or binder, composed of ½-in. gage clean granite chippings mixed with Tarvia (12 gals. to 1 ton of chippings), was laid a two-stone thickness of 2-in. gage clean broken granite. This was lightly rolled down into the mastic, and when the aggregate was just "placed," not consolidated, by means of a 6 or 8 ton roller, the surface was dressed with hot liquid Tarvia, using 1 gal. to 3 or 4 sq. yds. Over this was sprinkled and brushed in a small quantity of the above described mastic or matrix, sufficient being used to fill the surface voids, and the whole was then rolled to consolidation, a few dry chippings being used in order to prevent the matrix sticking to the roller wheels. The result is a compact, resilient, and waterproof surface, which is still in good condition and has only required a top dressing of Tarvia and chippings once since it was laid. The extra cost of this work over the ordinary water-bind work with the same description of aggregate was 6 cts. per sq. yd., which has been more than saved in maintenance alone in 1½ years. Ordinary water-bound work on the same road has required renewal every third year. The work above described shows no real signs of wear, and will only require an occasional top dressing to carry it on for many years.

It is also easy to patch this class of work; indeed, so simple is the operation that the road man who has it to do is in danger of losing interest in his work.

From the point of view of the advocates of mud binding the only disadvantage of this class of work is that one cannot get any mud off it for use as binding elsewhere.

The author firmly believes in the value of surface dressing of roads with good dehydrated tar, but only as a temporary expedient and only on roads having a good surface. In his opinion it is more economical in the long run to incorporate in the structure of a road crust a certain definite quantity of bituminous binder than to use the same quantity (by recurrent applications) on the surface only.

With respect to the general management and control of highways, the question of classification of roads according to their traffic importance, and of the standardization of road-making materials, have an important bearing. Much practical benefit in this direction may be confidently expected to accrue from the deliberations and conclusions of the road board and its advisory committee, who appear to have entered upon their important duties with a full sense of their opportunities and responsibilities. It is to be hoped that road surveyors generally will do all they can to assist in the good work thus inaugurated.

Method of Laying Rock Asphalt Pavement.

In Europe the common form of asphalt pavement is made from rock asphalt, which is a distinct natural product and may be described as "calcareous rock impregnated naturally by bitumen." Pavements made of rock asphalt have been laid to only a comparatively small extent in this country, and therefore the following description of the methods employed in certain sections of England for laying this type of pavement may be of interest. The description is taken from a paper by Edward Walker, which was read last month at the North-Western District Meeting of the Institution of Municipal Engineers at Manchester, England:

The principal places from which rock asphalt is obtained are Val de Travers in Switzerland; Seyssel and Lovagny in France; Limmer in Hanover; and also from mines in Sicily. For using, the lumps of rock are reduced to powder by machinery, then screened, the coarse pieces taken out and reground, and the powder stored under cover. It is afterwards placed in slowly revolving cylinders and subjected to a heat of from 250° to 280° F., or in winter and during cold weather this may be raised to 300° F. The fire must be of wood or coal, as coke injures the material.

When heating, which takes from three to five hours, the utmost care must be taken, as if overheated the bitumen is fused, and if underheated it will not bind properly, the exact heat varying, however, with the brand of asphalt. The object of heating is to eliminate all moisture and so leave the bitumen in the best possible condition for binding. Formerly the powder was put in the foundation, in its heated state, at from 2 in. to 3 in. deep, according to the thickness at which it was required to be finished; it was then raked to make it even, and rammed with hot rammers or tampers, usually weighing about 12 lbs., and finally rolled with a 10-ton roller until the asphalt got cold. Roads made in this way were most satisfactory where the traffic was heavy and so helped to consolidate the material, but for light traffic it was a failure, and gradually the mastic asphalt has been introduced into this country and has superseded the powder. The majority of rock asphalts contain from 5 to 10 per cent of bitumen, and in order to obtain the mastic condition a sufficient quantity of bitumen is added to bring the proportion up to 15 per cent. The bitumen and the powder are then put into a cauldron or boiler and heated up to 400° F., after which the product is run off into moulds to cool, forming flat cakes about 3 in. or 4 in. thick and weighing about 56 lbs. each, and it is in this state that it is imported into this country. When required for use, the blocks are broken up again, heated with an addition of from 5 to 8 per cent more bitumen, and from 20 to 40 per cent of clean grit. Limestone is recommended by some authorities and sand by others, but in our district ⅜-in. screened Dalbeattie granite chippings are used with satisfactory results. Half of the mastic and half of the bitumen are then placed in a combined cauldron and mixing machine, and when melted the other half of bitumen and mastic is added; when the mass is quite soft the grit is added and the composition is spread evenly over the surface. The "cooking," as it is generally termed, takes from four to six hours, during which it should be carefully tended and stirred.

The method of carrying out the making up of a street may be shortly stated as follows: Taking an ordinary cinder-made road, the first thing is to have it excavated so as to admit of a 6-in. foundation of concrete and 1½ in. of asphalt, to finish level with the surfacewater gullies, with a camber of about 1 in 36 from the crown to the channels. The curbs should then be redressed, if necessary, and relaid, and where the footpaths are to be finished in the same manner it improves the look of the street to have the backs of the curbs dressed to a straight line, so that the asphalt may have a clean line of finish, rather than a wavy one. If the street is on a slight gradient so much the better, as the surface water can then get away without having to make summits in the water tables. If, however, gradients have to be formed in the channels, it will be found that a fall of 1-250 will be quite ample from summit to gully. Mr. Walker states that he always has the gullies set at about 5½ ins. below the curb, and the summit 3 ins. below the curb, thus giving 2¼-in. end fall either way. If there is a similar fall in the street he has a uniform depth of channel of 3 ins. from top of curb. Before the concrete is put down, it is as well to have all manhole tops, water hydrants, gas-valve covers, and gullies adjusted to the camber of the roadway when finished. For the concrete care should be taken that only the first-quality Portland cement of British manufacture by approved makers, and complying with the Engineering Standard Committee's specification, is allowed to be used. The sand should be clean and sharp, and if necessary should be washed before mixing; the stone should also be clean broken stone, not brickbats, to pass through a 1½-in. or 1¾-in. ring. The proportions used to get the best results are, I find, 4½ of broken stone, 1½ sand, and 1 Portland cement. These should be accurately measured on to a banker and thoroughly mixed by turning over twice dry and twice wet; the water used must be clean and applied only out of a can with a proper rose, or from an elevated tank through a hose pipe fitted with a rose or spray. The heights having been put in, a screed is run along the curbs, and when these have set the concrete is filled in to the required thickness and brought to an even surface with a spade, and worked to a template made to the proper camber. To keep the crown of the road at one regular height, pieces of wood, graded from 0 to 2½ ins., or the depth of the fall allowed in the channels, are placed along the screeds on each side of the road for the template to run on, and this work should be entrusted only to skilled men, who understand making a good and neat job in adjusting the camber to the end fall to the gullies. Any hollows in the concrete should be made level with cement mortar in the proportion of 1½ parts of sand to 1 part cement. No concreting should be permitted during frosty weather, and no softening or retempering should be allowed. The concrete should then be given ample time to mature, as on this depends to a large extent the wearing capacity of the roadway.

The mixed granited asphalt is then conveyed in buckets from the boiler and emptied on to the concrete, where it is taken in hand by skilled workmen who spread it out with wooden floats in the shape of a plasterer's trowel to the specified depth, camber and gradients. Before the asphalt has cooled too far, it should be sprinkled with granite dust, raised to a temperature of not less than 200° F., and then finished off by rolling with suitable rollers for indenting the surface. Where a rock-asphalt street meets another which is not of the same material, it is well to insert blocks of granite, from an approved quarry, 9 ins. deep and 6 ins. wide, on edge, to protect the asphalt from the collision which naturally arises when vehicles pass from one material to another of a harder or softer nature, these blocks being of course removed when other rock asphalt is to join up to that already laid. At all joints and along the sides of the carriageway there should be an under layer of fine asphalt to ensure the proper adhesion of the parts. During very cold weather it is as well to suspend the laying of the asphalt, as I have observed that in almost every case where intense cold has been during the period of laying the asphalt is liable to crack and shrink from the sides, no doubt from the contact of the hot material with the cold concrete, which makes it cool too suddenly and thus contract, or "creep" as it is sometimes called.

The Use of Mechanical Tests to Determine the Relative Value of Various Stone for Road Construction and Maintenance.*

The resources of Ireland in respect to the supply of stone for road purposes are very abundant, and an ample supply of the most excellent quality is available, provided that proper measures are taken to insure that only the best stone is selected and quarried for the purpose.

To determine accurately, in the case of macadam roads, the wearing qualities of different classes of stone from actual results is an extremely difficult and almost impossible task, owing to the varying conditions of wear due to variations in road structures, drainage, incidents of traffic, gradients, and changes in the seasons.

Numerous efforts have been made to apply mechanical tests to determine the relative qualities of stones used for road work. The qualities desirable may be summed up as follows: Hardness, non-friability, non-absorption (non-slipperiness in the case of paving), and last, but not least, uniformity. The specific gravity of the stone should also be carefully considered as a factor in the relative value of the surface covering power of the stone.

The French government maintains a laboratory in Paris for the testing of materials, and for some time Monsieur Anstett, the director, has been carefully studying the best methods of applying a practical test to road material.

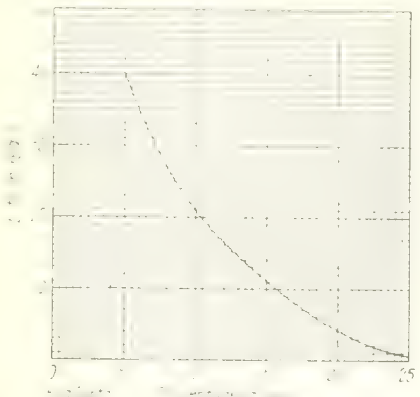

Fig. 2—Life of Stone Paved on ,Concrete Foundation as Compared with Percentage of Loss Due to Belfast Standard Impact—Attrition Test.

Those who were present at the first International Road Congress in that city will recollect the very ingenious attrition testing machine, formed by oscillating planes, which was then on exhibit. In England and America various forms of machines have been devised for a similar purpose, in an endeavor more or less closely to apply by mechanical means the actual conditions of wear and tear to which stone is subjected when used for road purposes, and Mr. J. E. Lovegrove, who has for many years studied the question of stone testing, has published, in conjunction with the petrographer of his majesty's geological survey and the curator and librarian of the Museum of Practical Geology, a very interesting table of the results of attrition tests of various stones used for road making in the light of petrology.

Some years ago considerable reliance was placed on tests of the resistance of stone to a thrusting or crushing stress, but actual results in road work show that such tests are of little value to the road maker, the reason being that a crushing test does not fulfill the conditions of wear a road stone is called upon to withstand.

The author has for some years tested a large number of samples of stone from quarries in Ireland, Wales, Scotland, and other countries. The machine used is very much on the same lines as the one adopted by Mr. Lovegrove, consisting of a revolving perforated cylinder with blades attached to the internal surface. The stone submitted for testing, after being broken to a standard size, is accurately weighed and placed inside the cylinder. The number of revolutions per minute is uniformly regulated, and an automatic recorder indicates the number of revolutions during the period of the test. The stone is afterwards removed from the cylinder and again weighed, and the percentage of loss due to wear and tear ascertained.

The object of this test is, as far as possible, to apply in a mechanical form similar conditions to those which obtain when stone is in actual use for road purposes, the rubbing of the stone on the inside surface of the cylinder as it revolves corresponding with the wear of the wheel traffic, while the hammering or "jar" which the stone receives when dropping from the internal blades on to the bottom of the cylinder corresponds with the hammering which is applied by horses' shoes when traveling over the surface.

It will be readily understood that owing to the uniformity of conditions of wear and tear the wearing properties of stone when used for street paving laid on concrete foundations can be more accurately determined than is the case when dealing with macadam roads, and in order to determine the comparative value of wear and tear under actual conditions, as compared with this impact-attrition test, the author has for a number of years been engaged in the investigation of the wearing properties of stone under actual conditions in paved streets and macadam roads, along with the results obtained by the means of this mechanical test.

With this object in view a street, with a considerable traffic, which is practically uniform from end to end, has been paved with stone from various quarries, of varying degrees of hardness, under exactly similar conditions, and the results of the wear carefully recorded. The various stones were also tested mechanically and the records thus obtained compared. The wear and tear of stone laid down in other streets has also been compared with the results of the mechanical test, due regard being made to any variations in local conditions.

The results of these investigations, both in the case of paved streets and macadam roads, have been most interesting and instructive, and have more than fully confirmed the value of the impact-attrition test as a means of determining the wearing properties of stone for road purposes. The accompanying diagrams indicate the relative life of stone under equal conditions of wear as compared with the results of the impact-attrition test. The diagram showing the life of stone paved on concrete foundation is based on an intensity of traffic of 300,000 tons per yard per year. The diagram showing the average life of stone on a macadam road† is based on an intensity of traffic of 100,000 tons per yard per year.

In the application and comparison of mechanical tests it must, however, be borne in mind that absolute uniformity is essential (1) in the preparation of the stone for testing, (2) in the construction of the machine, and (3) in the carrying out of the actual test to enable comparisons to be accurately determined; and the author ventures to suggest the great advantages which would be secured to the road authorities of this country were the Department of Agriculture and Technical Instruction, or some such central authority, to undertake to provide the means for obtaining this information.

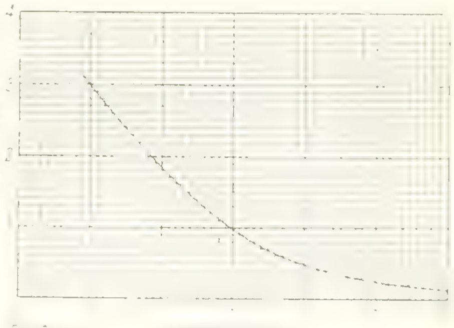

Fig. 1—Average Life of Stone on Macadam Road as Compared with Percentage of Loss Due to Belfast Standard Impact—Attrition Test.

As an illustration of the difficulties that road engineers are faced with in the selection of stone, the author would mention a number of what appear to him interesting facts he has ascertained in the course of these investigations—(*a*) within certain limits the geological and petrological formation of the stone does not of necessity indicate any special value in regard to stone for use for road purposes, (*b*) stone from the same quarry apparently of the same texture may not have the same wearing qualities, (*c*) stone of two

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*Paper by Hector F. Gullan, Superintendent of Works Department, Belfast, presented to the Second Irish Road Congress, Dublin, Ireland, April 19-21, 1911.

[illegible] effect of the variations of the weather, the aver- [illegible]

[illegible] stones from the same quarry had exactly the same wearing qualities.

It is impossible to estimate the value of accurately and readily determining the wearing quality of stone. As Major Crosby, chief engineer of the Maryland Geological and Economic Survey, in his recent paper *† on "The present status of laboratory tests and the use of materials in road construction" well says, "Good judgment is frequently a thing difficult to obtain and, when had, as hard to support by facts of ready comprehension," and no one knows this better than the road engineer who has given the question of the relative quality of stone his careful consideration.

Absorption, as indicating resistance of stone to disintegration by weather or frost, is a further test which should be applied to stone when being examined for the purposes of road construction. This may be readily done by immersing a piece of stone of given weight or cubic contents in a given quantity of water for a given period. The stone is then carefully withdrawn, the water measured, and the loss by absorption recorded.

Due judgment must also be used in respect to this test. Certain stones—flint, for instance, while showing a minimum amount of absorption, are unsuitable for road purposes, and as a safeguard the author would recommend the absorption test should be made only after the results of the impact-attrition test have been determined.

Although not a test of quality, the specific gravity of stone as representing a commercial value must not be overlooked in dealing with the subject. The specific gravity of stone may vary from 2.50 to 3.10, and Table I illustrates the increased cost due to the reduction in the bulk of stone received for every additional 0.10 increase in specific gravity, in the case of paving, a stone of 2.5 specific gravity being taken at 25s per ton and in the case of macadam 5s per ton.

TABLE I. EQUIVALENT COST BULK FOR BULK OF STONE OF VARIOUS SPECIFIC GRAVITIES AS COMPARED WITH 1,000 TONS OF SETTS AT 25S PER TON, AND OF MACADAM AT 5S PER TON, OF STONE OF 2.50 SPECIFIC GRAVITY.

Specific Gravity.	Setts.	Macadam.
	£	£
2.50	1,250	250
2.60	1,300	260
2.70	1,350	270
2.80	1,400	280
2.90	1,450	290
3.00	1,500	300
3.10	1,550	310

The following is a simple method of determining the specific gravity of stone: Immerse a piece of stone of known weight in water and after removal ascertain the weight of water displaced. Divide the weight of displaced water into the weight of the stone and the result will give the specific gravity of the stone.

For example:	Lbs.
Actual weight of stone	184
Weight of water displaced................	62.278

$$\text{Specific gravity} = \frac{184}{62.278} = 2.95.$$

After every care has been taken to determine the wearing quality of the stone to be used in the construction and maintenance of roads, there is yet one condition which must be most carefully observed, especially in the case of road surfacing, in order to obtain entirely satisfactory results. It is insuring that the material used over a given surface is of a uniform quality. The indiscriminate use of two or more stones of different qualities, even when relatively good, both in paved streets and macadam roads, will be found to produce very disastrous results. On macadam roads in particular the traffic will very soon find out the spots where the softer material is situated. Where the surface begins to wear down below harder material surface water will gather, slightly at first, and gradually increasing, with the result that the crust of the road is softened and the less hard material is subjected to disintegrating effects of the weather to a far greater degree than the other parts of the road, thereby causing further damage, and in combination with the traffic the wear goes on daily with an increasing ratio, and the general surface of the road rapidly becomes a series of hills and hollows.

In presenting this paper the author desires to draw attention to the advantages, both financial and otherwise, of accurately and systematically determining the qualities of stone for road construction and maintenance by mechanical means; and, judging by the number of applications the author has received from all parts of the country for the undertaking of such tests, there is no doubt that the importance of such tests is becoming largely realized.

Many local authorities, even if they had the enterprise, have not the means to fit up and maintain a proper equipment. In order that full value should be obtained for purposes of comparing and correlating the quality of the stone supply throughout the country, the conditions of tests should be standardized in every respect. The establishment of a central laboratory, fully equipped to undertake the testing of stone and to tabulate results and promptly furnish information, appears to be greatly needed, and to be the only means whereby the necessary conditions to deal with this question can be fulfilled to the best advantage.

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*†Engineering-Contracting, Jan. 18, 1911.

WATER-WORKS AND SEWERS SECTION

Revision of Downtown Chicago's Sewerage System.

In our issue of Feb. 15, 1911, brief reference was made to the imperative need of new sewers in the downtown, or so-called loop district of Chicago. At a recent meeting of the City Council a report on the condition of the present system of sewers in this district was made by C. D. Hill, Superintendent of Sewers. This report also outlines the proposed new sewerage system.

The conditions which now obtain in this district are likely to develop in similar districts of any large city, so the situation is of more than local interest. It is presumed that actual construction of the proposed municipal passenger subway will be commenced within the next two or three years, and the new sewerage system in the central part of the city will be constructed simultaneously with the subway. It is our intention to follow this sewerage problem all the way through so we are here abstracting Mr. Hill's report to show the present status of the problem.

PRESENT SEWER SYSTEM.

The district under consideration is sewered by main sewers in all the east and west streets. These sewers are 3 ft. in diameter where they empty into the south branch of the Chicago River, and are 2 ft. in diameter at their summits. From the summits they slope to the east to a north and south main sewer in Michigan Ave., the lake front street in the downtown district. This main sewer is 4 ft. in diameter where it empties into the river and 2½ ft. in diameter at its summit. From the summit it slopes south to an intercepting sewer in 12th St., an east and west street. There are tile pipe sewers 1 ft. in diameter in all the north and south streets discharging into the previously described brick sewers in the east and west streets. These pipe sewers have summits in the middle of each block.

Insufficient Size of Sewers.—The sewers in this district were designed and built fifty years ago on a liberal scale to provide for the storm water run-off that was to be expected, and proved sufficient for the conditions of the following twenty-five years. During that period there were no sky-scraper buildings, the pavements of the streets were not impervious, there were considerable areas of private land not roofed or paved, and there was no serious difficulty in draining the streets and the buildings. The conditions of today, with large buildings, impervious pavements, and private property all covered with either roofs or paved areas, require a capacity much larger than these sewers possess. With the conditions that we will have ultimately, the sewers should have a capacity of about five times the capacity of the present sewers.

During recent years, many complaints from owners of buildings as to lack of drainage have made apparent the inadequacy of the entire system of sewers in this district. These complaints are increasing as the years go by, and the conditions that cause them are growing. It is not remarkable that sewers that were designed and built fifty years ago are no longer adequate to care for this district, which has been completely built up and is now being rebuilt with enormous modern buildings.

Sewers Not Self-Cleansing.—The surface of the streets in this portion of the city was originally six or eight feet below the present grade of the streets. The sewers necessarily were built shallow and with flat grades, and for this reason the current is sluggish and sedimentation occurs in all of them, it not being possible for them to be self-cleansing. At the present time these sewers are nearly half full of mud and water, even in dry weather. This is due partly to the fact that it is impossible to keep them clean, and partly to the fact that such a vast amount of water is used in the buildings in the district.

Obstructions in Sewers.—In several places these sewers are obstructed by pipes passing through them. It is probable that these pipes were laid in the early days when the surface of the street was so low that it was not practicable to lay water mains over the sewers. These pipes are obstructions to the flow of the sewage, and in many cases cause very considerable deposits, and they prevent the proper cleaning of the sewers.

Cleaning of Sewers Difficult.—As has been stated, these sewers are not self-cleaning, and the work of cleaning them becomes more and more difficult. This difficulty is due partly to the fact that they are generally submerged, particularly the small pipe sewers, so that it is difficult for the men to pass rods and chains through the sewers. The vast amount of traffic on the streets, particularly the street car traffic, makes it impossible to place derricks over the manholes and to scrape the sewers in the usual manner, except by having the men work after midnight and before 5 o'clock in the morning. This night work is not only very expensive, but it is not as effective as it would be if it were under the supervision that could be given day work. In this district, more than elsewhere, it is important that the sewers be self-cleaning.

Grease in Sewers.—There are a great many restaurants and hotel kitchens in this district, and sufficient precaution is not taken to prevent the grease from these kitchens passing into the sewers. In fact, an examination of most of the tile pipe sewers shows a large accumulation of grease in the sewers. This grease adheres to the sides of the sewers and to the sides of the manholes, and very materially prevents the flow through the sewers. In many cases of complaints from buildings, the trouble is due primarily to this accumulation of grease in the main sewer and in the private drain from the building.

Damage Caused by Large Buildings.—The construction of the modern large buildings, and particularly the construction of curb walls extending to a depth of over thirty feet below the surface, has caused settlement of the sewers. Naturally the settlement of the sewer, even though the sewer may not collapse, will cause sedimentation to take place, thereby obstructing the flow through the sewer.

Drains for Buildings.—All of the modern buildings have deep basements, and power pumps are installed that force the sewage from the buildings into the main sewers under pressure. Such buildings have very little trouble; but the water that is forced into the sewers from them is forced back through the drains into the basements of buildings of the old type, particularly when it rains, at which times the sewers are insufficient in size to carry off the water. This forcing of water back through the drains has the effect of forcing the silt from the main sewers into the drains, thereby further damaging the drainage from these old buildings. The connections from the buildings to the main sewer are frequently laid too low and at too flat a grade, so that these pipes are often submerged, and in consequence the flow through them is very sluggish, and they become filled with sediment and completely obstructed.

Maintenance of Catchbasins Difficult.—All of the streets in this district are filled from curb to curb with various pipes and conduits. Some of these conduits are laid along the sides of the streets where catchbasins are built, and in some cases they interfere very seriously with the effectiveness of the catchbasins, and particularly with the connections from the catchbasins to the main sewer. It is almost impossible to clean some of these basins, and in others, the connecting pipes have been placed below the conduits and are so low that a comparatively small amount of dirt swept into the basins will completely fill the mouths of the outlet pipes. When streets are paved, it is almost impossible to find room to build the necessary additional catchbasins. Recently the construction of the new curves connecting the street railway tracks has made it necessary to remove the catchbasins at the curb corners, and it has been difficult to build the new basins necessary. In some cases connecting pipes from the street inlets to the adjacent catchbasins are laid over conduits, and they are so shallow and laid at so flat a grade that they soon fill up with the detritus washed from the pavement.

SUMMARY OF CONDITIONS.

It has been shown that these sewers are of insufficient size; that they have been badly damaged by the construction of buildings and other structures; that they are not self-cleaning, and that it is practically impossible to keep them clean.

Sewer System Condemned.—The more this problem is studied, the less possible it seems that we will be able to use any of the present sewers. A system of relief sewers, giving additional outlets to the main sewers, will not be sufficient, for the reason that the greatest trouble is from the small lateral sewers. The entire sewer system should be condemned and replaced with an entirely new system that will be completely up to date and will take care of all possible future developments of the district.

RECONSTRUCTION [illegible]

The reconstruction of these sewers should have been commenced years ago, but it was impossible to make any intelligent plan for a new system of sewers that could be used in connection with the proposed subways for transportation and other uses. The cost of such a system of sewers would be so great that it would be manifestly absurd to build them with the idea that they would be torn out when the subways were constructed. It was impossible to prepare any definite plans for such sewers until definite plans had been adopted for the construction of subways. These subway plans have now been prepared, and it is the purpose of this report to suggest how the sewerage problem can be solved in connection with the construction of these subways.

ESSENTIAL [illegible] DESIGN.

The new sewers should be designed in accordance with certain fundamental principles:

1. There should be a complete separation of storm-water from the sewage, necessitating the construction of separate systems of sewers.

2. All storm water drains, without exception, should flow by gravity to the river and should be free from inverted syphons. No storm-water should be pumped.

3. All storm drains should have ample capacity to carry off promptly all rain from roofs and pavements.

4. Inlets from streets to sewers should be so arranged as to permit the flushing of pavements. It may be necessary to omit catchbasins on account of the construction of subways.

5. At necessary points arrangements should be made for connection with water mains for the purpose of flushing the storm drains.

6. Large sedimentation basins should be constructed along the line of the storm drains near the outlets to prevent the discharge of detritus into the river.

7. All sanitary sewers should, so far as is practicable, flow by gravity to the river with a minimum amount of pumping and a minimum number of inverted syphons.

8. All sanitary sewers should be so designed as to be self-cleansing.

9. All sanitary sewers should be discharged into the South Branch of the Chicago River.

10. If possible, arrangements should be made that will prevent the discharge of sludge from the sanitary sewers into the river.

11. The sewer pipes of all adjacent buildings should be so arranged that all rain-water will be discharged into the storm-drains, and all other sewage and waste water will be discharged into the sanitary sewers.

12. It may be necessary to require the owners of buildings to lift the sewage from basements so that it will discharge into sanitary sewers laid at an elevation higher than that of the basements. All sewage from that part of the building at or above the street level should discharge into the sanitary sewers.

13. All sewage and drainage from the subways should be lifted and discharged into the sanitary sewers.

IMPORTANCE OF PROBLEM.

The most important problem in the designing of the new sewer system is the determination of the amount of water that will be delivered to the sewers. With the streets paved in a modern fashion, with shallow gutters, there is little storage room for storm-water on the surface of the streets. If the sewers are not of sufficient size to take the rain as fast as it falls on the pavements and on the roofs, the water will accumulate on the pavements and will overflow into the entrances of the subways; at the same time the sewers being full, it will be impossible to drain the basements of the adjacent buildings, and a flooding of the subways and the buildings will result.

Determination of Amount of Sewage.—The determination of the amount of sewage to be discharged from the buildings is comparatively easy, as it will equal in amount the water supplied to the buildings. Elaborate estimates have been made of the amount of water that will probably be consumed in this district when it is completely rebuilt with modern buildings, and water mains of the size necessary to supply this water will be installed. Sanitary sewers that will take this water from the buildings should have as great a capacity. The volume of sewage from the buildings will be constant day after day, and will not vary much during the hours of the day.

Determination of Amount of Storm-Water.—To determine the necesary size of the storm drains to carry off the rainfall is more difficult. Ordinarily in designing sewers provision is not made for taking care of all the rainfall in times of storms of exceptional severity, that is, it is not considered bad practice to design a sewer that will prove insufficient in size two or three times in a period of ten years. Because of the great damage that would be done by the flooding of the subways, the storm-water drains should be of sufficient size to take all of the water that could be reasonably expected, judging from the experience of the past. In designing sewers in Chicago, particularly in the outlying districts, it has been customary to assume that only a small portion of the rainfall will enter the sewers during the time of the rainfall; that is, we assume that the larger portion of the rain will be held back on the surface of the ground, and will enter the sewer slowly, and that a considerable portion will not enter the sewer at all. In designing the new storm drains for this district, we must assume that all of the rain will enter the drains as rapidly as it can flow from the various parts of the roofs and pavements to the nearest inlets, and that the volume of the flow through the sewers during any period of time will equal the volume of rain during the same period of time. Sewers designed on this principle will have a much greater capacity per acre of land drained than any sewers heretofore built in the city of Chicago.

SEPARATE SYSTEM NECESSARY.

The volume of the maximum rainfall will greatly exceed the mlximum volume of sewage from the buildings. If combined sewers are built that will receive and carry the sewage from the buildings, as well as the stormwater, the sewers will be so large that in dry weather the stream of sewage will be comparatively small, and will be sluggish, so that it will be impossible for these to be self-cleaning. If, in addition to this, street sweepings are washed into the sewer the sedimentation will be increased, and the sewer will become very foul and offensive. A majority of authorities on sewerage advocate a separate system of sewers under all conditions. In this district it is particularly necessary, for the reason indicated above, that the separate system be established.

Flushing of Drains.—The flushing of pavements is advocated by many authorities on street cleaning; it is usually opposed by officials who have charge of sewer cleaning, but the opposition is seldom effective, for the reason that the public is more desirous of having clean pavements than clean sewers. The flushing of the pavements of this district appears to be inevitable, and it is advisable that such provision be made as will permit of the flushing of the pavements with the least possible harm to the sewerage system. It will be impracticable to construct catchbasins that will prevent the washing of detritus from the pavements into the storm-drains. During dry weather this detritus will lodge in the drains, and the water from the flushing of the pavements will not have sufficient force to carry it along. If this sediment is not mixed with sewage from the buildings, it will not be particularly offensive, and no harm will result, provided the sediment is flushed out of the drains in times of rain. For fear of the smaller storm drains being obstructed, it is advisable that pipes be laid connecting the water mains with the upper ends of the drains and provided with the necessary valves, so that it will be possible to flush them.

Drains Free From Inverted Syphons or Pumps.—Because of the large amount of sediment that will be washed into the storm drains, it is absolutely necessary that they should be laid on proper gradients, and that they should be entirely free from inverted syphons. An attempt to pass such a storm drain beneath the subway by means of an inverted syphon would certainly result in the syphon becoming absolutely obstructed with sediment. The construction of a system of storm drains laid at a level lower than that of the river, thereby requiring the use of pumps, would be very unwise, for the reason that it would be necessary to install machinery of so great a capacity that all of it would not be used except once or twice in a period of years, and at the same time it would be necessary to maintain all of this machinery ready for instant use. The installation and operation of such machinery would be very expensive, and as a matter of fact, there need be no difficulty in installing gravity storm drains in connection with a well designed system of subways.

Sedimentation Basins.—This general arrangement will result in a large amount of sediment being washed into and through the storm drains and discharge into the river. In view of the growing opposition of the Federal Government to such practices, it is advisable that these storm drains be arranged to discharge through large sedimentation basins which should be located near the outlets. Apparatus could be installed that would remove the sediment from the basins much more economically than it is now possible to clean the ordinary catchbasins in the streets.

Inverted Syphons and Pumps in Sanitary System.—In the case of the sanitary sewers it is permissible to use inverted syphons and pumps if the conditions absolutely require them. The flow through the sanitary sewers is fairly constant at all times, and there is very little danger of sedimentation in the inverted syphons. However, it is advisable to avoid anything of the sort. The particular objection to the pumping of sewage is the cost of operation. If all of the sewage were carried through low-level sewers and were lifted by pumps it would be necessary to pump all of the water that would be delivered to all of the buildings in this district. The greater portion of this water is discharged from the upper stories of the buildings, and it should not be difficult to arrange the sewerage system so that all water discharged from the upper stories of the buildings would be carried by gravity to the river. The sewage from the ordinary basements of buildings located near the river could be discharged in the same manner, but it would not be possible to take the sewerage from basements at a considerable distance from the river without pumping.

NO SEWAGE DISCHARGE INTO MAIN RIVER

It is very important that no sewage be discharged into the main river, but that the sewers be so built that the sewage will be discharged into the South Branch. While it is true that there is a flow in the main river from the lake, it is also true that a momentary fluctuation in the level of the lake will sometimes cause a corresponding reversal of flow in the main river, and a large flood in the valley of the North Branch may cause the normal flow in the main river to be reversed for several hours, and any sewage in the river, or any sludge in the bottom of the river, might be washed into the lake. It is hardly conceivable that any flood would be so great as to reverse the flow in the South Branch of the river. It is therefore apparent that the discharge of the sewage into the South Branch is much preferable to its discharge into the main river.

ANTICIPATE FUTURE PURIFICATION OF SEWAGE.

In the designing and the building of these sewers it is advisable to anticipate the future construction of an intercepting sewer that will convey all of the sewage of this district to some convenient place for purification, as the population of the city of Chicago will undoubtedly increase to such an extent that the mere dilution of its sewage will not be sufficient. It will be necessary to install apparatus that will purify at least partially the sewage before it is discharged into the Sanitary District Channel.

[illegible]

It is possible that some apparatus might be installed at the outlet of each sewer that would to some extent purify the sewage and thereby decrease the pollution of the river. It is quite probable that some form of a sludge tank could be installed that would materially decrease the amount of sludge that is now being discharged directly into the river. It is a fact that a vast amount of sludge has accumulated in the river and in the main channel of the Sanitary District and the Federal Government is taking notice of this accumulation.

This sludge problem is one of the most serious problems that is confronting Chicago today and in the designing of these sewers the sludge problem should receive very careful attention.

SEPARATION OF ROOF WATER FROM SEWAGE OF BUILDINGS.

It will be necessary to require the owners of all buildings to rearrange the sewer pipes of all buildings so that all rain water will be discharged into the storm drains, and all other sewage and waste water be discharged into the sanitary sewers. The neglect of this rule would result in the overloading of the sanitary sewers during time of rainfall, or else in the discharge of sewage into the storm drains, where it would lie stagnant and putrify.

Sewage From Basements to Be Pumped.—The sewage from all portions of the buildings above the elevation of the sanitary sewers would discharge directly by gravity into the sewers. The sewage from the basements that are below the level of the sewers would have to be lifted by pumps. This is now being done by the owners of modern buildings, and it would not be a hardship to require it in all cases. There may be difficulty in working out the details of this requirement, but it should be no more difficult than the adjustment of other questions involved in the construction of the subways in front of the buildings. If a complete system of subways is built in accordance with the general plans and recommendations contained in the report of Mr. Bion J. Arnold, dated January 31, 1911, it will not be difficult to arrange the system of drainage and sewerage to conform to the foregoing requirements.

Sewers on Each Side of Street.—The lack of space between the pavement and the tops of the cars in the high level subways will prevent the crossing of these subways with drains and sewers except where these subways are depressed. It follows that it will be necessary to lay a drain and a sewer on each side of such subways. In general the direction of the principal sewers and drains will be parallel to such high level subways. The sewers and drains in cross streets where there are low level subways will necessarily be limited in length by the intersecting high level subways.

In such streets it will be possible to obtain the necessary service with one sewer and one drain, but it is preferable to adhere to the general plan of providing one sewer and one drain on each side of the street near the buildings, leaving the space in the center of the street over the low level subway for other utilities.

Space for Sewers and Drains.—Where the high level subways contain but two tracks, there will be ample space beneath the sidewalk for both sewer and drain, as well as for other utilities. Where there are four tracks, the requirement of entrances to the stations between the tracks necessitates the placing of one track beneath the sidewalk leaving a narrow space for the sewer and drain and a very limited space for other utilities. It will be necessary, therefore, to lay the principal lines of such utilities in other streets, which can be done without any difficulty.

Objection may be raised to the narrow roadway in the typical cross-section of a four-track subway, and a remedy may be suggested by narrowing the sidewalk and placing the car nearer the building line. This must not be done if it results in eliminating the necessary space for the sewer and drain.

Where the drain serves a small area (one or two blocks) but little space is required for it, but where it serves a large area it may be several feet in diameter. In general it is advisable that the main drains be laid in streets other than those containing four-track subways, and this can be done with possibly one or two exceptions.

MATERIALS OF CONSTRUCTION

In streets where high level subways are built, it will be necessary either to incorporate the storm drains in the roof of the subway (particularly near the summits of the sewers), or to suspend the drains along the side walls inside of the subways. The sewers will be suspended in a similar manner at an elevation somewhat lower than that of the drains. For this form of construction iron or steel pipes are apparently the most suitable material, provided the sizes are kept within reasonable limits. Where the storm drain serves as an outlet for a considerable area, the necessary size of the drain will require some other material, and for this purpose reinforced concrete is suitable. The concrete drain will be incorporated in the structure of the subway and should be inside the outer walls. As the subways approach the river and are correspondingly depressed, the drains and sewers will emerge through the roof and will continue to the outlets as independent structures.

COST OF NEW SEWER SYSTEM.

It is impossible to estimate the cost of the new system of sewers and drains in advance of the preparation of definite plans. It is probable that the cost will be between one million and two million dollars.

STEAM AND ELECTRIC RAILWAY SECTION

The Design of a Timber Treating Plant for Railroad Use.

BY CHAS. C. ANTHONY*

The practice of preserving timber by treating it with an antiseptic is spreading rapidly in the United States. As the railroads use about 100,000,000 ties per year, besides structural timber, it is surprising that they are only operating about 20 timber treating plants.

A careful consideration of the expenses for ties and tie renewals and a comparison between the cost and life of treated and untreated ties would indicate that timber treating is a paying investment.

Enough statistics have been compiled to prove beyond a doubt that an antiseptic as a method is thoroughly efficient in preserving ties in the tracks, and in increasing their life over that of untreated ties.

Skillful operators have been developed, processes perfected, mechanical devices invented, and the art of timber treating placed on a scientific basis and brought to a high degree of efficiency. The advance has been rapid and thorough along certain lines, but a very important phase of the problem has been neglected.

An investigation of the timber treating plants now operating will show a great many with an arrangement of yard and plant not consistent with economical handling. Everywhere you see a disinclination to incur initial outlay to secure permanent economy. The yards are poorly arranged and the plants poorly designed. There is not a plant now operating in the United States that could be taken as a model of first-class design.

Table I, which is a delay report, is typical, and gives a very good idea of some of the troubles caused by faulty design. All the items marked with a star are caused by faulty design of plant and a poorly arranged yard. At one plant the total of delays to retorts for one year was 8200 hours, 75 per cent of which was caused by faulty design.

PROPOSED PLAN FOR TIMBER-TREATING PLANT.

For the purpose of providing a plant in which these causes of delay shall be eliminated, the design shown by Fig. 1 is submitted. This design is the result of a study of a great mass of data, and of practically all of the existing plants in the United States.

Arrangement of Yard.—As yard operations have an important bearing upon the cost and facility of handling, special attention has been given to the arrangement of tracks around the plant. With a yard arranged as shown by

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*363 E. 58th St., Chicago.

Fig. 1 there can be no delays due to switching. The tracks leading to the loading platforms are so arranged that the trams can be returned to the tie yard for reloading as fast as released. With this arrangement the plant can operate with the minimum number of tie trams.

The natural movement of ties in the yard is from the cars, on the unloading tracks, to the ground; from the ground to the tie trams; on the trams along the narrow gage tracks to the treating cylinder; from the treating cylinder to the loading platform, where they are loaded into cars and the trams returned to the tie yard for reloading. By keeping the narrow gage tracks separate from the standard gage, and doing away with the three rail system, each operation can be carried on without conflicting with the others. The trams moving to and from the retort house and loading platform cannot interfere with the movement of switch engine and cars nor with each other. With the three-rail system this is constantly happening. By providing a cylinder open at both ends the pulling of a treated charge cannot conflict with the introduction of an untreated charge.

The narrow gage tracks are connected at both ends in order that the loaded trams can be sorted and classified for treatment with very little switching. The classification of timber for treatment is of the greatest importance, and this yard is designed with the idea of providing facilities for switching both standard-gage and tram cars promptly and economically. The capacities of the standard gage tracks in the yard shown by Fig. 1 are as follows:

Loading [illegible]	
No. 1	[illegible]
No. 2	[illegible]
No. 3..........................	14 "
No. 4..........................	17 "
T[illegible]	[illegible]
Unloading [illegible]	
No. 1..........................	29 cars.
No. 2	[illegible]
No. 3	[illegible]
Tot[illegible]	[illegible]
Storage [illegible]	
No. 1	[illegible]
No. 2..........................	23 "
To[illegible]	[illegible]
Spur track..........................	12 "
Grand total..........................	205 cars.

The tie yard provides storage room for 265,200 ties. Sections 1 to 12, inclusive, and sections 14 [illegible] 13 and 17 hold 8,840 each. The ties are stacked as indicated on Section 4 of Fig. 1. In other words, there are 10 piles 33 ft. long and 20 ties high, giving 80 tiers of 221 ties each, or 17,680 ties per section.

All the tanks are placed outside the building. They are so connected to the retorts, pressure pumps, etc., that the following processes can be used: Lowery process, Creo-air, straight creosote, Allardyce process, card process, zinc tannin process and Burnettizing process.

Operation of Retorts.—The use of the tanks for the different processes is shown by Table II. In Table III is shown the number of ties that can be treated per day and per year by the different processes with a plant as shown.

In arriving at the capacity of such a plant the following data and computation are used:

The capacity of one retort is 6,281 cu. ft., or 47,109 gallons. One retort will hold 19 trucks of 60 ties each. This equals 1,140 ties per charge. Assuming three charges of 1,140 ties per day, the daily capacity of each retort is 3,420 ties. On this basis the yearly capacity of each retort, assuming 300 days per year, is 1,026,000 ties.

A charge of 1,140 ties, with an average of 2.64 cu. ft. per tie, will occupy 3,010 cu. ft. The space occupied by the 19 trucks, at 2.74 cu. ft. per truck, is 52 cu. ft. This gives a total of 3,062 cu. ft. as the space occupied by ties and trucks in one charge.

As stated above, the capacity of one retort is 6,281 cu. ft. Subtracting from this the space occupied in the retort by ties and trucks, or 3,062 cu. ft., the remaining space in the retort is 3,219 cu. ft., or 24,146 gals.

One tie is estimated to absorb 5 gals. of the solution, which is equal to 5,700 gals. per charge of 1,140 ties. Adding this to the amount of liquid necessary for filling the space remaining in the retort, it is found that a total of 29,846 gals. is required for each charge.

Since the ties absorb 5,700 gals per charge, three charges per day require 17,100 gals. For a year of 300 days, this is equal to 5,130,000 gals.

The capacity of the plant in treating seasoned tires is shown by Table III.

TABLE II.—USE OF TANKS IN DIFFERENT PROCESSES.

L[illegible]	[illegible]	[illegible]	Lowery or Creo-Air or Straight Creosote	Allardyce Process	[illegible] Process	[illegible] Process	[illegible] Process
A	100,000 Gallons	[illegible]		Zinc Chloride less than 5% Solution	Zinc Chloride less than 5% Solution	Zinc Chloride [illegible] Solution	Zinc Chloride less than 5% Solution
B	100,000 Gallons	Iron			Zinc Chloride and Creosote	Tannin Solution	
C	100,000 Gallons	Wood	Water	Water	Water	Water	Water
D	48,000 Gallons	[illegible]	Creosote	Hot Creosote		Glue Solution	
E	7,200 Gallons	Steel	Measuring Tank	[illegible]	[illegible] Tank	Measuring Tank	Measuring [illegible]
F	7,200 Gallons	Steel					
G	300,000 Gallons	Steel	Cold [illegible]	Cold Creosote	[illegible]	[illegible]	[illegible]
H	30,000 Gallons	[illegible]		Zinc Chloride 50% Solution	Zinc Chloride 50% Solution	Zinc Chloride 50% Solution	Zinc Chloride 50% Solution

N[illegible] L[illegible]

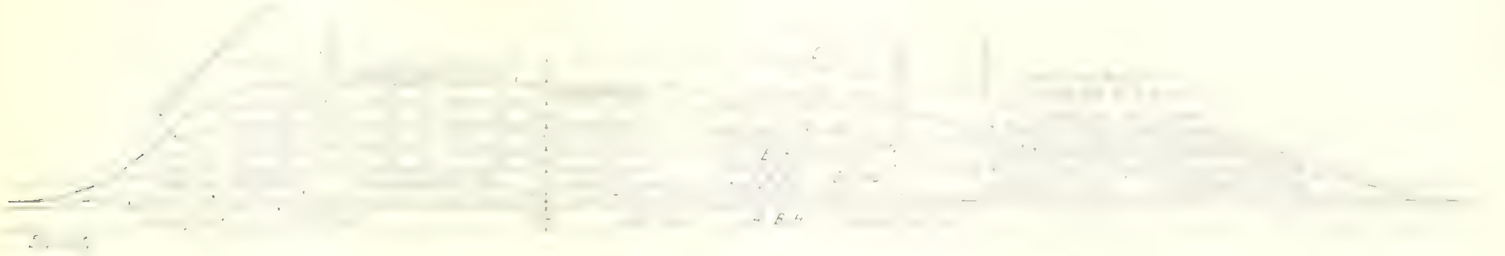

Fig. 1—Proposed Arrangement of Timber Treating Plant.

TABLE I.—DELAYS TO RETORTS FOR YEAR [illegible] TIMBER [illegible] PLANT.
Operating 3 Retorts, 6 ft. Diameter, 132 ft Long.

Cause of Delay.	Del[illegible] Hours.	Min.	[illegible]
[illegible]	381	[illegible]	34,061
*[illegible]			610
[illegible]		17	34,732
*Insufficient measuring tank			[illegible]
Weather conditions ..	1,406	14	125,419
*Preparing solution ...		26	13,176
Shortage of tie men.......		43	[illegible]
*Trams stuck in retort.....	13	1	1,207
Repairing pipes and valves		10	1,743
[illegible]	16	45	1,475
[illegible]			7,979
[illegible]			1,341
*Forcing back solution......			1,408
*Cylinder line broken.......			8,046
*Introducing solution		21	7,510
Electric engine repaired...	1	[illegible]	101
Shortage of retortmen.....			[illegible]
Repairs to retorts..........		58	[illegible]
*Indicator chains and floats [illegible]	30		2,682
*Hoisting engine out of or[illegible]			[illegible]
*Classifying ties for treat[illegible]			[illegible]
*Vacuum on other charges..			12,438
Repairs to tanks...........			402
[illegible]		45	2,280
Shortage of cars for loading		01	4,559
*Weighing of bridge timber and test ties............		51	[illegible]
Miscellaneous delays in [illegible]		4	4,291
Total	[illegible]	4	[illegible]

Av. No. of hours [illegible] ....[illegible] hrs. [illegible] min.
Av. No. of ties per charge.................... 670.5
No. of working retort hours in year 1909...22,104
No. of working retort hours delays........ ....4,003 hrs. 45 min.
Total time entire plant was on delay..18.11 days

*Delays caused by faulty design.

TABLE III.—DAILY AND YEARLY CAPACITY OF PLANT IN TREATING SEASONED TIES.

Process	Hours per Charge	[illegible] Treated per Day	No of Ties Treated per Year (300 days)
Lowery	[illegible]	13,600	4,104,000
Card	[illegible]	9,900	2,970,000
Zinc Tannin	6 Hrs 30 Min	8,300	2,490,000
Allerdyce	[illegible]	8,300	2,490,000
Creo-Air	5 Hrs 00 Min	10,900	3,270,000
Straight Creosote	[illegible]	9,900	2,970,000
[illegible]	[illegible] 30 M[illegible]	9,900	2,970,000

An Analysis of the Stresses in Guy Wires.

[illegible] quiry in regard to the stresses in steel wires [illegible] Upon investigation he was unable to find any treatment of the subject and began an investigation which resulted in the following demonstration.

Steel stacks which are not self-supporting are usually supported by one or more sets of wires, each set consisting of four wires even-

Fig. 1—Typical Arrangement of Guy Wires for Stack.

[illegible] is shown in Fig. I. [illegible] the plane of the paper. With OC in a vertocal position, and with no horizontal force tending to overturn the stack, the two wires AC and BC will assume the same form. Each will exert a force at C, but under the conditions assumed the horizontal component in AC will be just equal but opposite in direction to the horizontal component in BC, so that the two acting together will have a horizontal resultant equal to zero and will therefore exert no horizontal force upon the stack. Suppose that some external force such as the wind acts upon the stack and moves it to some [illegible] the position AC' and BC the position BC'. By inspection it is seen that the horizontal component of AC has been increased and that of BC decreased. The two acting together now exert upon the stack a horizontal force equal to the difference between the horizontal components of the stresses in the two wires. This force tends to return the stack to its original position and has been designated by the writer as the *righting force*. The guy wires produce this righting force when, and only when, the top of the stack moves out of the position which it occupies when no external force acts upon it.

It is evident that the less the initial strees in the wires the greater the displacement of the stack required to produce a given righting force, and also the lower the initial stress the greater the ratio of the righting force to the maximum stress in the wires. An analysis of the problem involves the determination of the relation existing between the four variables, initial stress in the wire, deflection of the stack, horizontal righting force, and the maximum stress in the wire. It was found that the mathematical relations between the quantities involved are so complex that the numerical solution of any specific problem would be impractical. The writer, therefore, undertook the solution of typical cases in order to get data from which curves could be platted for use in the solution of specific cases. The cases considered are those in which $a = 100$ ft. $b = 50$ ft., and $a = 100$ ft. $b = 100$ ft., (see Fig. 2) when the horizontal component of the initial stress in the wire had the following values: 1,020 lbs. per sq. in., 1,700 lbs. per sq. in., 3,400 lbs. per sq. in., 6,800 lbs. per sq. in., 10,200 lbs. per sq. in., and 13,600 lbs. per sq. in. If the length of the wire whose weight is equal to the horizontal component of the stress in the wire be represented by c, the above stresses would correspond to values of c equal to 300 ft., 500 ft., 1,000 ft., 2,000 ft., 3,000 ft., and 4,000 ft. Plate 2 of Fig. 3, is for wires for which $a = 100$ ft. and $b = 100$ ft. It shows the relation between the deflection of the top of the stack and the resulting horizontal component of the stress in the wire. This curve was originally drawn for a wire having an initial value of $c = 1,000$ ft. but can be used for other cases in which $a = 100$ ft. and $b = 100$ ft. by properly shifting the origin. Plate 1 of Fig. 3 is the corresponding curve for the case in which $a = 100$ ft. and $b = 50$ ft. The portions of these curves to the right of the origin are for the taut wire, and the portions to the left are for the loose wire. Plate 3 (Fig. 4) was derived from Plate 1, and Plate 4 (Fig. 5) from Plate 2, as follows: Consider two points on the curve of Plate 1,—one a certain distance to the right of the origin and the other an equal distance to the left. The value of the ordinates of these two points gives the horizontal components of the stresses in the wires, and their difference gives the righting force resulting from a deflection represented by the abscissæ of the points chosen. In this way a number of points can be transferred from Plate 1 to Plate 3 and the curve on Plate 3 determined. This has been done for different values of the initial stress in the wire as indicated above for both Plates 3 and 4. The relation between righting force and deflection is given by the lower curves, and the relation between stress in the wire and deflection is given by the upper curves.

In the equation of a catenary, used in developing this method, all the quantities can be represented by lines. That is, if a catenary with a given value of c is drawn to a given scale, the same curve can be made to represent some other catenary by changing the scale of the drawing, but the value of c for the second catenary must bear the same ratio to the value of c for the first as the true value represented by any ordinate of the second catenary bears to the true value represented by the same ordinate of the first catenary. That is to say, while Plates 1 to 4 were originally drawn for cases in which $a = 100$ ft. $b = 100$ ft. and $a = 100$ ft. $b = 50$ ft., by properly changing the scale they will apply to all cases [illegible] $a = b$ equals n times 100 ft. the value of the maximum stress in the wire to be read from the curve would be the allowable stress divided by n, and the initial value of c to be [illegible] n, while the deflection and the righting force would be the values read from the curves multiplied by n. That is, the scale of the curve is changed by properly introducing the factor n.

As far as the writer is aware, but little is known regarding the value of the initial stress which is desirable. As it is increased, the righting force for a given allowable stress in the wire is decreased, and as it is increased the rigidity of the stack is increased. The value chosen should be such as to give the necessary rigidity and at the same time give as high an efficiency as possible. Some idea of the location of this happy medium may be

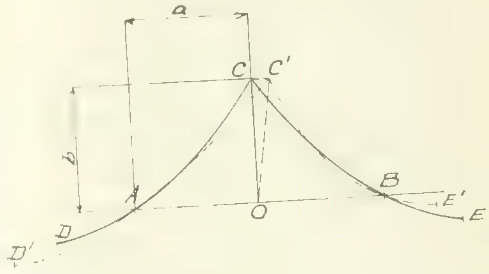

Fig. 2—Position of Guy Wires with Stack in Normal, and in Deflected Positions.

obtained from a study of Plates 3 and 4. It is seen in both cases that as the initial value of c increases a high degree of rigidity is first obtained when c is about 1,000 ft. With c much below this value, a considerable deflection is required to obtain any considerable righting force, as is seen from the curve for which $c = 500$ ft., while with $c = 1,000$ ft. the ratio of the righting force to the stress in the wire is quite large. In view of this fact the writer suggests that $c = 1,000$ ft. be taken as the proper value to use when the ratio of a to b varies from 1 to 2 and $a = 100$ ft. This value of c corresponds to an initial stress of approximately 4,900 lbs. per sq. in. when [illegible] 3,900 lbs. per sq. in. when [illegible] for a steel wire. When $a = n \times 100$ ft., the proper initial value of c to be used to correspond to the above would be $n \times 1,000$ ft.

Considering the numerical solution of a problem in which $a = 100$ ft. $b = 100$ ft. and the allowable stress in the wire is 16,000 lbs. per sq. in., in which it is desired to find the proper size of wire to be used if the stack is acted upon by an overturning moment equivalent to a horizontal force of 6,000 lbs.

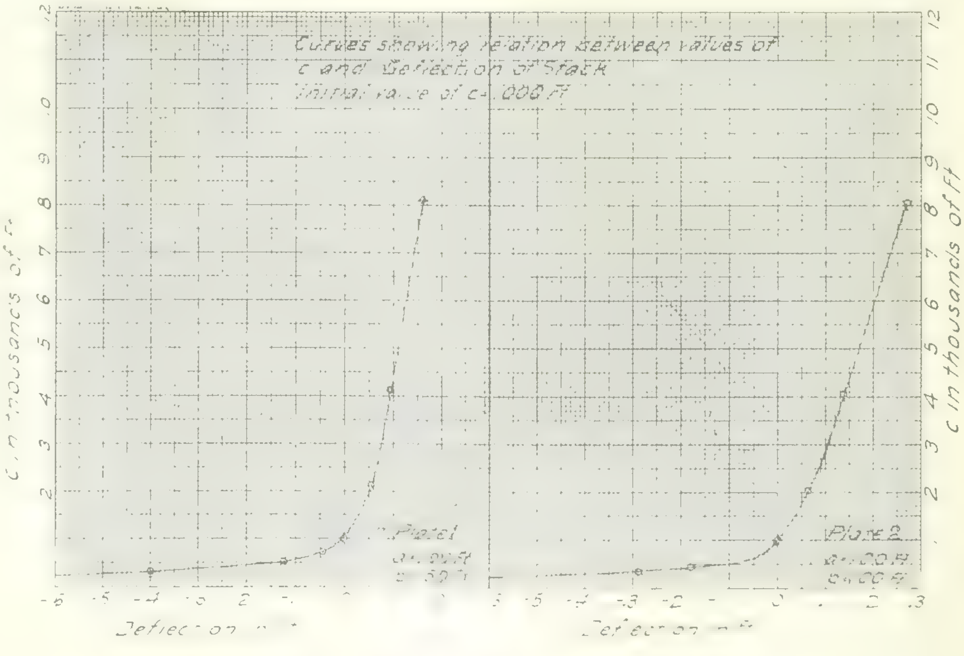

Fig. 3—Plates Showing Relation Between Values of "c" and Deflection of Stack.

[illegible] Western Society of Engineers, Chicago, May 3, 1911.

applied at the point where the wire is fastened to the stack. Reading from the curve for $c = 1{,}000$ ft. on Plate 4, the deflection is seen to be 0.110 ft. and the righting force is 9,400 lbs. per sq. in. The area of the section of the wire would be 6,000 divided by 9,400, or 0.638 sq. in. If the same problem had been solved by considering the wire on the taut side only, neglecting the loose wire, and considering it as acting at an angle of 45°, the righting force would have been 16,000 divided by the square root of 2, or 11,300 lbs. per sq. in. That is to say, with an initial value of $c = 1{,}000$ ft. the slack wire causes a loss of possible righting force of only 1,900 lbs. per sq. in., or 17 per cent, and allows a deflection of only 0.110 ft. at a point 100 ft. above the base of the stack.

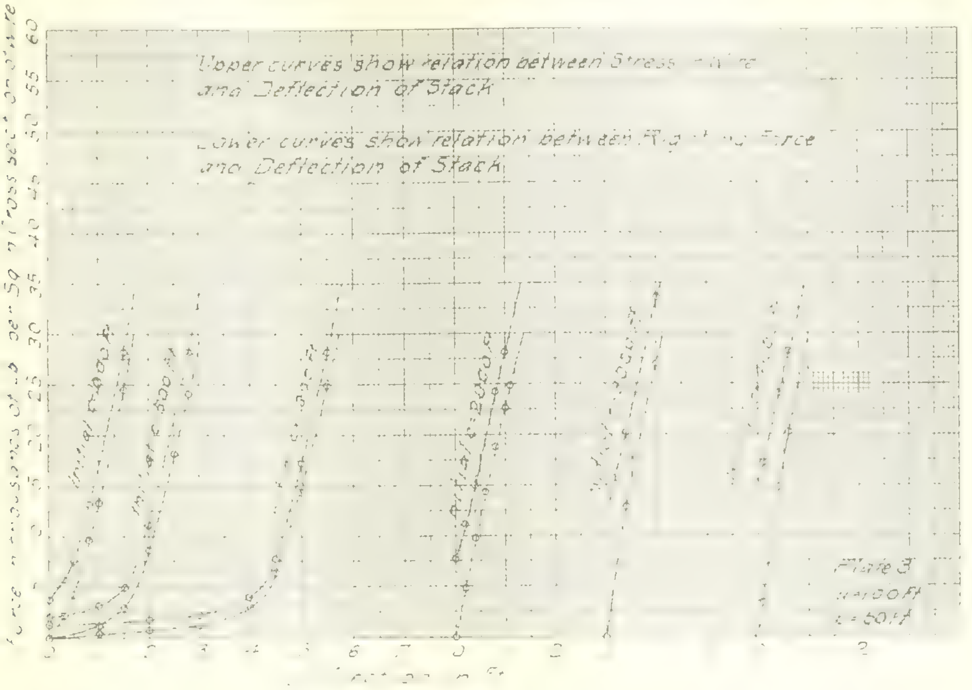

Fig. 4—Stress in Wire, Righting Force and Deflection of Stack, When a = 100 Ft. and b = 50 Ft.

Consider the solution of the above problem with the wire fastened to the stack at the same point as before, but take the ratio of a to b equal to 2. That is, $a = 200$ ft. and $b = 100$ ft. The initial value of $c = n \times 1{,}000$ ft., in which $n = 2$. The value of c to be read from the curve is 1,000 times 2 divided by 2, or 1,000 ft., and the allowable stress to be read from the curve is 16,000 divided by 2, equals 8,000 lbs. per sq. in. Reading from the curve for $c = 1{,}000$ ft. on Plate 3, the deflection is 2 times $0.052 = 0.104$ ft., and the righting force is 4,800 times 2, or 9,600 lbs. per sq. in. The area of the section of the wire is 6,000 divided by 9,200, or 0.625 sq. in. If the taut wire only had been considered and that considered as acting in a straight line having a slope of 1 to 2, the righting force would have been 16,000 divided by the square root of 1.25, or 13,560 lbs. per sq. in. That is to say, with an initial value of $c = 2{,}000$ ft. the slack wire causes a loss of possible righting force of 3,960 lbs. per sq. in., or 29 per cent, and allows a deflection of 0.104 ft. Since the section of the wire is about the same, and the length of the wire is considerably greater in the second case than in the first, and as there is but little difference in the deflection in the two cases, it would seem that an arrangement of the wires so as to give a slope of 1 to 1 is better than with a slope of 1 to 2.

In the first numerical case considered above, it was noted that the slack wire had but little effect upon the value of the righting force for a given stress in the wire, causing a reduction of only 17 per cent from the maximum theoretical possible. If, however, the initial stress had been greater, the reduction in the righting force would have been considerably more. For example, take the conditions of the problem the same as before except that the initial value of c be taken at 2,000 ft. Reading from the curve on Plate 4 for a stress in the wire of 16,000 lbs. per sq. in., the deflection is 0.051 ft. and the righting force is 7,600 lbs. per sq. in., or a reduction of 3,700 lbs. per sq. in., or 32.7 per cent below the maximum possible. If c had been taken equal to 3,000 ft., the deflection would have been 0.012 ft. and the righting force 2,400 lbs. per sq. in., a reduction of 8,900 lbs. per sq. in., or 79 per cent. These figures bring out quite emphatically the necessity of keeping the initial stress as low as possible without endangering the rigidity of the stack.

Ordinarily [illegible] equipment is not available for measuring the stress in the wire and the use of such equipment would hardly be practical. However, a study of the curves shown on Plates 1 and 2 (Fig. 3) will suggest a means of determining the point at which the proper stress has been induced in the wire. By referring to these plates it is seen that each curve is made up [illegible] sharp curve. When the stress has been increased to the point of sharp curvature, any further deflection of the stack is due almost entirely to the elongation of the wire. That is, after this point has been reached any further increase in the stress in the wire causes but little reduction in the sag in the wire. Also, after the stress is increased up to this point, any further taking up of the wire will cause an abrupt increase in the stress in the wire which ought to be noticeable in the equipment by which the stress is induced. For ordinary cases the wire ought to be stressed up to this point but not beyond it for the best results.

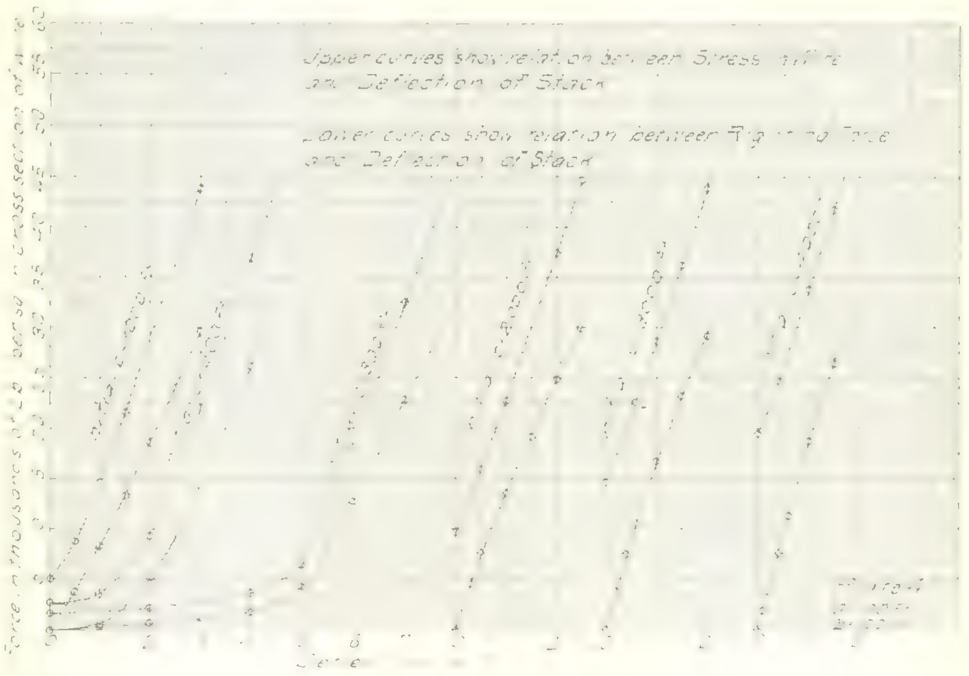

Fig. 5—Stress in Wire, Righting Force and Deflection of Stack, When a = 100 Ft. and b = 100 Ft.

Record of a Drifting Contest.—The Vekol Mining Co., near Casa Grande, Pinal County, Ariz., is advancing a drift in hard blue limestone from the 120-ft. level. The size of the drift is 8x6x4½ ft., and the working face is now about 500 ft. from the shaft. The drilling is done with a Sullivan 2¾-in. air drill on a double screw mining column. Two drill runners recently had a contest to see which one could break the most rock in five shifts, with results as follows, as given in *Mines and Min-* [illegible]

The time for setting up included the time required by the men in walking from the shaft station on the 120-ft. level until the air was turned on at the drill. The total working time included setting up, drilling, tearing down, loading, and blasting. Seventy-five pounds of 1¼-in. powder were used per round of holes. A Sullivan straight-line, two-stage compressor furnished power for the drills at 110 lbs. receiver pressure.

A large steel arch bridge is being erected at present over the St. Croix River seven miles north of Stillwater, Minn., on the Minneapolis, St. Paul & Sault Saint Marie R. R., known as the "Soo line." It consists of 5 arch spans of 350 ft. each, exclusive of the viaduct approaches. The arches contain one particularly novel feature in design, by means of which the arches have practically three hinges for dead load and temperature and two hinges for live load. The bridge is 150 ft. high.

[illegible] 3-hinged spandrel braced arch bridge over the Crooked River in Oregon, for the Oregon Trunk Ry. Its span is 340 ft. This railroad is to connect with the Spokane, Portland & Seattle Ry. at the falls of the Columbia River at Celilo by means of a bridge with simple truss spans, which is now under construction.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Appraisal of Gas Properties in Chicago, and Investigation as to Reasonable Rates for Gas.*

Valuation of Physical Property.

[illegible] a gas utility is entitled to a reasonable rate of return, consistent with the risks inherent in the business [illegible] the fair present value of the property used and useful in the production, [illegible] sale of gas. The value consists of two principal divisions, namely: the [illegible] value and the intangible or going value of the plant. The former value embraces the land and buildings of the company, distribution mains, services and meters, gas holders, horses and vehicles, stores on hand and the allowance for working capital. The going value of the plant exists by virtue of the plant being a live, operating unit, supplying gas to those customers who have been induced to subscribe to the service, thus giving to the company an established income, in the development of which large expenditures have been made in one form or another by the investor and doubtless numerous losses sustained. Together, they constitute the legitimate and honest investment of the stockholder and represent the amount on which he is entitled to a reasonable return.

To arrive at the value of the property several methods are possible, any one of which may be satisfactory or unsatisfactory, depending upon the condition of the construction records of the company and the conditions under which the plant was constructed and the business developed. The value of the plant for the purpose of rate adjustment cannot be computed from the cost records alone. It must be determined from a consideration of all the elements making for value, of which the principal ones are the original cost of the plant, its reproduction cost new as of today, its reproduction cost new less depreciation to show the fair present value, the cost of developing the business, the amount of outstanding securities and the earning capacity of the plant. No formula or mathematical rule can be blindly followed, but from all the facts and elements of value it is necessary to apply a reasonable judgment to the end that substantial justice shall be done to both the public and the investor.

In this instance the methods of arriving at the value of the plant have been restricted by conditions over which neither the city nor the company had entire control. The present property is a consolidation of several competing plants, the records of which are not available today. Many of the books and records of the merged companies were never turned over to the consolidated company. Even if they were in its possession today the data could not be given the greatest consideration because of the conditions under which such plants were constructed. Several plants were poorly erected, with insufficient regard for the future wear and tear of the property and often represented unnecessary duplication of facilities. To attempt to analyze the construction account from the company's records today would, therefore, be impossible, both because of the incompleteness of the records and because abnormal charges have been made to this account which cannot be considered as capital today. The value has, therefore, been arrived at by the appraisal of the property.

Ordinarily, in undertaking an appraisal the first step would be to make a complete detailed inventory of all the property of the company, to be followed by a study of the local conditions affecting the cost of such work, the age of each unit of equipment, the degree to which it has been maintained and its adaptability to the service required, together with the determination of the unit prices to be used, and, finally, the application of such prices to the determined inventory. In the present case much of this work was not undertaken for the reason that a complete inventory in general carefully prepared was submitted by the company through its engineers. The inventory was submitted in the following groups: (1) detailed description of each important building and unit of apparatus; (2) tabulations of the size and mileage of mains; (3) the number and size of meters and services in use; and (4) field books which contain the miscellaneous items, such as cast and wrought iron piping, tools, fences, docks, walks, paving about the plant and sundry small items. The cost of reproduction for each of the items mentioned was included with the inventory, which was sufficiently detailed to enable the unit quantities to be checked. This was particularly the case as regards buildings and foundations. Exhibits were also available showing the method of arriving at the cost of the various parts of the distribution system. While the inventory made unnecessary the detailed field work of checking and classifying every piece of property, it was not accepted without an inspection of all the plant and a check of the more important items included in the exhibits in order to prove their correctness.

APPRAISAL.

The value of the land owned by the company was obtained from an appraisal of this property made by the valuation committee of the Chicago Real Estate Board. This appraisal was submitted by the company as its estimate of the land value. The classification was checked against the land occupied by the company and which it was reported to own. The reasonableness of the appraisal was verified by comparing the amounts with the prices paid for land in the neighborhood of the parcel under consideration. The values so furnished were accepted as representing the best evidence available.

The company's detailed building inventory was checked item for item in making the appraisal of this portion of the property. Building plans on file with the company were examined before any inspection of the premises was undertaken and important dimensions were checked. Where the building plans were not available it was necessary to secure all the information by visits to the structures in question. In addition to checking the quantities, the inspection work also covered a general examination in order to determine the specifications for all materials, the character of the maintenance and such additional matters as would affect either the cost of construction or the present value. The depth of underground foundations was taken from the plans and from the statements of superintendents, and in each case it was determined whether it was in keeping with common practice for similar soil conditions. The unit prices applied to the quantities found were compared with the company's own records covering the construction in question. Local contractors, including some who had performed a large portion of the company's work and who were familiar with present conditions in this city and vicinity, were interviewed as to the cost of labor and material. The prices used in each case covered the actual cost of the work, plus a fair contractor's profit. Where it had been necessary to remove dirt from the premises, the excavation cost was made sufficiently high to cover such expenses. The value of the new office building just completed for the company was taken from the company's books.

To prove the inventory submitted for the machinery and apparatus each station was visited by machinery and building inspectors, separate forms were prepared upon which were classified the various units of apparatus reported by the company and their correctness as to type, age, workmanship and per cent of condition noted. Where the inventory was insufficient additional information was secured in this manner. Besides checking the items contained in the inventory, these inspections embraced a general survey of each station, particularly with a view of ascertaining the probable accuracy of the numerous items included in the field books. While the machinery was examined with the same detail as would have been followed had no inventory been available, it was much simplified by the co-operation of the company in this manner, since the apparatus was listed and it was necessary only to verify the inventory and to record information not contained therein.

In arriving at the unit prices to be used, an effort was made to have the figures represent present conditions in the city of Chicago. Prices for iron and steel, cast iron pipe, labor and all other items entering into the cost of construction fluctuate from year to year with the condition of business, as is reflected in the cycles of industrial activity and depression. Because of these conditions it was necessary to use average prices, since to use either the highest or lowest prices during the last five years would be equally unfair. In comparing such prices with those actually paid by the company it was observed that because of its very large requirements each year and the facilities and skill of its officers in the making of purchases, it was able to secure contracts at substantial concessions from the prevailing market prices. The position of the company in this respect is typical of large industries generally. It is well known that there is considerable difference in the ability of companies to purchase at low figures. As a rule, the larger companies are able to purchase more favorably than the smaller ones because of their larger requirements and also because of more favorable market and shipping facilities in large cities. There are, however, obstacles which tend to increase costs due to the higher wage scales prevailing in large cities and the additional costs incurred in construction work because of the congested traffic conditions in the streets. In this instance, however, there can be no question but what the company is securing prices on contracts which on the whole compare very favorably with the general market. It is therefore evident that local conditions and the particular facilities of the company in question must be given full consideration in determining the proper units to apply in the appraisal of a given property.

In general, the benefits of favorable purchase of operating supplies and material for construction purposes belong to the investor. To deprive him of the benefits due to skill in management and operation would be to destroy every incentive for economy and efficiency. It does not follow, however, that every economy is to be credited to the company, for the public is entitled to the benefit of that degree of intelligence and technical skill which can reasonably be expected of men entrusted with responsibilities of administering a property so large as the plant in question. The best evidence of reasonable prices to be used for this purpose was, therefore, to be found in the records of the company itself. Wherever possible, examination was made of the company's contracts and vouchers to determine how favorably its purchases were made, and from such records averages were taken. For this purpose a large number of contracts was submitted by the company for cost analysis. Prices which departed materially from the average, or were at great variance with the market, were submitted to the officials of the company for additional information and explanation. Wherever it appeared that a contract was placed at a price in excess of what was reasonably to be expected under the circumstances, the amount was reduced. In those instances where it appeared that the company secured an extraordinary bargain, the benefits of such saving were allowed to the company and only those prices were used which appeared reasonable and just. In the figures as finally adopted the average embraced many instances where the unit costs as shown by the company's own records were slightly increased.

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*[illegible] of report made by Wm. J. Hagenah, in charge of gas investigation [illegible] the Gas Subcommittee of the City Council of Chicago, Ill., 1911.

In placing values on specific apparatus various features were considered. In general, machinery of the same capacity varies greatly in price, due to the quality of the material, the character of workmanship, the type of construction, the use of patented devices and other features. The unfairness of using a single unit price for all machinery of the same capacity was at once apparent. In the present appraisal an effort was made to give careful consideration to every feature, and the more important units of equipment were appraised only after additional information had been secured. Where such machinery was installed under contract, the detailed costs thereof were easily analyzed. Where the installation was made by the company itself an addition was made covering the costs which would reasonably be incurred in the proper placing of the equipment under normal conditions.

It was found that during the last few years several classes of machinery, particularly water gas generators, had been built by the company for its own use. The actual cost of construction in each case was obtained and was found to be much below the price for which such equipment could be purchased in the open market. The prices for units of substantially the same character were obtained from the various manufacturers for comparison with the costs as shown in the company's records. In placing the value on this equipment for the purpose of this appraisal the figures used contained an addition of what was believed to be a fair allowance for burden and profit to the actual cost of the apparatus. In this manner the economies of construction due to the peculiar facilities developed by the company were credited to the company, for it was believed that the public was entitled to no better price than the most favorable price which the market provided for a unit of similar capacity and efficiency.

Considerable difficulty was encountered in determining the reasonableness of the value placed upon the items included in the field books. They constituted an unclassified mass of unlike items, ranging in value from a few cents to thousands of dollars. To properly arrive at what constituted a fair value for this property it was necessary to classify the many items into fourteen separate groups and to apply the proper units in each case. The prices of most of the classes of property as submitted by the company were found to be substantially correct. The same was true with regard to the allowance for labor wherever this entered as an element of cost, although in a few instances revisions were found necessary. The value of such large items as docks, tracks, paving and sidewalks at stations, fences, etc., were revised where specific instances showed such to be necessary. In a number of cases the company's basis of estimating the value of the work in question was not accepted and additional information was secured from the general officers. Numerous conferences were held in which the differences were thoroughly discussed and in most instances a conclusion was arrived at which was accepted as substantially correct.

In the appraisal of the company's holders the method used was similar to that used in valuing the machinery and apparatus. Equipment of this character cannot be valued on a cost per unit or capacity basis without detailed information concerning the type of the apparatus and the conditions surrounding its construction. In this instance it was necessary to secure all the information which was afforded by the specifications covering the foundation work and the erection of the steel work. The masonry work was estimated on the basis of present prices for concrete, brick work, excavation and piling, and the values arrived at were in general somewhat above the contract prices. Detailed estimates of weight for holders of various types of construction were made. In arriving at the final values, full consideration was given to market prices and the type of construction in each instance. The large holders were valued on what amounted substantially to a pound-price basis.

In appraising the distribution system different methods were necessary. Owing to the fact that the mains and services could not be inspected, it was necessary to resort to the records of the company. These records consisted of maps and atlases drawn carefully to scale and showing the proper location of the mains, valves, drips and specials. The atlases of the company were drawn to a scale of 100 ft. to the inch. This scale was carefully verified and found to be correct. All such maps were scaled and each run of pipe located and the points between which it was laid, together with the size of the pipe and the date when laid, were noted. This record was summarized to show the different sizes of pipe and the amount of each size, and also the amount of pipe laid during each year. The total length of pipe as scaled from the company's records was somewhat less than the total as arrived at from the records of the consolidated companies, but agreed substantially with the company's own scaling of the atlases. These maps were prepared by the company since the consolidation in 1897 and have been corrected wherever errors and omissions were found. They have been tested by making excavations at various points, and it is believed they constitute the best record of the extent of the distribution system. As a test of the accuracy with which the scaling from these records could be done, the 24-in. main laid during the last two years was totaled from the original work orders and scaled, the amount so obtained agreeing with the record length within two-tenths of one per cent.

In arriving at the present unit costs to be applied in the distribution system, it was decided to use the company's records of actual expenditures for a number of years, believing that these costs most nearly represent the cost of such work today under the conditions which prevail in this city. With this in view, the various individual construction undertakings shown by the atlases to have been made within the last ten years were analyzed and the original work orders which are used in the regular course of business by the company were secured. This analysis did not include all the pipe laid during these years, because in a number of cases the construction work as entered on the record did not show the date when the work was performed. The analysis, however, did include construction work on all sizes of pipe between 4 ins. and 30 ins. in diameter, and may be regarded as representative of the cost of laying mains not only during these years, but as a fair unit cost for the present. These work orders showed in detail the amount of material used and the labor employed. The material included the pipe, specials, small fittings, lead, coal, blocking, etc. The labor was shown in the detailed statement in such form that it was possible to determine the expense for foremen and supervision, calkers and common labor. To secure this detailed information, it was, therefore, necessary to analyze and tabulate these work orders. Many hundred of such orders, including over three hundred 6-in. pipe construction orders and all orders where other than 6-in. pipe was laid, were analyzed in this manner. From the summary of all such tabulations it was found that the costs were substantially the same in the three districts in the city, i. e., the North Division, the West Division and the South Division. For this reason a single unit cost was used for the different classes of property throughout the city. In arriving at the total as thus used, full consideration was given to the relatively higher cost of construction work where small amounts were involved. The cost of 4-in. pipe and 30-in. pipe appeared abnormal, due to the fact that so small an amount of pipe of these sizes was laid. Since the work orders did not contain any provision for the use of tools and teams, it was necessary to make adjustments for this purpose. The work orders did include the cost incurred in disturbing paving where this was done, but did not include the cost of repaving. Every effort was made to have the final units agree, in so far as appeared just, with the actual construction costs as shown by the company's records and conditions known to exist at present.

The most important item of material in the distribution system is the main pipe. Cast-iron pipe varies widely in price at different times of the year, and also from year to year. It being the object in this appraisal to use prices which are representative of present conditions, and which it is believed could be secured in the reproduction of an enterprise on a scale of the property in question, it seemed advisable to use a unit which would be an average price over a number of years. It is a matter of common knowledge and substantiated by the records of the company, that the largest purchases of pipe are not made at a time when prices are the highest. As a rule, purchases are made on a more liberal scale when prices are low, at which time contracts are entered into covering the requirements for a considerable period of time, deliveries being made as called for. In fixing the price for this pipe the company's contracts for cast-iron pipe from 1901 to 1910 were tabulated. The variation in price ranged from $22 to over $34 per ton. Since a comparatively small amount of pipe was laid when the price was at the highest, it would appear unfair to use an average of these two figures. A weighted average was, therefore, used, which was secured by multiplying the contract price for each year by the number of tons purchased at the particular price as shown by the contract. The total of such figures was the total amount of pipe purchased and the total prices paid, from which was computed the proper average price of $26.10 per ton. Due to the differential which usually exists between the large and small sizes of pipe, an allowance was made of $1 additional, so that the average cost of $26.10 per ton was used for 6-in. pipe and larger sizes, while $27.10 per ton was used for 4-in. pipe. Since these prices did not include the cost of teaming nor the use of tools, adjustments were necessary and a percentage computed from the company's records was allowed to cover these expenditures.

The method of arriving at the cost of services was similar to that described in regard to mains. It was, however, impracticable to secure all the original work orders, but instead a recapitulation of these work orders was used which had been compiled from year to year by the company in the regular course of its business. These summaries were kept with much detail prior to 1904, since which date much less information is contained in the records. A careful analysis was made of all the records in possession of the company for the period from 1900 to 1904 covering 1½-in. service pipes, which is the size of the greatest number of services. By making comparisons it was found that the cost of labor per service was substantially the same in recent years as it was in the years immediately preceding 1904. The price to be allowed for the service piping was the same as that used by the company for wrought-iron pipe at the station, to which cost was added 1½ cts. per ft. to cover the cost of preparing pipe with protective coatings. It was also necessary to adjust the average cost used for fittings because it was found that certain services were installed without a curb box and cock. From all the data which could be obtained and the tabulations based upon the records, it was decided that $1 for fittings represented a fair average for 1½-in. services and those of smaller size. The larger services were allowed curb box and cock, the cost of which was taken from the summarized cost of the services. The labor cost on the larger services varied greatly, with the result that the average cost was uncertain. Special attention was directed to the irregularity shown in the analysis of these larger services, and the resulting figure arrived at is believed to be fair to the company and to the public. The amount involved in connection with the larger services is comparatively small and could not appreciably affect the result. The service pipes when finally installed consist of a number of small articles which are handled through storehouses, making it necessary to add a reasonable charge for warehouse and storage service and also a charge covering the cost of tools.

The value of meters and meter connections in this appraisal is based on the present actual cost to the company. Here again it was necessary to add to the bare cost a percentage covering storeroom charges and a small additional charge to cover the handling and first test of the meter. The cost of the original installation was graded proportionally to the size of the meters, and the average cost per meter represents the average cost of installation during the last 2 years, which cost is accepted as most nearly representing present costs.

The company's value for house governors was accepted. There are in the streets a number of vaults which contain district governors used in connection with the booster system. The work orders for 54 out of a total of 58 of these vaults were secured and used as a basis for the cost of material and labor in placing governors in vaults. To the final cost in this case there was also added an allowance for the use of tools. The value of the masonry work in the construction of the vaults was taken from the contracts covering their construction. There are at present 7 tunnels under the river owned by the company. To arrive at what represents a fair price, information in addition to that possessed by the company was sought from parties acquainted with work of this character, and the unit costs for the different materials and classes of labor were obtained from this analysis and investigation.

The miscellaneous classes of property representing minor items in the inventory and valuation were accepted after investigation as being substantially correct and were so entered in the detailed tables.

Indirect or Overhead Construction Charges.

The different classified values above referred to embrace only the costs of labor and material, or the direct costs. There must be added to the cost of each item of equipment, or to the value of the sum of all such items, a certain amount to cover the indirect or overhead cost. This cost is made up of a number of items of which the most important are legal and organization expenses, engineering and supervision, interest during construction, fire and liability insurance during construction, taxes, if the period of construction is of considerable length, and an allowance for hazards and contingencies during construction. While all agree that allowance must be made for overhead expense for each of the items enumerated, much difference of opinion exists as regards the amount to be allowed. Although the valuation of the property is to be determined largely on the theory of reproduction cost, it does not necessarily follow that these costs should be determined upon a basis more or less hypothetical, but, on the contrary, that consideration should also be given to the actual costs incurred in constructing the plant in question. The records of the company are the best evidence as to what such overhead expenses should be, and full weight has, therefore, been given to the cost shown for expenditures of this character for a number of the items during the last few years. The figures used are based on the theory of the plant being constructed over a number of years, or what is generally called the piecemeal-construction plan. If all the overhead charges were based on the company's records for recent years the amount would clearly be too small. It is, therefore, assumed for the determination of this question that the plant will be reproduced over a period of approximately ten years, but it does not seem reasonable that the same units of cost which are incurred in the construction of the first half, or the first third of the plant, should be used for the entire plant. In arriving at a fair overhead charge, the assumed years of construction have been divided into three periods and the items of expense increased or reduced as shown to be justified from actual construction records and the history of the plant in question.

It is safe to assume for the purpose of this appraisal that the first third of the plant was constructed under the least favorable conditions. The credit of the company being low at this time, the addition for interest was placed at 6 per cent. It is known that the bonds issued for the first construction expenses were sold at substantial concessions. The interest charges would not apply for the full period since as soon as any part of the plant was completed it would be put into operation. Further, construction work could be carried on only during about six or eight months of the year, so that the time for which the interest must be paid would be considerably less than the full period during which the first third of the construction was completed. Engineering expense during this period is placed at 5 per cent, which is the usual charge for work of this character. Organization and legal expenses would be highest during the first period, during which time the company would be incorporated and its various contracts subject to examination and titles to property verified. It would seem that 3 per cent is a reasonable additional allowance for this purpose. One per cent is allowed for taxes. In addition to the above charges there is added 7 per cent for contingencies, hazards and omissions, making a total overhead charge of 22 per cent for the first third of the property.

During the second period of the company's construction work considerable progress would have been made and the management of the company would have reached an efficient stage. Additions for interest charges on construction during this period have been placed at 5 per cent and the organization expense at 2 per cent. Engineering expense, it is assumed, will require a 5 per cent charge, since the construction of the plant was proceeding on a very large scale and at a rapid pace. With the perfection of the organization and the development generally of the plant, it is believed that the allowance for contingencies should not be as large as during the earliest period, and 5 per cent is added for this purpose. The foregoing allowances provide a total overhead charge of 17 per cent on what represents the second or middle period of construction work.

During the third of the assumed periods it is believed that substantial economies can be secured which should be shared with the public. To provide the same high indirect charges for this period of construction as were provided for the first period would be contrary to established practice and must result in excessive overhead charges. It is an established fact that the engineering service at this stage of development was performed chiefly by the company's own staff, part of whose services were engaged for the benefit of the operating department, so that the cost thereof should be distributed over operation and construction. This is true of every large utility construction work. An addition of 4 per cent for engineering and superintendence is deemed reasonable. With the large development of business which the company has secured by this time and the protected monopoly which it possesses of the gas business, it is natural that a relatively higher credit will have been established and that money can be secured at a lower rate. An allowance of 3 per cent is added for this purpose. Organization expenses during this period will be very much reduced and consist only of the examination of contracts and titles involved in transactions connected with the extension of the plant, which requirements should not exceed 1 per cent. Contingencies are provided for in an additional allowance of 4 per cent. These additions are equivalent to 12 per cent of the direct costs during the last third of the total plant construction. The allowance for overhead or indirect charges on the total property is, therefore, equivalent to the average of the rate applied during each of the three assumed periods of construction, or an average of 17 per cent. This addition is included in the tables showing the plant valuation.

It would seem that 17 per cent is an unreasonable overhead charge to add to the value of the land, since engineering expense is not incurred to as great an extent as in the construction of the plant as a whole, nor does the item of contingencies materially affect the cost of the land. The interest charge, however, should be somewhat larger than that for the construction work, since the purchase of land represents probably the first investment. Instead of 17 per cent, it is believed that 12 per cent is more nearly correct, which amount has been used in this appraisal. This allowance appears especially fair since this percentage is applied to the present value of the land instead of to the smaller amount representing the original investment.

In judging the fairness of the above overhead charges it must be borne in mind that the unit costs used in this appraisal are based upon the piece-meal construction of the property as determined from the company's records, and further, that certain portions of the property now in service were constructed under contracts which included some provision for engineering and superintendence, together with a part of the contingency expense. Since the unit prices were obtained largely from the company's records, the amounts used, therefore, include some provision for overhead charges. This, in general, is true with respect to the cost of the buildings, holders and such apparatus as purifiers, condensers and scrubbers. The addition, therefore, of 17 per cent to these costs for overhead expenses must be accepted as fair.

DISCOUNTS.

Closely allied to the subject of overhead charges, but differing in several particulars, is the additional construction charge due to discounts on bonds. In other words, provision must be made in the appraisal for the cost of the funds with which to finance the undertaking. Not to allow any sum in this valuation for discounts on bonds issued for construction purposes would be equivalent to assuming that a sum of money as large as is required to construct a plant of the magnitude of that under investigation could be obtained for investment in a somewhat hazardous undertaking without any price for such funds. It would be equivalent to assuming that capital seeks such investments without inducement, being willing to incur the risks of the industry in return for no more than a reasonable profit. The financing of corporations in the past and at the present time clearly shows that securities bearing a fair rate of interest can rarely be sold at a price netting par to the corporation.

The amount of the discount on securities is determined by a number of factors, chief of which are the credit position of the company, the interest rate which the bond bears, the condition of the money market and the life of the bond. Naturally, the company whose business is firmly established and whose record has been a prosperous one can dispose of its construction bonds at a comparatively low discount, while a new company, untried in its field and whose business is yet in an uncertain stage of development, must pay a heavy discount if it would dispose of its issues at all. Discriminating investors find little to encourage them in paying par for an issue of uncertain merit. The security which it is sought to dispose of must compete for favor with all other investment issues in the open competitive money market and the discount there exacted must be regarded as a cost of securing the funds, just as additional charges are incurred over and above the bare construction cost in securing the physical plant. There is no escape from this conclusion, especially when the bonds cannot be sold on any other terms. It may be possible to escape the discount by paying a sufficiently high interest rate to attract capital, but such a step would mean a heavy burden on the earnings throughout the entire life of the bonds.

Under normal conditions the discount on bonds is almost inevitable. The amount of such discount may be charged to capital or to operating expenses. Where the utility cannot be constructed at the time when the public demands the service to be furnished, except through the sale of its securities at a discount, such discount creates a charge which the public should bear as the cost of securing the service at such time. If the construction work had been postponed until the money market was more favorable or until the city had grown to a point where the success of the industry was made more certain, the public would have been deprived during such period of the benefits which the company was to furnish. To supply a large amount of money at a particular time entails heavy expenses. These charges must be met by some party. The company cannot escape paying the amount of the discount at some future date, and its financial program must be shaped with this end in view. If operating expenses are to be charged with the discount the company must be very prosperous in order to have sufficient margin over its current charges and the fixed expenses on prior issues of securities. It would also mean that the cost of securing the utility through this method would be paid for by those who used the service during the early years of development. To charge the discount to construction means that until amortized through sinking-fund operations the customers throughout the life of the bond are gradually meeting this charge. Under certain conditions discounts should be wiped out through the surplus account or a suspense account, but under financial conditions most frequently encountered they must be considered as a cost of construction, and in this disposition officials of the company have practically little choice.

If the discount is to be charged to construction, and this would seem to be proper, especially where it is known that most of the securities of this company were put out at a substantial concession, it becomes a problem to determine the amount of such allowance. Clearly the discount would be highest during the early years of development, and much reduced when the success of the plant and its earning capacity is established. Under normal conditions, such discounts range from 5 to 20 per cent as affected by the facts in each particular case.

It is known that some of the bonds issued for construction purposes by this company, and bearing interest at the rate of 6 per cent, sold at a price as low as 80, or at a discount of 20 per cent. The most recent issue of bonds sold at a price fractionally under par. In most instances, prior to 1897, the discount was in excess of 10 per cent. In arriving at an amount which fairly represents the discount charge to be allowed here, consideration has been given both to the price for which the different issues have been sold, or cost of construction theory, and to what would be a reasonable discount today under the cost of reproduction theory. The former was entirely a matter of record. The latter was determined from interviews with those familiar with the sale of securities and a study of the investment market. From both the weighted average of the discounts on the bonds issued since the consolidation in 1897 and the probable discount on the securities if the plant were reconstructed today, it is believed that an allowance of 6 per cent for this expense is reasonable.

[illegible] OF PROPERTY.

Not all of the property owned by the company is being used in the manufacture, distribution and sale of gas to the people of Chicago. Aside from the investment in land, buildings, apparatus, holders and distribution system used directly for this purpose, considerable property is used exclusively for the distribution of natural gas, a separate service which the company is furnishing under a franchise of one of the companies embraced in the consolidation of 1897. The company also owns some real estate which it acquired in the settlement of obligations due to it, which property is now being rented. Certain of the old manufacturing stations acquired in 1897 have since become unserviceable and a part of one of them has been rented to the Pintsch Gas Company, which manufactures gas for car-lighting purposes, while a portion of another plant has been rented to a manufacturing company. The company is also the owner of a large modern office building, only a part of which is used for its own purpose. Apportionments have been made of all the property so as to determine what amount is used and useful in the manufactured gas service and the natural gas service and what amount is to be considered as commercial property. The separation between the manufactured gas property and the natural gas property has been made to enable a cost analysis for each service.

Table I shows the classification of the physical property and the additions to the direct costs representing the overhead or indirect charges and also the discount on the securities represented by the amount of the plant cost. The property has been classified so as to show both the cost new and the present value of the investment in the manufacturing stations, distribution system and the miscellaneous equipment, with the subdivision of the property above referred to showing the investment in manufactured gas property, natural gas property and commercial property.

[illegible]

The difference between the reproduction cost new of the physical property and its present value is $6,786,538, which represents the estimated depreciation through wear and tear and obsolescence. To offset this reduction in value, the company should have created a depreciation reserve to which should be credited annually [illegible] charged to operating expenses equal to the estimated depreciation of the plant during the year. The rate of return to which the investor is entitled should be applied on the fair present value of the property. If the property has depreciated, and no allowance has been made to restore the capital so consumed, the rate of return must apply on the depreciated value of the plant instead of on the cost new. If, as a matter of law, the present value of the plant is equal to the reproduction cost new, less depreciation, the present value of the investment should be enhanced by an amount which the company has set aside for the replacement of those units which have decreased in value through age and use. The company in this case has charged operating expenses annually with an amount which it deemed sufficient to offset the depreciation. These charges, although large in the aggregate, are not sufficient to equal the difference between the cost new and the present value. The reserve for depreciation on December 31, 1909, as shown by the company's books, was $1,617,095. In some respects, the amount shown to the credit of such a specific reserve is largely a bookkeeping transaction, the important consideration in each instance being whether the company actually possesses property which, if not set aside for specific depreciation purposes, could be set aside without doing violence to any other obligation. This is believed to be the situation here. The company has earned large sums during recent years [illegible] might have set aside for depreciation had the officers so decided. Its earnings have exceeded, by a liberal margin, all necessary requirements; but instead of creating a reserve for depreciation sufficiently large to represent the estimated depreciation of the property, such surplus earnings have been placed to the credit of other accounts from which they may be transferred by book entry to the depreciation reserve when occasion requires. It is, therefore, assumed that the board of directors, being in a position to protect the assets of the company against wear and tear, will take such steps as will insure the maintenance of the physical investment by the use of any funds now available for that purpose, although not specifically set aside at this date for that use. Since such assets are ample in amount, the value of the physical property through the addition of these amounts is considered on the basis of its cost new.

WORKING CAPITAL.

Because of the nature of the gas industry the amount to be allowed for working capital can be determined with reasonable accuracy. Such an allowance should embrace the cash requirements of the company for current use, together with the quick assets readily convertible into cash. The amount of working capital will vary with every industry, depending upon the frequency of collections, the amount of materials and supplies tied up in the process of manufacture at any one time, the amount of supplies which it is necessary to have on hand at all times, the probable cash demands on the company, etc. An analysis of the conditions affecting the industry in Chicago indicates clearly the more important elements governing the amount of working capital.

In this connection, it must be borne in mind that the company is operating a very large business which, aside from any conditions peculiar to the industry, requires a large working capital. Its pay-roll shows many thousand employes who are paid at frequent intervals. The operating expenses constitute a very large amount, and in addition to the regular requirements in every business, to which this is no exception, demands are constantly arising which cannot reasonably be anticipated, and to meet these demands additional cash is required. To take advantage of favorable markets, the company must have available funds by means of which it can reduce both the charges to capital and the operating expense. It is desirable that all bills be promptly paid and that advantage be taken of all discount privileges. During the last few years the cash resources of the company have ranged from approximately $1,000,000 to nearly $3,000,000. From its experience during a number of years the company has found that it is inexpedient, and not without certain elements of danger, to permit the cash on hand to fall below [illegible]

The amount of material and supplies on hand as shown by the inventory is very large and at first glance appears unreasonably so. These stores consist chiefly of coal, coke and oil. The daily requirements of the company are very heavy and to insure itself in the possession of sufficient material to permit the operation of the plant without interruption due to freight congestion, strikes and unfavorable weather, large stores are necessary. If no supply were carried to guard against such contingencies excessive prices would be demanded at a time when coal strikes, rail strikes or storms prevent the movement of certain supplies, while at certain times it would be difficult to obtain the necessary material at any price. These large stores are further made necessary because the sources from which the company receives its material are long distances from this city. Favorable contracts and the choice of rail and water routes for shipment reduce these requirements to some extent, but prudence dictates that [illegible] in the inventory be kept on hand.

Against these more or less unfavorable features requiring a large working capital are the [illegible]

[illegible] in the operating expenses and inventory accounts. The amount of sales for each month is not subject to great variation and the company is, therefore, able to estimate with a considerable degree of accuracy the money which it will have at any time to meet current obligations. Under the present schedule of charges for gas a penalty of 10 cts. per thousand cubic feet is charged in case of failure to pay bills promptly. The amount unpaid at the expiration of the discount periods rarely exceeds 8 per cent. On these arrears the company receives a profit of 10 cts. per thousand cubic feet. With the city divided into many districts so that all the customers' payments are not due at the same time, the cash is received in large volume each day and the necessity for temporary borrowing from this cause is reduced to a minimum. With respect to its collections the gas company is undoubtedly in a more favorable position than a commercial enterprise doing a business of the same proportion.

The stores account, the pay-roll requirements and the current assets of the company do not fluctuate through a very wide range. Whatever changes take place are largely seasonal and can be anticipated by the officers of the company. The following table shows the range of the gas stores account, accounts receivable and the pay-roll through a twelve-months' period:

1910.	Gas stores.	Acc'ts receivable.	Pay roll.
January	$1,098,551.87	$1,856,054.41	$253,175.65
February	1,178,042.95	1,735,428.78	240,782.12
March	[illegible]	1,628,258.12	268,474.39
April	1,382,814.87	1,604,220.79	293,341.47
May	[illegible]	1,762,717.27	304,670.56
June	1,320,725.43	1,521,618.04	297,669.41
July	[illegible]	1,418,670.32	290,038.86
August	1,235,679.30	1,460,753.06	297,371.79
September	1,219,047.51	1,620,872.88	277,316.07
October	1,183,797.54	1,761,298.46	281,126.80
November	1,156,609.23	1,743,654.28	272,229.69
December	1,140,011.03	1,734,090.46	272,811.79

The best information as to what constitutes a reasonable allowance for working capital is supplied by the balance sheets showing the current assets and the current liabilities. In examining these statements it must be borne in mind that during the last three years the company has been engaged in very extensive construction work and has sold additional securities which shows in the material increase in the cash on hand. So much of the balance sheets as is material to the determination of the working capital is shown in the tabulation below for the last five years:

Current Assets:					
Cash	$1,322,664	$ 987,965	$3,207,644	$3,546,428	$4,819,934
Accounts receivable	1,220,377	1,476,514	1,485,021	1,747,491	1,734,090
Gas stores and supplies	832,398	1,384,791	1,142,873	1,071,247	1,140,011
Total	$3,375,439	$3,849,270	$5 835,538	$6,365,166	$7,694,035
Current liabilities	$ [illegible]	$1,185,272	$1,201,359	$1,187,383	$1,531,150

There is no fixed rule by which the amount of working capital can be computed. The range of maximum and minimum allowance can be ascertained with reasonable accuracy, but there are numerous demands on the company which are not reflected in the balance sheet, but must be arrived at through the application of a reasonable judgment. Among such items mention may be made of cash requirements to guard against contingencies, the allowance for temporary financing of plant extensions, the cost of gas which has been consumed by the customer since the last reading of his meter and also the cost of gas in the holders and distribution system. A review of all the balance sheet items and other factors materially affecting working capital must lead to the conclusions that an allowance for 1909 of $3,200,000 is approximately correct. This amount is, therefore, used in the computation of the investment value upon which the stockholders are entitled to a reasonable return.

Intangible Property.

The analysis showing a valuation of $49,023,947 as the cost of the property applies to the physical plant alone. This, however, does not necessarily represent the entire investment of the stockholder upon which he is entitled to a return. In addition to the physical value of the property allowance must [illegible] intangible property as the company possesses. While courts have stated in a number of decisions the various elements of value, all of which must be taken into consideration in arriving at the final amount upon which the rate of return is to be computed, all agree that the value of the property for the purpose of rate-making is substantially the reproduction value, or the value of the property at the time of the investigation, thus giving credit for every increment in value and making allowance for the depreciation which has taken place. While the strictest adherence to the reproduction theory may work hardship to one party in a particular case, the rule can be applied with reason, and when so followed undoubtedly represents the established law. On this basis the company insists that the reproduction cost includes the value of the franchise and the going value of the corporation. No specific amount was suggested which appeared fair to the officers of the company, nor was any method submitted by which these values could be determined, but it was claimed that the valuation used in the adjustment of the rates must recognize an allowance for these intangible assets, both of which are indefinite and extremely difficult of determination.

The People's Gas Light & Coke Company is operating under a perpetual franchise of its own and has secured by purchase the franchises of a number of other gas companies which have been merged into the present corporation. These franchises, it is claimed, possess a large commercial value, and to exclude them from the investment would be equivalent to taking private property for public purposes without due compensation. The term "franchise" is clearly understood and the question of its value from the standpoint of rate regulation has been the subject of court decisions, and while these are not as specific as might be desired, the reasoning of the court and the dicta of other cases suggests a disposition of the question here which it is believed will be just, in view of the conditions under which the so-called franchise value has arisen. The term "going value" has never been defined by the courts or students of public-service problems in a manner to meet with general acceptance. Its existence, however, has been recognized by all the courts and public-service commissions and it must be allowed in computing the amount of the investment. Whether such value exists as an incident of the physical plant, whether it is entirely independent of the physical value and to be determined from other sources of information, as, for example, the number of customers or the gross earnings, or whether such value may deserve no consideration as an addition to the physical plant, depends largely upon the definition adopted.

FRANCHISE VALUE

A franchise authorizes the use of private property in a particular manner and generally conveys an exclusive right. In this particular instance the right issued from the people for the specific purpose of having the grantees of that right use it for the public good in the operation of a gas utility and with such profit to themselves as was represented by a reasonable return upon the capital actually invested. There is no proof that the company paid any value for this original right. It was a grant for which the people received nothing in return except the service to be furnished. The company made no franchise investment of its own at the time or thereafter. Its expenditures in constructing the gas plant and the development of the business represented investments in the business and not in the franchise. It is only by virtue of the franchise that the business itself could be developed. The mere granting of such a franchise or privelege conveys with it no right on the part of the grantees to a separate value in the franchise above the amount paid for it, distinct from its use in the business for which it was granted, which the parties may capitalize as against the public in rate adjustment proceedings.

To grant a value for the franchise as against the public, when no payment was made therefor to the public would be to increase the value of the investment of the company and hence increase the cost of gas. The question for the purpose of this valuation is two-fold: first, does the franchise possess value; and secondly, can it possess a value and the amount thereof be excluded in arriving at what constitutes a reasonable rate? Without going into any lengthy discussion of these two questions and their bearing on the rates in this investigation, the reason for taking the course which was pursued can easily be shown. That franchises represent property is elementary. They are eagerly sought by capital for the privilege of serving the public and the promise of profit which such service holds forth. They pass from one interest to another for substantial consideration, in none of which the public ordinarily shares. These prices may be large because the profits under the existing rate schedule are liberal, but since such rates are subject to revision to a point where they cease to be unreasonable it is impossible to see how such valuation can long rest on this basis. Until the public sees fit to reduce the rates such profits are legal for the stockholders, but they do not constitute a basis for capitalization against the public.

If a franchise possesses any public value it must be such a value as will inure to the owners of the franchise because of the exercise of the privilege conveyed, subject to the legal and moral limitations surrounding it. Any value based on excessive rates is purely commercial and does not exist as against the public, since the franchise cannot justly be exercised for that purpose. Since the utility is at all times authorized to charge rates which will yield reasonable returns, it may be assumed that any commercial value which attaches to the franchise is due to the general desire on the part of capital to seek an investment from which a reasonable return can always be obtained without serious risk to the invested principal. In the last analysis payments for franchises really indicate that certain investors are willing to pay a bonus for the right to engage in a particular utility service in the city in question, the amount paid representing the capitalization of the difference between the rate of return deemed reasonable for the utility purchased and the rate which the purchasers are willing to accept on their investment. Especially does this appear true when the losses in developing the business are considered as costs and permitted in the capital account. Under this theory the commercial value of a franchise represents the price which capital is willing to pay for a safe income. If rates are always retained at the point of reasonableness no great sum will ever be paid for the franchise and if payment is made it should be to the city, in which case the amount may justly be capitalized. If payments for franchises are very large with respect to the value of the physical property it would indicate that the schedule rates of the utility purchased are too high, or, what is equivalent thereto, that the rate of return deemed reasonable is higher than it should be in the judgment of capital seeking investment.

Further, the regulation of rates may be an exercise of the police power, but it is not equivalent to condemnation, even though the market value of the property may be affected at the time. If the rate reduction is based upon correct grounds it will be because the schedule has been unreasonably high, and since the franchise was granted to serve the public only at reasonable rates, the reduction of the value due to the existence of excessive rates [illegible] the removal of a value which existed subject only to the public will and sufferance. Rate reduction, therefore, when correctly made eliminates, as against the public, the value which existed only by public consent and not as a matter of right; condemnation is the actual taking of private property for a public purpose which in its private sphere was based upon the general principles of ownership of property. In the light of these general considerations no allowance is made in this investigation for franchise value. It is not intended to claim that such franchise has no value. On the contrary, it is believed that the perpetual right to manufacture, distribute and sell gas in the city of Chicago is very valuable from a commercial standpoint, but it is claimed that as such right was a grant from the people to the company without payment therefor, or any other restriction on the freedom of its most liberal exercise, the company has made no investment as against the public upon which the latter should be held to pay a return.

While the company cannot be said to possess a property value as against the public in its authority to use its private property in a particular manner for the public good, it must be conceded that an allowance, intangible in its nature and large in the aggregate must be made, not as a franchise right but as a necessary cost of exercising that franchise. It is an elementary proposition, the correctness and justice of which must appeal to every mind, that the franchise to operate a public utility should be granted with the least possible restriction in order not to increase the capital investment, and that the company when once supplied with the franchise should be left to develop its business without hindrance and restraint in order that a low rate for service may ultimately be obtained. To charge a large sum for the franchise only adds to the interest burden to be carried by the public and likewise to heap one burden upon another in the exercise of that franchise by the company is adding costs to the business which must be met in one form or another. Fortunately for the public now, it did not exact any charge from the company in its grant of the original franchise, for which the public is free from burdensome obligations today, but in its attitude toward the gas industry in this city since the business was established, a most expensive policy has been pursued which has given rise to substantial investment rights.

The history of the gas business in Chicago extends over a period of more than 60 years. During this time there have been incorporated and authorized to operate in this city a large number of independent and competing gas plants. The details of the business development, the number of companies created, the bitter competition which ensued, the struggles of the different companies for existence, the combinations and mergers of interests and the legal warfare in state and federal courts is a matter of history. One franchise after another was granted to supply the people with gas when the streets already contained mains of sufficient capacity to supply the demand, and plants constructed under then existing franchises possessed ample facilities and were provided with ample capacity to furnish all the gas required. These franchises entirely ignored the uncontrovertible fact that gas utilities are natural monopolies and that to authorize additional companies for the purpose of creating or continuing competition only creates economic waste. The most economical construction and operation, the most satisfactory service and consequently the lowest price for gas is possible only in the recognition of the economic law that utilities are natural monopolies and that their duties can best be discharged when the franchise is held by a single company and that company regulated by proper administrative agents of the public.

It is impossible to trace the history of the gas business in Chicago without realizing that the policy pursued has created tremendous losses. Plants have been built, streets torn up and the development of the business of established companies greatly hampered, if not partly destroyed, for all of which there was no real occasion. To protect itself in such a situation there was little which an established utility could do except to purchase its rival outright or to enter into an agreement at the earliest possible date before extensive investments were made. This situation in a sense created prior to 1897 a ready market for franchises and the prices varied with the possibilities of the newer companies and probably also with the influence of grantees. That this situation with its opportunity for private profit in addition to the desired competition was clearly realized may be assumed from the number of franchises granted and the prices paid therefor. Unfortunately the records of these many transactions are not as complete as they should be in order to make possible the most satisfactory analysis of the intangible values due to the forced investment, but there appears to be sufficient data to warrant a belief that some of those who were entrusted with the protection of the public rights and also certain officers of the purchasing companies found in the combinations means for mutual profit. When the public, even with the best intention, has thrown obstacles in the way of development of its utilities, leaving them no option except to remove those obstacles at a heavy cost or to engage in a struggle in which the company must inevitably suffer, such burden in law and in common fairness must be regarded as an investment expenditure. Where such expenditure is increased because of private gain this amount should not be considered as an addition to the investment. The problem in each case is to determine the legitimate expenditure which the existing company could not avoid because of the city's erroneous policy.

That such repeated efforts to enforce competition create investment values of an intangible nature as against the city was held in the case of Wilcox vs. Consolidated Gas Company (212 U. S., 19). Prior to 1884 there were seven gas light companies in New York City, each operated under separate rate charters granted at different times between 1823 and 1865 or 1871. They each had the right to use the streets of certain portions of the city for the purpose of laying mains and service pipes in order to furnish gas. Not one of the companies had ever been called upon to pay for such privilege. In 1884 authority was given by law to consolidate these corportions upon conditions named in the act, which specified, among other things, that the amount of capital issued should not be in amount more "than the fair aggregate value of the property, franchises and rights of the several companies to be consolidated." A legislative committee of investigation found that the franchises of the merged companies were reasonably worth $7,781,000 and stock to this amount was included in the total issue. The court held that the public having approved the consolidation and the amount of securities issued on this basis, should not be permitted to question the valuation at this time and therefore accepted the valuation fixed under the act of 1884 as conclusive, but did not permit an increase in franchise value since the consolidation.

The consolidation of the several gas companies into The People's Gas Light & Coke Company was made in 1897 under state authority expressed in the Gas Consolidation Act. This company assumed the bonds of the merged companies and issued stock to the amount of $25,000,000 which was subsequently placed with investors. In the merging of these companies making up the present consolidation, some of which themselves represented a combination of gas companies, there were included those expenditures which had been incurred in purchasing the competing plants, the cost of which had been charged to the construction or plant account of the purchasing company. This account contained, through these acts, heavy charges for duplicate property and expenditures for franchises. From all the data which can be obtained concerning plant values and yearly construction, it is doubtful if an appraisal of the property embraced in the merger of 1897, including overhead charges and a reasonable discount on securities, would have shown physical value in excess of $27,000,000. It is clear that the property value was not equal to the bonded debt assumed, leaving the total capital stock without any foundation in tangible property. The construction account on December 31, 1897, five months after the marger, showed an investment of $60,181,559, against which there were outstanding stocks and bonds to the amount of $59,246,000.

It will be observed that the facts in this case are somewhat similar to those in the New York case above referred to, in which it was held that a reasonable investment value in the franchises was created, the extent of which the public was estopped to deny. It also found in the same act of estoppel a measure of value for the property in excess of the physical value. In this valuation, however, neither the city of Chicago nor the state of Illinois has ever by agreement, sanction or acquiescence, committed any act which would estop it from denying the existence of franchise value. If any value exists in this case over and above the physical value it must be founded on some ground other than that of estoppel to deny franchise rights, and it is believed that such a ground exists. The value in this case is founded on the basis of cost. Since for all practical purposes the policy of the city compelled the older company to purchase the newly organized companies, the amount which it was honestly compelled to pay represents an expenditure which can be regarded either as a cost of extending and strengthening the business or as a necessary loss in maintaining the business. In either event the expenditure must be met by the investors in the gas business, and since the public compelled this act which increased the cost of the plant it should in all fairness be estopped from denying the reasonable consequences of its acts. Where an expenditure is made necessary by an act of the public which increases the cost of the plant, or adds to the operating expenses of the utility, it is but fair that the city, as between the investor and the public, should bear the burden of such costs. The question here is not one of franchise values but of costs of business. This expenditure is not intangible property in the sense that it creates a right to perform a specific act, although it is intangible today in that there is no physical property in existence for the payment.

That such present value is difficult to determine is no proof of its nonexistence. While it cannot be computed with accuracy it can be approximated. It may safely be assumed that the actual plant value in 1897, when the present company came into existence, was not in excess of the amount of securities issued. In fact, it is known that the physical plant value was less than the amount of the bonds assumed. If the value of the stocks and bonds at the date of consolidation be taken as the investment value of the property an injustice would be done to the public, since the balance sheet shows the par value of the securities which it is known exceeded the market value at the time of the consolidation, and also because a reduction should be made from the total for what appears to be unreasonable personal profits and excessive prices paid in the transactions. The subject of valuation, with respect to this question, has been carefully analyzed from all the records which could be obtained, and it is believed that if the physical value of substantially $27,000,000 is increased by an amount of approximately $10,000,000 to represent the intangible value due to the necessary investment costs and an allowance be made for working capital, the fair value as of 1897, in round numbers, should be $39,000,000, instead of the amount of securities shown at that date. With this amount as a value in 1897 it is possible to compute the fair tangible and intangible value as of 1909, [illegible] plete.

[illegible] above referred to, held that the intangible value there allowed and which the city was estopped to deny, did not increase with the growth of the business. Neither is there any ground for believing, under the reasoning in that case, that the intangible value of the People's Gas Light and Coke Company has increased because of the great increase in physical value since 1897. The question naturally arises, if the city by its early action compelled the company to increase its cost of plant, which must be allowed as part of the investment, is it possible by any subsequent act of the city to reduce that value? If adverse acts of the city result in investment increases, does it not logically follow that any acts of the city which permit a return over and above that which is deemed reasonable on a fair valuation should, by the amount of such excess, be applied as a credit to the investment and thus reduce the valuation so created against the public? Whether there has been an increase or reduction of the going value under this theory must be determined from an analysis of the company's [illegible]

The disposition of the franchise value may be summarized by the statement that franchises are property, but that no value should be allowed as against the public in rate adjustments except to the extent of the price paid for them to the community. Even though no amount be allowed for franchises in the valuation an addition must be made to the physical value to the amount of reasonable costs which were incurred due to the municipal policy of forced competition and that such losses constitute construction charges which the city in justice is estopped to deny. Since the public is to be charged with the costs incurred through its erroneous policy in the form of an increased investment, the same logic requires that the public receive the benefit through a credit to such intangible investment by any amount which the company may have been permitted to earn since 1897 over and above a reasonable rate of return on the investment actually made. The discussion of the subject of the intangible value of the company's property as affected during the last thirteen years is so involved with the subject of going value that digression is here made to the latter subject.

[illegible]

While no definition of the term is entirely satisfactory, it is admitted by authorities that the "going value" represents an element of value due to the company in question being a live, active, operating plant instead of a bare physical mass of material. Going value must not be confused with "good-will" which implies the exercise of choice on the part of the customer as to which of several establishments offer the best inducements for his patronage. Since a gas utility is a natural monopoly there can be no room for selection by the customer. If there is only one establishment which can supply the people, there is no "good-will" value due to their choice to take its product or subscribe to its service. Every one will agree, however, that a given plant having a valuation of $50,000,000, with an established business supplying 500,000 customers with its product, is worth more to the present investor and to the prospective purchaser than is the same plant ready to serve the community, but with no customers attached for service and its business unde- [illegible] great deal to develop any business. The early years of nearly every business are beset with many serious difficulties which not infrequently terminate in bankruptcy. The problem is how to measure the value of such an established business for the purpose of rate adjustment.

[illegible] by some, and also advanced in this valuation, that if the going value of a company represents the cost of developing its business, it means the value of the present patronage of [illegible] ords it is possible to obtain an accurate statement of the cost of securing a customer. If the company in question has 522,000 customers, as is true in this case, the going value, with the assumed cost of development of $30 per customer, would mean a value of $15,660,000. Regardless of the justice or injustice of this amount it will readily be seen that this is not the proper measure of going value. The average rate per customer which the records show will be an average over recent years and will not cover the entire history of the company. This method fails to give information as to the cost of development at the time when development is a real problem to the company. In order to be accurate it should consider the cost of securing business during the entire history of the company, so that the development expenses as determined would be the development cost of this particular plant under the difficulties which confronted it at different times. It is generally known that fifteen or twenty years ago the use of gas had not reached the stage of necessity which it holds today, and that it required more argument, solicitation and many inducements to secure the development of the business. This method of arriving at going value does not, therefore, recognize the investment which the company has made for the development of the business.

The theory in this case, however, that of reproduction as of the time of the investment, must recognize that gas is today not an unknown quantity. It is a service of general use. It does not require so large an expenditure to develop the gas business today in a large city as was needed a generation ago. Everybody knows the value of gas for heating and for illumination. There is always a certain inertia to be overcome, but this calls for less expense today than was necessary years ago. Development expenditures must be incurred even today, for every utility must be continuously engaged in campaigns of education to secure the widest and at the same time most economical use of gas. These expenses are proper operating expenses and as such should be included in the expense accounts. To also capitalize them would mean the duplication of expenses.

If the reproduction rule means the cost of development of an equal business as that which exists today, as if, to be more clear, the present plant passed out of existence and its customers would have to be solicited to use gas of the new company to take its place, it must be remembered that no such expense for development would be required as was generally necessary years ago, or as was actually incurred by the company. Reproduction means reproduction now, at the time of this investigation, and this is the time when thousands of gas users are thoroughly alive to the advantages of gas and demand its widest possible use. These customers as a rule are not seeking education today on the uses of gas. The general demand in 1910 and 1911 is the demand for adequate service and reasonable rates. Given these conditions under the reproduction theory, it is safe to assume that a very large proportion of the present customers would take gas from the company without solicitation or any demonstrations. Some would require visits by solicitors to induce them to take gas from the new proprietors and a number probably would be lost entirely, but it is obvious that when the public has become accustomed to the use of gas as under present conditions, the cost of reproduction would apply only to a portion of the present customers. To attempt to measure going value by applying a development cost per customer to the entire number of customers is therefore unjust, not only because it does not recognize the losses and surplus profits during the operation of the business, but for the reason that a very much lower rate per customer should be used than the average cost of development shown by the books.

[illegible] other basis suggested for the measuring of going value was to allow an amount equivalent to one year's gross income. This suggestion has the merit of simplicity, but is unsound because the going value of the company as of today has no definite relation to the gross earnings. Going value has no reference to the capitalization of the plant on the basis of its earning capacity, for that would be governed largely by the present rate schedule, which may be too high. The real basis of the suggestion is that in a number of plants the cost of developing the business has been found upon investigation to be substantially equal to the gross earnings for one year. In this instance the going value, following this method, would be approximately $15,500,000. It will be seen that in this case this value is almost the same as what would be the going value if computed on a cost per customer basis. It would appear that the similarity of the two figures is a matter of accident rather than that it represents substantially the measure of the going value. The gross earnings of today give no information as to the cost of developing the business. In one city the public may have been ready for the gas utility and customers were easily secured. In another city the service may have been in advance of its necessity and owing to the cheapness of other fuel and illuminants development was slow and expensive. The gross earnings may be an element to be considered in arriving at the going value of a corporation, but can hardly be accepted as a true measure of it.

Hypothetical Plant.—Another measure for determining going value, one which has served several times in computing the intangible worth of water works plans, and the adoption of which was strongly urged by the engineers of the company in this valuation, is based upon the cost of reproducing the business of the corporation under conditions of today. This method assumes that an investor is desirous of engaging in the gas business in Chicago and has in his possession sufficient capital to purchase the present plant. Leaving aside for the sake of argument the question of franchise rights, the investor must decide whether to purchase the existing plant with its established business, or to construct a plant of sufficient capacity and develop the business so that at the end of the necessary construction and development period the new plant will have overtaken the present plant and will have a business of substantially the same proportions as that of the present going concern. This method aims to place a value upon an established income and to determine whether it is more economical to purchase the going concern with its established business or to develop the business.

This method is of course purely theoretical, but it is based upon assumptions founded in actual practice and although not conclusive it deserves consideration. The length of time required to build a plant as large as that needed to serve Chicago, the actual construction and overhead charges, the interest rates to be paid during construction, the probable date when gas could first be sold and the increasing output each year with the extension of the plant and the development of the business are matters which the company's engineers believed could be estimated with a considerable degree of accuracy. To show the application of this reasoning as indicating the amount of going value several tables were submitted showing the growth of the existing or going concern and the development of the hypothetical plant. It was necessary for the purpose of this computation to assume a plant value, a working capital and a going value for the plant now in operation. The operating expenses, taxes and depreciation requirements were taken from the present company's accounts. It was further necessary to assume a rate of increase in business from the beginning of the period covered in the table for both the present plant and the hypothetical plant. It is considered that the hypothetical plant will be built as rapidly as is consistent with good engineering practice, and the financing of the enterprise will be on the most favorable basis under present conditions. Construction, it is assumed, would be started on January 1, 1911.

In the tables the sum of $42,000,000, exclusive of the office building [illegible], was taken as the physical value of the plant necessary for the manufacture, distribution and sale of gas, which amount was apportioned over the principal classes of divisions of property. The allowance for working capital was placed at $4,000,000 and the estimated going value of the present plant was placed at $12,800,000, showing a total investment value of $58,800,000. It is assumed that a period of ten years would be required to complete the plant with all of its present facilities, although gas would be supplied to some customers before the end of the second year and each year to an increasing number as the plant was extended into new territory. The extensions of the plant would be made as rapidly as possible and the time assumed in this instance is based upon the best available records of continuous construction in large undertakings which the company possessed. The plant would naturally be built so as to supply some customers at the earliest possible date and efforts would be centralized to complete the plant first in the most profitable business section. Neighborhoods would be canvassed in advance of actual construction, so that the plant would be self sustaining as soon as possible, or at least earn part of its operating expenses.

The first year, it is assumed, in all probability would be given over to securing franchises, taking out incorporation papers, perfecting the organization of the corporation, selecting office locations, closing contracts and making surveys. Real estate would be acquired early, as shown to be needed by the surveys, for the location of manufacturing stations, holders and pumping stations. The amount allowed for real estate purchases in this instance has been based upon the idea that plants would be constructed simultaneously in the different divisions of the city. Additional land would be purchased the second year and the immediate requirements probably completed by the end of the third year, although the construction of mains, services and meters would continue rapidly throughout the entire 10-year period, thus extending the service into new territory to additional customers and greatly increasing the output to near capacity.

The figures were taken largely from the company's own records, although certain changes were made after conference with its engineers and additional data supplied by estimate. It will be noted that the value of the physical property in the hypothetical plant is not the actual physical property which would be required for the assumed output at the end of the period of development, but instead is more nearly equal to the value of the property of the present plant at the beginning of the period. Since whatever construction would be necessary during the development period must be added to both the present plant and the hypothetical plant and therefore would not affect the result, the amount has been omitted from the calculation.

Beginning with a total investment value of $58,800,000, the tables show the investment today, the amount of the total available capital not used in the enterprise on which a return of 4 per cent is assumed, and that amount which is withdrawn for construction during the year on which 2 per cent is allowed for one-half the period, or its equivalent of 1 per cent on the amount withdrawn for the entire period. The income from sales of gas is placed at 85 cts. per thousand, which is the present rate. The operating expenses during the first three years would naturally be somewhat higher per thousand cubic feet than for the same years in the present plant. Particularly during the first years it is unlikely that the plant would be operated at capacity. The machinery would be new and require frequent adjustment and operators would have to be trained in their duties. It is assumed in the tables that the hypothetical plant would be placed in operation September 1, 1912, and that for the four months of that year the operating expenses would be 65 cts. per thousand. During the second year a cost of 55 cts. is assumed, 50 cts. for the third year and 48½ cts. per thousand for the remaining years, which last rate is that shown by the company's books at present. Depreciation and tax estimates are based on the property in use for the given year and reach at the end of the period substantially the same figures as those in the going plant. By adding the interest from the unemployed capital to the net income from operation for the year the table shows the total income for the period, the present worth of which is determined on a 5 per cent basis. The difference between the income of the going concern and the income of the hypothetical plant for the same year shows what going value has accumulated. The sum of these yearly accumulations amounts to $12,935,000, as against the assumed going value of the present plant of $12,800,000. It would appear therefore from the tables that the correct value was somewhere between these two amounts.

This method, while it arrives at a going value which does not appear to be very unreasonable, is open to criticism and apparently the greatest reliance can not be placed upon the result in this case. While no single formula can be followed to show exactly what constitutes the proper allowance for this purpose, it is believed that on broad principles of justice a consideration of both profits and losses should be recognized. There is no such recognition in this method. Neither does this method recognize the rapidity with which the business of the company was actually developed, nor any extraordinary expenditures or changed conditions, such as those due to competition or unfavorable legislation, either municipal or state. The conclusion is arrived at almost entirely on a basis of assumptions which are largely independent of local conditions confronting the property at present, or under which it was developed in the past. The calculations begin by assuming that which it is sought to prove, and the correctness of the computations lies in arriving at a final value which justifies the original estimate. The result is also affected by the amount assumed to represent the present physical value. If such value is high the going value arrived at will be reduced. In justice to this method it should be said that an extensive investigation of the company's records would show information and units more nearly correct than the assumptions which were used. It should also be stated that somewhat different figures instead of those assumed would not greatly affect the result, since they would apply equally to both properties. The real purpose of this computation is to show the cost of developing the business, a calculation which, if used as the basis of valuation, should take into consideration other factors than those embraced here. While its application under certain conditions may lead to correct values, at which times it may be the best of the several methods available, it is no more likely to give correct results under specific local conditions than is the application of average cost units to result in a correct physical value in a particular appraisal. This method of arriving at going value possesses some merit and like those previously discussed was considered in arriving at the final amount, but it is not sufficiently proof against criticism to warrant the adoption of its results without additional data.

Whatever single method should be followed for determining going value, if there is such a correct method, it is believed that the final calculation should be tempered with a consideration of fairness to all interests. The amount involved representing many millions of dollars and the effect on the final rate schedule both as regards the investor and the public requires that consideration be given to equity as well as to mathematics. A high going value means a large investment upon which returns must be allowed and this requires a high gas rate; a low going value or no allowance for going value at all means a smaller interest requirement and consequently permits a low rate for gas. It is therefore possible to secure a very low gas rate if the value of the plant is placed sufficiently low, but court decisions are firm in defining particular elements of value. Capital does not obey the mandate of public or private opinion unless such opinion is founded in justice and sound economics. To be correct in the final analysis the valuation arrived at must recognize the clear rights of capital invested in public enterprises, but it must not lose sight of the rights of the public. There is no question but what corporations engaged in public service are by virtue of their character invested with valuable rights and privileges and in return charged with well defined duties. The public, by virtue of whose grant these corporations exist, is entitled to the proper discharge of their duties and likewise owes certain obligations. In most instances these duties and obligations are clearly defined by the courts. In some instances where the decisions are indefinite or the subject has not been adjudicated, political economy supplies what the law omits. Where the courts have defined the basis of valuation with respect to the different classes of property the allowances in this report have followed such cases. Where the law is not definitely settled mooted questions of valuation have been decided upon a basis which appeared reasonable and just in the premises. With these principles in mind it is believed that the going value of the Peoples Gas Light and Coke Company can best be determined from its own records and history.

A public service corporation is entitled both by common law and by statute to a reasonable return upon its investment. If a given rate schedule yields more than a reasonable return to the investor it is an injustice to the public and the rates should be lowered. If the rates fail to produce sufficient revenue the investor is not receiving that return to which he is entitled by law. If he has received a reasonable return each year on his investment from the beginning of the enterprise justice would seem to be satisfied, at least as against the public, without allowing any increase in the value of the property which produced that income to represent going value. If the investor has failed to receive each year that amount which constitutes a reasonable return he should be permitted to charge rates sufficiently high to reimburse him for early losses or such losses should be considered as costs of developing the business and their addition to the value of the physical property permitted. Such additions, from an equitable standpoint at least, may be said to constitute the correct going value of a public service corporation. The application of this doctrine to the facts in this city and the logic upon which it is founded is shown in the following discussion.

DEVELOPMENT EXPENSE.

New plans seldom yield a return on the investment during the first year of operation. In fact it is more likely to require a number of years of continu[illegible] basis, while the history of the gas industry clearly shows that many of such plants have not reached a position of profit to the investor until many years after their construction. During the earlier years a large amount of money is required for development purposes. Where a corporation is in possession of adequate capital, expenditures of this character can be made without serious loss to the stockholders, but where, as is almost universally the case, the business is developed out of the earnings at the expense of interest and dividend payments, a deficit will result. When a corporation is earning less than its operating expenses, interest and depreciation, it is absolutely necessary that the stockholders make further payments for development purposes. Where a small surplus is earned, such amount may be used for development purposes, but it is at the expense of the stockholders' rights unless such development requirements are recognized in the capital. If the development cost is not met out of the earnings it must be met directly by the sale of securities, which becomes a liability against the plant.

The amount by which the earnings fail to meet the operating expenses and the return on the investment creates deficits which constitute the cost of building up the business. Just as supervision, interest and insurance during construction are expenditures to be added to the construction cost of the plant, so the deficits representing the amounts by which the stockholders have failed to receive their reasonable return are costs to be added to the value of the physical plant in order to show the complete investment which has been made in the industry as a live, going concern.

The cost of developing a gas industry consists of expenditures for advertising, soliciting, demonstrating, the sale of appliances at less than cost, free house piping, and in some instances free gas for a limited period. Concessions in rates below actual cost are also given to stimulate a large and general use of gas. Development expenditures may further be increased through the failure of the plant to earn even its current operating charges for a number of years, when the stockholders must supply additional capital to keep the plant in operation. Such expenditures are additional investments upon which the stockholder is entitled to a return as well as upon expenditures for physical plant. The investor has a right to expect reimbursement for such losses. They are legitimate costs of business. The public has a right to exclude from the valuation of utility properties upon which it is compelled to pay reasonable returns all amounts representing unnecessary expenditures, excessive discounts on securities, promotion fees, expenditures due to poor management and extravagance and errors of judgment which the exercise of reasonable care and foresight might have avoided. It, however, can not avoid payments on a valuation consisting of necessary expenditures honestly made, and the cost of operating the plant until it reaches the point where it returns the reasonable interest to which the investor is entitled by law. The cost of securing a paying business can best be computed from a cost analysis of the annual surplus and deficit shown by the records.

Capital is not unmindful of the uncertainties of business development. Money seeks the avenue of greatest returns consistent with security and stability. A return of 5 or 6 per cent in a safe investment will attract capital, while a 10 per cent return which is accompanied with a considerable element of risk will find little encouragement. If, however, the return which is considered reasonable in any instance in view of the risks inherent in the venture, can not be secured until several or many years from the date of the original investment, and additional capital must be provided in the meantime upon which no return will be allowed, utility development will be retarded and, in some instances, it will be indefinitely postponed. To prevent the progressive development of business results in hardships to the customers and to the public generally and would tend to keep operating unit costs at a higher level. It would be unjust to the stockholder to deny him a return upon his money actually and honestly invested. A utility has no legal right to charge more than a reasonable rate, and if this is not to be computed on the development of the business and unavoidable losses, as well as on the investment in physical property, the reasonable rate allowed in after years when the industry has reached a stable basis will not be a reasonable rate on the amount actually invested. Losses need not be considered in the valuation, provided a rate of return is permitted which includes an allowance over and above the rate deemed reasonable, which will serve to reimburse the stockholder for his early losses. It necessarily follows that where the rate for service must be reasonable, and as such is subject to regulation by law, the early losses must be regarded as a part of the investment until restored to the stockholder by means of a higher rate of return on his investment. Equity admits of no other disposition.

As an offset in favor of the public, equity requires that if the deficits incurred in building up the business are to be regarded as a part of the investment, any surplus earnings over and above a reasonable return on the legitimate investment should also be taken into consideration. If the utility has earned in its later years a large profit because of favorable rate schedules, this excess above a reasonable return should be considered as a reimbursement for some of the early losses. The rule of justice should work in both directions.

This manner of arriving at the fair present investment value to be used as the basis of rate adjustment was suggested by the court in the case of Mo. Kan. & Tex. Ry. Co. vs. Love (177 Fed. 493, 496) as follows:

> An established railroad system may be worth more than its original cost and more than the mere cost of its physical reproduction. It has passed the initial period of little or no return to its owners which, of greater or less duration almost always follows construction, and is not infrequently marked by default and bankruptcy. The inevitable errors in its building which finite minds and hands cannot avoid have been measurably corrected, time and effort have produced a commercial adjustment between it and the country it was intended to serve, relations have been established with patrons, and sources of traffic have been opened up and made tributary. In other words, the railroad, unlike one newly constructed, is fully equipped and is doing business as a going concern. It has attained a position after many experiences common to railroad enterprises which entail loss and cost not paid from current earnings, and which correspondingly make for value.

This method was perfected and extensively applied by the Railroad Commission of Wisconsin in the leading utility rate cases which have come before that body. The rule was stated in Hill, et al., vs. Antigo Water Company (3 W. R. R. C., 623).

The same principle was adhered to in re Investigation of Menomonee and Marinette Light and Traction Company (3 W. R. R. C., 778) and in the case of State Journal Printing Company vs. Madison Gas and Electric Company (4 W. R. R. C., 501). The logic of this reasoning has recently been approved by the Supreme Court of the state of Oklahoma in the case of the Pioneer Telephone and Telegraph Company vs. Westenhaver.

The above method of computing the going value and the derivation of the final investment value has been described at length because of the reliance placed upon the conclusions which it shows. It is believed to be the most equitable solution of the problem of going value, since by this means the investor is protected in the development of the business and the public is insured against the dangers of excessive valuations. This method of computation is not advanced as being infallible. On the contrary, there are many cases where this reasoning could not properly apply, either because of specific conditions or the absence of financial data covering many years of operation. If every valuation could be solved by the application of a single rule, rate adjustments would be simple indeed. At no time can the exercise of judgment be entirely eliminated. Each case must be analyzed on its own peculiar facts. In this particular case this method of reasoning is believed to be proper.

Reverting to the discussion of franchise values and the cost incurred by the company in developing its business and the expense due to the purchasing of competing plants, it was found that the fair value of the plant in 1897, including physical valuation, working capital and the going value, was approximately $39,000,000. By applying the above reasoning to this valuation and by an analysis of the company's profits and losses since 1897, it is possible to determine the fair investment value of the plant at the end of any subsequent year. This computation is shown by a progressive statistical analysis based on the company's records and embraced in Table II.

The table begins with the valuation of $39,000,000, this value including, as above stated, the physical value, the working capital and the allowance for going value. Seven per cent is deemed to be a reasonable rate of return at the present time, but in the historical treatment of this subject, an income rate must be used which is reasonable, not so much under present conditions but reasonable for the year when it is used. If 7 per cent is reasonable today, it is believed that 8 per cent was reasonable some years ago. The table is therefore based upon a rate of return of 8 per cent for the years from 1898 to 1906, inclusive, and a rate of 7 per cent since that date. The yearly requirements under these rates are shown in the second column. Column three shows the additions to the physical property and to the working capital, and in the following column is shown the annual requirements for earnings on these additions. Since the additions are extended over a period of twelve months, the interest rate is applied only for six months, or one-half of the time, since very little construction was completed during the first month and practically all of the investment of this character was completed in the twelfth month. The next column shows the necessary operating expenses, including depreciation. The next column shows the total of the foregoing columns, which is the total amount which the stockholders put into the business during the year, or which they would have put into it if the earnings would permit, and if the earnings were insufficent indicates the amount of losses which accrued. Against this total there is shown in the next column the gross earnings or the amount which the stockholders took out of the business. The deduction of those earnings from the total cost contained in the preceding column shows in the last column the cost of the plant or its investment value at the close of the year. According to this table, the investment on which the stockholder is entitled to a reasonable return is equal to $60,933,630. There should be added to this total the amount of $916,249, representing construction work practically completed and partly in service, but technically not yet turned over to the company, and for which payment will not be made until final certification from archietcts as to the compliance with all specifications. With these adjustments the investment value of the entire property of the company may be said to be $61,849,879.

PAVING

Although strongly argued by the company, no allowance has been made in the above total to cover the value of the pavement over the company's distribution system. It was claimed that since the valuation for the purpose of this investigation must be the reproduction cost, the company should be given credit for the value of the street pavement over all of its mains and services, even though the company paid no part of the cost of such pavement, since if the plant were to be reproduced as of this date it would be necessary to cut through such pavement for the purpose of laying the pipes. The facts show that on most of the streets the mains were put down before any pavement was laid by the city, and in many other streets the mains were laid at a time when the city was replacing the pavement, so that in either case the company was put to no expense because of the street improvement. Where, however, the company did cut through the pavement and replace it as required by the city ordinance, the cost thereof has been added to the cost of the mains and is now included in the valuation tables. The purpose throughout the appraisal of the distribution system was to allow a valuation where the company incurred pavement expenditures and to exclude any allowance for pavement laid and paid for by the city.

Valuation Conclusions.

The above detailed analysis leads to the conclusion that the investment value of the property owned by the Peoples' Gas Light and Coke Company at the close of 1910 was approximately $61,849,879. In arriving at this amount no allowance has been included for the value of the perpetual franchise or for the value of the pavement placed by the city over the company's distributing system. The above total includes the value of all the physical property, both that used and useful in the company's business and the commercial holdings, together with its necessary working capital and an allowance for going value as defined in this report.

Since the purpose of this inquiry is to determine a reasonable rate for manufactured gas, it is necessary to apportion such investment value over the utility service and the commercial service. The utility service at present, at explained, really consists of two distinct services—namely: the sale of manufactured gas, the heating and lighting standard of which is prescribed by ordinance and for which the present rate is 85 cts. per thousand cubic feet, and the sale of natural gas sold in a restricted area of the city at a rate of 50 cts. per thousand cubic feet. This necessitates the separation of the utility property over these two departments of service. The general office building and the real estate not used in the gas business has been excluded from the rate analysis. The company occupies only a portion of its new office building, the remaining space being rented for commercial purposes. For the purpose of this analysis it is optional to consider a portion of the above building as a gas investment or to exclude it entirely and to regard it as a commercial investment, at the same time making a charge in the operating expenses for rent based on the space now occupied by the company. This latter alternative has been adopted and the cost of the building is therefore excluded from the investment upon which the gas service must yield a reasonable return, but there has been included in the operating expenses the proper rental allowance. Deducting from the total of $61,849,879 for 1910 the office building investment, the commercial property and the natural gas investment, and adjusting the total for the end of 1909, the period under investigation, the amount on which the rate of return must be applied in the computation of a reasonable rate for manufactured gas is $51,575,678.

Revenue.

The original records of earnings from all sources were checked in detail. The record of receipts from the sale of gas was carried in 104 customers' ledgers containing over half a million accounts. It was impossible to check each of these volumes in the brief time allowed and with the facilities available, and it was deemed unnecessary to undertake such work. Certain parts of the customers' ledgers were audited in detail and the correctness of the conclusions verified by various checks against the sales and the plant output. In all instances the records were found complete and in great detail.

The revenue items appearing on the general books are as follows:

Gas sales	[illegible]
Tar sales	[illegible]
Receipts from Pintsch Company	[illegible]
Penalties	[illegible]
Interest	113,276.25
Rentals	17,591.06
Green Street rentals	955.68
Interest on securities	2,500.00
Arc lamp rentals	[illegible]
Carbide	870.23
Indiana Natural Gas & Oil Company	40,172.18
Miscellaneous receipts	[illegible]
Total	$14,622,096.51

Since the object of this investigation is to ascertain a reasonable rate for gas, it is necessary to apportion the earnings so as to show the proportion to be credited directly and indirectly to the gas utility department, and the amount which represents income from outside sources or commercial transactions which can not properly be applied to reduce the cost of gas. The amount so eliminated from the above total of $14,622,096.51 is $240,353.44 and consists of seven separate items.

There has been excluded from the revenue to be applied to the gas utility the amount received from the Pintsch company. This income consists of rentals paid by the Pintsch company for the use of a part of one of the company's stations.

The total amount received by the company in the form of interest is $113,276.25. Practically 90 per cent of this total consists of interest on funds deposited in banks, a large part of which represents the proceeds from bond sales to be devoted to construction purposes. The total interst item has been analyzed so as to determine the reasonable income from this source which can be applied as a credit to the gas utility. Such analysis suggested the exclusion from the total of $63,276.25 as being an extraordinary earning. The $50,000 retained as an earning agrees favorably with the ordinary income from this source as shown by the records over a number of years. The rental received from the Green street property has been excluded because such property is not devoted to the gas industry and was also excluded from the plant valuation. For like reason the interest on securities to the amount of $2,500 was excluded. The receipt of $870.23 from the sale of carbide is a strictly commercial transaction in no way connected with the gas utility, and for this reason has been excluded. There has further been deducted from the total earnings the amount of $40,172.18 received from the Indiana Natural Gas and Oil Company, since this is a service distinct and apart from that now being investigated.

[illegible]

From the above explanations, the revenues of the company for the purpose of this investigation may be rearranged and stated as follows, in which form they are entered in the final income account:

Operating Revenue:		
Gas sales	[illegible]	
Tar sales	[illegible]	
Penalties	[illegible]	
Arc lamp rentals	[illegible]	
Total		[illegible]
Non-operating Utility Revenue:		
Interest	50,000.00	
Rentals	17,591.06	
Miscellaneous receipts	[illegible]	
Total		[illegible]
Commercial and Extraordinary Revenue Excluded:		
Receipts from Pintsch Company	[illegible]	
Interest	63,276.25	
Green street rentals	955.68	
Interest on securities	2,500.00	
Carbide	870.23	
Indiana Natural Gas & Oil Co.	40,172.18	
Total		240,353.44
Total revenue as on books		$14,622,096.51

Operating Expenses.

The expenses as shown by the company's books consist of seven classes which are based upon the chronological steps in the manufacture, distribution and sale of its products. These classes and the total charges for each in 1909 were as follows:

Manufacturing expense	$ 3,601,058.51
Gas purchased and [illegible]	[illegible]
Distribution expense	[illegible]
Commercial expense	[illegible]
Other expense	[illegible]
General expense	[illegible]
Annual fixed [illegible]	[illegible]
Total	[illegible]

The analysis of these accounts suggested certain adjustments for rate making purposes and a detailed study was therefore made of each account in order to obtain the amount which constituted a correct utility operating charge and also the reasonableness of such charges for the purposes indicated. As outlined above, there was deducted from the classified operating expense accounts a reasonable proportion for the natural gas department, and also all maintenance and administrative charges for other departments, on the theory that each department should be self supporting. Various minor adjustments were made which were more in the nature of transfers from one group to another in order more clearly to show the correctness of departmental costs and also to meet specific operating conditions. The distribution of a number of expense items over construction, operation and maintenance was also changed with a small reduction resulting in operating expenses.

[illegible]

The provision for depreciation is a proper operating expense and allowance must be made for [illegible] in the income [illegible] count. Every public utility should set up an adequate depreciation reserve to provide against the wasting of assets, charging operating expense annually or at more frequent intervals with an amount representing the estimated depreciation during such period and making a corresponding credit to the depreciation reserve. Maintenance charges should cover only the upkeep of the property or the current ordinary repairs, renewals and replacements resulting through the use of the property or through those casualties which are incident to the nature of the operation and which expenditures are necessary in order to keep up the productive capacity of the plant to its original or equivalent state of efficiency. When, however, through wear and tear, inadequacy, obsolescence, supersession or public requirements, the unit of equipment becomes economically irreparable the uncurrent or extraordinary repairs, renewals or replacements made necessary should be charged to the depreciation reserve which has been accumulated for this purpose through charges to operating expenses.

To determine what constitutes a proper depreciation charge it is first necessary to compute the composite life of the plant. The length of life of the various parts of a gas plant vary greatly. Cast iron mains, for example, have a very long life, while wrought iron mains and services have a much shorter period of use. Some of the machinery at the station may be used for 50 years. Other portions are consumed through use in less than 10 years. The depreciation reserve to be provided must be such an amount as will permit of the replacement of each item of equipment when such step becomes necessary. The composite life of the plant must be determined from a study of the reasonable life in service of each class of equipment. The gas industry is relatively old and much information is available to show the probable life of the different classes of property. Since the depreciation allowance must provide for all replacements, the adequacy and efficiency of the equipment must be considered as well as the actual physical life. Not all the property, however, is subject to depreciation. Land and working capital, for example, may be excluded from such a calculation as not depreciating in the sense in which that term is here used.

The life table which was used as a basis for the determination of the required allowance in the present case was compiled from the records of manufacturers and utility companies, supplemented by the opinions and experience of those brought into close contact with equipment of this character under practical operating conditions. Local conditions affect the term of life and it is therefore necessary in estimating the depreciation to modify such periods to correspond with the conditions known to exist. Where output affects the life of the property a shorter period must be used if the apparatus is more heavily loaded than under average conditions. Climatic and soil conditions affect the life of the property and the growth of the business may render it necessary to substitute larger types of equipment before the normal life is run. It is also necessary to consider the skill of management and the state of repair in which the property is kept, since it is possible through proper handling to materially lengthen the life of the property in service. In preparing the life table in this computation those various factors have been given due weight so that the assumptions used are deemed to be conservative under present conditions in Chicago. Table III contains the statistical data showing the calculation of the composite life of the property in question.

In calculating the composite life the so called straight line method was used. This method gives proper weight to the fact that the short lived apparatus must be replaced several times during the life of the property having a longer life, so that the composite life determined in this manner will provide a fund sufficient to meet the replacements as they occur. All the property subject to depreciation has been classified according to its normal life in service and the cost new of the property for each classified age as shown. Since the salvage value can be secured upon the property after its usefulness in service has terminated, this amount must be deducted from the cost new to show the amount which actually depreciates, which is called in the table the "wearing value." The number of times each class of property will be renewed during the term of the longest life contained in the table is also shown, together with the total expenditures for replacement purposes during such longest life period. Having determined the total requirement during the entire period for each class of property it is necessary to multiply this amount in each case by the number of years during which each dollar is employed, giving the amount in the terms of "dollar years." By dividing this number by the total expenditure during this period of 75 years there is shown the composite life of the property, which in this case is practically 35 years. This computation embraces all the depreciable property devoted to the manufacture, distribution and sale of the manufactured gas, together with the proportion of the office building used by the company for this purpose. On the basis of the above life of 35 years and the assumption that an accumulation for depreciation would be able to earn 4 per cent interest, it would be necessary to set aside for this purpose 1½ per cent of the total depreciable property each year. While this amount would be sufficient to meet the replacements as they normally occur, it is probable, due to the uncertainties of a business which extends for 75 years into the future, that some allowance should be made for contingencies and almost certain departures from conditions upon which the table is based. The replacement of services and mains will doubtless cost more in the future, due to the improvements in the streets and the required reconstruction before the property in many instances has reached the point of complete depreciation will mean added costs. For this reason it is more than probable that some equipment will be abandoned before the end of assumed life and also that improvements in the process of manufacture will render obsolete some of the property now in use. Based on those considerations an annual allowance of 2 per cent on the depreciable property is sufficient to cover this requirement. Applying this percentage to the depreciable property in 1909 the allowance for depreciation is $642,487, which amount is considered as an operating expense and included in the adjusted income account.

TABLE I.—SUMMARY OF PHYSICAL VALUATION OF CHICAGO GAS PROPERTIES 1910.

UTILITY OPERATIVE PROPERTY.

ITEM.	Manufactured Gas Cost new	Manufactured Gas Present value	Natural Gas Cost new	Natural Gas Present value	Total Cost new	Total Present value
Land	$3,254,965	$3,254,965	$6,986	$6,986	$3,261,951	$3,261,951
Add 12% for overhead	390,956	390,956	838	838	391,794	391,794
Buildings	1,129,590	1,053,655	17,793	13,416	1,147,383	1,067,071
Station equipment	3,560,068	[illegible]	80,794	68,149	3,640,862	2,923,220
Holders	3,766,300	3,235,833	32,200	31,297	3,798,500	3,267,130
Distribution system	19,958,050	16,437,602	2,115,576	1,839,240	22,073,626	18,276,842
Miscellaneous	374,605	337,785	....	....	374,605	337,785
Sub-total	$29,068,813	$23,914,606	$2,276,163	$1,957,432	$31,344,976	$25,872,038
Add 17% for overhead	4,941,698	4,066,333	386,948	331,913	5,328,646	4,398,246
Total for all items	$37,659,432	$31,634,860	$2,670,935	$2,292,169	$40,330,367	$33,927,029
Discount on securities at 6%	2,250,366	1,898,092	169,456	137,530	2,419,822	2,035,622
Total util. oper. prop'y	$39,918,798	$33,533,952	$2,831,391	$2,429,699	$42,750,189	$35,963,651

NON-OPERATIVE PROPERTY.*

ITEM.	Manufactured Gas Cost new	Manufactured Gas Present value	Natural Gas Cost new	Natural Gas Present value	Total Cost new	Total Present value
New gas building					$4,817,162	$4,817,162
Add 7% for overhead					337,201	337,201
Land					240,586	240,586
Add 12% for overhead					28,870	28,870
Buildings					61,107	61,107
Station equipment					295,329	295,329
Holders					15,507	15,507
Distribution system (dead mains)					50,981	50,981
Sub-total					$422,924	$422,924
Add 17% for overhead					71,897	71,897
Total for all items					$5,918,640	$5,918,640
Discount on securities at 6%					355,118	355,118
Total non-operative property					$6,273,758	$6,273,758
Grand total of all physical property					$49,023,947	$42,237,409

*The non-operative property was not depreciated.

Return on Investment.

Not only must the rate to be charged for gas be placed at such a figure as will yield sufficient revenue for operating expenses, taxes and depreciation, but it must provide a reasonable allowance as a return upon the investment. A rate sufficient to meet these requirements must be provided as a matter of law, but a considerable difference of opinion exists as to what may be said to constitute a reasonable rate of return. Clearly what is reasonable in one industry or under one set of conditions will not necessarily be reasonable in all cases. Capital flows from one field of industry to another in response to established economic laws. The attractiveneess of an investment may be temporarily increased or diminished by public or legislative acts, but in the last analysis economic fundamentals govern. It therefore becomes necessary for the determination of this rate of return to consult a wider sphere of investment than that of this industry alone and to arrive at such a rate from the consideration of the entire investment world rather than from an abstract conclusion.

At the outset it is evident that the rate must provide at least that amount of return which is equal to the income from the least hazardous undertakings. The yield from bonds and mortgage investments is lower than the return from manufacturing and commercial investments because of the diminished risk and also because of the small amount of supervision required after such investment has been satisfactorily placed. The risk in an investment may be due to several causes, chief of which are the unstable nature of the industry, the severity of competition and the fixedness of the investment. In general the rate of return demanded by investors varies directly with the risks or hazards encountered in the business. This would indicate that the rate to be allowed on an investment in the gas industry must embrace two distinct elements—namely: that rate of interest to which a creditor is entitled as determined by the general cost of money in safe investment channels and that rate of return over and above the interest, representing in a certain sense the profit of the partners or those who share the risks of the industry. That the holder of a single certificate may stand in the position of both creditor and partner is immaterial. There must be paid to capital, irrespective of who provides it, such a return as will yield a fair interest for the use of the money and an additional allowance determined by the risks of the enterprise.

The interest proportion of the return is indicated by the yield of approved mortgages and bonds. Such investments without burdens of management reasonably yield from 4½ and 5 per cent to 6 per cent, depending upon a variety of conditions. The rate of profit to be allowed is a matter of judgment based upon general and specific conditions. Among these may be mentioned risks inherent in the business, the probability of inventions rendering a part of the plant obsolete and greatly impairing the usefulness of the company's service, the degree of managerial skill and the probable future of the enterprise. As affecting more particularly a utility investment, reference may be made to the likelihood of condemnation for the purpose of public purchase, the frequency of public rate revision with its accompanying uncertainties and the danger of competing utilities in a city where the investment is already sufficient to supply the entire community. These conditions taken together tend to restrain the movement of capital into such investments, unless the rate of return provides some compensation for the risks assumed.

In favor of a comparatively low rate of return is the fact that the product of the company finds a ready market and that the sales are far more uniform and certain than in commercial undertakings. This is shown by the stability in gross earnings of utility companies during periods of business depression. While manufacturing companies are often compelled to close their establishments for a time or to greatly reduce their operating forces, utilities in general show practically no loss in revenue and often substantial improvement. The Peoples Gas Light and Coke Company is also especially favored through the ownership of a perpetual franchise, the value of which can not be doubted. These factors serve in part to offset certain disadvantages which warrant a somewhat higher rate of return. When all the factors bearing on the subject of interest and profit are considered together with respect to the investment here in question, it must be concluded that 7 per cent on the fair present value of the property devoted to gas business is a reasonable and proper allowance.

Gas Utility Income Account.

The foregoing financial data have been combined in Table IV, which is an income account for the gas utility alone, showing the operating revenues, the operating expenses, net earnings,

TABLE II.—ANNUAL INVESTMENT VALUE ON 8% AND 7% BASIS.

Year.	Cost of plant first of year.	Interest on value of plant.	[illegible]	[illegible]	[illegible]	Total cost.	Gross earnings.	Cost of plant close of year.
1898	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$70,890,969	[illegible]	$43,625,383
1899	43,625,383	3,490,031	[illegible]	[illegible]	[illegible]	[illegible]	8,036,320	47,290,007
1900	47,290,007	3,783,201	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	48,257,615
1901	48,257,615	3,860,609	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50,741,464
1902	50,741,461	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9,661,746	[illegible]
1903	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1904	[illegible]	4,181,281	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1905	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1906	[illegible]	4,296,833	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1907	[illegible]	3,857,391	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1908	[illegible]	3,882,184	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1909	[illegible]	3,925,361	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1910	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE III.—CALCULATION OF COMPOSITE LIFE—MANUFACTURED GAS PROPERTY.

CLASSIFICATION.	Depreciable property.	Salvage value.	Total wearing value.	[illegible]	Total [illegible]	Total dollar-years.
Property having 75 year life.	$8,921,772	$8,203	$8,913,569	1	[illegible]	$668,517,679
Property having 60 year life.	[illegible]	......	[illegible]		[illegible]	40,500,005
Property having 50 year life.	6,040,785	257,664	5,783,121	[illegible]	[illegible]	433,734,150
Property having 45 year life.	[illegible]	......	[illegible]	[illegible]	[illegible]	186,208,031
Property having 40 year life.	[illegible]	38,978	[illegible]	1⅞	[illegible]	41,929,346
Property having 30 year life.	178,825	2,255	[illegible]		[illegible]	13,242,729
Property having 25 year life.	4,488,518	22,213	[illegible]		[illegible]	334,972,875
Property having 20 year life.	5,375,447	74,918	5,300,529	[illegible]	[illegible]	397,539,667
Property having 15 year life.	523,242	8,738	[illegible]		[illegible]	38,587,796
Property having 10 year life.	[illegible]	......	[illegible]	[illegible]		26,274,530
Total	[illegible]	$412,969	[illegible]		[illegible]	$2,181,506,808

indirect or non-operating utility revenues, the deductions from the gross corporate income and the surplus for the year.

This table, after deducting the operating expenses and an amount representing the return on the investment, shows that the revenue produced by the present rate of 85 cts. per thousand cubic feet of gas is equal to nearly 9.8 per cent on the fair present value of the property. If 7 per cent represents a reasonable return for the investor there remains a surplus of $1,424,051.69. During the year 1909 the company put into the distribution system a total of 16,845,175,000 cu. ft. of gas, of which 14,323,047,000 cu. ft. was manufactured water gas and 2,523,110,000 cu. ft. purchased gas. The total amount sold to customers in that year was 16,079,064,181 cu. ft., the difference between the output and the sales being gas lost and unaccounted for. It will be seen that the surplus from these sales over and above actual requirements is equivalent to 8.85 cts. per thousand cubic feet sold. Applying this surplus to a reduction in rates, the data indicates that the present rate may be reduced by 8 cts. per thousand cubic feet to a charge of 77 cts. Stating such a rate in terms of gross and net charges, the investigation leads to the conclusion that a reasonable charge for gas under present conditions would be 77 cts. per thousand cubic feet, with a penalty of 10 cts. per thousand for failure to pay the bill rendered before the expiration of such a time as may be deemed reasonable through the company's rules and regulations. Applying a rate of 77 cts. per thousand cubic feet to the total sales of 1909 instead of the rate actually in force, and assuming the same operating charges and non-operating revenue, there remains, after the payment of a return to the investor amounting to 7 per cent on the present value of the investment, a surplus of $141,753.

TABLE IV.—INCOME ACCOUNT—GAS UTILITY—1909.

			Per M sold
Operating Revenue:			
Gas sales	[illegible]		.8496
[illegible]	[illegible]		.0081
Penalties	167,462.09		.0104
Arc lamp rentals	340,873.31		.0212
Total operating revenue		$14,302,147.44	.8893
Operating Expenses:			
Manufacturing—			Per M made
Steam material	$ 160,451.74		.0112
Generator material	2,874,299.24		.2007
Purifying material	11,541.61		.0008
Station supplies	30,279.35		.0021
Manufacturing labor	341,832.68		.0239
Works repairs	117,845.48		.0082
Eng. Dept. general charges	[illegible]		.0032
Total		3,582,147.[illegible]	.2501
Gas purchased and allied expenses		[illegible]	[illegible]
Distribution—			Per M sold
Distribution station operation	$ 82,924.54		[illegible]
Street mains maintenance	331,297.94		.0206
Service pipe maintenance	146,905.32		.0091
City lamp post maintenance	16,599.98		.0010
Meter maintenance	[illegible]		.0195
Gratuitous work	151,112.78		.0094
Arc lamp maintenance	308,701.58		.0192
Total		1,351,342.13	.0840
Commercial Expense—			
Promotion expense	$ [illegible]		.0087
Branch store expense	[illegible]		.0014
Appliance expense	[illegible]		.0065
Total		57,354.60	.0036
Office Expense—			
Turn on and off	$ [illegible]		[illegible]
Statement taking	[illegible]		.0060
Bookkeeping	165,082.99		.0103
Collecting	[illegible]		.0085
Applications, receiving, auditing, etc.	236,637.63		.0147
Total		[illegible]	.0433
General Expense—			
General office expense	$ 379,834.55		.0237
Telephone rentals	21,666.02		.0013
Rent	156,219.79		.0097
Legal expense	26,338.56		.0016
Claims and damages	54,000.00		.0034
Employees' Aid and Pensions Fund allowance.	133,372.00		.0083
Uncollectable bills	60,508.01		.0038
Fire and property damage	42,000.00		.0026
Main rentals	53,493.00		.0033
Lease rentals	340,000.00		.0011
Total		1,267,131.93	.0788
Taxes		848,115.00	.0527
Depreciation		642,487.00	.0399
Sundry revenue requirements		153,941.00	.0096
Total operating expenses		9,347,394.38	.5812
Net earnings		4,955,053.06	.3081
Non-Operating Utility Revenue:			
Interest	$ 50,000.00		0031
Rentals	17,591.06		.0011
Miscellaneous	11,704.57		.0007
Total non-operating utility revenue		79,295.63	.0049
Gross corporate income		5,034,348.69	.3130
Deductions from Gross Corporate Income:			
Return on investment at 7%		3,610,297.00	.2245
Surplus		$1,424,051.69	.0885

A summary of the data and conclusions given in this report is shown by Table V.

TABLE V.—SUMMARY OF APPRAISAL OF CHICAGO GAS PROPERTIES.

	1910.	1909.
Total value of investment	$61,849,879	$58,060,210
Total value of physical property	49,023,947	44,494,972
Total going value as defined in the report	9,425,932	10,365,238
Gas utility investment including used proportion of office building		[illegible]

(Office building excluded from income account investment and rental charge for space occupied provided.)

No allowance made for value of franchises.

No allowance made for the cost of street pavement over the company's distribution system not paid for by the company.

Allowance for working capital	$3,200,000
Allowance for depreciation	642,487
Allowance for taxes	848,115
Rate of return allowed on the investment	7%
Gross operating revenues	14,302,447
Non-operating revenues	79,296
Present actual earnings available for interest and dividends	5,034,349
Allowance for return on present value of utility investment at 7%	3,610,297
Surplus in 1909 after allowance for interest and dividends	1,424,052
Present rate for gas—95 cents per M gross—85 cents per M net.	
Rate recommended—87 cents per M gross—77 cents per M net.	
Saving to public at 77 cents per M on 1909 sales	[illegible]
Probable saving in five years	7,400,000
Earnings available for interest and dividends under proposed rate	3,752,050
Surplus under proposed rate after allowance of 7% for return of investment	141,753

Proposed Legislation.—Some inspired Pennsylvania solon last month introduced a bill under the title, "An Act to Prohibit the Use of Alum Compounds in the Filtration of Water by any Person or Persons, Corporation or Municipality Furnishing Water to the Public and Providing a Penalty for a Violation Thereof."

If the bill becomes a law a fine of $100 for each day of violation of the act, or imprisonment of 100 days, is provided for, the law to be in full force and effect on and after Jan. 1, 1912.

There are 61 cities in Pennsylvania using this rapid filtration process. Fortunately one of the best plants of this kind in the entire country is located at Harrisburg, the capital city of Pennsylvania, so the engineers and water works officials who are opposing the bill have a specific example near at hand to use as an illustration of the value of this process in their arguments with the legislators. The bill will certainly fail to pass. It is of interest chiefly as an example of the case with which proposed legislation can outstrip the advance of applied science.

An item of bridge history worth noting is the fact that in 1909 the Grand Trunk Ry. replaced a deck tubular bridge which had been in continuous service since 1855. The excellent quality of the material and workmanship is attested by such long service under steadily increasing live loads.

LETTERS TO THE EDITOR.

What Is the Effect of Washing Soda on Concrete?

[illegible] cilitate setting, and some doubt exists as to whether or not this has affected its strength. I would greatly appreciate opinion on the sub[illegible] information in any of the reference books which I have at hand.

Yours truly,
ENGINEER.

Calgary, April 28, 1911.

Specifications for Drainage Work.

Sirs: We are [illegible] several drainage districts in this section, and would appreciate it very much if you would address some of your friends in this line of work and have them send us a few copies of specifications of this class of work.

Fort Worth, Tex., May 5, 1911. W. T. M.

(We shall be glad to have our readers send us copies of specifications to be forwarded to our correspondent.—Editors.)

The Weeks Drag Line Excavator Bucket.

Sirs: In your issue of April 26th there appeared an article by Mr. G. A. Collins of Seattle describing my patented shovel. Inasmuch as this account made no mention of the fact that the Weeks Patented Two Line Shovel is fully protected by numerous patents both in the United States and Canada I would ask that you kindly supplement this article by a statement supplying this, to me a very important omission, lest those who might be interested think this device is free to the public. Thanking you in anticipation, I beg to remain,

Very truly yours,
W. C. WEEKS

Vancouver, B. C., May [illegible], 1911.

A Problem in Drainage Ditch Maintenance in Shifting Sand.

Sirs: Referring to the letter of O. F. Reece, Wellington, Kan., in your issue of April 26, I would note:

(1) If the sand be very light and movable—being flaky and having more or less feathery edges—watch the operations of drifting snows. If the winds keep the line of the ditch steadily and the sand remains dry it will by the increased pressure and draft in the cut be kept clear as far as the line of the ditch continues in a tangent. If the wind should veer in course and cross the ditch obliquely, any considerable degree at least, it might fill the ditch when dry in a single storm. Mr. Reece describes the soil as "light and easily drifted." Its components may in part be but impalpable dust easily lifted into the air after the fashion of our desert "sand storms," and carried long distances, leaving but little material that drifts far in the field, while the appearance of a storm is that of great movement. Would not such drifted material in a channel of water of the dimensions indicated be readily "scoured" out if the drift be really sand? We may, however, observe that chaff blown into the air in falling adjusts itself into a somewhat compact and tenacious mass. The sides of the ditch might in some cases wear away more easily than a drift formed in air or water of the same material.

(2) If the sand is round, heavy and must be very dry to move in the wind—observe the traveling "sand dunes" of the shores of Lake Michigan. The cleaner sand at the beach, having become dry by the force of the moving air, is rolled along. A little obstacle may arrest its [illegible] the slope which, [illegible]ing the sand, falls into the lull behind the forming mound or ridge and adjusts itself into a surface as steep as sand will lie. The process is to bring on more of the movable sand from the beach and at the same time to drive more and more of the grains on the windward slope upwards and over the top, which continues to both rise and to advance on the lee side. The process is slow; the windward side may for a time fill up towards the beach by increasing the flatness of the slope. It is remarkable that just below the surface of these banks of sand moisture is always found and coarse grasses grow—stock may be found feeding on such sparse bunches as appear—trees of an aspen sort are found flourishing by the conditions for a term of years—when some new phase of the elements determines a new movement. The winds resume the process of pushing the windward slope up over the "ridge"—and in time you may stand under the original set of lateral roots of the trees, now denuded of the sand that covered them, and successive laterals—as branches—the tree holding on to its life by its extended top root—an inverted trunk with new feeders. At such times the dune makes much more perceptible advance leeward. Such an one, with crest 20 or 25 ft. high, maybe higher, might have been seen forty years ago a little north of Kalamazoo River, Saugatuck, quite rapidly encroaching on a pond (known, I believe) as "Goshorn Lake." I suppose the water may have long ago been wholly covered and now forgotten.

Returning more directly to Mr. Reece's problem, if we are to understand that measured from the ground there has accumulated a bank of 18 ins. against the stone wall in 30 years, there should be apparently no alarm for anybody but some one "opposing the scheme" for his own reasons. But if it is meant that the drift is 18 ins. above the top of the fence, the statement is a very uncertain premise for reasoning in the matter. Is the base to the lee of the wall spread to a long distance? Has the wind kept down the height of the drift? Or might the drift have risen to the top of the fence many years ago?

If the constituents of the soil that drifts are such as to prevent the prevailing winds which run with the canal and the water from clearing it, a close high board fence would protect it for a long term, it would seem, by as much as is given.

C. A. E.

Los Angeles, Cal., May 1, 1911.

PERSONAL.

Mr. W. T. McKinney, of Chicago, has been placed in charge of the construction of the C. & S. C. R. R., an interurban line at La Valle, Wis.

Mr. C. C. Dudley, a civil engineer in the employ of the city government of Muskogee, Okla., was struck and killed by a Missouri, Kansas & Texas train at that point on May 2.

The Andersen-Evans Co., manufacturers of grab buckets for handling ore, coal, etc., have removed their offices from 1501 Monadnock Bldg., to 635 Railway Exchange Bldg., Chicago.

Mr. John F. Wallace has resigned as president of the Electrical Properties Co., of New York City, to become president of Westinghouse-Church-Kerr & Co. He succeeds Mr. H. H. Westinghouse, who retires to devote his attention to his other interests.

Mr. Charles N. Monsarrat has been appointed chairman and chief engineer of the Board of Engineers, Quebec Bridge. He succeeds Mr. H. E. Vantelet, whose resignation was tendered about two months ago. Mr. Charles Macdonald has also resigned. The board now consists of Mr. Monsarrat and Mr. Ralph Modjeski, of Chicago, with a vacancy to be filled [illegible] retirement of Mr. Macdonald.

Mr. William J. Nead, a prominent railroad contractor, died of pneumonia in St. Joseph's Hospital, Philadelphia, on May 10, at the age of 75 years. As a contractor he had amassed a large fortune, and had had much to do during the past ten years with the extensive improvements on the Pennsylvania R. R. He took an active part in business affairs in Philadelphia, being a director of the Union Trust Co. and of the Mechanics' Insurance Co.

Announcement is made of the incorporation of the Allen & Garcia Co., consulting and contracting engineers, McCormick Bldg., Chicago. This company is composed of Mr. Andrews Allen and Mr. John A. Garcia. They will give attention to plans, specifications and superintendence of coal mining and coal handling structures, power plants and steel structures generally, as well as reports, appraisals and contracts relating to mining and other properties.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Steel Mine Timbers.—Paper, 5x7⅝ ins., 60 pp. Carnegie Steel Co., Pittsburg, Pa.

This is a valuable pamphlet containing data and tables for the use of mining engineers. Another catalog under the same name is also published (paper, 8¼x10¼ ins., 40 pp.) giving illustrations and descriptions of types of construction and examples of installation.

Waterproofing.—Paper, 3¼x6¼ ins., 24 pp. The Neuchatel Asphalt Co., Ltd., 265 Broadway, New York.

Describing briefly the requirements of waterproofing and the properties of this compound, also illustrating work successfully executed.

The Photostat.—Paper, 5½x8½ ins., 8 pp. Commercial Camera Co., 50 Church St., New York.

Illustrating and describing a special camera for commercial purposes.

Intermittent Flush Tanks.—Paper, 6x9 ins., 24 pp. Pacific Flush Tank Co., Singer Bldg., New York

Containing illustrations of sections of various forms of siphon flush tanks without moving parts. Descriptions and tables of dimensions and prices are given.

The Machinery List.—Paper, 3¾x6¼ ins., 72 pp. A. H. Hitchcock, 1220 Caxton Bldg., Chicago.

This is the May number of a reference list of sawmill and woodworking machinery.

Hayward Buckets.—Paper, 7¼x9 ins., 4 pp. The Hayward Company, 50 Church St., New York.

Illustrates a number of uses to which Hayward clamshell and orange peel buckets are applied.

Industrial Cars.—Paper, 8x10 ins., 64 pp. The Youngstown Car Mfg. Co., Youngstown, O.

This is a complete catalog for industrial cars, showing designs for many purposes. Tables of dimensions and capacities accompany the illustrations. Other industrial track equipment also shown.

Gardner Crushers.—Paper, 6x7 ins., 12 pp. Gardner Crusher Co., 556 West 34th St., New York City.

Illustrating and describing a crusher adapted for grinding any material, wet or dry, to any degree of fineness, from 1 inch to 100 mesh.

Hydro-Cator.—Paper, 6x9 ins., 12 pp. Van Auken Indicator Co., 123 Liberty St., New York.

The hydro-cator is a fluid or water gauge for registering the water level in steam boilers, tanks, steam pipes, reservoirs, etc., with precision and is designed to be placed any distance above or below the level of the liquid.

Wire Rope.—Paper, 7x10 ins., 12 pp. The Broderick & Bascom Rope Co., St. Louis, Mo.

This is the April number of The Yellow Strand, a monthly pamphlet of useful information about wire rope.

Steel Fabric.—Paper, 6¾x9¾ ins., 24 pp. The Clinton Wire Cloth Co., Clinton, Mass.

Containing interesting illustrated articles about fireproof construction and concrete reinforcement.

Steam Shovels.—Paper, 6x9 ins., 32 pp. The Thew Automatic Shovel Co., Lorain, O.

This catalog illustrates each of the types of the Thew shovel and describes each type in detail. The ability and rated capacity of each is given for various services. The operating costs per day and estimated output is given for various conditions of operation. A line drawing supplemented by a table of dimensions of various sizes is included.

Reliance Engines.—Card, 8x3¾ ins., 4 pp. Reliance Machine & Tool Works, St. Louis, Mo.

A mailing card illustrating hoisting engines, derricks, pumps and listing contractors' machinery.

Grab Buckets.—Paper, 6¾x9¼ ins., 16 pp. C. W. Hunt Co., [illegible] Broadway, New York.

Illustrates and describes grab buckets of heavy design and steel coal tubs. Catalog describes various coal handling plants and gives table of comparative costs between old and new plants.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

Railroad construction work appears to be picking up a bit, judging from the number and size of contracts reported to have been let in the past few days. In this section of the country the principal contract appears to have been the one secured by the Walsh Construction Co. Davenport, Ia. This contract calls for grading and masonry for second track and grade reduction work between Sharonville and Kyles O., for the Cleveland, Cincinnati, Chicago & St. Louis Ry. The contract involves about 2,200,000 cu. yds. of grading and 20,000 cu. yds. of concrete. Among the other railroad construction contracts let recently are the following: J. N. Gillis & Son, Brewton, Ala., for building about 20 miles of railroad and two large storage dams at Bodka, Miss., for the Sumter Lumber Co.; J. G. McGuire & Co., New Brighton, Pa., for constructing a line between Woodlawn, Pa., and Aliquippa, Pa., for the Woodlawn & Southern Street Ry. Co.; Utah Construction Co., Ogden, Utah, for grading for 112 miles of line for the Oregon Short Line R. R., the work including the grading for the double tracking of the main line of the road from Farmington to Ogden, 22 miles, from Burley to Kelton Pass, a distance of 66 miles, in Idaho, and for the grading for the south side line from Nyssa, Ore., to Homedale, Ia., a distance of 26 miles.; Gilmore & Weaver, Morgantown, W. Va., a $50,000 sub-contract for constructing stone retaining walls on the new line of the Buckhannon & Northern R. R., in West Virginia; P. Nelson & Co., San Francisco, Cal., for driving a 840 ft. tunnel for the Fort Gragg R. R., near Willits, Cal.; Kilpatrick Bros. & Collins, Beatrice, Neb., for construction of double track between Julesburg, Colo., and Pine Bluffs.

Bids for the construction of another government lock and dam in the Ohio River were opened May 10 at the office of the U. S. Engineer at Wheeling, W. Va. The low bidder was the Missouri Valley Bridge & Iron Co., Leavenworth, Kan., at $862,091, with an alternate bid of $839,851.

One of the largest private paving contracts let recently on the Pacific Coast has been awarded to the Oakland Paving Co., Oakland, Cal. The contract amounts to about $300,000 and calls for the paving of 7th St., Oakland, for a distance of 2½ miles with asphalt. The work is to be done for the Southern Pacific Ry.

The governor of Rhode Island has signed the bill by which the Grand Trunk Ry. secures a right of way to a tide-water terminal in Providence for its subsidiary, the Southern New England Ry. It is now expected that the Grand Trunk Ry. will soon take steps to have construction work started on the Southern New England Ry., which is to extend from Palmer, Mass., to Providence, R. I. The Grand Trunk Ry. and the New York, New Haven & Hartford R. R., which have been threatening to do all sorts of construction work in southern Vermont and New Hampshire, seem to have decided on a compromise in regard to terminal land and rights of way at Bellows Falls and Brattleboro, Vt., and may not undertake so much construction work as originally planned.

A municipal irrigation district is proposed in Colorado. A special election has been ordered for June 17 by the Commissioners of Pueblo County, Pueblo, to decide on whether a municipal irrigation district shall be established in the Boggs flats section. The project, if carried, will necessitate a bond issue of $5,000,000 and water will be brought from the western slope by a tunnel through the Continental divide.

A large contract is to be let shortly at Boston for the construction of two steamship piers. The piers are to be of steel and concrete construction, 1,200 ft. long and 300 ft. wide, and will cost about $1,250,000 cash. They are to be erected in South Boston by the American Buildings Trust.

The state election board of Oklahoma has completed the final count of the returns on the recent election on the proposed amendments to article 9, section 9, of the constitution to permit the consolidation of railway lines which shows that the proposed amendment lost by a majority of 4,894. The total vote for the amendment was 41,768, against 46,662; total vote cast in the election, 88,430. This will probably knock out quite a bit of proposed railroad construction.

Sewer Trenching in Wet Sand.

The new specifications for the construction of sewers adopted recently by the Board of Local Improvements of Chicago, Ill., contain a number of interesting provisions. Not the least of these are the careful definition of "rock," noted in our issue of May 3, and the provision for protection against water where the excavation to its entire depth is in wet sand. Cases like this are covered by the following paragraph in the specifications:

> Where the excavation to its entire depth is in wet sand the contractor shall install a pumping system connected with well points so as to effectually drain the sand.

New Road Laws for Kansas.

State legislatures during the past year or two have paid much attention to legislation for highway improvements. In several states laws have been passed within the last two years for the establishment of state highway departments or for some form of state aid, and in other states many of the old road laws have been repealed and better ones placed upon the statute books. In Kansas the legislation of 1911 recently enacted new road laws, which contain many important features. The special features of this new road law are that the old law has been revised and codified, the roads classified, all poll taxes to be paid in cash, road dragging work made compulsory, the weeds and brush to be cut at township and county expense, and provision made for a county engineer in all counties where the people desire it. One feature of the new road laws of special importance is the classification of the roads of every county, according to their relative importance, as "state roads," "county roads," "mail routes" and "township roads,' and the provision that the main roads be kept up at general county expense and under the direction of the county board. This will very materially relieve the different townships and, since the townships are now permitted to levy for road and bridge purposes three mills on the dollar's valuation instead of a mill and three quarters in most townships, there should be ample funds available to maintain the earth roads. The section of the laws regarding the dragging of the roads provides that the township trustees determine what mail routes and township roads are to be dragged and make arrangements to have such work done. The compensation for road dragging is in no case to exceed 75 cents per mile for each time the road is dragged and there shall not be expended more than $10 per mile per year for any one mile upon which work in done during any year. Arrangements for the dragging of state and county roads are to be made by the county engineer.

The Engineer of Today.

During the last quarter century an extraordinary change has taken place in the position of the engineer in the community. The advance in scientific knowledge and the broadening of the engineering field has seemingly made necessary an extremely composite type of training for the engineer who would have complete command of the field. The engineer of today was thus defined by Prof. Henry P. Talbot of the department of civil engineering at the Massachusetts Institute of Technology in an address at the 50th anniversary of the founding of that institution:

> The wholly successful engineer of the day (I do not speak now of the recent graduate) must be a man possessing capacity for logical, quick and exact thought; a detailed knowledge of some portion and a broad knowledge of the whole of his professional field; and be a master of a certain amount of tichnique of his profession. He must have the ability to select and guide competent and trustworthy associates and to obtain from them loyal and willing service. He must be strong in his sympathies and generous in his public services, and while quick to enlist desired interest in his enterprises he must be shrewd in detecting avarice or perfidy. He should be a loyal husband and father, and should find opportunity for that enjoyment of art and literature which will afford him present pleasure and ensure the happiness of advanced years. It is a matter for sincere rejoicing that the engineering profession has reached such a commanding position in our national life that only a man of this type can completely fill it; but the imperfect portrait just drawn is evidently that of a man for whom Nature must have done much at the start, and toward whose efficiency many elements must have contributed.

How to Save $1,000,000.

The part "little things" play in the operation of a great railroad is well brought out in a circular recently issued to the employes of one of the large railroad systems in the west. The circular states: "You are one of about 50,000 employes on the —— —— —— lines. Can you save 5 cts. a day for the company? That is only $1.50 a month. A few spikes, bolts, etc., saved or not replacing material until full use has been obtained will turn the trick for track men. Train and yard crews watching every move and not wasting time will do their share. Enginemen can easily use a few less shovelsful of coal and make a better showing. Station and telegraph employes by being prompt on the wires and careful handling of freight will save delay to trains and reduce claims. Office men can reduce unnececsary wires and correspondence, saving stationery and postage. Shop men have many ways of saving time and materials. Everyone can help and some can help others. A small saving by each employe spells prosperity. Prosperity hires more men and pays better wages than hard times."

RAILWAYS, STEAM AND ELECTRIC

Alabama.

⊙[illegible] & Son of Brewton, Ala., the contract for building of about 20 miles railroad and two large storage dams at Bodka, Miss. John Alexander, Chicago, Ill., is president of the Sumter [illegible] Miss., is general manager.

The Louisville & Nashville R. R. is reported to have placed an order for 80,000 tons of steel rail. It is understood some of this rail will be used in the double-tracking of the south and north division, from the Black creek junction, near Jefferson, towards Decatur. The land department of the big railroad system is systematically buying the right of way for the double tracking between Black creek and Decatur and already considerable mileage has been covered.

A syndicate composed of Joseph H. Hoadley, of New York, president of the Alabama Consolidated Coal & Iron Co.; Senator James F. Shaw, of Boston, and other financiers of [illegible] concluded the purchase of the Lake Borgne canal. This move is a part of the plan projected for shipment of the products of the Coal & Iron Co. from the Birmingham district to Mobile and New Orleans by rail and water without breaking bulk. It is expected that an announcement regarding the plans for the projected railroad to run from Gadsden via Birmingham to the Warrior river near Tuscaloosa will be made shortly.

Surveys for a railroad are being made in Calhoun County south of Piedmont, and efforts are being made to interest capitalists in the project. George D. Harris, Piedmont, Ala., is the engineer.

The Louisville & Nashville R. R., is reported to be planning to enlarge its yards at Gadsden.

As noted in our last issue construction work has been started on the section of the Tidewater R. R. from East Lake to Bessemer. E. A. Yates is engineer in charge of the work for the contractor. Engineering offices have been opened in the Brown-Marx Bldg., Birmingham, Ala.

Arizona.

The El Paso & Southwestern R R. Co. has completed a preliminary survey for the construction of the proposed extension of its line from Tucson to the Willow Springs Flats and Ebrence, and the project has been pronounced feasible. J. R. Emerson, Douglas, Ariz., is resident engineer.

Arkansas.

The Little Rock, Pine Bluff & Eastern Traction Co., has been incorporated with a capital stock of $1,500,000, and proposes to build an electric interurban line connecting Little Rock and Pine Bluff and a number of the intermediate points on the east side of the Arkansas river. The officers of the company are C. C. Kavanaugh, Little Rock, President; J. M. Mehaffy, Secretary, and E. W. Jackson, Treasurer.

At the annual meeting of the Arkansas Central Ry. Co. stock holders at Fort Smith, Ark., the following officers and directors were elected: J. H. Wright was re-elected president and treasurer; L. P. Miles, vice president, and George H. Whybark, secretary; directors, J. H. Wright, L. P. Miles, D. J. Young of Fort Smith, Ark., J. P. Falconer of Charleston, J. S. Shibley of Paris and C. A. Pratt of Little Rock.

California.

⊙The contract for boring the 840-ft. tunnel on the Fort Bragg R. R. has been let by L. J. Scooffy to P. Nelson & Co., San Francisco, Cal. In addition to the tunnel the contract calls for excavating the approaches, which is estimated at 10,000 yds. The contractors expect to have a force of 80 men and will work both ends of the tunnel. Their force will be divided into four crews and they will work two shifts at both ends. It will take five months to finish the tunnel and by that time the railroad will be connected up at both ends. The east portal of the tunnel is about four miles due west of Willits.

Officials of the San Pedro, Los Angeles & Salt Lake Ry. (Salt Lake Route) are reported to have decided definitely upon the completion of the St. Thomas branch of the road in the Moapa district and have under consideration the feasibility of the contemplated branch to St. George in southern Utah. E. G. Tilton, Los Angeles, Cal., is chief engineer.

Advices from Lakeport, Cal., state that the proposed articles of incorporation of the Clear Lake-Hopland R. R. have been pronounced satisfactory by the officials of the Northwestern Pacific and are to be submitted to the prospective stockholders today, May 17.

Funds are being raised by public subscription in Yolo, Glenn, Shasta, Tehama and Colusa Counties for the preliminary work for the proposed west side electric railroad. Each county is to raise $5,000 and this amount has already been raised in several of the counties. C. L. Donohoe, Willows, Cal., is interested.

The Board of Public Works of San Francisco, has appointed A. M. Hunt, Consulting Engineer, to have charge of the construction of the Geary St. electric railway. The line will probably be constructed by force account Most of the materials have already been bought by the city.

The Oakland Traction Co., Oakland, will shortly begin work on the extension of its North Grove line at Berkeley from the circle to Northbrae to the heart of Thousand Oaks. The extension will be along Arlington road for a distance of eight blocks. The company plans to have the improvement completed within 90 days.

The Ocean Shore R. R., H. M. McCartney, Chief Engineer, San Francisco, is reported to have come into the control of Speyer & Co., bankers, New York City. It is said that several million dollars will be expended in new equipment and many extensions of the route. A $200,000 depot is planned for the Eighth and Market St. terminal at San Francisco, and the electrification of the entire line will be begun shortly.

Colorado.

⊙Kilpatrick Bros. & Collins, Beatrice, Neb., according to advices from Laramie, Wyo., have been awarded the contract for the construction of double track between Julesburg and Pine Bluff and work will be started at once.

The Colorado Interurban Ry. Co., which filed articles of incorporation the latter part of April, has secured practically all right of way for its proposed line and intends to have construction work started some time this summer. The company proposes to build an electric line connecting Denver with Pierce, Ault, Eaton, Greeley, Fort Lupton, Firestone, Longmont, Idaho Creek and Fort Collins. The incorporators are E. Armour, Charles H. Pierce, Irving Hale, James Leonard, O. S. Storrs, E. B. Reaser and D. E. Young, of Denver.

Grading work on the Colorado & Southern extension from Wellington to Cheyenne is practically completed and several contractors have moved their outfits to other jobs. The pile driver crew is building bridges north of Wellington, several hundred carloads of ties have arrived and new 80-lb. steel is being distributed between Fort Collins and Wellington. It is expected that the track laying gang will begin work June 1.

Good progress is being made by the Union Pacific in laying rails on its extension into Fort Collins. The steel gang and machine on May 7 were about seven miles southeast of Fort Collins. It is said that the Union Pacific will extend its line from Fort Collins west up the Poudre river over Cameron pass, across the North Park into Steamboat Springs and follow the line of the Moffat survey to Salt Lake.

It is reported here in Denver that the recently organized Denver Securities Co., backed by local capital, will undertake the extension of the Denver, Northwestern & Pacific Ry. (Moffat road) to Salt Lake City. It is said that $4,000,000 worth of notes of the road, due this spring, have been extended one year and may be extended for two or three years. It is understood that the new corporation takes over the Moffat interests in the road, subject to this indebtedness, and the extension of the time of payment is to allow the company to use all available capital for a period of two or three years in construction work.

The Englewood & Arapahoe County R. R. Co. has been incorporated with a capital stock of $10,000, and proposes to construct a line in Sheridan Ave., extending one mile east from Broadway, at Englewood, a suburb of Denver. The incorporators are George F. Higgins, J. Camenisch, H. F. Albers, E. A. Tuttle, M. H. Straight, H. W. Skerritt, E. E. Nichols and B. F. Ferkin, of Englewood, Colo.

Florida.

Promotion work is under way for the formation of a company to build a trolley line connecting Ocala with Silver Springs and Lake Weir. E. H. Mead, Lansing, Mich., and E. L. Carney, Ocala, Fla., are interested.

Georgia.

The Georgia Ry. & Electric Co., P. S. Arkwright, President, Atlanta, Ga., has filed a petition with the Railroad Commission providing for an extension of the line from Buckhead to the county line, a distance of 2½ miles.

Right of way is being secured for the proposed line of the Adel, Paro & Thomasville R. R. This company recently secured a charter and proposes the construction of a line from Adel to Thomasville. H. H. Tift, Tifton, Ga., is interested.

The State Railroad Commission has granted the Pelham & Havanna, R. R., A. C. Felton, Jr., President, Macon, Ga., permission to issue $100,000 worth of stock. This is a steam road 16 miles long extending from Cairo to Caverly.

Surveys are now being made for the proposed line of the Cary North & South Ry. Co. The projected length of this line is 50 miles and the route is Hawkinsville to Gordon, via Cochran, Cary and Danville, Ga. Construction contracts will probably be let in July or August. D. B. Dunn, Macon, Ga., is Chief Engineer, and H. R. Brown, Macon, Ga., is President.

The Atlantic Coast Line Ry., according to reports in circulation in Savannah, Ga., will shortly award contracts for the double tracking of its line from Savannah to Folkston, Waycross and Albany, necessitating an expenditure of several millions of dollars. D. W. Gross, Wilmington, N. C., is engineer of construction.

Idaho.

The Boise & Interurban Ry. Co., W. E. Pierce, President, Boise, is believed to be planning to have work started this year on its proposed extension from Boise through the Deer Flat country and ending with a terminal at Roswell.

The Oregon Short Line R. R. Co., according to advices from Caldwell, Idaho, has commenced grading operations for the extension from Caldwell to the Snake River, a distance of 17 miles, known as the Golden Gate Route, and it is expected to have it in operation within 60 days. This extension will run west from Caldwell to the new town of Wilder, a distance of 12 miles. From Wilder the old Homedale right of way is to be abandoned

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

and a new right of way established to the Snake River. The old right of way would necessitate a 705 ft. bridge across the Snake River. The new right of way continues west of Wilder to the Snake River at a point where only a 380 ft. bridge is necessary to cross the river.

Bids were opened May 1 by the U. S. Reclamation Service, Boise, Idaho, for constructing road bed for a branch railroad from Barberton to the site of the Arrowrock Dam The bids received were as follows: (1) Thomas Dixon, Salt Lake City, Utah; (2) W. H. Thompson, R. D. 4, Boise, Idaho; (3) Phil Harris, Caldwell, Idaho; (4) Maney Bros., Nyssa, Ore.

Bids Received.

Sched. 1	Cu. yds.	(1)	(2)	(3)	(4)
Class 1...	15,000	[illegible]	[illegible]	....	$0.25
Class 2...	2,000	[illegible]	[illegible]	....	.75
Class 3...	100	1.00	[illegible]	....	.90
Overhaul	20,000	.015	.02	....	.04
Total...		$7,090	$9,140		$8,215
Sched. 2					
Class 1...	16,000		.50		.25
Class 2...	4,000		.70		.75
Class 3...	100		[illegible]		.90
Overhaul	67,000		.02		.04
Total...			$12,250	...	$9,600
Sched. 3					
Class 1...	15,000		.50	[illegible]	.25
Class 2...	6,500		[illegible]	.50	.75
Class 3...	200		[illegible]	[illegible]	.90
Overhaul	70,000		.02	[illegible]	.04
Total			$12,950	$11,700	$10,005
Grand total ...		$7,090	$31,340	$11,700	$27,910

Illinois.

The East St. Louis Interurban Electric Ry. Co., East St. Louis, Ill., has been chartered with a capital stock of $2,500, and proposes to construct a line from the city of East St. Louis in an easterly direction through St. Clair county to the county of Clinton, Illinois. The incorporators and first board of directors are: J. L. Finnigen, East St. Louis; W. H. Hauss, East St. Louis; Fred W. Kraft, East St. Louis; Albert E. Meints, East St. Louis; Edward L. Cragen, East St. Louis.

Preliminary surveys have been started by R. P. Van Deusen, C. E., Pekin, for the proposed route for the interurban line between Pekin and Delaware, mentioned in our last issue.

The permanent survey for the Princeton extension of the Sterling Moline Traction Co. from Walnut to Princeton has been completed and survey from Walnut to Sterling has been started. It is understood that the survey from Walnut to Sterling will be made by way of Deer Grove. The preliminary survey was made by way of Van Patten. It is reported that the project will be fully financed in a short time. The Northwestern Engineering & Construction Co., Milwaukee, Wis., has the contract for this line, as noted some time ago in these columns.

The Illinois Central R. R., A. S. Baldwin, Chief Engineer, Chicago, Ill., proposes to construct two additional tracks for passenger service on the west side of the existing tracks from Blue Island Junction, which is a short distance south of Kensington, Ill., to Matteson, a distance of approximately 13.12 miles. When completed the existing two tracks will be used exclusively for freight business north from Matteson.

Grading work on the Decatur-Pana Interurban Ry. is stated to have been started north of Pana. Peter Chase, Pana, is the promoter of this line.

The Chicago, Waukegan & Woodstock Traction Co. has been incorporated with a capital stock of $50,000 and proposes to construct a line from Waukegan in Lake County, to Woodstock in McHenry County, through the counties of Lake and Henry, Illinois. The principal office is in Chicago. The incorporators and first board of directors include Charles A. Spenny, Secretary Woodstock & Sycamore Traction Co., 711 Tacoma Bldg., Chicago, Ill.; Irving D. Stevens, Chicago, Ill.; W. P. MacCracken, Chicago, Ill.; Peter B. Olsen, Chicago, Ill.; H. S. Hedberg, Chicago, Ill.

The Metropolitan West Side Elevated R. R., 1001 Royal Insurance Bldg., Chicago, Ill., will soon begin work on two additional tracks from 52nd Ave., Chicago, to the Desplaines River, which will give the company a four track line between the points named. The Aurora, Elgin & Chicago Co. will use the new tracks when they are completed. This is said to be about all of the new construction work the company has in view at this time and the cost, which will be a nominal one, as it is a surface road, will be paid out of surplus account.

The Alton, Jacksonville & Peoria Ry. has started work at Godfrey laying track for the extension of its line to Jerseyville. It is said that in 90 days the line will be in operation between Alton and Jerseyville. A power house will be erected on Piasa Creek, nine miles out of Alton.

At a recent meeting of the Elgin Commercial Club, a representative of the Dunlap Engineering Operating Co. made a statement concerning the proposed plans for the new belt line. Five miles of road will be built from the Illinois Central tracks at Youngsdale north to Highland Ave. and four miles of track from the Elgin, Joliet & Eastern tracks east of Elgin west to Dundee Ave., spanning the Fox River with a bridge. Toward the cost of the proposed work, which is estimated at $100,000, the city is expected to contribute $27,000, besides $3,000 for the construction of the proposed bridge.

The Chicago, Burlington & Quincy Ry., according to rumors circulating at Arenzville, is planning the construction of double track from that city in Illinois to Beardstown. W. L. Breckinridge, Chicago, Ill., is engineer, maintenance of way.

Indiana.

Advices from Petersburg state that the plan for the construction of the Vincennes Southern Ry. has been revived, and that a meeting was recently held in that city, a number of the promoters being present. The road is to extend from Vincennes to Jasper and ultimately, it is said, to West Baden.

The Crawfordsville & Danville Interurban Association has been organized for the purpose of aiding in the promotion work for a proposed electric line between the two cities. The new road would form a continuous route between Indianapolis and Danville, Ill. The officers of the association are W. A. Van Valkenburg of Danville, Ill., president; N. R. Myers of Crawfordsville, Ind., vice president; R. Allen Stephenson of Danville, Ill., secretary, and W. H. Black of Kingman, Ind., treasurer.

The Capital Circuit Traction Co. of Indianapolis, mentioned in recent issues, has applied to the Marion County Circuit Court for permission to change its name to the Circuit Terminal Co. It is understood that the original plans to build a line circling Indianapolis and joining many of the county seats will be followed immediately.

The Louisville & Nashville, R. R., is said to be planning the expenditure of between $100,000 and $150,000 in the extension of the yards at Howell, two miles below Evansville. About $50,000 is being now spent on an addition to the shops in order to take care of the Big Four engines when the Big Four extension from Mount Carmel to Evansville is completed in June. The Big Four will use the terminals of the Louisville & Nashville in Evansville.

Iowa.

⊙Information received from Knoxville, Ia., is to the effect that contractors have started grading for the new spur which is to extend one and one-half miles south and west from the village of Flagler, five miles east of Knoxville, to the proposed new mining camp on section 22, East Knoxville township. J. H. Johnson Construction Co., Des Moines, Ia., has the work at the Flagler terminal.

Among the many reports in circulation concerning new railroad construction work throughout Iowa is one to the effect that the Chicago & Northwestern R. R. will soon rebuild its double track main line between Luzerne and Belle Plaine, Ia., at an estimated cost of $750,000.

The Illinois Central R. R., according to advices from Manchester, Ia., has announced that $35,000 has been appropriated for improvement of the company's yards at that city. Among the improvements to be made during the summer will be a new freight depot, to be erected on the north side of the tracks, and additional side tracks are to be laid sufficient to accommodate at least 200 more freight cars than the present trackage can accommodate.

The Sioux City, Crystal Lake & Homer Electric Ry. Co., Sioux City, Ia., has asked the City Council of South Sioux City for another franchise through the town. It is the intention of the company to connect with the rails of the combination bridge across the Missouri river so its cars may gain an entrance into the heart of Sioux City's business district.

Kansas.

It is proposed to extend the Union Traction Co.'s line from Cherryvale to Parsons. The proposition provides that the citizens of Parsons vote $20,000 of bonds and take $25,000 of stock. The Union Traction Co. is controlled by D. H. Siggins, Coffeyville, Kans. Mr. Siggins recently took out incorporation papers for the Southeastern Traction Co., with a capital of $200,000, for the purpose of extending his Montgomery county system from Cherryvale to Iola by way of Chanute and Humboldt. He has been granted a franchise by Iola, and in addition to having the franchise for the use of the streets by his interurban line in Chanute, that city has granted him permission to construct and operate a city system.

Surveys are under way at Wichita for the elevated tracks through the city which will be built jointly by the Santa Fe, Frisco and Orient railways at a cost of $2,000,000, including a union passenger station.

Citizens of Wichita, Kan., at a recent election voted in favor of the elevation of the Atchison, Topeka, & Santa Fe Ry. through the city from Central Ave. to Gilbert St., abolishing all dangerous grade crossings.

The first survey of the Arkansas City, Wellington & Northwestern Ry., according to information from Hutchinson, Kan., has been completed and nothing further will be undertaken until arrangements can be made with citizens of Hutchinson and Cheney for the necessary subscriptions. S. D. Hill is locating engineer of the company.

We are advised that there is no truth in the report that the Atchison, Topeka & Santa Fe Ry. has awarded contracts for an extension of the Denver, Enid & Gulf Ry. to Dodge City.

Kentucky.

Plans have been consummated at Owensboro, Ky., for organization of a $2,000,000 company to build interurban lines between Owensboro, Henderson, Calhoun and Madisonville, Kentucky.

The Dawson Street Ry. Co. has applied to the City Council of Newport, Ky., for a franchise to operate cars in the eastern part of the city. The route provided for begins at the extreme eastern end of 6th St. and runs to Columbia St., where it turns north to 3rd St. to the Central bridge.

Louisana.

The New Iberia, St. Mary & Eastern Ry., planning a 52-mile railway, has plans well advanced and will probably be in shape before long to let grading contracts. It is impossible at this writing to state just when these contracts will be let. H. A. Genung, New Iberia, La., is Chief Engineer.

The Maurepas & Northern R. R. Co. has been chartered with headquarters at Walker on the B. H. & E. R. R. The company proposes a line on practically the route that was to be taken by the New Orleans, Natchez & Fort Scott road a few years past.

It is reported that the Santa Fe system has under consideration the construction of a 55 mile line from Carthage to Shereveport, La., to tap the timber territory.

[illegible] tax for the proposed railroad to be built through that parish.

The St. Louis & San Francisco R. R. has authorized a 7-mile branch extension at Erwinsville. Mr. M. P. Johnson, Constructing Engineer, left St. Elmo, Ill., last week, to start the work.

Work on installing the large interlocking plant of the Illinois Central at Harrahan will shortly be begun. The interlocking plant is to be one of the largest in the South, and the machinery is being constructed from special patterns along the most modern and improved lines.

Maryland.

Engineers reported to be in the employ of the Cumberland Valley R. R. are working northward from the Potomac River at Williamsport, Md., surveying, it is understood for the new low-grade line to be built from the Potomac River to Hagerstown. The railroad company, it is known, has under consideration a plan to reduce the heavy grade and cut out curves to facilitate the handling of freight.

Massachusetts.

The commission on Boston transit problems has reported to the legislature recommending the construction of a subway through Boylston St. from the Commons westward to Charlesgate. The estimated cost of a subway over this route is $4,700.

Minnesota.

Construction work will probably be started shortly on the Minneapolis Northern Suburban Ry., an interurban line which will connect Minneapolis with Amoka, Onaway and Fridley. At a recent mass meeting at Amoka $30,000 of stock was subscribed by the citizens of that place. W. J. Whitcomb, Minneapolis, is President, and H. A. Pathey, Minneapolis, is Vice President.

The recent placing of an order by the Duluth, South Shore & Atlantic Ry. for 15,000 tons of rails for early delivery, is understood to mark the start of the practical rehabilitation of the road by the Canadian Pacific Ry., which controls it through a majority stock ownership. V. D. Simar, Marquette, Mich., is Chief Engineer of the Duluth, South Shore & Atlantic Ry.

Duluth and the Ranges.

BY PETER F. MEAGHER

I regret very much to report the decease of Mr. Frank Simor, a civil engineer well known to the contracting fraterity. Mr. Simor at the time of his death was one of the Division Engineers on the Canadian Northern Railway building into Duluth. He was very well known, especially in this section, and his death is greatly regretted by a large number of friends.

⦿Foley, Welch & Stewart, contractors of St. Paul, who have the general contract for the Soo Line Extension from Frederick to Duluth, a distance of 80 miles, have sublet all of the same and the contractors who took this work are already engaged in building camps and getting their outfits on the work. The following are some of the contractors who took work: R. A. McMenemy, Peter Nelson, Richard Evans, F. J. Mann, Torreen & Sandeen, Higgins & McDonald, F. A. Baxter. This work is to be completed as fast as possible.

Ned Mowatt, Chicago manager for the Anchor Packing Co., spent a week with us here recently calling on the trade. He reported business in his line very good.

T. J. Walsh, of the Johnson-Carey Co., was a caller at this office a few days ago, and stated that their work on the Canadian Northern Railway near Duluth, and their large contract on the same railroad in Canada, was progressing very nicely, and that they were working a large number of men.

H. L. Bartlett, of the H. L. Bartlett Co., contractors, was a caller in Duluth last week. They have a contract for the City of Virginia, and that is about the only work they are doing at the present time.

⦿P. G. Pastoret, of the Pastoret-Lawrence Co., General Contractors, was a caller at this office a few days ago, and reported that his firm had been awarded a sewer contract by the City of Cloquet, Minn., amounting to $29,000 and that work will be started immediately.

⦿Owen McDonnell, brother of P. McDonnell, Contractor, was a caller last week, and he stated that the new contracts secured by his firm was about $16,000 worth of work at Grand Forks, North Dakota, and about $14,000 worth of work at Duluth, Minn. Both of these contracts to be started immediately.

⦿Charles Magnusson, formerely superintendent for John Runquist, railroad contractor, was a caller recently, and stated that he had gone into the Railroad Contracting business for himself. We wished him all kinds of luck, and are very glad to advise that he secured his first contract this week, which was given him by the Duluth and Iron Range Ry. Co., Duluth, Minn.

James McGrath, of the Walsh-McGrath Construction Co., who have the ballasting contract on the Canadian Northern Extension into Duluth, was a caller at this office this week, and stated that their work was progressing very satisfactorily.

⦿E. A. Dahl, contractor, was awarded some paving by the City of Duluth this week amounting to about $10,000 and will start on the same immediately.

⦿F. A. Baxter, contractor, reported that he had taken seven miles of work from Foley, Welch & Stewart on the Soo Line, and that he would start on the same immediately.

Contractors and others when in this vicinity, are cordially invited to make the offices of Peter T. Meagher, 409 West Michigan St., their headquarters while here. We are always glad to see our old friends, and will be pleased to make new ones.

Missouri.

It is expected that no definite action on further financing of the Missouri Pacific Ry. will be taken until B. F. Bush, the new president, has had an opportunity to look over the entire field. The company still has about $1,000,000 cash available for improvements and betterments, remaining from the funds secured by sale of first and refunding bonds in 1910. Up to the present time about $14,000,000 has been spent for these purposes on the Missouri Pacific and Iron Mountain.

The Missouri, Arkansas & Gulf Ry. has partly completed surveys and has also partly secured the capital for the construction of its projected 125 mile line, the route of which is as follows: Rolla, Lecoma, Licking, Raymondsville, Willow Springs and Bakersfield. It is expected to let construction contracts soon. J. B. Payne, Rolla, Mo., is Chief Engineer, and Gilbert Lay, St. Clair. Mo., is President.

Kansas City and Vicinity.

(REGULAR CORRESPONDENCE.)

The board of commissioners let contracts yesterday for opening the Paseo from 27th to 29th along the west side of Troost Ave., Park lake. The Acme Paving & Crusher Co. will do the grading; the paving will be done by Norton Bros., and Spitaufsky & Wagner were awarded the drainage contract. The final settlement of the location of that part of the Paseo that started several years ago, when the park board first undertook to open the parkway through old Troost Park grounds.

Col. J. H. Hampson of Mexico City is registered at the Baltimore. The colonel reports things pretty warm just now and the peace of the United States appeals to him.

Ben. Reynolds is in from Texas. It has been two years since Mr. Reynolds has done any grading work, but he expects to be in the game once more. He is thinking some of going to Iowa to look over the Rock Island work.

From the present outlook it seems pretty certain that work on the Kansas City, St. Louis Electric Ry. will start within the next three weeks. There have been a number of exasperating and unavoidable delays. These appear now to be overcome. Contractors in this section of the country are certainly anxious for this road to begin work, as it means a busy season even though it should be late in starting.

McGuire & Brown have secured two small contracts in Kansas City, Kans. There is enough work in these contracts to keep their outfits working until work in large quantities develops.

Practically every idle contractor in Kansas City has been investigating the Rock Island work between Allerton and Des Moines, Ia. Some have taken work, others concluded not to go to Iowa at present.

Mr. Lou Barber of the J. H. Flick Construction Co., Chicago, was a Kansas City visitor this week.

Quite a number of Kansas City contractors will take a trip to Carrolton, Mo., on May 15 to attend the big ditch letting at that place on the above date. There will be about 2,000,000 yds. of work let to the highest bidder at public outcry. We understand the work is practically all for drag line and dredge.

St. Louis Items.

BY A. B. KOENIG.

M. Klaus, a French engineer, representing the Bank of Paris, made a trip over the St. Louis & Kansas City electric line in company with D. C. Nevil, the president, last week. Mr. Klaus cabled a favorable report to the Bank of Paris, who are going to finance the road. The L. J. Smith Construction Co. will begin work as soon as the finances are deposited in this country, which is expected to be done this week.

Chief Engineer Jacob of the east side levee and sanitary district made his regular monthly report the other day at the meeting of the board of trustees of the district held in East St. Louis. His report states that during the present month surveyors in the engineering department will locate the second and third sections of the front or flood protection levee extending from the Merchants' bridge through East St. Louis to the Pittsburg dike. The location of the levee below Pittsburg dike will be made some time during the summer. It will end at the mouth of Prairie Dupont creek. The contract for the first section of the levee was let a few days ago from Cahokia diversion channel to Mitchell, three miles. The engineer reported yesterday the location of the second section from Mitchell to the Merchants' bridge.

J. W. McMurray, representing J. W. McMurray Contracting Co. of Kansas City, Mo., spent a day with us. McMurray informs us that the three jobs they are working on at present are making rapid progress and nearing completion.

The construction of the tunnel which will connect the city hall with the municipal court building under what before it was closed was 13th St. began the other day. The contractor will dig an open excavation and will install the tunnel in the open air, filling back the earth afterward. The tunnel is to be 6 ft. wide and 6½ ft. high. It is to carry the steam pipes for heating and the wires for lighting the municipal court building from the power plant to the city hall. The earth excavated for the tunnel is being dumped in what was formerly 13th St., which is to be raised about 10 ft. in some places and converted into a park between the buildings. The city inspector on the municipal court building, Max Paffrath, is supervising the construction of the tunnel.

Mayor Charles S. Lambert of East St. Louis informs us a large number of owners of automobiles in East St. Louis favor the plan followed by the state association, which includes the organization of automobile clubs for the purpose of urging road building on the state legislature. The mayor says there are 36,000 automobiles in Illinois that pay an annual tax of $2 each. At this time no part of the $72,000 is used for the road improvement. Automobilists will petition the legis-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

lature to enact a law [illegible] the tax of $3 a year, provided that half or more of the fund be expended by the state, through the highway commissioners, in the improvement of through routes or roads betweens centers of population.

L. E. Mitchell and Frank Nevins, representing the Federal Commissary & Supply Co., left here for Hawk Lake, Canada, to open up a lot of boarding camps for the O'Boyle Construction Co., who is laying track and ballasting the Algoma Central R. R. between Sioux St. Marie and James May, Canada. The Federal Commissary Co. expect to board in the neighborhood of 2,700 men on this line.

The following contracts for street improvements were awarded by the board of public improvements May 9: Asphalt, Clay Ave., between a line about 136 ft. south of Greer Ave. and Natural Bridge road, G. A. Heman, $13,058.02; Ashland Ave., between Taylor and Cora Aves., Barber Asphalt Paving Co., $9,540.42; Greer Ave., between Taylor and Marcus Aves., G. A. Heman, $12,470.84; Howard St., from 7th St. to Blair Ave., G. A. Heman, $23,202.20; 21st St., from Washington to Cass Ave., G. A. Heman, $28,411.52. Brick, Michigan Ave., between Wyoming and Arsenal Sts., G. Eyermann & Bro., $10,040; Linton Ave., between Broadway and 21st St., Perkinson Bros. Const. Co., $16,089.31; California Ave., between Caroline St. and Chouteau Ave., G. Eyermann & Bro., $12,224.62; Idaho Ave., between Itaska and Virginia Avs., G. Eyermann & Bro., $8,040.45; Clara Ave., between North Market St. and St. Louis Ave., Harry F. Heman, $15,971.83; 15th St., from Carr St. to Cass Ave., William H. Redemeyer, $14,726.81. Bitulithic, Osceola St., between Virginia and Grand Avs., Granite Bituminous Paving Co., $14,704.27; Wyoming St., between Oak Hill Ave. and Morgan Ford road, Granite Bituminous Paving Co., $17,912.04; Spalding Ave., between Clara Ave. and Goodfellow Ave., Granite Bituminous Paving Co., $12,384.95; 25th St., from Cass to St. Louis Avs., Granite Bituminous Paving Co., $34,733.87. Wood block, 7th St., from Market St. to Washington Ave., G. Eyermann & Bro., $13,909.18; Pine St., from 4th St. to 12th St., G. Eyermann & Bro., $16,604.05; Benton St., from Broadway to 20th St., Parker-Washington Co. of West Virginia, $45,948.26.

Public hearing on the improvement of the following streets were called for June 6: Marine Ave., Chippewa St. to Broadway; Terry Ave., Union Blvd. to Abner Pl.; Cora Ave., Page Blvd. to Easton Ave.; Illinois Ave., Chippewa St. to Broadway; Oregon Ave., Miami St. to Potomas St.; Eichelberger St., Broadway to Virginia Ave.; Taylor Ave., Margaretta Ave. to Kossuth Ave.; Labadie Ave., Union Blvd. to Adner Pl.; Wisconsin Ave., Chippewa St. to Broadway; Obear Ave., Penrose St. to Carter Ave.; Rush Pl., Kossuth Ave. to Lee Ave.; Sacramento Ave., Cora Ave., West 492 feet; Tholozan Ave., Grand Ave. to Spring Ave.; Crittenden St., Missouri Ave. to Indiana Ave.; Crittenden St., Indiana Ave. to Jefferson Ave.; Virginia Ave., Chippewa St. to Winnebago St.; Salena St., Chippewa St. to Broadway; Rosedale Ave., Washington Ave. to Delmar Blvd.; Harris Ave., Kossuth Ave. to Lee Ave; Kimberly Ave., Greer Ave. to Ashland Ave; John Ave., 11th St. to Von Phul St.; Louisiana Ave., Neosho St. to Osceola St.; Gasconade St., Pennsylvania Ave. to Minnesota Ave.; Grace Ave., Gravios Ave. to Fairview Ave.; Pennsylvania Ave., Meramec St. to Osage St.; Newhouse Ave., Blair Ave. to 19th St.; Shaw Ave., Tower Ave. to King's Highway Blvd.; Sidney St., Wharf to 1st St.; Angelica St., Wharf to 1st St.

Public hearings on the improvement of the following streets were called for June 9: Terry Ave., Norwood Ave. to Union Blvd.; Garfield, Hodiamont Ave., west 122 feet; Koeln Ave., Vermont Ave. to Eugene Ave.; Hornsby Ave., Broadway to Newby St.; Lloyd Ave., Tamm Ave., west 393 feet; Delmar Blvd., Rosedale Ave. to Skinker road; Delmar Blvd., Skinker road to western city limits; Byvard Pl., Commonwealth Ave. to Esplanade St.; Esplanade St., Byron Pl. to Tennyson square.; Manhattan Ave., western city limits to Leamington Blvd.; Tennyson square, Commonwealth Ave. to Canterbury Ave.; Canterbury Ave., Ellendale Ave. to Western city limits; Oxford Ave., western city limits to Commonwealth Ave.; Commonwealth Ave., western city limits, located south of Piccadilly Ave. and western city limits located west of Tennyson square; Piccaddily Ave., Fyler Ave. to western city limits; French Ave., Grand Ave. to Eugene Ave. to 10th St.; Cass Ave. to Brooklyn St.; 10th St., Brooklyn St. to intersection with Hebert St.; Blair Ave., Biddle St. to Wright St.; Natural Bridge road, Salisbury St. to Grand Ave; Clark Ave., Jefferson Ave. to Compton Ave.; 7th St., Broadway to Park Ave.; Mallinckrodt St., Broadway to 11th St. to Florissant Ave.; Newhouse Ave., 19th St. to 20th St.; 9th St., Pestalozzi St. to Sidney St.; 9th St., Wyoming St., east of 9th St. to Arsenal St.; 11th St., Chouteau Ave. to Gratiot St.; Sidney St., 1st St. to Broadway; Madison St., Wharf St. to Broadway; Angelica St., 1st St. to 11th St.; Mount St., 2nd St. to Broadway; St. Charles St., 4th St. to 7th; Washington Ave., 12th St. to 18th St., running south of Washington Ave.; 9th St., Market St. to Washington Ave.; Bell Ave., Garrison Ave. to Grand Ave.

Costello Bros. bought a car load of the finest mules that ever left the National Stock Yards in East St. Louis, which they shipped to their work at Hughes, O., on the Big Four R. R. In addition to this job they have another one on the New York Central R. R. at Bicknell, Ind.

Trustees of the East Side Levee and Sanitary District met in East St. Louis and passed an ordinance adopting plans for construction of section No. 4 of the front levee, the principal feature of the flood protection work for the east side, for the building of which the levee and sanitary district was created. Section 4 of the front levee is two miles long, from the village of Brooklyn at the Mississippi river to the Pittsburg dyke, a mile below Eads bridge. The ordinance passed by the trustees described the work of the engineering and legal departments of the board to be the getting of a right-of-way along and east of the recently established harbor line, paralleling Front St. from Church St. on the south to a point opposite the Chicago & Alton freight house on the north and on the East St. Louis Connecting Ry. and the Wiggins Ferry Co. The ordinance provided the method of condemnation and for exercise of the right of eminent domain, in order to gain use of ground necessary to build the levee embankment. As surveyed, the levee will pass beneath the east tower of Eads bridge, and necessitates removal of rebuilding of the Belt grain elevator, above Eads bridge. Inside the levee all railroad tracks except on the Eads bridge approach will be left several leet below the crown of the levee, thereby giving East St. Louisans opportunity of offering an ordinance providing for a complete and satisfactory plan of track elevation to obliterate all steam railroad grade crossings. The National Stock Yards, which diverts its sewage from the yards to the river by an old and inefficient sewer, has planned to rebuild its outlet and feeders at the yards at a cost of $300,000. The new outlet sewer will be underneath the new levee. The intake of the City Water Co., above the stock yards outlet sewer, will also be reconstructed beneath the new levee, involving heavy expenditure. The estimated cost of new work by the railroads made necessary by the construction of the flood protection levee within the limits of East St. Louis is $1,500,000.

C. W. Grant of Grant Bros. passed through St. Louis the other day on his way to Sheridan, Ia. Charley informs us that their work at Bicknell, Ind., will be finished in a short time and are in the market for more work.

The Alton, Jacksonville & Peoria Electric Ry. will begin track laying at Godfrey, Ill., on May 15 on their extension to Jerseyville, Ill., and expect to have their line in operation between Alton and Jerseyville within 60 days.

A large power house is being erected on Piasa Creek, nine miles out of Alton, Ill.

L. J. Smith and L. A. Nutter of the L. J. Smith Construction Co. spent a couple of days in town last week.

J. W. Skinner is offering his farm at Chadwick, Mo., for sale and will devote all his time in the future to his bridge and concrete contract.

Bids for work on the board of education property, amounting to more than $100,000, were opened by the committee on school buildings of the board of education. The bids were for work on the Froebel, Washington, Simmons, Benton and Central high schools and the board of education building. The lowest bid in each case will be recommended for approval to the board of education at its meeting next Tuesday night. Of seven bidders for general work on the Froebel school building, Nebraska Ave. and Winnebago St., Geo. Moeller & Co. were lowest with a bid of $26,900. The following were low bidders on the other contracts for the same building: Gas fitting, plumbing and sewering, Henry D. M. Doerner, $1,921; heating and ventilating apparatus, O'Mara Heating Co., $15,380; heat regulation, National Regulator Co., $1,215; wiring, E. A. Koenemann Electric Co., $4,100; vacuum cleaning, Vacuum Cleaning Co., $1,220. The sum of these bids is $50,736. The following were the lowest bidders for work on the Washington school, Euclid and Fountain Ave.: General work, Wall Bros., $28,661; plumbing, sewering and gas fitting, Henry D. M. Doerner, $2,494; heating and ventilating, O'Mara Heating Co., $12,900; heat regulation, National Regulating Co., $1,249; wiring, Eclipse Electric Co., $3,680; vacuum cleaning, Spencer Turbine Cleaner Co., $1,235; total $50,299. The Spencer Turbine Cleaner Co. was also the lowest bidder for the vacuum cleaning of the Simmons and Benton schools, with bids of $1,345 and $1,312, respectively. John F. Ruth bid lowest of eight bidders for putting standard fire windows and doors in the board of education building, $7,170. John B. Sills was low with a bid of $724 for changes in the Central high school auditorium.

P. J. Murphy, Moberly, Mo., has 15,000 yds. of good track work on the Burlington R. R. south of Beardstown, Ill., to sub-let. In addition to this Murphy is filling a bridge for the Wabash R. R. at Moravia, Ia.; also one at Alvia, Ia. He is also building a reservoir for the same company at Mexico, Mo., and is putting in a spur for the same company at Woodland.

E. A. Wickham & Co., Council Bluffs, Ia., have a lot of nice work on the Rock Island R. R. to let in quantities to suit outfits.

Jim Cary of Cary Bros. is here buying a lot of supplies and tools to be added to their outfit at work on the levee near Cora City, Ill.

Mike Conroy has finished his work on the Alton, Jacksonville & Peoria Electric line in Illinois. His outfit is resting up at Godfrey, Ill.

L. E. Hamblet, the local manager of the Petersen & Fell Boarding & Commissary Co., is in the north looking after a lot of new camps and boarding outfits that his company are starting in this territory.

B. F. Bush, the new president of the Missouri Pacific R. R., evidently brought a lot of alarm clocks with him when he came to St. Louis and has woke up the Missouri Pacific R. R. During the past week this road has put on over 2,500 section men. Sections that formerly had two or three men in them now have from 8 to 15, and it is only a matter of time before Mr. Bush will have the Missouri Pacific as he stated when he arrived here, the Pennsylvania R. R. of the west.

C. L. Petersen of the Petersen & Fell Boarding & Commissary Co. is here adding a lot of new boarding camps on the Missouri Pacific R. R.

Railroad labor is getting very scarce here. During the past week the Missouri Pacific put on in the neighborhood of 2,500 men. The government engineers and contractors on the Mississippi and Missouri rivers have also doubled their forces. Several new electric [illegible] the labor market here. No trouble for all the good laborers in the country to get work if they will come to St. Louis.

Pat Hannon of Hannon & Hickey came in from their Kansas City Southern R. R. work at Richards, Mo. They have this work well [illegible] the material and supplies on the ground.

J. W. Wright, Jr., of Union Springs, Ala., is constructing the Jackson, Dyersburg & Northwestern R. R. between Jackson and Dyersburg, Tenn.

T. J. Dolan, the hustling wide-awake secretary and treasurer of the International Brotherhood of Steam Shovel & Dredgemen, was with us a day. As usual, one of the busiest men we ever saw. Left here for Chicago, promising a return call shortly.

Nebraska.

Surveyors of the Union Pacific are now in the field running lines for the extension of the Kearney & Black Hills branch from Callaway, Neb., to Gandy or further. Grading, it is said, will be commenced in a short time. This project was mentioned in our last issue.

Nevada.

It is reported in Tonopah that the Las Vegas & Tonopah R. R., A. Maguire, Chief Engineer, Los Angeles, Cal., is planning in the near future to extend its line from Goldfield to Tonopah.

New Mexico.

It is reported that the property of the Albuquerque Eastern Ry. Co., which was recently placed in the hands of a receiver, will be purchased by the Atchison, Topeka & Santa Fe. The holdings consist of a railroad grade, 45 miles long, running from Moriarty, on the Mexican Central, to Albuquerque, and a branch line into the Hagan coal fields, 18 miles. By utilizing these grades the Santa Fe can enlarge its present system in New Mexico to good advantage, it is claimed.

It is rumored in East Las Vegas, N. M., that the Santa Fe system has had surveys completed for the proposed Colmor cutoff and that work will be started early this summer. The cutoff will begin some few miles east of Syracuse, Kas., and shoot straight across the country in an air line through strips of Kansas, Colorado and New Mexico to Colmor, 60 miles east of Las Vegas.

New York.

⊙The Rome & Osceola R. R. Co., according to advices from Rome, N. Y., has awarded two contracts for grading its roadbed. Henry Albrecht, Ava, N. Y., got 3,700 ft. and Remember Kent 2,100 ft.

The Buffalo, Lockport & Rochester Ry. (electric), Rochester, N. Y., is expending considerable money in improvements. These include the double tracking of about five miles of the road. Eventually the whole line, from Lockport to Rochester, will be double tracked.

Rapid progress is being made with the work on the site of the new station of the New York Central & Hudson River R. R., at Rochester. Specifications for the superstructure have been completed and it is expected that bids will be asked this week. These bids will probably be opened about the middle of June.

The state legislature is reported to have passed the bill giving to city officials of Buffalo the right to contract with the Delaware, Lackawanna & Western R. R., for terminal improvements in that city.

The Grade Crossing Commission of Buffalo is stated to have reached an agreement with the Erie R. R. for the elimination of crossings at grade on its line between Walden Ave. and Military Road, skirting the northerly boundary of the city.

The Skaneateles R. R., S. A. Kane, Secretary, Skaneateles, N. Y., proposes to extend its line through Elbridge to Jordan. The company at present operates five miles of standard gage steam line.

Officials of the New York Central & Hudson River R. R. have authorized the expenditure of $500,000 this summer for the installation of additional signal systems between New York and Buffalo.

North Carolina.

The Raleigh & Southport Ry., J. A. Mills, President, Raleigh, N. C., now operating 64 miles of standard gage line, is reported to be about ready to let contracts for building a 25-mile branch from Lillington to Sanford, N. C.

The Piedmont Ry. & Electric Co., has been chartered with a capital stock of $1,000,000 and proposes to build and operate electric railways connecting Burlington, Graham, Haw River, Hopedale, Carolina and Glenco. The incorporators are J. M. Cook and A. L. Davis of Burlington, N. C., and E. S. Parker, Jr., Graham, N. C.

A railroad is projected to extend from Andrews to Aquone in Macon County. The line will be about 15 miles long and will be built by the owners of timber lands on the upper Nantahals River. Surveys for the line were made about six months ago.

Ohio.

⊙Bids were opened April 29 by the County Commissioners at Cleveland, O., for labor and material for the elimination of the grade crossing of the Penna. and W. & L. E. Railroads at Dunham Road, in Bedford Township, by the construction of an overhead bridge across the railroads on Dunham Road between Granger Road and Bedford Road. The contract for the substructure was awarded to T. B. Husband, 3,706 E. 71st St., Cleveland, O., at $47,479; the contract for the superstructure was awarded to McMyler Interstate Co., Bedford, O., at $26,310.

⊙The Cleveland, Cincinnati, Chicago & St. Louis Ry., G. P. Smith, Chief Engineer, Cincinnati, O., has recently let to the Walsh Construction Co., of Davenport, Ia., a contract for grading and masonry for second track and grade reduction work between Sharonville and Kyles, O. About 2,200,000 cu. yds. of grading are involved and about 20,000 cu. yds. of concrete.

Cleveland, Cincinnati, Chicago & St. Louis Ry. expects to make extensive improvements and extensions to its Sharonville yards, the work involving a round-house, turntable, coal dock, cinder pit and other equipment, together with about 12 miles of additional yard tracks.

The Hills & Dales Ry. Co. of Dayton, recently mentioned in these columns, has filed an amendment to its articles of incorporation, whereby its name is changed to the Dayton Power & Light Co.

The State Legislature has passed the bill of Senator Bader of Cincinnati granting to the city of Cincinnati the right to issue $500,000 bonds for the construction of terminals for the Southern railroad, owned by the city.

The Cincinnati, Hamilton & Dayton Ry., F. H. Alfred, General Superintendent, Cincinnati, O., will expend $400,000 this summer in improving the road between Cincinnati and Toledo. The principal improvements will consist of double-tracking and extension of passing sidings at places where the traffic makes the move necessary. North of Hamilton there will be about two miles of second track laid and north of Dayton the second set of rails will be laid for about four miles. The total amount of new track to be put down approximates ten miles.

A conference was recently held by City Engineer F. M. Lillie, Youngstown, O., and H. H. Althouse, representative of the Erie and Pittsburg & Lake Erie R. R., in regard to the elimination of grade crossings in that city.

The Court of Common Pleas has sustained the curative ordinance passed a short time ago by the City Council of Cleveland providing for the elimination of the grade crossings at Madison and Lake Aves. N. W., over Lake Shore tracks. The names of the two avenues were omitted from the ordinance passed last fall providing for the issuance of $2,000,000 in bonds for elimination of a dozen grade crossings over tracks of the Lake Shore, Pennsylvania and Nickel Plate roads. The suit to enjoin the publication of the Madison Ave. and Lake Ave. curative ordinance and use of the funds provided in the $2,000,000 bond issue ordinance passed last fall was a purely friendly action. The city law department filed a demurrer to the petition and the demurrer was sustained by the Judge, who held that both ordinances are valid. Work on plans for the dozen grade crossing eliminations can now proceed. Robert Hoffman is City Engineer of Cleveland, O.

An official of the Cleveland, Akron & Columbus Ry., advises that the company does not contemplate the extension of any second track. It was reported that the company was planning to extend its second track south from East Union.

Oklahoma.

The state election board has completed the final count of the returns on the recent election on the proposed amendments to article 9, section 9; of the constitution to permit the consolidation of railway lines which shows that the proposed amendment lost by a majority of 4,894. The total vote for the amendment was 41,768, against 46,662, total vote cast in the election 88,430.

Announcement has been made that the Oklahoma Union Traction Co., A. A. Small, President, Tulsa, Okla., will build two miles more of city street car lines to go south on Guthrie Ave., a mile from 4th Street, then east ½ mile and south ½ mile at Tulsa.

Oregon.

The Portland, Eugene & Eastern Ry. Co., 502 Fenton Bldg., Portland, is reported as about ready to begin work on its loop system at Salem.

⊙It is reported in railroad circles that the Oregon Short Line Ry. Co. has awarded the contract for the construction of its Camas Prairie R. R. to Kilpatrick Bros. & Collins, Beatrice, Neb., and that actual construction work will be started at once.

Track laying was started May 1 on the North River branch of the Oregon-Washington Ry. & Navigation Co. Grading of the entire branch extending from Cosmopolis 12 miles into the timber tracts southeast of Grays Harbor has been completed. The line will be completed for the present only as far as the summit.

At a meeting held recently by the citizens in the vicinity of Mulino, Ore., $5,000 was subscribed for the construction of the Clackamas Southern Ry. from Oregon City through the Mollalla Valley. Grading work is progressing nicely from Oregon City and will be rushed as far as Beaver Creek.

Pennsylvania.

⊙J. G. McGuire & Co., New Brighton, Pa., have been awarded the contract by the Woodlawn & Southern Street Ry. Co., for the construction of an electric line between Woodlawn and Aliquippa, with a branch to New Sheffield, Pa. The new line is owned by the Jones & Laughlin Steel Co., Pittsburg, and it is intended to meet the necessities of the workmen at the new Aliquippa works of the company, and provide transportation from the homes of the men to the various departments of the plant. In Woodlawn the line will run through the main business street known as Franklin Ave.

The Williamsport Passenger Ry. Co., Williamsport, Pa., is planning to build a branch from Market St. and Southern Ave., at Williamsport, to the new Carey amusement park at the southern end of Market St.

An official writes that there is no construction contemplated now for the extension of the Lake Erie & Pittsburg Ry. to Pittsburg.

The Conewago & Southern R. R. Co. has been chartered with a capital stock of $150,000 and proposes to operate eight miles of line in Adams county, extending from Biglerville through Arendtsville to Cashtown. The officers are: President, H. W. Hahmblin, Harrisburg, and these directors: M. A. Garvin and J. J. Garvin, Gettysburg; Mark E. Johnson, Millersburg; Paul Voorhees and J. H. Freeland, Harrisburg; D. M. Sheeley and J. A. Deardorf, Cashtown, and J. A. Kane, Arendtsville.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The Centre Brick Ry. Co. has been incorporated with a capital stock of $20,000. The incorporators are W. D. Lerby, W. G. Bunkie, Ellis L. Orvis, Bellefonte, Pa.

Rhode Island.

The Governor of Rhode Island has signed the bill by which the Grand Trunk Ry. secures a right of way to a tide-water terminal in Providence for its subsidiary, the Southern New England Ry. The bill provides for access by the Grand Trunk to its proposed docks by passing over and under the tracks of the New York, New Haven & Hartford railroad. The bill was in the form of an amendment to the charter of the Southern New England Ry. Co., and had been mutually agreed upon by the Grand Trunk and New Haven interests. It is expected that the Southern New England will immediately file amended articles of incorporation and begin the actual construction of its roadbed from Palmer, Mass., a terminal of the Central Vermont, another Grand Trunk subsidiary, to a point on the Providence water front near the new state docks. Under the provisions of the amendment the Grand Trunk is given right of way to its docks across the New Haven road's tracks, crossing the latter at grade in one place and through a tunnel beneath in another. By the terms of the agreement reached between the railroads, the New Haven will defray the expenses of construction of the tunnel.

Santo Domingo.

Senor Don Federico Velasquez, minister of Finance of Santo Domingo, has gone to New York for the purpose of closing a contract with the owners of the Sanchezna Vega R. R. to continue the Dominican Railroad to the capital. He desires the approval of the American government for this and for the building of six highways. It is purposed to spend $500,000 on the improvement of the Puerto Plata-Santiago Railroad and the building of a custom house at Puerto Plata.

South Carolina.

⊙The Piedmont Traction Co., which has grading work under way for an interurban line through the Carolinas, has awarded the contract for practically the entire electrical equipment of the line between Charlotte and Greenwood, S. C., to the Westinghouse Electrical & Manufacturing Co. of Pittsburg, for $300,000.

No definite steps have been taken as yet for the proposed electric railway from Camden to Sumter, S. C., mentioned in our issue of April 26. The surveys have not been made, and the project is yet in a tentative state. It is hoped, however, to have something done this year. The projected length is 31½ miles. Robt. E. Sharp, Rembert, S. C., is interested.

According to reports from Columbia, S. C., grading work is progressing rapidly on the projected railroad from Wards, S. C., on the Southern Ry., between Columbia and Augusta, to Saluda.

Tennessee.

The Nashville & Gallatin Interurban Co., H. H. Mayberry, President, Nashville, Tenn., will probably have plans and specifications for its proposed line completed this month and will have construction work started in July. It is planned to have the line in operation in 16 months. The road will be about 30 miles long.

A mass meeting attended by representatives from a dozen cities of Tennessee and North and South Carolina was held at Knoxville recently to lend assistance to the movement to connect Knoxville and Greenville, S. C., by railroad. The Knoxville, Sevierville & Eastern has recently been built 30 miles east of Knoxville and the Greenville & Knoxville 30 miles west from Greenville, leaving a 90 mile ling to be built. Presidents of these two roads were present and pledged themselves to connect their lines if proper support is given.

The Lake View Traction Co., North Memphis Savings Bank Bldg., Memphis, is planning to have extension work started shortly on its lines south from Lakeview. The line will be extended to Walls, Miss., immediately and later to Clarksdale. In order to comply with the conditions of the franchise given the company it will extend its line north from its present terminal in New South Memphis to terminal headquarters at Union Ave. and South 3rd St. by Jan. 1 of next year. J. H. Sullivan, former superintendent of the Frisco system in Memphis, has been elected president of the Lakeview Traction Co. Other officers have been elected as follows: Vice-president, Walter Goodman; secretary, J. R. Pleasants; treasurer, P. S. Smithwick; directors, R. F. Tate, R. T. Faut, J. S. Robinson, B. G. Henning, W. A. Percy, R. H. Nebhut, D. D. Saunders.

Great progress is reported in the plans of the New Orleans, Mobile & Chicago for the extension of its system from Middletown, Tenn., to Jackson, a distance of 40 miles, and ultimately to the Ohio river. W. F. Owen, Mobile, Ala., is vice president and general manager of the company.

Texas.

Engineers of the Southern Traction Co. have been working south of Dallas restaking the survey from Dallas to Ferris. Surveying outfits of the Fred A. Jones Construction Co., Dallas, have been laying routes for the Southern Traction Co.'s interurban lines from Dallas to Corsicana and Dallas to Waco.

A company is to be incorporated shortly to construct and operate the proposed Dallas-Denton interurban line. It is planned to incorporate with a capital stock of $500,000 and to start building operations from the Denton end of the line, the construction of that part of the line lying out of Denton being a much easier work than the Dallas end of the line. Alvin C. Owsley, Denton, Tex., is interested.

A mass meeting has been held at San Diego, Tex., to discuss ways and means of persuading the San Antonio & Brownsville R. R. to come through San Diego. A committee of six was appointed to confer with the railroad committee of San Antonio, as follows: Charles Hoffman, R. H. Corbett, W. W. Meek, J. W. Shaw, S. H. Woods and Judge Luby, who was appointed chairman of the committee.

The Waco, Land, Mining & Fuel Co., Waco, which is to open a new coal mine near Teague has secured right of way for the track to connect the mine with the Trinity & Brazos Valley. Work will begin immediately, it is said.

The Wichita, Falls & Southern Ry., R. A. Thompson, Chief Engineer, Wichita Falls, has entered into contract with citizens of Graham for the extension of the line to that town from New Castle, the contract calling for a bonus of $35,000 and right of way from New Castle to Graham, a distance of eleven miles. The road is to be in operation within three months and work will be started at an early date. Other important extensions of the Wichita Falls route are expected to be announced shortly.

The Gulf, Texas & Western Ry., which, as noted in our last issue, is projecting several extensions, has made a proposition to the citizens of Fort Worth to immediately extend the line to that city from Jermyn, a distance of about 75 miles. The proposition calls for the purchase of $250,000 of bonds of the road by the people of Fort Worth. It is expected that the proposition will be favorably acted upon and that the construction of the extension may be started this summer. The preliminary survey has already been made. B. B. Cain, Dallas, Tex., is General Manager.

The State Railroad Commission has authorized the registration of $2,536,000 in bonds for the Houston Belt & Terminal Ry. in accordance with the recent inspection and valuation by its engineer on betterments, additional trackage and the new passenger depot.

It is reported that the St. Louis, Brownsville & Me [illegible] the Frisco, will be extended up the valley of the Rio Grande from Roma, about 45 miles, during the present year, and later the line will be continued along the border to Laredo.

The Palacios, San Antonio & Pecos Valley R. R. is reported to be preparing to let contracts for the building of the first 36 miles on its line. The construction work is to be started from Palacios, Tex., west to Francitas, in Jackson county, thence to Edna. About two-thirds of the right of way northwest to San Antonio has been secured. The plans call for building a main line, with branches of 160 miles. H. W. Dean, Palacios, is Manager.

Advices received from Lubbock, Texas, state that on May 1 the Lubbock-Coleman cutoff of the Atchison, Topeka, & Santa Fe Ry. was completed and thrown open to traffic. The new line is part of the Santa Fe's new short route to the Pacific and gives Lubbock a direct line to Galveston and a much shorter route to Dallas and Fort Worth.

Judge David B. Hill, District Court, Dalhart, Texas, is reported to have ordered the sale of the Enid, Ochiltree & Western R. R. The company was chartered two years ago to build a railway easterly from Dalhart to Enid, Okla., a distance of 250 miles, and a good portion of it was graded across the Panhandle country.

Utah.

⊙The Utah Construction Co., Ogden, Utah, has been awarded the contract for grading for 112 miles of line for the Oregon Short Line R. R. The contract includes the grading for the double tracking of the main line of the road from Farmington to Ogden, 22 miles, from Burley to Kelton Pass, a distance of 66 miles, in Idaho, and for the grading for the south side line from Nyssa, Ore., to Homedale, Ida., a distance of 26 miles.

The Wasatch R. R. Co., recently incorporated with a capital stock of $100,000, is planning to begin work this month on the reconstruction of the old railroad to Wasatch. Four miles of the line is now in condition, from Midvale to a point beyond Sandy, and the remaining six require reconstruction, which will include the laying of new ties. The grade and roadbed are in good shape, and the rails are intact, so that the work of putting the road in order for the opening by June 15 will go rapidly forward. J. G. Jacobs, Salt Lake City, is President.

The Utah Development League, upon the request of the Cedar City Commercial Club, is to request the influence of several senators in obtaining of the United States Geological Survey right of way through the government lands for the proposed line of the Utah & Grand Canyon R. R.

Virginia.

The Norfolk & Western Ry. is planning to construct a 1-mile spur from its Lamberts Point main line near Norfolk to the warehouse of Jones & Co.

The Surry, Sussex & Southampton Ry., F. E. Waters, President, 905 Union Trust Bldg., Baltimore, Md., is extending its line from Surry courthouse to Smithfield in Isle of Wight county. Nine miles of the extension have already been graded.

It is believed that construction work will be started this year on the proposed 90 mile electric line of the Washington & Old Dominion R. R. Co., mentioned in our last issue. It is stated that the company is backed by the syndicate headed by John R. McLean, of Cincinnati, O., which controls the Great Falls & Old Dominion line, now operating from Georgetown through Fairfax county, Va.

The Henrico & Chesterfield R. R. Co. with headquarters at Richmond, Va., has been chartered with a capital stock of $20,000 to $50,000 and proposes to operate a 6-mile electric line from Ridge Church, Henrico county, to Bonair, Chesterfield county. The officers of the company are as follows: Thomas S. Winston, president; W. O. Burton, vice president; W. C. Schmidt, secretary and treasurer; George Bryan, John B. Badenoch, and M. G. Wright, directors, all of Richmond, Va.

[illegible] A. M. Moore, Cleveland, O., with the plans for the construction of the Blue Ridge Railroad or Rappahannock Ry. line from Washington in Rappahannock County, Va., to Culpeper, a distance of 30 miles. It is reported [illegible] counties, Va.

Washington.

[illegible] Bellingham, has engineers in the field re-running a line on the original survey from Blanchard to Avon with the apparent intention of establishing a route entering Mount Vernon on the east side of the Skagit river instead of [illegible] West Mount Vernon. [illegible] has been definitely established to Blanchard. The route now being surveyed is practically [illegible] Avon. From Ladysmith it runs south to what is known as the Joe Leary slough and then follows along the west side of Olympia marsh around a point at the old Knutzen creamery. It then continues south to Avon, where it crosses the river and runs on into Mount Vernon.

Good headway is being made on the grade of the proposed line of the Chehalis & Cowlitz R. R. The mayor of Chehalis, Wash., has signed the ordinance providing a franchise for the company.

Advices from Springdale, Wash., state that active construction work has been commenced on the new Springdale & Long Railroad, to extend from a junction with the Great Northern Ry. at that place to the site of the new plant of the Washington Water Power Co. on the Spokane River, 22 miles south of Springdale. Several miles of the right of way have been cleared, and at a point two miles south of town two grading crews are at work, and the grade of the new road is already beginning to assume shape.

Efforts are being made by J. J. Ives, Seattle, Wash., to interest Bellingham citizens in the construction of the contemplated railroad from Spokane to Bellingham, through Lincoln, Okanogan, Skagit and the western part of Watcom counties.

West Virginia.

⊙Gilmore & Weaver, Morgantown, W. Va., have been awarded a sub-contract for constructing retaining walls on the new line of the Buchannon & Northern R. R. The contract amounts to about $500,000. Derrick rubble stone will be used for the construction of the walls.

At a recent meeting of the stockholders of the new Fairmont, Clarksburg & Grafton Traction Co., at Grafton, the following officers were elected: President, Charles F. Sutherland, Morgantown; first vice president and general manager, John H. Roberts, Pittsburg; second vice president, C. Lee Reynolds, Grafton; treasurer, A. B. Corder, Grafton; secretary, Charles C. Benton, Pittsburg. It is understood that construction work will be begun at once.

The Gilmer & Parkersburg R. R. Co. of Glenville, W. Va., has been chartered with a capital stock of $50,000 and proposes to build a line from Burnside via Glenville to Parkersburg, W. Va. The incorporators include S. A. Hays, Glenville, C. M. Bennett and D. W. O'Brien.

The Steubenville, Wellsburg & Weirton Ry. Co., a new electric railway company, has requested the Brooke County Commissioners, at Wellsburg, to co-operate with it in rebuilding the highway from Wheeling Junction to Holliday's Cove. The railway company proposes to construct its trolley line between Steubenville and Weirton between the steam railroad and the county road. The proposition is that the county court shall pay $5,000 toward bringing the county road down to the grade of the new trolley line. This would make the county road much broader and of a uniform grade. The actual cost of remodeling the county road would probably be $15,000 or $20,000.

According to advices from New Martinsville, W. Va., work has been started on the preliminary survey on the Clarksburg & Northern R. R. to be constructed from New Martinsville, W. Va., to Middlebourne. Col. T. Moore Jackson, Clarksburg, W. Va., who is interested, is quoted as stating that work will be started May 20.

Canada.

E. A. Studer, formerly at Wesley, Ia., is now located at Swift Current, Sask., where he has a contract on the Canadian Pacific R. R., the work being located six miles south of that place.

The Grand Trunk Pacific Ry., B. B. Kelliher, Chief Engineer, Winnipeg, Man., will shortly call for bids for the erection of a new station in Quebec. Bids for the railway work shops to be erected at Quebec will also soon be asked.

George H. Pettit and William C. Perkins of Niagara Falls, N. Y., have applied to the City Council of Welland, Ont., for a franchise for the Niagara Frontier Railway which proposes to build an electric railway from Niagara-on-the-Lake to Fort Erie along the Niagara River.

The Dominion Minister of Railways has announced that a resolution will be presented to Parliament providing for a bond guarantee for the Canadian Northern Ry. that will insure the speedy construction of the link from Port Arthur to Montreal. The Government will ask Parliament to guarantee the bonds of the company to the extent of $35,000 per mile for the whole distance from Port Arthur to Montreal via Sudbury and the Ottawa Valley. From Montreal the company will have access to the seaboard for its through freight by means of an interchange of traffic at Montreal with the Intercolonial Railway. From Port Arthur to the Rockies the line is already completed, and is now heading for its Pacific coast terminus near Vancouver. The Canadian Northern Ry. now has a through line from Ottawa to Quebec. It is proposed to begin at once the construction of a line branching off from this at Hawkesbury to Montreal. From Ottawa the road will run on the south side of the Ottawa River to the Chats, about thirty miles west of Ottawa. From there it will cross the Ottawa River and run along the north shore to Portage du Fort, where it will again cross the Ottawa, and proceed thence nearly in a straight line to Sudbury, and thence along the route now surveyed to Port Arthur.

The capital expenditure of the Canadian Government for the current year amounts to $46,462,621, largely made up of four items—namely, $27,000,000 for National Transcontinental Ry. construction, $2,000,000 for Hudson Bay Ry. construction, $2,550,000 for the Quebec bridge, and nearly $5,000,000 for improvements and extensions of the Intercolonial Railway, principally in Nova Scotia.

The Canadian Northern Ry. is reported to have secured the Jesuit College site on Bleury St. at Montreal as a location for terminals. It has been known for some time that the Canadian Northern Ry. was looking for a suitable central site, and from time to time reports were spread that they had secured one. To reach the new site on Bleury St. it will be necessary for the company to tunnel under the mountain. The cost of the new terminal and the entrance to it will involve the expenditure of $2,000,000 to $3,000,000.

BRIDGES—STEEL AND CONCRETE

California.

⊙Commissioners of Yuba County at Marysville, Cal., have awarded the contract for the construction of a steel bridge over Little Dry Creek to the Ross Construction Co., at $2,364 and $8.50 per cu. yd. for substructure. Other bids were received as follows: Jenkins & Wells, $2,533, and $11.50 per yard for concrete; Cotton Brothers, $2,480, and $9.50 a yard for concrete; Clark & Henery, $2,448, and $9 a yard for concrete. The Judson Manufacturing Company also entered a bid to furnish the steel for the structure for $856.

City Attorney of Pasadena, Cal., has entered into an agreement with the Pacific Electric Ry. Co. to build culverts at California St. and Orange Grove Ave. under its tracks. The improvement will necessitate an expenditure of about $6,000.

Florida.

City Council of St. Augustine, Fla., on May 3, approved the plans and specifications for the proposed new concrete bridge to replace the old wooden structure spanning the San Sebastian River and connecting St. Augustine with New Augustine at King St.

Advices from Tampa, Fla., in regard to the proposed bridge over the Hillsboro River at Lafayette St. state that the proposition has not advanced sufficiently to make any definite statement concerning the plans. F. T. Warren is City Engineer.

Idaho.

Commissioners of Lincoln County at Shoshone, Idaho, have appropriated $3,000 for the construction of a new bridge across the Wood River just north of Gooding to replace the old structure. Bids for the work will be asked soon.

Illinois.

✣Bids will be received at Schmidt Mound, between East St. Louis and Collinsville, up to 2 p. m., May 18, for the construction of one steel bridge in Nameoki Township, Madison County. John Schmitt, Edgemont Station, Route No. 3, East St. Louis, Illinois. Canteen bridge:—Span, 60 ft.; roadway, 16 ft.; Plain concrete substructure. Estimated amount of concrete, about 135.1 cubic yards. Excavation will be in black loam and silt. Proposed work is over a new drainage ditch. Nearest railroad station is Griswold, on the Vandalia, 1½ miles. Material will have to be shipped in. Superstructure is to have a removable concrete floor. Field connections to be bolted. Commissioners wish bids submitted as follows: First, one new abutment and recapping old west abutment and pointing same; second, two new abutments in accordance with plans. Work to be completed on or before June 20, 1911.

✣Bids will be received at the Town Hall, Fulton, Ill., up to 2 p. m., May 27, for the construction of one reinforced concrete bridge in Ustick Township, Whiteside County. Earl Hollinshead, Town Clerk, Fulton, Ill. Edland Bridge—Span, 24 ft.; roadway, 22 ft.; finished roadway to bottom of footings, 15 ft.; wings, 12 ft.; Estimated amount of concrete in structure, 90 cu. yds.; reinforcing steel, 9,373 lbs. Nearest railroad station, Union Grove on the C. & N. W., 7 miles; Fulton, 9 miles. Gravel, 4 miles from bridge site; pit gravel, 75c per cu. yd.; creek gravel, 25c per cu. yd. Haul, about 4,000 lbs. Sand in gravel is rather fine, will need reproportioning or extra cement. Present bridge wood, length 17 ft. Excavation will average about 13 ft. in sandy loam and clay. Work to be completed on or before July 20, 1911.

✣Bids will be received at the bridge site, 3 miles from Quincy, Ill., up to 2 p. m., May 27, for the construction of the substructure for a bridge in Melrose Township, Adams County. Jos. Schonarth, Town Clerk, R. F. D. No. 5, Quincy, Ill. Summer bridge—Span, 80 ft.; roadway, 16 ft., height of abutments, 22 ft. Total amount of concrete in the new abutment, 145 cu. yds. Nearest railroad station, Quincy on the Wabash and Q. lines, 3 miles south on 24th St. Roads, good. Crushed rock furnished free by the Commissioners at quarry,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

2 miles from bridge site. Ordinary flow of stream, 4 ft. deep and 30 ft. wide. Excavation in sand. Piles will be necessary. Present structure is an old steel arch span of 75 ft. South abument to be removed and rebuilt with concrete. North abutment to be pointed up and recapped with concrete by removing the two top courses of stone. Work to be completed on or before September 1, 1911.

✤Bids will be received at the bridge sites in Richfield Township, Adams County, Ill., up to 2 p. m., May 26, for the construction of two bridges, one of reinforced concrete, the other reinforced concrete abutments with repairs for old steel superstructure. Floyd Finchum, Town Clerk, R. R. No. 1, Plainville, Ill. Hastings Bridge—Span of old steel bridge, 39 ft., resting on tubes. Wanted new concrete abutments to be built back of the tubes; 45 ft., face to face; cleaning and painting of the present steel bridge, new steel stringers with white or burr oak floor. Present tubes not to be disturbed. Estimated contents of new abutments, 52.5 cu. yds.; reinforcing steel, 2,202 lbs. Nearest railroad station, Barry on the Wabash, 7½ miles. Gravel available in creek bed, free, 2 miles from bridge site. Excavation, north side, 8 ft.; south side, 4 ft. in sandy loam to clay or rock. Dradge Bridge—Span, 40 ft.; roadway, 16 ft.; reinforced concrete. Estimated contents in structure, 145.6 cu. yds.; reinforcing steel, 15,598 lbs. Nearest railroad station, Barry, 7 miles. Gravel available ½ mile from bridge site in creek bed free. Excavation will average 12 ft. in sand and loam. Earth approaches, back filling and macadam or gravel wearing surface to be included in contract for the above bridges. Work to be completed on or before September 15, 1911.

✤Bids will be received at the County Clerk's office, Virginia, Ill., up to 2:30 p. m., May 25 (readvertisement of bid received May 11) for the construction of the following reinforced concrete bridges in the County of Cass. L. O. Skiles, County Clerk, Virginia, Ill.

wings, 10 ft. Estimated amount of concrete in structure, [illegible] cu. yds.; reinforcing steel, 8,203 lbs.

⊙W. S. Elder, De Land, Ill., has been awarded the contract for the construction of the bridges of the DeWitt special drainage district at $1,674.

⊙The contract for the reconstruction of a bridge over Mud Creek near Boyle's Grove in Tremont Township has been let, according to advices from Pekin, Ill., to Edward Cooney, Tremont, Ill., at $1,544.

⊙The contract for the construction of the proposed new Landau Ave. concrete bridge over Spring Creek was awarded by the Highway Commissioners, Joliet, Ill., to Newkirk & Powers Construction Co., Joliet, Ill., at $4,200. Citizens hope to secure next the construction of a new bridge across Spring Creek at Ohio St.

⊙Commissioners of Iroquois County at Watseka, Ill., have awarded the contract for the construction of the new Hodel bridge, west of Cissna Park, to C. A. Weaver & Son, Clayton, Ill., at $2,175.

Highway Commissioners of New Lenox Township and Manhattan Township recently held a meeting at New Lenox, Ill., to consider the matter of constructing a new highway bridge on the New Lenox-Manhattan line. The cost of the work will be divided between the two townships.

All materials for the above bridges will have to be shipped in. Excavation will be in sandy loam and clay. Numbers 3, 4, 5, 7, 8, and 9 have plain concrete sub-structures. Work to be completed on or before Sept. 1, 1911.

Highway Commissioners of Rosedale Township at Rosedale, Ill., recently held a meeting to consider the construction of the proposed new Groppel branch bridge. H. E. Bilger, Assistant Engineer of the State Highway Commission, will submit plans for the structure.

Name	Span [illegible]	Roadway [illegible]	Cu. yds. concrete	Total lbs. steel.	Nearest R. R. Station.
[illegible]	[illegible]	[illegible]	[illegible]	2,510	E. of Chandlerville, 8 mi.
[illegible]	[illegible]	[illegible]	[illegible]	2,240	S. E. of [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	N. E. of Philadelphia, 3 mi.
[illegible]	[illegible]	[illegible]	[illegible]	783	N. W. of [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	941	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2,722	E. of Palmerton, ¾ mi.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	E. of [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	524	E. of Virginia, 6 mi.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	N. of [illegible]

✤Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 25, for the removal of the superstructure and substructure of the 35th St. bridge over the South Branch of the Chicago River and for dredging and rock excavation of the river channel at the site of the bridge. The work includes furnishing labor and material, for moving and disposing of the superstructure, the center pier and center pier protection of the present 35th St. bridge, in pulling all piles, in dredging the river channel and in blasting and excavating any non-dredgeable hardpan and rock within certain boundary lines. The channel to be dredged shall have a width of about 130 ft. and shall extend 140 ft. both ways from the center line of the 35th St. bridge. The rock to be excavated is an impure limestone of medium hardness. The approximate quantity of materials to be dredged without blasting riprap, loose rock, etc., is 7,000 cu. yds. Approximate amount of material requiring blasting is 4,000 cu. yds. above a plane whose elevation is 23 ft. below city datum. Approximate amount of material, between planes whose elevations are minus 23 ft. and minus 25 ft., is 1,000 cu. yds. Cash or certified check for $1,000 must accompany proposal.

⊙The contract for the construction of the concrete and steel bridge in Libertyville township, Ill., has been let by the Commissioners at the Town Clerk's office, Libertyville, Ill., to Breemm Bros., Libertyville, Ill., at $1,585. The structure, according to plans is as follows: Span, 25 ft.; roadway, 20 ft.; finished roadway to bottom of footings, 13 ft.;

Advices from Aurora, Ill., state that William C. Flannigan, City Clerk, has advertised for bids on the $30,000 bond issue to cover the cost of erecting the proposed Illinois Ave. bridge. The contract for the bridge will be let shortly after the disposal of the bonds

Indiana.

✤Bids will be received until 10 a. m., June 6, by Commissioners of Shelby County, Shelbyville, Ind., for the construction of certain culverts, abutments, etc. G. B. Huntington is County Auditor.

✤Bids will be received until 2 p. m., June 6, by Commissioners of Rush County, Rushville, Ind., for the construction of 6 bridges and repair of others. J. M. Stone is County Auditor.

✤Bids will be received until 2 p. m., June 5, by Morgan County Commissioners, Martinsville, Ind., for the construction of a concrete bridge over White River at Waverly. J. S. Whitaker is County Auditor.

✤Bids will be received until 1:30 p. m., June 5, by Board of County Commissioners, Salem, Ind., for the construction of a concrete bridge at Colvin's Ford in Jackson Township; steel bridge on stone abutments and fills in Brown Township; crossing of concrete at Reyman Ford, Washington Township. Frank S. Munkelt is Auditor of Washington County.

⊙Advices from Columbus, Ind., state that the Board of County Commissioners has awarded the following bridge contracts: Reflooring and repairing the Lowell Bridge, C. W. Boyer, $723; construction of the Glick bridge, E. A. Diewert, $170; the construction of the Fitch bridge in Ohio Township, W. H. Smith at $1,448; bridge over Clifty, near Hartsville to Fox Bros., at $3,987.

⊙The County Commissioners at Crawfordsville, Ind., have awarded the following contracts for bridge construction: The Thompson bridge, $385, to Homer E. Biddle, of Wayne Township; Shaver bridges, Nos. 1 and 2, south of Darlington, and the Abe Caster bridge, east of Crawfordsville, in Franklin Township, to D. L. Reichard, for $654; the John Walter bridge and the Hyten bridge to P. S. Hauk, for $559; the Lewis bridge, near Waveland, and the Shannondale bridge were awarded to G. B. Lynch for $1,940; the Shaver No. 3, the Tipton and the LaFollette bridges were given to Chadwick & Son for $641

⊙The following bridge contracts have been awarded by the County Commissioners at Lebanon, Ind.; Nos. 149, 158 and 164, Shannan & McCarthy, their bids being $537, $646 and $482 respectively; bridge over Prairie Creek on North Lebanon St., Lebanon, George T. Miller for $2,888; No. 151 to F. M. Gregory for $270; Nos. 148 and 155 to D. P. Turner, his bids being $390 and $397 respectively; Nos. 143 and 144 to George Truitt, his bids being $399 and $588 respectively.

⊙The Fiscal Court at Henderson, Ky., has awarded the contract for the construction of 6 iron bridges in Henderson County to the Vincennes Bridge Co., Vincennes, Ind., at $9,720.

⊙H. F. Burke, New Castle, Ind., has been awarded the contracts for four bridges and some bridge repairs aggregating $10,000. They are the Simpson bridge, on the line between Jefferson and Harrison Townships, $3,747; the D. W. Harris bridge, Clay Township, $1,974; the Lannerd bridge, Jackson township, $1,949, and the Mary A. Wright structure, Abington Township, $419. The sixth contract, the repairing of the canal bridge east of Hagerstown, was let to Marshall M. Knapp for $300. Beeler bridge in Center Township went to Isaac E. Smith at $7,350.

Commissioners of Bartholomew County at Columbus, Ind., has been asked for the following appropriations for bridge work: For joint bridge in Flatrock Township, $150; for joint bridge in German Township, $250; for joint bridge in Nineveh Township, $250; for additional appropriation, bridge in Ohio Township, $175; for Powell bridge, Hawcreek Township, $1,200; for additional appropriation Ohio Township bridge, $300; for Pugh ford bridge, $3,800; for Union Township bridge $500; for Finkle bridge, Clay Township, $450; for Catharine Creek bridge, Harrison Township, $250; additional appropriation for John Williams bridge in Rockcreek Township, $350; for Wolf Creek bridge, Harrison Township, $250; two new bridges in Wayne Township, $500 each; levee in Flatrock Township, $500.

The Board of County Commissioners, Logansport, Ind., has been petitioned for the construction of a wagon bridge across the Wabash River east of Rock Island near Cass Station connecting the Walton and Adamsboro roads. The cost of the structure, as proposed, is estimated at $20,000.

A conference was recently held between the Railroad Commission of Indiana and the officials of the Chicago, Indianapolis & Louisville Ry. in regard to the construction of the overhead bridge at the crossing at Vernal Pike north of Bloomington, Ind. It was decided to build the structure. A. Anderson, Lafayette, Ind., is Division Engineer of the railroad.

All bids received May 8 by the city of Louisville, Ky., for the construction of the proposed bridge in Underhill St. were, according to information received from that place, rejected. New bids will be advertised shortly and opened probably between May 20 and 25. D. R. Lyman is Chief Engineer of the Department of Engineering, Louisville, Ky.

[illegible] Ind., today (May 17), the Board is to ask the County Council for an appropriation of $37,- [illegible]

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] the townships as [illegible] Wayne Township, [illegible] road, culvert [illegible]. Decatur Township, near Cecil farm, culvert, $1,000; near Dr. Mill's farm, culvert, $1,000; over Goose Creek, bridge, $2,500; Zeisler's ford, culvert, $1,200; near Dr. Mill's farm, culvert, $1,000; near W. T. Pike's farm, culvert, $1,000. Franklin, culvert, $1,500; bridge, $2,000. Washington, over canal, bridge, $8,000. Pike, near Robert Miller's farm, culvert, $1,000; near schoolhouse on Michigan road, bridge, $2,000 (now a footlog for the use of school children). Perry, culvert, $800; bridge over Lick Creek, $4,000; culvert, $1,500; Bluff road, culvert, $1,000. Center, Dalton and Brill Sts., three box culverts, $1,800; culvert, $1,500; culvert on Three Notch road, $1,000. Warren, bridge over Grassy Creek, $1,000. Repairs for the stone arch bridge on Michigan road in New Bethel, $1,000.

Iowa.

✣Bids will be received until 10 a. m., May 20, by Paul J. Wells, City Clerk, Sioux City, Ia., for furnishing all material and labor necessary for constructing a re-inforced concrete abutment on the east end of the West 4th St. bridge over Perry Creek, in accordance with plans and specifications prepared by the city engineer and on file in the office of the city clerk.

⊙It is reported that the contract for the construction of a county bridge has been let by the Board of Supervisors at Dubuque, Ia., to the Clifton Construction Co., Clinton, Ia., at $1,300.

⊙Wm. Steele of Wheatland, Ia., has been awarded the contract by the Clinton County Commissioners, Clinton, Ia., for the construction of pile bridges in the county during the year 1911. E. W. Leadham is County Auditor. Bids were opened May 10.

City Attorney F. E. Gill, Sioux City, Ia., is taking active steps to induce the Great Northern R. R. Co. to build a new bridge over the Floyd River at Missouri St. to replace the wooden piling structure which now stands.

Kansas.

✣Bids will be received until 3 p. m., June 2, by Board of Commissioners, Hutchinson, Kan., for the construction of a slab girder bridge, 50 ft. long, 15 ft. spans and 90 ft. wide. C. L. McLane is City Engineer. Ed Metz is Clerk of the city. Official advertisement will be found elsewhere in this issue.

⊙The Commissioners of Wyandotte County at Kansas City, Kan., have awarded the contract to the Missouri Valley Bridge & Iron Co., Leavenworth, Kan., for making all borings, plans and estimates for the reconstruction of seven county bridges across the Kaw Rilver within the Drainage District.

⊙The Commissioners of Mitchell County, at Beloit, Kan., have awarded the following contracts for bridge work: Three 12-ft. bridges and one 100-ft. bridge with steel superstructure and concrete floors to the Midland Bridge Co., Kansas City, Mo., at $2,875; the Simpson bridge between Mitchell and Cloud Counties, to the same company at $1,100.

An election was held May 2, by the city officials of Wichita, Kan., to vote on the proposition of issuing $70,000 of bonds to cover one-third the expense of constructing a viaduct over Kellogg St.

Louisiana.

✣Bids will be received until June 20, by either F. L. Maxwell, Mounds, La., or A. L. Slack, Secy., Tallulah, La., for lowering the steel bridge over Bayou Vidal at the The Point Clear plantation in Madison Parish, La., at least 15 ft. Said bridge has a span of 185 ft. and the entire length is 344 ft., including the approaches. The bids will be opened by the committee appointed to close the contract with the lowest most responsible bidder. The original plan of the bridge can be seen at the office of the President in Tallulah, La.

Maryland.

✣Bids will be received until 11 a. m., May 18, by Highway Commission, Baltimore County, Towson, Md., for furnishing the necessary labor and material for the construction of a Strauss Trunion Bascule bridge on Eastern Ave. over Back River. Henry G. Shirley is Baltimore County Roads Engineer.

Massachusetts.

A hearing was held May 8 by the County Commissioners at Greenfield, Mass., on the petition of the Boston & Maine R. R. for the relocation of the highways in Greenfield and Deerfield near Cheapside so that the railroad can build a double track bridge over the Deerfield River at that point. It is the plan of the company to build an entirely new structure at that point at an estimated cost of $200,000.

Michigan.

A meeting was recently held by the Council of North Muskegon, Mich., to decide upon the construction of the proposed new bridge over the Bear Lake Channel to replace the old structure.

The Saginaw-Bay City Railway Co., Saginaw, Mich., has under consideration plans for the improvement of the Bristol St. bridge at an estimated cost of $1,500. F. T. Hepburn, Saginaw, Mich., is General Manager of the company.

The Kalamazoo Township Board, Kalamazoo, Mich., has decided to accept the plan of the Michigan Engineering Co., for the construction of the proposed Lover's Lane bridge. The structure will be of steel and concrete.

Mississippi.

✣Bids will be received until noon, May 27, by John I. Pierce, City Engineer, Jackson, Miss., for the erection of two bridges of reinforced concrete arch design, also of a steel girder design. Plans and specifications are on file at the office of the engineer.

Missouri.

⊙The Court of Buchanan County let the following contracts at St. Joseph, Mo., recently: Cutting ditch and building culvert on Linville road, to Olson & Schmidt Construction Co., culvert, $495; ditch per cu. yd., 17½ cts; cutting hill and making fill on Linville road, to Olson & Schmidt Construction Co., 18 cts. per cu. yd.; culvert and fill at J. W. Giddings' farm, to W. W. Arnold, culvert, $719; fill per cu. yd., 25 cts.; culvert and fill at Norman's, to Belden Boyd; culvert, $190; fill, per cu. yd., 10 cts.; culvert and fill at J. H. Payne's, to Tom Foster; culvert, $240; contracts for culverts at Clark Deppins', Joseph Weidmaier's, Doctor Minor's and J. P. Seilas', awarded to Olson & Schmidt Construction Co., at $1,500, for the culverts and 18 cts. a cu. yd. for the grading; culvert at Connett's pond, to Tom Foster, $363; culvert and fill at Mrs. W. T. Dittemore's, to Olson & Schmidt Construction Co.; culvert, $495; fill, per cu. yd., 18 cts.; five culverts on J. B. Ferris' road, to W. W. Arnold; culverts, $1,164; fills, per cu. yd., 18 cts.; culvert at W. D. Pyne's, to W. W. Arnold; culvert, $199; fill, 17 cts.; two culverts on John Black road, to Jesse Warren; culverts, $518.50; east fill, 27 cts.; west fill, 25 cts.; culvert and fill at Silas Steele's, to Olson and Schmidt Construction Co.; culvert, $445.50; fill, per cu. yd., 25 cts.; culvert and fill at Jacob McCawley's, to W. W. Arnold; culvert, $219; fill, per cu. yd., 25 cts.; bridge at Cavey's, to the Canton Bridge Co., $213; repairs to bridge at Troutman's, to the Standard Bridge Co., $309; erecting bridge across Cloverdale ditch, to Jesse Warren, $244.25; bridge on Zeb Baker road, to the Standard Bridge Co., $649; culvert at W. B. Crumpley's, to W. W. Arnold; culvert, $1,419; fill, per cu. yd., 20 cts.; grading hill at Lin McDaniel's, to M. B. Wilson, per cu. yd., 18 cts.

City Council of Marysville, Mo., has ordered the destruction of the old wooden bridge over the railroad at Mulberry St. and T. J. Jones, Supt. of the Moberly division of the Wabash R. R., has announced that the company will start work shortly on the new viaduct.

New Jersey.

⊙The Hudson County Board, Jersey City, N. J., has awarded the contract for the construction of the new steel bridge over Morris Canal on Communipaw Ave., in Jersey City, to Stillman, Delahanty & Ferris, Jersey City, N. J., at $7,620. Other bidders for the work were as follows: Cement Paving Construction Co., $9,850; Joseph H. Cutley, $10,650; F. W. Schwiers, $12,450; Bond & McNally, $10,800.

Citizens of Hackensack, N. J., are endeavoring to secure the construction of a new bridge over the Susquehanna R. R. cut at Summit Ave. by the County Board of Freeholders.

New York.

✣Bids will be received until 8 p. m., June 5, by Common Council, Lackawanna, New York, for furnishing necessary labor and material for the excavation for the realignment of Smokes Creek. The construction of two plain concrete abutments, erection of a 43-ft. Skew span steel girder highway bridge. J. J. Monaghan is City Clerk.

⊙The Board of Contract and Supply, Troy, N. Y., has awarded the contract for making repairs to the Rensselaer St. viaduct to E. J. Doyle & Co., Albany, N. Y. In connection with the work the Mayor signed an ordinance providing for the issuance of $12,000 to provide funds for the improvement.

Plans have been prepared by the State Highway Department, Albany, N. Y., for the construction of a steel highway bridge over Sauquoit Creek. As proposed the structure will consist of two spans 40 ft. each, with 5-ft. reinforced concrete pier and concrete roadway 55 ft. wide between curbs with 5-ft. walks on both sides, the latter being level with the curbs and higher than the driveway.

The Common Council of Watertown, N. Y., at a recent meeting adopted a resolution calling for a special election on May 22 to vote bonds in the sum of $135,000 for the construction of a bridge at Jackson St.

At a recent meeting of the city officials of Albany, N. Y., the construction of a concrete bridge over the creek on South St. was recommended.

Ohio.

✣Bids will be received until noon, May 24, by Director of Public Service, A. B. Lea, Cleveland, O., for the construction of alterations in the bridge over Doan Brook on East Boulevard. Plans and specifications can be obtained of the Chief Engineer. I. O. Hoffman is Secy. of the Director.

✣Bids will be received until noon, May 24, by A. B. Lea, Director of Public Service, Cleveland, O., for structural steel work for West 3rd St. bridge over the tracks of the Lake Shore & Michigan Southern and C. & P. Ry. Plans and specifications can be obtained of the Chief Engineer. I. O. Hoffman is Secy. of the Director.

✣Bids will be received until 1 p. m., by Board of Trumbull County Commissioners, Warren, O., for the necessary labor and material for the construction of the superstructure of a bridge near the Cox Farm, Farmington Township. Extreme length of bridge 42 ft., roadway 12 ft. clear. Capacity, 15-ton Road Roller. Proposals are desired on plank and concrete top. Plans to be submitted. Proposals must be accompanied by a certified check for $200, payable to Fred T. Stone, County Auditor Trumbull County.

✣Bids will be received until 11 a. m., June 3, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction of bridge work per report No. 2,800, conduit, pike road, Brooklyn Township. Frank Lander is County Surveyor and J. F. Goldenbogen is Clerk of the commissioners.

⊙Advices from Cleveland, O., state that in connection with the reconstruction of the Central Ave. viaduct a contract has been let for the drainage system to Hoag & Zullo at $16,465. A test well is being sunk near the west pier and one important feature of the drainage work that will later be carried through is the construction of a tunnel beneath a series of eight tracks under the bridge. The railroads would not permit an open cut at this point and for this reason a 250-ft. tunnel must be dug.

The Northern Ohio Traction & Light Co. has submitted a proposition to the County Commissioners at Akron, O., providing for the construction by the company of a bridge at the Gorge and the delivering of 30,000 yds. of earth for filling, making the new bridge 10 ft. higher than the old structure now at that place. Charles Currie, Akron, O., is General Manager of the Traction company.

Commissioners of Auglaize County at Wapakoneta, O., have announced their intention to build two bridges, one over the canal in the village of Minster known as the 5th St. bridge in Jackson Township and a bridge over the St. Marys River on the Roby road near the Forty Acre pond. A. E. Schaffer is County Auditor.

Advices from Portsmouth, O., state that a hearing will be held May 25 at Kenova, W. Va., by Board of U. S. Engineers, of which Capt. Alstaater, Wheeling, W. Va., will probably be a member, on the matters relative to the reconstruction of the Norfolk & Western Ry. bridge over the Ohio River at Kenova. J. E. Crawford, Roanoke, Va., is Bridge Engineer of the railroad.

Commissioners of Seneca County at Tiffin, O., have passed a resolution declaring the necessity for the reconstruction of the following bridges: Daniel Unser bridge, Hopewell Township; Senn bridge, section 4, Venice Township, new abutments; Stall bridge, section 31, gore Thompson Township, wing walls; Billman bridge, section 19, Scipio Township; Kuntz bridge, Sec. 11, Scipio Township; Kramer bridge, section 3, Scipio Township, new floors and walls raised; bridge No. 150, section 15, Scipio Township, where the pipe is too small.

The Commissioners of Scioto County at Portsmouth, O., recently rejected all bids for the construction of the substructure of the proposed Garrett bridge over Marsh Run on the Bullhead road in New Haven Township and new tenders will be asked. The estimated cost of the new bridge is $1,920.

The Cleveland, Cincinnati, Chicago & St. Louis R. R. has, according to reports from Cincinnati, O., notified the Commissioners of Hamilton County that they are planning the construction of a bridge over the tracks in the yards at Sharonville and a small creek on Saron Ave. F. W. Smith, Cincinnati, O., is Engineer of Construction of the Railroad.

Pennsylvania.

✣Bids will be received until noon May 20, by Board of Dauphin County Commissioners, Harrisburg, Pa., for the repairing of the bridge over Paxton Creek on Maclay St., in Harrisburg. D. F. Lebo is Clerk.

✣Bids will be received until noon, June 1, by Board of Commissioners of Clinton County at Lock Haven, Pa., for the construction of a bridge over the West Branch of the Susquehanna River at McElhattan. The superstructure shall consist of 10 duplicate plate girder spans each 97.5 ft. long with one roadway 16 ft. clear. The substructure shall consist of 9 reinforced concrete piers and two reinforced concrete abutments. Plans and specifications are on file at the office of ENGINEERING-CONTRACTING, 537 S. Dearborn St., Chicago, Ill. Farris Engineering Co., Jenkins Arcade Bldg., Pittsburg, Pa., Engineers.

⊙The Commissioners of Blair County at Hollidaysburg, Pa., have let contracts for the construction of repairs to bridges as follows: Over Beaver Creek, at Claysburg, on State road, Myers, Gable & Ritchey, of Duncansville, for $1,047.50; over Blair's Creek, near the eastern end of Main street, Duncansville, to Myers, Gable & Ritchey, for $1,110; over Juniata River between Hollidaysburg and Gaysport, near Condron's planing mill to Owego Bridge Co., of Owego, N. Y., for $2,411; over branch of the Juniata River, on public highway, leading from residence of J. S. Vipond to that of Samuel Robeson, in Allegheny Township, to W. W. Saupp, of Altoona, for $1,020.00; over the Juniata River at Franklin Forge and at Williamsburg, between Catharine and Woodbury Townships, to Metz & Fay, for $2,408.29 and $1,306.47, respectively.

⊙The Philadelphia & Reading Ry. Co. has awarded the contracts for the construction of two concrete slab girder bridges, one at Kempton and the other at Virginsville on the Schuylkill and Lehigh branch to H. E. Ahrens Co., Reading, Pa.

At a recent meeting of the County Commissioners, Pittsburg, Pa., it was decided to construct a bridge across Pine Creek on the Butler Plank road in Shaler Township. The estimated cost of the work is $12,000. Samuel D. Foster is County Road Engineer.

The Philadelphia & Reading Ry. Co., according to advices from Reading, Pa., has awarded the contract for the construction of a 3-span concrete arch bridge over the Allegheny Creek at Gibraltar to L. H. Focht, Reading, Pa. The structure will be about 100 ft. in length and will replace the trestle at that point.

A meeting was recently held by the citizens and council of Meadville, Pa., at which the type of structure to be built across the French Creek at Meade Ave. was discussed. It is believed that the Commissioners of Crawford County at Meadville, Pa., will soon take charge of the matter.

Officials of the Jersey Central, Lehigh Valley and Pennsylvania Railroads and the city of Wilkes-Barre, Pa., recently conferred in regard to the apportionment of $210,000 for the construction of a new bridge to cross the railroad tracks from Welles St. to South Washington St. between the present structure and East Ross St. The apportionment has been suggested as follows: Wilkes-Barre Railway Co., whose tracks are to cross the bridge, $60,000; Central R. R. of New Jersey, $10,000; Lehigh Valley R. R. Co., $35,000; Pennsylvania R. R. Co., $25,000; Wilkes-Barre City, $80,000.

Texas.

✣Bids will be received until [illegible] p. m., May 22, by Commissioners Courts of Burnet and Llano Counties, at Llano, Texas, for the construction of a bridge over the Colorado River at or near Bluffton, Texas. A. H. Willbern is Judge of Llano County.

Advices from Hillsboro, Texas, state that the citizens of Whitney have subscribed between $1,200 and $1,500 toward the construction of the proposed aerial bridge across the Brazos River at Smith's Bend between Hill and Bosque Counties.

Attorney General, Austin, Tex., has approved a Fort Bend County bond issue of $30,000 for the construction of a bridge across the Brazos at Orchard and another bond issue of the same amount for the construction of the proposed bridge over the river at Thompson. Richmond, Tex., is the county seat.

Information received from Galveston, Tex., is to the effect that the city engineering department is about ready to submit plans for the construction of the proposed Main St. viaduct in that city and that bids for the improvement will be asked shortly.

Utah.

⊙The Commissioners of Box Elder County at Brigham, Utah, have awarded two contracts for bridge construction as follows: A concrete structure over the Box Elder Canyon at the mouth to Wheelwright Construction Co., Ogden, Utah, at $858; a 50-ft. steel bridge over the Malad River at Garland, to C. G. Sealy Co., Pocatello, Idaho, at $2,800.

Washington.

The Commissioners of Yakima County at North Yakima, Wash., have been requested by the ranchers in Natchès Valley to change the location of the proposed bridge across the Natches River from Gleed to Eschbach. The matter will be taken into consideration.

Wisconsin.

⊙The Wausau Iron Works, Wausau, Wis., has been awarded the contract for the construction of two bridges across the Black Creek in the town of Bern.

⊙The contract for the superstructure of an iron bridge near Browntown, Wis., has been awarded to W. H. Shons, Freeport, Ill., at $1,350.

According to advices from Milwaukee, Wis., in regard to the construction of the proposed Oneida St. bridge at that city, plans and specifications are being rushed and bids for the work will be asked shortly. L. J. Klug is Supt. of Bridges and Public Buildings.

Canada.

✣Bids will be received until noon, May 30, by G. R. Geary, Chairman Board of Control, Toronto, Ont., for the construction of a steel and concrete bridge at Turner's Baths, Hanlan's Point, Toronto Island. Plans and specifications can be obtained of Department of Railways, Bridges and Docks, City Engineer's Office, Toronto.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣Bids will be received until 8 p. m., June 5, by City Council of Gadsden, Ala., for the following street improvements: 4,377 sq. yds. concrete sidewalk; 200 sq. yds. concrete driveway; 2,073 lin. ft. of 4x18-in. granite curb; 10 catch basins; 500 cu. yds. grading; 685 lin. ft. combination curb and gutter. Plans and specifications are on file at the office of Charles L. Marsh, City Engineer.

The City Council of Troy, Ala., has passed paving ordinances which provide for the paving of sidewalks of all of the principal streets of the city. The streets that will be paved are: South Three Notch, Montgomery, Brundidge, Church, Elm, West Madison, East College, Cherry, Pine, Murphee and Market Sts. Bonds will be sold for the improvement.

California.

⊙The Southern [illegible] Ry. [illegible] awarded the contract for paving 7th St., in Oakland, Cal., to the Oakland Paving Co., for $300,000. The contract includes standard asphalt paving of two and a half miles of street from Fallon St., on the east to the bay.

The Board of Supervisors, Los Angeles, Cal., has ordered the Pacific Electric Co. to build a highway over Cahuenga Pass, over which it was given permission to put its railway [illegible]

The Board of Supervisors, Stockton, Cal., has adopted a resolution favoring the raising of the French Camp grade [illegible] Camp slough to the Southern Pacific R. R. crossing and providing for $3,000 with which to do the work.

The County Supervisors, Sacramento, Cal., have endorsed the idea of having a 12-mile stretch of the Trinity State road built by contract instead of by the State Engineering Department.

The West Adams Improvement Association, Los Angeles, Cal., has filed a petition asking that the $13,580 turned over to the [illegible]

[illegible] in the district west of Arlington St., and north of Pico St., and that additional lights [illegible] provided.

The citizens of Fullerton, Cal., at a recent meeting launched a campaign for the issuance of $192,000 of bonds for good roads, paved streets and concrete bridges. Business [illegible] announced that it was practically assured that the business section will be paved from curb to curb by the abutting property owners.

Consulting Engineers Reynolds & Whitman, 529-30 Oehner Bldg., Sacramento, Cal., have completed the surveys and maps of a large subdivision on the Famous Rancho Del Paso, Sacramento County, of about 4,000 acres of land, laid out from the landscape point of view with 20 miles of winding roads and avenues. Also two large subdivisions in the vicinity of Marysville, Cal., totaling about 5,000 acres of land, which is cut up into five, ten and twenty acre tracts.

District of Columbia.

✣Bids will be received until 11 a. m., May 25, by Maj. H. L. Pettus, Quartermaster, Washington, D. C., for the work of repairs to roadway at Culpeper, Va., National Cemetery.

Florida.

The County Commissioners, Jacksonville, Fla., have instructed Engineer G. L. Barnard to make a survey of the proposed road from the Atlantic Blvd. to Mayport.

The Board of County Commissioners, Jacksonville, Fla., received the following bids for estimates for resurfacing St. Johns Ave., from the city limits to McGirt's Creek bridge with asphalt macadam: George R. Foster, Jr., per cu. yd., $3.90; per sq. yd., No. 1, $1.12, and No. 2, $1.24. Atlantic Bitulithic Co., per cu. yd., $3.20; No. 1, sq. yd., $1.08; No. 2, $1.15, and No. 3, $1.35. F. W. Long & Co., per cu. yd., $3.95, and per sq. yd., No. 1, 94 cts., and No. 2, $1.04. Mattair & Young, per cu. yd., $3.78, and per sq yd., No. 1, $1.31, and No. 2, $1.49. Logan Concrete and Engineering Co., per cu. yd., $3.31; per sq. yd., $1.09, and No. 2, $1.16. J. C. Rock, of Philadelphia, Pa., per cu. yd., $4.12; per sq. yd., No. 1, $1.06; No. 2, $1.24, and No. 3, $1.45. Continental Asphalt & Equipment Co. of Chicago, per cu. yd., $3.50, and per sq. yd., No. 1, $1.07; No. 2, $1.22, and No. 3, $1.47.

Georgia.

✣Bids will be received until 11 a. m., May 29, by Capt. R. L. Carmichael, Chief Quartermaster, Department of the Gulf, Candler Bldg., Atlanta, Ga., for construction of drives, walks, curbs, and gutters at Shiloh National Cemetery, Pittsburg Landing, Tenn.

A committee of citizens of Atlanta, Ga., has filed a petition with the City Council asking for aid in the grading and paving with wood block or asphalt of West Peachtree St.

Illinois.

✣Bids will be received until 2 p. m., May 30, by F. B. Wright, Jr., Mayor, Mt. Carmel, Ill., for the construction of 15,725 sq. yds. of vitrified brick pavement; concrete foundation, cement filler, concrete curb and gutter. Guy W. Courter is City Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., May 25, for furnishing and delivering to the Bureau of Streets two tandem type steam rollers, according to specifications on file at the office of the Cmmissioner. Cash or certified check for $200 must accompany proposal.

Following are the low bids received by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Secretary, for paving the following streets. The work includes concrete curb and gutter, sandstone curbing, manhole and catch basin construction and adjustment and all work necessary for the completion of the work. Bids opened May 2nd, 1911: W 37th St., Halsted St. to Morgan St., 3,900 sq. yds. asphalt, $8,713.00, American Asphalt Paving Co., 138 Washington St.; Wilson Ave., Lincoln Ave. to Western Ave., 2,330 sq. yds. asphalt, $5,261.90, R. F. Conway Co., 138 Washington St.; Burnside Ave., System, 10,980 sq. yds. macadam, $66,334.50, The Farr Bros. Co.; 356 W. 111th St.; 90th Pl. System, 43,020 sq. yds. macadam, $66,334.50, The Farr Bros. Co., Greenwood Ave., 55th St. to 56th St., 1,900 sq. yds. asphalt, $4,543.90, American Asphalt So.; Hamlin Ave., Armitage Ave. to McLean Ave., 1,140 sq. yds. asphalt, $2,468.90, American Asphalt Paving Co.; Maplewood Ave., Diversey Ave. to Elston Ave., 2,410 sq. yds. asphalt, $5,139.00, American Asphalt Paving Co.; Medill Ave., Kimball Ave. to Central Park Ave., 3,570 sq. yds. asphalt, $8,323.60, American Asphalt Paving Co.; Sacramento Ave., 37th St. to 39th St., 3,120 sq. yds. asphalt, $7,063.00, R. F. Conway Co.; Seminary Ave., Maud Ave. to Center Ave., 2,000 sq. yds. asphalt, $4,455.45, American Asphalt Paving Co.; 76th Pl., Marquette Ave. to Coles Ave., 1,340 sq. yds. asphalt, $4,189.70, R. F. Conway Co.; 23rd Pl., Wentworth Ave. to 150 ft. W. of Canal St., 6,570 sq. yds. asphalt, $13,265.00, American Asphalt Co.; 33rd Pl., Archer Ave. to Ashland Ave., 5,600 sq. yds. asphalt, $12,239.00, R. F. Conway Co.; Alleys, Webster Ave., Lincoln Ave., etc., 1,110 sq. yds. brick, $2.951.30, Jas. A. Sackley Co., 307 Chamber of Commerce Bldg.; Alleys, Wilson Ave., Sheridan Rd., etc., 1,220 sq. yds. brick, $3,136.60, P. J. O'Brien, 145 La Salle St.; Alleys, E. 42nd St., Grand Blvd., etc., 1,490 sq. yds. brick, $4,167.40, Jas. A. Sackley Co.; Alley, Wisconsin St., Sedgwick St., etc., 1,070 sq. yds. brick, $2,882.00, Jno. A. McGarry Co., 188 Madison St.; Alleys, Garfield Blvd., Larrabee St., Lincoln Ave., etc., 1,290 sq. yds. brick, $3,674.20, Jno. A. McGarry Co.; 42nd Pl., Drexel Blvd., I. C. R. R., 5,120 sq. yds. asphalt, $11,717.50, American Asphalt Paving Co.; 53rd St., Indiana Ave. to South Park Ave., 3,750 sq. yds. asphalt, $8,064.40, American Asphalt Paving Co.; Chestnut Pl., Delaware Pl. to Walton Pl., 470 sq. yds. brick, $1,362.10, Central Paving Co., 172 Washington St.; Alley, Fullerton Rk'y to Arlington Pl., etc., 1,220 sq. yds. brick, $3,192.10, P. J. O'Brien; Alley, Superior St., Chicago Ave., etc., 620 sq. yds., No. 2 granite, $2,308.20, P. J. O'Brien; Alley, Grant Pl. to Webster Ave., etc., 1,390 sq. yds. brick, $3,680.70, Jas. A. Sackley Co.; Alley, Shades Pl., Willow St., etc., 1,850 sq. yds. brick, $4,503.00, P. J. O'Brien; Alley Schiller St., Sigel St., etc., 830 sq. yds. brick, $2,004.70, Jno. A. McGarry Co.

Frank N. Bass, J. E. Hamlyn and A. H. Hartman, a committee representing property owners on Jefferson St., Freeport, Ill., have received bids for the construction of a macadam street, calling for 2,105 sq. yds. of macadam, 470 ft. of excavating and 1,300 ft. of cement curb and gutter. William Ascher at $1,742 submitted the lowest bid.

Indiana.

✣Bids will be received until 2 p. m., June 8, by Board of County Commissioners, Mt. Vernon, Ind., for the construction of a 2-mile gravel road in Marrs Township. Paul Maier is Auditor of Posey County.

✣Bids will be received until 2 p. m., June 8, by Board of Posey County Commissioners at Mt. Vernon, Ind., for the construction of a 1-mile road and 3,520 ft. of gravel roads in Lynn Township. Plans and specifications are on file at the office of Paul Maier, County Auditor.

✣Bids will be received until 10 a. m., May 24 by Board of Public Works, Indianapolis, Ind., for improving Eastern Ave. from North curb line of Michigan St., to the south property line of North St., by grading, graveling and rolling the roadway and for improving Eastern Ave. from north curb line of Michigan St. to south cement walk of North St. by grading and paving the sidewalk.

✣B ids will be received until noon, June 6, by Board of Porter County Commissioners, Valparaiso, Ind., for the construction of macadam roads in Pleasant township. C. A. Blachly is County Auditor.

✣Bids will be received until 10 a. m., June 6, by Board of Gibson County Commissioners at Princeton, Ind., for the construction of a gravel road in Columbia township. W. T. Roberts is County Auditor.

✣Bids will be received until 10 a. m., June 6, by Commissioners of Cass County at Logansport, Ind., for the construction of a gravel road in Jefferson township and for macadam roads in Jackson, Harrison and Tipton townships. J. E. Wallace is County Auditor.

✣Bids will be received until 11:30 a. m., June 6, by Board of Clay County Commissioners, Brazil, Ind., for the construction of a stone and gravel road in Harrison township and a gravel road in Sugar Ridge township. Edgar A. Staggs is Auditor.

✣Bids will be received until 2 p. m., June 6, by Commissioners of Orange County at Paoli, Ind., for the construction of three gravel roads. A. B. Hamis, County Auditor.

✣Bids will be received until 10 a. m., June 6, by Commissioners of Gibson County, Princeton, Ind., for the construction of a gravel road in Columbia township. William T. Roberts is County Auditor.

✣Bids will be received until 2 p. m., June 8, by Commissioners of Posey County, Mt. Vernon, Ind., for the construction of 7 gravel roads comprising 3,335 ft. of improvement in Center Township. Paul Maier is County Auditor.

✣Bids will be received until 2 p. m., June 8, by Commissioners of Posey County at Mt. Vernon, Ind., for the construction of 6 roads comprising 12 miles of work in Smith Township. Plans and specifications are on file at the office of Paul Maier, County Auditor.

✣Bids will be received until 10 a. m., June 7, by Monroe County Commissioners, Bloomington, Ind., for the improvement of a highway in Bloomington Township. Horace Blakely is County Auditor.

✣Bids will be received until 1:30 p. m., June 6, by Commissioners of Wabash County, Wabash, Ind., for the improvement of the following highways, one on line dividing Waltz, Liberty and Noble Townships; one on line dividing Waltz and Noble Townships; one in Noble Township and the highway petitioned for by W. O. Talbert. J. P. Noftzger is County Auditor.

✣Bids will be received until 10 a. m., June 6, by Gibson County Commissioners, Princeton, Ind., for the improvement of several public highways. W. T. Roberts is County Auditor.

✣Bids will be received until 2 p. m., June 6, by Commissioners of Knox County at Vincennes, Ind., for the construction of gravel roads in Busseron and Vincennes Townships. J. T. Scott is County Auditor.

✣Bids will be received until 10 a. m., June 6, by Commissioners of Wabash County at Wabash, Ind., for the construction of a road on Pawpaw-Noble Township line. J. P. Noftzger is Auditor of the County.

✣Bids will be received until 1 p. m., June 6, by Board of County Commissioners, Wabash, Ind., for the construction of a gravel road in Chester Township. J. P. Noftzger is Auditor of Wabash County.

✣Bids will be received until 10 a. m., June 5, by Commissioners of Jay County, Portland, Ind., for the construction of improvements on the public highway at Bear Creek Township. W. Lea Smith is County Auditor.

✣Bids will be received until 10 a. m., June 6, by Cass County Commissioners, Logansport, Ind., for the construction of a gravel road in Jefferson Township and for macadam roads in Jackson, Harrison and Tipton Townships. J. E. Wallace is County Auditor.

✣Bids will be received until 2 p. m., June 5, by Commissioners of Crawford County at English, Ind., for the construction of pike roads in Jennings Township. J. Evan Jones is County Auditor.

✣Bids will be received until 3 p. m., June 5, by Board of Jasper County Commissioners at Rensselaer, Ind., for the construction of five stone road improvements in Keener Township. J. N. Leatherman is County Auditor.

✣Bids will be received until 1:30 p. m., June 5, by Washington County Commissioners at Salem Ind., for the construction of a road in Washington Township. F. S. Munkelt is Auditor of the County.

✣Bids will be received until 1:30 p. m., June 6, by Wabash County Commissioners, Wabash, Ind., for the construction of two gravel roads in Noble Township and one in Chester Township. J. P. Noftzger is County Auditor.

✣Bids will be received until 11 a. m., June 5, by Commissioners of Jennings County, Vernon, Ind., for the construction of a pike road in Vernon Township. M. W. Brogan is County Auditor.

✣Bids will be received until 1 p. m., June 5, by Commissioners of Warren County, Williamsport, Ind., for the construction of a gravel road in Kent Civil Township. D. H. Moffett is County Auditor.

⦿The Board of County Commissioners, Bluffton, Ind., has awarded the contracts for the construction of four roads as follows: George W. Tabor, $3,759, for the A. J. Miller road in Rockcreek Township; J. N. Neff, $9,767, for the W. M. Beck stone road in Jefferson Township; Charles Nash, $5,669, for the Conrad Gallmeyer stone road in Jefferson Township; Alexander & Crosbie, $2,209, for the Settle gravel road in Nottingham Township.

⦿The Clay County Board of Commissioners, Brazil, Ind., has awarded the contract for the construction of three improved roads, Hawkings Bros. getting the Gillaspie and Snow roads for $8,938 and $3,746 respectively, and A. M. Shattuck the Paitson road for $[illegible].

⦿The Madison Construction Co. of Anderson, Ind., has been awarded the contract by the City Council of Greencastle, Ind., for the improvement of the streets about the public square for $21,720.

Iowa.

⦿The McCarthy Improvement Co. of Davenport, Ia., has been awarded the contract by the City Council of Aurora, Ill., for the paving of Liberty, St. with asphalt for $26,405.

The city of Mount Pleasant, Ia., has had plans and specifications drawn for about one mile of street pavements. Contracts will be let soon. Hall & Adams, Centerville, Ia., are Engineers.

Kentucky.

The Lincoln Way Finance Committee recently held a meeting in Elizabethtown, Ky., for the purpose of securing the necessary funds, material and labor to reconstruct the old Louisville & Nashville pike in Hardin County, and a spur to Hodgenville. The Hardin County Fiscal Court has appropriated $250 per mile to build the roads and the committee decided it would require at least $20,000 more to obtain the improvement.

Louisiana.

State Highway Engineer Gervais Lombard has rejected the two bids received for the construction of the proposed new highway from Colfax to Rochelle, via Dry Prong, Selma and Georgetown, in Grant Parish, because they were considered too high. Bids were received for two kinds of road, labeled No. 1 and 2. For No. 1 it was stipulated that the timbers should be creosoted, concrete culverts, vitrified pipe for sewers and other high-class materials. No. 2 road did not call for treated timber and instead of concrete culverts and vitrified piping, it was stipulated that corrugated iron would be acceptable. Bids were submitted as follows: Road No. 1, J. W. Thompson of Jackson, Miss., $107,290; A. L. Patterson & Co., New Orleans, $98,768. Road No. 2, J. W. Thompson & Son, $82,937; A. L. Patterson & Co., $76,116. The work will be readvertised at once. Bids will probably be opened in [illegible]

The City Council of Estherwood, La., has ordered the building of more than 2,000 ft. of sidewalk in South Estherwood.

Michigan.

✣Bids will be received until 2 p. m., May 18, by John Venus, Village Clerk, Redford, Mich., for the construction of a gravel road on Grand River road through the village.

✣Bids will be received until 9 a. m., May 26, by Township Clerks of Ovid and Kinderhook townships in Branch County, Mich., for the construction of 6 miles of gravel road, half of which is in each county, under Michigan State Reward Road Plan. Plans and specifications are on file with the highway commissioners and clerks of the townships; also at the office of J. J. and W. W. Cox, Engineers, Coldwater, Mich.

⦿The Board of Public Works of Saginaw, Mich., on May 12 awarded the contract for furnishing the best quality of Trinidad asphalt for this year's pavements improvements to W. N. Sager.

⦿The Barrett Manufacturing Co. has been awarded the contract by the city council of Manistee, Mich., for furnishing the city with tarvia and the Lake Shore Stone Co., for furnishing stone to the city for the coming year.

The City Council of Calumet, Mich., has instructed the street committee to have plans prepared immediately for the erection of a retaining wall at the north end of 5th St., extending from Pine St., to the Copper Range yards.

The Iron County Commissioners, Crystal Falls, Mich., have engaged Edmund H. Edyvean of Lake Linden as road engineer. The county recently voted to expend $150,000 in the building of new highways.

The citizens of Monroe, Mich., have formulated a plan for the construction of a boulevard, 70 miles long, between Detroit and Toledo, by way of Monroe. About 38 miles of the 70-mile highway is in Monroe County and the remainder in Wayne County and Lucas County, Ohio.

The St. Clair County Commissioners, Port Huron, Mich., have retained Engineers John J. & Wm. Cox as engineers for the proposed road in St. Clair County to be known as the Fort Gratiot road, 12 miles southwest of Port Huron. This road is one of the largest and most difficult roads to be built in Michigan this year.

Minnesota.

✣Bids will be received until 8 p. m., May 17, by Fred Cary, City Clerk, Little Falls, Minn., for the paving with creosoted wood blocks the Broadway wagon bridge over the Mississippi River in accordance with plans and specifications on file at the office of the city clerk.

The City Council of Duluth, Minn., has passed a resolution calling for the expenditure of $3,000 on the Getchell Road at West Duluth and $2,000 for the improvement of the Sundby Road, which enters the city in the Second ward.

Specifications for the paving of Grand Ave., Duluth, Minn., are being prepared in the office of the city engineer. The Board of Public Works will soon call for bids on the work.

The City Council of Mankato, Minn., has approved the plans and specifications for the paving of the streets heretofore ordered paved, and added two more blocks to the paving district, as follows: Liberty St., with creosoted blocks from Broad to Second St., and Lincoln St., with creosoted blocks or with tar or asphalt macadam from the east side of Center St., to the east side of Second St.

Mississippi.

✣Bids will be received until noon, May 22, by E. S. Donnell, Mayor, Columbus, Miss., for the construction of approximately 6,000 lin. ft. of concrete curb and gutter or granite curb and concrete gutter.

⦿The Road Commission, Collins, Miss., has awarded to Boyd & Bradshaw 18 miles of road in Best Three of Covington County for $9,410. The district contains over 70 miles of roads which will be let from time to time. A bond issue was recently made for $50,000 to construct roads in the Collins district.

Missouri.

⦿Bids were opened May 4, by the city of Fulton, Mo., P. D. Thurmond, City Engineer, for constructing 9,000 sq yds. brick pavement and 12,500 sq. yds. asphalt macadam, the contract being awarded to Joseph Pope, Jefferson City, Mo., at $36,484. The unit bid of the successful [illegible] follows [illegible] adam, asphalt binder, and 6x16 in. 1-2-3 concrete curb on West 7th St.:

Excavation, 1,[illegible] cu. yds.	[illegible]
Curb, [illegible] lin. ft.	[illegible]
Macadam, [illegible]	[illegible]
Parking, 1,[illegible]	[illegible]
Total	[illegible]

For similar work on E. 5th St. the successful bid was

Excavation, [illegible] cu. yds.	[illegible]
Curb, [illegible] lin. ft.	[illegible]
Macadam, 7,[illegible] yds.	[illegible]
Parking, 3,500	.93
Total	[illegible]

For constructing brick pavement on Court St. the unit bid was as follows; the pavement is to consist of best vitrified brick laid on a 5-in. 1-3-5 concrete base, with asphalt filler and 6x16 in. 1-2-3 concrete curb:

Excavation, 1,[illegible]	[illegible]
Curb, 2,030 lin. ft...........................	.35
Brick pavement, [illegible] sq. yds.	1[illegible]
Total	[illegible]

Bids were also received for constructing 4,007 sq. yds. brick pavement on 5th St., and 1,354 sq. yds. on Market St., the unit bids for these streets being the same as for Court St.

At a recent meeting of the property owners on Springfield Ave., Springfield, Mo., it was decided to circulate a petition for the curbing and paving with Hassam of Springfield Ave., from Commercial to Turner Sts.

Contracts for paving 12 streets have been awarded by the Board of Public Improvements of St. Louis, Mo., as follows: Asphalt—Arkansas Ave., between Miami and Potomac Sts.; Parker-Washington Co., $5,174; Virginia Ave., between Osage and Keokuk Sts., same, $5,188; Mary Ave., between Carter and Florissant Aves., same, $5,391. Brick—Michigan Ave., between Bates and Eichelberger Sts., Ruecking Construction Co., $7,866; Virginia Ave., between Potomac and Cherokee Sts., William R. Bush Construction Co., $5,663; Clark Ave., between Prospect and Spring Aves., Skrainka Construction Co., $5,230; Compton Ave., between Keokuk and Chippewa Sts., Ruecking Construction Co., $5,328; Greer Ave., between Elliot and Glasgow Aves., William H. Redemeyer, $2,482. Bitulithic—Cottage Ave., between Grand and Spring Aves., Granite-Bituminous Paving Co., $4,479. Wood Block—Twelfth St., between Hebert and Branch Sts., Gustavus A. Heman, $5,102. Granite—Brooklyn St., between Second St. and Broadway, Heman Construction Co., $3830. Telford—Mitchell Ave., between McCausland Ave. and city limits, John B. Turner, $2,660.

The City Council of Springfield, Mo., has instructed City Engineer H. G. Horton to prepare plans, specifications and estimates of cost for the construction of a brick pavement on Pearl St., and construct concrete curbing to the property line.

Montana.

The City Council of Billings, Mont., has passed an order authorizing the city clerk to advertise for bids for the construction of concrete sidewalks and curbs around the front and side of the new fire station and west of the city library.

Advices from Kalispell, Mont., state that the matter of the projection of a wagon road from Columbia Falls northward to the settlements in the North Fork valley and Kintla lake region is being revived by those interested. Supervisor J. F. Preston of the Blackfeet forest has made a recommendation to District Forester Greeley at Missoula that the department subscribe $6,000 toward the project. The estimated cost of the improvement is $12,000.

The Citizens' Committee of Polson, Mont., created for the purpose of raising funds to improve the roads leading into the city from the south have succeeded in raising $1,000 among the merchants.

Nebraska.

✣Bids will be received until 7:30 p. m., May 25, by Board of Public Works, Fremont, Neb., for furnishing necessary labor and ma-

[illegible] stimated cost of the work is $12,048. P. A. Nelson is Chairman of the Board.

⦿The City Council of Lincoln, Neb., has warded the contract for the paving in alley aving district No. 60 to Lang & Browitt for [illegible]

A petition is being circulated for the paving of 7th St., between Lincoln and Wabash Aves., in Hastings, Neb. It is probable that nother petition will be started to extend the aving from Lincoln Ave., to Bellevue Ave.

Nevada.

The City Council of Reno, Nev., has deided to pave Riverside Ave. with macadam rom near Ralston St. to the western city imits.

New Jersey.

⦿Henry Byrne, Mercer & Viaduct, Jersey City, N. J., has been awarded the contract by he Board of Street and Water Commissioners f that city for the improvement of Whyte St., rom Fairmount Ave., to the northerly line of Dupont St., for 98% of standard. The estiate of quantities is: About 860 cu. yds. of arth excavation, 115 cu. yds. of earth filling, 75 cu. yds. of sand filling, 1,625 sq yds. of pavng (Belgian), 925 lin. ft. of curbstone, 5x16 et in concrete, 500 sq. ft. of bridgestone, 3,800 q. ft. of flagging, 15 sq. yds. of repaving, 100 q. ft. of relaid and dressed bridgestone, 175 q. ft. of relaid and dressed flagging, 90 lin. ft. f cribbing, 5x16, set in concrete, 1 reset receivng basin head, 5 reset manhole heads, 3 new eceiving basins and connections, 1 receiving asin and connection complete, and 2 resetting ater gate boxes. Bids were opened May 8.

New York.

✣Bids will be received until 8 p. m., May 3, by Thomas H. O'Neill, Mayor, Auburn, N. Y., construction of subways in Washington St., from Clark St. to Tehan Ave., and he paving with vitrified brick of said secon of Washington St., of Monroe St., from lark St. to Orchard St., and of Mason Lane. or the work bid upon a certified check for 1,000 or a bond for 50 per cent of the conract is required of all bidders. Plans and pecifications may be seen and examined at he office of the City Engineer or copies will e sent by said City Engineer upon the reeipt of ten dollars, such amount to be rerned upon the return of the plans, etc. Furher information in regard to said subways or aving can be obtained upon application to lbert C. Aldrich, City Engineer. The approximate quantities of the work are as folows: Subway—8,000 duct ft. 12-way tile; 600 duct ft. 12-way iron pipe; 2,200 lin. ft. raight iron pipe; 5 double manholes. Paving -5,350 sq. yds. vitrified brick; 3,384 lin. ft. Medina sandstone curbing; 135 lin. ft. curved urbing; 570 lin. ft. limestone headers, 10 ormwater inlets.

At a recent meeting of property owners in opeland St., Rochester, N. Y., it was deded to have the street improved with brick. n ordinance providing for the paving has een presented to the Common Council.

It is reported that Governor Dix of New ork has signed the bill of Senator Murtaugh ppropriating $1,000,000 for the improvement f state highway routes Nos. 4 and 12 in ioga County, Chemung, Schuyler and Yates ounties, so as to complete a connection beveen highways already built on such routes.

North Carolina.

⦿The city of Fayetteville, N. C., has let the ollowing contracts for street paving, for hich Jno. K. Strange is Engineer: About 3,500 sq. yds. of Tarvia X paving with 4-in. oncrete base, F. J. McGuire of Norfolk, Va.; bout 7,000 sq. yds. of clay and gravel paving, bout 16,000 lin. ft. of granite curb, about 000 lin. ft. of storm sewers, Bowe-Page ray & Construction Co. of Charleston, S. C.

Ohio.

✣Bids will be received until noon, May 24, y A. B. Lea, Director of Public Service, leveland, O., for paving the portion of West 5th St. affected by the separation of grades of said street and tracks of the N. Y., C. & St. L. R. R. Plans and specifications can be obtained of the Chief Engineer. Ira O. Hoffman is Secy.

✣Bids will be received until noon, May 24, by A. R. Lea, Director of Public Service, for grading and macadamizing the East Boulevard at the N. Y., C. & L. R. R. Plans and specifications can be obtained of the Chief Engineer. I. O. Hoffman is Secy. of the Director.

✣Bids will be received until noon, June 2, by Board of County Commissioners, Cincinnati, O., for the following work in Hamilton County under Specifications No. 202: For improvement of Crookshank road from Muddy Creek road north to Gamble's land, thence east to the Bridgetown road, in Green Township. The work to be done according to the plans and specifications now on file in the office of the Board of County Commissioners. All bids must be accompanied by a bond in the sum of $2,000.00. Fred Dreihs, Clerk.

✣Bids will be received until 11 a. m., May 27, by Board of Cuyahoga County Commissioners, at Cleveland, O., for the grading, draining and improving of Irish Road No. 2 from Usher Road to the westerly line of Cuyahoga County in Olmsted Township. Frank R. Lander is County Surveyor. J. F. Goldenbogen is Clerk of the Commissioners.

⦿The County Commissioners at Marion, O., on May 4 awarded the following contracts for the King road: A. J. Brady, for the Gracely road; Fred Turner of LaRue, for the Sumerlott road.

⦿Bigler Bros. have been awarded the contract at Middletown, O., for the paving of Tytus Ave. with brick, for $27,500.

⦿It is reported that the Hewitt Construction Co. of Geneva, O., has been awarded the contract by the Village Board of Geneva for the paving of Broadway and Main Sts.

⦿Service Director Sundmaker of Cincinnati, O., has awarded the contract for the crushed stone and screening for the use of the street and sewer repair department to the Tarco Construction Co., for $29,987. Of this amount $24,127 is for crushed stone and $5,859 for screenings.

A petition has been filed in the county auditor's office, Hamilton, O., by citizens of Hamilton, seeking the establishment of a new road from the east line of property of Albert Horning in Fairfield Township, to a point on the Mt. Pleasant pike.

A resolution declaring it necessary to pave East 28th St., between Fulton road and Grove Ave., has been presented to the city council of Lorain, O.

Service Director Brotherton of Ashtabula, O., has been authorized to have plans prepared for the paving of Drexel St. and Scoville court.

Residents of Vienna Ave., Niles, O., have circulated a petition for street paving.

The Board of Public Service of Columbus, O., has rejected all bids received for the paving of Summit St., from 11th Ave. to Mock Road, with either brick or asphalt. The work will be readvertised.

Oklahoma.

The City Council of Hugo, Okla., has passed a resolution providing for paving the business streets of the city with creosote pine blocks, 4x4x8, and bids for the paving are to be asked as soon as it can legally be done.

Oregon.

The City Council of Grant Pass, Ore., has passed an ordinance calling for the paving of 6th St., in the residence portion, with bitulithic, and for the paving of the allays in the down-town business section.

W. W. Harmon, County Road Engineer, Jacksonville, Ore., plans the construction of an oil macadam road this summer between Medford and Central Point.

The following contracts have been awarded by the City Executive Board of Portland, Ore., for street work: Hermosa Blvd. and Beuhla Vista and Alpine Terraces on Kings Heights, grading and concrete curbs and walks, Porter Bros., $114,558. Commercial St., from Skidmore to Killingsworth, Hassam pavement, Consolidated Contract Co., $26,610. East Morrison St., from East Water to Union, wood blocks, Carbolineum Wood Preserving Co., $18,665. Emerson St., from Patton St. to St. Johns Road, grading and concrete curbs and walks, Baker Bros. & Hayden, $7,777. East 10th St., from Alberta to Going, grading and concrete curbs and walks, Baker Bros. & Hayden, $2,078. East 29th St., from Francis Ave. to Kenilworth, grading and concrete curbs and walks, Baker Bros. & Hayden, $1,846. Roselawn Ave. from East 19th to Concord Heights, grading and concrete curbs and walks, Baker Bros. & Hayden, $2,140. East 33rd St., from Francis Ave. to Kenilworth, grading and concrete curbs and walks, Baker Bros. & Hayden, $6,651. East 30th St., from Francis Ave. to Kenilworth, grading and concrete curbs and walks, Joplin & Meeks, $2,152. Nineteenth St., from Washington to Couch, Hassam pavement, Oregon Hassam Paving Co., $1,463. Wasco St., from Holladay's Addition to East 24th St., bitulithic pavement, Pacific Bridge Co., $9,345. Barker St., from Lovejoy to Melinda, bitulithic pavement, Warren Construction Co., $6,-958. Center St., from Williams to East 39th, grading and concrete curbs and walks, Keenan Bros., $2,281. East Everett St. district, bitulithic pavement, Warren Construction Co., $41,733. Greenwood Ave., from Francis to Kenilworth, grading and concrete curbs and walks, Baker Bros. & Hayden, $2,450. East 27th St., from Francis Ave. to Kenilworth, grading and concrete curbs and walks, Baker Bros. & Hayden, $2,197. Kenilworth Ave., grading and concrete curbs and walks, Baker Bros. & Hayden, $1,877. Oakdale St., grading and concrete curbs and walks, Coast Construction Co., $1,287. East 25th St. district, Hassam pavement, Oregon Hassam Paving Co., $13,747.

Pennsylvania.

⦿The Freal Construction Co. of Wilkes-Barre, Pa., has been awarded the contract by the City Council of Plymouth, Pa., for the paving of Main St. with brick between the Lackawanna station and the Bull Run Crossing.

The Filbert Paving & Construction Co. of Philadelphia, has submitted the lowest bid to the Highway Bureau of that city for repairing asphalt streets occupied by street railway tracks. The bid was $.54 per sq. yd. for asphalt and $.15 per sq. yd. for granite blocks.

The Luzerne County Commissioners, Wilkes-Barre, Pa., have agreed to place the road leading from Pittston to Avoca in a satisfactory condition.

The Public Road Supervisors of East Bradford, Bradford, Pa., are having plans and specifications made to improve the road at the Johnson farm, near Alton station.

Tennessee.

✣Bids will be received until Noon, May 23, by City Clerk, Memphis, Tenn., for the folowing street improvements: 175,000 cu. yds. excavation; 70,000 sq. yds. of gravel pavement; 48,000 tar macadam pavement; 10,000 sq. yds. of old stone pavement; 20,000 sq. yds. of brick pavement; 70,000 sq. yds. of asphalt, wood block of bitulithic pavement. J. H. Weatherford is City Engineer. Official advertisement will be found elsewhere in this issue.

Texas.

⦿The Board of Municipal Commissioners, Dallas, Tex., has awarded F. O. Brown three contracts for street paving as follows: Third Ave., at $7,381, of which the city's part will be $2,528; Oak Lane, for $4,836, of which the city's part will be $1,616, and 2nd Ave., at $12,971, of which the city will pay $4,366. The material will be of asphaltic macadam.

The Board of Municipal Commissioners, Dallas, Tex., has been petitioned by property owners for the paving of Columbia Ave.

The Chamber of Commerce of Longview, Tex., Luther Ellison, Secy., is getting up a list of taxpayers requesting that Gregg County call an election to vote $150,000 to build macadamized roads through the county.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

The Engineering Department of Dallas County and the Dallas Automobile Club are planning the building of a macadam roadway from Red River to Galveston. The proposed road will be a little more than 400 miles in length and will pass through Grayson, Collin, Dallas, Ellis, Hill, McClellan, Falls, Robertson, Brazos, Grimes, Waller, Harris and Galveston counties.

Property owners along the Harrisburg road have decided to take up the matter of improving the road from Milby St., the end of the paving on Preston Ave., to the city limits, a distance of about 12 city blocks with Mayor Rice of Houston, Tex.

An election was held in Bonham, Tex., on May 15 for the purpose of deciding on the adoption of street paving bonds for $100,000 and waterworks bonds for $30,000.

The City Council of Cleburne, Tex., has authorized the street committee to confer with the County Commissioners, Cleburne, with reference to paving the court house square.

The citizens of Groesbeck, Tex., on May 8 voted the issuance of bonds to the amount of $12,000 for the building of sidewalks, and to the amount of $6,000 to purchase the water works.

Utah.

Citizens of Elberta, Utah, have petitioned the County Commissioners, Provo, for a new road district for Elberta and surrounding country.

Virginia.

Plans for the improvement of the roads of Alexandria County, Va., are being considered by the County Commissioners, Clarendon. The county has agreed to raise $30,000 for the improvement.

Washington.

The City Council of Mount Vernon, Wash. has selected asphalt as the pavement to be used in the improvement of Mount Vernon streets. Besides the business district, several blocks in the residence section will be paved.

Property owners have filed a petition asking for the grading of a 40-ft. roadway in Kiernan Ave., from Nevada to Division St., Spokane, Wash.

The Board of County Commissioners, Hoquiam, Wash., has decided not to award the contract for the construction of a plank roadway 20 miles long at an estimated cost of $60,000, for which bids were asked and opened May 1, there being no funds available for the work. Geo. L. Davis is County Commissioner.

The City Commissioners of Spokane, Wash., have rejected the plans for paving Ash St., Broadway to Northwest Blvd., with Hassam and ordered that competition be thrown open to five kinds of paving. The estimated cost of the improvement is $46,500.

The City Commissioners, Spokane, Wash., have approved plans for grading Arthur St., from Newark to 12th Ave., for grading Gordon Ave., from the alley between Callspel and Washington Sts., to Post St., and for grading Lidgerwood St., from Liberty to Rowan Ave. The estimated cost of these improvements is about $40,000.

The City Council of Colfax, Wash., is considering different kinds of paving material for the proposed paving of recently formed paving districts and the principal streets in the residence portions of the city, as well as in the business section.

The City Commissioners of Spokane, Wash., have approved plans for grading and parking 38th Ave., from Perry St. to Grand Blvd. The estimated cost of the improvement is $9,200.

West Virginia.

The Harrison County Commissioners, Clarksburg, W. Va., at their next meeting will probably order the construction of the National road from the corporation limits to the foot of the Big Hill, Bridgeport. The total cost is estimated at $30,000.

The Board of Commissioners, Huntington, W. Va., has ordered the paving of Buffington St., from Bridge St. to the river front to connect with the Proctorville ferry grade.

Wisconsin.

⦿John Brogan of Green Bay, Wis., has been awarded the contract by the County Commissioners, Marquette, Mich., for grading the county road from Wakefield to Dunham, Gogebic County, for $1,300.

Members of the North Ave. Advancement Association, Milwaukee, Wis., have adopted a resolution asking Ald. J. P. Carney to introduce a resolution in the common council to have North Ave., between 26th and 48th Sts., paved with asphalt.

Wyoming.

The advisability of paving a portion of the business streets of Cheyenne, Wyo., has been taken up by the public utilities committee of the Industrial Club.

The city of Green River, Wyo., has let contract for 18 blocks of sidewalk and 20 street crossings to George Dunstand of Evanston, Wyo. Turpin & Eldridge, Hugus Block, Rawlings, Wyo., are Engineers.

Canada.

✣Bids will be received until noon, May 25, by O. T. Springer, Clerk and Treasurer, Burlington, Ont., for the laying of cement for concrete walks in the village.

✣Bids will be received until Noon, May 23, by G. R. Geary, Chairman of the Board of Control, Toronto, Ont., for the construction of the following works: Concrete walks—Delaware Ave., E. S., Bloor to Hallam; Duchess St., N. S., George to Sherbourne; Edgewood Crescent, E. S., Summerhill to W. Limit Lot 15; Edgewood Crescent, W. S., Summerhill to E. Limit Lot 14; Euclid Ave., W. S., Queen to Robinson; Hazelwood Ave., S. S., Pape to East Limit Lot No. 1; Harbord St., S. S., Bathurst to Markham; Island Roadway (South of Bay Front), S. S. from 1,140 ft. east of Chippewa Avenue Bridge to 3,500 ft. east. Manning Ave., E. S., Olive to North End; Maplewood Ave., S. S. Pape to 500 ft. east. Marjory Ave., E. S., 654 ft. S. of Gerrard to Dagmar; Montrose Ave., W. S., Harbord to 250 ft. south; Morley Ave., E. S., Old City Limits, to Apple Grove; Newsham St., S. S., Brock to East End; Oak St., S. S., Sumach to East End; Oak St., N. S., Sumach to East End; Osler Ave., W. S., Davenport to Connolly; Quebec Ave., E. S., Annette to Humberside; Quebec Ave., W. S., Annette to 12 ft. S. of N. Limit No. 306; Queen St., S. S., Power to 246 ft. east; Queen St., S. S., George to 142 ft. east; Ritchie Ave., E. S., from 309 ft. N. of Dundas to 225½ ft. fur. N.; Runnymede Ave., E. S., Annette to St. John's Road; Strathcona Ave., N. S., Pape to East End; Salem Ave., W. S., Bloor to Shanly; Sarah St., E. S., Danforth to N. End; South Drive, N. S., May to 165 ft. east; St. Clair Ave., N. S., Keele to E. S. King prod.; St. John's Road, N. S., Dundas to Gilmour; Wright Ave., N. S., 732 ft. E. of Roncesvalles to Sorauren; Wright Ave., S. S., 732 ft. E. of Roncesvalles to Sorauren. Concrete curbs—High Park Ave., W. S., Dundas to Bloor; High Park Ave., E. S., Dundas to Bloor; Spadina Road, E. S., St. Clair south to Bridge. Sewers— Rhodes Ave., 200 ft. north of Queen St., to Gerrard St.; Marchmont Road, Shaw St. to Davenport Road. Specifications may be seen and forms of tenders obtained at the office of the City Engineer, Toronto.

The St. Boniface Bitulithic & Contracting Ltd., St. Boniface, Man., has been awarded the contract for the construction of 50,000 sq. yds. of bitulithic pavement in the city of Winnipeg, Man. N. P. Blair is City Engineer.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Colorado.

A special election has been ordered for June 17 by the Commissioners of Pueblo County, Pueblo, to decide on whether a municipal irrigation district shall be established in the Boggs flats section. The project, if carried, will necessitate a bond issue of $5,000,000 and water will be brought from the western slope by a tunnel through the Continental divide.

The Highland Ditch Co., operating a large ditch near Longmont, Colo., has had plans and specifications prepared for a large reservoir. The dam will be 55 ft. high, nearly 200 ft. long and the water will be 45 ft. deep. It will cover 208 acres and hold 217,800,000 cu. ft. of water. It will be located two miles west of Hygiene and eight miles west of Longmont. The cost will be over $100,000 and it is expected to be finished by May 1, 1912.

Illinois.

✣Bids will be received until 2 p. m., May 19, by Commissioners of McConnell Mutual Drainage Contract, Leroy, Ill., for the following contracts: 1. For the furnishing of 6,000 ft. 20-in. tile and 5,210 ft. 18-in. tile. Tile to be unloaded at Leroy, Ill. Said bids to be on glazed, vitrified, shale or concrete tile. 2. For the digging, laying and covering of said tile, according to the profile, plans and specifications of ditch now on file in the office of Leslie J. Owen, Leroy, Ill. 3. For the hauling of said tile from Leroy, Ill., and scattered along the line of said ditch, as the commissioners may direct. 4. For the furnishing of said tile, doing all the work in the digging of said ditch, laying and covering of said tile, hauling said tile and fully completing the work.

The County Court at a meeting at the Court House at St. Charles held a rehearing on the petition for a levee in Missouri Point. The levee will protect about 4,000 acres and if built, it will be paid for by special taxation levied on the property protected.

Indiana.

⦿Bids as follows were received by Drainage Commissioner O. E. Deeds at the office of County Surveyor Earl B. Lockridge at Peru for the construction of the Jacob Snearly ditch, in the vicinity of Miami, and the Bell ditch. The bids on the Snearly ditch were as follows: George E. Leedy, $4,862.89; Sherman Bros. $4,800; S. A. Gost, $4,849.49, and Geo. C. Tombaugh, $4,800. The contract was awarded to George C. Timbaugh. The bids on the Bell ditch were: Alexander Oticker, $1,699.40; C. E. Carmichael, $1,700; L. C. Illard, $1,788, and Sweetzer Drain Tile Co., $1,729. The contract was awarded to Alex Oticker.

Iowa.

⦿Bids were opened May 3 by W. L. Fitkin, County Auditor, Garner, Ia., for cleaning ditches requiring 6,000 cu. yds. of excavation. The contract was let to Gade Bros.' Excavating Co., Dows, Ia., at 30 cts. per cu. yd.

⦿Bids were opened May 9 by V. A. Burley, County Auditor, Sibley, Ia., for tile and open work in Drainage District No. 12, the contract being awarded to Elmer Knox, Adel, Ia., at $6,827.

⦿Johnson & Jefson, Clear Lake, Ia., have been awarded the contract at $11,858 for constructing Judicial Ditch No. 12. Bids were opened May 12 by P. D. McKellor, County Auditor, Jackson, Miss. The work includes 1,288 cu. yds. of excavation and 18,900 ft. of tile.

Louisiana.

The Police Jury at Halmville, La., W. Lus-

[illegible] trict extending from the Jefferson line to the St. John line on the east bank of the river. The district will be known as the Pontchartain Drainage District. Joseph Schexnaydre, George F. Kugler and W. A. Elfer were appointed commissioners. The establishment of a drainage district on the west bank of the river was also authorized.

Michigan.

⊙The contract for constructing the Swan and Beatty drain located in Leroy and Wheatfield Townships, Ingram County, has been awarded to J. A. Black, Lansing, for the open work and tile work. The contract for furnishing the tile was let to M. A. Dunlap, Williamston, at $1,148. The total cost of the drain is $2,450.

Petition has been filed with Walter R. Carven, County Drain Commissioner, Mason, Mich., for deepening, widening, straightening and relocating the South Looking Glass and Vermillion Creek drains. The total length of this drain will be about 18 miles and it will traverse the township of Locke in Ingram County, Perry, Sciota and Woodhull in Shiawassee county and Bath and Victor in Clinton county. This work will be a dredge job with a bottom width not to exceed 25 ft.

Minnesota.

✣Bids will be received until May 27 by Louis G. Vogel, County Auditor, New Ulm, Minn., for the construction of Brown County [illegible] No. 18. The following tile will be required: 2,000 ft. 6-in., 7,959 ft. 7-in., 1,400 ft. 8-in., 800 ft. 10-in., 2,500 ft. 12-in., 600 ft. 14-in. and 2,680 ft. 15-in. Bids may be on either clay or cement tile. Maximum depth, 12.20 ft. Estimated cost $4,419. Also an open outlet ditch 1,320 ft. long, 4 ft. wide at bottom. Nearest railroad station is Sleepy Eye, three miles from work. C. N. Robertson of Sleepy Eye is the Engineer.

⊙Bids were opened May 10 by E. D. Stocking, County Auditor, for the construction of County Ditch No. 18 and furnishing the following tile: 5,700 ft. 6 in., av. depth 4.57; 4,000 ft., 7 in., av. depth 4.5 ft.; 6,100 ft. 8 in., av. depth 4.50 ft.; 4,850 ft. 10 in., av. depth 6.30 ft.; 2,600 ft. 12 in., av. depth 6.10 ft.; 2,800 ft. 14 in., av. depth 5.40 ft.; 2,400 ft. 15 in., av. depth 12.33 ft.; 814 ft. 18 in., av. depth 13.50 ft. The contract was let to Niels P. Jensen and Carl Christensen, Hutchinson, Minn., at $7,559.

Mississippi.

⊙Roach & Stansell, Memphis, Tenn., at 10.98 cts. per cu. yd. have been awarded the contract for constructing the Warfield Point Levee (new work) in the Lower Yazoo Levee District. Bids for this work were opened April 28 by Capt. J. A. Woodruff. U. S. Engineer, Vicksburg, Miss.

Tennessee.

At the annual meeting of the St. Francis Levee Board held last week at Memphis, Chief Engineer B. G. Covington reported that it would require about $2,000,000 to complete the work in the basin to bring the levees to perfection.

Texas.

The American Rio Grande Land & Irrigation Co., Mercedes, Tex., is planning to at once extend its canals to water 6,000 acres. The flumes and trunk canals, however, will be of ample capacity for 50,000 acres to provide for future extensions. This is merely an extension as the company already has under irrigation about 25,000 acres and 85,000 acres of land unsold. Thos. M. Plummer, Mercedes, Tex., is General Manager, and W. F. Shaw, Mercedes, is Engineer.

Virginia.

The Bureau of Drainage investigations of the Department of Agriculture at Washington, will shortly begin the survey of the Chickahominy river district below Richmond for the purpose of gaining information as to the proper method of draining the area. G. M. Warren, drainage engineer of the Bureau, will supervise the work and a complete plan of reclamation will be devised.

Wyoming.

The Parkman Irrigation District, W. H. Wallace, Secretary, Sheridan, Wyo., is taking bids for the purchase of $150,000 irrigation bonds.

WATER-WORKS

Alabama.

✣Bids will be received until 1 p. m., June 2, by Lieut. Edwin F. Barlow, Construction Quartermaster, Fort Morgan, Ala., for motor driven deep well pump, electric transmission line, switch panel transformer, 4-in. cast iron water main, etc.

The City Council of Pollard, Ala., has decided to construct a water works and a sewer system. The work will include the laying of a 6-in. pipe for a distance of 1,000 ft. and the construction of a tank having a capacity of 35,000 gals.

Arkansas.

The Booneville Oil & Gas Co. of Booneville, Ark., has asked for a franchise to construct a water works system in the city.

California.

The Ventura County Power Co., according to advices from Oxnard, Cal., will lay a new 7-in. water main at once for the southwestern part of the city.

The Sacramento Power & Water Co. has filed articles of incorporation at San Andreas, Cal. A part of the scheme is to provide Calaveras, Sacramento, Amador, El Dorado and other counties with water. The incorporators are Charles Chapman of San Francisco, Charles Barsotti of San Andreas, John Muldoon of Berkeley, Dudley Smith of Oakland and C. J. Lancaster of Alameda. The capitalization is $2,500,000, of which each director has subscribed for $500 worth of stock.

Consulting Engineer C. E. Moore of Santa Clara, Cal., is preparing to make some additions to the municipal pumping plant at Mountain View, Cal.

Colorado.

The City Council of Colorado Springs. Colo., has passed a resolution directing the Commissioner of the Department of Public Works to advertise for bids for the equipment of the new pumping station.

Florida.

The City Council of Fort Pierce, Fla., contemplates calling an election for the purpose of voting on the issuance of bonds to the amount of $25,000 for the construction of a water works system.

Georgia.

Bonds to the amount of $50,000 have been voted by the citizens of Thomaston, Ga., for the purpose of constructing a water works and a sewer system.

Doak & McKechnie, civil engineers, Greenville, S. C., have been engaged by the city of Collegepark, Ga., as consulting engineers in charge of the installation of the proposed water works and sewer system.

Plans have been made for improvements to the water system of Fort Valley, Ga., at an estimated cost of $5,000. The source of supply will be secured from deep wells. J. W. Rundell is Mayor.

Idaho.

The City Council of Ilo, Ida., contemplates the installation of a water works system.

Illinois.

✣Bids will be received until 2 p. m., May 22, by Village Clerk, Stanford, Ill., for the construction of a water works system. W. C. Murphy is Clerk. Melluish & Broyhill, Bloomington, Ill., are Engineers.

✣Bids will be received by the Board of Local Improvements of the Town of Cicero until 8 p. m., May 23, for furnishing and laying water mains in S. 53rd Court and S. 52d Court. George Comerford is President of the Board.

✣Bids will be received by L. E. McGann, commissioner of public works, Chicago, until 11 a. m., May 23, for labor and material to erect in place coal bunkers with platform, ash hopper, coal receiving hopper spouts and valves in the Roseland Pumping Station, 104th St. and Stewart Ave. The contract includes two coal bunkers, one ash hopper and one coal receiving hopper with spouts and valves of an estimated weight of 160,000 lbs. Each coal bunker, of about 6,200 cu. ft. capacity and having two spouts, shall be supported by four columns about 50 ft. long, with cast iron shoes. The ash hopper, of about 2,200 cu. ft. capacity, shall be supported by two columns 55 ft. long and shall be erected according to plans. The coal receiving hopper, of about 2,000 cu. ft. capacity, shall be built under the railroad track in the boiler house. The hopper shall be built to permit of the attachment of a reciprocating feeding device to be furnished by others. The spouts shall be not less than 12 ins. in diameter and valves made to fit the openings as shown on detailed plans on file at the commissioner's office. Cash or certified check for $300 must accompany proposal.

⊙The following contracts for laying water pipe have been awarded by the Board of Local Improvements, Chicago: Torrence Ave., 103d St. to 110th St., David Walsh, 6628 South Chicago Ave.; Grand Ave., N. 44th Ave., to N. 48th Ave., Jas. H. Roche, 222 E. 31st St. Details and prices were published in ENGINEERING CONTRACTING.

Following are the low bids received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering to the Water Works Department plumber's solder as ordered. Bids opened May 5, 1911. Raymond Lead Co., 735 S. Washtenaw Ave., 19 cts. per lb. The contract has not been awarded.

The City Council of Anna, Ill., has passed an ordinance providing for the laying of distributing mains totaling 23,347 ft. The total cost, including fire hydrants, valves and valve boxes, is $20,608.

Kansas.

Plans and specifications are being prepared by the J. S. Worley Co., Reliance Bldg., Kansas City, Mo., for the construction of a water works for Cherryvale, Kan.

Louisiana.

✣Bids will be received until noon, May 22, by G. G. Gill, town clerk, Homer, La., for the following: 2 high pressure horizontal return tube boilers, size 66 ins. by 16 ft., three-quarter front, gallows frame setting and steel casing; 1 steel smokestack, 48 ins. diam., 80 ft. high, of No. 8 gage steel, to set on foundation independent of boilers; 1 steel horizontal breeching for two boilers, of No. 8 gage steel; 2 standard underwriter fire pumps, cap. 500 gals. per min.; 1 straight line air compressor, size 10x12x10 ins.; 1 long air receiver, 36 ins. by 8 ft.; 2 boiler feed pumps, 6x4x6 ins.; 2 air lifts; 1 feed water heater, 150 h. p.; 1 steel tower and tank, complete; 5 miles of cast iron pipe, 4-in., 6-in., 8-in., with all fittings, valves and hydrants for the complete installation. H. W. Wright is engineer.

⦿The mayor and City Council of White Castle, La., have awarded the contract for laying 2,000 ft. of water mains on lower Bowie St. to David Lopez of that city. Woodward, Wight & Co., Ltd., of New Orleans secured the contract for furnisihng the material.

The City Council of Kentwood, La., has authorized the mayor to have a survey of the town made for the location of water works and an electric lighting system.

H. W. Wright of Homer, La., has been retained by the City Council of that city as engineer to prepare plans for a water works. Bids are now being received for furnishing material for the work.

Maryland.

Bids will be received until noon, May 18, by Highway Commission, Baltimore County, Towson, Md., for grading and macadamizing about 3,400 ft. of Boyce Ave., Ninth District. Henry G. Shirley is Baltimore County roads engineer.

Michigan.

It is reported that the citizens of Benton Harbor, Mich., on May 4 voted the issuance of bonds to the amount of $100,000 for the purpose of developing the present wells, building a new station and placing mains in all parts of the city.

The citizens of Three Rivers, Mich., have voted in favor of purchasing the Emery water power for $40,000.

Minnesota.

The St. Anthony Park North Improvement Association, St. Paul, Minn., has asked the assembly to pass the resolution authorizing the water board to issue $100,000 in bonds for extensions and improvements.

Residents of Avondale, Lake Minnetonka, a suburb of Minneapolis, Minn., have formed the Avondale-Harris Park Improvement Association for the purpose of making roads and figuring on a water plant. J. J. Dalton is president, C. W. Fisher, Jr., secretary, and W. Bailey, treasurer.

Mississippi.

The Illinois Central Railroad Co. has purchased about 150 acres of land from C. C. Clement, I. F. Hales and the Heidenreich Land Co., in the northern part of McComb, Miss., for the purpose of constructing a reservoir.

Missouri.

⦿Bash & Gray of Joplin, Mo., have been awarded the contract by the city of Hoisington, Kan., for the construction of a water works system. Rollins & Westover, Kansas City, engineers.

⦿The Commercial Construction Co. of Kansas City, Mo., has been awarded the contract by the City Council of Moberly, Mo., for the reconstruction of the water works, for $23,323, and G. A. Sinclair of Moberly has secured the contract for constructing a power house for $9,190. Rollins & Westover, Kansas City, Mo., Engineers.

The stockholders and the directors of the Independence Water Works Co., Independence, Mo., have decided to extend the service to Maywood and Mount Washington provided 300 consumers could be found in those two places.

Nebraska.

✣Bids will be received until 8 p. m., May 22, by Village Clerk, Battle Creek, Neb., for the construction of a water plant, including building, 25 h. p. engine, triplex pump, air compressor, air pressure tank, approximately 1,600 ft. of 6-in. cast-iron pipe, 6,400 ft. of 4-in. cast-iron pipe, 5 4-in. gate valves and boxes, together with necessary belts, pipe, pipe valves and fittings. Each bid must be accompanied by certified check in the amount of 10% of any or all equipment bid on. Engineer's estimate, $10,000.00 Plans and specifications are on file with the Village Clerk, or copy of the same may be secured from the engineers at $5.00 each. Alamo Engine & Supply Co., Omaha, [illegible]

New Jersey.

⦿The Harrison Construction Co. of Newark, N. J., has been awarded the contract by D. F. Weeks, M. D., Supt., New Jersey State Village for Epileptics, Skillmab, N J., for the labor and material necessary for the extension of the water system with necessary fire hydrants, gates, valves, fittings, etc. The contract price is $9,884. Bids were opened May 1.

New York.

✣Bide will be received until 3 p. m., June 15, by M. Gray Zalinski, Depot Quartermaster, Army Bldg., New York City, for installing six pumps and accessories at Fort Mills, P. I.

⦿Lupfer & Reinick, 714 Ellicott Square, Buffalo, N. Y., have been awarded the contract by the Board of Public Works of Geneva, N. Y., for laying about 13,000 ft. of 20-in. cast iron water main for $10,640. Bids were opened May 11.

An election was held at Fredonia, N. Y., on May 15 for the purpose of voting on the question of improving the present water works system of the village. Plans have been prepared by Engineer Wilder for a system of improvements which it is claimed will insure clear water. In addition the plans call for an enlargement of the present reservoir to a capacity of 180,000,000 gals. The estimate of the cost of installing the improvements is $16,400.

Special County Judge Frank S. Wheeler and others have petitioned the City Commissioners, Jamestown, N. Y., for the extension of the city water mains on Lakewood road beyond the city line. The proposed extension would be about 1¼ miles in length and would cost about $5,500.

At a recent meeting of the taxpayers of the village of Coxsackie, N. Y., held for the purpose of discussing the question of increasing the village water supply, a committee of citizens and the Village Trustees and the Board of Water Commissioners was appointed to look up sites and report at a future meeting.

North Carolina.

✣Bids will be received until 3 p. m., May 31, by the Board of Water and Light Commissioners, Concord, N. C., for building auxiliary pumping station, furnishing turbine pumps and motors, about two miles 12-in. cast iron pipe, reinforced concrete 1,000,000-gal. sedimentation reservoir and coagulating basin and 1,000,000-gal. filter plant; plans and specifications on file at office of superintendent, and copies of specifications, forms of proposal, etc., may be obtained from Engineer Gilbert C. White, at Durham, N. C. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 3 p. m., May 31, by the Board of Water and Light Commissioners, Concord, N. C., for building an auxiliary pumping station, furnishing turbine pumps and motors, about two miles 12-in. cast-iron pipe, reinforced concrete 1,000,000-gal. sedimentation reservoir and coagulating basin, and 1,000,000-gal. filter plant. Plans and specifications will be on file at the office of the superintendent, and copies of the specifications, forms of proposal, etc., may be obtained from the Engineer at Durham, N. C. No bid will be considered unless accompanied by a certified check for $500. C. B. Wagoner, Chairman, and G. H. Rutledge, Supt. of Commissioners. Gilbert C. White is Engineer, Durham, N. C.

Bonds have been voted by the city of Thomasville, N. C., to the amount of $75,000 for the construction of a water works system. Plans and specifications have been prepared by the J. B. McCrary Engineering Co. of Atlanta, Ga.

The citizens of Morgantown, N. C., at a recent election voted the issuance of bonds in the sum of $35,000 for the construction of a water works system. It is probable thta bids for the work will be asked shortly.

North Dakota.

✣Bids will be received until 2 p. m., June 2, by Lee Nichols, City Auditor, Mandan, N. Dak., for furnishing necessary labor and material for the construction of a water works system consisting of the following contracts:

1. General contract: To consist of hauling and laying cast iron water mains and appurtenances, furnishing all material and labor and constructing power house, intake, intake well, settling basins, clear water well, etc. Certified check, $1,000. 2. Machinery Contract: To consist of furnishing and erecting boilers, heater, feed pumps, high duty and auxiliary pumping machinery, steam piping, etc. Certified check, $500. 3. For furnishing hydrants and valves f. o. b. cars, Mandan, N. Dak. Certified check, $100. 4. For furnishing cast iron pipe and special castings, f. o. b. cars, Mandan, N. Dak. Certified check, $500. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Ohio.

✣Bids will be received until May 22 by Director of Public Service, Cincinnati, O., for the laying of cast-iron special castings and valves and other miscellaneous work in connection therewith for the Water Distribution System of the city of Cincinnati. Plans and specifications may be obtained at the office of the General Supt. of the Water Works Department. J. J. Wenner is Clerk of the Director.

A new water works crib will be constructed by the city of Cleveland, O., at a cost of $100,000, in connection with the work on the new $800,000 water tunnel to be extended from the northerly end of the old West Side tunnel. It will be 65 ft. high and will have a circumference of 100 ft.

Oklahoma.

⦿Mayfield & Shaw of Lawton, Okla., have been awarded the contract by the City Council of Mangum, Okla., for extensions to the water works mains.

⦿Hunter & Hunter of Oklahoma City, Okla., have been awarded the contract in that city for the construction of a sedimentation basin for $12,988. The basin is to be constructed at the water works pumping station and will be 200 ft. long, 100 ft. wide and 12 ft. deep.

Advices from Bartlesville, Okla., state that the Corporation Commission has instructed the Water & Light Co. of that city to spend $106,700 in extension of mains and increasing facilities. Consulting Engineer T. C. Hughes of Tulsa, Okla., has recommended the cutting of a ditch about a half mile long so as to straighten the Caney river and reserving the bend for a reservoir.

Plans and specifications are to be prepared for the construction of a sedimentation basin at the water works, Tulsa, Okla. It is proposed to construct a basin having a capacity of 6,000,000 gals. The estimated cost of the improvement is $25,000.

Bonds have been voted by the citizens of Wetumka, Okla., to the amount of $10,000 for the purpose of extending the water and the electric light systems.

Oregon.

Improvements will probably be made to the water works system of Elgin, Ore., in the near future.

Pennsylvania.

✣Bids will be received until 2 p. m., May 22, by Water & Lighting Department, John A. Affleck, President, Harrisburg, Pa., for laying water pipe in Revere St., from Seventeenth St. to Elizabeth St., in Sycamore St. from Sixteenth St. to Seventeenth St., in Bellevue Road fom Twenty-first St. to Twenty-second St. and in Twenty-second St. from Bellevue Road to Market St. For particulars apply to the office of the Department, where plans and specifications may be seen.

⦿The Ohio Valley Water Co. has awarded the contract for drilling the additional 12-in.

wells for the water supply on Neville Island [illegible] Pittsburg, have charge of the work.

The York Water Co. of York, Pa., has decided to spend $15,000 to extend a trunk line through the northern and western sections of the city.

The Lower Gwynedd Water Co. of North Wales, Pa., has been incorporated with a capital stock [illegible]

South Dakota.

⊙The City Council of Brookings, S. Dak., has awarded Roberts & Few the contract to extend the city water system 13½ blocks, at a cost of $[illegible]

The Dayton Water, Light & Improvement Co. of Pierre, S. Dak., has been granted a permit to do business in Texas. The Texas headquarters will be at Dayton, Liberty County. The capital stock is $100,000.

The citizens of Bradley, S. Dak., have voted the issuance of bonds to the amount of $14,000 for the installation of a water works system. The work will include a pumping house to cost $4,000 and mains to cost $10,000.

Tennessee.

Plans have been prepared by R. C. Huston, 1219 Central Bank Bldg., Memphis, Tenn., for the construction of a new water works estimated to cost $20,000. The water supply will be secured from wells. Bonds will be sold June 2.

Plans have been prepared for the extension [illegible] mains for a distance of almost eight miles during the coming year in the city of Nashville, Tenn.

Texas.

The citizens of Yorktown, Tex., on May 7 voted the issuance of bonds to the amount of $6,000 for the purpose of extending the water mains.

Plans and specifications are to be prepared at once for the proposed new reservoir for Fort Worth, Tex., the Commissioners having decided upon a site. It is expected to let the contract within three weeks.

It is reported that the city of Slaton, Tex., contemplates the installation of a water works system at an estimated cost of $100,000. It is probable that a sewer system will also be constructed.

Utah.

The following bids were recently received by the City Council of Park City, Utah, for the construction of a new water works plant: Lynch & Cannon Engineering Co., Salt Lake, $48,949; J. W. Percival, Salt Lake, $56,380; A. A. Clark, Salt Lake, $47,499; McKay & Reed, Salt Lake, $47,800; P. J. Moran, Salt Lake, $57,732; Moran Construction Co., Ogden, $59,725; Gillis Construction Co., Salt Lake, $47,010; Wheelwright Construction Co., Ogden, $47,144.

W. W. Wilson and James Jensen of Sandy, Utah, recently visited Lehi for the purpose of determining definitely just how much money will have to be expended on the proposed pumping station which is to be installed on the banks of the Jordan river between Riverton and Midvale. The present estimated cost of the improvement is $3,000!

Virginia.

⊙The contract for building an extension to the present water system of Luray, Va., has been awarded to A. N. McKim and Joseph T. Campbell, both of Luray. The contract covers bringing a stream of water from portions of the Blue Ridge mountains, crossing another mountain and emptying it into the main leading from the present reservoir at Luray.

West Virginia.

An election will soon be held in Ronceverte, W. Va., for the purpose of voting on the issuance of $5,000 in bonds to extend the water and the sewer systems.

Canada.

✣Bids will be received until 8 p. m., May 23, by City Council, Niagara-on-the-Lake, Ont., for repairing and enlarging the tank of the water works swstem of the town of Niagara. Plans and specifications can be obtained of W. E. Lyall, Clerk, or F. W. Paulin, C. E., Niagara Falls, Ont.

The Water Commissioners of Windsor, Ont., have asked the City Council to submit a debenture by-law to the people this spring to raise about $50,000 for proposed improvements to the city water works system. The work to be covered by the by-law is the construction of the proposed new intake and the laying of additional water mains to supply growing parts of the city.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

✣Bids will be received until noon, May 22, by Board of Revenue, Jefferson Co., Job Going, President, Birmingham, Ala., for furnishing the necessary labor and material for the construction of a sewage disposal plant. Plans and specifications can be obtained of L. H. Salter, Sanitary Engineer, Room 101 Court House, Birmingham, Ala.

The citizens of Oxford, Ala., on May 15 voted the issuance of bonds in the sum of $12,000 for the installation of a sewer system.

California.

⊙The Western Engineering & Water Supply Co., First Nat. Bank Bldg., Oakland, Cal., has been awarded the contract at Concord, Cal., for the installation of sewers and a septic tank for $16,349. The contract covers the laying of 20,000 ft. of 6 to 8-in. sewers, 3,000 ft. of 15-in. outfall, and the building of a 30 by 60 ft. septic tank and pump station.

The City Trustees of Hemet, Cal., have decided to call an election as soon as details can be arranged to vote upon the issuance of $44,000 sewer bonds.

The citizens of Dixon, Cal., on May 2 voted the issuance of bonds to the amount of $40,000 for the construction of a sewer system and the acquisition of a site for a septic system for the disposal of the sewage.

The Trustees of Rio Vista, Cal., recently appeared before Secy. W. F. Snow of the State Board of Health at Sacramento, for the purpose of having a preliminary conference upon the matter of the proposed sewer system for Rio Vista. The city authorities desire to have the sewage empty into the Sacramento river. F. J. Kalber is City Clerk.

The City Council of Oakland, Cal., has adopted recommendation of the drainage and sanitary committee that City Engineer Fred C. Turner be directed to prepare plans and specifications for the sewering of 13th St., between Union and Peralta Sts., for sewers in portions of Broadway and Fourth Ave., for sewers in Manila Ave., and Broadway, and for a sewer in Bryant Ave.

The citizens of Orland, Cal., on May 2 voted the issuance of bonds in the sum of $50,000 for municipal water and sewer systems. It is proposed to use $25,000 of this sum for the construction of a sewer system and the balance for a municipal water system.

Consulting Engineer C. E. Moore of Santa Clara, Cal., is making preparations for the installation of several miles of sewers in the city of Santa Clara.

Consulting Engineer C. E. Moore, Santa Clara, Cal., is preparing to make some additions to the sewage disposal plant at College Park, near San Jose.

Consulting Engineers Reynolds & Whitman, 529-30 Ochsner Bldg., Sacramento, Cal., are preparing plans for the installation of a sewer system in the city of Dixon, Cal., including septic tanks and contact filter beds. The approximate cost of the system complete exclusive of the real estate is $30,000.

Connecticut.

The Legislature has passed a resolution favorable to the bond issue of $100,000 by the city of Bridgeport, Conn., for the construction of sewers. Plans were prepared by Engineer Zalmon Goodsell.

Florida.

Specifications for the sewerage extension on the north side of Rome, Ga., are now completed. The Board of Public Works intends to have this work done under the direct supervision of its own employes and with day labor.

⊙Bids were opened May 2 by the city of Jacksonville, Fla., George Rommel, Jr., Engineer, for constructing storm water and sanitary sewers, the contract being awarded to J. W. Gurley, Mobile, Ala., at $60,762 for reinforced concrete pipe storm sewers and at $19,117 for terra cotta pipe sanitary sewers. Bids were received on brick, monolithic concrete, reinforced concrete pipe, and terra cotta pipe sewers. The quantities of the various sizes of sewers were as follows: 66 in., 650 lin. ft.; 63 in., 2,560 lin. ft.; 60 in., 2,200 lin. ft.; 48 in., 1,650 lin. ft.; 36 in., 2,400 lin ft.; 30 in., 1,450 lin. ft.; 24 in., 1,450 lin ft.; 15 in., 950 lin. ft.; 12 in., 2,450 lin. ft.; 10 in., 750 lin. ft. The unit bids on the various kinds of sewer were as follows: (1) McCartin & Co., Birmingham, Ala.; (2) J. W. Gurley & Co., Mobile, Ala.; (3) McCaulley Manton Co., Brooklyn; (4) A. L. Patterson, New Orleans; (5) Sullivan-Long, Bessemer; (6) Meeks-Dunn, Atlanta; (7) Bryan & Co., Jacksonville; (8) Guild & Co., Chattanooga; (9) W. W. Hatch, Pensacola; (10) H. Monk, Pensacola; (11) A. F. Helms, Cleveland.

	Brick Sewer					Monolithic Concrete					Reinforced Concrete Pipe					Terra Cotta Pipe					
	[illegible]	[illegible]	60″	48″	36″	66″	63″	60″	48″	36″	66″	63″	60″	48″	36″	36″	30″	24″	15″	12″	10″
(1)	$[illegible]	[illegible]	[illegible]	[illegible]	$4.60	$....	$....	$....	$....	$....	$....	$....	$....	$....	$....	[illegible]	$1.90	$1.60	[illegible]	$ .65	[illegible]
(2)	[illegible]	[illegible]	6.35	4.36	[illegible]	7.19	6.75	[illegible]	4.36	4.35	7.19	6.75	6.35	4.36		1.35	[illegible]	1.75	.78	[illegible]	.50
(3)	[illegible]	[illegible]	[illegible]	4.19	4.80	9.00	[illegible]	[illegible]	5.50	6.25	8.75	[illegible]	7.65					1.83	[illegible]	[illegible]	.66
(4)	[illegible]	[illegible]	[illegible]	[illegible]	4.40	8.57	8.01	7.96	4.65	4.41	[illegible]	7.01	6.96	3.65	3.61	[illegible]	3.00	1.50	.60	.60	[illegible]
(5)											12.00	9.60	9.00	[illegible]	4.80	5.50	3.00	2.40	2.00	.90	[illegible]
(6)	[illegible]	[illegible]	9.40	[illegible]	5.50	9.60	9.70	[illegible]	7.75	5.50	9.50	9.40	[illegible]	7.50		4.80	4.40	3.90	2.50	2.00	[illegible]
(7)	[illegible]	7.85	9.00		5.50	7.25	[illegible]	8.00	4.40	4.60	8.25	7.90	8.90	[illegible]	4.30	4.90	3.15	[illegible]	[illegible]	.63	[illegible]
(8)	[illegible]	[illegible]	8.50	6.00	6.00						8.20	7.39	[illegible]		[illegible]	3.00	2.50	[illegible]	.57	.60	.52
(9)	[illegible]				[illegible]		....				8.75	[illegible]	[illegible]	6.25	[illegible]		2.30	1.72	.87	.85	1.02
(10)	[illegible]	[illegible]	8.60	7.00	[illegible]	[illegible]	7.85	[illegible]	[illegible]	[illegible]	8.25	8.00	7.80	[illegible]	4.05	[illegible]		1.50	.85	[illegible]	[illegible]
(11)						[illegible]	6.55	[illegible]	[illegible]	5.47	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	3.40	2.19	1.17	1.02	[illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Georgia.

A bond issue of from $75,000 to $150,000 for improvements in Waycross, Ga., is being agitated. Improvements contemplated are sewerage extensions, water main additions, street and sidewalk paving and the erection and equipment of additional fire stations.

Plans have been prepared by the H. S. Jaudon Engineering Co., Savannah, Ga., for the construction of a complete sewer system for the city of Blakely, Ga., at an estimated cost of $25,000. The sewer will be about nine miles long. The contract will be let about July 1. The City Council will have charge of the work.

Plans will soon be prepared for the installation of a sewerage system and school building in the city of Fort Valley, Ga., estimated to cost $15,000 and $20,000 respectively. The work will include vitrified sewer pipe, flush tank and septic tank. J. W. Rundell is Mayor.

Illinois.

✣Bids will be received until noon, June 5, by Capt. M. E. Saville, Constructing Quartermaster, Fort Sheridan, Ill., for the necessary labor and material for the installation of a sewage disposal plant complete, including hydrolithic tank, filters, sludge beds, pumps, motors, electric pole line and connections, sewer main and outlet, etc., at Fort Sheridan, Ill.

The Milwaukee Sewerage Commission, composed of John W. Albord, Hartford Bldg., Chicago, Ill.; Harrison P. Eddy, 14 Beacon St., Boston, Mass., and George C. Whipple, 103 Park Ave., New York City, has submitted its report to Mayor Seidl of Milwaukee. A complete change in the rearrangement of the city's sewerage system, involving a total expense of $13,255,000, has been recommended. This outlay of money covers work extending to 1950, when, according to the commission's estimate, Milwaukee will have a population of 850,000 and an area of 54.7 sq. miles. The work recommended for completion by 1915 will cost $4,997,000. The work recommended consists of filtration plants, Menomonee flushing tunnel, low and high level intercepting sewers, a sewage pumping station, two purification plants and outfall sewers.

Petitions for the installation of a sewer system in the village of Plainfield, Ill., at an estimated cost of $38,072, have been filed in the County Court, Joliet, Ill., by Village Attorney Coll McNaughton of Joliet. The plans and specifications for the system have been prepared by Civil Engineer H. D. Hallett of Aurora, Ill.

The City Council of Anna, Ill., has passed an ordinance providing for a system of sewers. The total length of pipes to be laid under this improvement is 21,578 ft. The total cost, including pipes, manholes, flush tanks, and septic tank, is estimated at $21,266.

Contracts will be let and work started on the new sewer districts Nos. 7, 8 and 9, it is reported, in Aurora, Ill., before July 1. Bids for the work will be advertised for immediately. Charles Clyne is City Attorney. M. J. Tarble is City Engineer.

The City Council of Assumption, Ill., has passed an ordinance providing for a system of drainage and sewerage for the business section and west side of town. The estimated cost of the improvement is $7,499.

Indiana.

✣Bids will be received until 9 a. m., May 22, by Board of Public Works, Gary, Ind., for constructing District Sewer No. 5. A certified check for $4,325 must be filed with each bid. Plans and specifications are on file at the office of the city engineer. Harry G. Moose is City Clerk. Official advertisement will be found elsewhere in this issue.

⊙Michaels & Mumeck have been awarded the contract by the Board of Public Works, Kokomo, Ind., for the construction of an intercepting sewer for $47,041. The work includes 5,333 ft. of 48-in. concrete, 422 ft. of 10-in. vitrified tile, 1,967 ft. of 42-in. concrete, 400 ft. of 9-in vitrified tile, 444 ft. of 36-in. concrete, 363 ft. of 20-in. vitrified tile, 1,967 ft. of 15-in. vitrified tile, 200 ft. of 12-in. cast iron pipe, 935 ft. of 18-in. vitrified tile, 100 ft. of 16-in. cast iron pipe, 716 ft. of 24-in. vitrified tile, one automatic flush tank. Ben Havens is City Clerk. Bids were opened May 1.

Permission has been obtained from all property owners, Brazil, Ind., to allow the construction [illegible] sanitary sewer through their lots, to run from the piano factory west, connecting with the Pogue Run sewer. Plans and specifications have been prepared for the work and the contract will be let immediately. The estimated cost of the work is $4,400.

Iowa.

✣Bids will be received until 9 a. m., May 17, by City Council of Des Moines, Ia., for the construction of a 12-in. No. 1 vitrified clay pipe sewer on College Ave. from the sewer in place at Eighteenth St. to the center of Nineteenth St., and on Nineteenth St. from the center of College Ave. to a point 40 ft. north of the north line of Clark St., a 10-in. No. 1 vitrified clay pipe sewer. About 930 lin. ft. of sewer, more or less. Work to begin on or before the 26th day of May, 1911, and to be completed on or before the 1st day of July, 1911. Horace Susong is City Clerk. J. R. Hanna is Mayor.

The City Council of Nevada, Ia., has passed a resolution ordering the construction of the proposed sanitary sewer system with a disposal plant. The City Clerk has been instructed to advertise for bids for the same. Plans and specifications for this work were prepared some time ago by Civil Engineer Sam Steigerwald of Boone, Ia.

The city of Fairfield, Ia., has employed engineers for the preparation of plans for a complete sanitary sewer system, filtration plant for the water works, three miles of street pavement and some improvements at the electric light plant. Hall & Adams, Centerville, Ia., are Engineers. J. P. Starr is Mayor.

Kansas.

⊙O. F. Davis, 5th west, Hutchinson, Kan., has been awarded the contract for the construction of 3,675 ft. of 8-in. sewer and 170 ft. of 6-in. sewer in Hutchinson. Bids were opened May 9.

A movement has been started at Scandia, Kan., to put in a sewer system in the principal business part of the town.

A resolution has been introduced in the City Commission, Topeka, Kan., organizing all the west side of Topeka now without sewers into a benefit district. The proposed district will be three and a half miles long and a half mile wide. The main sewer will have its outlet in the river in Auburndale and will start in the College Hill district. City Engineer A. R. Young is working on plans and boundary lines for the district.

The City Commissioners of Wichita, Kan., are considering the plans and estimates for the proposed new sanitary sewer, which includes the packing house district and a large section in the northern part of the city now without sewer facilities. It also includes all that territory in the region of the drainage canal, which the main sewer will parallel for the greater part of the distance north and south through the city. Bert C. Wells is City Engineer.

Louisiana.

The Board of Liquidation of New Orleans, La., has awarded an issue of $7,000,000 public improvement bonds to the Canal-Louisiana and Whitney Central banks of New Orleans. The proceeds of the bond issue are to be used in completing the sewerage and drainage system of the [illegible]

Maryland.

✣Bids will be received until 11 a. m., May 31, by Board of Awards, J. Barry Mahool, President, Baltimore, Md., for constructing the [illegible] the Sewer pumping station, sanitary contract No. 67, including 2,400 cu. yds. excavation; 450 cu. yds. concrete masonry; 80 cu. yds. of brick masonry; 40,000 lbs. reinforcing steel; 25,000 ft. b. m. sheeting; 800 sq. yds. of waterproofing.

Massachusetts.

✣Bids will be received until 2 p. m., May 20, by Board of Selectmen, Adams, Mass., for the necessary labor and material for the construction of sanitary sewers. The work will consist of approximately 40 ft. of 18-in., 200 ft. of 14-in. C. I. pipe, 2,500 ft. of 18-in., 1,500 ft. of 15-in., 100 ft. of 10-in., 200 ft. of 8-in. and 3,000 ft. of 5-in. Akron pipe, 10 manholes and 8 catch basins. Each bid must be accompanied by a certified check for $500, payable to George H. Holden, Town Treasurer. Plans and specifications are on file at the offices of Lindholm & Tuller, Civil Engineers, Agricultural Nat. Bank Bldg., Pittsfield, Mass.; Town Hall, Adams, Mass., and the Dowlin Blk., North Adams, Mass.

Michigan.

The Allegan (Mich.) City Council has adopted resolutions to build a sewer on the north side of the city.

The City Council of Cadillac, Mich., has accepted the plans prepared by the City Engineer for the construction of the 2-ft. trunk sewer from the pumping station in the north end of the city to Farrar St., near Fifth St. The estimated cost is $4,750. The sewer will be about four blocks long.

The city of Cadillac, Mich., will install a pumping apparatus to elevate the sewage from the lower sections of the city to the disposal plant on the borders of the city.

The Common Council of Escanaba, Mich., has accepted recommendations of the sewer committee for the building of sanitary sewers between Elm and Birch Sts.

Minnesota.

✣Bids will be received, it is reported, until May 29 by City Council, Gilbert, Minn., for the construction of a new sewer system.

The East Side Commercial Club of St. Paul, Minn., has appointed a committee to urge the Common Council and the city railway to act at once on the proposed construction of a sewer at a cost of about $60,000 to serve the hospital for crippled children at Lake Phalen, a state institution, and the Lutheran seminary, on Ivy St.

Missouri.

✣Bids will be received until 4 p. m., May 25, by City Clerk, Paris, Mo., for furnishing the necessary labor and material for the construction of approximately 3.8 miles of sewers. Rollins & Westover, 534-5 Beals Bldg., Kansas City, Mo., are Engineers.

Plans for the construction of O. K. creek sewer have been approved by the Board of Public Works of Kansas City, Mo. The expense of constructing this sewer will be borne by the Kansas City Terminal Railway Co., John V. Hanna, Chief Engineer. The plans will be sent to contractors within a short time and it is probable that the contract will be let within three weeks

The citizens of Unionville, Mo., are advocating the installation of a sewerage system for their town. The estimated cost is $24,-[illegible]

Sewer Commissioner Fardwell, in his annual report to the Board of Public Improvements, St. Louis, Mo., recommends the construction of a foul water sewer along the River Des Peres Valley, reserving the use of the latter for storm water only. It is claimed that the construction of such a sewer will solve the overflow problem of River Des Peres. The estimated cost of a sewer 23,500 ft. in length is $283,000

The City Council of Springfield, Mo., has passed a bill adopting the specific plans made by City Engineer H. G. Horton for the construction of a district sewer in sewer district No. 25 of section No. 2. The Council also instructed the City Engineer to prepare plans, [illegible]

[illegible]

Montana.

The City Council of Billings, Mont., [illegible] sewer district No. [illegible] [illegible] Sts.

New Jersey.

✣Bids will be received until [illegible] by Oliver Drake Smith, Secy. Englewood Sewerage Company, Englewood, N. J., for furnishing [illegible] labor and material [illegible] construction of a sewage disposal works. Plans may be seen and specifications and forms of proposal obtained at the office of the Englewood Sewerage Company, Englewood, N. J., and also at the office of Clyde Potts, 30 Church St., New York City. Each bid must be accompanied by a certified check on a solvent bank for $500.

The Sewerage Commission of Haledon, N. J., has submitted the report of City Engineer Harold J. Harder, concerning the construction of sewers and the disposal of waste matter, to the City Council. The report recommends the adoption of a sand filtering plant equipped with sedimentation and settling tanks. The estimated cost is between $10,000 and $1[illegible].

New York.

✣Bids will be received until 1[illegible] a. m., May 18, by Lieut. J. J. Thomas, Constructing Quartermaster, Fort Adams, R. I., for furnishing all the material and labor required in the construction of approximately 300 ft. of 6-in. sewer with one manhole at Fort Adams, R. I.

✣Bids will be received until May 22, according to reports, by George J. Metz, City Clerk, Syracuse, N. Y., for the construction of the proposed Colvin St. trunk sewer extension and several lateral sewers.

The Assembly, Albany, N. Y., has passed the Fiero bill, which legislates out of office the present Bronx Valley Sewer Commission and authorizes the Governor to appoint a new commission of three members to complete the work.

The Board of Contract and Supply of Rochester, N. Y., has awarded the contract for the construction of the third section of the new sewage disposal system to Ripton & Murphy for $169,834. This section begins at Avenue B and runs along the river bank in tunnel 25 ft. below the surface to Norton St., where it connects with the East Side trunk sewer. It proceeds from St. Paul St., by trench, to Ridge road. The first section of the system begins at North Water St., crosses the river, and from Mill St. extends northerly to the northern side of the R. W. & O. bridge. The contract for the section has not been let.

Supt. Sluyter of the Municipal Commission, Herkimer, N. Y., has been in consultation with the State Health Department relative to the extension of the sewer system in several of the streets of the village.

North Carolina.

The Public Works Commission of Fayetteville, N. C., has let the contracts for a filter plant of two filter units of 500,000-gals. each to the Clarendon Construction Co. of Wilmington, N. C. The work to be completed by Nov. 1, 1911. John K. Stange, Fayetteville, is Engineer in charge.

North Dakota.

✣Bids will be received until 5 p. m., May 25, by city of Fargo, N. Dak., for the necessary labor and material for the construction of a 12-in. lateral sewer on Eleventh Ave. North from College St. to Thirteenth St. North, in sewer district No. 1 of said city, according to the plans and specifications thereof on file in the office. E. R. Orchard, City Auditor.

✣Bids will be received until 5 p. m., May 25, by City Auditor E. R. Orchard, Fargo, N. Dak., for frunishing the necessary labor and material for the construction of a 12-in. lateral sewer in Eighth Ave. North from Tenth St. North to Eleventh St. North, in sewer district No. 1 of city, according to the plans and specifications thereof on file in the office of the City Auditor.

Ohio.

City Engineer F. J. Cellarious of Dayton, O., estimated that it would cost about $125,000 to construct storm sewers adequate to remedy the overflow conditions on the West Side.

The City Council of East Liverpool, O., has decided to build the $40,000 storm sewer draining the Leake run region in the East End, providing the property owners secure the necessary right of way and waivers.

The City Council of Columbus, O., has authorized a bond issue amounting to $108,000 to cover the cost of constructing a main trunk sewer in the town of Milo.

Oklahoma.

The City Commissioners of Sapulpa, Okla., recently accepted plans and specifications prepared by Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., for the reconstruction of the water and sewer works. The plans include the construction of a reservoir on the top of a hill near the wells and about three miles from the city. Bids for the work have been advertised for and received May 16.

Oregon.

The City Council of Hillsboro, Ore., has accepted the plans prepared by the City Engineer for street improvements and sewers. The estimated cost of the work is a little over $142,000, which covers only the business district, together with the necessary outlet to a septic tank near the southern part of the city. A sanitary sewer is planned and another drainage system to take care of storm water.

Pennsylvania.

⊙The Pittston Construction Co. has been awarded the contract for laying a two-pipe sewer system along Main St., Old Forge, Pa. The approximate cost of the work is $42,000.

⊙The Highway Committee of the City Council of York, Pa., has awarded contracts to the General Supply & Construction Co. for the extension of the storm water sewer on West Jackson St., the construction of a similar sewer on Vine St., and furnishing Belgian paving blocks.

Property owners in Lansdale, Pa., are advocating the introduction of a modern sewer system.

Texas.

The City Council of Mount Pleasant, Tex., has ordered an election for June 2 to vote on a bond issue of $16,000 for installing a system of sewerage for Mount Pleasant. J. V. Moore is Mayor.

The citizens of Bastrop, Tex., have subscribed sufficient stock to put in a sewerage system on the several blocks on Main St. Work will begin as soon as a charter is secured. It is thought that later the sewerage will be extended throughout the town.

The City Commission of Waco, Tex., has authorized an election for an additional bond issue of $80,000 for sanitary and storm sewers.

Wisconsin.

✣Bids will be received until 7:30 p. m., May 17, by A. W. Huebing, City Clerk, Reedsburg, Wis., for the construction of trunk sewers along the Franklyn St. sewer system at that place. The work consists of 1,650 lin. ft. 30-in. pipe, 1,200 lin. ft. 27-in. pipe, 1,410 lin. ft. 18-in. pipe, the trenches varying from 8 to 20 ft. in depth, 10 manholes and 22 catch basins. Plans, specifications and proposal forms may be had on application at the City Clerk's office.

⊙The contract for the trunk sewer to be constructed in Kenosha, Wis., has been reawarded to the Cleary, White, Newman Co., 125 La Salle St., Chicago, for $97,200. The sewer is to be of concrete, 5,000 ft., to be 99 in. in diameter, 1,200 ft. 72 in., and the remainder will be 66 in. The sewer will have a brick invert and the walls 12 in. in thickness.

The City Surveyor of Madison, Wis., has filed plans and specifications for the construction of sewers on Keyes St., Fox Ave. and Englewood Ave., in the Monroe St. district, in City Clerk O. S. Norsman's office.

The City Council of Eau Claire, Wis., has granted a petition calling for the construction of a sewer in Whipple St. from Chestnut to Platt Sts.

Wyoming.

⊙The town of Lusk, Wyo., has awarded the contract for the construction of a sewer to the Midwest Engineering Co.

Surveys and estimates have been completed by Consulting Engineers Turpin & Eldridge, Hugus Block, Rawlins, Wyo., for the laying of 2,500 ft. of 8-in. sewer as an extension to the present sewer system of Green River, Wyo. Bids for this work will be asked about June 1. Hugo Gaenslein is Mayor.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until 2 p. m., June 7, by the city of Eufaula, Ala., for furnishing equipment and supplies for an electric light plant, including boiler, engines, generators, switchboard, transformers, pumps, condensing equipment, line material and auxiliaries. Specifications may be seen at the office of the City Clerk or obtained of the Engineers, The W. L. Upton Co., Brown-Marx Bldg., Birmingham, Ala.

Arkansas.

The North Arkansas Power Co. has been organized by E. D. Munger of Springfield, Mo., [illegible] J. R. N[illegible] [illegible] Berryville, Ark., who recently acquired 20 acres of land on King's river half way between Berryville and Eureka Springs, Ark. It is proposed to establish a hydro-electric power plant at Grandview. It will be necessary to build a tunnel 180 ft. long which will shorten the course two miles. A 300 ft. concrete dam will be constructed.

California.

✣Bids will be received until 11 a. m., June 1, by Col. G. McK. Williamson, Constructing Quartermaster, Fort Mason, Cal., for the construction of an isolation hospital at the U. S. Army General hospital, Presidio of San Francisco, Cal.

A straw vote was taken at the general election at Richmond on May 8 to determine whether or not the City Council should call an election to vote on the issuance of bonds for the construction of a wagon road and tunnel to connect the city with the Santa Fe Co.'s wharf.

Work is under way on the structural design of a 5-story warehouse, 160 ft. x 160 ft., to be erected for Thompson & Diggs, Sacramento. The building will have reinforced concrete footings and mill construction above the first floor line. The approximate cost of structure is $100,000. Reynolds & Whitman, 529 Ochsner Bldg., Sacramento, Cal., are the engineers.

The Canal Committee appointed by the President of the Chamber of Commerce of Fresno to ascertain the cost of construction of a ship canal from Fresno to tidewater, has decided to get figures on the cost of construction of a canal over different routes, two of them being from Fresno to Herndon and from Fresno to Crow's Landing. The committee consists of T. J. Hammonds, T. L. Cobb and H. G. Parsons, all of Fresno.

Colorado.

W. H. Haigler, Colorado Springs, Colo., has applied to the City Council of Canon City, Colo., for permission to build and operate an aerial railway, or trolley line hung on cables, across the Royal gorge at a point directly over the hanging bridge, 2,500 ft. above the Arkansas River.

Connecticut.

A bill has been introduced in the State Assembly at the instance of Mayor Mahan of New London, providing a State appropriation of $1,000,000 for the improvement of New London harbor. The money is to be raised by a State bond issue of water terminal bonds bearing interest at not over 4 per cent. The improvement of the harbor is placed in the hands of a special Commission on Rivers and Harbors appointed at the instance of the last General Assembly and continued in office by this. There has been reported favorably in the General Assembly also a bill which gives the city of New London the right to acquire land for and build municipal docks.

District of Columbia.

✣Bids will be received until 10:30 a. m., June 8, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing under Canal Circular 632 of the following: Electrical material, including fittings, fixtures, batteries, carbons, wire cable, mica, paint, cross-arm pins, insulating material, soldering material, hardware, torches, fire pots, etc.

✣Bids will be received until May 24 by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing steel castings, bolster springs, sheels, steam boat ratchets, soldering iron and blanks, under Circular No. 632A.

✣Bids will be received until 2 p. m., May 19, by Commissioners of the District of Columbia, Washington, D. C., for furnishing 1-0 stranded three-conductor rubber insulated lead-incased cable for three-phase 2,500-volt A. C. service for the use in the sewer department of Washington.

✣Bids will be received until 3 p. m., June 20, by Commissioners of the District of Columbia, Washington, D. C., for furnishing the District with 15,000 ft., more or less, of 2½-in. cotton covered rubber lined hose for use in the fire and other departments.

✣Bids will be received until 11 a. m., June 3, by R. C. Hollyday, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing approximately 2,500 tons of fabricated structural steel and certain castings for seven buildings, to be delivered at the naval station, Pearl Harbor.

✣Bids will be received until noon, June 7, by Lieut. Col. W. C. Langfitt, U. S. Engineer, Washington, D. C., for constructing one dredge hull and three deck scows.

Florida.

✣Bids will be received until noon, June 3, by Capt. G. R. Spalding, U. S. Engineer, Jacksonville, Fla., for dredging in the Indian river, Fla.

Illinois.

✣Bids will be received until 2 p. m., June 8, by Maj. C. Keller, U. S. Engineer, Safety Bldg., Rock Island, Ill., for construction and repair of dams and shore protections between Reads Landing, Minn., and Alma, Wis.; between Genoa and Lynxville, Wis.; between McGregor and Dubuque, Ia.; between Rock Island, Ill., and Muscatine, Ia., contiguous to sections 16, 17, 32, 33 of Flint creek-Iowa river levee; between Keokuk, Ia., and Hannibal, Mo., and between Hamburg, Ill., and Cap au Gris, M

✣Bids will be received until 2 p. m., June 8, by Maj. C. Keller, U. S. Engineer, Safety Bldg., Rock Island, Ill., for the construction and repair of dams and shore protections between Reads Landing, Minn., and Alma, Wis.; between Genoa and Lynxville, Wis.; between McGregor and Dubuque, Ia.; between Rock Island, Ill., and Muscatine, Ia., contiguous to Sections 16, 17, 32 and 33 of Flint Creek-Iowa River Levee; between Keokuk, Ia., and Hannibal, Mo.; and between Hamburg Ill., and Cap au Gris, Mo. Official advertisement will be found elsewhere in this issue.

Following are the low bids received by L. E. McGann, Commissioner of Public Works, Chicago, for furnishing and delivering sand to the Bureau of Engineering for period ending Dec. 31, 1911: McLaughlin Building Material Co., 145 La Salle St., Chicago, $1.09 per cu. yd. Bids opened May 11, 1911.

Following are the low bids received by L. E. McGann, Commissioner of Public Works, Chicago, for furnishing hay, straw and oats to the Bureau of Engineering: Wm. Hereley Co., 315-19 W. Chicago Ave., hay 80 cts. per cwt., straw 55 cts. per cwt., oats 36 cts. per bushel.

The Northwestern Gas Light & Coke Co., Evanston, Ill., has recently commenced a 14-mile extension of its gas mains, from Blue Island to Clearing and Argo, Ill. It is planned to complete [illegible] A further extension to the Northwest into the village of [illegible]

Indiana.

✣Bids will be received until 10 a. m., May 29, by Lieut. Col. George A. Zinn, U. S. Engineer, Chicago, Ill., for dredging in Michigan City harbor, Ind.

The Haskell & Barker Car Co., Michigan City, Ind., is preparing to build a large steel car plant. The main buildings will be 1,100 ft. long with a total width of nearly 300 ft., in addition to which there will be a power plant, pattern shops, paint shops, etc. This plant will cost about $1,250,000 and W. J. McBride, president of the company, hopes to have it in operation in a year. Horace H. Lane of Detroit, Mich., is engineer in charge of the design and construction of this plant.

Iowa.

✣Bids will be received until 3 p. m., May 17, by Lieut. W. V. Carter, Quartermaster, Fort Des Moines, Ia., for furnishing all material and labor necessary for the construction of about 17,000 lin. ft. of wire fencing with gates and wooden posts, at the Fort Des Moines rifle range.

City Engineer C. H. Reynolds of Fort Dodge, has reported to the City Council of that city a dam at or near the North Fort Dodge bridge for the furnishing of a water supply for the city for the creation of electric power is altogether practicable and feasible. Further surveys will be made by the City Engineer and an estimate of cost prepared.

Kansas.

✣Bids will be received until 3 p. m., June 19, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office at Wellington, Kan.

Louisiana.

✣Bids will be received until 11 a. m., June [illegible] St. Charles Ave., New Orleans, La., for furnishing about 26,000 tons of rock for bank revetment.

Massachusetts.

The following bids per ton of 2,000 lbs. were received May 12 at the U. S. engineer office, Boston, Mass., for repairing breakwater at Gloucester, Mass.: The Breakwater Co., Philadelphia, Pa., 79 cts.; Rowe Bros. Co., Richmond, Me., $1.73. The work required is to furnish and deposit heavy rubblestone along the seaward face of the breakwater which extends westward from Eastern Point at the entrance to the outer harbor at Gloucester, Mass. About $14,000 is available.

Unit bids as follows were received May 12 by the U. S. engineer, at Boston, Mass., for building stone jetty at Scorton harbor, East Sandwich, Mass.: William H. Connor, Middleboro, Mass., $3.21; William Sears, East Dennis, and James H. Connolly, Hyannis, Mass., $3.10.

Plans are being prepared for steamship piers to be erected by the American Buildings Trust in South Boston. The piers are to be of steel and concrete construction, 1,200 ft. long, 300 ft. wide, of the most modern construction, with freight handling equipment, automatic sprinklers and other fire protective apparatus, rolling steel shutters, steel water tower 200 ft. high, of 200,000 gals. capacity, metal windows and wire glass—the cost to be approximately $1,250,000 each. Plans will be ready for bids within the next ten days. H. L. Gilman, 39 Haverhill St., Boston, Mass., is Consulting Engineer.

The Massachusetts Commission on Inland Waterways, appointed April 1 to investigate the question of the need of a free ship canal from Boston to Narragansett bay, has reported to the legislature that present conditions make it inadvisable to build such a canal, though it is conceived that conditions may so change as to render it eventually a desirable or necessary enterprise. The commission says that if the state were to contribute the right of way and terminals for the proposed inland waterway the cost would [illegible]

Michigan.

◉Bids were opened May 13 by Maj. Francis R. S. Runk, U. S. engineer, Duluth, Minn., for dredging in Ontonagon harbor (46,000 cu. yds. more or less scow measurement), the bids received being as follows: Northern Dredge & Dock Co., Duluth, Minn., 13.9 cts.; Zenith Dredge Co., Duluth, Minn., 11.5 cts. (accepted); Great Lakes Dredge & Dock Co., Chicago, Ill., 16.5 cts.; Duluth Marine Contracting Co., Duluth, Minn., 18 cts.

Minnesota.

✣Bids will be received until 11 a. m., May 29, by Ramsey County Board of Control, St. Paul, Minn., for the erection and completion of the Service and Maintenance building at the city and county hospital in accordance with plans and specifications prepared by C. H. Johnston, 715 Capital National Bank Bldg., and on file at the office of the Board of Control.

Missouri.

✣Bids will be received until 11 a. m., May 19, by Capt. Stanley H. Ford, Constructing Quartermaster, Jefferson Barracks, Mo., for furnishing and installing in barracks building No. 27 steel boilers.

✣Bids will be received until 9 a. m., May 25, by Executive Committee of the School of Mines and Metallurgy of the U. of Missouri for drawings of a fireproof library and assembly hall. E. Kahlbaum is Secy. of the School of Mines and Metallurgy, Rolla, Mo.

Nevada.

✣Bids will be received until 2 p. m., June 8, by Department of Interior, Office of Indian Affairs, R. G. Valentine, Commissioner, Washington, D. C., for furnishing the necessary labor and material for the construction and completion of a school house for the Western Shoshone School, Nev.

New Hampshire.

✣[illegible] noted in our last issue, by Lt.-Col. W. S. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for construction of breakwater at Isles of Shoals, Me., and N. H. The proposed breakwater is to be built on the southeasterly side of Gosport Harbor, between Cedar Island and Star Island in the Isles of Shoals, about seven nautical miles southeast of Portsmouth Harbor Light House.

✣ indicates work now open for bids. ◉ indicates a contract let recently.

[illegible] the breakwater is to be 15 ft. above mean low water. The width on top will be 20 ft., and [illegible] the outer or southeast face, and one vertical on one horizontal on the inner face. No preparation of the bottom to receive the stone will be required. The bottom is practically all rock. About 450 ft. of the breakwater site lies below mean low water, with depths varying from zero to 18 ft. The remaining 200 ft. [illegible]

New Jersey.

✣Bids will be received until 2 p. m., June 6, by New Jersey State Armory Commission, Trenton, N. J., for all the labor and material necessary for the complete erection of an armory at East Orange, N. J., in accordance with the plans, drawings and specifications prepared by the Commissioner of Charities and Corrections. Copies of the same will be on file in the room of the Commissioner of Charities and Corrections at the State Capitol.

New York.

✣Bids will be received until 2 p. m., May 24, by Board of Contract and Supply, Utica, N. Y., for the construction and extension of electric subways in the city. The work will consist of 150,000 duct. ft. of tile and appurtenances. Stuart F. Day is Secy. of the Board.

⦿The Niagara Falls Power Co., Niagara Falls, has awarded contracts for the construction of two 200 ft. long concrete docks at Niagara Falls. Read-Coddington Co. secured the contract for one dock and Braas Bros. the contract for the other.

⦿The M. A. Talbott Co., of Baltimore, Md., which has Contract No. 43, covering the construction of the barge canal between Oriskany and Rome, has sublet to the Baltimore Ferro-Concrete Co., Baltimore, Md., the work at the month of the Nine Mile Creek. At this point there will be a spillway 700 ft. long, guard gates for controlling floods, and a large Tainter gate for draining the summit level of the canal.

⦿The Alexander, Shumway & Utz Co., of 16 State St., Rochester, N. Y., Engineers and Contractors for reinforced concrete construction, have been awarded the general contract for the following reinforced concrete buildings to be erected for the Johnston Harvester Co. at Batavia, N. Y.: A 1-story addition to malleable foundry to be 109 ft. by 511 ft., a 2-story pattern storage building 55 ft. by 200 ft., a 2-story addition to grey iron foundry 82 ft. by 186 ft., and a 4-story factory building 70 ft. by 491 ft. The latter building will be designed for 300 lb. live load and all the buildings will be equipped with all steel sash. The above addition will give a malleable foundry over 900 ft. long.

W. R. Grace & Co., New York City, has purchased property in Red Hook Point, at the foot of Conover St., Brooklyn, to be the central shipping point of its South American trade. Piers are to be built and warehouses erected at a cost of approximately $500,000.

Plans and specifications have been prepared by City Engineer Cogley, of Utica, N. Y., for an extension of the city's electric wire subway.

Ohio.

✣Bids will be received until noon, June 2, by Board of Franklin County Commissioners at Columbus, O., for furnishing material and labor for the construction of a power house on the county infirmary farm, in accordance with plans prepared by Howard & Merriam, Architects, Capitol Trust Bldg., Columbus.

✣Bids will be received until noon, May 25, by F. G. Hogen, Director of Public Safety, Cleveland, O., for furnishing of materials and performing of labor necessary in the erection and completion of the administration building; hospital building No. 1, with connecting [illegible] cottage ward No. 1, in accordance with the plans and specifications, which can be seen at the office of the architect, J. Milton Dyer, 825 Cuyahoga Bldg., Cleveland, O. A certified check for $10,000 must be filed with each bid. C. A. Marvin is Secy. of the Director.

✣Bids will be received until 10 a. m., June 7, by Commissioners of Ottawa County, Port Clinton, O., for dredging, furnishing and installing and constructing engines, pumps, building, etc., for the West Harbor improvement, according to plans and specifications on file at the office of F. H. Suhrbier, County Surveyor.

✣Bids are asked until 10 a. m., June 1, by Col. John Mills, U. S. engineers, Federal Bldg., Cleveland, O., for constructing breakwaters and removing breakwater, Ashtabula Harbor, O. The work to be done consists in extending the west breakwater shoreward about 1,500 ft., extending it lakeward about 1,700 ft.; removing about 600 ft. of the outer portion of the present east breakwater and constructing so much of the proposed east breakwater as funds available or to be made available will permit. The quantities estimated to be required for the various sections are: Shore extension, west breakwater, 25,560 tons; lakeward extension, west breakwater, 224,400 tons; east and west portion, east breakwater, 248,700 tons; shore arm, east breakwater, 240,000 tons; breakwater to be removed, 600 lin. ft.

✣Bids will be received until noon, May 22, by Clerk of Board of Education, Cincinnati, O., for furnishing all material and labor necessary to complete the grading, cementing and parking of the lot surrounding the building known as the Twenty-third District Public School, located on the southwest corner of Vine St. and University Ave., in the city of Cincinnati, O., in accordance with drawings and specifications on file in the office of C. W. Handman, Business Manager, No. 511 West Court St., in said city of Cincinnati.

Bids were opened May 10 by the Hospital Commission, Cincinnati, O., for the 18 buildings of the new general city hospital. Six bids on the entire work complete, and 106 bids on different divisions of the work were received. The Westlake Construction Co. of St. Louis, submitted the lowest lump bid, its price being $1,544,135. Thompson-Starret Co., of Chicago, had the second lowest lump bid, its figure being $1,608,000. Henry Harig & Co. was the only Cincinnati lump bidder at $1,856,000. The three other lump bids were Puls-Porter Co., New York, $1,792,054, with the exception of hardware; Robert H. Evans & Co., Columbus, $1,765,000, and Robert Heningham, New York, $1,898,000. The estimate of the Commission's Architect, Harvey Hanneford, Cincinnati, was $1,850,000. The commission was granted $2,365,000 at a referendum election with which to build and equip the 18 buildings.

Oregon.

✣Bids will be received until 3 p. m., June 22, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office at La Grande, Ore.

South Carolina.

✣Bids will be received until noon, June 1, by Emslie Nicholson, Chairman, Courthouse Commission, Union, S. C., for the erection and completion of a new courthouse building. Plans and specifications may be obtained at the offices of A. Ten Eyck Brown, 607 Forsyth Bldg., Union, S. C.

South Dakota.

✣Bids will be received until 3 p. m., June 24, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, and electric conduits and wiring of the United States Post Office at Lead, S. Dak.

Tennessee.

✣Bids will be received until 11 a. m., June 6, by Maj. W. W. Harts, U. S. Engineer, Nashville, Tenn., for the construction of dredge Tellico.

Texas.

✣Bids are asked until noon, May 25, as noted in our last issue, by Maj. G. P. Howell, U. S. Engineer, Galveston, Tex., for dredging mouth of Brazos River, Texas. The Brazos River empties directly into the Gulf of Mexico, about 45 miles southwest of the entrance to Galveston Harbor. Twin jetties have been constructed at the entrance, about 5,000 ft. long and 550 ft. apart. A channel with a least depth of 13 ft. and least width of 75 ft. now extends from the end of the jetties to the railroad wharf of the Houston & Brazos Valley Railroad, a distance of about two miles. This channel will be enlarged to a depth of 18 ft. and width of 150 ft., and the approximate yardage will be 291,000.

A 30-year gas franchise has been granted by the City of Temple, Texas, to Raymond G. St. John and Henry M. Wallace of 706 Union Trust Bldg., Detroit, Michigan; work to be commenced on the plant within 90 days and same to be completed within one year, and maximum price of gas $1.50 per M. A 30-year gas franchise has also been granted to the same parties by the City of Waxahachie, Tex.; work on the plant to be commenced within nine months, and same to be completed within 15 months, and maximum price of gas to be $1.50 per M. The City of Temple has a population of about 15,000 people, and Waxahacnie of about 10,000. A 4-ft. water gas set and a 60,000 cu. ft. steel tank gas holder will be installed in each city. The above parties, together with their associates, have in the past built, and now own and operate, gas plants in the following cities: Ludington, Mich., Stoughton, Wis., Iron Mountain, Mich., Ironwood, Mich., and Hurley, Wis., and Menomonie, Wis.

Washington.

✣Bids will be received until 2 p. m., June 18, by Department of the Interior, Office of Indian Affairs, Washington, D. C., for furnishing the necessary labor and material for the construction of employes' cottage at Yakima School, Wash. R. G. Valentine is Commissioner.

✣Bids will be received until 3 p. m., July 27, by E. W. Ross, Secy., State Capitol Commission, Olympia, Wash., for general architectural plan for series or group of buildings to be erected at the Capitol Place and designs and plans for a Temple of Justice. Official advertisement will be found elsewhere in this issue.

West Virginia.

✣Bids will be received until 11 a. m. (Eastern time), June 5, by Maj. F. W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for construction of lock and dam No. 15, Ohio river, near New Martinsville, W. Va.

Bids were opened May 10 by Maj. F. W. Altstartter, U. S. Engineer, Wheeling, W. Va., for constructing Lock and Dam No. 14, Ohio River, at Woodland, W. Va. The bids received were as follows: Missouri Valley Bridge & Iron Co., Leavenworth, Kan., $862,091, alternate bid, $839,851; the Ohio River Contract Co., Evansville, Ind., $967,309, alternate bid, $953,559; Dravo Contracting Co., Pittsburg, Pa., $897,776, alternate bid, $873,176; Sheridan-Kirk Contract Co., Cincinnati, O. $866,989, alternate bid, $867,279; the T. A. Gillespie Co., Pittsburg, Pa., $1,009,665; alternate bid, $1,002,705. The itemized bids on this work will be given in our next issue.

The following bids were received May 11 by Maj. F. W. Altstaetter, U. S. Engineer, Wheeling, W. Va., for erecting one lock house and two outbuildings on Little Kanawha River, W. Va.: Cantrel Construction Co., Parkersburg, W. Va., $2,740; the Guy Johnson Contracting Co., Toronto, O., $3,084; Stephen Davidson, Parkersburg, W. Va., $3,300.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Wisconsin.

✣Bids will be received until 10:30 a. m., May 18, by Department of Public Works, H. E. Briggs, Commissioner, Milwaukee, Wis., for furnishing the city of Milwaukee 4,500 cu. yds., more or less, of crushed stone, approximately ⅔ of which amount will be the size passing a 2½-in. ring and held on a ¾-in. ring, and ⅓ passing a ¾-in. ring and held on a ¼-in. ring, all in accordance with specifications on file.

⊙The Superior Shipbuilding Co., Superior, Wis., has been awarded the contract for the erection of two new oil tanks for the Standard Oil Co., at its plant at Superior north of Winter street near St. Louis bay. The tanks will cost about $5,000 apiece and will each hold about 30,000 bbls. of oil.

The Wisconsin Valley Improvement Co., at its annual meeting at Wausau on May 9 is reported to have taken steps for the erection of a power dam near Bradley in the Tomahawk River.

Canada.

✣Bids will be received until 4 p. m., May 29, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for the construction of a public building at Seaforth, Ont. Plans and specifications can be obtained of H. J. Lamb, District Engineer, London, Ont., or at the post office of Seaforth.

✣Bids will be received until May 25 by John Crow, Secy.-Treas., Melville, Sask., for furnishing the following machinery and materials for delivery the current season: Two 50 K. W. 3-phase, 60-cycle, 2,300-volt A. C. generators; two exciters for same; three 2,300 A. C. motors; one marble switchboard, instruments, switches; 300 cedar poles; three tons copper wire and other line and wiring material; ten lightning transformers, 2,300-volt to 110-volt; series street lighting system; two 3-stage turbine pumps; one 6-in. vertical submerged type centrifugal pump, with shafting and piping; approximately 3 tons of 10-in. standard c. i. water pipe; approximately 60 tons of 8-in. standard c. i. water pipe; approximately 200 tons of 6-in. standard c. i. water pipe; approximately 25 tons of 4-in. standard c. i. water pipe; special castings for all above sizes; 4-in., 6-in. and 8-in. gate valves and valve boxes; 44 fire hydrants; approximately 17,000 lbs. of pig lead; approximately 1,000 lbs. of oakum; 400 ft. of 8-in. wood pipe.

✣Bids will be received until 5 p. m., May 20, by Gordon & Heilliwell, Architects, 527 Confederation Life Bldg., Toronto, Ont., for the various works required in the erection and completion of a large building for Sabbath school and church parlor purposes for the Presbyterian Church at Orillia, Ont.

Mt. Carmel, Ill., May 13, 1911.

[illegible] 2 p. m., Tues[illegible] May [illegible] the construction of [illegible] brick pavement [illegible] 000. For additional information apply to [illegible]

[illegible] WRIGHT, [illegible]

[illegible] OFFICE, Safety Bldg., Rock Island, Ill., May 8, 1911.—Sealed proposals for construction and re[illegible] protections between Reads Landing, Minn., and Alma, Wis.; between Genoa and Lynxville, Wis.; between McGregor and Dubuque, Ia.; between Rock Island, Ill., and Muscatine, Ia., contiguous to Sections 16, 17, 32, 33, of Flint Creek-Iowa River levee; between [illegible] Hannibal, Mo., and between Hamburg, Ill., and Cap au Gris, Mo., [illegible] here until [illegible] p. m., June 8, 1911, and then publicly opened. [illegible] C. KELLER, [illegible]

PAVING.

Sealed proposals will be received by the undersigned for the Borough of Scottdale, [illegible] m., Wednesday, May 31, 1911, for the grading, curbing and paving of the following streets:

South Chestnut street from the south side of Pittsburg street to the north side of Market street.

South Chestnut street from the south side of Market street to the south side of the Ridgeway property.

Grant [illegible] from the west side of Broadway to the east side of Spring street.

Stoner street from the south side of Pittsburg street to the north side of Market street.

Fourth [illegible] side of Wall street [illegible] south side of [illegible] along Kelly property on the north, in the following approximate quantities:

Grading, [illegible] yds.

Backing stone, 418 lin. ft.

Curbing with [illegible] stone [illegible] lin. ft.

Paving with vitrified brick or block, 6,734 sq. yds.

Also paving with vitrified hillside brick or block, 1,824 sq. yds.

Bidders [illegible] makers of brick or block and bid on using same.

Maker of accepted brick or block will be required to furnish surety bonds of $5,000 and guarantee for ten years to successful bidder and by him to be assigned to the Borough.

Each bidder [illegible] furnish certified check, on a National Bank or Trust Company, in the sum of $500.00, payable to the Borough Treasurer with bid as guarantee.

Plans and specifications may be seen at Borough Engineer J. B. Hogg's office at Connellsville, Pa. Bids must be addressed to F. M. Newcomer, Secretary of Council, Scottdale, Pa., and indorsed Street Improvement.

The Borough reserves the right to reject any or all bids or to purchase material for said improvement.

R. F. ELLIS, [illegible]

F. M. NEWCOMER,
Secretary of Council.

SEWER.

Sealed proposals will be received by the Board of Public Works of the City of Gary, Ind., on the 22d day of May, 1911, not later than nine (9:00) a. m., for construction [illegible]

Approximate Quantities:

582.3 lin. ft. 78-in. sewer.
313.9 lin. ft. 72-in. sewer.
[illegible]
499.7 lin. ft. 66-in. sewer.
1,823.8 lin. ft. 60-in. sewer.
754.2 lin. ft. 54-in. sewer.
995.2 lin. ft. 48-in. sewer.
[illegible]
816.6 lin. ft. 30-in. sewer.
403.0 lin. ft. 24-in. sewer.
437.3 lin. ft. 15-in. sewer.
1,224.7 lin. ft. 12-in. sewer.
[illegible]
4 catch basins
4 gutter inlets.
Certified check required, $1,325.00.

[illegible]

PROPOSALS FOR TOWBOAT.—U. S. Engineer Office, Vicksburg, Miss., May 5, 1911. Sealed proposals for furnishing and delivering one steel-hull towboat will be received at this office until noon, June 6, 1911, and then publicly opened. Information on application. J. A. WOODRUFF, Capt., Engrs.

NOTICE TO ARCHITECTS.

The State Capitol Commission of the State of Washington, at Olympia, Wash., being thereunto duly authorized by law, invites a competition among architects for a general architectural plan for a series or group of buildings to be erected on "Capitol Place" and designs and plans for a Temple of Justice.

Application for the Program of Information and Contour Map accompanying the same should be made to E. W. Ross, Secretary, State Capitol Commission, Olympia, Wash. In accordance with the law, a charge of one dollar ($1.00) is made for the Contour Map, and this sum must accompany each application.

All drawings and designs called for must be in the hands of the Commission before 3 o'clock p. m., July 27, 1911.

By order of the State Capitol Commission.

M. E. HUY, Governor,
Chairman.

Attest:
E. W. ROSS,
Secretary, Commissioner of Public Lands.

PROPOSALS FOR BUILDING AUXILIARY PUMPING AND FILTER PLANT.

Sealed proposals will be received by the Board of Water and Light Commissioners of Concord, N. C., until 3 p. m., May 31, 1911, for building an auxiliary pumping station, furnishing turbine pumps and motors, about two miles 12-inch cast iron pipe, reinforced concrete 1,000,000 gallon sedimentation reservoir and coagulating basin, and 1,000,000 gallon filter plant. Plans and specifications will be on file at the office of the superintendent, and copies of the specifications, forms of proposal, etc., may be obtained from the Engineer at Durham, N. C. No bid will be considered unless accompanied by a certified check for $500.00.

The right is reserved to reject any or all bids.

CHAS. B. WAGONER,
Chairman.
GEO. H. RUTLEDGE,
Superintendent.
GILBERT C. WHITE,
Engineer,
Durham, N. C.

BRIDGE.

Bids [illegible] Board of Commissioners of the City of Hutchinson, Kans., at the City Clerk's office, up to 3 o'clock p. m., Friday, June 2, 1911, for the construction of a reinforced concrete slab and girder bridge, 50 ft. long., 15 ft. spans and 90 ft. wide, in accordance with plans and specifications of the City Engineer on file in the City Clerk's office.

A check for $500.00, certified by a local bank, must accompany each bid.

Plans and specifications will be furnished on a deposit of $5.

The Board reserves the right to reject [illegible]

ED METZ, City Clerk.

[illegible]

Fort Yellowstone, Wyo., April 27, 1911. Sealed proposals, in triplicate, will be received here until 12 noon, May 31, 1911, and then publicly opened, for furnishing labor and material for constructing pipe line from Panther Creek to point near Rustic Falls for Fort Yellowstone water system. Information furnished on application. Envelopes containing proposals to be indorsed "Proposals for pipe line" and addressed to Constructing Quartermaster.

DEPARTMENT OF STREETS, BRIDGES AND SEWERS.

Memphis, Tenn., May [illegible] 1911.

[illegible]

10,000 sq. yds. old stone pavement.
25,000 sq. yds. brick pavement.
70,000 sq. yds. asphalt, wood block or bitulithic pavement.

Specifications and bidding blanks may be obtained from J. H. Weatherford, City Engineer.

J. H. WEATHERFORD,
City Engineer.

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PROPOSALS.

OFFICE OF STATE HIGHWAY COMMISSION.

Richmond, Va., May 1, 1911.

Bids will be received by the undersigned and the Board of Supervisors of Wise County at the clerk's office at Wise Court House up to 11 a. m., Thursday, May 25, 1911, for the permanent improvement of about one hundred and twenty-five (125) miles of county highway.

Separate bids are ask on the following sections in according with the printed notice to contractors, as follows:

Section 1. Big Stone Gap to West Norton and from West Norton to Dorchester, 13.3 miles.

Sec. 2. Lee County Line through Big Stone Gap and East Stone Gap to Mintern, 8¼ miles.

Sec. 3. Appalachia through Norton to the end of present macadam, 13.4 miles.

Sec. 4. Appalachia up Pigeon to Lee County Line, Appalachia up Looney to Inman, Appalachia up Callaghan to Stonega, 13 miles.

Sec. 5. Coeburn through Virginia City and St. Paul to Lick Creek, 15.3 miles.

Sec. 6. Wise through Coeburn to Banner and Slabtown to Riverview, 11½ miles.

Sec. 7. Wise through Glamorgan to Donkey, 11½ miles.

Sec. 8. Wise to Cranes Nest, 10 miles.

Sec. 9. Coeburn to Cranes Nest, [illegible] miles.

Sec. 10. From mile 1 to 8 inclusive, Esserville to Flat Gap, 8 miles.

Sec. 11. From mile 9 to mile 17 inclusive, Esserville to Flat Gap, 9 miles.

Plans and specifications and instructions to bidders may be seen at the office of the State Highway Commission, Richmond, Va., and at the office of the County Engineer, Norton, Va., and the Clerk's office, Wise, Va., and at the Monte Hotel, Big Stone Gap, Va., or a complete set of maps, plans and specifications may be had on application to the Highway Commissioner, Richmond, Va., or the County Engineer, Norton, Va., for the sum of $.............. per section. Bids on each separate section must be accompanied with a certified check, payable to the Board of Supervisors of Wise County, in the sum of five hundred (500) dollars; but a certified check in the sum of fifteen hundred (1,500) dollars will entitle the bidder to bid on three (3) or more sections; this as a guaranty of the acceptance and performance of the contract by the party to whom it may be awarded, and his failure to execute said contract will forfeit said check.

The right is reserved to reject any or all bids.

P. ST. J. WILSON,
Commissioner.

War Department, U. S. Engineer's Office, Montgomery, Ala., May 1, 1911. Sealed proposals for furnishing about 35,000 barrels American Portland Cement will be received at this office until one o'clock p. m., May 31, 1911. Information on application. G. D. Fitch, Lt. Col., Engineers.

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SEWERS AND PAVING.

Sealed proposals will be received by the Mayor and Board of Aldermen of Frederick, Maryland, until 11 a. m., May 24, 1911, for constructing approximately 4,000 lin. ft. of sewers (6" to 42") together with necessary inlets, manholes and lampholes. Each bid must be accompanied by a certified check for $250.00 drawn payable to J. Ed. Schell, Mayor.

At the same time and place sealed proposals will be received for paving approximately 16,000 sq. yds., and for furnishing and setting 8,500 lin. ft. of curbing. Each bid must be accompanied by a certified check for $1,250.00 drawn payable to J. Ed. Schell, Mayor.

Plans, specifications, instructions to bidders, and forms of proposals may be obtained from the City Engineer, upon payment of $2.00.

The right to reject any or all bids or any portion of any bid, or to accept any portion of any bid, which may be deemed for the best interest of the city, is expressly reserved.

J. ED. SCHELL,
Mayor.
E. C. CRUM,
City Engineer.

SPECIAL BOND ISSUE OF 1911.

MUNICIPAL IMPROVEMENTS FOR MUSKOGEE, OKLA.

CONTRACTS A to F, Coody Creek Sanitary Outfall Sewer.

Sealed proposals will be received by the City Council of the City of Muskogee, Okla., at the Council Chamber until Tuesday, May 23, 1911, at ten o'clock a. m., for the construction of a portion of the Coody Creek Sanitary Outfall Sewer and opened immediately thereafter.

The work included in the advertisement will be Section 1 to 6, inclusive.

Section 1 embraces 5,200' of 48" sewer.
Section 2 embraces 5,000' of 48" sewer.
Section 3 embraces 5,600' of 48" sewer.
Section 4 embraces 5,400' of 48" sewer.
Section 5 embraces 6,500' of 45" sewer.
Section 6 embraces 7,100' of 42" sewer.

Alternative bids are asked for two ring brick with vitrified invert; manufactured concrete pipe; and monolithic concrete with vitrified invert.

Proposals for these contracts shall be accompanied by certified checks amounting to 10 per cent of the amount of the work bid upon, made payable to the City of Muskogee, Okla., without conditions.

Plans and specifications can be secured at the office of the City Engineer, or at the office of Consulting Engineer, Alexander Potter, 114 Liberty Street, New York, on or after May 10th, by depositing $10.00 for any or for all sections.

The right is reserved to reject any or all bids and to accept those that in the opinion of the City Council is for the best interest of the City.

By order of the City Council.

D. H. MIDDLETON,
Mayor.
CHAS. WHEELER, JR.,
City Clerk.
T. P. CLONTS,
City Engineer.

U. S. Engineer's Office, Kansas City, Mo., April 20, 1911. Sealed proposals for constructing standard revetment on Missouri River about four miles below St. Charles, Mo., will be received here until 12 noon, May 22, 1911, and then publicly opened. Information furnished on application. Edward H. Schulz, Major, Engrs.

Engineering - Contracting

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The Opportunity for Engineers in the Operation of Irrigation Works.

The large amount of space in this issue devoted to articles relating to the delivery and measurement of irrigation water is well utilized. Few problems in irrigation work are so difficult to solve as that of delivering to purchasers the water which they buy when, where, how, and in the quantities wanted. Irrigation water is a commodity. How to manage so that each user shall be able to secure this commodity in the amount and at the time required; how to divide it so that each user shall receive the amount to which his [illegible] contract or interest in the works [illegible] how to prevent waste and misuse [illegible] measure the allotted supplies, [illegible] organize a working force [illegible] delivery which will operate without friction and which can be operated at [illegible] the users are willing to pay [illegible] answer determines in a large [illegible] success or failure in irrigation work. [illegible] existing irrigation works has answered [illegible] tasks with some measure of success [illegible] methods in general by which it [illegible] are outlined in the articles in [illegible]. These articles also suggest [illegible] matter, and it is the matter with [illegible] particularly interested here, which merits attention. This is the opportunity which the operation of irrigation works offers [illegible] the employment of engineers.

The utility of the engineer in the design and construction of irrigation works is recognized, and his position here is assured. Neither [illegible] with respect to the engineer in the work of operating an irrigation system. We are of the opinion that very few engineers realize that in this work of operation there are tasks of an engineering nature to be performed. As a matter of fact, there are these tasks, and the articles to which we refer above are largely valuable for indicating them, and they are tasks which, if adequately performed, call for a high character of engineering talent and which carry a remuneration well worth the consideration of engineers. The proof of this statement may readily be [illegible] in the articles being discussed.

There is a wide field for work in developing cheap and accurate measuring devices of a sort which shall measure the total quantity of water flowing in open channel as effectively as a meter measures that flowing in a pipe. The measuring devices now commonly used by irrigators do not meet the demands and are used often only because they are the best available. Engineering talent can find work well worthy of its best effort in the solution of the problem of measuring irrigation water.

Among the many questions of engineering that await answers, the hydrometric work at Sunnyside, as briefly described elsewhere, furnishes a good example. What becomes of the water entering the main canals? This study indicates that some 25 per cent is lost before it reaches the irrigator. What use is made of the water available to the irrigator? This study indicates that a very large proportion is wasted [illegible]. These are only partial results of the study so far as it has gone and it has only been begun. No one will claim that they are not very important in themselves, but it is evident that the work of greater importance is yet to come—the task of remedying these faults. This is quite as truly a task for the engineer as is that of distributing water without waste and misuse to the residents of a large city. Indeed, the two are closely analogous in many respects—water supply to cities and water supply to irrigators. Mr. Stevens, in his article, says: "The time is not far off when the water used in these large systems will be distributed [illegible] as carefully as under the metered systems of large cities, where patrons pay only for the water they use." One hardly needs assurance that there is a field for the engineer in this [illegible].

There is, [illegible] a broader field for engineering talent than lies in the technics of water storage and distribution. It is the field of efficiency engineering in the productive utilization of water. Every practical authority agrees that maximum efficiency in irrigation farming can be secured only through intensive cultivation, coupled with a minimum use of water. Practice is exactly opposite; irrigation is substituted for cultivation. An excess of water is used to make up for a difficiency in labor. All over the older irrigated west are examples of lands waterlogged and cropless because of former excessive irigation. In many places the owners of these lands are now building drainage systems at nearly the cost of the original irrigation systems to reclaim their property. Certainly here is opportunity for the efficient engineer to exercise his talents.

The three great problems in irrigation work today are: First, the design and construction of systems, having definitely in mind means of distributing water efficiently, of measuring the quantity consumed and of detecting and preventing waste; second, the devising and provision of these means; third, the development of efficiency in the productive utilization of water. Every one of these problems is an engineering problem. In no one of them are engineers taking the commanding positions. This is not only detrimental to public welfare, it is evidence of lack of enterprise on the part of the engineering profession.

The Donation to Public Service of Useful Inventions by Engineers.

In a paper presented by Mr. R. M. Hosea, chief engineer of the Colorado Fuel & Iron Co., at a recent meeting of the Western Society of Engineers, a detailed description is given of a meter developed in connection with the water supply of that company at Pueblo, Colo. This meter promises to be of value to engineers, owing to its simplicity and low cost, and to the fact that its operation does not require the services of an expert. As indicated in the paper, which is published elsewhere in this issue, the degree of accuracy of this meter is equal to that of the Pitometer.

Of as much interest to engineers as the device itself, is the purpose of the publicity given this invention. As stated by the author, this meter is the result of the labor and investigation of a number of persons working cojointly, and no one man can lay exclusive claim to any rights in the invention. As the one having the greatest claim, and with the consent of the others interested, he proposes to make their invention free for the use of the engineering profession, and, by making it a matter of publication, to prevent any possible taking out of letters patent in the future by persons having no claim on the invention. The value of this invention seems apparent. Considering its probable commercial value if protected by Letters Patent, one is compelled to admire the public spirit shown by the inventors in their making it free to the public.

The giving to the public of the rights in an invention is rare—but it is less rare among engineers, we believe, than among the members of other professions. For this reason it may be of interest to our readers to know something of the legal points involved in giving away the rights in an invention for public use.

In such a case the important thing is to make the public secure in its right to the free use of the invention, as against any person who might attempt later to take out letters patent. This may be accomplished in two ways, either of which may be successfully attacked in the courts if fraud has been practiced on the true inventor. One method is the taking out of letters patent by the inventor, with a subsequent renunciation by him of the rights conferred by that instrument. The other method is through publication by the inventor, with or without the intent of making the use of the invention free; matter of publication being essentially nonpatentable. In this case publication must include drawings, showing the device in sufficient detail to make the construction clear to a person skilled in the art.

The vital point in this connection is that publication must be made by the true inventor; or, if the invention is the result of collaboration, publication in order to be effective, must be made by or with the consent of all of the inventors, as any other course would be interpreted by the courts as a fraud practiced on the true inventor. All contest is barred after the expiration of two years following the date of publication, unless legal proceedings have been begun within that period.

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CONCRETE AND REINFORCED CONCRETE SECTION

Cost and Maintenance of Various Types of Building Construction.*

The cost of an industrial building is not merely the sum of money paid to the architect and the builder for their services in designing and erecting the structure, but is actually this initial cost plus certain fixed annual charges which vary with the character of the building constructed. Ultimate cost is of extreme, though often lightly regarded, importance in determining the type of construction to be selected for a proposed factory or warehouse.

In many cases all of the following nine items have bearing on the ultimate cost of a building and in all instances some of these charges affect the owner's final expenditure on account of his building: (1) Interest; (2) Taxes; (3) Insurance on Building; (4) Insurance on Contents; (5) Depreciation; (6) Results of Vibration; (7) Effect of Increased Light and Sanitary Qualities; (8) Vermin Losses; (9) Fire Protection Value.

There are generally three classes of construction open to the choice of a prospective builder; mill construction, steel construction fireproofed, and reinforced concrete.

Combinations of these three types are numerous and form exceptions to any cost comparisons which may be drawn. As for instance steel (or cast iron) columns and steel girders are used with heavy mill floors, or steel columns support reinforced concrete floors, while the wall construction may be brick, concrete, terra cotta, or masonry. For the purpose of this paper, the three distinct classes only will be considered, their variations being so numerous as to prohibit detailed study. The relative cost of these three kinds of buildings may be stated to be thus:

Mill construction	100-130
Steel fireproofed	154-140
Reinforced concrete	143-128

In other words, reinforced concrete will cost from 10 to 20 per cent less than structural steel (varying sometimes up to about equal cost with very light steel work) and from equal (or slightly less) cost to 10 per cent more than first class mill construction and perhaps 30 to 40 per cent more than the poor light mill or frame construction. This comparison of cost is based on data, given hereafter, gathered in reply to letters sent by the writer to 44 architects, engineers, and contractors, all of whom have designed or built numerous concrete buildings.

With some knowledge of what the initial cost of a proposed building will be, attention should be directed to the items of annual expense already given. No contracts for a new structure should be awarded without careful study having been made by the investor into these yearly charges, for the reason that it is often possible to show an annual saving in cost on a building in favor of one type of construction in spite the fact that another kind of building might cost a good deal less originally.

Interest.—The amount of this charge varies directly with the initial cost of the building.

TABLE III.—COMPARATIVE COSTS OF BUILDINGS OF CONCRETE MILL CONSTRUCTION.

Initial Cost of Building.	Mill Construction, $100,000.	Reinforced Concrete, $110,000.
Yearly charges:		
Interest at 6 per cent	$6,000	$6,600
Taxes at 1 per cent	1,000	1,100
Fire insurance:		
Building	at 75 cts. 750	at 25 cts. 275
Contents	at 100 cts. 1,000	at 80 cts. 800
Depreciation	at 1.25% 1,250	at .25% 275
Items charged against mill construction only:		
(a) Loss due to vibration, assume	450	
(b) Increased light, 1 per cent increase in efficiency of labor. Assume labor equal to ½ value of contents on $50,000	500	
(c) Vermin losses	100	
(d) Protection against fire at .5 per cent on value of 50 per cent of building and contents	500	
Total	$11,550	$9,050
Annual saving of concrete over mill construction.	....	$2,500

Taxes.—The amount of this charge varies with the initial cost.

Insurance on Building.—As a rule, reinforced concrete buildings and steel buildings properly fireproofed will receive the same rate of insurance. Mill construction or frame construction buildings, as compared to reinforced concrete structures, run from equal rates to two or three times greater. Equal rates apply only where the rate on mill construction is so low that no lower rates can be given by the insurance company. It may be stated here that the mutual companies of New England are beginning to quote lower rates on reinforced concrete than on even the best of mill construction. Table I prepared by L. H. Kunhardt of the Boston Manufacturers' Mutual Fire Insurance Co., gives comparative rates on different classes of buildings. The data are taken from typical examples throughout the United States. The table is based upon absence of automatic sprinklers and other private fire protective appliances of the usual completely equipped building. They are not schedule rates, but may be an approximation to actual costs under favorable conditions based on examples in various parts of the country.

TABLE II.—AVERAGE COST OF INSURANCE ON REINFORCED CONCRETE BUILDINGS AND CONTENTS, WITH SPRINKLER EQUIPMENT.

Agricultural implement factories	$0.06
Automobile factories	.045
*Bakeries	[illegible]
*Clothing factories	.08
Lithographing and printing establishments	.055
Machine shops	[illegible]
*Metal-working plants, without sprinklers	.06
Rubber factories	.055
Shoe factories	.05
Textile mills	[illegible]
Tobacco factories	.06
Wood-working plants	[illegible]

Under this type of construction the insurance may be accepted not only at a lower rate, but under a considerably lower valuation, probably resulting as a whole in reducing the cost of the insurance from 40 to 50 per cent over the ordinary type of factory and warehouse buildings.

*Risks not ordinarily open to competitive rates unless of superior construction.

An officer of another mutual fire insurance company gives the rates shown in Table II, taken from the report of the Committee on Insurance of the National Association of Cement Users.

In connection with the matter of insurance on buildings, attention might be called to the results of the canvass made by the Committee on Insurance, which showed thatt 26.6 per cent of 255 owners of concrete industrial buildings carried *no insurance* on their buildings, and that a great many more would not carry insurance were it not for mortgages or loans requiring it.

TABLE I.—COMPARATIVE APPROXIMATE YEARLY COST OF INSURANCE IN CENTS PER $100 OF FACTORY BUILDINGS

Exposures none; area not large; good city department; no private fire apparatus except [illegible] pails and standpipes.

	All concrete.		Brick mill construction or open joists		Wood mill construction or open joists.		Add for [illegible] of wood buildings small town without [illegible] water [illegible] departments.
	Bldg	Contents.	Bldg.	Contents.	Bldg	Contents.	
General storehouse	20	15	60	100	100	125	25
Wool storehouse	20	35	40	60	75	100	25
Office building	15	30	35	[illegible]	100	125	[illegible]
Cotton factory	40	100	100	200	200	300	50
Tannery	20	40	75	100	100	100	25
Shoe factory	[illegible]	80	75	100	150	200	50
Woolen mill	30	80	50	[illegible]	150	200	50
Machine shop	15	[illegible]	35	75	150	100	25
General mercantile	[illegible]	100	50	100	100	150	25

Insurance on Contents.—This expense varies almost directly with the character of the building. Of course, some lines of industry are so constituted that the cost of insuring the contents of the buildings will remain disproportionately high, regardless of the character of the building.

Depreciation.—Owing to changing conditions of American life and the comparative youth of the average business, exact data on depreciation are difficult to obtain. Structural steel buildings, properly fireproofed, are of so comparatively recent construction that depreciation figures are not available. It is the general feeling, however, that there is unquestionably some depreciation on structural steel buildings. Kidder's "Handbook" gives the annual depreciation of a mill building as varying from 1 to 1.5 per cent; or, in other words, the life of a building is about 66 years. These figures include roofing, doors, windows, and other details. Matheson's "Depreciation on Factories" gives a table showing the result of very comprehensive study of English factory buildings for a period of many years and indicates that the value of a building costing $50,000, is at the end of 30 years $31,775, a depreciation of 36.6 per cent, or an annual depreciation of 1.2 per cent.

The amount of depreciation on a concrete industrial building would be confined almost wholly to roofing, doors, and similar parts of the structure not of concrete. Though there are no records on which to base the estimate other than a knowledge of the permanency and the constantly increasing strength of the material as well as the protection it affords the reinforcement, it may be conservatively stated that under the same conditions as given above for the mill building the annual charge for a sinking fund on a reinforced concrete factory or mill or warehouse would not exceed ¼ of 1 per cent.

Results of Vibration.—In the case of warehouses, foundries, and similarly used buildings the vibration element does not enter. With the ordinary industrial structure, however, one of the most important matters in a successfully operated plant is to keep down machinery repair and operation charges. Vibration in the building plays a considerable part in the amount of these charges. If machines placed in position will remain so and if shafting once lined up will not vary, the repairs to machinery, and more particularly the cost of operating the machinery, will be at a minimum. Vibration in a building causes "walking" of the machinery, with consequent loss of alignment and increased wear on journal blocks and moving parts, and an increase in the amount of power necessary for operation.

Reinforced concrete has been chosen in numerous instances in competition with structural steel and in a great many more cases in competition with mill construction for proposed buildings largely because of its vibration resistant qualities. While there are, it is true, some concrete buildings where vibration is noticeable, the conditions are such as to create vibration in any kind of a building and the amount existing in the concrete structure is probably less than would otherwise obtain. There are many concrete buildings in which heavy machinery is operated on upper floors without any indication of their presence being given to the tenants in the lower stories.

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*A paper by J. P. H. Perry, Manager Contract Department, Turner Construction Co., New York City, read before National Association of Cement Users.

To arrive at the annual value of the reduction or the elimination of vibration in a building, is somewhat difficult. The case of a paper goods manufacturer in Brooklyn, N. Y., the owner of both reinforced concrete and slow burning mill construction factories, bears on this subject. A saving of $5,000 per year in machinery repair and operation charges in favor of the concrete buildings compared with the mill buildings, is effected. This amounts to about 1 per cent of the value of the building only, no allowance for contents.

In a concrete building occupied by a shoe machinery manufacturing concern, it was found that machines were being run at a much higher speed than ever possible before. The percentage of increased output was not doubled, but was very large indeed and the men operating the machines in their old building claimed the work was better in the new building, even with the increased speed.

In another large concrete building occupied by a book company of Cincinnati, Ohio, 15 or 16 heavy presses were operated on the second floor with perfectly satisfactory results. The owner stated that this would have been absolutely impossible in any other type of building.

The experience of another manufacturer, this time of buttons, occupying several concrete buildings, illustrates the effectiveness of concrete construction in reducing vibration. The officials of this company visited many concrete buildings before selecting this material for their present structures, and now state:

> We are running our [illegible] at as high [illegible]eed as we were ever able to [illegible] other buildings [illegible] in general at higher [illegible] and with less waste time for adjustments and consequent repairs. I have no scientific data to furnish on this speed. * * * It is perfectly obvious that [illegible] can get [illegible] or 10 [illegible] efficiency [illegible] of machinery [illegible] advantage over others.

The chief engineer of this company writes as follows:

> In the matter of our experience with vibration in our reinforced concrete building as compared with the vibration of the same equipment in a building of the [illegible] mill construction, would say:
>
> First, the type of vibration that concerns us the most is that due to very slight lack of balance in parts rotating at high speed, in distinction from the vibration that might be evident from machinery of a heavier type, due possibly to reciprocation as in heavy printing presses, or from shock as in punch press work and the like, or vibration of a machine tool due to chatter or like cause.
>
> In our experience previous to this building we had difficulty in anchoring our machinery so that this high frequency vibration would not in a short time loosen the fastenings as well as cause loss of adjustment in the machines themselves. We find this difficulty almost wholly overcome in our present concrete buildings, and further, machines standing rather high from the floor which are subjected to more or less horizontal shock, we were never able in a mill construction building, even by bolting through the floor, to prevent those machines from loosening. On our present concrete floors we have no record of any one of these machines requiring even to be tightened to the floor after being installed.
>
> As to building vibration, we never had experience with any buildings as free from jar, trembling, etc., as our present one, the results in all cases being a surprise to us in the elimination of these undesirable features.

In all plants where the amount of machinery installed was not as large as in these instances, the percentage saved based on the value of the building would be less. It may be assumed, however, for the purpose of comparison, that in the case of the usual manufacturing plant, the saving by the elimination of vibration would amount at least to $1.50 per day, or $450 per year. When it is remembered that this includes power, oil, attendance, new bearings, parts, belts, and wear on the building structure, this estimate would seem conservative. The increased efficiency of the machines alone would in most cases equal or exceed this daily saving.

Effect of Increased Light and Sanitary Qualities.—It is well known that employes can work more efficiently in the open air (assuming good weather conditions), than indoors, for the simple reason that the ample light increases their efficiency. A garage owner recently stated he found that his men could repair an automobile when working out of doors in nearly one-half the time required when in his building. The effect upon the efficiency of employes of the amount of light obtainable is sometimes [illegible] appreciated [illegible] owners.

An increase of [illegible] per cent [illegible] the area of windows would certainly advantageously affect the working conditions in a building. Not only would the employes be able to see better, but also their spirits would be raised owing to more cheerful working conditions. The increase in the earning power of the working forces ought to be at least 1 per cent; in most cases it would be higher.

Welfare managers in many large manufacturing plants appreciate that the surroundings in which a man labors have a decided bearing on his output. Clean, sanitary rooms with plenty of light, good ventilation and uniform temperature have a certain dollar and cents value. A saving of 1 ct. per day per employe, with 100 hands, represents $300 per year. One cent a day for a man earning $2 to $4 per day requires but a small increase in his effectiveness. Reinforced concrete buildings usually permit maximum light, owing to the method of construction. It is not unusual to find buildings of this material with 70 per cent of their wall space taken up by windows. It is possible to increase this light area to 80 per cent when necessary. In mill construction as generally adopted, the window area does not run over 30 to 40 per cent of the wall area. Cement being a lime product is essentially sanitary. The waterproof qualities of reinforced concrete render frequent washing of floors possible and make dampness or rotting impossible where wet processes are involved. The low conductivity value of concrete results in small variations in temperature within the building and the homogeneous construction largely prevents draughts. With these facts, not theories, as a basis, the assumption that the effectiveness of the employes will be increased at least 1 per cent by using reinforced concrete in place of mill construction, would seem conservative.

Vermin Losses.—Mice, rats, roaches, and other vermin are responsible for loss in most factories or warehouses. Raw materials or finished products are subject to inroads by these pests and although in well run plants the damage may be less than in others, it certainly has a monetary value. As an example of this, the experience of one paper goods manufacturer may be cited. With two mill buildings, and one reinforced concrete factory building for purposes of comparison, he states that the last named structure saves him $4,000 per year in vermin loss alone. There is no place in a concrete building for rodents to live. An allowance of $100 loss annually would be too low for most businesses of sufficient magnitude to require a fireproof building.

Protection from Fire.—The relative insurable value of a concrete building and a mill building has already been gone into. The protection from fire which a modern reinforced concrete industrial building affords its owner is probably the greatest asset which this form of construction possesses. Although a building and its contents may be fully covered by insurance, its owner cannot protect himself in event of fire against losses to his reputation owing to his failure to complete orders or con-

TABLE IV.—COMPARISON OF COSTS OF STEEL AND REINFORCED CONCRETE BUILDINGS

BUILDINGS					Character and Comparison.	[illegible] Walls [illegible]			
Location.	Size in Plan.	No. of Stories.	Size of Panels.	Use and Load.		Reinforced Concrete.	Fireproof Structural Steel.	Per Cent More than steel.	Cost R. C. Less than steel.
Brooklyn	140x[illegible]	[illegible] and bsmts.		W[illegible] 200 lbs.	Bid	$250,000	$280,000		10 7-1[illegible]
Boston	550x1[illegible] 341x[illegible]1	[illegible] & bsmt. [illegible] & bsmt. Sawtooth roof.		Textile mfgr [illegible]	[illegible]	[illegible]	Combination steel with heavy mill floor [illegible]		[illegible]
Cambridge	60x[illegible]				[illegible]	90,[illegible]	Wood floors [illegible]	[illegible]	
Cincinnati		16 & bsmt.		Office 70 lbs.	[illegible]	[illegible]	[illegible] higher than R. C		[illegible]
Des Moines	1[illegible]	6	[illegible]x16[illegible]	F[illegible] 200 lbs.	[illegible]	60,650	[illegible]		13
Fairmont ...	[illegible]	[illegible] & [illegible]		Mch. factory 200 [illegible]	Bid	25,000	28,000		10 7-10
Indianapolis		[illegible] & bsmt.		Hospital	Bid	793,000	[illegible]		[illegible]
Indianapolis	[illegible]	[illegible] & bsmt.	16 -8x20	Depart[illegible] store, 125 lbs	Bid	89,500	96,000		[illegible]
Ohio		[illegible]		Mfg. 200 [illegible]	Bid	40,000 Less than steel	40,000 More than R. C.		
Springfield	[illegible]	[illegible] & [illegible]	20x20	Loft 150 lbs.	[illegible] Estimate	280,000	320,000		12 1-2
St. Louis		[illegible] & bsmt.		Apartment 70 lbs.	Bid	290,000	301,000		[illegible]
St. Louis .	[illegible]x140	7 & bsmt.		Hotel 70 lbs.	[illegible]	171,000	184,000		
St. Louis	[illegible]x120	6 & bsmt.	16x18	Office 70 lbs	[illegible]	170,000	184,000		7 6-10
Wichita	[illegible]x140	10 & bsmt.	[illegible]x18	Office 7[illegible]	Bid	282,000	303,000		6 [illegible]-10

Mean [illegible] R.C. costs [illegible] less than Fireproof St. Steel.

[illegible] COMPARISON [illegible] MILL AND REINFORCED CONCRETE BUILDINGS.

[illegible]				[illegible]	Comparative Cost of Mill and R. C. Building. Walls assumed the same.			
Location.	[illegible] Plan.	[illegible] Stories.	Loads.	Bid or [illegible]	Reinforced Concrete.	Mill Construction.	Per Cent More than Mill.	Cost R. C. Less than Mill.
[illegible]	[illegible]	—	—	Bid	[illegible]	$212,500		6 3-10
[illegible]				Estimate	[illegible]	16,000	[illegible]	
[illegible]			[illegible]	Bid	[illegible]	4% less than R. C.	[illegible]	
[illegible]	[illegible]		Bakery	Bid	[illegible]	64,000		2 3-10
Detroit, Mich.		[illegible]	[illegible]	Bid	[illegible]	28,200	1 1-2	
[illegible]	[illegible]	—	Factory	Bid	82,500	74,000	10 3-10	
Grand Rapids, Mich.			Factory	Bid	[illegible]	85,300	1 3-10	
[illegible]	[illegible]		Factory 200 lbs.	Bid	[illegible]	52,000	7 1-10	
[illegible]	[illegible]	[illegible] bsmt.	Warehouse 200 lbs.	Bid	[illegible]	39,000	9 3-10	
Manchester, N. H.	100x45	—	Factory	Est.	[illegible]	52,000	27 7-10	
[illegible]	[illegible]	[illegible]	Storehouse	Bid	131,000	117,000	10 7-10	
[illegible]			Shop	Est.	[illegible]	65,868	5 2-10	
[illegible]	[illegible]	[illegible]	[illegible]	Bid	[illegible]	61,489	3 3-10	
St. Paul, Minn.	165x235		Mfg. 200 lbs.	Bid	10,000 less than mill	10,000 more than R. C.		

[illegible]

[illegible] to the skilled operatives [illegible] of the burnt out plant; and loss to his trade due to [illegible] until a new building can be procured. Beyond this protection against the ordinary fire, concrete buildings offer a protection against conflagrations which cannot be estimated. In cases of great fires, a manufacturing building, remaining practically unharmed, as has been the case with concrete buildings, would be of inestimable value. The certainty that a fire cannot destroy a building affects the confidence of [illegible] panics and, incidentally, adds greatly to the peace of mind of the owner of the building. Many manufacturers occupying concrete buildings state that they can wake up in the night and hear fire engines go by without a fear that their plant is burning up. Concrete first attracted attention because of its absolute fireproofness.

"Use and Occupancy" insurance policies can be obtained at a cost of about 5 per cent on building and contents. They cover estimated profits, commissions, or similar legitimate sources of income, based upon the use and occupancy of the given building. In event of fire causing interruption to a business, the insurance company will pay the insured a certain amount for each day the building is out of commission. The value of a [illegible]structible building ought to be at least as much as this "Use and Occupancy" insurance. In fact, it is worth a good deal more because a concrete building would not only make such insurance practically unnecessary, but would protect its owner against injury to reputation and organization. An assumption, therefore, that reinforced concrete buildings will save ½ of 1 per cent per year, owing to the protection which they give against fire, is permissible.

Table III sums up the various comparisons made between buildings of concrete and mill construction. Assume a building costing complete in mill construction $100,000, contents equal in value to the cost of the building and that it is used for general manufacturing purposes.

If the saving of $2,550 per year be capitalized at 6 per cent, it would represent a capital of $42,500. In other words, a concrete building, though 10 per cent more in initial contract cost than a mill building of similar design, would save each year 2½ per cent over all fixed charges. Stated differently, an owner can afford to pay nearly 50 per cent more for a concrete building than for a mill building and still save money on his annual output.

Careful consideration of Table III will show that the assumptions are conservative throughout. Several owners of large concrete factory buildings have commented on this table in much the same form as it appears and all have stated that in their judgment they could show a saving in favor of the concrete building much greater than appears from the table.

Table IV and V give comparisons of the cost of actual buildings in structural steel, reinforced concrete and mill construction.

Information contained in these tables is not authoritative, but is believed to be fairly accurate. The percentage of cost in favor or against reinforced concrete construction as shown in these tables, cannot be applied as generalizations, as the number of cases cited is too small.

No comparison has been made herein between reinforced concrete and fireproofed steel construction such as has been attempted between concrete and mill construction, for the reason that in most of the items considered there would be but little difference between a steel building and a concrete building. A modern reinforced concrete factory or warehouse is certainly the equal of a steel structure and can be constructed for considerably less money. It therefore does not seem necessary to enter into as close a study of the comparative working conditions in these two classes as it did between mill construction and concrete.

EARTH AND ROCK SECTION

Unit Costs of Work on the Panama Canal for the First Quarter of 1911.

The unit costs of work on the Panama Canal for the first three months of 1911, which have just been made public, are chiefly notable for the reduction shown in the cost of excavation at Culebra. As will be seen from the tabulations which follow, the cost was over 10 cts. less per cu. yd. than during the last quarter of 1910. A number of other comparisons of interest are possible from these tabulations, which have for this purpose been cast into the same form as those for the last quarter of 1910, published in our issues of Feb. 22 and March 1, 1911, and also those for the preceding 15 months, published in our issues of Dec. 7, 14 and 21, 1910.

Gatun Dam.—The general method of constructing the Gatun Dam is to build two parallel stone embankments across the valley by dumping from trestles and to fill between these embankments with earth, examined and placed by hydraulic dredges. A plan and section of the dam, and a description of the work in more detail were given in our issue of Dec. 21, 1910.

The unit costs of dry filling for January-March, 1911, were for 684,745 cu. yds., as follows:

Item.	Per cu. yd.
Excavation	$0.0011
Clearing site	[illegible]
[illegible]	[illegible]
Trestle	[illegible]
Transportation	[illegible]
Filling	[illegible]
Maint. of equipment	[illegible]
Plant arbitrary	[illegible]
Division expenses	[illegible]
General expenses	[illegible]
Total	[illegible]

During the last quarter of 1910 the yardage was 695,299 cu. yds., and the cost per cubic yard was 39.18 cts., or 1.37 cts. per cu. yd. less.

The amount of fill placed by hydraulic dredging in January-March, 1911, was 856,525 cu. yds., and the cost as follows:

Item.	Per cu. yd.
Clearing site	[illegible]
Clearing for dredge	[illegible]
Dredging	[illegible]
Relay pumps	[illegible]
Pipe lines	[illegible]
Wood flumes	[illegible]
Power	[illegible]
Small boats	[illegible]
Maint. of equipment	[illegible]
Plant arbitrary	[illegible]
Division expenses	[illegible]
General expenses	[illegible]
Total	[illegible]

The cost of 853,519 cu. yds. of hydraulic fill for the preceding three months, October-December, 1910, was 28.84 cts., or 1.98 cts. per cu. yd. less.

Colon Breakwater.—The breakwater is rock fill made by dumping from trestle. The rock is quarried especially for the purpose and is hauled by train. This is mentioned because the dry fill at Gatun Dam is made with rock from the canal excavations and entails no excavation costs. The cost of the Golon Breakwater fill for January-March, 1911, was as follows:

Item.	Per cu. yd.
Surveys	$0.0175
Clearing	0.0282
Drilling	0.0522
Blasting	0.2114
Loading by power	0.1060
Tracks	0.0551
Transportation	0.0873
Maint. of equipment	0.0795
Total excavation	$0.6372
Trestles	0.7253
Dumping	0.0200
Maint. of equipment	0.0141
Total filling	$0.7594
Plant arbitrary	0.1690
Division expenses	0.0344
Tug service	0.0547
General expenses	0.2030
Total general	$0.4611
Grand total	1.8577

The cost of breakwater work in October-December, 1910, was $1.5816, or 27.61 cts. less per cu. yd. The increase in cost during January-March, 1911, is largely in the items of blasting and trestles; trestles cost nearly 20 cts. per cu. yd. more for the three months of 1911 and blasting some 5 cts. more per cu. yd.

Lock Masonry.—The costs of plain cement masonry at the Gatun Spillway, Gatun Lock, Pedro Miguel Lock and Miraflores Lock were as follows:

Item	[illegible]	Gatun	Pedro Mig.	Mira-flores.
Cement	[illegible]	[illegible]	[illegible]	[illegible]
Stone	[illegible]	[illegible]	[illegible]	[illegible]
Sand	[illegible]	[illegible]	[illegible]	[illegible]
Mixing	[illegible]	[illegible]	[illegible]	[illegible]
Total concrete	[illegible]	[illegible]	[illegible]	[illegible]
Cu. yds. concrete...	17,823	212,872	120,101	74,765
Cu. yds. rubble	[illegible]	[illegible]	[illegible]	[illegible]
Cu. yds. masonry	[illegible]	[illegible]	[illegible]	[illegible]
Cost [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cost of Masonry:				
Concrete	$4.2625	$1.4015	$3.0289	$3.1573
Rubble	[illegible]	[illegible]	[illegible]	[illegible]
Wood forms	[illegible]	[illegible]	[illegible]	[illegible]
Steel forms	[illegible]	[illegible]	[illegible]	[illegible]
Placing	0.5971	0.3088	0.3348	0.2394
[illegible]	[illegible]			
Reinforcement	......	0.0137	0.0351	0.0126
Pumps	[illegible]	[illegible]	[illegible]	[illegible]
Power		[illegible]	[illegible]	[illegible]
Maint. of equipment	[illegible]	[illegible]	[illegible]	[illegible]
Plant arbitrary	0.4670	0.7110	0.7154	0.4100
Division expenses	0.0761	0.0647	0.0868	0.0956
General expenses	0.2322	0.1885	0.2992	0.3012
Total masonry	$6.5127	$6.5873	$5.2131	$4.8434

Comparing these totals with those for the corresponding work for October-December, 1910, we have:

Work	[illegible]	1911
Spillway	$7.12	$6.51
Gatun Lock	[illegible]	[illegible]
Pedro Miguel Lock	4.64	5.21
Miraflores Lock	5.07	4.84

Except at Pedro Miguel the reduction in cost is material; the increased cost at Pedro Miguel is stated to be due to the "smaller yardage consignment upon a portion of the construction plant having been removed to the lock at Miraflores." In addition to the plain concrete placed at Gatun there were placed 3,314 cu. yds. of reinforced concrete in the operating tunnels, which cost as follows:

Item.	Per cu. yd.
Cement	[illegible]
Stone	[illegible]
Sand	[illegible]
Forms	[illegible]
Mixing	[illegible]
Placing	1.5916
Reinforcement	[illegible]
Maint. equipment	0.1833
Plant arbitrary	0.7110
Division expenses	0.3577
General expenses	1.1705
Total	[illegible]

Averaging this 3,314 cu. yds. of reinforced concrete into the total concrete work at Gatun we obtain an average cost per cubic yard of $6.6972.

Dry Excavation.—The total excavation of the Central Division (Culebra Cut) was 5,216,978 cu. yds. for the three months, January-March, 1911. The [illegible] as follows:

Item.	Per cu. yd.
Drilling	[illegible]
Blasting	0.0507
Loading	[illegible]
Tracks	[illegible]
Transportation	0.0666
Dumping	[illegible]
[illegible]	[illegible]
Maint. equipment	[illegible]
Plant arbitrary	0.1000
Div. [illegible]	0.0111
General [illegible]	0.0391
Total	[illegible]

During October-December 4,448,488 cu. yds. were excavated at a cost of 67.36 cts. per cubic yard.

Dredging.—The cost of dredging for January-March, 1911, as compared with the immediately preceding three months, was slightly greater in the Atlantic Division and slightly less in the Pacific Division. The itemized costs for 1911 are given in Table I.

[illegible] [illegible] item of work the most notable feature is the reduction of 23.11 cts. per cu. yd., as compared with the last three months of 1910, in producing crushed stone at Porto Bello. The itemized figures are as follows:

Item.	[illegible] Total.	[illegible] Total.
Quarrying—Quantities [illegible]	[illegible]	[illegible]
Stripping	$0.0062	$0.0839
Drilling	.0364	[illegible]
Blasting	.1543	.0507
Loading	[illegible]	.0621
Transportation	.0654	[illegible]
Tracks	[illegible]	.0245
Power	[illegible]	[illegible]
Maintenance of equipment	[illegible]	[illegible]
Plant arbitrary	[illegible]	[illegible]
Total	[illegible]	[illegible]
Crushing—Quantities [illegible]	[illegible]	[illegible]
Operation, [illegible]	[illegible]	[illegible]
Stone [illegible]	[illegible]	[illegible]
Power	[illegible]	[illegible]
Maintenance of equipment	.1164	[illegible]
Plant arbitrary	[illegible]	[illegible]
Total	[illegible]	$0.1363
Total cost of production	$1.1820	$0.7738
Towing—Quantities [illegible]	[illegible]	
Operation tugs and barges	[illegible]	
Maintenance of equipment	.1490	
Plant arbitrary	.1710	
Total	[illegible]	
Unloading—Quantities [illegible]	[illegible]	
Operation, cableways and cranes	$0.1162	
Power	[illegible]	
Track repairs	.....	
Dumping		
Maintenance of equipment	[illegible]	
Plant arbitrary	.2070	
Total	[illegible]	
Rail Transportation to Storage—Quantities [illegible]	[illegible]	229,543
Operation of trains	$0.0695	$0.0454
Repairs to tracks	[illegible]	[illegible]
Dumping in storage	.....	.0129
Maintenance of equipment	[illegible]	[illegible]
Plant arbitrary		[illegible]
Total	[illegible]	[illegible]
Division expense	[illegible]	[illegible]
Total cost [illegible]		[illegible]

The corresponding totals for October-December, 1910, were: Porto Bello, $2.4098 and at Ancon, $[illegible].

Sand Production.—The cost of dredging sand and transporting it to the storage piles was, for the first quarter of 1911, as follows:

Items.	Atl. Total.	Pac. Total.
Dredging—Quantities—Cu. yds.	110,291	119,280
Operation [illegible]	[illegible]	[illegible]
Maintenance of equipment	[illegible]	[illegible]
Total	[illegible]	[illegible]
Plant arbitrary	[illegible]	[illegible]
Total cost of production	*$0.7770	$0.1711
Towing—Quantities—Cu. yds.	110,291	119,280
Operation, tugs and barges	$0.2169	$0.1141
Maintenance of equipment	.1193	.0618
Plant arbitrary	[illegible]	[illegible]
Total	$0.5772	$0.2459
Unloading—Quantities—Cu. yds.	110,291	119,280
Operation, cableways and cranes	$0.1146	$0.0630
Power	.0151	.0321
Maintenance of equipment	.0839	.0806
Plant arbitrary	.1620	.1045
Total	$0.3756	$0.2802
Rail Transportation to Storage—Quantities—Cu. yds.	41,934	119,235
Operation of trains	$0.0707	$0.0469
Repairs to tracks	.0159	.0249
Dumping in storage		[illegible]
Maintenance of equipment	[illegible]	[illegible]
Plant arbitrary		[illegible]
Total	[illegible]	[illegible]
Division expense	$0.0099	$0.0185
Total cost in storage	$1.8017	$0.9038

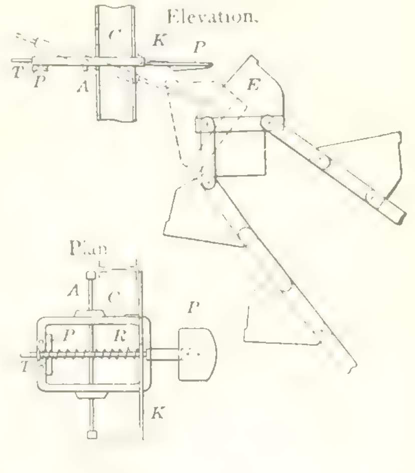
TABLE I.—COST OF EXCAVATION BY DREDGING, ON THE PANAMA CANAL, FOR JANUARY [illegible] MARCH, 1911.

Items.	—Atlantic Division— Quantities, cu. yds.	Unit cost	—Pacific Division— Quantities, cu. yds.	Unit cost
Pipe lines	423,427	[illegible]		
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	.0021	1,314,480	
Operation [illegible]	[illegible]	[illegible]	720,210	$0.0453
Repairs seagoing [illegible]	[illegible]	.0161	720,210	.0155
Operation ladder dredges	232,950	[illegible]	408,268	.0535
Repairs ladder dredges	[illegible]	[illegible]	408,268	.0507
Operation dipper dredges	147,298	[illegible]	186,002	.0778
Repairs dipper dredges	147,298	[illegible]	[illegible]	.0523
Operation pipe line dredges	423,427	[illegible]		
Repairs pipe line dredges	423,427	[illegible]		
Operation tugs, clapets and scows	380,248	.0750	594,270	[illegible]
Repairs tugs, clapets and scows	380,248	[illegible]	[illegible]	[illegible]
Drilling	133,202	.0246	82,381	.0696
Blasting	[illegible]	[illegible]	82,381	.1778
Operation drill barges	[illegible]		82,381	.1420
Operation rock breakers	....		82,381	.0765
Small boats	1,367,235		1,314,480	.0030
Repairs miscellaneous [illegible]	[illegible]		1,314,480	.0157
Plant arbitrary	1,367,235		1,314,480	.0881
Division expense	1,367,235	[illegible]	1,814,480	.0054
Total division cost	1,367,235	[illegible]	1,314,480	$0.2653
Administration and general expense	1,367,235		1,314,480	$0.0213
Total cost	1,367,235	$0.2409	1,314,480	$0.2866
Earth excavation, per cent	[illegible]	90.26	1,232,099	93.73
Rock excavation, per cent	[illegible]	[illegible]	82,381	06.27

Device for Emptying Dredge Buckets.

A device for clearing the buckets on a ladder dredge is shown by the accompanying illustration. It is the design of a French engineer by the name of Delvaux, who describes the device in the *Engineering and Mining Journal*. The material excavated is frequently clayey and sticky and the buckets become clogged and do not discharge when revolving around the top tumbler; the same load thus goes round and round, and the output is practically reduced to nothing. In such cases it is necessary to stop the bucket chain, even several times an hour, and have men with shovels clear the buckets. The device installed has in some instances increased the output by fully 50 per cent.

It consists of a steel shovel, *P*, riveted on a stem *T*, which is carried on a frame *C*, through which it can slide. The frame *C* is mounted on an axle *A*, held in two bearings which are attached on the vertical girders of the main framing. An adjustable cross bar *K* is also attached on the girders and makes the stop for the oscillation of the shovel. The frame is fitted with a weight *P*, which counter balances the shovel. The shovel, being in the horizontal position shown on the sketch, enters the bucket *E* near the lip; the shovel



Device for Emptying Dredge Buckets.

forces its way through the material which fills the bucket, and is thrown downward (as shown in dotted lines) by the motion of the bucket chain, thus clearing the bucket. As soon as the forward end of the shovel is clear of the bucket [illegible] brought [illegible] to the original position, ready for the following bucket. Although this return could be theoretically effected through the balance weight alone, it has been found useful in practice to keep one man on watch and to help the shovel frame on the return stroke. If a boulder comes up in one of the buckets, the shovel recedes, the stem sliding back through the frame, and is brought again in position through the coil spring *R*. The device is, of course, only suitable for open connected buckets.

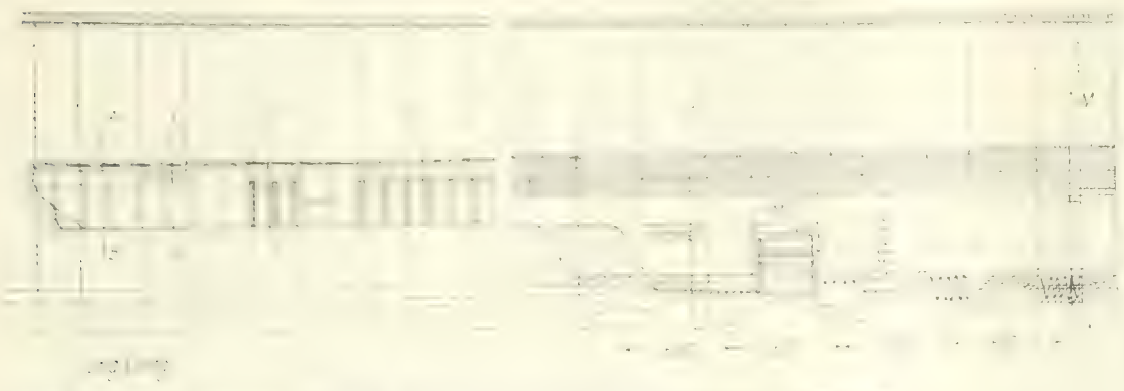
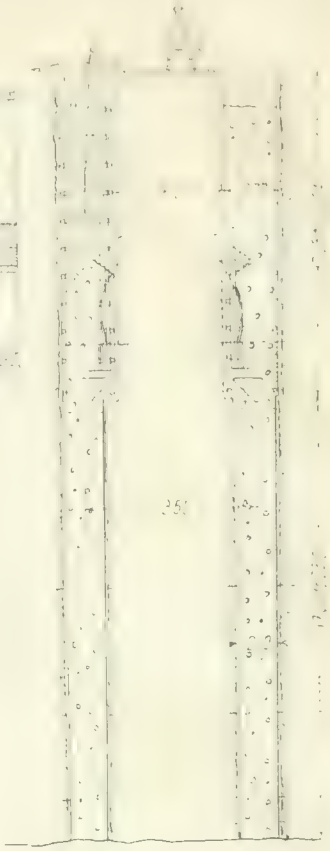



Fig. 1—General Sections Showing Method of Constructing Passenger Subway on Concrete Piers, Paris, France.

Method of Constructing a Section of Passenger Subway on Cylinder Piers, Paris, France.

A portion of the Paris Metropolitan Railway, comprising some 320 m. (1,050 ft.) of double track subway and a two track station and approaches, is founded on concrete piles or cylinder piers sunk by methods closely resembling those employed in Chicago in recent years for building foundations. Altogether 220 piers were sunk to depths from 25 m. (82 ft.) to 35 m. (115 ft.) below street level. The main line subway structure is a full centered concrete and masonry arch, with side walls and invert, with a row of piers under each side wall. The station and approach are twin tunnel structures with a row of piers under each side wall and a third row under the center or dividing wall. An explanation of [illegible] main line construction will explain also the station and approach work.

Referring to the drawings, it will be seen that a reinforced beam in one piece with the invert and reaching across track is carried on each pair of piers. Between the piers of each row are connecting arches. These transverse beams and longitudinal arches form a skeleton or framework platform connecting the tops of the piers. The whole structure, piers and platform together, constitutes a supporting viaduct for the subway structure proper, the invert proper of which closes the openings in the framework platform and makes it a solid slab. The other structural features will be understood from the drawings alone. The following description relates to the methods of construction only.

The piers were sunk from the street surface as shown by Fig. 1, the street being appropriated for construction purposes and a narrow gage railway being laid along it. Down to a point below the invert structure the piers were made rectangular and 2.4x2.7 m. (7.87x8.86 ft.); below this point they were made cylindrical and from 2 m. (6.56 ft.) to 2.5 m. (7.7 ft.) in diameter, depending on location. The pits or wells were excavated by hand, the material being hoisted by windlass and bucket and the timber curbing being carried down as the excavation progressed. The only novel feature of the excavation was the ventilation of the wells. Ventilating mains were laid along the street, from which branch pipes extended to and down the wells; electric fans on the mains gave the necessary air circulation. The wells ranged from 30 to 42 m. (98.4 to 136.8 ft.) in depth and it required an average time of 6 weeks to sink a well.

The wells were concreted by means of a vertical chute, the circular curbing being removed as the filling progressed. When concreting reached the rectangular portions of the piers the reinforcement as shown was placed and also the form work which shaped the inner sides of the subway structure. The concreting was then continued, as clearly shown by the drawings.

The piers being completed, the next step was to drive a heading as indicated by Section A B, Fig. 2. This heading was then widened and the sections of arch ring between piers were built as shown at E F, Fig. 2. Next the intervening sections of arch ring were built with haunches resting on the ground as shown at G H and I J, Fig. 2. Sections K L and M N show the succeeding processes, which completed the structure. The construction was accomplished without any serious difficulty.

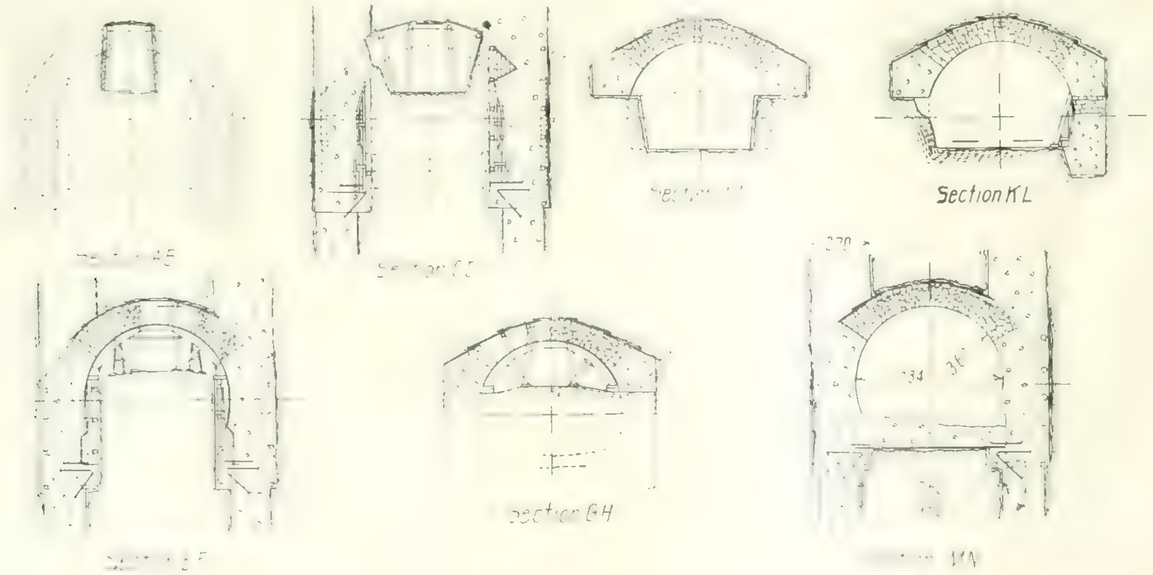


Fig. 2—Sections Showing Sequence of Operations in Excavating and Concreting subway Structure Built in Paris.

A New Auto Traction Rock Drill for Drilling Holes Without Changing Steel.

The development [illegible] drill and pump [illegible] an important step in rock excavation efficiency. For some time past there has been no important change in rock drills themselves. Mechanical details have been bettered, air consumption and repair costs have been decreased, and cutting speed raised. The chief source of inefficiency has been the loss of time in changing drills and in shifting the drill and its mounting from one hole to another. The main feature of the Auto Traction drill is the long feed arrangement for saving the time of changing steel. Another feature hardly less important, is the "pump steel" arrangement by which the motion of the drill steel is used to throw the cuttings out of the hole. The following is a detailed description of the development and work accomplished by the machine arranged from an article [illegible]

Economical rock excavation requires the drilling of deep holes of large diameter, to accommodate heavy charges of explosive. These holes, in current practice, range in depth from 15 to 50 ft., and from 3 to 5 ins. in diameter at the bottom. They are drilled principally with large tripod drills, from 3⅝ to 5½ ins. in cylinder diameter, with a derrick or tripod of wood or pipe to handle the heavy steel, as shown in the cut on this page.

Three difficulties arise in using machines of this pattern. They are cumbersome and hard to move from one hole to another. Much time is lost in changing drill steel, since th[illegible] ft.; the deep holes are hard to keep free from mud and sludge, so that the force of the drill's blow is partly lost by cushioning on mud instead of striking fresh rock at each stroke. The result of these handicaps is that a comparatively small proportion of the total working time is spent in actual drilling.

Two of these difficulties, those of transportation and of changing steel, have been solved by the use of traction well-drill outfits or churn drills. These machines have been employed with some success in railroad work in Pennsylvania and in the Canadian Northwest, on the Panama Canal, and elsewhere. The difficulty of cleaning the holes persists in this type, and is a considerable impediment to efficient work.

It was with these considerations in mind that Mr. C. H. Locher, of the engineering firm of Grant, Smith and Company and Locher, undertook, about two years ago, to devise a blast hole driller more rapid and efficient than any machine then available.

Grant, Smith and Company and Locher are contractors, under the United States government, for the excavation of the Livingstone Channel, in the Detroit River, between Amherstburg, Ontario, and Grosse Ile, Mich. This channel will be 300 ft. wide and about one mile long, with a normal depth of water of 21 ft. The area was first enclosed by cofferdams and pumped out, then steam shovels and traveling cableways removed the overburden in the usual manner, leaving a rock cut to be made from 12 to 20 ft. in depth. It may be mentioned in passing that this area was drained in record time by an invention of Mr. Locher's. A battery of air lift pumps was constructed by means of long sections of 8-in. pipe laid side by side at an angle of about 45 degrees and reaching from the bottom of the water over the edge of the cofferdam. These were connected with air piping, compressed air turned on, and the water fairly blown out of the enclosure.

The walls of this rock cut are being channeled in one or more lifts, as occasion requires, by two Sullivan steam driven channeling machines, and two 8-in. channelers of another make. The rock between is then drilled by 3¼-in. tripod drills driven by air, and broken by blasting to sizes suitable for the shovels and conveyors. With these drills, an average 8-hrs.' work, including all delays, moving from hole to hole, is about 40 ft. of 3-in. hole. The rock is a soft limestone, turning to dolomite with depth, and easy to drill, except for the presence of joints and seams, which tend to throw the holes out of alignment and make proper "mudding" or cleaning of the holes rather difficult.

The machine which Mr. Locher has invented to replace the tripod drills, is shown by Fig. 1. It consists of a vertical standard or carriage, carrying a rock drill cylinder attached to a heavy iron block, which is suspended in guides or ways over 20 ft. in length by a steel cable, which passes over a sheave and is alternately paid out or taken in, as needed, by a hoisting drum. The standard and hoist are mounted on a steel wagon truck. A two-cylinder reversible engine provides power for the hoist and for moving the outfit from place to place, by [illegible] rear wheels, above which the standard is mounted. The front wheels swivel to permit steering. The truck carries an air reheater or a boiler as required, and jackscrews are provided at the rear end for taking up motion while drilling is in progress.

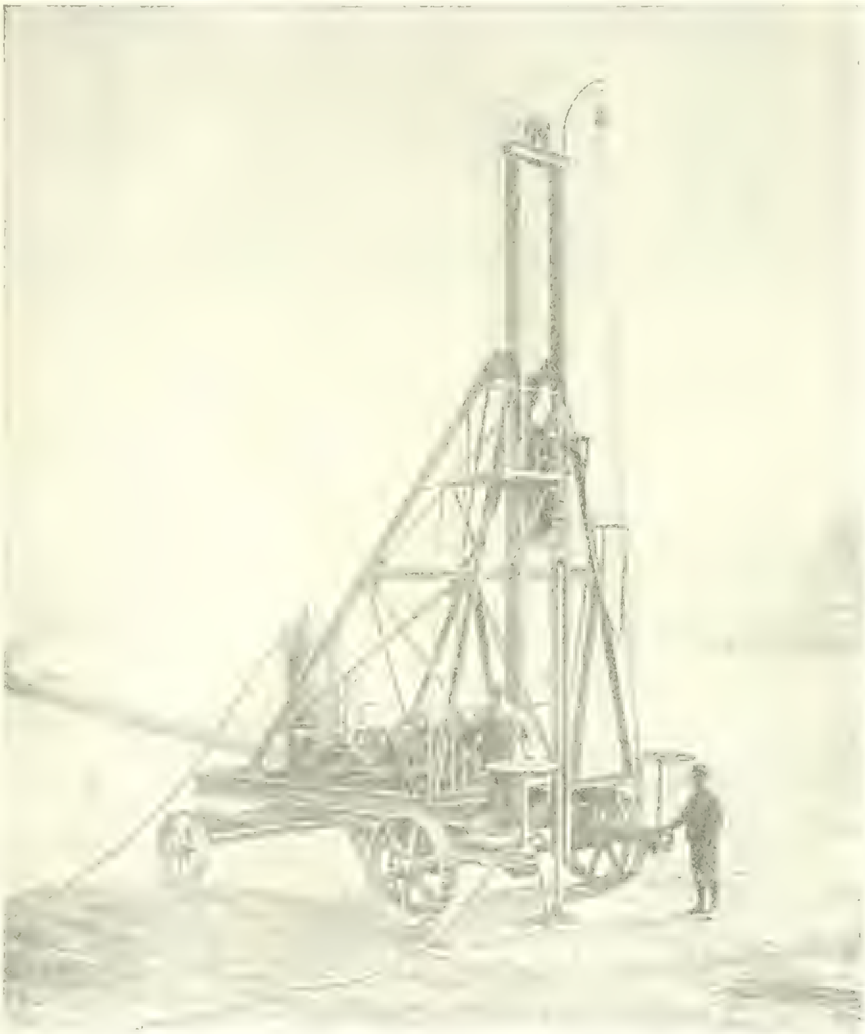


Fig. 1—View of Auto Traction Drill for Drilling 5 in. Holes 50 Ft. Deep.

[illegible] holes is accomplished by an entirely new device, which will be described before telling the nature of the performance done with this outfit or explaining its details of construction.

The extraction of cuttings from the hole as the depth increased in this blocky formation was the chief difficulty encountered with tripod drills. This was due not only to the broken condition of the ground, but seams were often encountered which led to the opening made by a previous blast, so that it was practically impossible to properly "mud the hole." After many devices and special kinds of steels had been tried without success, the idea of using the movement of the drill steel for direct pumping suggested itself, and upon trial gave good results. The scheme employed for this purpose consists of an ordinary drill steel, cruciform in section, over which is shrunk, a tube, Fig. 2. The bottom end of this tube is made in the form of a cage, carrying four ⅝-in. steel balls, which act as valves. When the drill steel is thrown forward, these balls are raised from their seats by the resistance of the mud in the bottom of the hole, and a quantity of the sludge is thus thrown above them. When the steel lifts, these balls are naturally dropped to their seats, thus preventing the entrapped sludge from escaping, and the rearward stroke of the drill is sufficient to throw the cuttings out of the top of the tube, where they are deflected downward by a saucer shaped plate securely fastened to the shank of the steel.

Difficulty was at first experienced in securing the tube to the drill steel. This, however, has been largely overcome by rolling the steel with corrugations into which the tube is rolled by a special process. The valve cages are then inserted in openings cut in the lower part of the tube directly opposite the grooves in the steel, and are held in position against unintentional displacement by an outer sleeve. With this device no difficulty was encountered in cleaning the hole of cuttings and even in broken ground little trouble was experienced in keeping the bit free.

When drilling with this arrangement, it is absolutely necessary to have a good stream of water running into the mouth of the hole. To prevent the cuttings from finding their way back into the hole, it is customary to use old sacks, held in place about the mouth of the hole, by stones. To clean the hole after it has been drilled to the required depth, preparatory to loading for firing or to regain [illegible] a cushion provided for this purpose. It will [illegible] without striking either head, and thus pump [illegible] the [illegible]. This system of drilling has been patented by Mr. Locher in both this and foreign countries.

The drill as it stands today was not perfected all at once. It is the third of this kind which has been built to Mr. Locher's plans. The first rig was built of heavy timbers and carried a drill 5 ins. in diameter, in guides providing a travel or depth of hole of 8 ft., without changing steel. This served its purpose admirably, for it demonstrated that an arrangement of this kind was practical.

In drilling to the required depth, however, two changes of steel were needed for each hole, and the time required to make the changes was found to be a large percentage of the total consumed in bottoming each hole. It was further more found that by drilling larger holes a given amount of rock was broken to steam shovel size with fewer lineal [illegible] of drilling, and that there was a marked saving in the amount of powder used.

In spite of these handicaps, this first machine, crude as it was, worked steadily for several months, and made some interesting records. On one occasion, 29 ft. of 3-in. hole were drilled in 55 min., including 4 moves, occupying about 45 sec. each. In an hour's run [illegible] drill steel and low air pressure, 37 ft. 3 ins. of hole were drilled, with 5 moves. [illegible] 3 holes were drilled 6 ft. 2 ins., 7 ft. 2 ins., and 7 ft. 2 ins. deep, and the rig was moved 3 times. The first of these 3 holes was drilled in 5¼ min. Moving, from the time one hole was finished, until the next was started, occupied just 2 minutes.

This success led Mr. Locher to design and build another machine of more substantial construction, with a 14-ft. feed, on which was mounted a Sullivan "UM" drill, with a piston 7 ins. in diameter, capable of drilling holes to the required depth with a 5-in. bit. With this machine remarkable work was accomplished, and a drilling speed of 12 ins. [illegible] hr. shifts and put in 3,282 ft. of holes, averaging 11 ft. in depth. This gives an average speed of 117.2 ft. per shift, of holes 5 ins. in diameter, as compared with 39 ft. per shift for the 3¼-in. tripod drills, drilling 3-in. holes as mentioned above. So that the auto traction drill actually put in three times as many lin. ft. of holes as the tripod machines, and these holes were nearly three times as large in area as those bored by the old type of drill.

The 28 shifts included 31 hrs. of lost time, moving away from shots, changing water lines and other delays caused by limited space, low working faces, etc. Seventy-five feet were drilled in 3 hrs., 165 ft. in 7½ hrs., and 145 ft. per day for 5 consecutive 8-hr. shifts.

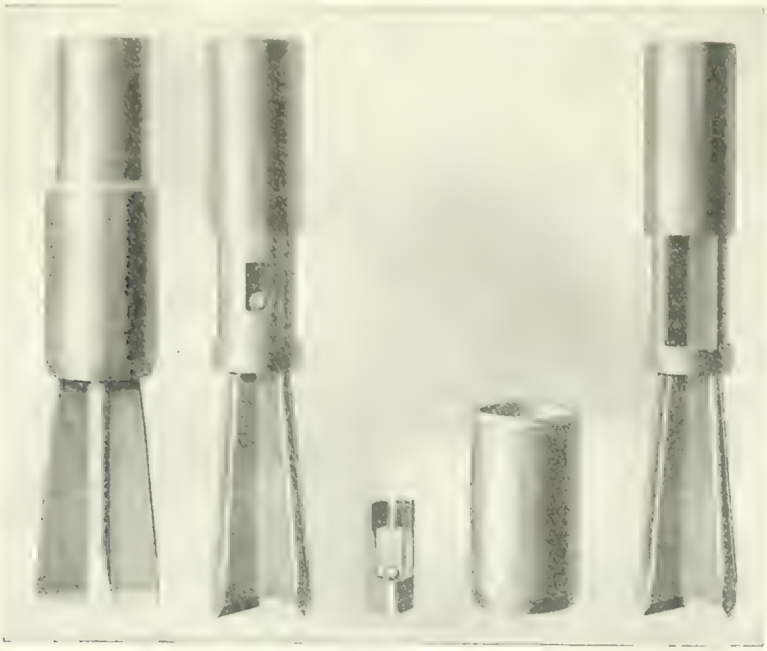


Fig. 2—View of Pump Steel Used With Auto Traction Drill.

From left to right: (1) steel complete, (2) with outer casing removed, (3) cage, [illegible] (4) casing, (5) steel with cage, ball and casing removed.

It may be noted at this point, to emphasize the economy in time of long runs without changing steel, that a Sullivan 3⅝ drill, mounted experimentally on a quarry gadder standard, bored 594 ft. of 3-in. hole in 6 days. The length of the standard permitted holes 6 ft. deep to be drilled without change of steel. The machine was new and the men unused to handling it. Both this and the auto traction drill records mentioned above, were made with the use of the pump steel. The following detailed record shows the saving in time accomplished by the use of the pump steel, and by increasing the length of the feed:

On October 26, 1910, two sets of records were taken. The first was made with a Sullivan 3⅝-in. drill, mounted on a gadder frame, with a small hoisting engine to raise and lower the steel, and pump steel. The leads permitted holes to be drilled 6 ft. deep without changing steel.

Hole No.	Depth, ft.	Changing Steel, Min.	Drilling, Min.	Total, Min.
1......	8	6	12	18
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3......	8	5½	9	12½
4......	8	4	12	16
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total ...	38	18½	51½	70

Six holes were then put in by the same drill, using regular steel, and pumping the holes by hand. The regular feed screw, 2 ft. long, was employed, so that the steel had to be changed once in 24 ins.

Hole.	Depth, ft.	Drilling, Min.	Total Min.
1..................	8	14½	42
2..................	8	24	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	18½	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Total	46	126	225

*Bad hole.

The time for moving from hole to hole was not considered in either case. It will be noted that if the length of feed in the first record had been 8 ft. instead of 6, 18½ min would have been saved in drilling 38 ft.

It will be seen from these two records that with the pump steel and long feed, the rate of drilling was 1 ft. in 1.35 min., with the regular steel and usual feed (ordinary tripod drill methods) 1 ft. in 4.89 min. That is, with the same labor and in the same time the improved method accomplished 3.62 times as much work as the old or standard method.

In the summer of 1910, work was encountered which necessitated the drilling of holes to the depth of 20 ft. Mr. Locher decided to have built a new machine incorporating all the features which were found to be advantageous in the earlier machines, including a vertical range of feed for the drill exceeding 20 ft., and capable of drilling 5-in. holes at the rate of 12 ins. per minute in the limestone of the Livingstone Channel.

The order for this outfit was given for execution to the Sullivan Machinery Company, and the machine was delivered late in the fall of 1910.

The 50-ft. Drill.—This outfit is capable of drilling holes to a depth of 50 ft. The mounting is arranged to move backward or forward at a speed of 20 ft. per minute. The hoisting speed for raising the drill and weight is 30 ft. per min. The rig stands about 31 ft. high, is 21 ft. long and 12 ft. wide, and weighs 33,000 lbs.

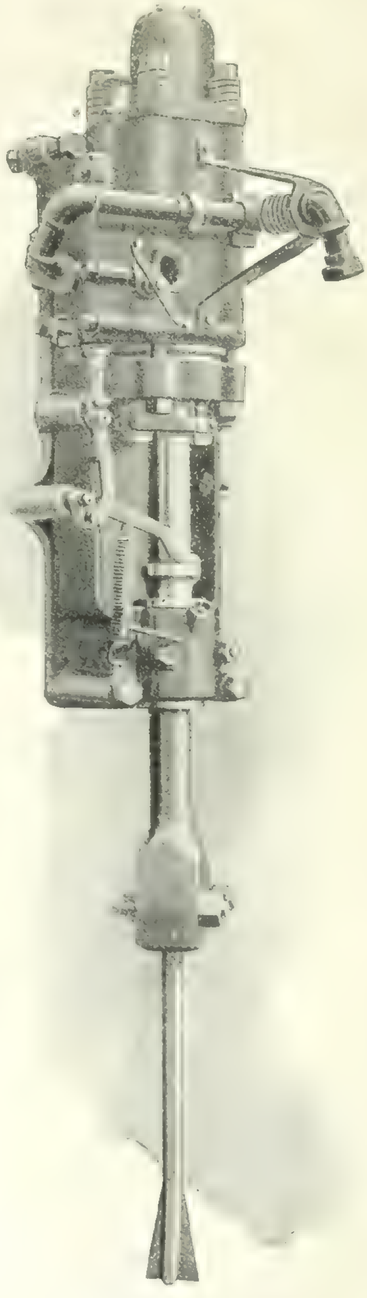


Fig. 3—View of Sullivan "U. M." Drill Designed For Use on Auto Traction Drill.

The horizontal frame, built entirely from structural steel, is mounted upon four wide-tread steel wheels, those in front being swiveled for steering, while those at the rear are on a fixed axle. A drive shaft, geared direct to the engine through jaw clutches, carries two small sprockets on either side which are connected by [illegible] chains to the larger sprockets secured to the rear or driving wheels for moving the outfit. Directly over the rear wheels is the vertical standard, composed of channel irons, securely braced to the frame of the machine and serving as a guide for the drill. Forward of this, mounted upon the frame, is the hoisting and propelling mechanism with its two cylinder, reversible engine, while over the front wheels is mounted an air reheater, through which the compressed air passes to supply both the engine and drill. It will thus be seen that the greatest weight is directly over the rear drive wheels. Jack-screws are provided at the rear of the frame, which may be set down upon the rock to give the entire machine stability in a lateral direction while drilling is in progress.

The feeding of the drill is accomplished entirely by a suspended weight, to which the drill cylinder is bolted and which provides stability for it. A slow retrograde movement of the hoisting drum for lowering is given by worm gearing, while the hoisting is accomplished by a train of spur gears which connect the main shaft of the engine, through a jaw clutch, with the hoisting drum. An automatic locking arrangement is provided between the hoisting drum and its gear, which prevents any possibility of the drum slipping. With the worm gear in mesh, both hoisting and lowering may be accomplished on the slow speed, while with the spur gears, the drill may be hoisted only. No brakes of any description are employed and the speed at which the various devices operate is controlled entirely by the engine throttle. The engine runs continuously while the drill is being fed at any desired speed. Every movement of the entire machine is controlled by a bank of levers from the operators' platform at the rear, and located in such a way that each is accessible and convenient for the operator. One of these levers controls the power steering mechanism, by which the course of the outfit is directed when in motion.

When starting a hole the drill steel is guided by a hinged clamp fastened to the lower end of the standard, and through which the drill rod reciprocates. After the steel has cut to a depth slightly over the length of its stroke, this clamp is disengaged and swung out of the way, where it remains until the hole is bottomed.

A davitt, with block and tackle, at the top of the standard, provides for handling the long lengths of drill steel, in connection with a winch on the main shaft of the hoisting engine.

The drill proper used with the auto traction drill is an entirely new development in rock drill practice. The cylinder is seven inches in diameter, with a piston stroke of 8⅝ ins. Important changes have been incorporated in it to handle the heavy lengths of steel, and to secure at once, speed, economy of power, and adaptability to the rock and other working conditions. It may be described as a combination of the standard drill and the chopping engine of the Sullivan direct acting channeler, which has been in satisfactory use for many years.

The channeler valve and piston motion have been adopted, to secure economy, by using the air or steam expansively. The main valve is air-thrown, but is controlled by a reverse valve mounted on the stem of a cut-off valve, which in turn is actuated by a lever in direct contact with the piston, so that the point of cut-off and the length of the stroke may be automatically regulated. Corliss valves in the exhaust ports provide a cushioning effect and prevent damage to the cylinder head in case the drill should run into a mud seam or pocket.

The usual method of rotation is employed, except that instead of boring out the piston to make provision for the rifle bar the rifle bar is made a part of the piston proper by cutting the flutes upon a projection from the rear of the piston head. To eliminate cylinder wear, a guide bearing for the rod is provided by an extension from the cylinder proper, carrying a removable bronze bushing through which the piston rod reciprocates. This is one of the most valuable features about the machine, as it reduces cylinder wear to a minimum. This wear would otherwise be very pronounced when handling the long lengths of steel.

The drill is lubricated by an automatic oiling device, located in the upper head, controlled by the pulsations of the air in the cylinder. The chamber holds about one quart

ROADS AND STREETS SECTION

Details of Construction and Cost Data on Quarrying for the System of Oil Macadam Roads of Los Angeles County, California.

In 1907 an act was passed by the Legislature of California providing for the improvement of the main public highways in any county. Under the terms of the act counties were allowed to vote bonds to pay for such work. Los Angeles County at once took advantage of this act, and the supervisors appointed a county highway commission to have charge of the construction of a system of improved highways. Preliminary surveys or reconnoissances were made covering 409½ miles of road, the estimates for construction of which system totaled $5,380,160, or an average of $13,135 per mile. The engineering expenses incurred in making the preliminary surveys and estimates on this 409½ miles of road amounted to $21,364.15, including expenses of highway commission and office. This is .39 of 1 per cent of the estimated cost of the 409½ miles.

The original idea of the promoters of the county system was that 300 miles of road could be constructed for $3,000,000. In order to keep as near as possible to the original plan of the good roads advocates, reductions were made in the quantity and quality of work anticipated, bringing the estimate down to 306.99 miles of road, at an estimated cost of $3,554,174. The county officials decided to call an election to vote on the issuance of $3,500,000 of bonds for the construction of the 306.99 miles of road. The officials assumed, correctly by the way, that the premium on the bonds would account for the additional $54,174 in the estimate. On July 30, 1908, an election was held and the electors of the county authorized a bond issue of $3,500,000.

The sum of $1,100,137 from the sale of the first block of the Good Roads Bonds became available in February, 1909, but during that year very little actual road construction was undertaken or accomplished. At the time of beginning construction work there were no crushing plants in the county with facilities for furnishing rock at any extensive rate of delivery, and for this reason the first year construction work was very light. Accordingly the county officials decided to develop their own supply. In November, 1909, a contract was let for the construction of a rock crushing plant on property owned by the county at Pacoima. This plant began operations in April, 1910. During the month of June following the plant got under good headway and a night shift was put on. This plant during the six months, July-December, 1910, produced and shipped 144,793 tons of crushed rock. With this source of rock supply it was possible to secure a continuous delivery of crushed rock, and as a result the major portion of the construction work to Dec. 31, 1910, was accomplished during the last six months of that year. At the end of 1910 of the 307 miles of macadam highways authorized at the bond election, there had been turned over to travel 76.33 miles of oiled macadam; in addition 14¼ miles of finished grading, bridges and tunnel had been completed. The total mileage constructed or advertised at the end of 1910 was 170.32 miles. It is now expected that the entire undertaking will be completed during 1912.

ORGANIZATION [illegible]

The organization of the Highway Commission and its employes is shown graphically in the accompanying diagram, Fig. 1. The chief engineer is in charge of all construction, office and engineering work. He is the executive representative of the commission and is responsible for the selection of all employes of the organization and their work.

The engineering organization is made up of three main departments: The office department, in charge of the assistant chief engineer, Pacoima Quarry department in charge of the quarry superintendent, and the construction department, in which the several assistant engineers in charge of the construction division report directly to the chief engineer, as does the superintendent of the Pacoima Quarry.

The work of the office department includes all surveys, and the preparation of all plans, specifications and estimates of costs. Where new right of way is required, this department prepares the deeds and secures the necessary signatures of property owners. This department also has charge of tests of materials being used in construction, the tests being made by private testing laboratories.

In July, 1910, the cost and clerical division was created and placed under the direction of a chief clerk, who reports to the assistant chief engineer. All bookkeeping, accounting and other general clerical work has been centralized in this division. A very complete system of bookkeeping and cost keeping under the most modern methods has been installed and all of the old accounts reconciled with the books of the county treasurer. This department has charge of all purchases, also handles the collecting and compiling of cost data, the preparation of statistical reports, the caring for and accounting for property, and the checking of all freight bills. One of the most important functions of this division is the distribution of rock and oil and checking the freight and purchase bills for the same.

The construction department is divided into three construction divisions, each in charge of an assistant engineer, who is responsible for the proper execution of all contracts and force account work, and makes all progress and final estimates for payments to contractors. Reporting to each assistant engineer are his inspectors, who are permanently stationed on the work to see that all the provisions of the plans and specifications are complied with and to report on the progress and cost of the work. As surveying parties are needed to set construction stakes, they are assigned to the assistant engineers and work under their direction. The number and classification of the employes of the Los Angeles County Highway [illegible]

No.	Classification.	Salary.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
1 General inspector (until Feb. 1 only).	
[illegible]	[illegible]

the heaviest rollers. The rock and screenings [illegible] readily, forming a hard, rigid road.

The rock has been taken from two quarry openings, the larger one of which has a face [illegible] ft., with a height varying from 20 to 85 ft., while the smaller or auxiliary quarry has a working face of 110 ft. in length and from 20 to 50 ft. in height. [illegible] amount of waste [illegible] down in the quarry, partly from the stripping mixed with the surface rock and partly from seams. The rock is cleaned of muck as it is loaded by stone forks into the cars at quarry face, the accumulated muck being removed with Fresnos between shifts.

Fig. 1—Organization Diagram for Los Angeles County Highway Work, Dec. 31, 1910.

1 [illegible]	[illegible]
1 [illegible]	[illegible]
2 Roller engineers (part time), per day.	4.00
1 [illegible]	[illegible]
1 Chauffeur, per month..................	100.00
Pacoima Quarry:	
1 [illegible]	[illegible]
1 [illegible]	[illegible]
1 [illegible]	[illegible]
1 Machinist, per month..................	125.00
1 [illegible]	
1 [illegible]	
Blacksmiths, Miners, Laborers, etc.	
1 [illegible]	[illegible]

ROCK SUPPLY.

The total amount of rock received from all sources to Dec. 31, 1910 was 327,702 tons. Of this amount 63,489 tons were received prior to June 30, 1910. The sources of supply have been: San Dimar, 18,337 tons; Pacoima, 173,018 tons; Riverside quarries, 89,883 tons; other sources, 46,464 tons. The Pacoima quarry is owned and operated by the county, and the San Dimas quarry property is owned by the county and operated under a lease by which the lessee furnishes the county 1,200 tons of crushed rock per day [illegible] quarry.

[illegible]

Pacoima.—This quarry is located at Pacoima, on the Southern Pacific R. R., about 20 miles south of Los Angeles. The quarry site, containing 191.13 acres, was purchased by the Board of Supervisors at a cost of $23,891.25, and, on Nov. 8, 1909, a contract was let for the installation of a crushing plant having a capacity for an output of 500 tons per 8-hour shift. The Pacoima quarry is located in the side of a large butte extending from the floor of a level valley, and is advantageously situated less than ½ mile from the main line of the Southern Pacific R. R., with ample room for railroad yards, on an easy grade descending to the main line. The topography affords ample space for disposing of waste material.

The rock being quarried and forming the major portion of the hill is volcanic in origin, having been broken and shattered in cooling and later disturbances. This andesite rock is dark brown in color, considerably fractured, with weathered surface. [illegible] this rock is the fact that when quarried and crushed it fractures in cubical form, with sharp corners. It compacts and bonds very readily under rolling and is not crushed by

During the early operation of the quarry as many as three 3¼-in. air drills capable of drilling holes 24 ft. deep were used, during the day shift only. The number of drills was lessened as the quarry face increased in height, until at present one 3¼-in. drill is usually able to bring down all the rock necessary. The depth of holes ranges from 20 to 24 ft., about 70 per cent of them being drilled from the floor of the quarry as "lifters," and the remainder from the top. The holes are sprung from one to three times and charged by the powderman with from 100 to 300 lbs. of 40 per cent dynamite per hole, and fired in batteries of from one to ten holes at a time. Moisture in the hill prevents the use of black powder.

The rock is loaded into specially designed low 36-in. gage end-dump quarry cars, having 2 tons to 2½ tons' capacity, and a total height of 30 ins., which results in economy of labor in loading. The quarry cars are snatched by mule to main quarry line and thence in trains of ten cars are transported by a 5-ton electric locomotive a maximum distance of 400 ft. over trestle to tipple above crusher, where as soon as being uncoupled the cars dump themselves automatically and return by gravity [illegible] Dumping is [illegible] special automatic cross-over mine tipple and gravity switchback, all capable of dumping ten cars in 4 min., requiring but one man who handles a brake to control speed.

The rock is fed by one man into the No. 6 gyratory crusher, whence it passes through a preliminary 3-in. screen, the rejects being returned and crushed by the No. 4 gyratory crusher. The total product is conveyed by belt to final sizing screens over storage bins, being at this point screened into four sizes and stored for gravity loading into the railroad cars.

After a car is loaded for shipment it drifts over track scales by the office and continues to loaded yard below. The railroad yards are capable of handling 40 cars per day, which is frequently required on Mondays, when the product of three shifts must be loaded.

All requisitions for rock are telephoned daily by the construction clerk to the quarry, giving sizes and destination. The quarry clerk on the departure of rock trains mails the day's waybills and other daily reports directly to the main office and also mails to each contractor an advice stating the details of the day's shipments to his work.

The quarry is operated with two shifts, giving a capacity of practically 1,000 tons per day. For the period July 1 to Dec. 31, 1910, the average production for the entire six months covered was 902 tons per day, including time of shut-downs for minor repairs and waiting for cars.

The older storage bins have a height of 35 ft. above the railway track, while on the new addition to bins the height is 45 ft. They are made of heavy timber, crib construction, filled to the ground, and have side loading chutes. All machines have independent electric motor drives. The bunk house, office and plant are lighted by electricity, while the quarry face is lighted by means of 5,000-cp. acetylene portable lights.

An 18x11x12-in. 2-stage compressor furnishes air for drills, forges and cleaning motors. Dynamite and explosives are purchased under a yearly contract in carload lots and stored in an isolated reinforced concrete magazine.

During the six months' period it has been found that while this quarry furnishes a good average percentage of rock screenings, its output of this size has not been sufficient to meet the demands of the character of construction. To overcome this a high speed swing hammer impact pulverizer, fitted with manganese steel hammers and bars, with a capacity of 20 tons of screenings per hour, has been installed to reduce a larger quantity of rock to screenings. This will, it is believed, make it possible to more than treble the present percentage of screenings when desired.

The daily reports from the quarry show the distribution of every item of labor and material expended during the day and previous night, which is reconciled with the daily payroll, thus affording the office with a daily indicator of the expense on each item of the work.

The quarry location being isolated from a town or places of habitation, it has been necessary to maintain a large number of employes on the grounds. At present there is a permanent camp with well constructed buildings. The bunk houses will accommodate 140 laborers, all of whom can be seated at one time in the well lighted and ventilated dining room. The laborers are charged 25 cts. per meal or $5 per week, which is deducted from their wages of $2 per day of eight hours.

The boarding house is maintained by the commission. Supplies of good quality are purchased at wholesale prices in Los Angeles and the men are provided with good meals, which makes it easy to keep labor, and adds to their efficiency, in addition to the county making a handsome profit.

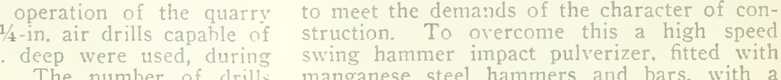


Fig. 2—Typical Cross-section of Oiled Macadam.

The following tabulations contain data on the operation of the Pacoima quarry for the period July 1 to Dec. 31, 1910:

The following table shows the output,

amount of powder [illegible] and power consumption for the six months' period:

	Total	Powder Lbs.	Power consumption K. W. hours
July	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]
October	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]
Totals and average	[illegible]	[illegible]	[illegible]

The total number of [illegible] worked from July 1 to Dec. 31 was 321, which is equivalent to 2,568 hours. The power consumption was 179,000 [illegible] an average of 69.7 k. w. hours [illegible] The average output per 8-hour shift was 451 tons, not deducting time for temporary shut-downs.

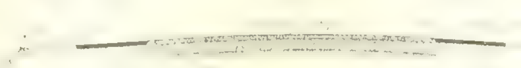


Fig. 3—Typical Cross-section of Oiled Macadam With 4-ft Oiled Shoulder.

DETAILS OF HIGHWAY [illegible]

Macadam.—The first contracts entered into for oiled macadam pavement work were on the lump sum basis. For the 1911 work, however, bids are received on unit price basis. The following description refers to the work done previous to 1911, the general details, however, differ very little from the present work. Extracts from the specifications under which the 1911 work is being done are given elsewhere in this article.

On the more important highways the roadway is graded 40 ft. in width in cuts and on fills, while on the less traveled lines the graded width is reduced to 30 ft.

The sub-grade is excavated and shaped with a proper grade and width; then cultivated, watered and thoroughly rolled until solid, soft spots being replaced with gravel or good material. The pavement is constructed with a maximum width of 16 ft., located in center of graded portion of right of way. In many cases this width is reduced to 15 ft. and in a few outlying districts it is proposed to reduce the width of pavement to 12 ft.

On each side of the paved portion of the road is constructed a thin oiled shoulder, from 4 to 7 ft. in width, to protect the edges of pavement and afford greater width of driving way.

The thickness of macadam varies from 5 ins. to 8 ins., according to the amount of travel. The pavement consists of a macadam road laid in two courses, thoroughly cemented and bonded before oiling the surface. The first or foundation course is composed of rock from 1½ to 3 ins. in size,* thoroughly rolled, with the interstices filled with screenings to within 1 in. of surface, leaving a good bond for next course of rock. The foundation course is rolled and bonded until a heavily loaded wagon will not displace the rock.

The wearing course, approximately 2 ins. in thickness, is composed of rock from ¾ in. to 1½ ins. in size,* which is thoroughly rolled, having the voids filled with ¼-in. to ¾-in. clean screenings. This course is thoroughly rolled and watered, leaving a true well bonded surface within ½ in. of finished grade. This surface must be finished in such manner that the screenings reach to the top of stone, but do not cover same or form pads or cemented patches over the surface. The success of the road depends largely upon the uniformity of this surface, previous to oiling. Any irregular or cemented patches should be broomed.

When the surface has dried to a depth of 1 in. or more, and during the warm part of the day, heavy asphaltic oil or liquid asphalt is applied at a temperature of 212° F., being atomized or sprayed on the surface under pressure of from 30 to 50 lbs. per sq. in. This coat of oil is applied at the rate of 1 gal. per sq. yd.* Clean rock screenings are then uniformly spread over the surface to bond the wearing course and form a true surface barely covering the oil, with no excess patches. The surface is then thoroughly rolled and again oiled at a rate of approximately ⅜ gal. per sq. yd., and uniformly covered with a light coating of rock screenings under ¼ in. in size, in sufficient quantity to take up all oil, usually requiring two or more light applications of the screenings, after which it is rolled until it becomes hard and smooth, and is immediately thrown open to traffic.

Contrary to the older practice on oil macadam, no water is used for sprinkling the pavement after the first application of oil. The specifications permit the engineer at his discretion to vary the quantity of oil applied by a quantity [illegible] suit the class of rock being used.

On all new work advertised, the contractor is required to place a final "sealing coat" on the wearing surface after the road has been open to public travel for two months. This permits the surface of road to be toughened by travel. The coating consists of asphaltic oil or liquid asphalt, atomized under heavy pressure, applied at a rate of ⅛ to ¼ gal. per sq. yd., as surface requires, uniformly covered with very fine rock screenings and coarse sand, and rolled.

The earth or gravel shoulders are graded 1 in. below grade after being thoroughly cultivated, watered and rolled. A light application of ¾-in. screenings is then applied to barely cover the ground and hold the oil from running. This is oiled at the rate of ¾ gal. of oil per sq. yd. and again covered with ¾-in. screenings or gravel, and rolled. Following this a second application is made at the rate of ½ gal. per sq. yd., covered with screenings or sand, and rolled to grade.

This thin treated shoulder is not intended as a pavement but merely as a protection. On some soils it carries heavy travel quite well, while on other soils it is not so substantial. In [illegible] amount of travel on this shoulder it tends to disintegrate in time.

At frequent intervals transverse shoulder drains are placed along the work to afford drainage from the sub-grade to gutters, and on the worst adobe soils or uncertain foundations a substantial gravel sub-grade is placed under the macadam; a concrete foundation having been found necessary in a few exceptional cases.

The highways thus far constructed under this method and opened to travel are stated to have proved a source of great satisfaction both to the public and those in charge of their construction, and have caused many visits of inspection from engineers from various parts of the country. The lack of success of this class of construction in other places undoubtedly has been due in most cases to lack of uniformity and rigidity of road structure and the use of too much oil and oil of inferior quality. A number of the pavements have been open to travel for a sufficient length of time to demonstrate that they grow better by use, and in most cases the finished surface after long heavy travel is said to be more uniform and satisfactory to drive over than some new city asphalt pavements.

Application of Oil.—The experience of the highway commission with the many gravity oiling machines in use has demonstrated the absolute necessity for uniformity in the application of oil and that this is the leading essential of good construction. It has been found that few of the present gravity oilers are capable of applying uniformly a quantity as low as ¼ gal. of oil per sq. yd. and cover every particle of the road; also that the pressure in such oilers, being due only to the slight gravity head, is variable as the tank is emptied, which with change in temperature of oil results in considerable variation in rate of application. Frequently part of the openings will become clogged, leaving streaks in the work. It is also observed that the older oilers having a width of only 6 ft. reach but a short distance beyond the wide gage wagon being used, and unless the driving is perfect, wagon wheels will lap on edge of previously oiled strip and pick up, or the second course of oil will fail to meet the first by a few inches. The slightest defect, streak or irregularity in oiling shows up after the road has been open to travel a few months and starts trouble, even though much care is given to "bucketing" and hand application to cover defects.

During the past season's work a new type of oiler, applying the liquid asphalt in a fine [illegible]

---

*On 1911 [illegible]

[illegible]

[illegible]

TABLE [illegible]

[illegible]					1.50		1.52	2.9
[illegible]								9.0
[illegible]						2.12	2.12	
[illegible]						1.01		
[illegible]								
[illegible]					.14	.33	.15	
[illegible]								
[illegible]								1
[illegible]								12.8
Plant Operation:								
[illegible]							1.71	
[illegible]								
[illegible]								1.9
[illegible]								
[illegible]							1.25	
[illegible]		.17			.31			
[illegible]			.12					
[illegible]					2.16			3.9
[illegible]				.61				
[illegible]					3.82			
[illegible]								

[illegible] the remedy for the previous oiling troubles. During the latter part of the season a considerable number of these machines were in use by contractors who had voluntarily discarded the previous method of oiling. The machine is a local product, having been developed largely on the work by the inventor, the machine being known as "Ward's Liquid Asphalt Atomizer."

This machine consists of a light rig trailing on a substantial four-wheel truck, equipped with a small high class gasoline engine, direct connected through friction clutch to rotary pump, which draws the hot oil through a large steel flexible hose from wagon tank and forces it through distributing boot under pressure from 30 to 50 lbs., as desired, where it is atomized and forced into the surface of the road in fine film the width of oiler when applying even as small a quantity as ⅛ gal. per sq. yd. The roads or portions of roads on which this method of oiling has been used during the past season can now be easily picked out even by the casual observer by the density and uniformity of surface. The uniformity secured makes it possible to use a smaller quantity of oil, which is desirable in this class of work.

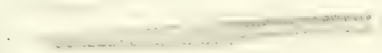


Fig. 4—Cross-section Showing Broken Stone Shoulder.

As a result of the past season's work, the specifications now require that all oil or liquid asphalt shall be applied with a machine which will apply the oil under pressure of not less than 30 lbs. per sq. in., and which is capable of perfectly coating every particle of the road with as small a quantity as ⅛ gal. per sq. yd. It is also required that the oil distributor shall have a width of not less than 8 ft. A temperature of 212° F. is required in applying.

Oil Used.—During the past season's work the oil has been secured under a 60,000 bbl. contract at a price of $1 per bbl. of 42 gals. f. o. b. contractor's refinery, Los Angeles, or $1.04 per bbl. in the county oil pit.

The specifications covering purchase require the following, in brief:

The oil to be a residuum of a natural oil of asphaltic base, uninjured by overheating. It cannot be manufactured by adding solid asphalt to natural oil or distillate. It shall not lose in excess of 1.5 per cent volatile matter when heated from ordinary temperature to 220° F. in the course of one hour and maintained at said temperature for 15 min. Deductions are made for water and sediment, and not more than two per cent of water and sediment is permitted. The residuum shall not contain in excess of two-tenths of one per cent organic matter insoluble in carbon tetrachloride at ordinary temperature. In case natural oil is submitted under specifications, it shall not contain in excess of 1.9 per cent of sulphur. The residuum shall not contain in excess of 2.5 per cent of sulphur. The asphalt requirement is as follows: "After being freed from water and other foreign matter, the asphaltic oil or residuum shall contain not less than 80 per cent of asphalt, having at a temperature of 77° F. a penetration of 80° District of Columbia Standard. The percentage of asphalt shall be determined by heating 25 grams of said oil or residuum in an evaporating oven at a temperature of four hundred degrees F. and maintaining it at this temperature until it has reached the proper consistency, when the weight of the residue shall be determined and the per cent calculated.

[illegible] the most part the highways are being constructed along [illegible] these roads follow old trails, along the lines of least resistance, with easy curves and grades, and without regard to rectangular subdivisions of land. The majority of the roads, however, traverse country laid out in valuable subdivisions years ago, and it often becomes necessary to follow sharp turns, in many cases right angles. At such points every effort is made to secure new rights of way permitting of easy curves at dangerous turns.

Where rights of way are of sufficient width and the angle is not too sharp, a satisfactory curve is secured by throwing the macadam pavement to the inside of the right of way as far as the obstructions will permit. In all cases an effort is made to remove obstructing trees or shrubbery, allowing a clear view at curves.

It has been observed on completed roads first laid out that the travel pulls across the inside of curves, destroying the light oiled shoulder which is not intended to carry traffic, and producing damaging results. In such cases the road section had been thrown as far to the inside of curve as considered practicable. While the law under which the commission is working limits the width of pavement to 16 ft., it was at once found imperative to widen the macadam at the more important curves as a measure of protection to the pavement and traffic. The macadam at such points is now being laid as follows:

The center line and outside of macadam is first laid out as far to the inside as practicable; a curve, not concentric, is then laid out for the inside edge of macadam, usually with a considerably longer radius than for the outside, in such manner that the inside curve gives somewhat the effect of a taper and its tangent points extend beyond the tangent points of the outside curve. The elements of the inside curve are determined by assuming the extra width of pavement desired or permissible at center of curve. On the work thus far, the increase in width on the regular macadam section varies from 2 ft. to 8 ft. Thus, on a 16-ft. road, when an extra width of 8 ft. is added on curve, the width of pavement varies from 24 ft. at center of curve to 16 ft. at the end of the taper beyond the ends of the original curve. The result is that accidents are avoided and the road surface preserved. Fig. 5 is a typical layout, showing the widening and super-elevation of macadam at curves. In the figure, R_1 = center line radius less half the standard macadam width

$$R_2 = R_1 + \frac{d}{[illegible]\ \text{Sec}\ [illegible]}$$

in which d is made to vary from 2 ft. to 8 ft. The amount of super-elevation and extra width of macadam on curves varies according to the radius of the curves and elements of danger.

Super-Elevation.—To further protect the surface of pavement against the side skidding of automobiles and to add to the comfort and safety of travelers, the macadam pavement is elevated on the outside of curve and depressed on the inside of curve, giving a slightly banked effect, tapering to a normal crown beyond the end of curve; the result being similar to that obtained on a properly super-elevated and tapered railway curve. While in the case of the railway curve the amount of elevation is established to give smooth riding at a given rate of speed, which is not departed from to any considerable extent by passenger trains; on the other hand, the interurban highway curve must be made to accommodate more varying rates of speed and a wide range in character of traffic. Therefore no fixed rules can be adhered to for super-elevating and widening highway curves based simply upon the sharpness of curve and speed. These elements must be arbitrarily determined in each case, dependent upon the importance of the highway, the probable speed and volume of travel, the obstructions to the view, and, most of all, upon the sharpness of the curve. Care must also be exercised in extreme cases that the bank on the outside of curve will not damage abutting property by an unreasonable fill, and that ample drainage can be secured from the lowest edge of the pavement on the inside.

In finishing the pavement, the crown must be thrown well outside of center of pavement and slightly flattened, it being a mistake to eliminate the crown altogether. While no fixed rule is being followed, on moderate curves the maximum super-elevation in the width of stone pavement has been rarely made steeper than 8 ft. in the width of 16 ft., or a rate of 0.5 ft. super-elevation per foot of width of macadam on bad curves. On easy curves this is decreased. A practical and easy riding entrance to the curve can best be laid out by the trained eye on the ground.

In one case on an important highway where the right of way makes a sharp angle of 68°, the macadam being laid with a center-line radius of 80 ft., actual tests since completion demonstrate that a speed of 30 miles per hour can be maintained with safety and comfort passing this point. This result is due to properly elevated and tapered curve, although the super-elevation is barely noticeable at first glance.

EXTRACTS FROM SPECIFICATIONS FOR MACADAM ROAD CONSTRUCTION TO BE USED DURING THE SEASON OF 1911.

Sizes of Broken Stone.—For all purposes in connection with these specifications, broken stone of various sizes shall be designated by size numbers as follows:

"No. 1 Stone" shall be used to designate broken stone of a size not larger than will pass through a 3-in. ring and not smaller than will be retained by a 1½-in. ring.

"No. 2 Stone" shall be used to designate broken stone of a size not larger than will pass through a 1½-in. ring, and not smaller than will be retained by a ¾-in. ring.

"No. 3 Stone" shall be used to designate broken stone of a size not greater than will pass through a ¾-in. ring and be retained on a ¼-in. ring, or sharp sand and fine gravel for shoulder work.

"No. 4 Stone" shall be used to designate rock screenings ¼-in. and under in size; it shall also include coarse, sharp sand or fine gravel of a quality acceptable to the engineer.

"No. 12 Stone" shall be used to designate a mixture of No. 1 and No. 2 stone as above defined, in proportions approved by the engineer.

Broken Stone Foundation. — After the subgrade shall have been prepared as heinbefore specified, a layer of No. 1 stone shall be uniformly spread to such a depth that after being thoroughly watered and rolled, the surface shall be 2 ins. below the surface of the finished pavement. All depressions shall be filled with broken stone of the same size and quality and re-rolled until a firm, even surface, with the required grade and cross-section is obtained.

After the broken stone foundation has been rolled until thoroughly compact and firm, No. 3 stone shall be uniformly spread over the surface in sufficient quantities to thoroughly bind the broken stone foundation to within 1 in. of the surface of same after rolling, leaving the top 1 in. of the larger rock exposed to form a bond with the wearing course.

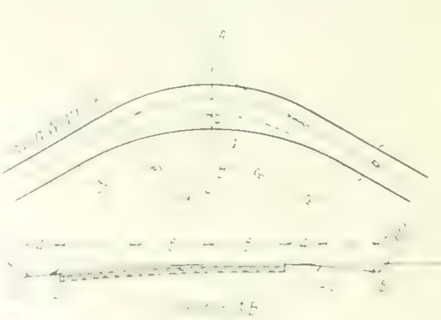


Fig. 5—Typical Layout, Showing Widening and Super-elevation of Macadam at Curves.

The surface shall then be sprinkled and rolled until the stone foundation shall not yield under the weight of the [illegible] wheels of a heavily [illegible]

When the sub-grade [illegible] such that it becomes desirable to place broken stone of a smaller size on the sub-grade to prevent the soil [illegible] the broken stone [illegible] at his discretion, permit the contractor to place upon the sub-grade No. 2 stone, in a layer not exceeding 2 ins. in thickness, before spreading the broken stone foundation above specified.

Wearing Surface.—A layer of No. 2 stone shall be evenly spread over the broken stone foundation, of such thickness that, after being thoroughly [illegible] shall conform to the [illegible] terial as this course, and again rolled until a [illegible]

One or more light applications of No. 3 stone shall then be uniformly spread over the surface and swept in with street brooms, in sufficient quantity to fill all voids remaining in the foundation course, and the wearing course of rock, after thorough rolling and watering. The No. 3 stone is to be applied in such manner that the [illegible] be open and free from screenings to a depth of ¼ in. to permit of free penetration of oils.

[illegible] ficient quantity to thoroughly bind the wearing [illegible] stone shall not extend more than ¼ in. above the larger rock after thorough rolling

The surface shall then be thoroughly rolled, followed by a coating of heavy asphaltic oil, uniformly applied at the rate of ⅜ gal. per sq. yd. of rock surface.

A light coating of No. 4 stone shall then be uniformly spread or drifted over the surface in sufficient quantity to absorb all surplus oil and produce a uniform surface with no oil exposed [illegible] The pavement shall then be thoroughly rolled until it becomes hard and smooth, true to grade and cross-section, and free from all hollows or irregularities.

The engineer may, at his discretion, and as required by the quality of stone being used, increase or decrease the total quantity of asphaltic [illegible] exceeding 30 per cent of the above total quantity, but shall not require the oil to be placed in more than three applications without extra compensation to the contractor.

Use of No. 12 Stone.—At the discretion of the engineer, No. 12 stone may be furnished to the contractor by the county for the construction of the broken stone foundation and wearing surface. In case No. 12 stone is to be used in the wearing surface, the surface of the broken stone foundation, after being thoroughly watered and rolled, shall be 3 ins. below the surface of the finished pavement, instead of 2 ins.

Oiled Shoulders.—The earth or gravel shoulder or border extending along the sides of the oiled macadam pavement, shall be finished and thoroughly watered and rolled to the form and width [illegible] way," and shall be sufficiently below the required grade to receive the final treatment of screenings or gravel. The surface of the shoulder shall then be thoroughly loosened or culti- [illegible] thoroughly watered and rolled to a true and unyielding surface.

Upon this prepared surface shall be immediately spread a thin course of No. 3 stone or gravel, sufficiently thin and uniform to hold the oil from running, but such stone or gravel shall not completely cover the surface. Upon this screened surface and before the shoulder has dried to a depth of more than 1 in. shall be uniformly applied heavy asphaltic oil, at the rate of ¾ gal. per sq. yd.

The No. 3 stone or gravel shall then be uniformly applied to cover and absorb the oil.

The surface shall then be lightly rolled and treated with a second coating of oil, applied at the rate of ½ gal. per sq. yd. of surface, lapping over approximately 4 ins. of the edge of the macadam pavement.

No. [illegible] spread over the surface to cover the oil and barely take up any excess oil, after which the entire surface shall be thoroughly rolled until solid.

When, in the opinion of the engineer, the soil conditions are such that an equally good surface can be secured, the thin screening of No. 3 stone or sand over the shoulder before the first application of oil may be omitted and in lieu thereof the watered earth surface shall be lightly harrowed to a depth of not more than 1 in. with a fine-toothed agricultural harrow, and the process of oiling and screening completed as above described.

The screenings and oil shall be placed on the shoulders at the same time that the wearing course of the pavement is being constructed, and the second coat of oil shall be placed on the oiled shoulder simultaneously with the second coat of oil on the [illegible]

Oiling.—The oil or liquid asphalt shall be applied by a spray or atomizing machine which must be subject to the approval of the engineer. The machine for applying oil must be of such construction that the oil will be spread uniformly over the surface of the road in any quantity per application from ⅛ gal. per sq. yd. to 1 gal per sq. yd. The oil must be spread or forced upon the surface of the road in such manner as to immediately cover every particle of surface when applying a quantity of oil as small as ⅛ gal. per sq. yd. The oil or liquid asphalt above the nozzles must be maintained at a uniform pressure during the application of the entire tank of oil, and such pressure shall not be less than 30 lbs. per sq. in.

The machine shall be provided with a transverse distributing cylinder of such length that it will spread oil over a width of road of 8 ft. in each course.

The heavy asphaltic oil used shall be applied at a temperature of not less than 212° F., nor more than 303° F. In case the oil has become cooled in transit from the county shipping point, it shall be reheated by the contractor at his own proper expense to conform to the above temperature requirement.

For heating oil, hot air coils or steam coils containing superheated steam shall be used, and in no case shall live steam or water be injected into or allowed to enter the oil after it has been received by the contractor.

No oil shall be applied until the surface upon which it is to be applied has dried to a depth of 1 in., nor until the weather conditions are favorable in the opinion of the engineer or his duly authorized representative. Before any tank of oil is applied, it must first be inspected by said engineer or representative to determine its quality and temperature.

All wagon tanks used for the distribution of oil shall first be submitted to the engineer, who will gauge and mark the capacity in gallons of said tanks and determine whether they are suitable for the proper distribution of oil.

The contractor shall use every precaution to prevent the waste of oil and it shall be used only in such quantity and in such places as herein specified.

When through carelessness, or from any other cause, the contractor has used a greater quantity of oil than herein specified, on any portion of the road, and when in the opinion of the engineer such excess of oil will damage the pavement, said contractor shall, upon notice from the engineer, excavate such portion of the pavement as deep as the oil has penetrated and rebuild the same in accordance with these specifications.

None but qualified men of experience shall be employed to operate oiling machines, and only skilled drivers shall be employed for drawing oil distributors. When in the opinion of the engineer such drivers handle the distributors in an unsatisfactory manner by overlapping or missing portions of the road surface in the application of oil, a power roller shall be used to draw the oil distributor.

At least 12 hours shall elapse between any two applications of oil over the same area.

Sealing Coat for Wearing Surface.—After the completion [illegible] contractor shall temporarily provide for the passing of public travel over same, providing proper entrances to same, in order to thoroughly season and toughen the surface of the road. During such time, any sticky spots of oil which develop shall be lightly covered with No. 4 stone.

After this travel has continued for one month, or longer if possible, the surface of the pavement shall again be closed to travel, and all dust, dirt or excess screenings thoroughly swept from the surface with head brooms or sweepers.

A final coating of heavy oil or liquid asphalt shall be uniformly spread over the surface of macadam pavement at the rate of approximately ⅛ gal. per sq. yd. of surface, the rate of application being varied as required by the condition of the road surface, as directed by the engineer.

[illegible] stone or fine gravel shall be uniformly spread over the surface in a quantity sufficient to cover same and take up any excess oil

The surface shall then be lightly rolled and screened again if necessary until it will not pick [illegible] travel.

[illegible] ing in the surface of the road previous to its final acceptance shall be remedied by the application of screenings or oil, as directed by the engineer.

It is the intent of this paragraph that the contractor shall not be required to delay the placing of the sealing coat on the last portion of the pavement built under his contract longer than the time required to finish and clean up the remainder of the work under said contract.

[illegible] the highway [illegible] is in charge of a commission, consisting of Geo. H. Bixby, M. C. Marsh and J. W. Calvert. A. E. Loder was appointed chief engineer of the commission in 1907. He made the preliminary plans and estimates, and has been in charge of the construction work since that time. We are indebted to the semi-annual report of the commission for the period ending Dec. 31, 1910, for the information from which this article was prepared.

Prize Competition for Plans.—The object [illegible] suitable plans [illegible] the construction of [illegible] crete bungalow and it is open to all architects, architectural draftsmen and others desiring to enter it. The bungalow is to be planned for a suburban lot with a north frontage of 73 ft. and a depth of 190 ft. The cost of the house, not including heating apparatus, plumbing, electric wiring or fixtures is not to exceed $4,000. Each design submitted must be accompanied by a brief typewritten statement of the materials and methods of construction proposed, cubic contents, and itemized cost based upon price of labor and materials in the vicinity of Chicago, Ill. The prizes offered are $200, $75 and $50. Full particulars can be obtained from the Cement Products Exhibition Co., Chicago, Ill.

Test of Waterproofed Concrete.—The test was made on an 18-in. cube by means of a 2-in. pipe molded into the concrete. The pipe was located at the center of one side and reached to within 5⅝ ins. of the face of the opposite. The concrete consisted of 1 part Portland cement waterproofed by the McCormick process, 2 parts torpedo sand and 4 parts ¾-in. crushed limestone. The proportion of water was 13 per cent of the total volume of materials. The block was aged for 28 days in the open air. A hydraulic pump was connected to the protruding end of the pipe and pressure applied in increments of 50 lbs., each 50-lb. increment in pressure being maintained for five minutes. No sign of dampness or leak was evident up to 600 lbs. [illegible] leak was observed, and at 1,000 lbs pressure several leaks were observed. The test was made by the Robert W. Hunt & Co., Chicago, [illegible]

A new cantilever bridge for highway traffic has recently been built over the Ohio River at Sewickley, Pa. The anchor spans are 300 ft. long and the cantilever span 750 ft.

WATER-WORKS AND SEWERS SECTION

The Disposal of the Sewage and Protection of the Water Supply of the City of Milwaukee.*

[illegible] tion of the city water supply. The plan will [illegible] will be about $4,997,000.

[illegible]

Topography.—The city is situated at the confluence of the Milwaukee, Menomonee and [illegible] Lake Michigan. Its present area is 14,374 acres. The general elevation is well above the lake; a large portion of the residential district is from 50 to 100 ft. above the lake level, and about one-fourth of the present area—occupied by business, commercial, and manufacturing plants—is comparatively low lying land along the rivers between 15 and 25 ft. elevation. An elevation of 140 to 150 ft. is reached in some portions of the city.

The three rivers which unite within the limits of the city for a common outlet, are dredged and decked for two or three miles above their junction and are practically arms of the lake, ordinarily with little or no current in their natural condition. Above the navigable portions they are comparatively small streams with small summer flow.

The Milwaukee River has a drainage area of about 715 square miles. It flows in a general southeasterly course and during its lower portion is practically parallel with the lake shore. At a point three-fourths of a mile from the mouth it joins the Menominee River, and at the point where it enters the lake it is joined by the Kinnickinnic River from the south. The drainage area of the Menominee is 125 square miles and that of the Kinnickinnic is 32.5 square miles. This makes a combined drainage area of 872.5 square miles for the three streams. The width of the Milwaukee River is between 200 to 300 ft. The other rivers are slightly less in average width and each river is a fraction more than two miles in length, not including about one mile of water way from the junction of the Milwaukee and Menominee Rivers to their mouth. The total contents of the three rivers is about 158½ million cubic feet.

Since 1888, a flushing tunnel has been in operation between the lake and the upper Milwaukee River. It is 12 ft. in diameter and 2,534 ft. long. The pumping station is located at the lake shore and has one vertical tandem screw pump rated at 323,000,000 gals. daily. Another flushing tunnel serves to clear the Kinnickinnic River in the same manner. This tunnel is 7,185 ft. long and the pumping works are practically the same as at the Milwaukee tunnel except that they are placed at the river end of the tunnel. This tunnel was first operated in 1907. The flushing tunnels have successfully diluted and cleared the rivers, but the capacities will soon be too small to secure proper dilution. From studies preliminary to the construction of the Chicago Drainage Canal, it was decided to provide a dilution of 3.3 cu. ft. per second of lake water per thousands persons contributing sewage. The Milwaukee tunnel under present conditions provides 5 cu. ft. of water per 1,000 persons and the Kinnickinnic 5.2 cu. ft. Instead of increasing the capacity of the flushing plants it is advised to continue them under their present capacities and to dispose of the increas- [illegible] increase in flushing capacity would, of course, clear the rivers but would endanger more and more the water supply of the city.

Population.—The population of the city has increased from 20,000 in 1850 to 374,000 in 1910 and a study of the percentage of increase each decade indicates a population of 585,000 in 1930 and 850,000 in 1950. The density of the population, which is now about 26 persons per acre (a density exceeded in 1905 by only three cities in the United States), is estimated to be about 24 persons per acre in [illegible]

[illegible] Milwaukee is essentially a manufacturing city, being fortunate in the possession of many and varied industries. Several of these produce comparatively large quantities of waste liquors which are now discharged into the sewers or rivers. No effort has been made to obtain a complete census of the quantity of industrial wastes, but a number of the manufacturies which were known to produce large quantities of waste sewage, were visited, samples of wastes collected for analysis, and estimates of the quantities of water used were obtained as an index to the quantity of waste likely to be discharged into the sewers. This quantity as estimated amounts to about 57 gals. per capita per day for the industrial wastes.

Gagings of the sewers during 1910 showed that on 10,803 acres of sewered area there were produced 7,640 gals. per acre per day. Applying this to the whole area of the city the total quantity of domestic sewage now produced is 70 gals. per capita per day.

The volume of sewage due to ground water leakage (when leakage is moderate, as in modern sewer construction) is calculated to be about 38 gals. per capita per day.

This quantity, equivalent to 165 gals. per capita per day, may be expected for periods of one or two months in the spring and for periods of possibly a month at a time during other seasons of the year. The water supply contributed in the form of sewage is thus estimated to be 42 per cent of the total sewage flow and the manufacturing wastes nearly 35 per cent. The quantity of sewage estimated for 1910—61,610,000 millions gallons—is 1.58 times the daily average water consumption throughout the year.

From the data on sewage and trade wastes and the known capacities of the rivers and volumes of flushing water, calculations have been made to show the relative intensity of pollution in the rivers at various points. From this data it is shown that the current in the Milwaukee River varies from 6.9 ins. per second to 2.4 ins. per second. The time required to displace the river water by flushing is 14.6 hours. In the Menomonee the velocity of the current was found to be much less than that in the Milwaukee river, varying from 0.02 ins. to 0.11 ins. per second. The time required for displacement by the time it reached the Milwaukee river is about 20 days. The natural flow of this stream amounts to only about one-tenth of the sewage emptied into it.

The Kinnickinnic River flows with a velocity of from 4.5 ins. to 0.9 ins per second, requiring about 24 hours for the displacement of the entire volume.

The currents of the Milwaukee and Kinnickinnic Rivers are much more rapid than at the Menomonee River, the time of displacement much shorter and the solution of sewage greater. These facts amply explain the offensive conditions that exist in the Menomonee River. The velocities found in the Menomonee and Kinnickinnic Rivers are such as to permit the deposition of soot and heavy suspended matter but not the final suspended matter found in sewage, except as these are coagulated by trade wastes in certain sections. The amount of sludge deposited is considerable, and dredging is required. This is especially true in the Menomonee River, [illegible] and the deposition of sludge greater. The deposited sludge decomposes, giving rise to bubbles of gas that may be seen to rise to the surface of the water at many places in the river, especially during hot weather. Before the flushing tunnels were put in use, the odors from the other rivers are said to have been very offensive, but since flushing began there has been a marked improvement in this respect and odors are very much less pronounced, yet at certain times, and especially on warm, muggy nights, the odor is noticeable on crossing the Milwaukee River bridges and for some distance away.

The lower Milwaukee River near the outlet resembles the Menomonee River in appearance but is slightly less offensive than where the latter enters the Milwaukee River. The average age of the sewage at the mouth of the river is about 112 hours. The total time of displacement in the rivers is 23 hours. The sewage is diluted with about 8.7 volumes of water and the dilution is 2.6 cu. ft. per second for each 1,000 pollution accumulating on the basis of flushing water and minimum stream flow. With average stream flows this pollution is 5.2 cu. ft. per second per each 1,000 pollution.

The Menomonee valley intercepting sewer, shown on the accompanying plan, Fig. 1, and the pumping plant on Jones' Island, was put in operation in 1886. The Menomonee special sewerage works consists of an intercepting sewer in the Menomonee valley and a pumping station on Jones' Island near the mouth of the river which was put in operation in 1886. The inspection of this intercepting sewer has shown that the sewer is not working satisfactorily. At various places there are opportunities for this intercepting sewer to communicate with the water in the canals and at these points of overflow there are flap gates so arranged that if the capacity of the sewer is exceeded, the sewage can overflow into the canals, while on the other hand, by holding the gates open under certain conditions, the canal water can enter the sewer. These connections were made so that the sewer could be used as a means of creating currents in the canals and thus prevent stagnation. The inspections have shown that the Jones' Island pumps were pumping chiefly water that entered the intercepting sewer from the canal, and that only a very small amount of sewage, at times perhaps none, was being pumped from the south side of the river. Apparently the gates through which the canal water entered the sewer had been opened for a considerable time, so that while 57,000,000 gals. per day of foul water have been pumped through the lower part of this intercepting system, the upper portion of it has been practically idle. The lower velocities in the upper portion, therefore, gave opportunity for the accumulation of sludge, so that the sewer is almost completely choked. Grease from packing houses has undoubtedly been a large factor in clogging the sewers.

[illegible] The water in the lake, taken as a whole, has of course a general drift toward its outlets, but as the capacity of the lake is as much as the natural discharge during 100 years, this is far too small to be recognized as an appreciable current. There are currents in the lake, both surface currents and under currents. The surface currents are induced by the wind, and the water moves in the direction of the wind and at a velocity of perhaps 2 to 5 per cent of the wind velocity, varying considerably under different conditons, such as direction of the wind, wind velocity, duration in wind direction, etc. A wind blowing steadily from the West at 36 hours at an average rate of 20 miles per hour would cause a wind movement of 720 miles and during this time the induced surface velocity might carry a particle of water at the surface 25 miles toward the east. When the wind changes, the surface currents also change for a time.

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*[illegible] City Council by the Commissions of Consulting [illegible]

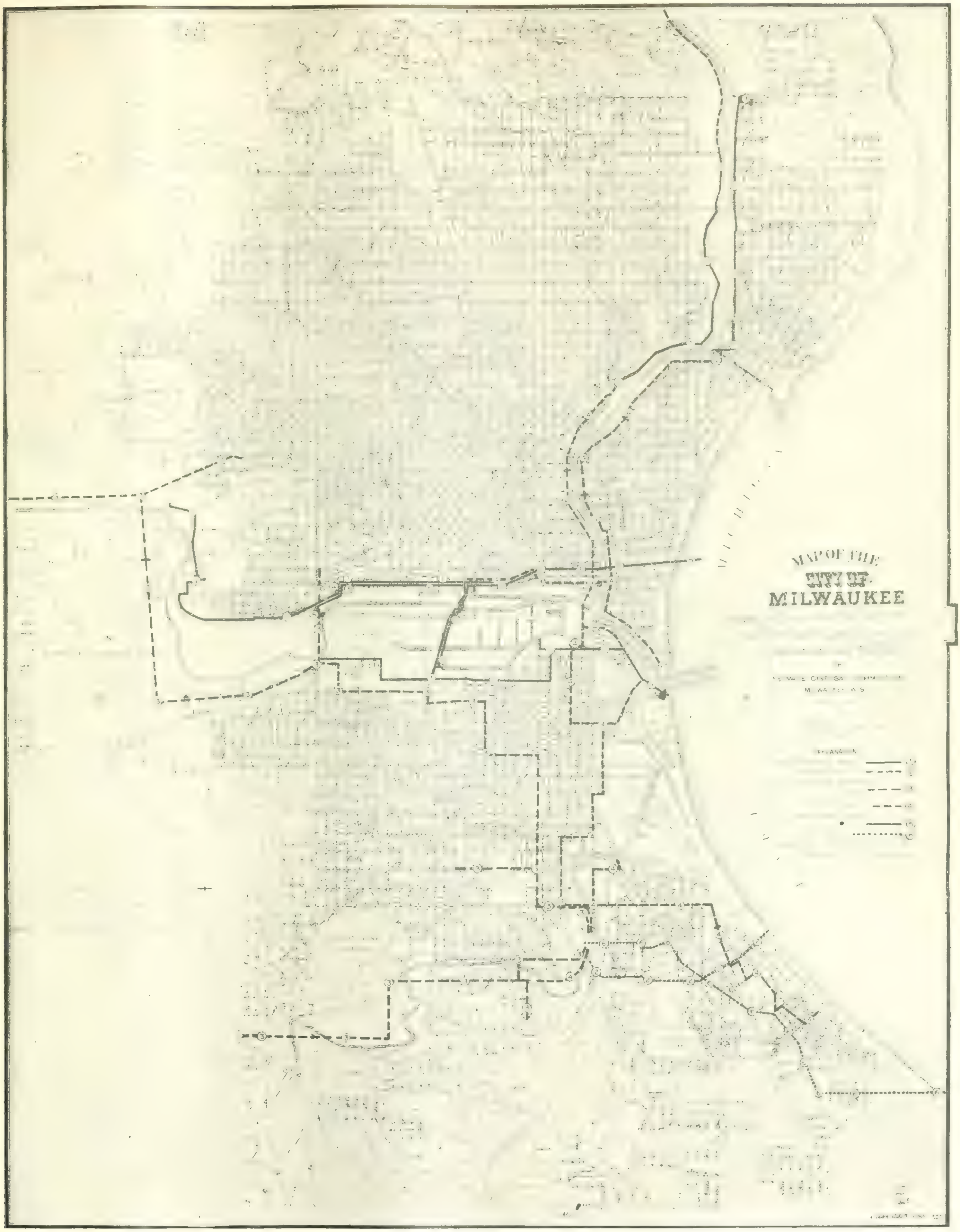

Fig. 1—Map of Milwaukee, Showing Existing and Proposed Sewers.

[illegible] definite and fixed current, and in general the surface currents follow the resultant of the wind currents except as they are modified by striking the shore and being deflected. Beneath the surface the waters gradually acquire movements in the same direction so as the depth increases, the velocities become materially less until they cease at depths of 10, 20, 30 or 40 ft. as the case may be, according to the intensity and constancy of the wind movement. The temperature of the water at different depths by influencing the specific gravity of the water also affects these subsurface movements.

Milwaukee Bay is an indentation of Lake Michigan extending from Lake Park on the north to Cudahy on the south. The center of the bay where the river enters is about two miles west of the line connecting these two points. The area of the bay back of this line is about 10 square miles. The depth of the water gradually increases from the shore; at first slightly and then somewhat more rapidly. A half mile from the shore the depth [illegible] from the shore it [illegible] two miles from the shore it is from 50 to 60 ft.

The Milwaukee River enters the bay through a channel about 1,800 ft. long, 250 ft. wide and 20 ft. deep, between the two projecting piers that extend eastward at right angles to the shore. Thus the river discharges, not at the shore line, but at a point about 1,800 ft. east of it.

All of the sewage ultimately reaches the bay. The sewers discharge into the rivers and most of it reaches the bay through the river outlet between the piers. Part of it, however, is discharged near shore at Jones' Island, [illegible] the pier, where about 57,000,000 gals. daily are delivered by the pumps connected with the Menomonee intercepting sewer. A very large part of this 57,000,000 gals consists of water from the South Menomonee Canal and the Burnham Canal. Its out-fall discharges at the surface of the lake where the river discharges through a channel having a depth of 20 ft. Besides these out-falls, sewage is also discharged directly into the lake by the district sewers in the south-east section of the city near the Illinois Steel Works. There are also a few minor points of discharge on the north side.

In considering the effect of sewage pollution on the bay, two different aspects of the subject must be kept in mind and clearly distinguished, namely, the decomposable organic matter and the effect of living organisms or bacteria.

The decomposed organic matter influences the dissolved oxygen in the water, causes bad odors, unsightly turbidities, scums, deposits, gas bubbles, etc. These effects disappear on dilution, organic matter being dispersed and destroyed by the oxygen in the flushing water or lake water and by microscopic organisms and higher forms of animal life.

The living organisms are invisible and thus cause no offense to sight or smell. When discharged into the lake they become scattered and may be carried long distances. Most of the bacteria found in sewage are harmless so far as is known, and contribute to the construction of the organic matter but among the sewage bacteria there may be, and perhaps always are, some that may cause disease.

Observations and analyses show unmistakably that the waters of the Milwaukee Bay are subject to pollution at all points as far as the intake of the water works on the north, and to and beyond the south boundary of the city. Iinside the break water and for a distance of perhaps a mile from the mouth of the river, the pollution is obvious to the senses. The water at the bathing beach at McKinley Park is polluted with sewage. A sample collected at the beach on Nov. 2 contained [illegible] bacteria per cu. c. [illegible] positive test for B. coli. in 0.1 c. c. Outside of this inner circle the pollution decreases quite rapidly as a result of dilution [illegible] polluted water is carried northward, eastward or southward according to the direction and intensity of the wind and spreads out over the surface or flows out at the bottom according to the circulation of the water in the lake. The water supply of the city is at times seriously polluted. In order to get beyond the source of dangerous pollution it would be necessary to go at least three or four miles from the shore, but it is impossible to extend the water works intake to this distance on account of getting into too deep water.

Separate System Not Practical.—The sewers thus far constructed in Milwaukee have been in accordance with the combined system, which means that the one conduit only is provided in each instance for the collection of both sewage and storm water. It is not practicable to build intercepting sewers which will be provided for intercepting the entire flow in trunk sewers in times of storm. Consequently there must be overflows into the rivers at such times which will consist of sewer as well as storm water and thus cause a contamination of the rivers.

It is possible in some communities, particularly in smaller towns, to provide for the needs of the community by building a single system of sewers to receive sewage only, allowing the surface water to flow in the street gutters, in the limited number of storm drains, or more frequently in the natural water courses. In the larger cities, on the other hand, it has has been found that it is necessary to practically parallel the system of sewers with storm drains. This would mean a double system and would require two pipes in practically every street, if an attempt were made to resewer the city in accordance with the separate system planned. The proportion of the capacity of the combined sewers devoted to carrying sewage is relatively small. For this reason it is probable that if a separate system of sewers were to be constructed, the sewers now built would be used for storm drains and the new ones would be devoted to carrying sewage. To provide an effective separate system would therefore involve the transfer of the old to the new sewers in nearly all connections between the sewers and present buildings, and also corresponding changes in plumbing, in many cases where roofs are now drained into the sewers It is extremely difficult under these conditions to prevent the accidental connections of roof water with sewers and of house sewers with storm drains and this and other complications would make a separate system objectionable.

Milwaukee at the present time has over 420 miles of combined sewers, equivalent to about 30 miles per square mile of area. The cost of doubling the combined system for an area of between 7,000 and 8,000 acres in one of the large cities of the country has averaged over $650 per acre. The unsewered area could, of course, be provided with both sewers and drains at one time, so that it would seem that a conservative estimate of the additional cost of providing the double system over that of the combined system for this new area would be $300 per acre. It therefore appears that the cost of the separate system for Milwaukee as of 1950 would be as follows:

Resewering present area, 1[illegible],000 acres at $[illegible]	$ [illegible]
Sewering new area, [illegible],000 acres at $[illegible]	[illegible]
Total cost of separate system of sewers	$[illegible]

To provide a separate system of sewers would thus require an ultimate extra expense of about $15,000,000, not allowing for changes in existing plumbing which would doubtless be required in many cases. The cost of providing such a system is therefore considered as prohibitive.

Storm Water.—The figure to be used for the percentage of storm water actually reaching the sewers is almost wholly a matter of judgment. It must depend upon the extent of impervious surface, such as roofs, pavements, etc., and upon the character of the earth itself, particularly its porosity and capacity for quickly absorbing water. In Milwaukee the percentage of impervious surfaces is large and the soil is very largely of a comparatively impervious nature. Accordingly the percentage of 70 per cent has been assumed in this study.

In making a study of this subject it was desired also to estimate the percentage of sewage which the storm water would carry with it into the rivers. This was estimated from the records of average annual duration of precipitation and rate of precipitation as follows:

The rate of precipitation corresponding to any interval has been assumed as the average within the limits of the interval measured, and the percentage overflowing for this rate has been taken from a 70 per cent curve (assuming 70 per cent of the rainfall as reaching the sewers). This percentage has been multiplied for each such rate by the number of hours in the average year for which this rate prevailed. The products have been added together and divided by the number of hours in the year and the result is considered as representing approximately the percentage of the total sewage overflow in time of storm in a year of average rainfall. The results show that with conditions as assumed for 1910 that .73 of 1 per cent of the sewage would be rejected and for 1950 conditions, 1.9 per cent of the sewage.

Character of Sewage.—In Milwaukee at the present time the sewage is composed of the domestic wastes of 375,000 people and very large quantities of industry wastes from breweries, packing houses, tanneries, and many other industries. In view of the possibility of obtaining at a nominal expense large quantities of water from the rivers for industrial purposes, it is to be expected that the sewage in the future will contain at least as great a proportion of industrial wastes as it does at the present time. These industrial wastes, together with the storm water, have a material bearing on the character of sewage and open the problem of its disposal. Such sewage will undoubtedly contain greater quantities of impurity, and especially of suspended matter, than that from a strictly residential community with a separate system of sewers, receiving no street washings.

Offensive conditions are caused by the putrefaction of the organic matter contained in the sewage. Putrefaction cannot, however, take place in the presence of large quantities of oxygen. It is influenced by the temperature, being much more rapid when the water is warm. A certain length of time is necessary also for the production of offensive conditions. It is therefore evident that such conditions will not exist if the sewage is carried rapidly away before sufficient time has elapsed for a material reduction in the quantity of oxygen itself in the water and that the low temperature of the lake water, tending to increase the rapidity of bacteria growth, assists in maintaining the supply of oxygen. If the excess of oxygen cannot be provided or if for other reasons it is not desirable that sewage be discharged into the rivers, it is necessary to resort to methods of treatment which may be divided into two classes—those by which the organic matters are taken out of the sewage and those by which they are transformed either into mineral matters or into more stable organic compounds which decompose so slowly that they do not use up the available supply of oxygen in the water into which the sewage is discharged.

[illegible] Various Projects [illegible]posal.—Before deciding on the project that has been recommended for adoption, various studies were made of possible projects for sewage disposal which were compared with respect to the relative advantages and disadvantages and costs. As a matter of record some of these projects are described briefly.

Project 1: Partial Purification on the Kinnickinnic Tract: Effluent to South Point Outfall.—According to this project there would be a high level system of intercepting sewers, so located as to collect the sewage from a large part of the city and convey it by gravity to land near the Kinnickinnic pumping station [illegible] system of low level intercepting sewers to collect the sewage [illegible] the city including a large part of the manufacturing districts, and convey it by gravity to the pumping station at the Kinnickinnic tract. Here sedimentation tanks would be constructed for the clarification of the sewage. The high level sewage would flow into the tanks by gravity, but the low level sewage would be pumped into them. The partially clarified effluent would be conveyed by the gravity tunnel to a point in the lake below the surface about 40 ft. and at a distance of about 9,000 ft. from the shore. The first cost of the work involved in this project, including intercepting sewers, pumping stations, sedimentation tanks and outfall sewers, as well as land, engineering and contingencies, was estimated to be $7,536,977, the annual charges including interest, depreciation and operating expenses were estimated to be $345,823. The project is similar to the one finally chosen for recommendation to the city and described later, but it makes no provision for the installation of sprinkling filters or other form of purification for the future.

Project 2: Sedimentation at the Kinnickinnic Tract and Further Purification at the Austin Tract.—This project involves the construction of systems in high and low level intercepting sewers, pumping stations and sedimentation basins at the Kinnickinnic tract, as in project No. 1, but the tank effluent, instead of being discharged directly into the lake, would be pumped to land south of and outside of the city known as the Austin tract and further purified there by passing it through percolating filters and finally settling basins. The effluent from these works would be conveyed to the lake at a point off South point, as in project No. 1, but would be discharged somewhat nearer the shore and in water of less depth. The total estimated cost of the construction for this project would be $9,169,927. The annual charges, depreciation, etc., are estimated to be $632,203. The cost of pumping alone is estimated to be $150,100 per annum. Aside from the fact that the Austin tract may in the future be surrounded by a residential district, it was also believed that for the present it is not necessary to purify the sewage by the use of percolating filters, in view of the opportunity to utilize the flushing water from the Kinnickinnic works for temporary dilution.

Project 3: Sedimentation at Jones' Island. Effluent to South Point Outfall.—According to this project the sewage from a large part of the city would be collected in the system of high level intercepting sewers and conveyed by gravity to sedimentation tanks located at the northerly end of Jones' Island. The sewage from the low level districts would be collected in the system of low level intercepting sewers and conveyed by gravity into an enlarged pumping station at Jones' Island and discharged into the sedimentation basins. The effluent would flow by gravity from here to a conduit constructed along the shore of the lake to a subaqueous tunnel under the lake as referred to in Project No. 1. The cost of these works is estimated at $7,441,650 and the annual charges $354,646. Although this plan had many favorable aspects, it was found that it would interfere to some extent with the proposed plans for the development of a harbor.

Project 4: Sedimentation and Further Purification at Jones' Island.—According to this project the sewage would be collected by a system of high and low level intercepting sewers and conveyed to Jones' Island and clarified just as in project No. 3, but the effluent from the sedimentation basins before being discharged through the outfall sewer would be further purified by passing it through percolating sewers adjoining the sedimentation buildings on the island. The effluent from these filters would be conveyed by gravity to an outlet at the South point, shorter and much less expensive than in project No. 3. It is estimated that the cost of works for this project would be $7,044,900 and the annual charges would be $413,257. More land would be required at Jones' Island for this project than for that of No. 3 and the same objections are found for both projects.

Project 5: Sewage Purification on the Austin and Evergreen Park Tracts.—According to this project the sewage of the city would not all be conveyed to one point but the city would be divided into two sections. A considerable part of the sewage from the highway districts of the north side of the city would be collected in a system of high level intercepting sewers and conveyed in a northely direction to sand in the vicinity of Evergreen Park, or it would be conducted through sedimentation tanks and be further purified by percolating filters. The effluent would be discharged in the Milwaukee River and the sewage from the low level system and the south side of the city would be conveyed to the Kinnickinnic tract and pumped to sedimentation basins as described in the previous projects. The effluent from these latter works would then be pumped to the Austin tract and further purified by percolating filters. The effluent from the Austin tract would be discharged into the lake at South point through a comparatively short outlet. The cost of the construction of these works would be $8,348,655 and the annual charges would be $527,144.

THE PROJECT PLAN [illegible]

[illegible]

Synopsis.—The works recommended for the solution of the sewage disposal problem may be grouped into four classes, as follows:

(1) The building of a flushing tunnel and pumping station for furnishing a sufficient supply of lake water to flush the Menomonee River, canals and slips, and thus prevent them from being made foul by the overflows of storm water and sewage and the small dry weather sewage flows which will inevitably escape interception.

(2) The construction of a system of intercepting sewers to collect the sewage and conduct it to a purification plant, thus preventing its discharge into the rivers. A pumping station will be required to lift the sewage from the low level intercepters to the sedimentation basins.

(3) The construction of a purification plant which will remove the suspended matter from the sewage and disinfect the effluent to destroy the pathogenic germs contained in it. It may be necessary ultimately to supplement such a process by treatment with chemicals or in percolating bacteria beds for the purpose of removing more completely the finely divided organic matter in suspension or that which is dissolved.

(4) The building of an outfall sewer from the purification plant located on the Chase tract to the shore of Lake Michigan; thence a subaqueous tunnel to a point near the Black Can Buoy; thence two comparatively small steel pipe lines laid in the bed of the lake and provided with numerous orifices through which the purified sewage will be discharged at a depth of about 40 feet over a distance of approximately 3,000 ft. easterly of the Black Can Buoy.

The Present System.—There are now constructed as integral parts of the sewer system of the city, 57 district sewer systems. In a general way a sewer district comprises the area draining to one trunk sewer. Such sewers are frequently laid in the bottoms of valleys substantially parallel to natural watercourses. From the trunk sewers sub-mains and lateral sewers are extended to serve the various streets in the district. In some cases a number of parallel streets slope toward the rivers and the sewers are built independently of each other, or two or more streets are grouped into a small system having a common outlet.

New [illegible] The sewage from various parts of the city is thus collected and discharged at different points by means of many trunk sewers. At the present time every trunk sewer discharges directly into the lake, rivers, or the intercepters which are already built. For the purpose of collecting and conveying the sewage to the disposal area it is necessary to construct additional intercepters to receive the sewage from the present trunk sewers. Such intercepters are necessarily laid at a lower elevation than the trunk sewers so that the sewage may flow by gravity into them.

The intercepters are not to be of sufficient capacity to carry storm water in excess of the maximum rate of sewage after the city reaches the size upon which the designs have been based. They will, therefore, accommodate but a small portion of the flow in the trunk sewers in time of storm, and it will be necessary to provide controlling apparatus by which the quantity of sewage admitted to the intercepters may be regulated.

The topography of the city is such that it will be possible to convey the sewage from about one-half of the ultimate area to the purification works by gravity, and accordingly high and low level systems of intercepters have been designed.

A large portion of the main high level intercepters will be parallel to low level intercepters, and will intercept the flow in the trunk sewers which will also be connected at a lower elevation farther down the slope, with the low level intercepters. In this way the sewage from a large portion of the area draining at first into the low level intercepters will be transferred into the high level intercepters, leaving the full capacity of the former to provide for the flow from the low level areas and other districts to be served permanently by them.

As soon as the high level intercepter is built and all connections made, the quantity of sewage to be pumped will be materially reduced, and there should be a corresponding reduction in the cost of operating the pumping station.

One incidental advantage of the double system will be that in case regulators on the high level line become clogged or otherwise disabled, the flow can be temporarily allowed to pass down to the lower intercepter through which it will flow to the pumping station, thus avoiding its discharge into the rivers.

It is the intention that the low level intercepters shall be built some years before the main high level intercepters, the latter to be constructed when the former becomes overtaxed or the cost of pumping becomes greater than the fixed charges upon the high level system.

Regulators.—Various types of regulators have been devised, but for the purpose of illustrating the method of operation it will be sufficient to describe one, the Boston type. The structure consists, in brief, of an orifice with the intercepting sewer, regulating gate, float to automatically operate the gate and a tell-tale pipe through which the height of sewage in the intercepting sewer is communicated to the float chamber. See Fig. 2.

The orifice in the trunk sewer is designed of sufficient capacity to allow the proper quantity of sewage to pass through it. In some cases it is necessary to provide a law dam in the trunk sewer at a point immediately below the orifice to assist in diverting the sewage. The pipe leading from the orifice may pass through the regulating chamber and thence to the intercepting sewer. The regulating gate seats against a cast iron nozzle which forms the orifice in the trunk sewer. This gate is carried on the end of a lever, to the other end of which is attached a large float which rises and falls in the float chamber with the rise and fall of the sewage in the intercepting sewer, the communication of the height of sewage between the intercepting sewer and the float chamber being accomplished by means of a tell-tale pipe of small size which connects the two. Thus, as the depth of sewage in the intercepting sewer increases in time of storm, the float is raised and correspondingly the gate is lowered or closed. When the intercepter is as nearly full as described, the gate through which the sewage into the intercepter and at the same time causing the sewage and storm water to flow past the orifice through the lower part of the original trunk sewer into the river. [illegible] to the Kinnickinnic River so that coal can be unloaded directly from steamers into the bunkers. Its proximity to the flushing pumping station assures an abundant supply of clean, cool, lake water for steam generating and condensing purposes.

The sewage will pass through the grit chambers and screens before reaching the pumps, so that it will be free from materials which may unduly wear or damage the machinery.

The invert of the main low level sewer will be at elevation 18, and the surface of the water in the tanks will ordinarily be at elevation [illegible] million gallons per day) it is planned to raise the water to elevation 25. The main low level intercepting sewer will be 10 ft. in diameter, and it may be assumed that the sewage in the grit chambers will be at elevation 14, or that it will be 4 ft. deep in the intercepter at its lower end. The ordinary lift on the pumps will, therefore, be about 38 ft.

The minimum rate at which sewage will reach the pumping station from the low level intercepters during the earlier years will be in the vicinity of 25 million gallons per day, which will occur at night and in dry weather. The corresponding maximum rate will probably be from 50 million gallons per day to 75 million gallons per day, while in time of storm the main low level intercepter (the one to be built first) will run full, the rate of flow being about 160 million gallons per day. The ultimate capacity of all the low level intercepters reaching the pumping station, will be about 180 million gallons per day, which is the maximum rate at which sewage will be pumped. The average rate of sewage flow during the earlier years will probably be between 25 and 50 million gallons per day, and [illegible] million gallons per day.

Taking into consideration all the conditions, it has been deemed wise to provide three pumping engines, each of the capacity of 25 million gallons per day, and two others having a capacity of 50 million gallons per day each, making the combined capacity of the pumps 175 million gallons per day, or slightly less than the ultimate requirements. They will, however, be ample for many years, and the station should be made large enough to accommodate two additional units.

Vertical centrifugal pumps, so placed that the sewage will flow to the impellers, seem to us to be best adapted to this service. If the quantity of sewage to be pumped were uniform or even as nearly uniform as it will be during dry weather, we should advise the use of steam engines for driving all of the pumps. In view of the fact, however, that upon very short notice the flow may be increased from a minimum of 25 million gallons to a maximum of 180 million gallons per day, and the consequent expense and impracticability of having available at the moment it is required a sufficient quantity of steam for pumping so large a quantity, we would suggest that both steam and gas engines be considered for this service. We have, therefore, included in the estimate three steam pumps, two of 25 million gallons, and one of 50 million gallons capacity, with the necessary horizontal triple expansion, condensing engines and boiler plant, and two gas engine units, one of 25 million gallons and one of 50 million gallons capacity. The steam engines will be used for the regular pumping, while the gas engines will be held in reserve for pumping the storm flows.

The pumping station will contain the necessary sludge pumping machinery and a lighting plant for furnishing light about the station and purification works. A machine shop for making repairs to gates and machinery, and suitable offices and laboratories, properly equipped, will be provided.

Site.—A very thorough study has been made of all sites available for purification works, in or near the city. After considering the various advantages and disadvantages of each, it was decided that the Kinnickinnic tract is particularly well adapted for use for a pumping station and purification works. It lies west of the Kinnickinnic River and between Chicago Road and Lincoln Ave. It is directly across the river from the present Kinnickinnic flushing pumping station. Its elevation varies from 8 or 9 ft., near the river, to nearly 50 ft. at the westerly side. It was formerly used for a brick yard and an area of approximately 20 acres has been excavated to an average elevation of 15. The material is a very compact clay which gradually hardens into a shale at elevation about 30. As the site is near the C. & N. W. R. R. location, the railroad facilities are excellent for delivery of building materials and supplies to be used in constructing and operating the plant, and, if found desirable, for hauling sludge away for disposal upon land. Being adjacent to the navigable portion of the Kinnickinnic River, it will also be possible to deliver supplies and remove sludge by boat. Its area is approximately 30 acres and it has a river frontage of about 2,000 feet, available for docking purposes.

Grit Chambers.—The sewage when delivered at the purification works will be discharged into grit chambers. There will be two sets of these chambers, one at a low level intercepter, before it is pumped, and another at a higher elevation to receive the sewage from the high level intercepters before it flows to the sedimentation tanks. These chambers are so designed that the velocities through them will be 20 ft. per minute which will be sufficiently low to permit the precipitation of sand and the coarser solid matters. The length of flow through the chambers will be about 40 ft. The bottoms of these chambers will be several feet lower than the inverts of the sewers to provide sufficient room for the storage of the sediment until such time as it is removed.

The grit chambers will be cleaned by means of dredges, which will remove the sediment without necessitating drawing down the sewage. As these chambers are located close to the Kinnickinnic River, the refuse may be loaded directly into barges and towed far out into the lake and there emptied. It will also be possible, if found desirable, to provide a railroad siding so that the refuse may be loaded onto cars and carried out into the country and disposed of upon suitably located land. Such a method of disposal does not now seem necessary and it is a fact that very large quantities of similar refuse are dredged from the rivers and deposited in the lake. We would recommend that such matter, as well as that dredged from the rivers, be carried from ten to twenty miles off shore instead of being dumped within three miles, as is the practice at the present time.

Screens.—Between the low level grit chambers and the pumping station, and between the high level grit chambers and sedimentation tanks, screens will be provided for removing from the sewage any coarse floating matter which may prove injurious to the pumps, or which would be objectionable in the tanks or might float in the lake after its discharge. Such screens may be mechanically cleaned, and screenings removed from the sewage may be disposed of with the refuse from the grit chambers.

Sedimentation Tanks.—The tanks have been designed of the shallow rectangular type, though it is recognized that by the time working drawings are to be prepared the merits of other types of tanks now being developed may have been sufficiently demonstrated in this country to warrant their adoption in Milwaukee.

The tanks are arranged in two series so that during the first few years of operation when the effluent is discharged into the Kinnickinnic River, the sewage may first be roughly clarified in the primary tanks, then receive the disinfecting solution and later have a period of contact in the secondary tanks in which some further sedimentation will take place. Sufficient tank capacity has been provided for a flow of 100,000,000 gallons of sewage. This quantity it is estimated, may be received continuously by 1930 for periods of one or two months at a time. The flow through the tanks at such times will be at the rate of about 80 lineal feet per hour, although it will be somewhat reduced during the dryer portions of the year when the flow will be less. During storms the intercepting sewers will, for a time, run full and the flow of sewage will be increased to a rate of from 180,000,000 to 300,000,000 gals. in 24 hours, according to the proportion of the intercepting system constructed. The velocity of flow in the tanks at such times will be increased to from 140 to 240 feet per hour. Under such conditions the efficiency of the sedimentation process will be slightly reduced, but it is believed that sufficient tanks have been provided to prevent a rate of flow sufficient to carry out with the effluent the heavier suspended matter.

The tanks as designed will have a depth of 9 ft. at the inlet end and 7 ft. at the outlet. They will be provided with suitable baffles and sludge dams to prevent the escape of floating matter and facilitate the removal of sludge.

With this system of tanks and careful attention to their operation, particularly to the removal of sludge, it is believed that from 30 to 50 per cent of the suspended matter will be removed from the sewage.

While the first installation will include but thirty tanks and is designed of a capacity sufficient to serve the city until 1930, all the channels and conduits which cannot be readily enlarged, should be designed for the maximum ultimate quantity of sewage which can be discharged by both the high and low level intercepting systems. It is estimated that by 1930 the city will have reached a size which will warrant the enlargement of the purification plant, which can be accomplished by the construction of one additional series of fifteen basins. No material changes in the plant previously built will be necessary at that time. The Chase tract is of ample size to accommodate the large plant which may be required after 1930.

The grit chambers, sedimentation tanks and sludge storage reservoirs with appurtenant structures, will be built of Portland cement concrete generally reinforced with steel. The sedimentation tanks will be covered by a groined arch roof constructed of concrete. A row of columns will be required to support the roof midway between the walls of each basin. These will be so designed as to cause as little disturbance to the flow of sewage as possible. Low buildings will be constructed over the influent and effluent conduits and extend for a short distance over the ends of the basins so that the character of the sewage at various stages may be observed. The gates for controlling the flow of sewage and sludge will also be located in these buildings.

Disinfecting Plant.—Sedimentation cannot be depended upon to remove a very large proportion of the bacteria contained in sewage. In view of the fact that pathogenic germs may be present in the effluent, and that there is a possibility that the water supply may be occasionally contaminated by it, disinfection of the effluent is warranted, at least while it is being discharged into the Kinnickinnic River.

The disinfecting station will be provided with sufficient storage room for the necessary quantity of bleaching powder, suitable tanks for mixing and measuring the disinfecting solution and the necessary stirring apparatus. If the effluent from the purification works is to be discharged into the Kinnickinnic River, during the first few years of operation, while the quantity of sewage will be comparatively small, it will be advisable to use the two sets of basins in series so that the disinfectant may be added to the sewage after the coarser suspended matter has been removed and sufficiently long before it is discharged into the river to provide a suitable period of contact. The disinfecting solution will be discharged into the sewage as it flows from the first series of settling basins. It will be thoroughly [illegible] with the sewage before entering the [illegible] basins through which it will pass under ordinary conditions in a period of about two hours, thus providing an ample period of contact before the effluent is discharged into the Kinnickinnic River.

Outfall Sewer.—The outfall sewer will extend from the purification works to a point about 1⅔ miles from shore east of the Black Can Buoy, which is located about one mile off the shore nearly oposite St. Francis College.

The settling tanks have been placed at such elevation that the surface of the water in them will ordinarily be 24 feet above datum, and 25 ft. at times of maximum rate of flow. makes it possible, by building the outfall of large size and at a flat slope, to deliver the effluent at the shore of the lake at such elevation that it can be passed through percolating beds for further purification, providing the beds are built upon "made" land along the shore.

As it leaves the purification works the outfall will be laid in the form of an inverted siphon under the Kinnickinnic River, and thence in trench or tunnel, as its depth below the surface may dictate, for a distance of about 15,500 ft. to the shore of the lake. Throughout this distance it will be equivalent in cross-sectional area to a circular sewer 13 ft. in diameter, although it may be either of the "horseshoe," or the "semi-elliptical" tpye. It will have a hydraulic gradient of 1 in 3333, and a capacity of 300,000,000 gals. in twenty-four hours. Its crown elevation at the tanks will be 25, and at the lake shore about 20.34.

Near the lake shore a drop chamber will be constructed to connect with that portion of the outfall which will be laid below the bottom of the lake. The difference in elevation of these two adjacent sections will be about 10 ft. at the drop chamber.

[illegible] the drop chamber to the Black Can Buoy the sewer will be constructed 13 ft. in diameter slightly below the bottom of the lake, and will probably be built in tunnel. The depth of the lake along this line is about 15 ft. at mean low water. At the outer end of this section a crib will be constructed from which two steel pipes about 5 ft. in diameter will be laid just under the bottom of the lake for a distance of 3,000 ft. These pipes will be laid in dredged trenches, and will be from 35 to 40 ft. or more below mean low water. They will be provided with orifices, spaced about 150 ft. apart, through which the sewage will flow into the lake.

On account of the expensive character of the work, the subaqueous portion of the outfall, from the drop chamber to the Black Can Buoy, has been kept large, so that if the percolating beds are built it will be of ample capacity for carrying the maximum rate of flow provided for in the intercepting system and purification works. The head upon the steel pipes will be such that they will have a capacity practically equal to that of the tunnel until the percolating beds are built, after which time additional pipes will be required, extending from the Black Can Buoy easterly a distance equal to that of the two pipes first laid.

The route selected for the subaqueous portion of the outfall and the location of the steel pipes are ideal for the purpose. The fact that the water is shallow from the shore to the Black Can Buoy may prove a great advantage in building the masonry conduit as it may make it possible to construct the conduit either as a single or twin pipe in a dredged trench. If it should finally be decided to build this portion of the outfall in tunnel, the bottom of the lake is at so high an elevation that it will not be necessary to go to such an extreme depth as would be necessary in any other available locality.

The conditions are such that the steel pipes through which the sewage is discharged can be located far from shore and in deep water. which are decided advantages. They will be a long distance, about five miles, from the water works intake. They are, however, comparatively close to the water works intake of the town of Cudahy and for that reason it is probable that the city of Milwaukee should enter into an agreement to furnish the town with a supply of pure water or to compensate it for building suitable water filters. The distance to the water works intake of South Milwaukee is about the same as to the Milwaukee intake and it is not anticipated that any additional burden will be placed upon the water filters now in operation.

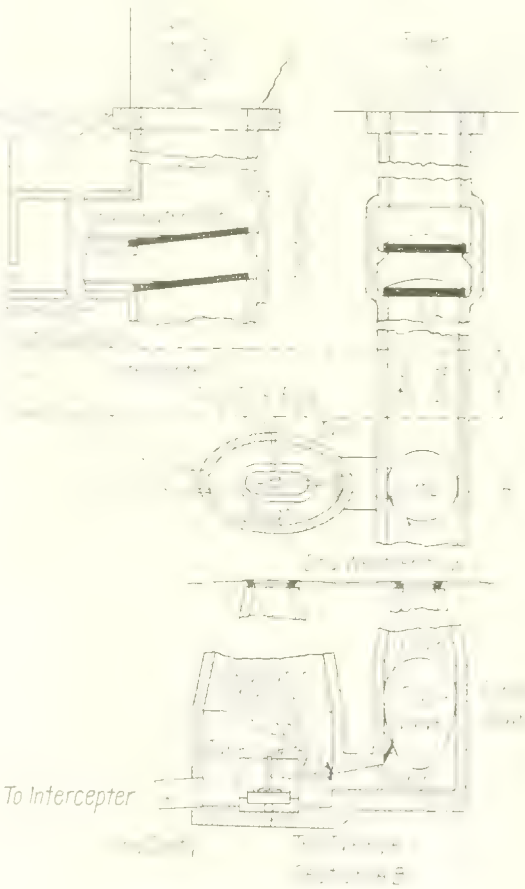

Fig 2—Boston Type Regulator.

Another advantage of the location is that it is outside present and possible future harbor breakwaters and when it is put into use and sewage excluded from the river, the new constant source of contamination of the harbor waters will be forever removed except so far as storm and unavoidable overflows may cause occasional and comparatively slight contamination.

The outlet will be sufficiently far from the shore to be outside the region of any shore drift. This drift is slight and yet if it exists it will have a tendency to hold the sewage off shore instead of permitting it to mix with the shore water and drift along the shore.

[illegible] jectionable and unsanitary condition of the Menomonee River is to be relieved by flushing it in substantially the same manner as is now done for the Milwaukee and Kinnickinnic Rivers and investigations show that flushing will be necessary even though intercepting sewers be constructed to relieve the stream of most of its pollution. The amount of pollution outside of the city limits is always likely to be large while even with the best endeavors it will be difficult to keep all sewage out of the river, flowing as it does through the heart of the city when there are doubtless many old forgotten drains that canont be readily removed or connected with the system of intercepting sewers.

In the project recommended for flushing the river, water will be taken from the lake at a point opposite Huron St., about 1,000 ft. from the shore, or 400 ft. beyond the easterly line of the projected park. Here an intake crib will be constructed in the lake with boards of ample size for taking water at a low velocity and with coarse screens to remove any large objects that might enter the pumps. From the crib a conduit 11 ft. in diameter and having a capacity of 2,000,000 gals. per day, will extend under the proposed park to the pumping station. From the pumping station a 7½ ft. conduit, having a capacity of 75,000,000 gals. daily, will extend to a point on the river bank near Canal St., where water will be discharged into the North Menomonee River at the head of navigation. From the pumping station a second conduit 11 ft. in diameter will extend to the North Menomonee Canal where there will be an outlet sufficient to discharge all the water that the pumps can deliver. An extension of this conduit reduced to 8½ ft., and having a capacity of 1,000,000 gals., will cross the river to the Burnham Slip with outlets both itno the Burnham Slip and into the South Menomonee Canal. There will also be a connection by means of a 48 ft. conduit from the 11 ft. conduit to the Kneeland Canal, with sufficient capacity to flush this canal once in 24 hours. The rivers will be crossed by double lines of inverted syphons. It seems quite likely that when the main canals are flushed, the waters of the slips will be brought into circulation by reason of the trade wastes discharged into them and the conditions in temperature between the warmer surface water of the slips and the cooler deep water of the canals. The location of the crib, conduits, pumping station and river outlets are shown on the map, Fig. 1.

THE WATER [illegible] OF THE [illegible]

The water supply of Milwaukee is taken from Lake Michigan at North Point. The pumping station is about 2½ miles north of the Milwaukee River, measured around the shore. The crib is a twelve sided structure, 56 ft. in diameter and about 33 ft. deep. About 8 ft. are exposed above the water. It con-

[illegible] with spaces between filled with concrete. [illegible] below the level of the lake. There is a vertical shore shaft which connects with the distributing well through a short shore tunnel and from the distributing well section pipes extend to the pumps. The shaft is 11 ft. in diameter.

As has been indicated before, the pollution of the city water supply has been excessive and the manner of dealing with this question has been considered. Four methods of improving the sanitary quality of the water, which have been considered, are as follows:

First. The removing of polluting matter from the lake. Second, the removal of the intake to a point remote from the pollution. Third, the disinfection of the water. Fourth, the filtration of the water.

The removal of pollution from the lake is not feasible to such an extent as to warrant the permanent sanitary quality of the public water supply, taken from the present intake, and if it were feasible the excessive cost of doing so would make it prohibitive.

The question of removing the intake to a point more remote from the polluted water is not feasible because no site could be secured farther in the lake where the water was shallow enough to permit the construction.

Disinfection of the water by the use of chemicals has been practised here and there at various times for many years. It is extremely doubtful whether at the present time the subject has been sufficiently studied in all its aspects to warrant a city of the size of [illegible] this process as the only permanent safeguard of the purity of its public water supply.

Filtration, therefore, is the best method of maintaining the purity of the water supply of Milwaukee. This can be done readily on the shore of the lake at the North Point pumping station house. There are two well recognized methods of water filtration in use today in America—Sand Filtration and Mechanical Filtration. For the Lake Michigan water, taken at a point far out from the shore as at Milwaukee, a slow sand filter has an excellent opportunity to demonstrate its economy and with a water of this type such a filter could probably be operated most of the time at a rate of 16,000,000 gals. per acre daily.

A sand filter plant at North Point will require the construction of a breakwater to be built out 600 ft. from the shore and the reclamation of lands from the lake where the water at the present time is ordinarily less than 4 ft. deep. It is understood that such a breakwater has been planned along the north shore from McKinley Park in order to provide a shore park. The sand filter would naturally fit this plan and would be in no way unsightly, as the filter would be covered with a roof and grassed over. According to this plan water would be taken from the intake conduit and raised to the filters by low lifting pumps of high efficiency. The water would flow through the filter by gravity from which it would flow likewise by gravity to the section of the present pumps. In order to provide for the present needs of the immediate future, the filter should have a normal capacity of 75,000.000 gals. daily and if a rate of 6,000,000 gals. can be maintained, an area of about 12½ acres would be required.

There can be no doubt that the natural purification that takes place in the lake, fortified by the operation of the filter, will effectually safeguard the quality of the water supply of the city and protect the citizens against any sort of water borne disease.

DRAINAGE AND IRRIGATION SECTION

Hydrometric Investigations Conducted at the Sunnyside Irrigation Project in Washington.*

The Sunnyside Canal is 60 miles long and parallels the Yakima River. It irrigates practically all of the land between itself and the river and has one lateral which crosses the river to lands on the opposite bank. In all about 47,000 acres of land were irrigated in 1909. The soil of the valley is of volcanic ash, loam, sand and clay, with occasional deposits of gravel and, at the lower end of the canal, porous lava rock with occasional pockets. Diversified farming prevails and small holdings of 10 to 40 acres predominate. The rainfall, mostly snowfall, averages 7 ins. per annum.

For operating purposes the canal is divided into 12 beats, and there are 3 lateral beats. Each beat is in charge of a patrolman whose duty it is to inspect daily his proportion of canal and to regulate the gates for delivering water to laterals and to individual tracts. There is a guying station at the extremity of each beat, and at points where water is diverted there are wiers or other measuring devices with gages for measuring heads. Each morning each patrolman reads gage heights at stations and heights of head at diversions and reports them immediately by telephone and later by weekly report card. These reports are received by the hydrographer, who also conducts supplementary current meter readings, etc., by whom they are computed and analyzed and reported daily, weekly and monthly to the manager. The reports to the manager show quantity received at the intake, quantity diverted into laterals, and quantity wasted and lost.

Conditions of Canal Hydrometry.—The desire for greater efficiency in operation led to the adoption of a hydrometric division as a part of the operation department of the Sunnyside Project. It was soon realized that conservative distribution could not be obtained without a systematic and exhaustive study of the disposition of all waters diverted into the canal, the object being to determine as nearly as possible the relative quantities actually used on agricultural lands, wasted in operation, and lost by seepage and evaporation.

The first steps were necessarily experimental, for the scheme opened up somewhat new phases of hydrometric work. The chief difference consists in the fact that a much higher degree of accuracy is required than is considered necessary in ordinary river hydrometry. The truth of this will be at once recognized after considering the ultimate aim of the two lines of work.

In river hydrometry the aim is to determine the flow at desired points in order that the future behavior of streams may be predicted, the assumption being that past behavior is a fair indication of future conditions. These data form a basis for the design of structures, and for determining the feasibility of proposed projects. In general, if results on rivers are secured within 10 per cent of the actual flows they are sufficiently accurate for practical purposes, for it would not be wise to go to the expense of securing ultra-refined results on rivers when it is known that past behaviors are only approximate indications of the future. Other uses for river data, of course, create exceptions to this general statement.

In canal hydrometry, however, an entirely different perspective must be taken. The flow is always under artificial regulation. Unnecessary wastes are at once detected, and changes for betterment, either in structures or methods of delivery, can be adopted, with actual data as a basis. The diversion of more water than is required for the system unnecessarily deprives other canals, below or above, of water that could be used beneficially elsewhere. From the operation standpoint, in connection with the "human problems" encountered, it is highly important to know at all times how much water is being delivered to every farm unit of the system. In short, if systematic hydrometric work is carried on, in conjunction with the operation of any canal system, the officers know the conditions at all times; if not, they work blindly.

A little reflection will reveal the exacting nature of these investigations, if consistent results are obtained. The hydrometric division is frequently concerned with differences of 1 sec.-ft. or less in 500 or more. It is impossible, of course, to secure as accurate results as this, yet they are useless unless they possess a degree of accuracy considerably beyond that heretofore conceded possible in ordinary field hydrometry. The present methods cannot be discarded, but they can be refined and adapted to the exigencies of the case.

Sources of error, which in ordinary river work could be overlooked, must be eliminated as far as possible, or the results secured will not fulfill the purposes for which they are intended. Some of the physical difficulties encountered on the Sunnyside Project and the methods used to overcome them will be more or less applicable to all large irrigation systems.

Gage heights, heretofore, have been used in all hydrometric work as a basis for determining the daily flow. From measurements of discharge by current meter at various stages a discharge curve is developed to which intermediate gage heights are applied. Strictly speaking, gage heights are an index of area only. Under permanent conditions of bed and banks, or when indicative of the head over some controlling obstruction, as a rocky ledge or a weir, gage heights are a fair indication of discharge. These conditions, however, seldom exist in earth sections.

The water in most irrigation canals carries large quantities of silt. This causes continual changes in the bed and banks, and consequently the gradient of the canal. Tumble-weeds and thistles are a source of endless trouble. They roll into the canal, are carried along by the current until they encounter an obstruction or become water-logged, or weighted with silt, and sink to the bottom. There they form the nucleus of an obstruction which continually enlarges, backing up the water until the increased pressure and currents carry them away. Such back-water effects are relatively small, but by no means negligible; yet their effect is indeterminate, and no corrections can be applied for them.

Wherever the velocity is retarded, the canals gradually silt up as the season advances, so that a gradually increasing back-water effect is encountered. In many places the growth of weeds and moss in the canal and along the banks produce the same back-water effect. Sweet clover is particularly troublesome. It grows luxuriantly along the banks, and, as the tops bend over and trail in the water, they soon become heavy with silt and seriously obstruct the channel. Such back-water effects are progressive with the season, and corrections are readily applied if a sufficient number of discharge measurements are made. For these reasons, gage readings as reported are not an index of discharge, and only become so after corrections for these effects have been applied to them.

Gage heights and the head on weirs are read and reported once a day. A single reading indicates only the rate of flow at the time of observation, and it is necessary to assume that this rate obtains for the entire 24 hours. This assumption may lead to errors which are sometimes cumulative instead of compensating, as might be expected.

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*[illegible] Hydrometric [illegible] the Su[illegible] Irrigation Project," by J. C. Stevens, Treas. Am. Soc. C. E., Vol. LXX [illegible]

The delivery of water usually begins about April 1, and, as the season advances, the head of water in the canal is gradually increased to the maximum requirement, which occurs about the middle of August. Crop requirements are variable, and these variations are largely taken care of at the waste-ways.

The operation of checks for keeping the water to levels required for delivery usually proves to be one of the most serious difficulties. These checks are so numerous in the first 30 miles of the Sunnyside Canal that it is almost impossible to select a point for a gaging station which is not influenced by one of them. The difficulty arises from the variable back-water they cause.

If it were not for the weeds and trash, which, in spite of all precautions, will find their way into the canal and accumulate at these checks, no serious difficulty would be encountered at gaging stations within their influence, although the data to be gathered and analyzed, in order to correct for the back-water they cause, greatly increase the labor of computations. This accumulation of trash, and its subsequent removal, renders the control they exert on the flow an irregularly variable quantity. If this were not the case, the control would vary with some degree of regularity, and due allowances could be made.

Such severe conditions, of course, are seldom if ever met in river hydrometry, and it is on river requirements that the present hydrometric methods have been developed. It is true that in canals there is not a great range of stage with which to contend, yet the conditions within these stage limits are far more intricate than are encountered in river work, and require special treatment.

Methods Adopted.—The methods followed on the Sunnyside Project will be generally applicable to all cases where results of a fairly high degree of accuracy are required. The plan followed is by no means perfect, neither were the results secured as accurate as might be desired, however, they were sufficient for the immediate requirements, and marked a decided advance over ordinary river hydrometry. In general, the methods were those at present practiced by the Water Resources Branch of the U. S. Geological Survey, except that each detail was carried to a greater degree of refinement.

Current-Meter Measurements.—The current-meter measurements were all made with the improved Small Price Pena-Meter, which indicates every fifth revolution of the wheel. The meter, at all except the shallow-water stations, was suspended on a single steel wire in order to reduce oscillations. A ground circuit completed the electrical connection with the telephone indicator.*

Velocity observations were taken at 2/10 and 8/10 of the depth, and the average velocity thus determined was taken as the mean velocity in the vertical. This method has proved to be the most reliable for general field practice, where depth of water will permit. In depths less than about 1 ft. the 6/10 method of determining velocity was used. Observations were taken at intervals not greater than 2 ft. across the stream.

Gages.—Several types of staff gages have been tried. One graduated directly to hundredths of a foot by fine saw marks was found to be the best. The graduations are made on a clear piece of 1 by 3-in. board. For a space of 1 in. along one edge, the face of the board is slightly beveled, and the hundredth marks are first laid off in pencil on this beveled portion, and then sawed in a miter-box. The tenth and foot marks are made in the same manner on that portion of the face which is not beveled. The figures are stenciled in black paint. In placing gages, an arbitrary datum was used at each station, the only precaution being to place the gage low enough to avoid negative gage heights.

The gages for reading the head of water on the weirs were made in 1-ft. and 2-ft. lengths. The graduations were in inches and eighths. Each was placed with its zero level with the crest of the weir. It is the intention to replace all weir gages with a better type, reading to hundredths of a foot, but the water users under the old management had become accustomed to weir-heads measured in inches and the patrolmen's tables for individual allowances were in these units. For the sake of uniformity, therefore, the same units were used at diversions.

Four Lietz self-registering gages were placed at favorable points along the main canal, in order to determine the extent of fluctuations and the error involved in using a single gage reading for ascertaining daily discharge. They were placed respectively at the Intake, the 17-Mile, 28-Mile, and 42-Mile gaging stations. The staff gages at these stations were reported the same as at all other stations, irrespective of the Lietz gages. Some difficulty was encountered at first in keeping them running. The stylo-pens furnished by the manufacturers were found to be worthless, and not until soft pencils were substituted and the patrolmen became familiar with the peculiarities of the gages were good results obtained.

Computations.—Discharge curves were prepared in the usual manner, and daily discharges were taken from rating tables made from the discharge curves. As soon as two or three measurements were taken at one station a provisional rating was made. This was revised from time to time as more data were secured. At the close of the season the entire field was reviewed, and new ratings were prepared, using the entire season's data, and all discharges were tabulated anew.

At [illegible] was it possible to use the rating tables directly. At all other stations indirect methods had to be followed. This was due to silting, or the growth of weeds, causing back-water effects. Where these changes are progressive, the indirect method will give as good results as the direct, if a sufficient number of measurements are taken to define the correction curve.

Stout's indirect method was the one followed. This was first used by O. V. P. Stout, Professor of Civil Engineering, University of Nebraska, to determine daily discharges in streams with shifting sandy beds. In effect it reduces the labor otherwise involved in the use of a number of rating tables, each applicable for a short period, and smooths the transition from one to the other. A rating table is prepared which gives, as nearly as possible, the relation between gage heights and discharge if there were no changes in the rating. Then corrections are applied to the gage heights before applying them to the table. The corrections are read from a correction curve in which the times are the abscissas and the differences between this rating table and the measured discharges are the ordinates.

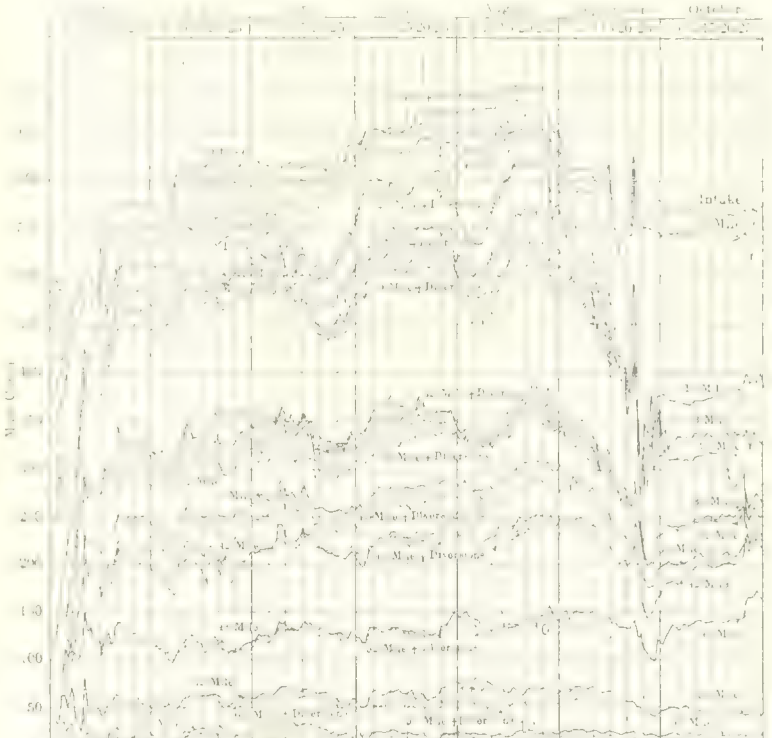

Fig. 1—Hydrographs of Sunnyside Canal.

Cost.—Careful records of the costs of the hydrometric work were kept on this project, and are summarized in Table I. They do not include the services of a recording clerk nor the time spent by patrolmen in taking gage readings. These men were regular employes of the operation department, and had many duties not connected with the hydrometric work. Otherwise these costs include all field work during the irrigating season, current analysis and reports, and the cost of the final analysis and report after the season closed.

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*The Use and Care of the Current Meter, as Practiced by the U. S. Geological Survey. By John C. Hoyt, M. Am. Soc. C. E. Trans. Am. Soc. C. E., Vol. LXVI, p. 7[illegible]

[illegible]

	Amount.	of total.
[illegible]	....$ [illegible]	[illegible]
Computations [illegible]		
[illegible]	201.12	
[illegible]	272.16	
[illegible]	110.10	
[illegible]	[illegible]	[illegible]

[illegible] use in operation, it is necessary that the results be worked up as rapidly as they accrue. If the direct method of applying daily gage readings to discharge curves could be used throughout, this requirement could easily be met; but, for stations in earth sections and within the influence of checks and other disturbing factors, some indirect method must be used, as long as gage heights alone are depended on as an index of discharge. Discharge measurements must be made at frequent intervals and at critical times. It is obviously impossible to determine the proper corrections to be applied to gage heights on any one day until the measurement at the end of that time interval has been made. To make a meter measurement every day at each station is out of the question. The period which may safely be allowed between times of gagings will depend on the stability of conditons at that station; but, in general, from ten to fifteen days may be regarded as the limit.

In preparing discharge data for current uses, the only method that can be followed is to estimate from known conditions and the corrections indicated by the gaging last made, what corrections to gage heights are necessary. This will enable the hydrographer to prepare daily reports showing approximately the disposition of water in the system. At the end of the week or month it is possible to revise the rating tables and correction curves, and approximate the truth more closely. At the end of the season all tabulations are made anew, and final adjustments permit the elimination of all errors as far as possible. The labor involved in this process is great, for the estimates for some stations may require revision ten or more times. However, a little practice, and the adoption of some short-cut methods, enabled the hydrographer with one clerical assistant to keep the computations up to date.

For daily requirements approximate results are sufficient, because they are used chiefly for the distribution of water in the main channels day by day. The weekly and monthly reports are revisions, and serve for a broader study of distribution to certain areas or to certain crops. The final seasonal report furnishes data whereby the general efficiency of the season's operation can be studied. The lessons learned from one season's operation are thus utilized in planning the next season's work.

Under the Sunnyside Project, sufficient data on crop statistics and crop requirements had not been secured previous to 1909 to render the discharge data of the highest possible use. The acreage irrigated varies day by day and month by month, and this variation should be known in order to operate the system efficiently. The acreage in the various crops had not been secured except in a very general way. It takes a great deal of time to gather all these statistics and to keep them up to date. On this project steps are being taken to gather very complete data of this nature, but they are not available for study in connection with the discharge data secured in 1909. On this account, only general lessons can be drawn from that season's operation.

Table II shows the monthly and seasonal disposition of all water received at the intake. The unit is the acre-foot. It also shows the quantity wasted through operation and the quantity delivered to the water users. The latter is an approximation, and includes the error of estimating the seepage losses in the distributing laterals.

Table II is worthy of study. It shows that 68 per cent of the water diverted from the Yakima River was delivered to water users and that 28 per cent was lost by seepage, of which 17 per cent applies to the main canal and 11 per cent (estimated) to the distributing laterals. This, of course, is not "seepage," in the strict sense of the word, for it includes evaporation and the uncompensated errors of observation and measurement. In regulation, 4 per cent was wasted.

The percentage of water diverted into the distributing laterals by months is a fairly good measure of the efficiency of the system. This had its maximum value of 83 per cent in May. During this month the canal is free from weeds, all weirs are in good measuring condition, and the head in the canal is not excessive. August is the least efficient month, for the canal is crowded to its maximum capacity to supply the demand for water, the carrying capacity of the laterals is relatively low, and the losses are consequently high.

Table II also indicates that the lands under the canal received water equivalent to a total depth of 2.87 ft. during the season of [illegible] months. This figure is obtained by dividing the total quantity of water delivered to distributing laterals by the total acreage, after making reasonable allowances for seepage. It is somewhat doubtful whether or not the lands received all of this water, because the disposition of water on individual tracts is not known, but, if they did, it surely represents a great waste. It means that there were applied to the land large quantities which did not benefit the growing plants. In the irrigation of alfalfa, for instance, the frequent practice is to run the water in long furrows. Before any water has reached the farthermost end of the field, the soil at the upper end has become saturated to depths far beyond those required by plant roots. This can be remedied by running the water in shorter furrows, by the use of additional heading ditches, or by using a sufficient head of water to carry it to the farther end quickly. The latter plan is by far the better, but, under the continuous-rate method of delivery, it is frequently impossible, because of lack of sufficient water at one time. As a general thing, water can be saved by giving the irrigation a large volume for a short time rather than a small volume for the entire season. A plan of rotation can frequently be effected by mutual agreement among those irrigators drawing water from the same lateral. Sufficient water is delivered to the head of the lateral, at a continuous rate, to furnish the contract allowances for all land under it. The irrigators then agree among themselves as to the times of distribution, and arrange a schedule of delivery accordingly. The water is distributed by the patrolman in accordance with these agreements. On some of the newer projects this plan has been adopted with excellent results, but, on the Sunnyside Project, there are several different contracts outstanding, as the government assumed to carry out all contracts in force between the former owners of the system and the water users. On this account it has been very difficult to put improved methods into practice, although the necessity for adopting them is fully realized.

The engineering difficulties connected with the development of such a system are entirely eclipsed by the "human problems" encountered in operation. The human tendency has always been to take everything that is due—and more. If an irrigator is by contract entitled to 1 sec.-ft. of water, he is likely to insist on having that quantity delivered whether or not he has use for it, even knowing that its application to his land would practically ruin his crops. He fears that by a relinquishment now he would forfeit his right to the water in the future. This human tendency will always be a source of trouble as long as water is delivered at a continuous rate. Some of the newer contracts allow so many acre-feet per acre per annum, or so much thereof as may be necessary for the production of crops, but the farmer is usually the judge as to the necessary quantity. While these provisions have certain advantages, the evil will never be cured until the irrigator is required to pay, according to a properly graduated scale, for the actual quantity of water used.

Another "human problem" encountered by the new administration was very satisfactorily solved after some experimental work had been done: The Sunnyside type of weir delivers from 2 to 8 per cent more water than would be delivered over a sharp-crested steel weir under the same head. This was determined by calibrating the two types by volumetric tests. Each water user's allowance is calculated for him in inches of head over his weir, and each irrigator, of course, knows the number of "inches of water" to which he is entitled. In order to limit each irrigator to the exact quantity allowed to him, it would have been necessary to reduce slightly the head allowed each. The reason for such a reduction could never be explained to the layman, and would have brought forth very bitter protest, and probably litigation would have followed; but, by substituting a weir sheared from thin steel plate, each irrigator could still get the same head of water over his weir, but not the excess water to which he had become accustomed. The reduction in individul cases could hardly be detected, but in the aggregate a saving of nearly 4 per cent of the water supply would result. The steel weir is being installed on the new work of the project, and is gradually being substituted for the old type in present structures.

In designing an irrigation system, as well as a power-plant, it is necessary to provide for the "peak load." In power-plants this feature usually becomes the major item in the cost of operations. In irrigation, however, the situation in this regard is rarely so acute. The maximum demand may continue for 15 or 20 days, and, by judicious management, it is frequently possible to extend it over a longer period. The carrying capacity of a canal and distributing laterals, and thus the cost of the project, is largely fixed by the maximum requirement. By intelligent distribution of the water, with regard to the time of irrigating the various crops, and by encouraging the water users to plant a diversity of crops, this peak can be broadened, thus reducing a rate of flow that otherwise might be difficult to main-

TABLE II.—SEASONAL DISPOSITION OF WAT[illegible] RECEIVED AT THE INTAKE OF SUNNYSIDE CANAL IN 1909.

	April 16 to 30.	May.	June.	July.	Aug.	Sept. 1 to 15.	Total.
Water received at intake, in acre-feet	[illegible]	[illegible]	36,830	40,820	42,060	18,300	192,600
Wasted in operation, in acre-feet	[illegible]	655	2,416	915	2,101	1,077	8,070
Wasted in operation, percentage	5.3	1.8	6.6	2.2	5.0	5.9	4.2
Losses from main canal (seepage, etc.), in acre-feet	[illegible]	5,643	5,015	7,453	8,324	3,441	32,650
Losses from main canal, percentage	16.1	15.1	13.6	18.2	19.8	18.8	16.9
Diverted into distributing laterals, in acre-feet	13,640	31,130	29,380	32,240	31,670	13,830	151,900
Diverted into distributing laterals, percentage	79	83	80	79	75	76	79
Estimated loss in distributing laterals, in acre-feet*	1,857	4,118	4,017	4,358	4,324	2,093	20,800
Net amount used on lands, in acre-feet	11,780	26,990	25,360	27,890	27,340	11,740	131,100
Net amount used on lands, percentage	67	72	69	71	65	64	68
Acres irrigated	......	..	..	..	......	......	47,000
Depth of water applied, in feet	......	..	..	..	..	......	2.79
Rainfall, in feet	0.001	0.015	0.016	0.043	0	0.002	0.077
Total depth received by the land, in feet	....	..	..	..	....	......	2.87

*Loss in distributing laterals assumed as follows:

5%, intake to 17-mile; 10%, 17 to 30-mile; 15%, 30 to 52-mile; 25%, below 52-mile. These values [illegible] from the investigations of seepage made in 1908 on certain laterals chosen for that purpose.

[illegible] greater quantity of water than most other crops. Under the same project, this crop ripens and is cut at about [illegible]. It is irrigated after each cutting. Under the Sunnyside Project, three cuttings are secured, hence, if the entire area was cropped to alfalfa, there would be three "peaks" to the distributing load during the season, and they would be so high that it would be impossible to supply the water, with the present ditch capacities; but, where alfalfa fields alternate with orchards, potatoes, beets, timothy, clover, small fruit, etc., the demand is much more uniform. The extent to which conditions in this regard can be improved by encouraging diversified farming among the irrigators, is somewhat surprising. To do this effectively there is need for exhaustive and systematic study of the most efficient duty of water, for different crops and for different soils. Only the most general results have been secured in this line, up to the present time, nor is it possible to secure more specific data elsewhere than on the project where the data are to be utilized.

An experimental irrigation farm should be as much a part of the equipment of a large irrigation system as the ditches themselves. Such a farm should be placed in charge of a skilled agriculturist, and then the results should be presented to the water users in an attractive and forceful manner.

Fig. 1 shows the hydrographs obtained at all stations on the Sunnyside Project during the season of 1909. These illustrate the "peak loads" for that project. The solid lines represent the inflow into each beat. The dotted lines represent the outflow plus the diversions in each beat. The differences between these two curves, shown as shaded areas, represent losses.

The volume carried by the canal is regulated at the intake and at the Zillah Waste-way, just above the 17-Mile gaging station. The lands above the 23-Mile station are nearly all in orchards, while below this point alfalfa is the prevailing crop. The effect of the necessary manipulation of the Zillah Waste-way to supply the variable demand for alfalfa irrigation is well illustrated in the 23-Mile hydrograph (Fig. 1). The first irrigation of alfalfa occurred during May. Cutting began about the middle of June, and water had to be wasted or lands at the lower end of the canal would have been damaged and the safety of the canal menaced. As soon as the alfalfa was cut, the fields required another irrigation, which began about July 5th. The second cutting was made early in August, and irrigation of the cut over fields began about August 15th. The third cutting began about September 15th, and other crop requirements began to fall off, which necessitated shutting down the supply very suddenly.

The gates to individual measuring boxes are arranged so that the water user may shut off his supply at will, but he cannot open it to deliver more than a certain quantity without breaking a padlock and subjecting himself to penalties. The result is that considerable quantities are frequently turned into the main canal without the knowledge of the management, although patrolmen are always on the watch for such an emergency. The head-gates of laterals are being adjusted continually, and this requires continual adjustment at the head and waste-way in the main canal. At the time of maximum requirement—August 14 to 26, 1909—the situation in this regard became very acute, for the canal and laterals were almost to the breaking point in many places, and a few second-feet more would cause serious damage.

[illegible] average of the inflow, outflow, diversions, and losses in 1909 on the Sunnyside System, considered in four principal sections. The sections are, respectively, 30, 18, and 12 miles in length, for the main canal, and 9 miles for the principal lateral. For general use, the losses are expressed in percentages of the inflow into each section, and in second-feet per acre of wetted area in the bed and banks of the canal. Seepage is not properly expressed as a percentage of flow, because it may occur from a still pond, but it is given because it is a convenient unit and is useful for relative comparisons.

The losses shown in Table III are not seepage alone, but include the uncompensated errors of the methods used; hence daily losses, as shown in Fig. 1, will be more variable than monthly averages, and should not be used for general deductions. Observing this precaution, it is seen, from Fig. 1 and the foregoing tables, that the maximum flow in the main canal at the head was 11 per cent greater than the average for the season. The highest diversion in one month into the distributing laterals of the system was 8 per cent greater than the average for the season, while the average losses for the month of greatest diversion was 38 per cent greater than the average losses for the season. This disproportionate increase in the losses with an increase in the flow of the canal and laterals is very striking, and indicates the necessity of keeping the demand as nearly uniform as possible.

The foregoing tables and figures show briefly the results of hyrometric work secured on the Sunnyside Canal in 1909. This work is being continued as an operation adjunct. In connection therewith complete crop statistics are being gathered, and it is likely that these practices will suggest methods whereby the efficiency in operation of such a large system can be continually improved. Hydrometry is seen to be at the foundation of every investigation of this nature, but its use in this connection is comparatively new. The exigencies of the case demand a much higher degree of accuracy than heretofore has been considered possible. Yet if refined methods can be adopted and practicable results secured it offers a possible method of determining the flow in many canals, which, on account of low gradients, could not be measured in any other way.

It has been estimated that 1 sec.-ft. of water applied to lands under the Sunnyside Project creates for them a valuation of $80,000. Every second-foot of water, therefore, which by judicious management can be transferred from waste to beneficial use, increases the taxable property of the state that much, and adds its due proportion of homes to the social system.

It would seem, therefore, that almost no limit of accuracy should be recognized for hydrometric work on an irrigation system, because hydrometry is the essence of conservative operation. The fact remains, however, that canals have been operated after a fashion with only the crudest general knowledge of the flow. Such methods are not destined to continue, for, although the water supply may be bountiful and the prevention of waste an unnecessary expense, systematic hydrometric work is not the less important. The excessive use of water on land is a most harmful practice, for, not only is the immediate owner depriving himself of profits which a more conservative use would insure, but he frequently works untold injury to his neighbors. Examples of this pernicious practice are only too numerous. It is practically certain that irrigated lands, the country over, would produce more and better crops if less water was used, and more attention was given to cultivation and the times and manner of irrigation. In determining the most effectual quantity of water for different crops and different soils, and in the proper delivery of this quantity after determination, the highest possible degree of accuracy in canal hydrometry must be attempted.

TABLE III.—INFLOW, OUTFLOW, DIVERSIONS, AND LOSSES [illegible] PRINCIPAL SECTIONS OF SUNNYSIDE CANAL IN 1909.

	Av. [illegible]	May.	J[illegible]	[illegible]	Aug.	Sept. [illegible]	[illegible]
Main Canal:							
[illegible]							
Inflow	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Outflow	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	326	[illegible]
Difference	[illegible]	[illegible]	[illegible]	305	[illegible]	290	[illegible]
Diversions	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	246	[illegible]
Losses, in second-feet	[illegible]	[illegible]	[illegible]	13	[illegible]	[illegible]	[illegible]
Losses, in percentage of inflow	[illegible]	[illegible]	[illegible]	6.5	[illegible]	7.1	6.0
Wetted perimeter, in acres	[illegible]	[illegible]	155.5	[illegible]	160.6	[illegible]	156.8
Losses, in second-feet per acre	[illegible]	[illegible]	[illegible]	[illegible]	0.112	0.253	[illegible]
30-Mile to 48-Mile.							
Inflow	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	326	340
Outflow	[illegible]	[illegible]	[illegible]	[illegible]	137	[illegible]	129
Difference	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	182	211
Diversions	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	171
Losses, in second-feet	[illegible]	[illegible]	[illegible]	[illegible]	29	24	40
Losses, in percentage of inflow	13.7	14.6	12.1	13.4	[illegible]	7.4	11.8
Wetted perimeter, in acres	71.1	71.0	72.1	[illegible]	81.6	79.5	76.1
Losses, in second-feet per acre	[illegible]	[illegible]	0.568	0.577	[illegible]	[illegible]	0.520
48-Mile to 60-Mile.							
Inflow	[illegible]	[illegible]	[illegible]	128	137	114	129
Outflow	10[illegible]	10[illegible]	11[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Difference	117	[illegible]	11[illegible]	121	[illegible]	135	120
Diversions	[illegible]	88	1[illegible]	103	106	105	[illegible]
Losses, in second-feet	20	14	[illegible]	[illegible]	24	30	21
Losses, in percentage of inflow	16.0	12.5	[illegible]	11.1	17.5	20.8	16.3
Wetted perimeter, in acres	23.9	23.9	[illegible]	[illegible]	26.9	[illegible]	25.2
Losses, in second-feet per acre	0.837	0.586	[illegible]	0.723	[illegible]	1.16	[illegible]
Snipe's Mountain Lateral:							
0 to 9-Mile.							
Inflow	70	86	[illegible]	[illegible]	95	90	[illegible]
Outflow	18	20	[illegible]	[illegible]	20	20	20
Difference	[illegible]	66	[illegible]	[illegible]	[illegible]	70	63
Diversions	18	57	[illegible]	56	[illegible]	[illegible]	57
Losses, in second-feet	4	9	[illegible]	17	16	14	12
Losses, in percentage of inflow	5.7	10.5	[illegible]	[illegible]	16.8	15.6	13.5
Wetted perimeter, in acres	18.3	19.0	[illegible]	19.1	20.1	19.5	19.2
Losses, in second-feet per acre	0.22	0.47	[illegible]	0.89	0.80	0.72	0.63

One span of this type is in the new Mississippi River bridge at Keithsburg, Ill., on the Iowa Central Ry. The span is about 230 ft. and the lift about 45 ft. The inclined legs of the towers are connected to the adjacent fixed spans, and in case the river channel shifts the towers may be transferred and another span arranged to life. Another one completed last year is the Hawthorne Ave. bridge at Portland, Ore., which has a lift span about 244 ft. long. The width of this highway bridge is 63 ft. 8 ins. and the vertical lift is 110 ft.

Reference has been made previously to the lifting suspended deck of one of the spans in the Kansas City bridge which gives a clearance of 55 ft. for steamboats. At Portland a bridge is under construction in which a suspended deck is to be lifted for vessels requiring a low clearance while the entire span is lifted for higher clearances. At Chicago the direct lift has been adopted for a skew span on the Pennsylvania Lines. The span is about 217 ft. between centers of bearings and the vertical lift about 130 ft. Several other examples of this type are located in Arkansas, Idaho, and Washington, and during the past year one was completed at Mohawk Pl. in Cincinnati over the Miami and Erie Canal.

Bascule bridges are being built extensively and their use is no longer confined to locations where it is necessary to avoid encroachment upon the adjacent frontage for docks.

An Instrument for Measuring the Flow of Water in Large Pipe Lines.*

[illegible]

[illegible] flowing in 3 large pipe lines supplying the Minnequa Works of the Colorado Fuel & Iron Co. at Pueblo, Colo. Two of these pipe lines conduct the water from certain receiving reservoirs about 150 ft. higher than the works, and

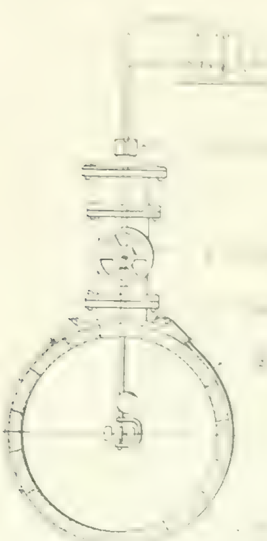

Fig. 1—Current Meter with Electric Counting Device, and Method of Inserting in Pipe.

[illegible] system of supply to which [illegible] was made in the writer's paper, "A Colorado Mountain Reservoir," published in the *Journal* of the Western Society of Engineers, of August, 1907. One pipe is of 48-in., the other of 28-in. inside diameter, both of the wood-stave, banded type. A third pipe line of 28-in. diameter, also wood stave, leads from Lake Minnequa about a mile distant and 35 ft. above the works. All these lines are connected to a stand pipe and to the general distributing system of the plant, and can be used singly or in combination as desired. There is considerable fluctuation in pressure and in the amount of use, governed to a large extent by the operations of a repumping station and six blast furnaces.

Upon first taking up the problem there appeared to be only two recognized methods of measuring the flow of water in large pipe lines:

(1) By means of the Venturi tube and attachments.

(2) By the use of the Pitot tube or "Pitometer" apparatus.

A Pitometer apparatus was available, but [illegible] that in expert hands only would results be satisfactory.

It was also found that the cost of installation and operation of Venturi meters on the three pipe lines was greater than the results desired would justify. A thorough investigation of all known and accessible methods failed to disclose any cheap and simple "fool proof" apparatus for the purpose.

The insertion of a special form of current meter through an opening into the pipe in a similar manner to the Pitometer and registering its revolutions by an electric contact point was thought to be entirely feasible.

The construction of a special meter was entrusted to a well known maker of current meters and he produced a device which, after some changes and modifications, was put into use. It consists of the usual meter cups carried on a vertical spindle with steel pivot below and a guide bearing above. The spindle and upper bearing are within a closed, cup-shaped chamber and by means of a worm-gear-drive a dial plate carrying a platinum point, is made to contact with a tongue insulated from the body of the machine and connected by insulated wire through a hollow tube to the outside air. By attaching this in circuit with one or more dry cells and a counting device, the revolutions of the meter are recorded. This device, attached to a hollow tube of sufficient length, can be inserted into the pipe line as illustrated by Fig. 1.

This arrangement, in the case of wood pipe, consists of a curved saddle carrying a 6-in. flanged Tee, which is strapped on the pipe over a 6-in. hole. On this is placed a 6-in. gate valve and above this a chamber or nipple piece provided with flanges at top and bottom. The top is closed with a cover, which carries a stuffing box and gland. The cover and gland cap having been placed on the tube, the meter is inserted into the chamber piece, the cover bolted on and the gland packed. Then the 6-in. valve is opened and the meter pushed down through the disc opening of the valve to the required position. It is, of course, necessary that the device be of proper clearance diameter to pass the valve disc. The gland cap and stuffing box keep the hollow tube in a vertical position and the tube must have sufficient stiffness to retain, at least approximately, that position.

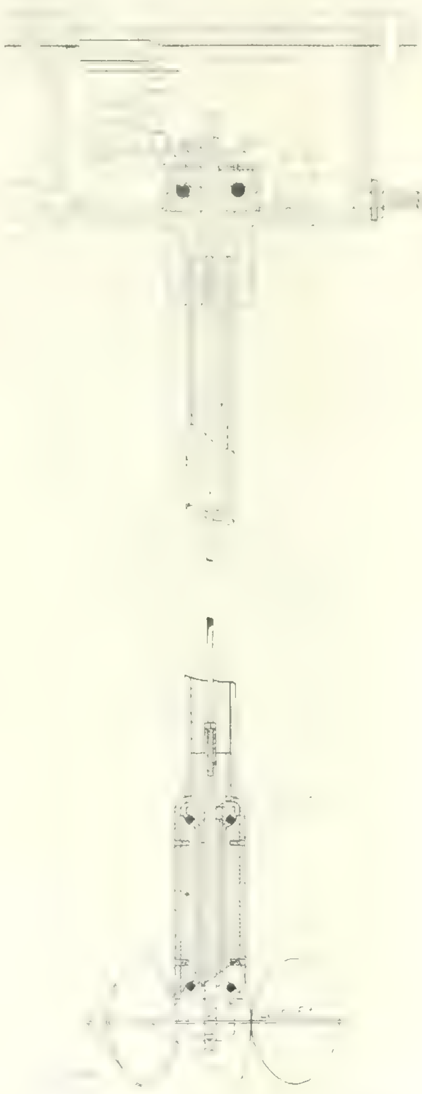

Fig. 2—Details of Current Meter with Mechanical Counting Device.

With such a device a velocity curve and coefficient of mean velocity can be experimentally determined for the particular pipe (in a vertical plane only), and the results of flow obtained are to that extent approximate.

Some experiments made with a 28-in. pipe line at different rates of flow, where the discharge passed over a carefully constructed weir, showed a variation between weir measurements and meter measurements of 3 per cent.

Similar vertical velocity curves obtained on a 48-in. wood-stave pipe of same character at different rates of flow gave substantially the same coefficient, but we are not able to check as yet against weir measurements of flow.

The meter registers the central velocity in the pipe, and the coefficient of mean velocity is taken at 0.89 to 0.91 as determined by a number of tests. In other words, if mean velocity equals Vm, and central velocity equals Vc, in a wood-stave pipe in clean condition,

$$\frac{Vm}{Vc} = 0.89 \text{ to } 0.91.$$

The equation of this meter is $V = 2.32 \frac{R}{T} +$ 0.02, determined between practical limits of velocity, as shown by diagram, Fig. 4.

In practice this device proved unavailable for continuous records owing to the difficulty of maintaining electric contacts, running down of batteries, and certain electrolytic action or corrosion which destroyed the working parts in steady service.

A mechanical meter therefore was constructed, as shown by Fig. 2, using the same style of cups and spindle coupled to a light brass rod extending centrally upwards through a hollow tube attached to a closed box with a cover, containing a plate glass window, intended to be bolted on to the box and by means of proper gasket made air or water tight. The central rod carries a striker at its upper end and is centered in a bearing, the lower end being carried on a steel pivot as in the ordinary current meter. The striker is made to successively engage with a 10-point pin wheel geared to an ordinary 6-dial counter such as is used in straight reading meters. In this manner the revolutions of the meter are registered positvely as long as the water moves with enough velocity to move the cups.

If the total revolutions are read daily, by using the equation of the meter and the proper coefficient of mean velocity, the daily discharge in cubic feet or gallons is readily deduced.

Careful tests on our own rating station show that under low velocity too much water passed this meter without being registered, due to the friction of the parts. Efforts were, therefore, made to improve the mechanical construction and reduce the friction coefficient.

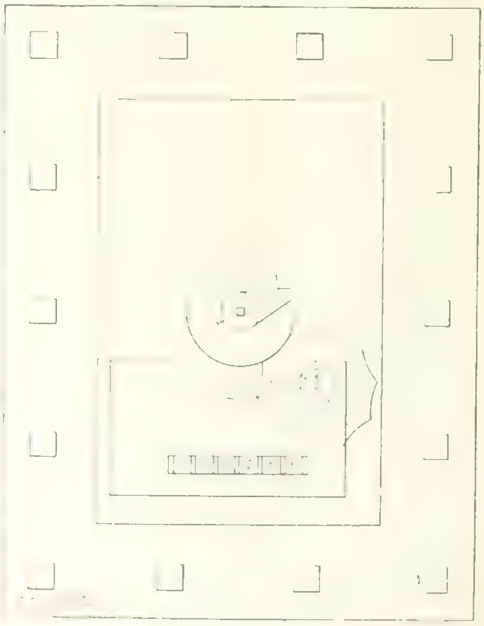

Fig. 3—Details of Counting Device Used with Meter Shown by Fig. 2.

A ball bearing meter was then designed containing a mechanical device as shown in Figs. 2 and 3, which prevents jamming or locking between the striker and the 10 pins on the driven wheel of the [illegible] In this device the striker is carried at the top of a light brass rod which is adjustably attached to the upper or movable half of a ball bearing. The latter is of a form to be easily removed from its seat. An upper liner or side thrust ball bearing not shown can be used, but it has not proved necessary in practice. The lower end of the brass rod passes through a ball bearing at the bottom of the hollow tube, similar to a bicycle pedal, but the rod fits loosely so that

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*[illegible] Western Society of Engineers [illegible] This paper was read before the Western Society of Engineers on May 1, 1911.

†[illegible] Engineer, Colorado Fuel & Iron Co., Pueblo, Colo.

[illegible] conditions warrant. This bearing takes up the side thrust due to the pressure of the water on the meter cups. The latter are removably tached in a similar manner to those furuished by several well known manufacturers.

It is interesting to note that the mean velocity in wood-stave pipe is here shown to be 90 per cent of central velocity, while reference to a paper entitled "The Pitometer and Water Works Losses," by Edward S. Cole, published

in *Proceedings*, American Water Works Association, of 1907, shows that in large cast-iron removing large masses of overlying materials. In order to judge of their suitableness for dam construction, a series of percolation experiments was made. After careful study of the results of these experiments a section of dam was adopted, as shown on Fig. 1. Stability was secured by the use of gravel throughout the entire section of the dam, water tightness by an admixture of fine sub-

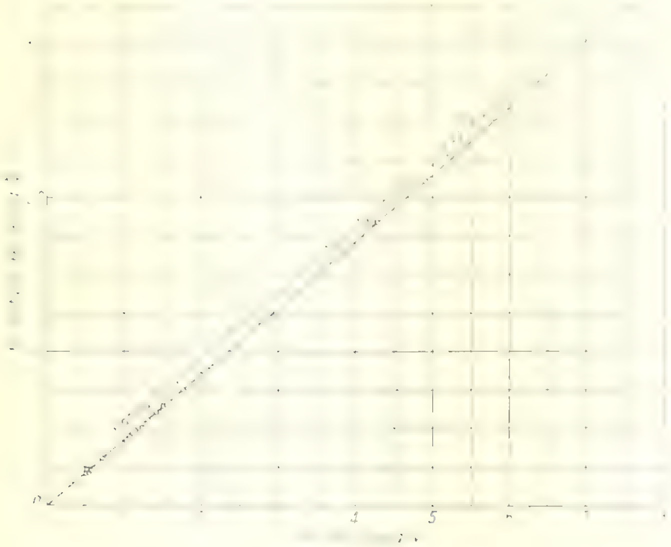

Fig. 4—Rating Curve of Electric Pipe-Meter as Shown by Fig. 1.

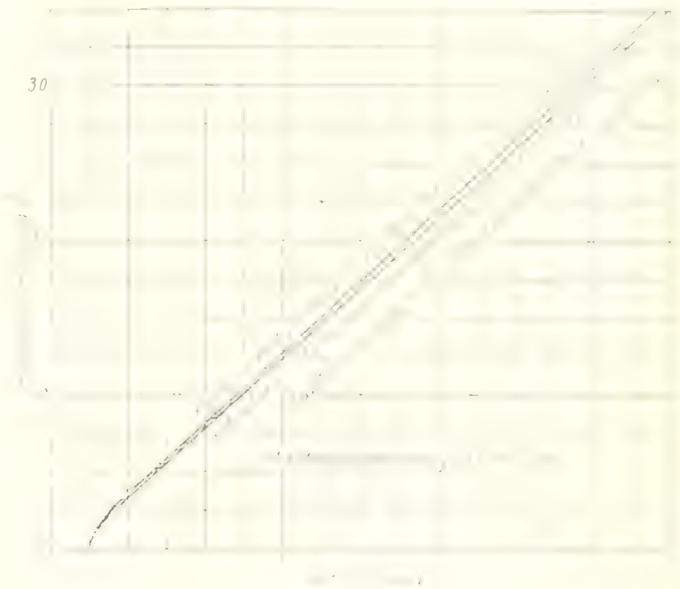

Fig. 5—Rating Curves of Mechanical Pipe-Meter as Shown by Fig. 2.

attached to the brass rod which extends through the end of the hollow tube and by suitable washers and locking nuts, is given sufficient end play. In operation the weight of the cups, washers, nuts, rod, striker, etc., is carried on a bronze ball bearing, and, as the whole can be made to weigh only a few ounces, the friction is very small.

Figure 5 shows the curve and equation of two of these meters.

Figures 2 and 3 show the details of construction as found most practical. It is evident of course that a train of gears would accomplish the purpose of recording the turns of the meter wheel, but it is believed that less friction is produced by using the striker and pin wheel, and it is to insure the proper and continuous action of these that the special device shown in detail, is used, in which there is no friction except at the moment of contact of striker and pin, when the momentum of the parts is utilized. The box being air and water tight can be pumped up with an automobile pump whenever necessary, which keeps out grit or mud and facilitates reading the dials. A blow off cock enables sediment to be blown out. The box is made of aluminum, and, the other parts being very light, the meter is easily handled by one person. All bearings can be kept oiled if desired.

In case the balls, or any parts wear or corrode or the water is shut out of the line, the meter can be taken out and, if desired, rerated at a rating station and the new equation determined in a few hours.

The same device can be used on an iron pipe of any sort by attaching a Tee, or other connection large enough for a 6-in. valve opening, and a stuffing box connection similar to that shown here.

The meter as described and illustrated herein can be built for about $100, and the necessary fittings to attach to a wood-stave pipe will cost about $50 more. In a cold climate some sort of protection for the meters will be necessary, such as a small brick house heated by some means in very severe weather. The house will cost about $300 more; the total outfit costing $600 for 2 meters.

In case a permanent automatic record is desired an electric recording device can be at-

pipes this coefficient ranges from 80 per cent to 85 per cent.

Methods and Cost of Constructing the Cold Springs Earth Fill Dam for the Umatilla Irrigation Project, Oregon.*

The Cold Springs Dam is part of the works of the Umatilla Project, which comprises a tract of land lying south of the Columbia River and east of the Umatilla River, encompassing the town of Hermiston, 192 miles due east of the city of Portland. The principal dimensions of the dam are:

Greatest [illegible]
[illegible]
Height [illegible]
Width [illegible]
Length [illegible]
Top width [illegible]
Length [illegible]
Up-stream [illegible]
Down-stream [illegible]
Total [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Area of [illegible]
[illegible]
Drainage [illegible]

[illegible]

There were available for dam construction, within reasonable distance, the following classes of material: (1) Basaltic rock, hard and sound, readily blasted and quite suitable for rip-rap; (2) gravel in deep hillside deposits on the north side of the canyon, ½ mile below the dam; (3) fine sandy loam, most readily available in any direction, for use in the embankment; (4) pure volcanic ash, in occasional strata and in small quantities; (5) indurated clay deposits, principally at the north end of the dam, and limited in area; (6) sand and gravel, in deeper strata underlying the surface soil, and to some extent indurated.

The first three were the only ones which could be obtained in large quantities without

soil in the up-stream portion of the section, and perfect drainage by the use of unmixed gravel in the down-stream portion.

The cut-off trench across the bottom of the canyon is 2 ft. deep and 30 ft. wide at its connection with bed rock. It reduces in depth and width up the hillsides until it is 6 ft. deep and has a bottom width of 10 ft. at the ends of the dam. To retard the flow along the plane of contact with bed rock a thin cut-off wall, 7 ft. high, was constructed on the center line of the trench, across the canyon, reducing in height up the side hill. Five additional walls were built on the north hillside where the rock was exposed.

Provision was made for drainage by a gravel-filled trench along the entire down-stream toe of the dam with tile drain, and a network of additional trenches under the high portion of the dam, consisting of a parallel trench 120 ft. up stream from the water toe, with cross trenches every 100 ft.

Slope Protection.—The water face of the dam is covered with 12 ins. of pit gravel and [illegible] face is covered with 12 ins. of rock rip-rap principally to prevent the gravel from being displaced and as a protection against wind action.

[illegible] reservoir near the south end of the dam. No rock could be found over which to drop the water, and a protective structure therefore became necessary. This consists of two continuous reinforced side walls, with bottoms stepped and tops sloping, with cross walls forming water pockets, floored with concrete and covered with wooden wearing floors, the water spilling over each cross wall and dropping into the water cushion formed by the next cross wall. There are nine water steps, with a vertical drop of 6 ft. each, the lowest cross wall having its top at low water elevation. At the top of the structure the side walls spread apart to accommodate a steel plate weir with a 24-ft. crest.

This drop structure was built in deep excavation, it being left to the incoming water to overflow through a training furrow and cut its own channel to low water in the reservoir. This was partly accomplished in the course of

---

*Ext[illegible] Two Earth Dams of th[illegible] United S[illegible] Henry [illegible] C. E., Vol. xxxvi [illegible]

[illegible] sec.-ft. Several steps still remain buried, owing to the grade assumed by the bottom of the cut. The sides of this cut stood at first vertical, but have gradually slumped and are tend[illegible].

About ¼ mile up stream from this structure, following the canal line, and where the canal alinement crosses the extended center line of the dam near its south end, a concrete gate structure has been built, with four arched openings, 6 ft. 6 ins. wide in the clear, with hinged floating gates to prevent the reservoir water, when raised above the spillway height by cloudbursts, from running back into the canal and overtopping its banks.

Flash boards are also provided for backing the canal water over a concrete crest in the canal bank some distance up stream into a lined channel, affording direct connection between the inlet and outlet canals and the means of by-passing the reservoir.

[illegible] let conduit and gate tower are located on bed rock on the south side of the canyon, with out-flow elevation at 560 ft., or approximately 17 ft. above the canyon bottom. There are two 4 by 4 ft. Coffin sluice gates, placed in series, one at the outside of the gate tower and the other at the inside, the former being an emergency gate.

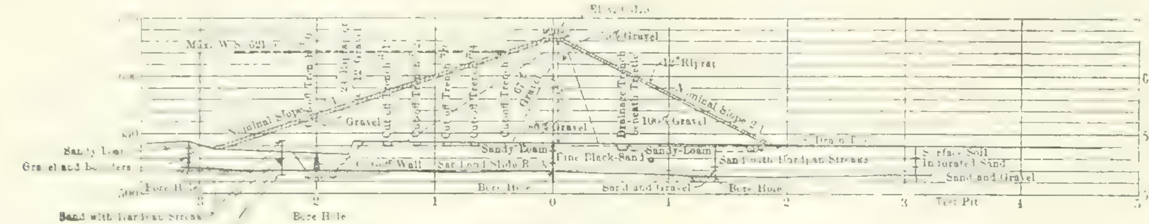

Fig. 1—Cross Section at Maximum Section of Cold Springs Earth Fill Dam.

The conduit is founded on rock, and there are cut-off collars at intervals of 30 ft., the conduit discharging into a canal cut in the rock for about 200 ft., below which it continues in earth. An overflow spillway is provided in the canal bank, cut in the rock section, the spill crest having concrete guide walls to the bottom of the canon. The outlet canal capacity is 225 sec.-ft. The gate tower at the upper end of the conduit stands near the water toe of the dam. It is built of concrete, slightly tapering, and is connected with the top of the dam by a steel footbridge.

Spillway.—On the hard clay bed on the north hill shoulder a spillway was built, with a crest length of 330 ft. and a crest elevation of 8 ft. below the top of the dam. At each end there are abutment walls, with cut-off walls reaching into the body of the dam. The water, after spilling over the crest, slides down an inclined concrete-paved slope and enters a concrete-lined channel with a general direction parallel to the overflow crest and at right angles to the dam. This channel is excavated in thorough cut past the line of the dam, through hard clay and fine sand formation, and terminates in hard rock at an elevation of 40 ft. above the canyon bed, the end being provided with a heavy cut-off wall extending well into the rocky sides.

The entire spillway channel has a concrete lining built in disconnected sections to 10-ft. squares, with joints underlaid by concrete cut-off walls. Where it passes through sand formation it is reinforced with ⅛-in. bars laid in 12-in. squares, and has weep holes on the dam side. The capacity of the spillway, with 3 ft. of water over the crest, is assumed at 5,900 ft., at which point the dam will have a freeboard of 5 ft. independent of a superelevation of 2 per cent of the height for possible settlement.

Method of Construction.—The design called for the handling of approximately 490,000 cu. yds. of gravel from the gravel pit in the north canon side, about ½ mile below the dam, for the excavation of 191,000 cu. yds. of loam or [illegible] mostly from the slopes within the reservoir, and for about 36,000 cu. yds. of rock pitching, to be placed on both slopes.

The gravel was excavated with a 70-ton, [illegible] No. [illegible], Marion steam shovel, with 2½ cu. yd. bucket. The rolling stock consisted of fifty 4-yd. side-dump cars and five 16-ton American locomotives running on a 3-ft. gage track of 35-lb. rails. The track system is shown by Fig. 2, the average distance of gravel haul being 2¼ miles and the maximum grade being 1¼ per cent. The gravel in the pit rose to from 30 to 60 ft. above the shovel and was in places overlaid with considerable soil, rendering it necessary to watch the proportions of soil and gravel as they came on the cars to the dump.

The shovel was served by four gravel trains of from nine to twelve cars each, which handled on an average, including moving and delays, about 1,600 cu. yds. per shift of 8 hours, the output per shift occasionally exceeding 2,200 cu. yds. The total rise from the steam shovel to the top of the dumping trestle was 65 ft., and the coal consumption per locomotive, for 1,149 shifts of 8 hours, averaged 2,400 lbs., coal being obtained from the Kemmerer mines in Wyoming.

The gravel was delivered on the dam by dumping from a trestle, 65 ft. high, built across the canon, with its center line about 60 ft. down stream from and nearly parallel to the center line of the dam. The entire trestle came within the 100 per cent of the gravel section, and the posts were left buried in the gravel, but all bracing was removed as the work progressed.

The fine subsoil or loam was obtained from various sources as follows:

	Cu. yds.
From surface layers overlying the gravel in the gravel pit	100,000
From borrow-pits on the side hill, up stream from the dam	108,600
From the feed canal and trenches	40,700
From the spillway channel	17,700
Total	267,000

The loam from the gravel pit was handled in the same manner as the gravel. The loam from the borrow pits was handled by wheel scrapers up to distances of 500 ft. (22,300 cu. yds.), and by dump wagons loaded by an orange-peel excavator for greater distances up to 2,000 ft. (86,300 cu. yds.). The loam from other sources was moved by scrapers, only that portion excavated from trenches, etc., being used which was found suitable, the remainder being wasted.

The loam was delivered first, in its proper proportions, and spread by a road scraper, after which gravel was spread over it, being scraped by Fresno scrapers from the foot of the gravel dump near the trestle. The materials were mixed at first with disk harrows and subsequently with cultivators, the points of which scraped over and into the top of the previously mixed and rolled layer, after which the material was watered and rolled, producing a final layer of from 4 to 5 ins. compacted into a hard mass which required picking to excavate. Constant watch was kept of the thoroughness of the mixing process by excavating test pits. It was found impossible to secure complete mixing at all times. Unmixed gravel was nowhere found, but in some places fine streaks of loam had been left unmixed with gravel, in spite of every effort to avoid it.

The gravel in the 100 per cent gravel section was not rolled to a large extent and was not watered. When the gravel dump had reached the height of the trestle, the track was raised by grading up until the full height of the dam was attained.

The rock for slope pitching was obtained from the rocky basalt bluff on the north side of the canon, a short distance below the dam. It broke up in fragments from 1 cu. ft. in volume down. A part of it was loaded by an orange-peel excavator, but most was handled from wheelbarrows into dump cars. It was hauled by rail, dumped on the slopes from the dump cars and sloped by hand. The total required was 36,000 cu. yds. The construction of the auxiliary structures contained no elements of special interest.

The work on the installation of the plant was commenced in December, 1906. The first gravel was dumped in May, 1907, and the dam was completed on January 1, 1908.

Shrinkage.—The design of the dam calls roughly for one-third of the mass 100 per cent gravel, one-third 50 per cent gravel, and the remaining third 67, 75 and 80 per cent gravel. Laboratory tests indicated a shrinkage of about 10 per cent for the various mixtures, and from this it was figured that there would be required 490,000 cu. yds. of gravel and 191,000 cu. yds. of loam, or a total of 681,000 cu. yds., to make the 637,000 cu. yds. of compacted dam.

The actual quantity of gravel excavated corresponds closely to the estimate, but the quantity of soil handled was 76,000 cu. yds. in excess of that figured. This large excess must be principally attributed to the difficulty of keeping the soil and gravel apart in the gravel pit, and may be partly due to the occurrence of volcanic ash or dust in the delivered soil, which may not have assisted in swelling the quantities. The proportion of loam in the gravel, where it came unavoidably mixed with gravel from the gravel pit, may have been underestimated, and it is quite probable that much of the gravel, which from all appearances contained no soil, may have held proportions of from 5 to 10 per cent. While the excess soil has added to the cost, it can hardly be deemed injurious as regards the drainage qualities of the gravel or its stability, and it has also added to its mass weight.

Cost.—The total cost of the dam, arranged by its principal features, is shown in the following tabulation:

Main dam	$361,140
Auxiliary structures:	
Inlet works	16,110
Outlet works	19,710
Spillway	35,010
	$437,860
Preliminary engineering	[illegible],000
Total, 49,000 acre ft., at $8.98 per acre ft.	$440,000

General administration, engineering and supervision, other than preliminary engineering, are included in the above figures.

The principal details of the cost of the main dam are as follows:

Embankment (yardage on basis of excavation measurement):

Material from gravel pit: Gravel, 490,000 cu. yds.; earth, 100,000 cu. yds.; total, 590,000 cu. yds. at $0.385	$227,020
Material from borrow-pits, spillway and trenches:	
Earth, 86,300 cu. yds., orange-peel excavator, 36.1 cts.	31,120
80,700 cu. yds. wheel scraper at 19.4 cts.	15,630
167,000 cu. yds., average, at $0.28	46,750

Rip-rap [illegible]	
From quarry, 32,[illegible] cu. yds. at $1.46	47,480
From trenches [illegible] (charged to excavation)	
Excavation [illegible]	
Earth from trenches [illegible] temporarily or permanently [illegible], 31,400 cu. yds. at $0.[illegible]	10,0[illegible]
Hardpan or loose [illegible] cu. yds. at $1.[illegible]	[illegible]
Solid rock [illegible] cu. yds. at $[illegible]	11,310
Concrete cut-off wall [illegible] cu. yds. at $1[illegible]	1,[illegible]
Drainage, including [illegible] to date [illegible] 1910	7,[illegible]
Total	$[illegible]

General [illegible]	1.8
Camp [illegible]	[illegible]
Clearing [illegible]	[illegible]
Engineering, administration and general expenses	[illegible]
	38.5

Embankment. Material from borrow-pits, 86,300 [illegible]

Cost per cubic yard, measured in excavation:

	Cents.
Excavation [illegible]	[illegible]
Wagon [illegible]	[illegible]
Sprinkling	0.4
Rolling	0.7
Water supply	[illegible]
Plant depreciation [illegible]	[illegible]

[illegible] follows:

	Per [illegible]
Common labor	[illegible]
Teamsters	[illegible]
Teams [illegible]	[illegible]
Steam [illegible]	[illegible]
Cranesmen	4.00
L[illegible]	[illegible]
Carpenters	$3.60 to 4.00
[illegible]	[illegible]

A number of direct lift bridges have been built in the last two years and others are now under construction, thus indicating a considerable revival of the type of the South Halsted St. bridge in Chicago, completed in 1894. Previous to that time the type in which a simple span is lifted vertically with the aid of counterweights had only been used for very short spans like those over the Erie Canal.

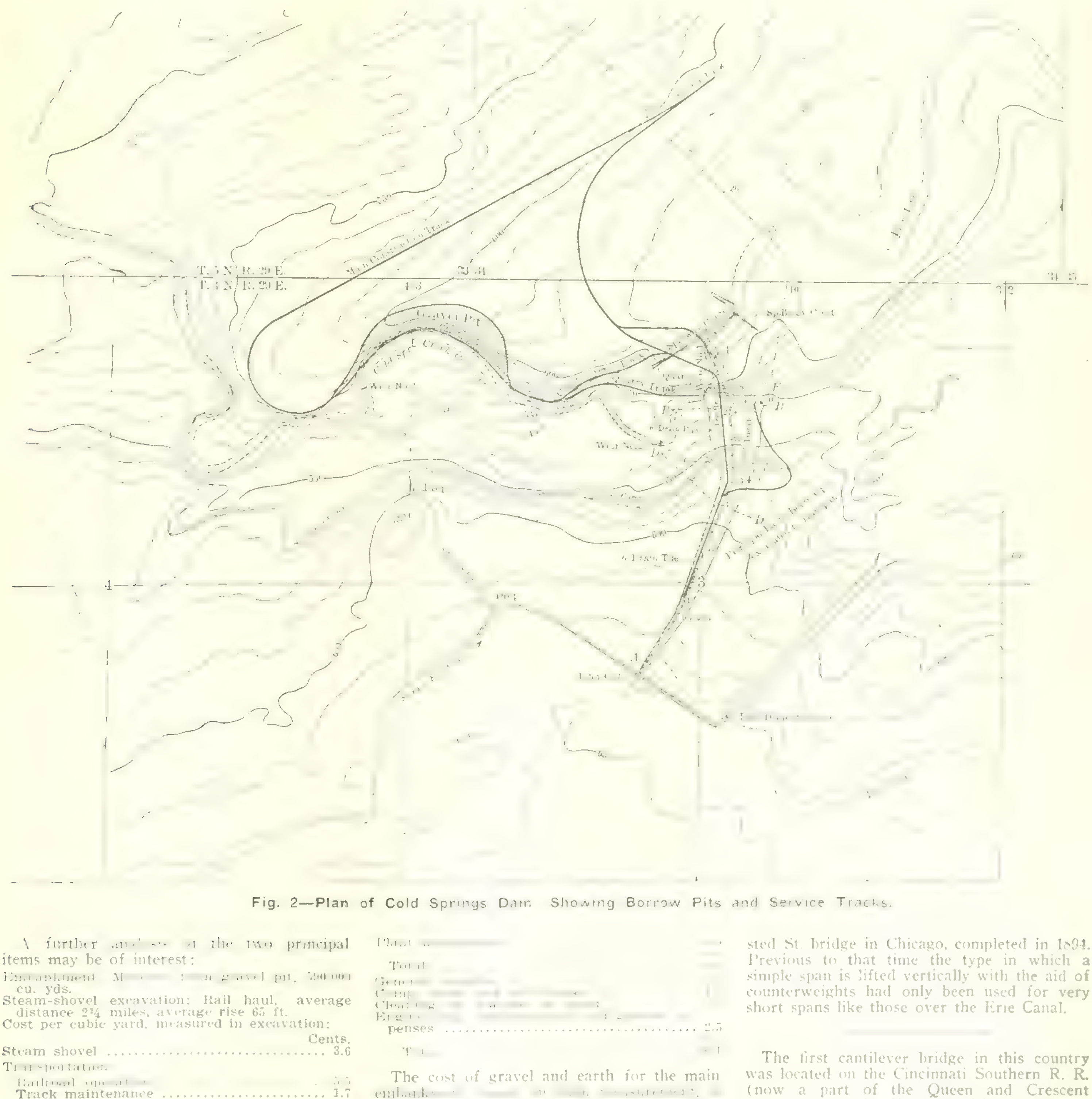

Fig. 2—Plan of Cold Springs Dam Showing Borrow Pits and Service Tracks.

A further analysis of the two principal items may be of interest:

Embankment. Material from gravel pit, 590,000 cu. yds.

Steam-shovel excavation: Rail haul, average distance 2¼ miles, average rise 65 ft.

Cost per cubic yard, measured in excavation:

	Cents.
Steam shovel	3.6
Transportation:	
Railroad operation	[illegible]
Track maintenance	1.7
Total	[illegible]
Work on dam:	
Scraping, spreading and mixing	8.2
Sprinkling	0.[illegible]
Rolling	0.[illegible]
Water supply	0.7
Total	9.6
Plant depreciation	10.4
Plant maintenance	0.4
Total	10.8
Plant [illegible]	[illegible]
Total	[illegible]
General [illegible]	[illegible]
Camp [illegible]	[illegible]
Clearing [illegible]	[illegible]
Engineering, administration and general expenses	2.5
Total	[illegible]

The cost of gravel and earth for the main embankment [illegible], is higher than the foregoing figures indicate, by reason [illegible] and is shown as follows:

Material from gravel pit, 590,000 cu. yds. at 38.5 cts.	$227,020
Material from borrow-pits, etc., 167,000 cu. yds. at 28.0 cts.	46,750
Total, 757,000 cu. yds. at 36.2 cts.	$273,770

Embankment [illegible] 637,000 cu. yds., [illegible] 4[illegible]

The first cantilever bridge in this country was located on the Cincinnati Southern R. R. (now a part of the Queen and Crescent route) across the Kentucky River, and was completed in 1877. At that time it was also the highest bridge in the United States. This bridge was replaced in 1910 by three simple truss spans of the same length or 375 ft. The deck of the new bridge is 31.3 ft. higher than the old one in order to improve the railroad grade. The trusses were erected by the balanced cantilever method from each tower, and without interference with traffic.

The Use of Oxy-acetylene for Welding and Costs of Welding.

[illegible] welding, with figures of cost. The information is taken from Bulletin No. [illegible] of the Engineering Experiment Station of the University of Illinois, which treats the subject thoroughly. The method should be especially interesting to contractors because its field is especially repair work and field work. The Bulletin says:

> While the oxy-acetylene blowpipe method of welding may be applied economically to a very wide range of work in emergencies such as "break-down repairs," etc., the cost of the necessary gases for welding thick pieces is so high that this method will never entirely dis[illegible] for manufacturing conditions. Its field is especially repair work, field work, and manufacturing operations on pieces of small cross-sectional area, say, plates not exceeding ¼ in. in thickness. The process has been used successfully for the following work:
>
> (1) Welding tanks and sheet metal work of all descriptions.
>
> (2) Welding frame joints for automobiles, making a rigid structure all in one piece.
>
> (3) Adding metal where needed, usually in small quantities; for example, eliminating defects in castings, particularly in steel castings, such as blowholes, etc., or adding metal to a piece which has been machined under size.
>
> (4) Repairing boilers by either welding cracks, patches, etc., or adding metal where "grooving" or "pitting" has occurred.
>
> (5) Bonding of electric traction rails by fusing the copper bond to the rails.
>
> (6) Repairs of all kinds, made necessary by breakage. For example, a cast-iron punch press frame, broken at the throat, has been welded so that practically it is as useful as ever.

The accompanying diagram shows the welding rate and cost in terms of length of weld, section of plate, and volume of filler for blowpipes of various sizes. The cost of operation rises rapidly with the thickness of plate, reaching possibly $4 per hour for labor and gas on ¾ in. plates. The oxy-acetylene blowpipe is best adapted to plates up to ¼ in. thickness. The welding rate is nearly constant at 17.5 sq. ins. of weld section per hour. The cost of welding beveled plates may be estimated also at 25 cts. per cu. in. of filler assuming oxygen at 3 cts. per cu. ft. acetylene at 1 ct. per cu. ft. and labor at 30 cts. per hour. It should also be noticed that, provided this rate holds for any type of grooved joint, if the plates were grooved from both sides, the cost per foot of weld would be only half that for plates grooved from one side only, because the required amount of filler would be reduced one-half.

PERSONAL.

Mr. F. C. Finkle, consulting engineer, [illegible] announces the removal of his offices from [illegible] South Spring St. to 448-9 J. W. Hellman Bldg., Los Angeles, Cal.

Mr. C. F. Ford has been appointed supervisor of the tie and timber department of the Chicago, Rock Island & Pacific Ry., succeeding Dr. Hermann von Schrenck, who is assigned to special work. Mr. Ford will make his headquarters at Chicago, Ill.

Mr. E. F. Harper has recently been appointed city engineer of East St. Louis, Ill., succeeding Mr. W. J. Crocker. Mr. E. W. [illegible] has been appointed assistant in charge of outlet sewer, and Mr. Jas. F. Parr assistant in charge of street paving and sewers.

At a meeting of the Gary, Ind., Board of Public Works, on May 10, Mr. A. P. Melton was appointed consulting engineer to the city at a salary of $10 per day. This action followed Mr. Melton's resignation two weeks ago as city engineer. It is understood that the position of city engineer will be filled immediately, at a salary of $1,500 per year.

Mr. O. P. Chamberlain, president of the Western Society of Engineers and chief engineer of the Chicago & Illinois Western R. R., has been appointed chief operating engineer of all the properties of the Dolese & Shepard Co., of Chicago. He will make his headquarters at Gary, Ill., and will have charge of all the outside plants of the Dolese & Shepard Co., in[illegible] & Western [illegible] R. R., which is an industrial line controlled by this [illegible]

Mr. H. S. Baker, who has been track elevation engineer for the city of Chicago for the past year, was appointed assistant city engineer on [illegible]. Mr. [illegible] Giedenhagen, now in charge of the technical work in the efficiency division of the civil service commission, will assume charge of the track elevation office until Mr. Baker's successor is selected by civil service examination. The position of assistant city engineer has been vacant since the death of D. W. Church, two years ago.

Mr. Charles C. Schneider, one of the leading bridge engineers of the United States, and for many years president of the American Bridge Co., has been appointed a member of the Board of Engineers, Quebec Bridge. He succeeds Mr. Charles Macdonald, whose resignation was noted in our issue of May 17. The membership of the board is now complete, and consists of Mr. E. N. Monsarrat, chairman, Mr. Ralph Modjeski and Mr. Schneider. It is stated that Mr. Monsarrat will be chief engineer in charge of construction and will devote his whole time to the work, and that Messrs. Modjeski and Schneider will act in a consulting capacity.

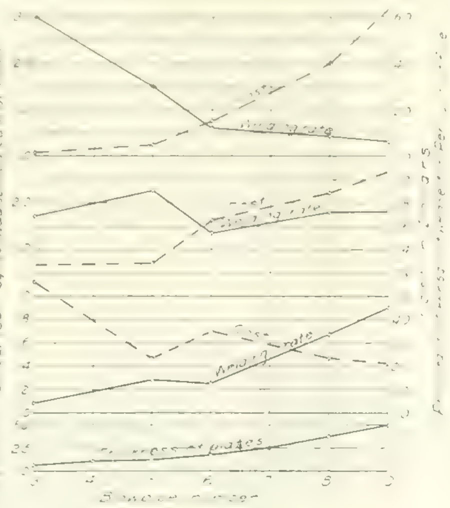

Diagram of Cost of Oxy-Acetylene Welding.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Commercial Photography.—Paper, 5½x8½ ins., 8 pp. Commercial Camera Co., 50 Church St., New York.

Cameron Pumps. Paper, 6x9 ins., 12 pp. Ingersoll-Rand Co., 11 Broadway, New York

Containing a discussion of the points regarding Cameron steam pumps and their operation. Tables are given showing prices, sizes and capacities. Illustrated.

Chicago Improved Cube Mixers.—Paper, 9x6 ins., 64 pp. Municipal Engineering & Contracting Co., Railway Exchange Bldg., Chicago.

A complete catalog describing the development of the cube mixer and a discussion of the various methods of mixing concrete. The various types of machines are illustrated. Photographs of plant installations on various classes of work are shown and drawings are given showing useful ideas as to arrangement of plant on high wall work.

Concrete Chimneys.—Paper, 6x9 ins., 16 pp. Lehigh Portland Cement Co., Chicago.

Illustrating and describing Weber chimneys and forms.

Gates Rock Breaker.—Paper, 8x10½ ins., 20 pp. Allis-Chalmers Co., Milwaukee, Wis.

This is Bulletin No. 1415, containing a description and history of the development of this type of [illegible]. Tables of dimensions, weights, capacities and horsepower required are given and also drawings of crushers mounted on timber and [illegible]

Oil Break Switches.—Paper, 8x10½ ins., 16 pp General Electric Co., Schenectady, N. Y.

Two bulletins on the above subject have recently been issued by the General Electric Company. Bulletin No. 4821 deals with switches for use on circuits, the voltage of which does not exceed 15,000, and No. 4823 refers to switches designed for voltages of from 22,000 to 110,000.

Railway Motors.—Paper, 8x10½ ins., 20 pp. General Electric Co., Schenectady, N. Y.

Bulletin No. 4822 illustrates and describes the GE-98 railway motor, which was designed to meet the demands of heavy city and suburban service, and is suitable for either two or four-motor equipments. The motor is rated at 50 hp. The publication contains dimension diagrams, characteristic curves and a table of schedule speeds.

Derricks.—Paper, 9⅜x12⅛ ins., 60 pp. Clyde Iron Works, 318 Fisher Bldg., Chicago.

This catalog is one of the most complete derrick catalogs published. It illustrates and describes—with suitable tables of dimensions and capacities to accompany the illustrations—the various classes of derricks. Details, parts and accessories are also treated fully.

Eclipse Mixers.—Paper, 6x9 ins., 8 pp. Standard Scale & Supply Co., Pittsburg.

Giving a discussion on the economy of operation of this mixer and testimonial letters.

Gas Traction Engines.—Paper, 4½x6½ ins.; 110 pp. Gas Traction Co., Minneapolis, Minn.

This is a very complete little book illustrating and describing a machine called the Big Four "30" and telling of the various work upon which the machine has been engaged. Estimates of the cost of operation under various conditions and comparisons of the cost of operation with gasoline, kerosene and horsepower are given. The book also contains cuts showing detailed parts of the machine.

Furnace Stokers.—Paper, 4½x9 ins.; 8 pp. American Stofler Co., 11 Broadway, New York, N. Y.

This pamphlet is a record of repeat orders from various patrons of the company.

American Gas Tractor.—Paper, 9x6 ins., 4 pp. P. J. Downes Co., 300 Washington Ave., N., Minneapolis, Minn.

This folder illustrates and describes a gasoline tractor for which the particular claims are simplicity and durability.

Cisco Reference List.—Cloth, 4¼x6⅝ ins.; 120 pp. Cincinnati Iron & Steel Co., Cincinnati, Ohio.

This is a new list containing classifications, list of extras and weights on iron and steel products, being the most complete book gotten out by the company and containing all extras and weights. Prices for extras given.

Underrunning Third Rail.—Paper, 6x9 ins.; 12 pp. Standard Third Rail Co., 165 Broadway, New York City.

This catalog contains interesting photographs and descriptions of installations of the Standard Underrunning Third Rail. Drawings are given showing methods of installation for switches on single and double track and other various conditions. The photographs illustrate the conditions of this type of third rail during a sleet storm when the contact surface of the rail is free from ice.

Leader Traction Engines.—Paper, 8¾x5¾ ins.; 48 pp. Ohio Tractor Manufacturing Co., Marion, Ohio.

Illustrating and describing various types of gasoline, kerosene and steam traction engines and tractor road rollers.

This company also issues another catalog (9x6 ins., 32 pp.) entitled the Ohio Gasoline-Kerosene Tractor which deals specifically with this type of traction engine.

Road Rollers and Traction Engines.—Paper, 9¼x8¼ ins.; 48 pp. The Huber Manfg. Co., Marion, Ohio.

This catalog illustrates and describes traction engines and road rollers. Illustrations are shown of the various types of contractors engines at work hauling trains of wagons and also shows road rollers under operation. Some costs of operation are given.

Shay Locomotives.—Paper, 6x9 ins.; 80 pp. Lima Locomotives & Machine Co., Lima, Ohio.

This catalog describes Shay geared and rod locomotives, the material used in their construction is described in detail and the work for which they are best adapted as shown in the illustrations. Tables for each class of locomotives showing dimensions of various types, and hauling capacities on various grades are given.

Concrete Materials.—Paper, 6x9 ins.; 12 pp. Chicago Portland Cement Co., 30 N. LaSalle St., Chicago, Ill.

Cement, Sand and Gravel for Concrete is the title of the pamphlet recently published by this company. It is a guide for the cement user in the selection of sand and gravel and tells how to wash and screen sand. It also contains a list of instructive booklets.

Odorless Steel Vehicles.—Paper, 6¾x4½ ins.; 28 pp. Geo. H. Holzbog & Bros., Jeffersonville, [illegible]

This catalog contains descriptions and illustrations of a type of garbage wagon manufactured by this company. Table of weights and capacities of various vehicles is given. Also net prices of vehicles and extras to wagons, sewer pumps, refuse cans, etc., are given.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

The past week has been rather quiet as regards the letting of large railroad construction contracts. A considerable number of good sized contracts, however, have been placed in the last few days and there are good prospects that other contracts will come up shortly. Among the railroad construction contracts let recently are the following: Vance Construction Co., Birmingham, Ala., Sec. 1, Tuscaloosa Mineral R. R., Watson Constructing Co., Birmingham, Ala., Secs. 2 to 7, and Dunn & Lallande Bros., Birmingham, Ala., Secs. 8 to 18 inclusive; The Foster-Creighton-Gould Co., Nashville, Tenn., for reconstructing bridges over Choctawhatchie and Apalachicola Rivers on the Pensacola Division of the Louisville & Nashville R. R., in Florida; Gremmit & Johnson, Alton, Ill., for laying all the track, setting the poles, stringing the wire and the building of all necessary structures along the line of the Alton, Jacksonville & Peoria Ry.; J. C. Dunn, 537 South Dearborn St., Chicago, Ill., for the bridging and concrete work on the new Carlisle-Allerton, Ia., line of the Chicago, Rock Island & Pacific, the contract including 6,000 cu. yds. concrete masonry; Yale & Reagan, Fisher Bldg., Chicago, Ill., for grading 9 miles of the new Carlisle-Alberton line south of Carlisle, Ia.; Buffat & Nipper, Knoxville, Tenn., for six miles of grading between Whitesburg, Ky., and Dry Fork, Ky., on the Lexington & Eastern R. R.; Frank Bliss, 1810 J. St., Bellingham, Wash., for 1½ miles, and McClellan Bros., 1000 Michigan Ave., Bellingham, 1 mile of logging railroad for the Lake Whatcom Logging Co.; Acme Construction Co., Toronto, Ont., for constructing the proposed electric railway of the People's Ry. Co. from Guelph to London, Ont.; J. D. Lynch, Monmouth, Ill., for double track work from Blue Island Junction to Matteson, Ill., for the Illinois Central Ry., the work extending for a distance of 13.12 miles and containing about 50,000 cu. yds. of steam shovel excavation besides ditching and other work; J. P. Mullarkey, Montreal, Que., A. Sinclair, Toronto, Ont., and Evan Mackenzie, Toronto, Ont., for completion of the Toronto-Ottawa line of the Canadian Northern Ry., the contracts amounting to several million dollars.

Bids were opened last week by the Board of Water Supply of New York City, for four large contracts for rock tunnel work. The work is to be done in connection with the New York City tunnel portion of the Catskill aqueduct. Mason & Hanger Co., Cornwall on Hudson, N. Y., at $3,709,372 was low bidder on contract 63; Patrick McGovern, 6 Beacon St., Boston, Mass., at $5,775,393 was low bidder on Contract 65; Grant, Smith & Co. & Locher, Rome, N. Y., at $4,512,600 was low bidder on Contract 66, and Holbrook, Cabot & Rollins Corp., 103 Park Ave., New York, at $5,272,435 was low bidder on Contract 67.

Bids for government lock and dam contracts on the Ohio River amounting to over $1,500,000 have been opened within the last two weeks by the U. S. Engineer in charge of the work. Bids for Lock and Dam No. 14 were opened May 10, as noted in our last issue. Bids for Lock and Dam No. 20 were opened May 17, the lowest bidder being the Sheridan-Kirk Construction Co., Cincinnati, O., at $653,825. Bids for Lock & Dam No. 15 are to be opened June 7.

One of the largest irrigation contracts of the year is now being advertised by the South San Joaquin Irrigation District, Manteca, Cal. The work calls for the construction of a dam, headworks, canals, tunnels, etc., and will involve the expenditure of about $1,000,000.

The trustees of the Sanitary District of Chicago, Ill., opened bids on May 18 for the excavation and construction of Section 3 of the Calumet-Sag channel. S. R. H. Robinson & Son Contracting Co., St. Louis, Mo., at $324,580 was the low bidder. This is the first contract for excavation work in connection with the Calumet-Sag channel. Other contracts will be let later on.

A New Profession.

The keystone of the commission form of city government is the concentration of authority in the hands of a few men who are directly responsible to the citizens. In one or two American cities which have adopted the commission form of government, this concentration of authority has gone even farther than the placing of the actual administration in the hands of a commission of five, each one of whom should have charge of a distinct branch of the city government. In these one or two cities it has been arranged that the commissioners shall be merely the guiding and consultative body. They have been authorized and directed to choose a business manager who should have charge of the administration of the city as their servant, subject to removal by them at any time and obliged in all particulars to carry out their directions. Commenting on this development of the commission form of government, Governor Woodrow Wilson of New Jersey in an address last week said:

> [illegible] be generally [illegible] would [illegible] in the growth of [illegible] to be [illegible] of [illegible] it would be [illegible] the various departments of city government and to take charge of [illegible] trained [illegible] looking [illegible] either [illegible] of experts. It [illegible] that the best governed cities of the world are those in which there is a short ballot, concentrated authority and [illegible] for expert service [illegible] America, as elsewhere, by reason of this concentration of authority and simplification of political methods. There is [illegible] have [illegible] permanent corps of [illegible] officials.

Compensation and Liability Bills.

The legislature of Illinois in the closing days of its last session passed two bills of great interest to contractors in that state. One of these is a workingmen's compensation act; the other is an employers' liability law. The last mentioned law eliminates the fellow servant doctrine of law that has been followed by the courts in defining the liability of employers where one of their employes is injured by the negligence or inefficiency of a fellow employe. The workingmen's compensation act establishes the principle of compensation, optional with the employe, and based upon the recent decision of the New York courts. Some of the features [illegible] No employer of labor in hazardous occupations shall escape payment [illegible] by pleading an employe assumed the risk. No employe shall recover damages in any court other than those provided in the act. Damages, in case of death, to the widow and children shall be one-fourth of salary, or not less than $1,500, nor more than $3,500; if no heirs, $150 for funeral expenses. Compensation shall be paid either in lump sum or in weekly installments. Pay in case of disability for life shall be not less than $10 per month. Pay for the first eight years of disability shall be not less than $5 nor more than $12 per week. Waiver of claims procured within seven days of accident is fraudulent. No employe has the right to waive his claim.

Drainage Work in Arkansas.

Greene County, Arkansas, offers an excellent example of the progress being made in the Southern states in the reclamation of swamp land by drainage. Five years ago when the county judge of Greene County authorized the formation of the first drainage district for the reclamation of swamp land in the county, a surging mob of protesting taxpayers, surrounded the court house, remonstrating against the levying of the tax, and threatening to lynch the Judge. Today there are thirteen drainage districts in the county, that will reclaim one-third of the area, and lands that a few years ago were not worth the taxes are now worth from $5 to $50 an acre, and are supporting splendid plantations. Adjacent counties in the state have also taken up the movement and drainage districts are being established which will reclaim millions of acres of land.

We Note That—

"J. H. Sawyer, of Preston, on ground owned by the Sawyer family for 85 years, this morning broke dirt on the railroad of the Backwater system. Mrs. Sawyer, with a bottle of Welch's grape juice, christened the pick with which Mr Sawyer struck the first blow." Our old friend, Scaldy Bill Quinn, rises to remark that the above is a helluvaway of launching a new battleship or starting a new railroad. We also note that the first bid for the $50,000,000 issue of Panama Canal bonds was received by the Treasury Department 12 hours after the advertisement for bids had been announced. The bidder offered to take the entire issue at $152,101,050. The bidder was an inmate of a well known sanitarium in New York state and through an oversight, probably, neglected to inclose a certified check for $1,042,021, or the 2 per cent of the amount of his bid required by the department.

The supplemental estimates of the Canadian Government for the coming fiscal year include $2,403,000 for marine improvements. Some of the proposed appropriations are: Lighting equipment of Williamsburg canal, $55,000. Burlington Beach canal, $100,000. Goderich harbor improvements, $116,000. Hamilton harbor improvements, $16,000. Kincardine pier, $10,000. Meaford harbor improvements, closing of eastern entrance and removal of "L" of inner checkwater, $34,600. River Thames, removal of obstructions, $1,500. Rondeau, harbor improvements, $10,000. Sarnia bay improvements, $50,000. Windsor, landing dock, $30,000. Port Arthur and Fort William, harbor improvements, $500,000. Quebec, harbor improvements, $638,000. [illegible]

RAILWAYS, STEAM AND ELECTRIC

Alabama.

● [illegible] tion Co. of Birmingham, Ala.; sections 2 to 7, [illegible] Ala. The total cost of the work will be something less than $750,000. This railroad will be 18 miles long, with fairly heavy construction work, some of it steam shovel. There will be one high viaduct on the work, 150 ft. high by 580 ft. long. Ewing D. Sloan, Tuscaloosa, Ala., is Chief Engineer.

City Council of Gadsden, Ala., has granted a franchise to J. M. Dewberry, Birmingham, Ala., to operate a steam and motor railroad [illegible] commenced, under the franchise, at some place between Gadsden and Birmingham within two years from the time the franchise is granted, and cars must be operated over the road within three years.

Messrs. A. J. Stap, C. G. Kershaw and W. H. Boynton, have organized the Central Construction Co., with a capital stock of $15,000. The company will have its head office at Talladega and will engage in railroad construction.

California.

◉Advices from San Bernardino, Cal., state that a contract has been awarded George West, of that city for reconstructing the roadbed of the Santa Fe from Fresno, Cal., to Merced, a distance of 58 miles.

The Pacific Electric, Co., Los Angeles, has awarded contracts for construction work on the Glendale-Burbank branch line of the Pacific Electric, and work will be begun immediately. This line will be about 4 miles in length and will branch from the main line of the Glendale tracks some miles south of Glendale, going in an almost direct line to Burbank. It will take several months to complete the work.

H. W. Sheridan, Division Superintendent of the Southern Pacific is reported to have announced that work will be commenced this summer on the branch from Arbuckle, Cal., through Grimes, Princeton and Colusa City to Hamilton City.

Engineers of the Southern Pacific Co. have made surveys for an extension of the electric railway at Redlands from Orange St. on Colton Ave. to University St., a distance of one mile, giving electric service to the university.

The Fresno-Coalinga-Monterey R. R. will shortly ask a franchise from the city trustees of Fresno. It is proposed to enter the city from the south through either Mono or Kern Sts. Albert Albrecht is the promoter of this line. Senator G. W. Cartwright, Fresno, is also interested.

The Sacramento-Folsom Electric Ry. Co. has been incorporated with a capital stock of $1,000,000 and proposes to build a main line of 22 miles between Sacramento and Folsom and a branch line of four miles out from the Fair Oaks bridge. The incorporators and initial directors and their cash subscriptions are: Francis V. Keesling, $24,000; Herman H. Grau, $500; Ernest L. Brune, $500; J. W. Cook, $500, and Otto Grau, $500. Total subscriptions, $26,000, or $1,000 a mile for each proposed mile of road. All the incorporators are residents of San Francisco except Herman Grau, who lives in Sacramento. Keesling, the ostensible head of the corporation, is a young lawyer, who was a candidate for lieutenant governor.

The status of work for the Geary St. municipal street railway at San Francisco was as follows on May 6: Contract No. 6—For furnishing and delivering trolley poles. Plans and specifications completed and cost estimated at $17,000. Awarded to the National Tube Co. by the Board of Public Works. [illegible] way. Contract No. [illegible] For furnishing and delivering cast iron trimmings for trolley poles. Plans and specifications 20 per cent completed. Contract No. 8—For furnishing and delivering redwood railroad ties. Specifications completed and cost estimated at $17,000. Awarded to J. Heyman; 10,000 ties have been received and are being hauled to the pipe yard. Contract No. 9—For furnishing and delivering tie plates. Awarded to Eccles & Smith by the Board of Public Works on May 1. Contract No. 11—For furnishing and delivering street cars. Plans and specifications 55 per cent completed. Contract No. 13—For hauling rails. Cost estimated at $[illegible]. Awarded by the Board of Public Works to McNab & Smith Draying Co. Work has been completed. Contract No. 14—For hauling rails to the pipe yard. Awarded to McNab & Smith. Contract No. 15—For track and overhead work. Specifications 25 per cent completed. Contract No. 16—For hauling ties. Awarded to Farnsworth & Ruggles.

The Southern Pacific Co., through its subsidiary company, the Peninsula R. R. Co., has petitioned for a franchise to construct standard gage tracks on the Monterey road to the cemetery on Willow, Lincoln and Minnesota Avs., on 14th St. and other places in San Jose where the standardization has been contemplated or already completed.

Surveys have been completed by the Santa Fe and Southern Pacific R. R.'s along their joint line from Bakersfield to Mojave over the Tehachepi Pass for the laying of an 8-in. pipe line for the purpose of transmitting the large quantities of oil used by the two companies in their engines on the southern divisions as well as that destined for the east for commercial purposes. This pipe line will cost in the neighborhood of $1,250,000 and will be 80 miles in length. The maps and plans prepared by the companies' engineers call for pumping plants every 30 miles, or three of them for the entire length of the pipe line. H. C. Phillips, Los Angeles, Cal., is Chief Engineer of Atchison, Topeka & Santa Fe Coast Lines.

Florida.

◉The Foster-Creighton-Gould Co., Nashville, Tenn., has been awarded contract by the Louisville & Nashville R. R., W. H. Courtenay, Chief Engineer, to reconstruct bridges across Choctawhatchie and Apalachicola Rivers on the Pensacola Division in Florida. The work includes both substructure and superstructure. The new substructure is to be of plain and reinforced concrete, which will replace the creosoted pile piers which are now in use.

Georgia.

The Georgia & Florida R. R. is now building a 2.4 mile line from Sparks to Adel. The work is being done with company forces. The work is light and the grading is nearly completed. It is expected to open the extension in about six weeks. W. A. Swallow, Augusta, Ga., is chief engineer.

Idaho.

An announcement reported to have been made by E. H. Dewey, Nampa, Ida., President Idaho Northern, is to the effect that construction work will be started shortly on the proposed line from Emmett in Western Idaho north for a distance of 100 miles through the Long Valley to the Payette Lakes.

Illinois.

◉Grommit & Johnson, Alton, Ill., have been awarded a contract by the Alton, Jacksonville & Peoria Ry. for laying all the track, setting the poles, stringing the wire and the building of all necessary structures along the line of the railroad from Alton to Jerseyville, and thence to Hardin in Calhoun county. Grommit & Johnson have started work on their contract.

◉J. D. Lynch, Monmouth, Ill., has been awarded a contract for double track work from Blue Island Junction to Matteson, Ill., for the Illinois Central Ry. The work extends for a distance of 13.12 miles and contains about 50,000 cu. yds. of steam shovel excavation besides ditching and other work suitable for small team outfits. A. S. Baldwin, Chicago, Ill., is Chief Engineer of the Illinois Central.

The Grand Trunk Ry. is said to be planning to begin work this summer on relaying 900 miles of track between Montreal and Chicago with 100-lb. rails.

The Chicago & Western Indiana R. R. has secured the last piece of property on Federal street necessary to carry out its plan to build a new union passenger station. This is the southwest corner of Federal and Polk streets. The Western Indiana represents five other roads, including the Wabash, which will be tenants of the new station.

Stockholders of the St. Louis, Quincy & Terre Haute Interurban Ry. Co. have voted to increase the capital stock from $50,000 to $1,680,000; and the directors have been authorized to issue bonds for that amount. The name of the company was changed to the Quincy & Terre Haute Ry. Co. It is stated that St. Louis capitalists have agreed to float about 75 per cent of the bond issue. The route as now proposed is through the towns of Liberty, Beverly, Kingston, Baylis and Pittsfield. The officers of the company are: President, William C. Fick; vice president, H. C. Simons; secretary, F. W. Knollenberg; treasurer, S. P. Landcraft. All the above, with the exception of Mr. Simons, are residents of Quincy.

Indiana.

The City Council of Vincennes has adopted a resolution calling upon the Vincennes Traction Co. to make the desired extension of their line on Main St. from 7th to 15th St., and on 15th St. from Main to Willow St. within the next six months.

Iowa.

◉J. C. Dunn, 537 South Dearborn St., Chicago, Ill., has been awarded the contract for the bridging and concrete work on the new Carlisle-Allerton line of the Chicago, Rock Island & Pacific. Mr. Dunn's contract includes 6,000 cu. yds. concrete masonry, 2,000,000 ft. trestle timber, and driving 170,000 lin. ft. of piles. Yale & Reagan, Fisher Bldg., Chicago, Ill., have taken the contract for grading nine miles of the line south of Carlisle. MacArthur Bros. Co., Fisher Bldg., Chicago, are the general contractors for the line, as noted in our May 10 issue.

Kansas.

◉The extension of the Quindaro Blvd. car line in Kansas City, Kan., has been finished and work has been started on the extension of the Chelsea car line. H. H. Hannakat has the contract for grading the right-of-way and the rails will be laid when men have finished grading. All the material for the construction is on the ground. The Quindaro extension is out 18th St. to 27th St., and north on 27th St. to Brown Ave. The Chelsea line will be extended from 25th St. to 27th St., north on 27th St. to Parallel Ave. and west on Parallel Ave. to the city limits.

The State Railroad Board has granted the Missouri, Kansas & Texas R. R. Co. permission to issue $24,000,000 in bonds, $5,000,000 to be spent in betterment of the road in Kansas. S. B. Fisher, St. Louis, Mo., is chief engineer of the Missouri, Kansas & Texas Ry.

Plans are being formulated by the Commercial Club of Meade, Kan., for building an electric line from Meade to Beaver, by way of Miles, Kan., and Hatten, Okla. A committee has been named, composed of Meade

✣ indicates work now open for bids. ◉ indicates a contract let recently.

and Beaver men, to enter into negotiations with F. Corp, who will have charge of the work of promotion.

Rumors throughout southwest Kansas are to the effect that the Santa Fe system is considering the construction of a short line from Dodge City or Garden City to New Mexico to cut out the Raton Pass and develop new territory in Colorado, New Mexico and Kansas. It is stated that the necessary right of way is already being secured.

Kentucky.

⦿Buffat & Nipper, Knoxville, Tenn., have been awarded a grading contract between Whitesburg and Dry Fork, Ky., on the Lexington & Eastern Ry. The work covers six miles of line and much of the grading is heavy.

The bond holders of the Indianapolis & Louisville Traction Co., Louisville, Ky., have agreed to a proposed plan of reorganization of that company in which it is contemplated that an issue of $1,500,000 5 per cent 30-year first mortgage bonds under date of Jan. 1, 1911, $600,000 6 per cent cumulative preferred and $600,000 common stock shall be made. The capitalization of the present company is $1,250,000 first mortgage bonds, $334,500 second mortgage bonds and $100,000 preferred and [illegible] common stock.

Further details regarding the $2,000,000 traction company at Owensboro, Ky., mentioned in our last issue, are now at hand. The plans contemplate the organization of a company to be known as the Western Kentucky Electric Rys. Co. and the making of surveys and a commercial report on the territory tributary to Owensboro to determine the cost of the construction as a basis for financing the scheme. The special committee of the Business Men's Association, interested in the project, consists of L. D. Ray, Dan Griffith, J. Ed. Guenther, D. C. Stimpson and George H. Cox. Chicago promoters are behind the project.

The Hickman extension of the Chicago, Memphis & Gulf was completed last week between Dyersburg, Tenn., on the Illinois Central and Hickman, Ky., on the Nashville, Chattanooga & St. Louis, a distance of 52 miles. An extension of the line northwardly to Clinton, Ky., a distance of 15 miles, and connecting with the Mobile & Ohio at Stubbs, Ky., is contemplated. S. G. Latta, Dyersburg, Tenn., is President of the Chicago, Memphis & Gulf R. R.

Louisiana.

Surveys have been made for the construction of a short street car line in St. Bernard Parish from the Barracks to the plant of the American Sugar Refinery. It is expected that construction work will be started shortly. A. L. Black, New Orleans, La., has the franchise for the line.

Maryland.

Good progress is being made with the construction work on the Western Maryland extension from Cumberland, Md., to Connellsville, Pa., and it now looks as though the road would be turned over to the operating department ahead of contract time, which calls for its completion on Nov. 1 next. Up to May 1 over 4,000,000 cu. yds. of excava- [illegible] 000,000 required. This is proceeding at the rate of 500,000 cu. yds. a month, which will enable the contractors to complete the excavation work by Sept. 1. About 80 per cent of the 150,000 cu. yds. of concrete work had been finished. Track laying has already commenced and by the end of May will be well under way at half a dozen points. The headings of all the tunnels, except the Big Savage, have been connected, and several of the shorter tunnels have been made ready for concreting and track laying. The Big Savage tunnel, 3,275 ft. in length, has been bored for 2,500 ft.

Massachusetts.

The State Railroad Commisison was recently over several routes of projected extensions at North Adams of the Berkshire Street Ry. Co., Pittsfield. It is the general im- [illegible] extensions will be built in N[illegible] the immediate future.

Michigan.

The Battle Creek, Coldwater & Southern Ry. Co. has opened an office in Coldwater, Mich., in charge of Fred Warren. Promotion work for the proposed electric railway is now under way.

A conference is to be held on June 7 between the city officials of Kalamazoo and representatives of the railroads regarding the elevation of tracks in that city. The conference will mark the first important active step tending towards the accomplishment of grade separation. At that time the commissioners will have an opportunity to learn the attitude of the various roads towards the matter. A. K. Edwards, Kalamazoo, is chairman of the grade separation commission of that city.

Minnesota.

The Duluth & Northern Traction Co., incorporated early this month with a capital stock of $200,000, is reported to be planning to have grading work started shortly. The line will leave the Woodland car line at Hardy St., Duluth, and run in a northeasterly direction along the Greysolon road, through the Greysolon farm to the Tischer road on the north line of section 25; its length will be about 4½ miles. Charles P. Craig and J. G. Williams, Duluth, Minn., are interested.

Advices received recently from Hibbing, Minn., state the Duluth, Missabe & Northern Ry. has been instructed to remove its tracks from the property of the owners of Brainerd mine to permit additional stripping. It has been decided to build a spur line through Brooklyn to the old depot, starting at the southern end of the new Brooklyn trestle and swing west towards the present Duluth, Missabe & Northern depot, finally taking a more northerly direction and swinging back again to the west as it joins the present main line and depot entrance. H. L. Dresser, Duluth, Minn., is chief engineer.

The Great Northern Ry. is reported to have had surveys made with a view to making a change in its right of way leading into Chisholm.

Mississippi.

The city of Meridian, Miss., on May 17 voted by 586 to 6 to issue $50,000 in bonds for terminals and rights-of-way for the Meridian & Deep Water R. R. The bonds are to be payable when the road is completed and being operated. It is stated that work will begin July 1. The road will cover a distance of 47 miles from Meridian to the Tombigbee river. The promoters are C. F. Scofield, S. A. Neville, of Meridian, and W. C. Stowell of Chicago.

Missouri.

The City Council of Columbia, Mo., has granted a six months' extension to the franchise of the Mexico, Perry & Santa Fe R. R. Co. The company has built nine miles of track north of Mexico, Mo., and four miles south. It is understood that additional contracts are to be let shortly. Matthias Krum, Mexico, Mo., is President.

Kansas City, Mo., and Vicinity.

⦿Mr. H. B. Nelson of Muskogee, Okla., has secured quite an extensive sewer contract in that city. He may be addressed care of Security Building, Muskogee.

McGuire & Brown have moved their outfit to Kansas City, Kan., where they have taken a contract on the streets of that city.

J. J. Fitzgerald is moving his outfit from near Carrolton, Mo., to the Chicago, Rock Island & Pacific work in Iowa. We understand Mr Fitzgerald will be located near Chatiton, Ia

The writer was in Worland, Mo. this week and called at the camp of Wood, Bancroft & Doty. This firm has work on the Kansas City Southern, and it did look good to see [illegible] Wood, Bancroft & Doty will be located at Worland for several months

Mr. J. H. Williams a superintendent of construction, is in Kansas City this week. Mr. Williams has just come in from Denver. He reports things as moving slowly in that section of the country just now, but that the prospects for an increased business shortly are good.

The report that the Spiteaufsky & Wagner Construction Co. has taken contract for 35 miles of electric line work is a trifle premature. That is, no time for the construction to begin has been set. Spiteaufsky & Wagner will do the work when it is actually begun.

Mr. H. F. Riley, member of the firm of Clapp, Norstrom & Riley, Chicago, stopped in this city for a few hours on the 18th. Mr. Riley has been traveling extensively of late and as a result is quite optimistic over the outlook in general. He says there are signs on all sides for a steady growth in railway building. While the movement of labor and sale of contractors' machinery is not as heavy just now as compared to some former years, yet inquiries are coming in from all sides in constantly increasing numbers and that is always a sure forerunner of an increased business. The many friends of Mr. Riley, and there are many, will be glad to know that he is well and prosperous.

E. H. Bradbury of Kansas City will do considerable rock paving near here. It is understood the work will start at once, although there are some preliminaries to be agreed upon before actual construction begins.

Mr. James Smith of this city is doing some team work at 6th and Broadway. Mr. Smith has recently joined the ranks of Kansas City dirt movers.

James Doud & Son are among those who have moved on the C., R. I. & P. work in Iowa.

Joyce Bros. & Bagwell are doing some work on the Paseo, Kansas City. The work is not extremely heavy and no doubt it will be finished up very shortly Contractors who may desire a splendid team outfit could do no better than to write Joyce Bros. & Bagwell., 520 & Troost Ave., Kansas City, Mo.

Nebraska.

Articles of incorporation have been filed by the Nebraska Central & Western R. R. Co., with a capital stock of $100,000. It proposes to construct a railroad from Milldale in a northwesterly direction through Arnold, to the Logan county line, a distance of 11 miles. The articles provide for building a railroad from Loup City in Sherman county, north of Arcadia in Valley county, thence through Custer, Logan, McPherson, Morrill, Garden and Banner counties. E. H. Morey, Kearney, Neb., is engineer. The incorporators are: E. R. Smith, Gandy; John Finch, Arnold; E. W. Brown, Burkett, Neb

New Jersey.

The Jersey Central Traction Co., Keyport, N. J., which operates a trolley line between Keyport and Red Bank, contemplate extending the road to Long Branch by way of Little Silver, Port-au-Peck and Branchport. The proposed route, it is stated, will be through Branch Ave. to Pickney road, then on private property to Little Silver, where it will take [illegible]

New York

The Public Service Commission held a hearing May 19 on the plans for the elimination of the Erie R. R. and Lackwanna R. R. crossings at grade on Elmwood Ave in Buffalo. Plans submitted to the commission several months ago call for a subway at both crossings. It is stated that the plans are generally satisfactory

The Corning & Painted Post Street Ry Co., 50 Church St., New York City, operating a line from Corning to Painted Post, is planning an extension of lines in Corning for the purpose of reaching North Corning The dou- [illegible] is also proposed. About $10,000 is to be expended.

[illegible]

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible] undercrossing.

The Lehigh Valley R. R. plans an extension from the present terminus at Fair Haven to Oswego, N. Y., a distance of 14 miles, according to advices from the latter city. This [illegible] tion for some time, although nothing definite [illegible]

North Carolina.

[illegible] been raising funds for a preliminary survey for a railroad from Greensboro to Henderson by way of Burlington, Roxboro and Oxford.

North Dakota.

[illegible] ber, Secretary, Odd Fellows Blk., Grand [illegible] into East Grand Forks and make other improvements.

Grading contractors, according to information received from Carrington, N. Dak., have resumed work on the Fargo-Minot cut-off of the Great Northern. Operations were suspended during last fall, but there now seems to be no doubt but the line will be completed this summer and fall. It will greatly shorten the main line from Minot to Fargo and the Twin Cities.

Ohio.

[illegible] Gibbs, General Manager, Cambridge, O., proposes during the coming summer to extend its lines to Pleasant City. The extension of the lines south from Byesville has been held up for some time on account of the inability to get the necessary legislation through the Byesville council for a franchise over the additional streets necessary. The matter has now been adjusted.

The Cleveland Ry. Co., C. H. Clark, Engineer Maintenance of Way, Electric Bldg., Cleveland, is planning to relay about 22 miles of track this summer at a cost of about $1,000,000. The tracks are all to be put down with concrete base for the ties and with the improved groove rail.

The stockholders of the Lake Erie & Pittsburg Ry. Co. have authorized an issue of $5,900,000 of new common stock and $15,000,000 of bonds. This road was chartered eight years ago to build a line from Lorain to Youngstown, O., with a branch to Cleveland, a total length of 120 miles. Forty miles have been built, from Cleveland to a connection with the Pittsburg & Lake Erie, and trains are now being run on that section. The increase in the capital stock is said to be for the purpose of resuming construction through to Pittsburg. The line is being constructed in the joint interest of the Pennsylvania and the Lake Shore & Michigan Southern Rys. Samuel Rockwell, Cleveland, O., is chief engineer.

Oklahoma.

The Tulsa & Sand Springs interurban line, which has nine miles of track completed, which was placed in operation on May 14, proposes to extend the line to Collinsville and Oologah to connect with the Iron Mountain R. R.

Petitions are to be circulated for initiation of the state railroad scheme which was proposed before the third legislature and failed of enactment. Three propositions are drawn. One proposes a constitutional amendment, permitting a bond issue of $15,000,000 to finance the venture, another creating a state board of public utilities to handle the property and build the road and a third creating an improvement district, through which the railroad is to be projected. The improvement district extends from the Colorado line on the northwest within 20 miles of Des Moines, Colo., a point on the Gould system, diagonally across the state to a point near Texarkana, Tex., another town on the Gould system. Under the proposition, the road district will merely guarantee payment of the bonds, and be taxed each year to make up the deficit, should one occur. Upon payment of the bonds the railroad would become the property of the state.

It is expected that track laying on the Cherryvale, Oklahoma & Texas R. R. now being built from Caney, Kan., southeast to Siloam Springs, Ark., and southwest to Geary, will be started June 1. The grading work on the southeast line is practically completed from Caney to the Verdigis River, 7 miles east of Nowata, Okla., and it is believed that the road will be completed into Nowata and cars running by Jan. 1. S. M. Porter, Caney, Kan., is President.

The citizens of Lawton have completed their bonus of $50,000 promised to the Jake Hamon line, the Ardmore, Duncan & Lawton R. R., and announcement is made that work will be commenced on June 1. As mapped out, it is practically an air line from Lawton east through Duncan to Ardmore, and thence east to Sherman, Tex. It follows the divide between the Washita and Red rivers.

William Kenefick of Kansas City, President of the Missouri, Oklahoma & Gulf Ry., who is promoting with former Gov. Haskell the construction of a road west from Henryetta to Oklahoma City and thence northwest to Woodward, has returned from Paris, France, and it is announced that he has financed the construction between Henryetta and Oklahoma City. This is understood to be an extension of the Missouri, Oklahoma & Gulf, a road which Kennefick has been building during the past few years and is now in operation from Wagoner, Okla., to Denison, Tex., together with several side lines.

Oregon.

The Commercial Club of Baker, Ore., is formulating plans for the construction of an interurban line from that city into the Powder River Valley.

The Nevada-California-Oregon Ry., according to advices from Lakeview, Ore., has purchased terminal site, including right of way, depot grounds and a tract for stock yards, at a cost of $100,000. As mentioned recently in this paper, the company proposes the construction of its line to that city within a short time. George S. Oliver, Reno, Nev., is chief engineer.

The Willamette & Molalla Valley Ry. Co. property, a 12-mile line, has completed surveys and expects to let construction contracts in 30 days. Frank Bryant, Canby, Ore., is chief engineer.

Pennsylvania.

It is expected that the tentative plans for the improvement of the Broad St. station of the Pennsylvania R. R. at Philadelphia will be completed this month. The changes contemplated are many, although no decision has been arrived at concerning the extent to which they shall be carried out. Of 12 or 14 distinct plans on which the board of engineers and the advisory board appointed about six months ago will pass, one comprehends the enlargement of the West Philadelphia station with a view to making it the terminus for through trains. This is intended to relieve Broad St. station of its congestion. The same plan provides for only local trains in the Broad St. terminal. Another plan would widen the approach to Broad St. station from the Schuylkill by taking in all of Filbert St. Provisions for electrical operation are also made in some of the plans, but on what scale has not been revealed.

The Philadelphia Rys. Co. has been incorporated and takes over the old Southwestern Street Ry. The new owners will re-equip the line, enlarge its power house, increase the number of motor cars to 25 and, in general, rehabilitate the system. The route of the road is as follows: From 3rd and Jackson Sts. via Moyamensing Ave. and Penrose Ferry road to the Delaware county line, connecting there with the Chester Short Line to Essington, Eddystone and Chester. There is also a branch from the Penrose Ferry bridge to the Billingsport ferry. The line comprises six miles of double track and three miles of single track. The officers are: President, Isaac H. Silverman; treasurer, Benjamin Wolf; secretary, Alvin W. From. The company's offices are at 605 Land Title Bldg., Philadelphia.

The Pittsburg & Lake Erie R. R., J. A. Atwood, Chief Engineer, Pittsburg, Pa., is reported to be planning the straightening of its line through Sharon, Pa. The Pittsburg & Lake Erie and the Erie recently closed a 99-year lease for the Sharon-Newcastle R. R., running between Jamestown and Greenville. It is proposed that the Pittsburg & Lake Erie and the Erie jointly rebuild the line from Sharon to Jamestown, double tracking it. The Pittsburg & Lake Erie also contemplates the double tracking of the road from Newcastle, where it leaves the main line to Sharon.

Rhode Island.

The commission appointed by the Board of Aldermen, Pawtucket, R. I., to investigate the matter of abolishing the grade crossings in that city submitted a report to the effect that the work, including the depression of the tracks at Pine, Dexter and Broad Sts., the removal of the station at Pawtucket 300 ft. north and the abolishing of the station at Central Falls, would necessitate an expenditure of $1,220,247. George A. Carpenter is city engineer of Pawtucket, R. I.

In regard to the improvements contemplated by the Grand Trunk, E. H. Fitzhugh, vice president, Montreal, Quebec, is reported to have announced that besides the immediate construction of the Southern New England R. R. between Palmer and Providence, the company was planning the expenditure of $8,000,000 or $9,000,000 for the double tracking around Montreal.

The West Penn Rys. Co., Pittsburg, Pa., has authorized the expenditure of about $100,000 for the extension from Masontown to Martin works, a distance of 2½ miles. The extension will require the construction of a $25,000 bridge over the Monongahela R. R. and Cats Run at Ifield Station.

South Dakota.

Good progress is reported as being made in the sale of stock for the South Dakota Interurban Ry. Co. This company is projecting an electric railway from Sioux City to Chamberlain, via the Bijou Hills. W. E. Miller, Academy, S. Dak., is President.

The Missouri River & Northern Ry. Co. has not as yet completely financed its projected 82-mile line, and consequently no date has been decided upon for letting construction contracts. The projected route of this line is from Chamberlain, S. Dak., to Huron, S. Dak., through the counties of Brule, Buffalo, Hand, Jerould and Beadle. Surveys for the line were completed in November, 1910, as noted at the time in these columns. The Missouri Valley Enginering Co., Mitchell, S. Dak., is the Engineer; A. E. Parsons, Darlington, Wis., is President, and E. E. Dye, Chamberlain, S. Dak., is Vice President.

Tennessee.

Surveys are now being made for the projected 40-mile extension of the New Orleans, Mobile & Chicago R. R., from Middleton to Jackson, Tenn. L. W. Duffee, New Albany, Miss., is Locating Engineer.

Regarding the proposed line of the Nashville-Gallation Interurban Ry., mentioned in our last issue, we are advised under date of May 11 that plans and specifications are promised to be ready within six weeks, on receipt of which contracts will be let. H. H. Mayberry, Stahlman Bldg., Nashville, Tenn., is President.

Texas.

⊙J. W. Thompson has been awarded the contract for the completion of the ballasting of the Frisco's lines between Beaumont and Houston. Delivery of Crawford Island gravel will begin at once.

The Quanah, Acme & Pacific Ry., C. E. Ensminger, General Manager, Quanah, Tex., has location work under way for the extension from Paducah, 50 miles west of Quanah, to Roswell and down the Pecos valley to Artesia and on to El Paso. It is stated that construction work [illegible] to be begun [illegible] July 1.

Surveys are now under way at Longview for a belt line. This line will be an extension of Longview & Junction Street Ry.

The Crystal City & Uvalde Ry., E. Breaker, Chief Engineer, Crystal City, Tex., has placed orders for material to be used in the construction of 23 miles of new line, which will extend from Crystal City to Fowlertown. Grading for the road is already in progress. At the present time the Crystal City and Uvalde road consists of about 94 miles of track extending from Uvalde south to Carrizo Springs, with a line east from Crystal City to Gardendale, connecting with the International and Great Northern at that point. The new construction will start at Gardendale and extend east to Fowlertown, from which point it is ultimately planned to extend the line to connect with the Southern Pacific at Beeville. Contracts for the construction material have been let as follows: Kirby Lumber Co., Houston, all the lumber and bridge material; Continental Lumber & Tie Co., Houston, 70,000 selected cypress ties for the work, and the National Iron & Steel Co., Houston, all rails, spikes, bolts and other steel products to be used in the construction.

Announcement has been made that work will be started at once on a 4-mile extension of the street railway system at Cleburne. The city council of that city has granted a franchise for the Fort Worth-Cleburne interurban in the city.

A. Holland syndicate, according to advices from Llano, Texas, has submitted a proposition to the Railroad Committee of that place offering to build a standard gage railroad from Brownwood to San Antonio, Tex., by way of Llano and Fredericksburg, a distance of 150 miles. R. A. McInnis, Llano, Texas, is interested.

Advices from Dallas, Texas, state that the sale of the International & Great Northern R. R. has been postponed until June 13, by order of the judge.

The Palacios, San Antonio & Pacos Valley Ry. Co., projecting a 160-mile line, has made surveys for 90 miles of line, and expects to let construction contracts shortly. H. L. Montandon, Palacios, Tex., is chief engineer, J. P. Pierce, Palacios, is president, and H. W. Dean, Palacios, is general manager.

Utah.

The Utah Light & Ry. Co., Salt Lake City, has announced its intention of building an extension at Salt Lake City. It is stated that work will be started as soon as a franchise is secured, provided the right is granted before fall, in order that the line may be built this season. The route is two miles long.

Press reports from Salt Lake City state that the Gould railroad interests have called a conference, to be held in New York, to consider financing the double-tracking of the Denver & Rio Grande between Salt Lake City and Denver and the proposed improvements on the Western Pacific between Salt Lake and San Francisco. It is estimated that this work will cost $50,000,000. It is reported that the Gould system proposed to raise $100,000,000 to be used in double-tracking and improvements throughout its western lines. The plans include the expenditure of $50,000,000 on the lines west of Denver. Later it is reported a like amount will be put into the Missouri Pacific.

Virginia.

The Surry, Sussex & Southampton R. R., operating 28 miles of narrow gage line, is considering extending its line from Surry Courthouse to Smithfield. F. E. Waters, 905 Union Trust Bldg., Baltimore, Md., is President.

The Norfolk & Portsmouth Belt Line R. R., L. E. Johnson, Vice President, Roanoke, Va., has been purchasing water front property, and it is understood to be contemplating extensive terminal developments at Sewalls Point, near Norfolk.

Washington.

Work has been started on the extension of the [illegible] Yakima Valley Transportation Co., North Yakima, from that city to Moxee City. It is expected that the line will be in operation by Sept. 1.

The Chicago, Milwaukee & Puget Sound R. R. hopes to complete the line into Everett, Wash., within the course of a couple of months. Track laying is completed to a point some distance this side of Monroe. Rapid headway is being made on the bridge at Monroe and the overhead crossing above the Great Northern is under construction.

Advices from Raymond, Wash., state that the Northern Pacific Ry. Co. is making preparations for relaying that branch with 72-lb. rail and ballasting with gravel.

⊙The Lake Whatcom Logging Co., J. J. Donovan, Manager, Bellingham, has awarded contracts for 2½ miles of logging railroad extending in a northwesterly direction from Alger, in Whatcom county. Frank Bliss, of 1810 J St., Bellingham, was awarded 1½ miles and McClellan Bros., of 1000 Michigan Ave., Bellingham, was awarded the contract for the [illegible] mile.

We are advised that there is nothing in the reports that the Spokane, Portland & Seattle Ry. is going to construct a new depot at Centerville and lay new tracks from Lyle to Warwick.

Improvements costing $750,000 are reported as being contemplated for the year at Centralia, Wash., by the Northern Pacific, the Great Northern and the Oregon-Washington Railroad & Navigation Co. The plans are said to provide for freight sheds, a passenger depot, extensive yards, a large roundhouse, repair shops, trackage and warehouse.

The Kittitas Railway & Power Co., which proposes to build and operate an electric railway between Cle Elum and Roslyn, has filed a list of its officers with the county auditor at Ellensburg. Paul L. Richards of Tacoma is named as president, Andrew Norris of Roslyn vice president, H. N. DeWolf of Tacoma, secretary, A. T. Patrick of Tacoma assistant secretary, S. A. Watson of Tacoma, treasurer, Peter Giovanini and William Adam of Roslyn are directors.

West Virginia.

⊙Gilmore-Weaver Co., Morgantown, W. Va., as noted in our last issue, has been awarded a sub-contract for work on the Buckhannon & Northern R. R. The contract includes 6,000 cu. yds. river excavation (all dredging), 2,000 cu. yds. mortared rubble masonry and 10,000 tons derrick rubble masonry. The masonry is for protection of fills, and the walls are to be from 400 to 1,100 ft. in length. Patterson, Moran & Luck Co., Morgantown, W. Va., is the general contractor for the 32-mile line of the Buckhannon & Northern R. R. from the Pennsylvania-West Virginia state line to Fairmont, W. Va.

C. L. Williams of Parkersburg, W. Va., has been appointed receiver of the Parkersburg & Ohio Valley Electric Ry. Co., a concern formed for the purpose of building an electric line from Parkersburg through the counties of Wood, Pleasants, Tyler, Welzel, Marshall and Ohio to the Pennsylvania line. This company began construction work in 1904 at Sisterville and has completed five miles of the road to Friendly. The receiver is authorized to take charge of the property and complete and operate it.

Wisconsin.

The Wausau Street Ry. Co., Wausau, is planning the expenditure of $50,000 this summer for improvements. These will include a new amusement pavilion and double tracking on one street.

Plans [illegible] completed [illegible] neer Vinal of Appleton, Wis., for a subway in the [illegible] end of the city, under the C. & N. W. Ry. tracks.

Canada.

✣Bids [illegible] asked until [illegible] 11, [illegible] Commissioners of the Transcontinental Ry., P. [illegible] Ryan, Secretary, Ottawa, Ont., for the erection of station and other buildings required along the line of the Transcontinental Ry. as below: Section 1—From Plaster Rock in the Province of New Brunswick westward to the Quebec boundary. Section 2—From Mile [illegible] to Mile [illegible] east of Quebec bridge. Section 3—From Mile 5 to Mile 105 east of Quebec bridge. Section 4—From the Quebec bridge westward to Mile 45. Section 5—From Mile 55 to Mile 194 west of Quebec bridge. Section 6—At Cochrane in the Province of Ontario. Section 7—From the divisional yard at Graham, Ontario, eastward for a distance of 60 miles. Plans and specifications may be seen and full information obtained at the office of Gordon Grant, Chief Engineer, Ottawa, Ont., and at the following district offices: Section 1—C. O. Foss, District Engineer, St. John, N. B. Sections 2, 3, 4 and 5—A. E. Doucet, District Engineer, Quebec, P. Q. Section 6—A. N. Molesworth, District Engineer, North Bay, Ontario. Section 7—S. R. Poulin, District Engineer, St. Boniface, Man.

⊙The Acme Construction Co., Toronto, Ont., has been awarded the contract for constructing the proposed electric railway of the People's Ry. Co., from Guelph to London, Ont. It is proposed that the line eventually will connect Toronto with Detroit, and form the backbone of a network of interurban lines extending from Collingwood and Owen Sound to Goderich, Port Huron and Port Stanley.

⊙The Canadian Northern Ry. has awarded the contracts for the completion of its Toronto-to-Ottawa line to J. P. Mullarkey, Montreal, Que.; A. Sinclair, Toronto, Ont., and Evan Mackenzie, Toronto. Mr. Sinclair will complete the section between Toronto and Belleville. Mr. Mackenzie will perform the grading and timber work on the 20-mile section between the 180th mile post to the 200th mile post. Mr. Mullarkey will construct the rest of the road between the 164th and the 180th mile posts and between the 200th and the 250th mile posts. He will also do the track laying and ballasting on Mr. Mackenzie's section. Mr. Mullarkey in all will build 66 miles. His portion of the road starts at Sydenham. The contract of Mr. Mullarkey covers the grading, fencing, track laying and ballasting. Work will be put under way on these contracts at once.

Advices from Prince Albert, Can., state that information has been received from London, England, to the effect that the contract for the construction of the Hudson Bay Pacific Ry. has been let.

A resolution is to be introduced into the House of Commons, by the Minister of Railways, providing for an extension of the terms as specified in the act of last session whereby the Government might acquire branch lines in the Maritime Provinces as parts of the Intercolonial system. Under that act it was provided that no branch line could be taken over unless the board of management reported that the road was in good condition, and practically up to the standard of the Intercolonial. It has since been found by the report of the engineers who examined these roads that very few of them are up to the required standard, and under the conditions of last year's legislation very few, if any, of them could be leased. Under the resolution it is proposed to give the governor in council power to take over some 13 branch lines in New Brunswick and Nova Scotia, aggregating 643 miles. These lines are as follows: The Vale Ry., property of the Acadia Coal Co., extending from New Glasgow to Thorburn, a distance of about 6 miles. The Quebec Oriental Ry., extending from Metapedia to Paspebiac, a distance of about 100 miles. The Hampton & St. Martin's Ry., extending from Hampton to St. Martin's, a distance of about 30 miles. The Albert Ry. extending from Salisbury to Albert, a distance of about 45 miles. The Moncton & Buctouche Ry., extending from Moncton to [illegible] distance of about 28 miles. The [illegible] and Gulf Shore Ry., together, [illegible] om Bathurst to Tracadia, a dis-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

tance of about 85 miles. The York & Carle- [illegible] beyond Stanley, a distance of about 10 miles. The International Ry., extending from Campbellton to the St. John Valley and St. Leonard's, a distance of about 113 miles. The Cape Breton Ry., extending from Point Tupper to St. Peter's, a distance of about 30 miles. The Temiscouata Ry., extending from Riviere du Loup to Connor's, a distance of about 113 miles. The New Brunswick & Prince Edward Island Ry., extending from Sackville Junction to Cape Tormentine, a distance of about 30 miles. The Elgin & Havelock Ry., extending from Elgin to Havelock, a distance of about 28 miles. The Kent Northern Ry., extending from Kent Junction to Richibucto, a distance of about 27 miles.

Three shipments of over 30,000 tons of steel rails have been received on the Pacific coast for use in the construction of the Canadian Northern Pacific Ry., from Port Mann to the North Thompson River, and two other shipments of about 20,000 tons of steel are on their way to Vancouver.

A resolution will be considered by the Canadian Parliament when it convenes in July to amend chapter 6 of the act of 1910, the Canadian Northern Alberta Railway act, under which the governor in council was authorized [illegible] the construction of a line of railway from a point at or near Edmonton or Strathcona, thence in a generally westerly direction to the coal areas situated at or near the Brazeau River and the head waters of the McLeod River, for a distance of 150 miles—such aid and assistance being thereby authorized to be given in the form of a guarantee, with the dominion as guarantor, of the princi- [illegible] of the company to the extent of $13,000 per mile for the first 50 miles, and to the extent of $25,000 for the remaining 100 miles of the line to be aided," by substituting in the said act for "the line so authorized to be aided" the following desired line of railway, which the company by its charter is empowered to construct—namely: "a line of railway of the Canadian Northern Alberta Ry. Co. from a point at or near Edmonton or St. Albert, Alberta, thence in a generally westerly direction to the coal areas situated on the company's authorized line at or near Brule Lake in Jasper Park"; and to provide that such aid and assistance may be granted the line by these resolutions proposed to be substituted in said act for the line therein described.

The Dominion Power & Transmission Co., Ltd., Hamilton, Ont., is making a survey for an electric railway line from Hamilton to Galt. The present Hamilton & Brantford line will be used as far as Langford. A loop will be constructed connecting with John Patterson's Hamilton, Guelph & Waterloo Railway, if that road is built.

The Canadian Northern Ry. has completed surveys for the line by which it will secure its own route from Port Arthur, at the head of Lake Superior, at which point it will be linked up with the western portion of its system. The projected route of the Canadian Northern will take it through the Algonquin National Park region, along the great clay belt of Ontario, the Tenagami Reserve and thence across the territory north of Lake Superior. It is understood that work will be started this year, and the line will be completed in about three years. The line between Ottawa and Montreal is already under way.

City Engineer C. H. Rust of Toronto has submitted estimates to the Board of Control of Toronto on the cost of constructing the proposed civic street railway lines on St. Clair Ave. and on Gerrard St. east. The estimated cost of construction of the St. Clair Ave. line from Avenue Road to the G. T. R. R. tracks, 2.65 miles, is as follows: Rail structure, $11,450; overhead construction, $10,600; car barns and repair shops, $35,000; passenger equipment, $49,000; operating equipment, $16,500; transformer station and feeder wires, $40,000; total, $262,550. Adding 7 per cent for engineering, general expenses and contingencies, $18,378.50, makes a grand total of $280,928.50. The estimated cost of construction of the Gerrard St. east line, from Greenwoods Ave. to Main St., 1.85 miles, is as follows: Rail structure, $69,000; overhead construction $8,510; car barns and repair shops, $35,000; passenger equipment, $42,000; operating equipment, $16,500; transformer station and feeder wires, $40,000; total, $211,010. Seven per cent added for engineering, general expenses and contingencies, $14,770.70, bringing the total up to $225,780.70.

Announcement has been made that the Grand Trunk Pacific R. R. extension from Halifax, N. S., to Prince Rupert, B. C., will be completed within the next three years. This line will connect two ports that are open to navigation throughout the year, and also will tap a huge wheat belt. It is expected that next month the Grand Trunk Pacific will begin regular train service from Fort William, at the head of Lake Superior, to the foothills of the Rocky Mountains, a distance of 1,500 miles.

ROADS, STREETS AND PAVEMENTS

Alabama.

An ordinance has been introduced in the city council of New Decatur, Ala., authorizing the paving of Sixth and Eighth Aves., from Gordon Drive to Moulton St., at an estimated cost of $14,000.

California.

⦿Bent & Pennebaker have been awarded the contract by the Board of Supervisors, Los Angeles, Cal., for macadamizing sections 2, 3 and 43 of the Harbor Blvd. to the sea. Sections 2 and 3 from Victoria Ave. to the city limits on Main St., and section 4 comprises a short link from the boulevard to Gardena. Section 1 extends from Wilmington to Victoria Ave., a distance of five miles. The contract for the last named section has not been awarded.

The viewers appointed by the Board of Supervisors, Nevada City, Cal., for the proposed road from the Maybert road to the Arctic mine, on Canyon creek, near Nevada City, have estimated that the cost will be about $6,000.

Colorado.

✣Bids will be received until 11 a. m., May 27, by Board of Public Works, Denver, Colo., for furnishing necessary labor and material for grading, paving, curbing and guttering with brick, Broadway Paving District No. 4. J. B. Hunter is president.

⦿The city of Lodi, Cal., on May 15 awarded the contract for asphalt pavement on Sacramento St., from Lodi Ave. to Lockeford St., and Elm and Pine St. from School to Sacramento St. and Elm St.; also from Sacramento St. to the Southern Pacific Railroad to the Barber Asphalt Co., for $35,098. The work includes the following: 1,696.6 cu. yds. of grading, 2,325.2 cu. yds. of grading, cut; 3,000 sq. ft. of grading; 6,366 ft. of concrete curbing; 8,262.5 sq. ft. of gutters (concrete); 153,315 sq. ft. of concrete base; 153,315 sq. ft. of binder; 80 cu. yds. of binder; 38 culverts; 70,500 sq. ft. of asphaltic wearing surface. [illegible] Construction Co., $40,421; Federal Construction Co., $38,314; Ransome-Crummey Construction Co., $37,781. R. C. Tumelty is City Engineer of Lodi and Stockton.

Advices from Telluride, Colo., state that Representative Fred Anderson has secured from the legislature the sum of $1,400 to aid in the construction of the road from Telluride to Norwood.

Residents along West 38th Ave., beyond the city limits, Denver, Colo., are planning to have the road for at least a mile and a half of its distance from the city limits west macadamized. It is estimated that it will cost $5,500 to put the road in good shape.

Florida.

✣Bids will be received until 7:30 p. m., June 1, by W. F. Divine, City Clerk, St. Petersburg, Fla., for grading and paving 6th St. from Central to 7th Ave., and 1st St. from 4th to 5th Ave., with vitrified brick laid flat. Plans and specifications on file with the City Engineer.

⦿The Engineering & Paving Co., of Jacksonville, Fla., has been awarded the contract by the Board of County Commissioners, Jacksonville, for the resurfacing of a portion of the Lem Turner road, at the following bid: Grading with teams, 21 cts. per cu. yd.; with shovel, 15 cts. per cu. yd.; paving and curbing complete, $1.29 per sq. yd.

The Board of County Commissioners, Jacksonville, Fla., has rejected all bids received for the construction of certain roads in the county, and decided to make additional advertisement for estimates for the work. A list of bids received was given in our last issue.

Georgia.

The City Council of Waycross, Ga., has passed an ordinance providing for the paving of two miles of streets. Reynolds St. and Albany Ave. will be paved. Work will begin immediately.

The City Council of Americus, Ga., on May 16, sold bonds to the amount of $105,000 to Hambleton & Co., of Baltimore, Md., the proceeds to be used immediately in street paving and sewerage extensions.

Illinois.

✣Bids will be received until 3 p. m., May 29, by Board of Local Improvements, Hillsboro, Ill., for paving, curbing and constructing gutters on a number of streets including the following approximate quantities: 12,590 sq. yds. brick pavement on Portland cement concrete foundation 5 inches thick with a sand cushion 1½ inches thick and sand filler complete in place: 6,600 cu. yds. excavation, grading and preparing subgrades. 8,560 lin. feet Portland cement concrete combined curb and gutter on a 6-in. cinder foundation complete in place. 260 lin. feet retaining curb on ground.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Secretary, until 11 a. m., June 1, for paving the following streets: Alley Webster Ave., 800 sq. yds. brick pavement; alleys 24th St., etc., 870 sq. yds. brick pavement; alley E. 31st St., 1,050 sq. yds. brick pavement; alley 40th St., etc., 1,010 sq. yds. brick pavement; alley Hyde Park Blvd., 680 sq. yds. brick pavement; N. Ashland Ave., 5,020 sq. yds. asphalt pavement; Cottage Grove Ave., 11,010 lin. ft. sandstone curbing, 10,000 cu. yds. earth cutting, 27,650 sq. yds. brick pavement; Ellis Ave., 6,300 sq. yds. asphalt pavement; Frankfort St., 1,920 sq. yds. asphalt pavement; 41st Ave., 5,390 lin. ft. gravel concrete combined curb and gutter, 8,800 sq. yds. asphalt pavement; 56th St., 5,310 lin. ft. concrete combined curb and gutter, 8,580 sq. yds. creosoted wood block pavement; Hillock Ave., 3,200 sq yds. asphalt pavement; Lock St., 2,790 sq. yds. asphalt pavement; Mendell St., 2,100 sq. yds. granite block pavement; Perry st., 13,000 lin. ft. concrete combined curb and gutter, 23,000 sq. yds. asphalt pavement; Rascher Ave., 4,070 sq. yds. asphalt pavement; 62d Place, 690 sq. yds. asphalt pavement; 65th St., 2,460 sq. yds. asphalt pavement; 77th St., 850 sq. yds.

macadam pavement; [illegible]th St., [illegible] lin. ft. sandstone curbing, 5,390 sq. yds. brick pavement; 30th St., 3,980 lin. ft. concrete combined curb and gutter, 8,140 sq. yds. asphalt pavement; Washtenaw [illegible] sq. yds. asphalt pavement complete; Winchester Ave., 4,280 sq. yds. macadam; Montrose Ave., 4,710 sq. yds. asphalt pavement; 42d Court, 7,450 lin. ft. gravel concrete combined curb and gutter, 4,750 cu. yds. earth cutting, 11,510 sq. yds. asphalt pavement; Dauphin Ave. System, 37,610 lin. ft. concrete combined curb and gutters, 16,000 cu. yds. earth cutting, 49,920 sq. yds. macadam pavement complete (8 in. slag, 3 in. limestone, 3½ in. granite top); Clara Place System, 21,280 lin. ft. gravel concrete combined curb and gutter, 33,100 sq. yds. asphalt pavement. All pavement except macadam to be placed on 6-in. concrete foundation. Brick, granite and creosoted block to have a 2-in. sand cushion. All concrete combined curb and gutter to be built of granite screenings unless specified differently.

⊙A. E. Kutledge, of Rockford, Ill., has been awarded the contract for putting in 12,560 sq. yds. of brick paving on the main business street of Harvard, Ill., for $22,900.

⊙A. D. Thompson has been awarded the contract by the Board of Local Improvements of Peoria, Ill., for paving West Armstrong Ave., from Knoxville to Elizabeth St., for $8,000.

⊙L. E. McGann, commissioner of public works, Chicago, Ill., has awarded the contract for making asphalt repairs to the American Asphalt Paving Co., 138 Washington St., Chicago. The contract prices are as follows: Concrete in place, $7 cu. yd.; binder in place, $5 per ton top dressing (½ in. thick), 59 cts. per sq. yd. Bids opened May 6, 1911.

⊙The following contracts for paving have been awarded by the Board of Local Improvements, Chicago, bids opened May 2: Chestnut Pl., Delevan Pl. to Walton Pl., $1,362, Central Paving Co., 172 Washington St.; alley, Fullerton Parkway, Arlington Pl., $3,192, P. J. O'Brien, 145 La Salle St.; alley, W. Chicago Ave., Superior St., $2,308, P. J. O'Brien; alleys, Webster St., Cleveland Ave., etc., $3,681, Jas. A. Lackley Co., 307 Chamber of Commerce Bldg.; alley, Shades Pl., Willow St., etc., $4,503, P. J. O'Brien; alleys, Schiller St., North Park Ave., etc., $2,005, John A. McGarry Co., 188 Madison St.; alleys, Webster Ave., Orchard St., etc., $2,951, Pas. A. Sackley Co.; alleys, Wilson Ave., Leland Ave., etc., $3,137, P. J. O'Brien; alleys, Bourn Ave., Grand Blvd., etc., $4,167, Jas. A. Sackley Co.; alley, Wisconsin St., Sedgwick St., etc., $2,882, Jno. A. McGarry Co.; alleys, Garfield Ave., Larrabee St., etc., $3,675, Jno. A. McGarry Co.; E. 42nd Pl., Drexel Blvd. to I. C. R. R., $11,717, American Asphalt Paving Co., 138 Washington St.; E. 53rd St., Indiana Ave. to South Park Ave., $8,064, American Asphalt Paving Co.; Greenwood Ave., 55th St. to 56th St., $4,544, American Asphalt Paving Co.; Hamlin Ave., Armitage Ave. to McLean Ave., $2,469, American Asphalt Paving Co.; Maplewood Ave., Diversey Ave. to Elston Ave., $5,439, American Asphalt Paving Co.; Medill Ave., Kimball Ave to Central Park Ave., $8,324, American Asphalt Paving Co.; Sacramento Ave., 37th Pl. to 39th St., $7,063, R. F. Conway Co., 138 Washington St.; Seminary Ave., Maud Ave. to Center St., $4,455, American Asphalt Paving Co.; E. 76th Pl., Marquette Ave. to Coles Ave., $4,190, R. F. Conway Co.; W. 23rd Pl., Wentworth Ave. to Canal St., $13,265, American Asphalt Paving Co.; W. 33rd Pl., Ashland Ave. to Archer Ave., $12,239, R. F. Conway Co.; W. 37th St., Halsted St. to Morgan St., $8,713; Wilson Ave., Lincoln Ave. to N. Western Ave., $5,262, R. F. Conway Co.; Burnside Ave. System, $66,334; 90th Pl. System, Farr Bros. Co., 356 W. 111th St. Details were published in Engineering Contracting.

Residents of North Main St., Rockford, Ill., are agitating the improvement of that thoroughfare with brick

The last legislature of Illinois, which closed its session May 19, has passed the following acts relative to road work: Establishing office of county superintendent of road and redrafting all roads and bridges statutes. Providing for tax on motor vehicles, graduated by the horsepower of the vehicles, and providing that the receipts from license fees shall be disbursed among the counties in proportion to the amount of road and bridge tax levies. Providing speed limit for motor vehicles, 25 miles per hour in the country. Prohibits heavy hauling on gravel or macadamized roads, when in wet weather roads are in bad condition. Authorizes additional tax levy of 25 cts. on $100 for roads and bridges purposes by counties.

The citizens of Charleston, Ill., have circulated a petition calling for the paving of South 18th St.

Assistant Corporation Counsel McKenna, Chicago, Ill., is making plans to have the ordinances for the repaving of downtown streets confirmed in court at an early date.

The city attorney of Sterling, Ill., has been directed to draw up an ordinance providing for the paving of East Fourth St. The estimated cost of the work is $31,000.

The Board of Local Improvements of Aurora, Ill., is making preparations for the laying of asphalt paving in Jefferson St. and Marion Ave. M. J. Tarble is city engineer.

Indiana.

⊙C. C. Heffine of Frankfort, Ind., has been awarded the contract by the town of Carmel, Ind., for improving College Ave., both sides, with cement sidewalks and curbs, from south corporation line to Gray St.; also Main St., with curbs, from south corporation line north to Hawkins St.; also Main St. to Monon Railroad right of way, and curbs from tracks of Indiana Union Traction Co. to right of way of Monon Railroad. Bids were opened May 15 by D. W. Puckett, Town Clerk.

⊙Samuel B. Royse of Perrysville, Ind., has been awarded the contract at $4,025, for repairing the west abutment and reflooring 800 ft. of the bridge over Wabash River at Perrysville. The floor is to be of concrete slab and the entire work to be completed by Aug. 15. Bids were opened May 15 by H. T. Payne, County Auditor, Newport, Ind.

⊙The Board of Public Works of Vincennes, Ind., has awarded the contract for paving Jefferson Ave. to P. W. Lenahan for $13,037.

⊙The Board of Public Works of Muncie, Ind., has awarded the following contracts for paving work with brick: Jackson St., from Mulberry St. to Ohio Ave., John Gubbins & Co., $15,305; Howard St., from High to Council, William Birch, $7,158; Jefferson St., from Adams to Charles, William Birch, $939; Liberty St., from Seymour to Washington St., William Birch, $8,256.

⊙The Board of Park Commissioners, Indianapolis, Ind., has let the contract for constructing macadam pavement in Maple road, from Northwestern Ave. to Capitol Ave., to the American Construction Co.

Plans were made at a recent meeting of the Merchants' Association, South Bend, Ind., for the improvement of the South Michigan St. road, from Ewing Ave. to the city limits. It is planned to improve the roadway 12 ft. in the center, with either gravel or macadam, leaving 7 ft. at one side of the center for the proposed tracks of the South Bend & Logansport Traction Co.

The Board of Public Works of Hammond, Ind., has adopted confirmatory resolutions providing for the extension of Monroe and Carroll Sts.

The Board of Public Works of Indianapolis, Ind., received the following low bids for paving Locke St. from Walnut St. to Indiana Ave.: American Construction Co., brick, $2.33 per lin. ft., on each side and street and alley intersections, $1,150; Marion County Construction Co., asphalt or bitru mineral, $3.30 per lin. ft., for each side and street and alley intersections, $1,120.

Iowa.

✣Bids will be received until 8 p. m., June 5 [illegible] by O. F. Graves, City Clerk, Harlan, Ia., for the construction of 7,000 lin. ft. of concrete curb and gutter and 15,000 sq. yds. of concrete pavement, more or less.

⊙It is reported that E. A. Wickham Co., of Council Bluffs, Ia., has been awarded the contract by the City Council of that city for repaving Broadway from the Methodist church to Park Ave., and from Sixth St. to the Northwestern tracks. The bid was as follows: Galesburg brick block, $1.99 per sq. yd.; Buffalo brick block, the same; Des Moines brick block, the same, extra sand, $1.50 per cu. yd., added asphalt filler, 19 cts. per sq. yd., extra stone, $2.50 per cu. yd., 35 cts. per sq. yd. for old granite blocks.

The City Council of Corning, Ia., intends to pave Davis Ave., from the Railroad right of way to the north line of 8th St., and 8th St., from the alley between Davis Ave. and Adams St., to Grove Ave. The work will include 14,133 sq. yds. of brick pavement, 3,000 lin. ft. of curb and gutter, 2,419 lin. ft. of gutter, 290 yds. of concrete pavement. Theodore S. De Lay, Creston, Ia., is Engineer.

The City Council of Fort Dodge, Ia., has passed a resolution of necessity for many blocks of asphalt. The proposed paving included in the resolution is on the following streets and avenues: From Second Ave. north from the east line of 18th St. to the east line of 20th St.; on Fifth St. from the south line of First Ave. south to Fourth Ave., south; on Fourth Ave. south from the west line of Fifth St. to the west line of Sixth St.; on North Eighth St. from First Ave. north to Fourth Ave., north; on Third Ave. north from Eighth to Ninth St., and on Fourth Ave. north from Eighth to Ninth St.

The Board of Supervisors and the City Council, Washington, Ia., have decided to construct a permanent road from the end of the pavement on South Iowa Ave., at the city limits, west to Elm Grove cemetery, a distance of 1,821 ft., about five blocks. The roadway is to be 27 ft. wide. The estimated cost is $4,000.

Thomas H. McDonald, highway engineer for the state highway commission, Des Moines, Ia., has offered plans for the improvement of the army post road to the Greater Des Moines Committee.

The City Council of Washington, Ia., has decided to macadamize or cement the road running west from the John Park place, south of town, to the Elm Grove cemetery. The county will pay for one-half the work.

The Town Council of Greenfield, Ia., has passed a preliminary resolution to provide for the paving of the public square and the streets leading into the square. The improvement will cost about $30,000. Brick or cement paving will be used.

Kentucky.

⊙Daniel Trapp, 725 Mammoth Ave., Newport, Ky., has been awarded the contract by the Board of Council, Catlettsburg, Ky., for the construction of approximately 25,000 sq. yds. of block pavement for $1.69 per sq. yd., and 15,000 lin. ft. of concrete curb and gutter at $.50 per lin. ft. Bids were opened May 15. John McDyer is City Engineer.

Louisiana.

The Police Jury of East Carroll, Lake Providence, La., has appropriated $7,500 to be used in conjunction with $7,500 to be put up by the state for the betterment of roads under the supervision of the Highway Commission. The main road to be built will extend from the northern line of Madison parish through East Carroll parish to the southern line of the state of Arkansas. Gervais Lombard is state highway engineer.

Francis F. Constant of Alexandria, La., is the probable contractor for the construction [illegible] ish, Louisiana, a distance of 32 miles at his bid of $56,920. Bids were opened May 15 by [illegible] Engineers, 104 New Orleans Court Bldg., New Orleans, La. Frank M. Kerr is Chief Engineer and President of the board.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Maryland.

✣[illegible] Havre de Grace, Md., for paving Second St. and Madison St. with bituminous macadam, grading, setting and resetting curb and other incidental work as described in the plans and specifications on file at the office of J. C. Little, city engineer.

⦿Jacob A. Frederick, Carroll County, Manchester, Md., has been awarded the contract for building a section of State Aid Road 1.12 miles long in Carroll County along the Black Rock road between Hampstead and Baltimore County line for $10,320. Bids were opened by the County Commissioners, Westminster, Md., on May 15.

A committee of the State Roads Committe of Maryland, composed of Dr. Ira Remsen, Samuel M. Shoemaker and Francis Hutton, is considering a plan to construct the section of State Road No. 1—the Washington-Baltimore Blvd.—through the village of Elkridge in Howard county.

J. C. Little, of Annapolis, Md., has been appointed consulting engineer on street paving, etc., in Havre de Grace, Md. Plans and specifications will be completed about June 1 for the proposed work.

Michigan.

The citizens of Buchanan, Mich., at a recent mass meeting, decided in favor of bonding the village and township for [illegible] to build state reward roads. It is estimated that this amount would build 50 miles of gravel roads with state aid, the state contributing $500 per mile toward the cost of building each mile of road. An election will be held June 3 to vote on the question of bonding the township.

No bids were received May 18 by Village Clerk John Venus, Redford, Mich., for the construction of a gravel road on Grand River road through the village.

Minnesota.

✣Bids will be received until 10 a. m., May 29, by City Council, Mankato, Minn., for furnishing the necessary labor and material for the paving of the following streets: On Cherry St., from Front St. to First Railway track, with brick; Cherry St., from Front St. to Broad St., with creosoted blocks; Cherry St., from Broad St. to 5th St., with tar or asphalt macadam; Hickory St., from Milwaukee freight depot to Broad St., except intersections, with creosoted blocks; Walnut St., from Front St. to Broad St.; except intersections, with creosoted blocks; Walnut St., from Broad St. to 5th St., with tar or asphalt macadam; Jackson St., from Broad St. to 4th st., with tar or asphalt macadam; South Broad St., from end of pavement at Warrent St. to Grove St., with creosoted blocks; South Broad St., from east side of Grove St. to Lincoln St., with creosoted blocks or tar or asphalt macadam; Warren St., from 2d St. to Broad St., with creosoted blocks; 2d St., from north side of Cherry St. to Byron St., with creosoted blocks; Liberty St., from Broad St. to 2d St., with creosoted blocks; Lincoln St., from east side of Center St. to east side of Byron St., with creosoted blocks or tar or asphalt macadam; and also for curbing and guttering said streets where necessary. All said improvements to be made according to plans and specifications therefor now on file in the office of the City Clerk, A. H. Scherer.

⦿Hewett Bridge Co., of Minneapolis, Minn., has been awarded the contract for paving Broadway bridge with creosoted blocks for $7,438, at Little Falls, Minn. Bids were opened May 17 by Fred Cary, City Clerk.

The State Highway Commission, St. Paul, Minn., under the new state law, has divided the state into 40 districts to have either assistant or district highway engineers, or to be covered in some other way. In each district there are from two to four counties, arranged to make traveling convenient. The resident engineer, if there is one, will be a superintendent of highways for the district, having full charge of all work on the highways where state aid is given. The resident engineer will also give advice to the county and towns whenever solicited. Hennepin, Ramsey and St. Louis counties have been omitted from the arrangement for the reason that they are supposed to have compentent supervision of their highways. The same law that provides for the districts and engineers also calls for a tax of one-fourth mill for state road purposes. This, however, cannot be levied until next spring and no part of it will be available until 1912. The following districts have been formed: Winona, Houston, Freeborn, Mower, Fillmore, Jackson, Martin, Faribault, Rock, Nobles, Pipestone, Murray, Cottonwood, Watonwan, Blue Earth, Le Sueur, Waseca, Rice, Steele, Dodge, Olmsted, Goodhue, Wabasha, Dakota, Washington, Carver, Scott (R. P. McNamara, engineer), Sibley, Nicollet, Brown, Renville, McLeod (Walter Johnson, engineer), Lyon, Lincoln, Redwood (E. Keeter, engineer), Yellow Medicine, Big Stone, Lac qui Parle (W. F. Rosenwald, engineer), Chippewa, Swift, Kandiyohi (J. A. Rowatt, engineer), Meeker, Wright (N. Y. Taylor, engineer), Anoka, Sherburne (F. W. Nickeson, engineer), Isanti, Chisago, Mille Lacs, Kanabec (R. S. Chapman, engineer), Stearns, Benton, Traverse, Grant, Stevens, Pope, Otter Tail, Douglas, Morrison, Todd (A. J. Fem, engineer), Aitkin, Carlton, Pine (W. J. Buckley, engineer), Lake, Cook, Itasca, Cass, Crow Wing (J. W. Curo, engineer), Wadena, Hubbard (C. E. Spencer, engineer), Becker, Mahnomen, Wilkin, Clay, Norman, Polk, Red Lake, Marshall, Pennington, Roseau, Kittsön, Beltrami, Clearwater, Koochiching.

Mississippi.

✣Bids will be received until noon, June 6, by Board of Commissioners of the Board of Supervisors, Hazlehurst, Miss., for the complete construction of 50 miles of gravel highway construction in Beat 1, Copiah County. The work will include all excavation, embankment, ditching, preparation for sub-grade and quarrying, hauling, placing, sprinkling, rolling and finishing of gravel roadway on 10 roads a total of 50 miles. The George Co., Randolph Bldg., Memphis, Tenn., Engineers, have plans and specifications on file.

Missouri.

⦿The City Council of Webb City, Mo., has awarded the contract to the Webb City Paving & Improving Co., for the construction of asphalt macadam pavement for $.65 per sq. yd., and the contract for the construction of concrete curb and gutter and sidewalks to Maret & Anthoney of Webb City. Bids were opened May 15.

An ordinance providing for the improvement of State St., from 26th St. to Ashland Ave., with mineral rubber asphalt, has been recommended to the City Council of St. Joseph, Mo.

County Surveyor G. W. Culler has been instructed by the county court, Springfield, Mo., to inspect the proposed routes of the two roads petitioned for, one in Washington township and the other in Republic.

Nebraska.

✣Bids will be received until noon, May 31, by quartermaster, Fort Robinson, Neb., for the necessary labor and material for the construction of concrete sidewalks.

⦿The Western Bridge & Construction Co., of Omaha, Neb., has been awarded the contract at $3.38 per sq. yd., by the Board of County Commissioners, Sioux Falls, S. Dak., for planking and paving the 6th St. bridge and the 10th St. bridge in Sioux Falls, with 3-in. creosoted fir planks covered with two layers of heavy tar felt paper, and paved with creosoted wood blocks, 3½ in. deep, 3 to 4-in. wide and 4 to 9-in. long. Bids were opened May 12.

Petitions have been filed by property owners of Omaha, Neb., to have Ames Ave. paved from 36th and 38th Sts., about one mile in extent. The repaving of Jones St. from Seventh to 14th, and Ninth from Leavenworth to Howard is also proposed.

New Hampshire.

✣Bids will be received until 1 p. m., June 2, by State Highway Department, Concord, N. H., for the construction of trap rock road in Hillsboro, N. H., estimated to cost $4,500. H. C. Hill is state engineer.

✣Bids will be received until 1 p. m., June 2, by State Highway Department, Concord, N. H., for the construction of a native stone highway 5,500 ft. long in Tilton, N. H. H. C. Hill is State Engineer.

⦿The Lane Construction Co., of Meriden, Conn., has been awarded the contract by the State Highway Department, Concord, N. H., for the construction of three and one-half miles of nature stone road in Hinsdale, N. H. H. C. Hill is State Engineer. Bids were opened May 19.

New Jersey.

✣Bids will be received until 11 a. m., May 24, by Board of Freeholders, Camden, N. J., for cleaning and resurfacing Browning Road, near Merchantville, with about 1,200 tons of Amiesite; also 600 tons 1½ inch trap rock for shoulders, all to be furnished and applied by the ton; also 600 cu. yds. of approved gravel to be furnished and applied by the cu. yd., as directed; all completed, consolidated and ready for immediate use.

✣Bids will be received until May 24 by State Commissioner of Roads, Trenton, N. J., at the office of the Clerk of Chosen Freeholders, Camden, N. J., for resurfacing White Horse Pike with asphalt concrete including 11,981 tons type B asphalt concrete; 6,885 tons 1½ in. stone; 9,988 cu. yds. of gravel. J. J. Albertsön is County Engineer.

The city of Trenton, N. J., will, on May 23, sell bonds to the amount of $105,000 for municipal improvements.

The citizens of North Wildwood, N. J., on May 16 voted the issuance of bonds to the amount of $60,000 for street improvements.

New York.

✣Bids will be received until 8 p. m., June 2, by Commissioners of Public Works, Olean, N. Y., at the office of J. H. Gaynor, City Engineer, City Bldg., for the construction of a vitrified wire-cut brick pavement on concrete foundation in 2d St., from Sullivan St. to State St. and from Henley St. to Green St. The approximate amount of pavement is 6,678 sq. yds. The approximate amount of excavation is 1,930 cu. yds. The approximate amount of stone curbing is 3,960 lin. ft. Plans and specifications may be examined and bid sheets procured and any other further information may be obtained at the office of John H. Gaynor, City Engineer, City Building, Olean, N. Y.

⦿The Village Trustees of Seneca Falls, N. Y., have awarded the contract for paving East and West Bayard Sts. and State St. to Patrick D. Conley, of Ithaca, for about $54,210. Brick or bitumen-macadam will be used.

Proceedings have been made by the Board of Local Improvements of Queens, New York City, for paving with asphalt block on a concrete foundation, the following thoroughfares, calling for an estimated total expenditure of nearly $100,000: Third Ave., Long Island City, from Webster Ave. to Graham, estimated cost $18,950. Fourth Ave., Long Island City, from Washington Ave. to Broadway, estimated cost $30,700. Thirteenth St., Long Island City, from Grand Ave. to Flushing Ave., estimated cost $22,200. Onderdonk Ave., Ridgewood Heights, from the south house line of Hart St. to the north house line of Willoughby Ave., about $10,000. William St., Long Island City, from Jane St. to Beebe Ave., estimated cost $15,700.

The village engineer of Tarrytown, N. Y., has submitted propositions calling for $154,000 for bricking several streets in the village to the Village Trustees. A special election is to be called immediately.

Ohio.

✣Bids will be received until noon, May 29, by Director of Public Service, Canton, O., for the necessary labor and material for the construction of improvements on Gibbs St.,

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

from Tuscarawas St. to Lawrence Ave.; Williams St., from M[illegible] Ave. to Walnut St.; South South Court St., from Ninth St. to Cedar St., and for the construction of a sanitary sewer and house connections in Fulton St., from 207 ft. north of Chance Ave. To the [illegible] the approximate quantities are as follows: 11,000 sq. yds. vitrified block pavement; 500 lin. ft. new straight curb; 450 lin. ft. new circle curb; 1,000 lin. ft. old curb relined; 1,000 lin. ft. old stone curb redressed and reset; 600 lin. ft. concrete pavement headers; 10 manhole tops reset; 11 catch-basin tops reset; 600 lin. ft. 6-in. vitrified sewer pipe laid; 540 lin. ft. 4-in. vitrified sewer pipe laid (house-connections); 14 trees grubbed out and removed from street; 3 lamp hole tops set; 3,890 sq. yds. vitrified block pavement; 20 sq. yds. old brick pavement relaid; 1,300 lin. ft. straight stone curb; 30 lin. ft. circle stone curb; 470 lin. ft. old stone curb redressed and reset; 3 man-hole tops reset; 1 lamp hole top reset; 100 lin. ft. concrete headers; 3,170 sq. yds. vitrified block pavement; 360 cu. yds. excavation; 2,720 lin. ft. straight stone curb; 140 lin. ft. circle stone curb; 230 lin. ft. concrete headers; 2 catch-basin tops reset; 990 lin. ft. 6-in. vitrified sewer pipe laid; 410 lin. ft. 4-in. vitrified sewer pipe laid (house-connections); 6 lamp hole tops set; 1,800 lin. ft. 8-in. vitrified pipe sewer laid; 120 lin. ft. 6-in. vitrified pipe sewer laid; 1,220 lin. ft. 4-in. vitrified pipe sewer laid (house-connections); 5 man-holes built; 2 flush-tanks built.

✣Bids will be received until noon, June 16, by the Commissioners of Hamilton county, Cincinnati, O., for the improvement under Specifications No. 72 of Loveland and Maderia road from Remington to the Camargo pike in Symmes township. Fred Dreihs is clerk of the board.

✣Bids will be received until June 14, by the Board of County Commissioners, Canton, O., for the North Industry Road Improvement. The road will be 2¼ miles in length, 20 ft. wide through the town of North Industry, and 17 ft. wide elsewhere.

✣Bids will be received until noon, June 9, by Board of Hamilton County Commissioners, Cincinnati, O., for the improvement of the Springfield pike from Gas Hall in Carthage to Cincinnati, Hamilton & Dayton R. R. bridge in Hartwell in Springfield township. Fred Dreihs is clerk.

✣Bids will be received until noon, May 31, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and material for the improvement of Hooker St., from Montana Ave. to the south line of Broadwell Ave., by grading, setting cement, combined curb and gutter, macadamizing the roadway and constructing the necessary basins and drains. Plans and specifications are on file at the office of the chief engineer of the Department of Public Service. J. J. Wenner is clerk

✣Bids will be received until noon, May 31, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and material for the improvement of Buck St., from Harrison Ave. to Barnard St., by grading, setting granite curbs, paving the roadway with wood block and constructing the necessary drains and inlets. Plans and specifications are on file at the office of the chief engineer of the Department of Public Service. J. J. Wenner is clerk.

⊙Paul & Henry have been awarded the contract by the City Council of Barberton, O., at $5,284, for the paving of Wunderlich Ave.

⊙Oberlander & Oberlander of Bucyrus, O., have been awarded the contract by the County Commissioners, Marion, O., for the construction of the Clements pike in Montgomery township for $13,144. The road runs along the north edge of the village of DeCliff and is four miles long. Other bidders were: J. D. Gillispie, $13,843; E. C. Brady, $13,800; J. M. Stone, $14,490; J. W. Scott, $13,750; Uncapher & Shaw, $14,144, and T. J. Gruber, $14,345.

⊙The [illegible] awarded the contract by the Board of Hamilton County Commissioners, Cincinnati, O., for the improvement under specification No. 129 of Carthage Ave., between corporation line of Norwood and Reading road in Columbia Township for $5,444. Bids were opened May 5.

The Village Council of Doylestown, O., has decided to pave the main street of the village.

The Glen Echo Improvement Association of Columbus, O., has adopted resolutions requesting the city to extend the Summit St. paving as far north as Hudson Ave.

Ordinances determining to proceed with the paving of South Limestone St. and South Center St. have been introduced in the City Council of Springfield, O.

The Glen Echo Improvement Association of Columbus, O., has adopted a resolution requesting the city to extend the Summit St. paving improvement as far as the north side of Hudson Ave. Henry Maetzel is city engineer.

James McCarron submitted the lowest bid to the Department of Public Service of Youngstown, O., for the repaving of Market St. with brick, the bid being $27,609. F. M. Lillie is city engineer.

A petition will be presented to the County Commissioners, Akron, O., June 1, praying for the establishment of a county road on the following lines: Beginning at the Highland Springs road in Boston township, thence running north to the town line road in Northfield township.

Service Director Harbert of Canton, O., has asked the City Council to furnish him with $8,000 for the improvement of waterworks park. It is planned to expend most of the money in the improvement of the park from Lake to Fairfield Sts.

Oklahoma.

✣Bids will be received until 10 a. m., June 10, by Capt. D. L. Stone, constructing quartermaster, Fort Sill, Okla., for constructing macadam roads at Fort Sill, Okla.

✣Bids will [illegible] 29, by Bob Parman, City Clerk, Oklahoma City, Okla., for repaving with 2-in. Bermudez asphalt macadam surface upon the present macadam foundation intersections of 12th St. and Hudson Ave. and 12th St. and Walker Ave.

Oregon.

Following bids were received May 15 by the City Executive Board, Portland, Ore., for street improvements: Beaumont district, bitulithic pavement—Elwood Wiles, $91,156; Warren Construction Co., $91,371. Belmont St. district, bitulithic pavement—Warren Construction Co., $55,705; Pacific Bridge Co., $53,631. Cora Ave., grading and concrete curbs and walks—Stevens Bros., $3,831; Beehill Bros., $3,267; C. A. Akerson, $3,768; Joplin & Meeks, $3,621; Coast Construction Co., $3,970; Giebisch & Joplin, $3,718; Baker Bros. & Hayden, $3,769. Second St., from Sheridan to Arthur, fill—Pacific Bridge Co., $29,214. Gantenbein Ave., from Skidmore to Alberta, grading and concrete curbs and walks—Concrete Construction Co., $1,479. Klickitat St. district, bitulithic pavement—Elwood Wiles, $62,799; Warren Construction Co., $68,841. Mississippi Ave., from Killingsworth to West Piedmont, grading and concrete curbs and walks—R. J. Debuhr, $2,779; O. Poulsen, $2,817; Bechill Bros., $2,871; Kelkenny Bros., $2,826; C. A. Akerson, $2,605; Hilliard & McGinnis, $2,549; Baker Bros. & Hayden, $2,802; P. H. Flynn, $3,033; Jeffery & Bufton, $2,745; Portland Sidewalk & Concrete Co., $2,800. East 60th St., from Alberta to Killingsworth, grading and concrete curbs and walks—Stevens Bros., $3,350; Bechill Bros., $3,021; O. Paulsen, $3,190; Manning & Co., $3,232; Joplin & Meeks, $3,155; Coast Construction Co., $3,108; Jeffery & Bufton, $3,039; Hilliard & McGinnis, $2,858; Baker Bros. & Hayden, $3,071; Giebisch & Joplin, $3,236. East 23rd St., from Alberta to Killingsworth, grading and concrete curbs and walks—Jeffery & Bufton, $3,053; Giebisch & Joplin, $3,247; Coast Construction Co., $3,090; Hilliard & McGinnis, $2,848; Manning & Co., $3,203; Baker Bros. & Hayden, $3,102. East 24th St., grading and concrete curbs and walks—Manning & Co., $4,303; Joplin & Meeks, $3,906; Giebisch & Joplin, $4,145; Baker Bros. & Hayden, $4,125. East 26th St., from Hawthorne to Belmont, bitulithic pavement—Warren Construction Co., $10,537. East 31st St., grading and concrete curbs and walks—Bechill Bros., $2,047; McSween & Son, $2,104; Joplin & Meeks, $1,895; Coast Construction Co., $2,074; Baker Bros. & Hayden, $2,049. Williams Ave. district, asphalt pavement—Oregon Independent Paving Co., $98,324. Webster St., from Albina to Michigan, grading and concrete curbs and walks—Bechill Bros., $510; R. J. Debuhr, $495; O. Paulsen, $528; Kelkenny Bros., $508; E. R. Gustafson, $469; C. A. Akerson, $486; McSween & Son, $528; M. Hansen, $506; P. H. Flynn, $531; Portland Sidewalk & Construction Co., $469. Woodstock Ave. district, grading and concrete curbs and walks—Manning & Co., $13,270; Bechill Bros., $13,582; Joplin & Meeks, $12,004; Coast Construction Co., $14,084; Giebisch & Joplin, $13,485; Baker Bros. & Hayden, $13,697; Stevens Bros. $14,358. Zanita Ave., from Milwaukee to East 22nd, grading and concrete curbs and walks—Bechill Bros., $2,734; Stevens Bros., $2,755; Coast Construction Co., $2,819; Joplin & Meeks, $2,995; Giebisch & Joplin, $2,870; Baker Bros. & Hayden, $3,055.

The City Commissioners of Baker, Ore., have ordered the paving of six thoroughfares in the central portion of town. Bids will be asked on bitulithic and other material.

The City Council of Hillsboro, Ore., has adopted a resolution to pave the main business streets and in addition to pave the entire street around the court house. The paving district embraces 11 blocks and covers Main, from First to Fourth; Washington, from Second to Third; Lincoln, from First to Second; First, from Main to Lincoln; Third, from Lincoln to Washington, and Second, from Baseline to Lincoln. City engineer's estimate places the cost at approximately $69,000.

Pennsylvania.

✣Bids will be received until 5 p. m., June 12, by G. F. Greiner, Secy., Towns Council, Ridgeway, Pa., for setting curb and for grading, paving, including 2,500 cu. yds. excavation; 7,000 sq. yds. paving; 5,600 lin. ft. curbing. F. W. Ward is Borough Engineer.

✣Bids will be received until 8 p. m., May 31, by Borough of Scottdale, Pa., R. F. Ellis, Burgess, for the grading, curbing and paving of the following streets: South Chestnut St., from the south side of Pittsburg St. to north side of Market St.; South Chestnut St., from the south side of Market St. to the south side of the Ridgeway Property; Grant Ave., from the west side of Broadway to the east side of Spring St.; Stoner St., from the south side of Pittsburg St. to the north side of Market St.; 4th Ave., from the north side of Wall St. to the south side of alley along Kelly property on the north, in the following approximate quantities: Grading, 5,481 cu. yds.; backing stone, 418 lin. ft.; curbing with native sandstone, 5,679 lin. ft.; paving with vitrified brick or block, 6,734 sq. yds. Also paving with vitrified hillside brick or block, 1,824 sq. yds. Bidders shall name the makes of brick or block and bid on using same. Maker of accepted brick or block will be required to furnish surety bonds of $5,000 and guarantee for ten years to successful bidder and by him to be assigned to the Borough. Each bidder shall furnish certified check, on a national Bank or Trust Compuany, in the sum of $500, payable to the Borough Treasurer with bid as guarantee. Plans and specifications may be seen at Borough Engineer J. B. Hogg's office at Connellsville, Pa. Bids must be addressed to F. M. Newcomer, Secretary of Council, Scottdale, Pa., and indorsed Street Improvement. F. M. Newcomer is Secy. of Council.

✣Bids will be received until noon, May 31, by W. J. Williams, Secy., Borough of Kingston, Pa., for paving approximately 10,-

[illegible] ing, and for furnishing and setting approximately 8,700 lin. ft. of curbing. Each bid must be accompanied by a certified check for 5 per cent of the total amount of the bid, drawn payable to E. M. Rosser, Treasurer. At the same time and place, sealed proposals will be received for constructing approximately 3,000 lin. ft. of sewers 8 in. to 20 in., together with the necessary inlets, manholes, and lamp holes. Each bid must be accompanied by a certified check for 5 per cent of the total amount of the bid, drawn payable to E. M. Rosser, Treasurer. Plans, specifications, instructions to bidders and forms of proposals may be seen and examined at the office of the Borough Engi- [illegible] tional Bank Bldg., Wilkes-Barre, Pa.

✣Bids will be received until 7:30 p. m., June 5, by Town Council, Steelton, Pa., for subgrading, paving and curbing 2d St. from Adams St. to Chestnut St. A certified check for $500 payable to L. H. Sutton, Borough Treasurer, must be filed with each bid. C. D. Feidt is Borough Secy.

✣Bids will be received until noon, May 31, by W. J. Williams, Secy., Kingston Borough, Luzerne County, Pa., for paving, curbing and grading Division St. including approximately 6,000 sq. yds. and furnishing and setting approximately 3,500 lin. ft. of curbing. Plans, specifications, instructions to bidders and forms of proposals may be seen and examined at the office of the Borough Engineers, Young & Wintermute, 414 Second National Bank Bldg., Wilkes-Barre, Pa., or at Smith & Wells, 1003 Coal Exchange Bldg., Wilkes-Barre, Pa. W. J. Wililams is Borough Secretary.

The following bids were received by the Highway Department, Harrisburg, Pa., W. W. Caldwell, Commissioners, on May 16, for paving 15 sections of streets, aggregating 28,087 sq. yds. of paving: Berryhill, Cameron to 13th—Barber asphalt, $1.72 per sq. yd. for paving; Central Construction Co., $1.87; Warner-Quinlan, $1.74. Hunter, Crescent to 15th—Barber, $1.80; Central, $1.81; Warner-Quinlan, $1.90. Nectarine, Swatara to Berryhill—Barber, $1.79; Central, $1.81; Warner-Quinlan, $1.90. Shrub, 12th to 14th—Barber, $1.79; Central, $1.81; Warner-Quinlan, $1.90. Whitehall, 18th to Prospect—Barber, $1.80; Central, $1.76; Warner-Quinlan, $1.90. Forrest, 6th to Jefferson—Barber, $1.76; Central, $1.59; Warner-Quinlan, $1.90. 15th, Berryhill to Catharine—Barber, $1.76; Central, $1.74; Warner-Quinlan, $1.90. 16th, Berryhill to Catharine—Barber, $1.76; Central, $1.74; Warner-Quinlan, $1.90. Catharine, 15th to 17th—Barber, $1.76; Central, $1.74; Warner-Quinlan, $1.90. Naudain, 15th to 17th—Barber, $1.76; Central, $1.74; Warner-Quinlan, $1.90. Linden, Bailey to State—Barber, $1.79; Central, $1.81; Warner-Quinlan, $1.90. Balm, Bailey, to State—Barber, $1.77; Central, $1.81; Warner-Quinlan, $1.90. Summit, Bailey to King—Barber, $1.79; Central, $1.83; Warner-Quin- [illegible] Barber, $1.79; Central, $1.84; Warner-Quinlan, $1.90. Peffer, 2d to 7th—Barber, $1.85; Central, $1.59; Warner-Quinlan, $1.70.

The Grand Jury of Washington county, Washington, Pa., has authorized an issue of $500,000 4 per cent tax free road improvement bonds.

Citizens of Lansdowne, Pa., in a special election last week defeated the proposition to borrow $80,000 for highway improvement.

Tennessee.

✣Bids will be received until noon, June 20, by Robertson County Pike Commission, Springfield, Tenn., for grading, ditching and macadamizing about 50 miles of public roads. J. E. Washington is Chairman of the Commission. Official advertisement will be found elsewhere in this issue.

Texas.

⊙Horton & Horton, Houston Theater Bldg., Houston, Tex., have been awarded the contract by Howe & Wise, County Engineers, 722 National Bank, Houston, Tex., for the paving of Washington County road from the city limits of Houston to the Houston Heights Blvd., with wood block. The contract price is $11,159. Bids were opened May 11.

The mayor of Marlin, Tex., has appointed a committee to represent and act with the street and alley committee of the council in the matter of devising a plan for paving the streets.

At a county good roads mass meeting recently held in Waco, Tex., it was unanimously decided to call an election to see whether $600,000 shall be issued in bonds for roads.

Utah.

The Board of County Commissioners, Logan, Utah, has been petitioned by residents of Newton, Peterboro, Benson, Clarkston, Trenton and Mendon for an appropriation from the issuance of bonds as proposed by the commissioners shall be spent in each precinct in proportion to the taxes paid there for road improvements.

Virginia.

✣Bids will be received until 11 a. m., May 29, at the office of the Clerk, Amherst, Va., for the construction of 4½ miles of macadam road including 5,000 cu. yds. of stone and 10 ton steam roller. S. L. Von Gemmingen, Resident Engineer, Amherst, Va.

Washington.

The City Council of Seattle, Wash., has passed an ordinance ordering the paving of a mile of residence streets in the south portion of the city so selected as to form a portion of what will eventually be the Pacific highway. Other paving is contemplated on East Fourth St., which forms a part of the direct route from Seattle and Tacoma to Gray's harbor, via Summit lake and the Elma cut-off.

Wisconsin.

✣Bids will be received until 10 a. m., June 10, by Board of Public Works, Racine, Wis., for furnishing the necessary labor and material for the following work: Paving Water St. from Fourth St. to Park Ave., including approximately 2,642 sq. yds. of brick pavement. P. H. Connolly is chairman of the board.

⊙It is reported that the Board of Public Works of Madison, Wis., has awarded the following contracts for paving work: John Blake at $30,000, for paving State St. with asphalt; The Andrus Asphalt Co. at $10,015, for paving Park St. with asphalt; Nicholas Quinn at $11,995, for improving several streets with macadam; Nicholas Quinn at $7,956, for paving Webster St. with creosote block; John Cullinaine at $16,709, for paving East Johnson from Wisconsin Ave. to Butler with creosote blocks; John Blake at $7,700, for paving West Gilman from State St. to University Ave.

⊙The White Construction Co., of Milwaukee, Wis., has been awarded the contract by the City Council of Racine, Wis., for the paving of North Erie St. with Trinidad pitch lake asphalt for $1.89 per sq. yd.

⊙F. Booitz, Waukesha, Wis., has been awarded the contract by that city for laying macadam on three streets for $8,292. The work includes 4,649 cu. yds. of excavation, 4,796 ft. of curb and gutter, 4,620 sq. yds. of asphalt macadam with granite top, 172 ft. of 8-in. storm sewer, three catch basins, 270 sq. yds. of brick gutters. Bids were opened May 15.

The street committee of the City Council of Menasha, Wis., has decided to pave Chute St. with concrete, extending from the Main St. intersection to and including the Wheeler transfer line property on Chute St., and from that point west to the Tayco St. intersection, tar macadam will be used.

Mayor Jones of DePere, Wis., is agitating the paving of two blocks of Main Ave., from the bridge to the Kidney boat factory.

A resolution has been introduced in the City Council, Milwaukee, Wis., providing for an asphalt pavement from Seventh to 48th Sts.

Canada.

✣Bids will be received until May 31, by G. W. Robinson, secretary-treasurer, Lethbridge, Alta., for the following work: Contract A—Street grading, approximately 130,000 cu. yds. Contract B—Cement sidewalks, approximately 45,000 sq. yds. Contract C—Water mains, approximately 10 miles. Contract D—Sanitary sewers, approximately 6½ miles. Contract E—Storm sewers, approximately 28 miles. Plans, profiles and specifications may be seen and information obtained from C. M. Arnold, city engineer, Lethbridge.

✣Bids will be received until noon, May 31, by William Thomson, secretary-treasurer, Fort Qu'Appelle, Man., Can., for the construction of approximately 15,000 sq. ft. cement sidewalks within the village.

The City Council of Brandon, Man., on May 18 decided that asphalt block be the material used for street paving. R. E. Speakman is City Engineer.

BRIDGES—STEEL AND CONCRETE

Alabama.

⊙Board of Revenue, Jefferson County, Birmingham, Ala., has let the contracts for the construction of two bridges to the Southern Bridge Co. The substructures will be built by Beardon & Co.

California.

County Surveyor of Tehama County at Red Bluff, Cal., has been instructed by the Board of Supervisors to prepare plans and specifications for the construction of three bridges. Two of the bridges are in supervisoral district No. 5, and one of them will be a steel bridge with a span of 80 ft. on Pine creek. The other is a bridge with a span of 80 ft. on what is known as Jimmy Shed creek. Both bridges are about 12 miles southeast of Vina. The third bridge will be in district No. 1, across Little Stony Dry creek. This bridge will have two spans of 80 ft. each and two 40-ft. trestles for approaches to the bridge.

Connecticut.

⊙Streuli & Puckhafer, Newfield Bldg., Bridgeport, Conn., have been awarded the contracts for the construction of two concrete bridges at Deep River, Conn., for the town of Saybrook. One of the structures will be 125 ft. long and the other 150 ft. long and designed to support trolley traffic.

Florida.

✣Bids will be received until noon, June 6, by Commissioners of Suwanee and Lafayette counties, Fla., at Live Oak, Fla., for the erection of a steel bridge across the Suwanee River at Dowling Park. H. A. Thomason is chairman of the joint board. J. W. Bryson is

Illinois.

✣Bids will be received until 2 p. m., May 25, by Board of Local Improvements at the office of the City Engineer, Bloomington, Ill., for the necessary labor and material for the construction of the following improvement: Extending the reinforced concrete bridge now built at the intersection of Empire St. and

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Colton Ave. from [illegible] line of Empire St. to the west line of Colton Ave. north, in accordance with [illegible] and specifications now on file in the office of the City Engineer. A. L. Moore is Chairman of the Board.

◉Bordner & Parker, Clinton, Ill., have been awarded the contract for the construction of a bridge over the dredge ditch in Creek township. The cost of the structure, which will be 20 ft. long and 12 ft. wide, is $1,350.

◉The Board of Livingston County Supervisors at a recent session in Pontiac, Ill., awarded the contract for the construction of a new steel bridge over the Vermillion River south of Saunemin to the Joliet Bridge Co., at $1,750. The substructure was let to Walter Farmer, Cullom, Ill., at $750. The structure will be 80 ft. long and 14 ft. wide.

Bonds amounting to [illegible] were sold on May 20 for the construction of the Illinois Ave. bridge. Plans and specifications for the structure are about completed. It is believed that bids for the work will be asked by the City of Aurora, Ill., at once.

At a meeting of the State Senate, Springfield, Ill., a bill was passed appropriating $12,500 for the construction of bridges over the Illinois & Michigan Canal.

Bids will be received at the town hall, Collinsville, Ill., up to 7 p. m., June 2, for the construction of one reinforced concrete bridge in Collinsville Township, Madison County. William Grenard, town clerk, Collinsville, Ill. Groenemeyer bridge—Span, 10 ft., box culvert; roadway, 20 ft.; wings, 20 ft. Estimated amount of concrete in structure, 87.7 cu. yds.; reinforcing steel, 6,751 lbs. Nearest railroad station, Collinsville, 2 miles. All material will have to be shipped in. Excavation will be in sandy loam. Stream usually dry. Commissioners advise that vouchers for this work will be issued, payable April 1, 1912. Work to be completed on or before August 1, 1911.

Bids will be received at the county clerk's office, Pekin, Ill., up to 1:30 p. m., June 5, for the construction of two reinforced concrete bridges in Tremont Township, Tazewell County. E. L. March, town clerk, Tremont, Ill. Yentes bridge—Span, 30 ft., slab bridge; roadway, 16 ft.; length of wings, 13 ft.; finished roadway to bottom of footings, 13 ft Estimated amount of concrete in structure, 89.3 cu. yds.; reinforcing steel, 9,856 lbs. nearest railroad station, Morton, on the Vandalia and Santa Fe, 3 miles. Present structure is a [illegible] ft. wooden truss. Excavation will average 10 ft. in sandy, black loam to clay. Lackland bridge—Span, 40 ft., girder bridge; roadway, 16 ft.; wings, 12 ft.; height over all, 13½ ft. Estimated amount of concrete in structure, 120.7 cu. yds.; reinforcing steel, 14,563 lbs. Nearest railroad station, Tremont on the Big 4, 2¾ miles. Present structure is o 40-ft. bridge on piles. Excavation about same as above. All material for the above bridges will have to be shipped in. Work to be completed on or before October 1, 1911.

Indiana.

Board of Public Works, Indianapolis, Ind., has adopted plans and specifications for the construction of the reinforced concrete bridge across Pleasant Run at State Ave. The cost of the work is estimated by City Engineer at $11,466.

A mass meeting was recently held by the citizens of Fort Wayne, Ind., for the purpose of agitating the question of constructing a new bridge over the Maumee River between the Walton Ave. and Columbia St. bridges.

A petition has been presented to the County Commissioners at South Bend by the citizens of that place for the construction of a bridge at Logan St. The new bridge, which will replace an old concrete pile and frame structure, will be of reinforced concrete, consisting of four 110 ft. spans. The estimated cost of the work is $65,000. W. S. Moore, South Bend, Ind., is City Engineer.

Citizens of Mishawaka, Ind., have submitted to the Board of County Commissioners at South Bend, Ind., a petition asking for the construction [illegible] at Mishawaka in St. Joseph County.

Advices from Spiceland, Ind., state that the old covered bridge on the National Road just east of Dunreith is to be replaced by a modern steel structure. Newcastle, Ind., is the county seat of Henry County.

Commissioners of St. Joseph County, South Bend, Ind., have included among their appropriations amounting to $129,600 one of $65,000 for the construction of a bridge over the St. Joseph River at Logan St. near Mishawaka. An appropriation of $15,000 was also made for the building of a new bridge on La Salle Ave.

The Henry County Court at Newcastle, Ind., has appointed viewers to look over the conditions relative to the construction of a new bridge over the Connoquenessing Creek petitioned for by the residents of Hazel Dell.

Commissioners of Shelby County at Shelbyville, Ind., have awarded the contract for the construction of the Holmes Bridge to the Lafayette Engineering Co., Lafayette, Ind., at $1,700.

Iowa.

✣Bids will be received until [illegible], May [illegible] by F. W. Leedham, county auditor, Clinton, Ia., for the construction of county bridges from No. 1 to No. 7. R. C. Hart is city engineer. Official advertisement will be found elsewhere in this issue.

◉The Board of Emmet County Supervisors, Estherville, Ia., has awarded the contract for the construction of eight concrete bridges to M. M. Stark & Co., Des Moines, Ia., at $6,080.

The Board of Hardin County Supervisors, Eldora, Ia., has approved the bond guaranteeing the city of Iowa Falls paying one half the cost of the new steel bridge over the Iowa River at that point. Plans for the proposed structure will be prepared at once.

Board of Hardin County Supervisors have decided upon the construction of a new bridge at the foot of Marion St. in Eldora, Ia. The structure as proposed will be of steel and will necessitate an expenditure of about [illegible]

Kansas.

Cities of Kansas City, Kans., and Kansas City, Mo., have decided it necessary to reconstruct entirely the James St. viaduct extending from James St. and Central Ave., in Kansas City, Kans., over the tracks of the Missouri Pacific, Union Pacific and Atchison, Topeka & Santa Fe Rys. to Genesee St. in Kansas City, Mo., a distance of 700 ft. It is planned to build the new structure of reinforced concrete at a cost of about $75,000, and it is hoped to induce the Missouri Pacific officials to bear part of the expense.

City Commissioners of Topeka, Kans., are seriously considering taking action toward the construction of the proposed Fillmore St. bridge over the Shunganunga Creek.

Commissioners of Labette County at Oswego, Kans., have granted the petitions for the construction of three concrete bridges in Hackberry, Howard and Osage townships, estimated to cost about $3,335.

Kentucky.

A meeting [illegible] of Bellevue, Ky., to form a club to boost the construction of the proposed viaduct connecting that city with Newport and the Dawson St. Ry.

Minnesota.

◉Advices from Wadena, Minn., state that Board of Compton township in Wadena County awarded the contract for the construction of two small bridges, one over Oak Creek at Lifquist farm and the other at Veli place to the Continental Bridge Co., at $898. Other bids were as follows: Perham Bridge Co., $1,090 for concrete arches without piling. Hennepin Bridge Co., $1,396 for concrete arches with piling, and $1,290 for double reinforced concrete bridge. Minneapolis Bridge & Iron Co., $1,400 for concrete arch bridge with piling. Twin City Bridge Co., $1,278 for double reinforced concrete bridge. W. B. Bassett & Co., $1,530 for reinforced bridge with [illegible] Nordin, $979 for concrete arch bridge, without piling.

Instructions have been given Andrew Rinker, City Engineer, Minneapolis, Ind., to draw plans for the construction of a bridge 2,000 ft. long spanning the Mississippi River and connecting Third Ave. S. with the intersection of First Ave. and Second Ave. S. E.

Mississippi.

✣Bids will be received until June 5 by Supervisors of Leflore County, Greenwood, Miss., for the construction of a steel drawbridge across Tallahatchie River between Leflore and Tallahatchie counties. C. W. Crockett, clerk, has plans and specifications on file.

Missouri.

✣Bids will be received until noon, June 6, by W. Ten Eyck, highway engineer, Lynn County, at Linneus, Mo., for the construction of the following bridges in accordance to plans and specifications on file at the office of the highway engineer: Moore's, 58-ft. three-panel steel girder. Stauber's, 28-ft. steel girder; Haley's, 24-ft. steel girder; Reick's, 45-ft. pin-connected span; Wilson's, 45-ft. pin-connected span; Knight's, 30-ft. steel girder. Certified check for $250.

◉County Court of Nodaway County at Marysville, Mo., has awarded the contract for the construction of two bridges in Lincoln township to the Standard Bridge Co. W. D. Beaver was awarded a contract for the construction of a concrete culvert in Lincoln township

New Jersey.

◉The contract for the construction of the proposed steel and concrete bridge over the Third River and Morris Canal at Baldwin St., Bloomfield, N. J., has been awarded by the Board of County Freeholders of Newark, N. J., to Linde & Griffith, Newark, N. J., at $12,995. The other bidders were: Schwires & Co., New York, $16,383; Long & Co., Hackensack, $14,200; Fusco Construction Company, Newark, $20,700; Charles W. Bance, Jersey City, $16,200; R. C. McMains & Co., Caldwell, $16,453; Frederick E. Paddock, Caldwell, $29,016; F. W. Shrump & Sons, Pleasantdale, $19,915; Snare & Triest Co., New York, $18,470; Ferro Concrete Company, Harrisburg, Pa., $17,921.

Board of Freeholders, Gloucester County, Woodbury, N. J., have decided upon the construction of a bridge over Bethel Creek on Holly Ave. at the Washington township line.

The Township Committee, Cranford, N. J., has made a contract with the Central Railroad of New Jersey, whereby the railroad will bear the expense of building a new underground crossing east of Rahway River, including both sub and superstructure, providing the town vacates Linden Ave., east, grade crossing. J. I. Yates, New York City, is Bridge Engineer [illegible]

New York.

◉The Supervisors of Suffolk County at Riverhead, N. Y., have awarded the contract for the repair of the North Haven-Sag Harbor drawbridge to the York Bridge Co., York, Pa., at $2,965. A row of piles with 2½ ft. centers will be driven around the pivot pier. The piles are to be encased in a concrete jacket not less than 2 ft. thick, to extend from the bottom of the stream to the pier. The top of the old pivot pier is to be removed to a depth of 12 ins., and a grillage constructed of eight 5-in. "I" beams, extending entirely over the old pier and resting on the new casing, which in turn will be encased in new concrete and the present rack replaced so that the bridge shall revolve in a satisfactory manner

The Public Service Commission, according to advices from Albany, N. Y., has issued an order providing that the proposed bridge over the New York Central tracks, as an extension of Bridge St., Solvay, shall not be built to accommodate street car traffic. The order directs that the center line of the over-grade [illegible] Bridge St. The total length of the over-grade crossing and its approaches will be about 1,115 ft. The grades are to be 6 per cent. The approaches are to consist partly of steel and partly of earth embankment. The over-grade crossing, or the bridge proper, is to be entirely of steel. Paved flooring is also directed.

The State Senate, Albany, N. Y., has passed a bill authorizing the construction of a bridge over the Erie Canal at the road leading from [illegible] River road to the Grand Island ferry. An appropriation will be made for the purpose.

According to plans received by the Board of Public Works, Fulton, N. Y., for the construction of the proposed $170,000 steel reinforced concrete bridge over the Oswego River at Broadway the structure will be 1,205 ft. long extending from East First to West First St. and consisting of six spans the longest being 145 ft. The face of the bridge will be pebble finished. The roadbed will be of brick and the balustrade will be 4 ft. high, faced with an ornamental scroll. It is expected that bids will be advertised for at once.

North Carolina.

✣Bids will be received until 11 a. m., May 31, by [illegible] county commissioners, Mecklenburg and [illegible] counties, at the office of the Mecklenburg County Court House at Charlotte, N. C., for the construction of a steel bridge over Catawba River. W. M. [illegible] is chairman of the board. A certified check for $1,000 must be filed with each bid. Plans and specifications are on file at the office of the register of deeds of both counties.

Ohio.

✣Bids will be received until noon, June 16, by Board of Hamilton County Commissioners, Cincinnati, O., for the construction under Specifications No. 149, for culvert and approaches on Betts Ave. near the residence of John Robinson north of College Hill in Springfield township. Plans and specifications are on file at the office of the Board. Fred Dreihs is Clerk.

✣Bids will be received until 11 a. m., June 3, by Board of County Commissioners, Cleveland, O., for the construction of bridge work per report No. 2800, Conduit, Shun Pike Road, Brooklyn township. J. F. Goldenbogen is clerk.

⦿The following contracts were let by the County Commissioners, Marion, O., for removing the concrete flooring and replacing the Prendergast bridge on its present abutments, for removing the bridge on the Marion-Agosta Pike and replacing it on the abutments, and for dismantling the bridge on the Morris Pike. The first contract went to Dan Stout, Wilmington, at $599, and the third to the Home Engineering & Construction Co., Canton, O., at $447.

⦿Contracts were awarded May 17, by the Board of County Commissioners, Cleveland, O., for the painting of bridges, as follows: Report No. 2782, bridge on Harvard Road, R. H. Uhinck, 1785 W. 57th St., Cleveland, O.; Report 2783, bridge on Harvard Road in Brooklyn township, W. C. Kibbee, 3421 Riverside Ave., Cleveland, O.; Report No. 2784, bridge on Lorain Road, to A. W. Brainard, 8947 Broadway, Cleveland, O. J. F. Goldenbogen is Clerk.

Plans and specifications have been accepted by the Baltimore & Ohio R. R. for the elimination of the Ludlow Ave. grade crossing, Cincinnati, O. The first steps for the construction of the viaduct will be the condemnation of a right of way across the Baseball park 70 ft. wide, extending from the canal bridge and Ludlow Ave. to Knowlton's corner, Cumminsville. City Engineer believes a contract could be entered into within two months. The acceptance means that the Ludlow Ave. viaduct will be the first structure to be erected with the funds derived from the recent $800,000 bond issue. By the terms of the agreement the railroad is to pay 65 per cent of the cost, the city bearing 35 per cent, [illegible] of which, not to exceed 50 per cent, will be charged to the street railroad company if it makes use of the viaduct. The structure will be approximately 1,336 ft. in length, with a 40-ft. roadway and 10-ft. sidewalk. The total cost is estimated at $425,000, $325,000 for the structure and the balance for the property.

Commissioners of Summit County, at Akron, O., and representatives of the Northern Ohio Traction & Light Co., at a recent meeting in regard to the proposed new bridge at Cuyahoga Falls to replace the present structure it was decided to raise the level of the new bridge 10 ft. to the roadbed. The estimated cost of the structure is $6,000.

Commissioners of Butler County at Hamilton, O., have been petitioned by the Councilmen to repair the old or build a new structure over the Canal at Grand Boulevard.

County Commissioners have agreed to construct a bridge over the Canal at East Main St., Massilon, O., eliminating the hump providing the city will agree to assume all possible damages resulting. George Brissell, Canton, O., is president of the Board of Commissioners. $8,000 is reported to be available for the improvement.

Oklahoma.

•The following contracts were let by the Commissioners of Bryan County, Durant, Okla., May 10, for the construction of bridges: J. R. Johnson, Sherman, Texas, 13-ft. span bridge across Mineral Bayou northeast Durant, $940; Midland Bridge Co., A. B. Kissick, agent, Sherman, Tex., [illegible]-ft. span bridge two and one half miles west of Colbert, $944; 12-ft. span bridge across Shawnee Creek, 10 miles northeast of Bennington, $547; 50-ft. span bridge across Cannilla Creek 3 miles east of Durant, $1,025; 45-ft. span bridge across Little Blue River 6½ miles northwest of Durant, $950.

Pennsylanvia.

⦿The following bids were received by the Bureau of Surveys, Philadelphia, Pa., for the widening of the Chestnut St. bridge over the Schuylkill River: M. & J. B. McHugh, $74,084; Oswego Bridge Co., Oswego, N. Y., $76,096; American Paving & Construction Co., $77,519; Strabel Steel Construction Co., $88,805; Richard Walsh, $97,868. As the bids received for the work October 4, 1910, were above the estimate of $90,000, it was necessary to change the specifications by substituting granolithic-faced concrete for all cut stone where the latter was originally required. M. & J. B. McHugh, Arcade Bldg., Philadelphia, Pa., were awarded the contract.

⦿The York Construction Co. of York, Pa., has been awarded the contract by the Commissioners of Chester County, West Chester, Pa., for the erection of a reinforced concrete bridge at Springdale Station, West Marlborough township, over Doe Run Creek. The contract price is $2,745. Bids were opened May 15.

City Engineer of Wilkes-Barre, Pa., has been instructed by the Committee of the City Council to make a survey for the construction of the new bridge to replace the condemned South St. structure. According to plans the bridge will extend from a point on South Washington St. to Welles St. and will be an overhead structure of modern type. B. K. Finch is City Engineer.

Advices from Pittsburg, Pa., state that the Grand Jury has approved the report of the Court Viewers recommending the construction of a bridge over Guys Run at Harmarville in Harmar township.

Citizens of Glassport and Wilson townships want the Commissioners of Allegheny County at Pittsburg, Pa., to erect a bridge across the Monongahela River.

Plans have been about completed by the County Engineer of Berks County at Reading, Pa., for the construction of the proposed Penn St. bridge in that city and it is believed that bids will be advertised about the middle of June. Nothing definite can be done until the pending legislation is disposed of by the city council providing for the widening of Penn St. between Front and Second St. to a width of 200 ft. allowing a 60 ft. street to be established on each side of the bridge.

The following bids were received by the Bureau of Surveys of Philadelphia, Pa., for constructing a double-track steel plate girder bridge with grading and paving of streets on the line of Springfield Ave. under the Philadelphia & Baltimore Central R. R. tracks: Denorte Delise, $32,874, complete the work in 8 months (awarded contract); William P. Mahoney, 4 months, $33,216; P. F. Reilly, 5 months, $33,314; McNichol Paving & Construction Co., 5 months, $37,891; American Paving Co., 10 months, $39,765. The bids received for completing Passyunk Ave. bridge were: American Paving & Construction Co., $7,260, in 3 months; W. S. P. Shields (awarded contract), $5,608.88 in 2 months, and Armstrong, Latta Co., $7,537, in 3 months.

The West Penn Rys. Co., W. E. Moore, Connellsville, Pa., General Manager, will, in connection with the construction of an extension from Masontown to Martins Works, build a $25,000 steel bridge over the Monongahela R. R. and Cat's Run.

⦿Commissioners of Cambria County at Ebensburg, Pa., have awarded the contracts for the construction of two bridges, one over Brubaker Creek in Elder township to Polo Azarro at $1,975; the other over Trout Creek at Portage to A. J. Lord at $2,300.

Bids were received May 15 by the Department of Public Works, W. A. Schunk, Chief Engineer, Bureau of Engineering, Scranton, Pa., for the construction of the Mulberry St. viaduct. The viaduct will extend from the intersection of Mulberry St. and Mifflin Ave. to the intersection of Carbon St. and Providence Road. It is to carry a double-track street railway, a driveway and a sidewalk, over the Lackawanna River and the railroad tracks in the valley. The street railway tracks are to be entirely separate from the roadway to be used for city highway purposes. The viaduct will consist of 3 through structural steel spans on steel towers and concrete abutments over the river and railroad tracks, and a long earth fill approach on the north end. According to plans the structure will be as follows: Length, 602 ft.; width C. C. of trusses 26′ 6″ and one 8-ft. sidewalk, making a total width over all of 62 ft.; approximate weight of steel 1,600 tons; length of northerly approch 940 ft. The following bids were received for (1) entire work complete, except concrete piles, as per plans, and for (2) entire work complete, except concrete piles, with reinforced concrete floor, substituted for buckled plates on driveway of bridges as shown by alternate section on drawing, 307-20A: The Yorke Bridge Co., York, Pa., (1) $194,745 and (2) $187,947; Carlucci Stone Co., Scranton, Pa., (1) $202,427 and (2) $200,427; Pennsylvania Steel Co., Steelton, Pa., (1) $208,900 and (2) $206,400; Penn Bridge Co., Beaver Falls, Pa., (1) $211,000 and (2) $205,000; M. H. Stebbins, Wellsboro, Pa., (1) $212,460 and (2) $207,500; W. W. Lindsay & Co., Philadelphia, Pa., (1) $214,000 and (2) $209,700; Oswego Bridge Co., Oswego, N. Y., (1) $214,000 and (2) $209,000; Fort Pitt Bridge Works, Pittsburg, Pa., (1) $238,543 and (2) $233,752; Johnson-Gifford Co., New York, N. Y., (1) $239,950 and (2) $239,950. The following are the unit bids received for (A) 15 concrete pedestal piles, bottoms 25 ft. or less, below position of heads shown in plans with all appurtenances in place per. lin. ft. of pile; for (B) 85 concrete pedestal piles, bottoms over 25 ft. and up to 45 ft. below position of heads shown in plans with all appurtenances, in place, per lin. ft. of pile; for (C) 160 concrete pedestal piles, bottoms over 45 ft. and up to 60 ft., below position of heads shown in plans, with all appurtenances, in place, per lin. ft. of pile:

	(A)	(B)	(C)
York Bridge Co.	$1.30	$1.10	$1.15
Carlucci Stone Co.	1.15	1.00	1.05
Pennsylvania Steel Co.	1.35	1.10	1.15
Penn Bridge Co.	1.46	1.31	1.41
M. H. Stebbins	1.45	1.30	1.40
W. W. Lindsay & Co.	1.40	1.20	1.25
Oswego Bridge Co.	1.40	1.20	1.25
Fort Pitt Bridge Works	1.35	1.15	1.20
Jobson-Gifford Co.	1.35	1.15	1.20

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Tennessee.

⊙The Louisville & Nashville R. R. Co., W. H. Courtenay, Chief Engineer, has awarded the Foster-Creighton-Gould Co., Nashville, Tenn., the contract for reconstructing bridge across Choctawhatchie and Apalachicola Rivers on the Pensacola Division in Florida. The work will include both sub and superstructure, the former to be of reinforced and plain concrete replacing the creosoted pile piers now in use.

Texas.

J. W. Maxcy, Consulting Engineer, Houston, Texas, has been retained by the Commissioners Court, Richmond, Texas, to prepare plans and specifications for the bridge across the Brazos at Thompson and Orchard. A. H. Leach, Chicago, Ill., was awarded bridge bonds amounting to $60,000.

Citizens of Galveston County are to petition the commission, Galveston, Texas, to join with the Harris County officials in the construction of a joint bridge over Clear Creek to replace the present ferry at Seabrook.

A meeting was recently held in the Court House at Fort Worth, Texas, by representatives of the city, county and the Northern Texas Traction Co. in regard to the construction of the proposed bridge over Marine Creek at 23d St. in North Fort Worth. The structure as proposed will consist of two reinforced concrete spans each 40 ft. long.

Virginia.

It has [illegible] that the Norfolk & Western Ry. has decided to support the construction of the proposed bridge connecting Norfolk and Berkley. W. T. Brooke is City Engineer, Norfolk, Va.

Supervisors of Henrico and Hanover Counties, Va., recently held a meeting at Richmond, Va., to consider the question of repairing or constructing a new bridge over the Chickahominy River at Creighton Road. A new reinforced concrete structure is favored.

Washington.

⊙Commissioners of Skagit County at Mt. Vernon, Wash., have awarded the contract for the construction of a new steel bridge across the north fork of the Skagit River to Lance & Peters at $25,377.

Commissioners of Clarke County at Vancouver, Wash., are considering the construction of a steel bridge on concrete abutments over Gee Creek at Ridgefield, Wash.

⊙Commissioners of Spokane County at Spokane, Wash., have awarded the contract for the construction of the new bridge across the Spokane River at Spokane Bridge to O. H. Stratton at $19,400. The next low bidder was the Missouri Valley Bridge Co., at $19,862. The structure will include three spans the longest of which extending over the river will be 216 ft. The other two spans will be 75 ft. each. Charles L. Graves is County Engineer.

G. G. Harvey, Deputy Engineer, Lincoln County, Davenport, Wash., has completed plans for the construction of 75 highway bridges in that county. It is the idea of J. L. Thayer, County Engineer, to have all structures under 24 ft. in length of uniform type.

Wisconsin.

Commissioners of Price County at Phillips, Wis., have adopted a resolution favoring the construction of a bridge across the Wind Lake Canal at the township of Norway. The cost of the improvement is estimated at $1,000.

Canada.

✣Bids will be received until noon, June 15, by James R. Shanks, Chairman, Bridge Committee, Wheatland, for the necessary labor and material for the construction, as follows: (1) the masonry abutments; (2) a 90-ft. steel span, 16-ft. roadway steel stringers, for a bridge over the Little Saskatchewan River, 1½ miles, approximately, from Rivers, Manitoba. Copies of the drawings, specifications, etc., may be seen at the office of the Chief Engineer, Department of Public Works, Parliament Buildings, Winnipeg, Man. Bridge plan E. 213.

⊙The contract for the construction of a steel bridge near Birnie was awarded by M. E. Boughton, Secy.-Treas., Lansdowne, Arden, Man., on May 9 to the Tacoma Steel Bridge Co., at $1,000. The contract for the abutment and wing walls went to Albert Scobie, Winnipeg, Man., at [illegible]

IRRIGATION, DRAINAGE, LEVEES AND CANALS

California.

✣Bids will be received until 10 a. m., June 19, by directors of the South San Joaquin Irrigation District, Manteca, Cal., for the necessary labor and material for the construction of the Contract Divisions from 1 to 6 inclusive. Edwin Duryea, Jr., is Chief Engineer. Plans and specifications are on file at the office of Engineering-Congracting, 537 S. Dearborn St., Chicago, Ill. Official advertisement will be found elsewhere in this issue.

Business men of Colusa are considering increasing the acreage of reclamation district No. 108 and building of a levee at a cost of $500,000. Reclamation district No. 108 is in the southern part of Colusa county, and contains about 40,000 acres. It is proposed to take in all the land in the old district, which will increase the acreage to 60,000. The back levee will be rebuilt on a much larger scale than the levee now used for protection from the back-water, and will be connected with the Fair levee.

The Great Western Power Co., 25 Broad St., New York, and Shreve Bldg., San Francisco, is to build at Big Meadows, in northern California, a reservoir sufficient to store water for the irrigation of 300,000 acres.

Idaho.

The Commercial Club of Carey, Idaho, has organized a company to dam the Little Wood River and put in a reservoir that will store a sufficient quantity of water to irrigate 20,000 acres of land besides the 12,000 to 15,000 acres already irrigated, and mostly in cultivation.

Illinois.

✣Bids will be received until 2 p. m., June 5, by Commissioners of Sub-District 18, Kankakee Drainage District, at the office of Webber & Roth, Urban, Ill., for furnishing 495 ft. 8-in.; 2,109 ft. of 10-in.; 4,300 ft. of 12-in.; 1,200 ft. of 16-in.; ave. depth 3½ ft.

✣Bids will be received until 10 a. m., June 3, by Commissioners of Two-Mile Slough Drainage District at the office of J. P. Gulick, Attorney, Champaign, Ill., for furnishing, hauling, trenching, laying and back-filling tile drain in Branch No. 27, or Page Run, of said district, consisting of 11,500 ft. of 20-in. tile, average depth 5 ft. 10 [illegible] 5,100 ft. of 18-in. hile, average depth 5 ft. 6½ ins. Certified check for $100 with bids of $2,000 or less, $200 with bids over $2,000 and up to $5,000, and $500 with bids of $5,000 or over. H. J. Bialeschlaic, Tolono, Ill., and E. Shelby and J. W. Mathews, Sadorus, Ill., are Commissioners.

✣Bids will be received until [illegible] p. m., June 12, by Commissioners of "Bailey" Branch Drainage District at the office of Webber & Roth, 1st National Bank Bldg., Urbana, Ill., for the construction of drainage work in St Joseph and Ogden townships. The work will include 85 rods open ditch; 2,016 ft. of 16-in. tile; 1,050 ft. 18-in. tile; 6,500 ft. of 27-in. tile. J. C. Fairclo, Champaign, Ill., is Engineer.

Bids were opened May 18 by the Sanitary District of Chicago, for the excavation and construction of Contract Section 3 of the Calumet-Sag channel, the bids received being as follows: (1) S. R. H. Robinson & Son Contracting Co., St. Louis, Mo.; (2) Foley & Gleason Co., Aitkin, Minn.; (3) Robert Grace Contracting Co., Cleveland, O.; (4) John Marsch, Chicago, Ill.; (5) John J. McCaughey, Chicago, Ill.; (6) Schnable & Quinn, Chicago, Ill.; Marquette Construction Co., Chicago, Ill.; National Contracting Co., Chicago, Ill

	(1)	(2)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Glacial drift, [illegible]	[illegible]	$0.20	[illegible]	[illegible]	$0.27	$0.30	$0.45	[illegible]
Rock, 197,000 cu. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.91	.83	.80
Channeling [illegible]	[illegible]	[illegible]	.20	[illegible]	.20	.30	.28	.20
Concrete [illegible] wall, [illegible] cu. yds.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.21	5.17	5.45
Riprap slope [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.80	[illegible]	1.43	[illegible]
Totals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Among the bills passed at the last session of the Illinois Legislature are the following relating to drainage: Amends drainage act to provide that where lower drainage districts are damaged by upper districts court may assess damages against the upper district and determine the proportion which an upper district shall pay for benefits which may be derived. Creates sanitary districts in counties, by combination of two or more incorporated towns or cities; wanted in Lake county; law is modeled after Chicago sanitary district act. Companion measure to foregoing, authorizing the organization of water districts for the purpose of securing pure water.

The Illinois & Michigan Canal Commission, William Sackett, Chairman, Morris, Ill., will probably be allotted the following appropriations: $21,000 for abutments and approaches for bridge over the canal; $35,000 for repairs and for maintenance of locks, dams and dikes in the Illinois, $10,000 for dredging at La Salle.

Indiana.

✣Bids will be received until May 27 by W. K. Stevenson, Constructing Commissioner, at the office of the County Recorder, Rochester, Ind., for the construction of various arms and branches of the S. D. Collins ditch.

Kansas.

The City Commissioners of Wichita have taken action looking to the extension of the new drainage canal from its present end near Harry St., at Linwood park to Sewer Island, in the Big Arkansas river, a distance of about 3 miles; and the construction of a new drainage canal from 16th to 31 street, a distance of about half a mile; it is probable that the county will co-operate with the city in the extension of the new drainage canal south to the Big Arkansas River. Bert C. Wells is City Engineer of Wichita.

Iowa.

✣Bids will be received [illegible] June 6, by Boards of Supervisors of Sac, Buena Vista and Calhoun Counties, Ia., at the office of J. Wilbur Neal, Auditor, Sac County, Sac City, Ia., for the construction of tile drains in Drainage Districts Nos. 16, 30 and 92 in accordance with plans and specifications [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] as follows:

Section.	[illegible] ft.	Size, ins.	Average [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	6.40	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	7.00	
[illegible]	[illegible]	[illegible]	5.80	
[illegible]	[illegible]	20	5.00	
[illegible]	[illegible]	21	7.80	2
[illegible]	[illegible]	22	6.30	
4	1,000	[illegible]	5.00	
[illegible]	[illegible]	14	7.30	
[illegible]	[illegible]	12	[illegible]	
[illegible]	[illegible]	[illegible]	5.00	
5	600	[illegible]	4.65	1
[illegible]	[illegible]	[illegible]	4.50	
6	285	10	4.10	2
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	4.50	
[illegible]	[illegible]	[illegible]	4.50	2
[illegible]	[illegible]	[illegible]	4.65	
9	700	10	[illegible]	
[illegible]	[illegible]	[illegible]	4.10	2
11	1,200	12	4.50	2
11	500	10	5.20	
11	600	[illegible]	4.70	
[illegible]	[illegible]	[illegible]	4.70	
[illegible]	[illegible]	12	5.30	1
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	6.20	
[illegible]	[illegible]	8	5.00	
[illegible]	[illegible]	[illegible]	4.30	
16	[illegible]	[illegible]	[illegible]	[illegible]
16	1,350	[illegible]	6.50	
[illegible]	[illegible]	[illegible]	6.10	
16	950	18	6.70	
16	1,525	16	6.65	
16	900	14	7.00	
16	997	12	[illegible]	
17	740	16	6.50	
[illegible]	[illegible]	15	6.60	
[illegible]	[illegible]	14	5.10	
[illegible]	[illegible]	8	4.65	
19	[illegible]	[illegible]	4.05	
20	1,287	10	5.70	
21	4,550	16	7.00	2
[illegible]	[illegible]	14	6.00	
21	300	12	4.50	
21	300	10	4.50	
21	1,729	8	4.50	
[illegible]	[illegible]	[illegible]	4.20	
[illegible]	[illegible]	[illegible]	3.90	
[illegible]	[illegible]	[illegible]	4.10	2
[illegible]	[illegible]	[illegible]	5.20	
24	400	12	5.20	2
[illegible]	[illegible]	10	[illegible]	
[illegible]	[illegible]	20	5.50	
[illegible]	[illegible]	26	9.10	
[illegible]	[illegible]	18	5.40	
[illegible]	[illegible]	16	5.00	
26	612	[illegible]	7.00	
27	900	[illegible]	8.00	
[illegible]	[illegible]	18	6.90	
27	350	14	4.50	
27	2,200	[illegible]	[illegible]	
[illegible]	[illegible]	12	[illegible]	

⦿[illegible] Feser, Mason City, Ia., has been awarded the contract at $1,398 for the tile work for Drain No. 40, Story County, Ia. Bids were opened May 13 at Nevada, Ia.

Minnesota.

⦿Bids were opened May 16, by W. A. Seeman, County Auditor, Slayton, Minn., for Ditch Job No. 19, the contract being let to J. E. Gelbertson, St. James, Minn., at $6,[illegible]. The contract includes tile, hauling, digging and filling.

Nevada.

⦿Bids were opened April 15, by the Pacific Reclamation Co., George M. Bacon, Consulting Engineer, Salt Lake City, Utah, for constructing a storage dam about 15 miles north of Wells, Nev. The dam is to be of earth and rock fill, with a reinforced concrete facing on the upstream side. The bids received were as follows: (1) P. J. Moran, Salt Lake City, Utah (awarded contract), $110,060; (2) Gillis Contracting Co., $150,850; (3) S. Birch & Son, $167,770; (4) Moran Contracting Co., $261,490:

Work and Material.	(1)	(2)	(3)	(4)
Earth excavation, 20,000 cu. yds.	$ 0.70	$ 3.00	$ 2.50	$ 8.00
Rock excavation, 30,000 cu. yds.	3.50	2.00	2.75	7.00
Earth embankment, 71,000 cu. yds.	.60	.75	70	.60
Dry rubble wall, 6,000 cu. yds.	3.00	2.00	6.25	5.00
Concrete—Class A, 750 cu. yds.	18.00	12.00	16.50	17.60
Concrete—Class B, 500 cu. yds.	14.00	12.00	15.50	14.00
Hauling and placing steel reinforcement, 85,000 lbs.	.05	.05	.025	.03
Hauling and laying 12-in. vitrified pipe, 350 lin. ft.	.60	1.00	.20	.40

Ohio.

⦿William Hazel, Youngstown, O., has been awarded the contract at $700 for constructing an open ditch in Coitsville Township.

The County Commissioners of Seneca, Huron and Crawford counties met at Attica on May 11 to take some action in reference to the deepening and widening of Honey Creek for the purpose of providing drainage for a large tract of land in the north part of Crawford county and the southwest part of Huron county. The proposition is for Seneca county to pay 40 per cent of the expense of construction and damage to abutting property and the other counties to pay the remaining 60 per cent.

Petition has been filed with the County Commissioners at Urbana, asking that Kings Creek be improved by straightening, deepening and widening it.

Tennessee.

The U. S. Government has allotted $742,000 to the Memphis district for revetment work and repairs in the first and second engineering districts. This is practically the same amount as was appropriated last year. The allotment for levees has not been made. This will be done in June. The allottment for the engineering district in charge of Capt. Clarke S. Smith, Memphis, includes: For surveys, $5,000; for bank revetment at Sunflower, Miss., $40,000; for bank revetment at Porter Lake, Ark., $105,000; for bank revetment at Golden Lake, Ark., $105,000; for general repairs and stone, $100,000; for care of and repairs to plant, $65,000; for new plant, $222,000.

Utah.

✣Bids will be received until 2 p. m., June 19, by U. S. Reclamation Service, Provo, Utah, for the construction of a dike to be located 35 miles northeast of Thistle, Utah. The work involves approximately the following: 88,000 cu. yds. of earthwork; 4,800 cu. yds. of rock, 12,100 cu. yds. of paving, 1,100 lin. ft. of drain tile, 1,700 cu. yds. of reinforced concrete.

WATER-WORKS

Arizona.

⦿The Concrete Construction Co., V. S. Griffith, Tucson, Ariz., has been awarded the contract by that city for the erection of a 90-ft. concrete stand pipe having a capacity of 1,000,000 gals., for $15,540. Bids were opened April 12 by L. O. Cowan, City Clerk.

California.

Consulting Engineer F. C. Finkle, 448-449 I. W. Hellman Bldg., Los Angeles, Cal., has just completed an extensive report for the city of Long Beach, Cal., giving an appraisement of the two existing water plants owned by the Long Beach Water Co., and Alamitos Water Co., respectively. An estimate has also been made for an entirely new plant for the city. A mass meeting was held on May 18 to discuss the question of purchasing the existing plants or constructing a new one and to hear the engineer's report.

Colorado.

The citizens of South Canon, Colo., are considering the plan of installing their mains themselves at an estimated cost of $25,000 in connection with the installation of a water system in the town.

Connecticut.

✣Bids will be received until 8 p. m., May 30, by Board of Public Works, Waterbury, Conn., for stripping surface soil from the basin of Morris Reservoir in the towns of Morris and Litchfield. Plans and specifications can be obtained of R. A. Cairns, City Engineer, 9 Leavenworth St., Waterbury, Conn.

Florida.

Bids will be received in about two months, it is reported, by the city of Titusville, Fla., for the installation of a water works system and for materials for the same. Bonds in the sum of $30,000 were recently voted for this purpose.

Georgia.

Bonds in the sum of $5,000 have been voted by the citizens of Cornelia, Ga., for a water and sewer system.

The village of Summerville, Ga., will sell bonds June 1 to the amount of $75,000 for extensions to the sewer and water system and for street improvements. Sewer and water extensions will amount to about $30,000 and street improvements to $45,000. Address all communications to O. B. Palmer, Treasurer, The Hill, Augusta, Ga.

The Pipe Committee of the Board of Water Commissioners, Atlanta, Ga., has recommended the laying of new water mains under the bond issue on the following streets: Glenndale Ave., 500 ft. north of De Kalb Ave.; Brook St., 800 ft. from De Kalb Ave. to McLendon St.; Mayson's Ave., 500 ft. south to La France Ave.; Haas Ave., from Glenwood to McPherson Ave.; West Tenth St., 1,500 ft from West Peachtree to State St.; Strong St., 250 ft. from North Ave. to D'Alvigny St.; Davis St., 500 ft. from Jones Ave. to Bush St., and Ashby St., 2,500 ft. from Drummond St. to Fair St. The committee also recommend laying pipe out of the regular appropriation on White's alley from Davis to Dover St.; and on Dover St., from Davis to Markham St.

An election will soon be held in Tallapoosa, Ga., for the purpose of voting on the proposition of issuing bonds to the amount of $25,000 for the purchase of the present water system and improving the same.

A contract will be let about July 1 by the city of Oglethorpe, Ga., for the installation of a new water works, estimated to cost $18,000. A light plant will also be installed.

Illinois.

✣Bids will be received by the Board of Local Improvements, Chicago, Illinois, Chas. A. V. Standish, Secretary, until 11 a. m., June 1st, for labor, material, tools, etc., to construct water supply mains, with hydrant and valve basins where necessary, in portions of 15 streets.

⦿The Ketler Elliott Co., Chicago Opera House Bldg., Chicago, have been awarded the contract for the structural steel and iron work for the net well of the Roseland Pumping Station at Chicago. The contract price is $3,895; bids opened April 19th.

⦿The Builders' Iron Foundry Co., Providence, R. I., has been awarded the contract for furnishing and delivering two Ventura meters with registering mechanisms to the 22d St. Pumping Station, Chicago, and supervising the erection of the same. Contract price is $2,380; bids opened March 17.

It is probable that a water works system will be installed in the town of Canton, Ill., in the near future. Carl Beam is City Engineer.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Following are the low bids received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing tools, labor, material, etc., for constructing the foundations for the centrifugal pumps and miscellaneous work at the 22d St. pumping station. (A) price per cu. yd. for earth excavation in pump pits, vault floors, etc. (200 cu. yds.); (B) rubble excavation in pump pits, vaults, etc., price per cu. yd. (10 yds.); (C) price per cu. yd. for furnishing and setting all concrete (340 cu. yds.); (D) price per cu. ft. for cutting out all masonry buttresses (400 cu. ft.); (E) furnishing steel for floors, pipe extension and supports, price per lb. (4,000 lbs.); (F) furnishing and erecting stairs and railing; (G) price per lb. for furnishing cast iron for stuffing boxes, etc. (7,000 lbs.); (H) price per sq. ft. for relaying brick, tile or concrete floors (250 sq. ft.); (I) cutting holes in well wall, etc., necessary to complete work as specified; (J) total: A, $3; B, $4; C, $11; D, 85 cts.; E, .04 cts.; F, $500; G, .06 cts.; H, 40 cts.; I, $2,165, J, $9,505. Myers B. Reynolds, Highland Park, Ill., was low bidder.

Indiana.

The complete rehabilitation of the city water works system, South Bend, Ind., at an expense of approximately $335,500 is recommended by Clinton S. Burns of Burns & McDonnell, hydraulic engineers, Scarritt Bldg., Kansas City, Mo. The following recommendations have been made: New pumping station in the northwest section of the city at a cost of $25,000; auxiliary station in Leeper Park, costing $7,200; water tower in the south end, $18,700; new lines and extensions, $110,000; 5,000,000-gal. reservoir, $43,500; new wells, $20,000, and 8,000,000-gal. capacity engine, [illegible]

Kentucky.

Consulting Engineer Charles E. Collins, Drexel Bldg., Philadelphia, Pa., is preparing plans for the construction of a concrete dam for the Shelbyville Water & Light Co., Shelbyville, Ky.

Maine.

The Town Trustees of Topsham, Me., have decided to have plans and specifications prepared for the installation of a reservoir on Sprague's Hill.

Maryland.

The Town Board of Commissioners, La Plata, Md., has instructed Engineer Geo. E. A. Fairley of Baltimore, Md., to prepare plans for a water supply system. It is proposed to drill an artesian well and erect a water tower so as to give a pure water supply and fire protection system to the town.

The citizens of Cumberland, Md., have voted in favor of a $500,000 bond issue for the Evitts Creek water supply for that city. J. H. Fuertes, Hydraulic Engineer, 140 Nassau, New York City, is Engineer.

[illegible] 1 by the Town Commissioners of LaPlata, Md., for the installation of a water plant, estimated to cost $10,000. The water supply will be secured from artesian well.

Michigan.

✣Bids will be received until 8 p. m., June 9, by Board of Fire & Water Commissioners, at the office of J. P. Kern, Secy., Marquette, Mich., for the construction of an existing water works intake in accordance with the plans and specifications on file at the office of the board, from whom copies may be obtained, and also on file at the office of Hering & Fuller, Engineers, 170 Broadway, New York City. The work consists of furnishing and laying an extension of the present intake pipe, approximately 2,230 ft., the extension to be 36-in. cast-iron pipe with all necessary flexible joints, fittings, anchorages, crib, riprap, dredging, etc., as shown on plans and specifications, pipe to be laid in from 22 to 70 ft. of water.

The Town Council of Leesburg, Mich., it is reported, has decided to install a water works system. The citizens recently signed a petition in favor of the proposition.

Minnesota.

The City Council of New Ulm, Minn., has granted the request of the Eagle Roller Mill Co., to lay a 10-in. water main from the pump station direct to the property line of the Eagle Mill. The approximate cost of the main [illegible]

Mississippi.

It is planned to extend the water works system of Biloxi, Miss., to the extent of $70,000. An election will soon be held to vote on the issuance of bonds to that amount for the purpose.

Montana.

N. J. Littlejohn, president of the Libby Water Works, Libby, Mont., is making arrangements for the completion of that system. It will take about two months to complete the system. The company also plans the installation of an electric light plant and telephone system.

New Hampshire.

The Ossipee Water Co., of Ossipee, N. H., is having plans prepared by Dudley & Sawyer of Manchester, for the installation of a water works to supply the village of Mountainview, Moultonville and Center Ossipee with water from Dam Hole Pond.

New Jersey.

✣Bids will be received until 7:30 p. m., May 26, by Crosswicks Water Co., Crosswicks, N. J., for the complete construction of a water works, including piping, pumping stations with equipment, stand pipe or tower, collecting system and all machinery and accessories. George B. Thorn is Secy., W. W. Young is Engineer.

The Town Council of Irvington, N. J., has decided to hold a final hearing June 5 with a view to reaching a decision as to the advisability of taking over the plant of the Clinton Water Co., which system has been offered to the community for $185,000.

New Meixco.

The citizens of Tucumcari, N. Mex., have voted the issuance of bonds to the amount of $75,000 for the purpose of purchasing the water works [illegible] system.

New York.

✣B[illegible] June 8, by Board of Public Works, Geneva, N. Y., for the construction of 2,000,000-gal. concrete covered reservoir. C. T. Church is Superintendent.

✣Bids will be received until 3 p. m., May 31, by State Commission in Lunacy, 53 Lancaster St., Albany, N. Y., for changing refrigerating plant; additional water supply, water filtration plant; fire escapes for nurses' home at Binghamton State Hospital. T. E. McGarr is Secy. of the Commission.

The citizens of Lyons, N. Y., have voted against the proposed pure water fund of $4,000.

The village of Bloomingdale, N. Y., has just completed arrangements for the installation of a water works system to supply the village at a cost of $15,000. The water is to be secured from an artesian well 305 ft. deep, with a flowing capacity of 100 gals. per minute. The water is to be pumped to a reservoir from the well, to be built on the highlands about a mile from the village.

⊙The Board of Public Works of Geneva, N. Y., has let the contract for laying the water mains to Lupier & Remick of Buffalo, N. Y., for $10,610. Other bidders were: Thomas Fitzgerald of Fredonia, $10,909; Burns & McConnell of Ogdensburg, $12,031; John D. Kuhn of Greensburg, Pa., $13,744; H. W. Golden of Troy, $11,127, and D. D. Dugan of Olean, $11,830.

Plans are bing prepared by W. G. Stone, Mann Bldg., Utica, N. Y., for the construction of a water works for the town of Mexico, N. Y. The estimated cost is $40,000.

The following bids were received by Commissioner of Public Works Francis Ward, Buffalo, N. Y., for the construction of two tunnels under the New York Central tracks from the west end of the old pumping station, for discharge mains and new pumps Nos. 3 and 4: Eastern Concrete Steel Co., $22,162; William Franklin, $25,860; B. I. Crooker Co., $26,981; George W. Moore, $27,900; Joseph F. Stabell Co., $29,500; Dark & Co., $29,600. The lowest bid has been recommended to the Common Council for acceptance.

Bids were opened May 16 by the Board of Water Supply of New York City, for four contracts in conection with the construction of the New York City tunnel portion of the Catskill aqueduct. The bids received were as follows: Contract 63—Mason & Hanger Co., Cornwall-on-Hudson, N. Y., $3,709,372; Grant Smith & Co. & Locher, Rome, N. Y., $3,775,552; Keystone State Construction Co., Philadelphia, Pa., $3,782,760; Pittsburg Contracting Co., Pittsburg, Pa., $3,999,380; T. A. Gillespie Co., 50 Church St., New York, $4,403,540; S. Pearson & Son, 507 Fifth Ave., New York, $4,433,025; Bradley Contracting Co., 1 Madison Ave., New York, $4,627,360; Degnon Contracting Co., 60 Wall St., New York, $4,639,710. Contract 65—Patrick McGovern, 6 Beacon St., Boston, Mass., $5,775,393; Mason & Hanger Co., Cornwall-on-Hudson, N. Y., $5,590,225; Bradley Contracting Co., New York, $6,798,819; T. A. Gillespie Co., New York, $6,822,100; Degnom Contracting Co., New York, $6,872,255. Contract 66—Grant Smith & Co. & Locher, Rome, N. Y., $4,512,600; United Engineering & Contracting Co., 17 W. 42 St., New York, $4,719,975; Degnon Contracting Co., New York, $4,961,645; Bradley Contracting Co., New York, $5,028,686; T. A. Gillespie Co., New York, $5,550,000. Contract 67—Holbrook, Cabot & Rollins Corp., 103 Park Ave., New York, $5,272,435; United Engineering & Contracting Co., New York, $5,295,219; J. F. Cogan Contracting Co., 280 Broadway, New York, $5,469,300; Bradley Contracting Co., New York, $5,976,920; T. A. Gillespie Co., New York, $6,178,450; Degnon Contracting Co., New York, $6,417,385; Winston & Co. and Breuchand & Rodgers, New York, $6,178,450; MacArthur Bros. Co., New York, $6,572,515.

North Carolina.

✣Bids will be received until 3 p. m., June 15, by Mayor and Board of Commissioners, Tarboro, N. C., for the construction of water works improvement, including a 500,000-gal. concrete filter plant and 260,000 concrete storage reservoir. G. C. White, Durham, N. C., is Engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 3 p. m., May 31, by Board of Water and Light Commissioners, Concord, N. C., for building an auxiliary pumping station furnishing turbine pumps and motors, about two miles 12-in. cast-iron pipe, reinforced concrete 1,000,000-gal. sedimentation reservoir and coagulating basin, and 1,000,000-gal. filter plant. Plans and specifications will be on file at the office of the superintendent, and copies of the specifications, forms of proposal, etc., may be obtained from the Engineer at Durham, N. C. No bid will be considered unless accompanied by a certified check for $500. Gilbert C. White, Engineer, Durham, N. C.

North Dakota.

The following bids were received by the City Council of Fargo, N. Dak., for the proposed filtration plant: T. F. Powers & Co., $109,300; S. Birch & Sons, $118,000; James Kennedy, Fargo, $98,960; Pittsburg Filter Manufacturing Co., $115,700, and the Fargo Plumbing & Heating Co., $130,507. The contract will be awarded to James Kennedy. The following bids were received on the engines: Fargo Plumbing & Heating Co., four bids averaging $22,000; Platt Iron Works Co., horizontal, $12,650; vertical, $23,900; Epping-Carpenter Co., horizontal, $12,700; James Kennedy, four bearing, $12,300; two bearing, $11,860; Murray Iron Works Co., $14,748; Allis-Chalmers Co., vertical, $28,000; horizontal, $12,625. The following bids were received

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] boilers and stokers: Robinson Cary & [illegible]; Detroit Stoker & [illegible]; Lewis Kennedy, [illegible]; R. B. [illegible] Co., $9,965; R. B. Whitacre, $8,715; Minneapolis Steel & Machinery Co., $7,-[illegible]; [illegible] Boiler Works, [illegible]. [illegible]

Ohio.

Service Director Harbert of Canton, O., has asked the City Council for $5,000 to be used [illegible] the water.

Oklahoma.

⦿The Oregon Iron & Steel Co., of Portland, Ore., has been awarded the contract by the Water Board, Frank T. Dodge, Portland, Supt., for furnishing 1,500 tons of cast-iron water pipe at $32.25 per ton. The Smith & Watson Iron Works was awarded the contract for furnishing 100 tons of specials at $4,900. Bids were opened May 9.

Specifications have been prepared by City Engineer T. C. Hughes of Tulsa, Okla., for the new settling basins which are proposed for the water works department. The basin will provide a settling capacity of 7,000,000 gals. of water. The estimated cost is $26,700.

Plans are being prepared for the city of Waynoka, Okla., by William Haviland of Alva, Okla., for the installation of a water and an electric light system.

Pennsylvania.

✣Bids will be received until noon, June 7, by Borough Council, Bristol, Pa., for furnishing materials and constructing a complete system of water works and filtration plant, comprising the following: Bulkhead and intake; pump well; pumping station; mechanical gravity filter plant, capacity 2,000,000 gals; pumping machinery and boilers; water tower, capacity 150,000 gals.; about 10 miles of 4-in. to 14-in. cast-iron pipe; fire hydrants, stop valves, special castings, etc.; pipe laying. Bids will be received for the entire work or any portion thereof. Plans may be seen and specifications and blank forms of proposal procured by applying to the office of the Borough Surveyor, No. 209 Radcliffe St., Borough of Bristol, Bucks County, Pa. A certified check for $500 must accompany each bid. Joseph R. Grundy is Chairman of Committee; Jay M. Whitman is Engineer, 607 Bullitt Bldg., Philadelphia, Pa.

⦿The Ohio Valley Water Co., Bellevue, Pa., has awarded the contract for lining the supply reservoir at Bellevue to Pihl & Miller of Pittsburg, Pa., Chester & Fleming, Pittsburg, are Consulting Engineers.

A resolution has been adopted by the Town Council of Montrose, Pa., providing for the appointment of a committee to investigate the ways and means of installing a water plant in Montrose, to be operated by the borough.

South Carolina.

Bonds have been voted by the citizens of Honea Path, S. C., to the amount of $26,000 for the construction of a water system.

South Dakota.

Business men of Claremont, S. Dak., have commenced an agitation for a municipal water works system.

Tennessee.

The voters of Dyersburg, Tenn., have voted the issuance of bonds to the amount of $30,000 for water and light plant improvements.

A movement is on foot in Henry, Tenn., to put in a water works on a small scale for the protection of the business houses on Main St.

An election will be held in Lenoir City, Tenn., on June 3 for the purpose of voting on the issuance of bonds for the construction of a water works system.

Bonds to the amount of $40,000 have been voted by the citizens of McKenzie, Tenn., for the purpose of extending the water system and the electric light system.

Texas.

The citizens of Nocona, Tex., have voted the issuance of bonds for the installation of a water plant.

The city of Clarksville, Tex., is planning extensions to cost $10,000 to its water works system. The work will include extension of mains, fire hydrants, one new boiler, one new pump and one air compressor. Jno. R. Webb is superintendent of water works.

Water Commissioner R. R. Nelms and City Engineer J. M. Preston, Dallas, Tex., have made cross-section surveys for the temporary and for the permanent dams to be erected at California Crossing on Elm Fork. It is expected that within a few days the call for bids for the erection of the dams will be issued.

The voters of Yorktown, Tex., have voted bonds to the amount of $6,000 for the purpose of extending the water mains of the town.

Utah.

⦿A. A. Clark & Co., of Salt Lake City, Utah, have been awarded the contract by the City Council of Park City, Utah, for the construction of the new water works system for $47,499. A list of the bidders was given in our last issue.

Virginia.

The following streets are to be furnished with 6-in. water mains in Richmond, Va.: Charles Burkett, Asst. City Water Supt.: Decatur St., from 17th to 21st; on 20th St., from Decatur to Stockton; on Fifth St., from Bainbridge to Porter; Fifth St., from Everett to Maury. The estimated cost is $3,000.

West Virginia.

✣Bids will be received until 8 p. m., June 1, by Mayor and Council, Romney, W. Va., for the necessary labor and material for the installation of a pipe line and the construction of a concrete reservoir. The work to consist of laying approximately 3,559 ft of 4-in. wrought-iron or steel screw pipe or 4-in. wood-stave pipe, 10,250 ft. of 3-in. wrought-iron or steel screw pipe or 3-in. wood-stave pipe; 3,550 ft. 4-in. cast-iron pipe, 350 ft. of 6-in. wrought-iron or steel screw pipe or 6-in. wood-stave pipe in concrete, and the setting of the necessary valves, hydrants and specials. The building of a concrete reservoir with a capacity of 100,000 gals. The repairing of old dam and cleaning out, widening and making mill race watertight, and building of a stone or concrete pump well. A certified check drawn to the order of C. W. Haines, Recorder, for $500 will be required to accompany each proposal. A. N. McKeever is Mayor.

⦿Thoney Pietro, Morgantown, W. Va., has been awarded the contract by the borough of Springdale, Pa., for grading certain streets, construction of a sewer system, a system of water lines, and the building of a reservoir. Approximate quantities are 30,000 cu. yds. of grading, 36,660 lin. ft. of sewers, 35,660 lin. ft. of cast-iron water lines, and one 350,000-gal. capacity reservoir. H. J. Barnes, Clerk of Council. Bids were opened May 1.

Wisconsin.

✣Bids will be received until noon, June 1, by Lexington, Va., for furnishing 41,800 ft. of wood pipe and 16,800 ft. of 8-in. cast-iron pipe valves and special castings. A certified check for $250 must accompany each bid. N. Wilton Day of Harrisonburg is Engineer.

The Common Council of Milwaukee, Wis., has authorized a survey of wastes and damages to the water works system by electrolysis. It is reported that Engineer Jacob Cloos of Milwaukee will do the work.

Wyoming.

✣Bids will be received until 10 a. m., June 7, by J. F. Ewers, Towns Clerk, Basin, Wyo., for furnishing the material and labor for the construction of improvements to the water works and lighting systems as follows: (1) For furnishing material, labor and equipment (except as otherwise required by subsequent items of this notice) and constructing improvements to the water works and lighting systems. Certified check $1,000. (2) For furnishing cast iron pipe and special castings f. o. b. cars Basin, Wyoming. Certified check $500. (3) For furnishing hydrants and valves, f. o. b. cars Basin, Wyoming. Certified check $100. (4) For furnishing pumping and electrical machinery f. o. b. cars Basin, Wyoming. Certified check $100. (5) For furnishing and erecting mechanical filter of 500,000 gallons daily capacity. Certified check $100. Burns & McDonnell, Engineers, Scarritt Bldg., Kansas City, Mo.

Canada.

City Engineer MacCallum of Hamilton, Ont., estimates that the city will have to spend $500,000 on enlarging its waterworks system in the near future.

The Board of Control of Montreal, Que., will soon call for bids for the following improvements: Sidewalks, $500,000; public improvements in the new wards, $720,000; water mains, $677,000, and $616,000 for sewers.

SEWERAGE AND GARBAGE DISPOSAL

California.

Plans and specifications for the first group of lateral sewers for the sewer system now being installed in Allendale, Oakland, Cal., have been approved by the City Council. This group carries about two miles of laterals south of Penniman Ave. The estimated cost is $16,000. The second group of laterals running from Penniman Ave. northerly will cost about $21,000, about 3½ miles of sewer being called for in the plans and specifications drawn up by Assistant City Engineer Walter Frickstad.

Illinois.

Bids will be received by the Board of Local Improvements, Chicago, Ill., until 11 a. m., June 1, for constructing sewers in the following streets:

	Length, ft.	Diam., ft.	Depth, ft.	M. H.	[illegible]	[illegible]
[illegible] St	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
George St	630	1	7.0	4	4	
East End Av....	[illegible]	1¼	11.5	..	..	
[illegible] Av	670	1	10.0	10	14	
[illegible] St	660	1¼	11.0			
[illegible] St	570	1	8.5	10	[illegible]	
[illegible] Av	[illegible]	1	8.5	[illegible]	[illegible]	
[illegible] Av	820	1	8.0	7	[illegible]	1
[illegible] Av	340	1½	6.0			
[illegible] Av	[illegible]	1½	7.5			
[illegible] Av	[illegible]	1¼	8.0	11	7	
[illegible] Av.	2,000	1	8.0	13	19	3,150
[illegible] Av.	1,340	..	11.5			
77th St..	240	3*	12.0	..	.	
[illegible] St	1,340	3*	12.5	.	.	
Perry St.	1,341	2½*	10.0	..	.	
77th St....	[illegible]	1½	11.5			
75th St....	[illegible]	1½†	10.5			..
[illegible] St	[illegible]	1	9.5			..
[illegible] Av.	[illegible]	1	9.5			.
[illegible] Av	1,300	1	9.0			..
Yale Av...	670	1¼	7.0			
Yale Av...	[illegible]	1	7.0	[illegible]	[illegible]	$31,810

*[illegible] brick sewer. †Double strength [illegible]

✣Bids will be received until 10:30 a. m., June 5, by Lieut.-Col. Thomas Cruse, Deputy Quartermaster General, 556 Federal Bldg., Chicago, Ill., for the construction of storm sewer and connections at Fort Benjamin Harrison, Ind.

✣Bids will be received until June 9, by City Council of East St. Louis, Ill., for paving and sewer construction in 27th St., estimated at $15,000; in 18th St., estimated at $14,200;

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

in Gray Boulevard, estimated cost of $17,300. James F. Parr is Assistant Engineer in charge of street paving and sewer. E. F. Harper is City Engineer.

✣Bids will be received until May 25, by Board of Local Improvements, Hoopeston, Ill., for the construction of the new sanitary sewer for Greater Hoopeston. A bond of $100,000 is required of the successful bidder.

⊙A. C. Schreiter of Manitowoc, Wis., has been awarded the contract by the city of Galva, Ill., for the construction of 22,000 ft. of sewers for $26,000. The work includes pipe and brick work.

The City Council of Galesburg, Ill., proposes to lay a sewer from Cedar Fork on Henderson St., to Losey St.; on North St., from Henderson to Hawkinson Ave., and between North and Losey Sts. on Olive St., Lawrence Ave. and Hawkinson Ave.

Indiana.

⊙H. B. Holman of Rochester, Ind., has been awarded the contract by the city of Auburn, Ind., for the construction of storm sewers in Wagnoner and 10th Sts., approximately 10,000 ft., of from 20-in. to 12-in. vitrified and concrete sewers. The contract price is $25,000. Bids were opened May 17 by L. O. Little, Clerk.

The Common Council of Terre Haute, Ind., has decided to appropriate money to build a complete sewer system at an estimated cost of $337,000, which will afford an outlet for every street within the city limits. According to the plans adopted by the council 44 miles of sewers will be built during the year. Donn M. Roberts is City Engineer.

⊙The Northern Construction Co. has been awarded the contract by the City Council of Elkhart, Ind., for the construction of the Twelfth district sewer in Riverside for $40,000.

William A. Barnes and A. R. Lockhart of the firm of Metcalf & Eddy, 14 Beacon St., Boston, Mass., are collecting data and making surveys in Fort Wayne, Ind., to be used in connection with the recommendations of the engineers as to changes in the sewer system which will remove the accumulation of sewage from the rivers.

Iowa.

✣Bids will be received until 8 p. m. May 29, by W. E. Hayes, City Clerk, Clinton, Ia., for the construction of main and lateral sewers, including 300 ft. 48-in. 2-ring brick sewer, 500 ft. 48-in. 1½-ring brick sewer, 400 ft. 42-in. 1½-ring brick sewer, 1,343 ft. 30-in. 1½-ring brick sewer, 765 ft. 36-in. pipe sewer, 1,988 ft. 30-in pipe sewer, 2,452 ft. 24-in. pipe sewer, 1,544 ft. 20-in. pipe sewer, 5,560 ft. 18-in. pipe sewer, 2,993 ft. 15-in. pipe sewer, 11,515 ft. 12-in. pipe sewer, 7,165 ft. 10-in. pipe sewer, 5,513 ft. 10-in. catch basin pipe, 14,860 cu. yds. rock excavation, 76 manholes, 62 catch basins and 122 inlet basins. R. C. Hart is City Engineer. Official advertisement will be found elsewhere in this issue.

⊙Geo. M. King, Construction Co. of Des Moines, Ia., has been awarded the contract by the City Council of Des Moines, for the construction of a 12 in. vitrified clay pipe sewer in Mondamin Ave., 10-in. vitrified clay pipe sewer in 21st St., for $0.89. The entire work includes about 1,573 lin. ft. of sewer. Horace Susong is City Clerk. Bids were opened May 12.

Surveys are being made by William A. Carson, Engineer-Contractor, 409 Boone National Bldg., Boone, Ia., for the proposed sanitary sewer system in the town of Gladbrook, Ia.

E. A. Wickham & Co. submitted the lowest bid to the City Council of Council Bluffs, Ia., for the laying of the sewer on Charles St., between Kappel to Stahl Aves., and from the center of Third Ave., east to a point 116 ft. east of the east line of High St. The bid was as follows: 12-in. sewer, $0.75; 10-in. sewer, $0.64½; 8-in. sewer, $0.49½; and 6-in. sewer, $0.40; manholes, $34 each.

Plans have about been completed by Engineer [illegible] of Clinton, Ia., [illegible] installation [illegible] sewerage and a water system in Leon, Ia. As soon as the plans have been passed upon bids for the construction of the water works will be asked.

East Des Moines [illegible] (P. O. Des Moines, Ia.) have decided to adopt the plan advocated by Councilman John MacVicar, and will install a septic tank south of the Rock Island tracks near 30th St., for the disposal of sewage of the eastern part of East Des Moines. City Engineer Budd has been instructed to draw plans for the septic tank and for a sewer system.

⊙The A. L. Wilson Co. has been awarded the contracts by the Board of Aldermen of Mason City, Ia., for the construction of sewers on First and Inland Sts., Stillson St. and Jackson St.

Kansas.

W. C. Hoad, State Sanitary Engineer of Kansas, has inspected the plans for the extension of the sewers north of 12th Ave., on the west side of Emporia, Kans.

⊙The contract for constructing the new sewer laterals ordered in west of Cow Creek between Sherman and Second Sts., Hutchinson, Kans., has been let to O. F. Davis of that city for $1,397.

A resolution has been presented to the City Commissioners, Wichita, Kans., providing for the extension of the storm water drainage canal to the Arkansas River.

A resolution has been presented to the Board of City Commissioners, Topeka, Kans., providing for the construction of three miles of sewer, taking in all of the western part of the city.

The City Commissioners of Wichita, Kans., have taken action on the proposed construction of the new Central sanitary sewer from 21st St. in the northwestern portion of the city to Sewer Island in the southeast part of the city, a distance of 2,900 ft. The total estimated cost of the sewer is $212,813, made up of the following items: 9,750 lin. ft. of 48-in. double ring brick sewer or reinforced concrete block or tile sewer, costing $52,650; 14,300 lin. ft. of 45-in. double ring brick sewer or reinforced concrete brick or tile sewer, costing $71,500; 11,675 lin. ft. of 42-in. double ring brick sewer or reinforced concrete block or tile sewer, costing [illegible]; 2,635 lin. ft. of [illegible] double ring brick sewer or reinforced concrete block or tile sewer, costing $11,1[illegible]; 300 lin. ft. of [illegible] single ring brick sewer or reinforced concrete block sewer or tile sewer, costing $1,918; 1,050 lin. ft. of 18-in. vitrified title sewer, costing $1,3[illegible]; 1,775 lin. ft. of 15-in. vitrified tile sewer, costing [illegible]; [illegible] lin. ft. of 12-in. vitrified tile sewer, costing $788; one outlet protection, $125; 105 manholes of brick or concrete, costing $4,200; 31,500 lbs. of castings, $945; 9 sewer crossings, $900. Bert C. Wells is City Engineer.

Michigan.

✣Bids will be received until 8 p. m., June 8, by Board of Public Works, Grand Rapids, Mich., for the construction of a public sewer to be known as the East Side trunk sewer. E. H. Christ is President of the Board and Samuel A. Freshney is Secy. and Gen. Mgr.

✣Bids will be received until 7:30 p. m., May 29, by W. L. Guyer, City Clerk, Bessemer, Mich., for the laying of 1,850 ft. of 12-in., 3,607 ft. of 15-in., 293 ft. of 19-in., 400 ft. of 20-in. vitrified pipe sewers 2 ft. to 16 ft. deep; 1,835 ft. of 2x2½ ft. reinforced concrete sewer 3 to 9 ft. deep; 19 manholes, 5 concrete manholes and catchbasins, 4 inlets and [illegible] W. G. [illegible]fer, Madison, Wis., is Engineer.

Tentative plans have been made by the Village Council of Reed City, Mich., for the [illegible] of the village.

Minnesota.

✣Bids will be received until 5 p. m., June 1, by City Council, Albert Lea, Minn., for [illegible] follows: 2,513 ft. [illegible] 18 ft. deep; 1,408 ft. of 10-in., 6 to 16 ft. deep; 208 ft. 8 and 15-in. double sewer, 8 to 12 ft. deep; 28 ft. of 15-in., 8 to 10 ft. deep; 40 ft. 10-in. catch basin connections; 50 catch basins [illegible] 8-in. Y's and [illegible]. Bids will be received at the same time for the construction of 2.9 miles of concrete curbs. C. J. Dudley is City Clerk and William Barneck is City Engineer.

The Proctor, Minn., Commercial Club recently held a meeting to prepare for bonding the village in the event that it should decide to adopt the sewer system, now under consideration.

Missouri.

The voters of Unionville, Mo., [illegible] voted against the proposition to issue bonds in the sum of $21,000 for the construction of a sewer system in the city.

Montana.

R. M. Bardsen & Co., of Butte, Mont., are the probable contractors for the construction of a sewer system in Local Sewerage Improvement District No. 1 in the village of Mullan, Ida., at $15,714. The work includes 1,865 ft. of 12-in. pipe, 200 ft. of 10-in. pipe, 670 ft. of 9-in. pipe, 1,125 ft. of 8-in. pipe, 12,604 ft. of 6-in. pipe, 33 manholes, 13 lamp holes, 10 flush tanks and 10 yds. of masonry. Bids were opened May 10 by J. W. Hutchins, Chairman, sewer committee, Local Sewerage Improvement District No. 1.

An election will be held shortly in Libby, Mont., for the purpose of voting on the proposition of issuing bonds to the amount of $15,000 for the installation of a sewer system.

Nebraska.

⊙Elmer V. Morgan has been awarded the contract by the Sewer and Water Commissioners, Auburn, Neb., for the construction of 1,410 ft. of 8-in. lateral sewer, three manholes, one flush tank and 18 6-in. on 8-in. Y's. The contract price is $1,017. Bids were opened May 15.

New Jersey.

⊙The Street and Water Board of Jersey City, N. J., has awarded the following contracts for the construction of three sewers: Philip Tumulty, Brooks St. sewer, 99 per cent of the cost for labor and material; Henry Byrnes, White St. sewer, 98 per cent of the cost, and Van Keuren & Son, North St. sewer, 92 per cent of the cost.

The Mutual Improvement Association of Wenonah, N. J., is considering the matter of the borough buying the sewer plant which belongs to the estate of the late Stephen Greene.

New Mexico.

⊙Thomas McGovern and P. J. Ryan of Pueblo, Colo., have been awarded the contract by the city of East Las Vegas, N. Mex., for furnishing labor and material for a sanitary sewer [illegible] 19,750 lin. ft. of 8-in. vitrified pipe sewer, 3,350 lin. ft. of 10-in vitrified pipe sewer, 100 lin. ft. of 15-in. vitrified pipe sewer, 50 manholes complete, and 12 single flush tanks complete. The contract price is $20,663. Charles Tamme is City Clerk. Bids were opened May [illegible]

[illegible] special election recently voted the issuance of bonds in the sum of $75,000 for a water and a sewer system.

New York.

✣Bids will be received until 8 p. m., June [illegible] N. Y. For constructing the Kill Brook Trunk Sewer, [illegible] Chambers at Outfall, and also Water Street, Barlow Lane and Mill Street Trunk Sewers, with the various lateral sewers or branches tributary thereto. Plans may be seen, blank forms of proposal, specifications and other necessary papers can be obtained on applica[illegible]

✣Bids will be received until 1:30 p. m., [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

No. 2, Grand St., White Plains, New York, for the construction and laying in a water tight manner of 322 ft. of 48-in. cast iron pipe from the end of the sewer as now laid extending out in the bed of the Hudson River in a double line 161 ft. All in compliance with the details and conditions set forth in the plans and specifications, which may be seen at the office of the Commission. Form for bids and form of contract and form of bond or security may be obtained from the Secretary of the Commission upon payment of [illegible] dollars, to be returned when the same said forms are properly used in bidding. F. N. Glover, Secretary.

The Board of Local Improvements of Queens Borough, New York City, has passed a resolution calling upon the Board of Estimates to approve the drainage plans for two districts in Brooklyn, which include the following street sections through which the outlet mains to carry the entire dry weather sewage of 1,300 acres in the Maspeth territory of Queens. The streets through which the outlet mains for Queens must be laid are as follows: North 12th St., from East River to Union Ave.; Union Ave., from North 12th St. to Richardson St.; Richardson St., from Union Ave. to Graham Ave.; Graham Ave., from Richardson St. to Conselyea St.; Conselyea St., from Graham Ave. to Maspeth Ave., and Maspeth Ave., from Conselyea St. to Newton Creek, together with a pumping station and appurtenances at Maspeth and Morgan Aves.

The Common Council of Geneva, N. Y., has passed a resolution authorizing the Board of Public Works to expend $1,992 for the construction of sewers in Maxwell and Lafayette Aves. and Monroe and Brock Sts.

The Sewer Commission of Frankfort, N. Y., has been completed with the appointing by the Village Board of H. S. Getman for a period of three years, F. J. Tine for two years and Howard Smith for one year. Vrooman & Terry of Gloversville have been engaged by the commission as engineers in charge. The plans for the sewerage system recently submitted to the State Board of Health have been approved and it is expected that steps will be taken at once toward letting the contract for construction.

The Board of Sewer Commissioners of Ilion, N. Y., has decided to lay a sewer the entire length of Morgan St.

An ordinance has been introduced in the Common Council of Binghamton, N. Y., declaring the intention of that body to construct a sewer on Williams St., from Griswold St. westerly a distance of 445 ft.

William M. Mills, president of the Niagara Frontier Pure Water Conference, North Tonawanda, N. Y., recently called a meeting of the organization to discuss a proposed sewage disposal proposition for the Niagara frontier.

The City Council of Binghamton, N. Y., has adopted ordinances approving plans and specifications and ordering the construction of sewers on Schubert, Vine, Main and Moeller Sts., Highland, Seminary and Bennett Aves.

An ordinance has been introduced in the City Council of Albany, N. Y., authorizing the construction of an intercepting sewer to cost the taxpayers $[illegible]. Walter Mellus is City Engineer.

⊙The Board of Sewer Commissioners of Ilion, N. Y., has awarded the contract for placing sewers in McCann St., Spring St. extension and Hakes Road to George Seesch for $1,200.

North Carolina.

✣Bids will be received until 3 p. m., June 27, by Board of Public Works, Red Springs, N. C., for the construction of a water works and sewerage system. G. C. White, Durham, N. C., is Engineer. Official advertisement will be found elsewhere in this issue.

Ohio.

✣Bids will be received until noon, May 29, by Director of Public Service, Cincinnati, O., for the construction of main and lateral sewers and drains with their appurtenances in Worth St., between Humbert St. and Eastern Ave. Each bid must be accompanied by a certified check for $1,000. J. J. Wenner is Clerk.

✣Bids will be received until noon, June 2, by Director of Public Service, City Hall, Cleveland, O., for the construction of sewers in the following named streets and avenues: That part of Eddy Road N. E. between St. Clair Ave. N. E. and L. S. & M. S. R. R. which lies between St. Clair Ave. N. E. and Sellars Ave. N. E. Eddy Road N. E. between St. Clair Ave. N. E. and Woodside Ave. N. E. Ostend Ave. N. E. between E. 99th St. and E. 105th St. That part of Lorain Ave. between W. Boulevard and W. 117th St. which lies between W. 110th St. and West 117th St. Each bid must be made in accordance with plans and specifications which may be seen at the office of the City Engineer, Room 305, City Hall.

✣Bids will be received until noon, June 5, by Council of Village of Willoughby, O., for furnishing the necessary labor and material for the construction of a sanitary sewer with manholes and house and lot connections in Euclid St. from Maple St. west to the corporation line. Plans and specifications are on file at the office of C. C. Jenkins, Village Clerk. A certified check for $100 must accompany each bid.

✣Bids will be received until noon, May 26, by Director of Public Service, Youngstown, O., for the construction of a sewer in Floral Ave., between Mahoning Ave. and the end of the street; and for Hawthorne Ave., from Glenwood Ave. and City Lot 15964; for grading Clifton Ave. between Lafayette and Fox Sts., and Ayers St. from Hawn to Rigby Sts.; for paving Bruce St. between Rigby to Shehy Sts. and Grace St. between Belmont and Ford Aves.

✣Bids will be received until noon, May 24, by Village Clerk L. S. Creek, Struthers, O., for the necessary labor and material for the construction of a combination storm water and sanitary sewer in Broad St. in the village between Bridge St. and center line of Grant St. Brick tile or cement may be used.

✣Bids will be received until noon, May 24, by L. S. Creek, Village Clerk, Struthers, O., for furnishing the necessary labor and material for the construction of sanitary sewers in Hawthorn St. from Elm St. to Sexton St. A certified check for $200 must be filed with each bid.

✣Bids will be received until noon, May 24, by L. S. Creek, Clerk of the Village of Struthers, O., for the necessary labor and material for the construction of a storm water and sanitary sewer in Stewart St. from Elm St. to Sexton St.

✣Bids will be received until noon, May 21, by L. S. Creek, Clerk of the Village of Struthers, O., for furnishing the necessary labor and material for the construction of storm water and sanitary sewers in State St from Park Ave. to the west village limits. A certified check for $200 must be filed with each bid.

✣Bids will be received until noon, May 21, by L. S. Creek, Village Clerk, Struthers, O., for the necessary labor and material for the construction of a sanitary sewer in Bridge St. from Lowell Ave. to Poland Ave. A certified check for $200 must be filed with each bid.

✣Bids will be received until noon, May 24, by L. S. Creek, Village Clerk, Struthers, O., for the necessary labor and material for the construction of a storm water and sanitary sewer in Poland Ave. from State St. south to the end of the macadam roadway on same street. A certified check for $200 must be filed with each bid.

✣Bids will be received until noon, May 24, by L. S. Creek, Clerk of the Village of Struthers, O., for the construction of sanitary tile sewers in Terrace St. from Short St. to Poland Ave. A certified check for $200 must be filed with each bid.

✣Bids will be received until noon, May 29, by Director of Public Service, Lorain, O., for furnishing necessary labor and material for the construction of sewers, as follows: Lateral sanitary sewer in E. 33d St., from Clifton Ave. to Elyria Ave. Storm water sewer in Globe Ave., from E. 31st St. southerly to E. 34th St. Storm water sewer in Pearl Ave., from E. 32d St. to E. 34th St. Storm water sewer in 14th St. and Washington Ave. L. B. Johnson is City Clerk.

⊙Huonker & Williams, South Limestone St., Springfield, O., have been awarded the contract at $1,500 for the construction of a sewage purification plant at the Infirmary at Xenia, by the County Commissioners at that city. A. Elliott Kimberly, 827 Columbus Savings & Trust Bldg., Columbus, O., is Engineer.

⊙Huonker & Williams, South Limestone St., the contract by the Board of Greene County Springfield, O., at $1,310 have been awarded contract by the Board of Greene County Commissioners, W. L. Dean, County Auditor, Xenia, O., for the construction of a sanitary sewer system on the new Greene County Children's Home grounds and premises and for the preparatory sewage treatment devices. The contract price is $2,800. A. Elliott Kimberly, 827 Columbus Savings & Trust Bldg., Columbus, O., Engineer. Bids were opened May 15.

⊙T. G. Chapman of Lorain, O., has been awarded the contract by the village of Fairport Harbor, O., for the construction of a sewer in district No. 1, for $24,000. The work includes about 24,000 ft. of sewers from 15 to 6-in. in diameter. A part of the sewer will be laid with cast iron pipe. Robert Meyers is Village Clerk. Bids were opened May 12.

A new bill to authorize county commissioners to provide for construction of sewers outside of municipalities has been introduced in the Senate by Senator U. S. Grant Deaton of Toledo. The bill is primarily for the benefit of owners of property in Toledo and along the Maumee River above Toledo.

An election is to be held in New Philadelphia, O., on June 5 for the purpose of voting on the issuance of bonds for the installation of a sewer system. .

⊙Harry Baxter of Lorain, O., has been awarded the contract by the Village Council of Hubbard for the construction of a sewer system and disposal plant for $23,270.

Oklahoma.

City Engineer T. C. Hughes of Tulsa, Okla., has prepared specifications for the sewer extensions for the East End. The estimated cost of the improvements is $25,000.

Oregon.

The Milwaukee sewer district has been formed in Portland, Ore., including that portion of Midway north of Westmoreland. It covers the streets and territory between the Brooklyn district and the proposed district for Westmoreland and Sellwood.

It is reported that on May 9 the citizens of Pendleton, Ore., voted for the installation of a mountain water system, sewer extensions, further street improvements, etc.

Following bids were received May 15 by the City Executive Board, Portland, Ore., for sewer work: Carl St.—Jeffery & Bufton, $491; Beehill Bros., $463; John Keating, $478; Williams & Beggs, $439; E. D. Riner, $449; Bidewell & Hayden, $445. Garfield Ave.—Bechill Bros., $383; John Keating, $376; E. M. Riner, $380; Jeffery & Bufton, $414; Bidewell & Hayden, $389; Williams & Beggs, $382. Sheridan St.—Jeffery & Bufton, $530. Irvington Heights district—Frazer & Conley, $16,623; John Keating, $14,329; Lundstrum & Sandeberg, $13,878; Jeffery & Bufton, $14,639; Jacobsen-Bade, $15,554; Williams & Beggs, $14,290; John Construction Co., $15,222; Johnson, Anderson & Co., $16,698; Bidewell, Hayden & Co., $14,544. East Madison St.—Bechill Bros., $256; Bidewell, Hayden & Co., $259; Jeffery & Bufton, $266. Grand Ave.—Jeffery & Bufton, $270; Bechill Bros., $250; J. Keating, $243; Williams & Beggs, $252; E. W. Riner, $251; Bidewell, Hayden & Co., $255. East 38th and East Market.—Bechill Bros., $803; J. Keating, $835; Williams & Beggs, $797; Bidewell, Hayden & Co., $798; Jeffery & Bufton, $830. East Ninth St.—Bechill Bros., $287; J. Keating, $245; Williams & Beggs, $260; [illegible], $272; Bidewell, Hayden & Co., $268; Jeffery & Bufton, $272.

The Hillsboro, Ore., City Council adopted a resolution providing for the construction of a complete sanitary and storm sewer system covering not only the business section but the residence district.

Pennsylvania.

✣Bids will be received until noon, May 27, by Highway Department, Harrisburg, Pa., for the construction of a sewer in Peffer St. from Front to Fourth St. W. W. Caldwell is Commissioner.

✣Bids will be received until 2 p. m., May 26, by Board of Public Works, D. E. Tracy, Secy., Harrisburg, Pa., for the construction of a terra-cotta pipe sewer in Front St. from Eagle St. to Conoy St. Plans and specifications are on file at the office of the board.

✣Bids will be received until 8 p. m., May 31, by Charles C. Rambo, Chairman, Sewer Committee, Norristown, Pa., for the construction complete of an 8-in. vitrified pipe sanitary sewer on the east side of Markley St. between Beach St. and a point 100 ft. north of Sterigere St. with 5 manholes, flush tanks, lamp holes, etc. S. Cameron Corson is Borough Engineer.

✣Bids will be received until 8 p. m., May 31, by Charles C. Rambo, Chairman of the Sewer Committee, Norristown, Pa., for the construction of an 8-in. vitrified pipe sanitary sewer on the east side of Markley St., between the south side of Beach St. and a point about 100 ft. north of Sterigere St., with 5 manholes, flush tanks, lamp holes, etc. S. Cameron Corson is Borough Engineer.

⊙The contract for building a sewage disposal plant on Harvey Ave., in Doylestown, Pa., has been awarded to Julian W. Soloman of [illegible]

⊙F. J. Eichenlaub has been awarded the contract by the City Council of Erie, Pa., for the construction of a 9-in. sewer connecting the sewer on the west side of Mill Creek in East 14th St., with the intercepting sewer which is in French St. The contract was let at $4.50 for the pipe and $150 for the manholes.

A bill has been introduced at Harrisburg, Pa., providing that the state shall bear one-half [illegible] plants in the cities and towns and villages of Pennsylvania.

Plans have been presented to the City Council of Weatherly, Pa., for the installation of a sewer system estimated to cost $13,000.

South Dakota.

✣Bids will [illegible] June 5, by City Council, Plankinton, S. Dak., for the construction of a sanitary disposal plant for sewage now emptied from the main sewer into a small creek. C. E. Goodlad is City Auditor.

[illegible] mond, City Auditor, Aberdeen, S. Dak., for the construction of approximately 1,430 ft. of 8-in., 430 ft. of 12 in., and furnishing five [illegible]

Tennessee.

✣Bids will [illegible] Mayor and Board of Aldermen, Erwin, Tenn., for the construction of a system of domestic sewers. Plans and specifications can be obtained of the City Auditor, O. E. Bogart.

Washington.

⊙It is reported that the City Commissioners of Spokane, Wash., have awarded the following contracts for sewer work: G. Burgie at $7,800 for a sewer on Sheridan St. and Fifth Ave. from 276 ft. south of Harston to 70 ft. east of Hatch; James C. Broad at $5,765 for a sewer in alley between Mansfield and Montgomery, Wall to Northwest Blvd.; J. L. Wood at $3,620 for a sewer in Garfield St. from Hartson to Fifth Ave.

A petition has been filed with the City Commissioners, Spokane, Wash., for a sewer in Arthur St., 26th to 29th Aves.; in 29th Ave., Garfield St. to a point 360 ft. east of Perry St.; in 28th Ave., Arthur to Ivory Sts., and in 27th Ave., Arthur to Ivory Sts.

A resolution has been passed by the City Commissioners of Spokane, Wash., calling for plans for a sewer in 16th Ave., from Perry to Crestline St. Plans were also ordered for a sewer in Art Ave., Chandler St., to a point 325 ft. west of Chandler St.

Wisconsin.

The Board of Public Works of Racine, Wis., has decided to advertise for bids for sewer construction on the following streets: High St., Marquette St., Deane Blvd., West Blvd., Lincoln Ave., Green St., Gertrude St.

The Board of Public Works of Fond du Lac, Wis., has decided to advertise for bids on sanitary sewers to be built from Emma to Ruggles St. on Hickory, from Rees to Merrill on Marquette, and from Boyd to 13th St. on South Park Ave.; for the extension of the Ninth St. sewer east to Marr; for the construction of a storm sewer on Third St. east of Park Ave., and for the construction of a bridge across the de Neveu Creek.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

Advices from Nevada City state that the Nevada County Deep Drainage Tunnel Co. plans to run a tunnel three miles long, tapping the mining depths at 1,050 ft., to drain all the mines in the district. The tunnel as projected, will run from the South Yuba River at a point near Jones bar toward the Champion mine. Connections will be made with other shafts through drifts and crosscuts tapping either the sumps or pumping levels of all the deep mines. The company includes F. J. J. Sloat, manager of the Mountaineer mine, Arthur W. Hoge of the Cassidy, Montana and Fairview mines, Fred M. Miller, a civil and mining engineer, formerly manager of the Gaston mine; W. H. Martin, a foundryman and extensive mine owner, Dr. L. W. Hays, president of the Nevada county promotion committee, D. E. Morgan, cashier of the Citizens bank. George W. Downey is the promoter of the company.

Colorado.

✣Bids will be received until noon, June 15, by Board of Capitol Managers, Denver, Colo., for work on the Colorado State Museum. Plans and specifications are on file at the office of F. E. Edbrooke, Opera House Bldg., Denver, Colo.

An additional appropriation, probably $200,000, will be asked of Congress with which to complete the reclamation work in Imperial valley. Work on the Colorado dam has been suspended until after the spring floods, but will be resumed when the water subsides. It is stated that estimates show that the appropriation under which the work has been carried on so far will fall short of the amount necessary for completion.

Delaware.

✣Bids will be received until 11 a. m., May 29, by Lieut. E. A. Stockton, Jr., quartermaster, Fort DuPont, Delaware City, Del., for constructing an addition to the post hospital at Fort du Pont, Del.

The following bids were received May 15 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Appoquinimink River, Del. River & Harbor Improvement Co., Phildelphia, Pa., 12.8 cts. per cu. yd.; Rickards Dredging Co., Philadelphia, Pa., 13.8 cts. per cu. yd. About $5,100 is available for the work.

Following bids were received May 11 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging in Murderkill River, Del.: Rickards Dredging Co., Philadelphia, Pa., 9.8 cts. per cu. yd. place measurement; River & Harbor Improvement Co., Philadelphia, Pa., 13.4 cts. per cu. yd. place measurement. About $13,500 is available for the work.

District of Columbia.

✣Bids will be received until 10:30 a. m., June 15, by Capt. F. C. Boggs, general purchasing officer, Isthmian Commission, Washington, D. C., for furnishing under canal circular 633, trunions, line material, including insulators, copper wire, copper sleeves, cross arms and pins, galvanized braces, bolts and washers, kitchen utensils, glassware, dishes, spoons, counter scales, cooks' aprons, towels, oilcloth, etc.

✣Bids will be received until noon, May 29, by chief of ordnance, War Department, Washington, D. C., for painting roof, interior walls of second floor, partitions, woodwork and window frames and sashes, shelters, etc.

Florida.

✣Bids will be received until 11 a. m., June 1, by constructing quartermaster, Fort Barrancas, Fla., for the construction of a captain's quarters at Fort Pickens, Fla.

✣Bids are asked until noon, June 3, as noted in our last issue, by Capt. Geo. R. Spalding, U. S. Engineer, Jacksonville, Fla., for dredging in Indian River, Florida. The area to be dredged extends from the south end of Great Pocket, through a mangrove swamp, to Pecks Lake. The total length of the cut is 6,150 ft. of which 5,700 ft. is through the swamp, and 450 ft. through mud flats from the edges of the swamp to the 4-ft. contours in Great Pocket and Pecks Lake. The cut will be 40 ft. wide. The estimated yardage is 82,000 cu. yds., the material being mud, sand and shell..

Bids were opened May 12 by Capt. Geo. R. Spalding, U. S. Engineer, for dredging in the St. John's River below Jacksonville, Fla. The lowest bidder and probable contractor for the work is the Bowers Southern Dredging Co., Galveston, Tex., at 10.4 cts. per cu. yd. The area to be dredged extends from a point opposite Fulton, about five miles above the mouth of the river, to the lower end of Trout Creek Shoal, a distance of about 10 1-3 miles. The work to be done is to dredge a channel having a bottom width of 300 ft. in the straight reaches and varying widths at the turns. The depth to be obtained is 30 ft. at mean low water. The channel at the turn opposite Browns Creek will be made 400 ft. wide. The increased width will extend about 3,000 ft. in Browns Creek Cut and about 1,000 ft. in St. Charles Creek Cut. The channel opposite Dames Point will be made 600 ft. wide for a distance of about 4,000 ft. It may be required to increase the width for a distance of about 1,000 ft. at the intersections of New Berlin Cut with St. Charles Creek Cut, and with Dames Point Cut. The total estimated quantity of material to be removed under the project is 5,486,200 cu. yds place measurement.

Georgia.

✣Bids will be received until 3 p. m., June 2, by chairman of the Street Committee at the office of R. M. Clayton, chief engineer of construction, Atlanta, Ga., for moving and readjusting the buildings on the south side of Mitchell St., from Elliott St. to [illegible] St., to conform to the new line of said street.

Idaho.

✣Bids will be received until 11 a. m., June 3, by constructing quartermaster, Boise Barracks, Idaho, for the construction of one cavalry stable, two double stable guard and shop buildings and one granary, all frame, including plumbing in stable and electric wiring and fixtures in stable and stable guard buildings at Boise Barracks.

⊙Bids were opened April 27 by the U. S. Reclamation Service, Washington, D. C., for furnishing electrical apparatus for the Boise project, Idaho. Contracts have been awarded as follows: Allis-Chalmers Co., Milwaukee, Wis., three alternators, $17,700, four auxiliary transformers, $1,240, one air compressor, $515; Westinghouse Electric & Mfg. Co., three transformers, $5,400, two blowers, $480; General Electric Co., switchboard, $3,540, 24 disc switches, $280; six circuit breakers, $1,300, supplies, $476, two lightning arrestors, $500.

Illinois.

✣Bids will be received until 2 p. m., June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing one Cincinnati variable speed planer.

✣Bids are asked until 2 p. m., June 8, as noted in our last issue, by Maj. C. Keller, U. S. Engineer, Safety Bldg., Rock Island, Ill., for the construction and repair of dams and shore protections between Reads Landing, Minn., and Alma, Wis.; between Genoa and Lynxville, Wis.; between McGregor and Dubuque, Ia.; between Rock Island, Ill., and Muscatine, Ia.; contiguous to Sections 16, 17, 32 and 33 of Flint Creek-Iowa River Levee; between Keokuk, Ia., and Hannibal, Mo.; and between Hamburg, Ill., and Cap au Gris, Mo. The work to be done will be the construction and repair of brush and rock dams and shore protections at such localities in the Mississippi River between Reads Landing, Minn., and Cap au Gris, Missouri, as may be selected by the contracting officer or his assistant. The construction and repair will include the furnishing of all labor and materials necessary for the work covered by the contract. The locations of work are as follows: Between Reads Landing and Alma.—Amount available, $40,000, including cost of superintendence and inspection; probable operations commencing at Reads Landing and proceeding down river as far as funds will permit. Between Genoa and Lynxville.—Amount available, $40,000, including cost of superintendence and inspection. Probable operations between DeSoto and Lansing. Between McGregor and Dubuque.—Amount available, $80,000, including cost of superintendence and inspection. Probable operations in vicinities of McGregor, Cassville and Dubuque. Between Rock Island and Muscatine.—Amount available, $80,000, including cost of superintendence and inspection. Probable operations between Rock Island and Fairport. Sections 16 to 32, Flint Creek-Iowa River Levee.—Amount available, $11,500, including cost of superintendence and inspection. Operations to consist of shore protection (about [illegible] lin. ft.) in Huron Slough contiguous to Sections 16 and 17, and shore protection (about 3,000 lin. ft.) above head of O'Connell Slough, contiguous to Sections 32-33. Between Keokuk and Hannibal.—Amount available, $75,000, including cost of superintendence and inspection; probable operations commencing at Keokuk and proceeding down river as far as funds will permit. Between Hamburg and Cap au Gris.—Amount available, $100,000, including cost of superintendence and inspection. Probable operations in vicinity of Stag Island. The dams will consist of brush made into fascines and loaded with rock. The fascines may be laid singly or in mats, except in places where the water is over 2 ft. deep, when they must be made into mats. The shore protections will consist of a layer of fascines made into mats, sunk at the foot of the slope of the bank, extending out into the river and up the slope as far as may be necessary, with a covering of rock from 6 ins. to 12 ins. thick, as required, evenly and compactly laid.

✣Bids will be received until 2 p. m., June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing one 26-in. heavy single traverse shaper.

✣Bids will be received until 2 p. m., June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing one induction motor.

✣Bids will be received until 2 p. m., June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing three Universal shaping machines.

✣Bids will be received until June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing one 36-in. New heavy high duty drill.

✣Bids will be received until 2 p. m., June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing one Pratt & Whitney spline milling machine complete.

✣Bids will be received until 2 p. m., June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing four Hamilton 16-in. sliding head drill presses.

✣Bids will be received until 2 p. m., June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing one Lucas power forcing press No. 1, capacity 15 tons, with pressure guage on ram to be furnished with countershaft complete.

✣Bids will be received until June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing under Circular 302, one induction motor, polar wound, slip ring type.

✣Bids will be received until 2 p. m., June 6, by commanding officer, Rock Island Arsenal, Ill., for furnishing one radial Bickford drill, 3½ ft. arm.

✣Bids will be received until 7:30 p. m., May 29, by Matt Berscheid, city clerk, Joliet, Ill., for the construction of concrete retaining walls along the property lines at the northeast and southeast corners of Fifth Ave. and Eastern Ave. A certified check for $100 must be filed with each bid.

⊙Great Lakes Dock and Dredge Co., Chamber of Commerce Bldg., Chicago, has been awarded the contract for erecting a dock on the north side of the main channel of the Chicago River at Orleans St., for the city of Chicago. Contract price is $2,300. Bid received April 8.

Iowa.

✣Bids will be received until 2 p. m., May 29, by school board of the district township of Sioux in Clay county, Ia., at the office of the city auditor, Spencer, Ia., for the necessary labor and material for the construction of 8 school houses in said township. J. A. King is secretary of the board.

The town of Pocahontas, Ia., is to build an electric light plant sometime this summer. The bonds ($11,000) have been sold.

Kansas.

✣Bids will be received until 3 p. m., June 26, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures, of the U. S. Post Office at Clay Center, Kan.

Kentucky.

✣Bids will be received until noon, June 6, by Kentucky State Board of Control for Charitable Institutions, at Central Kentucky Asylum for the Insane, Lakeland, Ky., for the equipment of three water tube boilers with stokers of the underfeed plunger type. Albert Scott is president of the board.

Louisiana.

✣Bids will be received until 11 a. m., May 24, by Lieut. Col. Lansing H. Beach, U. S. engineer, 325 Custom House, New Orleans, La., for furnishing sand and gravel for Keystone Lock, Bayou Teche, La.

✣Bids will be received until 11 a. m., May 24, by Lieut. Col. Lansing H. Beach, U. S. engineer, 325 Custom House, New Orleans, La., for furnishing about 7,250 barrels Portland cement for Keystone Lock, Bayou Teche, La.

Bids per cu. yd., as follows, were received May 15 by the U. S. Engineer, New Orleans, La., for furnishing and delivering 10,000 cu. yds., more or less, of stone for use in connection with maintenance of jetties and auxiliary works at South and Southwest Pass, Mississippi River: Oscar F. Barrett, Cincinnati, Ohio, $3.45; Richard M. Murphy, New Orleans, La., $3.74; C. C. Huthmacher, Grand Tower, Ill., $3.75; Eskald & Alexander, New Orleans, La., $3.79; A. J. Terrell, Bessemer, Ala., f. o. b. cars, New Orleans, $1.90 per ton of 2,000 lbs., f. o. b. barge, New Orleans, $2.15 per ton of 2,000 lbs.

Maryland.

✣Bids will be received until 11:30 a. m., June 12, by Lieut. T. A. Terry, constructing quartermaster, Fort Howard, Md., for constructing electric light plant and electric lighting system.

Massachusetts.

✣Bids will be received until 2 p. m., May 26, by Board of Harbor and Land Commissioners, Boston, Mass., for strengthening and extending the jetties at East Bay and West Bay at Osterville in the town of Barnstable, and at Cuttyhunk in the town of Gosnold. Frank W. Hodgdon, 131 State House, Boston, Mass., is chief engineer of the board.

Michigan.

✣Bids are asked until 3 p. m., June 29, by Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for construction of lock masonry at Sault Ste. Marie, Mich. The work to be done consists in furnishing all necessary plant, labor and supplies, and building the concrete masonry of a lock and a portion of the approaches thereto, with pump well, tunnels, etc., including the furnishing of cement and certain reinforcement and metal parts to be built into said masonry. The estimated quantities are as follows:

Excavation, cu. yds.	2,000
Concrete, Class "A," in lock and canal walls (exclusive of cement), cu. yds.	138,000
Concrete, Class "B," elsewhere than in walls (exclusive of cement), cu. yds.	35,000
Drilling rock for anchor rods, lin. ft.	26,000
Portland cement, delivered, bbls.	217,000
Iron and steel delivered and placed.	
Square cold-twisted steel bars, tons	385
Anchor rods in rock, with nuts and square plate washers, tons	215
Wire cloth, tons	150
Miscellaneous iron, steel and cast'gs, tons	35
Sheet lead, etc., waters, delivered and placed, tons	30
Alternative concrete made with limestone aggregate:	
Class "C," when substituted for Class "A," cu. yds.	120,000
Class "D," when substituted for Class "B," cu. yds.	10,000

The Muir-O'Sullivan Dredge & Dock Co., Port Huron, Mich., submitted the lowest bid to Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., on May 15, for dredging Clinton River, Mich.

Missouri.

✣Bids will be received until 11 a. m., June 14, by Capt. Stanley H. Ford, quartermaster, Jefferson Barracks, Mo., for furnishing and installing in the new mess hall heating and cooking apparatus.

New Hampshire.

✣Bids will be received until 11 a. m., June 10, by R. C. Hollyday, chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for a granite block quay wall extension at the navy yard at Portsmouth, N. H.

New York.

✣Bids will be received until May 26, by Col. W. M. Black, U. S. engineer, 710 Army Bldg., New York City, for dredging in Saugerties Harbor, N. Y.

✣Bids will be received until 3 p. m., June 5, by Board of Contract and Supply, Albany, N. Y., for alterations to School No. 17 in that city. Proposals will be received in two ways, viz: 1. Bids for the entire work, including all branches. 2. Separate bids for (a) all the work, except the heating; (b) heating work.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

⊙The Robbins-Ripley Co., 50 Church St., New York, has been awarded the contract for constructing a concrete pier at Ellis Island, New York Harbor. This pier is to be built entirely of reinforced concrete, the piling being 18 ins. square and about [illegible] ft. long, and will be composed of a 1—2—4 mixture, in which an approved waterproofing will be used. The beams, girders and deck are also of reinforced concrete.

Ohio.

✣Bids will be received until noon, May [illegible], by Director of Public Safety, Cincinnati, O., for the necessary labor and material for constructing and laying gas maines to connect main buildings within the grounds of the Branch Hospital, and all interior pipe fitting required for connecting gas appliances in use within the main buildings at said institution, located near Greenley Ave. and intersection of Gurley road, Price Hill, in accordance with plans and specifications at the office of the Director of Public Safety. E. P. Durr is secretary Department of Public Safety.

Pennsylvania.

✣Bids will be received until 11 a. m., June 9, by Col. C. B. Baker, depot quartermaster, Philadelphia, Pa., for furnishing and erecting in place at that depot one 200-hp. water tube boiler.

✣Bids will be received until noon, May 26, by Joseph F. Hasskarl, Director, Department of Wharves, Docks and Ferries, 555 Bourse Bldg., Philadelphia, Pa., for furnishing and installing one 6 cu. yd. clam shell bucket on the dredge "Schuylkill." The amount available for the work is $2,000.

✣Bids will be received until 3 p. m., June 27, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, conduit and wiring, of the U. S. Post Office at Gettysburg, Pa.

Utah.

⊙The Merchants' Light & Power Co., of Ogden, which has recently been granted franchises for the lighting and power in the city of Ogden, Utah, and which has also obtained the municipal arc lighting contract, has awarded to the Falkenau Electrical Construction Co., 617 Stock Exchange Bldg., Chicago, Ill., the general contract for the complete installation and construction of this system. The work will be undertaken immediately and pushed to rapid completion. H. A. Strauss, Consulting Engineer, of Chicago, has prepared plans and specifications for this system and is now engaged in making the necessary purchases at his Chicago office, in the Stock Exchange Bldg.

Washington.

⊙The contract for furnishing the stone to be used in the continuation of the work on the Grays Harbor jetty has been awarded by the government to the Hercules Sandstone Co., of Tenino, Wash. Under the new contract the Hercules Sandstone Co. agrees to deliver 700 tons of stone per day, the first at South Aberdeen where it will be received [illegible] succeeding seasons the company is to deliver 1,200 tons daily. The Tenino company's bid was $1.78 per ton. The contract will amount to upwards [illegible] is completed.

West Virginia.

[illegible] Alstaetter, U. S. Engineers, Wheeling, W. Va., for constructing Lock and Dam No. 11, Ohio River, at Woodland, W. Va., as noted in our last issue. The following bids were received; (1) Missouri Valley Bridge & Iron Co., Leavenworth, Kan., (2) The Ohio River Contract Co., Evansville, Ind., (3) The Dravo Contracting Co., Pittsburg, Pa., (4) Sheridan-Kirk Contract Co., Cincinnati, O., (5) T. A. Gillespie Co., Pittsburg, Pa.:

			(1)	(2)	(3)	(4)	(5)
Cofferdam, 16 ft	Lin. ft.	[illegible]	$25.70	[illegible]	[illegible]	$20.00	[illegible]
Cofferdam, 10 ft	Lin. ft.	[illegible]	11.00	10.00	10.00	9.25	14.00
Common excavation	Cu. yd.	[illegible]	[illegible]	.70	.70	.60	[illegible]
Rock excavation ...	Cu. yd.	[illegible]	[illegible]	3.00	[illegible]	1.60	5.00
Drilling bolt holes..	Lin. ft.	[illegible]	.70	1.00	.50	1.00	1.00
Fill	Cu. yd.	[illegible]	[illegible]	[illegible]	[illegible]	.40	.50
Riprap	Cu. yd.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Reinforced concrete	Cu. yd.	180	12.00	[illegible]	10.00	15.00	15.00
Stone paving	Cu. yd.	[illegible]	[illegible]	[illegible]	5.00	6.00	7.00
Round piles	Lin. ft.	15,000	[illegible]	.60	.60	.70	.70
Steel piles	Ft. B.M.	[illegible]	70.00	[illegible]	60.00	70.00	110.00
Oak timber	Ft. B.M.	[illegible]	[illegible]	100.00	80.00	90.00	130.00
Concrete (solid construction)	Cu. yd.	[illegible]	5.40	6.25	[illegible]	5.85	[illegible]
Concrete (arched-void construction) alternative bid	Cu. yd.	70,000	[illegible]	7.00	[illegible]	6.71	7.50
Concrete paving ...	Cu. yd.	[illegible]	7.50	[illegible]	6.00	10.00	7.00
Structural steel	Pounds	[illegible]	.075	.07	.06	.065	.07
Reinforcing steel	Pounds	20,160	.04	.07	.06	.055	.05
Forgings (including wrought-iron)..	Pounds	[illegible]	.07	.07	.06	.07	.05
Bolts, etc	Pounds	[illegible]	[illegible]	[illegible]	.06	.0565	.05
Iron castings	Pounds	[illegible]	.055	.07	[illegible]	[illegible]	.05
Steel castings	Pounds	[illegible]	[illegible]	.10	[illegible]	[illegible]	.10
Bronze	Pounds	[illegible]	[illegible]	[illegible]	.50	.85	1.00
Pipe, 5-in	Lin. ft.	[illegible]	2.50	3.00	[illegible]	1.59	2.00
Pipe, 4-in......	Lin. ft.	2,330	2.00	3.00	2.50	1.10	2.00
Pipe, 3-in......	Lin. ft.	1,020	1.50	3.00	2.00	[illegible]	1.00
Pipe, 2½-in	Lin. ft.	[illegible]	1.20	1.50	1.50	[illegible]	.60
Pipe, 2-in......	Lin. ft.	[illegible]	1.00	1.50	1.00	.40	.60
Tile drain	Lin. ft.	[illegible]	.50	[illegible]	1.00	[illegible]	.60
Total			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total of [illegible]			[illegible]	[illegible]	$873,176	[illegible]	[illegible]

The following bids were received May 17 by Maj. F. W. Altstaetter, U. S. Engineers, Wheeling, W. Va., for constructing Lock and Dam No. 20, Ohio River, near Belleville, W. Va.: (1) Sheridan-Kirk Contract Co., Cincinnati, O., (2) The Dravo Contracting Co., Pittsburg, Pa., (3) The T. A. Gillespie Co., Pittsburg, Pa., (4) The Ohio River Contract Co., Evansville, Ind.:

			(1)	(2)	(3)	(4)
Cofferdam, 16 ft	Lin. ft.	1,240	[illegible]	[illegible]	$25.00	$25.00
Cofferdam, 10 ft	Lin. ft.	1,500	[illegible]	10.00	15.00	12.50
Common excavation	Cu. yd.	[illegible]	.60	.65	.60	.70
Rock excavation	Cu. yd.	1,000	1.00	3.00	4.00	[illegible]
Fill	Cu. yd.	57,200	.40	.30	.30	.50
Riprap	Cu. yd.	2,670	3.00	3.00	[illegible]	3.50
Stone paving	Cu. yd.	100	6.00	5.00	7.00	8.00
Round piles	Lin. ft.	9,050	.70	.60	.60	.60
Steel piles	Ft. B. M.	129,000	70.00	[illegible]	100.00	80.00
Oak timber	Ft. B. M.	[illegible]	80.00	80.00	[illegible]	100.00
Reinforced concrete	Cu. yd.	[illegible]	12.00	10.00	15.00	10.00
Concrete (solid construction)	Cu. yd.	57,800	5.61	6.00	6.20	[illegible]
Concrete (arched-void construction) alternative bid	Cu. yd.	54,309		6.40	6.70	6.75
Concrete paving	Cu. yd.	1,800	7.73	6.00	7.00	8.00
Structural steel	Pounds	917,900	.065	.06	.07	[illegible]
Reinforcing steel	Pounds	22,400	.055	.06	.07	.07
Forgings (including wrought iron)	Pounds	52,450	[illegible]	.06	.07	.07
Bolts, etc	Pounds	74,700	.075	[illegible]	.07	.07
Iron castings	Pounds	[illegible]	.055	.06	.07	.07
Steel castings	Pounds	180,200	.098	.08	.10	.10
Bronze	Pounds	1,170	.85	.50	[illegible]	.90
Pipe, 5-in...........................	Lin. ft.	400	1.59	3.00	2.00	2.00
Pipe, 4-in	Lin. ft.	[illegible]	1.10	2.50	2.00	2.00
Pipe, 3-in	Lin. ft.	[illegible]	[illegible]	2.00	2.00	2.00
Pipe, 2½-in.............................	Lin. ft.	190	[illegible]	1.50	2.00	1.50
Pipe, 2-in	Lin. ft.	580	.40	1.00	2.00	1.50
Tile drain	Lin. ft.	[illegible]	[illegible]	1.00	1.00	[illegible]
Total of bid....................................			[illegible]	$686,343	$748,041	$774,564
Total of [illegible]			[illegible]	[illegible]	$753,191	$765,389

✣Bids [illegible] as noted in our last issue, by Maj. F. W. Altstaetter, U. S. Engineers, Wheeling, W. Va., for constructing Lock and Dam No. 15, Ohio River. The site for the work is in the Ohio River, near New Martinsville, W. Va. The Ohio River Division of the B. & O. R. R. passes the site on the West Virginia side at a distance of about 500 ft. from the river, and New Martinsville station on that road is about one mile above the site. The work to be done is constructing lock, guide walls, river-wall, power-house, the dam, (including the navigable pass and the bear-trap and Chanoine wiers) and the abutment; and grading and paving the esplanade and the bank back of the abutment. Trestles and wickets with horses and props; the lock gates, operating machinery for the lock valves and gates. The following is the estimate of quantities:

Cofferdam, 16 ft., lin. ft..	1,270
Cofferdam, 10 ft. lin. ft	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	32,000
[illegible]	2,300
Stone paving, cu. yds	250
Round piles, lin. ft	6,750
[illegible]	95,000
[illegible]	3,000
[illegible]	88,000
[illegible]	[illegible]
Concrete (solid construction), cu. yds...	65,500
Concrete (arched-void construction) (alternative bid) [illegible]	[illegible]
[illegible]	500
[illegible]	[illegible]
[illegible]	[illegible]
Forgings (including wrought iron), lbs...	53,300
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Bronze, lbs..............................	1,170
Pipe, 5-in., lin. ft........................	370
Pipe, 4-in., lin. ft........................	2,510
Pipe, 3-in., lin. ft........................	1,030
[illegible]n., lin. ft	190
[illegible], lin. ft..	580
Tile drain lin. ft ..	860

Canada.

✣Bids will be received until 4 p. m., June 12, by R. C. Desrochers, secretary, Department of Public Works, Ottawa, Ont., for constructing [illegible] township of Monck, Muskoka, Province of Ontario. Plans, specifications and form of contract can be seen and forms of tender obtained at the department, at the offices of J. G. Sing, district engineer, Confederation Life Bldg., Toronto, Ont., H. J. Lamb, district engineer, London, Ont., H. J. Lamb, district cation to the postmaster at Beaumaris, Muskoka, Ont.

✣Bids will be received until 4 p. m., May 26, by R. C. Desrochers, secretary, Department of Public Works, Ottawa, Ont., for dredging required at Belleville, Ont.

✣Bids will be received until 4 p. m., May 31, by R. C. Desrochers, secretary, Department of Public Works, Ottawa, Ont., for the construction of an addition to the post office building at Gananoque, Ont.

⊙W. H. Lytle, Peterboro, Ont., has been awarded the contract at $1,400 for constructing telephone line for Huron & Kinloss muni[illegible] at [illegible]

DAM, HEAD-WORKS, CANALS, TUNNELS, ETC., OF THE SOUTH SAN JOAQUIN IRRIGATION DISTRICT.

Manteca, San Joaquin, Co., Cal.

[illegible]

[illegible]

of the 19th day of June, 1911, for furnish- [illegible]

Contract-Division 1
[illegible]
Contract-Division 3
Contract-Division [illegible]
Contract-Division [illegible]
Contract-Division 6

of their Irrigation System; and said Pro- [illegible] public meeting at said office immediately thereafter.

Contract-Division 1 and Contract-Division 2 will be let jointly by the South San Joaquin and Oakdale Irrigation Districts, and will be paid for as follows:

	By S. S. J. Dist.	By O. I. Dist.
[illegible]	[illegible]	[illegible]
Contract-Division 2	about 81%	about 19%

[illegible] will be let and paid for solely by the South San Joaquin Irrigation District.

Copies of the Contract-Forms, Specifi- [illegible] Bids may be seen and further information obtained at the following places:

Office of the Directors, Manteca, Cal.

Office of the Chief Engineer, 1315 Hum- [illegible]

Office of Engineering News, New York and Chicago.

Office of Engineering-Contracting, Chicago.

Proposals will be made upon Forms provided therefor, and only such proposals will be considered as are complete, in proper form, comply with the requirements herein stated, and are offered by parties of known reputation, experience and responsibility.

[illegible] or all of the six Contract-Divisions will be received from any bidder; but the proposal for each Contract-Division must [illegible] distinct Form or Blank.

Each bidder will be required to deposit with his proposal in the offices of the Directors, as security for the execution by him (if his bid be accepted) of the contract and the giving of the required bond within fifteen (15) days after due notice of the acceptance of his bid, certified checks payable to the order of J. S. Moulton, Treasurer, for the following amounts:

[illegible] Division 1, a certified check for...	$5,000
With the Proposal for Contract-Division 2, a certified check for..	1,000
With the Proposal for Contract-Division 3, a certified check for..	1,000
With the Proposal for Contract-Division 4, a certified check for..	1,000
With the Proposal for Contract-Division 5, a certified check for..	1,000
[illegible] Division 6, a certified check for..	1,000

[illegible] any Contract-Division is awarded will be [illegible] Surety Company, for twenty-five per cent [illegible] conditioned for the faithful performance and completion of the Contract.

Contracts will be awarded to the lowest responsible bidder or if considered by the Directors for the interest of the District all bids may be rejected. Should bids for all six of the contracts be received from a single bidder, and should the aggregate amount of such bid be less than the sum of the lowest bids received from separate bidders; then in such event preference will be given by the Directors in awarding the contracts to the single bidder on all six contracts.

The various contracts must be entirely completed at dates not later than the following:

Contract-Division No. 1, March 31, 1912.
Contract-Division No. 2, March 1, 1913.
Contract-Division No. 3, March 1, 1913.
Contract-Division No. 4, March 1, 1913.
Contract-Division No. 5, March 1, 1913.
Contract-Division No. 6, March 1, 1913.

And Bids will be received contemplating the completion of the work of the various contracts at above dates.

The works to be constructed under [illegible] Contracts are as briefly described below:

Contract-Division 1—

A concrete Diversion-Dam about 450 ft. long on crest and of about, 75 ft. maximum height.

Concrete Head and Regulating-Works to Canal.

The quantities are shown in detail in the Specifications; and are very roughly as follows:

Concrete, about........... 8,400 cu. yds.
Earth and Rock Excavation, [illegible]
[illegible]
Etc., Etc.

The total amount of this contract will be roughly about $100,000.

Contract-Division 2—

A Conduit about 3.6 miles long of open canal and tunnels, along the canyon of the Stanislaus River, mainly slate rock excavation on steep side-slopes. Two tunnels about 1,000 ft. long each, one about 2,900 ft. long, remainder open canal. Entire length lined with concrete.

About 112,000 cu. yds. of Excavation in open canal; etc., etc.

Total amount of this contract about $300,000.

Contract-Division 3—

A conduit about 2.7 miles long of open canal and tunnels, in foot-hills, mainly hard-pan excavation in deep cuts. Four tunnels only 980 ft. in aggregate length, remainder open canal. Entire length lined with concrete.

About 180,000 cu. yds. Excavation in open canal, etc., etc.

Total amount of this contract about $200,000.

Contract-Division 4

A Flume about 14½ ft. wide by 9 ft. high in inside dimensions, and about 2,000 ft. long, carried on a trestle or piers of about 65 ft. maximum height, and about 38 ft. average height.

Bids are asked both on a Wooden and on a Reinforced-Concrete Structure.

The Wooden Structure would contain approximately:

190 M ft. b. m. of Redwood Lumber.
430 M ft. b. m. of Oregon Fir Lumber.
25,000 lbs. of spikes, bolts, etc., etc., etc., etc.

[illegible] would cost roughly [illegible]

The alternative Reinforced-Concrete Structure would contain approximately 6,700 cu. yds. concrete, 200 tons steel bars, etc., and would cost roughly, $80,000.

[illegible]

A conduit about 3.9 miles long, of open canal except one tunnel about 740 ft. long, in foot-hills, mainly hard-pan excavation, moderate cuts.

About 250,000 cu. yds. excavation, about 60,000 cu. yds. embankment. Tunnel and embankments (about 6,000 ft. of latter) lined with concrete.

Total amount of this contract about $175,000.

Contract Division 6 –

About 6.4 miles of open canal, no tunnels, in plain, no concrete-lining.

About 300,000 cu. yds. excavation, largely hardpan.

The amount of this contract will be roughly, $130,000.

Each of the above Contract-Divisions contains auxiliary structures, such as Drainage-Culverts, Waste-Gates, Bridges, Drops, or Siphons, etc., etc.—all of which are shown with quantities in the Specifications and Contract-Drawings.

B. A. GOODWIN, Pres.
E. N. PIERCE, Sec.
Board of Directors South San Joaquin
Irrigation District.
EDWIN DURYEA, JR.,
M. Am. Soc. C. E.,
Chief Engineer.

The South San Joaquin Irrigation District's System will be built by funds acquired by the sale of bonds. The District is organized and the bonds issued under the Wright-Bridgeford Act, a California Law governing the organization and operation of Mutual or Citizens' Irrigation Districts. Such Districts have the status of municipalities and are administered by a Board of Directors elected by the people. The districts have the power to issue bonds or to raise money by direct taxation. The bonds are a lien upon the lands. By the law, such District Bonds are 5 per cent, 30-year bonds, redeemed from the 21st to the 30th years. The bonds of the South San Joaquin Irrigation District have been subjected to attack by a Taxpayer's suit, in which the suit was won by the District, and the organization and bonds were decided by the Court to be lawful in all respects. The bonds are legal investments for banks, trust companies and State School Funds and have the same legal standing in California as other Municipal Bonds.

By the law, such District Bonds cannot be sold for less than par, and cannot be used in (direct) payment for construction-work. Under present conditions it is very difficult to sell 5 per cent irrigation bonds at par; hence it will be necessary for the successful bidder on any Division to finance his Contract by finding a bidder for the bonds at par up to at least the amount of his contract—and to compensate for a reasonable discount in the bonds by increasing his unit-price bids by a corresponding proportion.

The area of the South Joaquin Irrigation District is 71,050 acres. The total bond-issue authorized is $1,875,000, or $26.40 per acre. The assessed value of the land alone, exclusive of all improvements, is $2,848,997, or $40.10 per acre. The present market value of the land, exclusive of improvements, averages $85 per acre, or amounts to $6,039,000 for all the lands of the District; and the market value will be two to three times as great as soon as the irrigation-system is completed and the land irrigated.

The present population of the District is about 3,500, and the value of its agricultural and viticultural products during 1910 was at least $2,500,000.

Fort Yellowstone, Wyo., April 27, 1911. Sealed proposals, in triplicate, will be received here until 12 noon, May 31, 1911, and then publicly opened, for furnishing labor and material for constructing pipe line from Panther Creek to point near Rustic Falls for Fort Yellowstone water system. Information furnished on application. Envelopes containing proposals to be indorsed "Proposals for pipe line" and addressed to Constructing Quartermaster.

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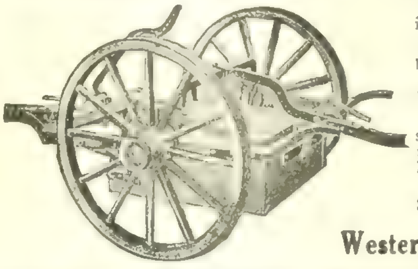

WATER WORKS AND SEWERAGE.

Red Springs N. C.

Sealed proposals will be received by the Board of Public W[illegible] of the Town of Red Springs, N. C. [illegible] June the 27th, 1911, for building a water works and [illegible] system of sewerage.

The water works will [illegible] fireproof building, return tubular boilers, steam pumps, [illegible] water tower, and about [illegible] miles of 6 [illegible] cast iron water pipe, [illegible] and valves.

The sewerage will consist of about [illegible] inches diameter, and appurtenances.

Plans and specifications will be on file at the office of the [illegible] of Red Springs, N. C., and at the office of the engineer at Durham, N. C.

No bid will be considered unless accompanied by a certified check for 5 per cent of the bid, but not less than $250.00 as an evidence of good faith.

The right is reserved to reject any or all bids.

[illegible] PEARSALL
Chairman
[illegible] W. TOWNSEND,
Secretary.

GILBERT C. WHITE.
Engineer,
Durham, N. C.

ROADS.

Sealed bids will be received at the office of the Robertson County Pike Commission, in Springfield, Tennessee, up to 12 o'clock noon, on Tuesday, June 20, 1911, for grading, ditching and macadamizing about fifty miles of public roads in Robertson County, Tennessee. Plans and specifications may be seen at the office of the Pike Commission, at any time after June first

JOSEPH [illegible] WASHINGTON
Chairman.
[illegible]
Secretary.

BRIDGES.

Bids will be received until 12 o'clock noon, May 22nd, 1911, by F. W. Leedham, County Auditor, Clinton County, Clinton, Iowa, for County Bridges num[illegible]

Work embracing approximately as fol[illegible]

[illegible]

15,985 lbs. reinforcement.

[illegible]

R. C. HART
County Surveyor.

SEWERS.

Sealed bids [illegible] W. L. Hayes, City Clerk of the City of Clinton, until the 29th day of May, 1911, at 8 o'clock P. M., and then publicly opened and read [illegible] and lateral sewers in said city, consisting of:

300 ft. 48-in. 2-ring Brick Sewer.
500 ft. [illegible] Brick Sewer.
400 ft. 42-in. 1½-ring [illegible]
1,343 ft. [illegible] Sewer.
765 ft. 36-in. pipe sewer.
1,988 ft. 30-in pipe sewer.
2,452 ft. 24-in. pipe sewer.
1,544 ft. 20-in. pipe sewer
3,560 ft. 18-in pipe sewer.
2,993 ft 15-in pipe [illegible]
11,515 ft. 12-in. pipe sewer.
[illegible] ft [illegible] pipe [illegible]
5,513 ft. 10-in. catch basin pipe.
14,880 cu. yds. rock excavation.
76 manholes.
62 Catch [illegible]
122 Inlet Basins.

Said work is divided into four (4) districts. Work to be commenced by June 15th, 1911, and completed by Sept. 15th, 1912. Cost of improvement to be paid for by special [illegible] property, not in excess of special benefits, balance, if any, from bonds of the district issued in anticipation of collection of taxes. Improvement to be done under a written contract.

Proposals or bids must be in sealed envelope [illegible] envelope containing a certified check on a responsible bank in the City of Clinton, in the sums of $500 for District "A"; $1,000 for District [illegible] District "D"; or the sum of $1,500 for all districts combined

In considering bids the checks will be first examined, and if not according to these conditions or if the proposal is conditioned it will be declared illegal. Bond will be required when contract is let in [illegible] bid. Council reserves the right to reject any and all bids and advertise for new bids.

R. C HART, City Engineer
Clinton, Iowa.

WATER WORKS IMPROVEMENTS.

Tarboro, N. C.

Sealed proposals will be received by the Mayor and Board of Commissioners of the Town of Tarboro, N. C., until 3:00 P. M. June 15, 1911, for water works improvements.

The work will consist of a 500,000 gallon concrete filter plant, electric driven turbine pumps and a 260,000 gallon concrete storage reservoir and auxiliary electric pumping station and one mile of 10-in cast iron pipe.

Detail plans and specifications will be on file at the Clerk's office, at Tarboro, N. C., and at the Engineer's office at Durham, N. C. Copies of the specifications, form of proposal, etc., may be obtained from the Engineers at Durham, N. C.

No bid will be considered unless accompanied by a certified check for $500, as an evidence of good faith.

The right is reserved to reject any or all bids.

W. O. HOWARD,
Mayor.
JNO. A. WEDDELL,
Clerk.

GILBERT C. WHITE,
Engineer,
Durham, N. C.

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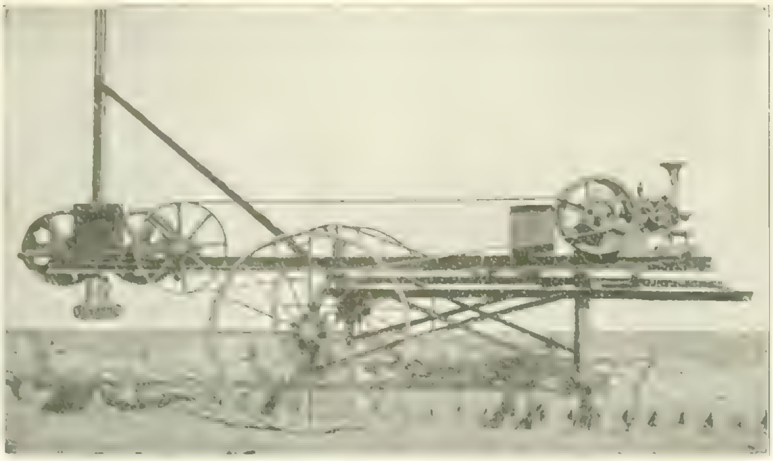

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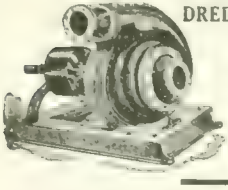

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NOTICE TO ARCHITECTS.

The State Capitol Commission of the State of Washington, at Olympia, Wash., being thereunto duly authorized by law, invites a competition among architects for a general architectural plan for a series or group of buildings to be erected on "Capitol Place" and designs and plans for a Temple of Justice.

Application for the Program of Information and Contour Map accompanying the same should be made to E. W. Ross, Secretary, State Capitol Commission, Olympia, Wash. In accordance with the law, a charge of one dollar ($1.00) is made for the Contour Map, and this sum must accompany each application.

All drawings and designs called for must be in the hands of the Commission before 3 o'clock p. m., July 27, 1911.

By order of the State Capitol Commission.

M. E. HUY, Governor,
Chairman.

Attest:
E. W. ROSS,
Secretary, Commissioner of Public Lands.

U. S. ENGINEER OFFICE, Safety Bldg., Rock Island, Ill., May 8, 1911.—Sealed proposals for construction and repair of dams and shore protections between Reads Landing, Minn., and Alma, Wis.; between Genoa and Lynxville, Wis.; between McGregor and Dubuque, Ia.; between Rock Island, Ill., and Muscatine, Ia., contiguous to Sections 16, 17, 32, 33, of Flint Creek-Iowa River levee; between Keokuk, Ia., and Hannibal, Mo.; and between Hamburg, Ill., and Cap au Gris, Mo., will be received here until [illegible], June 8, 1911, and then publicly opened. Information on application. C. KELLER, Maj. Engrs.

War Department, U. S. Engineer's Office, Montgomery, Ala., May 1, 1911. Sealed proposals for furnishing about 35,000 barrels American Portland Cement will be received at this office until one o'clock p. m., May 31, 1911. Information on application. G. D. Fitch, Lt. Col., Engineers.

WATER WORKS.

[illegible]

[illegible] June [illegible] S. G. Mitchell, city clerk, for necessary labor and material for the installation of [illegible] works system [illegible] proximate quantities: 70,000 gal. steel tank, 100 ft. tower; 98 hydrants, 1,130 ft. 8 in. mains, 10,862 ft. 6 in., 19,914 ft. 4 in., 1½ tons specials.

Yours very truly,
S. G MITCHELL,
[illegible]

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SEWERS AND PAVING.

Sealed proposals will be received by the Mayor and Board of Aldermen of Frederick, Maryland, until 11 a. m., May 24, 1911, for constructing approximately 4,000 lin. ft. of sewers (6" to 42") together with necessary inlets, manholes and lampholes. Each bid must be accompanied by a certified check for $250.00 drawn payable to J. Ed. Schell, Mayor.

At the same time and place sealed proposals will be received for paving approximately 16,000 sq. yds., and for furnishing and setting 8,500 lin. ft. of curbing. Each bid must be accompanied by a certified check for $1,250.00 drawn payable to J. Ed. Schell, Mayor.

Plans, specifications, instructions to bidders, and forms of proposals may be obtained from the City Engineer, upon payment of $2.00.

The right to reject any or all bids or any portion of any bid, or to accept any portion of any bid, which may be deemed for the best interest of the city, is expressly reserved.

J. ED. SCHELL,
Mayor.
E. C. CRUM,
City Engineer.

PROPOSALS FOR TOWBOAT.—U. S. Engineer Office, Vicksburg, Miss., May 5, 1911. Sealed proposals for furnishing and delivering one steel-hull towboat will be received at this office until noon, June 6, 1911, and then publicly opened. Information on application. J. A. WOODRUFF, Capt., Engrs.

Engineering - Contracting

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Exaggerated Dangers of Scientific Management.

[illegible] reasons for this belief.

[illegible] told [illegible] engineering cost data could bring nothing but harm. Advocates of the free promulgation of these data were [illegible] to their [illegible] set [illegible] tion of management. The most that would be conceded was that costs often might be of value to the man who collected them and was familiar with every detail and circumstance of the [illegible] they [illegible] nant with harm. Truly pitiful pictures were drawn of young engineers and contractors inveigled into loss by undue confidence in costs. This was four or five years ago. The public [illegible] and they are being published now in greater amounts than ever. The demand for them is greater than ever; contractors and engineers are [illegible] more than ever, they are showing greater willingness than ever to exchange their experience with one another. The voice of remonstrance is still raised but it is only an echo of its former volume. [illegible] experience to show that even a monster of [illegible] may, when better known, present attributes and appear not wholly uncomely.

It seems [illegible] that the public may be misled into its too wholesale adoption by exaggerated statements of the efficiency of scientific management. Every earnest worker for scientific management deplores this phase of its growth. Yet it is natural, just as was the practice of certain persons a decade or so ago to exploit "electric processes" of doing various things, and like its precedents in the development of engineering [illegible] it block the wheels of real progress. Finally we question whether the "public," that is the [illegible] of being misled. We have followed the development of this idea of scientific management rather carefully for a considerable number of years and we have not noticed on the part of managers any dangerous avidity in absorbing it. Indeed we have often felt some impatience at their deliberation in taking notice of it at all. As we have previously remarked, it may almost be stated as a rule that 20 years or more are required to popularize any novel method of management and 20 years not from the inception of the idea but from its formulation into a working scheme. It need not be feared, we think, that there will be any abnormal precipitancy in adopting scientific management.

Another fear that is frequently expressed is that it will not be realized that scientific management is more easily adapted to certain industrial processes than to others. We think that this fear is largely groundless. The very same thing was said of the application of electricity to industrial purposes not very many years ago. Electrical development did not stop, however; instead the difficulties in its way were overcome. No railway manager prepared to scrap his locomotives and install dynamos whe[illegible] cessfully. May we not reason analogously in respect to scientific management. It is perfectly obvious that scientific management can be most readily applied when the labor performed consists of a continuous repetition of some definite set or series of acts carried on under practically uniform conditions. It is quite as obvious that, by removing difficulties, this same scientific management can be extended to more complex work, done under more variable conditions. If it is worth while, as we believe time will prove, the difficulties will be removed. Meanwhile we anticipate that no one need be worried for fear that railway managers, let us say, will upset their train schedules in a hasty attempt to introduce scientific management because they have heard of its successful operation in a button hook factory.

Recently, much effort has been expended to make it plain that there is nothing fundamentally new in scientific management. Wherein, then, lies the fear of it as evidenced by the frequent calls of warning? Now, as a matter of fact, the principles of scientific management [illegible] science of management is new. Apparently it is the [illegible] dangerous and not the principles of scientific management [illegible] are familiar to all of us and have been used at one time or another and are, many of them, in use now. This means, if it means anything, that principles which are safe if followed unconsciously as an art become dangerous if followed consciously as a science. The [illegible] greatly alarming.

Finally, no single risk of scientific management [illegible] apparant refutation of the belief that managerial ability is a God-given attribute. It has been the fate of faith in necromancy in all lines of thought to disappear as a science was developed. We can not do otherwise than be content with the knowledge that a similar [illegible]

An Interesting Court Decision Relating to Time Penalty in Contracts.

A curious litigation has recently been decided by the Appellate Court of Illinois. We call it curious because what would seem to the layman to be plain reason and common sense was not so held by one court of law and by a higher court was admitted without qualification. The circumstances were briefly as follows:

The structure to be built was a steel gate or dam with necessary concrete floors, walls, piers, abutments, etc. The site for this structure was to be provided by the owner free of obstructions and excavated to proper form and dimensions and the contractor was also to be provided with properly staked locations and with plans of the structure to be built. The contract required construction to be begun within 15 days from the signing and the work to be completed at a set time. It also provided that for every day of time beyond this set date until the completion of the work the contractor should pay a penalty of $100. The owner failed to have the site cleared and excavated at the contract time stipulated for beginning work; in fact he proceeded with this work during the whole time originally set for the contractor to finish his work. The owner also delayed in locating the dam structures and in furnishing plans for them. The result was that the contractor did not complete his work until four months after the date of completion named in the contract. Upon its completion he offered to waive any charge against the owner because of delays due to the owner providing the owner would in turn waive any claim for penalties for overtime. The owner's engineers recommended that this settlement be made, but the owner (a board of trustees) decided to enforce the penalty clause and set an example that would deter other contractors from delinquency. The dispute went first to the Municipal Court, which decided in favor of the owner. The case was appealed with the result that the Appellate Court reversed the decision of the lower court with many criticisms of its procedures. As of general interest we publish the following sections from the Appellate Court's decision:

[illegible]

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[illegible] time limit was either waived altogether, thus giving the plaintiff a reasonable time to complete the contract, or, that defendant extended [illegible] to the delay caused by the defendant either in failing to deliver the site or in obstructing the [illegible] right to the liquidated dam- [illegible] provided for in the contract for delay on the part of the plaintiff.

We think it is a necessary inference from the terms of the agreement that the Sanitary District of Chicago undertook to provide the site for the dam in question properly excavated in its channel; and that the failure of the Sanitary District to deliver over the entire site of the dam to the plaintiff for the prosecution of its work under the contract for the length of time [illegible] by the evidence, resulted in the [illegible] in completing the contract by the plaintiff, and that thereby the provision in the contract for liquidated damages of $100 per day was as effectually eliminated from the contract as if the parties had cancelled it by express agreement.

The interest of this decision is in the principle which it lays down that delay of the owner to fulfill the implied terms of the contract, thereby causing a delay in the contractor's work, eliminates any provision in the contract for liquidated damages for delay.

CONCRETE AND REINFORCED CONCRETE SECTION

Cost of Concrete Foundation for a 24x36-in. Nordberg Engine Direct Connected to 300 K. W. Westinghouse Generator.

This foundation was built in side an engine room already in place. The work comprised cutting out floor, joists, and sills of engine room floor, removing floor piers, excavating, concrete work and completing the foundation ready to receive the engine and generator.

The work was performed by the regular factory floating gang which comprised four laborers at 25 cts. per hour and one carpenter at 30 cts. per hour. There was 75 cu. yds. of excavating and 95 cu. yds. of concrete work. No charge is included for supervision.

The excavation was all pick and shovel work and comprised 4 ft. of clay and shelly rock, the last foot being quite difficult. Barrows were loaded in the pit and hoisted by hand with a rope block to floor level and wheeled about 60 ft. to dump. Both digging and wheeling cost more than it should have done.

Stone and sand were dumped as close to the mixing board as possible and were measured and wheeled to the board in barrows. The average length of wheel was about 30 ft. The mixing board was placed just outside of the engine room door about 45 ft. from the foundation. Concrete was 1:2:5 mixture approximately and was hand mixed. One man loaded the barrows with sand and stone and wheeled them up to the mixing board and wheeled the mixed concrete to the pit. Two men dumped sand and stone on the mixing board, mixed it and loaded the concrete barrows. One man spread the concrete in the pit and spaded it.

To insure accuracy of location of generator pit, wheel pit, duct for oil pan and exhaust piping, core boxes were attached to the lower side of a template before any concrete was poured. This also obviated the difficulty of sawdust, blocks, etc., getting in the green concrete.

Pieces of scrap pipe 1 in. larger in internal diameter than the foundation bolts were centered on the bolts at the bottom of the pit and raised as the concrete set.

The detailed costs of the various parts of the work are as follows:

Labor:	
[illegible]	$ [illegible]
[illegible]	4.75
	$ [illegible]
Cleaning form lumber, 16 hrs. at 25 cts.	$ 4.00
[illegible]	[illegible]
	$ [illegible]
Making [illegible]	[illegible]
Excavating [illegible]	[illegible]
Excavating [illegible]	[illegible]
	$ [illegible]
Wheeling [illegible]	$ [illegible]
Draining [illegible]	[illegible]
Making and setting [illegible] at 30 cts.	8.70
Making [illegible] cts.	1.50
	$ 10.20
Forms, [illegible] hrs. at [illegible] cts.	$ 10.80
Forms, 29 hrs. at 25 cts.	7.25
	$ [illegible]
Cutting pipe casings for anchor bolts, 7 hrs. at 30 cts.	$ [illegible]
Setting anchor bolts and raising casings, 14½ hrs. at 30 cts.	4.35
Setting anchor bolts and raising casings, 18 hrs. at 25 cts.	4.50
	$ 8.05
Runways, 15 hrs. at 25 cts.	$ 3.75
Water pipe line to mixing board, 5 hrs. at 25 cts.	1.25
Wheeling stone, sand and concrete, 109 hrs. at 25 cts.	27.25
Mixing concrete, 231 hrs. at 25 cts.	57.75
Spading concrete in form, 107 hrs. at 25 cts.	26.75
Spading concrete in form, 2½ hrs. at 30 cts.	.75
	$ 27.50
Repairs on wheelbarrows, 3 hrs. at 30 cts.	$ .90
Stripping forms, 16 hrs. at 25 cts.	4.00
Patching rough places in foundation, 6 hrs. at 25 cts.	1.50
Cleaning up premises, 7 hrs. at 25 cts.	1.75
Pointing up sand pile, 6 hrs. at 25 cts.	1.50
Total labor	$283.48
Materials:	
121 bbls. Portland cement	$139.15
74.5 yds. crushed stone	104.40
12 yds. gravel	[illegible]
39.2 yds. sand	[illegible]
Cartage	46.99
3 shovels	1.65
450 B. F. T. & G. fencing lumber	13.50
22 ft. 6-in. sewer tile	1.32
10 lbs. soap	.25
Miscellaneous, bolts and nails	1.50
Total materials	$400.56
Grand total	$684.04

A Summary of Practice in Reinforced Concrete Building Construction.*

The data for this article were secured from a large number of working drawings of buildings actually erected during the past few years. A number of firms are represented so as to show the general tendency throughout the country rather than to emphasize the idiosyncrasies of any one designer. The general divisions of the investigation follow the natural division of a building into its component parts, namely: footings, columns, beams, girders and slabs.

FOOTINGS.

There are two general types of footings: those carrying one column, and those carrying more than one column. Of the latter, there is the slab foundation, extending over the whole building area, and the raft foundation which usually connects a wall column with an interior column. The slab is only used in extremely soft ground, and if founded on piles, is made of uniform thickness and reinforced in two directions near the upper surface with loose rods or some mesh reinforcement. Rafts are usually employed where the wall column fronts on the building line and the footing can not extend beyond this line. They are designed so that the center of gravity of the footing is directly under the resultant of all the superimposed loads, thus giving a uniform pressure on the soil beneath. Since the interior column load is usually greater than that from the wall column, the raft must be trapezoidal in plan. The area is made large enough to distribute the loads over the soil, and the sides are determined so as to bring the center of gravity under the resultant load. The depth and per cent of steel are then figured for this gravity cross-section. Distributing rods are used under the columns, and they are figured by considering that portion of the slab passing under the column as a beam supported at the middle and carrying a uniform load. Sometimes, rather than deepening these cross-beams, extra steel is placed in the top of the slab beneath the column, as well as at the bottom. It is to be noted that the slab steel is upside down from what it would be in a floor beam. (See Fig. 3.) Bent rods, as shown in the figure are used, or merely straight rods running across between columns near the top. Flat band stirrups are sometimes used for heavy loads, and they are figured as in girders. Trussed frames have also been used.

Detached footings may be designed as square or circular plates with uniform load and central support, or more commonly they are divided into strips of uniform width and passing through the center. Each of these strips is considered as a cantilever over the column and carrying its proportion of the load. In plan they are either rectangular or octagonal (See Figs. 1 and 2.) The rectangular footings are made as nearly square as possible. The sides of the vertical section may be vertical, stepped back, or battered. The minimum thickness at the outer end is limited by practical considerations only. The least was 6 ins. for a square footing, battered, and the maximum depth at the edge for a battered footing was 18 ins. The minimum for a stepped footing is usually greater than for a battered one. It varied from 12 to 19 ins. The footing was seldom stepped back more than once, and never more than twice. The rise and tread were nearly equal, or the tread was the larger.

In the octagonal footing the steel is placed in bands of the same width as the superimposed column and pass under the column in four directions perpendicular to the sides of the footing as in Fig. 2. In the rectangular footings the steel is usually arranged in lines parallel to the sides and forming a grillage. In most cases the rods are uniformly spaced across the entire width of footing, but sometimes they are arranged in bands equal to the column width with one or two rods running near the edges of the footing and parallel to them which act as distributers. No designs for rectangular footings where rods ran in more than two directions were noted. The clearance between the bottom of the steel and the base of the footing was usually 2 ins, and occasionally 3 ins.

Plain round, plain square, and square twisted rods were most used, with plain round the favorite. Deformed rods were seldom used except by the concern holding the patent. Although most analyses show that stirrups or bent up rods are required to care for diagonal tension, in practice they are seldom met with. Only one case where stirrups were used in a detached footing was noted. Here two rows of steel band stirrups parallel to the edges of the footing were used 10 ins. on centers. In one case the main rods, which were plain round, were given a short hook at the ends to increase the bond strength.

The usual way of allowing for the reduced bending moment at the edge of the footing is to cut the rods from 15 to 21 ins. shorter than the footing dimension and then stagger them so that they alternately come about 3 ins. and 12 to 18 ins. from the edge

The size of the rod used is usually such as will give a spacing of 5 to 6 ins. on centers. Owing to the short length embedded, small rods are more desirable than large ones to insure sufficient bond strength. They varied from ½-in. rods 3 ins. on centers to 1⅛-in. rods 12 ins. on centers, but the majority were between ⅝-in. and ⅞-in. with a spacing of about 5 ins. on centers.

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*A paper by W. H. Morris, Instructor in Civil Engineering, Cornell University, in the "Cornell Civil Engineer" for May, 1911.

Footings are usually made of concrete in

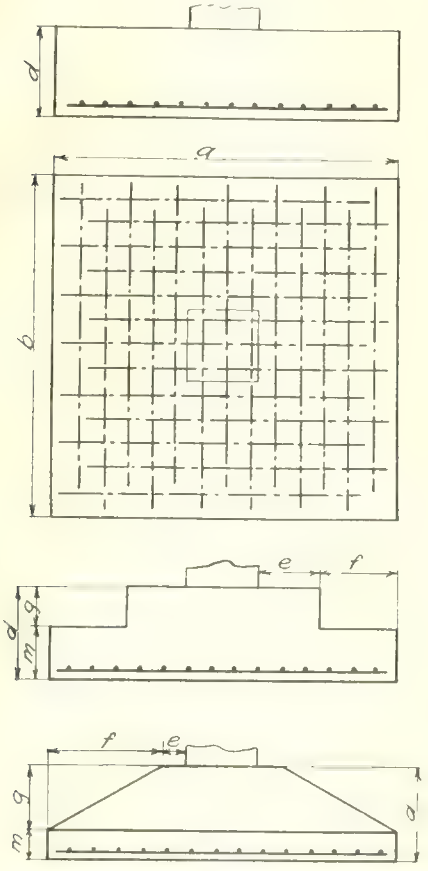


Fig. 1—Rectangular Isolated Footing.

proportions of from 1:2:4 to 1:3:6, the latter being rare. Either screened gravel or stone up to 1 in. is used.

When piles are used they are usually capped with a 6-in. mat of plain concrete, before the steel in the footing proper is laid.

Sometimes, in deep footings, an auxiliary grillage of rods is placed about 5-ins below the top, 6 ins. on centers and extending over the middle half of the footing.

Dowels about 1 in. in diameter and 18 ins. long are frequently set 6 ins. deep in the footing and made to firmly bond the column. From two to six are used in each footing.

COLUMNS.

In general, there are two types of columns which are used in reinforced concrete building construction, namely, those reinforced with longitudinal steel only, and those reinforced with longitudinal plus some form of hooping or spiral. A third class of columns consisting of structural steel members encased in concrete is used where excessive loads are to be carried and floor space is too valuable to permit of using the ordinary type of column.

Columns reinforced with longitudinal steel rods only will be known as "vertical type" in this article. If we first consider the interior columns, we find the cross-section of the vertical type is almost universally made square and there are usually special reasons when this shape is departed from. The range in size depends chiefly on the load to be carried, but columns are seldom made less than 12 ins. square even in the top story. In order to improve the appearance of the column and to prevent chipping off the edges, the corners of the square are usually beveled or chamfered about 1 in. or 1½ ins., measured on the side. This is accomplished by splitting a 1¼x1¼-in. stick say—along the diagonal—and nailing one piece in each corner of the column form. In fairly large sections where the concrete to be saved would be considerable, the section is often made octagonal. Where this was done in the designs noted, the diameters varied from 24 to 42 ins. Columns No. 6 and 7, Fig. 3a, were for mushroom floor systems and were probably made octagonal for convenience in design of the column cap.

The hooped columns are either square or octagonal in cross section, with the latter shape predominating. The choice of the two will be determined by the relative value of the concrete saved in the octagonal section to the increased cost of forms. The edges of the octagonal section are not usually beveled. Naturally this type of column is only used under heavy loads and where the cross-sectional area must be kept small. It is generally found in the lower stories of buildings. In size they average larger than the vertical type, since the minimum is larger. The smallest section was a square 14 ins. on a side; the largest, a circle 42 ins. in diameter.

The proportions of the concrete used varied from 1:½:2 stone to 1:2¼:4½ stone. Crushed stone or gravel were used and the maximum size was usually ¾ or 1 in. The average proportions given were about 1:1½:3 and where stated, they were usually somewhat richer than for [illegible] of the building.

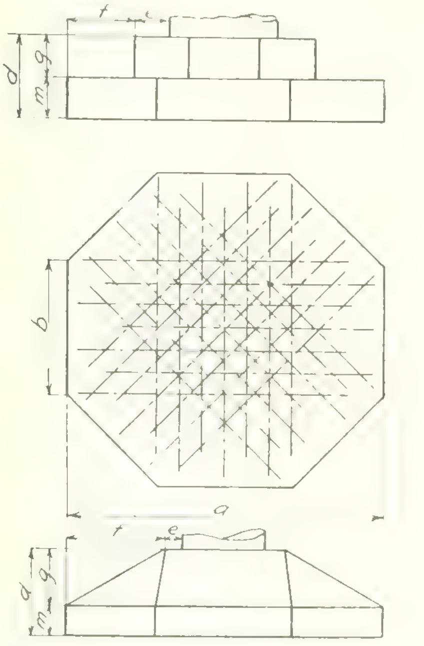


Fig. 2—Octagonal Isolated Footing.

Ordinarily [illegible] in clear height more than fifteen times the least diameter of the column. In the designs tabulated, this ratio is never reached, except in one slender column for a private residence. In the lower floors the clear height rarely exceeds ten times the least diameter. Hence it will not be necessary to apply long column formulas in common practice.

The fire proofing of the steel varied from 1 in. up to 3 ins. The average installation was about 1½ ins. of concrete outside of the steel. The Standard Building Regulations of the National Association of Cement Users give 2 ins. below the bottom of the steel as a minimum.

Wall columns are rectangular or T-shaped. Corner wall columns are usually L-shaped. They are all of a vertical type. For architectural reasons, the width of wall columns is usually maintained constant up to the roof, the reduction in area being accomplished through the other dimension. The surface width is made from [illegible]

Reinforcement. The percentage of vertical steel used is based on a net section of the column excluding the fireproofing. Where dimensions are missing, the percentages are rather indefinite. The amount of steel used varied widely with the different designers. The minimum was ¼ per cent for an octagonal column 42 ins. diameter. The maximum was 8.8 per cent, but in this case there was 3 ins. of fire proofing all around the steel, so that the percentage of gross area was only 5.3. The average for all the columns was 2 per cent. The average for 5 hooped columns was 1.6 per cent with a minimum of 0.4 per cent and a maximum of 3 per cent.

The number of vertical rods used seems to be fairly uniform. Four rods were used in 18 of the 35 designs tabulated, or about 50 per cent. Six rods were preferred in the wall columns. Eight rods were occasionally used in octagonal columns. One column with a large steel area had 26 rods closely spaced throughout the section, but such designs are uncommon. When four rods were used in square columns, they were placed in the corners with about 1½ ins. clear distance between them and the column surface. In wall columns when six rods were used, one was placed in each corner and the rest in the middle of the longer sides about 1½ ins. from the surface. Two designs had additional rods in the center of the column.

As to the kind of bar used for vertical reinforcement, there seemed to be a marked preference for plain rounds. They were used in 43 per cent of the designs. Plain square and square twisted bars ranked next. Corrugated round, Johnson round, Kahn cup, and Lug bars were also used. It is interesting to note that in some of the designs where patented reinforcement was used elsewhere, plain rounds were used in the columns.

The size of rods used varied from ½-in. round to 2⅜-in. round. The average size was between ⅞-in. and 1-in. round.

The rods were usually spliced at the floor level. Pipe splices were used in almost all the cases where the detail was shown on the blue print. The pipe was 10 or 12 ins. long and usually about ¼ in. larger diameter than the rods, and was grouted in place. The rods were supposed to butt evenly and it was often specified that the ends should be milled. Another method used was to lap the rods by one another 2 ft. and wire the intersection. This method is not ordinarily used on large rods, but rather on the smaller rods in the upper stories.

The method of transferring the loads carried by the rods to the concrete footing varies. Dowels were left in the footing which were later fitted with a pipe slice or wired to the column steel. In some cases cast iron base plates were used to distribute the stress. They were provided with cups into which the column rods slipped. Individual cast iron base plates for each rod were also used. Column rods were set a few inches in the footing in some cases and a bed of mortar placed immediately beneath them. Sometimes a flat steel plate was used upon which the milled rod ends butted.

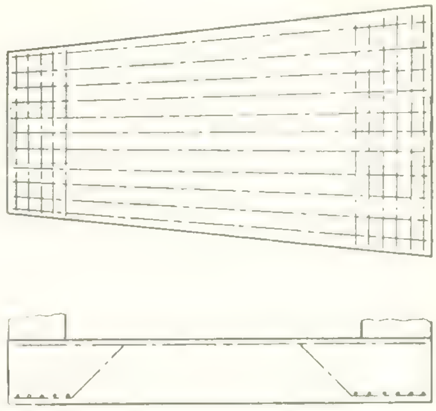


Fig. 3—Trapezoidal Combined Footing.

In the hooped columns the steel was always arranged around the circumference of a circle. The hooping was in the form of bands or a continuous spiral, the latter predominating. Round steel was universally used for hooping. The sizes used were 3/16, ¼, 5/16, 0.45 and ½ in. The last size was used to care for heavy eccentric loading and were placed in the form of bands 3¾ ins. on centers. Smaller [illegible] because of greater facility in winding the spiral. The pitch varied from 1½ to 4 ins., with an average of 2¼ ins. This pitch is usually maintained by the use of four longitudinal spacers placed between the vertical steel. They are made of flat iron with notches punched to receive the spiral. The vertical steel is then wired to the spiral.

In the vertical type of column, horizontal ties are used to prevent displacement of the steel rods during construction or buckling under possible excessive loading. The practice in this respect seems to be remarkably uniform. The bands were always of round steel, except a very few square ones, and were fairly uniform in size. Nineteen out of 35 designs provided for ¼-in. bands. A few varied to 5/16 and ⅜-in. Over half the designs called for a hoop spacing of 12 ins. on centers. In a few cases, larger spacings equal to the diameter of the columns were used. The minimum spacing was 4 ins. and the maximum 20 ins. There seems to be no end to the methods of bending and arranging these bands to bind the rods together. Judging from the results of tests made at the Royal Testing Laboratory, Berlin, Germany, these variations seem to have little effect on the strength of the column. It was found, however, that the combination of lateral and diagonal reinforcement in the same section weakened the column. Some of the more elaborate web systems are very difficult to pour. The ends of the hoops are either bent and hooped together, or lapped by one another, the usual allowance for lap being from 6 to 12 ins.

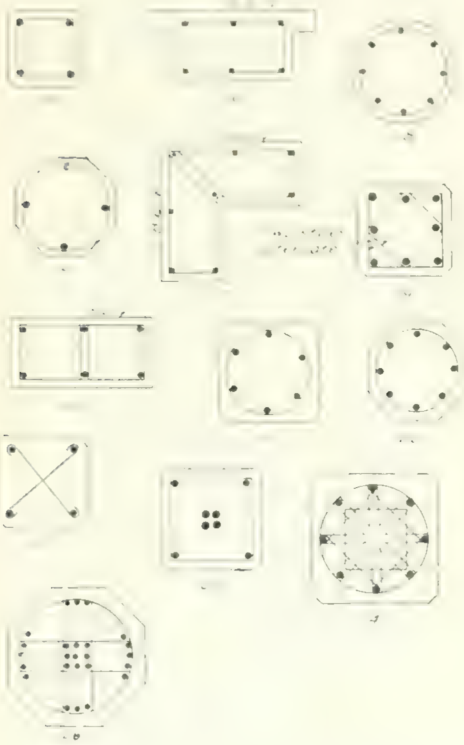


Fig. 3a—Typical Column Sections.

BEAMS AND GIRDERS

The difference in details of beams and girders is seldom of any importance, so they will be treated together. Beams support the floor slab only, whereas girders usually support one or two beams, or other concentrated loads.

The range of spans throughout which concrete girders may be used seems to be very wide. They varied from 7 ft. 6 ins. to 48 ft. in different designs but spans of from 16 ft. to 25 ft. were more common. The girder dimensions also varied widely, but with regard to depth, there is noted a tendency to follow the general rule of making the depth of beam in inches equal to the span in feet. The average of 17 separate designs gives a ratio of depth in inches (total) to span in feet c. to c. of supports [illegible] 7 [illegible] practically [illegible] fluctuates from 1.0 to 4.5 with an average of 2.3. Seven agreed closely with this average. This ratio would be affected by the method of design, whether T-beam or rectangular.

The insulation of the steel at the bottom of the beam, where mentioned, varied from ½ to 2 ins., with 1½ ins. to the outside of the steel the usual amount, which agrees with the recommendations of the National Association of Cement Users. The rods in the top of the girders usually had less insulation, about 1 to 1½ ins. At the intersection of beams and girders, the lower girder steel passes below the beam steel, and the upper girder steel passes above the beam steel.

The arrangement, type and details of the reinforcement presented so many special problems, and the data on the available drawings were seldom complete, so that a complete tabulation of details was impossible. For instance, few drawings gave the lap of steel over supports for continuity. This could probably be obtained from the steel lists or specifications however.

The kind of rods used presented no definite problem as in the case of column steel. There is a veritable plethora of patented systems on the market, all based more or less on some special advantage, real or imaginary. Many designs employing patented reinforcement were noted, but plain round and square twisted rods predominated.

The number of rods used varied from two to nine. Many designers evidently had a preference for a certain number of rods and they seldom departed from this. Three, four and six rods were used in these cases. The average of those tabulated was about five. Some designs provided for an even number of rods arranged in pairs as in Fig. 7. Others used an odd number of rods and alternated them as Figs. 6 and 8.

The size of rods used varied from ⅝ in. to 1¼ ins. with a preponderance of 1-in. rods. Moreover, the average of all was 1 in. About one-third of the designs called for more than one size rod in a beam, usually two or three. This would require extra careful supervision to insure placing the right rod in the right place.

The principle of bending up part of the rods to care for diagonal shear and negative bending moment over supports, when they are no longer needed in the bottom of the beam, is almost always followed. Some firms bend up one rod at a time, others always bend up in pairs, the latter being in the majority. In an ordinary beam with four or five rods, two are generally bent up. In a heavy beam four are bent up. The rods are bent up at an angle of 30 or 45 degrees, and sometimes vary between these limits. All the bent rods in a given beam usually are bent up at the same angle.

The negative moment over supports is generally taken care of by the bent up rods. As these rods lap by one another, they furnish sufficient steel immediately at the support, but in many of the designs shown, the upper steel did not extend to the quarter point. Some of the bent up rods had almost reached the column edge before they came to the top. The amount of lap beyond the center line varied from 1 ft. 3 ins. to 4 ft. or from 1/12 to ¼ the clear span. One firm used negative steel over supports and then bent these rods down at the column edge and at 1/9 the span to hook under the main tension steel which was all straight. In one case a slab bar was used as negative steel in the girder. About 40 per cent of the designs showed negative steel other than the bent up rods, and in most of these the rods extended over the whole span. Sometimes extra rods were used up to the quarter point.

The provision for continuity of steel over supports is usually very scant, and when allowance is made, it is generally accomplished by lapping the rods. The bent rods usually lap sufficiently to develop their full strength, as the lap affords additional negative steel. But the straight rods generally lap a shorter length. Various designs showed from 6 to 40 ins. A very small percentage provided 3 to 6-in. hooks and right angled bends on the ends of rods, but considerably more did so in special cases as where an end span beam rested on a brick wall.

The design of stirrups and their spacing still seems to be in the empirical stage. In some cases the bent rods are assumed to carry all the shear, stirrups being added merely as an extra factor of safety. In other cases the bent rods take half the shear and the stirrups are designed to take the rest. Again a rule used is to provide a stirrup for every foot span of beam, usually spacing them closer at the ends than near the center. Still others show a definite spacing and number for a given range of spans, regardless of loading. In one case noted, the stirrups were spaced wider at the supports than in the center. Some of the designs were in accord with the results of tests and sound theory. The minimum spacing next to supports varied from 3 ins. to 12 ins., but the average was about 6 ins. Several designs showed a uniform spacing of 12 ins. throughout, while one gave a uniform spacing of 6 ins. and did not use any bent up rods. The maximum spacing varied from 6 ins. to 36 ins. with an average of about 15 ins. In about 40 per cent the maximum spacing did not exceed half the depth of beam. The number per linear ft. span varied from 0.44 to 2.0 with an average of about 0.8.

The type of rod used for stirrups was generally square, twisted or plain round. Corrugated and Johnson bars and flat steel bands ⅛-in. thick were also used. The size varied from ¼ to ½ in., with an average of about ⅜ in. The shape of the stirrups is generally a U.

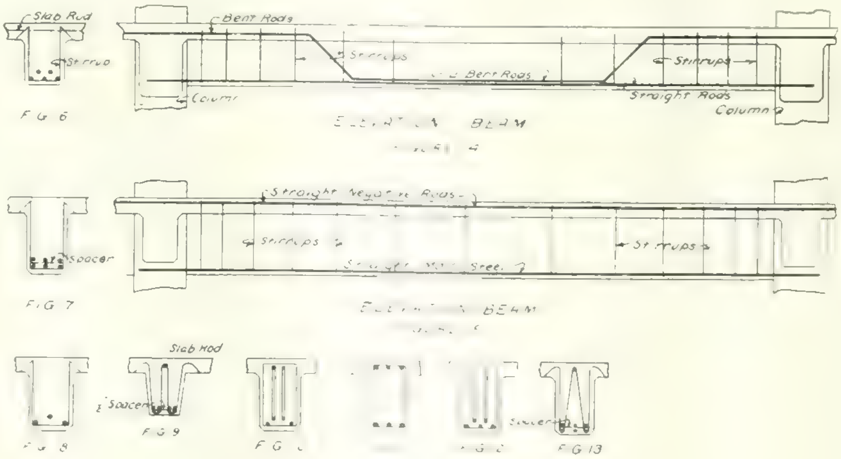


Fig. 4 to 13—Typical Beam Details.

SLABS

Slabs supported by beams and girders are comparatively simple in their design and details. In general there are two types, the one way and the two-way reinforced. The latter is seldom used where the length of a panel is more than 1.30 per cent of the breath. One design was noted where the ratio was as high as 1.8, but this was for a private residence where other features may have governed.

The short span steel [illegible] under the long span rods, and at least [illegible] the rods of each system are bent up over supports. The details are the same as for one-way reinforcement.

The spans varied from 2 ft. [illegible] to [illegible] supports for heavy loading to 12 ft. c. to c. supports for a medium live load. The majority of the spans varied [illegible] 6 ft., and the average of all was 6 ft. [illegible] The length of slab is determined by the girder spacing, which in turn depends on the column spacing, and the nature of the building influences this considerably. The length varied from 7 ft. 6 ins. to 31 ft. 3 ins., but both of these dimensions were exceptional, the common range being from 12 ft. to 22 ft. The average of all was 19 ft.

The depth of slab varied from 3 ins. to 7½ ins., although a 2-in. roof slab was noted. The average depth was 4½ ins. The depth of concrete below the bottom of the steel was from ½ to 1 in., with perhaps ½ in. the customary allowance, which is hardly sufficient fire proofing. The depth of slabs was generally varied by ½-in. increments.

Square twisted rods were the favorite, with plain rounds in second place. Various other rods and mesh reinforcements were used, the latter usually in light construction. The size of main rod varied from 5/16 to ½ in., with an average of about ⅜ in. These rods were spaced from 4½ to 12 ins. on centers, averaging about 7 ins.

Slabs are usually designed as continuous, hence it is necessary to provide some steel in the top over supports. This is always done by bending up the regular slab steel. Alternate bars are usually bent up at the quarter points and pass over the support about ½ in. to ¾ in. below the top of slab. The bars lap over supports also, and if the lap comes in the upper plane, an equal amount of steel over supports as at the center is provided.

The amount of lap of rods varied considerably, from 1 ft. 3 ins. to 4 ft. 5 ins. This is more significant when expressed as the number of times the diameter of the rods, or 48 to 106. The lower ratios provided for bond only, whereas the higher ones were attained by extending the steel to the quarter point to care for negative moment.

Steel is also needed to take care of shrinkage and temperature stresses. This is always placed at right angles to the main steel, and on drawings is designated as temperature, carrier, or distributing steel. It usually consists of three or more rods running the length of the panel, either in the top or bottom of the slab, but usually the latter. Some designs were noted where they ran at right angles to the main steel and about ½ in. below the upper surface. Where they were used for spacers and carriers for main steel, they were placed on the bottom below the main rods. They were held clear of the forms in various ways, by cement blocks, cut washers, or patented devices. A sufficient number of rod intersections were wired to hold the steel in position during concreting; 20 per cent was specified in some instances. Usually the depth to the main steel must be kept a maximum, and this resulted in placing the temperature steel immediately above and suspending the main rods from them. This auxiliary steel also generally lapped over supports, but was not bent up. The amount of lap was seldom stated, but was often less than for the main steel. In two cases noted, no lap was provided, and in one of them the rods only extended the clear span.

In all but one case the type of rod was the same as for the main steel, but the size was changed as a rule, sometimes smaller, sometimes larger. They varied from ¼ in. to ½ in., but ⅜ in. was a decided preference and about the average. The bars were generally specified as so many per panel, rather than so many inches on center. Two and three were commonly used. The average spacing figured out close to 2 ft. on centers. With an average slab depth of 4½ ins. and ⅜-in. rods this amounted to about 0.75 per cent temperature steel in terms of area of concrete section.

WALLS.

Concrete buildings are usually of skeleton construction, with curtain rather than bearing walls. Hence the walls generally follow behind the rest of the construction, grooves being left in the wall columns and beams to bond the wall slabs.

Brick walls or a brick veneer over concrete wall columns and beams were used in many of the designs. The difficulty of geting satisfactory surfaces, the necessity of harmonizing with adjacent construction and the cost may have influenced in favor of the brick.

The wall column details have been noted under columns. In addition, the exterior surface of the wall column is usually marked off into blocks by horizontal grooves from 1 ft. 6 ins. to 2 ft. c. to c.

Beams are the same as for the interior, except that the headroom is greater and hence the depth. Stirrups are seldom necessary, but are used about as in other cases. There is seldom need for more than 3 rods in wall beam. In some cases the windows came up to the ceiling, which made the beam carry the floor slab on the base rather than top. In these cases an extra rod was used at the middle and top of the beam.

Where a brick veneer was used, a 12-in. brick wall usually rested on the beams and a 4-in. veneer covered the beam and was anchored to it by copper bands. Where a brick bearing wall was used, the slabs usually bedded 4 ins. or 5 ins. in it, and the beams 8 ins. or 9 ins. Dowels or anchors about 3 ft. long were provided at proper places in the brick wall by the masons. The beam rods were generally bent or hooked at the wall end.

Aside from the columns and beams, the available space was usually taken up by windows. When it was not, the concrete wall was generally 6 ins. or 8 ins. thick with horizontal and vertical reinforcement. Some designs only showed horizontal steel as ½-in. bars 8 ins. c. to c. in both sides of the wall. The steel was placed near the inside, near the outside, both, or in the middle, with no special preference. The average was about ⅜-in. rods horizontally from 15 ins. to 24 ins. c. to c., and ⅜-in. rods placed vertical at slightly greater spacing.

Especial care was taken in all cases to reinforce around all openings. Diagonal rods ¼ to ½ in. and from 3 ft. to 4 ft. long were placed near the corners of all windows and doors. Two or three extra rods were also placed horizontally immediately over all openings. In many cases, at corners of buildings rods about 10 ft. long were bent around from one side to the other, and one design called for two ½-in. rods running continuously around the building at each floor level held together by bands 6 ins. c. to c.

In general, owing to their prominence, it is better to over reinforce exterior walls than to run the risks of unsightly cracks.

EARTH AND ROCK SECTION

New Steam Trip for Shovel Dippers.

A steam trip, which increases the output of a steam shovel at least 100 cu. yds. per working day, has been invented and tested at Panama. The new device was invented by A. H. Geddes, a shovel engineer, and has been recommended for use on 40 dippers of the 95-ton class.

The present trip, or latch, by which the bottom of a steam shovel dipper is opened, to permit material to fall through, is operated by a rope in the hand of the steam shovel craneman, and under conditions frequently met, the force required is extreme. The device invented by Mr. Geddes consists of a steam cylinder, the piston of which opens the latch on the door of the dipper through levers. Steam is admitted and exhausted from the cylinder through a three-way valve located on the boom beside the craneman's seat. A steam pipe extends from the valve along the boom opposite the dipper stick slot, and at the end of the pipe and on the cylinder are universal joints connected with a flexible hose.

A test of the new trip was made on a shovel in the Culebra Cut. The test was begun on January 18 and ended on March 31, and in this period the shovel excavated an average of 1,118 cu. yds. a day. In the 60 working days from Oct. 30, 1910, to Jan. 12, 1911, this same steam shovel, working under practically the same conditions, using the old style trip, excavated an average of 939 yds. a day. Six other shovels, working under practically the same conditions, using the old style trip, during the period of the test excavated an average of 1,222 cu. yds. a day.

A committee of engineers, in reporting upon the merits of the device, says:

> [illegible] per day.
>
> [illegible] to the device, and the committee is of the opinion [illegible] above.

The committee is of the opinion that the general principles and features of the device will result in an increase in output and will prove economical, and recommends its adoption and installation on all dipper sticks of 95-ton shovels on which four and five-yard dippers are used. It recommends also that the cylinder and piston which were used in the experimental device, and were taken from available material, be redesigned. Meanwhile, a thrust cylinder, now in stock, will be tested, and, if it proves satisfactory, will probably be used. If it does not prove satisfactory a cylinder and piston will be designed especially for the purpose.

Examination for Filling Position of Junior Engineer.—[illegible] made of a civil service examination, to be held June 14, 1911, for filling 15 vacancies, and other vacancies as they may occur, in the position of junior engineer in the Water Resource Branch of the U. S. Geological Survey. Entrance salaries range from $900 to $1,200 per year, and expenses when on field duty. In addition to training, experience and fitness, the examination will cover the subjects of mathematics (algebra and geometry), plane surveying, irrigation engineering, river hydraulics and water-power engineering. Age limit is 20 years or over on date of examination. Persons appointed under this examination will be eligible to promotion to the position of assistant engineer, with salaries ranging from $1,380 to $2,000 per annum, and to the position of engineer, with salaries ranging from $2,400 to $3,000 per annum.

Progress of the Panama Canal.

The Panama canal construction was started seven years ago on May 1. The amount of excavation completed is about [illegible] cu. yds., or more than three-fourths of the entire amount estimated for the completed canal, leaving only about [illegible] cu. yds. to be removed. For the past three years more than 30,000,000 cu. yds. have been taken out each year, so that at the end of [illegible] the excavation should be completed.

A new development of an old trouble and a factor in the completion of the canal is the increase in the number of slides in the Culebra cut where the banks have broken in 22 places between the Pedro Miguel locks and the Chagres River at Gamboa, a distance of 9 miles. An addition of 6,104,000 cu. yds. was made to the estimate of the total amount to be excavated, as an allowance for the slides, and the amount in motion, or that has given an indication of probable movement, does not exceed this. This amount may be increased, but this causes no apprehension as after the locks are completed it will be possible to concentrate dredges for the removal of the material that remains and which may slide in, enabling the work to proceed much more expeditiously and much more economically.

Previous to the widening of the Culebra section to 300 ft. on the bottom, the movement of slides into the cut was due almost entirely to slides caused by the movement of the top layer of clay upon the smooth sloping surface of rock, or other material harder than the clay itself. The overlying top layer of clay, in such cases, varied in thickness from about 10 to 40 ft., the average being 15 to 20 ft. The widening of the canal in the Culebra section, however, necessitated the cutting of fresh slopes through this top covering of clay for a distance, including both sides of the canal, of about 6 miles. Consequently in a number of locations, slopes which had become permanent and were covered with a dense growth of vegetation were again disturbed and subjected to the action of tropical downpours. It was expected, therefore, that more trouble than usual from this cause would be experienced within the next year or so.

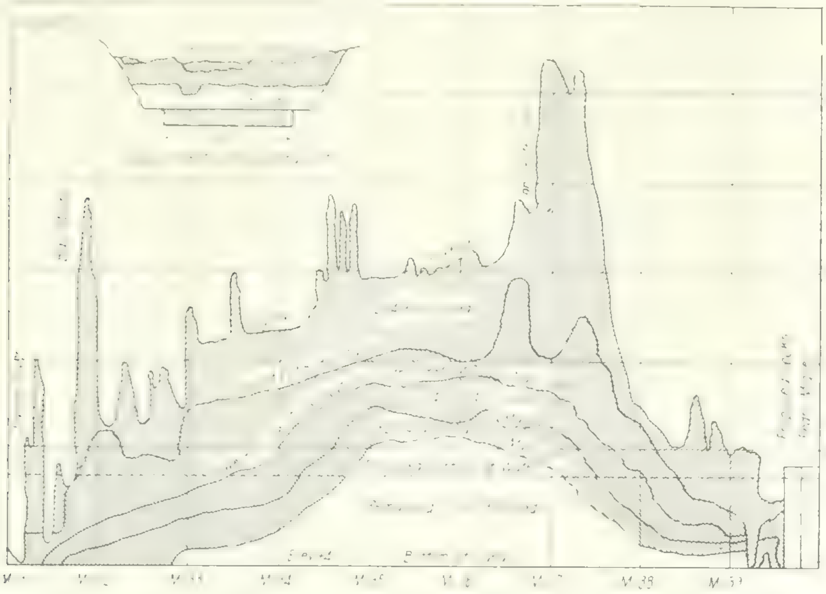
Of the total of 44,787,246 cu. yds. remaining to be excavated 21,371,975 cu. yds. are in the Culebra Cut. The rate of progress in this section of the work, as compared with other years ending May 1, is shown in the following table, and graphically, by the profile, Fig. 1.

May 1 to May 1.	Cu. yds.
1904-1905	648,91[illegible]
1905-1906	1,250,570
1906-1907	4,862,897
1907-1908	11,285,217
1908-1909	13,955,753
1909-1910	14,886,427
1910-1911	15,325,976
Total	6[illegible],811,749
Amount remaining	21,371,975

Lock Construction.—The placing of concrete in all the locks is 52 per cent completed, 2,153,386, out of a total of 4,284,000 cu. yds., having been placed up to May 1, and of this amount 1,694,086 cu. yds. were placed in the past year. At Gatun, 951,661 cu. yds. were placed during the year, and there remain to be placed 783,210 cu. yds. before the concrete work is completed. The installing of the lock gates has been begun, and the installation of the motors for gate operation and towing of ships, of the emergency dams and operating machines, will be carried on in the upper locks while concrete laying advances in the lower flights.

A total of 737,425 cu. yds. of concrete was placed in the Pacific locks during the year, and there remain to be placed 1,349,576 yds. The locks at Pedro Miguel are nearing completion, and those at Miraflores are fairly begun, and will advance with greater rapidity as soon as the cantilever mixing and handling plant is fully installed.

The estimated dry fill for the toes of Gatun Dam is 8,346,778 cu. yds., and there has been placed up to May 1 a total of 7,017,980 yds. It is probable that the amount of material actually dumped in the toes of the dam will greatly exceed the estimated total.. The total hydraulic fill is estimated at 11,653,222 cu. yds., and of this amount 7,058,559 cu. yds. were in place on May 1. The total estimated fill is 20,000,000 cu. yds., and 70 per cent of this amount was actually in place on May 1.



Profile of Culebra Cut, Panama Canal, Showing Progress of Excavation.

In the spillway the concrete work is 60 per cent completed, and has reached a stage where it may be continued during the rainy season. There remains to be constructed the concrete dam across the channel, and to be erected thereon the regulating gates.

Among other developments of the year was the change in the relocation of the Panama Railroad. The location on the 95-ft. level through Culebra Cut was changed to one parallel with the Canal, but far enough east of it not to be interfered with by slides.

The breakwater at the Pacific entrance to the Canal, extending from Balboa to Naos Island, was advanced to a point 13,000 ft. from shore, and now lacks about 4,000 ft. of completion. The breakwater at the Atlantic entrance, which will extend from Toro Point about 10,500 ft. into Limon Bay, was begun in August, 1910, and on May 1, the fill had been advanced to 4,214 ft. from shore.

Plans were approved for terminal docks and basins at both entrances. The basin at the Pacific entrance will be at Balboa, where work has been begun on the first of a series of reinforced concrete docks. The docks at the Atlantic entrance at Cristobal will consist of a series of reinforced concrete docks, or slips, reached from shore by a mole which will extend about 3,300 ft. into the bay and serve as a breakwater to protect the harbor on the south.

Cost of Fuels for Forges.

Tests with various fuels for forges were made at the mines and smelters of the Mammoth Copper Co., to determine which fuel was the cheapest to use. The results as taken from the *Engineering and Mining Journal* are given below. Coal, coke and oil were tried. Oil proved to be the cheapest at the smelter, and also at the mine where it was used for heating steel for the drill sharpeners and coal was found to be cheapest in the ordinary blacksmith work.

The oil heats steel and iron quickly, but an undesirable feature is the roaring noise caused by the compressed air used to atomize the oil. For general blacksmithing, such as bending, the oil gives too large a flame, but when a large area is to be heated it is superior to other fuel. Most smeltery work requires a flame heating a large area, while the reverse is true for most mine blacksmith work. Moreover, at the smeltery, as there is considerable work to be done, there are usually several forges in use and the number of forges that are kept running is adjusted to the amount of work, so that a forge is kept in operation as continuously as possible. This makes the wear and tear on the oil-fired forge considerable. At the mine there is generally not enough work to keep one forge going all the time. The consequent alternate cooling and heating plays havoc with the firebricks in the bed of the forge. This is the main expense in the maintenance of an oil-fired forge.

TABLE I.—FUEL COST FOR MINE FORGE.

	Coal.	Oil.
Number of shifts	75	28
Forges running per shift	1	2
Amount of fuel used	9.239 tons	992 gal.
Fuel used per shift	246.3 lb.	35.4 gal.
Fuel per shift per forge	61.6 lb.	17.7 gal.
Cost of fuel	$179.236	$28.768
Freight to mine	30.119	15.475
Charges for loading oil	.....	4.444
Total cost of fuel at mine	$209.355	$48.687
Cost of fuel per shift	$2.791	$1.738
Cost of fuel per shift per forge	0.691	0.867
Extra charges for oil:		
Cost of bricks	...	$5.40
Cost of labor	...	5.01
Total repairs		$10.41
Cost of repairs per shift		$0.371
Cost of repairs per forge per shift	...	0.185
Total cost per shift per forge	$0.671	$1.052

At the smeltery blacksmith shop the use of oil has resulted in a saving of a third of the labor required to do the blacksmithing as compared with coal-fired forges, while the oil is also much cheaper. The accompanying tables give the results of tests of the two fuels best adapted to the work in hand, which were made at the Mammoth mines:

TABLE II.—FUEL COSTS OF HEATING DRILLS FOR SHARPENER.

	Coke.	Oil.
Number of nine-hour shifts	235	58
Amount of fuel	*44,795	†550
Amount of fuel used per shift	*190	†9.5
Drills sharpened per shift	429	312
Cost of fuel	$273.72	$15.95
Cost loading fuel	$11.20	$0.833
Haulage to mine	$10.08	$1.13
Total cost of fuel at mine	$295.00	$17.91
Total cost of fuel per shift	$1.2555	$0.3088
Total cost of fuel per shift per drill	$0.0029	$0.00098
Amount of fuel used per drill sharpened	*0.444	†0.0304
Amount saved per day of two nine-hour shifts, sharpening steel with Word sharpener by using oil instead of coke		$1.88

*Lbs. †Gals.

The test to determine the fuel cost for heating steel for the drill sharpener indicates that coke is better than coal; oil better than coke. The cost per drill heated with oil was 0.098 ct. and with coke 0.29 ct., a saving of 0.192 ct. For the mine forge, oil proved more expensive than good blacksmith coal, and the maintenance of the forges was much greater when oil was used.

The cost of the coal per forge per shift, with coal at $22.69 per ton, delivered at the mine, was 69.1 cts., and for oil at 4.9 cts. per gal at the mine, it is 86.7 cts. for fuel alone, while the repairs averaged 18.5 cts per forge per shift, making the total cost of oil firing $1.05 per forge per shift. The saving per forge per shift with coal was 36 cts.

There can be no question that in such work as sharpening steel, where an even temperature is essential to good work and the work is fairly continuous over periods of a few hours, oil is not only the cheapest but also the best fuel to use in bringing the steel to forging temperature.

Methods and Cost of Excavating a Canal With Four-Wheeled Scrapers.

At Los Animas, Colorado, an irrigation canal, 50 ft. wide and deep enough to carry about 5 ft. of water, is being excavated with Maney four-wheeled scrapers. The canal follows the contour of a rather broad and level basin and the material is a hard adobe clay. The scrapers were first loaded with a snatch team and later with a traction engine and cable. The latter method made a reduction in the operating costs of about 1 ct. per cu. yd. The cost of the team outfit was as follows:

Maney Four-Wheeled Scrapers Digging Irrigation Ditch.

4 Maney [illegible]	[illegible]
16 animals, including [illegible]	[illegible]
Total	[illegible]
Cost of operation [illegible]	
8 animals, feeding per day	[illegible]
4 men on [illegible]	[illegible]
1 pit man	[illegible]
1 dump man	[illegible]
1 [illegible] man	[illegible]
Total	[illegible]

With this outfit and an average haul of 250 ft. 600 loads of 1 cu. yd. each were made per day of 10 hours, costing about 6 cts. per cu. yd.

The use of the traction engine brought the cost of the outfit up to $5,040, but the output was increased considerably. The traction engine remained stationary in loading the scrapers. A horse was used to drag the cable from the engine to the farthest point for loading the scrapers and the cable was then wound in on the drum of the engine as each scraper load was taken. The cost of operation with the engine in place of the snatch team was as follows:

1 traction engine [illegible]	[illegible]
8 animals (feed [illegible])	[illegible]
1 pit man	[illegible]
1 dump man	2.50
1 snatch man	[illegible]
1 cable man	[illegible]
1 engineer	[illegible]
1 clutch man	[illegible]
Coal	[illegible]
Haul of water	2.00
Total daily expense	[illegible]

With this method about 1,000 loads per 10-hour day were averaged on a 250 ft. haul, or at a cost of about 5 cts per cu. yd.

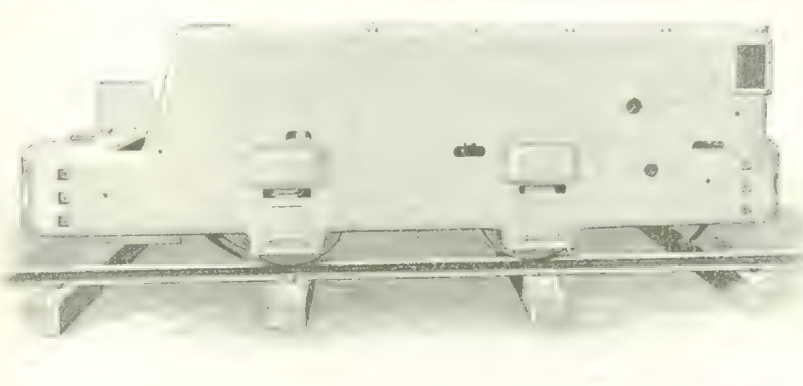
The scraper itself differs from the ordinary scraper not only in the number of wheels but in that the scoop is tilted backward when unloading. The mechanism can be entirely in control of the driver, who operates the levers from his seat in the rear of the machine. By means of these levers he controls the sprocket chains that mesh into the sprocket wheels on the rear axle. The movement of the team therefore dumps the load. The capacity of the scraper is 31 cu. ft.

The manufacturers of the Maney four-wheeled scrapers are the Barron & Cole Co., 200 W. Broadway, New York city. The work described is being done by W. A. Colt & Sons, Los Animas, Col.

Cost of Hauling with Gasoline Mine Motors.

The installation of three gasoline mine motors to replace mule haulage in the entries of the mines at Walden's Ridge, Tenn., as described by [illegible] Sylvester in [illegible], has displaced [illegible] mules and reduced the cost of hauling by 49.1 per cent. All the extra work in the mine entry necessary for the installation of these motors was some slight trimming to give ample clearance and going over the track to replace with 20-lb. rail the places on the entry where a lighter rail had been used.

There was no difficulty found by reason of the many curves, as the motors have a 4-ft. wheel base and can take a curve of 25-ft. radius. The [illegible] and


Gasoline Motor for Hauling Cre Cars, Walden's Ridge Mine, Tennessee.

were built for the mine gage of 33 ins. They are designed with 4-cylinder engines, of ample power to slip the wheels, and all parts are well protected, as is necessary for mine use.

The trouble feared was that the gases from the exhaust would be objectionable. This has not proved to be the case, however. The motors work on the return air, of which there is from 15,000 to 18,000 ft. per minute on each entry, and a short distance from the motor the fumes from the exhaust are hardly noticeable.

The mine cars used are about 1,400 lbs. in weight and carry 1 1.5 tons of coal. As the grade is in favor of the loads, the empty cars up the entry make the load for the motor. The regular 20-car trips are handled without difficulty, and on trial trips 40 cars have been taken up the entry.

The comparative estimate of mule and motor haulage on one entry is as follows:

COST OF COAL HAUL ON NO. [illegible] ENTRY, 1½ MILES OR [illegible] MILES FOR ROUND TRIP

10 twenty car trips equals	224 tons
By mules:	
[illegible] drivers at [illegible]	[illegible]
[illegible] mules at [illegible]	[illegible]
Total	$11.10
By motor:	
motorman, per day	[illegible]
1 coupler, per day	[illegible]
13 gals. gasoline at 11½ cts	1.50
[illegible] lbs. cylinder oil [illegible]	[illegible]
[illegible] gasoline [illegible]	12
1 [illegible]	[illegible]
Total	[illegible]
Saving by motor	[illegible]
or 49.1 per cent	

These motors use 12 to 13 gals. of gasoline each per shift. The gasoline tanks, of which there are two on each motor, are so placed in the frame as to be well protected in case of derailment or accident. The tank can only be filled when detached from the motor, and in changing these tanks it is necessary to have the valve closed. There are two extra tanks with each motor and these are filled on the outside. When brought into the mine they are perfectly sealed until after being exchanged with empty tanks on the motor. There is therefore no handling of exposed gasoline in the mine. The motors are made by the Geo. D. Whitcomb Co. of Rochelle, Ill.

Making Adobe Brick.—Adobe brick are made in southern climates by drying the molded clay in the sun. Three men can make 1,000 bricks in 3 days. One man picks the clay from the bank and puddles it, another transports it to the molds in a wheelbarrow and gathers dry grass, cutting it into 6 in. lengths to be mixed with the puddle. The third man fills the molds. After the molds have set for a day the bricks are dried enough to be removed and piled for further drying, which requires 2 or 3 weeks before they are ready for use. The bricks are about 11x5x22 ins.

Preparations are being made to mix and place concrete in the arch of the La Salle Street Tunnel by means of a compressed air, combination mixer and conveyor. The mixer is located on shore and its batches are to be simultaneously mixed and conveyed through a 6 in. pipe to place. The work and the machine will be described later.

The construction of the Chicago subway will be undertaken by the city and not by the city in conjunction with the street railway companies. A fund of $6,000,000 is now available for commencing the work.

ROADS AND STREETS SECTION

Mountain Road Construction in California.

At the November election [illegible] the citizens of California voted to bond the state for [illegible] ways. Heretofore the only roads constructed by the state have been in the mountainous districts. With the exception of the Trinity-Humboldt state road, all of the state highways are in the Sierra Nevadas and have either been acquired from the counties through which they pass or have been constructed by the state. Those roads that have been acquired from the counties are of very irregular grade, and usually, at the time the state assumed control, were in an extremely bad state of repair. Up to the present time the state policy has been to construct or maintain roads in counties that were scarcely able to properly maintain long stretches of isolated road. Inasmuch as the construction and maintenance of these mountain roads offers problems not met in ordinary road work, the following notes from the last report of N. Ellery, state engineer, may be of interest:

The Lake Fahoe wagon road was the first road to be acquired by the state. It traverses El Dorado County from near Smith's Flat to the state line at Lake Tahoe. As time goes by, the traffic on this road becomes greater and each year the number of automobiles traveling through the mountains over this highway is greatly increased. The first 14 miles of this highway is in the summer time extremely dusty. An appropriation of $20,000 was made by the state legislature for the purpose of establishing a sprinkling system and sprinkling the road for the first 10 or 12 miles. The first money from this appropriation became available on April 1, 1909, and during that year 10 stand pipes and 8 tanks were erected. Water for the stand pipes was secured from a ditch company. Two Austin steel sprinkling wagons were also purchased. The year's operation and plant cost $11,132. During 1910 the facilities for sprinkling were increased by erecting another tank, two tanks with gas engine and pump, and six stand pipes. These stand pipes were supplied for a large storage tank connected by 6,300 ft. of pipe. The actual sprinkling began May 22 and ended Oct. 9, the cost for labor and water being $3,350. The total cost of sprinkling and plant for the season was $7,950.

The maintenance fund on this road has been $5,000 per year. This has been applied to keep the road in shape for the summer travel, as during the winter over the summit of the Sierra Nevada the road is completely blocked by snow. During 1910 the work of maintenance and repair was begun on March 15 at the western end of the road. For a stretch of several miles a grading machine was used, the road crowned, and in many places the grader was used to fill up the ruts and bring the material on the road bed. The Tahoe road is essentially a mountain road, traversing the Sierra Nevadas, and, like other roads in these mountains, is constructed for many miles in a granite region. Its grades, when originally laid out, were in many places steep, and in other places comparatively flat. In early days, this was the usual plan of carrying out a road line. It was then that they thought but little of the maintenance of the road. This lack of uniformity of grade creates an extra maintenance expense that can never be averted unless the road is changed, or these grades eliminated.

The Sonora and Mono Road has been owned by the state for nine years.

The section on the eastern end, from Bridgeport to Junction, for 17 miles, is easy of maintenance, but from Junction to Leavitt Meadows and over the Sonora pass to Baker's Station, there is a section of road, for the most part in solid granite, with very steep grades. From Baker's Station to Long barn, at the western terminus of the road, about one-half of this distance is in good soil; the remainder traverses a section through granite rock and boulders. When the state took possession of the road the granite sections were in very bad condition, being nothing but a gully in many places.

The particular location of the Sonora and Mono road seems to be in a belt especially liable to the occurrence of great waterspouts. Since this road has been under the jurisdiction of the state several times it has been torn to pieces, for from 1,000 ft. to a mile in length. During the last summer about a half mile of the roadway near Leavitt Meadows was almost completely torn out and it therefore necessitated a heavy expense to replace this section of road. In 1909 the state completed the bridge number one, on what is known as the lane going from Bridgeport toward Carson Valley. This structure was to be placed in 1908, but the cold weather of that fall prevented it being completed. It was erected, however, under the following conditions: Work began Sept. 6, 1909, and the bridge was finished Sept. 25, 1909; size, 18 ft. clear span, 16 ft. roadway, and clear height 4 ft.; built of reinforced concrete on concrete abutments. The cost was as follows:

COST.

Preliminary work and excavation labor..	$ 145.50
28 cu. yds. concrete labor...............	267.50
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

On the eastern end of the Sonora and Mono road the state now has five reinforced concrete bridges, and a combination bridge over the West Walker near Junction. In addition, about 200 rock and vitrified pipe culverts have been built. Special effort has been put forth on this road in an endeavor to drain by ditches, and thus save the roadway. The state engineer recommends that if the state is to bring the Sonora and Mono road up to a proper plan of maintenance, it should not only allow an appropriation for $6,000 per annum, for ordinary maintenance, but should also appropriate about $10,000, for the removal of solid rock and the change of grades.

During 1906 a survey of the first 20 miles of the King River Canyon road was completed to a point near Horseshoe Bend, on the south fork of the Kings River. In 1907 the survey was completed to the flat near the Cedar Grove Hotel, in the floor of the Kings River Canyon. This survey was 32.8 miles in length, from the General Grant National Park, and was made through a most difficult country. In places it became necessary to spend money for trails, in order to get supplies and provisions to the men on the survey. Solid cliffs of granite, and the extremely rough territory in which the men worked, made the survey expensive. To complete the work of surveying alone, on this route, cost $6,032.94. During 1907 construction work was started at the General Grant National Park, and continued during that year to within a half mile of the summit of the ridge, between Ten-mile Creek and Millwood. The following year work was continued until about 5¼ miles of roadway had been built. Burleigh drills, and a steam shovel were furnished the state road superintendents to continue the work of construction. After leaving the ridge or summit, whence the road gradually descended into Ten-mile, it was found that beneath the surface of the ground either solid rock or granite boulders was encountered. This made construction difficult and expensive. Up to Nov. 30, 1910, about 9¼ miles of this road had been completed. Table I shows the cost and amount of work done on this road.

TABLE I.—COST FIGURES ON KING'S RIVER CANYON ROAD.

	-1909-			-1910-		
	Cost.	done.	cost.	Cost.	done.	cost.
Steam shovel ...	$9,627	25,509	$0.378	$5,435	10,356	$0.524
Pick and shovel ...	1,933	3,368	.568	995	1,519	.655
Solid rock.	3,699	1,917	1.91	3,789	1,957	1.93
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Acres.

In the work on the Kings River Canyon road, and in fact in all highway work in the Sierra Nevadas, provisions and supplies are expensive and difficult to obtain. It is also extremely difficult to hold labor after about the first of November, on account of the snow.

Work on the Trinity-Tehama-Shasta-Humboldt road was begun in 1909, near Salt Creek, and continued until Nov. 6, that year, when the rains and snows made it impossible to hold labor. During this year work was carried on for 5½ months, an average of 40 men being employed in the construction of this road. The work was mostly through a timbered country and the grading was principally in earth. During 1910 the work of construction was started on May 2, and continued until Oct. 6, when about 13½ miles of road had been completed. Steam drills and a plain boiler on wheels were furnished to aid in the construction along what is known as Rattlesnake Creek. The work along this particular creek is the most difficult on the whole route, and was the one expensive feature at the time of the selection of this route. Table II contains cost figures of the work done during 1909 and 1910 on this road.

TABLE II.—COST FIGURES ON TRINITY-HUMBOLDT ROAD

	1909			1910		
[illegible]	Cost	Amount done	Cost unit	Cost	Amount done	Costs unit.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ 0.31
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.677
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.20
[illegible]	[illegible]			[illegible]		[illegible]
[illegible]	[illegible]			[illegible]		[illegible]
[illegible]	1,314.00	22.56*	62.80	1,575.38	15.7*	100.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$4,427.41
[illegible]						

Standardized Street Widths.*

If we are to remedy the municipal ills from which we now suffer some large physical changes in American cities are absolutely necessary and inevitable. Nevertheless, permanent progress in city planning will not result usually from spectacular schemes for the sudden transformation of our cities, nor from revolutionary programs and proposals. Advances will come more often from a patient but open-minded and scientific study of such problems as are represented by the title of this paper, followed by a close co-ordination of one subject with another in a comprehensive plan, thus recognizing the unity of the city and the inter-relation of all its parts.

It would not be difficult to convince anyone not already convinced—if such there be—of the importance of fixing street widths more intelligently and discriminatingly. At the present time an average of 20 to 40 per cent of the total area of cities is devoted to streets, rising in the case of Washington, D. C., to 54 per cent. Therefore, even a slight variation in the width of the streets of a city becomes a matter of importance. Consider, for example, what an excess of 2 ft. in the width of the 1,400 miles of paved streets of Philadelphia would involve in the cost of land and paving! On the [illegible] hand and here the lack of intelligent and discriminating action has even graver aspects—consider what the *lack* of a few feet in the width really necessary for streets in Philadelphia already involves! It involves directly the expenditure of enormous sums of money for street widening or, indirectly, of much greater sums, practically incalculable in amount, as the penalty for conditions which still appear to our too timid minds virtually unchangeable.

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*Paper by John Nolen, Cambridge, Mass., prepared for the Third National Conference on City Planning, Philadelphia, Session of May 17, 1911.

The evils of the present system of fixing street widths are acute. They demand prompt but careful examination and correction. What, then, are the causes of the existing difficulties in this matter of street widths and what are the remedies? Some students of this subject are of the opinion that the evils are due, in part at least, to a standardization of street widths; to the fact that city councils or other municipal authorities have heretofore fixed upon a certain number of feet, usually 40, 50 or 60 ft., as the width for all streets. Undoubtedly such action has proved a handicap to many a city. But is the standardization itself the evil? Is it not the arbitrary and unintelligent character of that standard; and is not the remedy another standard, or other standards, rather than the abandonment of the principle of standardization? Is there not danger of reacting too far, or of reacting in the wrong direction? The remedy for a stupid standardization of street widths, is not likely to be found in the abandonment of all standards, but in the adoption of more intelligent standards.

It would seem that street widths could be satisfactorily standardized because the facts upon which such widths rest are capable of definite classification and, furthermore, because it is practicable to collect scientific data concerning these facts and from this data to reason to sound conclusions with a considerable degree of confidence. While these facts are numerous and varying, they are not more so than those connected with the cutting of metals or some of the other operations that have been so successfully standardized in the industrial world in recent years.

What are the facts which should determine street widths? They are: (1) the width required for "a line of vehicles," thus fixing roadway units; (2) the width required for "a line of pedestrians," thus fixing sidewalk units; (3) the classification of the streets of a city according to the traffic requirements put upon them, or the other functions that they are to serve; and (4) an estimate of the present and future traffic of the streets of any given class, the width required to meet that traffic, and then the standardization of that width.

(1) It is not yet possible to fix with scientific accuracy the width required for a line of vehicles, partly because the data as to the actual average width of present day vehicles is inadequate, and partly because that width is just now in process of change, due mainly to the increasing size and use of the motor truck. Nevertheless, the conclusions on this point are already fairly definite. The difference is represented by about 1 ft. One set of investigators holds that 9 ft. or thereabouts should be fixed as the width required for a line of vehicles. They base their opinion upon the fact that some motor truck bodies today have a width of 8 ft. and that the tendency of manufacturers is to increase the width of trucks. The margin for safe clearance, taking into account average skill in driving, would require about another foot for each line of vehicles, making the total width 9 ft. Other investigators find that today very few vehicles, even large motor trucks, measure more than 6½ or 7 ft. in width, and that conditions of construction or laws are likely to place a limit upon advantageous width close to 7 ft. This view has the support of some of the vehicle companies who hold, in the interest of the manufacturer and user of trucks, as well as the public, that 6½ ft. or, at most, 7 ft. should be the maximum width.

It is not the purpose of this paper to try to settle finally the width required for a line of vehicles or, indeed, any other fact or specific point connected with the standardization of street widths. The purpose is merely to indicate the advantages and necessity for such standardization and to suggest some reasonable basis for it.

But to apply further the method suggested above, we may assume for the sake of making the application definite, that a width of 8 ft., the present working figure of many of the best practitioners, is sufficient for a line of vehicles. As a matter of fact, not only the width of vehicles but also the load is likely to be standardized by law, so that the engineer, landscape architect, or city planner will have a definite maximum figure to work with. These limits may have exceptions, but the exceptions should be discouraged by a vehicle license tax, which would increase very rapidly on vehicles above certain dimensions.

In addition to the space required for vehicles, allowance must be made on many streets for electric cars. Assuming double tracking, which is the most economical method usually, this allowance should be not less than 20 ft.

(2) Various methods have been devised and followed for determining the width of sidewalks. The most customary is to make the sidewalk some fixed proportion of the roadway. In some cases, following this method, each sidewalk is one-half the width of the roadway; in others one-third the width of the roadway. The latter appears to represent the most frequent practice. This method, however, appears arbitrary and, in some instances, would be unsound, because the use of the sidewalks does not necessarily increase and diminish with the amount of traffic on the roadway. However, the custom of making the sidewalk one-third the width of the roadway has proved fairly satisfactory in practice. For example, in the subdivision of a 100 ft. business street into a 60 ft. roadway and 20 ft. sidewalks. Fixing the width for a line of pedestrians at 2 ft., if the applicant of the principle to pedestrians does not appear too academic, this allows, on a street with a total width of 100 ft., for ten lines of pedestrians on each of the 20 ft. sidewalks. The proper width of sidewalks, the method of determining that width, and a more rigid control of encroachments upon sidewalks, all deserve more attention than they have heretofore received.

(3) The classification of the streets of a city according to the traffic requirements put upon them or the other functions that they are to serve is, of course, one of the fundamental requirements of any attempt to standardize street widths. European countries have made such classifications. Here are the figures for some of the cities of England and Germany.

The London Traffic Commission made five divisions as follows:

	Feet.
Main Avenue	[illegible]
First class [illegible]	[illegible]
Second class [illegible]	[illegible]
Third class [illegible]	[illegible]
Fourth class [illegible]	[illegible]

No street was to be less than 40 ft. This standard classification, applying to London and its suburbs, is a great advance over the London Building Act of 1894, which put the average width of streets "in the public interest" at 40 ft. clear or 20 ft. from the center of the roadway to the nearest external wall; and the council could not require a greater width than 60 ft.

The standard classification for German cities of the second size, cities like Leipzig and Frankfort, is as follows:

	Feet.
Main [illegible]	[illegible] to 118
Secondary [illegible]	[illegible] to 80
Local streets	[illegible]

A Prussian law, in force since 1875, apparently drawn to meet the requirements of Berlin, fixes the following dimensions for the laying out of new streets and for the alteration of old ones:

	Feet.
Main thoroughfares	[illegible]
Secondary thoroughfares	[illegible]
Local streets	[illegible] to [illegible]

The width of streets in different American cities varies greatly. There are very few that have adopted standards for the classification of streets according to traffic requirements. Probably the best classification is that of Washington, D. C., which is as follows:

	Feet.
Main thoroughfares	160
Secondary thoroughfares	120
Local streets	[illegible] to 90

The German city standards, given above, appear to be more reasonable and logical than those of London or Washington, and there is a distinct advantage in having more or less range within each classification, as against fixing the width hard and fast to a single figure. It ought to be practical to classify most of the streets of a city either as main thoroughfares, secondary thoroughfares, or local streets, and to apply to them one of the standard widths adopted for their respective classifications.

(4) To determine such classification, however, requires an estimate of the recent and future traffic requirements of the streets of any given class. It does not seem wise to begin by fixing the width of a street at say 50 or 60 or 100 ft., and then apportioning that width as favorably as may be between roadway and sidewalk. It is better to begin at the other end and try to decide what traffic capacity in roadway and sidewalk the street should provide for, thus determining which class it falls in; and then applying the unit of measurement adopted for car lines, for vehicles, for pedestrians, for trees, etc., decide upon the required width. For example, here are three illustrations of this method.

I. An average main thoroughfare is to have, say:

	Ft.
A double track car line	[illegible]
[illegible] lines of vehicles, [illegible] on each side of tracks, [illegible] ft. each	[illegible]
[illegible] lines of pedestrians, 10 on each of the two sidewalks, 2 ft. each	40
Total for an average main thoroughfare	108

II. An average secondary thoroughfare is to have, say:

	Ft.
A double track car line	[illegible]
4 lines of vehicles, 2 on each side of tracks, [illegible] ft. each	[illegible]
16 lines of pedestrians, 8 on each of the two sidewalks, 2 ft. each	32
Total for an average secondary thoroughfare	[illegible]

III. An average local street is to have, say,

	Ft.
[illegible] lines of vehicles, [illegible] ft. each	[illegible]
[illegible] lines of pedestrians, 6 on each of the two sidewalks, 2 ft. each	24
Total for an average local street	[illegible]

These are only averages and are given simply as illustrations of the method of standardization proposed and its application. The range of street widths for such a classification might be as follows:

	Feet.
Main thoroughfares	[illegible]
Secondary thoroughfares	[illegible]
Local streets	[illegible]

Such a standardization would naturally differ from city to city as conditions and requirements differed. Its advantages would be twofold; first in fixing the range of normal street requirements of three or more important classes; secondly in definitely and consciously trying to determine in advance to which class a particular street belonged. Of course, even with such a classification there would be many, many exceptions—special streets, having special requirements and, therefore, calling for special provisions. But if no standards whatever are fixed—and this is the important practical point—there is danger that the normal differentiation of the streets of one class from those of another will be constantly overlooked, or that private interests through pressure and influence [illegible] which is in conflict with the public requirements. It was largely to prevent these results that street width standards, in most cases unintelligent and undiscriminating, were adopted by cities in the past. Where no standards whatever have been adopted many illustrations can be found of the abuses that have crept in, particularly the failure to allow sufficient street width for main and secondary thoroughfares.

In the discussion thus far, no reference has been made to trees, grass strips or other planting in the streets or of space set aside primarily for the adornment of the street or for insuring the benefits of light and air and an appearance of spaciousness. Such reference was omitted merely to simplify the subject and bring it within the compass of a brief paper. Of course, trees are desirable not only in residence streets, but also in most business streets. Of the many arguments against the greater use of trees in our business streets, the only sound argument in most instances is that there is no room for them. But as with traffic so with trees. The same method should be applied. If we are to have trees we must determine the width requirements of a line of trees or two lines of trees or whatever else is needed. Except for temporary effects, it is not good policy to plant trees in a space that is needed for roadway or sidewalks; nor is it good policy to plant one or more lines of trees in a space that is inadequate for their successful growth. If, for instance, it is decided that 6 ft. is the minimum space in which a line of trees of a given species can flourish, then we should standardize that width for that species of tree and provide it. Exceptions there would be undoubtedly to standards for trees as for roadways and sidewalks, but they would be recognized as exceptions and justified because of exceptional conditions. Standards can only be applied profitably to the normal, but in such matters as street widths five-sixths, perhaps nine-tenths of all cases would be normal.

The traffic and use of many city streets increase from year to year, tending to shift some streets from one classification to another. How to provide a method of meeting this increase is a difficult question to answer. To begin with, we must recognize that a city that is alive has growth, and that growth makes changes from time to time necessary. Street widths cannot be made right "once for all." The utmost foresight must be exercised and then adjustments and widenings made to meet new conditions. Street development, like most other features of city planning, is an unending process. In the field of education, the unending character of the process was expressed by the boy who inquired at a public library for a book which, he said, was entitled "How to Get Educated and How to Stay So." So it is with streets. The problem is how, by the exercise of skill and foresight, to design and arrange them to fulfill their functions and then from time to time how to redesign and rearrange them to meet new requirements. In the case of streets where increased traffic is expected, the most practical method of providing for it, perhaps, would be to reserve some extra space between the roadway and sidewalk, or in the center of the roadway, or between the sidewalk and the buildings, utilizing this space temporarily as an area planted with trees and shrubs or merely with grass.

The evils that might follow from the adoption of an undiscriminating set of standards or from an unintelligent application of a discriminating set, have not been overlooked. They might be serious.

But it is my opinion that under our present city organization such evils would ordinarily be less than those that almost inevitably follow from a lack of any established standards and from the policy of determining street widths piecemeal as each is presented for decision.

Experimental Road Work in Allegheny County, Pennsylvania.*

The experiments carried on in this county have been many and varied; the first were for the purpose of laying the dust which had become a great nuisance. The idea that the oil had another value that held out a vision of road preservation caused a number of experiments along the line of increasing this value, and I believe Allegheny County has had as much success along this line as probably any other county. Our method consists today of the application of an asphaltic oil running about 50 per cent asphaltic base. This oil comes in tank cars and the oil is fluid enough to be readily pumped from the cars, in ordinary summer weather, but during the first few days of each season it has been necessary to apply steam heat to the cars to cause it to flow readily. This oil is pumped into oil tank-wagons, that hold from 400 to 500 gals., and are provided with a valve and distributor arrangement that allows the operator to govern the amount of flow at all times. The roadway before being treated is swept thoroughly by a horse sweeper and with hand brooms to entirely remove all dust and dirt from the surface. This also loosens the immediate surface and gives the oil a chance to penetrate the road and form a bond. The road is then left to dry by the natural evaporation of the lighter oils, or is covered with small stone or sand, to alleviate the disagreeable condition that sometimes follows the application of this light oil. The work done during the past three years has shown up extremely well and we have cases where the oil has stood an extra heavy travel for a period as high as two years without showing a dusty condition, and this is on such roads as the Brownsville and Steubenville Pikes.

The cost of applying this light oil for the various years since 1907 is as follows:

	1907. Per Sq. Yd.	1909. Per Sq. Yd.	1910. Per Sq. Yd.
Oil material	......	$0.01599	$0.012212
Labor	$0.0615	0.00663	0.007086
Demurrage and freight charges	...	0.00018	0.000315
Supplies, tools, wagons, etc.	..	..	0.001265
Averages	$0.0615	$0.02280	$0.020878

The heavy cost during 1907 was probably due to the fact that the work was done by contract. During the years 1909 and 1910 the work was carried on by the county maintenance force, and correct cost data have been obtained.

On the Steubenville Pike, outside the Pittsburg city limits west, granulated calcium chloride was used to allay the dust. Calcium chloride is a chemical salt, white, clean and non-corrosive and is without odor. Its main property when applied to a road is that it immediately absorbs moisture from the atmosphere and holds that moisture in the road, thus keeping the road moist and dustless, and by preventing dust lengthens the life of the surface. It is distributed on the road either by hand or by a machine distributor, and costs approximately between 3 and 4 cts. per sq. yd. during the season. It is necessary to treat a roadway with calcium chloride every four to six weeks, dependent a great deal on the humidity of the air. The main point of merit in this treatment lies in that the disagreeable conditions arising from the first application of oil are not present where calcium chloride is used; on roadways in close proximity to a number of houses and where there is much travel of a pedestrian nature, it might well be recommended. Another point in favor of this material which I have gathered from our experiments is that ice and snow do not remain as long on the roadway and in this way helps to solve the question of slipperiness in wintry weather. These experiments, looking towards the prevention of deterioration, have been carried on by most engineers with the idea in view of merely tiding over the immense systems of macadam roads already built, until a more satisfactory surface could be obtained.

The experiments in Allegheny County with bituminous binder have been carried on along practically the same lines as in general throughout the country. On the Steubenville Pike a bitumen pavement was constructed in which the stone were supposed to be graded very carefully and mixed with a heavy bitulithic binder. The stone were graded, thoroughly dried, and conveyed into a large roadway mixer, mixing a batch of approximately 2,500 lbs. at a time. To every ton of stone were added a certain number of pounds of bitulithic binder. This material was carried immediately from the mixer and placed in the road by small hand-barrows. It was raked into a true and uniform surface, rolled with a 10-ton roller, and allowed to thoroughly set before travel was allowed to go on the road. This road at the present time does not show any cracks and gives promise of making an exceptionally good roadway. The one objection seems to be in the nature of a slippery surface; but it is my opinion that as soon as sufficient wear has been placed on the road to cause the stone aggregate to be exposed that this condition will be much improved. The cost for this type of pavement will approximate between 80 cts. and 90 cts. per sq. yd., according to the location of the roadway.

On the Freeport Road a road was constructed in which traprock of size 1½-in. to dust, "run of the crusher," was thoroughly dried and mixed with asphaltic binder, about 110 lbs. of asphaltic binder being used to one ton of stone, together with 2 bus. of sand. A precaution on this work was used by cleansing the stone thoroughly with naphtha before placing the asphalt. This material was placed in the road both warm and cold and like results obtained from both experiments. This material at the present time shows a very satisfactory surface, and gives promise of withstanding the extra heavy wear of the traffic placed upon it. The detailed costs of this type of pavement are as follows:

	Per sq. yd. Cents.
Amiesite material cost	66.25
Labor cost, including rolling	10.17
Total cost of placing on road	76.42

On the Lincoln Way Road, just outside the city of McKeesport, a mixture of granulated slag and asphalt tar binder was used. This material was composed of slag screenings ½-in. and under, fine slag dust, asphalt tar binder, and an asphalt residuum oil. Twelve per cent in weight of slag was mixed with 7 per cent in weight of slag of the asphalt tar binder, at a temperature of 300°. The ½-in. slag screenings were mixed with 2 per cent in weight of slag, of the residuum oil at 300°. The two mixtures are then combined and thoroughly mixed, and must be placed on the road while hot. This experiment shows a very satisfactory condition at the present time, and seems to turn the rainfall quicker than any of the other experimental work, and gives promise of being able to withstand extra heavy traffic. The costs of this experiment, as near as possible to obtain, are as follows:

A mixture of one ton of material costs $3.02. The cost of the oil was 60 cts. and the cost of labor in mixing, 60 cts., making a total of $4.22. We are able to obtain approximately 10 sq. yds. to the ton, making a total cost per square yard of 42 cts. To this add the cost of placing and rolling of 10 cts. per sq. yd., bring the actual cost to 52 cts. per sq. yd. This is by far the cheapest and if it holds up anyway well at all, will make an economical and serviceable pavement.

On the Perrysville Road the penetration method was tested by placing 4 ins. of limestone ballast, thoroughly rolling the same, and applying by hand sprinklers a coal-tar binder to the amount of 3.8 gals. per sq. yd. Unfortunately this work was done very late in the fall and the binder became chilled on striking the cold stones on the roadway and a sufficient penetration was not obtained. Consequently about twice the amount of binder necessary was present in the upper 2 ins. of stone and none penetrated to the base. When the warm suns of last summer and very hot days came, very naturally the excess of binder was drawn to the surface and ran into the gutters and made a very disagreeable condition. This was obviated by distributing 1½ ins. to 2 ins. more crushed stone over the road and thoroughly rolling the same. This apparently cured the defect. The cost of this type of road is as follows:

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*Abstract of a paper by S. D. Foster, Allegheny County Road Engineer, read before the Engineers' Society of Western Pennsylvania on May 2, 1911.

	Per sq. yd. Cents.
Tarvia material	[illegible]
Stone material	[illegible]
Labor charges	[illegible]
Total cost	[illegible]

On our Peoples Road an experiment was made with Kentucky rock asphalt. This material is a disintegrated sandstone, thoroughly impregnated with natural mineral asphalt to a percentage of approximately 8 to 10 per cent. The foundation course of 2 ins. to 3 ins. of ballast is placed on the road and thoroughly rolled. On top of this 1 in. of rock asphalt is distributed and thoroughly rolled into the surface. The surface is then raked over with an ordinary rake in order to roughen up the asphalt binder. Another 1 in. or 1½ ins. of rock asphalt is then distributed over the surface and the road again rolled until thoroughly compacted. This surface presents a rather rough appearance for six weeks or so after construction, inasmuch as this material contains some light volatile oils and does not obtain its initial set until these oils are evaporated. After it has been thoroughly exposed from four to six weeks it presents the appearance of a sheet asphalt pavement, and for some districts where the traffic is not composed of extra heavy hauling, and for level roadways, this type of surface—with some improvements which we expect to experiment with this coming summer—I believe will make a cheap and economical road. The cost of this type of road is as follows:

	Per sq. yd. Cents.
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total cost	76.1

Notes on the Workings of Road Quarry in Scotland.

The following notes on the workings of a road quarry in Ayrshire, Scotland, are taken from a paper by James Lang, Surveyor to the Kilmarnock District of the County of Ayr, presented at the Second Irish Road Congress at Dublin. They are interesting mainly because of the fact that a gas plant was used for operating the crushing machinery. The cost data, of course, are of very little value for comparison with costs of quarry work in this country, owing to the different conditions under which this work is done in Scotland. In that country, for instance, common labor is paid at the rate of 50 to 60 cts. per day of 9 hours, and all other labor is on a corresponding sccale. The "ton" mentioned in the notes is the long ton (2,240 lbs.) of this country.

The metal is a hard igneous rock, commonly known in Scotland as "Whinstone," and has a face about 80 ft. in height. The quality is excellent, and for road purposes cannot be surpassed. The distance of the Quarry from the main line of railway is about 400 yds. A suction gas plant, with engine of 70 hp., is in use for driving the stone breaking, elevating, and screening machinery and haulage plant. An air compressor, also driven by the engine, is used for operating the rock drills and pneumatic hand drills. The breaking plant is placed about 70 yds. from the Quarry face, and the metal is conveyed to it on a 24-in. gage railway by side tipping steel bogeys of 15 cwts. capacity attached to an endless wire rope by a "clip." The metal is delivered direct from the bogeys into a chute feeding the "sledger," which is placed at a level of 18 ft. above the railway siding.

The jaws of the "sledger" are set 5 or 6 in. apart, and it delivers into a chute which feeds two breakers placed in line with each other and 12 ft. lower than the sledger chute. The broken metal passes into an elevator, and is delivered into a screen with holes 2⅜ ins. in diameter. The metal which is broken to a suitable size passes through into a lower screen and the large tailings fall down a chute to be again put through one of the lower breakers. The lower screen is divided into lengths with ¼-in., ¾-in., and 1½-in. holes, and the metal which comes out at the end of this screen is from 1½-in. to 2⅜-in. in size. The screen is placed above bins constructed of timber with a holding capacity of 30 tons for each of the above sizes.

The empty railway cars are shunted into the siding by the railway company's engine, and the gradient has been arranged so that the cars, when the brake is lifted, move forward to whatever chute in the storage bins it is desired to load from. They are filled in a few seconds, and then run into a lie-by, where they are picked up for despatch twice a day. The railway rates vary from 14 cts. (minimum) to 50 cts. per ton, according to distance.

The cost of equipping the quarry was as follows:

Railway siding	[illegible]
Stone breaking plant	5,564.70
Gas suction plant	[illegible]
Storage bins, etc.	1,409.40
Air compressor, [illegible], etc.	[illegible]
Haulage system	[illegible]
Smithy, tools, etc.	[illegible]
Opening up quarry	[illegible]
Total	[illegible]

The plant is capable of breaking 200 tons of "melled" metal per day of 9 hours.

The percentages of the various sizes broken are as follows:

	Per cent.
2⅜-in. metal	61
1½-in. metal	20
[illegible]	[illegible]

The working costs are as follows:

	Cost per ton. Cents.
Quarrying, filling bogeys, [illegible], etc.	[illegible]
Attending breaking plant, [illegible] loading wagons, blacksmith, and foreman	6.46
Materials and [illegible] Wear, etc.	
Explosives	[illegible]
Gas plant	[illegible]
Renewing jaws, screens, shoots, etc.	8.00
Insurance, taxes, etc.	1.50
Interest and repayment of loans	8.72
Lordship to owner of quarry	5.20
Total cost of metal in railway cars	[illegible]

Notes on Road and Street Work.

Cost of a Section of Hassam Concrete Pavement.—One section of the White Plains Ave. experimental road* in the Borough of the Bronx, New York City, was paved with Hassam Concrete pavement. Data of this section, which extended from station 31.00 to 33.00, are as follows: 1½ in. crushed trap rock was laid and rolled with an 18-ton roller to a finished depth of 6 in. Sand and cement were mixed in proportions of 1¾ sand to 1 cement and forced into the voids of the stone by means of a special pressure machine used by the Hassam Paving Co. The total cost of the pavement was $1.209 per sq. yd., itemized as follows:

	Total.	Per Sq. Yd.
Labor	[illegible]	[illegible]
1½-in. trap, 111.6 cu. yds., at $1.65	184.14	.390
Sand, 33 cu. yds., at $1.21	39.93	.085
Cement, [illegible]	[illegible]	[illegible]
Hauling sand, [illegible] tools		
6 teams, 80 hours, at 62½ cts.	50.00	.106
2 [illegible]	5.62	.012
Total (472 sq. yds.)		$1.209

The itemized cost of the field labor was as follows:

	Hrs.	Rate.	Total.	Per Sq. Yd.
1 foreman	[illegible]	[illegible]	[illegible]	[illegible]
8 men spreading [illegible] stone	[illegible]	[illegible]	[illegible]	[illegible]
12 men spreading 1½-in. stone	[illegible]	[illegible]	[illegible]	[illegible]
16 men spreading 1½-in. stone	[illegible]	[illegible]	[illegible]	[illegible]
3 men filling [illegible] sand	[illegible]	[illegible]	[illegible]	[illegible]
3 men filling [illegible] sand	[illegible]	[illegible]	[illegible]	[illegible]
1 mixer and roller engineer	[illegible]	1.50	13.50	[illegible]
Total (472 sq. yds.)			$110.40	$0.234

The actual time for laying the pavement was 2 days, 4 hours, an average of 188 sq. yds. of pavement being laid per day. It is stated that the cost of hauling could be considerably reduced.

Cost of an Oil-Gravel Road.—The following data relate to the construction of an oil-gravel road at Santa Maria, Cal., the work being done under the supervision of the U. S. Office of Public Roads. The work consisted of surfacing with oiled gravel a section of the Geary Road, 2,710 ft. in length and 16 ft. wide. The surface of the road was a sandy loam which had been oiled several times with crude oil, and was badly rutted and full of chuck holes. The oiled surface was broken up by spiking with a roller, scarifying and harrowing with a chisel-toothed harrow and a disk harrow. The road was then shaped with a road grader and 1,137 cu. yds. of gravel were spread upon the road in two courses, 5½ and 3 ins. in thickness. The average cost of the gravel was $1.683 per cu. yd., which included loading on flat cars, shipping a distance of 35 miles, hauling an average distance of 1 mile, spreading upon the road, rolling and sprinkling. The crude oil was applied at the rate of 1 gal. per sq. yd. on the foundation course, 1 gal. per sq. yd. on the second course, and ¼ gal. per sq. yd. on the surface. The oil was secured from the county sump. Waste oil from the oil fields floats on the surface of the small streams, which are diverted to the sump, and the only expense of the oil is that of collecting, heating, and pumping into tank wagons. With labor at $2.00 to $2.50 per day and teams at $4.00 per day, the total cost of the road to the community was $2,613.68, which is at the rate of 54.2 cts. per sq. yd., or $5,087.57 per mile.

Surface Treatment of Macadam and Gravel Surfaces with Light Refined Coal Tar.—In the recent discussion on Road Construction and Maintenance held under the auspices of the Americal Society of Civil Engineers, Mr. H. C. Poore described* his experience with the treatment of 300,000 sq. yds. of macadam and gravel surface with a light refined coal tar, for the purpose of laying the dust and incidentally preserving the road surface. The general method of application was as follows: After the surface had been thoroughly swept, thin refined tar (½ gal. per sq. yd.) was applied by a pressure tank wagon, sprinkler wagon or by some form of hand dipper. After a few hours the surface was covered with grit. Both pea stone and fine gravel were used, and 1 cu. yd. of material usually sufficed to cover 120 sq. yd. of surface. Where the entire road or only a portion could be closed and guarded for 24 hours after spreading, the coating of grit was not always necessary. The average cost of this work in Massachusetts was from 3 to 5 cents per sq. yd., including all materials and labor. Mr. Poore states that with this treatment, a macadam or gravel road in fair condition will become hard and free from lose grit in the course of about 10 days. The surface then remains in condition for the season, and, with a re-treatment of ¼ gal. per sq. yd. in the fall or following spring, will be in good condition for a second year. The second treatment may be applied at a greatly reduced cost In various localities a thin asphaltic oil is laid in practically the same way on some streets, while on others, where it is desired to have a clean and hard surface which will remain in good condition through rainy and variable fall weather, refined coal-tar is preferred. Mr. Poore states that since a tarred surface is hard, and does not assimilate all foreign matter dropping on it, but easily allows the street to be cleaned by hand or by Nature, tar materials usually remain intact during the entire season, and in some cases throughout the winter.

In one large city in Maine, where refined coal-tar was used for dust-laying on a large area, but where a larger quantity per square yard was applied than is customary, a dustless surface is stated to have been in existence

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*For the detailed costs of the other sections of this road, see Engineering-Contracting, April 12, 19 and 26, [illegible].

*Proceedings American Society of Civil Engineers, Vol. XXXVII, No. 3, p. [illegible]

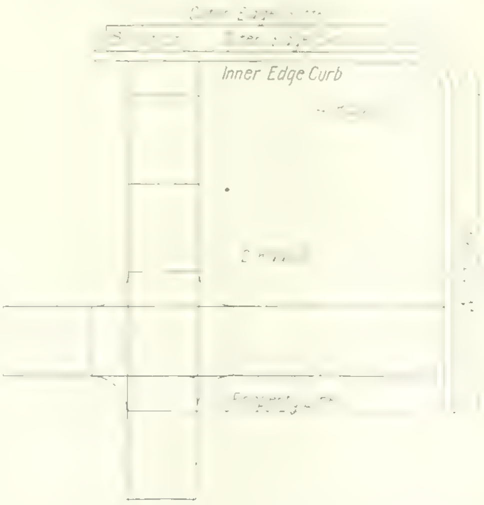
[illegible] film treatment, as the surface was mosaic, and the tar was absorbed by the road materials. A very efficient and economical way of applying a thin tar for dust prevention is by using 500-gal. tank wagons, fitted with auxiliary pressure tanks for blowing out the material through suitable nozzles under pressure. [illegible] very practical method of distributing all light materials, and when they are delivered by pressure, the spreading of a ¼-gal. coat to the square yard is easily accomplished. According to Mr. Poore two applications of this quantity of material during the first year, followed by one coat during the second year, will suffice to keep the surface of a macadam road in first-class condition.

[illegible] ber of methods are in use for placing street names in the sidewalk. In some cases the name has been cut in the top of the curbstone and the letters colored black. In cases where concrete is used for the sidewalk wooden pattern letters 1 in. deep have been bedded in the concrete. When the concrete has set sufficiently the letters are removed and the space filled with colored cement mortar or letters made of brass or composition metal. The city of Arkansas City, Kan., has adopted a system of marking the names of streets on top of the concrete curb, as shown in the accompanying sketch of one of the standard street corners. In this city a brass letter 3½ ins. by 1½ ins. is used to stamp the name of the street in the curb while the concrete is green. This has been found to give a legible and permanent street sign and has proved to be very satisfactory. Mr. J. H. Titus is city engineer of Arkansas City, Kan.

Chart System for Road Records.—In the county of Notts, England, a chart system is employed to show where and how road material is used in this county. At the second Irish Road Congress this system was briefly described as follows by Mr. E. P. Hooley, county surveyor, Notts: Each county foreman has to show by his weekly accounts where material has been laid during the preceding week. Each sheet of the record book equals one mile of road, and has 176 divisions forward. It is also divided into four main divisions, each representing ¼ mile, and each ¼ mile is divided into 616 squares; each square repreesents 1 yd. in width and 10 yds. forward. The total width allows for a road 42 ft. in width. Different colors show the materials used, and a column is provided in which the date is entered when the materials are applied to the road surface. A reference shows at once in the office when any excess of materials or repairs is in progress on any one section or road. Tracings are taken from the 25-in. ordnance maps of all roads, and each road is kept in a continuous roll which shows every length of material laid and road alteration that is carried out. The 1-in. ordnance map of the county shows the extent of the whole roads dealt with by the use of permanent material. The usefulness of this system has been marked in the success of an application made to the road board, for it enabled the applicant to point out where works of more permanent road construction had been carried out in the county for years past. In cases of claims for extraordinary traffic the record book is invaluable, because it shows at a glance the actual position where material is or has been applied to any road on a given number of years, and has proved most convincing to a county court judge on more than one occasion.

Tarvia Modern Pavement.—One section of the experimental road built last fall in the borough of the Bronx, New York city, was paved with Tarvia Modern Pavement. The itemized costs of this section were given in our issue of April 19, 1911. This form of road pavement has been developed during the past two years, the method of construction generally used being as follows: The foundation is prepared as for ordinary macadam, care of course being taken to see that this foundation is properly drained and properly consolidated. Upon the foundation the base course is laid, using run of crusher stone 3 ins. to 1 in. in size. Usually a thickness of 4 ins., measured after rolling, will be sufficient. This course is filled, rolled as for ordinary macadam and then has spread upon it ½ in. of clean, sharp sand or good gravel. Over this without further rolling is sprayed Tarvia-A to the amount of 1 gal. per sq. yd. Another layer of run of crusher stone (3 ins. to 1 in.) is spread over the Tarvia-A to such a depth that when rolled this course will be 2½ ins. thick. It is then rolled thoroughly with a steam roller until the Tarvia and sand are drawn up between the stone and until this layer of stone is bedded firmly into the stone below. It is claimed that the layer of Tarvia and sand holds this course firmly in place and cements the top course of the road thoroughly to the bottom course. A spraying of Tarvia-X, a denser grade of Tarvia, is then given to the road, using 1¼ gals. per sq. yd., and a thin layer of ¾-in. stone is spread over the surface. Enough stone must be used to fill in all the chinks of the surface, making it smooth, but not enough should be used to leave any loose material on the top. The road is rolled again until perfectly smooth and a final coat of "Tarvia A" amounting to ½ gal. per sq. yd. is sprayed on and the road finished by adding pea stone or screenings and given a final rolling.

Gypsum Surfaced Roads.—The following data relate to work done in 1909 at Carlsbad, N. Mex., under the supervision of the U. S. Office of Public Roads. The work of surfacing a 1,600-ft. section of the La Huerta-Avalon Road was started on June 7, 1909, and was entirely completed July 2, 1909. The road was first thoroughly irrigated, after which the necessary excavation and shaping were done. Gypsum was then spread on the road in three courses to a width of 16 ft. and a total depth of 9 ins. Each course was rolled with a 4-ton horse roller. After the material had been spread, the road was flooded from an irrigation ditch for 48 hours. The road and shoulders were then reshaped with a road grader and rolled until a smooth hard surface was obtained. The cost of the work was as follows:



Sketch Showing Manner of Marking Street Names on Concrete Curb.

Foreman	[illegible]
Excavation and shaping	[illegible]
Stripping, quarrying and loading, [illegible] cu. yds. gypsum	[illegible]
Hauling, 1 mile	128.12
Spreading	[illegible]
Irrigating	[illegible]
Rolling	[illegible]
Total	[illegible]

The cost of stripping, quarrying and loading the gypsum was about 45 cts. per cu. yd., the cost of hauling was 39 cts. per cu. yd., and the cost of spreading was 7.4 cts. per cu. yd. A section of the La Huerta Road, 900 ft. in length, which was surfaced with gypsum several years ago, was resurfaced. All the loose material and detritus were removed from the surface by scraping and sweeping. Gypsum was then spread to a depth of 3 ins. and all depressions were filled. An embankment 10 ins. high was then built along each shoulder and the road was flooded from an irrigation ditch for 36 hours. The usual traffic was maintained on the road during the flooding. The water was then drained away and the roadway and shoulders were shaped with a road grader and rolled with a 4-ton horse roller. The new material was found to be firmly bonded to the old surface. The total cost of this resurfacing was $167, which is at the rate of $979.70 per mile. Two other streets at Carlsbad were also surfaced with gypsum. These streets were Green and Tax Sts., and the work was carried on in a manner similar to that of the La Huerta-Avalon Road, except that the gypsum was put on 8 ins. deep and river sand 2 ins. in thickness was spread and mixed with the top course of the gypsum. A section 1,415 ft. long and 40 ft. wide was surfaced at a cost of $704.43, which is at the rate of 28 cts. per sq. yd. The cost of labor was $1.75 per 9-hour day. The rate for teams was $3.75 per day.

Dates for the Next New York and Chicago Cement Shows.—Announcement has been made by the Cement Products Exhibition Co., 72 West Adams Street, Chicago, that the Second Annual New York Cement Show will be held in Madison Square Garden, Jan. 29 to Feb. 3, 1912, and the Fifth Annual Chicago Cement Show will be held in the Coliseum, Chicago, Feb. 21 to 28, 1912. The determination of the Cement Products Exhibition Co. to continue these shows was the result of a letter ballot taken among exhibitors at prevous exhibitions. Nearly all of those who were represented at the New York and Chicago Cement Shows last winter voted in favor of continuing the shows and expressed their approval of the manner in which they had been conducted. Some excellent suggestions were made by the exhibitors in the letter ballot and several desirable changes in the rules and regulations will be made. The question of whether a Sunday should intervene during the show was not determined, the vote being about equally divided upon this point. The plan of segregating noisy and operating exhibits was also approved and if possible a plan of this kind will be worked out. The majority of the exhibitors favored a show of six days duration and expressed their approval of the general plan of uniformity of exhibits that has prevailed in the past. Most of the exhibitors stated that they thought the charges for space were not too high although some felt that it might be well to run the exhibitions on a smaller scale, thus enabling the Exhibition Co. to charge less for the rental of space. A great many exhibitors suggested the holding of shows in other cities. Of these Kansas City received the greatest number of votes and there is quite a strong possibility that an exhibition will be held in Kansas City sometime in March, 1912. It is the intention of the Management to obtain an expression of opinion from all the previous exhibitors upon the advisability of holding an exhibition in Kansas City in the spring of 1912. Plans for next year's shows in New York and Chicago are being started and a number of innovations are contemplated which is expected will be strongly endorsed by the exhibitors. Detailed information, diagrams, application blanks and new rules and regulations will be out in the hands of the exhibitors about the middle of the summer.

Method of Placing Plugs in Tunnel Roofs.—A method of placing roof plugs in rock tunnel roofs so that they will be of some permanence is to drill a hole about 3 ins. up into the roof and fit a wooden plug to the size of the hole. The upper end of the plug should be cut with a saw and a wedge inserted in the cut. Then, when the plug is driven in with a hammer the wedge will spread the plug until it makes a snug, tight fit.

WATER-WORKS AND SEWERS SECTION

Cost of Pumping at Two River Flushing Stations, Milwaukee, Wis.

At Milwaukee, Wis., three rivers run and enter Lake Michigan. Two of the rivers, the Milwaukee, which flows south parallel to the lake shore, and the Kinnickinnic, which flows north and also parallel to the lake shore, are constantly being flushed by means of pumping lake water into them some distance above their mouth. The tunnels supplying the water from the lake are each 12 ft. in diameter. The Milwaukee tunnel is 2,534 ft. long and the Kinnickinnic tunnel is 7,185 ft. long. The pumping plants are each of the same capacity, rated at 500 cu. ft. secs.

The Milwaukee river flushing station is located at the lake end of the tunnel and is equipped with an E. P. Allis vertical tandem screw pumping engine and four return tubular boilers, 54 in. x 16 ft., with down draft furnace.

The Kinnickinnic pumping station is located at the river end of the flushing tunnel. It is equipped with an Allis-Chalmers vertical tandem screw pumping engine and two horizontal tubular boilers, 72 in. x 18 ft., with down draft furnaces.

The data on the operation of these plants for the year 1909 are as follows:

	Milwaukee river	Kinnickinnic river
Total million gals. displaced	11,[illegible]	[illegible]
Av. dynamic head pumped against, ft.	[illegible]	[illegible]
Av. steam pressure, lbs.	[illegible]	1[illegible]0
Coal consumed when pumping, tons	[illegible]	1,694
Grade of coal, screenings*		
Coal consumed per million foot, gals.	13.89	12.15
Ft. lbs. of work per 100 lbs. of coal	[illegible]	[illegible]
Coal used for starting fires, lbs.	176,550	97,150
Coal used for all purposes, tons	[illegible]	1,[illegible]
Per cent of ash	11.[illegible]	13.94
Cost of coal per ton	$2.[illegible]	$2.26
Cost of Operation:		
Salaries	$11,[illegible]	$13,[illegible]
Coal	[illegible]	1,8[illegible]
Total cost	[illegible]	$19,542.[illegible]
Cost per million ft.-gals.	$0.068	$0.089

*Youghiogheny.

The Disinfection of Water.

At a recent conference of the state and local boards of health, held at Columbus, Ohio, Dr. Roger G. Perkins of Western Reserve University presented a paper on the disinfection of water. The subject was handled in a manner calculated to interest others than accomplished chemists and bacteriologists. We believe that a great many engineers in general practice who have not had occasion to specialize in the design and construction of works for the classification and disinfection of water, will find the following abstract of Dr. Perkins' paper of considerable interest:

DISINFECTION [illegible]

Although the term disinfection would ordinarily indicate the removal of some infectious type of organism, it is more generally used to indicate the removal of bacteria of all types, and may indeed be stretched to include the various algae which cause difficulties in reservoirs. The objection to the latter form of life is on the one hand that the amount may be actually so great as to clog the overflow pipes and on the other that the death of the algae involves the passing into the water of various decaying materials which may give rise to unpleasant tastes, odors and colors.

REMOVAL OF ALGAE.

A number of chemicals have been tried, but there is here no place for discussion of any but the successful. The best so far discovered is copper sulphate, which may be used in proportions from 1/1,000,000 down. The original experiments showed that the method of application was simple, merely involving the towing of bags containing the material behind a boat until the proper proportion was estimated to be met. It could also be introduced in other ways and according to the first results was very valuable, on the one hand in the destruction of the algae and on the other in that it did not injure the fish life in the small amounts used. It was hoped that it would also kill the bacteria, but this did not prove to be the case. As the method was tried out it was found that it did not quite come up to expectations, as in some cases the algae were of a resistant variety, in others they or some other form returned with renewed vigor after their apparent destruction. The method is by no means to be dismissed, as it may be a material aid in reservoirs where water is stored for some time, especially in the summer. The other means for the prevention of the algae, such as the exclusion of light where possible, and the removal of as much organic matter as possible from the bottoms and sides of the reservoir, must not, however, be neglected.

From the standpoint of prevention of disease the removal of the pathogenic organisms is more important. While by no means all of the typhoid in the United States can be attributed to the use of polluted water supplies, there is no doubt that a great deal of it does come from this cause and that it is practical to prevent all such cases. Evidence in favor of epidemics being due to water is overwhelming and need not be brought forward here. Each method of making a water supply safe has been found to have its weak points, as indicated on the one hand by typhoid incidental after apparent purification and on the other by laboratory findings of pollution by improved methods in waters supposed to be purified.

The usual American municipal supply is surface water of some sort, either from a pond, lake or stream, the number of large supplies from springs or wells being small. This involves the protection of the entire watershed, which under our present method is rarely accomplished. These waters are either supplied, in the majority of cases, untreated, or undergo some type of filtration. Since it has been satisfactorily demonstrated that the old theory of the self purification of water no longer holds in the original form, but that the important factor in the whole matter is that of time, more or less regardless of distance, attempts have been made to put this new information into practice by holding the water for as long as possible before distribution. Houston of London, Eng., has found a very marked disappearance of the sewage organisms in 48 hours, and recommends the process. The efficiency of the reduction depends notably on the quality of the water and he notes that for an absolute safety factor a month would be necessary. This of course would necessitate a reservoir area of prohibitive size, where as much water is used as is the habit in our American towns. On the other hand, where the supply comes from a great distance this factor will materially help in disposing of a good deal of pollution.

It appears then that unless the source of the water is very distant or is above suspicion, some form of treatment must be used. The most frequent of these is filtration, in some form or other, either the slow sand type or the rapid mechanical with use of chemical precipitants. While with waters fairly grossly polluted careful management will give a nearly bacteria free effluent, it is admitted that either type of filter needs constant and conscientious supervision, or else there will be leakage of sewage forms from time to time. The London data may be quoted, as there are a number of plants there of various sizes, corresponding to supplies to individual municipalities and handling different types of water. In the year 1908-9 summary of the results in the daily tests showed that 5 to 50 per cent of the filtered waters contained colon in 100 cc. or less, and that in the next year 3.8 to 31.3 per cent showed the same results. Sometimes the appearance of the colon is very sudden and rapid changes in the weather conditions may bring about so gross a change in the bacterial content of the water that the filtered water will be polluted before any change can be made. The results at other places are similar. At Hamburg, where the conditions of weather approach more nearly those of northern Ohio than do those at London, the formation of ice on the filter beds or presence of floods in the river leads to the appearance of colon in the water. It is true that where colon is found only in so large amounts of water as 100 cc. there is very possibly no typhoid or dysentery, but in the absence of accurate knowledge as to the actual number of bacteria necessary to set up disease, we cannot take any chances. In summary then one may say that in the presence of a polluted water supply, filtration will remove the suspended matters, and will remove the greater part of the bacteria, but that sudden variations in weather conditions or in technic may allow pollutions to pass the filter, when the belief in its efficiency will cause continued free use of a dangerous water. For safety then it would appear necessary to sterilize waters for domestic use even after filtration. It is unnecessary to refer to the various household methods, though it is the duty of all health officers in case of uncontrollable pollution of the city supply to warn the inhabitants to boil the water.

GENERAL METHODS.

There have been many plans for sterilizing the water for drinking purposes and for all conditions, such as armies in the field, institutions and municipalities. Only those which may be applied to central supplies with comparative simplicity will here be considered. The main general methods at present in use by municipalities are three in number. They will here be discussed in inverse order to their practicabilty.

Ultra-Violet Rays.—It has been known for some time that the rays at the ultra-violet end of the spectrum have marked bactericidal powers, but it is only recently that the principle has been practically applied. The essentials for success are in the first place a white light, containing a large proportion of ultra-violet rays, next a water free from any opacity or turbidity, and in the third place an apparatus so arranged that the water will pass under the arc in a thin film and be thoroughly exposed. There has been recently established at Marseilles an apparatus of this sort, where the water passes into a constant level reservoir from which it issues over a central weir, passing at this point under the light from an arc formed between two carbons with cores containing alumina, giving a white light with many ultra-violet rays. The plant has been recently established and the results in the line of efficiency and economy will be watched for with interest. The objections at present to the method are that it has not yet been sufficiently tried out on a commercial scale, that it is not standardized, and that it requires expert care for its proper control. Moreover the absolute necessity for a transparent water makes a preliminary filtration necessary in most cases of polluted waters.

Ozone.—Here the destruction of the bacteria depends on the presence of nascent oxygen in the water. This is obtained by passing an arc through a current of dry air, which is then, with its new content of ozone, passed onto a rising column of water, which is thereby sterilized. Some failures in the process which have occurred in municipal plants have been found to be due to the insufficient drying of the air, so that special measures must be taken to avoid this trouble. There is no question of the actual efficiency of the method and plants have been adopted by St. Petersburg, in Paris and elsewhere for the treatment of the city water supplies in whole or in part. The advantages lie in that the main expense after the rather expensive first installation is the electric current, and that there are no waste products to be disposed of. Also from the point of view of the laity there is less objec[illegible] of any other chemical. On the other hand the primary expense is large, the constant services of an expert electrician are required, and the method is not as yet standardized. The necessity of dry air makes further complications in the apparatus.

Chorine.—It is probable that the essential principle involved is the same as in the ozone method, though more roundabout, the available chorine so acting on the chemicals in the water as to free nascent oxygen which acts on the organic matter and the bacteria. For this reason the method by which the so called available chlorine is obtained is more or less indifferent and a commercial rather than a laboratory proposition. The three usual methods used are chlorine gas in liquid form, chlorine as given off from the electrolysis of salt water, and chlorine in the form of the commercial bleaching powder. The first method is the most expensive, and is said by some to be less efficient than the others. Where supplies of bleaching powder are not available except under prohibitive freight conditions it may be profitable to establish local electrolytic plants, but under ordinary circumstances the use of bleaching powder has been found equally efficient with the other methods and a good deal cheaper. The form in which it is usually sold contains about 35 per cent of available chlorine, which goes readily into solution in water, and can be fed into the reservoir, the mains, or at any other place desirable, in measured quantities. The cheapness of the material, usually less than $25 a ton, the small amount necessary per million gallons, and the simplicity of the methods used are all in favor of this plan. The disadvantage of the use of bleaching powder lies in the necessity of constant purchase of new supplies and in the large amount of residual sludge which must be disposed of after the chlorine is removed. When this method is used the usual practice is to have two or more tanks, one in which the bleaching powder is mixed with water to the consistency of a cream, either by hand or where necessary by mechanical means, allowed to settle, and the supernatant fluid drawn off into a second tank from which it is passed over a weir, through a grid, or by any scheme found mechanically acceptable, into the water to be disinfected.

Save under exceptional circumstances the proportion to the water to be treated is very small, one part to one million or less, according to the quality of the water and the degree of pollution. This proportion is of course in terms of available chlorine. The method is in use in a number of cities abroad and in the United States and when the chlorine is used in these amounts causes no complaints from the consumer. Certain very important facts must be kept in mind when using chlorine as a disinfectant. In the first place it is a strong corrosive and the materials in which it is kept must be constructed with this in view. The fumes from the raw material, or the concentrated solution, are very irritating and precautions must be taken on the part of the workmen. If the proportion used is too high, it will be smelt and tasted in the water and will cause complaints. When used in the dilutions noted above, there will be practically complete disappearance in an hour or less, so that if possible this time factor between introduction of the chlorine and the distribution to the first users on the line should be adhered to. In some cities, however, it is stated that the time factor is notably less and that there is no complaint.

GENERAL SUMMARY.

In regard to all these methods as a whole there are certain broad lines of action. It must be remembered that the action of the disinfectant is on organic matter, which is broken up to a greater or less degree, depending on its individual chemical composition. Bacteria are affected differently according to their varieties and the spore formers are less acted on than the non-spore formers. Fortunately the organisms of the ordinary water-borne diseases, such as typhoid, dysentery and cholera, have no spores, and are readily killed. The index of the efficiency therefore can be the amount of destruction of the colon bacilli, as these are slightly more resistant than the typhoid and accordingly any measures that will take care of them will also take care of their more dangerous relatives.

In the next place none of these methods has any particular effect on the appearance of the water and will have no influence on the turbidity or the color. For the removal of these or for treatment of the hardness it will be necessary to use the standard methods. The use of chlorine has a tendency to increase the permanent hardness slightly, but in the small amounts used will not make a material difference.

Lastly, these disinfectants are not intended to supply the place of a pure supply. While in suitable proportions they will remove the dangerous organisms even from the sewage, there will be certain changes which will cause a taste in the water and the sewage chemicals will still be present. The disinfection is not a panacea which will admit of drinking sewage with impunity. Of the methods at present available the bleaching powder is perhaps the simplest and the cheapest, and is in use in more places. If the dilution is high and the time factor before delivery is cared for there will be no complaints.

An Electric Pipe Locator.

The accompanying engraving shows the method of using a device for relocating underground pipes that is now on the market. The device was developed by the Modern Iron Works of Quincy, Ill., and is sold on ten days' trial, for fifty dollars. It is known as the D-B-M Pipe Locator. It is not a magnetic instrument, but is operated with batteries on the wireless principle.

View Showing Manner of Operating Electric Pipe Locator.

This device will relocate any metal pipe buried not over 15 ft. underground, even if the ground is covered with snow, ice, boards or concrete. It is of special value in relocating lost service connections. In small towns, where a lot is unimproved, the service pipe is often stubbed at the curb or property line, terminating by a shut-off valve in a stop box. Frequently this stop box, which serves to witness the location of the lot end of the service pipe, gets lost during grading, curbing, and paving operations. In such cases the usual method of finding the pipe is to dig for it and this frequently proves to be expensive. Records of the exact location of services, even though accurately and faithfully made, often get lost or misplaced before they are wanted. This is especially true in villages where there is a divided responsibility in the matter of keeping records. The use of the Electric Locator does away with the necessity of digging test holes.

The apparatus consists of an instrument for producing an electric current on the pipe which is to be located, and a special head telephone receiver and detector coil, constructed to pick up the electric wave produced by the instrument so that it can be distinctly heard in the receiver. After the instrument is properly connected up according to the printed instructions, either inside or outside of the buildings, the operator can hear the tone in the receiver distinctly with the detector coil held in his hand. In this manner the exact location of the buried pipe can be traced as far as desired.

The apparatus is light and is readily stored and carried in a box provided for that purpose.

Street Paving.—Active agitation on this subject has been recently carried on by many civic organizations of New York city. As the result of the strong protests made to the city authorities as to the defective condition of the streets, the subject has been seriously taken up, with the probable result of a radical reorganization of methods. General Theodore A. Bingham, formerly police commissioner, a civil engineer of high standing, has been appointed chief engineer of highways. The borough president has under consideration a complete revision of the paving system of the borough of Manhattan with a view to the adoption of much better standards than at present prevail. Careful studies of the practice and specifications in use in foreign cities where paving is in the most advanced state have been made by Mr. Ernest A. Flagg on behalf of the Fifth Avenue Association. An elaborate report thereon has been prepared, which is under consideration by several other organizations, including the Merchants' Association of New York, with a view to co-operation in urging upon the city authorities the adoption of the recommendations of the report. The subject will be presented formally to the borough president at an early date.

Engineering Changes, Panama Canal.—On May 10, 1911, the engineering department of the central division was reorganized. Heretofore the field and office work has been handled by the resident engineer at Empire, with offices in charge of assistant engineers at Paraiso and Las Cascadas. These two offices have been abolished, and the field and office work heretofore handled in them has been centralized in the division engineer's office at Empire, from which point all engineering work in the central division will be handled in future, under the jurisdiction of the resident engineer and one assistant engineer. In making these changes, Assistant Engineer William L. Thompson, formerly in charge of the office at Las Cascadas, has been transferred to the Pacific division, where he has been placed on work in connection with hydraulic operations below Miraflores Locks. Assistant Engineer Mark W. Tenney, formerly in charge of the Paraiso office, has been transferred to the office of the resident engineer at Empire.

STEAM AND ELECTRIC RAILWAY SECTION

The Feasibility of Grouping Timbers For Treatment.*

It is held by some engineers that in order to secure the best results from treatment, by any process, that it is necessary to separate ties into groups or classes before placing them in the retorts, so that each tie will receive, as nearly as possible, the same quantity of creosote oil, consequently result in a more uniform penetration and absorption, than would otherwise be obtained if the ties were not separated.

There are a good many factors entering into the problem and to give due consideration to any or all of them would require the separation of the ties in a good many groups. To do this necessarily involves labor and expense, and unless the advantage due to greater uniformity of treatment more than offsets the expenditure of time and money to separate the ties into groups, it would be unprofitable to have a system of grouping.

By "uniform treatment" it is generally understood to mean that each tie or cubic foot of timber in any charge shall contain, after treatment, about the same quantity of creosote oil. Some specifications for treating limit the quantity of creosote oil at so many gallons per tie, or so many pounds per cubic foot of timber, and in order to leave as nearly as possible the same quantity of oil in each tie, or cubic foot of timber, resort is made to grouping of the ties or timber for treatment. Whenever the quantity of oil or preservative is not limited and the material is treated to refusal, grouping of ties and timbers is not so essential, because when the material has absorbed all the preservative that can be put into it, it cannot imbibe any more. But whenever the quantity of oil is limited in the specifications the operation usually ceases before the material is completely treated and the variation in quantity of oil in each tie or cubic foot of timber is sometimes very large. To cite an example: Last year the writer conducted a test at a certain treating plant and weighed 1,020 ties separately, before and after treatment. It was found that the quantity of creosote oil left in each tie ranged from 2 lbs. to 60 lbs. Fifty-two per cent of the ties had less than 21¾ lbs. or 2½ gals. per tie; 48 per cent had more than these quantities. The average was 21.72 lbs., or nearly 2½ gals. per tie, which was the quantity of oil that the contractors were required to put in the ties under the terms of their contract.

Inasmuch as no two ties or two pieces of lumber are exactly alike in respect to moisture content, wood structure, proportion of heart wood and sap wood, and in many other respects, it is quite impossible to attain uniform treatment as generally understood, by grouping of the ties and timbers, and the variation is found to be considerable, regardless whether the ties or timbers are grouped or not, for treatment.

The main factors that enter into the problem may be stated as follows:

(1) Moisture content or degree of seasoning.

(2) Physical structure of wood in relation to its penetrability by preservatives.

(3) Percentage of heart wood and sap wood.

These are some of the main factors entering into the problem of grouping or separating the woods for treatment. Mention might be made of several others of lesser importance. Let us consider the main factors only.

MOISTURE CONTENT OR DEGREE OF SEASONING.

Moisture content or degree of seasoning, is, perhaps, the most important factor under consideration. It is a well known fact that wood must be dry before it can be treated, as green wood resists the entrance of the preservative. Therefore upon the extent of dryness of the wood depends in a great measure the quantity of preservative that will be absorbed.

The green, unseasoned timber of hardwoods contains on the average water to the extent of about 42 per cent of its total weight; that of the softwood, about 52 per cent, and that of pine, about 57 per cent. Hence, green wood in general may be said to contain water to the extent, in round numbers, of about half of its weight, but the actual quantity varies with the kind of tree, season of the year, part of the tree, soil and locality, etc. It is never pure water, but here, too, the kind and quantity of sap substance it contains varies also according to the tree, season, soil, etc. This water, contained throughout the tissues and in the intercellular spaces, begins to diminish in quantity by evaporation into the air after the tree is felled, and this evaporation goes on, at a gradual, diminishing rate, until a condition is reached when there is more or less equilibrium between the tension of the atmosphere and power of evaporating the water still contained in the wood. When this condition is attained the wood is said to be seasoned or air-dried, but it still contains a considerable quantity of water, varying according to the nature of the wooded tissue and other substances within the wood and their power of retaining water. After the log is manufactured into ties or lumber it loses its moisture quite rapidly at first. From experiments made with beech ties which were cut immediately after the trees were felled, it was found that thy contained an average of 45 per cent of their weight of moisture. They were then placed on supports, under shelter, to season. At the end of 5 months' seasoning (from May to October) the ties were weighed and it was found that they still contained 21 per cent of moisture. It was also found that the wood seasoned very slowly after the first 6 months, and that after 6 years of seasoning, under shelter, the beech wood still contained from 10 to 12 per cent of moisture. From the point of view of practicable seasoning of ties, it is scarcely possible, without kiln drying, to lower the moisture much below 20 per cent. The various kinds of woods season at various rates. Some woods dry more slowly than others. Again, some woods contain more moisture at the beginning, so that after air-seasoning for several months the moisture content in the various kinds of woods is considerable and not definitely known and on this account it is difficult to say when the preservation process can best be undertaken. This refers to heart wood, not to sap wood, which loses its water very rapidly.

The writer has seen contracts made between railroad companies and treating companies that required the ties to be shipped in the "order of their cutting," so that all of the ties in any car would be equally seasoned. Anyone who has practical experience knows very well that it is impossible to deliver ties at the treating plant in the order of their cutting. They are manufactured at all times during the year along the railroad lines or along the rivers and transported in various ways, by rail, by barges and rafts.

It is not always possible to separate the ties or timbers into groups according to their different degree of seasoning, as they are loaded on cars or barges, as it is absolutely necessary to fill them to their full capacity, and ties of different degree of seasoning must necessarily be loaded together. For these and other reasons it is manifestly impossible to separate the ties into groups according to their degree of seasoning, as they are loaded into cars; therefore it is impossible to ship them to the plant in the order of their cutting. The writer has observed that when ties reach the treating plant they are unloaded and piled together regardless of their degree of seasoning. It is a common practice to consider all ties in any car as being of equal dryness. This is not correct in all cases, as there may be some ties that were cut one month, two months, three months and upwards. It would be useless to attempt to separate the ties according to their different degree of seasoning at the plant, because the men who unload the ties are not competent to determine that, consequently could not separate them into groups intelligently.

The manner of piling ties in the yard also affects the rate of seasoning. Ties that are piled together dry slower than those piled more openly. Again, ties on top of the piles dry faster than those in the body of the pile. Some woods dry faster than others, but in going through some yards the writer observed that they are all usually piled in the same manner.

From the foregoing it is evident that ties and timbers placed in the retorts must contain varying amounts of moisture; that is, some are drier than others and the exact amount of moisture contained in each tie is unknown. All we know is that the material has had an average seasoning. Some pieces may be under-seasoned, while others are overseasoned.

The theory of separating woods according to their moisture content so that they will absorb the proper quantity of preservative is a nice theory, but it does not work out in practice.

PHYSICAL STRUCTURE OF WOOD IN RELATION TO ITS PENETRABILITY BY PRESERVATIVE FLUID.

The group of physical properties of wood now to be considered and on which the penetrability of fluids is directly dependent are: (1) Anatomical structure. (2) Density, weight and hardness. The proportion of wood fibers forming the framework and of other elementary substances contained in wood varies in different parts of the tree, as well as different kinds of trees and also according to age, soil, locality, etc. No two trees are alike in wood structure. Some woods are more porous than others. For these reasons and many others the wood takes the treatment unequally when exposed to the same retort condition, even if it was possible to bring the wood to a uniform degree of seasoning. No two speices of wood have the same anatomical structure. Each one differs from the other in proportion of woody fiber, size, character and arrangement of the wood vessels and wood cells. Some woods take the treatment easier than others. Red oak, for example, takes creosote clear through the heart, while beech under same conditions is very refractory. No doubt this is principally due to the difference in the wood structure of the species. Some engineers have advocated the grouping of various woods according to their degree of absorption, again some have advocated the grouping according to their specific gravity; others would group them according to the density or weight per cubic foot of dry wood; while some say that they should be segregated according to their degree of hardness. To separate woods into so many groups involves a great deal of labor and expense and it is doubtful if the results obtained would justify it. Some experiments have been made to determine the percentage of absorption of various kinds of woods. From experiments made by Mr. F. J. Angier, for the Chicago, Burlington & Quincy R. R. at Galesburg, Ill., during 1908 and 1909, the woods were divided into three groups, as follows:

Class A. Absorbing less than 22 per cent in volume.

[illegible]

Class C. Absorbing more than 30 per cent.

Upwards of 20,000 ties were carefully weighed before and after treatment and a special effort made to find out just what each kind of wood would absorb under normal [illegible]

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*Abstract of paper by W. F. Goltra, published in Proceedings, Wood Preservers' Association, 1911.

TABLE I.—CLASSIFICATION OF WOODS ON BASIS OF PERCENTAGE OF ABSORPTION.

Kind of Wood	No. ties treated	Absorption per cent	[illegible]
Class A.			
Oak, red	[illegible]	20.9	[illegible] to [illegible]
Oak, pin	671	19.5	10
Oak, white	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	18.8	[illegible] to 8
[illegible]	[illegible]	21.8	[illegible]
[illegible]	[illegible]	20.7	8 to [illegible]
Tamarack	2,329	17.1	[illegible] to 8
Class B.			
[illegible]	[illegible]	23.0	[illegible] to 9
[illegible]	[illegible]	22.6	12
[illegible]	[illegible]	28.3	15
Ash	318	23.0	[illegible] to [illegible]
Sycamore	364	26.6	[illegible]
Poplar	1,348	[illegible]	[illegible] to 9
Class C.			
Short leaf pine	2,192	[illegible]	[illegible] to 9
Soft maple	599	33.1	6
Tupelo gum	790	30.7	8
White elm	872	36.6	[illegible] to 1[illegible]
[illegible]	[illegible]	34.9	6 to [illegible]
[illegible]	[illegible]	[illegible]	[illegible] to 8
Red birch	775	33.0	6 to 9

these tests made covering a period of nearly two years. The classes were arranged so that nearly an equal number of woods would fall in each class, there being seven different species of woods in Class A, six in Class B, eight in Class C.

This road has also made known the results of other experiments, also made by Mr. F. J. Angier, to determine the absorption of the various species of woods treated together under like conditions, using the Card Process and an experimental retort. Three or four ties of each kind were treated. All the ties used in this treatment were seasoned at least eight months and carefully selected, so as to be as free as possible from knots and other defects. No steaming or initial vacuum. In each case the solution, consisting of 23 per cent creosote by volume and water containing 5 per cent of zinc-chloride, was introduced at a temperature of 180° F., and a pressure of 150 lbs. was maintained for 3 hours. This was followed by a one-hour vacuum. The results are given in Table II.

Mr. Samuel S. Rowe, who was an authority on wood preservation, furnished the American Railway Engineering Association with his opinion regarding the grouping of timbers. He said:

> In practice it is found that woods will absorb in the course of the ordinary methods of impregnation under pressure of 100 puonds, while in the solution, about as much as is taken up by immersion in 28 to 30 days, and on this basis the following classification is made:
>
> Class A: Those that absorb less than 20 per cent in volume.
>
> Class B: Those that absorb from 20 to 40 per cent; and,
>
> Class C: Those absorbing over 40 per cent.
>
> [illegible] of tests gives more than 25 per cent [illegible] class (B) [illegible] the exceptions [illegible] considering [illegible] it hardly seems worth while to attempt classification.
>
> The condition of the climate and other causes and conditions may vary as well as differences in the same woods in different locations, so that it will be difficult to cover all cases. I have never believed in guessing or jumping at conclusions when it is possible to get something that will aid to guide, and I am sure that this method, no matter how many classes are de[illegible], will [illegible].

From the three experiments given above it is apparent that there is a good deal of variation in the percentage of absorption among the different kinds of woods and even among the same species.

In the first set of experiments made by Mr. Angier, given above, he found red oak absorbed in volume 20.9 per cent, while in the second experiment he found that it absorbed 32 per cent; and the beech in the first experiment absorbed 21.8 per cent, while in the second experiment 27.5 per cent. In Mr. Rowe's classification he gives the per cent of absorption of red oak as 16.9 per cent and of beech 21.4 per cent.

So much depends upon the character and condition of the wood and the pressure, temperature and character of the preservative, that it is very difficult to determine, with any degree of accuracy, the relative percentage of absorption of the various kinds of woods. It is almost impossible to arrive at the same results when woods are treated under different conditions, so that no rule can be safely established regarding the classifying of timbers.

The New York Central Lines requires the separation of woods, accepted for treatment, into five groups, but the grouping was not determined by actual experiments. One of the contracts with the treating company provides that the various woods be separated into groups as follows:

(1) Beech and sycamore.
(2) Gum and elm.
(3) Red, black and water oak.

Various other woods as experience shows can be grouped together.

In another contract made with the same treating company some years later, it provided that the various woods be separated into the following groups:

(1) Beech.
(2) Hickory and sugar maple.
(3) Red, black and water oak.

Various other woods as experience demonstrates can be grouped together.

When the writer was General Tie Agent of the New York Central Lines, he undertook to group the timbers in such a manner as to comply with the specifications contained in these contracts, with the result that the various species were grouped as shown by Table III.

TABLE II.—RESULTS OF TREATMENT OF SELECTED TIES.

Species	No. ties treated	Wt. per cu. ft. before treatment	Gain in weight per cent	Absorption per cu. ft. Zn Cl Lbs.	[illegible] Lbs.	[illegible]
Cypress	1	27.3	98.01	4.09	16.96	[illegible]
Cottonwood	4	23.2	88.31	2.11	12.59	68.1
Willow	1	28.6	82.03	2.42	[illegible]	[illegible]
Birch	4	38.2	67.93	2.75	16.45	53.0
White elm	4	34.4	60.50	2.11	12.59	48.5
Poplar	4	[illegible]	58.74	1.71	[illegible]	45.2
Soft maple	1	32.5	50.58	1.69	10.12	[illegible]
Hemlock	4	31.6	[illegible]	1.78	[illegible]	37.6
Short leaf	4	32.3	44.22	1.47	[illegible]	[illegible]
Hard maple	4	42.0	40.72	1.75	10.46	[illegible]
Red gum	3	35.0	[illegible]	1.45	8.67	29.0
Beech	4	46.0	36.57	1.70	10.18	27.5
Red oak	3	44.0	[illegible]	[illegible]	[illegible]	[illegible]
Ash	3	42.3	34.47	1.69	10.12	[illegible]
Hickory	4	48.4	23.85	1.09	6.55	20.6
Tamarack	1	40.8	20.29	.81	[illegible]	20.3
White oak	4	47.0	7.97	.39	[illegible]	5.98

After three years' trial in separating the different species of woods, the writer comes to the same conclusion as Mr. Samuel S. Rowe, that it is hardly worth while to attempt a classification. It involves considerable labor and expense to separate the ties into groups and perhaps just as good results would be obtained, under present method of treatment, if the woods were not separated at all.

The percentage of absorption of the various kinds of woods is only one of the many factors that enter into the problem, and no undue consideration should be given to it. Due consideration should be given to all factors and it is useless to go into extreme refinements concerning one or two influences and neglect wholly or in part the others, for the deductions will be both incorrect and misleading.

Some engineers think that the groups should be governed by the "specific gravity" of the wood, or "density," or "weight" per cubic foot of dry wood. This rule would apply in general, but there are many exceptions. There are some woods that are light, yet difficult to treat, while there are some that are heavy and easy to treat. Again some engineers would classify or group the timbers, according to their degree of "hardness." Hardness in wood is rather an indefinite term, because the hardness manifests itself differently when such different kinds of instruments are applied to the wood, as the ax, knife, plane, saw, nail, etc., some of which would work parallel to the fibers and others at right angle to them. However, it has been found that it is not always the hardest woods that are most refractory, nor the softest woods always the easiest to treat. As a general rule, perhaps, it is so, but there are several exceptions. For example, red oak is considered a comparatively hard wood, yet it is easy to treat, whereas red gum is a much softer wood, yet more refractory.

In view of the foregoing it is evident that no satisfactory grouping can be made of the various kinds of woods, either according to their absorptive powers or penetrability, or weight per cubic foot, or density and resistance to penetration, or hardness, and in the opinion of the writer it is futile to attempt it.

PERCENTAGE OF HEART WOOD AND SAP WOOD.

The percentage of heart wood and sap wood in timber is another important factor in the problem of grouping timbers for treatment. No two pieces of timber can be found with exactly the same percentage of heart wood and sap wood. The proportion of the heart wood and sap wood in a finished product depends upon the size of the tree, the part of the tree from which it was obtained and upon the size and shape of the manufactured product. The sap wood is considerably more porous than the heart wood in all kinds of woods, therefore the former takes the treatment much easier than the latter. The depth of the preservative absorbed depends upon the resistance of the wood to injection, consequently it requires less time and less pressure to treat the sap wood than it does the heart wood. In treating woods with varying percentages of heart wood and sap wood in the same cylinder, the sap wood naturally absorbs more oil than the heart wood, and if only a limited amount of oil is injected in the material, it is probable that the heart wood might not receive any treatment, or at any rate, only partially, as the limited amount of oil would all be absorbed by the sap wood. However, if the material is treated to a refusal the heart wood would absorb all that is possible to inject into it, after the sap wood has imbibed all that it can contain.

It has been suggested by some engineers that the ties and timbers be grouped as follows:

Heart, less than 20 per cent.
Intermediate, more than 20 per cent and less than 50 per cent.
Sap, more than 50 per cent.

It must be apparent to anyone that is acquainted with the conditions at treating plants that it is impractical to group ties or timbers in such a manner. The material is usually loaded on tram buggies, by day laborers, who possess very little scientific knowledge of this character and who cannot be expected to examine every piece of timber as they load it on the trams to determine the percentage of heart wood and sap wood, so as to know to which of the three classes it belongs.

TABLE III.—EXPERIMENTAL GROUPING OF TIMBERS FOR TREATMENT.

Group No. 1.

Red oak.
Pin oak or swamp Spanish oak.
Black or yellow oak.
Spanish oak.
Water oak or Jack oak.
Scarlet oak.
Shingle oak or scarlet oak.
Willow oak.
Honey locust or honey shucks.

Group No. 2.

Beech.
Sweet birch or black birch.

Group No. 3.

Sugar maple or rock maple.
White ash.
Bitternut or swamp hickory
Shellbark hickory.
Mockernut hickory.
Pignut hickory.
Hackberry, sugarberry or nettle tree.

Group No. 4.

Silver maple, soft maple or white maple.
Red maple, swamp maple or soft maple.
Sycamore.
Red birch or river birch.
White elm, American elm or water elm.
Cork elm, rock elm or hickory elm.
Tupelo, pepperidge sour gum or black gum.

Group No. 5.

Red gum, sweet gum or liquidambar

We have considered the three main factors that enter into the problem of grouping, but there are several others that might be mentioned, such as size and shape of ties and timbers, whether sawed or hewed, method or process of treatment.

In conclusion, it might seem at first that a suitable grouping could be predicated upon the moisture content or degree of seasoning, or upon the known structural characteristic of the various species, or upon the relative percentage of heart wood and sap wood, but it must be apparent from the foregoing that it sounds well in theory, but cannot be worked out in practice. The opinions regarding the proper grouping of ties for treatment are so contradictory and reliable data are so meager and there are so many factors that enter into the problem, it is deemed inadvisable, in the opinion of the writer, to attempt it. Some method or process can perhaps be devised whereby it would be unnecessary to separate the ties or timbers into so many groups for treatment. It is easy enough to discuss the probable behavior of certain species from a purely theoretical point of view, taking into consideration the physiological structure of the different timbers, their organic cell contents, their percentage of heart wood and sap wood, etc., but experience has shown very emphatically that the controlling factors which influence the absorption of different preservatives by different processes, are so complex that theoretical deductions are erroneous more often than correct.

Manganese Steel in Street Railway Special Work.

Manganese steel has long been used extensively by street railways in large cities for the wearing parts in tongue switches, mates, frogs and crossings. This material has been so successful as a substitute for other kinds of steel that its use has become practically a standard requirement in all large installations. This does not mean, however, that methods of applying have been standardized. In our issues of Feb. 8 and March 22 we described in detail the use of manganese steel in frogs, crossings and switch points for steam railway use. In these articles a striking similarity in standards was shown to prevail among the different manufacturers. In street railway work the opposite condition exists, and in certain matters of detail there appears to be as many standards as there are manufacturers. This difference in practice is due in part to the fact that owing to the lighter wheel loads of street railway cars, a greater variation in details is possible.

In practice, preference is apparently given to built-up or cast work with manganese steel inserts, rather than to solid manganese steel construction. In this connection an important difference exists between steam railway and street railway practice. In steam railway practice, where the built-up, insert type of construction is used, it is of vital importance that the manganese insert shall be of the same height as the rail and that it shall bear directly on the tie or base plate. In street railway work a manganese plate, 2 to 2½ ins. thick, is found to be ample, and the use of built-up or cast work, with a plate insert of about this thickness placed at the intersection of flangeways, is the most common practice. In order to secure a firm and even bearing these plates are usually imbedded in spelter. Many different methods of fastening are used, several of which will be explained later.

TONGUE SWITCHES.

The most difficult piece of street railway track material to design satisfactorily is the tongue switch. This is due to the fact that the tongue must be freely movable about a pivot at the heel. Owing to the necessary construction of the base, the attachment of the tongue in such a way as to secure solidity, and at the same time flexibility, is difficult, and has led to the invention of a number of interesting devices.

A late type of the built-up tongue switch is shown by Fig. 1. This design is typical of practice generally, with the exception of the

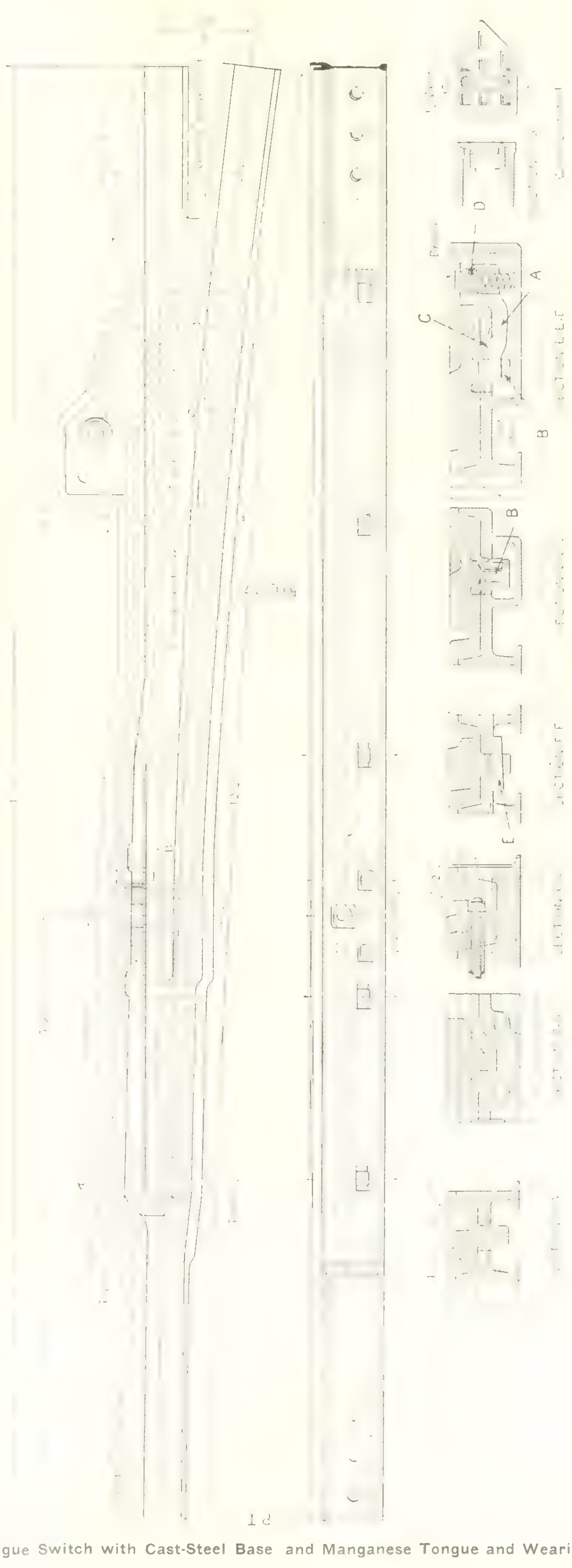

Fig. 1—Tongue Switch with Cast-Steel Base and Manganese Tongue and Wearing Plate.

[illegible] to the base. These two details are seen at a glance to be excellent features.

The main structure is of open hearth cast steel. The wearing plate, shown in sections [illegible] is of manganese steel and rests on a bed of spelter, which is also shown in the sections.

Rigid attachment is made by wedges as indicated at *E*, section *FF* of Fig. 1. The wearing plate extends beyond the tongue both at the point and the heel.

The diameter of the circular tongue heel is 9½ ins., assuring a solid bearing of 60 sq. ins. This is about 5 times the bearing given in the ordinary tongue, in which the bearing is a trifle more than the width of the tread at the heel. The tongue, while sometimes made of symmetrical section, is usually grooved in order to secure lateral stiffness. It is common practice to use a grooved tongue where the radius of the curve is 75 ft. or less. In this particular practice differs from steam railway practice. In steam railway practice the switch point is almost universally straight, the turnout curve beginning at the heel of the switch. In street railway practice, on the contrary, the tongue is a part of the curve.

A lug is provided near the point of the tongue, as shown in Sections *BB* and *CC* of Fig. 1, for attaching spring locking device or electrical equipment.

The bearing faces of both the wearing plate and the tongue are carefully ground so that the parts fit together accurately. An accurate fit in this particular is necessary, not only in manganese but in steel tongue switches, in order to avoid rocking motion, as the tongue can be attached to the base only at the heel end.

A number of interesting devices are in use for making this pivotal attachment. One of the best of these is shown in Section *EE* of Fig. 1. This fastening consists of a cast-steel lever *A*, having jaws which engage the lug *B*. This lug is cast as a part of the tongue, and is slightly rounded to permit of lateral movement by the tongue. The lever has a bearing at *C* and is tightened by means of the screw and spring at *D* which fit into the sleeve of the lever. By means of this screw and spring it is possible to place a downward pressure of about two tons on the heel of the tongue.

A more common type of fastening for manganese tongues is shown by Fig. 5. The heel of the tongue is prevented from rising by the projection *A* in the main casting. The lower end of the tongue is cylindrical in plan and rests on the plate *B*, which in turn is adjusted to the proper height by means of a bed of [illegible] The locking device consists of four pieces, one of which is the wedge *C*. This wedge contains a screw, *D*, which after all parts are in place is turned till the head has a firm bearing against the casting *E*. In this way the possibility of the wedge working loose is avoided, and the tongue is secured firmly in place. Furthermore any adjustment necessary on account of wear is easily made. The casting *E* fits into a slot in the base of the main casting, and is removable. This is the Wharton fastening.

With the ordinary cast steel tongues a very simple form of fastening is in common use. This fastening is shown by Fig. 6. This consists of a pin which sets into a groove of the cylindrical lug at the heel of the tongue, as shown at *A*. This pin fits closely into an opening in the base casting, shown at *B*, and is held in place against the lug by the pin *C*. In the best practice the portion of this device that projects outside the casting is enclosed in a steel box having a removable top, so that adjustments and renewals can be made without disturbing the paving.

The solid manganese tongue switch is similar in design to the composite type, and differs from it only in having a cast manganese base, and by the presence of spelter and wedges by which the manganese wearing plate is fastened to the open hearth base in the composite type.

MANGANESE MATE.

A typical mate with renewable hard-center (manganese) insert plate is shown by Fig. 2. The base is of cast steel. Unlike the condition that prevails in steam railroad practice, the portion of the mate that is subject to great wear, and is therefore protected by manganese, usually becomes, under the extremely frequent service of large cities, unserviceable sooner than the open hearth portion. This is due, not to wear, but to flow of the metal. In the majority of branch-offs almost all of the traffic is along one route. In such cases the metal, from being subjected to frequent impact, will flow—in some cases sufficiently to close the flangeway of the opposite route. Hence the utility of the renewable insert plate. Renewable plates are not in universal use, however, owing to the difficulty involved in removing them from the steel base, and with some street railway men there is doubt as to their practicability.

As shown by Fig. 2 the plate is set in spelter. The plate is further secured to the base by means of wedge or screw fastenings, of which there is a variety of types in use. The most common fastening is a screw passing vertically through the plate into the base. The head of the screw is contersunk and the space around and above the head is filled with spelter. Another form of fastening is the wedge, as explained in connection with the tongue switch. In this fastening a cotter pin, not shown in the drawing, is used for holding the wedge in place. A third form of fastening is the double wedge shown by Detail *C* of Fig. 2. For applying this fastening, projections, as shown at point *C*, are cast in the plate. These projections, as well as the adjacent cast steel portions, have a sloping side. Into the space between these surfaces the wedges are driven, and are then filled over with spelter. Detail *C* is a section taken longitudinally of the track.

In removing spelter it is necessary to soften it with a gasoline flame and then chip it out with a chisel. This is often a difficult process, and is the greatest objection made to the renewable plate.

MANGANESE CURVE CROSS.

The device shown by Fig. 3, known as a "curve cross," corresponds to the turnout frog of steam railroad practice and to the

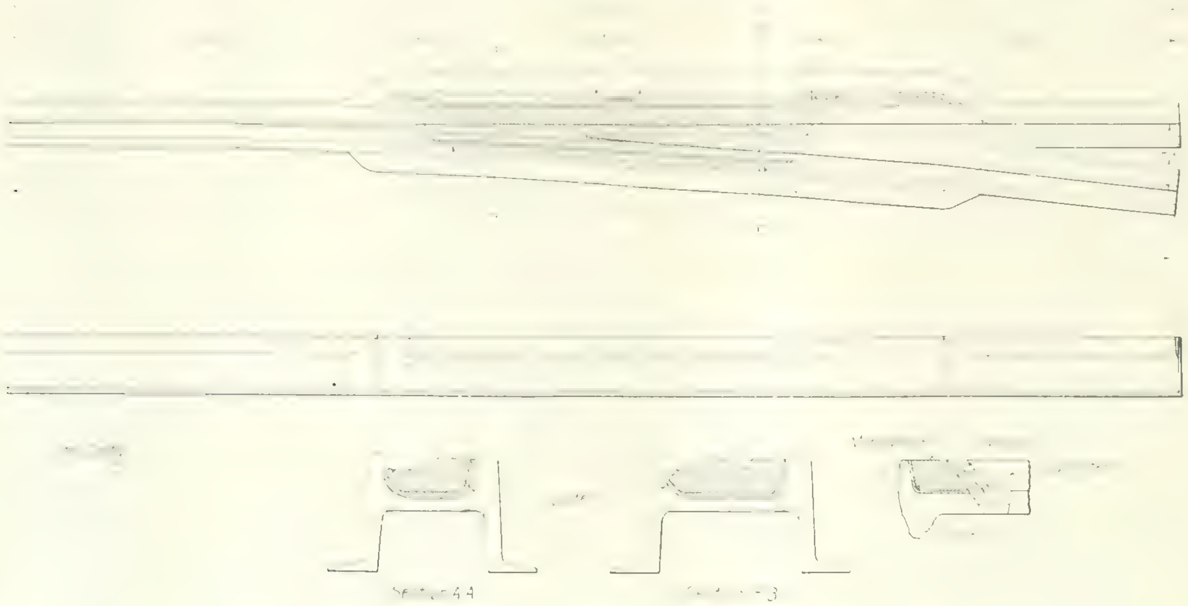

Fig. 2—Cast-Steel Plate with Renewable Manganese Insert Plate.

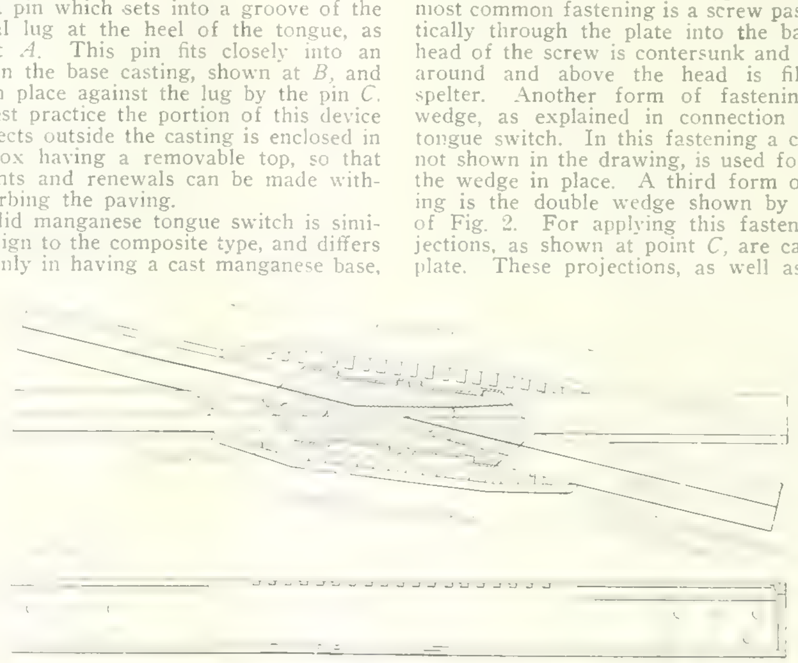

Fig. 3—Girder-Rail Curve Cross with Renewable Manganese Insert Plate.

frog of curved crossing. In this frog the ends are formed of rolled girder rails, and the center is of cast iron, the whole being cast together as shown in the illustration. Renewable manganese plate is applied as in the case of the mate, the plate being imbedded in spelter and the same types of fastening being used.

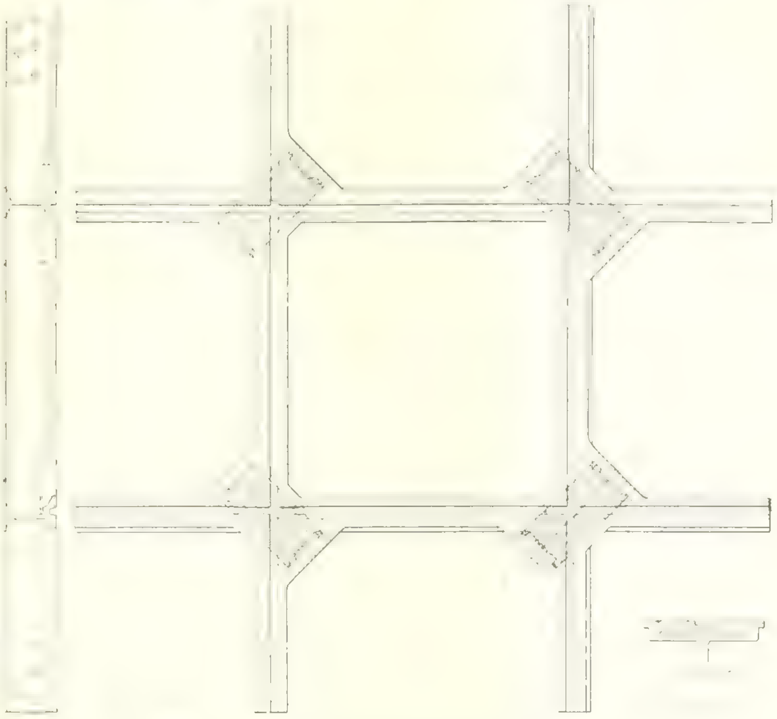

Fig. 4—Typical Street Railway Crossing.

MANGANESE CROSSINGS.

In street railway practice, the term "crossing" is commonly applied only to crossings of straight rails, usually at right angles or nearly so. Where one or both rails are curved, the term "curve cross" is used for the individual frogs. As in matters of design, however, there are no accepted standards governing, and each manufacturer employes a nomenclature that differs from that of other manufacturers. Ordinarily solid manganese is not used in the curve cross or the crossing, insert plates being found to be the more economical. The usual thickness of all insert plates is 2¼ ins. With a right angle crossing, as shown by Fig. 4, it is possible to protect the parts subjected to heavy wear by using small insert plates. The plates are renewable as in the mate and curve cross. Except for the plates, the crossing is made in one piece, the rails being cast into a cast iron or cast steel block at the intersection.

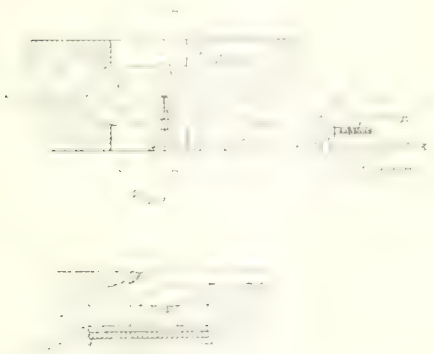

Fig. 5—The Wharton Fastening for Manganese Switch Tongues.

An important feature in street railway practice is the raised floor at the intersection of flange ways. The standard depth of flangeway is 1⅛ ins., and with this depth the tread of the wheel bears on the top of the rail. In order to avoid the jump at the intersection of flangeways, the floor of the flangeway for a distance of 6 ins. to 1 ft. each side of the intersection is raised sufficiently to lift the tread of the wheel slightly above the top of the rail. Through this space the wheel is thus carried on its flange and the wear due to jumping the flangeway is avoided. This plan works out well where the frog, crossing or mate is comparatively new; but flow of metal under the impact of the flange will in most cases eventually cause a deepening of the flangeway, with the result that the tread of the wheel bears on the rail. The raised floor is approached by an incline or taper, and so long as it is effective is an excellent means of securing smooth riding in the car. This plan is made possible through the fact that the maximum load on a street railway wheel rarely exceeds 5 tons.

Owing to wide variations in practice, not only between the different street railway companies, but even in the practice of individual companies, no such degree of standardization is possible as has occurred in steam railway practice. Neither has any accepted standardization been secured in the matter of nomenclature. Since the ordinary run of track arrangement at street intersections is easily classified into a few types, there would seem to be no reason why the names given these types and their parts should not be uniform among the different manufacturers and street railway companies .

The practice outlined above is in the main that of the Lorain Steel Co., of Johnstown, Pa. We are indebted to Mr. E. B. Entwisle, chief engineer of that company, for details and illustrations.

Forging Drill Steel.—Steel having a high carbon content should not be heated above a clear red color, and in an ordinary forge care should be taken that drill bits are well covered by the fuel. The blast should not impinge directly upon one drill or parts of it so as to cause local overheating. Drills should be constantly turned in the fire. Inasmuch as different steels require to be heated and tempered in different ways, it is well that the man at the forge have but one grade of steel to work with at a time.

Pacific Northwest Society of Engineers.—The annual meeting of the Society will be held at Seattle, Wash., June 9 and 10, 1911.

Balanced Grades for Use of Assistant Engines.*

[illegible] N. HUGHES.†

Bulletin No. 120 of the American Railway Engineering Association shows, as adopted, the following as the formula for freight train resistance at slow speeds (7 to 35 miles per hour) on level tangent

$$R = 2.2T + 121.6C$$

where R = total resistance of train,
T = weight of train in tons,
C = number of cars.

When resistance on grades is considered and "X" is the rate per cent of the grade, we have

$$R = 20XT + 2.2T + 121.6C$$

Since the co-efficient C is so near 122, it will be so taken, and the formula will then be

$$R = 20XT + 2.2T + 122C$$

RESISTANCE VARIES INVERSELY AS WEIGHT OF CAR.

This formula considers resistance to vary inversely as the weight of the car between the limits set by a 70-ton load and a 20-ton empty.

R for 1 70-ton car = 3.8 lbs. per ton.
R for 1 20-ton car = 8.3 lbs. per ton.

This is not exactly correct, but near enough for practice. It is well known that some 70-ton cars will show a resistance as low as 2 lbs. per ton, and some 20-ton cars a resistance as high as 10 lbs. per ton. The foregoing formula was the average result from a number of actual tests and is good enough to use as a basis for doing some figuring.

Absolute Rating is Constant.—The number of tons hauled may be figured as being in few or many cars, but the absolute rating for any given grade will be constant. Only the weight of the train will be lighter as the number of cars increases. The following is given as an example:

Let there be 38 cars of 70 tons each on a 0.3 per cent grade,

then $R = 6T + 2.2T + 122C$
$T = 70C$
$R = 574C + 122C$
$R = 696C$
$C = 38$ cars
$R = 26{,}448$ lbs. of resistance.

38 cars at 70 tons per car = 2,660 tons.

If we take an equal amount of resistance and use 20-ton cars on a 0.3 per cent grade, we have

$R = 26{,}448$ lbs. $= 6T + 2.2T + 122C$
$T = 20C$
$26{,}448 = 164C + 122C$
$= 286C$
$C = 92.4$ cars
$T = 1{,}848$ tons.

ADJUSTMENT DUE TO WEIGHT OF CAR.

The resistance of 2,660 tons in 70-ton cars and 1,836 tons in 20 ton cars being the same (26,448 lbs.), it is evident that an adjustment has been made for the weight per car. If we add 15 tons per car to the 70-ton per car train and 15 tons per car to the 20-ton per car train, we will find the total tonnage of each train is about the same.

38 cars × 85 tons = 3,230
92 cars × 35 tons = 3,220

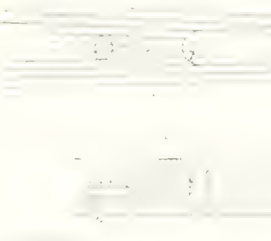

Fig. 6—Common Fastening for Steel Switch Tongues.

This 15 tons is known as the adjustment. It is a function of the grade (in that it will

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*From Bulletin 120, American Railway Engineering Association.

†Assistant to Chief Engineer, B. & O. R. R.

[illegible] resistance due to grade and the co-efficient of T. Following are the adjustments for the different grades from level to 2 per cent:

TABLE OF ADJUSTMENTS

[illegible]	[illegible]	[illegible]	[illegible]
0.0	55.0	1.1	5.0
0.3	15.0	1.4	4.0
0.8	7.0	1.9	3.0
1.0	6.0		

It will be noted that the adjustment decreases with the rate of grade. At 0.7 per cent, it is 8 tons per car (these adjustments are given nearest even ton per car).

[illegible]

Loads.—The resistance of a train of 70-ton cars weighing 1,330 tons on a 0.75 per cent grade is

$$R = (15 + 2.2)T + 122C$$
$$R = 17.2T + 122C$$
$$C = 19$$
$$R = 17.2 \times 1{,}330 + (122 \times 19)$$
$$R = 25{,}194$$

Bearing in mind that the draw bar pull of the locomotive behind the tender must equal the train resistance, and examining the case again, we see that

R on a 0.3 per cent grade with 2,660 tons = 26,448 lbs.

R on a 0.75 per cent grade with 1,330 tons = 25,194 lbs.

By adding on the grade resistance in each case for a locomotive and tender weighing 166 tons, we have

26,448 lbs. + (0.3 × 20 × 166) = 27,444 lbs.

25,194 lbs. + (0.75 × 20 × 166) = 27,614 lbs.

Note that the totals are about equal in both cases.

Balanced Grade for 0.3 *Per Cent.*—The foregoing means that what one engine can haul up a 0.3 per cent grade needs two engines of the same class on a 0.75 per cent grade, and that each engine must develop between 27,444 and 27,614 lbs. of cylinder tractive effort; in other words, the helper engine grade for a 0.3 per cent grade is a 0.75 per cent grade—the same class of power being considered.

If the adjustment was the same for all grades and the resistance of loads and empties the same, it would be found that the rate of the helper grade was considerably higher.

[illegible]

Let R = 6 lbs. per ton in all cases, and the rate of helper engine grade is found to be about 0.9 per cent.

In his book, A. M. Wellington gives it as 0.94 per cent. He advises the use of a grade 10 per cent less than the figured grade, which would make about 0.85 per cent. This latter rate has been used indiscriminately in the past, and many roads are todav paying for it. In other words, the helper grades are in many cases the ruling grades.

FORMULA FOR COMPUTATION OF RATE PER CENT OF HELPER GRADE

Following is a general formula for computing rate of helper grade for any case, whether helping power is equal to road power or not:

Let R = drawbar pull of road engine behind tender at given speed on level tangent,

R^1 = drawbar pull of helper engine behind tender at given speed on level tangent,

W = weight of road engine and tender in tons,

W^1 = weight of helper engine and tender in tons,

T = tons of weight of train,

C = number of cars in train,

G = single engine grade per cent,

X = rate per cent of helper grade.

Then a single engine will haul on X grade

$$R - (20 \times W) = (20X + 2.2)T + 122C$$

Both engines will haul on X grade:

$$[R - (20XW)] + [R^1 - (20XW^1)] = (20X + 2.2)T + 122C$$
$$R - 20XW + R^1 - 20XW^1 = 20XT + 2.2T + 122C$$
$$R + R^1 - 2.2T - 122C = 20XT + 20XW + 20XW^1$$
$$X(20T + 20W + 20W^1) = R + R^1 - 2.2T - 122C$$
$$X = \frac{R + R^1 - 2.2T - 122C}{20(T + W + W^1)}$$

The following table of balanced grades assumes that the helper can do about 10 per cent more work than the road engine. This should be a fact, as the helper engine's work is not sustained for long periods of time. These figures should be safe for grades not more than 10 miles in length. Following is a table of balanced grades for helper engines:

Road Engine Grades	Helper Engine Grades: 1 Helper.	2 Helpers.	3 Helpers.
Level	0.204	0.400	0.587
0.05	0.302	0.536	0.766
0.10	0.401	0.673	0.946
0.15	0.497	0.813	1.114
0.20	0.594	0.954	1.283
0.25	0.688	1.083	1.441
0.30	0.782	1.217	1.599
0.35	0.874	1.336	1.749
0.40	0.966	1.461	1.899
0.45	1.055	1.580	2.039
0.50	1.145	1.699	2.179
0.55	1.233	1.813	2.311
0.60	1.321	1.928	2.444
0.65	1.407	2.037	2.569
0.70	1.494	2.147	2.697
0.75	1.578	2.253	2.814
0.80	1.662	2.359	2.933
0.85	1.744	2.460	3.045
0.90	1.826	2.561	3.158
0.95	1.907	2.659	3.271
1.00	1.988	2.757	3.384

Note.—Values given are based on coal consumption of 4,000 lbs. per hour for road engine and 5,350 lbs. per hour for helper (E 21 engines—13,000 B.t.u. coal).

Compared to the foregoing, Wellington published the following table in his book on the "Economic Theory of the Location of Railways":

Through grade worked by One Engine.	Grade up which the same train can be hauled by the aid of 1 Pusher.	2 Pushers.	3 Pushers.
Level	0.38	0.74	1.08
0.05	0.47	0.87	1.25
0.10	0.57	1.00	1.41
0.15	0.66	1.13	1.57
0.20	0.75	1.26	1.74
0.25	0.84	1.39	1.89
0.30	0.94	1.52	2.05
0.35	1.03	1.64	2.20
0.40	1.12	1.76	2.35
0.45	1.21	1.88	2.49
0.50	1.30	2.01	2.64
0.60	1.47	2.24	2.92
0.70	1.65	2.47	3.20
0.80	1.82	2.69	3.45
0.90	1.99	2.91	3.70
1.00	2.16	3.13	3.95
1.10	2.32	3.33	4.20
1.20	2.48	3.55	4.42
1.30	2.64	3.73	4.65
1.40	2.81	3.93	4.87
1.50	2.96	4.13	5.07
1.60	3.13	4.32	5.27
1.80	3.43	4.68	5.68
2.00	3.72	5.03	6.04
2.20	4.01	5.35	6.40
2.40	4.30	5.67	6.73
2.60	4.57	6.00	7.05
2.80	4.86	6.30	7.34
3.00	5.10	6.58	7.63

Note.—Correct within an unimportant percentage for all classes of engines and conditions of service, the through and pusher engines having the same weight and tractive power.

The foregoing is submitted in the light of information secured since Wellington wrote his admirable book.

GENERAL ARTICLES AND CLASSIFIED ITEMS

A Comparison of Representative Building Laws Concerning Loads and Stresses.*

Among the first questions that arise in connection with the structural design of buildings are those concerning loads and stresses. What loads are to be carried? What structural materials are to be employed for the purpose? What unit stresses will those materials bear with safety? Upon these questions the building code is an authority not to be overlooked. Structural engineering practice is governed and in a large measure dictated by the building ordinances.

The provisions of the building code are therefore deemed of sufficient importance to claim our attention. Generally speaking a building code may be regarded as (1) a composite structure embodying the work of many minds; (2) a compromise measure expressing the preponderance of opinion among varied and conflicting interests; (3) a live growing tissue and consequently always subject to change. Its very nature precludes the idea of perfection, and renders even consistency, however much desired, very difficult of attainment.

A general survey of the building laws of the larger cities should give a fairly accurate notion of the prevailing practice regarding any feature of building construction, and by inference should reveal the collective mind of architects and structural engineers upon the subject. It is proposed in this paper to correlate the provisions of a number of building codes upon the subject of loads and stresses for the purpose of study and comparison.

Whatever may occasion the passage of laws in general to meet the requirements of government, it is thought that laws on the subject here considered are necessary and just only so far as they serve to safeguard life and property. Government would fail in an important function if it should neglect the safety of the lives and property of its citizens. Upon the other hand, laws that go further than is necessary in the direction of safety become burdensome by unduly swelling the cost of construction. Building laws that are unnecessarily stringent are unwise. They have a tendency to defeat their own ends by promoting evasion and a resort to inferior types of construction. Every one naturally prefers the highest type of construction, and nothing but ignorance or considerations of cost could prevent its universal use.

If we accept the propositions just stated, we have arrived at the basic principles on which building laws should be established, principles that may serve as a foundation for sound judgment respecting laws as we find them and a guide to any who may be entrusted with the duty of making or altering them.

Loads and stresses in structures are so intimately related that there can be no intelligent legislation respecting one without considering both. To say, for instance, that a floor must be strong enough to carry safely 100 lbs. per sq. ft. without prescribing safe unit stresses in the materials of construction would leave the matter entirely to the judgment of the designer. Such a law would be indefinite and hard to enforce.

For the purpose of definition let it be understood that by *loads* we mean all extraneous forces acting upon the materials of construction. By *stresses* we mean the resistance offered by materials to hold the loads in equilibrium. Loads in buildings are usually due directly or indirectly to the force of gravity. They include the weight of the materials of construction, known as *dead load*, and the superimposed weights which the build-

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*Paper by [illegible] read before the Pacific Northwest Society of Engineers, March 4, 1911.

TABLE I. LIVE LOADS REQUIRED BY VARIOUS BUILDING CODES.

FLOOR LOADS. Character of Structure	Boston	New York	Philadelphia	Washington D. C.	Pittsburg	[illegible]	[illegible]	[illegible]	Minneapolis	Los Angeles	San Francisco	Oakland	Spokane	Tacoma	Seattle
Dwellings	50	75-50	70	50	70	40	[illegible]	[illegible]	[illegible]	40	60	60	60	50	50
Tenements		75-50	70	50		[illegible]	60	60	50	..	60	60	60	50	..
Apartments		.....	70	50		50		[illegible]	[illegible]	[illegible]	60	60	60	[illegible]	[illegible]
Apartment hotels		75-50	..					[illegible]							
Lodging houses	.	75-50	..			[illegible]	[illegible]				60	[illegible]	[illegible]	[illegible]	[illegible]
Flats		..	.	.	..					60					50
Stable and carriage [illegible] than 500 sq. ft.)		150-75	..			[illegible]					[illegible]	[illegible]	[illegible]		[illegible]
Garages		150							[illegible]						
Hotels	..	75-50	70	50				[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Hospitals		75-50	70			[illegible]					[illegible]				
Asylums		75-50	70			[illegible]									
Detention bldgs., cells, [illegible]		75-50													[illegible]
Schools (except assembly [illegible])	60	100		75			[illegible]	[illegible]							
School rooms (fixed desks)		100									75	[illegible]	[illegible]	[illegible]	[illegible]
School assembly rooms	125	100					[illegible]								80
Theaters (fixed seats)		..									[illegible]				
Churches, chapels, theaters, assembly halls or court rooms*		100													[illegible]
Assembly halls (movable seats)															100
Theaters (over 300 [illegible])		100	..	.		[illegible]									
Public buildings		100													[illegible]
Public buildings (except schools)	1[illegible]		.	110		100									
Public assembly halls		100	120	..	150	100	[illegible]	[illegible]		[illegible]	12[illegible]	[illegible]	[illegible]	[illegible]	
Public rooms of hotels and houses over 500 sq. ft.	100		.			100									
Dance halls	200	100	.							[illegible]					
Drill halls	200	100													
Riding schools	200														250
Armories		100		.											
Libraries		100									[illegible]				
Other buildings	1[illegible]	75	100	7[illegible]			[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]
Office buildings, first floor		150	.				[illegible]	[illegible]	100			1[illegible]	[illegible]	[illegible]	
Halls, offices, dining rooms, cafes or rooms for public use in hotels, etc.		150-75		75											
(Do) for office buildings				110											
Corridors of hotels, public buildings										125					100
Halls of schools, theaters and hospitals											125				
Retail stores	[illegible]	150	120	..		[illegible]	1[illegible]	1[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]	12[illegible]	[illegible]	
Stores for light merchandise		150	..	110		100		..	..	..	..	..	..	..	125
Stores above first floor		150	..	..				..	..	..	..	..	..	..	100
Stores for heavy merchandise		150	..	..							[illegible]	[illegible]	[illegible]	[illegible]	150
Wholesale houses		....	..	..				..	..	250	..	..	..	..	..
Mercantile buildings (heavy)	2[illegible]	....	..	200		[illegible]		1[illegible]							
Storage (light)								120	..	..	..	120	120	120	..
Storage (heavy)															
Commercial buildings							150					250	250	150	
Storehouses		150	150	..	200	100			[illegible]						
Warehouses	[illegible]	150	150	200	200	..	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]	[illegible]
Light manufacturing	125	....	120	..	..	100		120	..	..	125	120	120	120	..
Ordinary manufacturing		....	150	..	200	100	150	150	..	..	250	250	250	150	125
Heavy manufacturing		1[illegible]						..	..	250	..	..	..	..	..
Machine shops		1[illegible]						..	..	..	..	..	..	..	250
Roofs (all)		....	30	..	50	..									
Roofs, less than [illegible] slope	40	[illegible]					[illegible]	70	..	..	30	..	50	40	..
Roofs, more than [illegible] slope		[illegible]							..	..	20	..	30	30	..
Stairs, landing, platforms	70														
Sidewalks		300						[illegible]			150		[illegible]	[illegible]	

*Fixed seats.

Note.—Where two [illegible] are given in New York Code the first [illegible] is for floors above the first.

ing is designed to carry, such as the weight of people, furniture, merchandise, etc., all of which are termed *live load.*

Besides ordinary dead and live load we have to consider *wind pressure* in designing high buildings, *earth pressure* on retaining walls, the effect of [illegible] and the impact of suddenly applied load as on elevator supports, floors of factories, drill halls, etc.

The *weight of materials* is usually known or can be ascertained to the degree of accuracy desired. Several of the codes prescribe unit weights of building materials which must be used in calculating dead load.

Live loads are necessarily somewhat variable and uncertain, and code requirements differ considerably respecting buildings of the same class. In office buildings, for example, the actual applied load is generally much smaller than that prescribed by law as the basis of design. In view of this fact and the possibilities of their removal or rearrangement, partitions in office buildings are frequently treated wholly or in part as live load. It would doubtless be more logical to class partitions as dead load and prescribe a live load somewhere near the actual load usually realized. But this course is not entirely free from difficulty. In cities where high buildings abound many stories are built as lofts. The partitions are afterwards arranged to suit tenants and put up only when needed. Large areas may be without partitions. The weight of the partitions in such buildings can hardly be regarded as a definite dead load. This is one of those matters in structural engineering that seem to call for some exercise of judgment on the part of the designer and some discretion on the part of the superintendent of buildings.

Wind pressure varies in different localities and at different altitudes. There is also some variation in code requirement and still more in engineering practice in regard to wind bracing. It is a rather common legal requirement that buildings having more than a given ratio of height to width shall be designed to resist wind pressure of 30 lbs. per sq. ft., but the designing engineer must decide what resistance the ordinary walls, floors and partitions will offer before determining what further bracing is required. Again the code usually permits unit stress caused by wind pressure to be 50 per cent higher than unit stress from ordinary load. This provision is interpreted in two ways. Some engineers consider the high unit stress applicable to the entire section of a member under its maximum stress due to wind and other load combined, whereas others design the full strength required for ordinary load, at ordinary unit stress, plus the strength required for wind load at 50 per cent higher unit stress. This difference in interpretation of the law leads to widely variant results, affecting the strength of beams, columns and foundations—and makes a considerable difference in the quantity of material required. The law in New York is subject to this ambiguity and dual interpretation, but the present law in Chicago clearly permits the more liberal construction.

Lateral earth pressure and the bearing value of soils are variable and not thoroughly known. These subjects are usually covered in the building code or by rulings of the building department. Owners of business buildings when intending to use the space under the sidewalks are required to build street retaining walls. The design of these walls in Seattle until quite recently was subject to the approval of the street department. Such walls were required to be self supporting and [illegible] earth

TABLE IV.—TABLE OF LOADS—TEN-STORY OFFICE BUILDINGS.

STORIES	Boston.	New York.	[illegible]	[illegible]	[illegible]	St. Louis	Kansas City	Minneapolis	Los Angeles	San Francisco	Oakland	Spokane	Tacoma	Seattle
Live load—Roof	40	50	40	40	40	40	50	[illegible]	[illegible]	[illegible]	30	50	[illegible]	[illegible]
Live load—Office floors	100	75	100	[illegible]	50	70	[illegible]	[illegible]	[illegible]	60	75	[illegible]	[illegible]	[illegible]
Live load—First floor	125	125	120	110	[illegible]	1[illegible]	1[illegible]	[illegible]	1[illegible]	125	150	150	150	[illegible]
Live load—Per cent on columns	Varies	Varies	85%	100%	60%	Varies	Varies	V[illegible]	100%	[illegible]	60%	[illegible]	[illegible]	V[illegible]
STORY	COLUMN LOADS PER SQUARE FOOT OF FLOOR AREA.													
10th	140	150	[illegible]	140	134	140	150	130	140	130	130	[illegible]	[illegible]	150
9th	3[illegible]	325	[illegible]	315	[illegible]	336	[illegible]	305	315	[illegible]	305	[illegible]	[illegible]	[illegible]
8th	501	496	[illegible]	[illegible]	412	499	[illegible]	476	490	426	450	470	[illegible]	[illegible]
7th	[illegible]	664	[illegible]	665	[illegible]	[illegible]	664	[illegible]	[illegible]	[illegible]	595	[illegible]	605	664
6th	830	829	[illegible]	810	679	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	740	760	[illegible]	829
5th	978	989	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	834	885	[illegible]	895	989
4th	1116	1145	1244	1190	937	1116	1145	1125	[illegible]	[illegible]	1030	[illegible]	[illegible]	[illegible]
3rd	1244	1298	[illegible]	1365	1062	1262	1298	12[illegible]	1365	1106	1175	[illegible]	1185	1298
2nd	1362	1407	[illegible]	[illegible]	1187	1403	1407	1387	1540	[illegible]	1320	1340	[illegible]	1407
1st	1470	1552	[illegible]	1715	1312	1542	1552	[illegible]	1715	[illegible]	[illegible]	1485	1175	1552
Basement	1632	1721	2011	[illegible]	1462	1709	1734	1687	[illegible]	1553	1655	1675	1665	1721
Relative load compared to New York	95%	100%	117%	[illegible]	[illegible]	[illegible]	101%	[illegible]	114%	[illegible]	[illegible]	98%	[illegible]	[illegible]

NOTE: Assumed dead load of floors and roofs:—

Floor finish and plaster..................20 lbs.

5-inch concrete slab......................60   80 lbs.

Allow for beams and girders..................20 lbs.

Total ....100 lbs.

TABLE I.—REDUCTION OF LIVE LOAD PERMITTED BY VARIOUS BUILDING CODES

[illegible]	[illegible]	[illegible]	[illegible]	Washington D. C.	Pittsburgh	Cleveland	Chicago	St. Louis	Kansas City	Los Angeles	San Francisco	Oakland	Spokane	Tacoma	Seattle
[illegible]	[illegible]			No Provision in Code for Reductions	No Provision in Code for Reductions	No Provision in Code for Reductions	[illegible]	[illegible]		No Provision in Code for Reductions					
[illegible]			[illegible] A								80%	80%	80%	80%	
Cols. found't'ns, hotels, etc.	.....		do								60%	60%	60%	60%	
[illegible]			[illegible] A												
[illegible]			do												
[illegible]															
[illegible]	[illegible]		[illegible]												
[illegible]	[illegible]		[illegible]												
[illegible]	[illegible]		[illegible]												
[illegible]	[illegible]		[illegible]												
[illegible]	[illegible]		[illegible]												
[illegible]	[illegible]		[illegible]												
Carrying 8 floors	55%		[illegible]												
[illegible]	[illegible]		[illegible]												
Carrying 1st floor above	.....							100%							
Carrying 2d floor above	.....						. . .	[illegible]							
Carrying 3d floor above	.....						. . . *	90%							
Carrying 4th floor above, etc	.....						....								
[illegible]							.	[illegible]							
[illegible]															
Cols. found t'ns. roof and top floor..	.....	100%					. . .	100%	100%						100%
1st floor below		95%					85%	[illegible]	[illegible]						95%
2d fl., etc., to 50%..	.....	90%					80%	90%	90%						90%
							75%								

*General code.
†Reinforced concrete code.
A = Tributary floor area.
[illegible] manufacturing buildings.
[illegible] reduction for top floor regardless of number of stories.

ods of designing were given which were entirely inadequate. In a recent ordinance a more logical formula is given, the subject is transferred to the building department, and permission is given to support the walls laterally by means of the building itself. The street retaining wall is thus made a part of the structure. This arrangement conforms to the prevailing practice in large cities.

Another variable factor in load calculations is the matter of reducing the amount of live load upon the different elements of construction. Some codes, as in Chicago, require the floor arch or slab in certain buildings and the supporting beams to be designed for the entire dead and live load, the girders for dead plus 80 per cent of the live load, and the columns and piers for dead plus 60 per cent of the live load, whereas some other codes as in New York require beams and girders as well as floor arches and slabs to be designed for the entire dead and live load, but permit in certain classes of buildings a reduction of 5 per cent of the live load on the columns for the top floor but one, and 5 per cent further reduction for the next lower floor and so on until the reduction reaches a limit of 50 per cent of the live load. The code is usually silent as to reducing the live load on foundations. Some engineers and architects omit all live load. Some leave it all in and others take a middle course. The logical procedure when the soil is somewhat yielding, is to approximate the actual load that will be realized in order to avoid unequal settlement, but with very hard soil, piles, caissons or rock the full columns load should be used in the calculations.

Some engineers neglect the weight of the column itself, while others include in it the column load. Some again attempt to calculate the dead loads exactly as they are distributed according to the architectural plan, while others find the average weight per square foot of floor surface and assume the floor to be uniformly loaded. The former will place a heavier beam under a partition than elsewhere; the latter assume that the entire floor

TABLE V.—THE COMPARATIVE STRENGTH OF FLOOR GIRDERS FOR OFFICE BUILDINGS

	—Structural Steel—							Reinforced Concrete					
Cities.	A	x	B	C	D	Concrete Stresses.	E	F	Bending Moment	G	H	I	J	K
Boston	.90x = 75	[illegible]	[illegible]	1.08	183	500	87	[illegible]	WL/10	1.25	1.25	229	129	[illegible]
New York	1.00x = [illegible]	75	1.00 × [illegible] 75	1.00	175	[illegible]	87	1.00	do	1.25	1.25	219	119	1.58
Philadelphia	.86x = 75	87	[illegible]	1.06	187	600	104	[illegible]	WL/8	1.00	1.20	225	125	1.66
Washington	1.00x = 75	75	[illegible]	1.00	175	500	87	[illegible]	WL/10	1.25	1.25	219	119	1.58
Chicago	[illegible]	[illegible]	[illegible]	[illegible]	194	700	121.8	1.40	$WL^2/12$	1.50	2.10	407	307	4.10
St. Louis	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	800	140	[illegible]	do	1.50	2.41	454	354	4.70
Kansas City	1.00x = 75	75	1.00 × [illegible]	1.00	[illegible]	750	131	1.50	WL/10	1.25	1.88	[illegible]	229	3.05
Minneapolis	1.00x = 75	75	1.00 × [illegible]	1.00	175	650	114	1.31	WL/12	1.50	1.97	345	245	3.26
Los Angeles	1.00x = 75	75	[illegible]	1.00	175	500	87	[illegible]	WL/8	1.00	1.00	175	75	1.00
San Francisco	[illegible]	94	[illegible]	.845	194	500	87	1.00	$WL^2/12$	1.50	1.50	290	[illegible]	2.53
Oakland	1.00x = 75	75	1.00 × [illegible]	1.00	175	500	87	[illegible]	$WL^2/8$	1.00	1.00	175	75	1.00
Spokane	.80x = 75	94	[illegible] 75 = 60	.915	194	500	87	1.00	WL/8	1.00	1.00	194	94	[illegible]
Tacoma	.80x = 75	94	.80 × 75 = 60	.915	194	700	121.8	[illegible]	$WL^2/12$	1.50	2.10	407	307	4.09
Seattle	1.00x = 75	75	[illegible] 75 = 75	1.00	175	500	87	[illegible]	WL^2 [illegible]	[illegible]	1.00	175	75	1.00

Note.—Dead load of floors assumed at 100 lbs.

Ax = Nominal live load that a Seattle steel girder will carry.

B = Actual live load that a girder must be designed to carry.

C = Relative strength of girders as required = $\frac{B + 100}{175}$

D = Nominal total load that a Seattle steel girder will carry = (x + 100). (Using .9% steel reinforcement.)

E = Relative strength of given beam as affected by changes in unit compression stress.

F = Same relation in terms of Seattle beam.

G = Relative strength as affected by formulae for bending moment.

H = Relative strength as affected by combined influence of unit stress and bending formulae.

I = Nominal total load that a Seattle reinforced concrete girder will carry.

J = Nominal live load that a Seattle reinforced concrete girder will carry.

K = Relative live load that a Seattle reinforced concrete girder will carry = $\frac{75}{J}$

TABLE III. Allowable Stresses and Bending Formulas of Various Building Codes.

PERMISSIBLE UNIT STRESSES IN STEEL AND CONCRETE	Boston	New York	Philadelphia	Washington, D. C.	Pittsburg	[illegible]	[illegible]	St. Louis	Kansas City	Minneapolis	Los Angeles	San Francisco	Oakland	Portland	Spokane	Tacoma	Seattle
Steel structural Ext. Fibre	16000		F = 4	16000	F = 4		16000	F = 4	16000	16000		16000	16000		16000	16000	16000
" " Comp. Cols.	$\frac{16000}{1+\frac{L^2}{20000 R^2}}$	15200 — 58 L/R	$\frac{65000}{1+\frac{L^2}{11000 R^2}}$		F = 6		16000 – 70 L/R			17100 – 57 L/R		15000 – 57 L/R	17100 – 57 L/R		17000 – 57 L/R	17100 – 57 L/R	[illegible]
" " L/R 40		12880	F = 4	12880	Code refers to standard works on Engineering for Design			12400	12880			Limited to 13500	Limited to 12000		Limited to 12000	Limited to 12000	[illegible]
" " " " 60		11720		11720				11300	11720								
" " " " 80		10560		10560				10600	10560								
" " " " 100		9400		9400				9800	9400								
" " " " 120		8240		8240				8600	8240								
Reinforced Concrete:																	
Concrete (direct comp)	400	350	500	400	.	500	400	500		600		500	400	400	450	[illegible]	450
" bending comp	500	500	600	500		700	700	800	750	650	450	500	500	600	500	.35 Ult.	500
Reinforcement: -																	
Medium Steel Tens. . . .	16000	16000	16000	16000		16000	18000	14000	16000	16000	500	[illegible] E. L.	1/3 E. L.	1/2 E. L. 18000	/3 E. L.	2/3 E. L.	1/3 E. L.
High El. Limit Steel Tens		.			.	20000		20000	. . . . . .	20000	16000	20000	[illegible]	[illegible]	do	do	[illegible]
Medium Steel Compr. . .		10000		14000		10000	[illegible] Ec [illegible]	[illegible]	[illegible]	8000		15 [illegible] Conc.					15 × Conc.
Spiral Hooped Cols., Conc			1000				¼ Ult. Not over [illegible]	500		800	750	¼ Ult. or 700	750	750	750	¼ Ult. or 500	
" Vert. Steel, V.R			V. R & R R.				[illegible]	[illegible]		10000	H. P.	15 Conc.		11250		Not over [illegible]	
" " Hooping, H.R			[illegible] 4				2.5 × V	2.4 × V		2.4 × V	[illegible]	H. P. [illegible] laterally		2.4 × V		2.5 × V	
Bending Moment on Girders and Beams.	WL/10		WL/8	WL²/10		WL²/10	WL/12	WL/12	WL/10	WL/12	WL/8	WL/12	WL/8	WL/10	WL/8	WL/12	WL/8
In Steel Cols. filled with concrete.																	
							Varies										
Figure the Concrete @ .														750		¼ Ult.	
" " S[illegible]						17000	16000 max.; 18000 – 70 L/R							11250		Ec [illegible]	

[illegible]

should be strong enough to support all ordinary partitions howsoever arranged.

If now we turn to the subject of stresses we shall find variations no less marked both in law and in practice than we found in the treatment of loads.

There is pretty general agreement regarding stresses in structural steel, if we except the formulas for columns and compression members, but in timber and masonry construction and in combinations of steel and concrete the variations are wide. It can readily be understood that these variations combined with variable load requirements and methods of computing produce some rather contradictory results in building construction.

By comparative studies we may hope to discover some of the present legal inconsistencies and point the way to their avoidance in future enactments.

The building codes selected for comparison in the accompanying tables are those of our principal American cities, arranged geographically from the Atlantic to the Pacific.

Table I shows the live load required by law for all classes of buildings.

Table II shows the live load reductions permitted.

Table III shows the permissible unit stress in materials.

Table IV shows the effect of Tables II and III applied to a ten-story office building.

Table V shows the effect of changes in unit stress, load reductions, bending formulas, etc., upon steel and reinforced concrete work, using the Seattle law as a basis of comparison.

The variable factors herein noted as affecting the structural design may be summarized as follows: (1) Live loads required; (2) reductions permitted; (3) unit stress in material; (4) bending moment formulas; (5) designers' interpretation of the law, and (6) administration of the code.

The Hydro-Electric Development of the Colorado River in Texas.

The natural dam on the Colorado River at Marble Falls, Texas, was characterized in Water Supply and Irrigation Paper No. 165, written by Thomas U. Taylor of the United States Geological Survey staff, and issued by the Department of the Interior in 1904, as the most remarkable along the course of the river. At this point there is a natural fall of 26 ft. and power is developed and used at Marble Falls for electric light and power and to pump the water supply for the city. This fall, together with a fall of about 12 ft. at a distance of 1,000 ft. down stream and a third fall of 15 ft. within one mile and at the site of the new Marble Falls dam, together with the slope of the river bed and the depth of the back water above the upper falls, will furnish a head of 70 ft. at the site of the new dam. This site offered greater possibilities for water power development than any other point in Texas. The rights to the site were secured by Mr. C. H. Alexander of Dallas, Texas, who has been the moving spirit in this enterprise since its inception by him several years ago. Mr. Alexander has organized the Colorado River Power Co., of which he is president, for the purpose of developing the natural power resources of the Colorado River. The power company engaged the W. H. Zimmerman Co., engineers and constructors, to design, build and equip a power plant at this point. The data, plans and views relating to this installation were secured by courtesy of the engineers.

Figure 1 shows a map of the Colorado River and small tributary streams in the Marble Falls region. It will be noted that in addition to the dam at Marble Falls there is to be constructed a storage dam known as the Cummins dam, 10 miles distant up stream, and a power dam called the lower dam, 12 miles down stream from the installation at Marble Falls.

The present upper dam is constructed of concrete, and the head now secured is 7 ft. This dam is to be raised until a head of 42 ft. is secured. The original plan contemplated the use of this dam for storage only, but it now develops that in addition to furnishing a reserve supply for the dams down stream, power units will be installed and operated in parallel with the plants at Marble Falls and the lower dam.

The lower dam is to be a power dam and will utilize a head of 50 ft. The power developed at this dam will be transmitted over the same system which connects the other two developments. The three dams are to form a comprehensive power development in that section of the river and in conjunction with these three power dams, a [illegible] storage dam will be constructed at a point about 80 miles

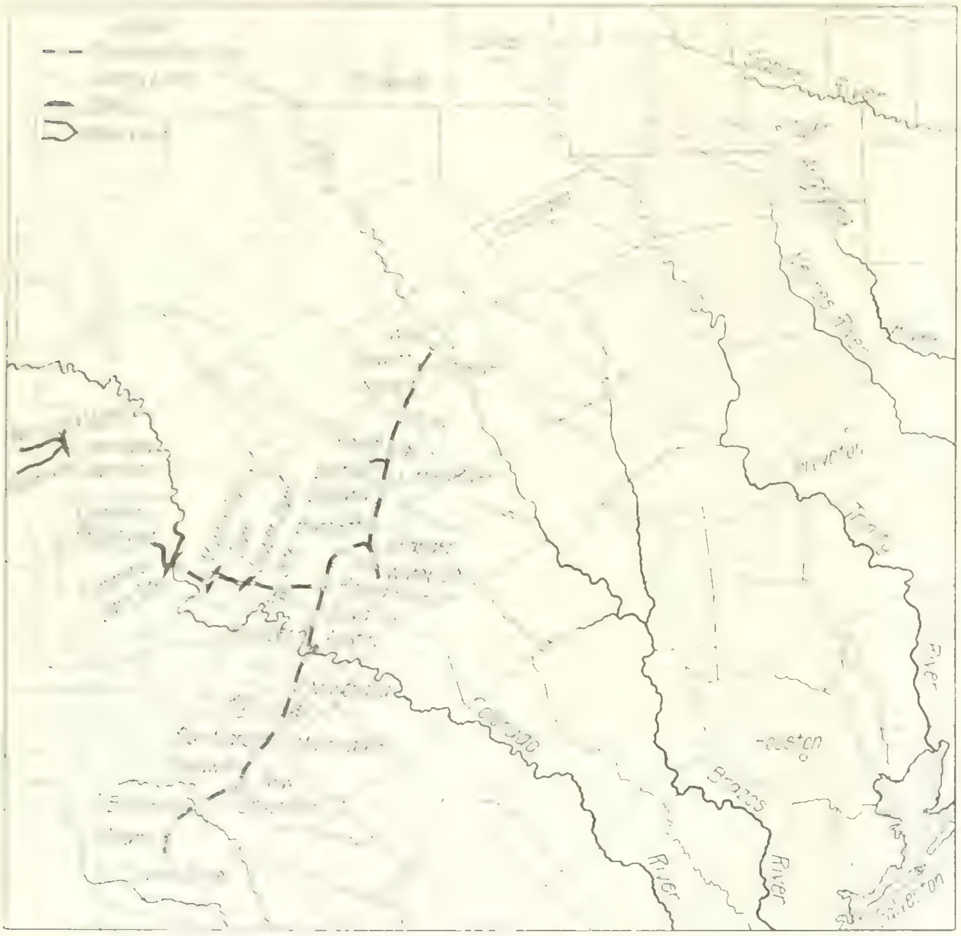


Fig. 1—May of Transmission Lines and Power Market Region.

by river above the Cummins dam on the San Saba River. The San Saba reservoir, to contain approximately 100,000 acre feet, will be erected by constructing a dam about 80 ft. in height across a comparatively narrow gorge, the dam being 300 ft. in length at the base, 650 ft. at the 40-ft. level and 1,150 ft. at the top or 80-ft. level.

This dam is to be constructed by reinforced concrete, and will be of a design quite similar to the Marble Falls dam. Provisions will be made to receive four generating equipments, so that it can be installed later if desired.

Hydrographs of the flow of the Colorado River at Austin were available for all years from 1896 to 1903 inclusive. These were of much value, with slight modifications of course in estimating the flow at Marble Falls. In addition to this earlier data, hydrographs were compiled for Marble Falls for 1908 to 1910. There is now a gauging station of the United States Weather Bureau at that point.

Figure 2 shows the hydrographs taken at Marble Falls for the year 1909. The key to the various shadings is given in the table on the diagram. It is estimated that the minimum primary power output of the plant will be 56,325,000 h. p. hours per year, and the company will contract to sell primary power aggregating that amount. This primary power output corresponds to a river flow of 740 cu. ft. per second continuously throughout the year.

Reference to the hydrograph for 1909 will show that the minimum river flow was less than 150 cu. ft. per second. Assuming that the several dams and storage reservoir had been in operation during the year 1909 the deficiency at any given time could have been made up either by drawing on the storage back of the Cummins dam or by drawing on the San Saba reservoir. For example, it will be noted that the river flow was below that required for [illegible] the estimated primary power output from Jan. 1 until about April 25, but the efficiency could have been entirely made up from the storage reservoir at San Saba.

Figure 1 also shows the transmission lines and the area which constitutes the power market. It will be noted that power is carried 40 miles to the southeast from Marble Falls to a point near Austin. From there the lines will run in northeasterly and southwesterly directions, terminating on the north at Waco and on the south at San Antonio, 110 and 80 miles respectively from Austin. The maximum distance of power transmission will thus be seen to reach 150 miles from Marble Falls. This transmission line will distribute the power ultimately developed in the comprehensive system embodying the three plants.

The majority of the principal power buyers are electric light, traction and power companies now operating steam plants in the various cities and towns along the transmission lines. Secondary power will be sold to some of the heavy consumers who own steam plants on contracts which provide that the purchaser shall operate his steam plant at such times as secondary power is not available, although water power may be used at such times to assist the purchaser to carry his peak loads, provided that the purchaser will deliver his surplus steam power during the off peak periods to the water power company when desired.

In Figure 2 the shaded areas lying above the horizontal line corresponding to a stream flow of 740 cu. ft. per second represent secondary power. It will be noted that this secondary power was equal in amount to 36 per cent of the primary power output for the year 1909.

Figure 3 shows the down stream elevation of the completed dam. It will be noted that the over-all length of the dam is 748 ft. and its greatest height is approximately 115 from the lowest point of the original main channel under the power house section to the top of the concrete of the transforming and transmission tower. The dam is divided into three main sections, which will be referred to as the operators' quarters, power house section and sluice gate and spillway section, as shown by Fig. 4. The compartment form of reinforced concrete construction was used throughout the entire dam.

The operators' quarters consist of two two-story apartments, each of eight rooms. With the exception that stove heat will be used, these apartments will have the modern conveniences of city apartments; all plumbing will be modern.

The power house consists of nine compartments, three of which will be occupied by the three 550-h. p. vertical Victor turbines, direct connected to 350 k. w. Westinghouse generators now being installed. Each unit is equipped with a Lombard oil governor. Five additional compartments will provide for future units of 2,200 h. p. each, similar in design to the above. One compartment will contain the high tension transformers and switching apparatus.

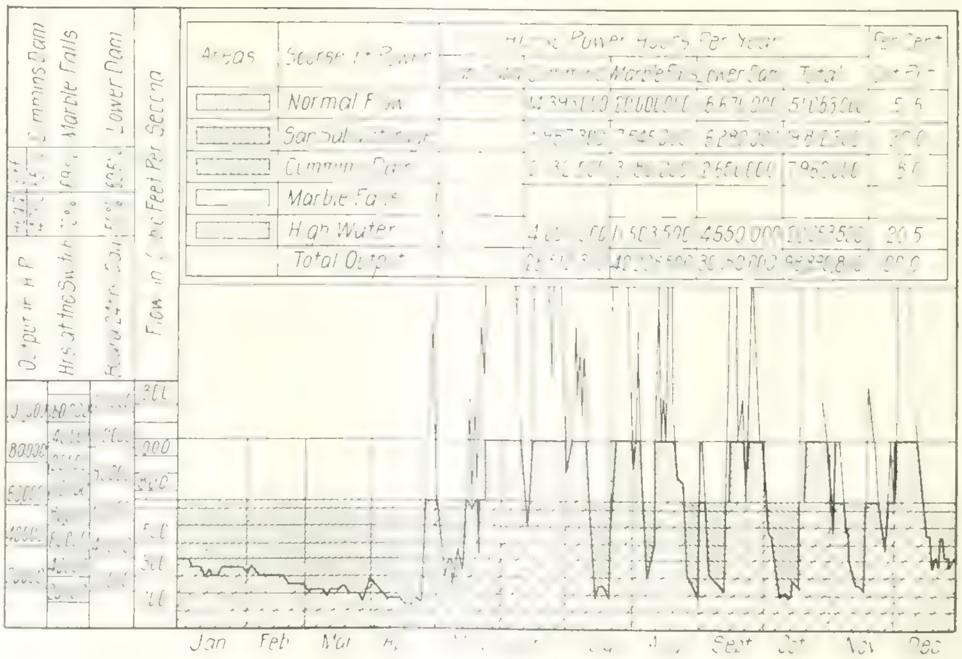


Fig. 2—Hydrograph of the Colorado River at Marble Falls, Texas, Year 1909.

Figure 4 shows a cross section of the power house which is typical of the installation of the units already purchased. The water is admitted to these units through butterfly valves instead of the usual head gates. Head gates, however, will be used in the future installations. The turbines will be protected from foreign matter by trash racks 18 ft. long and 5 ft. wide, and built of ¼x2½-in. flat steel bars spaced 2 ins. c. to c., and supported on I beams which are imbedded in the concrete. The flow of the water through these trash racks will be about 2 ft. per second under full load.

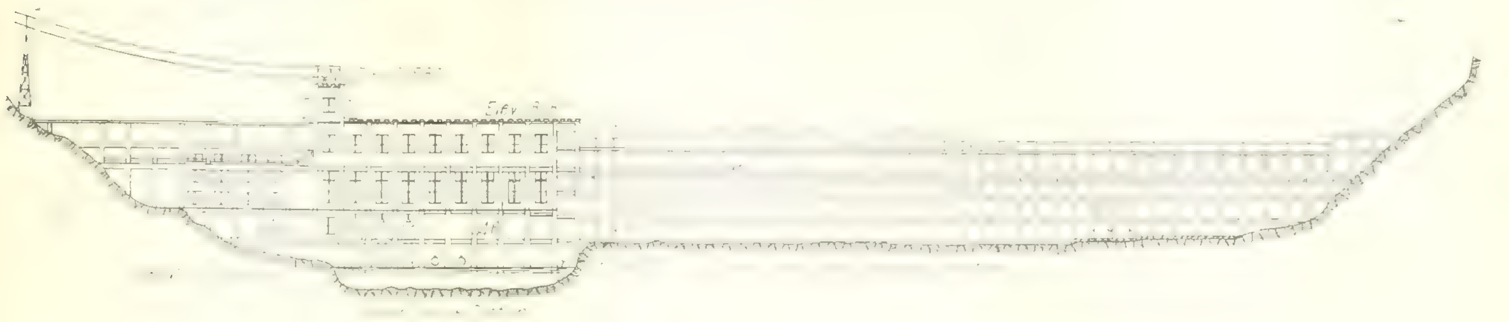


Fig. 3—Down-Stream Elevation of Marble Fall Dams.

The design of the power house section differs from that adapted in hollow concrete dams in that the bulkhead is so designed that the machinery in the power house does not set directly under the bulkhead, thus avoiding any possibility of leakage or moisture affecting the apparatus. This also makes it possible to equip the power house with a suitable traveling crane.

In order to make it possible to inspect the footings of the dam at any time it may be thought desirable, a permanent concrete coffer dam 25 ft. in height has been built in front of the power house and provided with three 48-in. pipes leading through the bulkhead to the tail race as shown in Fig. 4. These pipes are figured to carry the ordinary flow of the river, thus providing a means of diverting the water from the spillway section to allow the inspection of the footings. By providing a small drain pipe the space between the coffer dam and power house can also be drained, thus making the upstream side of the power house and bulkhead dry. Tail gates are also provided for each compartment of the power house so that the water may be pumped from any one compartment and inspection of the footings made possible. From this it will be seen that every part of the dam is accessible for inspection and repairs. The tail race gates also provide a weir which can be used for testing the turbines at any time.

In order to provide ample means for handling the high floods which frequently occur on the Colorado and which have been recorded as high as 123,000 ft., sluice gates have been placed over 35 of the bottom compartments of the sluice gate and spillway section and a 5 ft. movable crest extends across practically the entire top, and will be lowered in times of extreme floods to allow part of the water to pass over the top of the dam. These features of design are shown in Fig. 5.

The sluice gates are 7½x8 ft. in size and are made of structural steel built up of 9-in. channels and I beams, the upper faces being covered with flat steel plates. The frames are built up of structural steel shapes in 20-ft. sections, and are so designed that when finally placed in the concrete will be practically one continuous structure from end to end. The sluice gats are opened one at a time by a hydraulic hoist which is mounted on a transfer car. The hoist is completely equipped with motor driven pump capable of producing a hydraulic pressure of 2,000 lbs. per sq. in., and a reservoir for the water, both of which are also mounted on the car. The upper end of the piston rod of the hoist is fitted with a cross-head to which the two rods comprising the gate stems are secured for opening and closing the gates. Stuffing boxes are provided where the gate stems pass through the bulkhead to prevent leakage.

The movable crest is made in 10-ft. sections of 3-in. planks bolted to angle iron frames, and secured to the top of the dam by heavy hinges. The joints between the sections and at the base are made water tight by means of rubber belting. The braces at the back of each section are of angle irons, pin connected to the frame of the gate at the upper end and at the lower end terminate in round plates, which when the gates are operated, move along the vertical guides shown in the figure. The sections are operated one at a time by means of a hydraulic hoist similar to that used for operating the sluice gates. To hold the sections rigid in a vertical position against the pressure of the water, the lower end of the braces are keyed to the guides.

In the handling of floods the sluice gates will always be opened first, after which the movable crest will be lowered if necessary. By this means the water flowing through the dam forms a cushion for the water flowing over the dam and thus minimizes the scour at the foot of the dam.

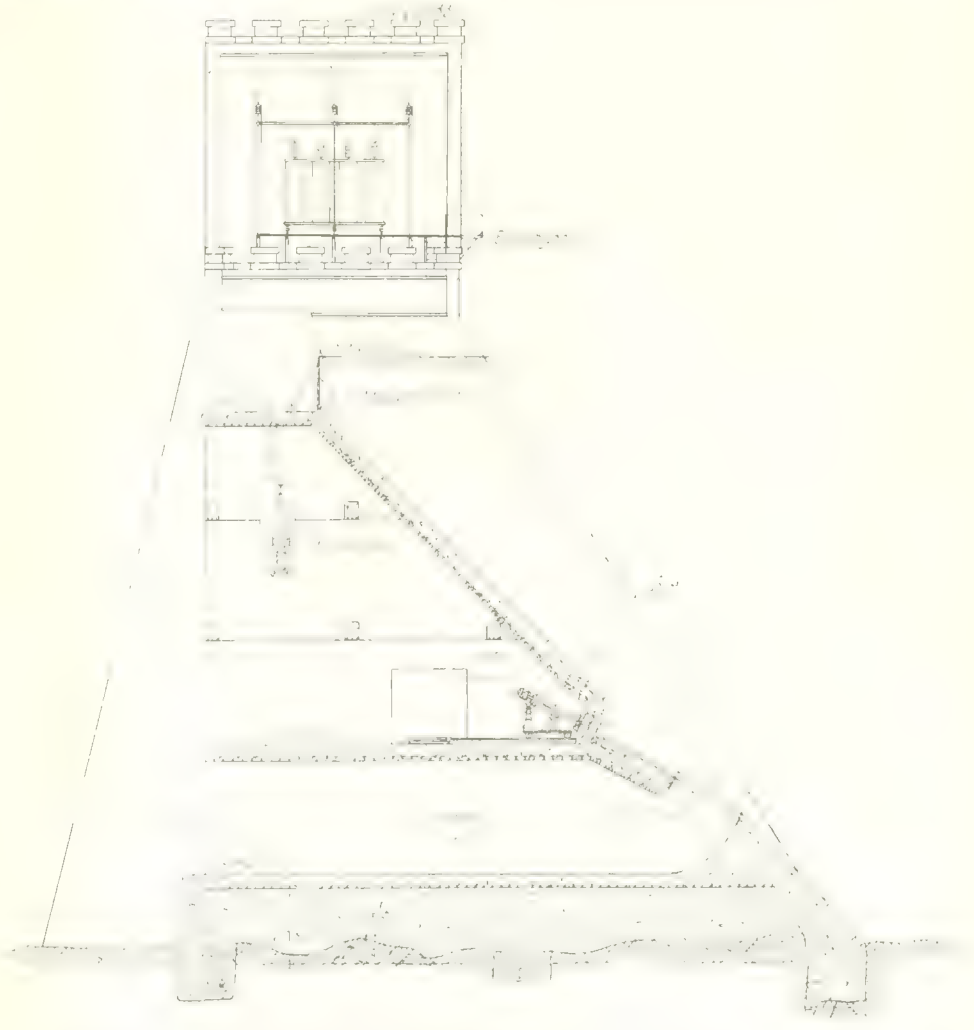


Fig. 4—Cross-Section Through Slime Gate and Spillway Section, Marble Falls Dam.

Figures 6 and 7 show the dam during construction. The concrete forms were built in sections and were moved from buttress to buttress across the river one story at a time The second floor was laid as soon as the first story buttreses were completed. A notch was left in the second floor over each buttress in the first floor to form a bond for the corresponding buttresses in the second floor. These walls and floor are all reinforced. In all about 23,000 cu. yds. of concrete were used on the job.

The concrete was all mixed on the sloping banks of the river. These banks rise very abruptly to a height of 150 ft. above the river bed. The raw materials were conveyed to the mixers by means of chutes from the top of the bank, and the mixed concrete was then conveyed by chutes to dump cars of 30 cu. ft. capacity running on tracks lengthwise of the dam. No trouble was experienced by the segregation of the concreate materials due to the use of the chutes after mixing. Batch mixers of ⅔ cu. yd. capacity were used in mixing the concrete. Electric motors were used to drive the mixers, the current being generated by the old power plant previously mentioned. Power from the same source was also utilized to run the centrifugal coffer dam pump.

[illegible] started in the fall, [illegible] hour shifts. Floods have caused considerable trouble and delay in the construction. At one time in less than two hours the river rose from normal and poured over the top of the 25-ft. concrete coffer dam, carrying away some of the form work, some green concrete and two of the 48-in. by-pass pipes, both of which, however, have been recovered.

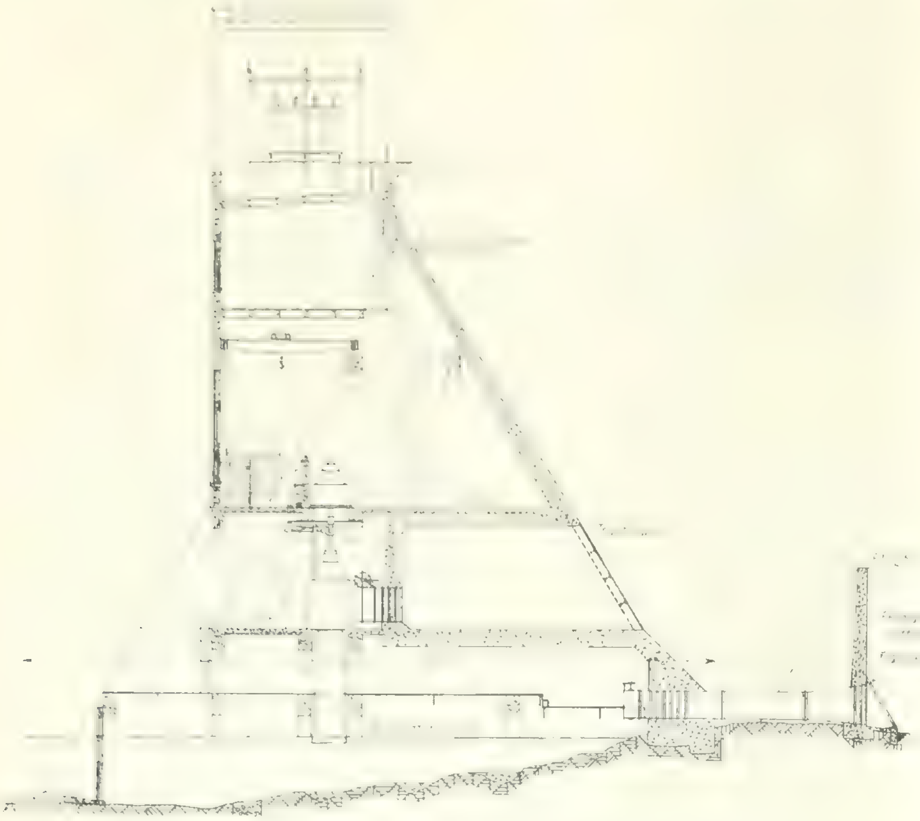


Fig. 6—Cross-Section Through Power Section, Marble Falls Dam.

Effect of Motor Traffic on Oil Macadam.

Three general methods of treating broken stone roads have been used in the United States in an effort to overcome the defects of the old type of water-bound macadam. These general methods are: By the use of dust or palliatives and surface treatment; the use of binder by the mixing method; the use of binder by the penetration method. Pavements constructed by the penetration method require the application and partial penetration of asphaltic oils or tars on the top course or courses of the macadam. In California pavements constructed by this method are known as oil macadam. Inasmuch as this type of pavement has been in use in a number of cities in that state for the past several years, some information has been obtained as to the effect of traffic upon it. In a recent issue of Pacific Municipalities Mr. S. J. Van Ornum, City Engineer of Pasadena, Cal., describes the effect of motor traffic on one of the first oil macadam streets constructed in that city.

The general method of constructing oil macadam pavement which has been used in Pasadena is similar to the construction of macadam roads, except that heavy California asphaltic oil is applied to the top layers of rock. On the base rock, which is brought up to within 1½ ins. from the surface of the finished pavement, is spread ¾ gal. of asphaltic oil to the square yard of street surface. A layer of rock consisting of stone from ¾-in. to 1¼-in. in size is then spread upon the rock base and thoroughly rolled with a heavy roller, after which ¾ gal. of asphaltic oil is again applied. A second course of rock from ¼-in. to ¾-in. in size is then placed and rolled, followed by ⅜ gal. of asphaltic oil. Rock screenings are then spread over the surface in sufficient quantities to absorb all [illegible] In constructing a street by this method, the asphaltic oil is thoroughly and uniformly incorporated with the top layers [illegible] also the pavement is trued up as the construction progresses with the result that the completed pavement has a uniform surface.

One of the first oil macadam streets constructed in Pasadena was west Colorado St., from Terrace drive to Orange Grove Ave. This section of Colorado St. is the main artery leading the western and finest residential district of the city and on one of the main routes largely used by touring parties from Los Angeles. It is 810 ft. in length and the hill rises abruptly for 150 ft. on an 8 per cent grade. The slope then gradually decreases on a 400 ft. vertical curve to a 2.2 per cent grade having a length of 310 ft. On account of the heavy grade, a 6-in. oil macadam was selected. The pavement was constructed the latter part of 1907; completed and accepted in December of the same year. The roadway is 46 ft. between curbs with 3-ft cement gutters along each side and a standard gage single track street railway along the center, thus concentrating the traffic to two roadways of approximately 16 ft. on each side. In reality the drivers confine the traffic to a narrow strip along each side of the railroad track, which fact, coupled with the heavy grade, produced most severe conditions for a pavement to withstand.

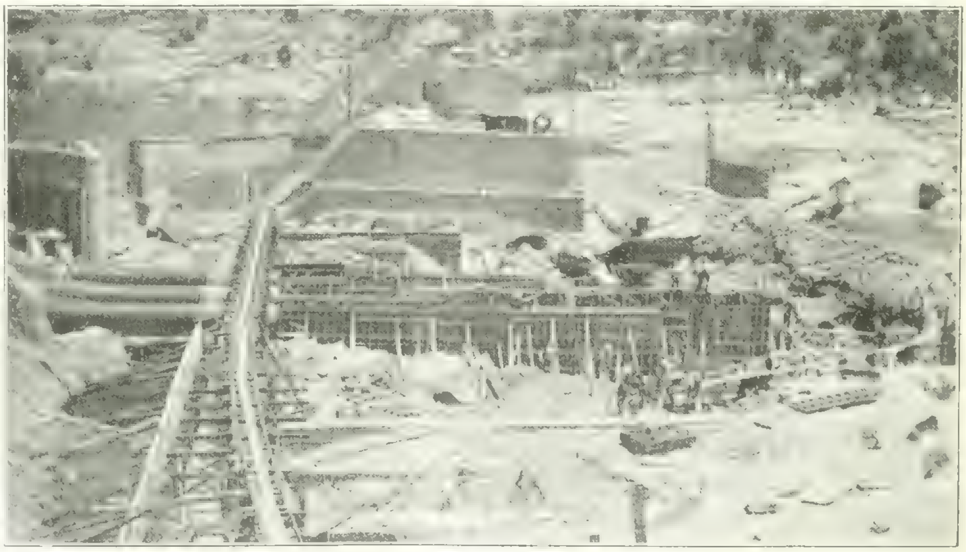


Fig. 7—Down-Stream View of Marble Falls Dam During Construction.

The census of the traffic per day of 11 hours passing over this portion of Colorado St. was taken on Tuesday, Wednesday, Thursday and Friday, March 28th to March 31st, 1911. The traffic was found to be very uniform, varying from 1274 vehicles on March 31st to 1398 vehicles on March 29th. If the census had included Saturday and Sunday the maximum traffic would have been greater with a slight increase in the mean. It was found that the motor traffic passing over this street amounted to over 1,000 machines a day, or over 500 machines in each direction. The average daily traffic per day of 11 hours is given in the following tabulation:

(Day of 11 Hours.)

Horse Drawn Vehicle Traffic.	East Traffic (Down Hill.)	West Traffic. (Up Hill.)
One-horse vehicles	75	56
Two-horse vehicles	33	37
Motor Vehicle Traffic.		
Motor cycles	42	57
Motor runabouts	103	107
Motor touring cars (4, 5 or 6 passenger)	213	239
Motor touring cars (7 passenger)	165	173

The local speed limit is 20 miles an hour, yet nearly every machine exceeded this rate in passing over the street and automobiles sometimes speed up and down this hill making 40 and 45 miles an hour, it being almost impossible for a machine to make the hill on high speed unless the driver increases the velocity of the car as he approaches the heavy grade.

After nearly 3½ years of continual traffic Mr. Van Ornum states that this pavement has required no maintenance whatever and shows no signs of ravel. The surface has worn somewhat in places until the rock is exposed in the form of a mosaic but is bound firmly together by the surrounding screenings and asphaltic oil which is now hardened until it is practically an asphalt. Only one local spot of about 5 sq. ft. in area has appeared where the binder surrounding the rock is loosened, yet the rock is held firmly in place and this local spot has been left in this condition as a practical test of the effect of leaving the rock exposed in this manner. The cost of repairing a defect of this character is slight and the method used consists of cleaning out any loose foreign substance, covering the exposed rock with a light coating of asphaltic oil, after which sand or rock screenings are spread over the surface. The oil and sand unite thoroughly with the old pavement and form a new wearing surface.

From experience in the construction and maintenance of oil macadam and a study of the traffic passing over these pavements for the past several years Mr. Van Ornum believes that the oil macadam overcomes the defect in the water bound pavement due to motor car traffic.

The Life of Wire Rope.

Upon investigation of the records of the hoisting cables in South African shafts it develops that the life of a rope cannot be calculated in ft. lbs. of work done. In a record of the life of 78 wire ropes, of 5 in. circumference, the life runs from 2,000 to 11,000 million ft. tons of work done and with no apparent reason for the great difference. In a paper before the South African Institute of Engineers by Mr. A. F. Williams the factors entering into the life of the wire rope are given as follows:

1. The initial strength of the rope.
2. The personal element.
3. Chemical deterioration.
4. Shocks.
5. Stability of the rope during hoisting.
6. Surface wear on the drums.
7. Internal wear between the different elements of the rope.
8. The design and layout of the hoisting machinery.

As to the initial strength of the rope the factor of safety employed for mining operations is between 2.5 and 4.

Probably the personal element effects the life of the rope as much as any other factor.

The splicing of the rope may be done in such a way as to throw unequal loads upon the different strands, and a kink in the rope caused during the process of fitting may not apparently do much harm at the moment, but may sooner or later reveal itself by a local defect. Excessive stresses due to bumps, shocks or unusual jerks, due to drivers doing something unusual with their engines, all affect the life of a rope. Breakdowns of a rope due to the personal element causes are naturally difficult to trace to their source as the delinquent is averse to reporting anything which he ought not to have done. In some cases the failure of a comparatively new rope has been explained by the candid confession of carelessness or accident by one of the workmen, but in others the confession which might explain matters is never made.

Shocks may be imposed upon the rope by the conditions of working, distinct from those which may be caused by careless handling.

A shock may be given to a rope by a high initial rate of acceleration of the load, by variations in the rate of speed during the hoist, by want of uniformity in the turning moment of the engine, by the skip running beyond the terminal point, and by other causes, some of which may be classed as belonging to the personal type.

To hoist a load by means of a rope without making it set up some vibration during the trip is practically impossible. During each trip when the load is initially suspended it follows that there is a stretch in the rope, the amount of stretch depending upon the weight lifted and the elasticity of the rope.

An interesting point in connection with vibration as [illegible] by Kimberley experience, is the fact that there is a critical velocity for each length of rope at which these vibrations become absolutely dangerous. At Kimberley mine, if the hoisting engine is run at a certain speed below the normal it is possible to make the rope flap from side to side of the hoisting compartment. Below and above this speed the disturbances are not excessive.

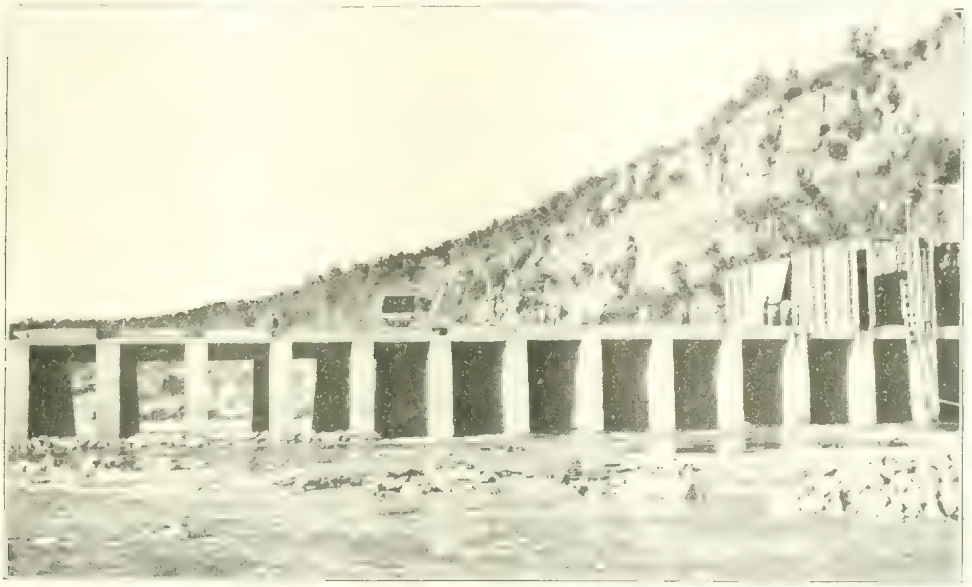


Fig. 8—View of Power Section of Marble Falls Dam During Construction.

The surface wear of the rope is due to its friction on the drum and its twisting action in passing over the drum or sheaves. Internal wear also manifests itself and is attributed to the adjustment of the elements of the rope to the curves or bends.

The law of "rest after work" is a universal one and it is reasonable to assume that it applies to wire ropes. In Kimberley it is arranged that after the day's work is done the skips are run empty up and down the shaft to ensure that no rope is left overnight coiled on its drum under the high tension imposed by hoisting a full skip, and Mr. Williams is confident that the rope appreciates the treatment. In actual cases where a rope, after hoisting more than the average number of loads, has been laid aside for practically two years owing to the closing down of one of the mines, these ropes were afterwards put into service again and had a subsequent life about equal to a new rope. This, of course, does not imply that a long rest, such as this, is desirable, but in cases where the hoisting can be done in, say, eight hours per day, the rope will have the benefit of a rest of sixteen hours, during which time it is able partly to recover from the effect of the work done.

New Safety Hook for Hoisting Operations.

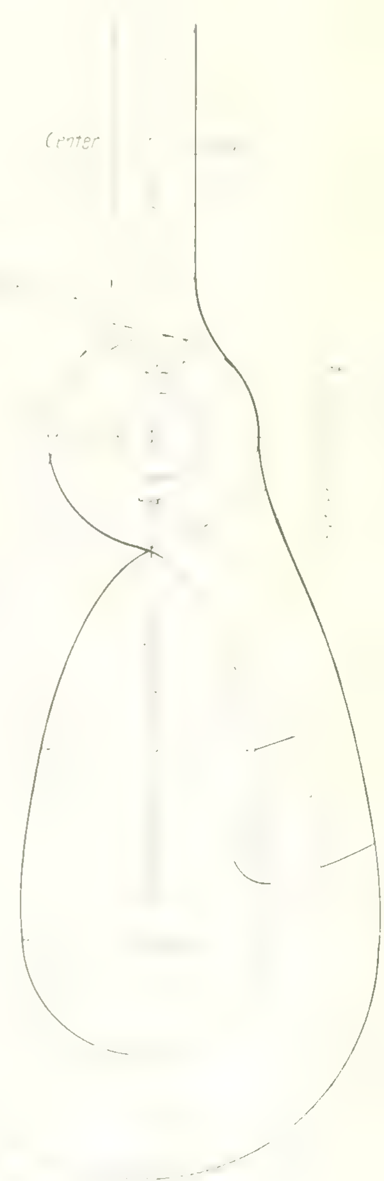
The accompanying sketch shows a patented self closing shackle hook for hoisting work. There are two parts to the hook—the main hook and attaching member. The lower end of the attaching member is prolonged to form a jaw or guard. On the lower end of the attaching member there is a lug, which is adapted to fit into an opening formed in the lower end of the hook, which acts as a support to the hook when loaded, thus preventing to a considerable degree any chance of straightening out the hook under a heavy load. A hook made in this manner should be safe and convenient and also stronger than an ordinary open hook, as the stress is transmitted to all parts. This hook is on exhibition at the American Museum of Safety, 29 West 39th St., New York city.

The Massachusetts Eight-Hour Bill Invalid. The Massachusetts Supreme Court has dealt the final blow to an eight-hour bill which has been before the legislature of that state for two years, and which would have become a law a year ago had it not been for the veto of the governor.

This legislation has been considered pernicious because it provided that "working more than eight hours in any one day shall be prima facie evidence of the violation of the statute." The legislature caused the bill to be brought before the Supreme Court for a decision as to its legality. The court holds that the clause quoted is unconstitutional. The decision reads:

"There are many statutes in which the legislature has enacted that the existance of a fact which ordinarily creates a strong probability of the commission of an offense shall be prima facie evidence of guilt, and such statutes have been held constitutional. The provision of this section of the proposed act differs from those referred to . . . and is not within the principles on which the cited cases rest.

"Under this act 'in cases where a Saturday half holiday is given' employes may work more than eight hours on other days of the week. Such cases will be common and in all of them work for a longer time than eight hours on any other day will not indicate a probability of violation of the law. To pro-



Details of Safety Hook.

[illegible]

[illegible] public works by the commonwealth, the county and such cities and towns as have accepted the provisions of certain earlier acts.

Record of a Drifting Contest.—[illegible] Mining Co., near Casa Grande, Pinal County, Ariz., is advancing a drift in hard blue limestone from the 120-ft. level. The size of the drift is 8x6x4¼ ft., and the working face is now about 500 ft. from the shaft. The drilling is done with a Sullivan 2¾-in. air drill on a double screw mining column. Two drill runners recently had a contest to see which one could break the most rock in five shifts, with results as follows, as given in *Mines and [illegible]*:

Shifts	1	2	3	4	5	Averages
Minutes to set up	26	16	19	21	17	19.8
No. holes drilled	[illegible]	11	12	10	[illegible]	11.2
No. ft. drilled	[illegible]	95	102	85	92	93.6
Avg. depth holes, ft.	[illegible]	8.6	8.5	8.5	7.66	8.36
Total working time	[illegible]	[illegible] m.	7 h. 15 m.	7 h. 10 m.	7 h. 2 m.	7 h. 9 m.
Feet of advance per shift	[illegible]	6.9′	6.9′	5.1′	5.0′	6.17

The time for setting up included the time required by the men in walking from the shaft station on the 120-ft. level until the air was turned on at the drill. The total working time included setting up, drilling, tearing down, loading and blasting. Seventy-five pounds of 1¼-in. powder were used per round of holes. A Sullivan straight-line, two-stage compressor furnished power for the drills at 110 lbs. receiver pressure.

Some Costs of Dredgework on the Los Angeles Aqueduct.

The following costs of dredging are taken from the monthly report for February on a section of the Los Angeles aqueduct through the Owens Valley. The dredge consists of a scow on which is mounted a No. 60 Marion electric shovel with a 1½ cu. yd. clipper. The cost of the dredge was $19,897 and was built according to the specifications of the aqueduct engineers. The yardage is based upon the theoretical section of the aqueduct or 14.81 cu. yds. per lineal foot. This is exceeded a small amount by excess cutting. The following are the data for February:

	Teams and [illegible]	Operation.	Renewals and repairs.	Misc.	Totals.
Men—Number days	[illegible]	[illegible]	241	[illegible]	459
Live stock—Number days....		56	12		
Lineal feet		2,625			
Cubic yards		38,876			....
Labor costs	$34.29	$[illegible]	$[illegible]	$17.85	$1,618.34
Live stock costs		[illegible]	[illegible]		61.20
Cost materials and supplies		1.75	120.32		[illegible]
Power cost		[illegible]	[illegible]		[illegible]
Freight cost		0.35	24.06		24.41
Total costs	$34.29	$1,188.10	$1,003.78	$17.85	$2,[illegible]
Unit cost per cu. yd..............................	[illegible]	$0.0306	$0.0258		$0.0565

The unit cost per cubic yard for the month figures 5.65 cts., but the unit cost given for the work of the dredge to date is 6.7 cts.

Effect of Heavy Rain in Culebra Cut, Panama Canal.—The heavy rain of May 11—2.57 inches—caused considerable inconvenience in Culebra Cut from noon of that day until the afternoon of the day following. The drainage ditch at the south end of the cut, which carries water through the culvert under the old P. R. R. embankment west of the locks at Pedro Miguel, so that it may flow around the lock site, broke and allowed the water to empty into the steam shovel cut which is being made to provide drainage through the center wall culvert of the locks. A battery of two 10-in. and one 15-in. centrifugal pumps, which had been installed in the new drainage ditch to take care of such water as might collect from rains, was flooded, and the pumps were forced to suspend temporarily. This new drainage ditch will be subject to similar inundations until it is completed to the culvert of the locks; that is, until the water from the south half of the cut may drain through the locks at Pedro Miguel. All the [illegible] of the summit are working with the end in view of keeping open the central drainage ditch. Last year the slides at Culebra forced the bottom of the canal up and closed this ditch, and it was necessary to maintain pumps in order to keep the water down in the cut. Pumping is neither so economical nor so effective as gravity drainage. North of the summit, the central drainage ditch has a slight grade from Las Cascadas to the sump at Gamboa, due to the fact that the excavation is so near to its ultimate depth in this section. The water drains off slowly, and because of this several steam shovels in the Empire district were obliged to suspend on May 11 due to the accumulation of water in the pits in which they were working. At Culebra, on May 11, a portion of the west bank gave way, and one steam shovel was nearly overturned and obliged to suspend work. The portion that slipped was a ledge of lava rock about 40 ft. above the level on which the shovel was digging, which was at a point where the banks seems uncommonly firm. The ledge of lava on top of this bank became water soaked and gave way, tumbling over the firm bank into the cut. On the east bank of the cut at Las Cascadas a mud slide was accelerated by the rains, and the track leading to two steam shovels was put temporarily out of service. This slide, although difficult to handle on account of its nature—viz.: soft mud—now contains only a few thousand cubic yards of material. Eleven shovels in all were forced to suspend work for part of the day on the 11th, on account of flooded pits or covered tracks.

PERSONALS.

Mr. John S. Runnells, vice-president and general counsel of the Pullman Co., has been elected president of that company. He succeeds Mr. Robert T. Lincoln, whose resignation was announced recently.

Mr. F. L. Cranford announces that he has opened an office at 177 Montague St., Brooklyn, N. Y., and will engage in an engineering and contracting business. With him will be associated Messrs. J. C. Meem and H. P. Moran.

Mr. George H. Maurice has been appointed engineer in charge of the river front intercept[illegible] and the Paxton creek improvement at Harrisburg, Pa. It is expected that work will [illegible] the latter project within a few days.

Announcement is made of the resignation of Mr. Henry C. Adams, head of the Division of Statistics and Accounts of the Interstate Commerce Commission. He is succeeded by Mr. Chas. A. Lutz, now chief examiner of accounts.

Mr. Daniel H. Newton, a prominent contractor of Holyoke, Mass., died in Brookline, Mass., on May [illegible]. He was the founder and head of the firm of D. H. & J. C. Newton, builders of many manufacturing plants in western Massachusetts, and was also organizer and president of the [illegible] Tunnel & Wilmington R. R.

[illegible] W. Bemis has been engaged by the city of Toledo, Ohio, to make an appraisal of the Toledo street railways. The appraisal is [illegible] connection with a renewal of franchise. Mr. Bemis was formerly deputy commissioner of the Department of Gas, Water Supply and Electricity, of New York City.

Mr. R. W. Creuzbaur, formerly Consulting Engineer of Public Works of Brooklyn, N. Y., [illegible] at [illegible] Church St., New York City. He will engage in consulting practice in matters involving preliminary study, design, construction and operation of engineering utilities, and in expert work in litigation requiring knowledge of construction and interpretation of contracts.

Mr. Charles C. Moore has been chosen the executive head of the Panama-Pacific International Exposition, to be held in San Francisco in 1915. Mr. Moore is head of the engineering and contracting firm of C. C. Moore & Co., of that city. He will be responsible for every detail of the exposition, and will have the appointment of all officers and department heads, who will be directly responsible to him.

Mr. W. C. Parmley and Mr. E. S. Nethercut have formed a partnership as consulting engineers under the firm name of Parmley & Nethercut. They will give attention to the design, construction and manufacture of reinforced concrete sewers and other structures. Offices will be maintained at 45 East 17th St., New York City, and in the Monadnock Block, Chicago. The New York office will be in charge of Mr. Parmley, while Mr. Nethercut will have charge of the Chicago office.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Silica Building Brick and Stone.—Paper, 6x9 ins., 32 pp. The National Sand-Lime Brick & Machinery Co., 90 West St., New York.

This book gives the history and process of manufacture of silica building brick and stone, a material recently introduced from Germany. The object of the book is to interest persons in establishing plants for the manufacture of this material. Illustrated.

Universal Cement.—Paper, 6x9 ins., 16 pp. The Universal Portland Cement Co., Chicago-Pittsburg.

This bulletin is devoted to the use of Universal cement in the state of Ohio, and illustrates a number of buildings where this material has been used.

Conneaut Shovels.—Paper, 5¾x8⅞ ins., 12 pp. Conneaut Shovel Co., Conneaut, Ohio.

This catalog describes the special features of this make of shovels and their manufacture. It contains illustrations, sizes and prices of shovels of twelve different types.

Hy-Rib.—Paper, 5⅜x7⅝ ins., 104 pp. Trussed Concrete Steel Co., Detroit, Mich.

This is a complete description of this metal, its application to roofs, floors, walls, conduits, etc. Designs showing details of construction with Hy-Rib are given; also illustrations showing how the construction work is carried on. Tables of safe loads are given.

Doud Clam Shell Buckets.—Folder, 5½x7 ins., 6 pp. Arthur N. Doud Engineering Co., 6720 Dunham Ave., Cleveland, O.

This is a description of a clam shell bucket designed to meet the demand for satisfactory work in all classes of material. A table of dimensions is given. Illustrated.

Disc Grader.—Paper, 3⅜x6¼ ins., 16 pp. Disc Grader & Plow Co., 709 Andrus Bldg., Minneapolis, Minn.

This little booklet contains an illustrated description of the rotary disc plow attachment for elevating graders. Illustrations of the discs and roll bearing parts and practical points for elevating grader users are given.

Collapsible Forms.—Paper, 6x9 ins., 32 pp. Concrete Form & Engine Co., Detroit, Mich.

This catalog contains an illustrated description of a metal collapsible form for building road culverts and other classes of concrete conduits. The operations are described in detail and estimates on the complete costs of building culverts of various sizes are given.

Profile Plan Paper.—Circular, 5⅝x8½ ins., 1 p. Keuffel-Esser Co., 127 Fulton St., New York.

This is a new page for the company's regular catalog which illustrates and describes the profile plan paper. The profile ruling with its margin is only half the width of the paper, the other half being left blank for sketching difficult cuts, fills, etc., and for explanatory notes so that the combination is effective for ready reference. Sizes and prices are given.

New York-Port Huron Road Roller. Paper, [illegible] ins., 32 pp. Port Huron Engine & Thresher Co., Port Huron, Mich.

This catalog introduces the New York Road Roller recently acquired by the Port Huron Co. It illustrates and describes the roller and its parts in detail.

CONTRACT NEWS SECTION
of
ENGINEERING-CONTRACTING

The Doings of the Week.

Very little appears to have been doing during the past week in the way of the letting of big railroad construction contracts. A number of good sized contracts, however, have been let in the past few days, among them being the following: Robert Sherer & Co., Los Angeles, Cal., for the extension of the Burbank line of the Pacific Electric Ry. Co., for a distance of about four miles; James S. Orman, Greeley, Colo., for 12 miles of line for the Denver, Laramie & Western R. R., from the present terminus four miles northwest of Greeley toward Severence; W. J. Oliver & Co., Knoxville, Tenn., for the construction of the line of the Charlotte Rapid Transit Co., Charlotte, N. C.; James McGraw Co., Arcade Bldg., Philadelphia, Pa., at about $170,000 for constructing masonry walls and abutments between Trenton Ave. and Richmond St., Philadelphia, on the Richmond Branch of the Philadelphia & Reading Ry.; American Bridge Co., Pennsylvania Bldg., Philadelphia, at about $264,000, for bridges over Aramingo, Belgrade and Thompson Sts., on the Richmond Branch of the Philadelphia & Reading Ry.; P. T. McCourt & Co., 407 S. Main St., Akron, O., for the 46 mile steam line of the Akron, Canton Youngstown Ry.; Keystone State Construction Co., 704 Pennsylvania Bldg., Philadelphia, Pa., for work on the Norristown Branch of the Philadelphia & Western R. R., this contract including 450,000 cu. yds. earth excavation, 100,000 cu. yds. rock excavation, and [illegible]

A good piece of railroad construction work in New England which will probably come up soon, is the building of the Allegash extension of the Bangor & Aroostook R. R. Location surveys for this extension, 157 miles, from West Seboois, Me., to St. Francis have been made. The line is very favorable for grades and for traffic, and will doubtless be built soon.

Several important road construction contracts are now being advertised. The New York State Commission of Highways is calling for bids on 59 contracts for state highway work. Bids on 29 of these contracts are to be opened on June 12; bids on the remainder will be opened June 14. Bids are being asked the Robertson County Pike Commission, Springfield, Tenn., for grading, ditching and macadamizing about 50 miles of public roads in Robertson County, Tenn.

The biggest sewer job of the past few days appears to have been the one at Seattle, Wash. Bids were opened May 19 by that city for constructing the interbay section of the North Trunk sewer. The Colson Construction Co., at about $925,000, was the low bidder.

Bids were opened May 23 by the Board of Water Supply of New York City for the completion of the Hudson Spihon, a deep pressure tunnel in rock 14 ft. inside diameter, extending under the Hudson river about 1,100 ft. below the water surface, with two shafts, 3,022 ft. apart on the opposite shores between Storm King and Breakneck Mts., in the towns of Cornwall and Fishkill. Anthony C. Douglass, [illegible] Rector St., New York, at $1,432,323, was the low bidder.

In the way of drainage work the largest contract let recently appears to have been the one for the construction of the main canal and laterals for Drainage District No. 3, at Carrollton, Mo. The contract for the main ditch was let to R. B. Gordon Co., Celina, O., at 7.4 cts. per cu. yd. The contract for the laterals was let to M. J. Hanawalt, Monticello, Ind., at 8.73 cts. per cu. yd. The work calls for cutting bends and straightening water course. Bottom width main canal, 40 50 and 60 ft.; laterals, 12 to 20 ft.; side slopes, 1-1; cutting, 12 to 18 ft. deep; 1,710,000 cu. yds. in main canal and 286,000 cu. yds. in laterals.

Bids are now being asked by the city of Houston, Tex., for the construction of a large reinforced concrete viaduct over the Houston Ship Canal. The structure will be 1,650 ft. long and 60 ft. wide.

Automobile and Macadam Roads.

A few years ago, when automobiles came into general use and the old type of macadam roads began to go to pieces, road engineers were ready to ascribe the deterioration to this new form of traffic. While there is no doubt that the automobile plays an important part in the destruction of the old water bound type of macadam, it is not so much the machine itself that causes the damage as the greatly increased traffic resulting from its use. Where a few years ago 20 teams passed over a road each day, now ten times that number of automobiles pass. This point was well brought out by Mr. S. D. Fisher, road engineer of Allegheny county, Pennsylvania, in a paper presented early this month before the Engineers' Society of Western Pennsylvania. In the course of his paper Mr. Fisher stated:

> While [illegible] hicle for pleasure, driving probably once or [illegible]

Finding Old Survey Marks.

[illegible] many years ago under the U. S. [illegible] lands for townships and [illegible] witnessed by mounds or bearing trees. The stone monuments would of course remain for a long time, but the stakes would soon practically disappear. However, these government corners could sometimes be located by excavating and examining the location carefully. Shaving off the ground with a spade, the first thing that would be noticed would be a spot of different colored earth. Digging down further pieces of wood and bark might be found, and digging still further the points of the survey stakes might be found. Corner stakes have been located in this way many times. It is, however, an entirely different matter to find ax marks on a corner tree after the tree is entirely gone. Such an instance is described by a correspondent in a recent issue of the Engineering News. In 1876 an old county surveyor of Huntingdon County, Pennsylvania, was employed in running the lines of an old furnace property, and incidentally in a hunt for land marks scattered over some 20,000 acres of mountain land in Blair and Huntingdon counties. The call for one important corner was for a "jack pine" tree. The measures after certain corrections located the spot within 50 ft. or so in a bit of woodland. No pine of any kind was there. The surveyor who had been "ranging" like a hound off the trail, suddenly stopped and called attention to a long, narrow strip of ground where there was enough difference in the character of the growth on the forest floor to show that once a fallen tree had rotten away there. Starting 3 or 4 ft. from what had probably been the butt of the fallen tree, he began to poke around in the thick mold, and after a bit drew out what looked like a pine knot, but which turned out to be a piece of pine covered with resin. In this wood was a distinct ax mark. Hunting on he found at about 18 ins. and 36 ins. respectively, farther along this streak, two pieces, and no more, exactly similar "pine knots," each with the same distinct ax mark. He had truly found the ax marks in a tree after the tree itself was entirely gone. The "fat" resinous "jack pine" had healed its ax wounds with resin and left an almost indestructible monument for the skill of the old surveyor to uncover.

Driving the Golden Spike.

Muskogee is to have a new interurban line, and following the precedent established by other Oklahoma towns of doing something out of the ordinary, introduced an innovation in the celebration for the commencement of the work. The golden spike was driven in a manner befitting the occasion, and the first speaker began his oration. In the meantime the track layers began to lay the track. By the time the first speaker had completed his speech the track had been advanced 600 ft. The crowd moved up to the track layers and another orator began to orate. Before he had finished several hundred feet of track had been laid and the crowd again moved up. Another speech was delivered, the band played, and the track laying went on, the crowd trailing along behind. In this way, regaled by speeches and musical selections, our correspondent would have us believe, the vast concourse trailed along over the bounding prairie, vainly endeavoring to keep up with a gang of track layers fast vanishing in the distance.

Co-operative Road Building.

The "get together" road building idea, exemplified in Kansas by the building of 380 miles of dirt road in a single day, and in Nebraska by the building of 20 miles of road in a day, has taken a firm hold in Tennessee. In that state a movement is well advanced for the co-operative building of a road from Memphis, Tenn., to Bristol, Tenn., a distance of 542 miles, in two days. The movement had its inception with the organization of the Memphis-to-Bristol Highway Association. The first efforts of the association were to bring the people up to the point where they wanted better roads, and to see that it was to their advantage to join heartily in a co-operative movement to build the highway from one end of the state to the other. This was easily done and sub associations, each affiliating with the main state association, were organized in 42 counties. These county organizations went to work to get men to sign a blank to either give two days or more time on the road, to give money or material, to furnish wagons and [illegible] farms or to give free access to gravel pits. At the present time the association has the signa- [illegible] in building the road. Of this number over 32,000 men, with more than 6,000 teams, have agreed to work for two days in building the [illegible] In addition, over $130,000 has been sub[illegible] individuals and organizations, to be used in various counties along this proposed road. It was intended to make the survey during May, and the state of Tennessee was asked to appropriate $15,000 for this purpose. As there is a possibility that the legislature will refuse to make this appropriation, the association has decided to raise the $15,000 by public subscriptions with a view to having the survey completed in June. It is intended to build the road on Aug. 14 and 15, and it is expected by that time that at least 50,000 men will have become interested in the movement.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

Right of way is now being secured for the proposed railroad up the Cahaba valley from Selma to the Birmingham district. As soon as this feature of the work has been completed other steps toward the building of the projected railroad will be gone into, and it is expected that the actual work of construction will be started during the coming fall months. Ernest Lamar, Selma, Ala., is the promotor.

Arizona.

The Santa Fe system has planned to construct a new wye track at mile post 748 at an estimated cost of $10,000. The Santa Fe system will expend in the near future $70,000 to cover the cost of new machinery to be installed in the various shops. This is exclusive of the cost of electric interlocking plants to be installed at Argentine, Kan., and between Camden Junction and Hardin, Mo., at a cost of $50,000, for which an appropriation has been made.

California.

⦿The San Pedro, Los Angeles & Salt Lake R. R. has awarded the grading contract for the completion of the branch to St. Thomas, 22 miles in length, to the Utah Construction Co., Ogden, Utah.

⦿The contract for switches, frogs, fish plates, track specials, etc., for the Geary St. Municipal street railway at San Francisco has been let to the Pennsylvania Steel Works, at $45,713. Construction work on the roadbed of the road will probably be commenced next month. It is likely that the work will be done by force account.

⦿Robert Sherer & Co., Los Angeles, Cal., have been awarded a contract by the Pacific Electric Ry. Co. for the extension of the Burbank line from Arden Av., Glendale, to the city limits of Burbank, a distance of about four miles.

The Santa Fe system has planned to spend $14,000 to protect its tracks along the Colorado River, near Needles. The company has appropriated $7,500 to cover construction cost of making track connections with the Union and Risdon Iron Works at San Francisco. The company has also decided to install an automobile truck service with the Midway Oil Field.

The Los Angeles & San Fernando Electric Ry. Co., of Los Angeles, recently organized with a paid up capital stock of $25,000, proposes to construct an electric line between Los Angeles and San Fernando, through Griffith Park, a distance of 25 miles, by the most direct route. The company, whose officers also own the San Fernando Mission Land Co., which has some 1,600 acres in the vicinity of San Fernando, plan to establish a townsite of 300 to 400 acres adjoining San Fernando on the south. It is expected the building of the new electric line, which is first to be constructed between Van Nuys and San Fernando, a distance of 4½ miles, will promote the rapid settlement of the rich San Fernando valley.

Advices from San Jose state that the Southern Pacific Co. is planning the construction of an electric railway to connect that city with the village of Hacienda and the New Almaden quicksilver mines.

Mass meeting has been held at Ukiah to discuss the matter of a proposed electric railroad from that city to Lakeport to run to the various summer resorts in that section. It is proposed to raise $100,000 in Ukiah and a like sum in Lake county, with the idea that outside capital will furnish the remainder of the $400,000 necessary to construct the road. There are several roads projected into Lake county at present, some coming from Hopland and other places.

The Oakland Traction Co. has secured franchises for street car lines on E. 16th St. or the Boulevard and on 14th Ave. and Hopkins St. at Oakland. The first taps a territory at present without adequate car service, and the second is for a short cut to avoid going around a hill, being applied for on the petition of the residents of the neighborhood.

The Fresno, Coalinga & Monterey R. R., projecting the construction of a line from Fresno to Monterey, Cal., has filed deed for 6 miles of right of way. Albert Albrecht, Fresno, Cal., is one of the promoters.

It is believed that the Great Northern Ry. Co. is considering the construction of a double track from Seattle south through the lumber regions of northern California to San Francisco, and eventually to Los Angeles.

Work has been started for the Northwestern Pacific R. R., W. C. Edes, San Francisco, Cal., Chief Engineer, on the 4,650-ft. tunnel necessary to complete the company's line. The mountain through which the tunnel will extend is about half way between Willits and Shivley, and is in the southwestern part of Trinity county. The Northwestern Pacific now operates to Willits from the south and from Eureka toward the south operates as far as Shivley. The distance unconstructed is approximately 150 miles, but much preliminary work has been done, and it is probable that by the time the tunnel is completed conditions will be such that trains will be operated from San Francisco to Eureka. Every effort will be made to complete the big bore in the shortest time possible, but it is believed that the time estimated, a year and a half, will be fully required to complete the work.

The Clear Lake R. R. Co. has been incorporated with headquarters at Lakeport, Cal., and the following board of directors elected: L. H. Boggs, S. E. Brooks, M. M. Gopcovic, C. M. Hammond, Euvelle Howard, H. V. Keeling, C. C. McMahon, Joseph Levy, M. S. Sayre, Z. T. Spencer, A. H. Spurr. C. R. Rankin was employed to make the permanent survey, and he will start the work immediately. The plan is to build a standard gage road from the Northwestern Pacific at or near Hopland to Clear Lake at Lakeport, with branches from Lakeport to Upper Lake and Kelseyville. The Northwestern Pacific has agreed to take bonds to the amount of at least $80,000, payable in relaying rails, spikes and other hardware at market rates. The estimated length of the road is twenty-three miles; branch to Upper Lake, eleven miles; branch to Kelseyville, eight miles. The capital stock is $500,000, divided into 5,000 shares of par value of $100 each. Eighty thousand dollars has been actually subscribed to date by some 300 subscribers. The largest subscribers are: C. M. Hammond, Upper Lake, $5,000; Mrs. C. M. Hammond, Upper Lake, $1,500; Joseph Levy, Lakeport, $5,000; M. M. Gopcevic, Lakeport, $5,000; S. F. Brookes, Hopland, $5,000; L. H. Boggs, Kelseyville, $1,500; M. S. Sayre, Lakeport, $1,000; H. V. Keeling, Lakeport, $1,000; Z. T. Spencer, Lakeport, $1,000.

Colorado.

⦿James G. Orman, Greeley, Colo., has been awarded the contract for building 12 miles of line for the Denver, Laramie & Northwestern R. R., W. D. Hodge, Chief Engineer, Denver, from the present terminus four miles northwest of Greeley toward Severence. It is said to be the intention of the railway to continue the extension at least to Wellington this year.

The Colorado Interurban Ry Co. has filed its articles of incorporation. The capital stock is $6,000,000, and it is proposed to build a line in Adams, Weld, Larimer, Boulder and Jefferson counties between Denver, Pierce, Ault, Eaton, Greeley, Fort Lupton, Firestone, Longmont, Idaho Creek, Fort Collins and interurban points. For the last six years this company has been doing preliminary work in Weld county, and it is said it is now ready to make its grade. The plan now is to establish a direct line between Greeley and Denver, but later branch lines may be built and the entire farming country of northern Colorado embraced. Denver and Eastern capital, it is understood, has been secured to push the work to completion. The officers of the company are Irving Hale, manager of the General Electric Co., president; Eben N. Reaser, Denver, first vice president; D. E. Young, second vice president; O. S. Storrs, secretary; E. E. Armour, treasurer.

The Chicago, Burlington & Quincy R. R. and the Colorado & Southern Ry. have applied to the City Council of Denver for an extensive trackage way into the heart of the city through Market and Walnut Sts. by asking the city for a revocable permit granting them the right to lay standard gage tracks along these streets. In return for the privilege the railroads agree to pay the city $50,000 and to construct a storm sewer and catch basins on Walnut St. to cost not in excess of $113,750, and pay special improvement taxes for the curbing, grading and surfacing of Market St. and Walnut St. from 19th to 36th Sts. The proposition is the same which has been under discussion for some time, the only new feature being the flat tender of $50,000 to the city.

The Union Pacific Ry. Co. is said to have steel on hand for the construction of the Denver-Dodd cutoff crossing southeastern Weld County, Colo., shortening the route from Denver to Omaha about 25 miles. R. L. Huntley, Omaha, Neb., is Chief Engineer and Assistant General Manager of the company.

Connecticut.

It is understood that the work that is now being done by the Connecticut Co. of Hartford, Conn., in increasing the power at its power stations in Buckland and Rockville is the first step towards the continuation of the lines of the Connecticut Co. into Palmer, Mass. The line from Rockville to Stafford Springs is over a route that the Shaw Co. of Boston, the company that bought the Hartford, Manchester & Rockville Tramway Co. lines and later sold them to the Connecticut Co., had secured a charter for. The increasing of the power at both of these places, it is said, will be sufficient, with the aid of a substation or two, to furnish sufficient power from Stafford Springs, the present end of the line, into Palmer, Mass.

Cuba.

The Matanzas Terminal R. R. Co., of Cuba, has filed a certificate of organization at the Department of State, with principal offices at

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Havana, Cuba. It proposes the construction of a railroad in the city of Matanzas running across the rivers San Juan and Yumuri to Fort San Severino.

Georgia.

Citizens of Cairo, Ga., are endeavoring to have the Gulf Line Ry. build a line to that place. W. T. Hargrett, Sylvester, Ga., is General Superintendent.

The Board of Directors of the Southern, D. W. Lum, Chief Engineer Maintenance of Way, Washington, D. C., has authorized the construction of 32 miles of second track between Atlanta and Gainesville, Ga. It is proposed to continue the use of the existing track from Armour, six miles north of Atlanta, to Crosskeys, a distance of five miles, as a single track gauntlet. Double track will be constructed from Crosskeys to Duluth, a distance of 15 miles. From Duluth to Suwanee, five miles, the existing track will be operated as a single track gauntlet, and 17 miles of double track will be built from Suwanee to Oakwood. Work on the double track is to be begun without delay.

Idaho.

✣Bids will be received until 2 p. m., June 10, by U. S. Reclamation Service, Boise, Idaho, at the offices in the Shaw Bldg., for constructing roadbed for branch railway from Barberton to the site of the Arrowrock Dam, between Stations 491-57 and 874-00. The work involves the excavation of about 100,000 cu. yds. of earth and about 35,000 cu. yds. of rock. F. E. Weymouth is Supervising Engineer.

⦿The contract for grading for the construction of the Central Idaho R. R. (Camas Prairie Line) of the Oregon Short Line R. R., from Richfield to Taft, Idaho, 58 miles, has been let to the Utah Construction Co., Ogden, Utah. It was reported that this contract had been awarded to Kilpatrick Brothers & Collins.

Condemnation proceedings, according to advices from Boise, Idaho, have been started for sections of right of way for the proposed railroad to be constructed by the Reclamation Service from Barberton to Arrow Rock Reservoir, a distance of 17 miles.

Illinois.

⦿Mike Conroy, East Alton, Ill., has taken 200,000 cu. yds. of machine work at East Alton. He expects to have four machines on the job very soon.

The Chicago & Joliet R. R. Co. has been incorporated in Illinois, with general offices at Chicago, Ill., and capital stock of $5,000, The incorporators are J. R. Blackhall, Joliet, Ill.; H. K. Crafts, George M. Stevens, William B. Stevens and Clayton F. Crafts, Chicago, Ill. The object of the company is to get a charter empowering it to remove certain parts of the Joliet electric system from the streets to private property. It has been announced that the actual construction work will be commenced shortly.

The Northern Illinois Industrial Co. has been incorporated with a capital stock of $50,000 and proposes to build a railroad from North Chicago to Waukegan. The principal office will be at Waukegan. The incorporators and first board of directors are: C. E. Sayler, S. Schwartz, J. P. Arthur, Theodore H. Durst, M. H. Hussey of Waukegan and John Sherwin, James T. Hayes, Dr. L. B. Jolley, M. C. Decker, all of North Chicago.

The Chicago, Burlington & Quincy R. R. is to erect a 14-story building in Chicago to be used exclusively by the railroad for office purposes. It will be erected at the corner of Jackson Blvd. and Clinton St. and will cost, in addition to the ground, $1,380,000. The building will be a modern fireproof structure, 14 stories in height, and will have 2½ times the amount of available snace that is now contained in the company's present building at 209 Adams St.

Preliminary surveys have been started looking to an extension of the Aledo stub of the Rock Island Southern, W. W. McCullough, General Manager, Monmouth, Ill., from Aledo to Buffalo Prairie, several miles west.

The Chicago, Burlington & Quincy R. R. is now constructing about 12 miles of second track between Beardstown and Concord. Work is now under way with company force except a little team grading. It is all parallel and inexpensive work.

The Santa Fe system has planned for the following improvements in the near future: Rearrangement of tracks and construction of extensions at Pekin, for which $12,500 has been appropriated; constructing new water line at Streator, for which $1,800 has been appropriated.

Indiana.

The Cincinnati, Madison & Western Traction Co. of Hanover, Ind., is reported to have received bids for building a projected railway to connect Hanover, Madison, Scottsburg and Lexington. The line will be about 40 miles long.

The Gary, Hobart & Eastern Traction Co., which was planning to let construction contracts this month for a 5-mile line from Hobart to Broadway, Gary, Ind., has been delayed in its plans and will not let construction contracts until later. J. C. Cavender, Hobart, Ind., is interested.

Iowa.

Citizens of Iowa City have completed the raising of $100,000 in stock subscriptions for the proposed Iowa City-Davenport interurban line.

It is reported that plans and specifications have been completed for the construction of the proposed new Illinois Central R. R. Company's new depot at Waterloo, Ia. The improvement, it is estimated, will necessitate an expenditure of $20,000. F. L. Thompson, Chicago, Ill., is Engineer Bridges and Buildings.

It is rumored that farmers of Kimbalton, Audubon County, Ia., have raised $30,000 to purchase 17 miles of the northern section of the Atlantic North & South Ry. at the sale June 24. First, second and third mortgage bonds amounting to about $140,000 are also held by the same organization.

In addition to the subcontracts awarded by MacArthur Bros. Co., Chicago, Ill., to J. P. Atkinson & Son, Omaha, Neb., E. H. Wickham & Co., Council Bluffs, Ia., J. C. Dunn, Chicago, Ill., and Yale & Reagan, Chicago, Ill., for portions of the Rock Island work in Iowa, as mentioned in our issues of May 10 and 24, E. N. Mathews Co., Davis, Okla., has contracts for making several cuts in the vicinity of Chariton, Ia., where headquarters have been established. The largest job will be the cut about a mile northeast of Chariton. It will only be 1,400 ft. long, but will be between 40 and 50 ft. deep, which is an unusually deep cut for this section of Iowa. At least 100,000 cu. yds. of dirt wiil have to be moved from this one cut, and most of it will have to be hauled to the White Breast Creek bottom. Mathews Co. also have a contract for the two deep cuts in Chariton, one north and one south of the Burlington tracks. These cuts will be quite deep also, as the Rock Island tracks must be about 25 ft. lower than the Burlington tracks, it taking at least 22 ft. to clear a high box car with a man standing on it. There will be in the neighborhood of 45,000 cu. yds. of dirt to be moved in each of these cuts. Donald Jeffrey, of Delmar, Ia., who has the contract for a two-mile stretch north of Whitebreast Creek, and three miles north of Dallas, has four steam shovels ready to begin work.

According to the report of S. R. Ballard, C. E., employed to make a valuation of the defunct line of the Newton & Northwestern Ry., it will require $70,000 to place the road in shape to operate it safely. H. W. Martin, Newton, Ia., is interested.

Foley & Son, Anamosa, Ia., who have been working 70 horses and a steam shovel on a railroad construction job in Wisconsin, have completed their work there and will, it is understood, move onto a railroad job in Canada.

The Waterloo, Cedar Falls & Northern Ry. Co. (electric) T. E. Rust, Chief Engineer, Waterloo, Ia., is reported as taking steps for securing the right of way for an interurban extension from Waterloo to Laporte City. It is understood that this extension will be in operation by Jan. 1, 1912.

Efforts are being made to have the Chicago Great Western Ry. build a line from New Hampton to Protivin in Howard County. A. H. Markle, New Hampton, Ia., is interested.

Kansas.

Engineers of the Atchison, Topeka & Santa Fe, the Chicago, Rock Island & Pacific, St. Louis & San Francisco and the Kansas City, Mexico & Orient Railroads are preparing field plans to be used by the contractors in elevating the tracks through the city of Wichita, Kan. Permission has been granted by the State to the recently organized Wichita Terminal Association to issue $2,500,000 in bonds and $100,000 in stock to provide funds for the work.

The Santa Fe system plans on making the following improvements in the near future: Changing tracks at Atchison, estimated cost $10,000; change of tracks at Winfield, estimated cost $12,000; track changes at Strong City, estimated cost $34,000; and installing additional machinery in the shops at Wellington.

The transportation lines in Kansas have signified their willingness to help the State Railroad Commission make a physical valuation of their properties. It is estimated that it will require at least 18 months to make this valuation. Carl W. Witt, Topeka, Kan., is Engineer of the State Railroad Commission.

Promotion work is now under way for the proposed interurban line from Meade to Beaver, mentioned in our last issue. As surveyed, the road will run due south from Meade, along the Crooked Creek valley to the south line of the county, crossing the Cimarron River and then going due south to Beaver. The new road will be about 40 miles long. F. Corp, 22 Avenue B west, Hutchinson, Kan., has been engaded to promote and build the road.

The Atchison, Topeka & Santa Fe Ry. is reported to have bought the Garden City, Gulf & Northern, a line running from Garden City to Scott City and being built northward from the latter point. The line is now operating 40 miles to Scott City and by July 1 it will have the road completed to Winona, on the Union Pacific, 91 miles north of Garden City. It is said that when this is done the Santa Fe purposes to establish two new divisions, one at Great Bend and the other at Garden City, operating trains from Great Bend to Winona over part of the main line and the Garden City, Gulf and Northern as if it were a separate line.

It is reported that one of the first improvements of the Missouri Pacific under the new management will be the double tracking of that company's line between Kansas City and Leavenworth.

Kentucky.

The Chicago, Memphis & Gulf Ry., mentioned in our last issue, is reported as being about ready to let contracts for the extension of the line northwardly to Clinton, Ky., a distance of 15 miles, and connecting with the Mobile & Rhio R. R. at Stubbs, Ky. S. G. Latta, Dyersburg, Tenn., is President.

The Western Kentucky Electric Rys. Co., mentioned in our last issue, has opened offices in Owensboro's Banking Co.'s Bldg., Owensboro, Ky. The company plans a system of railways 215 miles long connecting Owensboro with points south and southeast. H. C. Wallace & Co., 201 Dearborn St., Chicago, Ill., will have charge of the engineering work.

Thrasher & Gunter, Knoxville, Tenn., who have been boring a new tunnel for the Louisville & Nashville R. R. in the hill south of Covington, have pierced the hill from both sides after 2½ months' work. The length of the bore is 1,154 ft. The new tunnel, a double-tracked affair, is being built directly over the old single-track tunnel, one of the oldest on the road, which was used by the old Kentucky Central Road, the predecessor of the Knoxville division of the Louisville & Nashville.

Citizens of Bowling Green are taking steps to secure the construction of an electric railway from that city to Gallatin, Tenn., to connect with the proposed line from the latter city to Nashville, mentioned in our last issue. It is said that H. H. Mayberry, Stahlman Bldg., Nashville, Tenn., President of the proposed Nashville-Gallatin interurban, has been interested in the proposed new line from Bowling Green.

Conferences have been held between officials of the Louisville & Nashville R. R. and the Chesapeake & Ohio R. R., and it is reported that radical changes are contemplated in the original plans for the Covington, Ky., station and the present arrangement of the railroad entrances into the city. Both roads for some time have been contemplating making extensive improvements in the road through the city, some of which already have been started. The new station is under way and work on the improvement in the L. & N. yards is progressing. The question of the elimination of the grade crossings in the city has been under consideration for some time and this principally, with other needed railroad improvements, was the subject of the conference. It is rumored that one of the chief improvements will be the enlargement of the C. & O. bridge across the Ohio River. It is said that the wagon roadway will be abolished and four tracks constructed on the bridge.

Louisiana.

Petition has been presented to the City Council of New Iberia, asking that a special election be called to take the sense of the taxpayers on the proposition to give a bonus of $45,000 to the Southwestern Traction & Power Co. of New Orleans for its proposed line.

Massachusetts.

The first electric locomotive was run through the Hoosac tunnel of the Boston & Maine R. R. on May 18. The bill permitting the Berkshire Street Ry. Co. to sell power to the Boston & Maine R. R. was signed by the governor on May 18. The bill having become law, electrically hauled trains will now be operated through the tunnel regularly.

Michigan.

The Detroit & Mackinac Ry., J. D. Hawks, General Manager, Detroit, Mich., has made surveys for a change of line which will cut out two large curves from the Van Eltan bridge to Cowley's Cedar yard.

Minnesota.

Citizens of Barnesville, Minn., are considering the proposition of bonding to raise a bonus to induce the Chicago, Milwaukee & Puget Sound R. R. to construct the branch surveyed from Hutchinson to Fargo, N. Dak., through Barnesville, instead of a point several miles west, as now planned.

The Interurban Construction Co., of Hastings, Minn., has been incorporated with a capital stock of $100,000 and proposes to construct and operate electric railroads, street railways, interurban lines, telephone and telegraph systems. It is understood that this company will build the new Lake Pepin electric line to Hastings and possibly farther. The articles of incorporation for $100,000 constitute the preliminary step in the work. The incorporators are Otto Ackerman and Senator Albert Schaller of Hastings, A. T. Stebbins of Rochester, Edward Feldhauser of St. Paul and Foster B. Seager of Cannon Falls.

The engineers who made a survey for the proposed electric railway between Mankato and St. Peter have completed their report, showing that the cost of the road will be $350,000. The mileage would be 10.87. The most expensive part of the construction would be where the line crosses a large swamp between Mankato and Kasota and where it crosses the Minnesota River between Kasota and St. Peter. It is reported that J. J. Cummings of Chicago may take an interest in the Mankato street [illegible] company is a preliminary to having the company back the enterprise with a bond issue, as it is authorized under its charter to issue $400,000 bonds.

Mississippi.

Steps are being taken at Gulfport, Miss., to organize a terminal corporation with a view to securing the building of another railroad into the city. A committee has been appointed to confer with the railroad authorities, especially the management of the Gulf and Ship Island R. R., touching the proposition of building a road from Gulfport to Baton Rouge, La.; also the railroad authorities on the west side of the Mississippi River, and arrange preliminaries for the surveying a right of way, and as to obtaining a charter, and to report in ten days. The committee will confer with Baton Rouge and Hammond Road, the Queen & Crescent and Great Northern Roads. W. G. Evans, Gulfport, Miss., is interested.

Missouri.

Plans are reported under consideration for the extension of the Clarinda & Southwestern electric line to Savannah, through Tarkio, Graham and Fillmore. A. C. Snyder, Graham, is interested.

The Missouri Pacific Ry. has made financing arrangements which will provide the company with $23,000,000. This means that, after paying off the company's floating debt, there will remain $15,000,000 to spend for improvements. At the meeting of the Board of Directors in New York, at which the financing arrangements were made, Mr. E. J. Pearson of Seattle, Chief Engineer of the Chicago, Milwaukee & Puget Sound R. R., was elected first vice president, in charge of operation of the Missouri Pacific-Iron Mountain, with headquarters in St. Louis, effective June 1. Mr. E. F. Mitchell, heretofore Chief Engineer of Construction of the M. P., was appointed Chief Engineer, the former position being abolished.

Montana.

It is understood in Bozeman, Mont., that the Northern Pacific R. R. is to apply to the city officials for permission to cross Broadway at a point north of Main St., completing the right of way and permitting the construction of a line to their property on Main St., the proposed site for the new depot.

Steps are being taken by business men of Glendive, Mont., to induce the Northern Pacific Co. to complete the construction of the Missouri River Railroad from Glendive to Sidney. The line is known as the Lower Valley Road. A. H. Phillips, Glendive, Mont., is interested in the movement.

Articles of incorporation have been filed with the County Clerk and Recorder at Choteau, Mont., for the Choteau & Great Falls Ry. Co., with a capital stock of $100,000. The company proposes the construction of a standard gage line between Great Falls and Choteau, Mont., and it is hoped to have preliminary matters advanced sufficiently to let contracts about the first of August. The incorporators are Wm. F. Rieckhoff, Wm. Hutcheson, Barret Klay, C. D. Van Osterhoup, W. S. Short and John Hosters, all of Orange City, Ia.; also George E. Bowers, Phil I. Cole and J. E. Malmin, of Choteau.

Engineers of the Great Northern R. R. are reported to be making a survey for a branch line of the Billings & Northern R. R. (Hill System) from Moccasin to Lewistown.

Nevada.

⊙The Utah Construction Co., San Francisco, Cal., has been awarded the contract for constructing the 18-mile line of the Southern Pacific Co., extending from Lucin to Montelle, Nev.

New York.

A bill has been introduced in the State Legislature creating what is to be known as the Railway Terminal Station Board for the city of Buffalo. The board is to be composed of the Mayor and Commissioner of Public Works ex officio, the chairman of the Grade Crossings Commission and several citizens. Any six members are to be authorized to adopt plans for the purpose of relieving present terminal conditions in Buffalo, with power to require the railroads to make changes in location of existing tracks and stations and to require the city to make such changes as to streets, etc., as may be necessary in carrying out the plan. The committee is to elect a chairman and employ a secretary and such other assistants, an attorney, one or more engineers, as they deem necessary, and provide offices for them.

The Lehigh Valley R. R. is reported to be considering extending its line from the terminus at Fairhaven into Oswego.

North Carolina.

⊙The Charlotte Rapid Transit Co. of Charlotte, N. C., has awarded the contract for the construction of its line to W. J. Oliver & Co. of Knoxville, Tenn. The contract calls for the construction of the line of the company from the present terminus of the Elizabeth line to the Mecklenburg County Club and includes the grading of the entire line, subway crossing under the Seaboard Air Line Ry., any small culverts that may be necessary and the laying of the tracks. The contract is said to amount to about $45,000.

The City Council of Fayetteville, N. C., has granted a franchise to the Fayetteville Traction & Power Co. to extend its line over Haymount on Hay St.

Jno. A. Mills, Raleigh, N. C., President of the Raleigh & Southport R. R., has made a proposition to the Council of State of North Carolina, offering to take over the Elkin & Alleghany R. R. and to complete it and put it in operation forthwith. The Elkin & Alleghany R. R. is to be 30 miles long, extending from Elkin to Sparta and 12 miles of the road have been graded, at a cost of about $135,000, of which the state holds $100,000 in stock as compensation for convict labor.

North Dakota.

It is understood in St. Paul, Minn., that the Minnesota, Dakota & Western R. R. is contemplating the extension of the road now operating between International Falls and Lomen, a distance of 22 miles, on into North Dakota. E. W. Backus, Andrus Bldg., Minneapolis, Minn., is President of the company.

The Northern Pacific Ry. now has under way extensive improvement and maintenance operations over a large portion of its lines. A large amount of rock and gravel ballast is being placed on the right of way, especially in North Dakota and eastern Montana, and widening of right of way preparatory to constructing double track is being pushed rapidly in those sections east of the Rocky Mountains, where the system is not already double tracked. Of its total mileage between St. Paul, Duluth and the Pacific coast the Northern Pacific now has in daily use a total of 520 miles of double track and 1,047 of alternate line.

Ohio.

⊙Work has been started on the Akron, Canton & Youngstown Ry.'s 46-mile line from Akron to Youngstown. P. T. McCourt Co., 407 South Main St., Akron, O., has the general contract and is now getting its outfit on the job. Several hundred men will be employed on the work. F. E. Bissell, 317 Everett Bldg., Akron, O., is Chief Engineer.

The Louisville & Nashville R. R., W. H. Courtenay, Chief Engineer, Louisville, Ky., is understood to be about ready to let a contract for widening the tunnel at Grants Bend for double tracks.

At a recent meeting of the executive committee of the Hocking Valley R. R., W. Michel, Chief Engineer, Columbus, O., plans and specifications for the new through freight yards at South Columbus were submitted for approval. No information is available as to what action was taken but it is expected that the plans will be approved and an appropriation made. All of the 12 acres of land necessary for the yards, except ½ acre, has been secured. The construction of the yards will involve the expenditure of several hundred thousand dollars.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Oklahoma.

Citizens and business men of Okeene, Okla., have succeeded in raising the required $11,000 to secure the construction of the Winnipeg, Salina & Gulf R. R., from Omaha, Neb., to Oklahoma City, through that city. According to the plans under consideration by the company, Okeene will be a division point on the new system.

Proposition has been made to the Packingtown Development Co., John W. Shartel, President, Oklahoma City, for the purchase of 26 acres of land at the old Delmar Garden at Oklahoma, to be used as part of the site for a union station, a central freight depot and a complete terminal system for the handling of freight and passenger traffic. A syndicate of capitalists is reported to have made the proposition. It is reported that a fund of $500,000 is already available for starting operations.

Pennsylvania.

Citizens of the south side of the Lykens Valley have started a movement to secure railroad facilities. It is proposed to have the Williams Valley R. R., a subsidiary of the Philadelphia & Reading Ry., now terminating at Lykens, extended through Oakdale, Elizabethville and the smaller settlements intervening to Millersburg. It is stated that the extension could readily be constructed, the roadbed along the entire route having been surveyed some years ago and the right of way could be secured at a nominal figure.

⦿The Keystone State Construction Co., 704 Pennsylvania Bldg., Philadelphia, Pa., has a contract for constructing the Norristown branch of the Philadelphia & Western Ry., between Villa Nova and Norristown, Pa The contract includes 450,000 cu. yds. earth excavation, 100,000 cu. yds. rock excavation, 550,000 cu. yds. embankment, eight bridges with concrete foundations and steel superstructures and 20,000 cu. yds. concrete masonry.

⦿The Pennsylvania & Reading Ry., William Hunter, Chief Engineer, Philadelphia, has recently awarded two contracts for work on the elevation of the tracks of its Richmond branch between Somerset St. and Richmond St. Contract No. 24, calling for masonry walls and abutments between Trenton Ave. and Richmond St., was let to James McGraw Co., Arcade Bldg., Philadelphia; estimated cost being $170,000. Contract No. 25, calling for bridges over Aramingo, Belgrade and Thompson Sts., was let to the American Bridge Co. of New York, Penna. Bldg., Philadelphia, the estimated cost being $264,000. The work of elevating the tracks on the Richmond branch, between Somerset St. and Richmond St., is covered by an ordinance of councils, approved October 13, 1906, which provides for the elevation of tracks between Somerset St. and Richmond St., abolishing two very busy grade crossings at Kensington and Frankford Avs. by depressing the streets; opening a new wide street at Aramingo Ave., where formerly Cedar St. passed beneath the tracks, and opening two entirely new streets beneath the tracks, viz., Belgrade and Thompson Sts. The cost of the entire work is to be borne equally by the city of Philadelphia and the Reading Ry., except where the railway company enlarges its present facilities. Up to the present time the work is under way between Somerset St. and Trenton Ave., the contracts having been awarded as follows: Contract No. 22, masonry and embankment; John McMenamy, contractor, 319 E. Lehigh Ave., Philadelphia; estimated cost $135,000. Contract No. 23, bridges at Kensington and Frankford Aves.; American Bridge Co. of New York, contractors, Pennsylvania Bldg., Philadelphia; estimated cost $135,000. Contract No. 113, grading, paving and appurtenance work in streets at Kensington Ave. and adjacent streets; McNichol Paving & Construction Co., contractors, Betz Bldg., Philadelphia; estimated cost $215,000. Contract No. 112, grading, paving and appurtenant work in streets at Frankford Ave., Aramingo Ave. and all streets to east; James D. Dorney, contractor, 1204 E. Montgomery St., Philadelphia; estimated cost $315,000. All contracts numbered over 100 are executed by the city of Philadelphia, all others with the railway company. All track work and maintenance of railway travel is done by the railway company's maintenance of way forces. All masonry walls and abutments are of concrete. The bridges at Kensington Ave., Frankford Ave. and Aramingo Ave. are steel half through plate girders with solid steel floors waterproofed with concrete and asphalt mastic. At Belgrade and Thompson Sts. the bridges are deck structures with curb girders and I beams embedded in concrete, waterproofed with 5-layer felt and protected with hard brick.

The [illegible] Street Ry. Co. has been organized with a capital stock of $350,000 and proposes to build an electric railway between the places named. [illegible] Elizabethtown are now being considered. Dr. H. K. Blough, Elizabethtown, is President and Fred Alleman, Summit, N. J., is Secretary and Treasurer.

Among the reports circulating throughout the railroad world in regard to construction work under consideration by the Pittsburg & Lake Erie R. R. is one to the effect that right of way has been purchased between Elwood City, [illegible] the main line to Franklin. J. A. Atwood, Pittsburg, Pa., is Chief Engineer of the company.

The proposed railroad from Washington to Gettysburg, Pa., has been graded from Washington to Hyattsville, and ties and rails for this portion have been furnished. This road is to be a steam line. The route surveyed and for which rights of way have been generally granted is from Washington to Hyattsville, and thence into and through Montgomery and Howard counties, in as nearly as possible a direct course toward Mount Airy, on the border between Carroll and Frederick counties Near Ridgeville, a mile south of Mount Airy, it will enter and run for a short distance through the eastern edge of Frederick county and cross the Baltimore and Ohio R R., both at that point and at Mount Airy. From Mount Airy it will run through Carroll county to Westminster, and from that point north through the county to the Pennsylvania line, and thence through Adams county, Pennsylvania, crossing the Pennsylvania railroad west of Littlestown, on to Gettsburg, altogether a distance of about 72 miles. William H. Saunders, Washington, D. C., is President. The Columbia Construction Co., Washington, has the construction contract

South Carolina.

Construction work has been started on the Bamberg, Ehrhardt & Waterboro Ry. This railway was chartered about five years ago. The line is to be standard gage and about 14 miles long. The construction contract is held by a company composed of Jones A. Williams and E. C. Hays of Bamberg and Wm C. Wolfe of Orangeburg. J. A. Wyman, Bamberg, is President of the railway.

Tennessee.

⦿The Olsen-Lesh Construction Co., Memphis, has been awarded the contract for the new freight depots for the L. & N. and the N., C. & St. L. R R.'s at an estimated cost of about $100,000 The depots will be built near the new Union depot, fronting on Calhoun Ave. at Memphis. The buildings are to be completed before Jan. 1, 1912

It is reported that the Lewisburg & Northern R. R., now under construction into Lewisburg, Tenn., has filed deeds to a large portion of the necessary right of way from Nashville, Tenn., to Decatur, Ala. It is believed that actual construction work will be commenced on the line within a short time.

Committees have been appointed at Tusculum and Greenville to take action looking to the construction of a railway between the two places.

A plan is under consideration at Jackson for the construction of a railroad from Jackson to Shiloh National park via Henderson, Tenn. J. D. Johnson is interested.

The Tennessee, Alabama & Georgia R. R., operating 98 miles of line, and having a number of extensions in contemplation, is reported to have been secured by the Tidewater Development Co. of Birmingham, Ala. This latter company has extensive projects in view. It controls the belt line at Tuscaloosa and proposes to build a railroad from that city to Birmingham, about 40 miles. It is said the purpose of the line is to afford a new outlet for the Alabama coal and iron fields from Tuscaloosa to Birmingham, and thence to Gadsden and to Mobile, having the opening of the Panama Canal in the near future in view

Texas.

It is reported at Dallas, Texas, that the work of constructing the proposed extension of the Wichita Falls & Northwestern Ry. from Hammon, Okla., to Woodward, Okla., a distance of 50 miles, will be started within a short time The extension will go through two counties not now touched by railroads, and will open up a new section of Oklahoma. With the completion of this line, the Northwestern will have a total mileage of nearly 300 miles, and, with the Wichita Falls Railway and Wichita Falls and Southern, which are under the same control, there will be over 350 miles under the management of the Kemp & Kell interests at Wichita Falls.

Information received from Roma, Texas, states that the Rio Grande Construction Co., mentioned some time ago in these columns, is running surveys for the construction of a proposed railroad between Brownsville and Eagle Pass, Tex., a distance of about 400 miles. The route, which is up the valley of the Rio Grande, passes through a number of border towns, among the more important of which are Laredo, Roma and Rio Grande City A. W. Liliendahl, of Saltillo, Mexico, who constructed the Coahuila & Pacific Railroad between that city and Torreon a few years ago, is at the head of the new project.

The St. Louis, Brownsville & Mexico Ry. has applied to the Railroad Commission for permission to register $1,340,000 additional in bonds on branch line extensions and permanent improvements. The bonds are desired on the 39-mile Port O'Connor line, the 16-mile Collegeport line, the Brownsville Belt line of eight miles and the Donna spur. There are also certain permanent improvements to be included.

At a recent citizens' meeting under the auspices of the Commercial club of Artesia, N. Mex., it was voted unanimously to give $100,000 to the first railroad running trains between Artesia and El Paso; if the shops should be located at Artesia the bonus is to be $150,000.

Tracklaying is to be started immediately at Mertzen, Tex., on the Mertzen-Alpine extension of the Kansas City, Mexico & Orient Ry. A Hurley tracklaying machine will be used, company forces being employed on the work. The bridges will also be built by company forces. W. W. Colpitts, Kansas City, Mo., is Chief Engineer of the Kansas City, Mexico & Orient Ry. This extension will be 200 miles long. Roach & Stensell, Memphis, Tenn., have the grading contract.

At a recent meeting of the stockholders of the proposed Rock Island, Texas & Gulf R. R. M. J. Healy, Amarillo, Tex., was elected President. This company projects a line from Dalhart, Tex., through the counties of Smith, Palmer, Bailey, Cochran and Yoakum, thence through New Mexico to Knowles, thence in a southwesterly direction to Midland, with the final destination at Nunville, Tex It is stated that over $800,000 in bonuses will be secured locally for the building of this road, and 12 to 15 new towns will be opened. It is understood that the financing of the road has been completed and that construction will be started as soon as the line is permanently located.

The Sugarland Ry., W. T. Eldridge, President, Sugarland, Tex., has filed an amendment to its charter providing for 90 miles of extensions. The road, at present, is in operation from Sugarland to Arcola, 15 miles, and the northern extension of 60 miles will take it to Hempstead, in Waller county, to connect with the Houston & Texas Central, while the southern extension is to afford connection with the Brownsville line below Angleton. The southern line is to be run from a point [illegible] miles south of Sugarland down the east side of the Brazos. The northern extension goes north from Sugarland through Ford Bend and Waller counties to Hempstead. This will give a line through the richest part of the Brazos bottom. The company has a capital stock of $142,000, of which $109,000 is paid in.

The Santa Fe system has appropriated $12,000 to cover the cost of raising the grade between mile posts Nos. 16 and 17 and 21 and 22, Beaumont Division. This will necessitate the remodeling of three bridges.

Citizens of Victoria have raised a required bonus of $30,000 to secure the extension of the St. Louis, Brownsville & Mexico Ry. from Bloomington to Victoria.

A track laying outfit reached Longview, Tex., on May 18 and started work laying the steel for the Port Bolivar Iron Ore Ry., which is being built from Longview to the iron ore fields near Jefferson.

An ordinance is before the city council of Houston authorizing the recently completed Galveston-Houston Interurban Co. to change its route into the city. According to a previous ordinance the interurban company was granted authority to use the tracks of the Houston Electric Co. on Caroline St. from Pierce to Texas Ave., but under the new ordinance that route is abandoned and the company is given the right to use the track on Jackson Ave., with authority to construct a double track from Pierce to Texas Ave.

Utah.

At a recent meeting held by the Industrial Club of Gentile Valley, according to advices from Grace, Utah, the feasibility of inducing the Oregon Short Line to construct a line from Alexandria, Idaho, southward through the valley to some point in Cache Valley was considered.

A conference was recently held by the Mayor, W. D. Kuhre, and W. W. Wilson, of the Commercial Club, Sandy, Utah, with J. G. Jacobs, in regard to the construction of the proposed railroad he is promoting into Little Cottonwood Canyon, through Sandy to Alta.

The commissioners of Davis County have granted to the Utah Light & Railway Co., Salt Lake City, a franchise for a street car line from North Salt Lake through Bountiful to Centerville. The city council at Bountiful has already granted the company a franchise through the town. The line will run from Beck's Hot Springs four miles to Bountiful, and then two miles further to Centerville.

The Utah Construction Co., Ogden, Utah, has sublet a considerable part of the work on the Raft River branch of the Oregon Short line from Burley to Kelton Pass, and on the new line from Nyssa to Homedale, along the south side of the Snake River. The two extensions call for the building of a total of 90 miles of new road, through territory not now supplied with railroad facilities.

Virginia.

Stockholders of the Norfolk & Portsmouth Traction Co. and the Virginia Railway & Power Co. will take action on the merging of the companies at a special meeting to be held June 22. The directors of the companies have already approved the merger. The combined properties will be known as the Virginia Railroad & Power Co. The Virginia company is principally owned by Frank J. Gould, and will control nearly 300 miles of street railways, several lighting systems and power plants in the cities of Richmond, Petersburg, Norfolk and Portsmouth. It is proposed to issue $[illegible]0,000,000 of stock.

Washington.

The promoters of the Puget Sound & Chelan Ry. Co., recently incorporated with a capital stock of $300,000 and headquarters at Tacoma, Wash., report good progress on the proposed line across the State of Washington. The route proposed extends southwesterly over the Cascade Mountains from Bellingham to the north extremity of Lake Chelan, thence down the lake to Chelan Falls, securing a water level grade, then across to Spokane, paralleling the tracks of the Great Northern. Among those interested are: F. S. Blattner, Tacoma, Wash.; U. G. Wynkoop, Tacoma, Wash.; J. J. Ives and W. W. Schenk, Seattle, Wash.; A. F. Mead.

It is reported that H. W. Walther, Spokane, Wash., manager of the Walther Lumber Co., has employed engineers to run a preliminary survey for a logging railroad from Nanum Canyon to Ellensburg, Wash.

Advices from Wenatchee, Wash., state that it is believed there that the Great Northern Ry. is about to take action regarding the construction of its Wenatchee-Pateros Line. A considerable part of the 49 miles of right of way in Chelan County for this line is known to have been secured, and it is believed that negotiations are under way for obtaining the remainder.

Announcement has been made by the Great Northern that a new line from Monroe, Wash., south to Tolt, Wash., a distance of 17 miles, had been completed and turned over to the operating department May 14.

It is reported that the shops, roundhouse and entire yardage and terminal facilities of the Northern Pacific, now located bteween Erie and Division Sts., in Spokane, Wash., a distance of three quarters of a mile, will be moved to Yardley within a year, at an expenditure of over $1,000,000.

The Centralia Electric Light & Traction Co. of Centralia has been incorporated and proposes the construction of an electric line between Centralia and Chehalis, 15 miles. The greater part of the right of way has been secured. The incorporators and directors are Walter Coppin, G. W. Muck, N. W. Mills, Bruce Richards and Dan Salzer.

City Council of Bremerton, Wash., has granted a 50-year franchise to the Puget Sound & Southern Ry., represented by L. H. Gray of Seattle. The corporation acquires the right to run street cars and interurban trains over certain streets, as part of an interurban system with terminals at Bremerton and on Grays Harbor. Passing through Charleston the company plans to build through the country to Hoquiam and Aberdeen. The franchise allows one year in which to start construction and three years in which to get the cars in operation.

The Elwha Power Co., represented by W. D. Perkins & Co., Seattle, has applied to the City Council of Bremerton for a franchise in that city. The company proposes a trolley line to connect Bremerton with the Olympic peninsula by ferry across Hoods canal.

West Virginia.

Preliminaries are being arranged for the construction of a railroad from Uniontown, Pa., to the lakes through Wileyville, Wetzel County, and from this point across the Ohio River at or near New Martinsville, then on to the great lakes. Alscot E. Boone, Zanesville, O., is one of the promoters.

The Richwood & Gauley R. R. Co., of Richwood, W. Va., has been incorporated with a capital stock of $75,000, and proposes to construct a railroad along Cherry River in Nicholas County. The incorporators are Charles S. Weston, James W. Oakford, Walter Briggs, Fred L. Spates, of Srcanton, Pa., and Henry W. Armstrong of Richwood.

The Wisconsin & Northern Ry., W. Cambier, 'Chief Engineer, Oshkosh, Wis., has had engineers in the field going over the old survey into Antigo. It is believed that work on the line to Antigo will be taken up this year.

Wyoming.

Work has started relaying the 80-lb. rails on the Union Pacific between Millis and LeRoy, Wyo., with new 90-lb. steel.

Canada.

⊙P. H. Secord & Sons, Ltd., of Brantford, Ont., have been awarded the contract for the construction of the St. Patrick's Ward extension of the Radial Railway Co. at Guelph, Ont.

It has been officially announced, according to information received from Nelson, B. C., by the Canadian Pacific Ry., that a line will be constructed this summer from Three Forks to the Lucky Jim Mine, and that contracts will be let and work started shortly.

The Canadian Northern Ontario Ry., A. F. Stewart, Chief Engineer, Toronto, is reported to have called for bids for the construction of the section of its line between Port Arthur and Silver Junction, a point about 30 miles north of Sudbury. This is a stretch of about 550 miles.

The Grand Trunk Ry. is said to be planning the expenditure of several million dollars this season for improvements to its system in the Province of Ontario.

The Canadian Northern Ry. is understood to be planning an initial expenditure of $5,000,000 and an ultimate expenditure of between $30,000,000 and $40,000,000 for the construction of terminals in Montreal and Toronto. It is understood that there will be new terminals in Toronto and Montreal, and in connection with the latter it is proposed to ultimately put a bridge over the St. Lawrence.

The Grand Trunk Pacific Ry. has decided upon the location of the divisional point on the Edmonton-Calgary line. It will be at the west end of Buffalo Lake and the name selected for it is Mirror. Steel already has been laid to that point, and a train service will be inaugurated next month. It is expected that in addition to being a divisional point, Mirror will also be a junction point for at least two branch lines, one east and one southeast, with a possibility of a western extension. Provision will be made for yards, roundhouses and light repair shops.

Preliminary surveys have been completed by the Canadian Pacific Ry. for a line of railway from Wilkie, Sask., through to the Cold Lake country, to meet a line located west from Fort McMurray country two or three years ago.

ROADS, STREETS AND PAVEMENTS

Arkansas.

✣Bids will be received until 2 p. m., June 8, by Commissioners of the East Fourth St. District, Little Rock, Ark., for paving with creosote block or asphaltic surface on a concrete foundation, East Fourth st. from Main to Rector Ave. Plans and specifications for the work may be seen at the office of the engineer, J. A. Kingsley, Markham and Center sts. All proposals must be addressed to the engineer and be accompanied by a certified check for $1,000. Claud Ringo is Secy. of the commission.

The City Council of Fort Smith, Ark., has approved a petition providing for the formation of an improvement district for repaving Garrison Ave.

California.

⊙The Board of Trustees of Mountain View, Cal., has entered into a contract with J. F. Adams for the building of an oiled macadam road for three blocks of the town, the work to be completed within 30 days.

⊙The City Trustees of Redondo Beach, Cal., have let the contract to Fairchild, Gilmore & Wilton of Los Angeles, Cal., for the asphalt paving of [illegible] Ave., from Carnelian St. to the northern boundary line of the city. The improved street will connect with Camino Real in Hermosa Beach.

⊙R. P. Rossen of Nevada City, Cal., has been awarded the contract for the construction of a new road leading to the Arctic mine and way points from Canyon creek, for $6,400. The road will be a little over three miles long.

The City Trustees of South Pasadena, Cal., are planning to pave Mission St., Pasadena Ave., and Monterey road, through their entire length.

The citizens of Sausalito, Cal., have decided in favor of a bond issue of $50,000, half of which amount will be devoted to the repair of its municipal highways, while the other half will go toward other needed municipal improvements.

The Board of Public Works of Los Angeles, Cal., has authorized City Engineer Homer Hamlin to make a survey with a view to determining a feasible location for a road extending north from Griffin Ave., to the east city boundary, where such road can connect with some county road, thus affording a direct line of travel to South Pasadena and Pasadena.

The City Council of San Diego, Cal., has been petitioned for the construction of a highway from the Old Town bridge east and then northeast along the foot hills and the north side of San Diego river valley to an interception of the Escondido road and [illegible]

Colorado.

At the general state election in 1912 the people of Colorado will vote on the constitutional amendment for a bond issue of $10,000,000 authorized under the provisions of a resolution passed by the 18th general assembly. The bond issue is an extra indebtedness on the state and is exclusively for public highways, to be distributed under the direction of the state highway commission. The general assembly has appropriated $50,000 for the commission to carry on the work.

The Board of County Commissioners, Trinidad, Colo., will receive bids some time in June for the construction of 21 miles of highway between the city of Trinidad and Aguilar. The work is to be completed within two months after the contract has been let.

Connecticut.

✣Bids will be received until 8 p. m., June 5, by Paving and Sewer Commission, Vernard Keating, Secy., Bridgeport, Conn., for furnishing and laying about 23,680 sq. yds. of wood block paving on State St., in said city, from Broad St. to Fairfield Ave. Separate proposals are required for the wood block, and for the furnishing of all other materials, and labor, except the wood block. Specifications and blank forms for bidding may be obtained from Bernard Keating, Secretary, Room [illegible]

District of Columbia.

✣Bids will be received until 11 a. m., June 17, by R. C. Hollyday, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for the construction of pavement at the navy yard, Norfolk, Va.

A bill has been introduced in the Senate, Washington, D. C., by Representative Richard P. Hobson providing for the appointment of two commissioners, the members from various states, to work out two improvements, one a highway to extend from the Atlantic to the Pacific ocean along the 35th parallel of north latitude; the other to extend from Canada to Mexico on a line near the 23d meridian west from Washington.

Illinois.

⊙The Board of Local Improvements of Moline, Ill., has awarded the contract for the paving of Fourth Ave. with brick from 34th to 55th Sts., to Britt & Layden for $61,677. Other bids received were: Tri-City Construction Co, $62,140; Western Improvement Co., [illegible], Keys & McNamara of La Salle, Ill., $61,321.

The Board of Local Improvements of Rockford, Ill., has decided to pave with brick West State St., from Winnebago St., to Royal Ave., at an estimated cost of between $25,000 and $30,000. The distance to be paved is about a mile and the cost per lin. ft., is about $5.

Mayor Moore of Monmouth, Ill., is considering the proposition to improve West First Ave., and South E St. An ordinance providing for the appropriation of $70,000 for paving has been presented to the City Council.

At a recent meeting of the property owners on Otto Blvd., Chicago Heights, Ill., it was decided to pave that thoroughfare with brick, to a width of 36 ft.

The Sheridan Road Improvement Association has been incorporated at Chicago, Ill., to secure the rebuilding of the Sheridan road. The incorporators are: William R. Dickinson, Houston C. Adcock and Edwin L. Johnson.

Indiana.

✣Bids will be received until 7:30 p. m., June 9, by Board of Trustees, Town of Salem, Ind., for the improvement of portions of Hackleberry and Cherry Sts. A. E. Tille is Town Clerk. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 2 p. m., June 5, by Board of County Commissioners, English, Ind., for the construction of pike roads in Jennings township, Crawford County. J. J. Evans is County Auditor.

✣Bids will be received until 2 p. m., June 5, by Board of Henry County Commissioners, New Castle, Ind., for furnishing one or more roadgraders. W. L. Risk is County Auditor.

✣Bids will be received until 10 p. m., June 2, by Board of Public Works, Indianapolis, Ind., for the improvement of streets and alleys as follows: First alley east of Cornell Ave., from the north property line of 11th St. to the north property line of first alley north of 11th St., by grading and paving the roadway; Pratt St. from the west property line of Senate Ave. to the east end of bridge over the Canal, by grading and paving the roadway; 29th St. south side, from the east curb line of Bellefontaine St. to the west property line of Cornell Ave., by grading and paving the sidewalks; Trowbridge St. from the south property line of Prospect St. to a point 420 ft. south, by grading and paving the sidewalk; Washington St., north side, from the east curb line of Temple Ave., by grading and paving the sidewalk; Laurel St. from the north property line of Prospect St. to the south property line of Lexington Ave. by grading and paving the gutters; Graceland Ave. from the north property line of 38th St. to the south property line of 40th St., by curbing the outer edge of the roadway.

✣Bids will be received until 10 a. m., May 31, by Board of Public Works, Indianapolis, Ind., for the improvement of a number of streets as follows: Alvord St., east side, from the north curb line of 16th St. to the south curb line of 19th St. by grading and paving the sidewalks; Downey St. from the east curb line of Madison Ave. to the west curb line of East St. by grading and paving the sidewalks; Concord St. from the north property line of Walnut St. to the south property line of 10th St. by grading and paving the sidewalks; 28th St. from the east property line of Illinois St. to the west property line of Meridian St. by grading and paving the roadway; Chestnut St. from the north property line of Raymond St. to the south property line of LaGrande Ave., by grading, graveling and rolling the roadway; Concord St. from the north property line of Vermont St. to the north curb line of Walnut St. by grading and paving the sidewalks; Illinois St., east side, from the south curb line of McCarty St. to the south curb line of Ray St. by grading and paving the sidewalks; Chestnut St. from the south Curb line of Raymond St. to the south curb line of LaGrande Ave. by grading and paving the sidewalks.

✣Bids will be received until noon, June 15, by Board of Pulaski County Commissioners, Winamac, Ind., for the construction of a highway on line between Pulaski and Starke Counties. W. E. Munchenburg is County Auditor.

✣Bids will be received until 10 a. m., June 8, by Board of LaPorte County Commissioners, LaPorte, Ind., for the construction of a macadamized road in Center and Springfield townships. F. A. Hanshier is County Auditor.

✣Bids will be received until 10 a. m., June 8, by Board of Tippecanoe County Commissioners, LaFayette, Ind., for the construction of five gravel roads. G. W. Baxter is County Auditor.

✣Bids will be received until noon, June 6, by Board of Pulaski County Commissioners, Winamac, Ind., for the construction of two gravel roads in Beaver township. W. E. Munchenburg is County Auditor.

✣Bids will be received until 2 p. m., June 6, by Board of Greene County Commissioners, Bloomfield, Ind., for the construction of a macadam road in Taylor township. C. H. Jennings is County Auditor.

✣Bids will be received until 2 p. m., June 6, by Board of County Commissioners, Petersburg, Ind., for the construction of a gravel road in Patoka township. John D. Gray is Auditor of Pike County.

✣Bids will be received until 1 p. m., June 6, by Commissioners of Lawrence County, Bedford, Ind., for the construction of eight gravel or macadamized roads. Ezra W. Edwards is County Auditor.

✣Bids will be received until 2 p. m., June 6, by Commissioners of Hamilton County, Noblesville, Ind., for the construction of a gravel road in White River Township and macadam road in Jackson township. George Griffin is County Auditor.

✣Bids will be received until noon, June 6, by Board of County Commissioners, Winamac, Ind., for the improvement of two public highways in Pulaski County. W. E. Munchenburg is County Auditor.

✣Bids will be received until 2 p. m., June 6, by Commissioners of Davis County at Washington, Ind., for the construction of three gravel roads in Bogard and Madison townships. Thomas Nugent is County Auditor.

✣Bids will be received until noon, June 5, by Board of County Commissioners, Delphi, Ind., for the construction of a gravel road in Tippecanoe township. M. G. Haun is Auditor of Carroll County.

✣Bids will be received until 1 p. m., June 5, by Board of County Commissioners, Greensburg, Ind., for the construction of a macadamized road in Clay township; also macadamized road on the line between Sand Creek and Marion townships. Frank E. Ryan is Auditor of Decatur County.

The County Commissioners, Indianapolis, Ind., have approved the petition for the opening of a road on the township line between Franklin and Perry townships. The road will be approximately two miles long. Viewers for the road have been appointed.

Popular subscriptions are being solicited to assist South Bend, Ind., in the improvement of the road from South Bend to Indianapolis for several miles south of the city.

County Surveyor J. B. Vernon, Huntington, Ind., has completed his survey on the proposed county line road improvement on the Whitley-Huntington County boundary. The stretch petitioned to be improved is five miles long.

Iowa.

✣Bids will be received until June 2, by City Clerk, Mt. Pleasant, Ia., for 10,710 yds. brick pavement, on 6 in. concrete base and asphalt filler; 9,000 ft. combined curb and gutter; 1,200 yds. extra Grading. Hall & Adams, Centerville, Ia., are Engineers.

✣Bids will be received until 5 p. m., June 5, by Charles J. Duff, City Clerk, Council Bluffs, Ia., for the construction of approxi-

[illegible] Switch track.

[illegible] Board of Public Works, Davenport, Ia., on [illegible] Summit Ave., from Eastern to Kuehl:

	Excavat- [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible] & Co.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Co.	[illegible]	[illegible]	[illegible]
[illegible] Const. [illegible] Co.	[illegible]	[illegible]	[illegible]
John Fey	.40	1.39	.35
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Const. Co.	[illegible]	[illegible]	[illegible]
Northwestern Const. Co.	.40	1.40	.33
John Fey	.44	1.25	.33

Kansas.

The city of Topeka, Kan., has sold bonds [illegible] $125,000 for the proposed [illegible] during this year.

According to advices from Hutchinson, Kan., [illegible] Reno county, approximately [illegible] will be spent in that county during the year for improving and maintaining the various towns of the county.

It is reported that Wellington, Kan., will construct about $100,000 worth of paving during this year.

Kentucky.

⊙The State Board of Agriculture, Frankfort, Ky., has awarded the contract for the construction of modern highways upon the State Fair grounds to the Southern Asphaltolene Construction Co., of Louisville.

Louisiana.

⊙The Police Jury of Grant Parish, Colfax, La., on May 23, awarded the contract for building 32 miles of model road from Colfax to Rochelle to Francis T. Constant for $1,778 per mile. Vitrified pipe will be used for culverts and work will begin at once.

The Polic Jury of the parish of East Carroll, Lake Providence La., has appropriated $7,500 for the purpose of constructing a trunk line of public road from the line of Madison parish to the line of the state of Arkansas on the north. This road is to be constructed by the State Board of Engineers. Frank M. Kerr, 104 New Orleans Court bldg., New Orleans, La., State Engineer and president of the board.

Maine.

The City Council of Rockland, Me., has ordered the joint standing committee on highways and sidewalks to lay out, alter and widen Sea St. The estimated cost is $30,000.

Through the enactment of the bill by the last legislature, Augusta, Me., relating to a trunk line system of highways, it is expected some work will be done on the project this season. The route will begin at the eastern terminus of the Portsmouth, N. H.-Kittery, Me., bridge, and continue through Kennebunk, Saco, Portland, Auburn, Waterville, Orono and other important points to Frenchville and Fort Kent, the northern terminus.

Maryland.

✣Bids will be received until noon, June 6, by Commissioners of Prince George County, Upper Marlboro, Md., for the grading and macadamizing of one mile of the Queen Chapel Road between District line and Hyattsville. H. St. J. L. Briscoe is Clerk of the Commissioners.

⊙The State Road Commission, Baltimore, Md., on May 22, awarded contracts for the construction of three sections of road as follows: Charles County, from Waldorf to St. Mary's county line, Hickey-Swann Co., from Shiloh to Brookview, Baker-Smith Construction Co.; Prince George's County, from the District of Columbia line to the Charles County line, Peter F. Connelly & Co.

Massachusetts.

The Board of Street Commissioners, Boston, Mass., has submitted an estimate of $2,184,370 to the mayor, as the total cost of the proposed Park square street improvements. For the Providence St. change of grade the [illegible] placed at $27,500, with [illegible] $24,000. For the extension of Arlington St., to Providence at a width of 69 ft. the land and building damages are figured at $606,550 and the construction of the [illegible] $1,300. For the widening of St. James Ave., from Berkeley St., to Trinity place to 100 ft. would require $1,101,750 and the construction would cost $40,300. For Ferdinand St., widening to 58 ft., would require $217,050 for land and building damages and $86,200 for construction. New bridge over the Boston & Albany Railroad would be necessary at a cost of $60,000, making the total cost $303,250, with betterments of only $26,673.

Michigan.

✣Bids will be received until 2 p. m., June 9, by State Highway Commissioner, Lansing, Mich., for the construction of 1 mile of highway, including 10,000 cu. yds. of excavation and embankment and 500 cu. yds. of reinforced concrete retaining wall and culvert. Townsend A. Ely is State Highway Commissioner. Official advertisement will be found elsewhere in this issue.

⊙The City Council of Detroit, Mich., has awarded the contract for paving work to be done in the city amounting to approximately $50,000, to John S. Affeld of Detroit.

John Brogan of Green Bay, Wis., has been awarded the contract by the County Road Commissioners, Bessemer, Mich., for the grading of the road between Wakefield and Dunham for $19,495. The work is to be completed by Sept. 1. H. A. Harper is county engineer.

The citizens of Maple Grove Township, Maple Grove, Mich., on May 22, voted in favor of borrowing $10,000 for good roads.

The citizens of Richland Township, Richland, Mich., on May 23, voted in favor of borrowing $20,000 for stone road purposes. About six miles of road will be constructed.

Minnesota.

⊙The Board of Trustees of the township of Stuntz, according to advices from Hibbing, Minn., has awarded the following contracts for the construction of roads: The Northern Construction Co., at $4,870, the new Chisholm road; John McHale, $1,970, the O'Rourke road southeast of Hibbing.

⊙The Town Board of Pelan, Minn., has awarded the contract for grading one mile of line between Sections 6 and 7 in the town of Pelan to John G. Jacobsen for $.09½ per cu. yd., and the contract for grading ¾ of a mile on the section line between Sections 19 and 30 to Peter Folland for $.09¾ per cu. yd. Bids were opened May 20 by Oscar Roos, Town Clerk.

Advices from Duluth, Minn., state that West End business men will again push the agitation for the improvement of West Third St., from 20th to 39th Aves. west.

Missouri.

Petitions are being circulated about Excelsior Springs, Mo., and vicinity, for the creation of a special road district, for the purpose of building 40 miles of macadam roadway. The scheme is to get the county court to form a section eight miles square into a district, which then can bond itself for $110,000. The system of roads planned will lead half way to Liberty.

Plans are well under way by the Board of Public Works of St. Joseph, Mo., for improving East Jule St., by paving as far as 32nd St. The board has also approved a petition calling for the paving of 29th St. to 32nd St., with bermuda asphalt.

Nebraska.

⊙Abel Roberts, Lincoln, Neb., at $2.23½ per sq. yd., secured the contract from the Board of Public Works of Fremont, Neb., for paving districts 15 and 16. The curbing will cost $0.18, curb and gutter $0.49, and corner curb $0.50. The estimated cost of the entire work is $12,048. Bids were opened May 25 by P. A. Nelson, chairman of the board.

Ordinances for the paving and curbing of the following streets have been passed by the City Council of Omaha, Neb.: Harney St., 41st to 42nd, 35th Ave., Dewey Ave., to Howard, 25th St., Central Blvd. south to city limits; 25th St., Marcy to Mason; Castellar St., 10th St. to a point 364 ft. east; 22nd St., Pierce to Poppleton; 30th St., Lake to Bristol, Maple, Sherman Ave., to the alley between Sherman Ave. and 18th; 35th St., Dewey Ave. to Howard.

New Hampshire.

✣Bids will be received until noon, June 5, by Board of Public Works, Portsmouth, N. H., for the following brick and granite block paving on a concrete base: Furnishing and laying about 1,540 lin. ft. of straight edge-stone, furnishing and laying about 510 lin. ft. of circular edge-stone; about 7,890 lin. ft. existing edge-stones to be reset; about 14,250 sq. yds. to be made in preparing roadway excavations, about 14,250 sq. yds. concrete base to be furnished and laid; about 3,200 sq. yds. granite block paving to be furnished and laid; about 11,050 sq. yds. brick block paving to be furnished and laid. The proposal, with certified check for $250,000, is to be left at the office of the Board of Public Works, J. E. Parker is engineer and superintendent.

⊙Martin & Condon, 87 Palfrey St., Watertown, Mass., have been awarded the contract by the State Highway Department, Concord, N. H., for the construction of 4,500 ft. of native stone road in Bethlehem, N. H. Bids were opened May 22 by H. C. Hill, state engineer.

New Jersey.

✣Bids will be received until 11 a. m., June 14, by Board of Chosen Freeholders, Camden, N. J., for resurfacing the Camden and Westfield Turnpike in accordance with plans and specifications on file at the office of the State Commissioner of Roads at Trenton, N. J., or Board of Chosen Freeholders. Material to be applied by the ton, railroad weight to govern. Estimate of quantities: Asphalt concrete, 4,065.32 tons, Type B; 1½-in. stone, 3,677.15 tons, gravel, 3,465 cu. yds. J. J. Albertson is county engineer.

✣Bids will be received until 8 p. m., June 6, by Shade Tree Commission, A. T. Hastings, Jr., Secy., for grading about 70,000 cu. yds. of Montgomery Park in accordance with plans and specifications prepared by J. T. Withers, 1 Montgomery St., Jersey City, N. J., where they are on file.

The Board of Public Works of Patterson, N. J., has awarded the following contracts for road work: McKiernan & Bergen, macadamizing 12th Ave., East 26th St., 10th Ave., Spring St., 17th Ave., and Vreeland Ave.; Wayne Contracting Co., filling holes on Fifth Ave.; J. S. Sowerbutt, macadamizing Crooks Ave., Cliff St., Lafayette St., Straight St., North Eighth St., Clifton Ave., Haledon Ave., and Pompton road, and filling the holes on Getty Ave.; F. J. Marley, macadamizing Washington Pl.; Francesco Bros., macadamizing Little Falls turnpike; filling holes on Signac road, A. Bunn; putting screenings on Stone House and Plains road, Francesco Bros.; macadamizing Long Hill road, Francesco Bros.; J. S. Sowerbutt, extending the macadam on East 23rd St., and on Summer St.; James Maybury & Sons, for extending the macadam on Hammond Ave., Passaic; George F. Bracket, for putting Tarvis oil on Long Hill road, and McKiernan & Bergen for putting Tarvis oil on Van Houten Ave., Cliff St., Washington Pl., and 17th Ave.

New York.

✣Bids will be received until June 6 by Common Council, Dunkirk, N. Y., for paving and grading Leopard St. J. M. Hackett is city engineer. R. H. Heppell is city clerk.

✣Bids will be received until 5 p. m., June 5, by D. J. Coutant, City Clerk, Newburgh, N. Y., for furnishing the necessary labor and material for permanently improving by paving Grand St. its entire length, from Washington St. to Leroy Pl. The work will include 25,630 sq. yds. paving; about 11,500 lin. ft. curbing; about 15 catchbasins; 8 inlet basins; 12 sewer manholes; 25 cu. yds. extra concrete. W. J. Blake, Jr., is city engineer.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

✣Bids will be received until 1 p. m., June 14, by State Commission of Highways, S. Percy Hooker, chairman, 55 Lancaster St., Albany, N. Y., for the improvement of the following highways:

County.	Road No.	Approx. Length in Miles.
Albany	[illegible]	[illegible]
Allegany	945	4.18
Cattaraugus	[illegible]	8.83
Chautauqua	[illegible]	6.63
Chautauqua	[illegible]	[illegible]
Erie	[illegible]	10.16
Erie	917	4.11
Genesee	5,145	4.44
Hamilton	5,133	5.48
Jefferson	5,140	5.24
Oneida	931	7.05
Oneida	[illegible]	[illegible]
Orange	5,144	3.31
Otsego	[illegible]	[illegible]
Otsego	936	4.15
Otsego	[illegible]	[illegible]
Schenectady	[illegible]	[illegible]
Seneca	[illegible]	[illegible]
Steuben	5,130	1.16
Suffolk	911	3.01
Tioga	[illegible]	[illegible]
Tompkins	[illegible]	[illegible]
Washington	942	0.66
Washington	[illegible]	[illegible]
Westchester	5,146	3.34
Westchester and Putnam	[illegible]	[illegible]
Wyoming	5,134	3.59
Yates	[illegible]	[illegible]
Warren	5,157	6.54
Warren	[illegible]	[illegible]

An alternate proposal [illegible] combined" will also be received for the following roads combined in one contract, viz:

Oneida	931	
Oneida	933	12.07

The Commission reserves the right to award contracts for State Highways 931 and 932 in the manner which shall be deemed most advantageous for the State, namely, either on separate proposals for highways 931 and 933 or on proposals for these two highways combined. Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the offices of Division Engineer Spencer J. Stewart, Columbus Hall, Poughkeepsie, N. Y., for highways in the counties of Dutchess, Orange, Putnam, Suffolk and Westchester; at the office of Division Engineer Harry P. Willis, Humane Building, Albany, N. Y., for highways in the counties of Albany, Clinton, Essex, Montgomery, Schenectady and Washington; also at the office of Division Engineer Guy H. Miller, Cleveland Bldg., Watertown, N. Y., for highways in the counties of Hamilton, Jefferson, Lewis and Oneida; also at the office of Division Engineer F. W. Sarr, South Clinton and West Jefferson Sts., Syracuse, N. Y., for highways in the counties of Cayuga, Cortland, Madison, Onondaga, Seneca and Yates; also at the office of Division Engineer M. W. Wilbur, Cutler Bldg., Rochester, N. Y., for highways in the counties of Cattaraugus, Chautauqua, Erie, Genesee, Livingston, Niagara and Wyoming and at the office of Division Engineer P. McLoud, Press Building, Binghamton, N. Y., for highways in the counties of Alleghany, Broome, Chemung, Otsego, Steuben, Tioga and Tompkins.

✣Bids will be received until 1 p. m., June 12, by State Commission of Highways, S. Percy Hooker, Chairman, 55 Lancaster St., Albany, N. Y., for the improvement of the following highways:

County.	Road No.	Approx. Length in Miles.
Albany	[illegible]	[illegible]
Allegany	[illegible]	[illegible]
Broome	[illegible]	[illegible]
Cayuga	[illegible]	[illegible]
Chautauqua	5,151	5.20
Chautauqua	938	5.58
Chemung	946	1.98
Clinton	[illegible]	[illegible]
Cortland	[illegible]	[illegible]
Dutchess	5,135	5.22
Dutchess	[illegible]	[illegible]
Dutchess	[illegible]	[illegible]
Erie	[illegible]	[illegible]
Erie	[illegible]	[illegible]
Essex	929	1.44
Genesee	[illegible]	[illegible]
Herkimer	5,159	0.05
Jefferson	5,152	0.29
Lewis	937	3.83
Livingston	5,142	4.05
Madison	908	2.07
Montgomery	[illegible]	[illegible]
Niagara	749	10.30
Oneida	5,139	7.97
Oneida	933	1.20
Onondaga	[illegible]	[illegible]
Otsego	[illegible]	[illegible]
Otsego	[illegible]	[illegible]
Suffolk	[illegible]	[illegible]

⊙Hurley & Lyne of Fredonia, N. Y., have been awarded the contract by Mayor Robert H. Reed and the Board of Common Council of Lackawanna, N. Y., for the paving of Ridge Road for $95,000. Vitrified brick will be used. Bids were opened May 15.

⊙Geo. Gimlech & Co., 65 Columbus Ave., Pittsfield, Mass., have been awarded the contract by E. Cady White, Town Supt. of Highways, East Chatham, N. Y., for the construction of a section of town highway in Chatham known as Rowe Hill for $1,945. Bids were opened May 20.

The Assembly, Albany, N. Y., has passed a bill carrying an appropriation of $10,000 for improving the highway between the Cattaraugus Indian [illegible] Irving.

Governor Dix of New York has signed four bills appropriating about $1,000,000 for the improvement of certain state highway routes. The cost is to be met by the $50,000,000 bond issue authorized for road improvement. The bills are as follows: For the completion of a highway from New York to Rouses Point, $1,500,000; for a route in the Central Adirondacks, between Fulton Chain and McKeever, $500,000; for improving parts of route 7, completing a stone road from Albany to Binghamton, $625,000; for improving highway route 4 in Orange and Sullivan Counties, $1,200,000. The bill giving Franklin County power to issue bonds to the amount of $500,000 for the construction of a county road system has also been signed.

Ohio.

✣Bids will be received until noon, June 23, by Board of Hamilton County Commissioners, Cincinnati, O., for the following county work under specifications No. 215, for oiling Cleves and Bridgetown Pike from Harrison Pike to Cleves, in Green and Miami townships. Fred Dreihs is clerk of the board.

✣Bids will be received until noon, June 23, by Board of Hamilton County Commissioners, Cincinnati, O., for the following county work under specifications No. 218, for oiling Colerain Pike from Miami River to Pool Road in Colerain township. Fred Dreihs is clerk of the board.

✣Bids will be received until noon, June 23, by Board of Hamilton County Commissioners, Cincinnati, O., for the following county work under Specifications No. 213, for the repair of the Blue Rock Pike from the Colerain Pike to the Miami River Road in Colerain township. Fred Dreihs is clerk of the board. A bond amounting to $2,000 must accompany each bid.

✣Bids will be received until noon, June 13, by Director of Public Service, Galion, O., for the improvement of North Market St., from Public Square to north corporate line about 3,200 ft. in length with treated macadam; also East Main St. from Big Four R. R. to east corporate line, a distance of about 5,500 ft., with brick. Henry Hocker is director and E. C. Yochem is clerk. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until noon, June 9, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and material for the improvement of Spring Grove Ave., from Ludlow Ave. to the Old Corporation line by grading, setting new curbs and resetting old curb and paving roadway with bitulithic on sides and with granite in tracks and 18 in. on each side. J. J. Wenner is clerk.

⊙Henry Mouder & Sons have been awarded the contract at Van Buren Center, O., for construction work on the Blosser stone road in that township for $17,914 The improvement consists of four miles of water bound pike.

⊙F. L. Speicer of Bowling Green township, O., has been awarded the contract for building the Windfall Pike in that township for $6,900. The pike begins at the Winnemac Pike at Denman's corners and runs to the county line between Marion and Union counties, a distance of nearly two miles. Other bidders were: D. F. Molloy, $8,300; Shaw & Uncapher, $8,400; M. O. Watkins, $7,424; J. D. Gillispie, $7,638, and John Jones, $8,100.

⊙The Board of County Commissioners, Cincinnati, O., has awarded the following contracts for road improvements: R. E. Cash at $15,500, for improving Bond road from Montgomery pike to Carthage pike; E. Robinson at $1,952, for repairing Colerain pike from Mount Airy to Poole road; H. E. Steele at $4,053, for macadamizing Struble road.

⊙Moran & Springmeier, 2415 Symmes St., Cincinnati, O., have been awarded the contract by the Department of Public Service, Cincinnati, for improving Wellington Place from Auburn Ave. to its western terminus by grading, setting cement curb, paving the roadway with brick where grade is 6 per cent less and by macadamizing the roadway and paving the gutters with brick where the grade exceeds 6 per cent and constructing the necessary drains and inlets. The contract price is $70,005. Bids were opened April 21.

⊙C. F. Rieley has been awarded the contract by the Department of Public Service, Cleveland, O., for paving the portion of West 25th St., affected by the separation of grades of said street and tracks of the N. Y. C. & St. L. R. R., for $21,849. Bids were opened May 24.

The South Side Business & Improvement Association of Columbus, O., is urging the immediate paving of Mound St., from High St. to Central Ave.

Murray & Jameson submitted the lowest bid, about $14,000, to the City Council of Lima, O., on May 15 for the paving of West Elm St., from Collett to Cole Sts. The work includes 10,550 sq. yds. of concrete pavement. Other bids were received from the following: The Lima Stone Co., C. C. Rhodes, H. S. Enck, Blodgett & Hardin and T. J. Mulligan.

An ordinance has been passed by the City Council of Lorain, O., to proceed with the paving of East Erie Ave., between Kansas Ave. and the east line of the Gregg addition. Bids will be advertised for on all classes of pavement.

The plans for the extension of Ray St. and Chapel road in Dayton, O., will be submitted to the Court of Common Pleas for approval.

The Township Trustees of Struthers, O., have sold bonds to the amount of $50,000, authorized by the voters of the township, for the improvement of roads.

The City Council of Wooster, O., has passed a resolution providing for the paving of South Buckeye St., from Liberty to the intersection with Madison Ave. The paving is to be 24 ft. wide from Henry St., to Madison Ave., and 30 ft. wide from Liberty to Henry St.

Oregon.

⊙The Executive Board of Portland, Ore., has awarded the contract for paving East Morrison St., from East Water St. to Union Ave. with treated wood blocks to the Carbolineum Wood Preserving Co., of Portland.

Contracts for street improvements in the city have been awarded by the street committee of the City Executive Board, Portland, Ore., as follows: East 23d st. from Alberta to Killingsworth, grading and concrete curbs and walks, Hilliard & Maginnis, $2,848; East 16th st. from Alberta to Killingsworth, grading and concrete curbs and walks, Hilliard & Maginnis, $2,858; Mississippi Ave. from Killingsworth to West Piedmont, grading and concrete curbs and walks, Hilliard & Maginnis, $2,547; Woodstock Ave., grading and concrete curbs and walks, Joplin & Meeks, $2,473; Klickitat St. district, bitulithic pavement, Elwood Wiles, $62,799; Zanita Ave. from Milwaukee to East 22nd, grading and concrete curbs and walks, Bechill Brothers, $2,731; Cora Ave. from East 37th to East 42nd, grading and concrete curbs and walks, Bechil Brothers, $3,267; Boise St. from East 39th to East 42nd, grading and concrete curbs and walks, Joplin & Meeks, $2,231; Beaumont St. district, bitulithic pavement, Elwood Wiles, $91,156; East 26th St.

from Hawthorne to Belmont, bitulithic pavement, Warren Construction Co., $10,537; 2nd St. from Arthur to Sheridan, fill, Pacific Bridge Co., $29,214; Webster St. from Albina to Michigan, grading and concrete curbs and walks, E. R. Gustafson, $469; East 24th St. from Prescott to Alberta, grading and concrete curbs and walks, Joplin & Meeks, $3,906; Gantenbein Ave. from Skidmore to Alberta, Hassam pavement, Consolidated Contract Co., $14,779; East 31st St. from Francis to Kenilworth, grading and concrete curbs and walks, Joplin & Meeks, $1,895; East 47th St. from Halsey to Belgrade, grading and concrete curbs and walks, Giebisch & Joplin, $1,256; Belmont St. district, bitulithic pavement, Pacific Bridge Co., $53,631.

Pennsylvania.

✣Bids will be received until 5 p. m., June 6, by T. J. McGiven, Borough Clerk, Sharpsburg, Pa., for repaving and repairing and otherwise improving North Canal, Clay, 10th, 15th and Clifton Aves. in said borough. Plans and specifications may be seen at the borough office, 1113 North Canal St. Council reserves the right to reject any and all bids.

✣Bids will be received until 8 p. m., June 7, by Town Council, Dickson City, Pa., for lighting said borough with electricity. William Kennedy is Borough Secy.

✣Bids will be received until 6 p. m., June 6, by James M. Simeral, Clerk of Council, 69 Harrison Ave., Bellevue, Pa., for subgrading, curbing and paving Dakota Ave. from Forest Ave to the north line of Bellevue borough. Approximate quantities: 2,500 cu. yds. grading; 2,800 feet curbing; 4,700 sq. yds. paving. A certified check for $500.00 to accompany each proposal. Plans and specifications can be seen and bidding blanks obtained at the office of John McBride, Borough Engineer, room 708 Fitzsimmons bldg., Pittsburg, Pa.

The Sproul highway bill and the Sproul bill amending Article 9, Section 4 of the state constitution, authorizing the state of Pennsylvania to issue bonds to the amount of $50,000,000 for the improvement of the highways of the state, have been passed by the House. The former provides for the establishment of a State Highway Department by the appointment of a state highway commissioner, two deputy state highway commissioners, chief engineer, chief draughtsman, superintendent of highways and a staff of assistants and employes; provides for taking over from the counties or townships of the Commonwealth certain existing public roads connecting county seats, principal cities and towns and extending to the state line; describes and defines these roads by route numbers as the state highways of the Commonwealth; provides for the improvement, maintenance and repair of the state highways solely at the expense of the Commonwealth, and relieves the several townships and counties from any further obligation and expense to improve or maintain the roads and also relieves townships and counties of authority over them. It requires the state highway commissioner to make maps, which are to be complete records, and confers authority on the state highway commissioner. It provides for the payment of damages in taking of property or otherwise for improvement, and for the purchase or acquiring of turnpikes and toll roads forming all or part of any state highway, and procedure therein. Work of improvement of state highways is to be done by contract except where the state highway commissioner decides that it shall be done by the state. The bill provides for aid by the state to counties and townships desiring such aid in the improvement of township or county roads.

Tennessee.

✣Bids will be received until 1 p. m., June 15, by Hamilton County Road Commissioners, Chattanooga, Tenn., for improving Main St. (Montgomery Ave.) between the Chattanooga Corporation Line at East End Ave. and the Ringgold Road, Ridgedale, Tennessee, for the construction thereon of a pavement of the type to be selected by the Road Commissioners, being either vitrified brick, bituminous concrete or bituminous macadam, with concrete curb and gutters. Approximately 32,000 sq. yds. of pavement and 19,000 lin. ft. of concrete curb and gutter will be built, with an additional amount of approximately 75,000 sq. yds. of pavement and 42,000 lin. ft. of concrete curb and gutter to be built on the streets authorized and to be let at a later date. Plans may be seen, and specifications and blank forms of proposal can be obtained at the office of the Road Commission, at Chattanooga, Tennessee. Proposals must be accompanied by a certified check for $500, drawn to the order of Joe V. Williams, County Judge of Hamilton County, Chattanooga, Tennessee. E. D. Bass is Chairman.

✣Bids will be received until noon, June 20, by Robertson County Pike Commission, Springfield, Tenn., for grading, ditching and macadamizing about 50 miles of public roads in Robertson County, Tenn. Plans and specifications are on file at the office of the Pike Commission. J. E. Washington is Chairman and E. S. Eckles is Secretary.

The City Council of Knoxville, Tenn., has instructed the Recorder to advertise for bids for paving five improvement districts, and has adopted resolutions as to the specifications now on file in the recorder's office. The districts to be paved are No. 11, 89, 90, 91 and 92

Texas.

The Commissioners' Court, Brownsville, Tex., has created Cameron county road district No. 1, on the petition of citizens from the Raymondville-Sebastian-Lyford district, and an election has been ordered for June 24. It is estimated this work will cost about $250,000.

The County Commissioners, Beaumont, Tex., have signified their willingness to expend $5,000 for the proposed county road from the Beaumont Saw Mill Co. plant to Mansfield ferry on the Neches.

The county engineers of Dallas and the Dallas Automobile club are planning to build a macadam road from the Red river to Galveston, the proposed road to be more than 400 miles in length.

An election will be held in McLennan County, Tex., in the near future relative to the matter of building good roads in the county by direct tax or by a bond issue. Waco is the county seat of McLennan County.

The County Commissioners, Lockhart, Tex., have ordered an election to be held in road precinct No. 4 on June 24, for the purpose of issuing $25,000 worth of bonds for the building of macadamized roads in that district.

The citizens of Dayton, Tex., on May 23, voted bonds to the amount of $275,000 for road improvements. There will be one road from the Trinity, ta a point two miles west of Liberty, to the Harris County line; a road from Dayton to Chamber's County line, the Montbelvieu road; a road from Dayton to the Harris County line at Huffman; a road from Dayton to Tarkington Prairie and several short feeders.

The citizens of Liberty County, Liberty, Tex., county seat, have voted the issuance of bonds to the amount of $250,000 for the construction of good roads.

Washington.

✣Bids will be received by the city of Vancouver, Wash., H. H. Lotter, engineer, on June 5 and 19, for the construction of street improvements as follows: Hard surface pavements, concrete walks, curbs and gutters, etc., on 10th St., estimated cost $21,600; 6th St., estimated cost $11,100; 8th St., estimated cost $13,260; 8th from Washington to Depot, estimated cost $82,600; Main St., $51,150; 7th St., $4,500; grading, macadamizing, concrete walks, curbs, etc., Pattullo Ave., estimated cost $7,100; Franklin St., estimated cost $13,100; 26th St., $26,900; grading, graveling, concrete walks, curbs, etc., E. 15th St., estimated cost $6,600; Connecticut Ave., $6,300. Grading, concrete walks, curbs, etc.: 14th St., $3,850; 15th St., $10,500; Harney St., $8,700; Esther Ave., $3,500; Park St., $3,760; 9th St., $14,300; Jackson St., $3,980.

⊙The City Commissioners of Spokane, Wash., have awarded the following contracts for street improvements: R. S. Blome & Co., paving McClellan, Pacific to Second Ave., estimate $2,940; contract price, $3,212; C. M. Payne, grading, curbing, parking and sidewalking Euclid Ave., Cedar to Maple St.; estimate, $2,400; contract price $2,660; James C. Broad, sewer in alley between Mansfield and Montgomery from Northwest Blvd. to Wall St., estimate $6,170; contract price, $5,765.

The City Council of Waitsburg, Wash., has established another paving district which will add five bocks to the district already outlined and give an asphalt pavement the entire length of Main St. E. B. Shifley of Walla Walla is Engineer.

M. E. Halverson, engineer of Pacific County, South Bend, Wash., is reported to have said that that portion of the highway from Centralia to the coast running through Pacific County will be completed this season. The work to be done by the county officials is part of the road known as state road No. 5, which was left unfinished when the legislature adjourned without appropriating the necessary funds to insure the connection of the parts previously finished. Pacific County recently passed a bond issue of $100,000 for its part of the work.

It is reported that the City Commissioners of Spokane, Wash., have decided to pave the Northwest Blvd.

The City Council of Ellensburg, Wash., has decided to proceed with the paving of Pine, Sixth, Water, Pearl and B Sts. Bids for this work are now being asked.

West Virginia.

County Road Engineer S. Howe Bonar, Moundsville, W. Va., is preparing the plans for the paving of the Glendale road from Newmans run to the postoffice, near the old Wheeling Traction Co.'s switch. It is estimated that the work will cost about $5,000.

The City Council of Morgantown, W. Va., has ordered an election for June to pass upon a $100,000 bond issue for paving and sewers.

Wisconsin.

⊙The Wisconsin Stone Co. has been awarded the contract by the city of Milwaukee, Wis., for furnishing 16,500 cu. yds. of crushed stone for the West Side at $1.23 per cu. yd., and 9,000 cu. yds. of crushed stone to the South Side at $1.25 per cu. yd. The city will readvertise for bids for furnishing crushed stone for East Side work.

⊙The Department of Public Works of Milwaukee, Wis., has awarded the following contracts for bituminous pavement on a concrete foundation for which bids were opened May 24: Contract 1, Greenfield Ave. from Clintin St. to 11th Ave., 5th, 8th, 11th and 12th wards, 21,810 sq. yds. of pavement, 275 lin. ft. of new curb, and 264 lin. ft. of curb reset, The Badger Construction Co., Railway Exchange bldg., Milwaukee, $1.40, $.50 and $.08 respectively; Contract 2, Greenfield Ave. from 11th Ave. to Layton Blvd., 11th and 23rd wards, 15,276 sq. yds. of pavement, 824 lin. ft. of new curb, 2,036 lin. ft. of curb reset, R. F. Conway Co., Chamber of Commerce bldg., Chicago, Ill., $1.41, $.45 and $.15 respectively; Contract 3, North Ave. from 7th to 26th Sts., 9th, 10th and 22nd wards, 22,581 sq. yds. of pavement, 1,965 lin. ft. of new curb, 2,281 lin. ft. of curb reset, R. F. Conway Co., $1.45, $.45 and $.15 respectively.

Mayor D. C. Jones of De Pere, Wis., secured signatures to a petition providing for the paving of two blocks on Main Ave. from the bridge to the Kidney boat factory.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

BRIDGES—STEEL AND CONCRETE

California.

✣Bids will be [illegible] July 5, by Board of County Supervisors, W. J. Neilson, Clerk, Eureka, Cal., for the construction of [illegible] bridge over Scott River [illegible]

✣Bids will be received until 1 p. m., June 7, by Board of Butte County Supervisors, Oroville, Cal., for the construction of a concrete steel and wooden bridge over Merrill Slough. H. T. Batchelder is Clerk of the county.

The Merchants' Exchange, Oakland, Cal., at a recent meeting, voted unanimously in favor of supporting and endorsing the organization to span San Francisco Bay with suspension bridge connecting San Francisco and Oakland. A conference is to be held with Col. John Biddle, U. S. Engineer, San Francisco, Cal., in regard to using the Yerba Buena Island as a site for one of the piers for the proposed structure.

Colorado.

Commissioners of El Paso County at Colorado Springs, Colo., are having plans prepared for the construction of a new 30-ft. concrete bridge over Kettle Creek, 8 miles north of the county seat.

Florida.

✣Bids will be received until 10 a. m., June 7, by Commissioners of Duval County, Jacksonville, Fla., for the construction of a reinforced concrete bridge across Marine Creek at 23d St. in North Fort Worth; roadway is to be 40 ft. wide, 2 ft. higher than that of the present structure. C. I. Barnard is County Engineer.

Georgia.

⊙Board of Wilcox County Commissioners, Abbeville, Ga., on May 15 awarded the contract for the construction of a steel bridge over the Allapaha River to the Roanoke Bridge Co., Roanoke, Va., at $2,000. J. J. Gibbs is Clerk of the Board.

Idaho.

⊙Commissioners of Idaho County at Grangeville, Idaho, on May 10 awarded the contract for the construction of the proposed steel wagon bridge across the Salmon River at the town of Goff, 50 miles south of Grangeville, to the Security Bridge Co., Minneapolis, Minn., and Lewiston, Idaho, at $15,950. Other bids received are as follows: Beach Manufacturing Co., Charlotte, Mich., $19,500; Missouri Valley Bridge & Construction Co., Denver, Colo., $16,750; O. H. Stratton, Spokane, Wash., $17,400; Charles Sheeley, Denver, Colo., $16,500.

Illinois.

✣Bids will be received until 2 p. m., June 9, at Town Hall, Manhattan, Ill., John Eberhart, clerk, for the construction of five reinforced concrete bridges in Manhattan township, Will county, Ill. Pfundstein bridge will include 76 cu. yds. concrete and 9,332 lbs. steel; Walsh, Jr., 36.5 cu. yds. concrete and 767 lbs. steel; Walsh, 129.3 cu. yds. concrete and 15,323 lbs. steel; Bellward, 88.8 cu. yds. concrete and 6,574 lbs. of steel; Baker 60 cu. yds. concrete and 1,072 lbs. of steel. Plans and specifications are on file at the office of the Highway Commission and the town clerk. Work is to be completed before Sept. 1.

✣[illegible] L. E. McGann, Commissioner of Public Works, Chicago, for construction of temporary pontoon bridge and approaches over the South Branch of the Chicago River, near 35th St. Work includes: Transferring movable span and scow from the present storage place to bridge site, placing it on new supports, and furnishing and building in place all metal work, etc., furnishing and placing crushed stone in pockets of bent supports in the river, and grading necessary in setting bents, sills and blocking for the approaches; oak planks and timber furnished and built in place, 35,000 ft. B. M. yellow pine timber furnished and built in place, 82,000 ft. B. M. yellow pine timber and lumber furnished and built in place, 80,000 ft. B. M. white pine timber and lumber furnished and built in place, 26,000 ft. B. M. structural steel furnished and built in place, 5,000 lbs. concrete loading blocks, 110 cu. yds. Cash or certified check for $800 must accompany proposal.

✣Bids will be received until noon (standard time), June 8, by I. J. Bryan, Clerk, Sanitary District, 1500 American Trust Bldg., Chicago, Ill., for anchoring the abutments of the Western Ave. bridge. The work is located at the bridge crossing the Main Drainage Channel on the line of Western Ave. Plans and specifications are on file at the office of the Sanitary District. Thomas A. Smyth is President. Official advertisement will be found elsewhere in this issue.

✣Bids will be received at the Court House, Jerseyville, Ill., up to 3 o'clock p. m., June 10, 1911, for the construction of a reinforced concrete superstructure on old stone abutments, in Rosedale Township, Jersey County. William Brown, Town Clerk, Rosedale, Illinois. Groppel Bridge: Span, 23 ft.; roadway, 14 ft. Estimated amount of concrete in superstructure, 25 cu. yds.; reinforcing steel, 3,979 lbs. It will be necessary to rake out moss and dirt from old abutments and wings and repoint with cement mortar; surface top of abutments and place reinforced concrete superstructure. Finished roadway to bed of stream, 10½ ft. Nearest railroad station, Grafton, on the C., P. & St. L., 8½ miles. Gravel available in creek bed, ¼ mile from bridgesite; not familiar with its character. Work to be completed on or before August 10, 1911.

⊙The contract for the construction of a steel bridge in Nameoki township, Madison County, Ill., was awarded to the Missouri Bridge & Iron Co., East St. Louis, Ill. The structure will be of steel, consisting of 60 ft. span with 16 ft. roadway and plain concrete substructure.

⊙Bids will be received until noon, June 1, by Board of Trustees, Village of Benld, Ill., for the construction of two cement bridges with iron railings in the village. Bids will be received for bridges separately and combined. One bridge to be on Central Ave., to be 139 ft. long and eight feet wide in the clear. On bridge on Main street to be 191 ft. long and six ft. wide in the clear. For plans and specifications and further particulars see Village Clerk Harry Hutton.

⊙Highway Commissioners of Silver Creek Township awarded the contract for the construction of two bridges in that township to W. H. Shons, Freeport, Ill., at $3,150. Iron and concrete will be used.

⊙Frank R. Dandrea, 148 22d St., Chicago Heights, Ill., has been awarded the contract for the construction of five concrete bridges at $1,800.

Highway Commissioners have decided to replace the worn out wings of bridges in Bushnell Township, Ill., with new concrete ones.

The Santa Fe System has appropriated $9,700 to cover the cost of constructing bridge No. 32, Eastern Division, and plans to renew bridge No. 526, Missouri Division, at a cost of $3,600.

Indiana.

✣Bids will be received until 1 p. m., June 13, by Board of Scott County Commissioners, Scottsburg, Ind., for the construction of two iron bridges and 4 concrete bridges. Robert Blunt is County Auditor.

✣Bids will be received until 1 p. m., June 5, by Board of Johnson County Commissioners, Franklin, Ind., for the construction of 7 small reinforced concrete bridges. W. B. Jennings is County Auditor.

✣Bids will be received until 1 p. m., June 7, by Board of Boone County Commissioners, Lebanon, Ind., for the construction or repair of 18 bridges. B. F. Herdirch is County Auditor.

✣Bids will be received until 2 p. m., June 6, by Commissioners of Warrick County, Booneville, Ind., for the construction of four bridges. N. M. Spradley is County Auditor.

Iowa.

✣Bids will be received until 2 p. m., June 22, by Board of County Supervisors, Hardin County, Ia., Eldora, Ia., for the construction of a steel bridge with concrete floor across Iowa River at Iowa Falls, Ia. The structure will be 353 ft. long and 20 ft. roadway and two 5-ft. sidewalks. E. L. Marriage is County Auditor. Official advertisement will be found elsewhere in this issue.

⊙Sioux City, Ia., has awarded the contract for furnishing the necessary labor and material for the construction of a reinforced concrete abutment on the east end of W. 4th St. bridge over Perry Creek to P. C. Hanson & Son, Box 85, Sioux City, Ia., at $894.

City Council of Muscatine, Ia., has decided upon the construction of a new concrete bridge on North Cedar St., and bids for the work will be received some time in June.

Kansas.

Plans are being prepared by W. D. Harris, County Engineer, Hutchinson, Kan., for the construction of a concrete bridge near Little River by Buhler Township in Reno County.

The United States War Department has approved and returned the plans for remodeling the James St. bridge over the Kaw River to O. K. Williamson, Wyandotte County Engineer, Kansas City, Kan. The plans involve the construction of an additional 287-ft. double span and an expenditure of $150,000.

Commissioners of Reno County, Hutchinson, Kan., have decided to replace the Baughman bridge over the Ninnescah River, in the southeastern part of the county, with an 8-[illegible]

Kentucky.

⊙The contract for the construction of the arch bridge at Underhill St., Louisville, Ky., has been awarded to The National Concrete Co., Indianapolis, Ind., at $11,510. Other bidders were H. H. Snyder, Louisville, Ky.; Hy. Bickel Co., Louisville, Ky.; L. W. Hancock Co., Louisville, Ky.; L. R. Figg Co., Louisville, Ky. Bids were opened May 22. D. R. Lyman is Chief Engineer of the Department of Engineering, Louisville, Ky.

Maryland.

All bids received by the Highway Commission, Baltimore County, Towson, Md., on May 18, for furnishing the necessary labor and material for the construction of a Strauss Trunnion bascule bridge on Eastern Ave., over Back River, have been rejected as being ex-[illegible] neer.

Massachusetts.

✣Bids will be received until 2 p. m., June 1, by Commissioners of Norfolk County and the Trustees of the Weymouth Fore River bridge at the office of the Mayor, Quincy, Mass., for driving piles around the pivot pier and repairing and strengthening the center fender piers of the Weymouth Fore River bridge. Each bid must be accompanied by a certified check for $200, payable to the Commissioners and Trustees. Plans and specifications are on file at the office of Whitman & Howard, 220 Devonshire St., Boston, Mass., or at Room 21, Adams Bldg., Quincy, Mass.

Plans have been received from the Engineering Department of the New York, New [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] Mass., for the construction of the new South Main St. bridge. It is said that the plans are nearly identical with [illegible] improvement [illegible] City Engineer. B. T. Wheeler, Boston, Mass., [illegible] road.

Michigan.

✣Bids will be received until 10 a. m., June 1, by Department of Public Works, Detroit, Mich., for furnishing the necessary labor and material, and building, according to the plans and specifications on file in the Department, concrete bridge over Fox Creek, on Alter R[illegible] Ave., in the city of Detroit. Each bidder must deposit with his bid a certified check in separate envelope in the sum of $1,000, payable to the order of the Department of Public Works. J. J. Haarer is Commissioner.

⊙[illegible] Board [illegible] K[illegible], Mich., has awarded the contract for the construction of the bridge over the creek just south of Milham Park, on Lovers' Lane, to W[illegible] & B[illegible], K[illegible], Mich., at $[illegible].

Minnesota.

⊙The Beltrami County Commissioners, according to advices from Bemidji, Minn., have awarded the contract for the construction of the bridge over the Mississippi River in the township of Jones, 4½ miles south of Solway, to Iblings Bridge Co., Minneapolis, Minn., at $858. Roy Bliler, Bemidji, Minn., is County Surveyor.

According to plans prepared by Andrew Rinker, City Engineer, Minneapolis, Minn., for lowering the tracks of the Milwaukee main line through that city, the improvement will necessitate an expenditure of $1,800,000. The plans contemplate the lowering of the main tracks between the depot and Forty-eighth St. and Minnehaha Ave., and those between the junction in South Minneapolis and the Mississippi River, no attempt being made to include those at the Milwaukee shops. The scheme is for a lowering of 20 ft., and the new estimate is $216,000 more than that in the plan to lower the tracks 16 ft.

Mississippi.

✣Bids will be received until June 5 by Supervisors of Leflore County, Greenwood, Miss., for the construction of a steel drawbridge across Tallahatchie River at Minter City. The cost of the improvement is estimated at $25,000. C. W. Crockett is Clerk.

Missouri.

✣Bids will be received until noon, June 5, by Lincoln County Court, Troy, Mo., for the construction of a steel bridge over Sulphur Creek, at the Reynolds ford, about 6 miles west of Whiteside, Mo. Plans and specifications are on file at the office of the clerk, Troy, Mo. Andy J. Brown is ex-officio Highway Engineer.

Montana.

⊙The County Commissioners, according to advices from Missoula, Mont., have awarded a contract for the construction of the proposed new bridge over Mission Creek, about 5 miles northeast of Dixon, to J. F. Harrington, at $1,950.

Advices from Troy, Mont., state that a petition is being circulated asking for the construction of a bridge across the Kootenai River at that place. George Moore is interested in the movement.

New Jersey.

✣Bids will be received until 2:30 p. m., May 31, by Board of Chosen Freeholders, Elizabeth, N. J., for the construction of the steel superstructure for bridge over the Elizabeth River at Summer St., Elizabeth, N. J. J. L. Bauer, 120 Broad St., Elizabeth, N. J., is County Engineer.

A hearing was recently held at the State House, Trenton, N. J., in regard to the reconstruction of the arch bridge over Assanpink Creek on South Warren St. Abram Swan, Jr., is City Engineer, Trenton, N. J., and Frank J. Eppele is County Engineer.

New York.

⊙Town Board, Corinth, N. Y., at a recent meeting awarded the contract for the construction of the bridge over Sturdevan Creek, at the north end of Main St., on the proposed new Corinth-Hadley State Road, to C. Fred White, Corinth, N. Y., at $2,375. The other bid for the work was that of Doyle & Co., [illegible], N. Y., $[illegible].

The Assembly, according to advices from Albany, N. Y., has passed the bill of J. S. Parker, appropriating $75,000 for the reconstruction of a bridge across Great South Bay, Lake Champlain.

Ohio.

✣Bids will be received until noon, June 23, by Board of Hamilton County Commissioners, Cincinnati, O., for the following work under Specifications No. 195, for construction of bridges, culverts and approaches thereto on County Club Road, between Readville Pike and Ohio Ave., in Silverton, in Sycamore and Columbia Townships. Fred Dreihs is Clerk of the Board.

✣Bids will be received until noon, June 1, by A. B. Lea, Director of Public Service, Cleveland, O., for the construction of a reinforced concrete culvert under East Boulevard, extending southerly from the present culvert under Kinsman Road. I. O. Hoffman is Secretary.

⊙Department of Public Works, W. A. Budroe, Secy., Dayton, O., has awarded the contract for the re-erection of the Wolf Creek bridge to Al Fox, Dayton, O., at $14,000. The bids for the work were opened May 19.

⊙Board of Lorain County Commissioners has awarded the contract for the superstructure of the Twining Bridge, in Camden Township, O., to the Brunk Machine Forging Co., Lorain, O., at $447. The substructure was awarded to Morris Bros., Oberlin, O., at $568.20. C. H. Lawrence, Elyria, O., is County Surveyor.

⊙Commissioners of Lorain County at Elyria, O., on May 22 awarded the contract for the construction of the superstructure of of the Bassett Bridge to James Scroggie, Olmstead Falls, O., at $476. The substructure went to Charles Hamil, Amherst, O., at $637. Charles Chandler is Clerk of the Commissioners.

⊙The Van Dorn Iron Co. has been awarded the contract by the Department of Public Service, Cleveland, O., for structural steel work for West 3rd St. bridge over the tracks of the Lake Shore & Michigan Southern Railroad, for $6,110. Bids were opened May 24.

An election will soon be held at Elyria, O., giving the citizens of Lorain County an opportunity to vote on the question of authorizing the commissioners to issue bonds amounting to $70,000 for the construction of a bridge in the southeast corner of the city of Lorain and partly in the western portion of Sheffield.

The Commissioners of Cuyahoga County, at Cleveland, O., are planning the construction of a $3,000,000 bridge over the Cuyahoga River the latter part of this season. John Goldenbogen is Clerk of the Board of Commissioners.

Oregon.

✣Bids will be received until 10 a. m., June 2, by A. L. Barbur, City Auditor, Portland, Ore., for furnishing the Park Department of the city galvanized iron culverts, according to plans and specifications on file at the office of the Auditor.

✣Bids will be received until 10 a. m., June 2, by A. L. Barbur, Auditor, Portland, Ore., for the construction of a wooden trestle for the Park Department of the City of Portland, on the line of Terwilliger Boulevard, as per plans and specifications on file at the office of the Superintendent of Parks, 4th floor, City Hall.

Citizens of Portland, Ore., will vote at the June election on the proposition to construct a new bridge in South Portland over the Willamette River from Woodward Ave. at or near its intersection with Grand Ave., following a line to the intersection of the west line of Corbett St. with Meade St. on the west side of the river, thence west along Meade St. to its intersection with Water St. The people are asked to approve a bond issue of an amount not to exceed $1,400,000 to provide funds for the improvement.

Pennsylvania.

✣Bids will be received until noon, June 9, by R. J. Cunningham, County Controller, Pittsburg, Pa., for: First—Furnishing lumber for the repair of sundry county bridges. Second—Making repairs to floors of sundry other county bridges. Third—New creosoted wood block floors on the following bridges: Nos. 1 and 2, Abers Creek; No. 2, Bull Creek; Nos. 10, 15, 16 and 17, Chartiers Creek; No. 1, Cow Run; No. 2, Lobb's Run; No. 2, Lowrie's Run; No. 4, Miller's Run; No. 3, McLaughlin's Run; No. 2, Painters Run; No. 4, Peters Creek; No. —, Plum Creek; No. 3, Robinson's Run; No. 4, Robinson's Run, South Branch, and No. 2, Little Sewickley Creek. Bids for the lumber shall be by the thousand feet delivered, and bids for the repairs and new floors shall be by the lump sum for each bridge.

⊙The Ferro Concrete Co., Harrisburg, Pa., has been awarded the contract for the construction of the proposed reinforced concrete arch bridge over the Pequannock River on the road from Newfoundland to Petersburg, N. J. The contract price was $3,096 and $10 per cu. yd. for extra concrete and $7.50 for extra piles.

⊙The Philadelphia & Reading Ry., William Hunter, Chief Engineer, Philadelphia, Pa., has awarded contract No. 25 for the construction of bridges over Aramingo, Belgrade and Thompson Sts. to the American Bridge Co., New York, and Penna. Bldg., Philadelphia, Pa., at an estimated cost of $264,000. This work is being done in connection with the track elevation work at Philadelphia described in our railway columns.

City Council of Newcastle, Pa., has appointed a committee to consult the County Commissioners in regard to securing the erection of a new steel bridge at North St.

A jury of viewers, according to advices from Philadelphia, Pa., has reported in favor of the construction of a bridge over Chester River at Fifth St.

The Grand Jury of Bucks County at Doylestown, Pa., has approved the petitions for the construction of new bridges over Beaver Creek, Nockamixen Township, and over Tohickon Creek, in Haycock Township.

Tennessee.

⊙Advices from Ripley, Tenn., state that the Commissioners of the County Court have awarded the contract for the construction of 8 county bridges to the Joliet Bridge & Iron Co., Joliet, Ill., at $4,800.

Texas.

✣Bids will be received until noon, July 3, by Dan C. Smith, Jr., City Controller and Secretary, Houston, Texas, for the construction of a reinforced concrete viaduct over the Houston Ship Channel. The structure will be about 1,650 ft. long and 60 ft. wide. Plans and specifications are on file at the office of F. L. Dormant, City Engineer. A certified check for $20,000 must be deposited with each bid. Official advertisement will be found elsewhere in this issue.

City Council has authorized the city of Houston, Texas, to advertise for bids for the construction of the proposed Main St. bridge and viaduct, for which plans are on file with F. L. Dormant, City Engineer.

At a special meeting at the court house, New Braunfels, Texas, the City Council accepted the preliminary plans for the construction of the proposed bridge across the Guadalupe River. W. K. Palmer Co., Kansas City, Mo., Engineers.

Commissioners of Cameron County at Brownsville, Texas, have decided upon the construction of a new bridge over the Fresnos Resac in the city of San Benito. The structure will cross Stenger St., and will be of steel and 324 ft. long. The cost is estimated at $6,900.

Utah.

The Board of Grand County Commissioners at Moab, Utah, received on May 20, the following bids for the construction of a bridge consisting of three 200-ft. spans with wood joists and rails, stone or concrete abutments and tubular piers in center: Patterson-Burghardt Construction Co., Denver, Colo., $47,000; Monarch Engineering Co., Falls City, Neb., $48,000; Midland Bridge Co., Kansas City, Mo., $43,000 (contract awarded); Charles G. Sheely, $46,577; Empire Bridge Co., Falls City, Neb., $47,800; Central States Bridge Co., Indianapolis, Ind., $47,060; A. M. Blodgett Construction Co., Kansas City, Mo., $46,925.

Vermont.

⊙The Central Vermont Ry. Co. has awarded D. W. Cooley, Waterbury, Vt., the contract for the construction of the concrete substructure for the proposed new railroad bridge on Stowe St. The contract price was $5,000.

Virginia.

⊙Mayor Richardson, of Richmond, Va., on May 20 signed the contract with I. J. Smith & Co., Richmond, Va., for the construction of the new reinforced concrete bridge at the site of the old Mayo bridge across the James River, connecting Richmond with South Richmond, on plans drawn up by the Concrete Steel Engineering Co., New York. The contract price was $224,734. This bridge is to be built in accordance with the Melan System and diamond bars, and is to have a concrete railing and a combination trolley and light pole of reinforced concrete. There will be eighteen arches, each having a span of 71 ft., with four abutments and sixteen piers. Seven of these arches cross the James River from Richmond to Mayo's Island and eleven from Mayo's Island to South Richmond. The total length of the bridge is to be 1,721 ft., with a roadway of 44 ft. and two sidewalks of 8 ft. each. Provision is made for water and gas mains, and three conduits of six sections each for power, police and telephone wires. The bridge is designed to carry fifty-ton electric cars, and will be provided with two tracks.

Washington.

⊙Commissioners of Whitman County at Colfax, Wash., recently awarded the contract for the construction of two bridges, known as the Codd and Court House bridges. The first was let to J. M. Janey, Colfax, Wash., at $505 and [illegible] per [illegible] concrete. The second structure was awarded to O. H. Stratton, Spokane, Wash., at $61 per ton of steel, amounting to over $2,800.

Property owners in the vicinity of the site of the proposed Twelfth Ave. bridge are divided as to the advisability of using wood or steel in building the superstructure, and a meeting will soon be held by the City Council of Seattle, Wash., to consider the matter.

Morton Macartney, City Engineer, Spokane, Wash., has completed plans for the construction of the proposed new steel bridge over the river at Nettleton St. It is estimated that the cost will be approximately $285,000. The bridge will be about 1,000 ft. in length, with a grade of less than 1 per cent, the Riverside Ave. end being about 10 ft. higher than the north end. The north end of the bridge is on a grade with Nettleton St. and Summit Boulevard, and the south end on the present grade of Riverside Ave., 150 ft. east of Spruce St. The center span is approximately 100 ft. above the river. There are two spans of 192 ft. and one 100-ft. span, as well as three smaller spans.

Plans for the construction of the proposed Chicago, Milwaukee & Puget Sound Ry. Company viaducts at Division and Market Sts. have been submitted by Morton Macartney, City Engineer, Spokane, Wash., to the Council. J. F. Pinson, Seattle, Wash., is Engineer of Bridges and Buildings.

Boone Avenue Improvement Club, Spokane, Wash., has asked the City Engineer, Morton Macartney, to prepare plans and estimates of the cost of building a bridge across the river at the foot of Boone Ave.

Plans have been filed with Owen Woods, Commissioner of Public Works, Tacoma, Wash., by Waddell & Harrington, Kansas City, Mo., for the construction of the vertical lift and bascule type of bridges over the city waterway and the Puyallup River at 11th St. The plans for a vertical lift bridge as proposed call for two spans and a vertical lift span over the waterway, the lift providing an opening 200 ft. wide between the piers and 135 ft. above high water when raised. Two street railway tracks will be built on the upper deck. Provision is also made for a second deck, if the city desires it. The operating machinery of the bridge will be carried on top of the lift span. Provision is also made for carrying a water main over the structure.

The Senate has passed the Heyburn bill, authorizing the Idaho & Western R. R. to construct a bridge over the Pend O'Reille River at Box Canyon, Stevens County, Washington. E. J. Pearson, Seattle, Wash., is Chief Engineer of the railroad.

Wisconsin.

⊙The contract for furnishing the necessary steel for the construction of the temporary bridge at Oneida St., Milwaukee, was let to the Milwaukee Bridge Co., Milwaukee, Wis., at $580.

The matter of constructing a new bridge at Water St. is soon to be taken up by the city officials of Eau Claire, Wis.

Canada.

⊙The contract for the construction of the Wakefield and Burrows Ave. bridges in Dauphin, Man., was awarded by J. W. Johnston, Secy.-Treas. of the town, to Farrelly Bros., McCreary, Man., at $4,791. Other bids received were as follows: Dominion Steel Bridge Co., Winnipeg, Man., $4,294; Dickson Bridge Works Co., Campbellford, Ont., $4,815; Algoma Steel Bridge Co., Winnipeg, Man., $5,275 or $4,975. According to plans, the structures will be 70 ft. in length and with 18 ft. roadway.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

Surveys are now being made for a drainage system in the Fourche bottoms, to be constructed for the Fourche Drainage District. No plans have as yet been formulated, but the work will be ready for letting this fall. Lund & Hill, Little Rock, Ark., are the Engineers.

Florida.

P. Sanford Ross, Inc., Jersey City, N. J., at $66,370, submitted the lowest bid May 25 for dredging and constructing shore revetment in St. Johns River, Fla. The work will include 65,000 cu. yds. dredging and furnishing 6,200 tons stone. The bid for dredging was 74 cts. per cu. yd. and for stone $2.95 per ton. Capt. J. R. Spalding, Jacksonville, Fla., is U. S. engineer in charge.

Bids were received May 22 by Capt. George R. Spalding, U. S. engineer, Jacksonville, Fla., for dredging in the Caloosahatchie River entrance. Bowers Southern Dredging Co., Galveston, Texas, at $50,000, submitted the lowest bid and will probably be awarded the contract. The job will include about 414,400 cu. yds.

Illinois.

⊙The National Drain Tile Co., Terre Haute, Ind., at $4,960 has been awarded the contract for furnishing the Commissioners of McConnell Mutual Drainage District with 6,000 ft. of 20 in. tile and 5,210 ft. of 18 in. tile. Bids were opened July 19. Leslie J. Owen, Le Roy, Ill., is Attorney for the district.

⊙Bids were opened May 20 by L. O. Howell, Commissioner, Lawrenceville, Ill., for constructing open ditches and tile ditches, the contract being awarded to Spencer Bros., Vandalia, Ill., at $4,165. The work includes 15,300 ft. open ditch 4 ft. bottom, requiring 12,712 cu. yds. excavation. Also to furnish and lay 3,500 ft. 10 in. tile and 2,600 ft. of 8 in. tile.

The Trustees of the Sanitary District of Chicago have voted to adopt the direct route through Blue Island for the Calumet Sag channel. Bids for the first construction contract on this channel have already been opened, as was noted in our last issue.

Hearing has been held by the County Judge at Belleville on the petition to create the Richland Creek drainage district. The proposed district is to comprise a part of Belleville and a given territory three miles south of the city. The project includes the straightening of Richland Creek, while about 2,500 acres now subject to overflow will be reclaimed.

Iowa.

✣Bids will be received until noon, June 14, by Charles A. Root, County Auditor, Estherville, Ia., for the construction of County Drain No. 48, including approximately 30,560 ft. of 5 to 24 in. tile, and County drain No. 62, including approximately 16,425 ft. of 6 to 26-in. tile.

✣Bids will be received until 3 p. m., June 14, by Board of Supervisors, Page County, Clarinda, Ia., for the construction of a new channel for the Nodaway River in Drainage District No. 9 in Page County. Plans and specifications are on file in the office of C. W. Duke, County Auditor, Clarinda, Ia. The total amount of excavation is estimated at 909,053 cu. yds. of loam, silt and clay. A. S. Van Sandt is engineer in charge. Official advertisement will be found elsewhere in this issue.

Louisiana.

The Franklin Drainage Board, Franklin, La., is reported to have asked bids for the digging of a canal from Bayou Portage to the beginning of Willow St., near the depot at Franklin, and also for a continuation of the canal up around Irish Bend.

Michigan.

Work will be started soon on the deepening, widening and straightening of Looking Glass River for a distance of 18 miles in Ingham, Clinton and Shiawassee counties. Walter R. Carver, Mason, Mich., is County Drain Commissioner of Ingham County.

Minnesota.

✣Bids will be received until June 1, by E. E. Reynolds, chairman, Pequaona, Hall City, Minn., for the construction of 240 rods of ditch.

Missouri.

⊙Bids were received May 15 at Carrollton, Mo., for the construction of main canal and laterals for Drainage District No. 3. The contract for the main ditch was let to R. B. Gordon Co., Celina, O., at 7.4 cts per cu. yd. The contract for the laterals was let to M. J. Hanawalt, Monticello, Ind., at 8.73 cts. per cu. yd. These contracts are subject to action of the Carroll County Court in June. The work calls for cutting bends and straightening water course. Bottom width main canal, 40-50 and 60 ft.; laterals, 12 to 20 ft.; side slopes, 1-1; cutting, 12 to 18 ft. deep; 1,710,000 cu. yds. in main canal and 286,000 cu. yds. in laterals. Brooks & Jacoby, Kansas City, Mo., are the Engineers for the district.

The Adair Drainage District, Thos. J. Dock-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ery, Secretary, Kirksville, Mo., will on June 6 sell $[illegible] drainage bonds.

South Dakota.

Bids were opened May 18 at the [illegible] of the U. S. Reclamation Service, Newell, S. Dak., for the construction of the Townsite lateral. L. W. Dotson and Lee Shirley, Newell, S. Dak., at $7,162, will probably be awarded the contract. The work includes about 39,000 lin. ft. of canal, involving the excavation of about 65,000 cu. yds. of earth.

Utah.

Bids were opened May 15 by T. L. Lytle, Engineer in charge of the Strawberry Valley Tunnel Project of the U. S. Reclamation Service, Provo, for hauling freight between Diamond switch railroad station and the west portal of the Strawberry tunnel. The bids received were as follows, the first figures being for hauling from April 1 to Nov. 13, and the second from Nov. 16 to March 31:

Harmon Cummings, Heber, Utah...	$8.95	$8.95
Frank McKenzie, Springville........	8.75	15.00
E. F. Dixon, Payson................	8.50	12.50
James R. Farrer, John J. Peters, O. L. Hedenberg, Provo..............	7.90	12.00
J. S. McBeth, T. G. Wimmer, Payson and Salt Lake.....................	7.70	12.50
George Billings, D. Billings, Edwin Johnson, Provo...................	7.25	11.00
Thomas Broadbent, Joseph Broadbent, Provo.........................	5.85	5.85

The distance for the freight to be hauled is about 28 miles and up grade. The amount stated in the bids is for a ton of freight.

WATER-WORKS

Alabama.

The City Council of Birmingham, Ala., has sold bonds to the amount of $50,000 for the purpose of completing the municipal water system and extending the mains to the steel plant.

Arkansas.

✣Winters & Dove, Civil Engineers, 810 First National Bank Building, Fort Smith, Ark., have completed plans and specifications for a new distribution system for Water Works District, No. 2, Mena, Ark. Separate proposals will be entertained for the materials and the construction, as follows: For 780 tons cast iron pipe and special castings; 71 4 in. to 12 in. valves and 27 hydrants; and for laying approximately 40,000 ft. of 4 in. to 12 in. mains. Proposal blanks and specifications may be had by addressing the engineers. A deposit of $5.00 will be required for the plans and specifications of the pipe laying. Contract will be let in about 30 days.

California.

The City Board of Trustees of Sacramento, Cal, has adopted a resolution clearing the way for calling an election for the purpose of voting bonds in the sum of $200,000 to purchase and install a new pumping unit for the city water works department. It is expected that the election will be held some time during July. The proposed pump will have a capacity of 15,000,000-gals. per day.

Colorado.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the Rensselear Valve Co., Monadnock bldg., Chicago, the contract for furnishing to the Water Pipe Extension Department 3 36-in., 5 30-in. and 1 24-in. valves. Contract price, $2,935.00.

⊙Malacky Murphy, 5315 Wabash avenue, Chicago, Ill., has been awarded the contract by the Board of Local Improvements of the town of Cicero, Ill., for furnishing and laying water mains in S. 53d Court and S. 52d Court for $566. George Comerford is president of the Board. Bids were opened May 23.

A six-inch pipe line will be laid from Colorado Springs to Pike View, a distance of approximately three miles and a half, by the Santa Fe System to reduce the cost of water; estimated cost $15,000.

Bids were opened May 23 by L. E. McGann, Commissioner of Public Works, Chicago, Ill. for erecting boiler room of the Roseland pumping station, coal bunkers with platform, ash hopper, coal receiving hopper spouts, valves, etc.; bids were as follows: Roemheld & Co., 171 LaSalle st., $.0408 per lb., John J. Gallery, 154 Whiting st., $.05, Phillips Lang & Co., 98 Jackson blvd., $.041; estimated weight, 220,000 lbs.

Connecticut.

⊙The Connecticut Engineering & Construction Co., Norwich, Conn., has been awarded the contract by the Board of Water Commissioners, Holyoke, Mass., for the construction of a new dam at the storage reservoir, for $33,361.

Florida.

The citizens of Bradentown, Fla., on May 23, voted the issuance of bonds in the sum of $15,000 for the installation of a waterworks.

The citizens of Arcadia, Fla., have voted the issuance of bonds in the sum of $20,000 for the construction of a waterworks.

Bonds to the amount of $100,000 have been voted by the taxpayers of Ocala, Fla., for the purpose of installing a waterworks.

Georgia.

It is reported that the city of Sylvester, Ga., is considering the issuance of bonds in the sum of $20,000 for extending the water and sewer mains of the city.

An election will be held in Unadilla, Ga., on June 15 for the purpose of voting on the proposition of issuing bonds in the sum of $12,500 for extending and improving the water works system.

Illinois.

✣Bids will be received until 7:30 p. m., June 5, by Matt Berscheid, City Clerk, Joliet, Ill., for furnishing and erecting complete, a pumping plant of a capacity of 1,500,000 gals. of water per 24 hrs. at the site of the artesian well at the intersection of Des Plaines and Lafayette sts., Joliet, Ill.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., June 8th, for furnishing tools, labor, material, etc., necessary to construct a concrete floor in the Roseland pumping station, 104th St. and Stewart Ave. Cash or certified check for $250 must accompany proposal.

An ordinance has been passed by the City Council of Anna, Ill., providing for the laying of 23,347 ft. of distributing mains.

A mass meeting of East Alton, Ill., citizens was recently held for the purpose of discussing the proposed building of a municipal waterworks.

The citizens of Peoria Heights, Ill., at a recent meeting voted in favor of a bond issue for the construction of a waterworks plant. The estimated cost of the work is between $20,000 and $30,000. The Harman Engineering Co., Fredonia av., Peoria, Ill., is Engineer.

Indiana.

✣Bids will be received until 9 a. m., June 5, by Board of Control, The Indiana Boys' School, Plainfield, Ind., for the construction of a water tower. Guy H. Humphreys is president.

✣Bids will be received until 10 a. m., June 17 by City of Evansville, Ind., at the office of Alvord & Burdick, Engineers, No. 1417 Hartford bldg., Chicago, Ill., for furnishing the following material: Approximately 250 tons C. I. Pipe and Specials; 30 Valves, from 4" to 30" in size; One 24" Venturi Meter and one Pitometer, in accordance with the plans and specifications of the Engineers.

The town of Leesburg, Ind., contemplates installing a waterworks system at [illegible] estimated cost of $8,000.

The Town Council of Morocco, Ind., will soon ask for bids for the installation of a waterworks system.

The City of Clinton, Ind., contemplates the installation of about two miles of 4-in. [illegible] and 8-in. cast iron pipe water mains.

Iowa.

✣Bids will be received until 10 a. m., [illegible] 3, by City Clerk, Sioux City, Ia., for the construction of a concrete foundation for a water works station at Leeds. Bids will be received separately. G. B. Healy is Supt. Parks and Public Property.

⊙The Des Moines Bridge & Iron Works, Des Moines, Ia., has been awarded the contract by the Board of Public Service for the construction of a steel water tower on a concrete base, for which the William H. Evers Engineering Co., Arcade bldg., Cleveland, O., is Engineer.

Louisiana.

✣Bids will be received until June 10, by J. D. Hunter, Mayor, Rayne, La., for the following materials and supplies: 12 ft. of 8-in. cast-iron water pipe; 5,946 ft. of 6-in. cast-iron water pipe; 250 ft. of 4-in. cast-iron water pipe; 16 6x6x4-in. cast-iron tees (reducing branches); 1 8x8x6-in. cast-iron tee (reducing branches); 1 6x6-in. cast-iron tee; 4 6-in. cast-iron end plugs; 4 6-in. cast-iron sleeves; 1 8-in. cast-iron sleeve; 3 6-in. cast-iron gate valves; 16 Gorey's fire hydrants, 4-in. valve opening, 4-in. hub end connection, 5—⅞-in. standpipe with 2 2½-in. nozzles for 24-in. trench; 5,000 lbs. of pig lead; 300 lbs. of hemp (tarred).

Maine.

The Bodwell Water Power Co., Milford, Me., has been sold for a consideration of $500,000 according to advices from Bangor, Me.

Maryland.

The Cumberland, Md. City Council on May 22 decided to employ Consulting Engineer James H. Fuertes, 140 Nassau, New York City, to personally supervise and direct the construction of the dam, pipe, reservoir and filtration plant to compose the proposed new water system, for which bonds to the amount of $500,000 were recently voted. The estimated cost of the system is $469,928. Leander Schaidt is City Engineer.

Massachusetts.

⊙Daniel A. Dory of Natick has been awarded the contract by the Water Commissioners of Pittsfield, Mass., for laying 10,500 ft. of 15-in. water main from the Farnham dam toward the center of the city. The contract price is $10,018.

⊙Vaughn & Kibbe, of Springfield, Mass., have been awarded the contract by the City Council of Longmeadow, Mass., for constructing a concrete reservoir and for a pump house foundation.

The Massachusetts State Legislature has granted the town of West Brookfield, permission to borrow $30,000 for the construction of a waterworks system.

Minnesota.

⊙The village of North Mankato, Minn., has awarded the contract for the construction of a pipe line, furnishing valves and hydrants to the Pastoret-Lawrence Co., of Two Harbors, Minn., for $14,000; the contract for constructing reservoirs and pump house to J. B. Nelson & Co., of Mankato, Minn., and the contract for drilling wells to the Zion City Well Co., Chicago, Ill. Otto Neitge is president of the village.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

New York.

Bids were opened May 16 by the Board of Water Supply of New York City for the construction of four sections of the deep pressure tunnel to be built under New York City to carry water from the Catskill Aqueduct. The contracts on which bids were received were as follows: Contract 63—Construction of a portion of the City tunnel of the Catskill Aqueduct, a circular tunnel in rock, 15 ft. inside diameter, and about 21,260 ft. long. From the northerly end of the work in Yonkers, about 200 ft. north of the New York City line, between Jerome and Mt. Vernon Aves., the tunnel line extends in a general southernly direction through the Borough of The Bronx, under Van Cortlandt Park and Jerome Park reservoir, and thence beneath the Old Croton Aqueduct and Aqueduct Ave. to Burnside Ave., near University Heights. Tunnel construction will be carried on through five shafts, spaced from 3,500 to 5,000 ft. apart, and varying in depth from 215 to 240 ft. Contract 65—Construction of a portion of the City tunnel of the Catskill Aqueduct, a circular tunnel in rock, 15 ft. and 14 ft. inside diameter. From the northerly end of the work at Aqueduct and Burnside Aves. near University Heights, the tunnel line extends in a general southerly direction under Aqueduct and Lind Aves., in the Borough of The Bronx, to the crossing under the Harlem River at 167th St., near Highbridge, thence beneath Highbridge, St. Nicholas and Morningside Parks and connecting streets, in the Borough of Manhattan, to Central Park near Eighth Ave. and West 99th St. The work will be carried on through 7 shafts, spaced from 2,500 to 5,100 ft. apart, and varying in depth from 260 to 475 ft. Contract 66—Construction of a portion of the City tunnel of the Catskill Aqueduct, a circular tunnel in rock, varying from 14 ft. to 12 ft. inside diameter. From the northerly end of the work in Central Park, near 8th Ave. and West 99th St., the tunnel line extends in a general southerly direction under Central Park, 6th Ave. and Broadway to 14th Sts., in Union Square. The work will be carried on through 6 shafts, spaced from 2,300 to 4,550 ft. apart, and varying in depth from 200 to 250 ft. Contract 67—Construction of a portion of the City tunnel of the Catskill Aqueduct, a circular tunnel in rock, 12 ft. and 11 ft. inside diameter. From the northerly end of the work in Union Square, at 14th St., the tunnel line extends in a general southerly direction through the Borough of Manhattan, under 4th Ave., the Bowery, Delancey, Allen, Hester and Clinton Sts., thence beneath the East River to the foot of Bridge St., in the Borough of Brooklyn, and through this borough under Bridge St. and Flatbush Ave. to the terminal shaft, Shaft 23, at 3rd Ave. and Schermerhorn St., and from Flatbush Ave. under Lafayette St. to the terminal shaft, Shaft 24,

UNIT BIDS OF LOWEST BIDDERS ON THE FOUR CONTRACTS FOR CONSTRUCTING THE PRESSURE TUNNEL, NEW YORK CITY.

	-Contract 63-		-Contract 65.-		[illegible]		-Contract 67.	
	Quantity.	Bid.	Quantity.	Bid.	Quantity	Bid.	Quantity.	Bid.
Removing [illegible]						$1,000.00		$5,000.00
Sinking [illegible]	[illegible]		[illegible]	400.00	[illegible]		[illegible]	466.00
Sinking shaft, per lin. ft.	16[2]	292.00	435	400.00		[illegible].00		471.00
Sinking shaft, per lin. [illegible]	[illegible]					330.00		1,082.00
Sinking shaft, per lin. [illegible]	10[illegible]	310.00					[illegible]	456.00
Sinking shaft, per lin. ft.							120[14]	735.00
Sinking shaft, per lin. ft.							150[15]	393.00
Sinking shaft, per lin. ft.							10[illegible]	614.00
Sinking shaft, per lin. ft.							705[17]	426.00
Sinking [illegible]							1.500[18]	354.00
Sinking shaft, per lin. ft.							215[19]	423.00
Sinking [illegible] included, per lin. ft.	615	310.00	[illegible]	[illegible]	815	330.00		
Refilling shaft, per lin ft.		[illegible]						
Drain tunnel for shaft 3, complete, per lin ft.		[illegible]						
Excavation of tunnels and drifts, per cu. yd.	[illegible]	[illegible]	310,000	[illegible]	218,000	11.25	157,000	10.70
Additional trimming on shafts, tunnels and drifts, per sq. yd.	2,000	5.00	1,500	2.00	1,100	5.00	1,500	4.00
Furnishing structural steel roof support, per lb.	[illegible]	.03	2,400,000	.03	1,380,000	.03	1,600,000	.04
Erecting structural steel roof support, per lb.	[illegible]	.01	2,400,000	[illegible]	1,380,000	[illegible]	1,600,000	[illegible]
Temporary timbering, per M. ft.	[illegible]	60.00		50.00	325	70.00	290	70.00
Pumping from shafts and tunnels during construction, per 1,000,000 ft. gals.				.20		.25		.35
Drainage channels for shafts and tunnels, per lin. ft.	[illegible]	1.25	30,950	1.50	24,465	2.00	[illegible]	2.50
Forms for outer lining of all shafts, per lin. ft.	[illegible]	10.00	2,350	10.00				7.50
Forms for lining main tunnels and connecting tunnel, per lin. ft.	21,420	[illegible]	28,150	10.00	23,250	4.50	730	8.75
Forms for inner lining of all shafts, per lin. ft.				10.00				
Forms for outer and inner linings of suction valve shafts, per lin. ft.						12.00		
Forms for lining risers, per lin. ft.	500	1.50	[illegible]	10.00		5.00	2,350	2.00
Tunnels and drifts, per lin. ft.							21,720	[illegible]
Concrete masonry in shafts, per cu. yd.	6,000		13,600	8.00	[illegible]	10.00	26,000	10.85
Concrete masonry in tunnels and drifts, per cu. yd.	86,000	6.75	120,000		[illegible]	7.50	70,000	10.25
Excess concrete masonry in shafts, tunnels and drifts, per cu. yd.	2,000	3.00	2,000	3.00	2,000	3.00	2,000	3.00
Brick masonry in shafts, tunnels and drifts, per cu. yd.	200	[illegible]	300	15.00		25.00	[illegible]	20.00
Venturi meter fittings, lump		16,000.00						
Dry packing in tunnels and drifts, per cu. yd.	6,500	2.50	[illegible]	3.00		.50	6,500	[illegible]
Drainage interlining in drainage shaft, per sq. ft.			20,500	.30			36,500	[illegible]
Drainage interlining in section valve shaft, per sq. ft.					13,500	1.[illegible]		
Steel interlining in risers, per lb.	140,000	.10	[illegible]	.05	365,000		820,000	.07
Steel interlining in tunnel and at section valve, per lb.					155,000			[illegible]
Steel lining in and adjacent to drainage drift, per lb.			60,000	.06				
Cutting channels for water stops, per sq. ft.			450	1.00	1,500	2.00	475	2.50
Dri[illegible]			[illegible]				1,000	1.00
Drilling 1¾-in. holes in rock or masonry, per lin. ft.	2,000	.60						
Drilling 1¾ to 2½-in. holes in rock or masonry, per lin. ft.			3,000	.50			3,000	2.50
Steel pipe for grouting, per lin. ft.	30,000		40,000		30,000	.30	10,000	.50
Plant and equipment for grouting, lump		4,000.00		[illegible]		5,000.00		5,000.00
Hi[illegible]		300.00	11	200.00		300.00	10	300.00
Ai[illegible]		300.00		[illegible]		300.00		300.00
Mechanical stirring grouting machine	5	600.00		400.00		300.00		350.00
Grouting pads, each	30			12.00	10		10	100.00
Making grouting connections, per connection	5,000		8,000		5,000	1.75	8,000	1.50
Setting grouting pads, per pad	1,500	1.50	2,500	1.00			2,500	1.50
San[illegible]			[illegible]	2.00	3,500	1.75	4,000	2.00
Mixing and placing grout, per cu. yd.	5,000	5.00	[illegible]	1.00	5,000	10.00	6,000	6.00
Earth excavation in open cut, per cu. yd.	9,000		7,200	2.00	12,500	2.00		
Excavation in open cut, per cu. yd.							11,500	3.50
Rock excavation in open cut, per cu. yd.	4,300		3,300	[illegible]	5,000	4.00		
Refilling and embanking, per cu. yd.	9,600		5,500	1.00	12,000	1.00	4,800	1.00
Timber and lumber, per M. ft.	150	65.00	150	55.00		60.00	250	75.00
Concrete masonry in open cut, per cu. yd.	1,700			6.50		8.00	3,200	12.00
Portland cement, per bbl.	180,000					[illegible]	[illegible]	1.50
Reinforcing steel, per lb.	70,000	.05	160,000	.04	100,000	.05	1,000,000	.04½
Miscellaneous iron and steel, per lb.	120,000	.07	115,000	.06	125,000	.07	450,000	.07
Galvanizing, per lb.	30,000		30,000	.05	25,000	.0[illegible]	15,000	.06
Setting metal work furnished by city, per lb.	410,000	.02	[illegible]		[illegible]	.03		.06
Cast iron pipe and specials, per ton	150	100.00		100.00			100	80.00
Bronze pipe and miscellaneous bronze, per lb.	1,000	.65	8,000		600	1.00	5,000	.80
Ga[illegible]			12	75.00				
Vitrified pipe, 18-in. and smaller, per lin. ft.					1,000		500	2.50
Vitrified pipe, 18 to 24-in., per lin. ft.							[illegible]200	1.25
Vitrified pipe, 15-in. and smaller, per lin. ft.	2,500		[illegible],000	1.50				
Vitrified pipe, 20-in. and smaller, per lin. ft.				3.00	70		100	[illegible]
Dry rubble masonry and paving, per cu. yd.	100		100		150	7.50	100	6.00
Rubble masonry and paving in mortar, per cu. yd.	100	5.00	2,000	3.00	[illegible]	5.00	[illegible],500	3.00
Pavement, per sq. yd.			300	2.00	100	2.50	500	3.00
Crushed stone and gravel, per cu. yd.	300			2.00			50	2.00
Reinforced concrete ladders, per lin. ft.								
Section office building, lump		5,000.00		9,000.00		5,000.00		8,000.00
Section and locker house, lump								
Lo[illegible]		6,000.00		8,000.00		8,000.00	8,000	5.00
Sinking [illegible]								
Resto[illegible]				9,000.00		10,000.00	[illegible]	[illegible]
Casing left in place, per lb.								

[1]Sinking shaft 1. [2]Sinking shaft 5 in earth. [3]Sinking upper portion of shaft 3. [4]Sinking lower portion of shaft 3. [5]Sinking shaft 7 in earth. [6]Sinking [illegible] 17 in [illegible]. [8]Sinking [illegible] [9]Sinking shaft 12 and portions of shaft 18 in rock. [10]Excavation of shaft 19 in earth. [11]Excavation of shaft 20 in earth. [12]Excavation of [illegible] in earth. [15]Excavation of lower portions of shafts 23 and 24 in rock. [16]Excavation of shaft 24 in earth. [17]Excavation of shaft 21 in rock. [18]Excavation of shafts 19, 20 and 22 in rock. [19]Excavation of upper portions of shafts 23 and 24 in rock.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

in Fort Greene Park. The work will be car- [illegible] to 5,200 ft. apart, and varying in depth from [illegible] Mason & Hanger Co., Cornwall-on-Hudson, N. Y., $3,709,372; Contract 65, Pittsburg Contracting Co., Pittsburg, Pa., $5,590,225; Contract 66, Grant Smith & Co. & Locher, Rome, N. Y., $4,512,605; Contract 67, Holbrook, Cobort & Rollins, Corp., New York, $5,272,435. The unit bids of these above four low bidders are given in the accompanying tabulation.

✣Bids will be received until 11 a. m., June [illegible] Public Works, Buffalo, N. Y., for the improvement of the water works system. Separate bids will be received on the following: For cast-iron pipe and special castings; for brass corporation cocks and plugs; for hydrants; for oil; for valves; for general carting. Francis G. Ward is Commissioner of Public Works.

✣Bids will be received until June 5, according to reports, by Board of Water Commissioners, Niagara Falls, N. Y., for laying mains in Robinson Court, Sixth st. and also to place several hydrants on Buffalo av. between Union st. and the City line.

⊙The Board of Aldermen of Buffalo, N. Y., has awarded the contract for the construc[illegible] tunnels under the railroad tracks at the Massachusetts Ave. station to the Eastern Concrete Steel Co., 401 S. D. Morgan bldg., Buffalo, for $22,462.

The State Water Supply Commission, Albany, N. Y., has made a final order approving the application of several counties, towns, cities and villages and by individual owners of riparian property for the regulation of the flow of the upper Hudson river by the construction of a storage reservoir upon the Sacandaga river near Conklingville at a cost of $4,650,000. The state is to have absolute ownership and control of the reservoir at any point on the Sacandaga river between the dam and the junction of the Sacandaga and Hudson rivers. The proposed reservoir will have a storage capacity of thirty-two billion cu. ft. It will create a lake of twenty-five miles long with a surface area of forty-two sq. miles or about the same as that of Lake George. The extreme depth of the water will be seventy ft. at the dam and thirty ft. at Northville, the upper extremity of the reservoir. All timber, buildings and brushwood are to be removed from the basin of the reservoir and all stumps cut close to the ground. The extreme height of the dam above the river bed is ninety feet and its extreme width at the bottom is 580 ft. The crest of the dam will be 1,200 ft. long and it will be twenty feet above the flood flow line.

The Board of Aldermen of Buffalo, N. Y., has adopted the finance committee's report recommending a bond issue amounting to $1,000,000 to equip the new pumping station.

The taxpayers of Niagara Falls, N. Y., have voted in favor of the expenditure of $360,000 for the purpose of paralleling the mains of the Western New York Water Co., and for the improvement of the fire department, for which $42,500 is required. Work on the mains will be commenced immediately.

The citizens of Rockville Center, L. I., have voted the issuance of bonds to the amounts of $11,000 and $6,000 for extensions to the light and water systems respectively. Thomas Murphy is president of the village.

T. J. & G. L. Brown, 87 Hamilton Place, New York City, submitted the lowest bid to the Board of Water Supply, 165 Broadway, New York City, for Contract 77, for the construction of the Wakefield Ave. blow-off, a concrete and cast-iron pipe conduit in Wakefield Ave. about ½ mile north of the New York City line in the city of Yonkers, N. Y. The bid is $58,179. Bids were opened May 4 by Charles Strauss, President of the Commission of Board of Water Supply.

Anthony C. Douglass, 2 Rector St., New York City, submitted the lowest bid May 23 to the Board of Water Supply, 165 Broadway, New York City, for the completion of the Hudson Siphon, [illegible] deep pressure tunnel in rock 14 ft. inside diameter, extending under the Hudson river about 1,100 ft. below the water surface with two shafts, 3,022 ft. apart on the opposite shores between Storm King and Breakneck Mts., in the towns of Cornwall and Fishkill. The bid is $1,432,323.

Minnesota.

✣Bids will be received until 8 p. m., May 31, by City Council, Barnesville, Minn., for the construction of two extensions to the water works system. M. P. Philippi is City Clerk.

Mississippi.

An election will be held in Biloxi, Miss., on June 27 for the purpose of voting on the issuance of bonds to the amount of $70,000 for extensions to the water works system. The work will include about 63,200 ft. of mains ranging in size from 4 to 8-in. in diameter, reservoir, two pumps, fire plugs and fire house. E. C. Castanera is Supt. of the water works.

Nebraska.

⊙The Inter-Mountain Bridge & Construction Co., Tecumseh, Neb., has been awarded the contract by the Village Board of Battle Creek, Neb., for the construction of a water plant. The work includes concrete pump house, furnishing one 25 hp. gasoline engine, one 6-in.x8-in. triple pump, one 6-in.x6-in. air compressor, one steel tank, 9 ft.x38 ft., and furnishing and laying 9,800 ft. of 4 and 6-in. water mains. The engineer's estimate is $10,000. The Alamo Engine & Supply Co., Omaha, Neb., is Engineer. Bids were opened May 22.

North Carolina.

The city of Clinton, N. C., has voted the issuance of bonds to the amount of $30,000 for waterworks and sewers.

Ohio.

✣Bids will be received until noon, June 6, by Director of Public Service, Kenton, O., for furnishing the materials and labor for constructing a reinforced concrete reservoir approximately two million gallons capacity, also for the building of additions and making alterations to the pumping station at the City Water Works Plant, according to plans and specifications on file in said office. Each bid must be accompanied by a bond in the sum of $500.00, or a certified check on some solvent Kenton, O., bank. G. S. Binckley is Clerk.

⊙Jas. J. Brown, of Cincinnati, O., has been awarded the contract by the Department of Public Service, Cincinnati, for laying cast-iron pipe in Lick Run road, Boudinot Ave., Mozart Ave., Walnut St., and Harrison Pike for $6,430. Bids were opened May 9.

The City Council of Urbana, O., has passed an ordinance providing for the issuing of $25,000 worth of bonds for water works improvements. A new engine will be purchased.

An election will be held in the village of Bedford, O., on June 20 to decide whether a bond issue for $45,000 shall be floated partially to pay for the construction of a water and sewage system and a disposal plant. It is estimated the improvement will cost $95,000.

Oklahoma.

⊙The contract for the construction of the new water system for the city of Sapulpa, Okla., has been let to the Southwestern Engineering Co., of Oklahoma City, Okla., for $229,400. The system is to be a series of reservoirs and deep wells. Burns & McDonnell, Scarritt bldg., Kansas City, Mo., Engineers in charge.

The City Commissioners of Tulsa, Okla., have engaged Consulting Engineer Dabney H. Maury, of Peoria, Ill., to investigate the Arkansas river and the sand and gravel beds of the Arkansas river valley as a possible source in water supply, and to report to the commission the most feasible source, their relative purity, and healthfulness, cost of installation and maintenance.

The city of Kingfisher, Okla., will let contracts about July 1 for the construction of new water works and electric light plant, estimated to cost $28,000. C. V. H. Francis is official in charge.

The city of McAlester, Okla., on May 20, sold bonds to the amount of $80,000 for extensions to the waterworks.

Oregon.

✣Bids will be received until 4 p. m., June 13, by the Water Board, Frank T. Dodge, Supt., Portland, Ore., for furnishing 200 fire hydrants, f. o. b. cars Portland.

⊙The Water Board of Portland, Ore., has awarded the contract for 1,500 tons of cast-iron water pipe of the dimensions of 6, 10 and 12-in. in diameter to the Oregon Cast Iron & Steel Works of Oswego for $48,375, and the contract for furnishing the department with 100 tons of water main specials for $4,900 to Smith & Watson Iron Works of Portland.

Pennsylvania.

✣Bids are being received by the Borough of Masontown, Pa., for the construction of a water filtration plant in accordance with plans prepared by Chester & Fleming, Consulting Engineers, Pittsburg, Pa. E. C. Baker is City Engineer.

The city of Franklin, Pa., plans the construction of a filter plant and the drilling of new wells at an estimated cost of $18,000. L. E. Chapin of Canton, O., and Pittsburg, Pa., is Engineer. Philip B. Hied is Supt. of the water works.

Tennessee.

⊙The Board of Public Works of Nashville, Tenn., has awarded the contract to the J. N. Stone Construction Co., Nashville, for the construction of over 41,000 ft. or nearly eight miles of new water mains touching about 50 streets of the city. The following bids were received for the work: M. J. Cuniff, $15,442; Southern Roofing & Paving Co., $14,178; T. I. Curtis & Son, $14,250; E. T. Lewis & Co., $15,724; Foy-Proctor Co., $16,478; J. N. Stone Construction Co., $12,249; J. P. LeSueurer & Co., $18,761; W. M. Leftwich, $14,113; S. T. Stewart & Bro., $18,572; John Broderick, $13,773. About three-fourths of the new mains will be 6-inch pipe, and the remainder 12 and 18 inches.

An election will be held in Greenville, Tenn., on June 5, for the purpose of voting on the proposition to issue $65,000 in bonds for the erection or construction of an electric light and water plant.

Bids will be asked about July 1 by the city of McKenzie, Tenn., for the construction of a water works and an electric light plant and for improvements to several streets. The city recently voted bonds in the sum of $40,000 for these improvements. C. H. Jenks, of St. Louis, Mo., is Engineer.

Texas.

✣Bids will be received until 6 p. m., June 7, by City Council, Winters, Texas, for furnishing the necessary material for the construction of water works system including electric motor or gasoline engine, triplex pump and steam pumps, boilers, heater, water works pipe, valves, hydrants and tank and tower. O'Neil Engineering Co., Engineers, 1503-8 Praetorian bldg., Dallas, Texas. G. T. McDonald is City Secy.

✣Bids will be received until 10 a. m., June 1, by City Commissioners Fort Worth, Texas, for furnishing necessary labor and material for the construction of a 5,000,000-gal. filtration plant. A certified check for $1,000, payable to J. J. Nunnally, City Auditor, must be filed with each bid. J. D. Trammell is one of the Engineers. T. J. Powell is Water Works Commissioner.

The city of Brady, Tex., contemplates purchasing the existing water works at a cost of $40,000. If the system is purchased dams will be constructed on Brady Creek so that a permanent water supply can be secured.

Bonds in the sum of $30,000 have been voted by the citizens of Bonham, Tex., for improvements to the present water works.

Plans have been prepared by the Fountain-

Shaw Engineering [illegible] of Dallas, Tex., for the installation of [illegible] water works system in the town of Nocono, Tex., estimated to cost $20,000. The work will include a concrete pumping station, concrete reservoir, of $1,000,000-gal. capacity and a steel tower and tank of 50,000-gal. capacity.

Citizens of the district between German St. and the Harrisburg [illegible] eastern portion of Houston, Tex., have presented a petition to the City Commissioners asking for the extension of the water mains throughout that section.

The City Council of San Antonio, Tex., has appropriated $10,000 to be expended by the mayor to investigate the water supply system. The mayor will employ experts to investigate its income, operating expenses, charges, sources, extent of supply, value, etc.

Virginia.

✣Bids will be received until noon, June 1, by town of Lexington, Va., for furnishing 41,800 ft. of 8-in. cast-iron pipe valves and special castings. N. Wilson Davis, Harrisonburg, Va., is Engineer.

Advices from Blacksburg, Va., state that the citizens of that city have voted the issuance of bonds in the sum of $12,000 for the construction of a waterworks and a sewer system.

Washington.

✣Bids will be received until 11 a. m., June 3, by Capt. E. C. Long, Constructing Quartermaster, Seattle, Wash., for the construction of a 2,000,000-gal. reinforced concrete reservoir with water mains, etc., at Fort Worden, Wash.

According to advices from North Yakima, Wash., the Pacific Power & Light Co. will extend its water mains to the city limits in a number of directions.

Wisconsin.

✣Bids will be received until 10:30 a. m., June 1, by Department of Public Works, Milwaukee, Wis., for the necessary labor and material for the laying of a 30-in. cast iron water main in and along 29th St. H. C. Briggs is Commissioner of Public Works. missioner of Public Works.

✣Bids will be received until 10:30 a. m., June 1, by Department of Public Works, Milwaukee, Wis., for furnishing the necessary labor and material for the laying of a 30-in. cast iron water supply main in and along Greenbush St. H. E. Briggs is Commissioner of Public Works.

Canada.

✣Bids will be received until noon, June 13, by Secretary-Treasurer, Village of Biggar, Sask. for the following water works contracts; Tender No. 1, trenching, laying and back filling, for cast-iron water main, hydrants, valves, etc.; Tender No. 2, for supplying cast-iron water mains and specials; Tender No. 3, for supplying hydrants, valves, and valve boxes; Tender No. 4, for supplying and installing all pumping machinery; Tender No. 5, for supplying and installing a compressed air storage tank; Tender No. 6, for erection of a Power House; Tender No. 7, for the construction of a concrete reservoir. Plans and specifications can be seen at the offices of the Secretary-Treasurer of the Village of Biggar, Sask., or the Engineer, Yorkton, Sask., or copies can be had from the Engineer on receipt of a marked cheque for $10 which cheque will be returned on return of the plans and specifications. F. McArthur, Consulting Engineer, Yorkton, Sask.

⊙The Robert Filter Mfg. Co., Inc., Derby, Philadelphia, has been awarded the contract by the City Commissioners of Saskatoon, Sask., for the installation of a mechanical water filtration plant for the city for $55,890. Bids were opened March 31 by W. B. Neil, City Clerk.

The Wilkie, Sask., Town Council has engaged a municipal engineer to prepare plans and specifications for the installation of a water works. It is planned to have the system completed by fall.

SEWERAGE AND GARBAGE DISPOSAL

California.

It is reported that the citizens of Winters, Cal., on May 20 voted the issuance of bonds to the amount of $28,000 for the installation of a sewer system.

The following bids were received by the City Council of San Diego, Cal., on May 15 for furnishing sewer pipe and fittings: J. S. Schirm, $34,187.24, less 2 per cent, net $33,503.50; A. H. Busch & Co., net $33,575.27; Pacific Sewel Pipe Co., net $31,541.93; W. J. Bailey, $34,197.24; less 2 per cent, net $33,513.30; Western Metal Supply Co., $34,077.19, less 2 per cent, net $33,395.65; Glazed Cement Pipe Co., net $26,648.30.

Colorado.

The Chicago, Burlington & Quincy Railroad and the Colorado & Southern Railroad have offered the city of Denver, Colo., $50,000 and agree to construct a storm sewer and catch basins on Walnut St., to cost not in excess of $113,750, for the privilege of extending their tracks into the heart of the city.

Connecticut.

✣Bids will be received until 4 p. m., May 31, by the City Clerk, Danielson, Conn., for the construction of a sewer 1,700 ft. long in Mechanics St. Harry E. Back is a member of the Sewer Committee.

District of Columbia.

✣Bids will be received until 2 p. m., June 5, by commissioners of District of Columbia, Washington, D. C., for the construction of sewers in the District of Columbia.

Florida.

⊙Advices from Tampa, Fla., state that the Swann & Holtsinger Co., has let the contract for about one mile of sewer pipe, to be laid in that company's suburb on the Bayshore Blvd., to the E. N. Jelks Brick & Tile Co., of Macon, Ga.

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., June 3rd, for furnishing and delivering 125 hand portable incinerators to the Bureau of Streets. Incinerators are to be constructed of Bessemer steel, 24 ins. square and 36 ins. deep, mounted on wheels, with a steel frame, and are to be equipped with ash-pan covers, handles, etc., as shown on plans attached to specifications. Cash or certified check for $100 must acompany proposal.

⊙Henry Rees, Quincy, Ill., has been awarded the contract by the City Council of Hoopeston, Ill., for the construction of a sanitary sewer system for $48,172. The work will include 10 miles of glazed sewer pipe. Bids were opened May 25.

The Board of Local Improvements of Bloomington, Ill., has approved the engineer's estimate for a sewer on Clay St., Woodland Ave., and Jackson St., at $4,736. The city clerk has been instructed to advertise for bids at once for this work. Elmer Folsom is city engineer.

Indiana.

✣Bids will be received until 10 a. m., June 5, by Board of Public Works, Indianapolis, Ind., for the construction of the following local sewers. Separate bids: In first alley east of Adams St., from Twentieth St. to first alley south; in first alley west of Adams St., from Twentieth St. to first alley south; in Thirty-fourth St., from Ethel St. to Missouri St., and in Thirty-fourth St., from College Ave. to Cornell Ave.

✣Bids will be received until 7 p. m., June 5, by Board of Trustees, Bloomfield, Ind., at the offices of Guy & Humphries, Bloomington, Ind., for the construction of concrete water way and combined curb and gutter about 700 ft. in length. Franklin Ramsey is president.

Iowa.

✣Bids will be received until 10 a. m., May 31, by O. W. Sandberg, City Clerk, Keokuk, Ia., for the construction of a number of sewer improvements in Section 1, 2 and 3.

✣Bids will be received until 2 p. m., June 1 by City Council, Sheldon, Ia., for the construction of a public sanitary sewer in several streets. E. W. Smale is city clerk.

⊙The City Council of Chariton, Ia., has let the contract for the construction of a new sewer in northeast Chariton to Guy Smith of Indianola, Ia.

⊙J. L. Hansman has been awarded the contract by the City Council of Des Moines, Ia., for the construction of a 12-in. vitrified pipe sewer on College Ave., from the sewer in place at 18th St., to the center of 19th St., and on 19th St., from the north of the north line of Clark St., 10-in. in diameter, for $1.119 a lin. ft. About 930 ft. of sewer will be laid. Horace Susong is clerk. Bids were opened May 17.

A special election was held in Waterloo, Ia., on May 29 for the purpose of voting on the proposition to install sewers in the Third and Fourth wards, comprising District No. 1.

City Engineer C. H. Young of Muscatine, Ia., has been instructed by the City Council to prepare a plat and schedule of the proposed sewer extensions in sub-sewerage district No. 21, of main 1, which will likely include sewerage on Bartlett St., Parham St., and possibly Cedar, together with Main St., in South Muscatine, and 11th between Iowa Ave. and Chestnut St.

Kansas.

The City Commissioners of Topeka, Kans., have passed a resolution providing for the organization of a benefit district to pay for the proposed sewer for the west part of the city. The district includes all the territory not now included in sewer districts already organized and takes in the College Hill district on the south, running north through Auburndale to the river, where the sewer main will empty into the river.

Minnesota.

✣Bids will be received until 8 p. m., June 12, by City Council, Willmar, Minn., for the construction and installation of a sanitary sewer system, septic tanks and filtration beds. H. Gunderson is city clerk.

✣Bids will be received until 8 p. m., June 19, by A. V. Roderick, City Clerk, Brainard Minn., for the construction of a new general sewer in the city.

The City Council of Gilbert, Minn., has approved the plans for the proposed sewer system. The contract will be let about June 1.

The city of Minneapolis, Minn., will sell bonds June 13 in the sum of $275,000 for the construction of sewers. Plans have been made by the City Council to expend about $200,000 on main sewer construction this season. Andrew Rinker is city engineer.

The Village Council of Proctor, Minn., contemplates the installation of a sewer system at an estimated cost of $80,000. It is proposed to have the sewer drain into two large septic and filtering tanks on the east and west sides of the village.

Missouri.

⊙The Board of Public Works of St. Joseph, Mo., has awarded contracts for the construc-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible]

Burns & McDonnell, Consulting Engineers, Scarritt Bldg., Kansas City, Mo., have been engaged by the city of Girard, Kan., to prepare plans and specifications for the construction of a sewer system in the town. The main sewer will run from the north side to an outlet near the southwest corner, where a septic tank will be erected.

⊙The Board of Public Works of St. Joseph, Mo., has awarded the contract for the Fifth Ave. sewer to D. B. Kelley for $7,000. The sewer will extend five blocks in Fifth Ave., as follows: Fifth Ave., from Blacksnake sewer east to 12th St. Other bids received were: Land Construction Co., $9,664; Skilbred Construction Co., $8,830; Olson-Schmidt, Construction Co., $9,572.

The Board of Public Works of St. Joseph, Mo., has ordered ordinances prepared for an extensive sewer system in district No. 119, particularly along 22nd, 24th and Jackson Sts., and Doniphan Ave.

Montana.

The City Council of Whitefish, Mont., has decided to issue six per cent warrants instead of bonds for the installation of a sewer and septic tank.

Nebraska.

✣Bids will be received until 2 p. m., June 5, by City of Omaha, Neb., for the construction of the Burt St. main sewer, including the following approximate quantities: Reconstruction—420 lin. ft., more or less, 4 ft., six-inch Brick Circular Sewer; 1,710 lin. ft. more or less, 3 ft., six-inch Brick and Plain Concrete Sewer; 510 lin. ft., more or less, 5-ft., Reinforced Concrete Sewer; also for the new construction—510 lin. ft., more or less, 7-ft., 2½-ring Brick Circular Sewer; 1,220 lin. ft., more or less, 5-ft., two-inch, two-ring Brick Circular Sewer; 910 lin. ft., more or less, 5-ft., two-ring Brick Circular Sewer. C. W. Craig is city engineer.

✣Bids will be received until 2 p. m., June 5, by City of Omaha, Nebr., for the construction of the Southwest branch South Omaha Main sewer. The work will include the following approximate quantities: 400 lin. ft., more or less, 6-ft., 2½-ring Brick Circular Sewer; 1,342 lin. ft., more or less, 6-ft., Reinforced Concrete Sewer; 16 lin. ft., more or less, Funnel Section, as shown on plans; 1,392 lin. ft., more or less, 5-ft., 2-inch, 2-ring Brick Circular Sewer; 1,227 lin. ft., more or less, 3-ft., 4-inch, 2-ring, Brick Circular Sewer; 556 lin. ft., more or less, 3-ft., 2-ring Brick Circular Sewer. G. W. Craig is city engineer.

South Dakota.

⊙H. J. Cathroe of Omaha, Neb., has been awarded the conract by the Board of Commissioners, Huron, S. Dak., and South Dakota State Fair Board, for the construction of sewers on Third and Ninth Sts., in the state fair grounds. The work includes 2,150 ft. of 18 and 20-in. vitrified pipe sewer, 10 to 18 in. deep, 650 ft. of 12-in. vitrified sewer, 1,200 ft. of 8-in., and 10-in. vitrified pipe sewer. S. S. Oviatt is city auditor. Bids were opened May 22.

F. S. Dobson of Lincoln, Neb., on May 20 submitted the lowest bid to the Board of Public Works of that city for the construction of the Washington St. storm sewer, which is to be constructed out of a part of the proceeds of the sale of $50,000 of sewer bonds [illegible]

New Jersey.

The Township Committee of the township of Linden, N. J., plans to join with the [illegible] in the construction of a trunk sewer in the township, beginning at the dividing line between [illegible] extending to the trunk sewer of Roselle. Frank R. Anderson, Wood Ave., Linden, is township clerk.

An ordinance has been presented in the City Council of Trenton, N. J., providing that the city issue bonds to the amount of $10,000 for the purpose of preliminary work and plans for the establishment of a sewage disposal plant.

New York.

✣Bids will be received until 7:30 p. m., June 12, by Grover E. Yerdon, City Clerk, Johnston, N. Y., for the construction of a Trunk Sewer in or along the Cayadutta Creek, from Market St. to Main St., including the following estimated quantities: 240 lin. ft. 24-in. vitrified tile sewer; 510 lin. ft. 24-in. iron pipe sewer; 609 lin. ft. 30-in. vitrified tile sewer; 1,030 lin. ft. 30-in. iron pipe sewer; 122 lin. ft. in 11 brick manholes; 700 cu. yds. slate rock excavation. Bidders are required to submit a certified check of $500 with the bid. Plans, profiles and specifications may be seen, and blank forms and all necessary information obtained at the office of the city engineer.

✣Bids will be received until 11 a. m., June 1, by Department of Public Works, Buffalo, N. Y., for the construction of a 12-in. tile sewer in Newfield St., between Roesch Ave. and O'Neil St.; a 10-in. tile sewer in Sheridan Ave., from Northland to Delevan Aves.; a 48, 27, 24-in. brick, and 20, 18 and 15-in. tile sewer in south side of Delavan Ave., between Texas St. and the city line. Francis G. Ward is commissioner of public works.

⊙P. R. Kiely, Wood Ave. Syracuse, N. Y., has been awarded the contract by the city of Syracuse, N. Y., George J. Metz, City Clerk, for the construction of the E. Colvin St. trunk sewer extension and several lateral sewers for $51,704. Bids were opened May 22.

⊙H. C. Schroeder of Rochester, N. Y., has been awarded the contract by the Village Trustees of Dansville, N. Y., for the construction of an extension of the surface water sewer system for $2,000.

⊙The contract for putting a sewer through the main street of Old Forge, N. Y., has been awarded to the Old Forge Hardware & Furniture Co., for $1,475.

The plans for the proposed New Hartford, N. Y., sewer district have been filed with Town Clerk Charles A. Padley.

The Village Board of Saint Johns, N. Y., has advertised for bids for the construction of the sewer and water systems of William St., and Failing Ave.

Petitions are being circulated in the village of Herkimer, N. Y., asking the Board of Trustees to call a special election for the purpose of submitting the question of raising $25,000 to build sewers in those sections of the village not already covered by the present system.

The city of Troy, N. Y., proposes to build a storm water sewer from Fourth St. to the top of the hill near St. Joseph's cemetery, with the necessary manholes and catchbasins, to build gutters, grade and crown the surface of the street, and to treat it with quarry chips and clay so as to make a hard dirt road, with sufficient crown to give a good drainage. The estimated cost of this work in constructing sewer is $7,000, building gutters, grading and resurfacing, $5,000.

The Board of Contract and Supply of Albany, N. Y., has engaged Consulting Engineer Rudolph Herring, 170 Broadway, New York City, relative to the construction of an intercepting sewer. Plans for the sewer will be prepared at once.

Patrick Kiley of Syracuse, N. Y., submitted the lowest bid, $14,448, to the Board of Public Works of Fulton, N. Y., for the building of sewers in the city.

The sewer commissioners of Batavia, N. Y., on May 15 received bids for the construction of the disposal plant in connection with the new $375,000 sewer system, from the following: Schaefer & Locke, Batavia; F. G. Diefendorf, Erie, Pa.; John W. Danforth Co., Buffalo; C. H. Murray, Rochester; Hard & Worm, New York. The bids run from $37,737 to $55,659.

The notice of intention of the city of Buffalo, N. Y., to overhaul and reconstruct the sewers as recommended by the Commissioner of Public Works and approved by the Common Council, has been signed by the mayor. The improvement will cost between $3,000,000 and $4,000,000.

Ohio.

The City Council of Girard, O., has adopted plans for a storm water sewer on Liberty St., and will also pave that street from State to the railroad.

The city of Lorain, O., plans the construction of a sewer on Broadway St. Henry E. Riggs of the engineering firm of Riggs & Sherman, The Nasby, Toledo, O., has been engaged to render an opinion concerning the best type of sewer.

The City Council of Norwalk, O., has decided to install a new system of sewers. Three sewers will be constructed on Oak St., from Maple St. to the west end of Oak; on East Main St., from Townsend Ave. to the east corporation line, and on Forest St., from Benedict Ave. to the end of Forest St.

According to Engineer Wilson's estimate submitted to the City Council of Girard, O., it will cost $4,595 to install a 30-in. storm sewer in Liberty St., from the east line of the State St. intersection to the river, equipped with six manholes and the necessary catchbasins.

The Lindenwald Improvement Association of Hamilton, O., recently sent a delegation to the City Council to urge the plans for certain sewers in Lindenwald be prepared and the work done.

Oklahoma.

The city of Shawnee, Okla., has taken steps toward advertising for bids for the construction of about 40 blocks of new sewer. The sewers will be constructed in various parts of the city where residents have petitioned the city council to construct sewers.

City Engineer T. C. Hughes of Tulsa, Okla., has presented plans, estimates of cost and final estimates for the sanitary main sewer from the east side of Tulsa to the city commissioners. The estimated cost is $20,698. Bids for this work will shortly be advertised for.

Oregon.

✣Bids will be received until 7:30 p. m., June 7, by City Council, Pendleton, Ore., for the furnishing of necessary labor and material for the construction of an extension to the sewer system. Plans and specifications were prepared by Geary Kimbrell, City Surveyor. Thomas Fitzgerald is City Recorder.

Pennsylvania.

✣Bids will be received until 4 p. m., June 1, by Engineer Dale Borough, 306 Suppes Bldg., Johnston, Pa., for the construction of sewers in the borough of Dale as follows: McMillan St., 590 ft. 12 in. line; Unnamed alley, 320 ft., 10 in. line; Deckman alley, 180 ft., 12-in. line; Adleman alley, 150 ft. 8-in. line. There will be required approximately 728 ft. of 12-in. terra-cotta sewer pipe; twenty-one 12 by 6 in. terra cotta Y branches; five 12 by 6-in. terra cotta T branches; 312 ft. of 10-in. terra cotta sewer pipe; eight 10 by 6-in. Y branches; one 10 by 8-in. Y branch; one 10 by 8-in. T branch; 156 ft. of 8-in. terra cotta pipe; five 8 by 6-in. Y branches; two manholes; three inspection holes, and 357 cu. yds. of excavation in trench 2 ft. wide. All as per plans and specifications on file with the Borough Engineer.

✣Bids will be received until 8 p. m., June 14, by Secretary Westchester, Pa., for the construction of outfall sewers and disposal plants. Plans and specifications are on file at the office of the Borough Engineer and at the office of A. F. Damon, Jr., Engineer, P. O. Bldg., [illegible]

⊙Moses Griffith has been awarded a contract in Hudson, Pa., for the building of the sewer from the new silk mill on Oak St., to the creek for $2,354.

The Ben Avon Heights Sewer Co., has been incorporated at Pittsburg, Pa., with a capital stock of $5,000. The incorporators are W. P. and J. D. Fraser, Ben Avon and L. W. Monteverde of Pittsburg.

The Tamaqua, Pa., Council has decided to hold a special election on June 20 to decide whether or not a bond issue of $12,500 shall be floated for sewer construction.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

The Borough Council of Dormant, Pa., has authorized the [illegible] 30 acres of land known as Fleming Place, in the 19th ward, Pittsburg, and the Anderson farm, a similar sized plot of ground in Dormont borough.

Texas.

The town of West, Tex., contemplates the installation of a sewerage system at an estimated cost of [illegible]. A [illegible] will be necessary to provide the money for the system.

The City Council of Victoria, Tex., has made provisions for the construction of the first storm sewer in the city, which will extend two blocks west on Power Ave., from Bridge St., and three blocks south on Moody St., from Power Ave. The estimated cost of the work, exclusive of the pipe, which will be 24-in. in diameter, is $1,000.

Washington.

⊙The City Council of Centralia, Wash., has let the contract for extensive trunk sewerage to F. A. Keasel of Centralia.

⊙The City Council of Ritzville, Wash., has let the contract for the construction of a sewer on College hill to J. J. Royce for $5,950.

The City Commissioners of Spokane, Wash., on May 18 received the following bids for the construction of a sewer on Havermale St., from Washington to Howard: Archer & Madison, $7,895; Lang & Smith, $5,660; R. B. DeCamp, $6,280; J. C. Broad, $5,765, and Robinson & Foster, $5,598.

The Board of Public Works, of Seattle, Wash., on May 19 received bids for the construction of the interbay section of the north trunk sewer from F. McLellan, Stirratt & Goetz and the Erickson Construction Co., and the Colson Construction Co. Fred S. Stimson and C. R. Collins, under the name of the Colson Construction Co., at $925,000 submitted the lowest bid on the work, and will probably be awarded the contract. This contract is for the last end of the north trunk sewer, which will have its outlet under Fort Lawton, and will call for a 12-ft. sewer, running from Ross Station to the outlet, to be circular in form, and to be built of brick and concrete.

WestVirginia.

✤Bids will be received until 1 p. m., June 10 by Board of Commissioners, City of Huntington, W. Va., for the following lateral sewers: 15-in. tile sewer in 21st St. from alley between 8th and 9th Aves. to alley between 9th and 10th Aves.; 12-in. tile sewer in the alley between 9th and 10th Aves. from 20th to 21st Sts.; 12-in tile sewer in the alley between Rockwood and Dalton Aves. from 19th to 20th Sts.; 18-in. tile sewer in 2nd Ave. from 11th to 13th Sts.; 12-in. tile sewer in Railroad Ave. from 12th to 13th Sts. Which plans and specifications are on file in the city engineer's office. A certified check of $500 made payable to the city treasurer must accompany each bid. John Coon is commissioner of streets. A. B. Maupin is city engineer.

Wisconsin.

✤Bids [illegible] until 7:30 p. m., June 5 by T. B Olsen, Village Clerk R. R. 8, Sta. E, East Milwaukee, Wis., for furnishing the necessary labor and material for constructing a section of sewer in Columbia, from Prospect Pl. to Maryland Ave.; in Farwell Pl. from Columbia Pl. to Mineral Spring road, and in Maryland Ave. from Columbia Pl. to Mineral Spring road. Approximate quantities: 695 lin. ft. of 36-in., 2-ring brick sewer; 1,330 lin. ft. of 30-in., 2-ring brick sewer; to include 78 lin. ft. of 18-in. pipe laterals; 168 ft. of 15-in. pipe laterals; 19 manholes; 13 catch-basins and the necessary connections as shown on the plan. Bidders will state a price per lineal foot for each size of the brick sewer, which is to include all manholes and catch basins complete, and all the laterals, pipe sewers and connections as shown on the plan Work to be completed within 90 days from the date of the award of the contract. Each bidder must accompany his bid with the sum of $2,000 in money or a duly certified bond or check, payable to the treasurer of the village of East Milwaukee.

✤Bids will be received until 7:30 p. m., June 5, by T. B. Olsen, Village Clerk, East Milwaukee, Wis., R. R. 8, Sta. E., East Milwaukee, Wis., for furnishing the necessary labor and material for the construction of a section of sewer in Prospect Place, from Olive St. to Cottage Ave., and in Olive St. from Prospect Place to Farwell Place. Approximate quantities: 1,075 lineal feet of 30-in., 2-ring brick sewer; to include 132 lin. ft. of 18-in. pipe laterals, 55 lin. ft. of 18-in. pipe laterals; 12 manholes; 8 catch basins and the necessary connections as shown on the plan. Bidders will state a price per lineal foot for each size of the brick sewer, which is to include all manholes and catch basins complete, and all the laterals, pipe sewers and connections as shown on the plan. Work to be completed within 60 days from the date of the award of the contract. Each bidder must accompany his bid with the sum of $1,000 in money, or a duly certified bank check, payable to the treasurer of the village of East Milwaukee.

✤Bids will be received until 7:30 p. m., June 5, by Theodore B. Olsen, Clerk of the Village of East Milwaukee, Wis., R. R. 8, Sta. E, East Milwaukee, Wis., for furnishing the necessary labor and materials for the construction of the following described sewers: A 15-in. pipe sewer in Jarvis St., from Richland Ave. to Whitefish Bay Ave.; an 18-in. pipe sewer in Downer Ave. from Olive St. to Marion St.; a 15-in. pipe sewer in Marion St. from Downer Ave. to Whitefish Bay Ave.; an 18-in. pipe sewer in Marion St. from Downer Ave. to Stowell Pl.; a 15-in. pipe sewer in Stowell Pl from Marion St. to Cottage Ave.; a 2-in. pipe sewer in Cottage Ave. from Stowell Pl. to Whitefish Bay Ave.; an 18-in. pipe sewer in Cottage Ave. from Prospect Pl. to Farwell Pl.; a 15-in. pipe sewer in Cottage Ave. from Farwell Pl. to Maryland Ave.. Approximate Quantities: 957 lin. ft. of 15-in. pipe sewer; 1,507 lin. ft. of 18-in. pipe sewer. To include 22 manholes, and 12 catch basins complete. Work to be completed within 60 days from the date of the award of the contract.

The following bids were received by the Board of Public Works of Antigo, Wis., on May 17 for the construction of the sewage disposal plant and intercepting sewer designed by Consulting Engineer W. H. Kirchoffer of Madison, Wis.: Intercepting Sewer, James McCabe, Fond du Lac, $18,749; W. H. Fisher, $22,487; Robert Nelson, Racine, $19,802; Walter Blake, Appleton, $25,817; John Stiefler, Wichita, Kan., $19,465; Mulholland, King & Co., Kaukauna, $21,269; F. C. Robinson & Co., $21,500; John Brogan, Green Bay, $19,888; A. Harding Co., Racine, $24,000, and William Moran of Joliet, Ill., $19,987. For Disposal Plant: W. H. Fisher, $22,285; Walter Blake, $22,130; John Steifler, $18,900; F. C. Robinson, $30,000; John Brogan, $19,945; A. Harding Co., $22,650, and William Moran Co., $19,987.

Canada.

The taxpayers of Victoria, B. C., have voted the issuance of bonds to the amount of $300,000 for extending the sewer system.

The Board of Control of Montreal, Que., has authorized the following expenditures for sewer and water mains during the year: Water service, $164,270 for water mains on such streets as are to be paved; $110,869 for new mains in the older city wards; $211,000 for a 12,000,000-gal. steam pump, to be installed in readiness for service when the aqueduct enlargement works have been completed. New sewers, $174,000 on trunk sewers in the old wards; $283,400 for a new main sewer for the northeastern section of the city, passing through St. Denis, Rosemount, and Longue Pointe wards to the river; $75,000 as the city's share of the cost of diverting the sewer from Elgin basin to the Craig St. main; $25,000 for sewage farm improvements in St. Denis ward; $25,000 for improvements at Craig St. pumping station; and $36,500 for sewers in the new wards. The programme of public works for this season stands as follows: Permanent pavements, $1,000,000; sidewalks, $500,000, and sewers and watermains, $1,293,883.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

✤City Council of Pasadena, Cal., is reported to be calling for bids until 10:30 a. m., June 6, for one turbo-generating unit Terrill regulator and exciter and a condenser, pumps and appliances, for the Municipal Lighting Plant.

Cuba.

⊙Michael J. Dady, 350 Fulton St., Brooklyn, N. Y., is reported to have been awarded the contract by the Cuban Ports Improvement Syndicate, Havana, for dredging at Havana, Cienfuegas, Santiago and other Cuban ports. The contract is reported to amount to about $7,000,000.

District of Columbia.

✤Bids will be received until 10:30 a. m., June 22, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing under Canal Circular 634 of cargo handling and locomotive cranes, gasoline engine-driven passenger car, rock skips, chaplets, electric cable and cable terminals.

✤Bids will be received until 2 p. m., June 5, by Commissioners of the District of Columbia, Washington, D. C., for furnishing and installing, complete, in the McKinley Manual Training School, this city, one double beam hand power geared traveling crane with a capacity of 4,000 pounds. Cuno H. Rudolph is one of the commissioners.

Georgia.

✤Bids will be received until 11:45 a. m., June 14, by Constructing Quartermaster, Fort Screven, Ga., for the construction, including plumbing, heating, electric wiring and fixtures, of one additional hospital ward.

✤Bids will be received until noon, June 16, by D. C. Kingman, Col. U. S. Engineers, Savannah, Ga., for dredging in the harbor at Savannah, Ga.

Illinois.

✤Bids will be received until 7:30 p. m., June 5, by Board of School Inspectors, District 86, Joliet, Ill., for the erection of a school building at Forest Park according to plans and specifications on file at the office of J. H. Barnes, Architect. J. F. Skeel is Clerk of the Board.

✤Bids will be received until 3 p. m., June 7, by C. E. Gillaspie, Township Trustee, of Posey Township, at Staunton, Ill., for the construction of two-story brick school house in Staunton.

✤Bids will be received until 11 a. m., June 16, by Lieut.-Col. Thomas Cruse, Chief Quartermaster, 556 Federal Bldg., Chicago, Ill., for furnishing and installing a central heating and power plant at Fort Sheridan, Ill.

✤Bids are asked by L. E. McGann, Commissioner Public Works, Chicago, Ill., until 11 a. m. June 5, for furnishing labor and material for building three pile platforms in Lake Michigan and making borings to bed rock. Platforms are to be made of four piles with suitable caps and timber platforms 12 ft.

✤ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] The four borings are located as follows: One in Lake Michigan at Carter H. Harrison Crib, one in Lake Michigan at Two Mile Crip, one at the U. S. Government breakwater, and one on premises of the Chicago Av. Pumping Station. Borings shall be such as to permit of examination of all materials encountered to bed rock. Cash or certified check for $250 must accompany all bids.

✣Bids will be received by William Carroll, City Electrician, Chicago, Ill., until 11 a. m., June 5, for furnishing the Department of Electricity with approximately 25,000 lin. ft. of No. 6, B. & L. G., rubber coated lead encased electric light cable.

Indiana.

✣Bids will be received until 2 p. m., June 10, by George M. Sheidler, Township Trustee of Marion township, in Decatur County, at Millhousen, Ind., for the construction of a one-story brick school house in Marion township.

✣Bids will be received until 10 a. m., June 12, by S. A. Richardson, Trustee, Advisory Board, Hensley Township, Johnson County, at Franklin, Ind., for the erection of a school house in Hensley Township.

✣Bids will be received until June 6 by Board of Trustees, Indiana Sailors' Orphans' Home, Rushville, Ind., for metal ceilings on several rooms. P. P. Stult is Superintendent.

✣Bids will be received until 10 a. m., July 5, by Board of Bartholomew County Commissioners, Columbus, Ind., for the construction of improvements to the county jail. P. J. Sater is County Auditor.

✣Bids will be received until June 5 by Board of Decatur County Commissioners, Greensburg, Ind., for the repair of retaining wall. F. E. Ryan is County Auditor.

✣Bids will be received until 9 a. m., June 9, by John Burkhart, School Trustee of Sugar Creek Township of Hancock County, for the installation of heating and ventilating system in two-story brick school building in New Palestine.

Iowa.

✣Bids will be received until 10 a. m., June 10, by City Clerk, Sioux City, Ia., for furnishing six drinking fountains for man equipped with sanitary cup. G. B. Healy is Supt. of Parks and Public Property.

✣Bids will be received by City of Oskaloosa, Ia., until June 8, for the construction of a city hall, for which plans and specifications are now on file with T. H. Carlin, City Clerk.

Kansas.

Bids were opened May 18 by the U. S. Treasury Department for the construction of public building at Coffeyville, Kan. The bidders and the kind of stone bid upon were as follows: Hiram Lloyd Building & Construction Co., St. Louis, limestone $58,243, sandstone $58,925; King Lumber Co., Charlottesville, Va., $64,850 and $66,000; Barnes Bros., Logansport, Ind., $63,000 and $64,300; Deiter & Wentzel Construction Co., Joplin, Mo., $58,996 and $59,496; Latimer & Berney, Kansas City, Mo., limestone $57,768; H. N. Green, Kansas City, Mo., limestone, $54,469; the Connor Bros. Co., Lowell, Mass., limestone, $63,300.

Louisiana.

✣Bids will be received separately or combined until noon, July 6, by Police Jury, Evangeline Parish, Ville Platte, La., for the construction of a court house and jail buildings at Ville Platte, La. Plans are on file at the office of Emile Weil, Architect, 1312 Whitney Central Bldg., New Orleans, La., or at the office of H. E. Currie, Clerk of the Police Jury.

✣Bids will be received until 11 a. m., June 7, by Lieut.-Col. Lansing H. Beach, U. S. Engineer, Custom House, New Orleans, La., for furnishing willows at South or Southwest Pass, Mississippi River.

Maryland.

✣Bids will be received until 1 p. m., June 26, by Col. Thomas L. Casey, U. S. Engineer, 309 Custom House, Baltimore, Md., for dredging in Rockhall, Queenstown, Claiborne and Cambridge Harbors and Susquehanna Chester, Choptank, Warwick, Pocomoke, La Trappe, Wicomico and Manokin Rivers and Tyaskin Creek, Md.; Nanticoke River, Del. and Md., and Broad Creek River, Del.

Massachusetts.

✣Bids will be received until noon, June 23, by Frederic V. Abbot, Col., U. S. Engineers, Boston, Mass., for rock excavation in Gloucester Harbor, Mass.

✣Bids will be received by Col. Frederick V. Abbot, U. S. Engineer, Boston, Mass., for the dredging in Weymouth Back River, Mass.

✣Bids will be received until noon, June 25, by Col. Frederick V. Abbot, U. S. Engineer, Boston, Mass., for rock excavation in Boston Harbor. Official advertisement will be found elsewhere in this issue.

Michigan.

⊙The Asphalt Paving & Block Co. of Toledo, O., has awarded Eric Anderson, Hancock, the contract for rebuidling its new dock at Grosse Point. Mr. Anderson is now engaged in building a sand conveyor for this company at Point Mills and expects to have the work complete in a few weeks.

✣Bids will be received until 11 a. m., June 8, by Capt. T. A. Baldwin, Jr., Quartermaster, Fort Wayne, Detroit, Mich., for the installation of new steam heating apparatus in four barrack buildings at that post.

✣Bids will be received until June 6 by Col. C. McD. Townsend, U. S. Engineer, Jone Bldg., Detroit, Mich., for dredging Black River at Port Huron, Mich.

Minnesota.

✣Bids will be received until 2 p. m., June 19, by Maj. Francis R. Shunk, U. S. Engineer, St. Paul, Minn., for construction of canal between Lake Winnibigoshish and Leech Lake headwaters of Mississippi River.

Missouri.

✣Bids will be received until 1 p. m., June 3, by Board of Managers, Missouri State Sanatorium, Mt. Vernon, Mo., for furnishing and installing a 175-h. p. water and fire tubular boiler, additional apparatus and pipe work in power house; also for pipe covering in power house and tunnels of said institution. Plans and specifications are on file at the office of Dr. E. W. Schauffler, President Board of Managers, 317 Argyle Bldg., Kansas City, Mo., and of H. H. Hohenschild, 309 Navarre Bldg., St. Louis, Mo. W. L. Gupton is Secy. of the Board.

Montana.

✣Bids will be received until June 7 by Lieut. W. W. Winter, Quartermaster, Fort Missoula, Mont., for furnishing door and window screens.

New Hampshire.

✣Bids will be received until noon, June 17, by Lieut.-Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for the dredging of Exeter River, N. H.

New Jersey.

✣Bids will be received until 8:30 p. m., June 5, by Board of Education, Hoboken, N. J., for the furniture, equipment, etc., for the new High School Building according to plans and specifications drawn by John T. Rowland, Jr., Architect. William A. Kerr is secretary of the board.

New York.

✣Bids will be received until 10 a. m., June 9, by I. W. Littell, Chief Quartermaster, Governors Island, N. Y., for dredging, construction of a ferry slip, ferry bridge, steel gallows frame and bridge handling machinery.

⊙Steacy-Schmidt Mfg. Co., York, Pa., has been awarded the contract by Commanding Officer, Torpedo Depot, Fort Totten, N. Y., for furnishing 1,840 compound plugs with brass fuse cans, 280 extra fuse cans, 2,000 extra split bins, 70 gross set screws, 100 lbs. friction bushings, 125 lbs. gland washers, 200 gland nuts, 2,000 ft. steel glands and 280 connecting nuts. Bids were opened May 8.

North Carolina.

✣Bids will be received until noon, June 30, by Capt. E. I. Brown, U. S. Engineer, Wilmington, N. C., for constructing complete two wooden hull, one-propelling, 15 in. hydraulic pipe line dredges Neuse and Port Arthur. Official advertisement will be found elsewhere in this issue.

Ohio.

✣Bids will be received until 2 p. m., June 23, by Maj. H. Jervey, U. S. Engineer, Cincinnati, O., for the construction and delivering the steel or steel and iron hull sternwheel towboats Miami, Guyandot and Scioto.

✣Bids will be received until noon, June 8, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and material for removal and replacing and rewiring of tile on tower of the City Hall. J. J. Wenner is Clerk.

✣Bids will be received until noon, June 8, by Board of City Hall Commissioners, Cleveland, O., for furnishing and setting in place cast iron braces for steel castings for the new City Hall. J. Milton Dyer, 825 Cuyahoga Bldg., is architect.

⊙The Westlake Construction Co., St. Louis, Mo., has been awarded the contract at $1,648,747 for constructing the 18 buildings for the new general city hospital of Cincinnati, to be erected on Burnet Ave., Avondale.

Oregon.

✣Bids will be received until 4 p. m., June 15, by Fire Committee of the Executive Board, Portland, Ore., at the office of the City Auditor, for the furnishing of two 1-ton auto trucks with solid tires.

Pennsylvania.

✣Bids will be received until noon, June 24, by Maj. Herbert Deakyme, U. S. Engineer, 815 Witherspoon Bldg., Philadelphia, Pa., for dredging in Delaware River on Tinicum and New Castle Ranges.

✣Bids will be received until 10 a. m., June 19, by Commanding Officer, Frankford Arsenal, Philadelphia, Pa., for constructing one 1-story brick and steel building 258 ft. 10½ in. long and 58 ft. 6½ in. wide for artillery ammunition assembling shop, and one 1-story brick and steel building 86 ft. 5¾ in. long and 42 ft. 10½ in. wide, for scrap storehouse, at Frankford Arsenal.

✣Bids will be received until June 5 by Commanding Officer, Frankford Arsenal, Philadelphia, Pa., for furnishing and installing a 1-ton electric traveling crane in the scrap storehouse at Frankford Arsenal, Philadelphia, Pa.

⊙The contract for the Grand Lodge Hall, the central building in the group comprising the Masonic Home, at Elizabethtown, Pa., has been awarded to John R. Wiggins & Co., Philadelphia, Pa. It is understood that the building will cost between $375,000 and $500,000. Work on the structure will be started very soon.

Rhode Island.

✣Bids will be received until 2 p. m., June 20, by Col. F. V. Abbot, U. S. Engineer, Newport, R. I., for dredging in Providence River and Harbor, R. I.

✣Bids will be received until 2 p. m., June 9, by Col. F. V. Abbot, U. S. engineer, Newport, R. I., for the construction of breakwater at Point Judith, R. I.

✣Bids are asked until 2 p. m., June 9, by Col. Frederic V. Abbot, U. S. Engineer, Newport, R. I., for constructing westerly shore arm breakwater at Point Judith, R. I. The westerly shore arm of the Point Judith breakwater will commence at the end of the westerly jetty protecting the entrance to Point Judith Pond at a point about two miles northwesterly from the Point Judith Rhode Island Light House and will extend in a southwesterly direction for a distance of about 940 ft.; thence in a general direction about south by east 2,620 ft. It is divided into three sections of about equal volume. Section I will extend to Station 13+68 on the breakwater, section II will be 1103 ft. long and extend to station 24+71,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

and section III will be 1,089 ft. long and extend to the southerly end of the breakwater. About $193,500 is available at the present time. The cross section of 940 ft. of the shore end of the breakwater, all of which is within section I, will be as follows: Height of top above mean low water, 8 ft., width of top, 8 ft., with slopes of 1 on 1 on the easterly side and 1 on 2 on the westerly side. The core of this part of the breakwater is that portion which is 8 ft. or more inside of the finished slopes. The cross-section of the portion of the breakwater south of the angle at station 9+40 is: height of top above mean low water, 10 ft.; width at top, 15 ft., with slopes of 1 on 1 on the easterly side and 1 on 2 on the westerly side. The core of all this portion is that part that is 10 ft. or more inside of the finished slopes. The core will be formed of quarry run of stone. The facing or covering for the easterly slope must be of stones weighing at least 1.5 tons with an average weight of not less than 3 tons, except that occasional smaller stones may be used where necessary to fill up openings and give a firm bearing for the larger stone. Stones for surfacing the top and westerly slope must weigh at least 3 tons each with an average weight of not less than 4.5 tons except that occasional smaller stones may be used as stated for the easterly slope. The interstices between the larger facing stones must be filled above low water level, as far as practicable, with small stones similar to these used in the core. The facing stones must be put in position with care (not merely dropped in place), and as may be directed, and the exterior surfaces below the plane of mean low water made reasonably even and as near specified slope as reasonably practicable.

South Carolina.

✣Bids will be received until 2 p. m., June 13, by architects, U. S. Immigration Station, Charleston, S. C., for the construction, respectively, of a wharf and station buildings in the city of Charleston, S. C. Walker & Burden, 42 Broad St., are architects.

South Dakota.

✣Bids will be received until 10 a. m., June 12, (time extended from May 22) by Board of County Commissioners, Belle Fourche, S. Dak., for the construction of a court house. D. C. Barr is County Auditor. The structure will be of brick, 2 story, and trimmed with sandstone. The cost of the work is estimated at $35,000. C. A. Randall is architect.

Tennessee.

✣Bids will be received until noon, June 12, by Capt. Clarke S. Smith, U. S. Engineer, Memphis, Tenn., for furnishing 40,000 tons of rip-rap stone for the first and second districts of the Mississippi River.

Texas.

✣Bids will be received until June 3 by Board of Trustees, Independent School District, Garrison, Texas, for the construction of a 2-story, 8-room school building of brick for the district. Plans and specifications are on file at the office of the First State Bank, Garrison, Texas. C. R. Langston is Treasurer of the Board.

✣Bids will be received until 11 a. m., June 6, by P. W. Guiney, constructing quartermaster, Fort Sam Houston, Texas, for the plumbing, hot water heating and electric lighting in one company barrack, one band barrack and one company and band mess building.

✣Bids will be received until noon, May 25, by Maj. G. P. Howell, U. S. engineer, Galveston, Texas, for dredging Texas City Channel, Texas.

Virginia.

✣Bids will be received until 11 a. m., June 17, by R. C. Hollyday, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for the renewal of 40-ton locomotive crane track at the navy yard, Norfolk, Va.

✣Bids will be received until 11 a. m., June 17, by R. C. Hollyday, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for a sea wall at the navy yard, Norfolk, Va.

✣Bids will be received until 6 p. m., June 14, by Bedford Pulp & Paper Co., Big Island, Va., for the construction of concrete dyke, tailrace raising concrete and timber dam and reinforced floor construction. F. R. Weller, Hibbs Bldg., Washington, D. C., is engineer.

Bids were opened May 15 by Lt. Col. Mason M. Patrick, U. S. Engineer, Norfolk, Va., for dredging channel to Newport News, Va., the probable contractor being the Morris & Cummings Dredging Co., 17 State St., New York, at $135,000. The work calls for the dredging within the limits of a new channel across Newport News Middle Ground Bar, north of the Middle Ground light, and will require the removal of approximately 1,960,000 cu. yds. of material, scow measurement. The area to be dredged is 3 miles long, 300 ft. wide for a distance of 1¾ miles, and 200 ft. wide for a distance of 1¼ miles. The least depth now existing is 22 ft. below mean low water, and the ultimate depth to be secured is 35 ft. at mean low water.

Washington.

✣Bids will be received until 11 a. m., June 15, by Capt. E. C. Long, Constructing Quartermaster, 482 Arcade Annex, Seattle, Wash., for the construction of an electric lighting system at Fort Flagler, Wash.

Canada.

✣Bids will be received until 11 a. m., July 3, by Chairman Board of Control, Winnipeg, Man., for the supply of apparatus and materials required for the installation of a police patrol telegraph system. Specifications and full particulars, together with conditions governing tenders as prescribed by by-law, may be obtained at office of F. A. Cambridge, City Electrician.

✣Bids will be received until 4 p. m., June 6, by L. K .Jones, Secy. Department of Railways and Canals, Ottawa, Ont., for the construction of an extension of the North Mooring Pier at the upper entrance, Sault Ste. Marie Canal. Plans, specifications and the form of the contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the engineer in charge, Sault Ste. Marie, Ont., at which places forms of tender may be obtained. An accepted bank check for the sum of $3,000, made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into a contract for the work at the rates stated in the offer submitted.

✣Bids will be received until 8 p. m., June 13, by C. O. Davidson, Secy.-Treas., Prince Albert, Sask., for the construction of dam and headworks and canal and power station foundations, being portions of the proposed Hydro-Electric Power Development, on the North Saskatchewan River, at La Colle Falls (distant 25 miles east of the city). Each tender must be accompanied by an accepted bank check for $5,000, payable to the Secretary-Treasurer. The plans and specifications will be on file, and may be seen on and after May 23, 1911, at the City Hall, Prince Albert; office of "Canadian Engineer" at Winnipeg; office of "Canadian Engineer," Montreal, or at the offices of the Engineers, C. H. & P. H. Mitchell, Traders' Bank Building, Toronto, Ont.

A bill is before the House of Commons to incorporate the Western Canal Co., the promoters of which are, G. A. Graham, John T. Horne, Fort William; David C. Mackenzie, G. A. Stethen, H. Williams and O. J. Albert, all of Fort Francis. The company proposes to construct a canal from a point on Rainy Lake, five miles east of Fort Frances by way of Rainy River, to a point five miles west of the foot of the Long Sault rapids on the Rainy River. The company is authorized to dispose of bonds or other securities to an amount not exceeding $2,000,000. The bill provides that under certain conditions the canal may at any time be taken over by the Government.

DRAINAGE EXCAVATION.

STATE OF IOWA,
COUNTY OF PAGE.
DRAINAGE DISTRICT NO. 9.

Notice is hereby given that the Board of Supervisors of Page County, Iowa, will receive sealed bids until 3 p. m. of the 14th day of June, 1911, for the construction of a new channel for the Nodaway river in Drainage District No. 9, in said county.

Plans and specifications are on file in the office of C. W. Duke, County Auditor, and copies thereof may be obtained upon application.

The bids will be opened at the hour of 3 p. m., of the said day, viz.: the 14th day of June, 1911, at a meeting of said Board of Supervisors to be held at the Court House in Clarinda, and the contracts will be awarded at that time.

The bids should be directed to the Board of Supervisors, Clarinda, Iowa, and marked "Bids for the Construction of New River Channel in District No. 9."

The entire length of the proposed new channel is 54,900 feet; width of bottom from station 0 to station 355+25, 20 feet, from station 355+25 to station 549, 24 feet; average depth in 20 ft. channel, 14.54 feet; in 24 ft. channel, 15.81 feet; maximum depth 24 feet through an abandoned R. R. fill; side slopes 1-2 horizontal to 1 vertical; berme to be 9 feet.

The total amount of excavation is estimated to be 909,053 cubic yards, supposed to be all earth consisting of loam, silt and clay.

Part of the right of way, which is 100 feet wide, is covered by timber and must be cleared by the contractor.

The ditch is divided into two (2) sections, viz.:

Section 1, from station 0 to station 301, excavation 439,958 cubic yards.

Section 2, from station 301 to station 549, excavation 469,095 cubic yards.

Bids will be received on each section separately.

The starting point of section 1 is near the track of the K. & W. R. R. and the starting points of both sections are less than 2 miles from R. R. stations.

The date for beginning the work is fixed at not later than September 1, 1911, and the date for the completon of the work is fixed at not later than May 1, 1913.

All bids to be accompanied by cash deposit or certified check to the amount of ten (10) per centum of the bid.

Deposits of unsucessful bidders will be returned to them promptly after the contract is awarded. Deposits of successful bidders will be held until contract and bond are executed by them as required by law.

The successful bidders will be required to execute an approved bond equal to 25 per centum of the estimated cost of the work so let.

The Board reserves the right to reject any or all bids and readvertise the letting of the work.

Dated at Clarinda, Iowa, this [illegible] day of May, 1911.

A. S. VAN SANDT,
Engineer in Charge.
Address:
C. W. DUKE.
Auditor of Page County, Clarinda, Ia.

ROADS.

Sealed bids will be received at the office of the Robertson County Pike Commission, in Springfield, Tennessee, up to 12 o'clock noon, on Tuesday, June 20, 1911, for grading, ditching and macadamizing about fifty miles of public roads in Robertson County, Tennessee. Plans and specifications may be seen at the office of the Pike Commission, at any time after June first.

JOSEPH E. WASHINGTON,
Chairman.
ED. S. ECKLES,
Secretary.

STREET IMPROVEMENTS.

Salem, Ind., May [illegible], 1911.

Notice is hereby given that the Board of Trustees of the Town of Salem, Salem, Indiana, will receive sealed proposals at the hour of 7:30 P. M., on Friday, the 9th day of June, 1911, for the following described public improvement in the Town of Salem, Indiana, as authorized by Improvement Resolutions Nos. 4 and 6.

Improvement Resolution No. 4.—For the improvement of that part of Hackberry Street in said town of Salem, beginning on the east line of High Street, in said town, and run thence east with said Hackberry Street to the east line of the corporate line of said town of Salem.

Improvement Resolution No. 6.—For the improvement of that part of Cherry Street in said town of Salem, beginning on the west line of College Avenue, in said town, and run thence west with said Cherry Street to the east line of Harrison Street.

All work done in making of said described public improvements shall be in accordance with the terms and conditions of the improvement resolutions, as numbered, and the details, plans, profiles, drawings and specifications which are on file and may be seen in the office of said Board of Trustees of the Town of Salem.

The bidders, in submitting proposals to make said described public improvements, must accompany each bid with a certified check in the sum of not less than 2½ per cent of the engineers' estimate as evidence of good faith that the successful bidders will execute, within ten days from aceptance of proposals, contracts and bonds satisfactory to the said board to do the work of making said improvement. A failure of the successful bidders to enter into such contracts and bonds upon the acceptance of such proposals will forfeit the checks and the sums of money payable thereon to the city as agreed and liquidated damages for such failure. The Board of Trustees of the Town of Salem reserves the right to reject any or all bids.

ALBERT E. TILLE,
Town Clerk.

CONCRETE VIADUCT OVER HOUSTON SHIPCHANNEL.

Houston, Texas, May 23, 1911.

Sealed proposals will be received at the office of Dan C. Smith, Jr., City Controller and City Secretary, City Hall, Houston, Texas, until 12 o'clock noon, July 3d, 1911, for the construction of a reinforced concrete viaduct over the Houston Shipchannel. The structure will be about 1,650 feet in length and 60 feet wide.

Specifications and plans, bidding blanks, etc., can be obtained upon application at the office of F. L. Dormant, City Engineer, Houston, Tex., by making a deposit of $20.00 with the City Engineer.

A certified check of the bidder on any bank in Houston, Tex., payable to the order of H. B. Rice, Mayor, for $20,000 will be required to be deposited with the bid.

Bidders are expected to examine the site of the viaduct and acquaint themselves with local conditions.

The successful bidder will be required to give bond and comply with City Charter respecting contracts, and to execute the usual form of contract as prepared by the City Attorney.

The right is reserved to reject any or all bids or to accept any bid considered advantageous to the City of Houston.

H. B. RICE,
Mayor of the City of Houston,
Texas.
F. L. DORMANT, City Engineer.

THE SANITARY DISTRICT OF CHICAGO—PROPOSALS FOR ANCHORING ABUTMENTS.

Sealed proposals for anchoring the abutments of the Western Avenue Bridge will be received by the Clerk of the Sanitary District, 1500 American Trust Building, Chicago, Illinois, until 12 M. Standard Time on Thursday, June 8, 1911.

The work is located at the bridge crossing the Main Drainage Channel on the line of Western Avenue. Plan, specifications and forms of proposals may be obtained at the said office of the Sanitary District.

The Board of Trustees of the Sanitary District of Chicago reserves the right to reject any or all bids.

The Sanitary District of Chicago,
By THOMAS A. SMYTH,
President.

Attest:
I. J. BRYAN, Clerk.
Chicago, May 23, 1911.

STREET IMPROVEMENT.

Bids will be received until 12 o'clock noon on June 13th, 1911, by the Director of Service, Galion, O., for the improvement of North Market St. from Public Square to north corporate line, about 3,200 ft. in length, with treated macadam.

Also East Main St. from Big Four Railroad to east corporate line, about 5,500 ft. in length, with brick.

Also storm sewer 470 ft.—10-in.
Storm sewer 110 ft.—12-in.
Storm sewer 1,017 ft.—15-in.
Storm sewer 2,865 ft.—18-in.
Storm sewer 552 ft.—27-in.
Storm sewer 1,434 ft.—30-in.
12 manholes

ED. C. YOCHEM, Clerk.

BRIDGE.

Notice is hereby given that sealed bids will be received until 2 o'clock P. M. of June 22, 1911, for the construction of a steel bridge with concrete floor across Iowa River at Iowa Falls, Iowa. Length of bridge 353 feet, roadway 20 feet wide, 2 sidewalks each 5 feet wide. Check for 10 per cent of bid must accompany bids. The Board of Supervisors reserve the right to reject any or all bids. Plans and specifications on file at County Auditor's Office, Eldora, Iowa. Letting to be at Court House, Eldora, Iowa, June 22, 1911, at 2 P. M.

E. L. MARRIAGE,
County Auditor,
Hardin County, Iowa.

U. S. ENGINEER OFFICE, Wilmington, N. C., June 1, 1911. Sealed proposals for constructing complete the two (2) wooden hull, non-propelling, 15-in. hydraulic pipe line dredges Neuse and Port Arthur will be received at this office until noon, June 30, 1911, and then publicly opened. Information on application. EARL I. BROWN, Capt. Engrs.

U. S. ENGR. OFFICE, Boston, Mass., May 26, 1911.—Sealed proposals for rock excavation in Boston Harbor, Mass., will be received here until 12 M., June 26, 1911, and then publicly opened. Information on application. FREDERIC V. ABBOT, Col., Engr.

PROPOSALS FOR TOWBOAT.—U. S. Engineer Office, Vicksburg, Miss., May 5, 1911. Sealed proposals for furnishing and delivering one steel-hull towboat will be received at this office until noon, June 6, 1911, and then publicly opened. Information on application. J. A. WOODRUFF.

ROADS.

Bids will be received on the 9th day of June, 1911, at 2 o'clock p. m., at the old Ramsey Farm on the Gratiot Turnpike, in Section 28 of Columbus Township, St. Clair County, Michigan, by the State Highway Commissioner, under the provisions of Act No. 99 of the Public Acts of 1911, for the building of one mile of highway in accordance with plans and specifications now on file in the office of said State Highway Commissioner at Lansing, and at the residence of Hon. Jas. M. Haviland adjoining the Ramsey Farm above mentioned.

The work consists of some 10,000 cu. yds. of excavation and embankment and some 500 cu. yds. of reinforced concrete retaining wall and culvert, with other details.

All bids must be sealed and made on blanks furnished by the State and accompanied by a certified check for $500.00, payable to the order of the State Highway Commissioner, conditioned that said check will be forfeited to the State by any bidder should he be awarded the contract and fail to execute the same.

The right is reserved to reject any or all bids.

TOWNSEND A. ELY,
State Highway Commissioner.

U. S. ENGINEER OFFICE, Safety Bldg., Rock Island, Ill., May 8, 1911.—Sealed proposals for construction and repair of dams and shore protections between Reads Landing, Minn., and Alma, Wis.; between Genoa and Lynxville, Wis.; between McGregor and Dubuque, Ia.; between Rock Island, Ill., and Muscatine, Ia., contiguous to Sections 16, 17, 32, 33, of Flint Creek-Iowa River levee; between Keokuk, Ia., and Hannibal, Mo.; and between Hamburg, Ill., and Cap au Gris, Mo., will be received here until 2 p. m., June 8, 1911, and then publicly opened. Information on application. C. KELLER, Maj. Engrs.

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Engineering & Contracting

Devoted to the Economics of Civil Engineering Design and to Methods and Cost of Construction

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SUBSCRIPTION RATES [illegible]

VOLUME XXXV. No. 23 June 7, 1911

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"Engineering-Contracting" Becomes "Engineering & Contracting."

It has seemed wise to make a slight change in the name of this journal by substituting the word "and" for the hyphen in the name. While we have used the name ENGINEERING-CONTRACTING to denote the coordinate branches of engineering and contracting, yet a few persons have taken it to mean [illegible] contracting for engineering works.

ENGINEERING & CONTRACTING will continue to specialize in the civil engineering field, describing and discussing engineering work both from the viewpoint of the designing engineer and of the constructing engineer or contractor. It will also continue to present and advocate the possibilities of "scientific management" in engineering construction. It remains the one engineering journal maintaining the definite policy of publishing unit costs and holding unit costs essential to a complete discussion of the economic merit of any engineering work.

Appraisal Engineering.

It is evident that every state will eventually have one or more public service commissions to regulate the public service corporations within the state. Nearly all the states now have railway commissions and, as the records show, nine states have appraised or are now appraising the steam railway lines. Three of these nine states are appraising all the public utilities—railways, street railways, gas and electric lighting systems, telephone and telegraph lines, water works, etc. This appraisal work has already developed a number of men who may properly be designated as expert appraisal engineers, and the number is steadily increasing.

The corporations whose property is appraised are slowly learning that it is wise to employ consulting engineers who have made a study of appraisal problems. Each consulting engineer, in turn, has an organization of men trained to secure the necessary data and to estimate values. But it is not merely his ability to lay his hands on skilled appraisal engineers that serves to make the consulting engineer superior, as an appraiser, to the average engineer who is an employe of a [illegible]. The consulting engineer, if he is truely expert as an appraisal engineer, has a thorough knowledge of accounting and is exceptionally well versed in the law that relates to valuations and to rate making. Moreover he has the faculty of presenting his evidence to a commission or a court in a logical and convincing manner. Finally, if he has a reputation for probity, his testimony will not be regarded as biased.

The inevitable result of the appraisal of all public utilities will be to raise their taxes, and quite inevitably also to raise a howl. The howl will probably be justified, for there can be no doubt that it is unfair to appraise one kind of property in a thorough and scientific manner, while other kinds of property are appraised in a slipshod, ignorant fashion. The ordinary tax appraiser is both ignorant and slipshod. Hence his appraisal of a manufacturing plant is almost invariably below its true value. There can be no doubt about this, for wherever railway property has been appraised by engineers, its value has been found greatly to exceed previous values assigned to it by tax commissioners or assessors.

In addition to the fact that public service commissions and tax commissions will employ many engineers as appraisers, it seems likely that there will be evolved other commissions that will require the services of appraisal engineers. Already we have talk of a permanent tariff commission or board, whose duties will consist mainly in ascertaining the cost of production here and abroad. No satisfactory study of cost of production is possible without an appraisal of the plants used in producing the manufactured articles.

It requires no far seeing eye to discern the evolution of commissions to supervise all large corporations doing an interstate business. The steam railways have come under government regulation, other public utilities are following, and all large corporations must eventually go the same road. This means that their properties must be appraised, for, as before stated, no detailed knowledge of operating expenses is possible without a knowledge of the value of the physical plant.

Finally, when it becomes generally recognized that [illegible] of management, no large organization will long remain without an appraisal of its plant, and the appraisal will always be kept up to date. To the scientific manager it is clear that proper provision for maintenance expense can best be made by a study of the relation of maintenance cost to first cost. Thus also can it best be seen whether or not the cost of repairs and renewals is susceptible of reduction. An accounting record that shows an expense of $100,000 for repairs and renewals of "buildings" can not be interpreted even with a fair degree of satisfaction until the total first cost of the buildings, their weighted age, and kind of construction are known. These are matters for appraisal. Had such knowledge been in the possession of a certain railway, it could not have been robbed of great sums of money through the "padding" of charges for repairs to rolling stock.

From consideration of the various reasons why appraisals will become much more common and very extensive, it seems likely that many hundreds of engineers will find continuous employment in this kind of work.

A Suggested Concrete Roadway with Reinforcement of Steel Just Beneath the Top Surface.

We are accustomed to think of concrete pavements as being of very recent development, yet in 1885 Codrington, the British authority, published the following in the Encyclopædia Brittanica:

"Concrete macadam, formed by grouting with lime or cement mortar a coat of broken stone laid over a bed of stone previously well rolled, has been tried as an improvement on an ordinary macadamized surface, but not hitherto with much success."

Concrete, or concrete macadam, is an ideal pavement in many respects, but, due to its comparatively slight tensile strength, the surface is apt to become pitted with holes when subjected to heavy traffic. Once the pitting starts, wear is very rapid, for the edges of a chuck hole in concrete crumble away with greatest ease. It is this that accounts for the very slow progress that concrete has made as a wearing coat for pavements.

The writer has made a number of experiments with concrete slabs reinforced just below the surface with wire mesh and expanded metal. Concrete slabs thus reinforced show far greater resistance to impacts of hammers or chisels than concrete not provided with surface reinforcement. This fact, coupled with a consideration of the theory of impact stresses upon a surface stratum, leads the writer to believe that great progress in concrete roadway construction may occur if subsurface reinforcement, as we may term it, shall be applied. This subsurface reinforcement, be it understood, in nowise resembles the reinforcement that concrete slabs are given on the lower side, for the object of that is to take the tensile stresses that occur when the slab acts like a beam. The subsurface reinforcement which we suggest is of an entirely different nature. Its object is to distribute surface impact stresses over an area of concrete sufficiently large to prevent rupture of the surface, and the consequent formation of [illegible] or chuck holes. [illegible] even were pitting to occur, such a subsurface reinforcement would prevent the rapid enlargement of the hole.

In considering the various forms of subsurface reinforcement, it has seemed to the writer that herringbone lath offers an excellent shape for the purpose. Possibly a corrugated wire mesh or an expanded metal bent so as to form close rows of pyramidal points would serve better. This is a matter for experiment under traffic conditions.

The objection has been raised that when the concrete wears down sufficiently to expose such a reinforcement, the steel would quickly wear so as to leave protecting "spikes" that would injure rubber tires. This objection would probably be met by applying a fresh layer of cement mortar to replace the worn out concrete. The use of a wash, like "Ransomite," would serve to bond the new mortar to the old. Concrete, however, does not wear with rapidity, except by crumbling from the edges; and if the formation of holes could be prevented by subsurface reinforcement a long life would be reasonably certain.

In a recent consular report mention was made of a foreign pavement consisting of small steel fragments (turnings from lathes, etc.) and cement mortar, which was said to possess great resistance to destruction under traffic. Such a pavement is, in a way, a concrete having a subsurface reinforcement, but of a kind that might be too expensive for general use.

Concrete railway ties have frequently failed because of the crumbling of the concrete directly under the rail. This too might be prevented by a subsurface reinforcement of the kind here suggested.

The Storage of Power Developed by Windmills.

Prof. R. A. Fessenden has recently announced that he is about to build a 3,000 h. p. plant of combined wind power and rain power, which involves the ingenious idea of utilizing a worked out copper mine as a part of his power storage scheme. His idea is to provide two water storage reservoirs, one at the bottom of the mine and one on the surface of the ground. Windmills will pump from the lower reservoir to the upper, when the wind is blowing, and enough water will be stored in the two reservoirs so that a steady stream of water will flow down the mine shaft and operate water wheels at the bottom. Thus a uniform amount of electricity can be developed by the water wheels, regardless of the intermittent character of the original source of power—the wind.

While this scheme appears to be economically applicable wherever there are old mines available, together with a good commercial demand for the electric power developed, it is not so certain that the plan would be economic in the event that a shaft would have to be sunk and a subterranean storage reservoir built expressly for the purpose.

Incidentally, it may be added, Prof. Fessenden made a serious error in calculating the necessary size of reservoirs. He assumed that 1 cu. yd. of water falling 1,000 ft. would develop 1 h. p. hour (to be more exact, the necessary head would be more than 1,200 ft.). He assumed that 14 days' storage capacity would suffice to provide for the intermittent action of the wind. Then he concluded that such a reservoir would provide 1 h. p. *day* for each 14 cu. yds. of water stored, whereas it would provide only 1 h. p. *hour*. *Engineering News* has called attention to this error, and has attempted to show that it would never be economic to build two reservoirs and a connecting shaft for the purpose of using water power in this manner. While we incline to this view also, we would call attention to the fact that there are many places where Prof. Fessenden's scheme could be applied without the necessity of sinking a shaft or excavating a subterranean reservoir. He has suggested the use of abandoned mine shafts, but a much more satisfactory and much more general plan would be the location of the upper and lower reservoirs at the top and bottom of a high cliff or a steep hillside.

The water, it should be noted, would be used over and over again, being raised by windmills from the lower storage reservoir to the upper and thence discharged through a penstock to the water wheel at the lower reservoir.

The cost of such reservoirs per horsepower will vary inversely as the difference of elevation between them. Hence it would be important so to locate them as to secure as large a difference in elevation as practicable. The cost of reservoirs per cubic yard of capacity varies greatly, depending on the topography; but even where there is not a natural basin it is generally possible to excavate a reservoir for less than 50 cts. per cu. yd. of capacity, and frequently for less than half this cost. If we assume that the efficiency of the water wheels (including consideration of friction in the penstocks) is 80 per cent, it will require a head of 1,500 ft. for each cubic yard of water to develop 1 h. p. hour. Hence 10 cu. yds. of water will be required per horsepower day of 10 hours. If a 10-day storage capacity is provided in each of the two reservoirs, there will be 100 cu. yds. capacity in each reservoir, or 200 cu. yds. in both reservoirs for each 1 h. p. day, where the head is 1,500 ft. With half this head, or 750 ft., 400 cu. yds. of reservoir capacity will be required per horsepower day, and at 25 cts. per cubic yard of reservoir capacity the first cost of reservoirs would be $100 per horsepower.

In many localities, particularly on the ocean coast, winds are so frequent that a reservoir capacity of much less capacity than that above assumed will suffice. Also in many localities at least one of the two reservoirs can be so located in a natural basin or valley as to reduce the cost far below 25 cts. per cu. yd. of capacity; and in not a few places there is such an abundance of water available that the lower reservoir can be dispensed with entirely.

It would seem that windmills, supplemented by reservoirs and water wheels, may eventually find extensive use, particularly along mountainous coasts.

CONCRETE AND REINFORCED CONCRETE SECTION

Methods and Cost of Building Reinforced Concrete Bents for Carrying a Pipe Line.

At the Witherbee Sherman mines at Mineville, N. Y., there was recently built a series of reinforced concrete bents for supporting an air line 3,800 ft. long. The 188 bents, as described in the *Engineering and Mining Journal*, were spaced 20 ft. apart and were from 3 to 20 ft. high, it being necessary to carry the line over irregular ground and maintain an average gradient in the pipe.

The bents are of monolithic concrete, 8x8 ins. in section, and the legs have a batter of 1½ in. per foot. The bent is reinforced by two 1⅛ in. cables placed 4 ins. apart and overlapping in the concrete sill. The forms are assembled as shown by Fig. 1 and raised to proper height and level by nailing strips *A* to the bottom of the forms. The bent is braced in all directions by short guy lines from stakes driven into the ground. After inserting the reinforcing cables, which are held in position by wooden struts, filling is begun. When the sill has been poured, rocks or old bricks are placed around the bottom of the forms where the side boards are not long enough to hold the concrete in the legs. Before filling the cap, a 1 in. pipe is introduced to receive a ⅞ in. bolt, to which the pipe hanger *I* is attached.

The *U* hanger is made from ½x2 in. flat iron and tapped near the ends to receive a ¾ in. bolt on which is mounted a pipe roller. The roller is merely a concave spool casting around a piece of 1 in. pipe, 6 ins. long. In this case an 8 in. pipe was suspended in the bents.

The average height of the bents above the ground was 4 ft. 10 ins., and the average amount of concrete used per bent was 0.61 cu. yd. The cost per average bent was $5.90 and the cost per cubic yard on concrete was $9.67. For the foundations a 1:8 mixture and for the bents a 1:6 mixture was employed.

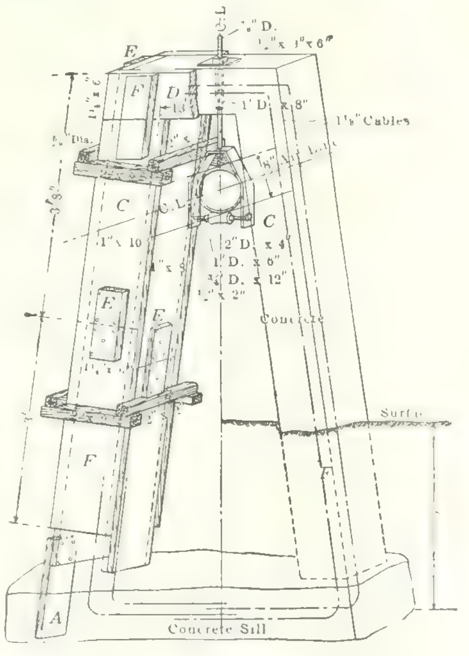

Fig. 1.—Reinforced Concrete Bent for Carrying Pipe Line.

Sixteen complete bent forms having the dimensions shown in the accompanying drawing were used in erecting the 188 bents. The forms were easily removed by pulling off the nailing strips *E* and unbolting the 2x2 in. brackets. Strip *F* is not disturbed, for it is advisable to keep pieces *C* and *D* together to facilitate assembling and in order not to disturb the batter. The bent was designed by H. Comstock, engineer in charge of power and plant at the mines.

Methods and Cost of Constructing a 145-Ft. Concrete Arch Bridge.*

BY JOHN McMICHAEL.†

The bridge was constructed for Huron County, O., over the Vermillion River. It consists of a 145-ft. reinforced concrete center arch supported by abutment piers and of two cantilever half-arches, each with a span of 37 ft. 3 ins. The total length between end abutments is thus 219 ft. 6 ins. Figure 1 shows the completed bridge. The rise between centers of hinges is 32 ft. 6 ins. Each span consists of two parallel ribs supporting columns which carry the roadway platform, consisting of longitudinal and transverse girders and a 12-in. floor slab. The roadway is 18 ft. wide between curbs and the total width of the bridge is 21 ft. The contractors were Schillinger Brothers of Columbus, O., and the engineer was Wilbur J. Watson of Cleveland, O. This article describes the construction methods and gives the cost of the work.

The excavation of the east skewback piers was started on July 1[illegible], 1909. The foundation was carried down about 8 ft. below the water line and about 4 ft. of this depth was rock excavation. This excavation was completed, the concrete was placed and the steel shoe was set before the wrecking of the old bridge was started, as it was necessary to use the old bridge in placing the concrete in these piers. The concrete was spouted from the floor of the bridge. While this work was being done, the plant was being erected and the lower bents of the centering for the arch were being put in. The centering posts were 10x10 ins. and were set on bed rock, a 1-in. dowel pin being placed in the bottom of each post to hold it in place. These posts were capped with 10x12-in. timbers parallel to the arch rib and tied together with 6x8-in. timbers. The cap was on a level with the center of the pin on the lower hinge of the arch.

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†Superintendent of Construction, 175 Dearborn St., Chicago, Ill.

*The design of this bridge was described in Engineering-Contracting, Feb. 14, 1906.

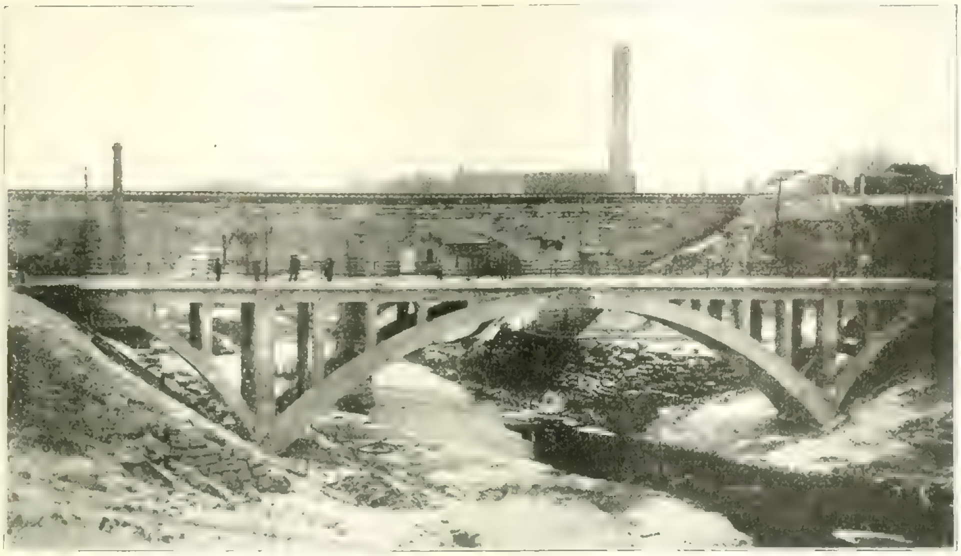

Fig. 1—Three Hinged Reinforced Concrete Bridge Built at Wakeman, Ohio.

As soon as the east piers were completed the work of wrecking the old bridge, west abutment and the excavation for the west piers was commenced. The west end of the old iron bridge was lowered upon cribbing built upon the first story of the false work already in place. Two panels of the bridge were taken down at a time, the cribbing being carried back and placed under the bridge as it was needed. The east end of the bridge during this time remained upon its abutment. A small stiff-leg traveling derrick was used for wrecking the old bridge, the steel being swung around as removed and loaded on a car which carried it off the work. This derrick was located on the old bridge and was moved back as each section was taken down.

While the old bridge was being wrecked the excavation for the west piers and the removal of the old stone abutment was being done. This material was handled by a guy derrick with a 64-ft. mast and 70-ft. boom, and was swung to the south side to form a bank for the roadway. The foundation of the west piers was carried down about 10 ft. below the water line. The bottom of this excavation was a blue shale rock. The concrete in the west skewback piers was placed with the derrick in ½ cu. yd. skips.

Main Arch.—During the time this work was in progress the carpenters were framing the timber centering and the arch ribs for the main arch, and their erection was started as soon as the concrete was finished and the steel shoes set in place. The centering of the arch was made up of 10x10-in. posts and 8x10-in. caps. The bents in the center of the arch were 12 ft. on centers and decreased in span to 9 ft. at the haunches, Fig. 2. The wedges for lowering the centering were placed on the 10x12-in. sill under each post. Under each concrete rib were placed eight 2x12-in. joists in pairs bridged at the bearings and twice in each span. On top of these were placed the furring strips 24 ins. on centers to [illegible] curvature of the arch. On top of these was placed the floor of the rib, which consisted of 1x6-in. dressed and matched pine flooring. The bracing and cross ties were 2x12 ins. The center bents were braced up and down stream with timbers about 45 ft. long and the lower bents were located on both sides with timbers about 20 ft. long. This was to give stability to the arch as well as to protect it against high water. These braces were set in holes blasted in the rock, and were bolted on top to the posts.

The forms for the arch ribs and the piers and the floor forms were all made of 2x8-in. pine plank dressed on four sides. The studding was 2x6-in., set about 2 ft. on centers and wired through the ribs, using No. 9 annealed wire. On all exposed surfaces bolts were used which projected into the concrete about 1½ ins. and the tie wires were fastened to hook nuts on the bolts. When the forms were taken down, these bolts were unscrewed, leaving only a ½-in. hole in the concrete to be filled.

Improvised Cableway.—For the erection of the centering and the forms for the arch, the boom of the derrick was shortened to 50 ft. and raised to an angle of about 60° and the cable from the forward drum of the engine was carried from the end of the boom across to the opposite side of the river, forming a cableway for carrying and setting all forms and other material needed on the bridge. The carrier was placed on this cable and was controlled by the cable on the rear drum of the engine, the load traveling out by gravity and being hauled in by the rear drum of the engine. The cable was run from the end of the boom so that by swinging the derrick the cable way could be thrown directly over any part of the structure. It was also used in removing the forms and the centering of the arch and in carrying about 100 yds. of dirt from the west bank to finish the grading on the east bank of the river. Before the concrete was started, the forms for the entire structure up to and including the top girders over the main arch were completed. Runways were built on top of the girder forms and the concrete was handled in Sterling carts. The concrete for the arch was started on the big steel hinges and was carried up on each end of both ribs at the same time, giving a uniform loading on the centering. Immediately after the completion of the arch the columns and girders were poured.

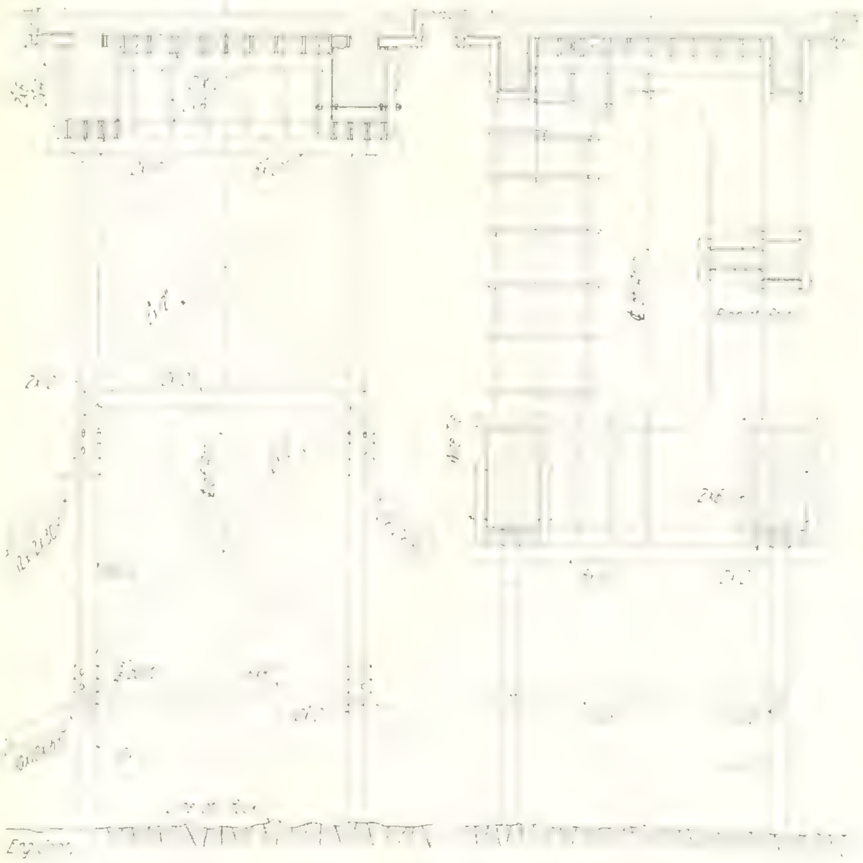

Fig. 2—Vertical Section at Center of Arch, Showing Falsework.

Cantilevers.—After this part of the work was completed the work on the cantilevers was started. The lower chords of these were 18x36 ins. and about 45 ft. long. The extreme end of the cantilever being very heavy on account of solid cross walls and beams connecting the two ribs, it was necessary to construct this in such a way that there would be no settlement. It was decided to fill the extreme end of the cantilever first, bringing the steel in the top chord into tension. This was allowed to stand until the concrete was set hard enough to remove the bulkhead. Then the central part of the cantilever arm was poured. In this way it acted as a wedge driven by its own weight, between the two extreme ends of the cantilever, and perfect results were secured.

Roadway Flooring.—The cross beams and girders having been run with the vertical posts, arch, and cantilever ribs, made it possible to have the centering of the roadway slab on the cross beams by stirrups made of No. 5 wire. Before placing the reinforcement a coat of mortar about 1 in. thick was placed on the forms, then the steel was placed and the balance of the concrete completed to the required thickness of 10 ins. On top of this floor slab there was placed a 2-in. finish, composed of 1 part Portland cement and 2 parts torpedo sand, troweled to a hard, smooth surface and cut with ⅜-in. grooves every 12 ins.

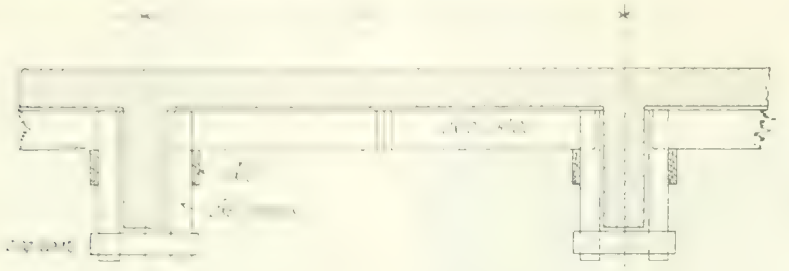

Fig. 3—Vertical Section B. B. at Main Arch Pier.

The concrete work was finished Nov. 1 and the centering under the arch ribs was struck Nov. 16, 1909. The settlement of the arch ribs at the center on the removal of the forms was 3/64 in.

After the concrete work on the superstructure was finished, and the forms removed, sheet lead ¼ in. thick was placed on the foundation at the center of the lower hinges and the concrete filling around the top half of the lower hinges was placed.

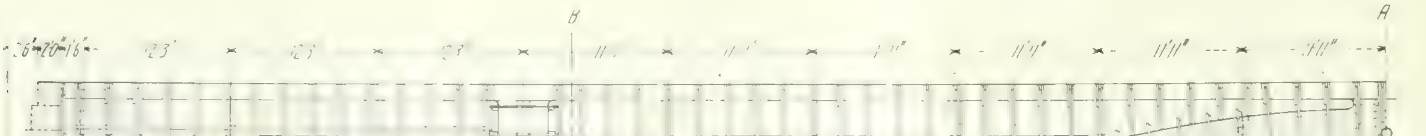

Fig. 4—Elevation Showing Forms for Arches and Piers in Place.

The work, as will be seen, involved several items of greatly different character, making it necessary to give the costs of the various items separately. The wages paid ranged from 17½ cts. to 25 cts. per hour for common labor and from 30 cts. to 40 cts. per hour for carpenters. The costs given below are labor costs only except for the item dynamite in excavation.

The cost of erecting a temporary foot bridge 200 ft. long, 8 ft. wide and about 8 ft. above water level and of wrecking the old bridge was as follows:

Common labor	$368.47
Foreman, timekeeper, etc.	53.50
Total	$421.97

There were altogether 600 cu. yds. of excavation, comprising 503 cu. yds. of earth, 57 cu. yds. of rock and 40 cu. yds. of shale. The cost of this excavation was as follows:

Common labor	$307.05
Foreman, timekeeper, etc.	46.00
Dynamite	26.75
Total	$379.80

This gives an average cost for excavation of 63½ cts. per cu. yd. All material was shoveled into skips and removed by derrick. Alternately with the handling of the skip loads of excavation the derrick was used to remove stone from the old abutment. As the mortar had disintegrated these stones were loose. The signal man, between loaded skips, hitched onto one or two stones and the derrick swung them into the bank. By this method of work the cost of removing the old masonry was as follows:

Common labor	[illegible]
Foreman, etc.	[illegible]
Total	[illegible]

There were 562 cu. yds. of masonry, so that the cost was 16 cts. per cu. yd.

The grading work amounted to 1,800 cu. yds. and cost as follows:

Common labor	$518.33
Foreman, etc.	78.00
Total	$596.33

This gives a cost of 33.1 cts. per cu. yd The average per man per day was 5.3 cu. yds.

The cost of hauling and setting the steel shoes weighing 18.12 tons was as follows:

Common labor	$63.2
Foreman	8.6
Total	$71.9

This gives a cost per ton of $3.97.

For reinforcement 18½ tons of new steel and 14½ tons of steel removed from the old bridge were used. The cost of placing the new steel was as follows:

Common labor	$117.71
Foreman, etc.	18.77
Total	$136.48
Per ton	7.52

The old steel was stacked up and heated to remove the paint and scale. The cost of this preparation and of placing the steel was as follows:

Common labor	$175.00
Foreman, etc.	22.50
7 cords wood	10.50
Total	$208.48
Per ton	14.34

The cost of forms for 874 cu. yds. of concrete was as follows:

Common labor	$1,866.26
Foreman, etc.	202.62
Total	$2,068.88

This gives a cost per cubic yard of $2.37.

The costs of mixing and placing concrete in the two piers, using two-wheel carts for the east pier and a derrick for the west, were as follows:

Item.	East.	West.
Cubic yards	68	122
Common labor	$70.73	$69.26
Foreman, etc.	12.00	8.00
Total	$82.73	$77.26
Per cu. yd.	$1.22	$0.633

The cost of placing 80.5 cu. yds. of rubble concrete in the west abutment was as follows:

Common labor	$28.29
Foreman, etc.	[illegible]
Total	[illegible]
Per cu. yd.	[illegible]

The cost of placing 603.5 cu. yds. of con-

[illegible] crete in the arch [illegible] floor was as follows:

Common labor	$430.90
Foreman, etc.	18.90
Total	[illegible]
Per cu. yd.	0.79

All materials were unloaded from cars by hand and hauled four blocks by teams at [illegible] costs were as follows:

[illegible]	[illegible]	[illegible]	Cement.	Steel.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	$68.92	[illegible]
[illegible]	[illegible]	[illegible]	12.9	3.36
Total	$178.45	$97.02	$81.96	$11.86

[illegible]

The construction of two derricks and a cement shed and the installation of the mixer cost as follows:

Common labor	$384.33
Foreman, etc.	67.87
[illegible]	[illegible]

The grand total labor cost of the bridge [illegible]

EARTH AND ROCK SECTION

Some Principles and Methods for Controlling Underground Excavations.*

The art [illegible] with that of control of ground as some suppose; a good carpenter can frame a timber better than any miner, but unless he places it underground as directed by the latter, his accurately jointed sets are liable to prove worthless for the purpose intended. The subject of ground control naturally divides itself into two classes: (1) the subject of roof control, and (2) the control of the sides and bottom of an excavation and of the whole overlying formation.

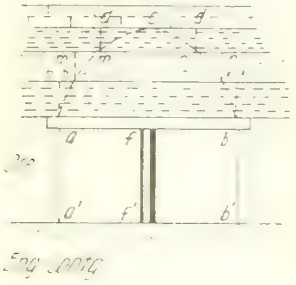

Fig. 1.

Figure 1 represents the cross section of a rectangular excavation in a horizontal seam or bed *a b b'a'*. The support of the roof over the opening *a b* depends upon the immediately overlying formation which usually may be classed as one of the following: Homogeneous; horizontally bedded; weakly consolidated; non-conformable, or broken.

With a homogeneous roof stratum either massive or in a sufficiently thick bed to act as such, the lines of vertical pressure far above *ab* tend to combine themselves into resultants which follow a surface *a c b* and throw downward pressure onto the walls at *a* and *b*. The resultant surface takes the form of an arch. This means that the sub-arch block *a c b* is all the weight that has to be supported to maintain the roof intact, and that its stability depends, first, on its strength as a beam of continuous width to bear its own weight across the span *ab* and, second, on its being held in place by the tensile strength of the rock area along the arch *a c b*. In homogeneous ground the natural arching is usually sufficiently convex so that the sub-arch block has sufficient depth *c f* to make it self-sustaining as a beam across *ab* except in soft rocks like certain shales which may not only need the support of a cap like *ab* but also must be lagged. In old mine workings where the sub-arch block *a c b* has fallen out so that the shape of the natural surface of equilibrium *a c b* can be discerned, it appears as an arch whose proportions vary with the width of the roof, and its nature. Fayol gives the following rules for limited areas of roof: If [illegible] = the height of the excavation (as *e f* in Fig. 1); if *w* is less than 6 ft., *h* may be as much as 2 *w*. This is Fayol's first rule. If *w* is more than 6 ft., *h* may be as much as 4 *w*.

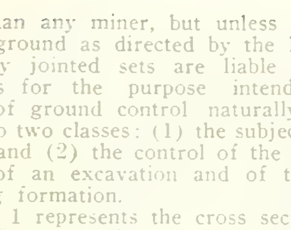

Fig. 2.

In railroad or mine tunnels a homogeneous roof can be made self-sustaining by excavating it, at the start along the natural arch form. If it is desired to hold the sub-arch block *a c b* in place the cross beam *a b* must be of a strength equal to the difference between the weight of *a c b* and the tensile strength at the arched surface. If the homogenous sub-arch block *a c b* has fractured at all before the beam *a b* has been placed then the beam must be strong enough to bear the entire weight.

In the second case where the roof is in horizontal beds thinner than the sub-arch block so that bedding planes like *h k* and *m n* (Fig. 1) intersect the surface *a c b*, a different condition arises from the case in which homogeneous material is considered. In this case the sub-arch block consists of several stone beams, so that for a self sustaining roof the lowest beam must be strong enough to sustain the weight, in this case, of the two [illegible] sustain the top beam and the tensile strength of the sub-arch block must be strong enough to hold up the whole sub-arch block. It is likely that stronger props would be needed in this second case than with the first or homogeneous material, because the lowest sustaining beam as a *h' k' b* has a depth in the middle of *h a* which is only a fraction of the corresponding depth *c f* for the first case, and the cross breaking strength of a beam increases directly as the square of the depth. Also each of the three beams may have a different tensile strength. Hence we have t[illegible] both the cross-breaking strength and tensile strengths of all beds in the sub-arch block before we can tell how much propping is necessary to sustain the roof across a given width. A roof of an elastic nature, like slate, may at first simply bow downwards from an excess of pressure instead of fracturing as a beam. This may cause it to fail by shear at the abutments. For the maximum strength of a roof it is important to exclude water from the bedding plans in order to prevent the slipping and weakness caused by its presence.

In the third case, where the sub-arch consists of a weakly consolidated stratum like a conglomerate the problem of support is similar to that of a homogeneous material. Practically the whole weight of the sub-arch block must be held in place by artificial supports, and in addition the beam *a c b* must be reinforced by crossbeams and props. Where the roof stratum is so weakly consolidated as to be incoherent it requires close lagging, and where it is quite loose an advance can only be made by driving forepoles ahead of the timber sets right up to the working face. Loose sand, if dry or only moist, can be sustained, like loose gravel, by close fore-poling, but if it is wet enough to flow freely like quicksand the case is hopeless except by the use of some such system as that of the pneumatic shield recently employed in the Hudson river tunnels at New York.

When the quicksand once begins to flow, the results may be far reaching as its escape from its matrix may mean the collapse of the latter and consequent disastrous movements of the whole overlying cover.

In the fourth case, or non-conformable roof, the strata may dip in any direction. If the strata lies as shown in Fig. 2 the conditions will not produce an arch of fracture as in Fig. 1. The upper stratum *g' g p v* is entirely above the opening and bridges it slantingly from one side to the other, while the two lower strata, *v p v' q'* and *q' v' q* have their lower ends unsupported and projecting like cantilever beams. Then the natural surfaces of fracture will be normal to the bedding planes and will be *q q'* for the lowest and *q' v* for the middle stratum. The tensile strength of surface *q q'* must be enough to hold the weight of projection *q' v' q* and any unbalanced pressure from above, while surface *v q'* must hold its end *v p v' q'* and any weight above. A line of props at *t* strong enough to sustain the excess of strain over the resisting strength of surface *q q'*, will hold up the roof without a second line at *t* provided that surface *v' p'* is strong enough to sustain the weight on it from the projection [illegible]

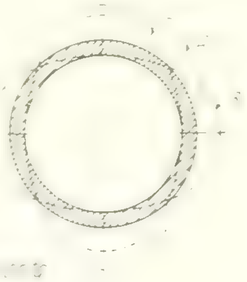

Fig. 3.

As the dip of the roof beds increases, the strains on the surface of fracture *q q' v* becomes more tensile than cross-breaking until with vertical beds the strain is all tensile. In the last case, the weight to be sustained by each stratum is its block below a natural arch of fracture across the room, which is differently proportioned for vertical beds than is *a c b* of Fig. 1 for horizontal beds.

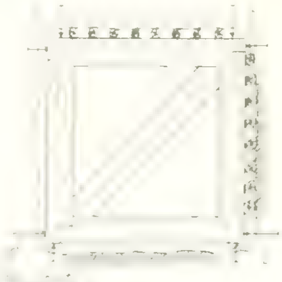

Fig. 4.

Where the strike of the inclined beds of the roof is *across* instead of *along* the room beneath, we have a mixture of the cases illustrated by Figs 1 and 2. Each bed can first be considered separately as forming a single sub-arch beam whose side elevation is *a c b* in Fig. 1. Each bed must then be calculated separately for the self-sustaining power of its sub-arch beam, across the span

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*Abstract from an article in the Mining World by Robert B. Brinsmade, Professor Mining Engineering, University of West Virginia.

[illegible] centre. A roof may then be arti[illegible] supported if necessary by a cap or [illegible]

The fifth case or broken roof may arise from planes of faulting, etc. If the fracture planes are parallel or in one general direction, we can handle the roof as suggested for the fourth case. If the planes are in several directions so as to cut the roof into monoliths, the support of each block will have to be studied separately. Where a roof monolith is of indefinite height, we may illustrate it by Fig. 1 with *a b* its length and *a c b* the section of its natural surface of fracture, which will be of dome shape, so that only the support of the sub-arch portion *a c b* has then to be considered. When, however, the roof monoliths are broken also by a plane in a horizontal direction, like *m n* in Fig. 1, so as to become free blocks like *a m n b*, they can only be kept in the roof by sustaining their entire weight artificially, and forepoling will have to be used for excavating beneath a roof surface containing them.

Curved Sections—A tunnel section may be supported by the circular lining *1* (Fig. 3) against external pressure from any direction since the portion of the ring taking the ground pressure will be an arch to transmit its load to the balance of the ring acting like arch abutments. If we consider only the keeping open of a given area with the least material, the circular lining may be replaced with advantage by the elliptical, when the pressure is greater in one direction than in another, by placing the long axis of the ellipse parallel to the direction of greatest pressure. Thus if the greatest pressure comes from roof or floor, the ellipse should be vertical as *2* in Fig. 3, and if from the sides, the ellipse should be horizontal as in *3*. The circular lining is most economical when the external pressure is equally distributed, or where it comes in an oblique direction, for an oblique ellipse would be generally unsuitable for use. The oblique pressure is apt to occur when driving along the strike of inclined beds. Other considerations, besides economy of lining, usually prevail in practice so that circular sections are less used than elliptical ones, which fit cars more closely in transportation tunnels, or egg-shaped ones, like *4*, which have a lesser hydraulic gradient for water conduits or drains. The material most used for curved linings is cast iron or some kind of masonry, though steel shapes are also formed to fit, and timber polygons to approximate, curved sections. To merely support the ground it is clear that only that part of the tunnel section need be lined which has weak walls so that we see in practice linings on the roof alone, on the roof and one side, or on three sides, the ends of the lining resting in each case against abutments of solid rock.

Rectangular Sections—The greatest available area in transportation tunnels for the minimum volume of excavation is obtained by using the rectangular instead of the curved section. Ordinary brick or stone masonry, having little tensile strength, is unsuitable for lining any part of the rectangular section subject to cross-breaking strains. Therefore it is not used except for side walls. Timber or steel beams and re-enforced concrete are the common linings for rectangular sections. With a weak roof and strong sides only the piece *a b* (Fig. 4), which is called a cap or a "quarter-set" is put in; with both roof and one side weak the cap *a b* and the post *b c* called a "half set," are needed; with roof and both sides weak a cap and two side posts, or a "three-quarter set," is used; while with four weak walls a cap, two posts and a floor sill, or a "full set," is required.

The attempt will not be made here to discuss methods of framing except as they are affected by ground pressure. With a predominating vertical pressure a good joint for square timber is at *a* (Fig. 4), and for a round timber at *b*. Where the main pressure is horizontal a joint for square timber is shown at *d* and one for round timber at *c*. A rectangular frame can resist pressure acting parallel to its sides, but tends to collapse under oblique pressure. It is to make them more stable under oblique pressure that tunnel sets have outward-battered instead of vertical posts.

Types of Drill Bits Adopted in South Africa.

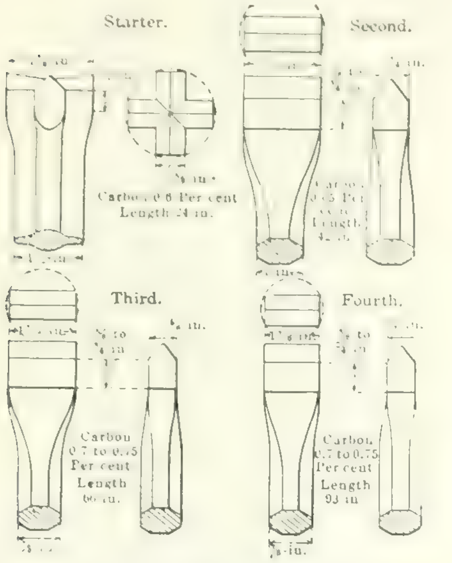

Fig. 1.—Types of Drill Bits Adopted at South African Mines.

The accompanying sketch shows the shapes and dimensions of various drill bits recently adopted at the Robinson Mines, South Africa. The tests, according to the *Engineering and Mining Journal*, were made to determine the most suitable steel for use in the Rand mines. Many varieties of steel have been tested in the following way.

From 40 to 60 drills made from each brand of steel were sharpened by hand, weighed, measured by a micrometer gage, then sent to the mine, where they were used in 2¾ in. machines to drill the hardest rock. The depth of holes drilled and time taken were noted. The drills were then sent to the surface, where they were again weighed and measured and the quality of the steel compared by the loss in gage.

It is difficult to convince the Rand miners that the proper heating and tempering of the steel has an important bearing on the efficiency of the drills, so it was necessary to recommend steel of such carbon content as would permit of direct plunging in the type of tank, giving a limited depth of immersion for cross bits.

The bits, as finally adopted, are shown in the accompanying illustration. They are used in 2½ and 2¾ in. machines. The starting bit is used to drill 15 ins. of hole, the second 21 ins. and the third and fourth 24 ins. each.

With higher air pressure it is believed that the third and fourth bits should be made of 1 in. steel, as even with 70 lbs. air pressure a 2¾ in. machine will bend some of the ⅞ in. drills. From 0.7 to 0.75 per cent carbon is the highest that will permit of steel being satisfactorily welded and which will temper without cracking on direct plunging.

An Economical Automatic Dump for Shaft Sinking.

The automatic-dump hoisting apparatus shown in the accompanying figure is the invention of R. H. Pascoe, former superintendent of the Burk Mines of the Cœur d'Alene district, Idaho, and, as described in the *Engineering and Mining Journal*, has been used in sinking a three compartment shaft and, it is claimed, effecting a saving of $10 per foot, of which $7 per foot is saved by the elimination of one top man.

While the cost of the bucket arrangement is small, it has all the advantages of an expensive skip installation and is in many respects superior to the hoisting apparatus commonly used for shaft sinking or bailing.

The main features of construction and operation are clearly shown in the accompanying illustration. The laterally extending trunnions *A* on the bucket (which is suspended by chains from a crosshead) engage in the trunnion recess *B* on the skids when the upper end of the bucket comes in contact with the deflector opposite to the skids, thus causing the bucket to capsize and discharge its contents into the chute or other receptacle. In the cut the deflector is shown as being composed of wooden pieces faced with iron; 3-in. angle irons are sometimes used for this purpose. The crosshead is preferably constructed of steel I-beams or angle irons, properly braced, with an eyebolt for suspension from the cable. The bucket is suspended from the crosshead by a pair of eyebolts con-

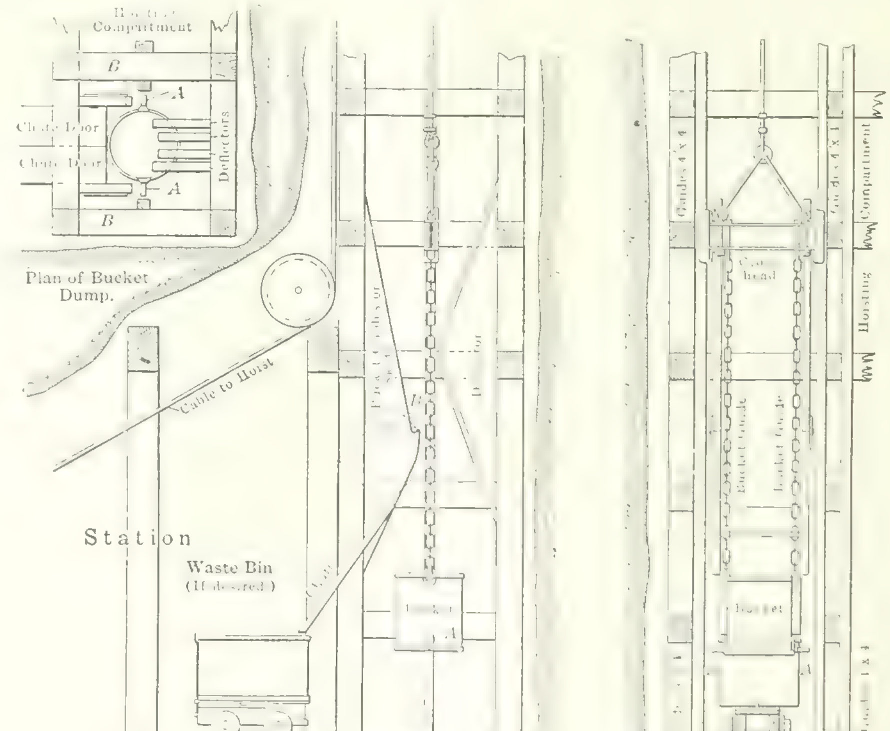

Fig. 1.—Plan and Sections of Shaft Showing Automatic Dump Bucket for Shaft Excavation.

nected with chains of sufficient length to allow easy dumping. The crosshead runs between a single pair of timber guides secured in proper alinement. If desired, a safety clutch can be applied to the crosshead.

This apparatus has been thoroughly tested under actual working conditions in the mines of the Federal and other companies operating in the Cœur d'Alenes. By its use a 1-ton bucket can be hoisted, dumped, delivered back to the bottom of 100-ft. shaft in 90 seconds, this having been proved in the actual work of sinking two three-compartment shafts 300 ft. each. This work also demonstrated a 1-ton bucket would [illegible] the rock or [illegible] to hoisting the [illegible] and suppiies.

One great advantage of using this apparatus in shaft sinking lies in the degree of safety afforded the men. No rock falls back into the shaft, and the quick, positive action and freedom from sway and sideplay reduces confusion when ready to blast. As the bucket rides as steadily as a skip, it is unnecessary to line a shaft in good ground. In sinking two or three-comparement shafts, the chain on one side can be unhooked and the bucket taken to any part of the shaft for loading, thus enabling this operation to be performed readily and conveniently. After loading, the bucket is pulled [illegible] hoist and the loose chain hooked on, when the load is ready for hoisting. Owing to vibration being taken up by the chains, a bucket fitted with a valve makes an ideal bailer.

Dumping can be effected at any level at or below the hoist station, making it unnecessary to move the hoist until the limit of capacity of the engine is reached, which cannot be done with an ordinary bucket without the services and extra expense of a topman at the dumping point. If the shaft has more than one compartment this apparatus is best installed in the pipe compartment.

ROADS AND STREETS SECTION

Instructions of the Ohio State Highway Department for Inspectors on State Aid Road Work.

The following instructions have been issued by the Ohio State Highway Department, Jas. C. Wonders, commissioner, for the guidance of inspectors in the inspection of material and workmanship used in the construction of state aid roads in Ohio:

Duties of Inspectors.—An inspector is placed on the work to keep the department informed as to the progress of the work and the manner in which it is being done; also to call attention of contractor to any infringements upon plans or specifications. He is not authorized to approve or accept any portion of the work or to issue instructions contrary to the plans and specifications.

The inspector must at all times be gentlemanly and businesslike, but firm in securing honest work.

The inspector's duties may be divided into three heads:

1. The inspection of methods used in construction, including quality of workmanship.
2. The inspection of both quality and quantity of material used.
3. The keeping of a daily record of the progress and condition of the work. The inspector must report the progress of each day's work, and at the end of the week mail the reports of that week's work to the office of the State Highway Department. He must also keep a small diary, in which he will jot down the principal events of the day; also the record of the work done on each day as given in his daily reports. This diary will be of great value in settling controversies, disputes, etc.

Specifications.—He must thoroughly acquaint himself with the requirements of the plans and specifications for the work, and must keep a copy of the specifications with him at all times while on the work. If there is any point that he does not clearly understand he should make inquiries of the resident engineer or some member of the Highway Department.

[illegible] carefully examine the samples of material submitted by the contractor with his bid, as he will be justified in condemning material inferior to these samples. In this particular the inspector must use judgment, and discriminate between a mere blemish and a real defect. He should at all times be fair and reasonable with the contractor and must not be too exacting in particulars which do not materially affect the quality of the finished road.

The Resident Engineer.—The resident engineer is the inspector's superior officer and his orders must be respected unless they conflict with the specifications. The inspector must keep in close touch with the resident engineer and assist him as much as possible in taking measurements, setting stakes, etc. Many of the stakes can be set by the inspector himself. He must see that the stakes are not lost or removed, and shall use care in preserving all stakes, reference points and bench marks. He must always insist upon a complete understanding of exactly what the stakes represent, and see to it that the work is carried out in accordance with these stakes.

In the absence of the engineer the inspector is in full charge of the work and is there to see that the specifications are rigidly carried out. All of his orders in accord with the plans and specifications must be obeyed. If they are not, his duty is to stop the work on that branch in dispute and communicate with this office at once.

Dont's.—Don't under any circumstances make any agreement with the contractor for the furnishing of material, teams, or labor, nor derive any profit from anything used in the construction of the road.

Don't quarrel with the contractor or foreman. If possible, keep on good terms with them, but at all times be firm in holding them to the terms of the contract.

Don't give orders to workmen. If work is not being done properly notify the foreman or person in charge of the work.

Don't do work on the road. You are paid to see that the work is done properly, not to do it yourself.

Don't accept favors from the contractor or try to be a "good fellow."

Don't be intimidated or "bluffed" by the contractor or any of his employes, and report any or all threats, if any be made.

Don't take orders or follow out suggestions from the contractor or from outside parties concerning the manner of doing work. Complaints and suggestions by residents along the road may be considered and reported, but orders must be followed as given by the department, and plans and specifications carried out, unless written consent to a change is secured from the department.

Don't let the contractor deposit stone or other material within the lines of the road at any point until after grading and rolling has been properly completed.

[illegible]

The specifications as to the treatment of macadam are to be your guide at all times, but it is the purpose of these paragraphs to emphasize and enlarge upon a few particular points. In the construction of a macadam road the points to be observed are:

1. The thorough consolidation and specified crown of the subgrade or earth bed.
2. Cleanliness of the stone; it must be free from clay and loam.
3. Size of the stone as given in the specifications. Long, flaky pieces or "tailings" must be excluded; they will never compact, no matter how much they are rolled.
4. An excessive quantity of binding must not be used. The proportion should be about equal to the voids in the broken stone. By using a larger quantity than this the amount of rolling is lessened, but at the expense of durability

[illegible] as nearly cubical as possible and be clean and free from dust, dirt and screenings, for the reason that it is impossible to prevent the dust and screenings from being deposited in bunches and producing weak places in the road. All excess of dust and screenings on the finished road is to be avoided, as it ruts easily and produces a soft surface. The watering of the finishing layer shall be thorough and the watering and rolling continued until water flushes over the whole surface and the passage of the roller will bring moisture to the partially dry surface, as in the case of concrete when it is tamped. If the material sticks to the roller it is clear evidence that there is not sufficient water being used.

No screenings shall be dumped on either layer, but they should be deposited in piles on the shoulder or at one side of the road. The material should be evenly applied to the road with a spreading motion of the shovel. It is also desirable that there shall be no displacement of the rolled stone before the spreading of the screenings, but should this occur the roller shall be brought to use again immediately before the spreading of screenings has begun. The caulk of horseshoes and wheels of vehicles driven over the surface of the rolled stone will tend to loosen and displace the stone, leaving pockets that will be filled with screenings, making weak spots in the road. The intention of the specifications is that the stone shall be closely packed together and held in place until the interstices have been completely filled with screenings. The rolling on each course should be continued until the stones are brought firmly together and do not move ahead of the roller or when walked over. Any hollows or depressions in either layer that develop during the process of rolling shall be filled with the same size of stone that has been used in the layer and brought to a true grade when rerolled.

Heavy loads of material will not be permitted on the surface of an unfinished road, nor after the finishing, until the surface has completely dried.

The inspector must not permit material of any kind to be placed upon the subgrade when it is in a soft or muddy condition or when the ground is full of frost. He must see that trenches are cut that will thoroughly drain the subgrade during wet weather, and while construction is under way. After the road has been completed there will be no necessity for subdrainage, as the finished surface will act as a roof, completely shedding water from the subgrade.

The inspector should keep a record of the depth of stone used on each course on each 100-ft. section.

[illegible]

Tar or asphalt binders should be applied only in warm, dry weather. The conditions which should be particularly observed by the inspector are as follows:

1. The stone for the upper course should be clean and free from dust at the time of applying the binder. If the stone should be coated with dust or other fine material, the binder would not penetrate and would soon peel off, resulting in a raveling of the surface.
2. The stone should be dry. Moisture will prevent the proper penetration of the binder.
3. The binder should be applied during warm weather. Cold weather has a tendency to chill and stiffen the binder before it has had time to penetrate, and unsatisfactory work will result.

The inspector should keep an exact record of the number of barrels of tar or asphalt binder that is used on each 100-ft. section of [illegible] whether the contractor is using the specified amount of material per square yard of surface.

[illegible]

[illegible] duty, the inspector should procure samples of brick as they are being delivered, selecting of bricks that are an average in quality as nearly as he can determine. Twenty-four of these brick should be boxed and sent by express, charges collect, to the address given on the shipping tag. He will be furnished with shipping tags on which he should state the name of the county, road, contractor and name of inspector. He should select samples from the first lot of brick delivered and send them immediately. He should not allow any brick to be laid until he has been notified by this department that the samples have met the requirements of the specifications. If the first test shows that the material is not of the required quality, additional samples may be required. At the time shipment of brick is made, notify this department that samples have been sent. At any time during the construction of the work if, in his opinion, the quality of the brick delivered should change, he should send additional samples to be tested.

In the work on a brick road the specifications furnish information and directions for the greater part of the work, but circumstances and conditions usually arise when the inspector must be guided by his own judgment and discretion.

Curb.—The inspector must see:

1. That the forms are accurately and securely lined and braced.

2. That the inner surfaces of the forms are thoroughly drenched before concrete is put in place.

3. That the surface of the concrete is worked smooth by spading and troweling.

4. That the forms are left in place and the exposed surface of the concrete kept wet until it has thoroughly set. Care should be used in removing the forms so as not to injure the concrete.

Foundation.—The inspctor must see:

1. That the subgrade is thoroughly rolled and compacted, and has the specified crown.

2. That the foundation material is equal to the samples submitted and has the required depth and crown, and is well rolled.

3. Where concrete foundation is used, he shall insist on all of the details of the specifications being followed. The concrete must always be a wet mixture, so that it will flow into place with little ramming.

4. That the sand used for the cushion coat is of good quality, dry and properly luted when brick are laid, as it is impossible to make an even and uniform cushion coat out of wet sand. The surface of this sand cushion or bed should have the specified crown as shown by cross section drawing. This cushion coat should have a uniform depth, must be of fine sand and must not contain any pebbles larger than ½ in. in greatest dimensions.

Laying.—The importance of care in properly laying the brick can hardly be overestimated. After laying no loads should be permitted on the brick during the process of construction. The inspector should see that the lines of brick are kept straight and the specifications rigidly carried out in every detail.

Rolling.—The brick must be thoroughly rolled before filling, as it is impossible to get a smooth and uniform surface without exercising great care in this particular.

Culling.—After the brick are laid and before rolling, the inspector shall carefully examine the same. The brick to be removed should be marked with an X and those to be turned marked with an I. This marking may be done with lumber crayon or chalk. It is not a duty of the inspector to turn brick or remove faulty ones. The inspector should see that the contractor removes all culled brick from the work and that they are replaced by brick of acceptable quality before the work of rolling and filling is undertaken.

Filler.—See that the proper proportion of sand and cement is used. The sand must be fine or it will fail to go down between the bricks. It must also be dry, and it shall be thoroughly mixed with the cement, until the mass assumes a uniform color without streaks, before the water is added. It must be mixed in small quantities, as it is almost impossible to keep the sand in suspension in quantities of more than one-half bushel at one time. Unless it is perfectly mixed when it is deposited on the pavement the water and cement will go to the lower portion of the joints between the bricks and the sand will remain on top. In mixing the grout it is best to add the water slowly, making a mortar first, and continue adding water until the required consistency is attained. The first pouring must be almost as thin as water. The second pouring must be about like thick cream. Experience is required to know when you are getting the best results and you are advised to study this work very carefully until you have determined the exact conditions that are most desirable. The pavement must be thoroughly saturated with water before beginning the pouring. This is the most particular work in the laying of a brick pavement, and the success of the pavement depends more on proper filling than any other one thing that enters into the construction except brick.

Final Inspection.—When the work has been nearly completed the inspector shall notify this office, and some member of the Highway Department will examine the work and give instructions as to the completion of same.

Bill for Services.—At the end of each month the inspector should send to the office of the Highway Department a carefully itemized and receipted bill for his services during that month.

The inspector is expected to be on the work at all times while work is in progress.

Any neglect of duty or failure to comply with any part of these instructions will be sufficient cause for immediate dismissal.

Dust and Its Prevention on City Streets.*

Public nuisances shall not be tolerated within the city limits is a phrase to be found on all our municipal statute books, and yet repugnant, dirty, dusty streets are characteristic of practically all of our American cities. Why should a people who spend vast sums of money for public improvements which add to the comfort of mankind submit to streets covered with dust and dirt of all kinds? One reason is that the large majority of the people of this country do not appreciate that it is economically possible to have clean and practically dustless streets and those who are familiar with cities where clean streets are the rule rather than the exception have not the courage of their convictions to make an emphatic protest to those responsible or to carry the issue to the polls if necessary. The present is an opportune time for vigorously attacking the broad problem of prevention of dust on city streets, since it is slowly becoming recognized that clean streets contribute not only to the healthy condition of a city but also play an important part in attracting capital and desirable residents. One must have a callous mind indeed who can drive through the streets of Dresden at any time of the day and not be impressed with the spotless, dustless condition of the streets of that municipality and not feel that it is a desirable place in which to live.

Before considering the effects of dust and the methods of alleviating the nuisance caused by its presence a study of the sources from which street dust arises may be of interest. A self evident source of dust is the mechanical abrasion by traffic of the road or street surface. It is manifest that the degree of abrasion will depend upon the amount and nature of the traffic, the kind of materials used, and the method of construction and maintenance employed. Other sources of street dust depending upon traffic are the deposition of dirt which has adhered to the wheels of vehicles coming from adjacent earth, gravel, or macadam streets, from the leakage of the contents of loaded vehicles both in transit and while loading and unloading, and from the excrement of animals. All street dust is by no means the result of traffic. In sections where shade trees are common a source of dust is to be found in the decay of twigs, bark, and leaves, while pollen, seeds, and spores of various plants are further sources. Mineral matter applied to certain street surfaces to prevent slipperiness is a constant source of dust. Dust resulting from manufacturing enterprises frequently forms a very considerable part of street dust. Mills where pulverizing is carried on, textile establishments and foundries are prolific sources of dust, while soot and fine ashes from chimneys find their way to the streets. From the nature of these sources it is apparent that the composition of street dust is extremely varied and complex.

Dust exerts a considerable pathogenic influence aside from its acting as a conveyor of disease germs. Various delicate membranes are irritated by the simple mechanical action of the dust, with the result not only of local inconvenience, but many times of general debility. The membranes of the respiratory organs are susceptible to this influence, especially if a person be asthmatic. The membranes of the eye are also frequently seriously irritated by dust. In the sections where the dust problem has been successfully solved physicians report a marked falling off in the number of cases of conjunctivitis.

In considering the problem of dust prevention on city streets it is advisable to classify the public ways under two general heads, business and residential streets, and to further differentiate between residential streets which are narrow, heavily shaded with trees and bordered with residences, and those streets which are more or less open

There is one way and only one way to satisfactorily prevent dust on bituminous, cement-concrete, brick, wood block and stone block pavements which are subjected to excessive horse drawn vehicle traffic. That method consists of removing the dung of animals and other street refuse by hand sweeping during the day, mechanical sweeping of the streets at night, which should be preceded by sprinkling, and finally flushing with water to remove fine dust and thoroughly cleanse the surface of the pavement. Under certain conditions dependent upon the amount and character of traffic and the uses to which the street is subjected it is feasible to omit the mechanical sweeping. It must be realized that it is absolutely impossible to economically remove fine dust by either hand or mechanical sweeping. The use of the so called dust palliatives and surface treatments on pavements subjected to heavy mixed traffic is entirely wrong in principle, as sanitary conditions require the constant removal of filth from streets, and if this is removed periodically by flushing the effectiveness of these processes is curtailed. Again, periodical watering of pavements to lay dust throughout the day is fundamentally wrong, as the fine dust which necessitates sprinkling should have been removed.

However, bituminous, cement-concrete, brick and wood block pavements may be used on streets subjected primarily to motor car traffic and light horse drawn vehicle traffic such as boulevards, open intra-urban trunk lines, etc. In such cases flushing is not necessarily a prerequisite to cleanliness. Generally patrol hand sweeping throughout the day will be sufficient.

Residential streets may be built with bituminous surfaces or as bituminous pavements, dependent upon local conditions. On this class of street the traffic is usually comparatively light from the standpoint of city traffic. If such streets have a surface coat of the proper kind of asphaltic material the dung of animals and other refuse can be removed by patrol hand sweeping, while the nature of the surface will be such as to absorb fine dust and render the street practically dustless.

For macadam streets in poor condition for **superficial treatment or when financial conditions do not render expedient the use of sur-**

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*Paper by Professor Arthur H. Blanchard, M. Am. Soc. C. E., Consulting Highway Engineer, Providence, R. I., presented at the Second New England Conference on Street Cleaning held in Springfield, Mass., May 17, 1911.

face treatments and patrol sweeping, recourse must be had to the use of palliatives such as light oils or light tars. To attain successful results it is necessary that light products having the proper chemical and physical properties should be used in small amount periodically during the season of dust.

In slum residential districts the streets, unless subjected to heavy horse drawn vehicle traffic, should, provided grades will permit, be constructed of water-bound macadam with a superficial coat of refined tar or as bituminous pavements with a seal coat of refined tar. The gradient, however, may require the use of an asphaltic-tar compound or an asphalt for the superficial or seal coat. These forms of construction will give a sanitary surface, one from which excess dirt, dung of animals and refuse can easily be removed by patrol hand sweeping, and which during the night can be thoroughly cleansed by flushing. It should be noted that the nightly flushing with water will add materially to the comfort of the people by perceptible cooling of the atmosphere during the hot summer nights.

In closing it is paramount to emphasize the fact that economical and efficient results will only be attained by municipal ownership of the requisite plant equipment and a well organized force of competent workmen.

General Directions and Specifications of the Road Board of Great Britain for the Treatment of Roads with Tar.

The Road Board of Great Britain has recently issued the following general directions and specifications relating to the tar treatment of roads. These directions and specifications, which were prepared for the board by its advisory engineering committee, are of much interest, as they may be presumed to be the conclusions reached from several years' experience in England in the use of tar for road construction and maintenance purposes. The text of the Road Board's directions and specifications follows:

NO. 1. GENERAL DIRECTIONS FOR SURFACE TARRING.

1. Surface tarring may be advantageously applied either to an old road surface in good condition or to a new surface after it has been consolidated and dried, but the tarring should never be carried out unless the road is thoroughly dry.

If there are any depressions, pot-holes, waves, grooves, or other irregularities, these should as far as practicable be made good before tarring is commenced, so as to provide an even surface.

2. Painting and spraying machines get through the work of tarring more rapidly than application by hand, and consequently are to be recommended, but hand work gives satisfactory results, and the selection of the method to be employed must be largely determined by the available supply of efficient labor.

3. If it is intended to tar an old surface it is advisable to take advantage of the early months of the year to scrape or brush the road during wet weather as a preparation for subsequent tarring, and especially to keep the road free from caked mud.

4. If the crust of a road is thin at the sides, but adequate in the center, the sides should be strengthened and consolidated before application of tar to the surface.

5. In resurfacing any road the surface of which is afterwards to be tarred, stone chippings and not fine material should be used for binding.

6. The road while being tarred should be closed to traffic over half its width, or, where practicable, over its whole width.

7. The road should be thoroughly brushed and cleaned before application of the tar. Wet brushing should be used some time previous to dry brushing, if there is any caked mud. Any method of brushing may be used which will scour and clean the road thoroughly, the best being horse brushing, followed by hand brushing.

8. Tar should be used for surface tarring which complies with either Road Board Specification for Tar No. 1 or Road Board Specification for Tar No. 2, but if the heavier grade of the tar is used, care should be taken to apply it only when the road is dry and well warmed by the sun's rays, otherwise it will not flow freely.

9. The tar should be heated to its boiling point at convenient positions on the works, and should be applied as hot as possible, so that it may flow freely. The desired temperature will be generally found in practice to lie between 220° and 240° F. for Tar No. 1 and between 260° and 280° F. for Tar No. 2.

10. In order that the tar should be applied to the road as hot as possible, it is advisable, if the method of application is by hand, to use flexible pipes to convey the tar from the boiler to the point of application. If these are not available, it will be found convenient in case of hand pouring to use 3-gal. cans specially constructed for the purpose, fitted with spouts leading direct from the bottom of the cans, and being not less than 1½ ins. in diameter at the orifice.

11. Immediately on application the liquid tar should be brushed so far as necessary to insure regularity in thickness of the coating.

12. The quantity of tar required will vary according to the physical conditions of the road, but generally, in the case of a road to be treated with tar for the first time, the quantity should be 1 gal. to coat from 5 to 7 sq. yds.

13. If the road must be opened for traffic before the tar has set hard, grit should be spread on the surface to prevent the tar from adhering to the wheels of vehicles, but gritting should be delayed as long as possible, and the quantity of gritting material to be spread should be no more than sufficient to prevent the tar from adhering to wheels. Stone chippings, crushed gravel, coarse sand, or other approved material (free from dust) not larger than will pass through a ¼-in. square mesh should be used for gritting, in quantity not exceeding 1 ton for 300 to 350 sq. yds. if grit is used, and 1 ton for 200 to 250 sq. yds. if coarse sand is used.

14. Precautions should be taken to prevent liquid tar passing directly through drainage gratings or outlets.

15. For the safty of the public precautions should be taken by lighting, watching and warning. It is specially desirable to place warning notices at points in the neighborhood of the work where other roads join or cross the road being tarred, to enable motorists and cyclists to avoid the obstructed road by taking any available alternative route.

16. On heavily trafficed roads it is advisable to apply a second coat to either the whole width or from 9 to 12 ft. of the center of the road in quantity of 1 gal. to coat from 8 to 10 sq. yds. about two to three months after the first application.

17. Surface tarring should be renewed annually on all important roads, and as required on roads with light traffic. On such recoatings the quantity of tar to be applied will vary with the extent to which the previous coating of tar has been removed by weather or by traffic.

18. Two or more samples of the tar used should in all cases be kept in quart tin cans, and be carefully labeled, including particulars fixing the locality or length of the road on which the tar was used. The Road Board will arrange with the National Physical Laboratory to submit a selection of these samples to a series of chemical and physical tests with a view to the results being recorded for future reference, and surveyors will from time to time be invited to send samples for the purpose.

19. In all cases careful record should be kept of the condition of the road surfaces in winter and summer, both before and after tarring, the quantity and quality of tar used, the superficial area covered, the state of the weather when the work is being done, the time occupied in actual work and in waiting while work is stopped owing to wet weather, the number of men employed, and full details of the cost of labor and material.

20. Surveyors are invited to send records to the Road Board to be classified and published for general information. Forms for these records will be supplied by the board.

21. Surveyors are recommended to have samples of the tar supplied to them under contracts properly tested by a qualified analytical chemist for—

(1) Specific gravity.
(2) Freedom from water.
(3) Fractionation.
(4) Free carbon.

Note.—These general directions are not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

NO. 2. GENERAL DIRECTIONS FOR TREATMENT WITH TAR-MACADAM.

1. Any road which is to be surfaced with tar-macadam should have a proper foundation or sub-crust of adequate thickness to bear the traffic likely to use it.

2. Before laying a new surface of tar-macadam the thickness of the old crust, including foundation, should be ascertained by opening trial trenches at intervals averaging about 150 yds., extending from the haunch of the road to the center, such trenches to be made alternately on opposite sides of the road.

3. The thickness of the surface coating of tar-macadam when consolidated by rolling should be from 2 ins. to 3 ins., according to traffic requirements. For a greater thickness than 3 ins. the material should be applied in two coats.

4. In the case of naturally hard subsoils, not materially softened by infiltration of surface water, the total thickness of the road crust, including foundation, if any, after consolidation of the new surface of tar-macadam by rolling, should not under ordinary circumstances be less than 6 ins. unless the subsoil is so hard as in itself to act as a good foundation, in which case the thickness of the road crust may be reduced to 4 ins. In the case of clay or other yielding subsoils, the total thickness should not be less than 11 ins.

5. The finished surface should have a cross-fall of about 1 in 32. If the crust is not sufficiently thick at the crown to enable this cross-fall to be obtained with a new coating of the thickness above mentioned, then the old surface should be left intact and unscarified, and the thickness of the new coat of tar-macadam increased as far as may be necessary. If the crust is of sufficient thickness for the purpose, the regulation of the cross-fall should be carried out by scarifying the surface and removing material from the crown to the sides previous to the application of the new coating. The material loosened by scarifying should be screened and all finer material than ½ in. should be thrown aside.

6. The aggregate of the new surface of tar-macadam should be composed of broken stone of approved quality, or selected slag of approved quality, and should contain at least 60 per cent. broken to the size of 2½ in., not more than 30 per cent of from 2½ in. to 1¼ in., and 10 per cent of ¾ in. to ½ in. for closing. The last mentioned size should be kept separate and used as top dressing during rolling operations.

7. The stone used must be thoroughly dried before being coated with tar.

8. For making tar-macadam, tar should be used which complies with Road Board Specification Tar No. 1, or Road Board Specification Tar No. 2, the choice being determined by the circumstances of each case.

If Tar No. 1 has been used for tarring the stone, care should be taken, especially in hot weather, that the tarred material has been allowed to stand for a sufficient length of time to allow the tarred surface of the stones to become partially hardened and in a tacky condition.

If Tar No. 2 has been used for tarring the stone, the macadam should be laid soon after being tarred, and if the tar be of the heavier grade of this quality, the stone coated with such tar should only be laid when the road is quite dry and in warm, sunny weather.

9. The quantity of tar used to coat 1 ton of stone should be approximately from 9 to 12

[illegible] varying according to the size of the stone, the grade of tar used, the method of mixing and other conditions.

10. The tar-macadam after having been spread and leveled should be rolled into a smooth surface, but too much rolling should be avoided. Less rolling is required than in the case of water-bound macadam. A 10-ton roller is a suitable size for use in most cases, but good results can be obtained by using a 6-ton roller, and finishing with a 10-ton roller.

11. In order to get the best results from the use of tar-macadam, it is advisable to apply a coating of tar to the surface after the road has been used by traffic for several weeks. This tar should comply with the provisions of Road Board Specification for Tar No. 2, and should be poured or sprayed on the surface at a temperature of about 270° F.

12. Stone chippings, crushed gravel, coarse sand, or other approved material (free from dust), not larger than will pass through a ¼-in. square mesh, should be used for gritting in quantity not exceeding 1 ton for [illegible] sq. yds. if grit is used, and 1 ton for 200 to 250 sq. yds. if coarse sand is used.

Note.—These general directions are not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

NO. 3.—GENERAL DIRECTIONS FOR SURFACING WITH PITCH-GROUTED MACADAM.

1. Any road which is to be surfaced with pitch-grouted macadam should have a proper foundation or sub-crust of adequate thickness to bear the traffic likely to use it.

2. Before laying a new surface of pitch-grouted macadam, the thickness of the old crust, including foundations, should be ascertained by opening trial trenches at intervals, averaging about 150 yds., extending from the haunch of the road to the center, such trenches to be made alternately on opposite sides of the road.

3. The thickness of the surface coating of pitch-grouted macadam when finished and consolidated by rolling should be 2½ ins. to 3 ins. (except on very light traffic roads, when the thickness may be 2 ins.) for single-pitch grouting, and from 4 ins. to 4½ ins. for the double-pitch grouting hereafter described.

4. In the case of naturally hard subsoils, not materially softened by infiltration of surface water, the total thickness of the road crust, including foundation, if any, after consolidation by rolling of the new pitch-grouted surface, should not under ordinary circumstances be less than 6 ins., unless the subsoil is so hard as in itself to act as a good foundation, in which case the thickness of the road crust may be reduced to 4 in. In the case of clay or other yielding subsoils the total thickness should not be less than 11 ins.

5. The finished surface should have a cross-fall of about 1 in 32. If the crust is not sufficiently thick at the crown to enable this cross-fall to be obtained with a new coating of the thickness above mentioned, then the old surface should be left intact and unscarified, and the thickness of the new pitch-grouted coating increased as far as may be necessary. If the crust is of sufficient thickness for the purpose, the regulation of the cross-fall should be carried out by scarifying the surface and removing material from the crown to the sides previous to the application of the new coating. Material loosened by scarifying should be screened and all material finer than ½ in. should be thrown aside.

6. The aggregate of broken stone to form the new surface of pitch-grouted macadam should contain broken stone of approved quality, of which at least 60 per cent must be broken to the size of 2½ ins., and 35 per cent to sizes graded from 2½ ins. to 1¼ ins. In addition to this 5 per cent of chippings of the same stone, varying from ¾ in. down to ⅜ in., should be used for closing after the grouting with melted pitch.

7. For making pitch-grouted macadam the pitch used should comply with the Road Board Specification for Pitch, its viscosity being altered to suit climatic and local conditions by varying the quantity of the tar oils as specified therein.

8. It is important that the pitch should not be poured if the surface of the stone is wet. The stone may be protected by tarpaulins, or, if wet, may be dried *in situ* by portable blowers or other means.

9. The quantity of pitch required to grout a single coating is approximately, for a consolidated thickness of 2 ins., 1¼ gals. per yard super.; for 2½ ins., 1½ gals. per yard super.; and for 3 ins., 2 gals. per yard super; but these quantities may vary with different materials, and care must always be taken to fill the voids adequately.

10. The aggregate after having been spread must be rolled down dry until the surface is formed, but without the addition of any small material.

11. The pitch, after being carefully melted, as described in Clause 18, must be raised to a temperature of 300° F. Clean, sharp sand must be heated on sand heaters to a temperature of 400° F. A dandy, or portable mixing vessel, is then to be filled with equal parts, by measurement, of the heated pitch and the hot sand, and the mixture, hereafter called the matrix, is to be kept well stirred while it is being emptied from the dandy or portable mixing vessel into pouring cans of from 2 to 3 gals. capacity, which are used for pouring matrix on to the roadway. Not only during the process of mixing, but afterwards, right up to the time of actual pouring, the matrix must be kept well stirred. The matrix prepared with pitch in the quantities specified in Clause 9 should be sufficient to fill the voids of the aggregate.

12. The final rolling should be commenced immediately after pouring the pitch matrix, and carried on rapidly before the matrix has time to set. The 5 per cent of graded chippings should be spread over the grouted surface in part previously to and the remainder during the process of rolling. The traffic may be allowed on to the finished surface as soon as the surface has cooled to the normal temperature

Double Pitch-Grouting.

13. When the traffic is so heavy that a consolidated thickness of from 4 ins. to 4½ ins. of pitch-grouted macadam is required, it is desirable, in order to obtain the best and most economical results, to divide the coating into two layers, the bottom layer to be the thicker one and to consist of large stones, the two layers being rolled down and grouted separately. Any local stone which can be procured cheaply may, if suitable in quality for foundation work, be used for the bottom layer graded from 3-in. gage down to 2-in. gage. No chippings are required for finishing the rolling of the bottom layer. The aggregate for the upper layer should consist of hard road stone of approved wearing quality, broken to 1½-in. gage, and 5 per cent of chippings of the same stone used for the upper layer, graded from ½ in. down to ¼ in., should be added before and during the process of rolling, and rolled down so as to form the finished surface of the road.

14. In pouring the pitch on the bottom layer the surface of the pitch should not be brought to the surface of the stone, but should lie about ½ in. below such surface, with the object of providing a key for the upper layer.

15. The materials and the methods of grouting and laying down in the case of double pitch-grouting, except when otherwise expressly stated, conform to the provisions of Clauses 7, 8, 10, 11 and 12.

16. The quantity of pitch required for double pitch-grouting is approximately, for a considerable thickness of 4 ins., 3¼ gals. per yard super., and for 4½, 3½ gals. per yard super., but these quantities may vary with different materials, and care must always be taken to fill the voids in the surface coating adequately.

17. For the purpose of accurately ascertaining the proportions necessary for the matrix, it is essential that portable weights, scales and measures be provided, and all materials used in the preparation of the matrix should be accurately proportioned by weight or measurement.

Instructions for Melting the Pitch.

18. The pitch boilers of from 2 to 3 tons capacity should be charged with pitch and about one-half of the proper proportion of tar oils. The fire should then be lighted, and thereafter a steady fire, with fire doors closed, should be maintained, when, in from four or five hours, the pitch should be thoroughly melted. A bright fire should be kept until the pitch reaches a temperature of 300° F., when the remainder of the oils should be added, and the mixture thoroughly stirred; the fire doors should then be opened and the temperature of the melted pitch permitted to fall to 250° or 270° F. The pitch should then be ready for use, and in all cases should be thoroughly well stirred before being drawn off. In the event of bad weather stopping the work of grouting, the fire door should be left open, the damper closed, and the temperature of the pitch allowed to fall to 200° F. It can be kept at this temperature for long periods with banked fires consuming 7 lbs. of coke per hour. It is recommended that a suitable Fahrenheit thermometer with metal protection should be at hand to indicate the temperature of the melted pitch. Whenever the weather is favorable for the recommencement of the work the pitch must be again raised to 270° F. by closing the doors and sharp firing. It is desirable that the boiler should be kept air-tight when the pitch is being melted, by the use of air-tight covers properly packed so as to make an air-tight joint.

Note.—These general directions are not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

NO. 4.—SPECIFICATION FOR TAR NO. 1.

1. *General.*—This tar is suitable for the surface tarring of roads.

As to the use of this tar for making tar-macadam, see "Road Board's General Directions for Surfacing with Tar-macadam."

2. *Boiling.*—The tar should be applied as soon as the boiling point is reached, and over-boiling should be avoided. The desired temperature will be generally found in practice to lie between 220° and 240° F. in the boiler.

3. *Source of Tar.*—The tar shall be derived wholly from the carbonization of bituminous coal, except that it may contain not more than 10 per cent of its volume of the tar (or distillates or pitch therefrom) produced in the manufacture of carburetted water gas.

4. *Specific Gravity.*—The specific gravity of the tar at 15° C. (59° F.) shall be as nearly as possible 1-19, but in view of the great variation in specific gravity of the tars produced in various parts of the country, the specific gravity may be as low at 1-16, or as high as 1-22, provided that in other respects it complies with the provisions of the specification.

5. *Freedom From Water.*—The tar shall be commercially free from water—*i. e.*, it shall not contain more than 1 per cent by volume of water or ammoniacal liquor, which water or liquor (if present) shall not contain more ammonia, free or combined, than corresponds to 5 grains of ammonia per gallon (=70 milligrammes per litre) of the tar.

6. *Phenols.*—On vigorous agitation for a quarter of an hour with twenty times its volume of water at 21° C., (70° F.) the tar shall not impart to the water more than 5 grains of phenoloid bodies, reckoned as phenol, per gallon of water (=70 milligrammes per litre).

Tar From Gasworks.

The provisions in the following Clauses 7, 8 and 9 apply to tar supplied direct from gasworks.

7. *Source of Tar.*—The tar shall be solely the natural by-product of the manufacture of illuminating gas (coal-gas with or without admixture of carburetted water gas), and shall have been subjected to no other or further treatment than may be necessary for the abstraction of water or ammoniacal liquor and light oils.

8. *Fractionation.*—On distillation the tar must yield, below 170° C., not more than 1 per cent, and between 170° C. and 270° C., not less than 16 per cent, and not more than 26 per cent of distillate (exclusive of water).

9. *Free Carbon.*—The free carbon shall not exceed 16 per cent of the weight of the tar.

Tar From Tar Distilleries.

The provisions in the following clauses 10 and 11 apply to tar supplied from tar distilleries.

10. *Fractionation.*—On distillation the tar must yield: below 170° C. not more than 1 per cent and between 170° C. and 270° C. not more than 26 per cent of distillate (exclusive of water). The distillate shall remain clear and free from solid matter (crystals of naphthalene, etc.), when maintained at a temperature of 30° C. for half an hour. The distillation shall be continued to 300° C., and the residual pitch thus obtained shall not amount to more than 73 per cent of the weight of the tar.

11. *Free Carbon.*—The free carbon shall not exceed 16 per cent of the weight of the tar.

12. *Taking of Temperatures.*—The temperature during distillation shall be taken by a thermometer of which the bulb shall be opposite the opening to the side tube of the distillation flask, and the quantities of distillates and free carbon shall be stated in percentages by weight of the portion of tar submitted to distillation.

13. *Dehydrated Tar.*—A tar prepared by simple dehydration fulfilling the provisions of this specification may be used with satisfactory results in most cases, but tars from which the naphthalene has been extracted are superior for the purposes of surface tarring.

Note.—This specification is not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

NO. 5. SPECIFICATION FOR TAR NO. 2.

1. *General.*—This tar is suitable for surface tarring, and is specially recommended for re-tarring, but if the heavier grades of the tar is used, care should be taken to apply it only when the road is dry and well warmed by the sun's rays, otherwise it will not flow freely.

As to the use of this tar for making tar-macadam, see "Road Board General Directions for Surfacing with Tar-macadam."

2. *Boiling.*—The tar is to be applied as soon as the boiling point is reached, and over-boiling should be avoided. The desired temperature will be generally found in practice to lie between 260° and 280° F. in the boiler.

3. *Source of Tar.*—The tar shall be derived wholly from the carbonization of bituminous coal, except that it may contain not more than 10 per cent of its volume of the tar (or distillates or pitch therefrom) produced in the manufacture of carburetted water gas.

If pitch be added to the tar in order to secure the specific gravity and proportion of residual pitch referred to below, the pitch so added must also have been derived from tar of the foregoing description.

If oil be added to heavy tar or pitch in order to secure the specific gravity and proportion of residue referred to below, the oil so added must be derived from tar of the foregoing description, and must be practically free from naphthalene and tar acids or phenols.

4. *Specific Gravity.*—The specific gravity at 15° C. shall be as near as possible 1-21, and in no case shall it be lower than 1-18, or higher than 1-24.

5. [illegible] quarter of an hour with 20 times its volume of water at 21° C., the tar shall not impart to the water more than 5 grains of phenoloid bodies, reckoned as phenol, per gallon of water (=70 milligrammes per litre).

6. *Fractionation.*—The tar shall be free from water, and on distillation shall yield no distillate below 140° C., nor more than 3 per cent of distillate up to 220° C., which distillate shall remain clear and free from solid matter (crystals of naphthalene, etc.), when maintained at a temperature of 30° C. for half an hour.

Between 140° and 300° C. it shall yield not less than 15 per cent, and not more than 21 per cent of the weight of the tar.

7. *Free Carbon.*—The free carbon shall not exceed 18 per cent of the weight of the tar.

8. *Taking of Temperatures.*—The temperatures during distillation shall be taken by a thermometer, of which the bulb shall be opposite the opening to the side tube of the distillation flask, and the quantities of distillates and free carbon shall be stated in percentages by weight of the portion of tar submitted to distillation.

Note.—This specification is not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

NO. 6. SPECIFICATION FOR PITCH.

1. *General.*—This pitch is suitable for pitch-grouting. See "Road Board's General Directions for Pitch-grouting."

2. *Preparation.*—The pitch is obtained by softening the material known as commercial soft pitch, as specified below, by the addition of tar oils, also specified below.

Commercial Soft Pitch.

3. *Source of Pitch.*—The pitch shall be derived wholly from tar produced in the carbonization of bituminous coal, except that it may contain not more than 10 per cent of pitch derived from tar produced in the manufacture of carburetted water gas.

4. *Fractionation.*—On distillation the pitch shall yield:

Below 270° C. not more than 1 per cent of distillate.

Between 270° C. and 315° C. not less than 2 per cent and not more than 5 per cent of distillate.

5. *Free Carbon.*—The free carbon shall not exceed 22 per cent of the weight of the pitch, but if it be found difficult or unduly expensive to obtain this quality of pitch, a quality containing as much as 28 per cent of free carbon may be used with a reduced proportion of sand as filler.

6. *Taking of Temperatures.*—The temperatures during distillation shall be taken by a thermometer, of which the bulb shall be opposite the opening to the side tube of the distillation flask, and the quantities of distillates and free carbon shall be stated in percentages by weight of the pitch submitted to distillation.

Tar Oils.

7. *General.*—The tar oils to be used shall be derived wholly from tar produced in the carbonization of bituminous coal, or from such tar mixed with not more than 10 per cent of its volume of tar produced in the manufacture of carburetted water gas.

8. *Specific Gravity.*—The specific gravity of the tar oil at 20° C. shall lie between 1.065 and 1.075.

9. *Freedom From Naphthalene.*—The tar oils after standing for half an hour at 20° C. shall remain clear and free from solid matter (crystals of naphthalene, etc.).

10. *Fractionation.*—The tar oils shall be commercially free from light oils and water—*i. e.*, on distillation shall yield not more than 1 per cent of distillate below 140° C.

The amount of distillate between 140° C. and 270° C. shall lie between 30 per cent and 50 per cent.

11. *Taking of Temperatures.*—The temperatures during distillation shall be taken by a thermometer, of which the bulb shall be opposite the opening to the side tube of the distillation flask, and the quantities of distillates shall be stated in percentages by weight of the oils submitted to distillation.

12. *Proportions.*—The proportions by weight in which the pitch and tar oils are to be mixed shall be as follows:

Pitch 88 per cent to 90 per cent.

Tar oils 10 per cent to 12 per cent.

Note.—This specification is not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

Long Suction Dredge Line.—Dredge No. 86, which is now pumping through the longest line of discharge pipe ever laid on the Isthmus, and one of the longest, without relay, of record. By actual chaining, the pipe from the dredge to the fill at Colon hospital is 7,150 ft. long. The material is delivered by the 20-in. pump without a relay. The pipe is laid on level ground, and the pressure required runs up to 70 lbs.

Coming Meetings of the Western Society of Engineers.—Meetings of the Western Society of Engineers during the month of June, with papers to be presented, are announced as follows: June 7, "Foundation and Sewer Work; Costs and Comments," by Victor Windett; June 14, "Structural Steel Design," by Albert Reichmann. On "ladies' night," to be given June 21, Mr. Wm. B. Leffingwell will give a description of the Yosemite Valley, with stereopticon illustrations.

Contract for the Emergency Dams.—The contract for the six emergency dams for the locks at Gatun, Pedro Miguel, and Miraflores has been let to the lowest bidder, the United States Steel Products Company, at $2,238,988.40. Three bids were received. The subbidders with the contractor are the General Electric Company for the electrical machinery, and the Otis Elevator Company for the hoisting machines. The total amount of material required is about 12,000 tons. The contract calls for the material, erection, and test of the dams in place by January 1, 1913, at Gatun and Pedro Miguel, and September 1, 1913, at Miraflores.

Derrick Barges for Colon Breakwater.—Two derrick barges, to be used in placing rock in the work of facing the new breakwater at Toro Point, are under construction at the Cristobal drydock shops. The hull of one is more than 65 per cent completed, and will be finished early in June, and construction of the second has been begun. The hull is of wooden construction, with a length over all of 96 ft., beam 42 ft., depth 8 ft. 6 ins., and is divided into four single water-tight compartments. The derrick is provided with a 75-foot boom, is of the stiff-legged type, having two A-frame legs and two stiff back legs. The height to the top of the A-frame is about 48 ft. The cast iron bull wheel is 16 ft. in diameter, operated by double swinging lines. A friction brake will hold the boom at any desired position along the line of its horizontal movement. The boom hoist will have a vertical movement of about three-fourths of a foot a second, and will be rigged with a seven-part line; the load hoist will have a vertical movement of about one and one-half feet a second, and will be rigged with a four-part line. The turntable, on which the derrick will revolve, is of the dredge type, will weigh about 10,000 lbs., and will be cast in six segments. The total weight of the material entering into the derrick is about 75,000 lbs. The machinery equipment of each barge will consist of a Scotch marine boiler 11 ft. 6 in. in diameter by 9 ft. in length, and 125-lb. pressure; a double drum hoisting engine of the Lidgerwood type, with 14x18-in. cylinders, and an 8x8-in. compound geared swinging engine, with the necessary equipment of pumps, etc. An oil-burning system will be installed in the boiler, and tank capacity for 2,000 gals. of oil will be provided in the hold of the vessel. The machinery will be enclosed in a wooden deck house, 27 ft. wide, 30 ft. long, and 16 ft. high, built so that the sides can be thrown open for ventilation. Mounted on top of the deck house will be the operating room, 8x10 ft. in size, from which point the operator will be in control of all machinery. In operation, the derrick barges will be stationed at desired points along the breakwater. Barges, loaded with rock from the Porto Bello quarry, will be towed alongside. The derrick will lift the pieces [illegible] may be

WATER-WORKS AND SEWERS SECTION

Cost Analysis and Other Fundamental Considerations in the Determination of a Reasonable Return for Public Fire Hydrant Service.*

This paper outlines a rational mode of determining how much income should be derived yearly from the general public fire protection service rendered by water works through the public fire hydrants, and does not consider the value of the kindred service rendered by supplying water to special apparatus for extinguishing fire that may be placed in public or private buildings such as private hydrants or standpipes, sprinklers or other automatic devices. It is assumed that the quantity of water and extra capacity of distributing pipes required for the public hydrant service is always somewhat greater than that which is needed for the special apparatus referred to, when it is brought into action. It has been generally claimed that the yearly cost of this extra capacity for fire protection should be borne by the community as a unit, and when this principle applies, no large additional revenue for special fire protection service can be expected.

Data Regarding Fire Hydrant Service in Various Cities in the United States.—Certain fundamental data relating to fire hydrant service in various cities of the United States, are contained in a pamphlet upon "Tabulation of Water Rates of Various Cities of the United States, also data regarding Fire Hydrants,"† compiled for the Indianapolis Water Co., August, 1909, by Messrs. Frank C. Jordan, Secretary, and Charles C. Crey, Purchasing Agent.

A grouping of the hydrant rentals, contained in this table, according to localities, gives the following interesting results:

Average of 15 cities in Eastern States	$29.38
Average of [illegible] cities in Central and Southwestern States	45.03
Average of 24 cities in Southern States....	42.54
Average of 6 cities in Western States.....	28.42
Approx. average of total number........	$41.05

It is also of interest to note that the average of all (103 cities), excepting the Eastern cities, is $43.48, approximately 50 per cent greater than for the Eastern States. It is well to note, however, that the average for the Eastern states is obtained from the record of but 15 cities supplied by private works.

Hydrant Rentals By Decades.—In order to ascertain if there was ground for the belief that hydrant rentals had decreased somewhat in the last two or three decades the authors sent inquiries to the list of privately owned (corporation) water works, named in the table mentioned. While the replies received are too limited to draw final conclusions from, they indicate that no substantial reduction has taken place in rates paid for hydrant rental, during the past 30 years. It should also be added that in the great majority of cases the hydrant rental covered the furnishing of water for other public uses, tending to make the data incomparable.

Common Method of Paying for Fire Protection Service.—The usual method of paying for public fire protection service is by an annual rental per hydrant, coupled with the requirement in the contract of the water company with the community served, that one additional hydrant shall be ordered in the case of extension of the pipe system for every 600 ft., more or less, of such extension.

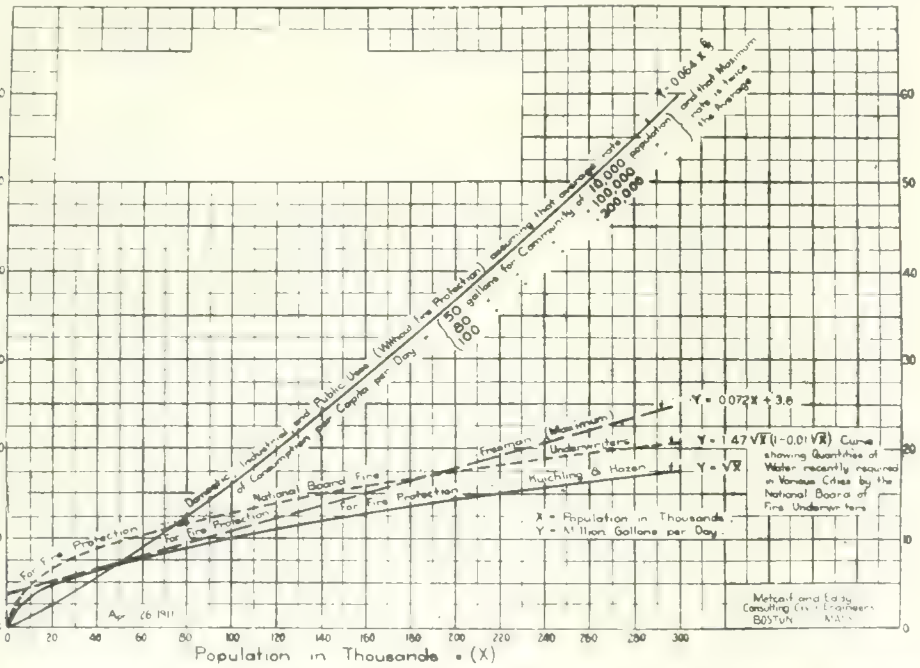

Fig. 1—Quantity of Water in Million Gallons per Day Required for Domestic, Industrial and Public Uses (Except Fire Protection) and for Fire Protection Only.

It is believed that this method of charge is a less equitable one than would be *the payment of a lump sum for public hydrant service, granting to the city the right to attach as many hydrants as it may desire to the water mains of the company, upon the additional payment of the actual cost of such additional hydrants and connections; and making provision for the increase of this annual payment for hydrant service, upon some such basis of payment as pro rata increase in population or assessed valuation or pipe line mileage within the municipality or district served by the water works.*

In this connection it is interesting to note the standard recently adopted by a water company supplying a number of different municipalities which was as follows:

Period of contract.	Per mile of distribution pipe system.	Per fire hydrant in service.
1 year ...	$325.00	$15.00
10 years ...	275.00	9.00
20 years ...	260.00	7.00

It will be noted that in this case, the charge for fire protection service is a combination of a mileage charge and an annual charge per hydrant, the latter being designed to cover the approximate maintenance and fixed charges resulting from the installation of additional hydrants.

Bases For Analysis of Hydrant Rental Charge.—Obviously the equitable hydrant rental should lie at some point between the cost of the service to the water company and its value to the community. The value of the public fire protection service must be greater than its cost, otherwise there will be no demand for it and no hydrant rental question. The reasonableness of the charge for hydrant rental may be reviewed from five points of view:

(1) The cost of furnishing fire protection service;

(2) The value of this service to the community, as measured by the saving in fire insurance premiums, ignoring the effect of the economic waste resulting from loss in business, income and wages, in the reconstruction period following the fire, and the loss of property that cannot be replaced.

(3) The actual and desirable number of hydrants and distance between them and the annual rental per hydrant resulting from the assumption of certain gross annual payments for fire protection service.

(4) The effect upon taxes, based upon the assessed valuation of property in the municipality or district served, and different assumed annual charges for fire protection service.

(5) The relative cost of different kinds of public service—police and public safety, light and fire protection—in the community served.

Cost of Furnishing Fire Protection Service.—It has been assumed, perhaps generally, by engineers, that of the entire cost of water works that furnish public fire protection as well as domestic and industrial service, approximately one-half is involved by the cost of the fire protection service. While this may be the case in large towns or small cities, it is not believed by the writers to be a safe or true statement as applied to water works generally, regardless of the extent of population in the communities served. It is believed that a fairer statement of the true conditions would be, to say that *the cost of the portion of the water works plant involved by fire protection service, probably constitutes from 60 per cent to 80 per cent of the entire cost of the physical property in the case of communities having less than 5,000 population, 20 per cent to 30 per cent in communities of 100,000 population, more or less, and perhaps 10 per cent to 20 per cent in the case of our largest cities.* Whatever the exact figures corresponding to average conditions in the United States may prove to be, hereafter when all of the facts have been determined, if such a time shall ever come, it is safe to say that the figures cited above probably indicate the general conditions very much more closely than do the prevailing opinions as first cited. As evidence a bearing upon the cost of public fire protection service, the following analysis is submitted:

Per Cent of Total Carrying Capacity of Water Piping System, Chargeable to Fire Protection Service.—From time to time during the past 20 years, standards for the amount of water required for fire protection service have been suggested by different engineers.

Upon the diagram, Fig. 1, is shown the quantity of water, in million gallons per day, required for domestic, industrial and public uses, excluding fire protection demands, and the quantity of water required for fire protection only, under the standards suggested by Mr. John R. Freeman (1892), Mr. Allen Hazen, Mr. Emil Kuichling (1897), and the National Board of Fire Underwriters (1910), as interpreted by the writers.

Mr. Freeman suggested two standards—a maximum and a minimum—the first of which only is shown on this diagram, for the sake of

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*Abstract of a paper by Leonard Metcalf, Emil Kuichling and William C. Hawley, presented at the American Water Works Association Convention June 6-10, 1911.

†Reprinted in Volume 24, No. 4, December, 1910, "Journal of the New England Water Works Association."

TABLE I—SHOWING PERCENTAGE OF TOTAL CARRYING CAPACITY OF THE DISTRIBUTION PIPE SYSTEM OF A WATER WORKS PLANT, WHICH IS REQUIRED BY FURNISHING FIRE HYDRANT SERVICE; DERIVED BY A COMPARISON OF A SYSTEM FURNISHING BOTH DOMESTIC SERVICE AND FIRE HYDRANT SERVICE, WITH ONE FURNISHING ONLY DOMESTIC SERVICE (INCLUDING IN THE TERM "DOMESTIC SERVICE," INDUSTRIAL AND PUBLIC USES, OTHER THAN FIRE HYDRANT SERVICE). BASED UPON THE KUICHLING FORMULA.

Population	10,000	25,000	50,000	100,000	150,000	200,000	250,000	300,000
1. When maximum rate for domestic service is assumed to be 1½ times the average daily rate therefor, in both plants	80.6%	68.6%	57.4%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2. When maximum rate for domestic service is assumed to be twice the average daily rate therefor, in both plants	[illegible]	62.2%	50.2%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3. When maximum rate for domestic service is assumed to be twice the average daily rate therefor, in the plant furnishing only domestic service, and 1½ times the average daily rate therefor in the plant furnishing both domestic and fire protection service	74.1%	58.1	43.2%	27.1	17.9%	11.7%	7.2%	3.7%

Footnote: The authors have assumed in this paper that the third set of conditions is probably of most general applicability, and have given consideration, in making their final figure, to similar figures based upon the requirements of the National Board of Fire Underwriters.

simplicity and as being the most important today. A full discussion of Freeman's standard will be found in the "Journal of the New England Water Works Association for the year 1892, Vol. VII, page 49." The formulas for Freeman's curves, as worked out by Mr. Kuichling, are as follows:

Y minimum $= 1.7\sqrt{X} + 0.03X$ where $Y =$ the number of fire streams

Y maximum $= \frac{X}{5} + 10$ and $X =$ the number of thousands of inhabitants.

The Hazen standard which was based upon Mr. Kuichling's, if we are correctly informed, is to be found on page 947 of the "American Civil Engineers' Pocketbook," recently published.

For average American conditions take the square root of the population in thousands, and the quotient is the rate in millions of gallons of water per day at which water should be provided for fire service.

Mr. Hazen suggests that the required capacity of the pipe system be found by adding to the fire protection service demands, as figured above, the average annual rate of consumption, increased by an allowance of 20 gals. per capita to cover ordinary fluctuations in draft, or if these fluctuations are unusually great, as much as 30 to 40 gals. per capita.

From study of this subject some years ago, Mr. Kuichling concluded* that the number of efficient fire streams required in our American towns and cities might be expressed by the formula:

(1) $y = 2.8\sqrt{X}$ where $y =$ the necessary number of such streams, and $X =$ the number of thousand of population.

And if we assume that each such stream shall discharge about 250 gals. per minute, the resulting delivery from the fire hydrants will be at the rate of:

(2) $700\sqrt{X}$ gallons per minute, or

(3) $\sqrt{X}$ million gallons per day.

This discharging capacity is regarded as sufficient except in case of general conflagration, when help is required from neighboring communities and natural bodies of water in the vicinity are drawn upon by the additional steam fire engines.

If we assume that the average daily consumption per capita for domestic, industrial and public purposes (exclusive of fire protection service), increases with the population, from 50 gals. for communities having a population of 10,000 to 80 gals. for 10,000, and 100 gals. for 300,000, the variation may be expressed approximately by the relation:

(4) $S = 32\sqrt{X}$ where $S =$ the average per capita consumption in gallons per day.

This will make the maximum draft from the distributing system for domestic, industrial and public uses (other than for fire hydrants) at the rate of:

(5) $44.4X^{6/5}$ gallons per minute, or

(6) $0.064X^{6/5}$ million gallons per day, when the maximum rate is assumed to be 1½ *times* average, and

(7) $0.048X^{6/5}$ million gallons per day, when the maximum rate is assumed to be 1½ *times* the average.

Therefore the *maximum* draft, for combined fire protection service and domestic, industrial and public uses, is

(8) $\sqrt{X} + 0.064X^{6/5}$ million gallons per day, when maximum domestic rate is *twice* the average, and

(9) $\sqrt{X} + 0.048X^{6/5}$ million gallons per day, when maximum domestic rate is 1½ *times* the average.

and the ratio of the portion of the distribution pipe system devoted to fire protection service, to the total carrying capacity of the distribution pipe system

$$(10)\quad \frac{\sqrt{X}}{\sqrt{X} + 0.064X^{6/5}} \text{ and}$$

$$(11)\quad \frac{\sqrt{X}}{\sqrt{X} + 0.048X^{6/5}}, \text{ for the two cases}$$

cited.

Again, if it is assumed that *without* fire hydrant service a distributing pipe system must be designed for a maximum rate of *twice* the average for domestic and industrial uses, whereas *with* fire hydrant service the maximum rate for domestic and industrial uses may be taken at 1½ *times* the average rate, the ratio of the difference between the required carrying capacities with and without fire hydrant service to the carrying capacity with such service becomes

$$(12)\quad \frac{\sqrt{X} + 0.048X^{6/5} - 0.064X^{6/5}}{\sqrt{X} + 0.048X^{6/5}} = \frac{\sqrt{X} - 0.016X^{6/5}}{\sqrt{X} + 0.048X^{6/5}}$$

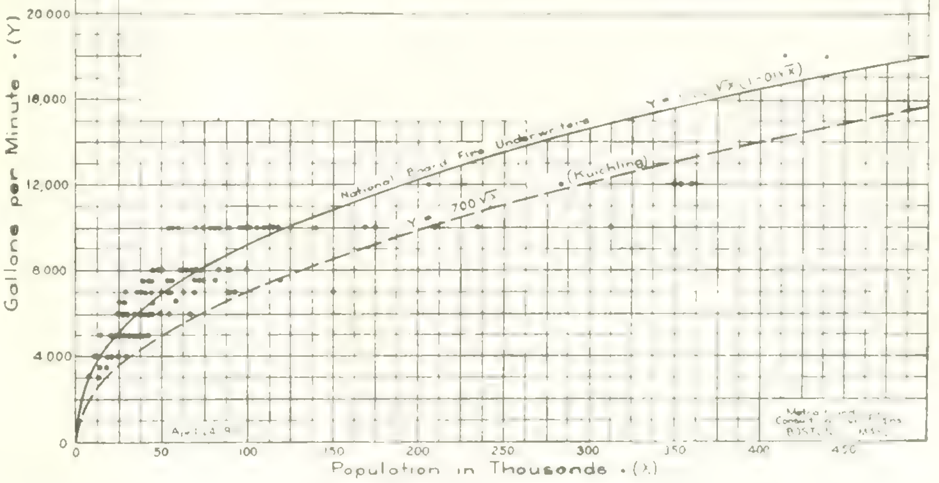

Fig. 2—Quantity of Water for Fire Protection Service Reported by The National Board of Fire Underwriters (1905 to 1911) as Necessary for the Conjested Value District of Various Cities, Together With the Resulting Average Curve and the Kuichling Standard (1897).

It will be noted that this ratio reduces to zero when $X = 367.74$, which means that in a city of 367,740 population, the pipe system must be of the same size to provide for a maximum rate of draft of *two* times the average draft for domestic and industrial uses *without* fire hydrant service, as that which would be required by a maximum draft of 1½ *times* the average draft for domestic and industrial uses *with* fire hydrant service.

It is also possible to determine the ratio $\frac{D}{d}$ of the diameters of two supply mains, one of which, D, is adapted to carrying the combined fire, and domestic and industrial supply, while the other d, is capable of delivering only the domestic and industrial supply, both pipes having the same hydraulic gradient. Under a given grade the pipe discharge varies as the five-halves power of the diameter. If the cost of the pipe per linear foot is expressed in terms of the diameter, the difference in the cost of the two lines may be computed. For the distributing system, however, the relative and absolute amounts of water required for fire hydrant service on the one hand and for domestic and industrial uses on the other will vary in different parts of the city, and hence a general formula covering the entire system cannot be made, as each principal division of the network of pipes must be considered separately with reference to the particular drafts for fire hydrant and domestic purposes.

The results of the application of these principles to each of the three assumed conditions are given in Table I and Table II.

From the tabulation giving the actual quantities of water in gallons per minute, reported by the National Board of Fire Underwriters as "necessary for fire fighting purposes in excess of domestic consumption" for a list of 143 cities, the data given have been printed in diagram, Fig. 2, together with a curve prepared by the authors, as representing the general requirements of the National Board of Fire Underwriters, the equation for which is:

(13) $y = 1020\sqrt{X}\,(1\text{-}0.01\sqrt{X})$

and with Kuichling's old standard

(14) $y = 700\sqrt{X}$

in both of which equations $y =$ gallons per minute and $X =$ population in thousands.

In making comparison of the relative capacities required for domestic, industrial and public uses, *excluding* fire protection service, as compared with the former *including* fire protection service, the authors of this paper have assumed, first, that under the conditions *excluding* fire protection service, the pipe system must be designed to have a carrying capacity of *double the average daily rate* of water consumption, in order to meet the ordinary fluctuations in demand; second, that under the conditions *including* fire protection service, provision must be made for a maximum demand for water for domestic, industrial and public uses of 50 *per cent in excess*

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*"The Financial Management of Water Works." Trans. Am. Soc. C. E., Vol. XXXVIII, p. 15.

TABLE II. SHOWING THE RELATIVE DIAMETER OF THE SUPPLY MAIN REQUIRED FOR COMBINED DOMESTIC AND FIRE SERVICE, TO THE DIAMETER OF THE SUPPLY MAIN REQUIRED SOLELY FOR DOMESTIC SERVICE, INCLUDING IN THE TERM DOMESTIC SERVICE INDUSTRIAL AND PUBLIC USES, EXCLUDING PUBLIC HYDRANT SERVICES, BASED UPON KUICHLING FORMULA

Population	[illegible]	[illegible]	50,000	100,000	150,000	200,000	250,000	300,000
1. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2. [illegible] average daily rate therefor, in [illegible]	[illegible]	[illegible]	[illegible]	1.11	[illegible]	[illegible]	1.120	[illegible]
3. When maximum rate for domestic service is assumed to be twice the [illegible] plant furnishing only domestic service, and 1½ times the average daily rate therefore in the plant furnishing both domestic and fire [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Example: From this table it appears that in a city having a population of 100,000 the ratio of the diameter of the supply main required for combined domestic, industrial and public uses, as well as for fire hydrant service, to the diameter of the supply main which would serve the former uses only, excluding public fire hydrant service, is as 1.135 to 1.

Footnote: The authors have assumed in this paper that the third set of conditions is prob- [illegible] similar figures based upon the requirements of the National Board of Fire Underwriters.

[illegible] thereto, and in addition thereto for the requirements of fire protection service, as determined by the several standards outlined above.

In diagram, Fig. 3, is shown the per cent of carrying capacity of water works pipe systems, required for fire protection, based upon the standards cited for fire protection service, and three different average daily rates of consumption for domestic, industrial, and public [illegible] gals. per capital daily. Upon this diagram are shown two curves *A* based upon the Kuichling standard, and *B* based upon the National Board of Fire Underwriters requirements, and both based upon the assumption of a varying per capita consumption for domestic, industrial and public uses of water—of 50 gals. per capita daily for a city of 10,000 population, 80 gals. per capita daily for a city of 100,000 population, and 100 gals. per capita daily for a city of 300,000 population.

From curves *A* and *B* it will be seen that upon these assumptions, as to the carrying capacity of the pipe system, there is chargeable to fire protection service:

Cities having pouiation of	—Per cent [illegible] Kuichling standard	 Nat. Bd. of Fire Underwriters [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	74%	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	19
300,000	[illegible]	[illegible]

While it is believed that the minimum values shown on this curve are too low, particularly under the old Kuichling standard, the curve probably clearly indicates the general tendencies.

Water Consumption.—As bearing upon the question of water consumption, the following figures are of interest, the statistics relating to the United States having been worked up from the United States Census Bureau, Department of Commerce and Labor. Report upon "Statistics of Cities Having Population of Less Than 30,000 for the Year 1907." The figures for England, France and Germany were worked up from Debauve and Imbeaux's Distributions d'eau, Paris, 1905:

Country. (1)	No. cities. (2)	Range of population. (3)	Consumption in U. S. -Gals. per capita daily- Maximum. (4)	 Minimum (5)	 Average (6)
United States	[illegible]	300,000-4,225,000	344	76	164
United States	[illegible]	100,000- 300,000	230	51	111
United States	[illegible]	50,000- 100,000	301	40	116
United States	44	[illegible]	398	26	117
United States	[illegible]	30,000-4,225,000	398	26	121
England	[illegible]	46,000-6,305,000	83	18	38
France	11	19,000-2,714,000	273	7	54
Germany	[illegible]	9,100-1,884,000	[illegible]	[illegible]	[illegible]

Variation in Water Consumption.—As bearing upon the maximum demand for water, as compared with the average daily consumption throughout the year, Table III reprinted from the 32d Annual Report of the State Board of Health of Massachusetts, for the year 1900, is significant. It will be seen that the maximum weekly consumption rarely equals double the average weekly consumption for the entire year, while the maximum daily consumption is from two to four times the average daily consumption for the entire year. The minor fluctuations are, however, taken care of by the storage capacity of the reservoirs and the surplus pumping capacity in the case of direct pumping systems. It is believed, therefore, that the assumption made in our comparison, to-wit, that with a pipe system designed solely for domestic and industrial uses, the maximum demands should be assumed to be about double the average daily demand, is probably fair, for if the maximum demand should exceed double the average demand, it would at most mean that there would be some fall in the normal pressure under which the water was delivered, and not an actual failure to deliver the required volume of water. In the case of the large community, the ratio would probably be less than double, in other words, the maximum demand would probably be relatively less, as compared with the average demand, than in the smaller community, and this is one reason for modifying curve *A* in the diagram, Fig. 3, in its application to the larger communities.

Sub-Division of Cost of the Physical Plant of Water Works Properties.—In Table IV are shown data relating to the sub-division of the reproduction cost of the physical plant of water works properties, based upon estimates submitted in water works valuations, which have come within the experience, or under the observation of the authors. In Table V are shown similar data kindly furnished to the writers by Mr. John W. Alvord of Chicago; in Table VI data from Mr. Morris Knowles of Pittsburg; and in Table VII data based upon the published reports of the Railroad Commission of Wisconsin. These results are shown in diagrammatic form in Diagram, Fig. 4.

Resulting Estimate of Cost of Fire Protection Service.—Upon diagram, Fig. 4, have been plotted the data given in Tables IV to VI, relating to the percentage of the reproduction cost of the physical plant of water works systems, chargeable to the distribution pipe system, and curve *C* indicating the general average conditions; curves *A* and *B*, showing the percentage of the total carrying capacity of the pipe distribution system, required for fire protection service, replotted from diagram, Fig. 3; and curves *D* and *E* showing the resulting percentage of total cost of the distribution system of water works plants, chargeable to fire protection service, based upon curve *C*, and the requirements of the Kuichling and the National Board of Fire Underwriters' standards, respectively. It will be noted that curves *D* and *E* are based *solely upon distribution pipe system costs*, whereas the fire protection service may involve some slight additional cost in supply and reservoir systems, and substantial increase in cost of pumping capacity. The costs involved by these increased needs will be much more important in small plants than in large plants, except when independent high pressure fire protection systems are required.

Curve *X*, shown also in diagram, Fig. 5, the equation for which is

$$y = \frac{147}{x^{0.31}} - 12.1$$

in which y = per cent of total cost and x = population in thousands.

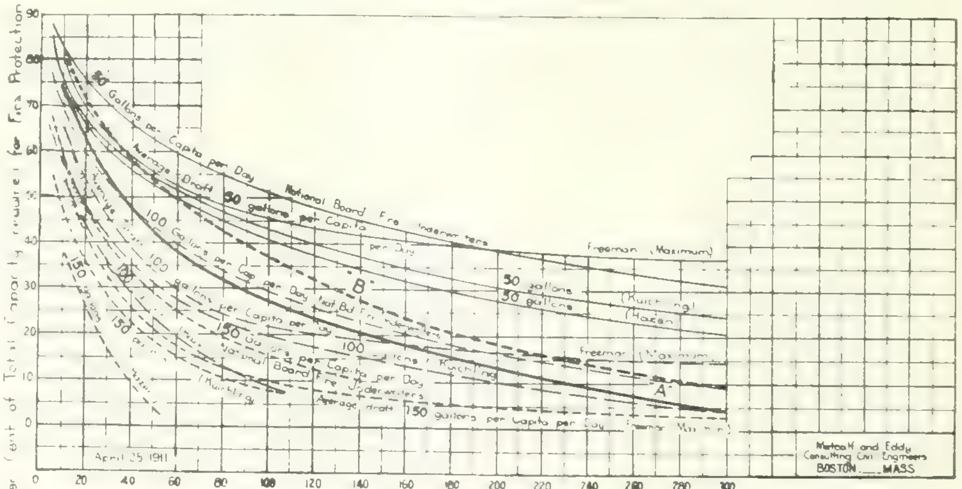

Fig. 3—Per cent of Total Carrying Capacity of Water Works Pipe Systems Required for Fire Protection.

represents the judgment of the authors as to the approximate percentage, of the total cost of water works, involved by the requirements of fire protection service, taking into consideration not only the distribution pipe system but also any additional cost involved in the water supply and reservoir systems, pumping capacity, etc., and the limitations of the assumptions made above as to per capita consumption and fluctuations in rate of water consumption in cities of different sizes. Attention is again called to the fact that these studies are of comparative value only, as indicating general tendencies and that substantial departure from normal conditions, as outlined, is to be anticipated in individual plants, so that if reliable information is desired concerning any particular plant the studies should be based upon the actual conditions existing at that plant. For comparative purposes, however, the curve is suggestive. The data shown by these curves are also given in tabular form below:

Population	Cost of distribution system [illegible] Curve C	Per cent of cost of distribution system chargeable to fire protection service [illegible] Curve D	Curve [illegible]	Curve X
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10,000	[illegible]	[illegible]	[illegible]	[illegible]
50,000	[illegible]	[illegible]	[illegible]	[illegible]
100,000	[illegible]	[illegible]	[illegible]	[illegible]
200,000	[illegible]	[illegible]	[illegible]	[illegible]

It is evident that the relative cost of the portion of the plant devoted to public fire protection service is greater in small cities than in large ones, and greater also in purely residential cities than in manufacturing cities.

Thus the conditions recently analyzed by the writers in a plant serving a manufacturing city of approximately 100,000 population showed the following approximate subdivision of reproduction cost:

Domestic service	[illegible]
Industrial service	[illegible]
Public fire protection	[illegible]

But it should be added that the relative capacity of pipe system required by the different classes of service was estimated as follows:

Domestic service	[illegible]
Industrial service	31%
Fire [illegible]	[illegible]

Had the demands for industrial service been substantially less—as would have been the case in a residential city—the relative cost of the public fire protection [illegible] have been substantially increased.

TABLE IV.—[illegible] DIVISION OF COST OF WATER WORKS PROPERTIES IN PER CENT OF REPRODUCTION COST OF PROPERTY.

(Including [illegible] engineering and contingencies, organization [illegible] interest during construction, exclusive of [illegible] value, franchise and other intangible values.)
Based [illegible] L. M[illegible]

City	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Population	[illegible]	100,000	[illegible]	[illegible]	[illegible]	17,000	11,600	3,100	[illegible]
	[illegible]	(2)	[illegible]	(4)	[illegible]	[illegible]	[illegible]	[illegible] gravity.	[illegible]
1 Supply	[illegible]		3.1%	13.5%	[illegible]				
2 Pumping			[illegible]	[illegible]	8.5	[illegible]			
3 Reservoir		[illegible]	2.0			[illegible]			
4 Distribution system	[illegible]	[illegible]	[illegible]	[illegible]		70.1		[illegible]	
5 Filtration	[illegible]			[illegible]	4.6				
6 Real estate [illegible]	[illegible]	1.5	[illegible]	7.8	[illegible]	8.7			
7 Organization	[illegible]	0.9	[illegible]						
8 Interest during construction	[illegible]	[illegible]		2.8	[illegible]	[illegible]			
	[illegible]	100.0%	100.0%	[illegible]	[illegible]	100.0%		[illegible]	[illegible]

*[illegible] connections and meters.
†[illegible]
[illegible] engineering [illegible] contingencies, etc.
‡Nearly 10%.
§[illegible]

TABLE III.—RELATION OF THE CONSUMPTION OF WATER DURING THE MONTH, WEEK AND DAY OF MAXIMUM CONSUMPTION TO THE AVERAGE FOR THE YEAR. AVERAGE OF SIX YEARS FROM 189[illegible] TO 19[illegible] INCLUSIVE.

City or Town	Average daily [illegible]	Maximum Monthly Consumption: Gals. per [illegible]	Maximum Monthly Consumption: Per [illegible] for Year	Maximum Weekly Consumption: Gals. per [illegible] per day	Maximum Weekly Consumption: Per [illegible]	Maximum Daily Consumption: Gals. per [illegible]	Maximum Daily Consumption: Per [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B[illegible] & E. B[illegible]water	[illegible]	[illegible]	116	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Brookline	85	105	124	146	160	167	184
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Canton	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cohasset	34	62	177	62	250	95	340
Cottage City	93	251	271	296	318	383	419
[illegible]	[illegible]	[illegible]	119	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Franklin	35	47	136	72	206	82	245
Gardner	62	77	125	86	128	113	169
Gloucester	32	41	129	47	142	64	193
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lowell	79	92	117	102	130	118	150
Lynn and Saugus	67	78	116	84	125	118	177
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	79	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Methuen	33	42	126	51	151	80	217
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	111	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	114	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. Brookfield	35	45	134	62	184	103	308
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Peabody	89	102	114	113	127	139	155
Provincetown	29	52	187	67	224	127	480
Randolph and Holbrook	45	72	161	96	226	131	306
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rockport	34	53	151	73	194	89	266
Salem	67	77	114	80	119	119	178
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Stoughton	43	52	122	59	146	77	192
Taunton	46	53	116	58	127	67	147
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wakefield and Stoneham	53	66	124	57	127	102	182
Walpole*	30	40	136	61	188	91	328
Waltham*	76	84	115	99	135	134	188
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Webster	34	39	117	42	125	59	175
Wellesley	42	54	130	66	157	82	236
Whitman	29	42	149	54	188	66	231
Woburn	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Worcester	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Five years only. †Less than six years.

[illegible] The cost of installing extra hydrants will vary with the different conditions under which the work has to be prosecuted. Upon the large mains, particularly those in the heart of the city, the connection is likely to be made through the agency of a Smith tapping machine, without interruption of the service, placing a valve upon the hydrant branch. In the city not only will various obstructions be encountered but the paving of the streets will add substantially to the cost of the work. In the outlying residential districts, particularly where the hydrants are inserted on small mains such as 6-in. pipe, gates may be omitted from the hydrant branches and little or no paving may be encountered in the work. The general range of probable costs of cutting in hydrants may [illegible] per hydrant, as follows:

Item.	24-in.	12-in.	6-in.
Excavation and backfilling	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	
Smith's sleeve, valve and box	62- 62	31	
Labor, lead and yarn	8- 10	5	$ 7*
[illegible]	[illegible]	[illegible]	
C. I. pipe, 20 ft. 6 in. and [illegible]	[illegible]		
Total	[illegible]	[illegible]	[illegible]

*Cutting in special [illegible]

[illegible]

[illegible] Larges Cities.—One of the factors tending to increase the cost of the portion of the water works plant chargeable to fire protection service in our largest cities, is to be found in the demand for a separate piping system devoted solely to the furnishing of water for hydrant service, not only in large volume but under much greater pressure than that which can be furnished ordinarily through the domestic piping system. This growth in demand is the outcome of higher insurance standards brought about indirectly by the disastrous losses entailed by some of the terrible conflagrations which have been suffered by a number of our American cities, such for instance as the Chicago fire, the Boston fire, the Baltimore fire, and the San Francisco fire, and by the admirable studies of and resulting recommendations concerning the water supply and fire fighting facilities of our larger American cities, made by the National Board of Fire Underwriters within the past five years. The effect of the building of skyscrapers should also not be lost sight of. Unfortunately the requirements of the building code as to the use of fireproof or slow burning construction, have not kept pace with building construction, and the problem has unfortunately been approached rather from the point of putting out the fire than of substantially reducing if not preventing the possibility of its development.

[illegible] Protection Service.—The data relating to the op-

erating and maintenance charges, involved in the fire protection service are meager. It is believed that these charges lie between 5 and 10 per cent of the total annual operation and maintenance charges, including taxes but excluding depreciation, interest and profit allowances.

If we assume the gross income [illegible] works to be 15 per cent per annum of the value of the works, and the portion of the gross income chargeable to hydrant protection service, to be 10 per cent, we should have an annual cost of operation and maintenance, including taxes, in terms of the value of the property, amounting to approximately 1.5 per cent, while for large works we might assume for the corresponding figures 6 per cent x 10 per cent = 0.6 per cent. In other words, the range of operating charges would seem to lie between 1½ per cent and ½ per cent of the value of the property, depending upon the size of the community. While these limits will undoubtedly be exceeded in individual cases, these estimates will perhaps serve for a general analysis of the problem. The limited amount of data upon which the above figures are predicated, however, must be clearly borne in mind. For depreciation, interest, and profit allowances we might assume approximately

Depreciation	[illegible]	to	[illegible]
Interest ...	[illegible]	to	[illegible]
Profit	[illegible]	to	[illegible]
Total	[illegible]	to	[illegible]

or say 8 per cent of the value of the portion of the system involved by fire protection service.

Applying these figures or assumptions to the general range of per capita values of water works, Table VIII results:

It is perhaps fair to infer, in default of more exact information that the *average cost of the hydrant service may be approximately* $1 *per capita, with variations of about 10 per cent, more or less*, though every plant must be examined individually as the range of variation is obviously a large one. Few works receive an aggregate hydrant rental approaching this amount; which is but another ground for the authors' contention that hydrant rentals rarely bear any relation to the cost of the service, usually being "traded out" as an offset to franchise and other business considerations.

Need of Inquiring Into Number of Hydrant Nozzles.—Attention is called to the need of inquiring into the number of hydrant nozzles as well as the number of hydrants attached to the distribution pipe system. Point is given to this fact in the excellent tabulation, now unfortunately out of date, made by Mr. Dexter Brackett, Chief Engineer, Metropolitan Water and Sewerage Commission, of the number of hydrants and fire reservoirs in use in different cities, together with the total number of hydrant nozzles and hose connections per mile of pipe in different cities in the United States (17th Annual Report of the Boston Water Board, Jan. 31, 1893). In this it appears, for instance, that while Chicago had 9.9 hydrants per mile of distribution system, as against 11.5 in Boston, the number of hose connections per mile of pipe was but 19.4 as against 35.8 in Boston.

Value of Fire Protection Service.—It is exceedingly difficult, if not impossible, to get accurate information concerning the amount of insurance risks carried and premiums paid in any community, from which their relation to the assessed valuation can be determined. It is doubtful if insurance men even have comprehensive figures of this sort, and it may at least be said that the writers have been informed by insurance men that they neither had such data nor knew where they could be obtained.

(The authors present certain available partial data bearing upon the questions stated which, because of its length and rather special interest, we omit giving only their conclusions.—Editors.)

The Massachusetts records indicate that the ratio of fire insurance premiums covering both buildings and contents, to the assessed valuation of buildings alone, is approximately 1.22 per cent and that the premiums written average approximately $5,400 per 1,000 of population, or $5.40 per capita annually; the New York records indicate an average of $4.90 per capita.

The writers are advised by insurance men who have been consulted, that the introduction of a water works system into a community will effect a saving *to the insured* of at least 25 per cent to 33 per cent in his insurance rate upon buildings and contents. Or in other words, that the rate of $1.25 per $100 of insurance would be reduced to at least $1 and a

TABLE [illegible] SUBDIVISION OF COST OF WATER WORKS PROPERTIES IN PER CENT OF REPRODUCTION COST OF PROPERTY.

(Including therein engineering and contingencies, organization and interest during construc[illegible] going value and franchise and other intangible values.)

(Courtesy of Mr. Morris Knowles.)

	Greater City. All divisions combined	Pittsburgh proper	Allegheny, or North Side	South Side, or former Monongahela W. Co.
[illegible]	540,372	301,919	132,283	106,170
[illegible]	(28)	(29)	(30)	(31)
[illegible]	0.3	....	1.5	1.2
Distribution system	18.7	14.2	30.6	[illegible]
Filter, etc.	8.5	11.0	1.5	[illegible]
Real estate, water rights and rights of way	36.8	34.8	38.5	49.6
Organization	29.6	36.8	13.5	19.4
Construction	6.1	3.2	14.4	2.4
	100.0%	100.0%	100.0%	100.0%

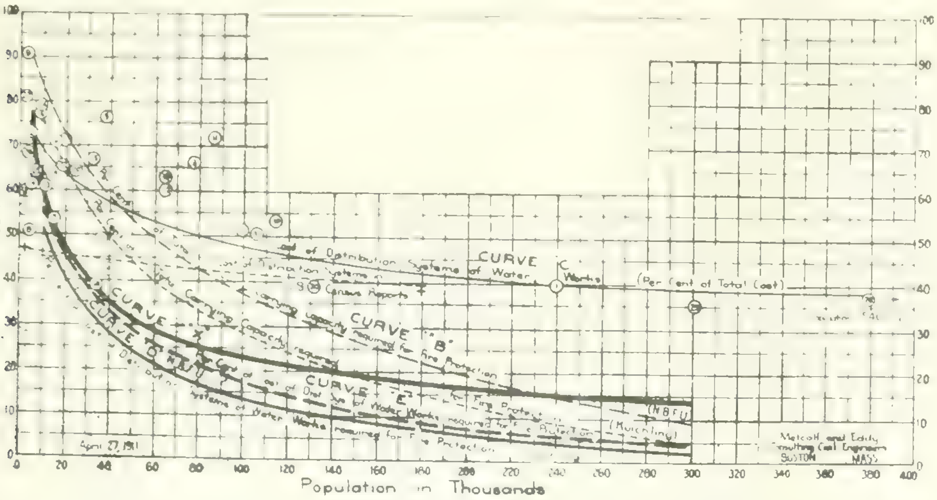

Fig. 4—Estimated Per Cent of the Total Capacity of Pipe Lines Required for Fire Protection and Estimated Per Cent Which Cost of Distribution System and of Fire Protection Service Are of the Total Cost of Water Works.

TABLE V.—SUBDIVISION OF COST OF WATER WORKS PROPERTIES IN PER CENT OF REPRODUCTION COST OF PROPERTY.

(Including therein engineering and contingencies, organization and interest during construction; excluding going value and franchise and other intangible values.)

(Courtesy of Mr. J. W. Alvord.)

Location	[illegible]	[illegible]	Peoria, Ill.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] Mich.	Middle West State	Miss. River State
Population	[illegible]	[illegible]	65,865	36,809	35,099	33,608	9,000	707†	8,420†	4,102
	[illegible]	[illegible]	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1. Supply	[illegible]	7.3	8.4		[illegible]		7.6	16.7	.....	.....
2. Pumping	11.0	[illegible]	11.4	51.3	[illegible]	31.9	11.8	28.4	29.7	[illegible]
3. Reservoirs					....				9.1	.....
4. Distribution system	[illegible]	71.1	59.1	48.7	[illegible]	66.2	76.5	54.9	61.2	60.6
5. Filters, etc.				......	...	....				
6. Real estate, [illegible]		[illegible]	9.6**	....	[illegible]	1.9	[illegible]**	...	......	......
7. Organization								.	......	......
8. Interest during construction	3.7	8.7	7.9				3.3		.....	.....
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Includes meter [illegible].
**Interest during construction on this item.
*Includes filters.
Included in general [illegible] engineering, [illegible] preliminary costs, etc.
†1900.

rate of $1 to approximately 75 cts., by the introduction of a system of reasonably efficient water works. Furthermore, it is asserted that the saving *to the insurance company* by such introduction of water works is undoubtedly much greater than the reduction in premium allowed to the insured cited above.

It is also stated that with the stock fire insurance companies in New England, the prevailing average insurance rates in cities having a good water supply increase from ¼ to ⅓ per cent when the distance between hydrants is greater than 500 ft.; that upon factory property, the increase is ½, more or less, and upon mercantile property, it may be two or three-fold.

Reduced to its simplest terms, this would seem to mean that in Massachusetts where the premiums amount to approximately $5,400 per 1,000 of population, and the total premiums in force may amount to a considerably great sum, the following per capita savings might result from the stated reduction in insurance rates:

[illegible]	[illegible]
20%	$1.08
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible] Hydrants.—In Table IX, reproduced through the courtesy of the Indianapolis Water Company, is shown the approximate number of feet of water pipe per hydrant in different cities in the United States, the average being 555 ft. excluding Indianapolis, or 558 ft. including Indianapolis. The latter corresponds to approximately 9.5 of hydrants per mile of pipe line.

Broadly speaking, it may be said that the tendency at the present time is to reduce the hydrant interval, or increase the number of hydrants per mile, in the interest of decreasing the amount of hose required and correspondingly increasing the efficiency of the fire protection service.

[illegible]

1. Public fire hydrant service in the United States is usually paid for upon the basis of an annual rental for each hydrant.

2. These hydrant rentals rarely bear any relation to the cost or the value of the service rendered.

3. They have heretofore usually been determined by average prices paid in the state or surrounding district, in the case of the larger communities, and by the requirement of meeting the interest charges upon the plant investment, in small ones.

4. The range of hydrant rentals paid in the United States is in general from $100 per hydrant per year to a nominal sum of $10 more or less. The average hydrant rental is probably in the neighborhood of $40.

5. Statistics obtained from 76 American cities supplied by water companies, out of 140 circulars sent, indicate that there has been no substantial decrease in hydrant rentals in the last 30 years, the substantial reductions occurring in only about one-third of the cities from which replies were received. The data upon this subject are, however, not sufficiently complete to make general characterization safe.

6. The number of hydrants per mile of distribution pipe system and the corresponding average amount of distribution pipe system per hydrant in 63 different cities in the United States, is shown in Table IX.

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

The general tendency is to reduce the hydrant interval and this is desirable. No hard and fast rule can, however, be laid down for the proper hydrant interval, local considerations, value of property, character of fire risks, water supply as to the size of mains and quantity and pressure of water available, danger of interruption of service, cost, etc., must control. A better basis for the consideration of the adequacy of the hydrant installation is perhaps to be had in a study of the area to be served by each hydrant in different parts of the city, the general range of values, under the best modern standards of service, being from 1 acre, in the mercantile and manufacturing districts of highest value, to 3 acres, more or less, per hydrant in the well built-up residential districts. From an insurance point of view, however, the individual districts should be studied with reference to the number of fire streams which can be massed upon them effectively.

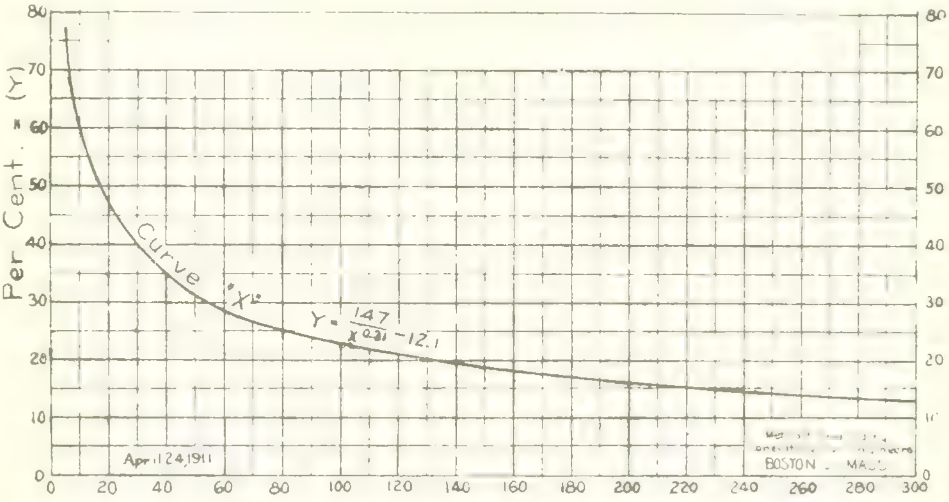

Fig. 5—Estimated Portion of the Total Cost of Water Works Necessitated by Fire Protection Requirements.

7. The additional cost of installing extra hydrants upon existing mains probably ranges from $50 to $150 per hydrant, the former corresponding to the outlying residential districts with unpaved streets, the latter to conditions existing in the heart of the city where the mains are large. The cost of installing hydrants at the time of building pipe lines is, of course, substantially less.

8. The cost of a modern steam fire engine of the sizes ordinarily used is $5,000 to $5,500. The cost per year of maintenance of a fire engine company including the attending hose company over that of a hose company of corresponding strength, is about $4,000, including operation, maintenance, depreciation, and interstate charges. The per capita annual maintenance cost is approximately $1.50 to $2.00, exclusive of the interest charges. The fire engines have been found, recently, to deliver, under average conditions in test, approximately 88 per cent of their rated capacity, the range in individual cases being from well

[illegible]

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Population	[illegible]	[illegible]	18,900	11,594	8,700 (24)	7,000	[illegible]500	[illegible] (27)	[illegible] (25a)	2,900
1. S[illegible]	[illegible]		5.2	16.4	3.8	[illegible]	[illegible]	1.6	4.8	12.3
2. Pumping*	[illegible]		21.1	10.3	11.3	10.9	14.0	11.3	15.3	21.0
3. Reservoir	[illegible]		5.1		5.9	[illegible]	[illegible]	6.0	6.7	[illegible]
4. Distribution system	[illegible]	[illegible]	65.7	60.0	78.9	63.6	[illegible]	[illegible]	[illegible]	59.1
5. Filters, etc.				12.0						
6. Real estate, water rights and rights of way..	9.3	1.8	[illegible]	1.3	0.1	8.9	[illegible]	0.4	[illegible]	0.9
7. Organization	**	**	**		**	**	[illegible]			[illegible]
8. Interest during construction	[illegible]		**		**	3.0	[illegible]	[illegible]	[illegible]	[illegible]
	100.0%	100.0%	[illegible]	100.0%	100.0%	10[illegible]	[illegible]	100.0%	100.0%	100.0%

†1905.

*Pumping includes buildings and miscellaneous structures.

°Includes office furniture, tools, horses and wagons, etc. Non-operative property not included.

**Included in general per cent engineering and contingencies, etc.

TABLE VIII.—ESTIMATED APPROXIMATE PER CAPITA COST OF PUBLIC FIRE HYDRANT SERVICE

Item (1)	Towns of 5,000 population (2)	Cities of 50,000 population (3)	Largest cities (4)
1. Value per capita of water works	[illegible]	$30.00	[illegible]
2. [illegible] of such value chargeable to public fire hydrant [illegible]	[illegible]	[illegible]	[illegible]
3. The approximate value [illegible] hydrant service	[illegible]	$ 9.60	[illegible]
4. Operation and maintenance charges, approximately 10% × [illegible]	$ 0.[illegible]	$ 0.28	$ 0.21
5. Annual charges [illegible] service covering depreciation and interest [illegible] of item 3	$ 1.2[illegible]	$ 0.77	$ 0.4[illegible]
6. Total annual charges per capita	$ 1.[illegible]	$ 1.05	$ 0.6[illegible]

[illegible] 80 per cent to less than 50 per cent of the rated capacity. But it is probably safe to say that under actual conditions prevailing during a large fire or conflagration, not more than 75 per cent of the above stated working capacity or two-thirds of the rated capacity, is developed.

9. The danger from serious conflagrations, such as the Boston, Chicago, Baltimore and San Francisco fires; property and business loss resulting from them, the hazard involved in having so many services of different character, such as domestic and industrial uses, elevators, fire sprinklers, flushing devices, water motors, etc., upon the same main from which the fire hydrants draft their supply, and greater danger of interruption in service for changes in, and repairs upon them; the construction of buildings covering great areas and reaching to great heights, requiring very heavy water pressures; the relatively greater cost of maintaining steam fire engines to do the same work—have led to the introduction of independent high pressure fire protection systems in our largest American cities, having one or more independent sources of water supply readily available at very short notice, in very large quantities and under pressures up to 200 or 300 pounds per square inch.

10. Hydrant rentals, or the demand for public fire protection service, may well be examined from five points of view:

(a) The cost of the service,
(b) The value of the service,
(c) The number of hydrants per mile of pipe and the distance between them, and area served.
(d) The rate of taxation corresponding to the amount paid for public hydrant service.
(e) The relative cost of other forms of public service, such as lighting and police.

11. The cost of the portion of the water works plant involved by fire hydrant service, probably constitutes from 60 to 80 per cent of the entire cost of the physical property in the case of communities having less than 5,000 population, 20 to 30 per cent in communities of 100,000 population more or less, and 10 to 20 per cent more or less in the case of our largest cities. The approximate annual cost of fire hydrant service is estimated at $1 per capita, with variations of 40 per cent more or less in different communities, being perhaps from 60 to 75 cts. in our largest cities, $1 in average cities, $1.25 to $1.75 in our small well served towns and cities. These per capita costs of fire hydrant service amount to about $55 per hydrant based upon present practice as to number of hydrants per thousand of population (ranging from 11 to 23 in cities of from above 300,000 population to 30,000 population, and per mile of pipe, ranging from 10.6 to 12.1 in cities of the size first stated.

12. Data as to the value of fire protection service are very meager. It is believed that a reduction in insurance premiums of from 25 to 50 per cent results with the introduction of a good water works system, and that the actual saving is much greater, as based upon the returns made by the Insurance Commissioners in the State of Massachusetts. The saving probably ranges from $1.35 to $3.

13. The cost of public fire protection service is generally much smaller than that of police and public safety, and public lighting service.

14. The most common method of paying for public fire hydrant service in the United States seems to be by annual rental per hydrant, coupled with the requirement that one additional hydrant shall be ordered in the case of extension of the pipe system, for every 600 ft. more or less of such extension.

15. Improvement is suggested along the following lines. Let it be provided that:

(a) At stated intervals of say ten years or more, the annual cost of hydrant or fire protection service as then rendered, including in such cost, operation and maintenance charges incurred by the fire hydrant service, and depreciation, interest and profit allowances upon the value of that portion of the water works property necessitated by, or chargeable to it shall be determined. In the latter, allowance for the so-called intangible values, should probably be included in many, if not in all cases. This work should be done by an expert, or board of experts in water works practice, acting in a purely judicial capacity, regardless of the method of appointment.

(b) Additional hydrants may be placed upon the existing water mains, subject to the approval of the water company, or other competent authority, provided an annual rental be paid for each such additional hydrant, which rental will cover the agreed estimated maintenance and depreciation costs, and interest charges involved by the estimated average cost (or varying cost upon a sliding scale covering different conditions, such as size of main, character of excavation, street surface, etc.) of making such installation.

(c) The basic amount paid for hydrant rental be increased annually to cover extensions of pipe system made during the year (upon which extensions hydrants may be placed at an agreed interval of spacing) pro rata in the relation of the extension to the length of the pipe system at the time of the review of the hydrant rental question, or in the ratio of the relative assessed valuations of property as of those dates, or in the ratio of the populations as of those dates, if the latter can be accurately determined, which is not usually the case. If additional hydrants be desired in excess of the agreed number per

TABLE IX.—NUMBER OF FEET OF PIPE TO EACH FIRE HYDRANT IN VARIOUS CITIES OF THE UNITED STATES.

(By courtesy of the Indianapolis Water Co., 1909.)

City	Population according to government estimate of 1906.	Mileage of mains	Number of fire hydrants	Number of feet of pipe to fire hydrants
Denver, Colo	151,920	500	3,200	790
Wilmington, Del	85,140	119	882	710
Atlanta, Ga	104,984	180	1,668	570
Augusta, Ga	43,125	60	750	[illegible]
Savannah, Ga	68,596	67	663	540
Aurora, Ill	26,823	59	499	620
Chicago, Ill	2,049,185	2,073	21,183	516
Decatur, Ill	24,727	[illegible]	[illegible]	511
Peoria, Ill	66,365	100	1,200	440
Terre Haute, Ind	[illegible]	70	928	398
Burlington, Iowa	[illegible]	32	335	[illegible]
Davenport, Iowa	40,706	[illegible]	668	590
Des Moines, Iowa	[illegible]	130	1,400	490
Kansas City, Kan	77,912	58	464	660
Paducah, Ky	30,329	36	424	448
Orange, N. J	26,493	40	400	528
Paterson, N. J	112,801	125	1,337	493
Auburn, N. Y	32,963	70	600	616
Binghamton, N. Y	[illegible]	80	800	566
Buffalo, N. Y	381,819	516	4,891	557
Gloversville, N. Y	18,624	33	289	603
Rochester, N. Y	185,703	[illegible]	3,500	490
Schenectady, N. Y	61,919	176	2,769	299
Troy, N. Y	[illegible]	104	1,024	536
Yonkers, N. Y	[illegible]	103	1,111	490
Cleveland, O	460,327	676	7,966	448
Columbus, O	145,414	210	1,740	[illegible]
Dayton, O	100,799	152	1,527	525
Hamilton, O	27,670	43	425	534
Toledo, O	[illegible]	215	1,650	688
Allegheny, Pa	145,240	200	1,789	590
Philadelphia, Pa	[illegible]	1,500	14,311	[illegible]
Pittsburg, Pa	[illegible]	402	[illegible]	565
Reading, Pa	91,141	[illegible]	909	633
Boston, Mass	602,278	743	7,772	505
Fall River, Mass	105,942	101	1,153	462
Cambridge, Mass	[illegible]	128	1,046	646
Holyoke, Mass	[illegible]	82	659	657
Lowell, Mass	95,173	140	1,271	581
Lynn, Mass	78,743	138	825	883
New Bedford, Mass	76,746	106	1,105	508
Somerville, Mass	[illegible]	91	1,018	472
Springfield, Mass	75,836	156	1,174	701
Taunton, Mass	30,953	[illegible]	877	[illegible]
Detroit, Mich	353,535	709	4,752	790
Grand Rapids, Mich	99,794	165	1,547	[illegible]
Jackson, Mich	25,360	72	600	633
Minneapolis, Minn	273,825	342	3,893	[illegible]
St. Paul, Minn	203,815	285	2,658	566
Kansas City, Mo	182,376	342	4,024	448
St. Joseph, Mo	118,004	115	895	678
St. Louis, Mo	649,320	813	9,298	[illegible]
Lincoln, Neb	48,232	67	568	623
Omaha, Neb	[illegible]	[illegible]	1,991	[illegible]
Atlantic City, N. J	[illegible]	65	[illegible]	[illegible]
Jersey City, N. J	237,952	224	2,331	508
Woonsocket, R. I	32,994	53	624	[illegible]
Charleston, S. C	56,317	59	605	515
Nashville, Tenn	84,703	110	931	624
Dallas, Texas	52,793	100	800	660
Galveston, Texas	34,355	[illegible]	460	[illegible]
Ft. Worth, Texas	[illegible]	85	876	510
Average of 62 cities	174,355	231	2,257	[illegible]
Indianapolis	[illegible]	293	2,294	674
Average of 63 cities	175,046	232	2,258	[illegible]

mile of pipe on [illegible], the [illegible] stalled upon the [illegible] outlined above [illegible]

In this manner, it should be possible to adjust the hydrant rental annually, without serious issue and the community will more nearly bear its just share of the burden, divided between the public, and private, and industrial consumers, than under the present method.

16. The offsetting [illegible] franchise, by free or reduced [illegible] service, is believed to be undesirable. If the community [illegible] franchise or other intangible property, it should be made quite independently of the hydrant rental, or fire protection service payment. The company, and the city, are both entitled to know just what [illegible] placed in a position to seek legal redress, in case of injustice or inequitable proceedings. The desirability, or undesirability of franchise [illegible]

17. In conclusion, the writers desire to call particular attention to the admirable reports which have been published by the National Board of Fire Underwriters upon the water works and fire departments of the leading cities of the United States, in [illegible] tained not only many significant and valuable facts, but suggestions of in [illegible]

DRAINAGE AND IRRIGATION SECTION

Specifications for Open Drainage Ditches, Drain Tile and Tile Drainage Ditching.

Published specifications for open and tile drainage ditches are not readily available. Engineers unfamiliar with such work will therefore be interested in the two examples which we present here. One of these specifications is for tile drain work and the other is for open drain work. Both are furnished by S. F. Moeller, Civil Engineer, of Knierin, Iowa.

SPECIFICATIONS FOR TILE DRAINS.

Tile. [illegible] He shall also furnish the necessary amount of [illegible]

[illegible] ment will be made upon the measurement of [illegible] the trench line.

[illegible] the entire thickness of the pipe for more than 3 ins. in length and but one of such cracks will [illegible] tion or handling will be cause for rejection. [illegible] objected to.

[illegible] Portland cement and clean sand and fine gravel in proportions of not less than 1 part cement [illegible]

The gravel used shall contain no pebbles [illegible] terial shall be thoroughly mixed by a mechanical mixer and shall be rammed into molds before setting begins. The mixture shall be [illegible]

The pipe as delivered to the drain shall be well seasoned and set, at least three months in [illegible] ring when struck with a light hammer.

The contractor shall furnish such junctions as [illegible] junction for every 100 ft. of pipe and to be paid for at the price named in his bid for same. All cracked tile and tile having variation of over 20 per cent in thickness of the shell shall be rejected.

Trenching.—The party contracting for the construction of the drain shall make his bid at a certain price per foot deep and 100 ft. in length for the trenching, which shall include excavating of trench, laying pipe or tile to grade as given by the engineer in charge or his deputy. He shall also name a separate price for each manhole and each retaining wall. Such manholes and retaining walls shall be built in accordance with plans. The price bid for such manholes and retaining walls shall include the furnishing of all necessary material and labor properly to construct said manholes and retaining walls.

In the construction of drains the contractor shall make straight portions of the drain reasonably straight and curved portions with a uniform curve.

He shall fit the pieces of tile together and whenever an opening of more than 1/4 in. is left it shall be covered with suitable pieces of broken tile (which pieces of broken tile shall be furnished by the parties furnishing the tile for this drain). He shall cull out such pieces of tile which will not join up well or which are not reasonably circular. Wherever sand or very soft material is encountered in excavating trenches which is liable to enter the joints of the tile, the contractor shall furnish hay and straw and use the same to pack or cover the joints of the tile before any covering of earth is placed over the tile. The contractor shall lay all specials, junctions or branch connection tile without extra charge.

Wherever old tile are encountered in constructing this drain the contractor shall remove the old tile with as little damage thereto as possible and leave them along the side of the new trench at a sufficient distance so they will not be in the way of refilling the trench.

Wherever work is being done through crops care shall be exercised to do as little harm to the crops as possible. Whenever the drain is being constructed across any portion of public road the contractor shall erect and maintain a sufficient barrier and display red lights at night and no public road shall be closed to the [illegible]

The contractor shall be held responsible for [illegible] cations will not relieve him from repairing or removing deficient work at any time before final settlement is made.

[illegible] same without extra compensation.

SPECIFICATIONS [illegible] CALHOUN [illegible] WEBSTER [illegible]

Items. [illegible] covered by these specifications are those required for the entire completion of ditch or drain No. 12 of Calhoun County and No. 21 of Webster County, Iowa, as shown by the maps and profiles prepared by S. F. Moller, Engineer, and on file in the office of County Auditors of the said Calhoun and Webster Counties, Iowa.

E[illegible] said ditch or drain shall be furnished or done by the contractor whether especially mentioned or not.

(1) The excavation of a ditch 11.66 miles in length with the bottom width varying from 1 ft. at the source to 21 ft. at the outlet and depths of cutting from 2 ft. (near the outlet) to 10 ft., containing about 300,000 cu. yds. of material.

(2) The removing of all fences, bridges, trees and other obstacles that may be encountered on or near the line of the ditch.

Application.—These general specifications shall apply to all items of workmanship and material enumerated above or hereinafter mentioned.

Definition of Terms.—Wherever in these specifications the word "Auditor" is used, it shall be understood to mean the duly elected and qualified Auditors of Calhoun and Webster Counties, Iowa; wherever the word "District" is used, in these specifications, it shall be understood to mean the drainage district No. 12 of Calhoun, and No. 21, of Webster Counties, Iowa; wherever the word "Engineer" is used in these specifications, it shall be understood to mean the person appointed by the Boards of Supervisors of Calhoun and Webster Counties, Iowa, to supervise the construction of the drainage ditch for the district or his duly authorized assistant. Wherever the word "Contractor" is used in these specifications it shall be understood to mean the person or persons, firm, company, [illegible] or any part of the work of construction of said ditch or drain.

Bids.—All bids must be enclosed in sealed envelopes addressed to the auditors of the respective counties at Rockwell City, Iowa, or Fort Dodge, Iowa. Each bid shall be accompanied by a certified check to the amount of 10 per cent of the bid, made payable to the order of the Boards of Supervisors of Calhoun and Webster Counties [illegible]

Certified Check and Bond. The certified check of the successful bidder or bidders shall be retained until he or they shall have furnished a good and sufficient bond to the Boards of Supervisors of the respective counties, approximately in the amount of 25 per cent of the estimate cost of the work so let and shall have signed a contract to execute the work in accordance with these specifications, when the certified check will be returned. All other [illegible]

Time.—The contractor to whom all or any [illegible] is let shall commence work on the same by [illegible]

[illegible] form his work in a skillful and workmanlike manner and follow the instructions of the engineer in such matters of detail as may arise from time to time or are not herein set forth. (2) He will preserve the stakes and reference points of the survey until permitted by the engineer to remove them. (3) He will remove all earth or other materials excavated from the ditch to a distance not less than 8 ft. from the [illegible] along side the ditch, where the quantity of material excavated from the ditch is so great that it is likely to fall back from the dump or spoil bank upon said berm, after the work shall have progressed beyond such point, the contractor shall spread out such sump or spoil bank sufficiently to prevent it from so falling back. (4) Where a dredge or other machinery is used in the construction of this ditch it shall be so designed and operated that the braces or anchors will not cut up the berm of the ditch. All clinging sods along the edge of the ditch shall be cut away clean and removed. (5) The grade and slope of the ditch shall be cut in a reasonably smooth and uniform manner, the contractor will be required to cut fully to the depth and width shown in the plans and profile and as marked out by stakes hereinafter to be set. He will not leave excrescence or humps or gouge out holes in the bottom or slope of the ditch, but shall construct the ditch closely in accordance with the plans, profile and instructions of the engineer. (6) The contractor shall without extra charge make and leave such openings through the spoil bank as are required for the admission of water from adjoining lands at all places designated by the engineer. (7) The contractor will be required without extra charge or compensation to remove all fences, bridges, trees and other obstacles encountered upon the line of work or within the limit of the dump except on the lines between the ne. ¼ and the se. ¼ of Sec. 28, T. 89, N. R. 31, W. S. P. M., for which separate price or bid will be received for grubbing. He shall remove the same to a safe place outside the dump and carefully pile up the material, doing no more damage thereto than is unavoidable. He shall before removing any bridge upon the public road notify the clerk of the township at least 10 days in advance that he is about to remove the same. After he has removed any such bridge he shall erect an efficient barrier and exhibit red lights at night at all such places where bridges have been removed, which lights and barriers shall be maintained for ten days after completion of the ditch through such point unless the bridge be sooner restored. (8) Any work found to be deficiently executed or which may have become filled up during the progress of the work or which at the time of acceptance by the engineer is found to be imperfectly done, shall upon notice from the engineer be promptly remedied by said contractor and if the same is not properly done within a reasonable time payment therefore will be withheld. No extra compensation will be paid for any work performed upon the part of the contractor except upon the written order of the Board of Supervisors or engineer. (9) No variation from and at which the work is let will be made whether the material encountered in the excavation be hard or soft or whether boulders, ordinary clay, muck, sand or whatsoever the material required to be excavated and removed from said ditch. (10) No extra compensation will be paid the contractor by reason of hindrance or delays from any cause whatever during the progress of the work except by an injunction from the courts. (11) The contractors shall guarantee that the District shall not be liable for any expense in addition to the contract price on account of infringing of patents. (12) Although the engineer may assent to the use of special means and appliances in the execution of the work which is found difficult to perform, this will not relieve the contractor of the responsibility of his undertaking as to final results. (13) The contractor shall hold the District harmless as to payments on account of liens for material and labor. Preliminary to any payment he shall, if required by the Boards of Supervisors, present to them satisfactory evidence that all bills for material and labor have been paid and payment may be reserved until such evidence has been presented. (14) The quantities named in the notice to contractor on the profile or in these specifications are approximate only, the right is reserved by the District to increase or decrease the quantities and payment only for the necessary amount of excavation to properly complete said ditch in accordance with the plans, profile, specifications and instructions of the engineer will be made.

Payment.—Monthly, during the progress of the work, approximate estimates shall be made by the engineer of the amount of excavation and material put in place during the previous month, which estimate the contractor shall file with the Auditor, who will draw a warrant in favor of the contractor for 80 per cent of the amount of such estimate, which warrant will be paid by the County Treasurer from funds collected for that purpose. The remaining 20 per cent shall be paid upon the completion and final acceptance of the work. No payment shall be considered as an acceptance of the work or releasing the contractor from any obligation to remove or make good defective work when discovered at any time.

Penalty.—The penalty for the failure to fulfill the requirements of this contract and these specifications are fully set forth in Sec. 10, Chapter 68, Acts of the 30th General Assembly, which section is made a part of these specifications, as fully as if incorporated at length herein.

Coating Rock Cuts With Cement to prevent deterioration, of the rock on exposure to the air is to be tested on the Isthmus of Panama.

A Discussion of Fundamental Principles in Tile Drainage.*

The subject assigned to me for discussion is of vital importance at the present time. The very vastness of the expenditures for the reclamation of waterbound land makes it imperative that the elementary principles of tile drainage be thoroughly understood by engineers. In the past, scientific investigation has not kept pace with the expenditures of money for drainage purposes, which must signify that some of this money has not been economically applied. In other engineering enterprises, as irrigation and highway construction, scientific investigation and the dissemination of knowledge have generally corresponded to the economic importance of the enterprise. Through the agencies of colleges, state and national research bureaus, engineering periodicals and engineering societies, methods and results have been investigated and resulting laws and conclusions incorporated in books, pamphlets and reports. On the one subject of highways, entire sections of engineering periodicals are weekly devoted to methods, costs and results; and libraries offer complete departments of highway literature.

In the field of drainage, however, we find in the scientific publications two or three general discussions in the course of a year, and the sum total of valuable books and pamphlets could be numbered on the fingers of one hand; and this notwithstanding that several millions of dollars are being annually expended for drainage in the Mississippi valley alone. There are several reasons for this deplorable condition. Drainage has developed on an important scale in a few recent years, its importance has not been propertly recognized and engineers engaged in this work have been too occupied with the problems presented to them to systematize their plans and methods with the thoroughness which the subject demands. There has been a tendency of late to promiscuously criticize the work of these pioneer drainage engineers, but not being one of the earliest of them I feel free to strenuously object to this injustice. True, some of them have been careless and inefficient, but as a class, these engineers, with little available knowledge and few established methods of procedure, have evolved many sound principles of drainage. These principles should be accepted and used as the foundations for a more efficient practice in the future. With this resume of the present status of the subject I will now point out some of the principles that have thus far been established and suggest methods for future improvement.

To plan the simplest tile system an engineer should comprehend the characteristics of ground water, and the natural movement of water through varying conditions of soil. Soils require artificial drainage about in proportion to the fineness of their component particles and the absence of natural outlets to subsoil watercourses. Coarse, gravelly soils offer little resistance to the movement of water, while the finely divided clayey soils offer the greatest resistance. Obviously these extreme compositions and many other intermediate mixtures of soil require different drainage diagnosis and treatment. All particles of soil are coated, cement-like, with a film of water held in place by the power of capillary attraction. These films of moisture surrounding the soil particles are interconnected in such a way as to form a continuous film free to move in all directions to supply the demands of evaporation, to supply plant roots and to replenish other portions of soil deficient in moisture. The average proportion of voids in soil is approximately 50 per cent, of which one-half is ordinarily occupied by the capillary water. For healthy plant growth the remaining 25 per cent should be free space for the passage of air and heat, and the province of tile drainage is to remove excess hydrostatic water from this space. To accomplish this purpose, tile lines are laid at sufficient intervals and depths to effectually maintain the plane of saturation by hydrostatic water at a level below the reaches of plant roots.

The items of main importance to be determined in planning a tile system may be briefly summarized as follows: Planning the grade lines, determining the sizes of tile and fixing the distance apart and general layout of laterals. A discussion of these factors will demonstrate that a thorough preliminary survey is essential, and will indicate the range of information that should be acquired.

Grade Lines.—The grade lines of all outlet mains must largely depend upon the natural formation of the watershed. The comparative elevations of all outlying depressions should be known and the depths of the main so arranged as to furnish the minimum depths for laterals in the depressions, sufficient fall for the distance to be traversed by the laterals and an outlet for laterals at or near the tops of the mains. After the different elevations on the grade line are fixed to meet the requirements of laterals, as a general rule, intermediate grades should be uniform. This rule must be varied when deep trenching becomes necessary in sandy soils. When unstable soils, as quicksand or joint clay are found to exist near the surface, it is best to give the grade line a very slight slope in order to keep the tile above the semi-fluid soils as much as possible. If more stable soils are found it is preferable to give the tile a fall of at least 2 or 3 ins. per 100 ft. In either case, excess fall should be distributed as regularly as possible along the remainder of the tile line. Best results are insured from regular velocities and discharges, and to this end broken grade lines should be avoided, as the flattest slope must regulate the capacity of the entire tile line above such a grade. However, broken grade lines are often necessitated by arbitrary conditions, and the remedy is different sizes of tile, proportioned to rate of fall and amount of water for each change in slope.

The question of minimum depths for laterals has been a much mooted one. In northwestern Iowa, where drainage is being prosecuted at a phenomenal rate, practice has varied more during different periods of time than among different engineers and localities. Formerly, a minimum depth of 3 ft. was there considered standard. Then a few of the more progressive experimented with depths of 3½ and 4 ft., and a comparison of resulting crops has almost invariably been indisputable evidence in favor of the deeper tile. These depths have now become about the most standard factors in drainage practice. A common objection to deeper tile has been that they will not collect ground waters with sufficient rapidity at times of excessive floods. An analysis of the movement of ground water to tile lines discloses the fallacy of such an objection. Soil water ordinarily enters the tile through the lower portions of the tile joints, and the general movement of percolating water is downward to a saturated surface between tile lines and then in a downward curving lateral direction to the water level in the tile. Thus at points midway between tile lines 100 ft. apart the vertical movement of water ranges from zero feet to a depth corresponding to the depth of the tile, as the degree of saturation varies, while the horizontal movement is approximately 50 ft. Or, since the proportion of vertical to horizontal movement is small, the difference of depth between a 3-ft. and a 4-ft. tile line would have little effect upon the rate of movement of water into the tile.

The advantages of deeper drainage are many and far-reaching. A drained soil is an immense sponge or reservoir, and the greater the capacity of this reservoir resulting from deeper drainage, the less the amount of water that will flood crops, overflow and erode the surface and rapidly reach the rivers to deposit its silt and swell dangerous floods. The economic limit to the depth of drainage would probably be the depth at which plant roots cease to effectively penetrate for food and moisture.

When tile of large diameter are used, the minimum depths should be increased, not only to meet the requirements of outlets for laterals, but also to insure the minimum depth of drainage along their courses. When large mains run full and under great pressure the level of saturation cannot extend below their tops, and to insure average 4-ft. drainage the tops of the tile should be placed at least 3½ ft. below the surface.

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*A paper by J. L. Parsons, Humboldt, Ia., before the Iowa Society of Engineers.

In some sections gumbo soils are prevalent and the problem of successful methods of drainage for them is far from solved. Soils of this nature resist the rapid percolation of water, and to offset this disadvantage, shallow tile lines placed at close intervals have often been advocated. This question should be thoroughly investigated by comparative experiments, which experiments I believe would prove an advantage for the deeper drainage. In such soils inlets should be constructed to aid in the rapid removal of flood waters, and in time the action of percolating waters would render the soil more friable and pervious. The arguments previously cited in favor of deeper drainage would also apply in a large measure to gumbo soils.

Proper Sizes of Tile.—Probably the most important factor in the design of any tile drainage system is the determination of the sizes of tile. The sizes must largely determine the efficiency of a tile system. If the sizes are unnecessarily large, money is economically wasted; if too small, money is worse than thrown away, as the expected adequate return upon the investment is not realized, and the tile at some time must be replaced. Also the science of tile hydraulics as now practiced may be described as chaotic, which is a natural condition. Drainage engineers, however thoroughly versed in hydraulics, have had no science or recorded experience to guide them in such vital questions as, the actual capacity of tile drains, the proportion of total rainfall that a tile drain should be designated to remove, and the effect that natural watershed formations have upon this proportion. The discharges of tile lines for different sizes and grades are now either taken from tables of discharge, as for instance, the tables in the proceedings of the Illinois Society of Engineers for 1909, or are figured from Kutter's or other formulas for each individual case. Reasonably accurate results are obtained by these methods, but extensive experiments are yet to be made to discover the actual value of the coefficient of roughness for tile drains and the effect of irregular grades and uneven tile upon this coefficient.

However, of greater importance than the particular formula to be used is the determination of the proportion of rainfall to be removed by tile drains. Detailed data and analysis are not so necessary for the smaller laterals, as experience has demonstrated the necessity of using at least 5 and 6 in. tile, 5 in. being used for lengths up to about 1,000 ft. for average grades and 6 in. at the outlet ends of longer laterals. The larger the sizes of tile the greater the necessity of accurate assumptions and computations, as the ratio of cost to size increases rapidly in the larger sizes. A removal of ⅛ in. of water in 24 hours was formerly considered sufficient for average watersheds. At the present time plans for the removal of ¼ to ⅓ in. in the same time have become so common as to be almost standard. But, whatever the assumed depth of water to be removed, extreme variations are necessary to compensate for peculiar watershed formations. While it is impossible to catalog these formations by types, they may be divided into the following four fairly representative classes:

Class I includes watersheds consisting of a narrow, slightly sloping draw extending lengthwise through the watershed flanked on either side by abrupt slopes. The effect of such conditions is that storm waters are delivered to the main tile in the draw so rapidly that unusually large tile must be provided to properly care for them.

Class II includes watersheds with steeply sloping draws and rolling side lands. The sizes of tile may be relatively smaller than for class one because of greater grades and because a considerable portion of flood waters spreads out over the surface and thus reaches the outlet without serious damage to crops.

Class III represents those watersheds with steep draws and flat side lands. Such a formation is probably the most favorable of all for smaller sizes of tile mains. Surface and sub-drainage water from the side lands is delivered more regularly over longer periods of time, while the main drain benefits from all the advantages of great fall and surface overflow.

Class IV includes watersheds with flat main draws and flat tributary lands. Watersheds of this nature closely approach the average of all the various formations for tiling purposes, and tabular sizes of tile for assumed depths of removal can be more safely applied to them. A portion of the flood waters falling upon them is delivered over the surface, while the remainder is collected and delivered by tile laterals regularly over considerable periods of time.

There is probably no watershed in existence that could be definitely listed under any one of these headings, while there are also none that do not approach some one type more than any of the others. In all formations are found deep depressions or ponds to a greater or less extent, and the tile drainage of these presents a new difficulty. Tile drains tapping such natural catch basins must be made large enough to remove the collected storm waters before serious injury to crops results To accomplish this purpose their capacity must be increased 50 to 100 per cent over the size necessary for the same amount of land under ordinary conditions. Inlets should also be constructed in the lowest places to aid in the rapid removal of surface water. I have not attempted to tabulate standard depths of removal and sizes of tile for different types of watershed, as there has not been sufficient experience and investigation to warrant doing so, but have attempted to show that natural conditions greatly affect the necessary sizes of tile and that they can be analyzed and intelligent conclusions arrived at. Every drainage engineer is probably thus analyzing and solving to a greater or less degree, but their efforts have lacked the impetus of co-operation and publicity.

Laterals—The distance apart that laterals are to be placed is essentially a factor of soil density. As the principal movement of soil water is laterally to tile lines, the greater the density of soil particles the closer must be the lines of tile to effect an increase in the rate of removal by reducing the distance to be traversed. The more porous, gravelly, subsoils may be successfully drained by laterals spaced 100 to 150 ft. apart, while the closer grained soils require them as close as 50 ft. or even less. Experiments should be conducted over extended periods of time showing the rate of velocity of water through different soils and the effect of tile drainage upon their density.

The location of laterals in level land requiring thorough drainage is a comparatively simple matter. A system of long parallel laterals extending about at right angles to contour lines should be aimed at. Also numerous connections resulting from the use of many short laterals should be avoided, as every unnecessary connectoin requires an expenditure for 50 to 75 ft. of tile placed through land already drained by the main tile line. Since the movement of soil water must be generally toward lower levels or at right angles to contour lines, tile lines laid in the direction of natural flow tend to rapidly collect this water instead of allowing it to pass on through the joints as in the case of laterals placed parallel to contour lines. When planning a tile system an engineer is in danger of being misled by the appearance of the low lands as compared with the soggy, wet lands, and thorough drainage planned for the wet lands and little or none for the lands lying higher up the slope. The result in average cases is a reversed appearance of the two kinds of land and a later extension of the laterals. It is a peculiar fact that tile lines draw from only a very short distance beyond the ends of the lines, and this, coupled with the fact that seepage water from adjacent hills often appears at points well up on hill sides, makes it necessary to extend laterals far enough to be safely through springy or seepage pockets.

The proper method of arranging laterals in narrow draws often taxes an engineer's ingenuity. Narrow draws with a lengthwise slope greater than the adjacent side slopes toward the center of the draw are best drained by two laterals, one at the edge of the draw on each side. The seepage water from the side lands tends to flow in the direction of greatest slope, or in the direction of the tile lines. On the other hand, if the draw has a flatter lengthwise slope or is irregular in width, wide in some places and narrow in others, drainage is best accomplished by a single line of tile up the center of the draw with laterals radiating up the side slopes where necessary.

Importance of Permanent Records.—The only existing record of probably 90 per cent of the private tile work laid out by engineers in northwest Iowa consists of a rough sketch accompanying the level notes in the engineer's note book, and this laxity is certain to result in endless future trouble. Engineers are not principally at fault, as land owners refuse to employ them to furnish complete maps and profiles in permanent form. A reform can only come through a process of experience and education, and engineers should aid in this reform in all ways possible. The ideal should be, complete records of each drainage survey drawn with such completeness that every tile line, its size, grade, depths, location and watershed area will be correctly shown, to be compiled and put in the proper form to accompany all the transfers of the land. Also many land owners do not yet employ engineers to investigate conditions and prescribe for their land. They have themselves done that to their own satisfaction, and the engineer is simply directed to take the levels and figure the notes for a tile line of a stated size, located there and of that depth. Although the importance of land owners intelligently investigating conditions and furnishing all possible information to the engineer should not be minimized, the results of such a method have generally spoken loudly for themselves. As a rule, however, the results of properly employed and paid engineering work is now demanding proper recognition from land owners. As this tendency grows, the better will be the character of the engineering work and the more permanent the drainage improvements executed.

Every drainage engineer should keep private records of his work. These should be in such form that all the original characteristics and data for each tile system are readily available, observations of success or failure to be recorded as noted. It is a difficult matter to keep such records of private farm work because of the volume of work done, in many cases the meagerness of the data and the lack of time and opportunity to investigate. This class of experimentation can be best done by state and national research bureaus and universities, although the observant engineer may gather valuable information by the study of representative tile systems. The engineer's best opportunity is in county drainage district work. In this work he is expected more and more to make complete and thorough preliminary surveys and furnish definite records, his opportunities for observation are relatively greater and he is certain to be notified of any failure. A list of headings for a form for drainage district records is here suggested; size of tile, length of section, average depth, minimum depth, actual cost, grade, watershed area, kind of tile used, nature of soil encountered, general character of watershed and general remarks. Each heading is suggestive of the sub-headings and range of information that may be placed under it.

Construction—Construction of tile drains is a question of accuracy and efficiency in the execution of the plans on the part of engineer and contractor. The days of laying tile by guess and by water are largely days of the past, and even though the engineer may be denied the planning of the tile system, he is usually employed to set the stakes. In this [illegible] must be laid according to the figures. The [illegible] contract with the tiler requiring especially that [illegible] pass inspection and that a sufficient per cent of the payments shall be withheld to insure the correction of any faults. In checking the work the engineer should take levels to the tops of the tile at close intervals for accuracy of grade, and the joints should be thoroughly inspected to be certain that careful patching has been done. He should be firm enough to insist that all serious faults in the work be corrected. Of especial importance is the making of connections. Many tilers do very competent work in the laying and joining of tile, but make their connections of laterals to main consist of an irregular hole punched in the main tile and a few tile bats thrown over the connecting laterals. Often the main tile is so shattered in the process that it is certain to fail. Connections should invariably be made by the use of special junction tile, but if they must be made otherwise, a circular hole of the proper diameter should be carefully chipped out of the ends of two adjacent tile, a semi-circle out of each, and the connection thoroughly surrounded with cement mortar.

Tilers should be constantly impressed with the necessity of keeping silt out of the tile during construction, as its removal is often only effected by the relaying of the tile line. The end of a tile line under construction should be kept open at all times in such a way that overflow water will be directed into the tile without an accompanying load of silt. If there is not too much slush present in the trench, this may be accomplished by placing an iron or wooden cover over the end of the tile, the upper half being perforated with closely spaced holes. If there is much slush present and the work is to be left for some time, a successful method is to place a T connection tile at the end and build up tile on the T to a level above the slush. A dam is then constructed in the trench back of the inlet to prevent overflow down the trench.

The proper laying of tile in sand, or other semi-fluid soils, is an almost superhuman feat. It is easy to specify that the tile be laid in good earthy material and to a true grade, but another matter to enforce the specifications. Very passable work can be done, however, with proper supervision and care. It is usually the most practicable to allow the tile to be laid directly on the sand, and bend all efforts to keeping the tile clean, superfluous water drained away, the joints thoroughly patched with fine grained soil and coarse hay [illegible] the tile

Storm water inlets are valuable assets to tile lines if properly constructed; if not, they are a positive menace. A poorly designed or constructed inlet tends to the washing of surrounding material into the tile line to obstruct the tile, leaving an exposed inlet in the center of a large washout. My idea of inlet design and construction is the placing of a sewer pipe T in the tile line to receive a vertical shaft of sewer pipe of about the same diameter of the tile, built up to the ground level, the top bell being fitted with a perforated iron gate. All vertical joints are cemented, the back filling thoroughly tamped in place around the vertical pipe, a circular sheet of concrete placed around the top of about 12 ins. in thickness and 6 ft. in diameter and the top covered over with a layer of tile bats or field stones, to serve as a filter for silt and prevent clogging by rubbish. Such an inlet carries surface water directly into the tile line, and a good connection of the inlet to the tile line is always insured.

Kinds of Tile.—My subject proper does not countenance a discussion of the quality of tile and the comparative merits of clay and cement tile. However, it is of prime importance to permanent construction work that only permanent tile be used, tile that will withstand all tendencies to disintegration and the pressure of soil brought to bear on them. I believe that cement tile have been made the object of much unwarranted and prejudiced criticism, and that they should have their day in court. If, after thorough experiments and investigation by unbiased authorities, they prove unable to meet the requirements, it is urgent that the facts be ascertained and made generally known as soon as possible. If, on the other hand, properly made cement tile meet all reasonable requirements as to strength and durability, these facts should also be known and standards of manufacture formulated and enforced.

In conclusion, this discussion has been of necessity very academic. Its aim has been to outline the progress achieved and to demonstrate the positive necessity of unified and systematized advancement in the science of tile drainage planning and construction.

Present State of Irrigation Development in California.*

To give an accurate account in detail of the present extent of irrigation development in California would require a class of information not in possession of this office. Much of the information necessary for such an account was, however, collected. Based on such information and eliminating projects still in the promotion stage, a conservative estimate places at 750,000 acres, the area for which construction to provide irrigation water is now under way. Of this area, about one-third is in southern California and the remainder north of Tehachapi.

Of the area now being brought under water in southern California, the principal acreage is under the various mutual water company systems of Imperial Valley, the Yuma project of the United States Reclamation Service, the new municipal aqueduct being built to supply water for use within the city of Los Angeles, but which will irrigate a large area outside of the city pending the increased needs by the city, and the southern coastal regions where development has already reached a high state. In the latter sections it is the increase in pumping plants, notably around Pomona, Corona, Chino, Whittier, Covina, Anaheim, Fullerton, Riverside and San Jacinto Valley, that is increasing irrigation. At Redlands the most notable addition will come by the construction of a large multiple-arch dam in the San Bernardino mountains to supply water to the various mutual water companies that two years ago acquired the property of the Bear Valley Irrigation Company, from which they had theretofore been purchasing water but which they have now mutualized. In San Diego county the matter of chief interest from the standpoint of irrigation engineering is the raising by 15 ft. of the height of Sweetwater dam.

The rapid irrigation development now taking place in southern California is the more surprising in view of the popular impression that all of the available water was long ago utilized in that section of the state. An account of it is submitted to show the great value attached to water there and the extreme efforts being put forth to acquire an increased supply.

Turning north of Tehachapi, in some sections development is not unlike that of the south. Pumping for water is being increasingly resorted to in the foothill sections of Kern, Fresno and Tulare counties, and one of the largest pumping irrigation systems in the west is now in operation in San Joaquin county, the water supply being the San Joaquin river. The lower San Joaquin valley is fortunate in having a plentiful supply of underground water of good quality and at relatively small distance below the ground surface. In the belt around Porterville, Lindsay, Exeter and Lemon Cove, Mr. V. M. Cone, of this office, finds it now considered profitable to pump against a head of 400 to 500 ft. for citris trees. Outside of pumping, very little irrigation development is being accomplished in the lower San Joaquin valley, owing to exhaustion of the low-water flow of the streams and the difficulties of utilizing flood waters that now go to waste for want of adequate water-right laws under which they can be acquired. In the upper San Joaquin, a steady increase in the irrigated area is being brought about in Modesto and Turlock irrigation districts, and what is perhaps the most notable accomplishment in the entire San Joaquin valley is the recent successful organization of the Oakdale and South San Joaquin irrigation districts, in San Joaquin and Stanislaus counties. These two districts have jointly purchased for $650,000 the old Tulloch irrigation system at Oakdale, with its valuable water rights in Stanislaus river, and have together voted bonds to the extent of $3,475,000 for the construction of reservoirs, canals and distributaries. In Sacramento Valley, which has been more backward than any other part of the state in recognizing the needs and advantages of irrigation, the largest single unit is that of the Sacramento Valley Irrigation Co. at Willows, which as the successor of the old Central irrigation district, formed under the original Wright act, is constructing works to cover a large area of the valuable land of this valley. At Orland the Orland project of the United States Reclamation Service, covering 14,000 acres in its first unit, was 77 per cent completed Oct. 1, 1910, and ready for settlement. Other areas of more or less size are also being put under irrigation and sold to settlers in Sacramento Valley. The opening of the Western Pacific Ry. over the Sierra Nevada at a considerable distance north of any other transcontinental line has given new impetus to development, which must be largely through irrigation, in the northeastern counties of Plumas, Lassen and Modoc. In the latter county additional land is to be irrigated by the Klamath project of the Reclamation Service. Plans of the Reclamation Service for reclaiming and ultimately irrigating 27,000 acres of Klamath marsh and about an equal area of Tule lake, all in California, have already been approved by the secretary of the interior and bids for construction in connection with the latter were opened Nov. 1, 1910. A third sub-project included in the plans of the Reclamation Service, but not yet approved, provides for the irrigation of 40,400 acres in California south and west of Clear Lake reservoir.

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*From the report of Frank Adams, in charge of irrigation investigations, to Nathaniel Ellery, State Engineer of California.

The Longest Discharge Line for a suction dredge is reported to be at Panama where 20-in. Dredge No. 86 is making a fill at the city of Colon. By actual chaining, the pipe from the dredge to the fill at Colon Hospital is 7,150 ft. long. The pipe is laid on level ground and the pressure required runs up to 70 lbs.

New York Barge Canal Construction.—Of 82 contracts which have been under way up to May 1, 1911, 11 have been completed, 7 are more than 80 per cent completed, 15 are between 50 per cent and 80 per cent completed, 28 are between 10 per cent and 50 per cent completed, and 21 are less than 10 per cent completed. The general averages show 42.8 per cent of the work, included in the 82 contracts let, completed.

Concrete Lining of Steel Pipe Siphons.—On the Catskill Aqueduct extension for New York city the steel pipe siphons are to be lined with 2 ins. of cement mortar. In making tests of various methods for doing this work the New York Cement Gun Company, 30 Church St., New York, lined 120 lin. ft. of pipe, 9 ft. by 9 in. in diameter with sand-cement mortar in the proportion of 1 of sand and 2 of cement which, after inspection by the engineers of the Board of Water Supply, has been approved.

The cement gun was illustrated and described in our issue of April 12th, 1911. It consists of a tank containing the materials under air pressure. The water is contained in a separate tank. The water and dry mixture are forced through separate hose to a common nozzle and shot against the surface which it is desired to coat. The coat may be built out to several inches in thickness. The coat is estimated at 15 to 18 cts. per sq. yd. including materials.

STEAM AND ELECTRIC RAILWAY SECTION

Competitive Designs for the New Quebec Bridge, and the Accepted Design.

As announced recently, the contract for the new Quebec bridge over the St. Lawrence river has been let to the St. Lawrence Bridge Co., Ltd. This company, formed for the construction of this bridge, is a combination of two Canadian bridge companies, the Dominion Bridge Co., of Montreal, and the Canadian Bridge Co., of Walkersville, Ont.

The accompanying illustrations show the competitive designs submitted, as well as the accepted design, Fig. 7 being the accepted design. The bidders for the superstructure were as follows: The St. Lawrence Bridge Co., of Montreal; Maschinenfabrik Augsburg-Nurnberg A. G., of Gustavsburg, Germany; the British Empire Bridge Co., of Montreal; and the Pennsylvania Steel Co., of Steelton, Pa.

The official plan, with accompanying specifications, embodied the requirements to which bids were expected to conform. Contractors were at liberty, however, to prepare independent designs of their own and to submit tenders on such designs. In accordance with this privilege, three of the competitors submitted independent designs, the St. Lawrence Bridge Co. submitting seven such designs, besides making tenders on the official designs.

The official plan is shown by Fig. 1. This design provides for a cantilever bridge with anchor arms of 12 panels, or 502 ft. 3⅜ ins., and cantilever arms of 14 panels, or 585 ft. 11 15-16 ins., and with a suspended span of the same length as the cantilever spans. The suspended span was to be erected from the cantilever arms. Five modifications of this design were prepared by the board of engineers, one of which was based on the plan of erecting the suspended span by cantilevering out, and four of which provided for erecting the span at some convenient site and then floating it into position. A tender on any of these plans was considered a tender on the board's design.

Tenders were submitted by the St. Lawrence Bridge Co. on each of the board's designs, and this company also submitted seven designs of their own. Three of these designs are shown by Figs. 2, 3 and 4. The Maschinenfabrik Augsburg-Nurnberg A. G. submitted tenders on three of the Board's designs, as well as one design of their own. The latter is shown by Fig. 5. Six tenders on the Board's design were submitted by the British Empire Bridge Co. This company proposed to erect the suspended span independently of the main structure, and then float it into position. Ten tenders on the Board's designs were submitted by the Pennsylvania Steel Co. An eyebar suspension span, designed by Mr. Gustav Lindenthal, was also submitted by this company. This design is shown by Fig. 6.

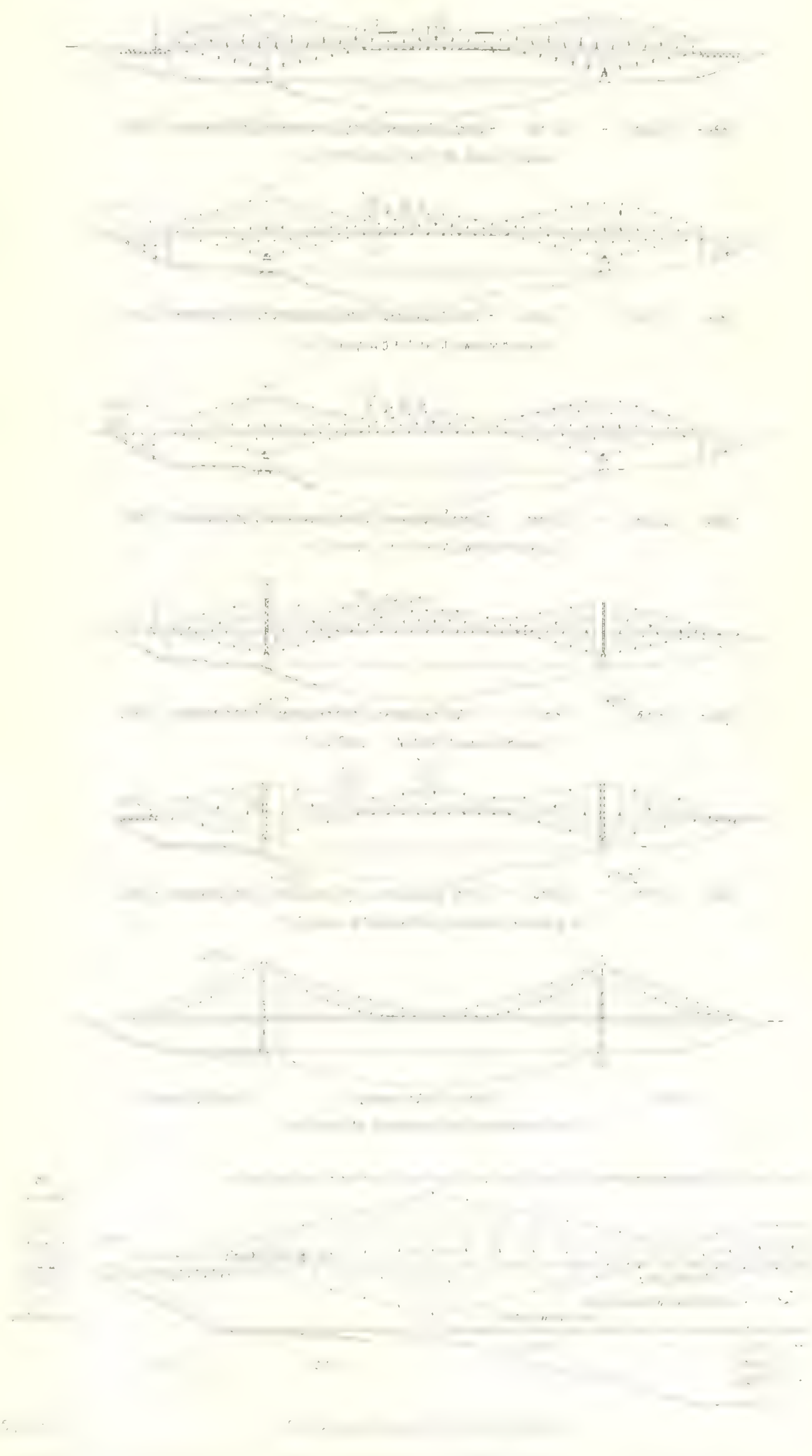
The accepted design, Fig. 7, was approved after careful consideration by the Board and by other experts appointed by the Dominion government. The question of facility and safety in erection had much to do with the selection of this design. In this design the "K" web system will be used in the cantilevers and anchor arms. The suspended span is a modified Pratt truss. The suspended span and cantilever arms will be of nickel steel, while the remainder of the structure will be of carbon steel.

As shown in Fig. 7, this bridge will have a channel span of 1,800 ft. It is designed to carry two railway tracks, and sidewalks for foot passengers. No provision is made for highway traffic, the government having decided that this is unnecessary. Stresses are to be allowed on each track for two [illegible] engines, followed by a train load of 5,000 lbs. per lin. ft. of track.

The cantilever arms are 580 ft. long, 310 ft. deep over the main post, and 70 ft. deep at the end. The anchor arms are 515 ft. long and 70 ft. deep at the ends. The suspended span is 640 ft. long, 110 ft. deep at the center and 70 ft. deep at the ends. Trusses are to be placed 88 ft. [illegible]

[illegible] pended span there will be a clear headroom of 150 ft. above extreme high water. The grade of the track will be level through the suspended span and through the end panel of each cantilever arm, making a total of 770 ft. of level grade. Approaching this level grade on each end will be 1 per cent grades.

The old main piers will be taken down to low water level, and piers built suited to the



Designs for New Quebec Bridge Over the St. Lawrence River, Near Quebec, Canada.

[illegible] structure. It is [illegible] the old stone will be used in the new piers.

Reinforced Concrete Bridge of the Southern Ry. Co. at Asheville, N. C.

[illegible][*]

The new bridge of the Southern Ry. Co. across the French Broad River at Asheville, N. C., completed in May, 1910, is a double-track reinforced-concrete girder bridge 733 ft. [illegible] girders [illegible] on 2 abutments and 22 piers, the clear span between piers being 30 ft. As indicated by Fig. 1, the new structure replaces a single-track steel girder bridge resting on wooden piers. In the new location a great amount of curvature is eliminated. The new bridge is built at an angle of about 60° with the axis of the stream, while the old bridge was built practically at right angle to the stream. The latter condition led to the use of 10° approach curves for the old structure, and it was with a view to eliminating this curvature that the new location was adopted. A side view of a portion of the new structure is shown by Fig. 2.

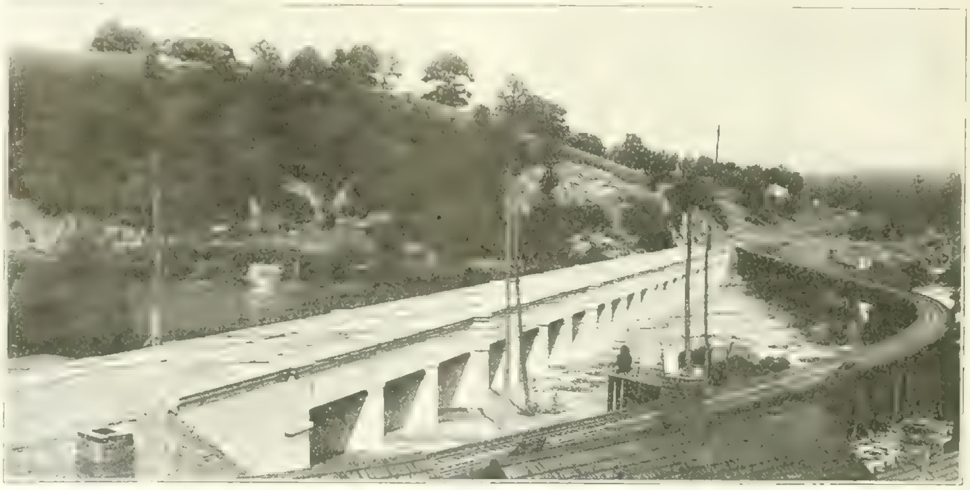


Fig. 1—General View of Old and New Bridges Over French Broad River, Asheville, N. C.

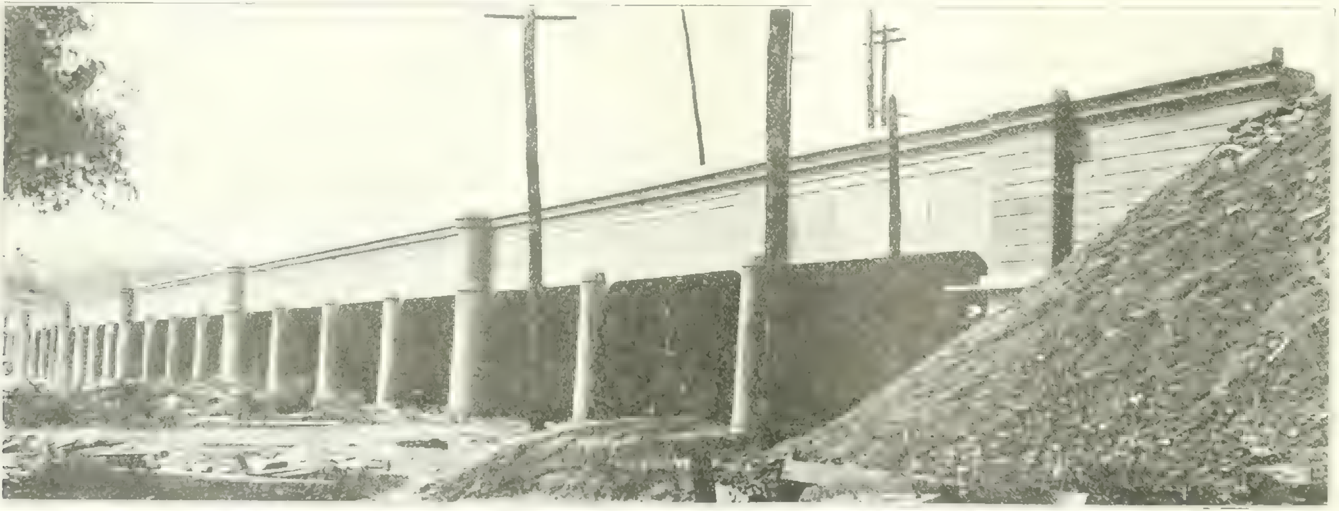


Fig. 2—View of East End of New Structure.

Beginning at either end, the first two piers are 3 ft. thick at the top; the third pier is 4 ft. thick, and every fourth pier is 4 ft. thick at top; there being five 4-ft. piers and seventeen 3-ft. piers. On the west end the abutment rests on [illegible] rock [illegible] and practically no difficulties were encountered in securing a solid foundation. The east abutment is located about 75 ft. from the foot hills on that side of the river and had to be carried down to solid rock about 14 ft. below the earth line. No difficulties were encountered in its construction and no timbering was necessary in order to protect the excavation. Of the 22 piers, 17 are in the water and 5 on dry land.

The foundations were carried down well in to the solid rock, especially the foundations in the river. All soft shale, or rotten rock, was removed and the excavation carried below the seams that appeared when the rock was stripped; the purpose being to be absolutely certain of a solid rock foundation. Some of these foundations were carried as much as 7 ft. below the rock bed of the river, and none less than 3 ft.

As there was not over 3 ft. of water in the river at low tide, ordinary timber cofferdams were used, with a chamber, between inside and outside timbers, of 8 ft. These were lined with sheet piling and puddled with a stiff clay taken from adjacent hill sides. Very little water seeped through the cofferdams, and most of it was kept out by ordinary hand pumps operated by two men; except when it was necessary to excavate a fissure in the rock beneath the cofferdams, and then an 8-in. centrifugal pump was used, which proved ample and sufficient to do the work.

The controlling idea in regard to the foundations was to get a foundation that would not settle. The entire space excavated was filled with concrete to a thickness of 3 ft. Where there was much water it was allowed to rise to a level with that outside the cofferdams, and the concrete was then placed in the foundations through sheet iron tubes to a uniform thickness and sufficient to shut off all seepage from the bottom. This was allowed to set for 8 days. Where there was little water in the foundations, ordinary methods of placing concrete were used.

The grade across the bridge being level, a certain elevation was assumed, parallel with grade for the neat work of all the piers, and at this elevation the piers were all constructed one foot larger in every way than the neat dimensions would require. This was done in order that the forms for the girders and top work would be the same for every span and when used could be taken down and moved ahead.

From this offset foundation elevation, the piers batter ½ in. to 1 ft. in all directions with semi-circular ends. By this method it required only 9 separate structure forms for the entire bridge, as they were taken down and used over again in other places without reframing—having been designed for this purpose.

Details of construction, with system of reinforcement and method of centering, are shown by Fig. 3. Details of collapsible forms are shown by Fig. 4.

The abutments and piers were first completed to an elevation of 3 ft. below the lower line of the girders before any attempt was made to do any of the top work. The forms for the piers were made in 4 sections, consisting of two rounded ends, and two plain, vertical sides which were properly bolted and fastened together; each form being 6 ft. high and fitting one on top of the other with proper batter in all directions, as shown by Fig. 4. In this way 5 sets of forms were all that proved necessary for the construction of the piers, 4 for the small piers and 1 for the larger piers. After the piers were completed the forms and centering were placed in position for the top work, 4 forms being framed and in position with all steel properly placed before any concrete work was started. The idea was always to have 2 spans of false work and steel ahead of any concrete work—although this was not always strictly adhered to, owing to unavoidable circumstances. This was the first method employed, and it was found that in waiting 21 days for the concrete to set, the contractors lost too much time; so 4 additional spans were framed and put in position and all steel placed before any further concrete work was done. This gave ample time for proper setting, and 3 spans from the rear were taken out and moved forward consecutively as the work progressed. In this way the time consumed in erecting the forms and placing the steel and concrete was about 21 working days.

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[*] Principal Assistant [illegible] Southern Ry. Co., Knoxville, Tenn.

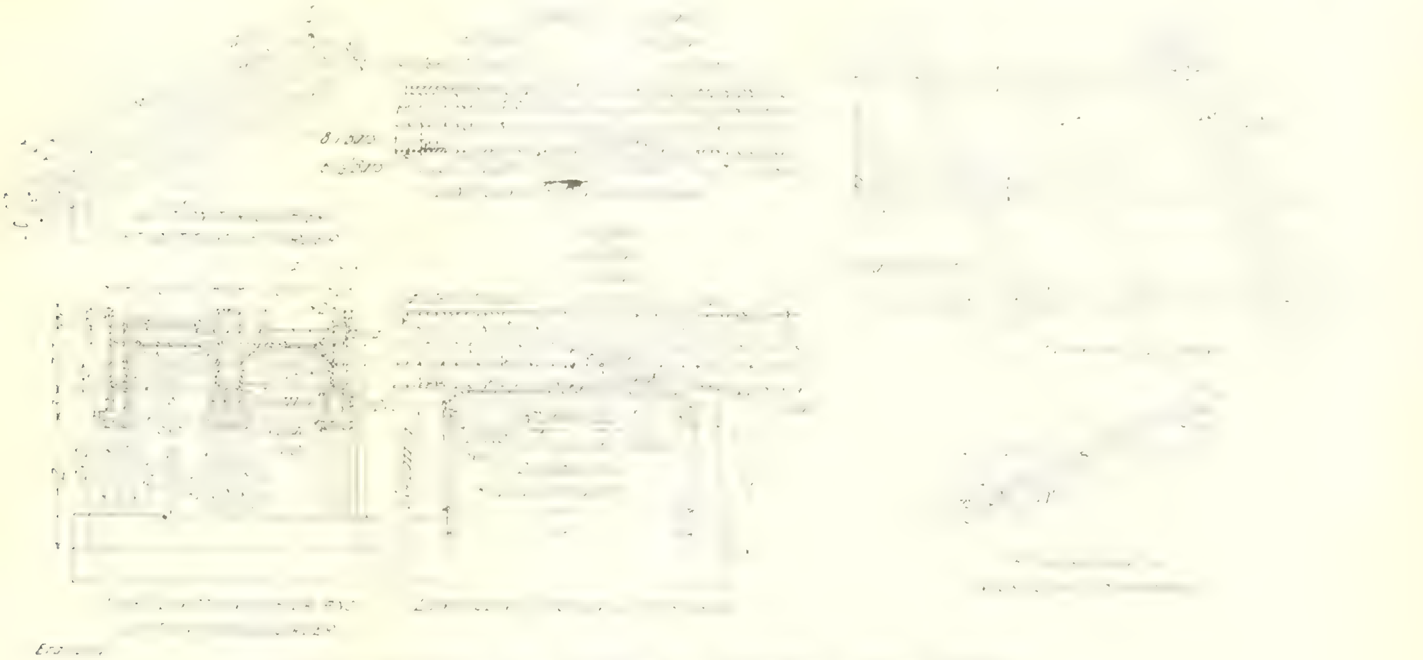

Fig. 3—Dimension Lines, Sections and Elevations of New Structure.

The floor system of the forms and also the sides were made in framed sections, and after the centering was loosened, dropped down and were moved forward, practically intact, to be used over again. In the reinforcement of the floor system bars of square section were used throughout. Longitudinal bars were ¾ in. square and were spaced from 18 ins. to 2 ft. centers. Transverse bars were ⅞ in. square and were spaced at 3-in. centers.

The contractor's outfit consisted of two 2-in. batch mixers, which were located on the ground in the rear of the east abutment. The concrete when mixed was poured into buckets and was carried to its place on two parallel cables the entire length of the bridge; each mixer operating alternately and connected with separate cables. There were also separate engines operating the mixers and buckets for transmission over the cables. To make the extreme haul from the mixers to the further end of the bridge, after the cables were put in good working order, took about 5 minutes.

The proportions used in the concrete were as follows:

In the [illegible] abutments and foundations, 1 part cement, 2½ parts sand and 5 parts clean stone, broken to pass through a one-inch ring. In the [illegible] floor system, and all work above the spring line in the piers, 1 part cement, 2 parts sand and 4 parts clean, crushed stone, one inch and under in size.

These proportions were strictly maintained by actual measurement of material before mixing, no variation being allowed in cement and sand, but allowance of mortar to vary, so that all spaces in the stone were thoroughly filled when properly tamped into place. On the removal of forms no voids nor honeycombed places were found in the structure.

The concrete was what is known as a wet mixture; that is, it was kept soft and wet enough always to slip easily through and fill the spaces between the reinforcement and around all steel without forcing it out of line or position; but not wet enough to be sloppy, or show any surplus water on top when properly tamped.

The girders are continuous for the entire length of the bridge, and on each pier at the spring line an expansion joint was left by placing on top of the piers 2 thicknesses of ordinary tar paper; and a 2-in. expansion joint was left between the ends of the girders and the [illegible] and the floor system connecting them, for the entire 733 ft., 10 ins., form a monolith; the reinforcement breaking joints is continuous and united throughout.

The piers are placed parallel with the current of the river at an angle of 30° with the axis of the bridge, the distance between piers along the axis being 30 ft. clear span.

The alignment is straight and the grade level. The under sides of girders are 8 ft. above extreme high water. The two outside girders are 2 ft. wide and 9 ft. 7 ins. deep. The center girder is 3 ft. wide and 9 ft. 7 ins. deep.

The bridge was designed as follows:

Fig. 4—Collapsible Forms for Piers.

[illegible] $M = \frac{wl^2}{8}$

Formula for design of floor slabs, $M = \frac{wl^2}{10}$

[illegible] allowance of

[illegible] Maximum stress [illegible] Maximum stress in concrete, 2,400 lbs. ultimate. Percentage of steel [illegible] Concrete mixture, 1:2½:5 in piers and [illegible] in top work. Factor of safety, 4, the steel being figured to carry all tensile stresses.

The floor system is solid and a weep hole was left for drainage in the center of each span, the floor being slightly inclined to this hole from all directions. A cushion, consisting of 2 ft. of crushed stone, was placed on the floor system. Upon this the track was laid, which, when properly ballasted, brought the top of the rail on a level with the top of the girders.

The general appearance of the bridge can best be determined by Figs. 1 and 2, which are made from photographs taken before track was laid over the work. These show not only the character of the bridge but also show the amount of curvature eliminated and character of the old structure as well.

Work was commenced on this bridge in October, 1906, and was prosecuted until November, 1907; then shut down until April, 1909, and completed in May, 1910. During the first period the piers and abutments were finished up to the spring line, and the top work, or girder system, completed during the latter period.

This structure was conceived and designed under the direction and supervision of Mr. W. H. Wells, chief engineer of construction of the Southern Ry. Co., and the details were worked up in the office of Mr. W. B. Crenshaw, principal assistant engineer. Mr. John F. Schwed and Mr. Jas. O. Hunt were in charge of construction as assistant engineers.

The principal contractor was Mr. W. J. Oliver of Knoxville, Tenn. The sub-contractors in direct charge of the work were the Monday Construction Co. of Knoxville, composed of Messrs. J. C. and M. C. Monday.

The following is a detail estimate of the cost, giving prices and quantities:

FOUNDATIONS EXCAVATION.

	Rate.	Amt.
[illegible] cu. yds. solid rock	$[illegible]	$[illegible]
[illegible] cu. yds. loose rock	1.[illegible]	[illegible]
[illegible] cu. yds. earth	[illegible]	[illegible]
[illegible] cu. yds. wet	[illegible]	[illegible]
		$[illegible]

FOUNDATIONS PUDDLING AND COFFER DAMS.

Force account, extras, etc.		$[illegible]
[illegible] cu. yds. puddling	$1.[illegible]	[illegible]
[illegible] ft. B. M. timber in coffer-dams	17.[illegible]	[illegible]
[illegible] lbs. iron in coffer-dams	.05	[illegible]
		$[illegible]

MASONRY CONCRETE.

[illegible] cu. yds. in abutments	$[illegible]	$[illegible]
[illegible] cu. yds. in piers	[illegible]	[illegible]
[illegible] cu. yds. in foundations	[illegible]	18,[illegible]
[illegible] cu. yds. in girders and floors above spring line.......	10.50	49,654.29
		$83,215.29

REINFORCING STEEL.

772,[illegible] lbs. steel corrugated bars	$[illegible]
Freight on steel	[illegible]
Cleaning rust from steel upon resumption of work, April, 1909	1,[illegible]
	$ 22,018.69
Total cost of bridge	$[illegible]

The Appraisal of the Third Avenue Street Railroad System, New York City.

Bondholders of the Third Avenue R. R. Co. applied to the Public Service Commission of the First District of New York State, for permission to issue refunding bonds and more stock. The desired permission was not granted, mainly because the proposed new capitalization would exceed the cost of reproducing the physical property of this street railway system. From a pamphlet entitled "Opinion Disapproving Plan of Reorganization (of the Third Ave. R. R.) July 29, 1910," we have abstracted the data relating to the appraisal.

From the 1909 annual report of the Public Service Commission of the First District of N. Y. we have compiled the statistics in Tables I and II, which serve to throw considerable light on the general character of the property covered by this appraisal.

TABLE I.—TRACK MILEAGE OWNED BY THE RAILWAYS OF THE THIRD AVE. SYSTEM.
(As of June 30, 1909.)

Name of Railway.	Road.	Second track.	Other track.	All track.
(1) Third Ave. R. R.	13.361	13.[illegible]61	7.940	34.668
(2) Kings Bridge Ry.	3.328	3.351	0.024	6.703
(3) 42d St. M. & St. N. Ave. Ry.	9.[illegible]78	9.616	0.373	18.567
(4) Dry Dock, E. Broadway & Battery	7.994	7.128	2.514	17.636
(5) Union Ry. Co. of N. Y. City	41.930	41.660	4.891	88.481
(6) So. Boulevard R. R.	3.937	3.937	0.000	7.874
(7) Bronx Traction Co.	9.774	8.716	0.170	18.660
Total of Items 1 to 7	89.[illegible]	87.172	15.862	192.589
(8) Yonkers R. R.	[illegible].850	11.410	0.210	39.470
(9) Westchester Elec. R. R.	29.972	7.937	0.121	38.030
Total of Items 1 to 9	147.377	106.619	16.193	270.189

Note.—All the railways are surface lines. Railways (1) and (2) are electric underground contact or conduit system. Railway (3) is all electric underground contact, except 2.41 miles of double track road (or 4.806 miles of track) which is horse-car line. Railway (4) has 7.909 miles of track that is electric underground contact, and 9.727 miles of track that is horse-car line. Railways (5) to (9) are all electric overhead contact, or trolley.

The following is quoted from the pamphlet above mentioned:

The applicants submitted an estimate of an engineer—Mr. Henry Floy—of the "cost of reproduction by a new company," which, they assert, amply justifies the proposed plan of capitalization. Mr. E. G. Connette, the transportation engineer of the Commission, was asked to examine this estimate and inventory. After a thorough examination of the property and of the records of the Commission, with the aid of a staff of assistants, his findings were put in evidence, and he was questioned at length by counsel for the applicants. In many instances the two engineers agree, but in several important cases they differ considerably. In the main Mr. Connette's appraisal has been accepted, for he has had wide experience as superintendent and general manager of railroads and street railroads, steam and electric, including traction, and the preparation of estimates for new work. Mr. Floy has never operated or managed a street railroad, and his general experience is not such as to cause the Commission to accept his estimates over those of Mr. Connette.

Before proceeding to the analysis of the evidence as to these appraisals, it should be stated that the Tarrytown, White Plains & Mamaroneck Railway Company will be omitted. The amount involved is very small and the facts are not clear.

COST TO SUB-CONTRACTORS.

Each engineer begins with the sub-contractors' cost of labor and material, assuming there is to be a general contractor also. Mr. Floy estimated such cost to be $38,319,382, excluding the Mamaroneck line. Mr. Connette fixed $37,595,458 as the appraisal cost of labor and materials, as shown in Table III. The net difference between the two appraisals is thus seen to be less than $730,000.

Regarding the preceding estimates, it should be noted that they are based upon unit prices that are considerably in excess of what Mr. Whitridge has been paying for supplies. Where definite comparison was made, the difference was found to be from ten to twenty per cent. The unit prices are also in excess of the contract prices of the supply companies when the major portion of the work of electrification was performed. The applicants did not attempt to show what the entire present existing physical property had actually cost the company originally, but a few contracts were produced and these show that the unit prices used in the appraisal of Mr. Connette range from seven to forty-two per cent in excess of the contract figures. These facts clearly establish that the estimates given in Table III are ample, that the company has been generously treated and any action based on these figures will be very favorable to the applicants when viewed from the standpoint either of original cost of unimpaired investment or present cost to reproduce. This should not be forgotten, for it has been considered in reaching final conclusion.

The omission to show fully what were the unit prices at the time the present property was constructed is significant. Ordinarily these would be important factors but only stray bits of information have been put in evidence. It is quite possible that the condition of the books and records of the various companies is such that the original cost prices can not be determined.

Table III also contains certain items that are based upon arbitrary assumptions. The record of the case does not show what subsurface obstructions were encountered in construction work, what was the condition of the paving when the work was begun, or the character and amount of the paving put down (See items 3, 9 and 10). The engineer who made the appraisal of items (9) and (10), in the first instance arbitrarily took a five-foot strip and computed the cost of removing the obstructions and of repaving such a strip. It has not been established that the equivalent to such a strip was actually cleared and paved, but as Mr. Floy accepted the same figures, it may be considered that the applicants do not consider the estimate unfair to them. Item (3) is based upon present conditions also, and it is possible that the city may have improved the paving in some streets since the track was laid, for example, by substituting asphalt for macadam. If such is the fact, estimates (3) and (10) exceed the original expenditure. The appraised value of real estate also probably exceeds the cost, as present prices are the basis of the appraisal.

CONTRACTORS' PROFIT, ENGINEERING, ETC.

To the cost of labor and materials already given, Mr. Floy added ten per cent for contractors' profit upon all items except (8), (11), (12), (13) and (14). To the amounts thus obtained, he added fifteen per cent on all items

TABLE II.—OPERATING STATISTICS OF THE THIRD AVE. SYSTEM.
(Year ending June 30, 1909.)

	[illegible] owned.	Revenue car-miles in 1909.	Kw. hrs. used for railway.
(1) Third Avenue	1,026	6,998,375	16,592,830
(2) Kings Bridge			
(3) 42d St. M. & St. N. Avenue...		3,661,166	9,130,248
(4) Dry Dock, E. Broadway & B.	[illegible]	1,896,216	2,426,040
(5) Union Ry. Co.		9,323,345	21,[illegible]
(6) South. Boulevard			
(7) Bronx Traction			
Total of Items 1 to 7.	1,603	21,879,102	50,161,518
(8) Yonkers	21	2,336,785	
(9) Westchester Elec.	[illegible]	2,168,967	[illegible]
Total of Items 1 to 9........................	1,644	26,384,854	....

Note.—Railway (1) produced 78,187,530 KW. hours and sold to the other railway companies the excess over its own requirements, and for the production of this power Railway (1) had electric generators of 24,000 KW. total capacity. Railway (2) was operated by Railway (1). Railways (6) and (7) were operated by Railway (5). Railway (8) lies within the jurisdiction of the Public Service Commission of the Second District, and their annual report does not give the KW. hours.

TABLE III.—COST OF LABOR AND [illegible] NEW
[illegible] of Third Avenue System [illegible]

Group	[illegible]	[illegible]	[illegible] R. R. Co.	Total
(1) Buildings and structures	$ [illegible]	[illegible]	[illegible]	$ [illegible]
(2) Track	[illegible]	[illegible]	[illegible]	[illegible]
(3) Paving	[illegible]	[illegible]	[illegible]	[illegible]
(4) Distributing system	[illegible]	[illegible]	[illegible]	[illegible]
(5) Overhead distribution	[illegible]	[illegible]	[illegible]	[illegible]
(6) Duct lines	[illegible]	[illegible]	[illegible]	[illegible]
(7) Power equipment	[illegible]	[illegible]	[illegible]	[illegible]
(8) Rolling stock	[illegible]	[illegible]	[illegible]	[illegible]
(9) Removing obstructions	[illegible]			[illegible]
(10) Paving over obstructions	[illegible]			[illegible]
(11) Real estate	[illegible]	[illegible]	[illegible]	[illegible]
(12) Tools, supplies and fixtures	[illegible]	[illegible]	[illegible]	[illegible]
(13) Horses, wagons [illegible]	[illegible]			[illegible]
(14) Salvage material and apparatus	[illegible]			
Total	[illegible]	[illegible]	[illegible]	[illegible]

In this [illegible] Third Avenue Railroad [illegible] Street Manhattan [illegible] Company, [illegible] Broadway & Battery Railroad Company [illegible] Company [illegible] of New York City [illegible] Railroad Company and the Bronx [illegible] Company.

In this [illegible] vehicles.

except (11) to (14) [illegible] engineers' and architects' fees, administration expenses during construction, incidentals, contingencies, etc. The [illegible] reached was $16,[illegible], the [illegible] omitted as [illegible].

Mr Connette [illegible] with Mr Floy upon certain points. He did not add an allowance for contractors' profit or for engineering upon the [illegible] structions and of (10) paving over obstructions. The estimates given in Table III were asserted to be sufficiently liberal to cover anything of that sort, and the estimate made by the engineer whose figures Mr. Floy accepted so state. Mr. Connette also maintained that five per cent upon (8) rolling stock, amounting to over $331,500, was ample for engineers' fees, administration expenses, etc. Cars are ordinarily bought directly from the manufacturers who bear the expense of designing and testing and who charge prices sufficient to cover all such costs. The unit prices adopted by Mr Connette include delivery in New York City, and the applicants presented no evidence through Mr. Floy or through any other witness to show that fifteen per cent as estimated by Mr. Floy, or even ten per cent of the cost was ever paid by the Third Avenue Railroad Company upon rolling stock for engineering or administration.*

Mr. Connette also testified that a ten per cent allowance for the general expenses included under the heading of engineering, administration and incidentals computed upon items (1) to (7) inclusive is ample in this case. It is sometimes customary to allow five per cent for contingencies, incomplete inventories and unforeseen requirements. Here, however, the property to be appraised is in existence; it is not to be created. Further, unusual care has been exercised in making up inventories. The first step was taken by the companies themselves, or their receivers, and naturally they listed everything that could be called to mind. These lists were then checked and corrected by a consulting engineer in charge of the appraisal and his assistants. Mr. Floy, employed by the applicants, went over the inventories again to see if he could find anything that had been omitted or undervalued and added a small amount. Then Mr. Connette and his engineers verified the data, making virtually a fourth examination. It is believed that there are now practically no omissions or unappraised tangible property. Surely the allowance made by Mr. Connette will amply cover them, if there are any.

Table IV gives the appraisal of the cost of reproduction now, as made by Mr. Connette. He estimates the total cost to reproduce anew the entire property of the Third Avenue system to be $42,907,816, or about $3,500,000 less than Mr. Floy's appraisal. Mr. Connette considers that the question is not whether a certain percentage somewhat arbitrarily selected shall be applied to every item, but whether $2,370,000 as a general contractor's profit and nearly $3,000,000 for engineers' fees and general administration expenses during construction are sufficiently liberal. He considers that these allowances are adequate to cover an estimated period of construction of two years, which period is agreed to by Mr. Floy.

In this connection, it should be understood that the above allowance for contractors' profit is not the profit of the *sub*-contractors. The unit prices upon which Table III is based include a profit to sub-contractors. The contractors' profit of $2,370,000 allowed in Table IV is a *general* contractor's profit. It is assumed that the company turns the work over to a general contractor. He sublets various portions to sub-contractors, and everybody takes his profit. Now it is not necessary nor is it customary for companies to follow such a practice throughout all their construction work. It is customary to do so at the start, but extensions are often made, new power houses built and additional equipment purchased without the aid of a general contractor. The company deals directly with the sub-contractors and eliminates the general contractors' profit

The same is very largely true as to engineers' fees. When a company is started or an entirely new motive power installed, an engineer is employed to design the nucleus of the system. Extensions and additions are afterwards made along the same lines by adapting the old plans to the new conditions. The engineers of the company oversee the work and it is not found necessary except upon very new and difficult work to employ outside engineers at high salaries. The sum [illegible] years' construction appears to be an adequate and liberal allowance, especially in view of the failure of the applicants to show that a larger amount was actually paid or is customary.

Thus far we have been concerned with the cost to reproduce the physical property in a new condition. But the property to be acquired by the new company is not new; some [illegible] lete upon the date for which the appraisal was made—September 1st, 1909. It is necessary, therefore, in order to ascertain present value to deduct an amount for depreciation. Mr. Floy's figures are about $1,400,000 less than those submitted by Mr. Connette, which are given in Table V. Possibly Mr. Floy made the error of considering *as spent* about $1,000,000 which the company has *not* spent but purposes to spend. As the applicants include this $1,000,000 among the purposes for which they desire to issue new securities, it should not deduct from the actual depreciation.

The remaining difference between Mr. Floy and Mr. Connette is principally in one item—buildings and structures. The former considers the average life of buildings used for street railway purposes 100 years; the latter says 50 years is fully as long a period as should be considered to cover adequacy as well as age. The testimony of Mr. Starrett, formerly engineer for the Metropolitan Street Railway Company, is to the same effect, and a 50-year life seems the more reasonable. A building may still be in fair condition at the end of 50 years if properly maintained, but may be entirely inadequate for the use to be made of it.

In explanation of Table V, it should be stated that a second-hand value is not given to property immediately upon its being put into use. For example, a dynamo that is considered to have a life of 20 years, that is, to last 20 years before it will need to be replaced by another, is depreciated five per cent for every year of the expired term. It is not written down to its second-hand value if it has been in use six months. This method is considered proper, as the system is to be considered as a going concern and appraised as such. If "going concern value" were to be disregarded, the value of the property would be very greatly reduced The "straight line" depreciation method has been followed by both experts and is not so far in error, if in error at all, as to necessitate a revision of the figures submitted.

From other viewpoints, the figures of Mr. Connette are certainly fair towards the applicants. No deduction has been made for anticipated progress in the arts. It is frequently pointed out that the electrical industry has passed through many metamorphoses and that there are still equally great changes to come. The depreciation computed by Mr. Connette is founded merely upon what is now in sight, and not upon the theory that some new invention or discovery will revolutionize the present street railway system and render useless a large part of the present property before it has worn out This may happen, but it has not been discounted in Table V.

Upon three items—(9), (10) and (11), Table V—no depreciation has been computed. Obviously, real estate does not normally decline in value It might be argued that a conservative financial policy would require a company to write off gradually at least a portion of the large amounts represented by items (9) and (10). But the commission does not consider that a deduction should be required upon this ground

Mr. Connette finds that the present value of the physical property of the Third Avenue system, nothing as yet being added for devel-

TABLE IV.—COST TO REPRODUCE [illegible]
[illegible] Avenue [illegible] 1, 1909.)

Group	[illegible]	[illegible] profit.	Sum	[illegible]	Total
(1) Buildings and structures	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(2) Track	7,970,024	797,002	8,767,026	[illegible]	9,643,728
(3) Paving	2,582,998	258,299	2,841,297	284,129	3,125,426
(4) Distributing system	2,341,924	234,192	2,576,116	257,612	2,833,728
(5) Overhead distribution	914,275	91,428	1,005,703	100,570	1,106,273
(6) Duct lines	1,571,949	157,195	1,729,144	172,914	1,902,058
(7) Power equipment	2,751,276	275,128	3,026,404	302,640	[illegible]
(8) Rolling stock	[illegible]		[illegible]	[illegible]	6,962,406
(9) Removing obstructions	[illegible]		[illegible]		1,169,209
(10) Paving over obstructions	[illegible]		[illegible]		1,098,052
(11) Real estate	4,375,120	....	4,375,120	....	4,375,120
(12) Tools, supplies and fixtures....	[illegible]		[illegible]		541,343
(13) Horses, wagons [illegible]	[illegible]				56,874
(14) Salvage material and apparatus					[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] engineering, etc. is figured on rolling stock.

*T[illegible] in the first column are sufficiently large to cover contractor's profit and all other allowances.

As [illegible] Table III

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*Upon this point, the admission of the attorney for the applicants is worthy of note.

Commissioner M[illegible]: I am asking if he knows any company that has actually paid 15 per cent on its rolling stock.

Mr. Guthrie: [illegible] does not know such company; such a thing does not exist; such a thing has never existed in the history of railroad construction. We don't pretend it has."

[illegible] expenses, was [illegible] September 1, 1909, [illegible] $31,[illegible]. The method by which he reaches this figure is shown in Table V. Having determined "scrap value" and "wearing value" by subtracting scrap value from cost to reproduce new, he computes the total allowance for depreciation by adding the deductions to be made for "obsolescence, inadequacy and age," "deferred maintenance," and "wear and tear." This total is then deducted from wearing value which gives "remaining wear." This amount added to "scrap value" gives "present value." It should be noted that if scrap value is liberally estimated, the final estimate for present value will be liberal. Such is evidently the case, for it appears from recent sales of old material by the receiver that property that Mr. Connette estimated as having a scrap value of over $74,000, brought at actual sale only about $46,000.

In order that the appraisal might be brought down to the date of the transfer of the property to the new company, or the day preceding the foreclosure sale, the applicants were asked to supply a list of the property acquired and actually delivered between September 1, 1909, and February 28, 1910. Mr. Connette was asked to complete the appraisal to February 28, 1910, so that all the physical property would be appraised which would be transferred and for which a liability had been entered upon the liabilities' side of the ledgers. Mr. Connette testified that the net additions to property had actually cost the receiver $588,142. From this he deducted the appraised value of property withdrawn from service and disposed of, amounting to $74,552, leaving $513,590. He also testified that this item included about $30,000 worth of property which had been delivered but for which no liability had been entered in the statement of liabilities to the Commission as of February 28, 1910. Consequently this also should be deducted, leaving net about $483,600.

In Table V depreciation has been computed to September 1, 1909. It is, therefore, proper that credit should be given for any deferred maintenance that has been made good since that date and also that depreciation down to February 28, 1910, be debited. Mr. Connette testified that reduction in deferred maintenance had been $352,310 and that accrued depreciation amounted to $320,619, leaving a net increase in value of $31,691. If we add this increase and the net result reached in the preceding paragraph to the value given in Table V, we obtain a total of *approximately* $31,600,000, *as the present value of the physical property upon February* 28, 1910, *omitting development charges.*

ACTUAL VALUE VS. COST TO REPRODUCE NEW.

Although the applicants have presented evidence showing the estimated present value of the property, deductions having been made due to lack of repair, wear and tear, obsolescence, inadequacy and age, they argue that stocks and bonds should be allowed according to the cost to reproduce all existing property in a *new* condition and not in its present condition. The necessities of the case seem to require the applicants so to argue, for if depreciation be deducted the value will not justify the capitalization proposed, as will be [illegible] If their position were to be accepted by the Commission, it would mean that [illegible], the property should be considered worth about $42,900,000, development expenses yet to be added. In substance this theory means that if a street railroad company were to acquire the property of another street railroad company, it would not matter, so far as capitalization and value go, whether the property acquired was entirely new and in first class operating condition or whether it was worn out and obsolete. Under such a theory, the only question to be determined upon an application for the approval of stock and bonds would be, what would it cost to reproduce the property *new?* That having been determined, the case would be settled, no matter what might be the actual condition of the property.

Such a theory is unsound. The value of property is not determined by what it will cost to reproduce it new; its actual condition, its age, its adequacy, its fitness to the needs of the community are most important and fundamental considerations. Think of a company which has preserved all of its old horse cars, all of the machinery, plant and cars of a cable road, and all of the worn-out electric plant and equipment formerly used. This property is worth practically nothing except as scrap, but under the theory of the applicants, a purchasing company would be entitled to issue bonds and stock to the full amount of the cost to reproduce *new* all of these useless cars, equipment and plant, regardless of their actual value or what the purchasing company paid for them. But suppose, instead of preserving all of this useless stuff by storing it at considerable expense, the selling company had sold it for scrap before word had come of this new theory, then the purchasing company could capitalize the assets acquired only at the amount received for the scrap. That is, the mere scrapping or destruction of property before a sale would reduce by millions the capitalization that might be approved.

It is also argued by the applicants that a plant, which is in first class operating condition, although its cars may be somewhat old, its rails worn and its machinery aged, is worth as much from an operating point of view as a plant which is practically new throughout. They doubtless mean that such a plant can earn as much as one which is practically new and represents in value 100 per cent of its cost of reproduction. If this theory be sound and a valid basis for action in this case, it would mean that of the $10,000,000 or $12,000,000 of depreciation, which even Mr. Floy, witness for the applicants, admits as a demonstrable fact, not more than $3,000,000 or $5,000,000 should actually be considered. Instead of subtracting from the cost of reproduction new about $10,000,000, there should be subtracted but $3,000,000 or $5,000,000—or whatever amount of money would put the property in fair operating condition.

It may be that from a *gross* earnings point of view a system whose present value is equal to 75 or 80 per cent of its cost to reproduce new is nearly equivalent to a system whose present value is 100 per cent of its cost to reproduce new; but there are several considerations which prevent the complete acceptance of this theory when applied to *net* earnings. The cost of maintenance and repairs is less when a road is entirely new than when it is 75 per cent new. Plant and equipment become less efficient with age. But most important of all, the period is shortened within which provision must be made out of earnings for renewals, replacements and reconstruction. For example, take a street car which we will say, with ordinary usage and good management will last twenty years. Assume that it has been operated ten years and kept in first class condition so that it is giving good service. Nevertheless, that car is not worth as much to a purchaser or to a manager as a car that is one year old, and largely for the reason that a car that is ten years old has a remaining life of only ten years, and in those ten years the manager must accumulate a sufficient fund out of earnings to replace that car. In the case of the one-year-old car, he has nineteen years in which to accumulate a fund equal to its cost; in the case of the ten-year-old car, only ten years. In an extreme case, such as a dynamo which must be replaced in two or three years because near the end of its usefulness, as compared with a dynamo recently installed, it becomes quite apparent that the former, because it is nearer the time when it must be removed is not worth as much as the new dynamo which has just been installed. It was admitted by witness Floy, that an old road could not be sold for as much as a new road, and that is practically the question at issue here, for the property of the old company is to be acquired by purchase by the new company.

SHOULD NON-EXISTING PROPERTY BE CAPITALIZED?

Closely associated with the above theories is the argument advanced by the applicants that as certain lines started as horse-car lines and as a few were changed into cable roads and then into electric roads, the new company should be allowed to capitalize not only the present value of the property actually taken over but the cost of the horse-car lines and the cable roads that have disappeared.

It should be noted in the first place, that there is no adequate information before the Commission to show how extensive or costly these changes were. There is considerable mileage still operated by horse cars. Many of the present electric lines were never horse-car or cable lines. They were built originally as electric lines. However, it is doubtless true that money was spent for horse-car lines and cable roads that have ceased to exist. The statement is made as to the Third Avenue Railroad Company, proper, that in the present book cost of road and equipment and in the liabilities which are outstanding, there is an amount of about $2,000,000 for horse-car lines and equipment and about $8,000,000 for cable roads. These figures have not been proved, but whatever may be the amounts, the question is whether the new company should be allowed to issue securities that do not represent any property to be acquired or necessary expenses connected with such property.

It is intimated that one reason for so doing

TABLE V.—DEPRECIATION AND PRESENT VALUE, SEPT. 1, 1909. APPRAISAL OF THIRD AVENUE SYSTEM.

	Group.	Total cost to reproduce.	Scrap value.	Wearing value.	Obolescence, inadequacy and age	Deferred maintenance.	Wear and tear	Total.	Remaining wear.	Present value.
1	Buildings and structures	$ 6,758,733	$ 493,392	$ 6,265,341	$1,985,803	.		$ 1,985,803	$ 4,279,538	$ 4,772,930
2	Track	9,643,728	579,272	9,064,456	201,484	$ 566,000	$3,104,628	3,872,112	5,192,344	5,771,616
3	Paving	3,125,426	.	3,125,426	.... .	518,424	1,562,713	2,081,137	1,044,289	1,044,289
4	Distribution system	2,833,728	944,595	1,889,133	389,951	......	168,823	558,774	1,330,359	2,274,954
5	Overhead distribution system	1,106,273	243,150	863,123	139,398	21,565	205,617	366,580	496,543	739,693
6	Duct lines	1,902,058	.	1,902,058	175,532		38,559	214,091	1,687,967	1,687,967
7	Power equipment	3,329,044	*253,438	2,938,890	956,490			956,490	1,982,400	2,372,554
8	Rolling stock	6,962,406	255,600	6,706,806	1,621,694			1,621,694	5,085,112	5,340,712
9	Removing obstructions	1,169,209	.	1,169,209	.... .				1,169,209	1,169,209
10	Paving over obstructions	1,098,052		1,098,052				.	1,098,052	1,098,052
11	Real estate	4,375,120	.	4,375,120	... ..				4,375,120	4,375,120
12	Tools, supplies and fixtures	541,343	....	541,343	...		135,335	135,335	406,008	406,008
13	Horses, harness and wagons	56,874	.	56,874	. .		14,219	14,219	42,655	42,655
14	Salvage material and apparatus	5,822	.	5,822	.. .		1,456	1,456	4,366	4,366
	Total	$42,907,816	$2,769,447	$10,001,653	$5,470,352	$1,105,989	$5,231,350	$11,807,691	$28,193,962	$31,100,125

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*A figure of $136,716, representing the Brook Ave. substation, is included in the Power Equipment group, and appears in the columns for Cost to Reproduce and Present Value but does not appear in the other columns in the group. The apparent discrepancy will be avoided by subtracting this figure of $136,716 from the figure for Cost to Reproduce before making computations and then adding it to the result of the computations in order to obtain the Present Value. This figure was treated in this manner because a scrap value could not be obtained owing to the fact that an estimated value for the substation was used although the substation was not complete at the time of appraisal.

is that it would have been difficult, and perhaps impossible, for the old company to have written off out of earnings the cost of the property which has disappeared. The difficulty has not been established as a fact; indeed the contrary seems to be true. During the period of horse-car operation, the Third Avenue Company declared dividends averaging about 13 per cent, ranging from 8½ per cent to 25 per cent. During this period the company could have amortized or accumulated by sinking fund a sufficient amount to have been paid off the entire cost of the road as set forth above, and still have paid dividends of over 8 per cent and founded a reserve fund besides. From 1891 to the time when electrification began, the average rate of dividend was somewhat less; and from 1900 to date the dividends have been very small. But the capitalization of the company represented not actual plant investment, but large premiums paid for stocks, interest charges and even operating expenses, as set forth in the previous pages. If from the beginning a reasonable amount as depreciation had been set aside out of earnings to take care of the various changes which have taken place, if the company had been conservatively financed and expenditures carefully watched, it is probably true, that dividends of 6, 7 or 8 per cent could have been declared and yet a sufficient amount have been accumulated to write off the old horse-car and cable roads that have disappeared.

However, it is the first duty of every company to see that its capital investment is kept intact. All charges for repairs, renewals and replacements should be met out of earnings, and dividends should not be paid until these expenses have been provided for in some way. It is evident that the Third Avenue Railroad did not do so, but issued new stocks and bonds instead. The result was that its capital was depleted, that it could not pay the interest on its bonds and that the property has been sold under foreclosure. Counsel for the applicants seem to be of the opinion that all a company needs to provide for out of earnings is its daily needs and mandatory demands, and that the stockholder is entitled to dividends regardless of provision for depreciation. They say:

> We venture to [illegible] that the [illegible] time [illegible] applicable to public [illegible] corporations, will ultimately be [illegible] within the following lines: (1) that efficiency and safety of operation must be maintained in any event, (2) that repairs and maintenance must be provided irrespective of and before any return to the investor, (3) that the charge to the public must be limited to what is reasonable for the service rendered, and that this is to be measured by what is customary [illegible] necessary to secure a fair return, and (4) that, after realizing a reasonable return upon the investment, it is the right as well as the duty of the corporate managers to see that from earnings the investment is kept unimpaired in value.

This policy has brought many roads to financial disaster. Companies that are soundly financed make ample provision for depreciation before dividends are paid, and the capitalization of replacements, repairs, etc. is only pardonable as a temporary makeshift to be avoided wherever possible. Neglect to keep investment unimpaired in order that dividends may be paid will lead to ruin.

The mill owner who has seen his machinery change decade by decade, who has seen revolutions in the arts which have compelled him to scrap his equipment several times, would be interested to know that he ought not to have charged the cost to operating expenses or accumulated surplus, but that he should have issued stock or bonds against these numerous replacements. It would be news to him to learn that he is entitled to earn a return upon not only his present plant but upon the half-dozen plants that have preceded the present one and have been destroyed. He knows that if he tried such a plan, came to bankruptcy, and found his property sold at foreclosure sale, the purchaser would not pay him for the property that had disappeared.

DEVELOPMENT CHARGES

As already pointed out, no allowance has yet been made for interest and taxes during construction, organization expenses and other development charges. Certain items must still be added in order to determine the full present value of the property.

It should be recalled that certain general items have already been included in the appraisal, such as engineering, general superintendence and administration during construction. Naturally, nothing already allowed should be added here, but in the estimates presented by the applicants there is tendency to duplicate items. For example, the cost of obtaining consents from authorities and property owners is included in the allowance made for general administration expenses; the same item appears under development expenses. It is a legitimate charge, but should be included only once.

The applicants have asked that approval be granted to the issuance of securities to pay expenses connected with the organization and incorporation of the new company, a subject which will be considered subsequently. Witness Floy has included in development charges an estimate of the expenses connected with the incorporation, organization and promotion of the old Third Avenue Company. It is apparent that both cannot be granted. As a new corporation is to come into being, and as we are dealing with the issuance of securities for the new company, the estimated expenses connected with the establishment of the bankrupt company as a corporation should be omitted entirely from consideration. The new company does not take over the corporate organization of the old company.

Mr. Floy considers discounts, and promoters' profits, aggregating fifteen per cent or 60 per cent of the total development charges, as proper items to be included in the value of the property. This theory is wrong, for value does not depend upon the amount of discount or other inducements which a company must give in order to raise sufficient cash to pay for that property. If it did, the same property would have a greater value when purchased by a company having poor credit than by one having unlimited credit. It is undoubtedly true that the former company must issue a larger par value of bonds to raise the same amount of cash than the latter. Similarly, more 4 per cent bonds must be issued than 5 per cent bonds. These factors must be considered at the proper time, but it is improper to increase figures of cost or value by the discounts and other inducements which a company may need to give to investors and consider that the value of the property has been increased by the amount thus added. A building is not worth more because the owner has to discount the notes he gives to build it.

Mr. Floy has included interest and taxes not merely up to the time when operation begins, but also until the company can earn a sufficient surplus over and above operating expenses and interest to pay a reasonable dividend to the stockholders. According to this theory the longer a company is unable to earn a fair profit for its stockholders, the greater will be the value of the property; but everyone knows that such is not the case. The same theory would justify stock dividends, for if a company is entitled to *capitalize* unearned dividends below a reasonable return, say six or eight per cent, it follows that it may issue securities for such unearned dividends. Would the converse be admitted by Mr. Floy, viz., that if a company earned a large amount above operating expenses, interest and fair dividends, such surplus should go to reduce capitalization? Such theories are neither sound nor practicable, and Mr. Floy could cite no case where they had been followed.

The applicants seem to have fallen into this error, through a failure to differentiate the present case from a rate case. It might be thought fair, if a rate were being fixed to allow a company which had failed to earn a fair return upon its unimpaired investment during the early years of its existence to make up these deficiencies by larger earnings during the later years. But this principle is entirely different from the one enunciated by the applicants.

The proper period for the capitalization of development expenses ends when operation actually begins. Securities ought not to be issued to cover operating expenses, fixed charges or dividends after that time, except possibly in a most unusual case when such procedure is absolutely necessary to preserve the undertaking. In such an abnormal case, repayment must be made sooner or later out of earnings, and a company which attempts to secure dividends that are not earned by the issuance of securities has started upon the road which leads to financial disaster.

Interest during construction is undoubtedly a proper capital charge. Both Mr. Connette and Mr. Floy agree that the average period of construction would be about two years, and this estimate seems reasonable. As it is not necessary to raise the entire cost of the undertaking before work begins, but only such portion from time to time as will pay for the work completed, and as several large expenditures need not be incurred until just before the road is opened, it is customary to estimate the interest as equivalent to the normal rate upon the whole cost for one-half the period of construction or upon one-half the amount for the full period.

Mr. Floy estimates taxes at one-half of one per cent. This amount includes apparently every kind of tax from capital stock tax to franchise tax. It does not seem to be unreasonable and except so far as it includes taxes paid in connection with the corporate organization of the old company, it should be allowed.

Attention has already been called to the fact that the property has been valued as a going concern and that the appraisal is considerably larger than it would have been if this factor had been disregarded. However, it has been thought proper to make a still further allowance under this heading for the adjustment of the various parts to each other and the unification that must be brought about before an undertaking is harmoniously operated.

If we begin with Mr. Floy's estimates for legal expenses, proceedings, consents, interest and taxes, and omit duplications, corporate expenses of the passing Third Avenue Company and unearned dividends, reserving discounts, etc. for consideration elsewhere, the amount for development charges will be about $3,500,000. In view of the large amounts which the Commission is asked to capitalize under the heading of reorganization expenses or expenses connected with the organization of the new company, the above amount seems adequate. It should be remembered also that the appraisal assumes the existence of a general contractor who receives 10 per cent on the work he oversees. This would reduce development expenses. Further, a company does not ordinarily wait until the whole system is completed before beginning operation. When a considerable portion is completed, it is put in operation and other lines are added from time to time. This method also operates to keep down expenses.

[illegible]

Much evidence was submitted upon the subject of depreciation. That property depreciates is an indisputable fact, and the failure to recognize and provide for it has brought low many corporations. Unless the investment of security holders is kept intact by a depreciation fund or some other similar means, the day will come when there will be no funds or property to represent their securities. The street railway situation in Manhattan for the past three years is an ominous warning, and any one who unduly minimizes the subject of depreciation harms not only the investor, but the public.

Various estimates for depreciation were submitted in evidence. Mr. Bronner estimated it at $300,000, but admitted that he knew of no street railway company where five per cent had proved sufficient as an annual depreciation reserve. Mr. Whitridge said from $300,000 to $340,000 would be sufficient [illegible] the 59th Street and the Third Avenue lines, where it was advantageous from the standpoint of the company to show small net earnings, Mr. Whitridge testified that ten per cent would be necessary in addition to proper maintenance charges, which is equivalent to over $700,000, on the basis of 1908-9 receipts, omitting receipts from the sale of power and the rental of land, buildings, track, equipment, etc. In the special franchise tax litigation, the decision of the court was that an allowance of about nine per cent of gross receipts should be made. Upon this basis the deduction would be over $630,000. Mr. Floy, the only engineer called as a witness by the applicants, testified that in his opinion $300,000 set aside annually and compounded would be sufficient to cover obsolescence, but not the retirement of property because of age or inadequacy. He also stated that the amount would need to be "considerably larger" if it were to cover replacements and that it would be preferable to provide such a fund in advance of the need. One method suggested, that of issuing long-term notes, bonds or stock to provide for replacements or renewals, is unsound and dangerous. It leads to overcapitalization and financial suicide.

If only normal wear and tear be provided for directly out of operating expenses, obsolescence, inadequacy and age must be met by a depreciation fund or some similar fund. The question is, how much should be set aside annually, for this purpose? Mr. Connette and Mr. Floy agree upon the average life of most parts of the road, but disagree as to the expected life of buildings and structures. Mr. Floy says 100 years; Mr. Connette, 50 years, and this period seems more nearly correct. With the changing conditions in street railway operation, it does not seem reasonable to assume that buildings will last upon the average 100 years. If not torn down, they will have to be thoroughly remodeled long before a century rolls around.

If we assume that all provision for normal wear, depreciation, etc., on all property except buildings and structures, power plant equipment, and rolling stock be made directly out of earnings, the amount which should be set aside annually for depreciation on these three divisions of property would be about, using the straight line method and the valuations of the applicants:

Power plant equipment, 5 per cent	$1[illegible],000
Rolling stock, [illegible] per cent	[illegible]
Buildings and structures, [illegible] per cent	[illegible]
Total	[illegible]

The applicants have argued that allowance should be made for compound interest instead of simple amortization as above. If this were done and interest compounded semi-annually at the rate of 5 per cent per annum, the annual payments would be about:

Power plant equipment, 20 [illegible]	[illegible]
Rolling stock, 20 years	[illegible]
Buildings and structures, [illegible] years	[illegible]
Total	$370,000

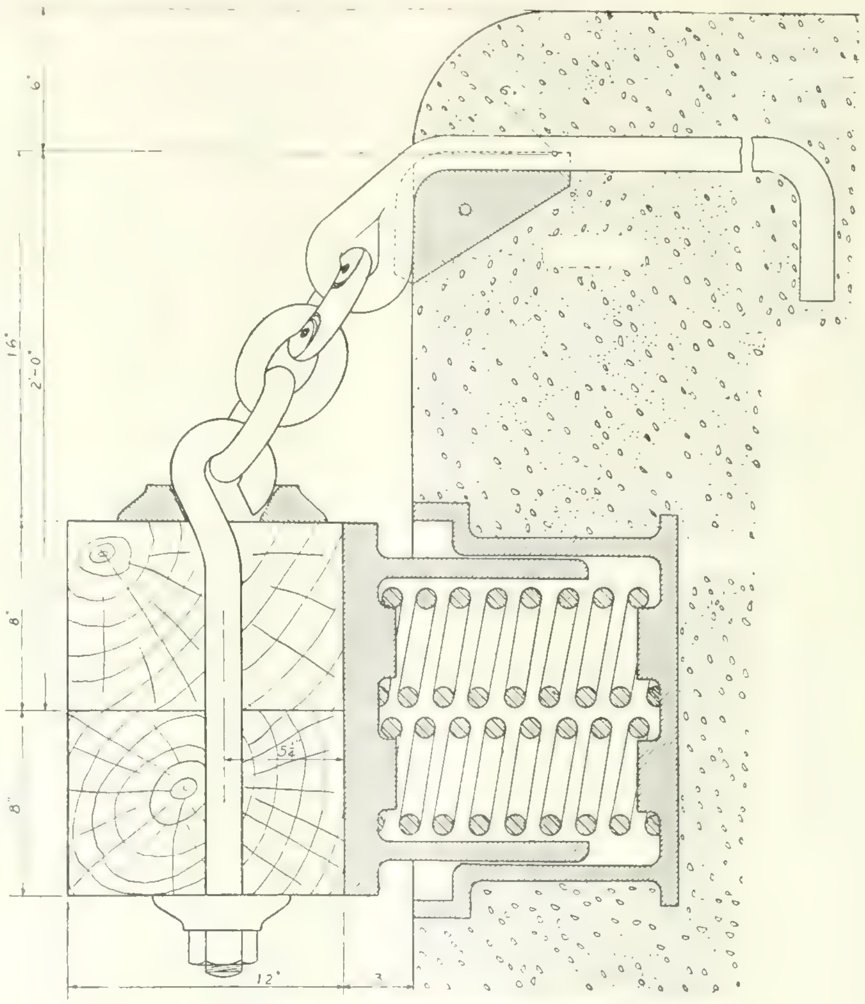
The sinking fund method would be very efficacious if it were possible to allow the payments to accumulate without drawing upon the fund, but it is not possible to do so. Replacements must be made year by year. For example, street cars do not have the character of the one-horse shay, all collapsing at the same time. Consequently, the fund would not compound without interruption. At times the demands would doubtless not be as great as the payments, and there would be some compounding. It would not be safe, however, to consider that the annual contribution could be reduced below $500,000, if the capitalization were to be that proposed by the applicants.

Provision should also be made for other reserves. No prudently managed company distributes every dollar of its net earnings. A contingent reserve to be used in emergencies and to meet unforeseen contingencies should be accumulated. It need not be large, and a part of one per cent of the gross earnings would probably be ample.

Movable Buffer Beams for Panama Locks.

The accompanying drawing shows the design for the movable buffer beams to be placed in the locks at Panama. Back of the timber beams, which will be suspended by short chains anchored to the lock walls, cast iron boxes containing two 1-in. car springs 12¾ ins. in length will be placed. The cast iron box will be set in the concrete and the movable part, as shown, will slip inside against the two springs. The buffer spring boxes will be placed at 5-ft. centers.

The anchor rods will be made of 1½-in. diam. steel 3 ft. long, set into the concrete and bent down 9 ins. at right angles in the concrete. The eye end of the rod will be bent downward over a grooved casting set in the face of the wall, as shown, to protect the concrete from chipping off and to prevent the rod from being bent at a sharp angle. The anchor chains will consist of three links and one of these will have a removable piece for making the connection with the anchor bolt. The anchor bolts will be spaced 15 ft. apart.



Detail of Movable Buffer Beam.

There will be two buffer beams on each lock wall. The top one will be placed 2 ft. 6 ins. below the top of the lock wall and the lower one will be 10 ft. below the top of the wall. Each beam will be made of two 8x12-in. timbers, bolted flat sides together.

PERSONALS.

Mr. W. Hollingsworth, a member of the staff of the city engineer of Toronto, Canada, has been appointed assistant city engineer of Hamilton, Ontario, Canada, at an annual salary of $2,000.

Mr. E. O. Reeder, assistant chief engineer of the Chicago, Milwaukee & St. Paul Ry., has been appointed chief engineer of the Chicago, Milwaukee &Puget Sound Ry., succeeding E. J. Pearson, as noted elsewhere in this column. Mr. Reeder is succeeded by Mr. W. H. Penfield.

Mr. F. [illegible] [illegible], division engineer of [illegible]

Missouri Pacific Railway at Atchison, Kans., has been appointed supervisor of bridges and buildings, with headquarters at Atchison. He succeeds Mr. W. B. Wood, whose death was announced recently.

Mr. H. I. Miller, who recently completed an expert examination of the Missouri Pacific properties, has been elected a vice-president of that company. Mr. Miller was formerly president of the Chicago & Eastern Illinois R. R., the Evansville & Terre Haute R. R. and the Evansville & Indiana R. R.

The new passenger terminal of the Chicago & North Western Railway at Chicago was opened to traffic on April 1. This is one of the largest terminal installations in the world, and has been under construction for over three years. A description of the important features of the station was given in our issue of Feb. 22, 1911.

Mr. H. P. Mobberly and Mr. W. A. Burton, civil engineers, have formed a partnership under the name of Mobberly & Burton, with offices at 422 Woodruff building, Springfield, Mo. They will engage in a general engineering practice, giving special attention to railroads, drainage, municipal engineering and hydro-electric practice.

Mr. J. W. Kendrick, vice-president in charge of operation of the Atchison, Topeka & Santa Fe Ry., severed his connection with that company on June 1. The vacancy caused by his resignation will not be filed. Mr. William B. Storey, vice-president in charge of construction, becomes vice-president in charge of construction and operation.

Mr. E. J. Pearson, chief engineer of the Chicago, Milwaukee & Puget Sound Ry., has been elected vice-president in charge of operation of the Missouri Pacific Ry. He is succeeded as chief engineer of the C., M. & P. S. Ry. by Mr. E. O. Reeder, assistant chief engineer of the Chicago, Milwaukee & St. Paul Ry. Mr. Pearson is a graduate of Cornell University. He entered the railway service in 1880 as a rodman on the Missouri Pacific. Later he served in the engineering department of the Missouri, Kansas & Texas Ry. and the Atlantic & Pacific R. R. Going to the Northern Pacific Ry. in 1883 as assistant engineer, he served in various capacities in the engineering and operating departments of that road, being successively superintendent of the Rocky Mountain division, superintendent of the Pacific division, general superintendent and chief engineer. When construction was started on the Chicago, Milwaukee & Puget Sound Ry. he became chief engineer of that road.

CONTRACT NEWS SECTION
of
ENGINEERING & CONTRACTING

The Doings of the Week.

Railroad work, as far as the letting of construction contracts goes, seems to have bumped up against a [illegible] the past week. Very few contracts of any [illegible] to have been let. It is not expected that this condition will continue, and many contractors believe that the present month will see the letting of a considerable number of good contracts. The authorizing of a $600,000,000 bond issue by the Great Northern Ry. Co. is thought to be the forerunner of extensive improvement work by that road. The recent traffic agreement between the Frisco and the Iron Mountain also provides for much betterment work by the latter road, and the construction of 40 to 50 miles of new line. The Union Pacific Ry. has also taken bids on the construction of a new line from Callaway to Gandy, Neb., and the contract will probably have been let by the time this paper appears. This work includes about 1,000,000 cu. yds of excavation, most of which will be [illegible] work.

Among the railroad construction contracts let recently are the following: John F. Dolan Contracting Co., for building about a mile cut off for the Delaware, Lackawanna & Western R. R., from the Hampton yards to the main line of the Bloomsburg division, at a point near the Dodge breaker in Pennsylvania; Roach & Stansell, Memphis, Tenn., for the grading work on the new line of the Kansas City, Mexico & Orient Ry., from Mertzon to Alpine, Tex., the contract amounting to about $600,000. The Atlas Engineering & Construction Co., Minneapolis, Minn., for constructing the 15-mile line of the Minneapolis Northern Suburban Ry. Co.; Ole Erickson, Cloquet, Minn., for building a spur line from the Great Northern Ry. to the Platte Mine, near Nashwauk; M. L. Linnan, Baton Rouge, La., for grading work on the 7-mile extension of the Frisco road from Lakeland up the False River in Louisiana.

The Board of Water Supply of New York has awarded two of the contracts for the construction of the deep pressure tunnel to be built under New York City for the Catskill water supply. Contract 63 was awarded to Mason & Hanger Co., Cornwall-on-Hudson, N. Y., and Contract 67 to the Holbrook, Cabot & Rollins Corporation, New York. Two other contracts are yet to be let on this tunnel work. Bids for all four of these contracts were opened May 16; the itemized bid of the low bidder on each contract were given in our last issue.

In the line of drainage work about the largest contract to be advertised this week is for work in Drainage District No. 1, of Bates County, Mo. This contract calls for the excavation of about 1,110,000 cu. yds. of material. Bids are to be opened June 21 at Butler, Mo.

A good sized road construction contract has just been let by the Commissioners Court of Williamson County, Texas. This contract calls for the construction of about 40 miles of gravel and macadam roads in Road District No. 2; it was let to the Texas Building Co., Waco, Tex., at $2,500 per mile.

Three large government dredging contracts are now being advertised. One of them calls for dredging in Savannah Harbor, Ga., the total approximate yardage to be removed being 1,600,000 cu. yds.; another contract calls for dredging in Delaware River, on Tinicum and New Castle Ranges, the work being for the main ship channel of the Delaware River. This contract calls for the removal of approximately 2,117,000 cu. yds. of material. The third contract calls for dredging in Providence River and Harbor, R. I., the work involving the removal of about 1,666,000 cu. yds. (place measurement) of material.

Tenders are to be asked at once by the Departments of Railways and Canals, Ottawa, Ont., for extensive harbor terminal improvements at Halifax, costing in the aggregate about $2,000,000. The plans provide for the construction of four new piers each 800 ft. long and 235 ft. wide.

It is believed that construction work may be started within the next two months on the drainage ditches for Cameron County Drainage District No 1 in Texas. It is said that arrangements have been about completed whereby a contractor will take the bonds amounting to $204,500 in payment for the work. A. W. Amthor, Brownsville, Texas, is Engineer of the District.

Israel M. Ross.

One of the first contractors to strike the one-mile-a-day pace for railroad construction in Canada is dead. The man was Israel M. Ross of Winnipeg. He was one of the pioneer railway contractors of Western Canada. He came to Winnipeg in 1879 when that place was the outpost of civilization in Western Canada. His first railway experience was acquired in the Maritime Provinces on the Intercolonial Ry. He then went west and for a number of years was connected with the Canadian Pacific system. He remained with this railway for a few years, and then entered into a partnership with Donald Grant, forming what was to be one of the greatest railway contracting firms in the history of Canada. The contracts this firm had with the Canadian Pacific Ry. were many. A big part of the road between Winnipeg and the Rocky Mountains was built by it. The Canadian Pacific north shore line and the Great Northern line from Lethbridge, Alberta, to Great Falls, Mont., were built by Ross & Grant. The Chicago & Northwestern Ry. line from Chicago to St. Paul was also double tracked by this firm. Early in the nineties Mr. Ross withdraw from railway contracting and settled down in Winnipeg. He immediately became interested in local building work, and many of the business structures now adorning the business streets were built by him. Later on he severed all connection with construction work and became interested in local financial institutions in Winnipeg. He died May 26 at his home in that city, aged 70 years.

Canadian Railroad Construction.

Railroad contractors in Canada have had no reason to complain of the amount of work this season. The three great railway systems—the Canadian Pacific, the Grand Trunk Pacific and the Canadian Northern—have been particularly active and have let contracts this year for a large amount of new construction work. That the many contracts already let are by no means the end of the present season's construction plans is shown by the fact that tenders are now being publicly asked for two of the largest contracts of the year. One of these contracts calls for the construction of three sections of the Canadian Northern Ontario Ry., a subsidiary line of the Canadian Northern. The sections on which tenders are being asked are: from Port Arthur to a point on the boundary line between the Districts of Thunder Bay and Algoma; from the end of Section 1 to Kapuskasing Lake; and from Kapuskasing Lake to Sellwood Junction. Tenders for these three sections are to be received at Toronto, not later than July 1. The tenders are to include cleaning, grubbing, grading, bridges, track laying, etc., and all of the work is to be completed by October 1, 1913. The other contract for which tenders are now being asked calls for the construction of a 185-mile section of the Hudson Bay Ry., from Pass Mission to Thicket Portage. This railway is being built under the auspices of the Dominion Government, and the tenders will be received until August 1 by the Department of Railways and Canals at Ottawa. Tenders on the remaining sections of this railway will probably be asked early next year. In addition to the above, surveys have been practically completed for the construction of the Halifax & Eastern Ry. and for the line around the north shore of the Bras d'Or Lake in Nova Scotia, which will be an extension of the Intercolonial system. Tenders for these works are to be asked at once. This work will also be done under the direction of the Department of Railways and Canals.

Highway Construction Prospects.

It has been estimated that within a few years the expenditures in the United States for the construction and maintenance of roads and bridges will amount to $1,000,000 per day. Some basis for this prophecy is found in the fact that in 1904 the expenditures for the construction and maintenance of roads and bridges totaled $80,000,000, while for 1911 the expenditure is estimated at about $140,000,000. The greater part of this sum, of course, will be spent for the ordinary maintenance work, but new construction work this year will take a larger expenditure than in any previous year. In one state alone, nearly $17,000,000 is already in sight for the construction of improved highways. This state, Texas, will construct its improved highways on the county system; that is each county votes bonds to improve the highways within its limits. On Jan. 1, 1911, bond money to the amount of $3,146,323 was on hand in some 20 counties in this state. Bond elections were held in these counties in the latter part of 1910 and this sum remained unexpended on Jan. 1. Since Jan. 1, 23 other counties have voted to issue or have issued bonds to the amount of $3,125,500. Of this amount the largest single bond issue was voted in Liberty County. This county voted the sum of $525,000 to build its portion of the continuous highway from Port Arthur to Galveston, via Beaumont and Houston. In nine other counties bond issue elections have been ordered and will be held during this month, the total amount of the bond issues being $1,430,000. In 18 other counties organized movements are under way for voting on bond issues for highway work. The total amount of these proposed issues is $4,580,000. In other states the matter of building county systems of im[illegible] North Carolina [illegible] from county bond issues, and the legislature has authorized the construction of 425 miles of road from the coast to the Tennessee line. In Virginia about $2,500,000 is available from county bond issues, and in many other Southern states county bond issues to a large amount have been authorized.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

Papers have been filed with Secretary of State showing that the Nashville & Decatur R. R., which is controlled by the Louisville & Nashville R. R., W. H. Courtenay, Chief Engineer, Louisville, Ky., will extend a branch from Athens, Ala., to a connection with the Lewisburg & Northern R. R., at a point on the Tennessee-Alabama state line, about eight miles east of Veto, Ala.

Advices from Montgomery, Ala., state that plans have materialized to such an extent as to make it practically certain that the Montgomery & Chattanooga R. R. will be constructed in the near future. This read will run from Montgomery to Alexander City, a distance of fifty-six miles through the counties of Montgomery, Elmore and Coosa and will traverse a territory of [illegible] miles of the richest white populated area in the State of Alabama. The entire line is said to have been located and the right of way for every mile from Montgomery to Alexander City secured. The work will be started from Montgomery and the line of road built out by Pickett Springs, crossing the Coosa River at Ware's Ferry and passing the town of Wetumpka on the western side of the river and not touching the line of the Louisville and Nashville at that point. From Wetumpka the route will be through that part of Elmore County, into and through Coosa County and on into Tallapoosa County to the other terminus of the road, Alexander City.

Alaska.

The Copper River & Northwestern Ry., E. C. Hawkins, Chief Engineer, Lowman Bldg., Seattle, Wash., is to start surveys shortly for an extension to the White River country in Alaska. The proposed extension will leave the main line at Mile 191 and will be 60 miles long. It will enter a mining district that is being developed rapidly.

Arizona.

The Atchison, Topeka & Santa Fe system is to build a branch line from Berry station, six miles east of Kingman, to the foot of Stockton Hill. This line will be approximately eight miles in length and will handle all freight to that point, being built especially to handle the ores of the Needles Mining & Smelting Co. The roadbed grading will probably be done by S. E. Bright of San Bernardino.

Arkansas.

Efforts are being made to interest the St. Louis Southwestern Ry. Co. in buying the Saline River Lumber Co.'s railroad and extending it to Warren. The road now runs from Draughon on the St. Louis-Southwestern or Cotton Belt, to Glynn, via New Edinburg.

In connection with the Missouri Pacific-Iron Mountain-Frisco trackage agreement, giving the Frisco the joint use of the Iron Mountain's tracks from Memphis to Baton Rouge, announcement has been made that the Missouri Pacific will construct a new short line of 41 miles between Memphis and Marianna, Ark., thus making a link in a direct route to the gulf. E. F. Mitchell, St. Louis, Mo., is Chief Engineer, Missouri Pacific.

California.

The Bakersfield & Kern Electric Ry. Co. has been incorporated with a capital stock of $200,000, of which $5,000 has been subscribed. The directors are C. R. Eager, S. B. Cushing, H. A. Blodgett, F. T. Whorff and C. N. Beal.

The San Joaquin Delta Ry. Co., incorporated last week with a capital stock of $500,000, proposes to build a railroad from Stockton in a southwestern direction across Robert's Island, Victoria Island, the Byron tract and into Contra Costa county. A branch line will be constructed from Robert's Island to Tracy to connect with the Southern Pacific. The following are the board of directors: E. W. S. Woods, L. H. Woods, Frank West and E. L. Wilhoit of Stockton, and W. P. Plummer, I. L. Borden and Marcel E. Cerf of San Francisco.

The San Joaquin Light & Power Co., Fresno, Cal., has applied to the City Council of Bakersfield for a franchise to extend its street car lines on North Chester to the city limits.

Construction work has been started on the proposed standard gage railroad from Auburn, Placer County, Cal., to Cool, El Dorado County, and about 1,000 men are reported on the work. The line will be used for hauling the products of the large quarry and mines along the route.

Right of way agents of the Southern Pacific Ry. are operating successfully in securing the necessary land for the construction of the branch line from Arbuckle to Hamilton City, via Colusa and Princeton, Cal.

The Ventura County Ry. Co. has filed its articles of incorporation in the office of the County Clerk at Ventura. The capital stock is $500,000 and the directors named are Robert Oxnard, Oxnard, Cal.; J. D. Barry, J. A. Driffill, A. M. Duperu and R. Beck. It is understood that this new company has been organized to extend the line of the Bakersfield & Ventura R. R. of the American Sugar Beet Co.

Colorado.

Business men of Greeley have petitioned the Union Pacific Ry., asking that the road construct a line between Gill and Cornish on the Crow Creek branch, and Fort Morgan or some other point of the Julesburg branch, and the operation of all but the fastest trains between Chicago and Omaha on the east and Denver on the west through Greeley.

The Commercial Club of Evans, Colo., is to ask the Greeley Street Ry. Co., Greeley, to extend its lines to Evans.

The Red Mountain Scenic Ry. Co. has been organized by D. H. Rupp, R. D. Weir and T. J. Sanford, all of Manitou, Col., and proposes the construction of a scenic incline railway at Manitou. It will run from Ruxton Ave. to the summit of Red mountain, a distance of 3,200 ft., and will cost in the neighborhood of $50,000. Construction work will be started in August or September and the line will be completed in time to begin operations at the opening of the 1912 tourist season.

The sum of $350,000 is reported to have been raised for building a steam railroad from Hotchkiss to Crawford and Maher, to be known as the Colorado & Red Canon Ry. The same company also contemplates the construction of a steam road from Cedar Edge to a point on the D. & R. G. near Austin. E. B. Priest, Delta, Colo., is interested.

Announcement has been made that the new owners of the Denver, Northwestern & Pacific Ry. (Moffat road) will at once issue bonds to complete the line from its present western terminal in Steamboat Springs, Colo., to Salt Lake. L. D. Blauvelt, Denver, Colo., is Chief Engineer.

Connecticut.

The New York, New Haven & Hartford R. R., Edw. Gagel, Chief Engineer, New Haven, Conn., is to widen its old Derby Division through New Haven for an additional track through the city and for a considerable distance outside. New bridges are to be built over the deep cut through which it runs and an additional track is to be built in the cut to double track the division for this distance. The cut is to be walled with concrete after the fashion of the main line cut through the city of New Haven. Upon the completion of the double tracking between Derby and Hawleyville now going forward and of the large freight yard which is to be built where the canal of the Birmingham Water Co. has been for many years, this division is to become an important freight line for through traffic from the Hudson River and west of there.

Florida.

The Citrus Southern Ry. Co. is seeking the adoption of an ordinance by the City Council of Kissimmee, Fla., providing for the construction of its tracks on Main St., Broadway, Stewart Ave., Brack, Vine and Parks Sts.

Georgia.

⊙Construction work is now under way on a 17-mile extension of the Gulf Line Ry. from Bridgeboro to Camilla, Ga. J. T. Lamb, Thomasville, Ga., is the contractor. H. O. Breman, Sylvester, Ga., is Chief Engineer of the Gulf Line Ry., and W. T. Haigrett, Sylvester, is General Superintendent.

The State Railroad Commission has authorized the Georgia Railway & Electric Co., Atlanta, Ga., to extend the Buckhead car line to the Brookhaven Country Club, a distance of about three miles. It is estimated that the extension will cost about $40,000.

The promoters of the proposed Atlanta, Griffin & Macon Electric Interurban line have been over the route in company with representatives of English and New York capitalists. W. J. Massee, Macon, Ga., President of the Central Georgia Power Co., is interested in the interurban project.

An announcement is reported to have been made by the officials of the Macon, Dublin & Savannah R. R., to the effect that work will be started the latter part of July on the improvement of the terminals at Macon, Ga. The cost of the work is estimated at $250,000, and will include among other items the construction of a new freight depot. J. T. Wright, Jr., Macon, Ga., is general manager.

Idaho.

⊙Maney Bros. Co., Boise, Idaho, has been awarded the contract by the U. S. Reclamation Service for constructing nine miles of railroad grade from Barberton, Idaho, to Boise River for the Boise Irrigation Project. The contract price is about $27,910. Itemized bids on this work were given in our issue of May 17.

Illinois.

The Central Terminal Ry. Co. has been incorporated with a capital stock of $2,000,000, and proposes to construct a line from Forest Park to Chicago. The principal office is at Chicago. The incorporators and first board of directors are Donald R. McLennan, Charles E. Vroman, Joseph W. Hiner, Fayette S. Munro, John C. Vroman, all of Chicago.

Steps are being taken for the formation of an independent transportation company to serve the residents of Berwyn, Melrose Park, River Forest and several other towns and villages near Chicago. It is stated that $35,000 has been subscribed and that $200,000 more is in sight. George B. Comerford, Cicero, Ill., is interested.

The Western Indiana R. R. has accepted an ordinance of the City Council of Chicago directing it to elevate its tracks between 111th and 120th Sts. on the Dolton branch of its line. The Illinois Central likewise has agreed to accept an ordinance requiring it to raise its tracks from State St. to Stony Island Ave. in South Chicago.

The Chicago & Northwestern Ry. is reported to have under consideration the construction of a bridge over the Mississippi River north of East St. Louis, Ill.

The Atchison, Topeka & Santa Fe Ry. is reported to have appropriated $12,000 to straighten and improve the condition of the road between Pekin and Streator, Ill. A large portion of the money will be required to improve the curve and heavy grade at the old race track east of Pekin.

Reports from Morris, Ill., state that all right of way between Lisbon and Wedron, LaSalle County, Ill., has been secured for the construction of the proposed line through Lisbon, a few miles north of Morris.

The Cicero & Southwestern Ry. Co., of Cicero, has been incorporated with a capital stock of $1,000, and proposes to construct and operate street railroads. The incorporators are Emil R. Rosenthal, Louis Cohen and Augustus J. C. Timm.

The Cleveland, Cincinnati, Chicago & St. Louis Ry., Geo. P. Smith, Chief Engineer, Cincinnati, O., is to construct four miles of switch track leading from the main line to Taylor Springs. This trackage will be used to accommodate the Montgomery County Coal Co., and the American Zinc, Lead & Smelting Co., which will soon be actively engaged in erecting a large plant west of the Taylor Springs mine.

The Kankakee & Urbana Traction Co. is reported to be planning to have construction work started in the next few weeks on the first 14 miles of its projected line. The company proposes to build 14 miles northward from Urbana on the east side of the Illinois Central tracks this season with Rantoul as a terminus. When the line is extended the Illinois Central tracks will be crossed at Rantoul and the line proceed northward to Kankakee on the west side of the railroad. At a recent meeting of the directors it was decided to transfer the headquarters of the company to Urbana. William Hickey, Kankakee, Ill., is a director.

Indiana.

The Winona Interurban Ry. Co., Warsaw, Ind., has made a proposition to the town of Nappanee to run cars to Nappanee, if that town will build a spur to Milford Junction.

The St. Louis & San Francisco Ry., according to reports from St. Louis, Mo., is planning as the first step toward merging all subsidiary lines, the absorption of the Evansville & Terre Haute by the Chicago & Eastern Illinois R. R.

The Elgin, Joliet & Eastern Ry., A. Montzheimer, Chief Engineer, Joliet, plans to extend its line from Porter, east of Gary, to Michigan City.

The Indianapolis, Nashville & Southern Ry. Co., which proposes to construct an electric railway from Indianapolis to West Baden and French Lick, has filed a petition with the Marion county commissioners for a franchise allowing the company to construct its line across certain highways in the county which the proposed line will intersect. The company proposes to build a line through Marion, Morgan, Brown, Monroe and Orange counties by way of Nashville and Bloomington. The right-of-way through Marion county, outside the city of Indianapolis, will start at the south end of Meridian St., and run parallel to the Three-Notch gravel road directly south, to the county line. John A. Johnston is president, and Thomas F. Wakeland is secretary of the company.

The City of Vincennes and Vincennes Township have recently voted subsidies to the Vincennes, Washington & Eastern Traction Co., the Vincennes North & South Traction Co., and the Vincennes Interstate Traction Co.

Iowa.

The Waterloo, Cedar Falls & Northern Ry. (electric) is projecting a 16 mile extension along the west side of Cedar River. Surveys have not been made as yet, and the capital for construction has not been entirely secured. It is possible, however, that construction contracts will be let in the next 60 days. L. S. Cass, Waterloo, Ia., is President; T. E. Rust, Waterloo, is Chief Engineer.

The Chicago, Rock Island & Pacific Ry., J. R. Berry, Chief Engineer, Chicago, Ill., is understood to be planning the expenditure of $200,000 for the improvement of its yards at Valley Junction.

Advices from Marshalltown, Ia., state that the engineering department of the Iowa Central R. R. is planning the improvement of the company's main line from Eldora to Steamboat Rock by which several curves and grades and bad highway crossings will be removed. The revision contemplates the abandonment of the present right of way for a distance of about two miles north of Eldora and about the same distance south of Steamboat Rock, and the laying of new steel on a new right of way. By the change, aside from obliterating a compound curve and a heavy grade, known as Steamboat hill, the Perkins crossing will be done away with at the north end of the cut. R. G. Keney, Minneapolis, Minn., is engineer.

The Chicago & Northwestern Ry. is preparing to ask the City Council of Sioux City, Ia., for a franchise for 11 or more side tracks throughout the lower business section of the city.

Kansas.

The Kansas City Terminal Ry. Co., Kansas City, Mo., has asked the City Commissioners of Kansas City, Kan., for the right to build a switch track across 5th St. in the Armourdale district to connect with its railroad yards in that section, which were recently purchased at a cost of $250,000. The Terminal Co. is planning extensive improvements for that section of the city.

In regard to the construction of the proposed line of the Scott City Northern Ry., reports from Russell Springs, Kan., state that grading is progressing nicely across the townsite. East and southward the grade is nearly finished except the big cut, and will take about 20 days to finish that. The bridge gang is busy and steel is being laid in the south part of the county at the rate of about ¾ mile per day.

The Chicago, Rock Island & Pacific Ry. is reported to be considering building a cutoff from Wichita to Arlington. The latter place is about ten miles southwest of Hutchinson on the Rock Island, and it is about 60 miles from Arlington across country to Wichita. It is also reported that the Rock Island is considering building a direct line from Pratt to Anthony. It is about 70 miles across country from Pratt to Anthony. The new line, also the proposed cutoff from Arlington to Wichita, would run in a southeasterly direction.

Surveys have been started from Anthony, Kan., for a proposed line of the Kansas, Southwestern & Colorado R. R. O. T. Reece, Wellington, Kan., is Engineer in charge of surveys.

Kentucky.

A committee has been appointed by the Board of Trade, Louisville, Ky., to interview the officials of the Kentucky & Indiana Terminal R. R. Co., relative to the approach of the new structure beginning at a point at the foot of 31st St. It is hoped to bring about an agreement whereby the grade crossings at Market and Main Sts. and Portland Ave. will be eliminated.

The Louisville & Nashville R. R. has recently awarded a contract for double tracking its line between Covington, Ky., and Paris, Ky.

The Edw. B. Garretson Co., 1210 Mercantile Library Bldg., Cincinnati, O., has two steam shovels working on its double track contract with the C. & O. Ry. Co., near Bradford, Ky. The work is progressing nicely, and the contract will be completed within the time specified.

Louisiana.

⦿M. L. Linnan, Baton Rouge, La., has been awarded the contract for the grading of the 7-mile extension of the Frisco road from Lakeland up the False River to the Mix place. This extension will make the False River branch 14 miles in length, and turn it into one of the important feeders for the Frisco. The road, when completed, will run from Erwinville to the Mix place, in Pointe Toupee Parish.

The Globe Lumber Co., Ltd., has completed surveys for a 10-mile logging road, and will let construction contracts in the near future. A. C. Chaddick, Yellow Pine, La., is Chief Engineer. Contract will be let by J. W. Martin, General Manager, Yellow Pine, La.

Leo A. Marrero, New Orleans, La., has secured the franchise for an electric street railway line between Gretna and Waggaman. It is planned to organize a company to build and operate the line.

Deeds have been recorded at Lake Charles conveying to the Jennings Construction Co. the rights of way for the Lake Arthur, Jennings & Northern R. R. from Lake Arthur to Elton. The papers show that most of the right of way was bought outright. It is understood that the filing of these papers is preliminary to the sale of the railroad, on which nearly all the grading has been completed, either to the Colorado Southern or to the Louisiana Western.

Maryland.

The Baltimore & Virginia R. R. Co., which proposes the construction of an electric line to Drum Point, is reported to be planning to have construction work started this month. It is estimated that the cost of the new line will be approximately $1,000,000. This includes laying rails and building trestles and the overhead work and the cost of equipment and construction of two "booster" stations which will be necessary for the transmission line which will carry the current. The company plans to secure its power from the Washington, Baltimore & Annapolis Electric R. R. Co.'s Washington plant. Littleton M. Sturgis, Baltimore, Md., is President of the Baltimore & Virginia R. R.

Michigan.

Engineers supposed to be in the employ of the Saginaw & Flint Ry. (electric), Saginaw, have been running surveys from the Saginaw & Flint terminal in Saginaw to a point a few miles south of Bay City.

The Stearns Light & Power Co., of Ludington, has taken over the property of the Interurban Electric Light & Power Co., which includes high transmission lines from Hamlin, Mason county, to Hart, Oceana county, and all other equipment except the power plant at Hamlin lake. It is believed that the Stearns Co. plans to operate an electric line in Ludington.

Work will soon be completed on the extension of the Manistique & Lake Superior R. R. from Shingleton to Evelyn on the East branch of the Munising railway which was begun last Fall. G. K. Lowell, Detroit, Mich., is vice-president and general manager of the company.

The City of Kalamazoo, Mich., as noted previously in these columns, has taken the initial steps looking to the elevation of railroad tracks. A committee consisting of five citizens has been appointed, whose duty it is to get in touch with the track elevation situation generally, and with the officials of the various railroads interested, to determine what it is necessary to do in the matter. The committee has visited Joliet, where much work of this kind has been done. It has also had a conference with one or two of the engineering departments of the railroads and it has a date fixed, viz., June 7, at which time it is expected the engineering departments of all the railroads entering the city will be present, and it is proposed that this conference shall determine, if possible, the position which the roads will take in the matter and to see whether within a reasonable length of time a start can be made in this direction in a friendly and cooperative way or whether in order to obtain this much desired object it will be necessary to go to the courts. The conferences so far held indicate that the railroads are willing and anxious to elevate their tracks, and that it is more a lack of funds than a disposition to resist, which is likely to delay the matter. J. J. Knight, Kalamazoo, is a member of the committee.

Minnesota.

⦿Ole Erickson, Cloquet, Minn., has been awarded a contract by the Great Northern Ry. for building a line to the Platte Mine about ½ mile from Nashwauk.

⦿The Atlas Engineering & Construction Co., Minneapolis, Minn., has been awarded the contract for constructing the 15-mile line of the Minneapolis Northern Suburban Ry. Co., of which W. J. Whitcomb, Minneapolis, is President. The line will be operated with gasoline motor cars.

The Interurban Construction Co. of Hast-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible], recently incorporated, as mentioned in our last issue, has elected the following officers: A. T. Stebbins, Rochester, Minn., president; Edwin Feldhauser, St. Paul, vice president; John Henon, Hastings, secretary and treasurer; F. B. Seager of Cannon Falls, Otto Ackerman and Senator Albert Scheller of Hastings, are directors. The company proposes to build an interurban line from St. Paul to Rochester, a distance of about 75 miles. It is planned to build the line to Hastings this year.

A project is under consideration for the construction of an electric railway from Brainerd to Crosby, Cuyuna, Deerwood, Ironton, Ironhub and Barrows, thus connecting all the towns of the Cuyuna iron range. Max Toltz, of the Toltz Engineering Co., St. Paul, Minn., was recently over the ground, investigating the feasibility of the project.

The Great Northern Ry. Co. has executed a first and refunding mortgage, securing a total authorized issue of $600,000,000 bonds. The size of the mortgage is explained by the fact that the outstanding obligations of the company, which are to be refunded, amount, approximately to $330,000,000. Included, however, in the figures last named is the direct and contingent obligation of the company on the Burlington joint 4s, maturing in 1921 and aggregating $222,400,000. Covering a future of 50 years, approximately $270,000,000 in bonds, therefore, will be available for general corporate purposes, double tracking and additional mileage.

Recently a party of railroad builders went over the new line of the Canadian Northern between Duluth and Virginia. In the party were: Timothy Foley of the firm of Foley, Welsh & Stewart of St. Paul and P. F. McCarthy, T. F. Walsh and F. Davis of Davenport, Iowa, of the Walsh-Hogan Construction Co., and the McGrath Construction Co.; H. T. Hazen, chief engineer of the Duluth, Winnipeg & Pacific and Frank Anderson, superintendent for Foley, Welsh & Stewart. The Walsh-Hogan and the McGrath companies are sub-contractors from Foley, Welsh & Stewart.

Duluth and the Ranges.

BY [illegible] MEAGHER

⦿Owen McDonnell, brother of Patrick McDonnell, who is in charge of sewer contracts for this firm, was a caller and stated that their work was progressing very nicely. Also stated that they were awarded a paving contract amounting to $58,000 by the city of Duluth, and would start on the same immediately.

⦿P. G. Pastoret and W. F. Lawrence of the Pastoret-Lawrence Co. were callers at this office and stated that they were recently awarded a $25,000 sewer job at Gilbert, and a $15,000 sewer job at Mankato, Minn., and that they were going to start on the same immediately.

⦿Zenith Dredge Co. of Duluth was recently awarded a small contract amounting to about $6,000 by the United States Government, and will start on the same at once.

C. J. A. Morris of Morris & Shepard, General Contractors, St. Paul, Minn., was a caller in the city recently. He stated at the present time they were not doing very much work, but he thought that there would be some work coming up in the very near future.

⦿Mitchell & McGary, members of a new construction company formed here recently, were callers, and announced that they had been awarded their first contract by the Duluth & Iron Range Ry. Co., amounting to about $15,000, and consisting of bridge work. They have already started on this work, and will rush same to completion as rapidly as possible.

⦿E. A. Dahl, General Contractor, was a caller at this office a few days ago and stated that he had been awarded several contracts, and had already started on the same.

Raymond Wales, who is the engineer in charge of the large Pittsburg Coal Dock, which was recently completed at Duluth, was a caller at this office, and stated that they were all ready to lay track on this dock, amounting to about three miles of 80-lb. rail.

We wish to thank Patriarche & Bell, manufacturers of drill and tool steel, of New York City, for the very nice paper weight that they sent to this office. It is very neat and not only ornamental but useful.

The labor situation at Duluth and vicinity has improved somewhat in the last few weeks. The surplus of labor that we had some time ago is rapidly disappearing, and men are getting scarcer. As yet, the wages have not been increased, and I do not believe that they will for some time, but there is all kinds of work of various kinds for every laborer that is waiting to accept it.

Greer Thompson, General Superintendent for the Drake & Stratton Co. interests in this territory, returned from Florida, where he has been spending the winter with his family. Mr. Thompson reports spending a very delightful vacation, and stated that the trip did him a great deal of good, but that he was glad to get back home.

Pat Walsh of the Walsh Construction Co., Davenport, Ia., accompanied by some of the members of his firm, H. T. Hazen, Chief Engineer for the Duluth, Winnipeg & Pacific Ry. Co., and Frederick Anderson, General Superintendent for Foley, Welch & Stewart, made a trip of inspection of the track laying and ballasting that the Walsh Construction Co. is doing on the Duluth, Winnipeg & Pacific Railway. This work is being rushed to completion as fast as possible, and contractors feel certain that same will be completed on time.

Mississippi.

Preliminary steps are being taken by several citizens of Gulfport, Miss., toward the organization of a company to construct a railroad from Gulfport west through the pine timber section and on to Covington, La. It is the plan of the promoters to connect with the Baton Rouge, Hammond & Eastern at Baton Rouge, La. W. G. Evans and T. M. Evans of Gulfport, Miss., are interested.

Mass meeting has been held at Natchez under the auspices of the Chamber of Commerce to urge an election for the issuance of $50,000 of municipal bonds to bring the Louisiana & Arkansas R. R. from Jena, La., to Natchez, and the Southern Railway & Navigation Co. to complete its line from Jeffries, Concordia Parish, La., to Natchez. The last named road is projected to build to Alexandria, La.

Missouri.

The North Missouri Central Ry. Co., organized two years ago, is reported to have secured the necessary capital in Europe for the construction of its line. This electric line is to extend from Jefferson City to Mexico, via Columbia, 62 miles, with a branch from Columbia to Moberly. The country through which the line will travel is said to be almost as level as a prairie, and little grading will be necessary. The ultimate purpose of the builders is to build north and east from Mexico to Hannibal and north and west from Moberly to the north line of Missouri. M. M. Stephens, East St. Louis, Ill., is President.

The following announcement has been given out regarding the organization of the operating department of the Missouri Pacific lines: The general manager shall have charge of transportation and the maintenance of way and equipment. The chief engineer shall have charge of construction and maintenance of way, reporting to the first vice president on construction and to the general manager on maintenance. He will assume the duties of the engineer of construction and of the chief engineer, maintenance of way. He will handle items of improvement and maintenance, exceeding the capacity of the superintendents' forces and equipment. He will instruct regarding standards and methods of construction and maintenance. The superintendent of machinery shall have charge of the construction and maintenance of locomotives, cars and machinery, and the direct supervision of the shops and yards for general repairs of importance requiring a shop superintendent. He will instruct regarding standards of construction and maintenance. The general superintendents shall have charge of the divisions in their districts and shall be assisted by an engineer of maintenance and an assistant superintendent of machinery. The superintendents shall have charge of the transportation and maintenance of their divisions and shall have supervision over the trainmasters, chief dispatchers, master mechanics and the division engineer in charge of the roadmasters, supervisors and assistant engineers.

The Missouri Pacific R. R. has bought 50,000 tons new rails. Some of these will be used in the line south of Pleasant Hill, Mo., and in Kansas.

Kansas City, Mo., and Vicinity.

(REGULAR CORRESPONDENCE.)

T. Kanihan of Kansas City, Kan., has secured a lease on an extensive quarry proposition on the outskirts of that city. The writer was shown over the work last week. Mr. Kanihan is to be congratulated over the splendid prospects. The quarry itself is of a high grade limestone and the rock lies so near the surface that no stripping will be required. A new crusher was purchased with which to do the work.

Mr. Graham Stearns of Dallas, Tex., was a Kansas City visitor last week. Mr. Stearns is one of the best known agents among the contractors in the west. He has represented the Western Wheeled Scraper Co. for almost twenty years. Mr. Stearns does not look for any great amount of railroad building in his state this year.

The firm of Randle & Hood of Independence, Mo., has just been organized to do an extensive job of road work near Lexington, Mo. While neither member of the firm would say that they expected to embark permanently in the grading business, yet the fact that a new grader and a number of wagons were purchased by them would indicate their intention to join the ranks of earth and rock movers.

Amos & Dean are moving a large outfit on the C., R. I. & P. work near Chariton, Iowa. Mr. Amos says they have a very fine piece of team work, enough to keep them busy for some time to come.

A very unfortunate accident occurred to the Lund Construction Co. several days ago. A new Bucyrus 70C shovel was being delivered over the lines of the Kansas City Southern road. Through some cause or other the shovel left the track and rolled into the ditch. The wreck was about as complete as anything could be and the repair of the shovel will be an expensive and long job. Mr. Lund lost no time, however, in duplicating his order for another shovel and probably by the time this is printed it will be digging on the Kansas City Southern work near Joplin, Mo.

The Missouri Pacific R. R. is reported on excellent authority as having placed an order for 50,000 tons of rail. A large quantity of this will, of course, be used in rehabilitating their old lines in various sections of the country, but it is persistently reported that some will be used on an altogether new project. It is thought that one of the first improvements to be made will be the double tracking of the line from Kansas City to St. Louis. Grades will also be reduced along the line, it is said.

Mr. G. E. Dutcher has taken work on the Kansas levee. It looks as though Mr. Dutcher has a nice contract and should make a nice profit on the work. No doubt he will.

Announcement has been received that Mr. Joseph McGerr, the well known labor agent of Kansas City has removed his headquarters from 902 to 913 Union Ave. Mr. McGerr has much more desirable quarters now than heretofore.

Considerable interest is manifested here over the Union Pacific letting contracts at Omaha. Bids have been received for the work but the successful bidder has not been announced as yet. The work will be from Gallaway to Gandy, Nebraska, about 30 miles. It is said to be almost, if not entirely, a team proposition, involving about 1,000,000 yds.

Montana.

The Billings Traction Co., Billings, which proposes the construction of a street railway at Billings, has made surveys of the principal business streets, and is understood to be planning an early commencement of construction work. John A. Connolly is the promoter.

The Chicago, Milwaukee & Puget Sound Ry. has applied to the State Land Board for rights of way across state lands lying along McDonald Creek, east of Grass range in the eastern central part of Fergus County. This right of way is desired for the Lewiston Line and it now looks as though this would be built from Melstone north along the Musselshell to Weede, then west along McDonald Creek into Lewiston, and from that point to Great Falls.

Nebraska.

Preliminary surveys are being made for the proposed railroad from Tekamah, Neb., to Decatur. E. A. Tennis, Garden City, Kan., is interested in the project.

The Omaha, Lincoln & Beatrice Ry. Co., 1400 O St., Lincoln, Neb., now operating a line from Lincoln to Bethany, is reported to be making financial arrangements to complete its line to Omaha, as originally projected.

New Jersey.

The Board of Trade of Dunnellen, N. J., is advocating the building of an extension of the trolley from that place to Metuchen, where it would connect with the line to New Brunswick, also to Staten Island. The line proposed would run to Newmarket, along the lake to South Plainfield and through private property to Metuchen, where it would connect with the lines running to Perth Amboy and New Brunswick.

New York.

The board of councilmen of Buffalo has ratified the agreement with the International Traction Railways, Buffalo, providing for a 30-year franchise which will permit the company to operate its cars in Abbott road between Cazenovia St. and the city line.

The Board of Trustees of White Plains has granted a franchise to the Hudson River & Eastern Traction Co., Ossining, N. Y., and it is understood that the company plans to start work shortly on its new branch line from the terminal of the New York, Westchester & Boston R. R. at White Plains to Ossining.

The Delaware, Lackawanna & Western Ry. is considering purchasing about 1½ acres of land near the city limits on the south side of Binghamton, for use in straightening its tracks at that point.

The Syracuse, Watertown & St. Lawrence River R. R. Co., a subsidiary company controlled by the Beebe interests, of Syracuse, has applied to the State Public Service Commission for a certificate of convenience and necessity and for authority to exercise franchises granted to it. It is proposed to build a railroad from a connection with the Syracuse & South Bay Electric R. R. to the village of Brewerton, a distance of 6⅓ miles. The authorized capital stock of the company is $1,250,000 and the estimated cost of the road now to be built is $300,000. C. D. Beebe, 500 O. C. S. B. Bank Bldg., Syracuse, N. Y., is interested.

We are advised that there is no truth in the rumor that the Lehigh Valley R. R. is planning an extension from the present terminus of its road at Fair Haven to Oswego.

The State Public Service Commission has granted permission to Leslie Sutherland, St. Andrews Pl., Yonkers, receiver of the Yonkers R. R. Co. (electric) to exercise franchises granted by the city of Yonkers. The company has been authorized to issue $91,000 in receiver's certificates for the construction of the proposed lines.

Property owners at East Syracuse have voted in favor of the granting of a franchise to the Syracuse Rapid Transit Ry. Co., Syracuse, to double track its line through East Manlius St., at East Syracuse. It is believed that the company after laying the new tracks through the village intends to double track the line all the way to Syracuse.

The New York Central & Hudson River R. R. has submitted plans to contractors for the superstructure work for its new station at Rochester. It is understood that bids will be opened at New York on June 21. The station will [illegible] station.

North Carolina.

The Raleigh & Southport Ry. will build a 25-mile branch from Lillington to Sanford, N. C. The work will be done by the company's forces. J. A. Mills, Raleigh, N. C., is President.

It is stated that $11,000,000 of French capital has been secured to finance the projected line of the South Atlantic Transcontinental R. R. This company proposes a line to run from the Tennessee coal fields through Knoxville, Waynesville, Asheville and Rutherfordton to Southport and other connections. A hearing was held recently at Raleigh relative to the question of securing convicts for the construction of the road in North Carolina. C. J. L. Lantry, Chicago, Ill., is interested.

Plans are under way for a hydro-electric development on the Roanoke River by the Virginia & Carolina Power Co., which will develop 25,000 HP. This power will be transmitted to Petersburg and Norfolk, and will also be used to operate the southernmost link in the Gould electric railway system from Norfolk to Baltimore, by way of Richmond and Washington. The development is one of the projects arising from the merger of the Norfolk & Portsmouth Traction Co. with the Virginia Railway & Power Co. of Richmond, following the acquisition by Frank Gould of the controlling interest in the local enterprise. It is stated that William C. Whitner, president of the Virginia & Carolina Power Co., is preparing to open offices at Weldon and to begin active operation.

A meeting was recently held at Henderson by representatives of the Chambers of Commerce from Greensboro and Oxford in regard to the construction of the proposed railroad from Greensboro to Henderson connecting with the Norfolk & Western at Roxboro, the Southern at Oxford and the Seaboard Air Line at Henderson, covering 100 miles of North Carolina. From Henderson it is proposed to extend the road through Franklinton and into Nash county and there tap the Atlantic Coast Line. This move will add 50 miles to the length of the road and will connect four big systems within the State. It is announced that the survey of the road from Greensboro to Henderson will be started at once.

North Dakota.

The Grand Forks Street Ry. Co., Grand Forks, N. Dak., has completed surveys and has secured the capital for the construction of a 1-mile extension to East Grand Forks, Minn. The work will be done by force account under the direction of the Manager of the company. This extension will give the street railway company about eight miles of track. R. B. Griffith, Grand Forks, N. Dak., is President.

Ohio.

The Dayton Street Ry. Co., W. L. Smith, General Manager, Dayton, is considering [illegible] Ave. to Fairview church, about 1½ miles north of the city in Harrison township.

[illegible] lumbus, will hold a special meeting on June 28 to authorize an increase of $3,000,000 in the capital stock, half common and half preferred, to reimburse the Columbus Ry. & Light Co. for expenditures for improvements and betterments on the railway company property.

Executive Committee of the Board of Directors of the Hocking Valley Ry. has authorized M. S. Connors, general manager, to proceed with the preliminary work for the construction of new through freight yards of the road in South Columbus, O. The company has 12 acres of land which will be utilized for the new yards, which will be most modern in every detail. The yards will be designed to care for through freight traffic passing through Columbus, and when completed will represent an expenditure of $250,000. It is said the grading of the yards will be started at once. This work, which will cost about $60,000, will not be let by contract, but will be done by the railroad. It is expected that by the time the grading is completed the committee will authorize the laying of tracks and other work to complete the new yards.

The Cleveland, Cincinnati, Chicago & St. Louis R. R. Co., has under consideration the construction of a new double track system between Kyles and Sharonville, O. G. D. Smith, Cincinnati, O., is chief engineer of the company.

It is reported that formal possession of the Ohio Valley Electric Ry., Huntington, W. Va., is to be taken by the banking interests which have been carrying the company and which are allied closely to the American Railways Co. It is understood that the latter company will issue $2,000,000 5 per cent collateral trust bonds, of which $1,700,000 will be given in exchange for the stocks of the Ohio Valley Electric Co., and the $300,000 will be retained for improvements and extensions of the new line.

Oklahoma.

Citizens of Tulsa have voted to ratify the granting of a franchise to the Tulsa & Sand Springs Interurban Ry. to run its tracks into the city on Archer St., from the west. Work on the extension will be started at once.

The Oklahoma Pacific R. R. Co., has filed articles of incorporation with the Secretary of State at Oklahoma City and proposes the construction of a line from the Texas line west of Cheyenne to Oklahoma City, with a branch line from some point on the main line to the Texas line in Comanche county. The system will include 275 miles of line and the estimated cost is $26,800 per mile. The company is capitalized at $6,000,000, and the directors are R. K. Kelly, L. K. Rhodyback and Alonzo Osborne, Mountain Park; G. M. Hohl and Sam Bretch, Hobart, Okla. The company was formerly known as the El Paso, Mountain Park & Oklahoma Central R. R. company.

William Kenefick, Kansas City, Mo., president of the Missouri, Oklahoma & Gulf R. R., has submitted the following propositions to J. H. Johnston, manager of the Chamber of Commerce, Oklahoma City, Okla. One for the construction of the northwest line for an outright bonus of $100,000 and terminal site; the other for the extension of the M. O. & G. to Oklahoma City for the terminal site only.

Oregon.

The Oregon-Washington R. R. & Navigation Co. has had engineers at work on the survey of an extension of the line from Brogan into the Lower Powder Valley. To extend the Willow Creek line from Brogan it will be necessary to tunnel the divide separating the lower Powder Valley from the Willow Creek Valley. The engineers are understood to have been working on the plans for this for some time.

William G. Steel, president of the Crater Lake Co., Portland, Ore., is contemplating the construction of a railroad to encircle the rim of Crater Lake leading to points of interest through the Crater Lake National Park.

Pennsylvania.

Officials of the newly formed Beaver Falls-Ellwood City-New Castle Street Ry. Co. have applied to the Ellwood City Council for franchise rights in the town. This is the first official step taken in this direction towards beginning the new line within a short time. The line will extend from Beaver Falls, via Koppel, to Rock Point and to Ellwood City. It will branch off at Koppel to Wampum, West Pittsburg and New Castle.

⊙The Delaware, Lackawanna & Western R. R. has awarded to the John F. Dolan Contracting Co., of which John F. Dolan, New York City, is President, the contract for building about a mile of railroad from the Hampton yards to the main line of the Bloomsburg division, at a point near the Dodge breaker. The new track will cut off more than a mile of the distance from the Hampton yards to the central city yards, and it will be called the Hampton "cutoff." It will be built to relieve the heavy traffic at the Hampton yards, which have just been completed by the Dolan company. More than 200,000 cu. yds. of dirt and rock will be excavated for the "cutoff." It will do away with a big curve south of the yards, over which trains are now hauled to the Bloomsburg division tracks, and will provide a better grade than the present route. The "cutoff" will be completed in about six months. The contract provides for a single track. About 200 men will be employed on the job.

South Carolina.

Work has been started on the extension of Bennettsville & Cheraw R. R. from Brownsville to Sellers, and it is expected to have the line in operation by fall.

Tennessee.

A traffic agreement has been arranged between the St. Louis, Iron Mountain & Southern Ry. Co., and the St. Louis & San Francisco R. R. Co., whereby the latter will have the use of the Iron Mountain's tracks between Memphis and Baton Rouge. The agreement holds good for both freight and passenger service and was made for 90 years. By this agreement the Frisco system will now have a continuous line from the Great Lakes to the Gulf. The link between Memphis and Baton Rouge, approximately 380 miles, is practically a water grade line, the grade being only 10 feet to the mile. Under the contract the Iron Mountain will start at once to relay the entire line with 85-lb. steel and ballast it with rock. It will also provide siding stations necessary to make it a high standard property. E. F. Mitchell, St. Louis, Mo., is Chief Engineer of the Missouri Pacific, which controls the Iron Mountain line.

Preliminary surveys have been completed for the proposed line of the Johnson City, Milligan & Elizabethtown Electric Ry. Co. of Johnson City, and it is believed that construction work will be started in a short time.

The Board of Trade of Morristown, Tenn., is interested in the proposition to secure the construction of a railroad to connect with the Norfolk & Western Ry. at Bristol, and with the Louisville & Nashville at Knoxville, Tenn.

The recently incorporated Lewisburg & Northern is securing right of way for the construction of its proposed line, which is thought to be subsidiary to the Louisville & Nashville system.

Representatives of the various railroads interested have notified Thomas Dies, Commissioner of Public Works, Memphis, Tenn., that active construction work will be started June 10 on the Rayburn Boulevard subway. It is hoped to complete the improvement by October 18. Work on the Mississippi Subway will be started shortly after and it is hoped to finish it at the same time as the Rayburn Boulevard work. J. H. Weatherford is city engineer.

Texas.

⦿Roach & Stansell, Memphis, Tenn., have been awarded the grading contract for the new line of the Kansas City, Mexico & Orient Ry., from Mertzon to Alpine, Tex. This will be a continuation of the main line from San Angelo to the Mexican border. The total cost of the work is understood to be about $600,000. This contract was briefly mentioned in our last issue.

The Missouri, Kansas & Texas R. R. has purchased the Denison, Bonham & Northwestern R. R. The line, which extends from Bonham Junction to Bonham, has been operated by the Missouri, Kansas & Texas since its construction.

The Bryan College Interurban Ry. Co., O. G. Gammil, General Manager, Bryan, has announced its intention of building an extension down Main St. and out Caldwell St. and Ursuline Ave. to the Villa Maria Academy.

The St. Louis, Brownsville & Mexico plans to extend from Samfordyce to Roma, a distance of 45 miles, and from there it will go up the Rio Grande to Laredo.

The Gulf, Texas & Western Ry., B. B. Cain, General Manager, Dallas, has applied to the State Railroad Commission for permission to issue and register bonds on the 25 miles from McGargel to Seymour, on which $22,000 a mile is asked.

It has been announced by L. E. Walker, Dallas, president of the Quanah, Seymour, Dublin & Rockport R. R. that construction work will be started out of Belton, Texas, toward Georgetown, on June 12.

Information received from Victoria, Texas states that $20,000 has been raised toward the required $30,000 bonus for the construction of the Bloomington Railroad and promoters have been instructed to select a site for the depot and terminals. S. E. Holland and F. B. Lander, Victoria, Tex., are interested.

A contract has been signed with the Waxahachie Commercial Club by representatives of the Stone & Webster Engineering Corporation, 147 Milk St., Boston, Mass., which controls the interurban lines from Dallas to Denison and Fort Worth, which, when the right-of-way is secured, will insure a new interurban from Dallas to Waxahachie, a distance of 30 miles. The cost of the new line is placed at about $1,000,000. It is stated that work will begin immediately upon securing right of way. Edward T. Moore, Dallas, Tex., is local manager for Stone & Webster.

Utah.

The Texas, Sierra Nevada & San Francisco R. R. Co. has been incorporated with a capital stock of $800,000, all of which is stated to have been subscribed. The headquarters of the company are at Taos, N. Mex., and it proposes to construct a railroad from Washington county, Utah, to the eastern boundary of Union county, New Mexico. The total length is to be about 750 miles. The officers of the company are as follows: H. S. Wannamaker, President; Frank Hamm, First Vice President; J. S. Holland, Second Vice President; James Gill, Secretary; A. C. Robert, Treasurer; W. P. Halliday, Chief Engineer. The directors are: W. P. Halliday, James Gill, H. S. Wannamaker, J. S. Holland, Charles J. H. Bushnell, A. C. Robert, Frank Hamm, John B. Bidwell, J. Wright Giddings, Malaquios Martinez and D. C. Clouthier.

It is reported that the San Pedro, Los Angeles & Salt Lake Ry., is contemplating the construction of a railroad line from Salt Lake City to Ely, Nev. E. G. Tilton, Los Angeles, Cal., is chief engineer of the road.

Virginia.

The New York, Philadelphia & Norfolk R. R., C. E. Brinser, Division Engineer, Cape Charles City, Va., has purchased a strip of land adjoining the present property of the company at Port Norfolk, containing about 5 acres of dry land and about 5 acres under water, which will be used by the railroad to enlarge the yards at Port Norfolk.

Washington.

Good progress is being made by the contractors on the construction of the new line of the Oregon-Washington R. R. & Navigation Co. between Spokane and Ayes Junction on the Snake River, and it now looks as though the line will be completed by Jan. 1, 1913. The principal activity at present is between the Snake River and Hooper, on the Connell branch of the O.-W. R. & N. Co. When this is completed it will be possible to convey material for the Snake River bridge over the company's own tracks by way of La Crosse. Watson, Flagg & Standifer, of Portland, are continuing their activity on the new line through Marshall Canyon between Spokane and Cheney, Wash. This stretch is only 18 miles long, but it will require more time for construction than any other portion of the cut-off because it is necessary to parallel both the North Bank and Northern Pacific tracks without interfering with traffic on either of those roads. Between Cheney and Hooper, 75 miles, 50 miles of grading has been done and work is being pushed on the remaining portion of the proposed road. Some of the most difficult portions of construction work lie in this 25-mile piece and the activity there will continue until the fall of 1912. Two bridges are to be built across the Spokane River in Spokane. Work on one of these is to be begun soon, while activity on the other will await progress on the Cheney-Spokane portion of the line so that material can be hauled in over the company's tracks. Extensive terminal facilities will be provided in Spokane, but actual work on the depot project and yards cannot be undertaken until the proposed new bridges will permit access to the selected site.

The Great Northern R. R. is reported to have placed agents in the field to secure right of way for a railroad to be constructed from Wenatchee to Okanogan, 300 miles north of the Columbia River.

West Virginia.

The Elk & Little Kanawha R. R. Co. has filed with the Secretary of State a copy of a resolution adopted by that company at a meeting recently held in Cleveland, O., by which it was decided to extend the road from its present terminus at or near Rosedale, in Gilmer county, by the most practicable route to a point at or near the mouth of Tanner Creek in the same county. The officers of the Elk & Little Kanawha R. R. Co. are Martin Snider, President, and Guy R. Snider, Secretary.

The Twin Mountain & Potomac R. R. Co., of Fairmont, W. Va., has been chartered with a capital stock of $100,000 and proposes to construct a railroad in Grant county, to connect with the Hampshire Southern R. R. The incorporators are R. T. Cunningham, Harry L. Heintzelman, J. M. Brownfield, Kemble White, and E. A. Russell, all of Fairmont.

Wisconsin.

The State Railroad Commission will shortly hand down its decision in the South Milwaukee track elevation cases. It is expected that the railroads will be ordered to elevate their tracks in accordance with plans made by the City Engineer of Milwaukee, the Railroad Engineers, and the Engineers appointed by the Railroad Commission. The St. Paul R. R., for the present, will be required to elevate its tracks only as far as the river.

Canada.

✣Bids will be received by Mackenzie, Mann & Co., Ltd., 1 Toronto St., Toronto, Ont., until July 1, for the construction of the following sections of the Canadian Northern Ontario Ry.: (1) Port Arthur to a point on the boundary line between Districts of Thunder Bay and Algoma. (2) From end of Section 1 to Kapuskasing Lake. (3) Kapuskasing Lake to Sellwood Jct. Tenders are to include clearing, grubbing, grading, bridges, trestles, culverts, masonry, fencing, telegraph line, track-laying and ballasting. Plans, profiles, specifications and forms of contract may be seen, and forms of tender procured, at the offices of Mackenzie, Mann & Co., Ltd., No. 1 Toronto St., Toronto. Total work is to be completed by Oct. 1, 1913.

✣Bids are asked until Aug. 1 by the Department of Railways and Canals, L. K. Jones, Secretary, Ottawa, Ont., for the construction of a section of the Hudson Bay Ry., of about 185 miles, from Pas Mission to Thicket Portage. Plans, specifications and forms of contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Chief Engineer of the Hudson Bay Ry., Winnipeg, at which places forms of bid may be obtained. An accepted bank cheque for the sum of $200,000, made payable to the order of the Minister of Railways and Canals, must accompany each bid. Bids for the remaining portion of the road will be called for early next year, as soon as the route is finally located. The Department of Railways and Canals will supervise the construction of the road. Chief Engineer Armstrong, who has had charge of the Government survey of the road for the past two years, will be the Chief Engineer in charge of construction with headquarters at Winnipeg.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

The city of Toronto has given the Canadian Pacific Ry. permission to close Tate St. from the intersection with the east limit of Cherry St. to a distance of about 1,000 ft., and close Water St. from its intersection with the south side of Front St., a distance of 330 ft. south. The company has acquired about 90 per cent of the property in the vicinity and will establish freight yards there.

The Canadian Northern Ry. is planning to reach the north shore of Georgian Bay. To do this it will swing to the west about two miles from Sudbury station, pass along a valley on the outskirts of the town and join up with the Manitoulin & North Shore Ry., which is now under construction, connecting with Little Current.

The Temiskaming & Northern Ontario Ry. Co., S. B. Clement, Chief Engineer, North Bay, Ont., has entered into an agreement with the Hollinger mines for an extension of the Porcupine branch from Lakeview Station at milepost 28½ to Campbell Veteran lot, milepost 33½, just west of the Hollinger mines.

The Canadian Pacific Ry. has awarded a contract for constructing a road from the main line of the Canadian Pacific between Medicine Hat and Calgary near the station Bassana, and running through a district into which large numbers of settlers have gone this year. It will be 40 miles in length, and will connect with the recently constructed line, which runs north from Langdon on the main line, and then runs east to Standard. The work is largely a scraper proposition. The name of the contractor was not announced, but it is thought that either the Janse MacDonald Construction Co., Calgary, Alberta, or LaMoreoux & Peterson Co., Omaha, Neb., secured the work. The latter firm has a contract on the line southeast from Swift Current, on which they have a large force at the present time. The Janse MacDonald Co. is doing much work in the immediate vicinity of the new line.

The Canadian Pacific Ry. has decided to at once proceed with the construction of a branch line from Boissevain to Lauder in Manitoba.

Suit is to be brought against the Federal Government by contractors on the National Transcontinental Ry. The amount involved totals about $700,000, and the issue is as to the proper amount the Government should pay for the work done by the contractors on the National line from Moncton to Winnipeg, now nearing completion. Some months ago the Board of Arbitrators, after an inspection of the whole line from Moncton to Winnipeg, agreed on a report deducting about $700,000 claimed by the contractors according to the classification of work done under the contract specifications. The deductions were made on the ground of over-classification of rock material, overbreak, etc. Most of the cases in dispute between the engineers of the Commission and the engineers for the contractors are in District "F," between Winnipeg and Superior Junction, under contract to J. D. McArthur. He is now entering suit, on behalf of all the contractors affected, to have the Exchequer Court decide as to the correctness of the arbitrators' award.

Surveys have been practically completed and bids will be called at once for the construction of the Halifax & Eastern Ry. and for the line around the north shore of the Bras d'Or Lake in Nova Scotia, an extension of the Intercolonial System. The work will be done under the direction of the Department of Railways and Canals, L. K. Jones, Secretary, Ottawa.

The Canadian Northern Ry. interests are stated to have completed the last deal which places the company in possession of about 8,000 acres of land, stretching in unbroken continuity from the present scene of building operations in Outremont to the Back River, on both sides of Cartierville. The land has been acquired primarily for the purpose of giving the Canadian Northern the right of way across the island for its tracks.

Included in the reports circulating in regard to the new construction work under way and under consideration by the Grand Trunk System, is one to the effect that over 1,500 miles of the new transcontinental system will be opened next month. This includes the line from Fort William, at the head of Lake Superior, to the foothills of the Rocky Mountains beyond Edmonton, B. C., and marks the completion of the prairie section of the road.

ROADS, STREETS AND PAVEMENTS

California.

◉[illegible] has been awarded the contract by the City Council of Los Angeles, Cal., for paving that avenue from Colorado St. to Columbia St., for [illegible]

◉Clark & Henery have been awarded the contract by the Board of Supervisors, Stockton, Cal., for improving the French Camp road from South St. to the Roberts Island road with asphalt macadam for $16,754. The estimate of Highway Engineer R. M. Morton was $16,000. Other bids received were: City Street Improvement Co., $17,983; Ransome-Crummey Co., $18,173; Federal Improvement Co., $17,453. It is proposed to improve a 20 ft. strip. The contract also includes a bridge over the McDougald canal.

The Golden Hill Improvement Club of San Diego, Cal., at a recent meeting decided to petition the City Council for the paving of H St., from 16th to 25th Sts.

The Board of Trustees of Fresno, Cal., has been petitioned for the paving of Van Ness Ave., from Central Addition to the south bank of Dry Creek.

Colorado.

✣Bids will be received until 11 a. m., June 14, by Board of Public Works, Henry Read, President, Denver, Colo., for furnishing materials, supplies, labor, etc., for West 23d Ave. Paving District No. 2. A certified check for $5,000 must be filed with each bid.

Florida.

The Board of County Commissioners, Jacksonville, Fla., has adopted resolutions providing for the construction of the remainder of the highway leading to Fernandina. County Engineer Gail L. Barnard has estimated the cost of the road at $78,942, including the Duval County proposition of the erection of the bridge spanning the Nassau River.

Georgia.

✣Bids will be received until 8 p. m., June 19, by Mayor and Council of Newnan, Ga., for furnishing the necessary labor and material for the laying of approximately 22,000 sq. yds. of smooth pavement in that city. Bids will be received on wood blocks, brick, bitulithic and asphalt pavements. Each bid must be accompanied by a check for $2,000. Plans and specifications are on file at the office of B. D. Fouse, City Clerk, or of J. B. McCrary Co., 1311-15 Empire Bldg., Atlanta, Ga., Engineers.

The Retail Merchants' Association of Savannah, Ga., has passed a resolution to petition City Council for the paving of West Boundary St., from the Brinson Railroad to Williams St.

Residents and property owners on Cherry St., between First and Spring, Macon, Ga., have petitioned the City Council to pave the portion of the street. C. C. Huderson is city engineer.

Idaho.

✣Bids will be received until June 17 by Rossfork Road Commission, Pocatello, Idaho, for constructing a macadam road between Rossfork and Gibson-Bingham County. J. P. Congd[illegible]

Illinois.

✣Bids will be received until 10 a. m., June 12, by Board of Local Improvements, Joliet, Ill., for the improvement of Hickory St., by paving with bituminous macadam, etc. W. S. Welch is clerk of the Board.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., June 12, for furnishing and delivering paving brick (1,100,000), for the use of the Bureau of Streets. Bricks shall be of best quality of vitrified paving brick, 8 ins. in length, 4 ins. in depth, and 2½ ins. in thickness, with edges rounded to a radius of ¼-in. and free from lime and other impurities, uniform in size and quality, and shall be burned to a maximum hardness. Cash or certified check for $1,000 must accompany proposal.

◉Property owners on Eighth St., in Murphysboro, Ill., have made private contracts with Myer & Thomas to pave that street. Vitrified brick will be used.

◉The Illinois Cement Construction Co., Springfield, Ill., has been awarded the contract by the Board of Local Improvements of Hillsboro, Ill., for paving, curbing and constructing gutters on a number of streets, including the following: 12,500 sq. yds. of brick [illegible] one and one half sand cushion and sand filler complete per sq. yd., $1.51; 6,600 cu. yds. of excavation, per cu. yd., $.25; 8,560 lin. ft. of combined curb and gutter of concrete, per lin. ft., $.45; 260 lin. ft. of concrete relaying curb, [illegible] Bids were opened May 29.

The Highway Commissioners of Shiloh Valley and Mascoutah townships, Ill., have decided to advertise for bids for the construction of a road above high-water mark through Silver Creek bottom.

The Illinois State Legislature has appropriated $26,000 for the purpose of paving the roadway paralleling the Elgin State hospital grounds on the east, Elgin, Ill.

The City Council of Pana, Ill., has decided to pave several streets in the city, the improvements to cost over $300,000. Petitions were received by the Council for the paving of West Second St. to the city limits, a total of nine blocks; South Oak St., West Main St., South Spruce St., Traders and Congress alleys.

Petitions have been prepared in Monmouth, Ill., calling for the paving of East First Ave., from First to Eighth Sts.; South Fourth St., from Broadway to Second Ave.; Third St., from First to Second Ave., and South B St., [illegible]

Indiana.

✣Bids will be received until 10 a. m., June 26, by Board of Miami County Commissioners, Peru, Ind., for the construction of approaches, including grading, curbs, sidewalks and steps for the new court house building in the city of Peru. F. K. McElheny is auditor of the county.

✣Bids will be received until 10 a. m., June 9, by the Board of Public Works, Indianapolis, Ind., for the improvement of Pennsylvania St. from the south curb line of 40th St. to the south property line of 42nd St., by grading [illegible]

✣Bids will be received until 10 a. m., June 9, by Board of Public Works, Indianapolis, Ind., for grading, graveling and rolling the roadway of Pennsylvania St. from north property line of 40th St. to the south property line of 42d St.

✣Bids will be received until 10 a. m., June 7, by the board of Public Works, Indianapolis, Ind., for grading and paving the sidewalks of Fourteenth St., from the east curb line of College Ave. to the west curb of Cornell Ave.

✣Bids will be received until 10 a. m., June 7, by Board of Public Works, Indianapolis, Ind., for the improvement of Capitol Ave., from the [illegible]

✣ indicates work now open for bids. ◉ indicates a contract let recently.

property line of Ohio St., by resurfacing the roadway.

✣Bids will be received until 10 a. m., June 12, by Board of Public Works, Indianapolis, Ind., for the improvement of the Indiana Ave. from a point in the intersection of west line of Illinois St. with the north line of Ohio St. to the Big Four tracks by resurfacing the roadway.

⊙The Board of Public Works of Terre Haute, Ind., has awarded a contract to William Birch for the construction of a combined cement curb and gutter on both sides of Jefferson St., from Willard to 12th St., for $0.45 per lin. ft., and a contract for the construction of cement sidewalks on South Jefferson and South Elm Sts., to William Torrence.

⊙The contract for paving Cross St. with brick in Carmel, Ind., has been awarded by the Town Board to William Slattery of Crawfordsville, for $1.32 per sq. yd., and for constructing curb at $0.22 per lin. ft. The Town Board has also awarded the contract for curbing Main St., as far north as Hawkins St., to C. C. Huffine & Co., of Frankfort for $0.21 per lin. ft., and at $0.09 8/10 per sq. ft., for building the sidewalks on College Ave.

It is reported that seven townships of Laporte County, Laporte, Ind., on May 23, voted bond issues amounting to $180,000 for the building of good roads.

The Board of Public Works of Terre Haute, Ind., has ordered plans and specifications prepared for the construction of a brick roadway on Franklin between Howard and Charles Sts.

Iowa.

⊙The contract to pave the 16th Ave. bridge with creosote block has been awarded by the City Council of Cedar Rapids, Ia., to Mike Ford of that city for $2 per sq. yd.

⊙The Burlington Construction Co., of Burlington, Iowa, has been awarded the contract by the city of Mt. Pleasant, Iowa, for the construction of 10,710 sq. yds. of brick pavement on a concrese base of 6 in., and asphalt filler, 9,000 lin. ft. of combined curb and gutter and 1,200 yds. of extra grading. The contract price is $2.07½ per yd. Hall & Adams, Centerville, Iowa, are Engineers. Bids were opened June 2.

A movement is on foot in Cedar Rapids, Ia., to petition the City Council to have State St. paved next year from 7th to 14th Sts.

The Davenport Commercial Club, Davenport, Ia., has adopted resolutions urging the City Council to provide for the paving of East River St., eastward from Mound St., at once.

The City Council of Davenport, Ia., has ordered plats drawn and paving laid on the extension of East River St., between Mound and Eddy Sts. A. M. Compton is Commissioner of Public Works.

The City Council of Shenandoah, Ia., has ordered asphaltic concrete pavement laid down on Church and Center Sts., and on Valley and Seventh Aves, in all, about 20 blocks, or 20,000 sq. yds. A 2-in. coating of the asphalt concrete will be laid on a 4-in. base of concrete.

The City Council of Oelwein, Ia., has decided to construct about 26 blocks of pavement this season. The following streets will be paved: North Frederick St., from the bridge to Eighth St.; First Ave., east from Charles St. to Eighth St.; West Charles St., from present terminus of paving to Seventh Ave.; East Charles St., from Rock Island tracks to Sixth Ave.; First Ave., south from First St. to Second St.; Second St., south from Frederick St. to Rock Island tracks; Second St. west from Frederick St. to the C. G. W. tracks.

Kansas.

Property owners of Main St., in Hutchinson, Kan., at a recent meeting decided in favor of paving that thoroughfare between the Rock Island and Fifth Ave.

The City Commissioners of Leavenworth, Kan., have been petitioned to reconsider the resolution to repave Shawnee St. with brick. City Engineer Joseph O'Neil has estimated the cost of the proposed paving, 19,234 sq. yds. at $22,473.

The Board of County Commissioners, Hutchinson, Kan., has designated 25 roads to be county roads. These roads bisect all of the townships in the county and aggregate 405 ½-miles. They include all of the main roads of the county connecting all of the towns and serving the townships in the best possible way.

Maryland.

✣Bids will be received until noon, June 15, by Baltimore County Highway Commission, Towson, Md., for the construction of a section of State Aid highway along Old Court road between Quarry lane and Rockland, about 2 miles. E. Stanton Bosley is Secy. of the Commission.

✣Bids will be received until 11 a. m., June 7, by Board of Awards, Baltimore, Md., for the construction of roadway and paths in Wyman Park from Cedar Ave. Bridge to the main road of Wyman Park, north of the United States Marine Hospital, including grading of roadways and slopes, scarifying cedar Ave. roadbed from Cedar Ave. Bridge to Viaduct Ave., construction of stormwater drains, concrete catch basins, laying fibre conduit construction of light post foundations, construction of concrete curb, construction of retaining walls, bitumen macadam work for paths and roads, etc. W. S. Manning is general superintendent of Board of Park Commissioners.

Massachusetts.

✣Bids will be received until 2 p. m., June 16, by Board of Public Works, Holyoke, Mass., for 6,100 sq. yds. of vitrified brick or Belgian blocks and as many more as may be ordered in writing by the Board prior to October 1, 1911. Oscar C. Ferry is assistant city clerk.

Michigan.

The town of Eaton Rapids, Mich., plans to put in concrete pavement on Hamlin St., from the west line of Hall St. to the west bank of Grand River, a total distance of about a block and a half.

Advices from Evart, Mich. state that about $40,000 are available for improvement of the highways in that vicinity. Osceola township will make four miles of stone roads, and grade several miles for the stone another year. Hartwick township, north of Evart, will make four miles of stone roads. Evart township about two miles of state award road this season.

McDermott & Cooper, at $21,091, submitted the lowest bid to the Board of Public Works of Grand Rapids, Mich., on May 25, for the improvement of West Leonard St., with brick.

Minnesota.

✣Bids will be received until June 13, by City of Virginia, Minn., for the construction of pavement on the following streets and avenues: Mesaba Ave. from Spruce to Sago; Cleveland Ave. from Maple to Larch; Poplar St. from New England Ave. to Railroad Ave.; Spruce St. from Ohio Ave. to Railroad Ave.; Cook St. from Central Ave. to southwest corner of the Second addition to Virginia; Lake Boulevard from Walnut to Willow Sts.; Walnut St. from Cleveland Ave. to Railroad Ave.; Central Ave. from Sage to Larch St.

✣Bids will be received until June 19 at 5 p. m., by Henry N. Knott, City Clerk, Minneapolis, Minn., for the construction of 32,280 sq. yds. of pavement. Bids will be received on creosoted wood block, vitrified brick, mineral rubber, bitulithic, sandstone and concrete. William Barneck is City Engineer.

⊙The contracts for paving sections of 11 streets in Mankato, Minn., have been awarded by the City Council, A. H. Sherer, City Clerk, to the North Star Concrete Co., and [illegible] & [illegible] for $[illegible] per sq. yd., [illegible] per sq. yd., for creosote block and macadam respectively. Bids were opened May 29

⊙The Hewitt Bridge Co., has been awarded the contract in Little Falls, Minn., for paving the Broadway bridge for $7,438.

The County Commissioners at Glencoe, Minn., have awarded the following contracts for graveling state highways: Prairie and Winsted road, State highway No. 22 to J. A. Cafferty for 38c per cu. yd.; Glencoe and Plato road, State highway No. 20 to E. A. Gibbs for $0.39 per cu. yd.; The Glencoe and Arlington road, State highway No. 8 to A. H. Reed, Jr., for $0.60 per cu. yd.; The Glencoe and Hutchinson road, State Highway No. 18 to A. H. Reed, Jr., for $0.64 per cu. yd.; The Hutchinson Lake Allie road, State highway No. 12 to E. A. Gibbs for $0.49 per cu. yd.; The Brownton, Lake Marion and Hutchinson, State highway No. 21 to Frank Wendland for $0.28 per cu. yd.; The Brownton and Penn Town road, State highway No. 7 to Hugh Cunningham at $0.33 per cu. yd.; The Stewart and Round Grove road, State highway No. 2 to Wm. Roland at $0.54 per cu. yd.; The Stewart and Hutchinson road, State highway No. 13 to John Neuhaus for $0.39 per cu. yd.; The Silver Lake and Cokato road, State Highway No. 17 to Thomas Blazinski for $0.50 per cu. yd.; The Glencoe and St. George road, State Highway No. 15 to Hugh Cunningham for $0.33 per cu. yd.; The Hutchinson and Silver Lake road, State Highway No. 3 to Hugh Cunningham for $0.45 per cu. yd.; The Hassan Valley Township road, State Highway No. 5 to W. G. Howe at $0.38 per cu. yd.; The Hutchinson and Litchfield road, State Highway No. 4 to E. A. Gibbs for $0.59 per cu. yd.; The Hutchinson and Dassel road, State Highway No. 14 to A. H. Reed, Jr., at $0.39 per cu. yd.

An election was held in Bemidji, Minn., on May 31 for the purpose of voting on the question of offering for sale $20,000 worth of bonds for the paving of 11 business blocks.

The County Commissioners, Minneapolis, Minn., have asked Paul D. Sargent, acting director of the public roads bureau of the department of agriculture, to visit Minneapolis to look over the proposed Superior Blvd. paving.

Mrs. Pat. Costello submitted the lowest bid to the County Commissioners, Minneapolis, Minn., for the building and grading of the Bloomington-Edina road. The bill was $1,501.

Missouri.

✣Bids will be received until 8 p. m., June 9, by Board of Local Improvements, St. Louis, Mo., for the improvement of 18th and 19th Sts. from State St. to Illinois Ave., and 27th St. from State to Summit Ave.

⊙The Parker Washington Co., Taylor & Duncan Aves., St. Louis, Mo., has been awarded the contract by the Board of Local Improvements, St. Louis, for 19 street improvement contracts, for $45,948. The work includes reconstructing street with wood blocks as follows: Taking up old paving, $.85; granite curb, $.83; marginal curb, $.10; wood block, $2.54; macadam, $.01. Bids were opened May 5.

A resolution has been adopted by the City Council of Joplin, Mo., ordering Main St., from the center line of Third St. south to the Frisco tracks on 10th St. paved with creosoted wood blocks. City Engineer J. B. Hodgdon has estimated the cost at $39,784.

Resolutions have been prepared for the following street work in Springfield, Mo.: Providing for the construction of concrete curbing on Main St., from Walnut to Phillips Sts.; concrete curbing on Guy St., from Mt. Vernon St. to Grand Ave.; for concrete curbing on Billings St., from State St. to Grand Ave.; also for concrete paving on Billings St. from State St. to Grand Ave. H. G. Horton is city engineer.

Advices from Montgomery City, Mo., state that the farmers along the country road leading from Elsberry to the Pike county gravel road at Gledds Point, have subscribed several thousand dollars to gravel the route. It is thought that about $25,000 will be raised for the improvement.

The following resolutions for public work have been received by the Board of Public Works of Kansas City, Mo., for adoption: Repairing asphalt pavement—McGee St. from south line of 11th St. to the north line of 18th St. Maintenance and repair of macadam pavement; Central St., from south line of 54th

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

to north line of 55th. Central St. from south line of 57th to north line of 58th; Central St. from south line of 59th to north line of 61st; Wyandotte St. from south line of 52d to north line of 55th; Wyandotte St. from south line of 57th to north line of 58th; Wyandotte St. from south line of 59th to north line of 61st. Asphalt pavement—30th St. from the east line of Wyandotte to the east line of Main St. Portland cement concrete—24th St. from the east line of Cleveland to the west line of Jackson; Elma St. from the east line of Ord St. to the west line of Park Ave.; Elma St. from the east line of Park Ave. to the west line of Olive St.; Hale St. from the east line of Woodland to a point east of Woodland Ave.; alley between Smart Ave. and Garner St. from east line of Benton to west line of Indiana; alley between Garner St. and Thompson from east line of Askew to west line of Monroe; Alley between Garner St. and Thompson Ave. from east line of Indiana to west line of Bales; alley between St. John and Morrell, from east line of Indiana to west line of Bales; alley between Bales and Indiana, from south line of 11th to alley next north of 12th; alley between Woodland and Michigan, from alley next south of Ninth to north line of 10th; alley between 9th and 10th, from east line of Michigan to west line of Euclid; alley between Michigan and Euclid, from alley next south of 9th to north line of 10th; alley between 10th and 11th, from east line of Olive to west line of Prospect; alley between 11th and 12th, from east line of Park to west line of Olive; alley between Peery and 12th, from east line of Chestnut to west line of Agnes; alley between 14th and 15th, from east line of Agnes to west line of Bellefontaine; alley between Flora and Vine, from south line of 22nd to north line of Cottage.

Nebraska.

✣Bids will be received until 5 p. m., June 12, by A. T. Bratton, City Clerk, Hastings, Nebr., for furnishing the necessary labor and material for excavating, filling, paving and curbing Districts No. 14 and 15. No. 14 will include 11,200 sq. yds. of asphalt pavement, 1,512 ft. white oak plank, 250 sq. yds. concrete pavement, 220 lin. ft. old curb reset, 320 lin. ft. new curb, 6,940 ft. combined curb and gutter, 5,200 sq. yds. of brick block pavement, 2,000 lin. ft. new concrete curb and gutter; No. 15 includes 11,100 sq. yds. asphalt paving, oak plank as in No. 14, 250 sq. yds. concrete pavement, 700 ft. old curb reset, 685 ft. concrete gutter, 300 ft. new concrete curb, 6,590 ft. combined curb and gutter, 5,600 sq. yds. brick block paving, 980 ft. old curb to be reset, 940 ft. new concrete curb.

The County Engineer, Lincoln, Neb., has prepared specifications for the paving of the P St. road from the city limits to the west line of Section 22-10-6, and the commissioners will at once advertise for bids for the work. The roadway is to be 16 ft. wide, specifications call for 9,564 sq. yds. of paving, 8,350 cu. yds. of grading and 10,750 lin. ft. of artificial stone curbing. Bids will be asked on brick and macadam.

New Hampshire.

◉The Lane Construction Co., Meriden, Conn., has been awarded the contract by the State Highway Department, Concord, N. H., for the construction of a native stone road, 5,500 ft. long, in Tilton, N. H. Bids were opened June 2.

◉The Lane Construction Co., of Meriden, Conn., has been awarded the contract by the State Highway Department, Concord, N. H., for the construction of a trap rock road in Hillsboro, N. H. Bids were opened June 2.

New Jersey.

◉E. C. Humphrey, of Hackensack, N. J., has been awarded the contract by the Board of Chosen Freeholders, Camden, N. J., for cleaning and resurfacing Browning Road, near Merchantville, with about 1,200 tons of Amiesite; also 600 tons 1½ in. trap rock for shoulders; also 600 cu yds. of approved gravel as directed. The contract price is $9,930. Bids were opened May 24.

The budget of the Board of Public Works of Newark, N. J., embracing all the prospective expenditures for this year in all departments of the board, has been submitted to the Committee of Finance of the Common Council. The estimates for streets and highways, lighting, sewers, scavenger contract, repairs to asphalt streets, and the maintenance of the executive and engineering branches of the board, together with the smaller items for baths, bridges, wharves, sidewalks and crosswalks, will make up a total budget of more than $1,000,000. M. R. Sherrerd is city engineer.

New York.

✣Bids will be received until June 12, by Lawrence Gresser, President of the Borough of Queens, New York, for paving, regulating, grading, curbing, recurbing, flagging and resetting manhole covers in various streets and avenues in the borough.

◉J. & M. Doyle of Erie, Pa., have been awarded the contract by the City Council of Dunkirk, N. Y., for the paving of King St., for $23,244.

The citizens of Tarrytown, N. Y., have voted in favor of the expenditure of $144,000 for the paving of streets.

North Dakota.

✣Bids will be received, it is reported, by City of Grand Forks, N. Dak., until June 12, for the construction of a large amount of pavement.

Ohio.

✣Bids will be received until June 21, by Board of Franklin County Commissioners, Columbus, O., for the improvement of Hilliard and Rome Pike, 6 miles in length, and Wilcox road, 9,550 ft., grading the ground at the tuberculosis camp, and constructing concrete walks; constructing a reinforced concrete culvert on the Canal Winchester Pike.

✣Bids will be received until 10 a. m., June 12, by Board of Erie County Commissioners, Sandusky, O., for constructing State Road, beginning at the Vermilion corporation line and running south 1,700 ft. in accordance with plans and specifications on file at the office of the County Surveyor. J. Diest is County Auditor.

✣Bids will be received until noon, June 30, by Board of Hamilton County Commissioners, Cincinnati, O., for oiling, under Specifications No. 223, Springfield Pike from Hartwell to Winton Road in Springfield township. A certified check for $500 must be filed with each bid. Fred Dreihs is clerk of the board.

✣Bids will be received until noon, June 30, by Board of Hamilton County Commissioners, Cincinnati, O., for treating, under Specifications No. 227, Hillside Ave., from Anderson Ferry Road to Cleves and Warsaw Pike, with tar, in Delhi and Miami townships. A certified check for $500 must be filed with each bid. Fred Dreihs is clerk of the board.

✣Bids will be received until noon, June 28, by County Commissioners, Columbus, O., for labor and material necessary for the construction of the following work: Estimate A—Furnishing and applying 10,489 gals. of surface treatment on Harrisburg Pike, from Mound St. to Bissinger Road. Estimate B—Furnishing and applying 15,739 gals. of surface treatment on the Sunbury Pike, from the Johnstown Pike to the Township line. Estimate [illegible] surface treatment on the National Road West, from the Big Four Railroad Crossing to Alton. John Scott is clerk of the board.

✣Bids will be received until noon, June 9, by Director of Public Service, Youngstown, O., for furnishing the necessary labor and material for the paving of Hillman St. from Mt. Pleasant St. to Warren Ave. Plans and [illegible] accompany each bid. W. H. McMillin is Clerk of the Department of Public Works.

✣Bids will be received until noon, June 9, by Director of Public Service, Youngstown, O., for furnishing the necessary labor and materials for paving McGuffey St. from the viaduct to the city limits. A certified check for $500 must be filed with each bid. Plans and specifications can be seen at the office of the chief engineer of the Department of Public Service. W. H. McMillin is clerk of the department.

✣Bids will be received until noon, June 12, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and material for the improvement of Peerless St., from Glenway Ave. to Warsaw Ave. by constructing concrete steps and all necessary appurtenances. Plans and specifications are on file at the office of the chief engineer of the Department of Public Service. J. J. Wenner is clerk.

✣Bids will be received until noon, June 26, by F. H. Shoaff, clerk of the village of Euclid, O., for furnishing the necessary labor and material for the improvement of Cliffview Ave., from the north line of Euclid Road to the south line of Roseland Ave. by constructing a 6-in. water main therein, according to plans and specifications on file at the office of the clerk, or F. A. Pease Engineering Co., 931 Williamson Bldg., Cleveland, O.

◉The Board of Control of Findlay, O., has awarded the contract for the paving of Ash Ave. to C. B. Hall & Son. Brick will be laid on the avenue for a distance of about three blocks.

◉N. Goodman, 328 W. 7th Ave., Cincinnati, O., has been awarded the contract by the Department of Public Service, Cincinnati, for improving Probasco Ave., from Deckebach to Marshall Ave., for $11,415. The work includes grading, limestone curbing and crossings, paving gutters with brick, roadway with macadam and special binder, constructing concrete retaining wall and necessary drains and inlets, etc. Bids were opened May 9.

◉The County Commissioners, Marion, O., have awarded the following contracts for pike improvements: Patten Pike in Claridon township, resurfaced for a distance of over two miles, D. C. O'Connell for $4,292; and for resurfacing the Prospect-Marysville Pike, beginning at the Prospect corporation line and running to the Delaware County line, for $4,086.

◉The County Commissioners, Marion, O., have awarded the contract for the building of the Beringer Pike in Big Island township, eight miles in length, beginning at Waldo running one and one-half miles, thence east six and one-half miles to the line between Marion and Morrow counties, to Carrol & Hoyles for $25,823, and the contract for building the Seiter road, three miles long, east of Agosta in Big Island township to A. J. Brady, for $10,515.

The County Commissioners at Steubenville, O., have received a petition from Toronto and vicinity, asking that the road be improved from north of King's to the Lee property at Costoma; also from the old Markle sewer pipe works to the south limits of Toronto; also from the north limits of Toronto to Factory 8 of the American Sewer Pipe Co.; also from the north limits of Empire to just south [illegible]

The citizens of Rawson, O., have signed a petition calling for the paving of about three-quarters of a mile of the main street of the village. Bituminous macadam will be used.

Oregon.

The County Court, Salem, Ore., has ordered the construction of the proposed county road between Gervais and Mt. Angel.

The City Council of Hillsboro, Ore., has passed the ordinances providing for paving the downtown district and installing storm and sanitary sewers in a district including nearly one-fourth of the city.

Mayor Simon of Portland, Ore., has vetoed four ordinances passed by the City Council, providing for the improvements of portions of 10th, Borthwick and Sumner Sts. and Montana Ave., with Hassam pavement.

Tennessee.

The County Road Commissioners, Knoxville, Tenn., have begun to make appropria[illegible]

Commissioners will soon ask for bids for the construction of a tar binder road, estimated to cost $10,000. This road will be constructed on the Kingston Pike for two and a half miles, beginning about the Mellen home and extending to a point east of the Lyon's View Asylum. The commissioners have also appropriated $4,500 for the repair of the Sharp's Gay and Central St. pikes.

Pennsylvania.

The citizens of Philadelphia, Pa., on May 23 voted the issuance of bonds to the amount of $11,500,000 for public improvements, as follows:

Sites and buildings for elementary schools, [illegible] erection of convention hall, $1,000,000; mandamus payments, $1,000,000; purchase of property for parkway, $1,000,000; improving Delaware and Schuylkill River fronts, $600,000; repaving streets not occupied with car tracks, $500,000; mill district high-pressure fire main system, $500,000; improving League Island Park, [illegible] improving Boulevard from Second street to Rhawn street, $500,000; opening streets under Richmond branch Reading Railway, between Richmond street and Kensington avenue, $500,000; improving Fairmount Park, $400,000; repaving streets with wood blocks, $300,000; taking property for Cobb's Creek Park, $300,000; new police stations and fire houses, $300,000; building for care of feeble-minded persons, $250,000; erection of new bridges, $200,000; construction of main sewers, $160,000; grading streets, $150,000; building for treatment of contagious diseases, $150,000; improvement of South Broad Street Plaza, $150,000; police and fire apparatus and new fireboat, $110,000; surfacing and resurfacing country roads, $100,000; construction of branch sewers, $100,000; soldiers' and sailors' monument, $100,000; children's playgrounds, $100,000; reconstructing city hall elevators, $100,000; reconstruction of Cohocksink sewer, $50,000; improvements to Hunting Park, $50,000; improvements to Pennypack Creek Park, $50,000.

South Carolina.

✣Bids will be received until noon, June 12, by City Council of Sumter, S. C., for paving Main St., including approximately 12,000 sq. yds. of pavement. Further information can be obtained of W. L. Lee, City Engineer.

Texas.

⊙TheStandard Engineering & Construction Co. has been awarded the contract by the City Commissioners of Dallas, Tex., for the paving of Jefferson St., from 10th to Tyler Sts., Oak Cliff. An asphaltic macadam is to be used for this work.

⊙The Commissioners' Court, Georgetown, Tex., has awarded the contract for the construction of graveled and macadamized roads in Road District No. 2, to the Texas Building Co., of Waco, Tex., for $2,500 per mile. The work includes about 40 miles of road. The county will furnish all gravel at railroad. Bids were opened June 1 by W. W. Jenkins, County Auditor.

Utah.

The County Commissioners at Salt Lake City, Utah, has decided upon the repaving of 14th South St., from State road to the Denver & Rio Grande tracks in Salt Lake City. The road will be surfaced with a combination of slack and tar.

P. J. Moran, of Salt Lake City, Utah, submitted the lowest bid to the City Council of Salt Lake City, for paving extension No. 70, amounting to $58,049; bids opened May 20. G. F. McGonagle, City Engineer.

P. J. Moran, of Salt Lake City, Utah, at $43,154, submitted the lowest bid to the City Council of Salt Lake City for paving extension No. 63. Bids opened May 19.

P. J. Moran of Salt Lake City, Utah, submitted the lowest bid to the City Council of Salt Lake City,. G. F. McGonagle, City Engineer, for paving extension No. 43, amounting to $57,111. Bids opened May 19.

Virginia.

The contract for the construction of 4½ miles of macadam road in Amherst County, Va., for which bids were asked until May 29, has not been awarded. The work includes 27,894 cu. yds. of excavation, 188 lin. ft. of 12-in. vitrified clay pipe, 356 ft. of 15-in. pipe, 48 ft. of 18-in. vitrified pipe, 88 ft. of 24-in. vitrified pipe, 24 ft. of 30-in. pipe, 32,320 sq. yds. of macadam, 6-in. in depth, 58 cu. yds. of cement rubble, 12 cu. yds. of dry rubble, 140 cu. yds. of concrete, 1,166 lbs. of reinforcing steel. The work will be done by the county force. S. L. Von Gemmingen, Resident Engineer, Amherst.

Washington.

A petition has been filed with the City Commissioners of Spokane, Wash., asking for the paving of Wall St., from Garland Ave. to the north city limits. Bids will probably be called for on various kinds of pavement.

⊙Property owners along First and Fourth Sts., in Hoquiam, Wash., have decided in favor of bitulithic for the paving of those streets. M. D. Hogan has been awarded the contract.

⊙The City Commissioners of Spokane, Wash., have awarded the following contracts for street improvements: Grading Oak St., Knox to Augusta Aves., C. M. Payne, $3,991; Grading 16th Ave., Crestline to Pittsburg Sts., John F. Costello, $6,600; Grading 16th Ave., Southeast Blvd. to Rockwood Blvd., Robinson & Foster, $2,622; Grading 20th Ave., Lincoln to Adams Sts., C. M. Payne, $3,750; Grading 25th Ave., Wall to Jefferson Sts., C. M. Payne, $6,500; Grading 25th Ave., Wall to Jefferson Sts., C. M. Payne, $5,100; Paving with brick, Howard and Havermale Sts., Mitchell Bros., $31,900; Paving with Hassam, Washington St., Spofford Ave. to Waverly Place, Hassam Paving Co., $42,860.

The City Council of Chehalis, Wash., received bids for paving a part of Chehalis Ave., Center St., North St., Prindle and East Market as follows: C. L. Morris Construction Co., Seattle, Wash., $58,200; Warren Construction Co., Portland, Ore., $57,740. The first bid was on asphalt, while the last was on bitulithic.

The City Council of Prosser, Wash., has passed a resolution of intention to pave Sixth St., from the alley between Prosser and Dudley Aves., to the Sixth St. bridge. The paving includes 2,760 ft., and will be built either of bitulithic or bitumass.

Canada.

The citizens of Calgary, Alta., on May 29, voted the issuance of bonds to the amount of $200,000 for civic improvements, subways, paving, bridges, etc.

BRIDGES—STEEL AND CONCRETE

Arkansas.

The Fort Smith District Quorum Court, Fort Smith, Ark., recently appointed or organized a commission with an appropriation of $10,000 to either build or buy the Poteau bridge.

California.

✣Bids will be received until 2 p. m., June 13, by Board of Humboldt County Supervisors, Eureka, Cal., for the construction of a pile trestle and fill on the road from the New Eel River bridge to Ferndale in Road District No. 1. George W. Cousins is clerk of the board.

The supervisors of Stanislaus county, at Modesto, Cal., have under consideration the construction of two bridges over Tuolumne river. One of the structures will be located near the Santa Fe bridge, between Empire and Hughson, and the other at Old Silva's Ferry.

Delaware.

Levy Court, of Kent county at Dover, Del., has decided upon the construction of a new modern iron bridge with 41 ft. span and 16 ft. roadway over the west branch of the Smyrna river, to replace the old Duck Creek bridge.

Florida.

✣Bids will be received until July 3 by Board of County Commissioners, Orange county, Orlando, Fla., for the construction of a steel swing bridge over west branch of the St. Johns River and a wooden swing bridge over the eastern branch of the St. Johns River at Geneva Ferry in Orange county. B. M. Robinson is clerk of the board.

Mayor of Tampa, Fla., has requested the City Council to order the Board of Public Works to commence work upon the necessary preliminaries for the construction of a bridge over the river at Lafayette St. A vertical lift type or Bascule style is under consideration.

Idaho.

It is reported that bids are being asked by the commissioners of Washington county at Weiser, Idaho, for the construction of a two span steel bridge over the Weiser river at Midvale, to replace the old wooden bridge at that point. The new structure will be 250 ft. long and will cost, it is estimated, $12,000.

Illinois.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the Fitz Simmons & Connell Co., Chicago, the contract for removing and disposing of substructure and superstructure of Belmont Ave. bridge, and constructing a new pontoon, a new center pier, abutment pier and approaches and such other work as is necessary to transfer the movable span to the bridge site and make it ready for traffic, including dredging, pile driving, etc. Contract price $22,000. Bids opened April 8th.

Following bids were received May 25, by L. E. McGann, Commissioner Public Works, Chicago, Ill., for removal of sub and superstructure of 35th St. bridge over the South Branch of Chicago river: (1) removing present draw span center piece, etc.; (2) dredging 7,000 cu. yds.; (3) blasting and excavating rock and non-dredgable hardpan, 1,000 cu. yds., Great Lakes Dredge & Dock Co., Chamber of Commerce Bldg., Chicago. (1) $765; (2) 39½ cts.; (3) $5.40; Fitzsimmons & Connell Co., Tacoma Bldg., Chicago (1) $900; (2) 35 cts.; (3) $5.85.

The Stroebel Construction Co., Chicago, Ill., is now completing its contract for the construction of the steel structural work on the $600,000 steel lift bridge over the Schuylkill river at Passyunk Ave., Philadelphia, Pa. The structure will be 1,300 ft. long, 60 ft. wide with a driveway of 40 ft. in the center. It will be supported by 12 high reinforced concrete piers.

Citizens of Belmont township, at a recent election, voted in favor of bonding for $5,000 for the construction of a new reinforced concrete bridge at Woodland, to replace the old iron structure at that site. Plans will be prepared by the State Highway Commissioner at Springfield, Ill. Rufus Kendall is town clerk.

The Sterling-Moline Traction Co. has under consideration the construction of a new bridge at First Ave. to carry the tracks into Sterling, Ill., as it is believed the present structure is inadequate.

The contract for the construction of the Smith and Woodcock bridges in Banner township, Ill., has been awarded to the Illinois Steel Bridge Co., of which C. E. Nickles, Tennessee, Ill., is agent.

The Pennsylvania Lines, the Baltimore & Ohio R. R. and the New York Central Lines are planning the construction of new bridges over the Calumet river in Chicago, Ill.

The Oak Park Elevated Railroad Co. is

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

having plans prepared for the construction of the proposed bridge over the river at Lake St., Chicago, Ill. R. D. Stephens, Chicago, Ill., is vice president of the company.

Mayor J. F. Bidinger favors the construction of a new bridge across the ravine in Waukegan, Ill., and will take the matter up with the officials of the street car company. The cost of the structure, it is thought, will be about $65,000.

Plans and specifications are being prepared by S. B. Hand, city engineer, for the construction of a bridge over the Keith creek at Sixth St., Rockford, Ill. The structure will be 125 ft. long and the cost is estimated at $12,000.

Indiana.

✣Bids will be received until [illegible] a. m., June 8, by commissioners of Daviess county, Washington, Ind., for the construction of bridges in Bogard and Elmore townships. Thomas Nugent is county auditor.

Plans are being prepared by W. S. Moore, city engineer of South Bend, Ind., for the construction of the proposed new bridge at Logan St., Mishawaka, Ind. Plans will be drawn for both steel and concrete structures.

The following bids were received by the Board of Public Works, Indianapolis, Ind., for the construction of the proposed State Ave. bridge over Pleasant Run. R. E. Pickens, $9,683; American Construction Co., $9,975; H. F. Hackedorn, $10,393; Cleary & Kuert, $9,991.

Iowa.

✣Bids will be received until 2 p. m., June 8, by F. W. Leedham, county auditor, Clinton, Ia., for the construction of three steel bridges in Clinton county, as follows: One 50 ft. steel pony superstructure; one 40 ft. steel pony superstructure; one 30 ft. steel pony superstructure. The work will include 611 cu yds. excavation and 401 cu. yds. of concrete in abutments. R. C. Hart, Clinton, Ia., is county engineer.

⦿The contracts for the construction of 7 reinforced concrete bridges in Clinton county have been awarded by the commissioners to P. V. Clarke, Clinton, Ia., as follows:

Length	[illegible]	Contract Price.
24 ft.	[illegible]	[illegible]
24 and 16 ft.	[illegible]	[illegible]
14 ft.	[illegible]	[illegible]
24 ft.	I-beam	[illegible]
12 ft.	[illegible]	[illegible]
10 ft.	[illegible]	191

Kansas.

⦿St. Joe Construction Co. has been awarded the contract by the Board of Commissioners, Hutchinson, Kan., for the construction of a slab girder bridge, 50 ft. by 80 ft., with 15-ft. spans, at Hutchinson, for $4,531. C. L. McLane is city engineer. Bids were opened June 2.

⦿The contract for the construction of the bridge over the river at Thirteenth St. in Wichita, Kan., has been awarded by the County Commissioners to the Wichita Construction Co., Wichita, Kan., at $19,450. According to the plans the structure will be 400 ft. long and 18 ft. wide.

The Logan Ave. Improvement League has instructed the Street Committee to make an effort to secure the construction of a bridge over Four Mile creek on Avenue Frederick Hubbell, by the city of Des Moines, Ia. The East Des Moines Commercial League also favors this improvement.

Plans are being prepared by county engineer for the construction of three large steel bridges in the vicinity of Delmar, Ia., in Clinton county.

According to information received from Topeka, Kan., city engineer will prepare plans and specifications for the construction of a new bridge at Fillmore St., to replace the structure condemned by bridge experts.

City engineer of Hutchinson, Kan., has completed plans for the construction of a new bridge at Walnut St. The structure will be similar to the Main St. bridge.

Commissioners of Reno county at Hutchinson, Kan., [illegible] planning the construction of two new bridges in Wellsville, Kan.

Louisiana.

✣Bids will be received until June 20 by F. L. Maxwell, Mounds, La., or A. L. Slack, Tallulah, La., for lowering the steel bridge over Bayou Vidal at the Point Clear plantation in Madison parish, La. The structure has a span of 185 ft. and the entire length is 344 ft., including approaches. Plans are on file at the office of the police jury, Tallulah, La. F. L. Maxwell is president of the jury.

Maine.

Among a number of recommendations made by the recently organized Civic Improvement Commission of Bangor, Me., in their report, are those for widening Central St., making a continuous thoroughfare from the Hampden line to Market St., and the construction of a bridge across the Lower Kenduskeag, just above the railroad bridge.

Maryland.

✣Bids will be received until 11 a. m., June 14, by Board of Awards, Baltimore, Md., for the construction of a masonry arch and retaining walls in place of a wooden trestle along the East Boundary road of Wyman Park, north of the United States Marine Hospital, Baltimore.

Massachusetts.

Selectmen of Southbridge, Mass., are making an effort to induce the Superior Court to appoint a commission to take up the matter of abolishing the grade crossings at Foster, Central and Hook Sts. in Southbridge.

Woodbury Ave. Extension Committee has submitted a report in favor of the construction of a bridge over the river on the line of Woodbury [illegible] in Saugus Center, Mass.

Michigan.

Board of Works, Grand Rapids, Mich., has voted to employ Daniel B. Luten to prepare plans for the construction of the reinforced concrete bridge at West Leonard St.

Minnesota.

Plans are being prepared by William Barneck, city engineer, Albert, Lea, for the construction of an 80-ft. concrete bridge and dam.

Missouri.

John V. Hanna, chief engineer of the Kansas City Terminal Ry. Co., is quoted as stating that work will be started this summer on 32 viaducts and five subways in Kansas City, Mo. The Campbell St. viaduct will be the first started. This can be built with comparatively little excavation work, and probably will be finished by January 1. Those at McGee St. and Grand Ave. also are to be started. The subways on which work will be commenced are at Indiana Ave., Fifteenth St., Ninth and Hardesty Sts., Jackson Ave. and Independence road. Several of these may be completed by spring, but one or two probably will require nearly a year. The viaducts will cost all [illegible] and the subways from $25,000 to $300,000. Most of the crossings along the Belt Line cannot be started until considerable excavation work is done. One shovel has started to excavate at Woodland Ave., near Nineteenth St. This one hill must be torn from a number of crossings. Should the proposed grade change be granted, 1,000,000 cu. yds. of dirt will be excavated. The other shovel is completing the work on the station site. It now is on the next to the last cut, and the remainder of the work will require about three weeks. Then work can be started on the station foundation and the O. K. creek sewer. The shovel then will complete the plaza excavating after which it will be put to work along the hill near Woodland Ave.

Nebraska.

⦿Commissioners of Gage county at Beatrice, Neb., recently awarded the contract for the construction of 20 bridges in different sections of the county to the Standard Bridge Co., Omaha, Neb.

New Jersey.

At a meeting of the freeholders of Union and Somerset counties at Plainfield, it was decided to replace the old wooden bridge at Washington Ave., in that place, with a new reinforced concrete structure 60 ft. long and 50 ft. wide. Elizabeth, N. J., is the county seat of Union county.

The Board of Somerset County Freeholders at Somerville, N. J., has decided to construct a new bridge of reinforced concrete at West End Ave. in Plainfield, N. J., to replace the present wooden structure.

Borough Council and Central R. R. of New Jersey are drawing up an agreement for the construction of two new bridges at Roselle, one over the tracks at Gordon St. and the other at Walnut St. J. L. Bauer is borough engineer, Roselle, N. J., and C. W. MacQuoid is mayor.

The Board of Freeholders of Warren county at Belvidere, N. J., has resolved to construct a new concrete bridge over the [illegible] the present structure, which is in bad condition.

New York.

Among the bills advanced at the Senate that went to the third reading was the one of Senator L. H. White, providing for the appropriation of $40,000 for the construction of a new bridge over the Mohawk at dam 5, between Glenville and Rotterdam, N. Y.

[illegible] voted to bond the town in the sum of $5,000 for the construction of the proposed new Greer Hollow bridge. Plans and specifications have been prepared for the improvement by Charles Roemer, county superintendent of highways. The structure will be a straight reinforced concrete structure, 100 ft. long and 6 ft. in diameter.

The Concrete-Steel Engineering Co., 13-21 [illegible] the city officials of Watertown, N. Y., plans and estimates of the cost of building the proposed Jackson St. bridge over the [illegible] is city engineer.

Ohio.

✣Bids will be received until noon, June 12, by Board of Lawrence County Commissioners, Ironton, O., for the construction of the superstructure of a steel highway bridge over Symmes creek on Waterloo and Mt. Vernon turnpike. The structure is to be 100 ft. long and 16 ft. wide, with 6 panels, height of truss equal to panel length. A. C. Robinson is county auditor.

✣Bids will be received until 11 a. m., June 28, by Board of Cuyahoga County Commissioners, Cleveland, O., for the construction, under Report No. 2769, of a concrete bridge, on Anderson road in Euclid township. Frank L. Lander is county surveyor. J. F. Goldenbogen is clerk of the board.

⦿City of Cincinnati, O., on May 9, awarded the contract for the cleaning and painting of the 8th St. viaduct to John Gruber, 2308 Gest St., Cincinnati, O., at $6,700. J. J. Wenner is clerk, Dept. of Public Service.

Board of the Oberlin Chamber of Commerce recently viewed the proposed site for the construction of the Lorain county bridge at East 31st St., Lorain, O. The estimated cost of the improvement is $68,000.

Plans for the construction of a bridge to eliminate the Oak St. crossing at Youngstown, O., are being prepared by F. M. Lillie, city engineer, and County Engineer Montgomery.

An election was held June 6 at Oberlin, O., for the purpose of submitting to the voters the proposition of issuing bonds amounting to $68,000 for the East 31st St. bridge in that city. James Edwards is president of the Oberlin Chamber of Commerce.

Surveyor of Butler county, L. A. Dillon, Hamilton, O., has been directed by the county commissioners to prepare plans for the construction of two bridges, estimated to cost about $12,000. One will be 175 ft. long at Sloat farm in Oxford township, the other

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

a 1[illegible] span [illegible] Collinsville.

It is reported that the Cleveland, Cincinnati, Chicago & St. Louis (Big Four) R. R. is planning the construction of a large viaduct over its yards at Sharonville and the creek at the same point. O. E. Selby, Cincinnati, O., is engineer bridges and buildings.

The following bids were received May 29, by Director of Public Service, Cincinnati, O., for the construction of the substructure of the Gilbert Ave. viaduct, estimated by engineer [illegible] $[illegible]: (1) [illegible] Gladorf; (2) McArthur Concrete Pile Foundation Co.; (3) A. J. Henkel & Sullivan; (4) Cleveland Construction Co.; (5) Thomas P. Strack; (6) Kaps-Brehm, 1st National Bank Bldg., Cincinnati, O.; (7) William Scully, Jr. & Bro.

[illegible] from Ligonier, Pa., state that the [illegible] of Westmoreland county at Greensburg, Pa., have decided upon the construction of a new bridge at Oak Grove on the road leading to Stark farm, to replace the old structure at that point.

Surveyor of Lackawanna county at Scranton, Pa., is making plans for the construction of a new bridge over Keyser Valley creek, near Tubbs & Watkins' lumber yard in Taylor, Pa. It is planned to have the structure built of reinforced concrete.

All bids opened June 1 by the Board of Commissioners of Clinton county at Lock Haven, Pa., for the construction of a bridge over the west branch of the Susquehanna River at McElhattan, have been rejected. The superstructure consists of ten duplicate plate girder spans, each 97.5 ft. long, with one roadway 16 ft. clear. The substructure consists of nine reinforced concrete piers and two reinforced concrete abutments. Plans and specifications are on file at the office of ENGINEERING & CONTRACTING, 537 Dearborn St., Chicago, Ill. Farris Engineering Co., Jenkins Bldg., Pittsburg, Pa., engineer.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
[illegible]	$ [illegible]	$ 0.60	$ 0.75	$ 0.75	$ 0.50	$ [illegible]	$ 0.60
[illegible]	[illegible]	6.00	8.00	6.60	7.50	[illegible]	[illegible]
80,000 lbs. reinforcing steel	.025	.025	.03	.03	.03	.0239	.03
[illegible]	[illegible]	[illegible]	1.27	[illegible]	.95	[illegible]	[illegible]
Filling old state sewer	4,500	6,000	6,000	4,090	6,000	5,330	6,000
[illegible]	$64,100	$59,200	$69,050	$50,160	$56,700		$68,500

[illegible], Separate [illegible], $1.26 for Peerless, $0.85 Peerless Construction Taper, $1.20 Peerless Corrugated Steel.

Oklahoma.

The Purcell-Lexington Toll Bridge Co., Purcell, Okla., has been incorporated with a capital stock of $100,000, and proposes the construction of a new toll bridge. The directors are G. H. Parker, J. T. Stathem and R. C. Boles, all of Purcell.

Pennsylvania.

✣Bids will be received until 10 a. m., June 10, by Board of McKean County Commissioners, Smethport, Pa., for the construction of a stone and concrete substructure and steel superstructure for a bridge over a branch of the Kinzua creek in Hamilton township.

✣Bids will be received until 10 a. m., June 20, by County Controller A. L. Rhodes, Reading, Pa., for the erection of a reinforced concrete arch bridge at Kutztown, Pa. The specifications include the removal of the iron truss bridge at present on the site. Plans and specifications can be had at the office of the County Commissioners, Reading, Pa.

✣Bids will be received until 10 a. m., June 10, by E. A. Jones, county controller, Scranton, Pa., for the construction complete of grand jury bridge of 1910 No. 11 over Keyser Creek on Main St. in Taylor borough.

⊙Commissioners of Washington county, Washington, Pa., recently awarded the following bridge contracts: Construction of the Main St. span of bridge over South Main St. to William Pickett & Co. at $1,924; substructure of McClane bridge on improved Washington-Meadowlands road to William Pickett & Co. at $1,116; superstructure of McClaine bridge to American Bridge Co., Penn. Bldg., Philadelphia, Pa. at $1,615; Applegate bridge over Sugar Run in Independence township to W. F. Kline at $1,068 for substructure, and Penn Bridge Co., Beaver Falls, Pa., at $859; concrete arch in Twilight borough to Forrest Construction Co. at $461.

The Finance Committee of the Pittsburg, Pa., City Council has recommended the authorization of a $30,000 bond issue to provide the necessary funds for the construction of a bridge over Everett St., in line with Hoevler St.

South Carolina.

The Free Bridge Commission of Columbia, S. C., W. G. Childs, chairman, has decided to advertise for bids for the construction of the proposed new free bridge at that place.

South Dakota.

The Board of Commissioners, Minnehaha county, Sioux Falls, S. Dak., has ordered the construction of the following bridges: 90-ft. span between section 32, Sverdrup township and section 5 in Brandon township; 40-ft. span between sections 17 and 20 in Split Rock township; 36-ft. span between sections 17 and 18 in Valley Springs township; 40-ft. steel bridge between sections 1 and 2 Edison township; 80-ft. span between sections 8 and 17 in Highland township; a 36-ft. span along the quarter section line of section 10 in Logan township; 20-ft. span between sections 34 and 35 in Taopi township; bridge between sections 28, Silver Creek township, and 38 Sverdrup township; 36-ft. span between sections 14 and 11 in Grand Meadow township; 40-ft. span between sections 17 and 20 in Wayne township; the approaches to the McGarragh bridge in Sioux Falls township will be graded up and a pile bridge will be built between section 7 in Brandon and section 12 in Mapleton.

Tennessee.

⊙The contract for the construction of the bridge over the Southern Railway tracks on McCallie Ave., Chattanooga, Tenn., has been awarded to the Chickamauga Quarry & Construction Co. at $8,000. The new structure will be the full width of the street.

Texas.

⊙The Lavaca County Commissioners' Court on May 27 let the contract for the construction of a bridge to be built over South Mustang creek, 4 miles south of Shriner, to the Penn Bridge Co., Dallas, Texas, at $1,030. Work is to be completed within 6 months.

Utah.

At an election held at Brigham City, Utah, it was voted to bond Box Elder county to the extent of $200,000 for the improvement of roads and the construction of bridges.

Virginia.

✣Bids will be received until June 24 by committee of Franklin County Supervisors, Rocky Mount, Va., for the construction of bridge over Pigg River at Haynes' Ford; also a bridge over Chestnut Creek in Franklin County. J. H. Ferguson is a member of the committee.

Washington.

✣Bids will be received from noon until 2 p. m., June 26, by Owen Woods, Commissioner of Public Works, Tacoma, Wash., for the construction of a steel bridge over the Puyallup river, and a steel bridge over the City Waterway, combined estimate $600,000. W. C. Raleigh is city engineer. Waddell & Harrington, Kansas City, Mo., are engineers.

Wisconsin.

✣Bids will be received until 10:30 a. m., June 10, by Department of Public Works, H. E. Briggs, commissioner, Milwaukee, Wis., for the construction of a bascule bridge across the Milwaukee River at the foot of Oneida St. in the city of Milwaukee. The structure is to be completed by March 1, 1912. Bonds to accompany bids are required as follows: For entire structure, $34,500; for superstructure, $18,000; for substructure, $16,500. L. J. Klug is superintendent of bridges and public buildings.

⊙The contract for the construction of the new bridge at Morrison, Wis., has been awarded to John Roberts, Rockland, at $1,540.

Canada.

✣Bids will be received until 5 p. m., June 30, by chairman of the Utilities Committee at the office of the city clerk, Fort William, Ont., for the construction of a reinforced concrete subway and supply of materials in connection therewith. John Wilson is city engineer.

✣Bids will be received until June 15, by James R. Shanks, chairman of the Bridge Commission, Wheatland, Man., for necessary labor and material for the construction of masonry abutments; a 90-ft. steel bridge with 16-ft. roadway over the Little Saskatchewan river, 1½ miles from Rivers. Plans can be seen at the office of chief engineer, Department of Public Works, Winnipeg, Man.

✣Bids will be received until noon, June 20, by F. S. Spence, chairman, Board of Control, Toronto, Ont., for the construction of a steel span crossing the tracks of the C. P. R. at Weston road in Toronto. Plans and specifications are on file at the Department of Railways, Bridges and Docks, city engineer's office, Toronto.

✣Bids will be received until noon, June 15, by City Commissioners, Saskatoon, Sask., for the construction of the 19th St. subway. M. H. McLeod, chief engineer of the Canadian Northern Ry., Winnipeg, Man., or George T. Clarke, city engineer, Saskatoon, Sask., can supply further information.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

⊙Bids were opened June 1 by the Commissioners of Drainage District No. 1, Wilmot, Ark., for the construction of a drainage canal and laterals in Ashley County, Ark., the work including about 700,000 cu. yds. The contract was let to Clyde A. Walb, La Grange, Ind., at 7.99 cts. per cu. yd.

California.

⊙Advices from San Bernardino state that the Bear Valley Mutual Water Company has let to W. M. Adams a contract for constructing 2,560 ft. of rock-covered canal, extending from the Sunnyside Divide, near the mouth of Santa Ana Canyon, to the main canal, the contract price being $3 per lin. ft.

The Northern California Power Co., 350 Post St., San Francisco, has started work on the boring of a 6,000-ft. tunnel in connection with its Dry Burney Creek conservation and irrigation project. Dry Burney Creek is to be dammed and a storage reservoir of 1,540 acres is to be made. The tunnel is to be bored from the Dry Burney Creek basin to Cero

Creek basin. The water will flow down Cow Creek to Kilare, where the company has had a 4,000 HP. plant for several years. This will be increased to 7,000 HP. The extra machinery has been ordered. In addition, a secondary plant will be built down Cow Creek, using the water a second time and generating 3,000 HP. more. After that the water will be used for irrigation purposes

Illinois.

✣Bids will be [illegible] until June 8 by Commissioner of Okaw Drainage District, Champaign and Douglas Counties, at the office of Ray & Dobbins, Champaign, Ill., for work in Subdistrict No. 7, including furnishing, trenching, laying, etc., of the following tile: 6,400 ft. 22-in., 800 ft. 20-in., 800 ft. 18-in., 2,000 ft. 14-in., 1,600 ft. 12-in. The average cut for the 22-in. tile is 5.8 ft., with a maximum of about 7 ft. For the balance of the ditch the average cut is about 5½ ft., with a maximum of about 7 ft. Work to be begun as soon as possible after July 1st, and to be completed by January 1, 1912. Bids may be sent to the commissioners or the attorneys, and must be accompanied by a certified check for $200. The commissioners are: E. V. Burton, Pesotum, Ill.; J. J. Chambers, Sadorus, Ill.; J. C. Roe, Hayes, Ill.

Surveys have been made for ditches for the extension of the Rush Creek Drainage District in McHenry County, so as to drain an additional 3,000 acres of land. Construction work is under way in the district as originally planned. A. L. Webster, County Surveyor, Woodstock, Ill., made the surveys.

Indiana.

Petition is to be filed with the County Commissioners at Hartford City, Ind., for the dredging of Little Lick Creek. This petition will take the place of one filed last March and which was not docketed for the reason that enough remonstrants had been obtained to defeat it. The proposed project is to dredge Little Lick Creek through two townships to a depth of 7 ft. and at a cost of $150,[illegible]

Iowa.

Advices from Emmetsburg, Ia., state that the work of dredging and improving Medium Lake, near Emmetsburg, will be started in a few days. The sum of $15,000 has been raised for this work.

Mayor Alfred C. Mueller of Davenport, Ia., has appointed a River Front Improvement Commission to have charge of the expenditure of about $250,000 for improving the river front at Davenport. The Commission consists of W. D. Peterson, Rudolph B. Clausen, architect, and Wm. H. Kimball, civil engineer, and it, with the Mayor and Commissioner of Public Works, A. M. Compton, will have full charge and control hereafter. This Commission was authorized by the last legislature. It will have power to issue bonds for such improvements as it decides on, and [illegible]

Louisiana.

✣Bids will be received at the office of the Board of State Engineers, Court Building, New Or[illegible] until noon, June 14, for the constru[illegible] the following named levee work: [illegible] Bossier Parish, Red River, Left Bank, New Levee; about 3,760 ft. in length; approximate contents, 48,500 cu. yds.; deposit required, $200; bond required, $2,400. South Bank of Loggy Bayou Levee, Red River Parish, [illegible] contents, [illegible] 000 cu. yds.; deposit required, $160; bond required, $1,750.

Minnesota.

✣Bids will be received until 10:30 a. m., June 22, by Arthur A. Caswell, County Auditor, Anoka, Minn., for constructing the main and branch ditches of the Judicial Ditch No. 1 of Anoka County. The estimated amount of work to be done and the estimated cost [illegible]

	Cu. yds.	Cost.
Main [illegible]	[illegible]	[illegible]
Branch No. 1	1,805.80	180.58
Branch No. [illegible]	[illegible]	[illegible]
Left 1 Branch [illegible]	[illegible]	[illegible]
Branch No. [illegible]	[illegible]	[illegible]
Branch No. [illegible]	[illegible]	[illegible]
Branch No. [illegible]	[illegible]	[illegible]
	[illegible]	[illegible]

[illegible] Work [illegible]

	Feet.	Cost.
Main [illegible]	[illegible]	[illegible]
Lat. [illegible] Branch [illegible]	[illegible]	[illegible]
Branch No. [illegible]	[illegible]	[illegible]
	[illegible]	[illegible]

⊙Bids were opened May 27 by Louis G. Vogel, County Auditor, New Ulm, Minn., for the construction of County Ditch No. 18, the contract being let to G. E. Gilbertson, St. James, Minn., at a bid 6 per cent below the engineer's estimate. The following tile will be used: 2,000 ft. 6-in., 7,959 ft. 7-in., 1,400 ft. 8-in., 800 ft. 10-in., 2,500 ft. 12-in., 600 ft. 14-in. and 2,680 ft. 15 in.

Bids will be received until 4 p. m., June 23, by P. D. McKellar, County Auditor, Jackson County, Jackson, Minn., for the construction of Judicial Ditch No. 3. The work includes 9,000 cu. yds. cleaning out Branch No. 1 and deepening same from station 155 to 96; average depth of cleaning 2 ft., width at bottom 14 ft. Main ditch, 52,357.90 cu. yds. of excavating and 19,920 cu. yds. of clearing away waste banks, from station 257 to 297. Total yds. of excavating, 61,357.90 cu. yds. Clearing away waste banks, 19,920 cu. yds. Estimated cost of whole job, $8,127.79. Ditch located 4 miles west of Lakefield, Minn.

Hearing is to be held on June 14 by the County Board of Polk County, Crookston, Minn., on petitions for the establishment of County Ditch No. 86.

[illegible] Board of Roseau County, Roseau, Minn., on a petition for a proposed County Ditch. The system [illegible] ditch, seven laterals and three branches.

Hearing is to be held June 17 by the District Court at Ada, Minn., for the establishment of Judicial Ditch No. 51.

Surveys are to be made for the establishment of Ditches 21 and 22 in McLeod County. T. C. Christlieb, Hutchinson, Kan., is the Engineer.

Missouri.

✣[illegible] George Bird, Engineer, at the office of C. G. Weeks, County Clerk, Butler, Mo., for the excavation of 1,140,000 cu. yds. of material in Drainage District No. 1, Bates County, Mo. A certified check for $1,000 must be filed [illegible]

North Carolina.

Bids will probably be asked this month for the construction of ditches for the Buckle Swamp Drainage District in Pender and Bladen Counties. The total cost will be about $20,000 and the work will include a main ditch six miles long, 4 to 6 ft. deep, and 12 ft. bottom width, and three open laterals, each about three miles long. W. K. Allen, Wilmington, N. C., is Engineer.

A $42,000 bond issue is proposed by the Commissioners of Mosely Creek Drainage District for the construction of a drainage system. G. V. Richardson, Newbern, N. C., is Chairman of the Commission.

North Dakota.

Surveys have been made for a reservoir to be constructed in the Nesson Valley for Herman Nelson's irrigation system. J. C. Field, County Surveyor, Williston, N. Dak., [illegible]

Utah.

✣Bids will be received until 2 p. m., June 19, by United States Reclamation Service, Provo, Utah, for the building of a dike to be located about 35 miles northeast of Thistle, Utah. The work involves approximately the following: 88,000 cu. yds. of earth work, 4,800 cu. yds. of rock, 12,100 cu. yds. of paving, 1,400 lin. ft. of drain tile and 1,700 cu. yds. of reinforced concrete. For particulars address the United States Reclamation Service, Provo, Utah, or Washington, D. C.

Wisconsin.

✣Bids will be received until June 15 (re-advertisement of bids received May 20), by Bushing Drainage District, C. W. Staples, Osceola, Wis., Chairman, for the construction of ditches Nos. 1, 2 and 3, including approximately 33,397 cu. yds. Total length of ditches, about 3⅝ miles; three concrete arch culverts; 7½ miles of five-wire fence, galvanized barbed wire, consisting of two No. 12-gauge wires twisted with barbs not over 6 inches. Work to be commenced on or before June 10, 1911, and be completed by November 1, 1911. Plans and specifications are on file with the clerk of the Circuit court at Balsam Lake. [illegible]

Bids will be received until 3 p. m., June 21, by Dan Devine, Secretary Albion Drainage District, 31 Vroman Bldg., Madison, Wis., for the excavation of 19,230 feet of ditches, 6 ft. bottom width, 5.35 ft. average depth; 9,915 feet of ditches, 4 ft. bottom width, 4 to 5 feet deep, and 34,930 feet of lateral ditches bottom width 2 ft., average depth 4 ft. Work suitable for trenching machine, drainage excavator or drag line dredge. W. G. Kirchoffer, Madison, Wis., is Engineer. [illegible]

WATER-WORKS

Arkansas.

✣Bi[illegible] til June 23, as [illegible] Board of Improvement, Water Works District No. 2, Mena, Ark., for furnishing materials and for new construction work. Reg[illegible] by addressing Winters & Dove, 810 First National Bank Bldg., Fort Smith, Ark. John Thompson is chairman of the Board of Improvement, Mena, Ark.

California.

⊙Braun, Williams & Russell, Inc., 503 Market St., San Francisco, Cal., have secured the contract at Fort Baker, Cal., for the construction of a 100,000-gal. steel water storage tank

The citizens of Long Beach, Cal., at a recent meeting voted in favor of a resolution presented by the Water Commission, asking the City Council to place before the voters a proposition of voting $850,000 bonds for the purchase of the property of the Alamitos Water Co., and the Long Beach Water Co.

Colorado.

✣Bids will be received until 10 a. m., June 16, by City Council, Colorado Springs, Colo., for furnishing the necessary labor and material for the construction of extensions to the water mains. The amount of work to be done is as follows: Furnishing and laying about 63,785 ft. of cast iron pipe 4 to 16 in., including about 43 tons special castings. Alternate bids will also be received for 16 in., also 12 in., steel pipe; 43 gate valves and boxes; five hydro electric remote controlled, 12-in. valves; five 12 in. pressure reducing valves; 53 tons of pig lead; two tons of calking hemp; 20 man hole covers; constructing 20 man holes. Charles Chapman is city clerk.

The citizens of Morgan Hill, Colo., recently

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

voted the issuance of bonds to the amount of $13,000 for the construction of a waterworks system.

According to advices from Denver, Colo., the Denver Union Water Co., has arranged to take steps to improve the water supply of South Denver. A pumping station will be installed at Jewell Ave. and University St. The work will be done by the company's forces.

Florida.

The voters of Bradentown, Fla., have voted the issuance of bonds to the amount of $15,000 for improvements to the water works system.

Illinois.

✣Bids will be received until 10 a. m., June 12, by Board of Local Improvements, Joliet, Ill., for the construction of water main in Seeser St. W. S. Welch is clerk of the board. Harry Stevens is city engineer.

✣Bids will be received until 10 a. m., June 12, by Board of Local Improvements, Joliet, Ill., for the construction of water mains in Wilson St. and Albert Ave. W. S. Welch is clerk of the Board. H. Stevens is city engineer.

✣Bids will be received until 10 a. m., June 12, by Board of Local Improvements, Joliet, Ill., for the improvement of Jackson St. by constructing a watermain therein. W. S. Welch is clerk of the Board. Harry Stevens is city engineer.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., until 11 a. m., June 14th, for furnishing all labor and material necessary to construct water service pipes in fourteen streets. Cash or certified check for 10 per cent of total bid must accompany proposal.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., until 11 a. m., June 14th, 1911, for furnishing all material and labor necessary to lay house drains in 14 different streets. Cash or certified check for 10 per cent of total amount must accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., June 13th, for labor and material for covering steam pipes, boilers, breeching, etc., in the 68th St. pumping station. The covering for the steam piping shall contain not less than 85 per cent asbestos fibre, loosely felted together, to fit various sized pipes, and covered with an 8-oz. canvas jacket. Steam headers 4 ins. in diameter and over shall be covered with a 3-in. covering in layers not less than 1-in. thick. Coverings for boilers shall be applied in block or sheet form applied in two independent layers, not less than 2 ins. thick, first layer to consist of 85 per cent of asbestos fibre, second layer not less than 85 per cent carbonate of magnesia. Each layer to be fastened with No. 14 galvanized wire. Cash or certified check for $150 to accompany proposal.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., June 14th, for furnishing and delivering 200 tons (2,000 lbs. each) of 99.5 per cent pure pig lead. Cash or certified check for $1,000 must accompany proposal.

Indiana.

Engineer Dabney H. Maury of Peoria, Ill., has submitted his report to the City Council of South Bend, Ind., as to the best method to pursue in reference to pumping the pure water from the East Mishawaka wells into the mains.

George Cadogan Morgan, Consulting Engineer, 160 Washington Blvd., Chicago, Ill., is preparing plans and specifications for the construction of a waterworks system for the city of Porter, Ind.

Iowa.

✣Bids will be received until June [illegible] by Water Committee, Galva, Ia., for digging and laying 1,100 ft. of 4-in. water main, 5½ ft. deep.

Mayor James R. Hanna of Des Moines, Ia., has issued his proclamation calling for a special election for June 19 to decide whether the city shall purchase the property of the Des Moines Waterworks.

Kansas.

✣Bids will be received until noon, June 19, by E. E. Bellamy, city clerk, Cherryvale, Kas., for the construction of a water purification plant, power house, storage reservoir, etc. Plans and specifications are on file at the office of J. S. Worley Co., Reliance Bldg., Kansas City, Mo.

The city officials of Augusta, Kan., have decided to install a new filtration plant for the waterworks at a cost of $12,000.

Advices from Topeka, Kan., state that the Water Commissioners will soon advertise for bids for a new pump of 8,000,000 gals. daily capacity.

An election will be held in Sylvan Grove, Kan., on June 26 for the purpose of voting on the issuance of bonds in the sum of $35,000 for the installation of water works and electric lights.

Massachusetts.

The City Council of Lynn, Mass., recently authorized an issue of $75,000 in bonds for the purpose of constructing two pumping stations, laying 5,400 ft. of 36-in. pipe, and for raising Breeds Point 30 ft.

Advices from Deerfield, Mass., state that the Deerfield Fire District has voted $30,000 for the installation of a waterworks and for fire protection. About five miles of 6-in. and 8-in. mains will be laid and a concrete reservoir constructed. William S. Johnson of Boston is engineer.

A bill has been introduced in the state legislature by the officials of Shelburne Falls, Mass., for the construction of a new water works, estimated to cost $75,000. H. Newell and F. H. Oakman of Shelburne Falls will have charge of the work.

Michigan.

✣Bids will be received until noon, June 13, by Board of Water Commissioners, B. F. Guiney, Secy., Detroit, Mich., for supplying seven 72-in. gate valves, seven motor operated floor stands and nine hand operated floor stands.

The city of Harbor Springs, Mich., has purchased a private pipe line for the municipal waterworks for a consideration of $20,000. Bonds to the amount of $45,000 were voted last fall for improvements to the plant.

Minnesota.

✣Bids will be received until 7:30 p. m., June 30, by Henry N. Knott, City Clerk, Minneapolis, Minn., for the construction of filter equipment and devices.

✣Bids will be received until June 12, by City of Millmar, Minn., for the construction of two purification plants and pumping stations. J. A. Rowat is City Engineer.

⊙The Mankato Mfg. Co., Mankato, Minn., has been awarded the contract by the City Council of that city for furnishing and installing a new boiler at pumping station, 125 h. p., 150 lbs. pressure, for $1,520. Bids were opened May 29.

⊙The City Council of Minneapolis, Minn., has let the contract for 4,000 water meters to be purchased by the city water department to the National Meter Co., for $7 each.

Estimates of cost for the construction of a waterworks system and an electric light plant for Wayzota, Minn., have been made by Consulting Engineer W. D. Lovell of Minneapolis, Minn.

Missouri.

⊙It is reported that J. W. Danforth Co., 70 Ellicott Square, Buffalo, N. Y., has been awarded the contract by the city of Columbia, Mo., for the construction of a waterworks system and electric light plant.

Montana.

✣Bids will be received until June 12, by P. A. Chase, City Clerk, Lewistown, Mont., for the construction of 56,000 ft. of 4 to 12-in. mains, including trenching and laying.

Nebraska.

According to advices from Omaha, Neb., the city has taken over the water plant and improvements will be made shortly.

New Jersey.

✣Bids will be received until 2 p. m., June 16, by Decatur M. Sawyer, president of the Board of Commissioners, New Jersey Reformatory, Rahway, N. J., for furnishing the necessary labor and material for the installation of an independent source of water supply, including the following: Construction and erection of tank and installation of pumps, and for furnishing and delivering f. o. b. Rahway, freight prepaid, the following: Cast iron water pipe, wrought iron pipe, valves, gates, etc., cement, sand, lumber, brick, crushed stone, reinforcing bars, nails, lead, manhole covers and frames, and any other material necessary. All as per plans and specifications on file in the reformatory.

City Engineer M. R. Sherrerd of Newark, N. J., will make surveys for the proposed construction of an impounding reservoir near Pompton turnpike at Midvale.

Advices from Oradell, N. J., state that the Hackensack Water Co., will soon construct a concrete dam across the Hackensack river near Oradell at an estimated cost of $50,000.

A public meeting was held in Millville, N. J., recently regarding the proposed purchase by the city of the electric light and water plants.

New York.

The City Council of Geneva, N. Y., has authorized the expenditure of $40,000 for the purpose of installing a slow sand filtration plant for the purification of the water supply. William S. Johnson, 101 Tremont St., Boston, Mass., is engineer.

North Carolina.

Bonds to the amount of $90,000 were recently voted by the citizens of High Point, N. C., to extend the water and sewer systems and for constructing streets and sidewalks.

North Dakota.

⊙C. H. Porritt of Fargo, N. Dak., has been awarded the contract by the City Council of Jamestown, N. Dak., for the construction of the proposed waterworks and sewer this summer for $16,758.

Ohio.

⊙The Trump Mfg. Co., Springfield, O., has been awarded the contract by the Department of Public Service, Cincinnati, O., for furnishing and installing two turbine water wheels for filtration plant at the Cincinnati waterworks. The contract price is $4,249. Bids were opened April 10.

⊙C. Underhill, 2878 Minto Ave., Cincinnati, O., has been awarded the contract by the Department of Public Service, Cincinnati, O., for laying water mains in Linwood Road, Union levee, etc., to Mt. Washington for $9,572. Bids were opened May 22.

The Department of Public Service of Cincinnati, O., has ordered plans and specifications prepared for the construction of a new water tank for Mount Auburn. It is proposed to increase the capacity of the tanks by 2,500,000 gals.

The City Council of Urbana, O., has authorized the Director of Public Service to contract with a consulting engineer in connection with the proposed improvement of the water works system of the city, by the purchase, installation and erection of pumps, pipes and appurtenances.

Oklahoma.

✣Bids will be received until 10 a. m., June 27, by City Council, Muskogee, Okla., for the construction of a water intake and inlet tower. The intake will include 2,600 ft. of 54-in. concrete pipe submerged and laid across the Arkansas River and up to the bed of the Grand River. The intake tower is concrete structure built at the upper end of the intake. Alexander Potter is consulting engineer, 114 Liberty St., New York city. T. P. Clonts is city engineer. Official advertisement will be found elsewhere in this issue.

It is proposed to construct a municipal water works and an electric light system in Talihina, Okla., at an estimated cost of be-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

tween $20,000 and $[illegible],000. The Mullergren Engineering Co. of Poteau, Okla., is the probable engineer for the work.

The city of Pawhuska, Okla., is planning on extending the present water works system of the city.

Advices from Comanche, Okla., state that the citizens of that town recently voted the issuance of bonds for the construction of a water works.

Oregon.

The city of Marshfield, Ore., is again discussing the matter of building a municipal waterworks. It is probable that the councils of Marshfield and North Bend will order the construction of a joint plant for the two cities.

Pennsylvania.

✣Bids will be received until June 9, by Commanding Officer, Frankford Arsenal, Philadelphia, Pa., for furnishing under proposal No. 129, 14 extra heavy gate valves, 10 check valves, 2 angle valves, 13 globe valves, 36 ft. wrought iron pipe, 40 ft. brass pipe, 25 extra heavy brass unions, 53 iron elbows, 12 iron tees, 12 elbows, 14 flanged tees, 40 corrugated copper gaskets, 38 cast-iron flanges, 1 steam ejector, 4 cast-iron tees, 8 heavy brass elbows.

The Borough of Shrewsbury, Pa., has sold bonds to the amount of $12,000 to C. C. Frick & Co., of York, Pa., the proceeds of which will be used for waterworks improvements.

South Dakota.

⊙P. F. Cavanaugh of Vermillion, S. Dak., has been awarded the contract by the Regents of Education, Fred W. Ford, secy., Vermillion, for the construction of a water works system at the University of South Dakota at Vermillion, for $2,517. Bids were opened May [illegible].

The Missouri Valley Engineering Co., 408-412 Western National Bank Bldg., Mitchell, S. Dak., has just received the contract for the design and superintendence of a complete water works system at Henry, S. Dak., estimated to cost between $10,000 and $12,000.

Tennessee.

Plans and specifications are being prepared by Consulting Engineer George Cadogan Morgan, 160 Washington Blvd., Chicago, Ill., for the installation of a waterworks system in the city of Lewisburg, Tenn.

The city officials of Henry, Tenn., are considering the installation of a system of waterworks on a small scale.

Plans have been made by Engineer C. H. Jenks for the construction of a new water works in McKenzie, Tenn., estimated to cost $40,000. The contract for this work will be let about July 1. Bonds will be sold about June 30. An electric light plant will also be installed.

Texas.

The attorney general of Austin, Tex., has approved the bonds of the city of Brownsville, Tex., amounting to $145,000 for various city improvements, including waterworks.

Utah.

At a recent mass meeting of the citizens of Santaquin, Utah, it was decided to bond the town for the installation of a waterworks system.

The citizens of Price, Utah, at a recent election, voted the issuance of bonds to the amount of $15,000 for creating a new park, removing indebtedness on the public lighting plant and extending the waterworks system.

Vermont.

✣Bids [illegible] June 21, by R. J. Fleming, Capt., Quartermaster, Fort Ethan Allen, Vt., for constructing an addition to pump house, installing electrically operated pumping machinery, building concrete reservoir and remodeling electric lighting system there.

Virginia.

✣Bids will [illegible] until [illegible] June 14, by E. E. Davis, Supt. Water Department, 103 City Hall, Richmond, Va., for furnishing and erecting two centrifugal pumps, piping and water meters; also two 200 h. p. electric motors, switchboard and wiring.

✣Bids will be received until 4 p. m., June 14, by Superintendent E. E. Davis, Water Works Department, Richmond, Va., for furnishing and erecting two centrifugal pumps, piping and water meters; also for two 200 h. p. electric motors, switchboard and wiring

Washington.

✣Bids will be received until June 19 by Board of Public Works, Seattle, Wash., for the construction of a penstock at Lake Union Auxiliary water plant. R. H. Thomson is city engineer.

The Zillah Water & Light Co., has filed articles of incorporation in the office of the county auditor, North Yakima, Wash. The incorporators and trustees of the company are: J. H. Bartley, John Pendricks and C. S. Ware. The capital stock is $25,000.

The Pacific Power & Light Co., J. E. Davidson, general manager, will begin within a short time the extension of the water mains to all parts of the city of North Yakima, Wash.

Wyoming.

✣Bids will be received until 10 a. m., June 10, by George H. Davis, town clerk, Upton, Wyo., for furnishing the necessary labor and material for the construction of a system of water works, including mains, pumping machinery, stand pipe, etc. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are engineers.

Canada.

✣Bids will be received until 8:30, June 19, by W. F. Heal, city clerk, Moose Jaw, Sask., for the following sewer and water works contracts: Contract 36, for laying approximately 7,900 ft. 24-in. trunk sewer; Contract 37, for laying approximately 16,832 lin. ft. sanitary sewer, varying sizes, and approximately 19,197 ft. of water main, varying sizes; Contract 38 for supplying approximately 20,553 lin. ft. of 6 to 24-in. cast iron pipe; Contract 39 for supplying approximately 23,474 lin. ft. of 6 to 24-in. vitrified tile pipe. J. M. Wilson is city engineer.

Plans have been made by Engineer F. W. Farncomb of London, Ont., for the construction of a new water works system, estimated to cost $35,000. The work will include about 13,000 ft. of 8, 6 and 4-in. cast iron pipe, 35 hydrants, valves, etc., and 40,000-gal. steel tank, elevated 100 ft. to bottom. The source of supply will be secured from deep wells.

SEWERAGE AND GARBAGE DISPOSAL

Alabama.

The citizens of Ozark, Ala., on May 23, voted the issuance of bonds to the amount of $15,000 for the purpose of sewering the city.

Arkansas.

⊙The contract for installing sewers in the recently organized district No. 10, Texarkana, Ark., has been awarded to Ockander Bros. by the City Commissioners, for $11,998. The district comprises about 40 squares and will equip with sewerage facilities all that territory embraced between Sixth and 16th Sts., north and south, and State Line Ave. and Ash St., east and west. Other bids received were: M. J. Nash, $12,190; W. A. Hanna, $12,840; J. R. Edmonds, $12,375; Almeter & Parker, $10,195, and the Arkansas Sewer Co., $8,640.

Georgia.

✣Bids will be received until June 20, by D. E. Hogsed, chairman Sewerage Committee, Tolocco, Ga., for the construction of sewerage system.

Idaho.

The City Council of Sandpoint, Ida., is preparing a new sewer ordinance which will be radically changed from the old ordinance, under which the two trunk lines of the present sewer system were constructed. The new sewer ordinance will create a sewer district of the entire city and will assess every property owner for sums necessary to build the trunk lines.

Illinois.

✣Bids will be received until 10 a. m., June 12, by Board of Local Improvements, Joliet, Ill., for the construction of a sewer in Seeser St. W. S. Welch is clerk of the board. Harry Stevens is city engineer.

✣Bids will be received until 11 a. m., June 14th, by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, secretary, for furnishing the labor and material necessary to construct the following sewers:

	[illegible]	[illegible]	[illegible]
	ft.	ft.	ft.
N. [illegible] Ave. [illegible] Cornelia Ave.	[illegible]	[illegible]	
N. [illegible] Ave. [illegible] to Roscoe St.	[illegible]	[illegible]	[illegible]
Muskegon [illegible] St. to [illegible] St.	[illegible]	[illegible]	
Muskegon Ave. [illegible] St. to E. [illegible] St.	[illegible]	[illegible]	[illegible]
Muskegon Ave. [illegible] to E. [illegible]	[illegible]		[illegible]
Nevada St. [illegible] to N. 47th Ave.	[illegible]	[illegible]	
Nevada St. [illegible] to N. 46th Ave.	[illegible]	[illegible]	[illegible]
Oglesby Ave. [illegible] St. to E. 67th St.	[illegible]	[illegible]	[illegible]
S. Morgan St. [illegible] to W. [illegible]	[illegible]	[illegible]	[illegible]
N. Ridge [illegible] W[illegible] Wood [illegible]	[illegible]	[illegible]	[illegible]
So. Park Ave. [illegible] 74th St.	[illegible]	[illegible]	[illegible]
So. Park [illegible] 77th St.	[illegible]	[illegible]	[illegible]
Alley N. [illegible] W. of [illegible] Cottage Grove Ave.	[illegible]	[illegible]	[illegible]
Belle Plaine [illegible] N. [illegible] Ave. to [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]
[illegible] 81st St.	630	1	
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Lewis St. from W. Division St. to [illegible]	[illegible]	[illegible]	
[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

⊙Andrew O'Neil has been awarded the contract by the Board of Public Works of Peoria, Ill., for the construction of the Swinerton St. sewer for $5,900.

⊙The Village Board of Forsyth, Ill., has awarded the contract for the construction of a sewer system with a main artery a little more than a mile in length to Arthur Birt, for about $1,000. The sewer will be of 8, 10 and 12-in. tile.

⊙The City Commissioners of Hoopeston, Ill., on May 25, awarded the contract for the construction of the new sanitary sewer to Henry Rees, of Quincy, Ill., for $48,172. Frank Payne is engineer.

Curtailment of the cost of the proposed sewer system in the First and Second wards of Rockford, Ill., has been made by the Board of Local Improvements. The system in the First ward is to cover only half of the territory originally proposed, and the sys-

[illegible] entirely.

Bids were received June 1, by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, secretary, for constructing sewers, the low bidders being as follows:

Cornelia St.	[illegible]		[illegible]		[illegible]	[illegible]
[illegible] W. Taylor St. Total						$780.00
George St.	630				4	$1.14
N. M[illegible], [illegible] W. Taylor St., Archille Scully. Total						$718.20
East End Ave.	[illegible]	[illegible]	11.5		..	$2.00
East End Ave.	[illegible]	1	[illegible]	10	[illegible]	$1.[illegible]
Thos. Burke, [illegible] W. McLean Ave. Total						$[illegible]
W. 108th St.	[illegible]	[illegible]	11.0			$1.44
W. 108th St.	[illegible]	1	8.5	[illegible]	[illegible]	$1.24
N. M[illegible], 200 W. Taylor St. Total						$1,657.20
N. Sacramento Ave.	[illegible]	1	[illegible]	[illegible]	2	$1.50
Wm. F. Healy, 101 Washington St. Total						$360.00
Stewart Ave.	820	1	8.0	[illegible]	[illegible]	$1.24
N. Mancini. Total						$1,016.80
North Shore Ave.	[illegible]	1½	6.0	..	..	$1.27
N. Ashland Ave.	[illegible]	1½	7.5	..	..	$1.27
N. Ashland Ave.	340	1½	8.0	11	7	$1.27
Jno. Tirtilli. Total						$1,714.50
Berenice Ave.	2,000	1	8.0	13	10	$1.26
Wm. F. Healy. Total						$2,520.00
[illegible] Ave.	1,340	[illegible]	11.5		..	$4.90
77th St.	240	[illegible]	12.0		..	$4.90
Perry St.	1,340	[illegible]	12.5		..	$4.90
Perry St.	1,[illegible]	[illegible]	10.0		..	$4.00
77th St.	[illegible]	1½	11.[illegible]		..	$1.95
7[illegible]th St.	[illegible]	1½*	10.5		..	$1.90
75th St.	400	1	9.5		..	$1.40
Wentworth Ave.	[illegible]	1	9.5			$1.55
Wentworth Ave.	1,[illegible]	[illegible]	9.0	..	..	$1.55
Yale Ave.	[illegible]	1½	7.0	..	..	$1.40
Yale Ave.	63	1	7.0	64	74	$1.30
N. Mancini. Total						$[illegible],636.50

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*Double strength. †Double ring.

The Common Council of Danville, Ill., has adopted a resolution to construct a sanitary sewer in the alley between Sherman and Sheridan Sts., from Fairchild to Woodbury Sts.

The Board of Local Improvements of Marshall, Ill., has ordered readvertisement for bids for the construction of the township high school sewer.

Indiana.

⊙The Board of Public Works of Gary, Ind., Harry G. Moose, city clerk, has awarded the contract for the construction of District Sewer No. 5, known as the Tolleston sewer system, to Michael Byrne, of South Chicago, Ill., for $165,000. The approximate quantities are as follows: 592.3 lin. ft. 78-in. sewer; 313.9 lin. ft. 72-in. sewer; 3,778.8 lin. ft. 6x6 ft. to 6x8 ft. 5½-in. sewer; 499.7 lin. ft. 66-in. sewer; 1,823.8 lin. ft. 60-in. sewer; 764.2 lin. ft. 54-in. sewer; 995.2 lin. ft. 48-in. sewer; 727.3 lin. ft. 42-in. sewer; 816.6 lin. ft. 30-in. sewer; 403.0 lin. ft. 24-in. sewer; 437.3 lin. ft. 15-in. sewer; 1,224.7 lin. ft. 12-in. sewer; 52 manholes; 4 catch basins; 4 gutter inlets. Bids were opened May 22.

The Board of Public Works of Terre Haute, Ind., has received a communication from the Common Council outlining the number and location of the sewers to be built in the city during the summer, together with an estimate of the cost of each sewer. Donn M. Roberts is city engineer.

Iowa.

✣Bids will be received until 8 p. m., June 9, by Otto P. Geiger, city recorder, Dubuque, Ia., for the construction of an 8-in. tile sanitary sewer in West Fourteenth St., from Prairie St. to Belmond St., thence in Belmond St. to the center of Lot 13, E. E. Jons' Sub., in accordance with plans and specifications on file at the office of the recorder. The approximate quantities are 1,650 lin. ft. of 8-in. tile pipe and 9 manholes.

✣Bids will [illegible] June [illegible] advertisement [illegible] Ia., for the construction of sewers in Sewer District No. 4. W. E. Hayes is city clerk and R. C. Hart is city engineer.

The Capital Realty Co. has applied to the City Council of Des Moines, Ia., for sewer, gas and water mains on 44th St. to Chamberlain Ave.

The City Council of Cedar Rapids, Ia. has taken steps looking to the laying of several blocks of sanitary and storm sewers.

The citizens of Essex, Ia. are taking steps to put in a number of new sewers.

Plans have been prepared for the construction of six and nine-tenths miles of sewers, a septic tank and filter beds for the town of Valley Junction, Ia. The estimated cost is $45,000.

The contract for the construction of a public sanitary sewer in several streets of Sheldon, Ia., for which bids were asked by the City Council until June 1, has not been awarded. The work will be readvertised. E. W. Smale is city clerk.

Following bids were received by O. W. Sandberg, city clerk, Keokuk, Ia., on May 31, for the construction of a number of sewer improvements in Sections 1, 2 and 3: Ette & Prasse, Section 1, excavation, 94 cts.; rock excavation, $5; insp. pipes, $20; 1-2, insp. pipes, $18; inlets, 35 cts.; pipe, 21 cts.; section 2, earth excavation, $1.65; rock excavation, $5; insp. pipes, $22; manholes, $30; flush tanks, $50; inlets, 40 cts.; pipe, 24 cts.; section 3, earth excavation, 68 cts.; rock excavation, $5; 1-2, insp. pipes, $17; inlets, 35 cts.; pipe, 21 cts. Cameron & McManus, section 1, excavation, $1; rock excavation, $5; insp. pipes, $20; inlets, 40 cts; rock excavation, $4; insp. pipes, $20; manholes, 24 cts; section 3, earth excavation, 75 cts.; insp. pipes, $20; inlets, 40 cts.; pipe, 24 cts.

Kansas.

Plans have been prepared for the construction of a sewer system in Mulvane, Kan. The estimated cost of the system is $8,000.

The City Commissioners of Coffeyville, Kan. have recently passed an ordinance creating an additional sanitary sewer district. Work is to be commenced at once.

The proposed west side sewer district of Topeka, Kan., will probably be made to include the Lowman Hill, the Elmhurst and Potwin sewers, which are already constructed. None of these sewers have sufficient outlet to the river and the proposed project will join the districts so as to give them a 5-ft. sewer main to the river. A. R. Young is city engineer.

Kentucky.

✣Bids will be received until noon, June 10, by J. B. Rice, city clerk, Dawson Springs, Ky., for the construction of sewers, sanitary sewers and appurtenances, including approximately 3,800 cu. yds. earth excavation, 200 cu. yds. rock excavation, 2,640 ft. 12-in. vitrified sewer pipe, 540 ft. 10-in., 1,400 ft. 9-in., 3,400 ft. 8-in. pipe and 25 brick manholes. Plans and specifications are on file with city clerk, or copies may be had from W. A. McDonald, engineer, Central City, Ky., upon payment of $[illegible]

Louisiana.

Engineer Alfred F. Theard, of the Sewerage and Water Board, of New Orleans, La., has prepared a report of his investigations of the drainage situation at Milneburg, and has presented the same to the board.

Maryland.

✣Bids will be received until 11 a. m., June 28, by Board of Awards, Baltimore, Md., for constructing Jones' Fall Conduits, Section No. 1. Storm Water Contract No. 14 in accordance with plans on file at the office of Calvin W. Hendrick, chief engineer of the Sewerage Commission, 904 American Bldg., Baltimore, Md. The work will include the following approximate quantities: 28,000 cu. yds. earth excavation; 900 cu. yds. rock excavation; 40,000 cu. yds. concrete masonry; 750 yds. brick masonry; 4,000,000 lbs. reinforcing steel; 12,000 sq. yds. granolithic resurfacing; 140,000 lin. ft. piles; 2,000 M. ft. B. M. lumber in foundation; 50 tons cast-iron pipe and specials; 900 lin. ft. vitrified sewer pipe, 6 ins. to 30 ins. in size; 40 tons structural steel.

✣Bids will be received until 11 a. m., June 28, by Board of Awards, Baltimore, Md., for constructing Jones Falls conduits, Section No. 1, Storm Water Contract No. 14. Plans on file at the office of Calvin Hendrick, chief engineer of the Sewerage Commission. Official advertisement will be found elsewhere in this issue.

The following bids were received by the Board of Awards, Baltimore, Md., on May 24 for the following contracts; Calvin M. Hendrick, chief engineer, Sewerage Commission: Sanitary Contract No. 60, office and laboratory building, sewage disposal works, David M. Andrew Co., Baltimore, $27,000; Piel Construction Co., Baltimore, $27,000 (informal); Benj. F. Bennett Bldg. Co., Baltimore, $27,900; J. L. Robinson, Baltimore, $29,663. Sanitary Contract No. 66, lateral sewers in District 36-A: B. F. Sweeten & Son, Baltimore, $87,645; W. H. & C. F. Thompson, Baltimore, $96,017; David Peoples, Baltimore, $101,893; William McCarthy & Co., Baltimore, $105,498; David M. Andrew Co., $106,255.

Michigan.

✣Bids will be received until 8 p. m., June 7, by Richard Cuddihy, city clerk, Hubbell, Mich., for the construction of 650 ft. of 30-in. No. 1 standard sewer tile.

The Board of Education of Iron Mountain, Mich., has engaged Engineer J. M. Goldsworthy to carry out a survey with a view to installing a sewage system for the Ludington school.

The Village Council of Hubbell, Mich., has decided to construct a new sewer system on Gregory and E. Sts., in the village, about 600 ft. in length. E. X. Gillet is president of the council.

Work of constructing the pumping station for the sanitary zone sewer system in the Fourth ward, Kalamazoo, Mich., will be commenced within a short time, according to advices from that city. The structure will be about 18 ft. in diameter, rising about 12 ft. to the eaves above the grade and extending nearly 15 ft. underground. Machine pressed bricks will be used. The sewage which flowed into the station, which will be located at the intersection of the Axtell creek with John St., will be elevated several feet by means of a 6-in. centrifugal pump driven by an electric motor, and forced into the outlet pipes running to the river. The estimated cost of the entire system is $20,000. H. A. Johnson is city engineer.

J. J. Rens, at $9,306, submitted the lowest bid, May 25, to the Board of Public Works of Grand Rapids, Mich., for the construction of a sewer in North College Ave.; John Van Ess, at $2,502, submitted the lowest bid for a sewer in North Ave., Marietta and Cole Sts.

The Board of Public Works of Duluth, Minn., has been ordered to proceed with the construction of a sanitary sewer in 63rd, 64th and 65th Aves., west.

The Board of Public Works of St. Paul, Minn., has made a favorable report on the Atlantic St. sewer. The city engineer's estimate is $2,350, or $1.02 per front foot. The sewer will extend from Beech to Margaret St., in Atlantic St., and in Margaret St., from Atlantic to Duluth Ave.

Minnesota.

✣Bids will be received until 8 a. m., June 14, by City Council of Hutchinson, Minn., for the construction of certain sewers and appurtenances. The work will include 2,600 lin. ft. of 12-in. sewer and three straight manholes. C. K. Goodnow is city clerk.

⊙Illstrup & Olson, Minneapolis, Minn., have been awarded the contract by City Council of Albert Lea, Minn., for the construction of sewer improvement for $14,400. The work includes 304 6x8 in. Y's and 39 6x10 in. Y's, 9,513.58 ft. of 8-in. single, 6 ft. to 18 ft. deep, 1,411.24 ft. 10 in., 6 ft. to 16 ft. deep, 207.32 ft., 8 ft. to 15 ft. double, 8 ft. to 12 ft. deep, 28.25 ft. 15-in. single storm, 8 ft. to 10 ft. deep, 50 manholes, 10 ft. 10-in. catch basin connection pipe, two connections. Bids were opened June 1. The Albert Lea Construction Co. secured the contract for the construction of 3 9-10 miles of [illegible] at $6,6[illegible].

⊙Bids were opened May 22, by the city of Gilbert, Minn., Frank A. Bowman, engineer, for constructing sewer system. The contract was let to Pastoret & Lawrence, Duluth, Minn., at the following bid:

1,944 cu. yds. filter plant excavation......$	0.34
1,315 cu. yds. crushed rock, screened 1 in. to 2½ in., for filter	2.30
Balance of plant: 730 ft. 12-in. pipe, 24-[illegible] drain [illegible] septic tank, settling tank, 54x100 ft. percolating filter, 6-in. [illegible] floor and bldg., 1 manhole, sludge [illegible] 20x30 ft. and [illegible]...........	3,950.00
14,540 lin. ft. 8-in. pipe, furn. and laying.	.32
5,279 lin. ft. 10-in. pipe, furn. and laying, inc. branches	.41
2,497 lin. ft. 12-in. pipe, furn. and laying, inc. branches	.51
12,000 cu. yds. trenching, av. 8½ ft., lowest 3 ft., deepest 17 ft., hard clay, some boulders	.50
Water tamping, if required..............	.03
Rock excavation	8.00
14 shallow manholes, under 6 ft. flat top	42.50
35 regular manholes, average 9 ft.......	42.50
29 lampholes	9.00
8 flush tanks and lampholes complete....	108.00
15 ext'n for each manhole with drop device or devices	5.00
M. ft. B.M. lumber left in trench	25.00

Missouri.

✣Bids will be received until noon, June 16, by the Board of Public Improvements, St. Louis, Mo., for the construction of sewers in Harlem Creek Sewer District No. 7. Plans and specifications are on file at the office of the board, City Hall.

✣Bids will be received until noon, June 13, by the Board of Public Improvements, St. Louis, Mo., for the construction of sewers in Harlem Creek Sewer District No. 6. Plans and specifications are on file at the office of the board.

Missouri.

⊙J. B. Pringle, of Kansas City, Mo., has been awarded the contract by the city of Paris, Mo., for the installation of a sewer system for $13,739. Bonds were recently voted by the citizens for this improvement.

Advices from Kansas City, Mo., state that the city contemplates building hundreds of miles of additional sewer, and the Board of Public Works has directed the city engineer and the engineer of the sewer division to make a thorough investigation as to the relative qualities of concrete and vitrified clay pipe.

Montana.

The Town Council of Libby, Mont., has decided upon June 17 as the date for the special election to be held for the purpose of voting bonds to the amount of $35,000, $15,000 of which will be used to construct a main sewer.

New York.

⊙L. J. Snell, of [illegible], N. Y., has been awarded the contract by the Board of Public Works of Little Falls, N. Y., for the construction of the sewer in West Main St., for $1,800.

The State Senate, Albany, N. Y., has approved both of the Oswego sewer bills, and they will now go to Oswego for the consideration of the Common Council, after which they will be submitted to the voters of the city. John Fitzgibbons is mayor.

A petition is being circulated among the residents of Grant Ave. in Lestershire, N. Y., calling for the construction of a sewer between Willow and Harrison Sts.

The sewer committee of the Town Board of New Hartford, N. Y., Supervisor A. P. Seaton, president, has reported that the property owners in the proposed sewer district have signed a petition for the creation of such a district. Plans and specifications for the sewers have been prepared by Engineer A. M. Scripture of New Hartford. Bids for the work will be asked as soon as the State Board of Health has approved the plans.

North Carolina.

Plans have been made by Engineer M. H. Stacy, of Chapel Hill, N. C., for the construction of new sewers in that city, estimated to cost $15,000. G. C. Pickard of Chapel Hill will have charge of the work.

North Dakota.

⊙The City Council of Jamestown, N. Dak., has awarded C. H. Porritt, of Fargo, the contract for the construction of the proposed sewer and waterworks, this summer, for $16,7[illegible].

The city engineer of Bismarck, N. Dak., has outlined a system of storm water sewers and estimated the probable cost of installing the same at $40,000.

The city auditor of Bismarck, N. Dak., has been instructed to advertise for bids for the construction of the extension of the sewer system on Second St. T. R. Atkinson is city engineer.

Ohio.

✣Bids will be received until noon, June 9, by Director of Public Service, Youngstown, O., for the necessary labor and material for the construction of sewers in Empire St., from Edwards St. to City Lot No. 6215. W. H. McMillin is clerk of the Department of Public Service.

✣Bids will be received until noon, June 9, by Director of Public Service, Youngstown, O., for the furnishing of necessary labor and material for the construction of sewers in Washington St., from Oak to Vine St. Plans and specifications are on file at the office of the city engineer. W. H. McMillin is clerk of the Department of Public Service.

✣Bids will be received until noon, June 7, by John B[illegible], Director of Public Service, Sandusky, O., for the necessary labor and material for the reconstruction of a sewer in Third St., between Erie St. and Sycamore Line St., in accordance with plans and specifications on file at the office of the chief engineer of the Department. J. Loth, Jr., is clerk.

⊙The Board of Control of Hamilton, O., has awarded the contract for the construction of a sanitary sewer on Millikin St. to Frank J. Davis & Son, for $2,190.

⊙The Department of Public Service, Cleveland, O., has awarded the following contracts for the construction of sewers, for which bids were opened June 2: Eddy Road, from St. Clair Ave. to Sellars Ave., Sprague & Jackson, $3,562; Eddy Road, St. Clair Ave. to Woodside Ave., James Duff Co., $[illegible]; Ostend Ave., E. 99th St. to E. 105th St., Reserve Construction Co., $10,635, and Lorain Ave., W. 110th St. to W. 117th St., James Duff Co., $9,917.

⊙Theodore N. Hill, E. Chillicothe Ave., Bellefontaine, O., has been awarded the contract by the Department of Public Service of that city for furnishing and constructing reduction tanks and primary contract beds, and for building [illegible] and erecting all automatic controlling machinery. [illegible] sewer outlet drain, 2,100 cu. yds. of excavation, 1,530 cu. yds. of broken stone, 4 manholes, 16 cu. yds. of masonry in bulkhead. The contract price is $25,707.

⊙Harman Bros., Youngstown, O., have been awarded the contract by the village of Struthers, O., for the construction of sanitary tile sewers in Terrace St., from Short St. to Poland Ave. Bids were opened May 24.

⊙John W. Gay of Youngstown, O., has been awarded the contract by the village of Struthers, O., for the construction of a sanitary sewer in Hawthorn St. from Elm St. to Sexton St. Bids were opened May 24.

⊙Harman Bros., Youngstown, O., have been awarded the contract by the village of Struthers, O., for the construction of a storm water and sanitary sewer in Stewart Ave. from Elm to Sexton Ave. Bids were opened May 24.

⊙The T. J. Backus Construction Co., of Dayton, O., has been awarded the contract by that city for the construction of the sanitary sewer in District 6, south of Bolander Ave., for $2[illegible].

Resolutions declaring it necessary to improve by sewering have been passed by the City Council of Cincinnati, O., as follows: Paxton road and Paxton Ave., from existing sewer south of Portsmouth Ave. to Taylor Ave., by constructing 12-in., 15-in., 18-in., 24-in. vitrified pipe sewers and 2½-ft. brick sewer; Wasson road, between Paxton road and Shaw Ave., by constructing 12-in., 18-in. and 21-in. vitrified pipe sewer; [illegible] Ave., between Sunrise Ave. and Shaw Ave., by constructing 12-in. vitrified pipe sewer; Sunrise Ave., between Wasson road and Minto Ave., by constructing 12-in. and 15-in. vitrified pipe sewers; Mornington Ave., between Wasson road and Minto Ave., by constructing 12-in. vitrified pipe sewer; Minto Ave., between Columbus Ave. and Sunrise Ave., by constructing 12-in. vitrified pipe sewer; Columbus Ave., between Wasson road and Minto Ave., by constructing 15-in. vitrified pipe sewer; Portsmouth Ave., between Paxton road and Columbus Ave., by constructing 12-in. vitrified pipe sewer; Portland Ave., between Ogden St. and Wasson road extended, by constructing 15-in. vitrified pipe sewer; Ogden St., between Paxton Ave. and Portland Ave., by constructing 3-ft. brick sewer, and right of way east of Paxton Ave., from Portland Ave. to Paxton Ave., opposite Taylor Ave., by constructing 3-ft. and 3½-ft. brick sewer. The estimated cost is $31,838.

The general improvement committee of the City Council, Youngstown, O., has decided to construct a sewer in Rayen Ave., between Elm and Holmes St., prior to repaving that thoroughfare.

The Board of Control of Dayton, O., has decided to readvertise for bids for the construction of the Perry St. sewer, estimated by City Engineer F. J. Cellarius to cost $6,000. The Central Construction Co., at $7,606, submitted the lowest bid, which was considered too high.

Oklahoma.

⊙The City Council of Muskogee, Okla., Chas. Wheeler, city clerk, on May 23 received bids for the construction of a portion of the Coody Creek sanitary outfall sewer, for which Alexander Potter, 114 Liberty St., New York City, is engineer. The work was advertised in six sections as follows, and bids were asked for two ring brick with citrified invert, manufactured concrete pipe; monolithic concrete with vitrified invert. Section 1 embraces 5,200 ft. of 48-in. sewer; section 2, 5,000 ft. of 48-in. sewer; section 3, 5,600 ft. of 48-in. sewer; section 4, 5,400 ft. of 48-in. sewer; section 5, 6,500 ft. of 45-in. sewer, and section 6, 7,100 ft. of 42-in. sewer. F. P. McCormick, of Muskogee, at $156,025, and Nelson Bros. of Parsons, Kan., at $106,311, were awarded the contract.

Oregon.

The City Council of [illegible], Ore., has passed an ordinance providing for the [illegible] city.

Pennsylvania.

✣Bids will be received until 8 p. m., June 7, by Council of Meadville, Pa., for the construction [illegible] from Mercer St. north to a point within 50 ft. of intersection of Norman Alley. Fred C. Kiebort is city clerk.

⊙[illegible] has been awarded the contract by the Board of Public Works of Harrisburg for the construction of a terra cotta pipe sewer in Front St., from Eagle St. to Conoy St., for $917. Bids were opened May 26.

The Board of Public Works of Harrisburg, Pa., has selected Consulting Engineer James H. Fuertes, 140 Nassau, New York City, as engineer on the river front intercepter and Paxton creek improvement jobs.

The Board of Public Works of Harrisburg, Pa., William Jennings, president, on

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

May [illegible] received the following bids for the construction of the first class sanitary sewer that will enter the intercepter: Stucker Bros. Construction Co., $1,146; Henry Opperman, [illegible] W. H. Lamb, $1,379, and James A. [illegible] $1,3[illegible]. The sewer will [illegible] the [illegible] Naples St. sewers and will enter the intercepter at Tuscarora St.

South Dakota.

✣Bids will be received until June [illegible] by J. W. Raymond, city auditor, Aberdeen, S. Dak., for the construction of any and all of the sewers ordered by the Board of City Commissioners. The work will include the following approximate quantities: 1,330 ft. of [illegible] 35 ft. of [illegible] pipe and 5 manholes.

Texas.

The City Council of Sweetwater, Tex., has granted a franchise for a sewage system to M. A. Joy, of Terrell. The system is to be in operation in six months.

The City Commissioners of Waco, Tex., have fixed June 27 as the date for the bond election for constructing and repairing sanitary and storm sewers, and for opening and establishing and improving streets, amounting to $130,000 in all. Of this amount, $80,000 is intended for storm and sanitary sewers, and $50,000 for streets.

Utah.

✣Bids will be received until 7:30 p. m., June 9, by Board of Public Works, Salt Lake City, Utah, for the work of constructing pipe sewers in Sewer Extension No. 387, from Sixth to 10th Aves. and from A. to M. Sts., according to plans on file at the office of the city engineer. H. G. McMillan is chairman of the board.

Virginia.

⊙R. L. Blevins of Bristol, Va.-Tenn., has been awarded the contract by the Board of Aldermen of Erwin, Tenn., for the construction of a system of domestic sewers for $10,395. Bids were opened May 27.

The Hampton Court Corporation of Norfolk, Va., will install at once a sewer system and private water supply on its property, Hampton Court, a suburb of Norfolk, Va. Arthur C. Freeman, 343-5 Arcade Bldg., Norfolk, is engineer.

Washington.

⊙The City Commissioners of Spokane, Wash., have awarded the contract for constructing the sewer in Garfield St., Hartson to Fifth Aves., to J. L. Wood for $3,620, and the contract for constructing the sewer in Sheridan St., Hartson to Fifth Aves., to G. Burgie for $7,800.

The Department of Public Works of Spokane, Wash., has recommended the creation of another North Side sewer district and the construction of about 40 blocks of new sewer in the Fourth ward. The territory affected is bounded by Summit Blvd. on the west and north, Lindeke St. on the east and Dean Ave. and part of Summit Blvd. on the south. It involves the construction of sewers on Summit Blvd., Sherbrook and Hollis Sts., Dean and Gardner Aves., in the alley between Sharp and Boone and in the alley between Sinto and Sharp. The district will be known as the Fourth Ward Sewer District No. 5.

City Engineer Redman, of Toppenish, Wash., has perfected plans for the construction of a sewer system in that town.

West Virginia.

A pipe sewer is planned by the Water and Sewerage Board of Clarksbury, W. Va., to be laid down Elk Creek to a point below the city, where a disposal plant is to be built and operated. The board appropriated $2,500 for this purpose.

Wisconsin.

✣Bids will be received until 6 p. m., June 9, by Board of Public Works, Waupaca, Wis., for the construction of about 5,000 ft. of 8 and 10-in. sanitary sewer with necessary manholes and connections. Plans and specifications are on file at the office of J. F. Knudson, city clerk.

⊙The contract for laying a sewer on Keyes Ave. and adjacent Sts. in West Lawn, Madison, Wis., has been awarded to J. W. Mitchell by the City Council for $2,280.

⊙John Brogan, of Green Bay, Wis., has been awarded the contract by the Board of Public Works of Antigo, Wis., for the construction of intercepting sewer for $19,888, for which W. H. Kirchoffer, of Madison, Wis., is engineer. Bids were opened May 17.

All bids received May 17 by City Clerk A. W. Huebing of Reedsburg, Wis., for the construction of trunk sewers along the Franklin St. sewer system at that place have been rejected. The work consists of 1,650 lin. ft. of 30-in. pipe, 1,200 lin. ft. of 27-in. pipe, 1,410 lin. ft. of 18-in. pipe, the trenches varying from 8 to 20 ft. in depth, 10 manholes and 22 catch basins.

Canada.

✣Bids will be received until noon, June 13, by W. D. Spence, city clerk, Calgary, Alta., for the construction of a 6-ft. concrete trunk sewer 12,000 ft. long.

Canada.

✣Bids will be received until noon, June 13, by L. A. Duncan, secretary-treasurer, Estevan, Sask., for laying about 2,000 ft. of water mains, 2,500 ft. of sewer and constructing about 85,000 sq. ft. of concrete sidewalks. Chipman & Power, Toronto, Ont., and Winnipeg, are engineers.

✣Bids will be received until 8 p. m., June 10, by J. Robinson, clerk, Steelton, Ont., for the construction of a reinforced concrete outfall sewer, 570 ft. long and 66-in. interior diameter. Chipman & Power, Toronto, Ont., engineers.

✣Bids will be received until 11 a. m., June 16, by Chairman, Board of Control, Winnipeg, Man., for supply of necessary labor and material for the erection of an incinerator in Ward 7. Plans and specifications are on file at the office of the city engineer, 223 James St. M. Peterson is secretary of the board.

✣Bids will be received until 4 p. m., June 15, by L. L. Knox, town clerk, Goderich, Ont., for furnishing and laying approximately 12,800 lin. ft. of storm sewers, building, manholes, catch basins, etc. M. G. Cameron is mayor.

The tax payers of Cranbrook, B. C., on May 23, voted the issuance of bonds to the amount of $100,000 for the construction of a sewer system.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until 1 p. m., July 6, by Col. G. D. Fitch, U. S. Engineer, Montgomery, Ala., for dredging at the mouth of Apalachicola River. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 3 p. m., June 28, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction of a wall on the premises of the U. S. Post Office at Anniston, Ala.

✣Bids will be received until 11 a. m., June 27, by Maj. A. F. Flagler, U. S. Engineer, Mobile, Ala., for dredging in harbor at Mobile, Ala.

⊙Jas. W. Gilbert, 307 Franklin St., Mobile, Ala., at $16,183, has been awarded the contract for building 1,150 ft. of creosoted timber bulkhead. Bids were opened May 27 by Maj. C. A. Flagler, U. S. Engineer, Mobile, Ala.

Bids were opened May 22 by Maj. W. W. Harts, U. S. Engineer, Nashville, Tenn., for rock excavation at Tuscumbia Bar, near Sheffield, Ala. N. C. McGinnis, Bement, Ill., was the only bidder, his bid being $2.95 per cu. yd for rock excavation and 45 cts. per cu. yd. for earth excavation. This bid was considered excessive and was recommended for rejection.

The City Council of Decatur is considering the advisability of building an electric light plant to be owned by the city. The J. B. McCreary Co., Engineers, of Atlanta, Ga., has submitted plans for a plant.

Arkansas.

✣Bids will be received until 10 a. m., June 12, by Maj. G. D. Deshon, Quartermaster, Hot Springs, Ark., for constructing addition to power house at Army and Navy General Hospital there.

California.

✣Bids will be received until 2 p. m., June 23, by U. S. Reclamation Service, Los Angeles, Cal., for furnishing transformers for the U. S. Reclamation Service. For particulars address U. S. Reclamation Service, 605 Federal Bldg., Los Angeles, Cal., or Washington, D. C. F. H. Newell is Director.

✣Bids will be received until 11 a. m., June 28, by Lieut. Chas. T. Leeds, U. S. Engineer, 723 Central Bldg., Los Angeles, for dredging at Los Angeles Harbor, Cal. The area to be dredged is the easterly half of the channel at the entrance to inner Los Angeles Harbor, Cal., with a bottom of about 200 ft. and a length of about 5,600 ft., extending from the 30-ft. contour in the outer harbor to about the northerly end of Deadmans Island and requiring the removal of about 350,000 cu. yds. of material. The material to be removed is believed to be sand, mud, clay and rock.

The following bids were received May 16 by the city of Los Angeles for constructing a conduit along Colorado St., to carry electric wires: G. M. Gerst Co., San Francisco, $45,000; Warren Construction Co., $46,250; Barber Asphalt Co., $46,071.

It is stated that if the Standard Oil Co.'s wells in Kern County develop as well as is expected, the company will put in a double 18 in. pipe line to convey natural gas to Los Angeles.

Colorado.

Bids were opened May 23 by the U. S. Treasury Department for construction of the proposed public building at Fort Collins. The bidders and kind of stone for which bids were made were: James Stewart Co., Denver, limestone, $95,640; sandstone, $91,540. William Simpson Construction Co., Denver, $108,504 and $109,704; Deeter & Wengel Construction Co., Wichita, $91,862 and $88,862; King Lumber Co., Charlottesville, Va., $94,700 and $98,700; Northwestern Construction Co., Kearney, Neb., $91,473 and $94,473; J. H. Weiss, South Omaha, Neb., $84,751 and $85,114.

District of Columbia.

✣Bids will be received until 2 p. m., June 15, by Commissioners of the District of Columbia, Washington, D. C., for furnishing and installing in the McKinley Manual Training School in that city two additional panels in the main switchboard, one switchboard for the new wood shop, one switchboard for the Engineering Laboratory, additional instruments for machine shop switchboard and certain conduits and cables.

✣ Bids will be received until noon, August 7, by Navy Department, Beekman Winthrop, Acting Secy., Washington, D. C., for constructing by contract 8 torpedo-boat destroyers.

✣Bids will be received until Noon, June 20, by Lieut. Col. W. C. Langfitt, U. S. Engineer, 920 17th St. N. W., Washington, D. C., for

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

furnishing and delivering about 400 tons sulphate of alumina.

✣Bids will be received until 2 p. m., June 12, by Department of Interior, Washington, D. C., for wiring and extension of electric lighting system in the buildings of Howard University, Washington, D. C. Carmi A. Thompson is Asst. Secy. of the Department.

✣Bids will be received until 2 p. m., June 26, by Director of Bureau of Standards, Department of Commerce and Labor, Washington, D. C., for furnishing materials and labor required for the construction of a laboratory building for the National Bureau of Standards.

Florida.

✣Bids are asked until noon, June 26, by Capt. Geo. R. Spalding, U. S. Engineer, Jacksonville, Fla., for dredging in channel from Clearwater Harbor to Tampa Bay, Fla. The work requires the removal of 131,000 cu. yds. plane measurement, of sand, mud and shell. The amount available is $18,000.

✣Bids will be received until Noon, June 26, by Capt. G. R. Spalding, U. S. Engineer, Jacksonville, Fla., for dredging in channel from Clearwater Harbor to Tampa Bay, Fla.

⊙Capt. Roderick G. Ross, Jacksonville, Fla., has been awarded the contract for furnishing and placing about 1,000 cu. yds. of stone in shore revetment at the entrance to Biscayne Bay, Florida. Bids were opened May 22 at the office of the U. S. Engineer at Jacksonville, Fla. The bids received were as follows: Roderick G. Ross, Jacksonville, $2.93 per cu. yd.; George F. Cook Co., Miami, $3.20 per cu. yd.; J. D. Goodman, Miami, $3.18 per cu. yd.; W. I. Huffstetler, Miami, $3.35 per cu. yd.

Georgia.

✣Bids will be received until Noon (Eastern Time), July 5, by Dan C. Kingman, Col. U. S. Engineers, Savannah, Ga., for dredging refractory material in harbor at Brunswick, Ga.

✣Bids are asked until noon, June 16, as noted in our last issue, by Col. Dan C. Kingman, U. S. Engineer, Savannah, Ga., for dredging in harbor at Savannah. The dredging to be done will be at the following localities in the Harbor of Savannah: In the channel opposite the City of Savannah; in Wrecks channel, two miles below the city; and in Long Island Crossing channel, about twelve miles below the city. In the channel opposite the city and in Wrecks channel the width to be obtained is 450 ft., and in Long Island Crossing channel a width of 200 ft. The length of the cut in the channel opposite the city will be about 11,200 ft., in the Wrecks channel about 7,500 ft., and in Long Island Crossing channel from 10,000 to 15,000 ft. The approximate yardage to be removed is 1,600,000 cu. yds. The work will be awarded as a whole to one contractor.

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., June 14, for constructing a dock on both sides of the north branch canal at the ends of Weed St. The work includes removing 60 lin. ft of old docks on the west side of the channel and 34 lin. ft. on east side of the channel, and replacing same with new docks. The docks are to consist of white oak piles, capped, sheathed with oak, sheet piling and pine battens and anchored with wrought iron tie rods to anchor piles and back logs. All front piles to be 40 ft. long, tapering from 18 ins. to 8 ins. and are to be driven on 5-ft. centers. Anchor piles to be placed on 7-ft. centers and to be 40 ft. long. All the rods are to be 12 ft. long, 1¼ ins. in diameter, and placed 5 ft. apart. Cash or certified check for $200 must accompany proposal.

Among the bills passed by the Illinois Legislature at the session which closed on May 19, are the following: City bill passed authorizing the city of Chicago to proceed with the building of an outer harbor. Bond issue authorized, which must go to referendum before becoming effective. Entire project left in the hands of the city council, unrestricted as to time. Kleeman bill passed authorizing the sanitary district of Chicago to proceed with building of a harbor in Lake Calumet, connected with Lake Michigan by way of the Calumet River. Provision that one and one-half miles of the Sag sanitary channel shall be constructed before work begins.

The Chicago Municipal Subway Co., recently incorporated with a capital stock of $25,000, is to submit a proposition to the City Council of Chicago looking to the building of a municipally owned subway system in Chicago. The incorporators are William S. Jackson and Charles M. Harlan of New York, and Shirlaw D. Gookins of Chicago.

Among the appropriation bills passed at the last session of the Illinois Legislature are the following: $600,000 as first installment on building new penitentiary at Joliet. Next general assembly to approve prison plans. For securing plans and starting work on new $1,500,000 state insane hospital, $500,000. For improvements and ordinary, Chester prison, $285,350. For Carbondale Normal improvements, $100,000. For Eastern Normal school at Charleston, new buildings, etc., $83,500. For new training school at Normal, $125,000

Indiana.

✣Bids will be received until 10 a. m., July 5, by Board of County Commissioners, Columbus, Ind., for the improvement of the Bartholomew county jail. Philip J. Water is County Auditor.

✣Bids will be received until 1 p. m., June 20, by Fred J. Corn, Township Trustee, and Advisory Board of Lockhart township of Pike county, at Stendal, Ind., for the construction of a two-story brick school building containing six rooms. Separate bids will be received for steam heating and ventilating systems.

✣Bids will be received until Noon, June 8, by J. L. Barker, Trustee and Advisory Board of Sugar Creek township of Shelby county at Boggstown, Ind., for the erection of two story brick and stone high school in the towns including heating and plumbing.

Iowa.

✣Bids will be received until 5 p. m., June 10, by William Graham, Mayor, Odebolt, Ia., for the construction of public building in Odebolt, Ia., 45x70 ft. Plans and specifications are on file with the Mayor. A certified check for $150 must be filed with each bid.

✣Bids will be received until 10 a. m., June 10, by Paul J. Wells, City Clerk, Sioux City, Ia., for furnishing 500 ft. of 2½-in., 4 and 5-ply capped ends, rubber hose with couplings.

⊙Butler Bros., St. Paul, Minn., has been awarded the contract for a $178,000 hydro-electric plant for the Northern Iowa Power Co. The dam is to be completed by Feb. 1.

Kentucky.

Bids were opened May [illegible] at the office of the U. S. Engineer, Cincinati, O., for building Dam No. 14 in the Kentucky River at Heidelburg, Ky. The bids received were as follows: Gerin, Dodge & Maltby, New York City, $311,912. Skene, Richmond Contract Co., Shelbiana, Ky., $387,760; Dravo Contracting Co., Pittsburg, $371,680; Gabler & Co., Dayton, O., $371,586; George C. Hodgson, Dayton, O., $384,757; Mason Hanger Co and Dandridge & Lahey, Richmond, Ky., $361,375; Smith, Towle & Co., Thirteen, Ky., $355,378

Louisiana.

✣Bids will be received until 8 p. m., June 15, by the Orleans Levee Board, 201 New Orleans Court Bldg., New Orleans, La., for the demolishing and removal of the H. T. Lawler Milling & Trading Co., Ltd., reinforced concrete mill building. Jules C. Koenig is President of the Board.

Bids were opened May 24 by Lieut.-Col. Lansing H. Beach, U. S. Engineer, New Orleans, for 7,200 bbls. of cement, 3,200 cu. yds. of sand and 6,400 cu. yds. of gravel to be used in the construction of the Keystone lock in the Teche, near St. Martinville (La.). The lock is being built by the government and will cost about $185,000. There are three points of delivery for the material—at the wharf in New Orleans, and by rail either in St. Martinville or the lock site, Loreauville. The cement bids were: Fritz Jahncke, Inc., $2.13 at the lock; Allen Tupper, $2.40 at the lock; J. J. Clarke Co., $1.85 in New Orleans; the Salmen Brick & Lumber Co., $1.76 in the city; the Carolina Portland Cement Co., $2.05 at the lock, and $1.63 in New Orleans. The sand and gravel bidders were: J. W. Thompson, $2.15 per cu. yd. for sand in the city and $2.54 at the lock; $2.42 per cu. yd. for gravel at St. Martinville and $2.84 at the lock; the Avery Planting & Improvement Co., $1.60 for sand and $1.80 for gravel at St. Martinville; the Southern Gravel & Material Co., $2.84 for sand and $3.23 for gravel at St. Martinville.

Maine.

✣Bids will be received until 3 p. m., July 10, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, etc., including plumbing, gas piping, heating apparatus, and electric conduits and wiring system of the U. S. Post Office and Custom House at Ellsworth, Me.

✣Bids will be received until Noon, June 26, by Lieut. Col. W. E. Craighill, U. S. Engineer 537 Congress St., Portland, Me., for ledge excavation and dredging in Rockport Harbor, Me

✣Bids are asked until noon, June 26, by Lieut.-Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for ledge excavation and dredging in Rockport Harbor, Me. The work to be done consists in the removal of harbor ledge and overlying material to a depth of 15 ft. below mean low water. It includes the excavation and removal of 3,529 cu. yds. of rock and 525 cu. yds. of sand and mud, together with some timbers of an old wreck. The area is about 36,400 sq. ft. The ledge covers an area of about 23,500 sq. ft. at the plane of required depth, and the average cut to the required grade is about 4 ft., the maximum cut being about 11 ft. The soft material covers an area of about 14,300 sq. ft., about 1,400 sq. ft. of which overlays the ledge above the improvement plane.

The following bid was opened June 1 by Lieut.-Col. W. E. Craighill, U. S. Engineer, Portland, Me., for construction of breakwater at Isles of Shoals, Me. and N. H.: The Breakwater Co., Philadelphia, Pa., $2.75 per ton.

Maryland.

✣Bids are asked until 1 p. m., June 26, by Col. Thomas L. Casey, U. S. Engineer, Custom House, Baltimore, Md., as noted in our last issue, for the following dredging: Rockhall Harbor, 17,763 cu. yds. sand and mud; Queenstown Harbor, 10,658 cu. yds. sand and mud; Claiborne Harbor, 17,736 cu. yds. sand, clay and mud; Cambridge Harbor, 10,658 cu. yds. sand, clay and mud; Chester River, 10,658 cu. yds. sand and mud; Choptank River, 17,763 cu. yds. sand and mud; Warwick River, 7,105 cu. yds. sand and mud; Pocomoke River, 10,658 cu. yds. sand; La Trappe River, 7,105 cu. yds. sand; Wicomico River, 13,500 cu. yds., sand and mud; Manokin River, 17,763 cu. yds. mud; Tyaskin Creek, 7,106 cu. yds. sand and mud; Susquehanna River, 155,250 cu. yds. sand and mud; Nanticoke River, 162,000 cu. yds. sand, gravel and mud; Broad Creek, 9,000 cu. yds. sand and mud

Massachusetts.

✣Bids will be received until 8 p. m., June 9, by Fire Commissioners, A. S. Marshal, Chairman, Everett, Mass., for furnishing 1,000 ft. more or less of 2½ in. fire hose

✣Bids will be received until 3 p. m., July 12, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office at Milford, Mass.

⊙Bids were opened May 26 by the State Harbor and Land Commissioner, Boston, Mass., for furnishing and placing granite quarry grout and chips to strengthen and extend jetties at Osterville and Cuttyhunch. The contract was let to E. S. Belden & Sons, Hartford, Conn.

Michigan.

[illegible] Commonwealth Power Co., Jackson, Mich., is reported to be negotiating for the purchase of the Cleveland power site six [illegible] of [illegible]. It is said that the company proposes to build a power dam across the Kalamazoo River there similar to the ones at Cereco, Plainwell and Allegan.

⊙Bids were opened May 22 by the Light and Power Commission of the city of Marquette for the construction of two concrete dams on Dead River. Powell & Mitchell, Marquette, Mich., were awarded the contract for one of the dams at $57,000, and Wahlman & Trebilcock, Ishpeming, Mich., were awarded the contract for the other. The latter dam will cost about $15,000.

John S. Haggerty, Detroit, Mich., has applied to the board of supervisors of Osceola county for permission to dam the Muskegon River about six miles west of Evart. It is proposed to maintain a 13-ft. head, the power to be used for generating power for manufacturing purposes, commercial lighting, etc.

Minnesota.

✣Bids will be received until 7:30 p. m., June [illegible], by Henry N. Knott, City Clerk, Minneapolis, Minn., for furnishing the city for use in the fire department, the following motor driven fire apparatus: 1 85-ft. aerial hook and ladder truck; 1 auxiliary squad wagon; 1 combination hose and chemical wagon; 1 runabout. Same to be in accordance with specifications on file in the office of the Chief Engineer of the Fire Department; a complete description of the machine proposed to be furnished to accompany each bid. A certified check, payable to C. A. Bloomquist, City Treasurer, in the sum of $150 to accompany each proposal.

The Otter Tail Power Co., F. G. Barrows, Secretary, Fergus Falls, Minn., is reported to be considering building one and possibly two more dams in the near future.

Mississippi.

✣Bids will be received until Noon, June 29, by Capt. F. A. Woodruff, U. S. Engineer, Vicksburg, Miss., for furnishing about 30,000 cu. yds. of stone and about 36,000 cords of willow brush and piles for bank revetment work.

Missouri.

✣Bids will be received until Noon, July 3, by Maj. E. H. Schulz, U. S. Engineer, Kansas City, Mo., for the construction of standard revetment on the Missouri River about 18 miles below Kansas City, Mo. Official advertisement will be found elsewhere in this issue.

Bids as follows were received May 22 by Maj. E. H. Schulz, U. S. Engineer, for the construction of standard revetment on the Missouri River, four miles below St. Charles, Mo.; (1) DeWitt & Shobe, (2) Rust, Swift & Co., (3) Wm. Parkin, Little Rock, Ark., (4) A. W. Farney.

	(1)	(2)	(3)	(4)
11,000 ft. standard revetment	[illegible]	$8.19	$9.80	$10.48
Material in place:				
Yellow pine piles, per lin. ft.	.30	.30	.45	.38
Cottonwood piles, per lin. ft.	.20	.20	.30	.30
Stone, per cu. yd.	[illegible]	1.50	1.50	1.90
Willow brush, per cord	1.80	2.00	3.50	1.80

Bids were received May 22 by the U. S. Treasury Department, Washington, D. C., for the construction of the public building at Warrensburg, Mo. The bidders and the kind of stone bid upon were as follows: Deiter & Wentzel Construction Co., Wichita, Kan., limestone, $63,340; sandstone, $66,430; Harmon Bros., Wichita, $58,800, $60,550; Hiram Lloyd Building & Construction Co., St. Louis, $59,545, $60,545; L. W. Dumas, Jr., Construction Co., Columbus, Mo., $62,486, $62,486; M. Yeager & Son, Danville, Ill., $59,611, $60,447; H. M. Green, Kansas City, $58,768, $57,768; Latimer & Benning, Kansas City, $59,127, $59,127; Holliday & Crown, Greensboro, N. C., $58,500, $59,000; Connor Bros. Co., Lowell, Mass., $64,300, $66,000.

New Jersey.

✣Bids will be received until 11 a. m., June 29, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for the dredging and re[illegible] Alloway Creek, N. J.

⊙E. A. Van Brunt, Seabright, N. J., has been awarded the contract at $7.90 per lin. ft. for constructing about 1,900 lin. ft. of wood jetties at Sandy Hook Proving Grounds, for the U. S. Government.

Bids, as follow, were received May 18 by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Cohansey River, N. J.: Rickards Dredging Co., Philadelphia, Pa., [illegible] cts. per cu. yd.; American Dredging Co., Philadelphia, Pa., 14¾ cts. per cu. yd.; River & Harbor Improvement Co., Philadelphia, Pa., 13.4 cts per cu. yd. The total estimated quantity is 180,000 cu. yds.

New York.

✣Bids will be received until Noon, June 10, by Col. W. H. Black, U. S. Engineer, 710 Army Bldg., New York, N. Y., for dredging Wappinger Creek, N. Y., and in harbors at Tarrytown and Peekskill, N. Y.

⊙Bids were opened May 24 by Board of Contract and Supply, Utica, N. Y., for the construction and extension of electric subways in this city, the contract being awarded to the Safety Insulated Wire & Cable Co., New York City, at $29,906. The work will consist of 150,000 duct. ft. of tile and appurtenances.

Bids as follow were received May 15 by Capt. W. L. Guthrie, U. S. Engineer, Oswego, N. Y., for dredging 160,000 cu. yds., scow measurement, at Charlotte Harbor, N. Y.: Buffalo Dredging Co., Buffalo, N. Y., 16.4 cts.; Daly & Hannan Dredging Co., Ogdensburg, N. Y., 17.5 cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., 20 cts. It was recommended that all bids be rejected as too high.

Bids were opened May 15 by Capt. W. L. Guthrie, U. S. Enginer, Oswego, N. Y., for excavations at Ogdensburg Harbor, N. Y. Bids were received on the three schedules: (1) Schedule A, 475,000 cu. yds., scow measurement; (2) Schedule B, 590,000 cu. yds. scow measurement; (3) Schedule C, 710,000 cu. yds., scow measurement. The bids received were as follows: Duluth Marine Contracting Co., Duluth, Minn., (1) 14 cts., (2) 13½ cts., (3) 13 cts.; D. C. Stevens, Buffalo, N. Y., (3) 14.3 cts.; Daly & Hannan Dredging Co., Ogdensburg, N. Y., (1) 16 cts., (2) 18½ cts., (3) 19½ cts.; Buffalo Dredging Co., Buffalo, N. Y., (1) 17.4 cts., (2) 21½ cts., (3) 22½ cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 20 cts. The bid of the Duluth Marine Contracting Co., under Schedule C, was recommended for acceptance.

Bids were opened May 18 by Col. S. W. Roesseler, U. S. Engineer, New York City, for dredging in Flushing Bay, Hempstead Harbor and Huntington Harbor. The low bidders were as follows: Flushing Bay, R. G. Packard Co., 130 Pearl St., New York City, at 22 cts. per cu. yd.; Hempstead Harbor, P. Sanford Ross, Inc., Jersey City, N. J., at 21 cts. per cu. yd.; Huntington Harbor, Maritime Dredging Co., 78 Broad St., New York City, at 28⅔ cts. per cu. yd.

North Carolina.

✣Bids will be received until 3 p. m., July 5, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office and Court House at Washington, D. C.

Ohio.

✣Bids will be received until Noon, June 12, by F. G. Hogan, Director of Public Safety, Cleveland, O., for furnishing the necessary labor and material for the construction of a fire engine station at Lorain Ave. and West 101st st.

Pennsylvania.

✣Bids will be received until Noon, June 13, by Department of Wharves, Docks and Ferries, 555 Bourse Bldg., Philadelphia, Pa., for repairs to Bulkhead at foot of Fitzwater St., between Piers No. 35 and 36 South, Wharves, Delaware River. J. F. Hasskarl is Acting Director of the Department.

✣Bids are asked until noon, June 24, by Maj. Herbert Deakyne, U. S. Engineer, 815 Witherspoon Bldg., Philadelphia, Pa., for dredging in Delaware River, on Tinicum and New Castle Ranges. The work to be done is the dredging of the main ship channel of the Delaware River to a depth of 35 ft. at mean low water, and a width of 800 ft., at the following localities: Lower end of Tinicum range and upper end of New Castle Range. The dredging on Tinicum range will extend from Station 88, nearly opposite Dupont's upper wharf on Thompson's Point, N. J., to Station 100+250—near the lower end of Tinicum range—where dredging will be done under an existing contract, a distance of about 12,250 ft. The upper limits of this dredging may be extended until funds are exhausted or deep water at the upped end of the range is reached. The dredging on New Castle range will extend from the end of the connecting range at Bulkhead Bar, which connecting range is being dredged under an existing contract, to deep water at about Station 219, a distance of approixmately 5,800 ft. The quantity of material to be removed is estimated to be about as follows: Tinicum range, 1,617,000 cu. yds.; New Castle range, 500,000 cu. yds. The stated amounts include dredging to a depth of 35 ft. below mean low water, and additional cuts to equal side slopes of 1 on 5. The material to be removed is believed to be mainly mud, or mud with an admixture of fine sand, except along the westerly edge of the channel on Tinicum range, Station 96 to 100+250, where a harder material containing boulders in some quantity is found, and at various places on New Castle range where firm mud, sand and gravel occur.

The State Senate passed the bill appropriating $500,000 to improve the port of Philadelphia.

The House of Representatives has passed the Fox bill for extension of the Capitol Park, at Harrisburg. The bill provides an appropriation of $2,000,000 for the purchase of 28 city blocks of Harrisburg to provide a larger setting for the State Capitol building. The work of enlarging the park, as well as purchasing the land, is to be placed in the hands of a commission of three, to be appointed by the Governor. The bill stipulated that $200,000 shall be expended during the first two years and that the balance, $1,800,000, shall be appropriated as needed during the following four years. The commission is supposed to have its work done by June 1, 1917.

Rhode Island.

✣Bids are asked until 2 p. m., June 20, by Col. Frederic V. Abbot, U. S. Engineer, Newport, R. I., as noted in our last issue, for dredging in Providenece River and Harbor, R. I. The work to be done consists in dredging to a depth of 25 ft. at mean low water an area extending from Buoy No. 11 northward to a point just above harbor Junction Pier, limited on the east and west. Section "A" is about 5,400 ft. long, 600 ft. wide at its southerly end and 270 ft. wide at the northerly end. It is estimated to contain about 1,691,321 cu. yds., scow measurement, or 1,409,434 cu. yds., place measurement. Section "B" is about 2,200 ft. long, 270 ft. wide at the southerly end and 100 ft. wide near the northerly end, and is estimated to contain about 308,679 cu. yds., scow measurement, or 257,233 cu. yds., place measurement. The material to be dreged is believed to be as follows: Section "A." Mud at lower end with a mixture of sand as Fields Point is approached; sand, gravel and mud at Fields Point; sand, mud and some clay between Fields Point and the upper end of Section "A." Section "B."

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Compact sand, clay, gravel and boulders overlaid by a small amount of mud near the lower end.

Bids were opened May 15, by Col. Frederic V. Abbot, U. S. Engineers, Newport, R. I., for dredging Long Bed in Providence Harbor, R. I., the estimated quantities being 70,000 cu. yds., place measurement, and 10 cu. yd. boulders. The bids received were as follows (1) for dredging, (2) for boulders: Eastern Dredging Co., Boston, Mass., (1) 27.3 cts., (2) $8; Charles M. Cole, Fall River, Mass., (1) 21.9 cts., (2) $8; J. S. Packard Dredging Co., Providence, R. I., (1) 26 cts., (2) $10; Coastwise Dredging Co., Norfolk, Va., (1) 25 cts., (2) $8.

South Carolina.

Bids were opened May 10 by Col. Dan C. Kingman, U. S. Engineers, Charleston, S. C., for dredging in Wingate Bay., S. C., the bids received being as follows: (1) rate per cu. yd., (2) board for inspectors per month, each, (3) number and kind of dredges to be used, (4) daily capacity, (5) condition. P. Sanford Ross, Inc., Jersey City, N. J., (1) 11.37 cts., (2) $20, (3) No. 12, 12" Pump, No. 16 15" Pump, (4) Not given, (5) A-1; Atlantic, Gulf & Pacific Co., New York, N. Y., (1) 9.9 cts., (2) $20, (3) 1 20" Pump, 1 24" Pump, (4) Not given, (5) 1st class; North Amer. Dredging Co., (1) 10.69 cts., (2) $30, (3) 1 24" Pump, (4) 8 to 12,000 yds., (5) A-1; Southern Dredging Co., Mobile, Ala., (1) 11⅞ cts., (2) $25, (3) 1 Hydraulic, (4) 6,000 yds., (5) good; Bowers Sou. Dredging Co., Galveston, Texas, (1) 10.4 cts., (2) $20, (3) 3 20" and 22" Pumps, (4) 7 to 10,000 yds., (5) 1st class; Roderick G. Ross, Jacksonville, (1) 11 cts., (2) $20, (3) 1 18" Pump, (4) 10,000 yds., (5) Good; Coastwise Dredging Co., Norfolk, Va., (1) 12.5 cts., (2) $25, (3) 1 18" Pump, (4) 6,000, (5) Good.

South Dakota.

✣Bids will be received until 2 p. m., June 20, by Commissioner of Indiana Affairs, R. C. Valentine, Washington, D. C., for furnishing the necessary labor and material for the construction of one hospital building for the Canton Insane Asylum, S. Dak. Further information can be obtained of H. R. Hummer, Supt., Canton, S. Dak.

Texas.

⊙The U. S. War Department has awarded the contract for continuing the dredging of the Texas City channel to the Atlantic, Gulf & Pacific Dredging Co., at $2.33 per lin. ft. on a basis of 12,000 ft., or $27,960. Under the previous contract, let last fall, the Atlantic, Gulf & Pacific Dredging Co. has completed the improvement work up to Station 10, or 10,000 ft. from the docks at Texas City. For a distance of 5,000 ft. out from the docks the channel was widened to 200 ft. and deepened to 27 ft. From Station 5 to Station 10, a distance of 5,000 ft., the channel was deepened to 27 ft., and the original width of 100 ft. was maintained. Under the new contract just let the channel will be redredged and deepened to 27 ft. from Station 10 to Station 22, a distance of 12,000 ft. The bottom width will be 100 ft. and the side slopes as steep as the material will permit. The old contract has just been completed and the dredging company will simply continue the improvement work under the new contract.

⊙Lowell Machine Shop, Lowell, Mass., has been awarded the contract by the Prison Commission, J. A. Palmer, Secy., Huntsville, Tex., for supplying textile machinery for the prison system at Huntsville, for $4,915. Bids were opened May 22.

Bids as follows were received May 25 by Maj. G. P. Howell, U. S. Engineer, Galveston, Tex., for 291,000 cu. yds. of dredging at mouth of Brazos River, Tex.: Bowers Southern Dredging Co., Galveston, Tex., 15 cts.; Home Dredging Co., Mobile, Ala., 17 9/10 cts.

The Port Arthur Pleasure Pier Co., which proposes the construction of a pleasure pier at Port Arthur, has been chartered with a capital stock of $80,000, the incorporators being E. A. Laughlin, G. H. Eubank and John W. Tryon of Port Arthur. Bids for the construction of the pier are to be asked shortly.

Virginia.

✣Bids will be received until 2 p. m., June 9, by Commissioners of the District of Columbia, Washington, D. C., for furnishing and installing steam electric generating unit, switchboard and feeder system at District of Columbia Work House, Occoquan, Fairfax County, Va.

✣Bids will be received until 3 p. m., June 28, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office at Suffolk, Va.

The Old Dominion Steamship Co., Norfolk, is reported to have asked bids for the construction of piers on the South Ghent water front at Norfolk. There are to be two piers each 1,100 ft. in length by 225 ft. in breadth; two others, each 800 ft. long by 225 ft. wide, and a fifth or smaller one. It is stated that the pier construction work will be given out in two contracts. The first will include the actual pier building and top decking. The second will include the superstructure work. The total improvements, according to present plans, will cost about $1,500,000 when completed. It is understood that the bids will be opened about the middle of this month.

The following bids were received May 15 by Lt. Col. W. C. Langfitt, U. S. Engineers, Washington, D. C., for dredging in the Potomac River at Alexandria, Va. Sanford & Ross Co., Baltimore, Md., 15.6 cts.; American Dredging Co., Philadelphia, Pa., 17.7 cts.; Atlantic, Gulf & Pacific Co., New York, 16.9 cts. The dredging is to be done in the harbor of Alexandria, Va., on that portion of the bar outside of a line parallel to and 20 ft in front of the established pier head line and between the prolongation of the center line of Pendleton St. and the northern city limits. This area is about 2,400 ft. in length and will average about 200 ft. wide, and contains about 300,000 cu. yds. of excavation.

Wisconsin.

Bids were opened May 24 by Lt.-Col. Geo. A. Zinn, U. S. Engineer, Milwaukee, Wis., for dredging 380,000 cu. yds. for improvement of Oconto Harbor. The bids received were as follows: (1) Section A, dredging 227,000 cu. yds., scow measurement; (2) Section B, dredging 153,000 cu. yds., scow measurement, or (3) Section C, dredging 122,400 cu. yds., place measurement: Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 13.9 cts., (2) 13.9 cts., (3) 19 cts.; Duluth-Superior Dredging Co., Duluth, Minn., (1) 20.25 cts., (2) 20.25 cts., (3) 25 cts.; Fitz Simons & Connell Dredge & Dock Co., Chicago, Ill., (1) 14.5 cts., (2) 13.5 cts., (3) 18 cts.; Northern Dredge & Dock Co., Duluth, Minn., (1) 16 cts., (2) 16 cts.; Adolph F. Bues, Milwaukee, Wis., (1) 11⅜ cts., (2) 11⅜ cts., (3) 19 cts.; Greiling Bros. Co., Green Bay, Wis., (1) 11.7 cts., (2) 11.7 cts.; Zenith Dredge Co., Duluth, Minn., (1) 15.25 cts., (2) 15.25 cts.

Wyoming.

⊙Richard F. Clough, Colorado Springs, Colo., has been awarded the contract for laying 40 miles of pipe line for the Midwest Oil Co. The pipe is required to carry oil from the wells of the company to the nearest railroad station, Casper. Verner Z. Reed, Colorado Springs, Colo., is President of the Midwest Oil Co.

Canada.

✣Bids will be received until 6 p. m., June 20, by J. McCaw, Secy., P. S. Board, Welland, Ont., for the erection and completion of an eight-room school building at Welland. Plans and specifications may be seen at the office of A. E. Nicholson, Architect, 46 Queen St., St. Catharines, and at the store of D. McCaw & [illegible]

✣Bids will be received until 4 p. m., June 14, by R. C. Desrochers, Secy., Department of Public Works, Ottawa, Ont., for addition to fittings, Central Postoffice, Toronto, Ont. Plans and specifications are on file at the office of T. A. Hastings, Clerk of Works, postal station "F," Toronto, and the Department of Public Works.

✣Bids will be received until 6 p. m., June 15, by H. F. Maulson, Secy. Minnedosa Power Co., P. O. Box 369, Minnedosa, Man., for the construction of the power station foundations and Penstock and Spillway and Intake structures for the Minnedosa Power Company dam at that city. Plans and specifications may be seen at the office of Messrs. Andrews, Andrews & Co., Barristers, Aikens Block, Winnipeg; Messrs. Taylor, Colwill, Barristers, Portage la Prairie; and at the office of the Secretary of the company, Minnedosa.

The Dominion Public Works Department, Ottawa, has sent out engineering parties to complete this summer the survey of the proposed navigable waterway from Edmonton to Winnipeg, via the Saskatchewan River. It is expected that the work of clearing and deepening the channels will be actively begun next summer. The results of the surveys of last summer indicate that a 10-ft. waterway can be obtained from Winnipeg to Clear Lake, and a 6-ft. waterway for the rest of the distance to the foothills of the Rockies. By regulation works, conserving the flow of water in the river and tributary streams, it is asserted that the present difficulty of low water in the late summer months can be overcome. Only some half-dozen locks will be needed throughout the whole waterway to Edmonton, and it is estimated that the total expenditure required to make passable this 1,000 mile stretch of inland waterway through the wheat lands of the west will be about $2,000,000.

The Departments of Railways and Canals, L. K. Jones, Secretary, Ottawa, Ont., is to at once call for tenders for extensive harbor terminal improvements at Halifax, costing in the aggregate about $2,000,000. The plans provide for the construction of four new piers each 800 ft. long and 235 ft. wide.

The Canadian Government has awarded the contract for the drydock at Montreal to Vickers' Sons & Maxim, the English shipbuilders. The subsidy to be paid to the contractors by the Federal Government will be at the rate of 3½ per cent on a capital outlay of $3,000,000 for 38 years. The drydock will have a lifting capacity of 25,000 tons.

Notice has been given of a resolution calling for the ratification of an agreement between the government and the Collingwood Shipbuilding Co. for the construction of a drydock at Collingwood, Ont. The agreement provides that the government may pay the company a subsidy of 3 per cent for twenty years upon $306,965, the cost of the drydock.

The Canadian Public Works Department, Ottawa, Ont., will call for tenders shortly for extensive harbor works at St. John, totaling in the aggregate probably $5,000,000. The surveys of Courtney Bay, where a new division of the harbor will be provided to accommodate the G. T. P. steamship service, have been completed and a contract for dredging will be let next month. There will also be a drydock of the first class built, with an extensive ship-repairing plant in connection. Docks will be built providing three berths for the G. T. P. ocean steamship service. Several companies backed by British capital are reported to be ready to tender for the whole of the proposed work.

TRADE NOTES.

[illegible]

Mr. W. R. [illegible] assistant to Mr. Geo. E. Lambert, who has [illegible]

[illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] & [illegible] of New [illegible] Conn. [illegible] Max J. Unkelbach, New Britain, Conn., is the architect and engineer for the building.

The J. Faessler Mfg. Co., Moberly, Mo., makers of [illegible] flue cutters and other boiler tools, has reorganized [illegible] at 810 Olive St., St. Louis.

The Buffalo Forge Co., Buffalo, N. Y., report that its forge department is unusually busy with [illegible] large installations [illegible] down draft forges in [illegible] and industrial plants. Among these are [illegible] Havana Railways, Havana, Cuba, Central Railroad of Brazil, etc.

The McCaslin Conveyor, manufactured by the Mead-Morrison Manufacturing Co. of Cambridge, Mass., is about to be placed in a new use. The Mead-Morrison Manufacturing Co. have just closed a contract with the Canada Sugar Refining Co. of Montreal, Canada, for apparatus to handle raw sugar at its refinery. The capacity of the conveyor will be 70 tons per hour. The installation will be particularly interesting because of an ingenious device for preventing the accumulation of sugar in the buckets.

On June 1st, 1911, the Sprague Electric Co. was merged with the General Electric Co. of Schenectady, N. Y., and its business will be conducted under the name Sprague Electric Works of General Electric Co. The manufacture and sale of the lines of apparatus and supplies heretofore exploited by the Sprague Electric Co. will be continued by the Sprague Electric Works of General Electric Co. under the same organization, with Mr. D. C. Durland in responsible charge as General Manager. The offices of the Sprague Electric Works will be continued as heretofore, with main offices at 527-531 West 34th St., New York, N. Y., and branch offices in principal cities.

The J. W. Paxson Co., Philadelphia, Pa., is just completing a new factory building covering an area of 9,000 sq. ft. It is of substantial construction of steel and concrete and has a saw-tooth roof, which gives splendid lightning facilities. It will be equipped with up-to-date machinery for manufacturing foundry riddles (steel, brass and galvanized). This company weaves the wire cloth, especially suitable for riddle, sifter and window guards. It also makes wire, bristle and split bamboo brushes and brooms for foundries, machine shops, stables and for cleaning streets; also wire brooms and brushes for cleaning trolley and railroad tracks from snow, ice and dirt as they are fitted with a steel chisel pointed spear on the other end. The above building is entirely separate from the machine and plate-shop, pattern-shop and blacksmith-shop in which the Paxson Co. make cupolas, ladles, sandblast outfits, overhead tramrail, tumbling barrels, sifters, core-ovens, magnetic separators, etc.

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Concrete Bridges and Culverts.
(Both Railway and Highway.)
By H. Grattan Tyrrell. Leather, 4½ × 6¾ ins.; 272 pages. Postpaid, $3.00.

Tables for Structural Engineers.
By Edward Godfrey. Leather; 4 × 6½ ins.; 218 pages. Postpaid, $2.50.

Solid Bitumens.
Their Physical and Chemical Properties and Chemical Analysis, by S. F. Peckham. Cloth; 6 × 9 ins.; 330 pages. Postpaid, $5.00.

Graphic Statics.
By Charles W. Malcolm. This book has been adopted as a textbook by a large number of engineering colleges. Cloth, 6 × 9 ins.; 330 pages. Postpaid, $3.00.

Cost Keeping and Management Engineering.
By Halbert P. Gillette and Richard T. Dana. Cloth; 6 × 9 ins.; 360 pages. Postpaid, $3.50.

Theory and Design of Reinforced Concrete Arches.
By Arvid Reuterdahl, Chief of Bridge Dept., City of Spokane. Cloth; 6 × 9 ins.; 132 pages. Postpaid, $2.00.

Railroad Location Surveys and Estimates.
By F. Lavis, M. Am. Soc. C. E. Cloth; 6×9 ins.; 270 pages. Postpaid, $3.00.

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By J. Kindelan. Cloth; 5¼ × 7½ ins.; 350 pages. Postpaid, $1.50

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Concrete Construction—Methods and Cost.
By Halbert P. Gillette and Charles S. Hill, Editors of "Engineering-Contracting." Cloth; 6 × 9 ins.; 700 pages. Postpaid, $5.00.

Cements, Mortars and Concretes.
By Myron S. Falk. A summary of tests and conclusions derived therefrom. Cloth; 6 × 9 ins.; 184 pages. Postpaid, $2.50.

Surveyor's Handbook.
By T. U. Taylor, Professor of Civil Engineering, University of Texas. Leather; 4½ × 7 ins.; 328 pages. Postpaid, $2.00.

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By Halbert P. Gillette. Cloth; 5½ × 7 ins.; 384 pages. Postpaid, $3.00.

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Engineering Law—The Law of Contract.
By Alexander Haring, LL.B., M. Am. Soc. C. E., Professor of Bridge and Railway Engineering, New York University. Cloth; 6 × 9 ins.; 510 pages. Postpaid, $4.00.

Concrete Inspection.
By Chas. S. Hill, C.E. Cloth; 3½ × 6 ins. 186 pages; illustrated. Postpaid $1.00.

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By Ernest McCullough, M. West. Soc. Engrs. Cloth; 5 × 7¾ ins.; 136 pages, illustrated. Postpaid $1.50

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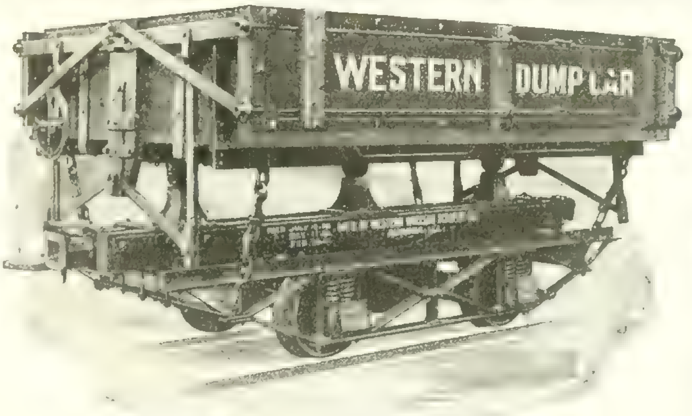

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CONCRETE VIADUCT OVER HOUSTON SHIPCHANNEL.

Houston, Texas, May 23, 1911.

Sealed proposals will be received at the office of Dan C. Smith, Jr., City Controller and City Secretary, City Hall, Houston, Texas, until 12 o'clock noon, July 3d, 1911, for the construction of a reinforced concrete viaduct over the Houston Shipchannel. The structure will be about 1,650 feet in length and 60 feet wide.

Specifications and plans, bidding blanks, etc., can be obtained upon application at the office of F. L. Dormant, City Engineer, Houston, Tex., by making a deposit of $20.00 with the City Engineer.

A certified check of the bidder on any bank in Houston, Tex., payable to the order of H. B. Rice, Mayor, for $20,000 will be required to be deposited with the bid.

Bidders are expected to examine the site of the viaduct and acquaint themselves with local conditions.

The successful bidder will be required to give bond and comply with City Charter respecting contracts, and to execute the usual form of contract as prepared by the City Attorney.

The right is reserved to reject any or all bids or to accept any bid considered advantageous to the City of Houston.

H. B. RICE,
Mayor of the City of Houston,
Texas.
F. L. DORMANT, City Engineer.

BRIDGE.

Notice is hereby given that sealed bids will be received until 2 o'clock P. M. of June 22, 1911, for the construction of a steel bridge with concrete floor across Iowa River at Iowa Falls, Iowa. Length of bridge 353 feet, roadway 20 feet wide, 2 sidewalks each 5 feet wide. Check for 10 per cent of bid must accompany bids. The Board of Supervisors reserve the right to reject any or all bids. Plans and specifications on file at County Auditor's Office, Eldora, Iowa. Letting to be at Court House, Eldora, Iowa, June 22, 1911, at 2 P. M.

E. L. MARRIAGE,
County Auditor,
Hardin County, Iowa.

SPECIAL BOND ISSUE OF 1911.

WATER DEPARTMENT

Muskogee, Okla.

WATER INTAKE AND INLET TOWER.

Sealed proposals will be received by the City Council of the City of Muskogee, Okla., until Tuesday, June 27, 1911, at 10 o'clock a. m., and opened immediately thereafter, for the construction of a water intake and inlet tower. All bids must be filed with Chas. Wheeler, Jr., City Clerk.

The water works intake is a 54-in. submerged concrete pipe line 2,600 ft. 1 in. long to be laid across the Arkansas River and up to the bed of the Grand River.

The intake tower is a concrete structure built at the upper end of the intake.

Proposals for this contract shall be accompanied by a certified check for $5,000, made payable to the City of Muskogee, Okla., without condition.

Plans and specifications can be seen and secured at the office of the City Engineer, Muskogee, Okla., or at the office of the Consulting Engineer, 114 Liberty St., New York City, after June 10, 1911, upon payment of two and one-half dollars ($2.50).

The right is reserved to reject any or all bids or to accept that one which, in the judgment of the City Council, is for the best interest of the city.

By order of the City Council.

E. H. FLEMING,
Commissioner of Water, Sewer and Lights.
ALEXANDER POTTER,
Consulting Engineer.
[illegible]
[illegible]

ROADS.

Sealed bids will be received at the office of the Robertson County Pike Commission, in Springfield, Tennessee, up to 12 o'clock noon, on Tuesday, June 20, 1911, for grading, ditching and macadamizing about fifty miles of public roads in Robertson County, Tennessee. Plans and specifications may be seen at the office of the Pike Commission, at any time after June first.

JOSEPH E. WASHINGTON,
Chairman.
ED S. ECKLES,
Secretary.

OPEN DITCHES.

Bids will be received until [illegible] July 15, 1911, by the Board of Commissioners of the Sixth Ward and Crowley Drainage District, at Crowley, La., for the construction of about 40 miles of open ditches ranging from [illegible] to [illegible] miles in length, 16 to 40 feet in width and 2 to 5 feet in depth, approximating 600,000 cu. yds., and about 90 acres of clearing. No rock. Mostly open prairie. Three lines of railway. The right is reserved to reject any and all bids. Each bid must be accompanied by certified check for $1,000.

H. E. LEWIS, President.
W. S. WHITE, Engineer.
L. A. WILLIAMS, Secretary.

WAR DEPARTMENT.—U. S. Engineer Office, Montgomery, Ala., June 6, 1911. Sealed proposals for dredging at mouth of Apalachicola River, Florida, will be received at this office until 1 o'clock p. m., July 6, 1911, and then publicly opened. Information on application. G. D. FITCH, Lt. Col., Engrs.

U. S. ENGR. OFFICE, Boston, Mass., May 26, 1911.—Sealed proposals for rock excavation in Boston Harbor, Mass., will be received here until 12 M., June 26, 1911, and then publicly opened. Information on application. FREDERIC V. ABBOT, Col., Engrs.

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—Engineering News.

This, we believe, will also be the verdict of all who study "Cost Keeping and Management Engineering" by Halbert P. Gillette and Richard T. Dana. Many young engineers will find that a knowledge of the principles of cost keeping will enable them to secure a position with contracting firms, for contractors are more than ever alive to the advantages derived from an accurate knowledge of unit costs. But, whether an engineer expects to be employed to keep costs, or not, he should know how to keep them. It is now the common practice for railway engineers and others to record costs of work done by the contractors, so as to insure accurate estimates of costs of similar work that may be done in the future. There is not an engineer, therefore, who should not secure a copy of this book. It contains [illegible] pages, [illegible] and its price is $3.00 net, postpaid. Order direct.

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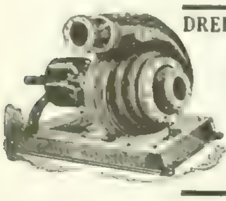

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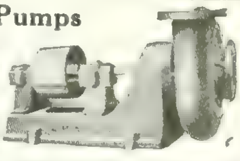

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DRAINAGE EXCAVATION.

STATE OF IOWA,
COUNTY OF PAGE.
DRAINAGE DISTRICT NO. 9.

Notice is hereby given that the Board of Supervisors of Page County, Iowa, will receive sealed bids until 3 p. m. of the 14th day of June, 1911, for the construction of a new channel for the Nodaway river in Drainage District No. 9, in said county.

Plans and specifications are on file in the office of C. W. Duke, County Auditor, and copies thereof may be obtained upon application.

The bids will be opened at the hour of 3 p. m., on the said day, viz.: the 14th day of June, 1911, at a meeting of said Board of Supervisors to be held at the Court House in Clarinda, and the contracts will be awarded at that time.

The bids should be directed to the Board of Supervisors, Clarinda, Iowa, and marked "Bids for the Construction of New River Channel in District No. 9."

The entire length of the proposed new channel is 54,900 feet; width of bottom from station 0 to station 355+25, 20 feet, from station 355+25 to station 549, 24 feet; average depth in 20 ft. channel, 14.54 feet; in 24 ft. channel, 15.81 feet; maximum depth 24 feet through an abandoned R. R. fill; side slopes 1-2 horizontal to 1 vertical; berme to be 9 feet.

The total amount of excavation is estimated to be 909,053 cubic yards, supposed to be all earth consisting of loam, silt and clay.

Part of the right of way, which is 100 feet wide, is covered by timber and must be cleared by the contractor.

The ditch is divided into two (2) sections, viz.:

Section 1, from station 0 to station 301, excavation 439,958 cubic yards.

Section 2, from station 301 to station 549, excavation 469,095 cubic yards.

Bids will be received on each section separately.

The starting point of section 1 is near the track of the K. & W. R. R. and the starting points of both sections are less than 2 miles from R. R. stations.

The date for beginning the work is fixed at not later than September 1, 1911, and the date for the completon of the work is fixed at not later than May 1, 1913.

All bids to be accompanied by cash deposit or certified check to the amount of ten (10) per centum of the bid.

Deposits of unsucessful bidders will be returned to them promptly after the contract is awarded. Deposits of successful bidders will be held until contract and bond are executed by them as required by law.

The successful bidders will be required to execute an approved bond equal to 25 per centum of the estimated cost of the work so let.

The Board reserves the right to reject any or all bids and readvertise the letting of the work.

Dated at Clarinda, Iowa, this 26th day of May, 1911.

A. S. VAN SANDT,
Engineer in Charge.
Address:
C. W. DUKE.
Auditor of Page County, Clarinda, Ia.

U. S. ENGINEER OFFICE, Wilmington, N. C., June 1, 1911. Sealed proposals for constructing complete the two (2) wooden hull, non-propelling, 15-in. hydraulic pipe line dredges Neuse and Port Arthur will be received at this office until noon, June 30, 1911, and then publicly opened. Information on application. EARL I. BROWN, Capt. Engrs.

OFFICE OF THE SEWERAGE
COMMISSION
OF THE
CITY OF BALTIMORE.

Sealed proposals indorsed "Proposal for Constructing Jones Falls Conduits, Section No. 1, Storm Water Contract No. 14," addressed to the Board of Awards of Baltimore City, will be received at the office of the City Register, City Hall, Baltimore, Md., until 11 a. m., Wednesday, June 28, 1911, for constructing Jones Falls Conduits, Section No. 1, Storm Water Contract No. 14, as shown on plans on file in the office of Mr. Calvin W. Hendrick, Chief Engineer of the Sewerage Commission.

Specifications and plans can be obtained upon application at the office of the Sewerage Commission, Room 904, American Building, Baltimore, Md., on and after June 2, 1911. A charge of $15.00 will be made for each specification and blue prints. This charge will be refunded upon the return, on or before June 28, 1911, of the unused specifications and plans in good condition, or upon the return of the plans in case a bid is submitted.

A certified check of the bidder, for the sum of $18,000, on a clearing-house bank, made payable to the order of the Mayor and City Council of Baltimore, will be required to be deposited with each bid.

Apprixomate quantities:
28,000 cu. yds. earth excavation.
900 cu. yds. rock excavation.
40,000 cu. yds. concrete masonry.
750 cu. yds. brick masonry.
4,000,000 lbs. reinforcing steel.
12,000 sq. yds. granolithic resurfacing.
140,000 lin. ft. piles.
2,000 M. ft. B. M. lumber in foundation.
50 tons cast-iron pipe and specials.
900 lin. ft. vitrified sewer pipe, 6 to 30 ins. in size.
40 tons structural steel.

The successful bidder on this contract will be required to give bond and comply with the City Charter respecting contracts.

The Board of Awards reserves the right to reject any and all bids.

By order of the Sewerage Commission.
CHARLES ENGLAND,
Chairman.
HARRY W. RODGERS,
Secretary.
Approved:
JAMES H. PRESTON, Mayor,
President, Board of Awards.

STREET IMPROVEMENT.

Bids will be received until 12 o'clock noon on June 13th, 1911, by the Director of Service, Galion, O., for the improvement of North Market St. from Public Square to north corporate line, about 3,200 ft. in length, with treated macadam.

Also East Main St. from Big Four Railroad to east corporate line, about 5,500 ft. in length, with brick.

Also storm sewer 470 ft.—10-in.
Storm sewer 110 ft.—12-in.
Storm sewer 1,017 ft.—15-in.
Storm sewer 2,865 ft.—18-in.
Storm sewer 552 ft.—27-in.
Storm sewer 1,434 ft.—30-in.
12 manholes

ED. C. YOCHEM, Clerk.

U. S. ENGINEER OFFICE, Kansas City, Mo., June 3, 1911. Sealed proposals for constructing standard revetment on Missouri River, about eighteen miles below Kansas City, Mo., will be received here until 12 noon, July 3, 1911, and then publicly opened. Information on application. EDWARD H. SCHULZ, Major, Engrs.

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SUBSCRIPTION RATES [illegible]
[illegible]
[illegible]

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Entered as second-class matter, April 17, 1907, at the Post Office at Chicago, Illinois, under act of March 3d, 1879. Copyright, 1911, by the Myron C. Clark Publishing Co.

The Deficit Theory of Development Expense of Public Service Corporations, and an Erroneous Application of the Theory by the Wisconsin Railroad Commission.

What may be termed [illegible] theory of development expense received, we believe, its first formulation in print in Gillette's "Handbook of Cost Data," as follows:

> The early losses (= deficits below fair return) in operating a plant should usually be regarded as actual expenditures in developing the business, and should be figured at compound interest up to the time there ceases to be a loss from operation.

It is [illegible] that the expression "losses" is used as a synonym for the expression "deficit below a fair return on the investment," although, to avoid confusion, it is probably wise at present to use the longer expression.

In our [illegible] discussion of this subject was given at considerable length: [illegible]

> Development expense is the deficit in "fair return" on the investment during the early years of operation, while the business is being developed to a point that it will yield a "fair return" on the investment. Unless this development expense is charged to the capital account as fast as it occurs each year, it should draw compound interest up to the end of the development period.

Elsewhere in this issue we reprint an abstract from the decision of the Wisconsin Railroad Commission in the Madison Gas and Electric Co. case, from which we quote:

> Comparatively few plants are therefore paying at first. Several years are often required to obtain customers enough for a paying business. In the meantime the plants have to be kept in operation and the losses from such operation [illegible] "losses" is here used also in the sense of being a deficit below a fair return on the investment. —Editors.] Where these losses are due to such delays in securing the required amount of business, which can not be reasonably avoided and have not been covered by subsequent surplus earnings, it is difficult to escape the conclusion that they must also be regarded as one of the elements that should be considered in appraising the plants and in fixing rates. If investors are not compensated for such losses (= deficits below fair return), either by being allowed reasonable returns thereon or through surplus earnings, they will not [illegible] plants of this kind.

[illegible] Commission proceeds to determine whether the Madison Gas and Electric Co. is entitled to a valuation for rate making purposes in excess of the appraised value of the physical property. To do so it begins with the period (1896) when the present owners acquired the property, and calls the purchase price the value of the property. [illegible]

1. Value of plant at beginning............$......
2. Additions [illegible]
3. [illegible]
4. [illegible]
5. Interest (or fair return) on Item 1..... ......

Total of Items 1 to 5............ .. ...
6. Deduct net earnings from operation... ......
7. Total [illegible]

This item 7 becomes the item 1 of the following year, and the values are calculated for each year up to the time of the appraisal. For an illustrative example of the entire process, the reader is referred to the article on the Madison Gas and Electric Co. case given elsewhere in this issue.

In our opinion there are three grave errors [illegible] theory for ascertaining development expense:

First, it is an error not to start the computation of development expense at the time the original plant first began its operation. Obviously the development expense is normally greatest in the early years of operation, and may have wholly ceased at the time the original company sold out to its successors.

Second, it is an error to assume that the [illegible] true criterion of the value upon which it was [illegible] panies are forced to sell out at less than that value, while others receive more.

Third, it is an error to assume that the surplus above a fair return secured in later years should be used to offset the deficits incurred in early years; for, as we shall show, this [illegible] minus development expense or going value [illegible] is tantamount to saying that a going concern has less value than one that has just begun.

The Madison Gas and Electric Co. purchased its predecessors in 1896, paying $323,000 for the plants and going business. During the subsequent years nearly $600,000 was expended in additions to the plant, making a total of about $923,000 at the end of 1908. Including stores and supplies, the estimated cost of reproduction new was $927,000 at the end of 1908. [illegible] it seems clear that the [illegible] development expense but just the bare cost of [illegible] development expense since 1896 (given in the quoted abstract elsewhere in this journal) show that there has been no deficit below a fair return since 1896, if it is granted that 7½ to 8 per cent is a "fair return" on the investment, and if the value of the property was only $330,000, in 1896. Hence it is clear [illegible] prior to 1896; and, as above shown, it is also [illegible] expense. We now see how erroneous it is to attempt to apply the deficit theory of determining development expense unless the calcula- [illegible] that in this case no harm has been done to the present owners, for, if they acquired the property at less than its real value they are not injured if their property is not credited with its full value. We believe that such a contention would not stand in court, for, in such cases, courts do not concern themselves with values based upon bargain counter or [illegible] under normal conditions. In our opinion, therefore, the Wisconsin Railroad Commission made its first serious mistake in this case when it failed to consider the development expense that had occurred prior to the purchase of the properties in 1896, and this primary error was interwoven with the second error of assuming that the purchase price in 1896 represented the true value of the physical proper [illegible]

Fortunately for the Madison Gas and Elec [illegible] did not carry its own dictum to a logical conclusion, or its third error would have given a *minus* "going value" to this property, as there was a surplus every year above the "fair return" of 7½ to 8 per cent. Their calculations indicate a minus "going value" of about $50,- [illegible] "surplus" over the "fair return" from the [illegible] or minus going value, would have been far more than $50,000 had proper methods of treating increments in land value and depreciation been employed. (See our discussion at the end of the article in another part of this journal.)

We concede that it sounds rational to say that if a company is to be allowed to earn a return on its early deficits—its development expense—it should be compelled to re- [illegible] "fair return." This in fact is definitely announced by the Wisconsin Railroad Commission as being the proper procedure, although, to be sure, they refrained from applying their theory in this particular case, for they decided to allow the Madison Gas and Electric Co. to earn its "fair return" on the full cost of reproducing the physical property new. Let us carry to a logical conclusion this theory of deducting the surplus from the value of the physical property, which we may call the deficit and surplus theory.

Many electric lighting plants have made handsome profits almost from their inception. There has been practically no development expense. On the other hand there has been a surplus above what may now be established by a public service commission as being a "fair return" on the investment. Let us assume that an electric lighting plant costing $100,000 has yielded a return of 15 per cent on the investment for a period of 15 years. Then if 8 per cent is a "fair return," it is evident that a 7 per cent surplus, or excess above a fair return, has been earned, which is equivalent to $7,000 surplus annually for 15 years, or a total of $105,000 surplus above a "fair return." Even without compounding an interest on this surplus, as would be done by the method of deducting each year's surplus from the value of the plant at the end of the last year, it is apparent that the owners of the plant and business would find not only that their property had been entirely confiscated by the public but that they actually were in debt to the public; for when the $105,000 surplus above a "fair return" is deducted from the $100,000 cost of reproduction, a minus value results. Obviously no court would permit such confiscation of property. Yet it is just as truly confiscation to apply the Wisconsin method of deducting the surplus even though it be a relatively small amount, as it would be were the accumulated surplus sufficient to wipe out the entire plant value, as in the hypothetical case just given.

In the Spokane Rate Case, before the Interstate Commerce Commission, the same fallacy appeared in the arguments of attorneys opposing the railways. It was claimed that all additions and improvements to plant that have been paid for out of surplus are not rightfully the property of the railway but of the public. This contention is precisely like the contention made by the Wisconsin Railroad Commission in the Madison Gas and Electric Co. case, and is certain to be rejected by the courts.

Every public service corporation is an agent of the public, acting usually without any specified limit as to its compensation for services, for, in the past, it has been assumed that competition would act as a rate regulator. The competition has often been direct, as when one steam railway strove against a parallel railway for the transportation business, or when a gas company competed with an electric light company, or when both competed with kerosene. In other instances the competition has been indirect, as when the products of one community competed in the same markets with the products of another community, and thus led to cutting of the rates of one railway to enable its patrons to meet the market prices of products hauled over another railway from another section of the country.

With the passing of the old laissez faire era, there has sprung into existence a new theory of rate regulation—the theory of fair return on the actual value of the plant. But, as we pointed out in our issue of May 25, 1910, this theory is itself defective, since it leads to absurd results if applied to classes of business involving the use of little or no plant, such as the express business. It can not be held that the theory of fair return on the investment [illegible] the [illegible] new or even that it is a sound theory as it now stands, for it certainly requires modifications. Yet if it is granted that the theory is new, it follows that any laws based upon it may involve features that are retroactive, and therefore unjust. If the theory of fair return is so interpreted as to result in public confiscation of all past [illegible] a fair return, we have retroaction of such flagrant character as to be most repugnant to every sense of equity. On the other hand, there is no injustice in permitting a public service corporation to add to its plant value all reasonable deficits that were incurred in developing the existing business. In fact, to do so merely complies with numerous court decisions that a going business possesses value as such. All that the deficit theory of development expense provides is a rational method of measuring going value. Whereas, if we adopt the deficit and surplus theory—the theory of the Wisconsin Railroad Commission—we are inevitably led both to unfair and absurd results, for it is clearly absurd and unfair to conclude that a going business and plant may be valued at less than the cost of the plant alone, to say nothing of entire confiscation of plant and business that may readily occur under the deficit and surplus theory.

It has been argued that the deficit theory of development expense is itself illogical, because it can be made seemingly untenable by a reductio ad absurdum, thus: If values can be created by permitting a public service corporation to charge to capital all deficits below a fair return, then that corporation that has been the most poorly managed for the longest time will have the greatest value.

This appears to be unanswerable until it is realized that it has never been conceded that *"all deficits"* are to be necessarily regarded as development expense. *All* deficits are no more to be accepted by an appraiser as being elements of value than are all expenditures for construction, or for interest during construction, or for engineering. It is the function of an appraiser to eliminate every *unreasonable* expenditure, and this holds quite as true of items of development expense as of construction itself. The appraiser should become familiar with the actual expenditures of many companies, that he may know, for example, what is a reasonable expenditure for "engineering" expressed as a percentage of the total cost. In a given instance, such an expense may have been 10 per cent, although the general average of similar construction may show only 5 per cent. The appraiser would not then be justified in allowing more than 5 per cent for engineering, even though the records of the company were to show 10 per cent. In precisely the same way a skilled appraiser would not allow an unreasonably high development expense, even though it might be deduced from the accounting records of the company under consideration.

It has also been argued that the deficit theory of development expense is weak because there might have been little or no deficit had high enough rates been charged at first. The weakness of this argument lies in failure to recognize the fact that rates can not be arbitrarily advanced simply because business is light. If street car rates were 10 cts., people might walk, even if they had to crowd into tenements near enough to their places of employment to make the walking distance short. If railway rates on a new line were made much higher than elsewhere, new settlers would not occupy the land tributary to the line. Practically all rates are limited by competition of one sort or another, so that it is usually impracticable to make rates high enough to eliminate deficits in the early years of light business, even if it were desired to do so. This matter is touched upon in the very interesting discussion of the Madison Gas and Electric Co. rate case, printed elsewhere in this issue. And at the end of that article we have pointed out certain minor errors of the Wisconsin Railroad Commission in its method of determining the effect of increments in land values and the effect of depreciation charges.

The Question Between Contract and Day Labor Work at New Orleans.

The city of New Orleans has in prospect the spending of $7,000,000, secured by sale of bonds, for the completion of its drainage, water-works and sewerage systems. The Sewerage and Water Board having direction of these works has received an opinion from the City Attorney to the effect that the work must, according to law, be done by contract let to the lowest bidder. This is a reversal of an opinion by a previous City Attorney which placed the decision whether construction should be done by contract or by day labor work at the discretion of the Board. The discretion of the Board has been to choose the day labor method for much of the work done. Naturally this decision has not met with the approval of the local contractors. Naturally also the Board has opposed their criticism of its policy with as strong a defense as occurred to it. Finally and again naturally the Board does not accept with equinimity the legal opinion that it must reverse its policy. We are not concerned particularly with the questions of law in this matter, but we have been interested for some time in the reports that have come to us from New Orleans of the relations between the Board and the contracting fraternity of its home city and in the present connection these relations seem to warrant discussion.

At the meeting of the Sewerage and Water Board which received the opinion of the City Attorney there was also received a report from Superintendent George G. Earl recommending that the first work of construction under the new bond issue—the Napoleon Avenue Drainage Canal—be done by day labor. An abstract of Mr. Earl's report, as well as of the City Attorney's opinion are given in the New Orleans *Times-Democrat* of May 27. Mr. Earl's report, we may assume, represents the opinion of the Board as to the advantages of day labor construction; one member of the Board is quoted by the *Times-Democrat* as "commending" it. It is, therefore, worth noticing. The report says:

> The board possess these advantages. It has no bond, interest on borrowed money or retainer to consider. The contractor's profit is eliminated. It can buy the best material without the restraining influence of the general contractor, whose interests lie in getting the cheapest. It will only cost the board 1 per cent in loss of interest on its funds as they are expended. Machinery and plant used in the construction of one work can be moved to another. The board has rights and privileges from other public service corporations which it cannot delegate to its contractors. It has its own wharf connected with the public belt, where supplies can be received and its great Washington avenue yard connected with the Illinois Central Railroad.

The reasoning it will be noted is along the familiar lines that the contractor's profit is saved, that the quality of the work is better, that the city can purchase at greater advantage, etc., none of which things is generally or even often true in practice. For the moment, however, we are more interested in the concrete evidence of the economy of day labor as it is presented by the report. It is pointed out that to Dec. 31, 1910, 80.5 miles of sewers were constructed by the Board at the cost of $676,000. Exactly the same items, declares the report, constructed at the prices bid by contractors, would have cost $1,055,415.33. To this, says the report, may be added 3 per cent for extra work and 5 per cent for supervision, making the cost $1,139,842.56, and this does not include the pro-rating of general expenses of $30,000 for two years which is included in the $676,000 mentioned.

The Board, it will be seen, did the work for about 41 per cent less than it would have cost at the prices bid by contractors. It may be interesting to note in this connection that some time ago, following an editorial in these columns arguing the economy of contract work, we received from an unknown reader a copy of a report of the New Orleans Sewerage and Water Board in which heavily underscored was the following statement:

> The total work done by the Sewerage and Water Board during this six months period amounts to 23.16 miles of sewer, ranging in size from eight inches to twenty-four inches, 309 manholes and 105 flush tanks, at a total cost of $152,953.95. At the prices bid in September, 1907, this work would have cost the board $287,905.33.
>
> The efficiency of the organization of the forces has resulted in a SAVING TO THE BOARD OF APPROXIMATELY 46 PER CENT OVER THE PRICES BID IN SEPTEMBER, 1907, FOR THIS WORK.

It occurred to us at the time that this obviously intended rebuttal to our remarks was too overwhelming to be free from suspicion. We cannot help feeling the same lack of confidence in the later figures presented by Mr. Earl. Few advocates of day labor construction have attempted to claim such percentages of saving, much less to show actual examples. The difference is too great to be legitimately accounted for by "contractor's profit," and the sundry other items so fondly believed to enter into the cost of contract work and not into the cost of day labor construction by a municipality. What is the conclusion? Obviously it must be that either the figures given do not represent the full cost to the city of this sewer work or else the bids received contained an abnormal charge intended to protect the contractor against exacting specifications and arbitrary rulings of the Board's engineers.

Lacking everything but the mere assertion of the report we have no proof that the costs given are not the full and actual costs. If they are they furnish a rare example. In every case where the book costs of municipal department day labor work have been critically analyzed they have been found to lack in one way or another overhead and general charges that should have been included to show actual costs. This does not happen generally because of intention to conceal the actual costs. It is the outcome, most frequently, of the conditions under which municipal business is conducted. The interrelation of departments with each other and with the general organization, and the arbitrary dividing lines between departments, make it laborious to allot all charges exactly and as there is no compelling motive for such an allotment all the expenses chargeable to any individual construction are seldom properly segregated and charged up.

In support of the supposition that bidding prices have been made excessive by exacting specifications and arbitrary rulings of the Board's engineers, it may be said that we have a number of letters and statements from contractors to that effect. As an example of this evidence we quote from a recent letter to us as follows:

> The engineering department of the Sewerage and Water Board have by their exacting specifications and arbitrary rulings gotten a reputation among contractors which is a little bit worse than the engineers for the United States Government, and as a result the bids heretofore submitted for public work have been high.

The reply to this can obviously be that the Board makes no requirements or rulings not demanded by the conditions and not needful to secure the character and quality of construction desired. Where the truth lies between the two sets of statements cannot be stated offhand. We can assert, however, that the specifications adopted by the Board furnish opportunities for arbitrary rulings and even exactions which no wise contractor can afford to overlook in making his bid. We cannot pretend here to note all of these opportunities but some of them deserve mention. We quote at random as follows:

> In filling around the sewer the engineer shall have the right to direct the kind of compacting tools to be used and the exact method to be followed in each case.
>
> The intent and meaning of these restrictions is that the best marketable quality of pipes and specials shall be secured by the contractor, and the engineer reserves the right to alter the foregoing requirements at any time during the progress of the work and to add such further restrictions and conditions as he may deem necessary to secure practically the best materials which can be obtained in the market.
>
> Should local conditions be met, which, in the opinion of the engineer, require changes in alignments, grade, form or dimensions of any part of the work under this contract, the same may be made by the engineer, either before or after the commencement of the work, even to a total readjustment of lines of flow of main, submain or lateral sewers embraced in said contract, and the contractor shall have no claim against the Sewerage and Water Board for such changes, but shall accept as full compensation the unit price bid for each unit of work which he is required to do, regardless of whether the location of such work shall be as shown in approximate plans upon which bids are compared and invited or not.
>
> The work shall be prosecuted in such manner, and from such points, at such times and with such forces as the engineer may determine from time to time during the progress of the work.

These quotations speak for themselves. They are not in the nature of exceptional clauses, they represent the tenor of the specifications throughout, which is that the work shall be done according to plans and specifications and *the requirements of the engineer.* Given an engineer with a disposition to be arbitrary and exacting these specifications afford him every opportunity and the power to exercise his tendencies. Given an engineer with the reputation of severity toward contractors, these specifications assure excessive bidding prices. The New Orleans Sewerage and Water Supply Board has the reputation among contractors who are familiar with its practice, of being arbitrary and exacting to the point of severity. It does not matter how the Board may justify its practice, the fact alone that this practice holds will make contractors bid abnormally high on any work under the Board's direction.

What will be the result under the new ruling that the Sewerage and Water Board must do its original construction work by contract let to the lowest bidder? One result, which we may predict with certainty, will be that if the Board maintains its alleged present policy toward contractors it will not secure normally reasonable bidding prices on its work. Another thing of which we are just as certain is that this Board can so direct and control the work that, without losing one iota in character, quality or convenience to the public, its contract cost will be as little and probably less than would be its day labor cost with all its charges credited in full.

CONCRETE AND REINFORCED CONCRETE SECTION

The Economy Gained by Proper Arrangement of Concrete Mixing Plant.

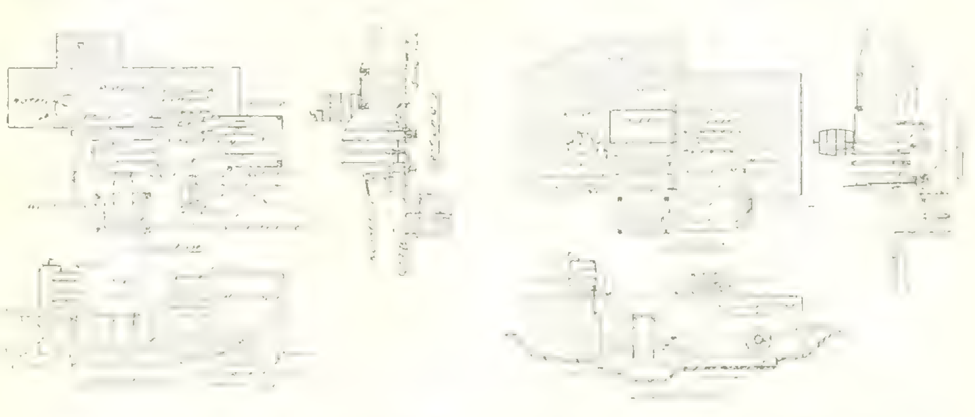
(Contributor.)

A great deal of thought and effort is being put into the manufacture of concrete mixers, but all too often the efficiency of a first-class mixer is sadly lessened by a poor plant arrangement. There seems to be a widespread belief that if a contractor gets a good mixer and plenty of men to operate it that no more is necessary on his part to insure a satisfactory job. Not enough care is taken properly to help out the mixer by a plant arrangement that shall insure a proper regulation of the raw material and a quick distribution of the finished product.

The problem of the mixer plant is peculiarly difficult because of the fact that all material must of necessity pass through the constricted area of the mixer itself. In this respect it is far different from a construction plant where steel is fabricated or stone or brick set in place. Accordingly, it is essential to economic operation that the arrangements should be the best possible.

That a proper layout will show results in dollars and cents to the contractor is clearly shown in the case illustrated by the accompanying drawings. Two plants, each having the same size and type of Ransome mixer were arranged as shown in the sketches and the saving effected by arrangement No. 2 over No 1 is so striking as to be worth an analysis. The original costs were almost the same, No. 2 exceeding No 1 by not more than $15. In the case of layout No. 1 the platform is too small. The men are in each other's way and are unable to work to advantage because of the small feed chute which is suitable only for a small mixer; the material cannot be dumped until the mixer has been discharged and then provided several barrow or cart loads are required to make up the batch, it is about 50 seconds before all the material is in the mixer. If the concrete is then discharged inside of ½ minute, it has not been properly mixed, and therefore, the best time made is about 80 seconds to the batch. The water is introduced into the mixer by means of a bucket, and therefore, an equal amount is not obtained each time, resulting in uneven concrete. The mixer and motor stand on the ground and the material and water which works under a mixer tends to rot out the skids, as it is impossible to get this out once it has gotten in. Furthermore, this waste concrete is apt to work into the boxes and rust them out so that the mixer runs harder. The accumulation of water and wet concrete results in the driving belt becoming damp and liable to come off. The distance from the mixer to the hoist bucket is so great as to require an extension chute and an extra man to attend this.

In the case of layout No. 2, the platform has been made sufficiently large so that the men have room to work with resulting quick action. An entire batch can be assembled in the large hopper while the other batch is being mixed and discharged and is fed to the mixer in 10 seconds. Thirty seconds is sufficient for mixing with this type of mixer and the 10 seconds additional required for discharging brings the total time for one batch up to 50 seconds. In this case the water is introduced into the mixer through a pipe in 10 seconds and it is a simple matter to assure each batch having the proper supply in this way. A pit is provided for receiving the material that works down around the



Figs. 1 and 2—Sketches Showing Two Arrangements of a Concrete Mixing Plant [illegible] and is washed out through a clean out [illegible] is pumped from the pit. Accordingly, the mixer is kept clean all the time and its running is much easier than in the case of layout No. 1.

It is estimated by the contractor who has had experience with both these plants, that layout No. 2 requires about 5 h. p. less to operate than No. 1. An important factor in this difference is the sliding sheave wheel used in the second layout. The stationery sheave used in arrangement No. 1 results in a cable winding up on one part of the drum with resulting friction and wear. The detailed cost figures are based on a 9-hour day and are the best 1½ days' run made by each plant, both being operated under identical conditions, hoisting to the fifth floor. The material in each case was delivered to the mixer in 5 ft. Ransome charging barrows and taken away from the hopper on the floor in two-wheel Ransome carts. The distance from the sand and stone piles to the mixer of plant No. 1 was 45 ft., but to plant No. 2 it was 120 ft. The distance wheeled on the floor was the same in both cases.

Although the values given are not average, they indicate very clearly what can be done by a proper plant arrangement. If maintained throughout the job, the average for plant No. 1 would have been 56 cts per yard and plant No. 2 42 cts, a saving of 25 per cent.

NUMBER OF MEN

		Plant	Plant
On the ground		2	1
Loading charging barrows	Sand	1	1
	Stone	4	4
Wheeling charging barrows	Sand	[illegible]	[illegible]
	Stone	[illegible]	[illegible]
	Cement	1	2
Charging mixer		2	4
Engineer		1	1
Working foreman (useful where needed)		1	0
On the floor:			
Wheeling concrete carts		4	4
Spading concrete carts		2	2
Shoveling concrete carts		2	2
Leveling concrete carts		1	1
[illegible]		1	1
Dumping hopper		1	1
Firemen		1	1
Total		28	29

*Short wheel.

COSTS.

Cost of mixing and placing concrete with Plant No. 1—9 hours work.

28 men at $1.75	$49.00
1 engineer at $2.25	2.25
1 foreman at $5.00	5.00
Cleaning up	1.75
Total	$59.00

13⅔ yds. per hour 9 hours = 123 cu. yds. = $0.463 per cu. yd.

Cost of mixing and placing concrete with Plant No. 1—4½ hours.

28 men at $1.75	$24.50
1 engineer at $2.25	1.12
1 foreman at $5.00	2.50
Cleaning up	1.50
Extra time allowed men for getting work finished in less than 5 hours	3.18
Total	$32.80

16 cu. yds. concrete per hour 4½ hours 72 cu. yds. = $0.455 per cu. yd.

Cost of mixing and placing concrete with Plant No. 2—9 hours.

25 men at $1.75	$43.75
1 engineer at $2.25	2.25
1 foreman at $3.00	3.00
1 sub-foreman at $2.00	2.00
Cleaning up	2.25
Total	$53.25

18 cu. yds. concrete per hour 9 hours 162 cu. yds. = $0.329 per cu. yd.

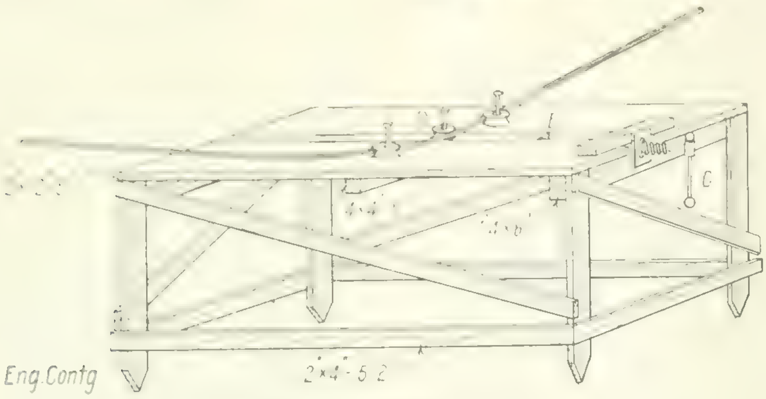
Cost of mixing and placing concrete with Plant No. 2—4½ hours.

25 men at $1.75	$21.87
1 engineer at $2.25	1.13
1 sub-foreman at $2.00	1.00
1 foreman at $3.00	1.50
Cleaning up	[illegible]
Total	$27.50

19¼ cu. yds. per hour 4½ hours 87 cu. yds. = $0.318 per cu. yd.

Miraflores Locks Flooded.—The temporary spillway, which provides an outlet for the water in the hydraulic fill of the west dam at Miraflores, Panama Canal, was undercut on May 24, an da torrent of silt and water rushed through the enlarged opening, the most of which found its way into the upper lock.

A Home Made Bench for Bending Reinforcing Bars.



Home Made Bench for Bending Reinforcing Bars.

The accompanying sketch shows a home-made bench for bending reinforcing bars which was devised by Mr. Edward O. Keater, civil engineer and contractor of Cincinnati, O. The bench proper is 30 ins. high and 5 ft. square on top and cost about $5 for labor to make, using second hand lumber. The bending device consists of two stationary sheaves and a moveable sheave *D* mounted on a sliding strip operated by a screw *C*. The bar is inserted between the sheaves as shown and a man operates the screw *C*, thus moving the sheave *D* to produce the bend. The principle of operation as will be seen is that of the familiar roller rail bender. A scale on the slide *E* indicates the travel required to produce corresponding bends. The bench as illustrated was used to bend the steel for sewers and a standpipe. It cost $1 per ton to bend ½-in. steel for an egg-shaped sewer. The sheaves used were taken from 6-in. double blocks used on the job and they were pivoted on ⅞x10-in. bolts. The stationary sheaves were spaced from 10 to 18 ins. apart; the heavier bars, ⅞-in. requiring an 18-in spacing.

Machine for Mixing and Placing Concrete by Compressed Air.

The Pneumatic Conveying Mixer, a machine which is used to mix and convey concrete through pipes to place, is being used at the La Salle St. Tunnel, Chicago, for placing the concrete in the arch of the steel tunnel tubes, which lie under the river about 30 ft. below the water level. As shown in the accompanying diagram, Fig. 1, the machine is located on the bank, and a 6-in. spiral riveted pipe leads horizontally from it to the manhole in one of the tunnel tubes, down the manhole 30 ft. and then horizontally to place in the far end of the arch, all bends in the pipe being made with not less than 5 ft. radius. As the arch is filled, the pipe is taken off in 10-ft. sections. The farthest point at which the concrete was deposited was through about 315 ft. of pipe. This work is difficult of access and would be tedious and costly by any other method.

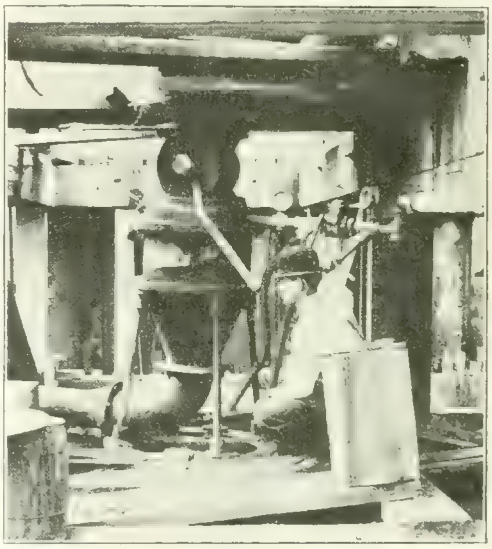


Fig. 2—View Showing "Mixer" of Compressed Air Concrete Mixing and Conveying Plant.

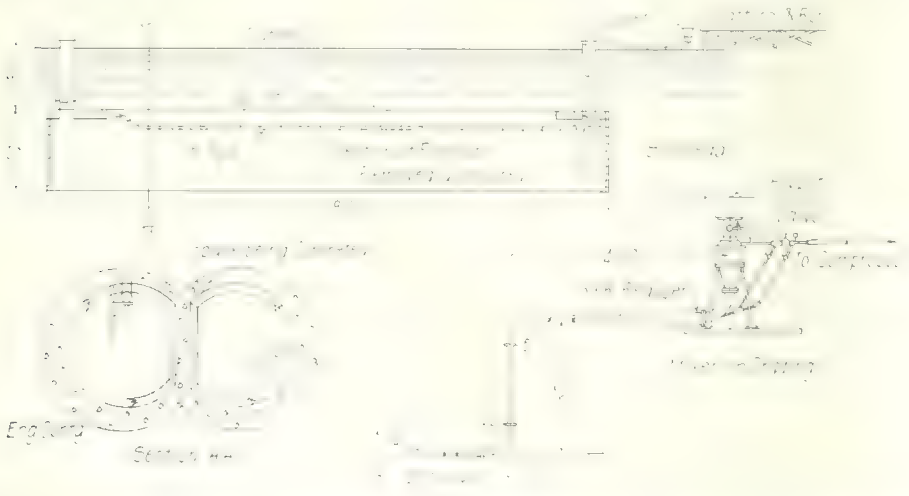


Fig. 1—Sketch Showing Arrangement of Compressed Air Concrete Mixing and Conveying Plant at the La Salle St. Tunnel, Chicago.

The mixer is shown by Fig 2. It consists of a cast iron chamber, elliptical in shape, which receives the charge from a hopper at the top. The material is let into the chamber and the hopper is closed off by an airtight valve. The chamber in this machine is of sufficient capacity for a batch of 6 cu. ft. The same machine may be fitted with a cylindrical extension for increasing the capacity of the machine up to 24 cu. ft. The bottom of the chamber tapers off to the size of the pipe. The air is let into the chamber through the two pipes shown by Fig. 2, one pipe allowing the air to rush in at the top tending to press the material downward, and the other pipe entering the chamber near the bottom introducing the same pressure at the lower point. The air entering the chamber at high velocity and at 80 or 90 lbs. pressure; produces an initial velocity in the material of 30 or 40 ft. per second. The material travels in the pipe mixed with nearly double the volume of air, which considerably reduces the frictional resistance. It is, however, the frictional resistance in the pipe which aids, it is claimed, in mixing the concrete. The theory is that the outer material is retarded by the friction against the pipe and the material in the center travels faster than that on the outside, producing a motion which may be likened to that of turning a stocking inside out. It takes from 1 to 2 seconds to empty the receiving chamber into the pipe line, and inasmuch as the materials travel with different velocities, owing to friction, and also to the difference in size, surface and specific gravities of the particles, a very good mixture is obtained. The mixture is 1:2:4 with torpedo sand and ¾-in. limestone.

The compressor for the machine on this work has a capacity of 275 cu. ft. per minute but the storage capacity is only 112 cu. ft. and necessitates a pressure of 90 lbs. per sq. in. to carry the batch across to the other side of the river, over 315 ft. The pressure in this case drops down to about 20 lbs by the time the batch is delivered and necessitates a delay in regaining sufficient air pressure for discharging the next batch. This might easily be remedied by providing a larger air reservoir, so that a lesser initial pressure would have to be used for discharging the batch. A pressure of from 40 to 60 lbs. should be sufficient to carry the batch for ordinary distances. At the La Salle Tunnel the writer timed the work and found that 2 batches were being sent 315 ft. each 5 minutes, and that when being sent about half that distance, about 4 batches were discharged in 5 minutes. At the same time it was necessary to wait for sufficient air pressure, showing that with a larger capacity for air storage more batches could be discharged in a given time. Some time was lost also in making changes at the discharge end of the pipe. At the rate observed, the machine was mixing and placing from 6 to 10 cu. yds. per hour using 8 men. Five men were employed to deliver materials into the hopper, and there was one machine man, and two men to look after the pipe. The compressor was run by a belt from a motor using city current. The cost of labor for mixing and placing concrete with these adverse conditions would therefore be about 60 cts. per cu. yd., which would cost, by any other method, considerably more.

This machine was also used at Cleveland, O., for mixing and placing concrete in the piers of the Dennison Harvard Viaduct in 1909. Here, the piers were 80 ft. high. The machine was set at the base of the piers and near a railroad track so that the material was handy for charging the machine. An 8-in. pipe was used which ran directly up to the top of the pier and into the form. The cost of mixing and placing the concrete was about 23 cts. per cu. yd. The rate per hour for common labor in Cleveland was about 20 cts. per hour, while that in Chicago for the work described about is 37½ cts. per hour.

The machine was invented and patented by Mr. J. H. McMichael and is being manufactured at the Drake Standard Machine Works, 1025 W. Jackson Boulevard, Chicago.

EARTH AND ROCK SECTION

Some Notes on Methods and Costs of Trench Excavation.*

Earth handling in engineering construction involves a number of operations. In this paper the word excavation is taken to mean the removal or digging of the soil only. Other collateral operations, such as backfilling, pumping of water, sheeting and bracing, are discussed under their respective titles.

In damp sand trenches to a depth of about 6 ft., the "bottom" man is supplemented by a "bank" man to cast the spoil back from the edge of the bank. For deeper trenches a "scaffold" man is put in at about 5 ft. below the surface, and additional ones at each 4½ to 5 ft. in depth. In pipe sewers the pipe layer excavates the final 1½ to 2 ft. and throws the spoil back on the last pipe laid.

In compact damp sand trenches, such as are found above the plane of the standing ground water or in trenches drained by well-points, the average angle of inclination of the sides of the trench has been found to be 8° 48 ft. from the vertical where skeleton sheeting and bracing is used. But these occasional braces are placed not so much from necessity of holding up the bank as a matter of safety against an accidental caving which would bury the men in the trench. Banks have been cut by scraper and stood without any bracing for 10 to 12 days at an average angle of 19° 26 ft. from the vertical.

The steepest angle measured in sand trenches were for hand work 3° 35 ft. and for scraper 8° 8 ft. from the vertical.

In the compact Indiana dune sand the slope at which standing water was found showed a rise of 6.3 ft. in 335 ft., starting at the surface of a river.

Table I gives the cost of labor of digging or excavation and depositing the earth in a spoil bank beside the trench, and does not include other trenching operations, such as pumping of ground water and sheeting and bracing.

The quantity dug per man is based on the total number of men in the digging gang, including scaffold men and bank men.

Machines for Trench Work.—One class of excavating machines for trench work does not eliminate hang-digging, but does away with scaffold and bank men and backfilling labor. Such are the Carson trench machine, Carson Lidgerwood cableway, Moore trench machine and Moore surface trench and pipe laying machine. In all of these machines the trench men dig by hand and fill buckets which are transported back of the masonry or pipe-work of the sewer, and backfill at once by dumping in the trench. All of these machines are useful, and are conducive to rapid work. For general trench work the cableway is superior to the other machines, especially where the work crosses street car tracks. The expense of the machine including thereby the items of depreciation, repairs and operation are usually far below the cost of scaffold and bank men and backfilling which the machine displaces. The other class of machines used by the writer are machines doing away with hand-digging, such as orange-peel derricks, steam shovels and the Austin trench machine.

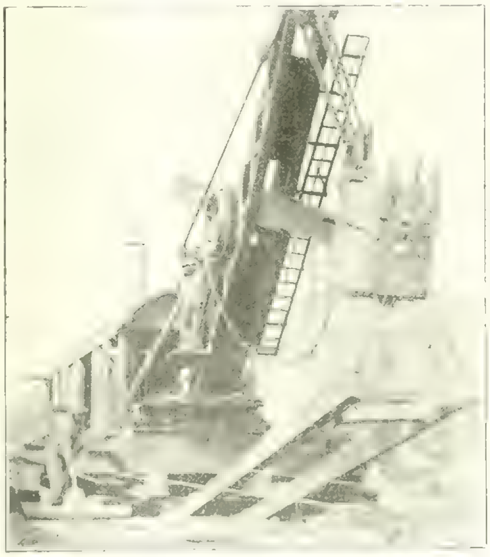


Fig. 1—Moving Steel Walings Used in Steam Shovel Trench Work.

Steam Shovel Work.—For trenching in clay a steam shovel is an economical and rapid working machine. For such work it is carried on heavy timbers on 8 ins.x4 ft. hard maple rollers over the trench. The railway trucks are taken off while the shovel is working.

The trench must be sheeted and braced except in the short space where the dipper is working. The bracing gang have at hand necessary sheeting and bracing, and are also busy in shaping up the bottom to fit the contour of the masonry. As soon as the dipper enters the trench for its last stroke a whistle is sounded and the bracers hold themselves in readiness to act. When the upward stroke of the shovel is half completed, the men spring into the section of 10 to 12 ft. of trench and quickly place a couple of pairs of stringers and braces, behind which sheeting is lowered into place by men on the banks. This work calls for great speed, as sometimes a fraction of a minute is sufficient time for a cave-in of the unbraced trench sides.

In some cases the trench is braced, in the portion being excavated, by two stiff steel beams with a cross brace at each end. The rear end of these beams is carried by chains hung from the frame of the shovel, and the forward end rests on the ground. These beams are used at a depth of 2 ft. or so below the ground surface. In moving these beams ahead the forward chain attached to them is caught over the dipper and pulled ahead by a forward stroke of the dipper. See Fig. 1. In sandy soil sheeting must be driven ahead of the shovel.

The shovel roughly shapes the bottom of the trench, and the work is completed by a small gang of men working under the body of the machine. They cast the earth ahead so as to enable the shovel to remove it.

In heavy work, and for trenches which are not too wide to be spanned by the frame carrying the machine, the shovel is unsurpassed for speed of work. A depth of 22 ft. has been dug in this way.

In New Orleans, using a half-yard dipper 25-ton steam shovel over a trench 14 ft. wide and 12 ft. deep, 855 lin. ft. of trench, or 5,320 cu. yds. of earth, were dug in 55 hrs. of work. The soil was alluvial river mud in an old partly drained cypress swamp, consisting of ¼ cypress roots and stumps. The sheeting for the trench sides had been driven ahead of the shovel and the bracing was carried on simultaneously with the digging of the trench. As the sheeting and bracing were a part of the permanent construction of the canal, a temporary set of stringers and braces was used for the operation of the shovel. The labor-cost of this trenching, including the bracing, was $0.08 per cu. yd. To this expense should be added the expense of moving the shovel on and off the job, which amounted to $0.04 additional, making the total cost equal to 12 cts. per cu. yd.

The cost of moving a shovel under its own steam on rails from a railroad-siding to the site of the work in Chicago, for a haul of something over a mile, was at the rate of $0.06½ per lin. ft.

In New Orleans a 25-ton shovel was moved 13,000 ft. at the rate of 260 ft. per hour. The work required 5 days time, as follows:

Removing and resetting track	$100.00
Labor, teams, coal and water	1[illegible].00
Cutting trolley wires and [illegible]	[illegible]5.00
Total	$350.00
Cost per lin. ft. to move	.02¾

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*From a paper by Victor Windett presented before the Western Society of Engineers, June 7, 1911.

TABLE I—COST OF EXCAVATION LABOR

[illegible]	Kind of [illegible]	Average depth, ft.	[illegible]	[illegible] wage	Cost per lin. ft.	Hand labor per cu. yd.	Total labor per cu. yd.	Total labor and materials, per cu. yd.
[illegible]	Hand¹	2.5	...	$0.23	$0.125	$0.27	$0.27	...
[illegible]	None	[illegible]	12.5	0.19	0.56	0.14	0.14	$0.15
[illegible]	None	5.4	15.3	0.22	0.076	0.13	0.13	...
[illegible]	None	6.2	[illegible]	0.36	0.173	0.37	0.37	...
[illegible]	None	5.0	[illegible]	0.22	0.106	0.12	0.12	...
12	None	[illegible]	9.3	0.23	0.31	0.16	0.16	...
12	T. P.	7.8	[illegible]	0.23	0.26	0.34	0.34	...
12	T. P.	10.0	4.0	0.225	0.53	0.50	0.50	...
[illegible]	Points	10.0	8.3	0.269	0.38	0.30	0.30	...
[illegible]	Points	6.7	11.2	0.282	0.204	0.25	0.25	
12	Points	[illegible]	11.9	0.265	0.22	0.25	0.25	
15	Points	9.0	9.0	[illegible]	0.32	0.28	0.28	
18	T. P.	9.1	7.6	0.268	1.10	0.37	0.37	0.39
18	Points	10.4	5.7	0.290	0.447	0.35	0.35	0.37
[illegible]	T. P.²	15.0	2.9	0.200	1.300	0.61	0.25	...
24	T. P	6.4	3.4	0.207	0.55	0.55	0.55	....
24	T. P.	8.3	4.2	0.210	1.01	0.44	0.44	...
24	T. P.	14.7	2.7	0.214	1.66	0.72	0.49	
24	Points	9.8	6.7	0.272	0.59	0.34	0.34	0.36
30	T. P.	4.8	2.4	0.261	1.84	0.98	0.48	
[illegible]	T. P.	6.0	7.2	0.217	0.81	0.27	0.24	0.30
36	T. P.	7.1	4.4	0.238	0.73	0.54	...	[illegible]
36	T. P.	9.0	[illegible]	0.210	1.05	0.76		...
36	Points	11.4	[illegible]	0.270	1.28	0.65	0.52	0.64
42	T. P.	12.0	[illegible]	0.27	1.68	0.42	0.61	...
42	T. P.	17.2	6.5	0.227	0.74	0.32	1.23	
48	T. P.	14.0	4.3	0.246	1.04	0.52	0.30	
[illegible]	T. P	12.7	4.3	0.290	1.19	0.19	0.43	
[illegible]	T. P	19.4	1.9	0.235	3.24	1.11	0.34	...
54	T. P.	21.9	3.1	0.247	2.15	0.71	0.20	...
[illegible]	None³	12.2	4.3	0.413	0.363	0.86	0.10	...
60	T. P.	16.7	3.7	0.21	2.79	0.50	0.29	...
60	T. P.	19.3	2.8	0.18	2.18	0.55	0.33	...
[illegible]	None³	13.7	2.8	0.41	0.55	...	0.117	.....
66	None³	16.7	3.1	0.44	0.71	1.29	0.127	.....
[illegible]	T. P	12.8	4.1	0.26	1.53	0.43	0.23	.....
[illegible]	T. P	15.2	3.4	0.21	2.14	0.55	0.30	...
72	T. P.	16.0	3.1	0.277	2.42	0.75	0.17	...
72	T. P.	19.7		0.26	3.04	0.30	0.47	
48	None	4.0	2.0	0.406		0.78	0.78	
48	None³	[illegible]				...	...	0.274

All soil was sand except ¹wet clay, ²muck and ³sand clay. Last two items are for work with Austin machine.

A team was used to drag, ahead into position for use again, the pieces of track over which the shovel had moved.

Kearns' Derrick.—Another machine which the author has used with success is a traveling swinging derrick, known as the Kearns swinging derrick, operating an orange-peel bucket. This machine moves on solid ground ahead of the trench. With a ¾ yd. bucket, operated by a power swinging 56 ft. boom. The best day's work done was 920 cu. yds. excavated in 10 hrs. This was in a trench sheeted by pile driving ahead of the digging. The braces were placed 8 ft. centers, as the depth of the digging required, in a trench 14 ft. wide by 12 ft. deep. The spoil in part was loaded on 3-yard cars and in part dumped on the ground 50 ft. away. The soil was alluvial river deposit.

In excavating for the Plaquemine, La., lock approach there was used a 3 cu. yd. orange-peel bucket hung from a boom 85 ft. long and loading on flat cars on a trestle 20 ft. above the working level. This boom was swung by gravity. The earth was wet Mississippi river alluvium. This bucket was changed in favor of a 2 cu. yd. bucket because the larger bucket overloaded the machine. The 3 cu. yd. bucket would, at times, take loads of approximately 4½ cu. yds. heaped up over the bull wheel, which strained the timber framework.

The digger discharged its load onto flat cars on a trestle adjacent to the work. The average haul for a loaded train was approximately 400 ft. Two light engines would handle 3 cars. Unloading was done by a Lidgerwood plow working between stakes on the sides of the car. The 3 cu. yd. bucket would place a load on the cars in 55 seconds. With delays due to all causes the average output of the machine was 1,320 cu. yds. in a day of 10 hours. The labor cost was $0.19 per cu. yd. of earth dug, including operating, maintenance, transportation of spoil and unloading. The maintenance of the trestle was a considerable item.

For trench work a ¾ cu. yd. orange-peel bucket is about as large as can be economically used, because a larger bucket requires too much room, and would also require the bracing to be spaced farther apart than 8 ft. centers; this would necessitate timbers too heavy to be handled easily by the trenching gang.

Austin Machine.—An Austin trench excavation was used at Clearing, Ill., in a clay soil for a 4 ft. width of trench. This machine runs on broad wheels ahead of the trench. It cuts and excavates by small plows fastened on bars, the ends of which are carried by link belt chains running over sprocket wheels. These plows carry the earth up a slide and discharge it on a belt conveyor which deposits the earth in a spoil bank parallel to the trench. A certain amount of the spoil falls back into the trench so that it was found necessary to dig some 6 ins. deeper than the depth required for the sewer. The quantity of earth excavated, as claimed by the operator in his reports to his company, exceeded the net quantity actually required by 5 per cent. The quantities of excavation given below are *net* quantities corresponding to the depth of the masonry.

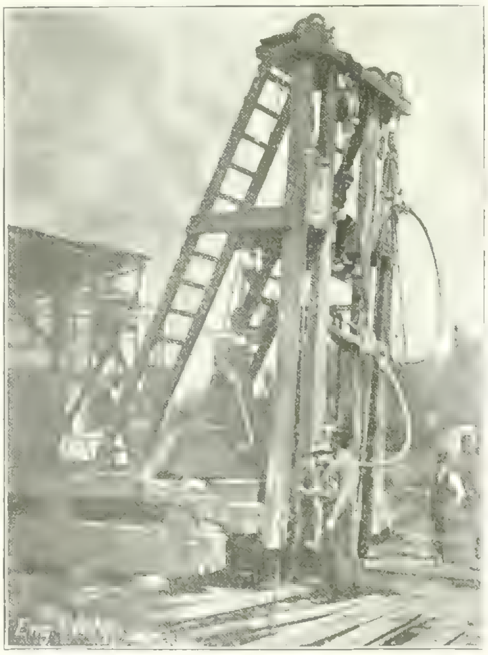


Fig. 2—Sheet Pile Driver With Double Leads for Trench Work.

Size of trench, 8 ft. 5 in. deep, 4 ft. wide, 2,974 ft. long.
Volume of excavation, 3,745 cu. yds
Time of digging, 72 hrs. 30 min.
Delays chargeable to machine, 39 hrs. 0 mins.
Delays chargeable to contractor, 42 hrs. 40 mins.
Total time of work, 154 hrs. 10 mins.
Time of excavation, per day, 9 hrs.
Rate of digging time, 372 lin. ft., or 468 cu. yds.
Rate of total time, 173 lin. ft., or 230 cu. yds.
Max. day's work, including 1 hr. 20 min. delay, 455 lin. ft., or 549 cu. yds.

The delays chargeable to the machine include all mechanical delays, shifting dead men, caving of bank onto gutter, etc. The delays chargeable to the contractor were those incidental to sheeting and bracing of the trench, and inability of the bricklayers working in so narrow a trench to work fast enough to keep up with the machine.

This machine required the following force of men: One operator at $5 per day, 1 engineer and fireman, $3.50; 1 team for coal and water, $5.50 per day; 4 laborers for runways and placing dead men logs at $2.50 each. The rental was $10 per day, together with a charge of 10 cts. per cu. yd. of earth dug. About ½ ton of coal per day was burned. This daily expense was equal to $0.274 per cu. yd. of effective depth of the trench.

Hand Work.—Usually in hand-excavated trenches, scaffold and bank men are needed only for a depth greater than that from which the bottom man can throw earth onto the surface at a convenient distance from the trench. Hence the output per man of the excavating force decreases as the depth of the digging increases, on account of the additional men engaged in rehandling the earth passed up on to scaffolds.

Trenches in sand of a considerable depth dug by slip scrapers, an orange-peel or drag scraper are usually widened to such an extent that the earth dug in the final hand bottoming can be cast up from the sheeted lower part of the trench in to the wider part thus provided, thereby saving additional bank men, which otherwise would be needed to cast this spoil above the original surface of the ground. The following is given as an example of very cheap hand labor, and a large output of work per man:

EXCAVATION OF A SHALLOW DRY (MERELY DAMP) SAND TRENCH.

Time, November, 1909.
Place, Buffalo Ave., S. of 124th St., Hegewisch, Ill.
Length, 275 ft.; Depth, 5 ft.; Width, 4 ft. 6 in.; 229.3 cu. yds.
Labor:

	Hrs.	Cost	Per hr.	Per cu. yd.
Trenchmen ...	107	$23.55	$0.22	$0.0994
Bankmen	27	5.40	0.20	0.0227
Total men....	134	28.95	0.216	0.1221

Each trenchman, per 9 hr. day, 20 cu. yds.

Slag Excavation.—Blast furnace slag in a liquid state is usually poured from ladles and forms a bank of solid hard stratified rock. The strata vary in thickness, usually up to 4 to 6 ins. or more. The bond between the strata is not strong. But on account of the irregularity of lines of fracture and its sharp angularity when broken by the action of picks, bars or wedges it is an exceedingly difficult and tenacious material to excavate by hand labor or by steam shovel. Four cases of slag excavation are given in Table II, as lettered. *A. B. C, D.*

Case *A.* The slag was cast up on the brim of the trench by the men who dug it. This was hard slag in a solid mass.

Case *B.* About half of the slag was cast

TABLE II.—BLAST FURNACE SLAG EXCAVATION.

	A.	B.	C.	D.
Kind of Slag.	Hard.	Hard.	Loose.	Loose.
[illegible]	2.9	13.	[illegible]	[illegible]
Length, ft..........		70.	60	
[illegible]	11.	13.	12	[illegible]
[illegible]	3.6	1.8	1.8	4.1
Rate per hr., cts...	15	[illegible]	12.5	12.5
Cost per cu. yd., cts	36.7	8.94	59.6	27.4
[illegible] hr.	25	25	[illegible]	25
[illegible]	61	[illegible]	19	55

up in a spoil bank by scaffold men and bank men, and about half (the lower portion) was loaded by the diggers into 1 cu. yd. buckets and emptied into cars by a locomotive crane. The spoil bank of the first portion of the digging was rehandled in part and loaded on to cars also. This slag was a solid mass of hard slag.

Case *C*. The mass excavated consisted of broken rubble masonry, loose slag, earth, brick and debris.

Case *D*. Loose slag, earth and a small amount of solid hard slag.

In Table II the cost of excavation has been recalculated on a basis of $0.25 wages per man per hour to make the expense comparable with the work in sand and clay of the other tables.

Summary.—In Table III are presented figures for excavation, being a summary of the preceding discussion. The writer would express his preference for sufficiently elaborated and numerous statements of individual prices of work rather than for average figures. The day's work is taken as 9 hrs., except for slip scrapers in which case 10 hrs. constituted a day's work.

Trenching in Gumbo.—In New Orleans the soil is alluvial. Near the Mississippi river it is quite sandy. That is, grains of exceedingly fine sand are intimately mixed with the usual constituents of soil which make a light earth easily dug. Further back from the river it takes on a more clayey character, making a dense, sticky, tough, elastic earth called *gumbo*. The gumbo earth is made more difficult of excavation by being saturated with water and the presence of cypress roots, stumps and logs in great quantities. Stumps many feet in diameter have been cut out of trench, sometimes only to find another equally as large immediately below it. In Table IV costs of labor in New Orleans are given, based on the excavation of upwards of 100,000 cu. yds. of earth. The laborers were negroes, whose rate of pay per hour in the light trenches varied from $0.175 to $0.20, and in the deep trenches from $0.20 to $0.27½. Pumping was done by gasoline-driven centrifugal pumps and by hand pumps.

SHEETING AND BRACING.

Sheeting a trench by hand is best done by using sheeting 2 ins. thick, 8 to 10 ins. in width and 12 or 14 ft. long. Larger sizes are inconveniently heavy and hard to handle. The upper end is trimmed to 6 ins. width to admit of using a cast steel or wrought iron cap to protect the end of the sheeting when being driven. The lower end is sharpened like a chisel with the bevel towards the center of the trench.

Mauls for hand driving are made of live oak, hickory or iron wood, with hickory handles. The striking face of the maul is 5 ins. in diameter and at the eye for the handle the diameter is 6 ins. to 7 ins. Wrought iron rings ⅜x1½ ins. are driven on the ends and fastened by oak wedges or ¼-in. boat spikes.

In sand trenches, sheeting should always be driven by means of a water jet to assist the maulers. The economy in labor and lumber is so great as to make this imperative, when it is possible to use it. Water pressure should be about 100 lbs. per sq. in. The point of the jet should be ¾-in. diameter.

The jet pump is advantageously placed a day's work ahead of the sheeting, and a pipe run along the trench from the end of which are run two lines of hose to operate a jet for each side of the trench.

The sheeting gang consists of a bottom man to guide the sheeting and three maulers. Ahead of them two men jet and place sheeting, assisted by a team and attendants to carry sheeting ahead [illegible] it is pulled from position behind the masonry.

For steam-shovel work, as at Hegewisch, in sand a light pile-driver was used with two hammers of 1,200 lbs. each. The sheeting used was triple lap. The center piece was 2x10 ins.x14 ft., with two 1x4 in.x12 ft. side pieces, made up for a 2-in. tongue and groove. In a 9 hr. day 240 pieces of sheeting could be driven easily.

The sheeting was pulled, after the trench was partly backfilled by a double drum, double cylinder, engine on a platform somewhat similar to the pile driver but substituting a hinged *A* frame for the leads. A ½-in. chain and ⅝-in cable were used for the line. This machine would pull sheeting for 100 ft. of trench in a couple of hours. The crew consisted of an engineer, winchman, hooker-on and sheeting-catcher to land the sheeting on the bank within reach of a team.

The wear and tear on the sheeting was very small, as far as the 2x10-in. pieces were concerned. They were used nine times over and then made into bottoms for catch basins. The 1x4-in. strips required quite frequent renewal. Possibly it might have been cheaper to use 2-in. lumber instead. This sheeting cost for labor as follows:

Triple Lap—Middle piece 2 ins. by 12 ins.—14 ft.
[illegible]
Side pieces [illegible]
732 pieces—34.5 ft. B. M. each.
Labor, making up (including pointing and heading to top width of 8 ins.).
[illegible]
hour.
[illegible]
M.
0.3 hr.—$0 093 each.

The stringers used were generally 3x12-in. or 4x12 in. and 16 ft. in length of long leaf yellow pine.

Braces were generally 6x6 in. yellow pine. In Gary, where the country was covered by a growth of various oaks, mainly small trees, many braces were cut from the standing timber. These braces were usually 3 to 5 ins. in diameter. Dunn trench screws are highly advantageous on account of ease of placing and removing the braces and of keeping them tight.

For pipe sewers in the case of pumping by well-points, it is not necessary to place the sheeting closer than 3 or 4 ft. apart and then not within a foot or two of the trench bottom. In fact, it is used as a safeguard to protect the pipe layers against possible caving of the bank, rather than from necessity to maintain the trench sides.

In similar cases for brick sewers where the trench is open longer, the same measure of safety can be secured by giving the trench sides an easier slope together with skeleton sheeting.

Stringers of 4x10 in., 6x8 in. and 8x8 in. are advantageously used, the length of which should be 16 ft. Braces of 6x8 in. and 8x8 in. are heavy enough when put 5 ft. 4 in. centers, or three to a stringer length, for depths up to 12 ft. and a width of 12 ft. The calculation of the size necessary is so simple an operation that it should always be done as a guide or check upon the practical judgment of the trench foreman. In alluvial soil 2x12 in. 14 ft. and 3x12 in. 24 ft. sheeting was driven by a 2,000 lb. drop-hammer pile-driver. No difficulty was experienced in sheeting 150 ft. of trench per day. The lumber was delivered along the line of the trench by teams. The pile-driver crew consisted of nine men

TABLE IV.—EXCAVATION LABOR—NEW ORLEANS AND LOCALITY.

Kind of Work	Depth, in ft.	Day's work per man, cu. yds., or per machine	Rate of pay per hour	Soil	Rank	Cost per cu. yd.
Hand	7.8	4.2	$0.175	a	[illegible]	$0.277
Hand	7.7	10.8	0.175	b	1	0.145
Hand	9.0	[illegible]	0.175	[illegible]	[illegible]	0.255
Hand	11.0	3.7	0.175	a	4	[illegible]
Carson trench mach.	8.0				[illegible]	0.44
Carson trench mach.	18.0				[illegible]	1.073
Carson Lidgerwood cableway	18-2[illegible]				[illegible]	[illegible]
Moore trench mach.	15-20			[illegible]	8	0.461
Moore pipe laying mach.	9			b	9	0.392
Steam shovel	12.0	887		a	1	[illegible]
Orange peel	[illegible]	[illegible]		b	12	0.19

a, sandy; b, gumbo.

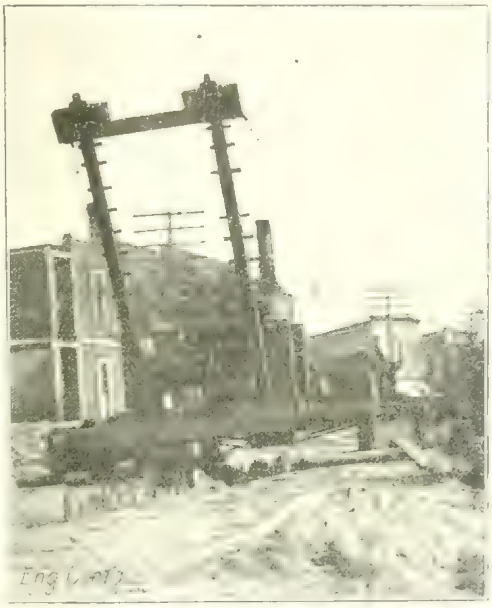


Fig. 3—Machine for Pulling Double Row of Sheeting.

TABLE I.—EXCAVATION COSTS VICINITY OF CHICAGO.

Kind of Work	[illegible]	Soil	Depth, in ft.	[illegible]	[illegible]	[illegible]	[illegible]
Hand		a	5.0			$0.122	[illegible]
Hand		[illegible]	7.0	13.2	0.182	0.184	Av.
Hand	[illegible]	a	[illegible]		0.273		Av.
Hand	[illegible]	a	9.0	4.53		0.553	Av.
Hand	[illegible]	[illegible]	[illegible]			[illegible]	Av.
Hand	[illegible]	b	[illegible]		0.23	0.27	Av.
Hand		b	11.7	[illegible]	0.42	[illegible]	Av.
Hand			[illegible]		0.17	0.29	Av.
Hand		[illegible]	[illegible]		0.175	[illegible]	Av.
Hand			[illegible]			[illegible]	[illegible]
Hand		[illegible]	11.0	3.7		[illegible]	1 case
Slip scraper		[illegible]	[illegible]	39.5		0.14	Av.
Orange peel	....	a	24.0			0.104	Av.
Orange peel	....	[illegible]	[illegible]			0.060	1 case
Steam shovel	....		11.0	918.0		0.035	1 case
Steam shovel	....		10.0			0.325	1 case
Steam shovel	....	b	[illegible]			0.068	1 case
Austin mach.	....	[illegible]	[illegible]			0.274	1 case

a, sand; b, clay; c, alluvium.

[illegible] trench sheeting is as follows:

[illegible]

[illegible]

[illegible] by hand labor, teams with scrapers and with plows, by steam shovels and by orange-peel derricks. In the case of narrow trenches such as are dug [illegible] hand work is cheapest. Men engaged in backfilling can do so within throwing distance of the trench or not over a step or two away. Thus their whole time and energy can be devoted to useful work. Teams necessarily lose much time in going to and from making turns at the ends of each trip. Hand work is easy also as the earth is in a loose and friable condition, suitable for shoveling.

A comparison between these two methods is made in Table V, under similar conditions of soil, size of trench, and weather, showing the economy of hand work.

TABLE V.—BACKFILLING OF SAND TRENCHES (NARROW TRENCHES) LABOR.

How Filled.	By Hand.	By Scraper.
[illegible]	12-15-18	
Length of trench, ft.	1,712	871
Width of trench, ft.	..	3.0- 3.5
Depth of trench, ft.		6.0-10.0
[illegible]	1,447	751
Volume of backfill per lin. ft., [illegible]	[illegible]	0.86
[illegible]	[illegible]	[illegible]
Cost of work	$121.41	$103.00
[illegible]	[illegible]	[illegible]
[illegible]	0.084	0.137
Cost per lin. ft. of trench	0.071	0.118
[illegible]		*$0.047

[illegible] Hegeswisch, 1909.
Soil, streets, weather and other conditions alike spoil leveled on the street.

*Or 66.1%.

A general average of all the work, large and small trenches included, showed the following costs per cubic yard:

[illegible]	[illegible]
Steam shovel and orange-peel bucket labor	0.078
[illegible]	[illegible]

In Table VI backfilling costs per lin. ft. of trench are given. In all of the cases the backfilling was loosely done, and the excess earth either left in place or spread over the ground surface except in the instances given for New Orleans in the last three items. In these cases where the work was in narrow paved business streets the trenches were carefully tamped as backfilling proceeded.

TABLE VI.—BACKFILL LABOR—CHICAGO.

Diameter of Sewer.	Soil.	Trench Depth Ft.	Rate of Pay.	Labor Cost Per Lin. Ft. Hours	Labor Cost Per Lin. Ft. Cost.
10 in.	Sand	[illegible]		0.16	0.03
12 in.	Sand	[illegible]		0.31	0.09
15 in.	Sand	[illegible]		0.31	0.08
18 in.	Sand	10.0		0.26	[illegible]
20 in.	Sand	15.0		1.00	[illegible]
24 in.	Sand	10.5		0.46	0.13
30 in.	Sand	13.6		1.35	0.27
36 in.	Sand	[illegible]		0.50	0.11
42 in.	Sand	[illegible]		[illegible]	0.21
48 in.	Sand	14.3		[illegible]	[illegible]
54 in.	Sand	[illegible]		1.00	0.31
57 in.	Clay	[illegible]		[illegible]	[illegible]
60 in.	Clay	14.0		1.74	0.50
63 in.	Clay	13.7		0.50	0.20
66 in.	Clay	16.7		0.87	0.33
72 in.	Sand	15.1		0.86	[illegible]
		NEW ORLEANS.			
6 in.	Alluvium	6.0	$0.175	[illegible]	0.07
[illegible]	Alluvium	[illegible]		0.4	[illegible]
8 in.	Alluvium	10.0		1.0	[illegible]
10 in.	Alluvium	[illegible]		1.3	[illegible]
15 in.	Alluvium	8.0		1.7	[illegible]

Backfilling of large trenches, especially in heavy soils such as clay, is done cheaper by a light steam shovel. Many such jobs will [illegible] for this work in addition to the machine used for digging.

[illegible]

Pumping ground-water from sand trenches will prove to be an expensive operation if ample preparations of thoroughly efficient apparatus is not made and kept ready for use as soon as needed. In trench work there is probably no way in which the expense can be run up so fast as trying to excavate, and lay brick or concrete with an inadequate or insufficient disposal of trench water.

Hand pumping is usually done by means of diaphragm pumps. In order to pump rapidly, such a pump usually takes three men to man it effectively. There are on the market now combinations of the diaphragm pump fitted to a small gasoline engine. These arrangements are so light, cheap, and economical in operation that there is little excuse for continuing the practice of hand pumping.

Probably the most usual way of pumping is to pump the water from the trench where it accumulates to a depth sufficient to keep the suction end of the supply hose covered, or runs to a sump in sufficient quantity to prevent the in-flow of air in the suction pipe. The best method of operation is as follows:

TABLE VII TRENCHING LABOR COST VICINITY OF CHICAGO.

Size of Sewer, Ins.	Pumping	Depth.	Rate of Wages.	Cost Per Cu. Yd.		Cost Per Lin. Ft.	
				Hours	Cost.	Hours	Cost.
6	....	5.0	$0.237	0.9	$0.20	0.34	$0.08
8	....	5.7	0.330	1.0	0.34	0.4	0.14
10	....	7.0	0.25	1.2	0.37	0.8	0.21
12	Points	7.0	0.27	2.6	0.71	2.1	0.57
12	Points	10.0	0.27	2.1	0.56	2.6	0.65
12	Points	11.0	0.25	2.6	0.64	3.1	0.77
12	....	7.0	0.27	2.0	0.57	1.5	0.32
12	....	10.5	0.30	0.8	0.22	1.5	*0.44
15	Points	9.0	0.27	2.1	0.57	2.6	0.65
18	Points	10.4	0.28	2.4	0.70	3.0	0.87
18	T. P..	10.0	0.29	2.1	0.81	3.8	1.21
18		[illegible]	[illegible]	[illegible]	0.59	[illegible]	[illegible]
24	T. P..	7.0	0.25	3.6	0.88	4.3	1.08
24	T. P..	10.0	0.26	2.5	0.70	4.5	1.23
24	T. P..	12.0	0.28	2.2	0.63	8.0	2.03
24	....	12.0	0.35	1.7	0.59	2.5	0.90
24	T. P..	15.0	0.24	3.2	0.78	10.8	2.60
30	T. P..	11.0	0.26	2.0	0.52	7.1	1.88
30	T. P..	15.0	0.26	3.2	0.83	12.3	3.20
36	T. P..	3.6	0.30	5.3	1.55	3.8	1.10
36	T. P..	7.5	0.24	3.0	0.71	5.9	1.43
36	T. P..	9.0	0.26	3.3	0.73	8.2	2.25
36	T. P..	11.4	0.36	2.6	0.93	6.6	2.32
36	Points	11.0	0.30	1.8	0.51	4.8	1.43
36	....	7.0	0.38	1.4	0.51	2.0	0.77
42	T. P..	14.6	0.30	2.1	0.63	7.8	2.28
48	T. P..	14.0	0.26	2.0	0.52	10.0	2.63
54	T. P..	12.0	0.26	6.7	1.69	21.5	†5.47
54	T. P..	12.7	0.37	2.1	0.81	6.0	‡2.23
54	T. P..	20.6	0.26	1.6	0.40	16.0	‡4.08
57	....	12.2	0.34	0.7	0.23	2.4	‡0.81
60	T. P..	18.0	0.26	2.0	0.50	14.5	3.70
63	....	13.7	0.36	0.7	0.23	3.0	1.08
66	....	16.7	0.38	0.8	0.28	3.9	1.35
			NEW ORLEANS				
8	....	7.5	0.175	2.7	0.40	1.1	0.17
8	....	8.3	0.175	4.5	0.71	2.3	0.33
10	....	8.0	0.175	6.0	0.80	2.9	0.36
10	....	8.0	0.175	3.4	0.50	1.5	0.22
10	....	10.0	0.175	4.6	0.69	3.1	0.47
12	....	9.0	0.175	4.1	0.62	2.5	0.38
12	....	9.0	0.175	2.2	0.32	3.9	0.58
15	....	9.0	0.175	5.1	0.82	3.5	0.56
18	....	12.0	0.175	5.5	0.83	5.7	0.86
18	....	13.0	0.175	3.6	0.53	4.8	0.73
22	....	6.0	0.175	3.3	0.49	2.6	0.38
22	....	12.0	.....	2.2	0.82	3.9	0.58

*Scraper work. †Work under R. R. tracks. ‡Steam shovel work. T. P.=Trench pumping.

The trench is dug to a depth of a foot or more below the water-surface, when the sheeting gang place the sheeting ready for driving. Behind this gang follows the driving gang, using the water-jet process when possible. Excavation is in progress all along by means of leaving an opening in the sheeting by using a short sheeting for each scaffold sand-thrower.

Where the sheeting is fully driven, a bag dam is placed high enough to keep water in this section deep enough for the pump, supplying the jets for driving the sheeting. The excess water flows over the dam into the next section. Here is placed a pump with preferably a 4 in. suction hose fitted with a strainer and foot valve on the lower end. At the lower end of this section is another bag dam. Excavation is in progress in this section. Back of this bag dam is a section which is being lowered to the final grade for the masonry. This section is usually 5 or 8 ft. longer than the length of work to be built by the masons, so as to leave room for bailing water over the dam ahead for the steam pump to handle.

Water is prevented from following the bricklayers by a bag dam in the last masonry invert completed.

At night time the dams are all lowered or removed, except one a few feet in front of the masonry to catch the sand brought down by the water, and the water is allowed to run down the sewer to the outfall.

One piece of work of a 3 ft. brick sewer built at Pine, Indiana, ran for 4,000 ft. across at right angles to a series of ridges and sloughs. The standing water in these hollows was 2 ft. to 5 ft. deep and stretched for a length of half a mile on each side of the sewer. In addition to handling the water by the method described above, a pioneer body of laborers kept ahead of the trench men throwing up levees across the sloughs, between which the ordinary operations of trenching were conducted. The contract price for this work was exceedingly low, yet a profit was made on the work, despite the extraordinary conditions under which the work was built.

Where the water pumped cannot be discharged at a considerable distance away from the trench by ditches in the ground and when the water is clean enough, it is often possible to carry it back in section box flumes or pipes to the last manhole built, and thus let run down the sewer.

This method of pumping involves the necessity of every one working in water from 3 or 4 in. up to 12 or 15 in. in depth. The consequence is a diminished rate of excavation and increased cost of construction.

Where possible to do so, the most satisfactory method of handling water is to pump it before it enters the trench. In sandy soil this is done by using the *well-point* pumping system. Well-points of 1¼ in. to 1½ in. pipe, with screened inlet opening in the lower 2 ft. of the pipe, are driven or *jetted,* so as to draw water from a level below the trench bottom. The customary spacing of the points along each side of the trench is 3 ft. apart. In coarse sand or in gravel a double line of points may be necessary. A satisfactory length of such a system is 300 ft.

At Hegewisch a 12 in. sewer was laid for 1,300 ft. at a depth of 7 ft. to 8 ft. in a street running along a piece of marsh land where 20 in. of standing water lay on the ground, and within 6 to 10 ft. of the trench. The *point* system kept the water out of the trench satisfactorily.

For small independent pieces of work, like building detached catch basins, half a dozen points can be operated by piping to a hand diaphragm pump.

The expedient of laying a sub-drain under the main sewer, so as to drain a wet trench, is an expensive and slow procedure. The chief difficulties are the choking and filling up of the sub-drain with sand through the joints. The delay required for laying the drain in a wet trench is dangerous, as the running water will carry sand with it, raising the level of the trench center, endangering the sheeting, and necessitating constant removal of the inflowing sand.

In using *points* it is best to draw the water from such a depth that there may be no danger of its rising between the lines of points in the center of the trench. Another advantage of deep pumping is that the possibility of sucking air through the drained-out sand is diminished. The use of points requires constant care and watchfulness to secure perfectly tight joints. Should the pump lose its suction through leaking joints, the results are apt to be disastrous and dangerous. In such cases the water rises rapidly and, entering the trench from the bottom and sides, causes caving banks, so rapidly sometimes, that the men have difficulty in escaping.

Clay soils are more or less impervious to water. In trenches dug in such soil the open-trench method of pumping direct from the trench bottom is thoroughly practicable practice. The quantity of water being so much less than in sandy soils, makes the problem a lesser one. The matter of moment is the prompt and thorough bracing of the trench, as a wet clay bank is treacherous.

As to the kind of machines to be used, the writer has used centrifugal pumps, duplex reciprocating pumps, the pulsometer type of pumps, and triplex plunger pumps with steam, gasoline and electric power. They are all serviceable machines. The most reliable and confidence-inspiring pumps are the centrifugal and the reciprocating pumps. The latter is positive in its action, every movement being due to a piston always under direct, constant steam pressure. Cleaning out chips, grass, or pebbles from the water end of such a pump is an item of small moment and quickly done. Another advantage is that if the pump happens to be large for the work at any time, it can be run at a speed commensurate with the in-flow of water

In sandy trenches, when pumping from the trench, the inflowing water generally carries, through sheeting cracks, a large quantity of sand. In such cases this is overcome by caulking the cracks with grass or old spoiled hay, which can be quite cheaply procured. In the Indiana contracts included in the paper, a man was employed steadily in cutting grass on the adjacent land. At Hegewisch fresh-cut grass cost $5.00 per ton load, delivered on the work.

Portable boilers are so much more easily moved from place to place along a trench as to leave no choice between them and any other style of boiler for trench work.

Duplex reciprocating pumps being small, compact, and low in proportion to the work they do, are best mounted upon two small skids sharpened at the ends. A *move* along the trench can be quickly and easily made by pulling the pump by a half dozen men or a team.

An 8 in. direct-connected centrifugal pump was maintained for 417 days in constant service in New Orleans for pumping a section of the sewerage system during construction. While steam was kept at operating pressure continuously, the pumping was intermittent during each 24 hours. The in-flow of water required pumping for a total of 12 hours each day. The labor charge was low, the men being paid $73.50 per month, or 20c per hour, one man on each 12-hour shift tending boiler and pump. The daily cost of operation was as follows:

Coal, Pittsburgh [illegible]	
[illegible] per ton	$ [illegible]
[illegible]	[illegible]
Supplies	[illegible]
Water tax	[illegible]
Repairs to pump and [illegible]	[illegible]
Depreciation	[illegible]
Wages	[illegible]
Total	$ [illegible]
[illegible]	[illegible]
T[illegible]	[illegible]

The lift of the pump was 19 ft.

Chicago union wages and hours would in-[illegible] day.

TRENCHING.

By *trenching* is meant all of the operations of digging or excavating, sheeting and bracing, pumping, backfilling, and disposing of the surplus earth. In making estimates or bids it is best to consider the work in question analytically and calculate the costs of the separate operations involved. For making approximate estimates, the labor costs for complete trenching operations are given in Table VII.

Method of Excavation, Transportation and Filling Used on U. S. Government Fortification, Puget Sound.

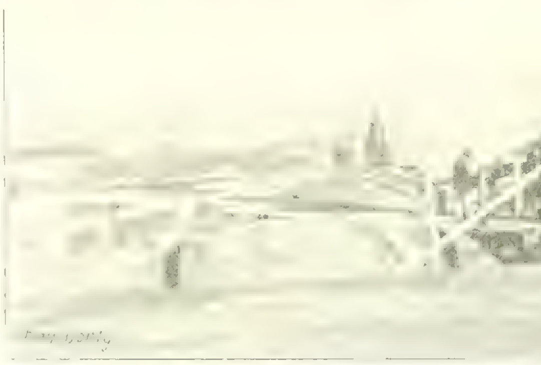
A[illegible] dumping it into a fill in a large concrete parados, was recently devised by United States engineers at the forts in the artillery district of Puget Sound, Washington

A drag bucket was used to excavate the material from the beach and drag it up from the water on to a platform fitted with a hopper. This hopper dumped the material into a narrow gage car which was hauled by cable about three-quarters of a mile to another platform, where the material was again dumped through a hopper into a second car running on a track at right angles to the first track. The cars on this track were hauled by cable to a position above the fill and dumped into place.

The drag bucket shown by Fig. 1 for making the excavation is of special design and is made by a blacksmith of the U. S. Department at the work. It is very similar to the ordinary road scraper in shape, except that it is much larger and is made of heavier material. It is about 5 ft. wide, 4 ft. deep and 18 ins. high. The bottom is rounded toward the front in the center.

The bucket was operated from an old power plant on shore which had formerly been used for a rock crushing plant, etc. A cable was run from the plant to a wharf some 50 ft. off shore, over a block and back to the rear of the bucket for the back haul. Another cable was attached directly to the chains on the front.

Th[illegible] the cars up the steep hill to the parados by means of long cables. This engine is located near the top of the incline. With a larger capacity donkey engine, it is said, that the power plant used for excavating could have been eliminated and the entire work handled by one donkey. Six men were employed to handle the work under the system described.



View of Cable Haul and Incline for Making Earth Fill.

ROADS AND STREETS SECTION

Instructions of the Ohio State Highway Department for the Guidance of Its Resident Engineers on State Highway Work.

The following instructions to resident engineers were issued last year by the State Highway Department of Ohio, Jas. C. Wonders, Commissioner, for the guidance of resident engineers of the department in making surveys and preparing plans and estimates for highway work. The idea in issuing the instructions was to give some of the methods that would be found helpful and convenient in making surveys and preparing plans and estimates for the state highway work, and to insure uniformity in the plans and field books that are to be sent to the office of the State Highway Department. The instructions are as follows:

The duties of the Resident Engineer are:

1. To make an accurate survey of the road to be improved; this survey to include alignment, levels and topography.
2. To prepare plans and estimates as are set forth in these instructions.
3. To assume general supervision of the work of construction, furnishing advice and instructions to the contractor and inspector and to see that they are provided with the necessary stakes.
4. To make out and send to the office of the State Highway Department each month, an estimate of work completed by the contractor, and also a pay-roll for his own services and those of all men employed in assisting him in the engineering work on this road.

[illegible]

Location of Line of Highway.

The survey [illegible] begin [illegible] south end of the road, which will make it possible to plat the work from left to right.

Road Record.—If there exists a recorded description of the road to be improved, the Resident Engineer shall ascertain from said description the width of right of way, location of monuments, and all other information that will aid him in making his survey. If the center line cannot be located from the rec-[illegible] traveled way, but make the center line as [illegible]

Change of Location.—Where a marked im-[illegible] the cost of maintenance in after years can be [illegible] obtained with a reasonable amount of excavation and embankment, a new location of such section of the road will be made under [illegible] evident that the road will have to be widened a note should be made from which side the [illegible]

Ce[illegible] should be set every 100 ft. and driven down so that they project about ½ in. above the surface of the ground. A numbered side stake should also be set at every station, facing the center line and far enough out to be secure from disturbance during grading; this distance out to be uniform, preferably 25 ft. Transit points or hubs should be placed at the intersections of tangents and at the beginning and ends of curves. All transit points to be referenced by at least three measurements to permanent objects, so that the hubs can easily be replaced after grading has been commenced. If at points opposite the station stakes the station numbers be painted on the fences with red or white paint, they will be found very convenient in locating points during the progress of the work.

Topography.

Data for Map. Locate all walls, fences, ditches, etc., which indicate boundaries of the road or of abutting property, giving correct names of owners; also all buildings within one hundred feet of the center line, and all cross streets or roads for a distance of two hundred feet from the center line. No more time should be spent in locating buildings than is necessary to give their approximate size and position. The size and location of objects beyond the fence line or beyond the probable limits of the finished road and work may be estimated, but the estimate is to be made in the field and recorded in the notes. Where property lines or intersecting roads are [illegible] opposite [illegible] should be recorded, and not left to the draughtsmen to locate from the sketch. The pluses to property lines and the number of feet frontage of each land owner must also be given.

Bridges and Culverts.—Locate all bridges; give the dimensions of the openings; the nature of construction; dimensions and conditions of the abutments and superstructures; height of stream at time of freshets; direction of flow of stream and elevations on bed of stream at both ends of the bridge. Give the approximate area of watershed, where it may be readily obtained. Locate gutters, ditches, curbing, catch-basins and trees valuable for shade, ornament or fruit. All existing culverts and drains are to be located; the size and conditions noted; elevations taken at both ends on top and bottom and shown on profile. Where streams enter or leave the highway at places not opposite the culverts, their location is to be noted. Levels should be taken far enough down the stream or ditch to give the required information for lowering the ditch to drain from the new culvert, which is usually placed lower than the old one. All information necessary for planning a complete drainage scheme should be recorded. Where, in the opinion of the Resident Engineer, new bridges and culverts are needed, he will indicate their proposed location and size, and take levels along the proposed location for an outlet.

Fig. 1—Sketch of Pipe Culvert.

(H [illegible] $\frac{1}{2}$ (L [illegible] L [illegible]), l [illegible] $1\frac{1}{2} \times h$; h^1 [illegible] T, h [illegible] H [illegible] H^1).

In planning culverts and headwalls for pipe, the Resident Engineer should exercise particular care in giving the wing walls the proper length and height, so that the earth will not spill over or around the ends of the wings and choke the opening. The length of pipe or barrel of culvert required is largely a matter of judgment and is usually governed by local conditions. A few simple formulæ for ascertaining the length and height of head-walls for pipe are given with the accompanying figure (Fig. 1).

Levels.

Datum.—Elevations should be referred to tidewater datum if a canal, railroad or geological survey bench-mark can be found and connected at small expense, and check levels should be run where such permanent benches cannot be found near each end of the road. Assumed elevations taken from the U. S. Geological Survey contour maps should be used where no better information is obtainable.

Center Line Levels.—At each 100-ft. station, at each change of grade, and at cross-roads, elevations are to be taken on the center line, and at such other points on either side of the center line as may be needed to plot true and accurate profile and cross-sections of the road.

Bench Marks.—All elevations must be worked out and checked. All level readings are to be taken to the nearest tenth of a foot, except the elevations of turning points and bench-marks, where they will be taken to hundredths of a foot. A bench-mark should be established at least every 1,000 ft. Before the survey party leaves the road all bench marks must be checked; and all bench marks shall be of a permanent nature and be so described as to be easily found.

[illegible]—[illegible] of the ground, and of the bottom of sills must be taken at the front corners of buildings where the same are within 50 ft. of the center line, and where a cut or fill on the new road is probable, and the elevations of the buildings should be platted on the profile.

Cross-Roads.—At cross-roads levels should be taken for at least 200 ft. each side of the intersection of the center lines, and these levels platted on the map, below the center line [illegible] and opposite the station at which the cross-road is located.

Cross Sections.—The elevations for cross sections need not be computed, as the work can be platted by comparing the cross section rod readings with the rod reading at the center line. e. g., if, at a point on the cross section the rod read 2 ft. longer than at the center line, this point should be platted 2 ft. below the center elevation of line; if the rod read 2 ft. less than at the center line, the point at which the observation was taken should be platted 2 ft. higher than the point on the center line.

Cross sections should extend at least 25 ft. from center line and to fence lines and beyond, where there is a possibility of heavy cutting or filling. On rough ground the hand level will be found a great convenience and is sufficiently accurate. Usually the slopes beyond the fences may be merely indicated, as: down 1 in 10, level, etc. The locations of the edge of beaten track, the edge of the sidewalk, line of trees, fence line, etc., are to be shown in cross section notes by the use of letters written under the distance figures. All elevations upon outcropping rock should be noted. The stations at the beginning and ending of rock outcrops should be given, and at places where the rock is near the surface, an estimate should be made of the depth of overlying earth. Care should be exercised in taking cross sections where there are marked changes at the sides of the road, even though there be no great changes of grade in the beaten track.

Construction.

Supervision.—After work on the road has commenced, the Resident Engineer must keep in touch with the inspector and contractor, provide the necessary stakes, and be ready at all times to interpret the specifications or furnish advice or instructions for doing work. He should see that the contractor provides himself with a templet crown board having the proper crown and width, and should provide him with necessary dimensions for the same.

Slope Stakes.—Before the contractor begins work on the road the Resident Engineer shall set slope stakes on each side of the road, having marked on the inside, facing the center line, the amount of cut or fill, and on the opposite side the station number.

The points at which the finished slope line intersects the existing surface may be obtained from the station cross sections on the map, and the distance of these points from the center line ascertained by scaling.

Grade Points.—At the points where the surface of the ground coincides with the elevation of the subgrade, stakes should be set and marked 0.0.

Fig. 2—Sketch Showing Method of Placing Grade Stakes for Road in a Cut.

Grade Stakes.—After the work of grading has progressed sufficiently far, or, if the work be light, before grading has commenced, grade stakes should be set at a uniform distance from the center line on both sides of the road at each station, the top of the stakes being at the elevation of the finished grade at these point. By means of these stakes the inspector or contractor may check his work at any time, by stretching a string across the road so that it rests on the tops of these stakes. The subgrade at the center line will be the thickness of the surfacing material below the string. At the outer edge of the roadway the subgrade will be the thickness of the surfacing material plus the crown of the roadway below the string. The elevation at a point midway between stations may be obtained by stretching the string from the top of one grade stake to the top of the stake on the opposite side of the road at the next station.

The accompanying sketches illustrate the use of this system of staking out a 16-ft. macadam road.

Fig. 2 shows the complete subgrade.

Fig. 3 shows the completed road.

On this type of road the subgrade has a crown of 6 ins. from the outer edge of the berme, and the completed macadam surface also has a 6-in. crown. The depth of the stone at the center is 8 ins., and at the sides 6 ins. The bottom of the ditch is 32 ins. below the crown of the road, or 18 ins. below the edge of the roadbed.

Curb Stakes.—On a brick road the stakes for curbing should be placed 2 ft. outside of the line of the curb, should be driven down to grade and carefully centered.

OFFICE WORK.

The Plans.

The plan, including map, profile and cross sections, shall be platted on one continuous sheet of standard cross section tracing cloth of 10 x 10 spacing. The work shall be platted on the rough side of the cloth, so that any erasures which become necessary will not disturb the cross section ruling. The work of platting should be done directly upon the tracing cloth, thus saving the labor of tracing and avoiding any difficulty in getting the divisions on the tracing cloth to match with the corresponding divisions on cross section paper. Existing surfaces should be shown in black, and proposed surfaces and the center line of the road shown in red, preferably red water color, as this prints much better than red ink. All work on the plans shall be platted from left to right.

The title should be placed near the beginning of the map, i. e., near station 1, and should be of the following form:

.... County State Highway ....
Petition No. ....
.... Road.

No pencil harder than 2H Kohinoor shouid be used on the tracing cloth. When the plans are completed the pencil marks mav be removed with a cloth saturated with benzine.

Map.—The map should be platted to a scale of 1 in. equaling 100 ft. It should show:

The center line of the road, including angles, curves and curve data—the bearing of each tangent being marked on the center line: property lines, boundary lines, fences, cross-roads, driveways, plan of approaches, streams, ditches, bridges, culverts, buildings within one hundred feet of the road, telephone or telegraph lines, railroads, traction lines, pipe lines located within the lines of the road, names of property owners and the foot fronttage of each; all trees that are within the lines of the work, and the pluses to all property lines and intersecting roads. A north point should be placed at at least one point on the map. If the road is more than one mile in length, a north point should be placed near each end of the map.

Profile.—The profile should give the contour of the center line as located by the Resident Engineer, the proposed grade line, all bridges and culverts, the elevation of the foundation of all buildings within 100 ft. of the road, and the elevation and location of all bench marks. The ground line on both station cross sections and profile should be inked in before the finished grade line is drawn.

Grade Line.—After a trial grade line has

TABLE I. CUBIC YARDS FOR SUM OF END AREAS.

Length of Prism 100 Ft.

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.		0.2	0.4	0.6	0.7	0.9	1.1	1.3	1.5	1.7
1.	1.9	2.0	2.2	2.4	2.6	2.8	3.0	3.1	3.3	3.5
2.	3.7	3.9	4.1	4.3	4.4	4.6	4.8	5.0	5.2	5.4
3.	5.6	5.7	5.9	6.1	6.3	6.5	6.7	6.9	7.0	7.2
4.	7.4	7.6	7.8	8.0	8.1	8.3	8.5	8.7	8.9	9.1
5.	9.3	9.4	9.6	9.8	10.0	10.2	10.4	10.6	10.7	10.9
6.	11.1	11.3	11.5	11.7	11.9	12.0	12.2	12.4	12.6	12.8
7.	13.0	13.1	13.3	13.5	13.7	13.9	14.1	14.3	14.4	14.6
8.	14.8	15.0	15.2	15.4	15.6	15.7	15.9	16.1	16.3	16.5
9.	16.7	16.9	17.0	17.2	17.4	17.6	17.8	18.0	18.1	18.3
10.	18.5	18.7	18.9	19.1	19.3	19.4	19.6	19.8	20.0	20.2
11.	20.4	20.6	20.7	20.9	21.1	21.3	21.5	21.7	21.9	22.0
12.	22.2	22.4	22.6	22.8	23.0	23.1	23.3	23.5	23.7	23.9
13.	24.1	24.3	24.4	24.6	24.8	25.0	25.2	25.4	25.6	25.7
14.	25.9	26.1	26.3	26.5	26.7	26.8	27.0	27.2	27.4	27.6
15.	27.8	28.0	28.1	28.3	28.5	28.7	28.9	29.1	29.3	29.4
16.	29.6	29.8	30.0	30.2	30.4	30.6	30.7	30.9	31.1	31.3
17.	31.5	31.7	31.9	32.0	32.2	32.4	32.6	32.8	33.0	33.1
18.	33.3	33.5	33.7	33.9	34.1	34.3	34.4	34.6	34.8	35.0
19.	35.2	35.4	35.6	35.7	35.9	36.1	36.3	36.5	36.7	36.9
20.	37.0	37.2	37.4	37.6	37.8	38.0	38.1	38.3	38.5	38.7
21.	38.9	39.1	39.3	39.4	39.6	39.8	40.0	40.2	40.4	40.6
22.	40.7	40.9	41.1	41.3	41.5	41.7	41.9	42.0	42.2	42.4
23.	42.6	42.8	43.0	43.1	43.3	43.5	43.7	43.9	44.1	44.3
24.	44.4	44.6	44.8	45.0	45.2	45.4	45.6	45.7	45.9	46.1
25.	46.3	46.5	46.7	46.9	47.0	47.2	47.4	47.6	47.8	48.0
26.	48.1	48.3	48.5	48.7	48.9	49.1	49.3	49.4	49.6	49.8
27.	50.0	50.2	50.4	50.6	50.7	50.9	51.1	51.3	51.5	51.7
28.	51.9	52.0	52.2	52.4	52.6	52.8	53.0	53.1	53.3	53.5
29.	53.7	53.9	54.1	54.3	54.4	54.6	54.8	55.0	55.2	55.4
30.	55.6	55.7	55.9	56.1	56.3	56.5	56.7	56.9	57.0	57.2
31.	57.4	57.6	57.8	58.0	58.1	58.3	58.5	58.7	58.9	59.1
32.	59.3	59.4	59.6	59.8	60.0	60.2	60.4	60.6	60.7	60.9
33.	61.1	61.3	61.5	61.7	61.9	62.0	62.2	62.4	62.6	62.8
34.	63.0	63.1	63.3	63.5	63.7	63.9	64.1	64.3	64.4	64.6
35.	64.8	65.0	65.2	65.4	65.6	65.7	65.9	66.1	66.3	66.5
36.	66.7	66.9	67.0	67.2	67.4	67.6	67.8	68.0	68.1	68.3
37.	68.5	68.7	68.9	69.1	69.3	69.4	69.6	69.8	70.0	70.2
38.	70.4	70.6	70.7	70.9	71.1	71.3	71.5	71.7	71.9	72.0
39.	72.2	72.4	72.6	72.8	73.0	73.1	73.3	73.5	73.7	73.9
40.	74.1	74.3	74.4	74.6	74.8	75.0	75.2	75.4	75.6	75.7
41.	75.9	76.1	76.3	76.5	76.7	76.9	77.0	77.2	77.4	77.6
42.	77.8	78.0	78.1	78.3	78.5	78.7	78.9	79.1	79.3	79.4
43.	79.6	79.8	80.0	80.2	80.4	80.6	80.7	80.9	81.1	81.3
44.	81.5	81.7	81.9	82.0	82.2	82.4	82.6	82.8	83.0	83.1
45.	83.3	83.5	83.7	83.9	84.1	84.3	84.4	84.6	84.8	85.0
46.	85.2	85.4	85.6	85.7	85.9	86.1	86.3	86.5	86.7	86.9
47.	87.0	87.2	87.4	87.6	87.8	88.0	88.1	88.3	88.5	88.7
48.	88.9	89.1	89.3	89.4	89.6	89.8	90.0	90.2	90.4	90.6
49.	90.7	90.9	91.1	91.3	91.5	91.7	91.9	92.0	92.2	92.4
50.	92.6	92.8	93.0	93.1	93.3	93.5	93.7	93.9	94.1	94.3
51.	94.4	94.6	94.8	95.0	95.2	95.4	95.6	95.7	95.9	96.1
52.	96.3	96.5	96.7	96.9	97.0	97.2	97.4	97.6	97.8	98.0
53.	98.1	98.3	98.5	98.7	98.9	99.1	99.3	99.4	99.6	99.8
54.	100.0	100.2	100.4	100.6	100.7	100.9	101.1	101.3	101.5	101.7
55.	101.9	102.0	102.2	102.4	102.6	102.8	103.0	103.1	103.3	103.5
56.	103.7	103.9	104.1	104.3	104.4	104.6	104.8	105.0	105.2	105.4
57.	105.6	105.7	105.9	106.1	106.3	106.5	106.7	106.9	107.0	107.2
58.	107.4	107.6	107.8	108.0	108.1	108.3	108.5	108.7	108.9	109.1
59.	109.3	109.4	109.6	109.8	110.0	110.2	110.4	110.6	110.7	110.9
60.	111.1	111.3	111.5	111.7	111.9	112.0	112.2	112.4	112.6	112.8
61.	113.0	113.1	113.3	113.5	113.7	113.9	114.1	114.3	114.4	114.6
62.	114.8	115.0	115.2	115.4	115.6	115.7	115.9	116.1	116.3	116.5
63.	116.7	116.9	117.0	117.2	117.4	117.6	117.8	118.0	118.1	118.3
64.	118.5	118.7	118.9	119.1	119.3	119.4	119.6	119.8	120.0	120.2
65.	120.4	120.6	120.7	120.9	121.1	121.3	121.5	121.7	121.9	122.0
66.	122.2	122.4	122.6	122.8	123.0	123.1	123.3	123.5	123.7	123.9
67.	124.1	124.3	124.4	124.6	124.8	125.0	125.2	125.4	125.6	125.7
68.	125.9	126.1	126.3	126.5	126.7	126.9	127.0	127.2	127.4	127.6
69.	127.8	128.0	128.1	128.3	128.5	128.7	128.9	129.1	129.3	129.4
70.	129.6	129.8	130.0	130.2	130.4	130.6	130.7	130.9	131.1	131.3
71.	131.5	131.7	131.9	132.0	132.2	132.4	132.6	132.8	133.0	133.1
72.	133.3	133.5	133.7	133.9	134.1	134.3	134.4	134.6	134.8	135.0
73.	135.2	135.4	135.6	135.7	135.9	136.1	136.3	136.5	136.7	136.9
74.	137.0	137.2	137.4	137.6	137.8	138.0	138.1	138.3	138.5	138.7
75.	138.9	139.1	139.3	139.4	139.6	139.8	140.0	140.2	140.4	140.6
76.	140.7	140.9	141.1	141.3	141.5	141.7	141.9	142.0	142.2	142.4
77.	142.6	142.8	143.0	143.1	143.3	143.5	143.7	143.9	144.1	144.3
78.	144.4	144.6	144.8	145.0	145.2	145.4	145.6	145.7	145.9	146.1
79.	146.3	146.5	146.7	146.9	147.0	147.2	147.4	147.6	147.8	148.0
80.	148.1	148.3	148.5	148.7	148.9	149.1	149.3	149.4	149.6	149.8
81.	150.0	150.2	150.4	150.6	150.7	150.9	151.1	151.3	151.5	151.7
82.	151.9	152.0	152.2	152.4	152.6	152.8	153.0	153.1	153.3	153.5
83.	153.7	153.9	154.0	154.3	154.4	154.6	154.8	155.0	155.2	155.4
84.	155.6	155.7	155.9	156.1	156.3	156.5	156.7	156.9	157.0	157.2
85.	157.4	157.6	157.8	158.0	158.1	158.3	158.5	158.7	158.9	159.1
86.	159.3	159.4	159.6	159.8	160.0	160.2	160.4	160.6	160.7	160.9
87.	161.1	161.3	161.5	161.7	161.9	162.0	162.2	162.4	162.6	162.8
88.	163.0	163.1	163.3	163.5	163.7	163.9	164.1	164.3	164.4	164.6
89.	164.8	165.0	165.2	165.4	165.6	165.7	165.9	166.1	166.3	166.5
90.	166.7	166.9	167.0	167.2	167.4	167.6	167.8	168.0	168.1	168.3
91.	168.5	168.7	168.9	169.1	169.3	169.4	169.6	169.8	170.0	170.1
92.	170.4	170.6	170.7	170.9	171.1	171.3	171.5	171.7	171.9	172.0
93.	172.2	172.4	172.6	172.8	173.0	173.1	173.3	173.5	173.7	173.9
94.	174.1	174.3	174.4	174.6	174.8	175.0	175.2	175.4	175.6	175.7
95.	175.9	176.1	176.3	176.5	176.7	176.9	177.0	177.2	177.4	177.6
96.	177.8	178.0	178.1	178.3	178.5	178.7	178.9	179.1	179.3	179.4
97.	179.6	179.8	180.0	180.2	180.4	180.6	180.7	180.9	181.1	181.3
98.	181.5	181.7	181.9	182.0	182.2	182.4	182.6	182.8	183.0	183.1
99.	183.3	183.5	183.7	183.9	184.1	184.3	184.4	184.6	184.8	185.0
100.	185.2	185.4	185.6	185.7	185.9	186.1	186.3	186.5	186.7	186.9
200.						370.4		2000		3703.7
300.						555.6		3000		5555.6
400.						740.7		4000		7407.4
500.						925.9		5000		9259.3
600.						1111.1		6000		11111.1
700.						1296.3		7000		12963.0
800.						1481.5		8000		14814.8
900.						1666.7		9000		16666.7
1000.						1851.9		10000		18518.5

been put on in pencil, the finished grade on station cross sections should also be drawn in pencil, and the earthwork computed. If the cuts and fills do not balance properly a new grade line can be established and the earthwork refigured. The grade line should be examined and approved by some member of the Highway Department before it is inked in.

Level Grades.—As a general rule, level grades [illegible] full [illegible] result [illegible] road [illegible] maintained in good condition at much less expense. Should a level grade seem unavoidable, drainage in the ditches should be provided by making them deeper at the end. In this case the ditch grade should be shown on the profile at cross sections.

Vertical Curves.—Vertical curves should be freely employed at all points where the grade changes 0.5 per cent or more. A simple form of vertical curve is here given (Fig. 1) as a suggestion. Other modifications of the vertical curve may be used if desired.

Cross Sections.—The cross sections should show the present ground line and the proposed section at each station, at all marked changes in grade. The platting of the ground line for cross sections has been taken up in the preceding paragraph under levels.

Platting the Finished Surface.—In platting the finished surface of the road for station cross sections a templet form made from a celluloid collar will be found convenient. The cross section of the road can be platted on the celluloid to the scale of 10 ft. to the inch, and the celluloid trimmed down to the line with a sharp knife.

In platting the station cross sections, care should be exercised in making an exact closure between the proposed slope line and the existing surface.

Estimates.

Earthwork Computations.—In figuring the earthwork the average end area formula or sum of end areas shall be used. A table (Table I) given at the end of the instructions will be found useful in this work. In computing the end areas, a planimeter will be found of great assistance, both in lessening the labor and increasing the accuracy of the work.

Method of Tabulating.—The method of tabulating the earthwork notes should be as follows:

CUTS

Station	End Area	Cu. Yds.	Total

FILLS

End Area.	Cu. Yds.	Total.	+15%

The total amount should be carried forward each station.

Rock Excavation.—If rock or shale excavation is encountered, the proportion in each 100-ft. prism should be estimated and the amount noted in the field book.

Slopes.—All cross sections should be drawn [illegible] both as to excavation and fills. Except in rock [illegible] a slope of one and one-half to one should be used in cuts, and a slope of two to one on fills.

Balancing Cuts and Fills.—Care should be exercised in balancing cuts and fills so that all [illegible] will be avoided. Ordinarily cuts should exceed fills by 15 per cent, and quantities of macadam or other [illegible] should be considered in [illegible] excavation. Results of calculations of cross [illegible] should be tabulated on even pages of level books, with opposite or odd pages left blank.

Haul.—Whenever possible the cuts and fills [illegible] cavation is to be hauled should be indicated on [illegible] being indicated by a vertical line marked "Di-[illegible]

[illegible] proaches shall extend 20 ft. from the edge of [illegible] at the outer end and shall gradually widen to 24 ft. at the edge of the roadbed. These ap[illegible] the mud from the wheels of vehicles and thus prevent its being carried onto the macadam surface. The amount of stone required for these approaches will vary with the condition [illegible] amount is left to the discretion of the Resident Engineer.

The Resident Engineer shall include in his estimate the excavation and embankment necessary for these approaches and also the number of cubic yards of loose stone that will be required. The number and kind of approaches needed shall be noted in the field book and also indicated in plan on the map.

[illegible]

The Field Book should contain:

Fig. 3—Sketch Showing Method of Placing Grade Stakes for Road on Embankment.

A title and complete index should be placed on the first and second pages, the same form of title being used as that placed on the map.

An explanation of abbreviations used.

The names of the members of the surveying party for each day's work, and duties performed by each.

The date and weather conditions for each day's work.

The transit or alignment notes, including all references.

The notes on topography.

The level notes, including bench marks.

The cross section notes.

The earthwork calculations.

The total amount of excavation and embankment.

The number of square yards of brick or macadam.

The number of lineal feet of curb.

The number of cubic yards of compact stone, gravel and sand.

The number and location of farm approaches.

The quality and nature of the soil and the stations at which changes occur should be fully noted, and especially the location of unstable subsoil and of clay or loam which is peculiarly affected by water.

The location of quarries or rock suitable for road metal, and of gravel pits in the vicinity of the road to be improved shall be noted.

The price of stone, gravel, brick and other material to be used shall be given f. o. b. at the railway station nearest the site of the road. Where materials of different qualities are obtainable, such as local stone and stone from nearby quarries, the prices and merits of each should be given. The length of haul and approximate size of load that could be hauled from the railway station or quarry to the new road should also be given.

The Resident Engineer should also note fully any unusual local conditions that would affect the cost of construction in any way.

The prices of laborers and teams in the locality of the road shall be given.

The field book or a copy of same should be sent to the Highway Department along with the plans. After the plans have been approved and the contract let, blue prints will be furnished the Resident Engineer, County Auditor, Contractor and Inspector.

If the work of grading will necessitate the removal of trees, the number, size, location and kind of tree should be fully noted in the field book and also on the map.

The names of the owners of property abutting on the road, together with the number of fee frontage of each, should be given in the field book. If the improvement lies in more than one township, it will be necessary to have the frontages in each township.

Where the work of construction will necessitate the moving of fences, telegraph or telephone poles, or pipe lines, the Resident Engineer should describe fully the sections to be moved and the distance they are to be shifted. This information should be placed in the field book and a copy also sent to the property owners or corporation interested.

PAY-ROLL.

The Resident Engineer will be furnished with pay-roll blanks, which must be carefully filled out, fully itemized, giving date and kind of service, receipted by the various men employed, and sent to the office of the Highway Department at the end of each month. The Board of Uniform Accounting has directed that these bills must be receipted before a voucher for the amount due can be made out. The inspector's bill shall not be included in the Resident Engineer's pay-roll, but shall be sent in separately by the inspector himself.

COST OF ENGINEERING.

There has been some criticism offered to the effect that the cost of engineering done according to these instructions is excessive. These instructions were compiled after examining the large number of maps and field books on file in this office, and it has been found an almost universal rule that the best work, that which conformed most closely to these instructions, always costs the least money.

Some Costs on Oiled Earth Road Construction in Kansas.

Oiled earth roads have been in use in California for the past 12 or 15 years. In several other states sections of this type of road have also been constructed. Different methods of construction have been employed in different states, and as a consequence uniform results have not always been obtained. In a recently issued pamphlet on "Highway Improvement," prepared by Mr. W. S. Gearhart, state highway engineer of Kansas, and issued by the Kansas State Agricultural College, it is stated that the following appears to be the one practical method of construction of oiled earth roads, which is giving fairly uniform results:

A shoulder furrow is plowed on each side of the center of the roadway, making the width to be treated from 16 to 18 ft., and the loose earth graded outside of this width, unless the crown of the road is too steep, in which case it should be plowed and this material thrown out to the sides. By only plowing the shoulders it is easy to shape the subgrade with a crown of about 1 in. to the foot. Practically the same care should be exercised in preparing the subgrade for oiled earth road work as for macadam. After shaping, the subgrade should be thoroughly rolled in order to compact the earth as well as take the spring out of the ground. The use of the solid shoulder is to prevent the oil from spreading and to facilitate the tamping process.

The kind of soil to be treated has much to do with the details of the construction and the amount of oil required. Sandy soils seem to be best adapted to the oil treatment, but satisfactory results are being obtained both on clay and heavy gumbo soils.

The grade of oil to be used is much more important than the kind of soil; light oils and those having a paraffin base are little better than so much water. The oil should be one having an asphalt base of at least 85 per cent. It should be free from paraffin and all lighter oil. The oil should be applied to the road at a temperature of not less than 250° F., and an oil containing 85 per cent of asphalt will have to be heated before it can be taken from the car. The tank cars have special steam coils for this purpose. It is necessary to heat the oil to a temperature of about 340° F. in the car so as to be delivered on the ground at a temperature of [illegible] This will require a steam pressure of about 110 lbs. per sq. in. The amount of oil used should be from 2 to 3 gals. per sq. yd. and should be placed in two courses.

After applying 1¼ to 1½ gals. of oil on the prepared subgrade sufficient earth should be graded on to absorb the oil. On a 2½-gal. treatment to the square yard about 4 ins. of loose earth should be graded in and then be thoroughly soaked with water and the tamping process begun. A disk harrow with the blades set at an angle should be employed to stir and help mix the oil with the earth. The harrow should precede the roller at all times. As soon as the first course is thoroughly mixed and rolled, the second course of oil should be placed and the same process followed. When the tamping roller rises to the top and the surface has been thoroughly compacted a water-tight wearing surface from 5 to 6 ins. thick will have been made. The rolling should be from the sides to the center, the same as in macadam construction, in order to maintain the crown.

Should any surplus oil come to the surface after the travel has been allowed on the road a small amount of loose earth should be graded in in order to absorb it, and the surface of the road may be made more durable by the application of one inch of sand or gravel.

The greater part of the work of preparing the road for treatment can be done with a traction engine and a road machine. The earth can be drawn back either by a road machine or a road leveler; the latter being much more rapid and leaving the road in almost a perfect cross-section. The oil should be hauled in a distributing wagon built for that purpose, which holds about 600 to 800 gals. and will require two teams. One to two teams will be necessary on the disk harrow and two teams on the tamping roller. The work of grading the earth on the oil should follow closely the placing of the oil to prevent it cooling and to assist in the mixing. There is very little danger of using too much water. The wetter the materials are the more thoroughly the oil and earth can be mixed.

During 1910 a section of oiled earth road about 1½ miles long and 16 ft. wide was constructed on West 10th St. in Shawnee county, Kan., the method of construction employed being about as described above. The Standard Oil Co., Kansas City, Kan., furnished the oil f. o. b. cars at Topeka, Kan., for one mile of the road. The county paid for the grading and the rolling and placing of the oil and also bought enough oil for the additional half mile of road. The soil was clay and heavy black loam. The work was done during the latter part of June and the first of July in 1910, under the direction of Mr. Gearhart.

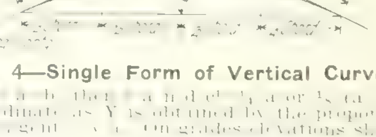


Fig. 4—Single Form of Vertical Curve.

Make a-b then [illegible] a or [illegible] (a - b). Any ordinate as Y is obtained by the proportion [illegible] Tangents [illegible] on grades elevations should be calculated on tangents and connected to conform to the curve. On alinement the curve can be directly run out with a tape.

The average cost for the 1½ miles of road, with an average oil and water haul of 1½ miles, was as follows, figuring the oil at what it would have cost f. o. b. the cars at Topeka, had it been bought:

	Per-sq. yd. Cts.
[illegible] gal. per sq. yd. at 4 cts. per gal.	[illegible]
[illegible] (not including extra [illegible])	[illegible]
Hauling oil	[illegible]
Distributing oil	1.5
Hauling water	.5
Rolling and disking	1.8
Total	1[illegible]

At this rate a road 16 ft. wide and one mile in length would cost complete $1,201.40.

Separate costs were kept on the last half mile of the road, where the average haul was about two miles, and the detailed cost of this work

TABLE I.—OILED EARTH ROADS CONSTRUCTED [illegible]

Manhattan, Sec. No. 1	[illegible] black	Disked 1½ in. [illegible]		[illegible] 1906..	0.5	1½	Good	Somewhat dusty	Very good	[illegible]	[illegible]
Manhattan, Sec. No. [illegible]	Heavy loam......	Disked 2 in....	Oct., 1905	[illegible] 1906..	1.0	[illegible]	[illegible]	Very dusty	[illegible]	[illegible]	[illegible]
Manhattan, Sec. No. [illegible]	[illegible]	Plowed [illegible]		[illegible] 1906..	3.0		Good	[illegible]			150
Manhattan [illegible] drive	[illegible]	[illegible]		[illegible] 1906..	0.5	[illegible]	Good	[illegible]			
Manhattan drive....	[illegible]	Smooth the [illegible]		[illegible] 1906..	1.0	[illegible]	Good	[illegible]		250	[illegible]
Hutchinson, Sec. No. [illegible]	[illegible]	Plowed 4½ in. [illegible]		July, 1906..	0.5	[illegible]	[illegible]	[illegible]	Very good.	500	[illegible]
Hutchinson, Sec. No. [illegible]	[illegible]	Disked [illegible]		[illegible] 1906..	1.0	[illegible]	[illegible]	[illegible] dusty			
Hutchinson, Sec. No. [illegible]	[illegible]							[illegible]			50
Maplehill	Very heavy black	Surface smooth		July, 1906..	[illegible]	[illegible]	Good	Only fair		125	[illegible]
		Plowed 4 in...		[illegible]	1.4		Very good			[illegible]	[illegible]
Garden City, Sec. No. 1	[illegible]	Graded slightly		Oct., 1906..	[illegible]	11	Fair			1,100	[illegible]
Garden City, Sec. No. 2	[illegible]	None necessary		[illegible] 1906..			[illegible]			1,350	20
Garden City, Sec. No. 3	Extremely sandy	None necessary		Oct., 1906..	[illegible]	[illegible]	Fair			[illegible]	20
Garden City, Sec. No. 4	Nearly pure sand	None possible.		Oct., 1906..	6.06	19	[illegible]			[illegible]	

*Sand cost 2½ cts. [illegible]

is as follows. It does not, however, include [illegible] of $100 [illegible].

	Per-sq. yd. Cts.
2 gals. oil per sq. yd. at 4 cts. per gal...	8.000
Pumping oil out of the car..............	.331
Hauling [illegible]	[illegible]
Covering the oil with earth.	[illegible]
Hauling water	.900
Disking	[illegible]
Rolling	1.418
Foreman	.173
Total cost	13.722

The [illegible] with [illegible] $1.2[illegible] [illegible] ing, hauling and mixing and finishing the road complete, not including the cost of the oil, should not exceed 5 to 7 cts. per square yard. The cost, however, in all cases is gov[illegible] hauled, price of labor, etc.

Late in the fall the east half mile of the road was in good condition with the exception of two short stretches. At these spots the crown of the road was so steep the center of the road had to be plowed to establish the subgrade, and the soil broke up in hard lumps and much difficulty was experienced in breaking them up and getting them sufficiently wet to thoroughly mix the oil and earth. In spite of the fact that the work was well done these spots are dusty.

Practically all of the next half mile was a heavy black loam and had to be plowed, and about the same trouble was experienced as mentioned above. This section, late in the fall, was very dusty. In the next half mile the soil was not so heavy and it pulverized much better. It was in better condition than the middle section but dusty in spots.

Mr. Gearhart states that these defects are evidently the result of improper mixing, caused by the lack of water to moisten and puddle the hard lumps of earth, or an excess of earth may have been used with the oil. Either one or both of these causes would have given about the same results. This trouble can be easily overcome by sprinkling the dusty [illegible]

A ¾ mile section of oiled earth road running out from Independence, Kan., to the Country Club, has been subjected to heavy automobile traffic and after about one year's use showed very little sign of deterioration. The soil is a sandy loam.

In 1905 and 1906 several sections of oiled earth road were constructed under the supervision of Prof. Albert Dickens, of the Kansas Agricultural Experiment Station. Data on these roads are given in Table I. It is stated that these roads proved very satisfactory while they were kept in repair. The sand roads have received little or no attention and the Maplehill and Manhattan roads were short and the mud was carried upon them from both ends and the sides until they were covered several inches deep. It was the custom to drag the mud off the Manhattan road occasionally, but about a year ago the grade of the street was changed and the oiled surface graded off.

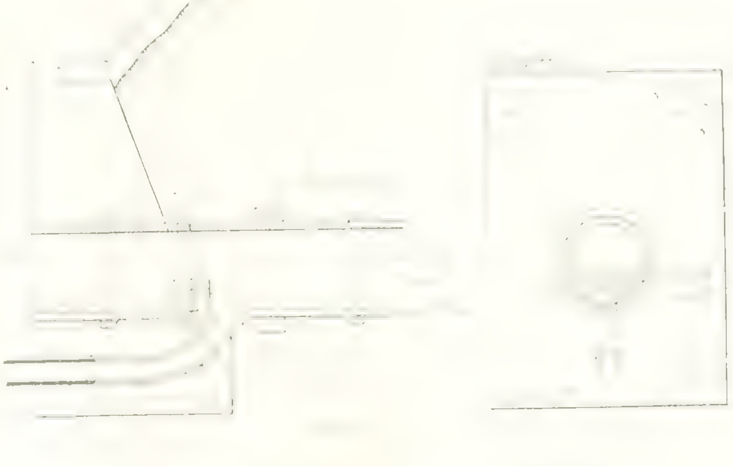
WATER-WORKS AND SEWERS SECTION

Methods and Cost of Constructing a Submerged Sewer Outfall Into a Stream.

BY [illegible]*

To the ordinary person the sight of sewage flowing from the outfall of a sewer into a stream is not only unpleasant, but is often the cause of astonishment that no method is in vogue to remedy it. This is especially true when the flow line of the sewer is some distance above the surface of the water. What is considered to be an excellent plan for the prevention of this annoyance has recently been designed by George C. D. Leuth Denison, Engineer of the Board of Local Improvements, Chicago, Ill., which has adopted it for the sewers emptying into the North Shore channel of the Sanitary Canal.

Before entering into a detailed description of the plan and construction of the outfall of the Leland Avenue system, a brief discussion of the conditions and causes demanding some such arrangement will be given. Along the North Shore Channel, controlled by the Sanitary District of Chicago, which dis- [illegible] and other suburbs, are many valuable sub-divisions of land, in which are being built many substantial residences and apartment buildings. Owing to the alinement of the channel, many of these homes overlook the water which is also rapidly becoming the rendezvous of motor boat enthusiasts and owners of other small craft, who live too far from Lake Michigan to enjoy their sport. To protect this property from the liability of decreased values from this source and to give a more pleasant outlook to adjacent property owners, the plan as shown in the accompanying sketch was presented to the Board of Local Improvements and approved by them.



Standard Submerged Sewer Outlet, Chicago, Ill.

Briefly the design requires the end of the sewer to be built as close as possible to the water edge where a concrete bulkhead is placed and the sewer carried through it to the face. At a sufficient distance back from the face, an ordinary junction pipe is placed with the connection on the flow line of the sewer. This in turn is joined by means of straight and curved tile pipes to a cast iron water pipe which extends into the water about 2 ft. below the surface. To deflect the sewage [illegible] at the joint on the down stream side of the junction, and of sufficient size to care for a quantity equal to two times the dry weather flow plus 10 per cent.

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*Engineer Staff Board of Local Improvements, Chicago

The construction of the Leonard Ave. [illegible] outfall was carried on as follows: After the sewer was built to the site of the bulkhead, the excavation for the latter was completed and filled with concrete to a depth of 6 ins. The junction pipe was then placed in its proper position and held by a block and tackle, while the connection with the cast iron pipe was made. Concrete was then placed and securely tamped around the pipes to protect them from disturbance, after which the work was merely a matter of constructing a cradle for the sewer proper and junction pipe. Elevations were taken on the latter to discover a settlement, if any, but none of material importance was observed. The next pipe was then set and in the joint was placed the brick weir. To fit the last pipe flush with the form the exact measurement was taken and a pipe cut to fit. The balance of the work consisted only of filling the form with concrete.

The work was carried on by direction of a foreman, who did the necessary mason work, and a gang of six laborers. The concrete was composed of 1 part Portland cement, 2 parts torpedo sand and 4 parts crushed stone. The itemized cost was as follows:

1 foreman ⅝ day at $10	$ 6.25
3 laborers (excavating), ½ day at $3.75	5.62
5 laborers (concreting), 1 day at $3.50	17.50
7 cu. yds. crushed stone at $1.65	11.55
4 cu. yds. torpedo sand at $1.50	6.00
11 bbls. Portland cement at $1.50	16.50
5 lin. ft. cast iron pipe at $1.00	5.00
6 lin. ft. 6-in. tile pipe at 10 cts	.60
2 lin ft. 24-in. junction pipe at $1.50	*3.00
100 lin. ft. matched lumber at $35 per M	3.50
Miscellaneous lumber	2.00
Total	$77.52

*Contractor allowed this amount for substituting junction pipe for straight pipe.

Mr. H. E. Hudson was Assistant Engineer in charge of construction and Mr. Wm. F. Healy the contractor.

Alexander Milne, President American Water Works Association.

Alexander Milne, the newly elected president of the American Water Works Association, was born in Aberdeen, Scotland, in 1860. With his parents he removed to Canada in 1875. Since that time he has lived in Ontario.

Before leaving Scotland Mr. Milne had progressed far enough in his school work to matriculate. After reaching Canada, he studied engineering in a four year apprentice course, according to the prevailing British practice. After finishing his studies he served for a number of years on railway construction in the engineering organizations of several companies. For the past twenty-four years he has been in municipal engineering, and for the past ten years he has occupied his present position as engineer and superintendent of the Water Works Department of St. Catherines, Ontario, Canada.

St. Catherines is a well known manufacturing city of 25,000 inhabitants. Although a manufacturing city, it is exceptional for its natural and artificial beauty, being known as the Garden City of Canada, and its public utilities are unsurpassed, particularly its water works system. Mr. Milne deserves much credit for developing the water works system to its present point of high efficiency, and incidentally has been a leading citizen and a prominent member of the St. Catherines industrial commission. While Mr. Milne has often been asked to take charge of large water works systems in this country, he has preferred to make his home in St. Catherines. Mr. Milne has held many important offices in the organization of the American Water Works Association; in 1904 he was a member of the Finance Committee, and has subsequently held in turn each of the five vice presidencies. He was elected president for the coming year at the recent convention of the association held in Rochester, N. Y. He is also a member of the Canada Society of Civil Engineers.

The election of Mr. Milne to the office of president was a reward for the great service he has rendered the association. Not only has he done his full share in presenting papers and discussion, but he has been directly responsible for the introduction of more new members than any other member of the association in its thirty-one years of existence. He is a very quiet man and gets results without keeping himself in the foreground.

Annual Convention of the American Water Works Association.

The 31st annual convention of the American Water Works Association was held in Rochester, N. Y., from the 6th to the 10th of June, inclusive. The convention was well attended, about 250 active members, composed of engineers and water works officials, over 100 associate members, composed of representatives of many of the leading water works manufacturing concerns, and about 150 guests, many of whom were wives of the members, attended.

The first session of the convention was held at ten o'clock Tuesday morning, June 6. President John W. Alvord of Chicago called the meeting to order and introduced the first speaker, Mayor Edgerton of Rochester. Mr. Edgerton welcomed the association to Rochester and reminded the members that the city he represents takes great pride in its public water supply, both in the excellent quality of water supplied by it to the public, and in the up to date equipment which pumps and controls the flow of water through the city mains.

Alexander Milne.

President Alvord delivered his address at the conclusion of the Mayor's address of welcome. Mr. Alvord spoke for a half hour and reviewed the work of the year, commented on the progress of the association during the past year and made many valuable suggestions to the members relating to the future undertakings, studies and observations of the association.

The report of the secretary-treasurer, Mr. John M. Diven, of Charleston, S. C., showed that the association is in a prosperous condition financially. Also substantial gains in membership have been made during the past year.

During the afternoon session a good deal of time was devoted to receiving the reports of the various standing committees. The report of the special committee on National Bureau or Department of Health was of great interest to all present. It is very likely that Congress will create such a bureau, and this special committee of the association was appointed at the last annual meeting to urge upon Congress the desirability of forming this new department in the national government. The idea has not been advocated before Congress by the committee as yet and will not be during the special session of Congress now being held. However, it is the intention of the committee to take this matter up with Congress in the next regular session.

Two papers were read during the afternoon session, the first on the subject: Fire Line Meters, a Comparison of Efficiency, by George Houston of Kalamazoo, Mich., and the second on the subject: Pumping Station Management, by Thomas McMillan of Milwaukee.

Mr. Houston discussed the conflicting interests of water works officials on one hand and the fire insurance companies on the other. The former contend that meters are desirable and necessary to prevent excessive waste of water and to determine the amount of a consumer's water bill on an accurate and logical basis. The insurance interests oppose placing meters in pipe lines designed to afford special fire protection to large industrial plants, office buildings, and so forth, on the grounds that meters obstruct the flow of water and reduce the available pressure. The insurance companies contend that this constitutes increase of risk and therefore should be compensated for in higher rates of insurance.

Attention was called to the fact that all the insurance companies object to all types of meters now on the market save one, on the grounds that all others are trash catchers. Mr. Houston raised the question whether it is better to have the meter intercept the trash, or to allow trash to pass the meter only to stop up the small branches of the sprinkler system. He considered that even though trash clogged the meter, even to the point of stopping the rotating parts, that still enough water would pass through the meter and sprinkling system to extinguish a starting fire. A specific case was cited, where the system was not metered, in which the small branches of the sprinkler were soon entirely plugged up; the flow of water completely cut off and a loss of $90,000 sustained.

Mr. McMillan's paper on Pumping Station Management was a detailed and comprehensive review of the operation of a pumping station in the Milwaukee water works system. The paper followed the development of the plant from 1872 to the present time, gave the cost of operation during the several decades, the method of handling and purchase of coal, the boilers and method of operation, the arrangement of steam piping to facilitate repairs, the method of feeding boilers and increasing the temperature of feed water, the system of oiling the engines and its cost, the auxiliaries for handling and making repairs, and the general method adopted in appointing and arranging the work of the operating force at the station. Much of the detailed information given in Mr. McMillan's paper, his methods of operating and corresponding costs, the results of his experience and his conclusions will be given in an early issue of this journal.

The Bartholomay Brewing Company of Rochester extended an invitation to the men attending the convention to be the guests of the company at their brewery from five to seven in the evening of Tuesday. The invitation was quite generally accepted.

At the Tuesday evening session Messrs. Metcalf, Kuichling and Hawley presented a very valuable paper on the subject: Some Fundamental Considerations in the Determination of a Reasonable Return for Public Hydrant Service. This paper was published in our issue of June 7, 1911.

Also, at the Tuesday evening session, Mr. Dabney H. Maury, consulting engineer, Peoria, Ill., gave a lecture on the Panama Canal. The lecture was illustrated with lantern slides and was appreciated by all, especially by members and guests who have not followed the progress of this construction as closely as the civil engineering members of the association have done.

At the Wednesday forenoon session the paper of Messrs. Metcalf, Kenchling and Hawley was discussed, the annual election of officers was held and the meeting place of the next annual convention was selected. Mr. Alexander Milne, superintendent of water works, St. Catherine, Ont., who for the past year has been first vice president, was elected as the next president of the association. Mr. Diven was re-elected as secretary-treasurer.

Three cities made an effort to land next year's convention, Louisville, Minneapolis and Richmond. A very spirited, but entirely good-natured contest between Louisville and Richmond developed. Both cities were represented by the presidents of their Chamber of Commerces, and the many good points of each city were brought out, special emphasis in each case being laid upon the superior natural and artificial facilities of the contesting cities to provide for the entertainment of the association. The 1912 convention was awarded to Louisville on the first ballot.

At the Wednesday afternoon session, Dr. William P. Mason of Troy N. Y., talked on the subject of Emergency Intakes, and spoke, in part, as follows:

When an improved water is substituted for a former polluted supply it is a common and an unfortunate practice to allow the old connections to remain in flow so that, in the event of an "emergency," valves may be opened and water from the abandoned intake be admitted to the city mains. Insurance rates depend upon ability to secure water for fire protection, and insurance men are not especially particular as to the quality of water furnished for such a purpose. While we recognize the force of the argument which demands protection against fire, we cannot remain totally deaf to the question, "How much does such protection cost?" an inquiry which in some cases almost takes the form, "Which would a man prefer, loss of his house by fire or death from typhoid fever?"

"Fire protection" has been very destructive of human life at times and we again inquire, is it wise to pay that kind of price for it? Ordinary sewage, being largely water, will readily put out a fire, but it is doubtful if the most stalwart advocate of an "emergency" system would apprrove of admitting straight sewage to the street mains, even in the event of great danger of conflagration. The people at large would oppose such use of sewage, but with polluted water they are willing to "take chances" in times of stress, being ignorant of the fact that they are dealing with "certainties," not "chances," when they open their "emergency" gates. Let a few instances speak for themselves.

At Newark, N. J., in February, 1879, because of water shortage, the polluted Passaic river was drawn upon for the city's supply. As a result there developed 395 typhoid cases and 50 deaths. It is true that public notice was given of the proposed use of Passaic water, but the bulk of the people are very careless about sanitary matters and ordinarily pay small attention to such warnings.

At Lowell, Mass., 1903, during the progress of a large fire grossly polluted water was pumped into the city mains by reason of the failure of certain check valves to properly seat themselves. An "emergency" arrangement then existed whereby connection could be established between private fire lines and the city system. This "arrangement" resulted in 231 typhoid cases and 10 deaths.

At Butler, Pa., on October 20, 1903, the filtered water supply became temporarily unavailable and polluted water was admitted to the mains from a former river intake. A serious epidemic of typhoid fever followed, resulting in 1,270 cases and 56 deaths.

At Ottawa, Can., on January 4, 1911, "the emergency valve at Pier No. 1 was opened for some five hours and the pumps worked at a high rate of speed to pour water upon a burning storehouse." Two weeks later a typhoid epidemic broke out with a record of many cases and deaths.

Still more recently a western city with which the writer had to do, developed a serious typhoid epidemic which was traced, at least in part, to leakage of polluted water around a closed gate of the old emergency intake. There followed over 800 cases of typhoid and a rather high death rate.

Do these "emergency arrangements" pay? Is it good economy to put out a fire at the cost of much suffering and many human lives? Is it not wiser and cheaper and more humane to derive our emergency supplies from sources that are not greatly inferior to those that furnish the water regularly delivered to the people? Even an indifferent water improved by a sufficiently long storage would be distinctly better than the "fire reserve" now too commonly employed.

Mr. T. Chalkley Hatton presented a very interesting paper on Wood Stove Pipe, the more important parts of which are printed in another column of this issue.

Wednesday evening the members of the association were the guests of the Water Works Manufacturers' Association at a fish dinner at Manitou Beach. On the way to the Beach the association visited the pumping station of the Rochester and Lake Ontario Water Company. After dinner the party was taken to Ontario Beach Park, Charlotte. This is the amusement park of Rochester.

The Wednesday forenoon session of the convention was opened by a general discussion on the use of leadite in making joints in cast iron water pipe. A good many members gave the results of their experience with this material. The degree of satisfaction given varied greatly. Some were enthusiastic about leadite, others quite the opposite. All agreed that much depended on the force of men engaged in using the material, and that a thorough knowledge of the material and its properties must be possessed by anyone hoping to use it successfully. In such cases the saving effected by using leadite carries a strong recommend with it, and gives rise to a general willingness on the part of everybody to see the merits of the case. Many who are willing to be shown the value and reliability of this material say they are not yet ready to recommend its use.

Mr. George G. Earl presented a very interesting paper, entitled "Water Rates." This paper was the outcome of Mr. Earl's experience in adjusting the water rates in his home city, New Orleans, in bringing its new water system into operation. First flat rates were tried, with meters optional by consumer or city, and then with all services metered. The high rate of consumption on the flat rate forced the adoption of the all meter system.

With meter rates the average small consumer paid less than half as much for water as he paid formerly under the flat rate. However, the consumption more than warranted the reduction in revenue, which indicates that the difference between meter rates and flat rates in annual payments by the combined rate payers and tax payers, taking everything into consideration and assuming a water works system fully used and kept always 10 years ahead of its capacity requirements, would be at least $450,000 per year in New Orleans.

The chief object of the paper was to outline a proposed method of determining water rates, where all services are metered, which Mr. Earl believes will always be as nearly as possible fair to all rate payers and tax payers, and which is easily adjustable to produce the required revenue.

He believes that in a water works, or any other public service corporation of an at all similar nature such as gas, telephone, electric light, etc., it is possible to arrange: 1st, a service charge that will justly differentiate between different characters of service, and cover certain costs which are applicable only to the individual served; and 2nd, a charge or charges based upon the quantity of service rendered; and urges that any charge for any item that is manifestly very much in excess of the average cost of furnishing or supplying such item is an injustice, which, when patrons once see straight, they will not tolerate.

Taking a water works system as an example, he instanced the New Orleans system, and assumed, as nearly as available, its correct data: 1st, as to first cost and essential divisions thereof; 2nd, as to cost of operation, maintenance and depreciation, including interest, with essential divisions thereof; and, 3rd, as to water consumption, and essential divisions thereof, each of which a proper system of accounting can always determine. He then, first, drew a distinct line between those items which should be paid by the tax payer and those which should be paid by the rate payer, maintaining that public institutions should pay water rates just the same as private consumers even though those rates have to be paid by the tax payer and are only charged to the institution and paid from the tax fund if not actually collected directly from the public institutions themselves, and that it is clearly inequitable for the rate payer, for instance, to pay for water privileges for the schools out of his water rate, though he should just as clearly join other tax payers in paying for them out of his tax rate. Secondly, for all metered consumers, which represent all uses of water except through fire hydrants, he maintained that having established a service charge for each given size and kind of meter and connection, which pays the average cost of meter reading, collection and accounting of water rates, inspection of connections, meters and premises, and interest charges upon, and maintenance and depreciation of those factors which are essentially and exclusively for the individual consumers (as connections and meters clearly are)—all plus a fair profit if the plant is privately owned—that there is no conceivable reason, which is practicable of application in ordinary cases, why any one consumer should get water from the water mains cheaper per unit of quantity than another, be that consumer large or small, private, corporate or a public institution; and that water rates, built up in this way, would be of universal application to almost every all-metered system; that they would permit of easy and certain adjustment as conditions change; that they would be simple, easy to understand, court-proof and fool-proof. The writer does not contend that he has worked out this system perfectly in the example assumed, but he asks correct consideration of the principles involved as suggesting a line along which a logical system can be established which will allow of comparison between rates in different cities through the comparison of items entering into their determination as ascertained through a uniform division of very simple accounts that would be required and somewhat as outlined to serve as a basis for such determination.

Because of the failure of the ordinary water meter to register at all on amounts of water very far below its proper rating, and in order to simplify the system of rates themselves and avoid the necessity of explaining the derivation of the rates to all consumers, the writer advocated a printed schedule somewhat as given below (which is the schedule recommended for New Orleans, where the price for water, after the minimum allowable consumption for a single meter is reached, is 10 cts. per 1,000 gals., said rates being in reality 10 cts. per 1,000 gals. for the stated minimum quantity of water, plus the service charge, as above designated, for each given size meter and connection). These rates eliminate the term "service charge," which has an irritating effect upon the mentality of many consumers

SAMPLE SCHEDULE OF WATER RATES

Size of meter and connection.	Limitation of service.	Quantity of water per year allowed at stated minimum rate.	[illegible] year.
[illegible] in	[illegible] not over two persons and [illegible]	[illegible] gallons	[illegible]
[illegible] in	Serving not [illegible] and rooms..	[illegible]	[illegible]
[illegible] in	[illegible]	[illegible]	[illegible]
[illegible] in	[illegible] limitation	10,000 gallons..	8.00
[illegible] in	No limitation	50,000 gallons..	[illegible]
1 in	No limitation	65,000 gallons..	[illegible]
1½ in	No limitation	[illegible]	[illegible]
2 in..	No limitation	145,000 gallons..	[illegible]
3 in..	No limitation	220,000 gallons..	[illegible]
4 in..	No limitation	260,000 gallons..	[illegible]
6 in..	[illegible]	635,000 gallons..	[illegible]
8 in..	No limitation	[illegible]	194.00

[illegible] that they assume that any charge whatever, under a new name, is a new form of extortion; yet they leave open for demonstration, [illegible] cold logic, which forms its real basis. This method of rate making also provides a way to [illegible] and quantity and charge for a compound or detector meter used on a fire service and a disc, velocity or other non-compound meter used on an ordinary service.

Water in excess of the above stipulated quantities is charged at the rate of 10 cents per 1,000 gallons. Meters are read quarterly or monthly, as consumption and conditions warrant, and quantity of water allowed at minimum rate is pro-rated proportionately to stated yearly quantity.

If one meter serves two or more houses and one responsible owner guarantees and pays the bill, the cost per house or family can go to anything which the consumption warrants. There are instances in New Orleans where this is done, and the cost per family seems to be ridiculously small, yet these payments just as fully reimburse the sewerage and water board for the service rendered as do the payments made by the largest consumer for the service rendered to him. Without such a schedule these small consumers would not have become consumers at all unless forced to do so.

At the afternoon session Mr. Geo. C. Whipple of New York City presented a very carefully prepared technical article on "Hot Water Troubles." The paper dealt chiefly with the "rusty" or "red water plague." This trouble is caused by the corrosion of steel and iron service pipes, tanks, boilers, etc. Mr. Whipple handled the subject from the chemist's point of view and the paper was of such a comprehensive and detailed scope that it is impossible adequately to prepare an abstract of it in the space available in a review of the convention.

A very helpful paper on the subject, "Interpretation of Chemical and Bacteriological Terms Used in Water Analysis," was presented by Mr. Daniel D. Jackson of New York City. So many references are made to chemical and bacteriological tests in all articles relating to water and sewage purification in the technical papers and in the proceedings of the various engineer societies that a knowledge of the outline of the methods used in conducting these tests is essential to even a fair understanding of the articles mentioned. Mr. Jackson outlined these methods in an admirable manner and this journal will print the text of his paper in an early issue. His paper was illustrated with lantern slides showing various forms of algae and bacteria.

Dr. John S. Seal presented a paper on "The Purification of Drinking Water." The paper was a review of the various systems of purification which have been adopted and are now in use, and was presented from the chemist's and bacteriologist's point of view.

The business of the afternoon session (Thursday) was concluded by Mr. Chas. Carroll Brown's paper on "Methods of Keeping Records of Improvements to Establish Water Works Plants." Owing to the lateness of the hour, Mr. Brown could scarcely more than outline his paper, but enough information was given to show the exceptional value of the paper. The central idea of the paper was the method of keeping records of all disbursements, value of stock and cost of construction and repairs. Since this journal is especially interested in cost keeping systems, a very full abstract of Mr. Brown's paper will be published soon.

At 8 o'clock in the evening all the members of the association and their guests attended an open air band concert held in the park arena.

The convention took up unfinished business at the opening of the Friday morning session. The matter of establishing a permanent headquarters [illegible] and thoroughly discussed. It was suggested that such a move on the part of the association would greatly benefit the members. At present the secretary of the organization is a water works superintendent and his ordinary business fully occupies his time. Often some member who wishes to obtain information relating to some paper or discussion in past issues of the proceedings writes to the secretary. However, the number and nature of these inquiries are such that a man who has to attend to other business cannot spare the time to search the files for the information desired. It was suggested that a clerk be employed for that purpose. A motion was passed to appoint a committee to take the matter of permanent headquarters and allied questions into consideration and report to the next annual meeting.

Mr. John C. Trautwine presented a paper and talk on the subject of "Public Utilities." Mr. Trautwine is a very enthusiastic municipal ownership man. He characterizes the private ownership of public utilities as a relic of the past.

Mr. Alexander Milne presented a short paper and discussion on the use of "Compressed Air in Water Works Construction." This papaper related especially to caulking lead joints by means of the pneumatic hammer, and the author gave his experience with that method and contrasted the pneumatic and hand labor methods.

A paper had been prepared by A. E. Walden on the subject, "Ultra-Violet Ray Sterilization," but as he was unable to be present, Secretary Diven read the paper. It was a description of the method used to disinfect drinking water by subjecting it to ultra-violet rays. The efficiency of the method is high, but as yet the cost of operation on a commercial scale is prohibitive. Improvements are looked for in the apparatus and developments along that line will be interesting.

Several papers were read by title and will be printed in the proceedings of the association.

Shortly before noon on Friday Mr. Alvord, the retiring president, made a short address, summing up the work of the association for the past year and the business of the present convention. He then turned over the gavel and the authority of his office to Alexander Milne.

President Milne made a short address, expressing his appreciation of the honor the association had conferred upon him, and after a short discussion by various questions submitted in the question box and a general discussion of plans for the coming year, the association adjourned to meet again next year in Louisville.

Characteristics of Wood Stave Pipe with Some Examples of Its Use and Cost for Water Supply.*

There are two distinct forms of wood stave pipe in common use. One is termed "continuous" and the other "machine made." Both are built of the same character of wood, and the staves are of equal thickness for like pressures. Those built into "continuous" pipe are made of uniform thickness throughout their lengths, with a bead on one longitudinal edge and with a saw kerf at each transverse edge into which a metal plate is inserted to make a water tight joint. The bead on the longitudinal edge serves to make a water tight joint by being squeezed into the face of its neighboring stave when the iron bands surrounding the pipe are cinched up. The staves are made in unequal lengths to enable joints to be broken in constructing the pipe. The staves are held together by round iron or steel bands of such diameters and spacing as will retain the pressures required, each end of the bands passing through a malleable iron shoe and having a thread to which a nut is fitted. Thus the staves can be brought together so close that no leakage can occur unless it oozes through the grain of the wood.

This form of wood pipe is built in the trench, and from 16 ins. to any diameter required, but is more commonly used for pipes over 24 ins. in diameter. It has one special feature well worth noting, if the pipe leaks at any point in the longitudinal joints, these leaks can be easily stopped by cinching up the bands near the leaks or if some defect shows up in the pipe line a few years after building, sections can be easily removed and replaced, by substituting new staves, or new bands.

The staves built into "machine made" wood pipe have two beads upon one longitudinal edge and two corresponding grooves in the other longitudinal edge. The beads are a little larger than the grooves, thus insuring their being totally filled and made water tight. At one end there is a tenon, cut 4 ins. long, where the staves are one-half the thickness of the balance of the walls of the pipe. On the other end there is a chamber cut 4 ins. deep. The tenon is smaller in diameter at the end than at the shoulder and when driven into the chamber makes a water tight joint, even though the two shoulders are not in perfect contact.

The staves are cut radially to correspond with the diameter of the pipe, and are held together by a steel band, steel wire or copper clad wire. This band or wire is wound spirally upon the pipe by a machine. The high tension produced by the machine squeezes the beads into the grooves making a longitudinal joint that cannot leak so long as the elastic limit of the band is not overcome.

Where steel is used for banding the pipe it is run through a bath of warm asphalt, which adheres to its surface, thus protecting it from any water which might ooze through the grains of the wood. After the pipe is wound, and the tenon and chamber cut, it is rolled in a bath of hot asphalt which adheres to the outside of the steel and wood protecting them from outside oxidizing agents. It is then rolled in a bed of sawdust. This saw dust enters into the asphalt and forms a protection for it in shipment and handling.

"Machine made" wood pipe are made in lengths from 5 to 12 ft. and shipped to the work ready to be laid. They are laid by driving one piece into another until the two shoulders are in contact, or nearly so. No skilled labor is required; the inspector standing on top of the trench can readily observe whether the pipe has been driven home by observing the two shoulders. This form of pipe is made for diameters from 3 ins. to 36 ins. Either form can be laid around curves of from 90 to 200 ft. radius, according to the diameter of the pipe.

One of the usual questions asked is "What pressure can wood stave pipe safely withstand?" The proper reply to this is that the tensile strength of the material composing the bands represents the pressure the pipe will stand. Wood pipes are made to withstand pressures up to 200 lbs. per sq. in., so far as the writer knows. The more the pressure under which the pipes are subjected, the more steel or wire is required to band them together.

As the tensile strength and elastic limit of iron and steel are well known, it becomes a simple matter of computation to determine the gage and spacing of the bands to make a wood pipe which will withstand any pressure up to 200 lbs. Beyond this pressure it is likely the water would waste through the pores of the wood so that a higher pressure would not be economical or practicable.

The writer has experimented with wood pipe up to a direct pumping pressure of 300 lbs., without fracturing the pipe. This experiment was made to ascertain what a pipe built for pressures up to 100 lbs. would do if it was subjected to a water hammer equal to three times the pressure. At 250 lbs. the water oozed through the walls of the pipe. At 300 lbs. it spurted in small streams at a few of the longitudinal joints, with a few leaks at the transverse joints. The pressure was suddenly removed to nothing and gradually brought up to 100 lbs. with the result that the leaks stopped. This showed that, while the steel bands had been stretched, the elastic limit had not been overcome, and the pipe would, under such conditions as frequently exist in a long pipe line, safely withstand a wide range of pressures suddenly applied.

Pressures from 100 to 150 lbs. are common in machine made wood pipe, while continuous pipe of large diameter is successfully operating under pressures from 80 to 130 lbs.

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*[illegible] T. Chalkley Hatton, [illegible] Works Association [illegible]

Assuming that wood stave pipe is laid where it will be constantly subjected to water pressure the life of such pipe is dependent upon the life of the material with which it is banded. While the fact is somewhat problematical there are well known installations where steel banded pipe has been in continuous operation for 50 years without apparent deterioration. While the writer has industriously made inquiries wherever such might be expected to give reliable information he has failed to learn of a single case where steel bands have given way on machine made pipe.

The engineer who designs a continuous wood stave pipe provides for at least a factor of safety of 3 in determining the size and spacing of his bands. The manufacture of machine made pipe provides for an equal factor of safety. Now when steel or iron corrodes it does so by pitting, and thus it is reasonable to assume that two-thirds of the cross-section of the steel can oxidize before the band will fail under ordinary conditions. From the writer's observation sheet steel, such as composes the bands of machine made wood pipe, pits in irregular spots, and never on a straight line, thus the band may be two-thirds gone before the pipe will fail.

Where oxidizing agents are known to exist, such as in salt marshes, through salt water or sulphur deposits, the pipe should be banded together with copper clad steel wire. This copper clad wire is cheaper than solid copper wire. It has an elastic limit of about 50,000 lbs. per sq. in., a tensile strength of from 90,000 to 100,000 lbs., and a coefficient of expansion less than two-thirds that of copper. Thus it becomes a product equal in strength with the steel and far better than copper. The writer knows of several cases where copper clad steel wire wound wood stave pipe has been successfully used where cast iron and steel pipe were very unsuccessful.

The claim is made by wood pipe manufacturers that wood pipe has a greater carrying capacity than cast iron pipe of equal diameter, and from a few well conducted experiments this claim seems reasonable. Marx, Wing and Hoskins conducted careful experiments to determine the coefficient of friction in wood pipes.* They found that coefficient *n* amounted to .009. Mr. Campbell on the El Paso and Southwestern Ry. pipe line, heretofore referred to, found the value of *n* in 13,200 ft. of 10-in. wood pipe to be .00866, and in 47,500 ft. of 16-in. wood pipe to be .0092.† Mr. Campbell had exceptional facilities for determining the true values of *n* which are rarely found in actual practice.

The value of *n* in new cast iron pipe has been determined repeatedly and found to be .012. From the results of these experiments it appears quite true that a wood pipe has greater capacity than cast iron of like diameter. For instance a 12-in. wood pipe with a loss of head of 8.85 ft. per 1,000 will carry approximately 2,025 gals per minute, whereas a new 12-in. cast iron pipe under the same loss of head will carry about 1,810 gals per minute. A 30-in. wood pipe under a loss of head of 2.05 ft. per 1,000 will carry about 11,600 gals. per minute, whereas a 30-in. cast iron pipe under the same head will carry about 8,810 gals per minute. The longer the cast iron pipe is used the less its carrying capacity, under frequent conditions. The capacity of wood pipe does not diminish with age, the inside perimeter becoming smoother from use.

So far as the writer's knowledge goes there have been very few well conducted observations made of the leakage from wood pipe lines. From general observations made by the writer of lines in operation, no leaks of any significance have been apparent. Mr. Campbell, however, conducted careful observations on his lines, and states that, after two years, there was no material leakage in the 10 miles of 10-in. and 16-in. wood pipe line between the source of supply and the reservoir, which pipe was working under a maximum pressure of 130 lbs. That in the 12.6 miles of 11-in. and 12-in. pipe lines below the reservoir, and subjected to a less pressure, the 11-in. line leaked 17.046 gals. per mile and the 12-in. about 3.702 gals. per mile. Along the railway, when the maximum pressure was 130 lbs. the 11-in. pipe leaked 120 gals. per mile, and 8½-in. and 7½-in. pipe leaked 268 gals. per mile. It occurs to the writer's mind that if there were 103.4 miles of wood pipe in this installation wherein the maximum leakage was 268 gals per mile, and 8.6 miles wherein the leakage amounted to 17,046 gals. per mile, there must have been some defective joints or pipes in the latter section which needed looking after, that if 90 per cent of the whole line was practically water tight, the other 10 per cent could easily be made so. However, from the result of the careful observations made by Mr. Campbell, it seems reasonable to assume that wood pipe, properly made and laid, can be made water tight under a pressure of at least 130 lbs.

This subject may be concluded by considering the difference in cost in installing wood stave and cast iron pipe. This difference is made up of several items, as, for instance: the cost of the two characters of pipe delivered f. o. b. cars at nearest railway point. Hauling pipe alongside of trench, width and depth of trench. Laying pipe, etc.

The difference in cost of furnishing and delivering the two characters of pipe at railway points is largely dependent upon the difference in diameters of the pipes to be used. The larger the diameter the greater the difference. The difference in weights per foot of pipe also increases in direct ratio to the increase in diameters. Therefore the cost of transporting wood pipe from railway to trench is from one-third, for wood pipe 8 ins. in diameter, to one-sixth, for wood pipe 30 ins. in diameter of the cost of transporting cast iron. To overcome frost conditions the wood pipe need not be built as deep as cast iron pipe, as wood is a good non-conductor and can be laid closer to the surface of the ground without being damaged by frost. In laying wood pipe no bell holes are necessary, and this item of cost is eliminated, which, in rock excavations, becomes a very important item. As there is no lead and hemp used in laying wood pipe these items of cost are eliminated, as is the cost of melting lead, transporting and furnishing fuel, and caulking joints.

While it is [illegible] showing the difference of cost between furnishing and laying the two characters of pipe which will fit conditions existing generally, it can easily be determined at a glance that there is a difference in favor of wood pipe; that this difference depends upon the size of the pipe, and that it can easily be determined for each locality when freight and labor charges are known.

A few instances of known costs might be interesting. The 23 miles of 30-in. continuous wood stave pipe laid for supplying Lynchburg, Va., with water, under the direction of Mr. James H. Fuertes, M. Am. Soc. C. E., cost, for furnishing and laying pipe, exclusive of trenching and backfilling, from $1.82 to $2.10 per. lin. ft., depending upon spacing of bands. This wood was shipped from the Pacific Coast at a freight rate approximately $300 per car.

The 42-in. continuous wood stave pipe laid as a supply main for the Atlantic City Water Works, under the direction of Mr. Kenneth Allen, M. Am. Soc. C. E., cost, exclusive of trenching and backfilling, $2.25 per lin. ft.

The 24-in. machine made pipe line laid under the direction of the writer for Carney's Point, N. J., cost, exclusive of trenching and backfilling, $1.32 per lin. ft.

Comparing the above costs with the cost of cast iron pipe of equal diameter, delivered f. o. b. cars at railway point, and the cost of lead and hemp for making joints, omitting transportation charges from railway to trench, laying charges, extra excavation for bell holes, fuel for lead melting, caulking and handling cast iron pipes.

The [illegible] cast iron pipe would cost at $[illegible] per ton [illegible]

The [illegible] cast iron pipe would cost at $[illegible] per ton [illegible]

The 24-in. cast iron pipe would cost at $22 per ton [illegible]

The difference in cost of laying wood and cast iron pipe including trenching and backfilling, and under exactly the same conditions, is well set forth in Mr. Campbell's paper above referred to.

He states that the 384,300 ft. of wood pipe from 11 to 3½ ins. in diameter were laid at an average cost of $0.0472 per lin. ft., whereas the 101,200 ft. of 12-in. cast iron pipe, including lead and hemp, were laid at an average cost of $0.2343 per lin. ft.

It is not the writer's purpose to recommend to his colleague, who may be interested in laying supply mains for water works, wood stave pipe under all conditions, but to suggest that, after knowing the conditions, he look into the advisability of using wood stave pipe, study its applicability to the existing conditions, including the comparative cost with cast iron or steel pipe, keeping his mind open to recommending the installation which will best suit the conditions, and he will find many circumstances when he can save his client's money and secure for him equal service.

Wood stave pipe has long been familiar to western engineers and water works superintendents. The great cost of transporting cast iron pipes from the East was prohibitory and engineers were forced to use wood pipe. These, however, have proven so efficient after many years' trial that they are being used wherever conditions are proper. There are many contractors who make a specialty of installing continuous wood stave pipe, and there are several manufacturers of machine made wood pipe in the United States, prominent among whom may be mentioned the Washington Pipe and Foundry Co., on the Pacific slope, the Eastern Mfg. Co., and A. Wyckoff & Son Co., of Elmira, N. Y., Smith and Son, of Bay City, Mich., and A. Wyckoff and Son Co., of Alexandria, Pa. To those who are interested in securing detailed information upon wood pipe the writer would refer them to the above [illegible].

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*See Trans. Am. Soc. C. E., Vol. [illegible]

†See Trans. Am. Soc. C. E., Vol. [illegible]

STEAM AND ELECTRIC RAILWAY SECTION

Methods of Computing the Dimensions of Railway Crossings.

In the matter of ordering railway crossings practice varies among the railway companies. Some railway companies submit to the crossing manufacturer, in addition to specifications, only such data as central angle, radii of curves and gages of tracks. Other roads have a series of standard plans covering all conditions of angle and curvature that may arise. These plans are complete as to details of construction and are usually accompanied by specifications. There is, however, a large class of railways that make a practice of supplying the crossing manufacturer with working drawings for each individual crossing. Such plans show all dimensions and details of construction. From them the manufacturer is able to make shop drawings, which cover all the small details of shop work, such as cutting and binding of rail, castings, drilling, etc.

Few if any field books cover the methods of computing the dimensions of crossings, and comparatively few engineers are familiar with these methods. It is, therefore, believed that the following outline of the most direct methods of making these computations will be of interest to our readers. The data furnished the computer, usually in the form of a sketch [illegible] intersection of center lines of tracks, radii and direction of curves, and gages of tracks (dependent on degree of curve). From these data are computed the length of each side of the crossing (the distance between the theoretical points of adjacent frogs), the lengths of long and short diagonals, middle ordinates of curves, and spreads at the heels of frogs.

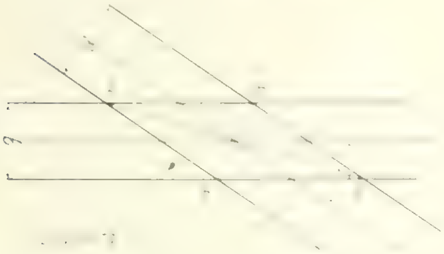

Fig. 1—Method of Computing Crossing of Two Straight Tracks.

CROSSING OF TWO STRAIGHT TRACKS.

The computation of the crossing of two straight tracks is so simple as hardly to require any explanation. Such a crossing is shown by Fig. 1. Side AB, as an example, is computed by means of the trigometrical relation

$$AB = \frac{g}{sin.\ I}$$

in which

g = gage of track, and

I = angle of intersection.

In tracks of equal gage, where both are straight, the four sides will be of the same length. In computing the long diagonal, AA, the following formula is used:

$$AA = \frac{g}{sin.\ \frac{1}{2}\ I.}$$

The short diagonal, BB, is computed from

$$BB = a\ sec.\ \tfrac{1}{2}\ I$$

$$= \frac{g}{cos.\ \frac{1}{2}\ I}$$

Spreads.—The spread of a frog or crossing may be considered in any one of three ways. One method is to consider it as a tangent of the frog angle, the computation being made for some specified distance from the theoretical point of frog to, or in the direction of, the heel of frog. Another method is that of considering the spread as a line at right angle to a line bisecting the frog angle. By this method the spread is equal to the length of the bisecting line multiplied by twice the tangent of half the frog angle. The third and most common method is that of considering the spread as a chord connecting points on the gage lines equidistant from the theoretical point of frog. This method possesses the advantage over the others of being the easiest of application either in measuring or in laying out. It is subject to the disadvantage, however, of being inapplicable to the measurement of spreads in ladders, since the line of the spread in this method is not at right angle to the center line of the main track. In this particular the first method outlined above is the best. It is difficult to see any advantage, practical or theoretical, in the second method outlined above.

CROSSING WITH ONE TRACK STRAIGHT AND ONE TRACK CURVED.

A diagram showing the method of computing the crossing of a straight track and a curved track is shown by Fig. 2. In this case it is necessary to work all computation from the center of the curve and from a radius perpendicular to the straight track. The distance GL is first found as the product of the radius and the cosine of the intersection angle. Then

$$GL - \tfrac{1}{2}\ G_1 = HL \text{ and}$$
$$GL + \tfrac{1}{2}\ G_1 = FL$$

By the solution of the right angle triangles formed by these two lines and the radii of the inner and outer rails of the curved track the distances [illegible] HC and HD are determined. Subtraction gives the sides AB and CD. The side AC is computed from the right angle triangle AKC, HK being equal to EA. The computation of the side BD and of the long and short diagonals is performed in the same manner as that for AC.

The frog angles are next computed, each frog angle being equal to the angle formed by the intersection of the radius passing through the frog point and the radius perpendicular to the straight track. In computing the spreads, as at F, it is necessary to allow for the curvature between A and F. The frog angle at A less one-half the angle subtended by the curve AF is the angle to be used in computing the spread at F. Inspection of the diagram will show in any given case whether this angle is to be added to or subtracted from the frog angle. The computation of middle ordinates for the curves AC and BD, and, where required, the deflections of the curves at the heels of frogs, complete the operation. For convenience in laying out or checking the work deflections are always computed from the chords (as at AC and BD) extended, and not from a tangent to the curve at the frog point.

CROSSING OF TWO CURVED TRACKS.

The computation of a crossing of two curved tracks is considerably more complex than the preceding case, and, by whatever method undertaken, involves tedious calculation. Several methods are in use for computing crossings of this kind, but the method outlined below is believed to be the most direct. Furthermore it involves the use of a diagram on which figures are placed as secured, a matter always of advantage to the computer.

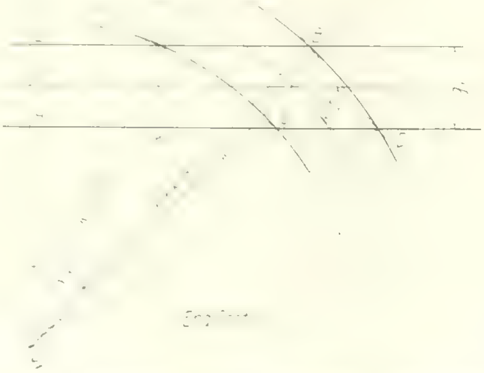

Fig. 2—Method of Computing Crossing With One Track Straight and One Track Curved.

A diagram for this computation is shown by Fig. 3. The first step is to compute the length of the line KL joining the centers of the two curves. For this computation we have the angle of intersection, I, and the radii of the two curves, designated as R_1 and R_2. Angles K and L are found by the following formula:

$$tan\ \tfrac{1}{2}\ (L - K) = \frac{(R_1 - R_2)\ tan\ \frac{1}{2}\ (L + K)}{R_1 + R_2}$$

assuming that

$$L > K \text{ and}$$
$$R_1 > R_2$$

The sum of the angles K and L is equal to 180° — I. Having derived their difference as outlined above it is an easy matter to compute the individual values of these two angles. There is thus given a triangle with two sides and three angles known. The third side KL is computed by means of the proportionality of sides to the sines of opposite angles. Particular care should be observed in computing the side KL, as any error in the length of this line will affect all subsequent portions of the computation.

In curved crossings the radii are usually different, with a resulting difference in gages. The gages are, therefore, designated as G_1 and G_2, corresponding to the radii R_1 and R_2.

The frog angles are next computed. For each frog angle there is given a triangle with the three sides known. For example, there is given for frog D the side KL, the side $KD = R_1 - \tfrac{1}{2}\ G_1$, and the side $LD = R_2 + \tfrac{1}{2}\ G_2$.

Any one of several trigonometrical formulas, of which the following is probably the simplest in application, may be used in determining this angle:

If $s = \tfrac{1}{2}\ (KL + KD + LD)$ then,

$$sin\ \tfrac{1}{2}\ KDL = \sqrt{\frac{(s - KD)\ (s - LD)}{(KD)\ (LD)}}$$

A perpendicular is then drawn from D to the line KL, and the distances KM and ML computed as follows:

$$ML + KM : KD + LD = KD - LD : ML - KL.$$

The length of the perpendicular, DM, is found by solving the right angle triangle KMD or LMD. For each frog a calculation similar to the above is performed. There is thus determined a series of distances along the line KL, and perpendicular distances from KL to the points of frogs, from which, by addition and subtraction, right angle triangles similar to DEC may be derived. From these triangles the sides and diagonals are readily computed, the sides in a curved crossing being considered as the chords connecting the theoretical points of frogs.

In computing the spreads allowance for curvature is made as explained in connection with a single-curve crossing, with the added consideration that the frog angle is modified by the algebraic sum of the small angles determined from the two curves.

THE USE OF LOGARITHMS

Except in computing the simple case of a crossing of two straight tracks, logarithms should be used in making these computations. The use of natural figures and functions, particularly in the case of two curved tracks, is exceedingly laborious and results in an unnecessary loss of time. Experienced computors, who know the exact limits of accuracy of their tables, are able to get correct results from 6-place logarithmic tables. It is far safer, however, to use 7-place tables, such as Chambers or Vega. With 7-place tables the maximum error due to the tables is of no practical importance in view of the limits of accuracy in making measurements and in cutting and bending steel under ordinary shop conditions.

REDUCTIONS FOR FINAL PLAN

In order to avoid the possibility of accumulated error it is best to carry all natural numbers in a crossing computation to 4 decimal places. In deriving the final figures, however, such accuracy as this is not only unnecessary, but is an actual detriment to the shop man. The final figures are always given in feet and inches. An ample degree of accuracy is secured by reducing sides and diagonals to the nearest sixteenth of an inch, and spreads, middle ordinates and deflections to the nearest thirty-second of an inch. These units are well below the unavoidable errors of practical shop work. In the matter of

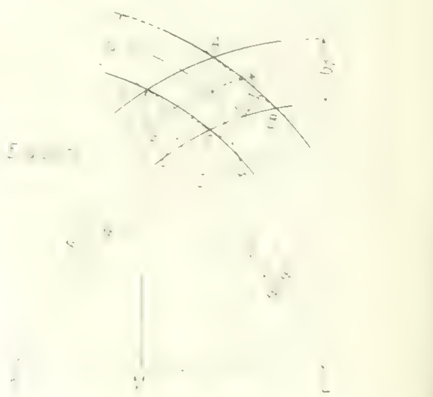

Fig. 3—Method of Computing Crossing of Two Curved Tracks.

angles, also, reasonable limits should be observed. Fractions of a second are out of place on a working drawing. A reduction to the nearest second is ample. Even this degree of accuracy is unattainable in shop work. But it is justifiable for the reason that the second is the logical unit for small angular measurements.

The Cost of Railroad Signal Protection.

BY JAMES B. LATIMER.*

There is a branch of railroad engineering which has so recently come to the fore that very few reliable data as to its cost have thus far been recorded, and yet as hardly any new work is planned now-a-days in which it does not appear, the readers of ENGINEERING & CONTRACTING may be interested in having some figures compiled from the cost of actual work of this nature. What I refer to is signaling and interlocking.

Mechanical interlocking, which is the type by far the most frequently met with, is today almost always built in a much more substantial and permanent manner than was formerly the case, which, of course, adds not a little to its first cost. Good construction, however, cheapens the cost of maintenance and materially lengthens the life of a plant of this sort so as to make the annual percentage to be charged off for depreciation considerably less than it was formerly. There is no doubt, therefore, that substantial tower buildings, the substitution of concrete and metal for wood in that part of the work which is exposed to the weather, and the substitution of pipe lines for wires is a paying investment in the end. The present form of construction accepted by most signal engineers completely eliminates the use of wood. Even the oak pipe carrier base or foundation top to which until recently the pipe carrier sides were fastened with lag screws, and which was the last ditch to which the use of timber was driven, is now giving way before several forms of metal bases, which have appeared on the market during the last two or three years.

Oak blocks, to which cranks, compensators and switch and lock movements were at one time always bolted, were driven off the field some four years back.

MECHANICAL INTERLOCKING.

The generally accepted unit for rough estimating is the working lever, and very substantial plants can be constructed for, roughly speaking, $400 per lever. This includes the tower and "power" (electric) distant signals, but does not include electric route locking, which adds considerably to the expense.

The accompanying figures (Tables I and II) give the actual cost in detail of 2 interlocking plants installed within the last year, one a plant to protect a grade crossing of 2 single track lines, almost at right angles to each other, with power distant signals on both lines and quite elaborate electric route locking. This machine contained 14 working levers and two spare spaces, and as there was apparently no immediate likelihood of enlargement the tower was made simply large enough for a 16 lever machine. Details of the cost of this plant are given in Table I.

The other was a plant to protect a junction of a single and double track line, with a number of switches, one of which was 1,600 ft. from the tower. The machine had 47 working levers and 5 spare spaces—a 52 lever frame. This plant had two power distant signals and two mechanical time locks, but no electric locking. Details of cost are given in Table II.

In both cases the tower buildings were contracted for and were built by the same contractor. He furnished all material and built the towers complete, including the foundations and service building. The towers are heated by hot water heaters which were installed by the railroad company's forces.

The reader will note that his attention was called to the fact that in the first case the railroad lines were nearly at right angles.

TABLE I.—DETAIL COST OF 16-LEVER INTERLOCKING PLANT WITH 14 WORKING LEVERS.

1 16-lever frame interlocking tower with concrete foundation and storm sash complete. Cost by contract		$ 925.00
1 hot water heater and necessary piping for same		101.69
Labor section men unloading material putting in ties and derails		54.20
Labor linemen stringing wires for distant signals		22.80
Labor signalmen installing interlocking and heater		1,608.22
1 interlocking machine with 14 levers and 2 spaces at $22.50 per working lever and $9.00 per space		333.00
10 vertical 90° deflecting bars	$ 6.40	$ 64.00
10 horizontal 90° deflecting bars	1.10	11.00
24 1½" cranks R. S. A. standard	1.60	38.40
14 compensators R. S. A. standard	[illegible]	66.50
25 one way pipe carriers	[illegible]	6.25
260 three way pipe carriers	[illegible]	[illegible]
8 eight way pipe carriers	1.81	12.67
10 one way transverse pipe carriers	.95	9.50
4 two way transverse pipe carriers	1.12	4.48
6 three way transverse pipe carriers	1.35	8.10
104 solid jaws, R. S. A. standard	.61	63.44
10 screw jaws, R. S. A. standard	.81	8.10
1 pipe lug, R. S. A. standard	.86	.86
10 point adjusting screws (turn buckles)	1.22	12.20
2 complete layouts for Wharton detail with facing point lock	[illegible]	[illegible]
2 complete layouts for Wharton detail with switch and lock movement	[illegible]	[illegible]
2 one blade pipe connected home signals	65.00	130.00
2 two blade pipe connected home signals	86.00	172.00
4 electric distant signals	187.50	750.00
2 electric time locks	30.00	60.00
2 hand releases	25.00	50.00
2 4 ohm indicating relays	11.50	46.00
4 500 ohm relays	19.00	76.00
4 circuit breakers for machine	9.00	36.00
4 floor pushes	1.95	7.80
1 large relay case for tower	....	14.00
4 commutators for home signal poles with operating rods	10.50	42.00
4 electric locks for machine	22.50	90.00
8 6½" red roundels	.68	5.44
4 8⅜" red roundels	1.05	4.20
4 8⅜" yellow roundels	.70	2.80
4 8⅜" green roundels	.70	2.80
4 6½" green roundels	.40	1.60
8 3" purple roundels	.13	1.04
50 lbs. ¼ x 9-16" pipe rivets (cwt.)	3.21	1.61
7,000 ft. 1" signal pipe R. S. A. standard	[illegible]	[illegible]
10 R. S. A. standard semaphore lamps	3.60	36.00
90 cast piers for cranks, compensators and deflecting bar foundations	.70	63.00
180 bolts for same ¾"x2½"	.04	7.20
325 8"x12"x24" concrete blocks for pipe line foundations	.30	97.50
650 hook bolts for same	.08	52.00
300 6 way metal bases for pipe carriers	.45	135.00
35 1 way metal bases for pipe carriers	.18	6.30
2,600 ½"x1¼" carriage bolts (C)	.56	14.56
75 bbls. Portland cement	2.15	161.25
87 yards concrete gravel	.30	26.10
32 hook bolts 1"x36" for signal pole foundations	[illegible]	3.84
2 right hand Wharton derails	35.00	70.00
2 left hand Wharton derails	35.00	70.00
8 pcs. oak 16"x10"x12' [illegible] (M) 2 pcs. oak [illegible]	30.00	[illegible]
10 gals. pipe line paint (mixed) gal	[illegible]	[illegible]
¼ gal. red signal paint (mixed)	2.40	.60
¼ gal. green signal paint (mixed)	2.40	.60
⅛ gal. yellow signal paint (mixed)	2.40	.30
2 gals. lard oil	.44	.88
12 gals. black oil	.08	.96
3 lbs. graphite	.10	.30
3 quarts [illegible]	.20	.60
2 tons [illegible]	[illegible]	[illegible]
33,000 ft. [illegible] wire 1,31[illegible] lbs.	[illegible]	[illegible]
50 8 ft. 6 wire cross arms	.50	25.00
50 pairs cross arm braces (C)	5.70	2.85
150 cross arm pins (C)	3.50	5.25
150 glass insulators (C)	3.45	5.17
50 through bolts (C)	2.58	1.29
4 small concrete battery wells	12.00	48.00
1,200 ft. [illegible] wire [illegible]	[illegible]	[illegible]
200 creosoted stakes 3"x4"x3'	.15	30.00
50 creosoted stakes 3"x4"x4'	.17	8.50
[illegible]	[illegible]	[illegible]
1,500 ft. No. [illegible] rubber [illegible] wire (M)	21.50	96.75
1,000 ft. No. [illegible] wire (M)	[illegible]	[illegible]
50 ft. No. 12 flexible rubber covered wire (M)	22.00	1.10
1 gal. insulating paint	1.55	1.55
[illegible]	[illegible]	[illegible]
12 insulated track joints	5.25	63.00
1 battery cupboard for tower [illegible]		[illegible]
600 [illegible]	[illegible]	[illegible]
1,200 channel pins (M)	6.50	7.80
80 cells [illegible] battery	[illegible]	[illegible]
6 cells gravity battery	.85	5.10
2 battery chutes	10.50	21.00
10 lbs. solder	.20	2.00
5 lbs. friction tape	.80	4.00
5 lbs. covering tape	.50	2.50
2 lbs. soldering paste	.50	1.00
100 porcelain cleats for inside wiring (C)	1.44	1.44
1 operator's table		9.00
1 centre lamp for tower	....	3.50
2 wall lamps for tower (doz.)	9.50	1.59
1 clock for tower		12.50
1 frame for manipulation chart	....	1.35
1 rubber mat, 3 ft. by 9 ft. 35 cts. per foot	....	3.15
Total	...	$[illegible]

This sort of a track layout usually adds to the cost of a plant, and in close estimating should be allowed for. The reason being that pipe lines to the signals and derails each side of the crossing on each line must be run on a separate set of foundations, which require more labor to set; besides which the concrete blocks which carry the pipe carriers cost about 30 cts. each. They are set every 7 ft. and as they will carry 6 lines of pipe as easily as they will 1, there is always a slight economic waste when they are not worked to their limit.

The Railroad Signal Association has adopted a table of so-called "operated units" which is designed to be used as a unit by which to divide the cost of construction and maintenance of joint interlocking plants. These units are shown in Table III.

This table works out very evenly as to cost, both of installation and maintenance, and might with advantage be used in place of the levers for estimating. For instance, in the first plant described above there were 24 operated units and in the second 68, which averages $272 per operated unit, which will be found a very fair figure for rough estimates.

The lever basis does well enough where no power signals or electric locking is introduced, but when, as is now pretty generally the case, either or both of these factors come in, the unit basis will be found to give more satisfactory results.

It should be noted also that the labor for both of the interlocking plants described, approximates $65 per unit. These figures are actual and show that the work can be done for that money. Many signal engineers estimate and spend much more than these amounts. All the writer can say is that when the labor exceeds $70 per unit, the person who is to pay the bill had better analyze the figures and discover, if possible, the causes for the excess.

The foregoing are, of course, "Railroad Company's" figures and do not include any charges for transportation of men, tools and material or any overhead charges.

POWER INTERLOCKING.

The cost of power interlocking (i. e., that in which the signals, switches, etc., are operated by electricity or compressed air), varies much more than does that of mechanical interlocking, and as none of the signal companies publishes a complete price list of the apparatus of this nature manufactured or furnished by it, really reliable estimating figures are hard to obtain. Six hundred dollars a function is a fairly safe figure, including tower and power plant; but as this sort of interlocking is rarely used except in large terminal work, so that the question does not come up often, the signal company whose apparatus is to be used had best be consulted if a very close estimate is desired.

[illegible]

The cost of a manual block, train order or station signal is about $100.00 per station. The items are as follows:

One 2-bladed station signal complete with lamp, table levers and connections	$ 74.00
Concrete for foundation	6.00
[illegible]	[illegible]
Total	[illegible]

[illegible] the track or any distance away from the station, allowance must be made for such fact.

[illegible]

The cost of automatic block signals varies with the number of signals used, the type of

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*Signal Engineer, C. B. & Q. R. R., Chicago, Illinois.

TABLE II.—DETAIL COST OF INTERLOCKING PLANT OF [illegible] LEVERS AND [illegible] SPACES WITH NO ELECTRIC BOLT LOCKING.

[illegible]		[illegible]
Machine [illegible]		[illegible]
Labor [illegible] and [illegible] thereto		[illegible]
Labor [illegible]		[illegible]
[illegible] interlocked		[illegible]
[illegible] with [illegible] per foot [illegible]		[illegible]
[illegible] detector bars	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible] R. S. A. [illegible]	[illegible]	[illegible]
50 R. S. A. compensators	4.75	237.50
[illegible] way pipe carriers	[illegible]	[illegible]
3,640 pipe carrier sides	.11	400.40
[illegible] top rollers	[illegible]	[illegible]
3,200 bottom rollers	.05	160.00
3,200 straps	.02	64.00
3,700 3/16"x1½" spring cotters (C)	[illegible]	[illegible]
[illegible] 1 way transverse pipe carriers	[illegible]	[illegible]
40 2 way transverse pipe carriers	1.12	44.80
15 3 way transverse pipe carriers	1.35	20.25
15 4 way transverse pipe carriers	1.65	24.75
[illegible] switch [illegible]	.61	[illegible]
[illegible]	.81	[illegible]
[illegible] pipe lugs	.86	[illegible]
42 point adjusting screws	1.22	51.24
20 [illegible] layouts for facing point locks	41.25	825.00
[illegible] power signals	187.50	[illegible]
[illegible] power signals	[illegible]	[illegible]
3 1 arm pipe connected home signals	[illegible]	[illegible]
[illegible] arm pipe connected home signals	[illegible]	[illegible]
9 1 arm dwarf signals	11.00	99.00
[illegible] relays	19.00	[illegible]
[illegible] for signal pole [illegible]	[illegible]	42.00
[illegible] battery wells	12.00	[illegible]
[illegible] red roundels	[illegible]	[illegible]
[illegible] green roundels	.40	[illegible]
4 6½" yellow roundels	.40	1.60
23 R. S. A. semaphore lamps	3.60	76.80
22,000 ft. R. S. A. signal pipe	.055	1,210.00
380 cast piers for cranks and compensators	.70	266.00
760 ¾"x2½" bolts for same	.04	30.40
650 8"x12"x24" concrete foundations	[illegible]	[illegible]
1,300 ⅝" hook bolts for same	.08	104.00
[illegible] way metal pipe carrier bases	.18	[illegible]
[illegible] two way metal pipe carrier bases	.24	12.00
20 three way metal pipe carrier bases	[illegible]	[illegible]
[illegible] four way metal pipe carrier bases	[illegible]	[illegible]
[illegible] six way metal pipe carrier bases	.45	180.00
110 eight way metal pipe carrier bases	.55	60.50
7,300 ½"x1½" carriage bolts (C)	.56	40.88
500 ft. B. M. 1" common pine for frames (M)	28.00	14.00
150 bbls. cement	2.15	322.50
180 yards gravel	.30	54.00
160 ¾"x5" lag screws (C)	.85	1.36
36 1"x36" hook bolts	.35	12.60
[illegible] hook bolts	[illegible]	[illegible]
[illegible] machine bolts	[illegible]	[illegible]
[illegible] machine bolts	.07	[illegible]
[illegible] x12" machine bolts	[illegible]	[illegible]
3 Wharton derails	35.00	105.00
2 Hayes derails	12.50	25.00
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible] steel track ties	[illegible]	[illegible]
34 rail braces	.27	9.18
[illegible] pipe rivets [illegible]	[illegible]	[illegible]
40 gals. pipe line paint	1.15	46.00
25 lbs. ground white lead	.07	1.75
10 gals. boiled linseed oil	.40	4.00
10 gals. black paint (mixed)	1.50	15.00
¼ gal. red paint (mixed)	2.40	.60
¼ gal. green paint (mixed)	2.40	.60
¼ gal. yellow paint (mixed)	2.40	.60
⅛ gal. blue paint (mixed)	....	.25
10 gals. black oil	.08	.80
[illegible] gals. [illegible] oil	[illegible]	[illegible]
2 lbs. graphite	[illegible]	[illegible]
2 tons blacksmith coal	4.50	9.00
[illegible] cloth	[illegible]	[illegible]
48,000 ft. copper telegraph wire, 1,920 lbs.	.15	288.00
50 10 ft. 8 wire crossarms	.70	35.00
50 pairs crossarm braces (C)	5.70	2.85
50 through bolts (C)	2.58	1.29
325 glass insulators (C)	3.45	11.21
325 crossarm pins (C)	3.50	11.38
98 cells caustic soda battery	1.91	187.18
1 battery cupboard for tower		[illegible]
[illegible] ft. trunking 1¾" groove	[illegible]	[illegible]
100 creosoted stakes 3 ft. long	.15	15.00
[illegible] ft. No. 12 rubber covered wire (M)	[illegible]	[illegible]
4 lbs. friction tape (C)	.80	.03
5 lbs. covering tape (C)	.50	.03
1 lb. soldering compound	.50	.50
6 lbs. solder	.20	1.20
25 lbs. 8d nails (C)	2.30	.58
[illegible] lbs. [illegible] nails (C)	[illegible]	[illegible]
15 lightning arrestors	1.25	18.75
[illegible] porcelain cleats	....	[illegible]
1 operator's table	....	9.00
1 rubber mat, 3 ft. by 22 ft.	....	7.70
1 tower lamp	....	3.50
[illegible]		[illegible]
2 tower indicators	15.00	30.00
4 electric locks for back locks of distant signals	21.00	84.00
2 mechanical time locks with attachments	60.00	120.00
7 circuit breakers for machine	9.00	63.00
Total		$16,290.25

[illegible] and the number of switches to be insulated.

Straight track circuit (i. e., for unbroken track) may be considered as a constant and costs $256.00 per mile. This cost is shown in detail in Table IV.

Each switch in the circuit must be insulated and equipped with a switch indicator. The itemized cost of 1 switch indicator is shown in Table V, and that of 1 signal in Table VI.

The usual practice in automatic signal work is to make the sections just about half a mile long. This means in each mile of circuited track there will be 4 insulated joints, 2 sets of track battery and 2 relays. Besides which the rails must be bonded together.

TABLE III.—"OPERATED UNITS" OF THE RAILWAY SIGNAL ASSOCIATION.

Name of Operated Unit.	Value. Units.
Each mechanical signal arm working in two or three positions	1
Each power signal arm working in two or three position on mechanical plants, normal indication locking included.	[illegible]
Each pair of switch points	1
Each single slip switch (2 pairs of switch points)	2
Each double slip switch (4 pairs of switch points)	4
Each set of movable point frogs (2 pairs of frog points)	2
Each derail	1
Each 55 ft. of detector bar with or without locks	1
Each torpedo placer	1
Each drawbridge coupler	1
Each drawbridge rail surface and alinement lock for one pair of rails	1
Each drawbridge leveling and operating apparatus lock	1
Each track circuit	1

A one-blade, three-position signal costs $245 and requires an additional relay so that in estimating they should be valued at $485 each.

A two-blade signal costs $260 and also requires two relays, and in addition thereto an extra lamp and three extra roundels so that in estimating they should be valued at $505 each.

An average of five line wires all the way is about right, though if a very close estimate is required it would be necessary to have a circuit plan drawn up, as almost every signal engineer or signal company uses a different circuit, and the location of switches has some bearing.

Bare copper wire in place at present prices is worth about $40 per mile per wire, or an average of $200 per mile for line wire.

Insulated copper line wire in place is worth about $70 per mile.

Galvanized iron or copper clad wire, either bare or insulated, is worth less than the above figures.

TABLE IV.—DETAIL COST OF 1-MILE TRACK CIRCUIT.

[illegible] bond wires	$ .01½	[illegible]
1,500 channel pins (M)	6.50	[illegible]
2 battery chutes	10.50	21.00
[illegible] battery	[illegible]	[illegible]
105 ft. trunking	.05	5.25
[illegible] stakes	.16	[illegible]
150 ft. No. 8 rubber covered wire (M)	30.00	[illegible]
16 ft. No. 6 bare copper wire	...	.48
[illegible]		[illegible]
½ yard concrete (for foundations [illegible])		[illegible]
4 insulated joints (each)	5.25	21.00
[illegible] rails	..	[illegible]
[illegible] joint (each)	.06	[illegible]
Labor putting in insulated joints	...	4.50
Labor setting battery chutes, [illegible] wiring for same [illegible] boxes and [illegible] same to [illegible]	...	[illegible]
Total		$ [illegible]

TABLE V.—DETAIL COST OF 1 SWITCH INDICATOR.

4 insulating joints	$ 21.00
2 insulated switch rods	11.00
1 switch box	15.00
1 switch indicator	16.50
155 ft. trunking	7.75
20 stakes	3.20
¼ yard concrete	1.75
Nails, tape, solder and paint	6.00
300 ft. No. 12 rubber covered wire	7.20
100 ft. No. 8 rubber covered wire	3.00
15 ft. No. 6 bare copper wire	.18
4 lightning arrestors	5.00
Channel pins and galvanized bond wires	.80
Total	$ 98.38
Less value of non-insulated switch rods taken off	3.00
Total	$ 95.38
Labor	58.00
Total	$153.38

To summarize, therefore, automatic block signals may be figured as follows:

Track circuit per mile	$256
Each switch in circuit extra	153
Each one-blade two-position signal	408
Each two-blade two-position signal	505
Each three-position signal	485
Line wire, per mile	200

TABLE VI.—DETAIL COST OF 1 SIGNAL.

1 1-blade signal (2 position signal)	$187.50
1 semaphore lamp	3.60
2 red roundels	1.80
1 green roundel	.70
1 relay (500 ohms)	19.00
1 yard concrete for foundation	7.00
4 1"x36" hook bolts	1.40
75 ft. trunking	3.75
15 stakes	2.40
500 ft. No. 12 rubber covered wire	12.00
1 battery well	40.00
5 lightning arrestors	6.25
18 cells caustic soda battery	35.00
Nails, paint, tape, solder	8.00
Total	$328.40
Labor	80.00
Total	$408.40

Selection of Length of Transition Spiral.*

In fixing the alinement of a projected fast interurban electric railway recently, the writer was confronted with a dearth of information concerning either theory or practice for rigorously selecting proper lengths of easement or transition curves. The only line of thought or suggestion on the subject which could be found was that outlined by Prof. Talbot in his work on the transition curve, and that appeared to be more or less specially applicable to his particular spiral. Because of the fact that standard spirals of the Searles type had been adopted and were in use on the road in question, it seemed inadvisable to make any radical change in the type of easement curve. None of these standard easement curves, however, were of a length greater than 100 ft., while the theory which is presented herewith demands lengths up to and in some cases exceeding 300 ft.

The old spirals having chord lengths of 10 ft. were adopted as "base tables," and new easement curves were developed from these by merely increasing the chord lengths to 20, 30, 40 and 50 ft., maintaining the same central angles with, of course, the same "angle of increment," which term will be readily understood by those familiar with the Searles spiral. For the benefit of those not familiar with this type, the Searles spiral may be defined as a compound curve with successive equal chord lengths sub-tended by 2, 3, 4, 5, etc., times the angle sub-tended by the first chord length, which latter, of course, may then be defined as the "angle of increment."

The determination of the proper length of transition, however, was as far from a reasonable solution as ever. Further search was then made of printed information on the subject, and a practically complete bibliography of existing English literature on the proper lengths of transition curves and rate of rise of superelevation of outer rail was compiled together with brief synopses of the main features in each article.

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*A paper by Frank H. Carter, 147 Washington St., Cambridge, Mass., in Appendix B, Report of Committee on Track, American Railway Engineering Association.

Almost [illegible] the [illegible] the completion of this compilation, and [illegible] the writer was engaged in an attempt [illegible] of the problem, with practically his only suggestion a mass of "rules of thumb" or tracklayer's experience, there appeared a very creditable report of the Committee on Track of the American Railway Engineering Association and published in Bulletin 108 of that body. This report is replete with compiled information, some, it is true, of the "rule of thumb" order, but with a principle, new to the writer, from several of the roads, namely, a length of curve dependent upon the rate of rise of the outside of a train on a curve (at the rail) in inches per second. There were letters from two roads with diagrams from one, both very suggestive of a method of attacking the problem; namely, the Cleveland, Cincinnati, Chicago & St. Louis Ry., and the Pittsburg & Lake Erie R. R.

With this new material, it proved to be an easy matter to establish a relation between superelevation of outer rail, radius of the central curve, speed of the train, rate of rise of train on outer rail in inches per second, and the proper length of transition curve, on a scientific basis. The result of these computations and a brief discussion of the basic principles involved, with reasons for their adoption, are presented as follows:

The rate of rise of superelevation on easement curves is largely, if not entirely, a question of its effect on passengers as to whether the rapidity of vertical rise of one side of the train produces a disagreeable sensation. An attempt to formulate the proper length of transition curve from the rate of rise of rail in inches per 100 ft., without regard to tthe speed of the train, is approaching the problem from the wrong standpoint. In any formula of type $l=C\,D\,V^2$ the constant C, as will be shown, fixes the rate of rise of superelevation of rail; therefore, but one curve and one speed will satisfy this equation in regard to rapidity of rise of train in inches per second. All other curves or speeds will convey different sensations of ease of riding to the passenger. The average rate of rise of the outside of the train (at the rail) in inches per second should be the governing function for the determination of the length of transition curve, as will be discussed a little later. In fixing alinement, smoothness of riding is all important for comfort; hence, the same rate [illegible] per second should govern for the entire road, where a schedule can be predicted with any degree of certainty; a difficult matter, of course, in most cases for new roads, but almost always capable of realization in realinement, when timetables are established.

It appears to the writer that the clause for insertion in the Manual of the American Railway Engineering Association, viz.: "that the length of the curve should not be less than thirty times the elevation in inches for the ultimate speed" (literally meaning that no rise of superelevation shall be greater than 1 in. in 30 ft.) is a wise provision for places where the speed cannot be predicted, but that is not the best practice, in that the rate of rise of transition will not in that case depend upon the speed of the train.

The last clause of the paragraph for the Manual of Recommended Practice of the American Railway Engineering Association, concerning the length of easement curve, viz.: "that the curve should not be less than two-thirds the ultimate speed in miles per hour times the elevation in inches," places a more rapid rate of rise of the car in inches per second than has been considered best practice for steam roads, according to available information in the hands of the writer. By this rule the rate of rise would amount to about 2.17 ins. per sec., while the common practice appears to be from 1¼ to 1½ ins. per sec. rise.

The length of easement curves used on the Cleveland, Cincinnati, Chicago & St. Louis Ry. is apparently based on an assumed rate of rise of 1¼ ins. per sec., and the practice of the Delaware, Lackawanna & Western Railroad is given as 1½ in. per sec.

It is true that cases may be cited where faster rates of rise have been used; notably, a local fast urban electric railway has several spirals where the rate of rise is 1 in. in 20 ft., corresponding to 2.20 ins. per sec. vertical rise at 30 miles per hour.

These curves are said to be easy riding curves from the standpoint of electric road practice, but jolts and roughness of riding which might be tolerated by passengers on an urban electric road or an elevated road, would [illegible] roads, where the demand is for smooth riding, such, for instance, that passengers might [illegible] a car in motion. It may be of interest to note at this point that this same railway has lately made radical changes in increasing its length of transition curve.

To formulate the foregoing discussion, let
e=the superelevation in feet,
[illegible] heads,
V=speed of train in miles per hour,
v=speed of train in feet per second,
R=radius of central curve in feet,
D=degree of curve,
L=length of transition curve in feet,
l=distance in feet transition curve superelevation 1 ins., and a=inches per second a train is assumed to rise vertically on transition

[illegible]

for superelevation of the outer rail on curves.

[illegible]

Diagrams have been made showing graphically the relations of the various functions to each other. With these diagrams a comparative study may be made of the practice of some of the companies given in Bulletin 108, previously referred to, and other information gathered elsewhere, by assembling the data on a common basis.

GENERAL ARTICLES AND CLASSIFIED ITEMS

Going Value of Public Service Corporations, As Determined by the Wisconsin Railroad Commission in the Madison Gas and Electric Case.

On March 8, 1910, the Railroad Commission of Wisconsin rendered a decision in the case of the State Journal Co. et al. vs. the Madison Gas and Electric Co., in which the deficit theory of determining "going value" was adopted, although the method of applying the theory is open to criticism. In the editorial columns of this issue we have indicated what we regard as being the most important mistakes made by the Wisconsin Railroad Commission in applying the deficit theory.

In a future issue we shall give the appraised value of the gas and electric lighting plant of the Madison Gas and Electric Co. The following is a complete abstract of the Commission's discussion of going value:

Contention was made by respondent that an important element of value which must be included in the valuation for the purpose of fixing reasonable rates was of an intangible character, variously designated as "going value," "going costs," "development value," "development cost," "cost to get the business," "enhanced value over physical value arising out of connected business," and numerous other terms and descriptions. Petitioners were inclined to object to any allowance of value on account of intangibles or franchises, and while the respondent did not claim any value on account of the fact that it is possessed of a practically exclusive franchise, testimony was adduced to show that a large portion of the value of a plant lies in other elements than those which would be included in an inventory of the physical property, together with proper allowances for piecemeal construction, for engineering, interest, etc., during construction, and for working capital. It was asserted that if the valuation were made exclusive of this intangible value, the respondent would be deprived of a portion of its property without due process of law, without just compensation, and contrary to the provisions of the constitution.

Two of respondent's witnesses estimated the value of the intangibles, the going value, at $250,000, and another witness for respondent placed it as high as $300,000 to $310,000. These estimates were based on a long hypothetical question formulated by respondent's attorneys and involving many of the controverted points of the case, for which reason the question was the subject of strenuous objections by attorneys for petitioners. The president of the respondent corporation, in elucidating a method of valuation which [illegible] should be allowed as the value of the development of the business, being half the receipts from one year's business of the plant assumed in the construction theory. He also claimed an allowance of $58,800 as interest on the whole investment up to the time at which the plant became profitable. In addition a third claim was made for $10,000, being the estimated excess of operating expenses over income during the development period. These three claims, totaling $218,800, witness contended, are of the nature of what is generally included in so-called "going value." Thus it appears that respondent's claim to an allowance as going value ranges from $218,000 to $310,000. The testimony on this element of alleged value was somewhat dissimilar, but had, nevertheless, many points of likeness. In general the witnesses maintained that this value was the difference of value between a plant with customers, connected business, revenues and going attributes, over the value of a similar plant ready to be operated but not yet quickened by operation, having no customers, no business, no revenues, merely an orderly aggregation of physical elements. Respondent apparently endeavored to keep away from that definition of going value which seeks to fasten upon a plant an item of value equal to the difference between the value based upon investment and the value arrived at by capitalizing the net earnings, evidently realizing the fallacy involved in the proposition so often made, that the value of public utility property should be based on its earnings, regardless of the fact that these net earnings might have been produced by exorbitant rates exacted from the public. In so far as these witnesses associated this claim of intangible or going value with actual or probable costs, they included in the amount claimed such sums as probably had been expended in order to get business, the doing of work free, the giving away of appliances or the sale of the same at cost or less than a fair profit, the solicitation of business, advertising of whatever kind, demonstrations of new conveniences for the utilization of gas or electricity, education of the public to the advantages of using the product of the plant, also expenditures in the way of interest on the investment during the development time prior to the point of profitable business, and likewise expenditures or losses in operating expenses during the unprofitable period.

In so far as going value was associated with other elements than the cost of building up the business, various items were included which differ greatly from each other, both as to their nature and in other respects, and which can, perhaps, in a general way be classified under one or the other of the following heads: Economies in construction resulting in relatively high efficiency for the amounts expended; the fact that the company has a connected business including the physical connections, such as service pipes, etc.; the fact that the plant has been kept in a good state of preservation and efficiency and can render good service; a steady increase in the takers or in the business; that the company has the right to conduct its business in the city; that it owns enough land to meet the demands for future growth of the plants; that the plants are economically operated; the amount people are generally willing to pay for such properties as compared with the cost of the tangible assets; the earning and producing capacity; the fact that the company has no direct competition in this city; and of other facts of this nature. Going value was also said to be measured dollar for dollar by the receipts of the first year's business of the plant, and again by one year's business.

This subject of going value is one of the utmost importance in the valuation of public utilities for the purpose of fixing rates, and it is, moreover, a subject upon which there are many differences of opinion. Because of these facts, and because of the interest generally attaching to this subject, a brief review of the individual testimony on this subject is included.

Dr. A. C. Humphreys, in his testimony for the respondent, estimated the intangible value of respondent's plant at $300,000 to $310,000, the highest estimate of this item ventured in the case. Explaining this estimate, witness said that in practically all cases, starting up a new undertaking of this kind, capital has to be put into the developing of the business, producing finally a development value that is sometimes equal to the tangible assets, sometimes even more. In the present case he estimated the development value equal to not less than one-third of the value of the physical plants, and he insisted that his estimate was low. He enumerated among the contributions to the development value all the money put into the developing of the business prior to the time when stockholders can get return for their money. Under the ordinary methods of accounting these payments would be charged up to operating expenses, but Mr. Humphreys preferred that they be charged up by some method that would show that the money had been spent as a development charge. Another contribution to this development, intangible or going value, he would name interest on the money raised by bonds or furnished by the owners of the plant themselves, which interest accrues during the period of development prior to the day of profit in the history of the plant. Still another contribution to the development value would be the difference of cost of construction in the direction of economy, or the difference of value in the direction of increased efficiency by reason of the fact that one plant might have had in its construction the advantage of the best talent in the country, while another somewhat similar plant might have suffered for lack of talent. It was sought, in the examination of this witness, to have him separate into its component parts the amount which he stated to be fair for a going value—33⅓ per cent over and above the physical value of the plant—but with this he did not comply, saying that he would simply mention elements, such as above enumerated, that enter into the intangible value. This witness had valued many gas plants for purchase, and he said he had in this work frequently placed the intangible value at as high a figure as the physical value. The witness also mentioned such other elements of intangible value besides those above referred to, as the cost of the development of an organization for the effective handling of the business, the loss in operating expenses prior to the profitable point in the history of the plant, loss of dividends during this period of development, the fact that the company is possessed of connected business, has service pipes to houses and other buildings—not meaning here the mere value of the physical connections and the pipes themselves—the fact that the plant had been kept in a good state of preservation and repair enabling the giving of good and satisfactory service and maintaining the good will element, the fact that the number of customers had been steadily increasing in the recent past, and the fact that the company has the right to conduct its business without violating any law, although witness declared that he had not estimated herein the fact that the respondent possesses a practically perpetual exclusive franchise, but he insisted that franchise value enters into going value. The fact of economical operation of the plant, witness said, would contribute to intangible value, but he had not included it in this case. The witness insisted that his estimate of going value was not based on earnings, nor on the cost of producing and distributing gas in this city, nor upon the price charged in Madison. Though repeatedly requested to do so, he made no attempt to separate into its component parts this great sum of $300,000 to $310,000 which, by his testimony, he proposed should be fastened upon the plant in such a way that the interest and profit charges thereon would become a permanent burden and charge upon the community.

The witness gave another method, which he said was sometimes used by posted utility men in estimating intangible value, that is, to base it on the amount of business actually secured, and witness would say that the value of the business actually secured would be equal dollar for dollar to the gross revenue, that is, if the gross revenue were $300,000 a year, witness would place the intangible value at not less than $300,000. He would not change his estimate of intangible value even if the facts as to gross and net earnings were left out of consideration, nor if the reproduction value of the plant were found to be $50,000 to $100,000 more or less than that assumed in the hypothetical question. He also held that the fact that the respondent is in possession of real estate ample for the extension of the business was an element that added to the intangible value, as otherwise the company might have to go out and buy real estate in order to avoid the necessity of moving. He again stated that there is a decided difference between the good will or going value of a gas company and a mercantile establishment. A mercantile establishment is not so fixed to a community as is a gas plant. The mercantile company can shift its business, turn stock rapidly, or pull up and move to another and presumably better locality, but the gas plant cannot be moved without great destruction and loss. Besides this it takes several years to turn the capital in a gas business. He acknowledged that he would make a different estimate of the value of a plant if he were estimating the value for purposes of purchase rather than for the purpose of rate making. If he were estimating with a view to purchasing, he would figure to get a bargain and so his judgment of value in that case would be less than in the case of estimating value for rate making. In the case of purchase of a plant, when the business proposition merely had to be met, the actual appraisal of the property was not usually considered. The point in such cases was to determine whether the plant was capable of doing the probable business. This method of valuation lays stress upon the question of the relative efficiency of the plant.

A. E. Forstall placed the going or intangible value of the plant herein at $250,000, and stated that he based his estimate largely upon what people are willing to pay for property and in comparison with the value of the tangible assets. This witness was rather positive in his estimate of the intangible value, and while he enumerated a large number of elements that contributed to that value, he was unable to give the Commission much, if any, assistance in definitely setting down the degrees in which each of these contributed to the going value. He would place among the elements assisting his judgment as to the intangible value that should be allowed respondent the following: The possible earning capacity of the plant, the value being the sum upon which the plant could be made to earn 10 per cent after taking care of depreciation, repairs, operating expenses, contingencies and all other items that should be taken care of before reaching profit; the possession of land ample for growth of the business during at least ten years; the maintaining capacity of the plant; the state of preservation, repair and efficiency of the plant; general cost of making gas and general cost of distributing gas; the number of consumers connected with the plant, although witness on cross-examination admitted that the going value could not be predicated upon connected load or volume of business unless the business were conducted at a profit, as in the case of unprofitable business the greater the volume the greater would be the loss; the fact that the company is doing all the gas and electric business in a community of a certain size; on good will, in the sense of established, developed business, witness was of the opinion that each customer connected with the plant was worth some $30 of going value. Witness said the franchise would contribute to the going value, but in this case he had not taken this item into consideration. He was unable to give figures for the general cost of gas manufacture and distribution and did not know whether respondent was doing business at a profit or loss, although he assumed that it was operating at a profit, a thing which he appeared to deem necessary before intangible value could be allowed, although this was later qualified in his testimony to the effect that a plant might have going value even though at present operating at a loss.

R. B. Brown, testifying for respondent, gave an explanation of the term "going value," which differed somewhat from the views presented by other witnesses. He would define as the going value the money which in all probability had been actually spent in order that the structurally complete plant might be transformed from a mere assemblage of physical parts into a going, operating, service giving, revenue producing establishment. This expenditure of money, chargeable against cost of developing business, would theoretically be at the point of completion of the plant to the operating stage, but practically this development cost begins in advance of the completion of the plant. Many successful managers of utility property are willing to spend dollar for dollar for new business on which basis the going value of the respondent's plant would be about $300,000. Some managers are unwilling to spend that much, but most managers will spend not less than half the first year's income in order to get the business. Witness testified that considering conditions in Madison he judged that $250,000 would be the going value of the plant. Explaining his idea of this value, he testified to the following effect:

"No man invests money in a gas plant except as a purely business proposition, and as such he would not consider that his plant was completely built and the investment completed until the plant was brought to the stage where it was returning a reasonable profit on the investment. That being the case, every investment entering into the planning and the building, and the obtaining of business up to the point where the business was giving a reasonable return on the investment, would be considered a part of the cost of the plant. Intangible value does not mean indefinite value at all. It is a very definite value, but one very difficult to figure because of its varying greatly with conditions and with different plants. In the case of a new plant the necessity arises, even in advance of the actual commencement of the work of construction, of opening an office and gathering together a commercial organization, not to have anything to do with the actual construction necessarily, but to take charge of the public relations of the company to the citizens and to the city authorities, and to obtain in advance as many service meter appliance orders as possible, and in that way to fit in with the construction department, and to educate the people in a theoretical way, before the starting of the plant, as to the advantages and possibilities of the use of gas. After the plant is in operation, this same department, simply augmented as to numbers and with somewhat increased expenses as to advertising, display, demonstration, etc., continues that same work to not only increase the number of consumers, but to increase the uses to which the consumers already obtained put the product, and such expenses are believed to be properly charged to construction until such time as the plant is on its feet. It is hard to state what this cost will be, but an example shows that up to the time of completion this cost had exceeded the cost of engineering by one per cent. In case of a plant starting out new, it will not pay operating expenses, usually not for several years. This is because of the small output that will be present during the beginning of operation, and also because of the many changes that inevitably have to be made to bring about coordination of the plant, correct constructional discrepancies and ill fitting together of parts. Later on it pays operating expenses and begins to pay a small proportion of the return on the investment. It is difficult to consider under the most favorable circumstances, a plant starting up with all the services in at the end of the period of construction; but on this entirely theoretical assumption it might be possible to assume that the plant would pay a return on the investment inside of two years, whereas the fact is, that the plants do not for some years begin to pay return on the investment. Some plants take five years before paying a return on the investment. There is no question about the difference in value between the plant which has been completed and has no business and the plant which has been completed and has the business. If no business could be put upon it, its value would be nothing, but assuming that it has an established business put upon it, the increased value is held to be directly proportionate to the added business. It would make no difference whether the intangible value is represented in bonds or stock. It would seem impracticable, in most cases, to bond the company for more than the tangible assets. The equity of the stockholders might be considered the value lying in the business they had developed, but not necessarily so, as they might have furnished all the money; it makes no difference because the money is there and the value is in the plant, and it makes no difference to the future because the value is a permanent charge upon the public, unless a sufficient rate of return be allowed to create a sinking fund and retire the bonds. The possession of ample land for future extensions of business is a fact contributing to intangible value.

"The valuation of a plant for the purposes of purchase is quite a different matter from valuation for the purpose of rate making. Capitalization of possible net returns is an unreliable way of valuing a plant, unless other considerations are taken very carefully into account. One would have to figure not only on what the plant is worth today, but what extensions will have to be made to take care of the increase of business, which is a part of what it can be made to pay, and here there is a good deal of judgment to be exercised, as in determining the future growth of the city and what the character of the businese is, as to the nature of the population, as to what their individual requirements may be or can be made to be, and then what additional money will have to be put into that plant to take care of that additional business, and then, on top of that figure what the ultimate returns will be and the return upon the ultimate investment; it is not a business of straight buying at so much per pound; one has to figure what the possibilities are and all the expenses that go with these possibilities. The amount a plant can be made to pay is quite a material element when one is purchasing. The expense of making and distributing gas, or the amount of net return, does not enter into the case of valuation for the purpose of adjusting rates. In valuation for purchase the possible net return would be one of the large factors, and the question of appraising the operating expenses would be gone into very carefully; the price of gas would be limited only by the price at which a profitable business could be done with the people. It is not a question necessarily of high price. If there is an opportunity of reducing the price, that opportunity or possibility is valuable because therein lies the possibility of getting a large increase of business at a small cost for developing, by reducing the price. Every time a reduction in price opens up new fields by competition with other fuel and lighting agencies, it will increase the business. The cost for development in a small plant would not be necessarily smaller than for a large plant, for the fight for business might be harder in the case of the small plant than in the larger. Even were the plant started thirty years ago, every bit of the business would have to be gotten by expensive work."

He declared further that the cost of getting business and of making extensions is usually paid by the stockholders rather than by the consumers, even though these costs have been charged up to operating expenses. Even if these expenses were included in the operating account, this fact would not signify that they had been paid for by the consumers over and above fair rates for the service. He maintained that the fair rate for service was the amount sufficient to cover actual operating expense, depreciation, allowance for contingent surplus, and interest on the investment, and until it be shown that the consumers paid anything in excess of these items, and yet there remained a portion of the income that was used for getting business and making extensions, it could not be said that the consumers paid for the development of new business and the making of extensions. The income over and above actual operating expenses belonged to the stockholders, but if divided among them they would be forced to go down into their pockets for funds with which to meet extensions of the plant and the development of its business. He also expressed the opinion that respondent's plants were not doing profitable business in the sense that the income is paying all the operating expenses, depreciation, contingent reserve and interest on the investment.

Investigation of the facts involved makes it quite obvious that justice between the investors on the one hand, and the consumers on the other, require that in valuing public utilities consideration should be given to the amounts expended by the former in building up the business of such plants. This is especially true when the earnings of a utility have not been sufficient to meet reasonable expenditures for development of the business and besides this cover operating expenses, depreciation and reasonable returns on the investment. No public utility can be a paying concern until it has obtained a paying business. To secure enough takers so that the revenues obtained from them will adequately meet all reasonable outlays, is a matter that usually requires both expenditures and time. Comparatively few plants are therefore paying at first. Several years are often required to obtain customers enough for a paying business. In the meantime the plants have to be kept in operation and the losses from such operation made up by investors. When these losses are due to such delays in securing the required amount of business, which can not be reasonably avoided and have not been covered by subsequent surplus earnings, it is difficult to escape the conclusion that they must also be regarded as one of the elements that should be considered in appraising the plants and in fixing their rates. If investors are not compensated for such losses, either by being allowed reasonable returns thereon or through surplus earnings, they will not continue to invest their money in plants of this kind. Again, the investors would seem to be entitled to such compensation on the ground of equity alone; for these losses enter into the cost of the service and, under normal conditions, it is only fair that the rates charged for the services rendered are fixed at a level that is high enough to cover all reasonable costs.

There are good reasons why all reasonable and legitimate costs should be considered in connection with the valuation of the plant and the rate of return on this valuation. The conditions are also usually such that costs of this character can be ascertained with a reasonable degree of accuracy, when, on the other hand, it comes to most of the other element which under the testimony herein should be valued and included in the valuation of the utilities, the situation becomes different and much more complicated.

Economies in construction and operation, and efficiencies in the producing capacity of the plant are important elements, but normal amounts of each of these factors are required to give the plant a value that is equal to the cost of producing it and its business, and anything beyond this will hardly be claimed in this case. The connected load or business is, of course, of value, but it appears to us that this value is covered by the cost of establishing the connections and acquiring the business, which costs, in one form or another, have found their way into the accounts of the company and therefore constitute a part of the facts that are taken into consideration in appraising the plants. The keeping of the plant in good repair or good operating efficiency is an item that it covered in the operating expenses and, theoretically at least, is borne by the consumers. It is not an item for the capital account. Possible future growth of the business can hardly be legitimately capitalized by utilities which are not entitled to more than reasonable returns on their investment; and this is also true of the rights to do business in a particular city, which rights have been granted free of cost. The ownership of land to meet future demands would not seem to imply any other value than that which is given to this land by including in it the physical valuation. Monopoly privileges can manifestly not be justly capitalized as against consumers; nor is the amount a man might be willing to pay for a plant a safe guide to its value, at least not unless all the facts which led to its purchase are fully understood. The offer, for instance, might be based upon conditions that are either temporary or without much significance in so far as they relate to the value of the plant. One year's, or even the first year's, gross receipts may throw some light on the amount of business a plant has, but it is not clear to us on just what theory they represent the going value of the plant.

In a certain sense the elements enumerated together with other like elements can be said to have value. But it seems that these values depend upon and are covered by the amounts that have been economically and legitimately invested in the physical property of the plant, the natural increase in the value of the land, such increases in the value of other physical parts that may be due to increase in prices, and the cost of developing its business as measured by the deficits from operation when all proper and legitimate outlays are included in the operating expenses. The investment in the plant and its business, as thus measured or determined, seems to us to constitute the valuation upon which the investors may ordinarily be entitled to reasonable returns and upon which, under like conditions, it may be the duty of the consumers to pay

TABLE I.—MADISON GAS AND ELECTRIC CO.—EARNING VALUE—GAS PLANT

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	$195,600	$10,576	[illegible]	$1,953	[illegible]	$219,061	$14,937	$204,124
[illegible]	[illegible]	14,071	2,400	3,107	15,309	239,011	27,820	211,191
[illegible]	211,191	8,629	2,400	3,344	15,839	241,403	18,937	222,466
[illegible]	222,466	15,969	2,400	[illegible]	[illegible]	[illegible]	19,147	241,862
[illegible]	[illegible]	12,329	2,400	3,757	[illegible]	278,488	24,534	[illegible]
1901	253,954	35,214	2,400	3,964	19,047	314,579	[illegible]	[illegible]
[illegible]	282,689	27,556	2,400	[illegible]	21,202	333,402	[illegible]	[illegible]
[illegible]	307,682	32,067	2,400	5,018	[illegible]	[illegible]	31,537	[illegible]
[illegible]	338,706	7,657	2,400	[illegible]	[illegible]	379,723	26,308	353,415
[illegible]	353,415	8,974	2,400	5,686	26,506	[illegible]	31,429	365,552
[illegible]	365,552	12,706	[illegible]	5,837	27,416	413,911	31,750	382,161
[illegible]	382,161	[illegible]	2,400	6,050	28,662	[illegible]	32,761	395,167
[illegible]	395,167	12,224	....	6,255	29,638	443,284	42,341	400,943

[illegible]

rates they will yield such returns to the investors.

It is true that such elements of value among those which have just been enumerated, as the natural increase in the value of land and such increases in other property as may be caused by rising prices of labor and material, may not be offset by actual outlays on the part of the owners of such plants; that to include such items in the valuation may, in a sense, amount to a capitalization of unearned increments; and that there may be some question as to whether this is equitable as between company and consumers. There is much, however, to be said on the other side of this question. That the law as well as our social system recognizes such gains in practically all other undertakings, is evident from the fact that rents and interest charges usually vary with the natural increase in the value of the property they cover. As the cost of reproduction of a plant usually plays perhaps the most important part in determining its value, it is more than likely that the owners would have to bear losses in case land and other property had depreciated instead of appreciated. It would seem only just that the rule should work both ways. Appreciations in value of the kind in question are also of an essentially different nature from such appreciations in value as those which by the respondent's testimony is classed as going value. It is appreciation of a kind that is generally acknowledged as rightfully belonging to the owners of the property which has thus risen in value. It is based neither on unreasonable rates, nor on assumed business conditions or similar facts of this nature. It is simply due to general growth and development. In view of these facts there would seem to be good ground, from both a legal and economic viewpoint, for giving such appreciations in value consideration in appraising public utilities. At any rate, we can not now see good reasons upon which to exclude these elements from the appraisal of utility properties.

The value of the various elements, which should thus be considered in the appraisal of public utilities for rate-making purposes, may be determined in various ways, but the methods which were employed for this purpose in the case of Hill vs. The Antigo Water Co. 3 W. R. C. R. 623, as more or less fully illustrated in the decision of this Commission in that case (page 738 and other pages) would seem to be as practical as any that could have been conveniently employed. In that case the plant was charged with the cost of the plant at the beginning of the first year, with the new extensions, interst on the investment, depreciation of the plant and the expenses of operation during the first year. It was next credited with the total gross earnings during the year. The balance between these debits and credits was regarded as the net value of the plant at the end of the year. This balance was then carried forward to the beginning of the second year, and with the extensions, interest, depreciation and operating expenses for this year charged up against the plant in the same manner as for the first year. The credits to the plant for the second year, the same as for the first, consisted of the gross earnings; and the balance was regarded as the net value of the plant at the end of the second year. These operations were performed for each year of the life of the plant, the balance at the end of the last year regarded as the value of the plant on the earnings basis in question at the end of the period. Computations of this character must of necessity show the value of a plant at the end of each year on any given earnings basis. If the figures that are included in these calculations contain only such items as equitably belong therein, and if the rate of interest and profit that is used is the rate that is fair and equitable to all concerned, then it also follows that the balances at the end of the year are fairly close representations of the reasonable valuation of the plant and its business.

Computations very similar to those just described have also been made for the plants involved in these proceedings. The cost of the plants at the time they were acquired by the respondent has been ascertained as closely as possible. This cost, together with new extensions, increases in land values, depreciation, and interest and profit on the investment were then charged up against the plants for the first year, while the plants were credited with the net earnings for the year, the balance thus indicating the value of the plants at the end of the year and representing the amount to be carried forward in the computations for the year which follows. Such calculations, for each plant separately as well as for both plants when combined, have been made for each year, and the results at the end of the period are believed to throw a great deal of light on the valuation upon which the rates for these plants should be computed.

In connection with these calculations there are many facts to be noted. The cost of the plants in 1896, the beginning of the period, was placed at $195,600 for the gas plant and $134,400 for the electric plant, or at $330,000 for both. The basis for these figures was obtained from the records in this case, which have already been explained. The figures for the new extensions or additions are also those furnished by records and so corrected as to exclude certain items for free house-piping, which were originally charged to construction. These items amount to some $9,440, and for the purposes of this case were transferred to the operating expenses. The respondent was given the benefit of the natural increase in the value of its land. It was estimated that this land is today worth at least three times as much as in 1896, and this increase in equal annual allowances was added to the values of the plant upon which the returns on the investment were figured. Depreciation was figured on the depreciable property only. The rate of depreciation was fixed on a 4 per cent sinking fund basis for the gas, and on the straight life basis for the electric plant. The returns on the investment for interest and profits were figured on the valuation as given at the beginning of the year, the rates being placed at 7.5 per cent for the gas and 8 per cent for the electric plant. The items thus enumerated make up the debits in the calculations. The credits consist of the net earnings, or of the balance between the operating expenses on the one hand and the gross earnings on the other. Several corrections of greater or less importance have been made in both the gross earnings and operating expenses, which have had some effect upon the net earnings used here, but the explanations of these changes will be postponed for the present, or until these subjects are taken up in detail. The reasons for using net earnings only in these calculations instead of both the operating expenses and the gross earnings, as was done in the case referred to above, is simply one of convenience in figuring. The plants were taken over by the respondent company in the spring of 1896, but the exact date of the transfer is not entirely clear from the records in the case. In the calculations herein, however, it has been assumed that it took place the beginning of April.

The results of these calculations are shown in the three tables which follow. The first of these, or Table I, is devoted to the gas plant alone, and the second, or Table II, to the electric plant alone, while Table III includes the figures for both of these plants. The right hand or last column in each table shows the value of the plants and their business at the end of each year.

The facts disclosed by these tables are of the greatest importance in connection with the question of valuation of the plants. Table I, for instance, shows that on a 7½ per cent earning basis the gas plant was worth about $400,943 at the end of the year 1908. Table II shows that on an 8 per cent earning basis the electric plant was worth about $450,451 at the same time. Table III shows, among other things, that on an 8 per cent earning basis both plants were worth about $879,540 at the time stated. These facts mean that the gas plant, since it was acquired by the respondents, has earned enough to meet the operating expenses, including depreciation and interest and profit at the rate of fully 7½ per cent on all the investments in this plant; that for the electric plants the earnings have been more than sufficient to cover the cost of operation, depreciation and interest and profits at the rate of 8 per cent on the investments; and that both plants, when con-

TABLE II.—MADISON GAS AND ELECTRIC CO.—EARNING VALUE—ELECTRIC PLANT.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total	[illegible]	[illegible]
[illegible]	[illegible]	$ 6,745	[illegible]	[illegible]	$ 7,168	$153,264	$14,718	$138,546
[illegible]	[illegible]	13,141	1,620	6,390	11,084	[illegible]	25,427	145,354
[illegible]	[illegible]	8,613	1,620	7,066	11,628	174,281	30,123	[illegible]
[illegible]	[illegible]	17,693	[illegible]	7,509	11,533	[illegible]	31,120	[illegible]
1900................	148,393	34,550	1,620	8,419	11,871	204,853	32,924	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13,754	[illegible]	34,810	208,649
1902................	208,649	55,329	1,620	12,559	16,692	294,849	40,388	254,461
[illegible]	[illegible]	34,936	1,620	15,403	20,357	[illegible]	31,818	294,959
[illegible]	[illegible]	23,345	1,620	17,199	23,597	360,720	[illegible]	321,969
[illegible]	[illegible]	42,889	[illegible]	[illegible]	25,758	[illegible]	40,938	[illegible]
[illegible]	[illegible]	13,138	[illegible]	20,605	29,576	434,637	54,341	380,296
[illegible]	[illegible]	81,707	1,620	21,281	30,424	515,328	60,560	453,768
1908................	453,768	13,887		25,482	36,301	[illegible]	78,987	[illegible]

[illegible]

sidered together, have earned more than their operating cost, depreciation, and a return of 8 per cent on the investment in these plants.

The facts indicate that the value of these plants for rate-making purposes, when all the elements which enter into this value are considered, does not exceed their cost of reproduction new, including that proportion of the depreciation up to the date which has not been actually covered by renewals. That is, if under the circumstances the rates of return that have been allowed in preceding calculations, when taken as a whole for the entire period, are reasonable to the investors in these plants, then it would also seem to follow that the cost of reproduction new, as shown in table I, represents the maximum values that, for the purposes of these proceedings, should be placed on these plants.

This conclusion is strengthened by the fact that both the new extensions and the operating expenses which entered into the above calculations were somewhat swelled by charges for renewals, which charges, under the methods of computation employed, necessarily increased, for their amount, the figures in Tables I, II, and III., which represent the values of the plants. That this must be the case, is clear, for the greater the cost of operation, the greater are the charges that are added to the cost of the plant from year to year, while the net earnings or credits of the plant become correspondingly smaller. In fact, the situation under the methods of calculation that were employed above is briefly this, that all deficits in the net earnings below the stipulated rates of return of 7½ and 8%, respectively, for their amount increased the cost of the plants and their business, while all surplus above these stipulated returns for their amounts reduced the cost of the plants and of their business. In the case of both of these plants there were years of such deficits as well as years of such surpluses. For the gas plant the former are, on the whole, about offset by the latter. For the electric plant, on the other hand, the surpluses, when taken as a whole, were considerably greater than the deficits. This accounts for the fact of the value of physical property and of the business of the electric plant, as shown in Table II, being lower than the cost value of this plant as given in table I, (which will be published in a subsequent issue of this journal).

On the other hand, if during the entire periods the earnings of the plant have been great enough for all legitimate purposes, and the deficits in the deprecation fund are not restored by the stockholders, then it would seem that the values of these plants for the purposes herein are approximately represented by their present value, plus the amounts by which these values are exceeded by the figures which in Tables I and II represent the values of the plants at the end of 1908. In other words, it is only in the event that the condition as a whole is such as to require a valuation of the physical property that is [illegible] the [illegible] II, that the plants can be said to have any valu[illegible] of the physical property for the purposes of this case. For instance, if under the prevailing circumstances it is found that the value of the physical property of these plants should not be placed higher than the figures which in table I represent their present value, then it would also seem that justice to the investors demands that, as just stated, something should [illegible] ence between the figures in the tables just mentioned and the present value of the physical property.

This excess of the total value of the plants over their physical value, which may be found for them under the conditions just described, or when their physical value is placed at the cost of reproduction new less depreciation, is not in the full sense a going value of the same kind as that which the respondent claimed in this case. This excess which, as stated, is the difference between the values given in Tables I and II and the present value of the physical property, on the present basis of figuring, simply represents the amount by which the plants have failed to earn reasonable returns upon the investment. The going value claimed by the respondent, on the other hand, appears to us, in final analysis, to represent the estimated value of the exclusive right to perform certain services in a particular city or place. In other words, it seems to be a value that is placed on what may be called a monopoly privilege. It is a value which, while in some respects it resembles the value of good will in commercial enterprises, is regarded as much more tangible and permanent, and this for the reason that it is based upon elements that, in the absence of legislation, are more substantial in character.

For public utilities which, under both the common and the statute law, under normal conditions are only entitled to reasonable returns on the investment, justice as well as equity appears to demand that the amounts, if any, by which they, under ordinary conditions, have failed to earn such returns, should be considered in fixing values and rates for such plants. In fact, such consideration would in most cases seem to be absolutely necessary in order to secure the capital required. For it must be obvious to all, that unless the prospects for obtaining at least a reasonable amount for interest and profit are at least fairly good, private capital will not enter such enterprises. By this is not meant, however, that deficits from operation can be equitably taken into account in the appraisals or rates regardless of the conditions under which they were incurred. As already stated, when such deficits are due to abnormal conditions, or when due to bad management, defective judgment, extravagance, lack of ordinary care and foresight, unduly high capital charges, and other causes of this nature, it is manifestly clear that they should be accorded little or no consideration in either the valuation or the rates. This is also likely to be the case for such deficits which were incurred under and borne by others than the present owners, and which have been wiped out in the various transfers of ownership. That these propositions are, as a rule, sound and equitable, appears to be so clear as to need no further argument.

When it comes to the capitalization of exclusive rights to perform the services that are rendered by public utilities, on the other hand, the situation appears to be different. Such exclusive privileges are monopolistic in their nature, due to natural conditions and belong to the community. They have been created by the growth of population, and by economic and social developments generally, rather than by any individual efforts. Belonging to the public, the right of control and of the disposal of such privileges also rests in the community. Under these conditions there appear to be no good grounds upon which the value of exclusive privileges of this kind should become private property. This is especially true where, as in this state, the trend of legislation is such as to reserve such values for the public. In fact, some of the principal reasons for the enactment of the Public Utilities Law, the law which restricts the issuance of security, and other legislation, appear to have been the restoration to or maintenance for the public the benefits that may be derived from the rights in question, or to protect it from such extortions which are possible when such rights are controlled by private individuals. The effect of such legislation is to eliminate speculative elements from the business of operating utilities of this kind and to increase the safety of investments therein. It appears to stand for restrictions upon possible speculative gains on the one hand, and greater security on the other. Its aims are to maintain just and equitable relations as between investors and consumers. A policy of which this can be said, insofar as it affects enterprises which bear such a peculiar relation to the public as is the case of public utilities, appears to us to be both wise and necessary. That in the face of these and other facts of similar import exclusive rights to operate public utilities can have any value that can be equitably capitalized as against the consumers, appears to us to be extremely doubtful.

In our editorial columns we have discussed the fundamental errors in the method used by the Wisconsin Railroad Commission in calculating going value. There are two more errors of minor importance which we shall indicate here.

The first of these errors consists in adding the annual increase in land values (4th column of Tables I, II and III), and then allowing interest (7½ to 8 per cent) on this increased land value. Table III shows that the total increase in land value was about $46,000. As the annual increments in value are added to the plant value, the result is to add compound interest to these increments, sufficient in this case almost to double the $16,000. But the present value of the land is estimated to be only $62,000. Hence the combined increment in value and the compound interest is far in excess of the present value of the land. This is irrational. The correct method is to ignore the increment in land value when calculating development expense. The land takes care of its own development expense, if we may thus express it. Although the original cost of the land should be included in the plant value, the increment in land value should be added in one sum at the end of the operation, that increment being the difference between the original cost of the land and its present value.

The second error consists in assuming an annual depreciation that differs from the actual depreciation, and also in compounding this depreciation by adding it in annually. The fifth column of Table III shows that the depreciation totals $233,000, whereas the actual depreciation was only $169,000 according to the engineer's estimate, for the cost of reproduction new was estimated to be $927,058, and the existing (depreciated) value was estimated to be $758,150, exclusive of working capital. But the error is even worse than appears on the face, for the method applied in Table III involves adding compound interest to the $233,000, which, in this case, is equivalent almost to doubling the $233,000.

[illegible] GAS AND ELECTRIC CO. [illegible] VALUE, GAS AND [illegible] PLANTS.

[illegible]	[illegible]	$17,321	$2,073	[illegible]	$17,600	$372,977	[illegible]	[illegible]
[illegible]	[illegible]	27,212	[illegible]	9,497	[illegible]	111,517	53,247	358,270
[illegible]	[illegible]	17,242	4,020	[illegible]	[illegible]	[illegible]	[illegible]	369,544
[illegible]	[illegible]	[illegible]	[illegible]	10,998	29,564	[illegible]	58,267	394,521
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31,562	[illegible]	[illegible]	431,700
[illegible]	[illegible]	[illegible]	4,020	14,160	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	82,885	4,020	17,111	[illegible]	612,820	71,108	571,712
[illegible]	[illegible]	67,003	4,020	20,121	45,737	[illegible]	63,355	615,538
[illegible]	[illegible]	[illegible]	4,020	[illegible]	[illegible]	754,959	65,059	689,900
[illegible]	[illegible]	[illegible]	4,020	[illegible]	55,192	825,061	72,367	[illegible]
[illegible]	[illegible]	[illegible]	4,020	26,442	60,216	[illegible]	86,091	783,125
[illegible]	[illegible]	[illegible]	4,020	27,331	[illegible]	967,488	94,321	873,167
[illegible]	[illegible]	26,111	[illegible]	31,737	69,853	[illegible]	[illegible]	[illegible]

The correct method would be to add to plant value only enough for depreciation each year to amount, at compound interest, to the actual depreciation at the end of the period, which in this case was $169,000 depreciation. The same result is attained more directly, however, by ignoring depreciation entirely until the end of the period under consideration, and then adding the full actual depreciation ($169,000) to the development expense.

Both the foregoing errors made by the Commission lead to greater development expense than was actually incurred.—Editors.]

The Economics of Power Supply from Low Head Hydraulic Plants and Steam Plants; a Comparison of Costs.*

In these days of conservation congresses and commissions we hear much of the duty of developing all possible water powers to their fullest extent, so as to conserve the fuel supply. While the conservation of the fuel supply is desirable it must be kept in mind that in order to bring about this result there is necessary an expenditure of material resources and human effort, both of which should be conserved. Since we measure all values in terms of money the test of the desirability of developing a water power is a comparison of the cost of the power developed and delivered at the point of consumption with the cost of power at the same point of consumption when developed by other means. In many cases the cost may be so great that the final result may not be conservation, but waste; even though the power of the water is utilized and fuel saved.

Before the advent of electrical transmission of energy the utilization of water power required that the factory where the power was to be used should be located near the power, the disadvantages of the location as respects transportation, operatives' dwellings, and so forth, being balanced against the advantage of cheap power. The possibility of the transmission of energy in the electrical form to great distances from the point of generation has removed this restriction, except in those cases where the cost of power is a large element entering into the cost of the finished product.

The writer of this paper will limit his discussion of the general subject to a consideration of the economics of the question for the conditions existing in Iowa.

Energy in the electrical form having been found the most desirable for distribution, and the electric distribution system being independent of the source of power, the limitation is set that the test of economy shall be the cost of delivering the power at the switchboard of the distributing system. Since the life of nearly every part of a power plant is not over 50 years, and that of most parts not over 25 years, it is not safe to consider prices of fuel as differing much from those which prevail at present. The electric plants of Iowa pay at present about $2.25 per ton for coal, of which the less efficient ones use about 12 pounds per kilowatt hour. With coal at $3.25 a ton the cost of supplies per kilowatt hour will be about 2 ct. for small plants and 12 cts. per kilowatt hour for large plants using steam turbines.

The rivers of Iowa not having a very rapid fall, it will be necessary to consider the hydraulic development for low heads of from 8 to 25 ft.

The problem is therefore reduced to a comparison of the economy of power supply from low head hydraulic plants and steam plants, other forms of power plants not being of sufficient importance at the present time to consider. The near future will probably see a development of the producer gas plant to such a point that it will be more economical than the steam plant.

The cost of supplying power is naturally divided into two parts: (1) Fixed expenses—interest, depreciation, taxes, insurance; (2) variable expenses—salaries and wages, maintenance, supplies (coal, water, oil, etc.).

As long as the plant is operating, some of the expenses under the second head are fixed, but as the determination of the proportion between the fixed and variable portions is very difficult, the tendency at present is to include under fixed expenses only those sources of expense which would continue if the plant were idle. The variable expenses being dependent on the output of the station, it is seen that an important consideration in the cost of power service is the relation between the fixed and variable expenses, which is largely determined by the time each year that the power is used. This discussion makes necessary the introduction of a term the meaning of which is often misunderstood—namely: the yearly load factor, which is the ratio of the average power developed during the year to the maximum power developed at any time during the year. This factor varies with the class of customers from 10 per cent for a purely lighting business in a small town to 80 per cent for an electro-chemical plant.

Owing to the great range in the cost of hydraulic development and pole line construction per unit of plant capacity each case must be considered individually; so the discussion will now be confined to plants actually constructed or to projects concerning which estimates have been made after a study of the location.

(1) Plant at Iowa City, owned by the State University of Iowa. Constructed during 1906-07. Approximate figures based on three years of operation. Capacity of plant 200 kilowatts. Head 2 to 9 ft.

Investment:	
Hydraulic plant	$39,000
Steam reserve 100 kilowatt (estimate)	11,000
Total cost	$50,000
Total cost per kilowatt	250
Fixed expenses:	
Interest, 6 per cent	$ 3,000
Depreciation	2,000
Taxes	500
Insurance	150
Total fixed	$ 5,650
Variable expenses:	
Wages	$ 2,000
Maintenance	250
Supplies, coal, etc	450
Total variable	$ 2,700
Total operating expense	$ 8,350

Load factor, 20 per cent.
Cost at switchboard, $0.028 per kw. hr.

Steam plant at Iowa City (estimate). Peak load 175 kilowatts. Load factor 20 per cent. Investment: 175 kw. steam plant, $24,500. Investment per kilowatt, $140.

Fixed expenses:	
Interest, 6 per cent	$ 1,470
Depreciation, 5 per cent	1,225
Taxes, 1 per cent	245
Insurance, 1 per cent	245
Total fixed	$ 3,185
Variable expenses:	
Wages	$ 3,000
Maintenance	800
Supplies	6,000
Total variable	$ 9,800
Total expenses	$12,985

Cost at switchboard, per kilowatt hour, $0.042.

(2) Hydro-electric plant at Palisades with steam plant at Cedar Rapids: 800 kw. hydraulic; 15 ft. head; 2,300 kw. steam. Load factor 25 per cent (estimate):

Investment:	
Hydraulic plant	$300,000
Transmission line	25,000
Steam plant	230,000
Total	$555,000
Investment per kilowatt, $179.00	
Fixed expenses:	
Interest, 6 per cent	$ 33,300
Depreciation	18,750
Taxes, 1 per cent	5,550
Insurance, 1 per cent	2,550
Total fixed	$ 60,150
Variable expenses:	
Wages	$ 13,000
Maintenance	4,500
Supplies	18,000
Total variable	$ 35,500
Total expense	$ 95,650

Cost at switchboard per kilowatt hour, $0.0141
Load factor on hydraulic plant, 75 per cent.

Steam plant at Cedar Rapids; 3,100 kilowatts; load factor 25 per cent. Investment: Steam plant, $310,000. Investment per kilowatt, $100:

Fixed expenses:	
Interest, 6 per cent	$ 18,600
Depreciation, 5 per cent	15,500
Taxes, 1 per cent	3,100
Insurance, 1 per cent	3,100
Total fixed	$ 40,300
Variable expenses:	
Wages	$ 13,000
Maintenance	4,500
Supplies	81,500
Total variable	$ 99,000
Total expense	$139,300

Cost at switchboard, per kilowatt hour, $0.0204.

(3) Hydro-electric plant at Iowa Falls (estimate); 75 kw.; 25 ft. head. Steam auxiliary 100 kw. Maximum load 150 kw. Load factor 20 per cent. Load factor on hydraulic plant 30 per cent:

Investment:	
Hydraulic plant	$ 36,000
Overflowed land	75,000
Steam plant	14,000
Total	$125,000
Investment per kilowatt, $830.	
Fixed expenses:	
Interest, 6 per cent	$ 7,500
Depreciation	625
Taxes, 1 per cent	1,250
Insurance, 1 per cent	175
Total fixed	$ 9,550
Variable expenses:	
Wages	$ 3,000
Maintenance	500
Supplies	1,320
Total variable	$ 4,820
Total expenses	$ 14,370

Cost at switchboard per kilowatt hour, $0.054.

Steam plant at Iowa Falls. Maximum load 150 kilowatts. Load factor 20 per cent:

Investment: Steam plant	$21,000
Fixed expenses:	
Interest, 6 per cent	$ 1,260
Depreciation, 5 per cent	1,050
Taxes, 1 per cent	210
Insurance, 1 per cent	210
Total fixed	$ 2,730
Variable expenses:	
Wages	$ 3,000
Maintenance	500
Supplies	5,260
Total variable	$ 8,760
Total expenses	$11,490

Cost at switchboard, per kilowatt hour, $0.044.

(4) Hydro-electric plant near Webster City (estimate). Capacity of plant 50 kw.; head of water 20 ft.; load factor 40 per cent Steam plant capacity 225 kilowatts. Peak load 250 kw. Load factor 20 per cent.

Investment:	
Hydraulic plant	$25,000
Reservoir*	35,000
Transmission line	3,750
Steam plant	31,250
Total investment	$95,000
Investment per kilowatt, $380.	
Fixed expenses:	
Interest, 6 per cent	$ 5,700
Depreciation	2,900
Taxes, 1 per cent	950
Insurance	350
Total fixed	$ 9,900
Variable charges:	
Wages	$ 4,300
Maintenance	800
Supplies	5,000
Total variable	$10,100
Total expenses	$20,000

Cost of switchboard, per kilowatt hour, $0.046.

Steam plant at Webster City. Peak load 250 kilowatts. Load factor 20 per cent. Investment: Steam plant, $35,000. Investment per kilowatt $140.

Fixed expenses:	
Interest, 6 per cent	$ 2,100
Depreciation, 5 per cent	1,750
Taxes, 1 per cent	350
Insurance, 1 per cent	350
Total fixed	$ 4,550
Variable expenses:	
Wages	$ 3,000
Maintenance	800
Supplies	8,670
Total variable	$12,470
Total expenses	$17,020

Cost at switchboard, per kilowatt hour, $0.039.

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*From a paper by Arthur H. Ford, Iowa City, Ia., before the Iowa Society of Engineers.

*From report of Iowa State Conservation Commission, 1910.

The foregoing figures show that in order to have a hydraulic development pay, the investment cost must be low or the load factor high. Where the demand is such that the hydraulic plant can be run at full load most of the time, it may pay to develop water power at a cost as high as $400 per kilowatt.

The author would not advise the development of heads of less than 8 ft., nor streams with a minimum flow less than that required to generate 75 kilowatts, nor where the development cost is more than $250 per kilowatt, unless the yearly load factor is greater than 25 per cent.

LETTERS TO THE EDITOR.

The Effects of Washing Soda on Concrete.

Sirs: In Engineering-Contracting last week there was an inquiry about the probable weakening effect of washing soda on concrete. I have used it several times to make a slow setting cement set up quickly and had occasion once to make a strength test of a concrete slab in which it had been used. The concrete was very strong and the soda ash apparently did not affect the strength.

The material is deliquescent to a high degree and leaches out, leaving the concrete porous. When it is used a waterproofing should be externally applied.

Yours truly,
ERNEST McCULLOUGH.
Chicago, Ill., May 22, 1911.

Development Expense in the Valuation of Public Service Properties.

Sirs: I have just read, with great pleasure, your remarks under the head of "Development Expense as a Factor in the Valuation of Public Service Property," published in "Engineering-Contracting" of March 8th, and wish to congratulate you on the very able way in which you have presented your view of the case.

There is one statement, however, that I desire to question. It is as follows: "So that, in the final analysis, depreciation should be ignored entirely in any appraisal of a public service corporation where the object is either rate-making or purchase of the corporation by the public."

It seems to me that there is a fallacy here, which I can perhaps best develop by quoting from the article entitled "Valuation of the Physical Property of the Peoria Water Co.," etc., page 253 of your March 1st issue.

"The Iowa court in the Cedar Rapids case appears to have furnished the only dissenting opinion of a high court as to the conclusion that the valuation for fixing rates should be the same as the valuation for sale.

"That there is no real distinction becomes apparent if we consider that no public utility can have two values at a given time, and that its fair value at the time of fixing rates must be its fair value at the same time for any purpose. If its fair value for sale differed from its fair value for fixing rates, at a given time, then rates should change, merely because of a change of ownership.

"To put it another way. If a given sum represents the investment which the owner of a public utility is entitled to have paid over to him in case of a forced sale under the franchise, or law, then he is entitled to a fair income on the same investment [illegible] is forced to return it."

I call attention particularly to the last sentence. The supposition on which this statement is based, and which I believe to be a fallacy, is that the purchaser of a depreciated plant at its depreciated value has to consider only the purchase price in fixing his rates, and that, therefore, there is no reason why the original owner should charge rates [illegible] higher.

A moment's reflection will, however, I think make it clear that the purchaser of such a plant should either at once provide, in a fund, the amount of the depreciation which has already accrued, and which, together with the price paid, will represent the reproductive value of the property, or he must collect, during the remaining life of the plant, rates which will enable him to make good both the depreciation which has and which will accrue. In either event, he will have to charge rates which will pay a return on the reproductive value.

The fact that there is a distinction between a valuation for the purpose of sale and one to be used as a basis for rate-making, is perhaps more clear when a simple example is used. Suppose, for example, that a contractor who desires to purchase two horses, has offered to him one horse with the expectation of ten years of useful life, and another, older horse, which will probably have to be replaced in, say, four years. Assuming that for the terms, respectively, of 8 and 4 years, the two horses will do the same amount of work, it is yet true that the first horse will command a higher price. Supposing, now, that the contractor desires to rent these two horses, is it not equally apparent that, so long as they are doing the same work, their owners are entitled to receive the same rental?

It is possible that you may be interested in the enclosed summary of my views on the subject of depreciation, which, I believe, contain one or two thoughts which have not heretofore been presented.

I shall be very glad to have your views on this question, and hope that you will favor me with a reply.

Yours truly,
W. H. WINSLOW,
Sec'y & Gen. Man.,
Superior Water, Light & Power Co.
Superior, Wis., March 10, 1911.

(The enclosed summary noted by our correspondent is printed below.—Editor.)

In theory, sums set aside out of earnings to cover depreciation and obsolescence of plant should be placed on deposit at interest or invested in readily convertible securities; but it frequently happens that such sums can be used to better advantage in providing additions to plant. This, for the reason that new capital can be secured only at rates much higher than can be realized on deposits or quick assets of any kind. It should, however, be clearly understood that when depreciation funds are used for extension, the owners of the plant are only temporarily relieved from the necessity of furnishing the additional capital, for the money has merely been borrowed from the depreciation fund and must be restored to it when the need for it arises. It seems to be a common practice to ignore interest on sums borrowed in this way, though, by so doing, a situation is created which is likely to become awkward. It would, for instance, be very difficult for the owners of a plant to prove to a court or a commission that they were entitled to earnings on capital provided by their customers through a depreciation charge. If, however, no earnings were to be allowed on such capital, a wholly illogical situation would arise whenever the depreciation fund was reimbursed by the raising of additional capital, as it is just as clear that the owners are entitled to returns on capital they have furnished as that they are not entitled to returns on capital they have not provided. Suppose, for example, that extensions to the value of $200,000 having been made with money borrowed from the depreciation fund (on which no earnings have been allowed) it becomes necessary for the owners to provide this sum for reconstruction. They must then be allowed, say, 8 per cent on $200,000, or $16,000, per annum, additional, which means that rates must be raised sufficiently to increase earnings that much without any change in the value or extent of the service rendered. This is, of course, wholly illogical. On the other hand it is equally illogical for the owners to receive a return on this part of the capital until they have been called upon to provide it. The only way, then, to do justice to both parties is for moneys so used to receive the usual returns, which returns must be treated as belonging to the depreciation reserve. This raises the question of the basis on which the depreciation reserves are to be figured, as, clearly, if these reserves are to be credited with earnings, they will not need to be as large as would otherwise be the case. The foregoing point [illegible] the following five statements.

(1.) To escape loss, the owners of public utility plants must be allowed to receive returns on the value new of the plants, provided they have furnished the entire sums for the building and extending of the plants, it being immaterial whether the moneys used for extensions are contributed directly by the owners or indirectly by foregoing dividends to which they are justly entitled.

(2.) Where [illegible] in a depreciation fund drawing interest are so calculated that such sums together with interest accumulations are just sufficient to provide for depreciation and obsolescence, there is no connection between such interest earnings and the revenues of the plants.

(3.) If, [illegible] themselves sufficient to reproduce the plants when worn out or discarded, the interest accumulations are part of the revenues of the plant and reduce the sums which it is necessary to collect from consumers in order to receive a fair return.

(4.) When [illegible] out of earnings to provide for depreciation are used for plant extensions (which really means that such sums are borrowed from the depreciation fund and must be restored by raising new capital, when the need for them arises), the proper rate of return should be allowed on extensions so financed, but this return belongs not to the owners of the plant but to the depreciation reserve, provided such interest accumulations are required to provide adequate reserves.

(5.) If, however, the sums set aside are ample, without interest accumulations, allowing a return to be earned on extensions to plant built with them would be equivalent either to paying dividends on capital not provided by the owners or to increasing the depreciation reserve beyond the sums needed.

If we assume that the first statement is not true and that the return is to be figured on the depreciated value, we have a constantly diminishing rate of return on the money invested, which means steadily declining prices to consumers up to a time when reconstruction of the plant restores the parity between value new and present value, when the rate of return would be restored to the original figure and the rates to consumers advance in proportion. Logically applied, this assumption would mean that consumers served with water or gas through new pipes or with electricity over new wires, would pay higher rates than those supplied by older portions of the plants. If it were true that increased age diminished in any way the value of the service rendered, the contention would have something to sustain it, but to assume that, for example, electricity is any less valuable because the poles and wires which carry it have lived half their useful life, is a manifest absurdity. The only condition under which the assumption can be sustained is when the owners of a plant have received a full return for the entire life of the plant and have, in addition, divided earnings which should have been retained in a fund for replacing wasted assets. Even in this case, it would be much better to permit earnings to continue based on value new and to compel the owners to turn net earnings into a depreciation fund until the sums improperly divided had been returned.

Statements 2, 3, 4 and 5 scarcely seem to need demonstration, as they mean simply that what the consumers of a plant should pay in addition to operating expenses and a proper return to the owners is such a sum as will exactly offset the depreciation due to wear and tear and obsolescence.

It is perhaps true that the owners should be allowed a profit on extensions financed out of depreciation funds to the extent of the difference between a full rate of return and the rate at which such funds could be invested, because of the fact that they practically underwrite the fresh capital needed for reconstruction and replacements, or, to put it in another way, by putting depreciation funds into fixed instead of quick assets, they assume the risk of having to contribute new capital or to procure loans in considerable sums at a time when either course may be difficult or expensive and for this risk they deserve some return.

(Regarding the meaning of the quoted statement in the second paragraph of our correspondent's letter, an example will serve to make clear Mr. Gillette's conclusion that the same final result is obtained whether or not depreciation is considered in calculating the value of a plant, including its development expense.

Table I gives an example of a plant assumed to cost $100,000 and to begin operating Jan. 1, 1900. The net earnings are the difference between gross earnings and operating expense, and the operating expense does not include any deposit in a depreciation fund. Assume that the plant depreciates $15,000 in the five years of operation, and assume that 8 per cent is a "fair return" on the investment.

TABLE I.

[illegible]	[illegible]	(3) Fair [illegible]	(4) Net [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	102,660
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note: Column (5) is found by adding columns (2) and (3) and deducting column (4).

The value of the plant and its going business is $105,143 at the end of the development period. Precisely the same result is obtained if we provide a sinking fund that will at 8 per cent amount to the $15,000 depreciation in the five years, since $2,572 annual deposit in the sinking fund will cover this depreciation. Table II gives the resulting value:

TABLE II.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1902..	109,010	8,721	2,572	7,200	113,100
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

The difference between $120,131 and the [illegible] $100,000 [illegible] development expense, [illegible] a total of $105,131, which is practically the [illegible] the depreciation. The results would be identical if all calculations were carried out to [illegible] makes no difference in the final result whether enough be added to operating expense annually to provide a sinking fund to cover depreciation, or whether it is assumed that there is no depreciation and consequently no sinking fund is provided. This is simply a question of mathematical logic, and there is no relation between Mr. Gillette's statement and court decisions relating to values.

For further discussions of this subject of development expense, the reader is referred to our editorial columns.—Editors.]

Constructing a Sand Clay Road in Kansas: The Wheeler & Kelleher Co., Contractors, are constructing a sand-clay road near Garden City, Kan., upon which three Maney scrapers are used with four mules abreast, pulling each, and a four-mule snatch team; thus giving eight head for hauling the load through the sand and over the fresh grade. The maximum haul is 1,000 ft. and the average haul 500 ft. The cost of the work per cubic yard is 30 cts. on an average. The contractors find that the use of the Maney scrapers saves about 25 per cent of the cost of operation with wagons and wheelers in similar work, where wheelers would be used for the 500 ft. haul and wagons for all hauls above that.

Atlantic Terminal Docks.—A project for terminal facilities at the Atlantic entrance of the Panama Canal has been approved. It consists of a series of five reinforced concrete docks at which ten 1,000-ft. vessels, or 20 vessels of the type now in the Isthmian trade, may tie up at one time and take on and discharge cargo. After consultation with representatives of the navy, Cristobal Point was determined upon as the site, and borings are now being made to determine the nature of the material underlying the water at this place. A preliminary estimate, based on a preliminary survey, places the cost of the series of docks at $7,811,666, divided as follows:

Breakwater and back filling	$ [illegible]
Permanent extension, Dock 11 (Pier [illegible]) and Pier 16	[illegible]
Pier [illegible]	[illegible]
Piers 18, 19, 20, 21	[illegible]
Dredging [illegible] cubic yards	[illegible]
Construction plant	[illegible]
Total	[illegible]

It is estimated that the breakwater and approaches to the docks will require 1,500,000 cu. yds. of filling; and the piers themselves 913,000 cu. yds. There will also be required 675 steel cylinders, 152,565 cu. yds. of concrete, 402,000 lin. ft. of reinforced concrete sheet piling, 1,498,560 lbs. of steel girder, and 804,000 lbs. of steel I-beam.

PERSONAL.

Mr. W. L. [illegible], of [illegible], N. C., was elected state highway [illegible] of North Carolina [illegible]

Mr. P. B. Motley, assistant engineer of bridges of the Canadian Pacific Ry., has been appointed [illegible] Mr. Chas. N. [illegible] chairman and chief engineer of the board of engineers of the Quebec bridge.

Mr. L. G. [illegible] for the Des Moines Bridge & Iron Co. [illegible]

Mr. C. F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul Ry., has been appointed consulting engineer of the Chicago, Milwaukee & Puget Sound Ry., in addition to his present duties. [illegible] Mr. E. O. [illegible] chief engineer of the latter road.

Effective [illegible] Mr. [illegible] pointed a vice-president of the Boston & Maine R. R. He will assume entire charge of the con-

[illegible] way department [illegible] of Mr. Frank [illegible] The appointment [illegible] these departments from [illegible]

Mr. Ed. Lee Heidenreich, formerly special [illegible] New York Central Ry., has been [illegible] concrete engineering department of the Builders' Material Supply Co., 301-335 Scarritt Bldg., Kansas City, Mo. Mr. Heidenreich is the author of "Engineer's Pocket Book of Reinforced Concrete," and is a recognized authority on concrete engineering.

Among the appointments made by the Mayor of Watervliet, N. Y., in accordance with the requirements of the new city charter, are the following: Commissioner of public works, Mr. Matthew J. Carr; city engineer, Mr. Peter J. Lind; civil service board, Fred J. Passano, Fred W. Carl and John J. Fogarty; water commissioners, Fred D. Durant and James McLeese.

Mr. Merton J. Douthitt has resigned his position as a member of the engineering staff of the department of public works, Chicago, Ill., to accept the position of city engineer of Waukegan, Ill. In a competitive examination recently held for the position Mr. Douthitt's name headed the list of successful candidates. He assumed the duties of the office on June 1.

At a meeting of the highway commission of York County, Toronto Canada, on June 1, the following appointments to engineering positions were made: Highway engineer, Mr. E. A. James, at a salary of $2,500 per year; assistant and construction engineer, Mr. A. E. Edwards, at a salary of $1,500 per year; bridge engineer, Mr. Frank Barber, whose remuneration will be based on a percentage of the work done. Definite plans for highway development in the county now provide for the expenditure of over $300,000.

Dr. Reginald A. Daly, of the Massachusetts Institute of Technology, and Dr. Andrew C. Lawson, of the University of California, have been engaged by the Canadian Geological Survey to do special research work in Canada this summer. Mr. Daly will take charge of the geological mapping of a cross-section of the Rocky Mountains along the main line of the Canadian Pacific Ry., a task that will probably require ten years to complete. Dr. Lawson will investigate the geology of the Lake Superior region. Both men are natives of Canada, and have made brilliant university records.

Mr. Edward M. Bigelow has been appointed chief of the reorganized state highway department of Pennsylvania. This appointment is made under the Sproul highway bill, which has recently become a law. Under the provisions of this bill the governor has authority to appoint a highway commissioner, two deputy commissioners, a chief engineer, chief draftsman and superintendent of highways, with necessary assistants and engineering staff. The position of first deputy commissioner has been offered to Mr. Joseph W. Hunter, former head of the department. An appropriation of $4,000,000 has been made for the use of the department, pending a bond issue of $50,000,000 to be provided by constitutional amendment. Mr. Bigelow is a civil engineer, is a native of Pittsburg, and was for years director of public works of that city. His present appointment is for a [illegible] period at an annual salary of [illegible]

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Three-Blade Orange Peel Bucket.—Paper, 7¼x[illegible] ins., [illegible] pp. The Hayward Company, [illegible] Church St., New York City.

This pamphlet is No. 573 and contains a complete description of the three-sided orange peel bucket. Illustrations are given showing the details of the bucket and also showing work upon which the bucket is used.

Sarco.—Paper, 3½x6 ins., 16 pp. Standard Asphalt & Rubber Co., 137 S. La Salle St., Chicago.

This booklet describes Sarco asphalt products and their uses. Illustrations are given showing the various classes of work upon which this material has been used.

Hand Tachometer.—Paper, [illegible] ins., [illegible] Schuchardt & Schutte, 90 West St., New York.

This new hand tachometer is a more universal instrument than the previous one placed on the market. It is now a combined hand tachometer and cutmeter which is equally convenient for indicating rotative speed as well as progressive speed and is used without a stop watch.

Oil Transformers.—Paper, 4½x6¾ ins., 20 pp. Ft. Wayne Electric Works, Ft. Wayne, Ind.

This book is Instruction Book No. 3048. Contains illustrations and detailed description of oil transformers, Type A, Form A.

Milwaukee Mixers.—Paper, 6x9 ins., 32 pp. Milwaukee Concrete Mixer & Machinery Co., Milwaukee, Wis.

This is a reprint of a paper given by Arthur R. Lord before the National Association of Cement Users, describing and illustrating the test of a flat slab floor in a reinforced concrete building.

New York Water Supply.—Paper, 6x9 ins., 152 pp. Blaw Collapsible Steel Centering Co., Pittsburg, Pa.

This book is a comprehensive illustrated description of the construction work on the Catskill aqueduct extension of the water supply system of New York City. The book contains a considerable amount of valuable and interesting information regarding the contract work and the Blaw form work. A list of contractors is given and also information for bidders on the work and approximate quantities included in the entire work.

Engineering Specialties.—Cloth, 12½x8 ins., 300 pp. The Wm. Powell Co., Cincinnati, Ohio.

This is a complete general catalog of valves, pipe fittings and general engineering specialties. Illustrations, accompanied by descriptions, dimensions and prices, are given. This is catalog No. 10.

The Pulsometer.—Paper, 6x9 ins., 28 pp. Pulsometer Steam Pump Co., 17 Battery Pl., New York.

This is a new and illustrated description of the pulsometer steam pump, describing the field, its operation, its accessibility, economy, etc. Drawings are given showing the design of the pump and replacement parts. Tables of sizes, capacities and dimensions are given, together with other tabular information.

Powder.—Paper, 8¼x3¼ ins., 32 pp. E. I. Du Pont De Nemours Powder Co., Wilmington, Del.

A book on trap shooting and points on gun club organization.

Alternating Current Switchboard Panels.—Paper, 8x10½ ins., 44 pp. General Electric Company, Schenectady, N. Y.

This is bulletin No. 4819. The panels described are equipped with oil switches suitable for general use in central stations and isolated plants. The bulletin contains information, including dimension and connection diagrams, regarding the three-phase generator panels, single circuit and double circuit three-phase feeder panels, generator voltage regulator panels and combination regulator and exciter panels and three-phase induction motor panels.

Electrical Machinery.—Paper, 8x10½ ins., 32 pp. Ft. Wayne Electric Works, Ft. Wayne, Ind.

This bulletin is No. 1128 and is entitled "Multiphase Induction Motors." It contains a complete description and illustrations of motors manufactured by this company. Bulletins Nos. 1127 and 1129, twelve pages each, entitled, respectively, "Direct Currents, Grinders and Buffers," and "Multiphase Induction Watthour Meter," are also issued and give complete information.

Conveying Machinery.—Paper, 10¾x8 ins., 32 pp. Conveying Machinery Co., 50 Church St., New York City.

This is catalog No. 110, illustrating various installations of conveying machinery for coal handling plants and other industrial plants where conveying systems are used. Illustrations of details of coal handling plants are given, including line drawings and dimensions of belt conveyor apparatus.

Conveyors.—Paper, 6x9 ins., 24 pp. Stephens-Adamson Mfg. Co., Aurora, Ill.

This is a monthly bulletin illustrating and describing various plants where Stephens-Adamson conveyors have been installed, and illustrating in particular the features of various conveying systems for special cases. Other machinery relating to this work is also described.

Multiplex Punching Machine.—Paper, 3¼x6 ins., 18 pp. F. P. Rosback Company, Benton Harbor, Mich.

This is a little pamphlet which illustrates various types and sizes of the adjustable multiplex punching machine. Prices are given.

Pipe Locator.—Paper, 3⅜x6 ins., 12 pp. Modern Iron Works, Quincy, Ill.

This illustrates and describes a simple machine for locating lost pipes underground by means of a small apparatus which works on the same principle as wireless telegraphy.

Shop Buildings.—Paper, 7½x5½ ins., 12 pp. Stone & Webster Engineering Corporation, Boston, Mass.

[illegible] with [illegible] illustrations of the construction of two large reinforced concrete buildings at Schenectady, N. Y., which were built in record time.

Blast Furnace Wastes.—Paper, 6x9 ins., 8 pp. Universal Portland Cement Co., Chicago, Ill.

This is an article on the utilization of wastes of blast furnace slag for the production of Portland cement, showing the increasing percentage of the total American production of Portland cement made from blast furnace slag.

Review of Technical Paints.—Paper, 6x9 ins., 52 pp. Cheesman & Elliot, 100 Williams St., New York City.

This is a comprehensive description of the qualities, characteristics and uses of paints for metal. Its object is to make recommendations as to the best paint to use in various places, considering locality, exposure, etc.

CONTRACT NEWS SECTION
of
ENGINEERING & CONTRACTING

The Doings of the Week.

[illegible] railroad construction work. Several large contracts have been let recently, and it looks as though the next few weeks would see the letting of many other large contracts. The Louisville & Nashville R. R. has recently let some large contracts for work on its Kentucky division and is also understood to be about ready to let contracts for considerable work in the way of constructing new branch lines in the south. The contracts let by this road for work on its Kentucky division are for reduction of grades on existing lines and for providing second track. The work is located between Paris, Ky., and Covington, Ky., the contractors in charge being as follows: Boxley Bros., Quincy, Ky.; Patterson & Griffin, Pittsburg, Pa.; Hough & Spradlin Co., Knoxville, Tenn.; Callahan Construction Co., Knoxville, Tenn.; J. L. Flick Construction Co., Chicago, Ill.; Robt. Grace Contracting Co., Cleveland, Ohio, and Price Construction Co., Station B, Memphis, Tenn. Among the other railroad contracts let in the last few days are the following: Texas & Oklahoma Construction Co., Wichita Falls, Tex., for the first 30 miles of a projected 67 mile extension of the Wichita Falls & Northwestern Ry. from Hammon, Okla., to Woodward, Okla.; McLean & Francisco, Lloyd C. Wiseman, Maney Bros. Co. and Tom Sagris for the completion of the line of the Nevada-California-Oregon Ry. to Lakeview, Ore.; John T. Adams, Columbus Trust & Savings Bldg., Columbus, O., for the grading of the new through freight yards of the Hocking Valley in South Columbus, O.

The commissioners of the Transcontinental Ry. of Canada are now calling for bids for constructing extensive car shops at Transcona, near Winnipeg, Man. The new shops comprise eleven buildings in addition to the indirect heating plant, the yard crane runway and the sewer system. The eleven buildings include lumber sheds, scrap platform and storage bins, scrap platform and machine shop, freight car shop, planing mill, paint storehouse, coach paint shop, coach shops east and west, car department office and motive power office. It is expected that the cost of these new buildings with their equipment will run [illegible]

Bids have been opened in the last two weeks for several good sized government contracts. Among these contracts are the following: Furnishing and delivering stone for rebuilding jetties at Humboldt Harbor, Cal., [illegible] bidder; building shore arm and outer arm of breakwater at Ashtabula, O., and removing 600 lin. ft. of old breakwater, the Edward Glen Dock, Dredge & Construction Co., Racine, Wis., at $951,775, low bidder; dredging 4,700,000 cu. yds. mud with some sand from Norfolk Harbor, Va., W. L. Randolph, Jr., Brooklyn, N. Y., at 10⅜ cts., low bidder; [illegible] River, near New Martinsville, W. Va., the Dravo Contracting Co., Pittsburg, Pa., at $742,451, low bidder.

President Taft is to send a special message to Congress recommending that an additional appropriation be made to complete the reclamation work on the lower Colorado River, undertaken by the United States to prevent the further overflow of the Imperial Valley region of California. An appropriation of $1,000,000 for the work has been largely expended, and considerable more money will be required to complete the work.

Bids were opened June 10 by the city of Milwaukee, Wis., for the construction of a large one leaf bascule bridge, the Milwaukee Bridge Co., Milwaukee, Wis., at $92,845, being the low bidder. The bridge will be 170 ft. long, with 40 ft. roadway and 12 ft. sidewalk.

A good sized contract for constructing gravel roads for Copiah county, Miss., has just been awarded to C. D. Smith & Co., Memphis, Tenn. The contract calls for the construction of 50 miles of road.

The Metropolitan Water and Sewerage Board, Albert St., Brisbane, Queensland, Australia, is now calling for bids for designs, specifications, supply, erection, etc., at the Mount Crosby Pumping Station of the Brisbane River of one, two and three complete units, consisting of power generating plant or plants and pump or pumps of ample power and capacity to raise from the suction wells through the delivery mains through a total vertical lift of 400 ft. not less than 6,000,000 Imp. gals. per unit plant per day of 24 hrs. Bids are to be opened Jan. 30, 1912.

New Forms of City Government.

Progressive ideas in city government are no new development: some years ago Newport, R. I., abolished [illegible] election of city officials, and a little city in Virginia employed a business manager to run its affairs. These were perhaps the earliest developments in the new idea of city government. Then came the Galveston plan of commission rule and later the Des Moines plan. The commission form of city government is now in use in many cities and is steadily gaining ground. Some cities, however, have hesitated to adopt the commission rule and have undertaken experiments of their own. Grand Rapids is one of these cities, and is shortly to vote on the adoption of a new charter which contains many original features. The charter provides for a non-partisan mayor, who is to be general administrator and manager of the city. Four de[illegible] name, public health and safety, and parks and [illegible] are to be appointed by the mayor and with him will constitute an administrative board in which will be vested the complete executive authority. This board will have no legislative functions; these will be intrusted to a non-partisan council of 12 members. The charter also provides for a secret ballot, the initiative and referendum, the recall and popular control of general policies. The city of Pittsburg, which a few months ago obtained much undesirable notoriety because of the "cheapness" of some of its councilmen, is also to have a new form of government. By an act of the state legislature the double house council of 70 members is abolished, and in its place is established a council of nine members elected at large. Each of these councilors is to receive a salary of $9,000 per year.

Crop Report and Railroad Construction.

Crop reports play an im[illegible] construction work. If the [illegible] abundant harvest railroad [illegible] their facilities for handling the expected business. The recent government report on the June condition of crops is exceedingly favorable and as a consequence there are at present many rumors of proposed double track work and the building of branch lines. It is rumored that an announcement will be made shortly by the directors of the Atchison, Topeka & Santa Fe Ry. of an appropriation of about $30,000,000 for double tracking in the southwest. The agricultural outlook in that section of the country is such that it is said that this sum will be expended as rapidly as possible in order to obtain increased facilities. The agricultural outlook in the districts covered by the Hill lines is also good, and it is expected that some of the $20,000,000 bond issue recently sold for the Great Northern Ry. will be used in increasing that road's facilities for handling the expected crop.

Col. Goethals' Parrot.

The following was found under the sweat band of a Panama hat; therefore it must be authentic: Col. Geo. W. Goethals, chief engineer of the Isthmian Canal, had a pet parrot which he admired greatly because of its cleverness and remarkable qualities. The parrot, however, had an embarrassing habit of repeating remarks it heard, and besides had a noisy and boisterous disposition. One day when it had been particularly boisterous, Colonel Goethals' negro attendant overheard the colonel say: "You old bird! I'll have you fried if you don't stop talking." The next day when the colonel sat down to luncheon he had what appeared to be a fried chicken placed before him. "This chicken has a queer taste," he said to his negro, when he sampled it. "Dat ain't no chicken, boss," the negro replied; "dat's dat 'er parrot. It didn't stop talkin'."

Cause and Effect.

The extensive state park system in the vicinity of Boston, which is under the charge of the Metropolitan [illegible] roadways open to automobiles and other classes of pleasure travel. The [illegible] automobiles with chains. Last year, because [illegible] suspended its prohibition from Nov. 15 to March 31. The results from allowing the use of automobiles with chains are thus set forth in the last annual report of the commission: "[illegible] in consequence an increased annual [illegible] mated to be necessary, and has been included in the estimates for this year."

Three 9's Beat Four 7's.

[illegible] seven rudely shaken. This contractor lives in the 17th ward, he was elected to the city council from that ward [illegible] addition he was born on March 17, 1877. He thus considered that seven was his lucky number. In a recent job on which he figured he made an estimate of $27,777 and put in his bid at that amount, thinking that with four sevens in it he couldn't lose. But he did, for the lowest bid was $26,999. According to that good old man Deacon Hoyle four sevens always takes the chips from three nines. But that rule applies to another game.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

The Louisville & Nashville R. R., W. H. Courtenay, Chief Engineer, Louisville, Ky., has perfected plans for the construction of a new line of double track from a point ten miles north of Nashville to Athens, Ala. From Athens to Colera, 34 miles south of Birmingham, the main line of the Louisville & Nashville will be doubled tracked.

The Tennessee & Tombigbee R. R. Co. has been chartered and proposes to build a standard gage railroad from Red Bay, Okla., to Decatur, Ala., a distance of 71 miles. This road will run through the brown hematite iron ore fields of Franklin County, Ala., also about 30 miles of virgin forest. The charter was taken out for $100,000 with A. J. Hackett of Red Bay, Ala., as President and Manager. The surveys have partly been made and will be completed at once. The road from Red Bay to Rockwood is through a somewhat rough country but from Rockwood to Decatur the country is mostly smooth and in good cultivation.

A party of surveyors under Woolsey Finnell, Chief Engineer of the Pascagoula Bay, Birmingham & Chicago R. R., of Tuscaloosa, Ala., has started work on the proposed route running from Demopolis to Linden and then Tuscaloosa, Ala. Offices of the company are in the Masonic Temple at the latter city.

Arkansas.

The Missouri Pacific system is reported to have awarded a contract for laying 85-lb. steel rails on its Iron Mountain line between Cotter, Ark., and Batesville, Ark., the work to be started at once. It is also expected that work will be started soon on the line between Aurora and Carthage and between Springfield and the White River division main line, which the Springfield branch touches at Crane, Mo. Between Aurora and Cotter, Ark., the road is in excellent condition and will need no heavier steel. The work is to be completed by November. This improvement work is being done in accordance with the traffic agreement with the Frisco mentioned in our last issue.

The Dermott, Selma & Northern R. R. Co. has been chartered with a capital stock of $75,000 and proposes to build a line along the logging road between Dermott and Selma in Drew County, a distance of 15 miles. The logging road is owned by the Leavitt Land & Lumber Co. and begins 1½ miles west of Dermott. The new road will follow this logging road to Bayou Bartholomew and thence run north to Selma, the entire route being in Drew County.

It is understood in Malvern, Ark., that Deere & Co. is considering the construction of a railroad north along the Ouachita River from Camden to Malvern through the company's timber tract.

California.

The San Joaquin Light & Power Co., Fresno, Cal., is going ahead with its plans for rebuilding its traction lines at Bakersfield. Frank W. Webster, manager of the Fresno Traction Co., Fresno, will be superintendent of construction.

The Glendale & Eagle Rock Ry. (electric), 329 Cedar street, Glendale, has plans under way for a line from Fourth street and Grand boulevard in Glendale, west across the country to Griffith Park. The proposed route is from the present western terminus of the Glendale-Eagle Rock line at Fourth and Brand, west on Fourth street to Central avenue, thence along Central to the continuation of Fourth street, thence on to Pacific and thence west to Griffith Park.

The Oakland Traction Co., Oakland, Cal., is to start work this month on the double-tracking of its Northbrae line from University and Grove to the southern boundary of the Spring estate in the environs of Berkeley

The Fresno, Coalinga & Tidewater Co., Inc., which is promoting the Fresno, Coalinga & Monterey R. R., has completed about 125 miles of the survey for the proposed line and has secured more than 50 per cent of the right of way between Fresno and Coalinga. As soon as all of the right of way between Fresno and Coalinga has been secured it is planned to commence construction of the first section of the railway. It is not the expectation, however, to commence construction work for about 90 days. Albert Albrecht, Fresno, Cal., is Secretary of the company.

Advices from Fresno, Cal., state that the Santa Fe system has started work on the new yards at Calwa about two miles south of that city, and that the improvements, including extensive freight yards and new machine shop, will necessitate an expenditure of $1,000,000.

The San Diego & Arizona R. R., according to advices from Los Angeles, Cal., is gradually pushing toward Imperial Valley. The rails are now laid to a point within 28 miles of Campo, and two of the four tunnels have been completed. In the mountain section of this road there will be two tunnels, one 2,600 ft. and the other 3,000 ft., within a distance of ten miles. Side tracks are being laid at points on the road already constructed, and as soon as this is completed ballasting of the road will begin. E. J. Kallwright, San Diego, Cal., is chief engineer.

The Petaluma & Santa Rosa Ry., E. M. Van Frank, Petaluma, Cal., president and general manager, is reported to have plans under way for the extension of the road to McNear's Point to a connection with the Western Pacific.

Connecticut.

The Shore Line Electric Ry. Co., Saybrook, Conn., has been making surveys for the layout of a proposed new line through Chester.

The New York, New Haven & Hartford R. R., through its subsidiary Rhode Island company, has obtained long term leases of the Providence & Danielson Ry. Co. (electric), Providence, R. I., and the Sea View R. R. Co., (electric) Wickford, R. I. It is believed that the lease of the latter road by the N. Y., N. H. & H. R. R., means that an important extension will be built westward along the Rhode Island shore to Westerly, R. I., where it would connect with the Westerly & Stonington Street Railway, already in operation.

Florida.

The Lake Weir-Ocala-Silver Springs Suburban R. R. Co., which projects an electric railway between the points named with tracks over the principal streets of Ocala, Fla., has perfected its temporary organization, the officers being D. S. Woodrow, Ocala, president; E. W. Davis, secretary and treasurer; H. A. Kramer, general manager. The capital stock is to be $500,000, of which it is said Chicago capitalists will take $200,000.

The Citrus Southern Ry. Co. has completed surveys for its projected 52-mile line, which is to extend from Sanford to Kissimmee by way of Orlando, and expects to let construction contracts about Sept. 1, 1911. T. K. Miller, Orlando, Fla., is President, G. R. Ramsey, Orlando, is Chief Engineer, and J. J. Brophy, Orlando, is Vice President and General Manager.

It is expected that construction work will be started this fall on the projected line of the Atlantic, Okeechobee & Gulf Ry. Franchise rights for the line are reported to have been granted in all the towns along the route with the exception of Tampa, which will be the western terminus. Henry C. Ferriott, New Orleans, La., is President.

The Pensacola & Perdido and the Pensacola, Alabama & Tennessee Railroads have merged under the new name of the Pensacola, Mobile & New Orleans R. R., and a loan of $750,000 has been secured with which to carry on the new construction work now under way. E. McLaughlin, Pensacola, Fla., is general manager of the company.

Georgia.

W. Z. Williams & Co., 302 American National Bank Bldg., Macon, Ga., have about 150,000 cu. yds. of steam shovel work to let within a short distance of Macon, Ga. The work is suitable for standard gage equipment.

The Southern Ry. is reported to have secured 100 acres of land just within the city limits of Macon, for the erection of shops and extension of trackage calling for an expenditure of approximately $1,000,000. It is stated that the shops to be erected at once will employ from 1,000 to 2,000 men.

Idaho.

Advices from Richfield, Idaho, state that actual construction work has been started on the proposed Owinza, Richfield and Camas Prairie R. R. line from Richfield to a point about 69 miles west.

Illinois.

The Southern Traction Co., now constructing a line from East St. Louis to Belleville, is reported to have purchased the Wabash, Chester & Western R. R., a steam line extending from Chester to Mt. Vernon, Ill., a distance of 65 miles. It is understood that this road will be electrified and made a part of system which the Southern Traction Co. is planning to build in southern Illinois. H. D. Mepham, St. Louis, Mo., is the promoter of the Southern Traction Co.

The Chicago & Northwestern Ry. is going ahead with its plans for the construction of the extension through central Illinois to the coal fields of Montgomery County, and it is understood that construction work will be started this summer. The projected length is 100 miles. E. C. Carter, Chicago, Ill., is chief engineer Chicago & Northwestern Ry.

The Highway Commissioners of Farmington Township held a hearing June 8 on the proposition of the Illinois Central Electric Ry., L. W. Morton, President, Canton, Ill., for building its extension through that place. It is understood that line will be brought into Farmington on the west side of the "Q" R. R.

Preliminary surveys have been made for the proposed Pekin & Delavan Electric Line. The projected length is 16 miles and the route is from Pekin, through Dillon to Delavan. Nothing definite has been done and the project is still in the promotion stage. R. P. Van Deusen, Pekin, is the Engineer.

The Chicago & Joliet Electric Ry. Co., Joliet, is making plans for changes in the location of its track in its interurban division. Details of these plans are not sufficiently advanced to be made public at the present time.

Information received from Elgin, Ill., is to the effect that the committee has been successful in raising the necessary $30,000 to secure the construction of the Elgin Belt Line Railroad. William Grote was chairman of the committee.

It is understood that the Central Terminal Ry. Co., of Chicago, Ill., mentioned in our last issue, is a subsidiary company of the Minneapolis, St. Paul & Sault Ste Marie Ry. and was organized to construct extensive freight yards, offices and sheds for a Chicago terminal in the vicinity of 12th St. of that city.

Indiana.

The Gary & Southern Traction Co., now building its line from Gary to Crown Point, is understood to have plans under way for an extension to Cedar Lake and Lowell next year, and from the latter place to Kankakee. H. W. Seaman, The Rookery, Chicago, Ill., is president.

The Indianapolis & Chicago Ry. Co. has filed its articles of incorporation and proposes the building of an interurban line between Chicago and Indianapolis. It is stated that east-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

ern capitalists have agreed to float the bond issue for the construction of the road. The present plan is to run a line from Indianapolis to Sheridan, thence to Flora, Monticello, Francesville, Valparaiso, Hobart, Wheeler, Gary and Hammond and into Chicago. The distance from Indianapolis to Chicago on the proposed line will be about 175 miles. John C. Billheimer, formerly state auditor of Indiana, is one of the incorporators.

The Gary Connecting Ry. Co., of Gary, Ind., has been incorporated with a capital start of $500,000 and proposes to operate a railroad in Porter and Lake Counties. The directors are V. O. Ward, W. L. Pollock, P. W. Fitzhugh, T. Person and H. W. Ickes.

The Gary, Hobart & Eastern Traction Co., mentioned in our May 31 issue, as planning to build a 5-mile line from Hobart to Broadway, Gary, has decided to do the work by force account instead of by contract. J. C. Cavender, Gary, Ind., is interested.

The Vincennes & Southwestern Traction Co., recently incorporated, with a nominal capital stock of $50,000, is to increase its capital stock to $1,000,000 with a view to making preparations for beginning construction work. George B. Hazleton, Vincennes, Ind., is President.

Iowa.

The Peoples Gas & Electric Co., C. H. Walsh, general manager, Burlington, Ia., has applied to the City Council of that city for permission to double track its street car line from Fourth street to Osborn street.

The Des Moines Terminal Ry., F. M. Hubbell, president, Des Moines, has awarded a contract to the Chicago Great Western Ry., for the hauling of 100,000 yards of dirt from the top of a gravel pit at East 30th street and the Chicago, Burlington & Quincy tracks to the levee which affords flood protection for the Factory addition in West Des Moines.

We are advised that there is nothing to the report that the Iowa Central Ry. was planning to improve its main line from Eldora to Steamboat Rock. It was reported that the company was planning to eliminate several curves and grades between the points mentioned.

Construction contracts for the first section of the Davenport-Muscatine interurban line are to be let at once, it is said. This section will extend from Blue Grass to Muscatine. The contract for the section from Blue Grass to Davenport will be let later, as the exact route the line will follow from Blue Grass to Davenport has not yet been determined. J. F. Porter, 220 Second St., Davenport, Ia., is President.

The Iowa City Street Ry Co., Iowa City, will shortly commence work on two extensions of its street car system in Iowa City. It is expected by fall that the system will have about five miles of line.

The Chicago, Rock Island & Pacific System is reported to be preparing to relay the entire track of the St. Paul & Des Moines line from a point 5 miles east and north of Des Moines, Ia., to Iowa Falls with 85-lb. steel.

Surveys are reported underway by engineers of the Chicago, Burlington & Quincy R. R., for the construction of a connecting line between the Burlington at Indianola, Ia., and Norwalk, on the Keokuk & Western, a distance of 7 miles. Such a line will give the Burlington a direct route from its main line to Des Moines, Ia.

Kentucky.

⦿The Louisville & Nashville R. R. has awarded contracts for work on the Kentucky division between Covington and Paris to the following: Parcel No. 1—Boxley Bros., Quincy, Ky., approximately 250,000 yds. excavation, 2,000 lin. ft. lined single track tunnel, 6,000 yds. concrete; Parcel No. 2—Patterson & Griffen, Pittsburg, Pa., approximately 400,000 yds. excavation, 10,000 yds. concrete; Parcel No. 3—Hough & Spradlin Co., Knoxville, Tenn., approximately 300,000 yds. excavation, 4,000 yds. concrete; Parcel No. 4—Callahan Construction Co., Knoxville, Tenn., approximately 290,000 yds. excavation, 5,000 yds. concrete; Parcels Nos. 5 and 6—J. H. Flick Construction Co., Chicago, Ill., approximately 300,000 yds. excavation, 3,000 yds. concrete; Parcel No. 7—Robt. Grace Contracting Co., Cleveland, O., approximately 250,000 yds. excavation, 8,700 yds. concrete; Parcel No. 8—Price Construction Co., Sta. B, Memphis, Tenn., approximately 50,000 yds. excavation. The work consists of reduction of grade work on the existing line and providing a second track.

Louisiana.

⦿P. M. Johnston, Son & Allhands, St. Elmo, Ill., have the contract for the grading, clearing, bridges, water tank and depot for the 7-mile extension of spur for N. O. T. & M. Ry. (Frisco lines) at Erwinville, La. All subcontracts have been placed, Lennan Bros., Baton Rouge, La., having the grading, and the Jarrett Construction Co., Springfield, Ill., the bridges and buildings. This contract was mentioned in these columns a short time ago.

Maryland.

The Baltimore & Ohio R. R., on June 5, placed an order for 25,000 tons of rails.

Massachusetts.

The Northampton Street Ry. Co., Northampton, Mass., is planning to double-track its Williamsburg line on Elm street, from Henshaw avenue to Vernon street and on Locust street from Prospect street to the car barns.

Michigan.

The Michigan United Rys. Co., Lansing, has leased the Kalamazoo, Lake Shore & Chicago Ry. It is understood that the road will be operated under the old name the Kalamazoo, Lake Shore & Chicago as a steam line, until the lessees are ready to electrify it. It is stated, however, that the Michigan United Ry. will continue to handle carload freight by steam after the passenger traffic between Kalamazoo and South Haven is moved by trolley. The road is taken over on a 5-year lease, with the option of buying at the termination of that agreement.

It is reported that the Michigan Central R. R. is planning the issuance of $15,000,000 of first mortgage bonds of the Detroit River tunnel, part of which will provide funds for the acquisition of terminal, freight and passenger yards at Detroit, Mich.

Mississippi.

The Liberty-White R. R., W. M. White, president, McComb, Miss., is reported to be securing right of way for the proposed extension from New Holmesville to Tylerstown, connecting Tylerstown and McComb. It is further planned to extend the road from Liberty, on the west, to some point on the Mississippi River.

The Fernwood & Gulf R. R., F. B. Enocks, General Manager, Fernwood, Miss., is reported to have entered into an agreement with the New Orleans Great Northern whereby it secures the use of the bridge across Pearl River at Columbia. It looks as thought this meant that the Fernwood & Gulf was preparing to extend its line further northeast to Columbia, Marion County, a distance of only 12 or 15 miles.

Construction work has been started on the spur of the North Mississippi Traction Co. from Tishomingo, Miss., to the Bear Creek stone quarry and water power. This water power will develop 5,000 hydro-electric power and will be used in Tishomingo for running the quarry and factory purposes. The road bed is to be finished by Sept. 1. J. C. Williams has the contract to build the road to the quarry and water power.

Missouri.

Representatives of Eastern capitalists have been over the route of proposed electric railway from Excelsior Springs to St. Joseph, with a view to financing the project. The Townsend-Arnold franchises for this line have been bought by a company known as the Kansas City, Clay County & St. Joseph Ry., under which name the line will be built.

The Kansas City Terminal Ry. Co., W. S. Kinnear, president, Kansas City, Mo., has presented an ordinance to the City Council of Kansas City, calling for changes and modifications in parts of its original franchise. The first change the company asks is a modification in the grades along the old Belt Line right of way from Southwest boulevard to Independence road as stipulated in the original grant. The modifications asked for follow: Independence road, raise .8 ft.; Independence avenue, raise 1.1 ft.; Ninth street, raise .7 ft.; Hardesty avenue, no change; East Twelfth street, lower .4 feet; Jackson avenue, raise 1.5 ft.; Fifteenth street, raise 1.6 ft.; Indiana avenue, raise .4 ft.; Eighteenth street, lower 2.9 ft.; Kansas ave., lower 3.2 ft.; Benton boulevard, lower 4 ft.; Montgall avenue, lower 4.2 ft.; Prospect avenue, lower 6.9 ft.; Olive street, lower 17 ft; Park avenue, lower 23 ft.; Brooklyn avenue, lower 27.7 ft.; Woodland avenue, lower 36.9 ft.; Vine street, lower 33 ft.; Paseo, lower 30.9 ft.; Tracy avenue, lower 26 ft.; Forest avenue, lower 23.1 ft.; Troost avenue, lower 20.7 ft.; Harrison street, lower 18.9 ft.; Campbell street, lower 16 ft.; Charlotte street, lower 13.4 ft.; Holmes street, lower 12 ft.; McGee street, lower 3½ ft.; Grand avenue, lower 2.4 ft.; Main, raise .5 ft.; Broadway, raise 7.9 ft.; Penn, raise 12 ft.; Summit, raise 23 ft.; Southwest boulevard, raise 22.2 ft.; Twenty-fifth street, raise 19.2 ft.; Allen avenue viaduct, raise 4.7 ft. No changes are to be made in the grades on West Twelfth street, St. Louis avenue, Sixth street, Fourth street or Broadway, near Second street. The changes along the Belt Line will require a subway instead of a viaduct at Vine street; a subway instead of a viaduct at the Paseo; lowering of the viaduct at Forest avenue; a subway instead of a viaduct at Harrison; a viaduct at Campbell; a viaduct at Holmes; affects south approach of viaduct at Broadway and reduces width of roadway to 60 feet; a subway instead of a viaduct at Summit; a subway instead of a viaduct at Southwest boulevard and a subway instead of a viaduct at Twenty-fifth street.

The Niagara Gorge R. R. Co. (electric), Geo. A. Ricker, chief engineer, 702 Ellicott square, Buffalo, N. Y., has double track work under way on its Lewiston-Youngstown division. It is expected that the work will be completed before the summer travel to Fort Niagara Beach becomes heavy.

Advices from Rochester state that it is believed there that some action may be taken this summer toward the construction of the proposed Rochester Belt Line R. R. C. D. Beebe, Syracuse, N. Y., president of the Rochester, Syracuse & Eastern railroad and affiliated electric railroad, is interested in the Rochester project.

The Buffalo Southern Ry., 2433 Seneca street, Buffalo, N. Y., is planning to build an extension of its electric railway to East Aurora this season. It is expected that work on this extension will be underway at no distant date.

Frederick W. Whitridge, 2396 Third avenue, New York City, receiver of the Union Ry. Co., New York City, has been authorized to extend the lines of that road over the Madison avenue bridge to connect with the company's lines in the Bronx and from 136th to 138th streets. The order also gives the receiver authority to double-track the extension from 225th to 230th street, connecting the Union Railway with the Kings Bridge Ry.

Advices from Springfield, Mo., state that 15 miles of the proposed route of the Missouri, Arkansas & Gulf Ry. (Ozark Short Line), is now ready for steel. As planned, the route will be from Rolla, Mo., where the general offices are located, through the southern part of Phelps County, the western part of Dent County, and through Texas, Howell and Ozark counties to Bakersfield, the southern terminal, a few miles from the Arkansas line. In all, the road will be 125 miles long as it is now planned. At Willow Springs, about 80 miles south of Rolla, it will intersect with the Kansas City, Fort Scott & Memphis and the Current River railroad, both of which are owned by the Frisco. The territory to be opened by the Missouri, Arkansas & Gulf [illegible] made up of the following classifications of the estimated cost: Right of way, $80,000; telegraph and telephone lines, $37,500; track and roadbed, including clearing, grubbing, grading, rails, ties, bridges, culverts, etc., $1,250,000; equipment, including depots, warehouses, rolling stock and terminal grounds, $284,000; miscellaneous, including legal expenses, surveys, charters, franchises, office supplies and advertising, $132,500; discount on securities, $360,000; interest during construction, $256,000. The officers of the Missouri, Arkansas & Gulf Railway Co., are Gilbert Lay, St. Clair, Mo., president and treasurer; E. C. Comstock, Lecoma, Mo., vice-president; William E. Fink, Rolla, Mo., secretary; Bland, Crites & Murphy, Rolla, general counsel. The board of directors, as they are at present, are: Gilbert Lay, St. Clair; E. C. Comstock, Lecoma; William T. Fink, Rolla; Carl Kimmel, Lecoma; J. A. Frank, Anutt; J. W. Cook, Lenox, and E. C. Halbert, Licking, Mo.

A bill is before the Municipal Assembly of St. Louis granting a 50-year franchise for the construction of an electric railway to David P. Leahy, Henry F. Woodward and Frank J. Steiner, along Florissant Ave. from Robin Ave. to the western city limits, a distance of about one mile. The line is to be known as the St. Louis & Jennings Ry. Company of St. Louis.

The St. Louis, [illegible] & Jefferson City Ry. Co., recently granted a franchise to operate a street railway in the southwestern part of St. Louis, has been chartered with a capital stock of [illegible]. The company plans to build a 15-mile line to Fenton, Mo., at the same time its line in St. Louis is constructed. The officers of the company are: E. R. Kinsey, President; Charles F. Vogel, St. Louis, Vice-President; Thomas G. Portis, St. Louis, Secretary and Treasurer. T. A. Hildebrandt, R. M. Hammond and H. Mackey are other directors.

Kansas City, Mo., and Vicinity.

([illegible])

⊙L. L. Maxon of Argentine, Kas., has secured a contract to build $1\frac{1}{4}$ miles of rock road in Wyandotte county.

⊙G. E. Dutcher has just returned from Iowa, where he closed with J. P. Atkinson for about 125,000 yds. of material. He will load out of here next week. The work is on the C., R. I. & P. road about 12 miles north of Chariton.

J. J. Fitzgerald is progressing nicely on the Chicago, Rock Island & Pacific contract near Chariton, Iowa. He has enough work at hand to keep him busy for some time to come.

Donald Jeffrey is moving his family to Chariton, Ia., to live while he is doing the shovel job he has secured on the Chicago, Rock Island & Pacific near that place. It is understood that Mr. Jeffrey will have four complete shovel outfits at work in the near future.

Practically all the work on the C., R. I. & P. in Iowa is now covered and the line certainly presents a busy aspect these days. The weather has been almost ideal so far for graders. It has been a little too hot at times for comfort, but there has not been so much rainfall but that the earth conditions have been at all times exactly right.

Jerry Connelly was in Kansas City this week. Mr. Connelly has just got back from Denver, where he has been for a year or more. Prospects in the Denver territory are not very bright according to Mr. Connelly's report.

Sten Lund, president of the Lund Construction Co. of Chicago, was a Kansas City visitor this week. It will be remembered that Mr. Lund has a large contract on the Kansas City Southern R. R. under Porter Bros. Mr. Lund reports splendid progress on his work.

Wm. Spencer is still doing work on the Santa Fe R. R. near Bosworth, Mo. We have not had the pleasure of seeing Mr. Spencer personally for some little time, but it is our understanding that the middle of July will see the completion of his contract.

J. B. Dorris, doing work at the present time on the Kansas City Southern at Jaudon, Mo., was a Kansas City visitor on the 9th. Mr. Dorris says that everything is moving along in first class shape on his work.

Wm. List of List & Gifford was in Memphis, Tenn., this week. We were talking with Mr. Crouth, secretary of the List & Gifford Co., a day or two ago, and were shown some figures on excavation done by that company during May that must certainly be gratifying to all concerned. When it comes to moving earth and rock, List & Gifford are hard to beat. Both members of the firm are young men and we know of no company to whom the future holds a brighter promise than to List & Gifford.

In our last week's items, we note we advised the contractors that the well known labor agent, Jos. McGerr, was moving to 913 Union Ave., Kansas City. This was a mistake. Mr. McGerr can be found hereafter at 918 Union Ave. Mr. McGerr's many friends join in wishing him continued prosperity at his new quarters.

Messrs. Hannon & Hickey, doing work at Richards, Mo., met with an accident on their work this week. In some manner or other six of the large 12-yd. cars became disengaged from the engine and rolled off the trestle. The particulars of the accident are not known to the writer, but it is safe to say those particular cars will be out of commission for some time. Mr. Hannon, however, placed his order immediately for new cars and the delay occasioned will be very slight.

L. I. Viall of the Wood, Bancroft & Doty Co., Omaha, Neb., was a St. Louis visitor this week. Mr. Viall went to St. Louis to look over a piece of work near that city. We have not learned whether or not he will do the work he went after. Mr. Viall reports conditions on the Wood, Bancroft & Doty contract at Worland, Mo., as first class.

There will soon be about 100,000 yds. of material available for contractors at the site of the new depot. The contract for removing the earth, it is understood, will be embodied in the contract for the depot itself and as that contract has not as yet been awarded, no definite idea as to the work can be given at this time.

St. Louis Items.

BY [illegible]

McCaughey Bros., 3402 Magnolia Ave., Chicago, Ill., can use two or three small team outfits for short wheeler and drag scraper work on the Burlington R. R. in Illinois. Free transportation. Big Jack McCaughey, the senior member of this firm, was in town the other day and assures us that this is splendid work.

Information from Washington, D. C., says that Major Schulz, army engineer in charge of improvement of the Missouri River, has submitted to the War Department a plan for the improvement of the Missouri in the vicinity of the Columbia bottoms in St. Louis county. This is near the mouth of the river, where the stream has been unstable, having made marked changes in its course. The plan is designed with a view primarily to improving the channel of the river for navigation, but when carried out, Major Schulz says, it will afford protection to the farms in that section that are annually submerged and are sometimes almost washed away by floods.

F. C. Hitchcock of the MacCarthur Bros. spent a day in town looking for a steam shovel outfit that they can use on the Rock Island R. R. near Chariton, Ia.

Reconstruction of the 25 miles of track and roadbed is in progress on the lines of the United Railways, at a cost of approximately $750,000. About 15 miles of improvements are practically completed, leaving about 10 to be done in the latter half of the year. The work costs $30,000 a mile of single track. The roadbed is of concrete, 18 ins. deep, incased in which are white oak ties. The railweighs 112 [illegible]. Twenty-five of the new standard cars have been built and as many more will be put in commission in the next six months. The car has a steel under frame with steel panels, and it is the nearest approach to an all steel car ever used on a city street railway. Each car costs $6,000. The roadway and car expenditures for 1911 will exceed $1,000,000. The track and road reconstruction completed or in progress is: Arsenal street, from Kingshighway to Wood street and from Morgan Ford road to Kingshighway; McPherson avenue, from Kingshighway to Union boulevard; Seventh street, from Market street to Washington avenue; Eighteenth street, from Washington avenue to Biddle street; Twenty-third street, from North Market street to Hobert street; Page avenue, from Taylor avenue to Kingshighway; Sixth street, from Locust street to Pine street and from Walnut street to Choteau avenue; Twelfth street, from Olive street to Chouteau avenue; Eleventh street, from Chouteau avenue to Park avenue; Easton avenue, from Kingshighway to Hamilton avenue; Euclid avenue, from Scott avenue to Maryland avenue; Pine street, from Fourth street to Twelfth street and Manchester avenue from Tamm avenue to Prather avenue. In all this is 15 miles. President Robert McCulloch said that when this year's improvements are completed all the lines in the heart of town will have been rebuilt except that on Locust street, and this work will be done as soon as contracts are let by the city for the street paving. The McPherson line is reconstructed from end to end, the Easton from end to end, and the Manchester from end to end. The Delmar will be reconstructed from end to end when the city decides as to the kind of crossing that should be constructed at the Wabash station. The strip adjacent to the Wabash station is the only part of the line not rebuilt. The reconstruction of the Manchester line is in advance of street paving. The thoroughfare will be paved to the city limits. The improvements which probably will be made next are: Natural Bridge road, from Spring avenue to Fair avenue; Sixteenth street, from O'Fallon street to Chambers street; Lemp avenue, from Utah street to Wyoming street; Nineteenth street, from Branch street to Salisbury street and from Carr street to Madison street; Fifteenth street, from O'Fallon street to Cass avenue; Lee avenue, from Prairie avenue to Fair avenue; North Market street, from Garrison avenue to Grand avenue; Broadway, from Gano avenue to Adelaide street; Jefferson avenue, from Gravois avenue to Geyer avenue; Shenandoah avenue, from Compton avenue to Grand avenue; Broadway, from Chippewa street to Osage street, and Delmar avenue, from Clara avenue to Hamilton avenue. This represents 10 miles of construction.

The following ordinances for granitoid sidewalks on 39 streets were introduced in the municipal assembly on Tuesday, June 6: Dalton avenue, between Arsenal street and Columbia avenue; Market street (formerly Manchester avenue), between Beaumont avenue and Leffingwell avenue; Pennsylvania avenue, between Bowen and Fillmore street; Alberta street, between Missouri avenue and Broadway; Tennessee avenue, between Itaska and Neosho streets; McDonald avenue, betweeen Grand and Custine avenues; Reber place, between January and Dalton avenues; Reber place, between Old Manchester road and January avenue; Broadway, between Elwood and Neosho streets; Broadway, between Neosho and Osage streets; Cleary avenue, between Dickson street and Cass avenue; Compton avenue, between Arsenal and Pestalozzi; Cooper street, between Old Manchester road and Shaw avenue; Daggett avenue, between Kingshighway and Cooper street; Garfield avenue, between Goodfellow and Hamilton avenues; Garfield avenue, between Union boulevard and Arlington avenue; Hammett place, between Marcus and west line of Papin tract; Howard street, between Glasgow and Garrison avenues; Norton place, between Hodiamont avenue and western city limits; Knapp street, between Hebert and Branch streets; Michigan avenue, between Geyer and

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Lafayette avenue; [illegible] Miami and Ch[illegible] streets; [illegible] avenue, between Osage and Chippewa streets; Minnesota avenue, between Miami and Chero-[illegible] and Grand avenues; Nineteenth street, between Penrose and Ferry streets; Obear avenue, between Kossuth and Lee avenues; Ohio avenue, between Arsenal and Pestalozzi streets; Osage street, between Broadway and Minnesota avenue; Osage street, between Minnesota and Louisiana avenues; Penrose street, [illegible] Hodiamont avenue and western city limits; Quincy street, between Thirty-ninth street (formerly Vandeventer avenue) and Tower Grove avenue; Theodosia avenue, between Clara and Goodfellow avenue; Vista avenue, between Boyle and Taylor avenues; Valentine street, between Second and Third streets.

Montana.

The Billings Traction Co. has completed surveys and has secured the capital for the construction of four miles of street railway at Billings, Mont. It is understood that the work will be done by force account. David Gunsberg, 228 Presidential Bldg., Buffalo, N. Y., is president of the Billings Traction Co., and C. A. Smith, Box 404, Billings, Mont., is chief engineer.

Nebraska.

[illegible] Kearney, Neb., has been appointed to take charge of final arrangements for starting work on the proposed line of the Dakota, Kansas & Gulf R. R., from Kearney, Neb., to Beloit, Kan. J. M. Dryden is a member of the committee. W. H. Mitchell is one of the directors of the new company.

Nevada.

It is reported that the Eureka & Palisade R[illegible] gage steam line, is to standard gage its line during the present year. It is further reported that the line will be extended beyond Eureka through the state. G. D. Abbott, Palisade, Nev., is Superintendent.

New York.

The State Public Service Commission has directed the Syracuse Rapid Transit Co., Syracuse, to make improvements to its transportation facilities in Syracuse which will involve the expenditure of $908,825. More than one-third of this amount will be expended during 1911. Among the immediate improvements ordered are the following: Purchase twelve large modern type double truck cars suitable for winter service and have all of such cars in service on its line by or before Nov. 1, 1911. Construct double tracks for the present East Syracuse line from the corner of Green and Lodi Sts. through Green St. to Robinson St., and thence through an acquired right of way to Shuart Ave. and Sedgwick St. to James St. Construct and operate at least one addition transformer station with necessary feeders, and comply with this requirement on or before Nov. 1, 1911.

Mass meetings are being held to consider the building of an electric railroad from Vernon to Waterville by way of Vernon Center, Augusta and Oriskany Falls, a distance of between 15 and 20 miles.

The Long Island R. R. and the Pennsylvania R. R., which own extensive tracts of land in Long Island City adjoining the big Sunnyside yards, are reported to be preparing plans for the development of about 20 blocks lying between Laurel Hill Ave. on the west, Woodside Ave. on the east, Jackson Ave. on the north and Dwyer Ave. on the south in Long Island City as a big industrial center. Extensions of tracks are to be made to the district from the Pennsylvania and Long Island lines and from the New York Connecting Ry.

The Syracuse, Watertown & St. Lawrence R. R., as noted in our issue of June 7, has applied to the Public Service Commission for a certificate to build. A hearing on the application is to be held next week and if the commission gives the company the necessary certificate on such terms as it can afford to accept the road will be built as rapidly as the work can be pushed. This company was recently organized to build a line from a connection with the Syracuse & South Bay Electric R. R. to the village of Brewerton, N. Y. C. D. Beebe, Syracuse, N. Y., is interested.

The Delaware & Hudson Co., Geo. H. Burgess, Chief Engineer, Albany, N. Y., is contemplating the erection of a new round house [illegible]

North Carolina.

[illegible] president of the Elkin & Alleghany R. R., that financial aid has been obtained of Northern capitalists, and that the line which has been in the course of construction for the past two years will be pushed to completion at once and operated under the present name. The [illegible] with the Southern, through Alleghany, Ashe and Watauga counties, penetrating fine timber [illegible]

North Dakota.

Surveys have been completed by H. F. Hamilton, resident engineer of the Great Northern Ry., Minot, N. Dak., for the construction of the proposed spur from Grand Forks to the [illegible] Co.

Ohio.

⊙John T. Adams, Columbus Trust & Savings Bldg., Columbus, O., has been awarded the contract for the grading of the new through freight yards of the Hocking Valley in South Columbus, and work will be started at once. It is estimated that the work will [illegible]

The Mahoning & Shenango Ry. & Light Co., Youngstown, O., has announced its intention of double tracking its line through Hubbard village as soon as possible.

The Northern Ohio Traction & Light Co., Hamilton Bldg., Akron, O., is reported to be planning to double-track its line from the Akron city limits to Springfield Lake.

Oklahoma.

⊙The Wichita Falls & Northwestern Ry. has completed surveys and has secured the capital for the construction of a 67 mile extension from Hammon, Okla., to Woodward, Okla. The contract for the first 30 miles has been let to the Texas & Oklahoma Construction Co., Wichita Falls, Tex.; the contract for the balance of the extension will be let in about 30 days. J. A. Kemp, Wichita Falls, Tex., is president of the Wichita Falls & Northwestern Ry. and R. A. Thompson, Wichita Falls, is chief engineer.

The Sand Springs Interurban line recently completed to Tulsa, is to be extended to Nowata, a distance of 60 miles from Tulsa. It is understood that the line will pass through Collinville, Colagah, Tolata and other towns in the oil field. Charles Page, of Tulsa, is the owner of the line.

The St. Louis & San Francisco R. R. and the Chicago, Rock Island & Pacific R. R. are reported to have set aside an appropriation of $600,000 for the construction of a union depot in Oklahoma City and the elevation of their tracks through the business portion of the city. It is understood that the union depot is to be located on the site of the present Frisco station at First and Harvey Sts. and that the work is to be done during 1912.

It is rumored in railroad circles of Oklahoma that the Missouri, Kansas & Texas (Katy) R. R., is contemplating the construction of an extension from Bartlesville directly west across Oklahoma through Pawhuska and Fairfax to the extreme northwestern portion of this state. F. Ringer, Parsons, Kan., is assistant chief engineer.

The Chamber of Commerce of Hugo, Okla., has closed a contract for the construction of the Hugo Northwestern R. R., from Hugo to Lehigh via Atoka and surveys are already underway. It is hoped to have grading started within 60 days. Mayor Jones of Hugo, Okla., [illegible]

Oregon.

⊙The Nevada-California-Oregon Ry., Geo. S. Oliver, chief engineer, Reno, Nev., has awarded contracts for the completion of its line to Lakeview, Ore., to the following: McLeon & Francisco, Lloyd C. Wiseman, Maney Bros. Co., and Tom Sagris.

The Lane County Assets Co., Eugene, Ore., is reported to be planning to have work started at once on the first 6-mile links of the Eugene-Florence R. R.

Information received from Lakeview, Ore., state that all arrangements have been completed for the necessary right of way for the extension of Northern California & Oregon R. R., to Lakeview. Engineers are busy at Davis Creek and Sugar Hill, and contractors are beginning to receive their equipment for starting construction work.

Pennsylvania.

⊙S. S. Johnson, Millersburg, Pa., is reported to have been awarded the contract for constructing the proposed line of the Conewago & Southern R. R., and it is stated that construction work will be started next month. The company projects a line from Biglerville to Cashtown. Daniel M. Sheeley, Cashtown, is Treasurer of the company.

The Beaver & New Castle Street Ry Co., recently organized, is to apply for a charter on June 23. The company proposes to build a connecting link between the Beaver Valley Traction lines and the New Castle & Beaver Valley Street Ry. The distance to be covered is about 6 2-3 mile. J. S. Herron, F. J. Lobert, J. F. Hayes, E. A. Morton and Charles Pederson, all of New Castle, are interested.

Extensive improvements to the Philadelphia Rapid Transit Co.'s lines are planned by the new management, which assumed control last week. During the next five years it is planned to expend $11,000,000 for new equipment and improvement work. The latter will include 150 miles of heavy standard track to replace worn-out tracks where a lighter type of rail had proven inadequate at an estimated cost of $4,500,000. The proper development of an adequate power supply and the charges for new track connections incident to the scientific rerouting of car lines, both of which must be immediately undertaken, will consume such a large portion of the available $2,500,000. Thomas E. Mitten, President of the Chicago City Ry. Co., Chicago, has been elected a director of the Philadelphia Rapid Transit Co., and will have charge of the re-[illegible]

South Carolina.

The Charleston Consolidated Ry. & Lighting Co., P. H. Gadsden, President, Charleston, S. C., is planning to extend its belt line tracks at Charleston, through Columbus St., from Meeting to King

Tennessee.

The Illinois Central R. R., A. S. Baldwin, Chief Engineer, Chicago, Ill., is reported to have about completed plans for beginning work on its new union depot at Main St. and Calhoun Ave., in Memphis. It is understood that the depot, which will be modeled after the new Pennsylvania station in New York, and other improvements, will cost about $3,000,000. Additional trackage will be an important feature of the change. The company has purchased property owned by the Merchants' Cotton Press and Storage company, almost immediately opposite the present union station on the north side of Calhoun Ave., which will be utilized for passenger terminal yards.

It is reported that on July 1 the Athens & Tellico R. R. will be merged with the Louisville & Nashville system and will become a part of the Knoxville division to be operated under the direct jurisdiction of Superintendent R. C. Morrison, of Knoxville. The Athens & Tellico R. R. is 24 miles long, extending from Athens to Tellico, Tenn., and crosses the main [illegible] of Athens. The Louisville & Nashville is understood to have acquired interest in this road

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

early last year and is reported to have expended about $250,000 on improvements.

Announcement has been made that the Lewisburg & Northern R. R. has about completed arrangements to build a line through middle Tennessee, from Portland near the Kentucky line, to the Alabama line, opening a stock and agricultural country. A $500,000 bridge across the Columbia River near Nashville is part of the plan. This road will be built for the Louisville & Nashville R. R. At the Alabama end it will connect with a new double track road which will be built from that point to Athens, Ala., under the charter of the Louisville & Decatur R. R. Co. At Athens connection will be made with the main line of the Louisville & Nashville.

Texas.

The new owners of the Bartlett & Florence R. R. are understood to be planning to complete the road from Jarrell to Florence, a distance of 12 miles, and from Bartlett to Rockdale. The road is already in operation from Bartlett to Jarrell, 12 miles. C. J. Granger, Palestine, Texas, is interested.

J. F. Strickland, 300 Commerce St., Dallas, Tex., President of the Texas Traction Co., is reported to have purchased the Citizens Street Ry. Co. of Waco and the Waco Gas Electric Light Co. It is stated that an interurban will at once be built from Hall to Waco by way of Waxahachie and Hillsboro, bridging the Brazos with a new bridge and establishing street car service to East Waco.

It is stated that as the result of the Texas Supreme Court's decision against Sweetwater, Hamlin will get the shops of the Kansas City, Mexico & Orient Ry.

The Crystal City & Uvalde R. R., E. Breaker, Chief Engineer, Crystal City, Tex., is planning to have work started at once on a 27-mile extension into McMullen County.

The Bankers Trust Co., of Houston, Tex., has purchased nine lots in block 220, bounded by Rusk and Walker Aves. and Dowling and Broadway Sts., and it is expected that the property will be used by the Houston Belt & Terminal Co., for the development of its yards in that city.

The Paris & Mt. Pleasant R. R., H. P. Mobberly, Chief Engineer, Paris, Tex., is shortly to be extended to Mt. Pleasant.

Residents of Temple and Gatesville have become sole owners of all the assets and other property of the Temple Northwestern Ry. This deal has been pending for some time, but was only consummated recently. Important developments in connection with the road are expected.

An expenditure of $94,700 has been authorized for work at the yards of the Gulf, Colorado & Santa Fe Ry. in Galveston: It is understood that bids for this work will be asked at once by Frank Merritt, Chief Engineer, Galveston, Tex. The work will include the following: 16-stall brick low type engine house, equipped with new 85-ft. turntable, $46,000. Brick storehouse, copper bronze screened, with waterproof concrete basement, $17,000. Brick machine shop and blacksmith shop combined, $9,500. Brick power house, $6,200. Brick sand house, $6,000. In addition, the Gulf, Colorado & Santa Fe will construct with the company forces two frame sheds to be used for carsheds, these two structures to cost approximately $10,000. The company forces will also build in the Galveston yards steel water tanks and the necessary pipe lines.

The Gulf, Colorado & Santa Fe Ry., Frank Merritt, Chief Engineer, Galveston, has completed plans for the construction of a $13,000 power house at Cleburne, a $20,000 6-stall engine house at Silsbee, and a $2,500 addition to the machine shop and boiler room at Silsbee.

The Galveston, Harrisburg & San Antonio Ry., D. K. Colburn, Engineer Maintenance of Way, Houston, Tex., is planning to build a 2-mile extension from Sansom to Uvalde.

It is reported that the San Antonio & Rio Grande R. R., a short line running from San Juan to Edinburg, is to be extended to Falfurrias, about 75 miles, where it will connect with a branch of the San Antonio and Aransas Pass. G. C. Moore of Cambridge Springs, Pa., and associates, who recently purchased the Butler ranch of 40,000 acres, situated about midway between Falfurrias and Edinburg, are said to be interested in the proposed extension.

Grading work has been started between Oak Cliff and Red Oak for the interurban line to be constructed between Dallas and Waxahachie by Stone & Webster. The line is to be completed and cars in operation within 12 months.

Utah.

Surveys have been completed from Payson to Provo for the projected line of the Salt Lake-Payson Interurban R. R.

The Salt Lake & Los Angeles Ry., Jos Nelson, President, Salt Lake City, operating a 15 mile steam line from Salt Lake City to Saltan, has applied to the City Council of the former city for a franchise to operate electric cars over certain streets in the city. It is believed here in Salt Lake City that this application for a franchise means that the entire line will be electrified.

The Westinghouse Electric & Mfg. Co., Pittsburg, Pa., is reported to be getting out plans, specifications and estimates on contracts for the complete electrical construction and equipment of a new 85-mile trolley railway connecting Theodore, Colton, Myton and Roosevelt, Utah, to be submitted shortly for approval and acceptance to the capitalists interested in the promotion and construction of the project.

The Oregon Short Line R. R. is taking active steps toward securing the necessary right of way for the construction of the double track through Clearfield, Utah. The company is reported to have secured about 90 per cent of the right of way between Salt Lake City and Ogden, the price ranging from $5,000 to $10,000 per mile.

Virginia.

⦿The contract for the construction of the new union station in Norfolk, Va., has been awarded to Henry Miller, Inc., Norfolk, Va. The new station will be seven stories high, and will be used by the Norfolk & Western, Virginia, Seaboard Air Line and Norfolk Southern Railroads. The cost of the improvement is approximately $500,000.

Washington.

The Twin City Life & Power Co., which has a franchise for an electric railway from South Bend to Raymond, is reported to be preparing to begin work. Ray Fulcher, Constructing Engineer for Sanderson & Porter, New York, who are supposed to be the owners of the franchise, is now in South Bend, Wash.

The Walther Lumber Co. has nearly completed surveys for a projected 52 mile railroad from Ellensburg to Wenatchee, Wash. The capital for construction has been secured and construction contracts will be let in August. Mr. Watson, Ellensburg, Wash., is chief engineer, H. W. Walther, Ellensburg, is president and W. C. Vaughn, 424 Kimball Block, Spokane, Wash., is secretary.

West Virginia.

The Kingwood Lumber Co., C. M. Hughes, Beaver, Pa., treasurer, which recently purchased a large tract of virgin hardwood timber in the vicinity of Parsons, W. Va., is preparing to construct a standard gage railroad into the new holdings from Parsons. W. R. Cover, Connellsville, Pa., is secretary, and R. D. Caddell, Connelsville, Pa., is president of the Lumber Company.

Conferences have been held looking to the building on an electric railway from Grafton via Fairmont, Morgantown, Blacksville and Waynesburg into Pittsburg, reaching the latter city either over its own line or through connection at Washington with another system. The proposed road would have a mileage of from 90 to 125 miles. John T. McGraw, Grafton, W. Va., President of the Grafton Traction Co., is interested in the project.

The Baltimore & Ohio R. R. has submitted plans to the City Council of Martinsburg for a $75,000 subway at North Queen St. The work will be completed this summer. The subway will be about 300 yds. in length, 40 ft. wide and 16 ft. high.

Wisconsin.

The city attorney of Milwaukee has been notified of the decision of the State Railway Commission to grant the petition of the city asking for the elevation of railroad tracks on the south side. The formal decision on the city's petition and the order to change the grades within two years will be issued as soon as the apportionment of cost has been agreed upon by the companies and the city. All parties were given until June 10 to file their agreement, and failing in this, arguments were to be held on June 12 in Madison. Tracks which will be elevated are at Greenfield Ave., Scott, Madison, Washington, Walker and Mineral Sts., National Ave., Clinton, Reed, Florida, Oregon, South Water, Greenbush, Hanover and Grove Sts. The tracks north of the Menomonee River at West Water, Fowler, Second and Clybourn streets, on the Chicago, Milwaukee & St. Paul Ry., will not be ordered elevated.

Canada.

✣Bids are asked until noon, July 11, by P. E. Ryan, Secretary Commissions of the Transcontinental Ry., Ottawa, Ont., for constructing car shops at Transcona, near Winnipeg, Man. Certified check for $100,000 is required with bid. Plans, details and specifications may be seen at the office of Gordon Grant, Chief Engineer, Ottawa, Ont., and Mr. S. R. Poulin, District Engineer, St. Boniface, Man.

The Board of Public Works of Windsor, Ont., has recommended to the City Council that the Sandwich, Windsor & Amherstburg Ry. (electric), 14 Sandwich St., Windsor, be given permission to double track its Ouellette Ave. line at Windsor from Tecumseh Road north.

The Saskatchewan government has approved a change in the route of the Grand Trunk Pacific between Moose Jaw and Regina. The present status of work on this line in Saskatchewan is as follows: Grading on the line from Qu' Appelle to Regina will be completed by the first week in July. Steel laying will be completed three weeks later. The grading gang when it reaches Regina will start immediately on the G. T. P. line from Regina to the border. A grading gang has reached Edenwold, 24 miles from Regina. Grading on the Moose Jaw-Regina G. T. P. line is going ahead rapidly.

H. M. E. Evans, Edmonton, Alta., acting in behalf of a syndicate of British capitalists, has applied to the City Council of Saskatoon, Sask., for power rights on the Saskatchewan River at this point, and also for a 20-year franchise for a street railway. The syndicate proposes to expend $2,000,0000. The scheme includes the taking over of the charter of the Saskatchewan Power Co., a local corporation, which obtained a franchise to dam the river 12 miles north from the Dominion government three years ago.

The Canadian Pacific Ry. has issued and sold in London $6,161,000 additional consolidated 4 per cent debentures stock. The proceeds are to be used for the construction of 553 miles of branch lines in Manitoba, Saskatchewan and Alberta.

Locating engineers of the Grand Trunk Pacific are reported to be working on a branch line from the new trans-continental route in Alverta up into the Peace River country. This proposition was not included in the contemplated branches.

The Bruce Mines & Algoma Ry. Co., now operating between Bruces Mines and Rock Lake, Ont., has been purchased by George P. McCallum and H. Appleton, Sault Ste Marie, Mich., and plans are under consideration for extending the line to a connection with the Grand Trunk Pacific, a distance of 350 miles. It is reported that the Fidelity Trust Co., Montreal, Que., will act as financial agents of the reorganized road and will underwrite

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

a bond issue amounting to $6,000,000. The road as extended will intersect the Soo branch of the Canadian Pacific, the main line of the same road at Ridout, and the Canadian Northern, now under construction, and connect with the Grand Trunk Pacific one hundred miles west of Cochrane. After the road crosses the Canadian Pacific main line it enters the great clay belt, which will thus be opened up to settlement and cultivation. A branch will run into the Porcupine district. It is expected all of the preliminary work will be done so that the work of actual construction may be started on August 1. It is hoped to complete fifteen to twenty miles this fall.

Mexico.

The Mexico Northwestern Ry., B. H. Bryant, Chief Engineer, Chihuahua, Mexico, now that the revolution is over, is planning to go ahead with its extensive construction plans. During the revolutionary troubles the work of constructing the extension from Nueva Casas Grandes to Madera, 121 miles, was carried on without interruption, and this division will soon be finished and in operation. In furtherance of the plan of rounding out the system, a line will be constructed from Minaca west to Tonichi, about 100 miles, with a branch line from El Tigre to the Pacific port of Agiabampo, about 125 miles. At Tonichi the branch line will connect with the Yuma River Division of the Southern Pacific. From a point about sixty miles north of Madera a branch line will be constructed northwest to Agua Prieta, opposite Douglas, Ariz., about 120 miles.

It is believed here in the City of Mexico that the control of the National Railways of Mexico will soon pass out of the hands of the government and that American interests closely identified with the Southern Pacific and the St. Louis & San Francisco properties may become the purchasers. The government merger system line embraces more than 7,000 miles of line.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣Bids will be received until noon, June 14, by Julien Smith, City Engineer, Selma, Ala., for laying about 5,000 yds. of brick paving on concrete foundation; about 2,000 ft. of granite curbing and all necessary storm sewers, inlets, etc.

⊙Chas. O. Duncan has been awarded the contract by the City Council of Gadsden, Ala., for the construction of concrete sidewalk, curb, curb and gutter and catchbasins for $5,990. Bids were opened June 5. Chas. L. Marsh is city engineer.

According to Secy. W. S. Keller of the State Highway Department, Montgomery, Ala., 10 counties have asked to receive the benefits of the state highway law passed by the recent legislature, allowing $2,000 to each county for the purpose of building roads, provided the counties raise a similar amount.

Arkansas.

⊙M. D. L. Cook, E. 4th St., Little Rock, Ark., has been awarded the contract by Commissioners of E. Fourth St. District, Little Rock, Ark., for paving with asphalt on a concrete foundation, East 4th St., from Main to Rector Ave., for $30,462. Bids were opened June 8 by Claud Ringo, Secy.

Lee County, Ark., Marianna, county seat, plans the expenditure of $100,000 on improvements to earth roads this year. W. B. Knox of Marianna is Supervisor of Roads.

The citizens of Paris, Ark., have asked the City Council to create District No. 1, for the purpose of paving the square and each street running one block from the square.

California.

⊙The Atchison, Topeka & Santa Fe Railway Co., J. W. Walker, Div. Supt., Fresno, Cal., has awarded the contract for the building of Ashland Ave., from Richmond Ave. to MacDonald Ave., a mile apart, to George W. Cushing of Richmond for approximately $20,000.

Advices from San Diego, Cal., state that India St. and M St. are to be paved as soon as proceedings will allow.

The Board of Supervisors of Plumas County, Quincy, Cal., has ordered bids advertised for the construction of a new road from Greenville to Big Meadows, a distance of 11 miles.

The Board of Public Works of Los Angeles, Cal., has approved the plans for paving North Broadway between Ord St. and the new Buena Vista bridge across the Los Angeles river.

Colorado.

✣Bids will be received until 11 a. m., June 19, by Board of Public Works, Denver, Colo., for furnishing all labor and material for the grading, construction of curb and gutter, alley returns and alley crossings and otherwise improving North Side Improvement District No. 16. Henry Read is President of the Board.

The City Engineer of Colorado Springs, Colo., has completed the specifications for the paving of the downtown district and is now preparing estimates and assessment lists. Bids for this work will be asked for about July 15.

Connecticut.

Work is to begin at once on the construction of a system of sidewalks in the city of New London, Conn., at an estimated cost of $150,000. About 30 miles of concrete walks will be laid.

District of Columbia.

✣Bids will be received until 3 p. m., July 10, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction of additional sidewalk in connection with the U. S. Post Office Building at New Brunswick, N. J.

✣Bids will be received until 3 p. m., July 7, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for additional sidewalks, curbs and coping in connection with the site of the U. S. Court House at Portland, Me.

Florida.

✣Bids will be received until July 1, by W. F. Divine, City Clerk, St. Petersburg, Fla., for the construction of 9 blocks of brick pavement on South 6th Ave., 6 blocks on Lake St. and 5 blocks on 5th St.

⊙The City Council of St. Petersburg, Fla., has awarded the contract for grading and paving Sixth St., from Central to Seventh Ave., with brick to the Georgia Engineering Co. of Augusta, Ga., for $1.40 per sq. yd. Bids were opened June 1 by City Clerk Divine.

Idaho.

At the last session of the Idaho Legislature $25,000 was appropriated for the building of the state road, which is to begin at Kootenai and extend to the Montana line, a distance of 26 miles, provided Bonner County could raise a like amount. Standpoint Commercial Club and Clarke Fork Commercial Club have voted $18,000 for the project.

Ilinois.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Secretary, until 11 a. m., June 21, for furnishing labor, tools, materials, etc., for paving the following streets and alleys: Kimball Ave. System, 29,500 sq. yds. asphalt pavement; Wall St., 3,110 sq. yds. asphalt pavement; Vincennes Road, 14,800 sq. yds. brick pavement; 37th Pl., 3,820 sq. yds. asphalt pavement; 69th St., 10,700 sq. yds. brick pavement; Milwaukee Ave., 5,520 sq. yds. brick pavement; Milwaukee Ave., 14,750 sq. yds. granite block pavement; Indiana St., 2,920 sq. yds. granite block pavement; Indiana Ave., 33,470 sq. yds. asphalt pavement; Grand Ave., 2,560 sq. yds. granite block pavement; Fairfield Ave., 2,060 sq. yds. asphalt pavement; Erie Ave., 3,580 sq. yds. asphalt pavement; W. Adams St., 12,000 sq. yds. asphalt pavement; alleys, Madison St., Sacramento Ave., etc., 940 sq. yds. brick pavement; alley, Oakwood Blvd., 1,900 sq. yds. brick pavement; Belmont Ave., 430 sq. yds. macadam pavement. All brick, granite block and creosoted block pavement to be placed on a 6-in. concrete foundation with sand cushion. Specifications may be had upon application to Jno. B. Hayes, Chief Clerk.

✣Bids will be received by the Board of Local Improvements, Jno. J. Forrest, Secretary, Town of Cicero, until 8 p. m., June 20, for resurfacing the macadam pavement on 14th St. Chas. Stoeffel is Town Clerk.

⊙The Board of Local Improvements of Sterling, Ill., has awarded the contract for the paving of West Tenth St. with Purington repressed brick, No. 1, for $1.33 per yd., to McCarty & Fitzgerald.

⊙The Board of Local Improvements of Peoria, Ill., has awarded the contract for the paving with brick of North Orange St., from Main St. to Chambers Ave., to the J. S. Allen Co., for $7,110. The board also adopted a resolution in favor of paving Stanley Ave.

⊙Hoffman & Townsend of Marion, Ill., have been awarded the contract by the City Council of Mt. Carmel, Ill., for paving and road building for $41,123. The contract covers the paving of Mulberry St., from McDowell to 13th St., a distance of 13 blocks, and about nine miles of hard or gravel road leading out of Mt. Carmel.

⊙F. L. Luth, manager of the Banner Clay Works, Edwardsville, Ill., has been awarded the contract in Hillsboro, Ill., for furnishing 750,000 paving blocks.

The Board of Local Improvements of Sterling, Ill., has passed a resolution authorizing the paving of Seventh Ave., from Third St. north to Tenth St. The paving will be 33 ft. wide.

An election was held in Georgetown Township, Georgetown, Ill., on June 3 for the purpose of deciding whether or not bonds to the amount of $30,000 were to be issued for paving the Georgetown road from Westville to Georgetown, a distance of six miles.

A number of residents of Main St., east of 24th St., in Quincy, Ill., are agitating for improved conditions in the surface of that thoroughfare. They have asked the City Council to macadamize six blocks of the street.

The Board of Local Improvements of Virginia, Ill., has completed arrangements to begin the work of street paving over a large area in the business section and adjoining streets. The contract for this work will be let immediately. Charles Savage is Mayor.

Following are the low bids submitted to the Board of Local Improvements, Chicago, June 1st, for paving; prices include constructing concrete curb and gutter, manhole and catch basin adjustment and 6-in. Portland cement concrete foundation where specified: 56th St., 8,580 sq. yds. creosoted blocks, $27,683, The Ryan Co., Tacoma Bldg.; Hillock Ave., 3,200 sq. yds. asphalt, $7,050, The American Asphalt Paving Co., Chamber of Commerce Bldg.; Lock St., 2,790 sq. yds. asphalt, $6,013, The American Asphalt Paving Co.; Mendell St., 2,100 sq. yds. No. 2 granite block, $7,806, R. F. Conway Co., 138 Washington St.; Perry St., 23,000 sq. yds. asphalt, $4,759, The American Asphalt Paving Co.; Rascher Ave., 4,070 sq. yds. asphalt, $9,258, R. F. Conway Co.; 62nd Pl., 690 sq. yds. asphalt, $1,661, The

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

American Asphalt Paving Co.; 65th St., 2,460 sq. yds. asphalt, $5,699, The American Asphalt Paving Co., 77th St., 850 sq. yds. macadam, $1,674, Calumet Coal & Teaming Co., 2926 E. 95th St.; 30th St., 8,140 sq. yds. asphalt, $17,626, The American Asphalt Paving Co.; Washtenaw Ave., 2,000 sq. yds. asphalt, $4,281, Standard Paving Co., 1101 S. 48th Ave.; Winchester Ave., 4,280 sq. yds. macadam, $8,207, Calumet Coal & Teaming Co.; Linden Ave., 4,710 sq. yds. asphalt, $11,056, R. F. Conway Co.; 42nd Ct. System, 11,510 sq. yds. asphalt, $26,328, American Asphalt Paving Co.; Dauphin Ave., 49,920 sq. yds. macadam, $82,817, Fair Bros. Co.; Clara Pl., 33,100 sq. yds. asphalt, $6,837, The American Asphalt Paving Co.; So. Chicago Ave., 14,700 sq. yds. brick, $36,252, The Ryan Co.; alley, Webster Ave., 800 sq. yds. brick, $2,072; P. J. O'Brien; alley, 24th to 25th St., 870 sq. yds. brick, $2,259, Central Paving Co.; alley, 31st St. to 32nd St., 1,050 sq. yds. brick, $2,818, Central Paving Co.; alley, 40th St. to 41st St., 1,010 sq. yds. brick, $2,850, Jas. Sackley Co.; Hyde Park Blvd., 680 sq. yds. brick, $1,885; Ashland Ave., 5,020 sq. yds. asphalt, $10,668, American Asphalt Paving Co.; Chicago Ave., 18,910 sq. yds. creosoted blocks, $63,276, American Asphalt Paving Co.; Cottage Grove, 27,650 sq. yds. brick, $67,617, Calumet Coal & Teaming Co.; Ellis Ave., 6,300 sq. yds. asphalt, $13,400, American Asphalt Paving Co.; Frankfort St., 1,920 sq. yds. asphalt, $4,134, American Asphalt Paving Co.; 41st Ave., 8,800 sq. yds. asphalt, $18,891, Standard Paving Co.; 43rd Ave., 8,750 sq. yds. asphalt, $18,752, Standard Paving Co.

Indiana.

✣Bids will be received until 1 p. m., June 28, by Board of Randolph County Commissioners, Winchester, Ind., for the construction of a road in White River township. H. F. Wood is County Auditor.

✣Bids will be received until 10 a. m., July 3, by Board of Jay County Commissioners, Portland, Ind., for the construction of highway in Bear Creek township. W. Lea Smith is County Auditor.

✣Bids will be received until 10 a. m., July 19, by Board of Public Works, Indianapolis, Ind., for the improvement of several roads and streets by grading and paving. (See under Sewer Section.)

✣Bids will be received until 2 p. m., July 10, by Board of Parke and Putnam County Commissioners at Rockville, Ind., for the construction of a gravel road on the county line between Jackson and Madison townships. J. E. Elder is Auditor of Parke County.

✣Bids will be received until 2 p. m., July 10, by Commissioners of Parke and Putnam Counties at Rockville, Ind., for the construction of a gravel road on the county line between Clinton and Madison townships in Putnam County and Jackson and Union townships in Parke County. J. E. Elder is County Auditor.

✣Bids will be received until 11 a. m., June 21, by Board of Public Works, Indianapolis, Ind., for the improvement of Delaware St. from the north property line of 28th St. to the south property line of 30th St. by grading and paving the roadway.

✣Bids will be received until 1 p. m., July 3, by Commissioners of Ripley County at Versailles, Ind., for the construction of macadam roads in Laughrey and Otter Creek townships. Nicholas Volz is County Auditor.

⦿J. M. Hamilton has been awarded the contract for the construction of the Fellmuth pike, located on the line between Marion and Grand Prairie townships, by the County Commissioners, Marion, for $4,000. The proposed pike is one and one-half miles long.

⦿Edward H. O'Leary of Lafayette, Ind., has been awarded the contract by the Board of White and Carroll Counties, Monticello, Ind., for the construction of a stone road on the county line for $9,217. Bids were received June 7.

⦿Campbell & Hawkins of Brazil, Ind., have been awarded the contract by the Posey County Commissioners at Mt. Vernon, Ind., for the construction of a gravel road in Center township for $23,780. Bids were opened June 8.

⦿L. R. Adams & Co., of Princeton, Ind., has been awarded the contract by the Commissioners of Posey County, Mt. Vernon, Ind., for the construction of a gravel road for $29,157. Bids were opened June 8.

⦿L. A. Gana and the Mt. Vernon Construction Co., of Mt. Vernon, Ind., have been awarded the contract by the County Commissioners, Mt. Vernon, for the construction of gravel roads for $16,104. Bids were opened June 8.

⦿White & Eigenmann of Evansville, Ind., have been awarded the contract by the County Commissioners, Mt. Vernon, Ind., for the construction of a gravel road in Robb and Lyon townships for $10,841. Bids were opened June 8.

⦿The County Commissioners, Wabash, Ind., have awarded the following contracts for the construction of seven roads, for which bids were opened June 6: H. B. Sark & Co., Bluffton, Ind., three roads for $8,750, $5,689 and $10,329; G. M. Sewell, Laketon, Ind., $7,400; Fred A. Grover & Co., Logansport, Ind., $10,738; D. O. North, Bluffton, $10,329; and D. P. Drook, Mier, $2,091.

⦿Elwood Johnson, Orleans, Ind., has been awarded the contract by the Commissioners of Washington County, Salem, Ind., for the construction of a road in Washington township for $10,190. Bids were opened June 5.

⦿Gibbons & Son and McGuire & Son have been awarded the contract by the County Commissioners, Brazil, Ind., for the construction of gravel roads for $4,200 and $2,148 respectively. The roads are in Harrison and Ridge townships. Bids were opened June 6.

⦿A. L. Waynick of West Baden, Ind., has been awarded the contract by the County Commissioners, Paoli, Ind., for the construction of two gravel roads. O. P. Turley, Orleans, Ind., secured the contract for the construction of one gravel road, and Elwood Johnson of Orleans secured the construction for one road. Bids were opened June 6.

⦿Campbell & Dobson, Bloomington, Ind., have been awarded the contract by the County Commissioners, Bloomington, Ind., for the improvement of a highway in Bloomington township for $5,438. Bids were opened June 7 by Horace Blakely, Auditor.

No bids were received by the Commissioners of Jennings County, Vernon, Ind., on June 5 for the construction of a pike road in Vernon township. The work will be readvertised. M. W. Brogan is county auditor.

⦿John G. Young of LaPorte, Ind., has been awarded the contract by the Board of County Commissioners, LaPorte, Ind., for the construction of a macadamized road in Center and Springfield townships for $18,420. Bids were opened June 8.

The contract for the construction of a concrete water way and combined curb and gutter, about 700 ft. in length, for which bids were opened June 5 by the Board of Trustees, Bloomfield, Ind., has not been awarded. Franklin Ramsey is president.

⦿The Board of County Commissioners, Bedford, Ind., has awarded the following contracts for the construction of gravel roads, for which bids were opened June 6: Miles Standish, Bedford, $2,495; E. N. Hendricks & Co., Heltonville, Ind., $10,498; Walter Norman, Heltonville, $2,720, and M. D. Clark, Bedford, $3,980.

⦿The Board of County Commissioners, Greensburg., Ind., has awarded the contract for the repair of retaining walls to S. D. Layton of Letts, Ind. Bids were opened June 5.

Iowa.

⦿Schweppe & Co. have been awarded the contract by the City Council of Ft. Dodge, Ia., for the construction of concrete pavement in the city for $1.58½ per yd. The contract amounts to 7,500 sq. yds. on Fourth Ave., north between 15th St. and Park Blvd.; on Third Ave., north from Park Blvd., between Third and Fourth Aves., north. Work is to begin July 1 and finished by October.

The town of Oelwein, Ia., plans a considerable amount of paving for this year. About 26 blocks will be constructed.

A good roads association has been organized in Kingsley, Ia., and has raised a fund of $1,000.

The City Council of Des Moines, Ia., has adopted resolutions for the paving of Mills St., from Cottage Grove Ave. to 20th St.; 20th St., from Mills St. to Cottage Grove Ave., and the north and south alleys in the block between 21st and 22d and Cottage Grove Ave. and School St.

Three petitions for paving or graveling suburban roads in Des Moines, Ia., have been received by the City Council. The roads are Easton Blvd., Sand Hill road and Grimes road.

The following low bids were received by the City Council of Des Moines, Ia., on June 1 for five contracts on paving and curbing in West Des Moines: Bryant F. McLaughlin, for paving 35th St., from Woodland Ave. to Kingman Blvd., $1.88 per sq. yd.; Meyer Bros., for paving on 12th from Mulberry to Walnut Sts., and on Mulberry St. from 11th to 13th Sts., $1.99 per sq. yd.; J. L. Lytton, curbing Mulberry St., from 11th to 13th Sts., and curbing 12th St., from Mulberry to Walnut, $0.30 per lin. ft.

Kansas.

✣Bids will be received until 10 a. m., June 20, by Newton, Kan., for the construction of 5,000 sq. yds. of brick pavement on concrete base with asphalt filler. H. E. Devlin is City Engineer.

✣Bids will be received until 10 a. m., June 20, by City of Newton, Kan., for the construction of 5,000 yds. of brick block paving; 2,100 ft. of curb; 2,600 cu. yds. of excavation. F. E. Devlin is County Surveyor.

The City Commissioners of Topeka, Kan., have petitioned for the paving of Branner St., between Sixth and Eighth Sts.

The city of Fort Scott, Kan., plans the paving of a number of streets within this year. Among the streets are Broadway and Lowman, and First and Holbrook.

West Douglas Ave., from Main to Wichita St., in Wichita, Kan., is to be paved with No. 1 vitrified brick paving blocks. The City Commissioners have granted a petition to repave Douglas Ave. between these two streets. Bert C. Wells is City Engineer.

Kentucky.

✣Bids will be received until June 17, by C. F. Redmon, Turnpike Supervisor, Paris, Ky., for the construction of 2½ miles of Silas Pike, 10 miles west of Paris connecting Hawkins and Cummins Pike.

A good roads association has been organized in Louisville, Ky. Petitions will be circulated over the county asking that a county levy be made sufficient to raise $18,000 for dragging the roads. James Stander is president and L. J. Mayfield secy.

Resolutions providing for the reconstruction of more than five miles of streets have been passed by the improvement committee of the City Council of Newport, Ky. The total cost of the improvements will be in the neighborhood of $100,000. The following streets will be reconstructed: Phillips alley, from Isabella to Patterson; Eighth St., from Monmouth to Saratoga; Thirteenth St., from John to Monmouth; Tennessee alley, from Sixth to Seventh; York, from Eighth to Twelfth; John St., from Tenth to Eleventh; Overton St., from Third to Ninth; Saratoga St., from Fourth to Seventh; Central Ave., from Third to Fifth; James alley, from Monmouth St. to Saratoga; Third St., from Central to Columbia; Columbia St., from Eleventh to Twelfth; Isabella, from Eleventh to Twelfth; Twelfth, from Isabella to Brighton; Eleventh St., from Saratoga to Washington Ave.; Bandermann alley, from Ninth to C. & O. R. R.; Brighton St., from Seventh to Eleventh; Tenth St., from Washington Ave. to Brighton.

The Fiscal Court of Pulaski County, Somerset, Ky., has passed a resolution appropriating $1,000 per mile to assist in the building of

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

pikes in the county. This amount will be given with the understanding that the citizens raise a similar amount. The court also authorized the county judge to borrow $30,000 to aid in this work. It is expected that at least 10 miles of pike will be built this year.

Louisiana.

✣The State Highway Department, Baton Rouge, La., will receive bids until noon, June 20, for the construction of 2 miles of gravel road in Baton Rouge, connecting the Hope Villa and Bayou Sara roads; also 20 miles of earth road known as the Mansfield and Logansport road in De Soto Parish.

Maryland.

✣Bids will be received until June 21, by Board of Awards, Baltimore, Md., for the paving of the 26th St. footway. B. T. Fendall is City Engineer.

✣Bids will be received until noon, June 15, by State Roads Commission, Baltimore, Md., for building two sections of the State Highway aggregating about 5.29 miles in length along the road between Gamber and Fenby in the county of Carroll. E. E. Goslin is Secretary and John M. Tucker is Chairman of the Commission.

⦿George Jewell, Madison and Licond Sts., Annapolis, Md., has been awarded the contract for grading and paving with bituminous macadam for 60 cts. per sq. yd., and $1.06 per sq. yd., respectively, in Annapolis. Bids were opened June 5.

The Paving Commission of Baltimore, Md., composed of R. Keith Compton, Douglas H. Thomas, Samuel C. Rowland and Mayor Preston, on May 31 held its first meeting to organize and map out preliminary plans. It is generally believed that the first work will be done in South and East Baltimore. Out of the $5,000,000 paving loan the Board of Estimates has appropriated $500,000 for work this year. R. Keith Compton is chairman of the commission.

Massachusetts.

✣Bids will be received until June 16 by Board of Public Works, Springfield, Mass., for the paving of Railroad, Essex and Jackson Sts. The work will include approximately 5,200 sq. yds.

Michigan.

✣Bids will be received until 2 p. m., June 19, by William T. Easton, City Clerk, Dowagiac, Mich., for furnishing labor and material necessary for the grading and paving of High St. from Front St. to Iowa St. with 6-in. concrete pavement, surfaced with bitumen and combined curb and gutter. Official advertisement will be found elsewhere in this issue.

⦿The Board of Public Works of Bay City, Mich., has awarded contracts for the building of permanent sidewalks as follows: Ryan & Son, District No. 1, $0.10 per sq. ft.; John Dardas, District No. 2, $0.09¾ per sq. ft., and William Green, District No. 3, $0.09½ per sq. ft.

Bean & Jones of Benton Harbor, Mich., at $11,800, submitted the only bid to the Township Clerks of Ovid and Kinderhook townships in Branch County, Mich., on May 26 for the construction of six miles of gravel road, half of which is in each county, under Michigan State Reward Plan. The letting has been adjourned until June 16. The work will probably be readvertised.

The following bids were received June 1 by the Board of Public Works of Grand Rapids, Mich., for paving work: Fountain St.—Peter Vanderveen, asphalt macadam, $7,126; Carpenter & Anderson, creosote block, $10,129; McDermott & Cooper, asphalt, $7,425; A. Green, asphalt macadam, $7,656; L. C. Hilding, creosote block, $10,407; E. W. Seamans, creosote block, $11,126; E. W. Seamans, asphalt macadam, $6,993. McConnell Court—L. C. Hilding, $1,211; H. A. Hoxie, $1,230; Kloote & Vanderveen, $1,134; Martin Den Boer, $1,043. Clancy St.—E. W. Seamans, asphalt macadam, $9,493; C. E. Williams, westrumite, $9,295; McDermott & Cooper, asphalt, $10,093; L. C. Hilding, westrumite, $10,129; A. Green, asphalt macadam, $10,361. Crescent Place—C. E. Williams, tar macadam, $1,282; Kloote & Vanderveen, tar macadam, $1,165; McDermott & Cooper, tar macadam, $1,456. Humboldt St.—Kloote & Vanderveen, $6,997; L. C. Hilding, $6,792; McDermott & Cooper, $6,811; Martin Den Boer, $7,092; Richard Pickett, $7,[illegible]

The County Road Commissioners, Cadillac, Mich., have been petitioned by the residents of the western portion of Clam Lake township to construct a mile of state reward road between sections 27 and 29.

The Board of Road Commissioners of Iron County, Crystal Falls, Mich., has engaged A. L. Burridge to supervise its road construction work. The county is planning a considerable amount of road work for this season.

Minnesota.

✣Bids will be received until 5 p. m., June 19, by city of Albert Lea, Minn., instead of Minneapolis, Minn., as mentioned in our last issue, for the construction of 32,280 sq. yds. of pavement. Bids will be received on creosoted wood block, vitrified brick, mineral rubber, bitulithic, sandstone and concrete. William Barneck is City Egineer.

E. A. Dahl is the probable contractor at $6,276 for the paving of Wyoming St., between 54th and 60th Aves., east, in Duluth, Minn. The work will be done with tarcon on a concrete base.

Mayor C. L. Swenson of Albert Lea, Minn., has recommended to the City Council additional paving amounting to about 38 blocks. William Barneck is City Engineer.

Winona County, Winona, Minn., will construct permanent roads under the Elwell good roads bill. The city, county and state will, under the bill, provide $120,000 worth of good highways for Winona County. The provisions of the bill to be carried out are that the state will pay one-half the sum, the county one-fourth and the benefited property holders one-fourth.

Mississippi.

⦿C. D. Smith & Co., of Memphis, Tenn., have been awarded the contract at Hazelhurst, Miss., for the construction of about 55 miles of gravel roads in Copiah County. Bids were opened June 6. The George Co., 526 Randolph Bldg., Memphis, Tenn., Engineers.

⦿McLeall & Baskerville of Macon, Miss., have been awarded the contract by the city of Columbus, Miss., for the construction of about 6,000 ft. of concrete curb and gutter at $8.14 per cu. yd. Bids were opened June 6.

Missouri.

Advices from Moberly, Mo., state that the proposition for the eight road districts of Randolph County, submitted to the voters May 31, has been carried.

Nebraska.

⦿The Board of Public Works of Fremont, Neb., has awarded the contract for the paving of Districts Nos. 15 and 16 to Abel & Roberts of Lincoln, Neb., for approximately $12,000. The bid was: District No. 15—Curbing, per ft., $0.18; paving, per sq. yd., $2.23½. District No. 16—Curbing and gutters, per ft., $0.49; curb corners, each, $0.50; end curb, each, $0.18, and paving, per sq. yd., $2.23½.

Farmers in the vicinity of Central City Neb., on June 1 constructed 49 miles of good roads along the line of the Union Pacific railroad from east to west. The work was done under the direction of H. E. Glatfelter and Joe A. Hays of Crystal City.

City Engineer E. H. Morey of Kearney, Neb., has prepared plans for the building of two miles of model highway according to the methods approved by government good roads builders.

The City Council of Hastings, Neb., A. T. Bratton, City Clerk, has passed an ordinance creating paving district No. 16, which embraces Seventh St., between Lincoln Ave. and east side of Wabash Ave. The City Engineer has been instructed to prepare specifications for the work. The work will be done with asphalt.

New Jersey.

✣Bids will be received until 3:15 p. m., June 15, by Board of Street and Water Commissioners, Newark, N. J., for paving Woodside Ave., from Elwood to Grafton Ave., with brick; Montclair Ave., from Summer to Mt. Prospect Ave., with bitulithic; Scheerer Ave., from Renner Ave. to Bergen St., with bitulithic; Weston Ave., from Frelinghuysen Ave. to the Pennsylvania Railroad, with granite, all to be laid on a 6-in. concrete foundation.

✣Bids will be received until 8 p. m., June 26, by the Common Council, Plainfield, N. J., for the construction of about 40,000 sq. yds. of plain and bituminous macadam. A certified check for $200 must be filed with each bid.

⦿The State Commissioners of Roads, Trenton, N. J., at the office of the Clerk of Chosen Freeholders, Camden, N. J., has awarded the contract to J. T. Shanley & Co., Arcade Bldg., Philadelphia, Pa., and Gibbs & Co., of Clementon, N. J., for resurfacing White Horse pike with asphalt concrete, including 11,981 tons type B asphalt concrete; 6,885 tons 1½-in. stone; 9,988 cu. yds. of gravel. Bids were opened May 24. J. J. Albertson is Engineer of Camden County.

⦿Bernard Gannon, 41 Graham St., Jersey City, N. J., has been awarded the contract by the Shade Tree Commission, A. T. Hastings, Jr., Secy., Jersey City, for grading Montgomery Park for $23,200. The work includes removing 70,000 cu. yds. of earth, garbage, etc., and furnishing about 5,000 cu. yds. of good top soil. Bids were opened June 6.

New York.

✣Bids will be received until 3 p. m., June 15, by Charles B. Stover, President of the Park Board, New York City, for the reconstruction of the surface of Hudson River road with gravel and asphaltic binder; also roadway of the Bronx and Pelham Parkway from Williams bridge road to White Plains road.

✣Bids will be received until 8 p. m., June 20, by Thomas H. O'Neill, Mayor, Auburn, N. Y., for the construction of about 8,430 sq. yds. of vitrified brick and 4,260 lin. ft. of Medina sandstone curbing.

✣Bids will be received until June 16 by the Board of Contract and Supply, Troy, N. Y., for the construction of pavement on Fourth St.

⦿The Board of Contract and Supply of Rochester, N. Y., has awarded contracts for street improvements as follows: Goldsmith Place, asphalt pavement, Whitmore, Rauber & Vicinus, $2,599; Depew St., asphalt pavement, Rochester Vulcanite Pavement Co., $14,512; Nellis Park, asphalt pavement, Whitmore, Rauber & Vicinus, $1,148; Agnes St., sewer, cement walks and grading, W. H. Madden, $3,141; Olean St., sewer, walks and grading, W. H. Madden, $3,177; Harvard St., sewer, John Petrossi Co., $168; Anthony St., cement walks, Crouch Bros., $630; Hoffner St., brick pavement, F. C. Lauer & Sons Co., $1,080.

⦿P. B. Colgon of Dunkirk, N. Y., has been awarded the contract by the City Council of Dunkirk for the paving of Leopard St., for about $10,000. The work includes one block of brick pavement on a concrete foundation with concrete curb and gutter. Bids were opened June 6.

⦿The Dunkirk Construction Co., of Dunkirk, N. Y., has been awarded the contract by the Commissioners of Public Works, Olean, N. Y., for the construction of a vitrified brick pavement on Second St., from Sullivan St. to State St., and from Henley St. to Green St., for $13,869. The work includes 1,930 cu. yds. of excavation, 6,678 sq. yds. of pavement, 3,645 lin. ft. of curbing, 276 lin. ft. of curbing and 10 lin. ft. of circle curbing, 100 cu. yds. of earth fill and 100 lin. ft. of curb to be reset. Bids were opened June 2.

Bids opened by City Clerk D. J. Coutant, Newburgh, N. Y., on June 5 for furnishing the necessary labor and material for permanently improving by paving Grand St. its entire length, from Washington St. to Leroy Pl.,

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

have not been awarded because council was served with an injunction. Further action has been deferred until June 19. The work includes [illegible] sq. yds. paving, about 11,500 lin. ft. of curbing, 15 manholes, 8 inlets, 12 sewer manholes, and 25 cu. yds. of extra concrete. W. J. Blake, Jr., is city engineer.

Ohio.

✣Bids will be received until noon, June 16, by Board of Control, Akron, O., for paving West Exchange St., from Portage Path to the corporation line; Howe St., from Bowery St. to Moeller St., and Stanton Ave., from Main St. to Sweitzer Ave. For the construction of a main trunk sewer in Glendale cemetery from Lock 8 to Willow St.; a storm water sewer in Rider Ave. and Tallmadge Ave from Wright St. to Cuyahoga Falls Ave.; a storm water sewer in Bishop St., from Willow St. to Douglas St., and a sanitary sewer in Jewett St. from a point 150 ft. north of Buchtel Ave. to Hazel St.; for the construction of a retaining wall along Pleasant Park. All in accordance with the plans, specifications, etc., on file in the office of the Department of Public Service, where said plans and specifications may be seen and blank proposals can be obtained. Each proposal must be accompanied by a certified check for $200 for the pavings, and a certified check for $100 for the sewers and the retaining wall, payable to the Director of Public Service of the city of Akron.

✣Bids will be received until noon, June 17, by Charles Craig, Clerk, Cheviot, O., for furnishing the necessary labor and material for the improvement of North Bend Road from Harrison Ave. to the north corporation line by constructing combined cement curbs and gutters. Plans and specifications are on file at the office of the Village Clerk.

✣Bids will be received until noon, July 7, by Board of Hamilton County Commissioners, Cincinnati, O., for oiling, under Specifications No. 232, Harrison Pike from the C. C. & L. R. R. to east corporation line of Harrison, in Harrison and Whitewater townships. Fred Dreihs is Clerk of the Board. A certified check for $500 must accompany each bid.

✣Bids will be received until noon, July 7, by Board of County Commissioners, Cincinnati, O., for the repair, under Specifications No. 203, of Indian Hill Ave. from Plainville Pike to Wooster Pike in Columbia township. Fred Dreihs is Clerk.

⦿The Stark County Commissioners, Canton, O., have awarded the contract for the construction of one mile of paved highway on the Alliance-Harrisburg road and one mile on the Lexington road to John Wilson of Alliance, O., for $17,608 and $18,449 respectively. The work includes paving with brick two miles of road. Bids were opened May 24.

⦿The Jos. Gradison Construction Co., Cincinnati, O., has been awarded the contract by the Board of County Commissioners, Cincinnati, for improving Crookshank road from Muddy Creek road north to Gamble's land, thence east to the Bridgetown road, in Green township, for $15,986. Bids were opened June 2.

⦿Chloe Edgington has been awarded the contract by the County Commissioners, Findlay, O., for improving the Philip Marquart road in Orange township for $12,685.

⦿The City Council of Covington, O., has awarded the contract for the paving of Fifth St., from Madison to Scott; Madison, from Seventh to Eleventh, and from Seventeenth to Twentieth, with asphalt to the F. J. Ruh Co.

⦿The contract for paving Huffman Ave. from Martz Ave. to Overlook Ave., in Dayton, O., has been awarded by the Board of Control to the J. E. Conley Co. for $38,590. Brick will be used.

⦿Baldwin Bros. were awarded the contract for the Irish road improvement by the County Commissioners, Cleveland, O., for $69,000. The County Engineer's estimate was $72,000.

⦿The Board of Control of Youngstown, O., has awarded the contracts for six street improvements as follows: Grace Ave., paving, to Miller Bros., $2,800; Bruce St., paving, to Turner & Olson, $7,219; Floral Ave., sewer, to E. Diorio, $746; Hawthorne St., sewer, to E. Drorio, $543; Clifton St., grading, to Shook & Gray, $1,833, and Ayers St., grading, to Connelly & Son, $755.

Oregon.

The County Court of Jackson County, Jacksonville, Ore., has ordered machinery to an amount of $30,000 for the building of good roads, employed W. W. Harmon to supervise the construction of new roads, and has asked for bids for the building of several miles of macadam roads, part of which will be oil-macadam. The county plans to expend about $200,000 in road work this year.

Pennsylvania.

✣Bids will be received until 10 a. m., June 16, by Department of Public Works, at the office of the City Comptroller, Pittsburg, Pa., for making certain public improvements, as follows: Grading, curbing and paving with repressed vitrified brick, class "A," Edwards alley, from South Twenty-seventh St. to a point 454 ft. eastwardly. Grading, curbing and paving with standard sheet asphalt and block stone, class "D," McIntyre Ave., from Perrysville Ave. to Euterpe (formerly Eudora) St. Grading, curbing and paving with block stone, class "D," Verner Ave., from California Ave. to first angle west. Repaving with creosoted wood block, roadway of South Twenty-second St. bridge. Sewers—Harpster St., from a point about 230 ft. northeast of Froman St. to present sewer on Froman St., 12-in. pine; Edwards alley, from a point about 460 ft. east of South Twenty-seventh St. to present sewer on South Twenty-seventh St., 15-in. pipe; Limasco Ave. (formerly Lonergan way), from a point 525 ft. east of Belasco (formerly Pauline) Ave. to present sewer on Belasco (formerly Pauline) Ave., 8-in. pipe; Fargo St. and Allison St., from a point about 630 ft. south of Allison St. to present sewer on Allison St., 15-in. pipe; private property of V. & B. Hybner, H. G. Reinermann, et al., Queen St. and Waco alley, from points about 250 ft. south and 50 ft. north of Waco alley to present sewer on Radner St., 8-in. pipe; Forty-third St., from Eden alley to present sewer on Willow St., with branch sewer on Eden alley, 8 and 15-in. pipe. New sidewalk, west side of Chartiers Ave. bridge crossing of the P., C., C. & St. L. R. R. Mill and shop inspection and testing—Steel reinforcement for Larimer Ave. bridge.

⦿The Supervisors of Pine Grove Township, Russell, Pa., have awarded the Erie Construction Co. of Erie, Pa., the contract for the proposed road from the corner of Main and Liberty Sts., in Russel, west to the Farmington township line. The road will be of brick.

⦿John McCormick & Son have been awarded the contract by the City Council of Erie, Pa., for the paving of Poplar St., from Second St. to Park Ave., with Class B asphalt, artificial stone curb and brick gutters. The contract was let at $1.27 per yd. on asphalt, $0.31 per ft. on curb, $32 on catchbasins, $5 on spills, $0.60 per ft. on 9-in. pipe and $0.40 per ft. on 6-in. pipe.

⦿The Borough of Kingston, Pa., W. J. Williams, Secy., has awarded the contracts for paving approximately 10,000 sq. yds. of brick paving on a concrete foundation, and for approximately 3,000 sq. yds. of Amiescite, Warrenite, or similar paving, and for furnishing and setting approximately 8,700 lin. ft. of curbing to R. W. Hensen of Geneva, N. Y., for approximately $46,000. The contract for constructing approximately 3,000 lin. ft. of sewers 8 to 20 ins. in diameter, with manholes, catchbasins, etc., was awarded to A. H Coon for $2,998. Bids were opened May 31.

Work on the reconstruction of the Jenners and Johnstown pike, under the supervision of the state, will be begun in Lincoln township, Cambria County, Pa., this summer, connecting the road now being constructed by Contractor McSpadden and extending to the Jenner township line. The road will be nine miles in length. Ebensburg is the county seat of Cambria County.

A company has been organized in York, Pa., by Dr. H. B. Rockwell to lay all the standard forms of street paving, including bitulithic, asphalt, brick and wood block. The capital stock of the company is $250,000.

Tennessee.

Advices from Rutledge, Tenn., state that survey for the pike roads in Grainger County is well under way. The engineers began at Rutledge and are making a survey westward to the line of Knox County. It will be some time before the survey of that end of the road is completed, then other routes will be surveyed as fast as possible.

President George A. Gowan of the Memphis to Bristol Highway Association has appointed the following as a committee to locate, have surveyed and superintend the construction of a state highway between those two cities: W. F. Carter, Johnson City, Tenn.; Dr. A. E. Foster, Lea Springs, Tenn.; Jerre Whitson, Cookville, Tenn.; J. M. Taylor, Cave, Tenn.; Geo. M. Cline, Crossville, Tenn.; Marino Richardson, Lawrenceburg, Tenn.; J. W. Walker, Centerville, Tenn.; J. H. Bayer, Huntingdon, Tenn.; L. L. Curtiss, Jackson, Tenn.; C. C. Hanson, Memphis, Tenn., and James Palmer, Nashville, Tenn. The first meeting of the commission was held at Nashville June 3, at which time preliminary plans for the work were discussed.

Texas.

✣Bids will be received until June 19 by city of Wharton, Texas, for the construction of three miles of concrete sidewalks. J. G. Johns is Engineer.

✣Bids will be received until 11 a. m., June 19, by John M. Murch, County Auditor, Galveston, Texas, for the construction, including regrading, culverts, etc., and resurfacing county road from causeway approach at Virginia Point to Texas City Junction, and to Highland Bayou. A certified check for $2,000 must be filed with each bid.

Utah.

The Pittsburg-Salt Lake Oil Co., in a communication to the Commercial Club of Salt Lake City, Utah, has made on offer to furnish all the crude asphalt necessary to surface the proposed state highway through Davis County.

Box Elder County, Brigham City, Utah, recently voted the issuance of bonds to the amount of $200,000 for the improvement of roads and the building of bridges.

Virginia.

✣Bids will be received until June 28 by the Board of Supervisors and State Highway Commission, Richmond, Va., for the construction of new roads in Wise County.

Washington.

✣Bids will be received until June 15 by County Commissioners, Hoquiam, Wash., for the construction of the Emerson road, at an estimated cost of about $17,000.

⦿The City Council of Chehalis, Wash., has awarded the contracts for paving the following streets to the Warren Construction Co. for $57,740: Portion of Chehalis Ave., North St., Prindle St. and Center St., with bitulithic; a mile and a quarter of East Market St. with Warrenite, 18 ft. in width.

⦿E. Wiles, Main E. 8th and E. 6th Sts., Portland, Ore., has been awarded the contract by the city of Vancouver, Wash., for constructing hard surface pavement for $156,827. The work includes grading, concrete walk, curbs and gutters, inlets, catchbasins and bithulitic pavement; also W. 15th, Franklin, 14th, and Park Sts., for grading sidewalking and curbing let to Oregon Engineering & Construction Co., at $21,500; also Jackson, Pattello, and E. 15th, let to White, Wright, et al., $12,909, for grading walks, curbs, etc. H. H. Lotter is city engineer.

The City Commissioners of Spokane, Wash., have voted to readvertise for bids on the following improvements: Grading, curbing, parking and sidewalking of Lincoln St., Cliff Ave. to Wall St.; for the brick paving of Eighth Ave., between Cannon and Chestnut Sts.; for the grading, curbing, parking and sidewalking of Hatch St., between 17th and 29th Aves., and for the grading, parking, curb-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

ing and sidewalking [illegible] Lincoln St., to Cliff Ave.

Van Wyck Township, lying east [illegible] of the city of Bellingham, Wash., is planning a considerable amount of road building. The Board of Supervisors has ordered the engineer to make the survey for a mile and a half of road in Sections 5 and 6, Township 38 North, Range 3 East. The road as proposed will be a continuation of King St. It is also planned to extend the Hannegan road for some distance.

The County Commissioners, Tacoma, Wash., have decided to advertise for bids for the clearing of a right of way from the Julius Gulch road through to Dash Point. The road will extend about five miles from across the tide-flats to the Kings County line at the most northwestern point of Pierce County. The clearing of the proposed right of way is estimated at about $6,000.

The City Commissioners of Spokane, Wash., have rejected the present plans for the proposed improvement of Stevens St., south, from Second Ave. to Seventh Ave., with Hassam. D. C. Coates is Commissioner of Public Works.

The citizens of Wahkiakum County, Cathlamet, Wash., county seat, recently voted the issuance of bonds to the amount of $50,000 for the building of a county road extending from the Cowlitz County line through Wahkiakum County to the Pacific County line. Bids for the bonds will be received July 3.

West Virginia.

✣Bids will be received until 7:30 p. m., June 16, by Board of Affairs, Bluefield, W. Va., for the construction of macadam roadway on Princeton Ave., from overhead bridge to corporation line. Plans and specifications are on file at the office of the City Engineer.

Wisconsin.

⦿The Standard Oil Co. has been awarded the contract by the Department of Public Works of Milwaukee, Wis., for furnishing the [illegible] Bids were opened May [illegible].

⦿Christ Johnson of Oshkosh, Wis., has been awarded the contract by the Board of Public Works of Wausau, Wis., for the paving of Scott and Washington Sts., between Third and Fourth, with creosote blocks for $2.48 per sq. yd., and $0.60 per lin. ft. to reline and reset the curbing.

Specifications are being drawn by Street Supt. Mullen of Milwaukee, Wis., for the paving of Walnut, Germania and Lee Sts.

Street Supt. Mullen of Milwaukee, Wis., has announced that he will advertise in two weeks for bids to extend the North Ave. paving improvement from 27th Ave to 43d St.

The Board of Public Works of Antigo, Wis., has received the following bids for laying a westrumite asphalt pavement on Clermont St., between Fourth and First Ave., and a macadam on Edison St., between Fifth and Fourth Aves.: Westrumite—Central Westrumite Co., $10,117, and W. A. Stewart, $10,722. Macadam—W. A. Stewart, [illegible], and W. [illegible] Fisher, $2,720. The contracts will not be let before June 15.

Petitions have been presented to the City Council of Milwaukee, Wis., asking that North Ave. be paved with bituminous pavement from 26th to 48th Sts. Charles A. Mullen is Street Supt.

Preliminary steps for the improvement of streets have been taken by the City Council of Green Bay, Wis. The streets to be improved are: Quincy, from Mason to Grignon; West Walnut, from bridge to Oakland; Shawano, from Oakland to Allard; Congress, Spring, East Walnut, from Washington to bridge; Main, from St. Paul railroad tracks to bridge; Dousman, from bridge to Broadway; Adams, from Main to Astor Place; East Walnut, from Adams to Webster; Crooks, from Washington to Webster; Dousman, from Broadway to Allard, and Oakland, from Walnut to Shawano.

Canada.

✣Bids will be received [illegible] cement sidewalks.

✣Bids will be received until noon, June 24, by H. B. R. Craig, City Engineer, Kingston, Ont., [illegible] and gutter.

⦿The Board [illegible] has awarded the following contracts for sidewalk construction: Granolithic walks—5 ft. south side Spadina, Clark to Prescilla, city engineer of construction; 6 ft. west side Wood, Bell to River Ave., engineer of construction; 6 ft. south side Wardlaw, Joseph to Clarke, engineer of construction; 6 ft. south side Bell, Wood to Clarke, engineer of construction; full width west side Ellen, Bannatyne to Notre Dame, Thomas Jackson & Son; 6 ft. both sides Ellen, William to Alexander, Thomas Jackson & Son; 6 ft. west side Maryland, Broadway to Fawcett, engineer of construction; full width both sides Fountain, Alexander to Logan, Thomas Jackson & Son; 6 ft. east side Lulu, Logan to Alexander, engineer of construction; full width south side Selkirk, Main to Bowers, J. Devitt; 8 ft. west side Derby, Dufferin to Stella, engineer of construction; 6 ft. both sides Gertie, Notre Dame to Bannatyne, Thomas Jackson & Son; 6 ft. south side Francis, Bannatyne to Notre Dame, Thomas Jackson & Son; 6 ft. west side Sherbrooke, Preston to Cornish, J. Devitt; full width west side Sherbrooke, Broadway to Preston, J. Devitt

The Good Road Board, to be known as the Board of Highway Commissioners of York County, Toronto, Ont., has prepared plans for the expenditure of $300,000, of which one-third was voted by the city of Toronto and the rest granted by the Legislature and York County Council, to provide good highways for York County. The board will advertise immediately for a road engineer to supervise the work.

The city of St Boniface, Man., plans the construction of bitulithic pavement this year at an estimated cost of $250,000 and a consid- [illegible]

BRIDGES—STEEL AND CONCRETE

California.

✣Bids will be received between 10 and 11 a. m., June 26, by Board of Public Works, Oakland, Cal., for furnishing the necessary labor and material for the following propositions: The construction of a concrete culvert in East 14th St., between 73d and 74th Aves.; the construction of a concrete culvert in Peniman Ave., opposite Viola St. J. W. Nelson is Secretary of the Board.

An election will be held about the middle of August, according to plans of the City Trustees, Fullerton, Cal., to vote on improving streets and constructing new concrete bridges.

Connecticut.

City of Hartford, Conn., has filed with the State Board of Railroad Commissioners two petitions asking that orders be issued for the construction and proper assessments of the costs for new bridges over the Central New England R. R. tracks on Edwards and Woodland Sts.

Delaware.

Plans and specifications have been filed with the Levy Court, Wilmington, Del., for the contruction of a new bridge at Roseville to replace the old covered structure.

Illinois.

✣Bids will be received by L. E. McGann Commissioner of Public Works, Chicago, until 11 a. m., June 19th, for furnishing and delivering lumber to the division of bridges and viaducts for the period ending Dec. 31st, 1911. Cash or certified check for $500 with bid.

✣Bids will be received at the Supervisors' room, Cook County Court House, Chicago, Illinois, up to 12 M., June 23, for the construc- [illegible] Northfield Township, Cook County. Robert Funk, Town Clerk, Shermerville, Illinois. Andrew Bridge: Span, 42 ft.; slab bridge; roadway, 20 ft.; reinforced concrete abutments, 14½ ft. high; wings, 12 ft. long. Estimated amount of concrete in structure, 177 cubic yards; reinforcing steel, 19,374 lbs. Nearest railroad station, Techny, on the C. M. & St. P., 2 miles; Northfield, on the C. & N. W., 1½ miles. Present structure, 47 ft., pile trestle. Excavation will average 5 ft., north side, 15 ft., south side, in loam and clay. Ordinary flow of stream, 3 ft. deep and 20 ft. wide. Contract to include back filling and gravel or macadam wearing surface. Commissioners wish crushed stone and sand used for all concrete. Work to be completed on or before November 1, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Illinois.

✣[illegible] 1911, for the construction of the following eight reinforced concrete bridges in Patton [illegible]

[illegible] S. W. Paxton, [illegible]

[illegible] N. W. Paxton, 2½ mi.

776 S. Perdueville, 3½ mi.

[illegible] All material will have to be shipped in Pres- [illegible] on piles with timber backing. Commissioners [illegible] orders drawn against the Road and Bridge levy for this year. Work to be completed on or before November 1, 1911. More detailed in- [illegible] the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Illinois.

✣Bids [illegible] Clinton, Illinois, up to 9 a. m., June 23, 1911, for the construction of one reinforced con- [illegible] Witt County. R. S. McBride, Town Clerk, Farmer City, Illinois. Maple Grove Bridge: Span, 2-40 ft. girder type; 18 ft. roadway. One plain concrete pier. Reinforced abutments; finished roadway to bottom of footings, 14 ft. Estimated amount of concrete in structure, 244 cubic yards; reinforcing steel, 33,636 lbs. Nearest railroad station, Farmer City, 3 miles [illegible] miles from bridge site. Haul, 1,500 ft. Pres- [illegible]

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

ent structure, 108 ft. pile trestle. Ordinary [illegible] stream, 1 ft. deep and [illegible] ft. wide. Excavation will average about 6 ft. in black loam and clay. Work to be completed on or before November 1, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received at the Town Clerk's office, Lanark, Illinois, up to 2 p. m., June 21, 1911, for the construction of one reinforced concrete bridge in Rock Creek Township, Carroll County. Mr. F. B. Speck, Lanark, Ill. Geo. Peters Bridge—Span, 40 ft.; roadway, 16 ft.; finished roadway to bottom of footings, 14½ ft.; wings 15 ft. Estimated amount of concrete in structure, 133 cubic yards; reinforcing steel, 15,451 lbs. Nearest railroad station, Lanark, on Chicago, Milwaukee & St. Paul, 5 miles. Gravel at bank, 50 cts. per cu. yd., ½ mile from bridge site. It will probably have to be screened and washed. Present structure is a 23 ft. A truss on stone abutments, same to be removed. Excavation will average about 13 ft. in sandy loam, piles may be necessary. Work to be completed on or before August 1, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfild, Illinois.

✣Bids will be received at the Court House, Mt. Carroll, Illinois, up to 2 p. m., June 20, 1911, for the construction of two reinforced concrete bridges in Salem Township, Carroll County. Mr. S. A. Keim Town Clerk, Mt. Carroll, Ill. Drenner Bridge:—Span, 16 ft.; roadway, 16 ft.; finished roadway to bottom of footings, 11 ft.; plain concrete substructure. Estimated concrete in structure, 67.3 cu. yds.; reinforcing steel, 2,243 lbs. Nearest railroad station, Lanark on the Chicago, Milwaukee & St. Paul, 4 miles. Gravel available at bank 25 cts. per cu. yd.; 5 miles from bridge site. Present structure is a 20 ft. A truss on piles. Excavation will average about 6 ft. in loam and clay. St. Paul Bridge:—Span, 32 ft.; roadway, 16 ft.; finished roadway to bottom of footings, 18 ft. Estimated concrete in structure 130.4 cu. yds.; reinforcing steel, 14,492 lbs. Nearest railroad station, Lanark, 3½ miles. Present structure 34 ft. steel truss on stone abutments, same to be removed. Ordinary flow of stream 18 ins. deep, 30 ft. wide. Material will have to be shipped in. Work to be completed on or before August 15, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received at the Town Clerk's office, LaMoille, Illinois, up to 10 a. m., June 22, 1911, for the construction of two reinforced concrete bridges in LaMoille Township, Bureau County. J. H. Showalter, Town Clerk, LaMoille, Illinois. Grady Bridge:—Span, 40 ft.; roadway, 16 ft.; finished roadway to bottom of footings, 14 ft. Estimated amount of concrete in structure, 122.6 cu. yds.; reinforcing steel, 15,120 lbs. Nearest railroad station, VanOrin on the C. B. & Q., 3 miles. Present structure is a 46 ft. pile trestle. Excavation will average about 11 ft. in sandy loam to clay. Average flow of stream, 1 foot deep and 8 ft. wide. Krupp Bridge:—Span, 50 ft.; roadway, 16 ft.; finished roadway to bottom of footings, 15 ft. Estimated amount of concrete in structure, 162.4 cu. yds.; reinforcing steel, 22,399 lbs. Nearest railroad station, LaMoille on the C. B. & Q., 4 miles. Present structure is a 60 ft. pile trestle. Excavation will average about 15 ft.; south abutment, 7 ft.; north abutment in sandy loam to clay. Ordinary flow of stream [illegible] ft. deep and 20 ft. wide. All material for these bridges will have to be shipped in. Work to be completed on or before October 1, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Illinois.

✣Bids will be received at the Town Hall, Stockland, Illinois, up to 2 p. m., June 21, 1911, for the construction of two reinforced concrete bridges in Stockland Township, Iroquois County. J. R. Frick, Town Clerk, Stockland, Illinois. White Bridge:—6x2½ box; 20 ft. roadway. Estimated amount of concrete in structure, 16.5 cu. yds. reinforcing steel, 2,170 lbs. Nearest railroad station, Stockland, 2½ miles. Present structure, 10 ft. wood; excavation, light. Gravel, 4 miles from bridge site, cost 10 cts. per cu. yd. Jones Bridge.—Span, 8 ft.; roadway, 16 ft. Plain concrete sub-structure. Estimated amount of concrete in structure, 37 cu. yds.; reinforcing steel, 774 lbs. Nearest railroad station, Stockland, on the C. & E. I., 3 miles. Gravel ½ mile from bridge site, 10 cts. per cu. yd. We are not familiar with the quality of the creek gravel in this district. Present structure, 12 ft. wood. Excavation light. Work to be completed on or before September 1, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office or may be obtained upon application in writing from the Illinois Highway Commission, Springfield, Illinois.

⊙Board of Cass County Commissioners, Virginia, Ill., has awarded the contract for the construction of 11 concrete bridges throughout the county to Walter Blake, Appleton, Wis., at $3,571.

⊙Road Commissioners of Sterling Township, Sterling, Ill., at a recent meeting let the contract for the rebuilding of an old bridge and the erection of a new bridge on the Pennington Road to the Clinton Iron and Bridge Works, Clinton, Ia., at $1,261.

⊙The contract for the construction of the five concrete bridges in Manhattan township for which bids were received June 9, has been awarded to the Joliet Bridge & Iron Co., Joliet, Ill., at $4,800. John Eberhart is clerk.

Bids were opened June 3 by the Commissioner of Public Works, Chicago, for constructing and erecting a temporary pontoon bridge and approaches over the south fork of the south branch of the Chicago River. Walsh & Masterson, 626 Reaper Bldg., Chicago, at the following bid being low bidder: Transferring movable span and scow, $750; oak plank and timber furnished and built in place, 35,000 ft. B. M., $50; yellow pine timber furnished and built in place, 82,000 ft. B. M., $50; yellow pine timber furnished and built in place for bents, etc., 80,000 ft. B. M., $50; white pine timber furnished and built in place, 26,000 ft. B. M., $52; structural steel furnished and built in place, 5,000 lbs., 5 cts.; concrete loading blocks, 110 cu. yds., $7.

The Illinois Central R. R., according to reports, will expend over $100,000 for the renewal of bridges over its tracks on the Springfield division. The two largest structures under consideration are at Salt Creek, 2 miles south of Clinton and the Sangamon River bridge near Decatur.

City Council of Chicago, Ill., has instructed L. E. McGann, Commissioner of Public Works, to take steps toward making the sidewalk space on the Madison St. bridge wider to accommodate pedestrians.

The following bids were received by I. J. Bryan, Clerk of the Sanitary District, Chicago, Ill., on June 8, for anchoring the abutments of the Western Ave. bridge: (a) standing for anchoring North abutment and (b) for anchoring both abutments: Paschen Bros., Chicago, Ill., (a) $2,120, (b) $4,200; Roemheld Construction Co., Chicago, Ill., (a) $2,480, (b) $4,600; John J. Gallery, Chicago, Ill., (a) $2,500, (b) $5,000; Young & Co., Chicago, Ill., (a) $2,883, (b) $5,383; John P. Daugherty, Chicago, Ill., (a) $2,790, (b) $5,400; National Contracting Co., Chicago, Ill., (a) $2,988, (b) $5,800; Great Lakes Dredge & Dock Co., Chicago, Ill., (a) $3,100, (b) $6,090.

Indiana.

⊙The Commissioners of Johnson County at Franklin, Ind., on June 5, awarded the contract for the construction of 7 small reinforced concrete bridges to D. B. Hill, Jackson Place, Indianapolis, Ind., at $1,923. W. B. Jennings is County Auditor.

⊙The Commissioners of Morgan County, at Martinsville, Ind., on June 5, awarded the contract for the construction of the concrete bridge over the White River at Waverly to the National Bridge Co., at $38,750. J. S. Whitaker is County Auditor.

⊙The Boone County Commissioners, Lebanon, Ind., have awarded the contracts for the construction of 18 bridges as follows: Rufus Davidson, Mellott, Fountain County, Ind.; D. P. Turner, Kirkland, Boone County; Earl E. McDonald, Terhune, Boone County, and Jno. Adam, Lebanon, Boone County. Bids were opened June 7.

⊙Commissioners of Washington County, at Salem, Ind., on June 5 awarded the following contracts for bridge construction: Concrete Bridge, Colvin's Fort, T. J. and H. F. Burk, Richmond, Ind., at $5,098; Steel bridge in Brown township to T. J. and H. F. Burk, at $292; fills and abutments for both structures to Hiram S. Smock, Salem, Ind.

A petition has been filed with the Commissioners of Huntington County at Huntington, Ind., for the construction of a bridge over the Wabash River near the old Elderry Smith Farm.

Kansas.

The order of the East Side Drainage Board requiring the city to give 1,350 sq. ft. of water way under all bridges across the Shunganunga Creek will necessitate the reconstruction of all bridges except the one at 10th St., Topeka, Kan.

Kentucky.

⊙The Commissioners of Jefferson County, Louisville, Ky., and Hardin County have awarded the contract for the construction of the joint bridge over the Salt River at West Point to the Capitol Construction Co., Columbus, O., at $53,600. The structure will be 800 ft. long and 20 ft. wide. The longest span will be 250 ft. and it will be of steel resting on concrete piers.

Louisiana.

City Council of Shreveport, La., and Bossier Parish Police Jury have decided to build the sub-structure of the $200,000 wagon bridge across Red River. The superstructure will be let after the piers and abutments have been built.

Maine.

✣Bids will be received until June 17 at Mars Hill, Me., for the construction of a reinforced concrete bridge 66 ft. long with 24 ft. roadway.

Minnesota.

A meeting was recently held by property owners of Gary and New Duluth with the Board of Public Works, Duluth, Minn., in regard to the construction of a new bridge at New Duluth.

Missouri.

⊙The County Court, Kansas City, Mo., has let contracts to the Midland Bridge Co., at $8,600 for the construction of two concrete bridges, one over a branch 3½ miles northeast of Lee's Summit and the other is a road crossing Sni-a-Bar Creek at Owings farm 2¼ miles northwest of Oak Grove.

A date for hearing on the bill providing for the changing of the date of the election on the suplementary bond issue for the Free bridge to August fourth has been set. Charles Espenschied is Vice President of the City Council, St. Louis, Mo.

As the result of a recent inspection of county bridges by the Commissioners of Livingston County, Chillicothe, Mo., a number of the structures will be repaired.

The contracts for six steel bridges have been awarded by the commissioners of Linn County at Linneus, Mo., to Monarch Engi-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

neering Co., Falls City, Nebr., at $2,267. Wade Ten Eyck is Highway Engineer of Linn County.

An ordinance is to be drawn up at once for introduction into the City Council, Joplin, Mo., for the construction of the proposed viaduct. The Southwest Missouri Ry. Co. and the Union Depot Co. will join the city in the improvement.

Montana.

A petition is being circulated in Libby, Mont., asking for the construction of a bridge across the Kootenai River.

Nebraska.

Advices from Minden, Neb., county seat of Kearney County, Neb., state that the Supervisors of Buffalo and Kearney Counties have decided to take immediate action toward repairing the joint bridge over the Platte River. The work will include laying a new floor.

A resolution has been introduced into the City Council, Lincoln, Nebr., instructing the Chicago, Rock Island & Pacific Ry. to construct new viaducts at P and J Sts. City Engineer has been instructed to prepare plans and estimates for the structures.

At a special meeting of the County Board of Supervisors, Kearney, Nebr., the County Surveyor was instructed to prepare plans for shortening the following bridges in Buffalo County: South Shelton Bridge by 155 ft.; North Gibbon bridge, by 446 ft.; Elm Creek bridge, by 1,500 ft.; South Gibbon bridge, 160 ft. New bridges will also be built at Elm Creek and Gibbon to be 60 and 40 ft. long, respectively.

Articles of incorporation have been filed with the Secretary of State, Lincoln, Nebr., by the Plattsmouth Auto and Wagon Bridge Co. The new company, which is capitalized at $50,000, proposes to construct a bridge over the Platte River east of the Burlington Railroad bridge connecting Cass and Sarpy Counties. The incorporators are T. H. Pollock, James K. Pollock, Olda P. Pollock, N. A. Duff and R. A. Duff.

City Council of Beatrice, Nebr., has decided to repair the old Mechanic St. bridge instead of building a new structure as suggested.

New Jersey.

⊙The Board of Chosen Freeholders, Elizabeth, N. J., on May 31, awarded the contract for the steel superstructure for bridge over the Elizabeth River at Summer St., Elizabeth, N. J., to DeHart & Stafford, 114 Liberty St., New York City, at $3,950. J. L. Bauer, 120 Broad St., Elizabeth, N. J., is County Engineer.

Board of Bergen County Freeholders, Hackensack, N. J., has received bids for the following bridges: Mahwak bridge—John T. Harrup Company, $15,000; John H. Magee, $14,280; Cement Paving and Construction Company, $12,487; Ernest Abraham, $12,717; William G. Broadhurst, $12,190; F. R. Long Company, $12,183; F. W. Schwirs Company, $10,582. The bids on this bridge show a difference of $4,418 between the highest and lowest. Ridgefield bridge—Nicolo Sciola & Son, $1,200; John Wehrle, Jr., $950; Ernest Abraham, $918. Widening Garfield Bridge—John Wehrle, Jr., $850; Geo. M. Brewster Company, $850; Ernest Abraham [illegible] pany, $500.

New York.

• [illegible] awarded the contract for the construction of three iron bridges to the Owego Bridge Co., Owego, N. Y., at $1,650.

⊙The contract for strengthening the end spans of the Williamsburgh Bridge over the East River between the boroughs of Manhattan and Brooklyn has been let by Department of Bridges, Kingsley L. Martin, Commissioner [illegible] to Snare & Triest Co., 143 Liberty St., New York City. The bids received for the work on June 1 were as follows: (a) being for lump sum bid; (b) for unit price bid per cu. yd. of caisson work below elevation -45 ft. multiplied by 1,000, as, for the purpose of comparison of the bids [illegible] work below elevation -45 ft. was taken at 1,000; (c) total bid received. Snare & Triest Co., 143 Liberty St., New York City, (a) $544,540, (b) $15,000, (c) $559,540; Northeastern Construction Co., 225 Fifth Ave., New York City, (a) $548,400, (b) $20,000, (c) $568,400; John Monks & Sons, 82 Beaver St., New York City, (a) $571,000, (b) $20,000, (c) $591,000; McClintic-Marshall Construction Co., 1214 Park Bldg., Pittsburg, Pa., (a) $573,738, (b) $18,000, (c) $591,738; Oscar Daniels Co., 38 Park Row, New York City, (a) $587,700, (b) $12,000, (c) $599,700; Rodgers & Hagerty, Inc., 41 Park Row, New York City, (a) $605,500; (b) $10,000, (c) $615,500; Phoenix Construction Co., 41 Park Row, New York City, (a) $599,897, (b) $30,000, (c) $629,897; Terry & Tench Co., Inc., 70 E. 45th St., New York City, (a) $666,950, (b) $10,500, (c) $677,450; Pennsylvania Steel Co., 71 Broadway, New York City, (a) $719,888, (b) $17,500, (c) $737,388; Charles Meads & Co., 165 Broadway, New York City, (a) $767,000, (b) $20,000, (c) $787,000. Alexander Johnson is Chief Engineer, Department of Bridges.

The contract for excavating for the realignment of Smokes Creek and the concrete abutments and the construction of new bridge at Lackawanna, N. Y., has been awarded to Fred Strack, Ridge Road, Lackawanna, N. Y., at $16,670.

Advices from Frankfort, N. Y., state that it has been recommended that a new steel bridge be built to replace the old covered structure at Dempster's bridge.

North Carolina.

✣The contract for the construction of the concrete bridge over the Catawba River at Sloan's Ferry on the National Highway between Charlotte and Gastonia, N. C., has been awarded to C. W. Requarth & Co., Lancaster, S. C., at $57,500. The work will include the construction of steel approaches.

Commissioners of Wake County, Raleigh, N. C., have under consideration the construction of a new steel bridge over the Neuse River in New Light township to replace the wooden structure now spanning the stream. The new bridge [illegible]

North Dakota.

✣Bids will be received until July 3 (readvertisement of bids received until June 5) by City Auditor, Valley City, N. Dak., for plans, detail drawings, strain sheets, specifications, and proposals for the erection and construction of a steel truss foot bridge over Cheyenne River. The structure as proposed will be 100 ft. long with two 20 ft. steel approaches. C. A. Myhre is City Engineer.

Ohio.

✣Bids will be received until noon, July 7, [illegible] Cincinnati, O., for construction under specification No. 235, of concrete bridge at the inter[illegible] Dreihs is Clerk.

✣Bids will be received until 10 a. m., June 22, by Board of Commissioners, Dayton, O., for the construction of superstructure of [illegible] ship, Montgomery County.

• [illegible] Canton, O., awarded the contract for the superstructure of the Levi Shirk Bridge in [illegible] & Construction Co., Canton, O., at $213. The substructure went to Peter Schisler, Canton, O., at $812. W. E. Scoville, Canal Fulton, O., [illegible] culvert in Plain township at $203.

[illegible] cothe, O., received the following bids for the [illegible] Paint Creek at the foot of Paint St. (a) for structure with concrete floor and (b) with [illegible] Pittsburg, Pa., (a) $17,000, (b) $19,400; Pennsylvania Bridge Co., Beaver Falls, Pa., (a) $17,836, (b) $19,367; Oregonia Bridge Co., Lebanon, O., (b) $19,000; Delaware Bridge Co., Delaware, O., (a) $19,670, (b) $23,030; Capitol Construction Co., Columbus, O., (a) $15,696, (b) $16,933, special plan, superstructure, $17,000, combined sub and superstructure, $36,000; Mt. Vernon Bridge Co., (a) $16,300, (b) $18,740, special plan (A) buckle plate $18,850, (B) buckle plate, $17,630; Wiley Bros., Frankfort, bid $13,635 for substructure.

Preparations are being made by County Engineer L. A. Dillon and Commissioner Frank Kinch, of Butler County, at Hamilton, O., for the construction of new bridges over the Canal at Heaton and High Sts. County Board has authorized a bond issue of $50,000 for the work, including the Grand Boulevard bridge.

The election held in Lorain County, June 6, on the proposition of issuing $70,000 in bonds for the erection of a high level bridge at old 13th Ave. south of Lorain was carried by a large majority.

Oklahoma.

•The Park Board of Oklahoma City, Okla., has awarded the contract for the construction of five new bridges on the new Grand Boulevard to the Kansas City Bridge Co., Kansas City, Mo.

Oregon.

•The contract for the construction of the wagon bridge across the Snake River at Nyssa, Ore., has been awarded to the Coast Bridge Co., Portland, Ore., at $30,000. The structure will be 684 ft. long and 20 ft. wide, consisting of four spans. W. Lee Blodgett is Secretary of the Nyssa Bridge Commission.

Pennsylvania.

✣Plans are being prepared by County Surveyor, N. R. Rambo, and assistants, West Chester, Pa., and the County Commissioners are planning to receive bids July 1, for the construction of an extension to the county bridge over the Brandywine.

✣Bids will be received until noon, June 16, by Commissioners of Northumberland County, Sunbury, Pa., for the construction of a bridge at Spurzheim St., in Shamokin. E. W. Young is Clerk of the Board of Commissioners.

✣Board of Northampton County Commissioners, Easton, Pa., awarded the contracts recently for the construction of the following bridges: Bridge No. 57 in Lower Mt. Bethel township, over Mud Run, a reinforced concrete arch 32 ft. long with 16 ft. roadway, to the Riegelsville Construction Co., Riegelsville, Pa., $1,693; Bridge No. 103, over East branch of Monocacy Creek in Lower Nazareth township, reinforced concrete arch, 10 ft. span, with 16 ft. roadway, with concrete parapet wing walls, to Bushkill Quarry & Construction Co., Easton, Pa., $1,000; Bridge 171, over Martin's Creek in Washington township, a concrete arch 10 ft., with 16 ft. roadway, and concrete parapet and wing walls, to W. H. Barrall, [illegible]

• [illegible] to advices from Scranton, Pa., has awarded the contract for the construction of a double track steel viaduct over Dundaff St., Carbondale, Pa., at a contract price of $300,000.

•Board of Chester County Commissioners at West Chester, Pa., has awarded the contract for the construction of the new county bridge over Ridley Creek, in East Goshen township, near Dutton's Mill, to George Dole, Westtown, Pa., at $2,885. The structure will be of reinforced concrete with stone wing walls and good graded approaches above ordinary high water. Other bids received were as follows: M. & T. E. Farrell, $2,997; N. Mere[illegible] Co., Philadelphia, Pa., $4,760; Hamlin & Watson, $3,500; York Bridge Co., York, Pa., $3,[illegible]

• [illegible] tional width to the Smithfield St. bridge, Pittsburg, Pa., has been awarded by the Mayor and Director to the Fort Pitt Bridge Co., Pittsburg, Pa., at $54,160.

Viewers have submitted a favorable report to the Lawrence County Court at Newcastle, Pa., on the proposed construction of a bridge [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

structure will connect Fifth St. and College Ave. in Hazel Dell, the total length being 750 ft. It is estimated that the cost will be about [illegible] is Engineer.

Texas.

✣[illegible] until 11 a. m., June 19, by John Murch, County Auditor, Galveston, Texas, for doing Galveston County's portion of the [illegible] required for the [illegible] and approach to the causeway at Virginia Point in accordance with plans and specifications on file at the engineer's office of the Gulf, Colorado & Santa Fe Ry. A certified check for $500 must be filed with each bid.

✣Bids will be received until 11 a. m., June 19, by John M. Murch, County Auditor, Galveston, Texas, for the construction of a wooden pile bridge across Highland Bayou on the Galveston-Hitchcock Road. Plans are on file at the office of the County Auditor.

⦿Commissioners of Tarrant County at Fort Worth, Texas, have let the contract for the construction of a 60 ft. concrete bridge over Marine Creek at Thirteenth St., on the North Side of Fort Worth, to Dennis Fagan, at $8,000.

Delegates from Cameron and Rockdale, Texas have selected a site to build an iron bridge across the San Gabriel River. J. T. Kemp is County Clerk and John Watson is County Judge at Cameron, Texas.

[illegible] agreement reported to have been made by W. G. Van Vleck, General Manager of the Texas & New Orleans, Houston, Texas, an agreement has been entered into by the Galveston, Harrisburg & San Antonio, the El Paso & Southwestern, the Santa Fe and the El Paso St. Ry. Co., to spend $75,000 for the construction of a viaduct of reinforced concrete at El Paso to carry the tracks of the street railway.

Utah.

At a meeting of the County Commissioners and the Booster's Club, Logan, Utah, arrangements were made for securing the construction of repairs to the bridges in the county.

Virginia.

⦿The contract for the construction of the Bridge over the Tallahatchie River at Minter City has been awarded to the Virginia Bridge & Iron Co., Roanoke, Va., at $14,680. Bids for the work were opened by county commissioners, Greenwood, Miss., June 5.

Washington.

Commissioners of Yakima County, Wash., have decided upon the construction of a bridge over the Klickitat River near the Soda Springs. The cost of the work is estimated at $3,000. County officials are at North Yakima, Wash.

Wisconsin.

⦿Bridge Committee of Chippewa County, at Chippewa Falls, Wis., has awarded contracts for the construction of bridges as follows: 30 ft. span in Arthur to Worden-Allen Co., Milwaukee, Wis., at $475; 45 ft. span in Bloomer to Wausau Iron & Bridge Co., Wausau, Wis., at $1,164; 120 ft. span in Delmar to Lynch Bros. Bridge Co., New Richmond, Wis., at $763; repairing bridge at Delmar to J. M. Vance, Lafayette, at $640; 26 ft. span in Wheaton to Kiermen & Co., Whitewater, Wis., at $1,194; 25 ft. span in Edson to Lynch Bros., New Richmond, Wis.; 60 ft. span in Tilden, Wausau Bridge & Iron Co., at $1,418. All structures are to be completed by Sept. 15, and are to be steel girders with cement floors.

The Milwaukee Bridge Co., Milwaukee, Wis., at $92,845 on June 10 submitted the lowest bid for the construction of the Oneida St. bridge at Milwaukee, Wis. The structure will be one leaf bascule type, 170 ft. long overall with 40 ft. roadway and 12 ft. sidewalks. The work is to be completed by March 1, 1912. H. E. Briggs is Commissioner of Public Works, and L. J. Klug is Superintendent of Bridges, Milwaukee, Wis.

Mexico.

It is reported that the Southern Pacific will have to construct $250,000 worth of bridges in Mexico in order to resume traffic in that republic. It is reported that as many as 200 bridges have been put out of commission during the revolution.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

✣Bids will be received until Noon, June 29, by St. Francis Levee Board, O. N. Kilough, President, Marion, Ark., for the construction of 500,000 cu. yds. of levee enlargement. B. G. Covington, 368 Randolph Bldg., Memphis, Tenn., is Engineer.

California.

Bids were opened May 29 by Col. John Biddle, U. S. Engineer, San Francisco, for furnishing and delivering stone for rebuilding jetties at Humboldt Harbor, Cal. W. G. Corbaley, Eureka, Cal., at $829,500 was low bidder.

Surveys are being made for an extensive levee system along the Feather River in Sutter County. One levee will be about twenty miles long, and another will be eight miles long. Fred Kiesel and Charles Silva, Sacramento, Cal., are interested.

A special message is to be sent to Congress by President Taft recommending that an additional appropriation be made to complete the reclamation work on the lower Colorado River, undertaken by the United States to prevent the further overflow of the Imperial Valley region of California. An appropriation of $1,000,000 for the work has been largely expended, and considerable more money will be required to complete the work. Col. J. A. Ockerson, St. Louis, Mo., is Engineer in charge of the work.

Colorado.

✣Bids will be received until 2 p. m., June 26, by Field, Fellows & Hinderlider Engineering Co., 435 Century Bldg., Denver, Colo., for the excavation of canals and the construction of headworks, wood stave pipe flumes pumping, machinery, etc., for the Grand Valley Irrigation District at Grand Valley, Colo. Plans and specifications are on file at the office of the engineers. Official advertisement will be found elsewhere in this issue.

Illinois.

✣[illegible] J. V. Waddell, Box 606, Vandalia, Ill., for the construction of tile drainage work in the Pond Lily Lake Levee and Drainage District in Fayette County, Ill. The following tile will be required: 530 ft. of 6-in.; 5 ft. deep; 1,350 [illegible] ft. deep; 1,320 ft. of 12-in., 4.8 ft. deep; 1,980 ft. of 14-in., 4.3 ft. deep; 3,970 ft. of 16-in. pipe, 5.4 ft. deep. The 12- 14 and 16 in. pipe is to be vitrified pipe while the rest is to be red or concrete tile.

✣Bids will be received until 1 p. m., June 22, by Commissioners of Lone Elm Drainage District, Harvel, Ill., for the furnishing of the following tile drains: 4,686 ft. of 27-in.; 1,749 ft. of 20-in.; 924 ft. of 16-in.; 4,050 ft. of 14-in.; 5,709 ft. of 12-in.; 2,493 ft. of 10-in.; 1,136 ft. of 8-in. Tile 12 in. or larger to be either concrete or vitrified drain tile.

✣Bids will be received until 1 p. m., June 22, by Commissioners of Lone Elm Drainage District, Harvel, Ill., for unloading from cars, hauling and distributing 20,747 ft. of 8 to 27-in. tile and for trenching and laying said tile and refilling trenches as follows: 27-in., 284 rods, 5 ft. deep; 20-in., 106 rods, 4 ft. deep; 16-in., 56 rods, 4 ft. deep; 14 in., 245 rods, 4 ft. deep; 12-in., 346 rods, 3.5 ft. deep; 10-in., 151 rods, 3.5 ft. deep; 8-in., 69 rods, 3 ft. deep.

⦿Bids were opened June 8 by the Commissioner Okaw Drainage District, Champaign and Douglas Counties, for work in sub-district No. 7. The contract was let to P. J. Goggin, Arcola, with the National Drain Tile Co., at $5,091. The work includes furnishing, trenching, laying, etc., of the following tile: 6,400 ft. 22-in., 800 ft. 20-in., 800 ft. 18-in., 2,000 ft. 14-in., 1,600 ft. 12-in. The average cut for the 22-in. tile is 5.8 ft., with a maximum of about 7 ft.

Indiana.

✣Bids will be received until 2 p. m., July 1, by Ollie M. Dodd, Supt. of Boone County, at the Surveyor's office, Lebanon, Ind., for the construction of a public ditch.

Iowa.

✣Bids will be received until 1 p. m., June 22, by J. A. Terry, County Auditor, Pocahontas, Ia., for the necessary labor and material for constructing Drainage District No. 49, in sections as follows: Section No. 1, open work, av. depth 8.5 ft., base 8 ft., approximately 62,000 cu. yds.; Section No. 2: 3,000 ft. 24-in. tile, 6.6 ft. deep; 1,500 ft. 20-in. tile, 7.7 ft. deep; 600 ft. 18-in. tile, 5.5 ft. deep; 600 ft. 15-in. tile, 5.4 ft. deep; 1,300 ft. 12-in. tile, 5.6 ft. deep; 377 ft. 10-in. tile, 4.5 ft. deep; 1,800 ft. 12-in. tile, 5.6 ft. deep; 600 ft. 10-in. tile, [illegible] 1,076 ft. 12-in. tile, 5.1 ft. deep; Section No. 3: 600 ft. 18-in. tile, 6.0 ft. deep; 1,800 ft. 16-in. tile, 6.0 ft. deep; 1,100 ft. 14-in. tile, 7.1 ft. deep; 1,472 ft. 10-in. tile, 5.4 ft. deep; 569 ft. 6-in. tile, 4.3 ft. deep; 750 ft. 12-in. tile, 5.1 ft. deep; 367 ft. 10-in. tile, 5.8 ft. deep; 113 ft. 8-in. tile, 7.0 ft. deep; 1,214 ft. 8-in. tile, 5.0 ft. deep; 1,100 ft. 12-in. tile, 5.6 ft. deep; 550 ft. 10-in. tile, 5.4 ft. deep; 933 ft. 6-in. tile, 5.2 ft. deep 541 ft. 6-in. tile, 4.8 ft. deep; Section 4: 739 ft. 12-in. tile, 6.0 ft. deep; 299 ft. 10-in. tile, 5.4 ft. deep; Section No. 5: 1,000 ft. 15-in. tile, 5.5 ft. deep; 2,112 ft. 12-in. tile, 5.2 ft. deep; four bulkhead walls, concrete, containing about 11 cu. yds. concrete. Time commencing Section 1, August 1, 1911, to be completed January 1, 1912; time commencing Sections 2, 3, 4 and 5, March 1, 1912, to be completed January 1, 1913. Bids will be for the completed work and tile ditches to be filled in all sections.

✣Bids will be received until 1 p. m., June 22, by J. A. Terry, Auditor of Pocahontas County, Pocahontas, Ia., for furnishing material and constructing Drainage District No. 62. The work will be done in sections as follows: Section 1, open work, av. depth 7.2 ft., bas 8 ft., approximately 41,500 cu. yds., branch "D" on main, open work, av. depth 7.3 ft., 6 ft. base including approximately 10,000 cu. yds. Section 2, 445 ft. of 10 in. tile 4.3 ft. deep. Setcion No. 3, 4,200 ft. of 14-in. tile 5.9 ft. deep; 600 ft. of 12 in. tile 3.8 ft. deep; 941 ft., 8-in., 4.4 ft.; 2,000 ft., 10-in., 5.4 ft.; 662 ft., 8-in., 5.4 ft.; 1,561 ft., 6-in., 4.1 ft.; 1,717 ft., 8-in., 4.0 ft. Section No. 4, 5,392 ft. 20-in. tile, average depth 6.4 ft., exclusive of overflow; 600 ft. overflow, average depth 1.8 ft., bottom width 3 ft., about 250 cu. yds. 1,000 ft. overflow, average depth 2.3 ft., bottom width 3 ft., about 800 cu. yds; 448 ft. 10-in. tile, average depth 4.9 ft.; Section 5, 2,400 ft. 18-in. tile, average depth 6.0 ft., exclusive of overflow; 800 ft. 16-in. tile, average depth 6.2 ft.; 1,034 ft. 14-in. tile, average depth 5.0 ft.; 1,200 ft. overflow, average depth 22.2 ft., base 3 ft., about 900 cu. yds.; 912 ft. 12-in. tile, average depth 5.4 ft.; 5 bulkhead walls, aggregating about 8 cu. yds., concrete; 2 10-in. inlets; 1 12-in. inlet; 4 14-in. inlets. Time for commencing Section No. 1 August 1, 1911, to be completed January 1, 1912; Section No. 2 to commence March 1, 1912, to be completed [illegible]

[illegible] 1, 1912, to be completed December 31, 1912.

✣All [illegible] June 6, by Boards of Supervisors of Sac, Buena Vista and Calhoun Counties, Ia., at the office of J. Wilbur Neal, Auditor, Sac County, Sac City, Ia., for the construction of tile drains in Drainage Districts Nos. 16, 30 and 92 were rejected and the work will be relet on June 28. The approximate quantities of tile included in the work, according to the plans, are as follows:

Section.	Length, ft.	Size, ins.	Average depth.	Catch basins.
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
3	600	20	5.00	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
4	1,000	18	5.00	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	553	7	4.50	
[illegible]	[illegible]	[illegible]	[illegible]	
7	7,700	14	5.10	2
7	324	12	4.50	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
9	700	10	5.60	2
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	
11	600	8	4.70	
[illegible]	[illegible]	[illegible]	[illegible]	
12	75	12	5.30	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	1,250	10	6.20	
14	1,215	8	5.00	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	1,350	24	6.50	
[illegible]	[illegible]	[illegible]	[illegible]	
16	950	18	6.70	
16	1,525	16	6.65	
[illegible]	[illegible]	[illegible]	[illegible]	
17	740	16	6.50	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
21	1,850	14	6.00	
21	300	12	4.50	
21	300	10	4.50	
21	1,729	8	4.50	
[illegible]	[illegible]	[illegible]	[illegible]	
22	270	7	3.90	
23	300	10	4.10	2
[illegible]	[illegible]	[illegible]	[illegible]	
24	400	12	5.20	2
24	592	10	4.10	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
26	612	15	7.00	
27	900	20	8.00	
[illegible]	[illegible]	[illegible]	[illegible]	
27	350	14	4.50	
27	2,200	12	4.50	
28	1,950	12	6.60	

Louisiana.

The Police Jury of Plaquemines Parish, Pointe a la Hache, La., has created two drainage districts—the English Twin, extending along the rear forty-arpent line, and covering the territory on the left bank from the upper line of the parish to the Greenwood plantation, and the Riviere aux Chenes, extending from Greenwood and connecting with the present back lèvee at Haarlem plantation. The commissioners of the English Twin District are Eugene A. Pharr, John Meyer, I. S. Lothrop, Walter Saxon and John H. Meyer, while those of the Riviere aux Chenes District are Henry Meyer, John Dymond, Simon Leopold, E. J. Rodriguez and Andrew Schexnaydre. It is probable the two districts will hold an election within the time prescribed by law in order to determine upon a bond issue.

The letting of contracts for the excavation of drainage canals, construction of levees, construction of pumping plant and other work necessary to the complete drainage of subdivisions 1 and 2 of the Bayou Sale Drainage District has been postponed. Bids were to have been opened June 6 by the Board of Commissioners at its office, 920 Hibernia Bank Bldg., New Orleans, La. J. T. Coleman & [illegible]

Minnesota.

✣[illegible] 23, by P. D. McKellar, Jackson, Minn., for the [illegible] work will include 9,000 cu. yds., cleaning out Branch No. 1, and deepening same from station 155 to 96; average depth of cleaning, 2 ft.; width at bottom 14 ft. Main ditch, 52,358 cu. yds. of excavation and 19,920 cu. yds. of clearing away waste banks from station 257 to 297. Estimated cost of whole job, $8,127.

Oregon.

The construction of a gravity irrigation system to serve about 1,200 acres of bottom lands along the John Day River near Twickenham, Ore., is proposed. H. C. Shown, Jerome Parsons, Sam Davis, John Asher, Joe Chapman, Z. T. Kenes, James Thompson, Marion Osborne and French & Company, stockmen and farmers of Twickenham, are interested.

Texas.

The County Commissioners of Cameron, Brownsville, Tex., have been petitioned to establish the boundary lines of the union irrigation district and to call an election to vote on the proposition of bonding the district for irrigation improvements. The proposed district, if ordered established, will be the first irrigation district, as authorized by the irrigation act of 1905, in the state, and will comprise an area of 185,000 acres in Cameron and Hidalgo Counties. There is said to be much opposition to the move.

The City Commissioners of Port Arthur have issued an ordinance to provide for a board of drainage commissioners, which shall look after the details for a thorough drainage system for the city, and at the proper time call an election to authorize a bond issue to carry through the work. The drainage board will consist of three members to be selected by the commissioners.

[illegible] Co. of Brownsville, Tex., has been incorporated with a capital stock of $5,000, the incorporators being James W. Hoyt, Arvid Franke and C. R. Scott.

WATER-WORKS

Alabama.

✣[illegible] June 2[illegible] by Water Works Department, D. E. Jones, supt., Gadsden, Ala., for the furnishing of about 900 tons of water mains; 20 tons spe- [illegible] hydrants.

The city of Birmingham, Ala., contemplates making improvements to the waterworks system. A source of additional water supply will be secured.

California.

The City Council of Berkeley, Cal., has passed a resolution looking toward condemnation of that part of the People's Water Co.'s [illegible]

Connecticut.

Mascetti & Holley of Torrington, Conn., submitted the only bid to the Board of Public Works of Waterbury, Conn., on May 30, for the contract for stripping the basin of the new Morris reservoir. The bid, which was $132,500, was considered too high and was rejected. The work will be readvertised. R. A. Cairns is city engineer.

Delaware.

George E. Fairley, 511 Equitable Bldg., Baltimore, Md., has been employed as engineer by the village of Milton, Del., in connection with the proposed improvements to the waterworks. A new 75,000-gal. standpipe will be constructed, three miles of pipe laid, pumping plant constructed, and two wells sunk.

Florida.

Plans have been prepared for the extension of the present systems of water works and sewers in Arcadia, Fla., estimated to cost [illegible] be let in about 60 days. J. L. Jones of Arcadia is the official in charge.

Illinois.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., June 20th, for furnishing and delivering 100,000 ft. B. M. of lumber to the various pipe yards, pumping stations, cribs and other places in the city.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, until 11 a. m., June 16, for making such repairs, as are shown on plans and specifications, to the Central Park Ave. Pumping Station. Cash [illegible] proposal.

✣Bids will be received until 2 p. m., June 17, by City of Morrison, Ill., for drilling an artesian well 1,400 ft. deep, 12 in. in diameter the first 200 ft. and 8 in. below. A. P. Pelham is chairman of the water committee.

✣Bids will be received by the Board of Local Improvements, Chicago, Ill., until 11 a. m., June 21st, for furnishing and laying water supply pipes in eight streets.

✣Bids will be received until June 17 by the city of Morrison, Ill., for the drilling out an old artesian well which was drilled out 1,600 ft. when caved in 900 ft. from surface. A. P. Pelham is chairman of the water committee.

⊙The contract for constructing the foundations for the pumps at the 22nd street pumping station, Chicago, Ill., has been awarded to Myron B. Reynolds, 4711 Kenmore avenue, for $9,500.

H. M. Price, Consulting Engineer, Hartford, Bldg., Chicago, Ill., is preparing plans for the installation of a new waterworks system for the town of Lostant, Ill.

Indiana.

✣Bids will be received until 10 a. m., June 21, by Board of Public Works, Hammond, Ind., for the furnishing and laying or separately of 6,400 ft. of 36 in. Standard Cast Iron Water Pipe weighing 5,850 pounds per 12 ft. length, and for furnishing of 1,950 ft. of 16-in. Standard Cast Iron Water Pipe weighing 1,600 lbs. per 12 ft. length, and the following valves and fittings F. O. B. Hammond, Indiana: 1 24 to 16 A. P. Smith Valve and fittings; 1- 36 to 12 Tee; 5- 36 in. geared valve with 4 in. by pass and valve; [illegible]

⊙[illegible] Des Moines, Ia., has been awarded the contract by the Board of Control, The Indiana Boys' School, Plainfield, Ind., for the construction of a 20,000 gal. tower and tank for $1,950. Chas. Brosmann, Union Trust Bldg., Indianapolis, Ind., Engineer.

Kansas.

✣Bids will be received until Noon, June 21, by City Commissioners, Emporia, Kan., for the improvement of the city water works by building a three-phase, four mile transmission line and installing two vertical electrical driv- [illegible] Smith is City Clerk.

The City Commissioners of Wichita, Kan., contemplate buying the plant of the local waterworks company, and operating its own plant in the future. The company has offered to sell its plant to the city for $1,303,000. The city has offered $1,000,000 for the plant. The American Water Co., of Pittsburg, Pa., C. E. Hoffmaster, president, controls the local plant.

J. M. Guiles, City Engineer of Parsons,

[illegible]

Kentucky.

✣[illegible] the Louisville Water Co., 435 3d St., Louis[illegible] main from Stiltz Lane and Workhouse Road to Lakeland. The work will consist of furnishing and laying 40,000 ft. of 8-in. c. i. bell spigot pipe, or as an alternative; 7,300 ft. of [illegible] Plans and specifications, and forms of proposals and contracts may be obtained at the office [illegible] State Board.

Louisiana.

The Town Council of Roseland, La., contemplates sinking an artesian well.

Maine.

[illegible] Lewiston, Me., contemplates extending its water works system. John Jones is city engineer.

Charles N. Taylor of Wellesley, Mass., has been employed by the Mars Hill & Blaine Water Co., Mars Hill, Me., to design and superintend the construction of a water system at Mars Hill. The work will include about five miles of 8-in. cast iron pipe, two miles of 6-in. pipe, 30 hydrants, and the building of a concrete dam.

The village of Presque Isle, Me., has engaged Consulting Engineer Charles N. Taylor of Wellesley, Mass., as engineer for the proposed improvements to the Presque Isle Water Co., which the village will take over. The water mains will be extended five miles, a 1,000,000-gal. reservoir will be built, and a concrete core dam.

Maryland.

✣Bids will be received until 11 a. m., June 28, by Board of Awards, James H. Preston, president, Baltimore, Md., for furnishing and delivering and erecting complete to the water board of Baltimore, one 30,000,000-gal. vertical triple expansion pumping engine, two batteries of two boilers each, the necessary steam piping between engines and boilers, the economizers for heating the feed water for the Mount Royal Pumping Station. Plans and specifications are on file at the office of A. M. Quick, Water Engineer.

✣Bids will be received until 2 p. m., June 15, by Board of Aldermen, Frederick, Md., for furnishing and laying cast iron pipe, specials, valves, etc. L. A. Rice is chairman of the Board. W. H. Boardman, 426 Walnut St., Philadelphia, Pa., is engineer.

Massachusetts.

⦿The Hodge Boiler Works, of Boston, Mass., has been awarded the contract by the city of Ayer, Mass., for the erection of a steel standpipe, in connection with the additional fire protection recently ordered by the city. The standpipe will be 45 ft. in diameter, and 50 ft. high. Lewis D. Thorpe, of Boston, is the engineer.

⦿John E. Plumer, 1012 Old South Bldg., Boston, Mass., has been awarded the contract by the City Council of South Hadley, Mass., for the construction of a steel standpipe, 60 ft. high and 35 ft. in diameter. Other improvements to the waterworks system will be made which will amount to about $60,000. Lewis D. Thorpe of Boston, is the engineer.

J. L. Tighe, consulting engineer of Holyoke, with the special committee on the water supply of Huntington, Mass., has been over the proposed water system preparatory to making a detailed report on the watershed and source of supply.

Michigan.

✣Bids will be received until Noon, June 27, by Board of Trustees, Imlay City, Mich., for the construction of an entirely new standpipe [illegible] with connections complete. Plans and speci[illegible] A. M. Morgan, 169 Jackson Blvd., Chicago, Ill.

⦿The [illegible] making improvements to the waterworks plant this year. The intake will be extended and two dams on the Dead River will be constructed to increase the power. The contract for the upper dam has been secured by Messrs. Wahlman & Son and Trebilcock Bros., of Ishpeming, Mich. Ward & Powell have the contract for the lower dam, which will be the largest.

The citizens of Benton Harbor, Mich., on June 14, voted on the proposition to issue bonds in the sum of $50,000 instead of $100,000 recently submitted to the voters, for the purpose of constructing a pumping station, extending water mains, removing pumps and boilers from the old station to the new one on the marsh, putting down additional wells, and making connections.

Minnesota.

⦿The Des Moines Bridge & Iron Works, Des Moines, Ia., has been awarded the contract by the town of Dodge Center, Minn., for the construction of a new waterworks system. The contract price is $18,318.

The property owners and residents on Agency hill and along or near to Main St., and neighboring streets, in the city of Mankato, Minn., have petitioned the City Council to take steps to install a system of waterworks, or to extend the present system to that section for domestic purposes and fire protection.

Mississippi.

The City Council of McComb City, Miss., has issued bonds in the sum of $15,000, to extend and improve the waterworks system.

Missouri.

Preliminary plans have been prepared by Hiram Phillips, Consulting Engineer, Third National Bank Bldg., St. Louis, Mo., for the installation of a waterworks system in the town of Milan, Mo., estimated to cost $25,000. The work will include the construction of a reservoir. The contract for this work will soon be let. John W. Boughen, of Milan, is the official in charge.

Nebraska.

⦿C. D. Rochey, has been awarded the contract by the City Council of Hastings, Neb., for the building of a brick smoke stack at the water and light plant, for $3,600. The stack will be 125 ft. high.

Surveys and estimates have been made for a gravity water supply system for Crawford, Neb., and on the 12th of June an election was held for the purpose of bonding the city in the sum of $24,000, to construct and equip the system. Page T. Francis and E. Walton M. Mee, Crawford, Neb., are Engineers.

New York.

✣Bids will be received until 2 p. m., June 21, by H. S. Thompson, Commissioner of Water Supply, Gas and Electricity, New York, N. Y., for furnishing and driving test wells in Kings, Queens and Nassau Counties, Long Island, N. Y., and for hauling, setting fire hydrants and appurtenances in various streets in Manhattan.

⦿The Newport Construction Co., of Newport, N. Y., has been awarded the contract by the town of Newport, for extending the water mains in the town for $12,241. Bids were opened May 29.

Frank A. Hill has been granted a franchise by the village of Salem, N. Y., to install a waterworks system. The source of supply will be Scott Lake.

The following bids were received by Henry S. Thompson, Commissioner of Water Supply, Long Island City, L. I., for furnishing and laying water mains in Amity, Academy, Cherry, Bragaw, Crescent and other streets in Queens: Roswell S. Williams, $87,571, including pipe, valves, hydrants, etc.; Leo E. Kelly, $80,182; Beaver Engineering & Contracting Co., $95,052; Franklin Contracting Co., $99,069; Daly Bros. Co., $87,695; Nelson & Dowling, $78,526; R. Carter Co., $96,035; Peace Bros., $77,449; Wilton Construction [illegible]

Ohio.

✣Bids will be received until noon, June 26, by F. H. Schoaff, Village Clerk, Euclid, O., for the construction of a 6-in. water main in Cliffview Ave., Hillview Ave., Dunham Ave., and Euclid Road. Plans and specifications can be seen at the office of the engineers, F. A. Pease Engineering Co., Williamson Bldg., Cleveland, or the clerk.

⦿The Beers-Offrett Construction Co., Fort Wayne, Ind., has been awarded the contract by the City Council of Kenton, O., for the construction of a reservoir. The work includes concrete reinforced, two million gal. capacity and additions and alterations in pumping station; also small pump house for deep well pumps. Bids were opened June 6.

Mayor Baehr and Director of Public Service, A. B. Lea, of Cleveland, O., are reported to have announced that the system of chlorine purification for city water will be installed at once.

Oklahoma.

✣Bids will be received until June 19, by City Engineer, Nowata, Okla., for the construction of extensions to the water works system, including filtering system, laying water mains to river and distribution system. T. C. Hughes, Tulsa, Okla., is engineer.

⦿P. J. McNerney of Carthage, Mo., has taken the sub-contract for the erection of a dam on Polecat Creek and a pipe line four miles in length in the city of Sapulpa, Okla. The dam will be 1,400 ft. in length, 57 ft. high in the highest place, and about 88 ft. wide at the widest place. It will be of concrete and masonry faced with cement, and will lie between two ranges of hills and back the water for several miles. The price is $120,000. Previous mention of this work was made in our May 31 issue.

Consulting Engineer E. T. Archer & Co., of Kansas City, Mo., is preparing plans and estimates of the Bartlesville, Okla., Light & Water Co., preparatory to the taking over of the property by the city. The approximate cost, including repairs and extensions, will be about $200,000.

Pennsylvania.

⦿Sharon Boiler Works, Sharon, Pa., has been awarded the contract by the city of Cortland, N. Y., for the construction of a 1,000,000-gal. standpipe for $13,000.

⦿P. J. McGovern, of Indiana, Pa., has been awarded the contract by the Citizens Water Co., of Clymer, Pa., for the construction of a reservoir for approximately $15,000.

The Mount Penn Suburban Water Co., Mount Penn, Pa., is having surveys made and specifications prepared for the construction of a new reservoir of 3,000,000-gal. capacity. H. S. Hinnershitz is superintendent of the Water Co.

The State Institution for Feeble-Minded at Polk, Pa., has employed the firm of Chester & Fleming, Union Bank Bldg., Pittsburg, Pa., as engineers to design and install a hypochloride treatment plant for the auxiliary water supply of the institution.

South Dakota.

⦿The City Council of Bradley, S. Dak., has let the contract for the city waterworks and fire departments to Joel McKee of Bradley, for $12,772. The contract will include a steel structure tank instead of wood, and 10 h. p. engine instead of wood and 10 h. p. engine instead of 5 h. p. engine. Other bids were: F. L. Dumech, Laurel, Neb., $14,589; Roberts & Few, Brookings, S. Dak., $14,405; Fraser & Danforth, Rochester, Minn., $13,216; Des Moines Bridge & Iron Works, Des Moines, Ia., $14,096; Cook Construction Co., Des Moines, Ia., $14,159; L. W. Schrurth, Fargo, N. Dak., $13,861; W. D. Lovell, Minneapolis, Minn., $13,631.

The citizens of Nittenberg, Stanley County, S. Dak., have petitioned State Engineer Lea, Pierre, for a survey for the purpose of locating four township artesian wells in the township of Black Hawk.

The City Council of Ipswich, S. Dak., has made arrangements to install waterworks at

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

an early date, $20,000 being appropriated. The water supply will be obtained from artesian wells.

Texas.

✣Bids will be received until noon, June 22, by John D. Kelley, City Secretary, Galveston, Tex., for furnishing one new compound Corliss flywheel pump in the city waterworks station. Specifications may be seen at the office of W. D. Masterson, city superintendent of electricity. A certified check for $500 must accompany each bid.

The city of Brady, Tex., contemplates the installation of a new waterworks at an estimated cost of $10,000. The contract will be let some time this summer. Source of supply will be Brady Creek.

The city of Sinton, Tex., plans the sinking of an artesian well. If successful additional wells will be sunk.

The Woodward Water Co., of Woodward, LaSalle County, Tex., has been incorporated with a capital stock of $10,000. The incorporators are: M. Barges, John F. Fentiman, and M. B. Stewart.

After inspecting the method of working of the filtration plant installed at Springfield, Mo., City Engineer J. D. Trammell of Fort Worth, Tex., and Consulting Engineer John B. Hawley have recommended the installation of a duplicate plant to the City Council of Fort Worth.

Utah.

A preliminary survey for a water system for Preston, Ida., has been made by an Ogden, Utah, engineer. Birch springs water will be piped into the city a distance of 15 miles. The City Board contemplates purchasing the springs from the Warm Creek Canal Co.

Virginia.

Chief Engineer Thomas B. Dornin, of the Norfolk, Va., water department, has submitted his recommendations to the Board of Control of that city affecting the present water works of the city. The engineer recommends a new source of supply, new pump and boilers, larger mains, etc.

The City Council of Norfolk, Va., has adopted City Engineer W. T. Brook's suggestion that the Director of the U. S. Geological Survey at Washington be requested to send one or more of its experts to Norfolk to advise the city as to the sources to which it should look for its proposed additional water supply.

The following bids for material and work on the New Gravity Water Supply of Lexington, Va., were received June 1: N. Wilson Davis, Harrisonburg, Va., Engineer: A. Wyckoff & Son, Elmira, N. Y., 41,600 ft. of wood pipe, $18,503; U. S. C. I. Pipe & Foundry Co., Philadelphia, Pa., 16,800 ft. of 8 in. C. I. pipe at $22.90 per ton, $8,931.00; Glamorgan Pipe & Foundry Co., Lynchburg, Va., 16,800 ft. of 8 in. C. I. pipe at $23.50 per ton, $9,165.00; Lynchburg Foundry, Lynchburg, Va., 16,800 ft. of C. I. pipe at $23.65 per ton, $9,223.50; R. D. Wood, Philadelphia, Pa., 16,800 ft. of 8 in. C. I. pipe at $21.00 per ton, $9,360.00; Central Foundry Co., 16,800 ft. of 8 in. Universal joint pipe, $11,592.00. Trenching and pipe laying: H. C. Brook, Clarksburg, W. Va., $28,943.50; S. B. Bennington, Lynchburg, Va., $32,024.00; J. L. Meem, Lynchburg, Va., $28,385.62; Stamper Ragland & Co., Richmond, Va., $25,090.12; Gallagher & Bryan, Baltimore, Md., $22,537.50; Cantrell Construction Co., Parkersburg, W. Va., $23,654.90; J. F. McGuire, Norfolk, Va., $24,249.00; C. O. Ladd & Co., Germantown, Ohio, $19,959.72.

Washington.

The Atlas Construction Co., of Everett, Wash., has sold the bonds of the city of Snohomish, Wash., issued for the purpose of installing a gravity water system and work on the pipe line will be commenced shortly by that company. The pipe line will be 16 miles long, and will extend from Snohomish to the headquarters of the Pilchuck in the foothills directly east of town.

The City Council of Pasco, Wash., has passed an ordinance authorizing the city attorney to institute condemnation proceedings against the Pacific Light & Power Co., for the purpose of acquiring the waterworks system now owned by that company. Hydraulic Engineer E. T. Tannant, of Spokane, has placed an approximate value of $15,000 on the plant. The city intends to enlarge the plant.

Wisconsin.

⊙Edward O'Donnell has been awarded the contract by the Board of Public Works of Milwaukee, Wis., for the laying of 30-in. water main for $19,800. Bids were opened June [illegible]

⊙Edward O'Donnell has been awarded the contract by the Board of Public Works of Milwaukee, Wis., for the laying of 20 and 30-in. water mains for $13,900. Bids were opened June 2.

Canada.

⊙The town of Melville, Sask., has awarded the following contracts in connection with the installation of a water system and electric light plant; bids opened May 25: Kilmer, Pullen & Burnham of Toronto, Ont., for generators, switchboards, exciters, pumps, motors and compressors, installed complete, $7,438; The Northern Electrical & Manufacturing Co., Ltd., Winnipeg, street lighting system, $832; Northern Electrical & Manufacturing Co., Ltd., poles and all line material, $2,947; Wm. Bross & Sons, Minneapolis, compression tanks, $2,018; Stanley Brock Co., Toronto, cast iron mains, per cwt., $37; special castings, $60.80; McAvity & Sons, St. John, N. B., 4-in. hydrants, $36; 6-in. hydrants, $46; 8-in. gate valves, $17.50, 6-in. gate valves, $9.75, and 4-in. gate valves, $6.60; Jas Robertson & Co., Winnipeg, pig lead, $4.55; oakum, $3.20.

The citizens of Estevan, Sask., on June 3, voted the issuance of bonds to the amount of $33,000 for the construction of a waterworks, further cement sidewalks and sewer extensions.

The city of St. Boniface, Man., will expend $75,000 on the waterworks system this year, nearly $40,000 of which will be toward the erection of the new reservoir.

SEWERAGE AND GARBAGE DISPOSAL

California.

✣Bids will be received between 10 and 11 a. m., June 17, by Board of Public Works, Oakland, Cal., for furnishing the necessary labor and material for the construction of a system of main sewers, together with lateral sewers within Oakland Sewer District No. 1. Plans and specifications are on file at the office of the Board. James W. Nelson is secretary of the Board.

✣Bids will be received between 10 and 11 a. m., June 17, by Board of Public Works, Oakland, Cal., for the construction of a system of sewers in the Oakland Sewer District No. 3. Plans and specifications are on file at the office of the board. J. W. Nelson is clerk.

✣Bids will be received between 10 and 11 a. m., June 17, by Board of Public Works, Oakland, Cal., for furnishing the necessary labor and material for the construction of a system of main and lateral sewers in Oakland Sewer District No. 4. Plans and specifications are on file at the office of the Board. J. W. Nelson is clerk.

✣Bids will be received between 10 and 11 a. m., June 17, by Board of Public Works, Oakland, Cal., for the necessary labor and material for the construction of a system of main and lateral sewers with Oakland Sewer District No. 2. Plans and specifications are on file at the office of the Board. J. W. Nelson is clerk.

⊙The City Council of San Diego, Cal., has awarded the contract for furnishing machine-made concrete pipe, to be used in the construction of the new $200,000 sewer system, to the Glazed Cement Pipe Co., of Los Angeles, for $26,600. E. E. Capps is city engineer.

Colorado.

✣Bids will be received until 11 a. m., June 19, by Board of Public Works, Denver, Colo., for furnishing all labor and material necessary for the construction of storm sewers, manholes, and appurtenances in part A of Sub-district No. 1 of Capitol Hill storm sewer District No. 1. Henry Read is president of the board.

Connecticut.

⊙Berardino & Silvestri, of Hartford, Conn., have been awarded the contract by the sewer committee of the City Council of Hartford, for the construction of sewers in West Park St., from Pleasant to South Park St., in South St., from Pleasant to South Park, in South Park, from South St. to John St., and in Hyden St., from Lebanon Ave. to Mountain St., a distance of 2,760 ft. The bid was as follows: 10-in. pipe sewer, including manholes, $0.57 per lin. ft.; 8-in. pipe sewer, including manholes, $0.28; rock excavation, $3.75 per cu. yd.

District of Columbia.

✣[illegible] lumbia, Washington, D. C., for furnishing and delivering 700,000 red sewer bricks.

Illinois.

⊙[illegible] Local Improvements, Chicago. Bids opened June 1, 1911. Cornelia St., 650 tile pipe, $780, Jno. Tutilli, 518 W. Taylor St.; George St., 630 lin. ft. tile pipe, $718, Archille Scully; W. [illegible] 240 lin. ft. tile pipe, $360, Wm. F. Healy, 101 Washington St.; Stewart Ave., 820 lin. ft. tile pipe, $1,017, N. Mancini; Bernice Ave., 2,000 lin. ft. tile pipe, $2,520, Wm. F. Healy; East End Ave., 1,310 lin. ft. tile pipe, $2,419, Thos. Burke, 4648 W. McLean Ave.; Armour Ave. System, 4261 lin. ft. brick and 5,010 lin. ft. tile pipe, $27,636, N. Mancini.

Property owners on Edith and Division Sts., in Murphysboro, Ill., have petitioned the City Council to construct a sewer from 22nd St. to connect with the main sewer at 20th St.

Property owners living in the vicinity of 34th and 48th Sts., have petitioned the City Council of Moline, Ill., for sewer and water.

The Board of Local Improvement of Bloomington, Ill., has readopted the resolution providing for a sewer to be constructed on Clay St., Woodlawn Ave., and Jackson St. Elmer Folsom is city engineer.

Indiana.

✣Bids will be received until 10 a. m., June 19, by Board of Public Works, Indianapolis, Ind., for the construction of improvements on the following streets, alleys, etc.: Construction of a local sewer in and along alley north of Stevens St., from second alley east of East St., to a point 216 ft. west; the construction of a local sewer in and along alley east of Miley Ave., from Calvelage St., to 11th St.; improvement of Reid Pl., from south property line Prospect St., to a point 496 ft. south of south property line Prospect St., by grading and paving the sidewalks; improvement of Washington St., north side, from east curb line Tacoma Ave. to west curb line Temple Ave., by grading and paving the sidewalks; improvement of Downey [illegible]

[illegible]

City Engineer Donn M. Roberts of Terre Haute, Ind., has prepared estimates on the [illegible] sewers contemplated for the seven wards of the city. The greater part of the work will be done in the Seventh ward, for which $25,000 have been allotted. The total cost of the improvements will be about $100,000.

The Board of Public Works, of South Bend, Ind., has granted a petition providing for the laying of a sewer on East Third St., from Merrifield to Mason Sts. William S. Moore is city engineer.

The city officials of Vincennes, Ind., are planning the formation of a company to be known as the Vincennes Sewer Association, with a small capital, but with a bond issue of at least $335,000, the estimated value of the sewer system. After selling the bonds the company will agree to install the complete system and rent it to the city for a consideration of $26,000 a year.

Iowa.

✣Bids will be received until 7 p. m., June 26, by R. A. Davis, City Clerk, Nevada, Ia., for the construction of approximately 38,000 lin. ft. of sanitary sewers and disposal plant. Official advertisement will be found elsewhere in this issue.

The City Council of Logan, Ia., has approved the installation of a septic tank, and one mile of sewer to drain the fair grounds district, recommended by the Logan Improvement league.

The citizens of Waterloo, Ia., have voted against the proposition to build a covered drain through Virden Creek channel from Park Road to near the edge of the city limits on the north.

The City Council of Corydon, Ia., has accepted the plans prepared by the Iowa Engineering Co., Clinton, Ia., for the construction of additional sewers in Clinton.

The City Council of West Union, Ia., has passed a resolution providing for the construction of a sewer system throughout the city. Engineer M. Tschirgi of Dubuque, Ia., has been employed to make the surveys and estimates, and the work will be pushed as fast as possible.

The City Council of Valley Junction, Ia., has passed a resolution to install sewers over the entire city. Bids for the work are now being asked and will be opened the latter part of the month.

Kansas.

The City Commissioners of Wichita, Kan., have granted the petition of the people living in the southern part of the city for a sewer. This south end sewer will ultimately be made a part of the central sewer system which is now being contemplated, and which will extend from the extreme north end of the city southward near the line of the drainage canal.

Maryland.

•The Board of Awards of Baltimore, Md., has awarded David M. Andrew & Co. the contract for erecting the office and laboratory building at the disposal plant for $29,600 and the contract for lateral sewers, Contract No 66, to B. F. Sweeten & Son for $87,645.

Following bids were received by the Board of Awards, Baltimore, Md., on May 31, for sanitary contract No. 67, Junction sewer at sewage pumping station: M. J. Beach, 809 [illegible] Bldg., city, $21,668; B. F. Sweeten & Son, Baltimore, Md., $26,197; McCay Engineering Co., [illegible] McCarthy & Co., Baltimore, Md., $32,102; [illegible]

The Board of Awards of Baltimore, Md., has approved specifications prepared by Sewerage Engineer C. W Hendrick for the construction of storm water sewers in Jones' Falls. [illegible]

earth excavation, [illegible]000 cu. yds. of concrete masonry, 750 cu. yds. of brick work, 4,000,000 lbs. of reinforced steel, 12,000 sq. yds. of granolithic surface, 140,000 piles, 2,000 ft. of lumber and 40 tons of structural steel used in constructing the sewers. The cost of the work will be between $600,000 and $700,000. Bids for this work will be called for immediately.

Massachusetts.

✣Bids will be received until 2 p. m., June 21, by Committee of Sewerage, Attleboro, Mass., J. J. Van Valkenburgh, Engineer, for laying cast iron and vitrified pipe, building brick manholes and other appurtenances. The approximate quantities of work to be done are as follows—main items: Laying 396 lin. ft. of 30-in. cast iron pipe; 4,970 lin. ft. of 24-in. cast iron pipe; 11,636 lin. ft. of 20-in. cast iron pipe; 1,530 lin. ft. of 18-in. cast iron pipe; 620 lin. ft. of 16-in. cast iron pipe; 1,485 lin. ft. of 12-in. cast iron pipe; 730 lin. ft. of 10-in. cast iron pipe; 2,180 lin. ft. of 8-in. cast iron pipe; 1,485 lin. ft. of 20-in. vitrified pipe; building 106 brick manholes.

Michigan.

Bids for the construction of the East Side trunk sewer in Grand Rapids, Mich., were opened June 8 by the Board of Public Works of that city, and the contract will be let June 15. The work consists of 2,500 ft. of combined dock line wall and sewer, the sewer being box section about 12 by 13 ft.; 3,000 ft. of horseshoe sewer, 13 ft. in diameter; 1,200 ft. of horseshoe section 12 ft. in diameter; and 250 ft. of horseshoe, 11 ft. in diameter, together with incidental work, the whole amounting to in the neighborhood of $370,000. L. D. Cutcheon is City Engineer.

Langley & Jeynes submitted the lowest bid, $34,500, to the Common Council of Detroit, Mich., for the completion of the Fairview sewer. Other bids received were: John A. Mercier, $35,000, and Porath & Son, $36,000.

Minnesota.

⊙It is reported that E. A. Dahl has been awarded the contract by the Board of Public Works of Duluth, Minn., for the construction of a sanitary sewer in East Superior St., between 26th and 32d Aves., for $3,316.

City Engineer Claussen of St. Paul, Minn., in a communication to the Common Council recommended an improved sewage system for Swede Hollow at an estimated cost of $100,000.

The Village Council of Cold Springs, Minn., has decided to construct a sewer the entire length of the main business street, beginning at a point near the schoolhouse and terminating in the creek near the river.

All bids received by the City Council of Albert Lea, Minn., for the construction of lateral sewer No. 5 have been rejected. The bids were as follows: Moeller Bros., Kneirim, Ia., $19,938; Omaha Construction Co., $19,650; E. F. Webster, St. Paul, Minn., $19,316, and J. J. Connelly, St. Paul, $18,887. William Barneck, City Engineer.

Nebraska.

⊙Jas. Jensen, 3024 24th St., Omaha, Neb., has been awarded the contract by the City Council of that city for the reconstruction of Burt St., main sewer, 26th and 32d Sts., for $24,393. Bids were opened June 5. Geo. W. Craig is City Engineer.

⊙Jas. Jensen, 3024 N. 24th St., Omaha, Neb., has been awarded the contract by the City Council of Omaha, for the construction of the southwest branch of South Omaha main sewer for $43,129. Bids were opened June 5. Geo. W. Craig is City Engineer.

Engineer C. H. Meeker, who is superintending the construction of the new water and electric light plant for the city of Wymore, Neb., has undertaken a survey for a sewer system. The citizens are in favor of the in[illegible] sewer system.

New Jersey.

✣Bids will be received until 8:30 p. m., June 15, by City Council, Elizabeth, N. J., for the necessary labor and material for the construction of a sewer in North Ave., from Newark Ave. to Pennsylvania Ave., including the following approximate quantities: 520 lin. ft. 12-in. pipe sewer, caulked joints; 3 manholes; 20 6-in. connections; 20 ⅛ turns; 480 lin. ft. 6-in. pipe to curb, caulked joints; 1 corner basin. Plans and specifications may be examined at the office of N. K. Thompson, Street Commissioner.

Petitions have been submitted to the Township Committee of Millburn, N. J., asking for about 10,000 ft. of lateral sewer in the Short Hills and Brantwood sections of the municipality.

At a recent meeting of the citizens of Hasbrouck Heights, N. J., it was voted that the town officials should appropriate $1,000 for complete working plans and estimates for a sewer system.

New York.

✣Bids will be received until noon, June 27, by Board of Trustees, Hempstead, Marcus O. Hedges, Clerk, for the construction of sewers and their appurtenances, the outfall sewer, pumping plants and appurtenances and sewage disposal plant and appurtenances. The engineers' estimate of the approximate quantities is as follows: 96,800 cu. yds. excavation, 0 ft. to 8 ft.; 18,500 cu. yds. excavation, 8ft. to 14 ft.; 200 cu. yds. excavation, 14 ft. and over; 86,600 lin. ft. 8-in. vitrified pipe; 16,700 lin. ft. 10-in. vitrified pipe; 10,700 lin. ft. 12-in. vitrified pipe; 770 lin. ft. 15-in. vitrified pipe; 1,500 lin. ft. 18-in. vitrified pipe; 7,660 lin. ft. 20-in. vitrified pipe; 30 lin. ft. 8-in. cast iron pipe; 60 lin. ft. 10-in. cast iron pipe; 1,830 lin. ft. 12-in. cast iron pipe; 30 lin. ft. 18-in. cast iron pipe; 3,000 vertical ft. concrete manholes; 113 flush tanks; 445 manhole covers; 18,000 lin. ft. 6-in. vitrified pipe for house service; 12,500 cu. yds. excavation for house service; 2 pumping plants and appurtenances; 1 disposal plant and appurtenances.

✣Bids will be received until 11 a. m., June 19, by Laurence Gresser, President of the Borough of Queens, New York City, for the reconstruction of the Harris Ave. sewer from Van Alst Ave. to Crescent St., and to construct a sewer and appurtenances in Harris Ave. from Crescent St. to Jackson Ave.; in Jackson Ave., from Harris Ave, to Purvis St.; in Purvis St., from Jackson Ave. to the Thompson Ave. viaduct, and under the Thompson Ave. viaduct to the existing sewer, located under the property of the L. I. R. R. Co., and a dry weather flow sewer and a storm water relief sewer in Creek St., from Meadow St. to Nott Ave.; and a dry weather flow sewer in Nott Ave., from Creek St., to a point half way between Mount St. and School St., and a storm water relief sewer in Nott Ave., from Creek St. to a point about 350 ft. east of Creek St., and a storm water sewer in Nott Ave., from a point half way between between Mount St. and School St., to a point about 350 ft. east of Creek St., and an outlet from the last point to the Dutch Kills Canal, First ward, together with the work incidental there. Also to construct a temporary sewer and appurtenances in 22d St., from Eighth Ave. to Eleventh Ave., at Whitestone, Third ward.

Negotiations are being carried on for acquiring rights of way for the surface water sewer to be built by the Intercepting Sewer Board of Syracuse, N. Y., from Mildred and Teall Aves. to Lay brook, in the town of Salina. The sewer will drain about 500 acres. H. J. Hamlin is Secy. of the Board.

Senator Brackett's bill authorizing the village of South Glens Falls, N. Y., to borrow $40,000 for the construction of a sewer system and a disposal works is now before the Legislature.

It is reported that Governor Dix of New York has signed the bill creating the commission to study the sewage disposal and water supply along the Niagara frontier. The purpose of the commission is to determine, if possible, what means can be taken to prevent the pollution of running streams from which municipalities get their water supply.

The borough officials of Queens, New York City, N. Y., have resolved to build a sewer in Stanhope St., Ridgewood, from Seneca Ave.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] W[illegible] Ave., [illegible] Wood[illegible]

[illegible] Rochester, N. Y. [illegible] sewer through [illegible] Lyceum St. and Hampton place.

Residents along State St., in Fort Plain, N. Y., have made application to the Village Board for an extension of the sewer system to their street.

Consulting Engineer Rudolph Hering, 170 Broadway, New York City, has submitted detailed plans for the proposed sewage disposal plant, blue prints, etc., to the City Council of Rome, N. Y. The site selected by the engineer is the rise of ground near the line of the outlet sewer near the continuation of Charles St., on the H. S. Bedell farm, south of the Erie Canal. The estimated cost of the work is as follows: Pumping station, including pumps, pump well and screens, $27,500; preliminary settling tank, $47,100; sprinkling filter, including dosing tank, $42,000; final settling tank, $6,300; sludge bed, $2,200; piping and appur[illegible]

North Carolina.

The Board of Trade and Mayor R. I. Dalton of Winston-Salem, N. C., are agitating the extension of the city's sewer system. It is proposed to extend the system through the thickly populated section of East Winston, West End and North Winston.

Ohio.

✣Bids will be received until noon, June 16, by Board of Control, Akron, O., for the construction of sewers. (See under Roads and Streets in this issue.)

✣Bids will be received until noon, June 15, by city of Bucyrus, O., A. Broemel, Clerk, for necessary labor and material for the construction of a tile sewer with necessary manholes, catch basins, etc., in Middleton St. F. L. Niederheiser is City Engineer.

✣Bids will be received until noon, June 17, by S. A. Arnold, Clerk, Village of Canfield, O., for the construction of storm water sewer in west side of Broad St., between Main St. and the Court House. Plans and specifications are on file at the office of the Village Clerk.

✣Bids will be received until noon, June 16, by Director of Public Service, Piqua, O., for furnishing the necessary labor and material for the construction of a sanitary sewer on South Main St. Bids will also be received for the improvement of East Water St., from Main St. to west end of Canal bridge; East Main St., from Main St. to Shawnee bridge; Bridge St., from Main St. to River bridge; South Main St., from Sycamore St. to south corporation line, by grading, curbing and guttering, construction of necessary culverts, drains and retaining walls, and paving the roadway with brick, cement, macadam, bituminous macadam, asphalt block, asphalt binder, or creosote block, according to the plans and specifications on file. The work will include approximately 4,823 lin. ft. of sewers and 22,000 sq. yds. of pavement. W. H. Mitchell is Clerk.

✣All bids received on May 24 by the Director of Public Service, Dayton, O., for the construction of storm and sanitary sewers in a number of streets have been rejected and new bids asked until June 21.

⦿Addison Cronk, 1112 Williamson Bldg., Cleveland, O., has been awarded the contract by the village board of Willoughby, O., for the construction of sewer extensions for $617. Bids were opened June 5 by C C Jenkins, Clerk.

⦿The Village Council of Amherst, O., has awarded the contract for the construction of the sewer system to the U. S. Construction Co. of Columbus, O., and the contract for the construction of the disposal plant to Engler Bros. of Findlay, O. Bonds in the sum of $13,000 have been ordered.

The citizens of New Philadelphia, O., on June 5 voted in favor of the proposition of installing a sewer system and disposal plant. Bonds to the amount of $100,000 for the improvement were also voted.

The City Council of Bellefontaine, O., has sold bonds to the amount of $28,500 for a sewage disposel plant to Stacy & Braun of To[illegible]

Oregon.

The Town Council of Linnton, Ore., has made provisions for the installation of a sewer system. The sewer committee is at work on plans for a comprehensive system.

Pennsylvania.

The sewer committee of the City Council of Lebanon, Pa., has approved the specifications and plans for the proposed sewer system. The plans have been submitted to State Health Commissioner Samuel Dixon for approval. James H. Fuertes, 140 Nassau, New York City, is consulting engineer.

The city officials of Harrisburg, Pa., contemplate letting the contract for the construction of the river front intercepting sewer about July [illegible] pared.

Following bids were received by Highway Commissioner W. Caldwell, Harrisburg, Pa., for the construction of a sewer in Hoffer St., from Front to Fourth: Central Construction & Supply Co., $3,875; Henry Opperman, $4,279; Stucker Bros., $4,300; Charles Fisher, $4,290; W. H. Lynch, $4,100; William H. Op[illegible]

South Dakota.

✣Bids will be received until 8 p. m., July 6, by City Council of Madison, S. Dak., at the office of William Rae, City Auditor, for the furnishing of material and construction of public sewer system on and through the streets and avenues. The following is approximately the amount of material to be furnished by the contractor: 3,360 lin. ft. 6-in. vitrified pipe; 11,520 lin. ft. 8-in. vitrified pipe; 3,325 lin. ft. 10-in. vitrified pipe; 6,060 lin. ft. 12-in. vitrified pipe; 2,700 lin. ft. 15-in. vitrified pipe; 3,000 lin. ft. 18-in. vitrified pipe; 1,500 lin. ft. 18-in. vitrified pipe, double strength, together with necessary Y branches; 300 lin. ft. 16-in. c.-i. pipe; 80 manholes; average depth, 9 ft.; c.-i covers, 5 flush tanks; Minimum depth, 0 ft.; maximum depth, 20 ft.

The City Council of Madison, S. Dak., has sold bonds to the amount of $65,000 to the Minnesota Loan & Trust Co. of Minneapolis. The bonds have been issued for the purpose of constructing a trunk sewer. Plans and specifications have just been completed by Engineer Trimmer, and bids will be asked for soon.

Tennessee.

⦿R. L. Blevins, of Bristol, Tenn., has been awarded the contract by the town of Erwin, Unicol County, Tenn., for the construction of a system of trunk sewers for $20,000. Work will be started immediately.

The City Council of Nashville, Tenn., has passed the $311,000 appropriation bill for constructing sewers in various parts of the city and referred the same to the standing committee on improvements and expenditures.

The Town Commissioners of St. Elmo, Tenn., have decided to install a sewer system throughout the entire town at an estimated cost of $100,000. Dr. H B. Wilson is mayor.

Texas.

An election will be held in Waco, Tex., on June 27, to determine whether or not the city shall issue bonds in the sum of $45,000 for the construction and repair of sanitary sewers. H. B. Mistrot is mayor.

Steps have been taken to build a sewerage system for the business section of the city of West, Tex.

Mayor A. P. Wooldrige of Austin, Tex., expects to have under way by the first of July the comprehensive sewer system of that city. Plans for the work will probably be prepared by a local engineer. An election will soon be held to vote bonds for this improvement.

The citizens of Forney, Tex., have voted the issuance of bonds for the installation [illegible]

Virginia.

The American Boulevard Corporation has instructed Engineer to prepare plans at once for sewerage on their property at Lochhaven, Va. Arthur C. Freeman, 343-5 Arcade Bldg., [illegible]

Washington.

⦿Foster & Robinson of Spokane, Wash., are the probable contractors for furnishing all material and constructing about two miles of extensions to the sewer system of Pendleton, Ore. Bade & Jacobson of Portland, Ore., submitted the second lowest bid. Bids were opened June 7.

City Engineer H. J. Doolittle of North Yakima, Wash., has presented preliminary plans for the municipal power plant and the sewer system to the City Council. The estimated cost of the sewer system is $150,000, and the power plant, $250,000. A bond election will probably be held the latter part of June to vote bonds for these improvements.

Work is to be started immediately by the Colson Construction Co., on the Interbay and Fort Lawton section of the North Trunk sewer system, Seattle, Wash., which will cost $925,000. The firm has two years from date to finish the outlet section of the sewer, which is to be 12 ft. in diameter and of brick and concrete construction. The outlet will be under the Fort Lawton reserve and the pipe will be built to a point in Elliott Bay where the current is such as to insure the carrying of refuse out to sea. Previous mention of this work was made in our May 31 issue.

The City Commissioners of Spokane, Wash., on recommendation of Commissioner of Public Works D. C. Coates, accepted the petition of property owners in the Fourth ward, asking for the construction of the Fourth ward sewer district No. 5 Plans and specifications will be prepared by City Engineer Morton Macartney. The sewer will begin at the intersection of Summit Blvd. and Lindeke St., running south on Lindeke to Sinto Ave., thence east to the Holmes school, thence south to Sharp Ave., east to Cochrane St., south to Boone Ave., west to Lindeke St., south to Gardner Ave., west to A St., south to Dean Ave., southwest to Summit Blvd., to a point 400 ft. east of Sherwood St.

Wisconsin.

✣Bids will be received until June 22, by the Board of Public Works, Wausau, Wis., for the construction of several sewers, one in Bridge St., starting from the river and running to Fifth Ave., to be of re-enforced concrete and 5 ft. in diameter. Another sewer will start at Fourth Ave. and Elm St., run north on Fourth Ave. to Maple St., west on Maple to Fifth Ave., thence north on Fifth Ave. 120 ft., to be a 30-in. pipe; 10-in. pipe sewers will be laid on Second and Division Sts., on Callon from Third Ave. west 220 ft., and on East Grant St., a 180-ft. extension

⦿The village of East Milwaukee, Wis., has awarded the contract for the construction of 15-in. and 18-in. pipe sewer to Herman Hohensee, 965 27th St., Milwaukee, Wis., for $1.49. The work includes 957 ft of 15 in. pipe sewer, 1,507 ft. of 18-in pipe sewer, 22 manholes and 12 catch-basins. Bids were opened J[illegible]

⦿The village of East Milwaukee, Wis., has awarded the contract for the construction of brick sewers to Herman Hohensee, 965 27th St., Milwaukee, Wis., at $4.23 and $3.97. The work includes 695 ft. of 36-in brick sewer, 1,330 ft. of 30-in. brick sewer, 78 ft. of 18 in. pipe sewer, 168 ft. of 15 in pipe sewer, 19 manholes, 13 catch-basins. Bids were opened June 5.

⦿Herman Hohensee, 965 27th St., Milwaukee, Wis., has been awarded the contract by the village of East Milwaukee, Wis., for the construction of brick and pipe sewers for $4.04 The work includes 1,075 ft. of 30 in. brick sewer, 132 ft of 18 in. pipe sewer, 55 ft of 15-in. pipe sewer, 12 manholes and 8 catch basins. Bids were opened June 5.

⦿Peter W. Galloway, of Racine, Wis., has been awarded the sub-contracts for the building of the outlet for the new trunk sewer in

[illegible]

⊙The City Council of Racine, Wis., has awarded the following contract for the construction of sewers: Thomas Construction Co., 1,400 ft., of sewer on 12th St., at $1.35 per ft., for 12-in. pipe and $39.50 for manholes; Andrew Thomsen, 8-in. pipe on Marquette St., at $1.08 per ft., a portion of High St., at $0.87 per ft., and Deane Blvd., at $1.03 per ft.; H. C. Hansen, sewering Gertrude and Linden Aves., at $1.62 per ft.; Pat Gavahan, High St., at $1.08 per ft., and Green St., at $0.95 per ft.; P. B. Johnson, West Blvd., at $1.10 per ft.

Robert Nelson of Racine, Wis., submitted the lowest bid to the City Council of Sheboygan, Wis., for the laying of the intercepting sewer from Ontario Ave., and North Eighth St., to North 10th St., thence to Niagara Ave., and thence to the river. The bid was as follows: 30-in. brick, $3.70; vitrified pipe, $3.70; 20-in. pipe, $1.65; 18-in. pipe, $2.70; manholes, $40 each.

Canada.

✣Bids will be received until noon, June 19, by Town Council, Battleford, Sask., for the necessary labor and material for the construction of a water works and sewerage system. Plans and specifications are on file at the office of William Kitson, Town Engineer.

✣Bids will be received until noon, June 15, by T. N. Colgan, Commissioner of Works, North Bay, Can., for the furnishing of sewer pipes as follows: Pipes to be delivered f. o. b. cars at North Bay, and delivery to commence not later than one week after contract has been awarded, and to continue as fast as may be required. Approximately 5,700 lin. ft. 10-in pipe (vitrified tile); 1,260 lin. ft. 20-in. pipe; 2,720 lin. ft. of 24-in. pipe; 1,800 lin. ft. 30-in. pipe; 1,520 lin. ft. of 36-in. pipe; No. 575 10x6 in. T junctions; No. 335 20x6 in. T junctions; No. 200 24x6 in. T junctions; No. 120 30x6 in. T junctions; approximately 102x26 in. by 6 in.; No. 80 20x8 in. T junctions; No. 60 30x8 in. T junctions; No. 20 36x8 in. T junctions. Parties tendering are requested to submit a tender for the 20-in., 24-in., 30-in. and 36-in. pipe in cement concrete as well as vitrified tile.

✣Bids will be received until noon, June 15, by T. N. Colgan, Commissioner of Public Works, North Bay, Ont., for laying 25,000 lin. ft. of sewers ranging from 6 to 36 in. in diameter.

⊙The city of Edmonton, Alta., has awarded the contract for the construction of the concrete sewer to W. Manders of Edmonton for $50.36 per lin. ft. A. J. Latornell is City Engineer.

The citizens of Estevan, Sask., on June 3, voted the issuance of bonds to the amount of $33,000 for further cement sidewalks, waterworks and sewer extensions.

The city of St. Boniface, Man., will expend $200,000 on sewers this year, of which $150,000 will be for laying the trunk sewer on Mission St., and the Dawson road.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Alabama.

✣Bids will be received until 1:30 p. m., June 17, by Edwin F. Barlow, Quartermaster, Fort Morgan, Ala., for furnishing and installing hot water heating system in the hospital at that post.

Bids were opened May 31 by Lt. Col. G. D. Fitch, U. S. Engineer, Montgomery, Ala., for furnishing 35,000 bbls. of American Portland cement. The bids received were as follows: (1) being price per sack for 20,000 bbls. delivered at Lock, Ala. (2) for 15,000 bbls. delivered at Rome, Ga., and (3) allowance per sack for sacks returned: Kirkpatrick Sand & Cement Co., Birmingham, Ala., Coosa brand, 95-lb. sacks, (1) 51 cts., (2) 50 cts., (3) 10 cts.; R. O. Campbell Coal Co., Atlanta, Ga., (1) Royal brand, 95-lb. sacks, (2) 51 cts., (3) 10 cts.; Southern States Portland Cement Co., Rockmart, Ga., Southern States brand, 95-lb. sacks, (1) 51 cts., (2) 45 cts., (3) 10 cts.

California.

✣Bids will be received until 3 p. m., July 10, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the painting, etc., at the United States Post Office and Court House, etc., San Francisco, Cal.

✣Bids will be received until 2 p. m., June 23, by U. S. Reclamation Service, Los Angeles, Cal., for furnishing transformers for the service. Particulars can be obtained at Los Angeles or Washington, D. C. F. H. Newell is director.

✣Bids will be received until 11 a. m., July 8, by R. C. Hollyday, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for auxiliary power plant equipment at the navy yard, Mare Island, California.

✣Bids will be received between 10 and 11 a. m., June 28, by Board of Public Works, Oakland, Cal., for the construction and completion of the New Oakland City Hall Bldg.

⊙ The Board of Public Works of Oakland, Cal., has awarded the following contracts for work in connection with the construction of the new city hall, bids for which were opened May 22. Mason work, to Gladding-McBean Co., $122,360. Structural steel, to Judson Manufacturing Co., Oakland, $234,376. Granite work to McGilvary Raymond Granite Co. (item b), $160,000. Concrete work, to Roebling Construction Co., $104,000. Granite work, to Raymond Granite Co. (item a), $19,680. Arch. terra cotta, to Gladding McBean Co., $65,000. Roofing and skylights, to Ford & Mallott, $13,650. Metal doors, to Forderer Cornice Works, $2,970. Ornamental iron and bronze, to Cal. Art Met. & W. Works, $97,700. Plastering and imit. stone, to C. C. Morehouse, $40,750. Int. marble and tile, to Jos. Musto Sons-Keenan Co., $104,993. Rough carpentry, to Oliver Duval, $34,100. Cork floors, to David Kennedy, Inc., $3,292. Finished hardware, to Pierce Hardware Co., $13,440. Vaults and vault doors, to Mosler Safe Co., $9,440. Vacuum cleaning, to H. W. Moffatt & Co., $3,120. Electric wiring, to John G. Sutton Co., $40,000. Plumbing to J. Looney, $37,627.

Bids as follows were received June 3 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the extension of dykes at the Navy Yard, Mare Island, Cal.: (1) price for the extension of all dykes, complete; (2) for the extension of dykes No. 12 only; (3) price per lin. ft. for constructing in continuation to the west of the extension of dyke No. 12 in item 1; (4) price per lin. ft. for round pile in place. Thomson Bridge Co., 103 Main St., San Francisco, Cal., (1), $165,521; (2), $131,000; (3), $32.75; (4), 40 cts. Grant Fee, 682 Monadock Bldg., San Francisco, Cal., (1) $222,000; (2) $168,000: (3) $40; (4) 47 cts. San Francisco Bridge Co., 865 Monadnock Bldg., San Francisco, Cal., (1) $169,700; (2) $131,000; (3) $33 per ft.; (4) 35 cts. Mervy Elwell Co., Oakland, Cal., (1) $185,640; (2) $142,800; (3) $35.70; (4) 25 cts. Cotton Bros. & Co., 241 Bacon Bldg., Oakland, Cal., (1) $191,900; (2) $150,000; (3) $45; (4) 50 cts. Hyde-Harjes & Co., 1 Drum St., San Francisco, Cal., (1) $183,227; (2) $140,000; (3) $35; (4) 30 cts. Mercer Fraser Co., 16 California St., San Francisco, Cal., (1) $180,180; (2) $138,600; (3) $34.65; (4) 42 cts. Healy Tibbitts Construction Co., 9 Main St., San Francisco, Cal., (1) $178,000; (2) $140,000; (3) $35; (4) 46 cts. American Construction Co., 359 Monadnock Bldg., San Francisco, Cal., (1) $191,750; (2) $149,750; (3) $37.50; (4) 45 cts.

Bids will be received until 10 a. m., June 26, by the Board of Public Works, J. W. Nelson, secretary, Oakland, for one motor driven pumping engine for the fire department; for three motor driven combination chemical and hose wagons.

District of Columbia.

✣Bids will be received until 10 a. m., July 24, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing and erecting Spillway Gates and Caissons; and to furnish Footbridges for Spillways; Rising Stem Gate Valves, Lower Guard Gate Valves, Lateral Culvert Valves, Bulkhead Gates, and Screens for the Lock Culverts; Castings, etc., to form the Gate Seats in Spillways; Roller Trains and Sealing Devices for the Rising Stem Gate Valves for the Locks; Roller Trains and Sealing Devices, Rocker Bearings, and Gate Rollers for Stoney Gates at Spillways, and Railings for Spillways.

✣Bids will be received until 2 p. m., June 20, by Department of the Interior, Washington, D. C., for the construction of Home for Nurses at Freedmen's Hospital, Washington, D. C.

✣Bids will be received until 11 a. m., July 1, by R. C. Hollyday, Chief of Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for 8 5,000-lb. and 10 4,000-lb. motor trucks for the navy yards and stations.

✣Bids will be received until 11 a. m., July 8, by R. C. Hollyday, Chief of Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for timber wharf, brush bulkhead, dredging and filling at Cuba.

The Georgetown Gas Light Co., Robert L. Middleton, General Manager, Washington, D. C., will expend about $220,000 for the purchase of site and the erection of a new gas plant.

Florida.

Bids were opened May 25 by Capt. George Spalding, U. S. Engineer, Jacksonville, Fla., for (1) dredging 65,000 cu. yds. of mud and oyster shell from the St. John's River and (2) placing about 6,200 tons of granite rock along a revetment wall. The bids received were as follows: P. Sanford Ross, Inc., Jersey City, N. J., (1) 74 cts. per cu. yd., (2) $2.95 per ton; Roderick G. Ross, Jacksonville, Fla., (1) 79 cts. per cu. yd., (2) $3.10 per ton.

Georgia.

✣Bids will be received until 3 p. m., July 15, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office at Cordele, Ga.

Illinois.

✣Bids will be received by the Board of Inspectors of the house of correction, 26th st. and California ave., Chicago, Ill., until 2 p. m., June 21, for furnishing sand, cement, sewer pipe, explosives, lubricating oils, paints, engineers' supplies, etc., according to specifications on file at the Superintendent's office.

✣Bids will be received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., until 11 a. m., June 22, for furnishing, delivering and erecting in the sub-basement of the City Hall building one railroad pattern scale according to plans and specifications on file. Cash or certified check for $100 must accompany proposal.

✣Bids will be received by the Board of Inspectors of the House of Correction, Chicago, Ill., until 2 p. m., June 21st, for furnishing f. o. b. cars at power plant, 26th street and

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

California avenue, two 250 H. P. water tube boilers.

•Martin Johnson Joliet Ill., has been awarded the contract for constructing concrete retaining walls along the property lines northeast and southwest corners of Fifth and Eastern Aves., for the city of Joliet. Bids were opened May 29. Matt Berscheid is City Clerk.

Following are the low bids received June 5th by L. E. McGann Commissioner of Public Works, Chicago, Ill., for making the necessary borings to bed rock in Lake Michigan from the water works cribs (A) constructing 3 pile platforms made of 4 piles with caps, braces, etc., to permit of 144 sq. ft. area, (B) making borings to bed rock at each of 3 cribs and on the premises of the Chicago Ave. pumping station (A) $900 (B) $7.35 per lin. ft. Robt. J. Green, 19 N. Curtis st.

Indiana.

✣Bids will be received until 9 a. m., June 22, by Charles C. Howard, Trustee, Marion Township, Boone County, Ind., for the construction of a frame school.

✣Bids will be received until 3 p. m., June 22, by Rufus Conrad, Township Trustee, Union Township, Boone County, Ind., for the construction of a frame school house.

✣Bids will be received until 10 a. m., July 5, by Commissioners of Bartholomew County, Columbus, Ind., for the improvement of the county jail. P. J. Sater is Auditor of the County.

✣Bids will be received until 1 p. m., June [illegible] by Commissioners of Jackson County, Brownstown, Ind., for the supply of furniture and filing cases, etc., for the Court House.

Kansas.

✣Bids will be received until June 20, by Capt. F. W. Van Duyne, Quartermaster, U. S. Military Prison, Fort Leavenworth, Kan., for furnishing 2,300 expansion bolts and shield; 1,050 pieces lumber; 100 lbs. white lead; 50 gals. linseed oil, raw; 10 gals. drier; 25 gals. turpentine; 30 lbs. lamp black; 15 lbs. yellow ochre; 350 lbs. paste filler.

Kentucky.

✣Bids will be received until 3 p. m., July 15, by James Knox Taylor, Supervising Architect Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office at Winchester, Ky.

Louisiana.

The Streets and Landings Committee of New Orleans, La., has reported in favor of extending the sea wall at West End around the Southern Yacht Club. The work will cost $40,000, to be shared by the city and the club equally.

Maine.

✣Bids will [illegible] until 3 p. m., July 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures, of the U. S. Post Office at Waterville, Me.

Maryland.

✣Bids will be received until 2 p. m., June 20, by James Wilson, Secretary of the Department of Agriculture, Washington, D. C., for the necessary labor and material for the construction of the proposed dairy barn on the grounds of the U. S. Experimental Farm, Beltsville, Md.

Massachusetts.

✣Bids will be received until noon, June 23, by Col. Frederic V. Abbot, U. S. Engineer, 25 Pemberton Sq., Boston, Mass., as noted in our issue of May 31, for rock excavation in Gloucester Harbor, Mass., The work is the removal of seven ledges, the total quantity of material to be removed being about 590 cu. yds. About $20,000 is available for contractor's estimates.

✣Bids are asked until [illegible], June [illegible] by Col. Frederic V. Abbott, U. S. Engineer, 25 Pemberton Sq., Boston, Mass., as noted in our issue of May 31, for rock excavations in Boston Harbor, Mass. The work is located in the upper main ship channel in Boston Harbor, Mass., and extends for a distance of about 12,000 ft. downstream from a point about opposite Commonwealth Docks. The rock excavation required is the removal of eight groups of ledges in the upper main ship channel in Boston Harbor. These ledges have been uncovered in dredging to obtain the depth of 35 feet at mean low water. These ledges and the areas around them are to be removed to a minimum depth of 35 ft. below mean low water. The material to be removed is believed to be slate rock. The total estimated quantity to be removed is 32,602 cu. yds.

Michigan.

⦿The Newton Engineering Co., Milwaukee, Wis., has been awarded the general contract for the construction of the concrete dam and power plant of the Peninsula Power Co. The dam is to be erected at Twin Falls of the Menonimee River, a few miles above Iron Mountain. About 4,000 HP. will be developed. D. W. Mead Madison, Wis., is Consulting Engineer for the Power Company.

Bids as follows were received June 6 by Col. C. McD. Townsend, U. S. Engineer, Detroit, Mich., for dredging in Black River at Port Huron, Mich., the price bid being per cu. yd. scow measurement: Great Lakes Dredge & Dock Co., Chicago, Ill., 19½ cts.; Muir-O'Sullivan Dredge & Dock Co., Port Huron, Michigan, 15½ cts.

Mississippi.

The following bids were received June 6 by the Mississippi River Commission, 3rd District, Vicksburg, for furnishing and delivering one steel hull tow-boat, "Issaquena:" Thomas M. Rees, P. O. Box 709, Pittsburg, Pa., $68,500, 300 days; Dubuque Boat & Boiler Works, Foot of Third St., Dubuque, Ia., $67,335, 294 days; Ed. J. Howard, Jeffersonville, Ind., $55,640, 300 days; The Charles Ward Engineering Works, Charleston, W. Va., $89,250, 300 days.

Nebraska.

✣Bids will be received until 2 p. m., June 20, by Board of Education, S. O. Reese, Secy., Randolph, Nebr., for the construction of a new high school building at Randolph. John Latenser, 632 Bee Bldg., Omaha, Nebr., is Architect.

✣Plans and specifications have been prepared and will be on file at the office of the Secretary of State and Commissioner of Public Lands and Buildings, Lincoln, Nebr., for the state buildings to be constructed as provided by appropriations made by the 32d session of the Nebraska Legislature, viz.: 2 buildings for Hospital for Insane, Lincoln, $100,000; 1 hospital building for S. & S. home, Grand Island, $15,000; 1 laundry building at Hospital for Insane, Hastings, $20,000; 1 School of Agriculture, Curtis, $75,000; 1 dining room addition at S. & S. home, Milford, $1,500; 1 dining room addition at Feeble Minded Institute, Beatrice, $4,000. Plans for the buildings at Grand Island are now ready [illegible]

New Jersey.

✣[illegible] 16, by J. Wilson, Secy. Department of Agri[illegible] tion of two brick barns on the grounds of the United States Animal Quarantine Station [illegible]

✣Bids are asked until 11 a. m., June 29, by [illegible] mington, Del., as noted in our last issue, for dredging and dike removal in Alloway Creek, [illegible] ft. in depth below mean low water and 75 ft. in width at bottom from Fosters Bottle to 1,000 ft. above Upper Hancock Bridge, and thence, as far as the available funds will permit, 60 ft. in width at bottom, and 6 ft. deep, toward Quinton, a total distance of about 7 [illegible] above Upper Hancock Bridge which has fallen over. The depth of cutting will average about 3 ft. The material to be removed is believed to be mud, sand and gravel, and the wrecked dike consists of piling, sheet piling, wales and connecting rods. The total estimated quantity of dredging is 36,000. About $7,700 is available.

New York.

✣Bids will be received until 11 a. m., June 27, by Capt. F. T. Arnold, Constructing Quartermaster, Fort London, Conn., for the construction, complete, at Fort Terry, N. Y., of four sets firemen's quarters.

✣Bids will be received until June 14, by F. H. Burton, Capt. Quartermaster, Fort Jay, Governors Island, N. Y. H., for furnishing 500 cu. yds. crushed trap stone.

✣Bids will be received until 10 a. m., June 15, by Capt. William D. Davis, Quartermaster, Plattsburg Barrack, N. Y., for excavating for a target pit about 500 ft. long by 15 ft. wide, constructing retaining walls in same and providing a 10-in. tile drain therefrom, approximately 1,200 feet long; moving a small building about 400 yards; placing in a trench a cable to be furnished by the government; extending masonry wall 50 ft. to the southeast; extending a dirt embankment 50 ft. to the southeast; clearing trees and underbrush from about two acres of the range.

✣Bids will be received until June 15, by Capt. F. H. Burton, Quartermaster, Fort Jay, Governors Island, N. Y. H., for furnishing miscellaneous plumbing supplies.

✣Bids will be received until June 17, by Capt. F. H. Burton, Constructing Quartermaster, Fort Jay, Governors Island, N. Y. H., for furnishing one portable hand concrete mixing machine, capacity, 5 cu. ft. dry.

✣Bids will be received until 11 a. m., June 14, by Capt. F. H. Burton, Quartermaster, Fort Jay, N. Y., for furnishing material and labor for repairing the Governors Island Ferry landing and the Castle Wharf at Governors Island, N. Y.

✣Bids will be received until June 29, by the Inspector, Third Light House District, Tompkinsville, N. Y., for furnishing for sixth order and fourth order 150 and 250 M. M. focal distance range and panel lenses, and six 60 degrees panels for fourth order fixed light lens.

✣Bids will be received until 11 a. m., July 1, by R. C. Hollyday, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for furnishing sixteen electrically-driven capstans complete; seven at the navy yard at New York and nine at the naval station, Pearl Harbor, Hawaii.

✣Bids will be received until 2 p. m., July 11, by Percy L. Lang, president of the Board of Managers, Craig Colony, Sonyea, N. Y., for the construction, including heating, plumbing and electric work for a dormitory building in the West Group of the Craig Colony for Epileptics, Sonyea, N. Y. Percy L. Lang is president of the board. Franklin B. Ware, Albany, N. Y., is architect.

Ohio.

Bids were opened June 1 by Col. John Mills, U. S. Engineer, Cleveland, O., for the work of building the shore arm and the outer arm of the breakwater at Ashtabula and removing 600 lin. ft. of the old breakwater. It will require 738,660 tons of stone to complete the work. The Edward Glen Dock, Dredge & Construction Co., of Racine, Wis., was the lowest bidder. That firm bid $1.30 a ton for the shore arm, $1.22½ a ton for the outer arm, and 80 cts. per lin. ft. for the removal of the old breakwater, making the total cost of the job $954,775.50. The Breakwater Co., of Cleveland and Philadelphia, was the next lowest bidder at $1.31 for both arms of the new breakwater, and $20 a ton for the removal of the old breakwater. The total of this bid was $979,644.60. The other firms and their total bids follow: Great Lakes Dredge & Dock Co., $1,036,417; E. M. Graves, $1,108,143; Inland Waterways Improvement Co., $1,139,072; Coast & Interior Construction Co., $1,-[illegible]

West Virginia.

[illegible] Co., Evansville, Ind.; (2) Sheridan-Kirk Contract Co., Cincinnati, O.; (3) The Dravo Contracting Co., Pittsburg, Pa..

		(1)	(2)	(3)
[illegible]	[illegible]	[illegible]	$20.00	$20.00
[illegible]	[illegible]	10.00	5.00	5.00
[illegible]	[illegible]	[illegible]	.65	.65
[illegible]	[illegible]	[illegible]	1.00	3.00
[illegible]	[illegible]	.30	[illegible]	.30
[illegible]	[illegible]	3.00	[illegible]	3.00
[illegible]	[illegible]	5.00	[illegible]	5.00
[illegible]	[illegible]	[illegible]	.70	[illegible]
[illegible]	[illegible]	[illegible]	70.00	70.00
[illegible]	[illegible]	50.00	70.00	60.00
[illegible]	[illegible]	[illegible]	80.00	80.00
[illegible]	[illegible]	10.00	12.00	12.00
[illegible]	[illegible]	5.50	5.63	5.75
Concrete (arched-void construction), alternative [illegible]	[illegible]	[illegible]	[illegible]	6.30
[illegible]	[illegible]	7.00	7.73	7.00
Structural steel, pounds	979,000	.07	.065	.06
[illegible]	[illegible]	[illegible]	.055	.065
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bolts, etc., pounds	75,400	.06	.055	.065
[illegible]	[illegible]	.06	.055	.065
Steel castings, pounds	181,700	.08	.098	.065
[illegible]	[illegible]	.90	[illegible]	1.00
Pipe, 5-in., lin. ft	370	[illegible]	1.59	2.15
Pipe, 4-in., lin. ft	2,540	2.00	1.10	1.45
Pipe, 3-in., lin. ft	1,030	[illegible]	[illegible]	1.00
Pipe, 2½-in., lin. ft	190	[illegible]	.60	.75
Pipe, 2-in., lin. ft	580	1.50	.40	.50
Tile drain, lin. ft	860	[illegible]	[illegible]	.65
Total of bid		[illegible]	$745,533	$742,451
Total of alternative bid		[illegible]	$749,268	[illegible]

Virginia.

Bids were opened June 1 by Lt. Col. Mason M. Patrick, U. S. Engineer, Norfolk, Va., for dredging about 4,700,000 cu. yds. of mud with some sand from Norfolk Harbor, Va., the bids per cu. yd. being as follows: Morris & Cumings Dredging Co., New York, N. Y., 11 6/11 cts.; P. Sanford Ross, Inc., Jersey City, N. J., 11 9/10 cts; Norfolk Dredging Co., Norfolk, Va., 11 4/10 cts.; Coastwise Dredging Co., Norfolk, Va., 11 cts.; W. L. Randolph, Jr., Brooklyn, N. Y., 10⅝ cts.; Maryland Dredging & Contracting Co., Baltimore, Md., 11 4/10 cts.; Atlantic, Gulf & Pacific Co., New York, N. Y., 12 6/10 cts.

Rhode Island.

Bids as follows were received June 9 at the office of the U. S. Engineer, Newport, R. I., for breakwater construction at westerly storm arm of breakwater at Point Judith, R. I.; (1) bid per ton 2,000 lbs. for Sec. 1, (2) bid per ton for Sec. 2, (3) bids per ton for Sec. 3, (4) bid per ton for any two sections, (5) bid per ton for Secs. 1, 2 and 3: (1) $3.93, (2) $3.93, (3) $3.93, (4) $3.00, (5) $2.11, James E. Gaynor, 39 E. 14th street, New [illegible] $2.50, Estate of John Beattie, Leoto Island, Conn.; (2) $2.23, E. S. Belden & Sons, Hartford, Conn., (1) $2.23.

Wisconsin.

Bids were opened June 3 by the Board of Public Works of Racine for completing the 7th St. pier and breakwater. The Keelyn-Schlueter Co., Chicago, Ill., at $27,390, was the only bidder.

Canada.

✣Bids will be received until noon, June 26, by City Secy.-Treas. C. O. Davidson, Prince Albert, Sask., for construction of Power Station Superstructure and transmission line portions of the proposed hydro-electric power development on the North Saskatchewan River at LaColle Falls, a distance of 25 miles.

✣Bids will be received until 4 p. m., July 5, by R. C. Desrochers, Secy. Department of Public Works, Ottawa, Ont., for the construction of a breakwater at Bare Point, Port Arthur, Electoral District of Thunder Bay and Rainy River, Ont. Plans and specifications may be seen at that Department, and at the offices of E. B. Temple, District Engineer, Port Arthur, Ont.; J. G. Sing, District Engineer, Confederation Life Bldg., Toronto, Ont.; H. J. Lamb, District Engineer, Merchants Bank Bldg., St. James St., Montreal, Que.

✣Bids will be received until 5 p. m., June [illegible] the Joint Building Committee [illegible] Burke Horwood & White, architects, [illegible] Toronto St., Toronto, [illegible] trades required in erection of the [illegible] Building, Nos. [illegible] College St.

U. S. ENGINEER OFFICE, Wilmington, N. C., June 1, 1911. Sealed proposals for constructing complete the two (2) wooden hull, non-propelling, 15-in. hydraulic pipe line dredges Neuse and Port Arthur will be received at this office until noon, June 30, 1911, and then publicly opened. Information on application. EARL I. BROWN, Capt. Engrs.

WAR DEPARTMENT.—U. S. Engineer Office, Montgomery, Ala., June 6, 1911. Sealed proposals for dredging at mouth of Apalachicola River, Florida, will be received at this office until 1 o'clock p. m., July 6, 1911, and then publicly opened. Information on application. G. D. FITCH, Lt. Col., Engrs.

U. S. ENGR. OFFICE, Boston, Mass., May 26, 1911.—Sealed proposals for rock excavation in Boston Harbor, Mass., will be received here until 12 M., June 26, 1911, and then publicly opened. Information on application. FREDERIC V. ABBOT, Col., Engrs.

SPECIAL BOND ISSUE OF 1911.
WATER DEPARTMENT.

Muskogee, Okla.

WATER INTAKE AND INLET TOWER.

Sealed proposals will be received by the City Council of the City of Muskogee, Okla., until Tuesday, June 27, 1911, at 10 o'clock a. m., and opened immediately thereafter, for the construction of a water intake and inlet tower. All bids must be filed with Chas. Wheeler, Jr., City Clerk.

The water works intake is a 54-in. submerged concrete pipe line 2,600 ft. 1 in. long to be laid across the Arkansas River and up to the bed of the Grand River.

The intake tower is a concrete structure built at the upper end of the intake.

Proposals for this contract shall be accompanied by a certified check for $5,000, made payable to the City of Muskogee, Okla., without condition.

Plans and specifications can be seen and secured at the office of the City Engineer, Muskogee, Okla., or at the office of the Consulting Engineer, 114 Liberty St., New York City, after June 10, 1911, upon payment of two and one-half dollars ($2.50).

The right is reserved to reject any or all bids or to accept that one which, in the judgment of the City Council, is for the best interest of the city.

[illegible] City Council.

E. H. FLEMING,
Commissioner of Water, Sewer and Lights.
ALEXANDER POTTER,
Consulting Engineer.
T. P. CLONTS,

PAVING.

The City of Dowagiac, Mich., hereby gives notice that proposals will be received until 2 o'clock p. m., on the 19th day of June, 1911, at the office of the City Clerk, for furnishing of all material and doing the work of grading and paving High street from the northerly line of its intersection with Front street to the easterly line of its intersection with Lowe street with a six-inch concrete pavement, surfaced with bitumen, and combined curb and gutter. Bidders will state in their bids the kind of paving and curb proposed. Bidders will also state the price of combined curb and gutter.

The work to be done according to specifications, plans and diagrams on file in the office of the City Clerk, and which contain an estimate of excavation and quantity of work to be done.

A guaranty of workmanship and durability for the term of one year will be required. A certified check for at least ten per cent of the largest amount bid by each bidder must accompany the bid; the same to be forfeited if the bid be accepted and the bidder neglect or refuse to enter into contract. The city reserves the right to reject any and all bids. Bidders will furnish satisfactory surety bonds for performance of contract, for labor and material and for said guaranty.

[illegible]
[illegible]

Dated June [illegible] 1911.

CONCRETE VIADUCT OVER HOUSTON SHIPCHANNEL.

Houston, Texas, May 23, 1911.

Sealed proposals will be received at the office of Dan C. Smith, Jr., City Controller and City Secretary, City Hall, Houston, Texas, until 12 o'clock noon, July 3d, 1911, for the construction of a reinforced concrete viaduct over the Houston Shipchannel. The structure will be about 1,650 feet in length and 60 feet wide.

Specifications and plans, bidding blanks, etc., can be obtained upon application at the office of F. L. Dormant, City Engineer, Houston, Tex., by making a deposit of $20.00 with the City Engineer.

A certified check of the bidder on any bank in Houston, Tex., payable to the order of H. B. Rice, Mayor, for $20,000 will be required to be deposited with the bid.

Bidders are expected to examine the site of the viaduct and acquaint themselves with local conditions.

The successful bidder will be required to give bond and comply with City Charter respecting contracts, and to execute the usual form of contract as prepared by the City Attorney.

The right is reserved to reject any or all bids or to accept any bid considered advantageous to the City of Houston.

H. B. RICE,
Mayor of the City of Houston,
Texas.
F. L. DORMANT, City Engineer.

BRIDGE.

Notice is hereby given that sealed bids will be received until 2 o'clock P. M. of June 22, 1911, for the construction of a steel bridge with concrete floor across Iowa River at Iowa Falls, Iowa. Length of bridge 353 feet, roadway 20 feet wide, 2 sidewalks each 5 feet wide. Check for 10 per cent of bid must accompany bids. The Board of Supervisors reserve the right to reject any or all bids. Plans and specifications on file at County Auditor's Office, Eldora, Iowa. Letting to be at Court House, Eldora, Iowa, June 22, 1911, [illegible] P. M.

E. L. MARRIAGE,
County Auditor,
Hardin County, Iowa.

IRRIGATION.

Denver, Colorado, June [illegible], 1911.

Sealed proposals will be received at the office of The Field, Fellows & Hinderlider Engineering Company, Denver, Colorado, until 2:00 p. m., June 26, 1911, for the excavation of canals and the construction of headworks, wood stave pipe flumes, pumping machinery, etc., for the Grand Valley Irrigation District, at Grand Valley, Colorado.

The work involves the [illegible] of [illegible] station.

Plans, specifications and other particulars may be obtained at the office of The Field, Fellows & Hinderlider Engineering Company, 435 Century Bldg., Denver, Colorado. A deposit of $5.00 will be required for each set of plans and specifications [illegible].

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OFFICE OF THE SEWERAGE COMMISSION OF THE CITY OF BALTIMORE.

Sealed proposals indorsed "Proposal for Constructing Jones Falls Conduits, Section No. 1, Storm Water Contract No. 14," addressed to the Board of Awards of Baltimore City, will be received at the office of the City Register, City Hall, Baltimore, Md., until 11 a. m., Wednesday, June 28, 1911, for constructing Jones Falls Conduits, Section No. 1, Storm Water Contract No. 14, as shown on plans on file in the office of Mr. Calvin W. Hendrick, Chief Engineer of the Sewerage Commission.

Specifications and plans can be obtained upon application at the office of the Sewerage Commission, Room 904, American Building, Baltimore, Md., on and after June 2, 1911. A charge of $15.00 will be made for each specification and blue prints. This charge will be refunded upon the return, on or before June 28, 1911, of the unused specifications and plans in good condition, or upon the return of the plans in case a bid is submitted.

A certified check of the bidder, for the sum of $18,000, on a clearing-house bank, made payable to the order of the Mayor and City Council of Baltimore, will be required to be deposited with each bid.

Apprixomate quantities:

28,000 cu. yds. earth excavation.
900 cu. yds. rock excavation.
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750 cu. yds. brick masonry.
1,000,000 lbs. reinforcing steel.
12,000 sq. yds. granolithic resurfacing.
140,000 lin. ft. piles.
[illegible] tion.
50 tons cast-iron pipe and specials.
900 lin. ft. vitrified sewer pipe, 6 to 30 ins. in size.
40 tons structural steel.

The successful bidder on this contract will be required to give bond and comply with the City Charter respecting contracts.

The Board of Awards reserves the right to reject any and all bids.

By order of the Sewerage Commission.
CHARLES ENGLAND,
Chairman.

[illegible]
Secretary.

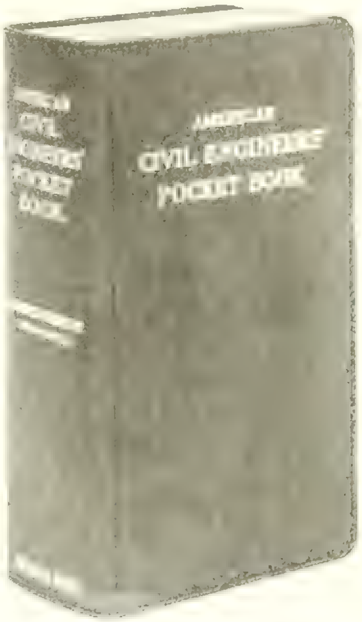
Approved:
JAMES H. PRESTON, Mayor,
President, Board of Awards.

OPEN DITCHES.

Bids will be received until 3:00 p. m., July 15, 1911, by the Board of Commissioners of the Sixth Ward and Crowley Drainage District, at Crowley, La., for the construction of about 40 miles of open ditches ranging from 2 to 6 miles in length, 16 to 40 feet in width and 2 to 8 feet in depth, approximating 600,000 cu. yds., and about 90 acres of clearing. No rock. Mostly open prairie. Three lines of railway. The right is reserved to reject any and all bids. Each bid must be accompanied by certified check for $1,000.

H. E. LEWIS, President.
W. S. WHITE, Engineer.
[illegible]

U. S. ENGINEER OFFICE, Kansas City, Mo., June 3, 1911. Sealed proposals for constructing standard revetment on Missouri River, about eighteen miles below Kansas City, Mo., will be received here until 12 noon, July 3, 1911, and then publicly opened. Information on application. EDWARD H. SCHULZ, Major, Engrs.



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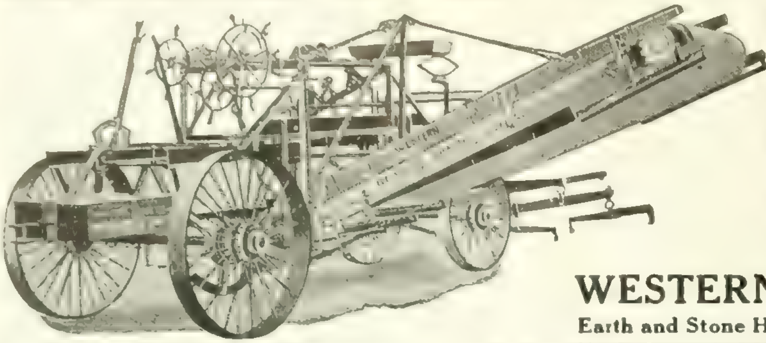

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The Possibilities of Flexible Suspended Centering for Arches.

A certainly interesting and, we believe, a promising development in arch centering is outlined on a succeeding page of this issue. The proposition is to use a flexible centering suspended from cables. On first thought this seems almost absurd, but we believe that a careful study of the article published elsewhere will beget very considerable respect for the idea. We shall not repeat the argument for the flexible suspended centering here as it cannot be better presented than it is in the article itself which should be read. The theory of the flexible centering is sound. Its practical success has been actually proven up to spans of 50 ft. If it is successful for 50 ft. spans it is reasonable to argue that it will be successful for somewhat longer spans. The question is for just how much longer spans may we reasonably expect success. The inventor evidently sees no insurmountable obstacle to practical success for any of the masonry arch spans which have yet been attained and apparently has great confidence of success for spans well beyond any that exist. He may, and doubtless does, expect to find engineers reluctant to agree with him. With increasing weight to be suspended the means of adjustment offer increased difficulties and with increasing span the possibilities of lateral cable sway offer uncertainties. We can, however, well leave these problems to the future. The more important matter is that we have in the suspended flexible centering a proved means of supporting masonry arches of small and moderate spans during construction which involves much less cost and risk than the ordinary rigid falseworks centering. One always takes a chance of having to confess error in passing judgment in such cases but we believe that a careful study of Mr. Aylett's tests and of the construction work carried out by him warrants us in risking the above statement.

Two Theories of Rate Making.

We are now in a period of transition from rate regulation by competition to rate regulation by government. Thus far only one theory of rate making seems to have been adopted by public service commissions. It may be termed the theory of fair return on the value of the plant and its established business. This theory has been so commonly accepted as rational that we have yet to hear of a single case where it has been contested. Yet it is open to two serious objections, one of which is so serious, we believe, as to be fatal.

Elsewhere in this issue we reprint that part of a decision of the Wisconsin Railroad Commission relating to its method of determining the rate of "fair return" on the value of a lighting company; and it is noteworthy that never once does the commission question the soundness of the fair return theory. Yet the commission quotes a pregnant sentence from the decision of Justice Timlin in the "Soo" case, as follows:

> It is also to be considered that this margin [of surplus above a "fair return" on the investment] ought not ordinarily to be exhausted or swept away by orders or requirements of the Railroad Commission as fast as accumulated, because human nature or railroad nature is such that no one will long economize on operating or other expenses if his economy only furnishes a larger [illegible]

Justice Timlin perceived the defect in the "fair return" theory, for he saw that if every public service corporation were permitted to earn a "fair return" on the value of its property and no more, then all the present struggle for greater efficiency would cease. No longer would it be judicious to buy a low priced machine capable of doing the present work of a high priced machine, for the very act of substituting the machine of lower price would act to reduce the "fair return" permitted by a public service commission because the less the cost of the plant the smaller the total profit allowed under the "fair return" theory.

In our issue of May 25, 1910, we pointed out the fallacy upon which this theory rests. It consists in reasoning that profits are a form of return to capital, whereas true profit is really a return to managerial brains. The Wisconsin Railroad Commission, in the decision quoted elsewhere in our columns, has the right conception about profits, for the commission points out that the "fair return" on the investment is composed of two elements: First, the interest or rental return on the capital; sec- [illegible]

The fundamental law of the science of man- [illegible] be proportionate to performance. Because this law prevails in the American world of competitive business, in so far at least as employers themselves are concerned, we have developed the most economic system of railway transportation to be found. Due to the keen struggle to increase profits by reducing operating expenses, American railway managers have accomplished wonders with comparatively small amounts of invested capital. Now these same men are confronted with a new condition founded on a new theory, the essence of which is this: It shall no longer be a mark of managerial merit to accomplish a desired result with little capital. The more capital you invest in the plant, the greater will be the permissible profits, for the "fair return" is to be a percentage of the total investment. It shall no longer avail you to reduce operating expenses, whether by invention and development of improved machinery, whether by the use of electricity instead of steam, whether by the elimination of curvature and grades, or by any of the myriad possible means of increasing railway efficiency. For you are absolutely limited to a "fair return" on the investment in the plant, and the moment you manage to increase the return by any means whatsoever, that moment will the public pounce upon you and take away all that you have secured above what the public has decreed shall be your "fair return"—your 6 or 8 per cent on the invested capital.

The "fair return" theory has little to commend it except its simplicity, and the simplicity is of the kind possessed by the guillotine. It is a simple contrivance that puts an end to ambitions, without discrimination between good or bad.

In our issue of May 25, 1910, we called attention to the reductio ad absurdum that will attend any attempt to apply the "fair return" theory to such public service corporation as the express companies, which have practically [illegible] Feb. 1, 1911, for data as to express companies). In the entire absence of a plant, the application of the "fair return on the investment" theory of rate making would result in no "return" at all to the corporation. Yet it can not be logically maintained that such a corporation is entitled to no profit.

The really *fair* return to which every corporation is entitled consists of two elements: first, the interest on the invested capital; second, the profit for the business management of the corporation. The first of these elements is properly a percentage of the cost of the plant and its development expense or going value. The second element—the true profit—bears no necessary relation to the cost of the plant, and it is therefore illogical to rate true profits in terms of the cost of the plant. True profits are preferably rated as a percentage of the gross annual income. A contractor, for example, never speaks of his profit in any other way than as a percentage of his contract price. So, too, the merchant and the manufacturer always rate their profits in terms of the selling price of the goods or products.

It may be contended that it is, after all, immaterial whether a profit be expressed in terms of the gross annual income or in terms of the capital invested in the busines. But we have already shown to what absurd conclusions the latter method leads when the "fair return" on the investment theory of rate making is applied. Hence there must be some underlying principle of economics that is violated when true profits are measured in terms of invested capital. Brief consideration only is necessary to disclose this economic principle, which may be formulated thus:

The measure of efficient management is the percentage of labor saved by its application.

If John Smith, who is an average manager, so manages the construction of a building that it requires 1,000 carpenter-days for its erection, whereas Tom Jones so manages the same construction as to require 900 carpenter-days, then Tom Jones is 10 per cent more efficient as a manager than John Smith. In the ordinary course of events Tom Jones will therefore command an income measured by his 10 per cent more efficient performance; and, if he becomes a contractor, his profits will be fully 10 per cent of the labor cost of his work. In the final analysis, all material and machinery are nothing but crystallized labor. Therefore the manager of a railway, from its inception to the present day of its operation, has been doing nothing more than direct the energies of men. Today, when the railway is in operation, a part of those energies exist as crystallized labor—rails, ties, embankments, locomotives, cars, buildings, etc. But the greater part of the labor of producing transportation is non-crystallized. It consists of daily wages and salaries, which have no necessary relation to the crystallized labor—the plant. Since the efficiency of the railway manager can only be measured in terms of the total labor economized, it follows that it must be expressed as a percentage of the crystallized labor saved plus a percentage of the non-crystallized daily labor saved. The "percentage of the crystallized labor saved" is the interest saved on the cash investment. The "percentage of the non-crystallized or daily labor saved" is the percentage of operating expense saved by efficient management. Interest saved is one thing; operating expense saved is another. The object of efficient management is to make the sum of these two savings a maximum, and thus secure the maximum economy of labor. *But this object would be completely frustrated by any rule of action compelling the manager to measure his savings of crystallized and uncrystallized labor in terms of crystallized labor only.* Yet this is precisely the rule of action that the theory of "fair return" on the value of the plant entails.

An elementary illustration may serve to make this statement clearer. Suppose the public were to say to Tom Jones, the builder: "Hereafter you will not be allowed to secure a profit of 10 per cent on the carpenter labor that you employ, but your profit will be limited to 8 per cent on the cost of the tools that the carpenters use." What would be the result? Would Tom Jones exert his wits and his energy in devising economic methods of erecting buildings? Would he be concerned as to the skill and energy of the carpenters employed by him? Not one whit! Under such a blighting rule of action, his one concern would be to invest as much capital in tools as possible. How effectively the tools were used, or who used them, would be a matter of complete indifference to Tom Jones. And this, in a nut shell, is the theory of rate making that we have termed the "fair return on the investment theory," which as yet is the only rate making theory that commisions and courts have had to consider.

In our issue [illegible] 1910, we proposed a new theory of rate making and discussed it under the caption of "A Periodic Rate Fixing System for Controlling Public Service Corporations." The theory was formulated as follows:

The rates charged by all public service corporations should be periodically fixed so as to yield only a small true profit at the date of regulation, the time between such periods of rate fixing being, in essence, the term of the patent granted to managerial brains.

In that article we pointed out the close analogy between the imaginative power and inventive ability of the great railway manager of the type of Harriman and the genius of Edison. Our Edisons have been protected in their creations by patents of limited duration (17 years), whereas our Harrimans have been unwisely permitted to enjoy the exclusive right to their inventions indefinitely. In fact where they have worked in monopolistic fields they have been able to capitalize a very large part of the annual savings they have effected, thus placing the public under perpetual bondage to their brains. For Harriman, as for Edison, there should be similar inducements to exercise their creative faculties, and similar protection for a period of time in the full enjoyment of the savings effected.

In offering the periodic theory of rate making as a rational solution of this extremely difficult problem in political economy we wish to urge that the periods of rate making should be long enough apart to encourage public service corporation investors and managers to work with the same zeal that they have shown in the past. In the periodic fixing of rates the invested capital should receive its return in the form of a low rate of interest, say 5 or 6 per cent at present, and the annual profits—the excess above this interest—should be a percentage of the gross income or of the operating expense—it is immaterial which.

The Use of Concrete in Irrigation Work and the Action of Alkali Salts on Cement.

The importance of concrete in irrigation work construction is well illustrated by the description on a succeeding page of the structural features of the South San Joaquin works in California. Concrete is being used in these works for lining tunnels and canals, for dams, canal drops, siphons, culverts, sand sluices and bridges and even contemplated for flumes on piers. This example is but one of many afforded by recent irrigation works construction in the western United States. Indeed so important has the material become in such work that the office of Experiment Stations of the Department of Agriculture has since 1908 been conducting a special study of its use and will soon, according to recent announcements, publish the results. Contemplating the availability in the sections where this irrigation work is going on of other materials suitable for the structures named speculation arises as to what the present status of irrigation construction would have been had not concrete been available. Incidentally too, viewing the extensive and general use of concrete and bearing in mind the alarms that have been voiced of the destructive action of alkali solutions on cement, speculation naturally arises as to the seriousness of this danger.

Some three years ago a series of investigations into the disintegration of cement by alkali was conducted by the Montana Agricultural College Experiment Station. This, we believe, was the first publication on the subject to be made with authority. The results were summarized in ENGINEERING & CONTRACTING for June 24, 1908. Subsequently other accounts and discussions of the action of alkali salts on hydraulic cements have appeared and will be found in our issues of June 5, June 15 and July 20, 1910. The latest statement in the matter is now before us in the form of a bulletin accounting the continuation of its early investigations by the Montana Agricultural College. Much of the work recorded—largely a chemical study—is of too special a character to be interesting in detail to engineers but the general scope of the work and the conclusions reached bear summarizing.

In its original bulletin the Montana Experiment Station proceeded no farther than to record the circumstances and characteristics of certain concrete failures attributed to alkali salts and to present such tests as had been made and considered sufficient to indicate that the attributed cause of failure was the [illegible] cause. In the present bulletin are given the studies made to answer why and how alkali salts act to disintegrate concretes and mortars. The general method of making the studies was to test the effect upon cement separately of solutions of the salts prevalent in "alkali" as that term is popularly understood in the arid regions of the West. These salts are sodium sulphate (white alkali); sodium carbonate (black alkali); magnesium sulphate, and sodium chloride. An artificial sea water solution was also tested. For the detail of the reasoning the reader is referred to the bulletin; the conclusions reached were as follows:

> The disintegration of cement by alkali salts is principally due to reactions between these salts and the calcium hydroxide necessarily present in set cement. As a result of these reactions relatively insoluble new compounds are formed in the body of the cement structures. These new compounds have greater weight and require greater space than the calcium hydroxide replaced. In order to obtain the necessary space the new compounds force apart the particles of the cement, thus weakening or breaking the binding material.
>
> The compounds resulting from these reactions with the various destructive salts are as follows: With sodium sulphate the resulting compounds are sodium hydroxide, which is soluble and therefore is removed by leaching, and gypsum, which is relatively insoluble and therefore accumulates in place of the calcium hydroxide. With magnesium sulphate the resulting compounds are magnesium hydroxide and gypsum, both of which are insoluble and accumulate in place of the calcium hydroxide. With sodium carbonate the soluble sodium hydroxide and the insoluble calcium carbonate are formed. In this case there is little increase in the space required but the silicates and aluminates are also attacked and dissolved. This solvent action is especially marked upon the silica. This loss of silica must weaken the cement but there is little, if any, crumbling due to expansion.
>
> The additional material, requiring increased space, consists in part of dry matter and in part of combined water, which is taken up by the cement during its exposure to the alkali solutions. This increase in dry matter is brought about by the formation of the sulphates, magnesium hydroxide, and carbonates. Part of this increased amount of combined water is due to the fact that the new compounds, gypsum, magnesium hydroxide, etc., require more water for crystallization than did the calcium hydroxide which they replaced. This further assists in the disruption of the cement. A part of this increased amount of combined water is due merely to the continued action of water upon the incompletely hydrated cement. This amount should serve to set free more calcium hydroxide, and thus to a certain extent repair the damage due to loss of the binding material and to expansion.
>
> A certain weakening, not a disruption of the cement, is due to the loss of a portion of the binding material, crystallized calcium hydroxide, which is merely dissolved and removed in solution.
>
> In order for destructive action to become marked the alkali solutions must percolate through the cement work, or at least must penetrate beyond the surface. When the action is strictly confined to the surface, as when briquettes of neat cement are immersed in a still solution, the tensile strength may be increased. In such cases the expansive action closes up the pores, making the surface more nearly impervious and preventing the alkali from penetrating further.
>
> When cracks are started by the expansive action due to alkali salts, wetting and drying, or freezing and thawing, will hasten the destruction of the cement by extending the cracks already started. Any measures that hinder the penetration of the alkali solutions into the interior of the cement will delay the destructive action. For this purpose both soap and aluminum sulphate have been tried in laboratory tests and have been found to afford some protection. The soap, however, in itself had a slightly injurious effect on the tensile strength of the cement.

It will be evident from these conclusions that, as we have pointed out several times, the protection of cements from the effects of alkali salts, sewage acids, sea water, etc., reduces itself down to the problem of securing an impervious concrete. Time and care spent in proper proportioning, mixing and placing will give a substantially impervious concrete. More or less close approaches to the same results may also be secured, temporarily at least, by various waterproofing compounds.

The Appraisal of the Railways of New Jersey, and Progress in Other States.

The first eastern state to appraise the railways in its territory is New Jersey. In *Engineering Record,* May 27, 1911, Mr. Charles Hansel, the engineer in charge of the appraisal, gives a few facts about it. He states that he has been engaged a year on the work, with a field and office force of 90 men, that the field work is now complete, and that the present office force numbers 60 men. He estimates that the cost of the appraisal will not exceed $90,000.

The New Jersey appraisal is being made as a basis for taxation. The Interstate Commerce Commission Report for 1909 gives 2,251 miles of roadbed or line in New Jersey, taxed at an average of $2,166 per mile. Mr. Hansel gives the number of miles as 2,370. There are a number of very costly terminals in New Jersey, the lands alone in Jersey City and Hoboken City being assessed at $31,[illegible]

Speaking of the cost of making the appraisal, Mr. Hansel says:

> [illegible] pense.
>
> [illegible] to the main office daily, setting forth the amount of work accomplished and giving conditions of [illegible] the chief engineer to keep in close touch with every part of the work. A premium system was also inaugurated and the status of each field corps plainly indicated on a diagram, a blue print of which was furnished to each field corps each month. This premium system tended to create rivalry, greatly to the benefit and prog[illegible]

The New Jersey Tax Law, under which the appraisal is being made, provides that the non-physical value, or the value of "the remaining property, including the franchise," shall be appraised and assessed.

Our readers will be interested in knowing that railway appraisals are now in progress in two western states, Nebraska and Kansas, the work in the latter state having just begun under the direction of Mr. Carl C. Witt. In both of these states all public service corporation property is being appraised. The state of Washington also has just begun the appraisal of all public utilities other than railways, the latter having been already valued.

Nine states have either made or are now making appraisals of steam railways, namely: Texas, Michigan, Wisconsin, Washington, [illegible] New Jersey and Kansas. From present indications California will be the tenth state to ascertain the physical value of the railways. Should Congress continue to ignore the recommendations of the Interstate Commerce Commission as to the necessity of an appropriation for appraising all the railways, it will be only a few years before nearly every state will have made an independent valuation.

CONCRETE AND REINFORCED CONCRETE SECTION

Method of Employing a Suspended Flexible Centering for the Construction of the Chickahominy River Concrete Arch, Richmond, Va.

[illegible] M. Am. Soc. C. E.

Disadvantages of Rigid Falsework.

Of all classes of falsework, the most difficult to erect, maintain and remove and that affording the greatest obstruction to traffic, both by land or water, is undoubtedly the ordinary rigid timber falsework, usual in the construction of arch bridges of masonry or concrete, especially the latter.

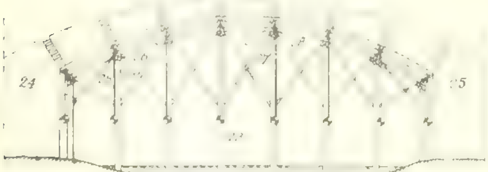

Fig. 1—Sketch Illustrating Method of Adjusting Arch Ring Distorted by Settling Centers.

The falsework of bridge arches is constantly liable to damage by fire and water, resulting in the injury or complete destruction of the incompleted superimposed structure. Even small movements in fasework from timber shrinkage or settlement prior to or at the time of striking the centering have proven prolific sources of permanent injury or even complete destruction. For example, the author was once constructing a concrete arch over a small stream 100 ft. wide by the ordinary rigid timber falsework method, when a sudden rise in the stream, and accumulation of drift, resulted in the loss of both falsework and partially completed arch. Many similar cases are upon record. In several known cases the falsework was destroyed by fire, the origin of which was probably due to shavings, chips, etc., left by carpenters.

In a number of cases of record, washout of falsework by a sudden freshet has resulted not only in disaster to the structure being built, but also other structures spanning the same stream below have been swept away by the floating falsework timbers. One case is known where injunction proceedings were instituted against the construction of the falsework for a proposed concrete arch bridge by the owners of a highway bridge located over the same stream, several miles below. As a result, the concrete structure was abandoned and one of steel substituted. Loss of life and property have frequently resulted from the proximity of falsework (supporting overhead structures) to railway tracks under traffic. In one case a bridge was being constructed over a cut containing the tracks of an important trunk line. The falsework was struck by the contents of an improperly loaded flat car, thus causing derailment which resulted in loss of life, destruction of falsework and blocking of traffic. Numerous like cases are recorded of similar accidents from rigid falsework. The presence of falsework in streams subject to floods, ice, drift, etc., always invites disaster.

In almost every case of the loss or damage to arch bridges during construction or subsequent, development of cracks, the failures, weakness or even small settlements incidental to the construction, maintenance or removal of the so-called rigid timber falsework are usually responsible. It has been found impossible completely to guard against such occurrences to timber falsework, especially in streams or upon soft ground, even when pile foundations are used, and there are few engineers with extended practice in arch construction whose experience has been exempt.

In addition to the risks, delays, etc., involved by the use of rigid falsework, its expense is usually the largest factor in the cost of arch bridge construction. Its cost, as well as its risks and dangers, increase out of all proportion with increase of span and depth. The usual demand in the engineers' specification for "absolutely rigid and unyielding" falsework in arch bridge construction has become both difficult and dangerous to meet under the heavy loads of modern long span arches, and this demand must, of course, add largely to cost by requiring expensive foundations, skilled construction, low working stresses and, consequently, heavier timbers and more of them in order to eliminate shrinkage settlements and insure the rigidity and strength required during the long periods of falsework maintenance prior to striking centers.

Steel bridges do not require falsework so invariable in level and form as do bridges of concrete and masonry; therefore they require less timber, shorter erection time, with no delay in striking centers, and thus less risk and expense.

Thus the main handicaps in the cost and feasibility of concrete in comparison with steel structures is obviously due to their rigid falsework methods of construction. Comparisons are especially unfavorable to concrete bridges over those locations which involve unusual risks or require structures of spans and depths above the ordinary. In many locations the cost of rigid falsework is not only altogether prohibitive, but the method is impossible on account of the nature of the stream or location to be spanned. Such cases occur with deep ravines, torrential streams, gorges and railroad tracks. In every such difficult location, steel structures or suspension bridges are almost invariably used, in spite of their constant maintenance and renewal cost, and the further fact that the steel is made and fabricated perhaps hundreds of miles away, with consequent high freight charges, high cost of material and the necessity of importing skilled mechanics and costly appliances to do the work. Concrete structures for such locations are rarely considered, although every material necessary for their construction, such as stone, sand and cement, is placed by nature at or near the site, ready to be incorporated and molded by native labor with simple appliances made on the spot, into a structure both beautiful and everlasting. Improvements in the quality of material have greatly increased the span length of steel structures and improvements in design, fabrication and erection methods, tending to partial or complete elimination of falsework, have decreased risk and cost. The disadvantages of steel structures have been largely offset by their comparatively economical and safe erection methods. The first cost of concrete bridges increases with the advances in the cost of timber, with no diminution of the risk and costs usual in the construction, maintenance and removal of their rigid timber falsework. In fact, so far as first cost is concerned, regardless of other considerations, it appears that the increasing scarcity of the timber supply will render future competition between steel and concrete

Fig. 2—Sketch Illustrating Construction of Suspended Flexible Arch Center.

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*4001 Connecticut St., St. Louis, Mo.

structures more unfavorable for ordinary locations, or even those locations especially adapted to concrete. The heavy annual drains upon the timber supply coupled with its misuse and forest fires will bring their sure result. All kinds of timber are becoming scarce and their prices higher. Even the south and west, which for years have been the source of supply of many eastern states, have resorted to methods of timber preservation. Timber preservation, while of value in reducing the expense of timbers which must constantly be renewed, such as fence posts, railroad ties, mine timbers, trestles, telegraph poles and the like, can obviously be of no practical value in the construction of temporary structures, such as falsework of arch bridges. At the present rate of consumption, the exhaustion of the supply of structural timbers in the United States is not very far off. Especially is this true of the long and heavy square timbers and piling so necessary in rigid falsework construction for masonry or concrete arch bridges. With the great weight incidental to recent long span arch construction, the future demand for structural material for fasework will be greater than in the past. To meet this demand there are two methods available; both unpromising. These are (1) by prolonging the life of the forests by wise use, (2) the use of structural steel or a combination of timber and steel.

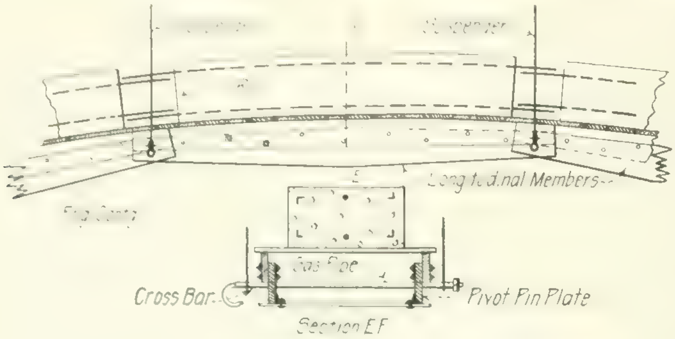

Fig. 3—Detail of Flexible Centering.

With the most efficient management many years will elapse before the supply of heavy timbers suitable for rigid falsework will increase in quantity or decrease in cost. It appears therefore that even the present generation must resort to the other alternative; viz., the use of structural steel or a combination of timber and steel. As a result of the cost of timber falsework and the greater risks incurred with increase of weight, height and span length, a number of recent concrete structures have been built (or are now under construction) with a combination falsework, or with a falsework exclusively of structural steel. Thus far, however, the use of structural steel falsework for concrete arch bridges has been restricted almost exclusively to those locations where the character of the stream or crossing rendered timber and pile falsework impossible or expensive. The approaches of the Manhattan bridge (New York) were erected by combination falsework, consisting of wooden columns and struts combined with steel diagonals and connections. By reason of the decreased weight, due to the diagonals and the facility of making pin connections with angles permanently bolted to wooden columns and the interchangability of corresponding members, expense and time was saved in the erection and removal of falsework. Falsework of this character is capable of repeated use. Another notable example of a combination timber and steel falsework is found in the construction of the great 233-ft. Walnut Lane arch over Wissachickon Creek, Philadelphia.

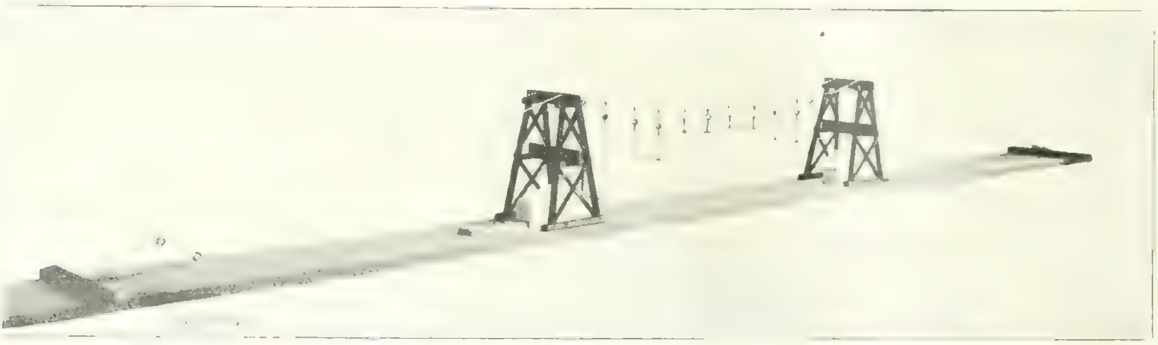

Fig. 5—View of Flexible Center for Small Test Arches, 2 to 5 Ft. Span.

Settlements caused by the compression and shrinkage of this great mass of timber under the enormous superimposed weight for so long a time nearly caused disaster to the partially completed arch ring in spite of the utmost care and vigilance in its design and construction.

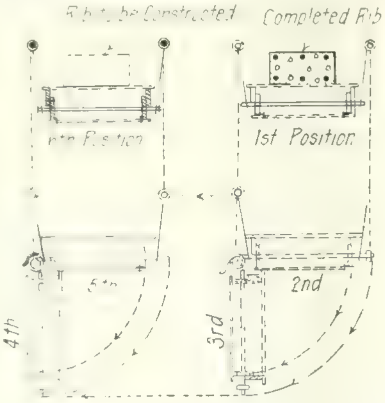

Fig. 4—Sketches Showing Manner of Shifting Flexible Center from Rib to Rib.

The designer of the structure stated as follows (transactions American Society of Civil Engineers):

> The stresses in the woodwork were high enough, apparently, to produce progressive deflection, so that during the time of loading and subsequent seasoning, the falsework compressed sufficiently to lower the crown three and three-quarter inches, this amount being the same for both ribs. In anticipation of this compression the falsework was originally set higher than the plan elevation.

Again the designer says:

> "No actual failure occurred, but it was evident that if the structure had been required to sustain its maximum load much longer, some of the falsework would have collapsed. The action of the falsework indicated that the unit stresses to which the wood was subjected, in cross grain bearing at least, were beyond its elastic resistance, and it is recommended, therefore, that the working stresses of wood in side grain bearing, even for temporary duty, should be limited to 500 lbs. per sq. in., and that the details should be made as compact as possible."

The design of the Sitter arch in Switzerland not only carried out this suggestion, but even went a step further. The falsework of the 259-ft. Sitter arch was over 200 ft. high and to a limited extent a combination falsework of wood and metal. Its settlement was only 1¼ ins., which is attributed to the high character of workmanship and extensive use of hardwood and channel iron corbels, and by limiting the cross grain compressive stresses to 250 lbs. per sq. in., or half as much as was recommended by the designer of the Wissahickon arch. In view of the experience of the builders of the Wissahickon arch, these were evidently wise precautions, although adding largely to falsework cost. The roadway of the Sitter arch is 261 ft. above the creek level, and 580 M. ft. of timber were used in the falsework and 50 tons of steel work and bolts. This falsework would cost in the United States $30,000, and $40,000 if constructed under the Swiss specifications.

The first recorded use of falsework entirely of structural steel for concrete arch bridge construction on a large scale was in 1909, upon the construction of five 150-ft. channel spans of the D. L. & W. bridge over the Delaware river. The Delaware river is subject to heavy floods with ice and drift. A concrete structure could, therefore, never have been considered at all but for the elimination of the ordinary pile supported rigid falsework and the introduction of structural steel falsework. This latter consisted of three centered steel arches supported upon concrete projections on the piers designed for the purpose. Two complete sets of these steel arch centers were provided in order that two adjacent concrete arches could be constructed simultaneously. These steel arches were erected, dismantled and removed from span to span by their manufacturer. The 280-ft. concrete arch span over the Rocky river at Cleveland, Ohio, is another interesting example of structural steel falsework. This arch consists of two plain concrete ribs, each 22 ft. in width by 11 ft. thick at the springing line, and tapering to 18 ft.x6 ft. in height at the crown. Here, as in the case of the D. L. & W., Delaware river bridge, the danger from flood and ice placed timber falsework out of the question, and steel centering composed of two parallel three centered steel arches was used.

The cost of the steel centering at Rocky river was actually less than timber falsework. This economy was affected largely by the temporary use during erection of a large number of 20 in. I-beams which were afterward imbedded in the permanent floor. At the completion of one arch rib, the entire steel centering was shifted bodily for use in construction of the second rib, as was done at the Wissahickon arch.

It cannot be denied that the cost of concrete arch bridges increases as the timber supply decreases, and that there are many locations in which steel is now used where concrete was not considered at all, or if considered in comparative estimates with steel was finally abandoned as unfeasible or impossible, after taking into consideration risks, expense, etc., incidental to the erection, maintenance and removal of rigid falsework.

Suspended Method of Arch Construction.

The use of a new method of arch construction at the Chickahominy river, Richmond, Va., and in other work, has demonstrated that it possesses many advantages and possibilities, in addition to economy and rapidity of construction. This method (as used at Chickahominy river), since it involves the use of no falsework whatever, eliminates the great expense, risks, etc., incidental thereto and thus a means is afforded of constructing concrete arch bridges over locations heretofore considered impracticable, expensive or altogether impossible, by reason of falsework considerations, difficulty of access or remoteness from civilization. Prior to the detailed description of methods, etc., used at Chickahominy river, a brief review of some of the most important experiments, test erches, etc., preceding and leading up to its use there will be of interest.

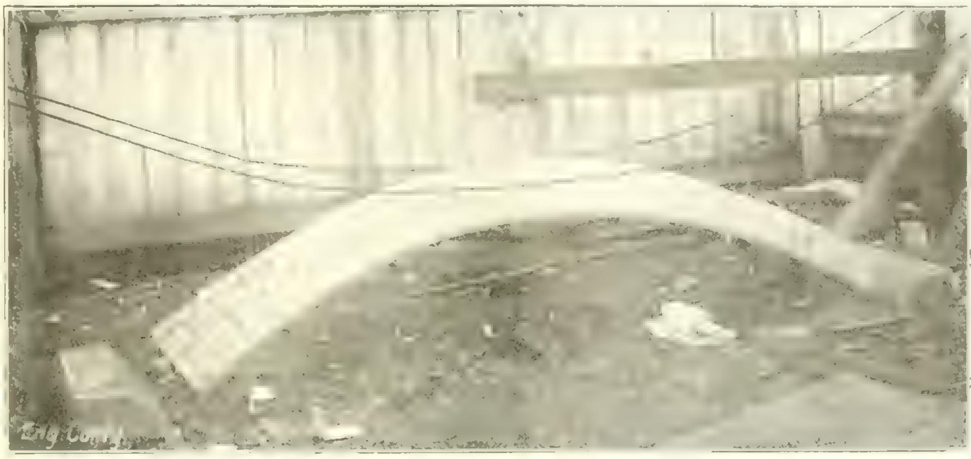

Fig. 6—View of 10 Ft. Span Test Arch Showing Haunch Keys Open.

The method was first suggested by an actual experience with rigid falsework supported on piles during construction of a 70 ft. concrete rib span. Skin friction of the piles being reduced by scour after a heavy freshet caused the sinking of the piles supporting the falsework, which, of course, threatened the destruction of the concrete ribs. Fortunately, the concrete ribs had been deposited in sections or voussoirs, and the spaces between them had not been filled with concrete when the settlement of fully 12 ins. occurred, decreasing towards the abutments.

Jacks were placed upon the caps (Fig. 1) of the pile falsework bents, which were located directly under the open spaces between the concrete rib sections. The rib sections were thus raised to the true curvature, as determined by computed ordinates between the intrados and a horizontal line (as shown by targets). The open spaces between the rib sections were then filled with concrete. Although sinking still continued, the true curvature was maintained by the jacks until the concrete was set up, and the arch became self-supporting. This structure has now carried heavy traffic for eight years.

All specifications covering the construction of masonry or concrete arches and their falsework provide for possible settlements by raising the falsework. This can be nothing more than a guess on the part of the designer or erector, and, as a result, there are few, if any, arches now extant which have their correct intrados curvature and elevation. They either have settled not as much as anticipated, or more. If the falsework is "rigid and unyielding," as usually specified, no settlement occurs, and the intrados never assumes the correct curvature. Maximum settlements in falsework usually occur prior to the self-supporting stage of the structure, or completion of the arch ring, as in the above case. These settlements are not uniform nor of equal amounts from end to end, but vary, showing that each supporting timber or pile bent has a settlement of its own—thus forming a series of hinges or points of flexure in the lagging, as it were—their movement depending upon the amount of load, its location, sequence of placing same, its weight and the character of the foundation, soil, etc., upon which the falsework is built and upon the falsework itself. The movement of the lagging near the crown is often upward, unless the arch is loaded at that point prior to loading elsewhere.

After the success of the above emergency work, two experimental arch ribs were constructed upon falsework. One of these ribs was composed of sections which were molded *in place*, which, after being properly adjusted for curvature, were keyed together by molding concrete keys in the key space between the sections. The other rib was composed of two previously molded sections, supported upon hinges located at the abutments and crown. Adjustments being made prior to keying or hinging by raising or lowering the crown ends of the two sections by means of jacks, placed upon one point of support, located under the crown. When the concrete keys were set, or the pins or hinges placed between the sections, as the case may be, the temporary supporting structure is removed, leaving the arch self-supporting.

It will be seen that the above method makes it possible for the temporary supporting structure to shrink, stretch, settle or otherwise become distorted without injury to the incompleted arch, since the arch section can, at any time, before keying them together, be accurately adjusted. The arch sections may be formed on the centering, or molded elsewhere and then placed in position, as stated, the sections being of any desired length.

When the sections are previously molded, the amount of temporary falsework is much reduced, this reduction depending upon the length of sections.

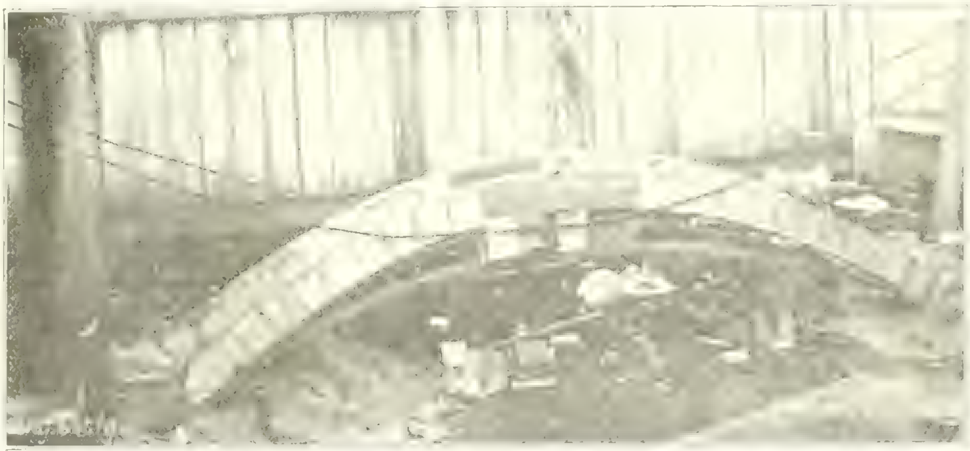

Fig. 7—View of 10 Ft. Span Test Arch With Haunch Keys Filled and Center Struck.

For instance, if the arch rib were composed of four sections, only three temporary supports in conjunction with abutments would be necessary. If the ribs were composed of only two previously molded sections, a temporary support at the center would only be required, the two sections being either keyed at the abutments and crown with concrete or hinged, as desired. This method, in addition to the economy effected by the partial elimination of falsework, is important in the construction of *very heavy long span arches* which necessarily require maintenance of their falseworks for *long periods*, with consequent distortion and injury due to shrinkage, settlements, etc. The above method, while eliminating injury due to shrinkage, settlement, etc., also reduces the amount of falsework, therefore effects much saving and is useful in many locations.

The foregoing work and experiments suggested the flexible support or suspended method, by which arch construction has been made possible without the use of any falsework whatsoever. While the method can be used for almost any location, it is especially adapted to rapid and economical construction for such locations as deep gorges, rapid streams, canals, railway tracks, etc., etc., over which, heretofore, any method of concrete arch construction has been found impracticable or altogether impossible. Figure 2 is a sketch in side elevation, showing the application of this method to the construction of an arch rib.

Cables indicated at 1 (Fig. 3) are hung from suitable supports, such as A frames or towers, located on or near the abutments. The cables are anchored by any convenient and suitable method, an ordinary deadman at each end of the cables for spans under 150 ft. being generally sufficient. Depending from the cables are the hangers, 6, carrying the cross members of wood, iron rods, steel shapes or pipes. The longtitudinal members, 9, are supported on the cross members. The longitudinal members, 9, are composed either of wood or steel shapes, such as angles or channels, as desired, and rest upon the cross members, so that by lengthening or shortening the hangers, 6, the series of supports can be made to assume any desired curvature, according to the design of the arch which is to be erected. Each cross bar or pivot, 8, passes through holes or slots in the ends of the longitudinal members (or rests in notches cut in their bottom edges), so as to permit the curvature of the arch to be varied. The end sections adjacent to abutment skewbacks may also be suspended by hangers from the cables, but it is sometimes preferable to mount them upon suitable hinged bearings directly upon the abutments, without suspension at this point from the cables. The series of longitudinal members, flexibly jointed together, constitute in effect a flexible centering upon which may be laid *previously molded vouss or sections* of the concrete arch rib, or molds, in which the con- [illegible] *suspended centering.* The lengths of the hangers are determined (approximately) in advance, so that when the cables and flexible centering are in place the latter will have the *approximate* curvature, but to permit of final accurate adjustment at any time, the hangers are provided with turnbuckles, 11, whereby they may be readily let out or taken up as desired, so as to correct the curvature of the centering whenever necessary. It has been found satisfactory to use wire rope suspenders instead of rods, and for very heavy spans differential pulleys may be used for adjustments, without the use of turnbuckles. Hanging from the ends of the cross bars or pivots is a row of targets (or plumb bobs), 12, on wires or rods of such length (determined by calculation) that when the curvature of the flexible centering has been adjusted correctly the targets will all be at the same level. Thus, under the direction of a leveler on the bank of the stream, or an adjacent pier, the sag of the cables and the lengths of the hangers can be varied until the targets are all at the same level, whereupon it is known that the centering, and therefore the concrete segments (or voussoirs) of the permanent structure are in proper form. Extending through the molds are the reinforcing bars, 14, which may either run continuously, or form lap joints in all key spaces, or be rigidly connected by one of several methods.

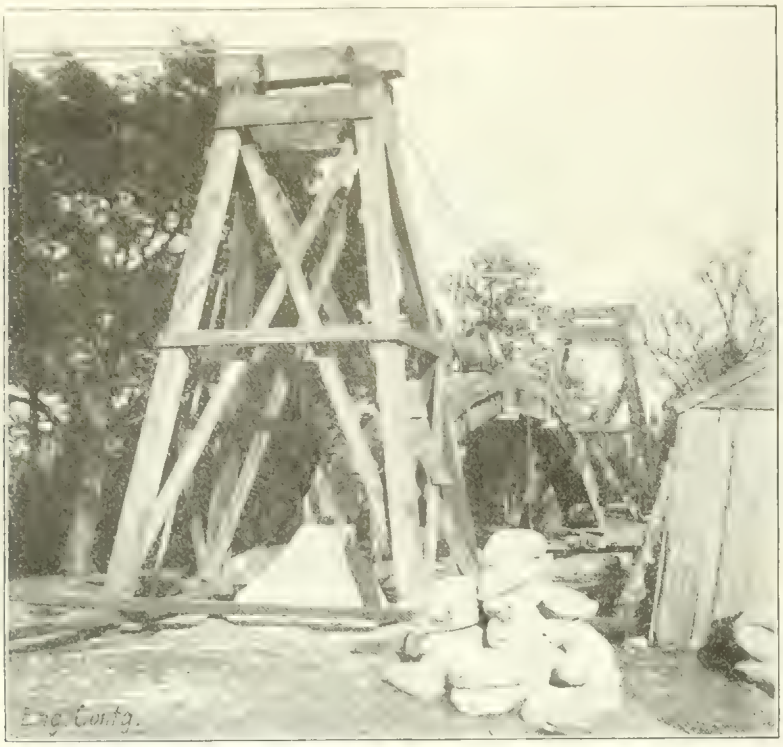

Fig. 8—View of Porthsmouth Test Arch Center and Forms.

A few years ago it was considered essential in concrete arch construction to have the arch ring a solid monolith from spring to spring. In short spans, to effect this, continuous work, night and day, was specified. With somewhat longer spans, continuous work was found inconvenient and expensive—and solid barrel arches were divided into longitudinal sections of such widths that the volume of concrete contained could be deposited in a working day. Thus, the completed arch is composed of monolith longitudinal sections.

With the longer and heavier spans of the last few years, monolith arch ribs and barrels (even in longitudinal sections) were found impossible. Experience in arch design and construction has shown such practice an unnecessary precaution and expense, with hingeless arches. In fact, monolith arch ribs and rings are not only unnecessary, but have been found impossible of construction in modern long spans, for the reasons that proper sequence of loading rigid falsework is essential in order to guard against deformation of centering and the impracticability of continuous work and even disaster.

In order to secure symmetrical loading of falsework and other advantages, the most recent practice in constructing arch ribs is to [illegible] With flexible support, such division is also used to afford a means of temporary flexibility, the points of flexure (or hinges) being located between the voussoirs and at the skewbacks. By this means, construction oscillations, deflections, etc., of the supporting cables have no effect upon the individual concrete rib sections or voussoirs during construction. Symmetrical loading has been found entirely unnecessary. In one case, with cable support, an arch rib was begun at one abutment and completed continuously to the other abutment. In another case, the arch rib was commenced at the crown and continued to the abutments. When the concrete in the sections sets up, the forms are removed and the spaces between the concrete rib sections enclosed by forms. The key spaces are then filled with concrete, embedding the reinforcement and keying the arch sections together.

Where two or more arch ribs are constructed with flexible support, side by side, they may be connected by transverse beams, as shown, cast in forms extending between the arch forms at suitable points, preferably opposite, and in communication with the key spaces, so that the transverse beams and keys will be integral or monolithic. Reinforcing bars may be provided, extending through the transverse beam forms and connected with the arch rib reinforcing bars. Since the longitudinal suspended centering members are preferably straight, furring members (preferably of wood) having their upper edges curved to the intrados of the proposed structure, are ragidly attached by bolts or otherwise to the longitudinal centering members. The furring members are also supported at their ends upon the cross members. Thus by substituting differently curved furring members and adjusting the length of the hangers, as mentioned, an arch of any *curvature and length* may be constructed with the *same apparatus,* within the capacity of the cables, etc. The arch ribs being completed, the cables and centering may be taken down and a superstructure of any desired character constructed upon the completed arch ribs: or the main cables may now be slacked off until the suspended centering drops from 3 to 5 ft. below the intrados of the arch and in this position used as a suspended scaffold for the workmen to finish up the surfaces of the completed structure. The cables (when not required for immediate use elsewhere after completion of arch ribs) may also be freed from hangers and suspended centering, then hoisted above the grade of the proposed roadway, and in this position used as an *ordinary cableway* for delivery of concrete from the mixers on shore to the spandrel and roadway forms, from *either* direction or from *both* banks of the stream or from barges or rafts in the stream below. In the construction of heavy spans requiring supporting cables of large diameters, it is best to use a special cable of small diameter for the delivery of material, this supported upon the main cable supports, thus avoiding wear and tear upon the main cables. Thus the expense and delays incidental to the transportation of concrete on runways by carts, cars, etc., is eliminated.

While the suspended system is especially adapted to the rapid and economical construction of rib bridges of the hingeless, two-hinged or three-hinged type, it may also be used in the construction of solid ring arches with or without hinges. By the introduction of hinges, not only are the stresses more readily determined, but it also becomes possible to lighten the rib design and reduce by so much the load on the cables.

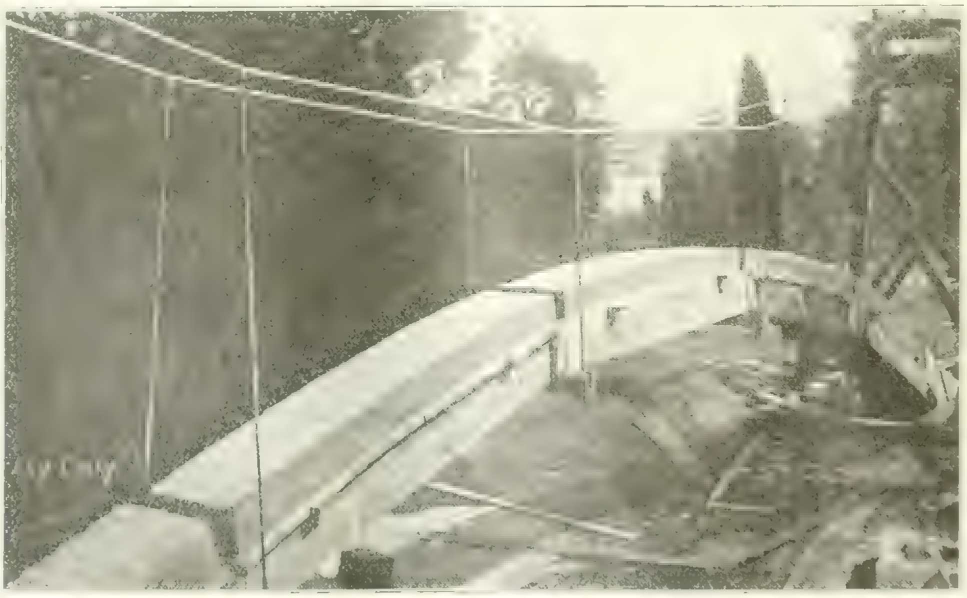

Fig. 9—View of Portsmouth Test Arch Showing Open Keys.

Further than this, much of the weight of the two concrete rib segments adjacent to the two abutments being supported by the abutment hinges, the weight upon the cables being thus reduced, the dimensions and weight of cables, anchorages, etc., are also correspondingly reduced. The end segments of the arch rib being pivoted by the hinges or pivots on the abutments are free to respond to the small construction oscillations of the cables due to depositing concrete, etc., in the intermediate segments, and in the open joints or key spaces between them.

Figure 3 is elevation and section of a panel of suspended centering constructed of wood. To adapt to a span of different radius it is *only necessary* to change the curvature of the furring member and increase or decrease the number of panels as the span length requires. The reinforcing bars are here shown embedded in the concrete segments, their ends projecting into the open key spaces and overlapping the bars from adjacent segments. Figure 4 shows one method of shifting the suspended centering from a completed rib to the location of a proposed adjacent rib in the same structure. The procedure is: (a) The main cables are slacked off until the flexible centering assumes a horizontal position. (b) The suspenders are released from one end of the cross-bars, allowing the centering to drop to a vertical position free from the completed rib. (c) Cables and centering moved laterally to position for adjacent rib. Released suspenders again attached to cross-bars and entire centering raised to proper position by tightening main cables.

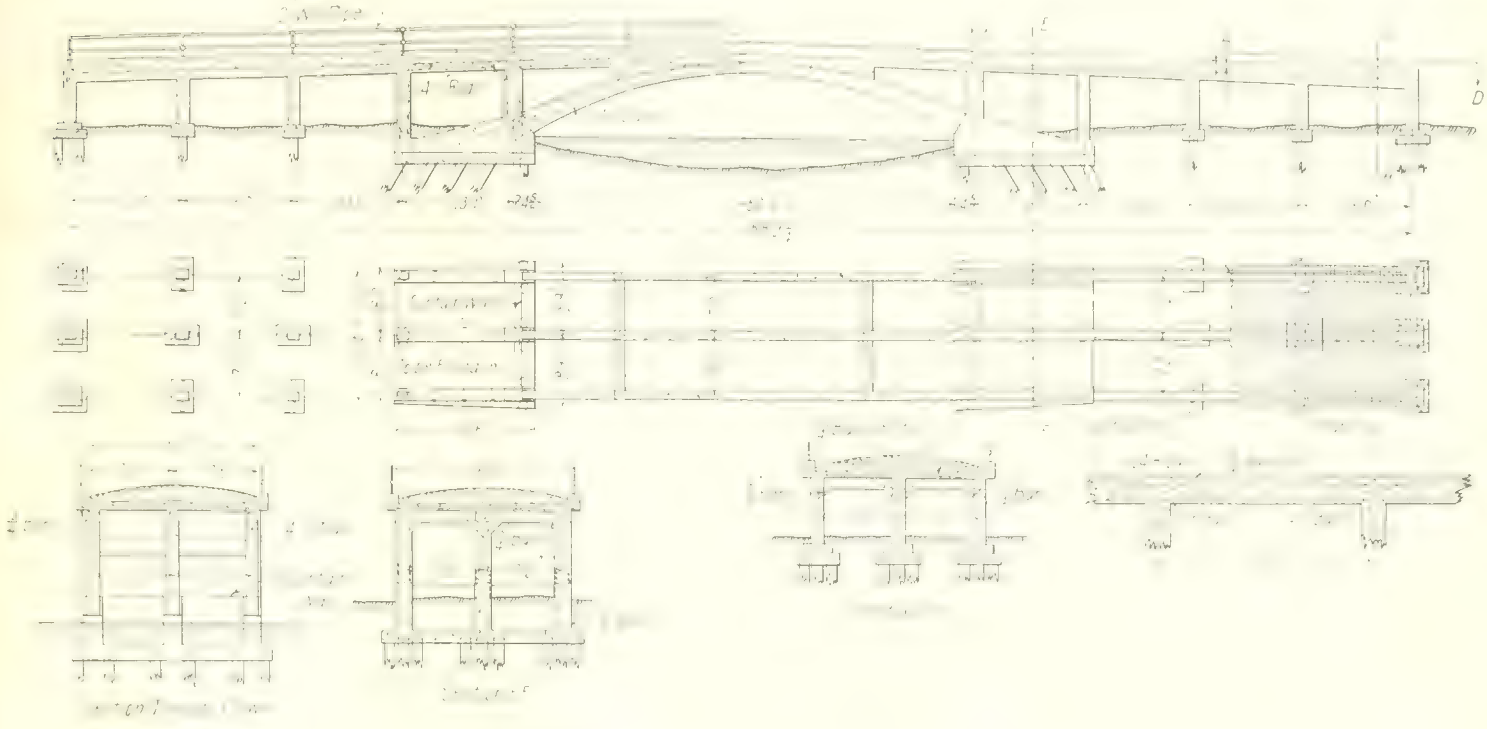

Fig. 10—Details of Chickahominy Arch Bridge, Richmond, Va.

Tests of Suspended Centering.

Prior to actual construction of arches in concrete, the method of arch rib construction by casting the voussoirs in place upon suspended flexible centering was demonstrated by constructing a number of plaster paris arches, all of varying curvature, and with span lengths ranging from 2 to 5 ft. For these arches only one apparatus, as shown in Fig. 5, was used, the various radii and span lengths being obtained as described. In this model the towers are of wood, and the cables of ordinary picture cord. The suspenders from the cables were cut from the threaded ends of wire bicycle spokes. The cables and suspenders were provided with miniature turnbuckles for adjustment of curvature. The suspended flexible centering was made of white pine. The abutments shown were cast first (in plaster of paris) and then the arch rib segments cast in forms or molds placed on the suspended centering. The key spaces were left open. After the plaster had hardened sufficiently in the rib segments and the suspenders were adjusted by their turnbuckles for true curvature the key spaces were filled. When the plaster keys had hardened, the suspended centering was struck instantaneously throughout the length and breadth of the arch intrados, by slacking off the little turnbuckles on both cables.

It may be interesting to mention in passing that several experimental arch ribs of wet sand were molded in these model suspended forms. These sand ribs were uninjured and self-supporting when the suspended centering was "struck," and the curvature perfect. Two of these sand ribs were made of clean, wet sand, with a small percentage of clay, while one other rib was composed of wet sand alone. The same experiment was tried upon sand ribs, also, sand-clay ribs (of same span and dimensions) using a model of *ordinary falsework*. Although great care was used in striking the model falsework, in no case was this accomplished without injury to or failure of the sand ribs.

After the success of these experiments, a two-rib concrete arch was designed and built. This had a span length of 10 ft. and 2 ft. rise, composed of two parallel ribs 12 ins [illegible] The section of each rib was uniform throughout and was 3 ins. in width and 4 ins. deep. The two abutments were built first. Two ⅜-in. cables were suspended over the location of the proposed span and anchored to the tops of a back-yard fence, after bracing same. The suspenders were made of small copper wire tied to the wooden cross-bars and cables at proper intervals. The volume of concrete in these ribs was so small that each rib was completed prior to the initial set of the concrete. It was therefore possible to adjust the suspenders for curvature while the concrete was in the wet state, [illegible] key spaces were necessary and none provided, except those adjacent to each abutment, Fig. 6.

The adjustments being made, the ribs were allowed to set up, after which the key spaces at the abutments were filled with concrete, Fig 7. The arch having reached the self-supporting stage, the centering was struck, merely by slackening the cables. These ribs supported ten men (all that could get upon them) within a week after completion.

It was now desired to make further tests upon a still larger scale. With this in view, the designs for an arch rib having a clear span of 53 ft. and a rise of 7 ft. were prepared, and the weights of arch, cable sag, etc., determined. It was found that steel cables 1 in. in diameter and suspender rods ⅝ in. in diameter would support the 53 ft. concrete rib and centering with a proper safety factor. This arch was built at Portsmouth, Va., Fig 8.

The rib was divided into six sections, which required six pairs of suspenders and cross bars for their support. The abutments and towers were first built and the cables placed in position and anchored to "dead men" buried 4 ft.

Fig. 11—View of Approach and Cable Supports, Chickahominy Arch Bridge.

in the ground. The longitudinal members of the centering were made of 2x10in. plank, resting loosely upon the cross bars with their ends overlapping. To prevent slipping longitudinally a [illegible] iron rod passed through the overlapping ends of the longitudinal members. No turnbuckles were used on the suspender rods in this case, but their lower ends were threaded 6 ins., so that the proper adjustments for curvature could be made by nuts under the cross bars. Cast iron plumb bobs were hung from each of the cross bars, with copper wires of computed ordinate lengths. The top halves of the plumb bobs were painted white, and the bottom black, to facilitate sighting when making adjustments, and thus affording definite lower terminii for the computed ordinates.

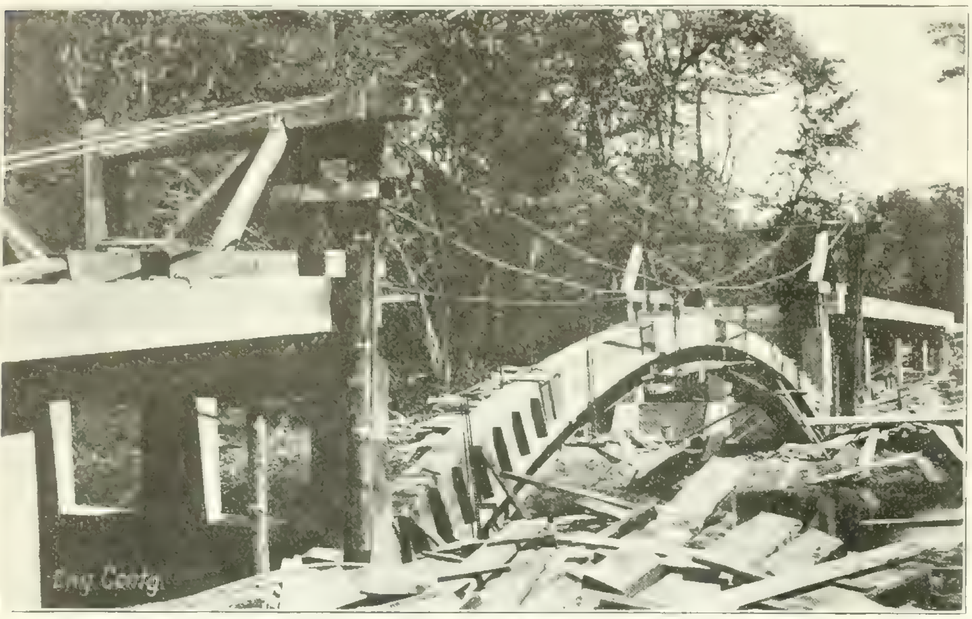

Fig. 12—View of Center and Key Forms, Chickahominy Arch Bridge.

When all concrete was deposited in the rib forms (except in the key spaces) the total deflection of the cables, due to the load, did not exceed by ½ in. their computed deflection, Fig. 9. Adjusting the intrados curvature to the true curvature was effected by adjusting so that the plumb bobs were brought to the same elevation. It was found only necessary to tighten up the nuts under the two central cross bars ½ in. and to slack off the nuts under the extreme end bars ⅜ in. Twelve hours after depositing the concrete in the key spaces, the suspended centering was dropped, or "struck," simply by slackening off both cables. This "striking" of the suspended center was effected instantaneously by a boy standing between the main cable turnbuckles near the anchorage, holding in each hand a stick, which passed through the turnbuckles and acted as a lever in turning them.

One of the greatest risks connected with the use of rigid falseworks is found in the operation of "striking the centers." Judging from experience, the striking of suspended centering is accomplished with such ease and uniformity that the usual dangers arising from shock and jar to the completed arch appear to be eliminated. This, and the further fact that all the concrete in the arch rib is set up at the time of filling the key spaces, made possible the striking of the suspended centering of the 53 ft. Portsmouth arch after 12 hours, and the Chickahominy river, 48 hours, after keying.

The Chickahominy River Bridge.

In 1909 the state highway commission of Virginia, in behalf of the commissioners of the counties of Henrico and Hanover, advertised for proposals for the construction of a highway bridge across the Chickahominy river on the Cold Harbor—Fair Oaks public road. This historic stream at this point constitutes the boundary line between the two counties. The old structure consisted of an ordinary trestle, in bad condition, and not in keeping with present requirements and traffic.

Alternative designs of both steel and concrete were furnished by the commission. The steel design contemplated an I-beam superstructure (with wooden floor) supported by concrete piers and abutments upon pile foundations. The alternative design contemplated a similar sub-structure with reinforced concrete girder superstructure. Bidders were also permitted to submit their own designs, if desired. The lowest bid submitted (for either steel or concrete) was that based upon the design, Fig. 10, this design being submitted by the low bidder with his proposal. It was also found that this bidder, if successful in the award, contemplated the use of suspended flexible centering in the erection of the arch ribs, thus employing no falsework whatever. This design and bid (being the lowest) were both accepted and the contract awarded accordingly.

The design of the Chickahominy bridge, as built, provides for a reinforced concrete structure, composed of a three-rib arch, having a clear span over the channel of 50 ft., the approaches being of beam and slab construction in panels of 13 ft. c. to c. of columns. The length of structure over all is 160 ft. and the clear width of roadway 16 ft. The three arch ribs are similar, each having a depth of 16 ins. at the crown and 32 ins. at the spring lines. The width of the ribs transversely is 14 ins. The weight of each rib (including suspended centering) to be supported by the cables was nearly 10 tons.

As the bed of the river was of sand and gravel, it was necessary to use batter piles in the arch abutment foundations. The concrete foundation slabs are 1 ft. 4 ins. thick (embedding the heads of the batter and plumb piles) and are slightly tapered with dimensions shown.

The arch ribs spring from skewbacks upon buttresses opposite each. These buttresses are connected by reinforced curtain walls or diaphragms 8 ins. thick located near the skewbacks, and thus act not only as horizontal ties, but also retain the filling deposited in the space between the buttresses. The new structure was located up stream and parallel to the old structure, and about 25 ft. away. The general specifications for concrete bridges of 1908 by Mr. Wilbur J. Watson were used in the design (Class "I" loading). The details, proportions of concrete, etc., are shown by Fig. 10.

Cables, Cable Supports, Anchorage, Etc.—The cables and centering used in the Portsmouth arch were ample for this service, but it was desired to obtain cables and suspenders of sufficient capacity for future use upon span lengths up to about 80 ft. For such service 1⅛ in. diameter galvanized steel cables and ⅞-in. diameter suspenders were obtained, provided with turnbuckles.

Both approaches were completed prior to the constructing of the arch ribs, in order that the cable supports might be mounted upon them, thus affording foundations for them and reducing their height. This arrangement reduced the height of the supports to only 4 ft. 6 ins., Fig. 11.

The cables were anchored to "dead men" located behind the concrete columns at the ends of the approaches. Slots, or openings, were provided in the roadway floor slab of the approaches in order that the inside cables might pass through same to their anchorages. The connection between cables and anchorage was made above ground, so that in shifting the cables from one rib to another, it was not necessary to make any excavation to the underground anchorage. The cable supports were constructed of round timber, cut at the site, and timber taken from the old structure. No saddles were used under the cables on the supports at either Portsmouth or Chickahominy river. The cables simply rested in notches (lubricated) cut in the supports. Saddles are, of course, necessary in longer spans.

Flexible Centering.—The Chickahominy river flexible centering was even simpler than that used at Portsmouth. The cross bars were 3-in. gas pipe, 4 ft. long. The ends of the 2x12-in. wooden longitudinals overlapped on the cross-bars and were notched to receive the bars—thus forming the pivots, or points of flexure. The lagging and concrete forms were nailed on the top edges of the longitudinal members.

Adjustment for Elevation and Curvature.—After the cables were loaded by the concrete (wet) rib sections, only 1-in. vertical adjustment for curvature was necessary, as determined by the plumb bobs. The key spaces were then filled, Fig. 12.

The maintenance of proper elevation, curvature, etc., were subject to such complete control that the intrados curvature upon completion was perfect in every rib. As stated, the cables and suspenders used were capable

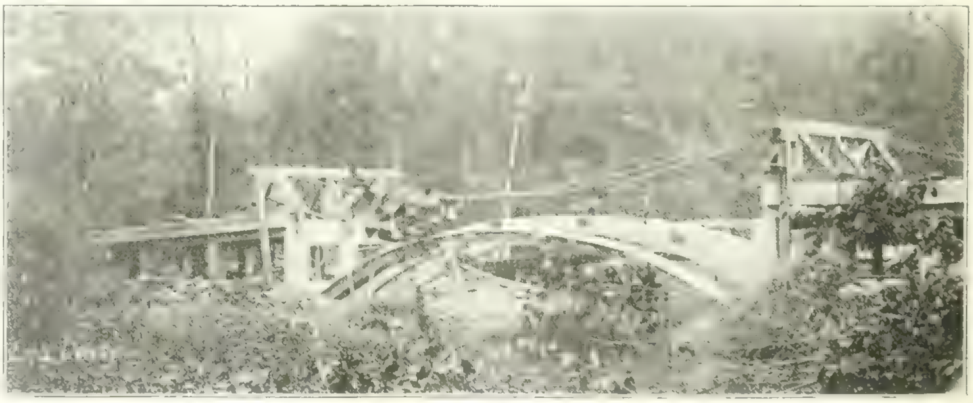

Fig. 13—General View of Chickahominy Arch Bridge Under Construction.

of constructing spans of 80 ft and under. Simply by substituting differently curved fillers, or furring members, upon the longitudinals and adding or decreasing panels of flexible centering, the plant is ready for use in constructing spans of any radius and length within the capacity of cables and suspenders used.

In order to assure perfect control at all times—in case of freshets—the main cable turnbuckles were located above the floor slab of the approaches. This location also afforded a full view of the entire ribs, intrados, suspenders, etc., to the operator at the main cable turnbuckle levers when making adjustments or "striking centers."

As soon as possible after completing a rib, the forms were stripped off in order to shorten the setting time of the concrete rib, sections and keys. Forty-eight hours after the completion of the first rib, the flexible centering was struck and transferred to the second rib—adjacent—as described, and from thence to the third rib, Fig. 13.

After completion of the ribs and removal of cables, the spandrils, beams and floor slabs were built, and the structure completed. The spandrils were anchored to the arch ribs by ¾-in. radial bars, as shown.

Prior to acceptance the commissioners required the specified test to be made under the supervision of their engineers. The specified test load was a 12-ton road roller, which was operated at various speeds back and forth over the entire roadway area, between curbs.

Although the Chickahominy was a most *favorable* location, with its low banks and slow current, for rigid falsework, and very unfavorable for flexible centering, yet a comparison of the actual bids received demonstrated the fact that even here concrete structures built by rigid falsework methods, or even steel structures, did not compete.

The next lowest bid for a concrete structure (girder type) exceeded the flexible centering bid by $1,500. The lowest bid on an ordinary cheap steel I-beam plank floor structure exceeded by $200 the lump sum bid of *$3,550 submitted by the contractor using flexible centering, this figure covering the structure complete, except macadam roadway and grading.

The work was executed by Mr. Charles McDermott, contractor of Washington, D. C. The structure was designed by the writer and submitted to the highway commission for revision and approval. Mr. Wilbur J. Watson, of Cleveland, Ohio, acted as consulting engineer. Mr. John Scott Banks was superintendent of construction who, with Mr. H. D. Ward, rendered valuable assistance in model making and experimental work.

Previously Molded Arch Rib Sections.

The method of constructing the Chickahominy and Portsmouth arches were confined to the application of cables in combination with a *suspended centering* upon which the arch sections were *cast in place* in the positions in which they were to occupy in the completed structure.

The method of flexible support, however, lends itself to another method of construction, similar to that used in connecting with falsework described. This consists of *previously molding* the concrete rib sections of any desired length, at the bridge site or other point, and *suspending* these concrete sections *directly* from the cables in the positions which they are to occupy in the finished structure. The lower ends of the suspenders being attached directly to the concrete sections by means of projecting metal lugs, eye-bolts or bars, embedded in the sections when casted. Thus the suspended centering is eliminated, resulting in still further economy and time of construction.

The concrete sections are coupled together longitudinally after being suspended in place by metal couplers, Fig. 14. The couplers being adjustable, if desired. These couplers (adjustable) in conjunction with the adjustable suspenders and cables hold this entire articulated rib, or any part of it, under perfect control, and permits of accurate adjustment horizontally, vertically and longitudinally at all times. Steel bars, I-beams, girders or other reinforcing material may be embedded in the concrete when molded. The previously molded concrete sections being suspended and adjusted, it only remains to rigidly connect the sections and their reinforcement together, in order to reach the self-supporting stage, or completed arch. There are a number of methods for effecting this, the choice in any particular case depending upon the character of reinforcing material used, dimensions of rib sections, span length, etc. In Fig. 14 are shown several methods for light sections. Key spaces are provided, into which the reinforcing bars from the adjacent sections project. After accurate adjustment of the articulated rib for curvature and elevation, the reinforcing material (bars, beams, girders, etc.) are rigidly connected by turnbuckles, lap joints or rivetted—splices, as the character of the reinforcement may require. The splices or connections are embedded in concrete when the open key spaces are filled—thus completing the arch.

The size of the key spaces depends upon the character of reinforcement, method of connecting same and also upon length of span, dimensions of rib sections, etc. In spans requiring heavy ribs, the dimensions of the key spaces and volume of concrete necessary to fill them would become large in proportion. In order, therefore, that the accuracy of the curvature elevations, etc., may be maintained and stress in connections avoided, the addition of any great volume or weight of concrete capable of causing cable deflections at this stage must be avoided. To meet this requirement in heavy sections, the key spaces are reduced to the width of an *ordinary mortar-joint*, such as used in masonry or brick work. The reinforcement between adjacent rib sections projecting into cavities provided in the previously molded sections.

An ordinary motar joint between the concrete sections is sufficient so far as flexibility is concerned, and but for connections between reinforcing material need never be larger, even when the sections are molded in place upon a suspended flexible centering (provided the rib is of sufficient width or sectional area to allow the cavities or splice chambers).

Any charater of reinforcement may be used, breaking joint on one or both sides of the mortar-joint or point of flexure between the concrete sections.

The arch can be begun at any point desired and the work of suspending and coupling the sections prosecuted from any number of points upon one or more ribs simultaneously from the banks of the stream and from barges, as shown.

The details of erection, plant, etc., by flexible support of a number of arch ribs for spans of 100, 145 and 200 ft. have been worked out, the results showing marked economy and time saving in every case over rigid falsework. The following figures demonstrate the simplicity, economy and light weight of that portion of the erection plant requiring shipment to and from the site, viz: (a) Two cables 2½ ins. in diameter will swing two concrete arch ribs *simultaneously* over a stream requiring a 145 ft. span length. (b). Two cables 1¾ ins. in diameter will swing one concrete arch rib of 145 ft. span.

The erection of a solid barrel arch over a railway yard by the flexible support method has been investigated. This structure was 80 ft. in width, with a clear span of 170 ft., designed for electric and highway traffic. It was found that by constructing the barrel in longitudinal sections of 5 ft. each in width, that the method was more economical and rapid than was possible with falsework, although the conditions were unusually favorable for falsework construction and maintenance.

A 5 ft. longitudinal section of a solid barreled arch, of 170 ft. span, of the design investigated, would require two cables of 2¾ ins. diameter each, with galvanized steel yacht rigging suspenders.

The erection plant, in addition to the advantages resulting from repeated use and adaptability to spans of varying length, curvature or rise (within the capacity of the plant) consists of standard commercial materials, obtainable upon short notice, of comparatively light weight—all occupying little space, thus affording rapid and economical transportation, even to isolated localities, without railway facilities.

As to towers or cable supports, when necessary they may be of the cheapest character. Generally a portion of the permanent structure itself can be utilized for cable supports. In important bridges, the entrance towers, portals, pylons may be used, and there are few cases where it would be necessary to provide special cabled supports—abutments, piers, approach foundations being nearly always available, even in designs contemplating rigid falsework construction.

As stated, for spans of 150 ft. and under, ordinary "dead men" give all the anchorage necessary. At Portsmouth and Chickahominy river dead men were used. These were nothing more than logs 12 to 14 ins. in diameter, buried in the ground, and the main cables passed around them, there being no iron work whatever connected with the anchorage.

With arches of such length and weight that the ordinary methods above cannot be relied upon for safe anchorage and the foundations of approach spans are not available, special anchorage will then be necessary. Such anchorages can be built of concrete, rubble concrete or of rubble masonry of the most available stone. The anchorages being for temporary service and located underground usually natural cement or Portland, with a large proportion of sand, may be used in their construction for ordinary structures.

In practical use, in order to secure economy and prevent handling plants of greater weight and capacity than the work in hand requires, the plans may be standardized, according to length of spans and weight to be supported.

The above methods of constructing arches (including applications to structural steel erection) by means of suspending concrete forms, or previously molded arch sections suspended chiefly from cables, also the method of supporting previously molded arch sections upon falsework, as mentioned and connecting same by concrete keys, pivots or hinges, were devised and patented by the writer.

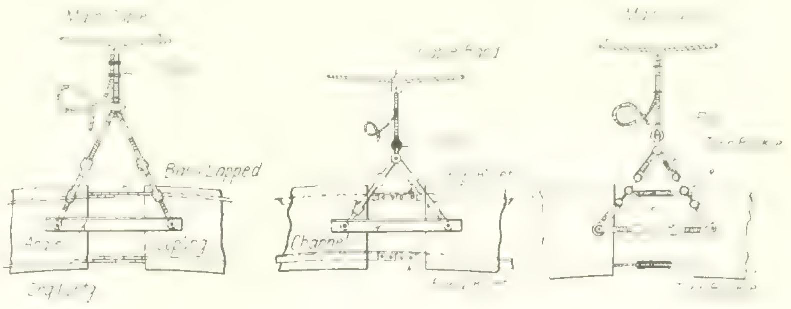

Fig. 14—Sketches Showing Method of Supporting Cast Arch Sections Without Centering.

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*$1.48 per sq. ft. of roadway between curbs or $1.39 between railings.

EARTH AND ROCK SECTION

Methods and Costs of Earth and Rock Excavation in Prospecting a Mining Property.*

On the road to Cripple Creek, Colo., is a [illegible] dike striking N. 40° [illegible] dipping [illegible] N. [illegible] W. direction. In the work of prospecting this, trenches and cross cuts were made, and later a 5x7-ft. shaft was sunk. The work was done by hand, and the following data were obtained:

Trench A. Fig. 1, 60 ft. long, was excavated 6 ft. wide by 7 ft. deep without any indication of bed rock. This work was done by 6 men with picks and shovels in 3.2 days, and the following data were obtained:

$$\frac{60 \times 7 \times 6 \text{ ft.}}{27 \text{ ft.}} = 93.4$$ cu. yds., material handled; or $\frac{93.4}{3.2 \times 6 \times 8} = .6$ cu. yd. per man per hour or 4.8 cu. yds. per man in 8 hours. As men cannot throw dirt with a shovel to advantage more than from 4 to 6 ft. from the trench, a staging was put in, the trench narrowed to 3 ft., and 3 additional men hired to rehandle the dirt. The capacity of the 9 men shoveling with two throws was equal to 6 men shoveling with one throw, but the cost was increased 50 per cent for labor. The second stage was excavated in $\frac{60 \times 3 \times 3 \text{ ft.}}{27 \times 1.8 \times 6}$ = 1.85 days.

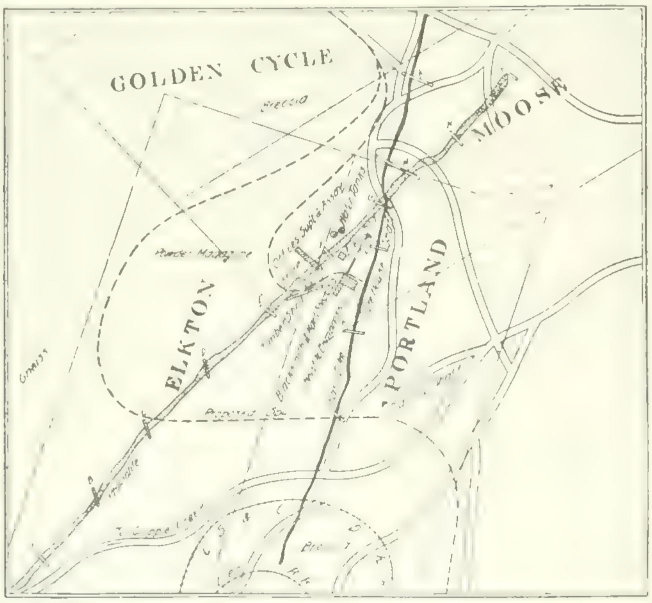
The cost of excavating 146.7 cu. yds. of earth from the trench was as follows:

Six men, [illegible]	[illegible]
Nine [illegible]	[illegible]
Six [illegible]	[illegible]
Two [illegible]	[illegible]
Six [illegible] drift picks	[illegible]
Six [illegible] drift pick handles	[illegible]
172 [illegible]	[illegible]
	$134.75

[illegible] yd. [illegible]

The results obtained from this trench decided the feasibility of prospecting by a series of cross-cut drifts spaced 250 ft. apart. The approaches were dug in the soil on the side hill until a face 10 ft. square was obtained. The sides of this cut were given a 1 to 1 slope to prevent their falling in, and a drift set was erected at the face to prevent the portal caving. Three drifts were started with 9 men, three at each drift, who completed the approaches in 2 days, from which it was ascertained that 2 men with pick and shovel and 1 man wheeling could do about as much work as 2 men in a trench. When tunneling in soft earth a man can pick, shovel, wheel and waste, when the run is not long, say 25 ft., about ¾ as much as he can shovel and pitch from a trench, or $\frac{4.8 \times 3}{4} = 3.6$ cu. yds.

When a rock face was reached, 2 men at each drift were put at work with single hammer and drills, while the third man of the party was occupied in mucking, carrying steel from the forge, etc. A blacksmith was hired at $4.50 a day, who also superintended the work and did the panning and sampling as the work progressed. Each tunnel was driven through the dike and through the ore in drifts *B* and *C*, and side drifts were driven 10 ft. in the direction of the strike up the slope. There was 85 ft. of drifting done in the prospect drifts *B*, *C* and *D*.



Map Showing Location of Ore Prospecting Trenches and Shaft.

In drifting, 11 holes were drilled in each face 2½ ft. deep, making an advance of 2 ft. for each round. Each man was able to drill 1 ft. an hour, and with six drilling, two in each tunnel, each 2-ft. advance took 11 holes, 2½ ft. deep, or 27½ ft. Two men in each tunnel drilled 16 ft. a day, making a new round every day and a half by working from 7 a. m. to 1 p. m. in the morning shift, so that shots could be fired at the noon hour. Each shot broke down 2.6 cu. yds., which was readily mucked and wheeled by the laborers.

The following data were obtained from this work: $\frac{85}{2} \times 43$ rounds of shots that demanded 27.5 ft. of drill hole for each round. Since 6 men drilled 48 ft. per day the advance required $\frac{27.5 \times 43}{48}$ = approximately 25 days. In all there were 473 holes drilled, and each was charged with 2½ sticks of ⅞×8 in. dynamite weighing 0.25 lb. each or 0.625 lb. per charge. The total quantity of explosives used was $\frac{473 \times .625}{50}$=6 fifty-pound boxes.

The diameter at the mouth of a 6-ft. hole need not be more than ¾ in. greater than at bottom, with ⅛-in. reduction in 2 ft. possible in very hard rock. The least admissible diameter of hole at bottom for dynamite is ¾ in. The steel used was ⅞ in. octagonal with 1¼-in. starting bits decreasing to 1-in. bits to finish. The drills were dulled every 2 ft. of drilling with usually two starters required for the 2 ft.

The following lengths comprised a set of steel: 3 ft., 2½ ft., 2 ft., 1½ ft., and 10 ins.; and each man in drilling 8 ft. a day put in a little over 3 holes, using a set of steel in the operation. This made, for the six men working, six sets of 5 or 6 pieces each or from 30 to 36 pieces of steel to be sharpened a day.

COST OF DRIVING THE CROSS-CUTS

One foreman 25 days at $4.50	$112.50
Nine laborers 3 days at $3	81.00
Three laborers 25 days at $3	225.00
Six miners 25 days at $3.50	525.00
Three wheelbarrows at $13.50	40.50
Six 4½-lb. striking hammers	10.80
Six 12-in. hammer handles	.60
344 lbs., 132 ft. ⅞-in. steel	20.58
300 lbs. dynamite at $0.101 per lb	30.46
1.5 tons charcoal at $20.75	31.12
171 ft. lumber for portals	3.42
One portable forge	42.00
One 90-lb. anvil, steel faced	9.00
One set blacksmith tools	9.00
600 candles at $0.0145 each	8.70
172 assays, four for each round	57.00
473 fulminate caps, 85 cts. per 100	4.02
1,419 ft. double tape fuse at 65 cts. per 100 ft.	9.22
Total	$1,219.72

To excavate the five trenches required the labor of 5 men 20 days, and cost $630. On the basic dike, trenches *J, K, L, M, N, O, P* were cut, in all a length of 700 ft., that took 47 days' time of 10 men and cost $1,495.

Shaft Sinking.—The sinking was done by hand with the aid of a windlass and bucket, from which operation the following data were obtained.

Shafts 5 ft.×7 ft. required 12 holes per round, average 2½ ft. deep, drilled in 12.5 hours; 3½ hours in two shifts were consumed in loading, firing, and cleaning up broken material.

On the first day two men drilled 30 ft. of holes, which were loaded and fired. On the second day, two men loaded and hoisted for 3 hours, and were followed by two miners who drilled 25 ft. of holes, which were loaded and fired. An average daily advance of 1 ft. 7 ins. was made in this way, and at every 6-ft. advance a set of timbers was placed. It took 38 days to sink a shaft 60 ft. in this way, and the cost which was $17.12 per foot was made up of the following items:

	Total cost.	Cost per ft.	
Powder, caps and fuse	$170.84	[illegible]	
Labor (miners and muckers)	1,824.00	10.12	
Labor (blacksmith and bosses)	323.00	1.79	
Labor (timberman)	171.00	.95	$2.39
Timber	[illegible]	1.44	
Steel (depreciation)	9.36	.05	
Candles	[illegible]	.15	
Coal	98.60	[illegible]	
Windlass, rope and buckets	[illegible]	[illegible]	
Shovels and picks	71.50	[illegible]	
Total	$3,083.22	$17.12	
Eliminating windlass, rope buckets, [illegible] picks		1.12	
		$16.00	

Extra men were hired to drive the main drifts in 500 ft. and make 7 cross-cuts averaging 15 ft. In *B* two drifts were carried 700 ft., and 9 cross-cuts, averaging 15 ft., were excavated. In *C* 4 drifts totaling 800 ft., and 8 cross-cuts, 25 ft. each, furnished an advance of 1,000 ft. In all, 2,240 ft. of drifting was accomplished. The estimation of 2,440 ft. of track (using 12-lb. rails at $47 per ton with fish-plates) is based on the cost per mile as follows: 364 pairs of splice bars; number of bolts, 1,456; weight of splice bars, .56 gross ton; weight of bolts, .15 gross ton; weight of spikes, .77 gross ton. Total weight of fastenings, 1.48 gross tons.

Weight of rails, 18.86 gross tons. Total weight [illegible] rails and fastenings, $\frac{2034}{2,240}$ gross tons per mile, the [illegible] gross tons, at $47=$441.80.

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*[illegible] of Poverty Gulch Claims by Chas. W. Hender- [illegible]

The 814 ties, spaced 3-ft. centers, were 2 in. ×4 in.×2½ ft., and cost $27.14.

In order to hasten the handling of broken rock and ore, and before drifting was commenced on the levels, three small electric hoists were purchased. This was necessary because the limit of a windlass is about 60 ft. for economical work. The heaviest load to be hoisted at one time was estimated at 850 pounds, and hoisters were ordered capable of raising 1,000 pounds 200 ft. in one minute, and motors having 8 h.p. were selected. The drums on the hoisters being 18 ins. diameter, a ½-in. steel wire rope was ordered with them.

It was found that 1 cu. yd. of the Cripple Creek ore when broken occupied 1.73 cu. yds., also that while 12.4 cu. ft. of solid ore weighed a ton, it took 21.5 cu. ft. of loose ore to weigh a ton. The breccia is not as free drilling as granite, and sludge is made rapidly in drilling, however, the rock breaks better than granite.

Notes on Channeling Costs in New York City.

The construction of the depressed railway yards for the New York Central R. R. in New York City involved the excavation of Depew Place for its full width for a distance of about 500 ft. Below the natural soil and fill, which extended from 15 to 25 ft. in depth, lay the ordinary gneiss rock, sloping downward to the west at an angle of about 30 degrees, and in some places nearly level. The surface was uneven and the stratification broken and irregular. The average depth of rock excavated was about 15 ft. and the total amount about 18,000 cu. yds. On account of the proximity of buildings on both sides of the cut, says *Mine and Quarry*, the contractors found it impossible to blast without first freeing the rock at the sides. This left them the option of making these wall cuts by drilling and broaching or by channeling. After figuring over the costs and estimating the rapidity of the two methods Sullivan channellers with 8-in. cylinders were adopted. They were operated by compressed air and fitted with air retracters. The steel used was the solid Z-shaped type. The cuts were made in two, and in some places three lifts, varying from 6 to 9 ft. in depth. These channelers cut as high as 10 ft. per hour in the irregular formation and averaged 40 sq. ft. per hour. The machines operated under a timber platform which temporarily carried the street traffic. In figuring the comparative costs of the two methods of cutting rock walls in work of this sort the following estimate was used. The drilling cost per shift was as follows:

Runner	$ 3.00
Helper	2.00
Power	3.00
Superintendent, [illegible] and supplies	2.00
Total [illegible]	$10.00

The cost of drilling and broaching was estimated as follows: Assuming that 60 ft. of holes can be put down per 8 hour shift, six 10-ft. holes can be drilled, and allowing a 1-in. rib between 3-in. diameter holes 20 sq. ft. will be drilled per 8 hour shift. Furthermore, it would take at least one-half as long to broach as to drill, so that the total cost of drilling and broaching 20 sq. ft. would be as follows:

Drilling cost per [illegible]	$10.00
Broaching cost [illegible]	[illegible] 00
Total for 20 sq. ft.	$1[illegible].00
Cost per sq. ft.	$ 0.75

The cost for running the channelers for 8 hours was about $16 including drill runner, helper, superintendence, blacksmith, and power. Therefore averaging 40 sq. ft. per 8 hour shift, the cost per foot was $0.40, a saving of $0.35 per foot or 46⅔ per cent over the method of drilling and broaching.

The contractors were the Butler Bros.-Hoff Co. of New York, N. Y.

Method of Framing Bracing Timbers Before Pumping Out a Cofferdam.

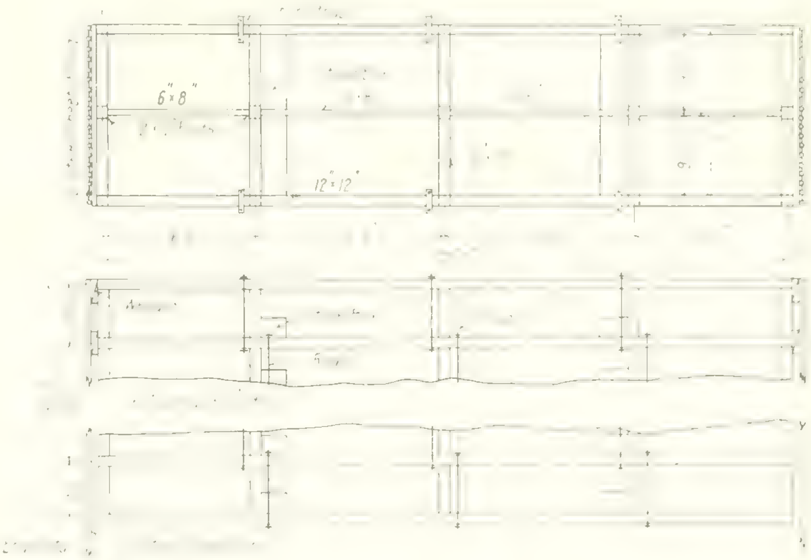
At the north end of the La Salle Tunnel tubes, which lie under the Chicago river, there is a space of 18 or 20 ft. between the end of the tubes and the bank of the river in which a section of tunnel is to be built to join the river tunnel with the land tunnel. Steel sheet piling has been driven enclosing the area which, when completely excavated and ready for construction, will be about 50 ft. deep below the river level.

A unique scheme for erecting the bracing was devised by which all the bracing could be placed before starting to pump out the cofferdam. The scheme was carried out as follows: The first tier of 12x12-in. timbers was framed and floated in the area as shown in plan, Fig. 1. Cables were fastened to this tier and tied to the steel sheeting to prevent the timbers from sinking under the load which was to be placed upon them. Then 12x12-in. posts about 4 ft. long were erected upon the floating frame and stone boxes were also placed on the frame and filled with enough stone to sink the timbers which were to be placed. Upon the posts erected a second tire of bracing timbers was laid. This tier was framed together the same as the one below and the two tiers were tied together by bolts as shown in the drawing. Then, the cables suspending the framework were loosened, allowing the framework to lower until the top tier was just out of water. Another set of posts was erected and a third tier of bracing was placed on them and sunk in the same way. This process was repeated six times or until [illegible] This brings the bottom of the frame work, therefore, to the top of the tunnel section to be constructed.

For bringing the bracing into contact with the steel sheeting, a diver was sent down to place wedges in the space between the ends of the tiers of bracing and the steel sheeting. The pumping will now be started and, as the water goes down and exposes the timbers, more wedges will be placed, giving a continuous bearing against the steel sheeting.

This method of erecting the bracing is not merely a good method for erecting the sheeting but is a cheaper and more convenient method for handling the timbers than the usual way. The scheme was worked up by Mr. Max Landguth who is Superintendent of the work for the contractors, the M. H. McGovern Co., of Chicago.

The Pennsylvania Railroad has, in the past 8 years planted more than 4 million trees, which are now being cultivated for railroad uses, particularly for ties.



Bracing Timbers for a Cofferdam.

Notes on Pile Driving Costs.*

[illegible] was sheeted with 2×10 in.×14 ft. hemlock and yellow pine sheeting, to carry a steam shovel over the trench. Triple lap sheeting was made by nailing 1×6 in.×12 ft. hemlock sides to give a 2 in. groove. The cost of making the sheeting ready for driving was 8.8 hours of labor at $2.63 per 1,000 ft. B. M. with labor at $0.31 per hour. The work was nailing on the side pieces, pointing the driving end, and cutting the hammer end to 8 in. in width to permit the use of a steel driving cap. The total labor cost, including the making of the sheeting in place, with labor at $0.30 per hour, was:

	Per M. ft. B.M.	Per lin. ft. of trench	Per sq. ft. of penetration trench side of sheeting.
Hours of labor	21.9	1.4	0.12
Cost of labor...	[illegible]	$0.422	[illegible]

A pile driver having two sets of leads complete was built for this work at a cost of about $600 for labor and material, excluding the double-drum hoisting engine. The leads and sheaves for the hammer line were fastened on the deck timbers so that when the width of the trench was reduced at a change in the size of the sewer, the leads were moved in towards the center line of the machine. This change took 1½ hours to make.

The sheet piling was pulled by a machine consisting merely of a platform to carry a hoisting engine and an A-frame carrying two sheaves. Over these sheaves two lines ran from the engine, on the free end of which was a few feet of ½-in. chain and a hook [illegible].

This machine would be manned by a pick-up crew of engineman, fireman, and four laborers, who would pull, in 1½ hours to 2 hours' work, all of the sheeting corresponding to a day's progress of the work, which would be from 130 to 160 ft. The average rate of wages per hour was $0.30. The average of work was:

	[illegible] ft. B M.	[illegible] of trench.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

One disadvantage of such sheeting was that the 1-in. side pieces had a short life, requiring renewing after about four times of use. The loss of the center pieces from hard driving and even though used nine times was very little. The pulling chain was rather severe upon the sheeting, as it was liable to cut into the wood. At the close of the work the sides were stripped off and half of the 2×10-in. pieces were sawed up for catch-basin bottom, which otherwise would have required the purchase of new lumber. The total

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*[illegible] presented before the Western Society of Engi-

TABLE I.—FOUNDATION PILES, CHICAGO DROP FORGE & FDY. CO. NASH DOWDLE CO., CONTRACTOR.

	Hours.	Cost.	Cost per lin. ft.	Material.
[illegible] cost shifting driver	386.5	$160.53	$0.088	
Loading and sawing piles in two	39	15.96	0.016	
Driving piles	236	99.32	0.011	96 piles.
Sawing pile tops to grade	48	19.88	0.054	20 ft. long. Crew 10 men.
Total	711.5	$295.69	$0.169	
Expense of supplies and piles, cost		279.02	0.152	
Total cost		$574.71	$0.321	

Soil, hard clay, hammer used, 3,000-lb. drop hammer.

waste of sheeting was about one fourth and the remainder was shipped to another job.

Hand driven sheeting of 2 ins. × 10-12 ft. long is best driven in sand by a combination of hand mauling and the use of the water jet. Employing labor at $0.314 per man per hour, the expense of this work for 1,102 ft. of trench was

	Per M ft. B. M.	Per lin. ft. of trench	Per sq. ft. penetration.
Hours of labor...	11.9	0.973	0.042
Cost of labor.....	$3.70	$0.305	$0.013

Foundation Pile Driving.—This statement is the record of a large piece of work carried on by the contractor with great vigor. At times as many as 9 pile drivers were at work simultaneously.

In foundation pile driving, where piles are driven in clusters, the general level of the ground will be higher after driving than it was before. This swell or rise of the level will cause an extra amount of excavation for the placing of the footing concrete around the pile tops.

Careful levels were taken over an area in which 1,570 piles were driven 2½ ft. centers. The piles were 35 ft. long, having 12-in. tops and 7-in. points. The swell of the ground amounted to 1.5 ft. in height, or 8.3 cu. ft. net measurement of the earth per pile, or 0.28 cu. ft. of pile penetration. Inasmuch as the volume of the piles below the original surface averaged 14.1 cu. ft., the consolidation of the earth amounted to 5.8 cu. ft. per pile. The soil consisted for about 10 ft. of a mixture of loose sand, gravel, and clay. Below this was a moderately soft blue clay.

At the job for the hammer shop, a drop hammer, weighing 3,000 lbs., was used. In fact, the same driver and crew foreman did this work as the drop-hammer driving, for which costs are given in Table II. But the soil was clay, whereas the first 10 to 12 ft. was sand, in the other case mentioned in Table II.

From points of view of speed, economy, and excellence of driving, the comparison between drop and steam hammers is strongly in favor of steam hammers.

In addition, a proportional share of local general office and yard expense and the general office expense, should be added.

In sawing off pile-butts two saw filers kept the saws sharp for the gang of sawyers. A pair of sawyers would cut 40 to 60 mixed wood piles per day at a cost per pile of $0.10 to $0.12.

Other men were employed in making runways and unloading piles from cars which were delivered at the edge of the work—a team and 2 men hauling piles to the more inaccessible drivers.

The ordinary pile driver crew was composed of men as follows:

Foreman, $0.58¾ per hr.	$ 4.80
1 engine runner, $0.55 per hr.	4.40
1 fireman, $0.37½ per hr.	3.00
1 winchman, $0.45 per hr.	3.60
1 leadsman, $0.45 per hr.	3.60
3 groundmen or deckhands, $0.40 per hr.	9.60
1 coal passer, $0.25 per hr.	2.00
1 pile hooker and trimmer, $0.37½ per hr.	3.00
Total labor of crew	$34.00
Auxiliaries, 6 men	15.00
Proportion of pumping station labor, supplying water for jetting	2.00
Field superintendence	2.75
Total labor	$53.75

Marine Pile Driving.—The marine pile driving, as given in Table III was all within a protected harbor shielded from the heavy waves of the open lake, so but little time was lost by rough seas. In the delivering of piles from cars to scows, a large part of the labor was done by steam devices, but it is considered as being equal to the expense of six men all of the time the marine driving was going on. The soil was sandy for a few feet and below that it consisted of a moderately soft clay. The piles stood out of the water on an average of 12 ft. per pile, undriven. A tug was occupied about one-third of a day per driver in towing out and back to the yard. A drop hammer of 3,500 lbs. weight was generally used, being attached continuously to the hoisting rope. Each driver had two scows for piles, one on the work and one at the yard being loaded with piles.

TABLE III.—MARINE PILE DRIVING BY GREAT LAKES DREDGE & DOCK CO.

Number of piles driven	9,896
Length of piles driven	326,295 lin. ft.
Length of pile penetration	207,816 lin. ft.
Average of piles	33 lin. ft.
Average of piles driven	21 lin. ft.
Total days' work and driver	137
Piles per day work and driver	72.2
Piles per day work and driver	2,380 lin. ft.
Penetration per day work and driver	1,516 lin. ft.
Crew of driver	10 men
Auxiliaries driver	6 men
Total men per driver	16 men
Total crew time	1,370 days
Total auxiliaries time	822 days
Total	2,192 days
Pay roll per day	
Tug service	$15.00
Crew	34.00
Auxiliaries	19.75
Total	$68.75

TABLE II.—FOUNDATION PILES; GREAT LAKES DREDGE & DOCK CO., CONTRACTOR.

	No. 1 Vulcan Steam Hammer.	3,000-lb. Drop Hammer.
Total number of piles	10,417	519
Total length of piles	373,715 feet.	17,855 feet.
Total length of pile penetration	358,090 feet.	16,817 feet.
Average length per pile	36.0 feet.	34.4 feet.
Average length of piles undriven	1.5 feet.	2.0 feet.
Average day's work for 1 driver	277 days.	30 days.
Average piles driven per day	37.7 piles.	17.3 piles
Average piles driven per day	1,349.2 lin. ft.	595.2 lin. ft.
Average piles penetration per day	1,296.2 lin. ft.	560.6 lin. ft.
Crew per driver	10 men.	9 men.
Auxiliary men per driver per day	8 men.	6 men.
Total crew per driver per day	18 men.	15 men.
Crew time 8 hr. day	2,770 days	270 days.
Auxiliary time 8 hr. day	1,634 days.	180 days.
Total time 8 hr. day	4,786 days.	450 days.
Daily pay roll crew	$34.00	$30.60
Auxiliaries	19.75	15.25
Total	53.75	45.85

Unit Cost.	Lin. ft. of pile.	Lin. ft. penetration.	Lin. ft. of pile.	Lin. ft. penetration.
Labor	$0.04	$0.042	$0.077	$0.082
Saving pile butts	0.003	0.003	0.003	0.003
Total labor	0.043	0.045	0.08	0.085
Supplies and repairs, est.	0.01	0.01	0.015	0.015
Piles	0.125	0.125	0.12	0.12
Total "field" expense	$0.178	$0.180	$0.295	$0.220

Costs.	Lin. ft. of piling.	Lin. ft. of penetration.
Labor	$0.029	$0.0453
Supplies and repairs	*0.015	*0.0235
Piles	*0.125	*0.1962
Total "field" expense	$0.169	$0.265

*Estimate.

Foundation Pits.—Triple lap sheeting was driven for three foundation pits. The upper 15 ft. of ground is sand, below which is a soft clay. Through the sand, driving was assisted by using a water jet. The expense of this work is given in Table IV.

TABLE IV.—FOUNDATION SHEET PILE DRIVING.

Piling driven, pieces	405
Piling driven, lin. ft.	9,291
Piling driven, ft. B. M.	83,622
Moving out and off job, 5 days	$227.50
Driving, 19 days	679.00
Total, 24 days	$906.50

Unit Cost of Labor—
$ 2.24 per pile.
0.098 per lin. ft.
10.84 per M. ft. B. M.

Two No. 1 Vulcan steam hammer drivers were used. Hence the item of moving on and off the work was somewhat high. The average rate of pay per man per 8-hour day was $3.50; including men nailing the sheeting planks together, the average size of crew per machine was from ten to twelve men. Including supplies and repairs, the expense per machine per day was approximately $50.00, whereas the labor as above given amounted to $37.77 per day.

At the same place 717 pieces of 9-in. by 12 in. 28 ft. triple-lap sheeting were driven. This formed a subaqueous front of a concrete-topped wharf. Table No. V gives the cost of this work.

TABLE V.—WHARF SHEET PILING.—TIME OCCUPIED IN THE WORK, 29½ DAYS.

Piling driven—
405 pieces.
14,340ft. driven in ground
180,784ft. B. M. of lumber.

Towing, ⅓ of cost of 30 days at $10.00	$ 300.00
Making sheeting, 75 days at $3.00	225.00
Driving, 285 days at $3.50	997.50
Pulling, 10 days at $3.50	35.00
Total, 370 days	$1,557.50
Labor cost per piece	$2.17
Labor cost per lin. ft. driven	0.109
Labor cost per 1,000 ft. B. M.	8.62

Canal Bridge Project Abandoned.—The board appointed to consider the question of the erection of a permanent bridge over the Panama Canal, and which, in November, 1910, made a preliminary report, favoring the construction of a bridge of the high, fixed type at Empire, has reconsidered the subject, and has submitted another report and recommendation to the effect that the project be abandoned. The action of the board has been approved by the Chairman and Chief Engineer.

Estimating Paint for Steel Work.—To find the amount of paint required for the structural iron in a bridge or building take the average thickness of the plates used and find the weight of a square foot of a plate of that thickness. Divide the total weight of the structure by this and the result will give the total square feet of one side. Multiply by 2 for the total sq. ft. of area to be painted. Various paints have different covering capacities. One gallon of carbon black for the first or shop coat will cover about 800 sq. ft., for a second coat about 15 per cent of covering capacity is gained over the first coat or about 925 sq. ft. per gallon. This may vary about 10 per cent either way, depending upon weather and workmanship.

A gallon of white lead weighs 21 or 22 lbs. Five gallons of oil and 100 lbs. of paste lead make 6½ gallons of paint, weighing 21.3 lbs. per gallon. A gallon of oil weighs 7.7 lbs. Fifteen lbs. of paste lead and 6.3 lbs. of oil make a gallon of paint, also, 14 lbs. of dry lead and 7¼ lbs. of oil make a gallon of paint.

ROADS AND STREETS SECTION

Methods and Apparatus for the Examination of Coal Tar Used in Road Work.

In the recently issued "General Directions and Specifications Relating to the Tar Treatment of Roads" of the Road Board of Great Britain the following clause appears:

> Surveyors are recommended to have samples of the tar supplied to them under contracts properly tested by a qualified analytical chemist for: (1) specific gravity, (2) freedom from water, (3) fractionalism, and (4) free carbon.

This clause has caused considerable discussion among English road engineers, many of them claiming that the above tests are a comparatively simple matter, and do not require the employment of an analytical chemist. In support of this contention Mr. John Hutchinson, 20 Tothill St., Westminster, London, S. W., England, has issued a pamphlet describing the methods and apparatus for making the distillation test of specific gravity determination, estimation of free carbon and evaporation test, in the examination of coal tar. The text of Mr. Hutchinson's pamphlet follows:

DISTILLATION TEST.

This important test for tars used in road work, now rendered indispensable by the Road Board specifications, can be carried out with a simple and inexpensive apparatus. Any road engineer, by observing the conditions and following the plain instructions given below, may obtain results sufficiently accurate for his purpose.

The apparatus consists of the following:

An ordinary [illegible] retort, or a Wurtz flask*;
Retort stand fitted with rings and clamp;
Thermometer (Centigrade), nitrogen-filled, graduated to [illegible].
Test tubes (with feet), or small conical flasks, in which to collect the fractions of the distillate;
Bunsen burner;†
Asbestos gauze with cup-shaped depression;
Balance.

Directions.—Take the tare of retort or flask, carefully noting the weight.

Mix the test sample thoroughly by pouring from vessel to vessel, or stirring well with a rod.

Now weigh into the retort or flask 100 frammes of the sample.

Next insert cork holding thermometer, so that the bulb will be opposite the side-tube of the flask, or half an inch above the level of the tar in the retort. (See that cork fits tightly to avoid any loss of vapor.)

Having thus partially filled and closed the retort or flask, next fit it on the ring of retort stand, with asbestos gauze under it, and keep it in place by a ring or clamp fitted easily round the neck.

Now take a test-tube, or small conical flask, and having first tared it accurately, place it so that it will collect the distillate. The preparations for making the test are now complete.

Ignite the burner and set it underneath the flask, starting with a very small flame, and regulating the flame so as to heat the tar very gradually and slowly.

When the temperature for the first fraction of the distillate is shown on the theremometer, change the receiver for the next fraction; and so on.

During the operation, if any of the distillate solidifies in the neck of retort or side tub of flask, apply at once sufficient heat to liquefy the solid and set it flowing. This may be easily done by attaching a bit of asbestos wool dipped in methylated spirit to a wire, and holding the lighted wool at the point where the distillate had solidified. Beware of setting fire to the vapors at outlet of retort.

It will be found that the distillates will condense at ordinary room temperature, and that it will not be necessary to employ water as in a Liebig's condenser.

Crude tar should be warmed very slowly and carefully or it will boil over as well as bump in the retort, and possibly break it. This caution should be observed until the water has been expelled and the first fraction collected, at 105° C. It will often be found that all the water has not come over at 105° C. A given quantity of tar should be distilled, and the water separated from the distillate after being noted. This is best done by distilling, say, 200 c.c. Take water by volume. Any oil coming with the water is returned to the tar in retort when it is cool; and from this dehydrated tar the 100 grammes should be weighed. The results of the distillation test will thus be on the dry tar.

The results of the test may be tabulated as follows:

Distillate up to 105° C.	% by weight.
Distillate from 105° C.—170° C.	% by weight.
Distillate from 170° C.—225° C.	% by weight.
Distillate from 225° C.—270° C.	% by weight.
Distillate from 270° C.—300° C.	% by weight.
Residue by difference	% by weight.

SPECIFIC GRAVITY DETERMINATIONS.

In these determinations water, at a temperature of 60° F. (15.5° C.), is taken as unity (1.000).

The specific gravity of tar is taken simply and with sufficient accuracy for practical purposes, by means of a hydrometer. Two forms of hydrometer are in general use, the "Specific Gravity Hydrometer," and the "Twaddell."

Directions.—See that there is sufficient tar in the vessel to fairly float the hydrometer. To ensure accuracy, the vessel should have a diameter of 4 inches, inside measurement. Stir the tar well with a rod, and note the temperature.

Immerse the hydrometer in the centre of the tar, not pushing it, but allowing it to sink with its own weight, and note the reading on the spindle at the point where it ceases to sink. If the temperature is 60° F. that reading denotes the specific gravity. If the temperature exceeds 60° F., then for every 2° in excess add 1 to the last figure of the reading. Thus, if reading be 1,200 and temperature 70° F. the true specific gravity is $1.205.

For tar and tar-oils a useful range of hydrometer is that graudated from 1.000 to 1.300.

Twaddell's Hydrometer.—Every degree on the scale represents an increase in specific gravity of .005. Thus,

1 degree Twaddell 1.005 specific gravity.
7 degrees Twaddell 1.035 specific gravity.

To convert Twaddell to specific gravity multiply the reading by 5, add 1,000, and cut off three decimal places. Thus, if the reading be 40, then T40, multiplied by 5, plus 1,000, equals 1,200, expressed as specific gravity 1.200.

With Twaddell, if temperature exceeds 60° F. add 1 to the reading for every 10 degrees in excess. Thus, if reading is T40 and temperature is 70° F. the Twaddell is expressed as T41.

[illegible]

[illegible]

Having tared a 200 c.c. flask, weigh into it 2 or 3 grammes of tar which has already been deprived of water as explained in note above.

Next add the solvent—about 100 c.c. of 90 per cent benzol. This solvent being inflammable, the operation must be carried out away from any flame or fire, or even a lighted pipe or cigarette.

Then, having corked the flask, shake up the contents so as to break up the tar. Do this two or three times, and leave the flask standing for several hours or overnight. The tar will then have been fully dissolved and is [illegible]

To prepare the filter, get two circular pieces of filtering paper (dried beforehand in water-oven) of absolutely equal weight; keep one as counterpoise for final weighing; fold the other twice, and open it out to form a cone. Support the cone in a glass funnel suspended over a jar or other vessel.

Next pour the contents of the flask on to the filter, and, should anything remain in the flask, wash it with the solvent till quite clear, and empty the flask on to the filter again.

Then wash the residue remaining on filter with some more of the solvent, until it runs off clear and colorless from bottom of the funnel.

Let the filter and its contents get dry in the funnel; when practically dry, and not till then, complete the drying in the water-oven. Weigh the residue in the filter, using as counterpoise to the filter the reserved paper.

The residue will be calculated on a percentage basis of the weight of tar orginally put into the flask, and will be described as free carbon.

EVAPORATION TEST.

Weigh 20 grammes of the tar to be tested into the aluminum dish, the tare of which has been previously noted.

Bring the air-bath to its full temperature, put the dishstand inside, and carefully place on it the dish containing the tar in a level position.

Adjust the thermometer so that the bulb may be close to the material under test without touching it.

The temperature decided upon for the test is to be maintained throughout the period of the test. This can be done with a little care and attention by regulating the flame of the burner with the quadrant tap.

At the termination of the test weigh the dish with the residue of the tar in it, and note the loss.

Note particularly the condition of the residue left in the dish, as to whether it is hard, or of a greasy, or of a sticky nature.

MEMORANDA.

1. To convert Centigrade degrees into degrees of Fahrenheit, multiply by 9, divide by 5, and add 32.
2. To convert Fahrenheit degrees into degrees of Centigrade, subtract 32, multiply by 5, and divide by 9.
3. One fluid ounce 28,412 cubic centimetres (c.c.).
4. One gramme=15,432 grains.
5. One centimetre 0.3937 in.

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*The flask should have a side-tube [illegible] long with a diameter of [illegible] inside measurement.

†If gas is not available, a spirit-lamp with controllable flame can be used.

Road Repairs and Road Maintenance Work of the Metropolitan Park Commission in 1910.

[illegible] Massachusetts has under its direction the repairs and maintenance of all roads in the extensive state park system in the vicinity of Boston, Mass. The commission is in charge of over 80 miles of formal roadways open to automobiles and other classes of pleasure travel. In addition, it is in charge of almost as many miles of roadways within the woods reservations, which are restricted to use by horse drawn vehicles. The problems connected with the maintenance of park roads, which are used almost entirely for pleasure travel, in which automobiles largely predominate, are somewhat different from the problems connected with the maintenance of a road system of a town or small city. For this reason, and also for the reason that the Metropolitan Park Commission was among the first to adopt tar and oil treatments for road maintenance and preservation work, the following data, taken from the last annual report of the commission, will be of interest:

The work of maintenance of and repairs to, the roadways in the reservations and parkways was done by the forces of the various divisions under the direction and supervision [illegible] mission, of which Mr. John R. Rablin is chief engineer. The work of reconstruction, repairs [illegible] on upon the same general lines as heretofore, by the use of refined tars, residual asphalts and asphaltic oils. Mr. Rablin states that the results of the employment of these methods for the preservation of the surface of the roads, under the traffic existing at the present time, have been generally very satisfactory.

SURFACE TREATMENT.

Calcium Chloride.—Calcium chloride was used for the surface treatment of sections of ten roadways. The roadways thus treated, their length, width and yardage, were as follows:

Parkway or Reservation.	Length. Ft	Width. Ft	Sq. yds.
(1) Charles River Reservation	9,200	60-40	51,220
(2) Fresh Pond Parkway...	2,700	40	12,000
(3) Furnace Brook Parkway	7,750	36-40	31,010
(4) Lynn Fells Parkway...	2,600	40	11,500
(5) Middlesex Fells Reservation	...	...	5,777
(6) Middlesex Fells Reservation			1,777
(7) Middlesex Fells Reservation	...	.....	6,000
(8) Middlesex Fells Reservation			3,400
(9) Nantasket Beach Reservation	5,760	40	24,933
(10) Quincy Shore Reservation	11,800	24-40	37,155

The costs per square yard of the surface treatment of these ten sections of roadways were as follows:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Labor	$0.022	$0.020	$0.001	$0.006	$0.008	$0.008	$0.009	$0.007	$0.018	$0.002
Gravel	.002	...	...	...	...	...	...	...	.002	...
Calcium chloride	.013	.016	.008	.030	.029	.011	.039	.011	.021	.014
Totals	$0.037	$0.036	$0.009	$0.036	$0.037[1]	$0.019[2]	$0.048[3]	$0.018[2]	$0.041	$0.016

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[1] 2 treatments. [2] 3 treatments. [3] 6 treatments.

Asphaltoilene, Tarvia, Liquid Asphalt, Etc.—Asphaltoilene purchased from the Good Roads Improvement Co. was used in the surface treatment of portions of three roads. The location of these roads, the length, width and area treated, were as follows:

Parkway or Reservation.	Length. Ft.	Width. Ft.	Sq. Yds.
(1) Blue Hills Parkway.....	7,600	36	30,400
(2) Neponset River Parkway	2,750	26	7,944
(3) Stony Brook Reservation	13,075	16	23,247

The costs per square yard of the surface treatment of these roads with asphaltoiline were as follows:

	(1)	(2)	(3)
Labor	$0.008	$0.003	$0.012
Asphaltoilene	.016	.023	.021
Total	$0.024	$0.026	$0.033
Asphaltoilene, gals. per sq. yd.	.21	.33	.27

Tarite-asphalt, obtained from the American Tar Co., was used in the surface treatment of sections of two roads. These roads were (1) Revere Beach Parkway road, 4,560 ft. long, 36 ft. roadway, and an area of 18,240 sq. yds. and (2) Revere Beach Reservation road, 2,000 ft. long, 40 ft. wide, the area treated being 7,550 sq. yds. The costs per square yard of the surface treatment of these roads with tarite-asphalt was

	(1)	(2)
Labor	$0.024	$0.013
Broken stone	.026	.012
Tarite-asphalt	.048	.039
Totals	$0.098	$0.064
Tarite-asphalt, gals per sq. yd.	.60	.43

Portions of four roadways were given a surface treatment with tarvia, obtained from the Barrett Manufacturing Co. The location of these roadways, length treated, width and yardage treated were as follows:

Parkway or Reservation.	Length. Ft.	Width. Ft.	Sq. Yds.
(1) Charles River Reservation	2,100	45	9,578
(2) Middlesex Fells Parkway	1,450	36	5,800
(3) Middlesex Fells Parkway	1,360	32	4,836
(4) Winthrop Shore Reservation	700	[illegible]	[illegible]

The costs per square yard of these surface treatments were

	(1)	(2)	(3)	(4)
Labor	[illegible]	[illegible]	[illegible]	[illegible]
Broken stone	[illegible]	.016	.020	.009
Tarvia	[illegible]	[illegible]	.018	[illegible]
Total	[illegible]	[illegible]	[illegible]	$0.094
Tarvia, gals. per sq. yd.	.60	.64	.22	.60

An asphalt oil obtained from the Texas Co. and the Indian Refining Co. was used in surface treatment on sections of roadway in the Lynn Shore Reservation. The length treated was 5,900 ft., the width of roadway being 40 ft., and the area 21,256 sq. yds. The cost of the treatment per square yard was as follows:

Labor	$0.004
Broken stone	.016
Asphalt oil	.040
Total	$0.060
Asphalt oil, gals. per sq. yd.	.61

Liquid asphalt obtained from the Indian Refining Co. was used in the surface treatment of portions of six roadways. The location of these roadways, length, width and area were as follows:

Parkway or Reservation.	Length. Ft.	Width. Ft.	Sq. Yds.
(1) Middlesex Fells Reservation	2,200	19	4,644
(2) Middlesex Fells Parkway	3,200	36	12,800
(3) Middlesex Fells Parkway	4,650	25	12,917
(4) Middlesex Fells Parkway	2,200	19	4,645
(5) Mystic Valley Parkway.	2,750	36	11,000
(6) Revere Beach Reservation	6,100	40	25,078

The costs per square yard of the surface treatment were as shown in Table I.

RESURFACING.

In the Blue Hills Reservation two sections of roads were resurfaced with broken stone and tar by day labor. The method employed was to clean and scarify the surface of the roadway, add sufficient new stone to properly shape and crown the surface, and, after rolling, apply the tar by the grouting or penetration method. The tar was applied at a temperature of about 175° F. from tank wagons by means of a gravity distributor attached to the rear of the wagon. On one of these sections, 1,650 ft. long, 26 and 30 ft. wide, having an area of 5,500 sq. yds., tarite-asphalt was used. The cost per square yard of resurfacing this section was:

Labor	$0.133
Broken stone	.160
Tarite-asphalt	.218
Total	$0.511
Tarite-asphalt, gals. per sq. yd.	2.55

On the other section, 2,000 ft. long and 26 ft. wide, tarine was used. The cost per square yard of the resurfacing on this section was as follows:

Labor	$0.118
Broken stone	.114
Tarine	.200
Total	$0.432
Tarine, gals. per sq. yd.	2.43

The easterly roadway of the Middlesex Fells Parkway from Salem and Pleasant Sts. to Medford St., a total length of 3,500 ft., 36 ft. in width, was resurfaced with gravel, asphalt oil, obtained from the Standard Oil Co., being used as a binder. This roadway was originally constructed of macadam, but, on account of the fact that the westerly roadway was recently resurfaced with broken stone with tar binder, it was thought advisable to resurface the westerly roadway with gravel treated with heavy asphaltic oil, so as to provide a surface more suitable to horse traffic. The method of doing this work was to clean and scarify the old surface, and cover with a layer of new binding gravel about 2 ins. in thickness. After this was thoroughly rolled with sectional horse rollers and steam roller it was treated with heavy asphaltic oil. The work was done by day labor. The cost per square yard was as follows:

Labor	$0.066
Gravel	.206
Asphalt oil	.015
Total	$0.287
Asphalt oil, gal. per sq. yd.	.34

Two other sections of roadways in the Middlesex Fells Reservation were resurfaced, liquid asphalt being used on one section and tarine on the other. The section on which the latter was used was 1,000 ft. long and 26 ft. wide, the cost per square yard of the resurfacing being as follows:

Labor	$0.094
Broken stone	.082
Sand	.007
Tarine	.153
Total	$0.336
Tarine, gals. per sq. yd.	2.14

The section on which the liquid asphalt was used was 1,400 ft. long and 19 ft. wide. The cost per square yard of resurfacing this section was:

Labor	$0.063
Gravel	.225
Sand	.020
Liquid asphalt	.040
Total	$0.350
Liquid asphalt, gal. per sq. yd.	.49

RECONSTRUCTION.

Sections of the roadway in the Mystic Valley Parkway between High St., Medford and Walnut Sts., Winchester, which were originally constructed on poor subgrade, and in winter and spring were in very bad condition, were reconstructed with broken-stone base and gravel surface, and treated with heavy asphaltic oil. Where necessary, the subgrade was drained. The work was done by the forces of the commission. This work was done in two sections: (1) being 1,600 ft. long and 36 ft. wide and the other (2) being 3,850 ft. long and 36 ft. wide. The cost per square yard of these two sections was as follows:

	(1)	(2)
Labor	$0.301*	$0.179
Gravel	.183	.245
Broken stone	.162	.179
Sand	.009	.008
Liquid asphalt	.027	.025
Totals	$0.682	$0.636
Liquid asphalt, gals. per sq. yd.	.34	.31

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*Includes hauling away dead material and rolling subgrade, and laying 712 ft. 6-in. underdrain.

In the Revere Beach Parkway a section of the roadway just west of Broadway, Revere, about 1,200 ft. in length, in which the subgrade was very springy and the roadway surface was maintained with difficulty, was excavated, underdrained, and reconstructed with about 12 ins. of gravel screenings under the macadam surfacing. Tarite-asphalt and tarvia were used as a binder. About 1,600 cu. yds. of clean gravel screenings were required, and were obtained from the bank washed up by the storms against the sea wall at Winthrop Shore Reservation. The work on this section of roadway was also done by the forces of the commission. The cost per square yard of the reconstruction was as follows:

Labor	$0.330*
Broken stone	.411
Binder	.190
Total	$0.931
Binder, gals. per sq. yd.	2.38

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*Includes excavation and gravel filling for subgrade.

Another piece of road reconstruction work was done last year by the commission. was in the Winthrop Shore Reservation, the section of road improved being 400 ft. long and 26 ft. wide. The cost per square yard was as follows:

Labor	$0.180
Broken stone	.160
Tarvia	.060
Total	$0.400
Tarvia, gal. per sq. yd.	.78

TABLE I.

	(1)	(2)	(3)	(4)	(5)	(6)
Labor	$0.006	$0.004	$0.011	$0.012	$0.021	$0.003
Gravel	.021	...	...	...	...	...
Sand	...	.016	.025	.020	.008	.
Liquid asphalt	.017	.027	.032	.040	.025	.013
Totals	$0.044	$0.047	$0.068	$0.072	$0.054	$0.016*
Liquid asphalt, gals. per sq. yd.	.21	.327	.40	.49	.31	16

*Patching, total cost was $0.022, which includes $0.006 per sq. yd. for broken stone.

Methods of Maintenance of the State Highways of Massachusetts.*

Before the advent of the motor vehicle, maintenance of state highways was of minor importance as compared with the construction thereof, but with the rapid annual increase in the number of such vehicles, maintenance has become a far greater problem.

Very few of the roads of the ordinary water-bound or of the gravel type will stand up many days under the traffic to which they are now subjected. Some of the roads built of local stone or other material that will in itself furnish a satisfactory binder, are still maintained by keeping their surfaces covered with sand; but these roads are constantly deteriorating, even where the motor vehicle traffic is comparatively light.

Some macadam roads built several years ago before the advent of the motor vehicle are still maintained with sand and remain in fair condition, while roads that are recently built rapidly deteriorate. This difference in the action of these roads under traffic is not due to poorer methods or materials of construction, but can rather be attributed to the fact that, having been constructed several years before being subjected to the destructive influence of motor traffic, the material in the road surface has become cemented together, making it somewhat monolithic. Clearly, the most effective method of mantaining macadam roads under present conditions is to use some form of bituminous binder. That which has been used to the greatest extent with economical and satisfactory results during 1910 has been the heavy asphaltic oil. Surface application has been made during the year, consisting of ¼ to ½ gal. of asphaltic oil on 202.4 miles of road, and of tar on 16.9 miles. Of the above, 67.5 had previously been treated in a similar manner one or more times. In addition to the above, there are 89.2 miles that have been treated previous to this year with asphaltic oil or tar, but have received no additional treatment this year, so that at the present time a total of 308.5 miles of state highway have received one or more surface applications of asphaltic oil or tar.

In the treatment of these roads practically every bituminous material now on the market has been used, the prices paid during 1910 for the material, delivered on the cars at [illegible] per gal.

Several conclusions have been reached, the principal of which is that, if the preservation of the wearing surface is considered paramount to the prevention of dust, a heavy bituminous material requiring heating before application is desirable.

Second, no bituminous material containing a large percentage of asphalt will adhere to a macadam road unless all dust and dirt is thoroughly removed from the same before applying the oil; and, furthermore, it is preferable that the stone surface be not extremely dry, but rather moist.

Third, better and more permanent results are obtained by the application of two coatings of ¼ gal. to the square yard than by one coating of ½ gal. to the square yard, allowing a few days to elapse after the first application before the application of the second coat.

Fourth, the distribution of the bituminous material under pressure on the surface of the road is preferable to allowing it to flow by gravity, as the application under pressure accomplishes a far more uniform distribution. It does not, however, increase the penetration to an appreciable extent.

The process of applying bituminous material as a surface treatment on a macadam road is as follows. The road is first thoroughly swept, so that there are no particles or patches of dust or dirt covering the upper course of stone. All depressions are then filled by applying preferably ¾-in. stone, bound with the bituminous binder that is to be used for the surface coating. The bituminous binder [illegible] a temperature of approximately 180°, and distributed under pressure of approximately 75 lbs. to the square inch, using ¼ to ½ gal. per sq. yd. This is immediately covered with coarse sand, fine gravel or pea stone, and, if convenient, is rolled with a steam roller. In the application of the oil it is the universal custom to apply the oil on one side of the road at a time, leaving the other side clear for traffic until the first side treated has been covered with sand. Following are the specifications under which a large portion of the oil used in 1910 has been furnished:

The oil shall be of uniform color, appearance, [illegible] the following requirements:

(a) It shall not froth when heated to 100° C.

(b) It shall have a specific gravity of at least 0.97.

(c) It shall not contain more than 0.5 per cent of dirt or adventitious mineral matter.

(d) It shall contain not more than 1 per cent of matter insoluble in carbon bisulphide.

(e) It shall be of such viscosity that 60 cc. measured at room temperature (78° F. or 25° C.) shall when at 100° C. be not less than 250 seconds nor more than 500 seconds in passing the Lawrence viscosimeter, or 200 cc. measured and tested at the same temperatures shall be not less than 900 seconds nor more than 1,800 seconds in passing the Engler viscosimeter.

(f) When 20 grams are heated in a flat-bottom dish 3 ins. in diameter for twenty-one hours in a well-ventilated oven kept at a temperature of 250° C., the loss in weight shall not be greater than 15 per cent.

(g) When subjected to a number of heatings at 250° C. in a well-ventilated oven, with intermediate separations of asphaltene and matter insoluble in carbon bisulphide, until the final petroleum ether extract is not more than 10 per cent by weight of the original sample, it shall show the following results, assuming also that this final 10 per cent has the same composition as the 90 per cent of the material examined: the total loss shall be not more than 35 per cent by weight; the amount of asphaltene in the original sample shall not be greater than 6 per cent by weight, and the amount of asphaltene formed by this treatment plus that in the original samples shall be at least 58 per cent by weight of the original sample; the amount of matter insoluble in carbon bisulphide as a result of this treatment shall be not greater than 5 per cent.

[illegible] This road was treated with about ½ gal. of oil to the square yard, in two applications of ¼ gal. each:

	Per sq. yd.
Cleaning and sweeping	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Delivering oil	.0038
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

The average haul for oil on the above road was 2 miles. The sand for covering was furnished and hauled under contract, an average haul of about 2½ miles.

[illegible] only a short section was done during that year; and early in 1910 the contract was cancelled, and resurfacing carried on by foreman and laborers in the employ of the commission. This road probably receives more varied and extensive traffic than any other state road. It was constructed of ordinary water-bound macadam in the year 1899. In the resurfacing of this road in 1910 a course of approximately 2 ins. in thickness of crushed stone, mixed by machine with natural asphalt, fluxed to the proper consistency, was spread on the road and thoroughly rolled with steam roller. Over this course was thinly sprayed a light coating of asphalt, which was immediately covered with pea stone. The preparation of the old macadam cost $0.089 per sq. yd., and the bituminous surface cost $0.904 per sq. yd., making the total cost of resurfacing $0.993. The cost of this work was increased very largely by the necessity of keeping one side of the road open for traffic while the other side was being resurfaced. This road is now in first-class condition, and should remain so for several years with but very little expenditure for maintenance.

In connection with bituminous work, attention is called to the cost and condition of [illegible] previous years, also, to the cost of maintenance of sand and oil roads that have been built for several years. Sand and oil roads built by the "building-up" method, so called, are the least expensive in construction, but do not until after a lapse of some time develop a uniformly hard wearing surface, probably due principally to inequality of the distribution and penetration of the oil, and partially to the variation in quality of the sand used. Roads built by the mixing method are more uniform in character, but invariably have a surface which, while appearing to the eye to be smooth, is somewhat rough for teams and automobiles passing over them at the ordinary speed at which such vehicles are driven. Either kind of road, however, will in the course of time, with proper treatment, become smooth and even, as has been demonstrated by the condition of the sand and oil roads built in Eastham.

The earliest sand and oil road built by the State Highway Commission in Eastham cost in 1905 for construction $0.1692 per sq. yd. The subsequent expenditure up to the present time aggregates $0.1918 per sq. yd., so that the road up to the present time has cost $0.3610 per sq. yd., or about $3,400 per mile (16 ft. wide); and its condition has improved each year since construction, and is now excellent. The fact that this matter is brought particularly to the attention of the Commission should not be construed as advising that sand and oil roads are preferable to roads built of macadam or good gravel, but rather to show that in localities where neither stone or gravel can be found, suitable for reasonable traffic at reasonable cost, an excellent road can be secured, as has been demonstrated in the above-cited case.

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*From [illegible] Engineer of the Massachusetts Highway Commission, included in [illegible] Commission for the fiscal year ending Nov. 30, 1910.

High Steam Shovel Average in Empire District [illegible] steam shovels working in the Empire District, Panama Canal, excavated 25,999 cu. yds., or an average per shovel of 1,529 cu. [illegible] dle. This is the highest average per shovel [illegible] 1911, when 20 steam shovels excavated 29,- [illegible] per shovel.

Setting Terra Cotta Tile for Floors.— [illegible] rectangular, 60 ft. by 300 ft. and the steel work is made in 15-ft. bays each way. The forms for holding the terra cotta consist of [illegible] men employed for knocking down forms and for getting material up from the ground. Two elevators are operated.

A Civil Service Examination for Mechanical Draftsman.—The United States Civil Service Commission announces an examination on July 19-20, 1911, to secure eligibles from which to make certification to fill vacancies as they may occur in the position of mechanical draftsman, Ordnance Bureau, War Department, at entrance salaries ranging from $900 to $1,200 per annum.

WATER-WORKS AND SEWERS SECTION

Proposed New Formulas for Computing the Thickness of Cast Iron Pipe.*

(1) Cast-iron pipe is commonly designed with an apparently much larger factor of safety than is used in the design of steel pipe. Notwithstanding this, cast-iron pipe frequently breaks in service, while steel pipe practically never breaks. Why is the steel pipe more reliable in this respect than cast-iron pipe?

(2) The president of a water board asked me, some years ago, after a very uncomfortable experience, how it was that pipes which had been tested in the foundry by a careful inspector, to a pressure of 300 lbs. break in service under a working pressure of less than 100 lbs.

(3) The formulas that we most commonly use in computing the strength of cast-iron pipe assume an ultimate tensile strength of only 16,000 to 18,000 lbs. per sq. in., with a factor of safety of 5, while it is well known that the castings turned out by pipe foundries at the present time considerably exceed this strength. Why is it not safe to reduce the thickness of the pipe walls in inverse ratio to the increased tensile strength of the iron?

These are questions which have come up for discussion in our office frequently in the last few years. In considering them I have frequently had the benefit of advice from Mr. Emil Kuichling, and I wish to asknowledge at once many of his suggestions in that which follows.

I propose to take up these questions today from the standpoint of all the forces that have to be actually met by the pipe in the trench and to see how thick the walls of the pipe really need to be to withstand these forces. In doing this I think we shall find at least a partial answer to these questions, and I hope that it may lead to discussion that will put the available knowledge on the subject in more satisfactory shape.

In this discussion I shall consider only pipes 36 ins. in diameter and over. In smaller pipes the strength requisite to make the pipe act as a sufficiently stiff beam to resist breaking in the trench may be an element of considerable importance in determining the thickness of the walls. In larger pipes this may also be a matter of some importance, but I do not think that it will often control.

Let us consider first the forces that act upon the pipe and the stresses resulting therefrom, which have to be met and resisted.

(1) *Internal Pressure.*—This may be divided into two parts: (*a*) the ordinary working pressure, and (*b*) the pressure resulting from water ram. The ordinary working pressure is ordinarily known with comparative certainty. The amount to be allowed for water ram is seldom known with anything like accuracy. In some cases, as, for instance, siphons opening freely to aqueducts of chambers at their ends, the conditions are not such as to permit any appreciable amount of water ram to occur, and the question is practically eliminated. The amount of water ram that may be obtained in long pipe lines is practically limited by the fact that the gates used upon the line ordinarily require a considerable time for them to be closed, and the longer they take in closing, the smaller is the probable amount of water ram that will result from the closing. Obviously, the use of gates smaller in diameter than the pipe line will allow them to be closed more quickly and will, therefore, tend to larger pressures from water ram.

Similarly, the operation of gates by hydraulic or electric power may permit them to be closed more rapidly with a great increase in the amount of water ram. It will, therefore, be desirable when such valves are used to so gear the electric motors, or provide such small openings to the hydraulic cylinders, that the operation of the gates will be very slow, corresponding in speed to hand operation. As it is only the final closing that produces water ram, it would seem mechanically possible to devise a gate that could be quickly brought by power to three fourths closed, and then move very slowly to its seat, by some change in the operating mechanism.

Mr. Kuichling has told me that in the 24-in. Rochester pipe line, with hand-operated gates of the same size as the pipe, with the most rapid closing of the gates that could be practically carried out, he never observed a water ram amounting to more than one half of the static pressure behind the gate. Probably with proper precautions, on a long pipe line, the water ram may be held within these limits, but there may be exceptions.

For instance, at Springfield, in a short line of 42-in. steel pipe leading from the settling basin to the filters, a balanced valve was provided for automatically controlling the water level on the filters. Only a part of the water went through this valve. On one or more occasions the valve has stuck until the water level got some distance beyond what was intended, and then closing quickly, the water ram behind the valve has been so great as to force water through various riveted joints in ¼-in. steel plates in a connected water wheel casing. I should say in this case that, with a total static head of only about 25 ft., the water ram must, at the very least, have been over 100 lbs. per sq. in., or ten times the amount of head.

The conditions in this respect correspond to those in the ordinary hydraulic ram, which, as is well known, will lift water to a height more than ten times as great as the distance that the water falls.

It is a good rule to design all the gates on main pipe lines so as to prevent water ram as far as possible, and then allow 50 per cent in addition to the static pressure.

(2) *Stresses from Internal Strains in the Metal.*—In cast-iron pipe there are internal strains in the casting resulting from unequal cooling. Such strains may be assumed always to exist, but in amounts varying very greatly with the excellence of the procedure in cooling the pipe after casting.

In steel pipe there are also internal strains in the steel plates, but these are usually of much less practical significance than those existing in cast-iron pipe because the material is malleable instead of brittle and is capable of being bent and considerably distorted without reduction in strength.

(3) *Stresses that Come from the Weight of the Backfill.*—If the backfill pressed equally on the pipe from all directions, or, in other words, if it acted as a liquid, these pressures would be radial and balance each other. But such backfill is never obtained. The inequality in the distribution of pressures varies with different materials, and with the manner in which those materials are packed. The best published discussion of this subject that the speaker has found is by Prof. Arthur N. Talbot, Bulletin of the University of Illinois, No. 22, April 29, 1908.

Professor Talbot concluded, as a result of his investigations, that for ordinary conditions it was best to assume that the pipe carries on its upper half a weight equal to the whole weight of the material in the backfill above the pipe as a uniformly distributed load, and that this weight is transmitted through the sides of the pipe to the supporting material underneath. The result of the weight of this backfill is to tend to break the pipe. For a condition of uniform loading and uniform support along the pipe underneath, Professor Talbot finds as a result of his experiments, in which many pipes were actually broken, that $M = \frac{WD}{16}$, where M is the moment of bending forces tending to break the pipe at that point in the pipe where it is greatest; W is the total weight of backfill above a unit length of pipe, and D is the average diameter of the ring, which is practically the inside diameter plus the thickness.

For conditions of unequal loading and unequal support, the moment tending to break the pipe may be considerably greater than is computed by this formula.

(4) *Stresses Due to the Beam Action of the Pipe.*—We have considered thus far that the pipe was supported equally at every point along its bottom, and that the loading was equally distributed in the same way. As a matter of fact, this does not occur. The pipe is supported unequally along its length. With cast-iron pipe laid on blocking, and the blocking left in place, a considerable part of the pipe and its load after the trench is backfilled may still be carried on the blocks, and in this case the portion of pipe between the blocks acts as a beam, which must carry the weight of the pipe, the water in it, and the weight of the backfilling over it. If the trench is rock or has projecting bowlders, these may act in the same way and to an even greater extent, because the length of pipe between supports may be greater. Where a considerable length of pipe rests upon such projections on the bottom, there will obviously be a much greater tendency to break the pipe over these points because the forces acting upon a considerable length of pipe are concentrated on a small area.

(5) *Stresses- Cumulative in Places.*—The effect of internal water pressure is to produce circumferential tension through the whole section of the metal. The stresses due to unequal cooling of the castings are partly of compression and partly of tension, and may be both circumferential and longitudinal. The stresses due to the weight of the backfill are partly compression and partly tension, and are circumferential when the pipe is uniformly loaded and supported. The stresses due to beam action are primarily longitudinal and, acting at 90° from the others, do not need to be considered in connection with the circumferential strains. However, the effect of beam action is to increase the loading in places, and so increase considerably in those places the circumferential stresses due to the weight of the backfill.

For this purpose, limiting the discussion to pipes 36 ins. in diameter and over, I shall consider at present only the circumferential stresses. These are cumulative in places. That is to say, there will be some points where the metal will be in tension from all of them,—from the internal pressure and from water ram, from the weight of the backfill, from the stresses due to unequal cooling of the metal, and also from the accumulated weight of the backfill caused by beam action.

When the accumulated stresses at any point exceed the ability of the metal to resist them, rupture begins and we have a broken pipe.

The formulas for the thickness of pipe in most general use take into account only the internal water pressure, including the ordinary working pressure and water ram. The other stresses are not taken into account.

These formulas have given reasonably satisfactory results for cast-iron pipe, because they have been based upon a working stress much below the stress that the metal is actually capable of sustaining, because the amount allowed for water ram has been in many cases above the truth, and because of an arbitrary addition to the computed thickness which adds considerably to the strength.

PROPOSED NEW METHOD OF COMPUTING THICKNESS OF CAST IRON PIPE

With Professor Talbot's work on the strength of pipes required to resist breaking in trenches, it seems possible to make a more rational calculation of the required thickness, based upon a higher unit working stress corresponding more nearly with the ultimate strength of the cast iron that is now available.

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*Paper read Nov. 9, 1910, before the New England Water Works Association, by Allen Hazen, New York, N. Y.

In carrying out this calculation no allowance is made at this time for internal stresses due to cooling, or for circumferential stresses resulting indirectly from beam action. It is assumed for the present that these and all other matters will be covered in the factor of safety, and that that factor will be increased if necessary to cover them in a subsequent revision of the calculation.

The calculation now made is to determine how thick the pipe must be to carry the stresses due to the backfilling as computed by Professor Talbot's formula, and at the same time to carry a stated internal pressure, with fifty per cent addition thereto for water ram.

Let

d = diameter in inches.

t = thickness in inches.

F = depth of backfill above top of pipe in feet.

s = permissible stress in pounds per square inch in cast-iron pipe, which I now take as 4,400 for an ultimate tensile strength of 22,000 lbs., with a factor of safety of 5.

W = weight of fill over one linear inch of pipe at the rate of 115 lbs. per cu. ft., the outside diameter of pipe being taken as 5 per cent greater than d.

$$W = Fd\,\frac{1.05 \times 115}{144} = 0.84Fd.$$

M = breaking moment normally present from backfill, according to Talbott = $1/16WD$, D being the average diameter of the shell, which is about $1.025d$.

$$M = \frac{1}{16}(1.025d)(0.84Fd) = 0.0538Fd^2.$$

Resulting maximum circumferential stress in metal in lbs. per sq. in. obtained by applying the usual formula, $M = \frac{1}{6}sbt^2$, b in this case being 1.

$$s_1 = \frac{6M}{t^2} = \frac{0.323Fd^2}{t^2}.$$

The stress available for resisting the water pressure is 4,400 less this amount. Of this, one-third is allowed for water ram and two-thirds for static pressure.

The stress allowable for resisting the static pressure is thus

$$s = \frac{2}{3}\left(4{,}400 - 0.322\frac{Fd^2}{t^2}\right)$$

H = head in feet that can be carried by a given stress:

$$s = \frac{pr}{t} = \text{lbs. pressure per sq. in.} \times \frac{d}{2t} \times \frac{H}{2.31} \text{ and}$$

$$H = s\left(4.62\frac{t}{d}\right).$$

and for s as reached above,

$$H = 3.08\frac{t}{d}\left(4{,}400 - 0.322\frac{Fd^2}{t^2}\right)$$

$$= 13{,}500\frac{t}{d} - 0.99F\frac{d}{t}$$

If we had taken the weight of the earth backfill as 116 lbs. per cu. ft., the 0.99 would have been unity, and we may make it unity for the purpose of simplifying the formula. We shall then have—

$$H = 13{,}500\frac{t}{d} - F\frac{d}{t}$$

Our specifications allow a variation in the thickness of casting of 0.10 in. for large pipe. To insure that the stress shall not exceed the calculated amount at any point, if we could be sure that the specifications were literally complied with, it would only be necessary to add 0.10 in. to the computed thickness. This rule might be adopted for country work and where an occasional break in the pipe would not be of the greatest importance.

For city work, or where a break might do great damage, it would seem better to add 0.25 in. to the computed thickness, this being the allowance made in the Brackett formula in all cases for this purpose.

Solving the last equation for t, and making this addition, we have,

For country work.

$$t = 0.10 + \frac{d}{27{,}000}\left(H + \sqrt{54{,}000F + H^2}\right).$$

For city work:

$$t = 0.25 + \frac{d}{27{,}000}\left(H + \sqrt{54{,}000F + H^2}\right).$$

This formula is not suggested as in any way final, but only for the purpose of discussion, and with the idea that it may possibly have in it some elements of a more rational calculation than are contained in the old formulas.

The formula for stress due to backfill is the one which Professor Talbot uses for ordinary backfilling of good material. With backfilling made of the very best material and with special care, the stress might be less. On the other hand, with poorly made backfill and with movements from settlement it might considerably exceed this figure. The most convenient way to allow for differences of this kind would be to allow more or less backfilling than the actual backfilling. For instance, with backfilling all made of coarse dry sand well tamped, it might be prudent to figure on a stress from backfill only three-fourths as great as the actual backfill, while in rock trench with bowlders, or material that was sure to have subsequent settlements, the calculation might be made for a backfill fifty per cent greater than the actual amount of backfill to be used, or even one hundred per cent greater, if the conditions were very unfavorable.

For ordinary use it would seem fair to take 5 ft. of backfill in computing the thickness of pipe to be used in favorable trenches where the work was to be done with special care, and a larger amount up to 10 ft., or more, where the trench was deeper than usual and where there was rock or bowlders.

COMPARISON WITH BRACKETT FORMULA

To see how the proposed new formula compares with the formulas in common use, I have taken the case of 42-in. pipe with 5 ft. of backfill. I have taken this because the question of the thickness and strength of 42-in. pipe has been under especial discussion in our office in the last year. The results may be shown in tabular form.

Class of pipe	Standard thickness in ins.	Head in ft. allowed by Brackett formula.	Head Allowed by Proposed New Formula	
			Country work	City work
A	[illegible]	50	Negative.	Negative.
B	1.00	100	[illegible]	Negative.
C	[illegible]	[illegible]	127	[illegible]
D	1.27	[illegible]	[illegible]	[illegible]
E	1.40	[illegible]	[illegible]	[illegible]
F	1.53	[illegible]	[illegible]	[illegible]

This indicates that according to the formula, Class A pipe is not really safe for 42-in. pipe with 5 ft. of backfill, even where there is no internal water pressure, and "B" pipe is not safe for city work. This corresponds with the practice of our office, where "C" pipe has been the thinnest pipe ordinarily used, and with the observation that has been made that 42-in. pipe 1 in. thick, even when cast and laid under the most favorable conditions, is not very reliable for moderate water pressures. For higher pressures the results correspond more nearly to those by the Brackett formula.

With pipe larger than 42-in. the differences, especially for moderate water pressures, would be greater and the formula proposed calls in general for considerably thicker pipe.

The practical effect of this study is to show that with large pipes the stresses resulting from the backfill upon the pipe are material, and are added to those resulting from the water pressure, and that when they are taken into account the factor of safety is by no means as great as has been assumed. It is largely and perhaps principally for this reason that cast-iron pipe which has stood successfully hydrostatic pressure in the foundry breaks in the trench with a fraction of the test pressure, and it is for this reason that it is not safe to reduce the thickness of the walls of pipes as rapidly as increase is made in the ultimate tensile strength of the castings.

DISCUSSION BY EMIL KUICHLING

This paper is a very valuable addition to the literature of the subject, as it brings out clearly some of the defects in the usual formulas for computing the thickness of water pipes, and indicates how a more rational formula should be made. In dealing with the internal pressure due to water ram, the author states that such pressure is practically limited by the fact that the closing of a stop valve or gate in a large pipe ordinarily requires considerable time. Such gates are usually geared in the ratio of 3 or 4 to 1, and there are generally three screw threads per inch on the stem, thereby requiring from nine to twelve revolutions of the operating pinion to lower the gate disk one inch. When the bottom of the disk reaches the axis of the pipe, an appreciable hydraulic pressure against the disk begins to develop which causes friction on the guides and corresponding resistance to the turning of the stem. This resistance increases rapidly during the last quarter of the descent, so that the final inch may require the utmost exertion of three or four men for at least one minute. Against a static pressure of 50 lbs. per sq. in., about twenty minutes are needed to fully close a 24-in. valve and thirty minutes for a 36-in. valve.

The writer has made a number of observations of the increase of pressure caused by closing a 24-in. stop valve in a long line of 24-in. cast-iron pipe. The point of observation was 2.53 miles from the supplying reservoir, the valve was 2,100 ft. beyond, and while the valve was shut the static pressure at said point was 49 lbs. Before closing the valve the hydraulic pressure was 40.2 lbs., and the water was flowing through the pipe with a mean velocity of 3.45 ft. per second. The valve was closed as rapidly as possible in about twenty minutes, and during the last four minutes the pressure rose to a maximum of 65 lbs. after which it oscillated rapidly from 40 to 64 lbs. for a few seconds and then gradually reduced in two minutes to a range from 42 to 57 lbs. In the course of eight minutes more, the range was from 46 to 52 lbs., with increasing intervals of time between the pulsations, and at the end of fifteen minutes the pressure varied little from 49 lbs. These observations were repeated several times subsequently with the same general results, and hence it was concluded that for long and large pipe conduits, the water ram caused by closing a stop gate would not induce an internal pressure greater than 1.5 times the static pressure.

In the small distributing pipes of a municipal water works, water rams of much greater magnitude may be expected by the rapid closing of fire hydrants and hydraulic motors of large size; but as this subject is not under consideration, further reference thereto will be omitted. It may also be remarked that stop valves larger than 24 ins. in diameter are usually provided with by-pass valves which are closed after the main valve has been shut and the velocity of the water in the pipe has been greatly reduced; and if by carelessness the by-pass gate happens to be closed, the men who attempt to close the main valve will usually become aware of the fact during the latter part of the operation by the increased frictional resistance of the large valve stem.

The stresses caused by the weight of the backfill are higly important and vary much with the condition of the material in regard to moisture. Even when the material is well compacted by ramming, a settlement usually occurs after water has percolated freely into it, and with such settlement a greater load upon the pipe must ensue. Little is yet known [illegible] or of the manner in which it is distributed [illegible]. So far as the writer is aware, the only experimental data that are available in this direction are those that pertain to the deformation or flattening of a few cast-iron and riveted steel pipes, the former being given in Prof. A. N. Talbot's Bulletin No. 22 of the University of Illinois, 1908, and the latter in the paper of D. D. Clarke, chief engineer of the Portland, Ore., water works, in Transactions of the American Society of Civil Engineers, Volume XXXVIII (1897), pages 93-114, together with some observations made by the writer at various times between 1874 and 1896.

In view of the fact that settlements of the backfill usually appear to extend nearly uniformly across the entire width of the trench, the writer has assumed that the pressure thus induced upon the upper surface of the pipe is distributed uniformly in a vertical direction over its width and that no considerable pressure is exerted horizontally against the sides of the pipe; also, that the pipe bears uniformly upon its earthen foundation in the same manner as the backfill on the top. These assumptions, moreover, facilitate the computation of the bending moments, stresses, and deformation in a ring-shaped section. On this bases the formula for the magnitude of the elastic flattening or reduction (y) of the vertical diameter of a relatively thin pipe becomes: $y = \frac{WD^3}{96EI}$, where W is the uniformly distributed external load acting vertically on the pipe per unit of length; D is the mean diameter of the section, or the internal diameter plus the thickness, t; E is the modus of elasticity of the metal of which the pipe is made, and I is the moment of inertia of the longitudinal section of the wall of the pipe per unit of length, which is expressed by $\frac{t^3}{12}$.

For the cast iron of the 36-in. and 48-in. pipes used in his experiments, Professor Talbot deduced the approximate average value $E = 11{,}000{,}000$ lbs. per sq. in.; and for wrought-iron and steel plates the writer has assumed the usual mean value $E = 30{,}000{,}000$ lbs. per sq. in. The weight W may also be expressed by $W = wD$, where w is the equivalent vertical load in pounds per unit of area. Taking the inch as unit and replacing I by its value $\left(\frac{t^3}{12}\right)$, we now have

$$y = \frac{wD^4}{8Et^3} \text{ whence } w = \frac{8Et^3y}{D^4},$$

which is the expression for the uniformly distributed vertical load or weight of backfill in pounds per square inch of horizontal surface required to produce a given deformation or reduction (y) of the vertical diameter of the pipe.

The values of w thus computed from the observed values of E, t, y, and D may now be compared with the observed or estimated weight w_1 per square inch of the backfill, and the writer has arranged some of the available data in the following table, in which the first four items refer to cast iron, and the remainder to soft steel pipes.

The values of the ratio $\left(\frac{w}{w_1}\right)$ in the foregoing table exhibit a wide variation, as is to be expected. In the case of the 35-in. steel pipe, it is probable that the filling under the lower quarters of the pipe was not well done, and that the pipe rested mainly on a narrow strip of the bottom, whereby the deformation was greatly increased.

Where a good support on the bottom is given by dry or well-tamped sand, it seems that the external load due to the backfill may be taken at from one-fifth to one-half the weight of the material, distributed uniformly on the horizontal projection of the pipe, when the depth of covering is from 3 to 7 ft.; but when the backfill is heavily loaded, a corresponding addition must be made, as indicated in the case of the cast-iron pipes. The data are not sufficiently numerous and diversified to give a clear view of the matter, as so much depends on the nature of the backfill and the way it is placed under and over the pipe; hence until further investigations have been made, it will be prudent to assume that in locations where the right of way for a pipe conduit is not affected by heavy moving loads, such as locomotives, road rollers, etc., at least two-thirds of the weight of the backfill acts upon the pipe as a uniformly distributed vertical load and produces circumferential bending stresses in the metal.

The magnitude of the maximum stress s in the outermost fiber, due to the said uniform vertical external load (w), is found by placing the moment or modulus of resistance equal to the maximum bending moment: $M = \frac{wD^2}{16} = \frac{st^2}{6}$, whence $s = 0.375\,w\left(\frac{D}{t}\right)^2$. Now, if we assume that the backfill weighs 115 lbs. per cu. ft. and is 6 ft. deep, the weight will be $w_1 = 4.8$ lbs. per sq. in.; and if two third thereof acts vertically upon the pipe as aforesaid, the value of the w will be $w = \frac{2}{3}w_1 = 3.2$ lbs. per sq. in., whence $s = 1.2\left(\frac{D}{t}\right)^2$. In general, the ratio $\left(\frac{D}{t}\right) = 37$ for thinnest large cast-iron pipes and 193 for the thinnest large steel pipes; hence we have in general the maximum stress due to bending $s = 1{,}643$ lbs. per sq. in. for cast iron, and $s = 44{,}699$ lbs. per sq. in. for steel. This latter value of s is greater than the elastic limit of the metal, and hence the pipe will become permanently flattened unless a considerable horizontal pressure is exerted on the sides of the pipe. From the foregoing experimental data it does not seem expedient to regard the ratio $\left(\frac{w}{w_1}\right)$ as being less than 0.25 under the most favorable conditions, and if the weight of the backfill is only 96 lbs. per cu. ft. with a depth of 3 ft., we will have $w = \frac{w_1}{4} = 2.0$ lbs. per sq. in., and $s = 0.75\left(\frac{D}{t}\right)^2 = 27{,}937$ lbs. per sq. in. for the thinnest steel pipes. These figures will suffice to show that the stresses caused by the backfill are of much importance when the pipe is empty or internal water pressure is small.

The question now arises whether the tensile bending stress due to the backfill is to be added to the tensile stress resulting from the internal water pressure, or whether the latter does not eliminate the former in large degree by reducing the initial deformation or flattening. There can be little doubt that a large internal water pressure will tend to restore the original circular cross-section of the pipe, but in doing this work the sides of the pipe will recede slightly from the adjacent earth and thus reduce or eliminate any existing lateral horizontal pressure. This action must be followed by a corresponding increase of the vertical external pressure until equilibrium is finally established with a somewhat greater external load than while the pipe was empty, and hence also with a slight deformation and a resulting tensile stress that will add to the stress produced by the internal water pressure. It is difficult to determine the magnitude of this final flattening and its accompanying tensile stress. In the case of cast-iron pipes it will usually be small, but in the case of thin steel pipes it may attain a considerable magnitude. Under existing conditions of inadequate experimental data, it will, therefore, be prudent to consider that the backfill will produce an appreciable deformation and tensile stress in large water pipes, as done in Mr. Hazen's formula.

Another feature in the case is the external pressure of the atmosphere against the wall of a pipe from which the water has been withdrawn, as when a valve is closed and a blow-off is opened. The backfill is usually more porous above the pipe than below the same, so that momentarily a greater atmospheric pressure will develop on the upper surface than on the lower one when all internal pressure ceases; and if the material is moist and plastic, the air pressure on the surface of the backfill will act like an applied load at the rate of 14.7 lbs. per sq. in., of which the greater part will be transmitted to the pipe. This atmospheric pressure is equal to the weight of a column of earth 22 ft. high at the rate of 96 lbs. per cu. ft. No provision for admitting air into cast-iron pipes by means of automatic vacuum valves is usually made, but if we assume a depth of 10 ft. of blackfill at 115 lbs. per cu. ft. in conjunction with the atmospheric pressure, the total external load will become $w_1 = 23$ lbs. per sq. in.; and if three-fourths of this load acts vertically upon the upper surface of the pipe, as indicated by Professor Talbot's data in the foregoing table, we will have $w = 17.25$ lbs. per sq. in., and the corresponding stress $s = 0.375w\left(\frac{D^2}{t}\right) = 8.857$ lbs. per sq. in. in the thinnest cast-iron pipe for which the ratio $\left(\frac{D}{t}\right) = 37$.

This is an extreme case, as there will be a little air pressure on bottom of pipe, owing to the density of the material and the high resistance to the circulation of air therein.

Severe circumferential stresses are also caused in cast-iron pipes by settling of several lengths. This produces an intense leverage pressure in the lead joint on the top and bottom of the spigot, with the probability that the fillet or bead comes in contact at the top with the bell, thus making a concentrated load of great magnitude. If we assume that this vertical load is not concentrated, but is distributed uniformly over the horizontal diameter D and on an effective width of 2 ins., and is resisted by a length of $b = 12$ in. of the spigot end of the pipe, we will have the relation $M = \frac{2wD^2}{16} = \frac{sbt^2}{6} = 2st^2$, whence $w = 16s\left(\frac{t}{D}\right)^2$. Taking the stress s at its limiting value for cast iron in flexure, viz., $s = 27\,000$ lbs. per sq. in., as per Professor Talbot's tests, we will have for a 36-in. cast-iron pipe 1 in. thick a limiting leverage load on the lead joint $w = 316$ lb. per sq. in. on width of

Internal diameter In.	Thickness (t) In.	Mean Diameter (D). In.	Deformation. (y). In.	Estimated load (w₁). lb. sq. in.	Computed load (w) lb. sq. in.	Ratio w / w₁	Backfill
48	1.25	49.25	1.00	37.2	29.2	0.785	S
48	1.50	49.50	1.00	51.2	44.4	0.864	S*
36	1.00	37.00	0.80	[illegible]	37.5	0.734	S*
36	1.25	37.25	0.50	63.8	44.6	0.700	S*
42	0.238	42.238	0.438	2.92	0.445	0.153	S*
42	0.203	42.203	3.70	4.69	2.216	0.472	SC†
42	0.203	42.203	2.75	4.69	1.741	0.372	SC†
42	0.203	42.203	1.00	3.61	0.633	0.175	WS‡
	0.203	42.203	0.763	2.92	0.356	0.122	S*
	0.203	35.203	3.00	3.13	3.922	1.255	SC†
	0.203	33.203	0.375	3.19	0.620	0.194	S*
	0.203	33.203	0.188	1.67	0.310	0.186	S*
	0.25	38.25	2.00	5.83	3.504	0.600	WC§
	0.25	38.25	1.50	5.83	2.628	0.450	WC§

*Weight of dry sand given at 80 lbs. per cu. ft.
†Weight of sandy clay estimated at 90 lbs. per cu. ft.
‡Weight of wet sand estimated at 100 lbs. per cu. ft.
§Weight of wet clay, etc., estimated at 120 lbs. per cu. ft.

S=Dry sand.
SC=Sandy clay.
WS=Wet sand.
WC=Wet clay and stones

2 in. Such a load is very easily developed by the settling of a few heavy pipes in a yielding soil.

In addition to the computable stresses mentioned in the foregoing, there are a variety of other stresses that should be taken into consideration, as cited in Mr. Hazen's paper. Concerning the magnitude of these other stresses, little information of a definite character is available, and hence allowance for them must be made in the adopted factor of safety. Mr. Hazen has shown very good reasons for modifying our previous formulas for the thickness of large cast-iron pipes, and submits a rational substitute. The only point that the writer can raise is in regard to the ultimate tensile strength of that quality of cast iron which is now commonly used for making pipes. The author has adopted for this a value of 22,000 lb. per sq. in. Not many years ago water-works engineers were satisfied if the direct tension tests of samples of the metal showed an ultimate strength of about 16,000 lbs. per sq. in. For breaking stress in bending, values of from 30,000 to 40,000 lbs. per sq. in. are often obtained, but as these figures are commonly based on the erroneous assumption that at rupture the neutral axis lies at the middle of the rectangular cross-section of the test bar, it is clear that they cannot represent the normal tensile strength of the metal which is brought into action by the internal water pressure. The use of $s=22,000$ thus implies a marked improvement in pipe foundry practice which deserves some explanation, and the author will add much to the value of his paper by submitting a brief abstract of recent tests of pipe metal on which his figure is based.

DRAINAGE AND IRRIGATION SECTION

Structural and Construction Features of the Supply System for the South San Joaquin Irrigation Works, California.

The supply system of the South San Joaquin Irrigation District, California, comprises works aggregating $1,000,000 in value. Its main structures are: Concrete deversion dam 450 ft. long and 75 ft. high; 16.6 miles of conduit, 6,620 ft. being tunnel and the remainder open canal concrete lined in part; 2,000 ft. of flume in trestle, and concrete head and regulating works. In addition there are various auxiliary structures such as culverts, waste gates, bridges, drops, siphons, etc. These structural features are chiefly the subject of this article. Figure 1 is a map of the district showing the locations of the principal works.

DESCRIPTION OF DISTRICT.

The South San Joaquin Irrigation District consists of 71,050 acres, is 18½ miles long east and west by 6 miles average breadth north and south, and lies along the north side of the Stanislaus River, a large Sierra Nevada stream. The northwest corner of the Irrigation District is only 5 miles from Stockton, a city of about 25,000 inhabitants at the head of San Francisco Bay navigation. Stockton is a railroad center, and the South San Joaquin District is intersected by the Southern Pacific and the Santa Fe railroads, while the Western Pacific runs along its western edge and another Southern Pacific line a mile east of its eastern boundary. The wagon-roads are numerous and excellent.

The district was organized (by a public election) on May 11, 1909. On June 15 Mr. Edwin Duryea, Jr., of San Francisco, Cal., was retained as Chief Engineer and on June 20 began his field examination and surveys. The preliminary surveys were completed in August, and on Oct. 8, 1909, a report was rendered to the directors, with studies of several sources, and with maps, designs and estimates of cost for the complete irrigation system recommended. A bond election was then called and on Dec. 30, 1909, bonds to the amount of $1,875,000, were voted by a majority of about 5 to 1.

These bonds are dated July 1, 1910, and mature serially from July 1, 1931, to July 1, 1940; 3,747 of the bonds are for $500 each and 6 for $250 each. The interest is payable semi-annually on January 1 and July 1, 2½ per cent at each date. A total of $357,500 of these bonds have already been sold; the proceeds from $325,000 of them being used to purchase a half-interest in an old irrigation system, the works and water rights of which were brought out jointly by the South San Joaquin and Oakdale Irrigation Districts; and $20,000 of the proceeds were used for engineering expenses, etc., and the remainder for the purchase of reservoir lands.

Soon after the election at which the South San Joaquin bonds were voted, studies and cost-estimates were begun by the engineer to determine the advisability of purchasing the only adverse irrigation system and water rights, mentioned above. After protracted negotiations, an agreement was closed for its purchase; and on July 1, 1910, the old irrigation system, known as the Tulloch System, was taken over jointly by the South San Joaquin and Oakdale Irrigation District, and since that time has been used by the two districts for the irrigation of about 6,000 acres, 3,000 in each district.

On July 7, 1910, as soon as subscriptions had been received guaranteeing the sale of some bonds, a survey party was put in the field by the South San Joaquin District and the final location, plans and estimates of that system were begun. The surveys of 1909 resulted in developing a good system at a reasonable cost; but the object of the later surveys was to develop the best system at the least cost. The works described here are the results of these surveys.

A special assessment or tax of $67,127.69 was voted by the district on May 12, 1910, to meet the interest on the bonds expended for the purchase of the Tulloch System, and to meet the cost of engineering surveys and plans and of other district expenses. These taxes did not become due until December, and on March 1, 1911, all but $135 had been collected, while on April 1, 1911, every dollar had been collected. An official statement made by the secretary on March 29, 1911, showed that the floating debt at that time was nothing, and that the cash in the treasury amounted to $21,438.90.

The total number of acres in the district is 71,050; of this 70,000 acres are now under cultivation, 800 acres are tillable but not under cultivation, while 250 acres are untillable. The total bond issue authorized is $1,875,000, or $26.40 per acre for the 71,050 acres. The assessed value of the land alone, exclusive of all improvements, is $2,848,997, or $40.10 per acre. The present market value of the land exclusive of improvements averages $85 per acre, or amounts to $6,039,000 for all the lands of the district; and the market value will be two to three times as great as soon as the irrigation system is completed and the land irrigated.

The present population of the district is about 3,500, and the value of its agricultural and viticultural products during 1910 was at least $2,500,000.

STRUCTURES.

For construction purposes the supply works are divided into six sections as indicated on the map, Fig. 1. This sectional division will not be followed here; instead the works will be classified according to general character.

Diversion Dam.—The water for irrigation is collected by diverting the Stanislaus River by means of a dam and head works located as shown in Fig. 1. Figure 2 shows a plan and a profile of the structures. The cross-sectional profile shows the valley to be rudely W-shaped, a mid ridge separating the valley into two parts. The dam structure consists of two arches, one spanning each half of the valley, these arches having a common buttress support at their ridge ends. The head works are built into the shore end of one of the arches. The concrete structure goes to bed rock, which will be excavated into and a solid surface secured.

Sections of the arches are shown by Fig. 3. All except the upper 6 ft. of the arches will be plain concrete, this upper portion will be reinforced as illustrated. Two qualities of concrete are specified; a 1:2½:5 mixture for the arches proper and a 1:3½:5 mixture for the buttress, foundations, etc. It is provided that rubble between 2 cu. ft. and ½ cu.

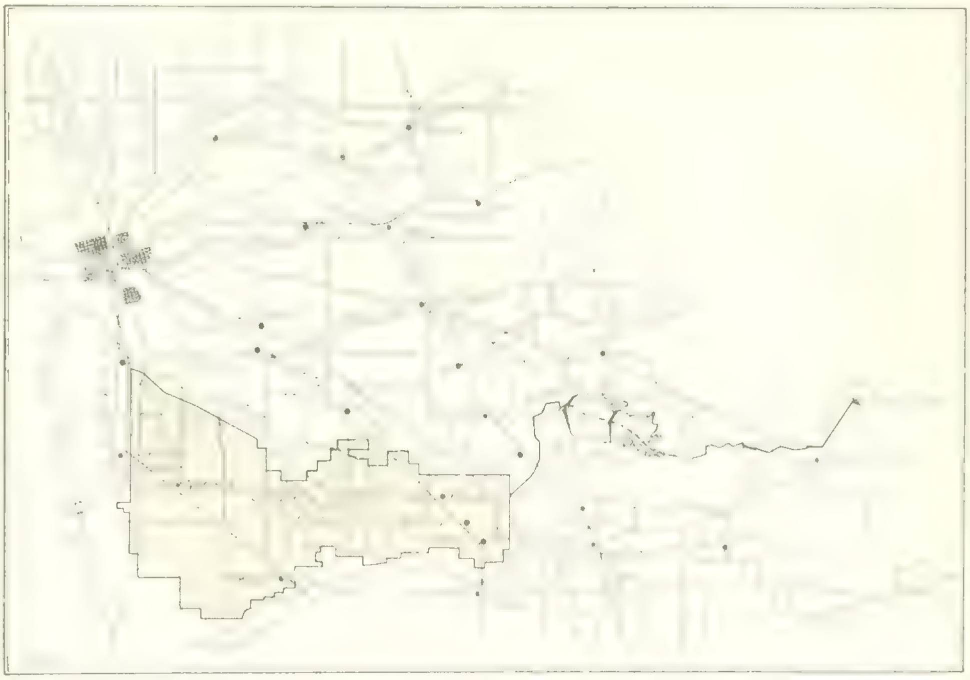

Fig. 1—Map of South San Joaquin Irrigation District, Supply Canal and Diversion Dam.

in volume may be used providing the stones are separated 1 ft. from each other and from faces. The upstream faces of the arches will have a ¾-in. plaster coat of 1:1 mortar placed when the concrete is placed by troweling it onto the forms just ahead of the concreting. In constructing the arches the specifications require that:

The concrete of the arches shall be placed in alternate blocks, generally not less than 50 ft. in length, as shown on Fig. 3. These blocks will be placed between temporary radial forms having projections on them to cause interlocking with adjoining blocks. The concrete shall be placed in horizontal layers in each block, and at the close of each day's work or whenever work on any block is discontinued, tapered groove timbers or forms shall be built temporarily into the horizontal top surface of each block to permit each block to interlock with the overlying blocks to be built subsequently.

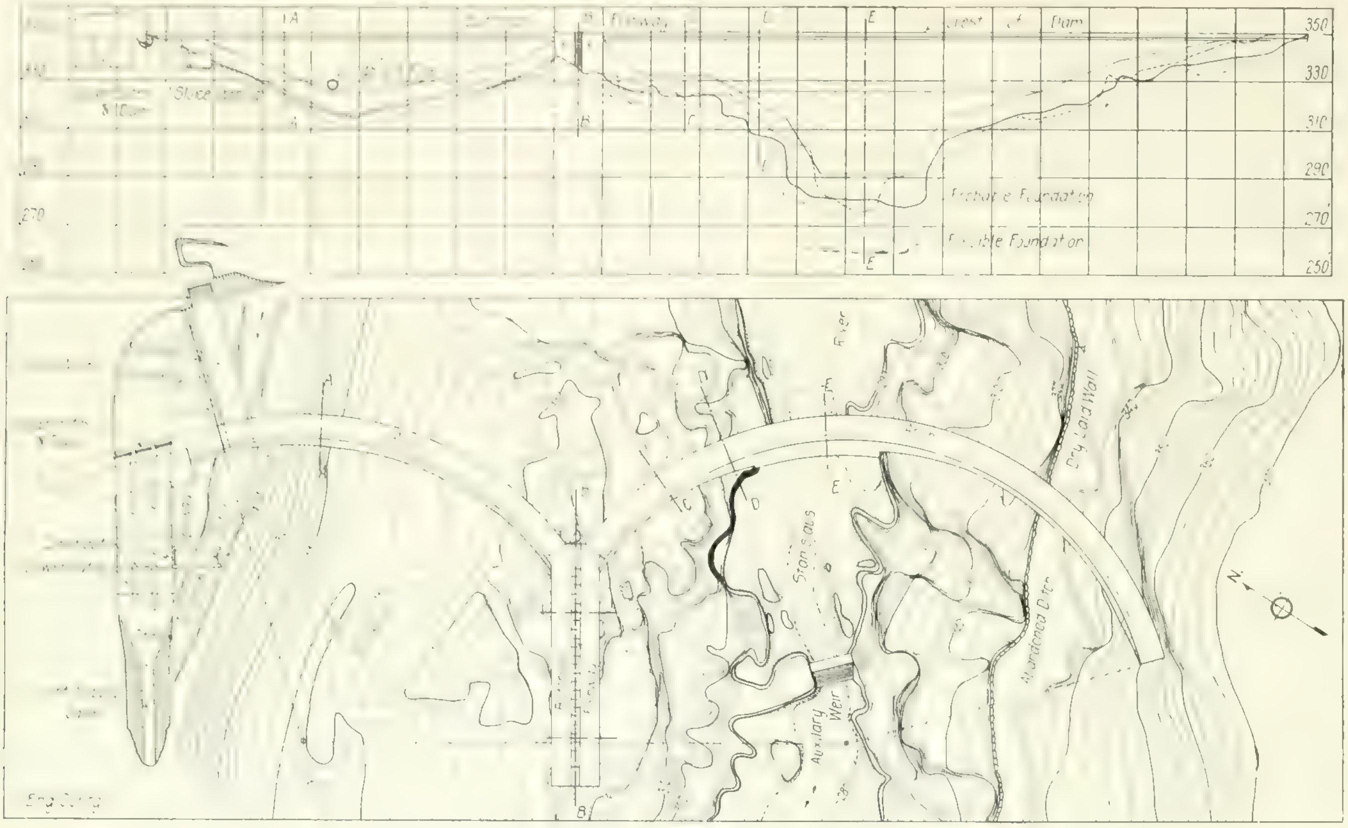

Fig. 2—Plan and Profile of Double Arch Concrete Diversion Dam and Head Works.

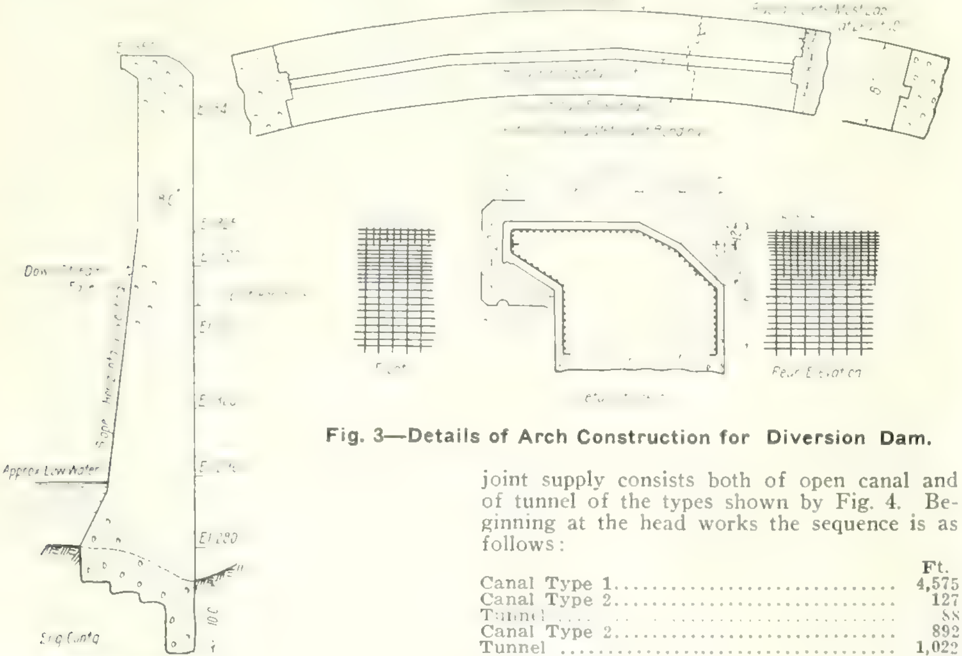

Fig. 3—Details of Arch Construction for Diversion Dam.

The general methods of conducting the concrete work conform closely to ordinary good practice. The head works forming a part of the dam conform in character of construction to the dam itself.

Joint Supply Canal.—From the diversion dam for a distance of 3.58 miles, corresponding to Div. 2 on the map, Fig. 1, there will be built a joint canal or conduit to supply both the San Joaquin and the Oakdale districts, and from the end of this canal each district will construct its individual supply canal. The joint supply consists both of open canal and of tunnel of the types shown by Fig. 4. Beginning at the head works the sequence is as follows:

	Ft.
Canal Type 1	4,575
Canal Type 2	127
Tunnel	88
Canal Type 2	892
Tunnel	1,022
Canal Type 2	961
Canal Type 2B	538
Tunnel	1,122
Canal Type 2B	493
Canal Type 2	4,451
Tunnel	2,940
Canal Type 4	563
Total	18,772

Of this total length 5,172 ft. are tunnel, of which 3,025 ft., viz., the 88-ft. and the 2,940-ft. tunnels, will be newly driven tunnel and the remainder will be old tunnel enlarged to sections, Type 3 or 3A.

The noticeable feature of the joint supply conduit work is that both open canal and tunnel are to be concrete lined in large part at least. The requirements for the lining work are a 1:3:6 mixture with a 1:1 mortar finish ¾ in. thick, laid simultaneously with the concrete by being troweled onto the forms. In canal the lining will be placed in alternate 12-ft. sections, using wood end forms for the first set of sections. The forms are not to be removed short of 48 hours, and other usual precautions taken to secure a sound concrete.

Supply Canal, San Joaquin District.—Beginning at the end of the joint canal above described there will be as shown by Fig. 1 a main supply canal to the San Joaquin District. This canal, with the exception of some 2,000 ft., which will be flume construction on trestle, will consist of open canal and of tunnels having the sections shown by Fig. 5. The lengths of conduit of the several types are as follows:

Type.	Length ft.
Open Canal Type 5	12,463
Open Canal Type 7	1,843
Tunnel Type 6 or 6A	980
Open Canal Type 8	13,643
Open Canal Type 8A	4,944
Open Canal Type 8B	1,070
Tunnel Type 9 or 9A	743
Open Canal Type 10	33,680

The sections of Type 10 will gradually decrease in width from the figures given by Fig. 5 to 11.43 ft. bottom and 22.76 ft. top. All open canal and tunnel of Types 5, 7, 6, 8A, 8B and 9 will be concrete lined, this lining being as described for the joint supply canal. The specifications for open canal excavation are as follows:

Excavations in open cuts shall be made true to the grades, lines and cross-section stakes or marks, and shall be finished with reasonably smooth surfaces, in order to facilitate the placing (where desired) of concrete lining. Blasting must be done with care, in order not to shatter the sides and beds of the canal against which (if desired) concrete lining is to be placed. High explosives shall be used very sparingly, and only with the approval of the engineer.

Embankments shall be thoroughly compacted in thin layers by rolling or tamping with a Petrolithic Roller or some equally efficient device. All lumps must be broken up and the materials as thoroughly compacted as can be made by moistening and rolling or tamping. The bed and inner slopes of embankments must be built full, the bed at least 1 ft. and the slopes at least 2 ft. inside the neat lines of the back surface of the concrete-lining; and before applying the concrete-lining the excess material shall be carefully trimmed off to said neat lines.

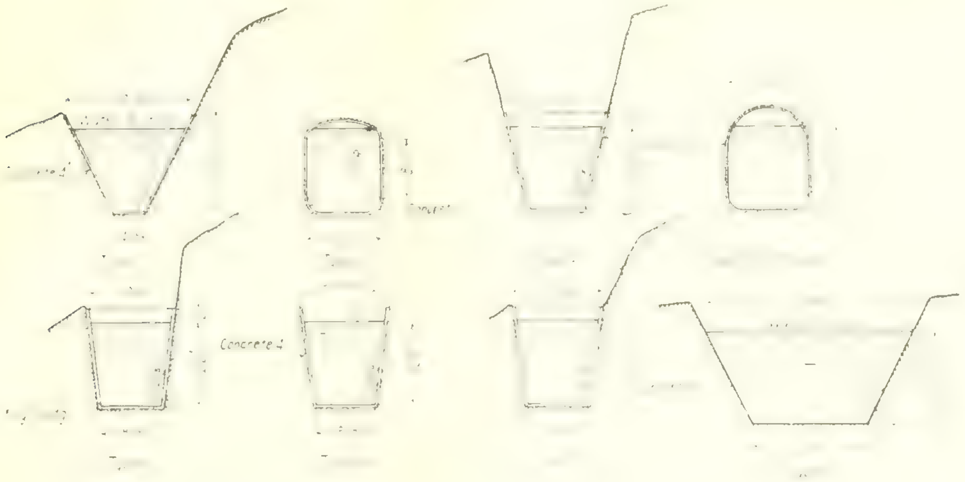

Fig. 4—Types of Joint Supply Conduit Sections.

The materials for embankments shall be furnished from nearby canal-excavations without other cost to the District than the regular price for canal-excavation; except such embankment material as cannot be furnished from canal-excavation without exceeding a 500 ft. haul from mouth of cut, which material shall be paid for at the same price per cubic yard as Canal-Excavation; but the contractor shall be paid for the work of moistening and rolling or tamping embankments, and of trimming them to receive the concrete-lining, the price being paid per cubic yard of completed compacted and trimmed embankment, and including all costs of compacting and trimming the embankment and of disposing of the trimmed material.

Flume on Trestle.—For a length of 2,000 ft., where the supply conduit crosses a sag, there will be built a flume 14½ ft. wide and 9 ft. high. Plans have been prepared for both a modern and a concrete structure, and the comparative prices bid will determine the construction selected. The essential plans for both structures are given in Figs. 6, 7 and 8.

The wood flume trestle, as shown by Fig. 6, is of the ordinary framed bent construction. The trestle and the flume, excepting the planks and battens, are Douglass fir. The planks and battens are of redwood and materials and construction are specified as follows:

The Redwood Planks and Battens of the Flume-Box shall be in general of the same quality of lumber as is used in the best quality of wood-stave pipes. The lumber must be "clear" (without knots) and free from shakes, checks, decay, dry or other rot, or any other defects that will impair its strength or durability. No sap-wood will be allowed. The redwood planks and battens shall be thoroughly air-dried (not kiln-dried) before sizing; and when so dried shall have a weight or not less than 33 lbs. per cu. ft. Both planks and battens shall be surfaced two sides and two edges—and when so surfaced or sized shall measure not more than 5/16 in. scant of the nominal thicknesses and widths. Where necessary to secure tight-fitting joints, the planks shall be sized to a uniform width; and calking-bevels shall be made uniform in slope.

The joints between the flume-box boards shall be thoroughly calked with a good quality of long fibre oakum, well driven in. The joints in the bed of the flume shall then be poured with hot asphalt of an improved quality and at once covered by a strip of 12-oz. canvas soaked in the hot asphalt, overlaid by a batten nailed with 3d. galvanized nails. The joints in the sides of the flume shall be calked in a similar way, but the canvas strip shall be omitted, the battens coated with hot asphalt just before nailing them in place with the galvanized nails, and the calked joint then poured with hot asphalt through the cavity shown along the upper edge of the batten.

The concrete flume is shown in general plan by Fig. 7, and Fig. 8 shows the details of the flume box proper. As this type of flume is somewhat unique we give the specifications for construction nearly in full. The [illegible]

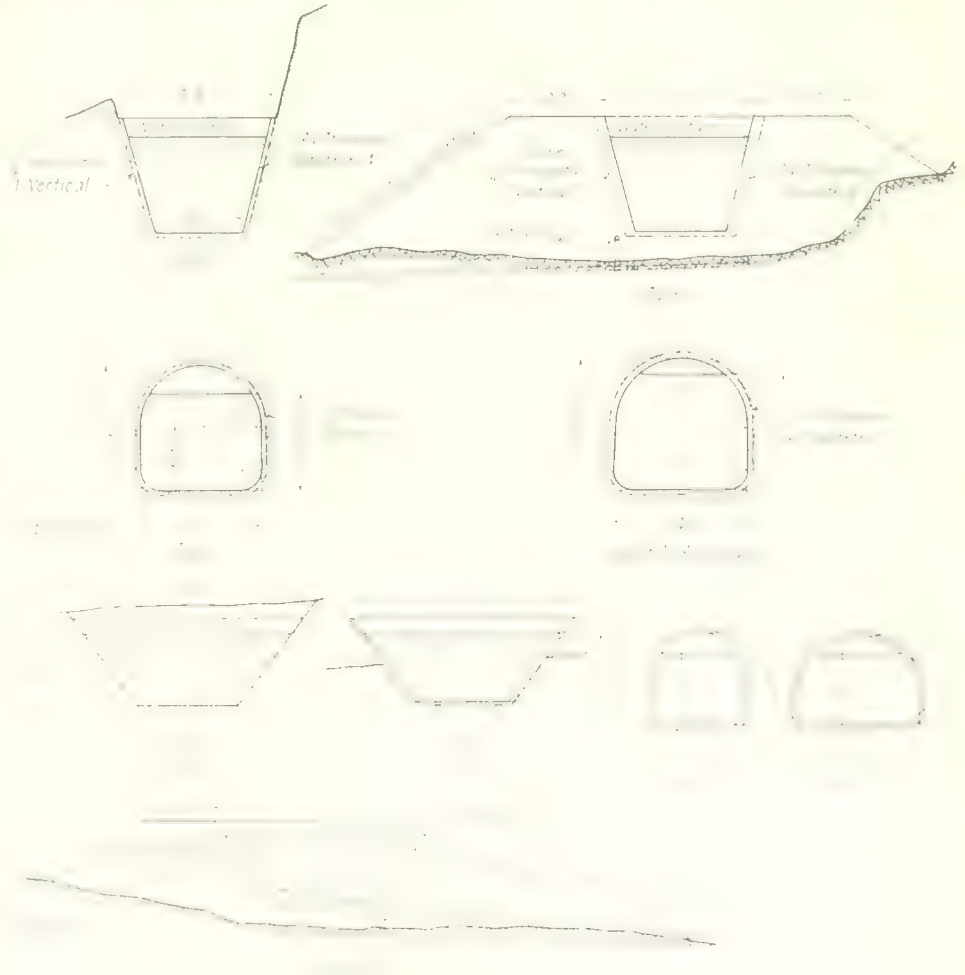

Fig. 5—Types of San Joaquin Supply Conduit Sections.

[illegible] the plans (Figs. 7 and [illegible] flume box and struts between piers [illegible]. The specifications for construction [illegible] are as follows.

Forms.—The forms for the piers, the longitudinal pier-braces and the flume-box shall be substantial and rigid, properly tied or braced together by means of wire or rods, and shall be so designed that the concrete will conform to the proper dimensions and shapes. They shall be simple of construction, and easy of erection, maintenance and removal; and shall be so designed as to be safely removable without the removal of their supports. The lumber for face-work shall be surfaced on one side and two edges and where secured to uprights the boards shall be in horizontal lines. Suitable moldings shall be placed in corners of the forms to bevel off the corners of the concrete. The forms shall be built as nearly water-tight as practicable, to prevent the escape of mortar.

In dry weather or whenever so required by the engineer, the forms shall be thoroughly wet with water just before placing the concrete within them. Unless specially permitted by the engineer, no forms shall be removed before 48 hours after the placing of the concrete; and forms shall not be removed until the concrete has set and hardened to his satisfaction. The forms and supports of the bottom-slab and the sides of the flume-box shall not be removed for at least 30 days after placing the concrete, or until the concrete has set to the satisfaction of the engineer, except such portions of the forms as may be permitted by the engineer to be removed for the purpose of plastering the inside of the flume-box.

Construction work shall not be carried on over the completed flume-box slab or sides, and extraneous weights or loads shall not be placed upon them, until the forms and supports have been removed and the concrete has set and hardened to the satisfaction of the engineer. No concrete pier shall be used to support forms for the flume-box for at least 10 days after its [illegible]

[illegible] may be used [illegible] extraneous weights and loads, the engineer may (if he so desires) test concrete beams about 4x6 in. x 3 ft. in length, made of concrete taken [illegible] portions of the structure under consideration.

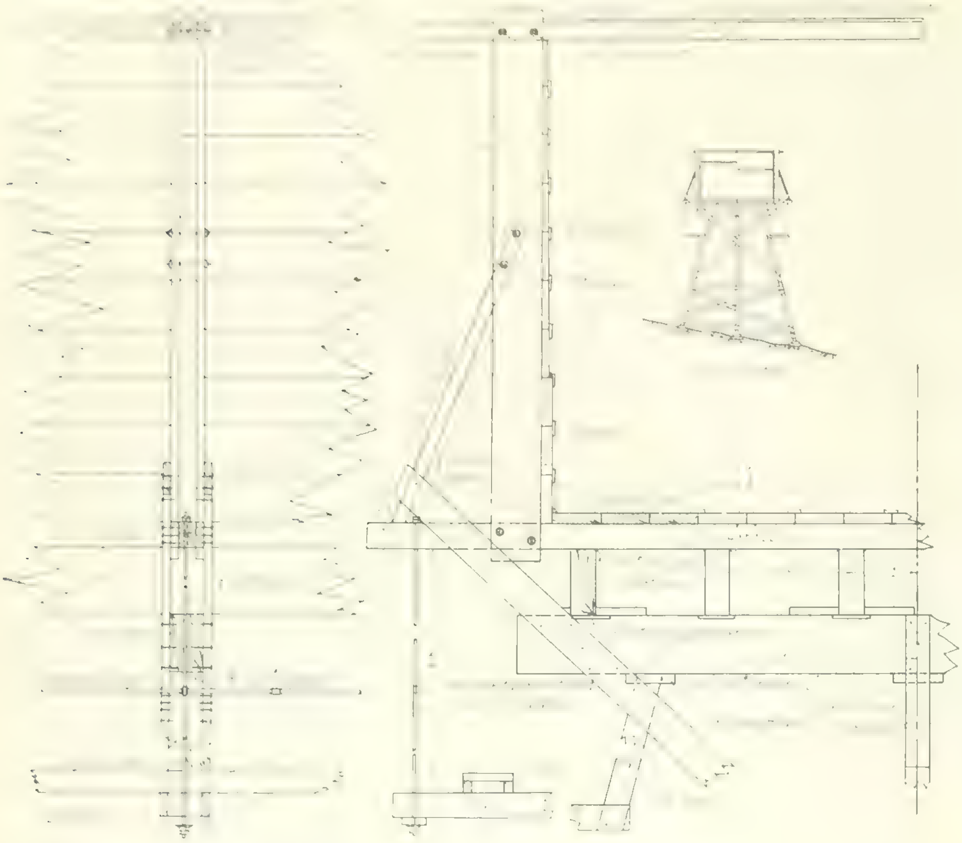

Fig. 6—Details of Wood Flume on Trestle.

In removing the forms and supports, all jar and vibration shall be avoided. No forms shall be removed except in the presence of the inspector. After the forms are removed, no patching or plastering shall be done until all surfaces have been inspected and permission given.

Unless otherwise preferred by the contractor, piers shall be built and completed before the flume-box carried by them shall be begun. And the weight of the forms and concrete for the flume-box may then (after a proper interval) be supported by the piers. To facilitate the construction of the flume-box forms and their support by the piers, the contractor may temporarily build the piers so as to leave pockets or recesses in the concrete at the tops of the piers, to receive wooden beams for the support of the forms and concrete of the flume-box; but the [illegible] and locations of such pockets must be satisfactory to the engineer, and after the removal of the beams the pockets shall be filled with concrete to his satisfaction.

The contractor will be permitted to build the [illegible] box at the same time and in one operation if he so desires—but in such event the forms and supports must be of sufficient strength and rigidity to support the weight of the forms and concrete of the flume-box directly from the ground, without supporting any part of their weight upon the concrete of the piers.

Reinforcing steel shall be so fixed and held in place in the forms that it will not be displaced from its proper positions and spacings during the placing and compacting of the concrete. Whenever practicable all the reinforcing metal shall be put in place in the forms and securely fastened in correct positions by wiring or otherwise before the placing of the concrete is begun.

The steel bars or other reinforcement shall be unpainted. When covered by the concrete they shall be free from dirt, oil or grease, and from mill-scale or heavy rust. A slight film of rust is not objectionable—but all heavy rust and all mill-scale must have been removed from the reinforcing metal by hammering, steel scrapers or brushes, pickling in a weak solution of hydrochloric acid, or by some other equally efficient means of cleaning the metal.

The reinforcing steel shall be of the forms, dimensions and spacings shown or of any other forms, dimensions and spacing of rods or fabric offering an equivalent area of reinforcing metal and satisfactory to the engineer; but the spacings between carrying rods, wires or metal shall never be greater than the thickness of the slab or section, nor less than the perimeter of the rod, wire or metal. The reinforcing metal shall be located at the distances from concrete faces shown or on amplified working drawings, but no part of the metal shall be nearer than 1 in. to a concrete face and generally the distance shall be much greater than 1 in.

All reinforcing steel shall be made by the open-hearth process, and shall contain not more than 0.04 per cent phosphorus and not more than 0.04 per cent sulphur. Steel reinforcing rods shall have an elastic limit not to exceed 50,000 lbs. per sq. in.; and wire in fabric an elastic limit of not less than 80,000 lbs. per sq. in. All steel shall be capable of being bent cold 180° around its own diameter without cracking. Where reinforcing steel is spliced, the rods or wires shall overlap each other 50 diameters or sides. All rods shall have ends bent 1 in. up at 90°. The free ends of all bars shall be bent 180° with a radius four times the diameter or side of the bar.

The consistency of the concrete shall be soft and wet without being sloppy, and in general shall be such that after dumping the concrete in the forms it may be consolidated and worked into place with spades or shovels, and a slight quaking secured with little or no tamping. The concrete shall be wet and soft enough to flow into the forms and about the reinforcing metal, but not so soft as to permit of the separation of the coarse aggregates from the mortar during the conveyance of the concrete from the mixer and its placing in the forms.

If required by the engineer, the outside of the forms shall be pounded with wooden mauls or mallets immediately after receiving the concrete, to assist in shaking down and consolidating the concrete. The greatest care must be taken to insure the coating of the reinforcing metal and the forms with mortar and the thorough compacting of the concrete around the metal. Concrete shall be handled rapidly after the addition of the water and shall be placed in its final position in the forms with as little delay thereafter as practicable. No concrete shall be used after its initial set has begun, and the "retempering" of mortar or concrete shall not be permitted.

The concrete shall generally be placed in small [illegible] and in thin horizontal layers of about 4 ins. to 6 ins. in thickness; but where satisfactory to the engineer and when satisfactory arrangements are made to insure the placing of the concrete in approximately horizontal layers.

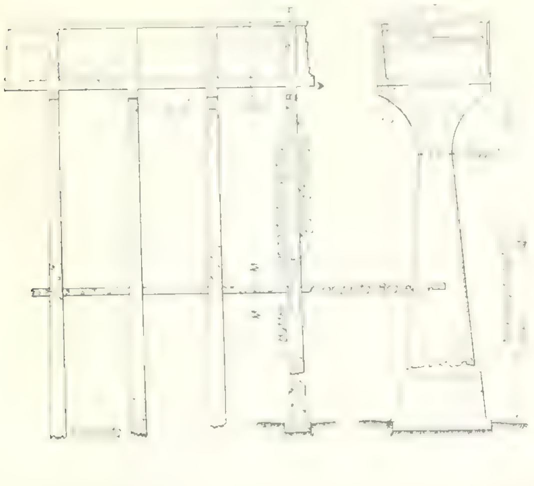

Fig. 7—General Plan of Concrete Flume on Piers.

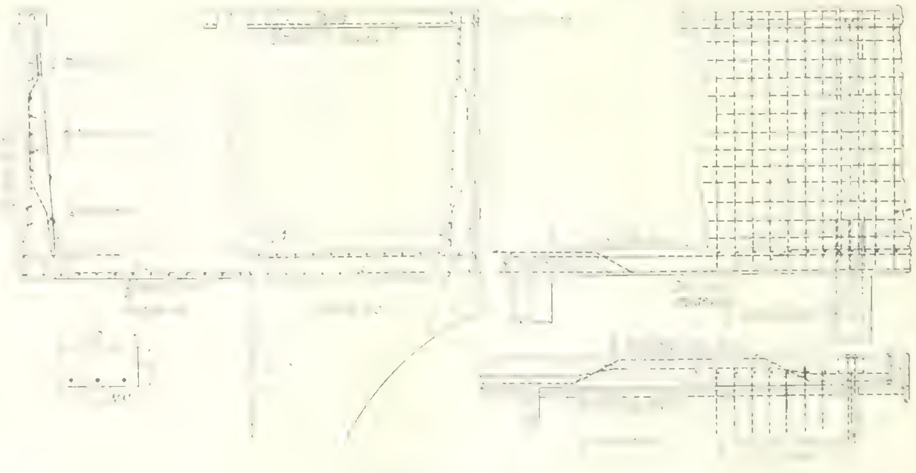

Fig. 8—Details of Reinforced Concrete Flume Box.

without the separation of its ingredients, and to insure the complete filling of the forms, the concrete may be "poured." If so required by the engineer, the forms or the concrete shall be kept wet for at least 10 days after the concrete is put in place. No concrete shall be laid in freezing weather unless precautions satisfactory to the engineer be taken to prevent injury to the concrete. When considered advisable by the engineer, fresh concrete shall be covered to protect it from danger of injury by frost.

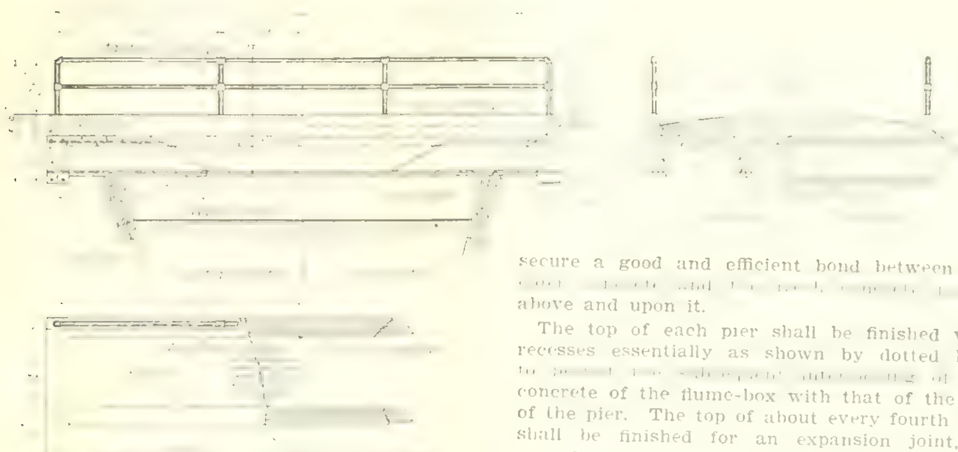

Fig. 9—Details of Reinforced Concrete Farm Road Bridge.

The concrete surfaces of the inside of the flume-box shall be lined with a ½-in. thick coating of cement-mortar of equal parts of Portland cement and sand. When practicable (as on the top surface of the bottom slab of the flume-box) this plaster coating shall be placed as soon as the concrete is finished and before it has had time to harden. When not so practicable, efficient means must be used to secure a lasting adherence of the plaster coating to the concrete, or some other method satisfactory to the engineer may be used to make the flume-box impervious and tight against seepage.

Unless otherwise specially permitted by the engineer in writing, each pier shall be completed from its foundation to the bottom of the flume-box in one continuous operation, without allowing time for any of the concrete to set and harden before fresh concrete has been placed upon it. If so desired by the contractor, the night work required by such procedure may be carried on with as small a gang as will insure the placing of fresh concrete before that beneath it has set.

Should the continuous laying of concrete in a pier be interrupted for any reason, means satisfactory to the engineer must be taken to clean and roughen the concrete which has set and to secure a good and efficient bond between the older concrete and the fresh concrete placed above and upon it.

The top of each pier shall be finished with recesses essentially as shown by dotted line, to permit the subsequent interlocking of the concrete of the flume-box with that of the top of the pier. The top of about every fourth pier shall be finished for an expansion joint, in accordance with detail working drawings to be furnished before construction. Expansion joints shall be made in the bottom and sides of the flume-box over the piers, at intervals of about four spans or of about 48 ft. The expansion joints cut the flume-box up into separate sections each of about 48 ft. length and containing about 57 cu. yds. of concrete in each such section, and each such section of flume-box shall be completed in one continuous operation, without allowing time for any of the concrete to set and harden before fresh concrete has been placed upon it. If so desired by the contractor, any night work required by such procedure may be carried on with as small a gang as will insure the placing of fresh concrete before that beneath it has set. Should the continuous laying of concrete in a flume-box section be interrupted for any reason, means satisfactory to the engineer must be taken to clean and roughen the concrete which has set and to secure a good and efficient bond between the older concrete and the fresh concrete placed above it.

Bridges.—Figure 9 shows the typical reinforced concrete form road bridge crossing to be constructed. For highway crossings the same type of structure is used, but it is wider and has six girders instead of four. The farm road bridge shown contains 11¼ cu. yds. of concrete and about 2,370 lbs. of reinforcement and for a highway bridge of the same span these quantities are 17 cu. yds. and 3,693 lbs. Another design for farm road bridge is shown by Fig. 10. The design calls for one pier as shown located in the middle of the canal. A 40-ft. span bridge calls for about 4,890 ft. B. M. of lumber.

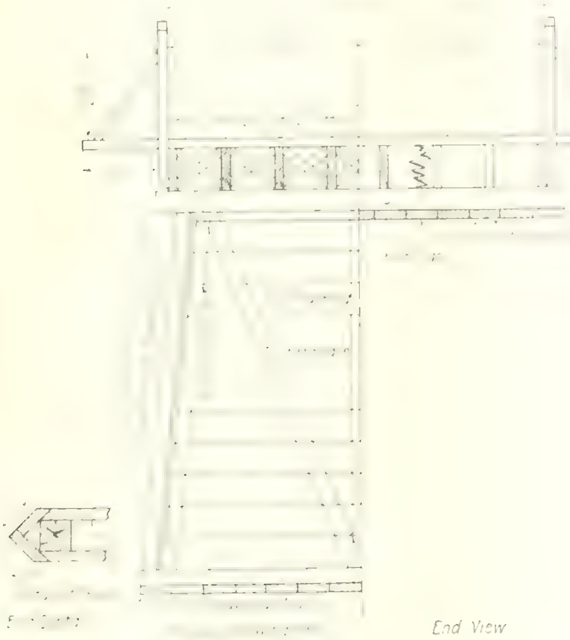

Fig. 10—Sections of Wooden Farm Road Bridge.

Culverts.—Figures 11 and 12 show typical culverts. Single culverts are used in sizes of 1x1, 2x2 and 3x3 ft. Figure 12 is a double 3x3-ft. culvert.

Drops.—Figure 13 shows typical reinforced concrete drop used on the canal. This design calls for 69 cu. yds. of concrete.

Inverted Siphon.—Where the supply canal crosses the line of Lone Tree Creek, the Southern Pacific Ry. and a highway it is carried by an inverted siphon, details of which are shown by Fig. 14.

Waste Gate and Sand Sluice.—Figure 15 shows the details of the standard waste gate and sand sluice.

The Influence of Underdrainage on Spring Floods.*

During recent [illegible] drawn to the opinion held by some that underdrainage increases floods. After much thought and some investigation, I have come to hold the opposite view.

In the first place, facts, so far as I have been able to observe and otherwise learn, show that underdrainage lessens the amount of water at times of freshet. Let me illustrate: On a certain farm of which I could give the lot, concession and township, there was a swamp of 15 acres, the water from which flowed along a lane ditch, a part of the fall being quite rapid. The swamp was all cleared at one time, but the upper 5 acres had been allowed to grow up into a slash. The remaining 10 acres was cropped, but with indifferent results, as it was too wet, a few open ditches and water furrows providing the only drainage. Every spring freshet brought down large volumes of water, the evidence of which might be seen in the washing of the banks and the cutting of the rock in the rapid portion of the ditch, and also in the large deposits of mud lower down where the grade was not so steep. Some years ago the 10 acres was tile drained, and personally observing the ditch from time to time since then, I have wondered at the comparative freedom from washing, cutting and sediment. The 5 acres was afterwards cleared and tiled and the erosion and deposit of sediment still further reduced. Only a week or so ago the owner corroborated my own observations and stated very emphatically that in his case tile drainage, and that alone, had decreased the floods.

There is the fact, as revealed by observation and testimony, in one case at least. Let us examine whether it is what should be expected as a result of underdrainage. Speak-

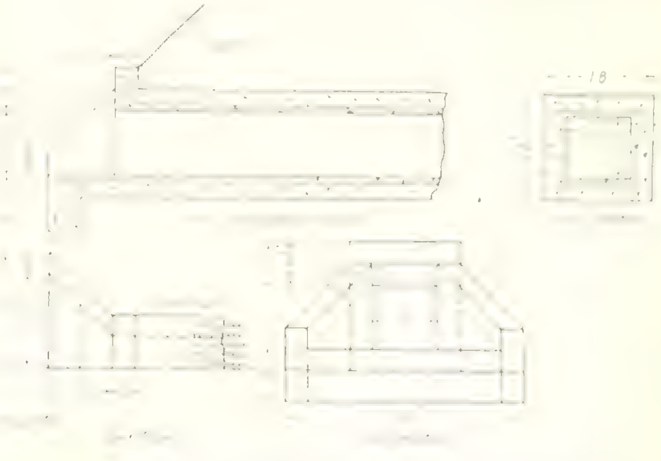

Fig. 11—Details of Standard Single Culvert.

[illegible]

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*[illegible] W. H. Day, 1911 [illegible]

[illegible] may be learned from the records kept at the observatory in Toronto, nevertheless the ground is drier in August and early September than at any other time. In late September, October and November, however, the ground becomes wetter and wetter, not because of increasing rainfall, for it is really less then than in the summer, but because evaporation is less, and any rain that does fall remains to moisten the ground instead of being returned to the air in vapor. The soil, however, is porous like a sponge, and in its dry state it is capable of absorbing a great deal of water before becoming really wet, and before any is lost either by run off or drainage. Often the rainfall for November is very large, for instance, in 1908, at Guelph, it was 5.07 ins. for one month, and in 1909, 6.41 ins., which is more than for April and May combined, except once in the 23 years' record at the college, yet the November rains do not cause floods, not even the phenomenal rain of November, 1909. Why? Because the soil is far from saturation, and consequently is able to absorb most of the rain that comes. Moreover, the November rains are usually of the moderate, steady nature, giving plenty of time for absorption of the water by the soil. By the middle of December when in most parts of Ontario it is permanently frozen up for the winter, the ground is usually pretty thoroughly saturated, and from the highlands considerable drainage, either natural or artificial, has occurred, with the result that much undrained, low land, such as slashes, swamps and marshes, is under water. On Dec. 4, 1909, I attempted to cross a swamp that I had crossed a month before without difficulty, but found the water so deep that I could not have done so had it not been frozen over. Practically all the undrained, slashes, swamps and marshes have their soil saturated, indeed, covered with water, by the middle of December, and in that condition they remain until spring, when in March or April the snow melts and several inches of water all over the country is liberated within a few days, sometimes, indeed, within a few hours. The soil on the upland being still frozen, or practically saturated with water, if the frost is out, the melted snow, unable to find entrance to the soil, takes the steepest slope for the low land, the slashes, swamps and marshes, where it finds a soil long since saturated and covered with water. These reservoirs, already nearly full, soon overflow and a flood results. These are conditions familiar to all who have given any thought or observation to the subject. What should we find if the slashes, swamps and marshes were tile drained? During the latter part of December last the drains in the one-time swamp previously mentioned were pouring a nice stream of water down the lane ditch, as they do every winter, and when the spring times comes around that 15 acres is thoroughly drained. Therefore when the snow-water from the high land reaches the swamp (?) instead of finding a saturated soil covered with water, it finds a soil comparatively dry and capable of absorbing great quantities of water. When this absorption has taken place, and when the soil has become covered with water to the same depth as it used to be during the winter before the drains were put in, there is not nearly so much surplus left to cause floods as if the snow-water had found the swamp already nearly full as it used to. Consequently, underdrainage should be expected to lessen floods, not increase them. That experience bears out the logic is strong evidence of its correctness.

To be sure, the drains begin working in the spring as soon as the water has saturated the soil, but underdrainage is slow compared with run-off, and the amount of water the drains deliver in a given time is small compared with the overflow that must occur in the same time if the water running into the swamps found them already full almost to overflowing.

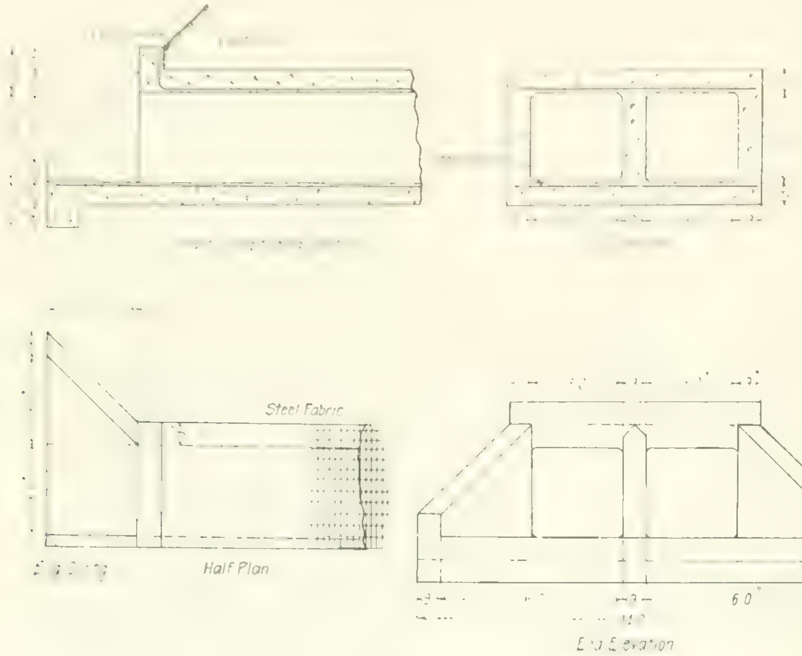

Fig. 12—Details of Standard Double Culvert.

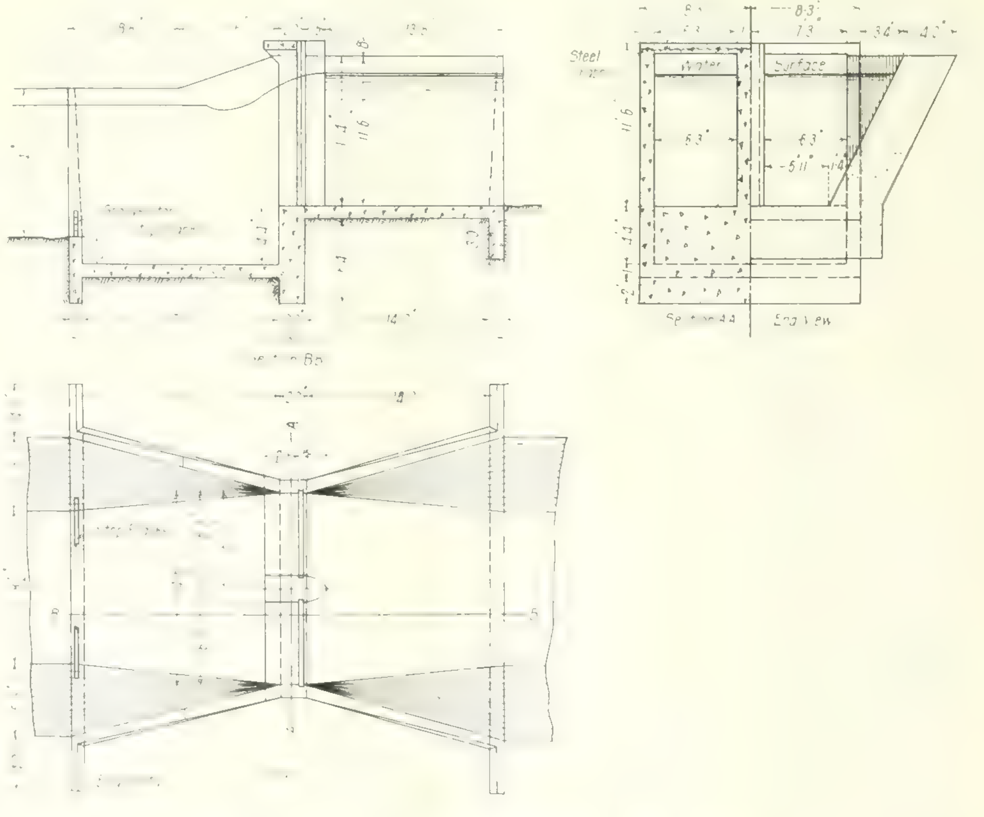

Fig. 13—Details of Standard Concrete Canal Drop.

Water Losses in Irrigation Canals and Methods of Prevention.*

When it is recalled that in large irrigation systems the water losses usually range from 30 to 60 per cent of the total supply taken into the canal and that the limitation of irrigation development in the arid regions of the United States is the result of water shortage rather than of land shortage, the relation of canal losses to the sufficiency of water supply for any irrigation project and to the need for their prevention is apparent. Where an adequate water supply exists the engineer must still give careful consideration to canal losses in order to arrive at intelligent designs of the capacities of the various canals and laterals to meet the needs of economy of construction and adequacy of delivery of water to the land. Even after an irrigation system has been designed with proper provision for canal losses, the irrigation engineer must take steps in many cases to prevent canal losses in order to protect the canals from breaking and the irrigable lands from seepage water.

Canal losses are due to evaporation and percolation. Evaporation can again be divided into direct and indirect evaporation, or that occurring from the water surface itself and that occurring from the adjacent soil wetted by percolation. Direct evaporation is clearly independent of percolation, but indirect evaporation is evidently dependent upon and contributary to percolation. Direct evaporation is so small that for all ordinary purposes it may be neglected in considering canal design, except where reservoirs are involved. At Boise, Idaho, the minimum evaporation occurs during January, at which time it amounts to 0.1 to 0.2 ft. for the month. The maximum evaporation occurs in July and amounts to from 0.6 to 0.8 ft. for the month. The total annual evaporation is approximately 5 ft., about 4 ft. of which occur during the legal irrigation season covering the period between April 1 and Oct. 31. These figures indicate that the loss of canal water due to surface evaporation during the period of greatest loss will not be far from .025 cu. ft per day per square foot of water surface, and that the average daily loss for the total irrigation season will be approximately 0.02 cu. ft. per square foot of water surface per day. These losses are, in most cases, considerably less than 5 per cent of the probable losses from percolation. In estimating canal losses, therefore, it is sufficiently accurate to assume a seepage rate that will cover losses due both to percolation and evaporation.

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*A paper by F. W. Hanna, Boise, Idaho before the Idaho Society of Engineers.

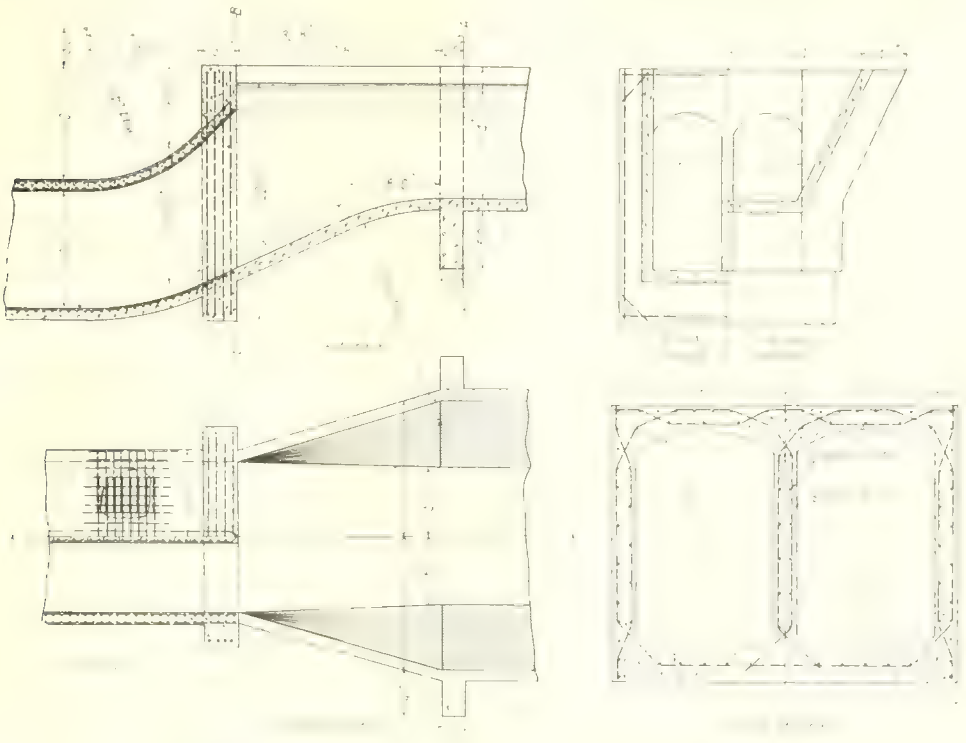

Fig. 14—Details of Inverted Siphon for Supply Canal.

Seepage losses are usually expressed in per cent of canal flow per mile, but such a unit of measure is not satisfactory because the loss is more properly a function of the canal cross section than of its capacity. It has been found from experiment that seepage losses hold a direct relation to the wetted area of the canal section. This relation naturally lends itself to the practice of expressing seepage losses in canals in terms of cubic feet per day per square foot of wetted area of the canal. In determining the carrying capacity of canals and laterals, however, it is most convenient to express the seepage loss per mile as a percentage of the canal or lateral flow at the beginning of the mile. The convenience of this method is, therefore, probably sufficient excuse for adhering to its use, but it should be clearly understood that the percentages should be arrived at from studies of rates of flow expressed in cubic feet per day per square foot of wetted area of canal channel.

Numerous investigations have been made to determine seepage losses in canal systems and it is to be regretted that much of this information has been compiled on the percentage of flow basis with inadequate data of canal cross sections for comparison with data compiled on the basis above recommended. Below is given a most interesting and valuable table (Table 1) of results compiled by Saville in his report on Gatun Dam in the Annual Report of the Isthmian Canal Commission for 1908.

This table shows a daily seepage loss in cubic feet of water per square foot of wetted area varying from .23 to 6.40. The greatest number of the experiments, however, show a rate of seepage varying from about 0.5 to 1.5 cu. ft. per square foot of wetted canal surface per day. The figures in this table correspond approximately with results obtained by Allen Hazen for average conditions under which seepage would occur. J. C. Stevens, district engineer, U. S. Geological Survey, has published some data in the Transactions of American Society of Civil Engineers, covering experiments made by him on the Sunnyside canal in Washington that are of interest to irrigation engineers in the volcanic region of the northwest. The Sunnyside canal, diverting water from the Yakima river, near North Yakima, runs through soil composed in places of pure volcanic ash or volcanic ash mixed with sand or loam. In other places it runs through extremely sandy soils and over porous lava areas. Mr. Stevens' experiments show that the loss in the first 30

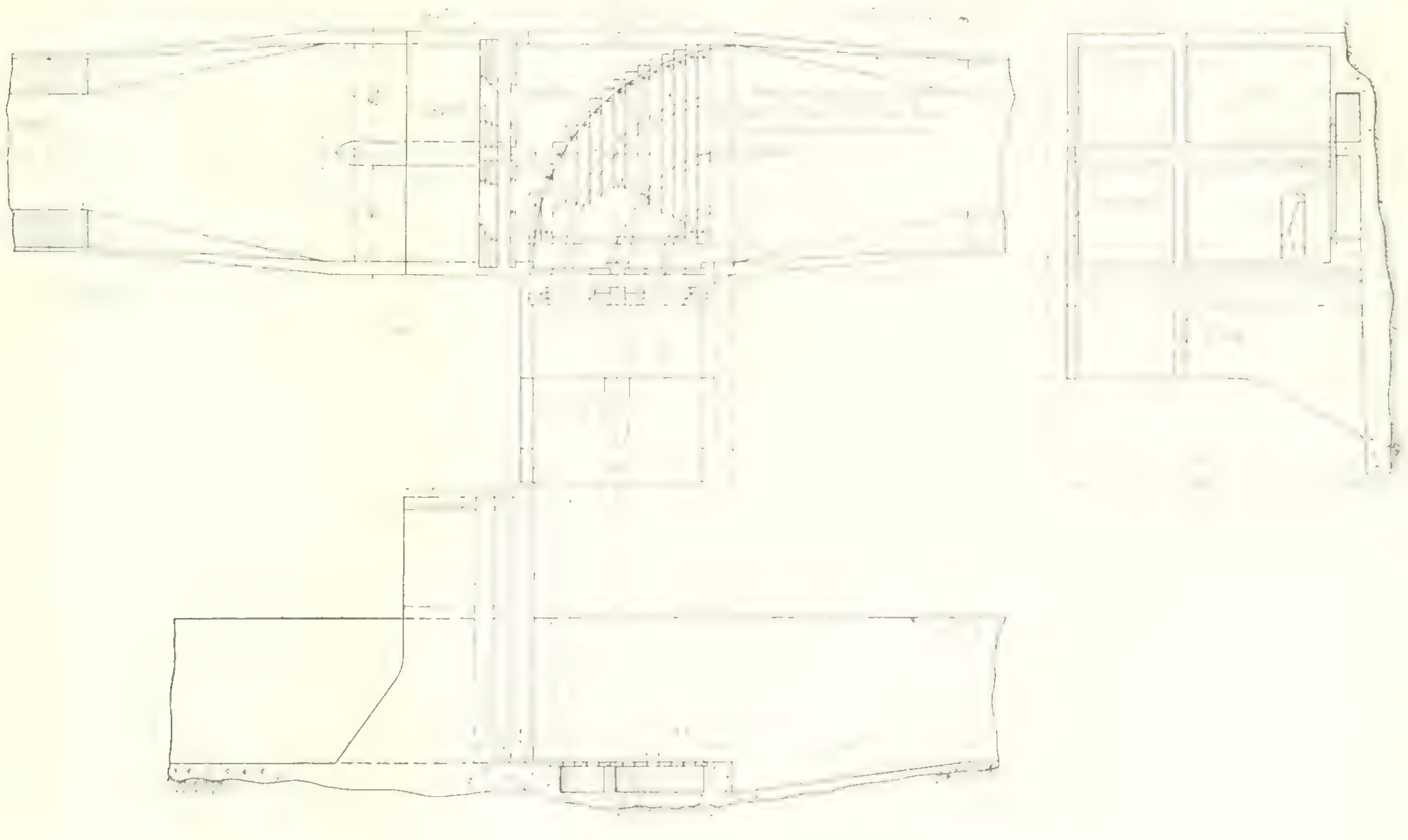

Fig. 15—Details of Standard Waste Gate and Sand Sluice.

[illegible] SEEPAGE FROM SOME CANALS

		Remarks
Fort Morgan, Colo	0.98	Sandy soil.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Fresno	0.4-2.8	Different sections.
Fresno Laterals	1.2-6.4	
[illegible], Italy	[illegible]	Italian canals 100 years old in very pervious soil.
Muzza, Italy	1.7	
Canale Martesana, Italy	1.5	
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	
[illegible]	[illegible]	
Erie	.42	American canals in rather impervious soils.
[illegible]	.71	
[illegible]	.71	

miles of this canal during the season of 1909 was approximately 0.48 cu. ft. per square foot of wetted area per day. In the next 16 miles this loss is 1.05 cu. ft. per day, and in the next 12 miles 1.66 cu. ft. per day. The lighter losses indicated by these experiments occur in soils composed of volcanic ash and loam and volcanic ash and sand, and the heavier of them occur in more sandy soils and in porous lava beds. Measurements have been initiated and are still in progress on the Boise project under the direction of the writer for the purpose of determining the rate of percolation for the soils of the project. These measurements indicate a loss of from about 0.25 to 1.50 cu. ft. per day per square foot of wetted area, for new canals with hard-pan bottoms and loam banks in a lava formation district. An old canal in this district showed a seepage of 0.25 cu. ft. per day in the upper portion and 0.86 in the lower. This canal is well silted both on the side slopes and on the bottom. The measurement of two laterals on the first bench showed a loss of 0.69 and 1.17 cu. ft. per day per square foot of wetted area. These laterals were new and run through lands with a light hardpan layer lying between gravel below and sandy loam above. From careful consideration of the data above cited and data from other sources, it would appear that a seepage loss of 0.5, 1 and 1.5 cu. ft. per square foot of wetted surface per day might be assumed for canal losses, respectively, for rather impervious, mediumly impervious and rather pervious soils.

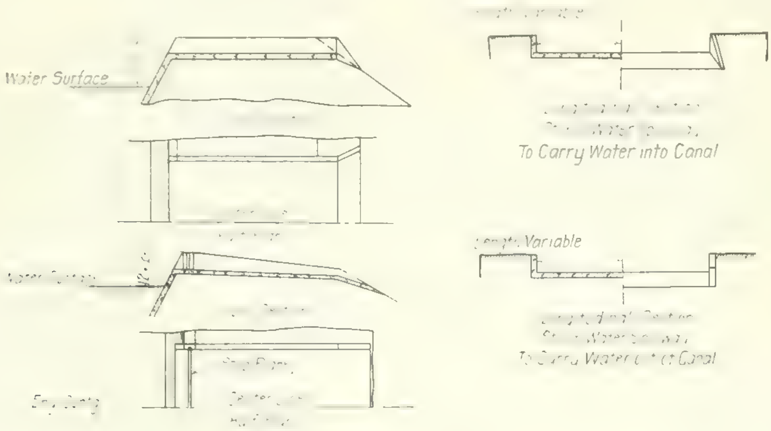

Fig. 16—Details of Storm Water Spillway.

Assuming an average relation of bed width to depth of water in laterals to be given by the formula, $b = 1.5\ d^2 + 1.5$, a mean velocity in feet per second of 2 and side slopes of 2:1, a table of losses in per cent of flow per mile of lateral can be compiled as shown below:

d	b	A	p	L	Q	P c=0.5	P c=1	P c=15
0.5	3	2	5.24	0.31	4	4.0	8.0	[illegible]
1.0	3	5	7.48	0.45	10	2.3	4.5	6.8
1.5	5	12	11.72	0.70	24	1.5	[illegible]	4.4
2.0	8	24	16.96	1.02	48	1.0	2.1	3.1
2.5	11	40	22.20	1.33	80	0.8	1.7	[illegible]
3.0	15	63	28.44	1.71	126	0.7	1.4	2.1

In the above table d equals water depth in feet, b lateral bottom width in integral feet with a minimum limite of 3; A area of water cross-section in square feet; p wetted lateral section per linear foot in square feet; L seepage loss in second feet per mile of lateral for C equaling 1; C the rate of seepage in cubic feet per square foot of wetted surface per day; Q the lateral discharge in second feet; P the per cent of loss of flow per mile. By use of these symbols it may be shown that L equals $0.06\ Cp$, and P equals $6\ Cp \div Q$ equals $100L \div Q$.

Inasmuch as computations on seepage losses are necessarily rough approximations, the following general values for use in the design of lateral capacities will be sufficiently accurate and sufficiently large also to account for evaporation losses. Table II.

The office of experiment stations, U. S. Department of Agriculture, in one of its circulars, gives the following values as a result of all of its experiments, including numerous measurements made during a long series of years: For canals carrying more than 100 second feet 0.95 per cent; between 50 and 100 second feet 2.58 per cent; between 25 and 50 second feet 4.21 per cent; less than 25 second feet 11.28 per cent. For data based on a multiplicity of varying conditions, it will be noted that these results agree quite well with those arrived at in the above table. The figures of this table may, therefore, be relied on to give fair average values for soils of varying degrees of imperviousness in average conditions with sufficient accuracy for lateral design.

The prevention of canal losses is yet in an incipent stage, but as the scarcity of water becomes more strongly felt and the magnitude of canal losses becomes better understood, there will be a rapid development along this line of engineering. The methods now employed for canal seepage prevention consist in carrying the water in wooden and steel flumes, or in wooden, iron and concrete pipes, or in channels, lined with concrete, stone masonry, plaster, clay or oil. All of these methods are expensive except where the additional cost is partly borne by some other necessity or where the value of the products of the irrigated lands is high. The engineering problem is, therefore, to determine which of these methods is adaptable to the particular conditions under consideration and whether the saving of water effected by the prevention of losses will bear the cost of the necessary improvement.

The United States Department of Agriculture has conducted in test pits similar to canal sections a series of experiments in co-operation with the University of California to determine the comparative effectiveness and cost of different kinds of lining. Table III shows in a condensed form the result of these experiments taken from the Annual Report of the Office of Experiment Stations for 1907:

In California Station Bulletin 188 are given considerable data on the cost of and methods of placing stone masonry, concrete and cement plaster lining in canals in Southern California. The various methods used in placing the same and different kinds of lining is interesting and well worth careful study by engineers engaged in irrigation work.

The United States Department of Agriculture notes in the report herein before referred to an instance in Southern California of the use of road oil for canal lining for the purpose mainly of preventing the growth of weeds and aquatic plants. The oil was applied to a length of 1½ miles of canal having a bottom width of 20 ft. and a depth of 1 ft., and the method of placing and the results are summarized in the following language:

> The oil used was crude petroleum from the Sunset district southwest of Bakersfield, and contains a large percentage of asphaltum. Its specific gravity is 11½ on the Baume scale. This oil when cold will not run freely. It was used hot and surinkled with an ordinary road sprinkler. The ditch had been previously cleaned of all vegetation and allowed to dry. The road sprinkler was driven first on the bottom of the ditch and then on the banks. The oil was applied at the rate of 1½ gallons per squqare yard. The oil was then thoroughly harrowed in until it was well mixed with the soil, which was very sandy.
>
> When examined about seven months after the application of the oil there was no vegetation in this part of the canal, while other parts of this same canal which had received no oil had been cleaned two weeks previously showed a vigorous growth of vegetation. The contrast is very striking and clearly shows the value of oil in preventing the growth of aquatic plants. Not only was this part of the canal free from vegetation, but it was only about one-third full, while the canal full of weeds had to be full to carry the same amount of water.

During the past two years the writer has had charge of the placing of about 30,000 cu. yds. of concrete lining covering nearly 6 miles of the Main South Side Canal of the Boise Project of the Reclamation Service in the vicinity of Boise, Idaho. This lining has been placed for the triple purpose of reducing seepage, preventing breaks in the canal banks and obviating a heavy expense of enlarging the canal section.

From experiments conducted on the canal flow in the lined portions during last summer, it was found that the value of n in Kutter's formula is about 0.014, giving a discharge on a 40-ft. base, 1½ to 1 side slopes and 8-ft. water depth approximating that in the same canal for an earth section of the same water depth and side slopes and a base of 70 ft. On side hill work, the cost of lining the old 40-ft. canal was much less than that of enlarging it to a 70-ft. canal.

The lining consisted of a 1:3:6 mixture of cement, sand and gravel placed in a 4-in. thickness with transverse joints at 16-ft. intervals and longitudinal joints at either 8 or 16-ft. intervals. The concrete was mixed at gravel pits located on the canal bank and was transported from the mixers to the points of deposition in one-horse carts, where it

TABLE II.

Lateral capacities in second-feet.	Lateral class designation.	Losses in per cent of flow per mile c=0.5	Losses in per cent of flow per mile c=1	Losses in per cent of flow per mile c=15
[illegible]	1	4	8	12
11 to 25	2	2.5	4.5	7
[illegible]	3	[illegible]	3	4.5
51 to 75	4	1	2	3
[illegible]	5	[illegible]	1.5	2.5

TABLE III. EFFECTIVENESS OF DITCH LININGS

Description of Lining	[illegible]	Experimental cost of lining per sq. ft. [illegible]	Actual cost of [illegible]
Cement concrete, [illegible] ins. thick	[illegible]	[illegible]	[illegible]
Cement lime [illegible] ins. thick	[illegible]	[illegible]	[illegible]
Cement mortar	[illegible]	[illegible]	[illegible]
Heavy oil, [illegible] gals. per sq. yd.	[illegible]	[illegible]	[illegible]
Clay puddle, [illegible] ins. thick	[illegible]	[illegible]	[illegible]
Heavy oil, 3 gals. per sq. yd.	[illegible]	[illegible]	[illegible]
Heavy oil, 2½ gals. per sq. yd.	[illegible]	[illegible]	[illegible]
Tar oil, [illegible] gals. per sq. yd.	[illegible]	[illegible]	[illegible]
Earth (no lining)	.0		[illegible]

(a) Excluding the preparation of the site.

was dumped [illegible] the ground and shoveled into place on a foundation that had been [illegible] The [illegible] obtained by the use of [illegible] x 16 ft. timbers placed at the proper intervals. Alternate panels were then placed to permit of the setting of the concrete and the removal of the forms. After the concrete was placed and compacted with shovels, a heavy straight edge reaching across the 16-ft. panel was run over it until the concrete was leveled down to the proper thickness. Following this a finishing coat of cement mortar was floated over the concrete giving it a smooth surface.

This work was done for a little less than 10 cts. per sq. ft., excluding the cost of preparing the foundation, and the lining thus far promises to give very satisfactory service.

STEAM AND ELECTRIC RAILWAY SECTION

Corrugated or "Roaring" Rails.

In steam railway operation corrugated rails are met with occasionally, and have at times caused considerable trouble, particularly in England and India. As a whole, however, the appearance of corrugated rails on steam railways has been infrequent, and the subject has not received much attention from steam railway engineers. In street railway operation, on the contrary, the corrugation of rails is a most serious problem. This is particularly the case where modern and heavy construction has been installed.

No specific cause for this condition has been discovered, although a number of investigations with this purpose in view have been made, and a good many theories have been advanced. The general opinion of men who have studied the problem is that a number of causes operating jointly produce corrugation. But just what is the effect of each one of these causes is a matter that has not been determined.

This question has been brought prominently to the attention of street railway engineers in recent years, following the general installation of heavy construction and equipment in large cities. Many stretches of track that were built in accordance with the best and most modern standards have been practically ruined through the development of corrugation. Grinding of the rail to an even surface is extensively resorted to, and several types of machine are employed for this work. The relief is as a rule only temporary, however, as corrugation shows a marked tendency to reappear. In fact, when new rails are substituted for the damaged ones, corrugation will usually appear in the new rails at the end of a period varying from 2 or 3 months to 2 or 3 years. On the other hand, corrugated rails, if laid in a zone not subject to corrugation, will often be ground to a flat surface by the wheels. This is particularly the case in steam railroad operation. The logical inference from these two facts is that corrugation is due to conditions that are local to certain zones of track, and not to characteristics of rail or rolling stock. What one of these conditions in street railway operation may be will be indicated later.

A perspective of a typical corrugated girder rail is shown by Fig. 1. As will be seen from this illustration, corrugation consists of a series of projections and depressions on the surface of the rail, alternating longitudinally of the rail. The distance from peak to peak may vary from about 3 ins. to 8 ins., and is slightly irregular. The depth of the corrugation may vary from a barely perceptible amount to as much as ⅛ in. Even when slight it is easily detected from the noise made by the car in passing over it.

When once started at any point in the track corrugation shows a marked tendency to spread. Usually it spreads in the direction of the traffic, but often it will spread in the opposite direction or in both directions at once.

Probably the first case of corrugation to attract wide-spread attention among engineers was that on the railways of India. The trouble on these railways has been extensive and serious during the past ten or twelve years. It has been rather exhaustively written about in British technical journals, but apparently little progress has been made toward a solution of the problem. One curious and significant fact stands out prominently in connection with the situation in India. Practically all the trouble occurs on roads having a gage of 1 meter. The broad-gage roads, as well as the 18-in. gage roads, are practically free from it. No explanation has been found for this difference in so far as it relates to broad-gage roads. In the case of roads of 18-in. gage, however, one wheel on each axle is loose to facilitate the passage of cars around the excessively sharp curves common to these lines. This has been thought by some investigators to explain in a measure the immunity of these lines from corrugation.

An explanation of the phenomenon has been sought in three directions—namely, the characteristics of the rail itself, the way it is laid (including the nature of the road bed), and the kind of rolling stock. It might be suggested that the mode of operation of the cars probably determines one cause of corrugation. It does not appear that this feature has received as much attention from investigators as

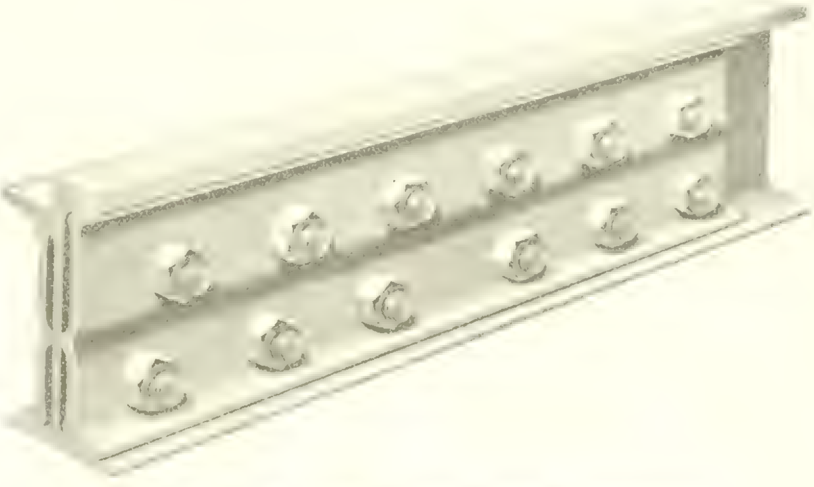

Fig. 1—Girder Rail Showing Typical Case of Corrugation.

In a paper read before the Institution of Electrical Engineers (of England) in March, 1907, Mr. J. A. Panton attempted to prove that defective rolling stock is the cause of the trouble. In this paper it was held that corrugations are caused by lateral play of the axles in weak trucks, in conjunction with the unsymmetrical thrust of the gear on the axles. This results in a skewing of the axle with reference to the track. The wheels under such conditions have a tendency to climb the rail slightly and then drop back. It is only reasonable to assume that these repeated impacts may cause the slight depressions in the rail that form the beginning of corrugation. It should be noted, however, that if this were the only cause, or even the principal cause, corrugation would not be confined, as it is, to particular zones of track. Furthermore, it would be expected that particular types of trucks would show greater damage to tracks than others. This as a rule is not the case, the damage appearing to depend principally on locality.

An interesting series of experiments were made during the year 1907 by Mr. W. J. Cudworth, of the North-Eastern Ry., of England, for the purpose of determining the connection, if any, between composition of rail and corrugation. These experiments were fully described in *Engineering* (London) in its issue of June 14, 1907.

Chemical analyses were made of samples of both corrugated and smooth rails, and comparison made of the composition of pairs (corrugated and smooth) subjected to the same operating conditions. These analyses did not appear to lead to any definite results. In connection with the investigation, however, two interesting points were brought out. One was that on the North-Eastern Ry. there had never been a case of the fracture of a corrugated rail. The other had reference to the relative hardness of the projections and depressions on a corrugated rail. With the Brinell scale the hardness of the projections on a typical corrugated rail was found to be 282, and that of the depressions 227, while the hardness of the side of the rail was uniform and was found to be 183. Although a good deal of wear occurs, the process is on the whole one of cold rolling combined with mashing of the metal at the edges of the depressions. That the trouble is not due to the composition of the rail is further indicated by recent experience with manganese rail in street railway tracks, corrugation appearing in such rail exactly as in Bessemer or open hearth rail, but requiring apparently a longer period for development.

A curious feature of the trouble is that it is not confined to any particular condition of gradient or alignment. Curves and tangents, grades and level track seem to be equally subject to corrugation. On one railroad in England there is a corrugated zone on a down-grade track, but the adjacent up-grade track is not affected. At another point on the same road this condition is reversed, the up-grade track being corrugated and the down-grade track free from corrugation.

[illegible] CAUSES OF CORRUGATION

As mentioned above, there is one line of inquiry that does not appear to have received the attention it deserves from investigators. Sudden changes in the application of power, combined with oscillations of the rolling stock, while, perhaps, not the only cause of corrugation, go far toward explaining the majority of cases. These changes in application of power, when they occur at one particular point, will eventually affect the track at that point, especially on the busy lines of large cities. This concentration of acceleration and retardation at particular points is rather a striking feature in the operation of street railways. In approaching a junction, for example, the points at which power is shut off and brakes are applied will be the same for the majority of cars. This is doubtless due in part to the instructions given the new motormen, but it is mainly due to the fact that the average motorman finds from experience the best way to handle his car. As there is only one best way this results in the concentration of these two operations at two definite points.

The same thing occurs in leaving a junction. The controller is turned to the first position, and after a brief interval is turned about half-way around. After the car has accelerated appreciably, full power is turned on. The points on the track at which the last two operations occur is the same for the majority of cars. At these two points sharp acceleration, accompanied by slip of the wheels and oscillation of the car, occurs. These are also the points at which corrugation is most likely to be found. It should be borne in mind that such conditions prevail only at points, such as junctions, where all cars stop, and where the exact manner of stopping and starting becomes a habit with the motormen. At intermediate points, where only a small percentage of cars stop, there is no such concentration of acceleration and retardation. And, as a matter of fact, corrugation is rarely found at these points.

Any condition that sets up slipping of wheels and oscillation may bring about corrugation. But it may be brought about in a limited way by oscillation alone. This is indicated by the short zones of corrugation sometimes found following an uneven joint.

While it is impossible to interpret the cases of corrugation on gradients, mentioned above, without knowing all the conditions, it is quite probable that investigation would disclose some feature in the operation of the cars on these gradients that causes slipping, or oscillation, or both.

If caused by slipping and oscillation, the mechanical action in connection with corrugation is not difficult to understand. The wheel, in starting to slip, causes a minute flow of metal. Ordinarily this action is distributed uniformly over a long stretch of rail, and no effect other than wear is produced. But when this action is localized to an intense degree, as explained above, a projection with corresponding depressions, will appear at some point in this zone. With one corrugation established, the oscillation of the car in passing over and leaving this projection will have a tendency, owing to impact, to produce a new projection adjacent to the one already developed. With such a combination of slip and oscillation it is easy to understand the marked tendency of corrugation to spread. The effect is one of wear and mashing of metal to some extent, but it is principally a matter of cold rolling. This fact explains the extreme degree of hardness found in the projections.

One point not to be overlooked is the relation between speed and period of oscillation. With cars of the same type the period of oscillation will be practically the same for the majority of cars running at the same speed. But there will be marked differences in period for different speeds. While there is some irregularity in the distance between nodes in a given corrugated zone, these distances are in general fairly regular. It is reasonable to assume that the nodal distance is mainly a function of the period of oscillation. This being the case, the transfer of a corrugated rail to a point where the speeds, and, therefore, the periods of oscillation, are markedly different from those prevailing over the corrugated zone, might easily result in restoring a flat surface to the rail. This would naturally occur where the period of oscillation was such that there was no longer a regular impact on the depressions. And, in fact, this is precisely the effect that is often produced by the transfer of a corrugated rail to a new location.

GRINDING OF CORRUGATED RAILS.

Apparently, periodical grinding of the rail is the only practicable relief for corrugation, as the corrugations eventually reappear under the conditions that first developed them. For this purpose several types of grinders are in use. Most of them are rotary grinders, and require great care and skill on the part of the operators in grinding the projections exactly the right amount. There has recently come into use a machine with a corundum grinding block that moves longitudinally on the surface of the rail. The block is about 24 ins. long, has a stroke of 5½ to 6 ins., and is operated at the rate of 270 strokes per minute. With this machine it is possible to grind the surface of the rail to an absolutely smooth surface. The machine is actuated by a 3-hp. direct current motor, the power being taken from the trolley wires.

The cost of grinding varies from 14 cts. to 30 cts. per foot of rail, depending on the degree of corrugation and the number of interruptions from passing cars. To reduce the cost due to interruptions the work is usually done at night, between the hours of 1 and 6. Under any condition the cost of grinding is less than that of replacement of the corrugated rails, and until some means of preventing corrugation is discovered, grinding appears to be the only practical means of dealing with this problem.

GENERAL ARTICLES AND CLASSIFIED ITEMS

The Determination of the "Fair Rate of Return" On the Value of the Property of the Madison Gas and Electric Co.

In our issues of June 14, 21 and 28 have appeared data relating to the appraisal of the Madison Gas & Electric Co. by the Wisconsin Railroad Commission. We come now to the commission's decision as to the "fair return" on the investment. This is obviously a matter of extreme importance, yet the subject of what constitutes a "fair return" to a public service corporation has received altogether inadequate consideration by rate making bodies. The best discussion that we have thus far seen on this subject is contained in the decision of the Wisconsin Railroad Commission on the Madison Gas & Electric Co. case, which we now reprint in considerable detail. In our editorial columns we offer some criticisms of the theory that rates should be based on the value of property.

The following is quoted from the decision of the Wisconsin Railroad Commission.

Under the laws of this state public utilities, under ordinary conditions, are entitled to earnings for their services that will yield enough to cover operating expenses, including depreciation and a reasonable return on the fair value of the property actually used and useful for the convenience of the public. The question what constitutes reasonable return upon this property is so closely connected with what constitutes reasonable rates for the services rendered to the public by such utilities that these two questions cannot very well be kept apart in discussions of this character. That this is the case is clear from the fact that the returns that are earned upon such investments are largely dependent upon the rates that are paid by the public for the services involved. In other words, the former are an essential factor of the latter. In sec. 1797m——3, ch. 499, Laws of 1907, it is provided that:

> Every public utility is required to furnish reasonably adequate service and facilities. The charge made by any public utility for any heat, light, water or power produced, transmitted, delivered or furnished or for any telephone message conveyed or for any service rendered or to be rendered in connection therewith shall be reasonable and just, and every unjust or unreasonable charge for such service is prohibited and declared unlawful.

Section 1797m—46, ch. 499, Laws of 1907, provides that:

> If upon such investigation the rates, tolls, charges, schedules or joint rates, shall be found to be unjust, unreasonable, insufficient or unjustly discriminatory or to be preferential or otherwise in violation of any of the provisions of this act, the commission shall have the power to fix and order substituted therefor such rate or rates, tolls, charges or schedules as shall be just and reasonable.

Substantially the same provisions are found in sec. 1797m—61.

Judicial precedents as to what constitute reasonable rates and returns upon the investment have almost uniformly been made in determining only whether legislative or commission action should be overthrown, or is in violation of constitutional rights.

Justice Timlin in the majority opinion in the "Soo" case, Minneapolis, St. P. & S. S. M. R. Co. vs. Railroad Commission, 136 Wis. 146, 165, states:

> In reviewing the order of the Railroad Commission the inquiry is not whether the rate, regulation, or service fixed by the Commission is just and reasonable, but whether the order of the Commission is unreasonable or unlawful. The nature of the inquiry is changed at this point, and the court is not investigating for the purpose of establishing a fixed point. Whether or not the order is within the field of reasonableness, or outside of its boundaries, is the question for the court. It is quite a different question from that which was before the Commission in this respect. The order being found by the court to be such that reasonable men might well differ with respect to its correctness cannot be said to be unreasonable. From this aspect it is within the domain of reason, not outside of its boundaries. This is the viewpoint of the reviewing court.

Substantially the same position is also taken by Justice Marshall in his concurring opinion in the "Soo" case, and it is also the conclusion in many other decisions both in state and federal courts.

The statutes thus provide that the rates charged the consumers and the rates of return upon the investment must be reasonable, but do not specifically state what the reasonable rate in either case should be. They further provide that it is the duty of this commission to enforce these statutes, or to determine the reasonable rate or rates. The decisions of the court are confined to the determination as to whether the rates thus found by this commission are reasonable or whether they violate constitutional rights. While neither the statutes nor the decisions are thus furnishing specific directions for the guidance of the commission in carrying out its duties, they contain certain rules which in a general way limit the range within which the reasonable rate should be found. In this connection Justice Timlin, in the "Soo" decision, says further, p. 168:

> It is also to be considered that this margin (between the amount sufficient to assure a fair

> return on the value of its property plus the amount of its fixed charges and operating expenses, and its gross receipts) ought not ordinarily to be exhausted or swept away by orders or requirements of the Railroad Commission as fast as accumulated, because human nature or railroad nature is such that no one will long economize on operating or other expenses if his economy only furnishes a larger basis for further exactions.

In his opinion in the same case Justice Marshall states, p. 171:

> In case of the Commission dealing with extortionate rates for service it should remove the element of injustice by reducing the rates sufficiently to measure the excess, leaving the proprietors free and opportunity to make further reductions.

Ordinarily the rate of return or the rates for services that are reasonable to the utility are also reasonable to the consumers. When consumers secure these services at rates that only cover operating expenses, including depreciation and a fair rate of return on the investment, they are obtaining the service at as low a rate as under normal conditions they can reasonably expect. But there may be exceptions to this. There may be utilities which are operating under such conditions that no rates that can be collected from the consumers would be sufficient to meet the above named charges. In fact, such utilities are met with more frequently than might be expected. This unfortunate situation may be due to lack of a sufficient number of customers, to mistakes in construction and excessive cost of the same, and to many other causes. Such utilities, in order to be paying concerns, would require higher rates for their services than their customers are willing to pay rather than forego these services, and the collection of such rates is of course out of the question. Utilities of which this is true, cannot be subject to any general rules. They can be dealt with only in the light of the conditions which surround them. No such abnormal conditions, however, appear to be present in the case now before us.

The rate that may be considered a reasonable return for interest and profits on the investment undoubtedly varies with the circumstances. Generally speaking, however, it can perhaps be said that under normal conditions it consists of the ordinary rates for capital similarly invested, and that are sufficiently high to encourage investors to enter such enterprises. Such rates are largely a question of fact, and the commission in determining the same, finds it necessary to examine the testimony upon these points as well as many other facts that throw light thereon.

With reference to the rate of return, testimony in behalf of the respondent was offered by the expert witnesses who already have been mentioned—A. C. Humphrey, R. B. Brown, A. E. Forstall and H. L. Doherty—all of whom have had wide experience in the construction, operation and management of gas and electric light plants.

R. B. Brown testified that it was impossible to properly manage a property and divide the entire profits, and as it would be necessary in order to attract capital to divide among the investors not less than 8 per cent, the minimum allowance of earnings should be 10 per cent. A. E. Forstall declared for an allowance of 10 per cent, but was free to admit that if local capital could be secured to take care of the business, it might be satisfied with a less rate than if the capital were secured in New York, for he related that it had been his observation that the farther from New York an investment was, the more attractive it had to be made in order to get the money. A. C. Humphrey was of the opinion that any sum less than 8 to 10 per cent would make investments in this kind of property unattractive and the money could not be obtained for extensions. Eight to 10 per cent on the total value, including in tangible value, witness believed to be a fair rate of return to be allowed to be earned in this business after the payment of all other expenses, contingent reserve, depreciation and tingent, bearing in mind that not all of the bond contingent, bearing in mind that not all of the earnings can be divided, but a margin has to be kept for what witness described as working capital for extensions and construction, or else, he said, money would have to be borrowed for every extension to be made and interest would have to be paid thereon.

H. L. Doherty, president of the company, by a process peculiarly his own, placed a value of $1,400,000 upon the property of respondent, which process is elsewhere referred to herein, and he was of the opinion that the company was entitled to an opportunity to earn a fair return upon this value. Such fair return he placed at 10 per cent on the above valuation, and he would separate this into 6 per cent interest and 4 per cent over and above interest for profits. He would not declare his ability to sell respondent's plant for $1,400,000 under the conditions which prevailed, and admitted the possibility that the plant might not now be able to earn 10 per cent, which, on a valuation of $1,400,000, would amount to $140,000 per year, but insisted that the plant ought to have a chance to earn the sum and that such earnings would not be so great as to indicate that they were the result of unreasonably high rates. A plant, he said, might acually be worth more than the amount upon which it could earn 10 per cent. He also spoke in optimistic terms about the future of Madison, declaring that this city would have a substantial growth in the near future and that it might be expected that the respondent's plant would before long be in position to earn $140,000 a year, whereas it now is earning only $92,145.05. He was inclined to capitalize future possibilities and base a present value upon what he thought the future held out, and declared that his $1,400,000 valuation was not entirely based on the present earning capacity of the plant but upon its possible future capacity to earn.

In support of the claim that the rates for service should be high enough to allow respondent to earn a return of not less than 10 per cent on the fair value of its property, these witnesses presented a great deal of testimony to the effect that the gas and electric business is one of many hazards and risks and consequently must be allowed to make a return higher than the necessary return of less hazardous enterprises in order that the necessary capital for such enterprises may be obtained. Many such hazards and risks were named, and the more important among them will be briefly mentioned.

Natural gas, for instance, is capable of being conveyed long distances. On account of this fact there was danger that eventually natural gas would be piped to Madison and sold in competition with the product of respondent. An illustration was given in the case of a Buffalo company, which suffered greatly by competition with natural gas, particularly when the Welsbach burners were developed so that they were used with natural gas. Then natural gas costing 30 cts. per 1,000 cu. ft. came into competition with coal gas costing $1 per 1,000, even while the dollar gas did not pay operating expenses and the interest on the bonds, and the result was that the Buffalo Coal Gas Company found it impossible to get money for extensions without selling its bonds as low as at 60 per cent.

The hazard of competition could not be eliminated by foreclosing the possibility of a rival company entering the field and making and distributing gas and electricity, for that is only one kind of competition. There would continue to be competition in the light and fuel business due to the introduction and development of other illuminants and other fuel. The [illegible] of competition [illegible] keeping out rival companies and preventing duplication of plants, was admitted to be an advantage and lessening of hazard, but it was insisted that competition goes on all the time, competition in the form of development and installation of other kinds of light and other fuel. The very developments in the progress of the art constitute competition and risk. Increasing efficiency of appliances for the use of both gas and electricity, such as the new high efficiency lamps in the electric service, all tend to make the business hazardous, as they generally add nothing to the income of the company. Even should the volume of business grow as a result of this competition within the business, due to the advancement of the art, it nevertheless introduces uncertainty and makes investors fearful. In the history of the gas business, when the first electric lighting companies were started, the holders of gas securities were fearful for the future and were crowding to get rid of their securities. However, new uses were found for gas and development work was done to maintain the business, saving the situation by getting new business in the development of the use of gas for new purposes, and thus making up for the business lost to the electric companies. In the case of a gas and electric company there is competition between the gas and the electric sides of the business, development of higher efficiency lamps in the electrical business taking away from the gas business, and the result is loss of gas business without corresponding increase of revenue from the electrical business, because the employment of higher efficiency electric lamps helps the consumer to get more illumination for less current, and therefore the result may be the falling off of the revenues of the electrical business as well as the loss of business on the gas side.

Another fact cited as a reason why capital will not be available for public utilities unless the investment in these properties is made especially atractive, is that money so invested is necessarily planted without the possibility of being readily recalled and placed in another locality or business in case the undertaking turns out to be a losing proposition. Money invested in ordinary commercial enterprises can readily be changed from one place to another. The merchant can usually move his stock of goods as often as he thinks he can find a better locality, but the gas man is unable to move his plant, except as though it were old junk.

Another advantage of the ordinary commercial business was noted in the fact that the merchant can turn his stock from three to five times a year, but the capital invested in a public utility business can be turned only once in several years, usually five, and never less than three. This fact results in certain costs which are continuing, fixed and independent of the variations in the amount of service distributed.

Still another disadvantage of the public utility as compared with the ordinary commercial or manufacturing establishment was cited in the impossibility of suspending operations of a public utility in order to avoid losses in time of unprofitable volume of business or special emergency, such as a strike. Regardless of whether the business is being conducted at a profit or loss, the public utility has to maintain service, must continue operation every hour and minute of the year. When slack times strike the manufacturer, he is able to curtail expenses, lay off labor or even close his doors entirely, but the utility must not cease operations, no matter what it costs.

The tendency toward legislation affecting public utilities, the creation of powerful commissions and the enactment of various regulatory laws constitute, according to the testimony of witnesses for respondent, another restraining influence against the free investment of capital in these enterprises. The fact that regulation was causing timidity on the part of investors was urged irrespective of the probability or improbability that this timid- [illegible] ably based; that the regulatory laws would improve the situation or make it worse as time goes on; whether the tendency toward legislation affecting the utilities operated to decrease competition and duplication of plants, or whether such legislation operated to assure the investor a reasonable return on the value of the property invested. The fact was declared to be that the tendency toward state interference with the management of these properties made investors reluctant to place their money in these properties.

The conditions and facts enumerated, which were said to contribute to the hazards and risks of gas and electric light undertakings and which were given as the reasons why such enterprises should be permitted to earn about 10 per cent for interest and profit on the investment therein, are of varying importance.

Thus the piping of natural gas to Madison would hardly seem to be worthy of serious [illegible] or unless [illegible] supplies of such gas should be discovered closer to this city than any known at present. The development and introduction of other illuminants or fuels that would displace gas and electricity is of course a possibility, but for the present at least there does not appear to be any great danger from this source. In con[illegible] with the development of the art, new inventions and mechanical and industrial progress generally, there is, of course, a great deal of waste that may prove costly to producers. Such progress often requires the discarding of costly and only partly worn out machinery and other equipment and its replacement by new and sometimes even more costly machinery and equipment. When in addition to this such progress also results in increasing the efficiency per unit of the products, it may often be seriously felt by the producers, though it may be a great gain to society when taken as a whole. But developments of this character are not always detrimental even to the producers. In many cases they are the means by which the cost of production is reduced and the net profits of the business increased. In other cases, again, by lowering the cost or increasing the efficiency of the products, they cause new and additional uses for the same, which so increase the demand that losses in one place are made up by gains in other places. Competition and wastes due to progress and invention, while thus causing temporary losses, do not always result in permanent ones. In the long run there are often net gains from this source even to producers. In passing upon conditions of this nature, there are therefore facts to be considered that point in both directions.

Investments in public utilities usually go into fixed assets which in case of failure are not readily adaptable to other uses and which are in such form that but a small part of the investment can be withdrawn therefrom. Unless the location is well chosen therefore and the plants so constructed as to be an efficient producing unit, there are in such undertakings many chances for investors to lose money. Fixed capital, such as that required in public utilities, also carries with it many constant charges for depreciation and interest, which go on at about the same rate whether the plants are paying concerns or not. In other words, expenses in these industries do not cease when operation stops. The risks from these sources, while considerable, can be greatly minimized by the exercise of ordinary care in entering upon and in conducting the business. The very amount of the fixed investment and the character of the same, when once made, is also often a safeguard against competition, because it often tends to keep other investors out of the same field.

Whether the fact that in public utilities, owing to the relatively large proportion of the fixed investment, the capital cannot be turned over as frequently as in commercial enterprises where the proportion of the fixed capital is smaller, can be justly considered as an element of risk, is not entirely clear. Much depends on conditions. Where the investment, when compared with the output, is proportionately large, the rate of profits on each unit of product sold must, of course, be greater than where this part of the investment is smaller. In the former case the expenses of production, as already pointed out, are also likely to be made up of relatively large fixed charges, which are constant. These and other similar facts undoubtedly have their drawbacks, especially when business is slack and where, as in the case for public utilities, the plants may have to be kept in operation and render services even when their business is carried on at a loss. The latter fact alone is often a serious drawback and has undoubtedly been the cause of many losses to investors in such utilities. Legislative regulation of public utilities through commissions may, in some respects, be detrimental to operators who endeavor to evade their obligations under the common law and who try to profit by the manipulation of capital issues rather than through legitimate, effective and economical operation of their plants. It is also possible that such regulation may prove unsatisfactory when ineffectual or misdirected, and until it has been fully tried out and become more generally understood. But it is difficult to see how such regulation can result in permanent injury to the great mass of the investors and to the utilities themselves, if honestly applied and administered with ordinary care and efficiency along the lines of and in the spirit of such laws as those which have been enacted in this state, laws under which such utilities, under normal or ordinary conditions, are practically protected from active competition and assured of reasonable returns on a fair valuation of the plants. In addition to this, such regulation ought to promote effective management and operate as a safeguard against many abuses which, in the long run, may be detrimental to the plants and their business from the investors' point of view. Among other things it ought to be a safeguard against such abuses as the slipshod way in which many companies charge up depreciation and keep their accounts. Proper charges to depreciation prevent the plants from being deprived of the necessary upkeep, and complete accounts or records enable those who are financially interested to ascertain its financial condition at almost any time. Matters of this kind are of considerable importance and go far in offsetting such inconveniences as effective regulation may impose.

Upon a closer examination of the law and its operation it is more than likely that the timidity of the investors, if there is any, will be changed to one of greater confidence, for they may find that under the public utilities laws of the state their interests are as well, if not better, safeguarded than they were before these laws were enacted. To be relieved from active competition and assured of reasonable returns upon the investment, as well as a reasonable price in case the plants are taken over by the municipality, are matters that deserve attention and that in the long run ought to attract rather than repel investments in such utilities. This would certainly seem to be the case as soon as it was found that the policy thus adopted by the state bids fair to become permanent and to be carried out in good faith.

While public utilities are subject to many conditions that tend to increase the risks under which their business is carried on, they are also afforded a great deal of protection that is of considerable value to the investors. This protection has its source partly in legal provisions, and partly in the fact that after all, such utilities are natural monopolies and are engaged in furnishing services that have practically become necessities and for which there appear to be no effective substitutes. While the investors in gas and electric light plants are exposed to certain hazards or risks, these risks, while greater than the risks which obtain for money placed, say, in trust companies and good mortgages, are not, on the whole, as great as those which obtain in ordinary competitive enterprises. This is as true for the plants involved in these proceedings as for such plants generally.

The rates of return upon the investment are usually divided into interest which goes to those who furnish the capital, and profits which go to those who assume the responsibility and direction of the business. The rate of interest depends on the supply and demand for capital; is, therefore, lower where the risks are low and where the troubles involved in looking after the investments are small, than where these elements are greater. That this should be the case, is only natural, for few are willing to assume risks and responsibilities unless they are compensated therefor in some form, or unless the prospects for such compensation are fairly good. There are other factors than those given which also affect the rate of interest, such as the readiness with which the money may be withdrawn, the location and nature of the industries, etc., which have been fully described in other decisions, but these are, perhaps, in most instances of smaller importance. Money placed in savings banks, trust companies and good mortgages yields from about 4 to about 5 per cent. In the case of such investments the risks are very small and they require but little care or trouble. These rates consist mostly of pure interest and can, perhaps, be regarded as the minimum rates that are obtained by the ordinary investors. Money invested in good bonds for which there is a ready market brings no more than the above rates, if as much. Bonds and mortgages of a somewhat lower grade yield from 6 per cent up to 8 per cent or more, and commercial paper brings from 6 to perhaps 10 per cent or better. In fact, there are such variations in both the character of the investments and the rates they yield, that it is difficult, if not impossible, to properly classify them.

The bonds of the company involved in the present proceedings which, as already pointed out, amount to about $400,000, covering less than one-half of the value of the plants, bear interest at the rate of 6 per cent and sell at from $106 to $108, thus yielding about 5.6 per cent on their price. These bonds are amply secured, being backed by the entire value of the plant as well as by its earnings, which show a surplus above the operating expenses and depreciation that is several times as great as the amount required to meet the interest charges on these bonds. If this bond issue had equaled the cost of the physical property of these plants, the chances are that they would sell at even less than par, and this regardless of the fact that, because of the connections of the owners of these plants, their securities had an unusually well developed market. There are also certain debentures outstanding against these plants which bear interest at 7 per cent. As these debentures do not appear to be quoted in any of the regular markets, we are unable to give their market value; while they bear a higher rate of interest than the bonds and would seem to be about as well secured, they do not constitute the first claim upon the assets of the company, and it is therefore not likely that they would sell at any higher prices in the market than those commanded by the bonds. These facts are important, because they indicate that the actual rate of interest on the capital invested in these plants does not appear to be far from 6 per cent.

Interest is justifiable because of the importance of capital in production, and necessary because without it capital cannot be had for industrial and commercial purposes. The rate of interest, as determined by economic forces over which individual borrowers have little or no control, and the effect of these forces, are often best measured by the prevailing rate in the various undertakings where money is obtained on the best terms that can be had. These terms, in such cases, usually take into account the risks involved, the trouble in looking after the loans, the readiness by which the loans can be converted into cash or withdrawn, and other factors, when compared with similar factors this particular case the position of the plants, with reference to the risks involved and other factors, when compared with similar factors in other industrial enterprises, appears to be about the same as those which obtain, with reference to the rates of interest which these plants pay, when these rates are compared with the rates of interest in other industrial enterprises. The conclusion, therefore, must be that, for the purposes of this case, it would hardly be fair to place the rate of interest alone at much of anything below 6 per cent on a fair valuation of the plants.

The profits of a business consist of the balance between the sum of all expenses and the total income of a business. In other words, it is made up of the difference between the sum of the rent, interest, wages and other items, such as taxes, etc., and the total gross receipts. The difference is the last share of the total income, the share of that factor or of those who, in the full sense, are responsible for the enterprise. This share, like the other shares, is not fixed. It simply consists of what is left after all other claims have been satisfied. Rent and interest are usually fixed at a certain rate annually, and this, in a sense, is also true of wages, salaries and other expenses. At any rate, these amounts are fixed in advance and are paid by the employes or by those who carry on the business out of the gross receipts. The amount left, however, after these shares have been satisfied, belongs to the employer and represents his share, or the profits of the business. If the balance left for such profits is large, then the rate of profit is also large, and vice versa. In some cases the profits are figured on the sales or on the turnovers; in other cases, again, on the year; but the most common basis of measurement is the investment, or the same basis as that upon which interest is measured. Interest and profits are thus often measured upon the same basis, and one reason for this would seem to be found in the fact that earlier writers on economics did not always draw any clear distinctions between these two elements.

Before the advent of the modern corporation and the present facilities for credits, the capitalist and the employer were one and the same person. Business undertakings were then carried on in comparatively small units. The employer himself furnished all the capital, managed the business, and assumed all the risks. In other words, he performed all the functions for which interest and profits are received. Since the functions of both capital and the employer were united in the same person, there was, in actual practice, no very good reason for separating the shares or compensation of these two factors. Since the advent of corporations, systems of credits and other modern conditions, all this has changed. Today those who have capital, but do not prefer to risk it in their own business, usually loan it to those who have business abilities and are engaged in industrial enterprises and who are willing to pay the current rates of interest on such loans. Since the business units have grown so large as is the case at present, it is usually found that those who have the capacity for the successful operation of a large undertaking, but who lack all or a part of the capital needed therefor, are much more numerous than those who have both such capacity and the requisite capital. Hence, a condition has developed under which business is largely carried on with borrowed capital. Those who furnish the capital receive interest thereon. Those who borrow it and who use it in their business pay this interest, and, as compensation for their services of management and the risks they assume, receive profits or the surplus above the expenses. This does not mean that employers, as a rule, have no capital of their own in the business they are carrying on, for most of them have more or less of their own money invested therein. It simply means that, as a rule, the business they are doing is much too large for their own means, and that they therefore find it necessary and economical to use the capital of others as well as that of their own. This has led to a separation of the functions of the capitalist and the employer. The investors or capitalists are treated as a class by themselves. The employers, or those who assume all the responsibilities for the management and the risks of the business, are treated as a separate class. To the extent the employers are investors in their bsuiness, they are also regarded as capitalists. In the employers more than one factor of production are thus combined, and they usually share in the proceeds of the business to the extent of each of these factors. The employers simply borrow from the capitalists such money as they may need and for the use of this money pay stipulated rates of interest which vary with the lenders' estimate of the security of the loan. This money, together with their own money, the employers use in their business. Such borrowing simply amounts to this, that the employers assume the control and risks of these loans until they are paid back. The employer is, in fact, the owner of this money in the meantime. He pays interest thereon and also pays all the other expenses of the business. The balance left after all expenses have been met, if any, is called profits, and these profits constitute the employer's compensation for his services. These are, in the main, the facts which have caused later writers on business and economic topics to enter upon a more complete analysis of the functions of capital and the employer, and of the compensations which each of these two factors receive for the part they play in producing, marketing and selling the products.

Present views upon these matters also appear to be in line with the facts which have thus been briefly outlined. Profits are now acknowledged to be a peculiar form of income which, while they differ from rent, wages and interest, occupy about the same rank when it comes to their fundamental importance. Profits are a surplus over and above the expenses of production. They are usually identified as the balance left over after the claims of all other factors have been satisfied, and as the income that goes to those who carry on the business. Those who carry on the business, or the employers or entrepreneurs, as they are usually called, are regarded as coordinators of the factors of production and as the assumers of the risks and responsibilities of industrial undertakings. In other words, the employers under modern conditions assume, on their own responsibilities, the difficult but important tasks of so directing the work of manufacturing, marketing and selling the products that any given amount of efforts may be most effective in supplying human wants.

The work of the employers may, in a general way, therefore be said to consist of bringing together the labor and capital that may be required; of arranging or laying the general plan of the business; of determining what is to be produced as well as the methods of production; of finding the market and arranging for the sale of the products; they superintend or watch the carrying out of their plans, sometimes in a more general way only, but often in detail, depending upon the volume and the nature of the business; and in addition to this they also assume the risks that are involved in their undertakings. In other words, they are the general directors and risk takers of their businesses. Their functions are, in fact, so numerous and varied that it is impossible in a brief space to even mention them all. They could easily be separated into several distinct classes.

What is true with respect to the varied character of the work of the employers is also true with respect to their compensation for this work. While this compensation, when considered as a whole, is called profit, it could undoubtedly, upon sufficient analysis, be divided up into as many classes as the work. To do this, however, is very difficult. Profits, being a surplus, are not determined by any one set of principles. They are the result of the many forces that affect the prices at which the products sell as well as the cost at which they are produced. In a general way, however, it can perhaps be said that profits are made up of the wages of managements, of speculative gains from the risks which have [illegible] on chance rather than foresight, and of gains due to power of bargaining and other condi- [illegible] powers [illegible] penses. This is especially true of public utilities and of most other corporations. When [illegible] for such technical skill and ability of management, including the work of planning the operations and their ultimate direction as may be required, and when this compensation is included in the operating expenses, then it is also clear that it should not also be included elsewhere among the outlays or under any [illegible] intendence and management is included as wages or salaries in general expenses, the balance between the outlays and the receipts of a plant need not be large enough to cover these costs. There are many cases, however, where all of these costs are not charged directly to what is termed the cost of operation. Superintendence, for instance, may be charged to this cost, while management expenses may be cared for out of profits. Again, a part of [illegible] and the remaining part into profits. Practices in this respect vary greatly, not only as between industries but as between different plants in the same industry. Since there are variations in the manner in which these costs are treated, it also follows that before any hard and fast conclusions are drawn from the figures given in the financial reports of such enterprises, it is necessary to determine their practices in this respect. The amount of work falling upon the management depends largely upon the investment, the amount of business that is done and the nature of the same. While there are great variations in this respect, it can perhaps be said that the amount of management that is required in a business depends more upon the circulating than on the fixed capital. In industries where the proportion of the former is relatively large, the work of the management is also relatively heavy, and vice versa. As the cost of the management bears a somewhat close relation to the work that is required of it, it also follows that this cost is comparatively low where by far the larger proportion of the investment consists of a durable and easily managed plant which requires but little attention after it has been constructed and put in operation. Public utilities come in this class. In these the cost of the management constitutes only a comparatively small part of the total cost of the investment, although this is not always the relation that exists between this cost and the value of the products of such utilities.

Abilities of the highest order are often required for the successful operation or management of a business enterprise. In many industries really effective superintendence requires the highest technical skill and training. When it comes to the management proper, so much may not be needed in the way of technical skill, but other qualities are often required that are even rarer. A manager, particularly if he is producing for the general market, must, first of all, have a thorough knowledge of everything that concerns his own business. He must have the power of forecasting the future, of foreseeing the broader movements that affect both production and consumption; of seeing where there are opportunities for supplying, if not for creating, new wants; of being able to improve old methods of production as well as the products that are made for the market. The manager must be a good and cautious judge not only of the present but also of the future. In addition to this he must also be a leader of men, able to choose efficient and conscientious assistants whom he can trust and rely upon, as well as of interesting them in their work so as to bring out the best there is in them. While doing all this, he must be able to exercise general control and to see to it that the main plans are adhered to in the business as a whole, and to so engineer the different processes that the products are turned out at costs that are low enough so that they may be sold at profits. All this requires a high order of ability, judgment, tact and determination, qualities that are perhaps more dependent upon natural capacity than upon technical training. There are, of course, many industries which are operating under favorable conditions and where the duties of the employer are less exacting. The products they supply are simple and require little change. The methods by which they are produced are uniform, well settled and do not require the highest technical skill. The markets in which these products are sold are also well established and defined. In such cases the operation of the plants is often reduced to merely routine work. This is the situation for some of the public utilities and for many other undertakings.

While the work of the management is among the highest classes of work that is performed in connection with any enterprise and often requires the greatest ability in order to attain success, it is a fact that managerial ability is not as scarce as may appear to be the case at the first blush. In our present commercial and industrial processes a class of men are constantly being developed who appear to be quite able to fill these positions as they become vacant or are created. The result of this is that the supply of almost all grades of managerial ability is, in most cases, equal to the demand. In view of these facts it is also obvious that the cost of this class of services is a matter that is not entirely independent of ordinary competitive conditions.

The cost of the executive officers alone for the two plants involved in these proceedings [illegible] to $9,[illegible] in 1907, to $9,117.50 in 1908, and to about $9,557.46 for the fiscal year ending June 30, 1909. These expenses in 1909 consist of the salaries of the president, vice president, general manager, secretary and treasurer, assistant secretary and treasurer, auditor, and engineer. These expenses for 1907 and 1908 also consist of the same items, with the exception of the salaries of the auditor and engineer, both of which items appeared for the first time in 1909. The salaries of the president, secretary and treasurer were increased during the latter year. The reasons why the executive expenses were higher in 1909 than for either of the two preceding years are thus easily accounted for. For 1907 and 1908 the executive salaries constituted less than 2 per cent of the gross earnings and about 3 per cent of the total operating expenses. For 1909 these percentages stood at about 2.8 and 4.9 per cent respectively. These relations between executive salaries on the one hand and the gross earnings and operating expenses on the other are somewhat lower than is the case for many such plants and slightly higher than is the situation for certain other plants in the state. There are plants, for instance, where these percentages amount to as much as from 5 to 10 per cent, and there are still other plants where they are as low as from 1.5 to about 3 per cent. Absolutely just comparisons of this nature, however, cannot easily be made, since this would imply exactly like conditions as between the plants compared, a situation which is rare and hard to discover. But while not exact, these comparisons throw some light on the situation, and therefore are not without value in this connection.

Whether the executive expenses in this case are unreasonably high is something that can be determined with only approximate accuracy. In passing upon this question the size of the plants, their earnings and expenses, the conditions under which they are operating, the grade of men required for safe and effective operation, are all matters that should be carefully considered. The larger the plant the more numerous the customers, the more is required of the management. High grade service safely rendered may also require greater efficiency on the part of the management than if the standard of the service were lower. When the salaries are fixed with these conditions in mind, and no more is paid than the amount that is sufficient to insure proper and efficient service, there is little to be said regarding the salaries paid. If, on the other hand, the salaries are kept at an unreasonably high level in order to cover up earnings, or for some other reason of this nature, there may be good ground for criticisms.

The increases in the executive expenses during the past year for the plants under review is, as stated, partly due to increases in salaries and partly due to the fact that additional positions have been added to this roll. These additions, however, should perhaps be regarded as new additions in the sense only that, while the plants under the present management have always had the benefit of the services of both an engineer and auditor, the cost of these services does not appear to have been charged up directly against these plants until the present year, but, on the contrary, appear to have been borne by the company which is the owner of the plants. That engineering and auditing services within reasonable limits are proper charges to expenses for plants of this size there can be but little question; and as the amounts thus charged for these services do not appear to be unreasonable at the present time, no objection can be raised against these two items. As to the increase in a few of the remaining salary items, it must be said that, while they may appear rather large, such facts as we have been able to gather upon these points up to the present time make it appear that the salaries, as they now stand, are not far, if anything, out of line with the salaries that are usually received for similar services. It is true that within broad limits executive salaries vary with the investment and the volume of the business that is transacted, but these variations are not always so adjusted that there can be an exact response between cause and effect. For instance, a difference of, say 25 per cent, in the cost of the plant or in the revenue of the business is not always accompanied by corresponding differences in the cost of the management.

The functions of the employer or entrepreneur as a director or manager of his business thus consist of combining and directing the factors of production and of marketing or selling his product. The efficiency of the employer in this capacity is measured by the maximum amount of products he can turn out at a given cost, or by the amount by which he can keep the cost of these products to him below their market price. Their compensation for this work, as said, is usually called wages of management. These wages are sometimes included in the operating expenses proper and sometimes, again, omitted from these expenses and taken directly out of the surplus of the income above these expenses. In the case under consideration the wages of the management were included among the general expenses, or in the cost of operation proper.

The managerial functions of the employer would thus seem to be of a different nature from his function as a risk taker. Since all modern business is based on production for the markets where the products are exchanged it necessarily follows that all business is speculative in character and that the employer is of necessity a speculator. He buys labor and capital in various forms. He employs these factors in the production of things which he expects or hopes to sell for more than they cost him. This is true not only for the manufacturer but for the farmer, who, in deciding what crop to raise, is guided by his estimate of the probable future demand and prices for each kind, and for the merchant when he is endeavoring to determine the kind of goods he can sell at paying prices. In fact, there is an element of risk in practically all industrial and commercial activities of life. It is today the very essence of all business. The most successful risk taker is as a rule also the one whose surplus or profits are the largest. Risk taking is not mere chance. It involves careful estimates, not only of the cost but of salability of the products at prices that will yield a profit. It means that costs, markets, prices, industrial and commercial conditions must be carefully studied and their trend estimated. In fact, it is upon the correctness of these estimates that success or failure largely depends. To correctly estimate the probable trend of these conditions requires knowledge, foresight and sound judgment. It requires ability of a high order. They are matters which no one can completely master, but in which some become much more efficient than others. While the elements of risk may thus be minimized by study and observation, they can not be entirely eliminated. This will necessarily remain so as long as many of the conditions mentioned are affected by conditions that are beyond any employer's control. If this is true, then it would also seem that the efficiency of the employer as a risk taker should be measured by the receipts he is able to obtain from a given expenditure, by the degree to which the factors of production are directed into the most remunerative ventures, or by his ultimate success in the business world.

But the risks are much greater in some industries than in others. Where the products depend upon fashions, the season, or where they are of a perishable character, the risks may be extremely great. In other undertakings, where competition is in every respect unrestricted, they are also considerable, though perhaps on the whole less than the cases just mentioned. Where some special favor, such as patent rights, monopoly powers, or some privilege of this character is enjoyed, the risks are of course less and in some cases may be very small. As risk is an element that is likely to affect the supply of both business capacity and capital, it is often found that, for those who are successful, the profits are much higher where the risks are great than where they are comparatively small. That this should be the case is only natural, for, after all, those among the investors are comparatively few who do not attach considerable importance to safety or who are not willing to concede a part of their possible profits for an increase in the security of their investments.

As already pointed out, the greatest risks usually prevail in competitive undertakings. In these there is a constant struggle between the competitors to reduce the cost of production and to bring about other changes that will give them some advantage in the markets. Such producers have no way of controlling the supply of their products; and since the prices of the same are therefore beyond their control, they are apt to suffer from any improvement in the method of production on the part of any of their competitors that tends to either reduce the cost of these products or to enhance the demand for them in the market. The uncertainties or risks that are arising from these and similar sources are often extremely great. Even the ablest and most foreseeing of the producers are often taxed to the utmost in holding their own in the market. In cases where they are protected by patent rights or enjoy other advantages of this nature, the risks are of course somewhat reduced. But the security which is derived from such sources is not permanent. Patent rights expire. Improvements, both in organization and in methods of machinery, are constantly going on. Advantages of this kind are therefore apt to disappear at almost any moment.

In industries where certain monopoly conditions prevail, such as public utilities, competitive risks are, of course, of much smaller importance. In such industries the supply is under control and there is no direct competition in the sale of their products or services. There are of course exceptions to this, but these are not frequent, nor often serious or permanent. But when direct competition exists between such utilities, it is in the very nature of things most destructive. It means serious losses to all the competitors, and if continued for some time, ruin to one or the other. It is for these reasons that such competition is usually short lived and that it soon ends either in the consolidation of the competing companies or in agreements between them of some sort, under which prices are restored and maintained. But, as said, such conditions are now not very frequent. Water works have little or no other direct competition to contend against than such water supplies as may be obtained from wells and nearby rivers and lakes, and such competition is not often serious enough to materially affect conditions. This is also, in the main, true for gas and electric companies, although these compete some as between each other. When they have exclusive franchises, they can meet with no direct competition, and even when their franchises are not expressly exclusive they are often practically so in effect. Both may suffer some from such substitutes as oils and acetylene plants, but even such competition is seldom met with as long as rates are held down to reasonable limits. Gas and electric current used for power have of course to contend against each other as well as against steam, but the seriousness of this is usually materially reduced by the fact that each, to a certain extent, has a field of its own to supply; that is, there are certain demands for power in each case that are best served by one or the other of the utilities mentioned, or in which each has some advantage over the other. In considering everything therefore these utilities do not appear to be as great sufferers from either direct or indirect competition as is the case in most competitive undertakings.

But there are, in public utilities as well as in other industries, other than competitive risks. In the construction and operation of such plants many accidents may be met with and many mistakes may occur. While some of these might have been foreseen and prevented, others may be beyond human intelligence and grasp. Many examples of this might be mentioned. Such plants may also be injured by the diversion of the growth of the city in a different direction from that expected when the plants were built; by the failure of the city to grow as rapidly as expected or as rapidly as the plant had made preparations for; by the failure of the city to grow at all, as well as by decreases in its population and industries; by actions of the local and other authorities by which unprofitable extension may be required, the rates reduced, or other burdens imposed, as public utilities usually have to furnish adequate service whether it is paying or not. In the case of such losses the owners or employers are the first to suffer, as their share of the proceeds is not fixed, but has to take what is left after the other claims have been met. Wages, salaries, supplies, taxes, interest on the bonds or notes, etc., must be paid by the employers or the business will stop or go into receivership. If the earnings are only large enough to cover these outlays, the employer will have to go without his pay. There is no escape from this. In view of these and other facts, it is clear that public utilities are not entirely exempted from risks and that therefore there is a speculative feature about them for which their owners are entitled to something in the way of speculative gains.

To state even approximately what the speculative gains or the compensations for the risks which employers assume for society should amount to in the various industries is of course difficult. The data so far collected upon these points are not as complete as they might be. Comparatively few enterprises issue regular reports showing their earnings and expenses in detail. Those which issue such reports usually show the total profit in a lump sum, making no attempts to separate this item among its constituent elements. In fact, the classification of the various property earnings, expense and other items on the records of most enterprises is quite likely to differ from the classification of these elements by economists. But while all this is true, it is nevertheless a fact that there are few elements in any business concerning which fairly reliable information cannot be had if the proper efforts are made to obtain them. A close study and observation of the actual facts in the business world, as well as of the reports in which the results of the various business operations are summarized, can hardly fail to throw a great deal of light upon questions of this character.

In monopolistic industries the average profits are often greater than in competitive ones. That this should be the case is only natural, for the former control the supply of their products and are therefore quite generally in position to charge such prices for the same as will yield the greatest net returns. In fact, the chief popularity of monopoly prices is found in the control which monopolies have over the supply. In other words, the former are governed through the control of the latter. In competitive industries the magnitude of the profits depends on the managing ability, foresight, bargaining skill, and good fortune of the employers. In monopolistic industries profits rest on these qualities as well as on an additional element which is of the greatest importance—namely: the ability of the monopolist to control the supply, which usually results in fixing prices at the point where, as said, they will yield the highest net profits. Competitive profits tend towards the minimum; monopoly profits tend towards the maximum. The latter profits are also apt to have greater stability than the former. This applies, in varying degrees, to all kinds of monopoly advantages or to public utility corporations as well, to good will, patent rights and other privileges of this character.

Regardless of these facts there appear to be many enterprises of a monopolistic nature, such as public utilities, that are not even earning the average profits, but are actually losing money from year to year. That this is the case is clearly shown by their financial reports and records. In some instances this is due to lack of customers or to the fact that the places where the utilities are located are too small to furnish the requisite number of customers or volume of sales that is necessary for a paying business. In other cases, again, it is due to such adjustment to the rate schedules that the proper extensions of the business are effectively prevented. In still other cases it is found in the fact that the rates charged are too low to yield a profit. This is sometimes the case when the rates are fixed by the municipality. In some cases such losses are therefore due to conditions that may be removed through more efficient management and more equitable rate schedules, while in other instances they seem to be beyond remedy until the places which the utilities are serving have attained their proper growth or development.

But while many public utilities are losing money, there are also a great many of them that are making good profits. While these profits are not often as large as appears to be the general belief, they are often above what appears to be the average run of profits in many other industries. A close examination of a great many financial reports shows that, while some utilities are not earning their operating expenses, including the wages of managent and interest on the investment at current rates, others are earning a great deal more than this. The present situation therefore is that the speculation and other gains vary from nothing up to sums that amount to several per cent on the investment. Just what the average speculative gains of gas and electric plants amount to at present is therefore a matter that is difficult to estimate. Where such gains actually exist, they appear to amount to sums that vary from 1 to 10 or more per cent on the investment. When interest on the investment is figured at 6 per cent there are plants that show a surplus above this that runs up to about a like amount on what appear to be fair valuations of the plants. As gas and electric lights, generally speaking, may be regarded as fairly safe enterprises, especially after they once have reached a paying basis, safer in fact than many competitive undertakings, the speculative gains in the former should also be measured by a lower standard than those which might prevail for the latter. While this is true as a general proposition, it does not apply in every case, nor is it always the view investors take of it. The plants in question here, however, are favorably situated. Their earnings appear safe and are gradually growing larger, and they enjoy fairly good credit, which is indicated by the prices at which their bonds are selling.

The processes of the equipment involved in producing and delivering gas to consumers are usually assumed to be more fully developed and subject to fewer changes than the processes and equipments that are involved in producing and delivering electricity. As these assumptions appear to be in accordance with the facts, it would also seem to follow that the risks involved are somewhat lower for gas than for electric plants and that for this reason the latter kind of plants are entitled to somewhat greater profits than the former. Just what this difference should amount to is a question that largely depends upon the conditions in each case and concerning which no general rules can be laid down that are likely to amount to a great deal.

In view of the facts that have thus been presented in relation to this subject, it may be said that the witnesses for the respondent placed that part of the return on the investment which might properly be termed profits at rather high figures, and that under the circumstances in this case it is not unreasonable to limit the profits to from 1½ to 2 per cent on a fair valuation of the gas plant and from 2 to 2½ on a fair valuation of the electric plant. Such rates, in addition to an allowance of 6 per cent in each case for interest, would seem to be fair to the present owners as well as sufficient to secure both the business capacity and capital that are required in this particular case. It would not be unreasonable to limit the returns for both interest and profit to not less than from 7½ to 8 per cent on a fair valuation of the gas plant, and to not less than 8 per cent on a fair valuation of the electric plant.

Profits often also contain other elements of gain, such, for instance, as are derived from unforeseen and fortuitous circumstances and from superior power of bargaining. The former of these two classes of gains would rather seem to be the result of chance. They depend upon sudden changes in the demand, temporary shortage of goods on the part of competitors, and other conditions of this nature, rather than on foresight and good business judgment. Such gains nevertheless are often of considerable importance and may be of material aid in the success of an enterprise. The gains of bargainings are also often of the greatest importance. They consist of the ability to buy at the lowest and sell at the highest possible prices. In actual practice it often happens that the shrewder one of the bargaining parties can sell for higher than his lowest price and buy for lower prices than those he might have been ready to pay, and that his advantages in these respects are simply due to the fact that he has the ability to drive the closest bargains. These powers may be due to greater natural capacity, to better and more complete information upon the matters involved, and to several other causes. In any event it is a valuable power to possess, as it frequently leads to considerable increases in the profits of a business.

In passing upon these matters, however, it should be borne in mind that under present industrial conditions the best interests of society, as a whole, are subserved when the share of each factor of production is high enough to cause a free and unrestricted flow of labor, capital and business ability into the various utilities. If wages, interest and profits are not high enough to attract the factors which they represent, then these factors will not enter the utility business. The result of this is clear. If either or all of the factors refuse to enter this field, then no service of the kind these utilities render will be furnished, and the people may have to forego what may have become necessities to them. In order to obtain such service therefore it is absolutely necessary that the wages paid should be high enough to attract competent workmen, superintendence and management; that the interest paid on the capital legitimately invested should be sufficient to attract the necessary capital into these enterprises; and that the speculative and other gains should be high enough to induce employers to enter these industries as coordinators of the other factors of production therein and as assumers of all risks and responsibilities that are involved in their operation. From these facts there is no escape. From this it also follows that the rates fixed for the services rendered by such utilities must, in the long run, be high enough to attract the various factors of production or to induce the employer to enter upon such enterprises and to become responsible for the risks that are involved.

LETTERS TO THE EDITOR.

Specifications for Tile Drainage Work.

[illegible] construction, one is struck by the fact that al-[illegible] ods of making the tile and the method for in-[illegible] the contractor is supposed to obtain. For instance, in the clauses relating to tile, would it [illegible] of cement tile "that the cement must conform [illegible] and free from mineral salts which are detrimental to cement work," and then allow the contractor the privilege of using what he knows to be the most satisfactory methods and mixtures for the manufacture of tile to conform with the strength and absorption tests specified for the completed pipe? Likewise, it is custom-[illegible] "bubbles, blisters, fine cracks, etc.," which, [illegible] purposes where it is desired to keep the sewage from contaminating the soil, are of no objection in drainage work as long as they do not affect the discharge and durability of the drain.

The laying of the tile is usually well described in the common specifications, it being frequently stated that "no tile shall be laid until they have a free outlet," "the tile shall be free from sand," "irregular shaped tile shall not be laid," etc. The time for completing the work is usually specified and the contractor is required to furnish a first-class drain so when these two things are complied with it makes but little difference how he lays out the work. Many times the work can be hastened by starting several gangs at work along the line of the drain, and even the sections of the tile are laid below water, good work can be done especially if the water is temporarily dammed off and the trench kept free from water by pumping at the place where work is in progress. The time given on many contracts is so short that the job cannot be completed as specified unless methods similar to these are employed. The question of sand in a completed drain is the cause of much trouble between the engineer and the contractor. It is an easy matter to keep the sand out when there is but little water to contend with, but in wet quicksand it is almost impossible to keep the tile to grade, and as for keeping the liquid sand out of the tile, it is as difficult as to keep the water out, besides the price usually paid for drainage work is so low that the contractor cannot afford to install the equipment necessary to contend with wet quicksand.

Contracts and the specifications for drainage work are usually so badly interwoven that they mean but little to any of the parties concerned, but what else can one expect under the conditions common in many sections where the contractor is supposed to do a first-class job regardless of restrictions or conditions, and the engineer gets the "cussing" of both the employer and contractor if the job comes out wrong.

It is very difficult to outline a specification for drainage construction which will be satisfactory to every one, but for the present the following is suggested:

Tile: The tile shall be of good quality, true in shape, and conform with the requirements for strength and absorption as specified herewith. (The requirements as to strength and absorption must be determined by the engineer for the drain he has in hand.) The methods for testing tile as adopted by the Iowa Engineering Society shall be the official methods for the testing of all tile. Concrete tile, if furnished, shall be made from materials which conform to the standards recommended by the Interstate Cement Tile Makers' Assocation.

Work: The tile shall be installed in a first-class workmanlike manner, care being taken to follow the alinement and grade given by the engineer in charge of construction. The contractor will be required to rectify at his own expense any deviations from the grade or alinement, or both, which in the opinion of the engineer will be detrimental to the successful operation of the drain. The tile and work will be inspected by the engineer as furnished and laid, and upon acceptance the trench shall be promptly refilled, or at the option of the contractor may be left open if securely fenced so as to prevent stock falling into the trench. All backfilling must be completed by the contractor before the final acceptance of the trench. When the work is completed the engineer shall make tests and measurements of the flow through the several sections and sizes of tile used in the drain. The work will be accepted if the "coefficient of roughness" as found by Kutter's formula does not exceed the value 0.015. The capacity of the drain as measured by a rectangular weir, or any other method of equal accuracy, must equal or exceed the amount calculated by the use of the above value of "N" in Kutter's formula.

The contract should be separate from the specifications and not interwoven with them as is common. Matters relating to the payments, time of construction, definition of terms, damages, bonuses, forfeits, etc., belong to the contract. If the determination of the coefficient of roughness be made the basis of settlement, it will be best to pay the contractor a bonus for each 0.001 he reduces the value below that specified, while a corresponding forfeit can be exacted for each 0.001 it exceeds the stated value. This would make it for the contractor's advantage to use straight tile and secure the best alinement for them.

[illegible] Engineering Experiment Station, Ames, Iowa, as well as drawings for the construction of inexpensive testing machines. The machines can be secured from Hubert Reidesel, Lanesboro, Iowa; Quinn & Co., Boone, Iowa, or almost any local machine shop can make them to order.

Respectfully,
A. O. ANDERSON.
Ames, Iowa, June 10, 1911.

PERSONAL.

Mr. Geo. F. Samuel has been appointed engineer of track elevation for the City of Chicago, succeeding Mr. H. S. Baker, who was made assistant city engineer on May 17.

Mr. L. F. Byam, formerly assistant to the chief engineer, Electric Zone Improvements, New York Central & Hudson River R. R., has been appointed secretary and treasurer of the Elliott C. Brown Co., a firm of constructing engineers of New York City.

Mr. W. W. Reynolds, who has been for the past seventeen years assistant city engineer of New Orleans, La., died at his home in that city on June 5. He had served in the Confederate army throughout the Civil War, and was 77 years old at the time of his death.

Mr. E. H. McHenry, who, as announced in our last issue, was elected vice-president in charge of maintenance and construction of the New York, New Haven & Hartford R. R., has been made vice-president in charge of the same departments of the Boston & Maine R. R.

Mr. Arthur H. Blanchard, consulting highway engineer, has resigned from the position of associate professor of civil engineering at Brown University to accept the appointment of professor of highway engineering at Columbia University. Mr. Blanchard wil have charge of the graduate courses in highway engineering which wil be established at Columbia University next year.

Mr. L. M. Perkins, engineer of maintenance of way of the Northern Pacific Ry. Co.'s lines east of Paradise, Mont., has been appointed to the same position for the lines west of Paradise, with headquarters at Tacoma, Wash. He succeeds Mr. A. R. Cook, transferred. Mr. Andrew Gibson becomes engineer of maintenance of way of lines east of Paradise, with headquarters at St. Paul, Minn.

Mr. Jerome Cochran, designing engineer for the Corrugated Bar Co., of St. Louis, Mo., has accepted a similar position with the Trussed Concrete Steel Co. of Detroit, Mich. Mr. Cochran was for several years with the Phoenix Bridge Co., Phoenixville, Pa., and professor of civil engineering at John B. Stetson University, De Land, Fla. He was also consulting engineer at Houston, Tex.

A number of engineers have recenty sailed from New York to Hayti, where they will engage in the construction of 500 miles of railroad, contract for which has recently been let to Mr. J. P. McDonald, railroad contractor of New York City. Among the engineers who have sailed are Norman R. Orcutt, Oliver Le Pointe, W. H. Peace, Harry Eldrick and Jack Neil, of Birmingham, Ala., and Raleigh Goddard, of Maryville, Tenn.

Dr. Albert Sommer, consulting chemist for the Texas Co., has resigned to accept a similar position with the Barber Asphalt Paving Co., of New York City. Dr. Sommer came to the United States in 1905 from the Technical University of Dresden, where he had been an instructor. In 1910 he was appointed lecturer on petroleum and its products in the School of Marine Engineering of the U. S. Naval Academy at Annapolis. He has done much scientific and development work in connection with the manufacture of petroleum products, and is a member of the leading chemical and engineering societies.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Automobile Testing Laboratory.—Paper, 6x9 ins., 32 pp. 44th and 55th streets, west of Broadway, New York.

This is a complete illustrated description of the apparatus in use at the Automobile Club of America in its laboratory of experimental automobile engineering. This apparatus is now available for all interested in making scientific investigations. This apparatus is installed for the tests of complete power units, carburetors, ignition devices and transmissions. Rules governing tests are given.

Worthington Centrifugal Pumps.—Paper, 6x9 [illegible] Worthington, [illegible] Broad[illegible]

Bulletin "W"-185 is entitled "Centrifugal House and Sump Pumps." It illustrates pumps directly connected to motors, gives descriptions, table of heads, capacities and diagrams and directions for installing and operating.

Bulletin "W"-176-A is entitled "Type D Centrifugal Pumps for Low-Head Service"; 12 pages. This catalog gives illustrations and descriptions, tables of capacities, speeds, prices and dimensions of these pumps and directions for installing and operating.

Creosoted Wood Pipe and Timbers.—Paper, 6x9 ins., 36 pp. Wyckoff Pipe & Creosoting Co., 48 Church St., New York City.

This booklet gives a history of the development of creosoting and gives complete illustrations and descriptions of creosoted pipe, poles, ties and other materials.

Wood Preservation.—Paper, 6x9 ins., 4 pp. C. S. McKinney Co., 50 Church St., New York.

A brief review of the subject of wood preservation and a description of the uses of Cop 'R-Oil Carbolineum.

Smith Crushing Equipment.—Paper, 6x9 ins., 16 pp. The T. L. Smith Co., Majestic building, Milwaukee, Wis.

This catalog contains a complete description and illustrations of crushers, both stationary and portable, screens, bins and elevators. Tables of dimensions of all machinery are given.

Air Compressors.—Paper, 7¾x10½ ins., 16 pp. The Allis-Chalmers Co., Milwaukee, Wis.

This is Bulletin No. 1525, entitled, "Portable and Stationary Air Compressors for Industrial Purposes." It gives a general description and photographs of this type of apparatus, together with tables containing data relative to sizes, capacities, weights, etc.

Polyphase Induction Motors. Paper, 7¾x10½ ins., 23 pp. Allis-Chalmers Co., Milwaukee, Wis.

This is bulletin No. 1081, which supersedes Bulletin 1040, and illustrates and describes these motors.

"Bulletin No. 1448" illustrates and describes Gates Rock and Ore Breaker in detail. Tables of prices and dimensions are accompanied by line drawings of different types.

"Modern Rock Crushing Plants" gives further information about rock crushing and handling machinery and data as to dimensions of all machinery are given and illustrations and line drawings showing different designs for rock crushing plants of various capacities are given.

Dynamite for the Panama Canal.—Bids for supplying 6,500,000 lbs. of 45 per cent. and 3,500,000 lbs. of 60 per cent. dynamite, a total of 10,000,000 lbs., the estimated amount required for the Canal work during the fiscal year 1911-12, were opened recently in Washington. Awards were made as follows:

1,625,000 lbs. of 45 per cent dynamite to the Keystone Powder Co., at $12.25 per 100 lbs.

4,875,000 lbs. of 45 per cent dynamite to the DuPont-Nemours Powder Co., at $12.73 per 100 lbs.

1,750,000 lbs. of 60 per cent dynamite, to the Keystone Powder Co. at $13.65 per 100 lbs.

1,750,000 lbs. of 60 per cent dynamite, to the DuPont-Nemours Powder Co., at $13.82 per 100 lbs.

The price of the dynamite under these awards averages over 1 ct. per lb. higher than the figures at which it was supplied for the present fiscal yer, which, in turn, were higher than for the previous fiscal year.

A blast which loosened 8,000 cu. yds. of limestone was set off at the plant of the Woodville Lime & Cement Co. recently. Cycline drills put down 5 in. holes about 18 ft. apart about 12 ft. back of the face of the cliff which was approximately 30 ft. high. The holes were loaded heavily near the bottom and a lighter charge was placed about 15 ft. from the surface. Sticks of explosives 4½ in. in diameter were used. The explosive was 60 per cent dynalite, made by the American Dynalite Co. of Elyria, Ohio. This explosive does not contain nitro-glycerine and does not require thawing even in the coldest weather. The cost of the explosive used was about 1½ cts. per cu. yd. of rock loosened.

A record of metal cutting in England was established by a man in the employ of the Knowles Oxygen Co., Ltd. He cut through 42 girders 15x5 in. section in 4¾ hrs. Less than 200 ft. of oxygen and 300 ft. of hydrogen were used. Labor cost 1 shilling per hour and 6 pence per cut.

CONTRACT NEWS SECTION
of
ENGINEERING & CONTRACTING

The Doings of the Week.

Railroad work, as far as the letting of large construction contracts is concerned, has been mighty dull during the past few days. Very few contracts of any size appear to have been let. It is not thought that this condition will continue long and many contractors expect to see the placing of a considerable amount of contract work by July 1. Bids on several contracts are now in the hands of railroad engineers, and it is expected that the work will be placed in a few days. The Southern Ry. Co. has received bids for 33 miles of second track work as follows: From Oakwood to Buford, Ga., 11 miles; from Buford to Pittman, Ga., 10 miles; from Pittman to Cross Keys, Ga., 12 miles.

Among the railroad construction contracts let recently are the following: H. Houser Construction Co., Los Angeles, Cal., for the grading and excavation for the new $1,000,000 division terminal to be constructed by the Santa Fe System at Colma, three miles from Fresno, Cal.; Co-Operative Construction Co., Austin Bank Bldg., Austin, Tex., for building the entire line of the Quanah, Seymour, Dublin & Rockport Ry. in Texas. The following obtained sub-contracts from the J. H. Flick Construction Co., in connection with the double track work on the Louisville & Nashville R. R., from Berry to Lair, Ky., 15 miles: Crowley-Salisbury Construction Co., Davenport, Ia., for 7,000 cu. yds. concrete masonry; Edward B. Garretson Co., Cincinnati, O.; John Berggsen, Denver, Colo., and Deavonshire & [illegible], O.

Canada seems determined to make a record this year for railroad construction work. Announcement has been made that the Grand Trunk Pacific Ry. has called for tenders for the construction of the uncompleted gap of 410 miles between Aldermere in the Bulkley Valley and the Tete Jaune Cache on the Fraser River, 50 miles west of Yellow Head Pass. This contract with the 185 miles of Hudson Bay Ry. to be let Aug. 1, and the contract for the construction of the Canadian Northern Ontario Ry. to be let July 1, makes something like 800 or 900 miles of line now open for bids.

The State Public Utilities Commission of Kansas has authorized the Missouri Pacific R. R. [illegible] and $20,000,000 in notes. This note issue is the same as the one approved by the Nebraska board. It is understood the proceeds of these notes are to be applied in cleaning up the floating and unrefunded indebtedness of the company amounting to about $9,500,000, and the balance is to be used in improvements, betterments, and purchase of equipment. A large amount of the improvements will be made in Kansas and Nebraska.

The city of Grand Rapids on June 11 awarded a large sewer contract to Carpenter & [illegible] 721. The contract calls for the construction of the East Side trunk sewer, the work including 2,500 ft. of combined dock line wall and sewer, the sewer being box section about 1[illegible] 13 ft. in diameter; 1,200 ft. of horseshoe section 12 ft. in diameter; and 250 ft. of horseshoe, 11 ft. in diameter.

The Board of Water Supply of New York City has awarded the remaining contracts for the construction of the high pressure water tunnel for which bids were opened May 16. [illegible] Pa., secured contract 65 at $5,590,295, and Grant Smith & Co. & Locher, Rome, N. Y., secured contract No. 66 at $1,512,605.

The legislative committee on metropolitan affairs has voted to report to the Massachusetts Legislature the $9,000,000 bill for the development of the port of Boston. The bill provides for the appointment of a commission of five to be known as the directors of the port of Boston. The Governor is to appoint three members and designate the chairman. The Mayor of Boston is to appoint a fourth member of the commission, and the fifth member is to be the chairman of the present State Harbor and Land Commission, ex officio. The chairman will receive a salary of $15,000 a year. An amendment inserted by the committee provides that he shall give all his time to the duties of his office. The four other members are to receive $1,000 a year.

The Board of Trustees of the East Side Levee & Sanitary District of East St. Louis, Ill., will call for bids shortly for the construction [illegible] These two sections will be about 10½ miles long and will contain 1,600,000 cu. yds. of earth.

The Atchison, Topeka & Santa Fe System has appropriated $605,000 for drilling 40 oil wells in the Midway oil fields, and $91,000 for drilling three additional wells in the Ulinda oil fields.

$257,400,000 for Transit Facilities.

[illegible] June 13 the conference committees of the Public Service Commission and the Board of Estimates made public their [illegible] ties of the city. The recommendations call for the expenditure of $257,400,000 for the construction and equipment of new transit lines. Of this sum it is proposed that the city shall supply $131,200,000, the Interborough Rapid Transit Co., $75,800,000, and the Brooklyn Rapid Transit Co. $50,400,000. By the plan recommended the Brooklyn Rapid Transit Co. will come into Manhattan by way of a tunnel at the Battery, under the East River, and will thence continue north under Broadway and 59th St. to the Queensborough Bridge to connect with its system on the Brooklyn side of the river. The Brooklyn company also gets most of the extensions it has asked for in Brooklyn, in addition to the right to operate the Centre St. loop and build a subway from the Brooklyn end of this subway under Nassau St. to join the company's line at a junction at the Battery, near where the tunnel will emerge from the East River. The [illegible] to be permitted to enlarge its system in [illegible] the Eastern Parkway loop. The Interborough [illegible] with its Manhattan system. The company also gets the right to third track its elevated lines. Inasmuch as the Brooklyn Rapid Transit Co. and the Interborough Co. have secured the particular points which they most desired—an entrance to Manhattan and the right to third track the elevated lines—the members of the Conference Committee are of the opinion that these companies will agree to the plans outlined in the report. The plan provides, however, that if either company fails to meet the demands suggested by the committee the lines awarded to it will be awarded to the rival company; should both companies refuse to respond to the offers made to them in the report it is recommended by the committee that the city have nothing further to do with the companies, but should proceed at once to arrange for the construction, as originally planned by the Tri-borough route. Some of the officials of the city are optimistic enough to express the opinion that there will be no further delay in starting construction work. Most of the New York papers seem to think otherwise.

Workmen's Compensation Laws.

[illegible] compensation law will go into effect in Illinois. This [illegible] columns, applies to specified hazardous occupations. Some of the features of the law are: A death compensation of four times the annual earnings of the employe; a graded compensation for injuries; complete disability gives the employe 50 per cent of his average wage for the first eight years of his disability, after [illegible] per cent of the death benefit, but not less than $10 a month. Blindness, loss of both hands or feet, or of one hand and one foot, injury to spine resulting in permanent paralysis, fracture of skull resulting in insanity are defined as permanent disabilities, not exclusive of other causes. In order to avoid the flaw that led to the invalidating of the New York statute, the Illinois law is made optional with both employers and employes. Employers electing not to come under it relinquish the defenses of assumption of risk, fellow servant and contributory negligence. So much for the Illinois law. In the meantime a Federal Commission is making an investigation of the practice of foreign countries in regards to workmen's compensation laws with a view to enacting a national law for this country. According to a bulletin of the Bureau of Labor, in European practice a distinction is drawn between employers' liability laws and workmen's compensation laws, the latter covering acts which provide for the award of fixed sums to employes injured by industrial accidents, without the necessity of litigation and without reference to the question of negligence upon which the employers' liability acts are based. Most such foreign compensation laws, however, provide that gross negligence on the part of the injured person will bar his right to compensation, or, on the other hand, such negligence on the part of the employer some [illegible] tion. Usually the injuries must cause a disablement for a specific number of days or weeks before compensation becomes due. In every case the laws fix the compensation to [illegible] ceived by the injured person. The compensation consists of allowance for temporary disability and annual pensions in lump sum payments for permanent disability or death. In European practice the industries usually covered by the acts are manufacturing, mining and quarrying, transportation, building and engineering work, and in some countries agriculture, forestry and irrigation. In two countries the acts are limited to mining.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

•W. H. Hall, Jasper, Ala., is working [illegible] [illegible] its grading contract for the [illegible]-mile extension of the Alabama Central R. R. east of Manchester.

The Ogle & Northwestern R. R. Co. has filed its articles of incorporation. The capital stock is $5,000, of which $1,000 has been paid in. Winslow Fitch, Masonic Temple, Tuscaloosa, Ala., Chief Engineer of the [illegible] Bay, Birmingham & Chicago R. R., mentioned in our last issue, is one of the incorporators.

A French syndicate is reported to have taken $7,000,000 worth of bonds of the proposed Birmingham & Vicksburg R. R., and this is said to assure the construction of road. The line will be 264 miles long, and will, it is understood, run east through Flora, Miss., Canton, Carthage, Edenburg, Shuqualak, thence to Tuscaloosa. C. Searles, Vicksburg, Miss., is president.

P. H. O'Bryan has moved a scraper outfit to Tuscaloosa for work on his sub-contract on the Tuscaloose Mineral R. R.

The Business League of Demopolis is taking steps to secure the extension of the Sumter & Choctaw Ry., E. F. Allison, President, Bellamy, Ala., from Lileta to Butler. From the latter place it is proposed to secure an entrance to Demopolis over the tracks of the Southern Ry.

Arizona.

•Ties and steel for 28 miles of road have been unloaded near Mesa, and will be used for the construction of the line that is to connect the Arizona & Eastern at McQueen ranch, opening up the Chandler properties. Grant Brothers, Los Angeles, have the contract and will immediately construct 12 miles of the line.

Arkansas.

Articles of incorporation have been filed by the Malvern & Camden R. R. Co., which proposes the construction of a railroad 60 miles long from Malvern to Camden, Ark., via Hot Springs. The capital stock of the company is placed at $1,500,000 and Thomas S. Buzbee, Malvern, Ark., is President.

The construction of a railroad north along the Ouachite River from Camden to Malvern is proposed by the Chicago, Rock Island & Pacific Ry. This is the line mentioned in our last issue as being considered by Deere & Co.

California.

⊙H. Houser Contracting Co., Los Angeles, Cal., has been awarded the contract for the grading and excavation for the new $1,000,000 division terminal to be constructed by the Santa Fe System at Calwa, three miles from Fresno. The contract covers both Calwa and Riverbank, the terminal to be built about 100 miles north of Fresno. The terminal at Calwa will cover a strip of ground nearly 1½ miles long and ½ a mile wide. It will include switching yards, besides roundhouse, repair shop and other buildings. It will be necessary to do extensive grading and filling, as part of the site is low and uneven. Part of the site will be cut down by several feet, and other parts will be raised from 2 to 6 ft.

The Santa Fe System plans on the following improvements for the near future: Repairing dikes Nos. 1 and 2 near Nebo, for which an appropriation of $[illegible] has been made, including extensive [illegible] at the Bakersfield yard, for which $48,700 has been appropriated; drilling 40 oil wells in the Midway oil fields and three additional wells in the [illegible] fields. To cover the cost of these an appropriation of $[illegible] has been made for the former and $94,000 for the latter; purchasing an engine hoist with shelter and pit to be located at Richmond to cost $6,000 and the construction of three new and repair of four old breakwaters at mile post 43, with necessary rip rap, to cost $11,000. H. C. Philips, Los Angeles, Cal., is Chief Engineer, Coast Lines.

The Peninsular Ry. Co. (electric) has applied for a franchise at Santa Clara over the following route: Commencing on the Saratoga Ave. at the southern limits of the town, thence north on Saratoga Ave. to Bellomy St., thence east on Bellomy St. to Lincoln, thence north on Lincoln to Franklin, thence east on Franklin St. to Jefferson to connect with the present electric railroad there.

A project is under consideration for a cross-town electric line at Hayward, Cal. I. B. Parsons, President of the Hayward Bank, Hayward, is interested.

The Sacramento-Folsom Electric Ry. Co. has applied to the city trustees of Sacramento for a franchise at that place. The company which was recently incorporated proposes to build a line from Sacramento to Folsom, with a branch to Fair Oaks. The directors of the company are Francis V. Keesling, Herman Gran, Ernest L. Brune, J. W. Cook and Otto Gran, all of San Francisco. Of the $1,000,000 capital stock, $20,000 has been subscribed by the directors.

The Fresno Traction Co., F. W. Webster, manager, Fresno, is considering an extension of the North Park car line to Roeding Park and Mountain View cemetery.

The Western Pacific R. R. is reported to be planning to soon begin work on a branch line from Susanville to connect with the main line, near Marysville.

The Southern Pacific Ry. is reported to have completed the Rocklin-Colfax Cutoff across the Sierra Mountains in California for a distance of 33 miles at a cost of $15,000,000.

Articles of incorporation have been filed by the Tidewater Southern Ry. Co. which proposes the construction of a railroad from Santa Monica Bay over Malibu ranch to Oxnard, Cal. The capital stock of the company is $800,000, of which $80,000 is paid up. The incorporators are Mrs. M. K. Rindge, F. H. Rindge and N. D. Darlington.

Colorado.

The promoters of the Hotchkiss & Red Canon R. R., have recently been over the entire route, and it is expected that definite announcement as to construction plans will be made shortly. George C. Harper, Minneapolis, Minn., is president.

It is expected that grading work for the new line of the Colorado & Southern Ry., from Wellington, Colo., to Cheyenne, Wyo., 34 miles, will be finished by July 1. It is also expected that the joint double track of the Colorado & Southern and Denver & Rio Grande from Pueblo to Walsenburg, 54 miles in length, will be completed by July 1. The Wellington-Cheyenne line will have cost about $1,500,000 complete. It will be a link in the transcontinental Hill route from Seattle to Galveston and Denver will be its principal city en route. Only one other link remains to be built, that of the Burlington through the Big Horn canon of Wyoming, and that is rapidly nearing completion. From Fort Collins, 71 miles north of Denver, to Wellington, the road, originally built for beet-hauling purposes, is being relaid with 85-lb. steel, and this immediate work will extend to Dixon, the first station north of Wellington. After July 1, when grading will be complete, tracklaying to Cheyenne will be begun as soon as steel can be delivered.

H. M. Byllesby & Co., Chicago, Ill., is reported to have purchased the property of The Pueblo & Suburban Traction & Lighting Co. It is said the price paid approximated $3,000,000. The property consists of the local street railway and electric lighting system, the lighting system and power plant at Victor and Skagway, the electric lighting plant at La Junta and plants in other places.

Connecticut.

The charter of the Branford R. R. Co., of Branford, Conn., has been amended so as to provide for increasing the capital stock from $25,000 to $150,0000. Permission was also given to extend the road about one mile north. It is understood that construction work on this road will be started this summer.

Georgia.

A project is under consideration for the construction of a railroad to penetrate the coal fields of East Tennessee, and run from Knoxville, Tenn. directly south to Rockmart, Ga., Carrollton, Ga., Bush Head Shoals on the Chattahooche River, La Grange, Ga., and Columbus, Ga. At the latter point it is proposed to make two branches, one going to Pensacola, Fla., and the other to Mobile, Ala. It is said that people of LaGrange and Carrollton stand ready to subscribe a bonus or bond issue of $50,000 each as an inducement to secure such an independent line. L. K. Smith, Gainesboro, Ga., is reported to be interested in this plan.

The Valdosta, Moultree & Western Ry., Gordon Tillman, Chief Engineer, Valdosta, Ga., which recently secured authority from the State railroad commission to issue $600,000 in bonds for the purpose of purchasing and improving its terminal facilities in Valdosta and Moultrie, is understood to contemplate extending its line to Camilla.

Right of way is being secured for an extension of the Bostwick R. R., R. L. Mobley, Receiver, Bostwick, Ga., through Monroe to the Seaboard Air Line on the north and to Greenboro, White Plains and Sparta on the south. This would make a railroad 70 miles long.

The Southern Ry. Co., W. H. Wells, Chief Engineer of Construction, Washington, D. C., has received bids for the following second track work: From Oakwood to Buford, Ga., 11 miles; from Buford to Pittman, Ga., 10 miles; from Pittman to Cross Keys, Ga., 12 miles.

Permission has been granted the officials of the Atlantic, Waycross & Northern R. R. by the Railroad Commission of Georgia to issue bonds and stocks in the sum of $6,300,000 to provide funds for the construction of the projected road to Fort Valley, a distance of 222 miles. Headquarters of the company are at St. Marys, Ga. An amendment to the charter is to be asked increasing the capital stock from $500,000 to $1,500,000. Capt. L. Johnson is President of the railroad.

Among the rumors in regard to the new construction work contemplated by the Southern Ry. is one to the effect that the company has under consideration the expenditure of approximately $1,000,000 for the erection of shops and the extension of the yard trackage at Macon, Ga. A site including 100 acres is reported to have been secured for the improvements.

Idaho.

Bids were opened June 10, at the office of the U. S. Reclamation Service, at Boise, F. E. Weymouth, Supervising Engineer, for constructing roadbed for railway from Barberton to Arrow Rock Dam, for the U. S. Reclamation Service. The bids received were as follows: (1) Bid of Nelson Rich, Prosser, Wash.; (2) M. H. Knudson, Boise, Idaho; (3) Maney Bros. Co., 123 S. 11th St., Boise, Idaho; (4) W. H. Thompson & Gus Carlson, Boise, Idaho.

Items.	Yds.	(1)	(2)	(3)	(4)
Sched. No. 4—					
Class 1...	45,000	$0.23	$0.32½	$0.25	$0.35
Class 2...	20,000	.50	.70	.70	[illegible]
Class 3...	2,000	1.40	1.50	1.00	[illegible]
Overhaul..	75,000	.02	.03	[illegible]	.03
Sched. No. 5—					
Class 1...	30,000	.24	.....	.25	.40
Class 2...	18,000	.70	.....	.70	.80
Class 3...	24,000	1.40	.....	1.00	1.65
Overhaul..	[illegible]	.02		[illegible]	.03

Conditional on acceptance of both schedules or none.

Right of way concessions are being secured for the proposed electric railway between Nampa and Caldwell. C. W. Van Kirk, Nampa, has been securing this right of way. It is understood that the right of way and

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

grade will be presented to the parties who will build the road.

Work has been started laying steel on the Golden Gate Branch of the Oregon Short Line from Caldwell, Idaho, to Homedale.

Material is being shipped to Emmett, Idaho, preparatory to starting construction work on the Idaho Northern extension. Surveyors have nearly completed their portion of the work and right of way is being secured.

Illinois.

Village Council at Yorkville has granted a franchise for the proposed Yorkville-Morris interurban line. Options on most of the right of way through to Morris are understood to have been [illegible] the line being promoted by F. M. Zimmerman and H. H. Evans [illegible]

The Chicago Consolidated Traction Co., 1165 N. Clark St., Chicago, Ill., has expressed its willingness to extend its tracks from the present terminal in Milwaukee Ave. to the Chicago city limits.

The Illinois Railroad and Warehouse Commission has granted the Alton & Mississippi River Belt Railway & Transportation Co. of East St. Louis the right to establish a connection with the municipal bridge now being constructed over the Mississippi River at St. Louis. The belt line operates in Madison and St. Clair counties, Illinois, and by the decision is given the right to construct a connection with the approach to the bridge at a point 2,400 ft. east of the river.

Indiana.

Track-laying on the Big [illegible] Railroad extension from Mt. Carmel, Ill., to Evansville, has now been completed, and it is expected that the first trains will be run on the new road July 1.

We are advised that the Gary Southern Traction Co. has no definite plans for extension beyond Crown Point, Ind. It was reported that the line would be extended to Cedar Lake and Lowell next year and thence to Kankakee.

Iowa.

⊙The Rock Island Southern Ry. System, J. W. Walsh, Secy., Davenport, Ia., has, in connection with the building of a 5½ mile line from Alexis Junction to Alexis, Ill., let a contract to the Myers Construction Co., St. Louis, Mo., for a large bridge.

The Illinois Central R. R. Co. has contracted to construct a side track to the property of the Cedar Falls Sand & Material Co., at Cedar Falls, Ia.

Kansas.

Preliminary surveys are still underway for the proposed track elevation and union depot in Wichita, and it will probably be some time before actual construction work can be started. C. J. Skinner, Wichita, Engineer Atchison, Topeka & Santa Fe Ry., is Resident Engineer in charge

The State Public Utilities Commission has authorized the Missouri Pacific R. R. to issue $10,000,000 of mortgage bonds, and $20,000,000 in notes due in three years, drawing 5 per cent interest. This note issue is the same as the [illegible] board. It is understood the proceeds of these notes [illegible] up the floating and unrefunded indebtedness of the company amounting to about $9,500,000, and the balance is to be used in improvements, betterments, and purchase of equipment. A large amount [illegible] will be [illegible] in Kansas [illegible] a large [illegible] the [illegible] sales [illegible] Central Branch and the branch from Topeka to Fort Scott and that the main line through Kansas will be put into the best possible condition. The work of improvement in Kansas will consist in laying heavier rails on the more important branches, putting on new ballast, reducing grades and curves and in building new bridges. For this work a large number of ties and rails have been ordered

Kentucky.

⊙The J. H. Flick Construction Co., 275 Old Colony Bldg., Chicago, Ill., as noted in our last issue, has secured the contract for double-tracking on the Louisville & Nashville R. R., from Berry to Lair, 15 miles. The contract includes 100,000 cu. yds. earth excavation, 300,000 cu. yds. rock excavation and 7,000 cu. yds. concrete masonry. All sub-contracts have been placed, the sub-contractors being: Crowley-Salisbury Construction Co., Davenport, Ia., for the concrete masonry; Edward B. Garretson Co., Cincinnati, O.; John Berggsen, Denver, Colo., and Deavonshire & Maxfield, Miamisburg, O.

⊙The Callahan Construction Co., Empire Bldg., Knoxville, Tenn., as noted in our last issue, has been awarded a contract by the Louisville & Nashville R. R., for work on its Kentucky Division between Paris and Cincinnati. The work is known as Section 4 and covers about 11 miles of line. The yardage will be something like 300,000 yds., most of which will be steam shovel work with some team work; and approximately 5,000 yds. of concrete masonry. The larger part of the work will probably be sub-let. The classification on the work will run from something between 50 to 65 per cent solid rock. There are no tunnels on the work and no trestle work. The masonry will be all concrete, part of it plain and part reinforced concrete.

Surveys are underway in Pike County for the projected line of the Levisa River R. R. This road was incorporated some months ago, Garrett B. Wall, Richmond, Va., an official of the Chesapeake & Ohio Ry., being one of the incorporators.

Louisiana.

The Maurepas & Northwestern R. R. Co., of Walker, La., recently incorporated, proposes the construction of a road from Clio to Live Oak, a distance of 10 miles. S. J. McKenzie, Adrian, Mich., is interested in this line.

Maryland.

The Cumberland & Westernport Electric Ry. Co., Cumberland, Md., is considering building an extension from Westernport to Piedmont [illegible]

Massachusetts.

Press reports quote Charles S. Mellen, president of the New York, New Haven & Hartford R. R., as stating before the committee of railroads of the State Legislature, that it is the intension of the N. Y., N. H. & H. R. R. upon the passage of the Boston, Revere Beach & Lynn and New Haven harbor tunnel bill by the legislature, to electrify the present narrow gage between Boston and Lynn as soon as the work can be started.

The Legislative Committee on Railroads has voted to report to the legislature for the abolition of the grade crossings in Lynn by depression, rather than elevation. The bill of the committee extends the decree of the superior court for separation of the grades in Lynn by elevation of the original two tracks to permit the Boston & Maine R. R. to construct four tracks through Lynn instead of two. The new trackage being an extension of railroad facilities, will be at the cost of the Boston & Maine entirely. The city of Lynn pays, beside the cost of removing work so far completed, 10 per cent of the cost of abolishing the crossings of the two original tracks; the state 25 per cent of that cost, and the Boston & Northern, where its lines run, pays no more than it would under the grade crossing act, 15 per cent of the cost of depressing the two tracks.

The Springfield Railway & Light Co., of Springfield, Mass., owning the entire capital stock of the Springfield Traction Co. and the Springfield Gas and Electric Co., has sold an issue of $2,000,000 of bonds. These bonds are part of an authorized issue of $7,000,000, of which the balance of $5,000,000 is reserved for additions and improvements.

The Athol & Orange Street Ry. Co., Athol, Mass., has started preliminary surveys for an extension from Athol to Winchendon by way of Baldwinville. The company is also planning to begin work next month on the line between Orange and Millers Falls.

Michigan.

The Grand Rapids, Holland & Chicago Ry. (electric), Holland, Mich., is reported to be planning to build a spur for its main line to Hudsonville.

Minnesota.

Erickson & Long, Cloquet, Minn., have completed their work for putting in a spur to the new Platt mine near Nashwauk, and have shipped their outfit to Virginia, Minn., where they have a contract to put in several miles of track in the timber country, and get out several hundred thousand feet of timber.

A Minneapolis paper gives a new explanation of the $600,000,000 bond issue authorized recently by the Great Northern Ry. According to this report part of the bond issue will be used for building lines in Canada to compete with the Canadian Pacific Ry. The report states that it is understood that Mr. Hill plans to run feeders into Canada all along the line, to build his own lines parallel to the Canadian Pacific right through the heart of Canada, and compete with the Canadian road in bringing the products of the northwest to Minneapolis, and to the east through Minneapolis and St. Paul as the gateway cities.

Mississippi.

✣Bids are wanted by R. J. Darnell, Inc., Memphis, Tenn., for clearing and grading 17 miles of railroad in Mississippi.

Advices from Hattiesburg, Miss., state that W. S. F. Tatum, president of the Bonhomie & Southwestern Ry., has taken an option on terminal property on Main St. This road has been completed for a distance of about 20 miles in the direction of Columbia, and it is thought will furnish an entrance for the New Orleans Great Northern into Hattiesburg.

It is reported that the Illinois Central R. R. will send engineers to make a survey of the route of the proposed Natchez and Woodville loop. If the tonnage of business to be offered is heavy enough and the proposition looks feasible, the construction of the line will be recommended.

At a recent citizens' meeting at Gulfport it was decided to secure a charter for a railroad to be called the Gulfport, Covington, Hammond & Batton Rouge R. R., the road to extend from the harbor in Gulfport to the Mississippi River at Baton Rouge. F. B. McQueely, Secretary Board of Trade, Baton [illegible]

The city of Natchez will probably be asked to vote on issuing $50,000 of bonds to secure the entrance into that city of the Louisiana & Arkansas Ry. and the Southern Ry. & Navigation Co. line. The Louisiana & Arkansas Ry. is now completed to Jena, La.

Missouri.

The St. Louis, Arcadia & Jefferson City Ry. Co., mentioned in our last issue, proposes the construction of five miles of electric railway in the city of St. Louis. From the city a line 10 miles long will be built to Fenton. Eventually it is planned to extend the line to Arcadia and Jefferson City. Surveys are now under way and the capital for construction is secured. It is planned to let construction contracts about six months hence. E. R. Kinsey, 810 Chestnut St., St. Louis, Mo., is President and Chief Engineer.

Kansas City, Mo., and Vicinity.

Mr. F. H. Blodgett of Wheeling, W. Va., is in the city this week. Mr. Blodgett is looking after some matters pertaining to the Kansas City Southern work which he completed some little time ago under the late Ferguson Construction Co.

Messrs. White and Maas are doing quite an [illegible] 37th St. on Waldron Ave. They are working an elevating grader and dump wagons.

It is said that considerable work will be let after July 1st in this territory. As July 1st marks the close of the railroad year, it seems quite possible that these reports may be with foundation. Just what the work will be and on what roads, it is hard to say. However, [illegible] is a pretty safe guess that the Kansas City [illegible]uthern will [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Missouri Pacific will have considerable grading to do. Also it would not be at all surprising if the Santa Fe let some contracts soon after July 1st.

The excessive heat and drouth in this section of the country has produced some fine specimens of pessimism. While it is probably true that business has been slackened on account of weather conditions, yet we firmly believe this is only temporary, and that the first real rain that falls will entirely change the bluish atmosphere that now seems to prevail.

Mr. W. J. Partington was a caller at our office this week. Mr. Partington has been superintendent for W. M. Spencer for some time past but has completed the work to which he was assigned. We reported last week that Mr. Spencer's Santa Fe work would be completed by July 15. Mr. Partington says if weather conditions remain good the completion will be before that time.

J. J. McInerney is now working his teams by the day for the terminal railroad near Sheffield Station. He is in the market for wheeler and grader work and can be addressed care of Sheffield Station, Kansas City, Mo.

The proceedings to grade 25th St. from Grand Ave. to Robert Gillham Road were dismissed in the Municipal Court on the 16th. In one place the grade is 9 per cent and that is regarded as too steep even for Kansas City. L. R. Ash, City Engineer, is to try to get a better grade established.

That the excessive heat is not interfering with the work of grading for the new Union Station is shown by the recent records made by the two 70-ton Bucyrus shovels. On Thursday the greatest amount of earth was moved of any day since the shovels have been at work. That record was 554 car loads. Each car carries 10 cu. yds. of earth, making the total amount moved Thursday 5,540 cu. yds. The greatest number of cars up to Thursday was 448. One of the shovels is working on the depot site proper, while the other is located east of Woodland Ave. The total amount of earth moved during May was 42,000 cu. yds. Up to June 1st 492,000 cu. yds. have been dug away since the excavation started. The grading has been finished for the depot site proper. According to A. C. Everham, assistant engineer for the Terminal Railway Co., all of the grading for the depot, yards, tracks, etc., should be finished by Sept. 1. At present 80 per cent of the grading for the station driveways and grounds has been done.

The Western Supply Co. has just been organized in Kansas City for the sale of contractors' machinery. Their place of business is at 1945 Grand Ave. M. C. Walker and E. E. Kinerk, formerly of Omaha, Neb., are the promoters of this company.

Mr. J. R. Flannigan of Jones & Flannigan, was in Kansas City this week. This firm is operating two steam shovels near Horatio, Ark., on the Kansas City Southern Ry. One of the shovels mentioned is loading gravel for the railroad company and the other is doing betterment work.

It is reported that work on the Excelsior Springs electric line will start very shortly. This is a 40-mile railroad running direct from Kansas City to the Springs. We will get more detailed information on this proposition and give same to our readers in next issue.

Montana.

The Camp Creek Ry. Co. has filed its articles of incorporation. The capital stock is $100,000, and it is believed that the road will run from Manhattan into the Camp Creek country to tap a large grain and hay district and follow the proposed route of the Chicago, Milwaukee & Puget Sound to the Yellowstone park. A preliminary survey has been made and most of the land necessary for the right-of-way has been bought. As projected, the road will be about 20 miles long.

Tobin & White, Missoula, Mont., who recently secured a large amount of railroad work on the Peace River branch of the Canadian Northern R. R., have shipped their equipment to the scene of construction. The new line will start from the Onoway station on the LacSte. Anne, 40 miles west of Edmonton, and run through the Grande Prairie District to the terminus in the Peace River section, a total distance of 400 miles.

New Jersey.

The Village Trustees of Ridgefield Park, at the June 13 meeting took action on the application of the Public Service Co., Newark, for a franchise for a trolley line north from the Little Ferry depot up Ridgefield Ave., through Brewster Ave. to Hackensack road and thence north through the center of the town to Queen Anne road, there to connect with the Hudson River line.

New Mexico.

The Santa Fe System has set aside an appropriation of $36,000 for a telephone train dispatching circuit from Albuquerque to Rincon and from the Texas-New Mexico state line to Silver City and Santa Rita.

New York.

The Syracuse Rapid Transit Co., Syracuse, is to extend its tracks for a mile in Court St., Syracuse, to the Church of the Asumption cemetery. The new work will cost about $18,000.

The Catskill Traction Co., Catskill, has preliminary work well along for a proposed 5-mile extension from Leeds to Cairo.

The matter of constructing a trolley line between Verum and Waterville, by way of Vernon Center, Knoxboro and Oriskany Falls, is proposed. The present plans provide for gasoline cars. Dewitt C. Hadcock, Oneida, N. Y., is interested.

North Carolina.

The State of North Carolina is reported to have accepted proposition of Gilbert L. Gilbert of New York, representing New York capitalists, to build the Mattamuskeet R. R., to extend 105 miles from Lake Mattamuskeet in Hyde county to Washington, N. C. The state owns a controlling interest, part of the road being already graded, and the proposition was accepted subject to rights of way, terminals and dock facilities being secured by the people along the route.

Arrangements are reported to have been made for securing the necessary capital for the completion of the Elkin & Alleghany R. R. At present 12 miles of the road is graded, and it is intended to begin laying rails on this section at once. The next section to be built will be to Stone Mountain; from that point the road will be extended to Sparta, a distance of 19 miles. It is also proposed to extend the road through Ashe and into Watauga County. Jno. A. Mills, Raleigh, N. C., President of the Raleigh & Southport Ry., is also president of the Elkin & Alleghany R. R.

The Atlantic & Western R. R., under management of W. J. Edwards, Sanford, N. C., is reported to have started active construction on the road from Broadway to Goldsboro by way of Lillington and Buie's Creek. Townships of Harnett County, Upper Little River, Lillington and Neils Creek recently voted a bond issue of $60,000 to aid this project.

North Dakota.

The Great Northern Ry. is stated to have ordered rails for its Fargo-Surrey line, and it is understood that construction work on this line is to be resumed at once and the line finished and ready for operation by next year.

Ohio.

⊙James A. Flack, Deshler, O., has a contract for grading for several new switches to be built along the Cincinnati, Hamilton & Dayton Ry., between Swanders and Toledo.

⊙The Northern Ohio Traction & Light Co., Akron, O., has awarded a $275,000 contract for electrical equipment for its new power plant at Cuyahoga Falls and six sub-stations to the Westinghouse Electrical & Manufacturing Co., of Pittsburg. The company has a large force of men at work grading the right of way for the double track of its A. B. C. line. In all, 16 miles of rails will be laid.

The Columbus, Urbana & Western Electric Ry. Co., 119 W. Gay St., Columbus, O., is understood to have straightened out the right of way difficulties for its extension to Dublin, and it is stated that construction work may be started soon. From Dublin the line will be extended to the Girls' Industrial Home, a $50,000 appropriation being available for the latter extension.

Engineers have been over the proposed route of the Lancaster-Buckeye Lake traction line for the purpose of estimating the amount of business that could be secured. As proposed this line will run through Lancaster, Pleasantville, Thurston, Millersport and along the south shore of the lake to Thornville. From Thornville the proposed line goes straight to Newark, making a total mileage of nearly 30 miles. Dodge, Day & Zimmerman, Philadelphia, Pa., are reported to be the engineers representing eastern parties who are to finance the line.

Right of way is reported to be assured for the proposed electric railway from Wapakoneta to Kenton. The Wapakoneta & Kenton Traction Co., with a capital stock of $50,000, was recently incorporated to build the line. Burr Finnell, President of the Kenton Commercial Club, Kenton, O., is interested.

The recently incorporated Wapakoneta & Kenton Traction Co. has completed its organization by electing the following officers: President Burr Finnell, president of the Commercial club of Kenton; vice president, L. N. Meams; secretary, City Clerk Fred A. Klipfel, and treasurer, A. S. Roberts, all of Wapakoneta. The company is now taking up a right of way 50 ft. wide between Wapakoneta and Kenton following the old survey, part of which has been graded, of the Sandusky Southwestern Ry. Co., which went into the hands of a receiver five years ago.

The Pittsburg & Lake Erie R. R., J. A. Atwood, Chief Engineer, Pittsburg, Pa., has filed in Cuyahoga County a first mortgage for $15,000,000. The funds from this mortgage, it is understood, will be used for the new line to be built from Lorain to connect with the Cleveland Short Line at Ravenna, O. This project has been under consideration for a number of years. It will connect at Ravenna with the Pennsylvania R. R., thus affording a direct connection between the lake port and the Pittsburg district. Bonds of the new issue to the amount of about $7,500,000 will be sold to reimburse the Lake Shore and the Pennsylvania for work already done on the line.

The Procter & Gamble Transportation Co. has been incorporated with a capital stock of $350,000, the incorporators being William Cooper Procter, John J. Burchanal, J. M. McDonald, H. L. French and H. G. French. It is understood that the company is formed with the intention of increasing the track and car capacity surrounding the Procter & Gamble soap factory, at Cincinnati.

Incorporation papers are to be taken out shortly for the Panama Canal Trade Promoting Co., of Hannibal, and the Ohio Coal & Promoting Co. of Hannibal. The first mentioned company, in addition to building a railroad from New Martinsville, W. Va., through a part of that state and across the river into Ohio, will operate gasoline propelled steel barges on the Ohio to supply the Panama canal trade with Pittsburg vein coal. The other corporation will develop coal mines and operate railroads. Col. A. E. Boone, Zanesville, O., is the promoter.

Stockholders of the Cleveland & Pittsburg R. R. Co., have voted to increase the company's capital stock $18,000,000, making it $40,000,000. The new issue goes to the Pennsylvania R. R. Co., lessor of the C. & P. and the money derived from the sale of the stock will reimburse the Pennsylvania for improvements made in and around Cleveland. Some of these improvements have been made and others will extend through several years. Out of the $18,000,000 will come the cost of the C. & P. grade crossings and track elevation in Cleveland, from E. 26th St. past Euclid Ave. to Central Ave. S. E., cost of the West Side docks, of some double tracking down state, new equipment, and so on. The company's directors also include a tentative estimate of $2,500,000 to be devoted to the new Union depot here when that is set afoot.

It is expected that announcement will be made shortly of plans to reorganize the Wheeling & Lake Erie and the Wabash-Pittsburg Terminal railroads. Following the reorganization, it is understood that plans for rehabilitating the entire Wheeling & Lake Erie line, at a cost ranging from $5,000,000 to $10,000,000, will be set afoot. H. T. Douglas, Jr., Cleveland, O., is chief engineer.

An ordinance has been passed by the City Council of Barberton, O., authorizing the Akron-Barberton Belt Line R. R. Co. to lay tracks on Robinson Ave., from Huston Ave., the Southern terminus, north to Baird Ave.

Oklahoma.

Announcement has been made that the Missouri, Oklahoma & Gulf R. R. will on Oct. 1 begin the building of an extension of 200 or 250 miles to the present system. Three routes are under consideration and a choice will be made within 30 days. The routes under consideration are: From Denison to Dallas and Fort Worth, Tex.; a northern route is from Muskogee to Oklahoma City, beginning at Henryetta, Okla., and running through Shawnee to Oklahoma City. A third route is a line to Kansas City through either Joplin, Mo., or Pittsburg, Kas. A line has been surveyed to both these points and will run through one or the other to Kansas City. J. J. Harrison, Muskogee, Okla., is Chief Engineer of the Missouri, Oklahoma & Gulf.

The proposed railroad from Lawton to Ardmore, 81 miles, is reported to have been financed, and it is understood that construction work will be started at once. This is a project promoted by Jake L. Hamon of Lawton.

A number of financiers from St. Louis, Mo., are reported to have visited Clinton, Okla., to look into the proposition involving the construction of the Clinton & Oklahoma Western Ry. W. B. Doddridge, Mississippi Valley Trust Co., St. Louis, Mo., is interested.

Oregon.

It is reported that the Brogan R. R. will be extended from Brogan, Ore., to Canyon City, Ore., and on to the Columbia River, tapping a good section of north Oregon.

Pennsylvania.

The Pittsburg & Lake Erie R. R., is reported to have appropriated $350,000 to be expended at New Castle, Pa., in the erection of a new station, car repair shops and the double tracking of the line from Sharon, Pa., to New Castle.

Plans are reported to have been completed, and it is said that work will be started shortly [illegible] Pittsburg & Butler Street Ry., from Butler to Erie, a distance of 128 miles. The route decided upon for the new road is via Slippery Rock, Grove City, Mercer, Polk, Franklin, thence up French Creek to Meadville, to Cambridge Springs and from Cambridge Springs via a surveyed route to Edinboro, Middleboro into Erie, thence via the Lake Shore route into Buffalo. W. H. Pape, Butler, Pa., is general manager of the Pittsburg & Butler Street Ry. Co.

The Lehigh Valley Transit Co., Allentown, Pa., has been petitioned to make a short extension to Siegfried.

M. C. Kennedy, Vice President of the Cumberland Valley R. R., Chambersburg, Pa., is quoted in press reports as stating that the company has decided to make an expenditure of $900,000 for the construction of the proposed high line. G. C. Koons, Chambersburg, Pa., is Engineer of the company.

Rhode Island.

The New York, New Haven & Hartford R. R. has leased the Narragansett Pier R. R., a standard gage steam line 9 miles long.

Tennessee.

A meeting of the parties interested in the Tennessee Traction Co. is to be held at Memphis, on June 29, for reorganization purposes. It is expected at that time that definite action will be taken relative to construction. Practically all of the right of way has been secured, and surveys have been made. If the present plans are carried out, the line will almost parallel the Louisville & Nashville between Memphis and Brownsville. From the latter point it will run direct to Jackson, Tenn.

Surveys have been completed for an electric railway to run from the city of Chattanooga, through the lands of the Chattanooga Estates Co., to the foot of Walden's ridge, where it will either connect with an incline or take an easy grade for a direct haul up the ridge. C. E. James, Chattanooga, Tenn., is interested.

Texas.

⊙The Board of Directors of the Quanah, Seymour, Dublin & Rockport Ry. Co., Austin National Bank Bldg., Austin, Tex., has accepted the proposition of the Co-Operative Construction Co. to build the entire road upon the terms of one-half in cash and one-half in securities. The offer of an equipment company to furnish new engines and cars for the entire line, estimated to amount to $1,500,000, and accept in payment therefor first mortgage bonds of the railway company at par, has also been accepted. Grading work has been started at Belton, as noted elsewhere in this column.

Grading work has been started at Belton for the proposed line of the Quanah, Seymour & Gulf R. R. The city of Belton has raised a $200,000 bonus, and as a result the general offices, round house and shops will be located there.

The Texas-Mexican Ry., A. C. Hamilton, Vice President, Laredo, Tex., has been making surveys in the vicinity of San Diego, Tex., for a new route around the town. The track is north of town, but the company is having the new line surveyed and expects to run it south of town to avoid the two bridges, which have always been an expense to keep in good repair. The new survey does away with the bridges by running up on the south side of San Diego creek. It also does away with the curve that the present track makes and will run straight from Springfield up the creek. The new depot will be south of town.

The St. Louis & San Francisco R. R. is reported to have entered into a contract with the town of Mason for the construction of an extension of the Fort Worth and Rio Grande Division of that system from Brady to Mason, 27 miles. It is thought that the line will be continued to Waring, where it will connect with the Kerrville branch of the San Antonio and Aransas Pass, and that there will be no delay in this construction work. From Brady to Waring is about 100 miles. The route will be via Fredericksburg, where a bonus of $250,000 awaits the coming of this or any other road that will give that town a transportation outlet.

[illegible] final action on granting to Stone & Webster [illegible] electric railway over the city streets. The Stone & Webster interests as previously noted in these columns, are planning to build [illegible] hachie.

An amendment to the articles of incorporation of the Crystal City & Uvalde R. R. Co. of Crystal City has been filed in the State department for an increase in the capital stock from $100,000 to $125,000, also for an extension of the road from Gardendale, in La Salle County, in an easterly direction 26.7 miles to a point near the east line of the La Salle County, known as Fullerton. The amendment also provides for an increase in the number of directors from seven to nine. This road at present runs from Crystal City, in Zavalla County, to Carizzo Springs, in Dimmitt County, and from Crystal City to Gardendale. E. Breaker, Crystal City, Tex., is Chief Engineer.

The Santa Fe System plans on the following improvements for the near future: Installation of track scales at Fort Worth, estimated cost $6,200; construction of a Y track at Amarillo to cost $5,900.

Surveys are underway for the proposed railway from Vernon to Crowell. The project is backed by Houston and local parties.

The International & Great Northern R. R. has been sold at auction to a committee of third mortgage bondholders represented by Frank D. Nicodemus, Jr., a New York attorney. Only one bid was offered. The price is $12,645,000. The Gould interests own the larger part of the third mortgage bonds.

The Beaumont & Great Northern R. R., C. J. Rogan, General Superintendent, Onalaska, Tex., is reported to be planning to submit a proposition to Beaumont for extending its line to that city.

The Houston & Texas Central R. R., L. A. Cottingham, Engineer Maintenance of Way, Houston, Tex., has about completed surveys for the proposed cut off to be constructed between Giddings and Stone City.

Good progress is reported as being made in the project to establish a new and direct line of railway between Waco and Beaumont by acquiring the Beaumont and Great Northern, which runs between Weldon and Livingston, 49 miles, and constructing the two gaps that are necessary to complete the line. From Weldon to Waco, 120 miles, and from Livingston to Beaumont, 60 miles, the route of the two proposed extensions is through a rich agricultural territory, heavily timbered region on the south. John N. Gilbert, Beaumont, is interested.

The Atchison, Topeka & Santa Fe Ry., on June 15, opened for operation the link of the Coleman-Texico line that gives its gulf division a connection with its new trans-continental line via Amarillo, Tex. The division opened runs between Sweetwater and La Mesa, about 125 miles, to a connection with the trans-continental line over the Pecos Valley division, from La Mesa to Canyon, Tex., 115 miles. The division between Coleman and Sweetwater, about 125 miles, has been finished several months. The link between La Mesa and Texico, about 125 miles, will be finished by Nov. 1. Pending this through trains will be operated between Amarillo and Coleman, connection being made with the gulf division at this place.

The engineer of the State Railroad Commission has filed his report of valuation of Western extension of the Chicago, Rock Island Gulf Ry from Amarillo to Glen Rio on State line, distance 69.89 miles. According to his report the total value of extension was found to be $1,202,299, or $17,202 per mile. Bonds will be applied for by the company.

The Committee in Charge of the construction of the proposed Brownsville & San Antonio R. R. has completed all arrangements for the undertaking and it is expected to have the company incorporated and work started shortly. The entire $500,000 necessary for the work has been subscribed, according to advices from San Antonio, Texas.

The Galveston, Harrisburg & San Antonio Ry. Co. (Harriman Line) has filed an application with the railroad commission for the registration of bonds under a blanket mortgage of $10,000,000, covering mileage included in the Galveston Victoria division Jan. 1, 1911. The commission valued the mileage at $7,622,187, exclusive af the company's pro rata interest in the Galveston causeway. The company tenders for cancellation the stock of the constituent lines composed of the Galveston-Victoria division amounting to $1,362,000. It also tenders for cancellation $3,866,000 of other bonds, but this does not include all bonds outstanding against the company.

Utah.

The Kamas Valley R. R. Co. has been organized and proposes to start location surveys at once for the portion of its proposed road between Wanship and Woodland in Summit County. It is proposed that the people of Summit county subscribe to $50,000 worth of the stock and $75,000 will be subscribed by other parties. The company will incorporate for $250,000. But only the $125,000 will be subscribed at present, which is sufficient to build the line a distance of 18 miles from Wanship, on the Union Pacific, to Woodland. It is proposed that the line shall [illegible] canyon to the Uintah reservation. This is the [illegible] promoters are now in communication with Colonel E. C. Dodge of the Moffat road in reference to constructing this road as a branch of the Moffat road. Harry S. Joseph is Chief Engineer. Judge S. W. Stewart, Salt Lake City, is interested.

Surveys have not been made as yet for the projected line of the Taos, Sierra Nevada & San Francisco Ry. This company was recently incorporated, as noted in our June [illegible] It proposes to construct a railroad from Washington County, Utah, to the eastern boundary of Union County, N. Mex. W. P. Halliday, McAlester, Okla., is Chief Engineer.

Virginia.

[illegible] for the financing of the proposed Cairo & Norfolk Ry. are reported to have been completed, arrangements having been made with French capitalists. This line is to be constructed from Cairo, Ill., on the Mississippi River, to Norfolk, Va., through portions of Kentucky, eastern Tennessee, and the southwest section of Virginia, thence on to Norfolk. Three routes have been surveyed. L. W. Goode, New York City, is President.

Washington.

The Washington-Oregon Corporation, owning the street car system and power and water systems at Centralia, has preliminary arrangements under way for a $750,000 power plant on the Kalamon River. A. Welch, 502 Fenton Bldg., Portland, Ore., is General Manager.

Plans are being worked out in detail for the construction of the proposed new shops and yards of the Northern Pacific Ry., east of Spokane, Wash., and it is reported that actual construction work will be taken up as soon as the officials pass on the plans. J. M. Rapelje, Spokane, Wash., is Division Superintendent.

West Virginia.

The Waynesburg & Blacksville R. R. Co. has taken bids at its office at Blacksville, W. Va., for the construction of 15 miles of electric railway between Blacksville and Waynesburg, Pa. This is the first section of the new Fairmont & Pittsburgh R. R. into Pennsylvania. The contract calls for grading, masonry and bridge work along the 15 miles of right of way and also the boring of a tunnel 500 ft. long on the right of way which carries the road over the backbone of the hills that the road passes through.

The Twin Mountain & Potomac Ry. Co recently incorporated, as noted in our June 7 issue, has surveys under way for its projected line. The company at first intended to construct a 10-mile line from Twin Mountain to a connection with the Hampshire-Southern at McNeill. The plans have now been amplified and it is proposed to construct the line to Keyser, a distance of 22 miles. E. A. Russell, Fairmont, W. Va., is interested.

Wisconsin.

Promotion work is reported under way for an electric interurban line between Eau Claire, Wis., and St. Paul and Minneapolis. Harry Norris, Hudson, Wis., and Fred Carr, Minneapolis, Minn., are said to be interested.

The Milwaukee Electric Railway & Light Co., Milwaukee, is reported to have again taken up the matter of extending its lines from Racine along the Rapids road out through Thompsonville, Raymond and other country towns, and also to Eagle Lake.

It has been announced, according to reports, by R. G. Huntington, General Manager of the Minneapolis, St. Paul & Sault Ste. Marie R. R. that work will soon be started on the proposed cutoff between Greenwood and Chippewa Falls. The track from Spencer to Stevens Point, Wis., a distanace of 40 miles, will be double tracked.

Engineers are working on surveys for the location of the Wisconsin & Northern Ry. extension to Antigo, Wis. W. Cambier, Oshkosh, Wis., is Engineer of the company.

Canada.

✣Tenders are asked by the Commissioner of the Transcontinental Ry., P. E. Ryan, Secretary, Ottawa, Ont., until noon, July 11, for the erection of two terminal stations, one at Redditt, Ontario, and the other at Transcona, Manitoba, on the line of the National Transcontinental Ry. Plans and specifications may be seen and full information obtained at the office of Gordon Grant, chief engineer, Ottawa, Ont., and of S. R. Poulin, district engineer, St. Boniface, Man.

⊙The contract for the construction of a subway under the Canadian Northern Ry. tracks at 19th St., Saskatoon, Sask., has been let to Hay & Elzy Co., Inc., St. Paul, Minn., at $49,721. The contract includes excavation, concrete abutments and retaining walls and piling. Bids were opened June 15. George T. Clark is City Engineer.

Surveys are to be started next month for the location of the proposed line of the Alberta Electric R. R. from Calgary to Banff, Medicine Hat, Lethbridge and Macleod. George E. Wood, Calgary, Alta., is local manager.

Good progress is expected this summer on the construction of the main line of the Grand Trunk Pacific through the mountains. Operations last summer were delayed owing to a shortage of both supplies and men on the eastern and western slopes. The closing of the Skeena River a month earlier than usual last fall shut supplies out on the Pacific side, and made the usual winter operations on cuttings and tunnel work almost impossible. However, the contractors made a special effort during the winter to get in supplies and succeeded in placing large quantities along the route, which can be drawn upon for summer work. An abundance of labor is said to be available for work on the eastern side of the mountains and prospects seem good for a fair number of laborers being obtained for summer operations on the Pacific side. It is expected that before operations are held up by the arrival of winter the two ends of the line will be driven far into the mountains from both ends and will be brought so closely together that the following summer the gap will be spanned and the two ends joined, thus completing the western through line from Winnipeg to Prince Rupert.

Good progress is being made with the National Transcontinental R. R. in the east. Some portions of the line east of Winnipeg are ready for freight. That portion from Winnipeg to Superior Junction has been operated all winter. The National Transcontinental commission is about to hand over to the Grand Trunk Pacific for operation a 320 mile stretch from Quebec bridge to Mont Auchene. This stretch will have a heavy lumber, pulp wood and pulp traffic to handle from St. Maurice. Negotiations are going on for the transfer of the section between Moncton and Plaster Rock to the Grand Trunk Pacific for operation, but it looks as if this would not be done until next autumn. Good progress has been made with construction all the way between Levis and Moncton, but there are a couple of big bridges to be put in which will hold back the transfer of the Maritime section for some time. However, the commission is arranging for the transfer and spanning of the Lawrence by car ferries until the Quebec bridge has been completed.

The Grand Trunk Pacific contemplates making an early start on the construction of a $2,500,000 dry dock at Prince Rupert, as well as other terminal improvements, provided an agreement is reached with reference to the rate of taxation on railway property at Prince Rupert. An agreement between the railway company and the city council of Prince Rupert was negotiated last winter, but has not been signed. The railway company seeks certain modifications and the aldermen desire certain sections of the waterfront developed for shipping purposes, and a deed of over 60 parcels of land for public squares and park purposes

The Canadian Northern R. R. will start grading work this summer, by August probably, for the southwest line of the system between Strathcona and Calgary. Final surveys have been about completed on the western parallel, and there remains but the purchase of the right-of-way to permit construction going forward on the road. This road by following the proposed route will shorten considerably the present railway mileage between Strathcona and Calgary. The survey leaves the C. P. R. about six or seven miles from Strathcona and bends northwesterly to a point east of Pigeon Lake, from which place it follows almost a straight line south until Red Deer is reached. Here the line will cross to the eastern Side of the C. P. R. and connect with the southeast extension to Calgary.

Announcement has been made that the construction of the proposed branch line from Fort George to Vancouver will not be undertaken by the Grand Trunk Pacific until after the completion of the main line. It is understood that tenders for the building of the gap of 410 miles between Tete Jaune Cache, 50 miles west of Yellow Head Pass and Aldermere, in the Bulkeley valley, will be called for immediately and it is expected that work will be in full swing before the end of the summer. The main line has now been extended 200 miles west of Edmonton to a point near the Athabasca River, and less than 35 miles from the summit of the Rockies at Yellow Head Pass. The rails, it is expected, will be laid across the summit as far as Tete Jaune Cache some time next fall if the present rate of progress is maintained. Two years more will be occupied in linking up the eastern and western sections. Then will follow the building of the branch line into Vancouver.

The Toronto Suburban Ry. Co. (electric), which was recently acquired by William Mackenzie of Toronto, and English interests associated with him, has issued $2,650,000 of first mortgage debentures. It is understood that the proceeds of the new issue will be used for extensive improvements to the present system and for the extension of the road to thoroughly cover the territory between Toronto and Guelph.

The Grand Trunk Pacific Ry., B. B. Kelliher, Chief Engineer, Winnipeg, Man., has asked tenders for the construction of the uncompleted 410-mile gap between Altermen in the Bulkley Valley and the Tete Jaune Cache on the Fraser River, 50 miles west of Yellow Head Pass.

The citizens of Brandon, Man., have voted to authorize a debenture issue for $25,000 for the purchase of rails for the municipal street railway.

ROADS, STREETS AND PAVEMENTS

Alabama.

✣The County Board of Revenue, Andalusia, Ala., will receive bids at the July meeting for the construction of 10 miles of good roads in Covington County.

Arkansas.

✣Bids will be received until June 30 by City of Argenta, Ark., for the construction of 13,000 sq. yds. of creosoted block pavement in District No. 11 and 25,000 sq. yds. of macadam pavement in District No. 12. E. A. Kingsley, Little Rock, Ark., is Engineer.

California.

✣Bids will be received until 11 a. m., July 5, by Board of County Supervisors, San Jose,

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Cal., for the construction of improvements on the Gilroy-Hot Springs Road, and for changing [illegible] Road.

• The Board of Supervisors, Red Bluff, Cal., has awarded the contract to W. D. Russell of Paskenta for the construction of the new Paskenta-Round Valley Road, the cost to be $62,300.

City Engineer Chris. P. Jensen, of Fresno, Cal., is making detailed surveys for La Sierra drive for 40 ft. on each side of the channel of Dry Creek from West Ave., to Zapp's [illegible]

Colorado.

✣Bids will be received until 11 a. m., June 21, by Board of Public Works, Denver, Colo., for furnishing the necessary labor and material for the construction of brick gutters and grading, curbing and paving Broadway Paving District No. 4. Henry Read is President of the Board.

The Boad of County Commissioners, Durango, Colo., has voted to add $4,000 to a joint fund to be used by the state highway commissioners in the preliminary work of putting Durango, Silverton, Pagosa Springs and the southwest section of Colorado in good condition.

Advices from Georgetown, Colo., state that $6,500 will be used to repair the road and reduce the grade at Floyd Hill. Following the improvement of this road a number of other roads will be reconstructed and widened.

District of Columbia.

✣Bids will be received until 11 a. m., July 8, by R. C. Hollyday, Chief of Bureau of Yards & Docks, U. S. Navy Department, Washington, D. C., for concrete walks at St. Helena Reservation, navy yard, Norfolk, Va.

Florida.

✣Bids will be received until 2 p. m., July 5, by Commissioners of Hillsboro County, Tampa, Fla., for the construction of hard surface pavement of 1½ miles of road 10 ft. wide and 10 in. deep; also for hard surface pavement on 2½ miles of road connecting Durant and Bledsoe roads, roadway 12 ft. wide and from 4 to 8 in. deep.

Georgia.

✣Bids [illegible] G[illegible] Smith, Mayor, Covington, Ga., for the laying of macadam road 15 ft. wide and 1,400 ft. long. Road to have 6 in. surface of crushed stone.

✣Bids will be received, it is reported, until July 1, by City of Rome, Ga., for the construction of wood block, asphalt, macadam, vitrified brick, compressed or bitulithic pavement.

The County Commissioners of Hancock County, Sparta, Ga., have sold bonds to the amount of $35,000 for the construction of good roads.

Idaho.

⦿The contract for the construction of what will be known as the High Line road between Pocatello and Ross Fork has been awarded by the County Commissioners at Pocatello, Ida., to E. B. Brown, of Pocatello for $7,212. Other bids received were: A. J. Reese, Blackfoot, $6,881; P. C. Felsted, Blackfoot, $8,466; J. F. Richmond, McCammon, $10,235; Bannock Engineering Co., Pocatello, $19,351, and S. W. Gleim, Pocatello, $18,171.

Advices from Boise, Ida., state that the Payette Lakes road commission has selected the route for the proposed road from Boise to Payette Lakes. The recent legislature appropriated $20,000 for the construction of the road upon the condition that Ada and Boise Counties would appropriate $8,000. Construction work will be started shortly. The commission consists of State Engineer A. E. Robinson, John Schilling, Boise, and Thomas L. Worthington of Van Wyck.

Illinois.

✣Bids will be received until 3 p. m., June 27, by Board of Local Improvements, Benton, Ill., for the grading, curbing and paving with brick of portions of West Main St., East Main St., North Main St., and South Main St. The work will include 36,200 sq. yds. of vitrified brick pavement and about 21,650 lin. ft. of sandstone curbing and 16 water inlets. Sidney B. Espey is Chairman of the Board.

✣Bids will be received until June [illegible], 1911, by L. E. McGann, Commissioner of Public Works, Chicago, for furnishing and delivering F. O. B. switch tracks in various wards, 10,000 cu. yds. crushed limestone according to specifications. Cash of certified check for $2,500 must accompany proposal.

✣Bids will be received until June 27 by Board of Local Improvements, Benton, Ill., for the construction of 36,200 sq. yds. of vitrified brick pavement on 5-in. portland cement [illegible] The work will include 16,000 cu. yds. of excavation. L. T. Putman, Benton, Ill., is Engineer. D. A. Burgess is Secy. of the Board.

⦿Bids were opened June 6 by the Village of [illegible], Ill., [illegible], Village Engineers, Winnetka, Ill., for constructing con[illegible] ton, Ill., at 11½ cts. per sq. ft. The contract for constructing 28,759 sq. ft. of 1½ in. concrete walk, on 6 in. of cinders in Brown's addition, was let to C. T. Bartlett, 827 Greenleaf St., Evanston, Ill., at 15.2 cts. per sq. ft. [illegible] Green Bay Road was awarded to Jno. A. McGarry & Co., 1008 Security Bldg., Chicago, Ill., at $2,637. Taroid H. is to be used on this road. The last named contractor was also awarded the contract for the construction of macadam in Sylvan Newhall Subdistrict, the total bid with Burmudez asphalt binder being $27,630, with Sarco the total bid was $26,181. The unit bid of the successful contractors in the [illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible] lin. ft. [illegible]-in. v.t. tile outlet drain..........	[illegible]
290 lin. ft. 18-in. drain..................	1.07
1,520 lin. ft. 15-in. drain..................	0.85
[illegible]	[illegible]
[illegible] lin. ft. [illegible]-in. drain..................	[illegible]
365 lin. ft. 6-in. drain..................	0.37
3,365 lin. ft. 4-in. drain..................	0.28
[illegible]	
[illegible]	[illegible]
2 concrete end walls	30.00
[illegible]	
Sarco	1.54

⦿William Moran & Co., of Joliet, Ill., have [illegible] Board of Local Improvements of that city for the paving of Hickory St., for $11,325. Bituminous macadam will be used. Bids were opened June 12 by Wm. S. Welch, clerk of the board.

⦿The following contracts for paving streets have been awarded by the Board of Local Im[illegible] Alley Webster Ave., P. J. O'Brien, 145 La Salle St.; alley 24th St., Central Paving Co., 172 Washington St.; alley 31st St., Central Paving Co.; alleys, Hyde Park Boul., Jno. A. McGarry Co., 188 Madison St.; N. Ashland Ave., The American Asphalt Paving Co., 138 Washington St.; W. Chicago Ave., The American Asphalt Paving Co.; Cottage Grove Ave., Calumet Coal & Teaming Co., 2926 E. 95th St.; Ellis Ave., The American Asphalt Paving Co.; Frankfort St., The American Asphalt Paving Co.; N. 41st Ave., Standard Paving Co., 1101 S. 48th Ave.; N. 43rd Ave., Standard Paving Co.; E. 56th St., The Ryan Co., 131 La Salle St.; Hillock Ave., The American Asphalt Paving Co.; Lock St., The American Asphalt Paving Co.; Mendell St., R. F. Conway Co., 138 Washington St.; Perry St., The American Asphalt Paving Co.; Rascher Ave., R. F. Conway Co.; E. 62nd St., The American Asphalt Paving Co.; E. 65th St., The American Asphalt Paving Co.; S. Washtenaw Ave., Coal & Teaming Co.; W. 30th St., The American Asphalt Paving Co.; S. Washtenau Ave., Standard Paving Co.; Winchester Ave., Calu[illegible] F. Conway Co.; N. 42nd Ct., The American Asphalt Paving Co.; Dauphin Ave. System, Furr Bros. Co., 356 W. 111th St.; Clara Pl. System, The American Asphalt Paving Co.

• [illegible] dota, Ill., have awarded the contract for the hauling of 5,000 tons, more or less, of material for constructing gravel road from the present hard road [illegible] 9 and 16, thence east on Sec. line one-half mile, thence north to the county line, as follows: Jos. Smith, Jos. Reisdorf, Henry Arndt, Jr., E. Grossenbach, and H. J. Hohner for $0.81 per ton.

A petition is in circulation in the city of Kankakee, Ill., for a permanent pavement on Poplar and Elm Aves., between Bourbonnais and Maple Sts., a distance of three blocks on each street. Tar macadam will probably [illegible]

Ordinances have been introduced in the City Council of Joliet, Ill., providing for the resurfacing of Chicago and Jefferson Sts. Ned Allen is Mayor. Matt Berscheid is City [illegible]

Indiana.

✣[illegible] 1.40 miles, and estimated cost $8,000. Peter Curtis, et al., in Union township, 1.98 miles, and estimated cost $11,700. Louis G. Horn, et al., in Center township, 2.81 miles, and estimated cost $15,500. Arthur B. Foster, in Center [illegible]

✣Bids will be received until 11 a. m., July 3, by Board of Jennings County Commissioners, Vernon, Ind., for the construction of 3 miles of pike road in Bigger township. M. W. Brogan is County Auditor.

✣Bids will be received until 3 p. m., July 3, by Board of Warren County Commissioners, Williamsport, Ind., for the construction of [illegible] Township. D. H. [illegible] County Auditor.

✣Bids [illegible] July [illegible] County Commissioners, Newport, Ind., for the construction of a gravel road on the line between Helt and [illegible] County Auditor.

✣Bids will be received until 1 p. m., July 3, [illegible] Commissioners, Franklin, Ind., for the construction of a [illegible] W. B. Jennings is County Auditor.

✣Bids will be received until 1 p. m., July 3, [illegible] County Commissioners, Versailles, Ind., for the construction of macadam roads in Laughrey and Otter Creek townships. Nicholas Volz is County Auditor.

✣Bids will be received until 1:30 p. m., July 3, by Board of Washington County Commissioners, Salem, Ind., for the construction of a [illegible] County Auditor.

✣Bids will be received until 10 a. m., July 5, by Board of Monroe County Commissioners, Bloomington, Ind., for the construction of a highway in Salt Creek township. Horace Blakely is County Auditor.

✣Bids will be received until 2 p. m., July 5, by Board of Rush County Commissioners, Rushville, Ind., for the construction of a macadam road in Jackson township. J. M. Stone is County Auditor.

✣Bids will be received until 1:30 p. m., July 5, by Board of Wabash County Commissioners, Wabash, Ind., for the construction of three roads in Paw Paw township, one on the Noble Waltz township line, one on the Noble-PawPaw township line, 2 in Chester township and two in North Manchester. J. P. Noftzger is County Auditor.

✣Bids will be received until 10 a. m., July 5, by Board of Cass County Commissioners, Logansport, Ind., for the construction of a stone road in Boone township. J. E. Wallace is County Auditor.

✣Bids will be received until 10 a. m., [illegible] sioners, Logansport, Ind., for the construction of gravel roads in Eel and Jefferson townships. J. E. Wallace is County Auditor.

✣[illegible] July 5, by Board of Jackson County Commissioners, Brownstown, Ind., for the construction of the Medora and River Bridge road and the Sparksville Hill road. H. W. Wacker is County Auditor.

✣Bids will be received until noon, July 5, by Board of Sullivan County Commissioners, Sullivan, Ind., for the construction of a gravel road, a bituminous asphalt macadam road and a stone road. Ben C. Crowder is County Auditor.

✣Bids will be received until 10 a. m., July 5, by Delaware County Commissioners, Muncie, Ind., for the construction of a road on line between Washington and Union townships, one on line between Center and Mt. Pleasant townships and one in Center township. Francis M. Williams is County Auditor.

✣Bids will be received until 10 a. m., July 6, by Vanderburgh County Commissioners, Evansville, Ind., for the construction of a gravel road in Center township. C. P. Beard is County Auditor.

✣Bids will be received until 10 a. m., July 6, by Board of Cass County Commissioners, Logansport, Ind., for the construction of a stone road on line between Deer Creek and Washington townships. J. E. Wallace is County Auditor.

✣Bids will be received until noon, July 6, by Board of White County Commissioners, Monticello, Ind., for the construction of a stone road in Honey Creek township. A. C. Fisher is County Auditor.

✣Bids will be received until 1 p. m., July 6, by Board of Newton County Commissioners, Kentland, Ind., for the construction of macadam road in Iroquois Township, a system of stone roads in Jackson township and a system of stone roads in Grant township. E. R. Bringham is County Auditor.

✣Bids will be received until 2 p. m., July 10, by Board of Warren County Commissioners, Williamsport, Ind., for the construction of a gravel road in Adams township. D. H. Moffitt is County Auditor.

✣Bids will be received until 10 a. m., July 3, by board of Clark County Commissioners, Jeffersonville, Ind., for the grading, curbing and paving with gravel and crushed stone the following described highway: Beginning at a point on the Memphis and Blue Lick road (said road is an improved free gravel road) on the line dividing No. 203 from No. 220 of the Illinois grant; thence running in a southwestwardly course along and on a line dividing No. 203 from 220, 202 from 219, 201 from 218 and 200 from 217, all of the Illinois grant, to the township line dividing Union Township from Carr Township where the line intersects the road on the line dividing No. 200 from 217 of the Illinois grant. Said road is about 3 miles in length and located in its entirety in Union Township, Clark County, Indiana. Peter Nachand is County Auditor:

⊙Hutchison & Ackerman, Michigan City, Ind., have been awarded the contract by the County Commissioners, Valparaiso, Ind., for the construction of a macadam road in Pleasant Township for $76,500. Bids were opened June 6 by C. A. Blachly, County Auditor.

⊙The County Commissioners at Noblesville, Ind., have awarded the contracts for the construction of two gravel roads to Holliran & Haverstick of Noblesville and Marvin Jessup of Noblesville for $4,986 and $5,574 respectively. Bids were opened June 6.

⊙The Commissioners of Porter Co., Valparaiso, Ind., have awarded the contract for the construction of 16 miles of macadam road in Pleasant Township to Hutchinson & Ackerman of Michigan City, Ind., for $76,500. G F. Stinchfield is County Surveyor.

The City Engineer of Rockville, Ind., has been instructed by the City Council to prepare plans and specifications for the paving of Perkins St., to the north side of Seventh.

Iowa.

✣Bids will be received until June 26, by City Council, Maquoketa, Ia., for the construction of pavement on a number of streets.

✣Bids will be received until noon, June 26, by E. J. Kullmer, City Clerk, Maquoketa Ia., for the construction of brick creosote block, Sarcolithic Mineral Rubber and Asphaltic Concrete pavement.

✣Bids will be received until 2:30 p. m., July 11, by Town of Greenfield, Ia., for the construction of about 14,000 sq. yds. of brick or cement concrete pavement and 4,500 ft. of curb. A certified check for $1,000 must be filed with each bid. Plans and specifications can be obtained for $5.00 of the Iowa Engineering Co., Chase Block, Clinton, Ia.

⊙Michael Ford of Cedar Rapids, Ia., has been awarded the contract by the city of Hastings, Neb., for the construction of asphalt pavement in Districts Nos. 14 and 15 for $2.11 per sq. yd., and E. R. Bing of Hastings secured the contract for brick pavement at $1.88 per sq. yd. No. 14 will include 11,200 sq. yds. of asphalt pavement, 1,512 ft. of white oak plank, 250 sq. yds. of concrete pavement, 220 lin. ft. of old curb reset, 320 lin. ft. of new curb, 6,940 ft. of combined curb and gutter, 5,200 sq. yds. of brick block pavement, 2,000 lin. ft. of new concrete curb and gutter. No. 15 includes 11,100 sq. yds. of asphalt paving. oak plank, 250 sq. yds. of concrete pavement, 700 ft. of old curb reset, 685 ft. of concrete gutter, 300 ft. of new concrete curb, 6,590 ft. of combined curb and gutter, 5,600 sq. yds. brick block paving, 980 ft. of old curb reset, 940 ft. of new curb. Bids opened June 12.

The City Council of Iowa City, Ia., has ordered bitulithic paving, about 17 blocks, to cost between $50,000 and $60,000, as follows: Bloomington St., between Clinton and Capitol; Jefferson St., between Capitol and Gilbert; Linn St., between Jefferson and Market; Iowa Ave., between Clinton and Dubuque; Dubuque St., between Iowa Ave., and Jefferson; Evers St., between Iowa Ave. and Market; Market St., between Evans and Union Pl.; Washington St., between Muscatine St. and Summit St.; Muscatine St., between Washington St. and Iowa Ave., and Summit St., between the south end of its paving and Kirkwood Ave.

The City Council of Carroll, Ia., has passed an ordinance ordering the installation of paving on the streets of the city for a distance of 13 blocks.

Kansas.

✣Board of Johnson County Commissioners, Olathe, Kan., will receive bids until July 5 for the construction of two miles of roadway.

Kentucky.

✣Bids will be received until July 1, by E S. Helburn, Mayor, Middlesboro, Ky., for the construction of sidewalks, curbing and guttering on Cumberland, Chester, Winchester and Rochester Aves., 21st, 25th and 18th Sts.

Louisiana.

⊙The City Council of New Orleans, La., has decided to proceed at once with the paving of Joseph St., from Prytania to Hurst, and Hurst from Joseph to Exposition Blvd. Craven & Co. have the contract for the subsurface drainage, and the Standard Paving Co. the contract for paving with creosoted wood block.

The Police Jury, Plaquemine, La., has appointed a committee to devise ways and means of meeting the expense of building a gravel road on Bayou Plaquemine to Indian Village, a distance of nine miles.

Maryland.

✣Bids will be received until 8 p. m., June 27 by Commission for the Improvement of Streets, Murray Vandiver, Chairman, Havre de Grace, Md., for the improvement of certain streets. The following is approximately the amount of work to be done according to the plans and specifications in the office of the Commission: 5,160 cu. yds. excavation; 8,480 sq. yds. bituminous macadam; 120 cu. yds. masonry. Certified check for $200 is to accompany each bid. Plans and specifications can be seen at the office of the Commission, or will be forwarded by express upon receipt of $2.

E P. Lindsay of Gardenville, Md., is the probable contractor for the construction of two miles of macadamized roadway, known as the Old Court road, between Quarry lane and Rockland, for which bids were opened by the County Highway Commission, Towson, Md., on June 15. E. Stanton Bosley is Secy.

Preliminary plans for paving out of the $5,000,000 loan have been submitted to the Paving Commission, Baltimore, Md. According to R. M. Compton, chairman of the commission, the $500,000 available this year will pave about 10 miles of streets.

Massachusetts.

✣Bids will be received until 3 p. m., June 28, by the Park Department, Boston, Mass., at the office of the Commission, Olmsted Park, Jamaica Plain, for constructing Bermudez asphalt roadway on Riverway drive. Plans and forms for proposals may be obtained of the Engineer, Franklin Park.

Mayor Fitzgerald, of Boston, Mass., has authorized the expenditure of the entire amount, $300,000, recently appropriated by the City Council, for the improvement of streets. Of the total sum, $85,000 will be expended in repaving and equipping with a sewer main Southampton St.; $42,000 for the construction of Highland Ave., in Neponset; $20,000 for the construction of Wallingford road, Brighton; $25,000 for Caterbury St., West Roxbury, and $15,000 for the construction and widening of Morton St., between Blue Hill Ave. and Norfolk St. L. K. Rourke is City Engineer.

Michigan.

✣Bids will be received until 4 p. m., July 15, by Newkirk and Ellsworth township, Lake County Mich., at the office of Norman Buckner. Clerk of Newkirk township, Luther, Mich., for the construction of 11½ miles of Class "B" State Reward Gravel road. Plans and specifications may be seen at the office of the Clerk of Newkirk township. Official advertisement will be found elsewhere in this issue.

The city of Pontiac, Mich., intends to pave South Saginaw St., from the Air Line tracks to the South Blvd.; the first alley east of Saginaw St., from Huron St. to Water St.; and the first alley west of Saginaw St., from Huron St. to the river.

Covington township, Baraga County, Mich., on June 19, held an election to vote on the issuance of bonds to the amount of $18,000 for the building of a road from Covington to Nestoria, and a road from Nestoria to the L'Anse township line.

The City Commission of Pontiac, Mich., has adopted an ordinance providing for the paving of South Saginaw St. Bids will be received shortly.

The City Clerk of Dowagiac, Mich., has been instructed by the City Council to advertise for bids on the High St. pavement and to advertise notice of intention to pave on Indiana from High to Division St., and on Michigan Ave., from High to Main.

No bids were received by the State Highway Commission, Lansing, Mich., on June 9 for the construction of one mile of highway, including 10,000 cu. yds. of excavation and embankment and 500 cu. yds. of reinforced concrete retaining wall and culvert. The work will be readvertised. Townsend A. Ely is State Highway Commissioner.

Minnesota.

⊙H. L. Bartlett Co., of Virginia, Minn., and P. McDonnell of Duluth, Minn., have been awarded the contracts by the city of Virginia for the paving of the following streets and avenues: Mesaba Ave., from Spruce to Sago; Cleveland Ave., from Maple to Larch; Poplar St., from New England Ave., to Railroad Ave.; Spruce St., from Ohio Ave. to Railroad Ave.; Cook St., from Central Ave. to southwest corner of the Second addition to Virginia; Lake Blvd., from Walnut to Willow Sts.; Walnut St., from Cleveland Ave., to Railroad Ave., and Central Ave., from Sage to Larch Sts. The first named contract is for bitulithic at $2.40 per sq. yd; the last named for wood blocks at $2.60 per sq. yd. Bids were opened June 13.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Mississippi.

✣Bids will be received until 8 p. m., July 3, by City Clerk, Vicksburg, Miss., for the construction of pavement on Belmont St., from Washington to Cherry Sts., and on Grove St. from Washington to First North Sts.

⦿The Board of Supervisors of Harrison County, Gulfport, Miss., has awarded the contract to W. A. Hughston for the building of 18¾ miles of roads in beat two for $27,300.

The Board of Supervisors of Lauderdale County, Meridian, Miss., has sold bonds to the amount of $150,000 for the purpose of constructing good roads in district No. 1.

The City Council of Jackson, Miss., has ordered the paving of Fortification St., from North State to Grayson. The estimated cost is $15,000.

Missouri.

⦿The Joplin special road district commissioners, Joplin, Mo., have let the contract for grading and graveling nearly a mile of road which includes the approaches at the Hallwood bridge across Spring river five miles northwest of Carthage, to the Winters Construction Co., of Joplin. The cost will be about $3,000.

The City Council of Joplin, Mo., has adopted an ordinance calling for the use of creosoted wood blocks in the paving of Main St., from Third St. to the south line of the Frisco right of way at 10th St.

The City Council of Chillicothe, Mo., has instructed the city engineer to prepare plans and specifications and an estimate of the cost of paving Webster St., from the east line of Locust St., to the C., M. & St. P. depot.

Montana.

Advices from Billings, Mont., state that Assistant County Surveyor Eder and surveying crew has begun the surveying of 27 miles of new county road in the vicinity of Acton.

Nebraska.

✣Bids will be received until 2 p. m., June 27, by County Clerk, Lancaster County, Lincoln, Nebr., for paving West P St., which is part of roads No. 667 and No. 1225 from the west limits of the city of Lincoln, Nebraska, to the west line of section 22, town. 10, range 6, as per plans and specifications on file in the office of county clerk. Engineer's estimates: Approximate quantities: 9,564 sq. yds. paving class C and G; 8,350 cu. yds. grading; 10,760 lin. ft. artificial stone curbing, class 3; grading, 25c per cu. yd.; paving classes C and G, $1.85 per sq. yd.; curbing, class 3, 40c per lin. ft. All bids should be addressed to H. E. Wells, County Clerk, and must contain a certified check for $200 made payable to the county clerk.

⦿Dan Hanan of South Omaha is reported to have been awarded the contract by the County Commissioners, Omaha, Neb., for paving the four blocks of the boulevard that runs through Clontarf precinct on 13th St., for $1.99 per yd. The total cost will be about $9,000.

⦿J. W. McGerr has been awarded the contract by the County Board of Commissioners, Lincoln, Neb., for grading the road in sections 8 and 9 in Elk precinct, for $0.20 per cu. yd.

A petition has been presented to the City Council of Hastings, Neb., providing for the extension of First St. paving east to Colorado.

New Jersey.

✣Bids will [illegible] 15 p. m., July 3, by Town Council, Westfield, N. J., 121 Prospect St., for improving a section of Mountain Ave. The engineer's approximate estimate of quantities is as follows: 1,600 cu. yds. of excavation; 5,320 sq. yds. of 8-in. bituminous macadam; 5,500 lin. ft. of underdrain; 425 lin. ft. 8-in. underdrain outlet; 200 lin. ft. 12-in. drain and appurtenances; 165 lin. ft. concrete culverts. Each proposal must be accompanied by a certified check for $500, drawn to the order of the Treasurer of the Town of Westfield, N. J. Charles Clark is Town Clerk.

Miller & Bro. of Cape May, N. J., are the probable contractors for resurfacing Camden and Westfield turnpike, for which bids were opened June 14 by the Board of Chosen Freeholders, Camden, N. J. J. J. Albertson, County Engineer. The road is to be resurfaced with Amiesite. The bid is $36,400.

New York.

✣Bids will be received until 8 p. m., July 5, by Commissioners of Public Works, Olean, N. Y., for the improvement of Washington St. from Fourth to 13th Sts., by paving with wire-cut-lug pavement on concrete foundation, including approximately 9,800 sq. yds. of pavement and 6,000 lin. ft. of curb. John H. Gaynor is City Engineer.

✣Bids will be received until 8 p. m., July 6, by Commissioners of Public Works, Olean, N. Y., for the improvement of South Third St., by constructing 5,000 sq. yds. of wire-cut-lug pavement on concrete foundation in South Third St., from State to Green Sts. The work will include 3,500 lin. ft. of stone curb. Plans and specifications can be obtained of the City Engineer, J. H. Gaynor, City Bldg.

All bids received by Charles B. Stover, President of the Park Board, New York City, on June 15, for the reconstruction of the surface of Hudson River road with gravel and asphaltic binder; also roadway of the Bronx and Pelham Parkway from Williamsbridge road to White Plains road, have been rejected. The lowest bid received was from the Continental Pub. Works Co., 2 Rector St., New York, which was $1.21 per sq. yd., or a total of $27,660.

Superintendent of Highways E. A. Howard Oswego, N. Y., has been notified by the State Highway Commission that the plans have been drawn for the improvement of the [illegible] that bids will soon be asked.

Tentative plans have been made by the Village Trustees of Seneca Falls, N. Y., for the submission to the voters of the village at an early date of a bonding and paving proposition. If the plan is carried out the village will pave the most important streets with brick.

North Carolina.

[illegible] provement bonds on July 3 to the amount of $55,000. H. L. Skinner is Clerk. James A. W[illegible]

The street committee of the Board of Aldermen, Asheville, N. C., has decided to pave Magnolia Ave. with bitulithic, from Cumberland to North Main St.

North Dakota.

✣Bids will be received until 8 p. m., July 3, by City Council of Valley City, N. Dak., for stone for such three and four ft crossings as may be laid by the city during the ensuing [illegible]

Ohio.

✣Bids will be received until noon, July 3, by B. M. Cook, Clerk, Lakewood, O., for furnishing labor and material necessary for laying delinquent sidewalks of stone in accordance with plans and specifications on file at the office of the Clerk and of William H. Evers Engineering Co., 332 The Arcade, [illegible]

✣Bids will be received until noon, June 27, by Director of Public Service, Lorain, O., for furnishing the necessary labor and material for the improvement of the following streets: East Erie Ave., by paving from Colorado [illegible] uminous Macadam, Bituminous Concrete, Sheet Asphalt, Block Asphalt, or Vitrified Brick, with the necessary excavation, drainage and curbing, foundations, etc. The first alley west of Broadway from 7th St. to 10th St., with Sheet Asphalt, Block Asphalt, or Vitrified Brick, with the necessary excavation, drainage, curbing, foundations, etc. Hamilton Ave., by paving from 5th St. to 8th St. with Sheet Asphalt, Block Asphalt, Vitrified Brick, with the necessary excavation, draining, curbing, foundation, etc. L. B. Johnson [illegible]

✣Bids will be received until June 21, by W. B. Golden, Clerk, Athens, O., for furnishing the necessary labor and material for the grading, draining, curbing and paving of Elliott St., from Mill St. to Morris Ave. in the village.

✣Bids will be received at Mt. Gilead, Ohio, by the Morrow County Commissioners, July 7, for the macadamizing of the following roads, Mills Road, Canaan Township, length of road 3 miles; Kirk Road, Westfield Township, length of road 1.56 miles; Osborn Road, Cardington and Lincoln Townships, length of road 4 miles; Clark and Purington Road, Peru Township, length of road 3½ miles. Plans and specifications on file with the County Auditor and David Underwood, County Surveyor.

⦿Frank Downs has been awarded the contract by the Stark County Commissioners, Canton, O., for brick paving the North Industry Road for a distance of 2¼ miles for $29,397. Bids were opened June 14.

⦿Wm. P. Flynn, Chase Ave., Cincinnati, O., has been awarded the contract by the County Commissioners, Cincinnati, for the improvement of Springfield pike from Gas Hall in Carthage to Cincinnati, Hamilton & Dayton R. R. bridge in Hartwell in Springfield township. The contract price is $1,122. Bids were opened June 9 by Fred Dreihs, clerk.

⦿J. M. Quill, Temple Court Bldg., Cincinnati, O., has been awarded the contract by the Department of Public Service, Cincinnati, for the improvement of Hooker St., from Montana Ave., to Broadwell, for $2,717. The work includes grading, cement curb and gutter, macadamizing the roadway, and constructing basins and drains. Bids were opened May 31. John J. Werner is clerk of the department.

⦿Frank Liles, R. F. District No. 1, Sandusky, O., has been awarded the contract by the County Commissioners of Erie County, Sandusky, for the construction of the state road beginning at the corporation line at Vermillion and running south 1,700 ft., for $1,800. Bids were opened June 12 by J. Diest, County Auditor.

⦿Turner & Olson of Youngstown, O., have been awarded the contract by the Department of Public Service of that city for the paving of Hillman St., from Mt. Pleasant to Warren Ave., for $30,000. Bids were opened June 9. W. H. McMillin is clerk of the department.

⦿The County Commissioners, Cincinnati, O., have awarded R. E. Cash the contract for repairing the Bond road from Montgomery Pike to Camargo Pike for $15,500; O. E. Robinson the contract for repairing Colerain Pike from Mt. Airy to the Poole road for $5,893, and for improving Compton road for $1,952; H. E. Steele the contract for macadamizing the extension of the Struble road from Pippin road to the Hamilton Pike for $1,053.

⦿The County Commissioners, Cincinnati O., have awarded the contract for the change of route and improvement of Crookshank road, Summit, to the Joe Grandison Construction Co., for $15,986.

⦿The contract for the paving of Spring Grove Ave. from Knowlton's corner to the cemetery gate has been awarded by the County Commissioners, Cincinnati, O., to J. M. Quill, Temple Court, Cincinnati, for $95,180. Granite paving will be used. Bids were opened June 9.

The City Council of Delaware, O., has passed a resolution ordering the service director to improve Wilder St., Fair Ave., and Channing St., by piking, rolling, etc.

Plans and specifications for the repair of the Blue Rock Pike from Colerain Pike to the Miami River at a cost of $14,960 have been approved and the work ordered advertised by the County Commissioners, Cincin[illegible]

The estimated cost of improving Main St., from Hardin St. to the bridge, Findlay, O., as submitted to the City Council, has been placed at $33,973. Brick will be the material.

The City Council of Toledo, O., has passed a resolution providing for the repaving of St. Clair St., from Monroe to Emerald St. The

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

Mayor H. D. Cook of Ashtabula, O., is agitating the paving of Lake St., its full width from the subway to Erie St.

The city of Wapakoneta, O., has sold bonds amounting to $37,500 for the purpose of paving two principal streets.

The City Council of Findlay, O., is making arrangements to repave Main St., from Hardin St., to the C., H. & D. tracks on North Main St. The estimated cost will be about $40,000.

The City Council of Bryan, O., has decided to pave East High St. with brick as soon as bonds can be sold and other preliminary work completed. The improvement will extend from the present pavement east to and across the Cincinnati Northern railroad tracks.

Oklahoma.

The first petition for the establishment of a road district, as provided for in the new state law, has been filed with the County Commissioners, Oklahoma City, Okla. The district includes two roads, from the eastern to the western and from the northern to the southern boundaries of the county, intersecting at Oklahoma City. Lateral roads will also be improved, amounting to about 288 sq. miles. The estimated cost is $500,000.

Oregon.

⊙According to information from Hood River, Ore., Walter G. E. Smith has been granted the contract for the improvement of the county road on the West Side from the front of the Epping ranch to Tucker's hill. The road, which is about two miles in length, will be graded and macadamized.

A number of business men of Burns and other Harney County points recently visited Vale, Ore., on behalf of a plan to improve the road from Vale to Burns.

Pennsylvania.

✣Bids will be received until 10 a. m., July 1, by Road Supervisors of Jefferson township, Fayette County, Pa., for the grading and biulding a macadam telford road, 10,700 ft. long, including bridges and culverts. Plans and specifications are on file with W. H. Binns, Secy. of the Board, Fayette City, Pa., R. F. D.

⊙The Elmira Construction Co., has been awarded the contract by the Town Council, Ridgeway, Pa., for setting curb, and for grading, paving, including 2,500 cu. yds. of excavation, 7,000 sq. yds. of paving, 5,600 lin. ft. of curbing. Bids were opened June 12. F. W. Ward is Borough Engineer.

⊙The City Council of Butler, Pa., has awarded the contract for the paving of Brugh Ave., South Side, to Norman Boyer, and the contract for the paving of First St., to Tony Morelli. Brick will be used.

⊙The City Council of Greensburg, Pa., has awarded the contract for constructing about one mile of pavement to Luther F. Edwards, of Yardley, for $22,213. The streets to be paved are Manahan St., to O'Hara St.; Center Ave., from Grant St. to Beacom St.; Hawthorne Ave., from Joe St. to an alley on the west; Maple Ave., from Kenneth Ave. to the borough line on the north, and the alley between Joe and Division Sts., from Otterman St. to the property of W. A. Wilson.

The residents of that portion of Torrence St., from Findley St., to Mitchell Ave., Punxsutawney, Pa., have petitioned the City Council to pave that section of the street with brick.

Plans for the construction of the new driveway from Water St., to the wharves, Pittsburg, Pa., have been completed and preparations for receiving bids for the work are being completed. The roadway will cost about $25,000.

Tennessee.

✣Bids will be received until 6 p. m., July 20, by W. M. Dunlap, City Commissioner, Johnson City, Tenn., for the construction of bridges, sewers, storm-water drains, concrete curb and gutter and street paving with brick, asphalt, bitulithic, wood block, granitoid or tar macadam for improvement districts No. 7 and No. 8 according to plans and specifications in the office of the City Engineer. Proposals with specifications for any good paving will be considered. 5,000 cu. yds. excavation; 23,000 sq. yds. street paving; 12,000 lin. ft. curb and gutter; 1,600 lin. ft. 6-in. sewer connections; 600 lin. ft. 15-in. T. C. drains; 11 catch basins; 16 cu. yds. reinforced concrete to cover drain 8 ft. wide. E. E. Ellsworth is Recorder.

⊙At a recent meeting of the road commission, Knoxville, Tenn., the contract for the reconstruction of the Kingston pike was awarded to Peters & Gibson. This contract includes the reconstruction of that road from the city limits to the forks of the road.

⊙Contracts for the paving of 30 streets have been awarded by the Board of City Commissioners, Memphis, Tenn., the most important of which will be the contract for paving Union Ave., from Dunlap St., to McLean Blvd., with asphalt. This contract was awarded H. P. Streicher & Co., Memphis, for $106,000.

⊙The City Council of Knoxville, Tenn., has awarded the contract for paving improvement districts Nos. 41, 89, 90 and 92 to the Barber Asphalt Paving Co., of Philadelphia. All of the districts will be paved with asphalt and a 5 in. base will be used in four of the districts, a 6 in. base having been ordered for district No. 89, Central St. The cost will be $1.78 per sq. yd., for the 5 in. and $1.88 per yd. for the 6 in.

The council committee, Nashville, Tenn., has asked the Board of Public Works that the money proposed by a bill now pending in the council for Demonbreun, Fourth Ave., and other streets, be used on the up-town section.

Utah.

P. J. Moran of Salt Lake City, Utah, on June 2 submitted the lowest bid to the City Council of that city for curb and gutter extension No. 16, contract. The bid is $12,357. G. F. McGonagle is City Engineer.

The following bids were received June 7 by the city of Salt Lake City, Utah, G. F. McGonagle, City Engineer, for sidewalk extension 179; (1) bid of McKay & Reed, (2) Gillis Construction Co., (3) James Kennedy Construction Co., (4) Strange & Maguire Construction Co., (5) Benj. F. Tibby:

		(1)	(2)	(3)	(4)	(5)
Abutters Portion						
Excav., cu. yds.	24,902.60	$ 0.38	$ 0.40	$ 0.40	$ 0.55	$ 0.75
4-in. cement walk	522,729.78	0.115	0.115	0.125	0.125	0.125
6-in. cement walk	11,195.00	0.15	0.15	0.16	0.175	0.17
Removing Trees						
6-in. or less in diam.	19.0	2.00	1.00	1.50	3.00	3.00
6-in. to 12-in. diam.	52.0	4.00	2.00	2.00	4.00	5.00
12-in. and over	126.0	6.00	4.00	7.00	4.75	6.90
4-in.x6-in. guard timbers, lin. ft.	3,969.0	0.12	0.15	0.20	0.18	0.14
Furn. and Setting:						
Flumes, M. ft. B.M.	85.99	40.00	30.00	37.00	45.00	38.00
Const. 16-in. bridge, M. ft. B.M.	0.655	45.00	30.00	50.00	50.00	40.00
Removing fence, lin. ft.	4,592.1	[illegible]	0.05	0.10	0.40	0.15
Resetting old flumes, lin. ft.	140.0	[illegible]	0.10	0.10	1.00	0.25
Furn. and Laying Vit. Pipe:						
4-in., lin. ft.	730.0	0.20	0.25	0.12	0.30	0.20
6-in., lin. ft.	170.00	[illegible]	0.35	0.30	0.35	0.30
8-in., lin. ft.	70.00	0.40	0.50	0.43	0.42	0.50
10-in., lin. ft.	100.00	[illegible]	0.50	0.60	0.52	0.60
12-in., lin. ft.	47.5	0.60	0.60	0.85	0.62	0.80
15-in., lin. ft.	55.0	[illegible]	1.00	1.10	0.80	1.50
18-in., lin. ft.	40.0	[illegible]	1.25	2.00	1.10	2.00
Pipe cut off and plugged	1.0	[illegible]	10.00	0.50	5.00	20.00
Fire hydrant moved [illegible] ft.	1.0	[illegible]	20.00	15.00	12.00	15.00
Remove coal sheds	1.0	[illegible]	10.00	1.50	6.00	10.00
Total abutter		$76,718	$76,320	$83,016	$ 88,954	$ 92,218
Rate per front ft 6' walk, front ft.	41,690.70	[illegible]	0.948157	...	.....	...
Rate per front ft. 5' walk, front ft.	48,178.34	[illegible]	0.763636	.	....	...
City Portion:						
Excav., cu. yds.	24,902.60	0.38	0.40	0.40	0.55	0.75
Grand Total		[illegible]	$86,281	$92,977	$102,651	$110,895

Virginia.

⊙The Board of Control of Norfolk, Va., has awarded the contract for paving with old stone and setting curbing on the street of the Fourth ward, material to be taken from Bank St., to P. W. Ruth & Co., for $0.49 per sq. yd., and $0.07 per lin. ft. The total amount is about $2,290.

The Leesburg-Washington Good Roads Association has been incorporated for the purpose of rebuilding that part of the old Leesburg and Georgetown Turnpike which lies between Leesburg and Langley, in Fairfax County.

West Virginia.

✣Bids will be received until noon, July 3, by Court of Wood County, Parkersburg, W. Va., for the construction of brick pavement on Williamstown Road, Dudley Ave., Northwestern Pike and Staunton Pike. W. H. McDowell is President of the court, and C. S. Skidmore is County Engineer.

✣Bids will be received until 1 p. m., July 6, by Board of Commissioners, Huntington, W. Va., for the construction of vitrified brick, sheet asphalt, bitulithic, concrete asphalt, tarvia or asphalt block pavement on various streets. John Coon is Commissioner of Streets. A. B. Maupin is City Engineer.

Wisconsin.

✣Bids will be received until 2 p. m., July 17, by Board of Public Works, Rhinelander, Wis., for furnishing the necessary labor and material for the improvement of the following named streets and portions thereof in the city by constructing thereon a first-class macadam roadway with combined cement curb and gutter on both sides thereof and doing necessary grading, excavating, and furnishing the materials therefor, all in accordance with plans and specifications on file in the office of the City Clerk. Brown St., from Frederick St. to the "Soo" Line viaduct; Baird Ave., from Dahl St. to Phillips St.; and Oneida Ave., from Anderson St. to the north side of the intersection of same with King St., and all intervening street intersections. The work shall be commenced forthwith, and shall be completed before the 1st day of November, 1911. G. C. Jewell is Chairman of the Board.

⊙The Larsen-Strey Co., of Oshkosh, Wis., has been awarded the contract by the City Council of that city for the repaving of 13th St., from Oregon St. to the crossing of the Wisconsin Central railway, and the White Construction Co., of Milwaukee, was awarded the contract for the repaving of Algoma St., from West Algoma St. to Murdock St., with asphalt.

The City Council of Wausau, Wis., has decided to pave Washington St., between Third and Fourth, with vitrified brick.

Canada.

✣Bids will be received until 6 p. m., June 24, by J. McTeigue, City Clerk, Port Arthur, Ont., for paving streets in the city as follows: Bay St., Cumberland to Algoma—With asphalt block, sheet asphalt and bitulithic, and laying and paving street car tracks according to Engineer's plans, etc. Estimated quantities: Pavement, approximately 4,784 sq. yds.; curb and gutter, approximately 2,930 lin. ft.; track construction, approximately 3,166 sq. yds. Algoma St., Bay to John—Estimated quantities: Pavement, approximately 4,100 sq. yds.; curb and gutter, approximately 2,060 lin. ft.; track construction, approximately 3,378 sq. yds. Algoma St., John to Queen—Estimated quantities: Pavement, approximately 1,685 sq. yds.;

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

curb and gutter, approximately 910 lin. ft.; track construction, approximately 515 sq. yds. Pearl St. South, Water to Court (no street car tracks)—Estimated quantities: Pavement, approximately 4,360 sq. yds.; curb and gutter, 1,836 lin. ft. Cameron St., Cumberland to Court (no street car tracks)—Estimated quantities: Pavement, aproximately, 1,780 sq. yds.; curb and gutter, 1,340 lin. ft. This latter street to include tender for construction with Roemac. All tenders must include construction of proper curbs and gutters. Further instructions as to specifications and forms of tender may be obtained from the City Engineer.

⊙A. L. [illegible] been awarded the contract for the construction of cement sidewalks at Fort Qu'Appelle, [illegible] ft. curb, lane and street crossings. Bids were opened June 15 by W. Thomson, Secy.-Treas.

The Civic Committee on Works, Toronto, Ont., has decided in favor of the extension of Victoria St., from Gerrard St. northward to Carlton St.

BRIDGES—STEEL AND CONCRETE

Alabama.

⊙Commissioners of Lauderdale County at Florence, Ala., have awarded the contract for the construction of a steel bridge across the Elk River to Austin Bros., Atlanta, Ga., at $20,000. The structure which will connect Lauderdale and Limestone counties will span the river on the old Huntsville stage route.

California.

Plans and specifications have been adopted by the Board of Trustees, Tehama, Cal., for the construction of an approach to the new county bridge across the Sacramento River. Bids for the work are being received.

Representatives of the Merchants Association of Rio Vista, Cal., recently met with the Solano County Board of Supervisors at Fairfield, Cal., seeking the co-operation of that county with Sacramento County in building a new bridge across the Sacramento River at Rio Vista.

A delegation of citizens from Esparto has petitioned the Board of Yolo County Supervisors, Sacramento, Cal., for the construction of a bridge over Cache Creek at that point.

Connecticut.

At a meeting of a joint board of Fairfield and New Haven Counties in Bridgeport, Conn., it was decided to take action on strengthening the Shelton bridge over the Housatonic River between Shelton and Derby.

Florida.

✣Bids will be received until July 27 by City of Tampa, Fla., for the construction of a bascule bridge over Hillsboro River at Lafayette St. According to plans the structure will be 400 ft. long, 80 ft. wide with 15 ft. clearance. The work will include concrete approaches. D. B. McKay is Mayor.

✣Board of Public Works, Tampa, Fla., will receive bids until about July 21 for plans, specifications and proposals for the construction of an 80-ft. bascule type bridge of concrete construction at Lafayette St.

Georgia.

✣Bids are being asked by George T. Smith, Mayor, Covington, Ga., for the construction of a concrete bridge 20 ft. high, 60 ft. wide and 100 ft. long.

Idaho.

A party including State Engineer, Boise, Idaho, and C. H. Mull, City Engineer of Twin Falls, Idaho, recently decided upon the definite location for the construction of the $12,000 bridge across the Snake River near Clear Lakes.

City Council of Weiser, Idaho, has granted a petition of the citizens for the construction of a cement bridge over Monroe Creek. As proposed the structure will have a 24-ft. roadway.

Illinois.

⊙Floyd Finchum, Town Clerk of Plainville, Ill., has awarded the contract for the construction of the Hastings bridge in Richfield Township, Adams County, to C. A. Weaver & Son of Clayton, Ill., for $1,595. Bids were opened May 26.

⊙The contract for the construction of two steel bridges in May township, Illinois, has been awarded to T. J. Covert, Palmer, Ill., at $1,495. One structure will be 42 ft. and the other 32 ft. long.

⊙The Myers Construction Co., St. Louis, Mo., has been awarded the contract for the construction of a large bridge for the Rock Island Southern Ry. Co., of which W. W. McCullough, Monmouth, Ill., is General Manager.

The Santa Fe System has planned to replace bridges Nos. 18 and 79, Eastern Division, at an estimated cost of $17,911, changing deck of bridge No. A83, Los Angeles Division, at a cost of $10,000, extension of bridge No. 533B, Arkansas River Division, at an estimated cost of $9,100, renewal of bridge No. 159, Missouri Division, at a cost of $4,000; to cover cost of raising grade five feet at Bridge No. 3296 and renewing with open deck trestle an appropriation of $5,000 has been made.

Advices from Champaign, Ill., state that the Commissioners of Union District No. 1 from the townships of Ogden and Oakwood recently met at that city to discuss the matter of replacing bridges in Oakwood township, Vermilion County, which had been removed for the widening and deepening of ditches throughout that district. Z. D. Alsip, Ogden, Ill., is one of the commissioners.

It is understood that the Chicago, Milwaukee & Gary R. R. Co. will soon take up the matter of constructing a new steel and cement bridge over East Main St. Road at DeKalb, Ill. I. W. Troxel, Rockford, Ill., is Chief Engineer of the Railroad.

All bids received on June 10 at the Court House, Jerseyville, Ill., for the construction of a reinforced concrete superstructure on old stone abutments, in Rosedale Township, Jersey County, have been rejected. Wm. Brown is Town Clerk.

Indiana.

✣Bids will be received until 10 a. m., July 5, by Board of County Commissioners, Valparaiso, Ind., for the construction of Bridge No. 141 in Morgan township, consisting of 30 ft. span and concrete superstructure; Bridge No. 142, Morgan township, with 30 ft. span and concrete substructure; Bridge No. 143 in Pleasant township with 36 ft. span, pony steel truss on skew with plank floor on concrete substructure; Bridge No. 149 in Boone township with 30 ft. span with concrete substructure; Bridge No. 151 in Boone township with 50 ft. span, pony steel truss on skew, with plank floor on concrete substructure; Bridge No. 155 in Pleasant township with 50 ft. span, pony steel truss, with 16 ft. roadway and combination concrete and steel tube substructure. C. A. Blachly is County Auditor.

✣Bids will be received until 2 p. m., June 26, by Board of Rush County Commissioners, Rushville, Ind., for the construction of several arches and bridges. J. M. Stone is Auditor of Rush County.

✣Bids will be received until 10 a. m., July 3, by Board of La Porte County Commissioners, La Porte, Ind., for the construction of several bridges throughout the county. F. A. Hausheer is County Auditor.

✣Bids will be received until July 5, by Board of Bartholomew County Commissioners, Columbus, Ind., for the construction of several county bridges. P. J. Sater is County Auditor.

✣Bids will be received until 1:30 p. m., July 5, by Board of Parke County Commissioners, Rockville, Ind., for the construction and repair of certain bridges. J. E. Elder is County Auditor.

✣Bids will be received until 10 a. m., July 6, by Board of Laporte County Commissioners, Laporte, Ind., for the construction of a certain number of county bridges. F. A. Hausheer is County Auditor.

⊙The Board of County Commissioners, Connersville, Ind., has awarded the contract for the construction of a concrete bridge over Williams Creek, west of Hawkins, to Payne-Thomas Bridge Co., at $2,277.

⊙The County Commissioners at Columbus, Ind., have awarded the contracts for the construction of the Williams Bridge, Rock Creek township, and Finkle Bridge, in Clay township, to Harmon Bros., at $635, and Forest Meredith, at $345, respectively.

Commissioners of Boone County at Lebanon, Ind., have received bids for the construction of bridges as follows: John Adams, bridges Nos. 147, at $253.56; 153, $323; 159, [illegible] 167, $623; D. P. Turner, bridges Nos. 152, $473.67; 157, $498. Shahan & McCarthy, No. 168, $640. Rufus Davidson, Nos. 142, $145; 145, $360; 146, $325; 150, $295. Earl McDonald, No. 154, $344.

Iowa.

All bids received June 8 by F. W. Leedham, County Auditor, Clinton, Ia., for the construction of three steel bridges in Clinton County, were rejected. R. C. Hart, Clinton, Ia., is County Engineer.

Citizens in the vicinity of Bettendorf, east of Davenport, Ia., have petitioned the Board of Scott County Supervisors at Davenport, Ia., for the construction of a new bridge to replace the one now on Middle Road.

Kansas.

✣[illegible] 1911, at the Court House in Leoti for a bridge to be built in Wichita County. George E. Ballard, County Clerk, Leoti, Kansas. White Woman Bridge. Concrete bridge abutments having a total height of 22 ft. and a 20-ft. roadway. Total amount of concrete 267 cu. yds. Excavation will be in sand; foundation to be carried 1 ft. below bed of stream; ordinarily, stream is dry. Wood poles may have to be used. Contract includes removing and placing 60-ft. steel bridge on new abutments. Nearest railroad station on Missouri Pacific, Selkirk, 2½ miles. County clerk reports sand can be had at bridge site and that most of the rock (man size stone which will have to be broken) is now on the ground.

✣Bids will be received up to noon, July 5, 1911, at the Court House in Belleville for the construction of a bridge in Republic County. Henry Douglass, County Clerk, Belleville, Kansas. Yale Bridge. Three reinforced concrete flat top spans, 27 ft. 6 ins. each; 90 ft. over all, with an 18-ft. clear roadway; height of piers and abutments 14 to 22 ft. Estimated amount of concrete—substructure 233.3 cu. yds, superstructure 104.5 cu. yds. Estimated weight of steel reinforcements 17,431 lbs. Excavation will be in soapstone. Nearest railroad station, Belleville, 1¼ miles. Stone will be shipped in from Fairbury, Nebraska, or the local stone crushed or broken by hand; sand available at 35 cents per cu. yd. 2½ miles from bridge site. Plans and specifications are on file with the county clerk and copies of the same may be had by mailing One Dollar to the State Engineer, Manhattan, [illegible]

⊙Commissioners of Cowley County, at Winfield, Kans., have awarded the contract for the construction of a pile bridge over the Arkansas River at Plum Douthitt Ford to the Illinois Steel Bridge Co., at $3,750.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Louisiana.

Town Council of Church Point, La., has appropriated money to build a levee and bridge across Bayou Plaquemine. Bids for the work will be received at once.

Minnesota.

⦿Commissioners of St. Louis County, Duluth, Minn., have awarded the contract for the construction of the proposed concrete bridge over Amity Creek on the East Duluth and Lester River road to B. Krebsback & Co., at $[illegible]. The structure will have a span of 102 ft.

Mississippi.

✣Board of Supervisors, W. H. Speights, Clerk, Monticello, Miss., will let the contract for the construction of a steel bridge across Fair River on Rock Port Road near Wanilla, Miss., at public outcry at 1 p. m., July 3.

⦿The contract for the construction of the steel drawbridge across Tallahatchie River at Minter City, Miss., has been awarded to the Virginia Bridge & Iron Co., Roanoke, Va., at $14,680. C. W. Crockett, Greenwood, Miss., is Clerk of the Board.

Missouri.

An election was held June 20 at Independence, Mo., to vote on the matter of issuing $40,000 of bonds for the construction of new bridges and culverts and $10,000 for the market square. Llewellyn Jones is Mayor of the City.

Montana.

County Commissioners, at Libby, Mont., have under consideration the petition filed by the citizens of that city for the construction of a new bridge across the Kootenai River. A petition has also been received by the Commissioners from Troy for a new bridge at that place.

Nebraska.

⦿The Ashland Platte River Bridge Co., Ashland, Neb., has awarded the contract for the construction of the proposed bridge over the Platte River to the Omaha Structural Steel Co., Omaha, Nebr., at $17,700. The structure will consist of six 160 ft. spans with 16 ft. roadway resting on 60 in. tubes with ice breaks.

New Jersey.

Consulting Engineer Alexander Hamill has informed J. P. Riordan, Mayor, Harrison, N. J., that the grade of Harrison Ave. at the approach to the Bridge St. bridge will have to be raised 18 in. Plans have also been completed for the new span, which will be wider than the present structure.

Members of the Bridge Committee of the Board of Freeholders in Bloomfield and Glen Ridge at the Council Chambers, Glen Ridge, N. J., recently discussed the matter of enlarging the present stone arch bridge over which the Lackawanna R. R. tracks now cross Clark St. in that town.

Plans are being prepared and will be submitted to the Bridge Committee of the Camden, N. J., Council for the construction of a new bridge to replace the old wooden structure over the tracks of the Pennsylvania R. R. at 27th St. Frederick A. Finkeldey is Alderman of the Seventh Ward.

New Mexico.

Citizens in the vicinity of Silver City, N. Mex., are making an effort to secure an appropriation of Congress for the construction of a new bridge across the Gila River in that vicinity.

New York.

⦿The Owego Bridge Co., Owego, N. Y., has been awarded the contract for the construction of a bridge over Mud Creek in Arcadia, N. Y., at $4,500. The structure will be 70 ft. long with 18 ft. roadway. Z. T. Darrow & Sons, Canandaigua, N. Y., were awarded the contract for the construction of two smaller structures on the same road at $2,500. All structures will be of reinforced concrete.

A special election will soon be held at Montour Falls, N. Y., for the purpose of voting on the question of constructing a bridge over Catherine Creek at South St.

The town of Lysander, N. Y., has been authorized to issue bonds amounting to $25,000 to provide funds for paying the town's share of the cost of building a new bridge at Schroeppel. The entire cost of the work is estimated at $100,000, of which the State, Oswego County, Onondaga County and the towns of Lysander and Schroeppel will each pay a fourth.

A meeting has been held by the Town Board at the Hall, Whitesboro, N. Y., and it was decided to hold a special election June 30 to decide upon the question of issuing bonds not to exceed $7,000 for the construction of a bridge across Sauquoit Creek.

At a special election recently held in the town of Lowville, N. Y., the proposition to raise $9,000 for the construction of a concrete arch culvert over Mill creek near the present high bridge was carried by a large majority.

Town Board of Newark, N. Y., has decided to rebuild three new bridges on the road which is a continuation of Main St. north of that place. The structures as proposed will be reinforced concrete arches.

North Dakota.

The Commissioners of Cass County, at Fargo, N. Dak., have received twelve petitions asking for the construction of new bridges. A committee will be appointed to investigate the necessity of the improvements.

Ohio.

⦿The New York Central & St. Louis Railroad Co. has been awarded the contract by the Department of Public Service, Cleveland, O., for the construction of alterations in the bridge over Doan Brook on East Blvd., for $1,000. I. O. Hoffman is Secretary of the Department.

Plans and estimates have been completed by Engineering Department of Cincinnati, O., for the flooring of the new Fern St. bridge. The flooring, which will be reinforced concrete, will cost $11,635.

Plans and estimates for the substructure of the Ludlow Ave. viaduct eliminating the grade crossing of the B. & O. in Cincinnati, O., have been submitted to the Director by the City Engineer. The cost of the work will be about $76,000

Commissioners of Auglaize County at Wapakoneta, O., are advertising for bids for the construction of two bridges, one at Minster and the other at Roby.

Commissioners of Meigs County at Pomeroy, O., are making preparations to put in an iron bridge at Bingham's Mills on Leading Creek. The span of the present wooden bridge is nearly 300 ft. long. By making longer fills and abutments this length can be cut 100 ft. in the new bridge. The new abutments will be about 25 ft. high. The bridge is located on the main road from Rutland and the Leading Creek region to Kyger and the Gallia County points.

Pennsylvania.

✣Bids will be received until 10 a. m., June 28, by A. L. Rhoads, County Controller, Reading, Pa., for the erection of the substructure of the Kutztown bridge No. 1. Plans and specifications are on file with County Controller.

⦿The contract for the construction of Grand Jury Bridge No. 11 over Keyser Creek on Main St., in Taylor borough, has been awarded to Dingleberry & McLaughlin, Dickson City, Pa., at $995. Bids were opened by E. A. Jones, County Controller, Scranton, Pa., June 10.

⦿Contracts were awarded June 9 by R. J. Cunningham, County Controller, Pittsburg, Pa., as follows: For furnishing lumber for county bridges, L. Z. Hodil, Wildwood, Pa.; W. J. McNeal, Allison Park, Pa.; A. M. Fell, Greenville, Pa. For creosoted wood block, Farris Bridge Co., Jenkins Arcade Bldg., Pittsburg, Pa. For repairs to county bridges, S. B. Little, 7120 Idlewild St., Pittsburg; Baumeister & Smith, Tropical Ave., Pittsburg; Eli Crum, Crafton, Pa.

⦿The contract for the construction of the stone and concrete substructure and steel superstructure of the bridge over the Kinzua Creek in Hamilton township was awarded by the Board of County Commissioners, Smethport, Pa., to Rogers Bros., Erie, Pa., at $3,989. Bids were opened June 10.

Commissioners of York County, York, Pa., have decided upon the erection of five new bridges throughout the county, located as follows: Across the Little Conewago Creek, between West Manchester and Dover township; Fox Run in Dover township; Fishing Creek, between Lower Windsor and Chanceford townships; over stream in Peach Bottom township, near Delta; and over stream in Spring Garden township, near Green Hill.

The Engineer of Berks County at Reading, Pa., has completed plans for the construction of a new bridge at Penn St. in that city. The work will involve the widening of the street between Front and Second St., in order that a 60-ft. street can be laid out on each side of the bridge. Specifications will be prepared at once.

The Board of County Commissioners, Somerset, Pa., awarded the following contracts for the erection of bridges and abutments, as follows: Superstructure for a steel beam bridge with concrete floor over Wells creek at Frieden Station, to Rogers Bros., Albion, Pa., at $567; stone abutments to John F. Trimpey, Somerset, at $6.30 per cu. yd. Superstructure for a low truss steel bridge, with concrete floor system, over Blue Lick Creek on Garrett & Meyersdale road in Summit township; extreme length, 38 ft., with 14-ft. concrete roadway. Farris Bridge Co., Pittsburg, $730 superstructure; substructure not awarded. Superstructure for steel beam bridge, with concrete floor system, over Blue Lick Creek on Berlin and Meyersdale road. Extreme length, 33 ft., with 14-ft. concrete roadway. Farris Bridge Co., Pittsburg, $1,600, superstructure and substructure complete. Stone abutments for a bridge over Shaffer Run on the road leading from Fairhope to Glencoe, in Fairhope township. H. M. Poorbaugh, Fairhope, $5.50 cubic yard for rubble. Superstructure for a low truss steel bridge over Stony Creek, on Berlin and Shanksville road, Stony Creek township. Extreme length, 43 ft., with a 14-ft. concrete roadway. Roger Bros., Albion, Pa., $778 superstructure; Jefferson Landis, Stony Creek township, $6.12 cubic yard stone abutments. Superstructure for a steel bridge over Brush Creek, near Brush Creek school house, in Northampton township. Extreme length, 33 ft., with a 14-ft. roadway. Steel beams and a 3-in. plank roadway. York Bridge Co., York, Pa., $357 for superstructure; John Trimpey, Somerset, $5.20 cubic yard stone abutment, rubble.

It is understood in Coatsville, Pa., that the Lukens Iron & Steel Co. is having plans prepared for the construction of an overhead bridge across the Flat, West Main St.

Tennessee.

✣Bids will be received until July 5, bv Road Commission, at office of the Clerk, Court House, Knoxville, Tenn., for the repair work on all the wooden bridges of the county.

Virginia.

✣Bids will be received until 1:30 p. m., July 6, by John T. Hume, Treasurer, Southern Branch, N. H. D. V. S., National Soldiers' Home, Va., for labor and material for the construction of a concrete bridge over John's Creek.

At a recent meeting the Supervisors of New Kent and Charles City Counties, Virginia, decided to build a new bridge over the Chickahominy River to replace the old structure, which is in bad condition. The new bridge will be of white oak and will be 432 ft. long. New Kent, Va., is county seat of New Kent County.

Washington.

The County Commissioners at North Yakima, Wash., have awarded the contract for the construction of a bridge over the Sunnyside Canal, north of Zillah, to C. E. Lum. The structure will be of steel.

Wisconsin.

✣Bids will be received until 2 p. m., June 22, by Town Board at the Northwestern

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

House, Appleton, Wis., for the construction of a reinforced concrete bridge over the Little Appleton Creek, between Sections 29 and 30, Town Kaukauna. Plans and specifications can be seen at the residence of Charles Appleton, Chairman of the Board, Town Kaukauna, also at Max Lemke's Hotel, North Kaukauna, and the office of Herman Wildhagen, Appleton, Wis.

⊙The contract for the construction of the bascule bridge at Oneida St., Milwaukee, Wis., was awarded to the Milwaukee Bridge Co. at $92,845. The improvement was mentioned in our last issue.

⊙The Chicago & Northwestern Ry. Co. has awarded the contract for the construction of two bridges, one a few miles north of Mountain, in Oconto County, the other in Oneida County, to J. Young & Bros., Oconto, Wis., at $22,500.

The State Railroad Commission at Madison, Wis., recently issued an order requiring the [illegible] Pacific R. R. 50 per cent, the Lake Superior Terminal & Transportation Co. 20 per cent and the Duluth, South Shore & Atlantic Ry. Co. 10 per cent of the cost of constructing a viaduct over the railway tracks crossing Belknap St., one of the principal thoroughfares of Superior. The structure is to be 800 ft. long and will cost $60,000.

Canada.

At a recent election at Dauphin, Mann., the debenture by-law for $14,000 for the construction of two new traffic bridges was carried by a large majority.

We are advised that the tenders for the bridge at Turner's Baths at Hanlan's Point were ordered by the City Council, Toronto, Ont., to be returned, and the matter of improvement reconsidered.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

✣Bids will be received until June 29 by St. Francis Levee Board, B. G. Covington, Chief Engineer, 368 Randolph Bldg., Memphis, Tenn., for the construction of approximately 500 cu. yds. of Levee Enlargement work at Marion, Ark.

California.

⊙Hard Brothers, Maxwell, Cal., have been awarded the contract for 110,000 cu. yds. of earth work for the Sacramento Valley Irrigation Co., and will also probably take an additional 100,000 cu. yds. from the same company. The first mentioned contract amounts to about $25,000.

Illinois.

✣Bids will be received until 10 a. m., June 22, by Commissioners of Little Vermilion Special Drainage District in the counties of Champaign and Vermilion, at the office of Ray & Dobbins, Champaign, Ill., for the construction of the main open ditch of the district. The work to be done in said district is the cleaning out and deepening and widening of the main open ditch of said drainage district, a distance of 57,840 ft., with slope of banks of one to one. Beginning at the upper end or head of said ditch, the same shall be made 22 ft. wide on the bottom for a distance of 20,450 ft.; thence for a distance of 10,600 ft., 24 ft. wide at the bottom, and from thence a distance of 15,157 ft., to be 26 ft. wide at the bottom, and from thence to the outlet on lower end of said ditch, a distance of 11,633 ft., to be 28 ft. wide on the bottom, said work requiring the removal of 160,550 cu. yds. of material.

⊙Bids were opened June 3, at office of J. P. Gulick, attorney, Champaign, Ill., for work in the Two-Mile Slough Drainage District, the contract beting awarded to the National Drain Tile Co., Terre Haute, Ind., at $7,415. The work includes furnishing, hauling, laying, etc., 11,500 ft. 20-in. tile, and 5,100 ft. of 18-in. tile. Other bidders were as follows: Whole work —Indiana Drain Tile Co., Brooklyn, Ind.; Goodwin & Ryan, Springfield, Ill.; R. P. Bender, Champaign, Ill.; hauling, Frank McGinnis, Tolono, Ill.

⊙Bids were opened June 8 by the Commission of Okaw Drainage District, Champaign and Douglas Counties, for furnishing and laying all tile for sub-district No. 7, the contract being let to the National Drain Tile Co., Terre Haute, Ind., at $5,092. The work includes 6,460 ft. 22-in. tile, 800 ft. 20-in tile, 800 ft. 18-in. tile, 2,000 ft. 14-in. tile, and 1,600 ft. 12-in. tile.

⊙Bids were opened June 12 by the Commissioners of Bailey Branch Drainage District, G. C. Fairclo, engineer, Champaign, Il., for the construction of drainage work in St. Joseph and Ogden townships. The contract was awarded to the National Drain Tile Co., Terre Haute, Ind., at $6,199. The work includes 1,500 cu. yds. excavation, 6,500 ft. 27-in. tile, 1,050 ft. 18-in. tile, and 2,016 ft. 16-in. tile. The other bidders on the work were as follows: Baldwin & Burns, excavation, 29c cu. yd.; Kelly Coal & Gravel Co., concrete tile, tile complete, f. o. b. nearest station, $4,000; tile complete f. o. b. Danville, Ill., $3,425; [illegible] Winget, St. Joseph, Ill., complete work, using concrete tile, with exception of open ditch, $5,930; Indiana Drain Tile Co., complete work, $6,948; W. D. Hittle & Co., complete work, $7,776.

Bids were opened June 8, by Maj. C. Keller, U. S. Engineer, for construction and repair [illegible] Mississippi River. The bids recommended for acceptance were as follows: Reads Landing to Alma, $38,000 available 1 to 1½ ratio of rock to brush, Albert Kirchner, Fountain City, Wis., at $1,084 per cu yd.; Genoa to Lynxville, $38,000 available, 1 to 1½ ratio of rock to brush, Albert V. Fetter, Quincy, Ill., at $1.08 per cu. yd.; McGregor to Dubuque, $76,000 available, 1 to 1½ ratio of rock to brush, Albert Kirchner, at $1.044 per cu. yd.; Rock Island to Muscatine, $76,000 available, 1 to 1½ ratio of rock to brush, Builders Sand & Gravel Co., Davenport, Ia., at $1.036 per cu. yd.; Sections 16-33 Flint Creek, Iowa River Levee, $10,925 available, 1 to 1 ratio of rock to brush, Albert V. Fetter, $1.17 per cu. yd.; Keokuk to Hannibal, $71,250 available, 1 to 1½ ratio rock to brush, Albert V. Fetter, $1.05 per cu. yd.; Hamburg to Au Gris, $95,000 available, 1 to 1½ ratio of rock to brush, Rust, Swift & Co., St. Louis, Mo., 98 cts per cu. yd.

The Board of Trustees of the East Side Levee & Sanitary District, East St. Louis, Ill., has approved the plans of the Engineering Department for the construction of Sections 2 and 3 of the Front Levee. These two sections will be about 10½ miles long, and will contain 1,600,000 cu. yds. of earth. T. N. Jacob, Room 201 Sexton Bldg., East St. Louis, Ill., is chief engineer.

Indiana.

✣Bids will be received until June 24 by Marion Curtis, Ditch Commissioner, Court House, Valparaiso, Ind., for construction of the John Koselki Drain, comprising: 17.7 miles dredge work, 10, 20 and 30 ft. bottom, including 466,199 cu. yds.; 1,338 ft. of 7 in., 2,000 ft. 10-in., 839 ft. of 12-in., 1,650 ft. 14-in., 1,705 ft. of 15-in., 4,346 ft. of 16-in., and 4,000 ft. of 18-in. drain tile. G. F. Stinchfield, Valparaiso, Ind., is County Surveyor.

✣Bids will be received until July 1 by C. L. Haslett, Valparaiso, Ind., for the construction of the O'Connor drain, including 1,068 ft. of 8-in., 952 ft. of 10-in., 5,138 ft. of 12-in., 1,200 ft. of 14-in., 3,313 ft. of 16-in., 3,500 ft. of 18-in., 4,350 ft. of 20-in. drain tile. A certified check of $200 must be filed with each bid. G. F. Stinchfield, Valparaiso, Ind., is County Surveyor.

Iowa.

✣Bids will be received until 10 a. m., June 29, by Board of Supervisors of Buena Vista County, Ia., Storm Lake, Ia., for the construction of drains in Drainage District No. 32. The work will include the following approximate quantities: Main Drain, Sec. 1—1,825 ft. open ditch, 3 ft. bot., 1.25 ft.; 1,400 ft. 24-in. tile 5.20 ft.; 1,000 ft. 22-in. tile 6.30 ft.; 4,000 ft. of 20-in. tile 6.40 ft.; 200 ft. 16-in. tile 7.20 ft.; 250 ft. 14-in. tile 6.00 ft.; 4,050 ft. 15-in. tile 5.30 ft.; 1,500 ft. 14-in. tile 6.20 ft.; 900 ft. 12-in. tile 5.40 ft.; 1,400 ft. 10-in. tile 5.30 ft.; 317 ft. 8-in. tile 4.10 ft.; 4 catch basins; 1 double bulkhead for 24 and 12-in tile; Sec. 2, Lateral No. 1—500 ft. 8-in. tile 5.50 ft.; 598 ft. 6-in. tile 5.20 ft. Sec. 3, Lateral No. 2—762 ft. 6-in. tile 5 ft.; 1 catch basin. Sec. 4, Lateral No. 3—2,500 ft. 15-in. tile 6.90 ft.; 1,730 ft. 10-in. tile 5.20 ft.; 1 catch basin. Sec. 5, Lateral No. 4—372 ft. 8-in. tile 4.20 ft. Sec. 6, Lateral No. 5—240 ft. 6-in. tile 4.30 ft. Sec. 7, Lateral No. 6—450 ft. 7-in. tile 4.10 ft. Sec. 8, Lateral No. 7—800 ft. 12-in. tile 4.20 ft.; 1,550 ft. 10-in. tile 4.80 ft.; 2,050 ft. 12-in. tile 5.80 ft.; 1 catch basin. Sec. 9, Lateral No. 8—700 ft. 8-in. tile 4.20 ft.

✣Bids will be received until June 27 by Board of Dickinson County Supervisors, Spirit Lake, Ia., for the construction of open and tile drain, as follows: 2,200 ft. of open ditch, av. depth 8 ft., 6-ft. bottom, and 37,190 ft. of 6 to 26-in. tile drain. John S. Blow is County Auditor.

✣Bids will be received until 3 p. m., July 3, by Board of Taylor County Supervisors, Bedford, Ia., for the construction of a new channel for the West 102 River Drainage District No. 1. The new ditch will be 26,052½ ft. long and will include 248,421 cu. yds. of excavation consisting of loam, silt and clay. W. L. Holbrook is Engineer. C. A. Hall is County Auditor.

⊙Bids were opened June 14 at Estherville, Ia., for work in Drainage Districts Nos. 48, 62 and 59. The Armstrong Cement Works, Armstrong, Ia., was awarded the contract for District 62, at $6,067, and the contract for District 48 at $11,370; Eikwold & Peterson, Emmetsburg, Ia., was awarded the contract for District 59, at $3,456.

Louisiana.

✣Bids will be received until 3 p. m., July 15, by Board of Commissioners, Sixth Ward, and Crowley Drainage District, Crowley, La., for the construction of 40 miles of open ditches ranging from 2 to 6 miles in length, 16 to 40 ft. wide and 2 to 5 ft. deep, including approximately 600,000 cu. yds. W. S. White, Engineer, and L. A. Williams is Secretary of the Board. Official advertisement will be found elsewhere in this issue.

The Bayou Tigre Drainage District, Abbeville, La., has voted to ratify the action of the Board of Commissioners in issuing $30,000 bonds, and also authorized the levy of a special tax of 5 mills for 40 years.

Minnesota.

✣Bids will be received until 3 p. m., July 6, by F. C. Bertilrud, Roseau County, Auditor, Badger, Minn., for digging and constructing Ditch No. 9. The main ditch will be 13½ miles long, averaging a depth of 4.8 ft. It will include 184,121 cu. yds. material. Lateral No 1—Length, 3¼ miles; number of cu. yds., 32,522.4; bottom width, 5.0; average depth, 5.0; maximum depth, 7.8; berm, 5.0. Branch No. 2 Length, 3 miles; number of cu. yds., 28,992.0; average cut, 4.9; maximum cut, 7.6; [illegible] Length, 3 miles; number of cu. yds., 22,734.4; average depth, 4.1; maximum depth, 6.7; bottom width, 5.0; berm, 5.0. Lateral No. 3—Length, 3½ miles; bottom width, 5.0; average depth, 4.2; maximum depth, 5.9; berm, 5.0; [illegible] Length, 5½ miles; bottom width, 5.0; average depth, 4.7; maximum depth, 8.5; number of cu. yds., 46,006.3; berm, 5.0. Lateral No. 5—

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] width, 5.0; average depth, 4.7; maximum depth, 5.9; berm, 5.0; [illegible], 37,956.0. Lateral No. [illegible] Length, 7½ miles; bottom width, 5.0; average depth, 4.8; maximum depth, 8.4; berm, 5.0; [illegible] Lateral No. [illegible] Length, 3 miles; bottom width, 5.0; average depth, 4.0; maximum depth, 7.7; berm, 5.0; [illegible] Branch No. 1— Length, 6 miles; bottom width, 5.0; average depth, 4.4; maximum depth, 8.8; berm, 5.0; number of cu. yds., 50,980.5. Branch No. 3— Length, 6¼ miles; bottom width, 5.0; average depth, 4.4; maximum depth, 6.7; berm, 5.0; number of cu. yds., 51,107.5. Top soil, muck, peat and sand; subsoil, clay. There is timber on most of the laterals and some on upper end of main ditch: Tamarack, spruce, cedar and poplar; good cord wood; some ties, posts and poles. Warroad, on the Canadian Northern and Great Northern Railroads, is about 20 miles from the upper end of ditch. Salol, on the G. N. R. R., is one mile from outlet of ditch. This is strictly floating dredge work. The contractor will find plenty of water at all times. Total number of cu. yds. in whole job, 575,572.00; total number of culverts to be used, 159; sizes, 18 and 48-in. diameter. There will be three wooden bridges used. All dumps on section lines are to be leveled for road purposes. Total estimated cost of construction, $70,372.00.

✣Bids will be received until 2 p. m., June 24, by D. P. Carney, County Auditor, Benson, Minn., for the construction of Ditch No. 10.

✣Bids will be received until 1 p. m., June 30, by H. P. Edwards, County Auditor, Fairmont, Minn., for the construction of County Ditch No. 24, including approximately 54,725 ft. of 6 to 24-in. tile at an estimated cost of $22,999.

✣Bids will be received until 2 p. m., June 30, by H. P. Edwards, County Auditor, Fairmont, Minn., for the construction of County Ditch No. 25, including approximately 29,625 ft. of 6 to 22-in. tile at an estimated cost of $10,146.

✣Bids will be received by A. P. Erickson, County Auditor, Minneapolis, Minn., for the construction of Ditch No. 21.

✣Bids will be received and contract let during July at St. Paul, Minn., for the construction of a state ditch in Northern Minnesota, including 1,800,000 cu. yds. of earth. The excavation will be 95 miles long and the work will include the construction of 35 miles of roadway. George A. Ralph is State Drainage Engineer.

Montana.

⊙E. Lindstrom, Billings, Mont., has been awarded the contract for constructing the Holling Drain, the contract price being $22,500. Bids were opened June 1.

Nebraska.

✣Bids will be received until noon, July 11, by Board of Dodge County Supervisors, Jorgen Larsen, Chairman, Fremont, Neb., for repairing, cleaning and widening and deepening the Fremont cutoff ditch.

The Commissioners of Buffalo County, Kearney, Neb., have decided to attempt to narrow the Platte River at the following points: At Shelton bridge, 155 ft; at Gibbon bridge, 446 ft.; at Elmcreek bridge, 1,550 ft.

North Carolina.

⊙The Central Dredging Co., Schuylerville, N. Y., and Cleveland, O., has been awarded the contract for the extensive drainage system for the Mattamusket Drainage District in Hyde County, N. C. Bids for this work were opened May 4. The work includes the excavation of 83 miles of drainage canals requiring the removal of 2,700,000 cu. yds. of material.

Ohio.

✣Bids will be received until noon, June 23, by Director of Public Safety, at the office of the Secretary, C. A. Marvin, Cleveland, O., for a traction ditcher, steam or gasoline power, delivered f. o. b. Colony Farm, Warrensville, O.

Oklahoma.

The Commissioners of Grady County, Chickasha, Okla., have issued $20,000 of bonds for the reclamation of a tract of agricultural lands near Minco.

Washington.

✣Bids will be received until 4 p. m., July 1, by H. J. Marshall, County Treasurer of Klickitat County, Goldendale, Wash., for the construction of ditches for Drainage District No. 1, Klickitat County, Wash. The work will include approximately 200,000 cu. yds. of material. Newell, Gosset & Walsh, 911 Spaulding Bldg., Portland, Ore., are Engineers.

City of North Yakima, Wash., will vote on July 1 on issuing $50,000 of bonds for a drain to serve the west side of the city. H. J. Doolittle is City Engineer.

WATER-WORKS

Alabama.

The citizens of Headland, Ala., recently voted the issuance of bonds to the amount of $7,500 for the purpose of extending and improving the water and electric light systems.

An election will be held in Jackson, Ala., on July 10 for the purpose of determining whether or not the town shall issue bonds for the purpose of putting in water works. The contemplated work will include a standpipe, mains and fire plugs. The Bigbee Ice & Development Co. will furnish the supply of water and pumping power.

California.

Plans and specifications have been drawn up by the City Engineer of Porterville, Cal., for the extension of the mains of the water system. It is estimated that the work of completing the system will cost in the neighborhood of $50,000.

The citizens of Lindsay, Cal., some time during the last of this month will be asked to vote on the proposition of issuing bonds to the amount of $55,000 for the purchase of the present privately owned plant or the construction of a new one.

The citizens of Oakdale, Cal., on June 3, voted the issuance of bonds to the amount of $50,000 for the construction of a municipal water system.

The Board of Supervisors, Oakland, Cal., have been petitioned by the residents and taxpayers of the Castro valley road district for the construction of a water plant for the purpose of sprinkling county road No. 678, for a distance of two miles northwesterly to a point opposite the head of the south arm of Lake Chabot.

Offers of a water supply from the high Sierra Mts., as yet undeveloped, nearer than the Hetch-Hetchy-Lake Eleanor project, have been made to the city of Oakland as a substitute for the taking over of the People's Water Co. plant by condemnation proceedings. This offer comes from the Sierra-Blue Lakes Water & Power Co., Eugene J. Sullivan of San Francisco, President. A supply of 60,000,000 gals. per day is assured for an expenditure of $20,000,000. The plan includes a watershed in Calaveras, Alpine and Amador counties of 534 sq. miles, a storage reservoir of fifty billion gals. capacity,' and conditions available for an electric power plant which will produce 50,000 h. p.

Colorado.

⊙Foster & Doll, of Denver, Colo., have been awarded the contract by the city of Greeley, Colo., for doing the concrete and iron work for filtration basin No. 3 at the city waterworks. The contract price is $7,565.

Connecticut.

P. M. Blake, Consulting Engineer for the city of New Britain, Conn., is preparing plans for an estimate of cost of constructing a pipe line from Burlington Brook to the city. F. H. Oldershaw is City Engineer.

The Bristol Water Co., Bristol, Conn., has increased its capital stock from $200,000 to $300,000 for improvements to its storage facilities and water sheds.

Georgia.

The city of Atlanta, Ga., has sold bonds to the amount of $840,000 for water works, school and sewer.

The Mayor and Council of Cuthbert, Ga., have authorized the sale of the $20,000 of water and light improvement bonds on June 21. The proceeds will be used to sink one or more artesian wells, moving the water and light plants into the city, and to extend, improve and perfect the light and water system.

Illinois.

✣Bids will be received until 11 a. m., June 28th, by L. E. McGann, Commissioner of Public Works, Chicago, for power piping installation for the Roseland Pumping station, 104th St. and Stewart Ave. The work consists of furnishing, delivering and erecting two vertical, duplex, donble-acting, bronze-fitted, outside packed, direct-acting feed water pumps, each having a capacity of 80 gals. per minute, against a maximum boiler pressure of 190 lbs. per sq. in. gauge, two Venturo hot water meters for 2 in. pipes, capable of measuring 55 gals. of water per minute at a temperature of 210° F. The meters shall measure correctly the quantity of water, within 2 per cent; and piping, valves, gaskets, etc., necessary to complete the piping and connections for four 300 h. p. water tube boilers. Cash or certified check for $500 must accompany proposal.

✣Bids will be received until June 26th, by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering lumber to the bureau of sewers for period ending Dec. 31st, 1911. Cash or certified check for $200 must accompany proposal.

⊙Following are the contracts awarded by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Secy., for furnishing and laying water supply pipes in various streets: Berenice Ave., Simon Ryan, 2927 W. Congress St.; Belden Ave., Simon Ryan; Belle Plaine Ave., Malachy Murphy, 5315 Wabash Ave., S. Carpenter St., Ed. Connors; Exchange Ave., M. Murphy; N. 47th Ct., Ed. Connors; Humboldt Ave., Jno. Tirtilli, 518 W. Taylor St.; S. Kedzie Ave., M. Murphy; W. Madison St., Simon Ryan; S. Kedzie Ave., Simon Ryan; W. Madison St., Ed. Connor; Melrose St., Walther & Suhn, 1301 Addison St.; W. 108th St., Malachy Murphy; N. 48th Ave. and Schubert Ave., Ed. Connor.

⊙The Board of Local Improvements of Joliet, Ill., has awarded William Moran & Co. of that city the contract for the laying of the Jackson St. water main for $814. Bids were opened June 12. Wm. S. Welch is clerk of the board.

Plans have been prepared by Claud James at Mattoon, Ill., for the construction of a new water works system for the city of Arthur, Ill., the estimated cost of which will be between $15,000 and $16,000. The work will include wells, pumps, hose, water tower, water mains, hose carts, etc. The source of supply will be secure from wells. Bonds will be voted on June 29 for this work. J. F. Martin of Arthur will have charge of the work.

Following is the low bid received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and delivering 200 tons of pig lead to the various pipe yards: Illinois Smelting and Refining Co., 410 N.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Peoria St., 0451 [illegible] per lb., by rail to all yards. Bids were opened June 14th.

The residents of North 14th and 15th Sts., Murphysboro, Ill., have filed a petition with the City Clerk asking that the water mains be extended north to Gartside Ave.

The City Council of Princeton, Ill., has appropriated $5,000 for the sinking of a new deep well for the city's use.

Following is the low bid received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing and placing the necessary covering for pipes in the 68th St. pumping station, 68th St. and Oglesby Ave.: Keasby & Mattison Co., 208 Lake St., $2,300. Bids were opened June 13th.

Indiana.

A. T. Maltby, Consulting Engineer, Great Northern Bldg., Chicago, Ill., has been retained by city of Oglesby, Ind., to prepare plans for the construction of a water works system.

Iowa.

⊙The City Council of Sioux City, Ia., has awarded the contracts for the construction of the Leeds' water works. The pumping station will be erected by N. Oien for $2,169, and the cement piers for the station will be built by the Iowa Cement Brick Co., for $455.

⊙The City Council of Leon, Ia., has let the contract for the installing and completing of the water works system in Leon to the Des Moines Bridge & Iron Works of Des Moines, Ia., for $25,033. The system will include tank, tower, hydrants, valves, deep well pump, pump head, pipe and fittings.

⊙Amil Forsland of Galva, Ia., has been awarded the contract by that city for laying, filling and digging of 1,100 ft. of water main, 5½ ft. deep, all connections, two hydrants, etc., for $106. Bids were opened June 12.

The citizens of Des Moines, Ia., on June 19 voted on the proposition of purchasing the water works of the city.

Kansas.

✣Bids will be received until June 22, by Capt. A. Lippincott, Quartermaster, Fort Riley, Kan., for furnishing 108½-in. compression stops; 500 ft. ½-in. galvanized pipe; 50 ½-in. G. I. unions; 50 1-in. G. I. unions.

Louisiana.

The residents of Franklinton, La., have consumated a deal with the Police Jury, Franklinton, for the use of the artesian well water flowing from the Courthouse square. A tank of 20,000-gals. capacity will be erected to a height of 50 ft., a pumping station will be built and mains laid at the expense of the citizens. J. S. Brock, Jr., of Franklinton is interested.

Maryland.

Plans to increase the water supply of Frederick, Md., to cost $10,000 have been decided upon by the Mayor and Aldermen. A new storage reservoir in the mountains with a capacity of 40,000,000 gals., to cost $50,000 is being considered. The improvements decided upon include a new pipe line from the mountains and [illegible]

Massachusetts.

⊙The Aberthaw Construction Co., of Boston, Mass., has been awarded the contract by the city of Great Works, Me., for the construction of eight reinforced concrete flumes. Henry S. Ferguson, 200 Fifth Ave., New York City, is Engineer.

⊙Charles M. Callahan, of Boston, Mass., has been awarded the contract by the city of Ayer, Mass., for the construction of about two miles of 6 and 8-in. pipe.

George F. Ashton, City Engineer, Salem, Mass., has prepared preliminary plans for the installation of a high-pressure salt water fire [illegible]

Michigan.

The citizens of Highland Park, Mich., have voted the issuance of bonds to the amount of $28,000 for fire station and equipment, and bonds to the amount of $15,000 for water extensions.

The Ann Arbor Water Co., has offered its holdings to the city of Ann Arbor, Mich., for a consideration of $525,000. A special committee of the Council has been appointed to consider the matter.

Minnesota.

✣Bids will be received by [illegible] City Clerk, Fairmont, Minn., for the construction of 17 blocks of water main and 16 blocks of sewers. Plans and specifications are on file with the city clerk. E. J. Edwards is Mayor.

✣Bids will be received until 2 p. m., June 24, by Frank Tolman, Village Clerk, Paynesville, Minn., for the construction of an extension to the pipe line service in connection with the village water works. A certified check for $200, payable to the City Treasurer, must be filed with each bid.

The bids which were to be received by the city of Millmar, Minn., on June 12 for the construction of two purification plants and pumping stations were not opened owing to the bonds being illegal. It is probable that bids will again be asked in about 75 or 90 days. J. A. Rowat is City Engineer.

Mississippi.

✣Bids will be received until [illegible] p. m., July 3, by City Clerk, Vicksburg, Miss., for the construction of water main in Grove St., from Washington to First North Sts., and in Belmont St., from Washington to Cherry St. J. J. Hayes is Mayor.

Missouri.

The Fuller-Coult Co., Chemical Bldg., St Louis, Mo., has been retained by the city of Festus, Mo., to prepare plans for the installation of a water works.

Nebraska.

⊙The Katz-Craig Contracting Co., of Omaha, Neb., has been awarded the contract for the construction of the water works and electric light improvements at Basin, Wyo., for $58,583. The work includes cast iron pipe, $11,944; hydrants and valves, pumping and electrical machinery, $12,250. Bids were received on the construction work are as follows: Katz-Craig Contracting Co., $30,384; Des Moines Bridge & Iron Works, Des Moines, Ia., $30,890; W. D. Lovell, Minneapolis, Minn., $30,996; Lindstrom & Oren, Billings. Mont., $31,500; Bruer & Stanton, Basin, $32,772, and Tanner Bros., of Webster, S. Dak., $32,900. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Plans and specifications have been completed by Engineers Wheeler & Willis, Bridgeport, Neb., for the installation of a water works system at Bridgeport. Bonds for this improvement have been voted. The work will include an elevated tank, 100 ft. high to balcony, 50,000-gal. capacity, 160 ft. of 10-in. pipe, 380 ft. of 8-in. pipe, 3,020 ft. of 6-in. pipe, 6,120 ft. of 4-in. pipe, 8,700 lbs. of special castings, and 20 fire hydrants.

Civil Engineer C. F. Sturtevant, of Holdrege, Neb., has been called by the Town Board of Haigler, Neb., to make estimates and go over the plan laid down by them to furnish water for the village.

New Jersey.

✣Bids will be received until 7:30 p. m., June 22, by Crosswicks Water Co., Crosswicks, N. J., for the complete construction of water works, including piping, pumping station with equipment, standpipe or tower, collecting system and all machinery and accessories. W. W. Young, 46 Park St., Bordentown, N. J., is Engineer.

The Town Council of Irvington, N. J., has decided to put the matter to a vote for the people to decide whether the plant of the Clinton Water Co. shall be purchased or not. The plant has been offered to the city for $185,000, including proposed extensions to be made at an estimated cost of $7,500, and to furnish water to the municipality for $75 per million gals. to 1919.

The towns of Bloomingdale, Riverdale, Pompton and Pompton Lakes, N. J., contemplate purchasing the property of the Apshawa Land Co., which has a lake with a storage capacity of over 150,000,000 gals. of water, for the purpose of securing a water supply.

New Mexico.

Plans are being prepared by Consulting Engineer G. N. Houston, 409 Equitable Bldg., Denver, Colo., for the installation of the proposed water works system at Farmington, N. Mex. Bids will soon be asked.

New York.

✣Bids will be received until 5 p. m., June 26, by Board of Water Commissioners, W. W. Hawks, President, Lander St., Newburgh, N. Y., for laying 30-in. water main about 1,000 ft. long with air valve chambers.

⊙The York Mfg. Co., York, has been awarded the contract by the State Commission in Lunacy, 53 Lancaster St., Albany, N. Y., for a water filtration plant at nurse's home at Binghamton, N. Y. The contract price is $3,150. Bids were opened May 31. T. E. McGarr is Secretary of the Commission.

⊙The Board of Water Supply of New York City has awarded the contracts for the construction of two sections of the high pressure water tunnel, which is to form part of the Catskill aqueduct system. The Pittsburg Contracting Co., of Pittsburg, Pa., received the contract for Contract 65 for $5,590,295, and Grant Smith & Co. & Locher, of Rome, N. Y., received the contract for Contract No. 66 for $4,512,605. The itemized bids for these contracts were given in our May 31 issue.

⊙The Holly Manufacturing Co., of Buffalo, N. Y., has been awarded the contract by the city of Buffalo, for the equipment of the new pumping station with five pumps at a cost of $700,000. Each of the new pumps will pump 30,000,000 gals. of water every 24 hours. They will be triple expansion, vertical type. F. G. Ward is Commissioner of Public Works.

⊙It is reported that Lupfer & Remick of Buffalo, N. Y., have been awarded the contract by the Board of Public Works of Geneva, N. Y., for the construction of the new reservoir in connection with the water system improvement, for $22,900, plan B. Other bids received were: Lupfer & Remick, plan A, $26,850; Coughlin, Lowman & Bradley, Elmira, N. Y., $24,632; Simpson Bros., Corporation, Boston, Mass., $28,960; G. W. Thompson, Utica, N. Y., $30,250; Hennebique Construction Co., New York, $34,900; Gahren, Dodge & Maltby, New York, $38,865.

The New York State Water Commission has given the village of Cornwall permission to construct an additional water storage reservoir.

North Carolina.

✣Bids will be received until 1:30 p. m., July 10, by City of High Point, N. C., Fred N. Tate, Mayor, for grading, macadamizing and curbing certain street amounting to approximately $40,000 and for the extension and building of water and sewer lines amounting to approximately $50,000. Plans and specifications are on file at the office of the Mayor.

North Dakota.

✣All bids were rejected June 2 by city of Mandan, N. Dak., for the construction of the proposed water works system mentioned in our May 17th issue and bids for the work have been readvertised for June 29. The estimated cost of the work is $80,000. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Ohio.

⊙The Board of Control of Alliance, O., has awarded the contract for furnishing an air compressor to the W. H. Allman Co., of Canton, O., for $1,038. It will have a speed of 125 revolutions per minute, of 75 h. p. and will weigh 11,800 lbs. The compressor will be used for pumping the city wells.

An election was held in Bedford, O., on June 20 for the purpose of voting on the issuance of bonds in the sum of $3,000 for the construction of water mains, laying water pipes and constructing sewers in the village. W. B. Yost is Mayor.

Oklahoma.

Plans have been made by J. M. Buckley of Pawhuska, Okla., for extensions to the water works system of that city, estimated to cost $50,000. The work will include dam, reservoirs, 6,500 ft. of 10-in. mains, settling basins, 28,000 ft. of 4-in. main and 1,000 ft. of 6-in.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] The water supply will be [illegible] by [illegible] creek.

Oregon.

The town of Merrill, Ore., will soon install a water plant. Mayor E. E. Fitch has employed two Portland engineers to figure on the plant.

Definite plans have been made by the city of Redmond, Ore., for the construction of the water pipe line from Cline [illegible] to Redmond. The work will cost [illegible]. With the new water system it is proposed to pump water from the Deschutes river at Cline Falls through a 6-in. main to a tank in Mountain View addition, elevated 100 ft. high, with a capacity of 100,000 gals. The Oregon Trunk railroad will build a 50,000 gal. tank and take water from the city tank as soon as the plant is in operation.

Pennsylvania.

⊙The contract for the water filtration plant for the Borough of Masontown, Pa., has been awarded to the Pitt Construction Co., of Pittsburg, Pa. Chester & Fleming, Union Bank Bldg., Pittsburg, are Engineers for the work.

The city of Shrewsbury, Pa., recently issued bonds to the amount of $12,000 for the purpose of making improvements to its water works.

Texas.

⊙The City Commissioners of Dallas, Tex., have awarded the contract for installing an air compressor at Record Crossing for $3,800 to Smith & Whiting.

⊙The City Commissioners of Fort Worth, [illegible] the contract for the construction of its water filtering plant to the Pittsburg Filter Manufacturing Co., of Pittsburg, Pa., for $69,983. The work will include [illegible] of 5,000,000 gals. daily capacity, clear well and coagulating basins. Bids were opened June 8. J. D. Trammell is Chairman of the Board of Engineers.

⊙The contract for the erection of two boilers at the White Rock pumping station, Dallas, Tex., has been awarded by the City Commissioners to A. G. Wright, for $2,045.

The city of Gainesville, Tex., on June 8, purchased the plant of the Gainesville Waterworks Co., for a consideration of $92,000. The city will expend about $60,000 in extending the mains to all parts of the city, putting in new pump and large standpipe.

The Santa Fe System has planned to replace its present water system at Galveston, Tex., by a standard 24x43 ft. steel tank and two standard 10-in. auto cranes at a total estimated cost of $4,700.

Bonds to the amount of $14,000 were recently issued by the town of Rogers, Tex., for the purpose of constructing a pipe line from Lake Leahrick to Little River to increase the water supply.

The city of Moulton, Tex., contemplates the installation of a water works system. It will be installed by public subscription.

Washington.

✣Bids will be received until 1 p. m., June 26, by State Board of Control, Olympia, Wash., for the construction of a gravity water supply system at Northern Hospital for Insane, Sedro-Woolley, Washington.

⊙McInnis & Harrington of Coupeville, Wash., have been awarded the contract by Capt. E. C. Long, Constructing Quartermaster, Seattle, Wash., for the construction of a 2,000,000-gal. reinforced concrete reservoir with water mains, etc., at Fort Worden, Wash., for $36,300. Bids were opened June 3.

Wisconsin.

✣Bids will be received until 7:30 p. m., June 28, by E. W. Van Norman, Village Clerk, Monticello, Wis., for the erection of a reinforced concrete standpipe, 15 ft. in diameter by 50 ft. high. Further information can be obtained by W. C. Kirchoffer, Engineer, Madison, Wis.

⊙The Fred M. Prescott Steam Pump Co., Milwaukee, Wis., has been awarded the contract by the city of Merrill, Wis., for furnishing a triple expansion duplex pumping engine for the water works station of 2,000,000 gals. capacity.

Canada.

✣Bids will be received until noon, June 29, by G. R. Geary, Chairman Board of Control, Toronto, Ont., for the main drainage pumping station on Eastern Ave., Toronto. Plans and specifications are on file at the office of the City Architect.

✣Bids will be received until noon, July 3, by F. S. Spence, Chairman of the Board of Control, Toronto, Ont., for the laying of between 3,000 and 3,500 ft. of riveted steel pipe, 6 ft. in diameter in Lake Ontario for the Water Works department.

SEWERAGE AND GARBAGE DISPOSAL

Arizona.

An ordinance has been introduced in the City Council of Tucson, Ariz., providing for the construction of a new sewer for North Meyer St., from Alameda to West Sixth St.

California.

The citizensof Oakdale, Cal., on June 3 voted the issuance of bonds to the amount of $32,000 for the installation of a sewer system.

A communication has been received from the Centerville Chamber of Commerce by the Oakland Chamber of Comerce that a regular campaign is to be started soon to agitate for the Niles-Centerville-Newark sewer project.

A proposition will be submitted to the voters of Lindsay, Cal., some time during the last of this month which will provide for the issuance of bonds to the amount of $75,000 for the construction of sewers, including a sewer farm and septic system of disposal.

Colorado.

✣Bids will be received until 11 a. m., June 23, by Board of Public Works, Denver, Colo., for the construction of sewers, manholes, inlets and appurtenances in Part A. of Subdistrict No. 3, West and South Side Sanitary Sewer District. Henry Read is President of the Board.

The city of Colorado Springs, Colo., proposes the construction of a pipe line from the mouth of the St. John tunnel to the intake at Lake Moraine at an estimated cost of $35,000. A. J. Lawton is Commissioner of Public Works.

Connecticut.

✣Bids will be received until June 25 by city of South Norwalk, Conn., for the construction of 925 lin. ft. of 18-in. and 750 ft. of 12-in. vitrified sewer with appurtenances. Average cut 19 ft. S. W. Hoyt, Jr., is city engineer.

District of Columbia.

✣Bids will be received until 2 p. m., June 22, by Commissioners of the District of Columbia, Washington, D. C., for furnishing and delivering 700,000 red sewer bricks during the fiscal year beginning July 1, 1911.

Illinois.

⊙William [illegible] been awarded the contract by the Board of Local Improvements of that city for the construction of a sewer in Seeser St. for $984. Bids were opened June 12. Wm. S. Welch is clerk of the board.

⊙The Board of Local Improvements of Marshall, Ill., has awarded the contract for constructing the Lynn St. sewer to James E. Dailey of Lewistown, Ill., for $1.47 per lin. ft.

The City Council of Edwardsville, Ill., has passed an ordinance providing for the year's appropriation for the different departments, as follows: Streets and alleys, $9,000; granitoid sidewalks, $2,000; salaries and fees, $4,000; fire department and water, $8,000; lights and lighting, $6,000; library, park and buildings, $5,000; permanent improvements, $6,000; special assessment installments, $8,000; contingent and emergency, $1,000; printing and stationery, $2,000; police, $5,000; sewer and drains, $2,000; redemption of city bonds, $3,000, and Lusk Cemetery improvement, $200.

Indiana.

City Engineer H. W. Klausmann of Indianapolis, Ind., has recommended to the Board of Public Works that sewers be built in Lee St., from Morris St. to Jones St., and in Jones St., from Lee St. to Belmont Ave.

⊙The contract for the extension of the Pogue Run trunk sewer has been awarded by the City Council of Brazil, Ind., to Campbell & Crabb for $4,399. The contract provides for the extension of the sewer from its present terminus to the food products and piano factories, a distance of over 4,000 ft.

Iowa.

✣Bids will be received until 7 p. m., July 13, by city of Valley Junction, Ia., for the construction of 5½ miles of 8 to 20 in. pipe sewers and a sewer disposal plant. Two certified checks for $500 each must be filed with bids. Plans and specifications can be obtained ($5) of the Iowa Engineering Co., Chase Block, Clinton, Ia.

⊙Green & Sons Co. have been awarded the contract by the City Council of Clinton, Ia., for the construction of main and lateral sewers, including 300 ft. of 48-in., 2-ring brick sewer, 500 ft. of 48-in. 1½-ring brick sewer, 1,343 ft. of 30-in. 1½-ring brick sewer, 765 ft. of 36-in. pipe sewer, 1,988 ft. of 30-in. pipe sewer, 2,452 ft. of 24-in. pipe sewer, 1,544 ft. of 20-in. pipe sewer, 3,560 ft. of 18-in. pipe sewer, 2,993 ft. of 15-in. pipe sewer, 11,515 ft. of 12-in. pipe sewer, 7,165 ft. of 10-in. pipe sewer, 5,513 ft. of 10-in. catch basin pipe, 14,860 cu. yds. of rock excavation, 76 manholes, 62 catch basins and 122 inlet basins. The contract price is $124,375. R. C. Hart is city engineer. Bids were opened June 1.

⊙J. F. Brown, 1597 Jackson St., Dubuque, Ia., has been awarded the contract by that city for the construction of a sanitary sewer in Belmont and W. 14th Sts. for $2,943. Tile pipe will be used. Bids were opened June 9 by Otto P. Geiger, city recorder.

⊙The contract for constructing the Perry Creek reserve conduit in Sioux City, Ia., has been awarded to Lewis & Leader of that city for $13,646.

The City Council of Belle Plaine, Ia., has called an election for July 10 for the purpose of voting on the issuance of bonds to the amount of $15,000 for sewer and water works. An outlet will be put in for the sanitary sewer system, and a septic tank will probably be constructed.

Kentucky.

The following bids were received by the City Council of Dayton, Ky., for the construction of a sewer on Sixth Ave., between Kenton and Benham Sts.: John B. McLane & Co., $1.10 per lin. ft. for 12-in. tile, $35.50 for manholes, $41 for catch basins and $0.98 for Y branches; Walter Bros., $1.25 for tile, $40 for manholes and catchbasins and $1 for Y branches.

Louisiana.

The plans for the completion of the drainage and sewerage system of New Orleans, La., have been completed. Immediately upon the adoption of the plans the superintendent will be instructed to advertise for bids for the work.

Maryland.

⊙John R. Jeffreys, Elberon, N. Y., has been awarded the contract for the construction of eight miles of sewers in Easton, Md., for which bids were received April 15. Clyde

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Potts, 30 Church St., New York City, Engineer.

The Anne Arundel County Commissioners, Annapolis, Md., have been petitioned for the construction of a 30-in. sewer to carry off the storm water on the streets of Curtis Bay. The petitioners ask that the drain pipe to be laid Curtis Ave., beginning at Plum St., to run 12 squares to Birch St., thence three squares to the river.

Massachusetts.

The Sewer Commissioners of Milford, Mass., have voted to ask the selectmen to call a special town meeting to raise and appropriate $30,000 for the completion of the sewage system. The election will be held June 26. Henry J. Glendenning is Engineer.

Commissioner L. K. Rourke, Boston, Mass., has rejected all bids recently received for garbage disposal. The commissioner proposes that the city at once appropriate money to be expended in the erection and construction of five receiving stations, one on Freeport St., one on Albany St., one at Fort Hill, one on Western Ave., Brighton, and one on Ritchie St., Roxbury, each at a cost of about $20,000. The estimated cost of garbage disposal for the next 10 years is about $2,500,000.

Michigan.

⦿Carpenter & Anderson of Grand Rapids, Mich., have been awarded the contract by the Board of Public Works of Grand Rapids for the construction of the East Side trunk sewer for $356,723. The work was bid on in three sections, for which the following bids were received: First section—Specifications, $154,189—G. W. Bunker & Co., $138,623; Albert Prange, $153,815; and Carpenter & Anderson, $156,646. Second section—Specifications, $132,847—Carpenter & Anderson, $133,236; Albert Prange, $146,312; and G. W. Bunker & Co., $154,099 Third section—Specifications, $98,898—Albert Prange, $70,691; McDermott & Cooper, $73,287; and Carpenter & Anderson, $79,576. The successful bidders submitted the only bid for the work as a whole. Bids for this work were opened June 8. L. D. Cutcheon is city engineer.

⦿Peter Becker of Bessemer, Mich., has been awarded the contract by the Common Council of that city for the construction of a trunk line sewer for $13,193. Other bids were: John Brogan, $13,493; Thos. E. Woolley, $13,825; Mueholland & Sons, $15,401; Oxnam & Southerland, $13,292, and Fraser & Danforth, $14,800.

The City Council of Caro, Mich., has instructed City Attorney Randall to prepare a resolution for the calling of a special election to bond the city for the completion of the sewer on which work is now in progress. The election will probably be held June 27 and will call for either $15,000 or $20,000.

Mayor M. W. Brown of Reed City, Mich., has selected an engineer to survey the streets and alleys of the town for the purpose of establishing the cost and submitting plans for a sewerage [illegible]

Minnesota.

✣Bids will be received until 8 p. m., June 27, by Morris, Minn., for the construction of Sewer District No. 3, on First St., consisting of 1,905 ft. of 8-in. sewer, five manholes and one line of 4-in. drain tiles. District No. 6, on Fourth St., consisting of 1,327 ft. of 8-in. sewer, three manholes and one flush tank and one line of 4-in. drain tile. District No. 17, Sixth St., consisting of 1,408 ft., 4 manholes and one line of 4-in. drain tile. C. B. Burpee is City Clerk. Plans and specifications are one file and blank proposals may be obtained at the office of the City Clerk of Morris, Minn., and of Loweth & Wolff, consulting engineers, St. Paul, Minn.

The City Council of Albert Lea, Minn., has rejected all bids for the construction of lateral sewer No. 5. City Engineer William Barneck estimates the cost of the sewer at $19,375.

✣Bids will be received until 8 p. m., June 26, by Village Council, Springfield, Minn., A. Frederickson, recorder, for the construction of the following branch sewers, together with necessary manholes and specials, according to plans, specifications and profiles, which may be seen at the office of the recorder: About 370 ft. 8-in. sewer on O'Connell St. from Railroad St. to Van Dusen St.; about 1,200 ft. 8-in. sewer on Cass St. from North St. to Van Dusen St.; about 370 ft. 10-in. sewer on Cass St. from Van Dusen St. to Railroad St. All of said work must be completed on or before Sept. 1, 1911.

⦿The City Council of Albert, Lea, Minn., has awarded the contract for the construction of a sewer to Ilstrup & Olson of Minneapolis, Minn., for $14,000. William Barneck is City Engineer.

Bids will be received until 8 p. m., June 27, by E. L. Lewis, city clerk, Fairmont, Minn., for the construction of 16 blocks of sewers and 17 blocks of water main.

Owing to technical law points the contract for the construction of a sewer system in the city of Willmar, Minn., for which bids were asked until June 12, has not been awarded. It is probable that the work will be readvertised. H. Gunderson is city clerk

Mississippi.

✣Bids will be received until 8 p. m., July 3, by City Clerk, Vicksburg, Mass., for the construction of storm sewers on Grove St., from First North to Washington Sts., forlaying storm sewers on Belmont St., from Washington to Cherry Sts., and for laying storm sewers on Levee St., from China to Clay Sts. J. J. Hayes is Mayor.

Missouri.

Plans and specifications are being prepared by Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., for the construction of sanitary sewers and sewage purification works at Girard, Kan. Bids will probably be received about Aug. 1.

Montana.

The city of Red Lodge, Mont., is preparing to comply with the order of the State Board of Health, giving the municipality until October 1 to change its system with the present method of dumping it into Rock Creek. It is proposed to purchase a sewer farm.

Nebraska.

⦿E. S. Dimick of Laurel, Neb., has been awarded the contract by the City Council of Hutchinson, Minn., for the construction of 2,608 ft. of 12-in. sewer, including three straight manholes and one lamphole for $1,275. Bids were opened June 14.

New Jersey.

⦿The Atlantic Construction & Supply Co. of Atlantic City, N. J., has been awarded the contract by the Englewood Sewerage Co., Englewood, N. J., Oliver Drake Smith, Secy., for the complete construction of a sewage disposal works. Bids were opened June 3. Clyde Potts, 30 Church St., New York City, is engineer

The City Council of Summit, N. J., is considering the matter of constructing a joint sewer with Milburn. The estimated cost to Summit is $13,500.

It is reported that the city of Highstown, N. J., has engaged Waring, Chapman & Farquhar, Civil Engineers, 874 Broadway, New York City, to make surveys and furnish speci- [illegible]

The town of Kearny, N. J., has entered into a contract with the Passaic Valley Sewerage Commission, Newark, N. J., to sewer into the trunk sewer. The town's share of the expense of construction will be $270,000. It will be provided with three branches, East Newark-Kearny branch, Kearny-North Arlington branches, and Kearny-Harrison Newark branch. Louis M. Brock is Mayor

The Town Council of Hasbrouck Heights, N. J., has made an appropriation of $1,000 to [illegible] tin is Mayor.

Acquackanonk Township has joined the municipalities in the proposed construction of the Passaic Valley trunk sewer, New Jersey. The township's estimated cost of constructing the sewer is $120,500, or one per cent of the total estimated cost. George Schmidt is township chairman.

New York.

✣Bids will be received until 4 p. m., June 28, by Board of Contract and Supply, Binghamton, N. Y., for the construction of a sewer in Union, Grace and Berlin Sts. The work will include laying vitrified pipe sewer with necessary manholes, catchbasins, flushing tanks and lot connections to the curb line. S. W. Murray is Clerk.

The village of LeRoy, N. Y., contemplates the installation of a sewer system.

Mayor Irving of Binghamton, N. Y., has signed ordinances passed by the Common Council, providing for the construction of sewers on Berlin, Union, Grace and William Sts.

The Board of Sewer Commissioners of Ilion, N. Y., have accepted the plans for the new Morgan St. sewer, and the same have been submitted to the state health commissioners for approval, after which bids will be called for.

Plans and specifications for the construction of a sewage disposal plant in the city of Rome, N. Y., have been submitted to the State Board of Health for approval. Rudolph Hering, 170 Broadway, New York City, is Engineer.

Selley, Nordone & Sellery of Mt. Vernon are the probable contractors for the construction of the Kill Brook trunk sewer, together with bulkhead dock and screening chambers at Outfall, and also Water St., Barlow Lane and Mill St. trunk sewers, with the various laterals, for which bids were opened by the Board of Trustees of the village of Ossining, N. Y., on June 6. John M. Terwilliger is clerk of the village.

Ohio.

⦿Thos. Maloney, 1858 Forest Ave., Cincinnati, O., has been awarded the contract by the Department of Public Service, Cincinnati, for sewering Worth St., Humber to Eastern Ave., for $2,220. Bids were opened May 29.

⦿Patrick & P. J. Grady of Youngstown, O., have been awarded the contract by the Department of Public Service of that city, W. H. McMillin, clerk, for the sewering of Washington St., for $670. Bids were opened June 9.

⦿Patrick & P. J. Grady of Youngstown, O., have been awarded the contract by the Department of Public Service of that city, W. H. McMillin, clerk, for the construction of a sewer in Empire St., for $338. Bids were opened June 9.

⦿A sewer system is to be constructed in East Youngstown, O., from plans prepared by George Montgomery. The contract for the construction of that portion extending from McVey's run to the eastern village line has been awarded to John Grady for $37,197. The contract provides for the construction of 5-ft. reinforced cement sewer 4,500 ft. in length. An ordinance providing for the construction of the other wing, which will extend from the center of the business section to the western town line has been adopted.

⦿Charles Hukari of Ashtabula, O., has been awarded the contract by the city of Conneaut, O., for the construction of a storm sewer on Chestnut St. and Jackson St., for $13,175. The work will include 5,200 ft. of 24-in. sewer pipe to be laid from 6 to 18 ft. deep.

The Village Council of Hilliard, O., has aproved the plans, specifications and profiles prepared by Civil Engineer Elmer E. Legg for the construction of a sewer system. Leroy Dobyns is Mayor and H. S. Romick is Clerk.

Consulting Engineer W. J. Sherman, The Nasby, Toledo, O., has submitted his report to the City Council of Lorain, O., relative to the construction of the Broadway sewer. The report contains two plans, one for the installing of an overflow at 12th St., and the second for the construction of an entire new sewer The sewer will probably be 87-in. in diameter.

An election will be held in Pleasant Ridge, O., shortly for the purpose of voting on the issuance of bonds to the amount of $20,000 for the construction of a sewer and sewage disposal system.

The special committee of the City Council, Cleveland, O., has inspected Morgan Run. It

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible] the [illegible] Kingsbury Run [illegible] branches of the intercepting sewer system. Robert Hoffmann is City Engineer.

Oregon.

⦿A contract calling for over seven and one-half miles of sewer from La Grange, Ore., has been awarded by that city to George H. Sutherland of Walla Walla, Wash.

⦿The City Council of Lebanon, Ore., has awarded the contract for the construction of a modern sewer system to Bidwell & Hayden.

The City Council of Hillsboro, Ore., has passed ordinances directing that a sanitary sewer be laid in a district covering the business section and the residence portion of the south of the city with a septic tank near the south corporate limits. Also a storm sewer or drainage district covering much the same territory.

Pennsylvania.

⦿Chas. Dugan, 959 High St., Williamsport, Pa., has been awarded the contract by the city of Williamsport for the construction of storm sewer in West 4th St., for $4,938. Bids [illegible]

⦿Charles Dugan has been awarded the contract by the city of Williamsport, Pa., for the construction of the West Fourth St. storm sewer for $4,939.

North York Council, York, Pa., it is reported, is calling for bids for construction of 510 ft. of sewer on Eighth Ave. E. M. Bare is Chairman of the Highway Committee.

Dr. Samuel G. Dixon, State Health Commissioner, has approved the plans of the city of McKeesport, Pa., for sewers for the Eighth, Ninth and Eleventh Wards. The plans are for trunk line sewers, withoutlets below the city water works, and consist of separate drains for storm water and sewage purposes.

[illegible] Engineer, 30 Church St., New York city, has been retained to design sewerage and sewage disposal works for [illegible] East Stroudsburg, Pa.

Rhode Island.

✣Bids will be received until 4 p. m., June 27, by Board of Sewer Commissioners, City Hall, Woonsocket, R. I., for the construction of about 900 ft. of 8-in. sanitary sewer and appurtenances and 500 ft. of surface water drain. Frank H. Mills is city engineer.

South Dakota.

⦿Beecher & Murphy of Chamberlain, S. Dak., have been awarded the contract by the city of Plankinton, S. Dak., for the construc- [illegible] sewage disposal plant for $1,198. Bids were opened June 12.

Preliminary arrangements have been made for the installation of a sewerage system at a cost of $4,043, in the town of Leola, S. Dak.

Tennessee.

The City Council's special committee, Nashville, Tenn., has recommended for passage the bill appropriating $311,700 out of the trunk sewer bond fund for trunk sewers in various sections of the city and the construction of new ones. The proposed Fourth Ward sewer will cost $100,000.

The Commissioners of St. Elmo, Tenn., have made definite arrangements for issuing bonds for sewer construction. The engineer to be employed will be required to make preliminary surveys and prepare a recommendation as to the character of sewer systems best adapted to the conditions in St. Elmo.

Wisconsin.

✣Bids will be received until 8 p. m., June 29, by Jacob Jackson, village clerk, Independence, Wis., for the necessary labor and material for the construction of sewers. The work includes the laying of 10 lin. ft. of 30-in. steel pipe, 1,089 lin. ft. of 24-in. vitrified pipe, 834 lin. ft. of 20-in. vitrified pipe, 1,254 lin. ft. of 15-in. vitrified pipe, 1,200 lin. ft. of 12-in. vitrified pipe including the necessary "Y's," the construction of 17 manholes and 40 catch basins and probably making about 26 6-in. house connections.

✣Bids will be received until 4 p. m., June 30, by E. L. Williams, City Clerk, Appleton, Wis., for the construction of a sewer on Lawrence St., between Mason and Spruce Sts.

✣Bids will be received until 4 p. m., July 5, by E. L. Williams, City Clerk, Appleton, Wis., for the construction of a sewer in Clark St. according to plans and specifications at the office of the clerk.

The city of La Crosse, Wis., contemplates extensive sewer additions in the south end of the city. Bonds to the amount of $35,000 will be issued for this work.

The City Council of Marinette, Wis., has taken action to provide for the extension of the main brick sewer from the west line of the C. & N. W. Railway to the center of Minnesota St., on Currie St., at an estimated cost of $9,000. The sewer will be 36-in. in diameter.

Canada.

✣Bids will be received until 8 p. m., June 26, by D. J. C. Munro, Town Clerk, Thorold, Ont., for necessary labor and material for the construction of a sanitary sewer system comprising about 13,000 lin. ft. of pipe sewers. Chipman & Power, Mail Bldg., Toronto, Ont., are Engineers.

✣Bids will be received until noon, July 4, by G. R. Geary, chairman of the Board of Control, Toronto, Ont., for the construction of low level interceptor: Section No. 4, 3,244 lin. ft., 4 ft. 9 ins. circular brick in tunnel. Storm overflow sewers: Wilson, Section No. 1, 4,499 lin. ft., average nominal size 5 ft. by 5 ft. 6 ins., brick or concrete in tunnel; Wilton, Section No. 2, 3,562 lin. ft., average nominal size 4 ft. by 4 ft. 3 ins., brick or concrete in tunnel.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

Arkansas.

Plans and specifications have been completed by the Scofield Engineering Co., Consulting Engineers, Arcade Bldg., Philadelphia, Pa., for power house and equipment for Helena Gas & Electric Co., Helena, Ark. Bids are being asked for at the present time.

Connecticut.

✣Bids are asked until 3 p. m., July 7, by Capt. A. E. Waldron, U. S. Engineer, New London, Conn., for dredging Saybrook Bar, Connecticut River, Conn. The Connecticut River empties into Long Island Sound at a point about 30 miles to the eastward of New Haven and about 13½ miles to the westward of New London. The entrance to the river is protected by two stone jetties, the outer portions of which are parallel to each other and about 700 ft. apart. There is a lighthouse at the outer end of the west jetty and another one on the main land about 3,000 ft. northerly from the breakwater light. The location of the proposed channel is between the two jetties above described. This channel will be 300 ft. wide, 15 ft. deep at mean low water and about 3,300 ft. long, extending from the 15-ft. curve just outside of the outer end of the jetties to depth of 15 ft. in the main river channel at a point nearly opposite the inner light. It is estimated that it will require the removal of about 165,000 yds. of material, scow measurement, to complete this [illegible]

District of Columbia.

✣Bids will be received until 10:30 a. m., June 26, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 636-A, locomotive cranes, reinforced steel bars, lumber, valves, pipe, fittings and copper wire.

✣Bids will be received by the Secretary of Agriculture, Washington, D. C., until noon, July 18, for the erection of a two-story and cellar cement and terra cotta building for the Weather Bureau, U. S. Department of Agriculture, at Key West, Fla., in accordance with plans and specifications which may be obtained from Observer, Weather Bureau, Key West, Fla., and at the Office of the Chief of the Weather Bureau, Washington, D. C. Bids must be sealed and indorsed on envelope "Proposals for Weather Bureau Building, Key West, Fla." and addressed to the Chief of the Weather Bureau, Washington, D. C. The department reserves the right to reject any or all bids, and to waive defects, should it be deemed in its interest to do so. Willis L. Moore is Acting Secretary.

Florida.

✣Bids are asked until 1 p. m., July 6, by Lt.-Col. G. D. Fitch, U. S. Engineer, Montgomery, Ala., for dredging at mouth of Apalachicola River, Fla. The work consists in deepening the present channed at the mouth of Apalachicola River, Fla., to a depth of 12 ft. at mean low water, and in furnishing all necessary plant, labor and supplies for the work; the length of the channel to be deepened is about 6,750 ft.; the width to be dredged is 100 ft.; the average depth of material to be removed is about 3.6 ft.; the amount to be excavated is, approximately, 90,000 cu. yds. The material to be removed is believed to be mud, [illegible] oyster shell.

Bids were opened June 3 by the U. S. Engineers, Jacksonville, Fla., for dredging in Indian River, Florida. The Hillsboro Dredging Co., Tampa, Fla., at 18 cts. per cu. yd., was the only bidder. The total yardage is 82,000.

Georgia.

✣Bids will be received until noon, July 12, by Col. D. C. Kingman, U. S. Engineer, Savannah, Ga., for furnishing and placing stone for raising the retaining wall in Brunswick Harbor, Ga.

Hawaii.

✣Bids will be received until 11 a. m., July 8, by R. C. Hollyday, Chief of Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the boilers and auxiliary power plant equipment at the U. S. Naval Station, Pearl Harbor, Hawaii.

Illinois.

Following are the low bids received by L. E. McGann, Commissioner of Public Works, Chicago, Ill., for furnishing the necessary tools, material, etc., to construct a dock 94 ft. long on both sides of the Chicago River at the foot of Weed St.: Fitz Simons & Connell Co., 131 La Salle St., $17.80 per lin. ft.; Great Lakes Dock & Dredge Co., 138 Washington St., $17.00 per lin. ft. Bids were opened June 14.

Indiana.

✣Bids will be received until 8 p. m., June 7, by Board of School Commissioners, Indianapolis, Ind., for the construction of an addition to Public School No. 50. John E. Cleland is Business Director.

✣Bids will be received until 11 a. m., July 15, by Board of Henry County Commissioners, Newcastle, Ind., for the construction of a masonry wall around county workhouse premises. W. L. Risk is County Auditor.

✣Bids will be received until noon, July 7, by E. T. McCown, Trustee of Helt Township, Vermilion County, Dana, Ind., for the construction of two brick school houses.

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

✣Bids will be received until 8 p. m., June 27, by Board of School Commissioners, Indianapolis, Ind., for the construction of an addition to Public School No. 39. John Cleland is Business Director.

Iowa.

✣Bids will be received until 4 p. m., June 27, by George Schneiders, City Clerk, Pocahontas, Ia., [illegible] necessary labor and material [illegible] of a complete electric light plant. Plans and specifications are on file and may be seen at the offices of City Clerk and Oscar Claussen Engineering Co., 514-515 National German-American Bank Bldg., St. Paul, Minn. A certified check for $1,000 must be filed with each bid for the entire work.

Louisiana.

⦿Eskald & Alexander, New Orleans, La., have been awarded the contract at $2.12 per ton for 26,000 tons of rock for bank revetment, delivery on U. S. barges, New Orleans, La. Bids were opened June 6 at the U. S. Engineer Office, New Orleans.

The following bids per cu. yd. were received by the U. S. Engineers, Rooms N, Custom House, New Orleans, for furnishing and delivering 3,200 cu. yds. sand and 6,400 cu. yds. gravel for Keystone Lock, Bayou, Teche, La., (1) being bid for delivering at lock site, (2) bid for delivery f. o. b. St. Martinville, and (3) bid for delivery f. o. b. cars Loreauville; the first figures are the bid for sand and the second are for gravel: Avery Planting and Improvement Co., Avery Island, La., (1) $1.60, (2) $1.80, (3) $1.8[illegible]; J. W. Thompson, New Orleans, La., (2) $1.65; (2) $1.95, (3) $1.65, (3) $1.95; Carolina Portland Cement Co., New Orleans, La., (1) $2.54, (1) $2.84, (2) $2.15, (2) $2.42, (3) $2.43, (3) $2.70; Southern Gravel & Material Co., Brookhaven, Miss., [illegible] $2.54, [illegible] $3.[illegible]

Maine.

✣Bids will be received until noon, July 17, by Lieut. Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for dredging in Saco River, Me.

✣Bids are asked until noon, July 17, by Lt.-Col. W. E. Craighill, U. S. Engineer, 537 Congress St., Portland, Me., for dredging in Saco Rover, Maine. The areas to be dredged are in the tidal portion of Saco River, Maine, which extends from Biddeford and Saco to Saco Bay, a distance of about five miles. The work consists in dredging through the shoals to provide a navigable channel having a least depth of 7 ft. at mean low water, the plane of reference. The estimated quantity of material to be removed is 37,500 cu. yds. scow measurement. The material to be removed is believed to be sand and mud.

Massachusetts.

✣Bids will be received until 3 p. m., June 28, by Department of Parks, Boston, Mass., for the construction of brick sanitary and locker building at the Strandway Playground. Plans and specifications may be obtained of the Engineer, Franklin Park. Bids are to be filed at the office of the Commission, Olmsted Park, Jamaica Plain.

✣Bids will be received until 3 p. m., June 28, by Department of Parks, Boston, Mass., for the furnishing and delivering of park seats. Plans may be obtained of the Engineer, Franklin Park. Bids are to be filed at the office of the Commission, Olmsted Park, Jamaica Plain.

✣Bids will be received until 2 p. m., July 11, by Col. F. V. Abbot, U. S. Engineer, Newport, R. I., for dredging harbors at New Bedford and Fairhaven, Mass.

✣Bids will be received until 10 a. m., June 29, by the Board of Norfolk County Commissioners, Dedham, Mass., for the construction, heating, ventilating, plumbing and wiring of a building for a district court.

The legislative committee on metropolitan affairs has voted to report to the State Legislature the $9,000,000 bill for the development of the port of Boston. The bill provides for the appointment of a commission of five to be known as the directors of the port of Boston. The governor is to appoint three members and designate the chairman. The mayor of Boston is to appoint a fourth member of the commission, and the fifth member is to be the chairman of the present state harbor and land commission, ex officio. The chairman will receive a salary of $15,000 a year. An amendment inserted by the committee provides that he shall give all his time to the duties of his office. The four other members are to receive $1,000 a year.

Michigan.

✣Bids will be received until 3 p. m., June 28, by Lieut. Col. C. H. Riche, U. S. Engineer, 57 Park St., Grand Rapids, Mich., for dredging at Saugatuck Harbor and Kalamazoo River, Michigan.

✣Bids will be received until 3 p. m., July 21, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including heat, plumbing, gas piping, electric conduits and wiring and the lighting fixtures, of the U. S. Post Office at Alpena, Mich.

Minnesota.

✣Bids will be received until 7:30 p. m., June 28, by L. P. Bigelow, Village Clerk, Browns Valley, Minn., for the installation of a municipal light plant. Plans and specifications are on file at the office of the Builders' Exchange, Minneapolis and St. Paul, Minn.

Bids as follows, per cu. yd. scow measurement, were received June 15 by Maj. Francis R. Shunk, U. S. Engineer, Duluth, Minn., for about $16,000 worth of dredging shoals in Duluth-Superior Harbor: Zenith Dredge Co., Duluth, Minn., 17½ cts.; Duluth-Superior Dredging Co., Duluth, Minn., 17¼ cts.; Northern Dredge & Dock Co., Duluth, Minn., 17 cts. (recommended for acceptance).

Missouri.

✣Bids will be received until 3 p. m., July 17, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the mechanical system of mail-handling apparatus in the U. S. Post Office, St. Louis, Mo.

✣Bids will be received until June 23 by Board of Public Works, Kansas City, Mo., for the following trucks: three 3-ton, two 2-ton and one 1-ton trucks. All bids must be accompanied by full and complete specifications, together with a statement of the guarantee that the company is willing to make. Bids must also state time of delivery, and each bid must be accompanied by a certified check for $100 guaranteeing the delivery upon the time stated. The board reserves the right to reject any or all bids.

Nebraska.

⦿The Selden-Breck Construction Co. of St. Louis, Mo., has been awarded the contract for building in Omaha a new headquarters building for the Woodmen of the World. The con[illegible] $900,000.

Nevada.

✣Bids will be received until 2 p. m., June 5, by W. B. Cole, Project Engineer, U. S. Reclamation Service, Fallon, Nev., for furnishing at Fallon one 36-in. belt conveyor 925 ft. long, gravel screen and all accessories complete.

New Hampshire.

The following bids were received June 17 by Lt.-Col. W. E. Craighill, U. S. Engineer, Portland, Me., for dredging in Exeter River, N. H. (1) Bid for dredging above Straham Bridge, (2) bid for boulders, (3) bid for dredging below Straham Bridge: Eastern Dredging Co., Boston, Mass., (1) 85 cts., (2) $8, (3) $1.25; Bay State Dredging Co., Boston, Mass., (1) 79¾ cts., (2) $10, (3) $1.10.

New Jersey

✣Bids will be received until 3 p. m., July 5, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for a hot water heating apparatus at the U. S. Post Office, Asbury Park, N. J.

New York.

✣Bids will be received until 3 p. m., July 5, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures, of the U. S. Post Office at Schenectady, N. Y.

✣Bids will be received until 11 a. m., July 10, by Constructing Quartermaster, Fort Hamilton, N. Y., for construction, complete, including plumbing, heating and electric wiring of the quarters for two N. C. officers at Fort Hamilton, N. Y.

✣Bids will be received until 11 a. m., June 26, by Constructing Quartermaster, Fort Hamilton, N. Y., for constructing, complete, including plumbing, heating, electric wiring, etc., bakery at Fort Hamilton, N. Y.

✣Bids will be received until June 23 by William Williams, Commissioner of Immigration, Ellis Island, N. Y., for the construction of a breakwater at Ellis Island.

Ohio.

✣Bids will be received until [illegible] by Director of Public Safety, Cincinnati, O., for the labor and material for the erection and completion of an additional steam and electrical equipment for power plant and switchboard and wiring at the City Infirmary, Hartwell, O. E. P. Durr is Secy., Department of Public Safety.

✣Bids will be received until noon, July 3, by Board of Education, C. W. Handman, Business Manager, Cincinnati, O., for the necessary labor and materials for the construction of the new Guilford School Building. Garber & Woodward, Andrews Bldg., have plans and specifications on file.

✣Bids will be received until noon, June 26, by Director of Public Service, Cleveland, O., for the construction of the West Side Market House. Hubbell & Benes, Citizens Bldg., are Architects.

✣Bids will be received until noon, July 3, by clerk of the board of education, City Hall, Cincinnati, O., for furnishing the necessary labor and material for the completion of the new Guilford School building. Garber & Woodward, Andrews Bldg., Cincinnati, are Architects.

✣Bids will be received until 3 p. m., July 17, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Post Office at Ironton, O.

Bids were opened June 1 by Col. John Mills, U. S. Engineer, Cleveland, O., for dredging in the harbor at Toledo. The Zenith Dredge Co., Duluth, Minn., was the low bidder on the work.

Incorporation papers are being prepared for the Central Ohio Power Co., which proposes to install a power plant at Beaumont, near Athens, O. The project is reported to be backed by the British Electric Traction Co., London, England. It is said that the plant will cost about $3,500,000, and the work will be started next month. C. W. Humphrey, 217 La Salle St., Chicago, Ill., is reported to be the Consulting Engineer for the plant.

Oregon.

✣Bids will be received until noon, June 24, by County Commissioners at the office of Whidden & Lewis, Architects, 701 Corbett Bldg., Portland, Ore., for the following work in the west wing of the new court house of Multnomah County, Ore.: The wrecking, excavating and foundation, structural steel and iron work, granite, terra cotta, brick and concrete, Bedford stonework, roofing and sheet metal work, metal frames, grilles and sashes, tile partitions, lathing and plastering, marble work, scagliola and floors, carpentry and cabinet work, painting and finishing, glass and glazing, ornamental iron, together with all such other work as may be called for in the specifications in connection therewith. Plans and specifications may be obtained at the office of the architects.

Pennsylvania.

Bids were opened June 8 by the Property Committee of the Board of Education of Philadelphia for the erection of the proposed new West Philadelphia High School. The estimates on the work were considerably high-

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

er than the school authorities had expected. [illegible] $900,000. The bids received were as follows: A. Raymond Raff, $1,352,000; J. G. Doak & Co., Philadelphia, $1,262,894; William Steele, Sons & Co., $1,289,000; B. Ketcham Sons, $1,330,000; Cramp & Co., $1,275,000; Mitchell Brothers, $1,489,727. The estimates call for a building of brick with limestone trimmings.

⊙The Franklin Construction Co., 1118 Palmer St., Philadelphia, Pa., has been awarded the contract, at $5,748, for repairs to bulkhead at foot of Fitzwater St., for the city of Philadelphia. Bids were opened June 13.

Rhode Island.

✣Bids will be received until 2 p. m., June [illegible], at the office of the Treasury Department, U. S. Lifesaving Service, Washington, D. C., for the construction of a lifeboat house and launchway at the Brenton Point Lifesaving Station, near Newport, R. I.

Tennessee.

•Rogers & K[illegible], Chicago, Ill., have been awarded the contract, at $42,000, for constructing the U. S. Post Office building at Dyersburg, Tenn.

The following bids were received June 6 by Major Wm. W. Harts, U. S. Engineer, Nashville, Tenn., for building dredge Tellico: The Marion Steam Shovel Co., Marion, O., $18,500; The Bucyrus Co., South Milwaukee, Wis., $32,000; The Marion Shovel and Dredge Co., Marion, O., $16,248; The Vulcan Steam Shovel Co., Toledo, O., $30,875. The amount available for payments under the proposed contract is about $35,000.

Bids were opened June 1 by Capt. Clark S. Smith, U. S. Engineer, Memphis, Tenn., for furnishing 40,000 tons of rip-rap stone for the first and second Mississippi River Districts. It has been recommended that W. D. Cammack, Little Rock, Ark., be awarded the contract at $1 per ton.

Texas.

✣Bids will be received until noon, July 5, by Capt. T. H. Jackson, U. S. Engineer, Dallas, Texas, for the construction of jetty work at Sabine Pass.

✣Bids will be received until 3 p. m., July 25, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures, of the U. S. Post Office at Cleburne, Texas.

✣Bids will be received until noon, July 8, by Maj. G. P. Howell, U. S. Engineer, Galveston, Texas, for dredging deep-water harbor at Harbor Island, Arkansas Pass, Texas.

Bids will be received until noon, July 15, by T. H. Jackson, Capt. U. S. Engineers, Dallas, Texas, for furnishing iron and steel delivered at Kleburg, Texas, on the Texas and New Orleans Ry.

The following bids were received June 7 for the construction of the U. S. Post Office building at Wichita Falls, Texas: Interstate Construction Co., Saginaw, Mich., $65,950; Deeter & Wenzel, Wichita, Kan., sandstone, $64,991, limestone $66,000; M. B. Whitlock & Co., Denton, Tex., limestone, $66,451.

Virginia.

✣Bids will be received by Committee on Improvements of James River at the office of Charles E. Bolling, City Engineer, Richmond, Va., for dredging along the left shore of James River from Gillies Creek to Nicholson St. A certified check for $200, payable to the treasurer, must be filed with each bid.

✣Bids will be received until noon, July 6, by Town Board of Minocqua, Wis., W. H. Fisher, Chairman, for the construction of an electric light plant and system. The work will include an addition to the present works building for power house; a 25 to 30 h. p. crude oil or fuel oil engine; a 20 kw. 220-volt direct current generator with switchboard, instruments, and appurtenances; a pole line and wiring system; one storage battery having a capacity of 100 16-c. p. lights for a period of 8 hours.

✣Bids will be received until 11 a. m., July 8, by R. C. Hollyday, Chief of Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the renewal of Richmond's dock at the Navy Yard, Norfolk, Va.

✣Bids will be received until 11 a. m., June 26, by R. C. Hollyday, Chief of Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., for the construction of wireless station buildings at the U. S. Reservation, Arlington, Va.

Washington.

✣Bids will be received until 11 a. m., June 30, by Chairman of the Board of County Commissioners, Spokane County, Spokane, Wash., for the construction and completion of two additional stories on the County Jail building.

The city of North Yakima, Wash., will vote on July 1 on a $300,000 bond issue for municipal electric plant. The proposed plant involves the construction of a 3-mile canal to a point three miles east of North Yakima, in the Moxee valley. The site is near the Moxee valley line of the North Yakima & Valley R. R., and the projected extension of the Yakima Valley Transportation Co. H. J. Doolittle is City Engineer.

Canada.

✣Bids will be received until June 25 by William Lawson, Chairman, Board of Works, and Property Committee, Dundas, Ont., for dredging the Desjardines Canal in accordance with the Jennings award involving the removal of about 27,500 cu. yds. of material. J. J. Armour, Dundas, is Engineer.

✣Bids will be received until noon, July 20, by L. K. Jones, Secy., Department of Canals and Railways, Ottawa, Ont., for the construction of a reinforced cement concrete pier and sheds at the Deep Water Terminus of the Intercolonial Railway at Halifax. Plans, specifications and forms of contract to be entered into may be seen and full information obtained at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, Ont., and at the office of the Chief Engineer of the Intercolonial Railway at Moncton, N. B., or at the office of the Consulting Engineer, Mr. John Kennedy, Montreal.

✣Bids will be received until 4 p. m., June 27, by L. K. Jones, Secy., Department of Railways and Canals, Ottawa, Ont., for the construction of protection works in Soulanges Canal. Plans, specification and form of contract to be entered into can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer of the Quebec Canals, 2 Place d'Armes, Montreal, Que., at which places forms of tender may be obtained.

⊙Matthew Dow, Seattle, Wash., has been awarded a contract by the Grand Trunk Pacific Ry., for building a $300,000 concrete wharf and warehouse at Vancouver, B. C. It is also reported that the Grand Trunk Pacific has awarded Mr. Dow the contract to build a $300,000 wharf and warehouse at Victoria and an office and store building in Vancouver to cost $175,000.

The $10,000,000 capital stock of the British Canadian Ship-building & Dock Co., has all been subscribed, and the company has purchased 300 acres of land at Sydney, N. S., as a site for its plant. The shipyard will have eleven building slips, eight of which will be able to take in the biggest dreadnought. The dry dock will be 1,040 ft. long by 110 ft. wide. The plant as planned will be one of the largest in the world, and it is understood will cost $6,000,000. Sir Henry Pellatt, Toronto, Ont., is chairman of the board of directors.

⊙The Department of Public Works of Canada, has awarded the contract for the public building, hot water boilers, etc., at Hamilton, Ont., to the Drake-Avery Co., Ltd., Hamilton.

⊙Contracts for dredging have been awarded as follows by the Department of Public Works of Canada: Thames River, Ont., Contractor W. F. Phin, of Welland, Ont.; Penetanguishene, Ont., Contractor, R. Weddell & Co., of Trenton, Ont.; Echo Bay, Ont., Contractors, K. Robertson, A. B. Ferrier and J. L. Kenredy, of Sault Ste. Marie, Ont.; Wiarton, Ont., Contractors, The C. S. Boone Dredging & Construction Co., Ltd., of Toronto, Ont.; Salt Point, Presqu'Ile, Ont., Contractor, R. Weddell & Co., of Trenton, Ont.; Kincardine & Port Elgin, Ont., Contractors, The Dredging & Drainage Co. of Ontario, Limited, of Toronto, Ont.; Toronto Harbor, from Eastern Channel into Ashbridge's Bay, Contractors, R. Weddell & Co., of Trenton, Ont.; Big Creek, Ont., Contractors, The Chatham Dredging & General Contracting Co., Ltd., of Chatham, Ont.; Kingsville, Ont., Contractors, The Windsor Dredging Co., Ltd., of Windsor, Ont.; Mahone Bay, N. S., Contractors, Beazley Bros., Ltd., of Halifax, N. S.; Digby, N. S., Contractors, Beazley Bros., Limited, of Halifax, N. S.; West Bay, N. S., Contractors, The Eastern Dredging Co., Ltd., of Louisburg, N. S.; Cape Tormentine, N. B., Contractors, General Construction & Dredging Co., Ltd., of Toronto.

Trade Notes.

The Goulds Manufacturing Co., of Seneca Falls, N. Y., is about to build four large additions to the No. 2 Plant, in which will be housed the part of the works known as the No. 1 Plant, part of which must be torn down to make way for the new barge canal. The new buildings will be parallel with the foundry buildings. A 1-story storage building for rough castings is completed. This building is 240 ft. by 60 ft. and of mill construction. Two machine shops, 300 by 100 ft. will parallel the storage building. They will be of steel frame and brick construction and about 70 per cent of the wall surfaces will be glass. South of the two machine shops a 4-story warehouse 240 by 60 ft. will be built. These will be reinforced concrete and on the south side there will be a loading platform. The New York Central will build two additional switches along the warehouse. All the new buildings will be lighted with tungsten clusters and will be heated and ventilated by the hot blast system. All the equipment of the machine shops will be motor driven. By Nov. 1 the buildings will be ready for use.

The eighth annual report of the General Asphalt Company, for the fiscal year year ending April 30, shows that the gross earnings for 1910 were $16,004,173, exceeding the gross of the preceding year by $2,011,190. Net earnings were $1,102,075, as compared to net of $1,031,741 in 1909. The progress made in the complete rehabilitation of the asphalt companies' affairs is further evidenced by the fact that the 5 per cent dividends on the company's $13,140,000 of preferred stock paid during the year, make a total cash disbursement for dividends since the company was organized, of 20¼ per cent. This, with the 8½ per cent cumulated dividends (represented by the 5 per cent debentures issued March, 1911), makes a total distribution of 28¾ per cent. Dividends on the preferred stock became cumulative at the rate of 5 per cent from June 15, 1905; so that with the payment of the regular 1¼ per cent on June 1, 1911, 30 per cent, the full dividend for six years past, will have been paid in cash or by debentures. The Barber Asphalt Paving Co. constructed 2,349,917 sq. yds. of new sheet asphalt pavements during the year, and 1,341,047 yds. of private work and paid repairs, an increase, taking the two classes of work together, of 560,000 yds., over 1909. These figures do not include contracts for 1,687,788 yds. carried over to the present year. Referring to the deduction from net earnings for maintenance guarantee account, the report points out the steady diminution of guarantee periods, which have been reduced from ten years or more to an average of 3.5 years on the work done by the Barber Company in 1910. In 1910-11 guarantees expired on more than 7,510,000 yds., on which the average period of guaranteed maintenance was 7.5 years. With the large yardage going out of maintenance each year, accompanied by the adoption of much shorter guarantee periods or their entire elimination, it is pointed out that the company's obligations in this respect will be largely reduced or entirely done away with. The first public announcement is made in the report of the discovery of immensely valuable oil deposits on the company's property adjoining the Trinidad asphalt lake. A small amount of oil has been obtained up to September of last year when a well being bored, and then at a depth of 915 ft., began to produce oil at the rate of 3,000 bbls. a day. With this proof of the existence of an extensive supply of asphaltic oil for fluxing, fuel and road treatment, the companuy began the construction of storage tanks of 1,000,000 bbls. capacity and chartered three tank steamers, the first of which arrived in this country some weeks ago with oil cargoes. The report refers to the finding of the Trinidad oil as "an asset hitherto wholly undeveloped, which is already of proven value, and which possesses great possibiities for the future." Aside from this oil discovery, the main development in the company's business, as shown in the report, relates to the increasing use of asphalt in macadam road construction, the tonnage of Bermudez road asphalt being eight times greater in 1910 than the total for 1909.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

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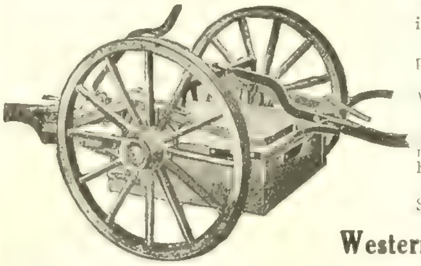

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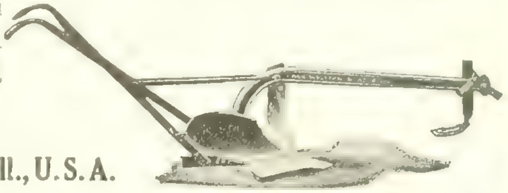

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BRIDGE.

Notice is hereby given that sealed bids will be received until 2 o'clock P. M. of June 22, 1911, for the construction of a steel bridge with concrete floor across Iowa River at Iowa Falls, Iowa. Length of bridge 353 feet, roadway 20 feet wide, 2 sidewalks each 5 feet wide. Check for 10 per cent of bid must accompany bids. The Board of Supervisors reserve the right to reject any or all bids. Plans and specifications on file at County Auditor's Office, Eldora, Iowa. Letting to be at Court House, Eldora, Iowa, June 22, 1911, at 2 P. M.

E. L. MARRIAGE,
County Auditor,
Hardin County, Iowa.

CONCRETE VIADUCT OVER HOUSTON SHIPCHANNEL.

Houston, Texas, May 23, 1911.

Sealed proposals will be received at the office of Dan C. Smith, Jr., City Controller and City Secretary, City Hall, Houston, Texas, until 12 o'clock noon, July 3d, 1911, for the construction of a reinforced concrete viaduct over the Houston Shipchannel. The structure will be about 1,650 feet in length and 60 feet wide.

Specifications and plans, bidding blanks, etc., can be obtained upon application at the office of F. L. Dormant, City Engineer, Houston, Tex., by making a deposit of $20.00 with the City Engineer.

A certified check of the bidder on any bank in Houston, Tex., payable to the order of H. B. Rice, Mayor, for $20,000 will be required to be deposited with the bid.

Bidders are expected to examine the site of the viaduct and acquaint themselves with local conditions.

The successful bidder will be required to give bond and comply with City Charter respecting contracts, and to execute the usual form of contract as prepared by the City Attorney.

The right is reserved to reject any or all bids or to accept any bid considered advantageous to the City of Houston.

H. B. RICE,
Mayor of the City of Houston,
Texas.
F. L. DORMANT, City Engineer.

GRAVEL ROAD.

Bids will be received until [illegible] p. m., July [illegible], 1911, by Newkirk and Ellsworth Townships, Lake County, Michigan, at the office of Norman Buckner, Clerk of Newkirk Township, Luther, Mich., for the construction of 11½ miles of Class "B" State Reward Gravel Road.

Plans and specifications and instructions to bidders may be seen at the office of the Clerk of Newkirk Township.

Bids must be made on blanks furnished by the townships and must be accompanied by a certified check in an amount equal to 10 per cent of the amount of the bid, payable to Norman Buckner, Township Clerk, this as a guaranty of the acceptance and performance of the contract by the party to whom it may be awarded, and his failure to execute said contract will forfeit said check.

The right to reject any or all bids or any portion of any bid, or to accept any portion of any bid which may be deemed for the best interest of Newkirk and Ellsworth Townships, is expressly reserved.

TOWNSHIP BOARDS OF NEWKIRK AND ELLSWORTH TOWNSHIPS.

SPECIAL BOND ISSUE OF 1911. WATER DEPARTMENT.

Muskogee, Okla.

WATER INTAKE AND INLET TOWER.

Sealed proposals will be received by the City Council of the City of Muskogee, Okla., until Tuesday, June 27, 1911, at 10 o'clock a. m., and opened immediately thereafter, for the construction of a water intake and inlet tower. All bids must be filed with Chas. Wheeler, Jr., City Clerk.

The water works intake is a 54-in. submerged concrete pipe line 2,600 ft. 1 in. long to be laid across the Arkansas River and up to the bed of the Grand River.

The intake tower is a concrete structure built at the upper end of the intake.

Proposals for this contract shall be accompanied by a certified check for $5,000, made payable to the City of Muskogee, Okla., without condition.

Plans and specifications can be seen and secured at the office of the City Engineer, Muskogee, Okla., or at the office of the Consulting Engineer, 114 Liberty St., New York City, after June 10, 1911, upon payment of two and one-half dollars ($2.50).

The right is reserved to reject any or all bids or to accept that one which, in the judgment of the City Council, is for the best interest of the city.

By order of the City Council.

E. H. FLEMING,
Commissioner of Water, Sewer and Lights.
ALEXANDER POTTER,
Consulting Engineer.
T. P. CLONTS,

OPEN DITCHES.

Bids will be received until 3:00 p. m., July 15, 1911, by the Board of Commissioners of the Sixth Ward and Crowley Drainage District, at Crowley, La., for the construction of about 40 miles of open ditches ranging from 2 to 6 miles in length, 16 to 40 feet in width and 2 to 5 feet in depth, approximating 600,000 cu. yds., and about 90 acres of clearing. No rock. Mostly open prairie. Three lines of railway. The right is reserved to reject any and all bids. Each bid must be accompanied by certified check for $1,000.

H. E. LEWIS, President.
W. S. WHITE, Engineer.
L. A. WILLIAMS, Secretary.

WAR DEPARTMENT.—U. S. Engineer Office, Montgomery, Ala., June 6, 1911. Sealed proposals for dredging at mouth of Apalachicola River, Florida, will be received at this office until 1 o'clock p. m., July 6, 1911, and then publicly opened. Information on application. G. D. FITCH, Lt. Col., Engrs.

U. S. ENGR. OFFICE, Boston, Mass., May 26, 1911.—Sealed proposals for rock excavation in Boston Harbor, Mass., will be received here until 12 M., June 26, 1911, and then publicly opened. Information on application. FREDERIC V. ABBOT, Col., Engrs.

U. S. ENGINEER OFFICE, Wilmington, N. C., June 1, 1911. Sealed proposals for constructing complete the two (2) wooden hull, non-propelling, 15-in. hydraulic pipe line dredges Neuse and Port Arthur will be received at this office until noon, June 30, 1911, and then publicly opened. Information on application. EARL I. BROWN, Capt. Engrs.

U. S. ENGINEER OFFICE, Kansas City, Mo., June 3, 1911. Sealed proposals for constructing standard revetment on Missouri River, about eighteen miles below Kansas City, Mo., will be received here until 12 noon, July 3, 1911, and then publicly opened. Information on application. EDWARD H. SCHULZ, Major, Engrs.

Engineering & Contracting

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The "Sales Method," The "Expert Witness Method," and The "Capitalized Rental Method" of Appraising Land.

The oldest and most common method of determining the value of land is by weighing the testimony of real estate experts—the expert witness method. Its great defect lies in the difficulty of segregating biased from unbiased testimony. If all the expert witnesses were unbiased and honorable, this method would probably be quite satisfactory in the majority of cases. The sales method is described at some length elsewhere in this issue. There is much to be said in its favor. In fact the worst that can be said against it is that frequently there have been no recent sales of land in the neighborhood of the land that is to be appraised, and that such sales as have been made do not always show on public records the full amount paid for the property.

We wish to call attention to a method that has been applied by one of the editors of this journal in appraising land values. It may be called the capitalized rental method. In brief the method is as follows: First determine the rental paid for real estate contiguous to, and similar to, the property to be appraised. Second, estimate the cost of the buildings on the land whose rental price is known. Third, estimate the fair annual return for the capital invested in the buildings alone, and to this add insurance, taxes and annual depreciation of the buildings. Fourth, deduct this total from the total rent received for the land and buildings, and the balance will be the land rent including land tax. Fifth, capitalize this land rent and the amount thus ascertained is the value of the land.

An example will clearly indicate the method:

A three-story store covers a lot 50x100 ft. The tenants pay a combined rent of $3,300. The estimated value of the building alone is $20,000. Then we have:

	Per cent.
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

Hence $20,000×9 per cent = $1,800, return on the building. Since the total rental is $3,300, this leaves a balance of $1,500 for the rental of the land alone. Capitalizing this $1,500 at 7 per cent (the combined percentage of interest and taxes), we have $21,430 as the value of the land. If the proper percentages have been applied, this method gives the minimum value of the land. Frequently land commands a higher price because of its speculative value in a growing community. However, in any community a proper factor to apply, in order to include the speculative value, may be ascertained by dividing a number of actual sale prices by the land values computed by the capitalized rental method.

In appraising land owned by public service corporations, it must always be remembered that such land may have to be purchased at prices higher than the ordinary market rate, particularly when the land is secured for right of way.

The capitalized rental method of land appraised lends itself admirably to the appraisal of city property. It is, we believe, far superior to any other method in the majority of cases; and, in the absence of recent sales in a given locality, it becomes the only rational method of arriving at a close estimate of the value of city land. Sale prices of land are, in the final analysis, merely capitalized rentals; and, as it is much easier to ascertain rentals than sale prices, it follows that the capitalized rental method of land appraised is usually to be preferred to any other.

Engineering As An Economic Science.*

[illegible] art is the history of the economic development of civilization; economic, as distinct from moral and social progress. In general, engineering has not been called into play to accomplish a final object that could not have been achieved somehow without engineering, for nearly all things are possible, given enough labor and time. The superiority of our present day engineering in such construction as that of the Great Pyramid of Egypt would be [illegible] intrinsic result as a tombstone.

[illegible] mid have given the height divided into twice [illegible] accords fairly well with what we would be [illegible] "stunt" today, yet to duplicate the work by modern methods would probably require much fewer actual man-days of work than in the [illegible]

The printing press for the cheap communication of ideas, the railroad for cheap transportation and the steam shovel, the rock drill and the concrete mixer, having given us improvements in method, which affect the possible quantity of result per unit of labor, rather than the ultimate nature of that result itself.

We can mix concrete on a board, and communicate our thoughts to our friends in long hand, and the concrete will be just as strong, the thoughts just as logical as though we employed modern methods, the only essential difference being the quantity or magnitude of the result per unit of labor and of time. This conservation of labor and of time by scientific methods is the true inwardness of engineering, and its present position with reference to the art of construction is the subject of this paper.

The contractor is interested in engineering as a means of getting the maximum pay with minimum expense; to help him to obtain from his men the maximum result per dollars and to guarantee to him a fair estimate. The economic value of the engineer's work is the only one that he can recognize, and he cannot always recognize that.

To erect a bridge over a given stream is entirely possible without an engineer, since bridges, and good ones, were built thousands of years before engineering developed, but today the bridge contractor knows that cutting, punching, riveting and minor assembling in the shop is far less expensive than at the site of the work, and that, furthermore, simultaneous operation on the many details of one structure is cheaper than its consecutive development; so he employs engineering as the only means by which he can secure simultaneous operation of a multitude of details and assure himself of a perfect fit; the minimum waste of material and labor; the lowest cost. He needs engineering to co-ordinate his labor and to assemble his materials, to save time to himself and to others, and for no other reason, since the cost of material is, in the last analysis, the cost of the time per man required to get it out.

Material alone has little or no intrinsic [illegible] ever branch of the subject we extend an investigation we find the same rule to apply, namely, that the economic development or evolution of every industry is in the direction of the conservation of labor by methods which tend to become more and more exact.

The application of the methods of exact science to the problems of construction has done more towards this conservation of labor than all other causes combined, and no effort [illegible]

[illegible]

this field than that which endeavors to bring into scientific order the facts that can be collated and tnat bear upon this same question of the conservation of labor; the effort—to borrow a bucolic phrase—to make two blades of grass grow where one grew before. Now, the most obvious step in this direction is the conservation of material.

To build a bridge that shall be of sufficient strength with the least waste of material is a most familiar example of the ultimate aim of the bridge engineer, and the development of this idea into a science by the application of the principles of mechanics has been the natural process in the engineering schools. Nothing is more certain to the academic mind than pure deductive reasoning, and to start from known laws of mechanics and develop an art of construction by applying mathematical principles has been, and would be again, the natural method of procedure. Certain fundamental data were wanting, such as the mechanical features of the various materials, and these mechanical features were, therefore, investigated with some thoroughness, so that for the materials which lend themselves most readily to the deductive method, such as steel, we have a well defined science of computation, which is, however, somewhat limited by this drawback, that it assumes the total cost of a structure as being nearly proportional to the weight of metal.

Now the cost of rolled shapes at the mill is something like 1½ cts. per pound, while the cost of the finished structure may be from 3½ cts to 5 cts. per pound, or more. Thus the weight of metal plays rather less than 50 per cent of the whole part in the general economics of the structure. The contractor's labor, the handling, the shop work, his plant and overhead charges, and transportation, which increase with the weight, but are not in direct lineal proportion to it, make up the other and the greater part.

Under the present economic system it is the custom for the design of the structure to be made by the owner's representative, who is entrusted with the duty of seeing that the result shall be what the owner needs for his own purpose, and who is supposed to fulfill that requirement by a design which can be complied with at the least expense consistent with the owner's purpose. It is a peculiarity of the art today that the methods of designing are predicated largely upon the theory that the cost of the work is proportional to the cost of the material involved in its construction.

Engineering students are trained along this line of reasoning, and before they have modified it as a result of practical work in the field they have become responsible for much unnecessarily expensive work.

The carrying out of the design the construction in the field, the delivery of the goods under the present economic system is the particular care of the contractor, who necessarily becomes the financial expert to carry on the work. His success is dependent upon his knowledge of the true economic conditions of labor and material, and he must so conduct his operation as to produce the result required by his contract at the least cost to himself; in addition to which he must guarantee the efficient performance of his work up to a sum of money which is often many times in excess of his entire available capital If he fail in his accurate estimate of what it ought to cost for construction, if he fail to live up to his estimate of what he himself can accomplish, or if, through accident or unforeseen conditions, he be unable to make good on his guarantee, he must bear the loss and take it out of his previous savings.

It is worthy of note that in this feature contracting is practically an insurance business in which the ratio of individual risk to capital employed is enormous compared with the similar risk in the fire insurance or life insurance business. A life insurance company reckons with the average of millions of cases, the contractor reckons with the average of dozens.

From the point of view of present-day practice, engineering resolves itself into engineering design and engineering construction, and under these two classifications will be found a convenient method of investigating it.

The art of design is efficient to the degree that the ratio of the economic value of the finished structure (for the purpose intended) to its actual cost approaches its maximum. This seems so obvious a truism as to be almost trite, yet a few words of explanation may not be out of place. The owner who desires a bridge rarely knows whether he needs an expensive one that will last for many years or a comparatively inexpensive and somewhat temporary structure. One of the most difficult duties of a railroad chief engineer is to decide, for example, how far he should go in providing for future and problematical heavy traffic in the design of his structures, and it is obvious that a bridge which will accommodate the locomotive 25 years hence is of greater economic value than one which would have to be rebuilt in 15 years. Granted that locomotive wheel loads are increasing, it is obvious that the former would necessarily cost more than the other, and one of the necessary criteria for determining the maximum value of the equation is the rate of increase of the wheel loads for the next 15 and 25 years. To solve the equation the engineer must know both numerator and denominator. He must estimate the cost of his design before the contract has been let and before it is too late to make an entirely different one. This he seldom knows with enough accuracy to be efficient.

The art of construction is efficient to the degree that the raito of the minimum possible cost of actual cost of the structure (as designed and specified) approaches unity. This is the contractor's problem in the field, while the preceding is that of the owner in the office.

Science has done something to aid in the solution of these problems, and to determine what may still be done is the immediately necessary step in the advancement of construction work as a civilized and scientific industry.

To this end we may take as our criterion the proposition that an industrial profession is scientific, i. e., is in accordance with the accurate and systematic knowledge of principles by observation and deduction in so far as each of its processes is scientific. Now, the development of every natural science that we have today has followed the deductive method, which consists of three operations.

(1) Induction from direct observation.

(2) Deduction, to specific cases from a general law, and

(3) Verification, to establish the integrity of the conclusions as compared with the facts of experience.

An examination of the extent to which each of the engineering processes compares with the true deductive method will disclose its position as a scientific one, and the sum of all the comparisons will establish the scientific, or other, basis of engineering as a whole.

The subject is so large that there is time only to investigate one or two of the special branches of engineering, and I have taken for illustration that of bridge building as of general application, and because it is perhaps the most nearly scientific of the engineering specialties, and for that reason will give conservative strength to the rather remarkable conclusions of this inquiry.

Supposing for the sake of a general illustration that a railway company needs a bridge with piers over a stream, and that the work is placed in the hands of a salaried engineering staff. It is my purpose in this discussion to examine the extent to which the processes of the construction of the bridge, including its design, are in accord with the principles of true science. We are considering the bridge problem alone, so we will assume that the point and angle of intersection of the line of road with the line of the stream have been established.

The aim of the designer is to comply with the requirements of the expression: *Economic value divided by actual cost, shall be a maximum.* The general location of the structure and the use to which it is to be put will be specified by the "owner," who will also exercise some influence on the choice of the factors which compose the numerator of this fraction, such for example, as the degree of permanence of the work, which is limited by the owner's available capital. Among the factors of the numerator are: (1) Depreciation in condition. (2) Depreciation in replacement value. (3) Annual repairs. (4) Varying condition of uses.

In so far as any of these conditions affects the denominator as well as the numerator of the fraction, must the dual effect be considered, which in many cases can best be done by considering each factor as one of unit cost. Hence, having established the specifications that will make the numerator of the fraction as large as possible under the conditions, it remains to make the denominator as small as it may be under the restrictions, since the smaller the denominator, the greater the value of the whole fraction. Among the factors of the denominator are the following: (5) The limiting depth of the structure. (6) The maximum pressure of wind, water and ice. (7) The amount of scour under water, as affecting the angle of the skew of the abutments and piers. (8) The clear span. (9) The bearing power of the soil. (10) The strength of materials. (11) Depths of footings. (12) The live load and its probable fluctuations during the life of the structure. (13) The nature of materials necessary for safety combined with low cost, whether steel, concrete or ashlar masonry, etc.. and the effect thereon. (14) The market for materials. (15) Type of design, which will be affected by the traffic density as well as the wheel loads. (16) The general nature of the contract and its provisions as to responsibility for various contingencies. (17) The nature of materials to be handled. (18) The probable interruption of traffic and cost thereof during construction. (19) The likelihood of accidents from high water and other causes. Provisions to meet unexpected conditions, extras, etc. (20) Terms of payment.

There must also be considered by the designer the factors of the actual cost to the contractor, which are necessarily his particular problem and which will depend upon the efficiency of the art of construction. This actual cost, while an essential factor in the main equation, is unknown usually until it is too late to change the design, and it is seldom known even very approximately. It must be estimated in a more or less empirical way, in which the available data are so meager in proportion to the quantity of material actually in existence as to be a crying shame to the entire bridge building community.

The cost of construction, as distinct from design, the structure having been planned and specified, will include the following factors: (21) The magnitude of the work. (22) The necessary amount of capital in proportion to the contractor's resources. (23) The nature and condition of the available equipment. (24) The efficiency of his managerial organization. (25) The general layout of the work. (26) The labor market. (27) Material. (28) The nature of the materials, whether in stock sizes and of such quality as to be easily worked. (29) The probable interference from trains. (30) The necessary speed with which the work must be conducted. (31) The weather.

Now an inspection of these 31 items (there are others) discloses the startling fact that in only one of them, namely, the strength of materials, and then only for the metals, has the study of these conditions been reduced to a scientific basis available to the engineer in general practice.

Some of the items, such as (8), the clear span,: are often decided for the engineer by local conditions which are absolute, but in most cases it is a matter of judgment what quantity to adopt.

Frequently, a standard criterion is prescribed, such as to make the thickness of the base of a retaining abutment four-tenths of the net height. This rule was in use on a certain railroad for many years when the standard of construction was of first class ashlar masonry, with rough and stepped back. In due course of time the road changed its construction to concrete with a different density and a smooth back; yet the same old four-tenths remained the standard practice. The concrete abutments, so far as I know, have all stood up safely, and it would be at least amusing to compute how much the railroad would have saved by some simple experiments before adopting the rule for ashlar, or else how much more risky its bridges are now, as compared to what they were formerly, by reason of the use of the more easily overturned concrete.

The bearing power of the soil for each problem in hand is generally assumed at a theoretically safe figure taken from some authority on foundations without much reference to whether the authority's data were compiled from conditions similar to those of the case in point. Rarely is it attempted to establish what the bearing power of the soil actually is for the structure which it is to support. Consequently, there is but an infinitesimal chance that the footings be both safe and economic, there being only one set of dimensions that will satisfy both conditions.

The engineer or the contractor of experience will readily supply his own commentaries to the various items which I have enumerated, and he can furnish many more items that have not been mentioned, and I believe in every case, except that of the strength of steel, he will come to the conclusion that "judgment," that elusive quality of experience, rather than scientific rule, must be applied in order to obtain the quotient of the fraction, $\frac{\text{Minimum Cost}}{\text{Actual Cost}}$ until after the work has been completed and the damage has been done.

Taking each item by itself, an independent study of it is vital to the Contractor's interest, yet how seldom is he in position to make such study when the cost of the expert work, except in large operations, may be in excess of the probable saving which the study may make possible?

In such case the activities of this Society may be of inestimable value to its members, since through the Journal the data for the necessary inductions may be exchanged, and rules of economic practice, far in advance of anything as yet available to construction men, may be placed at the disposal of the contractor, the owner and the engineer. No one will deny that when three per cent of the factors that go to make up the processes of a certain specialty are on a truly scientific basis, that specialty can hardly be classed as a completely systematized science; and when that specialty is chosen as the most highly developed one of engineering, it must be admitted that engineering as a whole has much to gain by future study.

ROADS AND STREETS SECTION

Road Grading with an Elevating Grader Handled by a Gas Traction Engine.

Grading and road construction work makes peculiar demands upon a traction engine: it calls for a machine which has an ample power reserve, which can travel easily over soft ground and loose earth and up and down all kinds of grades, and which is under perfect and instantaneous control of the operator. Within the last few years many gas traction engines have been used in this work.

Gas Traction Engine Hauling Elevating Grader.

The accompanying illustration shows an interesting piece of road grading work at South St. Paul, Minn., in which a gas traction engine was used. The work was done by Thornton Bros., contractors, using a Big Four "30" 4-cylinder gas traction engine, manufactured by the Gas Traction Co., Minneapolis, and a Russell elevating grader and ditcher. With this outfit the contractors took out an average of 1,000 cu. yds. of earth a day, using 11 teams and 1½ yd. dump wagons, and hauling from 1½ to five blocks, or an average of three blocks. The contractors averaged 70 to 80 loads per hour, and in some instances as many as 45 loads were taken out in 30 mins. It is stated that if there had been no time lost waiting for teams 100 loads could easily have been taken out in an hour.

As noted above, one of the demands made by road grading work is that the traction engine shall be able to travel easily over soft ground and loose earth. In this connection it may be stated that the lightest of the 30 HP. gas traction engines of the Gas Traction Co. weighs only 8¾ tons, and its weight is so distributed that the pressure per sq. in. under its drivers is said to be less than that per sq. in. under a horse's hoof. The drivers are 5 ft. high with rims 2 ft. wide, with conical self cleaning lugs which take a firmer hold on the ground. The front wheels and steering device are so arranged that the engine can turn in a small space—an obvious advantage in construction work. Another peculiarity of works of this kind is the necessity of continual starting and stopping. In the grading work at South St. Paul the contractors stated that with the gas traction engine they had horses beaten 15 seconds in starting.

Work of the Chemist of the Massachusetts Highway Commission and Methods of Analysis Used for Bituminous Materials.*

During the year 1910, 266 samples of bituminous road materials used in construction were submitted to certain chemical and physical tests, and a large amount of special experimental work was carried on to test and prove, if possible, the value of the various analytical methods used in this and other laboratories engaged in such work. As a result of the investigations of this kind carried on since the commission began to study the composition of these materials, certain tests have been worked out that appear to show with a fair degree of satisfaction, from a chemist's point of view, the relative value of the materials for road work. A comparison, however, of the analytical results and the practical results obtained from the use of such materials in road construction is of course [illegible] their real value.

During 1910 it has been customary in the laboratory to make, with all materials received, determinations of specific gravity, viscosity, the percentage of each material evaporating when a weighed portion is heated for 24 hours at 250° C., and the per cent of matters in each sample insoluble in carbon bisulphid. With the samples of asphaltic bodies forwarded, further tests have been made to show the per cent insoluble in petroleum ether, and also to show what we have designated "potential asphaltene." Penetration tests have been made on solid or semi-solid materials that could not be tested with the viscosimeter, and an adhesion test has also been largely used. With the samples of tar distillations have been made, as in previous years. A number of determinations of the percentage of paraffin present in the different samples were made during the year, but no considerable amounts were found in any sample examined. Many residues after extraction with petroleum ether were extracted with carbon tetrachloride and then with carbon bisulphid. [illegible] benes" formed during the laboratory heating, which was more severe than would ever occur in actual practice. "Carbenes" were found in only 8 of these residues, the average amount being about 1 per cent., the maximum 2.5 per cent and the minimum 2 per cent. The average per cent "carbene" formed by the heating was only 4 per cent. These figures seem to show that the significance of "carbenes" has been overestimated, at least in the class of asphaltic compounds used in Massachusetts.

The method for determining specific grav- [illegible] cept

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*[illegible] Massachusetts Highway Commission, included in the [illegible] real [illegible]

[illegible] samples which [illegible] when water. The [illegible] tends to [illegible] the density of the sample, and also tends to make the viscosity determinations high. Methods for determining the percentages insoluble in petroleum ether and carbon bisulphid, and also the penetration test, are apparently satisfactory. It is evident, however, from our continued work that the test for the weight evaporated when samples are heated to 250° C. for 21 hours should be modified. With the thinner samples the test is of considerable value, and shows with some clearness the residual material that should be of value in road binding. With the heavier or thicker samples, however, there is apparently a considerable decomposition taking place when the sample is heated at this temperature for so long a period.

Ninety-one determinations of potential asphaltene have been made and reported during the year. This test can hardly be recommended for routine work, because of the length of time required in carrying it out; but it is of value in determining asphaltic bodies present, and especially valuable for comparisons when new materials are being examined and in the case of thin oils.

A description of the various methods of testing these materials is given here:

Specific Gravity.—About 20 c.c. of the warmed sample are poured into a weighed 25-c.c. graduated flask, and allowed to stand for several hours at room temperature. The flask is then weighed and filled with distilled water at room temperature, and suction applied to the neck of the flask to remove air bubbles in the sample. The flask is then made up to the mark with water, and weighed. A simple calculation gives the weight and volume of the sample, and from these the specific gravity is calculated.

Viscosity.—Viscosity is determined by noting the seconds required for 60 c.c., at room temperature, of the sample to pass through the Lawrence viscosimeter at 100° C. The water jacket of the viscosimeter is heated to boiling, and the sample, previously heated to 100° C., is strained through wire gauze into the pipette of the viscosimeter. The 60 c.c. is measured by collecting a weight equivalent to 60 c.c.

Adhesion.—Two brass discs 1 in. in diameter, at the ends of rods 4 ins. in length, held in place by suitable supports, are smeared over with the sample to be tested, and pressed firmly together. One disc is held rigid, while to the end of the rod of the other a small pail is attached by a string led over a pulley. Shot is poured into the pail at a uniform rate of 2,250 grams per minute. The adhesion is expressed as the number of grams required to pull the discs apart when the sample is at a temperature of 20° C., and the weight is added at the uniform rate.

Penetration.—Penetration is determined by the Dow penetrometer, using 100 grams load. The sample is melted in a 3-in. tin dish, and cooled to 20° C. The penetration of the needle into the material in five seconds is measured and expressed in units of 1/100 c.m.

Per Cent Evaporation.—The per cent evaporated is obtained by weighing about 20 grams of the sample into a weighed flat-bottomed tin dish 3 ins. in diameter, and heating for 21 hours at 100° C. in the case of tars, and 250° C. in the case of asphaltic compounds. After cooling, the dish is weighed and the per cent lost calculated.

Per Cent Insoluble in Petroleum Ether and Carbon Bisulphide.—Five to ten grams of the sample are weighed into a weighed extraction shell, and then extracted in a Soxhlet apparatus until the solvent is colorless. The shell is then dried and weighed in a weighing beaker. In case of asphaltic compounds the carbon bisulphid insoluble is found by extracting the portion insoluble in petroleum ether.

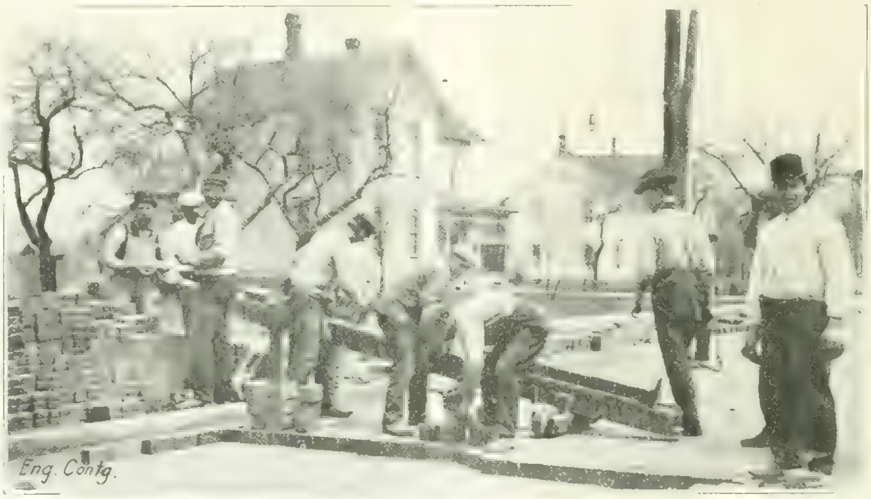
Distillation.—Distillations of tars are made in the usual way in an iron retort, as described in various places.

Potential Asphaltene.—This test is carried out as follows: the sample is subjected to a number of heatings at 250° C. in a well-ventilated oven, with intermediate separations of asphaltene and of matter insoluble in carbon bisulphid, until the final petroleum ether extract is not more than 10 per cent by weight of the original sample. Samples treated in this way should show the following results, if of satisfactory quality: assuming that the final 10 per cent has the same composition as the 90 per cent of the material examined, the loss should not be more than 35 per cent by weight; the amount of asphaltene in the original sample should not be greater than 6 per cent by weight, and the amount of asphaltene found by this treatment plus that in the original sample should be at least 58 per cent by weight of the original sample; the amount of matter insoluble in carbon bisulphid as a result of this treatment should be not greater than 5 per cent.

An Economical Method of Handling Brick for Paving; Costs of the Work.

BY SQUIRE E. FITCH

The accompanying illustration shows a method of conveying vitrified paving blocks from the curb to the brick-layer that might well be adopted, with considerable saving, in many cases. It was used by S. T. Benson & Co. on the state road through the village of Falconer, N. Y., during the season of 1910. The machine consists essentially of a frame holding a series of 2½x5 in. wooden rollers set 3 in. c. to c. with the tops of the rollers ¾ in. below the top of the vertical side pieces of the frame. The frame was set at such an angle that gravity would just carry the bricks along the roller. The whole machine was mounted on small wooden wheels so that it could be kept pushed up close to the work at all times. At the beginning of the work the laborers carried the brick to the brick-layer and the cost per sq. yd. was about twice as much as that after installing the machine. On wide streets a machine was used on each side of the street. It was found to be especially important to have the brick properly distributed along the street when unloading from the wagons, leaving enough to replace culls and a slight excess rather than a deficiency.



Conveyor for Paving Brick.

On several days work the cost of bricklaying was well below 5 cts. per sq. yd. The average cost on the whole job of about 20,000 sq. yds. is given below in detail, and, also, a few other costs of interests on the same work.

	Per sq. yd. Cts.
Spreading sand cushion (1½ to 2 ins. thick)	1.58
Laying brick	7.08
Replacing culls, turning, raising low brick, etc.	1.58
Rolling (steam roller)	0.55
Miscellaneous	0.87
Grouting (mixing and applying a 1 to 1 mixture)	2.74
Total	14.40

One bbl. of Portland cement (1 to 1) will grout 38 sq. yds. of New York state standard brick pavement (i. e., 3½x4x8½ in. brick).

The cost of labor on a 4x18 in. sandstone curb was as follows:

	Per lin. ft. Cts.
Cuting stone	5.72
Hauling stone, gravel and cement (average [illegible] mile)	5.81
Placing and finishing curb (set in concrete)	12.78
Total	24.31

The cost of mixing a 1 to 5 gravel concrete with a No. 2½ Foote continuous mixer after the gravel was on the ground was 62 cts. per cu. yd.; this included placing, spreading and smoothing it ready for the sand cushion.

The above is based on the following prices for labor: Labor, 23 cts. per hr. Teams, 50 cts. per hr. Stone cutters, 50 cts. per hr. Bricklayers, 30 cts. per hr.

A Narrowing of Minor Residence Streets as Affecting Tenant and Property Owner.*

It is well to begin any discussion with a definition of terms. Let us say, therefore, at the very beginning, that the phrase "minor residence streets," as used in the title of this paper, may be treated as a definition. Its working excludes all main highways, all avenues, and boulevards, and for the purpose of this discussion it shall be held to exclude all streets which carry a through travel that so much as even equals the traffic originating and terminating within the street itself. Accepting this as our understanding of the term, we shall exclude also from our consideration all streets that carry car lines or that are routes convenient for general teaming, driving and motoring.

Thus it is clear that the paper will be dealing for the most part with streets that are relatively uninviting to traffic, either because of the special development of other thoroughfares, or because of some physical handicap of their own, such as indirection, heavy grades or a break in continuity. Their traffic relation to the street plan of the city and its suburbs, will be mainly the harboring of the little eddies left at the side by the mighty traffic streams which flow through main thoroughfares. Because they have this character they will be generally in close connection with major streets and traffic highways. If we fancy an ideal city plan, in which arterial streets radiate from a common business center, we shall expect to find the minor streets located between the radii. They will not be limited, that is to say, to any one residential section of the city. They do not exclusively belong to any one class of citizens. Necessarily, therefore, they vary in character. The shack-lined alley off a third class business street, and a private "place" off a fashionable avenue will alike be considered here as a "minor residence street."

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*Assistant Engineer New York State Department of Highways.

*Paper by Charles Mulford Robinson prepared for the Third National Conference on City Planning, Philadelphia Session of May 17, 1911.

It is obvious that the streets which are to be discussed are very numerous and of much importance in the city's life. They are more numerous, indeed, than any other single class of streets; an imposing proportion of the total number of citizens dwells upon them, and the lives of these people are intimately affected by the character of the streets. The streets are minor, considered only in themselves and their street relations; they are not minor as regards their social value or their economic influence upon rents.

As this paper is to discuss the latter point, it is well immediately to emphasize the fact that their economic influence, for good or ill, is not their only influence. A moment's reflection explains this: Between two minor residence streets, or between two well defined divisions of one of them, there may be the diameter of the whole social structure. If, then, even the width of these streets be standardized, so that they all tend to uniformity, and the lives of the residents are not, and cannot be, reduced to a fixed social mean, there must inevitably result a series of misfits, of which the outcome can be only prodigality, social inconvenience and a general maladjustment to real conditions. There are other ways in which standardization means extravagance and maladjustment; but I shall speak of only the one matter of width.

In so doing I take up the economic effect, as regards rents, because it is the easiest measure of cost; and that effect, of course, carries suggestion of many far reaching tendencies which necessarily develop from it. As the English have set forth the matter in convenient statistical form, and the principle are the same in either country, I avail myself of some English figures.

Alderman M. W. Thompson, chairman of the National Housing Reform Council of England, in his valuable compilation, "Housing Up to Date," states that under modern conditions of subdivision the cost of roads, sewers, etc., reaches in some cases as high as £9 per room, or £45 per cottage, and that it averages £9 per cottage. This calculation is based on statistics covering thousands of cottage dwellings, and since the word "cottage" means in this connection houses built in continuous rows—that is, dwellings that occupy with their grounds a minimum street frontage—it reveals the effect on rents for even the cheapest homes. As to the more costly villa type of dwellings, the same authority notes that the English by-law requireing a paved or macadamized road surface of about 40 feet, has made the cost of thoroughfares, in newly developed estates on the outskirts of towns, from £200 to £500 per acre —"or more than the land itself."

John S. Nettleford, in his "Slum Reform and Town Planning," calculates that the interest on the expenditure for street work "comes to one shilling or more per week on a house rented for six shillings, if the number of houses is restricted to 15 per acre." One must hear that statement twice to get its full significance, and must realize that the suggested restriction is not a low one. At Bournville, the houses are restricted to 11 to the acre, and at Hampstead Garden Suburb to only eight. Yet at 15 to the acre, one sixth or more is added to the weekly rent by the English by-law requirement of 40 ft. streets.

Raymond Unwin puts the unreasonableness of the requirement in this striking way: "A mansion such as Chatsworth or Blenheim will be adequately served by a simple carriage drive from 13 to 20 ft wide. The population of such a building will be larger than that of a row of group of cottages, and the amount of wheel traffic to and from it many times as great; yet for the cottage road asphalt or concrete paved footpaths, granite curbs and granite macadamized surface, the whole from 40 to 50 ft. wide, and costing, with the sewers etc., from £5 to £8 a lineal yard, are required by the local authority, under our existing by-laws."

The burden of all this cost, to which is to be further added the value of the land thus withdrawn from productive use, is borne by the occupants of the district, whether they be tenants or owners. Now, as the tenant, in choosing his house, theoretically chooses the best he can afford, it can be argued that the rent factors which are imposed by the community in its official capacity, and without his permission, really go far to fix the scale of his living. And this clearly is true, even when admitting that the normal tax rate has of itself—as economists now quite generally claim—little effect on rents. The importance of the subject thus becomes clear. If our present method of standardization is unduly extravagant, it should not be permitted to persist simply through inertia and because it saves trouble in surveying and thinking.

The new town planning act in England recognizes the condition, by permitting English local authorities, in order "to secure proper sanitary conditions, amenity and convenience" to relax or modify former requirements, breaking away from the tradition that all streets should be of like width and like strength. Furthermore the act itself recognizes three distinct grades of roads—main arterial, secondary and residential.

Further interesting testimony is given by the Germans, who in the earlier days of deliberate town planning were wont to construct very broad streets when developing outlying areas. For example in the discussion which followed the presentation of my paper on this subject at the Town Planning Conference in London, last October, Dr. Hegemann of Berlin traced the relation of cause and effect between the wide streets and the tenements with which those streets are lined in the more remote portions of the German capital; while Thomas Adams, of the town planning department of the Local Government Board, of England, said that after investigating conditions in Germany and Sweden, he had come to the conclusion that the system of high tenement block dwellings was as much the result of wide roads, as wide roads had become the result of the tenement system. The one, he said, was complementary to the other. It was necessary that the owner extract from each yard of his frontage enough rent to pay its share of the costly street.

At the same conference Dr. Eberstadt, in a formal paper, told how English visitors are driven about the German cities and shown imposingly broad streets "with a display of asphalt that would empty half the pits of Italy, and a show of granite sufficient to level down the mountains of Sweden, lined all along with huge five or 6-story tenement barracks." Some English visitors, he added, were full of admiration for this sort of thing; but he testified that the Germans, who have had the opportunity to study it at close range, "now wish to do away with it, as far as may be practicable, and to make their aim the English home, the cottage the individual house."

That in England and America broad streets, in areas where the poor are congested, are not—save in New York—as commonly lined with tall tenement barracks as in Germany, does not mean that the same economic law is not in operation, or that it operates less unfortunately. A social repugnance to the big tenement, except as a last necessity, has led to the construction of small houses (often more crowded per room, and less sanitary, than is the tenement block) and then, to squeeze from the land the higher rent necessitated by the cost of frontage on an expensive street, has induced the construction of another house, sometimes a small tenement, on the rear of the lot. These houses, hidden by the structures in front, are uncontrolled by ordinary police inspection and unaffected by public observation and criticism. They become such breeding places of disease and vice, that at last, in city after city, it becomes necessary to forbid their erection.

Of great significance, also, is the fact that there could be cheaper minor streets for residence purposes, less capital would be required in the development of estates, less land tied up for want of the capital, and more land thrown open for building.

Perhaps we may not think it part of the town's business to build decent dwellings for its poorer citizens—though in Europe the clearance of slums and the rehousing of the people thus displaced has been accepted as a very important, and also very costly, part of municipal activity. Yet we must recognize that the city should at least do what can be done, by the wise building of streets, to encourage good housing. In its purpose to make citizens, rather than simply add to the total of street area, it must avoid, as far as it may, whatever fosters the "warehousing" of men, women and children in tenement barracks; it must discriminate between shelter and "home," seeing in the latter more than simply the four walls of a dwelling; it must realize that a policy which provokes unwholesome methods of living, through compelling a too intensive use of the land, drains the municipal treasury in other and more serious ways than simply for the cost of making and maintaining needless broad streets. The maintenance of health and morality among poor people who have to live on lots of high priced frontage, is a more expensive business than is the maintenance of the street. And failure in it is a more serious matter to the community.

But it is our duty to consider the owner as well as the tenant. In fact, the ideal would be a condition in which each citizen would own his own home, the tenant becoming a relatively negligible quantity among the multitude of lot owners.

Fortunately it does not always happen that the tenant's gain is the owner's loss. If the narrowing of minor residence streets tends to reduce rents, it does not follow that it tends to reduce property values. The latter are for the most part—as regards property of this character the capitalization of net income, expected if not realized. A reduction in rents, which results from reduction in carrying charges, may leave net income unaffected.

But this does not mean that a method of street designing adjusted to street needs would not have any influence upon property values. Real estate would feel its influence in various ways.

In the first place it would tend to create stability in values. This effect would be seen alike on the main thoroughfares and on the minor streets. The concentration of through travel upon certain streets would raise the value of the frontage on those streets for commercial purposes; while the assurance that intermediate streets would not be encroached upon for business purposes would not only settle definitely the business character of the chosen main highways but would have a beneficial effect upon property on the intermediate streets. The reason for this is the certainty which would then be gained that they would be free from the danger of invasion by elements inconsistent, and out of harmony, with their present use. The more certain, it has been well said, a man can feel that the character of any given street is fixed, the more he is willing to pay for the privilege of having a lot on that street, if it is the kind of a street he wants. He justifies this willingness from an economic standpoint by the argument that the property, for the use for which he desires it, will not decline in value.

Another effect of a more rational method of street platting, would be, as already suggested, the opening of additional tracts for building purposes. This means that fewer persons owning property on the outskirts of cities need be "land poor." There would follow a greater equalization of values between adjoining properties.

Over against the possible depressing effect [illegible] values, which would be attendant from a greater supply of available building lots, is to be put the increase in demand, which may be expected to follow an enhancement in the attractiveness of small streets. It must be clear that streets which follow more nearly the topography, which make use of every natural advantage, which are narrow, grass bordered, quiet ways rather than broad and dusty highways that are hot in summer and cold in winter, would call men from the city streets with an even greater appeal than suburban tracts now call. In the announcement, issued by the Russell Sage Foundation, of Forest Hills Gardens, the following sentence, significant from this point of view, was prepared by the landscape architect: "Probably one of the most notable characteristics of Forest Hills Gardens will be the cozy domestic character of these local streets, where the monotony of endless straight, windswept thoroughfares, which are the New York conception of streets, will give place to short, quiet, self-contained and garden-like neighborhoods, each having distinctive character."

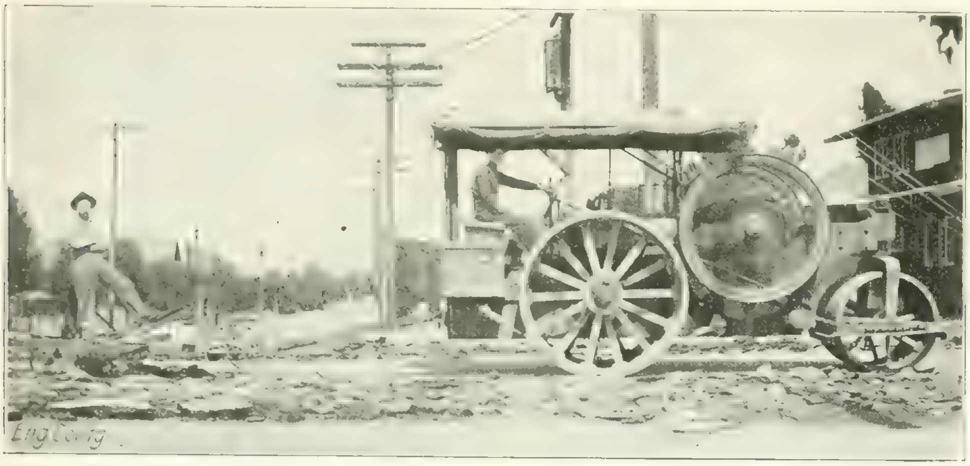

Fig. 1—View Showing Gasoline Roller Pulling Gang Rooter Plow for Breaking Up Old Asphaltic Road.

Though a good deal has been said about the cost of making needlessly wide streets, a factor of scarcely less weight is the cost of maintaining needlessly wide streets, a factor of scarcely less weight is the cost of maintaining such thoroughfares once they are built. The man who held property on a small street would make a great saving in this respect. His saving would represent not only the economy of having to provide for the depreciation of a smaller area of street, but it would be the result of a much less rapid rate of deterioration. This is because there would be nothing but local travel to wear out the street. The present property holder on a typical suburban street is very much in the position of a man required to cover his front sidewalk with a brussels carpet which each person who walks past his house does something to wear out. As everything is done to invite people to go through the street, and as now-a-days a great many play-loving persons are riding their little velocipedes up and down—in other words automobiles—the carpet wears out very fast. The man has not awakened yet to the injustice of the demand that he provides the carpet where he does not want one, and then invite people, who are only a nuisance to him, to use it. Under the saner method of street platting, his carpet would be in his front hall. It would not wear out so fast, because no one would use it but his own household, his nearest neighbors, and the persons who came to see him. He would not grudge the wear given to it in that way, and he would find that a cheaper grade of carpet, costing less in the first place, would last as long as the body brussels laid on the front walk. For these minor residential streets, inviting no through travel, would be as private entrance ways to the few houses gathered upon them.

It may be said that those who own property on the main traffic highways, would be pretty hard hit by construction and maintenance charges, if all through travel were concentrated upon their streets. This is true, but there are three answers to the objection: In the first place, their property would at once gain speculative value. It would have the commercial possibilities which are to be denied to the intermediate streets, and which pay such high returns. In the second place, it would be unfair, wherever it is demanded that wide streets be put through a residential estate for the convenience of communication between districts lying on either side of it, to require that the general body of taxpayers should pay the cost of street works in excess of what might reasonably be held to make for the convenience of the frontage and for the increase of its speculative value. Third, it is probable that, taking the city or even the neighborhood as a whole, the deterioration of pavement would be much less than under the present system. There would be a smaller street area to take care of, and some pavements, such as asphalt, deteriorate less rapidly if they carry a fairly heavy and constant stream of travel. At any rate, by concentrating the bulk of the traffic on a relatively small number of selected streets, these could be especially prepared for it, and given a width and style of pavement calculated to handle the business with the least delay and the smallest cost for operation and maintenance. Then each purely local street could be developed in the way that would best suit the needs, the means and the tests of the people it is designed to serve.

A final consideration with reference to real estate values is, that only such a system of street designing as here proposed can make just and reasonable—and that is to say, can make possible—a radical restriction of the number of houses which may be constructed to the acre. If the city is going to say to the owner of a certain tract that he can construct not more than fifteen houses to the acre, it must say to him that he will not have to pay, for the development and maintenance of the streets in his tract, any such sum that thirty houses to the acre would be necessary to give him an adequate return on the investment. The one act is really complimentary to the other. When a city restricts the number of dwellings per acre in any given area, it places an approximate limit on the amount of traffic for which provision need be made by the local streets of that area. The necessity no longer exists to require that there be adherence to rigid specifications designed to take care of a traffic which may increase with unchecked rapidity. It becomes possible at last to adjust the streets development to the property's development. But when no limit is set to the latter, as in unrestricted areas, the standard for the street work must be set by the promoter's dreams. It will be correspondingly high, and correspondingly forgetful of the common good.

Methods and Costs of Asphalt Macadam Construction at Santa Ana, Cal.

BY W. A. GILLETTE.*

The city of Santa Ana, Cal., has a considerable yardage of asphalt macadam pavement, which has combined the advantages of being solid under traffic yet resilient under the feet of horses and the wheels of vehicles, so that horses are not injured by travel and riding in iron tired vehicles is easy and pleasant. The pavement has had the further advantages of being easy of draft for all vehicles, of not being slippery when wet, and of being dustless and practically noiseless. This pavement was built under the most advanced modern methods of the type known as Petrolithic Macadam pavement.

There were several striking features in the method and the low cost of construction was surprising. Instead of crushed rock, screened gravel was used of corresponding sizes to the crushed rock that is ordinarily used. Contrary to the usual theory, the results were as good as has been produced with crushed rock. The asphalt used was a California liquid asphalt or asphaltic oil carrying 80 per cent pure asphaltum. The base was constructed of a mixture of the natural soil, which is a sandy loam, and asphalt compacted by Petrolithic tamping rollers. The asphalt macadam pavement was bedded into the top of the base by means of the same Petrolithic tamping rollers.

The old street was plowed up with a Petrolithic gang road rooter drawn by an Austin 12-ton gasoline road roller, made by the Austin-Western Co., Ltd., Chicago, Ill., as shown in the accompanying illustration, Fig. 1. The illustration, however, shows the same outfit at work on tearing up an old asphaltic road in South Pasadena, Cal. The rooter shown in the illustration is a lighter model than that now built by The Petrolithic Co. of Los Angeles. In Fig. 2 is shown the improved model of the gang road rooter.

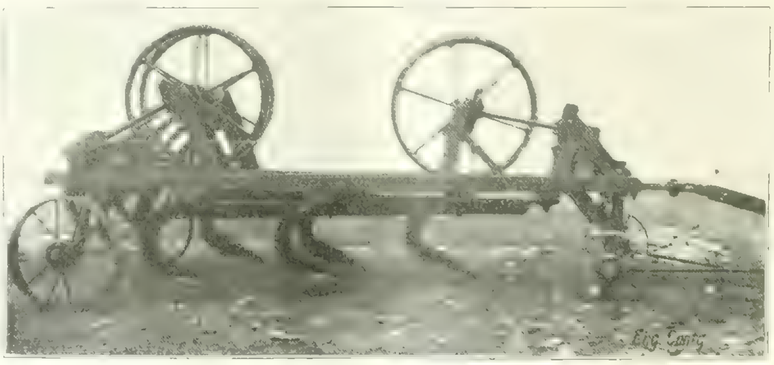

Fig. 2—View Showing Improved Model of Petrolithic Gang Road Rooter.

The cheapness of this plowing was a considerable item in reducing the total cost. One man operated the rooter, which was easily set so as to break the ground at any depth from 2 ins. to 15 ins. The rooter has five points mounted 12 ins. apart laterally, each point breaking at least 6 ins. on either side. The rooter therefore breaks a strip of ground

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*South Pasadena, Cal.

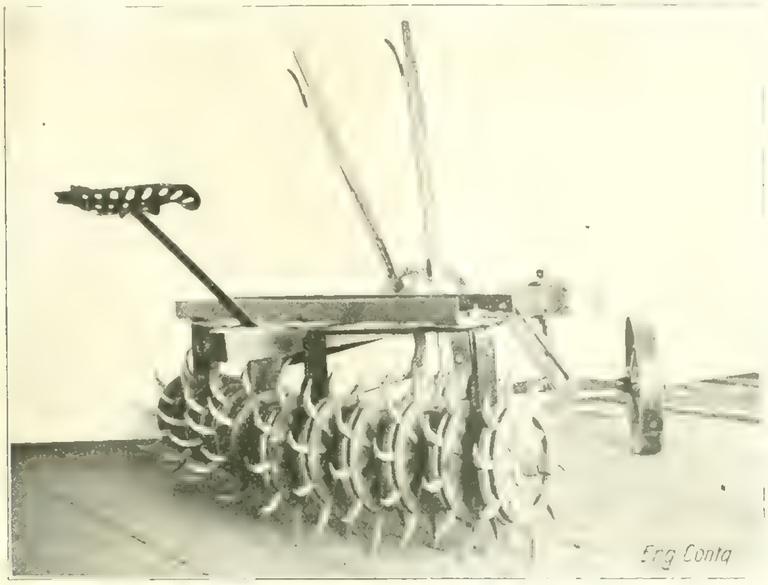

Fig. 3—Petrolithic Spike Disc Used for Mixing Oil With Rock.

5 ft. wide, reducing the cost of plowing to about one-fifth of the usual cost. The Austin gasoline roller developed sufficient power to pull the rooter in an old very hard roadbed. It lost very little time for stops and used a minimum of fuel. No stops were made during working hours to take on fuel. A usual day's work was nine hours. The operating cost of the roller was as follows:

	Per day
37 to 40 gals. distillate, 8 cts. per gal. maximum	$3.20
[illegible] lubricating oil [illegible]	.34
Engineer	[illegible]
Total	[illegible]

Three-quarters of a gallon of oil to the square yard was then uniformly spread over the loosened and pulverized material. The mass was moistened and mixed together by means of a revolving spike harrow, shown in Fig. 3, and a heavy cultivator. When evenly mixed, it was compacted with the tamping rollers, leaving about 1 in. of loose material on the top. Four inches of screened gravel was then spread on this unusually hard base and asphaltic oil carrying 80 per cent pure asphaltum was spread on the rock in the quantity [illegible] gal. per sq. yd. The rock and asphalt were then cultivated together so that each [illegible] with asphalt.

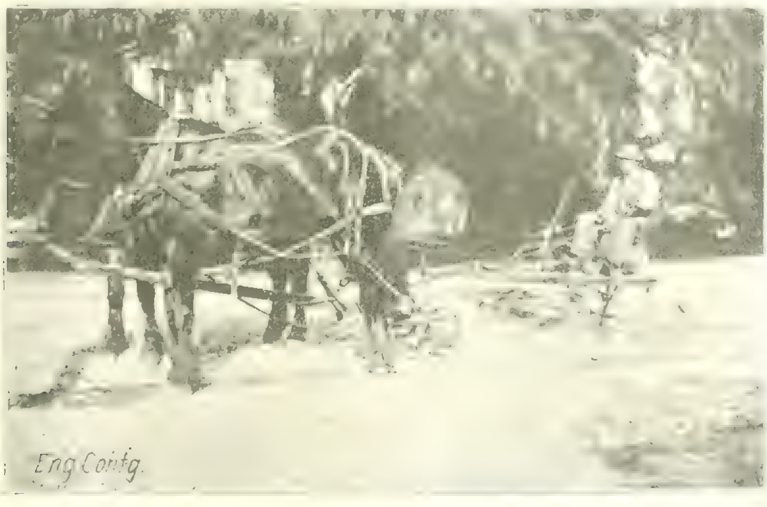

Fig. 4—View Showing Glide Road Grader Spreading the Rock.

The tamping rollers were again used until the rock became thoroughly compacted and set in the top of the base. During the entire process, the road-grader was used when needed to keep the roadway to proper crown. The compacted rock was then ironed out smooth with a smooth roller (Austin gasoline) and ⅜ gal. of asphalt oil to the sq. yd. was uniformly spread over the surface. A thin layer of rock screenings, minus the dust, was then spread over the asphalt [illegible]

Fig. 5—Finished Petrolithic Macadam Street at Santa Ana, Cal.

[illegible]

In spreading the surface coat of screenings the wagons were driven directly over the oil which did not pick up to any appreciable extent. The screenings were dumped in strips lengthwise of the roadway by putting a chain around the bottom of the wagon, the chain being hooked so as to permit the bottom doors to open only sufficiently to spread the screenings in a narrow ribbon as the wagon moved along. The screenings were then spread by using a Glide 2-horse road-grader made by the Glide Road Machine Co., Minneapolis, Minn. The driver of this grader developed such skill that he could spread the rock to any thickness required.

In hauling the rock and screenings two dump wagons, of 2 cu. yds. capacity each, were frequently hitched tandem. Five head of mules or horses were then used; two on the tongue, three abreast in the lead. Sometimes three such wagons were hitched tandem and then two more head of stock were hitched on ahead. In this way the cost of one or two drivers was saved.

Before rolling with the smooth roller the asphalt mixture was slightly dampened so as both to assist the compression and prevent the asphalt from sticking to the roller. The itemized cost of the work was as follows:

	Per sq. ft.
Grading, with an average cut of 4 ins.	$0.0075
Plowing and mixing [illegible] the base	[illegible]
¾ gal. of asphalt per sq. yd. in base, at $1.50 per bbl. [illegible]	[illegible]
Tamping the base	[illegible]
4 ins. gravel, at $1.80 per cu. yd.	[illegible]
[illegible] gal. oil per sq. yd. of gravel at $1.50 per bbl.	0.0025
Tamping the rock into the base	0.0075
[illegible] per bbl.	[illegible]
[illegible] of screenings [illegible] at $2.00 per [illegible]	[illegible]
Smooth rolling	0.0011
Total	$0.06

Notes on Road and Street Work.

Cost of Massachusetts State Highways in 1910.—The following figures, taken from the last annual report of the Massachusetts Highway Commission, show the cost of State highways completed in 1910. The table shows the costs per mile of preparing roadbed, and also the cost of the hardened surface. Under the head "grading, drainage," etc., is included all grading, all surface and sub drainage, culverts, bridges, paved gutters and fencing. The cost of hardened surface includes the stone, gravel, sand, binding materials and labor, and the use of tools and machinery used in the construction of the surface of the road. The table includes all contracts that have been

	Drainage			
			mile.	sq. yd.
trap. bituminous				
[illegible]	1,139	1,263	6,613	.614
[illegible]			6,571	.747
in trap, bituminous binder.				
Chelmsford			7,691	.828
North Andover	1,039	3,827	5,878	.667
[illegible]	1,590		3,242	.368
[illegible]	1,366	1,372	[illegible]	[illegible]
Macadam.				
[illegible]			[illegible]	[illegible]
[illegible]			[illegible]	[illegible]
[illegible]		[illegible]	6,000	.656

[illegible]	1.[illegible]	1,236	[illegible]	.570
[illegible]	[illegible]	8,669	5,044	[illegible]
[illegible]	[illegible]	438	3,710	.526
[illegible]	[illegible]	[illegible],294	[illegible]	[illegible]
Hatfield, 1909	.843[4]	1,[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4,203	.477
[illegible]	[illegible]	[illegible]	3,551	[illegible]
[illegible]	1.[illegible]		[illegible]	.361
[illegible]	[illegible]	[illegible]535	6,038	[illegible]
[illegible]	[illegible]	[illegible]	5,992	.681
Phillipston, 1909	1.751[10]	6,[illegible]	4,449	.540
[illegible]	[illegible]	[illegible]	3,792	[illegible]
[illegible]	[illegible]	[illegible]	6,571	.747
Stockbridge, 1909	.518[11]	7,[illegible]	6,356	.621
[illegible]	[illegible]	[illegible]374	1,906	.216
[illegible]	[illegible]	[illegible]	3,801	.432
Wareham	1.149[1]	2,[illegible]	6,962	.732
	Gravel.			
[illegible]	1.[illegible]	7,[illegible]	860	.098
[illegible]	[illegible]	1,812	1,030	.117
[illegible]	[illegible]	8,[illegible]	2,328	[illegible]
Lee, 1908-1909	.883[13]	7,000	2,813	.320
Marshfield	2.936[14]	1,784	[illegible]	[illegible]
Pepperell	.764[16]	5,470	2,427	.251
[illegible]	[illegible]	1,984	1,696	.193
[illegible]	[illegible]	8,374	1,906	.216
W[illegible]	1.26[illegible]	[illegible],393	2,708	.309
	Sand and oil, mixing method.			
Falmouth, 1909	1.104	8[illegible]	4,544	.481
[illegible]	1.[illegible]	1,[illegible]	3,231	.368
[illegible]	1.0[illegible]	[illegible]	3,407	.387
Wareham, 1909	1.775	1,[illegible]	2,204	.280

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[1][illegible] in. trap; [illegible] in. local stone; [illegible] in. local stone; [4]5 in. trap; [5]4 in. trap; [6]5 in. local stone; [7]5 in. local stone (cost includes bridge); [8]5 in. local trap; [9]5 in. local trap (cost includes masonry arch bridge); [10]5 in. local stone (1,000 sq. yds. oil and sand); [11]4½ local and trap; [12]4 in.; [13]5 in.; [14]4½ in.; [15]7 in. (cost includes concrete bridge); [16]5 in. (cost includes concrete bridge); [17]"Built up" method.

Cost of Street Flushing with High Pressure Machines.—In 1909 the Street Cleaning Department of New York City conducted tests of street flushing machines with a view to securing data to guide the department in awarding contracts for flushing and cleaning the streets by machines or devices in which water is used. A description of these tests was given in our issue of Aug. 25, 1909, and in our issue of Feb. 23, 1910, a summary of the data obtained from the tests was given. In the tests in order to obtain comparative costs each machine was assumed as costing $1,000, horses were placed at $300, wages of drivers and sweepers were $800 per year and horse maintenance was placed at $2.70 per day. A price of 13½ cts. per 1,000 gals. was placed on the water supplied by the city. The test showed that the flushing machine (the Connelly), which gave the highest efficiency, would on an average clean 30,605 sq. yds. of pavement per day, using for this purpose 401 gals. of water per 1,000 sq. yds. of pavement. On this basis the cost of street flushing was as follows:

Machine	$1,000
Two horses	600
Harness	50
Total	$1,650

The fixed charges per day, figuring 212 days as a year, were:

	Per Day.
Interest on plant at 4 per cent	$0.31
Repairs and depreciation at 14 per cent	.66
Depreciation on horses	.42
Horse maintenance, 2 at $1.35	2.70
Storage of machine	[illegible]
Total, fixed charges	$4.32

The operating expenses per day were as follows:

	Per Day.
One driver	$2.56
One sweeper	2.19
Total operating expenses	$4.75

It should be noticed that the item "sweeper" will be reduced when a number of machines are used in a gang, as one sweeper can serve at least two machines. On the basis of an average of 30,605 sq. yds. cleaned per machine per day, using 401 gals. of water per 1,000 sq. yds., the cost was as follows:

	Per Day.
Fixed charges	$ 4.32
Operating expenses	4.75
12,273 gals. water at 13½ cts. per 1,000 gals.	1.64
Total	$10.71

As it costs $10.71 to clean 30,605 sq. yds., the cost per 1,000 sq. yds. is 35 cts.

Average Prices of Pavements Constructed in Iowa Cities in 1910.—The following data for the average prices for pavements constructed in several Iowa cities in 1910 are taken from the Report of the Committee on Roads and Pavements of the Iowa Engineering Society, submitted at the annual meeting of the Society last February:

Brick and Brick Block.

			Concrete Base.		Cost of Materials.		
City.	Sq. yds.	Price per sq. yd.	Ins.	Proportions.	Sand per cu. yd.	Stone per cu. yd.	Brick blk. per M.
Albia	9,00	$2.07	5	1-3-6	....	....	....
Ames	1,261	1.94	5	1-6[1]	$1.00	$2.00	$11.75
Burlington	13,522	2.08	4	1-3-5	1.00[2]	1.90[3]	22.00
Cedar Rapids	44,133*	1.58	4	...	.55[4]	1.50[5]	....
Centerville	[illegible]5,000‡	2.05	5	1-3-6	1.50	2.03	1.00‡
Clinton	3,000	2.08	5	1-6	.85	1.25	....
Des Moines	93,440*	[illegible]	4	.	.75[7]	1.35[8]	.90*
Dubuque	6,263	2.00[6]	6	...	1.50	1.50	15.65
Grinnell	3,600*	1.9[illegible][9]	5	...		1.60	....
Marion	35,490*	1.60	4	...	1.25	1.25	....
Mason City	8,610	1.90	5	1-3-6	.85	1.35	18.00
Osceola	13,257	2.10	5	.	.	...	...
Oskaloosa	7,815†	1.57	..[10]	.	1.10	1.75	19.00
Sioux City	6,958	2.20	4	.	1.15[11]	1.25[12]	1.05‡
Waterloo	840[13]	3.00	6	1-3-6	1.25[14]	1.50[15]	22.00
Creosoted Block.							
Ames	2,347	[illegible].04	4	1-7[1]	1.00	2.00	.
Clinton	85,000	[illegible].40	5	1-3-6	.85	1.25	..
Des Moines	10,635	2.60	6	.	.75[7]	1.35[8]	.
Indianola	15,000	2.65	5		1.60	2.25	
Knoxville	.....	2.33	5	1-3-6	..	...	...
Perry	33,600	2.25	4	.	1.50	..	
Concrete.							
Burlington	1,255	1.48	6½	1-3-5	1.00[2]	1.90[3]	.
Des Moines	3,758	1.63	8		.75[7]	1.35[8]	
Knoxville	20,000	1.[illegible]	5	1-2-5	..	...	...
Le Mais	2,675	1.08	5	1-5[1]	.55	...	....
Mason City	18,400	1.25	5[15]		.85	1.35	.
Asphalt.							
Des Moines	101,968	2.08[17]	5		.75[7]	1.35[8]	....
Indianola	10,000	2.00	6		1.60	2.25	
Waterloo	56,707	1.88	5	.	1.00[18]	1.50[19]	. .

*Brick block. †Brick. ‡Per sq. yd.

[1]Gravel concrete; [2]$1.00 to $1.10; [3]$1.90 to $2.10; [4]At pit; [5]Delivered; [6]Also $2.09 per sq. yd. for alley paving, $2.04 for buts in 5 in. concrete and $2.02 brick in 6 in. concrete; [7]$0.75 to $1.25; [8]$1.35 to $1.50; [9]Alley paving; [10]On sand or cinders; [11]$1.15 for pit run. $1.25 for screened; [12]$1.25 to $2.50; [13]Short railway work; [14]$1.00 to $1.25; [15]$1.50 to $1.65; [15]1-2-5 concrete and 2 in. wearing surface; [16]$2.09 on 6 in. concrete base, $1.62 on macadam base, $1.24 on old foundation; [17]$2.28 on 6 in concrete base; [18]$1.00 to $1.25; [19]$1.50 to $1.65.

In addition to the above 2,927 sq. yds. of mineral rubber pavement was constructed in Burlington, the price per sq. yd. being $2.00. In Cedar Rapids 25,661 sq. yds. of tar macadam was constructed, the pavement being 10 in. thick, 2 gal. of taroid per sq. yd. being used, the price paid was $1.02. In Des Moines 412 sq. yds. of asphalt macadam was constructed, the price being $1.65 per sq. yd. The pavement consisted of a 4 in. concrete base and a 2½ in. wearing surface of mineral rubber. In Dubuque 12,327 sq. yds. of Sarco macadam and taroid macadam was constructed, the price per sq. yd. paid for the first named being $1.37; 95 cts. less per sq. yd. was paid for the taroid macadam. A total of 12,007 sq. yds. of telford macadam was also constructed in Dubuque, the price per sq. yd. being 67 cts. In Grinnell 91,020 sq. yds. of bitulithic was laid on a 5 in. 1-3-6 concrete basis, the price paid being $2.13 per sq. yd. In Perry 22,600 sq. yds. of bitulithic was laid on a 5 in. concrete base, the price being $2.08 per sq. yd.

Cost of Granite Block Pavement at Somerville, Mass.—During the past year Somerville Ave., between Lowell St. and Elm St., at Somerville, Mass., a length of 799 ft., was paved with granite blocks grouted with crushed stone and pitch, the work being done by the City Highway Department by day labor. The cost of the work according to the last annual report of Ernest W. Bailey, City Engineer, was as follows:

	Total Cost.	Per sq. yd. Pavement.
Paving blocks, 94,900	$ 6,395	$1.568
Pitch used, 53.9 tons	793	.194
Crushed stone used, 262 tons	288	.071
Labor, laying, teaming, rolling, etc.	4,650	1.145
Changing catch basins, manholes, etc.	97	.023
Resetting edgestone, relaying sidewalks, crossings, etc.	628	.154
Total (4,077 sq. yds.)	$12,8[illegible]1	$3.155

WATER-WORKS AND SEWERS SECTION

Notes on the Methods and Costs of Brick and Concrete Sewer Construction.*

From an average of 6,000,000 brick laid in two and three ring sewers in and near Chicago it is determined that there are 520 brick required per cubic yard of masonry. This average is taken for brick as counted in cars or wagons, including breakage. As it is customary to lay all bats of one-half brick or greater in the outer rings of the arch, the loss from breakage is trifling. As shipped from the brick yards, sewer brick are uniformly of good quality. Any underburned or soft brick found in the kilns are broken up or sold for building brick. The size of Chicago hard sewer brick will average 8⅜x3¾x2 7-16 ins. The use of the bats as indicated is not detrimental to the quality of the work, as the extrados is thickly plastered with cement mortar, and all joints well filled.

Utica natural cement is generally used in Chicago for mortar for brick sewers. That this is satisfactory is shown on examinations of old work in which the erosion of the brick of the invert has proceeded faster than has that of the mortar. Portland cement makes a stiff mortar that does not work freely under the mason's trowel. Hence brick-work of sewers laid in Portland cement is apt to have a larger proportion of poorly made joints than if a natural cement had been used. The remedy for this is to mix with the Portland cement a small quantity of Utica cement. The resulting mortar will be more *buttery* and easily worked.

Sewers generally, in the vicinity of Chicago, serve the double purpose of sanitary sewers and drainage of the soil. Hence the requirement of being water tight does not obtain. This permits the customary practice of building the outer ring of the invert with the first six or eight courses of brick laid tight to-

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*From a paper on Excavation, Foundations and Sewer Work presented before the Western Society of Engineers on June 7, [illegible] Windett.

TABLE I.—BRICKLAYING FORCE AND COST OF 2 RING SEWERS.

Diameter of sewer in ft.	4 No. men.	4 Cost per day.	[illegible] No. men.	[illegible] Cost per day.
Bricklayers	4	[illegible]	6	$ 60.00
Tenders	2	[illegible]	3	11.2[illegible]
Scaffoldmen	2	[illegible]	3	8.2[illegible]
Brick tossers	2	[illegible]	3	6.[illegible]
Brick wheelers	2	4.00	4	[illegible]
Sand throwers	2	[illegible]	3	6.7[illegible]
Mortar mixers	2	[illegible]	4	10.00
Mortar carriers	2	[illegible]	4	[illegible]
Water boy	1	1.[illegible]	1	1.[illegible]
Team	½	[illegible]	1	[illegible]
Foreman	1	[illegible]	1	[illegible]
Total	20½	[illegible]	3[illegible]	[illegible]
Brick and cement teaming	4½ incl. [illegible]	[illegible]	7 men	[illegible]
Total	25 men	112.77	4[illegible] men	[illegible]
No. of men to 1 bricklayer		6	6½	

gether without mortar. The writer has built many sewers discharging into Lake Michigan or Calumet river, whose inverts have been from 1 to 3 ft. below water level in sand trenches, in such locations that the use of well points would have been of no avail in the presence of so much water, and the use of water tight sheeting was not permissible with the prices obtainable for the work. By laying several courses without mortar and then following up with the haunches laid in rich mortar and also the inner course of brick likewise, sewers have been built in 10 or 15 ins. of water, which, on subsequent examination and removal, have been found to be substantially true to form and strong. This practice is also useful for work in sandy, loamy, wet trenches where points cannot be used, but water has to be pumped from a sump in the trench. In Gary, Indiana, where such a sewer was built and then cut into for examination in several places, it was found that the brick lay with joints so tight as to prevent the entrance of a thin penknife blade. The sewer was clean, as the entering water carried no sand; the coarse grains of sand, or coarse sand and fine pebbles around the joints acted as filters. By the construction of such sewers the ground-water level at Gary, Hammond, Hegewisch, and other localities has been lowered from the natural ground surface by 6 to 8 ft., making possible the building of house cellars, in what had been swampy localities.

TABLE II.—LENGTH OF SEWER PER DAY'S WORK AND COST PER FOOT.

Di[illegible]	[illegible] Rings		[illegible] Rings	
2 ft.	1[illegible] ft.	$0.81	[illegible] ft.	$0.8[illegible]
2½ ft.	107 ft.	1.05	160 ft.	1.09
3 ft.	102 ft.	1.10	153 ft.	1.15
3½ ft.	88 ft.	1.28	132 ft.	1.33
4 ft.	75 ft.	1.50	112 ft.	1.55
4½ ft.	68 ft.	1.66	103 ft.	1.70
5 ft.	55 ft.	2.08	83 ft.	2.10

Working an odd number of masons is expensive, as 1 tender, tosser, scaffoldman, sand thrower and mortar carrier can attend to 2 masons.

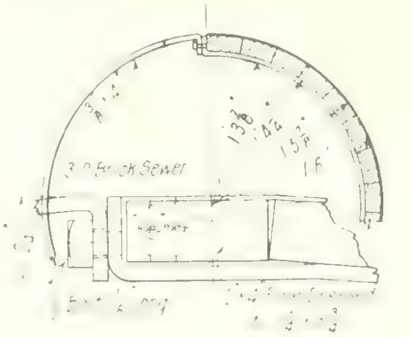
Bricklaying per mason per day, 4,009. (Ave. of 28,177 ft. of work.)

If a perfectly water-tight sewer with full joints is desired, the use of well points is imperative in wet, sandy soil. The points must be kept in service until the cement of the motar has set hard, that is, for at least two or three hours. But points cannot be used in a sand carrying clay or loam, as this will choke the screens of the points.

Brick Sewers.—The organization of a bricklaying gang is as follows: A foreman, whose duty it is to keep a steady supply of everything needed for the use of the masons, is placed on the berm of the trench. Each 2 bricklayers has a helper in the bottom. According to the depth of the trench there are 1 to 3 scaffold men for each tender and a brick tosser on the bank, and 1 mortar carrier. Two mortar makers will serve 4 masons. From 2 to 6 men are required to take down the arch centering of ribs and lagging, pass it ahead, and set it up again. It is uneconomical to work an odd number of masons, as the same number of auxiliaries can serve 2 masons as easily as one.

The average day's work of a mason working 8 hours was found to be 4,000 brick laid in place. The maximum number laid per day was an average of two days' work on a 2 ft. diameter two ring sewer in a moderately wet trench where an average of 7,583 brick were laid per man. The minimum happened to be on a larger and easier sewer to build where, however, other adverse circumstances cut the day's work to 2,700 brick. A safer average is 3,500 brick per man per day, at a cost of $28.20, or $8.05 per thousand for labor of the bricklaying gang.

Table I, based on 4,000 brick per day, gives the output and rate of construction for various sizes of sewers which ought to be reasonably expected, as it is the rate maintained for four years' time.



Form for Sewer.

Manholes.—Brick manholes are usually built 3 ft. internal diameter of two bricks in thickness or 9 ins. The inner ring is built with brick standing on end and bonded every fourth course with one course laid flat. The outer ring is built best of half bricks or bats laid flat.

The most economical way of building brick [illegible] slightly conical in shape as a *form* against which to lay brick. The taper need not be over ½ in. and is for the purpose of making it easy to raise the form as the brickwork requires. The height of the form or drum is usually 3 ft., so as not to make it too heavy for ease of handling. When iron steps are placed in the manhole, a slot can be cut into the drum 1 in. larger all around than the step for clearance.

In case steps are used they are best spaced approximately 16 ins. apart; a width of 9 ins. is sufficient. The best form of step is that used on telephone poles, in which the foothold or step is bent, or dropped 1 in. below the sides, so as to prevent a user's foot from slipping off sidewise. The ends should project through to the outside of the wall, and bend up 1 or 2 ins.

In building manholes or catch basins, two bricklayers should work together on account of requiring no more helpers than one mason. It is better to *raise* manholes when the bricklayers cannot work on the sewers, so as not to disorganize the main work of the masons; their work is to push construction of the sewer itself at top speed.

TABLE III [illegible]

Size of Sewer.	Height of manhole.	H[illegible]	Cost	Brick	Bbls	Materials	[illegible]
4 ft. [illegible] in. brick.	[illegible]	[illegible]	[illegible]	713	1.1	[illegible]	$15.[illegible]
3 ft. 6 in. brick.	[illegible]	1[illegible]	1.96	[illegible]	1.4	[illegible]	[illegible]
3 ft. [illegible] in. brick.	5.3	11.1	4.95	626	1.3	9.81	[illegible]
2 ft. 0 in. brick.	[illegible]	9.0	[illegible]	727	1.4	9.80	[illegible]
1 ft. 6 in. pipe..	8.8	31.1	13.60	1,262	2.6	13.50	[illegible]
1 ft. [illegible] in. pipe..	[illegible]	31.0	[illegible]	1,141	2.4	[illegible]	26.56
1 ft. 0 in. pipe..	7.9	[illegible]	12.05	1,100	2.[illegible]	12.10	24.[illegible]
Ave. brick	[illegible]	10.2	[illegible]	[illegible]	1.4	9.83	[illegible].78
Ave. pipe	[illegible]	[illegible]	12.62	1,168	2.4	12.80	[illegible]2

Height of manholes for brick sewers is measured from extrados of arch; for pipe [illegible] is the full height of the brick work.

Manholes on pipe sewers are best built up to the center line of the sewer as soon as possible after the excavation is made, so that pipe laying may proceed without delay. In some cases it is possible to do this ahead of pipe laying, which is highly advantageous, and then complete the manhole, when the mason is not preparing another *bottom*.

The cost of such holes is shown in Table III, in which is given average costs for 178 manholes.

A summary of Table III is as follows:

Average size, 3 ft. diam.; 7 ft. 11 ins. high; 9 in. walls.

No. brick each, 1,080, or 2.52 cu. yds.

No. bbl. [illegible]

Volume of masonry per lin. ft.	0.3
Labor [illegible] per [illegible]	21
Labor in hrs. per lin. ft. in height	2.65
Labor per [illegible]	[illegible]
Labor cost per manhole	$10.67
Labor cost per lin. ft. manhole	$ 1.36
Labor cost per cu. yd. masonry	$ 4.23
Average rate of wages, including masons, [illegible]	[illegible]

Table IV shows the average costs of concrete manholes.

TABLE IV.—CONCRETE MANHOLE COSTS.

	Hand-[illegible]	Machine-[illegible]
Concrete.		
Height	13 ft. 0 in.	11 ft. 3 in.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible] height, cu. yds.	.37	.37
Number [illegible]	[illegible]	10

COSTS PER MANHOLE.

	Hrs.	Cost.	Hrs.	Cost.
Haul of mixer			[illegible]	[illegible]
Unloading sand and stone	2.2	$0.39	2.2	0.39
Unloading cement	[illegible]	[illegible]	[illegible]	0.13
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mixing [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wheeling [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Spreading and tamping	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Forms	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]
Cost per foot of height	3.1	0.77	6.0	1.40
[illegible]				0.[illegible]

COST PER CUBIC YARD OF CONCRETE.

	Hrs.	Cost.	Hrs.	Cost.
Haul of mixer	...	.....	0.2	$0.10
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mixing concrete	2.1	0.52	2.6	0.61
W[illegible]	[illegible]	[illegible]	[illegible]	0.13
Spreading and tamping	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
T[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	13.4	$3.37	14.0	$3.51

Brick Catch Basins.—Brick catch basins are built in Chicago with a 2-in. plank bottom. The basins are 4 ft. internal diameter for 5 ft. 6 ins. height and draw in to a diameter of 2 ft. in 20 ins. of height. A 9-in. half trap is set with the bottom 3 ft. 6 ins. above the planking. The brick work is 8 ins. in thickness.

Catch basins are best built toward the close of piece of sewer work, as usually the soil is then somewhat drained by the sewer.

A small gang of diggers is organized so as to keep just ahead of the masons. Two men are put to digging each hole; no sheeting need be used, as the hole is open for so short a time as to render caving unlikely. The sides are sloped just enough to prevent slides. [illegible] points attached to a diaphragm pump will be needed.

As soon as bricklaying is begun, two men are put to digging for and laying the discharge pipes from the basins to the sewer. The work so organized can be cheaply and quickly built.

The cost of basins and connections are [illegible]

[illegible] brick at $[illegible]	[illegible]
[illegible] M [illegible]	
[illegible] at $0.636	1.[illegible]
[illegible]	1.[illegible]
[illegible]	[illegible]
Superintendence	[illegible]
Total	$[illegible]

The planks for the bottom were cut out of worn-out short sheeting which had done full service in the sewer construction and hence were charged to the catch basins at a low cost.

CATCH BASIN CONNECTIONS.

		Per ft.
Labor [illegible]		$[illegible]
Materials—9-in. pipe	$5.50	
Cement	.18	
Jute	.08	5.76
Superintendence		[illegible]
Cost per foot, [illegible]		$[illegible]

COSTS PER FOOT OF MAIN SEWER.

	Brick Sewers.	Pipe Sewers.
Manholes	$0.090	$0.1[illegible]
Catch basins	0.2[illegible]	0.2[illegible]
Catch basin connections	0.089	0.089
Total	$0.432	$0.532

CONCRETE SEWER MASONRY.

In this work, Smith ½ yd. concrete mixers were used. A course of considerable expense was found to be in the case of sewers running across country such as the sandy tracts of the Gary, Ind., locality in making runways for the transportation of the machine along the sewer. At every shift of the machine, runways and elevated dumping platforms for charging the machine called for considerable work. In the new style of elevator charging boxes this expense is done away with. Two wheeled stone and sand barrows or buggies holding 4 cu. ft. each with ball-bearing wheels are better than any ordinary steel wheel barrow for economy of operation, repairs and durability. The ordinary wheel barrow holds but 2 cu. ft. and requires harder work at a slower speed, as much of the weight of the load is carried by the wheeler.

As the volume of concrete per lin. ft. of sewer is comparatively small, the amount of work as indicated above amounts to so much per cu. yd. that the economy of machine work over hand work is small—amounting to $0.24 per cu. yd. for labor, based on over 8,600 cu. yds. of work.

At Clearing, Ill., on a job of 2,800 cu. yds. of concrete sewer, the invert was put in by machine and the arch was placed by hand, at costs of $1.70 and $2.40 per yd, respectively; for machine and hand labor, the work was so arranged that the material track was but 20 ft. from the men, and the concrete was made right over the work.

In the case of the concrete manholes built, the hand-mixed concrete was made on a small mixing board close to the manhole, and the machine-mixed concrete was usually wheeled a considerable distance, as the manholes were not complete until some days after concreting the sewer arch, and the machine had generally moved a considerable distance ahead. The costs for labor were: hand-mixing, $0.77, machine mixing $1.10, per foot of height of manhole.

In building a concrete sewer it is best to build the invert up to a height of 12 to 18 ins., forming it by mold boards set every 20 ft. or so. When this is hard, the ribs and lagging for the rest of the sewer are set up, and concreting carried to completion.

The operations are timed so that the concreting of the invert is done in the afternoon. The centers are set up early in the morning and followed immediately by concreting the arch.

In sewer work the operations naturally fall under three headings, viz.: trenching, masonry, general labor. Trenching includes excavation, sheeting and bracing, pumping and backfilling. The distribution of expense of the various operations of construction is given in Table V, which is based on 55,000 lineal feet of work.

TABLE V.—PROPORTIONAL DIVISION OF EXPENSES OF CONSTRUCTION.

	Concrete Sewers.	Brick Sewers.	Pipe Sewers.
Excavation labor	12.1%	20.7%	22.3%
Sheeting and bracing labor	7.0	10.0	7.2
Backfilling labor	4.9	3.3	6.0
Pumping labor	.5	2.3	10.0
Total trenching labor	24.5	36.3	45.5
Masonry labor	25.0	20.0	4.9
Operating superintendence	4.5	5.2	4.6
Total labor	54.0	61.5	55.0
Materials and supplies	41.6	30.0	29.6
Office expense	4.4	8.5	15.4
Totals	100.0	100.0	100.0

At the time when the invert is placed in the concrete or brick sewers, the work is 57 and 65 per cent, respectively, completed. In the case of the pipe sewers when the pipe is in

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Maps for City Use.

In a paper relating to the surveying and mapping of cities, published in *Railroad Men*, Mr. C. H. Rice gives the following outline of a set of maps ordinarily needed by a city, and the uses to which they may be put:

First.—A general map, embracing the entire city, on a scale of about 500 ft. to 1 in., showing horizontal contours at intervals of 5 ft., streets and their names, blocks and their numbers, the various political and governmental districts, public and important private buildings, and lines of transportation and travel.

Upon this map the broad, general lines for public improvement may be projected—such as streets, sewers, etc. It will serve the various branches of the city government for an index. For example: the water board can use it to show the general location of water mains, fire hydrants, etc. Corporations, such as the gas, electric and street railway companies, will make much the same use of it. It will serve the general public as a wall map. Such a map will be the last one to be prepared, because it is, in fact, a compilation of all the others.

Second.—Maps on a scale of 200 ft. to 1 in. should cover about 1 square mile for each sheet. They should show horizontal contours at intervals of 5 ft.; all streets and alleys; all buildings and fences; and the conditions of the ground, whether wooded, grass, or cultivated.

Upon the separate sections of this map the details of street locations and drainage problems can be more closely studied than upon the general map. If the contours are well located reasonably accurate profiles may be prepared from them.

The general public will use a great many copies of this map. Every real estate owner ought to possess the sheet upon which his property is located. From such a map the owners of large tracts may have relief models prepared, thus enabling the landscape gardener to study methods of improving and beautifying their grounds to far better advantage than by any other means.

Third.—Maps on a scale of 100 ft. to 1 in. may be conveniently made to embrace ¼ sq. mile. Nearly everything upon the surface of the ground should be shown, to say nothing of much that is underground—such as sewers, gas and water mains, electric conduits, etc. Most engineering problems may be worked out in detail with the assistance of such maps. The various departments of the city government will have occasion to use them constantly. As an example, the street department can show the character and condition of the pavement in different streets, the date and by whom laid, and much other information of like character—matters constantly wanted by committees of city councils, contracting firms or private individuals.

Fourth.—Maps on a large scale cannot, of course, cover a very large territory without becoming unwieldy. Twenty-four sheets to the square mile has been found a convenient size. The dimensions of blocks might be allowed to determine the matter, by so arranging the sheets that complete blocks would always be shown on each sheet.

Such maps ought to contain everything a map can be made to show, even to the ground plans of buildings, materials of which the buildings consist, number of stories, and owners' names.

STEAM AND ELECTRIC RAILWAY SECTION

Resistance to Flow Through Locomotive Water Columns.*

Water is delivered to the tanks of locomotives either directly from an elevated tank or through a pipe line and a discharging device known as a water columns, standpipe, or penstock. Qualifications commonly recognized as desirable in a locomotive water column are (1) the hydraulic properties of rapid discharge, moderate frictional resistance to flow, easy movement and control of valve, and freedom from objectionable water hammer; (2) a mechanical construction permitting easy and satisfactory operation and convenient inspection and repairs; (3) a design giving reasonable cost of manufacture and maintenance. Little definite information on the hydraulics of water columns has been available, so that in designing water service plants the engineer has been largely in the dark in making allowance for the head lost through the water column, or even in the selection of size of water column, and the differences of practice are considerable.

This paper gives the results of tests, made in the Hydraulic Laboratory of the University of Illinois, of fourteen water columns covering the principal types used in supplying water to locomotives in the United States. The tests were made for the purpose of determining the losses of head through the column, including the loss in the valve and in the riser and spout. Incidentally, the action of the valve in closing and the changes in pressure in front of the valve were studied with a view of getting information on the influence of the type of the valves on the development of water hammer in the supply main. A general statement of the principles of water hammer and their application to a

TABLE I.—CLASSIFICATION OF WATER COLUMNS.

Designation.	Name.	Valve.	Operation.	Spout.	Nozzle.
I	Poage, style D	Globe	Manual	Telescopic	
II	Poage, style B	Globe	Manual	Rigid	Anti-splash
III	Poage, style F	Angle	Manual	Telescopic	
IV	Poage, style A	Angle	Manual	Rigid	Anti-splash
V	Otto	Angle	Manual	Ball and Socket	
VI	[illegible]	Globe	Hydraulic	Rigid	Anti-splash
VII	Mansfield	Angle*	Manual	Rigid	With appended bucket
VIII	U. S.	Angle	Hydraulic	Rigid	With appended bucket
IX	Sheffield	Angle	Combination	Rigid	Conical anti-splash
X	Golden-Anderson	Globe	Hydraulic	Rigid	Anti-splash
XI	Sellew	Gate	Hydraulic	Rigid	Anti-splash
XII	Poage, style H	Angle	Manual	Telescopic	
XIII	Poage, style H	Angle	Manual	Rigid	Anti-splash
XIV	Otto	Angle	Manual	Telescopic	

*Angle valve does not replace the elbow.

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*Abstract of paper by Arthur N. Talbot and Melvin L. Enger, published in Bulletin 48, University of Illinois Engineering Experiment Station.

TABLE II.—LOSS OF HEAD IN 10-IN. WATER COLUMNS

Designation	3,000 gal. per min.			4,000 gal. per min.			5,000 gal. per min.		
	Valve.	Riser.	Total.	Valve.	Riser.	Total.	Valve.	Riser.	Total.
I	12.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35.0	8.0	43.0
II	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35.0	14.0	49.0
III	[illegible]	[illegible]	11.2	[illegible]	[illegible]	[illegible]	31.3	8.0	..
IV	[illegible]	[illegible]	[illegible]	20.0	[illegible]	[illegible]	31.0	14.0	45.0
V	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18.0	17.0	35.0
VI	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45.0	20.0	[illegible]
VII	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.0	72.0
VIII	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.0	10.0	35.5
IX	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.8	18.7	36.5
X	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.0	56.5
XI	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.3	19.7	[illegible]
XII	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.0	[illegible]	24.6
XIII	6.2	5.7	12.1	11.1	10.0	21.1	17.3	15.7	[illegible]
XIV	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.8	6.8	24.6

Note.—The loss is given in feet of water f[illegible]

water service installation, as well as [illegible] relief valves, is also given.

The water columns were furnished by the manufacturers as representing the regular article supplied to the trade. The 10-in. size was chosen for the tests, since it is a medium size and since with this size a high velocity could be maintained through the water columns with the facilities of the laboratory. The water columns are designated by the Roman numerals given in Table 1, the numbers being used in the order in which the tests were made.

In the classification, the terms globe, angle, and gate are used as roughly indicating the form of the valve. The method of operating the valves, both in the manual type and in the hydraulic type, differed considerably. The form of spout used was chosen by the manufacturer, the form used being no part of the test, since both rigid and adjustable spouts are made by manufacturers. The nozzles marked "anti-splash" are cylindrical nozzles having a reticulated diaphragm to straighten the filaments of the discharging stream. The one marked "Conical anti-splash" was an open cone. The other nozzles were plain cylinders.

The tests of the first ten water columns were made in October, November, and December, 1909. Water columns XII, XIII and XIV are new forms of columns, designed after the first tests were made; these were tested in January, 1911.

GENERAL ARRANGEMENT OF APPARATUS.

In a test, the water column was connected to a tank or standpipe (hereinafter referred to as the tank) as shown in Fig. 1; a constant head was maintained in the tank during the test run by means of large pumps; the rate of discharge of the water column was measured by means of a weir; and the pressures were determined by mercury gauges. The tank was 4 ft. in diameter and 60 ft. above the foundation and acted as a regulating chamber in maintaining a uniform flow. The pipe *B* leading from the 15-in. outlet of the tank was 12 ins. in diameter. The nipple at *C* was connected with a 10-in. pipe 3 ft. long, and the water columns were connected to this 10-in. pipe at *E*. The piezometer connection at *D* was from 6 ins. to 15 ins. from the inlet *E* of the water column according to the form of connection with the water column. One opening was placed in the side of the 10-in. pipe and one in the bottom, cocks being arranged to permit readings to be taken from the separate openings. A ¾-in. pipe led from the piezometer connection to a mercury gauge placed in a convenient position. A second piezometer connection was made in the vertical part of the water column at a point *G* about 6 in. below the usual ground line and this was connected with a second mercury gauge. The point *G* was chosen where conditions would be fairly common in all the water columns, being well above the valve arrangements in every case. The arrangement of the piezometer connection at *D* and at *G* is shown in the upper part of Fig. 1. The piping to the gauges was so arranged that any accumulating air would be carried out and the correct pressures observed. The effect of the elbows and not the 10-in. connection was such that the distribution of flow over the section at *D* was not uniform, and this lack of uniformity may affect the piezometer readings noticeably for the higher flows, although observations taken alternately with the two piezometer openings at *D* showed only little differences. The difference in level between the zero level of these gauges and the discharge level of the water column was measured, and the pressure with reference to this discharge level was recorded. The level of the free discharge was considered as at the end of the spout, except that for the water columns with telescopic spouts the center of the orifice discharging into the spout was used since there was free admission of air at this point. Having the observations and measurements, the total head lost in the column could be found. The observations also permitted the finding of the amount of head lost between the inlet to the column and the point in the riser just below the ground line; this would include the loss in the tee, the loss through the valve and the frictional and other losses in the lower portion of the riser. The loss between the point below the ground line and the discharge outlet was also determinable. In all cases, of course, the head required to lift the water to the level of the spout was not counted as lost head. The discharge of the water column was measured over a 3-ft. standard weir having suppressed end contractions. This weir has been calibrated so that its coefficients are known with reasonable accuracy, and the conditions of the test were such that the measurement of the discharge is trustworthy.

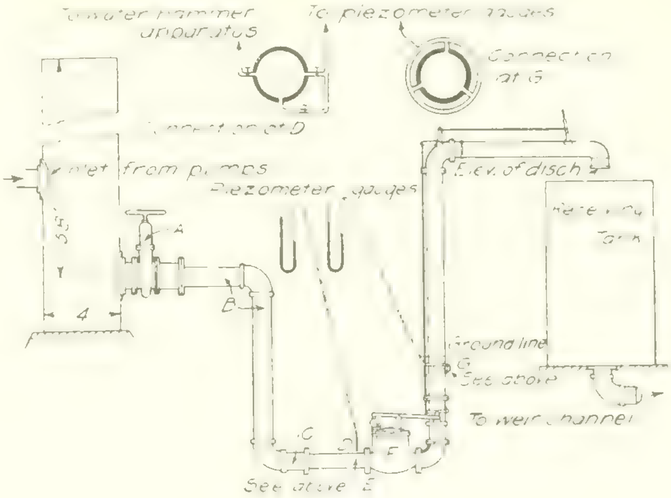

Fig. 1.—General Arrangement of Apparatus.

PROCEDURE OF TESTS.

For each of the water columns tests were made in such a way as to give discharges of approximately, say, 1,500, 2,000, 2,500, 3,000, 3,500 and 4,000 gallons per minute, the head of water in the tank being made such as to produce the desired discharge. In starting the test the valve was opened under a low or medium head, and the water was maintained at a uniform height in the tank during the run. After the flow over the weir had become constant at about the desired discharge, readings of the pressure gauges and the hook gauge were taken at four to five minute intervals for a period of twenty to thirty minutes. The pumps were then speeded up and the head in the tank increased until a quantity approximating the next higher discharge desired was obtained. After the flow over the weir had been found to be constant, readings were taken in a similar manner for a period of twenty to thirty minutes for the second run. Another increase in the head in the tank was then given and a run at the next higher discharge was made. The discharge was increased until it reached the limit of the capacity of the pumps for the head taken by the column under test. Repititions were obtained to give a check on the general conditions of any test.

[illegible]

The results of the tests were platted to logarithmic scale, a typical case being shown by Fig. 2. The abscissas give the discharge in gallons per minute and the ordinates the head lost in feet of water. [illegible] total head lost through the water column in the several experiments are shown by open circles. The values of the head lost through the part of the water column above the ground line piezometer connection are shown by solid circles. In each case the head necessary to give the velocity head and the entrance head are, of course, not included.

Loss Diagrams.—The lines for the 10-in. water columns drawn on these diagrams agree very closely with the observed results. It would seem that this line may be used with fair accuracy up to a discharge of 5,000 gal. per min. As drawn, the head lost is made to vary as the quare of the velocity. It appears that the variation as the square of the velocity fits the results of all the tests as closely as any power which could be selected.

From general considerations it would seem reasonable to expect that 8-in. and 12-in. water columns will have losses approximately the same as those from the 10-in. water columns at the same velocity of flow, although, of course, the element of pipe friction through the column would probably differ somewhat from this, and result in a somewhat smaller loss for the 12-in. columns and a larger loss for the 8-in. water columns. The lines marked "8-in. water column, estimated," and "12-in. water column, estimated," are based on the assumption of equal losses at the same velocities.

Table II gives the loss of the head in the 10-in. water columns for discharges of 3,000, 4,000 and 5,000 gallons per minute. The column marked "Valve" in the table gives the loss from the inlet to the ground line, and, of course, includes other losses than valve losses. The column marked "Riser" gives the losses from the ground line up, including that in the spout in water columns having fixed spouts.

Table III gives coefficients for the loss of [illegible]

this coefficient, the loss of head in feet equals

[illegible]

and *g* the acceleration of gravity. The nominal size of the column was used in calculating velocity. The coefficients give a good means of comparing the losses in the water columns with the losses by friction in supply pipe, bends, tees, etc. The table also gives the equivalent length of new cast-iron pipe which will give the same frictional loss as is found in the water column itself. As this length will vary somewhat with the velocity of flow, the tabular values are based on a discharged of 4,000 gallons per minute.

Comparison of Loss of Head.—By examining the water columns it may be seen that the form of some of them is not in accordance with the principles of good hydraulic design. Sudden changes in direction, sudden contraction and expansion of the section of the stream, and tortuous passages are among the objections found, and high local velocities are especially troublesome. The high losses found in some of the water columns were, therefore, not unexpected. It seems probable that the need of providing certain mechanical features was placed uppermost in making the design, and that the hydraulic requirements were neglected.

It is evident that the rate of discharge of water columns under working conditions is much less than many engineers have supposed and that water columns are frequently rated too high in the catalogs of manufacturers. A comparison with the length of pipe which will give a friction loss equal to the loss through a 10-in. water column may help to give an appreciation of the great loss of head in the water column. It may be shown that at a given discharge the loss through a 10-in. water column is equal to the frictional loss for the same discharge through a 10-in. pipe line 186 ft. long with the water column having the lowest loss of any in the series except XI, and 566 ft. long with the one having highest loss; or if a 12-in. pipe be used to feed the 10-in. water column a line 437 ft. long would give the same friction loss as the first named water column one 1,330 ft. long the same as the last named water column. If it is necessary to lift the water to a greater elevation to provide the necessary head, it is evident that the cost of pumping water to the extra height and also the expense of giving a greater elevation to the tanks must be considerable. The use of larger water columns suggests itself as one way of keeping the lost head to a reasonable limit, though it is reported that firemen have some difficulty in handling some types of adjustable spouts of the larger columns.

TABLE III.—COEFFICIENT OF LOSS OF HEAD IN 10-IN. WATER COLUMNS AND THE EQUIVALENT LENGTH OF STRAIGHT PIPE GIVING THE SAME FRICTION LOSS.

Designation	Coefficient n in $n\frac{v^2}{2g}$	Equivalent Length of Pipe 10-in.	12-in.	14-in.
I	6.72	338	791	1,690
II	7.65	384	900	1,920
III	6.14	308	722	1,540
IV	7.04	354	829	1,770
V	5.41	272	637	1,360
VI	10.20	510	1,195	2,550
VII	11.30	566	1,330	2,840
VIII	5.58	280	800	1,400
IX	5.65	284	811	1,420
X	8.83	444	1,040	2,220
XI	3.60	186	437	940
XII	3.67	190	446	960
XIII	4.94	256	603	1,295
XIV	3.67	190	446	960

The Discharging Capacity of Water Columns.—Since the head available in a water column depends upon local and other conditions, and the economic problem is so varied, the selection of a limiting or maximum velocity of flow upon which general design may be based can not be made. However, it is evident that the economical velocity through a water column and also through the supply main will be much above the limiting velocity used in ordinary water works practice where continuous flow through twenty-four hours and the cost of pumping against the friction head of long lines of mains combine to make the economical velocity less than 5 ft. per second and sometimes as low as 3 ft. per second. Aside from such considerations as the cost of pumping and that of giving sufficient elevation to the supply tanks, the maximum velocity allowable through a water column will depend upon such matters as the satisfactory operation of valve and the effect of closing the valve in producing water hammer in the supply main. From a study of these tests and a comparison with water works practice, it would seem that with a short line of pipe from the supply tank a velocity of 12 or 15 ft. per second through the water column may be considered as the maximum desirable velocity for ordinary conditions, and for longer lines the limiting velocity should be smaller. For a long line of supply main the limit of allowable velocity would be perhaps as low as 8 ft. per second. It would seem, then, that 3,000 gal. per min. for an 8-in. water column, 4,000 gal. per min. for a 10-in. water column, and 6,000 gal. per min. for a 12-in. water column may perhaps be considered to be the limit of desirable flow through water columns. It would also appear that a loss of much more than 20 ft. of head for the discharges just mentioned may be considered to be excessive, under conditions of ordinary tank supply.

Calculations for Water Service Installation.—Although the calculations involved in the design of sizes for water service plants are not within the scope of this bulletin, it may be convenient to some readers to include here a brief review of a method which may be used in making calculations of sizes of pipe mains and loss of head. The method here given follows the report of the Committee on Water Service of the American Railway Engineering Association,[*] the method being the joint work of Mr. Ferriday and the writers.

TABLE IV.—LOSS OF HEAD IN 10-IN. WATER COLUMNS.

Designation.	Loss of Head for Velocity Given in Caption 10	12	15	20
1	10.3	14.6	23.2	41.4
II	11.7	16.9	26.4	47.0
III	9.4	13.5	21.2	37.6
IV	10.8	15.5	24.2	43.1
V	8.3	12.0	18.7	33.5
VI	15.6	22.5	35.1	62.4
VII	17.3	25.0	39.0	69.3
VIII	8.6	12.3	19.3	34.3
IX	8.7	12.5	19.6	34.8
X	13.5	19.5	30.4	54.0
XI	5.6	8.0	12.6	22.4
XII	5.7	8.2	12.9	22.8
XIII	7.7	11.1	17.3	30.7
XIV	5.7	8.2	12.9	22.8

Note.—The velocities are given in feet per second and the loss of head in feet. These values may be considered also to be applicable to 8-in. and 12-in. water columns. The loss given does not include the velocity head of the entering water.

The total head producing flow (called by the committee the "flow head") is utilized in overcoming resistances and is equivalent to the sum of several items—velocity head of the flowing water, loss at entrance, friction in pipe, loss in elbows, etc., and loss through the water column. This may be expressed by the following equation:

$$H = m\frac{v^2}{2g} + e\frac{v^2}{2g} + h_1 + n\frac{v^2}{2g} + \frac{v^2}{2g} \ldots\ldots (1)$$

where H is the "flow head," $m\frac{v^2}{2g}$, $e\frac{v^2}{2g}$ and $n\frac{v^2}{2g}$ are the losses in head at entrance, in elbow and tees, and in the water column, respectively, $\frac{v^2}{2g}$ is the velocity head of the issuing water, and h_1 is the frictional loss in the pipe line. When the supply main and the water column are not of the same diameter, the v to be used in the several terms will be that for the size in which the loss occurs.

If it is desired to know the flow head necessary to produce a given discharge, substitute values in equation (1). Thus, if 6,000 gal. per min. is to be discharged through 200 ft. of 14-in. pipe and there is one elbow with a radius of curvature equal to 1½ diameters and if the water column used is a 12-in. Type V, the following values of the heads will be obtained, if we neglect loss in contraction of section from 14-in. pipe to 12-in. column:

	Feet of head.
Entrance head $m\frac{v^2}{2g}$	2.5
Loss in one elbow $e\frac{v^2}{2g}$	1.1
Loss in 200 ft. of 14-in. pipe	6.6
Loss in water column	24.0
Velocity head $\frac{v^2}{2g}$	4.5
	38.7

That is, it will require that the level of water in the supply tank remain not less than 38.7 ft. above the level of the discharge point of the water column.

If a given combination of pipe line and water column and a specified flow head be the known quantities and it is desired to find the rate of discharge, the most convenient process is a trial method. Assume a discharge as close to the probable discharge as may be estimated and by equation (1) calculate the flow head required to give this discharge with the combination of pipe line and water column. Divide the specified flow head by the flow head thus found by calculation and call the quotient the trial ratio. Multiply the water column loss used in the calculation by this ratio; the product may be considered an approximation to the loss which will be found in the water column under the conditions specified. From the diagram for water column losses find the discharge which corresponds to this water column loss. The amount so found will be approximately the discharge of the given combination of pipe line and water column.

TABLE V.—LOSS OF HEAD IN WATER COLUMNS.

Designation.	8-in. 2,000	8-in. 2,500	10-in. 3,000	10-in. 4,000	12-in. 4,500	12-in. 6,000
I	16.7	26.0	15.5	27.7	16.7	30.0
II	19.0	30.0	17.7	31.5	19.0	24.0
III	15.6	24.6	14.2	25.3	15.6	28.2
IV	17.3	27.0	16.2	29.0	17.3	31.0
V	13.5	21.0	12.5	22.3	13.5	24.0
VI	25.1	39.5	23.5	41.8	25.1	45.0
VII	28.0	43.0	26.1	46.5	28.0	50.0
VIII	14.0	22.0	13.0	23.0	14.0	25.0
IX	14.1	22.2	13.1	23.3	14.1	25.5
X	22.0	24.5	20.3	36.4	22.0	39.5
XI	9.5	14.6	8.7	15.4	9.2	16.7
XII	9.7	14.9	8.9	15.8	9.6	17.0
XIII	13.2	20.5	12.1	21.1	13.0	22.4
XIV	9.6	14.9	8.9	15.8	9.6	17.0

Note.—This table is based on the loss found in 1-in. columns and on the assumption that the loss of head at any given velocity of water is the same for the different sizes of columns of a given type. The loss is given in feet of head of water and the discharge in gallons per minute.

As an example, let it be required to find the dischage through 400 ft. of 12-in. pipe and a 10-in. water column of Type VIII, the line having two elbows with radius of curvature of 1½ diameters and the controlling level of the water in the tank being 30 ft. above the discharge orifice of the water column. Assume that the discharge will be 3,000 gals. per minute. Then the necessary head by equation (1) may be found as follows:

	Feet of head.
Entrance head, $m\frac{v^2}{2g}$	1.1
Loss in two elbows, $e\frac{v^2}{2g}$	1.0
Loss in 400 ft. of 12-in. pipe	8.4
Loss in water column	13.0
Velocity head (10-in)	2.5
Total head required	26.0

The trial ration then is $\frac{30}{26} = 1.15$, and the loss through the water column may be expected to be 13.0 × 1.15 = 15.0 ft. By Fig. 3 the discharge through the water column for a loss of head of 15 ft. is 3,250 gals. per min. Using equation (1) for a discharge of 3,250 gals. per min., the calculated loss is found to be 29.9 ft., so that the discharge of 3,250 gals. per min. may be considered to be sufficiently close.

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[*] See Proceedings, American Railway Engineering Association, vol. 11, p. 1161.

TABLE VI.—EXAMPLES SHOWING THE DISCHARGE AND THE LOSSES FOR VARIOUS COMBINATIONS OF PIPE LINES AND WATER COLUMNS.

Note—Distances, heads and losses are given in feet, diameters in inches, discharges in gallons per minute.

Depth in tank.	Tank bottom above rail.	Pipe Line Length.	Pipe Line Diam.	Water Column Dia.	Water Column Des.	Discharge.	Entrance loss.	Velocity head.	Elbow loss.	Pipe friction.	Column loss.	Total.
16.0	20.0	1,000	12	10	V	2,370	0.7	1.5	0.5	13.5	7.8	24.0
5.0	20.0	1,000	12	10	V	1,700	0.3	0.7	0.4	7.6	4.0	13.0
16.0	20.0	1,000	14	10	V	2,880	[illegible]	2.3	0.5	9.1	11.5	24.0
5.0	20.0	1,000	14	10	V	2,110	0.4	1.1	0.3	5.1	[illegible]	[illegible]
16.0	20.0	1,000	12	12	V	[illegible]	0.8	0.8	0.7	17.0	4.7	24.0
16.0	20.0	1,000	14	[illegible]	V	3,500	0.9	1.5	0.8	[illegible]	8.0	24.0
16.0	20.0	1,000	16	12	V	[illegible]	[illegible]	1.8	0.6	8.7	10.4	24.0
[illegible]	20.0	1,000	16	[illegible]	V	2,950	[illegible]	1.2	0.3	5.2	5.9	13.0
16.0	20.0	1,000	14	10	XII	3,070	0.8	[illegible]	0.5	10.0	9.3	23.2
16.0	20.0	1,000	[illegible]	10	VI	2,410	0.5	1.6	0.4	6.5	15.0	24.0
16.0	20.0	[illegible]	10	10	XII	[illegible]	[illegible]	1.4	1.3	14.1	[illegible]	23.2
16.0	20.0	500	[illegible]	10	XII	[illegible]	1.1	[illegible]	0.8	10.3	8.7	23.2
16.0	20.0	500	14	10	XII	3,490	0.7	[illegible]	0.7	6.4	12.0	23.2
16.0	20.0	[illegible]	14	[illegible]	VI	2,580	[illegible]	1.9	0.5	3.7	17.4	[illegible]
16.0	[illegible]	200	10	[illegible]	XII	2,830	[illegible]	2.2	2.0	[illegible]	8.0	[illegible]
16.0	20.0	200	12	[illegible]	XII	3,450	1.4	2.4	1.3	5.4	11.7	[illegible]
16.0	20.0	200	14	10	XII	3,800	1.0	3.8	0.9	3.0	11.4	[illegible]
[illegible]	20.0	200	14	[illegible]	VI	2,720	[illegible]	2.0	0.5	1.7	19.2	[illegible]
16.0	20.0	[illegible]	10	10	XII	3,160	[illegible]	2.7	2.8	5.4	[illegible]	[illegible]
16.0	20.0	100	[illegible]	10	XII	[illegible]	[illegible]	[illegible]	1.5	3.0	13.4	[illegible]
[illegible]	20.0	100	14	10	XII	3,910	1.1	4.1	1.1	1.6	15.3	23.2
16.0	32.0	1,000	14	10	V	3,560	1.0	3.4	0.8	13.2	17.6	36.0
16.0	[illegible]	500	14	10	XII	4,300	1.4	5.0	1.1	9.3	18.4	35.2
16.0	32.0	200	[illegible]	10	XII	[illegible]	[illegible]	4.8	2.1	7.8	[illegible]	35.2
16.0	32.0	100	[illegible]	10	XII	4,520	[illegible]	5.4	2.3	[illegible]	20.4	35.2
16.0	32.0	100	14	10	XII	4,870	[illegible]	6.2	1.5	2.3	23.6	35.2
16.0	32.0	[illegible]	14	10	VII	3,160	0.8	2.7	2.4	1.1	29.0	36.0
16.0	32.0	[illegible]	14	[illegible]	XII	6,500	2.9	[illegible]	2.6	[illegible]	20.2	35.2

Table VI gives examples of combinations of pipe lines and water columns under assumed conditions of height of tank and flow head, length of pipe line, and kind of water column, with summarized results of calculations of the discharge and the distribution of the flow head among pipe friction, loss in water column, etc.

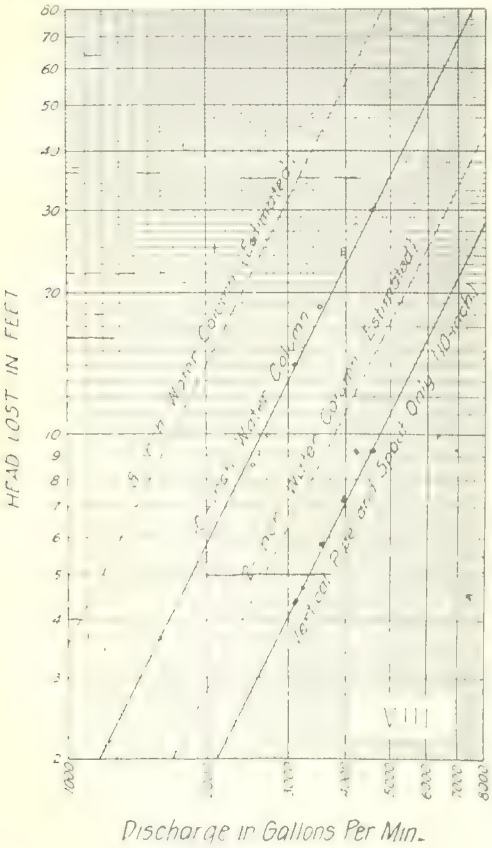


Fig. 2.—Typical Case of Loss of Head in Water Columns Calumet VIII.).

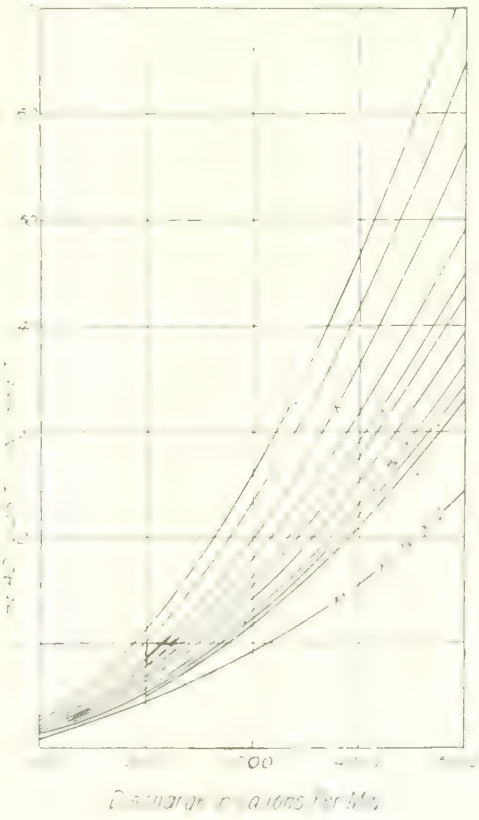


Fig. 3.—Loss of Head in Water Columns, All Forms.

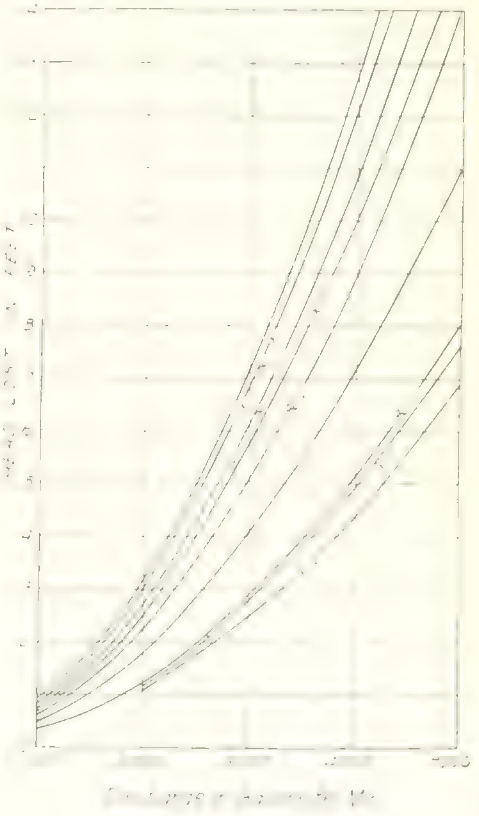


Fig. 4.—Loss of Head in Riser and Spout, All Forms.

PRINCIPLES OF WATER HAMMER CAUSED BY SUDDEN STOPPAGE OF FLOW

When a valve at the end of the pipe line is suddenly closed, additional water pressure is produced throughout the pipe line. Some of the conditions and results attending the phenomena may be briefly stated as follows:

(1) The energy of the moving water is expended in compressing the water in the pipe and in expanding the walls of the pipe.

(2) An increased pressure is developed within the pipe and the increase of pressure is called water hammer.

(3) The water next to the valve is immediately stopped and the full amount of water hammer is developed instantly at that point, the term "instantly" being here used to mean a very short time.

(4) The amount of this water hammer in pounds per square inch in pipes of the size and kind here considered is about fifty-four times as much as the original velocity of the water in feet per second.

(5) The water in the pipe away from the valve is stopped and compressed layer by layer, the full amount of the water hammer developing almost instantly at any point as soon as the water between that point and the valve has received its compression.

(6) This pressure wave or impulse of the water hammer (and the time when each layer receives its compression) moves along the pipe line away from the valve with a speed of about 4,000 ft. per second for the size of pipe ordinarily used in supply mains. The rate of travel is the same as the velocity of sound in water as modified by the thickness and elasticity of the walls of the pipe.

(7) When a pressure wave has traveled to a free water surface or to a larger body of water, a release of pressure begins at this relief point and travels backward at the same speed, about 4,000 ft. per second. The water at any point in the pipe is held at its full water hammer pressure while this impulse or pressure wave travels on to the point of release and back. At the valve the pressure will last the longest. Thus for a pipe 2,000 ft. long the water hammer pressure at the valve will be maintained for one second.

(8) This first pressure or first pulsation of pressure is followed by a series of pulsations of diminishing intensity. The water in the pipe may be considered as a springy substance bounding and rebounding from the closed end.

(9) This pressure developed when closure is sudden is expressed by the formula, the derivation of which will not be given here:

$$P = \frac{1}{\sqrt{1+\frac{Ed}{E't}}}\sqrt{\frac{[illegible]}{144}} \qquad (2)$$

in which

P = water hammer pressure (lbs. per sq. in.), the maximum additional pressure for a given velocity of flow.

v = the velocity of water in the pipe before valve was closed (ft. per sec.).

E = modulus of elasticity of the water (300,000 lbs. per sq. in.).

E' = modulus of elasticity of the metal in pipe (30,000,000 lbs. per sq. in. for steel and 15,000,000 lbs. per sq. in. for cast iron).

d = diameter of pipe.

[illegible]

g = acceleration of gravity (32.2 ft. per sec. per sec.)

[illegible] lbs. per cu. ft.).

For cast iron pipe of the sizes used as supply lines the formula reduces to approximately

[illegible]

(10) By sudden closing of the valve is meant that the effective part of the closure takes place in less than the time required for the first impulse to travel to the tank and to the valve at a rate of approximately 4,000 ft.

[illegible]

$$[illegible] \qquad (4)$$

$$\sqrt{1 + \frac{Ed}{[illegible]}}$$

[illegible] the resistance through the valve opening becomes large enough to give a considerable check to the flow of water. For the water columns under consideration the effective part of the closure may be said to be the last 15 to 25 per cent of the valve movement.

(11) The length of the pipe line does not enter into the expression for the amount of water hammer developed by sudden closure of the valve. It does affect the length of the time the water is under compression and hence in a way the damage which may be done. The length of pipe line is of importance in the problem in that if the valve is closed in a shorter length of time than is necessary for the valve to travel out and back, the resulting water hammer is the same as that which would be obtained with instantaneous closing of the valve. The pressure produced when the valve closure is slow is discussed in a later paragraph.

[illegible] *sure.*—The following theoretical investigation will assist in obtaining an idea of what is taking place in the supply line after the valve is closed, first for the case of slow closure and second for the case of sudden closure. In a long line of pipe when steady flow has become established,

$$[illegible] \qquad (5)$$

$$[illegible] \qquad (6)$$

in which q is the coefficient of valve loss, a variable whose value depends upon the amount the valve is closed; $m\frac{v^2}{2g}$ is entrance loss, $f\frac{l}{d}\frac{v^2}{2g}$ the loss in pipe friction, $e\frac{v^2}{2g}$ the loss in elbows, $n\frac{v^2}{2g}$ the column loss and $\frac{v^2}{2g}$ the velocity head. For simplicity place

$$[illegible]$$

Then

$$[illegible]$$

and

$$[illegible] \qquad (7)$$

It will be noticed that the velocity of flow produced by the head H depends upon both a and q. As an illustration, it has been found that for a gate valve 82 per cent closed q = 41. Then if

a = 13.7, the velocity in the pipe after steady flow has become established will be ½ of the velocity in the pipe when the valve is open; if

a = 53.0, the velocity will be ¾ of that with valve open; if

a = 175.6, the velocity will be 9/10 of that with valve open.

These values show that the velocity of flow is affected but little in a long pipe during the first 80 per cent of the closing of the valve, the three values of a corresponding to lengths of 12-in. pipe of 685 ft., 2,660 ft., and 8,800 ft., respectively.

When the valve is closed quickly, equation (7) does not apply because a water hammer pressure is produced which forces the water past the valve and hence keeps the velocity in the pipe at a higher value than it would have during a very gradual closure. If the valve is closed in less time than $\frac{2l}{4{,}000}$ seconds, it may be considered a sudden closure, and the velocity in the pipe near the valve at any valve position can be computed as follows. During a partial closure, the value of the valve coefficient q has changed from q_1 to q_2, and the head of resistance at the valve (neglecting the back pressure from the water column itself) is now

$$[illegible] \qquad (8)$$

Call the velocity v_2 after the flow has become steady. The pressure at the valve at that time becomes

$$[illegible] \qquad (9)$$

v_2 can be computed from equation (7) when q_2 is known, whatever the position of the valve.

From equations (8) and (9)

$$v = v_2\sqrt{\frac{P}{P_2}} \qquad (10)$$

If the velocity was originally v_0 the water hammer generated would be

$$54(v_0 - v) \qquad (11)$$

Substituting for P in equation (10),

$$v = [illegible]\frac{54v_2}{P_2}(v_0 - v)$$

or

$$v = -\frac{54v_2^2}{P_2} + \sqrt{\frac{54v_2^2 v_0}{P_2} + \left(\frac{54v_2^2}{P_2}\right)^2} \qquad (12)$$

Knowing v, P can be found from equation (8).

If the values of q are known for any valve, the manner of increase of pressure during a rapid closing of the valve can be easily determined.

Time Pressure and Valve Movement Pressure Diagrams.—The valve A (Fig. 1) was partially closed, so as to give added resistance to flow in the pipe line. As valve E closes it consumes more and more of the pressure until the entire static pressure is taken. Observations were first made with valve A slightly closed. The valve A was then closed somewhat more and another experiment made. The pressure at C was recorded by a Crosby indicator in two ways: (1) on a drum rotating at a uniform rate, (2) with the drum connected by a cord to the valve mechanism and moving as the valve moved. An electric attachment recorded half seconds on both forms of diagram.

Under the conditions of flow

$$H = [illegible]$$

where $b\frac{v^2}{2g}$ represents all losses except that due to the water column valve. Hence

$$v = \sqrt{\frac{2gH}{b+q}} \qquad (13)$$

which is similar to equation (7).

By means of the valve A any value of b can be obtained, and as b is similar to a in equation (7), a diagram can be produced which will represent the manner in which pressure rises in any pipe line.

Application to Formation of Water Hammer in Supply Lines.—The supply line used in the experiments was too short to permit water hammer to be developed to any extent. The time pressure and valve movement pressure diagrams give information from which the formation of water hammer in supply lines may be forecast.

(1) Velocities as high as 15 ft. per sec. in the supply line of a water column are not uncommon, while a velocity as high as 10 ft. per sec. is quite usual. With such large quantities of water flowing it is necessary that the water column be shut off promptly when the locomotive tender is full. The time required in closing the valves experimented upon ranged from 3 to 17 seconds, most of the valves closing in less than 8 seconds. The high velocity and the short time of closure make destructive water hammer possible unless means are used to prevent it. With a velocity of 10 ft. per sec. in the supply line, 540 lbs. per sq. in. water hammer is possible.

(2) An examination of time pressure and valve movement pressure diagrams indicates that in almost all the makes the pressure does not begin to rise rapidly until the valve is about 90 per cent closed and until only a very short time remains before valve is completely closed. Water column VII (Mansfield) is an exception. The remaining part of the closure is the effective portion of closure.

(3) If the time in seconds taken by the effective portion of the closure is equal to or less than twice the length of the supply line in feet divided by 4,000, maximum water hammer will be caused. If there is no relief valve or other device for reducing the water hammer, the pressure in pounds per square inch will be approximately 54 times the velocity of the water in feet per second in the supply line before shutting valve.

(4) If the time in seconds taken by the effective portion of the closure is greater than twice the length of the supply line in feet divided by 4,000, maximum water hammer will not be caused. The magnitude of the pressure will depend upon the manner in which the last part of the closure is made.

(5) It is immaterial how quickly the first 80 per cent or so of the closure is made. By making this part of the closure in less time, the time saved can be used in making the last part of the closure more gradual.

Pressures Produced by Slow Closure of Valve.—In some of the preceding paragraphs the water hammer produced by sudden closure of valve was discussed. When the time taken to make the effective part of the valve closure is greater than the time required for the pressure wave to make a circuit out and back, the amount of water hammer will be less than given by the formula for maximum water hammer. In case the time taken for closure becomes so much greater that the pressure at the valve is hardly more than the resistance which the partially closed valve gives to the passage of the amount of water carried at a given instant (and hence no real water hammer is produced or so little that it need not be considered), the problem is of a quite different nature. The following method for determining the effect of slow closure may be used:

From the principle of impulse and momentum,

$$\int_{t_1}^{t_2} P\,dt = \int_{v_1}^{v_2} \frac{62.5\,l}{32.2 \times 144}\,dv \qquad (14)$$

where

P = resultant pressure in lb. per sq. in. at any instant.

t = time in seconds.

v = velocity in pipe in ft. per sec. at any instant.

l = length of pipe in feet.

For very short intervals of time and small changes of velocity, the approximate form may be used:

$$[illegible]\ 0.0135\,l\,(v_1 - v_2) \qquad (15)$$

If the law of the valve movement and the corresponding valve resistance during closure are known (that is, if the time pressure diagram and the valve movement pressure are given, or if the coefficient of valve resistance and the law of valve closure are known), the pressures produced during slow closure may be calculated approximately by the use of equations (8) and (15).

If the resistance of the valve through the last part of closure were maintained in such a way that P would remain constant, the time required to make this part of the closure would be:

$$\frac{0.0135\,[illegible]}{P} \qquad (16)$$

It is not practicable to obtain such a valve movement. For ordinary methods of closing, the pressure will necessarily be variable and the maximum pressure will, in general, be larger than that given by this equation.

[illegible]

this paper to indicate a rational method of obtaining the size of opening required for the relief valve.

Let the velocity in the supply line be represented by v. Consider that the relief valve keeps the pressure down to some value P lbs. per sq. in. above static pressure, and that p is static pressure. The pressure P may be considered to be generated according to the law of water hammer. To produce this pressure P then the velocity in the pipe must be reduced by an amount v'. The formula for pressure produced by water hammer may be written $P = hv'$, where h is the coefficient by which the change in velocity v' is multiplied to find the pressure produced; h may be called 54 for the pipes ordinarily used for supply lines. The velocity in the pipe is now $v - \frac{P}{h}$ ft. per sec. The water must now all flow through the relief valve. The pressure at this point is P lbs. per sq. in. above static pressure or 2.3 P ft. of head. If A is area of pipe, a the area of relief valve and c the coefficient of discharge of the relief valve, then

$$A\left(v - \frac{P}{h}\right) = ca\sqrt{2g \times 2.3P}$$

$$a = \frac{A\left(v - \frac{P}{h}\right)}{c\sqrt{4.6gP}} \qquad (17)$$

Substituting $h = 54$ and simplifying

$$a = \frac{v - \frac{P}{54}}{12.2c\sqrt{P}}A \qquad (18)$$

The value of the coefficient of discharge c of the relief valve depends upon the shape and amount of opening and upon the conditions just inside the valve; the valve may open freely into air, or the passages may be constricted at places before reaching the outlet, conditions which will cause great differences in the coefficient of discharge. The coefficient of discharge may be determined by blocking the valve open and testing its discharging capacity separate from the water column itself. The range of the coefficient, based on the nominal size, is from 0.2 to 0.6. If the outlet is constricted it will be less.

SUMMARY

The following comments on the work are offered:

1. The tests give the loss of head for various rates of discharge in the principal types of locomotive water columns in use in the United States. The loss through the valve and through the riser of the water columns were each determined.

2. At a discharge of 4,000 gals. per min. the loss of head through the water columns ranged from 15.4 ft. of head to 46.5 ft. of head. The resistance to flow is surprisingly high—much higher than has usually been estimated. It is evident that the discharge of water columns under working conditions is smaller in many cases than has been estimated. It is worth noting that the water columns which give high resistance are the principal types which are used in large numbers by the railroads of the country.

3. A comparison with the frictional losses through pipes and elbows will help to give a fuller conception of this high loss of head. For the water column which gave the highest resistance, the loss of head is equal to the frictional loss for the same discharge through a 10-in. line of straight pipe 566 ft. long. Similarly this loss is 25 times as much as that through a 10-in. elbow.

4. An examination of some of the types shows that the forms of the valves and passages do not accord with the principles of good hydraulic design. Sudden change in direction, sudden contraction and expansion of the section of the stream, and tortuous passages are among the objections to be found, and high local velocities are especially troublesome. Mechanical features of construction, inspection and repair seem to have crowded out consideration of hydraulic efficiency.

5. The telescopic adjustable spout with its large cross section shows lower losses than the fixed spout, though it must be borne in mind that the point of discharge taken in water columns with telescopic adjustable spouts is at the end of the riser, and that for this reason the lift is greater than with the fixed spout. The ball and socket spout gives about the same friction loss as the rigid spout, but it has the advantage that the point of discharge is usually lower. It may also be noted that the anti-splash devices use up head in providing a solid stream.

6. The maximum velocity allowable through a water column will depend upon such matters as the satisfactory operation of the valve and also upon the effect of closing the valve in the development of water hammer in the supply main. With a short line from the supply tank a velocity of 12 or 15 ft. per sec. through the water column may be considered as the maximum desirable velocity for ordinary conditions, and for longer lines the limiting velocity may perhaps be as low as 8 ft. per sec. It would seem that 3,000 gals. per min. for an 8-in. water column, 4,000 gals. per min. for a 10-in. water column, and 6,000 gals. per min. for a 12-in. water column may be considered to be the limit of desirable discharge. It would seem that for the rates of discharge just noted the allowable loss through the water column itself should not be much more than 20 ft., and that the limit may well be placed at less than 20 ft.

7. The method outlined for making calculations of the losses of head and discharge in water service installations is a convenient one. By means of diagrams for friction in pipe and elbows and for loss through the water column and the use of the trial ratio, the discharge given by any flow head may be calculated without the labor attendant upon the use of the usual formulas for flow of water in pipes.

8. The examples of combinations of pipe lines and water columns given in Table 6 illustrate the distribution of losses in such installations. There is an advantage in a large pipe by reason of the large discharge for a given head and also in the smaller opportunity for water hammer. In an installation having a high head available (as in some gravity lines) the pipe may well be smaller than in the common installation, provided the arrangement of the valve closure guards against water hammer and proper relief valves are used.

9. The water hammer pressure generated in a pipe line when a valve is closed suddenly and no relief valve is used, for the sizes and thicknesses of pipe used in ordinary water service installations, will be, in lbs. per sq. in., about 54 times the velocity of water in the pipe in ft. per sec. The term "sudden closure" is here taken to mean that the time consumed in that part of the valve movement which gives relatively high valve resistance is less than the time required for the pressure impulse to travel from the valve through the pipe line to tank and back at a speed of about 4,000 ft. per sec. This effective portion for all but two of the water columns tested was the last 15 per cent of the valve movement.

10. For a slow closure the resistance through the valve opening is the chief force in stopping the mass of water.

11. In all but one of the water columns tested the resistance through the valve opening was not markedly larger than that at full opening until the valve had attained at least 85 per cent of its closure. Since during the first 85 per cent of the valve movement little work is done in stopping the water and since during this portion of the valve movement water hammer will not be developed even with rapid closing, it follows that it is immaterial how quickly this first 85 per cent of closure is made. The time thus saved may well be used in lengthening the time for the remaining 15 per cent of closure. The time pressure diagram and the valve movement pressure diagram of one of the newer forms of water column illustrate the hydraulic advantages which may be gained in this way.

12. With time pressure and valve movement pressure diagrams, and knowing the head, diameter and length of the pipe line, the pressure which will be developed when the valve is closed in a given time (slow closure) may be worked out approximately by the method given under the heading "Pressure Produced by Slow Closure of Valve."

13. When a relief valve is used as an auxiliary device, the size of the effective opening through the relief valve itself may be calculated from equation (18). Although relief valves offer a protection against excessive pressure, they do not of themselves fully solve the problem of stopping the mass of water. The type of water column having an internal relief valve which forms the seat for the cylindrical valve itself may be expected to give relief from high pressure with rapid closing, provided it is proportioned to furnish the proper resistance to flow to suit the conditions of flow head and length of pipe line.

14. From general considerations it is reasonable to expect that 8-in. and 12-in. water columns will have losses approximately the same as those found in the 10-in. water columns at the same velocity of flow.

GENERAL ARTICLES AND CLASSIFIED ITEMS

The Appraisal of the Madison Gas and Electric Co.

In our issue of June 14 was given an abstract of the decision of the Wisconsin Railroad Commission in the case of the State Journal Printing Co. vs. Madison Gas and Electric Co., and that abstract related to the method of determining the going value of the business of the Madison Gas and Electric Co.

In our issue of June 21 we gave an abstract of the same decision relating to the method of appraising the land by the sales method.

The following is an abstract of the Commission's decision as to the appraised value of the physical property of the company:

In the making of valuations of utility properties under ch. 499, Laws of 1907, an element of cost or value has been justly recognized in a sum which in case of reconstruction would be required for engineering interest and contingencies. In making the tentative valuation herein on the cost of the physical parts of the plants, 10 per cent was added to their cost value. This item received further consideration by the engineer of the Commission, with the result that in the revision it was changed to 12 per cent. This rate, however, was not satisfactory to respondent, and testimony of experts was adduced on the point in controversy. Respondent directed its proof toward an allowance of 18 per cent for these elements.

Engineering. Practically all of the witnesses in this case who were examined in relation to the cost of engineering, placed this cost at about 5 per cent on the cost of the physical plant, and there is, therefore, no division in the testimony insofar as this item is concerned. An amount that is equal to 5 per cent on this cost is no doubt sufficient to cover the expense of engineering. In fact, it is more than likely that in practice this amount is often higher than the actual cost. For the original part of the plant the cost of engineering may be fully 5 per cent. For subsequent extensions, however, it is apt to be lower than this, and this for the reason that such extensions are often planned and supervised by the officers of the company who are drawing regular salaries which are charged to the operating expenses. In other words, the plants are in this way extended without any additional cost for engineering. The proper [illegible] the officers' salaries in such cases would probably be to divide them up between the operating and construction, on the basis of the time devoted to each of these branches of the work; but in actual practice this is not often done. If in such cases the cost of engineering goes into operating expenses, it is clear that it should not also go into construction, and vice versa. In either or both cases the total cost of engineering to the company is likely to be lower for extensions than for the original part of the plant. This is a point that is frequently overlooked in considering both engineering and piecemeal construction.

Interest. The cost of interest during construction was the subject of much testimony. The staff of the Commission used 3 per cent under the assumption of one-year construction, but changed it to 4 per cent, because it was estimated that the construction might require more than one open season. Interest at 3 per cent under a one-year construction period would be at the rate of 6 per cent for the whole amount of capital during half of the period of construction. The same rule would give 6 per cent under an assumption of a two-year construction period. For this proposition the respondent contended, pointing to the apparent adoption of the proposition by the staff when the staff was proceeding under the assumption of the one-year construction period, and also bringing the testimony of experts as to the cost of the money which it would be necessary to borrow and have available as needed during the construction period. A good deal of this testimony dwelt upon the practical financing of construction, dealing with the rate that would have to be paid for money borrowed, how much would have to be borrowed at various stages of construction, and as to whether some of the money bargained for could be placed at interest until needed and so, by the earning of return interest, reduce the net cost of the money during the construction period.

While all these points are interesting and contribute to an intelligent discussion and determination of the question at issue, it would seem that the interest during construction, correctly allowable in a valuation under ordinary conditions, would be interest at the current rate on the cost of each part of the plant during its construction. The element of cost by reason of interest during construction is one which can not be escaped. It is present to some extent, no matter what the method of financing the construction may be. From the time an investment for construction is made until the completion of the entire plant enables that investment to become active as an integral part of a working whole, there is the element of interest, for that investment is necessarily involved and is necessarily idle until the completion of the plant to a working point. The fact of interest, like the fact of depreciation, is present, no matter what method be employed for the financing of it. This is as true when the money is furnished by the owners as when it is borrowed by them. The theory upon which such interest rests is sound, and remains so even in isolated cases where the investors may decide to charge no interest and choose to donate the same to the consumers in the way of lower charges for the services rendered. Even if the company let a contract for the complete construction of a plant, to be paid for in no part until wholly completed to the operating point, interest cost would come in as a part of the contract price, even though not expressly set forth. In that case the contractor would have to ask a higher price to cover the interest cost. Some additional compensation is needed for the investment made by him during the progress of the work and which is necessarily idle until the completion of the plant. Should the company itself construct the plant and be able to arrange to do the entire work on credit—gathering the material, machines and equipment, labor and everything additional needed on credit, to be paid for at the completion of the plant at the point of operation—the interest cost would enter nevertheless in some form in the entire cost of construction.

The element of interest during construction, theoretically, is the current rate for the use of each item of the outlays during the time which intervenes between each such outlay and the date of the completion of the plant up to the point of operation. The sum of these charges, however, is the minimum amount that should be allowed as interest during construction. As a practical question, it would seem inevitable that the actual interest cost might, in some cases, be even greater than this, for the money might have to be provided in advance of the installation of the integral parts of the plant. Land has to be provided, franchises secured, organization effected, bonds marketed and much expense incurred at the start. The opinion, however, seems to prevail that all the money should be figured as under interest for half the construction period. This is equivalent to an assumption that the expenditures involved in construction would follow a uniform curve from the commencement of construction to completion thereof to the point of operation, and that money could be borrowed just as needed or, if borrowed all at the beginning, could be placed at interest at the rate paid for the whole amount and withdrawn as fast as needed in the work of construction.

Such an assumption is no doubt warranted in cases where those who construct the plants possess ample means or good credit. For in that event they can undoubtedly make such arrangements for the necessary funds that no interest charges are incurred on the money for any other time than the period during which it is actually used. Thus, if the plant is not larger than can be built during the open season of, say, six months' duration, the probabilities are that interest would have to be paid for this time only, and that, with the current rate at 6 per cent, the interest charges would not exceed 3 per cent on the entire cost for six months. There are undoubtedly many plants where the interest chargeable to construction is relatively no greater than this.

When the plants must be financed under less favorable conditions, the chances are that the interest chargeable to construction is greater than that just outlined. In some cases, for instance, the conditions upon which the money is obtained are such that interest charges on the entire cost of construction begins at the time or even before actual construction is begun. In addition to this the bonds or other securities upon which the money is secured often have to be sold at discounts. When money is thus obtained in advance, part of the interest charges may, of course, be offset by re-investing the money until needed. But as such investments must be made for short periods only, the interest obtained therein is usually much less than sufficient to offset the amount paid by the company. Plants which must be financed under such or similar conditions may have very heavy interest charges to meet for construction. But if the plants are needed and the conditions are such that money can not be had on any better terms, such interest charges, though relatively large, would seem to be unavoidable. Such interest charges must either be paid or the municipality be compelled to do without the utility. The amount will depend largely upon commercial conditions.

But whatever the interest rate may be in any particular case, it is likely to be considerably higher for the original plant than for subsequent extensions to it. This is due partly to improvements in the credit of the plant, and partly to the fact that for a plant that is in operation and earning money there are many ways in which the income nd the working capital can temporarily be so used as to keep down the interest charges for new additions without materially affecting either the income or operating expenses of the plant. That this is the case, is so obvious as not to require further illustration.

The plant involved here appears to have been in fairly sound financial condition, at least from the time the present owners secured possession. It is true that the testimony shows that a certain amount of stock had to be given as a bonus with each given amount of bonds in order that these bonds might be disposed of at par. While this fact would seem to indicate that the credit of the plant was not the best, an investigation into the circumstances surrounding these transactions show quite clearly that these facts are not a true measure of the actual situation. Upon going over the facts, with this end in mind, we have not discovered anything which could lead us to the conclusion that these plants have not been able to obtain all the money they needed at current rates of interest and on such terms, in other respects, that little or no interest would have to be paid on idle funds or for unusual conditions generally. In view of all this, it appears to us that the interest allowed by the staff in this particular case is not unreasonably low under the circumstances.

Expenses for Legal Work, Organization, Casualty Insurance, Omissions and Contingencies. In the tentative valuation the engineer of the Commission allowed 2 per cent for various items, including contingencies, omissions, liability for casualties, legal and organization expenses, etc., but in the revision allowed 3 per cent on this account. One of the respondent's witnesses testified, that in his valuation work he had been in the habit of allowing 4 per cent for these items. The other three witnesses of respondent testifying on this point declared that 7 per cent would be necessary to cover these items, and they agreed in their distribution of the 7 per cent into 2 per cent for omissions and contingencies, 3 per cent for legal and organization expenses, and 2 per cent for casualty liability. These witnesses testified that, no matter how carefully an inventory were made and scrutinized, there would be omissions, and also many contingencies arise in the course of construction which occasion expense. This line of testimony sought to show that few successful engineers would figure omissions and contingencies at less than 10 per cent, that in the case of the building of a new plant these costs would be higher, but considering the fact that in this unusual and abnormal case there was especial opportunity for completeness and repeated scrutiny of the inventory, the item had been figured down to 2 per cent. The cost of accidents in shipment, breakage of machinery shipped at risk of company, was suggested as a certain cost entering here.

Under legal and organization expenses, witnesses would put the cost of lawyers, of effecting the corporate (not construction) organization, of preparing bonds and marketing stock, besides obtaining necessary franchises. Witnesses declared that heavy legal expenses were bound to occur, frequently being much greater than allowed here. One witness recalled a case in which litigation, resulting from a flood and the destruction of a dam, cost 25 per cent of the total construction cost of $800,000. The fact was shown, by exhibits introduced by respondent, that the actual legal expenses in connection with the organization of respondent in 1896 had been only $1,698.56 for the gas end of the business, and $615.56 for the electric end, a total of $2,314.12 for the entire company. An allowance of 3 per cent on this account would amount to some $24,000, so that the actual legal expenses incurred in the organization of respondent company were less than one-tenth of the amount claimed by its witnesses.

Witnesses for respondent asserted that responsible contractors always figured in an amount of expense due to accidents, loss of materials during construction, injury to employes and to the public. This, they maintained, would not be less than 2 per cent under average conditions. In some cases it would be very light and in others exceedingly heavy. These risks carried insurance rates so high that it was impracticable to insure against such losses, their cost enters, however, into the contractor's estimate.

It is easily conceivable that the amounts incurred for the items mentioned might greatly exceed 3 per cent on the cost of the plant. As was pointed out in connection with the rate of interest chargeable to construction, conditions are sometimes met with that may cause the outlays for these similar items to reach almost abnormal proportions. Abnormal conditions, however, do not appear to have been present in this case. While the amount allowed by the staff appears to be no higher than it should be, we have not discovered good grounds upon which to increase it.

Cost of Piecemeal Over Continuous Construction.—Respondent claimed a substantial allowance in the valuation by reason of the fact that it costs more to construct a plant by piecemeal than as one continuous piece of work, as would be the case under a general construction contract, and that the assumption in the valuation herein was continuous construction rather than piecemeal construction. Respondent's expert witnesses estimated that the additional cost of piecemeal construction over continuous construction would be not less than 15 per cent, and respondent claimed an allowance of $143,455 to reproduction cost, or $116,291 to present value on this account.

The engineer of the Commission stated at the hearing, and in his revised statement of valuation, that the inventory valuation was sufficiently high to cover this alleged extra cost by reason of piecemeal construction. In making the valuation each item had been taken separately, as though purchased in open market, and no consideration was had of the fact that the company or contractor would secure special figures in purchasing larger quantities of the material, equipment and labor. Actual conditions of construction had been liberally represented. While an added cost of piecemeal construction over continuous construction was recognized by the engineer, due to the embarrassment necessitated by maintaining continuous operation of the plant, the engineer maintained that there would be none with respect to a large part of the plant in this case.

In cases, if any, where the average figures taken for cost and installation were insufficient to cover contingent cost, arising through the necessity of maintaining uninterrupted operation of the plant, the engineer stated that such contingent cost would be covered in the allowance for contingencies. He also stated that the appraisal doubtless contained some figures that are lower than the actual cost to the company, as well as other figures that are greater than the actual cost to the company. There are very likely to be variations in both directions, but it is more than likely that these variations will offset each other. The cost of piecemeal construction was given further careful consideration and investigation by the staff of the Commission, and the chief engineer, in connection with the revised valuation, made the following statement:

> We [illegible] under continu- [illegible] basis of continuous construction as contrasted with the so-called piecemeal basis. As a result of these further studies, it now appears that our valuation, as made under entirely normal conditions, give results somewhat in excess of actual costs under the contract or continuous construction system. We therefore feel that there is suf- [illegible] our established method of valuing such properties and those on the strict contract basis to warrant the statement made by the Commission's engineer at the recent hearing to the effect that our revised figures, when fairly interpreted as to final results, are essentially those which would be obtained by using the so-called piecemeal or actual cost basis. In the light of the foregoing conclusion we feel that there would be no justification for an increase in our revised figures to cover the alleged excess of cost due to piecemeal construction.

That the construction cost of a plant built up piecemeal during a considerable number of years would be greater than the cost under one contract or as a continuous operation, is a proposition in this case supported by testimony from all the engineers and experts of the respondent. Nor was the truth of this general proposition seriously attacked either by witnesses offered by plaintiffs or by the engineer of the Commission, who simply held that this element had been taken into consideration by him in the selection of the units of cost upon which the total cost of the plants were computed, and was therefore included in the totals.

Among the elements of additional cost of piecemeal over continuous construction were mentioned the advantage that could be gained in buying materials in large quantities for continuous construction over small purchases as in piecemeal construction, the economy of laborers' time in continuous construction over piecemeal construction, in which latter case much time would be lost in traveling from one small construction job to another, the large expense of maintaining continuous operation of the plant during piecemeal construction as contrasted with continuous construction, also an element of value arising from the fact that one might be willing to pay more for a plant that was completed and ready for operation and not have to take the risk of additional expense arising out of contingencies, this value being the premium for insurance on the business capacity and ability of the engineers and others connected with the project. The extent of this additional cost of piecemeal construction was estimated by one witness as being in some cases 100 per cent over what continuous construction would cost, but, as stated, it was the opinion of three of the respondent's witnesses that an allowance of 15 per cent would be sufficient on this account. The testimony leaned to the conclusion that, whatever additional cost arose from piecemeal as contrasted with continuous construction, should be put in with the tangible value, as it is as much a part of the physical cost of the plant as is the cost of a machine, building or other tangible item.

That ordinarily the price is relatively greater for small than for large purchases, and that a small piece of work usually costs relatively more than a large piece of work or construction, are generally recognized facts. In computing the cost of a public utility, however, these are matters that can easily be adjusted or allowed for in fixing the cost per unit of the various elements entering into the cost of construction. As a rule the original part of a utility is built in one continuous operation and should be mostly classed under large scale construction. The various extensions, however, that are subsequently added to the plants in growing cities, are mostly of smaller proportions when taken separately, and will, therefore, generally come under piecemeal construction. In appraising utilities which have been constructed on this basis, the problem seems to be to find units of cost that represent a fair average of these conditions. To find such units appears to be practicable. In fact, it would seem that the extra costs of piecemeal construction can be more readily and accurately taken into account in this manner than by an arbitrary allowance of a lump sum to be added to a cost that has originally been computed upon the basis of continuous construction. At any rate, it is the practice of the engineers of this Commission to allow for piecemeal construction in the manner indicated, and this method, upon investigation, appears to us to be sound and to have led to reasonably fair and accurate results in both the present case and in other similar cases.

The increase in the cost of operation of a plant during the period while new extensions are under construction, is perhaps not a serious matter, as an analysis of the conditions indicates that it can occur only while the new extensions are actually being connected with the plant. Nevertheless, some consideration has been given to this item. The element of value arising from the fact that one might be willing to pay more for a completed plant than for one not as yet completed, because risks and contingencies involved in construction are probably elements which, if they enter into the value of a plant at all, should be considered in a different connection from the additional cost under consideration at this point.

While there are conditions which tend to increase the cost under piecemeal construction, there also appear to be certain factors which may have the opposite effect. Extensions to such plants as those in question here are often of such nature that their cost during the construction period is met out of current receipts or funds on hand in such a way that little or nothing in the way of interest charges is in reality incurred until the extensions are in operation and financed in the usual manner. Again, the planning and supervision of the work of such extensions is often, if not always, performed by the regular officers and employes of the company without any increase in their salaries or wages. The entire amount of such supervisory cost is usually charged to the operating expenses, and this tends materially to reduce the cost of engineering and supervision of these extensions. These and similar economies, often practicable under the conditions described, are not without significance in passing upon the cost of piecemeal construction and may go far in offsetting many of the factors which usually make piecemeal construction relatively the most costly.

Working Capital. Respondent made a claim for a substantial allowance for working capital, suggesting that for a company of the size of respondent not less than $100,000 would be necessary to be held as quick assets or working capital, either as money available or as stores and supplies on hand. The inventory included the stores and supplies valued at $30,130 present value. Respondent admitted that this was a part of working capital, but insisted that some $70,000 additional should be allowed for bills receivable and cash on hand and in bank to facilitate the conduct of the business. The theory advanced was, that ample supply of ready money would enable the company to effect many economies, such as advantageous buying and discounting of bills, and such economies would inure to the benefit of the business and eventually be of benefit to the public. This theory is undoubtedly sound.

The necessity of a corporation having ample working or current capital for the facilitation of its business, is perfectly apparent. As one witness in this proceeding stated, that while one may borrow from time to time to provide for current needs, paying interest on such loans, such a course would be equivalent to carrying on business from hand to mouth and advantage could not be taken of the best opportunities for discounts. The obvious result would be a heavier load upon the business, and a reduction of profits. If the customers were all to pay in advance of receiving service, the amount of necessary working capital would be greatly reduced.

The amount of the working capital required by the plant rather than the question as to whether something should be allowed for such capital is the issue raised by the testimony. Among the quick assets and liabilities of the company about Dec. 31, 1907 and 1908, the following items are found in the balance sheets of those dates:

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Cash	3,140	8,257
[illegible]	[illegible]	[illegible]
T[illegible]	$79,057	$88,030
[illegible]		
[illegible]	[illegible]	[illegible]
[illegible]	8,264	7,500
[illegible]	4,241	2,544
[illegible]	6,300	7,753
T[illegible]	[illegible]	[illegible]

The preceding items of current and quick assets differ slightly from the items which were discussed in the testimony, but these differences are so small that they need not be noted. The respondent claimed that the working capital consisted largely of stores and supplies, cash and bills receivable, which items, when taken together, foot up to $79,057 at the [illegible]

Some of the witnesses also intimated that the gas in the holder on the date of the valuation and the gas and electricity delivered to the consumers but not paid for should also receive some consideration in this connection. Because the gas in the holder on the date of the appraisal had been produced at a certain cost to the company it should appear in the inventory of the company and in the valuation of its property. This, it was said, may also be the way in which the gas and current delivered to the consumers but not as yet billed or taken into account should be treated. It was explained that the meters are read

TABLE I.—COST OF REPRODUCTION NEW AND EXISTING VALUE OF THE MADISON GAS & ELECTRIC LIGHTING PLANTS—1908.

Item	Constituent.	Gas. New.	Gas. Existing.	Electric light. New.	Electric light. Existing.	Total. New.	Total. Existing.
1	Land	$36,900	$36,900	$25,100	$25,100	$62,000	$62,000
2	Paving	4,264	4,256	4,264	4,256	8,528	8,512
3	Holders	40,825	36,084	.. ..	.. ..	40,825	36,084
4	Distribution system	167,235	134,531	144,535	111,841	311,770	246,372
5	Power plant equipment	68,507	56,610	223,606	167,965	292,113	224,575
6	Buildings	19,173	44,048	51,096	17,115	70,269	61,168
7	Office furniture and appliances	2,348	1,918	2,348	1,918	4,696	3,836
8	[illegible]	1,833	1,088	2,323	1,538	4,156	2,626
9	Horses, wagons and [illegible]	4,963	3,884	1,217	963	6,180	4,847
	Total items 1-9	$346,348	$289,319	$454,189	$360,699	$800,537	$650,018
10	Add 12 per cent (see note below)	41,562	34,718	54,503	43,284	96,065	78,002
	Total items 1-10	$387,910	$324,037	$508,692	$403,983	$896,602	$728,020
11	Stores and supplies	14,924	14,924	15,532	15,206	30,456	30,130
	Total items 1-11	$402,834	$338,961	$524,224	$419,189	$927,058	$758,150
12	Additional working capital	8,931	8,931	10,613	10,613	19,544	19,544
	Total	$411,765	$347,892	$534,837	$429,802	$946,602	$777,694

Note:—Item 10 includes superintendence, interest during construction and contingencies.

about the 20th to the 25th of each month, and the time intervening between the reading of the meters and the first few days of the month following is occupied with the clerical work of computing and making out bills. This product has been sold and delivered, but no account of it appears on the books until the bills are made out, although the cost of manufacture has actually accrued against the company. In the current service bills were entered, on the first of the month, the unbilled product for which the company is entitled to credit in a valuation of the amount of gas and electric current delivered after reading of the meters and up to the time at which the inventory and valuation are assumed to have been made.

Petitioners objected to the claim for working capital, both as to amount and as to principle, but confined their proof to what was to be brought out on cross-examination. Petitioners did not think that bills owing to the company should be capitalized against the public, and from one of the respondent's experts was drawn the admission that prompt payment of bills for service, such as would doubtless prevail under a prompt payment discount rule, would reduce the amount of working capital necessary to be allowed.

That stock and supplies and cash in sufficient amounts to insure economical and safe operation of the plant are proper items to be included in the working capital, is clear. This, in a sense, might also be true of bills receivable, except in such cases where they are offset by bills payable. The mechanism and nature of modern industry are such that the bills can not be collected on the delivery of the goods, and hence thirty and even sixty days' time for payment of bills are usually regarded as cash sales. The effect of this is, that bills and accounts receivable, and bills and accounts payable, to a considerable extent tend to offset each other, and that the former, for this reason, may not be an essential part of the working capital. Gas in the holder and gas and current delivered but not billed would, in this case, seem to be items that belong with earnings and operating expenses rather than in the capital account. For a company so situated as the one in question here, the essential items in working capital would seem to consist of stocks and supplies and cash on hand.

Regarding the method of estimating the amount required for working capital there was some variance in the testimony. One witness said that frequently one-third of the yearly receipts was adopted to estimate the amount of working capital, but that in actual business it was estimated by trial and error. The relation between fixed and quick assets, witness stated, varies with the size of the plant, being larger in a small plant because the large company is better able to handle finances. Remarking that no general rule would be applicable, without adjustment, to determine the amount of working capital which should be allowed, this witness said he had found that in this case 10 per cent of the total capitalization should be kept liquid. Witness mentioned another basis for determining a fair working capital for a gas business, viz., according to a certain number of cents per 1,000 cubic feet of gas sold, but later qualified his testimony by stating that this is not as good a method because the sales continually vary. Witness had used 20 cts. per 1,000 feet, and sometimes 30 cts. He considered 30 cts. reasonable under general conditions, but admitted that in a large company a less rate would be sufficient. He thought 30 cts. to be a fairly reasonable figure to be used in a company of the size of that in this case.

Another witness declared that he considered the working capital to consist of the difference between the quick assets and liabilities when the former were the greatest. That is, the working capital consists of the amount by which the current or quick assets, as distinguished from fixed assets, exceeds the sum of the current or quick liabilities, as distinguished from the fixed liabilities. This is no doubt true, but these facts show the existing condition of a plant in this respect rather than the amount that is actually required for working capital.

A working capital computed on these bases would lead to results that vary considerably from each other. One-third of the yearly receipts of the plants for the last two years or more would amount to slightly more than $100,000. About 30 cts. per 1,000 cubic feet of gas sold would amount to from $30,000 to $35,000 for the gas plant alone. The excess of the quick assets over the quick liabilities, according to figures given above, amounted to about $32,500 Dec. 31, 1907, and to about $62,300 Dec. 31, 1908.

In order to more clearly understand the situation with respect to the amount of working capital required, it is necessary to observe a little more closely the nature of the business and some of the conditions under which it is conducted. The company obtains its revenues from the gas and the electric current it manufacturers and sells. It collects those revenues from its customers very promptly about the 10th of each month. Its outlays consist of the cost of producing, delivering and selling this gas and electric current, or of the cost of fuel, material for repairs, and renewals, certain other supplies of various kinds, the wages of the labor it employs in the operation, repairs and renewals of its plant, the salaries of its clerks and officers, taxes, interest and profits on the investment. Coal is the principal material that is used in the production of gas and electric current, and is also in most cases the largest single item of expense. Inquiries upon this point indicate that, when storage and handling are taken into consideration, coal can be contracted for in larger quantities and paid for about as delivered, or monthly, on terms that are about as favorable as any that can be had. In fact, such transactions are usually regarded in about the same light as ordinary cash deals. Other supplies can probably be bought on thirty days on practically a cash basis. Wages and salaries are ordinarily paid monthly and about the time the bills for the gas and current sold are collected, or can be so paid. Taxes, interest and profits are not likely to be paid oftener than in one or two annual installments. The receipts, taken as a whole, are about one-third greater than that part of the expenses which, when considered together, it would be of any advantage to the plant to pay as often as once a month.

These facts are significant. They show that the company is in a position where it is practicable for it to meet at least the greater proportion of its current outlays from its current receipts, or to meet these outlays on a basis that is practically the equivalent of cash transactions. They make it clear that the conditions under which the business of this company is or can be done, are such that there is a very close relation between the collection of its receipts and the payment of its expenses, so close, in fact, that there ought to be little or no trouble in a reasonably uniform adjustment of the one to the other. There are, of course, certain items of the expenses, such as renewals and repairs, particularly in case of accidents, that may be much heavier at some periods than at others and which can, therefore, be more economicaly met when there are ample funds on hand. It is also a fact that, with a liberal amount of quick assets available, new extensions to the plants may be more cheaply constructed than otherwise, and this for the reason that temporarily it may be more economical to use working capital for such purposes than to meet the cost by regular loans or by the sales of new securities. There may also be other circumstances under which it is profitable to the plant to be fortified by an ample working capital. But, upon considering the facts thus presented, one cannot help but feel that the respondent claimed a greater amount for this purpose than that which is required for operating the plants and conducting their business as a whole, with a reasonable degree of economy, effectiveness and safety. In fact, it appears to us that a working capital of even less than 15 per cent of the amount derived from the sales of gas and current, or of from $45,000 to $50,000, is fully adequate under present conditions.

Paving.—The engineers, in their valuation, included the extra cost that would have been involved if the gas pipes had had to be laid through paving or after the streets had been paved. This extra cost was placed at $4,046 for the cost of reproduction new, and at $3,903 for the cost of reproduction new less depreciation. The additional cost because of paving is undoubtedly a legitimate item that should be taken into account in determining the cost of reproducing a plant. Whether it should also be included in the valuation of a plant when determined for rate-making purposes, is a question that would largely depend upon whether these expenses were actually incurred, that is, on whether the pipes were laid before or after the streets were paved. If the pipes were laid after the streets were paved, then it would seem that the additional cost because of the paving should be included in the valuation of the plant. If, on the other hand, the pipes were laid in advance of the paving, then equity as between investor and consumers would seem to require the omission of all or the greater part of this cost from the valuation. The costs of reproduction of the physical property of a plant, while of the greatest importance to that end, is not the only element that should be considered in determining the fair value when questions of rates are involved. The cost of reproduction constitutes valuable evidence of the amount upon which investors are entitled to reasonable returns, but it does not furnish the only evidence of this amount, even insofar as the physical parts alone of the plants are concerned. To include something in the valuation of the physical property for the cost of paving, is undoubtedly fair and just when such costs have actually been incurred. But when they have not been incurred, it is very difficult to find any just and reasonable ground upon which they can fairly be made a permanent charge against the consumers. If this is sound, and it apears to be, then it would follow that any additional cost for paving in this case can only be considered where the pipes happened to be laid after the streets were paved. Inquiries upon these points have revealed the fact that in this particular case the pipes were laid in advance of the paving. In view of these facts, it appears to us that

TABLE I. COMPARISON OF ASSESSMENT RATIOS WITH REFERENCE TO KIND OF PROPERTY BASED ON A SECTIONAL DISTRIBUTION OF MADISON CITY SALES.

Year	Group	No. of sales	Total assessment	Total consideration	Assessment ratio per cent
1905	1	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	3	[illegible]	[illegible]	[illegible]	[illegible]
	4	[illegible]	[illegible]	[illegible]	[illegible]
Total sales, 1905		[illegible]	[illegible]	[illegible]	[illegible]
1906	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	2	41	97,470	143,100	68.10
	3	47	91,650	132,038	69.41
	4	110	144,880	224,400	64.56
Total sales, 1906		[illegible]	[illegible]	[illegible]	[illegible]
1907	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	3	42	104,570	160,730	65.06
	4	127	199,158	328,707	60.58
Total sales, 1907		[illegible]	[illegible]	[illegible]	[illegible]
1908	1	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	3	44	78,200	131,745	59.35
	4	104	157,000	266,590	58.89
Total sales, 1908		[illegible]	[illegible]	[illegible]	[illegible]
Grand total, 4 years, 1905-1908		905	$1,922,378	$3,009,785	63.87
[illegible]					
1905-1908	group 1	23 (2%)	$ 302,700	$ 409,205	73.96
	2	188 (21%)	517,125	798,201	64.78
	3	201 (22%)	401,290	628,068	63.89
	4	493 (55%)	701,263	1,174,311	59.71
Grand total, 4 years		[illegible]	[illegible]	[illegible]	[illegible]

the reasons for paving in the engineers' valuation of the physical property should be excluded therefrom.

Summary of the Cost of the Present Property.—From the facts thus presented upon this point, it appears that the cost of reproduction new and the cost of reproduction new less depreciation, as determined by the engineering staff of this commission, has been somewhat modified. These modifications are confined to the land, the cost value of which was increased; to power plant equipment, the cost of which was reduced by omitting therefrom the allowance made for the use of the so-called Doherty economizers, on the ground that they are paid for in the form of royalties charged to operating expenses; to the allowance made for interest during construction, engineering, etc., which item was somewhat increased, said increase being due to the fact that, owing to other changes, the amount upon which this item is computed had been increased; and to the amount representing the additional cost of pipe-laying because of the paving in the streets, which, for the reasons given, was omitted from the valuation for the purposes of these proceedings; and to the working capital, which has been considerably increased. The cost of reproduction, as thus modified or changed, is summarized in the table which follows, or in table I:

The commission sums up its decision as to the value of the plant and its going business by saying:

[illegible], for the purposes of this case, it is equitable to all concerned to allow the respondent reasonable returns in the way of interest and profits on a valuation of about $412,000 for the gas plant, and of about $535,000 for the electric plant.

In a subsequent issue we shall give an abstract of the decision as to what constitutes a reasonable rate of return for interest and [illegible]

The "Sales Method" of Appraising Real Estate.

In the appraisal of the steam railways of Wisconsin the "sales method" of valuing real estate has been extensively applied. Prof. W. D. Pence, engineer of the Wisconsin Railroad Commission, recently submitted to the commission a statement as to the accuracy of this method, with a view to showing the reliability of its application to the land of the Madison Gas and Electric Co. We give the statement in full, as taken from the commission's findings in the case of the State Journal Printing Co. vs. Madison Gas and Electric Co.

The following memorandum relates to the valuation of the two parcels of land included in the inventory of the physical property of the Madison Gas and Electric Company. At the conclusion of this memorandum are submitted final valuation figures prepared in the light of all available information gathered in a review of the record in this case and by means of a further extended field investigation. In the process of reaching these final figures the judgment of the commission's expert staff has been aided, in part, by a use of the so-called "sales method," which had been the subject of criticism by counsel for the company. Before submitting these revised figures, however, a statement will be presented relating to the status of the sales method, as determined by direct comparisons on a large scale, of the results found by this method with those reached by local real estate experts, having qualifications similar to those who testified on behalf of the company in this case.

The Sales Method.—The sales method of valuing real estate was used partially in the Michigan railway appraisals of 1900-1901, and in the light of the experience gained in that work the method was adopted in the Wisconsin steam road valuations made under the provisions of the Ad Valorem Assessment Law of 1903. It has since been extensively used in Wisconsin and elsewhere in connection with important valuations of public service properties for both rate making and taxation purposes, and is generally accepted as a valuable aid to the judgment by experts engaged in such valuation work on a large scale. The sales method may be defined as a plan or process for the systematic collection and comparison of data relating to real estate transfers for the purpose of estimating true market realty values. It consists in a study of the transfers of neighboring property having conditions or characteristics similar to the land whose value is to be determined, and is intended to duplicate, as nearly as may be, the mental or judicial processes ordinarily employed by the so-called "local real estate expert," with a view to arriving at results approximating those which would be reached by such local expert acting without bias or [illegible] application in a variety of ways; in fact, is [illegible] the varied methods employed by individual local experts. Two interpretations of the sales method have been most commonly employed. In one of these the area and consideration in each sale of similarly situated land is found, and the average unit price (per square foot, per foot frontage, per lot, per acre, etc.), ascertained, and this unit applied to the tract under investigation. The other application of the method introduces what, in many cases, is believed to be an additional safeguard, consisting of the use of the average assessed value of adjacent or similarly situated lands, in combination with an average ratio or percentage representing the relationship of the [illegible] total consideration paid for such transferred lands in the district or locality under consideration, all of these figures being based on the "ground values" exclusive of the improvements thereon. Such use of assessment figures is designed to introduce, as far as may be, the results of the judicial processes of the assessor who, at least in theory, serves on behalf of the public as an unbiased expert in the matter of relative valuations, and who attempts to make allowance for the peculiar attributes or characteristics of individual parcels of real estate in any given locality or neighborhood of a city. In the broader and more flexible applications of the sales method, the expert adopts one or the other of the processes just outlined, or blends the two together in such fashion as to yield the most consistent and trustworthy final result. In the process of valuing a tract of land involving conflicting data, as in the case under consideration, the expert user of the sales method on this flexible basis derives a series of tentative results, similar to the results representing the judgments of individual local experts. The judicial function involved in the discriminating selection of data and in the derivation of final results is exercised along essentially parallel lines with the two classes of experts here compared. The further act of the judgment in selecting a final preferred valuation figure in the light of a group of preliminary or tentative results is identical in the two cases. In the particular valuations here considered, the similarity of the basis is further emphasized by the fact that the results by the sales method represent the composite judgment of four members of the commission's expert staff, as against an equal number of local real estate experts employed by the company. The foregoing statement relates to the revised or final figures submitted at the conclusion of this memorandum, these figures replacing the preliminary or tentative land valuations formerly submitted on behalf of the commission's staff. Although it is frankly conceded that the tentative land valuation figures first reported were derived by a comparatively restricted application of the sales method, issue is here taken with certain claims made in the argument by counsel for company. In view of the repeated favorable reference by counsel to the judgment of the assessor with respect to relative values, the criticism of a similar use of the assessor's judgment by the commission's experts need scarcely be considered, except with respect to the misapprehension by counsel, as regards the fluctuation of the assessment ratio in Madison. Entirely aside from the claim that assessment ratios should not be depended upon in making land valuations, counsel contends that, in any event, a general assessment ratio [illegible] sideration, chiefly because of a supposed "radical difference as between different sections [illegible] the purpose of throwing some light on this point, Mr A. E. James, statistician of the tax commission, was requested to prepare a comparative exhibit based on Madison city sales for a period of years, classified with respect to kind or locality as follows:

[illegible]

[illegible]	[illegible]	Locality [illegible]	Assessment [illegible]
1905	6	62.8	61.0
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

Group 4. Poor residence section.

Table A gives, in condensed form, the results of this investigation, which covered some 905 verified real estate transfers during the four year period, 1905-1908, with an aggregate

TABLE III.—COMPARISON OF RESULTS BY TWO METHODS OF VALUING REAL ESTATE. (A) BY LAND SALES METHOD AND (B) BY LOCAL EXPERTS. INVESTIGATION BY THOS. POLLEYS, AT ST. PAUL, MINN.

Classification of Property	No. of blocks.	Average Value per Front Foot. (A)	Average Value per Front Foot. (B)	Excess (B) over (A) Amt.	Excess (B) over (A) Per cent.
Group 1. Less than $10 per front ft.	96	$ 6.15	$ 6.70	$0.55	9.0
$10 to $20 per front ft.	69	14.10	15.45	1.35	9.6
$20 to $40 per front ft.	82	28.55	29.55	1.00	3.5
Above $40 per front ft.	30	63.10	63.20	0.10	0.2
Totals	277	$20.95	$21.75	$0.80	3.8

consideration of approximately $3,000,000. A somewhat similar, though less discriminating, comparison made in 1906 covering sale and assessment figures for the seven-year period ending with 1904, affords the following general ratios for the four groups of property of 71 per cent, 67 per cent, 65 per cent and 64 per cent, respectively, with an average for the aggregate for the seven-year period of 66.7 per cent. To bring the comparison still closer to the point at issue, "locality ratios" were computed from carefully verified transfers within an area of some 26 blocks, including a district of from three to four blocks in all directions from the tracts owned by the Madison Gas and Electric Company. The results of these compilations for a period of six years, ending in 1908, are embodied in table B, which also includes the revised general ratios for the entire city for the corresponding years. The ratios for the three years, 1906-1908, for which most recent data as to present values are available, average 67.6 per cent local, as against 64.7 per cent general.

The foregoing comparisons do not justify the claim of counsel with respect to the extreme variations at Madison. The contrary appears to be the case.

The question as to whether the general or local assessment ratio should be applied, or assessment figures be used at all, depends entirely on circumstances which the expert, familiar with the use of the sales method, will investigate and take into account before reaching his final judgments as to the value of a given tract of land. In this particular instance the values of the local and general ratios chance to differ but little.

Calibration of Sales Method.—In view of the close similarity as to fundamental basis of the sales method as compared with the local expert method of valuing real estate, particular interest and importance attaches to any specific cases affording a direct comparison of actual valuation results by the two methods made under normal or balanced conditions. The results of two such comparisons on a large scale are fortunately available for the present discussion, one involving some 300 blocks (more than three square miles) of representative residential property in the city of St. Paul, the other of some 500 acres of valuable railway terminal lands in the city of Milwaukee.

The St. Paul investigation was conducted by Mr. T. A. Polleys, secretary of the Chicago, St. Paul, Minneapolis & Omaha Railway Company, who for a number of years had made extensive studies of real estate sales and valuations in Wisconsin, Minnesota and neighboring states. After serving on a committee made up of local real estate experts, charged with the inauguration of a reform in the basis of assessing real estate in the city of St. Paul, Mr. Polleys conceived of a plan for calibrating or testing the accuracy of the sales method of valuing lands, with a view of stimulating local interest in the matter. To this end he chose the district in the westerly portion of the city of St. Paul, comprising over 300 platted blocks, extending from Western avenue on the east to Cleveland avenue on the west (a distance of 3½ miles), and from Marshall avenue on the north of Osceola avenue on the south (a distance of nearly a mile), as indicated by the shaded rectangle on the accompanying map. The district was selected for the reason that the great activity for several preceding years would insure ample sales data upon which to base estimates of value, and because of the representative characteristics of the territory, such as the following: Values ranging from one dollar to over one hundred dollars per foot front; a portion of the lots built over and a portion vacant; some localities increasing very rapidly in value and others little or none; the area comparatively uniform in topography, although somewhat broken in places; in short, a district affording a wide range of conditions for such a comparative test. The process was directed to the determination of the correct average "ground" value per foot, exclusive of improvements, in a given year (1907) for a distance of one block along a given street, each block frontage being termed a "locality" for the purposes of this test. The average ground values per foot front for each of the 277 "localities" was ascertained by a flexible application of the sales method, the work being performed chiefly by Mr. Polleys personally, who then requested some fourteen highly qualified real estate experts in the city of St. Paul to submit their estimates of the same values. In order to arouse interest in the investigation, Mr. Polleys charted his own determinations and submitted duplicate copies of the same to each of the experts, with the urgent request, however, that they should not be influenced by his figures, and further that values be submitted only on those blocks where they had direct personal knowledge of values. The experts served without compensation, acted independently of each other, that is, without conference or collusion of any sort, and, so far as known, were entirely free of bias or suggestion in preparing their estimates of value. Of the fourteen experts invited some twelve submitted more or less complete responses, most of them asking for additional time for fuller deliberation as to values. The condensed results of this remarkable investigation are shown in the accompanying table III, and the complete exhibit for a single representative street (Lincoln avenue), comprising some 21 localities, are given in table IV. In further illustration of the methods pursued in these studies, there are submitted with this memorandum, in addition to the map, a copy of a paper describing this investigation (Real Estate Valuations, by Thomas A. Polleys—Proceedings Minnesota Academy of Social Sciences, Vol. 1, pp. 59-78, 1907). I am also able to submit as information, through the courtesy of Mr. Polleys, the original figures of the twelve experts and the reduction sheets leading to the final comparative figures, these papers having been loaned to the commission's engineer during a recent personal investigation of the conditions surrounding this test of the sales method. While on the ground, conference was held with the president of the St. Paul real estate exchange, who participated in the Polleys investigation and who regards the sales method as an exceedingly valuable aid to the judgment, subject to limitations of a character in certain situations which are recognized and felt by all local experts who are called upon to value lands.

Tables III and IV show, in the last column, the percentages variation between the results of the sales method and the averages of the results of the local experts. It is seen that the tendency of the sales method is to give deficient results to an average amount of 3.8 per cent for the entire 277 localities or blocks.

This result or tendency is strikingly confirmed by the other instance above referred to, consisting of the valuation of terminal lands belonging to the Chicago, Milwaukee & St. Paul Railway Company in the city of Milwaukee, made in 1903 under the auspices of the tax commission. These lands amounted to upwards of 500 acres in the aggregate, scattered through some 15 wards or assessment districts of the city, and having an aggregate valuation of approximately $6,000,000. The market value of these railroad lands was determined by specially qualified local real estate experts under the personal direction of Mr. F. W. Adams, the secretary of the railway company, who preserved a remarkable balance of judgment throughout the work. The state valuation staff, under the personal direction of Prof. W. D. Taylor, engineer for the state board of assessment, used the sales method on a basis consistent with local conditions. The final results differed by only 3.5 per cent, the results by the sales method being the lower, as in the Polleys investigation.

As a result of the elaborate series of tests above described, it appears that, taking the results by the "local expert method" as a basis, the "sales method" tends to give slightly lower results, the difference appearing to be about 4 per cent on the average.

Final Revised Values.—The final valuation figures for the two tracts of land submitted by the commission's valuation staff in the light of all available evidence, including the testimony submitted by the local experts and the results of the comparative tests of the sales method above described, are as follows for the year 1908:

Block 131. The revised valuation of block 131 is placed by the commission's staff at $42,000, with a possible range from $37,000 as a minimum to $47,000 as a maximum.

Part of block 126. The valuation of this tract presents special difficulties, owing chiefly to extreme scarcity of trustworthy sales figures in the immediate locality. The revised valuation of this tract is placed by the commission's staff at $18,000, with a possible range from $16,000 as a minimum to $20,000 as a maximum.

TABLE IV.—POLLEYS INVESTIGATION OF SALES METHOD OF VALUING REAL ESTATE. COMPARISON OF RESULTS ALONG LINCOLN AVENUE, ST. PAUL.

Along Lincoln Avenue (3½ miles)	Average Ground Value Per Front Foot (A) By land sales process	(B) By local experts. No. of experts.	(B) By local experts. Value	Excess (B) over (A) Amount.	Excess (B) over (A) Per cent
1. Dale to St. Albans	$47.00	7	$50.87	$3.87	8.2
2. St. Albans to Grotto	49.00	8	51.20	2.20	4.5
3. Grotto to Avon	49.00	8	51.80	2.80	5.7
4. Avon to Victoria	50.00	9	51.65	1.65	3.3
5. Victoria to Milton	[illegible]	7	36.05	0.30	0.8
6. Milton to Chatsworth	29.00	8	29.85	0.85	2.9
7. Chatsworth to Oxford	[illegible]	[illegible]	[illegible]	—0.95	[illegible]
8. Oxford to Lexington	24.00	[illegible]	24.20	0.20	0.8
9. Lexington to Dunlap	[illegible]	[illegible]	16.15	1.15	[illegible]
10. Dunlap to Griggs	[illegible]	[illegible]	12.20	0.20	1.7
11. Griggs to Syndicate	[illegible]	[illegible]	8.90	0.40	4.7
12. Syndicate to Hamline	[illegible]	[illegible]	[illegible]	0.85	10.0
13. Hamline to Albert	7.00	[illegible]	8.05	1.05	15.0
14. Albert to Pascal	7.00	[illegible]	7.95	0.95	14.0
15. Pascal to Saratoga	[illegible]	6	[illegible]	1.10	28.0
16. Saratoga to Snelling	[illegible]	[illegible]	7.90	0.90	18.0
17. Macalester to Cambridge	[illegible]	6	[illegible]	0.35	3.9
18. Cambridge to Baldwin	[illegible]	[illegible]	[illegible]	0.20	[illegible]
19. Baldwin to Fairview	[illegible]	[illegible]	[illegible]	0.20	[illegible]
20. Fairview to Prior	[illegible]	[illegible]	3.90	0.40	11.4
21. Prior to Cleveland	[illegible]	[illegible]	4.10	0.60	17.[illegible]
Average for 21 blocks	[illegible]	7	$20.60	$0.85	4.2

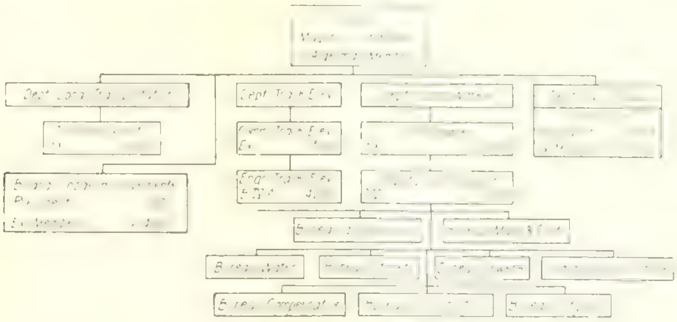
The Southern Pacific is about to commence the construction of a 6-mile tunnel under the Sierra Nevada Mountains between Cisco and Donner, Cal. There will then be a reduction in grade and distance to San Francisco and present troubles due to snow will be eliminated.

Organization of the Public Works Departments of the City of Chicago.

By J. C. Schniedwind.*

In March, 1909, Mr. Fred A. Busse, then mayor of Chicago, appointed the municipal efficiency commission. This commission was made up as follows: President of the civil service commission, chairman; commissioner of public works, president of the board of education, city comptroller, president of the board of local improvements, four leading business men and three aldermen. By the action of the city council this commission was appointed:

To adjust all controversies as to salary and civil service grade, to fix the same in all cases in which they have not been properly determined, to recommend uniform salaries as to the value of grades, to classify the inspection service of the city and to recommend the compensation of each class, and to make such other recommendations as its investigations may prompt; looking to greater municipal efficiency.



After a careful consideration of conditions, the commission proceeded with its work under the following heads: Classification of positions, grading and uniform salaries, elimination of titles of inspection, method of appropriation, pay roll schedule, paying employes, time keeping record, organization, civil service rules amended and miscellaneous.

To review the whole work of the commission is impossible, with a limited amount of space, and for this reason the paper has been confined to a description of the results accomplished under the first two heads, insofar as they affect the departments, which are of most interest to the engineering and contracting profession. Before entering into the description proper, the writer deems it advisable to point out in detail the work of each department, its organization and individual salaries of the more important positions.

GENERAL ORGANIZATION FOR PUBLIC WORKS

The engineering and construction work of the city is divided between two departments, the board of local improvements and the department of public works. To these might be added the department of local transportation, the department of track elevation, and the department of civil service, which has jurisdiction over all positions in the municipal service, except those which are elective, appointed or selected according to law.

Board of Local Improvements.—The board of local improvements was created by an act passed by the general assembly of the state of Illinois, and by it is given full power over all improvements, authorized by law and paid for by special assessment. The board consists of five members, who are appointed by the mayor, with the consent of the city council. The superintendent of special assessments, who is ex-officio secretary of the board, is under the jurisdiction of the civil service commission.

Department of Public Works.—The department of public works, which has charge of all improvements not paid for by special assessment, was created by a special ordinance of the city council and is made up of the following bureaus: Engineering, water, streets, sewers, compensation, maps and plats, architecture and city hall. The head of this department, the commissioner of public works, is appointed by the mayor, with the consent of the city council, and constitutes one of the mayor's cabinet.

Department of Local Transportation.—The department of local transportation was created by the city council and exercises jurisdiction over questions pertaining to local transportation. It is in charge of a traction expert, who is appointed by the mayor, with the consent of the city council.

Department of Track Elevation.—The department of track elevation prepares all ordinances pertaining to track elevation and through the committee on track elevation they are presented to the city council for passage. The dpartment is in charge of the commissioner of track elevation, who is appointed by the mayor with the consent of the city council.

HEADS [illegible] IMPROVEMENTS.

The board of local improvements is made up of two bureaus, construction and assessments; these in turn are sub-divided into divisions. The total force of employes is 308, with an aggregate salary of $435,296 per year.

Bureau of Construction.—The bureau of construction consists of the sewer division, street division and sidewalk division. The engineer of the board of local improvements directs the bureau of construction, and to him report the chief engineer of streets, superintendent of sidewalks and assistant engineers of the sewer division, over which he takes immediate supervision.

Street Division.—The street division, by [illegible] all plans, estimates, surveys and specifications pertaining to the pavement of streets and under his supervision is carried on the construction work. Assisting the chief street engineer are six assistant engineers, each in charge of a division, one expert asphalt chemist in charge of asphalt analysis, one engineering chemist in charge of tests, seven paving inspectors in charge of construction and one paving inspector in charge of repairs. To each assistant engineer reports one junior engineer at $1,300 per year and one rodman at $1,080 per year. To the inspectors in charge report the paving inspectors at salaries varying from $110 to $90 per month and one paving brick tester at $1,500 per year. Assisting the expert asphalt chemist are four asphalt inspectors in charge at $1,500 per year, one asphalt chemist at $1,500 per year and assistant asphalt chemists at $125 per month, a chief clerk, an accounting clerk at $1,500 per year, a stenographer at $1,200 per year and a messenger at $720 per year make up the clerical force.

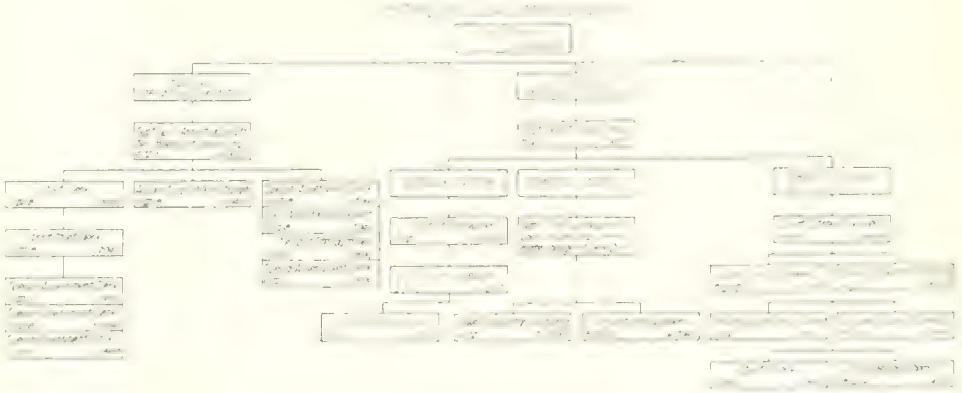
Sewer Division.—All the engineering work pertaining to the design and construction of sewers is done by six assistant engineers under the supervision of the engineer of the board. Each assistant engineer is in charge of all sewer work in his division and to him are assigned one junior engineer at $1,300 per year and one rodman at $1,080 per year.

The inspection of the construction work is directed by the sewer inspectors in charge, to whom report the mason inspectors, who are paid according to union scale. Materials, such as cement, tile pipe and brick, are inspected and accepted by the various inspectors at salaries ranging from $1,500 per year to $100 per month.

Construction of house drains is under the supervision of the house drain inspector in charge at a salary of $1,500 per year, and his assistants at $100 per month. The balance of the force is made up of two draftsmen at $1,320 per year each and two special assessment clerks at $1,500 and $1,200 per year.

Sidewalk Division.—The superintendent of sidewalks is in charge of all matters pertaining to sidewalks. Assisting him are one assistant superintendent at $1,500 per year, three assistant engineers, who are responsible for the line and grade of all sidewalks built, three supervising sidewalk inspectors at $110 per month, who have charge of sidewalk inspection in their respective districts and the sidewalk inspectors at $100 per month. The clerical force consists of seven clerks, at salaries ranging from $1,500 to $1,200 per year, and two stenographers.

Bureau of Assessments.—The bureau of assessments, under the supervision of the superintendent of special assessments, is divided into three divisions in charge of a chief clerk, an accounting clerk in charge and a special assessment clerk. All matters pertaining to spreading of assessments, public hearings, contracts, rebates, payrolls, etc., are handled by these divisions and require a force of 71 clerks, 9 stenographers and 2 messengers, whose salaries range from $2,040 per year for expert tax clerks to $720 per year for messengers.



[illegible]

[illegible] PUBLIC WORKS.

The department of public works of the city of Chicago is considered by many to be the most complicated of any municipal depart- [illegible] understood when one stops to realize that it is made up of nine different bureaus, employing 1,812 people, whose salaries annually amount to over $1,500,000. The commissioner of public works is directly responsible to the mayor and city council for the management of his department. He is assisted by a deputy commissioner of public works, who is appointed by the mayor, with the consent of the city council.

Bureau of Engineering.—The bureau of engineering ranks as the most important of the bureaus of the department. The city engineer is head of the bureau and has charge of [illegible] repairs and [illegible] work [illegible] rivers and harbor, all repairs and construction of bridges and viaducts, of the construction, maintenance, operation and repair of all city water works and the laying of all main and supply water pipe. The bureau is divided into eight divisions, as follows: Water pipe extension, water works shop and repairs, pumping station operation, bridges and harbor, designing, construction, tests and general office. The engineers or superintendents in charge of their respective divisions report directly to the city engineer through the assistant city engineer.

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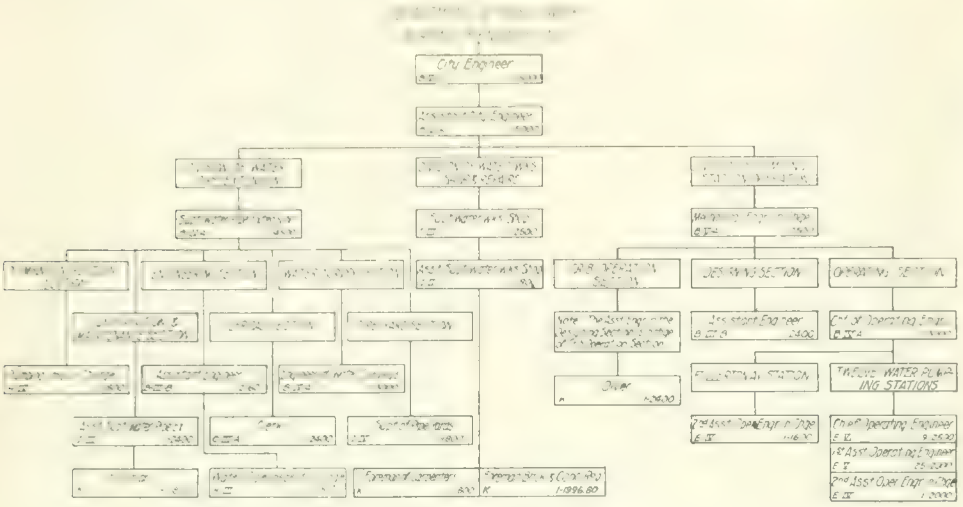
*Engineering Staff, Board of Local Improvements, Chicago.


City Engineer
Assistant City Engineer
Supt of Water Pipe Extension
Supt of Water Works Shop
Asst Supt of Water Wks Shop
CRIB OPERATION SECTION
DESIGNING SECTION
OPERATING SECTION
Note: The Asst Engr in the Designing Section in charge of Crib Operation Section
Assistant Engineer
Chief Operating Engr
Diver
FILTRATION STATION
TWELVE WATER PUMPING STATIONS
2nd Asst Oper Engr in Charge
Chief Operating Engineer
1st Asst Operating Engineer
2nd Asst Oper Engr in Charge
Clerk
Supt of Pipe Yards
Foreman of Carpenters
Foreman Bricks & Conc Rep
1-1996.60

Water Pipe Extension Division.—The water pipe extension division is in charge of the superintendent of water pipe extension, and all matters pertaining to water pipe extension, operation and maintenance comes directly under his supervision. The division is subdivided into six sections—construction and maintenance, engineering, water survey, pipe yard, plumbing and clerical.

The construction and maintenance section handle all field work by direction of the assistant superintendent of the water pipe extension division, to whom report 9 foremen, 23 assistant foremen of repairs at $1,500 per year, one foreman of laborers at $1,500 per year and mason foremen, who are paid according to union scale. To these men report the timekeepers, bricklayers, calkers and laborers.

To the engineering section is referred such matters as require the services of an engineer or his assistants. Under the direction of the assistant engineer are prepared plans, specifications, etc., for the work of the division. Reporting to him are four junior engineers at $1,500 per year and five draftsmen at $1,200 per year. The inspection of water pipe is carried on by four inspectors in charge and 72 inspectors at $100 per month.

The water survey section is in charge of the engineer of water surveys, and by his direction are made the waste water surveys, thereby locating leaks in the distributing system. Reporting to the engineer of water surveys are six junior engineers at $1,500 per year, two draftsmen at $1,200 per year and two rodmen at $1,200 per year and $1,080 per year.

The pipe yard section comprises the employes of four supply yards, located in various parts of the city and is under the supervision of the superintendent of pipe yards. At these yards are carried in stock all materials necessary for construction and repairs Reporting to the superintendent are the various foremen in charge of carpenters, clerks, laborers, watchmen, etc.

The plumbing inspector in charge of the plumbing section has supervision over the general inspection of service pipe installation, complaints regarding leaks, insufficient water supply, etc. He is assisted by the plumbing inspectors, who are rated at $117 per month, and are union plumbers.

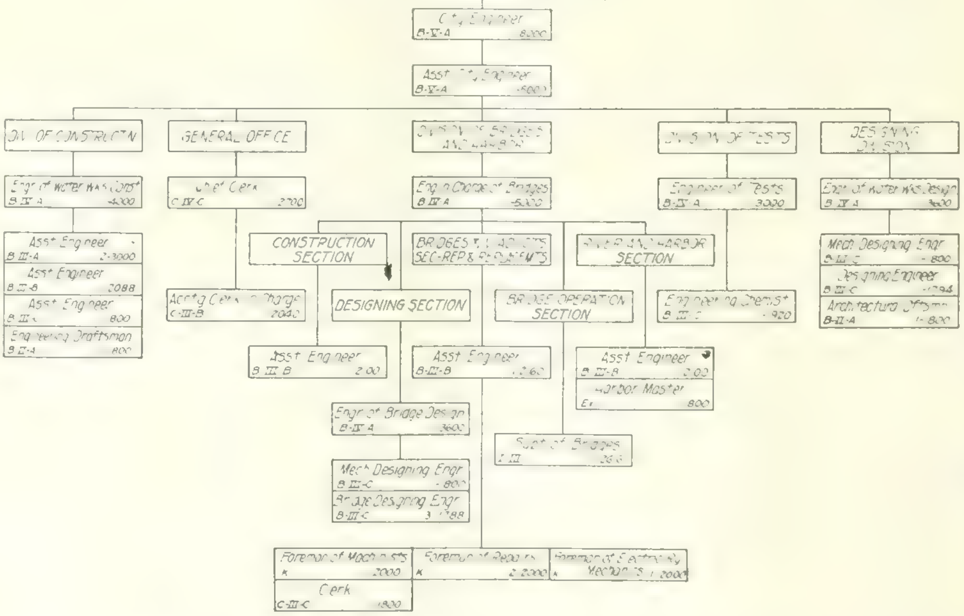
The clerical section, which handles all matters of a clerical nature, is in charge of chief clerk, assisted by ten clerks and a stenographer. Their salaries range from $2,400 per year to $1,080 per year.

Division of Water Works Shops and Repairs.—The division of water works shop and repairs, under the direction of the superintendent of water works shop, does such repairing and manufacturing as is found necessary. The work includes repairing and manufacturing hydrants and valves, machine work, brass castings and miscellaneous jobs of a similar nature. Reporting to an assistant superintendent are foremen of the various tradesmen at salaries ranging from $2,000 per year to $1,620 per year, one storekeeper at $1,320 per year, one architectural draftsman at $1,500 per year and three clerks at $960 per year. All tradesmen are paid according to union scale.

Division of Pumping Station Operation.—The division of pumping station operation, which has charge of the operation and maintenance of the pumping stations, lake cribs and their equipments, is divided into three sections—crib operation, designing and operation, all under supervision of the mechanical engineer in charge.

The crib operation section is in charge of the city diver, under the supervision of the assistant engineer of the designing section. All matters pertaining to the operation and maintenance of the five lake cribs are referred to him. To the city diver report two helpers at $1,200 per year, five crib keepers at $1,200 per year and ten assistant crib keepers at $1,000 per year.

DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING - CHART 2.



The designing section reports to the assistant engineer in charge and by his direction are prepared such plans, specifications and estimates as are necessary for the work of the division. Two draftsmen at $1,620 per year and $1,200 per year are employed to carry on the work of the section.

The operating section, which directs the maintenance and management of the various pumping stations, 13 in number, is in charge of the chief operating engineer. To him report 9 chief operating engineers and 4 second assistant operating engineers in local charge of pumping stations. The salaries for these positions range from $2,500 per year for the principal stations to $1,560 per year for the less important ones. Other employes are 25. First assistant operating engineers at $2,000 per year, 8 third assistant operating engineers at $1,460 per year, 5 conveyor engineers at $1,460 per year, derrick engineers at $5.60 per day, boiler washers, oilers, firemen, coal passers and janitors, whose salaries range from $1,260 per year to $900 per year; 2 clerks at $1,320 per year and one stenographer at $1,080 per year complete the force.

Division of Bridges and Harbors.—The division of bridges and harbors, under the supervision of the engineer in charge of bridges, handles all matters pertaining to the design, construction and repair of bridges, viaducts, harbor, docks, etc., which come under the jurisdiction of the city. The division is divided into five sections, as follows: Designing, construction, bridge and viaduct repairs and replacement, bridge operation and river and harbor. In the designing section, by direction of the engineer of bridge design, are prepared the various designs, plans and estimates for the division. Reporting to the engineer of bridge design are one mechanical designing engineer, three bridge designing engineers, three engineering draftsmen at $1,500 per year and one engineering draftsman at $1,400 per year.

All field work connected with the construction of new bridges is carried on under the supervision of the assistant engineer in charge of the construction section. To him are assigned two junior engineers at $1,400 per year, and three rodmen, whose salaries are $1,188 per year, $1,000 per year and $900 per year.

All repairs or renewals found necessary are made by the bridge and viaduct repair and replacement section, by direction of the assistant engineer in charge of the section. To him report one foreman of machinists, one foreman of electric railway mechanics, two foremen of repairs, one foreman of painters, one engineering draftsman and one junior engineer, whose salaries range from $2,000 per year to $1,500 per year. Storekeepers, clerks, mechanics, laborers and other employes of the section report to their immediate superior, who is one of the above men.

The bridge operation section is in charge of the superintendent of bridges, who is responsible for the maintenance and operation of all bridges; 66 bridge tenders at $1,200 per year, 115 bridge tenders at $900 per year and 1 ferry tender at $900 per year are employed in this section.

The river and harbor section, under the assistant engineer in charge, has supervision over the harbor of the city, which extends into Lake Michigan for a distance of three miles from the shore line, within the boundaries of the city, both branches of the Chicago river and the Calumet river within the city limits. One harbor master, one junior engineer, one vessel despatcher, six dredging inspectors, six harbor police and two rodmen, whose salaries range from $1,800 per year to $1,080 per year, make up the force.

Designing Division.—The work of the designing division of the bureau of engineering may be summed up as follows: Preparation of general maps, gathering of data pertaining to the increase and improvement of the water works system, the complete design of new construction, including cribs, tunnels, pumping stations, etc., which involves making contract drawings, writing specifications, examination of contractors' drawings and consultation with engineers in local charge of work, as to details, which develop as construction progresses. The division is in charge of the engineer of water works design, who is assisted by a mechanical engineer at $1,800 per year, a designing engineer at $1,794 per year and nine draftsmen at from $1,800 per year to $1,200 per year.

The division of construction, in charge of the engineer of water works construction, directs all work pertaining to the construction, equipment and repair of pumping stations, water tunnels, lake cribs and other improvements of a similar nature. In local charge of the various pieces of work are four assistant engineers, at from $3,000 per year to $1,800 per year, who have their own corps of assistants made up of draftsmen, engineers, rodmen, inspectors, etc.

The work of the division of tests consists of making evaporation and laboratory tests on all coal furnished the pumping stations, laboratory tests on oil furnished the pumping stations, and testing samples of cement, steel and other materials used in the construction work under the supervision of the bureau of engineering. The work is in charge of the engineer of tests, assisted by one engineering chemist at $1,920 per year, five assistant engineering chemists at $1,500 per year, six laboratory assistants at from $1,200 to $1,080 per year and three foundry pipe testers at $1,500 per year.

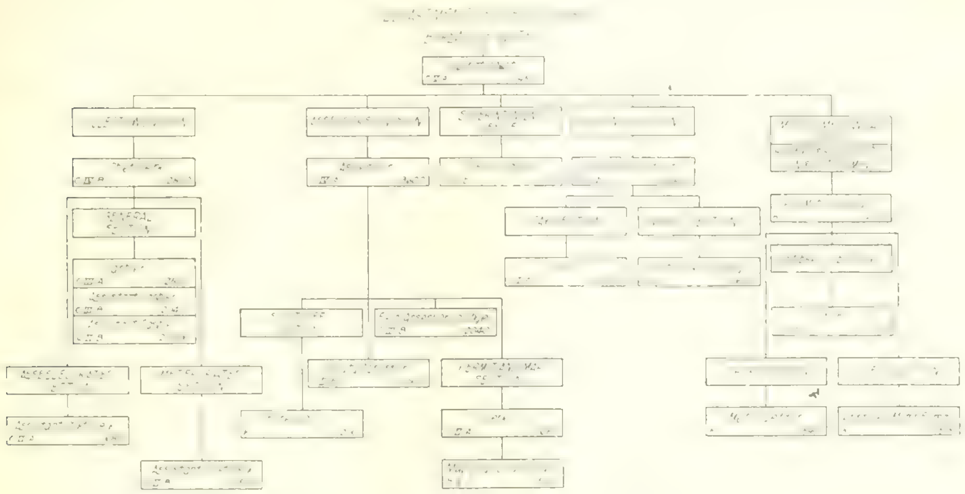
The general office is in charge of a chief clerk, assisted by an accounting clerk in charge, four clerks at from $1,500 per year to $1,200 per year and two stenographers at $1,500 per year and $1,200 per year.

Bureau of Water.—The bureau of water was organized for the purpose of assessing water rates and charges by frontage plan, meter measurement, estimate or contract, to install and maintain water meters, to collect all money derived from the sale of water and deliver same daily to the city treasurer.

The bureau of water is divided into five divisions, collection, assessor's, meter mechanical, auditing and superintendent's office, under the supervision of the superintendent of the bureau of water.

The collection division is divided into three sections, assessed rates, general and meter rates, in charge of a chief clerk. The assessed rates section reports to an assistant chief clerk at $1,680 per year. Six division clerks at $1,500 per year and thirty clerks at from $1,200 per year to $960 per year are employed in this section. In the general section are employed one cashier at $2,500 per year, one assistant cashier at $2,040 per year, two assistant cashiers at $1,500 per year, eight clerks and one stenographer at from $1,500 per year to $960 per year. The meter rates section is made up of an assistant chief clerk, a division clerk and twenty-one clerks at salaries ranging from $1,500 per year to $960 per year. These are exclusive of the rate takers, who are paid $100 per month.

The assessor's division is in charge of an [illegible]



[illegible] per year, to whom report 20 sha[illegible] men at $75 per month, and the permit an[illegible] [illegible] year and $1,200 per year and seven draftsmen, one at $1,500 per year and six at $1,080 per year. The division also includes [illegible] n charge, [illegible] varying number of field [illegible] month and two clerks [illegible] and the deputy assessor's force, made [illegible] salaries range from $1,500 per year to $9[illegible] [illegible] of setting, repairing and replacing all water meters. The division is divided into three [illegible] supervision of the general meter foreman. In the shop section are employed one meter setter at $1,540 per year and various tradesmen, all of whom are paid according to union scale. The general section is made up of six clerks, at from $1,200 per year to $960 per year, and one laborer at $900 per year. To the field section is assigned the field work of the division, in charge of two assistant general meter foremen at $1,500 per year. To these men report two expert meter and plumbing examiners at $1,350 per year and various tradesmen, who are paid according to the union scale.

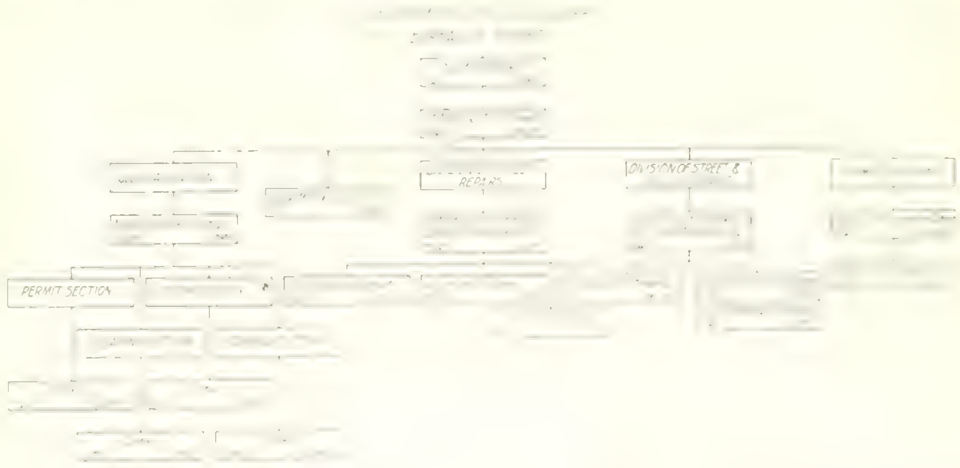
The auditing division is made up of two sections, day and night, in charge of the head accountant. The day section consists of two clerks at $1,200 per year. The night section is made up of six clerks at $1,200 per year, who report to the night clerk in charge at $1,680 per year.

The superintendent's office force is made up of one clerk, one stenographer and one messenger at from $1,500 per year to $720 per year.

Bureau of Streets.—The bureau of streets, by direction of the superintendent, makes all improvements or repairs necessary to the streets, sidewalks or public ways of the city, not paid for by special assessment, cleans all streets and alleys, removes and disposes of all garbage, ashes and other refuse and handles such other matters as are assigned by the commissioner of public works.

The bureau of streets is divided into four divisions, as follows: Street repairs, street and alley cleaning, permit and clerical, all of which report to the superintendent of streets through the first assistant superintendent.

The division of street repairs is in charge of the third assistant superintendent, and by his direction are handled all matters pertaining to street repairs, street location, alignment and grade for street car tracks and various other assignments. To him report one assistant engineer at $1,800 per year, one engineering chemist at $2,000 per year, three junior engineers at from $1,620 per year to $1,500 per year, four rodmen at from $1,320 per year to $1,080 per year and a force of paving inspectors, pavers, mechanics, laborers, etc., whose salaries are arranged either ac- [illegible]



The division of street and alley cleaning is in charge of the second assistant superintendent of streets, and by his direction is carried on the work of the division. To him report the various ward superintendents and superintendent of dumps. When conditions warrant it, the ward superintendents report to the first assistant superintendent.

To the ward superintendent report one timekeeper at $1,200 per year, twelve yardmen at $900 per year, sub-foremen at $2.75 per day and laborers at $2 per day. To the superintendent of dumps report one su- [illegible] per year, five foremen at $1,080 per year, mechanics, sub-foremen and laborers.

The public utility inspector in charge of the permit division is assisted by sixteen public utility inspectors at $1,800 per year, [illegible]

[illegible] at $1,[illegible] per year [illegible] public utility inspectors at $4 per day, as [illegible]

The clerical division in charge of the accounting clerk in charge is divided into four sections, as follows: Permit, cleaning, repair and general, and require the service of [illegible] clerks at from $1,500 per year to $1,080 per year, one secretary and ten stenographers, who are paid from $1,500 per year to $960 per year. One house moving inspector, at $1,500 per year, reports to the first assistant superintendent direct.

Bureau of Sewers.—The bureau of sewers has charge of all construction and repair of sewers in public streets and alleys, not paid for by special assessment, all sewer cleaning, all house drain construction by private contractors, and such other matters as are assigned to the bureau by the commissioner of public works.

The bureau of sewers is divided into six divisions, as follows: Sewer cleaning, sewer repairs, house drains, pumping stations, benches and grades and superintendent's office, all of which are in charge of the superintendent of sewers.

The division of sewer cleaning, by direction of the assistant superintendent of sewers, carries on such work as is referred to the division. To him report one foreman at $1,800 per year, six foremen at $1,680 per year and the assistant foremen at $4.30 per day, who have charge of work in their territory.

The division of sewer repairs is made up of three branches, which take charge of various classes of work assigned to the division. One branch is in charge of the assistant engineer, who makes such investigations as are necessary, prepare all plans and designs and handle other matters of a technical nature, which require the services of an engineer. He is assisted by one rodman. The second branch is in charge of an assistant foreman of sewer pipe yards, to whom reports the foreman of carpenters, at $1,600 per year who has charge of the mechanics, laborers and watchmen. The third branch reports to the foreman of brick masons, through an assistant foreman, whose force consists of mason inspectors, brick masons, timekeepers, etc.

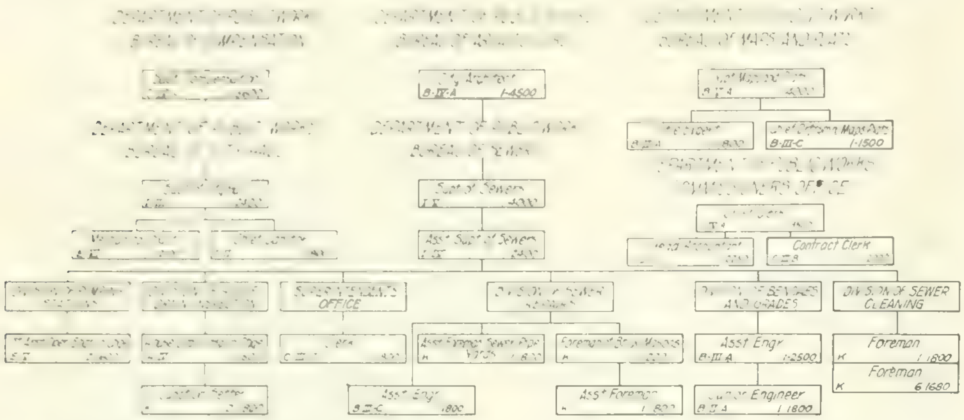
The division of house drains has charge of house drain construction, under the supervision of the house drain inspector in charge; assisting him are the house drain inspectors at $100 per month, pipe inspectors at $1,080 per year and two junction setters at $1,800 per year.

The division of pumping stations has charge of the operation and maintenance of five pumping stations connected with the bureau of sewers. In this division are employed two first assistant operating engineers in charge at $1,600 per year, two second assistant operating engineers in charge at $1,500 per year and one second assistant operating engineer in charge at $1,460 per year. To these men report the operating engineers, oilers and firemen.

The division of benches and grades, in charge of an assistant engineer, establishes all standard bench monument elevations and recommends to the city council for passage such ordinances as pertain to street grades. One junior engineer and two rodmen assist in the work.

The superintendent's office force is made up of five clerks, two draftsmen, one stenographer and one messenger, whose salaries range from $1,800 per year to $600 per year.

Bureau of Maps and Plats.—The bureau of maps and plats has charge of all matters pertaining to the keeping of records of maps and plats recorded in the city, street numbering plans, and the drawing of all plats required by the various departments.



In charge of the bureau is the superintendent of maps and plats, who also acts as examiner and recorder of subdivisions. He is assisted by a chief draftsman at $1,500 per year, who has charge of the office force, consisting of one title expert at $1,800 per year, twenty-one draftsmen at from $1,440 per year to $1,080 per year, one legal description clerk at $1,320 per year and one stenographer at $1,080 per year.

Bureau of Compensation.—The bureau of compensation has charge of and receives all applications for permits to use streets, alleys or public grounds for private use, and the issuance of permits for the same. The superintendent of compensation has charge of the bureau, to whom report one investigator at $1,500 per year, one clerk and one stenographer.

Bureau of Architecture.—To the bureau of architecture is referred all matters requiring the services of an architect. The city architect and one specification clerk, at $1,500 per year, make up the bureau.

Bureau of City Hall.—The bureau of city hall is responsible for the proper maintenance and care of the city hall building. The bureau is in charge of the superintendent of city hall, to whom report the mechanical superintendent, in charge of the heating, ventilation, etc., the chief janitor, in charge of the care of the building, the elevator starter, the carpenter and cabinet maker, who have their various assistants for assigned duties.

The commissioner's office force consists of one chief clerk, one contract clerk, one head accountant, one investigator, one bookkeeper, one stenographer and clerks, six in number, whose salaries range from $3,600 per year to $960 per year.

DEPARTMENT OF TRACK ELEVATION

The department of track elevation is made up of the commissioner of track elevation, the engineer of track elevation and the secretary.

DEPARTMENT OF CIVIL SERVICE

The department of civil service was established to carry out the provisions of an act adopted by the legislature of Illinois in 1895, and commonly known as the Civil Service Act. According to this act all employes in the municipal service, except the law department, municipal courts, teachers in public schools, members of the mayor's cabinet, heads of municipal departments and appointments confirmed by the city council, are placed under civil service.

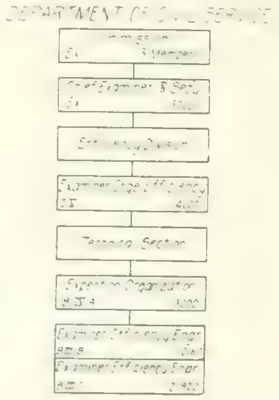
Administration of the act is vested in a commission of three members, appointed by the mayor. The members of the Civil Service Commission are apointed for a term of three years, one being appointed each year. The president of the commission is elected for one year at a salary of $5,000 per year, the other members receiving $3,000 per year each. Assisting the commission is an attorney and secretary and chief examiner, each at $3,000 per year.

The department is divided into five divisions, labor, physical, records, mental and efficiency, each directed by an examiner in charge, whose salaries range from $4,000 per year, for the examiner in charge of efficiency, to $1,500 per year for the examiner in charge of the labor division. In each division is a picked force of examiners and clerks, who have charge of the various details of the work.

Efficiency Division.—In view of the fact that the efficiency division of the civil service department is the outgrowth of recommendations of the municipal efficiency commission, the writer has decided to describe in detail the organization of the division. Assisting the examiner in charge are two experts on system and organization, one in charge of the clerical and accounting section, the other in charge of the technical section. By their direction are retained specialists, whose education and experience have fitted them for their particular duties.

Upon recommendation of the municipal efficiency commission, the Civil Service Commission has classified the entire service of the city into eleven divisions, according to the general character of the duties performed:

Division A, Medical Service.—Positions the duties of which require training and ability in the medical profession or some branch thereof. Division B, Engineering Service.—Positions the duties of which require training and ability in civil, mechanical, electrical or chemical engineering, architecture or related technical work. Division C, Clerical Service.—Positions of persons rendering clerical service or service in connection with general office work or management, which does not require knowledge of any of the specialties included in other divisions. Division D, Police Service.—Positions in the uniformed or detective forces of the department of police. Division E, Operating Engineering Service.—Positions the duties of which require training and ability in the operation and maintenance of equipment for the production of heat, light or power, or in work relating thereto. Branch A includes positions in all departments except the board of education. Branch B includes only positions under the board of education. Division F, Fire Service.—Positions in the uniformed service of the fire department. Division G, Library Service.—Positions connected with the administration of public libraries and requiring training and ability in library methods. Division H, Inspection Service.—Positions the duties of which relate to inspection (whether of work, material or conditions), but which do not require professional knowledge. Division I, Supervisory Service.—Positions the duties of which are chiefly supervisory, involving accountability for the maintenance of public property, for the work of public employes, or for the custody of public charges, but which do not require knowledge in any of the specialties included in other divisions. Division K, Skilled Labor Service.—Positions requiring knowledge of a trade



or useful art, or requiring special manual or mechanical skill. Division L, Labor Service.—Position of persons rendering labor service, general or specialized, where a choice by competition is impracticable. Branch A includes positions in which the service is general or common. Branch B includes positions in which the service is specialized.

The positions in each division are then classified into grades, which are in turn subdivided into groups, as follows. (The writer here has confined himself to those divisions employed in the various departments described previously):

Division B, Engineering Service.—Grade I: Positions the duties of which require some skill and accuracy and a general training, but not necessarily much practical experience. (Includes positions of rodman, draftsman and map draftsman.) Group C: $1,080. Group B: $1,200. Group A: $1,320. Grade II: Positions the duties of which require training, experience and ability, involving fixed responsibility, and which may or may not be supervisory (includes positions of junior engineer, engineering draftsman and architectural draftsman). Group C: $1,500. Group B: $1,620. Group A: $1,740. Grade III: Positions the duties of which are supervisory, involving independent judgment and accountability for the work of others, and for the definite part of an engineering work. (Includes positions of assistant engineer.) Also positions requiring a high order of specialized knowledge and professional ability, but which are not necessarily supervisory. (Includes positions of designing engineer and architectural designer.) Group C: $1,920. Group B: $2,160. Group A: $2,400. Grade IV: Positions the duties of which are administrative, requiring special qualifications and recognized expert knowledge, and involving responsibility, for the work of a minor department, under the head thereof, or entire responsibility for a division or a minor bureau. (Includes positions of engineer of track elevation and engineer of tests.) Grade V: Positions the duties of which are administrative and executive, involving entire responsibility for an important department or bureau, either independently or directly under the head or heads of such department or bureau. (Includes positions of engineer board of local improvements, city engineer and assistant city engineer.)

Division C, Clerical Service.—Class O: Positions the duties of which are of simple office routine, viz, positions of the standard of messenger. Group D: $480. Group C: $600. Group B: $720. Group A: $840. Class I: Positions the duties of which require skill and accuracy and some experience, involving routine work. Grade C: $960. Grade B: $1,080. Grade A: $1,200. Class II: Positions the duties of which require special training, experience and ability, involving fixed responsibility, and which may or may not be supervisory. Grade C: $1,320. Grade B: $1,500. Grade A: $1,680. Class III: Positions the duties of which are supervisory, involving independent judgment and accountability for the work of others. Also positions the duties of which require a high order of specialized knowledge and ability, but which are not necessarily supervisory. Grade C: $1,800. Grade B: [illegible] Grade A: [illegible] Class IV: Positions the duties of which are administrative, requiring special qualifications and involving responsibility for the clerical work of the entire department, under the direction of the head thereof, or for the work of a division or minor bureau of such department. Grade C: $2,700. Grade B: $3,000. Grade A: $3,600. Class V: Positions the duties of which are executive and administrative, involving responsibility for an entire department, either independently or directly under the heads or head of such department, or for an entire bureau.

Division E, Operating Engineering Service.—Branch A: Positions in this service shall be graded according to (1) the experience and ability required by the duties to be performed, or (2) the degree of responsibility of the positions and the class of the plant to which they are attached. For this purpose plants are divided into four classes, as follows: Class I: Water pumping stations of over 600 water horsepower, sewage pumping stations of over 400 water horsepower, and the plants of the Chicago Public Library and city hall. Class II: Water pumping stations of between 300 and 600 water horsepower, sewage pumping stations of between 150 and 400 water horsepower, and the plant of the House of Correction. Class III: Water pumping stations of less than 300 water horsepower, sewage pumping stations of less than 150 water horsepower. Class IV: Minor steam, electrical or heating plants, such as those of police stations. Grade I: Positions the duties of which involve assistance in the care of a plant of any class, but no responsibility for the operation of any equipment. (Includes positions of the same standard as that of oiler.) Also positions the duties of which involve charge of Class IV plants, viz, positions of station engineer, $1,080. Grade II: Positions of minor assistants, the duties of which involve general care of a plant of any class, or which may involve responsibility for the operation of a portion of such plant. (Includes positions of mechanical assistant and electrical assistant), $1,200. Grade III: Positions of assistants in Class III plants, the duties of which involve complete charge during a definite period or watch, viz, positions of third assistant operating engineer and positions which are of the same standard of importance, $1,460. Grade IV: Positions the duties of which involve complete responsibility for Class III plants, viz, positions of second assistant operating engineer in charge. Also positions of assistants in Class II plants, whose duties involve complete charge during a definite perior or watch, viz, positions of second assistant operating engineers, and positions which are of the same standard of importance, $1,560. Grade V: Positions the duties of which involve complete responsibility for Class II plants, viz, positions of first assistant operating engineer in charge. Also positions of assistants in Class I plants, whose duties involve complete charge during a definite period or watch, viz, positions of first assistant operating engineer, $2,000. Grade VI: Positions the duties of which involve complete responsibility for Class I plants, viz, positions of chief operating engineer, $2,500. Branch B, Grade I: Positions the duties of which involve the care of the building or buildings of a school, and the operation of its mechanical equipment. (Includes positions of school engineer and assistant school engineer.) Grade II: Positions the duties of which are supervisory, involving independent judgment and accountability for the work of others in the operation or installation of mechanical equipment and the care of school property in a definitely assigned district. (Includes positions of supervising engineer). Grade III: Positions the duties of which are administrative, involving responsibility for the work of an entire bureau, either independently or under the head of such bureau. (Includes positions of chief engineer and assistant chief engineer.)

Division H, Inspection Service.—Positions in this service shall be graded according to (1) importance of inspection work, and (2) the degree of responsibility involved. For purpose of grading, all inspection work is grouped into three classes, as follows: Work which involves the exercise of independent judgment in the inspection and supervision of operations, activities or condition, and which require a technical knowledge of the principles of design and construction underlying the same, as well as training, skill and experience. Class II: Inspection work which involves the exercise of independent judgment in passing on the quality of materials, workmanship or special conditions, and which require skill and experience and specialized knowledge. Class III: Inspection work which involves the observation of conditions and requires skill and experience, but no special knowledge. Grade I: Positions the duties of which involve Class III inspection work. Also positions of assistants or helpers to inspectors in Class I or Class II [illegible] Grade II: Positions the duties of which involve Class II inspection work. Grade III: Positions the duties of which involve Class I inspection work. Also positions the duties of which are supervisory, involving accountability for the work of inspectors in Class II and Class III inspection. Grade IV: Positions of principal assistant to the head of a department or principal branch thereof, the duties of which are supervisory, involving accountability for the work of the entire department or branch, under the direction of the head of such department or branch. Also positions the duties of which are supervisory, involving complete charge of an entire line of Class I inspection work. Grade V: Positions the duties of which are administrative, involving responsibility for the work of an entire bureau or division, and which requires the highest order of expert knowledge.

Division I—Grade I: Positions the duties of which include the care of public property or public charges, involving a fixed responsibility, but not necessarily the exercise of independent judgment. Grade II: Positions the duties of which are supervisory, involving accountability for the work of persons in Grade I positions, or for the care or custody of public property or public charges, and which require the exercise of independent judgment. Also positions of principal assistant to persons in Grade III positions. (Includes positions of assistant superintendent of sidewalks.) Grade III: Positions the duties of which involve accountability for public employes in a specialized division of work or in a given territorial district. (Includes positions of superintendent of bridges and ward superintendent.) Grade IV: Positions the duties of which are administrative, requiring special qualifications and involving responsibility for the work of an important bureau or division, under the head thereof, or entire responsibility for a minor bureau or division. (Includes positions of superintendent of sidewalks and assistant superintendent of sewers.) Grade V: Positions the duties of which are executive and administrative, involving responsibility for an entire department, either independently or directly under the head or heads of such department, or for an important bureau. (Includes position of superintendent of sewers.)

Division K, Skilled Labor Service.—Positions in this service shall be ranked according to authority, responsibility and importance of duties.

Division L.—Positions in this service shall not be provided with grades or ranks.

Explanation of chart: Each block gives the civil service title of the position. In the lower right hand corners is given the number of employes occupying the position, and the salary; in the lower left hand corner is given the division, grade and group to which the position is assigned by the Civil Service Commission. "Ex" in lower left hand corner signifies the position is exempt from the jurisdiction of the Civil Service Commission.

Notes on the Cost of Laying Common Brick and Fire Brick in Foundry and Blast Furnace Buildings.x

The Chicago Drop Forge & Foundry Co.'s hammer shop was built of 13 in. and 17 in. common brick walls some 30 ft. high from floor to roof, and required 100,000 brick in its construction. The actual bricklaying cost $4.29 per 1,000 brick, or 6.36 hours. The collateral operations of unloading brick, mortar, scaffold work, etc., cost $2.88, or 7.24 hours. A bricklayer's average 8 hour day's work was the laying of 1,257 brick. The cost of brick, mortar materials, coping and [illegible] 1,000 brick, making a total cost of $16.07 per 1,000 brick. If the scaffolding, horses, mortar boards, etc., had been available from some

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[illegible] Civil Service Commission, March, 1911.

x[illegible] Western Society of Engineers.

[illegible] would have [illegible]

An old wall 13 ft. high was taken down, and the brick were cleaned and piled at a cost [illegible]

A smooth red brick made at Hobart, Ind., not quite as fine as the pressed red brick available in the Chicago market, makes a very presentable wall. On account of its finish, more care is required in laying than is the case with the Chicago common brick. In building a power house 220 ft. long and 30 ft. high of side walls, using a 13-in. wall with plain pilasters at the steel columns and corners, and three smaller buildings adjacent, 370,000 brick were laid at the following costs for labor:

			Per 1,000 Brick	
	Hours.	Cost.	Hours.	Cost.
Bricklayer foreman	[illegible]	$ [illegible]	0.91	$ 0.72
Bricklayers	[illegible]	2,607.87	10.5	7.05
Helpers	[illegible]	[illegible]	11.6	2.02
Mortar mixers.....	717	154.15	1.94	0.40
Labor foreman....	175	61.25	0.5	0.16
[illegible]	[illegible]	363.65	5.68	0.97
Hoist operator	120	42.00	0.33	0.10
Carpenter foreman	[illegible]	42.50	0.03	0.11
Carpenters	[illegible]	113.40	0.90	0.30
Handy man........	190	[illegible]	0.51	0.12
Timekeeper	[illegible]	55.50	0.50	0.15
Total	...12,359	$4,506.27	33.4	$12.10

Teaming of scaffold, etc., to and from work and unloading of brick and sand from cars not included. Cost of washing walls inside and outside with acid is included. One-half of the work was done with scaffolds hoisted by cables and winches as the rise of the brick work required. The rest of the scaffolding was the ordinary wooden staging.

Laying Fire Brick.—In the building of a blast furnace plant 640,000 fire brick were used in the construction of gas flues from the hot blast stoves and boilers to the chimneys, and also for foundations of two blast furnaces. The flues were composed of 9-in. walls and arches and 4½-in. floors. As the flues were subsequently imbedded in massive concrete foundations, forms were built on the interior lines of the flues throughout. The fire brick laid in neat Portland cement grout were laid against the forms and then the concrete was built against the brick. The joints averaged 1/16 in. to ⅛ in. thickness. Half of the cost of the forms was charged against the brickwork. Due to the presence of the forms, the masons laid brick much faster than if they had to build a wall by plumb and line, or against the concrete while working in the interior of the flues. The floors were paved with brick on edge laid on 2 ins. of sand and grouted. The blast furnace foundations were in courses 3 ft. high and 9 ft. to 12 ft. thick.

Unloading brick from box cars and carefully piling took 5 hours at $1.12½ per 1,000 brick. The wages for an 8 hour day were as follows: Masons, $7; helpers, $2.50, and foremen, $3.75.

The exterior foundations of two blast furnaces was massive work. The form and dimensions of the work were such as to be exceedingly favorable to low costs. The brick were taken from cars on tracks immediately adjacent and parallel to the work. The mortar was 1:1 mixture of Portland cement and sand, and was mixed into a thin grout. This was poured over the brick from one quart [illegible] and the brick was laid with joints varying from nothing to ⅛ in. in thickness. About 5 per cent of the brick laid in the gas flues were laid as headers to project 4 ins. into the concrete which was afterwards built up around it.

Including unloading brick, mortar men, tenders, carpenters, or forms, and other laborers, there were ten men per bricklayer. Table I gives the costs of fire-brick masonry:

The average 9-in. straight fire-brick is 9x4½x2½ containing 101.25 cu. ins., with *rubbed* joints; this will take 17 brick per cu. ft. of masonry.

TABLE I. FIRE BRICK MASONRY LABOR

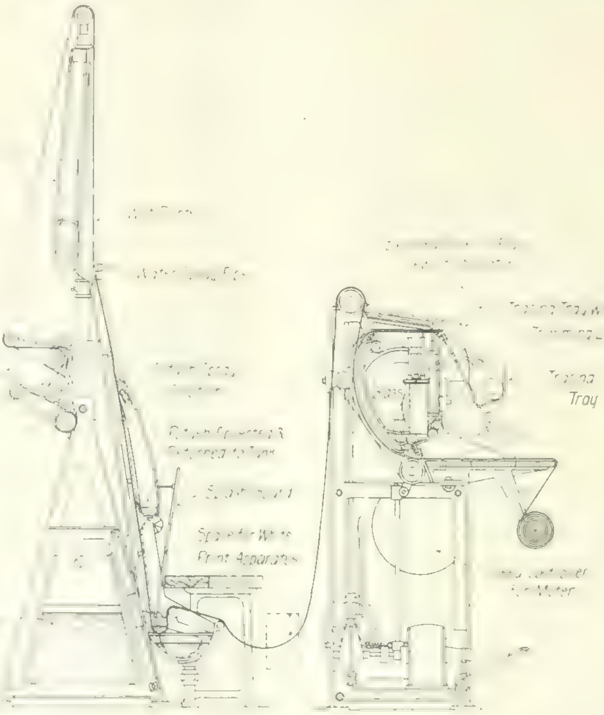
	Brick laid.	Masons' hours.	Helpers' hours.	Brick per mason per day.	Cost per 1,000 brick.
Arches of flues....	[illegible]	[illegible]	[illegible]	[illegible]	$14.45
9-in. walls of flues. . .	232,395	490	[illegible]	4,110	6.48
Paving of flues.......	32,580	221	1,320	1,480	14.40
Total	[illegible]	1,241	[illegible]	2,652	$ 8.73
Massive foundations.	311,495	1,150	5,600	3,386	6.85
Total or average.	[illegible]	[illegible]	13,750	[illegible]	$ 7.81

FIRE-BRICK SIZES.

Kind		Vol. of brick cu. in.	Brick per cu. ft.	⅛ in. joints brick per cu. ft.	Brick laid.
	8 7/16x2½x4 1/16	[illegible]	20.2	18.3	539,000
9 in. Straight	8 7/16x2½x4 1/16 . .	[illegible]	[illegible]	19.7	60,000
No. 1 Arch	8¾x4x2 1/16 and [illegible]	64.3	26.9	24.2	3,600
No. 2 Arch	8¾x4 1/16x1½ and [illegible]	[illegible]	25.5	23.2	10,000
No. 1 Key	8½x2½x2⅜ and 4...	72.6	23.8	21.7	[illegible]
No. 2 Key	8½x2½x3 and 3⅞	[illegible]	[illegible]	[illegible]	25,000
No. 3 Key	8½x2½x2½ and 4	63.8	27.1	21.5	1,700
No. 4 Key	8½x2½x[illegible] and 4				
Total	. . . .				641,400

An Automatic Printing, Washing and Drying Machine for Making Blueprints and Direct White Prints.

A process for making white prints directly from the tracing and a machine which may be used either for white printing or blue printing has recently been put upon the market by the C. F. Pease Co., 167 Adams St., Chicago.



Machine for Prnting, Washing and Drying Blue Prints.

Both features, the white print process and the machine which prints, washes and dries the prints, represent a decided advance in the reproduction of tracings.

The white prints are made on specially prepared parchment paper which retains the clear, sharp lines in the strongest sunlight and does not shrink. The white background is restored to its original whiteness, giving a better result than can be obtained from negatives on blueprint paper. The white prints have blue lines which can be erased by chemicals, and alterations can be made upon them with blue ink without destroying the print. The paper can also be washed in soap and water or gasoline. The process of printing is continuous, so that prints of any length desired and up to 54 ins. in width can be made in one piece.

In view of the fact that both blue prints and white prints may be desired, the machine has been arranged so that either prints may be made. The accompanying drawing shows a side view of the printing machine and the washing and drying apparatus. A roll of paper is suspended under the table on the front of the machine and passed over the table and convex glass back of the arc lamps. From here the paper passes over a roller toward the washing machine. For white prints the paper passes through a special solution before reaching the washing machine. This part is not shown in the illustration. The apparatus necessary for developing the white prints occupies a space about 1½ ft. in width between the machines shown. As shown, the machines occupy a space about 6½ ft. square.

On the washing and drying machine the paper is passed under a spray of water and also a spray of potash solution. The surface of the print only is washed and the back of the print does not get wet. The drying apparatus consists of gas tubes set vertically side by side and the paper passes up in front of them over a roller and down behind them, thoroughly dried and smooth, onto a roller. As an alternative to the gas drier, an electric drier may be used. In this the resistance coils of the arc lamps are used, thus making use of the heat which would otherwise be wasted.

The entire machine is operated by a small motor, which is adjusted as to speed by a regulating device giving 60 changes in speed. The average speed at which the blueprints are run is 6 ft. a minute and that for white prints about 4 ft. per minute. The speed is varied, according to the condition of the tracing, which, if soiled or dirty, requires a longer time to print. One man operates the machine and can produce from 60 to 75 yards of prints per hour. When closing down the machine, the sensitized paper is cut off, and a blank piece of paper is pasted onto the end and is run through until it reaches the final roller. The machine is then ready to start again whenever required.

The finished rolls of prints is taken to a trimming table which is fitted with roller cutter. This is operated by a small motor so that the operator's hands are free to hold the paper in position.

Both the white print process and the machines for printing, washing and drying are the [illegible] and are being manufactured at the new plant recently established by him. The company also carries on a large printing business at its Chicago headquarters.

Methods of Hauling and Placing Heavy Power Plant Machinery.

By [illegible]*

The problem of hauling heavy machinery

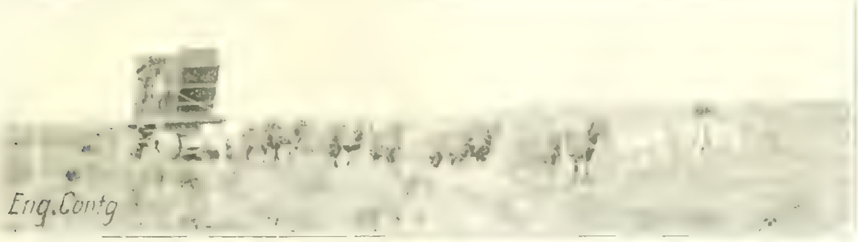


Fig. 1.—Team Hauling Heavy Machinery.

from the nearest railroad station to the isolated plants often encountered in mining and hydro-electric work sometimes becomes one requiring considerable skill, labor and expense for its solution. Local conditions usually affect the problem so that few data of value can be given which will serve as a reliable guide for estimating the costs of similar work, but the methods used will often work out as well in one situation as in another, and so become both interesting and valuable to those engaged in similar work. With this in mind, the methods used in hauling the machinery and material used in constructing the power house for the Minidoka Project of the U. S. Reclamation Service may not prove uninteresting.

There are in this installation, at the generating plant on the Snake River, in Idaho, five 2,000-HP. main turbine units operating under 46 ft. head, and therefore of considerable size, their estimated weight being 85 tons each; two exciter units are also installed here, while at the "lifts" or pumping stations, some 15 miles away, are 12 centrifugal pump units sufficient to absorb most of the power generated at the power plant when pumping against their normal head of 30 ft. The shipping points are respectively 6 and 15 miles away, over new roads leading through a fairly level country, varying in soil from heavy clay to deep sand, all thickly interspersed with outcropping ledges of lava rock. As the 6-mile haul over to the power house from Minidoka was comprised of much the heavier

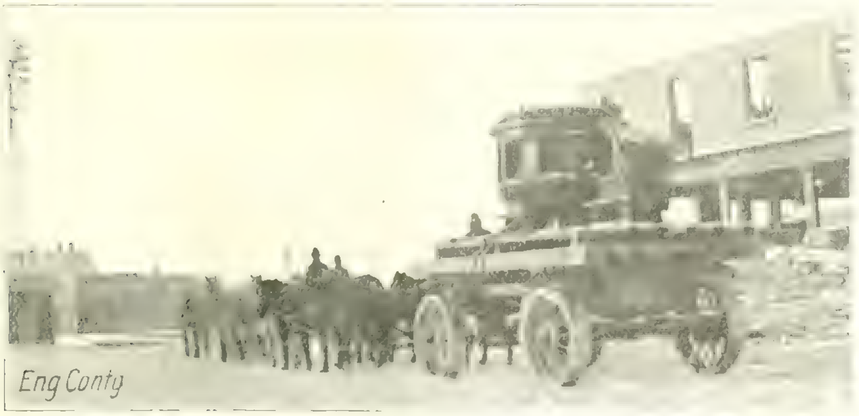


Fig. 2—View Showing Method of Lashing Machine on Wagon

pieces, and otherwise the conditions were much the same, a detailed description of the methods there employed will suffice.

This machinery was hauled on very heavily built special wagons with horses for the motive power, there being sometimes as many as 30 head of horses driven on a single team. [illegible] were used on the wagon wheels, as shown in the cuts, Figs. 1 to 4, to prevent them from cutting in under the weight of the heavy loads, which at times reached the total of combined piece [illegible] tor rotor, the heaviest piece handled, weigh[illegible]

The cost [illegible] in the case of the last two units, hauled under favorable conditions when the ground was frozen, the cost was decidedly lower than that of the earlier units, being but $5 per ton, thus figuring about 50 cts. per ton mile, $2

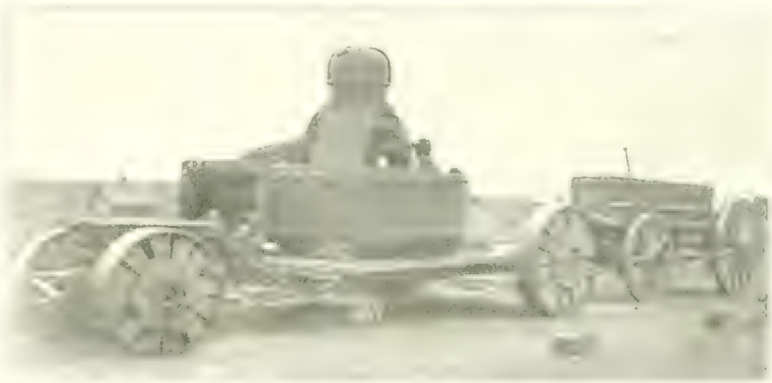


Fig. 3—Special Broad Tire Wagon.

per ton having been allowed for unloading and placing on skidways until needed, at the power house.

Usually the unloading from the cars onto the wagons was done by government day labor, though sometimes by contract; the [illegible] means employed, at least for the earlier units, was a hand traveling crane of ten tons capacity, set up on temporary crane ways, the crane used being ordered for regular use in one of the pumping station.

On arrival of the machinery at the power house there still remained the problem of placing it in position on the generator and turbine floors, situated as shown by Fig. 4, this was accomplished in a novel way by the building of an inclined skidway of 12x12-in. timbers, there being three rows of them, spaced about 5 ft. apart; upon these was placed a skip or sliding platform, which could be hauled up and down by means of an electrically driven hoist, operating with steel cables, through heavy sheaves. The ways were kept well covered with thick heavy grease, the sliding contacts being both of wood, capable of developing considerable friction if run unlubricated. The entire apparatus is well shown in Fig. 4, and can there be seen to very much resemble similar apparatus used in the cities of Pittsburg and Cincinnati for the transfering of street cars cars from one level to another where the grades are too steep for ordinary railway operation.

Upon its arrival at the generator floor level, the material was taken into the power house by means of ordinary pipe rollers, and thence handled by means of the usual overhead traveling cranes.

Perhaps, in closing, a brief description of the methods employed for widening the tires of ordinary wagons in a cheap but substantial manner, may be interesting. Heavy steel was bent to the form of a semi-circle roughly fitting the tire of the existing wheel. It was then clamped on, as per sketch, and the projecting edges of the tire supported by wooden braces, fitted tightly between the new tire and the hub. This construction is further shown in Fig. 5 and proved very effective in operation, as well as cheap in construction.

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*Erection Department, Allis-Chalmers Co., Milwaukee, Wis.

Excavation by Sluicing, Panama—Excavation in the lake region of the canal, between Gatun and Bas Obispo, is now confined to the work of two contractors, one of whom is working at Bohio and the other at Gorgona, both using a form of sluicing. At Bohio, E. C. McFarland & Co. are excavating earth and soft rock by the sluicing method, and hard rock by pan car. They used the sluicing method on a contract of 35,500 cu. yds. at Tabernilla, where all of the material was earth. The plant consists of two 8-in. three-stage turbine pumps, driven by an Ames engine of 200 h. p. and discharging into a 12-in main, from which there are leads for two monitors. Two or 3-in. nozzles are used, according to the character of the material to be cut. With the 2-in., 150 lbs. pressure is obtained at the nozzle, and with the 3-in. 100 lbs. At Bohio, about 50 per cent of the material is soft rock and the sluicing plant handles this profitably on a grade as low as 1 per cent. In May, 15,300 cu. yds. were excavated by this method at Bohio, and there still remain [illegible] of a total of 160,000. It is believed that 110,000 cu. yds. can be removed by the sluicing method. Opposite Gorgona the contractor, B. B. Duncan, is working with a 12-in. centrifugal pump, which raises water from the river into sluice boxes, through which it carries into the river material excavated with pick and shovel. In May 9,600 cu. yds. were excavated by this method.

Report on Uniform Specifications for Buildings.—A discussion of the report which was presented at the annual meeting of the American Society of Engineering Contractors was held in New York City on June 20th. The discussion brought out the importance of standardizing specifications and of adopting a single form of standard contract. The current of the discussion favored the unit price contract as opposed to lump sum or cost-plus-percentage or plus-fixed-sum contract.

PERSONAL.

Mr. Clarence A. Knight, president of the Chicago & Oak Park Elevated R. R., died on June [illegible]. Mr. Knight was also general counsel for the Northwestern Elevated R. R. and the Union Loop Co., of Chicago.

Mr. Samuel D. Foster, at present engineer in charge of the highways of Allegheny Co., Pa., has been appointed chief engineer of the state highway department of Pennsylvania. He will receive an annual salary of $7,000.

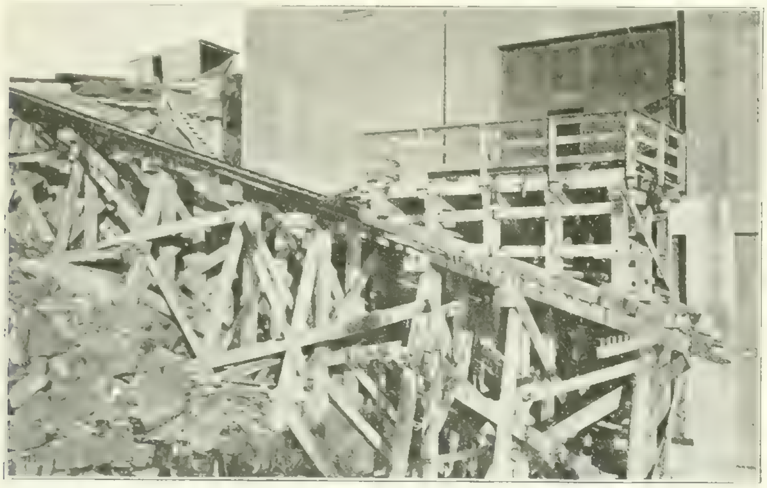

Fig. 4—Method of Lowering Heavy Machines Down Incline.

Mr. B. S. Wathen, chief engineer of the Texas & Pacific R. R., has been appointed consulting engineer of that road with headquarters at Dallas, Tex. Mr. C. H. Chamberlain, assistant engineer, will succeed Mr. Wathen as chief engineer.

Mr. J. P. Snow, for twenty-two years chief engineer of the Boston & Maine R. R., has tendered his resignation to take effect July 1. He will be succeeded by Mr. A. B. Corthell, consulting engineer of the New York, New Haven & Hartford R. R.

Mr. Walter O'Bannon became secretary and treasurer of the Oklahoma City Construction Company at the annual meeting early in June. Mr. O'Bannon was chief engineer for this firm for the past year. He has been engaged in construction work in Missouri, Oklahoma and Kansas, since leaving the University of Missouri in 1908.

Mr. F. G. Jonah, chief engineer of construction of the St. Louis & San Francisco R. R., has been appointed chief engineer of the New Orleans, Texas & Mexico R. R., and the St. Louis, Brownsville & Mexico Ry., with headquarters at St. Louis, Mo. He succeeds on the former road Mr. M. C. Byers, who will devote his entire time to other parts of the Frisco system.

Mr. Frederick T. Barcroft has been appointed a member of the city plan and improvement commission of Detroit, Mich., his term of office to expire in May, 1920. Other appointments off the commission are Mr. Walter E. Campbell, president of the Detroit Belle Isle & Windsor Ferry Co., with term expiring in May, 1915, and Mr. Herman Darmstaetter, with term expiring in May, 1917. Mr. Barcroft has also been selected to assist Mr. E. W. Bemis in the appraisal of the property of the Toledo Railway & Light Co., of Toledo, Ohio.

The Foundation Company of New York City is being reorganized and its capital stock increased to $2,100,000. Mr. Kingsley Martin, formerly commissioner of bridges of New York City, and Mr. Ralph Chambers, formerly of Chambers and Home Consulting Engineers, have joined the company. The officers of the company are as follows: Franklin Remington, Pres.; Kingsley Martin, Vice Pres.; E. S. Jarrett, Sec.-Treas.; B. E. Moran, Consulting Engineer; J. W. Doty, Chief Engineer. The company has offices in New York, Chicago, Montreal and New Orleans.

Messrs. Rudolph Hering and George W. Fuller, who have conducted a consulting engineering practice during the past ten years under the firm name of Hering & Fuller, of New York City, announce a termination of the partnership. Existing contracts will be completed by the firm. Mr. Hering will enter into a partnership with Mr. John M. Gregory and the new firm will engage in practice as consulting engineers and sanitary experts. Mr. Fuller has associated with him as partners Messrs. James W. Armstrong, James C. Harding and James R. McClintock, all formerly connected with the firm of Hering & Fuller.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING & CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Universal Cement.—Paper 6x9 ins., 20 pp. Universal Portland Cement Company, Chicago & Pittsburg.

This is the monthly bulletin No. 85 for June, 1911, which describes construction work in which universal cement is being used.

Vulcan Soot Cleaners.—Paper, 6¼x9 ins., 32 pp. S. L. Simonds & Company, 801 Steinway Bldg., Chicago.

This catalog describes in a comprehensive way the use of the Vulcan Soot Cleaner as a smoke reducer and an economizer. Drawings are given, showing old and new methods and of using the cleaner on various types of boilers.

Stamped Metal.—Paper, 6x9 ins., 64 pp. Niagara Falls Metal Stamping Works, Niagara Falls, N. Y.

This is a catalog and price list which contains descriptions and illustrations of all stamped metal goods, such as small chains, checks and coins, name plates, etc. Complete price lists are given.

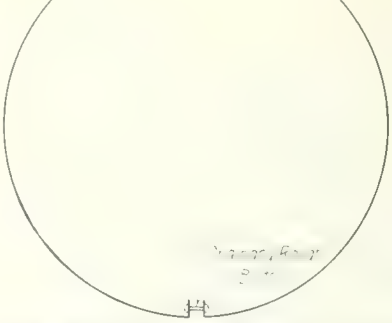

Fig. 5—Sketch Showing Method of Clamping Temporary Broad Tire on Wagons.

Building Progress.—Paper, 6¾x9¾ ins., 32 pp National Fire Proofing Company, Fulton Bldg., Pittsburg, Pa.

This is the June number of the monthly bulletin which contains several illustrated articles on recent building construction.

Earth and Rock Moving Machinery.—Paper 9¾x6¼ ins., 128 pp. Western Wheeled Scraper Company, Aurora, Ill.

This catalog contains illustrations and descriptions of a large variety of machinery for moving earth and rock. The book is divided into 4 sections, of which the first deals with scrapers and plows; the 2d with cars; the 3d with elevating graders and wagons and the 4th with road machinery. Brief descriptions are given together with tables of dimensions. Some tables of prices are also given.

Rock Crushers.—Paper, 10x6¾ ins., 20 pp. Western Wheeled Scraper Co., Aurora, Ill.

This catalog contains illustrations and descriptions of various types of jaw crushers designed for stationary or portable plants.

Chain Belts.—Cloth, 6¼x9¼ ins., 278 pp. Chain Belt Company, Park & 11th, Milwaukee, Wis.

This is the June catalog No. 40 for elevating, conveying and concrete machinery. The book is completely illustrated with photographs of plants in operation showing the actual installations of general belt machinery. Detailed descriptions are given with line drawings and tables of dimensions, showing size of various parts of chains and elevators. The book contains numerous tables and other information which is useful to designers of plants.

Cement Specifications.—Paper, 6x9 ins., 24 pp. The Universal Portland Cement Company, Chicago & Pittsburg.

This pamphlet embraces the report of the Committee on Standard Specifications for Cement of the American Society for Testing Materials; the report of the Committee on Uniform Tests of Cement of the American Society of Civil Engineers; and the report of the Committee on Uniformity in Technical Analysis for Limestones, Raw Mixtures and Portland Cements of the Society for Chemical Industry.

De La Vergne Machinery.—Paper, 8x10½ ins., 12 pp. The De La Vergne Machine Company, Ft. of E. 138th St., New York City.

This catalog illustrates and describes various installations of De La Vergne oil engines, giving the detailed costs of power developed in a number of cases.

Discount Sheet.—Paper, 6x9 ins., 40 pp.: H. Channon Company, Market & Randolph Sts., Chicago.

This discount sheet on hardware and contractors' machinery is supplementary to catalog No. 50. It is dated May 1, 1911, and corrects errors found to exist in catalog No. 50 and gives new lists to date. A supplement to catalog No. 50 is also issued, to which this discount also applies.

Parsons Trench Excavator.—Paper, 10½x8½ ins., 32 pp. The G. W. Parsons Company, Newton, Iowa.

This is a well illustrated catalog showing operations with the Parsons Traction Trench Excavator for excavating trenches of various widths and for various purposes. This catalog contains illustrations of the details of the machine and complete descriptions. A comparison table and discussion showing the cost of hand work and of work with the machine is given.

Pyle Electric Headlight.—Paper, 9x6 ins., 24 pp. The Pyle National Electric Headlight Company, 1401 McCormick Bldg., Chicago, Ill.

This catalog illustrates installations of this headlight on construction work showing the effects at night where work is being carried on. A complete description is given.

Industrial Cars and Tracks.—Paper, 10x14 ins., 4 pp. Ernest Weiner Company, 38-40 Dey St., New York City.

This folder illustrates a wide variety of industrial cars and track.

Amco Products.—Paper, 3⅝x6 ins., 8 pp. American Abrasive Metals Company, 51 Church St., New York City.

This pamphlet describes various machinery made of Feralun, which is a metal made by combining the electric furnace product Corundum with iron or steel by a patented process. This product is used for castings to resist abrasion and attrition. The metal is used in centrifugal pumps, stair treads, jig grates, ash pipes, etc. Another pamphlet (6x9½ ins., 16 pp.) gives extended descriptions of the metal as used for a number of purposes.

Lead Wool.—Paper, 3¼x6 ins., 8 pp. United Lead Company, 111 Broadway, New York City.

This booklet contains a discussion of the advantages of lead wool over cast lead for jointing cast iron pipe. This material is described as that which makes a perfectly tight and yet flexible joint with a saving of about 33⅓ per cent of lead and with the advantage of being able to calk joints anywhere under any condition.

J.-M. Sectional Conduit.—Paper, 5x9 ins., 8 pp. H. W. Johns-Manville Company, 100 William St., New York City.

This is a folder showing briefly the details of these conduits, with photographs of New York's Municipal Buildings which are heated through this conduit.

Bental Powder.—Paper, 3½x6 ins., 12 pp. Independent Powder Co., Joplin, Mo.

This pamphlet describes an explosive which is both practical and comparatively safe for use in gassy and dusty mines. The explosive is Bental coal powder which is packed in bags or in cartridges of various sizes.

CONTRACT NEWS SECTION
of
ENGINEERING & CONTRACTING

The Doings of the Week.

Railroad construction work continues dull; there have been plenty of rumors but not much action. However, prospects seem to be brighter this week than they have been before for some time, and there is reason to believe that there will shortly be a change in present conditions. In fact, bids are now being taken on one good sized railroad construction job and it is expected that other railroads will shortly ask bids. The work now open for bids calls for the grading and masonry on 66 miles of road in Arizona, for the El Paso & Southwestern R. R. It is understood that the directors of the Chicago, Milwaukee & Puget Sound Ry. will tomorrow (June 29) make some decision as to starting work on the Millstone-Missoula, Mont., cutoff. The Great Northern Ry. is also believed to be about ready to start work on its Mondak-Helena cutoff, and the Union Pacific R. R. is understood to be planning to have work started some time after the first of July on the extension of its branch lines in the vicinity of Greeley, Colo.

Among the railroad construction contracts let recently are the following: Yale & Reagen, Fisher Bldg., Chicago, Ill., for the grading for the 30-mile interurban line in Iowa of the Davenport-Muscatine Ry., the contract including about 400,000 cu. yds. team work; the McComb Construction Co., Olean, N. Y., for the construction of the interurban line of the Allegheny & Northwestern Ry. from Harmarsville to Evans City, Pa.; Monday Construction Co., Knoxville, Tenn., sub-contract for masonry and concrete work on the Kentucky Division of the Louisville & Nashville R. R.; W. H. Schoot Co., 39 Jackson Blvd., Chicago, Ill., for constructing the roadbed and overhead work complete for the Kokomo, Frankfort & Western Traction Co. The line is to extend from Kokomo to Frankfort, Ind., a distance of 25 miles; Arkansas Bridge Co., Fort Smith, Ark., for supplying the steel and erecting 21 new steel bridges to replace lighter structures now in use on the main line of the Kansas City & Southern Ry., between Kansas City and Port Arthur, Tex.

Bids will probably be asked in a couple of months on the largest single drainage contract which has yet come up in the Mississippi Valley. This work calls for the improvement of Drainage District No. 9 of Mississippi County, Arkansas. A number of smaller districts have heretofore been organized in the county with the object of improving smaller areas. District No. 9 includes most of the smaller districts, and covers an area of 300 square miles. About 300 miles of main and lateral dredge ditches will be required, costing somewhat more than $1,000,000. It will take 15 dipper dredges about two years to complete the job. Another good sized drainage job which will probably be advertised next month calls for the construction of the Edwards Ditch in Palo Alto and Montezuma Counties, Iowa. The estimated cost of this work is $225,000. One of the largest drainage work contracts let the past week was for additional work in Drainage District No. 1 of Bates County, Mo., the work requiring the excavation of about 1,140,000 cu. yds. of material. Callahan Bros., Kansas City, Kan., secured the contract at $123,990.

In the line of municipal work two large paving contracts were let by Pacific Coast cities. Portland, Ore., awarded a $306,000 contract to the Warren Construction Co. of Portland, for constructing bitulithic pavement, and Medford, Ore., awarded a $300,000 contract to the Clark & Henery Construction Co., Stockton, Cal., for about six miles of street paving.

In the way of government work the principal contract for dredging work appears to have been the one for removing 4,700,000 cu. yds. of mud and sand from Norfolk Harbor, Va. It has been recommended that the bid of the Coastwise Dredging Co., Norfolk, Va., be accepted. Bids for another large dredging contract were opened June 20 at Newport, R. I. This contract calls for 2,000,000 cu. yds. of dredging at Providence, R. I. The lowest bidder was the Daly & Hannan Dredging Co., Ogdensburg, N. Y., at $216,654.

For the third time the House of Representatives of the state of Illinois has knocked out the Deneen-Johnson waterway bill, which called for the issuance of $20,000,000 in bonds for the construction of a waterway and the development of water power in the Illinois and Desplaines Rivers, between Lockport and Utica.

Subway Suggestions.

Two subway schemes, somewhat out of the ordinary, to say the least, have been laid before the council local transportation committee of the city of Chicago. One of the schemes is an operating one exclusively and provides a very simple means for the transferring of passengers from express trains to local trains and vice versa. According to the scheme express trains are to be run without stop from city limit to city limit, at a speed of 60 miles an hour. Passengers wishing to take the express trains will board the local or feeder car. Then when the motorman on the feeder car sees a fast train approaching, of course on a parallel track, he turns on more power until his car has also attained a speed of a mile a minute, and the express is running alongside. The two cars are then grappled together, both going at the same speed, and a "draw bridge" is let down. The passengers then transfer, after which the feeder is cast loose for local stops. The other scheme calls for placing the traction system in the 6 ft. space under the sidewalks. It was suggested that small cars [illegible] street.

Sylvester T. Smith.

[illegible] more to do with the devel[illegible] in Chicago. A strong personal attachment existed between these two men and for many years they were intimately associated in railroad construction work. When Moffatt in 1887 became president of the Denver & Rio Grande R. R., Smith became general manager. When the famous Amethyst mine at Creede was discovered by Creede after he had been grubstaked by Moffatt and Smith, the latter immediately projected and successfully executed the building of the Creede branch of the Denver & Rio Grande R. R. In 1892 when Moffatt left the Rio Grande, Smith resigned with him. Later they undertook the building of the Florence & Cripple Creek R. R., furnishing most of the necessary capital, $1,500,000. In 1901-2 when Moffatt projected the Denver, Laramie & Northwestern Ry., Smith became president of the Colorado-Utah Construction Co., which undertook the building of the road. Smith remained with the construction company until the Moffatt road had been completed as far as Arrow, and then retired.

The Bob-Tailed Wasp.

A wi[illegible] greek named Socrates once said that "half the world are bugs and the other half are buggy." If Socrates knew what he was talking about, anything about bugs should be of interest, hence the following story scissored from The Yellow Strand:

Bill was a bridge builder and got the contract to do the bridge work for a railroad on a new line they were building through a section of Mississippi. What he found down in that particular section was mostly bugs and mosquitoes, and they kept the men busy slapping. Naturally Bill didn't have anything complimentary to say of the state and he said it freely to the natives themselves. One old planter in particular took offense at Bill's abuse. "Ah cayn't see why you-all cayn't stan' it. We-all live down hyar all right." "Sure you do," Bill retorted. "But all you can manage to do in a day is to slap bugs." "Sah, we-all don't slap bugs all day, sah." "Sure you do. I'll bet $10 you can't sit where you are and keep your hands folded for five minutes. The planter was game and indignant, so he took the bet. Bill complained that it was too hot to stay where he was and excused himself for taking up a position at the planter's back, supposedly to sit in the shade. But the minute Bill got around to the back of the planter, he took out a sunglass and focused it on the back of the planter's neck. Within a minute the hair on that particular spot began to curl up and smoke. Another minute and a half the skin was squirming and turning yellow. But the planter had grit. He ground his teeth and kept his arms folded. That lasted another minute and then he spoke: "Say, pard, Ah don't wanta hedge on the bet, but Ah'll compromise fo' five dollahs right now if you-all will let me brush that damned bob-tailed wasp offen the back of my neck."

City Councils and City Engineers.

It is no uncommon thing for the members of the city councils of American cities to take a more than fatherly interest in the working of their city engineers' departments. In fact this interference, this telling the engineer how to do his work, has often resulted in the city losing a capable official. In Canada, if we are to judge from a recent issue of one of our Canadian contemporaries, city councils are also quite active in the running of the city engineer's department. In the "personal mention" columns of the above issue are three items relating to the resignations of city engineers. In one city the city engineer resigned because of the refusal of the city council to give him sole control of his department and because of the independent appointment of an assistant engineer by the city council. In the second city the engineer resigned in consequence of interference with the department from the city council. It was one of the conditions of the appointment of this engineer that he should be given full control of the department. Instead, it is stated, he was treated in an arbitrary manner and has had to submit to aldermen "who knew little about civic improvement and less about engineering." In the largest of the three cities the city engineer resigned following an order of the city council that all civic employes must register their arrival and departure by a time clock.

RAILWAYS, STEAM AND ELECTRIC

Alabama.

The Mobile & Ohio R. R., R. V. Taylor, General Manager, Mobile, Ala., and the Southern Ry. are reported as about to place contracts for the construction of a $300,000 pier at the foot of Adams St. in Mobile.

The Birmingham, Demopolis & Pascagoula R. R. has completed surveys and has secured the capital for the construction of the first section of its proposed line. This section is to extend from Demopolis to Linden, 16 miles, and construction contracts for it are to be let within 90 days. A. R. Smith, Demopolis, is President, and Woolsey Finnell, Tuscaloosa, Ala., is Chief Engineer.

It is expected that the Montgomery & Chattanooga R. R. will ask bids next month for the grading of its proposed line between Montgomery and Alexander City. The entire right of way for the 56 miles of road is secured and the surveys have been made. Coming into Montgomery the road will cross the Tallapoosa River at Judkins Ferry near the Lower Wotumpka turnpike road. Matt Stokes, Montgomery, Ala., is the promoter.

Arizona.

✣Bids will be received by the El Paso & Southwestern R. R. Co., H. J. Simmons, General Manager, El Paso, Tex., until July 25, for the construction of the graduation and masonry of 66 miles of railway roadbed, including incidental work in Arizona. The principal items are, approximately: 2,600,000 cu. yds. grading, 30,000 cu. yds. foundation excavation and 36,000 cu. yds. concrete. Plans and specifications are on file in the office of the Engineer Maintenance of Way, Southwestern Bldg., El Paso, Texas. The official advertisement will be found elsewhere in this issue.

Arkansas.

The Fort Smith Light & Traction Co., J. Walter Gillette, General Manager, Fort Smith, Ark., is planning the immediate expenditure of about $200,000 for improvements. The sum of $65,000 is to be spent in improving the Garrison Ave. line and $40,000 is to be spent on the Little Rock line. The remainder will probably be spent in enlarging and rebuilding the company's car barns.

Citizens of Hot Springs are raising a $60,000 bonus to secure the extension of the Memphis, Dallas & Gulf R. R., H. C. Van Auken, Chief Engineer, Nashville, Ark., to Hot Springs. Work on the extension from Texarkana is well along and good progress is being made.

The Central Arkansas & Eastern R. R., which is to extend from England to Stuttgart, Ark., is now about completed, and will probably be ready for operation the first of next month. Judge R. M. Foster of St. Louis is president of the company, and H. F. Britton of the Cotton Belt is vice president. The road will be operated by the Cotton Belt under a 30-year lease. The branch of the line from Stuttgart to Hazen, 21 miles in length, was connected on June 21.

California.

The San Joaquin Valley Electric Ry. Co. has assembled at Stockton 300 tons of rails and 30,000 ties with which to commence track laying on its Stockton-Modesto line. The bonds, amounting to $1,000,000, have been sold. Morris L. Brackett is manager.

The Ventura County Ry. Co. has completed surveys and has secured $50,000 capital for the construction of its projected 5-mile line. Construction work is now under way. Robert Oxnard, 16 California St., San Francisco, is President, and J. A. Duffield, Oxnard, Cal., is General Manager.

The Northern Electric Ry. Co., Chico, has been granted a franchise to double track its lines at Chico.

We are advised that there is no truth whatever in the report that the San Pedro, Los Angeles & Salt Lake Ry. had decided to construct a line from Salt Lake City to Ely, Nev.

The Oakland & Antioch Ry. Co. has secured terminal facilities in the vicinity of 40th, Webster, Opal and Shafter Sts., in Oakland, Cal., at a cost of $65,000. Railroad yards will be built paralleling 40th St. between Opal and Webster Sts., and freight and round houses will be constructed. The general offices of the company are at Oakland, Cal.

A citizens' meeting was held at Sacramento, on June 19 to consider the proposition to build a steam railroad to connect the Haggin grant with Orangeville and Fair Oaks. It is estimated that 16 miles of railroad will be built in three sections at a cost of $225,000, which is to be financed by local capital. The first section is to connect with the city park, the second with Fair Oaks, and the third with Orangeville.

Engineers of the Southern Pacific have completed surveys for a second track over the Tehachapi mountains between Bakersfield and Mojave and the surveys, together with the estimates of the cost, have been sent on to President Robert S. Lovett in New York for final action. It is understood that the surveys provide for a line of much lower grade than the existing line; that it will be 86 miles in length and will cost $9,000,000, or more than $100,000 a mile. The present track is used jointly by the Southern Pacific and Santa Fe, the latter having a 99-year lease. The Santa Fe paid half of the cost of the track and pays half of the annual expenses of maintaining and operating it.

Colorado.

All plans have been completed by the engineers for the construction of a 2,400 ft. tunnel through Baxter Pass for broad gaging the Uintah R. R. and extending it to the Uintah Oil basin and the Rangeley oil field by low grade line. M. W. Cooley, Mack, Colo., is General Manager.

Plans are being discussed for the construction of a railroad in Kansas running across Meade, Grant and Johnson Counties from Meade through New Ulysses and Johnson City to Two Buttes, in Baca County, Colo., and Des Moines, New Mexico. C. D. Hickok and R. R. Wilson, New Ulysses, Kan., are interested.

At the present time no definite plans have as yet been made for the further extension of the Denver, Northwestern & Pacific Ry. from Steamboat Springs toward Salt Lake City, and no work, either in line of surveys or construction, has been authorized for the coming season. L. A. Blauvelt, Denver, Colo., is Chief Engineer.

The Union Pacific R. R. is understood to be planning to have work started some time after the first of July on the extension of its branch lines in the vicinity of Greeley. It is understood that the first work will be the building of the Crow Creek line from Briggsdale north through the Greeley-Poudre irrigation district, then eastward to the Willow Creek reservoir, 18 miles. This line will probably be further extended northeast from Briggsdale to Grover and through the main line in Nebraska.

The Denver & South Platte Ry. Co. (electric), Denver, Colo., has announced that if the business in sight justifies it, the company will build an electric line to the mouth of Deer Creek canon.

Connecticut.

The Tolland County Street Ry. Co., which was granted a charter to build a trolley road from Stafford Springs to Staffordville two years ago, has completed its organization. The charter has been turned over to A. S. May, New Haven, Conn., B. I. Spock and N. S. Buckingham, who subscribed for the 500 shares of stock. A. S. May, who took 480 shares, is treasurer of the New York, New Haven & Hartford R. R., and the other subscribers are also affiliated with the New Haven system. The charter would have expired unless organization was perfected, and the organization will now keep the charter alive two years more.

Georgia.

A company has been formed at Sylvania, and application has been made for a charter for the purpose of building a railroad from Millen to Newington, when a connection will be made with the Brinson Ry. As proposed, the line will be 29 miles. The temporary officers of the company are E. S. Lane, Blitch, Ga., president; I. H. Evans, Halcyondale, vice president; W. M. Blitch, Halcyondale, chairman board of directors.

⊙Gardiner & Pease, Columbus, Ga., have been awarded a contract by the Central of Georgia Ry. Co. for the construction of a concrete culvert over its tracks at Sixth Ave. and Cemetery St., Columbus. The cost of the improvement will be about $10,000.

Idaho.

At a recent mass meeting at Nampa, a committee of which Elmer Clark, Caldwell, Idaho, is chairman, was appointed to negotiate with W. E. Pierce, Boise, Idaho, President of the Boise & Interurban Ry. Co., regarding his proposition to build an electric railway between Nampa and Caldwell. It is stated that Mr. Pierce will put the line in operation if the right-of-way and grade is donated.

A crew of surveyors, under supervision of W. C. Smith, Spirit Lake, Idaho, Chief Engineer of the Idaho & Washington Northern R. R. are running a preliminary line up Big Muddy Creek into the territory of the Panhandle Lumber Co. It is rumored, however, that the survey is to be extended on to Deep Creek, across the divide, and from there on to Trail, B. C. The surveyors are now at Big Meadows, which is within a mile of the low divide between Big Muddy Creek and Deep Creek.

Illinois.

Committees have been appointed in all towns along the proposed route of the Rockford-Dixon interurban to raise funds to aid in the construction of the road. At a recent meeting at Rockford, it was stated that the 42 miles of road from Rockford to Dixon could be constructed at a cost of $1,600,000 and that if $250,000 could be raised by the people affected by the road, the building would be started. A. B. Brown, Rockford, Ill., was secretary of the meeting.

A project is under consideration for the construction of an interurban line from Kewanee to Henry on the Illinois River, a distance of 40 miles. The proposition is as yet in an embryonic stage, but present plans call for the raising of the necessary amounts from farmers along the way. C. N. Gerard, Bradford, Ill., is interested.

Advices from Rock Island state that arrangements have been practically completed for a preliminary survey for the proposed interurban line which is to have Rock Island, Muscatine and Aledo as its terminals. It is understood that the surveys will be made by Nash-Dowdle Co., contractors, 145 La Salle St., Chicago, Ill.

The Chicago & Western Indiana R. R. Co., E. H. Lee, Chief Engineer, Chicago, Ill., has recently accepted ordinances covering the elevation of tracks in Chicago, as follows: On the main line from State St. to Stony Island Ave.; on the Dolton Branch from 111th St. to a point east of the I. C. Ry. main line; on the Belt Ry. from Jackson Park Ave. to Jeffery Ave. Under the terms of the ordinances the work is to be completed by Dec. 31st, 1918. A total of

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

20 subways are required to be opened. The work is estimated to cost approximately $3,000,000.

The Hamilton Ry. Co. has been incorporated with a nominal capital stock of $1,000, and principal offices in Chicago. The company proposes to construct a railroad from a point on the bridge spanning the Mississippi River between Hamilton, Ill., and Keokuk, Ia., to points in the cities of Hamilton and Warsaw, Hancock County, Ill. The incorporators and first Board of Directors are: George Higginson, Jr., of Winnetka, Ill.; Joel D. Harvey of Geneva, Ill.; Joseph L. Valentine and Hoyne Wells of Chicago and Apollos W. O'Hara of Carthage, Ill..

The Central Terminal Ry. Co., incorporated recently, as mentioned in our June 7 issue, has begun suit for the condemnation of property said to be valued at several million dollars, lying between Canal and Clinton Sts., and extending south from Twelfth St., at Chicago. The property embraces five or six blocks and is covered mostly with tenements, part of it lying in the Jewish district. The railroad is understood to desire the ground for its Chicago terminal and its plans call for a freight depot, tracks and switches. The road will start in Forest Park and will connect with all trunk lines. It will handle the business of the Soo Line.

The Chicago, Milwaukee & St. Paul R. R., according to reports from Savannah, Ill., is planning the expenditure of $101,000 for the construction of improvements at that place. The work will include the building of a new depot, the improvement of the yards and the construction of additional trackage.

Engineers of the Chicago, Rock Island & Pacific are preparing plans for the construction of new yards at Rockdale, about one mile south of Joliet. It is rumored that the removal of the terminals from Blue Island to that point is under consideration by the company.

Indiana.

The Indianapolis, New Castle & Toledo Electric Ry. Co., 30 Union Trust Bldg., Indianapolis, is reported to have secured right of way from Newcastle to Muncie, and it is said that construction work on the extension will commence soon.

The City Council of Washington, Ind., has granted a 50-year franchise to the Vincennes, Washington & Eastern Traction Co., which proposes to construct an interurban line from Vincennes to Loogootee.

⊙The W. H. Schott Co., 28 E. Jackson Blvd., Chicago, Ill., has been awarded the contract for constructing the roadbed and overhead work complete for the Kokomo, Frankfort & Western Traction Co. The line is to extend from Kokomo to Frankfort, a distance of 25 miles. The W. H. Schott Co. will sub-let the grading and ballast work.

Iowa.

⊙Yale & Reagen, Fisher Bldg., Chicago, Ill., have been awarded the grading contract for the Davenport & Muscatine Ry. (electric) between Davenport and Muscatine, Ia. The contract includes 400,000 cu. yds. of team work, which has been practically all sub-let. The line is to be 30 miles long. J. F. Porter, Davenport, Ia., is President, and J. G. White & Co., New York City, are the engineers.

The Iowa Traction Co., which projects a 112-mile line to extend from Oskaloosa to Waterloo by way of Tama, is now working on estimates. The only contracts at present that the company is prepared to let, or which have been let, are for some grading work. Geo. E. Wodehouse, Oskaloosa, Iowa, is President.

Surveys for the Oskaloosa-Waterloo interurban line have been completed to Oskaloosa, and it is understood that grading contracts will be let shortly. J. C. Lathrop, formerly with the McKinley Construction Co., is the engineer.

Kansas.

The State Public Utilities Commission has granted a certificate of authority to the Manhattan City & Interurban Ry. Co., Manhattan, Kan., to issue $200,000 in bonds for the purpose of constructing an electric line from Manhattan to Fort Riley, a distance of 24 miles. At Fort Riley, the Manhattan line will connect with the interurban line from Junction City. It is stated that arrangements have been made for the sale of the bonds and that construction work will begin on the new line at once.

The State Public Utilities Commission has granted permission to the Hutchinson Interurban R. R. Co., Hutchinson, Kan., to issue $65,000 of bonds to take up some floating indebtedness and for improvements.

It has been announced by the officials of the Midland Valley R. R. that the line will be open for operation into Wichita, Kan., by September 1. Track laying on the extension of the road from Arkansas City to Wichita is now in progress, practically all grading work has been completed and it is believed that work will be rushed through to completion with no delay.

It has been announced by H. Leon Miller, Salina, Kan., promoter of the Winnipeg, Salina & Gulf R. R. that $20,000,000 of bonds have been disposed of in England providing the necessary funds for the construction of the proposed road through Kansas, Oklahoma and New Mexico. The first line to be built is from Okeene southeast to Oklahoma City, 100 miles, passing through Kingfisher. This line is to be extended westward to Alva, west into New Mexico and north from Alva through Salina to Kansas City and Omaha.

Kentucky.

⊙The Monday Construction Co., Knoxville, Tenn., has been awarded the contract for the masonry and concrete work on a division of the second track work which is being constructed between Cincinnati and Paris, Ky., for the Louisville & Nashville. It has been announced that the work will be commenced Monday at Latonia. The contract amounts to [illegible]

It is rumored that the Chesapeake & Ohio system is considering taking over the Carolina, Clinchfield & Ohio Ry. The latter road now extends from the Carolinas to Dante, Russell County, Va., and with the construction of a link between Dante and Elkhorn City, Ky., a direct connection would be established between Cincinnati and the southeast coast.

Contracts will be let at once, it is stated, for a six-mile branch of the Lexington & Eastern R. R. (a Louisville & Nashville line) from Potter's Fork up the main Boone's Fork to part of the holdings of the Consolidation Coal Co., where the company will at once start building a model mining town. Potter's Fork is the present terminus of the Lexington & Eastern now being rapidly rushed to completion.

Michigan.

At the recent annual meeting of the stockholders of the proposed Battle Creek-Coldwater electric line the following officers were elected: President, A. C. Kingman, Battle Creek; vice president, J. E. Watson, Bronson; secretary, T. A. Tompkins, Girard; treasurer, A. J. Dorrance, Coldwater. The offices of the company have been established at Coldwater.

Advices from Cadillac state that J. S. Weidman is to build a logging railroad into his forest tract and resume lumbering.

Minnesota.

⊙[illegible] contract for building the grade for a 6-mile line for the Red River Lumber Co., extending from the company's sawmill at Akeley into the northern boundary of a large tract of pine timber. The new roadbed will be graded from Camp S, five miles south of Lake George and east of the Park Rapids-Bemidji road, westward to a point within ¾-mile of the southeast corner of the State Park.

The Suburban Street Ry. Co. is reported to have financed its proposed line, and it is understood that construction work will be started shortly on its suburban lines at Duluth. N. J. Upham, Duluth, is one of the promoters.

The Northern Pacific road is planning the construction of additional track facilities in Duluth, Minn., and the improvement has been approved. The tracks will be put in just west of the Sixth Ave. west viaduct, and it is reported that the expenditure will be about $75,000.

Missouri.

⊙The Kansas City Southern Ry. Co. has placed contract with the Arkansas Bridge Co., Fort Smith, Ark., and 705 Finance Bldg., Kansas City, Mo., for supplying the steel and erecting 21 new steel bridges to replace lighter structures now in use on its main line between Kansas City and Port Arthur, Texas.

Preliminary surveys are to be made by the Cape Girardeau & Jackson Interurban Ry. Co., Robert Masters, Chief Engineer, Cape Girardeau, Mo., for an extension to Illmo, Edna, Chaffee and Jackson. The majority of directors of the company are understood to favor the construction of the extension. It is stated that much of the right of way will be given by Louis Houck, through whose lands the line will run between Cape Girardeau and several of the towns.

The Missouri Pacific R. R. is stated to be considering arrangements for acquiring the capital stock of the Boonville, St. Louis & Southern R. R. amounting to $250,000. The line, which extends from Versailles to Boonville, 44 miles, has been operated by the Missouri Pacific under a lease, which was recently renewed for 99 years. First mortgage 6 per cent bonds for $400,000 will mature August 1. It is understood that the property will be included in future as a part of the Missouri Pacific system, and its obligations will be assumed and refunded by the Missouri Pacific [illegible]

Mayor Cecil W. Thomas and other residents of Jefferson City have taken up with the officials of the Chicago, Rock Island & Pacific Ry. which crosses the southern point of Cole County, the proposition to build a branch from Henley, Cole County, to Jefferson [illegible]

Kansas City, Mo., and Vicinity.

[illegible]

⊙J. J. McInerney of this city has secured a nice contract at Callaway, Neb. on the Union Pacific R. R., under Phelan & Shirly. He is moving his outfit this week. The work is all Fresno proposition and there is a sufficient quantity to keep the outfit busy for some time to come.

Mr. C. A. Lawton, formerly of Wood, Bancroft & Doty, has accepted a position with Amos & Dean, who are operating on the Chicago, Rock Island & Pacific R. R., near Chariton, Ia. Mr. Lawton left for his new work on the 2d.

Mr. A. L. Cook was a visitor in our city on the 22nd. Just at the present time the well known firm of Ransof & Cook, of which Mr. A. L. Cook is a member, does not have a great amount of work, and any one desiring an A No. 1 team outfit should get in touch with these people. They can be addressed at Ottawa, Kansas.

Mr T. R McNair of the firm of Wood, Bancroft & Doty, has returned to the work [illegible] Omaha.

Mr. J. C. Mulville of Alton, Ill., was in the city on the 20th on business.

[illegible] of Baker & Crawford of this city, will probably leave for North Dakota during the coming week. He has been offered work for the summer in that section of the country.

Mr. John Richards of the firm of Joseph & Richards of Cape Girardeau, Mo., was in the city the other day. It was generally understood around here that Joseph & Richards [illegible] but Mr Richards said that is a mistake; that they had concluded not to do the work.

Mr. E. C. Hingston of the Bucyrus Co., was a caller on the 24th inst. Prospects are promising, according to Mr Hingston's re- [illegible]

Reports from the camp of Randall & Wood, Lexington, Mo., are to the effect that good work is being done on their road contract at that place.

White & Maas, Kansas City contractors, have just purchased a new Western grader with which to do some city work they have at hand. This new grader completes a splendid outfit, one that is strictly up to date in every particular.

We are informed that Ed Meegan has sold his grading outfit. Whether or not Ed is figuring on remaining in the business we cannot say at this writing.

We had a pleasant visit the other day at the office of Phelan & Shirly at Omaha, and were lucky enough to find both members of the firm "at home." Mr. Shirly had just returned from the Canadian work. He reports that good progress is being made there. This firm also has considerable team work in Nebraska on the Union Pacific R. R. All the work has been sub-let and the dry weather has helped make the work thus far very satisfactory to all concerned.

While in Omaha the writer had a little chat with Mr. Bancroft of the well known firm of Wood. Bancroft & Doty. The Kansas City Southern work at Worland, Mo., is about all they are doing at the present. But it is pretty safe to say that their splendid shovel outfit will not remain idle long.

Mississippi.

S. S. Bullis, President of the Vicksburg Traction Co., Vicksburg, has been granted a franchise for an electric car line between Vicksburg and Walters. It is planned to have the extension in operation within six weeks.

Petitions are being circulated at Laurel, Miss., asking the City Board to take the necessary action looking to the purchase of land, in order to secure the location of the shops of the New Orleans, Mobile & Chicago R. R., in Laurel.

The Wausau Southern Lumber Co. of Laurel, Miss., has secured a right of way for a logging road to its timber holdings, about 15 miles southeast of here. It is understood that grading will be commenced at once.

Montana.

At a meeting of the Board of Directors of the recently organized Camp Creek Ry. Co. at Bozeman, Mont., O. M. Harvey of Livingston was elected president and H. S. Buell of Bozeman named as vice president. A. J. Walrath of Bozeman is secretary, F. L. Benepe and Charles Anceney complete the board of directors. It is announced that the corps of surveyors will be in the field shortly, making the final surveys. Work of grading will follow immediately and it is fully expected to have the first 12 miles of road in shape to handle the crops this fall. The route will be from a point near Manhattan, where the Northern Pacific will be left, to Camp Creek, and from there up that stream into one of the richest hay and grain regions not yet reached by a railroad in the West.

It is understood that the directors of the Chicago, Milwaukee & Puget Sound Ry., at their meeting tomorrow, June 29, will take up the matter of constructing the Millstone to Missoula cutoff. Officials of the road were over to survey the latter part of the month.

It is believed that the Great Northern Ry. is about to start construction work on the Mondak-Helena cutoff. In fact, some reports have it that Guthrie & Co., St. Paul, Minn., and other contractors have already moved their outfits to Mondak for the work. It is planned to construct the line from Mondak, through Lewiston to a point near Judith Gap to connect with the Billings & Northern, and from that point to build a line through White Sulphur Springs and White's Pass, near Canyon Ferry to Helena, the latter stage of the line from Judith Gap to be used as a joint line between the Great Northern and the Northern Pacific's cutoff from Glendive.

The Columbia Falls & Southern R. R. Co. of Columbia Falls, Mont., has been incorporated with a capital stock of $100,000, and proposes to build a steam or electric railroad south from Columbia Falls. The incorporators are A. L. Jordan, Dr. J. T. Robinson, John Laux, W. P. Snow and H. F. Jessup.

Nebraska.

Surveys have been completed for the proposed route of the new railroad from Tekamah, Neb., to Decatur, and it is proposed to purchase a right of way between 50 and 100 ft. Aldah King is Engineer.

Grading work for the extension of the Kearney & Black Hills branch of the Union Pacific from Callaway to Arnold and Gandy was started the middle of this month at Callaway by William Warren of Callaway, who has a sub-contract for 1¼ miles of the grade. Several grading outfits were put to work by other contractors between Callaway and Arnold later in the month.

Nevada.

It is reported that a movement is on foot looking to the construction of a railroad from Winnemucca, Nev., or some other point on the Southern Pacific into the Quinn River Valley. It is understood that Duncan McVichie, Salt Lake City, Utah, is promoting the project and has secured practically all necessary funds.

We are advised as follows regarding the proposed reconstruction of the Eureka & Palisade Ry., A. R. Randolph, Superintendent and Secretary, Palisade, Nev.: On March 1st, 1910, the road suffered severely on account of floods and has never resumed operations. The property was sold under foreclosure sale Nov. 29th last, but before the redemption period had expired, May 29th, it was redeemed in the interests of the stockholders. The re-organization has not yet been effected, but it is expected that so soon as that is accomplished the work of re-construction will begin. At this time there is no likelihood of the road being broad-gaged; although it would appear that there is a great future ahead for the mining districts that it reaches, there is nothing to warrant broad-gaging at this time.

New York.

It is rumored that the officials of the Buffalo, Rochester & Pittsburg R. R. have under consideration the removal of the Lincoln Park shops to East Salamanca. T. F. Brennan, Rochester, N. Y., is General Manager of the Company.

The Carthage & Copenhagen R. R. has under consideration the extension of its line to Camden in Oneida County, N. Y., and it is reported that surveys are already under way. S. J. Gifford, Cathage, N. Y., is General Manager

Preliminary work will probably be started this year by the New York Central Lines for the new passenger station to be erected at Utica, N. Y. The preliminary work will include the shifting of the tracks through the city. It is expected that the railroad will have the permanent tracks laid and a subway system modeled after that in Troy constructed before the work of erecting the new passenger station is commenced. An enlargement of the yards will also be made.

The Syracuse Rapid Transit Co., Syracuse, has applied to the Village Trustees of East Syracuse for a double track franchise in Manlius St. to the corner of Ellis St. and Hartwell Ave.

North Dakota.

Clifton & Applegate, Missoula, Mont., contractors, extending and improving the grade of the Northern Pacific Ry. in North Dakota, have been instructed to resume work which was suspended last fall.

The Northern Pacific, it is rumored, has ordered resumption of construction on its Dakota cut off, and it is the opinion of the contractors that actual work will be under way within 30 days.

Ohio.

The Mahoning & Shenango Ry. & Light Co., Youngstown, has asked the council of East Youngstown to pass an ordinance granting the street railway the right to construct and maintain double tracks through the village, from Stop 8.

The Terminal Building Co., Cleveland, O., has been incorporated, and plans the construction of a freight depot in that city at an estimated cost of $1,500,000. According to the plans the new building will be located in a convenient site in the vicinity of Ontario St., Vinegar Hill and Canal Road, and will be used by nearly every road entering Cleveland. J. E. Latimer, Citizens' Bldg., Cleveland, O., is one of the incorporators.

Officials of the Lake Shore & Michigan Southern Ry. have been in conference with the city officials of Port Clinton regarding a new right of way through the city. It is understood that the railroad will not elevate its tracks through the city, but will construct subways at the principal crossings.

Announcement has finally been made of the long awaited plan for reorganizing the Wheeling & Lake Erie R. R. The Wheeling will be merged with the Wabash-Pittsburg Terminal railroad, $20,000,000 will be raised and part of it will be devoted to rehabilitating the combined system. The main line runs from Pittsburg to Toledo and an auxiliary line from Cleveland to Zanesville. The $20,000,000 will be raised by assessing all stock of the Wheeling & Lake Erie and the second mortgage bonds of the Wabash-Pittsburg Terminal; there will also be a sale of new first mortgage bonds. Of the $20,000,000 to be raised more than $8,000,000 will go to pay off Wheeling's notes, several more millions will pay receiver's certificates and current obligations and the balance will go into improvements. Important items in this betterment program will probably be double tracking the entire system from the Ohio state line clear across the state to Toledo and the purchase of new cars and other equipment to give the roads adequate facilities for handling coal from Ohio and Pennsylvania fields.

Oklahoma.

W. F. Harn, John F. Winans and Homer S. Hurst of the Oklahoma City Land & Development Co., Oklahoma City, are reported to be preparing to ask a franchise to build street railway lines in Oklahoma City. Messrs. Harn, Winans and Hurst recently acquired ownership of the railway interests of the Oklahoma City Land & Development Company which owns and operates a line from 16th St. and Robinson Ave. to a point four miles distant in the northeastern part of the city. This company also has almost completed construction of an extension to the proposed capital site. This line has been graded, and poles, hangers and cross arms have been placed ready for the wire. Steel sufficient to lay the track is now stored in the company's barns. The new franchise will cover about 12 or 15 miles of additional lines.

A French syndicate is reported to have agreed to finance the system of railroads promoted by H. A. Noah, of Alva. It is understood that the line will be built and operated under an Oklahoma charter. As projected the line will run from the Colorado coal fields through the western counties of Kansas and across the whole northern tier of counties of Oklahoma to Joplin, Mo., with a branch line from Alva to Oklahoma City. The entire length of the road is to be 864 miles.

It has been announced by Frank Kell, Vice President and General Manager of the Wichita Falls Route, Wichita Falls, Texas, that arrangements have been completed for the construction of a 150-mile extension and that engineers have been instructed to run surveys and make estimates. It is believed that the extension of the system includes lines to Lawton, Okla., and an extension of the Wichita Falls & Southern from Newcastle to Graham. An extension of the Wichita Falls & Northern from Hammon to Woodward, Okla., is now under way, as noted in our last issue.

T. J. Nance, Clinton, Okla., is reported to be promoting the construction of a railroad from Liberal, Kan., south through Beaver, Okla. It is believed that this is an extension of the Clinton & Oklahoma Western Ry., now operating 22 miles of line between Clinton and Butler, Okla.

The St. Louis & San Francisco R. R. is reported to be planning to build a cutoff from Tulsa to Mounds, on the Red River division, which will shorten the time on the route to Mexico at least one hour and will give the Frisco a line practically without obstructions from Monett to Denison, Texas. The proposed cutoff is about 14 miles in length and it is said if built it may follow the line of the old Battle-Axe road, which was projected about eight years ago, but was never completed.

Oregon.

The Jackson County Light & Power Co. has filed supplementary articles of incorporation amending its charter so as to include in its purposes the building, leasing and operating of an electric railroad between Grants Pass and Ashland.

Work was started June 12 at Eugene, Ore., on the proposed line of the Eugene-Siuslaw R. R. M. J. Duryea, President of the Eugene Commercial Club, is interested in the project.

The Willamette Pacific R. R. Co., has filed its articles of incorporation, the incorporators being G. X. Wendling, of San Francisco, president of the Wendling Lumber Co.; R. M. Cross, secretary Wendling Lumber Co., and S. R. Bodine, of Portland. The company proposes to build a number of railroad lines. The main one of these will be from Eugene to the Pacific Coast at a point near the mouth of the Siuslaw River and thence in a southerly direction to Marshfield. The capital is given at $1,000,000. A branch will extend from near Junction City of Swisshome on the main line of the road and another branch will extend from near Junction City to a point near Elmira on the main line. The principal place of business of the new company will be at Portland. The articles also provide that the company may own and operate steamship lines.

Engineers in the employ of the Portland, Eugene & Eastern Ry., 502 Fenton bldg., Portland, Ore., have begun what is believed to be the permanent survey for the proposed electric railway between Eugene and Corvallis. The survey was started at Eugene, following the preliminary survey made by the company's enginers last summer. The survey extends out West 11th St. to the city limits, thence in a westerly direction to a point five miles out, turning north and proceeding in as straight a line as possible to Monroe, where the Corvallis & Alsea Ry. is met. This line, which has been bought and paid for by the P. E. & E. Ry., will be used as a link in the through line and will be electrified. Right of way for a good part of the distance between the two cities has been secured, the deeds specifying that construction work must begin before Sept. 1, 1912, or the deeds become null and void.

Pennsylvania.

⦿The Allegheny & Northwestern Ry., which proposes the construction of an interurban line from Harmarville to Evans City, has awarded the construction contract to the McComb Construction Co., Olean, N. Y. The line is to be operated with McKeen gasoline motor cars.

The Lewisburg, Milton & Watsontown Passenger Ry. Co., Milton, Pa., is reported to be contemplating the extension of its lines to Northumberland to connect with the line of the Sunbury & Northumberland Electric Street Ry. Co. or the Sunbury & Selinsgrove Electric Street Ry. Co.

The Philadelphia & Western Ry. has submitted a proposition to the council of Bridgeport, Pa., offering $5,000 for permission to lay tracks in that borough.

The Bessemer & Lake Erie R. R., H. T. Porter, Chief Engineer, Greenville, Pa., is to expend about $425,000 during the coming months for improvements. More than half of this large amount will be used in the building of large classification yards at Albion. The remainder of the amount will go for lesser improvements.

South Carolina.

The Atlantic Coast Line Ry., according to information received from Columbia, S. C., is making preparations for improving its yards at that city which will about double the present trackage.

The Charleston & Northwestern Ry. Co. has been chartered with a capital stock of $300,000, and proposes to build a line from Mount Pleasant, near Charleston, to Guerings Bridge, and to Bonneau to a connection with the Atlantic Coast Line. The total projected length, including a branch to McClellanville, is 60 miles. Wm. C. Miller, Richard S. Whaley and Wm. C. Bissell, all of Charleston, S. C., are interested.

South Dakota.

The Chicago, Milwaukee & St. Paul Ry., according to information received from Aberdeen, S. Dak., is planning the expenditure of $200,000 for the reconstruction of its buildings destroyed last winter by fire. J. T. Gillick, Aberdeen, S. Dak., is Division Superintendent.

Tennessee.

Good progress is being made in the construction of the Dyersburg & Jackson R. R., and on June 15 6 miles of grade had been completed in Dyer County, one mile of which was ready for track. It is believed that the road will be completed by Oct. 1, 1911.

R. E. L. Wilson, Memphis, president of the Jonesboro, Lake City and Eastern R. R., is reported to have acquired two blocks of property in Railroad Ave. at Memphis, to be used as terminals for the proposed extension of the railroad into Memphis. It is said that the Jonesboro, Lake City & Eastern will form a connecting link with the new Kansas City & Memphis line, now building southeast from a point near Fort Smith. No definite information is available as to what point the Jonesboro, Lake City & Eastern will be extended to Memphis. It is said one route has been surveyed from Leachville, Ark., southward, splitting an old lumber section and reaching Bridge Junction over the Rock Island tracks. The Frisco bridge will be used to enter Memphis. The new line being surveyed from Kansas City to Memphis will come east from the Ozark Valley mountains. It will be direct into Jonesboro, connecting there with the Wilson road.

The Memphis Street Ry. Co., Memphis, will probably begin work in the near future on the extension of Livermore St. and Trigg Ave. The Union Stock Yards Co. is planning to spend $100,000 at that place in the erection of buildings and yards.

The Kentucky & Tennessee State Line R. R. Co. has filed its charter at the County Register's office at Paris, Tenn. The incorporators are leading farmers through whose section the proposed railway will traverse. They are: J. N. Hill, W. T. Jackson, C. V. McCampbell, J. W. Williams and J. T. Turnbow. According to the charter the road will run from the Tennessee to the Mississippi River, traveling on or near the Tennessee-Kentucky state line, from which it gets its name, and will pass through Hazel, where the general offices will be located. The capital stock will be $80,000, and the shares will be $100 each. The charter authorizes a first mortgage bonded indebtedness of not more than $8,000 per mile.

Contracts are now being let for the roadbed construction for the Nashville-Gallatin Interurban Ry. Contracts are being let in such amounts as to bring about completion by Oct. 1. The same will apply to concrete work, bridge piers, bridges and trestles. It is expected to cover all the line by July 1 with [illegible] completion. It is planned to establish along the line every 8 miles, resident engineering forces, all of them being under the Chief Engineer. The company is now ready to get in touch with bridge manufacturers, as it desires the following bridges delivered at Nashville, [illegible] truss bridge 100 ft. long, one through girder bridge 60 ft. long, one deck girder bridge 60 ft. long, one deck girder bridge 65 ft. long. All these bridges are to be of sufficient strength for heavy interurban traffic. The Fidelity Securities Corporation has contracted with the Nashville-Galkatin Interurban Ry. to construct and put in operation the interurban line. All purchases, contracts and dealings will be made by H. H. Mayberry, President, Stahlman Bldg., Nashville, Tenn.

Texas.

The Abilene & Southern Ry. Co., Percy Jones, Chief Engineer, Abilene, Tex., has filed an application with the state railroad commission for the registration of stocks and bonds of 54 miles of completed road from Abilene to Ballinger. The company [illegible] registered $1,700,000 of bonds and $70,000 stock.

The Missouri, Kansas & Texas Ry. is reported to have decided to connect its 67-mile Colmesneil-Trinity line with the rest of the system. To do this it is proposed to construct an extension from Trinity to Waco, about 125 miles. The construction of an extension of this line from Colmesneil to a connection with the Frisco Railroad at some point in Louisiana is also contemplated. The latter line will be about 140 miles long. It is understood that it was originally planned to extend the line to Beaumont from Colmesneil, but it was decided that a shorter route to New Orleans could be obtained by running north to Beaumont and entering Louisiana.

The Bartlett Western Ry. (formerly the Bartlett Florence Ry.) will probably begin work in the next few days on an extension from Jarrell to Florence. No contracts will be let as the work will be done under the direction of the company. C. J. Grainger, Bartlett, Tex., is first Vice President and General Manager.

Roach & Stansell, Memphis, Tenn., who, as mentioned recently in these columns, were awarded the contract for grading the Kansas City, Mexico & Orient extension from Mertzon to Alpine, Tex., have started actual work at the latter city and expect to push the work through to completion.

The Texas, Gulf & Northern Ry. Co., incorporated last week with a capital stock of $175,000, proposes to construct a line of railroad commencing at a point near Bovina, Parmer County, on a connection with the Pecos and Northern Texas Ry., thence in a southerly direction through Bailey, Cochran, Yoakum, Andrews, Ector and Midland counties to a connection with the Texas & Pacific Ry. at Midland, a distance of 175 miles. The directors are: J. A. Underwood, Honey Grove; J. D. Bedford, Amarillo; R. E. Underwood, Amarillo; J. F. Sadler, Weatherford; Robert E. Davis, Amarillo; Mike C. Lemaster and J. M. Neeley, Amarillo.

The El Paso & Southwestern [illegible] engineer in the field running a preliminary survey up the Rio Grande in the direction of Las Cruces, north of El Paso. It is believed that this is merely an investigation party to secure data on the character of the soil, the cost of construction, and other matters. It is reported that the line is to be run to the Elephant Butte dam or a point near there, and that the Southwestern means to be ready to enter the field first if the prospects appear feasible for a railroad line.

The San Benito Interurban Ry. is to extend its line at once to Santa Maria, and possibly to Brownsville. Sam Robertson, San Benito, is interested.

Some two years ago the citizens of Brownwood, Tex., undertook the construction of a line of railway with local capital, and were depending on financing the proposition to make further extensions. The drouth which prevailed over the United States in 1909 and 1910 prevented the completion of the road with local capital, and the enactment of what is commonly known as the I. & G. N. bill prevented financing with foreign capital, so [illegible] suspended temporarily. Recently, however, a [illegible] Brooks [illegible] a [illegible] W[illegible] hardware merchant [illegible] secretary of [illegible] Commercial club of Brownwood, closed a deal with a large company to take the line over and complete it as far north as Rising Star at present, with other extensions in view later. [illegible] will be opened on July 1 by the new owners and the road will be completed early this fall.

Official announcement is reported to have been made that the Fort Worth and Rio Grande division of the Frisco is soon to be extended from Brady to Mason, Texas, a distance of 27 miles. Later the road will be extended 100 miles further to Waring to connect with the Kirkville branch of the Aransas Pass. The town of Waring has put up a bonus of $250,000 for any road that will give it a transportation outlet.

The Houston & Texas Central R. R., I. A Cottingham, Engineer Maintenance of Way, Houston, has filed with the Secretary of State a charter amendment providing for the construction of an extension or branch line from a point on the main line at Giddings, extending thence in a general northeastly direction through Lee, Burleson and Brazos counties to a point on the line of the Hearne and Brazos Valley railroad at Stone City, Brazos County, a distance of 50 miles.

Utah.

It is expected that shortly after July 1 the Utah Light & Ry. Co., Joseph Wells, General Manager, Salt Lake City, Utah, will commence construction work on a number of extensions and other improvements in the vicinity of Salt Lake City.

Virginia.

The Southern Ry. is about to begin the construction of a spur track in South Lynchburg, which will open half a mile of track for industrial plants.

The Virginia-Carolina Ry., Wilton E. Mingea, president, Abingdon, Va., is reported to have started surveys from Konnarch, the southeastern terminus, for an extension across the mountains to Wilkesboro, N. C.

Washington.

An organization of business men of Seattle and the Olympic peninsula has been effected for the financing and construction of an electric railway between Port Angeles and Port Ludlow, on the peninsula. The first work will be to inspect the survey now available between the two cities named as terminals. This survey is said to be over a route having a maximum grade of 1½ per cent and a total distance between Port Ludlow and Port Angeles of 51 miles. David S. Troy, Chimacum, Wash., is chairman of the organization.

The British Columbia Electric Ry. Co., Ltd., Vancouver, B. C., is understood to have purchased the Great Northern R. R. Co.'s old right-of-way between Blaine and Cloverdale for the purpose it is believed of extending the line from Cloverdale to the Whatcom county town.

Press reports from Seattle state that City Engineer R. H. Thompson has completed physical valuation of the property of the Seattle, Renton & Southern R. R., with a view to its purchase by and its operation as a municipal street car line. This action is in accordance with a bond issue of $800,000, authorized at the last city election. It is stated that the city will offer this amount for the railroad.

It is believed here in Tacoma that the Northern Pacific Ry., is about to commence construction work on its Point Defiance double-track water grade line from Tacoma to Tenino. Among the engineering features of this line will be two tunnels through the hill at Ruston, under which the road must go to maintain the water level grade to the Narrows. It will also be necessary to construct several miles of sea wall along the Narrows and Sound shore west of Tacoma. A. R. Cook, for the last four years engineer of maintenance of way for the Northern Pacific lines west of Paradise, Mont., has been promoted to the newly created position of principal assistant to W. L. Darling, chief engineer of the system, with headquarters in Tacoma. It is understood that among the first problems to be undertaken by Mr. Cook in his new position will be the superintendency of the construction of the Point Defiance double-track water grade line from Tacoma to Tenino.

The State Public Service Commission has issued an order whereby the Chehalis & Cowlitz R. R. may cross streets in Chehalis if it will agree to plank between the tracks for 2 ft on the outside, and to pave between the tracks, and for 2 ft. on the outside.

The City Council of Wenatchee has granted to the Wenatchee Traction Co. a franchise to operate an electric railroad in this city. The company is now endeavoring to secure a franchise from the county commissioners to operate a line over the county road between Wenatchee and Leavenworth. Franchises will be asked for from the town of Cashmere and also from Leavenworth. Under the terms of the franchise granted by Wenatchee work must begin within 18 months.

West Virginia.

⊙John Shrader, Chester, W. Va., has been awarded the contract for completing the grading for the electric railway to extend from Sisterville to Friendly. It is estimated that this work will cost about $14,000. Charles L. Williams, Parkersburg, W. Va., has been appointed receiver of the road and has been granted permission to issue $30,000 of receivers' bonds to complete it and place it in operation.

Advices from Charleston, W. Va., state that the deed of sale of the Interior & West Virginia R. R. Co. to the Big Stony Ry. Co., has been recorded in the office of the Secretary of State. The line is 17½ miles long and extends from Potts Creek headwaters in Monroe County, W. Va., to a point in Giles County, Va.

The Mount Morris & Morgantown, R. R. Co. has been chartered with a capital stock of $125,000 and proposes to build a line from Morgantown, W. Va., to Mount Morris, Pa., 10 miles. The incorporators are William Hatfield and John Long, Mount Morris, Pa. Plummer Bowlby and Thomas Keenan, Bowlby, W. Va., and Rufus Lazell, Morgantown.

Canada.

✣Bids are asked until noon, June 30, by A. L. Hertzberg, Division Engineer, Canadian Pacific Ry., Toronto, Ont., for the construction of the concrete abutments required in connection with Jane St. subway, West Toronto. Plans and specifications may be seen in Resident Engineer Fullington's office, Room No. 605 Union Station, Toronto.

The Canadian Pacific Ry. has completed surveys and will have work started about July 1 on the construction of about 10 miles of yard track on No. 1 Island at Fort William, Ont. It is expected that the yards will be ready to assist in the handling of the fall business. Connections to the new yards will be made by the new Kaministiquia river bridge and also by the McKellar river bridge.

Plans are being formulated for the extension of the Bruce Mines & Algoma Ry., which was recently purchased by H. Appleton and George P. McCallum of Sault Ste. Marie, Mich., as noted recently in these columns It is not only proposed to extend the line, but it is also planned to construct branches in the clay belt, where there are indications that growing traffic will warrant it. The Fidelity Trust Company of Montreal are the financial agents of the company. It is proposed to extend the main line 20 miles northward this fall, and by August 1st it is expected to have the construction well under way to connect with the line of the Superior branch of the C. P. R. at Ridout. It is proposed to continue the extensions next year to the main line of the Transcontinental. The railway has a charter from Bruce Mines to James Bay and runs east of the Algoma Central.

The Grand Trunk Ry. will in the near future build a line from Brockville or Kingston to Ottawa. The management now has this under consideration and a decision on the point of junction with the main line will be made almost immediately. The Grand Trunk some time ago obtained a charter to build a line from Kingston to Ottawa, but it was not generally understood that this branch would be constructed for years.

ROADS, STREETS AND PAVEMENTS

Alabama.

The Commissioners' Court, Wetumpka, Ala., has ordered the construction of a good road from Hughes ferry to Central and from the Montgomery bridge of the Alabama river to Robinson Springs. The engineer is making a survey of these roads and preparing plans and estimates so that bids may soon be received for their construction. About eight miles of the road between Tallassee, Ala., and Elmore Station have been built at a cost of about $1,000 per mile.

Arkansas.

⊙The Commissioners of the East Fourth St. Improvement District, Little Rock, Ark., have awarded the contract for the paving of that street with asphalt to M. D. L. Cook for $30,162

California.

✣Bids will be received until July 5 by the Board of County Commissioners, San Jose, Cal., for the construction of a change in Cochrane Road and in Gilroy Hot Springs Road. J. McMillan is county surveyor.

Advices from Redlands, Cal., state that Mentone and Crafton residents have taken steps to secure the building of a new road in Mill Creek Canyon to replace the old one through the "wash."

The City Council of Ontario, Cal., proposes to pave about a mile of streets in the business center of the city. Both driveways of Euclid Ave. from Main St. to C St. and A St. from Lemon to Vine Ave. will probably be paved.

Colorado.

⊙The Board of Public Works of Denver, Colo., has awarded the contract for the paving of Broadway from Ellsworth to Exposition Sts., to Thomas J. Tully for $60,831. Asphalt will be used.

⊙The Board of Public Works of Denver, Colo., on June 14 received the following bids for the West 23d Ave. paving district No. 2: Commonwealth Construction Co., $22,895; Denver & Pueblo Construction Co., $22,293; The Colorado Const. Co., $27,771. The improvement consists of 14,912 yds. of asphalt and macadam paving. The contract was awarded the Colorado Construction Co., at $27,771.

The Auto Transportation & Toll Co. has been incorporated in Colorado with a capital stock of $500,000. The company will build an automobile toll road between McCoy station and Glenwood Springs. The company will also construct a bridge over the Eagle and Grand rivers. The incorporators are Robert C. Walker, A. P. Hubbard and Henry R. Rhone.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

City Engineer [illegible] of Colorado Springs, Colo., has completed his estimates of the cost of paving the business section as $972,485, divided as follows: For asphaltic concrete, $238,370; bitulithic paving, $265,218; sarcalithic paving, $229,420; sheet asphalt, $239,477.

District of Columbia.

✣Bids will be received until 2 p. m., June 29, by Board of District of Columbia Commissioners, Washington, D. C., for grading and improving suburban streets and avenues in the District of Columbia.

Georgia.

The citizens of Albany, Ga., on June 12 voted the issuance of bonds to the amount of $100,000 for improvements, as follows: The erection and equipment of a municipally owned gas plant and purchase of a site therefor, $50,000; for public parks, such as laying off, beautifying, maintaining and enlarging parks of the city, $10,000; for improving and maintaining the city cemetery and acquiring additional land therefor, $10,000; for opening and laying off new streets in the city, $5,000; for street paving, $12,500.

Illinois.

⊙The following contracts for paving have been awarded by the Board of Local Improvements, Chicago, Ill., Chas. A. V. Standish, Sec'y: South Chicago Ave. System, The Ryan Co., Tacoma Bldg.; W. 77th St., Calumet Coal & Teaming Co., 2926 E. 95th St. Bids opened June 1.

Petitions are being circulated for the pavement of Prairie St. from the park south to the city limits, in Champaign, Ill.

County Engineer Van Deusen, who is engineer for the village of East Peoria, Ill., is preparing an estimate for more paving in that village. The streets to be paved are South Main from Washington to the L. E. A. W. tracks, North Main from Washington to the interurban railway, West Washington from Main St. to the P. & P. U., about a half mile of paving in all. The material is to be brick on gravel, with sand filler. The cost will be about $15,000.

City Engineer McCalman of Decatur, Ill., has submitted the following estimated cost of paving North Main St. from the Wabash railroad north to the P., D. & E. railroad: 20,600 sq. yds. of completed pavement, $38,110; 50 ft. of sandstone curbing, $24; two brick catch basins, $70; 8,000 cu. yds. of excavation, $4,000; court costs and inspector's fees, $1,000—totaling for the entire improvement $43,204.

The Board of Local Improvements of Macomb, Ill., has decided to construct additional street paving in the north part of the city. The new pavemnt will extend on North Randolph St. from the depot north to Pierce St. and on Pierce St. west to North McArthur St. and back on North McArthur St. to West Carroll St. Nine blocks of brick will be laid at an estimated cost of $24,542. John Payne is superintendent of streets.

The Board of Local Improvements of Litchfield, Ill., has passed resolutions for the paving of North Jefferson St., from Union Ave. to Third; on Van Buren St., from Ryder to Union Ave.; on Chestnut, from Ryder to Park Pl., and on Montgomery Ave., from Park Pl. to North St. The pavement is to be of crushed rock foundation of 6-in. thickness, with a layer of paving block on top.

The Board [illegible] the town of Fulton, Ill., has accepted the petition providing for the construction of a new highway beginning at the east end of Avenue E, in the Southside addition and running due east along the north side of the north quarter section line in section 33 to the west end of 8th Ave., on the east side of the C., M. & St. P. right of way in Manufacturers' addition.

Indiana.

✣Bids will be received until 10 a. m., July 21, by Board of Commissioners of Allen and Adams Counties at Decatur, Ind., for the construction of macadamized road on line between Madison township, Allen County, and Root township in Adams County. H. S. Michaud is Adams County Auditor.

✣Bids will be received until 2 p. m., July 10, by Board of Commissioners of Parke and Putnam Counties, for the construction of a gravel road on county line between Jackson and Union townships, Park County, and Clinton and Madison townships in Putnam County. J. E. Elder is Auditor of Parke County.

✣Bids will be received until 2 p. m., July 10, by Commissioners of Parke and Putnam Counties at Rockville, Ind., for the construction of a gravel road on the county line between Jackson township, Parke County, and Madison township in Putnam County. J. E. Elder is Parke County Auditor.

✣Bids will be received until 2 p. m., July 6, by Board of Clinton County Commissioners, Frankfort, Ind., for the construction of seven gravel roads. Charles F. Cromwell is County Auditor.

✣Bids will be received until 10 a. m., July 5, by Board of Daviess County Commissioners, Washington, Ind., for the construction of gravel roads in Washington township. Thomas Nugent is County Auditor.

✣Bids will be received until 2 p. m., July 5, by Board of Greene County Commissioners, Bloomfield, Ind., for the construction of a macadamized road in Jackson township. C. H. Jennings is County Auditor.

✣Bids will be received until 2 p. m., July 5, by Board of Pike County Commissioners, Petersburg, Ind., for the construction of a rock road in Patoka township. John D. Gray is County Auditor.

✣Bids will be received until 10 a. m., July 3, by Board of Warrick County Commissioners, Greenfield, Ind., for the construction of grades in Sugar creek and other townships. C. H. Troy is County Auditor.

✣Bids will be received until 2 p. m., July 3, by Board of Warrick County Commissioners, Boonville, Ind., for the construction of certain dirt fills or grading. N. M. Spradley is County Auditor.

✣Bids will be received until 10 a. m., July 3, by Board of LaPorte County Commissioner, LaPorte, Ind., for the construction of macadamized roads in Scipio and Cass townships. F. A. Hausheer is County Auditor.

✣Bids will be received until 10 a. m., July 3, by Board of Jay County Commisioners, Portland, Ind., for the improvement of a public highway in Bear creek township. W. Lea Smith is County Auditor.

⊙Frank Bierwagon has been awarded [illegible] contract for the construction of a half mile [illegible] cross streets in the Caldwell addition at Gary, Ind., [illegible] vision.

The Board of Public Works of Muncie, Ind., has decided to pave Kilgore Ave., from the end of the pavement to beginning of the Yorktown pike. John Kelly is City Clerk.

The Board of Public Improvements of Mishawaka, Ind., has passed a resolution for the pavement of South Spring St., from 2nd St. to the Lake Shore railroad; 3rd St., from Spring to Union; North Spring St., from 2nd to Front. Front St., from Church to West; Race St., from 2[illegible] Bitulithic, asphalt [illegible] John A. Herzog is Mayor.

Iowa.

✣[illegible] will be [illegible] until 7.30 p. m., July 3, by William C. Chubb, City Clerk, Corning, Ia., for the grading, paving, curbing and guttering of Davis Ave., from the railroad right of way to the north line of 8th St. and 8th St. from the alley between Davis Ave., and Adams St. to the East line of Grove Ave. The work will include the following approximate quantities: 12,000 sq. yds. of brick pavement; 189 sq. yds. of concrete pavement; 2,373 lin. ft. of combined curb and gutter; 1,857 lin. ft. gutter; 2,650 cu. yds. of grading [illegible] Creston, Ia., is Engineer in Charge.

The City Council of Iowa City, Ia., has passed a resolution providing for the paving of 15 blocks of streets with bitulithic. Bids for this work are now being received by the City Clerk. C. T. Day is City Engineer.

The City Council of Clinton, Ia., has ordered the repaving of 5th Ave., from 2nd St. to 5th. R. C. Hart is City Engineer.

Following bids were recently submitted to The Road Commission of Chattanooga, Tenn., for the paving of Main St.: West Construction Co.—bituminous concrete and concrete base, using Trinidad asphalt as a binder, $76,560; Noll Construction Co.—bituminous macadam and macadam base, Standard Oil "C" as binder, $59,688; bituminous macadam and concrete base, using same binder, $76,648; 2½ in. bituminous macadam with 6-in. macadam base, $66,408; Southern Paving & Construction Co.—vitrified brick and macadam base, $69,717; vitrified brick and concrete base, $74,837; bituminous macadam and macadam base, Union Oil binder, $51,477; bituminous macadam and concrete base, California asphalt as binder, $55,317; bituminous concrete, concrete base, California asphalt, $60,757; H. S. Bosler, Chattanooga-Liquid asphalt, attached specifications, $67,383; Southern Bitulithic Co., Nashville—vitrified brick, macadam base, $79,528; vitrified brick, concrete base, $67,528; bituminous concrete and macadam base, Warren's Acme Puritan binder, $76,007; bituminous concrete base, same binder, $84,007; J. C. Collins, Mt. Vernon, Ill.—vitrified brick, macadam base, $80,957; vitrified brick, concrete base, $88,957; Smallwood & Co.—bids only on curb, gutters and catchbasins.

The City Council of Carroll, Ia., has passed an ordinance ordering the installation of 13 blocks of paving.

Kansas.

✣Bids will be received [illegible] City Clerk, Topeka, Kan., for paving 7th St. west of Kansas Av[illegible] is [illegible] Engineer.

Kentucky.

⊙The Board of Public Works of Louisville, Ky., has awarded the following contracts for the construction of vitrified block streets: L. R. Figg Co., McHenry to Hickory, two blocks, 29th St., from Madison to Chestnut; Henry Bickel Co., Shelby, from old to new city limits, four blocks; L. W. Hancock Co., Dandridge, from Logan to Ellison, three blocks; Swan, from Oak to Dandridge; Lydia, from Shelby to McHenry; Brook, from Lee to Avery. The prices range from $1.77 per sq. yd. to $1.90 per sq. yd.

The city of Georgetown, Ky., will construct 10 squares of brick pavement on a concrete foundation. J. H. Cleary is City Clerk.

Louisiana.

✣Bids will be received until August 1, by Highway Department of Louisiana State Board of Engineers, Baton Rouge, La., for two [illegible]

✣Bids will be received until July 10, by the Highway Department of the Louisiana State Board of Engineers, Baton Rouge, La., for the construction of the proposed road between New Iberia and Jeanerette, a distance of 9.1 miles. Bids will be received on dirt, gravel or shells.

✣Bids will be received until July 1 by Board of Control, W. W. Heard, President, Baton Rouge, La., for 13,000 ft. of 4-in iron pipe, delivered at Angola, La.; 15,000 barrels of fuel oil delivered at Angola, La., in tank either by boat or rail, not later than Oct. 1, 1911, and 5,000 barrels of fuel oil, delivered at Hope plantation the same time; 30,000 blue-stripe sugar bags, delivered at Angola, La., on Oct. 1, 1911, and 10,000 blue stripe sugar bags delivered at Hope plantation the same time.

✣Bids will be received until 6 p. m., July 6, by R. J. Boudreaux, City Clerk, Crowley, La., for the construction of 300,000 sq. ft. of sidewalks. Concrete is the material to be used.

⊙Geo. Epple of Shreveport, La., has been [illegible]

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Commission, Baton Rouge, La., Gervais Lombard, State Engineer, for the construction of a road from Mansfield to Logansport for $28,038. The work includes about 19 miles of earth road. Bids were opened June 20.

⊙Highway Department of the Louisiana State Board of Engineers, Gervais Lombard, Engineer, Baton Rouge, La., has awarded the contract for the building of an earth road from Mansfield to Logansport, in De Soto Parish, to George Eppel of Shreveport. The estimated cost is $28,000. The new stretch of road will embrace 19 miles and will cost about $1,475 per mile. The road is to be built under act 49 of the Legislature of 1910, known as the state aid law. E. B. Sinclair is president of the Police Jury of De Soto Parish.

All bids received June 20 by the State Highway Department, Baton Rouge, La., Gervais Lombard, State Engineer, for the construction of two miles of gravel road in Baton Rouge, connecting the Hope Villa and Bayou Sara roads, have been rejected. The work will be readvertised.

Maine.

✣Bids will be received until noon, July 30, by George R. Boyd, Town Clerk, Welland, Ont., for the construction of pavement on the following streets: East Main St. from Mellems Ave. to Muir St.; Muir St. from East Main St. to Division St.; West Main St. from Canal Bridge to Frazer St. Tenders will be considered on asphalt block, vitrified brick, taralithic and bitulithic with brick between tracks and extending 18-in. on the outside rails on 6-in. concrete foundation. A certified check for $1,000 must accompany each bid.

✣Bids will be received until noon, July 3, by Cecil H. Robinson, Town Clerk, Walkerville, Ont., for the construction of pavements in the town as follows: Concrete pavement and concrete curb on Brant St. from Kildare Road to Argyle Rroad; Tuscarora St. from Devonshire Road to Victoria Road; Cataraqui St. from Devonshire Road to West Town line limit; cedar block pavement and concrete curb approaches to overhead bridge on Grand Trunk Ry. from Devonshire Road to Victoria Road; Niagara St. from Kildare Road to West Town line limit. Asphalt block pavement: Victoria Road from Sandwich St. to Assumption St., repaving with asphalt block; Walker Road from Sandwich St. to Canadian Bridge Works; Monmouth Road from Wyandotte St. to Niagara St.; Argyle Road from Grand Trunk Ry. to Niagara St.; Kildare Road from Cataraqui St. to Niagara St.; Victoria Road from Assumption to Wyandotte; Sandwich St. from Devonshire Road to East Town line limit; Tuscarora St. from Walker Road to Devonshire Road; Cataraqui St. from Walker Road to Devonshire Road; St. Mary's Gate from Argyle Road to Kildare Road. Plans and specifications may be seen on application to Owen McKay, C. E., Walkerville, Ont.

⊙N. E. McKenzie of Estevan, Sask., has been awarded the contract by that city for the construction of 85,000 sq. ft. of concrete walks for 15 cts. per sq. ft. Bids were opened June 13 by L. A. Duncan, Secretary-Treasurer. Chipman & Powers of Toronto and Winnipeg are Engineers.

⊙The town of Cobourg, Ont., has awarded the contract for the construction of cement sidewalks to Martin Jex & Co. of that town at 9 cts. per sq. surface ft., and 9 cts. per cu. ft. for curbing, and 50 cts. for extra filling. D. H. Minaker is Clerk.

Massachusetts.

The City Council of Worcester, Mass., has ordered the expenditure of $33,700 for construction of streets. West Boylston St. will be repaired from Fales St. to Summit at an estimated cost of $15,000; west side of Mullbury St., between Endicott St. and Quincy Ave. at an estimated cost of $11,000, and Bradley St., with old granite blocks to cost $7,700.

Michigan.

✣Bids will be received by the State Highway Commissioner at his office in Lansing up to and including July 8th, for improving one mile of road in section 28, Columbus Township, St. Clair County, Michigan, said road being a part of the old Fort Gratiot Military Turnpike about four miles from Lenox station on the Grand Trunk R. R. The work required consists of the following items: (1) Building an earth embankment about 2,000 ft. long across Bell River Flats. Estimated quantity 10,700 cu. yds., embankment measure. (2) Surfacing the embankment to width of 20 ft. and other sandy portions of roadway to width of 15 ft., all to depth of 8 ins. with selected hard earth taken from the cuts. (3) Building a wooden guard rail along the embankment on both sides of the roadway for a distance of 1,800 ft., less 500 ft. on one side protected by retaining wall and gas pipe rail. (4) Building a reinforced concrete retaining wall to dimensions shown on plans. Estimated quantity 483.3 cu. yds. concrete. (5) Building a reinforced concrete culvert according to dimensions shown on plans. Estimated quantity 25 cu. yds. concrete. (6) Erecting a 2-in. gas pipe guard rail on protection wall, in accordance with plan. Length 500 ft. (7) Building a 12-in. concrete tile culvert with suitable head walls. (8) Riprapping the westerly bank of the river near station 26 with 12 cords of cobble stones. Lump sum bids will be received for the entire work, or separate bids will be received on earth word, concrete, guard rails and riprap. Certified checks, payable to the order of the State Highway Commissioner, for 10 per cent of the amount of the tender must accompany each bid. Persons wishing to bid on this work may see plans and specifications at the office of the State Highway Commissioner, Lansing, at the residence of Hon. James M. Haviland, one-half mile from the proposed road, and at the office of John J. Cox, Civil Engineer, Court House, Coldwater, Michigan, or plans and specifications will be mailed to intending bidders, with privilege of retaining the same for two days, after which they must be returned, postpaid, to the office of Townsend A. Ely, State Highway Commissioner, Lansing, Mich.

⊙The Department of Public Works of Detroit, Mich., has awarded the following contracts for the paving of six streets: Orleans St., T. E. Currie, $2,846, creosote; Brooklyn Ave., J. A. Mercier, $5,285, creosote; Reed Pl., John S. Affeld, $2,387, brick; Beacon St., Otis Cement Construction Co., $1,642, brick; Mt. Elliott Ave., T. E. Currie, $3,980, brick; Maple St., T. E. Currie, $9,082, brick.

The taxpayers of Walkerville, Mich., have voted in favor of an extensive paving scheme which will involve an expenditure of $79,000. It is proposed to pave Sandwich St., Argyle road, Devonshire road, Victoria Ave., and Monmouth road with asphalt block, besides laying reinforced concrete on one or two cross streets.

The Board of Public Works of Negaunee, Mich., has decided to improve every street of the city now in poor condition. Among those that will be improved are Merry St., Jackson St., Silver St., Healy, Brown and MacKenzie Aves.

The City Council of Lake Linden, Mich., has decided to pave Calumet St., from First to Vetter this summer, probably with tarvia. The total area of the street to be paved is 16,000 sq. yds. and the estimated cost of the improvement is $1.25 per yd. Bids for this work will probably be advertised for at once.

Minnesota.

⊙Fielding & Shepley, 216 W. University Ave., St. Paul, Minn., have been awarded the contract by the City Council of Albert Lea, Minn., for the paving of 32,28[illegible] sq. yds. of street with creosoted wood block for $72,514. Bids were opened June 19. William Barneck is City Engineer.

Mississippi.

⊙The city of Jackson, Miss., has awarded the contract for the construction of approximately $50,000 worth of asphalt pavement to the Southern Asphalt & Contracting Co., of Birmingham, Ala. The contract calls for all asphalt work. Arthur Crowder is Mayor.

Missouri.

⊙The contract for the construction of the brick paving on Phelps Ave. has been awarded to the Will F. Plummer Construction Co., of Springfield, Mo., by that city. The approximate cost of the work is $35,000. The Frisco and Missouri Pacific railroads will pay for practically all of the work.

Montana.

Property owners along First Ave., north from the east line of 11th St. to the west line of 13th St., Great Falls, Mont., have filed a petition with City Clerk William H. Harrison, asking for the paving of that portion of the street. James W. Speer is Mayor.

Nebraska.

✣Bids will be received until June 28 by County Clerk, Lincoln, Neb., for grading and paving the West P. St. road including 8,350 cu. yds. of material.

⊙The City Council of Hastings, Neb., has awarded the contract for the construction of asphalt pavement in St. Joe and Denver Ave. districts to M. Ford of Omaha, Neb., at the following bid: Asphalt section, paving $2.11 per sq. yd., new curb, $.36 per lin. ft., combined curb and gutter, $.54 per lin. ft., resetting old curb, $.10 per lin. ft. The contract for the construction of brick pavement in both districts has been awarded to E. R. Bing of Hastings, at the following bid: Hastings brick block paving, $1.88 per sq. yd., other brick block paving to meet test, $1.92, new curb, $.34 per lin. ft., resetting old curb, $.10 per lin. ft.

New Jersey.

✣The Board of Street & Water Commissioners, Newark, N. J., rejected all bids received June 15 for paving of Woodside Ave., from Elwood to Grafton Ave., with brick, and has readvertised the work, bids to be opened June 29.

✣Bids will be received until 3 p. m., July 5, by Board of Chosen Freeholders, Court House, Jersey City, N. J., for widening and improving Second Section of the Newark Plank road. Plans and specifications are on file at the office of the Board. Walter O'Mara is Clerk. A certified check for $15,000 must be filed with each bid.

✣Bids will be received until 3 p. m., July 5, by Board of Chosen Freeholders, Walter O'Mara, Clerk, Jersey City, N. J., for widening and improving Third Section of Newark Plank Road. Plans and specifications are on file at the office of the Board. A certified check for $15,000 must be filed with each bid.

✣Bids will be received until 3 p. m., July 5, by Board of Chosen Freeholders, Walter O'Mara, Clerk, Jersey City, N. J., for repairing the wall of Roadway of the Weehawken Branch of the Hudson Blvd. Plans and specifications are on file at the office of the Board.

The Camden County Board of Freeholders, Camden, N. J., has received bids for resurfacing the Camden and Westfield turnpike from 27th St. to the county line at Pensauken Creek with Amiesite, as follows: Kelly-McFeeley Co., $38,703; W. Penn Carson, $38,703; J. T. Shanley Co., $44,910; Edward M. & Frank W. Miller, Cape May, $36,412; Cunningham Paving & Construction Co., $46,125; Belmont Paving & Construction Co., $38,420; E. C. Humphreys & Co., $42,917; William S. Konover, $38,662, and Gibs & Co., $44,076. The contract will probably be let to the lowest bidder on June 28.

The Camden County Board of Freeholders, Camden, N. J., has appropriated $1,500 for the purpose of resurfacing the White Horse turnpike for a distance of half a mile with United Gas Improvement Co.'s material. The State Road Commission has appropriated a like amount for the same purpose.

The Standard Bitulithic Co. submitted the lowest bid to the Board of Street & Water

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

Commissioners, Newark, N. J., on June 15 for the paving of Montclair Ave., from Summer to Mt. Prospect Ave., with bitulithic and Scheerer Ave., from Renner Ave. to Bergen St., with bitulithic at $7,185 and $12,000 respectively.

New York.

✤Bids will be received until 7:30 p. m., July 3, by Grover E. Yerdon, City Clerk, Johnstown, N. Y., for an asphalt block pavement on South Perry St. between Main St. and Clinton Ave. The work will include the following approximate quantities: 2,946 sq. yds. asphalt block pavement, 30 lin. ft. of new straight curb, 1,244 lin. ft. of old curb to reset, 185 lin. ft. of new headers, 20 lin. ft. of new 6-ft. radius curb, 8 new driveway corners, 12-in. radius. Bidders are required to submit a certified check of $500 with the bid. Plans, profile and specifications may be seen, and blank forms and all necessary information obtained at the office of the City Engineer.

◉The Borough President of Queens, New York City, has awarded the following contracts for public works in Queens: Regulating, grading, curbing, recurbing, flagging and resetting manhole covers in Weirfield St., between Wyckoff and Myrtle Aves., Ridgewood, Charles A. Myers, $5,793; repaving with asphalt macadam, Broadway, Flushing, from Murray lane to 10th St., Bay Side, Long & Miller, $22,630, and for Astoria Ave., from 19th to Jackson, Corona, $22,416; repaving with asphalt macadam, Central Ave., Springfield, from Merrick road to the city line, Clancy & Van Alst, $24,806, and Cooper Ave., from Myrtle Ave. to Edsall, $3,878; paving with asphalt blocks, on a concrete foundation, Academy St., from Webster Ave. to Washington St., Long Island City, The Hastings Pavement Co., $5,696.

◉Following contracts have been awarded by the State Highway Commission, Albany, N. Y., for the construction of county and state highways, for which bids were received on June 12: Voorheesville—New Salem Road No. 948, Albany County, 3.76 miles, J. & T. Murphy, Cobbleskill, N. Y., $41,684, on Bermudez; Binghamton—Windsor, Part 3, State Highway No. 5,118, Broome County, 3.68 miles, Andrew D. Young, Brooklyn, N. Y., $14,026; Fairhaven—Sterling—Martville, Highway No. 687-A, Cayuga County, .17 miles, no contract awarded; Poland Center—Waterboro, State Highway No. 5,151, Chautauqua County, 5.20 miles, no contract awarded; Cassadaga—Fredonia Road No. 938, Chautauqua County, 5.58 miles, James McNamara, Dunkirk, N. Y., $72,754, on residuum; Fitch Bridge—Elmira, Chemung County, Road No. 946, 1.98 miles, Coughtny, Lowman & Bradley, Watkins, N. Y., $20,759; Mooers Village, Road No. 930, Clinton County, 32 miles, no contract awarded; Truxton—De Ruyter, Part 1, State Highway No. 5,141, Cortland County, 2.15 miles, S. P. Hull, Cortland, N. Y., $23,568, on residuum; Hyde Park—Staatsburg, State Highway No. 5,153, Dutchess County, 5.22 miles, Harry B. Sproul, Peekskill, N. Y., $52,890, on residuum; Fishkill Village — Wappinger Falls, Road No. 5,154, Dutchess County, 4.81 miles, Schunnemunk Construction Co., Highland Mills, N. Y., $46,950, on residuum; Peekskill—Fishkill, Part 5, State Highway No. 5,150, Dutchess County, 3.66 miles, Harvey B. Sproul, Peekskill, N. Y., $39,641, on residuum; Wales Center—Wales, Road No. 924, Erie County, 6.03 miles, no contract awarded; Jameson—East Elma, Road No. 925, Earie County, 5.10 miles, Busch & Percival, Buffalo, N. Y., $47,989; Saranac Village—Bloomingdale Village, Essex County, Road No. 929, 1.44 miles, no contract awarded; Stafford—LeRoy, Genesee County, Road No. 5,136, 2.89 miles, Thomas Grady & Co., Rochester, N. Y., $25,700, on residuum; East Creek, Road No. 5,159, Herkimer County, .14 miles, State Highway Construction Co., Albany, N. Y., $5,555, on residuum; Felts Mills, Road No. 5,152, Jefferson County, .29 miles, Burns Bros. & Haley, Watertown, N. Y., $7,267, on residuum; Copenhagen, Road No. 937, Lewis County, 3.83 miles, St. Regis Construction Co., Malone, N. Y., $40,940, on residuum; Lime—East Bloomfield, Part 1, Road No. 5,142, Livingston County, 5.05 miles, Frank L. Cohen, Buffalo, N. Y., $41,000, on residuum; Canastota Village, Road No. 908, Madison County, 2.07 miles, R. W. Unison, Geneva, N. Y., $53,121, on Bermudez; Schenectady County Line—Scotch Bush, Montgomery County, Road No. 943, 1.38 miles, John Allen, Schenectady, N. Y., $14,111, on residuum; Lockport—Gowanda Creek, Road No. 749, Niagara County, 10.30 miles, Brooks & Julian, Rochester, N. Y., $119,000, on residuum; Camden—Taberg, Part 2, Road No. 5,139, Oneida County, 7.97 miles, Newport Construction Co., Newport, N. Y., $76,265, on residuum; Waterville Village, Road No. 932, Oneida County, 1.20 miles, T. F. Shaughnessy, Albany, N. Y., $14,300, on residuum; Elbridge—Camillus, Part 2, Road No. 5,143, Onondaga County, 5.03 miles, Daniel L. Mott, Utica, N. Y., $55,790, on residuum; East Springfield—Cherry Valley, Road No. 934, Otsego County, 4.88 miles, D. I. Snell & Co., Canajoharie, N. Y., $49,436; Oneonta—Colliers, Part 4, Road No. 5,138, Otsego County, 1.36 miles, John & Thomas Murphy, Cobbleskill, N. Y., $16,673, on Bermudez; Shelter Island, Road No. 910, Suffolk County, 3.81 miles, Clancy & Van Alst, Astoria, N. Y., $38,826.

◉Following contracts were awarded by the State Highway Commission, Albany, N. Y., for the construction of state highways and highway improvements, for which bids were opened June 14: Albany—Guilderland State Highway No. 5,155, Albany County, 5.37 miles, B. D. Pierce, Jr., Co., Bridgeport, Conn., $75,701; Wellsville—Hallsport County Highway No. 945, Allegany County, 4.18 miles, no contract awarded; Olean—Hilldale—Cuba State Highway No. 5,137, Cattaraugus County, 8.83 miles, H. C. Banks & Co., Olean, N. Y., $109,495; Cutting—French Creek County Highway No. 939, Chautauqua County, 6.63 miles, Busch & Percival, Buffalo, N. Y., $78,898; Jamestown—Frewsburg County Highway No. 940, Chautauqua County, 4.24 miles, Thomas Mahoney, Jamestown, N. Y., $76,337; Akron—Tonawanda Creek County Highway No. 947, Erie County, 10.16 miles, no contract awarded; Lancaster—Alden County Highway No. 917, Erie County, 4.11 miles, Constantine Bros. Co., Buffalo, N. Y., $90,437; Batavia—Stafford State Highway No. 5,145, Genesee County, 4.44 miles, Fred J. Mumm, Buffalo, $41,800; Hope Center—Wells, Part 1, State Highway No. 5,133, Hamilton County, 5.48 miles, Brown & Lowe, Schenectady, N. Y., $65,102; Watertown—Clayton, Part 1, State Highway No. 5,140, Jefferson County, 5.24 miles, B. C. Miller, Wilkes Barre, Pa., $52,427; Marcy Hill—Trenton County Highway No. 931, Oneida County, Deerfield Corners—Marcy Hill County Highway No. 933, 12.07 miles, Olin T. Benedict, Pittsfield, Mass., $135,900; Monroe—Oxford State Highway No. 5,144, Orange County, 3.31 miles, Schunnemunk Construction Co., Highland Mills, $39,950; Schenevus—Westford County Highway No. 935, Otsego County, 3.83 miles, The Lane Construction Co., Meriden, Conn., $35,940; Schenevus—Westford County Highway No. 936, Otsego County, 4.15 miles, Lane Construction Co., Meriden, Conn., $47,450; Wells Bridge—Otsego State Highway No. 5,153, Otsego County, 4.61 miles, Newport Construction Co., Newport, $51,556; Scotia Village State Highway No. 5,132, Schenectady County, 1.27 miles, Dollard & Heeran, Albany, $15,882; Seneca Falls Village County Highway No. 911, Seneca County, 0.72 miles, Kennedy Construction Co., Albany, $12,573; Hornell—Big Creek State Highway No. 5,130, Steuben County, 1.16 miles, Greenfield Construction Co., Brooklyn, $11,290; Sag Harbor—North Haven County Highway No. 911, Suffolk County, no bids received; Owego—Newark Valley County Highway, 927, Tioga County, 7.39 miles, Lane Construction Co., Meriden, Conn., $63,395; Freeville—Groton County Highway No. 926, Tompkins County, 4.49 miles, Amos D. Bridges' Sons, Hazardville, Conn., $39,728; Smith's Basin—Lime Kiln County Highway No. 942, Washington County, 0.24 miles, C. J. Reardon, Glens Falls, $2,317; Byram Lake—Bedford State Highway, No. 5,146, Washington County, 3.34 miles, James Garafano, Mt. Vernon, $14,444; Peekskill—Fishkill, Part 1, Westchester and Putnam Counties, State Highway No. 5,147, 3,63 miles, Samuel Beskin, Fishkill, $51,850; Warsaw—Pavilion Road No. 5,134, Part 2, Wyoming County, 3.59 miles, Frederick J. Mumm, Buffalo, $50,790; North Reading—Dundee, Part 2, State Highway No. 5,128, Yates County, 2.68 miles, Thomas J. Ford, Elmira, $36,999; Wellsville—Scio, State Highway No. 5,129, Allegany County, 4.5 miles, P. H. Murray, Rochester, $58,876.

North Carolina.

✤Bids will be received until 8:30 p. m., July 5, by Executive Board, Charlotte, N. C., for the construction of approximately 58,400 sq. yds. of bitulithic, sheet asphalt, bituminous macadam, double bond, vitrified brick or wooden block pavement. Joseph Firth is City Engineer.

✤Bids will be received until 8:30 p. m., July 5, by Executive Board, Charlotte, N. C., for paving certain streets including approximately 58,400 sq. yds. of pavement. Bids will be considered on bitulithic, sheet asphalt, bituminous macadam, double bond pavement, vitrified brick and wooden block. Plans and specifications are on file at the office of Joseph Firth, City Engineer.

✤Bids will be received until noon, July 15, by P. Q. Moore, Councilman in Charge of Streets and Wharves, at the office of the Mayor, Wilmington, N. C., for grading, paving and curbing Front St. Among the quantities included are 21,000 sq. yds. of pavement and 6,000 lin. ft. of granite curb. Plans and specifications can be obtained of the city engineer.

✤Bids will be received until 4 p. m., July 7, by Street Paving Committee, Tarboro, N. C., for improving Main St., the work including approximately 25,000 sq. yds. of 8-in. bituminous macadam and a small amount of cement sidewalks, drainage, etc. Alternate bids will be considered on 8,000 sq. yds. of vitrified brick paving on concrete base and 17,000 sq. yds. of bituminous macadam. Plans and specifications will be on file at the office of the Clerk at Tarboro, N. C., and at the office of the Engineer, Gilbert C. White, Durham, N. C., and copies of specifications, form of proposal, etc., may be obtained from the Engineer at Durham, N. C. Certified check for $500 required as an evidence of good faith. J. A. Weddell is City Clerk.

North Dakota.

◉James Kennedy of Fargo, N. Dak., has been awarded the contract in Salt Lake City, Utah, for the construction of about $138,000 worth of sidewalks. G. P. McGonagle is City Engineer.

Ohio.

✤Bids will be received until noon, July 10, by Louis Allen, Village Clerk, Wadsworth, O., for grading, curbing and paving with vitrified brick Broad St. The work will include 9,500 sq. yds. of pavement.

✤Bids will be received until July 1, by Board of County Commissioners, Lisbon, O., for the grading of California Hollow road in Columbiana County.

✤Bids will be received until noon, July 6, by Director of Public Service, Cincinnati, O., for furnishing the necessary labor and material for the improvement of Terrace Ave. from Ormond Ave. to Clifton Ave. by grading, macadamizing the roadway 18 ft. in width, and for the construction of cinder walks and necessary drains. J. J. Wenner is Clerk.

✤Bids will be received until noon, July 5, by Director of Public Service, Youngstown, O., for furnishing the necessary labor and material for the construction of pavement on Glenwood Ave. from Mahoning Ave. to the city limits. A certified check for $500 must be filed with each bid. W. H. McMillin is Clerk of the Director of Public Service.

✤ indicates work now open for bids. ◉ indicates a contract let recently.

✣[illegible] by Director of Public Service, Youngstown, O., [illegible] construction of pavement on Cleveland St. from Market to Hillman St. Plans and specifications are on file at the office of the City Engineer. W. H. McMillin is Clerk of the Director. A certified check for $500 must accompany each bid.

⊙Van Camp Bros., Newtonville, O., have been awarded the contract by the County Commissioners, Cincinnati, O., Fred Dreihs, Clerk, for the improvement under Specifications No. 72, of Loveland and Maderia road from Remington to the Camargo pike in Symmes Township, for $16,032. Bids were opened June 16.

⊙Hennessey Bros. of Piqua, O., have been awarded the contract by the Department of Public Service of that city for the paving of South Main St., with brick and for constructing storm drains for $47,671. Bids were opened June 16 by W. B. Mitchell, Clerk of the Department.

⊙The City Council of Athens, O., has awarded the following contracts for grading, draining, curbing and paving for which bids were opened June 21, as follows: W. S. Bower, May Ave., $5,765; W. R. Wilson, State St., $2,174; Mills & Coss, Elliott St., $3,099, and State St., lot 143 to Cemetery St., $4,089. W. B. Golden is Clerk.

⊙The Board of Control of Dayton, O., has awarded the following contracts for street paving, all to be paved with brick, and cement curbs: River, from Ferguson to Iowa, to John Wroe, $13,170, combined cement curb and gutter; Valley, Brandt to M. and E. canal, W. J. Kernan, $11,974; Valley, Brandt to Findlay, W. J. Kernan, $8,827; Creighton, Wayne to Wyoming, W. J. Kernan, $14,165; Troy, Leo to Valley, J. O. Shoup, $37,518; Phillips, Wayne to Wyoming, J. E. Conley, $15,748; Broadway, Albany to Bolander, W. H. Boyd, $9,643; Clover, Wayne to Fillmore, J. E. Conley, $12,721; Bayard, Ludlow to Perry, W. H. Boyd, $2,401; Carrie, Perry to Mead, W. H. Boyd, $918; Perry, Fifth to railroad, W. H. Boyd, $2,325; alley west of Wayne, Fifth to Short, C. Hoolihan, $702.

⊙The City Council of Perrysburg, O., has awarded the contract for paving Second St., from Hickory to Pine to T. J. Mulligan of Lima, O., for $38,335. Wassell block with cement filler will be used. George B. Campe of Toledo, O., is Engineer.

⊙The Madison Township Trustees, Madison, O., have awarded the contract for the improvement of a piece of the Park Ave., west roadway, extending from the Baltimore & Ohio railroad tracks west to the township line, a distance of about three-quarters of a mile, to Carroll & Gruber of Galion, O., for $8,400. Brick will be used.

⊙M. J. McGinty of Minerva, O., has been awarded the contract for the paving of two miles of the New Franklin road, north of Minerva, by the County Commissioners, Canton, O., for $40,820. The contract calls for a 16 ft. brick highway, which will include half of the road and concrete curb on each side.

⊙The Board of Control of Dayton, O., has awarded the contract for the paving of Summit Ave., from Third to Germantown Sts., to the Warren Bros. Paving Co., of Boston, Mass., for $21,404. The street will be paved with asphalt with a combined cement curb and gutter.

⊙Cloe Edginton of McComb has been awarded the contract by the County Commissioners, Findlay, O., for the construction of the Daniel C. L. Ingold joint county pike, located on the Hancock Putnam County line, for $3,540. The road will be constructed of gravel and will be two miles long.

⊙The Board of Control of Columbus, O., has let the contract for the elimination of grade crossing in Spring St. and Dublin Ave. to D. E. Sullivan & Son for approximately $[illegible].

The citizens of Bowerstown, O., at a [illegible] election, decided to pave Main St., the principal street of the town.

The City Council of Bryan, O., has adopted a resolution providing for the paving of the east end of East High St. Brick will be used with a concrete foundation.

Property owners on South Cory St., Findlay, O., have petitioned the City Council for the pavement of that thoroughfare between Lima Ave. and Elm St., with vitrified brick.

Oklahoma.

The City Council of Muskogee, Okla., has passed an ordinance providing for the construction of $29,000 worth of rock asphalt paving. T. P. Clonts is City Engineer.

The city of Tulsa, Okla., is planning to construct 80 additional blocks of paved streets. T. C. Hughes is City Engineer.

Oregon.

⊙Following low bids have been received by the City Executive Board, Portland, Ore., for improvements to streets: East 55th St., from Division to Lincoln, grading and concrete curb and walks, J. M. Manning, $1,250; Multnomah St. district, asphalt pavement, Barber Asphalt Paving Co., $39,239 (awarded contract); Morrison St., from Stout to Washington, bitulithic pavement, Pacific Bridge Co., $5,317; Holladay Ave., from East 31st to Goodsell Addition, grading and concrete curbs and walks, Joplin & Meeks, $456; East 31st St., from Sandy to East Glisan, grading and concrete curbs and walks, Joplin & Meeks, $4,596; Skidmore St. district, bitulithic pavement, Warren Construction Co., $306,382 (awarded contract); Macrum St., from Lombard to Willamette, grading and concrete curb and walks, Welton, Kibbe & Cochran, $4,347; Kilpatrick St., from Delaware to Peninsula, grading and concrete curbs and walks, S. H. Kimball, $3,189; East 15th St., from Killingsworth to Highland Park, grading and concrete curbs and walks, S. A. Kimball, $5,026; East 14th St., from Weidler to Hancock, bitulithic pavement, Pacific Bridge Co., $5,408; Thurman St., from Blythswood to Aspen, bitulithic pavement, Pacific Bridge Co., $14,023; Edwards and South Depot Sts., grading and concrete curb and walks, Welton, Kibbe & Cochran, $2,660; Macadam St., Hassem pavement, Consolidated Concrete Co., $64,097 (awarded contract).

The Street Committee of the Executive Board of Portland, Ore., has awarded contracts for the improvement of streets as follows: Washburn St., from Lombard to Willis, grading and concrete curbs and walks, Kelkeny Bros., $6,720; East 39th St., from Prescott to Humboldt, grading and concrete curbs and walks, Carter Bros., $2,109; East 26th St., from Powell St., to Simon's addition, grading and concrete curbs and walks, Keenan Bros., $2,257; East 17th St., from Kililingsworth to Ainsworth, grading and concrete curbs and walks, Jeffery & Bufton, $3,157; East 32nd St., from Francis to Holgate, grading and concrete curbs and walks, Bechill Bros., $4,600; Holman St., from East 13th to East 18th, grading and concrete curbs and walks, Baker Bros. & Hayden, $3,717; College St. district, asphalt pavement, Barber Asphalt Paving Co., $60,735; East 38th St., from Prescott to Humboldt, grading and concrete curbs and walks, Carter Bros., $2.652; Wygant St., from Denver to Gay, grading and concrete curbs and walks, Carter Bros., $2,630; Winchell St., from Delaware to Peninsula, grading and concrete curbs and walks, Baker Brothers & Hayden, $3,058; East 24th St., from Alberta to Killingsworth, grading and concrete curbs and walks, Carter Bros., $3,681; East 15th St., from Prescott to Shaver, grading and concrete curbs and walls, Coast Construction Co., $3,896; East 40th St., from Prescott to Humboldt, grading and concrete curbs and walks, Joplin & Meeks, $3,299; East 16th St., from Killingsworth to Holman, grading and concrete curbs and walks, Coast Construction Co., $5,769; Dekum Ave. district, grading and concrete curbs and walks, Carter Bros., $13,881.

⊙The City Council of Medford, Ore., has awarded the contract for the construction of nearly six miles of paving to Clark & Henery Construction Co., of Stockton, Cal., for $300,000, approximately. The contract calls for a new pavement with an asphaltic concrete base at $1.71 per sq. yd. In all 29 streets and alleys will be paved as follows: North Grape St., 6th to Vermont; South Ivy, 8th to 13th; North Ivy, 6th to Oakdale; Rose Ave., 7th to 4th; Beatty, Central Ave. to Manzanita St.; Bennett Ave., Howard to Roosevelt; 11th St. west, Oakdale to Hamilton; 10th St. west, Oakdale to Holly; Washington St., Genesee to Roosevelt; Hamilton, Oakdale to Oleson, 2nd to 4th; 11th St., Central Ave. to Oakdale; Fir, 6th to Jackson; 5th, Front to Riverside; 3rd, Apple to Oakdale; 9th, Orange to Hamilton; 11th to Dakota; alley, Riverside to alley between 7th and 8th; alley from 8th to 7th; Dakota, Oakdale to Peach; Mistletoe, Main to 10th; South Peach, Main to 8th; Bartlett, 8th to 9th; Orange, 10th to 11th; Roosevelt, East Main to Jackson Blvd.; Minnesota, Geneva to Roosevelt; alley through block 21, East Main to East 6th; alley in block 21, Central Ave. to alley through block 21.

⊙The City Commissioners of Baker, Ore., have awarded the contract to pave three miles of streets to the Warren Construction Co., of Portland, Ore., for $2.02 per sq. yd.

Pennsylvania.

✣Bids will be received until 8 p. m., July 3, by Town Council, Northumberland, Pa., Charles H. Dodge, Clerk for the grading, curbing and paving of Front St. The work will include aproximately 3,102 sq. yds. of pavement of vitrified brick; 1,275 lin. ft. of stone curb, excavation, 1,200 cu. yds.; concrete, 13 cu. yds. This yardage includes the area at street and alley intersections as far as the building line of Front St. on said intersecting streets and alleys. Each proposal must be accompanied with a certified check in the sum of $500, drawn on the Northumberland National Bank, Northumberland, Pa., and made payable to the Borough Treasurer.

✣Bids will be received until 10 a. m., July 5, by R. J. Cunningham, County Controller, Pittsburgh, Pa., for the pavement of Buena Vista and Lovedale Road, 2.6 miles; Squaw Run Road, 1.2 miles; Wilmerding road, ½ mile; Cliff Mines and Coraopolis Heights Road, 4.8 miles; Guyasuta Road, .4 miles; Bakerstown and Valencia road, 1-3 mile.

⊙The City Council of Erie, Pa., has awarded the following contracts for street paving: East Ave., from 21st St. to Buffalo road with class B sheet asphalt, Mayer Bros. Construction Co., $1 per sq. yd., 5-in. concrete base, $.23 per lin. ft.; for artificial stone curbing, $.30 per ft., and catchbasins, $35. Paving with sheet asphalt, 21st St.,. from Parade to East Ave., J. & M. Doyle, asphalt, $.90, concrete base, $.30; artificial stone curbing, $.30, and catchbasin, $30.

The Town Council of Bridgeport, Pa., has voted to proceed with the paving of streets in the town, and has authorized a bond issue of $8,000 for that purpose. The work will cost more than $10,000.

The Finance Committee of the City Council of McKeesport, Pa., has decided to have Market St., paved between the P. & L. E. and 9th Ave., at an estimated cost of $10,000.

An ordinance has been introduced in the Common Council, McKeesport, Pa., authorizing the issuance of bonds to the amount of $79,000 to provide for repaving 5th Ave. and Walnut St.

South Carolina.

⊙Geo. W. Waring of Columbia, S. C., has been awarded the contract by the City Council of Sumter, S. C., for paving Main St. roadway with vitrified brick.

Tennessee.

✣Bids will be received until 10 a. m., July 1, by Pike Road Commissioner of Grainger County, Rutledge, Tenn., for the grading of 16½ miles of county highway. A. M. Nance is Secretary of the Road Commission.

The contract for grading, ditching and mac-

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] 50 miles of public roads in Robertson County, Tenn., for which bids were asked until June 20 by the County Pike Commission, Springfield, Tenn., has not as yet been awarded. It will probably be awarded about the first of July. J. E. Washington is Chairman of the Commission.

The Roach-Manigan Paving Co. has been incorporated at Memphis, Tenn., with a capital stock of $100,000. The company will operate throughout the south and southwest. The officers are: M. J. Roach, president; E. P. White, first vice-president; Stanton Palmer, second vice-president; E. J. Manigan, general manager, and W. P. McCadden, secy. and treas. With the officers, D. Smith, L. T. Kavanaugh and Ed. Scott compose the directorate.

Texas.

✣Bids will be received until 9 a. m., June 29, by F. J. Von Zuben, City Engineer, Fort Worth, Texas, for the paving of East Front St. from Chamber Ave. to Virginia St., including 7,466 sq. yds. of bitulithic, vitrified brick or asphalt. A certified check for $1,000 must be filed with each bid.

✣Bids will be received until July 15, by T. W. Ragsdale, Mayor, Bonham, Texas, for the construction of 4,538 ft. of concrete curb; 22,645 sq. yds. of paving; 1,000 sq. yds. grading; 670 ft. storm sewer; 6 catch basins. Plans and specifications are on file with the city engineer.

⊙J. C. Kelso of Galveston, Tex., has been awarded the contract by the County Commissioners, Galveston, John M. Murch, County Auditor, for the construction, including regrading, culverts, etc., and resurfacing county road from causeway approach at Virginia Point to Texas City Junction, and to Highland Bayou. The contract price is $28,491. Bids were opened June 19.

The City Commissioners of Dallas, Tex., have adopted specifications for the paving of the North Akard St. extension from Caruth to McKinney Ave.

Road District No. 2, Richmond, Tex., has petitioned the Commissioners Court to call an election for $500,000 bond issue for road purposes. The district embraces a large portion of the northwestern, western and southwestern portions of the county, extending from Richmond almost to the Brazoria county line. It is planned to connect all towns west of the Brazos with good gravel roads.

Virginia.

✣Bids will be received until noon, July 1, by Henrico County Clerk, Richmond, Va., for the construction of about 4 miles of gravel road on Creighton Rd.; about 3½ miles on New Market Road. P. St. J. Wilson is State Highway Commissioner, Richmond, Va.

Washington.

✣Bids will be received until 11 a. m., July 12, by John H. Moffitt, County Controller, Washington, Pa., for the furnishing of vitrified paving brick or block to be used in the construction of the following roads, prices to be quoted by the thousand (1,000) f. o. b. station named for each road. The number of brick or block required to the square yard must be guaranteed. No. 1. Pike Run Road, 31,650 sq. yds. paving, shipping point Coal Center, Pa., P. V. & C. R. R.; No. 2. Finleyville [illegible] 27,500 [illegible] paving, shipping point Hackett, Pa., Pittsburg and Wheeling Div. B. & O. R. R.; No. 3. West Alexander-Burnsville Road, 21,100 sq. yds. of paving, shipping point West Alexander, Pa., B. & O. R. R.; No. 4. Taylorstown-S Bridge Road, 11,150 sq. yds. of paving, shipping point Taylorstown Station, B. & O. R. R.; No. 5. Cross Creek Road, 19,800 sq. yds. of paving, shipping point Burgettstown, Pa., P. C. C. & St. L. R. R.; No. 6. Houston-West Middletown Road, 10,700 sq. yds. of paving, shipping point McConnells Mills, Pa., Western Washington Branch of C. V. R. R.; No. 7. Robb Run Road, 7,900 sq. yds. of paving, shipping point McDonald, Pa., P. C. C. & St. L. R. R.; No. 8. Beallsville-Zollarsville road, 11,850 sq. yds. of paving, shipping point Scenery Hill, Pa., M. & W. Branch of P. R. R.; No. 9. Claysville-Bethany Road, $11,200 sq. yds. of paving; shipping point Claysville, Pa., B. & O. R. R.; No. 10. Washington-Prosperity Road, 5,800 sq. yds. of paving, shipping point Washington, Pa., P. R. R., B. & O. R. R., or W. & W. R. R. A certified check for $200.00 must accompany each bid and samples of the brick or block upon which the bid is based must be furnished to Chaney & Armstrong, County Engineers, Washington, Pa.

✣Bids will be received until noon, July 12, by John H. Moffitt, County Controller, Washington, Pa., for the construction of the following sections of county roads, including small bridges, culverts, etc.: No. 1. Pike Run Road, beginning at the borough line of Coal Center and extending toward Beallsville, Pa., a distance of 4 miles more or less. A certified check in the sum of $600.00 required with bid.: No. 2. Finleyville-Thomas Road, beginning at the covered bridge in the west end of the Borough of Finleyville and extending toward Thomas Station, a distance of 3½ miles, more or less. A certified check in the sum of $500.00 required with bid: No. 3. West Alexander-Burnsville Road, beginning at the borough line of West Alexander and extending toward Burnsville, a distance of 3 miles, more or less. A certified check in the sum of $400.00 required with bid: No. 4. Taylorstown-"S" Bridge Road, beginning at a point on the improved road leading from Crothers' Station to Taylorstown and extending northeasterly to the National Pike at the "S" Bridge, a distance of 1.6 miles, more or less. A certified check in the sum of $200.00 required with bid: No. 5. Cross Creek Road, beginning at a point on the Washington-Burgettstown Road near residence of J. B. Henderson and extending through Cross Creek village toward Avella, a distance of 2.8 miles, more or less. A certified check in sum of $100.00 required with bid; No. 6. Houston-West Middletown Road, beginning at the west end of the recently improved road and extending westwardly a distance of 1.5 miles, [illegible] of $200.00 required with bid. No. 7. Robb Run road, beginning at the Borough of McDonald and extending northwardly, a distance of 1 mile, more or less. A certified check for $200.00 required with bid; No. 8. Beallsville-Zollarsvills road, beginning at a point on the State Road, 700 feet more or less, south of the National Pike and extending toward Zollarsville, a distance of 2.1 miles, more or less. A certified check in the sum of $300.00 required with bid; No. 9. Claysville-Bethany Road, beginning at the end of pavement on W[illegible], a distance of 1.6 miles, more or less. A certified check in the sum of $200.00 required with bid; No. 10. Washington-Prosperity road, beginning at the borough line of Washington and extending toward Prosperity, a distance of 2,900 feet, more or less. A certified check in the sum of $200.00 required with bid. All of the above roads are to be constructed with a brick surface. Certified checks as specified, or a surety company bond for double the amount must accompany each bid. Chaney & Armstrong are County Engineers.

⊙Allred & James of Rochester, Wash., have been awarded the contract by the County Commissioners, Hoquiam, Wash., for the construction of the Emerson Road at Montesano for $17,766. The road will be built with gravel. Bids were opened June 19.

The City Commissioners of Spokane, Wash., have passed ordinances providing for $283,975 worth of street and sidewalk improvements. The improvements are: Grade and sidewalk, Arthur St., Newark to 12th Ave., $12,400; grade and walk, Conklin St., 5th to Hartson Ave., $3,060; grade and walk, Crown Ave., Parry to Standard St., $8,700; grade and walk, Euclid Ave., Hemlock to Lindeke St., $5,300; grade and walk, Gordon Ave., from the alley between Calispell and Washington Sts. to Post St., $8,950; grade and paving with asphalt, Howard St., 23rd to 29th Ave., $21,000; grade and walk, Lidgerwood St., Rowan to Liberty Ave., $27,000; grade and walk, Mission Ave., Havana to Stone St., $35,500; sewer, 9th and 10 Aves., from Grand Blvd. to Hilliard St., $5,000; sewer, 20th Ave., Latawah to Hatch St., $4,880; paving with asphalt-macadam, Rockwood Blvd., Arthur to Hatch St.; Highland Blvd., Hatch St. to Rockwood Blvd; Garfield road, 29th Ave. to Rockwood Blvd. $57,000; grade and walk, Rockwood Blvd., Hatch St. to 17th Ave., $3,800; grade and walk, 38th Ave., Perry St. to Grand Blvd., $9,200; grade and walk, 23rd Ave., Wall to Jefferson St., $7,100; paving with hassam, Washington St., Spotford Ave. to Oregon-Washington R. R. & Navigation tracks, $29,000; grade and walk, Rich Ave., Division to Pittsburg. The council also approved plans for grade and walk on Green St., from 5th to Sprague Ave., at a cost of $6,300.

The County Commissioners, Dayton, Wash., have passed a resolution favoring the paving of that portion of Main St., in front of the courthouse grounds.

City Engineer H. J. Doolittle of North Yakima, Wash., is preparing plans and details for paving Front St., north from B St., to the city limits, to connect with the new road that is being built by the county to Selah over the extension of North 1st St. Bitulithic will be used.

Wisconsin.

Ordinances have been presented to the City Council of Eau Claire, Wis., for the macadamizing of the following streets on the East Side: Gray St., Jones St., Earl St., Emery St., and Sever St., from S. River to S. Farwell; River St., from Main St. to Jones St. Ordinances are being considered for the paving of other streets.

The City Council of Eau Claire, Wis., has adopted an ordinance providing for a macadam pavement without curb or gutter on Gilbert Ave., from Wilson St. to Farwell.

BRIDGES—STEEL AND CONCRETE

Arkansas.

⊙The Kansas City Southern Ry. Co. has placed contract with the Arkansas Bridge Co., Fort Smith, Ark., and 705-11 Finance Bldg., Kansas City, Mo., for supplying the steel and erecting 21 new steel bridges to replace lighter structures now in use on its main line between Kansas City and Port Arthur, Texas.

⊙The contract for the construction of three concrete bridges has been awarded by Judge C. M. Philpot, Pine Bluff, Ark., to M. S. Hasie, Jr., Dallas, Tex., at $3,475.

California.

✣Bids will be received until 11 a. m., July 5, by County Clerk, San Jose, Cal., for the construction of additions to the concrete abutments of the bridges over the Coyote Creek on Ford Road and Campbell Creek on Coffin Road. J. C. McMillan is County Surveyor.

✣Bids will be received until July 5, by Board of County Supervisors, Santa Barbara, Cal., for the construction of a 3-hinge reinforced concrete bridge over the Santa Inez River in San Lucas. The structure will have 5 arches and a 126 ft. span, total of 693 ft. Thomas & Post, Union Trust Bldg., Los Angeles, Cal., are engineers.

The Santa Fe Ry. Co. is planning the construction of a concrete bridge to replace the present structure spanning the Kings River at Reedley, Cal. It is also rumored that a new concrete bridge between Anwalt and Middle River has been authorized. This site would require a structure about 1½ miles in length. A. F. Robinson, Chicago, Ill., is bridge engineer.

Board of Butte County Supervisors, Oroville, Cal., has ordered the County Surveyor to prepare plans and specifications for the construction of a concrete bridge across the Feather river near Gridley in accordance with his recommendation. The cost of the work is not to exceed $30,000.

Delaware.

⊙The Levy Court at Wilmington, Del., has awarded the contract for the construction of a new bridge over the western arm of the Smyrna River to Joseph Anderson, Delaware City, Del., at $4,500.

The following bids were recently received by the New Castle County Levy Court, Wilmington, Del., for the construction of the new bridge to replace the old Roseville covered bridge: Nelson Meredith Co., $11,180, for arch bridge, or $11,650 for a girder bridge; Joseph Anderson, $14,900 for an arch bridge; Charles P. King & Co., $14,000; L. B. Jacobs, $14,357.60; J. J. Williams Co., $19,955; Luken Bridge Co., $13,700 and $13,510.

Illinois.

✣Bids will be received until noon, July 3, by John F. Murphy, Village Clerk, South Elgin, Ill., for the construction of a foot bridge across the Fox River in connection with road bridge at South Elgin. Bradish Webb is chairman of committee on Streets and Bridges.

✣Bids will be received at the Court House, Mt. Carroll, Ill., until 2 p. m., June 29, 1911, for the construction of one reinforced concrete bridge in Mt. Carroll Township, Carroll County. Sherman Meyers, Acting Town Clerk, Mt. Carroll, Illinois. Ashby bridge: Span, 40 ft.; roadway, 16 ft.; finished roadway to bottom of footings, 14 ft. Estimated amount of concrete in structure, 136 cu. yds. reinforcing steel bars, 15,954 lbs. Nearest railroad station, Big Cut Siding on the C. B. & Q. railroad, 1 mile. Gravel available in creek, 2 miles from bridge for 25 cts. per yd. Haul, 3,500 lbs. We know nothing of the quality of this gravel. Present structure, wood, A-truss of 28 ft. span with 2 12-ft. wood approaches. Ordinary water depth, 2 ft.; high water depth, 5½ ft. Excavation will be in sand, and bearing piles will probably be necessary. Work to be completed on or before October 1, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office, or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

✣Bids will be received at the Town Hall, Chadwick, Ill., up to 2 p. m., June 28, for the construction of five bridges in Fairhaven Township, Carroll County, as shown in table. H. F. Weber, Town Clerk, Chadwick, Ill. Gravel bank, 4½ miles from Adolph bridge; 2 miles from Sturman; 2½ miles from Lutz No. 2; 1 mile from Kemp and 1½ miles from Strauch, cost 30 to 50 cents per cubic yard. Not familiar with its character. Excavation will be in loam and clay. Present structure, wood. Work to be completed on or before October 1, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission, which may be seen at the Town Clerk's office or may be obtained upon application in writing, from the Illinois Highway Commission. Springfield, Ill.

✣Bids will be received at the bridge site of the Kemp bridge, 10 miles southwest of Stockton, in Pleasant Valley township, Jo Daviess County, up to 3 p. m., July 6, for the construction of new abutments and placing of old steel superstructure on same. M. A. Goodmiller, Town Clerk, Stockton, Ill. Span, 60 ft.; roadway, 16 ft.; finished roadway to bottom of footings, 20 ft.; wings, 20 to 26 ft. Estimated amount of concrete in abutments, 175 cu. yds.; reinforcing steel, 12,455 lbs. Gravel may be obtained ½-mile from bridge, free, in creek bed. Will have to be washed. Excavation will be in sandy loam to clay. West side average, 13 ft.; east side average, 8 ft. deep. Work to be completed on or before October 6, 1911. More detailed information may be had by an examination of the plans and specifications prepared by the Illinois Highway Commission which may be seen at the Town Clerk's office, or may be obtained upon application in writing, from the Illinois Highway Commission, Springfield, Ill.

⊙The contract for the construction of six reinforced concrete bridges in Patton township, Ford County, Ill., has been awarded to S. A. Christlieb, Paxton, Ill., $2,900. The contract for one 30-ft. steel bridge on steel legs with concrete backing was awarded to Burnham & Ives, Bloomington, Ill., at $475. Bids for the work were opened June 20.

⊙The Foundation Co., Chicago, has been awarded the contract for the substruction of the B. & O. Railroad bridge over the Calumet River at South Chicago. The work consists of six cylindrical piers to bedrock and one abutment.

⊙The contract for the construction of a reinforced concrete bridge in Santa Anna township, DeWitt County, Ill., for which bids were received until June 23 by R. S. McBridge, Town Clerk, Farmer City, Ill., has been awarded to C. A. Wever & Son, Clayton, Ill. The structure will have two spans and will be 80 ft. long.

⊙The contract for the construction of two reinforced concrete bridges in LaMoille township, Bureau County, Ill., has been awarded to J. L. Woodward, Ottawa, Ill., at $3,850. Bids were opened by J. H. Showalter, Town Clerk, LaMoille, Ill., on June 22.

Browning township has petitioned the Schuyler County Board of Supervisors at Rushville, Ill., for aid in the construction of the proposed bridge over Sugar Creek where it is crossed by the Bader-Rushville road. The cost of the work is estimated at $1,500.

The Clear Lake & Rochester Interurban, a subsidiary company of the Mississippi Valley Interurban Ry. Co., J. E. Melick, Springfield, Ill., President and General Manager, is planning the construction of a reinforced concrete bridge over the south fork of the Sangamon River to replace the old wooden structure.

Board of County Supervisors, Springfield, Ill., has adopted a resolution appropriating $897 for a bridge in Cotton Hill township over Brush Creek and $1,279 for a bridge over Buckhart Creek in Cooper township.

According to a report submitted by an engineer to the City Council of Waukegan, Ill., the construction of a concrete culvert over the South Genesee St. bridge would necessitate an expenditure of $45,000 while the necessary repairs to place the old structure in condition for light traffic would cost but $3,000.

The Highway Commissioners of Groveland township have petitioned the County Commissioners at Peoria, Ill., for aid to build a bridge across Lick Creek on the Elm Grove-Groveland township line. The cost of the improvement is estimated at $2,000.

Board of Supervisors of Stephenson County at Freeport, Ill., has passed resolutions for the erection of bridges in townships of Silver Creek, Kent and Jefferson. Bids for the work will be advertised soon.

City of Aurora, Ill., has submitted a proposition to the Chicago & Northwestern and the Aurora, Elgin & Chicago Railroads whereby the plans for the Illinois Ave. bridge will be changed so that the approaches will cross the tracks overhead providing the companies stand the extra expense of $40,000.

It is reported that the city of Waukegan is planning to erect a concrete bridge over one of the larger ravines in the city. Merton J. Douthitt is City Engineer.

Name	Span.	Rdy.	Cu. yds. concrete	Total lbs. steel		Location.
Adolph	24	16	90	8,164	8 mi.	S. W. Chadwick.
Sturman	4x1	20	31	2,080	5½ mi.	S. Chadwick.
Lutz No. 2	6	16	[illegible]	[illegible]	[illegible] mi.	S. E. Chadwick.
Kemp .	8x6	20	9	[illegible]	[illegible] mi.	S. W. Chadwick.
Strauch	12	16	43	1,469	2½ mi.	S. E. Chadwick.

Indiana.

✣Bids will be received until 2 p. m., July 5, by Board of Green County Commissioners, Bloomfield, Ind., for the construction of a bridge in Taylor township. C. H. Jennings is County Auditor.

✣Bids will be received until 2 p. m., July 5, by Board of Clinton County Commissioners, Frankfort, Ind., for the construction of four new bridges and repair of 12 old structures. C. F. Cromwell is County Auditor.

✣Bids will be received until 11 a. m., July 8, by Board of Wayne County Commissioners, Richmond, Ind., for the construction of a 24-ft. span concrete bridge in Green township north of Williamsburg; an 18-ft. span concrete bridge on Cart Road north of Richmond; a concrete floor on the Canal bridge at Hagerstowns; the approach of the Middleboro bridge. Demas S. Coe is County Auditor.

⊙The Board of County Commissioners, Indianapolis, Ind., has awarded the contract for the construction of the Capitol Ave. bridge over Fall Creek in Indianapolis, Ind., to Cleary-Kuert Construction Co., at $84,291. Paul Julian, Indianapolis, Ind., is County Surveyor.

Advices from Michigan City, Ind., state that the County Commissioners have decided upon the construction of a bridge over the Kankakee River across the old channel south of the new Wanbaugh Bridge, connecting Prairie township with Strake County. The cost of the work is estimated at $6,000.

Iowa.

⊙Board of Crawford County Supervisors, Denison, Ia., has awarded the contract for the construction of a new concrete bridge over East Boyer River on the road running north from the Northwestern track, to the Marsh Engineering Co., Des Moines, Ia., at $4,300. The structure will be 100 ft. long and 20 ft. wide with a 60 ft. concrete arch over the river.

⊙The contract for the construction of a steel bridge over the Iowa River at Iowa Falls, Ia., has been awarded by the Hardin County Board of Supervisors, Eldora, Ia., to the Lana Construction Co., Harlan, Ia., at $8,450. The structure will be 354 ft. long with 20 ft. roadway and two 5-ft. sidewalks. The floor will be of concrete. E. L. Marriage is County Auditor.

Final report and estimate of City Engineer, Clinton, Ia., for the construction of a concrete bridge wall on West Main St. and Fountain St., Lyons, has been filed with the City Council.

A petition is being circulated in Sioux City, Ia., asking the city council to order the construction of a bridge over the Great Northern Ry. Company tracks at 11th St. The railroad has expressed its willingness to assist in the improvement.

City Council of Des Moines, Ia., has considered favorably the proposition of constructing a bridge across Four Mile Creek at its intersection with East North St. and Frederick Hubbell Ave. The cost of the work is not to exceed $1,000.

Kansas.

✣Bids will be received until July 3, by Board of Leavenworth County, Leavenworth, Kan., for the construction of a stone arch bridge on Limit St.; also for the construction of a bridge over Tonganoxie Creek north of Tonganoxie and one over Little Stranger Creek in High Prairie township.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

✣Bids will be received up to noon, July 8, at the Court House in El Dorado for a bridge to be built between Butler and Harvey counties. M. L. Arnold, County Clerk, El Dorado, Kansas. Whitewater Bridge—Two reinforced concrete flat top spans 35 ft. each, 76 ft. over all, with a 16-ft. roadway; height of tier and abutments, 20 ft. Estimated amount of material in substructure 241.4 cu. yds. plain concrete; in superstructure, 88 cu. yds. concrete and 14,962 lbs. steel reinforcement. Excavation will be in clay and gravel. Foundations are to be carried 4 ft. below bed of stream. Nearest railroad station, Whitewater, 1 mile. Sand will have to be shipped from Wichita; cost at Whitewater, about $1.20 per ton. Crushed stone available at Augusta; cost at Whitewater, about $2.00 per ton. Plans and specifications are on file with the county clerk and copies of the same may be had by mailing $1.00 to the State Engineer, Manhattan, Kan.

Bids will be received up to noon, July 7, at the Court House at Alma for seven bridges to be built in Wabaunsee County. C. C. Stotler, Clerk, Alma Kansas. Fairchild Bridge —Reinforced concrete 25-ft. span; 16-ft. roadway; height of abutments, 15.5 ft.; estimated amount of material in substructure, 88 cu. yds. plain concrete; in superstructure, 27.5 cu. yds. concrete and 4,300 lbs. steel reinforcements; excavation will be in black loam and clay; foundation to be carried 3.5 ft. below bed of stream; nearest railroad station, McFarland, one mile; sand and crushed stone must be shipped by rail. Gross Bridge—Reinforced concrete top, stone abutment; 29-ft. 8-in. span; 16-ft. roadway; height of abutment, 17 ft.; estimated amount of material in substructure, 142 cu. yds. stone masonry; superstructure, 34 cu. yds. concrete and 6,336 lbs. steel reinforcements; excavation will be in clay; foundation is to be carried 5 ft. below bed of stream; nearest railroad stations, Paxico and Belvue, 6½ miles; crushed stone will have to be shipped by rail; sand available in Kaw River, 4 miles from bridge site; building stone can be had at about 12 cts. per cu. yd., 2 miles from bridge site. Todd Bridge—One stone abutment 35 ft. high; total amount of stone masonry 432 cu. yds.; excavation will be in clay; foundation to be carried 9 ft. 4 ins. below water; depth of water, ordinary flow, 4 ft.; nearest railroad station, Maplehill, 1 mile; old abutments contain enough stone to build probably 50 per cent of new one. Sand must be shipped by rail; building stone can be had near bridge site. Moggie Bridge—Reinforced concrete 20-ft. span; 16-ft. roadway; height of abutments, 6 ft. 4 ins.; estimated amount of material in substructure, 19.6 cu. yds. plain concrete; superstructure, 24.6 cu. yds. concrete and 3,800 lbs. steel reinforcement; foundations will be on rock stream bed; nearest railroad station, Halifax, on Santa Fe, 2 miles; stone and sand must be shipped by rail. McCrumb Bridge—Stone wing wall, 12 ft. long, 23 ft. high; estimated amount of stone masonry, 57.7 cu. yds.; foundations will be on rock stream bed; nearest railroad station, McFarland, 2 miles; sand will have to be shipped by rail; building stone can be had [illegible] Bridge—Two stone abutments, 10.5 ft. high; estimated amount of stone masonry 60.4 cu. yds.; excavation will be in clay and gravel; foundation [illegible] ft. below bed of stream; nearest railroad station, Admire, on Missouri [illegible] rail; building stone can be had near bridge site. Fink Bridge—Stone arch, 16-ft. span; 16-ft. roadway; estimated amount of stone masonry, 133.5 cu. yds.; foundations will be on rock stream bed; sand will have to be shipped by rail; building stone can be had at bridge site. Plans and specifications are on file with the county cleark and copies of the same may be had by mailing $1.00 to the State Engineer, Manhattan, Kansas.

Maine.

The contract for the construction of a concrete bridge at Mars Hill, Me., will probably be awarded to C. N. Taylor, Wellesley, Mass., at his bid of $3,745. The structure will be 66 ft. long with 20 ft. roadway and 4-ft. sidewalk. Bids were opened June 21.

Maryland.

The Baltimore County Highways Commission, Towson, Md., has awarded the contract for the construction of a draw for the new Back River bridge at Eastern Ave., to the York Bridge Co., York, Pa., at $4,495.

Michigan.

The Board of Schoolcraft township, Houghton County, Mich., has approved the plans prepared by the Joliet Bridge & Iron Co., Joliet, Ill., for a new bridge over Trap Rock River.

Minnesota.

City Council on the recommendation of H. P. Keller, Mayor, St. Paul, Minn., has instructed City Engineer to prepare plans and specifications for the construction of a new bridge over the Great Northern tracks at Lexington Ave. The cost of the bridge will be borne by the railroad company.

Mississippi.

✣Bids will be received until noon, July 3, by M. M. Spiars, County Clerk, Mayersville, Miss., for the repairing and placing of new draws in all bridges in Issaquena County over Steel's Bayou.

Montana.

W. A. Powers, Kalispell, Mont., has been awarded the contract for concrete bridge and pier work and the installation of culverts on the new government boulevard from Balton to Lake McDonald. The roadway will be 60 ft. wide.

Nebraska.

Board of County Supervisors, Beatrice, Nebr., has decided upon the construction of a 20-ft. concrete bridge two miles south of Beatrice.

Commissioners of Dodge County, at Fremont, Neb., have agreed to construct a new bridge over the Elkhorn River between Dodge and Washington Counties, providing the latter county will open a road connecting the bridge with the main road in that county.

State Engineer, Lincoln, Nebr., has received applications for state aid for the construction of bridges by the Supervisors of the following counties: Washington County, 200 ft. bridge over Elkhorn at Arlington, estimated cost, $10,000; Boone County, two bridges over Cedar River, near Cedar Rapids, estimated cost, $8,500 each; Boyd and Holt Counties, bridge over the Platte, five miles from Butte, 600 ft. long; cost not stated; Garden County, bridge over the North Platte River, near west line of county; estimated cost, $4,600; Morrill County, two bridges over the North Platte River, one at Bayard estimated to cost $15,000 and the other at Bridgeport estimated to cost $13,000.

New Hampshire.

✣Bids will be received until July 1, by Selectmen, Madbury, N. H., for furnishing a steel bridge. Specifications on file at the office of the selectmen.

New Jersey.

Residents Committee of Avenel, N. J., is to petition the Middlesex County Board of Freeholders for the construction of a new bridge over the Pennsylvania R. R. on Doug- [illegible] stroyed by fire.

The Committee on Rivers and Navigation of the Board of Trade, Newark, N. J., recently inspected the plans for the construction of the new bridge at Bridge St. George W. Tomkins is chairman of the committee.

Freeholders of Union and Somreset Counties, N. J., have approved the plans prepared by the county engineers for the construction of a new iron and steel bridge on Washington Ave., at a cost of $6,000. Elizabeth, N. J., is County Seat of Union County.

New Mexico.

In accordance with the recommendations of the Sidewolks and Bridge Committee, City Engineer W. A. Wilson, Roswell, N. Mex., has prepared plans and estimates for the construction of a new concrete bridge over Spring River at Eighth St. The improvement will cost about $3,000.

New York.

✣Bids will be received until noon, July 25, by C. E. Treman, Superintendent of Department of Public Works, Albany, N. Y., for the construction under Barge Canal Contract No. 86, of a portion of the bridge between the villages of Canajoharie and Palatine; and under Contract 88, of a portion of the bridge crossing the Hudson River at Schuylerville. J. A. Bensel is State Engineer.

✣Bids will be received until 8 p. m., July 5, by Town Board of Webster, N. Y., for the construction of a 16 ft. steel bridge on Lake Road west of Holt road, a 9½ ft. steel span on Lake Road near Forest Lawn and two 6-ft. spans on Webster road north of Webster. A. E. Volk is Town Superintendent.

⊙Town Superintendent of Highways, Hoosick Falls, N. Y., has awarded the contract for the construction of a gravel concrete culvert and fill at Geer Hollow to William P. O'Brien of Hoosick Falls, at $3,793.

⊙The Robbins-Ripley Co., 50 Church St., New York City, has been awarded the contract for the construction of a reinforced concrete bridge at Fort Hamilton, New York.

State Superintendent of Public Works, Albany, N. Y., has been asked to take up the matter of constructing a new bridge over the Erie Canal at Grand Island Ferry to replace the old structure at that place which is determined unsafe for the increasing heavy traffic.

The Erie Ry. Co. has petitioned the City Council of Elmira, N. Y., for permission to build a new bridge over its tracks at Washington St. to be from ⅛ in. to 2 ft. higher than the old structure.

The State Canal Board has approved plans submitted by State Engineer John A. Bensel, Albany, N. Y., for the construction of a lift bridge over the canal at Bridge St. in Phoenix, at a cost of $12,783.

At a recent election held by the town of Geddes, N. Y., it was voted to lay out a new highway from Solvay Village to the State Fair grounds, including the construction of a bridge over the tracks of the New York Central and West Shore Railroads, the cost of the structure being borne by the town and the railroad companies.

Legislature has passed an act granting the city of Fulton, N. Y., authority to construct a bridge over the river at Broadway. A public hearing was also held by the city council.

The Assembly at Albany, N. Y., recently passed a bill appropriating $50,000 for the use of the Superintendent of Public Works in constructing a bridge over the canal in Yorkville on Route 28 of the State Highway system, and for abolishing the present structure.

North Carolina.

As the result of a recent meeting of the North Carolina Corporation Commission it is believed that the construction of an overhead bridge over the Southern Ry. tracks at Lexington, will be ordered. The cost of the work will be about $12,000.

North Dakota.

✣[illegible] N. Dak., for the construction of the following bridges: 20 ft. wood bridge between sections 29 and 30, Empire Township, including wings; 22 ft. wood bridge between section 30, Empire Township, and section 25, Ayr Township, including wings; 22 ft. concrete bridge in the village of Tower City, with 10 ft. abutments and 8 ft. wings. Concrete driveway. Steel stringers; 20 ft. concrete bridge between section 36, Everest Township, and section 1, Maple River Township, with 7 ft. abutments and steel stringers. Concrete driveway. All work to be done according to plans and specifications to be on file at the office of the County Auditor, Addison Leech.

Ohio.

✣Bids will be received until [illegible] by Board of County Commissioners, [illegible] O., for the construction of a bridge on the County road southeast of Brigsdale.

✣Bids will be received until 11 a. m., July 12, by Board of County Commissioners, Cleveland, O., for the construction of bridge work per Report 2821, concrete bridge North Woodland Road in Cleveland Heights township, and a retaining wall on Irish road in Olmsted township. Frank Lander, County Surveyor, has plans and specifications on file at his office.

✣Bids will be received until 11 a. m., July 19, by Board of County Commissioners, Cleveland, O., for the construction of bridge work per Report No. 2822, Bridge extension, South Woodland Rd., Warrensville, twp. Report No. 2823, Bridge extension South Woodland Rd., Warrensville twp., in accordance with the form of contract and specifications to be furnished by Frank R. Lander, County Surveyor.

✣Bids will be received until noon, July 7, by Board of County Commissioners, Cincinnati, O., for the construction of a concrete bridge at the intersection of German and Compton Roards in Springfield township, Hamilton County. Work is to be done under Specifications No. 235. A certified check for $500 must be filed with each bid. Fred Dreihs is clerk of the board.

⊙Brookville Bridge Co., of Brookville, O., has been awarded the contract by the Board of County Commissioners, Dayton, O., for the construction of superstructure of Bridge No. 239 over Wolf Creek in Clay Township, Montgomery County. The contract price is $1,[illegible]. Bids were opened June 22.

Plans have been agreed upon by city officials of Youngstown, O., and representatives of the Erie and the Pittsburg & Lake Erie Railroads for the elimination of the grade crossings at Watt St., Walnut St., Wick Ave., Phelps St., Hazel St., Holmes St., North Ave. and Westlake's crossing, and for the construction of a bridge at Ardale St. A. W. Cravert is mayor and F. M. Lillie is city engineer.

A hearing was recently held by Col. John Mills, U. S. Engineer on the proposed construction of a new swing bridge at the Ashtabula Harbor, O., by the county.

Oregon.

Plans have been filed with the County Court, Jacksonville, Ore., for the construction of a new steel bridge over the Rogue River at Gold Hill. The cost of the structure as proposed will be about $7,000 or $8,000.

Engineers and surveyors are engaged in looking over the ground in the vicinity of the proposed site for the steel bridge of the Salem, Falls City and Eastern R. R., over the Willamette River at Salem, Ore.

Pennsylvania.

✣Bids will be received until 11 a. m., June 29, by Board of County Commissioners, Indiana, Pa., for the construction of bridges in Indiana County as follows: Concrete bridge over Little Yellow Creek, in Brushvalley Township, 40 ft. long and 14 ft. wide; concrete bridge at Hoovershurst, in Montgomery Township, 40 ft. long and 14 ft. wide; concrete girder bridge over Plum creek in Washington Township, [illegible] ft. long and 14 ft. wide, [illegible] as Bell's Schoolhouse Bridge. W. Ayers is clerk.

✣Bids will be received until July 1, by Board of County Commissioners, Harrisburg, Pa., for the repairing of two bridges, one at Middletown, Pa., over Swatara Creek, and the other one mile north of Elizabethville, over Wisconsin Creek. D. Lebo is clerk of the board.

The contract for the construction of a concrete arch bridge at Kutztown, Pa., has been awarded by the County Commissioners at Reading, Pa., to Carl B. Camp, Montrose, Pa., at $10,638. Bids for the work were opened June 20. A. L. Rhoads is County Auditor.

The Washington County Grand Jury, Washington, Pa., at a special meeting for consideration of a proposed bridge at West Brownsville received of the Fayette County Grand Jury its approval of the old site between South Brownsville and West Brownsville. The estimated cost of the new structure is between $250,000 and $300,000, which will be borne by taxpayers of both counties.

It is reported that the Pennsylvania R. R. is planning to dismantle the present bridge over the North Branch of the Susquehanna River at Sunbury, Pa., and replace it with a new 4-track structure. The old bridge, it is believed, will be shipped to Montgomery and erected at the site of the present bridge over the West Branch.

The Commissioners of Northampton County, Pa., have rejected the bid of Groman Bros. of South Bethlehem, Pa., for building the new pier in place of the one condemned at the north end of the bridge at Glendon over the canal and railroad tracks. The amount bid was $979.

South Carolina.

✣Bids will be received until 4 p. m., July 1, by Board of Newberry County Commissioners, L. Feagle, Chairman, Newberry, S. C., for the construction of a steel or iron bridge over Enoree River at Brazzleman's ferry. H. X. Holloway is Clerk.

Tennessee.

✣Bids will be received until 10 a. m., July 5, by S. G. Marshall, Supt. Turnpike Board, 405 Cole Bldg., Nashville, Tenn., for additional earth filling to widen approach to the Hyde's Ferry Bridge. The work will include about 35,000 cu. yds. Plans and specifications are on file at the office of the Board. A certified check for $1,000 must be filed with each bid.

✣The Fidelity Securities Corporation, which has contracted with the Nashville-Gallatin Interurban Ry. to construct and put in operation its line, is now in the market for one truss bridge, 100 ft. long, one through girder bridge, 60 ft. long, one deck girder bridge, 60 ft. long, and one deck guide bridge 65 ft. long. All purchases will be made by H. H. Mayberry, President, Stahlman Bldg., Nashville, Tenn. For further information see under railroads in this issue.

A hearing was held June 25, at Chattanooga, Tenn., by Maj. W. F. Harts, U. S. Engineer, Nashville, Tenn., to decide upon the site for the construction of the proposed new bridge over the Tennessee River at Chattanooga, Tenn.

Texas.

✣Bids will be received until [illegible] p. m., July 10, by George C. Baker, Jr., County Judge, Fort Bend County, Richmond, Texas, for the construction of two steel highway bridges across Brazos River, one near Thompson and the other near Orchard. Plans and specifications may be seen at the office of J. W. Maxcy, 1716 Dallas Ave., Houston, Texas, Consulting Engineer. A certified check payable to G. C. Baker, Jr., must be filed with each bid.

⊙The contract for the construction of wood pile bridge over Highland Bayou in Galveston County at the Mainland, has been awarded to Horton & Horton, Prince Theater Bldg., Houston, Texas, at $4,244. Bids were opened June 19 by John M. Murch, County Auditor, Galveston, Texas.

The Pleasure Pier Co., Port Arthur, Texas, has asked permission of the U. S. War Department to construct a drawbridge over the Beaumont-Orange Ship Channel.

Virginia.

✣Bids will be received until noon, July 3, by the Clerk, Rocky Mount, Va., for the construction of a bridge over Staunton River at Hardy's Ford between Franklin and Bedford Counties. P. St. J. Wilson is State Highway Commissioner, Richmond, Va.

Wisconsin.

City Council of Milwaukee, Wis., has under consideration the construction of a concrete bridge over the Kinnickinnic River at 5th Ave. The estimated cost of such a structure is $5,000.

⊙The contract for the construction of abutments for the new bridge at the Wilcox Marsh in Fort Winnebago has been awarded to Herman Kutzke of Portage, Wis., at $1,200.

Canada.

✣Bids will be received until noon, June 30, by William Purvis, Esq., Columbus, Ont., for the construction of a 36x20 ft. concrete arch bridge on the fourth concession East Whitby near Oshawa. Bowman & Connor, 36 Toronto St., Toronto, Ont., are Engineers.

✣Bids will be received until noon, June 30, by Clerk of Markham Township, Unionville, Ont., for the construction of a steel superstructure with concrete abutments for a concrete arch in the township of Markham near Thornhill. Bowman & Connor, 36 Toronto St., Toronto, Ont., are Engineers.

✣Bids will be received until July 5 by J. R. McNeillie, Clerk County of Victoria, Lindsay, Ont., for the construction of the following bridge work: Two steel spans with concrete floors, each 60 ft. over all, 14 ft. roadway between curbs, to carry a 10-ton roller at least, and to be approved by the Engineer of Highways of the Department of Public Works of Ontario; one 120-ft. span, same width and relative strength; three concrete piers to receive two 60-ft. spans; two concrete piers to receive one 120-ft. span; stone filling of approaches. Plans and specifications may be seen at the office of the County Clerk, Lindsay and Whitby.

✣Bids will be received until July 1, by William Milmini, Cathsart, Ont., for the construction of a steel bridge in Burford Township, Ont.

The Canadian Pacific Ry. has decided it necessary to remove the present bridge over the Bow River east of Calgary, Alta., and to replace it with a heavier structure capable of carrying four tracks. N. E. Brooks, Calgary, Alta., is Division Engineer.

IRRIGATION, DRAINAGE, LEVEES AND CANALS

Arkansas.

✣Bids will be received until noon July 3, by Commissioners of Drainage District No. 2, Jefferson County, Ark., at the office of J. B. White, Engineer of the Board, Pine Bluff, Ark., for the construction of a drainage canal, including about 200,000 cu. yds. in Jefferson County.

The Morgan Engineering Co., 610 Goodwyn Institute Bldg., Memphis, Tenn., has completed final plans for the improvement of Drainage District No. 9, of Mississippi County, Arkansas. A number of smaller districts have heretofore been organized in the county with the object of improving smaller areas. District No. 9 includes most of the smaller [illegible] 300 [illegible] miles. About 300 miles of main and lateral dredge ditches will be required, costing somewhat more than $1,000,000. This will probably be the largest single drainage contract which has been let in the Mississippi Valley. Bids will probably be called for within the next 60 days. It will take 15 dipper dredges about two years to complete the job. It is the intention of the engineers to divide the contract into several sections, leaving the various bidders to bid on one or more as they see fit. The engineers of the Morgan Engineering Co. have spent several months in making a complete topographic and drainage survey of the district.

The Cooks Slough Drainage District has been organized in Jackson County, Arkansas, to drain a part of the low flat lands of that county by means of a dredge ditch. The Morgan Engineering Co., of Memphis, Tenn., engineers of the district, will have plans and estimates completed in time for beginning the work during the fall.

Advices from Newport, Ark., state that the preliminary steps have been taken for the creation of a drainage improvement district, to provide for ditching Cow Lake from upper Richwoods, near the Cord Carter place to Bayou De View, near the county line. The ditch will be about 18 miles long, and will benefit land nearly a mile wide, at an estimated cost of $50,000. A levee will be necessary near the head of the ditch to prevent Cache River from running in. W. A. Bowman is making the surveys.

California.

Reclamation District No. 684 in San Joaquin County is to expend about $20,000 for raising a levee and cleaning ditches. Reclamation District 544 in the same county, will expend $15,000 for levee work. F. E. Quail, Stockton, is county surveyor.

Colorado.

At an election on June 19 the farmers of Phillips County by a vote of almost 2 to 1, decided to form an irrigation district, under the Old Fort reservoir system at Fort Morgan. It is proposed to take the water from a point three miles above Fort Morgan, carrying it down the river 20 miles, whence it will be conducted to land in Phillips county by canals. The district will cover 130,000 acres which heretofore has been farmed by the dry method. The project will cost about $4,000,000, and the land will be bonded for about $35 per acre to construct the reservoir and build canals. The reservoir will be constructed in the Platte river, with capacity of about 130,000 acre feet and be supplemented by another reservoir in Phillips county with capacity of 10,000 acre feet.

At a recent meeting at Fort Morgan the directors of the Morgan Ditch Co. were authorized to buy all obtainable water rights for use by the ditch company. It is now expected to spend $60,000 buying these water rights. Logan county individuals hold 121½ Jackson lake rights, and the directors plan to purchase these and add them to the supply for the Fort Morgan canal.

Denver parties are to construct a series of reservoirs and ditches to cost $29,000, to develop the country in the vicinity of Sligo, 40 miles east of Greeley.

The Secretary of the Interior has approved the application of the Routt County Development Co. for segregation of 12,000 acres along the Little Snake river valley in Moffat county, for reclamation and irrigation under the Carey act The application approved is supplemental to the main project of the company, which aggregates 50,000 acres.

Advices from Pueblo state that J. K. Dempsey, H. M. Shoup and Patrick Byrnes have been elected directors of the Pueblo Irrigation project which was authorized at a recent election, for the reclamation of about 50,000 acres of land in the western and northwestern parts of the county It is stated that bids will now be advertised for and after it is determined what the cost of the project will be, a second election will be held, at which the property [illegible] cide whether the bond issue shall be made. The estimated cost of the work will be $2,500,000. Old water rights on the western slope have been secured and water will be brought down the Arkansas river and stored in reservoirs near the county line.

Idaho.

Drainage District No. 1, Lemhi County, Idaho, has effected its organization and will start construction work as soon as the bonds can be floated. The project involves approximately 35,000 cu. yds. of excavation, and 7,450 ft. of 6 and 8-in. tile drains. The total length of canal is 20,000 ft.; the soil is a sandy loam over gravel. E. K. Abbott is secretary of the District, and McClung & Crandall are the engineers in charge. Their headquarters are Salmon City, Idaho. R. A. Hart, 1108 Boston, Bldg., Salt Lake City, Utah, was consulting engineer.

Florida.

✣Bids will be received until noon July 17, by Board of Orange County Commissioners, Orlando, Fla., for the improvement of St. Johns River ferry at Geneva Ave. crossing, at mouth of Lake Jessup, by deepening, widening and straightening cutoff channel north of present ferry channel and crossing; work consists of excavation 100x750 ft. an average of 7 ft. deep, approximating 20,000 cu. yds. B. M Johnson, clerk of Circuit Court.

Illinois.

✣Bids will be received until June 30, by B. T. Holmes, Town Clerk, R. F. D., No. 1, Streator, Ill., for the construction of 600 rods tile ditch and laying 400 rods of 10-in. tile; 80 rods of 8-in. tile; 40 rods of 6-in. tile; 80 rods of 5-in. tile.

•Bids were opened June 17 by J. V. Waddell, engineer, Vandalia, Ill., for tile drainage work in Pond Lily Drainage District, the contracts being let as follows: Vitrified tile, Stoneware Pipe Co., $1,360; red tile, Wm. E. Dee Clay Mfg. Co., $336; laying tile, W. C. Weaver, Vandalia, Ill., $1,290; hauling tile, W. C. Wiebener, Vandalia, $1.25 per ton.

Bids will be received until 10 a. m., June 29, at the office of A. J. Duggan, Carlinville, [illegible] 18-in. tile. Warren Engineering Co., Carlin- [illegible]

Iowa.

✣Bids will be received until 1:30 p. m., [illegible] ors, Spencer, Ia., for the construction of tile ditch No. 10, including the following quantities of tile: 4,100 ft. 24-in. salt glazed vitrified clay tile, 900 ft. 22-in. salt glazed vitrified tile, 4,350 ft. 20-in. salt glazed vitrified [illegible] salt glazed vitrified clay tile, 4,307 ft. 16-in. salt glazed vitrified clay tile, 6,450 ft. 15-in. salt glazed vitrified clay tile, 2,000 ft. 14-in. salt glazed vitrified [illegible] No. 1 hard burned clay tile, 5,197 ft. 8-in. [illegible] clay tile, 3,627 ft. 6-in. No. 1 hard burned clay [illegible]

✣Bids will be received at the office of County Auditor J. G. Devine, Dakota City, Ia., for the construction of Drain No. 37 in Norway township. J. L. Parsons, Humboldt, Ia., is Engineer.

•J. W. Burke, Mt. Pulaski, Ia., has been awarded the contract for the construction of a new channel for the Nodawa River in Page County. The work will require nearly 1,000,000 cu. yds. of excavation. The contract price was 6.68 cts. per cu. yd. Bids were opened June 14 by the county supervisors at Clarinda, Ia.

Bids will probably be asked next month for the construction of the Edwards Ditch in Palo Alto and Pochahontas Counties. The estimated cost of the ditch is $225,000. F. A. Malcolm, Rolfe, Ia., is engineer.

Kentucky.

•Contracts for ditch work for Jefferson County, bids for which were opened June 6, at Louisville, Ky., have been let as follows: Pond Creek ditch, R. H. & G. A. McWilliams, 39 Jackson Blvd., Chicago, at $27,150; Mill Creek ditch, C. H. Dickman, at $32,754.

Louisiana.

•Luinau Bros., Baton Rouge, La., have been awarded the following levee contracts by the Board of State Engineers; bids opened June 14: Jeter Levee, Bossier Parish, Red River, Left Bank, new levee; about 3,760 ft [illegible] yds., at 12.69 cts.; South Bank of Loggy Bayou Levee, Red River Parish, new levee, approximate contents, 35,000 cu. yds. at 22½ cts.

The Orleans Levee Board, Sidney F. Lewis, chief engineer, New Orleans, La., has decided to continue the proposed new levee work below Poland St., New Orleans, according to the lines laid down by the state engineers, and as far downtown as the finances will permit at this time.

The Smith-Newman Land Co., of Lake Charles, La., has been chartered with a capital stock of $2,500,000, and will buy and sell land, operate and maintain canals and do a general land and farming business. The stockholders are as follows: C. L. Smith, president, one share, $100; John Holmes, vice president, one share, $100; George W. Newman, treasurer, one share, $100; C. W. Stansell, secretary, 24,997 shares, $2,499,700.

Minnesota.

Bids were opened June 22 by Arthur A. Caswell, County Auditor, Anoka, Minn., for constructing the main and branch ditches of Judicial Ditch No. 1 of Anoka County. The only bidder for the work was Mulgrew-Royce Co., Dubuque, Ia. This bid was 12.85 cts. per cu. yd., or a total of $16,203. The estimated amount of work to be done and the estimated cost was as follows:

	Cu. yds.	Cost.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Branch No. 4	12,427.70	1,324.08
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible]

	Feet.	Cost.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Mississippi.

•N. C. McGinnis, Bement, Ill., has been awarded a contract at $72,193, for constructing a canal for the Tuscumbia River Drainage Canal Commission. The canal will be 22½ miles long, 26 ft. wide and 9 ft. deep, with 20 miles of laterals, 14 ft. wide and 5 ft. deep. About 20,000 acres of land will be reclaimed.

Missouri.

◉Bids were opened June 21 at the office of C. G. Weeks, County Clerk, Butler, Mo., by George Bird, engineer, for additional work in Drainage District No. 1 of Bates County; the work requiring the excavation of about 1,140,000 cu. yds. of material. The contract was let to Callahan Bros., Kansas City, Kan., at $123,990. The work includes deepening the old channel 10 ft and making new ditches.

Oregon.

A company has been organized for the purpose of developing Powder River land by an irrigation scheme. Ray Nye, Fremont, Neb., is president; W. A. Harmon, Red Boy, Ore., is also interested.

Tennessee.

Capt. Clarke S. Smith, U. S. Engineer, Memphis, has started 150 men at work at Sunflower Landing, Miss., rebuilding 5,000 lin. ft. of revetments that will cost $140,000.

Texas.

The Medina Irrigation Co., of San Antonio, has filed its articles of incorporation. The company has a capital stock of $1,000,000 and proposes to irrigate about 70,000 acres of land. The work is located about 25 miles west of San Antonio and it is understood that $6,000,000 will be expended for a dam across the Medina River and for canals. The incorporators are Thomas B. Palfrey, Charles C. Cresson and Franz Groos. Dr. F. S. Pearson, 20 Exchange Place, New York City, is behind the project and his holding company, the Pacific Securities Co., holds practically all of the stock.

The Neches Canal Co., of Beaumont, has filed an amendment to its charter increasing its capital stock from $100,000 to $500,000.

✣ indicates work now open for bids. ◉ indicates a contract let recently.

Texas.

[illegible] Court of Hidalgo [illegible] approved the petition [illegible] the formation of the Llano Grande Improvement District for the purpose of making improvements to prevent damage from flood water. Engineer Merriweather, chief engineer of the LaDonna Canal Co., has been appointed to report upon the feasibility, cost, etc., of the improvements desired. This report will be made within the next 40 days, after which an election to vote bonds for the purposes of the improvement may be held upon approval and due election notice. The proposed bond issue will amount to about [illegible] The [illegible] includes approximately 90,000 acres of land lying between Donna and the Cameron County line, in Hidalgo County, and the improvements contemplated consist in the clearing out of a wide channel through the depressions which overflow water leaving the Rio Grande between Mission and Mercedes has heretofore followed, to the Arroyo Colorado, whence it is carried into the Laguna Madre Bay.

Utah.

Bids were opened June 19, at the office of the U. S. Reclamation Service, Provo, Utah, for the construction of the Indian Creek Dike for the Strawberry Valley Project. The probable contractor is W. O. Morrison, 409 Cooper Bldg., Denver, Colo., at $107,091. The work is located about 35 miles northeast of Thistle, Utah, and includes 88,000 cu. yds. earthwork, 4,800 cu. yds. of rock, 12,100 cu. yds. of paving, 1,100 lin. ft. of drain tile and 1,700 cu. yds. reinforced concrete.

Canada.

✣Bids will be received until 5 p. m., July 1, by J. H. Jameson, Clerk of the township, Blanshard, Can., for the construction of the Youngson Creek drain in the township. Plans and specifications on file at the office of the Clerk.

WATER-WORKS

Alabama.

The city of Hartselle, Ala., has issued bonds for the installation of a waterworks system. The water will be secured from Short Spring, three miles from the town. X. A. Kramer, of Magnolia, Miss., is Engineer.

Arkansas.

✣Bids will be received until July 5 by City Council, Lake Village, Ark., for drilling deep well at water works. G. H. Bagby is recorder.

California.

⊙The Raissh Improvement Co., 109 Montgomery St., San Francisco, Cal., has been awarded the contract by that city for completing the laying of pipe for an auxiliary water system for $91,500.

⊙The American Construction Co., of San Francisco, Cal., has been awarded the contract at Vallejo, Cal., for the installation of a new reservoir on Fleming Hill, 20 miles north of the city. The contract price is $35,925.

Colorado.

⊙The City Council of Colorado Spr[illegible] Colo., has awarded the following contracts for furnishing labor and material for the construction of extensions to the water mains, for which bids were opened June 16. Hiram Phillips, 1000 Third Nat. Bank Bldg., St. Louis, Mo., engineer: J. S. Schwartz, city, for the valves (Eddy make) and lead, laying cast iron pipe, completing and constructing five manholes, laying steel pipe, taking up pipe; J. A. Clow & Sons of Chicago, Il., for special castings, motor operated valves; Hendrie & Bolthoff of Denver, reducing valves, steel pipe, 16,100 ft. of 16-in., 260 ins. thick, 12,300 ft. 12 ins. thick, 181 ins. thick, and hemp; American Cast Iron Pipe Co., Kansas City, Mo., valve boxes and cast iron pipe. Improvements estimated to cost $113,000.

State Engineer Comstock on June 24 investigated conditions at Silver lake, where the proposed Boulder, Colo., city water works will be constructed. The specifications call for a rock-ribbed structure. The Silver lake reservoir will cost approximately $150,000.

Georgia.

✣Bids will be received until noon, July 10, by City Council, Macon, Ga., for the construction of 5,003 ft. of 12-in. pipe, 3,140 ft. of 8-in. pipe, 5,363 ft. of 6-in. pipe; with hydrants, gate valves, tees, elbows and other special castings. Plans and specifications are on file with the city engineer, C. C. Huderson.

The city of Umadilla, Ga., has voted the issuance of bonds to the amount off $12,500 for the purpose of extending and improving its water works.

The citizens of Jesup, Ga., have voted the issuance of bonds to the amount of $25,000 for the construction of a water works.

Illinois.

✣Bids will be received until 8 p. m., July 1, by Board of Local Improvements, Homewood, Ill., for the construction of a connected system of cast-iron water supply pipes, together with all necessary fire hydrants, gate valves, valve boxes, crosses, tees, reducers, increasers and plugs. Plans and specifications are now on file in the office of the Village Clerk of said village in the Village Hall at Homewood, also at the office of the Engineer, James H. Thompson, 440 Dearborn street, Chicago, Illinois, and also at the office of the Secretary of the Board of Local Improvements at the Village Hall in Homewood, Cook County, Illinois.

⊙The following contracts for furnishing and laying water service pipes have been awarded by the Board of Local Improvements, Chicago, Chas. A. V. Standish, Secy.; S. Lincoln St., W. Madison St. S. Morgan St., W. 37th Pl.; Daniel Hardin, 3139 Indiana Ave. Vincennes Road, David Walsh, 6628 So. Chicago Ave.; Sawyer Ave. System, Jas. J. Renn, 367 W. Chicago Ave. Bids opened June 1.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded the contract for furnishing boiler tubes to the bureau of enginering to Jno. Mohr & Son, 349 Williams St. Contract price, $4,000. Bids opened May 3rd.

⊙L. E. McGann, Commissioner of Public Works, Chicago, Ill., has awarded to the McLaughlin Building Material Co., 145 La Salle St., the contract for furnishing sand to the bureau of engineering. Contract price, $1,090. Bids opened May 24.

Charles Noble, owner of the electric light plant in Farmersville, Ill., has been granted a franchise by the Village Trustees of that village for the installation of a waterworks. The water supply will be secured from Macoupin Creek.

The village of Tremont, Ill., will install a waterworks system. Bonds are being sold to the amount of $11,000 for the improvement, and bids are being asked for the sinking of an 8-in. well to the depth of about 150 ft.

The village of Stockton, Ill., will issue bonds to the amount of $4,500 for the purpose of extending and enlarging the present system of waterworks. Geo. Schroeder is Village President. Geo. H. Brown, Village Clerk.

The citizens of Herrin, Ill., on June 19 voted the issuance of bonds in the sum of $33,500 for the construction of a waterworks system.

The City Council of Hamilton, Ill., recently passed an ordinance for the issuance of bonds in the sum of $20,000, part of which will be used to construct a waterworks plant.

C. C. Bowman of Bloomington, Ill., has been awarded the contract by the city of Stamford, Ill., for the constructing of a system of waterworks for $5,800. The work will include a brick pumping station, pump pit, small system of mains, pumping machinery, and pneumatic tank. Melluish & Brayhill, 222-223 Unity Bldg., Bloomington, Ill., are Engineers.

Indiana.

⊙The city of Evansville, Ind., has awarded the contract for furnishing the valves for the filtration plant to the Rensselaer Valve Co. of Troy, N. Y., and the contract for furnishing approximately 250 tons of cast iron pipe and specials to the U. S. Cast Iron Pipe Co. Alvord & Burdick, 1417 Hartford Bldg., Chicago, Ill., are engineers.

Iowa.

✣Bids will be received until July 6, by H. C. Marmon, Town Clerk, Gilmore City, Ia., for furnishing the necessary labor and material for the construction of a complete water works system. C. W. Roland Co., Des Moines, Ia., are Engineers. The estimated cost of the work is $15,000.

The property owners of the town of Prairieburg, Ia., are considering the advisabilty of constructing a waterworks system in that town and are arranging for a special election some time in July to vote on the proposition. The estimated cost of the system is $4,000.

Kansas.

✣Bids will be received until 6 p. m., July 5, by Della Hall, City Clerk, Burlington, Kan., for the furnishing of all material, machinery and labor for the construction of a water works extension and well. Official advertisement will be found elsewhere in this issue.

Carl Stromquist, Supt. Water & Light Dept., Coffeyville, Kan., has prepared plans for improvements to the waterworks system, estimated to cost $100,000. The work will include additional mains, and a filter plant.

Louisiana.

The citizens of Lake Providence, La., on June 16 defeated the proposition to levy an additional 5 mill tax to aid the municipal water and light plant.

The Municipal Light & Water Co., of Tallulah, La., has purchased an additional 1,000 ft. of 4-in. water mains to extend the water mains to supply the new Tallulah high school building.

The Town Council of Kentwood, La., has been petitioned to call an election for the purpose of voting on the issuance of bonds to the amount of $50,000 for a water works and a sewer system.

Maryland.

The citizens of Delmar, Md., on June 16 voted the issuance of bonds for the construction of a waterworks system.

Michigan.

⊙At a cost of approximately $60,000 the intake pipe of the Marquette, Mich., city waterworks is to be extended more than half a mile further out into Lake Superior and to a point where the depth of the water is over 75 ft. The contract has been awarded to John B. Wanless of Duluth, Minn., for $58,075, including all material.

Minnesota.

⊙J. G. Jervbek of Paynesville, Minn., has been awarded the contract by that city for the extension of the water mains for $1,550. The mains will be extended 1,600 ft., 8-in. mains. Bids were opened June 24.

Missouri.

✣Bids will be received until noon, July 7, by Board of Public Improvements, St. Louis, Mo., for detailed drawings, constructing and erecting in place, exclusive of foundations, at Low Service Pumping Station, Chain of Rocks, two steam turbine driven centrifugal

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

pumping units, complete with condensing apparatus and all appurtenances.

✣Bids will be received until 7 p. m., July 8, by City of Milan, Mo., for the construction of an earth dam, including 25,000 cu. yds. furnishing and laying approximately 18,312 ft. of 4, 6 and 8-in. cast-iron pipe, fire hydrants, valves, etc. Official advertisement will be found elsewhere in this issue.

⊙The Board of Public Improvements of St. Louis, Mo., has awarded the contracts for furnishing cast iron coated water pipes, cast iron coated special castings, stop valves, post fire plugs and post fire plug top parts, to be delivered at the city yards, as follows: U. S. Cast Iron Pipe Co., water pipe, $74,907; Bessemer Foundry & Machinery Co., special castings, $12,418; Roe Stevens Mfg. Co., stop valves, $9,188.

⊙The Board of Fire & Water Commissioners of Kansas City, Mo., has awarded the contract for constructing a building for the city's hypochlorite plant at Quindaro to Flanagan Bros., for $7,100.

An election was held in Shelbina, Mo., June 27, for the purpose of voting on the issuance of bonds to the amount of $74,000 for the installation of a waterworks and a new light plant, to be run in conjunction with the water plant, and $10,000 for trunk line sewers and septic tanks.

The Interurban Water Co., of Independence, Mo., has been incorporated with a capital stock of $50,000. The incorporators are: M. A. Gallagher, Thomas Madden and Claud S. Gossett.

Montana.

⊙Lindstrom & Oren have been awarded the contract by the City Council of Lewistown, Mont., for the installation of the waterworks system for $15,703.

Nebraska.

It is reported that the citizens of Louisville, Neb., on June 13, voted the issuance of bonds for the installation of a waterworks system. C. A. Richey is Chairman of the Board of Trustees. D. K. Barr is Village Clerk.

New Jersey.

✣Bids will be received until 11 a. m., July 10, by J. J. Albertson, County Engineer, Camden, N. J., for pump house, gasoline engine, foundation, gasoline tank pump, connections and standpipe in position. Generator with foundation and electrical equipment in position. Plans and specifications may be obtained of F. W. George, Court House, Camden, N. J.

New York.

The State Water Supply Commission of New York has denied the application of the Monroe County Board of Supervisors for the regulation of the Genessee River by the construction of a reservoir at Portage at a cost of about $5,000,000. Rochester is the county seat of Monroe county.

It is proposed to expend $45,000 for a waterworks system in Middleport, N. Y. The city also contemplates the installation of a sewer system at a cost of about $25,000.

Consulting Engineer George W. Fuller of New York City has submitted his report to the Water Commissioners of Buffalo, N. Y., as to the proposed sterilization of the city water supply. The report calls for a structure 20 ft. wide and 60 ft. long adjacent to the old pumping station with necessary solution tanks, stirring arrangements and device for properly mixing the solution of hypochlorite of lime with the water; also a small laboratory inside the building is figured at $27,000.

North Carolina.

⊙The Water Board of Concord, N. C., has awarded the following contracts in connection with the water works system. The Clarendon Construction Co., Wilmington, N. C., $26,000 for the completion of the filter plant; Glamorgan Pipe & Foundry Co., Lynchburg, Va., $13,500, for furnishing cast-iron pipe. Gilbert C. White of Durham, N. C., is Engineer.

North Carolina.

✣Bids will be received until June 30 by city of New Bern, N. C., for the construction of two wells for the water works department. Thomas F. McCarthy is chairman of the Water and Light Committee.

Ohio.

✣Bids will be received until noon, July 3, by Director of Public Service, Cincinnati, O., for the furnishing and delivering of sulphate of iron for the filtration plant of the water works department. J. J. Wenner is clerk.

✣Bids will be received until Noon, July 25, by H. H. Canfield, Clerk of the Village of Cleveland Heights, O., for furnishing the necessary labor and material for the construction of a 10-in. water main in Taylor Road from Mayfield Road to the Euclid Heights Boulevard. Plans and specifications may be seen at the office of the clerk or at the office of the Pease Engineering Co., 921 Williamson Bldg., Cleveland, O.

✣Bids will be received until Noon, July 5, by Director of Public Service, Cleveland, O., for furnishing and delivering pipe and special castings. I. O. Hoffman is Secretary.

✣Bids will be received until Noon July 5, by Director of Public Service, Cleveland, O., for furnishing and delivering a crane framework and track at the Kirtland Pumping Station of the Water Department. I. O. Hoffman is Secretary.

✣Bids will be received until Noon, July 7, by Director of Public Service, Cleveland, O., for furnishing and delivering lubricants to the Water Department of Cleveland. I. O. Hoffman is Secy. of the Department.

✣Bids will be received until Noon, July 5, by Department of Public Service, Dayton, O., W. A. Budroe, Secy., for sanitary sewer and water connections on the following-named streets and avenues: Herman Ave., from Keowee St. to Herman Ave. bridge; Burns Ave., from Warren St. to Main St.; Keowee St., from Ewing St. to C., H. & D. R. R.; Valley St., from M. & E. canal to Findlay St.; Webb St., from Third St. to Second St.; Huffman Ave., from Third St. to Overlook Ave. The estimated number of sanitary sewer service connections is 318, and the estimated number of water service connections is 212. The same to be done in accordance with the plans and specifications therefor on the file in the office of the city civil engineer.

The City Council of Springfield, O., has authorized the purchase of 11 and a fraction acres from William Inman for the purpose of extending the waterworks system and secure a better suply of water. M. J. Bahin is City Engineer.

The citizens of Bedford, O., have just voted the issuance of bonds to the amount of $38,000 for the installation of water mains. The source of supply will be secured from the city of Cleveland.

Oklahoma.

⊙Nelson Bros. have been awarded the contract by the city of Nowata, Okla., for the construction of extensions to the water works system for $62,110. The work includes pump and boiler, pump and boiler engines, water line from the plant to town and distribution system in city. T. C. Hughes of Tulsa, Okla., is engineer. Bids were opened June 19.

The City Council of Bennington Okla., has ordered the installation of a waterworks system, estimated to cost $20,000, and 12 blocks of 12 ft. wide and 16 blocks of 4 ft. wide cement walks.

Mayor Joe Denton of Sapulpa, Okla, has called an election for June 28 for the purpose of voting bonds to the amount of $75,000 for the waterworks and the extension of the mains in the city in order to serve every section of the city.

The City Commissioners of Oklahoma City, Okla., contemplate the construction of another dam, about 15 ft. high, to be built near the waterworks. Engineer's figures show that the minimum flow of the river is 50,000,000 gal. per day. Of this amount, the present dam and the water system is consuming about 10,000,000 gals. daily. The new dam will be of sufficient size to utilize at least one-third or one-fourth of the flow. Wm. C. Burke is City Engineer.

The Western Engineering Co., of Oklahoma City, Okla., is preparing plans for the installation of a waterworks and electric light plant in Custer, Okla. The work is estimated to cost $40,000.

Oregon.

⊙The Water Board of Portland, Ore., Frank T. Dodge, superintendent, has awarded the contract for furnishing 200 fire hydrants to the Caldwell Machinery Co. of Portland at $39.20 each and Gilbert Hunt Co. of Walla Wala for $38.25. Bids were opened June 13.

The Water Board of Portland, Ore., Frank T. Dodge, Supt. of the Department, has received the following bids for 200 fire hydrants: Gilbert Hunt Co., $7,650; Ludlow Manufacturing Co., $8,000; Eddy Valve Co., $7,700; R. D. Wood & Co., $8,140; Caldwell Machine Co., $7,840, and Phoenix Iron Works, $8,000.

Plans have been prepared for the installation of a waterworks system for Hermiston, Ore., estimated to cost $49,000. The work will include an elevated tank distributing system and pumps.

Pennsylvania.

Plans and specifications are being prepared by Joseph H Brillheart, 34 N. Seventh St., Bethlehem Pa., for an additional water supply for the village at Glen Rock, Pa.

South Dakota.

✣Bids will be received until 9 a. m., July 11, by Board of Commissioners, Sioux Falls, S. Dak., for the construction of a reinforced concrete well and motor house for the municipal water works system. Lewis Larson is city auditor. L. P. Wolff, St. Paul, Minn., is consulting engineer. Official advertisement will be found elsewhere in this issue.

✣Bids will be received until 9 a. m., July 11, by Board of County Commissioners, Sioux Falls, S. Dak., for the construction of a reinforced concrete wall and motor house for the municipal waterworks system in accordance with plans prepared by L. P. Wolff, Consulting Engineer, St. Paul Minn. Official advertisement will be found elsewhere in this issue.

The Town Trustees of Bowdle, S. Dak., has been petitoned to call a special election to submit to the voters the proposition of incorporating Bowdle as a city. If the proposition carries it is planned to install a municipal system of waterworks.

A movement has been inagurated in Winner, S. Dak., to have a municipal system of waterworks installed. A special election will be called to vote bonds for the improvement.

The Missouri Valley Engineering Co., 408-412 Western Nat. Bank Bldg., Mitchell, S. Dak., has been awarded the contract for the design and superintendence of construction for a complete waterworks system for the town of Inwood, Ia. The estimated cost is $16,000. Work will be started soon.

Tennessee.

The city of Dyersburg, Tenn., has sold bonds amounting to $30,000 to improve the water and light plant.

Texas.

Bonds to the amount of $18,000 have been voted by the tax payers of Palacios, Tex., for the installation of a water works system.

The citizens of Melissa, Tex., have subscribed $5,050 to the stock of the Melissa Waterworks Co. The following directors have been elected for the ensuing year: Dr. W. S. Wysong; A. J. Cline; H. E. Morgan, J. L. Gibson, and J. S. Heard. The contract for sinking a deep well, purchase of machinery for pumping, erect steel standpipe and lay water mains will be let as soon as practicable.

The city of Hearne, Tex., will sell bonds July 10 for the construction of a water works.

The City Council of Huntsvile, Tex., has placed the matter of sinking another well at the city pumping station in the hands of the water commission. The present plant will be duplicated and a brick house built over the entire place. T. C. Gibbs is Mayor.

The Alvin Water, Light & Ice Co., of Alvin, Tex., has been granted a charter. The following directors for the first year have been

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

[illegible] W. [illegible] Neville, M. S. [illegible], H. Wallis, F. L. King, T. P. Majors, Z. C. Sedwick, H. P. Rhodes, S. Jones and R. H. King. C. Z. Sedwick is president; M. S. French vice president, and T. P. Majors, secretary and treasurer.

Virginia.

✣Bids will be received until [illegible], July 14, by John T. Hume, Treasurer, Southern Branch N. H. D. V. S. National Soldiers' Home, Va., for the necessary labor and material for installing electric driven sewerage pumps in buildings Nos. 19 and 60.

⦿R. P. Denby has been awarded the contract by the Board of Control of Norfolk, Va., for the installation of a water main on Pulaski St., for $1,138.

The citizens of Rocky Mount, Va., have voted the issuance of bonds to the amount of $50,000 for the installation of a water works, sewer system and an electric light plant. [illegible] W[illegible] Birlock of Kansas City, Mo., has been retained to prepare specifications.

Wisconsin.

✣Bids will be received until 2 p. m., June 29, by Board of Public Works, Oshkosh, Wis., for the construction of a portion of Stringham creek storm and sanitary sewer.

⦿Thomas E. Wooley of La Crosse, Wis., has been awarded the contract by the Board of Public Works of that city for the laying of the new $70,000 extension of the water system for $33,157.

The city of Rhinelander, Wis., is issuing bonds to the amount of $55,000 for the installation of a waterworks system. Gust Swedberg is City Clerk.

The village of West Milwaukee, Wis., has decided to lay water mains throughout the village and have the same ready for service by Oct. 1. About $8,000 will be expended for this work. E. J. Meisenheimer is president of the Village Board.

Canada.

✣Bids will be received until noon, July 13, by chairman of the Water Works Commission, James St., St. Catherines, Ont., for the construction of a tunnel in sections as follows: Section A—4,200 ft. of rock tunnel, 5x8 ft.; Section B—Excavation and pipe laying 5,000 ft. of 24 and 30 in. cast iron pipe, 36-in. c. i. intake pipe, concrete intake and valve chambers, building auxiliary reservoir; Section C—Excavation and pipe laying 15,000 ft. of 24-in. cast iron pipe. Alexander Milne is superintendent of the water works.

⦿W. H. Weller of St. Catharines has been awarded the contract to build the flume, wheel pits, foundation and tail race of Wellanad, Ont.'s, new waterworks plant. The contract price is about $40,000.

SEWERAGE AND GARBAGE DISPOSAL

Arizona.

The City Council of Phoenix, Ariz., has rejected the bid of the Hamilton Bros.' Construction Co., of Chicago, Ill., for the construction of the municipal sewer system for which $400,000 bonds were voted. Bids will [illegible] advertised for again.

Arkansas.

The citizens of Clarksville, Ark., contemplate the installation of a sewer system, water works and an electric lighting plant. M. Griffin O'Neil of the O'Neil Engineering Co., of Dallas, Tex., has estimated that sanitary sewers could be put in for $25,000, waterworks for $30,000 and electric lights for $20,000.

California.

⦿The Board of Public Works of Oakland, Cal., James W. Nelson, Secy., has awarded William Heafey of that city the contract for the construction of a new sewer in Lyon Ave., Allendale, for $11,348. Fred C. Turner is City Engineer.

The following bids were submitted to the Board of Public Works of Oakland, Cal., on June 17 for the construction of 78 miles of sewer for the annexed districts; J. W. Nelson, clerk: Oakland Sewer District No. 1—Michael Heafey, $97,184.56; Chambers & Heafey, $79,132.18; Bates, Borland & Ayres, $109,945.77; C. D. Vincent, $79,411.04. District No. 2—Bates, Borland & Ayres, $82,412.28, alternate, $76,648.04; Contra Costa Construction Co., $77,877.79, alternate, $80,119.66. District No. 3—Contra Costa Construction Co., $106,230.05; Bates, Borland & Ayres, $116,589.04 Williams & Belser, $121,905.82; alternate, $119,807.77; C. D. Vincent, $102,126.08, alternate, $100,267.58. District No. 4—Contra Costa Construction Co., $129,261.43; Williams & Belser, $140,015.25, alternate, $142,200.30; Bates, Borland & Ayres, $135,922.67; C. D. Vincent, $110,625.72, alternate, $108,730.62; Western Engineering & Water Supply Co., $136,775.53.

At a recent mass meeting of the citizens of Hemet, Cal., Engineer Lathrop of Los Angeles, presented data bearing on the subject of a sewer system. The Board of Trustees has called an election for July 5 to vote on the proposition of issuing bonds to the amount of $44,000 to install a system.

Advices from Los Angeles, Cal., state that the Southwest Land Co., which recently purchased the New Vermont Square, formerly known as the Dryden ranch, at the corner of Santa Barbara and Western Aves., will make improvements aggregating $250,000. Necessary proceedings are now before the City Council for the laying in New Vermont Square of 10 miles of cement walks, 10 miles of street curbs and 5 miles of sewer.

Florida.

⦿The City Council of St. Petersburg, Fla., has awarded the contract [illegible] construction of a sewer system in the city to L. B. Cooper for $.55 per ft., for 6-in. pipe, $70 for flush tank and $40 for manholes.

Georgia.

The citizens of Winder, Ga. on June 15 voted the issuance of bonds to the amount of $21,500 for the construction of sewers. It is proposed to have the sewers completed by Nov. 1.

The City Council of Columbus, Ga., has taken up the matter of installing a new and complete system of sanitary sewers. A committee has been appointed by the Mayor to investigate the cost and other details. Plans were prepared several years ago for a system by expert engineers.

Iowa.

✣Bids will be received until 2 p. m., July 1, by E. W. Smale, City Clerk, Sheldon, Ia., for the construction of a sanitary sewer system. Plans and specifications are on file at the office of the clerk.

⦿The Lewis & Leader Co. has been awarded the contract by the City Council of Sioux City, Ia., for the construction of the Perry Creek conduit, which is to take care of the flood water near the Dymond-Simmons Hardware Co.'s warehouse. The contract price is $13,646.

⦿Bids were opened June 13 by the city of Clinton, Ia., R. C. Hart, City Engineer, for the completion of sewers in District No. 4, the contract being awarded to Green & Son, Appleton, Wis., as noted in our June 21 issue. The itemized bids received on the work were as follows: (1) Standing for the City Engineer's estimate. (2) For bid of Greene & Son. (3) Independent Construction Co., Davenport, Ia. (4) Lyttle Construction Co., Davenport, Ia. (5) Dearborn & Jackson, Cedar Rapids, Ia. (6) Carey & Son, Clinton, Ia. (7) Rink & Schnall, Clinton, Ia

Division A.	Size. Ins.	Length Ft.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1½-ring brick sewer ..	30	[illegible]	$ 4.62	$ 4[illegible]	$ 4.60	$ 5.00	$ [illegible]	$ [illegible]	$ [illegible]
Vitrified pipe	[illegible]	[illegible]	4.00	4.50	4.10	5.00	5.50	4.00	5.00
Vitrified pipe	[illegible]	[illegible]	2.95	3.80	3.05	4.00	3.75	2.95	3.50
Vitrified pipe	24	1,[illegible]	2.12	2.15	2.10	2.00	2.00	2.12	2.50
Vitrified pipe	[illegible]	[illegible]0	1.7[illegible]	2.05	1.80	2.00	1.50	1.30	2.30
Vitrified pipe	18	1,[illegible]	1.45	1.45	1.50	1.50	1.75	1.45	1.90
Vitrified pipe	1[illegible]	1,715	1.22	1.16	1.20	1.50	1.40	1.22	1.60
Vitrified pipe	[illegible]2	4,576	.99	.90	1.00	1.00	1.15	.99	1.40
Vitrified pipe	10	3,605	.89	.80	.85	1.00	1.25	.89	1.20
Catch basin pipe	10	3,075	.60	.50	–	.66	.50	.60	1.69
Rock excavation, cu. yds.		[illegible]	2.25	[illegible]	2.50	4.00	3.50	3.25	3.00
Manholes		[illegible]	32.00	36.00	32.00	40.00	30.00	32.00	40.00
Catch basins		31	28.00	36.00	27.00	30.00	30.00	28.00	32.00
Inlet basins	..	63	26.00	14.00	25.00	30.00	30.00	26.00	29.00
Totals			$ 40,623	$ 40,6[illegible]	$ 41,113	$ 49,97[illegible]	$ [illegible]	$ 41,[illegible]	$ 51,148
Division B.									
2-in. ring brick ...	1[illegible]	[illegible]	$11.50	$12.00	$15.00	$12.00	$16.50		
1½-in ring brick .		500	9.00	12.00	14.00	12.00	16.50		
[illegible]	42	400	8.8[illegible]	12.00	13.00	10.00	14.25		
Vitrified pipe	36	[illegible]	6.75	9.00	12.00	9.00	14.00		
Vitrified pipe	30	810	6.25	7.30	10.00	8.00	10.90		
Vitrified pipe	24	8[illegible]	3.23	1.8[illegible]	4.00	4[illegible]	[illegible]		
Vitrified pipe	1[illegible]	831	2.12	3.20	[illegible]	3.00	[illegible]		
Vitrified pipe	15	840	1.8[illegible]	3.00	[illegible]	[illegible]	2.50		
Vitrified pipe	1[illegible]	[illegible]	1.34	2.15	1.75	1.50	1.75		
Vitrified pipe		740	1.05	1.50	1.25	1.20	1.10		
Catch basin pipe	10	[illegible]	.60	.60	.60	.60	.60		
Rock excavation, cu. yds.		[illegible]	[illegible]	2.50	5.00	5.00	6.00		
Manholes		6	[illegible]2.00	36.00	35.00	50.00	33.00		
Catch basins		[illegible]	[illegible]8.00	36.00	27.00	30.00	33.00		
Inlet basins		[illegible]	26.00	14.00	25.00	30.00	33.00		
Totals			$ 55,221	$ 64,2[illegible]	$ [illegible]	$ 78,[illegible]	$ [illegible]		
Division C.									
Vitrified pipe	1[illegible]	660	$ 1.18	$ 1.15	[illegible]	$ 1.[illegible]0	$ 1.25	$ 0.70	$ 1.78
Rock excavation, cu. yds.		[illegible]	2.25	2.60	3.50	4.00	3.20	3.25	2.00
Manholes		[illegible]	32.00	40.00	[illegible]	40.00	30.00	35.00	40.00
Totals			$ 1,71[illegible]	$ 1,[illegible]	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible],014
Division D.									
Vitrified pipe	30	[illegible]	[illegible]	$ 1.20	[illegible]	$ [illegible]	$ 3.75	$ 4.00	$ [illegible]
Vitrified pipe	[illegible]	[illegible]	[illegible]	1.60	2.50	2.00	1.50	1.75	3.00
Vitrified pipe	18	1,093	[illegible]	1.50	1.75	2.00	1.25	1.50	2.50
Vitrified pipe	15	438	[illegible]	1.50	1.50	1.50	1.00	1.25	2.00
Vitrified pipe	12	1,571	1.18	1.30	1.25	1.[illegible]	.90	1.00	1.50
Vitrified pipe	10	[illegible]	[illegible]	1.10	1.00	1.00	.75	.70	1.25
Catch basin pipe	10	[illegible]	.60	.60	.60	.60		.60	.70
Rock excavation, cu. yds.		2,900	[illegible]	2.60	2.50	3.00	3.25	3.25	2.00
Manholes		14	32.00	36.00	32.00	30.00	30.00	32.00	40.00
Catch basins		11	28.00	36.00	27.00	30.00	30.00	28.00	32.00
Inlets			[illegible]	14.00	[illegible]		30.00	26.00	30.00
Totals			$ [illegible]	$ 18,[illegible]	$ 19,101	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]
Grand totals			$1[illegible]	$1[illegible]	$11[illegible]	$1[illegible]	$1[illegible]	$ [illegible]	$ [illegible]

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

◉C. F. Brown has been awarded the contract by the City Council of Dubuque, Ia., for the construction of sanitary sewer in Belmont St., from Rose to West 14th, at $1.62 per lin. ft., for 8-in. tile pipe, and $30 each for manholes.

◉The following contracts for constructing sewers have been awarded by the Board of Local Improvements, Chicago, Ill.: Alley north of Second Ave., Jno. Tertilli, 518 W. Taylor St., Bell Plaine Ave., Ridgeway Ave. and 104th St., Carmini Roberts, 565 W. Taylor St., S. Morgan St. and Muskegon Ave., Chestnut Fosco, 814 Des Plaines St. Coles Ave., John W. Brunt, 2447 E. 74th St., N. 48th Ave. and South Park Ave.; Jas. Healy, 7738 Mound Ave.; Oglesby Ave., Fred Seip, 3057 E. 92nd St. Bids opened June 14.

The citizens of Cedar Rapids, Ia., have voted the issuance of bonds to the amount of $55,000 for the construction of storm sewers. P. P. Smith is City Engineer.

Illinois.

✤Bids will be received until 2 p. m., July 1, by Board of Local Improvements, Aurora, Ill., for the construction of sewers in Districts Nos. 7 and 8, including approximately 4 miles of vitrified tile pipe and one mile of concrete in the first and 4 miles of vitrified tile pipe in the second. Myron J. Tarble is City Engineer.

The Board of Local Improvements of Alton, Ill., has under consideration two improvement enterprises, involving the building of two trunk sewer systems. One, it is pronosed, will inclose Plasa Creek in the west end of the city, and cover over an open drain. The other will inclose Shields Branch in the east end.

The City Council of Hamilton, Ill., recently passed an ordinance providing for a $20,000 bond issue for the purpose of installing a water works and sewer system. The voters of the city will shortly be asked to vote upon the proposition.

The Board of Local Improvements of Danville, Ill., has ordered that the sanitary sewer proposed to be run from English St. to Rose- [illegible]

Indiana.

City Engineer W. H. Rights of Columbus, Ind., has been instructed to prepare an estimate for the proposed Maple Grove sewer. The sewer would empty into Haw Creek.

The Board of Public Works of Terre Haute, Ind., has ordered City Engineer Donn M. Roberts to employ five extra draftsmen to complete the plans and specifications for the 55 sewers in the various wards.

Kentucky.

✤[illegible] 7, by Commisisoners of Sewerage, 605 Equitable Bldg., Louisville, Ky., for the construction of the Long Avenue Sewer, Contract No. 81. The work consists mainly of the construction of 5,245 ft. of vitrified pipe sewer, ranging in size from 10-in to 22-in.; average depth of cut 8.5 ft.; about 300 cu. yds. rock and 45 cu. yds. concrete. Each bid must be accompanied by a certified check for at least 7 per cent of the total amount of the bid. Plans and specifications may be seen at the office of Harrison P. Eddy, Consulting Engineer, 14 Beacon St., Boston, Mass., or at the office of the Commissioners of Sewerage. P. L. Atherton, Chairman; Chas. P. Weaver, Secy. and Treas.; J. B. F. Breed, Chief Engineer.

Louisiana.

The Town Council of Kentwood, La., has been petitioned to call an election for the purpose of voting a bond issue of $50,000 for the construction of a waterworks and sewerage system.

Maine.

The city of Waterville, Me., contemplates the installation of a reinforced-concrete trunk sewer. Harry E. Green is City Engineer.

Massachusetts.

✤Bids will be received until 3 p. m., July 11, by Board of Sewage Disposal Commissioners, 352 Main St., Fithburg, Mass., for 2,928 lin. ft. earth excavation and refilling in trench for 45-in. concrete sewer, 50 cu. yds. rock excavation, 490 sq. yds. brick masonry in sewer invert, 23 cu. yds. brick masonry in manholes, 1,250 cu. yds. concrete masonry in trench, 40,000 lbs. steel bars for reinforcing concrete. David Hartwell is Engineer.

◉McCarthy & Walsh have been awarded the contract by the Board of Public Works of Boston, Mass., L. K. Rourke, Commissioner, for sewer work in St. Botolph extension, for $4,450.

Michigan.

◉The city of Eaton Rapids, Mich., has awarded the contract for constructing the State and River St. sewer to George A. Lowry of Saginaw for $2,958.

The City Council of Marquette, Mich., has ordered the construction of a new trunk sewer from Prospect St., to the lake. D. C. Tabor is City Engineer.

The City Council of Muskegon, Mich., contemplates the construction of a sewer in the Highland Park district of the city. The sewer would run on Barclay St., from Highland Ave. to Southern Ave., and on Southern Ave. to Hudson St. City Engineer H. N. Beck has estimated the total cost at $1,276.

The City Council of Flint, Mich., has rejected all bids for the second time for the construction of sewers on Oren St., from Francis St. to Detroit St., and on Helen St., from Donald St. to Oren St. The work will be done under the direction of the City Engineer, H. E. Terry.

An election was held in Caro, Mich., on June 27, for the purpose of voting on the proposition to borrow $17,000 to extend the present plan of sewers. A map of the streets the sewers will be constructed on is now being prepared.

Minnesota.

The sewer committee of the City Council, Fergus Falls, Minn., recently held a meeting to consider the matter of installing a sewer system in the Fourth ward.

Missouri.

•Patrick McIntyre has been awarded the contract by the Board of Local Improvements of St. Louis, Mo., C. A. Moreno, sewer commissioner, for the construction of the Harlem Creek sewer, District No. 6, for $58,817. The work includes 5,254 ft. of brick sewer and 20,037 ft. of pipe sewer, with inlets, manholes, etc. Bids were opened June 13.

•The Board of Public Improvements of St Louis, Mo., Chas. A. Moreno, sewer commissioner, has awarded the contract for the construction of the Harlem Creek sewers in District No. 7 to the City Construction Co. of St Louis for $90,295. The work includes brick and pipe sewers with inlets manholes [illegible] ers, 7,418 ft., 78 to 30 ins. in diameter; pipe sewers, 26,281 ft., 27 to 12 ins. in diameter. Bids were opened June 16.

Nebraska.

City Engineer Adna Dobson of Lincoln, Neb., has presented to the City Council plans and specifications for extensions of the storm sewers. The additions were provided for in the $50,000 issue of bonds. The districts are: North 26th St., three blocks north from Potter, and B St. from Third to Salt Creek.

New Jersey.

✤Bids will be received between 8 p. m. and 8:30 p. m., July 18, by Common Council, Summit, N. J., for the construction of vitrified pipe sanitary sewers in Summit. J. E. Rowe is city clerk. J. S. Stiger is city engineer. Official advertisement will be found in this issue.

Mayor Edward Pries of Haledon, N. J., is agitating the installation of a sewer system. It is estimated the system would cost $10,000.

New York.

✤Bids will be received until 2 p. m., July 11, by Percy L. Lang, President of the Board of Managers, Craig Colony for Epileptics, Sonyea, N. Y., for construction of altera- [illegible] Colony. Drawings and specifications may be consulted and blank form of proposal obtained at Craig Colony for Epileptics, Sonyea, N. Y., and at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to and in the discretion of the State Architect. Franklin B. Ware, Albany, N. Y.

◉Albert M. Banker of Johnstown, N. Y., has been awarded the contract by that city for the construction of a trunk sewer in or along the Cayadutta Creek from Market St. to Main St., including the following estimated quantities: 240 lin. ft. of 24-in. vitrified tile sewer, 510 lin. ft. of 24-in. iron pipe sewer, 609 lin. ft. of 30-in. iron pipe sewer, 1,030 lin. ft. of 30-in. iron pipe sewer, 122 lin. ft. of 11 brick manholes, 700 cu. yds. slate rock excavation. The contract price is $17,857. Bids were opened June 19 by Grover E. Yerdon, city clerk.

The Board of Public Works of Fulton, N. Y., has received bids for the building of the new sewers. The Whittemore Construction Co., of Binghampton, N. Y., at $15,400, is the probable contractor. George W. Hackett is City Engineer.

An election will be held in the village of Bridgeburg, N. Y., on July 10, for the purpose of voting on the issuance of bonds to the amount of $8,000 to complete the Bowen Rod trunk sewer.

Alderman Charles H. Bone of Binghampton, N. Y., is securing the rights of way for the trunk sewer which is to drain the Sixth ward and convey the sewage from the Fifth ward to the sewage disposal plant. It is also proposed to construct a sewer along Pennsylvania Ave., to the Susquehanna river which will drain a portion of the city now unsewered.

Utah.

◉James Kennedy of Fargo, N. Dak., has been awarded the contract in Salt Lake City, Utah, for the construction of a sewer system in a portion of the city for $100,000. G. P. McGonagle is City Engineer.

Ohio.

✤Bids will be received until Noon, July 5, by Director of Public Service, Youngstown, O., for furnishing the necessary labor and material for the construction of a sewer in Milton Ave., between Mahoning Ave. and Hillsdale Ave. Plans and specifications are on file in the office of the City Engineer. W. H. McMillin is Clerk. A certified check for $300 must accompany each bid.

•The Board of Control of Akron, O., has awarded contracts for the following improvement work, for which bids were opened June 16: E. McShaffrey & Son, Howe St., paving; S. W. Parshall, Bishop St., storm water sewer; Mathew McCoutt, Jewett St., sewer, and I. V. Kidder, retaining wall along Pleasant Park.

◉C. J. Chinnock of Warren, O., has been awarded the contract by the village of Canfield, O., for constructing the storm water sewer in west side of Broad St. between Main St. and the court house, and constructing brick pavement on the same. The contract price is $6,451. Bids were opened June 17 by S. A. Arnold, clerk.

•The Department of Public Service of Piqua, O., has awarded the contract for the construction of a sewer on South Main St. to Wm. McDowell & Son of Bellefontaine, O., for $11,663. The work includes sanitary sewers with spurs, house connections, etc. Bids were opened June 16 by B. Mitchell, clerk of the department.

•The Department of Public Service of Conneaut, O., has awarded Charles Hukari of that city the contract for the laying of the storm sewer on Chestnut St., from 16th St. to Jackson St., and on Jackson St. from Chestnut to Whitney Road, for $13,175. Other bidders were: James P. Callahan, Jamestown, N. Y., $17,084, and the J. Winterbottom Construction Co., $18,065.

•W. A. McDowell & Son have been awarded the contract to construct a section of the sewer system at Piqua, O., for about $15,000.

The County Commissioners, Sandusky, O., have decided to construct a sewer at the fair grounds to help carry away the surface water.

It will be [illegible] ft. in length and [illegible] $1,100.

The Board of Control of Toledo, O., has approved a contract authorizing Consulting Engineer W. J. Sherman, The Nasby, Toledo, to secure necessary date of the sewage in the Ten Mile and Swan Creeks.

The special committee of the City Council, Cleveland, O., has inspected Morgan run relative to the proposed construction of the Kingsbury Run and Morgan branches of the intercepting sewer system. It is probable that an election will be called for this fall to vote on a bond issue of $1,000,000 to extend the system. Robert Hoffmann is City Engineer.

The citizens of Bedford, O., have just voted the issuance of bonds to the amount of $8,000 for a sewage disposal plant. W. B. Yost is Mayor.

Oregon.

Following are the low bids received by the City Executive Board of Portland, Ore., for sewer construction: Buxton and Twenty-sixth Sts.—E. W. Riner, $465. East Landers St. district—John Keating, $812. East Thirty-ninth and East Ankeny Sts.—Bechill Bros., $618. East Mill and East Thirty-eighth Sts.—Bechill Bros. $269. East Main St. from East Sixth to East Ninth St.—Jeffery & Bufton, $1,839. East Fifty-second and East Lincoln Sts. Pacquet, Giebisch & Joplin, $762. Oregon St.—E. W. Riner, $201. Powell St.—Jeffery & Bufton, $771. Shaver St. district—Almeda Trust Co., $6,355. Water St.—Giebisch & Joplin, $883. East Seventeenth and Sandy boulevard—Bechill Bros., $1,949. East Twenty-second street—E. W. Riner, $249. East Twenty-fourth St.—Jensen Bros., $212. East Twenty-fifth and Oregon Sts.—J. Keating, $214; E. W. Riner, $214. East Twenty-sixth St.—E. W. Riner, $202. East Twenty-seventh St.—Bechill Bros., $135. East Thirty-third and East Oak Sts.—Jeffery & Bufton, $1,718. East Thirty-third and East Ash Sts.—E. W. Riner, $898. East Fifty-second and East Sherman Sts.—Jeffery & Bufton, $1,440. East Fifty-third and East Lincoln Sts.—Jeffery & Bufton, $936. East Fifty-third and East Sherman—F. H. Bryne, $1,844. East Fifty-fourth and Sherman—F. H. Bryne, $1,814. East Fourth and East Fifty-fifth and East Lincoln—Jacquet, Giebisch & Joplin, $1,172. East Fifty-fifth and East Sherman—Jeffery & Bufton, $2,053.

Pennsylvania.

⊙The City Council of Easton, Pa., has awarded Frank McInerney the contract for the construction of sewer on Line, Williams and Centre Sts., South Side, for $2,804.

An ordinance has been introduced in the City Council, Scranton, Pa., providing for a bond issue for the purpose of constructing relief sewers, estimated to cost $287,400, as follows: Prescott Ave. and Mulberry St., $20,000; N. Main and W. Market St., $1,900; Electric St. and Boulevard Ave., $4,500; Linden St. and Washington Ave., $70,000; Tripp Park system, $40,0000; 12th, 19th and 20th wards, $15,000; First and Third wards system, $40,000; 22nd ward system, $40,000; and Popular St. (Pine Brook) sewer, $50,000. William A. Schunk is City Engineer.

South Dakota.

The new City Commission of Aberdeen, S. Dak., contemplates the construction of a sewage disposal plant. The city some time ago voted bonds to the amount of $200,000 for this purpose. Engineer W. P. Mason of Troy, N. Y., has been engaged to go with City Engineer Russell B. Easton to inspect a new system of sewage disposal in operation at Santa Monica, Cal.

Preliminary arrangements are being made in Leola, S. Dak., for a sewerage system to cost $4,043. The funds will be raised by special assessment.

Tennessee.

✣Bids will be received until 3 p. m., August 10, by Board of Public Works, Nashville, Tenn., for the construction of 7 miles of circular brick trunk sewers from 30 to 111 ins. in diameter. W. W. Southgate is city engineer. Official advertisement is found elsewhere in this issue.

Texas.

⊙The East End Improvement Committee, Austin, Tex., has awarded the contract for the making of 859 ft. of 24-in. sewer main, about the same amount of 28-in. pipe, and 312 ft. of 42-in. main, to J. G. Parker at $0.40 per ft. for 24 in., $0.45 per ft. for 28 in. and $1.05 for 42-in. pipe. The 42-in. main is to be molded in the trench on East Ave. and 16th St.

The City Council of Beaumont, Tex., has instructed the City Attorney to prepare proper ordinances calling an election for the purpose of submitting to a vote of the people the proposition of issuing bonds as follows, for improvements: School house building, $25,000; sewers, $50,000; jail, $15,000; park, $60,000; paving, $25,000, and city abattoir, $25,-00. E. A. Fletcher is Mayor.

An election was held in Waco, Tex., on June 27 for the purpose of voting on the propposition of issuing bonds in the sum of $200,000 for street improvements, sanitary storm sewer systems, etc.

Washington.

The City Commissioners of Spokane, Wash., have passed ordinances providing for the sewering of Southeast Blvd., 10th Ave. to Garfield St.; on Garfield St. to Rockwood Blvd. to 14th Ave., $10,115, and for sewering Garfield road, Rockwood Blvd., to 29th Ave., $14,470.

Wisconsin.

✣Bids will be received until 7:30 p. m., June 30, by Theodore B. Olsen, clerk of the village of East Milwaukee, Wis., for the construction of the following described sewers in the village of East Milwaukee, Milwaukee county, Wisconsin, according to the respective plans and specifications on file, a 12-in. pipe sewer in Newton Ave. from a point 12 ft. west of Prospect Pl. to a point 12 ft. east of Maryland Ave. Approximate quantities: 563.36 lin. ft. of 12-in. pipe sewer, 4 manholes and 1 catch basin complete. Work to be completed within 40 days from the date of the award of the contract, failing in which the contractor shall pay to the village of East Milwaukee as liquidated damages the sum of $10 per day for each and every day's delay in completing the contract. Each bidder must accompany his bid with the sum of $200 in money or a duly certified bank check payable to the treasurer of the village of East Milwaukee, failing in which his bid will be rejected.

⊙The Board of Public Works of Wausau, Wis., has awarded the following contracts for the construction of sewers for which bids were opened June 22: F. W. Krause, Wausau, 2,300 ft. of 5-in. concrete sewer, $7.10 per foot; Lotz & Hase, Wausau, 1,000 ft. of 30-in. sewer, $2.84 per foot; also 624 ft. of 24-in. at $1.69, 230 ft. of 18-in. at $1.50, 370 ft. of 15-in. at 98 cts., 180 ft. of 10-in. at 65 cts., 220 ft. of 10-in. at 51 cts. and 440 ft. of 10-in. at 54 cts.

The vilage of West Milwaukee, Wis., E. T. Meisenheimer, president of the Village Board, expects to invest $28,000 in septic sewer tanks and a system in the near future.

Canada.

✣Bids will be received until 8 p. m., July 3, by Thomas M. Roberts, city clerk, Cranbrook, B. C., for the supply and delivery of 36,500 lin. ft. of vitrified tile sewer pipe from 18 ins. to 6 ft. in diameter; also Y junctions, 123 c. i. manhole covers, catch basin covers and flap valves; 800 barrels Portland cement. John Galt Engineering Co., 317 Portage Ave., Winnipeg, Man., has plans and specifications on file.

✣Bids will be received until noon, July 1, by city of Oshawa, Ont., W. E. N. Sinclair, mayor, for the construction of screening chambers, sedimentation tanks, sludge beds, etc. Plans and specifications may be seen at the office of T. Aird Murray, consulting engineer, Lumsdep bldg., Toronto, Ont. Frank Chappell is city engineer.

⊙A. Stuart of Port Arthur has been awarded the contract by T. N. Colgan, commissioner of public works, North Bay, Ont., for the laying of about 25,000 lin. ft. of storm and sanitary sewers, ranging in size from 6 to 36 ins. in diameter, and building manholes. Bids were opened June 15.

⊙W. G. Carr of North Bay, Ont., has been awarded the contract by T. N. Colgan, commissioner of public works, North Bay, for furnishing about 25,000 lin. ft. of pipe for sewer work, ranging in size from 6 to 36 ins. in diameter. Bids were opened June 15.

BUILDINGS, DOCKS, DREDGING, SUPPLIES, ETC.

California.

✣Bids will be received by the board of Public Works, of Los Angeles, until 11 a. m., July 24, for dredging 1,200,000 cu. yds. of earth from the inner harbor at Wilmington, and the filling of streets in the business centre of Wilmington. The specifications provide for the removal of 530,000 cu. yds. of earth from the basin and channel directly in front of Wilmington, the channel to be 25 ft. in depth below low water. The remaining 670,000 cu. yds. are to be dredged from the channel in the vicinity of Mormon Island. Work is to commence within 30 days of award of contract. The specifications provide for three proposals the most advantageous of which the Board is empowered to accept. The first proposal is that the contract be completed in seventeen months, making an average of 75,000 cu. yds. per month; the second, that the work be completed in twelve months, an average of 110,000 cu. yds. per month, and the third, that the contract shall be completed in nine months, an average of 150,000 cu. yds. per month. Homer Hamlin is city engineer.

✣Bids will be received until 2 p. m., July 14, by James Wilson, Secretary, U. S. Department of Agriculture, Washington, D. C., for furnishing material and labor and installing certain laboratory fixtures and plumbing in the U. S. food inspection laboratory, San Francisco, Cal.

✣Bids will be received until 11 a. m., July 17, by F. Von Schrader, Chief Quartermaster, Camp Yosemite, Cal., Chronicle Bldg., San Francisco, Cal., for the construction of one field officers' quarters, two barracks and two lavatories, all frame, including plumbing, at Camp Yosemite, Cal.

⊙The Thomson Bridge Co., 103 Main St., San Francisco, has been awarded the contract at $165,521, for the extension of dikes at the U. S. Navy Yard, Mare Island, Cal. Bids were opened June 3.

An ordinance was to be submitted to the Board of Supervisors of San Francisco on June 26, calling for the construction of the Stockton St. tunnel. This work calls for the boring of a tunnel under Nob hill at Stockton St., making a direct thoroughfare from the North Beach to the downtown business district. M. Marsden is city engineer of San Francisco.

Colorado.

The City Council of Fort Collins has instructed the city engineer to make surveys and estimates on the cost of installing a municipal light and power plant about 50 miles west of Fort Collins.

Cuba.

✣Bids will be received until 11 a. m., July 8, by R. C. Hollyday, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for timber wharf, brush bulkhead, dredging and filing at the U. S. Naval station, Guantanamo, Cuba.

Delaware.

✣Bids will be received until noon, June 30, by Light House Inspector, Fourth District, Room 427, Post Office Bldg., Philadelphia, Pa., for the furnishing of necessary labor and material for the rebuilding of wharves and retaining walls, etc., at Edgemore Light House Depot, Del.

District of Columbia.

✣Bids will be received until 2:30 p. m., July 11, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing of brass bolts, nuts and set screws.

✣Bids will be received until 2 p. m., July 3, by Department of Interior, Washington, D. C., for the installation of ash and coal handling machinery in the old post office building at Washington, D. C.

✣Bids will be received until 2 p. m., July 5, by Board of Commissioners of the District of Columbia, Washington, D. C., for the construction of alterations and addtions to the Armstrong Manual Training School No. 129, located on P street, between 1st and 3d streets.

✣Bids will be received until 2 p. m., June 29, by Board of Commissioners, Washington, D. C., for the construction of an 8-room school building.

Florida.

✣Bids will be received until noon, July 3, by County Commissioners, Kissimmee, Fla., for the construction of a county jail and sheriff's residence. E. L. Lesley is Chairman of the Board.

✣Bids will be received until noon, July 18, by Willis L. Moore, Acting Secretary, U. S. Department of Agriculture, Washington, D. C., for the erection of a two-story and cellar, cement and terra cotta building for the weather bureau, U. S. Department of Agriculture, Key West, Fla.

✣Bids are asked until noon, July 17, by Capt. Geo. R. Spalding, U. S. Engineer, Jacksonville, Fla., for dredging in Hillsboro Bay, Fla. Hillsboro Bay is an arm of Tampa Bay, about [illegible] long, and having an average width of 4½ miles. That portion of the bay lying between Hookers Point Peninsula and the city of Tampa is called Sparkman Bay. Ybor Estuary is the northern extremity of Sparkman Bay. Under a project completed in 1908 a channel 20 ft. deep and 150 ft. wide was obtained from the lower bay to the mouth of Hillsboro River, with a turning basin, 1,050 ft. long, and 450 ft. wide, at the upper end. This channel (approximately 52,550 ft. long is now being deepened to 24 ft. at mean low water to a width of 150 ft. and a portion of same (25,000 ft.) to a width of 200 ft. The present channel is divided into four [illegible] A, B, C and D, [illegible], 2,500, 33,000 and 13,000 ft. long respectively. Five additional sections will be dredged, as follows: Hendry & Knight Channel, 300 ft. wide and 4,360 ft. long, Section A, Ybor Channel, 300 ft wide and 2,800 ft. long, Section B, Ybor Channel, 300 ft. wide and 1,500 ft. long, Tampa Northern Channel, 200 ft. wide and 4,600 ft long, Sparkman Bay Channel, 200 ft. wide and 3,200 ft. long. The amount [illegible]

Georgia.

The following bids were received May 31, by Col. Dan C Kingman, U. S. Engineer, Savannah, Ga., for building and repairing dikes in Savannah River, near Augusta, Ga., (1) standing for bid of Simons-Mayrant Co., Charlestown, S. C., and (2) for Twiggs & Bryan, Augusta, Ga.; amount available is $84,500:

	(1)	(2)
Lot 1 [illegible]	[illegible]	[illegible]
Lot 2 piles, [illegible]	[illegible]	[illegible]
Lot 3 piles, [illegible]	[illegible]	[illegible]
[illegible] 100 [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Total	$79,897	$97,055

Bids as follows were received June 16, by Col. Dan C. Kingman, U. S. Engineer, Savannah, Ga., for dredging 1,600,000 cu. yds. of material for harbor at Savannah; amount available, $192,000: Morris & Cummings Dredging Co., New York, N. Y., 19½ cts.; Miner Engineering Co., Washington, D. C., 14⅞ cts.; Southern Dredging Co., Mobile, Ala., 15 cts.; Coastwise Dredging Co., Norfolk, Va., 15¼ cts.; Atlantic Gulf and Pacific Co., New York, N. Y., 13.9 cts.; Home Dredging Co., Mobile, Ala., 11.6 cts.; P. Sanford Ross, Inc., Jersey City, N. J., 13.69 cts.; North American Dredging Co. of Texas, Galveston, Tex., 16.1 cts.; Mitchell & Co., New York, N. Y., (a) city front, 650,000 cu. yds. at 18 cts. (b) Wrecks Channel, 600,000 cu. yds., at 20 cts., (c) Long Island Crossing, 350,000 cu. yds. at 16½ cts.

Indiana.

✣Bids will be received until 8 p. m., July 11, by Board of School Commissioners, Indianapolis, Ind., for the construction of heating, ventilating, plumbing and gas fitting electric wiring and fixtures. J. E. Cleland is Business Director.

✣Bids will be received until 10 a. m., July 5, by Bartholomew County Commissioners, Columbus, Ind., for the construction of improvements to the county jail. Philip J. Sater is County Auditor.

The Indiana & Michigan Electric Co., 220 Colfax Ave., South Bend, Ind., has engineers in the field making surveys for a [illegible] power development in the St. Joseph River at Elkhart. The plans are said to call for a 2,500 H. P. water plant. and a 5,000 H. P. steam plant. It is said that construction work will be started next spring.

Kansas.

✣Bids will be received until 3 p. m., August 2, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the U. S. Postoffice at Great Bend, Kan.

Kentucky.

✣Bids will be received until July [illegible], by J. G. Campbell, County Judge, Hazard, Ky., for the plans and specifications for the construction of a new court house to cost $25,000.

⦿Gahren, Dodge & Maltby, New York City, have been awarded the contract for building Dam No. 14 in the Ohio River at Heidelburg, for the U. S. Government, the contract price being $311,912. Bids were opened May 26, as noted in our June 7 issue.

Bids will be asked shortly by the Board of Works of Louisville, Ky., for extending the granite wharf from 5th to Bullitt Sts., at a cost of about $3,500.

Louisiana.

The city of Monroe, La., has a tax fund of $19,000 raised to give to the Arkansas, Louisiana & Gulf R. R., when that road extended its line north and south of the city. It is now reported that if the railroad fails to build the extension the city will use the $19,000 to bore for oil and gas.

Maine.

✣[illegible], Me. [illegible] done is the excavation and removal of material other than ledge rock, to a depth of 12 ft below the level of mean low tide, from the southerly portion of the proposed anchorage basin in Pepperells Cove. The entire area is about 41 acres. Of this area about 33¾ [illegible] and the work [illegible] the remainder, which consists of a [illegible] approximately 1,100 ft. long and [illegible] wide, immediately along the [illegible] of the improvement [illegible] of material in this section is [illegible], scow measurement.

Massachusetts.

✣Bids are asked until 2 p. m., July 11, as noted in our last issue, by Col. Frederic V. Abbot, U. S. Engineer, Newport, R. I., for dredging harbors at New Bedford and Fairhaven, Mass.: The site of the work is in that arm of Buzzards Bay, Mass., leading to and forming the harbors of New Bedford and Fairhaven, Mass. The project provides for an approach channel to be 300 ft. wide which is to commence in 25 ft. depth of water on the southerly side of Butler Flats and extend northerly about 1¾ miles to Buoy No. 15 near the north end of Palmer Island, where it enters an anchorage area to be made 25 ft. deep over about 114 acres. From the northerly side of the anchorage area, a channel from 250 to 300 ft. wide is to extend northerly about 2,300 ft. to and through the draw bridge between Fish and Popes Island and connect with a turning basin around the north end of Fish Island. An extension of the original project provides for dredging the passage between New Bedford and Fish Island both above and below the New Bedford and Fairhaven Bridge so as to extend the areas to be dredged to within about 50 ft. of the upper and lower sides of the bridge respectively. The work to be done consists of dredging and removing bowlders to a depth of 25 ft. at mean low water at the localities described below; (a) Approach channel. The length of this channel is about 9,750 ft., and its width when completed will be 300 ft. A width of about 135 ft. has been dredged, but there are shoals amounting to about 43,000 cu. yds. in the dredged part. The remaining part to be dredged is estimated to contain about 612,000 cu. yds., making 655,000 cu. yds. scow measurement, to be removed to complete the channel; (b) Such portions of the anchorage area as have not been deepened to 25 ft., estimated to contain 984,399 cu. yds. scow measurement; (c) A small strip on the easterly side of the channel leading to the draw bridge, estimated to contain 42,762 cu. yds., scow measurement; (d) The areas between Fish Island and the New Bedford wharves above and below the bridge connecting with the dredging done and to be done, estimated to contain 36,000 cu. [illegible] material to be removed is believed to be as follows: (a) In the approach channel, sand, mud, clay and bowlders; (b) In the anchorage area, compact sand, clay, gravel, cobbles and a small amount of mud; (c) In the channel leading to the draw bridge; mud, sand and gravel; (d) Below the bridge: sand, gravel, clay and mud. Above the bridge: mud, sand, clay, gravel and bowlders. Near the north end of Palmers Island at the junction of the approach channel with the anchorage area, there is an area of ledge rock which extends into the channel and the anchorage with a minimum depth of about 15 ft. of water over it. Portions of this rock [illegible] with some bowlders which must be removed as far as practicable by the dredge and left uncovered for drilling and blasting. The ledge rock is not to be removed under this call for bids.

Bids as follows were received June 23 by Col. Frederic V. Abbot, U. S. Engineer, Boston, Mass., for rock excavation in Gloucester Harbor, Mass.: Eastern Dredging Co., 247 At- [illegible] moved being about 590 cu. yds. About $20,000 is available for contractor's estimates.

Bids will be received until 1 p. m., July 11, by Capt. A. M. Miller, Constructing Quartermaster, Boston, Mass., for the construction, including plumbing, heating, electric

✣ indicates work now open for bids. ⦿ indicates a contract let recently.

[illegible] at an addition to the [illegible] at Fort Strong, Mass.

New Hampshire.

⊙[illegible] Fitzgibbons, Beverly, Mass., has been awarded the contract at $100,000 for granite block quay wall extension at the U. S. Navy Yard, Portsmouth, N. H.

New Jersey.

✣Bids will be received until [illegible] July 10, by Board of Education, School Building, No. 4 Parke Ave., near Sixth St., Hoboken, N. J., for carpenter, concreting, electrical painting, plumbing and masonry work, work on several public schools in the District of Hoboken. W. A. Kerr is Secy. of the Board.

New York.

✣Bids will be received until June 28, by Commanding Officer, New York Arsenal, Governor's Island, New York Harbor, for furnishing 20,000 gals. hydroline oil.

Ohio.

✣Bids will be received until noon, July 3, by Board of Education, Cincinnati, O., for the construction of the Guilford school building. C. W. Handman is Business Manager.

✣Bids will be received until noon, July 20, by Ohio State Board of Agriculture at the office of the Secretary, Columbus, O., for furnishing all labor and material for the construction of an adition to the sheep exhibit building at the Ohio State Fair Grounds, Columbus.

Oklahoma.

✣Bids will be received until noon, July 6, by town clerk, Sentinel, Okla., for electric light plant equipment. F. Murch & Co., engineers, Clinton, Okla., have plans and specifications on file. Official advertisement will be found elsewhere in this issue.

Oregon.

✣Bids will be received until 3 p. m., July 27, by L. Barbur, City Auditor, Portland, Ore., for furnishing the Fire Department of the city with 25 positive non-interfering successive fire alarm telegraph boxes, according to plans and specifications on file in the office of the Superintendent of Fire Alarm and Police Telegraph, City Hall.

Rhode Island.

✣Bids will be received until 2 p. m., July 18, by Col. F. V. Abbot, U. S. Engineers, Newport, R. I., for dredging in Pawtucket River, R. I.

South Dakota.

✣Bids will be received until 3 p. m., August 1, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and interior lighting fixtures of the U. S. Postoffice, Huron, S. Dak.

Texas.

✣Bids will be received until July 5, by Commissioners' Court, Aspermont, Texas, for the erection of a brick and stone court house. A certified check for $500 payable to W. J. Arrington, Judge, must be filed with each bid.

✣Bids are asked until noon, July 8, as noted in our last issue, by Maj. G. P. Howell, U. S. Engineer, Galveston, Tex., for dredging deepwater harbor at Harbor Island, Aransas Pass, Tex.: A deepwater harbor or port is to be constructed within the entrance to Aransas Pass, at Harbor Island, on the coast of Texas. Jetties have been constructed to improve the channel leading from the Gulf of Mexico to the Pass, and there is at present a narrow channel 20 ft. deep at mean low water, and a navigable channel 15 ft. deep, throughout this distance. From the upper end of this channel a harbor is to be formed, lying between St. Joseph Island on the east and Harbor Island on the west. A roadstead 1,200 ft. wide and 3,000 ft. long will be dredged to a depth of 20 ft., and from the upper end of this roadstead a channel 400 ft. wide and 20 ft. deep will be extended to the north in the direction of Rockport for an approximate distance of 5,420 ft. This channel will lie close to the 12-ft. contour on the Harbor Island side. The number of cubic yards to be removed is approximately 1,300,000. The material to be removed is believed to be sand and mud.

Virginia.

⊙The Baltimore Bridge Co., Baltimore, Md., has been awarded the contract for erecting the towers at Fort Myer for the wireless telegraph station for the U. S. Navy. The contract amounts to about $100,000 and includes three steel towers, one 600 ft. high and the others 450 ft., supported on steel bases and concrete foundations.

West Virginia.

✣Bids will be received until 11 a. m. (eastern time), July 17, by F. W. Alstaetter, U. S. Engineer, Wheeling, W. Va., for the construction of six 2-story, 8-room lock keeperhouses, two each at dams Nos. 12, 19 and 20.

Wisconsin.

✣Bids will be received until 10:30 a. m., June 29, by Department of Public Works, Milwaukee, Wis., for furnishing the necessary labor and material for the construction of a one-story brick locker building just west of the City Refuse Incinerator at the foot of Erie St. H. E. Briggs is Commissioner of Public Works.

Wyoming.

✣Bids will be received until 3 p. m.,, July 28 by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete including plumbing, gas piping, heating apparatus, electric conduits and wiring and interior lighting fixtures of the U. S. Post Office at Rock Springs, Wyo.

Canada.

✣Bids will be received until noon, July 3, by F. S. Spense, Chairman of the Board of Control, Toronto, Ont., for the construction of a seawall in Lake Ontario in the vicinity of the Exhibition grounds.

⊙The Department of Public Works of Canada has awarded the contract for the construction of a dam and sluiceway across the head of Gordon Creek at Kippewa Village, in the County of Pontiac, Que., to H. A. Morrow and Jas. A. Beatty, of Peterborough, Ont.

⊙Miller & Gibson, Toronto, are reported to have been awarded the contract at $119,900, for the construction of a dock at Ashbridge Bay for the city of Toronto.

BUILDING.

Sealed proposals will be received by the City Council of the city of Oskaloosa, Ia., up to 8 o'clock p. m., July 24, 1911, for the construction of a "City Hall" building in said city.

Plans and specifications will be on file in the City Clerk's office on and after June 24, 1911.

All "Bids" must be accompanied by a certified check for [illegible] per cent of amount of bid made payable to S. V. Reynolds, Mayor, conditioned that if the bid is accepted the bidder will enter into contract, otherwise same to be forfeited to the [illegible] city.

Bids will be opened at 8 o'clock p. m., July 24, 1911.

The council reserves the right to reject any or all bids.

For further information address

T. H. CARLIN,
City Clerk.

U. S. ENGINEER OFFICE, Wilmington, N. C., June 1, 1911. Sealed proposals for constructing complete the two (2) wooden hull, non-propelling, 15-in. hydraulic pipe line dredges Neuse and Port Arthur will be received at this office until noon, June 30, 1911, and then publicly opened. Information on application. EARL I. BROWN, Capt. Engrs.

SEWERS.

Sealed proposals will be received by the Common Council of the City of Summit from 8 p. m. to 8:30 p. m., on Tuesday, July 18, 1911, for the construction of vitrified pipe sanitary sewers in Summit in two sections, viz.:

Section 1.—3,000 lineal feet 10-inch vitrified pipe along Division Avenue, private right of way, Springfield Avenue and Passaic Avenue, varying in depth from 10 to 45 feet.

Section 2.—5,500 lineal feet 8-inch vitrified pipe sewer along Blackburn Road, Valley View Avenue and Sunset Drive, varying in depth from six to twelve feet.

The plans and specifications of the work can be examined at the office of the City Engineer, in the City Hall, Summit.

All work referred to in this notice must be completed on or before December 31st, 1911.

The Common Council will, if they consider it advisable, award the contract for each section to separate bidders.

Said proposals must be accompanied by a certified check or cash for five (5) per cent of the total amount of bid. If certified check is furnished it shall be made payable to the City of Summit without reserve.

Surety bond will be required of the successful bidder for the sum of $15,000 for Section one, and for $4,000 for Section two

By direction of the Common Council of the City of Summit.

J. EDW. ROWE,
City Clerk.

JOHN S. STIGER, City Engineer.

TRUNK SEWERS.

The Board of Public Works of Nashville, Tennessee, will receive and open sealed bids at its office, City Hall, on Thursday, August 10th, 1911, at 3 p. m., for building about seven miles of circular brick trunk sewers, ranging in sizes from thirty (30 in.) inches to one hundred and eleven (111 in.) inches in diameter. Certified checks on reputable banks, payable to the order of said board, required to accompany all bids as earnest money, as stipulated in the specifications. Satisfactory bond for faithful performance of contract, as stipulated by law, required and twenty (20 per cent) per centum retained upon partial estimates until the completion of the work. Bids will be received separately for the several sewers and as a whole for the entire work. Said board reserves the right to reject any or all bids. Plans and profiles can be seen at the office of the City Engineer, City Hall, Nashville, Tennessee, and specifications and proposal blanks can be had upon application at said office either by mail or in person, from and after July 1st.

Bids must be made upon said proposal blanks and sealed and addressed to the Board of Public Works, Nashville, Tennessee, and plainly marked "BID FOR TRUNK SEWER."

This work includes about eighty-one thousand (81,000) cubic yards of both earth and rock excavation and about thirteen million (13,000,000) brick.

By order of the Board of Public Works.

WM. W. SOUTHGATE,
City Engineer.

U. S. ENGINEER OFFICE, Kansas City, Mo., June 3, 1911. Sealed proposals for constructing standard revetment on Missouri River, about eighteen miles below Kansas City, Mo., will be received here until 12 noon, July 3, 1911, and then publicly opened. Information on application. EDWARD H. SCHULZ, Major, Engrs.

✣ indicates work now open for bids. ⊙ indicates a contract let recently.

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GRAVEL ROAD.

Bids will [illegible] 17, 1911, [illegible] Townships, Lake County, Michigan, at the office of Norman Buckner, Clerk of Newkirk Township, Luther, Mich., for the construction [illegible] State Reward Gravel Road.

Plans and specifications and instructions to bidders may be seen at the office of the Clerk of Newkirk Township.

Bids must be made on blanks furnished by the townships and must be accompanied by a certified check in an amount equal to 10 per cent of the amount of the bid, payable to Norman Buckner, Township Clerk, this as a guaranty of the acceptance and performance of the contract by the party to whom it may be awarded, and his failure to execute said contract will forfeit said check.

The right to [illegible] portion of any bid, or to accept any portion of any bid which may be deemed for the best interest of Newkirk and Ellsworth Townships, is expressly reserved.

TOWNSHIP BOARDS OF NEWKIRK AND ELLSWORTH TOWNSHIPS.

WAR DEPARTMENT.—U. S. Engineer Office, Montgomery, Ala., June 6, 1911. Sealed proposals for dredging at mouth of Apalachicola River, Florida, will be received at this office until 1 o'clock p. m., July 6, 1911, and then publicly opened. Information on application. G. D. FITCH. Lt. Col., Engrs.

WATERWORKS.

Notice is hereby given that the City of Milan, Missouri, will until 7 p. m., on the eighth day of July, 1911, receive bids for the following:

[illegible]

4,000 ft.—8-in. C. I. pipe.
11,968 ft.—6-in. C. I. pipe.

[illegible]

Resetting 8 fire hydrants.

Furnishing and setting:

[illegible]

Furnishing and laying 250 ft., 8-in. vitrified tile.

Laying 900 ft., 6-in. pipe.

[illegible]

Repairing service pump.

[illegible] 1000 Third National Bank Bldg., St. [illegible]

[illegible]

WM. COCHRAN, JR.,
Clerk, Milan, Missouri.

WATERWORKS.

Sealed proposals will be received at the [illegible] Kansas, up to 6 p. m., the fifth day of July, 1911, for furnishing all material, ma- [illegible] now on file with the City Clerk or City Engineer of Burlington, Kansas. Certified check for fifty ($50.00) dollars.

The city reserves the right to reject any and all bids.

[illegible]

GRADING.

[illegible]

Bids will be received in accordance with forms prepared by this company until the 25th day of July, 1911, for the construction of the graduation and masonry of 66 miles of railway roadbed, including incidental work, in Arizona. The principal items are, approximately: Grading, 2,600,000 cu. yds.; foundation excavation, 30,000 cu. yds.; concrete, 36,000 cu. yds. Work to be done in accordance with plans and specifications on file in the office of the Engineer Maintenance of Way, Southwestern Bldg., El Paso, Tex.

All bidders are required personally to examine the ground and conditions prior to bidding. The proposed work will be ready for inspection beginning June 20, 1911.

All bids must be in writing, addressed to said Engineer, and be accompanied by a certified check in the sum of $5,000.00 as evidence of good faith and security for the giving of a bond for $100,000.00 in a surety company approved by the company for the performance of the contract.

The envelope containing the bid shall be endorsed as such bid and have the name of the bidder written thereon.

The company reserves the right to reject any or all bids.

EL PASO & SOUTHWESTERN RAILROAD COMPANY,
By H. J. Simmons,
General Manager.

REINFORCED CONCRETE WELL AND MOTOR HOUSE.

Notice is hereby given that sealed bids will be received by the Board of Commissioners of the City of Sioux Falls, S. D., until Tuesday, July 11, 1911, at 9 o'clock a. m., for the construction of a reinforced concrete well and motor house for the Municipal Waterworks System, in accordance with plans and specifications therefor, prepared by L. P. Wolff, Consulting Engineer. The proposed well to be 50 feet in diameter and approximately 35 feet deep and to be completed on or be- [illegible]

All bids must be on blank forms furnished for that purpose and each bid must be accompanied by a certified check for a [illegible] of the bid, made payable unconditionally to the order of the City Treasurer as a guarantee of good faith. Plans and specifications may be seen at the office of the Superintendent of Water Works in Sioux Falls and at the office of L. P. Wolff, Consulting Engineer, St. Paul, Minn.

The Board of Commissioners reserves the right to reject any and all bids.

Sioux Falls, S. D., June 20, 1911.

[illegible]
City Auditor.

OPEN DITCHES.

Bids will be received until 3:00 p. m., July 15, 1911, by the Board of Commissioners of the Sixth Ward and Crowley Drainage District, at Crowley, La., for the construction of about 40 miles of open ditches ranging from 2 to 6 miles in length, 16 to 40 feet in width and 2 to 5 feet in depth, approximating 600,000 cu. [illegible] rock. Mostly open prairie. Three lines of railway. The right is reserved to reject any and all bids. Each bid must be accompanied by certified check for $1,000.

H. E. LEWIS, President.
W. S. WHITE, Engineer.
L. A. WILLIAMS, Secretary.

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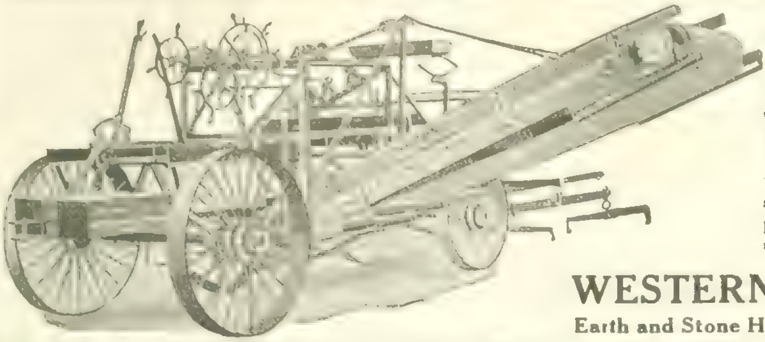

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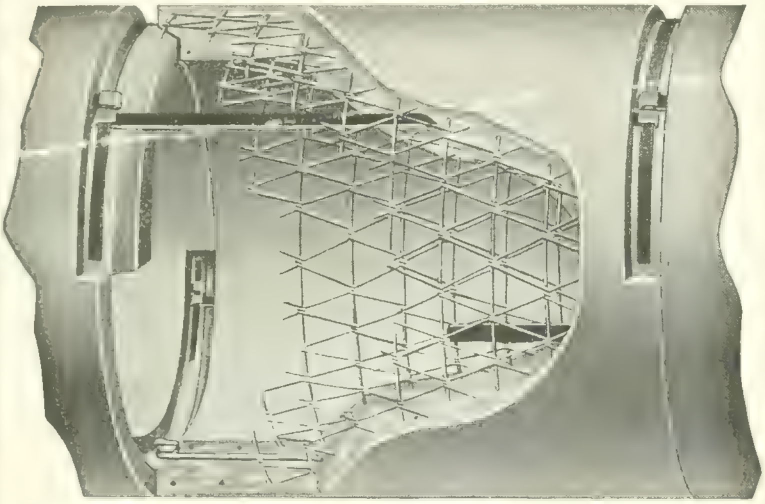

From the above illustration it will be seen that the *lower half* of the joint is joined and cemented from the interior of the pipe; while the arch, or upper portion of the joint is connected from the exterior.

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